OSHPC BARKI TOJIK

TECHNO-ECONOMIC ASSESSMENT STUDY FOR ROGUN HYDROELECTRIC CONSTRUCTION PROJECT

PHASE 1
ASSESSMENT OF EXISTING ROGUN HPP WORKS

Annexes

RP 39

September 2013

COYNE ET BELLIER
Ingénieurs Conseils

ELECTROCONSULT

IPA
Energy + Water Economics

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September 2013

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C	15 Sep 2013	Final assessment with PH Cavern	Various	LCO/CIS	LCO
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November 2012 Site Visit

1. SCOPE OF THE SITE INSPECTION

The site inspection was aimed to assess the current conditions of the open air works at Rogun HPP for further planning and evaluation of the preliminaries to be substantially completed prior to starting the Works.

Investigations have been made on the following preliminaries:

Access Roads and access Tunnels.

Aggregate Plants

Batching plants

Quarries

Embankment materials Conveyor System

General Site Installations:

  Camps

  Offices

  Workshop

  Facilities

Construction sites - Equipment available on Site

1 PARTICIPANTS TO THE MISSION

Mr Philippe Crosnier, Tractebel/Coyne et Bellier Technical Advisor, was assigned to the mission.

He has been assisted by two Taji translators Mr Rozicow Rahmatjon and Mr Rafiev Sharif who made oral and written translations from Taji and Russian languages into English.

He shared with Tractebel/Coyne et Bellier Rock Mechanic Expert: Mr Christophe Vibert a site visit in the clay core area of the Dam and a meeting with the Client upon the ²tests on quarry materials.

2 AGENDA OF THE MISSION

7th of November	:Travel from Paris to Dushanbe
8th of November	:Arrival in Dushanbe and transfer to site. Meeting with **Mr Nazar Odinaev** Deputy Technical Director of OSHPC BARKI TOJIK. Diner with **Mr Anvar Rakhmonov** Chef de production of OSHPC BARKI TOJIK
9th of November	:Formalities for visiting the site. Meeting with **Mr Nazar Odinaev** Deputy Technical Director, **Mr Zafar Buriev** Laboratory Manager; **Mr Shifiddin Bobokhonov** and Mr **Sultonbek Rhakmonskoev,** leading engineers on

geotechnical issues for the Dam and **Mr Nemat Azizov** head of the Technical department.

General site visit with the above mentioned Client representatives. Discussion upon installation of the Carpi membrane in the Cofferdam with the geotechnical engineers.

10th of November :Discussion with the above Client representatives upon the location of the stockpiles of excavated materials, the type and the end use of the stockpiled materials.

Discussion upon the delivery of these materials at the u/s and at the d/s of the clay core.

Site visit of the stockpiles at the u/s and at the d/s of the dam.

11th of November(Sunday) :- Meeting with the Technical Director **Mr Mahmadshid Shamsulloev. -** Visit on the Right Bank of: (a) exhausted alluvium pit N15A and deposit of excavated materials from quarry N26 above excavated materials from tunnel excavation. (b) Site for experimenting the chute of materials in a steel pipe. The tests are likely to be in relation with the transfer/chute of the embankment materials from the Conveyor belt system on the Left Bank down to the placing elevation in the embankment of the Dam. (c) Steel yard for steel lining of salt tunnel; (d) Suspended bridge to cross the river to reach the Left Bank by road that will be inundated after the closure of the diversion tunnels.

Visit on the Left Bank of the site installations and equipment: (a).7+3 heavy duty front excavators (transferred from Nurek Dam site HPP Project at the end of the project.) for excavating the raw material in the alluviums deposit on the Left Bank N15 They are idle on parking areas (b) steel yard for dry test assembling of the spiral case of the turbine No1; (c) route and the remains of the Conveyor system for transferring the embankment materials from the stockpiles to the placing areas on the Dam; (c) Visit of the access tunnel to the Conveyor Tunnel.

12th of November : Meeting with Laboratory Manager and geotechnical engineers on u/s pre-cofferdam method statement. Site visit of Aggregates plants and Batching plants in operation. Site visit to slope preparation at the u/s and d/s of the clay core. Site visit to stockpiles of materials for the pre-cofferdam. Visit of Concrete Laboratory.

13th of November : Read progress of the World Bank authorized Programme of the works. Check Conveyor features. Check location of Aggregates plants and Batching plants as well as in operation or shutdown. Check characteristics of the plants. Check

	Characteristics of the 30t Dumpers Belaz from Belarussia. Discussion with Laboratory Manager and geotechnical engineers upon ASTM and ACI standards.
14th of November	Visit to Main Contractor ROGUNGESSTROY, open joint stock Company. Meeting with the Managing Director of the Company on site Mr ASOEV **Khayrullo Asoevich**. Site visit of the Site installation close to the Office and on the Left Bank and equipment of the Company available on site.
15th of November	:Site visit of the conditions of the main roads and tunnels. Visit of site installation of geotechnical and foundation subcontractor Irania to the main Contractor Rogungesstroy. Meeting with the Mr Nader Darvish Zani. The Company is carrying out the additional geotechnical tests recommended by Tractebel/COB: Mr C.Vbert and J. Schittekat. Site visit of the Dam foundation in the clay core area to discuss the treatment of the foundation along the slope of the rock prior to placing the clay core and the embankment. Site visit of the former main Aggregate plant and Batching plant and weighing bridge before the Independence of the Tajikistan.
16th of November	: Meeting with Mr Nazar Odinaev Deputy Technical Director, Mr Zafar Buriev Laboratory Manager; Mr Shifiddin Bobokhonov and Mr Sultonbek Rhakmonskoev, leading engineers on geotechnical issues for the Dam dealing with aggregates production and density tests on embankment materials.
17th of November	: Mr Zafar Buriev Laboratory Manager; Mr Shifiddin Bobokhonov and Mr Sultonbek Rhakmonskoev, leading engineers on geotechnical issues dealing with aggregates production and grading tests concrete materials Meeting with Mr Nazar Odinaev Deputy Technical Director upon answer to list of questions in relation with the general site installations.
18th of November	: Return from Rogun to Dushanbe
19th of November	: Return from Dushanbe to Paris

3 MEETINGS WITH REPRESENTATIVES OF OSHPC BARKI TOJIK

Several discussions took place with the representatives of OSHPC BARKI TOJIK during the course of the visits of the worksites and at the Office.

They were mainly concentrated

- On the history of the development and progress of the Project and the status of the works;
- On request of information on materials, equipment, site installations, and climate and
- On request of records of tests and drawings.

Meetings took place with the Deputy Technical Director. In particular, clarifications on the organization and responsibilities on site of OSHPC BARKI TOJIK and of the Main Contractor Rogungesstroy were made.

On site OSHPC BARKI TOJIK is (but not limited to) supervising the Works together with the Representatives of the designer “HydroProject”, following up the quality and the progress of the works, liaising with the Contractor for planning the concrete works, checking and approving the monthly certificates. These are the site technical activities to which it should be added the administrative matters and the Public Relations with the third Parties.

As far as the procedure of awarding the Contract for the execution of the Project to a Main Contractor, the Procedure of the World Bank will be followed if the Bank is financing the Project. In this case the Tajik Company will have to follow the Procedure as well.

4 MEETING WITH THE CONTRACTOR ROGUNGESSTROY

The Managing Director on site of the Tajik Open Joint Stock Company Rogungesstoy has been met. The Design Manager and the Equipment Manager on site were attending the meeting. The following points were discussed.

Rogungesstroy Company is a Tajik Company that has been set up by the Tajik Government by Decree for the construction of the Rogun HPP Project. According to the Decree Rogungesstroy is the General Contractor for the Civil Works of the Dam and the HPP. The Works will be supervised by the Owner “OSPC Barki Tojik” and the Designer “Hydro Project” from Russia. The M&E and HSS works will be awarded to M&E and HSS Contractors and supervised by the Owner ”OSPC Barki Tojik”.

A Programme of Works with key dates to comply with and a Budget and a “Price List” are attached to the Contract of the Company for the maintenance Works agreed by the World Bank for the period of 2 years starting from June 2012.

For the Main Contract of the Work the Company considers that there will be no International Tender because the Company has been set up by Government Decree as the Construction Company of this Project. Therefore the Company will have only to submit a Programme of the Works and a Price on the basis of the Price List issued by the Government and revised every 3 months by the Government.

As per Contract the Company will submit to the Government for approval a yearly budget on the basis of the actual progress of the works and the Programme of the Works. With the first Budget the Company is paid for 20% advance payment of the budgeted amount. This advance is reimbursed during the year with the progress of the works.

Upon proposal of OSPC Barki Tojik to the Council Committee, chaired by the Prime Minister, an exceptional budget for the purchase of Equipment can be granted to the Company from time to time. This has been the case when the Company purchased brand new equipment between 2008 and 2010.

The Company selects the Subcontractors and submits them for evaluation and approval to “OSPC Barki Tojik”. If the Subcontractor is accepted by “OSPC Barki Tojik” the Company is authorized to sign a contract with the Subcontractor(s).

The Subcontractor is paid for by the Company and is also entitled to 20% advance payment of the first Budget. It was not clear whether the Subcontractor can request an advance payment for purchasing equipment.

The Company shall prepare the land for the site installations of the Subcontractor.

As far as the installation of an additional batching plant and aggregates plant, the Company shall submit a request for approval to “OSPC Barki Tojik”. The latter will evaluate the need and the location of the plants before giving its approval.

After the meeting the site installations of the Company have been visited. As the works are limited to the maintenance of the Site the activity is very limited. Several workshops and plants are shutdown. The report of the visit is made further down this Chapter.

It has been observed that the equipment of Rogungesstroy is mainly recent. But it has not been possible to check its performances as it is not in operation. However it should be noted that this equipment concerns the earthworks and concrete works activities only. The Company is not equipped for the underground and tunneling works. The list of equipment available has been handed over. The dates of Manufacture are indicated.

As the Company is already installed on site it could be granted a pre-contract for expediting the preliminaries to be completed prior to starting the permanent works and for securing faster implementation of the Project after the award of the Main Contract.

PHASE 1
ASSESSMENT OF EXISTING ROGUN HPP WORKS

ANNEX 2

LIST OF CONSTRUCTION EQUIPMENT AND SUBCONTRACTORS

List of machinery and mechanisms of OJSC 'RogunGESstroy' with technical characteristics					
No.	**Name of machinery and equipment**	**Brand and model**	**Year of manufacture**	**"Capacity (tons)"**	**Engine hp**
1	Dump trucks	MAZ-551605-272	2008	20	330 hp
2	Dump trucks	MAZ-551605-272	2007	20	330 hp
3	Dump truck	KrAZ-256B-1	1987	11	240 hp
4	Dump trucks	DFZ-3151A	2010	25	330 hp
5	Mixer	MAZ-630303-245	2008	6m3	250 hp
6	Mixer	MAZ-630303-245	2007	6m3	250 hp
7	Water tank truck	MAZ-533702	2008	8	250 hp
8	Mixer	MAZ-533702	2008	8	250 hp
9	Crew buses	MAZ-631705	2007	30 seats	250 hp
10	Crew buses	KAMAZ-43101	1987	30 seats	250 hp
11	Crew buses	NZAS GAZ-66	1987	25 seats	115 hp
12	Crew buses	Ural-43206	1986	26 seats	240 hp
13	Bus	Shouling	2008	26 seats	132 hp
14	Bus	Khudjand-ZIL	1998	24 seats	150 hp
15	Bus	PAZ-672M	1987	23 seats	115 hp
16	Middle-size truck	GAZ-33023-14	2008	7 seats	65 hp
17	Truck	ZIL-130	1986	6	150 hp
18	Truck	UAZ-452	2005	4	75 hp
19	Truck	NZAS GAZ-66	1987	6	115 hp
20	Semitrailer		2009	80	
21	Semitrailer		2009	40	
22	Dump truck	BelAZ-7540B	2008	30	265/360
23	Dump truck	BelAZ-7540B	2009	30	265/360
24	Towing truck	BelAZ-7522	1988		265/360
25	Water tank truck	BelAZ-76740	2008	40	300/408
26	Loader	CAT-1600R	2008	4.8m3	228/305
27	Water tank truck	DFZ 5141 GXW	2009	4m3	132 kW
28	Water tank truck	DFZ 5168 GPS	2009	4m3	118 kW
29	Truck	DFZ 5230 GJV	2009	4m3	170 kW
30	Cement carrier	DFZ 5254 GFLV	2009	25	170 kW
31	Cement carrier	DFZ 5141 GFL	2010	10	140 kW
32	Mixer	DFZ 5251 GJBAI	2009	7m3	250 kW
33	Truck	DFZ EQ5120SL	2010	6	90 kW

34	Crew buses	DFZ 5250	2010	45 seats	170 hp
35	Dump Truck	DFZ 3500RY	2010	35	250/340
36	Truck	MAZ - 53371	1990	8	180 hp
37	Crew bus	Ural-49457	1986	26 seats	240 hp
38	Crane	KSHT-50.01	2008	50	240 hp
39	Crane	KS-55727-1	2008	25	240 hp
	Crane	SANY Qy 50	2011	50	
40	Travelling bridge crane	KS-3242	1976	25	
41	Truck crane	KS-4361	1976	16	100 hp
42	Travelling bridge crane	KS-3032	1976	40	
43	Travelling bridge crane	KS-10	1976		
44	Loader	MoAZ-40484	2008	3.75m3	240 hp
45	Dump truck	MoAZ-7405	2008	26	240 hp
46	Motor scraper	MoAZ-6014	2008	22	240 hp
47	Motor scraper	MoAZ-546-P	2008	22	
48	Loader	CAT-1600R	2008	4.8m3	228/305
49	Loader	Liugong-856	2011	3m3	160 KW
50	Excavator	EKG-5.0	1978	5m3	
51	Excavator	EKG-4.6	1978	4.6m3	
52	Excavator	Hyundai-500R	2008	2.5m3	325 hp
53	Excavator	Hyundai-250R	2008	1.5m3	180 hp
54	Excavator	Hyundai-150R	2010	0.75m3	90/130
55	Excavator	Hyundai-210R	2010	1.0m3	160 hp
56	Excavator	Liugong-936D	2011	1.9m3	198 kW
57	Excavator	Liugong-923	2011	1.12m3	140 kW
58	Excavator-loader	CAT-428E	2011	1.0m3	90/130
59	Bulldozer	CAT D-8R	2008	6.9m3	320 hp
60	Bulldozer	CAT D-6R	2008	4.5m3	216 hp
61	Bulldozer	CAT D-6N	2009	4.25m3	160 hp
62	Bulldozer	CAT D-7R	2008	5.6m3	220/240
63	Bulldozer	Dresser TD-40B	1992	18.7m3	530 hp
64	Grader	DZ-98	1978		240 hp
65	Grader	Liugong-422	2011	3960mm	160 hp
66	Tractor	K-701	1976		300 hp
67	Tractor	T-150	1976		180 hp
68	Tractor	MTZ-82	2009		82 hp
69	Welding equipment	YAMAHA EDL	2008		56 hp
70	Welding equipment	Carburator	2009		56 hp
71	Compressor	K-250 LGCY-7/17	2009	17MPa	194 hp

72	Compressor		2008		194 hp
73	Boring machine	KY-140	2009	20 r.m.D140/h	75kW
74	Boring machine	Boomer	2010	25 r.m. 140/h	90kW
75	Concrete pump	SANY-HBT60C	2010	65m3/hour	194 kW
76	Concrete pump	CIFA	2010	35m3/hour	160 kW
77	Mobile crane	PY5110JGKZ20	2009	27m	118 kW
78	Mobile crane	DFZ 5129JSQZB	2009	3	110 kW
79	Truck with trailer	DFZ4251A	2009	40-80 tons	276 kW
80	Trailer	P-600 60 tons	2010	60	
81	Compactor	CAT	2011	36	175 hp

List of machinery, mechanisms and equipment UMR of OJSC 'RogunGESstroy'					
No.	**Name**	**Brand and model**	**Plate number**	**Year of manifacture**	**Note**
1	Mobile crane	PY-5110		2009	
2	Mobile crane	PY-5111		2009	
3	Mobile crane	PY-5112		2009	
4	Mobile crane	PY-5113		2009	
5	Mobile crane	PY-5114		2009	
6	Mobile crane	PY-5115		2011	
7	Mobile crane	PY-5116		2011	
8	Mobile crane	PY-5117		1991	
9	Grader	DZ-98		2011	
10	Grader	LiuGong-442		1984	
11	Grader	DZ-122A		2008	
12	Auto crane	KS-55727-1		2008	
13	Auto crane	KS-55727-2		2008	
14	Auto crane	KS-55727-3		2008	
15	Auto crane	KS-55727-4		2011	
16	Auto crane	SANY QU-50		2008	
17	Auto crane	KRAYAN' KSHT-50		2008	
18	Auto crane	KRAYAN' KSHT-50		2008	
19	Auto crane	KS-4561		1989	
20	Auto crane 'Yanvarec'	KS-6471		1985	
21	Off-road vehicle	33023-14		2008	
22	Off-road vehicle	UAZ-452		1988	
23	Off-road vehicle	HOWO-371		2007	
24	Off-road vehicle	UAZ-452		1986	
25	Gasoline tanker	GAZ-53		1977	
26	Truck	MAZ-53371		1990	
27	Crew bus	GAZ-66		1988	
28	Crew bus	URAL-375		2008	
29	Bus	GAZ-53ETL		1989	
30	Saddle pullman car	DFL-4251		2009	
31	Saddle pullman car	DFL-4251		2009	
32	Saddle pullman car	DFL-4251		2011	
33	Dump truck	MOAZ-74051		2008	
34	Dump truck	MOAZ-74051		2008	
35	Dump truck	MOAZ-74051		2008	
36	Dump truck	MOAZ-74051		2008	

37	Dump truck	MOAZ-74051		2008	
38	Dump truck	MOAZ-74051		2008	
39	Dump truck	MOAZ-74051		2008	
40	Dump truck	MOAZ-74051		2008	
41	Dump truck	MOAZ-74051		2008	
42	Dump truck	MOAZ-74051		2008	
43	Auto scraper	MOAZ-60148		2008	
44	Auto scraper	MOAZ-60148		2008	
45	Auto scraper	MOAZ-546		1988	
46	Concrete pump	Cifa		2010	
47	Concrete pump	SANY HBT 60C		2011	
48	Concrete pump	SANY HBT 60C		2012	
49	Concrete pump	SANY HBT 40C		2010	
50	Concrete pump	SANY HBT 60C		2012	
51	Electrical concrete pump	SANY HBT 60C		2011	
52	Bulldozer	CAT-D8R		2008	
53	Bulldozer	CAT-D8R		2008	
54	Bulldozer	CAT-D8R		2008	
55	Bulldozer	CAT-D8R		2008	
56	Bulldozer	CAT-D7R		2008	
57	Bulldozer	CAT-D7R		2008	
58	Bulldozer	CAT-D6R		2008	
59	Bulldozer	CAT-D6R		2008	
60	Bulldozer	CAT-D6N		2008	
61	Bulldozer	CAT-D6N		2008	
62	Bulldozer	CAT-D6N		2011	
63	Bulldozer	T-130		1989	
64	Bulldozer	T-130		1988	
65	Bulldozer	T-170		2006	
66	Bulldozer	T-330		1989	
67	Bulldozer	C-100		1983	
68	Bulldozer	DET-250		1987	
69	Bulldozer dresser	TD-40		1992	
70	Bulldozer dresser	TD-40		1992	
71	Boring machine	Kaishan		2008	
72	Boring machine	Kaishan		2008	
73	Boring machine	BOOMER-282		2011	
74	Vibro roller	PVK-282		1989	
75	Roller	CAT-CN76		2011	
76	Roller	CAT CS-76		1988	
77	Compressor	LGCY 17/17		2008	

78	Compressor	LGCY 17/17		2008	
79	Compressor			2008	
80	Crane	DEK-251		1970	
81	Crane	DEK-251		1988	
82	Crane	DEK-251		1988	
83	Crane	DEK-251		1970	
84	Crane	UZTM		1962	
85	Tower crane	KBGES-450		1975	
86	Tower crane	KBGES-450		1968	
87	Tower crane	KS-3242		1977	
88	Traveling bridge crane	KS-3032E		1980	
89	Traveling bridge crane	KS-10		1977	
90	Crane truck	KS-4361A		1988	
91	Manipulator	DFZ-5129		2008	
92	Manipulator	DFZ-5129		2008	
93	Manipulator	DFZ-5129		2008	
94	Manipulator	DFZ-5129		2008	
95	Manipulator	DFZ-5129		2009	
96	Manipulator	DFZ-5129		2009	
97	Manipulator	DFZ-5129		2009	
98	Manipulator	DFZ-5130		2009	
99	Wayside station	DES-100		1969	
100	Loader	LiuGong-856		2011	
101	Loader	LiuGong-856		2011	
102	Loader	LiuGong-856		2011	
103	Loader	CAT-1600R		2008	
104	Loader	CAT-1600R		2008	
105	Loader	CAT-1600R		2008	
106	Loader	CAT-1600R		2008	
107	Loader	MoAz-40484		2008	
108	Loader	MoAz-40484		2008	
109	Loader	MoAz-40484		2008	
110	Loader	MoAz-40484		2008	
111	Welding equipment	SAG		1989	
112	Welding equipment	SAG		2008	
113	Welding equipment	SAG		2008	
114	Welding equipment	SAG		2008	
115	Welding equipment	SAG		2008	
116	Wheel tractor	T-150		1985	
117	Wheel tractor	T-150		1988	
118	Wheel tractor	T-150		1989	

119	Wheel tractor	MTZ-82		2010	
120	Wheel tractor	K-701		1989	
121	Excavator	LiuGong-936		2011	
122	Excavator	LiuGong-926		2011	
123	Excavator	LiuGong-936		2011	
124	Excavator	Hyundai R-150		2010	
125	Excavator	Hyundai R-210		2010	
126	Excavator	Hyundai R-250		2008	
127	Excavator	Hyundai R-250		2008	
128	Excavator	Hyundai R-250		2008	
129	Excavator	Hyundai R-250		2008	
130	Excavator	Hyundai R-500		2008	
131	Excavator	Hyundai R-500		2008	
132	Excavator	Hyundai R-500		2008	
133	Excavator	Hyundai R-500		2008	
134	Excavator	EKG 5-A		1987	
135	Excavator	EKG 5-A		1987	
136	Excavator	EKG 5-A		1988	
137	Excavator	EKG 5-A		1987	
138	Excavator	EKG 5-A		1987	
139	Excavator	EKG 5-A		1987	
140	Excavator	EKG-5,0		1988	
141	Excavator	EKG-4,6		1989	
142	Excavator	EKG-4,6		1976	
143	Excavator	EKG-5,0		1988	
144	Excavator	EKG-5,0		1988	
145	Excavator	EKG-4,6		1990	
146	Excavator	EO-5126		2006	
147	Excavator	EO-5126		2006	
148	Excavator	EO-5126		2007	

Turning workstation

1	Tool-grinding machine			1975	
2	Hydraulic press	OKS-1671M		1972	
3	Turning workstation	1K62		1966	
4	Turning workstation	1M63DYA		1967	
5	Router	2H135		1960	
6	Turning workstation	16625PSP		1960	
7	Radial drilling machine	2L53U		1974	
8	Router	6P82		1959	
9	Horizontal milling machine	6N83		1959	
10	Straightening machine	9384		1979	
11	Straightening machine	Model 7D36		1975	
12	Slotting machine	MM400012		1959	

List of machinery and mechanisms of ATPO OJSC 'RogunGESstroy'

No.	Name	Brand and model	Plate number	Year of manufacture	Note
1	Dump truck	Kraz 256		1987	
2	Dump truck	MAZ 551605		2008	
3	Dump truck	MAZ 551606		2008	
4	Dump truck	MAZ 551607		2007	
5	Dump truck	MAZ 551608		2007	
6	Dump truck	MAZ 551609		2007	
7	Dump truck	MAZ 551610		2007	
8	Dump truck	MAZ 551611		2007	
9	Dump truck	MAZ 551612		2007	
10	Dump truck	MAZ 551613		2007	
11	Dump truck	MAZ 551614		2007	
12	Dump truck	MAZ 551615		2007	
13	Dump truck	MAZ 551616		2007	
14	Dump truck	MAZ 551617		2007	

15	Dump truck	MAZ 551618		2008	
16	Dump truck	MAZ 551619		2008	
17	Dump truck	MAZ 551620		2008	
18	Dump truck	MAZ 551621		2008	
19	Dump truck	MAZ 551622		2008	
20	Dump truck	MAZ 551623		2008	
21	Dump truck	MAZ 551624		2008	
22	Dump truck	MAZ 551625		2008	
23	Dump truck	MAZ 551626		2008	
24	Dump truck	MAZ 551627		2008	
25	Dump truck	MAZ 551628		2008	
26	Dump truck	MAZ 551629		2008	
27	Dump truck	MAZ 551630		2008	
28	Dump truck	MAZ 551631		2008	
29	Dump truck	MAZ 551632		2008	
30	Dump truck	MAZ 551633		2008	
31	Dump truck	MAZ 551634		2008	
32	Dump truck	MAZ 551635		2008	
33	Dump truck	MAZ 551636		2008	
34	Dump truck	MAZ 551637		2008	
35	Dump truck	DFZ-3251 A		2009	
36	Dump truck	DFZ-3251 A		2009	
37	Dump truck	DFZ-3251 A		2009	
38	Dump truck	DFZ-3251 A		2009	
39	Dump truck	DFZ-3251 A		2009	
40	Dump truck	DFZ-3251 A		2009	
41	Dump truck	DFZ-3251 A		2009	
42	Dump truck	DFZ-3251 A		2009	
43	Dump truck	DFZ-3251 A		2009	
44	Dump truck	DFZ-3251 A		2009	
45	Dump truck	DFZ-3251 A		2009	
46	Dump truck	DFZ-3251 A		2009	
47	Dump truck	DFZ-3251 A		2009	
48	Dump truck	DFZ-3251 A		2009	
49	Dump truck	DFZ-3251 A		2009	
50	Dump truck	DFZ-3251 A		2009	
51	Dump truck	DFZ-3251 A		2009	
52	Dump truck	DFZ-3251 A		2009	
53	Dump truck	DFZ-3251 A		2009	
54	Dump truck	DFZ-3251 A		2009	
55	Dump truck	DFZ-3251 A		2009	

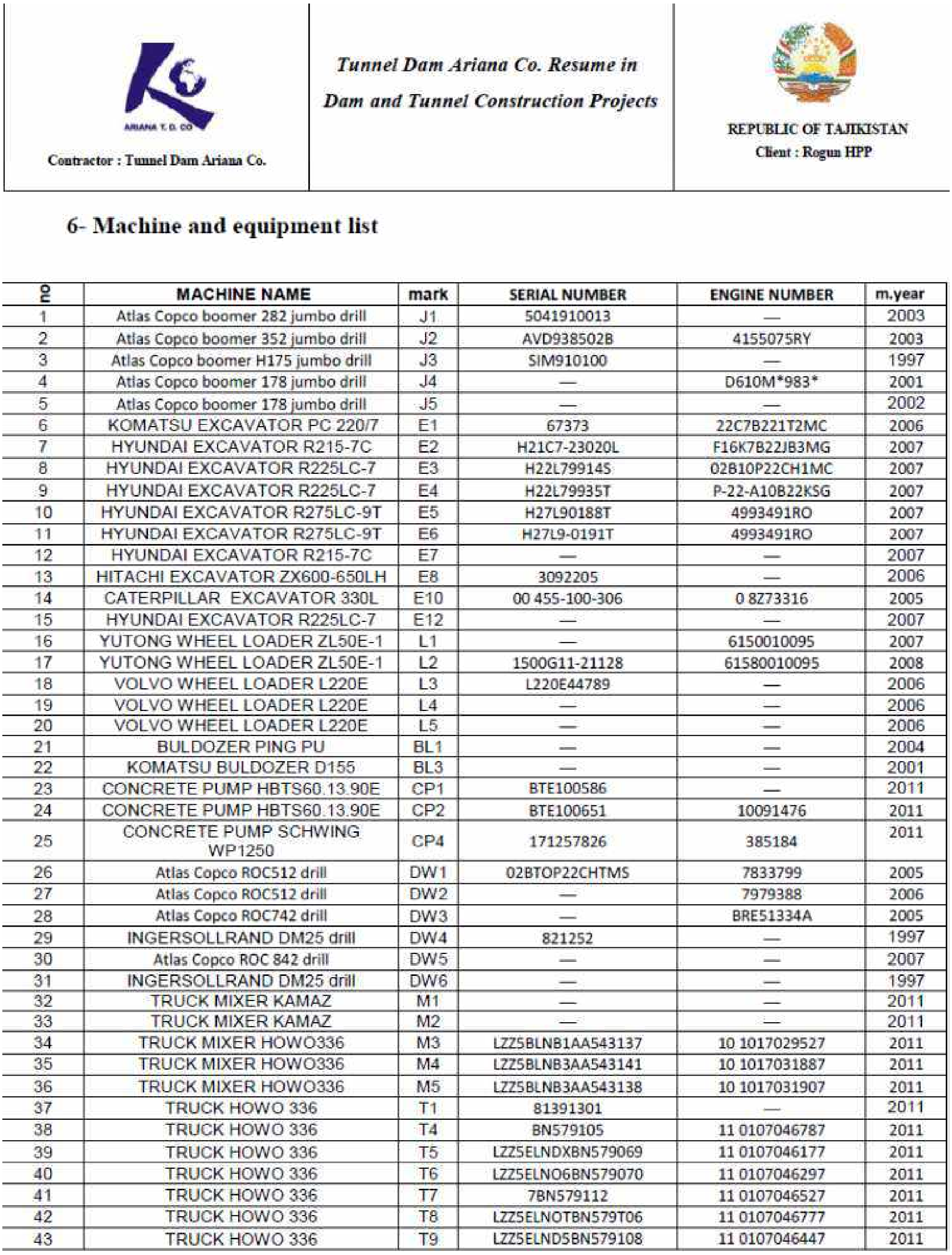
56	Dump truck	DFZ-3251 A		2009	
57	Dump truck	DFZ-3251 A		2009	
58	Dump truck	DFZ-3251 A		2009	
59	Dump truck	DFZ-3251 A		2009	
60	Mixer	DFZ 5251GJBA1		2009	
61	Mixer	DFZ 5251GJBA1		2009	
62	Mixer	DFZ 5251GJBA1		2009	
63	Mixer	DFZ 5251GJBA1		2009	
64	Mixer	DFZ 5251GJBA1		2009	
65	Mixer	DFZ 5251GJBA1		2009	
66	Mixer	MAZ 630303		2007	
67	Mixer	MAZ 630303		2007	
68	Mixer	MAZ 630303		2007	
69	Mixer	MAZ 630303		2007	
70	Mixer	MAZ 630303		2007	
71	Mixer	MAZ 630303		2007	
72	Mixer	MAZ 630303		2007	
73	Mixer	MAZ 630303		2007	
74	Mixer	MAZ 630303		2007	
75	Mixer	MAZ 630303		2007	
76	Mixer	MAZ 630303		2008	
77	Mixer	MAZ 630303		2008	
78	Mixer	MAZ 630303		2008	
79	Mixer	MAZ 630303		2008	
80	Mixer	MAZ 630303		2007	
81	Mixer	MAZ 630303		2007	
82	Mixer	MAZ 630303		2007	
83	Mixer	MAZ 630303		2007	
84	Mixer	MAZ 630303		2007	
85	Mixer	MAZ 630303		2007	
86	Mixer	KAMAZ-53229R		2006	
87	Mixer	KAMAZ-53229R		2006	
88	Mixer	KAMAZ-53229R		2006	
89	Mixer	KAMAZ-53229R		2006	
90	Crew bus	ZIL 130		1986	
91	Crew bus	Tojikiston bus		1998	
92	Crew bus	PAZ 672 bus		1987	
93	Crew bus	NZAS GAZ-66		1987	
94	Crew bus	Shouling bus		2008	

95	Crew bus	Shouling bus		2008	
96	Crew bus	MAZ 631705-24		2007	
97	Crew bus	MAZ 631705-24		2007	
98	Crew bus	MAZ 631705-24		2007	
99	Crew bus	MAZ 631705-24		2007	
100	Crew bus	MAZ 631705-24		2007	
101	Crew bus	MAZ 631705-24		2007	
102	Crew bus	MAZ 631705		2007	
103	Crew bus	MAZ 631705		2007	
104	Crew bus	MAZ 631705		2007	
105	Crew bus	MAZ 631705		2007	
106	Crew bus	KAMAZ 43101		1991	
107	Crew bus	URAL 43206		1984	
108	Crew bus	DFZ 5250 XXY		2010	
109	Crew bus	DFZ 5250 XXY		2010	
110	Crew bus	DFZ 5250 XXY		2010	
111	Crew bus	DFZ 5250		2010	
112	Crew bus	DFZ 5250		2010	
113	Crew bus	DFZ 5250		2010	
114	Bus	KAVZ-685			
115	Cement carrier	DFZ 5141GFL		2010	
116	Cement carrier	DFZ 5141GFL		2010	
117	Cement carrier	DFZ 5141GFL		2010	
118	Cement carrier	DFZ 5141GFL		2010	
119	Cement carrier	DFZ 5254GFLV		2010	
120	Cement carrier	DFZ 5254GFLV		2010	
121	Cement carrier	DFZ 5254GFLV		2010	
122	Cement carrier	DFZ 5254GFLV		2010	
123	Cement carrier	DFZ 5254GFLV		2009	
124	Cement carrier	DFZ 5254GFLV		2009	
125	Cement carrier	DFZ 5254GFLV		2009	
126	Cement carrier	DFZ 5254GFLV		2009	
127	Cement carrier	DFZ 5254GFLV		2009	
128	Cement carrier	DFZ 5254GFLV		2009	
129	Cement carrier	DFZ 5254GFLV		2009	
130	Cement carrier	DFZ 5254GFLV		2009	
131	Cement carrier	DFZ 5254GFLV		2009	
132	Cement carrier	DFZ 5254GFLV		2009	
133	Cement carrier	DFZ 5254GFLV		2009	
134	Cement carrier	DFZ 5254GFLV		2009	

135	Cement carrier	DFZ 5254GFLV		2009	
136	Cement carrier	DFZ 5254GFLV		2009	
137	Cement carrier	DFZ 5254GFLV		2009	
138	Cement carrier	DFZ 5254GFLV		2009	
139	Cement carrier	DFZ 5254GFLV		2009	
140	Cement carrier	DFZ 5254GFLV		2009	
141	Cement carrier	DFZ 5254GFLV		2009	
142	Cement carrier	DFZ 5254GFLV		2009	
143	Cement carrier	DFZ 5254GFLV		2009	
144	Gasoline carrier	DFZ 5230 GJY		2009	
145	Gasoline carrier	DFZ 5230 GJY		2009	
146	Gasoline carrier	DFZ 5230 GJY		2009	
147	Gasoline carrier	DFZ 5230 GJY		2009	
148	Gasoline carrier	DFZ 5230 GJY		2009	
149	Gasoline carrier	DFZ 5230 GJY		2009	
150	Gasoline carrier	DFZ 5230 GJY		2009	
151	Gasoline carrier	DFZ 5230 GJY		2009	
152	Gasoline carrier	DFZ 5230 GJY		2009	
153	Gasoline carrier	DFZ 5230 GJY		2009	
154	Gasoline carrier	DFZ 5230 GJY		2009	
155	Gasoline carrier	DFZ 5230 GJY		2009	
156	Gasoline carrier	MAZ 533702 ATZ		2007	
157	Gasoline carrier	MAZ 533702 ATZ		2007	
158	Gasoline carrier	MAZ 533702 ATZ		2007	
159	Gasoline carrier	MAZ 533702 ATZ		2007	
160	Water tank truck	DFZ 5168 GPS		2009	
161	Water tank truck	DFZ 5168 GPS		2009	
162	Water tank truck	DFZ 5168 GPS		2009	
163	Water tank truck	DFZ 5168 GPS		2009	
164	Water tank truck	DFZ 5168 GPS		2009	
165	Water tank truck	DFZ 5168 GPS		2009	
166	Water tank truck	DFZ 5168 GPS		2009	
167	Water tank truck	MAZ 533702		2007	
168	Water tank truck	MAZ 533702		2007	
169	Truck	DFZ EQ5120SL		2010	
170	Truck	DFZ EQ5120SL		2010	
171	Os. Car (Ос. Машина)	DFZ 5141 GXW		2009	

172	Os. Car (Ос. Машина)	DFZ 5141 GXW		2009	
173	Os. Car (Ос. Машина)	DFZ 5141 GXW		2009	
201	Middle-size truck	GAZel 33023		2008	
202	Middle-size truck	GAZel 33023		2008	
203	Tow truck	MAZ-5424		1982	
204	Tow truck	KAMAZ-54112		1988	
205	Truck	Kraz-255		1973	
206	Truck	KAMAZ 4310		1990	
207	Truck	GAZ 533309		2006	
208	Truck	KAMAZ 4310		1989	
209	Water tank truck	Kraz-255 b-1		1989	
210	Truck	GAZ-53		1989	
211	Laboratory truck	GAZ-5204		1989	
212	Laboratory truck	GAZ-5204		1988	
213	Truck	ZIL-43110		1989	
214	Truck	ZIL-43110		1987	
215	Trailer	Water tank trailer ODAZ 93-70		1991	
216	Water tank truck	ZIL-130		1988	
217	Cement carrying trailer	ODAZ - 9370		1990	
218	Trailer	ODAZ - 9370		1987	
List of machinery and mechanisms of UTM OJSC 'RogunGESstroy'					
No.	**Name**	**Brand and model**	**Quantity**	**Year of manufacture**	
1	Dump truck	BelAz-7540B	90	2008	
2	Dump truck	BelAz-7540B	10	2009	
3	Dump truck	BelAz-7540B	4	2006	
4	Dump truck	BelAz-7522	2	1988	
5	Water tank truck	BelAz-76740	1	2008	
	Total		107		

List of Equipment of Subcontractor Iriana



ARIANA T. D. CO

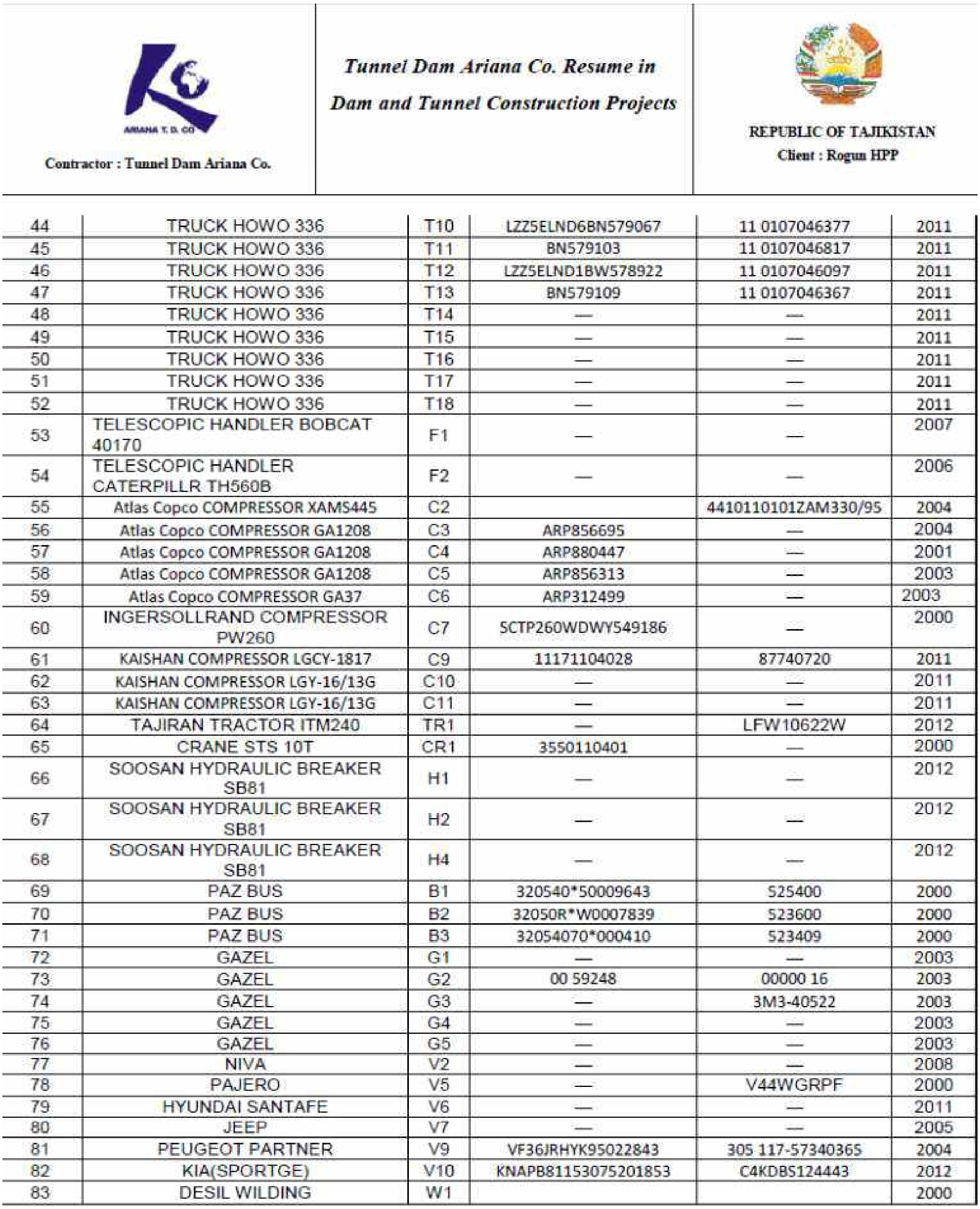
Contractor : Tunnel Dam Ariana Co.

Tunnel Dam Ariana Co. Resume in
Dam and Tunnel Construction Projects

REPUBLIC OF TAJIKISTAN
Client : Rogun HPP

6- Machine and equipment list

No	MACHINE NAME	mark	SERIAL NUMBER	ENGINE NUMBER	m.year
1	Atlas Copco boomer 282 jumbo drill	J1	5041910013	—	2003
2	Atlas Copco boomer 352 jumbo drill	J2	AVD938502B	4155075RY	2003
3	Atlas Copco boomer H175 jumbo drill	J3	SIM910100	—	1997
4	Atlas Copco boomer 178 jumbo drill	J4	—	D610M*983*	2001
5	Atlas Copco boomer 178 jumbo drill	J5	—	—	2002
6	KOMATSU EXCAVATOR PC 220/7	E1	67373	22C7B221T2MC	2006
7	HYUNDAI EXCAVATOR R215-7C	E2	H21C7-23020L	F16K7B22JB3MG	2007
8	HYUNDAI EXCAVATOR R225LC-7	E3	H22L79914S	02B10P22CH1MC	2007
9	HYUNDAI EXCAVATOR R225LC-7	E4	H22L79935T	P-22-A10B22KSG	2007
10	HYUNDAI EXCAVATOR R275LC-9T	E5	H27L90188T	4993491RO	2007
11	HYUNDAI EXCAVATOR R275LC-9T	E6	H27L9-0191T	4993491RO	2007
12	HYUNDAI EXCAVATOR R215-7C	E7	—	—	2007
13	HITACHI EXCAVATOR ZX600-650LH	E8	3092205	—	2006
14	CATERPILLAR EXCAVATOR 330L	E10	00 455-100-306	0 8Z73316	2005
15	HYUNDAI EXCAVATOR R225LC-7	E12	—	—	2007
16	YUTONG WHEEL LOADER ZL50E-1	L1	—	6150010095	2007
17	YUTONG WHEEL LOADER ZL50E-1	L2	1500G11-21128	61580010095	2008
18	VOLVO WHEEL LOADER L220E	L3	L220E44789	—	2006
19	VOLVO WHEEL LOADER L220E	L4	—	—	2006
20	VOLVO WHEEL LOADER L220E	L5	—	—	2006
21	BULDOZER PING PU	BL1	—	—	2004
22	KOMATSU BULDOZER D155	BL3	—	—	2001
23	CONCRETE PUMP HBTS60.13.90E	CP1	BTE100586	—	2011
24	CONCRETE PUMP HBTS60.13.90E	CP2	BTE100651	10091476	2011
25	CONCRETE PUMP SCHWING WP1250	CP4	171257826	385184	2011
26	Atlas Copco ROC512 drill	DW1	02BTOP22CHTMS	7833799	2005
27	Atlas Copco ROC512 drill	DW2	—	7979388	2006
28	Atlas Copco ROC742 drill	DW3	—	BRE51334A	2005
29	INGERSOLLRAND DM25 drill	DW4	821252	—	1997
30	Atlas Copco ROC 842 drill	DW5	—	—	2007
31	INGERSOLLRAND DM25 drill	DW6	—	—	1997
32	TRUCK MIXER KAMAZ	M1	—	—	2011
33	TRUCK MIXER KAMAZ	M2	—	—	2011
34	TRUCK MIXER HOWO336	M3	LZZ5BLNB1AA543137	10 1017029527	2011
35	TRUCK MIXER HOWO336	M4	LZZ5BLNB3AA543141	10 1017031887	2011
36	TRUCK MIXER HOWO336	M5	LZZ5BLNB3AA543138	10 1017031907	2011
37	TRUCK HOWO 336	T1	81391301	—	2011
38	TRUCK HOWO 336	T4	BN579105	11 0107046787	2011
39	TRUCK HOWO 336	T5	LZZ5ELNDXBN579069	11 0107046177	2011
40	TRUCK HOWO 336	T6	LZZ5ELNO6BN579070	11 0107046297	2011
41	TRUCK HOWO 336	T7	7BN579112	11 0107046527	2011
42	TRUCK HOWO 336	T8	LZZ5ELNOTBN579T06	11 0107046777	2011
43	TRUCK HOWO 336	T9	LZZ5ELND5BN579108	11 0107046447	2011



Contractor : Tunnel Dam Ariana Co.

Tunnel Dam Ariana Co. Resume in Dam and Tunnel Construction Projects

REPUBLIC OF TAJIKISTAN
Client : Rogun HPP

44	TRUCK HOWO 336	T10	LZZ5ELND6BN579067	11 0107046377	2011
45	TRUCK HOWO 336	T11	BN579103	11 0107046817	2011
46	TRUCK HOWO 336	T12	LZZ5ELND1BW578922	11 0107046097	2011
47	TRUCK HOWO 336	T13	BN579109	11 0107046367	2011
48	TRUCK HOWO 336	T14	—	—	2011
49	TRUCK HOWO 336	T15	—	—	2011
50	TRUCK HOWO 336	T16	—	—	2011
51	TRUCK HOWO 336	T17	—	—	2011
52	TRUCK HOWO 336	T18	—	—	2011
53	TELESCOPIC HANDLER BOBCAT 40170	F1	—	—	2007
54	TELESCOPIC HANDLER CATERPILLR TH560B	F2	—	—	2006
55	Atlas Copco COMPRESSOR XAMS445	C2		4410110101ZAM330/95	2004
56	Atlas Copco COMPRESSOR GA1208	C3	ARP856695	—	2004
57	Atlas Copco COMPRESSOR GA1208	C4	ARP880447	—	2001
58	Atlas Copco COMPRESSOR GA1208	C5	ARP856313	—	2003
59	Atlas Copco COMPRESSOR GA37	C6	ARP312499	—	2003
60	INGERSOLLRAND COMPRESSOR PW260	C7	SCTP260WDWY549186	—	2000
61	KAISHAN COMPRESSOR LGCY-1817	C9	11171104028	87740720	2011
62	KAISHAN COMPRESSOR LGY-16/13G	C10	—	—	2011
63	KAISHAN COMPRESSOR LGY-16/13G	C11	—	—	2011
64	TAJIRAN TRACTOR ITM240	TR1	—	LFW10622W	2012
65	CRANE STS 10T	CR1	3550110401	—	2000
66	SOOSAN HYDRAULIC BREAKER SB81	H1	—	—	2012
67	SOOSAN HYDRAULIC BREAKER SB81	H2	—	—	2012
68	SOOSAN HYDRAULIC BREAKER SB81	H4	—	—	2012
69	PAZ BUS	B1	320540*50009643	525400	2000
70	PAZ BUS	B2	32050R*W0007839	523600	2000
71	PAZ BUS	B3	32054070*000410	523409	2000
72	GAZEL	G1	—	—	2003
73	GAZEL	G2	00 59248	00000 16	2003
74	GAZEL	G3	—	3M3-40522	2003
75	GAZEL	G4	—	—	2003
76	GAZEL	G5	—	—	2003
77	NIVA	V2	—	—	2008
78	PAJERO	V5	—	V44WGRPF	2000
79	HYUNDAI SANTAFE	V6	—	—	2011
80	JEEP	V7	—	—	2005
81	PEUGEOT PARTNER	V9	VF36JRHYK95022843	305 117-57340365	2004
82	KIA(SPORTGE)	V10	KNAPB81153075201853	C4KDBS124443	2012
83	DESIL WILDING	W1			2000

ARIANA T. D. CO

Contractor : Tunnel Dam Ariana Co.

Tunnel Dam Ariana Co. Resume in Dam and Tunnel Construction Projects

REPUBLIC OF TAJIKISTAN
Client : Rogun HPP

No	Machine Name	Model	No. in site	No. in IRAN	m. year
1	Drill Rig	Diamec 232	-	3	2010
2	Drill Rig	Diamec 252	-	5	2010
3	Drill Rig	Diamec 262	-	6	2010
4	Drill Rig	JG200	2	2	2012
5	Drill Rig	XY4	1	2	2012
6	Drill Rig	XY1	4	12	2010
7	Drill Rig	DANDHOLE	8	20	2010
8	Drill Rig	Chines	6	24	2010
9	Drill Rig	Rasol	6	10	2010
10	Mud Pump	BW150	6	20	2012
11	Mud Pump	BW250	6	20	2012
12	Grout Pump	ITP	6	20	2010
13	Primary Mixer	ITP	6	20	2010
14	Secondary Mixer	ITP	6	20	2010
15	Bucket Packer	ITP	10	26	2010
16	Pneumatic Packer	Swedish	10	26	2012
17	Mechanics Packer	Swedish	15	30	2012

List of RogunGESstroy Subcontractors

Information about the contractors and subcontractors involved in activity at Rogun HPP		
#	**Name of Company**	**Description of work**
1	OJSC “RogunGeSStroy”	Construction erection works
2	OSHC “Tajikhydroelectricinstallation”	Electrical installation works. Batching plant
3	LLC MGTC “Nurafshon”	Installation of monitoring and measuring equipment. Production of salt brine
4	OJSC “GCC Dangara”	Maintenance and rehabilitation works
5	LLC “Dagspetsstroyservice”	Grouting works
6	OSHC “CherkeyGesstroy”	Construction erection works
7	OSHC “Tajikhydroinstallation”	Assembly of metal structures and equipment
8	LLC “Asry Nur”	Grouting works
9	LLC “Interstroy”	Construction erection works. Batching plant
10	LLC “Nurob”	Construction erection works
11	LLC TD “Hydroenergystroy”	Blasting works
12	LLC “WestTransStroy”	Grouting works. Batching plant
13	OSHC “Tajikhydrospetsstoy”	Construction erection works
14	OSHC “Tajiknaqbsoz”	Construction erection works
15	JSC IK “Tunnel saddi Ariana”	Construction erection works. Installation of deep anchors
16	LLC “Energystroy limited”	Grouting works
17	LLC “Sokhtmonsarmoya”	Grouting works
18	DP KIE #3	Exploration works
19	OSHC “TrustHydromontazh”	Assembly of metal structures and equipment. Commission works
20	LLC “Nekzod”	Construction erection works. Batching plant
21	OSHC “Hydroproject Institute”	Project Design
22	OSHC “TajikCGEM”	Steel structure and equipment installation
23	OSHC “Sanoatsoz”	Design works
24	SC “TajikGeology”	Exploration works
25	OSHC “Turboatom”	Pre installation engineering and supervising, equipment revision
26	OSHC “Shahrofar”	Design works
27	Unitary Enterprise “UTGRE”	Exploration works
28	State Unitary Enterprise “AirGeodesy Dushanbe”	Topographic work
29	CJSC “TaDES”	Crushing and sorting plant
30	UiF Service	Crushing and sorting plant
31	LLC “Vostochnaya Gornaya Companiya”	Batch Plant
32	“Somoniyon” Company	Design works

Construction site No1 - Layout of Workshops and Warehouses.

PHASE 1
ASSESSMENT OF EXISTING ROGUN HPP WORKS

ANNEX 3

CONSTRUCTION MATERIALS ASSESSMENT

September 2013

C	15/09/2013	Final Assessment	YOU	ALA/CVB	NSA
Revision	**Date**	**Subject of revision**	**Drafted**	**Checked**	**Approved**

CONTENT

FIGURES

TABLES

1 ANTECEDENTS AND SCOPE

This note aims identifying and providing an estimate of current conditions on the construction materials for the dam. This report is based on the analysis of available documents as well as information collected during site missions. It should be noted that these various documents (reports produced by HPI, report of investigations as well as documents presenting results of laboratory tests) were produced between 1975 and 2011.

The construction materials are identified and quantified, appropriate quarries and borrow areas are localized. The main characteristics of these areas are presented. As part of the available construction materials have been exploited, managed and stored since the 1980s, the actual properties of the stored materials are also described.

The main criteria for assessing the adequacy of materials characteristics are analysed and presented. The potential issues with respect to main materials characteristics, or quarries exploitation are identified and highlighted.

After a brief recall of the context of the project, we will define the major lines of the construction materials management and present a detailed analysis of the quarries, borrow areas and storage areas.

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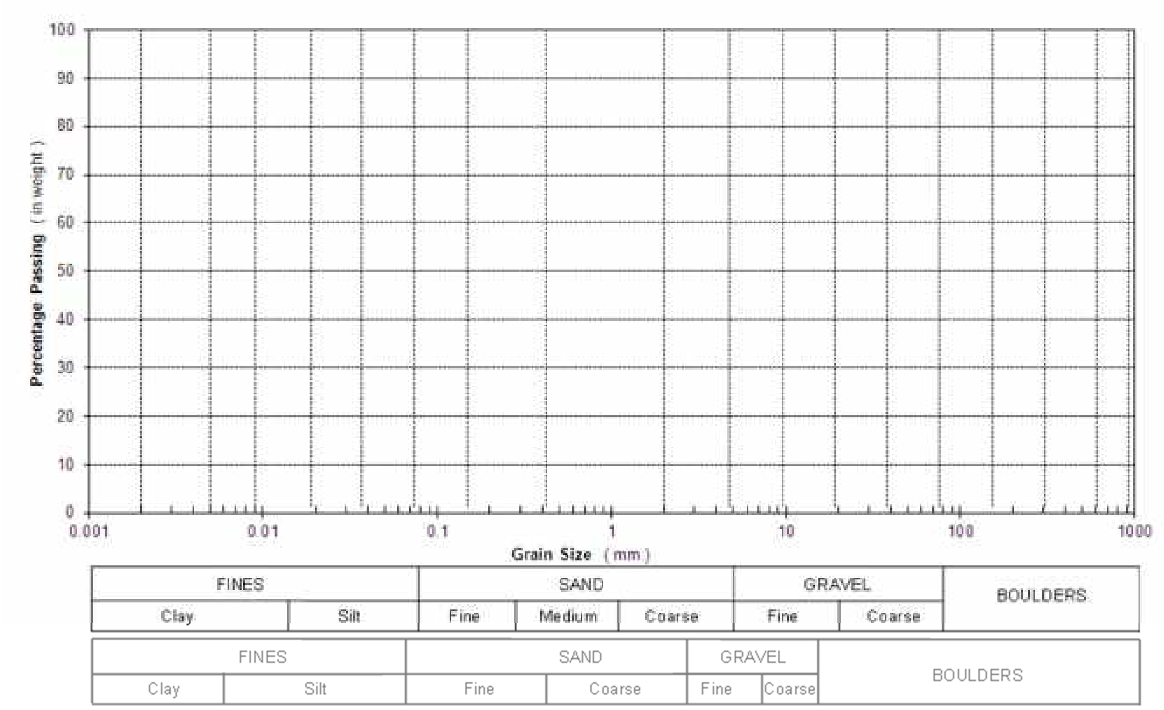
3 TERMINOLOGY

- Grading curves of this report are presented using two tables representing the classification of graded materials following respectively the ASTM standard, and the slightly different Russian standard. In the here below graph, classifications are presented along the grain size axis: ASTM classification in black colour, corresponding Russian classification in grey colour.



Important note: The “fine materials” definition considered in this report is related to the materials of size smaller than 80 µm, while the Russian definition for fine materials is related to particles smaller than 5 mm. therefore, utmost care shall be taken when speaking of fine materials, since it may designate, depending upon the documents, materials of quire different gradings.

4 CONTEXT - DAM DESIGN

The dam as project is an embankment dam of 335 m, with an impervious core. The underground hydropower plant is located on the left bank, with an installed capacity of 3 600 MW. The Rogun dam, as defined so far, is quite similar to Nurek dam located about 80 km downstream of Rogun site.

As designed so far by HPI (2010), the principal dimensions and characteristics of Rogun are reported on the following table:

Dam height	335	m
Crest level	1 300	m
Crest length	700	m
Upstream slope	1:2.4	-
Downstream slope	1:2	-

Table 4-1 : Main characteristics of Rogun HPP dam project – HPI (HPI, Drawings, 2010)

The associated typical cross section is available on drawings from (HPI, 1861-56-04, 2009), on (HPI, 1861-2-V-1, Main component of the hydro-power complex - Book 1, 2009), and on (HPI, Drawings, 2010).

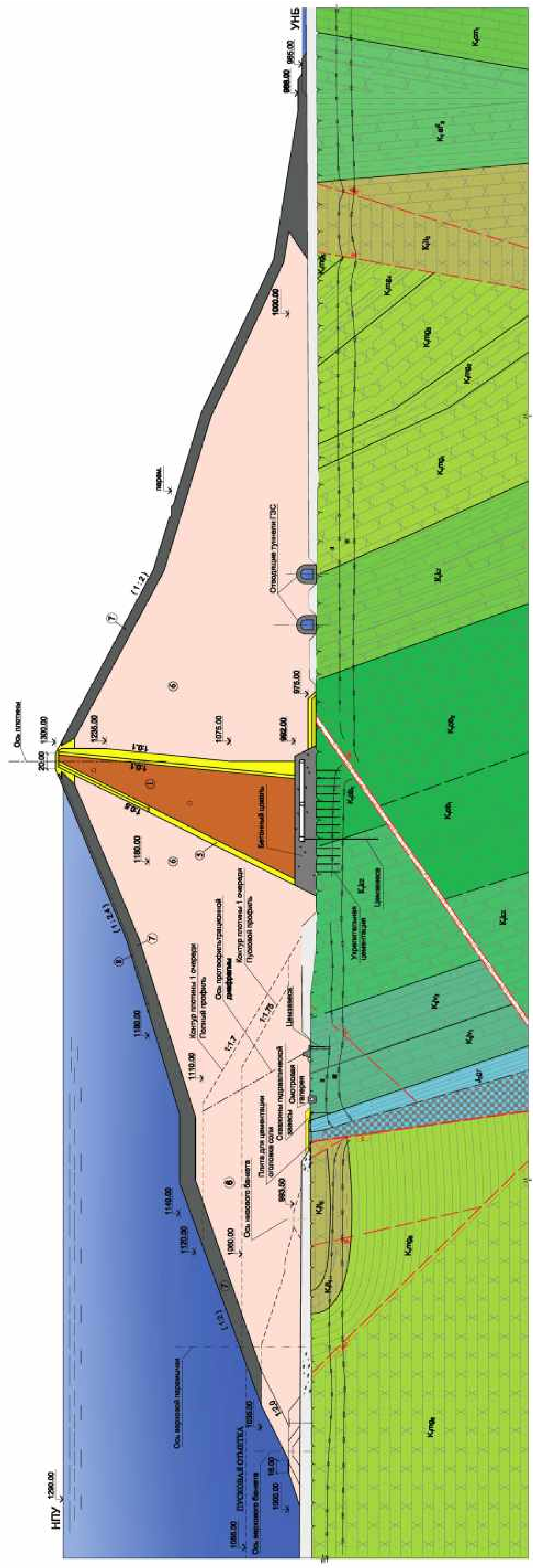


Figure 4-1: Dam typical cross section according to HPI 2010 design

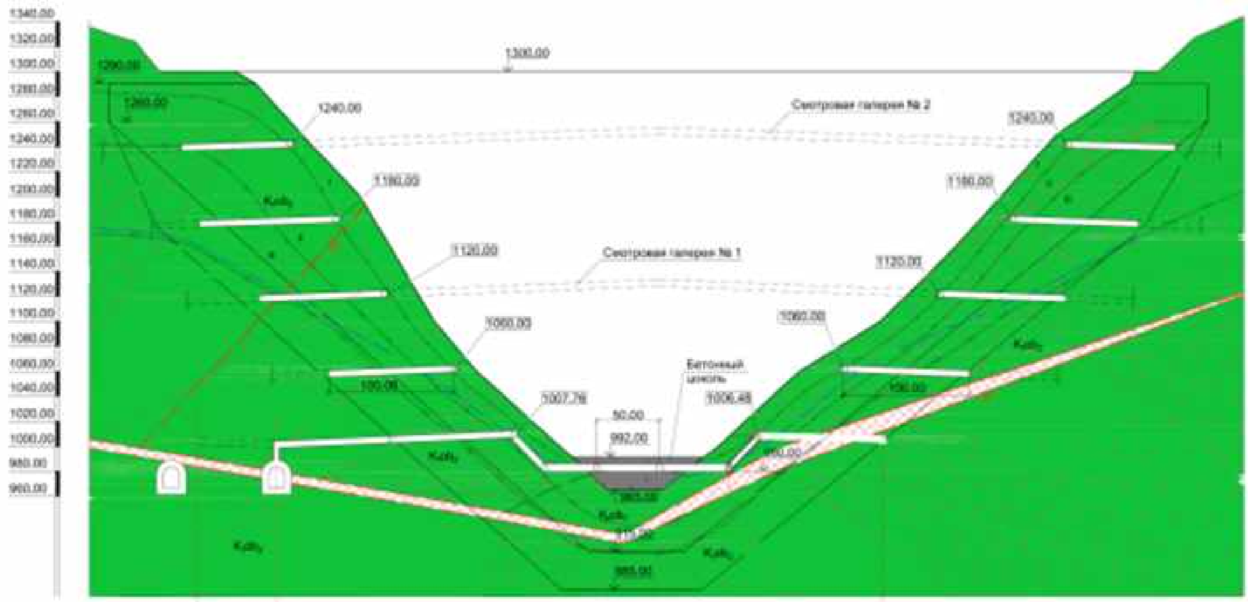


Figure 4-2 : Illustrative typical cross section of the dam site according to HPI 2010 design

The corresponding required materials quantities are as follows:

Reference on Figure 4-1	Dam part	Characteristic size	Quantity
	[-]	*[mm]*	*[m^3]*
1	Core	-	7 247 000
(2 – 3)	1st transition layer	0 – 10	4 893 000
	2nd transition layer	0 – 40	
5	Upstream lower transition	0 - 80	
6	Alluvium shoulder	≤700	39 567 000
7	Rock shell	≤700	17 753 000
8	Rip rap	300 – 1000	1 497 000
-	Concrete slab	-	481 000
Total			**71 438 000**

(HPI, Drawings, 2010)

Design of the dam has recently been reviewed by the Consortium (see Phase 2 report on construction materials), however, no major changes are introduced on the dam typical cross section, and the associated quantities of materials are of the same order of magnitude.

4.1 HPI materials specifications

Before the description of the materials characteristics ion site, we will here present the specifications for each different kind of construction materials as defined by HPI, to be fulfilled for placement into the dam body..

At project stage, the recommendations and technical specifications on dam materials were defined on the basis of various studies carried out by the following scientific and project research organizations (HPI, 1861-2-V-1, Main component of the hydro-power complex - Book 1, 2009):

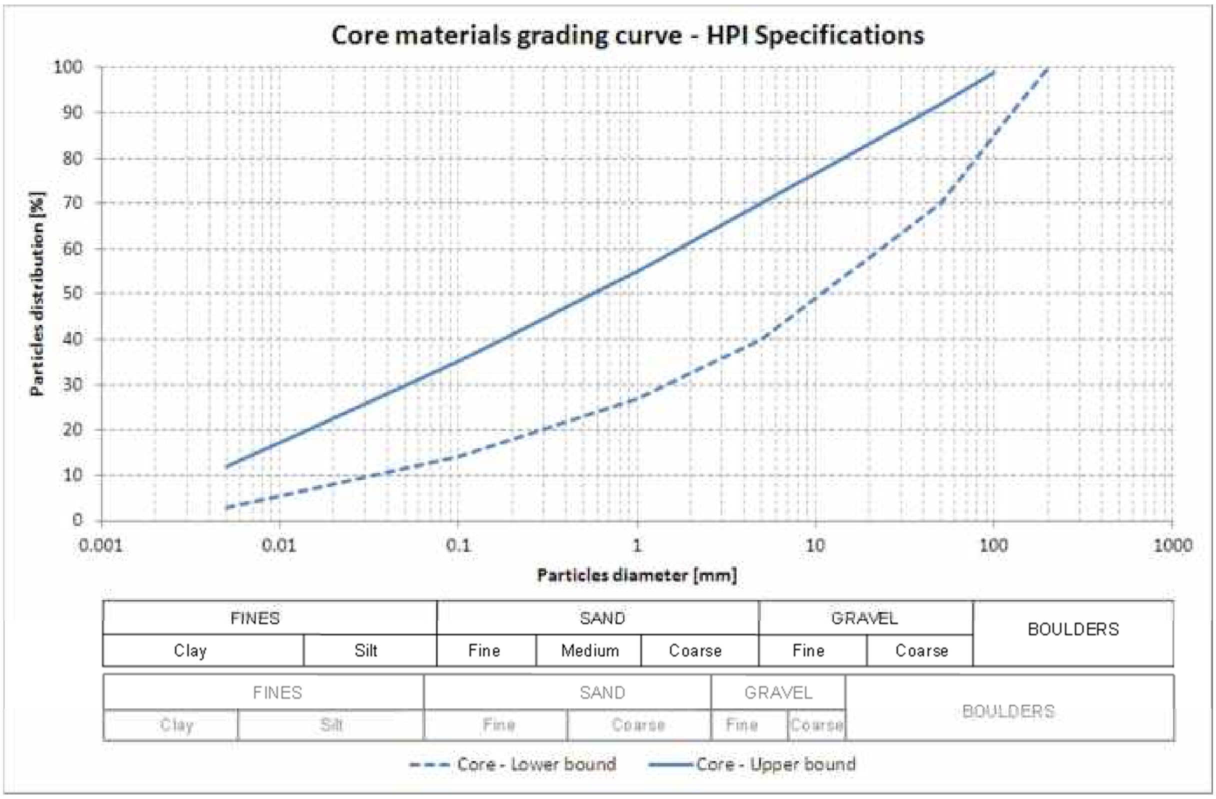
- Northern Administrative District and Scientific Research Institute Hydro-Project,
- Russian scientific Research Institute of Hydro-Technology,
- Scientific Research Institute of Hydro-Geology,
- The Moscow Institute for Strategic Research,
- Leningrad Polytechnic Institute.

Norms and standards adopted for almost all of the studies are the Russian GOST standards.

4.1.1 HPI specifications on materials grading

4.1.1.1 Core material

The grading curve for the core material as defined by HPI is presented on Figure 4-3.



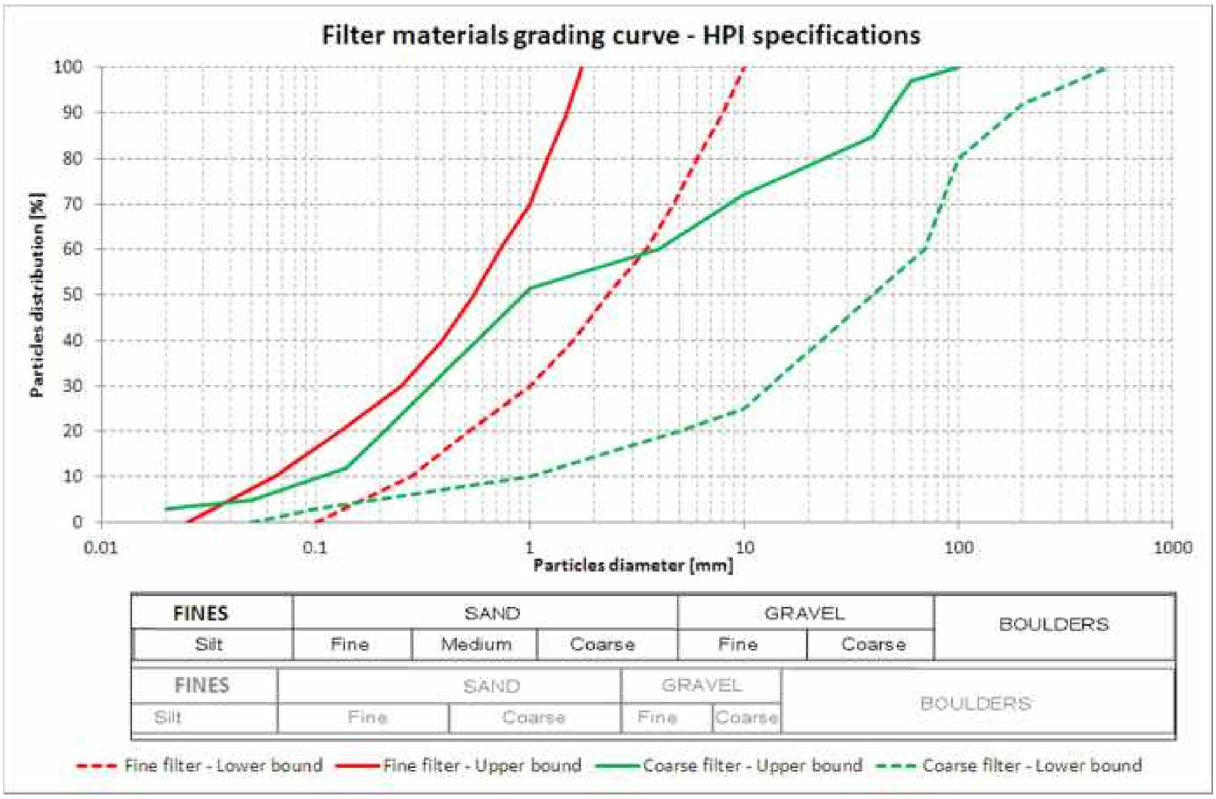
(HPI, 1861-2-V-1, Main component of the hydro-power complex - Book 1, 2009)

Figure 4-3: Grading curve for core material – HPI specifications

4.1.1.2 Filters materials

As defined by HPI, the grading curves of both fine and coarse filters are presented on Figure 4-4.

HPI explains in report (HPI, 1861-2-V-1, Main component of the hydro-power complex - Book 1, 2009), that the criteria for filters design follow the (ICOLD, 1994) *Bulletin 95.* These criteria are generally those accepted for most projects in the world.



(HPI, 1861-2-II-3, Local construction materials, 2008-2009)

Figure 4-4: Filter materials grading curves – HPI specifications

The grading boundaries of the coarse filter show an irregular shape, and present angularities. The justification of these grading curves was not found in the reviewed documents.

4.1.1.3 Alluvium shoulders and rock materials (rock shell, rip-rap)

The grading curves for dam shoulders materials, and for rock shell materials and rip-rap as defined by HPI are shown on the following figures:

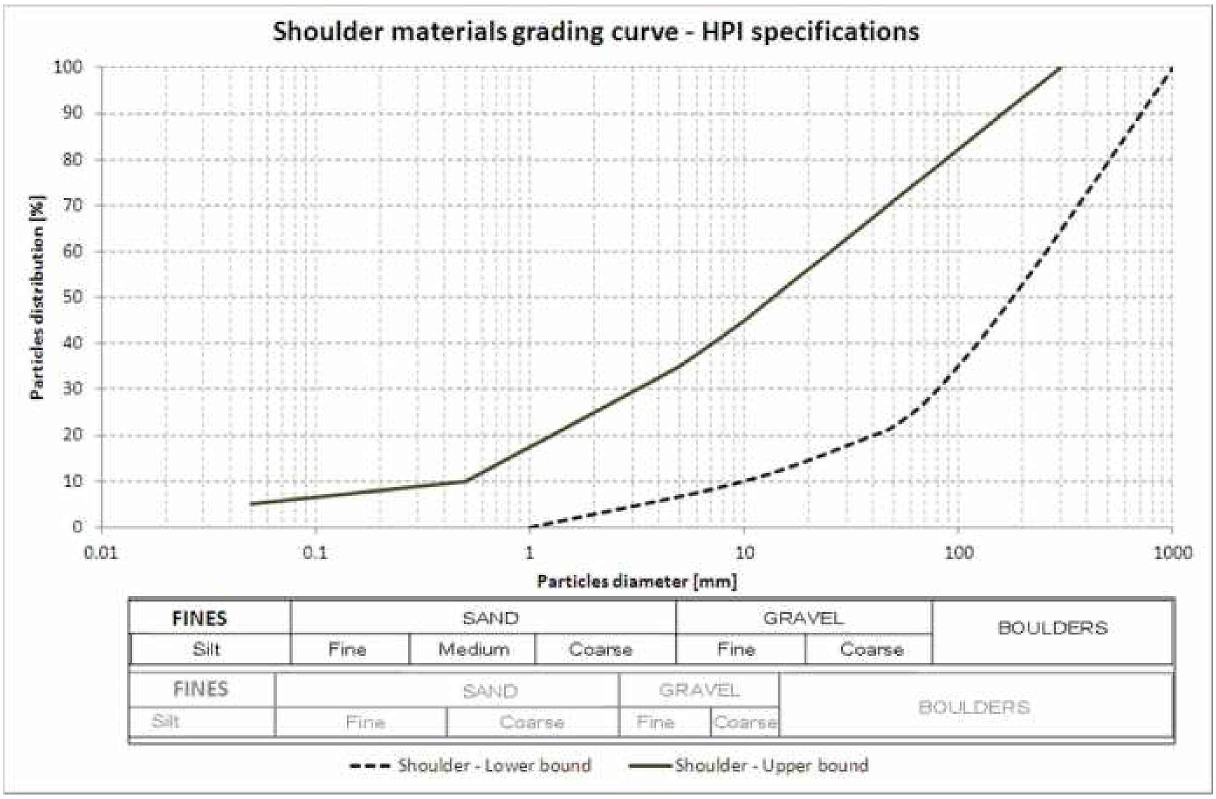


Figure 4-5: Shoulder materials grading curve – HPI specifications

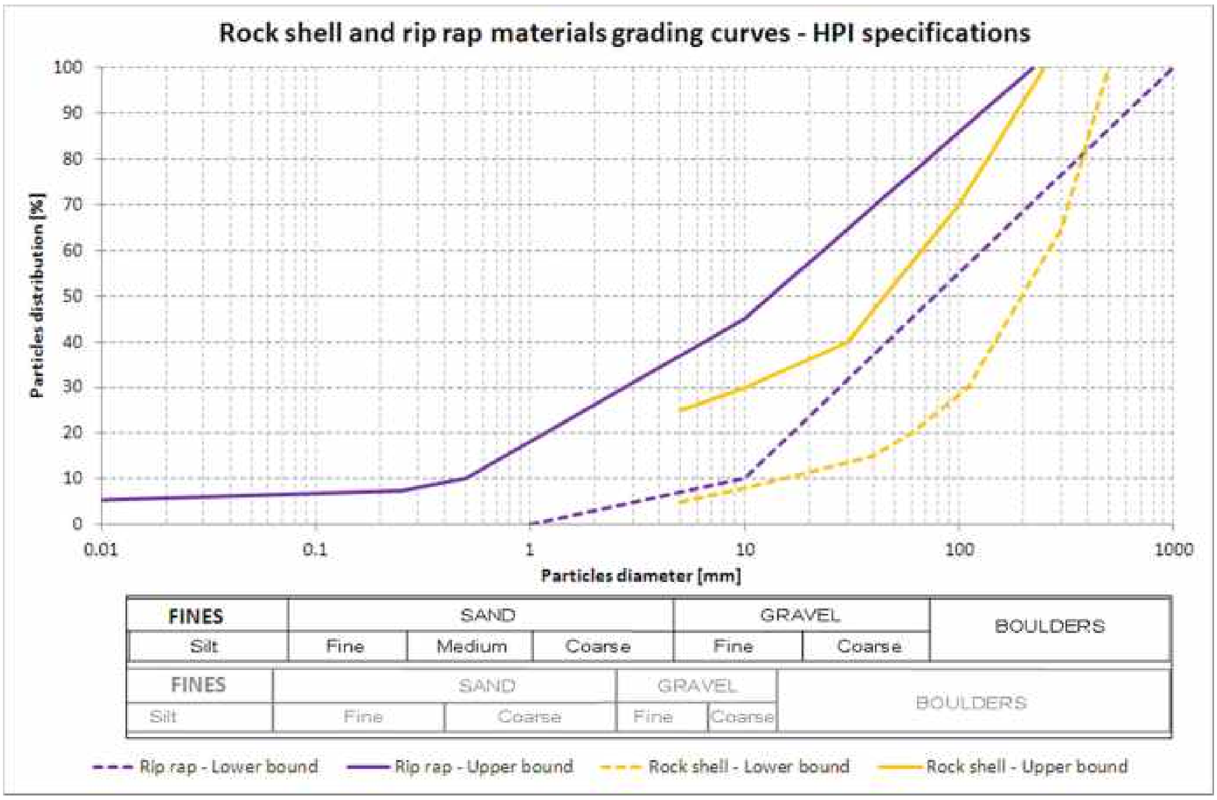


Figure 4-6: Rock shell materials grading curve – HPI specifications

General comment: It is to be noted that the presented grading curves are currently under review by the consortium, however, the possible adjustments are likely not to modify the conclusions of this report (refer to Phase 2 report on construction materials).

5 PROJECT AREA – GENERAL LAYOUT

This subsection deals with the description of the general conditions around the dam site, to define locate and identify the different assets linked to the construction materials management (as deposit areas, borrow areas or quarries, processing plants, storage areas). The following inventory is for August 2012.

Figure 5-1 describes the entire site area. The general layout has been reconstituted on the basis of the information collected from various reports, and also from information obtained during the site missions.

The considered area extends 4 km downstream of the dam site, and 8 km upstream along the Vakhsh River.

Construction materials for the dam are distributed in three types of zones, each one to be studied:

- Borrow areas (for alluvium, gravels, clay and others)
- Quarries (for rock materials),
- Storages areas for temporary deposit of materials.

Rock materials for slope protection and alluvium materials for dam core are both located downstream of the dam site, on left bank, i.e. in quarry 26 for rock materials, and borrow area 17 for core materials.

Materials for the dam alluvium shoulders and transitions are located upstream of the dam site, also on the left bank. Corresponding borrow areas are Lyabidora and the borrow area 15. It is to be noted that these borrow areas are located at low elevations, so they are to be flooded within the first years after the Vakhsh river will be diverted.

The borrow area 11 mentioned on this report, reported to contain pure clay, is located on the right bank, in the area of Rogun town.

The adopted method of exploitation of borrows areas 15 and Lyabidora consists in extracting the materials before the diversion of Vakhsh River and subsequent rise of water levels and store them on higher elevations. These stockpile areas are reported on the general plan Figure 5-1.

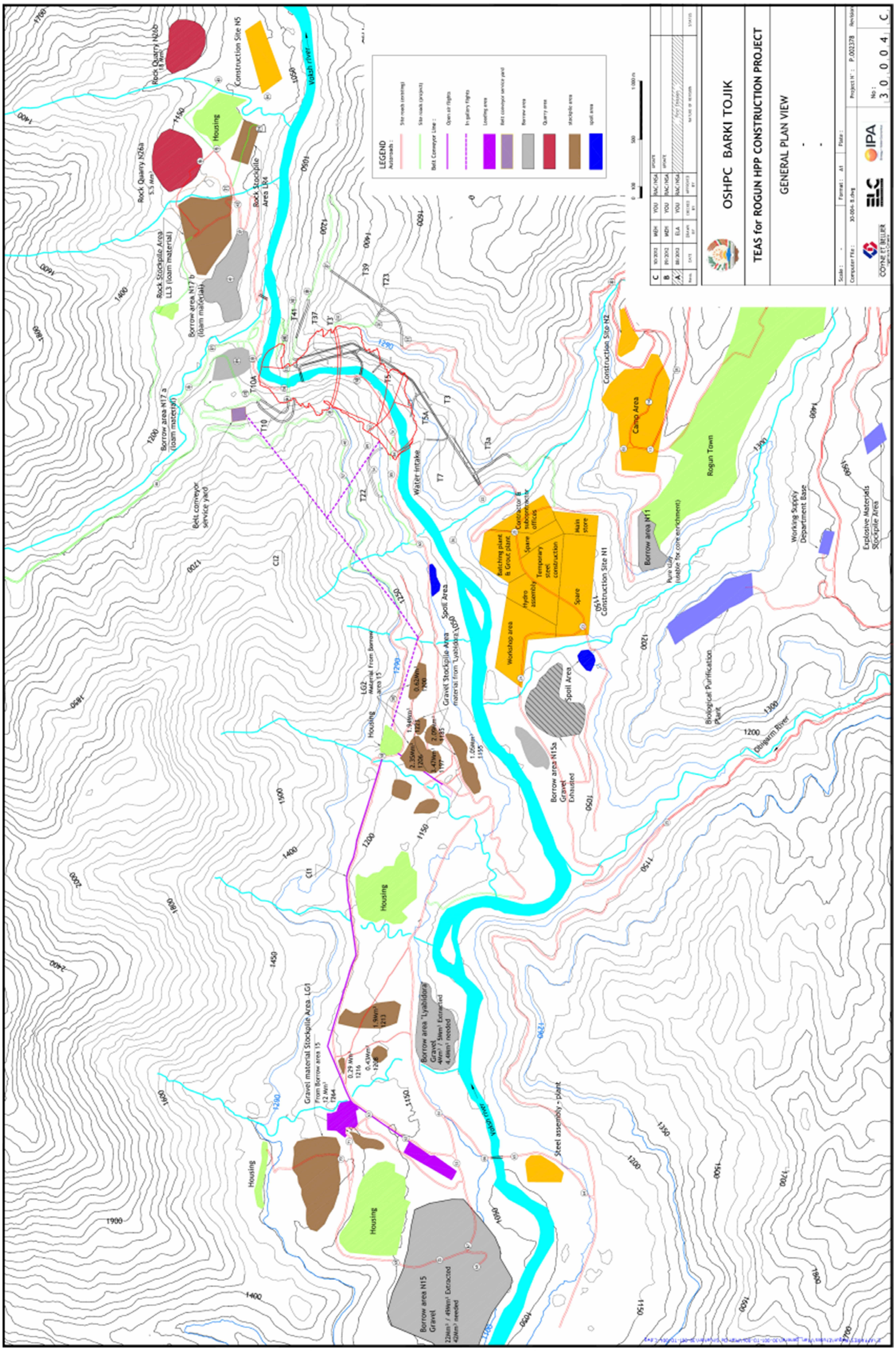
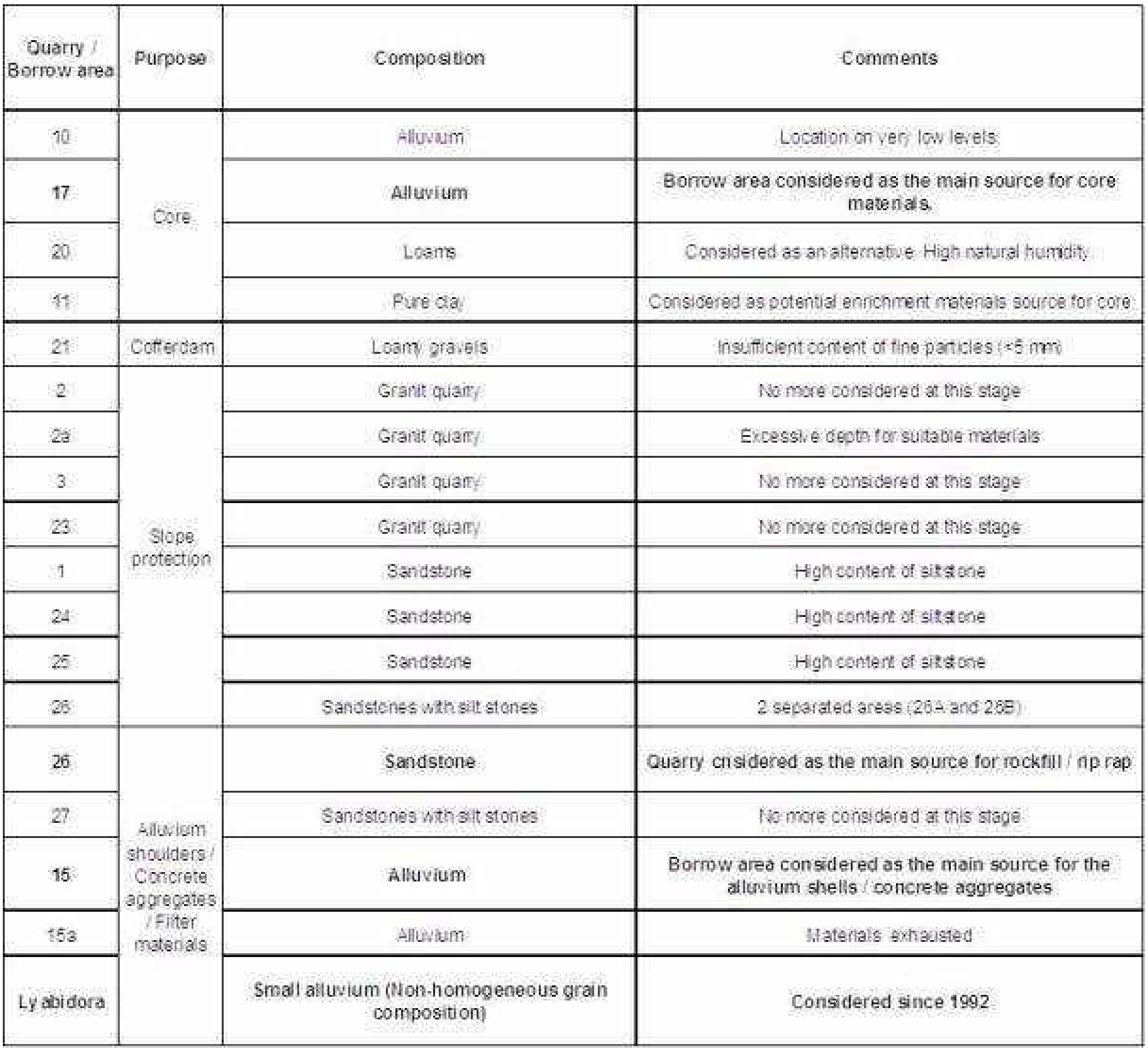


Figure 5-1 : General layout - Project area

6 CONSTRUCTION MATERIALS ASSESSMENT

In the beginning of the project, several quarries and borrow areas were preselected to provide the materials needed for dam construction. Initially, about 16 quarries and borrow areas were identified and explored. Since that time, and after more analysis of the materials, some of these quarries have been considered not suitable according to the conclusions of the previous studies.

The following table gives a general overview of the potential quarries and borrow areas first selected in the early beginning of the construction, during explorations and investigations. Most of them were discarded for various reasons (poor materials quality, difficult access as well as areas to be early flooded).



Quarry / Borrow area	Purpose	Composition	Comments
10	Core	Alluvium	Location on very low levels
17		**Alluvium**	**Borrow area considered as the main source for core materials.**
20		Loams	Considered as an alternative. High natural humidity
11		Pure clay	Considered as potential enrichment materials source for core
21	Cofferdam	Loamy gravels	Insufficient content of fine particles (<5 mm)
2	Slope protection	Granit quarry	No more considered at this stage
2a		Granit quarry	Excessive depth for suitable materials
3		Granit quarry	No more considered at this stage
23		Granit quarry	No more considered at this stage
1		Sandstone	High content of siltstone
24		Sandstone	High content of siltstone
25		Sandstone	High content of siltstone
28		Sandstones with silt stones	2 separated areas (28A and 28B)
26	Alluvium shoulders / Concrete aggregates / Filter materials	**Sandstone**	**Quarry cnsidered as the main source for rockfill / rip rap**
27		Sandstones with silt stones	No more considered at this stage
15		**Alluvium**	**Borrow area considered as the main source for the alluvium shells / concrete aggregates**
15a		Alluvium	Materials exhausted
Lyabidora		**Small alluvium (Non-homogeneous grain composition)**	**Considered since 1992**

Table 6-1 : Overview of the initially considered quarries and borrow areas

From the above list of explored areas, 4 quarries and borrow areas were selected and have been subjected to further studies. Currently, four quarries/borrow areas are considered suitable and adapted with respect to specifications and constraints of the project:

- Borrow area 15 mainly for alluvium shoulders,
- Lyabidora mainly for transition and filters,
- Borrow area 17 for the dam core,
- Quarry 26 for rock shell and rip rap.
- Concrete aggregates are proposed to be processed from materials of borrow area 15.

The following information was collected from various reports and studies that took place between 1968 and 2011, and updated on the basis of the information gathered during the site visits. The information concerning the extracted and deposited volumes was collected in July/2012 (Minutes of meetings, 27 to 29 August 2012).

6.1 Global summary

The volumes assessment of quarries and borrow areas for supply of the construction materials are reported on the Table 6-2.

It shows the gathered and synthetized data about the quarries, borrow areas and deposits, in terms of volumes and quantities.

Quarry / Borrow area	Material type	Volumes [Mm3]			
		Total volume	Extracted volume	Stockpiled volume	Needed volume
15	Alluvium	75.6	26.6	22.1	≥ 39.5
Lyabidora	Alluvium	6.6	4.0	4.0	4.9
17	Loam	17	2.5	2.5	7.2
26 a	Rock	5.5	0.8	0.8	19.2
26 b		18	0	0	

Updated to 15/07/2012

Stockpile areas *	Origin of material	Volume	Elevation
		[Mm3]	[m]
LG1	Q 15	22.1	1264
LG2	Q 15	0	1155 - 1206
LG2'	Lyabidora	4.0	1185 - 1223
LL3	Q 17	2.5	1100 - 1150
LR4	Q 26	0	1100

** **R/L: R**ight/**L**eft bank ; **G, R, L** : Gravel, Rock, Loam*

Needed volumes based on HPI 2010 design

Table 6-2 : Volumes assessment of construction materials

*Comments: The **“Total volume”** corresponds to the initial volume estimated during explorations. The **“Extracted volume”** corresponds to the total volume extracted from quarries/borrow areas. The **“Stockpiled volume”** corresponds to the stockpiled quantities, which were not used for the various purposes of the construction. The **“Needed volume”** corresponds to the estimated needs of each type of material, according to the dam construction. It is to be noted that some of the extracted materials on previous years have been used for different purposes, it explains the fact that all the extracted materials are not in storages. The **stored** and **extracted** volumes are reported to be bulked volumes. The **needed volumes** represent the compacted volumes in the dam.*

6.2 Material quantities and general processing assessment

The following paragraph summarises the assessment of the available quantities of materials and their processing, from the extraction of raw materials, to the placement within the dam, following the practices observed in the project site, and the documentation concerning the materials processing.

To discuss the construction materials issues for Rogun project, it is necessary to have a global and detailed appreciation of the construction materials uses. Information to take into account is that the construction schedule extends over 14 years: during this period, the materials requirements vary in quantity and type, and as stated farther, it is important to take this into account in order to avoid any loss of material in case some sources of materials would be flooded by the rise of the reservoir before having been exhausted.

6.2.1 Overall pattern for construction materials management

As a first approach, a general view of the construction materials management is developed.

The management scheme is approximately the same regardless of the material class. In fact, the exploitation steps can be divided in three major phases: extraction from the quarry or borrow area, processing of the material in order to meet the technical specifications and placement in the dam. Between each phase, a transport step of varying importance is to be considered. Each step implies a transformation of the material: corresponding losses can be estimated.

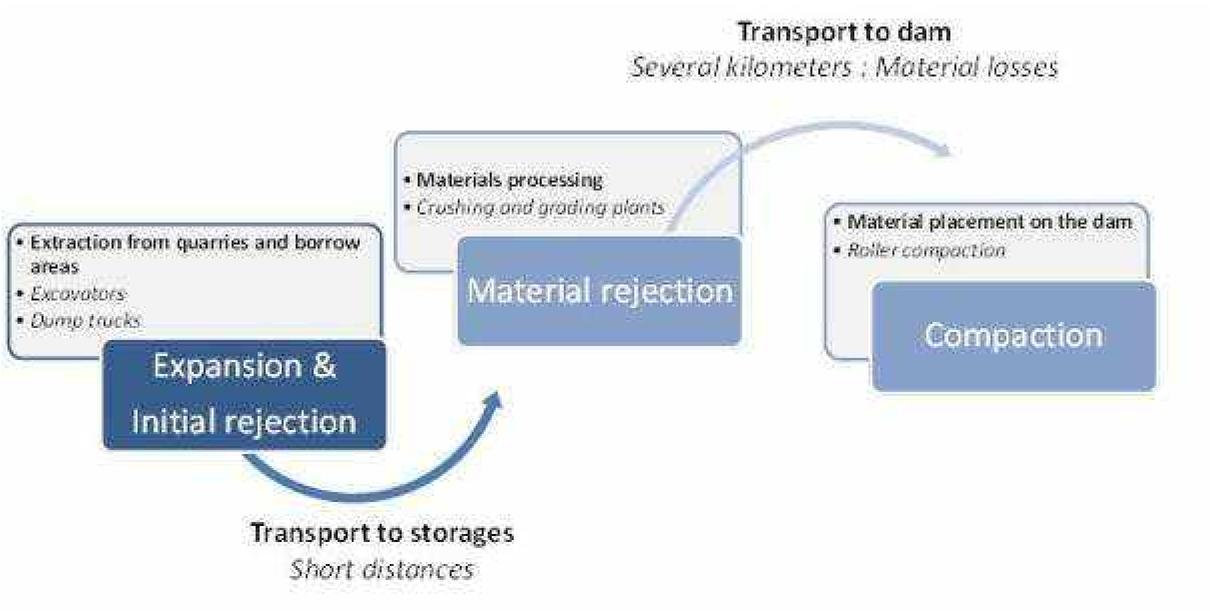


Figure 6-1 : General scheme for construction materials management

The processing of the materials intended to be followed by Rogun HPP is described as follows/

- After extraction, the materials expansion varies from 10% to 35% depending on the type of material..
- The material is then transported to storage areas where it is deposited.
- Before placement on the dam, the materials are treated in order to get the proper characteristics. The primary goal of the process is to modify the grading curve in order to meet the specifications. The main steps are crushing and grading. At this stage, some materials are rejected.
- The construction materials are transported from the storage areas to the dam using different transport means. Volume losses during transport are assumed to be low, and can be assessed by considering a coefficient of losses.
- The placement of materials on the dam requires roller compaction, which reduces the materials volume by a ratio of 9% to 15%, depending on the type of material.

Estimated values for volume losses coefficient considered by Rogun HPP are presented in Table 6-3. It should be noted that these coefficients are not definitive and may be updated in the light of new information, observations and in situ tests.

Quarry / Borrow area		15	Lyabidora	17	26 a	26 b
Material type		Gravels	Gravels	Loam	Rock	Rock
Volumes in the quarries [Mm³]	Initial total volume	49.0	5.0	17.0	5.5	18.0
	Extracted volume	22.0	4.0	2.5	0.8	0.0
	Needed volume	42.0	4.4	6.6	19.3	
Coefficient due to expansion after extraction	%	12.0%	12.0%	20.0%	35.0%	35.0%
Loss percentage due to bad quality material	%	11.6%	2.0%	4.1%	10.0%	10.0%
Transport losses	%	0.1%	0.1%	0.1%	2.1%	2.1%
Compaction coefficient	%	9.0%	9.0%	15.0%	10.0%	10.0%
Global coefficient	%	91%	101%	100%	108%	108%

These coefficients were collected during site visit.

Table 6-3 : Assessment of needed volumes for construction materials

6.3 Borrow area 15

6.3.1 General description

The quarry n°15 is located on the left bank of Vakhsh river, roughly 5 km upstream the dam site. This borrow area is limited by the Vakhsh River and extents over about 1 km along the river. The borrow area 15 is the most significant source of materials on the site. Initially, an estimated volume of 75.6 million m^3 was available. The material characteristics allow using them in the dam alluvium shoulder, and as concrete aggregates, but also, in a lesser extent, as filter and transition materials for the dam.

The borrow area is exploited in two terraces of different elevations. Absolute elevation marks of the lower terrace vary from 1030 to 1060 meters. A slope of 30-35 degrees inclination rises up to the upper terrace, which absolute elevation marks vary from 1100 to 1120 meters.

Almost all of the materials extracted are stocked on the LG1 stockpile, and a smaller part in LG2 stockpile.

Figure 6-2 : Partial view of LG1 stockpile (LI 2005)

Figure 6-3 : Storage LG2 – Looking downstream (COB 2012)

The productive stratum is made of alluvial gravels. A boulder layer with thicknesses varying between 7 m and 14 m has been stripped from above of the productive stratum. This layer contained 2% of boulders with size in the order of 1.0-1.5 m.

The gravel layer includes interlayers and lenses of weakly to medium-cemented conglomerates. These conglomerates have to be removed.

6.3.2 Estimation of the resources

According to the first survey results (1978), the total volume of the materials was estimated at ***75.6 Mm^3.*** Since this period, the borrow area has been exploited and the extracted materials has been stored (for the most part), or used for various purposes.

The extracted and stored quantities are **22.12 Mm^3** distributed following (August 2012 figures):

- At storage LG1 (**14.63 Mm^3**),
- At storage LG2 (**7.49 Mm^3**).

The remaining quantity in the borrow area is estimated to be **49 Mm^3.**

Stripped material is made of argillaceous soil and stone for a volume of **3,12 Mm^3**.

The borrow area n°15 is being exploited since several years. The extracted materials are stored in areas located at higher elevations.

6.3.3 Characteristics of materials

6.3.3.1 Composition and grading curve

Borrow area 15 contains alluvial gravel material with interlayers of boulders and conglomerates. Qualitative and structural composition of the materials remaining in the borrow area is the following:

Type of material	**Content**	
[-]	**[Mm^3]**	**[%]**
Alluvium gravels	42.6	86.9%
Conglomerates	3.46	7.1%
Pebbles	1.91	3.9%

(HPI, 1861-1-2, Explanatory note, 2009)

Results of petrographic analyses on materials of borrow area 15, performed during the initial prospection, and during the investigation campaign of 1992 are presented in the following table.

Composition	**Initial prospection (1978) %**	**1992' Exploration %**
Sandstone	35.2	42.01
Limestone	24.4	25.5
Metamorphic rocks	22.2	10.8
Weathered and weak slates	10.8	8.8

(HPI, 1861-2-II-3, Local construction materials, 2008-2009)

The grading characteristics of the materials from borrow area 15 have been studied from 1975 to 2011. During this period, many investigations were conducted, the most recent of them between 2010 and 2011 (Technical report, May, 2011). From 2010 to 2011, samples were taken from the main storage areas of materials extracted from borrow area 15. The results are presented in the following paragraphs.

It is to be noted that materials extracted from borrow area 15 are distributed within smaller storage areas, contained in the main storage areas LG1 and LG2 The following figure presents the organization of these storage areas:

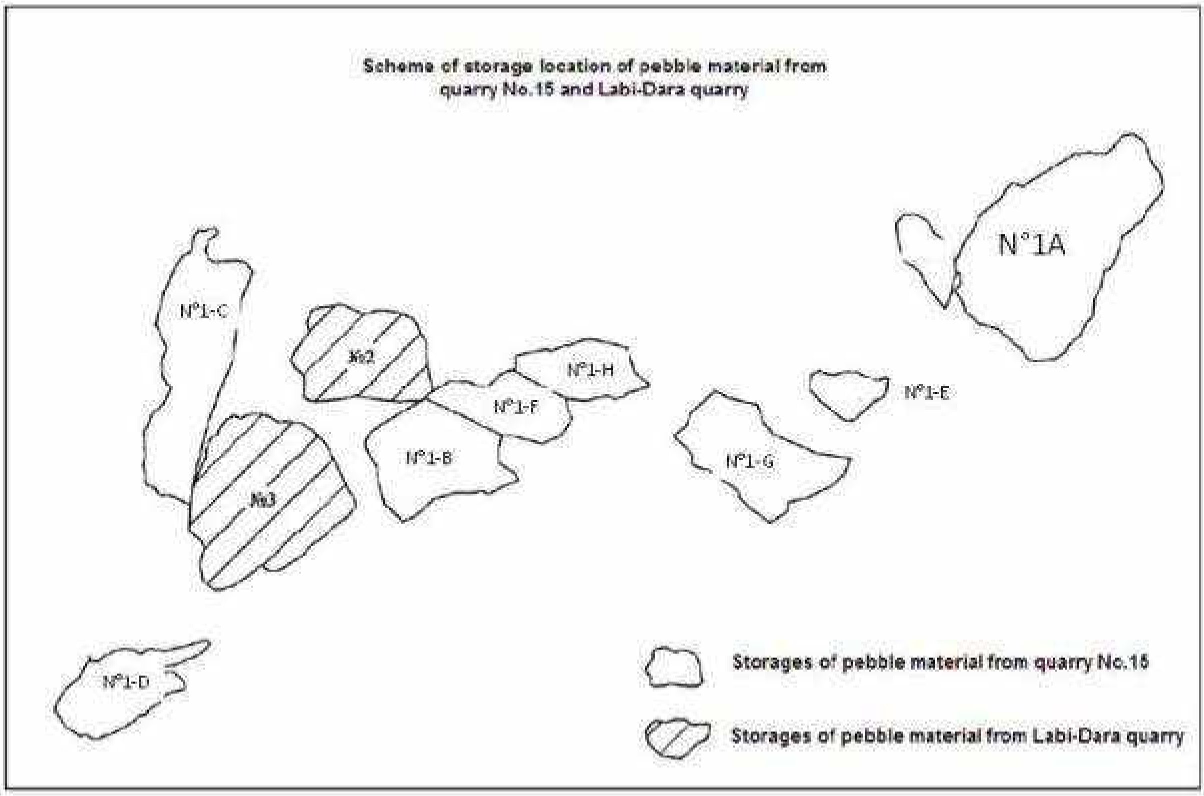


Figure 6-4: Organization of material storage

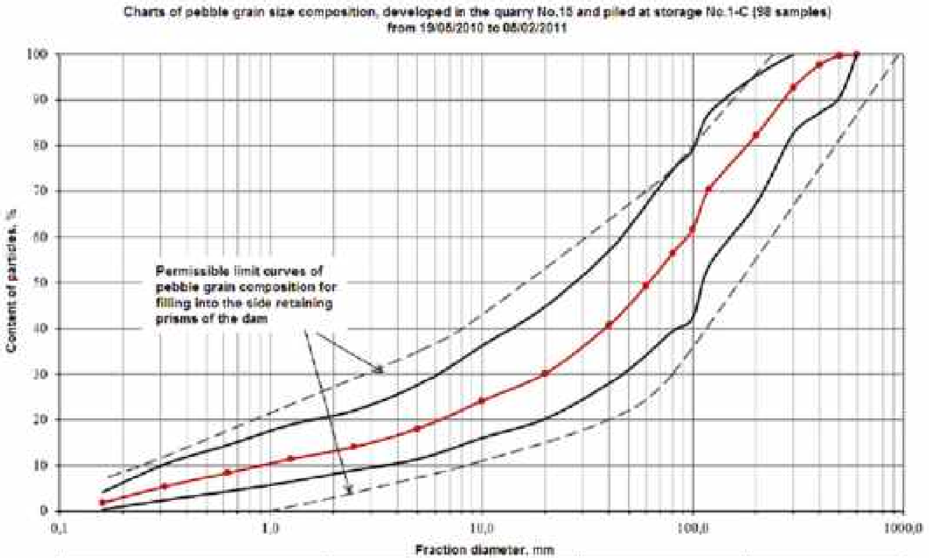
6.3.3.1.1 Storage 1-B and 1-C

234 samples were prepared from storage 1-B, and 98 from storage 1-C. Tests were conducted between May 2010 and March 2011, providing the grain size compositions which are, according to (HPI & Rogun, Informational report, 2011) within the acceptable limit curves defined for material to be placed in the dam alluvium shoulders.

Charts of grain size composition of pebble material developed in the bottom-holes of quarry No.15, piled at storage No.1-B (over the period of 02.06.2010 till 26.03.2011; 234 samples)

FINES		SAND			GRAVEL		BOULDERS
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	

FINES		SAND		GRAVEL		BOULDERS
Clay	Silt	Fine	Coarse	Fine	Coarse	



Charts of pebble grain size composition, developed in the quarry No.15 and piled at storage No.1-C (98 samples) from 19/06/2010 to 08/02/2011

FINES		SAND			GRAVEL		BOULDERS
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	

FINES		SAND		GRAVEL		BOULDERS
Clay	Silt	Fine	Coarse	Fine	Coarse	

Figure 6-5: Grading curves for pebble materials – Quarry 15 – Storages 1-B / 1-C

According to the grading curves, materials from storage 1-Band 1-C seem to fit correctly the boundary curves for grain size composition for alluvium shoulder materials.

6.3.3.1.2 Storage 1-E and 1-F

88 samples were prepared from storage 1-E and 98 samples from storage 1-F. Tests were conducted between June 2010 and January 2011, providing the grain size composition.

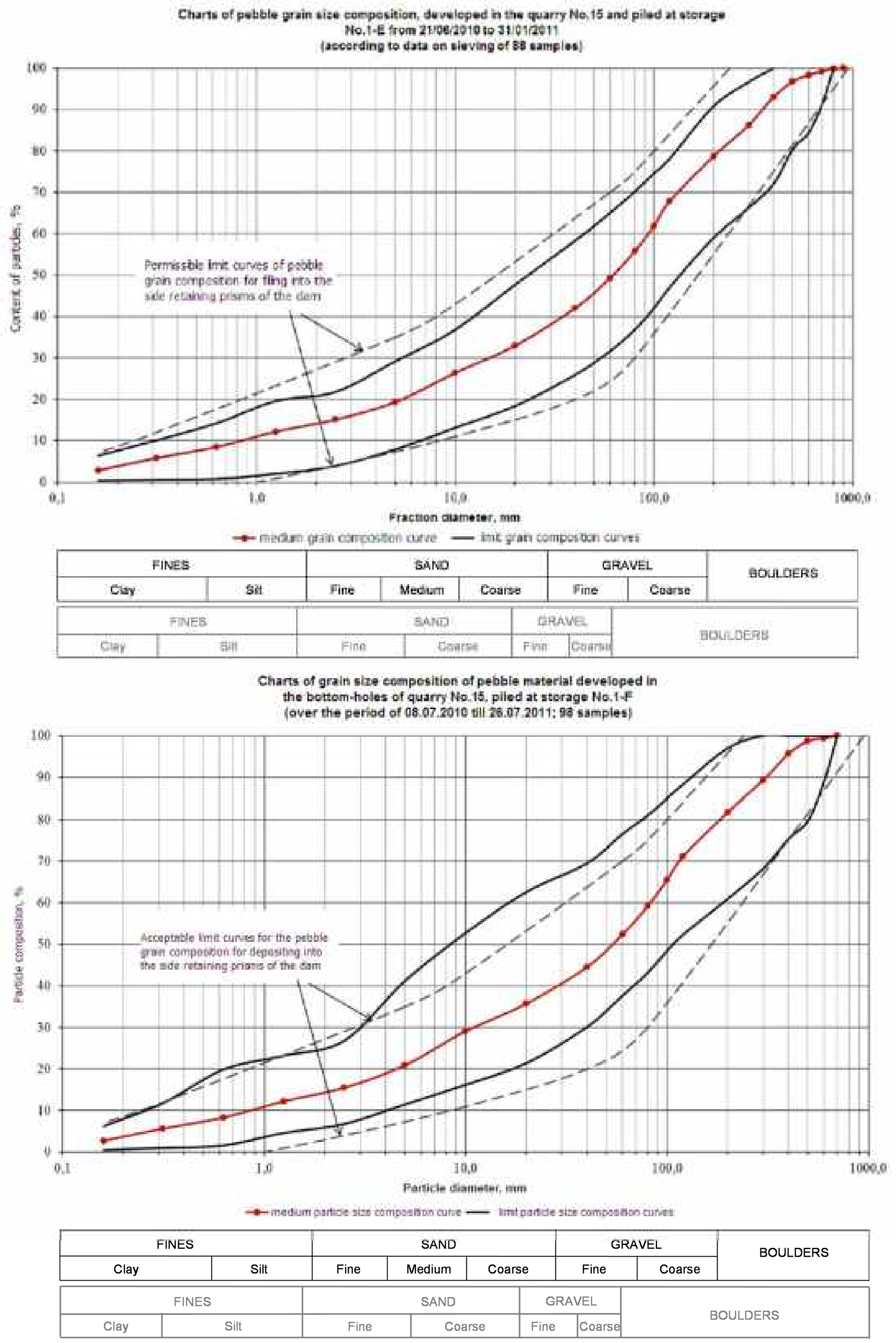


Figure 6-6: Grading curves for pebble materials – Quarry 15 – Storages 1-E / 1-F

Both storages 1-C and 1-E show a similar grading of materials. The only apparent difference is the presence of large boulders in storage 1-E compared to 1-C.

According to the grading curve, materials from storage 1-E seem to fit correctly the boundary curves for grain size composition of material to be placed in the dam shoulders.

Materials from storage 1-F do not fit completely with the design specifications defined by HPI. It is however to be noted that obtained grading curves are strongly dependent of the sampling conditions (location within the storage of the samples collection sites).

Some additional samplings are to be carried out on this storage area, in order to confirm or refute the need of a specific treatment of materials to bring them to grading specifications.

6.3.3.1.3 Storage 1-G and 1-H

253 samples were prepared from storage 1-G, and 83 samples from storage 1-H Tests were conducted between January 2010 and July 2011, providing the grain size composition.

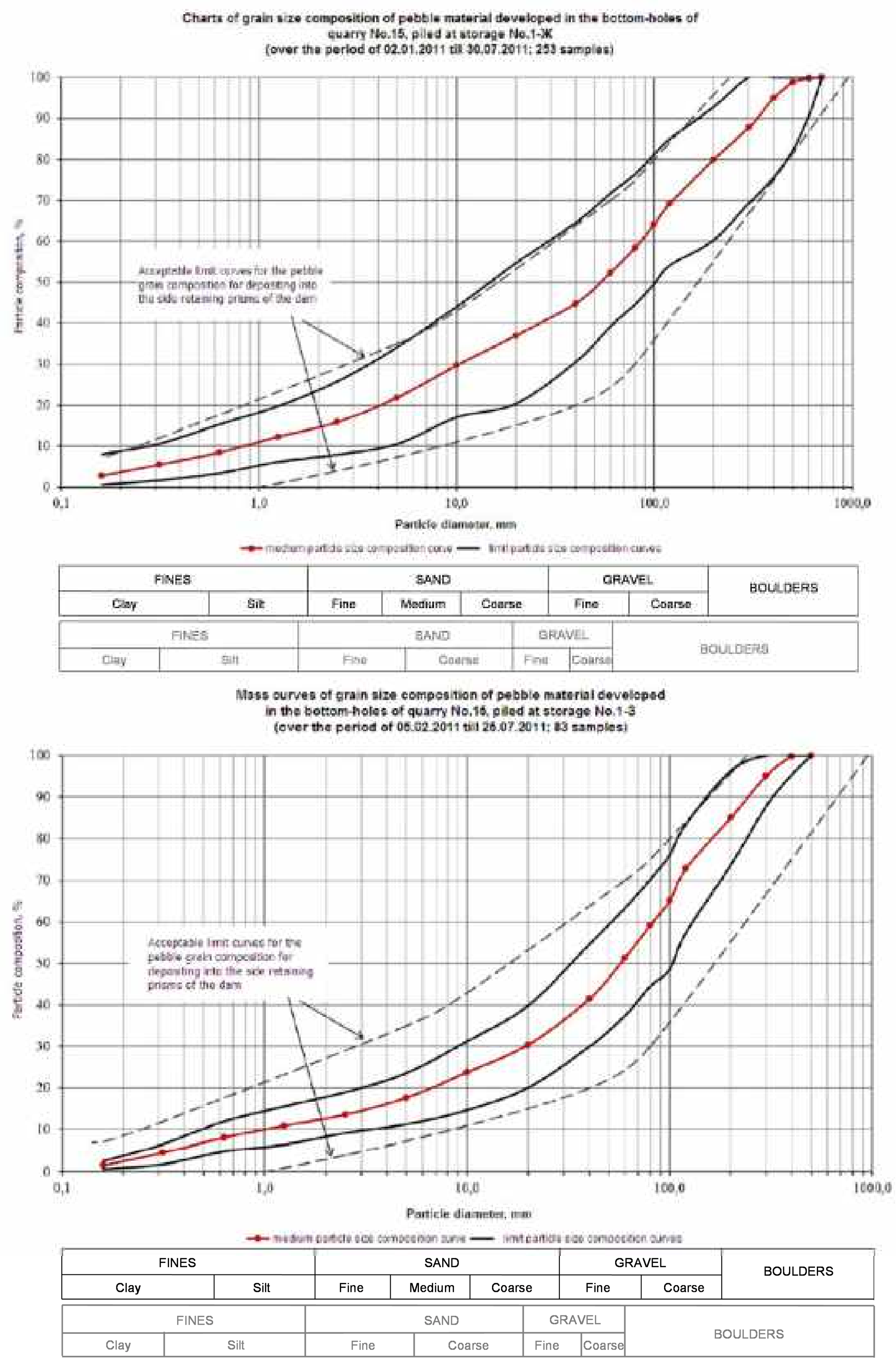


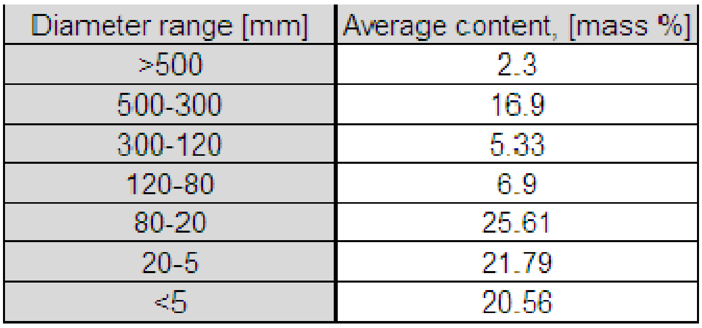
Figure 6-7: Grading curves for pebble materials – Quarry 15 – Storage 1-G

According to the grading curve, materials from storage 1-G and 1-H seem to fit correctly the boundary curves for grain size composition of the material to be placed in the dam shoulders.

6.3.3.1.4 Synthesis

The (Informational report, 2011) reports the granulometric composition of materials from borrow area 15 determined based on exploratory data, by distinguishing fine particles and other materials:

Table 6-4 : Grading composition of borrow area 15)



Diameter range [mm]	Average content, [mass %]
>500	2.3
500-300	16.9
300-120	5.33
120-80	6.9
80-20	25.61
20-5	21.79
<5	20.56

(Informational report, 2011)

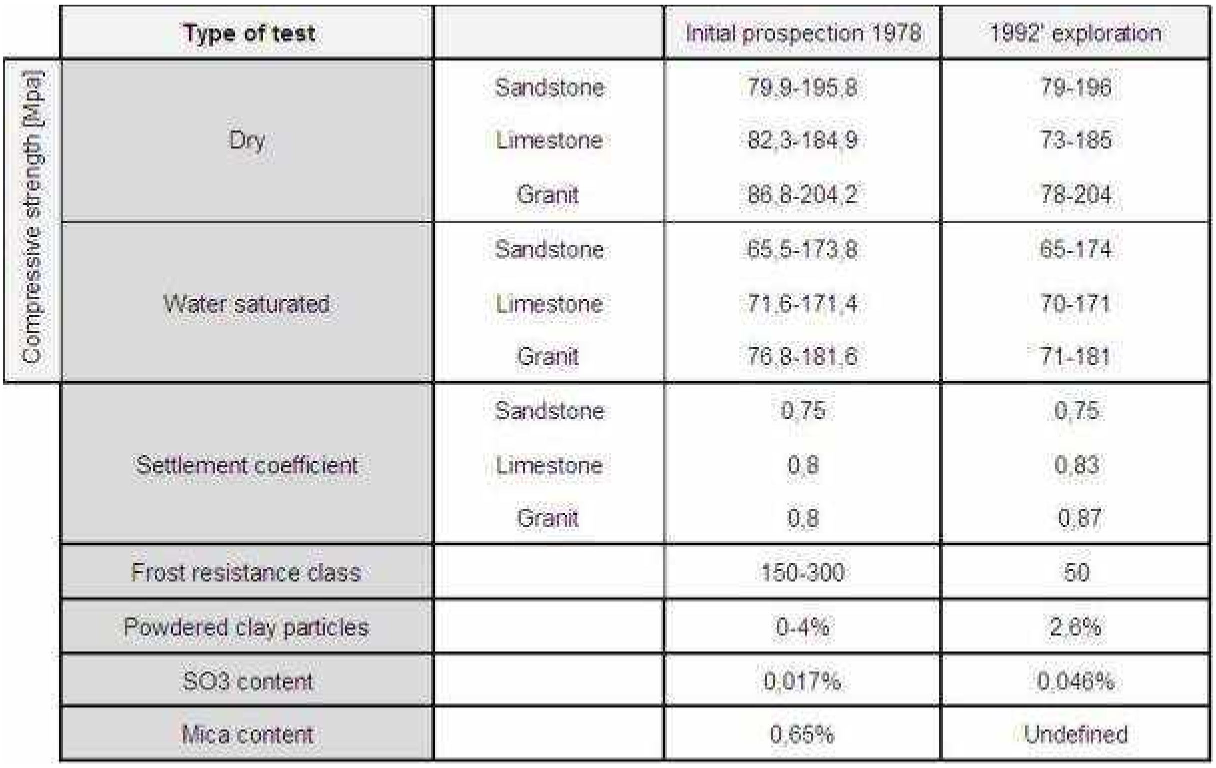
Table 6-5 : Grading composition of borrow area 15 (particles<5mm)

Diameter range [mm]	Average content, [mass %]
5 - 2.5	2.72
2.5 - 1.2	4.38
1.2 - 0.6	4.25
0.6 - 0.3	2.65
0.3 - 0.15	1.98
0.15 - 0.05	1.3
0.05 - 0.01	1.07
0.01 - 0.005	1.32
<0.005	0.68

(Informational report, 2011)

6.3.3.2 Characteristics

A table is presented in « *Local construction materials* » report (1861-2-II-3), summarizing the main results obtained from the 1978 and 1992 investigations of materials characteristics from the borrow area 15.



	Type of test		Initial prospection 1978	1992' exploration
Compressive strength [Mpa]	Dry	Sandstone	79,9-195,8	79-196
		Limestone	82,3-184,9	73-185
		Granit	86,8-204,2	78-204
	Water saturated	Sandstone	65,5-173,8	65-174
		Limestone	71,6-171,4	70-171
		Granit	76,8-181,6	71-181
	Settlement coefficient	Sandstone	0,75	0,75
		Limestone	0,8	0,83
		Granit	0,8	0,87
	Frost resistance class		150-300	50
	Powdered clay particles		0-4%	2,8%
	SO3 content		0,017%	0,046%
	Mica content		0,65%	Undefined

(HPI, 1861-2-II-3, Local construction materials, 2008-2009)

Table 6-6 : Summary of material characteristics for borrow area 15

Mention shall be made of the content of mica (we assume here 0.65%, but no unit is mentioned in the original table), and powdered clay particles. These parameters will strongly condition the use of the materials as concrete aggregates. Definition of the settlement coefficient is not clear, since not mentioned in the report.

The report (HPI, 1861-2-II-3, Local construction materials, 2008-2009) concludes that, in general, and according to exploration results, the material from the deposit can be used for placement in the dam shoulders. However, with regard to their possible use as coarse and fine aggregates for concrete, some of their characteristics do not meet GOST standards requirements (the Russian standards used by HPI). Additional studies are therefore required if materials from borrow area 15 is intended for concrete aggregates.

6.3.3.2.1 Optimal density

Many investigations have been conducted by various research institutes and organizations from 1973 to 2011 regarding the optimal conditions of placement of materials and obtained densities. A comprehensive synthesis is presented in the following chapter.

A summary of the early investigation results (carried out from 1973 to 1978) is presented in the following paragraph (HPI, Geotechnical properties of soil materials, 1973 - 1978). The report mentions that surveys and studies concerning soil properties have been performed in compliance with standards SNiP D-53-73 and SNiP P-16-76.

The required soil density for implementation in the dam is determined by the following formula:

$$\rho_{\text{in dam}} = J_{d} \cdot (\rho_{\max} - \rho_{\min}) + \rho_{\min}$$

- Where:
- J_d is the compaction degree (assumed to be 0.9),
- ρ_{min} and ρ_{max} are the limit densities determined experimentally. The values are: ρ_{min} = 1.85 t/m^3, ρ_{max} = 2.30 t/m$^{3.}$

The obtained value of required density in the dam is: **$\rho_{\text{in dam}}$ = 2.25 t/m^3.**

In the phase of technical project, the averaged value of **$\rho_{\text{in dam}}$ = 2.20 t/m^3** was selected by HPI.

Contractor	n° of mixture	Content of fraction diameter %					Moisture	ρ_{min} [t/m^3]	ρ_{max} with compaction [t/m3]		
		60-40	40-20	20-10	10-5	<5			Manual ramming	Vibro exciter	Vibro ramming
Moscow Institute of Building Engineering (Kuybyshev Institute)	1	-	55	15	10	20	-	-	-	-	-
VODGEO	1	-	20	15	15	50	Dry air	1.89	-	1.85	-
Sredazgidroprojekt 1	1	15	24	13	11	37	Dry air	1.99	2.16	2.2	-
Sredazgidroprojekt 1	2	20	35	10	11	24	Dry air	1.89	2.1	2.16	-
Sredazgidroprojekt 1	3	15	25	16	11	33	Dry air	1.99	2.18	2.28	-
Sredazgidroprojekt 1	4	24	32	12	8	24	Dry air	1.83	2.12	2.17	-
Sredazgidroprojekt 1	5	40	30	10	4	16	Dry air	1.89	2.07	2.12	-
Sredazgidroprojekt 1	6	23	30	24	8	15	Dry air	-	2.12	2.14	-
Sredazgidroprojekt 1	7	60	21	8	5	6	Dry air	1.77	2	2.07	-
Sredazgidroprojekt 1	8	5	15	20	14	45	Dry air	1.91	2.11	2.22	-
Sredazgidroprojekt 1	9	20	27.5	14	11.5	27	Dry air	1.96	2.1	2.18	-
Sredazgidroprojekt 1	10	40	31.5	10.5	9.5	8.5	Dry air	1.98	2.07	2.1	-

Table 6-7: Grading composition and limit densities for compaction tests – Borrow area 15

Investigations carried out in 2011 are more detailed, especially concerning the experimental protocol (Technical report, May, 2011). The experiments have been done in compliance with standard: *GOST 34-72-646-83 "The method of the estimation of the maximum density of cohesionless soil structure".*

The optimal density is obtained for moisture contents of about 10%, which confirms the need for additional moistening of soil materials, especially in dry season.

The obtained limit densities are in the range of **2.22 – 2.31 t/m^3 for ρ_{dmax}** and in a range of **1.47 – 1.71 t/m^3 for $\rho_{d\ min}$.**

Is to be noted that the range of 2.22 – 2.31 t/m^3 is roughly the same than the 2.25 t/m^3 obtained on previous studies, so it can be concluded on the good consistency of these results.

6.3.3.2.2 Compaction test

Experimental works on the compaction of materials from borrow area 15 were conducted in August 2010. The test was done on a layer of 15-80 cm of decompressed material. Equipment used for compaction is a vibro-roller (model: AMMANN ASC-200) with a roller weight of 21 775 kg, and 25 000 kg at vibro compression.

After performing a specified number of runs, the density, moisture and grain size composition were determined for the upper, medium and lower layers of the sample.

Thicknes s of loose material	Number of walks	Part of the compacted layer	Parameters			Fraction size / Grain size composition [%]															
			ρ_w [t/m^3]	W [%]	ρ_d [t/m3]	400-300	300-200	200-120	120-100	100-80	80-60	60-40	40-20	20-10	10-5	5-2.5	2.5-1.3	1.3-0.6	0.63-0.32	0.32-0.14	<0.14
75-80	5	Upper	2.24	2	2.2	-	100	98.3	84.1	76.9	68.2	58.4	43.7	27.1	21.3	15.3	10.3	7.8	5.6	3.6	1.1
		Mid	2.17	3	2.11	-	100	92.8	85.8	80	74.1	66.8	56.1	42.1	36.6	28.2	21.5	16.2	11	6.1	1.2
		Lower	2.06	4	2	-	-	100	91	85.6	79.7	71.9	59.7	43.7	37.8	29	22.3	16.9	11.6	6.7	1.7
	8	Upper	2.43	2	2.4	-	100	74.7	65.1	57.1	54.1	47.7	39.4	28.4	21.9	15.6	12.2	9.1	6.7	4	1.2
		Mid	2.39	2	2.34	100	94.8	73.8	56.5	48.4	43.8	36.8	29.4	21.3	17.8	12.9	8.7	6.3	4.3	2.6	0.7
		Lower	2.27	4	2.18	-	-	100	89.9	83.1	78.5	69.9	59.2	43.8	36.1	25.9	18	12.7	8.7	5.1	1.4
	10	Upper	2.44	3	2.36	-	100	97.8	89.7	84.1	80.1	73.1	63	48.1	36.7	27.9	20.6	17.3	12.6	7.9	3.4
		Mid	2.35	3	2.28	-	-	100	93.8	86.1	82.7	76.5	67.8	54.8	43.7	33.4	25.2	21.2	15.2	9	3.3
		Lower	2.31	4	2.21	-	-	100	95.6	89.7	80.9	75.3	63	46.1	36.1	31	22.3	19.5	14.2	9.1	3.2

Table 6-8 : Field tests results on compaction – Borrow area 15

The compaction test allowed estimating the optimum number of walks needed to obtain the maximal compression of the layer. The following table resumes the results of compaction tests.

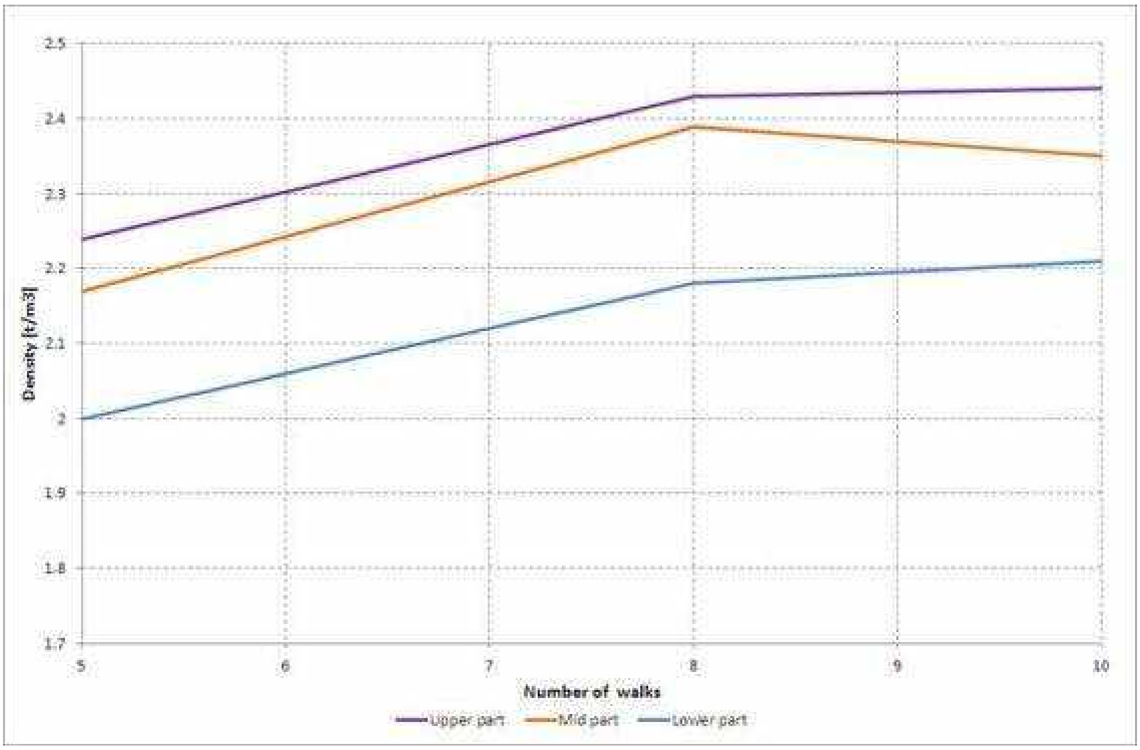


Figure 6-8 : Density variations depending on number of compaction walks

The compaction test showed that the maximal compacity is obtained, for the layer of specified thickness, after 8 walks using the previously mentioned compaction system.

However, this single test is not sufficient for selection of the optimal compaction system for pebble materials. Results shall hence be considered with caution, and additional investigations are required to determine the optimal compaction system. The experiment shall be repeated with the different compaction devices actually intended to be used, in order to update the data on the optimal number of walks needed to obtain the maximal compression of pebbles.

6.3.3.2.3 Strength characteristics

The compressive strength has been briefly presented in (HPI, 1861-2-II-3, Local construction materials, 2008-2009) :

	Type of test		Initial prospection 1978	1992' exploration
Compressive strength [Mpa]	Dry	Sandstone	79,9-195,8	79-196
		Limestone	82,3-184,9	73-185
		Granit	86,8-204,2	78-204
	Water saturated	Sandstone	65,5-173,8	65-174
		Limestone	71,6-171,4	70-171
		Granit	76,8-181,6	71-181

Table 6-9: Brief summary of compressive strength assessment – Borrow area 15

These data are provided without any additional information concerning the conditions in which it was obtained (experimental protocol, tested materials etc).

6.3.4 Weaknesses analysis

The first point of interest concerns the elevation of borrow area 15 which ranges between 1030 m and 1120 m. This implies that the zone is to be gradually flooded with the rising of the reservoir during the dam construction.

According to the construction schedule defined by HPI in 2009 (Drawing 1861-27-1, 2009), the lower terrace is expected to be flooded when the reservoir level will exceed elevation 1030 m, around the third year after the beginning of construction.

Date [-]	Reservoir level [m]
January N	988
June N	990
Nov N	997
March N+1	1000
August N+1	1017
May N+3	***1035***
July N+3	1053
...	...

(Drawing 1861-27-1, 2009)

Table 6-10 : Evolution of reservoir level during the first years of construction

Currently, the volume already extracted from the borrow area 15 and deposited in storage areas amounts to 22.11 Mm^3, to be compared to the total volume of 42 Mm^3 necessary for the fully-completed dam.

In order to maintain access to the borrow area, and to avoid any loss of material due to flooding, future exploitation is to be adapted, in order to guarantee that, in every location of the borrow area, all suitable material has been excavated and stored at higher elevation before flooding occurs. This is likely to require an anticipation of the excavation of the lower levels.

A possible solution would be to store the extracted materials on the right bank in front of the borrow area 15, where a relatively flat area, located at higher elevations, would allow avoiding early flooding.

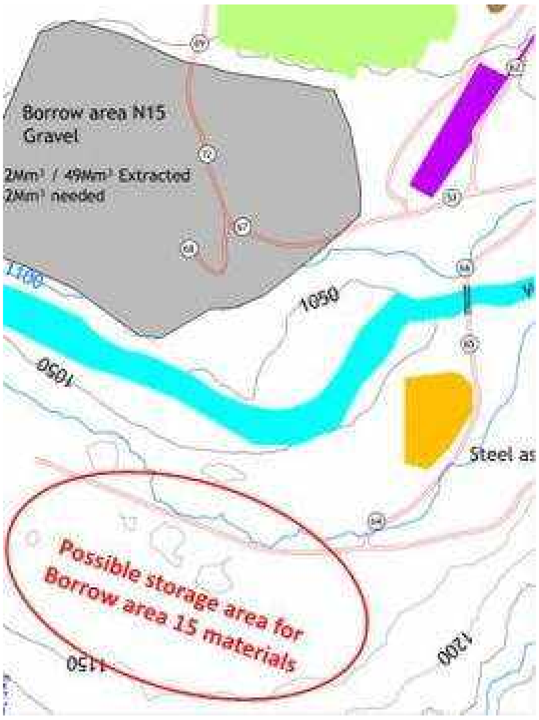


Figure 6-9: Location of a potential area for storage of borrow area 15 materials

It would be necessary to investigate new potential borrow areas, which could provide the missing materials in sufficient quantities in case adequate exploitation measures could not be taken in time to avoid loss of material by flooding in borrow area 15.

6.4 Lyabidora borrow area

6.4.1 General description

(HPI, 1861-2-II-3, Local construction materials, 2008-2009)

The borrow area of Lyabidora was selected in 1992, and its exploitation started at this time. It is located on the left bank of Vakhsh River, roughly 3.7 km upstream of the dam site. Elevation ranges between 1050 m and 1100 m, and materials are similar in nature to those of borrow area 15, except for their relatively smaller size. This is why the materials from Lyabidora are more likely to be used as filter and transition materials.

The productive stratum extends from elevation 1 020 m to 1 120 m, and is composed of alluvial gravels with pebbles inclusions covered by coarse gravels. The materials of Lyabidora are heterogeneous, as areas with small gravels and others with coarser gravels can be distinguished.

An initial prospection in 1992 allows estimating the total volume of 6.63 Mm^3 of materials. The borrow area is currently exploited, and the extracted materials are stockpiled at higher levels (LG2 stockpile area, at storage 2 and 3, see Figure 6-4).

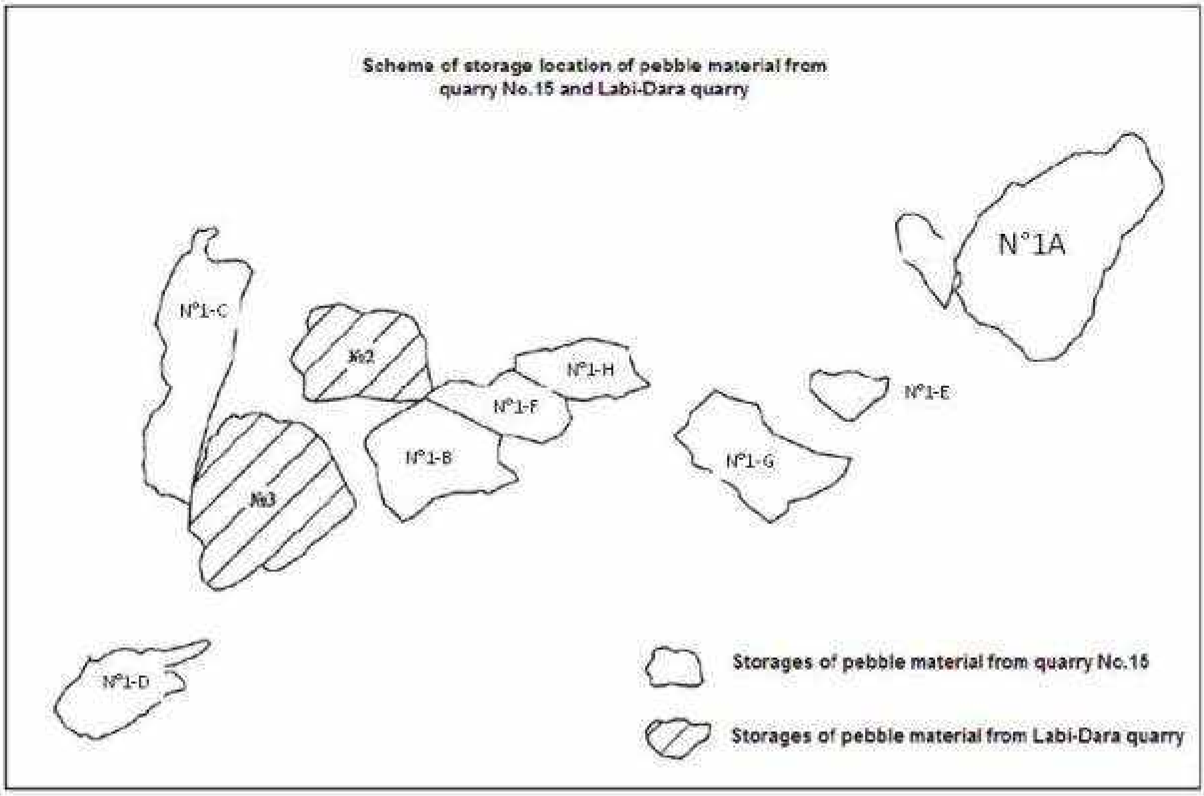


Figure 6-10 : Borrow area of Lyabidora (2011)

6.4.2 Estimation of the resources

The total available volume of suitable materials in Lyabidora borrow area at the beginning of exploitation had been estimated to **5 Mm^3**. About **4 Mm^3** have been already extracted, for needs estimated to **4.4 Mm^3** (Minutes of meetings, 27 to 29 August 2012).

6.4.3 Characteristics of materials

6.4.3.1 Composition and grading curve

The Lyabidora borrow area has been subjected to many investigation campaigns aiming at determining the materials quality and characteristics all along the exploitation. The first was conducted during initial exploration in 1992, providing a substantial assessment of materials characteristics. Grain size determinations were made during the period from 2008 to 2011.

Results of the petrographic analysis are presented in the following table (the analysis took place during the investigation campaign of 1992)

Type of component	1992' Exploration
Sandstone	27.2%
Limestone	22.8%
Granit	19.6%
Metamorphic rocks	10.4%
Weathered and weak slate	20%
Particles < 5 mm	25.80%
Powdered clay particles	9.2%
SO4	<0.01 %
Mica contained in sand	≤7.7 %

(HPI, 1861-2-II-3, Local construction materials, 2008-2009)

Table 6-11: Petrographic analysis of the Lyabidora materials (1992)

Materials from Lyabidora contain an important quantity of mica (up to a maximum amount of 7.7%, for an average value of 3.4%, as the maximum acceptable amount should not exceed about 3% according to GOST standards).

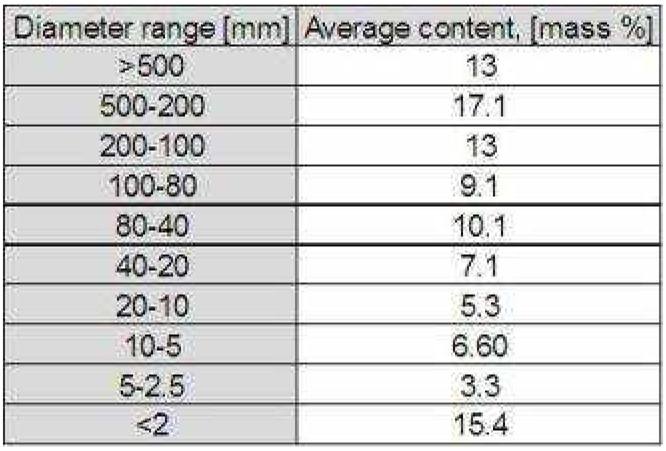
Powdered clay particles are also present in substantial amounts (about 9%, where maximum acceptable amount for use in concrete is 5%, according to GOST standards).

According to the tests, gravels and sand from the Lyabidora borrow area do not presents chemical potential reactivity, as the soluble silica content is below 50 mmol/l.

Laboratory conclusions are as follows: "Particles < 5 mm are present in large amount (25.8%), knowing that allowable quantities are about 5 to 10%."

Grading analysis carried out during exploratory works (1992) has been done for the two identified types of materials present in the Lyabidora borrow area defined as fine and coarse gravels.

Coarse gravels

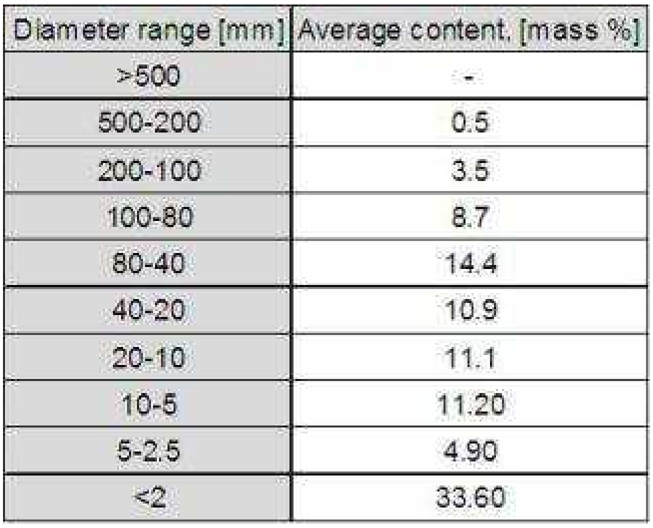


Diameter range [mm]	Average content, [mass %]
>500	13
500-200	17.1
200-100	13
100-80	9.1
80-40	10.1
40-20	7.1
20-10	5.3
10-5	6.60
5-2.5	3.3
<2	15.4

(HPI, 1861-2-II-3, Local construction materials, 2008-2009)

Table 6-12: Coarse gravels grain size composition – Lyabidora (1992)

Fine gravels



Diameter range [mm]	Average content, [mass %]
>500	-
500-200	0.5
200-100	3.5
100-80	8.7
80-40	14.4
40-20	10.9
20-10	11.1
10-5	11.20
5-2.5	4.90
<2	33.60

(HPI, 1861-2-II-3, Local construction materials, 2008-2009)

Table 6-13: Fine gravels grain size composition – Lyabidora (1992)

It is to be noted that, according to this table, the total percentage obtained is about 98.8%. No explanation is available about the missing 1.2%..

The 1992 investigations conclude on the suitability of Lyabidora materials concerning coarse gravels for placement in the dam shoulders (HPI, 1861-2-II-3, Local construction materials, 2008-2009).

Nevertheless, as those materials are the one to be used for filters and transitions, and considering that the available quantities are very near to the required amounts for these layers, placement of the Lyabidora borrow area materials in the dam shoulders should be avoided. Priority shall be given to the utilisation as transitional materials (filters).

Between 2008 and 2009, 41 samples of Lyabidora materials were collected from the borrow area; grading analyse provided the following grading curves:

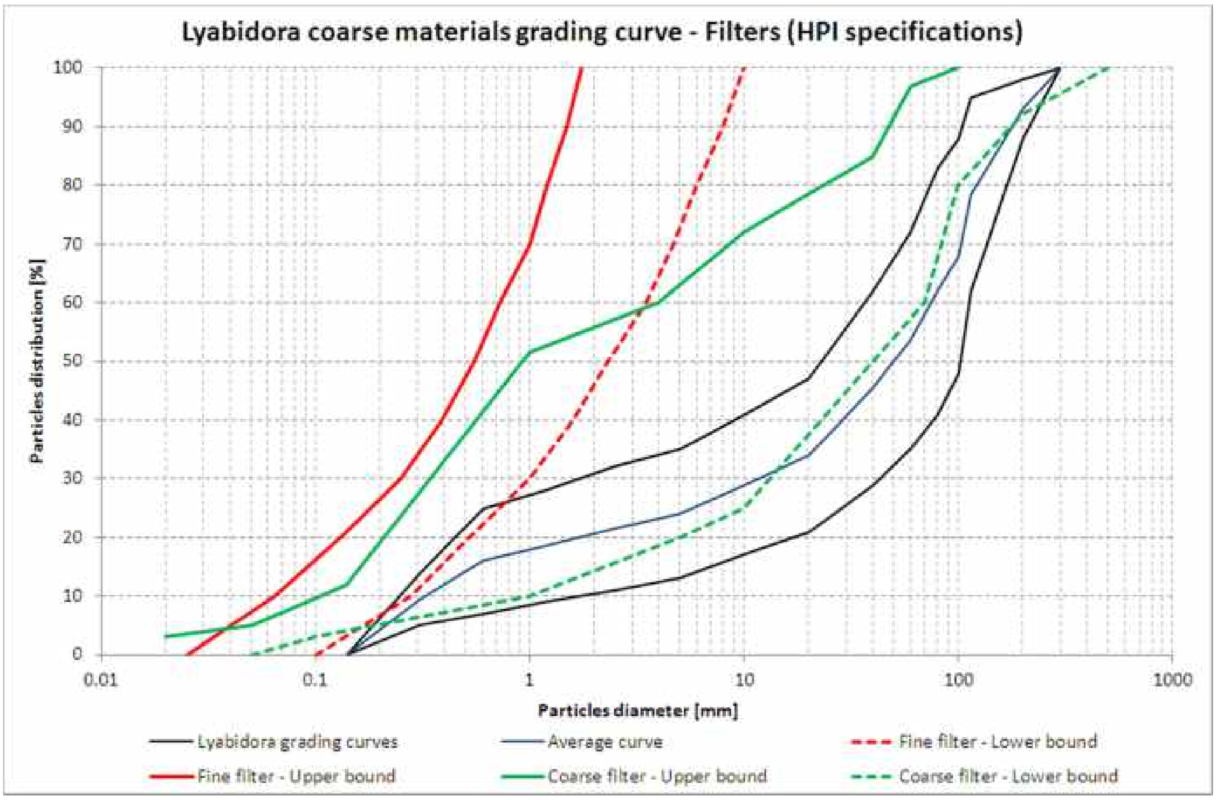


Figure 6-11: Grading curves for coarse gravels – Lyabidora (2008-2009)

These curves show that materials of the Lyabidora borrow area are on the coarse side of specifications for coarse filter. Taking into account such grading curves implies that a specific treatment (crushing and screening) is required to reach the specifications.

At the same period, 25 samples were taken from storage for testing. The obtained grading curves are the following:

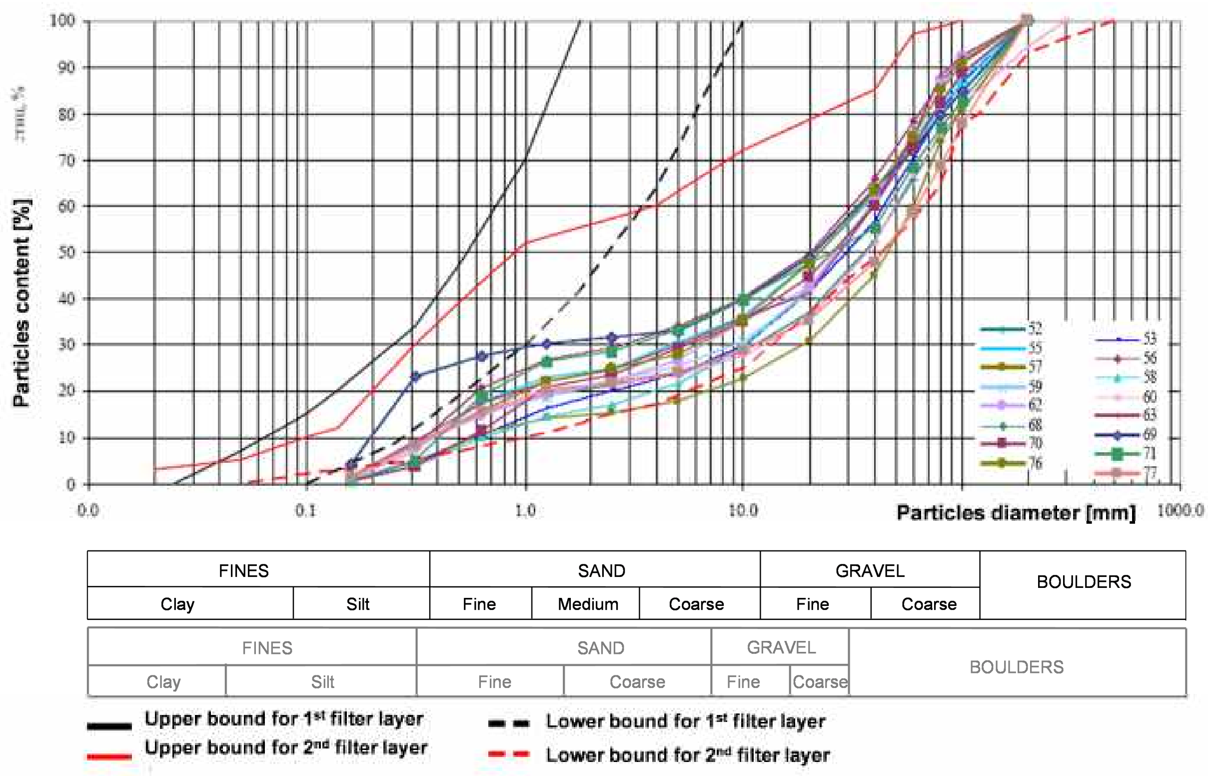


Figure 6-12: Grading curves of Lyabidora materials – Lyabidora (2008-2009)

The materials seem globally adapted for placement as coarse filter layer; nevertheless some precautions have to be taken because of a lack in particles smaller than 0.2 mm. Moreover, and as noticed before, they seem to be still on the coarse side (confirmed by

Figure 6-11), and even exceeding the lower boundary curve. A specific study is to be carried out in order to define adequate treatments (crushing/screening) to be applied in order to reach the required grading specifications.

6.4.3.1.1 Storage 2

From August 2008 to August 2009, 212 samples from storage 2 were collected and analysed determine the grading distribution of materials. Results are presented in Figure 6-3 and will be commented with those from storage 3.

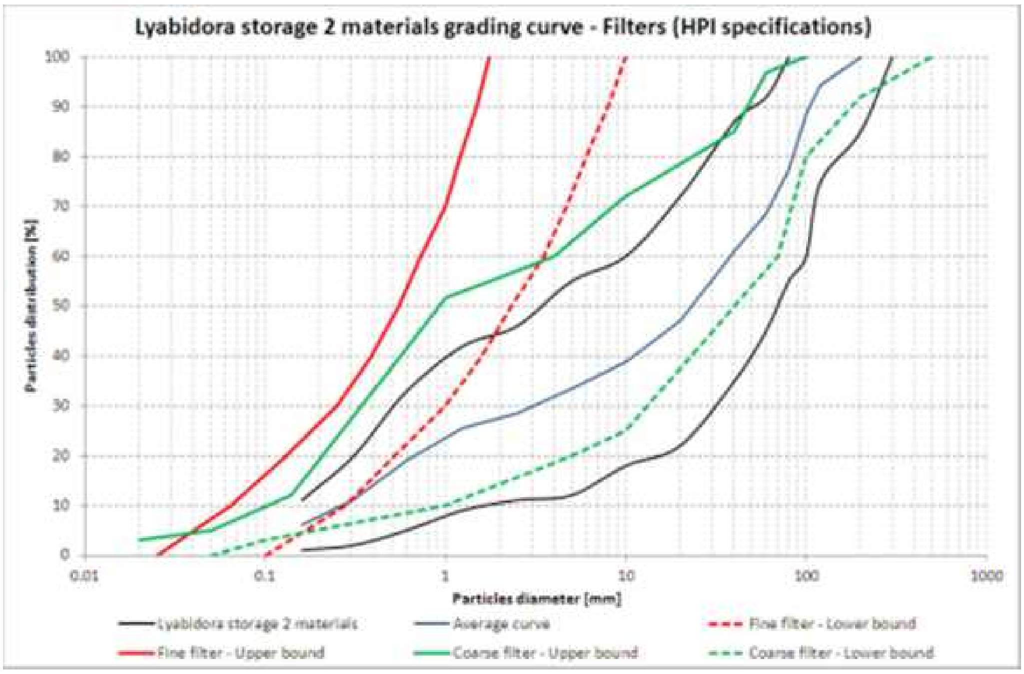


Figure 6-13: Grading curves – Lyabidora storage 2 (2008-2009 / 212 samples)

6.4.3.1.2 Storage 3

Analyses were carried out on 78 samples collected from Storage 3 between August 2009 and May 2010. The obtained boundary curves are presented in Figure 6-14.

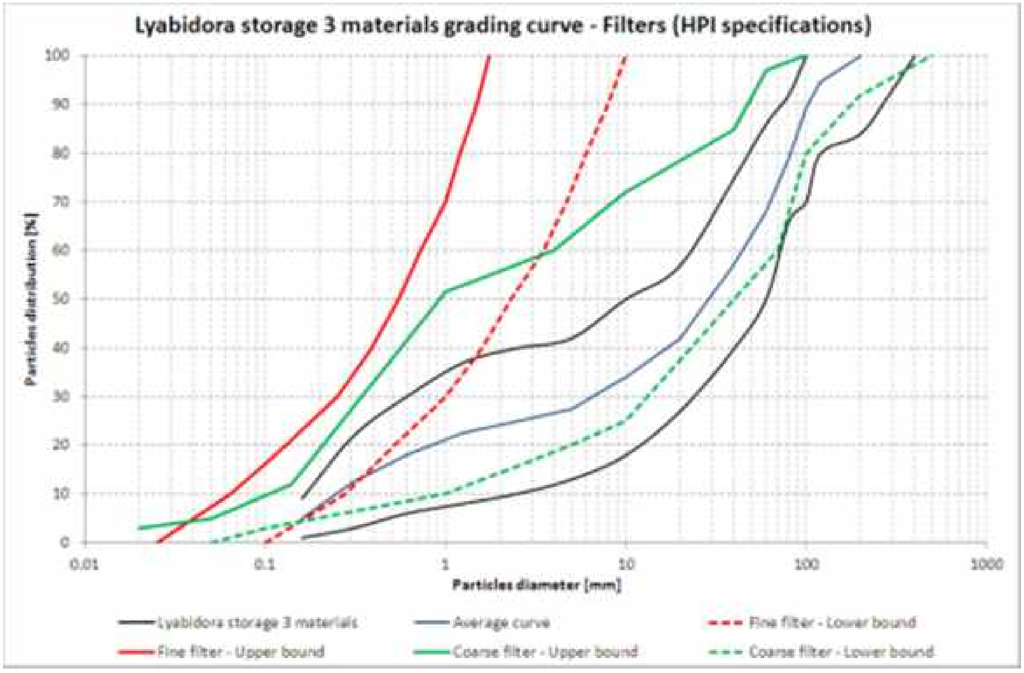


Figure 6-14: Grading curves – Lyabidora storage 3 (2009-2010 / 78 samples)

The conclusion of the report (Technical report, May, 2011) specifies that *“the average grain size composition of the pebbles from storage 2 and 3 of Lyabidora is almost identical. Pebbles from both storages contain fine soil (less than 5mm), from 24.4% to 28.4% and fractions more than 100 mm from 13.3% to 16.7%.”*

“The use of stored material for filling in the transition layers has to be accompanied by appropriate preparation and conditioning (removing particles > 100 mm)”.

This is in accordance with our analysis of the available grading curves, and appropriate treatment of the materials will have to be defined in detailed studies.

6.4.4 Weaknesses analysis

6.4.4.1 Optimisation of exploitation with regard to reservoir level rising

An important issue is that, considering the elevation of the Lyabidora borrow area, it is to be flooded within less than two years after the river diversion (according to Table 6-10). Therefore, considering the remaining volumes to be extracted (less than 1 Mm^3), exploitation schedule shall ensure that the borrow area is totally exhausted at the beginning of the construction of the dam. This implies therefore anticipated extraction of the remaining materials.

6.4.4.2 Use as concrete aggregates

As already stated, the available quantities of Lyabidora materials are limited with respect to the quantities required for filter of the dam. Hence, Lyabidora materials are to be used in priority for this purpose, and concrete aggregates shall be retrieved from borrow area 15.

Moreover, investigations have revealed that mica content on the Lyabidora materials to reach about 7.7%, while the fraction of powdered clay particles is estimated to be about 9% which does not comply with a use as concrete aggregates, as already noticed by HPI (HPI, 1861-2-VII, Organization of the construction, 2009).

6.5 Borrow area 17

6.5.1 General description

The borrow area 17 is located on the left bank of the Vakhsh River, roughly 1.5 km downstream of the dam site, at an average elevation of 1135 m. The borrow area is cut by 3 deep torrents, and is composed of torrential deposits and argillaceous sands.

The materials of borrow area are divided in two layers, with a boulder and pebbles alluvium layer lying below the proluvial materials, which presents a total useful thickness varying from 10 m to 50 m.

6.5.2 Estimation of the resources

Borrow area is decomposed into 3 separated zones numbered from upstream to downstream:

- **Zone I:** 5 Mm^3;
- **Zone II:** 12 Mm^3. this area seeming to contain the most adequate material for the dam core, it has been subjected to most of the investigations carried out on this borrow area.
- **Zone III**: 9 Mm3. however not exploitable because of excessive gypsum content (HPI, 1861-2-II-3, Local construction materials, 2008-2009).

Following the exploration of borrow area 17, 2.5 Mm^3 has been extracted and deposited in the early 1990' (according to (Minutes of meetings, 27 to 29 August 2012)).

It seems that no works took place there since 1992 (Minutes of meetings, 27 to 29 August 2012).

6.5.3 Characteristics of materials from borrow area 17

As the Zone III has been discarded, tests were carried out on materials of Zone I and Zone II.

6.5.3.1 Composition and grading curves

An estimation of the petrographic composition of the materials is available and presented in Table 6-14:

	Zone I	Zone II	Zone III
Limestones	71%	71%	73%
Sandstones	29%	29%	12%
Aleurolites	5%	5%	10%
Gypsum	1%	1%	6%

(HPI, 1861-1-2, Explanatory note, 2009)

Table 6-14: Composition of each area – Borrow area 17

As the borrow area is divided on 3 distinct areas, a grading distribution, densities and natural moisture levels are available for each of them (HPI, 1861-1-2, Explanatory note, 2009) :

Area	Grain size composition [% for the mass]									Density		
	Boulders - Gravels - Pebbles				Gravels		Sand	Dust	Clay	Particles	Dry soil	Natural moisture [%]
	>500	500-300	300-100	100-10	10-5	5-2	2-0.05	0.05-0.005	<0.005			
I	-	16.3	9	17.3	2.3	6	25.4	15.8	5.9	2.7	2.1	22
II	0.4	0.7	13	33.1	5.9	3.23	28.25	12.3	3.3	2.69	2.2	18.7
III	-	8.9	8.5	30	5.3	2.74	20.9	13.6	4.2	2.7	2.1	17

Table 6-15: Average granulometric distribution, density and moisture for each area – Borrow area 17

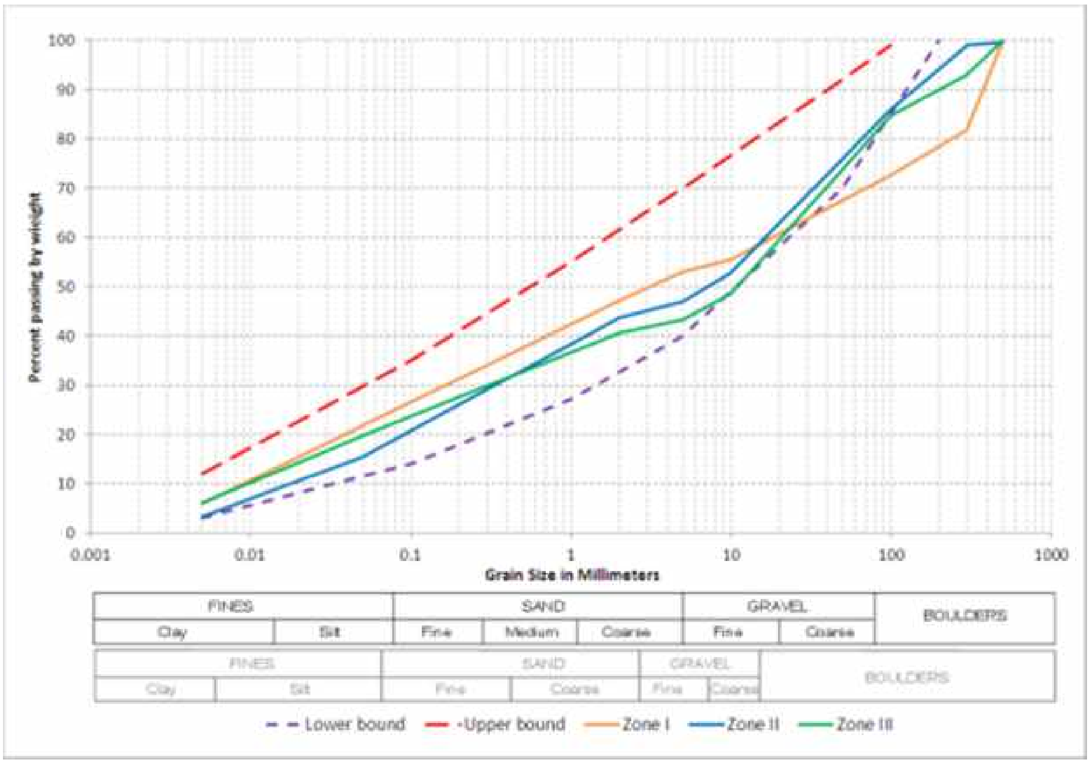


Figure 6-15: Design grading curves for core materials and average composition for each zone of borrow area 17

As stated before, Zone III presents excessive content of gypsum (6%, i.e. about ten times more than in areas I and II), which discarded its usage as materials for the dam.

6.5.3.2 Characteristics

6.5.3.2.1 Compaction characteristics

Content of this paragraph is based on information from *(HPI, Geotechnical properties of soil materials, 1973 - 1978)*

Compaction tests were carried out in the period between 1973 – 1978 by various research organizations. A summary of the obtained results is presented, based principally on the (HPI, Geotechnical properties of soil materials, 1973 - 1978)*:*

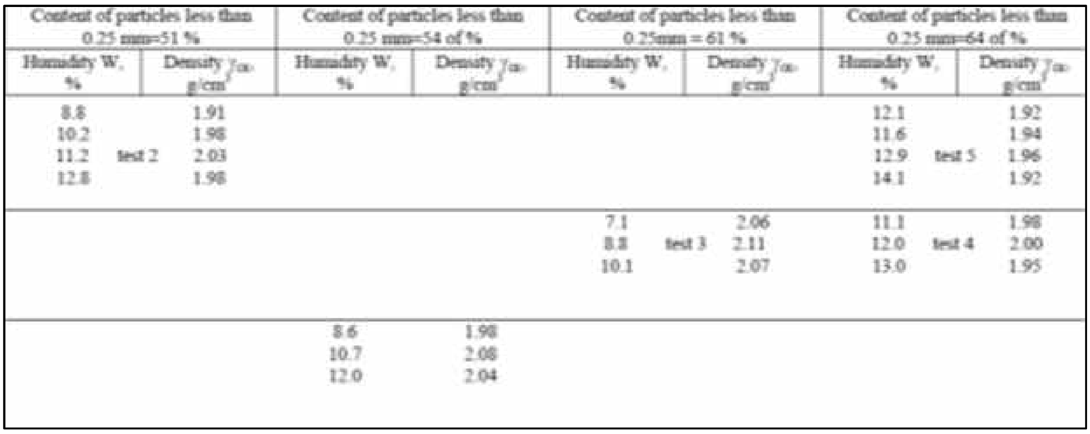
The main studies regarding compaction characteristics of the material of borrow area 17 and its fine fractions were carried out by the Sredazhydroproject and Research Council of Hydroproject.

Research Council of Hydroproject made tests on the fine fractions from samples taken in different years. Therefore, the content in fractions smaller than 0.25 mm varied in tests from 51% to 64%.

Rated density of the fine fractions of borrow area 17 materials can be characterized by values from 1.96 t/m^3 to 2.10 t/m^3 with average value of 2.02 t/m^3, with optimal moisture content from 9 % to 13 % with average value of 11 %.

Results of compaction tests are presented in

Table 6-16.

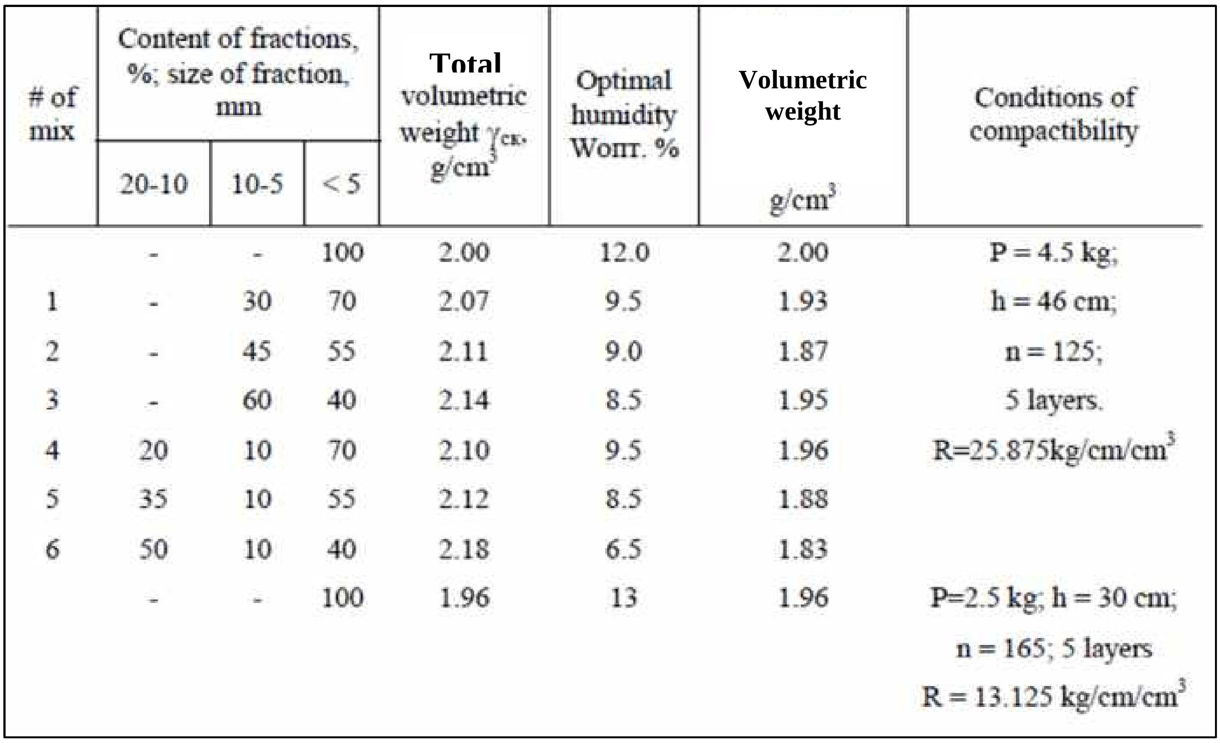


Content of particles less than 0.25 mm=51 %		Content of particles less than 0.25 mm=54 of %		Content of particles less than 0.25mm = 61 %		Content of particles less than 0.25 mm=64 of %	
Humidity W, %	Density γ_{ck} g/cm^3	Humidity W, %	Density γ_{ck} g/cm^3	Humidity W, %	Density γ_{ck} g/cm^3	Humidity W, %	Density γ_{ck} g/cm^3
8.8	1.91					12.1	1.92
10.2	1.98					11.6	1.94
11.2 test 2	2.03					12.9 test 5	1.96
12.8	1.98					14.1	1.92
				7.1	2.06	11.1	1.98
				8.8 test 3	2.11	12.0 test 4	2.00
				10.1	2.07	13.0	1.95
		8.6	1.98				
		10.7	2.08				
		12.0	2.04				

Table 6-16: Results of compaction tests on mixes of materials (particles< 5 mm) – Borrow area 17

Sredazhydroproject made compaction tests on coarser fractions (up to 20 mm), obtaining an average optimal moisture content of about 10%.

Results of compaction tests are presented in Table 6-17.



# of mix	Content of fractions, %; size of fraction, mm			Total volumetric weight $\gamma_{ск}$, g/cm^3	Optimal humidity Wопт. %	Volumetric weight g/cm^3	Conditions of compactibility
	20-10	10-5	< 5				
	-	-	100	2.00	12.0	2.00	P = 4.5 kg;
1	-	30	70	2.07	9.5	1.93	h = 46 cm;
2	-	45	55	2.11	9.0	1.87	n = 125;
3	-	60	40	2.14	8.5	1.95	5 layers.
4	20	10	70	2.10	9.5	1.96	R=25.875kg/cm/cm^3
5	35	10	55	2.12	8.5	1.88	
6	50	10	40	2.18	6.5	1.83	
	-	-	100	1.96	13	1.96	P=2.5 kg; h = 30 cm;
							n = 165; 5 layers
							R = 13.125 kg/cm/cm^3

Table 6-17: Results of compaction tests on mixes of materials (up to 20 mm) – Borrow area 17

These tests all tend to show that the optimum moisture content is around 10 to 11%.

The reported natural moisture of materials from borrow area 17 ranges from 16% to 20%, therefore exceeding the optimal moisture content as deduced from the compaction tests. A particular attention should therefore be given to this issue, since reducing the moisture content of large quantities of materials requires a complex process. This issue is to be treated with more details in the following paragraphs.

6.5.4 Weaknesses analysis

Characteristics of materials from borrow area 17 as deduced from the existing investigations raise two main issues to be solved, i.e. a lack of fine fraction materials and excessive moisture content.

6.5.4.1 Fine fraction issue

Watertightness of a dam core being directly linked to the content in the clayey-silty particles, i.e. smaller than 80 µm, the amount of the corresponding material shall be considered. From Table 6-15 and Figure 6-15, it can be seen that corresponding fraction in the material from borrow area 17 ranges between 18 and 25% in mass.

Such a proportion appears quite low compared to the grading curves of other high earthfill dams. For instance, the requirements for core materials in Nurek were, for particles finer than 80 µm, between 20 and 57% (Bortkevich, 1973).

The Consortium is therefore working on modified grading specifications (phase 2), since such low proportions in clayey-silty particles in the dam core is likely not to assure properly its watertightning function.

HPI, being aware of this, has investigated various means in order to increase the content in fine particles, however, and like emphasised in paragraph 3 (Important note), HPI refers to fine particles as particles smaller than 5 mm, and not specifically about fine, clayey-silty particles smaller than 80 µm.

The processing of the materials aims to put the extracted materials in conformity with the technical requirements and specifications in this matter, contemplating an increase in the fraction smaller than 5 mm.

,Two measures are envisaged by HPI to reach the requirements for the core material:

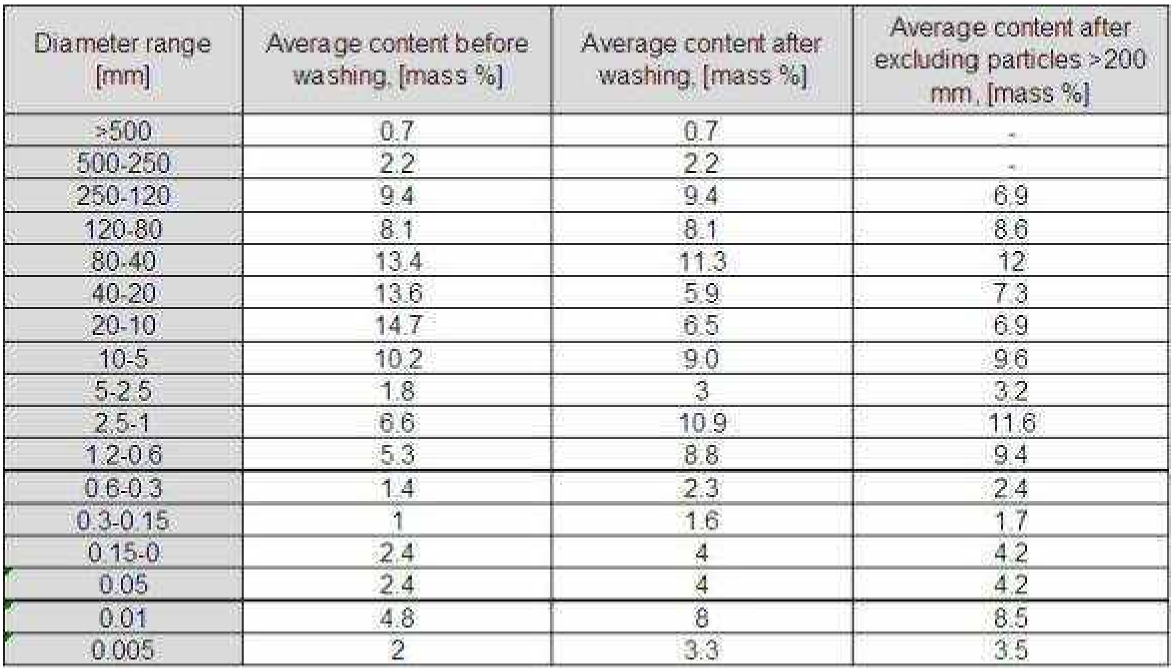
- The first consists on removing the large particles (>200 mm) with a specific process based on the natural segregation of materials in storages and the application of a method called “Pioneer method” (Minutes of meetings, 27 to 29 August 2012). No precise information is given concerning this method, but, it was understood that the process consists in dropping materials from a certain height, thereby allowing separating particles according to their size. This method seems rather uncertain, and in the absence of accurate on-site test results, it is impossible to comment or ensure the effectiveness and adaptation of this method to the requirements of the borrow area 17 materials. It can however be said no effect is expected in increasing the fraction of clayey-silty materials (finer than 80 µm).

- A washing of the materials is envisaged in order to increase the fine content of the materials. However, no precise information could be found concerning this processing except some results of a test carried out on the Zone II:

  “Zone II of borrow area 17 has been investigated by means of 16 prospecting pits with depth ranging from 5 to 20 m. Sampling for determination of materials grading was made at 1m of depth in 2 prospecting pits, and at 5 m in others. In total, 44 samples were used to determine material grading without any treatment, and 9 samples, which grading curves were determined after washing. The amount of the fraction smaller than 5 mm in the materials was then deduced.”

Comparison of granulometric compositions of the samples from before and after washing showed that after washing (see Table 6-18):

- The content in fractions larger than 40 mm had practically not changed;
- The content of the 5-40 mm fraction decreased from 46.8 % to 25 %.



Diameter range [mm]	Average content before washing, [mass %]	Average content after washing, [mass %]	Average content after excluding particles >200 mm, [mass %]
>500	0.7	0.7	-
500-250	2.2	2.2	-
250-120	9.4	9.4	6.9
120-80	8.1	8.1	8.6
80-40	13.4	11.3	12
40-20	13.6	5.9	7.3
20-10	14.7	6.5	6.9
10-5	10.2	9.0	9.6
5-2.5	1.8	3	3.2
2.5-1	6.6	10.9	11.6
1.2-0.6	5.3	8.8	9.4
0.6-0.3	1.4	2.3	2.4
0.3-0.15	1	1.6	1.7
0.15-0	2.4	4	4.2
0.05	2.4	4	4.2
0.01	4.8	8	8.5
0.005	2	3.3	3.5

(HPI, Geotechnical properties of soil materials, 1973 - 1978)

Table 6-18: Effect of washing on grading composition – Borrow area 17

As the exact process of washing is not known, it is difficult to conclude on the suitability of this method for the processing of the materials from borrow area 17.

It can however be said, as obvious, that there is almost no influence on the content of clayey-silty particles, finer than 80 µm, which is a point of concern, since materials from the borrow area 17, from those analysis, would not be satisfactory for placement as dam core material. An enrichment in clayey-sitly particles Is required.

The additional treatment needed may be an enrichment by pure clay from borrow area 11, as envisaged. This solution is a, technically complex, difficult process, and may raise many problems to obtain homogeneous and good quality materials, since mixes would have to be produced from moisted materials. Specific tests are needed in order to estimate the effectiveness and reliability of this method for large quantities.

Apparently, similar treatment was carried out on materials placed in the core of Nurek dam. If the materials of borrow area 11 (about which no data is available) are similar to those of the corresponding borrow area used at Nurek a similar method may be used, but should first be documented.

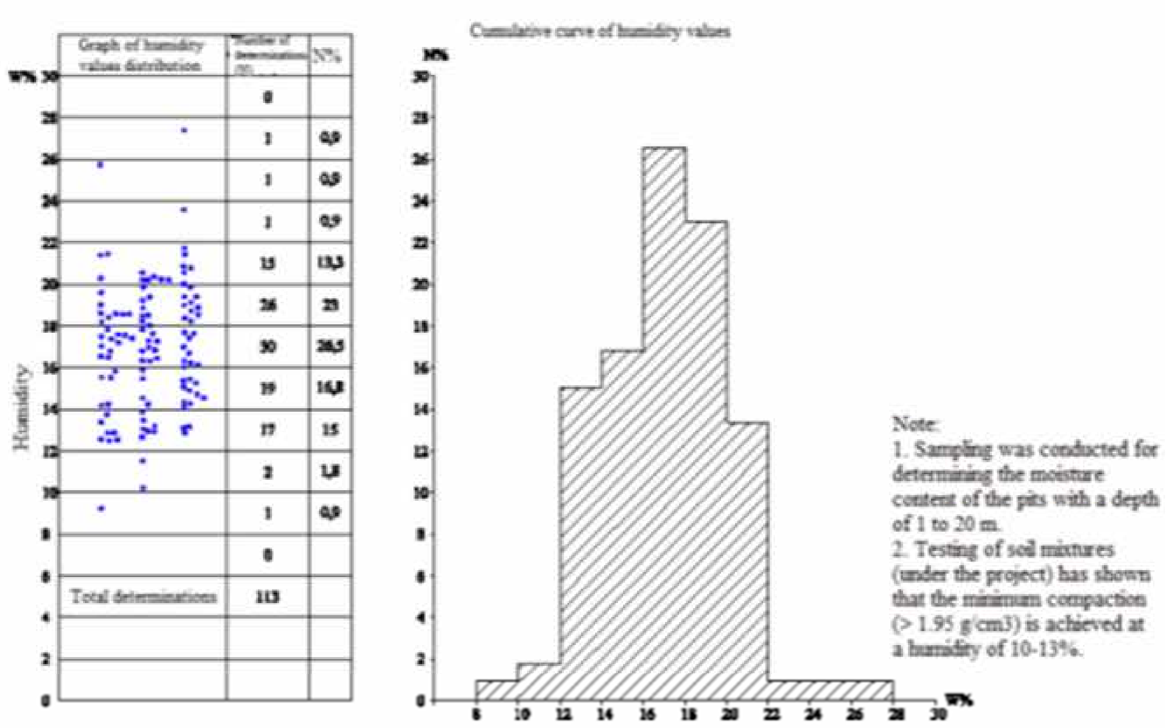
6.5.4.2 Moisture issue

The second aspect of the treatment of the materials is related to the control of moisture content of the extracted materials. According to the available tests, the in-situ moisture content of the materials ranges from 9.2% to 27.3%, and most frequently from 16% to 20%, whereas the moisture content for optimal compaction has been assessed between 10% and 13%. The moisture content within the borrow area 17 were analysed according to elevation, revealing as primary results that the moisture content would be independent from depth, thereby suggesting that the high moisture contents are mainly caused by the superficial infiltrations.

Variations of moisture contents with time were also measured in the upper layer of 10 m depth and are presented in Figure 6-16: Results of moisture levels determination on borrow area 17 (1/2)

Results are quite scattered, probably depending upon precipitations, but some seasonal tendency can be spotted. However, the average of moisture content, according to these results remains over the optimal one (about 11.5% in Figure 6-16: Results of moisture levels determination on borrow area 17 (1/2)

A system of drainage of the deposited materials is being considered as a remedial process, but needs more studies, as well as on-site verification before being validated.



Note:
1. Sampling was conducted for determining the moisture content of the pits with a depth of 1 to 20 m.
2. Testing of soil mixtures (under the project) has shown that the minimum compaction (> 1.95 g/cm3) is achieved at a humidity of 10-13%.

(HPI, 1861-1-2, Explanatory note, 2009)

Figure 6-16: Results of moisture levels determination on borrow area 17 (1/2)

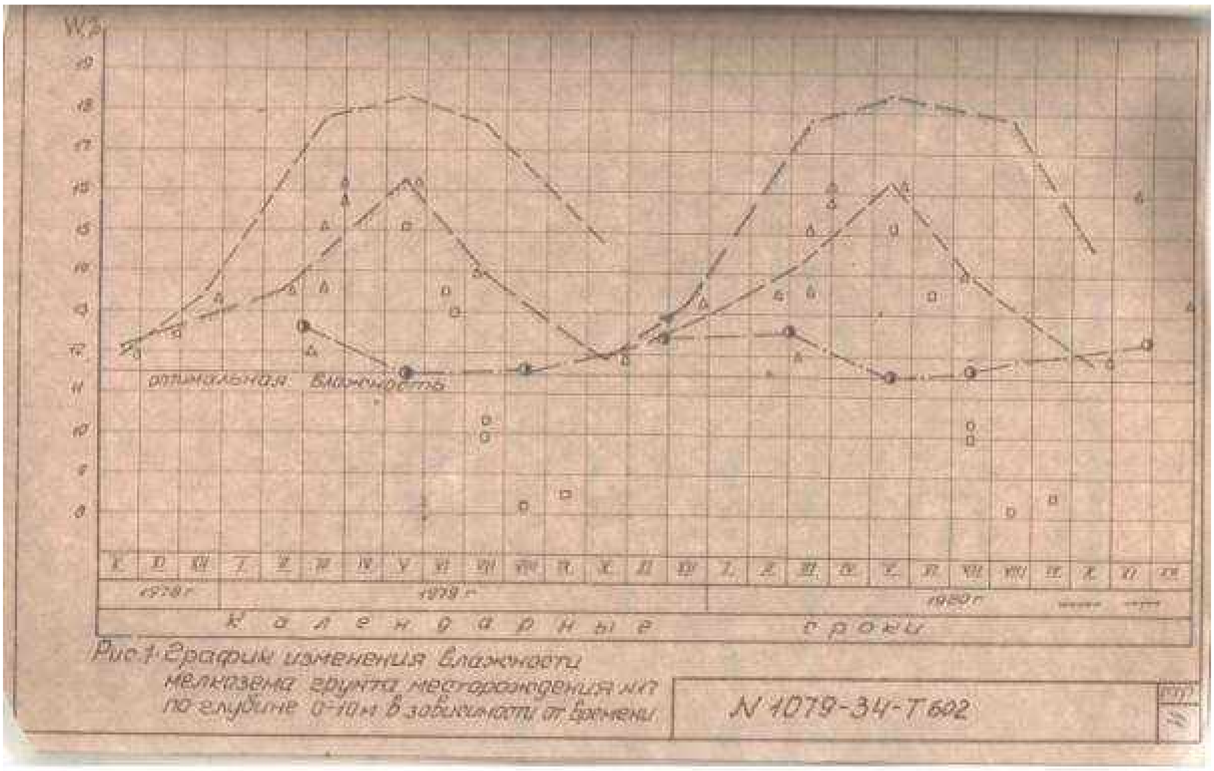


Table 6-19: Results of moisture content with time determination on borrow area 17 (2/2)

Further investigations are expected, especially in dry season, in order to precise the origin of the high moisture content, and to define, adapt and test precisely the remedial treatment process, in order to ensure the efficiency of the process.

6.6 Quarry n°26

6.6.1 General description

The quarry 26 is located on the left bank of Vakhsh River, roughly 3.0 km downstream of the dam site.

Elevation of the quarry ranges from 1030 m to 1300 m. It is separated in quarries 26A and 26B. The quarry contains hard sandstones of Upper Obigarm Formation, with aleurolite interlayers, which thickness ranges from some centimetres to 5 m, representing a global content of 5-6%.

Figure 6-17 : Quarry 26 during exploitation

6.6.2 Estimation of the resources

The available resources of quarry 26 assessed as follows:

- **26A** elevation ranging from 1030 to 1200 m.

  This area contains an estimated **5.2 Mm^3** of rock. The volumes to discard are 0.88 Mm^3 of loose materials, and 0.35 Mm^3 of rock materials.

- **26B**, elevation ranging from 1150 to 1350 m. This area is divided in 2 sectors :

  Sector 1, with elevation ranging from 1150 to 1200 m and an estimated available volume of **7.9 Mm^3** from which 0.13 Mm^3 of rock are to be discarded.

Sector 2, with elevation ranging from 1200 to 1350 m and an estimated available volume of **10.2 Mm^3**, from which shall be discarded 0.46 Mm^3 of loose materials and 0.53 Mm^3 of rock materials.

6.6.3 Characteristics of materials from quarry 26

6.6.3.1 Composition and grading curves

The first available data concerning element size distribution after blasting is is presented in the on reference report: (HPI, 1861-2-II-3, Local construction materials, 2008-2009).

	Q26 A		Q26 B
	Following natural cracking conditions. Average content, [mass %]	Following trial blast. Average content, [mass %]	Following natural cracking conditions. Average content, [mass %]
>1000	0.2	15.26	4.6
1000-500	33.5	33.11	25.1
500-300	42.3	14.84	27.3
300-100	12	18	27.2
100-80	9.7	18.8	15.8
80-40			
40-20			
20-10			
<10			

Table 6-20: Estimate of block size distribution in quarry 26 – Report 1861-2-II-3

As far as we understood, the natural cracking conditions corresponds to the block size distribution extracted by mechanical means.

The second set of available data is from report (Informational report, 2011). This block-size distribution is obtained by analysing of 33 samples of stored rock materials extracted from quarry 26A.

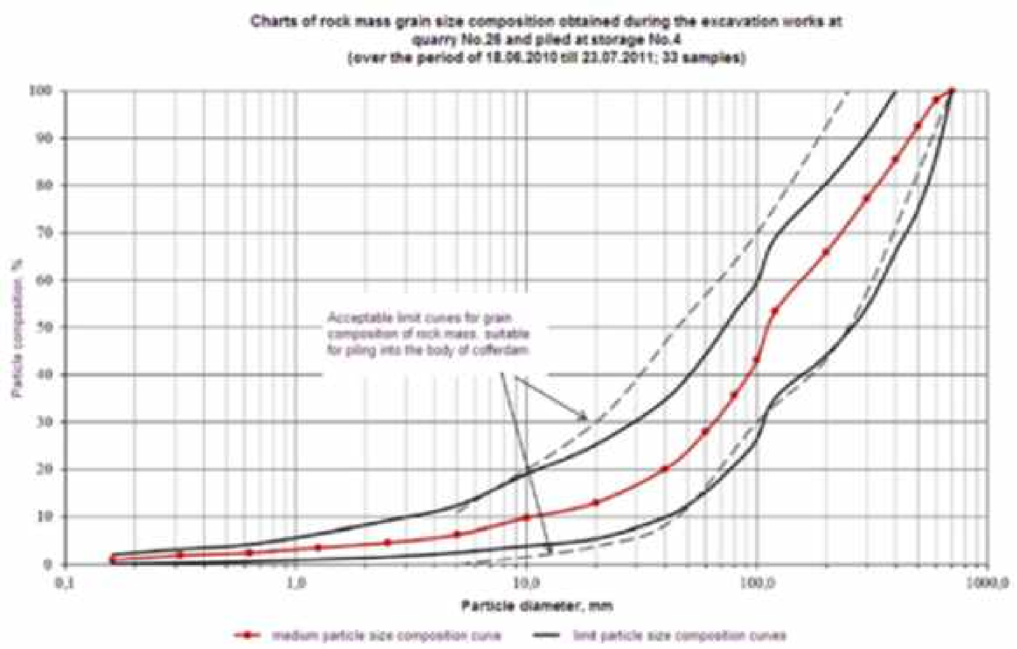


Figure 6-18: Grading curve of quarry 26 stored materials – Quarry 26

It is to be noted that the grain size distribution of quarry 26 materials is strongly depending upon both natural fissure conditions, and blasting characteristics. The blasting methods are to be adjusted in order to get the most suitable block size distribution.

6.6.3.2 Physical characteristics

6.6.3.2.1 Densities

The **material density** is between **2.62 and 2.63 t/m^3** in site conditions. (HPI, 1861-2-II-3, Local construction materials, 2008-2009).

6.6.3.2.2 Porosity

The **water absorption** by the materials has been evaluated to **0.65%.** (HPI, 1861-2-II-3, Local construction materials, 2008-2009).

6.6.3.3 Strength characteristics

6.6.3.3.1 Compressive strength

The compressive resistance for dry materials vary from **68 MPa** to **203 MPa**.

The saturated resistance is between **70 MPa** and **244 MPa**.

(HPI, 1861-2-II-3, Local construction materials, 2008-2009) (Informational report, 2011)

These results are surprising since, normally; the compressive strength tends to decrease when the material is saturated. No information is provided about how these results were obtained or the experimental protocol.

The available data are interesting in order to assess briefly, and for early stage of study, the characteristics and suitability of rock materials. They are however not sufficient for further study stages, and it is essential to conduct more tests and investigations.

With regard to tests to be performed on quarry 26 materials, the (Informational report, 2011) concludes as follows:

“For the specification and further study of the physical and mechanical properties of rock material being provisioned at rock mass storage, laboratory tests must be performed to determine the following characteristics: particle density, density, water absorption and compressive resistance under dry and water-saturated conditions with the calculation of a softening coefficient. The number of tests for each indicator is about 10 to 12.”

It is to be added that the frost resistance of the rock materials from quarry 26 is to be tested in priority, and a comprehensive investigation must be done for the definition and adjustment of the blasting methods, in order to get the most appropriate block size distribution.

7 CONCLUSIONS

At the light of all the collected data concerning the required characteristics and specifications of construction materials for the dam and the management of their extraction and processing, it is possible to make an overall assessment of available quantities. The main weaknesses or potentially critical issues for the different quarries and borrow areas could be identified, and preliminary recommendations to upgrade the quality of the extracted material can be formulated.

The

Table 7-1 and Table 7-2 summarise the conclusions about construction materials.

The main comments and recommendations are the following:

Borrow area 15

- The borrow area 15 is a large source of materials for Rogun project, and contains sufficient quantities of materials for placement in the dam shoulders. Materials from borrow area 15 can also be used as concrete aggregates, on the condition that proper tests are conducted, and that special processes are defined and applied (grading, crushing) in order to meet the specifications for concrete.
- The materials from borrow area 15 are also potentially usable for roads pavements.
- The main issue of the alluvium from borrow area 15 is its flooding, expected after the river diversion. In order to avoid any possible loss of materials by flooding, the anticipated excavation of the materials of the lower levels is to be carried out, during the mobilization phase or before, in order to extract the maximum quantities and store them at higher levels, as it was done so far.
- Comprehensive compaction tests are to be done under *in situ* conditions.

  The available volumes of materials in borrow area 15 and associated storages areas should be sufficient to provide the required quantities for dam shoulders, and also concrete aggregates.

Lyabidora borrow area

- Materials from Lyabidora borrow area are to be used exclusively for dam filters, as they present characteristics the most close to the required specifications, and because available quantities are actually quite close to the one required for this use.
- The suitability of Lyabidora materials for fine filter layer is not proven by the tests and investigations carried out so far. In order to be used as fine filter material, additional tests are to be done, as well as complete investigation on the processes to be implemented in order to meet the specifications on fine filters materials.

- The implementation as coarse filter is considered as acceptable. Particular attention should be paid to the fact that the grading curves of samples show that the materials seems to be almost systematically on the coarse side of the boundary grading curves. Additional studies and tests are to be carried out regarding this issue.

- The available quantity of materials is limited with respect to the needs for dam filters. As the Lyabidora materials are the closest to filter specifications, those should be used exclusively for filters and avoid any usage as concrete aggregate. Moreover, utilisation as concrete aggregate is problematic because of the excessive mica and powdered clay particles which require specific treatments to be defined and likely increase prohibitively the cost of the final material.

  On the basis of volume data from July/2012, the available quantities of materials in Lyabidora and associated storages should be just sufficient to provide the required quantities for transitions of the dam. It can however not be excluded that, considering losses to incur during treatment and transport, some material is to be extracted from another borrow area, which would be to investigate for this use.

Borrow area 17

- The materials of borrow area 17 are in sufficient quantity in order to satisfy the needs for the dam core implementation.

- The first issue concerning the alluvium materials from borrow area 17 is the insufficient fine content (clayey-silty particles finer than 80 µm). This is the main and the most sensitive issue for the borrow area 17 materials. The first proposed process to mitigate this problem consists in the removal of particles larger than 200 mm, in order to increase the fine fractions. This process could only partially solve this issue but cannot be considered as a solution for the problem.

  The second operation considered is the washing of the materials. Some partial results are available, but insufficient in order to conclude on the reliability of this method applied to large amounts of materials. Anyway, the preliminary results revealed that this process does neither allow to obtain the required proportion in fine particles.

  The third solution considered is mixing the borrow area 17 materials with materials from borrow area 11, which is reportedly pure clay. This process can potentially be a solution to the fine fraction issue, but no information about the materials from borrow area 11 are available yet. Moreover, no precise description of the mixing process was established, such process being a very sensitive operation (potential problems of final material homogeneity, segregation, cost…).

  Therefore, a comprehensive assessment on the borrow area 11 materials is still needed.

- The moisture content in natural conditions is also a point of concern. Indeed, the moisture levels recorded *in situ* are high compared to the target moisture content for placement as dam core materials (13% to 20% compared to 9% - 11%). The “drying” process proposed so far is not precisely defined, and has not been tested *in situ*.

  Additional tests with proper sampling are to be done on the borrow area 17 materials in order to ensure the moisture levels of the materials, and to exclude or confirm that the origin of the water content is related to seasonal infiltrations.

In case the moisture content levels are confirmed, a comprehensive analysis must be done on the processes to be established to reduce the moisture content of the materials. Various solutions can be explored: such as implementation of a drainage system in the storage areas, layer arrangement of the materials with superficial treatments to help decreasing the moisture content of the materials. A specific study must be carried out to have a better understanding of the moisture phenomenon on borrow area 17, and define the appropriate process to lower the moisture contents to appropriate levels.

- Additional investigations and studies are to be realized in order to test *in situ* the washing, mixing processes and ensure good results if these solutions are adopted. Moreover, a specific monitoring program must be planned during construction of the dam in order to regularly test and ensure the good quality of the core material.

- It is to be noted that both the drying and the mixing processes induce an increase in the cost of core materials for the dam.

The available quantities of materials in borrow area 17 and associated storage areas are sufficient to provide the required quantities for the core of the dam.

Quarry 26

- Materials of quarry 26 are in sufficient quantities for rock shells and rip rap of the dam. However, some more investigations are to be carried out in order to establish the materials characteristics with more precision and reliability, especially the compressive resistance under various conditions (dry and water saturated conditions), the frost resistance. Blasting methods to be used for exploitation shall allow obtaining the most suitable block size distribution for the final material. *In situ* tests are to be carried out for those purposes.

The available quantities of materials in quarry 26 (A and B) and associated storages are sufficient to provide the required quantities for rock shell and rip-rap.

The two following tables summarise the available amounts of material to be placed in the dam as well as the corrective processes to be implemented in order to let those materials satisfy the technical specifications. A list of subjects requiring further studies is also given.

Source (Quarry/Borrow area)	Total intitial quantities	Extracted quantities	Quantities to discard	Stockpiled quantities	Remaining quantities	Suitable quantities for dam (alluvium shoulders, core, rock shell, rip rap)	Needed quantities for dam	Suitable quantities for concrete aggregates
	[Mm^3]	[Mm^3]	[Mm^3]	[Mm^3]	[Mm^3]	[Mm^3]	[Mm^3]	[Mm^3]
BA 15	75.6	26.6	3.1	22.1	49	64.7	Alluvium shoulders : 39.6	Suitable for concrete aggregate after processing
Lyabidora	6.6	4.0	1.6	4.0	1.0	5.0	Transitions : 4.9	-
BA 17	17	2.5		2.5	14.5	17.0	Core : 7.3	-
Q 26 A and B	5.2 18	0.8	1.2 1.1	0.8	22.4	23.2	Rock shell : 17.8 / Rip rap : 1.5	-

Table 7-1: Conclusions summary on construction materials 1/2

Source (Quarry/Borrow area)	Processing / Treatment to bring to specifications	Issues left to be solved
Borrow area 15	Remove materials > 700 mm which represents about 2-3% (for alluvium shoulders)	Specific exploitation methods / phasing are to be defined to avoid flooding issues.
Lyabidora	Remove boulders > 100 mm which represents about 13 - 16 % (for transitions)	Additional tests are to be done to check out the high mica and powdered clay content.
Borrow area 17	Reduce moisture content to 10-12 %. Remove materials > 200mm. Increase fine content (*)	Processes for: fine content increase, particles >200 mm removals, moisture reduction, are to be defined and tested accurately.(*)
Q 26 A and B	Physical and mechanical properties are to be tested and defined precisely.	-

Table 7-2: Conclusions summary on construction materials 2/2 – According to HPI recommendations

(*) As discussed above, it is the opinion of the Consortium that, additionally, the material of borrow area 17 cannot be used as it is for placement in the dam core, due to its insufficient content in clayey-silty particles (finer than 80 µm). Special processing is to be designed accordingly.

The phase 2 studies on construction materials will confirm, adjust or modify the presented conclusions of this report.

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Adits Tunnels\P-1A — Total available files per this item 1

n°	ID	File Name	Path	Group
38	16	1079-55-4 ОРП .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-1A\1079-55-4 ОРП .TIF	2

Adits Tunnels\P-1Б — Total available files per this item 1

n°	ID	File Name	Path	Group
39	17	561ТП-4-2-11555Б (1).TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-1Б\561ТП-4-2-11555Б (1).TIF	2

Adits Tunnels\P-1в — Total available files per this item 1

n°	ID	File Name	Path	Group
40	18	561ТП-4-II-11576A.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-1в\561ТП-4-II-11576A.TIF	2

Adits Tunnels\P-1г — Total available files per this item 1

n°	ID	File Name	Path	Group
41	19	561ТП-4-II-11576A.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-1г\561ТП-4-II-11576A.TIF	2

Adits Tunnels\P-1E — Total available files per this item 1

n°	ID	File Name	Path	Group
42	1	561тп-4-2-11568а.TIF	DRAWINGS 03\Adits Tunnels - Подходные\П-1Е\561тп-4-2-11568а.TIF	3

Adits Tunnels\P-21 — Total available files per this item 3

n°	ID	File Name	Path	Group
43	4	1861-22-111-1.TIF	DRAWINGS\Adits Tunnels\P-21\1861-22-111-1.TIF	1
44	5	1861-55-11_001.TIF	DRAWINGS\Adits Tunnels\P-21\1861-55-11_001.TIF	1
45	20	1861-22-111-I.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-21\цементация\1861-22-111-I.TIF	2

Adits Tunnels\P-22 — Total available files per this item 5

n°	ID	File Name	Path	Group
46	21	1861-22-118-1 3ам.1 .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-22\крепь\1861-22-118-1 3ам.1 .TIF	2
47	22	1861-22-118-1 3ам.1.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-22\крепь\1861-22-118-1 3ам.1.TIF	2
48	23	1861-22-125-1.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-22\цементация\1861-22-125-1.TIF	2
49	20	561ТП-4-II-11646.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-22\561ТП-4-II-11646.PDF	4
50	21	P22.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-22\P22.pdf	4

Adits Tunnels\P-23 — Total available files per this item 10

n°	ID	File Name	Path	Group
51	6	1079-03-334_001.TIF	DRAWINGS\Adits Tunnels\P-23\1079-03-334_001.TIF	1
52	7	1079-03-334_002.TIF	DRAWINGS\Adits Tunnels\P-23\1079-03-334_002.TIF	1
53	8	1079-03-357_003.TIF	DRAWINGS\Adits Tunnels\P-23\1079-03-357_003.TIF	1
54	9	1079-03-415_001.TIF	DRAWINGS\Adits Tunnels\P-23\1079-03-415_001.TIF	1
55	10	1079-03-415_002.TIF	DRAWINGS\Adits Tunnels\P-23\1079-03-415_002.TIF	1
56	11	115030.TIF	DRAWINGS\Adits Tunnels\P-23\115030.TIF	1

57	24	561ТП-4-II-115153а.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-23\Первичная крепь\561ТП-4-II-115153а.TIF	2
58	25	561Ц-НПО-4-297404.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-23\Цементация\561Ц-НПО-4-297404.TIF	2
59	22	561Ц-НПО-4-297404.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-23\561Ц-НПО-4-297404.PDF	4
60	23	P23.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-23\P23.pdf	4

Adits Tunnels\P-25 **Total available files per this item** 16

n°	ID	File Name	Path	Group
61	12	115135.TIF	DRAWINGS\Adits Tunnels\P-25\as built\115135.TIF	1
62	13	115165.TIF	DRAWINGS\Adits Tunnels\P-25\as built\115165.TIF	1
63	14	115215.TIF	DRAWINGS\Adits Tunnels\P-25\as built\115215.TIF	1
64	15	11552.TIF	DRAWINGS\Adits Tunnels\P-25\as built\11552.TIF	1
65	16	11554.TIF	DRAWINGS\Adits Tunnels\P-25\as built\11554.TIF	1
66	17	11561.TIF	DRAWINGS\Adits Tunnels\P-25\as built\11561.TIF	1
67	18	11585.TIF	DRAWINGS\Adits Tunnels\P-25\as built\11585.TIF	1
68	19	297207.TIF	DRAWINGS\Adits Tunnels\P-25\as built\297207.TIF	1
69	26	20120316140130.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-25\p-25\20120316140130.PDF	2
70	27	561ТП-4-2-11554.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-25\p-25\561ТП-4-2-11554.TIF	2
71	28	561ТП-4-2-11585.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-25\p-25\561ТП-4-2-11585.TIF	2
72	29	561ТП-4-2-11590.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-25\p-25\561ТП-4-2-11590.TIF	2
73	30	561Ц-НПО-4-.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-25\p-25\561Ц-НПО-4-.TIF	2
74	31	297207.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-25\цементация\297207.TIF	2
75	32	561Ц- НПО- 4- 297281.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-25\цементация\561Ц- НПО- 4- 297281.PDF	2
76	33	561ц-НПО-4-297401.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-25\цементация\561ц-НПО-4-297401.TIF	2

Adits Tunnels\P-25A **Total available files per this item** 2

n°	ID	File Name	Path	Group
77	24	P25A.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-25A\P25A.pdf	4
78	25	561Ц-НПО-4-297401.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-25A\цементация\561Ц-НПО-4-297401.PDF	4

Adits Tunnels\P-26 **Total available files per this item** 4

n°	ID	File Name	Path	Group
79	34	11683.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-26\временная крепь\11683.PDF	2
80	35	561ТП-4-II-11683.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-26\временная крепь\561ТП-4-II-11683.TIF	2
81	26	561Ц-4-297476.TIF	DRAWINGS 04\Adits Tunnels - Подходные\P-26\561Ц-4-297476.TIF	4
82	27	P26.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-26\P26.pdf	4

Adits Tunnels\P-27 **Total available files per this item** 1

n°	ID	File Name	Path	Group
83	36	20120317172541.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-27\20120317172541.PDF	2

Adits Tunnels\P-28 **Total available files per this item** 8

n°	ID	File Name	Path	Group
84	20	1861-22-112-1.TIF	DRAWINGS\Adits Tunnels\P-28\1861-22-112-1.TIF	1
85	21	1861-22-113-1_001.TIF	DRAWINGS\Adits Tunnels\P-28\1861-22-113-1_001.TIF	1
86	22	1861-55-15_001.tif	DRAWINGS\Adits Tunnels\P-28\1861-55-15_001.tif	1
87	37	1861-55-15_001.tif	DRAWINGS 02\Adits Tunnels - Подходные\P-28\первичная крепь\1861-55-15_001.tif	2
88	38	561TP-4-II-115322.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-28\первичная крепь\561TP-4-II-115322.TIF	2
89	39	561ТП-4-II-115322.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-28\первичная крепь\561ТП-4-II-115322.TIF	2
90	40	1861-22-112-I.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-28\цементация\1861-22-112-I.TIF	2
91	41	1861-22-113-I.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-28\цементация\1861-22-113-I.TIF	2

Adits Tunnels\P-29 **Total available files per this item** 3

n°	ID	File Name	Path	Group
92	42	561ТП-4-II-115200.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-29\561ТП-4-II-115200.PDF	2
93	28	561ТП-4-II-115200.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-29\561ТП-4-II-115200.PDF	4
94	29	P29.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-29\P29.pdf	4

Adits Tunnels\P-3 **Total available files per this item** 6

n°	ID	File Name	Path	Group
95	23	192456.TIF	DRAWINGS\Adits Tunnels\P-3\192456.TIF	1
96	43	1079-55-4 ОРП .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-3\система окончательной заглушка	2
97	44	1079-55-4 ОРП .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-3\система окончательной заглушка	2
98	45	561ТП-4-I-11221.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-3\тип временой крепи\561ТП-4-I-11221.TIF	2
99	46	561Ц- НПО- 4-297168.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-3\цементация\561Ц- НПО- 4-297168.TIF	2
100	47	561Ц- НПО- 4-297205.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-3\цементация\561Ц- НПО- 4-297205.TIF	2

Adits Tunnels\P-30 **Total available files per this item** 6

n°	ID	File Name	Path	Group
101	24	184928.TIF	DRAWINGS\Adits Tunnels\P-30\184928.TIF	1
102	25	190119.TIF	DRAWINGS\Adits Tunnels\P-30\190119.TIF	1
103	48	561ТП-4-II-115189.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-30\временная крепь\561ТП-4-II-115189.TIF	2
104	49	561Ц-НПО-4-297426.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-30\цементация\561Ц-НПО-4-297426.TIF	2
105	30	561Ц-НПО-4-297426.TIF	DRAWINGS 04\Adits Tunnels - Подходные\P-30\561Ц-НПО-4-297426.TIF	4
106	31	P30.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-30\P30.pdf	4

Adits Tunnels\P-33, P-35A **Total available files per this item** 4

n°	ID	File Name	Path	Group
107	50	1101-55-10A_001.tif	DRAWINGS 02\Adits Tunnels - Подходные\P-33, P-35A\1101-55-10A\1101-55-10A_001.tif	2
108	51	1101-55-10A_002.tif	DRAWINGS 02\Adits Tunnels - Подходные\P-33, P-35A\1101-55-10A\1101-55-10A_002.tif	2
109	52	1101-55-10A_003.tif	DRAWINGS 02\Adits Tunnels - Подходные\P-33, P-35A\1101-55-10A\1101-55-10A_003.tif	2
110	53	1861-22-100-I.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-33, P-35A\цементация\1861-22-100-I.TIF	2

Adits Tunnels\P-34 **Total available files per this item** 5

n°	ID	File Name	Path	Group
111	26	1079-03-339_001.TIF	DRAWINGS\Adits Tunnels\P-34\1079-03-339_001.TIF	1
112	27	115317.TIF	DRAWINGS\Adits Tunnels\P-34\115317.TIF	1
113	54	561ТП-4-2-115317.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-34\временная крепь\561ТП-4-2-115317.TIF	2
114	55	1861-22-81-I.tif	DRAWINGS 02\Adits Tunnels - Подходные\P-34\цементация\1861-22-81-I.tif	2
115	56	1861-22-83-1.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-34\цементация\1861-22-83-1.TIF	2

Adits Tunnels\P-35 **Total available files per this item** 3

n°	ID	File Name	Path	Group
116	57	561ТП-4-II-115168.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-35\561ТП-4-II-115168.TIF	2
117	32	561Ц-НПО-4-297482.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-35\561Ц-НПО-4-297482.PDF	4
118	33	P35.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-35\P35.pdf	4

Adits Tunnels\P-35A **Total available files per this item** 2

n°	ID	File Name	Path	Group
119	34	1861-22-182-1.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-35A\P-35a\1861-22-182-1.PDF	4
120	35	P35A.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-35A\P-35a\P35A.pdf	4

Adits Tunnels\P-36 **Total available files per this item** 7

n°	ID	File Name	Path	Group
121	58	561ТП-4-II-115516.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-36\561ТП-4-II-115516.PDF	2
122	36	1861-22-181-1.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-36\1861-22-181-1.PDF	4
123	37	561ТП-4-II-115367.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-36\561ТП-4-II-115367.PDF	4
124	38	561ТП-4-II-115516.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-36\561ТП-4-II-115516.PDF	4
125	39	P36.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-36\P36.pdf	4
126	40	561ТП-4-II-115367.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-36\П-36\561ТП-4-II-115367.PDF	4
127	41	561ТП-4-II-115516.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-36\П-36\561ТП-4-II-115516.PDF	4

Adits Tunnels\P-37 **Total available files per this item** 4

n°	ID	File Name	Path	Group
128	28	1861-22-116-1.TIF	DRAWINGS\Adits Tunnels\P-37\1861-22-116-1.TIF	1
129	29	1861-55-12_001.TIF	DRAWINGS\Adits Tunnels\P-37\1861-55-12_001.TIF	1
130	59	1861-55-12_001.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-37\временная крепь\1861-55-12_001.TIF	2
131	60	1861-22-116-I.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-37\цементация\1861-22-116-I.TIF	2

Adits Tunnels\P-38 **Total available files per this item** 1

n°	ID	File Name	Path	Group
132	61	561ТП-4-7-116145.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-38\561ТП-4-7-116145.TIF	2

Adits Tunnels\P-4 **Total available files per this item** 5

n°	ID	File Name	Path	Group
133	62	1079-55-4 ОРП .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-4\система окончательной заглушка	2
134	63	1079-55-4 ОРП .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-4\система окончательной заглушка	2
135	64	561ТП-4-I-11221.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-4\тип временой крепи\561ТП-4-I-11221.TIF	2
136	65	561Ц- НПО- 4-297168.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-4\цементация\561Ц- НПО- 4-297168.TIF	2
137	66	561Ц- НПО- 4-297205.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-4\цементация\561Ц- НПО- 4-297205.TIF	2

Adits Tunnels\P-40 **Total available files per this item** 11

n°	ID	File Name	Path	Group
138	67	1861-22-75-I 1л..pdf	DRAWINGS 02\Adits Tunnels - Подходные\P-40\1861-22-75-I\1861-22-75-I 1л..pdf	2
139	68	1861-22-75-I 2л..pdf	DRAWINGS 02\Adits Tunnels - Подходные\P-40\1861-22-75-I\1861-22-75-I 2л..pdf	2
140	69	1861-22-121-1.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-40\цементация\1861-22-121-1.TIF	2
141	70	1861-22-64-1_001.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-40\цементация\1861-22-64-1_001.TIF	2
142	42	1861-22-121-1.TIF	DRAWINGS 04\Adits Tunnels - Подходные\P-40\1861-22-121-1.TIF	4
143	43	1861-22-75-I 1л..pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-40\1861-22-75-I 1л..pdf	4
144	44	1861-22-75-I 2л..pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-40\1861-22-75-I 2л..pdf	4
145	45	P40.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-40\P40.pdf	4
146	46	1861-22-75-I 1л..pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-40\1861-22-75-I\1861-22-75-I 1л..pdf	4
147	47	1861-22-75-I 2л..pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-40\1861-22-75-I\1861-22-75-I 2л..pdf	4
148	48	1861-22-121-1.TIF	DRAWINGS 04\Adits Tunnels - Подходные\P-40\цементация\1861-22-121-1.TIF	4

Adits Tunnels\P-5 **Total available files per this item** 3

n°	ID	File Name	Path	Group
149	49	1079-22-62 ОРП.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-5\1079-22-62 ОРП.PDF	4
150	50	P5.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-5\P5.pdf	4
151	51	П-5.docx	DRAWINGS 04\Adits Tunnels - Подходные\P-5\П-5.docx	4

Adits Tunnels\P-6 **Total available files per this item** 1

n°	ID	File Name	Path	Group
152	71	561ТП-4-I-11215.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-6\561ТП-4-I-11215.TIF	2

Adits Tunnels\P-67 **Total available files per this item** 3

n°	ID	File Name	Path	Group
153	72	561ТП-4-VI-13027.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-67\561ТП-4-VI-13027.PDF	2
154	52	561Ц-4-297454.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-67\561Ц-4-297454.PDF	4
155	53	P67.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-67\P67.pdf	4

Adits Tunnels\P-68 **Total available files per this item** 3

n°	ID	File Name	Path	Group
156	73	561ТП-4-VI-13031A.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-68\561ТП-4-VI-13031A.PDF	2

157	54	561Ц-4-297454.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-68\561Ц-4-297454.PDF	4
158	55	P68.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-68\P68.pdf	4

Adits Tunnels\P-69 **Total available files per this item** 4

n°	ID	File Name	Path	Group
159	74	561ТП-4-VI-13038.PDF	DRAWINGS 02\Adits Tunnels - Подходные\P-69\561ТП-4-VI-13038.PDF	2
160	56	561ТП-4-VI-13038.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-69\561ТП-4-VI-13038.PDF	4
161	57	561Ц-4-297294.PDF	DRAWINGS 04\Adits Tunnels - Подходные\P-69\561Ц-4-297294.PDF	4
162	58	P69.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-69\P69.pdf	4

Adits Tunnels\P-80 **Total available files per this item** 4

n°	ID	File Name	Path	Group
163	75	561ТП-4-VIII-13710 .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-80\561ТП-4-VIII-13710 .TIF	2
164	59	561ТП-4-VIII-13710 .TIF	DRAWINGS 04\Adits Tunnels - Подходные\P-80\561ТП-4-VIII-13710 .TIF	4
165	60	P-80.docx	DRAWINGS 04\Adits Tunnels - Подходные\P-80\P-80.docx	4
166	61	P80.pdf	DRAWINGS 04\Adits Tunnels - Подходные\P-80\P80.pdf	4

Adits Tunnels\P-9 **Total available files per this item** 7

n°	ID	File Name	Path	Group
167	76	561ТП-4-I-112164A.pdf	DRAWINGS 02\Adits Tunnels - Подходные\P-9\561ТП-4-I-112164A.pdf	2
168	77	561Ц- НПО- 4-297268.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-9\561Ц- НПО- 4-297268.TIF	2
169	78	1079-55-4 ОРП .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-9\П-3, П-4\система окончательной заглушка	2
170	79	1079-55-4 ОРП .TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-9\П-3, П-4\система окончательной заглушка	2
171	80	561ТП-4-I-11221.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-9\П-3, П-4\тип временой крепи\561ТП-4-I-11221.	2
172	81	561Ц- НПО- 4-297168.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-9\П-3, П-4\цементация\561Ц- НПО- 4-297168.TIF	2
173	82	561Ц- НПО- 4-297205.TIF	DRAWINGS 02\Adits Tunnels - Подходные\P-9\П-3, П-4\цементация\561Ц- НПО- 4-297205.TIF	2

Adits Tunnels\подходная к ДЦШ-1 **Total available files per this item** 1

n°	ID	File Name	Path	Group
174	83	112369.TIF	DRAWINGS 02\Adits Tunnels - Подходные\подходная к ДЦШ-1\112369.TIF	2

Auxiliary Tunnel **Total available files per this item** 19

n°	ID	File Name	Path	Group
175	30	297253.TIF	DRAWINGS\Auxiliary Tunnel\297253.TIF	1
176	31	20090907-154109.TIF	DRAWINGS\Auxiliary Tunnel\1079-22-37\20090907-154109.TIF	1
177	32	20090907-154332.TIF	DRAWINGS\Auxiliary Tunnel\1079-22-37\20090907-154332.TIF	1
178	33	20090907-154604.TIF	DRAWINGS\Auxiliary Tunnel\1079-22-37\20090907-154604.TIF	1
179	34	1861-22-1_001.tif	DRAWINGS\Auxiliary Tunnel\1861-22-1\1861-22-1_001.tif	1
180	35	1861-22-1_002.tif	DRAWINGS\Auxiliary Tunnel\1861-22-1\1861-22-1_002.tif	1
181	36	1861-22-1_003.tif	DRAWINGS\Auxiliary Tunnel\1861-22-1\1861-22-1_003.tif	1
182	37	1861-22-1_004.tif	DRAWINGS\Auxiliary Tunnel\1861-22-1\1861-22-1_004.tif	1
183	84	20090907-154109.TIF	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\жб обделка\1079-22-37\20090907	2

184	85	20090907-154332.TIF	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\жб обделка\1079-22-37\20090907	2
185	86	20090907-154604.TIF	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\жб обделка\1079-22-37\20090907	2
186	87	1861-22-1_001.tif	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\жб обделка\1861-22-1\1861-22	2
187	88	1861-22-1_002.tif	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\жб обделка\1861-22-1\1861-22	2
188	89	1861-22-1_003.tif	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\жб обделка\1861-22-1\1861-22	2
189	90	1861-22-1_004.tif	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\жб обделка\1861-22-1\1861-22	2
190	91	2-1-4(Смета).xls	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\жб обделка\1861-22-1\2-1-4	2
191	92	297253.TIF	DRAWINGS 02\Auxiliary Tunnel - Вспомогательный туннель\цементация\297253.TIF	2
192	62	561 ТП-4-0-11097.PDF	DRAWINGS 04\Auxiliary Tunnel\561 ТП-4-0-11097.PDF	4
193	63	auxiliary tunnel.pdf	DRAWINGS 04\Auxiliary Tunnel\auxiliary tunnel.pdf	4

BB warehouse — **Total available files per this item** 5

n°	ID	File Name	Path	Group
194	2	561M-4-vii-17734.tif	DRAWINGS 03\BB warehouse - Склад BB\561M-4-vii-17734.tif	3
195	3	561TC-4-VII-16736.tif	DRAWINGS 03\BB warehouse - Склад BB\561TC-4-VII-16736.tif	3
196	4	561TЭ-4-VII-18725.tif	DRAWINGS 03\BB warehouse - Склад BB\561TЭ-4-VII-18725.tif	3
197	64	561ТП-4-II-116213.PDF	DRAWINGS 04\BB warehouse - Склад BB\561ТП-4-II-116213.PDF	4
198	65	warehouse.pdf	DRAWINGS 04\BB warehouse - Склад BB\warehouse.pdf	4

Bus Duct Gallery — **Total available files per this item** 35

n°	ID	File Name	Path	Group
199	38	РАСЧЕТ ВРЕМЕННОЙ	DRAWINGS\Bus Duct Gallery\РАСЧЕТ ВРЕМЕННОЙ КРЕПИ-Calculation of temporary supports.pdf	1
200	39	1861-14-42_001.tif	DRAWINGS\Bus Duct Gallery\1861-14-42\1861-14-42_001.tif	1
201	40	1861-14-42_002.tif	DRAWINGS\Bus Duct Gallery\1861-14-42\1861-14-42_002.tif	1
202	41	1861-14-42_003.tif	DRAWINGS\Bus Duct Gallery\1861-14-42\1861-14-42_003.tif	1
203	42	1861-14-42_004.tif	DRAWINGS\Bus Duct Gallery\1861-14-42\1861-14-42_004.tif	1
204	43	1861-14-42_005.tif	DRAWINGS\Bus Duct Gallery\1861-14-42\1861-14-42_005.tif	1
205	44	1861-14-42_006.tif	DRAWINGS\Bus Duct Gallery\1861-14-42\1861-14-42_006.tif	1
206	45	1861-14-И- тип II 13.tif	DRAWINGS\Bus Duct Gallery\1861-14-42\1861-14-И- тип II 13.tif	1
207	46	1861-14-54_001.pdf	DRAWINGS\Bus Duct Gallery\1861-14-54 токопровод 3,4\1861-14-54_001.pdf	1
208	47	1861-14-54_002.pdf	DRAWINGS\Bus Duct Gallery\1861-14-54 токопровод 3,4\1861-14-54_002.pdf	1
209	48	1861-14-54_003.pdf	DRAWINGS\Bus Duct Gallery\1861-14-54 токопровод 3,4\1861-14-54_003.pdf	1
210	49	1861-14-54_004.pdf	DRAWINGS\Bus Duct Gallery\1861-14-54 токопровод 3,4\1861-14-54_004.pdf	1
211	50	1861-14-54_005.pdf	DRAWINGS\Bus Duct Gallery\1861-14-54 токопровод 3,4\1861-14-54_005.pdf	1
212	51	1861-14-54_006.pdf	DRAWINGS\Bus Duct Gallery\1861-14-54 токопровод 3,4\1861-14-54_006.pdf	1
213	52	1861-14-И- тип II 13.tif	DRAWINGS\Bus Duct Gallery\1861-14-54 токопровод 3,4\1861-14-И- тип II 13.tif	1
214	53	1861-14-И-тип III 13.tif	DRAWINGS\Bus Duct Gallery\1861-14-54 токопровод 3,4\1861-14-И-тип III 13.tif	1
215	54	1861-55-17_001.tif	DRAWINGS\Bus Duct Gallery\1861-55-17 И 1861-55-18\1861-55-17_001.tif	1
216	55	1861-55-18_001.TIF	DRAWINGS\Bus Duct Gallery\1861-55-17 И 1861-55-18\1861-55-18_001.TIF	1
217	56	1861-55-29_001.pdf	DRAWINGS\Bus Duct Gallery\1861-55-29 55-31\1861-55-29_001.pdf	1
218	57	1861-55-29_002.pdf	DRAWINGS\Bus Duct Gallery\1861-55-29 55-31\1861-55-29_002.pdf	1
219	58	1861-55-29_003.pdf	DRAWINGS\Bus Duct Gallery\1861-55-29 55-31\1861-55-29_003.pdf	1

220	59	1861-55-31_001.pdf	DRAWINGS\Bus Duct Gallery\1861-55-29 55-31\1861-55-31_001.pdf	1
221	60	1861-22-58-1_001.TIF	DRAWINGS\Bus Duct Gallery\цементация-Grouting\1861-22-58-1_001.TIF	1
222	61	1861-22-58-1_002.TIF	DRAWINGS\Bus Duct Gallery\цементация-Grouting\1861-22-58-1_002.TIF	1
223	62	1861-22-58-1_003.TIF	DRAWINGS\Bus Duct Gallery\цементация-Grouting\1861-22-58-1_003.TIF	1
224	63	1861-22-59-1_001.TIF	DRAWINGS\Bus Duct Gallery\цементация-Grouting\1861-22-59-1_001.TIF	1
225	64	1861-22-59-1_002.TIF	DRAWINGS\Bus Duct Gallery\цементация-Grouting\1861-22-59-1_002.TIF	1
226	65	1861-22-59-1_003.TIF	DRAWINGS\Bus Duct Gallery\цементация-Grouting\1861-22-59-1_003.TIF	1
227	93	1079-14-44 КЖ_004.PDF	DRAWINGS 02\Bus Duct Gallery - токопроводы (шинопровод)\жб обделка\1079-14-44	2
228	94	1861-22-59-I_001.TIF	DRAWINGS 02\Bus Duct Gallery - токопроводы (шинопровод)\токопровод 5	2
229	95	1861-22-59-I_002.TIF	DRAWINGS 02\Bus Duct Gallery - токопроводы (шинопровод)\токопровод 5	2
230	96	1861-22-59-I_003.TIF	DRAWINGS 02\Bus Duct Gallery - токопроводы (шинопровод)\токопровод 5	2
231	97	1861-22-58-1_001.TIF	DRAWINGS 02\Bus Duct Gallery - токопроводы (шинопровод)\токопровод 6	2
232	98	1861-22-58-1_002.TIF	DRAWINGS 02\Bus Duct Gallery - токопроводы (шинопровод)\токопровод 6	2
233	99	1861-22-58-1_003.TIF	DRAWINGS 02\Bus Duct Gallery - токопроводы (шинопровод)\токопровод 6	2

Cable Galleries **Total available files per this item** **41**

n°	ID	File Name	Path	Group
234	66	297384.TIF	DRAWINGS\Cable Galleries\Cable Gallery 01\297384.TIF	1
235	67	297446.TIF	DRAWINGS\Cable Galleries\Cable Gallery 01\297446.TIF	1
236	68	297539.TIF	DRAWINGS\Cable Galleries\Cable Gallery 01\297539.TIF	1
237	69	Л.1.TIF	DRAWINGS\Cable Galleries\Cable Gallery 01\1079-14-114а\Л.1.TIF	1
238	70	Л.2.TIF	DRAWINGS\Cable Galleries\Cable Gallery 01\1079-14-114а\Л.2.TIF	1
239	71	Л.3.TIF	DRAWINGS\Cable Galleries\Cable Gallery 01\1079-14-114а\Л.3.TIF	1
240	72	1079-03-404_001.TIF	DRAWINGS\Cable Galleries\Cable Gallery 01\геология\1079-03-404_001.TIF	1
241	73	1079-03-404_002.TIF	DRAWINGS\Cable Galleries\Cable Gallery 01\геология\1079-03-404_002.TIF	1
242	74	297448.TIF	DRAWINGS\Cable Galleries\Cable Gallery 02\297448.TIF	1
243	75	1079-14-125A_003 Изм.1.	DRAWINGS\Cable Galleries\Cable Gallery 02\1079-14-125 A\1079-14-125A_003 Изм.1.TIF	1
244	76	20100216-094715.TIF	DRAWINGS\Cable Galleries\Cable Gallery 02\1079-14-125 A\20100216-094715.TIF	1
245	77	20100216-094804.TIF	DRAWINGS\Cable Galleries\Cable Gallery 02\1079-14-125 A\20100216-094804.TIF	1
246	78	20100216-094919.TIF	DRAWINGS\Cable Galleries\Cable Gallery 02\1079-14-125 A\20100216-094919.TIF	1
247	79	1079-03-293_001.TIF	DRAWINGS\Cable Galleries\Cable Gallery 02\геология\1079-03-293_001.TIF	1
248	80	1079-03-293_002.TIF	DRAWINGS\Cable Galleries\Cable Gallery 02\геология\1079-03-293_002.TIF	1
249	81	1079-03-293_003.TIF	DRAWINGS\Cable Galleries\Cable Gallery 02\геология\1079-03-293_003.TIF	1
250	82	1079-03-293_004.TIF	DRAWINGS\Cable Galleries\Cable Gallery 02\геология\1079-03-293_004.TIF	1
251	100	20100316-155411.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\20100316	2
252	101	20100316-155436.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\20100316	2
253	102	20100316-161828.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\20100316	2
254	103	20100317-084845.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\20100317	2
255	104	20100403-145011.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\20100403	2
256	105	20100403-145128.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\20100403	2
257	106	20100403-145223.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\20100403	2

258	107	Л.1.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\Л.1.TIF	2
259	108	Л.2.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\Л.2.TIF	2
260	109	Л.3.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-114 A\Л.3.TIF	2
261	110	1079-14-125A_003 Изм.1.	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-125 A\1079-14	2
262	111	20100216-094715.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-125 A\20100216	2
263	112	20100216-094804.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-125 A\20100216	2
264	113	20100216-094919.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\жб обделка\1079-14-125 A\20100216	2
265	114	561ТП-4-2-11678.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\кабельный туннель №1\Временная к	2
266	115	561Ц-НПО-4-297446.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\кабельный туннель	2
267	116	561Ц-НПО-4-297448.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\кабельный туннель	2
268	117	561ТП-4-2-115144.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\кабельный туннель №2\временная	2
269	118	561Ц-НПО-4-297539.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\кабельный туннель	2
270	119	1861-22-94-1.TIF	DRAWINGS 02\Cable Galleries - Кабельные туннели\Объединенная кабельный туннель\1861	2
271	66	CABLE GALLERY 2.pdf	DRAWINGS 04\Cable Galleries - Кабельные туннели\CABLE GALLERY 2.pdf	4
272	67	JOINT K1-K2.pdf	DRAWINGS 04\Cable Galleries - Кабельные туннели\JOINT K1-K2.pdf	4
273	68	561Ц-НПО-4-297539.TIF	DRAWINGS 04\Cable Galleries - Кабельные туннели\Cable Gallery n°2\цементация\561Ц-	4
274	69	1861-22-94-1.TIF	DRAWINGS 04\Cable Galleries - Кабельные туннели\Joint K1-K2\Объединенная кабельный	4

Calculs **Total available files per this item** 3

n°	ID	File Name	Path	Group
275	5	Calculation of the	DRAWINGS 03\Calculs - Расчеты\Calculation of the permanent lining of conducting wires tunnel	3
276	6	calculation of the	DRAWINGS 03\Calculs - Расчеты\calculation of the permanent lining of the aspiration tunnel 4.6	3
277	7	Calculation of the	DRAWINGS 03\Calculs - Расчеты\Calculation of the permanent settlement lining of the tunnel	3

Collectors **Total available files per this item** 70

n°	ID	File Name	Path	Group
278	83	1861-14-55_001.pdf	DRAWINGS\Collectors\коллектор 1-3 агр\1861-14-55 коллектор 1-3\1861-14-55_001.pdf	1
279	84	1861-14-55_002.pdf	DRAWINGS\Collectors\коллектор 1-3 агр\1861-14-55 коллектор 1-3\1861-14-55_002.pdf	1
280	85	1861-14-55_003.pdf	DRAWINGS\Collectors\коллектор 1-3 агр\1861-14-55 коллектор 1-3\1861-14-55_003.pdf	1
281	86	1861-14-I-MH1.46_001.pdf	DRAWINGS\Collectors\коллектор 1-3 агр\1861-14-55 коллектор 1-3\1861-14-I-MH1.46_001.pdf	1
282	87	1861-14-I-MH2.46_001.pdf	DRAWINGS\Collectors\коллектор 1-3 агр\1861-14-55 коллектор 1-3\1861-14-I-MH2.46_001.pdf	1
283	88	1861-55-34_001.pdf	DRAWINGS\Collectors\коллектор 1-3 агр\1861-55-34\1861-55-34_001.pdf	1
284	89	1861-55-34_002.pdf	DRAWINGS\Collectors\коллектор 1-3 агр\1861-55-34\1861-55-34_002.pdf	1
285	90	1861-55-34_003.pdf	DRAWINGS\Collectors\коллектор 1-3 агр\1861-55-34\1861-55-34_003.pdf	1
286	91	297501.TIF	DRAWINGS\Collectors\коллектор 4-6 агр\297501.TIF	1
287	92	22.03.11 чертежи 1861-14	DRAWINGS\Collectors\коллектор 4-6 агр\14-49 14-70 14-71\22.03.11 чертежи 1861-14-49 1861	1
288	93	1861-14-46_001.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-46 коллектор 4-6 агр\1861-14-46_001.pdf	1
289	94	1861-14-46_002.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-46 коллектор 4-6 агр\1861-14-46_002.pdf	1
290	95	1861-14-46_003.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-46 коллектор 4-6 агр\1861-14-46_003.pdf	1
291	96	1861-14-I-MH1.46_001.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-46 коллектор 4-6 агр\1861-14-I-MH1.46_001.	1
292	97	1861-14-I-MH2.46_001.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-46 коллектор 4-6 агр\1861-14-I-MH2.46_001.	1
293	98	1861-14-47_001.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_001.pdf	1

294	99	1861-14-47_002.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_002.pdf	1
295	100	1861-14-47_003.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_003.pdf	1
296	101	1861-14-47_004.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_004.pdf	1
297	102	1861-14-47_005.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_005.pdf	1
298	103	1861-14-47_006.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_006.pdf	1
299	104	1861-14-47_007.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_007.pdf	1
300	105	1861-14-47_008.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_008.pdf	1
301	106	1861-14-47_009.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_009.pdf	1
302	107	1861-14-47_010.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_010.pdf	1
303	108	1861-14-47_011.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_011.pdf	1
304	109	1861-14-47_012.pdf	DRAWINGS\Collectors\коллектор 4-6 агр\1861-14-47 коллектор\1861-14-47_012.pdf	1
305	110	1861-55-26_001.tif	DRAWINGS\Collectors\коллектор 4-6 агр\1861-55-26 коллектор 4-6 скальная выломка\1861	1
306	111	1861-55-26_002.tif	DRAWINGS\Collectors\коллектор 4-6 агр\1861-55-26 коллектор 4-6 скальная выломка\1861	1
307	120	20120315082044462.tif	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1079-14	2
308	121	20120315082111014.tif	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1079-14	2
309	122	20120315082302936.tif	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1079-14	2
310	123	20120315082324691.tif	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1079-14	2
311	124	20120315082751402.tif	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1079-14	2
312	125	1861-14-55_001.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1861-14-55\1861	2
313	126	1861-14-55_002.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1861-14-55\1861	2
314	127	1861-14-55_003.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1861-14-55\1861	2
315	128	1861-14-I-MH1.46_001.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1861-14-55\1861	2
316	129	1861-14-I-MH2.46_001.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 1-3 агр\жб армирование\1861-14-55\1861	2
317	130	1861-55-26_001.tif	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\временная крепь\1861-55-26\1861	2
318	131	1861-55-26_002 Изм.1.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\временная крепь\1861-55-26\1861	2
319	132	20100224-143305.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14-66 А,	2
320	133	20100224-143357.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14-66 А,	2
321	134	20100224-143637.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14-66 А,	2
322	135	20100224-143741.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14-66 А,	2
323	136	20100224-143838.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14-66 А,	2
324	137	20090819-111118.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14	2
325	138	20090819-111206.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14	2
326	139	20090819-111325.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14	2
327	140	20090819-112402.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14	2
328	141	20090819-112523.TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1079-14	2
329	142	1861-14-46_001.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-46\1861	2
330	143	1861-14-46_002.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-46\1861	2
331	144	1861-14-46_003.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-46\1861	2
332	145	1861-14-I-MH1.46_001.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-46\1861	2
333	146	1861-14-I-MH2.46_001.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-46\1861	2
334	147	1861-14-47_001.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2

335	148	1861-14-47_002.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
336	149	1861-14-47_003.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
337	150	1861-14-47_004.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
338	151	1861-14-47_005.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
339	152	1861-14-47_006.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
340	153	1861-14-47_007.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
341	154	1861-14-47_008.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
342	155	1861-14-47_009.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
343	156	1861-14-47_010.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
344	157	1861-14-47_011.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
345	158	1861-14-47_012.pdf	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\жб армирование\1861-14-47\1861	2
346	159	561Ц-НПО-4-297219 .TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\цементация\561Ц-НПО-4-297219 .	2
347	160	561Ц-НПО-4-297349 .TIF	DRAWINGS 02\Collectors - Коллекторы\коллектор 4-6 агр\цементация\561Ц-НПО-4-297349 .	2

Concrete **Total available files per this item** **41**

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349	113	081044.TIF	DRAWINGS\Concrete\1\081044.TIF	1
350	114	081117.TIF	DRAWINGS\Concrete\1\081117.TIF	1
351	115	083659.TIF	DRAWINGS\Concrete\10\083659.TIF	1
352	116	083738.TIF	DRAWINGS\Concrete\10\083738.TIF	1
353	117	083823.TIF	DRAWINGS\Concrete\10\083823.TIF	1
354	118	083937.TIF	DRAWINGS\Concrete\11\083937.TIF	1
355	119	084017.TIF	DRAWINGS\Concrete\11\084017.TIF	1
356	120	084115.TIF	DRAWINGS\Concrete\11\084115.TIF	1
357	121	084334.TIF	DRAWINGS\Concrete\12\084334.TIF	1
358	122	084412.TIF	DRAWINGS\Concrete\12\084412.TIF	1
359	123	084503.TIF	DRAWINGS\Concrete\12\084503.TIF	1
360	124	084626.TIF	DRAWINGS\Concrete\13\084626.TIF	1
361	125	084711.TIF	DRAWINGS\Concrete\13\084711.TIF	1
362	126	084759.TIF	DRAWINGS\Concrete\13\084759.TIF	1
363	127	084916.TIF	DRAWINGS\Concrete\14\084916.TIF	1
364	128	084958.TIF	DRAWINGS\Concrete\14\084958.TIF	1
365	129	081215.TIF	DRAWINGS\Concrete\2\081215.TIF	1
366	130	081246.TIF	DRAWINGS\Concrete\2\081246.TIF	1
367	131	081316.TIF	DRAWINGS\Concrete\2\081316.TIF	1
368	132	081531.TIF	DRAWINGS\Concrete\3\081531.TIF	1
369	133	081602.TIF	DRAWINGS\Concrete\3\081602.TIF	1
370	134	081644.TIF	DRAWINGS\Concrete\3\081644.TIF	1
371	135	081832.TIF	DRAWINGS\Concrete\4\081832.TIF	1
372	136	081915.TIF	DRAWINGS\Concrete\4\081915.TIF	1

373	137	081949.TIF	DRAWINGS\Concrete\4\081949.TIF	1
374	138	082237.TIF	DRAWINGS\Concrete\5\082237.TIF	1
375	139	082317.TIF	DRAWINGS\Concrete\5\082317.TIF	1
376	140	082352.TIF	DRAWINGS\Concrete\5\082352.TIF	1
377	141	082453.TIF	DRAWINGS\Concrete\6\082453.TIF	1
378	142	082534.TIF	DRAWINGS\Concrete\6\082534.TIF	1
379	143	082614.TIF	DRAWINGS\Concrete\6\082614.TIF	1
380	144	082930.TIF	DRAWINGS\Concrete\7\082930.TIF	1
381	145	083005.TIF	DRAWINGS\Concrete\7\083005.TIF	1
382	146	083039.TIF	DRAWINGS\Concrete\7\083039.TIF	1
383	147	083152.TIF	DRAWINGS\Concrete\8\083152.TIF	1
384	148	083234.TIF	DRAWINGS\Concrete\8\083234.TIF	1
385	149	083323.TIF	DRAWINGS\Concrete\8\083323.TIF	1
386	150	083435.TIF	DRAWINGS\Concrete\9\083435.TIF	1
387	151	083503.TIF	DRAWINGS\Concrete\9\083503.TIF	1
388	152	083540.TIF	DRAWINGS\Concrete\9\083540.TIF	1

Connections **Total available files per this item** 19

n°	ID	File Name	Path	Group
389	161	561ТП-4-II-115212.TIF	DRAWINGS 02\Connections - Сбойки\сбойка между кабельным туннелям\561ТП-4-II-115212.	2
390	162	561ТП-4-II-115257.TIF	DRAWINGS 02\Connections - Сбойки\сбойка между кабельным туннелям\561ТП-4-II-115257.	2
391	163	561ОТК-4-VII-1815564.TIF	DRAWINGS 02\Connections - Сбойки\сбойка между Т-3 и Т-37\561ОТК-4-VII-1815564.TIF	2
392	164	561ТП-4-VII-116182.TIF	DRAWINGS 02\Connections - Сбойки\сбойка между Т-3 и Т-37\561ТП-4-VII-116182.TIF	2
393	165	561ТП-4-VII-11685.TIF	DRAWINGS 02\Connections - Сбойки\сбойка между Т-3 и Т-37\561ТП-4-VII-11685.TIF	2
394	166	561ТП-4-II-115181.TIF	DRAWINGS 02\Connections - Сбойки\Сбойка №10\561ТП-4-II-115181.TIF	2
395	167	561Ц-НПО-4-297426.TIF	DRAWINGS 02\Connections - Сбойки\Сбойка №10\561Ц-НПО-4-297426.TIF	2
396	168	561ТП-4-II-11632A.TIF	DRAWINGS 02\Connections - Сбойки\Сбойка №5\561ТП-4-II-11632A.TIF	2
397	8	1079-03-335.TIF	DRAWINGS 03\Connections\Сбойка №6\1079-03-335.TIF	3
398	9	561ТП-4-2-115219.TIF	DRAWINGS 03\Connections\Сбойка №6\561ТП-4-2-115219.TIF	3
399	70	Con10.pdf	DRAWINGS 04\Connections\Con10.pdf	4
400	71	Con3.pdf	DRAWINGS 04\Connections\Con3.pdf	4
401	72	Con4.pdf	DRAWINGS 04\Connections\Con4.pdf	4
402	73	K-2-T4.pdf	DRAWINGS 04\Connections\K-2-T4.pdf	4
403	74	Con #3.docx	DRAWINGS 04\Connections\(79) Con #3 (Сбойка №3)\Con #3.docx	4
404	75	Con3.pdf	DRAWINGS 04\Connections\(79) Con #3 (Сбойка №3)\Con3.pdf	4
405	76	K-2-T4.pdf	DRAWINGS 04\Connections\Conn k2-T4\K-2-T4.pdf	4
406	77	561Ц-НПО-4-297426.TIF	DRAWINGS 04\Connections\Сбойка №10\561Ц-НПО-4-297426.TIF	4
407	78	561ТП-4-II-11596.PDF	DRAWINGS 04\Connections\Сбойка №4\561ТП-4-II-11596.PDF	4

Conveyor Tunnels **Total available files per this item** 12

n°	ID	File Name	Path	Group
408	169	561ОТК-4-VII-18267 .TIF	DRAWINGS 02\Conveyor Tunnels - Конвейерные туннели\КЛМ-7а\561ОТК-4-VII-18267 .TIF	2

409	170	561ОТК-4-VI-18269.TIF	DRAWINGS 02\Conveyor Tunnels - Конвейерные туннели\КЛМ-8а\561ОТК-4-VI-18269.TIF	2
410	79	Conveyor 7a.pdf	DRAWINGS 04\Conveyor Tunnels\Conveyor 7a.pdf	4
411	80	Conveyor 8a.pdf	DRAWINGS 04\Conveyor Tunnels\Conveyor 8a.pdf	4
412	81	1861-22-195-1_001.TIF	DRAWINGS 04\Conveyor Tunnels\Конвейерный туннель КЛМ-7а\1861-22-195-1_001.TIF	4
413	82	1861-22-195-1_002.TIF	DRAWINGS 04\Conveyor Tunnels\Конвейерный туннель КЛМ-7а\1861-22-195-1_002.TIF	4
414	83	1861-22-198-1.TIF	DRAWINGS 04\Conveyor Tunnels\Конвейерный туннель КЛМ-7а\1861-22-198-1.TIF	4
415	84	1861-22-200-1.TIF	DRAWINGS 04\Conveyor Tunnels\Конвейерный туннель КЛМ-7а\1861-22-200-1.TIF	4
416	85	561-ОПТР-4-VI-17830.PDF	DRAWINGS 04\Conveyor Tunnels\Конвейерный туннель КЛМ-7а\561-ОПТР-4-VI-17830.PDF	4
417	86	561-ОТК-4-VI-18269.PDF	DRAWINGS 04\Conveyor Tunnels\Конвейерный туннель КЛМ-8а\561-ОТК-4-VI-18269.PDF	4
418	87	561-ОТПР-4-VI-17825.PDF	DRAWINGS 04\Conveyor Tunnels\Конвейерный туннель КЛМ-8а\561-ОТПР-4-VI-17825.PDF	4
419	88	561ТП-4-VI-13057.PDF	DRAWINGS 04\Conveyor Tunnels\Конвейерный туннель КЛМ-8а\561ТП-4-VI-13057.PDF	4

Dam **Total available files per this item** **74**

n°	ID	File Name	Path	Group
420	10	1861-10-14_001.pdf	DRAWINGS 03\Dam - 1060\1861-10-14_001.pdf	3
421	11	1861-10-14_002.pdf	DRAWINGS 03\Dam - 1060\1861-10-14_002.pdf	3
422	12	1861-10-14_003.pdf	DRAWINGS 03\Dam - 1060\1861-10-14_003.pdf	3
423	13	1861-10-14_004.pdf	DRAWINGS 03\Dam - 1060\1861-10-14_004.pdf	3
424	14	1861-10-14_005.pdf	DRAWINGS 03\Dam - 1060\1861-10-14_005.pdf	3
425	15	1861-10-14_006.pdf	DRAWINGS 03\Dam - 1060\1861-10-14_006.pdf	3
426	16	1861-10-14_007.pdf	DRAWINGS 03\Dam - 1060\1861-10-14_007.pdf	3
427	17	20120425102535.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1\20120425102535.PDF	3
428	18	20120425105046.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1003\20120425105046.PDF	3
429	19	20120425103942.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1004a\20120425103942.PDF	3
430	20	20120425103427.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1012\20120425103427.PDF	3
431	21	20120425103212.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1014a\20120425103212.PDF	3
432	22	20120425110039.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1015a\20120425110039.PDF	3
433	23	20120425105217.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1016\20120425105217.PDF	3
434	24	20120425105426.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1016\20120425105426.PDF	3
435	25	20120425110653.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1016b\20120425110653.PDF	3
436	26	20120425105825.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1020\20120425105825.PDF	3
437	27	20120425110828.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1057\20120425110828.PDF	3
438	28	20120425112057.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1057\20120425112057.PDF	3
439	29	20120425113142.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1060\20120425113142.PDF	3
440	30	20120425112722.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1080a\20120425112722.PDF	3
441	31	20120425112846.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1080a\20120425112846.PDF	3
442	32	20120425111040.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1080v\20120425111040.PDF	3
443	33	20120425110247.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1083v\20120425110247.PDF	3
444	34	20120425112304.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1085\20120425112304.PDF	3
445	35	20120425111806.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1085a\20120425111806.PDF	3
446	36	20120425111236.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1087\20120425111236.PDF	3

447	37	20120425111324.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1087\20120425111324.PDF	3
448	38	20120425111400.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1087\20120425111400.PDF	3
449	39	20120425111448.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1087\20120425111448.PDF	3
450	40	20120425111520.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1087\20120425111520.PDF	3
451	41	20120425110458.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1088\20120425110458.PDF	3
452	42	20120425104708.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1089\20120425104708.PDF	3
453	43	20120425111906.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1090\20120425111906.PDF	3
454	44	20120425113012.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1090a\20120425113012.PDF	3
455	45	20120425111641.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1091\20120425111641.PDF	3
456	46	20120425111124.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#1092\20120425111124.PDF	3
457	47	20120425101759.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2\20120425101759.PDF	3
458	48	20120425102026.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2011e\20120425102026.PDF	3
459	49	20120425102121.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2011e\20120425102121.PDF	3
460	50	20120425102210.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2011e\20120425102210.PDF	3
461	51	20120425102322.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2011e\20120425102322.PDF	3
462	52	20120425102405.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2011e\20120425102405.PDF	3
463	53	20120425102749.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2013\20120425102749.PDF	3
464	54	20120425103004.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2013\20120425103004.PDF	3
465	55	20120425103057.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2013\20120425103057.PDF	3
466	56	20120425103515.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2021a\20120425103515.PDF	3
467	57	20120425103603.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2021a\20120425103603.PDF	3
468	58	20120425103646.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2021a\20120425103646.PDF	3
469	59	20120425103731.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2021a\20120425103731.PDF	3
470	60	20120425103818.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#2021a\20120425103818.PDF	3
471	61	20120425104553.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#3\20120425104553.PDF	3
472	62	20120425101700.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#4\20120425101700.PDF	3
473	63	20120425101430.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#5\20120425101430.PDF	3
474	64	20120425101609.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#5\20120425101609.PDF	3
475	65	20120425104430.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#6\20120425104430.PDF	3
476	66	20120425104057.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#7\20120425104057.PDF	3
477	67	20120425104220.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#8\20120425104220.PDF	3
478	68	20120425104321.PDF	DRAWINGS 03\Dam - 1060\Materials ДП КИЭ№-3\Скважины\#9\20120425104321.PDF	3
479	69	20100623-102405.TIF	DRAWINGS 03\Dam - Плотина\1861-27-2 (1K)\20100623-102405.TIF	3
480	70	20100623-102510.TIF	DRAWINGS 03\Dam - Плотина\1861-27-2 (1K)\20100623-102510.TIF	3
481	71	20100623-102636.TIF	DRAWINGS 03\Dam - Плотина\1861-27-2 (1K)\20100623-102636.TIF	3
482	72	20100623-102751.TIF	DRAWINGS 03\Dam - Плотина\1861-27-2 (1K)\20100623-102751.TIF	3
483	73	20100623-102926.TIF	DRAWINGS 03\Dam - Плотина\1861-27-2 (1K)\20100623-102926.TIF	3
484	74	20100623-103148.TIF	DRAWINGS 03\Dam - Плотина\1861-27-2 (1K)\20100623-103148.TIF	3
485	75	20100623-103245.TIF	DRAWINGS 03\Dam - Плотина\1861-27-2 (1K)\20100623-103245.TIF	3
486	76	1861-27-6.tif	DRAWINGS 03\Dam - Плотина\1861-27-6\1861-27-6.tif	3
487	77	Альбом_1861-27	DRAWINGS 03\Dam - Плотина\1861-27-6\Альбом_1861-27-6_Страница_1.tif	3

488	78	Альбом_1861-27	DRAWINGS 03\Dam - Плотина\1861-27-6\Альбом_1861-27-6_Страница_3.tif	3
489	79	Альбом_1861-27	DRAWINGS 03\Dam - Плотина\1861-27-6\Альбом_1861-27-6_Страница_4.tif	3
490	80	Альбом_1861-27	DRAWINGS 03\Dam - Плотина\1861-27-6\Альбом_1861-27-6_Страница_5.tif	3
491	81	Альбом_1861-27	DRAWINGS 03\Dam - Плотина\1861-27-6\Альбом_1861-27-6_Страница_6.tif	3
492	82	Альбом_1861-27	DRAWINGS 03\Dam - Плотина\1861-27-6\Альбом_1861-27-6_Страница_7.tif	3
493	83	Альбом_1861-27	DRAWINGS 03\Dam - Плотина\1861-27-6\Альбом_1861-27-6_Страница_8.tif	3

Departement of acceptance **Total available files per this item** 2

n°	ID	File Name	Path	Group
494	84	BOQ.xlsx	DRAWINGS 03\Departement of acceptance - Отдел приемка\BOQ.xlsx	3
495	85	автодорог.xls	DRAWINGS 03\Departement of acceptance - Отдел приемка\автодорог.xls	3

Draft tube **Total available files per this item** 136

n°	ID	File Name	Path	Group
496	153	1861-55-38_002.tif	DRAWINGS\Draft tube\1861-55-38_002.tif	1
497	154	1861-55-38_001.pdf	DRAWINGS\Draft tube\1861-55-38\1861-55-38_001.pdf	1
498	155	1861-55-38_002.pdf	DRAWINGS\Draft tube\1861-55-38\1861-55-38_002.pdf	1
499	156	1861-55-38_003.pdf	DRAWINGS\Draft tube\1861-55-38\1861-55-38_003.pdf	1
500	157	1861-55-38_004.pdf	DRAWINGS\Draft tube\1861-55-38\1861-55-38_004.pdf	1
501	158	1861-55-38_005.pdf	DRAWINGS\Draft tube\1861-55-38\1861-55-38_005.pdf	1
502	159	1861-55-38_006.pdf	DRAWINGS\Draft tube\1861-55-38\1861-55-38_006.pdf	1
503	86	1861-14-111_001.pdf	DRAWINGS 03\Draft tube\1861-14-111\1861-14-111_001.pdf	3
504	87	1861-14-111_002.pdf	DRAWINGS 03\Draft tube\1861-14-111\1861-14-111_002.pdf	3
505	88	1861-14-111_003.pdf	DRAWINGS 03\Draft tube\1861-14-111\1861-14-111_003.pdf	3
506	89	1861-14-94_001.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_001.pdf	3
507	90	1861-14-94_002.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_002.pdf	3
508	91	1861-14-94_003.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_003.pdf	3
509	92	1861-14-94_004.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_004.pdf	3
510	93	1861-14-94_005.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_005.pdf	3
511	94	1861-14-94_006.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_006.pdf	3
512	95	1861-14-94_007.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_007.pdf	3
513	96	1861-14-94_008.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_008.pdf	3
514	97	1861-14-94_009.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_009.pdf	3
515	98	1861-14-94_010.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_010.pdf	3
516	99	1861-14-94_011.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_011.pdf	3
517	100	1861-14-94_012.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_012.pdf	3
518	101	1861-14-94_013.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_013.pdf	3
519	102	1861-14-94_014.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_014.pdf	3
520	103	1861-14-94_015.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_015.pdf	3
521	104	1861-14-94_016.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_016.pdf	3
522	105	1861-14-94_017.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_017.pdf	3
523	106	1861-14-94_018.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_018.pdf	3

524	107	1861-14-94_019.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_019.pdf	3
525	108	1861-14-94_020.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_020.pdf	3
526	109	1861-14-94_021.pdf	DRAWINGS 03\Draft tube\1861-14-94\1861-14-94_021.pdf	3
527	110	1861-14-95_001.pdf	DRAWINGS 03\Draft tube\1861-14-95\1861-14-95_001.pdf	3
528	111	1861-14-95_002.pdf	DRAWINGS 03\Draft tube\1861-14-95\1861-14-95_002.pdf	3
529	112	1861-14-95_003.pdf	DRAWINGS 03\Draft tube\1861-14-95\1861-14-95_003.pdf	3
530	113	1861-14-95_004.pdf	DRAWINGS 03\Draft tube\1861-14-95\1861-14-95_004.pdf	3
531	114	1861-14-95_005.pdf	DRAWINGS 03\Draft tube\1861-14-95\1861-14-95_005.pdf	3
532	115	1861-14-95_006.pdf	DRAWINGS 03\Draft tube\1861-14-95\1861-14-95_006.pdf	3
533	116	1861-14-95_007.pdf	DRAWINGS 03\Draft tube\1861-14-95\1861-14-95_007.pdf	3
534	117	1861-14-95_008.pdf	DRAWINGS 03\Draft tube\1861-14-95\1861-14-95_008.pdf	3
535	118	1861-14-96_001.pdf	DRAWINGS 03\Draft tube\1861-14-96\1861-14-96_001.pdf	3
536	119	1861-14-96_002.pdf	DRAWINGS 03\Draft tube\1861-14-96\1861-14-96_002.pdf	3
537	120	1861-14-98_001.pdf	DRAWINGS 03\Draft tube\1861-14-98\1861-14-98_001.pdf	3
538	121	1861-14-98_002.pdf	DRAWINGS 03\Draft tube\1861-14-98\1861-14-98_002.pdf	3
539	122	1861-14-98_003.pdf	DRAWINGS 03\Draft tube\1861-14-98\1861-14-98_003.pdf	3
540	123	1861-14-99_001 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_001 .pdf	3
541	124	1861-14-99_002 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_002 .pdf	3
542	125	1861-14-99_003 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_003 .pdf	3
543	126	1861-14-99_004 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_004 .pdf	3
544	127	1861-14-99_005 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_005 .pdf	3
545	128	1861-14-99_006 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_006 .pdf	3
546	129	1861-14-99_007 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_007 .pdf	3
547	130	1861-14-99_008 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_008 .pdf	3
548	131	1861-14-99_009 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_009 .pdf	3
549	132	1861-14-99_010 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_010 .pdf	3
550	133	1861-14-99_011 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_011 .pdf	3
551	134	1861-14-99_012 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_012 .pdf	3
552	135	1861-14-99_013 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_013 .pdf	3
553	136	1861-14-99_014 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_014 .pdf	3
554	137	1861-14-99_015 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_015 .pdf	3
555	138	1861-14-99_016 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_016 .pdf	3
556	139	1861-14-99_017 .pdf	DRAWINGS 03\Draft tube\1861-14-99\1861-14-99_017 .pdf	3
557	140	1861-20-73-00 ВС_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
558	141	1861-20-73-00 ДВМ_001.	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
559	142	1861-20-73-00 ДОД_001.	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
560	143	1861-20-73-00 ДОД_002.	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
561	144	1861-20-73-00 СБ_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
562	145	1861-20-73-00 СБ_002.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
563	146	1861-20-73-00_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
564	147	1861-20-73-10 СБ_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3

565	148	1861-20-73-10.01_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
566	149	1861-20-73-10.02_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
567	150	1861-20-73-10.03_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
568	151	1861-20-73-10.04_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
569	152	1861-20-73-10.05_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
570	153	1861-20-73-10.06_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
571	154	1861-20-73-10_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
572	155	1861-20-73-11 СБ_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
573	156	1861-20-73-11_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
574	157	1861-20-73-20 СБ_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
575	158	1861-20-73-20.01_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
576	159	1861-20-73-20.02_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
577	160	1861-20-73-20_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
578	161	1861-20-73-30 СБ_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
579	162	1861-20-73-30.01_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
580	163	1861-20-73-30_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
581	164	1861-20-73-40 СБ_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
582	165	1861-20-73-40 СБ_002.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
583	166	1861-20-73-40.01_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
584	167	1861-20-73-40.02_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
585	168	1861-20-73-40.03_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
586	169	1861-20-73-40.04_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
587	170	1861-20-73-40.05_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
588	171	1861-20-73-40_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
589	172	1861-20-73-50 СБ_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
590	173	1861-20-73-50 СБ_002.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
591	174	1861-20-73-50.01_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
592	175	1861-20-73-50.02_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
593	176	1861-20-73-50.03_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
594	177	1861-20-73-50.04_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
595	178	1861-20-73-50_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
596	179	1861-20-73-60 СБ_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
597	180	1861-20-73-60 СБ_002.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
598	181	1861-20-73-60.01.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
599	182	1861-20-73-60.02.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
600	183	1861-20-73-60.03.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
601	184	1861-20-73-60.04.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
602	185	1861-20-73-60_001.pdf	DRAWINGS 03\Draft tube\Стальная облицовка сливного коллектора\1861-20-73-00\1861-20	3
603	89	Draft Tube.pdf	DRAWINGS 04\Draft tube\Draft Tube.pdf	4
604	90	1861-14-94_001.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_001.pdf	4
605	91	1861-14-94_002.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_002.pdf	4

606	92	1861-14-94_003.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_003.pdf	4
607	93	1861-14-94_004.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_004.pdf	4
608	94	1861-14-94_005.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_005.pdf	4
609	95	1861-14-94_006.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_006.pdf	4
610	96	1861-14-94_007.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_007.pdf	4
611	97	1861-14-94_008.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_008.pdf	4
612	98	1861-14-94_009.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_009.pdf	4
613	99	1861-14-94_010.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_010.pdf	4
614	100	1861-14-94_011.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_011.pdf	4
615	101	1861-14-94_012.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_012.pdf	4
616	102	1861-14-94_013.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_013.pdf	4
617	103	1861-14-94_014.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_014.pdf	4
618	104	1861-14-94_015.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_015.pdf	4
619	105	1861-14-94_016.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_016.pdf	4
620	106	1861-14-94_017.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_017.pdf	4
621	107	1861-14-94_018.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_018.pdf	4
622	108	1861-14-94_019.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_019.pdf	4
623	109	1861-14-94_020.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_020.pdf	4
624	110	1861-14-94_021.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_021.pdf	4
625	111	1861-14-94_022.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_022.pdf	4
626	112	1861-14-94_023.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_023.pdf	4
627	113	1861-14-94_024.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_024.pdf	4
628	114	1861-14-94_025.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_025.pdf	4
629	115	1861-14-94_026.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_026.pdf	4
630	116	1861-14-94_027.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_027.pdf	4
631	117	1861-14-94_028.pdf	DRAWINGS 04\Draft tube\1861-14-94\1861-14-94_028.pdf	4

Drainage and Grouting galleries 1,2,3,4 **Total available files per this item** 29

n°	ID	File Name	Path	Group
632	160	1079-22-70 ОРП.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 1,2\1079-22-70 ОРП.TIF	1
633	161	1861-22-107-1_001.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 1,2\1861-22-107-1_001.TIF	1
634	162	1861-22-107-1_002.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 1,2\1861-22-107-1_002.TIF	1
635	163	561ТП-4-I-112241.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 1,2\561ТП-4-I-112241.TIF	1
636	164	1861-22-50-1.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 3,4\1861-22-50-1.TIF	1
637	165	1861-22-74-1_001.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 3,4\ДРЕНАЖНАЯ	1
638	166	1861-22-74-1_002.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 3,4\ДРЕНАЖНАЯ	1
639	167	1861-22-69-1_001.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 3,4\ЦЕМЕНТАЦИОННАЯ	1
640	168	1861-22-69-1_002.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 3,4\ЦЕМЕНТАЦИОННАЯ	1
641	169	1861-22-133-1_001.TIF	DRAWINGS\Drainage and Grouting galleries 1,2,3,4\Drainage Gallery 3,4\ЦЕМЕНТАЦИЯ\1861-22	1
642	171	1861-22-63-1_001.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\дренаж\1861-22-63	2
643	172	1861-22-63-1_002.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\дренаж\1861-22-63	2

644	173	1861-22-63-1_003.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\дренаж\1861-22-63	2
645	174	1079-22-70 орп.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\жб обделка\1079-22-70	2
646	175	112301.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\первичная	2
647	176	561ТП-4-I-112241.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\первичная крепь\561ТП	2
648	177	561Ц-НПО-4-297361 .TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\цементация\561Ц-НПО	2
649	178	1861-22-107-1_001.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\цементация\1861-22	2
650	179	1861-22-107-1_002.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-1,2\цементация\1861-22	2
651	180	1861-22-74-1_001.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-3,4\дренаж\1861-22	2
652	181	1861-22-74-1_002.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-3,4\дренаж\1861-22	2
653	182	1861-22-50-1.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-3,4\жб обделка\1861-22-50	2
654	183	1861-22-133-1_001.TIF	DRAWINGS 02\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\ДЦШ-3,4\цементация\1861-22	2
655	118	1079-22-70 орп.TIF	DRAWINGS 04\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\1079-22-70 орп.TIF	4
656	119	DG1.pdf	DRAWINGS 04\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\DG1.pdf	4
657	120	1079-22-70 орп.TIF	DRAWINGS 04\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\Access to DG1\1079-22-70 орп.TIF	4
658	121	561ТП-4-I-11221.TIF	DRAWINGS 04\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\Access to DG1\561ТП-4-I-11221.TIF	4
659	122	561ТП-4-I-112369.TIF	DRAWINGS 04\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\Access to DG1\561ТП-4-I-112369.	4
660	123	dg-1=p4.pdf	DRAWINGS 04\Drainage and Grouting galleries 1,2,3,4 - ДЦШ\Access to DG1\dg-1=p4.pdf	4

Drainage Gallery Powerhouse **Total available files per this item** 5

n°	ID	File Name	Path	Group
661	170	1079-14-125_001.TIF	DRAWINGS\Drainage Gallery Powerhouse\1079-14-125_001.TIF	1
662	171	1079-14-125_002.TIF	DRAWINGS\Drainage Gallery Powerhouse\1079-14-125_002.TIF	1
663	172	1079-14-125_003.TIF	DRAWINGS\Drainage Gallery Powerhouse\1079-14-125_003.TIF	1
664	173	1079-14-125_004.TIF	DRAWINGS\Drainage Gallery Powerhouse\1079-14-125_004.TIF	1
665	174	1079-14-125_005.TIF	DRAWINGS\Drainage Gallery Powerhouse\1079-14-125_005.TIF	1

Drainage Tunnels Powerhouse **Total available files per this item** 9

n°	ID	File Name	Path	Group
666	184	1079-14-65 ОРП л.1.TIF	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1079-14-65	2
667	185	1079-14-65 ОРП л.2.TIF	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1079-14-65	2
668	186	1079-14-65 ОРП л.3.TIF	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1079-14-65	2
669	187	1079-14-65 ОРП л.4.TIF	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1079-14-65	2
670	188	1079-14-65 ОРП л.5.TIF	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1079-14-65	2
671	189	1.tif	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1101-55-13\1.	2
672	190	2.tif	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1101-55-13\2.	2
673	191	3.tif	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1101-55-13\3.	2
674	192	4.tif	DRAWINGS 02\Drainage Tunnels Powerhouse - Дренажные туннели (постояные)\1101-55-13\4.	2

GG-3 **Total available files per this item** 4

n°	ID	File Name	Path	Group
675	175	561ТП-4-8-13701.PDF	DRAWINGS\GG-3\561ТП-4-8-13701.PDF	1
676	176	561ТП-4-8-13725a.PDF	DRAWINGS\GG-3\561ТП-4-8-13725a.PDF	1

677	177	561тп-4-8-13729.PDF	DRAWINGS\GG-3\561тп-4-8-13729.PDF	1
678	178	561ТП-4-8-13730.PDF	DRAWINGS\GG-3\561ТП-4-8-13730.PDF	1

Grouting galleries **Total available files per this item** 25

n°	ID	File Name	Path	Group
679	193	561Ц-НПО-4-297406.TIF	DRAWINGS 02\Grouting galleries - Противофильтрационные мероприятия\Солевая штольня и	2
680	194	561Ц-НПО-4-297424.TIF	DRAWINGS 02\Grouting galleries - Противофильтрационные мероприятия\Солевая штольня и	2
681	195	561ТП-4-VIII-13727.PDF	DRAWINGS 02\Grouting galleries - Противофильтрационные мероприятия\ЦШ\ЦШ	2
682	196	561ТП-4-VIII-13729 .TIF	DRAWINGS 02\Grouting galleries - Противофильтрационные мероприятия\ЦШ\ЦШ	2
683	197	561Ц-НПО-4-297436.TIF	DRAWINGS 02\Grouting galleries - Противофильтрационные мероприятия\ЦШ\ЦШ	2
684	198	561Ц-НПО-4-297430.TIF	DRAWINGS 02\Grouting galleries - Противофильтрационные мероприятия\ЦШ\ЦШ	2
685	199	561Ц-НПО-4-297436.TIF	DRAWINGS 02\Grouting galleries - Противофильтрационные мероприятия\ЦШ\ЦШ	2
686	124	561ТП-4-III-13379 a.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\561ТП-4-III-13379 a.	4
687	125	561ТП-4-VII-13732.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\561ТП-4-VII-13732.	4
688	126	561ТП-4-VIII-13727.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\561ТП-4-VIII-13727.	4
689	127	561ТП-4-VIII-13729.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\561ТП-4-VIII-13729.	4
690	128	561ТП-4-VIII-13733.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\561ТП-4-VIII-13733.	4
691	129	561ТП-4-VIII-13757 A.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\561ТП-4-VIII-13757	4
692	130	561Ц-НПО-4-297430.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\561Ц-НПО-4-297430.	4
693	131	561Ц-НПО-4-297436.TIF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\561Ц-НПО-4-297436.	4
694	132	gg1-gg2-gg3.pdf	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\gg1-gg2-gg3.pdf	4
695	133	561ТП-4-VII-13732.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(86) GG1	4
696	134	561ТП-4-VIII-13727.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(86) GG1	4
697	135	561Ц-НПО-4-297436.TIF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(86) GG1	4
698	136	561ТП-4-III-13379 a.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(87) GG2	4
699	137	561ТП-4-VIII-13757 A.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(87) GG2	4
700	138	561Ц-НПО-4-297430.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(87) GG2	4
701	139	561ТП-4-VIII-13729.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(88) GG3	4
702	140	561ТП-4-VIII-13733.PDF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(88) GG3	4
703	141	561Ц-НПО-4-297436.TIF	DRAWINGS 04\Grouting galleries - Противофильтрационные мероприятия\(88) GG3	4

Impervious material **Total available files per this item** 7

n°	ID	File Name	Path	Group
704	186	561Ц-НПО-4-297406.TIF	DRAWINGS 03\Impervious material - Противофильтрационные мероприятия\Salt tunnel and	3
705	187	561Ц-НПО-4-297424.TIF	DRAWINGS 03\Impervious material - Противофильтрационные мероприятия\Salt tunnel and	3
706	188	561Ц-НПО-4-297436.TIF	DRAWINGS 03\Impervious material - Противофильтрационные мероприятия\ЦШ\ЦШ	3
707	189	561ТП-4-VIII-13727.PDF	DRAWINGS 03\Impervious material - Противофильтрационные мероприятия\ЦШ\ЦШ-1\Lining -	3
708	190	561ТП-4-VIII-13729 .TIF	DRAWINGS 03\Impervious material - Противофильтрационные мероприятия\ЦШ\ЦШ-1\Lining -	3
709	191	561Ц-НПО-4-297430.TIF	DRAWINGS 03\Impervious material - Противофильтрационные мероприятия\ЦШ\ЦШ-2\561Ц-	3
710	192	561Ц-НПО-4-297436.TIF	DRAWINGS 03\Impervious material - Противофильтрационные мероприятия\ЦШ\ЦШ-3\561Ц-	3

Material supervision **Total available files per this item** 168

n°	ID	File Name	Path	Group
711	193	Изображение 001.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
712	194	Изображение 002.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
713	195	Изображение 003.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
714	196	Изображение 004.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
715	197	Изображение 005.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
716	198	Изображение 006.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
717	199	Изображение 007.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
718	200	Изображение 008.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
719	201	Изображение 009.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
720	202	Изображение 010.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
721	203	Изображение 011.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
722	204	Изображение 012.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
723	205	Изображение 013.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
724	206	Изображение.tif	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
725	207	сканирование0001.pdf	DRAWINGS 03\Material supervision - материалы технадзор\Executive	3
726	208	Table of granular material	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\Table of granular material (eng).	3
727	209	Table of granular material	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\Table of granular material (rus).	3
728	210	1.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №2 скан.	3
729	211	2.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №2 скан.	3
730	212	20120403172818.PDF	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №2 скан.	3
731	213	3.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №2 скан.	3
732	214	4.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №2 скан.	3
733	215	5.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №2 скан.	3
734	216	6.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №2 скан.	3
735	217	1079-03-204_003.TIF	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №2 скан.	3
736	218	1.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\1.jpg	3
737	219	2.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\2.jpg	3
738	220	3.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\3.jpg	3
739	221	4.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\4.jpg	3
740	222	5.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\5.jpg	3
741	223	6.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\6.jpg	3
742	224	7.JPG	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\7.JPG	3
743	225	8.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\8.jpg	3
744	226	9.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K№26\9.jpg	3
745	227	1079-03-200_002.TIF	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K	3
746	228	1079-03-201 ДП_001.TIF	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K	3
747	229	1079-03-201 ДП_002.TIF	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №3 скан.K	3
748	230	1.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\1.jpg	3

749	231	10.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\10.jpg	3
750	232	11.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\11.jpg	3
751	233	110.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\110.jpg	3
752	234	111.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\111.jpg	3
753	235	112.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\112.jpg	3
754	236	113.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\113.jpg	3
755	237	114.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\114.jpg	3
756	238	115.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\115.jpg	3
757	239	116.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\116.jpg	3
758	240	117.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\117.jpg	3
759	241	118.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\118.jpg	3
760	242	119.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\119.jpg	3
761	243	12.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\12.jpg	3
762	244	120.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\120.jpg	3
763	245	121.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\121.jpg	3
764	246	122.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\122.jpg	3
765	247	123.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\123.jpg	3
766	248	124.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\124.jpg	3
767	249	125.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\125.jpg	3
768	250	126.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\126.jpg	3
769	251	127.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\127.jpg	3
770	252	128.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\128.jpg	3
771	253	129.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\129.jpg	3
772	254	13.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\13.jpg	3
773	255	130.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\130.jpg	3
774	256	131.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\131.jpg	3
775	257	132.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\132.jpg	3
776	258	133.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\133.jpg	3
777	259	134.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\134.jpg	3
778	260	135.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\135.jpg	3
779	261	136.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\136.jpg	3
780	262	137.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\137.jpg	3
781	263	138.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\138.jpg	3
782	264	139.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\139.jpg	3
783	265	14.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\14.jpg	3
784	266	140.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\140.jpg	3
785	267	141.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\141.jpg	3
786	268	142.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\142.jpg	3
787	269	143.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\143.jpg	3
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789	271	145.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\145.jpg	3

790	272	146.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\146.jpg	3
791	273	147.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\147.jpg	3
792	274	148.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\148.jpg	3
793	275	149.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\149.jpg	3
794	276	15.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\15.jpg	3
795	277	150.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\150.jpg	3
796	278	151.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\151.jpg	3
797	279	152.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\152.jpg	3
798	280	153.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\153.jpg	3
799	281	154.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\154.jpg	3
800	282	16.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\16.jpg	3
801	283	17.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\17.jpg	3
802	284	18.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\18.jpg	3
803	285	19.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\19.jpg	3
804	286	2.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\2.jpg	3
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807	289	21.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\21.jpg	3
808	290	22.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\22.jpg	3
809	291	23.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\23.jpg	3
810	292	24.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\24.jpg	3
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813	295	27.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\27.jpg	3
814	296	28.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\28.jpg	3
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817	299	30.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\30.jpg	3
818	300	31.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\31.jpg	3
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820	302	33.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\33.jpg	3
821	303	34.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\34.jpg	3
822	304	35.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\35.jpg	3
823	305	36.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\36.jpg	3
824	306	37.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\37.jpg	3
825	307	38.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\38.jpg	3
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827	309	4.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\4.jpg	3
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833	315	45.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\45.jpg	3
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835	317	47.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\47.jpg	3
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837	319	49.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\49.jpg	3
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840	322	51.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\51.jpg	3
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847	329	8.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\8.jpg	3
848	330	9.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА №4 скан. №17\9.jpg	3
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852	334	ТУ 002.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
853	335	ТУ 003.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
854	336	ТУ 004.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
855	337	ТУ 005.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
856	338	ТУ 006.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
857	339	ТУ 007.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
858	340	ТУ 008.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
859	341	ТУ 009.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
860	342	ТУ 010.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
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863	345	ТУ 013.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
864	346	ТУ 014.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
865	347	ТУ 015.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
866	348	ТУ 016.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
867	349	ТУ 017.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
868	350	ТУ 018.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
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871	353	ТУ 021.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3

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873	355	ТУ 023.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
874	356	ТУ 024.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
875	357	ТУ 025.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
876	358	ТУ.jpg	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .№15\1079-10	3
877	359	1079-03-202дл-01.TIF	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .	3
878	360	1079-03-202дп-04.TIF	DRAWINGS 03\Material supervision - материалы технадзор\ВБ\ПАПКА№1 скан. .	3

Mud slide protection structure on Obi Shur **Total available files per this item** **58**

n°	ID	File Name	Path	Group
879	361	1861-13-01-I_001.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
880	362	1861-13-01-I_002.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
881	363	1861-13-01-I_003.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
882	364	1861-13-01-I_004.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
883	365	1861-13-01-I_005.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
884	366	1861-13-01-I_006.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
885	367	1861-13-01-I_007.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
886	368	1861-13-09_001.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
887	369	1861-13-09_002.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
888	370	1861-13-09_003.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
889	371	1861-13-09_004.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
890	372	1861-13-09_005.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
891	373	1861-13-09_006.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
892	374	1861-13-09_007.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
893	375	1861-13-09_008.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
894	376	1861-13-09_009.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
895	377	1861-13-09_010.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
896	378	1861-13-09_011.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
897	379	1861-13-09_012.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
898	380	1861-13-09_013.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
899	381	1861-13-09_014.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
900	382	1861-13-09_015.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
901	383	1861-13-09_016.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
902	384	1861-13-10_001.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
903	385	1861-13-10_002.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
904	386	1861-13-10_003.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
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906	388	1861-13-10_005.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
907	389	1861-13-10_006.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
908	390	1861-13-10_007.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
909	391	1861-13-10_008.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3

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911	393	1861-13-10_010.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
912	394	1861-13-10_011.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
913	395	1861-13-10_012.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
914	396	1861-13-10_013.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
915	397	1861-13-10_014.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
916	398	1861-13-10_015.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
917	399	1861-13-10_016.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
918	400	1861-13-10_017.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
919	401	1861-13-11_001.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
920	402	1861-13-11_002.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
921	403	1861-13-11_003.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
922	404	1861-13-11_004.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
923	405	1861-13-11_005.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
924	406	1861-13-11_006.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
925	407	1861-13-11_007.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
926	408	1861-13-12_001.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
927	409	1861-13-12_002.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
928	410	1861-13-12_003.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
929	411	1861-13-12_004.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
930	412	1861-13-12_005.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
931	413	1861-13-12_006.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
932	414	1861-13-12_007.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
933	415	1861-13-12_008.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
934	416	1861-13-12_009.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
935	417	1861-13-12_010.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3
936	418	1861-13-12_011.pdf	DRAWINGS 03\Mud slide protection structure on Obi Shur - Селезащитное сооружение на сае	3

Pedestrian Tunnels **Total available files per this item** 15

n°	ID	File Name	Path	Group
937	200	561тп-4-2-115164.PDF	DRAWINGS 02\Pedestrian Tunnels - Пешеходные туннели\временная крепь\561тп-4-2-115164.	2
938	201	20120319131419.PDF	DRAWINGS 02\Pedestrian Tunnels - Пешеходные туннели\жб обделка\20120319131419.PDF	2
939	202	20120319131516.PDF	DRAWINGS 02\Pedestrian Tunnels - Пешеходные туннели\жб обделка\20120319131516.PDF	2
940	419	561тп-4-2-115164.PDF	DRAWINGS 03\Pedestrian tunnels\временная крепь\561тп-4-2-115164.PDF	3
941	420	20120319131419.PDF	DRAWINGS 03\Pedestrian tunnels\жб обделка\20120319131419.PDF	3
942	421	20120319131516.PDF	DRAWINGS 03\Pedestrian tunnels\жб обделка\20120319131516.PDF	3
943	142	1079-14-95_001.PDF	DRAWINGS 04\Pedestrian tunnels\1079-14-95_001.PDF	4
944	143	1079-14-95_002.PDF	DRAWINGS 04\Pedestrian tunnels\1079-14-95_002.PDF	4
945	144	1861-22-186-1.PDF	DRAWINGS 04\Pedestrian tunnels\1861-22-186-1.PDF	4
946	145	561тп-4-2-115164.PDF	DRAWINGS 04\Pedestrian tunnels\561тп-4-2-115164.PDF	4
947	146	PEDESTRIAN.pdf	DRAWINGS 04\Pedestrian tunnels\PEDESTRIAN.pdf	4

948	147	561тп-4-2-115164.PDF	DRAWINGS 04\Pedestrian tunnels\временная крель\561тп-4-2-115164.PDF	4
949	148	1079-14-95_001.PDF	DRAWINGS 04\Pedestrian tunnels\жб обделка\1079-14-95_001.PDF	4
950	149	1079-14-95_002.PDF	DRAWINGS 04\Pedestrian tunnels\жб обделка\1079-14-95_002.PDF	4
951	150	1861-22-186-1.PDF	DRAWINGS 04\Pedestrian tunnels\цементация\1861-22-186-1.PDF	4

Power House **Total available files per this item** 29

n°	ID	File Name	Path	Group
952	179	1079-03-292_001.TIF	DRAWINGS\Power House\1079-03-292_001.TIF	1
953	180	1079-03-401_001.TIF	DRAWINGS\Power House\1079-03-401_001.TIF	1
954	181	1079-03-401_002.TIF	DRAWINGS\Power House\1079-03-401_002.TIF	1
955	182	20100610-160321.TIF	DRAWINGS\Power House\1079-14-82 a\20100610-160321.TIF	1
956	183	20100610-160433.TIF	DRAWINGS\Power House\1079-14-82 a\20100610-160433.TIF	1
957	184	20100610-160544.TIF	DRAWINGS\Power House\1079-14-82 a\20100610-160544.TIF	1
958	185	20100610-160835.TIF	DRAWINGS\Power House\1079-14-82 a\20100610-160835.TIF	1
959	186	20100610-160939.TIF	DRAWINGS\Power House\1079-14-82 a\20100610-160939.TIF	1
960	187	20100610-161108.TIF	DRAWINGS\Power House\1079-14-82 a\20100610-161108.TIF	1
961	188	1861-14-7-01[1].01.tif	DRAWINGS\Power House\1861-14-7\1861-14-7-01[1].01.tif	1
962	189	1861-14-7-01[1].02.tif	DRAWINGS\Power House\1861-14-7\1861-14-7-01[1].02.tif	1
963	190	1861-14-7-01[1].03.tif	DRAWINGS\Power House\1861-14-7\1861-14-7-01[1].03.tif	1
964	191	1861-14-7-02[1].00.tif	DRAWINGS\Power House\1861-14-7\1861-14-7-02[1].00.tif	1
965	192	1861-14-7_001.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_001.tif	1
966	193	1861-14-7_002.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_002.tif	1
967	194	1861-14-7_003.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_003.tif	1
968	195	1861-14-7_004.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_004.tif	1
969	196	1861-14-7_005.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_005.tif	1
970	197	1861-14-7_006.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_006.tif	1
971	198	1861-14-7_007.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_007.tif	1
972	199	1861-14-7_008.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_008.tif	1
973	200	1861-14-7_009.tif	DRAWINGS\Power House\1861-14-7\1861-14-7_009.tif	1
974	201	1861-55-27_001.pdf	DRAWINGS\Power House\1861-55-27, 1861-55-28\1861-55-27_001.pdf	1
975	202	1861-55-27_002.pdf	DRAWINGS\Power House\1861-55-27, 1861-55-28\1861-55-27_002.pdf	1
976	203	1861-55-27_003.pdf	DRAWINGS\Power House\1861-55-27, 1861-55-28\1861-55-27_003.pdf	1
977	204	1861-55-28_001.pdf	DRAWINGS\Power House\1861-55-27, 1861-55-28\1861-55-28_001.pdf	1
978	205	1861-14-65_001.pdf	DRAWINGS\Power House\киа\1861-14-65_001.pdf	1
979	206	1861-14-65_002.pdf	DRAWINGS\Power House\киа\1861-14-65_002.pdf	1
980	207	1861-14-65_003.pdf	DRAWINGS\Power House\киа\1861-14-65_003.pdf	1

Powerhouse **Total available files per this item** 12

n°	ID	File Name	Path	Group
981	203	1861-14-13-1 .TIF	DRAWINGS 02\Powerhouse - машзал\цементация (grouting)\1861-14-13-1 .TIF	2
982	204	1861-14-14-1 .TIF	DRAWINGS 02\Powerhouse - машзал\цементация (grouting)\1861-14-14-1 .TIF	2
983	205	561Ц-НПО-4-297208.TIF	DRAWINGS 02\Powerhouse - машзал\цементация (grouting)\561Ц-НПО-4-297208.TIF	2

984	422	1861-14-13-1 .TIF	DRAWINGS 03\Powerhouse - машзал\1861-14-13-1 .TIF	3
985	423	1861-14-14-1 .TIF	DRAWINGS 03\Powerhouse - машзал\1861-14-14-1 .TIF	3
986	424	561Ц-НПО-4-297208.TIF	DRAWINGS 03\Powerhouse - машзал\561Ц-НПО-4-297208.TIF	3
987	151	Powerhouse.pdf	DRAWINGS 04\Powerhouse - машзал\Powerhouse.pdf	4
988	152	1079-14-82a (1).TIF	DRAWINGS 04\Powerhouse - машзал\1079-14-82A\1079-14-82a (1).TIF	4
989	153	1079-14-82a (2).TIF	DRAWINGS 04\Powerhouse - машзал\1079-14-82A\1079-14-82a (2).TIF	4
990	154	1079-14-82a (3).TIF	DRAWINGS 04\Powerhouse - машзал\1079-14-82A\1079-14-82a (3).TIF	4
991	155	1079-14-82a (4).TIF	DRAWINGS 04\Powerhouse - машзал\1079-14-82A\1079-14-82a (4).TIF	4
992	156	1079-14-82a.TIF	DRAWINGS 04\Powerhouse - машзал\1079-14-82A\1079-14-82a.TIF	4

Protection of Salt **Total available files per this item** 33

n°	ID	File Name	Path	Group
993	425	20110914154935973.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
994	426	20110914155012508.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
995	427	20110914155035417.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
996	428	20110914155122487.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
997	429	20110914155142062.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
998	430	20110914155207315.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
999	431	20110914155232467.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
1000	432	20110914155249881.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
1001	433	20110914155407378.tif	DRAWINGS 03\Protection of Salt - Защита соль\Left bank\1079-10-510КЖ л.1	3
1002	434	1.TIF	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-511 КЗ\1.TIF	3
1003	435	2.TIF	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-511 КЗ\2.TIF	3
1004	436	3.TIF	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-511 КЗ\3.TIF	3
1005	437	4.TIF	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-511 КЗ\4.TIF	3
1006	438	5.TIF	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-511 КЗ\5.TIF	3
1007	439	20110621154813569.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-515КЖ л.1	3
1008	440	20110621154842554.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-515КЖ л.1	3
1009	441	10-553КЖ.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-553КЖ\10-553КЖ.tif	3
1010	442	20110621151731409.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-553КЖ\20110621151731409.	3
1011	443	20110621151754781.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-553КЖ\20110621151754781.	3
1012	444	20110621151851870.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-553КЖ\20110621151851870.	3
1013	445	20110621151903680.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-553КЖ\20110621151903680.	3
1014	446	20110621151919570.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-553КЖ\20110621151919570.	3
1015	447	20110621151928021.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-553КЖ\20110621151928021.	3
1016	448	20110621155141348.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3
1017	449	20110621155204216.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3
1018	450	20110621155216162.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3
1019	451	20110621155235686.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3
1020	452	20110621155302711.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3
1021	453	20110621155332652.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3

1022	454	20110621155353474.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3
1023	455	20110621155422287.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3
1024	456	20110621155441202.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3
1025	457	20110621155452104.tif	DRAWINGS 03\Protection of Salt - Защита соль\Right bank\1079-10-85ОРП л.1	3

PTS1 **Total available files per this item** 114

n°	ID	File Name	Path	Group
1026	206	1079-14-110_001.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Камера затворов\1079-14	2
1027	207	1079-14-110_002.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Камера затворов\1079-14	2
1028	208	20100108-075600.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Камера затворов\1079-14	2
1029	209	20100108-080154.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Камера затворов\1079-14	2
1030	210	20100108-080533.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Камера затворов\1079-14	2
1031	211	20100828-092126.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Камера затворов\1079-14	2
1032	212	20100828-092236.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Камера затворов\1079-14	2
1033	213	1079-14-111.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Монтажная камера ВПТ\1079-14	2
1034	214	20100828-091821.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Монтажная камера ВПТ\1079-14-35	2
1035	215	20100828-091923.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Монтажная камера ВПТ\1079-14-35	2
1036	216	1079-14-40 ОРП_001.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Монтажная камера ВПТ\1079-14-40	2
1037	217	1079-14-40 ОРП_002.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Монтажная камера ВПТ\1079-14-40	2
1038	218	1079-14-40 ОРП_003.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Монтажная камера ВПТ\1079-14-40	2
1039	219	561Ц-НПО-4-297381.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Монтажная камера	2
1040	220	561Ц-НПО-4-297353.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Подводящий	2
1041	221	561Ц-НПО-4-297354.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Подводящий	2
1042	222	561Ц-НПО-4-297356_.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Подводящий	2
1043	223	561Ц-НПО-4-297420.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Подводящий	2
1044	224	1861-55-35_001изм2.pdf	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1045	225	1861-55-35_002.pdf	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1046	226	1861-55-35_003.pdf	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1047	227	1861-55-35_004.pdf	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1048	228	1079-14-81.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1049	229	1861-14-83_001.pdf	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1050	230	1861-14-83_002.pdf	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1051	231	1861-14-83_003.pdf	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1052	232	1861-22-157-1.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1053	233	1861-22-158-1.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1054	234	1861-22-161-1.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1055	235	1861-22-162-1.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1056	236	561Ц-НПО-4-297414_001.	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1057	237	561Ц-НПО-4-297414_002.	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\Турбинные водоводы\водоводи	2
1058	238	561ТП-4-II-11674.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\эксплуатационный подъезд к	2
1059	239	20100828-091538.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\эксплуатационный подъезд к	2

1060	240	20100828-091654.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\эксплуатационный подъезд к	2
1061	241	561Ц-4-297476.TIF	DRAWINGS 02\PTS1 - Временный подводящий тракт (ВПТ)\эксплуатационный подъезд к	2
1062	157	1079-14-116_001.TIF	DRAWINGS 04\PTS1 - Access from T8 to gate chamber\1079-14-116\1079-14-116_001.TIF	4
1063	158	1079-14-116_002.TIF	DRAWINGS 04\PTS1 - Access from T8 to gate chamber\1079-14-116\1079-14-116_002.TIF	4
1064	159	561ТП-4-II-1151167Б.TIF	DRAWINGS 04\PTS1 - Erection Chamber\561ТП-4-II-1151167Б.TIF	4
1065	160	pts1 - erection chamber.	DRAWINGS 04\PTS1 - Erection Chamber\pts1 - erection chamber.pdf	4
1066	161	1079-14-40 ОРП_001.PDF	DRAWINGS 04\PTS1 - Erection Chamber\1079-14-40 ОРП\1079-14-40 ОРП_001.PDF	4
1067	162	1079-14-40 ОРП_002.PDF	DRAWINGS 04\PTS1 - Erection Chamber\1079-14-40 ОРП\1079-14-40 ОРП_002.PDF	4
1068	163	1079-14-40 ОРП_003.PDF	DRAWINGS 04\PTS1 - Erection Chamber\1079-14-40 ОРП\1079-14-40 ОРП_003.PDF	4
1069	164	561ТП-4-II-1151167Б.TIF	DRAWINGS 04\PTS1 - Erection Chamber\1079-14-40 ОРП\561ТП-4-II-1151167Б.TIF	4
1070	165	1079-14-86 (1).PDF	DRAWINGS 04\PTS1 - Gate Chamber\1079-14-86 (1).PDF	4
1071	166	1079-14-86 (2).PDF	DRAWINGS 04\PTS1 - Gate Chamber\1079-14-86 (2).PDF	4
1072	167	1079-14-86 (3).PDF	DRAWINGS 04\PTS1 - Gate Chamber\1079-14-86 (3).PDF	4
1073	168	1079-14-86 (4).PDF	DRAWINGS 04\PTS1 - Gate Chamber\1079-14-86 (4).PDF	4
1074	169	1079-14-86.PDF	DRAWINGS 04\PTS1 - Gate Chamber\1079-14-86.PDF	4
1075	170	561ТП-4-II-115109.TIF	DRAWINGS 04\PTS1 - Gate Chamber\561ТП-4-II-115109.TIF	4
1076	171	561ТП-4-II-115246A.PDF	DRAWINGS 04\PTS1 - Gate Chamber\561ТП-4-II-115246A.PDF	4
1077	172	PTS1 - Gate Chamber.pdf	DRAWINGS 04\PTS1 - Gate Chamber\PTS1 - Gate Chamber.pdf	4
1078	173	1079-14-81.TIF	DRAWINGS 04\PTS1 - Penstock\1079-14-81.TIF	4
1079	174	1861-14-83_001.pdf	DRAWINGS 04\PTS1 - Penstock\1861-14-83_001.pdf	4
1080	175	1861-14-83_002.pdf	DRAWINGS 04\PTS1 - Penstock\1861-14-83_002.pdf	4
1081	176	1861-14-83_003.pdf	DRAWINGS 04\PTS1 - Penstock\1861-14-83_003.pdf	4
1082	177	1861-22-157-1.TIF	DRAWINGS 04\PTS1 - Penstock\1861-22-157-1.TIF	4
1083	178	1861-22-158-1.TIF	DRAWINGS 04\PTS1 - Penstock\1861-22-158-1.TIF	4
1084	179	1861-22-161-1.TIF	DRAWINGS 04\PTS1 - Penstock\1861-22-161-1.TIF	4
1085	180	1861-22-162-1.TIF	DRAWINGS 04\PTS1 - Penstock\1861-22-162-1.TIF	4
1086	181	1861-55-35_001изм2.pdf	DRAWINGS 04\PTS1 - Penstock\1861-55-35_001изм2.pdf	4
1087	182	1861-55-35_002.pdf	DRAWINGS 04\PTS1 - Penstock\1861-55-35_002.pdf	4
1088	183	1861-55-35_003.pdf	DRAWINGS 04\PTS1 - Penstock\1861-55-35_003.pdf	4
1089	184	1861-55-35_004.pdf	DRAWINGS 04\PTS1 - Penstock\1861-55-35_004.pdf	4
1090	185	224721sb_01_z1.tif	DRAWINGS 04\PTS1 - Penstock\224721sb_01_z1.tif	4
1091	186	224721sb_02_z1.tif	DRAWINGS 04\PTS1 - Penstock\224721sb_02_z1.tif	4
1092	187	224721sb_03_z1.tif	DRAWINGS 04\PTS1 - Penstock\224721sb_03_z1.tif	4
1093	188	224721sb_04_z1.tif	DRAWINGS 04\PTS1 - Penstock\224721sb_04_z1.tif	4
1094	189	224721sb_05_z1.tif	DRAWINGS 04\PTS1 - Penstock\224721sb_05_z1.tif	4
1095	190	224721sp_01_z1.tif	DRAWINGS 04\PTS1 - Penstock\224721sp_01_z1.tif	4
1096	191	224721sp_02_z1.tif	DRAWINGS 04\PTS1 - Penstock\224721sp_02_z1.tif	4
1097	192	224721sp_03_z1.tif	DRAWINGS 04\PTS1 - Penstock\224721sp_03_z1.tif	4
1098	193	561Ц-НПО-4-297414_001.	DRAWINGS 04\PTS1 - Penstock\561Ц-НПО-4-297414_001.TIF	4
1099	194	561Ц-НПО-4-297414_002.	DRAWINGS 04\PTS1 - Penstock\561Ц-НПО-4-297414_002.TIF	4
1100	195	PTS1 - Penstock.pdf	DRAWINGS 04\PTS1 - Penstock\PTS1 - Penstock.pdf	4

1101	196	TWS6 TWS5.pdf	DRAWINGS 04\PTS1 - Penstock\TWS6 TWS5.pdf	4
1102	197	Объяснение.docx	DRAWINGS 04\PTS1 - Penstock\Объяснение.docx	4
1103	198	1861-55-35_001изм2.pdf	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\временная	4
1104	199	1861-55-35_002.pdf	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\временная	4
1105	200	1861-55-35_003.pdf	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\временная	4
1106	201	1861-55-35_004.pdf	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\временная	4
1107	202	1079-14-81.TIF	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\жб обделка\1079	4
1108	203	1861-14-83_001.pdf	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\КИА\1861-14	4
1109	204	1861-14-83_002.pdf	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\КИА\1861-14	4
1110	205	1861-14-83_003.pdf	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\КИА\1861-14	4
1111	206	224721sb_01_z1.tif	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и	4
1112	207	224721sb_02_z1.tif	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и	4
1113	208	224721sb_03_z1.tif	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и	4
1114	209	224721sb_04_z1.tif	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и	4
1115	210	224721sb_05_z1.tif	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и	4
1116	211	224721sp_01_z1.tif	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и	4
1117	212	224721sp_02_z1.tif	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и	4
1118	213	224721sp_03_z1.tif	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и	4
1119	214	1861-22-157-1.TIF	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\цементация\1861	4
1120	215	1861-22-158-1.TIF	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\цементация\1861	4
1121	216	1861-22-161-1.TIF	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\цементация\1861	4
1122	217	1861-22-162-1.TIF	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\цементация\1861	4
1123	218	561Ц-НПО-4-297414_001.	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\цементация\561Ц-	4
1124	219	561Ц-НПО-4-297414_002.	DRAWINGS 04\PTS1 - Penstock\Турбинные водоводы\водоводи №5 и №6\цементация\561Ц-	4
1125	220	1079-14-86 (1).PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86 (1).PDF	4
1126	221	1079-14-86 (2).PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86 (2).PDF	4
1127	222	1079-14-86 (3).PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86 (3).PDF	4
1128	223	1079-14-86 (4).PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86 (4).PDF	4
1129	224	1079-14-86.PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86.PDF	4
1130	225	561ТП-4-II-115109.TIF	DRAWINGS 04\PTS1 - Tunnel\561ТП-4-II-115109.TIF	4
1131	226	561ТП-4-II-115133 б.TIF	DRAWINGS 04\PTS1 - Tunnel\561ТП-4-II-115133 б.TIF	4
1132	227	561ТП-4-II-115246А.PDF	DRAWINGS 04\PTS1 - Tunnel\561ТП-4-II-115246А.PDF	4
1133	228	561Ц-НПО-4-297369.PDF	DRAWINGS 04\PTS1 - Tunnel\561Ц-НПО-4-297369.PDF	4
1134	229	PTS1 - Tunnel.pdf	DRAWINGS 04\PTS1 - Tunnel\PTS1 - Tunnel.pdf	4
1135	230	1079-14-86 (1).PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86\1079-14-86 (1).PDF	4
1136	231	1079-14-86 (2).PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86\1079-14-86 (2).PDF	4
1137	232	1079-14-86 (3).PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86\1079-14-86 (3).PDF	4
1138	233	1079-14-86 (4).PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86\1079-14-86 (4).PDF	4
1139	234	1079-14-86.PDF	DRAWINGS 04\PTS1 - Tunnel\1079-14-86\1079-14-86.PDF	4

PTS1 - Access to Gates Chamber of Stage 1 **Total available files per this item** 4

n°	ID	File Name	Path	Group
1140	208	1079-03-416_001.TIF	DRAWINGS\PTS1 - Access to Gates Chamber of Stage 1 Headrace Tunnel\1079-03-416_001.TIF	1
1141	209	1079-03-416_002.TIF	DRAWINGS\PTS1 - Access to Gates Chamber of Stage 1 Headrace Tunnel\1079-03-416_002.TIF	1
1142	210	20100828-091538.TIF	DRAWINGS\PTS1 - Access to Gates Chamber of Stage 1 Headrace Tunnel\1079-14-116\20100828	1
1143	211	20100828-091654.TIF	DRAWINGS\PTS1 - Access to Gates Chamber of Stage 1 Headrace Tunnel\1079-14-116\20100828	1

PTS1 - Penstock first phase **Total available files per this item** 7

n°	ID	File Name	Path	Group
1144	212	1861-14-83_001.pdf	DRAWINGS\PTS1 - Penstock first phase\1861-14-83 КИА\1861-14-83_001.pdf	1
1145	213	1861-14-83_002.pdf	DRAWINGS\PTS1 - Penstock first phase\1861-14-83 КИА\1861-14-83_002.pdf	1
1146	214	1861-14-83_003.pdf	DRAWINGS\PTS1 - Penstock first phase\1861-14-83 КИА\1861-14-83_003.pdf	1
1147	215	1861-55-35_001.pdf	DRAWINGS\PTS1 - Penstock first phase\1861-55-35\1861-55-35_001.pdf	1
1148	216	1861-55-35_002.pdf	DRAWINGS\PTS1 - Penstock first phase\1861-55-35\1861-55-35_002.pdf	1
1149	217	1861-55-35_003.pdf	DRAWINGS\PTS1 - Penstock first phase\1861-55-35\1861-55-35_003.pdf	1
1150	218	1861-55-35_004.pdf	DRAWINGS\PTS1 - Penstock first phase\1861-55-35\1861-55-35_004.pdf	1

PTS1 - Stage 1 PT **Total available files per this item** 141

n°	ID	File Name	Path	Group
1151	219	1079-03-294_001.TIF	DRAWINGS\PTS1 - Stage 1 PT\geology\1079-03-294_001.TIF	1
1152	220	1079-03-294_002.TIF	DRAWINGS\PTS1 - Stage 1 PT\geology\1079-03-294_002.TIF	1
1153	221	1079-03-294_003.TIF	DRAWINGS\PTS1 - Stage 1 PT\geology\1079-03-294_003.TIF	1
1154	222	1079-03-368_001.TIF	DRAWINGS\PTS1 - Stage 1 PT\geology\1079-03-368_001.TIF	1
1155	223	1079-03-368_002.TIF	DRAWINGS\PTS1 - Stage 1 PT\geology\1079-03-368_002.TIF	1
1156	224	226292dod.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1157	225	226292dvm.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1158	226	226292sb_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1159	227	226292sb_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1160	228	226292sp_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1161	229	226292sp_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1162	230	226292vp.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1163	231	226292_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1164	232	226292_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1165	233	226295dod_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1166	234	226295dod_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1167	235	226295dvm_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1168	236	226295dvm_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1169	237	226295sb_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1170	238	226295sb_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1171	239	226295sb_03.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1172	240	226295sp_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1

1173	241	226295sp_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1174	242	226295vp.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1175	243	226295vs.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1176	244	226295_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1177	245	226295_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1178	246	226295_03.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1179	247	226295_04.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1180	248	226295_05.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1181	249	226295_06.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1182	250	226295_07.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1183	251	226295_08.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1184	252	226295_09.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1185	253	226295_10.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1186	254	510555sb.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1187	255	510565sp.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1188	256	510565_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1189	257	510565_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1190	258	510566sb.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1191	259	510566sp.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1192	260	510566_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1193	261	510566_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1194	262	510566_03.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1195	263	510566_04.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1196	264	510567sb.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1197	265	510567sp.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1198	266	510567_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1199	267	510567_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1200	268	510567_03.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1201	269	510568sb.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1202	270	510568sp.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1203	271	510568_01.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1204	272	510568_02.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1205	273	510569sb.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1206	274	510569sp.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1207	275	224593dod_01_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1208	276	224593dod_02_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1209	277	224593dod_03_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1210	278	224593dod_04_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1211	279	224593sb_01_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1212	280	224593sb_02_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1213	281	224593sb_03_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1

1214	282	224593sb_04_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1215	283	224593sb_05_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1216	284	224593sp_01_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1217	285	224593sp_02_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1218	286	224593sp_03_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1219	287	224593vs_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1220	288	224573dod_01_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1221	289	224573dod_02_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1222	290	224573dod_03_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1223	291	224573dod_04_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1224	292	224573dod_05_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1225	293	224573dod_06_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1226	294	224573sb_01_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1227	295	224573sb_02_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1228	296	224573sb_03_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1229	297	224573sb_04_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1230	298	224573sp_01_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1231	299	224573sp_02_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1232	300	224573sp_03_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1233	301	224573vs_01_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1234	302	224573vs_02_zam1.tif	DRAWINGS\PTS1 - Stage 1 PT\Opera di presa temporanea (carpenteria met.)\ВПТ	1
1235	303	1079-14-111.TIF	DRAWINGS\PTS1 - Stage 1 PT\Penstock tratto orizzontale\1079-14-111.TIF	1
1236	304	1861-22-44_001.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-44\1861-22	1
1237	305	1861-22-44_002.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-44\1861-22	1
1238	306	1861-22-44_003.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-44\1861-22	1
1239	307	1861-22-47_001.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-47\1861-22	1
1240	308	1861-22-47_002.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-47\1861-22	1
1241	309	1861-22-47_003.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-47\1861-22	1
1242	310	1861-22-47_004.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-47\1861-22	1
1243	311	1861-22-47_005.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-47\1861-22	1
1244	312	1861-22-I-MH1.47_001.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-47\1861-22-I-	1
1245	313	1861-22-66_001.TIF	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-66_001\1861-22	1
1246	314	1861-22-66_002.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-66_001\1861-22	1
1247	315	1861-22-66_003.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-66_001\1861-22	1
1248	316	1861-22-66_004.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-66_001\1861-22	1
1249	317	1861-22-66_005.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-66_001\1861-22	1
1250	318	1861-22-66_006.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-66_001\1861-22	1
1251	319	1861-22-66_007.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-66_001\1861-22	1
1252	320	1861-22-I-MH1.47_001.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-66_001\1861-22-	1
1253	321	SCAN1365_000.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22	1
1254	322	SCAN1366_000.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22	1

1255	323	1861-22-67_001.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-67\1861-22	1
1256	324	1861-22-67_002.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-67\1861-22	1
1257	325	1861-22-67_003.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-67\1861-22	1
1258	326	1861-22-67_004.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-67\1861-22	1
1259	327	1861-22-67_005.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-67\1861-22	1
1260	328	1861-22-67_006.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-67\1861-22	1
1261	329	1861-22-67_007.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-67\1861-22	1
1262	330	1861-22-67_008.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-67\1861-22	1
1263	331	1861-22-68_001.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1264	332	1861-22-68_002.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1265	333	1861-22-68_002.tif	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1266	334	1861-22-68_003.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1267	335	1861-22-68_004.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1268	336	1861-22-68_005.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1269	337	1861-22-68_006.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1270	338	1861-22-68_007.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1271	339	1861-22-68_008.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1272	340	1861-22-68_009.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22	1
1273	341	1861-22-I-MH1.68_001.pdf	DRAWINGS\PTS1 - Stage 1 PT\оголовка водоприемника-Water Intake\1861-22-68\1861-22-I-	1
1274	342	20100108-071032.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\1079-14	1
1275	343	20100108-080358.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\1079-14	1
1276	344	20100108-080533.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\1079-14	1
1277	345	20100828-092126.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\1079-14	1
1278	346	20100828-092236.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\1079-14	1
1279	347	1079-14-96_001.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\1079-14-96\1079	1
1280	348	1079-14-96_002.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\1079-14-96\1079	1
1281	349	1079-14-96_003.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\1079-14-96\1079	1
1282	350	561Ц-НПО-4-297414_001.	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\цементация-	1
1283	351	561Ц-НПО-4-297414_002.	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\цементация-	1
1284	352	561Ц-НПО-4-297420.TIF	DRAWINGS\PTS1 - Stage 1 PT\Помешения управление затаоров-gates area\цементация-	1
1285	353	1861-22-70-1_001.TIF	DRAWINGS\PTS1 - Stage 1 PT\цементация-grouting\1861-22-70-1_001.TIF	1
1286	354	561Ц-НПО-4-297353.TIF	DRAWINGS\PTS1 - Stage 1 PT\цементация-grouting\561Ц-НПО-4-297353.TIF	1
1287	355	561Ц-НПО-4-297354.TIF	DRAWINGS\PTS1 - Stage 1 PT\цементация-grouting\561Ц-НПО-4-297354.TIF	1
1288	356	561Ц-НПО-4-297356.TIF	DRAWINGS\PTS1 - Stage 1 PT\цементация-grouting\561Ц-НПО-4-297356.TIF	1
1289	357	561Ц-НПО-4-297356_.TIF	DRAWINGS\PTS1 - Stage 1 PT\цементация-grouting\561Ц-НПО-4-297356_.TIF	1
1290	358	561Ц-НПО-4-297381.TIF	DRAWINGS\PTS1 - Stage 1 PT\цементация-grouting\561Ц-НПО-4-297381.TIF	1
1291	359	561Ц-НПО-4-297731.TIF	DRAWINGS\PTS1 - Stage 1 PT\цементация-grouting\561Ц-НПО-4-297731.TIF	1

Report on Nurek & Rogun **Total available files per this item** 3

n°	ID	File Name	Path	Group
1292	458	Comments on hydrology.	DRAWINGS 03\Report on Nurek & Rogun - Отчеты по Нурек и Рогун\Comments on hydrology.	3

1293	459	Conclusion on Nurek	DRAWINGS 03\Report on Nurek & Rogun - Отчеты по Нурек и Рогун\Conclusion on Nurek safety.	3
1294	460	Report on Nurek reservoir.	DRAWINGS 03\Report on Nurek & Rogun - Отчеты по Нурек и Рогун\Report on Nurek reservoir.	3

Road 1 Total available files per this item 24

n°	ID	File Name	Path	Group
1295	461	1.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\1.TIF	3
1296	462	10.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\10.TIF	3
1297	463	11.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\11.TIF	3
1298	464	12.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\12.TIF	3
1299	465	2.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\2.TIF	3
1300	466	3.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\3.TIF	3
1301	467	4.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\4.TIF	3
1302	468	5.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\5.TIF	3
1303	469	6.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\6.TIF	3
1304	470	7.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\7.TIF	3
1305	471	8.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\8.TIF	3
1306	472	9.TIF	DRAWINGS 03\Road 1\1079-16-48 Road to the crest of the dam\9.TIF	3
1307	473	1.TIF	DRAWINGS 03\Road 1\1079-16-82\1.TIF	3
1308	474	10.TIF	DRAWINGS 03\Road 1\1079-16-82\10.TIF	3
1309	475	11.TIF	DRAWINGS 03\Road 1\1079-16-82\11.TIF	3
1310	476	12.TIF	DRAWINGS 03\Road 1\1079-16-82\12.TIF	3
1311	477	2.TIF	DRAWINGS 03\Road 1\1079-16-82\2.TIF	3
1312	478	3.TIF	DRAWINGS 03\Road 1\1079-16-82\3.TIF	3
1313	479	4.TIF	DRAWINGS 03\Road 1\1079-16-82\4.TIF	3
1314	480	5.TIF	DRAWINGS 03\Road 1\1079-16-82\5.TIF	3
1315	481	6.TIF	DRAWINGS 03\Road 1\1079-16-82\6.TIF	3
1316	482	7.TIF	DRAWINGS 03\Road 1\1079-16-82\7.TIF	3
1317	483	8.TIF	DRAWINGS 03\Road 1\1079-16-82\8.TIF	3
1318	484	9.TIF	DRAWINGS 03\Road 1\1079-16-82\9.TIF	3

Road 2 Total available files per this item 38

n°	ID	File Name	Path	Group
1319	485	20090427-104130.TIF	DRAWINGS 03\Road 2\1079-16-141 Автодорога к кареьру №26 на отм. 1260\20090427-104130.	3
1320	486	20090427-104205.TIF	DRAWINGS 03\Road 2\1079-16-141 Автодорога к кареьру №26 на отм. 1260\20090427-104205.	3
1321	487	20090427-104345.TIF	DRAWINGS 03\Road 2\1079-16-141 Автодорога к кареьру №26 на отм. 1260\20090427-104345.	3
1322	488	20090427-104539.TIF	DRAWINGS 03\Road 2\1079-16-141 Автодорога к кареьру №26 на отм. 1260\20090427-104539.	3
1323	489	20090427-104607.TIF	DRAWINGS 03\Road 2\1079-16-141 Автодорога к кареьру №26 на отм. 1260\20090427-104607.	3
1324	490	20090427-100819.TIF	DRAWINGS 03\Road 2\1079-16-142 Автодорга к карьеру №26 на отм. 1140\20090427-100819.	3
1325	491	20090427-100855.TIF	DRAWINGS 03\Road 2\1079-16-142 Автодорга к карьеру №26 на отм. 1140\20090427-100855.	3
1326	492	20090427-102220.TIF	DRAWINGS 03\Road 2\1079-16-142 Автодорга к карьеру №26 на отм. 1140\20090427-102220.	3
1327	493	20090427-102517.TIF	DRAWINGS 03\Road 2\1079-16-142 Автодорга к карьеру №26 на отм. 1140\20090427-102517.	3
1328	494	20090427-102916.TIF	DRAWINGS 03\Road 2\1079-16-162 Автодорога к карьеру №26 2 очередь разр\20090427	3

1329	495	20090427-103145.TIF	DRAWINGS 03\Road 2\1079-16-162 Автодорога к карьеру №26 2 очередь разр\20090427	3
1330	496	20090427-103352.TIF	DRAWINGS 03\Road 2\1079-16-162 Автодорога к карьеру №26 2 очередь разр\20090427	3
1331	497	20090427-103624.TIF	DRAWINGS 03\Road 2\1079-16-162 Автодорога к карьеру №26 2 очередь разр\20090427	3
1332	498	20090427-103800.TIF	DRAWINGS 03\Road 2\1079-16-162 Автодорога к карьеру №26 2 очередь разр\20090427	3
1333	499	1079-16-165 ОРП _011.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\1079-16-165 ОРП _011.	3
1334	500	1079-16-165 ОРП _012.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\1079-16-165 ОРП _012.	3
1335	501	20100428-101938.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-101938.TIF	3
1336	502	20100428-102137.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-102137.TIF	3
1337	503	20100428-102307.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-102307.TIF	3
1338	504	20100428-102418.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-102418.TIF	3
1339	505	20100428-102655.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-102655.TIF	3
1340	506	20100428-102832.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-102832.TIF	3
1341	507	20100428-102949.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-102949.TIF	3
1342	508	20100428-103107.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-103107.TIF	3
1343	509	20100428-103653.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-103653.TIF	3
1344	510	20100428-103850.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\20100428-103850.TIF	3
1345	511	20100429-080558.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\1079-16-165	3
1346	512	20100429-080639.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\1079-16-165	3
1347	513	20100429-080716.TIF	DRAWINGS 03\Road 2\1079-16-165 ОРП Атодорга на гребень плотины\1079-16-165	3
1348	514	20090424-100402.TIF	DRAWINGS 03\Road 2\1079-16-173 Автодорога к выходным порталом отводящих туннелей	3
1349	515	20090424-102149.TIF	DRAWINGS 03\Road 2\1079-16-173 Автодорога к выходным порталом отводящих туннелей	3
1350	516	20090424-102229.TIF	DRAWINGS 03\Road 2\1079-16-173 Автодорога к выходным порталом отводящих туннелей	3
1351	517	20090424-102827.TIF	DRAWINGS 03\Road 2\1079-16-173 Автодорога к выходным порталом отводящих туннелей	3
1352	518	1.TIF	DRAWINGS 03\Road 2\1079-16-97\1.TIF	3
1353	519	1079-16-97_002.TIF	DRAWINGS 03\Road 2\1079-16-97\1079-16-97_002.TIF	3
1354	520	1079-16-97_003.TIF	DRAWINGS 03\Road 2\1079-16-97\1079-16-97_003.TIF	3
1355	521	1079-16-97_004.TIF	DRAWINGS 03\Road 2\1079-16-97\1079-16-97_004.TIF	3
1356	522	1079-16-97_005.TIF	DRAWINGS 03\Road 2\1079-16-97\1079-16-97_005.TIF	3

Saline Gallery **Total available files per this item** 34

n°	ID	File Name	Path	Group
1357	360	073756.TIF	DRAWINGS\Saline Gallery\073756.TIF	1
1358	361	073756.TIF.thumb.jpg	DRAWINGS\Saline Gallery\073756.TIF.thumb.jpg	1
1359	362	073844.TIF	DRAWINGS\Saline Gallery\073844.TIF	1
1360	363	073844.TIF.thumb.jpg	DRAWINGS\Saline Gallery\073844.TIF.thumb.jpg	1
1361	364	073944.TIF	DRAWINGS\Saline Gallery\073944.TIF	1
1362	365	073944.TIF.thumb.jpg	DRAWINGS\Saline Gallery\073944.TIF.thumb.jpg	1
1363	366	074040.TIF	DRAWINGS\Saline Gallery\074040.TIF	1
1364	367	074040.TIF.thumb.jpg	DRAWINGS\Saline Gallery\074040.TIF.thumb.jpg	1
1365	368	074159.TIF	DRAWINGS\Saline Gallery\074159.TIF	1
1366	369	074159.TIF.thumb.jpg	DRAWINGS\Saline Gallery\074159.TIF.thumb.jpg	1

1367	370	074253.TIF	DRAWINGS\Saline Gallery\074253.TIF	1
1368	371	074253.TIF.thumb.jpg	DRAWINGS\Saline Gallery\074253.TIF.thumb.jpg	1
1369	372	074346.TIF	DRAWINGS\Saline Gallery\074346.TIF	1
1370	373	074346.TIF.thumb.jpg	DRAWINGS\Saline Gallery\074346.TIF.thumb.jpg	1
1371	374	074643.TIF	DRAWINGS\Saline Gallery\074643.TIF	1
1372	375	074643.TIF.thumb.jpg	DRAWINGS\Saline Gallery\074643.TIF.thumb.jpg	1
1373	376	074749.TIF	DRAWINGS\Saline Gallery\074749.TIF	1
1374	377	074749.TIF.thumb.jpg	DRAWINGS\Saline Gallery\074749.TIF.thumb.jpg	1
1375	378	075001.TIF	DRAWINGS\Saline Gallery\075001.TIF	1
1376	379	075001.TIF.thumb.jpg	DRAWINGS\Saline Gallery\075001.TIF.thumb.jpg	1
1377	380	075054.TIF	DRAWINGS\Saline Gallery\075054.TIF	1
1378	381	075054.TIF.thumb.jpg	DRAWINGS\Saline Gallery\075054.TIF.thumb.jpg	1
1379	382	075640.TIF	DRAWINGS\Saline Gallery\075640.TIF	1
1380	383	075640.TIF.thumb.jpg	DRAWINGS\Saline Gallery\075640.TIF.thumb.jpg	1
1381	235	561Ц-НПО-4-297134.PDF	DRAWINGS 04\Saline Gallery\561Ц-НПО-4-297134.PDF	4
1382	236	joint_salt_left_bank.pdf	DRAWINGS 04\Saline Gallery\joint_salt_left_bank.pdf	4
1383	237	Saline Gallery - passive	DRAWINGS 04\Saline Gallery\Saline Gallery - passive stretch.pdf	4
1384	238	saline gallery.pdf	DRAWINGS 04\Saline Gallery\saline gallery.pdf	4
1385	239	561ТП-4-VII-24698 a.PDF	DRAWINGS 04\Saline Gallery\(21) JS_L (Совмещенная штольня солевой и гидравлической	4
1386	240	561Ц-4-297585.PDF	DRAWINGS 04\Saline Gallery\(21) JS_L (Совмещенная штольня солевой и гидравлической	4
1387	241	JS_L.pdf	DRAWINGS 04\Saline Gallery\(21) JS_L (Совмещенная штольня солевой и гидравлической	4
1388	242	Обоснование.docx	DRAWINGS 04\Saline Gallery\(21) JS_L (Совмещенная штольня солевой и гидравлической	4
1389	243	561Ц-4-297490.PDF	DRAWINGS 04\Saline Gallery\(80) SH_PASS_LEF (Штольня солевой и гидравлической завес.	4
1390	244	561Ц-4-297497.PDF	DRAWINGS 04\Saline Gallery\(80) SH_PASS_LEF (Штольня солевой и гидравлической завес.	4

Seismic Adit **Total available files per this item** 3

n°	ID	File Name	Path	Group
1391	242	561ТП-4-0-24646Б.PDF	DRAWINGS 02\Seismic Adit - сейсмические штолни\561ТП-4-0-24646Б.PDF	2
1392	243	561ТП-4-0-24652.TIF	DRAWINGS 02\Seismic Adit - сейсмические штолни\561ТП-4-0-24652.TIF	2
1393	244	561ТП-4-0-26647А.PDF	DRAWINGS 02\Seismic Adit - сейсмические штолни\561ТП-4-0-26647А.PDF	2

Seismic gallery **Total available files per this item** 8

n°	ID	File Name	Path	Group
1394	523	561ТП-4-0-24646Б.PDF	DRAWINGS 03\Seismic gallery - сейсмические штолни\561ТП-4-0-24646Б.PDF	3
1395	524	561ТП-4-0-24652.TIF	DRAWINGS 03\Seismic gallery - сейсмические штолни\561ТП-4-0-24652.TIF	3
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1397	245	561Ц-4-297528.PDF	DRAWINGS 04\Seismic gallery - сейсмические штолни\561Ц-4-297528.PDF	4
1398	246	561Ц-4-297530.PDF	DRAWINGS 04\Seismic gallery - сейсмические штолни\561Ц-4-297530.PDF	4
1399	247	Seismic Gallery.pdf	DRAWINGS 04\Seismic gallery - сейсмические штолни\Seismic Gallery.pdf	4
1400	248	561Ц-4-297530.PDF	DRAWINGS 04\Seismic gallery - сейсмические штолни\(62) Seismic Adit (Сейсмоштольня в П	4
1401	249	561Ц-4-297528.PDF	DRAWINGS 04\Seismic gallery - сейсмические штолни\(63) Seismic Adit (Сейсмоштольня в Т	4

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1402	245	120326 - File List.xls	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\120326 - File List.xls	2
1403	246	20120317135615.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера затворов\ПАРиОЗ\1079	2
1404	247	20120317135825.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера затворов\ПАРиОЗ\1079	2
1405	248	20120317135928.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера затворов\ПАРиОЗ\1079	2
1406	249	20120317134440.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера затворов\ПАРиОЗ\1079	2
1407	250	20120317134547.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера затворов\ПАРиОЗ\1079	2
1408	251	20120317134645.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера затворов\ПАРиОЗ\1079	2
1409	252	20120317135047.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера затворов\ПАРиОЗ\1079	2
1410	253	20120317135146.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера затворов\ПАРиОЗ\1079	2
1411	254	1861-22-101-1.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера	2
1412	255	1861-27-18-1.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера	2
1413	256	561Ц-НПО-4-297179_001.	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера	2
1414	257	561Ц-НПО-4-297241-1.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера	2
1415	258	561Ц-НПО-4-297241-2.TIF	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера	2
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1418	261	561Ц-НПО-4-297391_002.	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера	2
1419	262	561Ц-НПО-4-297391_003.	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера	2
1420	263	561Ц-НПО-4-297391_004.	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\камера	2
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1423	266	1861-22-40-1.pdf	DRAWINGS 02\ST - Diversion Tunnels - Строительные туннели\строительный туннель 1	2
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1535	531	1861-14-61_003.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-61_003.pdf	3
1536	532	1861-14-61_004.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-61_004.pdf	3
1537	533	1861-14-61_005.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-61_005.pdf	3
1538	534	1861-14-61_006.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-61_006.pdf	3
1539	535	1861-14-61_007.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-61_007.pdf	3
1540	536	1861-14-61_008.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-61_008.pdf	3
1541	537	1861-14-61_009.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-61_009.pdf	3
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1543	539	1861-14-I-MH2.61_001.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-I-MH2.61_001.pdf	3
1544	540	1861-14-I-Tip 1.61_001.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-I-Tip 1.61_001.pdf	3
1545	541	1861-14-I-Tip 2.61_001.pdf	DRAWINGS 03\ST - Outlets\1861-14-61\1861-14-61\1861-14-I-Tip 2.61_001.pdf	3
1546	542	1867-14-67-И-Мн 1.67.pdf	DRAWINGS 03\ST - Outlets\1861-14-67\1867-14-67-И-Мн 1.67.pdf	3
1547	543	1867-14-67_001.pdf	DRAWINGS 03\ST - Outlets\1861-14-67\1867-14-67_001.pdf	3
1548	544	1867-14-67_002.pdf	DRAWINGS 03\ST - Outlets\1861-14-67\1867-14-67_002.pdf	3
1549	545	1867-14-67_003.pdf	DRAWINGS 03\ST - Outlets\1861-14-67\1867-14-67_003.pdf	3
1550	546	1861-14-90_001изм1.tif	DRAWINGS 03\ST - Outlets\1861-14-90\1861-14-90_001изм1.tif	3
1551	547	1861-14-90_002.pdf	DRAWINGS 03\ST - Outlets\1861-14-90\1861-14-90_002.pdf	3
1552	548	1861-14-90_003изм1.tif	DRAWINGS 03\ST - Outlets\1861-14-90\1861-14-90_003изм1.tif	3
1553	549	1861-14-90_004изм1.tif	DRAWINGS 03\ST - Outlets\1861-14-90\1861-14-90_004изм1.tif	3
1554	550	1861-14-И-Мн 1.90.pdf	DRAWINGS 03\ST - Outlets\1861-14-90\1861-14-И-Мн 1.90.pdf	3
1555	551	1861-14-И-Тип 1.90-Тип	DRAWINGS 03\ST - Outlets\1861-14-90\1861-14-И-Тип 1.90-Тип 4.90.pdf	3
1556	552	1861-14-91_001.pdf	DRAWINGS 03\ST - Outlets\1861-14-91\1861-14-91_004\1861-14-91_001.pdf	3
1557	553	1861-14-91_002.pdf	DRAWINGS 03\ST - Outlets\1861-14-91\1861-14-91_004\1861-14-91_002.pdf	3
1558	554	1861-14-91_003.pdf	DRAWINGS 03\ST - Outlets\1861-14-91\1861-14-91_004\1861-14-91_003.pdf	3
1559	555	1861-14-91_004.pdf	DRAWINGS 03\ST - Outlets\1861-14-91\1861-14-91_004\1861-14-91_004.pdf	3
1560	556	1861-14-91_005.pdf	DRAWINGS 03\ST - Outlets\1861-14-91\1861-14-91_004\1861-14-91_005.pdf	3
1561	557	1861-55-36_001.pdf	DRAWINGS 03\ST - Outlets\1861-55-36\1861-55-36 производство\1861-55-36_001.pdf	3
1562	558	1861-55-36_002.pdf	DRAWINGS 03\ST - Outlets\1861-55-36\1861-55-36 производство\1861-55-36_002.pdf	3

1563	559	1861-55-36_003.pdf	DRAWINGS 03\ST - Outlets\1861-55-36\1861-55-36 производство\1861-55-36_003.pdf	3
1564	560	1861-55-36_004.pdf	DRAWINGS 03\ST - Outlets\1861-55-36\1861-55-36 производство\1861-55-36_004.pdf	3
1565	250	ST - Gates chamber.pdf	DRAWINGS 04\ST - Diversion Gate Chambers\ST - Gates chamber.pdf	4
1566	251	1079-22-86 (1).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (1).PDF	4
1567	252	1079-22-86 (2).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (2).PDF	4
1568	253	1079-22-86 (3).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (3).PDF	4
1569	254	1079-22-86 (4).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (4).PDF	4
1570	255	1079-22-86 (5).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (5).PDF	4
1571	256	1079-22-86 (6).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (6).PDF	4
1572	257	1079-22-86 (7).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (7).PDF	4
1573	258	1079-22-86 (8).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (8).PDF	4
1574	259	1079-22-86 (9).PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86 (9).PDF	4
1575	260	1079-22-86.PDF	DRAWINGS 04\ST - Diversion Gate Chambers\1079-22-86\1079-22-86.PDF	4
1576	261	ST1 - Tunnel.pdf	DRAWINGS 04\ST - Diversion Tunnels\ST1 - Tunnel.pdf	4
1577	262	ST2 - Tunnel.pdf	DRAWINGS 04\ST - Diversion Tunnels\ST2 - Tunnel.pdf	4
1578	263	1079-22-14 ОРП_001.TIF	DRAWINGS 04\ST - Diversion Tunnels\(12) Строртиельный тунель 2 яруса\1079-22-14 ОРП_001.	4
1579	264	1079-22-14 ОРП_002.TIF	DRAWINGS 04\ST - Diversion Tunnels\(12) Строртиельный тунель 2 яруса\1079-22-14 ОРП_002.	4
1580	265	1079-22-14 ОРП_003.TIF	DRAWINGS 04\ST - Diversion Tunnels\(12) Строртиельный тунель 2 яруса\1079-22-14 ОРП_003.	4
1581	266	1079-22-14 ОРП_004.TIF	DRAWINGS 04\ST - Diversion Tunnels\(12) Строртиельный тунель 2 яруса\1079-22-14 ОРП_004.	4
1582	267	1079-22-75ДП_002.TIF	DRAWINGS 04\ST - Diversion Tunnels\(12) Строртиельный тунель 2 яруса\1079-22-75ДП_002.TIF	4
1583	268	561ТП-4-1-112274А.TIF	DRAWINGS 04\ST - Diversion Tunnels\(12) Строртиельный тунель 2 яруса\тип временных	4
1584	269	561ТП-4-1-115197.PDF	DRAWINGS 04\ST - Diversion Tunnels\(12) Строртиельный тунель 2 яруса\тип временных	4
1585	270	561ТП-4-I-112011.TIF	DRAWINGS 04\ST - Diversion Tunnels\(12) Строртиельный тунель 2 яруса\тип временных	4
1586	271	1079-22-24 ОРП _001.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\1079-22-24 ОРП _001.TIF	4
1587	272	1079-22-24 ОРП _002.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\1079-22-24 ОРП _002.TIF	4
1588	273	1079-22-24 ОРП _003.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\1079-22-24 ОРП _003.TIF	4
1589	274	1079-22-24 ОРП _004.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\1079-22-24 ОРП _004.TIF	4
1590	275	1079-22-75ДП_002.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\1079-22-75ДП_002.TIF	4
1591	276	561ТП-4-1-11258а.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\561ТП-4-1-11258а.TIF	4
1592	277	561Ц-НПО-4-297150.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\561Ц-НПО-4-297150.TIF	4
1593	278	561Ц-НПО-4-297291.PDF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\561Ц-НПО-4-297291.PDF	4
1594	279	561Ц0НПО-4-297162.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\561Ц0НПО-4-297162.TIF	4
1595	280	561ТП-4-1-112274А.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\тип временных	4
1596	281	561ТП-4-1-115197.PDF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\тип временных	4
1597	282	561ТП-4-I-112011.TIF	DRAWINGS 04\ST - Diversion Tunnels\Строртиельный тунель 1 яруса\тип временных	4
1598	283	ST - DOWNSTREAM GATE	DRAWINGS 04\ST - Down stream gate chamber\ST - DOWNSTREAM GATE CHAMBER.pdf	4
1599	284	ST - OUTLETS.pdf	DRAWINGS 04\ST - Outlets\ST - OUTLETS.pdf	4
1600	285	1079-14-130 кж_001.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1601	286	1079-14-130 кж_002.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1602	287	1079-14-130 кж_003.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1603	288	1079-14-59_001.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4

1604	289	1079-14-59_002.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1605	290	1079-14-78_001.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1606	291	1079-14-78_002.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1607	292	1079-22-77 л2.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1608	293	1079-22-77 л3.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1609	294	1079-22-77_001.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1610	295	1079-22-77_004.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1611	296	1-3.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1612	297	2.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1613	298	4a.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1614	299	5a.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1615	300	6a.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1616	301	7.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1617	302	8.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1618	303	9.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1619	304	1861-22-25-1-3.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1620	305	1861-22-25-I-1.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1621	306	1861-22-25-I-2.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1622	307	091815.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1623	308	1861-22-29-I-1.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1624	309	1861-22-29-I-2.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1625	310	1861-22-29-I-3.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\конструктивная	4
1626	311	561ТП-4-1-112011.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\тип временных	4
1627	312	561ТП-4-1-112274A.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\тип временных	4
1628	313	561ТП-4-1-115197.PDF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\тип временных	4
1629	314	1861-22-48-I.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\цементация\1861-22	4
1630	315	561Ц-НПО-4-297212.TIF	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\цементация\561Ц-НПО	4
1631	316	561Ц-НПО-4-297309_001.	DRAWINGS 04\ST - Outlets\(82) ST1-OUTLET (Отводящий тракт 1-3 агр)\цементация\561Ц-НПО	4
1632	317	1079-14-78_001.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\жб обделка\1079-14	4
1633	318	1079-14-78_002.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\жб обделка\1079-14	4
1634	319	1079-22-77 л2.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\жб обделка\1079-22	4
1635	320	1079-22-77 л3.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\жб обделка\1079-22	4
1636	321	1079-22-77_001.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\жб обделка\1079-22	4
1637	322	1079-22-77_004.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\жб обделка\1079-22	4
1638	323	561ТП-4-1-112011.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\тип временных	4
1639	324	561ТП-4-1-112274A.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\тип временных	4
1640	325	561ТП-4-1-115197.PDF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\тип временных	4
1641	326	1861-14-17-I.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-14	4
1642	327	1861-22-32-1.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-22-32	4
1643	328	1861-22-49-I.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-22	4
1644	329	1861-27-17-I.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-27	4

1645	330	561Ц-НПО-4-297213.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\561Ц-НПО	4
1646	331	1861-22-2 ГРП л. 5.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-22-2	4
1647	332	20090821-144202.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-22-2	4
1648	333	20090821-144300.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-22-2	4
1649	334	20090821-144346.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-22-2	4
1650	335	20090821-144451.TIF	DRAWINGS 04\ST - Outlets\(83) ST2-OUTLET (Отводящий тракт 4-6 агр)\цементация\1861-22-2	4

ST - 1861-27-2 (1K) diversion **Total available files per this item** 13

n°	ID	File Name	Path	Group
1651	384	1861-27-2 (1K)_001.pdf	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_001.pdf	1
1652	385	1861-27-2 (1K)_001.tif	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_001.tif	1
1653	386	1861-27-2 (1K)_002.pdf	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_002.pdf	1
1654	387	1861-27-2 (1K)_002.tif	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_002.tif	1
1655	388	1861-27-2 (1K)_003.pdf	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_003.pdf	1
1656	389	1861-27-2 (1K)_003.tif	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_003.tif	1
1657	390	1861-27-2 (1K)_004.pdf	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_004.pdf	1
1658	391	1861-27-2 (1K)_004.tif	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_004.tif	1
1659	392	1861-27-2 (1K)_005.tif	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_005.tif	1
1660	393	1861-27-2 (1K)_006.pdf	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_006.pdf	1
1661	394	1861-27-2 (1K)_006.tif	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_006.tif	1
1662	395	1861-27-2 (1K)_007.pdf	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_007.pdf	1
1663	396	1861-27-2 (1K)_007.tif	DRAWINGS\ST - 1861-27-2 (1K) diversion\1861-27-2 (1K)_007.tif	1

ST - Diversion Gate Chambers **Total available files per this item** 11

n°	ID	File Name	Path	Group
1664	397	082147.TIF	DRAWINGS\ST - Diversion Gate Chambers\as builtd\082147.TIF	1
1665	398	082252.TIF	DRAWINGS\ST - Diversion Gate Chambers\as builtd\082252.TIF	1
1666	399	083118.TIF	DRAWINGS\ST - Diversion Gate Chambers\as builtd\083118.TIF	1
1667	400	083226.TIF	DRAWINGS\ST - Diversion Gate Chambers\as builtd\083226.TIF	1
1668	401	083339.TIF	DRAWINGS\ST - Diversion Gate Chambers\as builtd\083339.TIF	1
1669	402	083511.TIF	DRAWINGS\ST - Diversion Gate Chambers\as builtd\083511.TIF	1
1670	403	083621.TIF	DRAWINGS\ST - Diversion Gate Chambers\as builtd\083621.TIF	1
1671	404	561Ц-НПО-4-297391_001.	DRAWINGS\ST - Diversion Gate Chambers\цементация\561Ц-НПО-4-297391_001.TIF	1
1672	405	561Ц-НПО-4-297391_002.	DRAWINGS\ST - Diversion Gate Chambers\цементация\561Ц-НПО-4-297391_002.TIF	1
1673	406	561Ц-НПО-4-297391_003.	DRAWINGS\ST - Diversion Gate Chambers\цементация\561Ц-НПО-4-297391_003.TIF	1
1674	407	561Ц-НПО-4-297391_004.	DRAWINGS\ST - Diversion Gate Chambers\цементация\561Ц-НПО-4-297391_004.TIF	1

ST - Diversion Justification construction tunnel **Total available files per this item** 3

n°	ID	File Name	Path	Group
1675	408	1861-03-001_1.pdf	DRAWINGS\ST - Diversion Justification construction tunnel 1-2\1861-03-001_1.pdf	1
1676	409	1861-03-001_2.pdf	DRAWINGS\ST - Diversion Justification construction tunnel 1-2\1861-03-001_2.pdf	1
1677	410	заключение анкров ПНА.	DRAWINGS\ST - Diversion Justification construction tunnel 1-2\заключение анкров ПНА.pdf	1

ST - Diversion tunnel Intake **Total available files per this item** 252

n°	ID	File Name	Path	Group
1678	411	1861-22-2.tif	DRAWINGS\ST - Diversion tunnel Intake\1861-22-2.tif	1
1679	412	20090424-111437.TIF	DRAWINGS\ST - Diversion tunnel Intake\1861-22-10\20090424-111437.TIF	1
1680	413	20090424-111531.TIF	DRAWINGS\ST - Diversion tunnel Intake\1861-22-10\20090424-111531.TIF	1
1681	414	20090424-111703.TIF	DRAWINGS\ST - Diversion tunnel Intake\1861-22-10\20090424-111703.TIF	1
1682	415	20090428-131645.TIF	DRAWINGS\ST - Diversion tunnel Intake\1861-22-10\20090428-131645.TIF	1
1683	416	20090428-131900.TIF	DRAWINGS\ST - Diversion tunnel Intake\1861-22-10\20090428-131900.TIF	1
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1839	572	1861-20-14 ДОД.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-14 ДОД.tif	1
1840	573	1861-20-14 СБ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-14 СБ.tif	1
1841	574	1861-20-14.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-14.tif	1
1842	575	1861-20-15 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-15 СБ_001.tif	1
1843	576	1861-20-15 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-15 СБ_002.tif	1
1844	577	1861-20-15.01-05.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-15.01-05.tif	1
1845	578	1861-20-15.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-15.tif	1
1846	579	1861-20-16 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-16 СБ_001.tif	1
1847	580	1861-20-16 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-16 СБ_002.tif	1
1848	581	1861-20-16.01-08.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-16.01-08.tif	1
1849	582	1861-20-16.09-22.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-16.09-22.tif	1
1850	583	1861-20-16.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-16.tif	1
1851	584	1861-20-17 СБ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-17 СБ.tif	1
1852	585	1861-20-17.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-17.tif	1
1853	586	1861-20-22 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-22 СБ_001.tif	1
1854	587	1861-20-22 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-22 СБ_002.tif	1
1855	588	1861-20-22.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-22.tif	1
1856	589	1861-20-23 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-23 СБ_001.tif	1
1857	590	1861-20-23 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-23 СБ_002.tif	1
1858	591	1861-20-23.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-23.tif	1
1859	592	1861-20-24 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-24 СБ_001.tif	1
1860	593	1861-20-24 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-24 СБ_002.tif	1
1861	594	1861-20-24.01-04.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-24.01-04.tif	1
1862	595	1861-20-24.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-24.tif	1
1863	596	1861-20-25 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-25 СБ_001.tif	1
1864	597	1861-20-25 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-25 СБ_002.tif	1
1865	598	1861-20-25.01-06.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-25.01-06.tif	1
1866	599	1861-20-25.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-25.tif	1
1867	600	1861-20-26 СБ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-26 СБ.tif	1
1868	601	1861-20-26.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14 tif\1861-20-26.tif	1
1869	602	1861-20-14 ВП.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-14	1
1870	603	1861-20-14 ВС.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-14	1
1871	604	1861-20-14 ДВМ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-14	1
1872	605	1861-20-14 ДОД.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-14	1
1873	606	1861-20-14 СБ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-14	1
1874	607	1861-20-14.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-14.tif	1
1875	608	1861-20-15 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-15	1
1876	609	1861-20-15 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-15	1
1877	610	1861-20-15.01-05.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-15.01	1
1878	611	1861-20-15.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-15.tif	1
1879	612	1861-20-16 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-16	1

613	1861-20-16 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-16	1
614	1861-20-16.01-08.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-14-16.008\Новая папка\1861-20-16.01	1
615	1861-20-16.09-22.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-16.09-22.tif	1
616	1861-20-16.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-16.tif	1
617	1861-20-17 СБ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-17 СБ.tif	1
618	1861-20-17.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-17.tif	1
619	1861-20-22 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-22 СБ_001.tif	1
620	1861-20-22 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-22 СБ_002.tif	1
621	1861-20-22.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-22.tif	1
622	1861-20-23 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-23 СБ_001.tif	1
623	1861-20-23 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-23 СБ_002.tif	1
624	1861-20-23.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-23.tif	1
625	1861-20-24 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-24 СБ_001.tif	1
626	1861-20-24 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-24 СБ_002.tif	1
627	1861-20-24.01-04.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-24.01-04.tif	1
628	1861-20-24.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-16-24\1861-20-24.tif	1
629	1861-20-18 СБ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18 tif\1861-20-18 СБ.tif	1
630	1861-20-18.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18 tif\1861-20-18.tif	1
631	1861-20-18.ДОД.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18 tif\1861-20-18.ДОД.tif	1
632	1861-20-19.01.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18 tif\1861-20-19.01.tif	1
633	1861-20-19.02-03.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18 tif\1861-20-19.02-03.tif	1
634	1861-20-19.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18 tif\1861-20-19.tif	1
635	1861-20-20.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18 tif\1861-20-20.tif	1
636	1861-20-21.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18 tif\1861-20-21.tif	1
637	1861-20-18 СБ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18-21\1861-20-18 СБ.tif	1
638	1861-20-18.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18-21\1861-20-18.tif	1
639	1861-20-18[1].ДОД.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18-21\1861-20-18[1].ДОД.tif	1
640	1861-20-19.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18-21\1861-20-19.tif	1
641	1861-20-19[1].01.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18-21\1861-20-19[1].01.tif	1
642	1861-20-19[1].02-03.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18-21\1861-20-19[1].02-03.tif	1
643	1861-20-20.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18-21\1861-20-20.tif	1
644	1861-20-21.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-18-21\1861-20-21.tif	1
645	1861-20-27 DoD.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27 tif\1861-20-27 DoD.tif	1
646	1861-20-27 ВП.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27 tif\1861-20-27 ВП.tif	1
647	1861-20-27 ВС.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27 tif\1861-20-27 ВС.tif	1
648	1861-20-27 ДВМ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27 tif\1861-20-27 ДВМ.tif	1
649	1861-20-27 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27 tif\1861-20-27 СБ_001.tif	1
650	1861-20-27.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27 tif\1861-20-27.tif	1
651	1861-20-25 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-25 СБ_001.tif	1
652	1861-20-25 СБ_002.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-25 СБ_002.tif	1
653	1861-20-25.01-06.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-25.01-06.tif	1

1921	654	1861-20-25.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-25.tif	1
1922	655	1861-20-26 СБ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-26 СБ.tif	1
1923	656	1861-20-26.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-26.tif	1
1924	657	1861-20-27 DoD.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-27 DoD.tif	1
1925	658	1861-20-27 ВП.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-27 ВП.tif	1
1926	659	1861-20-27 ВС.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-27 ВС.tif	1
1927	660	1861-20-27 ДВМ.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-27 ДВМ.tif	1
1928	661	1861-20-27 СБ_001.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-27 СБ_001.tif	1
1929	662	1861-20-27.tif	DRAWINGS\ST - Diversion tunnel Intake\Paratoia\1861-20-27.zip4\1861-20-27.tif	1

ST - Diversion Tunnels erosion **Total available files per this item** 1

n°	ID	File Name	Path	Group
1930	663	340ЮР-80.1-22-1П3	DRAWINGS\ST - Diversion Tunnels erosion\340ЮР-80.1-22-1П3 Рекомендации по учету	1

ST - Down stream gate chamber **Total available files per this item** 4

n°	ID	File Name	Path	Group
1931	664	1861-55-36_001.pdf	DRAWINGS\ST - Down stream gate chamber\1861-55-36\1861-55-36_001.pdf	1
1932	665	1861-55-36_002.pdf	DRAWINGS\ST - Down stream gate chamber\1861-55-36\1861-55-36_002.pdf	1
1933	666	1861-55-36_003.pdf	DRAWINGS\ST - Down stream gate chamber\1861-55-36\1861-55-36_003.pdf	1
1934	667	1861-55-36_004.pdf	DRAWINGS\ST - Down stream gate chamber\1861-55-36\1861-55-36_004.pdf	1

ST1 - Diversion **Total available files per this item** 489

n°	ID	File Name	Path	Group
1935	668	1079-22-20 ОРП.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-20 ОРП.TIF	1
1936	669	1079-22-74.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-74.TIF	1
1937	670	1861-18-18 грп.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-18-18 грп.TIF	1
1938	671	1861-18-4 ГРП _001.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-18-4 ГРП _001.TIF	1
1939	672	1861-18-4 ГРП _002.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-18-4 ГРП _002.TIF	1
1940	673	1861-55-03.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-55-03.TIF	1
1941	674	20090319-102253.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-130 kj\20090319-102253.TIF	1
1942	675	20090319-102423.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-130 kj\20090319-102423.TIF	1
1943	676	20090319-102603.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-130 kj\20090319-102603.TIF	1
1944	677	1079-14-59_001.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-59\1079-14-59_001.TIF	1
1945	678	1079-14-59_002.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-59\1079-14-59_002.TIF	1
1946	679	20100224-143305.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-66 A,B\20100224-143305.TIF	1
1947	680	20100224-143357.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-66 A,B\20100224-143357.TIF	1
1948	681	20100224-143637.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-66 A,B\20100224-143637.TIF	1
1949	682	20100224-143741.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-66 A,B\20100224-143741.TIF	1
1950	683	20100224-143838.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-66 A,B\20100224-143838.TIF	1
1951	684	1079-14-78_001.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-78\1079-14-78_001.TIF	1
1952	685	1079-14-78_002.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-14-78\1079-14-78_002.TIF	1
1953	686	20090302-151711.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090302-151711.TIF	1

1954	687	20090302-151903.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090302-151903.TIF	1
1955	688	20090302-152021.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090302-152021.TIF	1
1956	689	20090302-152144.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090302-152144.TIF	1
1957	690	20090302-152255.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090302-152255.TIF	1
1958	691	20090302-152450.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090302-152450.TIF	1
1959	692	20090302-152612.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090302-152612.TIF	1
1960	693	20090302-152724.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090302-152724.TIF	1
1961	694	20090305-145611.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-64\20090305-145611.TIF	1
1962	695	1079-22-77 ʌ2.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-77\1079-22-77 ʌ2.TIF	1
1963	696	1079-22-77 ʌ3.TIF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-77\1079-22-77 ʌ3.TIF	1
1964	697	20090812-160652.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-160652.PDF	1
1965	698	20090812-160810.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-160810.PDF	1
1966	699	20090812-160950.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-160950.PDF	1
1967	700	20090812-161053.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-161053.PDF	1
1968	701	20090812-161153.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-161153.PDF	1
1969	702	20090812-161308.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-161308.PDF	1
1970	703	20090812-161449.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-161449.PDF	1
1971	704	20090812-161706.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-161706.PDF	1
1972	705	20090812-161806.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-161806.PDF	1
1973	706	20090812-161903.PDF	DRAWINGS\ST1 - Diversion\as built dr\1079-22-87\20090812-161903.PDF	1
1974	707	1861-18-14-1 ʌ.1.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-18-14-I\1861-18-14-1 ʌ.1.TIF	1
1975	708	1861-18-14-1 ʌ.2.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-18-14-I\1861-18-14-1 ʌ.2.TIF	1
1976	709	1861-18-14-1 ʌ.3.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-18-14-I\1861-18-14-1 ʌ.3.TIF	1
1977	710	1861-18-14-1 ʌ.4.tif	DRAWINGS\ST1 - Diversion\as built dr\1861-18-14-I\1861-18-14-1 ʌ.4.tif	1
1978	711	1861-18-14-1 ʌ.5.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-18-14-I\1861-18-14-1 ʌ.5.TIF	1
1979	712	084429.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\084429.TIF	1
1980	713	084503.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\084503.TIF	1
1981	714	084625.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\084625.TIF	1
1982	715	084704.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\084704.TIF	1
1983	716	084746.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\084746.TIF	1
1984	717	084823.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\084823.TIF	1
1985	718	084908.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\084908.TIF	1
1986	719	085003.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\085003.TIF	1
1987	720	1861-20-01-1 ʌ.5.tif	DRAWINGS\ST1 - Diversion\as built dr\1861-20-01-I\1861-20-01-1 ʌ.5.tif	1
1988	721	085343.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085343.TIF	1
1989	722	085420.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085420.TIF	1
1990	723	085505.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085505.TIF	1
1991	724	085546.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085546.TIF	1
1992	725	085638.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085638.TIF	1
1993	726	085720.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085720.TIF	1
1994	727	085805.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085805.TIF	1

1995	728	085851.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085851.TIF	1
1996	729	085935.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-20-02-I\085935.TIF	1
1997	730	091231.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-25-I\091231.TIF	1
1998	731	091314.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-25-I\091314.TIF	1
1999	732	091404.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-25-I\091404.TIF	1
2000	733	091522.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-29-I\091522.TIF	1
2001	734	091610.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-29-I\091610.TIF	1
2002	735	091727.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-29-I\091727.TIF	1
2003	736	091815.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-29-I\091815.TIF	1
2004	737	1861-22-72-1_001.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-72-1\1861-22-72-1_001.TIF	1
2005	738	1861-22-72-1_002.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-72-1\1861-22-72-1_002.TIF	1
2006	739	20091221-161223.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-9-1\20091221-161223.TIF	1
2007	740	20091221-161336.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-9-1\20091221-161336.TIF	1
2008	741	20091221-161430.TIF	DRAWINGS\ST1 - Diversion\as built dr\1861-22-9-1\20091221-161430.TIF	1
2009	742	1079-03-205 л.1.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-205 л.1.TIF	1
2010	743	1079-03-205 л.2.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-205 л.2.TIF	1
2011	744	1079-03-233л2.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-233л2.TIF	1
2012	745	1079-03-240.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-240.TIF	1
2013	746	1079-03-249 л.2.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-249 л.2.TIF	1
2014	747	1079-03-249 л.3.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-249 л.3.TIF	1
2015	748	1079-03-249 л4.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-249 л4.TIF	1
2016	749	1079-03-249.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-249.TIF	1
2017	750	1079-03-267 л.1.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-267 л.1.TIF	1
2018	751	1079-03-267 л.2.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-267 л.2.TIF	1
2019	752	1079-03-291 л.1.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-291 л.1.TIF	1
2020	753	1079-03-291 л.2.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-291 л.2.TIF	1
2021	754	1079-03-291 л.3.TIF	DRAWINGS\ST1 - Diversion\geology\1079-03-291 л.3.TIF	1
2022	755	091934.TIF	DRAWINGS\ST1 - Diversion\monitoring\1861-22-103 KIA\091934.TIF	1
2023	756	092018.TIF	DRAWINGS\ST1 - Diversion\monitoring\1861-22-103 KIA\092018.TIF	1
2024	757	092053.TIF	DRAWINGS\ST1 - Diversion\monitoring\1861-22-103 KIA\092053.TIF	1
2025	758	092127.TIF	DRAWINGS\ST1 - Diversion\monitoring\1861-22-103 KIA\092127.TIF	1
2026	759	20100218-101155.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-101155.TIF	1
2027	760	20100218-101654.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-101654.TIF	1
2028	761	20100218-102113.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-102113.TIF	1
2029	762	20100218-102354.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-102354.TIF	1
2030	763	20100218-102539.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-102539.TIF	1
2031	764	20100218-102708.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-102708.TIF	1
2032	765	20100218-102820.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-102820.TIF	1
2033	766	20100218-102927.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-102927.TIF	1
2034	767	20100218-102950.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-102950.TIF	1
2035	768	20100218-103047.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-103047.TIF	1

2036	769	20100218-103142.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-103142.TIF	1
2037	770	20100218-103247.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-103247.TIF	1
2038	771	20100218-103344.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-103344.TIF	1
2039	772	20100218-103447.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1861-20-05-I\20100218-103447.TIF	1
2040	773	226216dod_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2041	774	226216dod_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2042	775	226216dod_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2043	776	226216dod_04.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2044	777	226216dvm_01-02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2045	778	226216sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2046	779	226216sb_1.TIF	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2047	780	226216sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2048	781	226216sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
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2052	785	226216_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2053	786	226216_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2054	787	226216_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2055	788	226216_04.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2056	789	226216_05.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2057	790	226216_06.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
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2060	793	226216_09.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2061	794	226216_10.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2062	795	226216_11.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2063	796	226216_12.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2064	797	510062sb_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2065	798	510062sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2066	799	510062sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2067	800	510062sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2068	801	510062sp_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2069	802	510063sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2070	803	510063sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2071	804	510063sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2072	805	510064sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2073	806	510064sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2074	807	510064sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2075	808	510065sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1
2076	809	510065sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 110ЮР.1+(Облицовка стальная	1

2077	810	510065sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2078	811	510066sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
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2081	814	510067sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
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2084	817	510068sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2085	818	510068sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2086	819	510068sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2087	820	510069sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
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2089	822	510069sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2090	823	510070sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
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2093	826	510071sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2094	827	510071sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2095	828	510071sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
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2099	832	510073sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
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2104	837	510074sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2105	838	510075sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2106	839	510075sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
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2108	841	510076sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2109	842	510076sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2110	843	510076sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2111	844	510077sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
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2114	847	510078sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2115	848	510078sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2116	849	510078sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2117	850	510079sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1

2118	851	510079sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2119	852	510079sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2120	853	510080sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2121	854	510080sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2122	855	510080sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2123	856	510081sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2124	857	510081sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2125	858	510081sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2126	859	510082sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2127	860	510082sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2128	861	510082sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2129	862	569964sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2130	863	569964sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2131	864	569964sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2132	865	569965sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2133	866	569965sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2134	867	569965sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2135	868	569966sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2136	869	569966sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2137	870	569967sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2138	871	569967sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2139	872	569968sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2140	873	569968sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2141	874	Облицовка стальная	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 110ЮР.1+(Облицовка стальная	1
2142	875	226218dod_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2143	876	226218dod_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2144	877	226218dvm.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2145	878	226218sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2146	879	226218sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2147	880	226218vs.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2148	881	226218_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2149	882	226218_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2150	883	226218_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2151	884	569977sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2152	885	569977sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2153	886	569977sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2154	887	569978sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2155	888	569978sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2156	889	569978sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2157	890	569979sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1
2158	891	569979sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 111ЮР.1 +(3 тунн за рем затв)	1

2159	892	569979sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2160	893	569980sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2161	894	569980sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2162	895	569980sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2163	896	Входящие.rar	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2164	897	карточка.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2165	898	226215_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2166	899	510157sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2167	900	510157sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2168	901	569960_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2169	902	569975sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2170	903	569975sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2171	904	569976sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2172	905	569976sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 111ЮР.1 +(3 тунн за рем затв)	1
2173	906	226215dod_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2174	907	226215dod_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2175	908	226215dvm_01-02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2176	909	226215sb_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2177	910	226215sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2178	911	226215sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\226215sp.	1
2179	912	226215vs.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\226215vs.	1
2180	913	226215_01-02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\226215_01	1
2181	914	226215_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\226215_03.	1
2182	915	510061sb_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2183	916	510061sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2184	917	510061sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2185	918	510061sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2186	919	510061_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\510061_01.	1
2187	920	510157sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\510157sb.	1
2188	921	510157sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\510157sp.	1
2189	922	569960sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\569960sb.	1
2190	923	569960sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2191	924	569960sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2192	925	569960_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\569960_01.	1
2193	926	569961sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\569961sb.	1
2194	927	569961sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2195	928	569961sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2196	929	569962sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\569962sb.	1
2197	930	569962sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2198	931	569962sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)	1
2199	932	569963sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 135ЮР.1+(нач. участок)\569963sb.	1

2200	933	569963sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 135ЮР.1+(нач. участок)\569963sp.	1
2201	934	569975sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 135ЮР.1+(нач. участок)\569975sb.	1
2202	935	569975sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 135ЮР.1+(нач. участок)\569975sp.	1
2203	936	569976sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 135ЮР.1+(нач. участок)\569976sb.	1
2204	937	569976sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 135ЮР.1+(нач. участок)\569976sp.	1
2205	938	226243dod_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2206	939	226243dod_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2207	940	226243dod_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2208	941	226243dvm_01-02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2209	942	226243sb_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2210	943	226243sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2211	944	226243sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2212	945	226243sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2213	946	226243vs.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2214	947	226243_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2215	948	226243_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2216	949	226243_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2217	950	226243_04.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2218	951	226243_05.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2219	952	226243_06.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2220	953	226243_07.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2221	954	226243_08.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2222	955	226243_09.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2223	956	226243_10.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2224	957	226243_11.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2225	958	226243_12.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2226	959	226243_13.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2227	960	226243_14.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2228	961	226243_15.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2229	962	226243_16.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2230	963	226243_17.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2231	964	226243_18.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2232	965	226243_19.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2233	966	226243_20.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2234	967	510236sb_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2235	968	510236sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2236	969	510236sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2237	970	510236sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2238	971	510237sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2239	972	510237sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1
2240	973	510237sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 96ЮР.1+(Облицовка стальная 3	1

2241	974	510238sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2242	975	510238sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2243	976	510238sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2244	977	510239sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2245	978	510239sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2246	979	510239sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2247	980	510240sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2248	981	510240sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2249	982	510240sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2250	983	510241sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2251	984	510241sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2252	985	510241sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2253	986	510242sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2254	987	510242sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2255	988	510242sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 96ЮР.1+(Облицовка стальная 3	1
2256	989	226238dod_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238dod_01.tif	1
2257	990	226238dod_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238dod_02.tif	1
2258	991	226238dod_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238dod_03.tif	1
2259	992	226238dod_04.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238dod_04.tif	1
2260	993	226238dod_05.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238dod_05.tif	1
2261	994	226238dod_06.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238dod_06.tif	1
2262	995	226238dod_07.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238dod_07.tif	1
2263	996	226238dvm_01-02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238dvm_01-02.tif	1
2264	997	226238sb_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238sb_01.tif	1
2265	998	226238sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238sb_02.tif	1
2266	999	226238sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238sp.tif	1
2267	1000	226238vs_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238vs_01.tif	1
2268	1001	226238vs_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238vs_02.tif	1
2269	1002	226238vs_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238vs_03.tif	1
2270	1003	226238vs_04.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238vs_04.tif	1
2271	1004	226238_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238_01.tif	1
2272	1005	226238_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238_02.tif	1
2273	1006	226238_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238_03.tif	1
2274	1007	226238_04.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238_04.tif	1
2275	1008	226238_05.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\226238_05.tif	1
2276	1009	510185sb_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510185sb_01.tif	1
2277	1010	510185sb_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510185sb_02.tif	1
2278	1011	510185sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510185sp_01.tif	1
2279	1012	510185sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510185sp_02.tif	1
2280	1013	510185sp_03.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510185sp_03.tif	1
2281	1014	510185_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510185_01.tif	1

2282	1015	510186sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510186sb.tif	1
2283	1016	510186sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510186sp_01.tif	1
2284	1017	510186sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510186sp_02.tif	1
2285	1018	510187sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510187sb.tif	1
2286	1019	510187sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510187sp.tif	1
2287	1020	510188sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510188sb.tif	1
2288	1021	510188sp.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510188sp.tif	1
2289	1022	510189sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510189sb.tif	1
2290	1023	510189sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510189sp_01.tif	1
2291	1024	510189sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510189sp_02.tif	1
2292	1025	510190sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510190sb.tif	1
2293	1026	510190sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510190sp_01.tif	1
2294	1027	510190sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510190sp_02.tif	1
2295	1028	510191sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510191sb.tif	1
2296	1029	510191sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510191sp_01.tif	1
2297	1030	510191sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510191sp_02.tif	1
2298	1031	510192sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510192sb.tif	1
2299	1032	510192sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510192sp_01.tif	1
2300	1033	510192sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510192sp_02.tif	1
2301	1034	510193sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510193sb.tif	1
2302	1035	510193sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510193sp_01.tif	1
2303	1036	510193sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510193sp_02.tif	1
2304	1037	510194sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510194sb.tif	1
2305	1038	510194sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510194sp_01.tif	1
2306	1039	510194sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510194sp_02.tif	1
2307	1040	510195sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510195sb.tif	1
2308	1041	510195sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510195sp_01.tif	1
2309	1042	510195sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510195sp_02.tif	1
2310	1043	510196sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510196sb.tif	1
2311	1044	510196sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510196sp_01.tif	1
2312	1045	510196sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510196sp_02.tif	1
2313	1046	510197sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510197sb.tif	1
2314	1047	510197sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510197sp_01.tif	1
2315	1048	510197sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510197sp_02.tif	1
2316	1049	510198sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510198sb.tif	1
2317	1050	510198sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510198sp_01.tif	1
2318	1051	510198sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510198sp_02.tif	1
2319	1052	510199sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510199sb.tif	1
2320	1053	510199sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510199sp_01.tif	1
2321	1054	510199sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510199sp_02.tif	1
2322	1055	510200sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510200sb.tif	1

2323	1056	510200sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510200sp_01.tif	1
2324	1057	510200sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510200sp_02.tif	1
2325	1058	510201sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510201sb.tif	1
2326	1059	510201sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510201sp_01.tif	1
2327	1060	510201sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510201sp_02.tif	1
2328	1061	510202sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510202sb.tif	1
2329	1062	510202sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510202sp_01.tif	1
2330	1063	510202sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510202sp_02.tif	1
2331	1064	510203sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510203sb.tif	1
2332	1065	510203sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510203sp_01.tif	1
2333	1066	510203sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510203sp_02.tif	1
2334	1067	510204sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510204sb.tif	1
2335	1068	510204sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510204sp_01.tif	1
2336	1069	510204sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510204sp_02.tif	1
2337	1070	510205sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510205sb.tif	1
2338	1071	510205sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510205sp_01.tif	1
2339	1072	510205sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510205sp_02.tif	1
2340	1073	510206sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510206sb.tif	1
2341	1074	510206sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510206sp_01.tif	1
2342	1075	510206sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510206sp_02.tif	1
2343	1076	510207sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510207sb.tif	1
2344	1077	510207sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510207sp_01.tif	1
2345	1078	510207sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510207sp_02.tif	1
2346	1079	510208sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510208sb.tif	1
2347	1080	510208sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510208sp_01.tif	1
2348	1081	510208sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510208sp_02.tif	1
2349	1082	510209sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510209sb.tif	1
2350	1083	510209sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510209sp_01.tif	1
2351	1084	510209sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510209sp_02.tif	1
2352	1085	510210sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510210sb.tif	1
2353	1086	510210sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510210sp_01.tif	1
2354	1087	510210sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510210sp_02.tif	1
2355	1088	510211sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510211sb.tif	1
2356	1089	510211sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510211sp_01.tif	1
2357	1090	510211sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510211sp_02.tif	1
2358	1091	510212sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510212sb.tif	1
2359	1092	510212sp_01tif.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510212sp_01tif.tif	1
2360	1093	510212sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510212sp_02.tif	1
2361	1094	510213sb.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510213sb.tif	1
2362	1095	510213sp_01.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510213sp_01.tif	1
2363	1096	510213sp_02.tif	DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1A 97ЮР.1+\510213sp_02.tif	1

2364	**1097**	**510214sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510214sb.tif**	**1**
2365	**1098**	**510214sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510214sp_01.tif**	**1**
2366	**1099**	**510214sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510214sp_02.tif**	**1**
2367	**1100**	**510215sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510215sb.tif**	**1**
2368	**1101**	**510215sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510215sp_01.tif**	**1**
2369	**1102**	**510215sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510215sp_02.tif**	**1**
2370	**1103**	**510216sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510216sb.tif**	**1**
2371	**1104**	**510216sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510216sp_01.tif**	**1**
2372	**1105**	**510216sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510216sp_02.tif**	**1**
2373	**1106**	**510217sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510217sb.tif**	**1**
2374	**1107**	**510217sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510217sp_01.tif**	**1**
2375	**1108**	**510217sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510217sp_02.tif**	**1**
2376	**1109**	**510218sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510218sb.tif**	**1**
2377	**1110**	**510218sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510218sp_01.tif**	**1**
2378	**1111**	**510218sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1+\510218sp_02.tif**	**1**
2379	**1112**	**226252dod_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252dod_01.**	**1**
2380	**1113**	**226252dod_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252dod_02.**	**1**
2381	**1114**	**226252dvm_01-02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252dvm_01**	**1**
2382	**1115**	**226252sb_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252sb_01.tif**	**1**
2383	**1116**	**226252sb_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252sb_02.tif**	**1**
2384	**1117**	**226252sb_03.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252sb_03.tif**	**1**
2385	**1118**	**226252sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252sp_01.tif**	**1**
2386	**1119**	**226252sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252sp_02.tif**	**1**
2387	**1120**	**226252vs.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226252vs.tif**	**1**
2388	**1121**	**226264vp.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\226264vp.tif**	**1**
2389	**1122**	**510324sb_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510324sb_01.tif**	**1**
2390	**1123**	**510324sb_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510324sb_02.tif**	**1**
2391	**1124**	**510324sb_03.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510324sb_03.tif**	**1**
2392	**1125**	**510324sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510324sp_01.tif**	**1**
2393	**1126**	**510324sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510324sp_02.tif**	**1**
2394	**1127**	**510325sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510325sb.tif**	**1**
2395	**1128**	**510325sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510325sp_01.tif**	**1**
2396	**1129**	**510325sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510325sp_02.tif**	**1**
2397	**1130**	**510326sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510326sb.tif**	**1**
2398	**1131**	**510326sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510326sp_01.tif**	**1**
2399	**1132**	**510326sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510326sp_02.tif**	**1**
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2401	**1134**	**510328sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510328sb.tif**	**1**
2402	**1135**	**510328sp_01.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510328sp_01.tif**	**1**
2403	**1136**	**510328sp_02.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510328sp_02.tif**	**1**
2404	**1137**	**510329sb.tif**	**DRAWINGS\ST1 - Diversion\Облицовки 1-й стр туннель\1А 97ЮР.1.1(конечная)\510329sb.tif**	**1**

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2418	1151	1861-22-67-1_001.TIF	DRAWINGS\ST1 - Diversion\цементация\1861-22-67-1_001.TIF	1
2419	1152	1861-27-18-1.TIF	DRAWINGS\ST1 - Diversion\цементация\1861-27-18-1.TIF	1
2420	1153	561Ц-НПО-4-297212.TIF	DRAWINGS\ST1 - Diversion\цементация\561Ц-НПО-4-297212.TIF	1
2421	1154	561Ц-НПО-4-297241_001.	DRAWINGS\ST1 - Diversion\цементация\561Ц-НПО-4-297241_001.TIF	1
2422	1155	561Ц-НПО-4-297241_002.	DRAWINGS\ST1 - Diversion\цементация\561Ц-НПО-4-297241_002.TIF	1
2423	1156	561ц-нпо-4-297265.TIF	DRAWINGS\ST1 - Diversion\цементация\561ц-нпо-4-297265.TIF	1

ST2 - Diversion **Total available files per this item** 120

n°	ID	File Name	Path	Group
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2425	1158	1079-9.TIF	DRAWINGS\ST2 - Diversion\1079-9.TIF	1
2426	1159	1861-14-17-1.TIF	DRAWINGS\ST2 - Diversion\1861-14-17-1.TIF	1
2427	1160	1861-22-109-1.TIF	DRAWINGS\ST2 - Diversion\1861-22-109-1.TIF	1
2428	1161	1861-22-119-1.TIF	DRAWINGS\ST2 - Diversion\1861-22-119-1.TIF	1
2429	1162	1861-22-15-1.TIF	DRAWINGS\ST2 - Diversion\1861-22-15-1.TIF	1
2430	1163	1861-22-32-1.TIF	DRAWINGS\ST2 - Diversion\1861-22-32-1.TIF	1
2431	1164	1861-22-41-1Изм.2.TIF	DRAWINGS\ST2 - Diversion\1861-22-41-1Изм.2.TIF	1
2432	1165	1861-22-49-1_001.TIF	DRAWINGS\ST2 - Diversion\1861-22-49-1_001.TIF	1
2433	1166	1861-27-17-1_001.TIF	DRAWINGS\ST2 - Diversion\1861-27-17-1_001.TIF	1
2434	1167	1861-27-18-1.TIF	DRAWINGS\ST2 - Diversion\1861-27-18-1.TIF	1
2435	1168	561Ц-НПО-4-297213.TIF	DRAWINGS\ST2 - Diversion\561Ц-НПО-4-297213.TIF	1
2436	1169	561Ц-НПО-4-297242.TIF	DRAWINGS\ST2 - Diversion\561Ц-НПО-4-297242.TIF	1
2437	1170	1079-22-77 л2.TIF	DRAWINGS\ST2 - Diversion\1079-22-77\1079-22-77 л2.TIF	1
2438	1171	1079-22-77 л3.TIF	DRAWINGS\ST2 - Diversion\1079-22-77\1079-22-77 л3.TIF	1
2439	1172	20091120-134340.TIF	DRAWINGS\ST2 - Diversion\1079-22-86 Л8 Изм грп\20091120-134340.TIF	1
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2517	1250	226266dwm.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266dwm.tif	1
2518	1251	226266sb_01.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266sb_01.tif	1
2519	1252	226266sb_02.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266sb_02.tif	1
2520	1253	226266sp_01.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266sp_01.tif	1
2521	1254	226266sp_02.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266sp_02.tif	1
2522	1255	226266_01.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_01.tif	1
2523	1256	226266_02.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_02.tif	1
2524	1257	226266_03-04.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_03-04.tif	1

2525	1258	226266_05-06.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_05-06.tif	1
2526	1259	226266_07.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_07.tif	1
2527	1260	226266_08-09.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_08-09.tif	1
2528	1261	226266_10-11.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_10-11.tif	1
2529	1262	226266_13-14.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_13-14.tif	1
2530	1263	226266_15-16.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_15-16.tif	1
2531	1264	226266_17-19.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_17-19.tif	1
2532	1265	226266_20-21.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 96ЮР_2\226266_20-21.tif	1
2533	1266	226277dod.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277dod.tif	1
2534	1267	226277dvm.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277dvm.tif	1
2535	1268	226277sb_01.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277sb_01.tif	1
2536	1269	226277sb_02.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277sb_02.tif	1
2537	1270	226277sp_01.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277sp_01.tif	1
2538	1271	226277sp_02.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277sp_02.tif	1
2539	1272	226277_01-02.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277_01-02.tif	1
2540	1273	226277_03-04.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277_03-04.tif	1
2541	1274	226277_05-06.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277_05-06.tif	1
2542	1275	226277_07-08.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277_07-08.tif	1
2543	1276	226277_09-10.tif	DRAWINGS\ST2 - Diversion\Облицовки 2-й стр туннель\1A 97ЮР_2\226277_09-10.tif	1

ST3 - Diversion **Total available files per this item** 20

n°	ID	File Name	Path	Group
2544	1277	1861-22-89_001.pdf	DRAWINGS\ST3 - Diversion\1861-22-89 котлован СТ-3\1861-22-89_001.pdf	1
2545	1278	1861-22-89_002.pdf	DRAWINGS\ST3 - Diversion\1861-22-89 котлован СТ-3\1861-22-89_002.pdf	1
2546	1279	1861-55-24_001изм.pdf	DRAWINGS\ST3 - Diversion\1861-55-24\1861-55-24_001изм.pdf	1
2547	1280	1861-55-24_002.pdf	DRAWINGS\ST3 - Diversion\1861-55-24\1861-55-24_002.pdf	1
2548	1281	1861-55-24_002.tif	DRAWINGS\ST3 - Diversion\1861-55-24\1861-55-24_002.tif	1
2549	1282	1861-55-24_03изм.pdf	DRAWINGS\ST3 - Diversion\1861-55-24\1861-55-24_03изм.pdf	1
2550	1283	1861-55-32_001.pdf	DRAWINGS\ST3 - Diversion\1861-55-32\1861-55-32_001.pdf	1
2551	1284	1861-55-32_002.pdf	DRAWINGS\ST3 - Diversion\1861-55-32\1861-55-32_002.pdf	1
2552	1285	1861-55-32_003.pdf	DRAWINGS\ST3 - Diversion\1861-55-32\1861-55-32_003.pdf	1
2553	1286	1861-55-33_001.pdf	DRAWINGS\ST3 - Diversion\1861-55-33\1861-55-33_001.pdf	1
2554	1287	1861-55-33_002.pdf	DRAWINGS\ST3 - Diversion\1861-55-33\1861-55-33_002.pdf	1
2555	1288	1861-55-33_003.pdf	DRAWINGS\ST3 - Diversion\1861-55-33\1861-55-33_003.pdf	1
2556	1289	1861-60-16_001.pdf	DRAWINGS\ST3 - Diversion\1861-60-16 изм.1\1861-60-16_001.pdf	1
2557	1290	1861-60-16_002.pdf	DRAWINGS\ST3 - Diversion\1861-60-16 изм.1\1861-60-16_002.pdf	1
2558	1291	1861-60-16_003.pdf	DRAWINGS\ST3 - Diversion\1861-60-16 изм.1\1861-60-16_003.pdf	1
2559	1292	1861-60-16_004.pdf	DRAWINGS\ST3 - Diversion\1861-60-16 изм.1\1861-60-16_004.pdf	1
2560	1293	1861-60-16_005.pdf	DRAWINGS\ST3 - Diversion\1861-60-16 изм.1\1861-60-16_005.pdf	1
2561	1294	1861-60-16_006.pdf	DRAWINGS\ST3 - Diversion\1861-60-16 изм.1\1861-60-16_006.pdf	1
2562	1295	1861-60-16_007.pdf	DRAWINGS\ST3 - Diversion\1861-60-16 изм.1\1861-60-16_007.pdf	1

2563	1296	1861-60-16_008.pdf	DRAWINGS\ST3 - Diversion\1861-60-16 изм.1\1861-60-16_008.pdf	1

Test chamber **Total available files per this item** 4

n°	ID	File Name	Path	Group
2564	1297	561ТП-4-8-13765.PDF	DRAWINGS\Test chamber\561ТП-4-8-13765.PDF	1
2565	336	561ТП-4-8-13765.PDF	DRAWINGS 04\Test chamber\561ТП-4-8-13765.PDF	4
2566	337	561Ц-4-297537.PDF	DRAWINGS 04\Test chamber\561Ц-4-297537.PDF	4
2567	338	test Chamber.pdf	DRAWINGS 04\Test chamber\test Chamber.pdf	4

Transformer Chamber **Total available files per this item** 21

n°	ID	File Name	Path	Group
2568	1298	1079-14-84 l1.TIF	DRAWINGS\Transformer Chamber\1079-14-84 B\1079-14-84 l1.TIF	1
2569	1299	1079-14-84 l3.TIF	DRAWINGS\Transformer Chamber\1079-14-84 B\1079-14-84 l3.TIF	1
2570	1300	1079-14-84 B л4.TIF	DRAWINGS\Transformer Chamber\1079-14-84 B\1079-14-84 B л4.TIF	1
2571	1301	20090430-095953.TIF	DRAWINGS\Transformer Chamber\1079-14-84 B\20090430-095953.TIF	1
2572	1302	20110520111144601.tif	DRAWINGS\Transformer Chamber\1101-55-1\20110520111144601.tif	1
2573	1303	20110520111515473.tif	DRAWINGS\Transformer Chamber\1101-55-1\20110520111515473.tif	1
2574	1304	20110520112304730.tif	DRAWINGS\Transformer Chamber\1101-55-1\20110520112304730.tif	1
2575	1305	1861-14-6-01.01_001.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6-01.01_001.tif	1
2576	1306	1861-14-6-01.02_001.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6-01.02_001.tif	1
2577	1307	1861-14-6-01.03_001.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6-01.03_001.tif	1
2578	1308	1861-14-6-02.00_001.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6-02.00_001.tif	1
2579	1309	1861-14-6_001.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6_001.tif	1
2580	1310	1861-14-6_002.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6_002.tif	1
2581	1311	1861-14-6_003.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6_003.tif	1
2582	1312	1861-14-6_004.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6_004.tif	1
2583	1313	1861-14-6_005.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6_005.tif	1
2584	1314	1861-14-6_006.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6_006.tif	1
2585	1315	1861-14-6_007.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6_007.tif	1
2586	1316	1861-14-6_008.tif	DRAWINGS\Transformer Chamber\1861-14-6\1861-14-6_008.tif	1
2587	339	TRANSFORMER CHAMBER.	DRAWINGS 04\Transformer Chamber\TRANSFORMER CHAMBER.pdf	4
2588	340	561ц-нпо-4-5297277.PDF	DRAWINGS 04\Transformer Chamber\цементация\561ц-нпо-4-5297277.PDF	4

Transportation Tunnels **Total available files per this item** 6

n°	ID	File Name	Path	Group
2589	341	T-37'.pdf	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-37'.pdf	4
2590	342	T1.pdf	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T1.pdf	4
2591	343	T2.pdf	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T2.pdf	4
2592	344	T3'.pdf	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T3'.pdf	4
2593	345	T6.pdf	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T6.pdf	4
2594	346	T8.pdf	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T8.pdf	4

Transportation Tunnels\T-1 **Total available files per this item** 6

n°	ID	File Name	Path	Group
2595	347	561TK-4-VII-15524.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-1\561TK-4-VII-15524.PDF	4
2596	348	561TK-4-VII-15540.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-1\561TK-4-VII-15540.PDF	4
2597	349	561TK-4-VII-16110.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-1\561TK-4-VII-16110.PDF	4
2598	350	561TP-4-VII-21202.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-1\561TP-4-VII-21202.PDF	4
2599	351	561Ц-4-VII-7101.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-1\561Ц-4-VII-7101.PDF	4
2600	352	T-1.docx	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-1\T-1.docx	4

Transportation Tunnels\T-2 **Total available files per this item** 18

n°	ID	File Name	Path	Group
2601	1317	561-OTK-4-7-1815674.TIF	DRAWINGS\Transportation Tunnels\T-2\as built dr\561-OTK-4-7-1815674.TIF	1
2602	1318	561OTK-4-7-1815675.TIF	DRAWINGS\Transportation Tunnels\T-2\as built dr\561OTK-4-7-1815675.TIF	1
2603	1319	1079-03-215_001.TIF	DRAWINGS\Transportation Tunnels\T-2\геология\1079-03-215_001.TIF	1
2604	1320	1079-03-215_002.TIF	DRAWINGS\Transportation Tunnels\T-2\геология\1079-03-215_002.TIF	1
2605	1321	1079-03-251_001.TIF	DRAWINGS\Transportation Tunnels\T-2\геология\1079-03-251_001.TIF	1
2606	1322	1079-03-251_002.TIF	DRAWINGS\Transportation Tunnels\T-2\геология\1079-03-251_002.TIF	1
2607	1323	1079-03-269_001.TIF	DRAWINGS\Transportation Tunnels\T-2\геология\1079-03-269_001.TIF	1
2608	1324	1079-03-405_001.TIF	DRAWINGS\Transportation Tunnels\T-2\геология\1079-03-405_001.TIF	1
2609	1325	561Ц-НПО-4-297237.TIF	DRAWINGS\Transportation Tunnels\T-2\цементация\561Ц-НПО-4-297237.TIF	1
2610	353	561ТП-4-VII-11596.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-11596.PDF	4
2611	354	561ТП-4-VII-11605.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-11605.PDF	4
2612	355	561ТП-4-VII-116122A.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-116122A.PDF	4
2613	356	561ТП-4-VII-116134.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-116134.PDF	4
2614	357	561ТП-4-VII-116143.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-116143.TIF	4
2615	358	561ТП-4-VII-116159.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-116159.PDF	4
2616	359	561ТП-4-VII-11663.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-11663.PDF	4
2617	360	561ТП-4-VII-11687.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-11687.PDF	4
2618	361	561ТП-4-VII-13458.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-2\561ТП-4-VII-13458.PDF	4

Transportation Tunnels\T-22 **Total available files per this item** 9

n°	ID	File Name	Path	Group
2619	1326	1861-22-79-1_001.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-22-79-1_001.TIF	1
2620	1327	1861-22-79-1_002.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-22-79-1_002.TIF	1
2621	1328	20091019-162304.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-55-04\20091019-162304.TIF	1
2622	1329	20091019-162550.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-55-04\20091019-162550.TIF	1
2623	1330	20091019-162749.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-55-04\20091019-162749.TIF	1
2624	1331	20091019-162948.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-55-04\20091019-162948.TIF	1
2625	1332	20091019-163840.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-55-04\20091019-163840.TIF	1
2626	1333	20091019-164222.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-55-04\20091019-164222.TIF	1
2627	1334	20091019-165052.TIF	DRAWINGS\Transportation Tunnels\T-22\1861-55-04\20091019-165052.TIF	1

Transportation Tunnels\T-3 **Total available files per this item** 9

n°	ID	File Name	Path	Group
2628	1335	1079-03-313_001.TIF	DRAWINGS\Transportation Tunnels\T-3\1079-03-313_001.TIF	1
2629	1336	1079-03-407_001.TIF	DRAWINGS\Transportation Tunnels\T-3\1079-03-407_001.TIF	1
2630	1337	1079-03-407_002.TIF	DRAWINGS\Transportation Tunnels\T-3\1079-03-407_002.TIF	1
2631	1338	150601.TIF	DRAWINGS\Transportation Tunnels\T-3\150601.TIF	1
2632	1339	150705.TIF	DRAWINGS\Transportation Tunnels\T-3\150705.TIF	1
2633	1340	150901.TIF	DRAWINGS\Transportation Tunnels\T-3\150901.TIF	1
2634	1341	151241.TIF	DRAWINGS\Transportation Tunnels\T-3\151241.TIF	1
2635	1342	151422.TIF	DRAWINGS\Transportation Tunnels\T-3\151422.TIF	1
2636	1343	1861-03-005_4.pdf	DRAWINGS\Transportation Tunnels\T-3\1861-03-005_4.pdf	1

Transportation Tunnels\T-3! **Total available files per this item** 5

n°	ID	File Name	Path	Group
2637	1344	Л1.TIF	DRAWINGS\Transportation Tunnels\T-3!\561-ОТК-4-VII-1815569\Л1.TIF	1
2638	1345	Л2.TIF	DRAWINGS\Transportation Tunnels\T-3!\561-ОТК-4-VII-1815569\Л2.TIF	1
2639	1346	561Ц-НПО-4-297422.TIF	DRAWINGS\Transportation Tunnels\T-3!\цементация\561Ц-НПО-4-297422.TIF	1
2640	1347	561Ц-НПО-4-297452.JPG	DRAWINGS\Transportation Tunnels\T-3!\цементация\561Ц-НПО-4-297452.JPG	1
2641	1348	561Ц-НПО-4-297452.TIF	DRAWINGS\Transportation Tunnels\T-3!\цементация\561Ц-НПО-4-297452.TIF	1

Transportation Tunnels\T-37 **Total available files per this item** 3

n°	ID	File Name	Path	Group
2642	1349	11594 a.TIF	DRAWINGS\Transportation Tunnels\T-37\11594 a.TIF	1
2643	1350	297225.PDF	DRAWINGS\Transportation Tunnels\T-37\297225.PDF	1
2644	1351	297296.PDF	DRAWINGS\Transportation Tunnels\T-37\297296.PDF	1

Transportation Tunnels\T-4 **Total available files per this item** 3

n°	ID	File Name	Path	Group
2645	1352	1079-16-151_001.TIF	DRAWINGS\Transportation Tunnels\T-4\1079-16-151_001.TIF	1
2646	1353	1861-22-86-1.TIF	DRAWINGS\Transportation Tunnels\T-4\1861-22-86-1.TIF	1
2647	1354	561Ц-НПО-4-297456.TIF	DRAWINGS\Transportation Tunnels\T-4\561Ц-НПО-4-297456.TIF	1

Transportation Tunnels\T-7 **Total available files per this item** 12

n°	ID	File Name	Path	Group
2648	1355	1079-03-427_001.TIF	DRAWINGS\Transportation Tunnels\T-7\1079-03-427_001.TIF	1
2649	1356	1079-03-427_002.TIF	DRAWINGS\Transportation Tunnels\T-7\1079-03-427_002.TIF	1
2650	1357	152510.TIF	DRAWINGS\Transportation Tunnels\T-7\152510.TIF	1
2651	1358	152510.TIF.thumb.jpg	DRAWINGS\Transportation Tunnels\T-7\152510.TIF.thumb.jpg	1
2652	1359	152609.TIF	DRAWINGS\Transportation Tunnels\T-7\152609.TIF	1
2653	1360	152609.TIF.thumb.jpg	DRAWINGS\Transportation Tunnels\T-7\152609.TIF.thumb.jpg	1
2654	1361	152700.TIF	DRAWINGS\Transportation Tunnels\T-7\152700.TIF	1

2655	1362	152700.TIF.thumb.jpg	DRAWINGS\Transportation Tunnels\T-7\152700.TIF.thumb.jpg	1
2656	1363	152742.TIF	DRAWINGS\Transportation Tunnels\T-7\152742.TIF	1
2657	1364	152742.TIF.thumb.jpg	DRAWINGS\Transportation Tunnels\T-7\152742.TIF.thumb.jpg	1
2658	1365	152818.TIF	DRAWINGS\Transportation Tunnels\T-7\152818.TIF	1
2659	1366	152818.TIF.thumb.jpg	DRAWINGS\Transportation Tunnels\T-7\152818.TIF.thumb.jpg	1

Transportation Tunnels\T-8 **Total available files per this item** 13

n°	ID	File Name	Path	Group
2660	1367	1079-22-67_003.TIF	DRAWINGS\Transportation Tunnels\T-8\1079-22-67\1079-22-67_003.TIF	1
2661	1368	20100803-082147.TIF	DRAWINGS\Transportation Tunnels\T-8\1079-22-67\20100803-082147.TIF	1
2662	1369	20100803-082252.TIF	DRAWINGS\Transportation Tunnels\T-8\1079-22-67\20100803-082252.TIF	1
2663	1370	20100803-082448.TIF	DRAWINGS\Transportation Tunnels\T-8\1079-22-67\20100803-082448.TIF	1
2664	1371	20100803-082603.TIF	DRAWINGS\Transportation Tunnels\T-8\1079-22-67\20100803-082603.TIF	1
2665	1372	20100803-082707.TIF	DRAWINGS\Transportation Tunnels\T-8\1079-22-67\20100803-082707.TIF	1
2666	1373	20100803-082811.TIF	DRAWINGS\Transportation Tunnels\T-8\1079-22-67\20100803-082811.TIF	1
2667	1374	1079-03-408_001.TIF	DRAWINGS\Transportation Tunnels\T-8\геология\1079-03-408_001.TIF	1
2668	1375	1861-22-105-1_001.TIF	DRAWINGS\Transportation Tunnels\T-8\цементация\1861-22-105-1_001.TIF	1
2669	1376	1861-22-105-1_002.TIF	DRAWINGS\Transportation Tunnels\T-8\цементация\1861-22-105-1_002.TIF	1
2670	1377	1861-22-105-1_003.TIF	DRAWINGS\Transportation Tunnels\T-8\цементация\1861-22-105-1_003.TIF	1
2671	1378	297207.TIF	DRAWINGS\Transportation Tunnels\T-8\цементация\297207.TIF	1
2672	1379	297302.TIF	DRAWINGS\Transportation Tunnels\T-8\цементация\297302.TIF	1

Transportation Tunnels\T-2 **Total available files per this item** 2

n°	ID	File Name	Path	Group
2673	373	561Ц-НПО-4-297237.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-2\цементация\561Ц-НПО-4	2
2674	374	561Ц-НПО-4-297407.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-2\цементация\561Ц-НПО-4	2

Transportation Tunnels\T-3 **Total available files per this item** 10

n°	ID	File Name	Path	Group
2675	375	561ОТК-4-VII-1815557.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\жб обделка\561ОТК-4-VII	2
2676	376	561ОТК-4-VII-1815567.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\жб обделка\561ОТК-4-VII	2
2677	377	561ОТК-4-VII-1815624.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\жб обделка\561ОТК-4-VII	2
2678	378	561ТК-4-VII-13448А.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\жб обделка\561ТК-4-VII	2
2679	379	561ТК-4-VII-13468.PDF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\жб обделка\561ТК-4-VII	2
2680	380	561ТК-4-VII-15590.PDF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\жб обделка\561ТК-4-VII	2
2681	381	561ТК-4-VII-15594.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\жб обделка\561ТК-4-VII	2
2682	382	561Ц-НПО-4-297125.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\цементация\561Ц-НПО-4	2
2683	383	561Ц-НПО-4-297248 .TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\цементация\561Ц-НПО-4	2
2684	384	561Ц-НПО-4-297313.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3\цементация\561Ц-НПО-4	2

Transportation Tunnels\T-3' **Total available files per this item** 40

n°	ID	File Name	Path	Group
2685	385	561ТП-4-VII-116103 Б.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\временная крепь\561ТП-4-	2
2686	386	Л1.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\561-ОТК	2
2687	387	Л2.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\561-ОТК	2
2688	388	561ОТК-4-VII-1815572.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2689	389	561ОТК-4-VII-1815573.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2690	390	561ОТК-4-VII-1815574.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2691	391	561ОТК-4-VII-1815575.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2692	392	561ОТК-4-VII-1815576.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2693	393	561ОТК-4-VII-1815577.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2694	394	561ОТК-4-VII-1815578.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2695	395	561ОТК-4-VII-1815581_1.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2696	396	561ОТК-4-VII-1815581_2.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2697	397	561ОТК-4-VII-1815620_1.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2698	398	561ОТК-4-VII-1815620_2.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2699	399	20110127-130524.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2700	400	20110127-130644.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2701	401	20110127-130739.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	2
2702	402	561Ц-4-297568.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\цементация\561Ц-4	2
2703	403	561Ц-НПО-4-297422.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\цементация\561Ц-НПО-4	2
2704	404	561Ц-НПО-4-297452.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-3'\цементация\561Ц-НПО-4	2
2705	362	561ТП-4-VII-116103 Б.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\временная крепь\561ТП-4-	4
2706	363	Л1.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\561-ОТК	4
2707	364	Л2.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\561-ОТК	4
2708	365	561ОТК-4-VII-1815572.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2709	366	561ОТК-4-VII-1815573.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2710	367	561ОТК-4-VII-1815574.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2711	368	561ОТК-4-VII-1815575.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2712	369	561ОТК-4-VII-1815576.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2713	370	561ОТК-4-VII-1815577.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2714	371	561ОТК-4-VII-1815578.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2715	372	561ОТК-4-VII-1815581_1.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2716	373	561ОТК-4-VII-1815581_2.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2717	374	561ОТК-4-VII-1815620_1.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2718	375	561ОТК-4-VII-1815620_2.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2719	376	20110127-130524.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2720	377	20110127-130644.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2721	378	20110127-130739.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\жб армирование\жб	4
2722	379	561Ц-4-297568.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\цементация\561Ц-4	4

2723	380	561Ц-НПО-4-297422.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\цементация\561Ц-НПО-4	4
2724	381	561Ц-НПО-4-297452.TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-3'\цементация\561Ц-НПО-4	4

Transportation Tunnels\T-37 **Total available files per this item** 4

n°	ID	File Name	Path	Group
2725	405	561ТП-4-VII-11594 A.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-37\561ТП-4-VII-11594 A.TIF	2
2726	406	561Ц-НПО-4-297188.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-37\561Ц-НПО-4-297188.TIF	2
2727	407	561Ц-НПО-4-297296 .PDF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-37\561Ц-НПО-4-297296 .PDF	2
2728	408	561Ц-НПО-4-297296 .TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-37\561Ц-НПО-4-297296 .TIF	2

Transportation Tunnels\T-37' **Total available files per this item** 6

n°	ID	File Name	Path	Group
2729	382	1079-03-406.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-37'\1079-03-406.PDF	4
2730	383	561-ОТК-4-VII-1815669.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-37'\561-ОТК-4-VII-1815669.PDF	4
2731	384	561ТП-4-VII-11638.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-37'\561ТП-4-VII-11638.PDF	4
2732	385	561ТП-4-VII-11669.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-37'\561ТП-4-VII-11669.PDF	4
2733	386	561ТП-4-VII-11702.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-37'\561ТП-4-VII-11702.PDF	4
2734	387	561Ц-НПО-4-297359.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннелы\T-37'\561Ц-НПО-4-297359.PDF	4

Transportation Tunnels\T-4 **Total available files per this item** 17

n°	ID	File Name	Path	Group
2735	409	561ТП-4-7-116200_001.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\временная крепь\561ТП-4	2
2736	410	561ТП-4-7-116200_002.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\временная крепь\561ТП-4	2
2737	411	1079-16-105_003.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1079-16	2
2738	412	1079-16-151_001.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1079-16	2
2739	413	1079-16-169.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1079-16-169.	2
2740	414	1079-16-170.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1079-16-170.	2
2741	415	1861-20-09-I_001 (1).TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1861-20-09-	2
2742	416	1861-20-09-I_001.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1861-20-09-	2
2743	417	1861-22-22-1.PDF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1861-22-22-1.	2
2744	418	1861-22-24-1_001.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1861-22-24	2
2745	419	1861-22-28-1_001.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1861-22-28	2
2746	420	1861-22-44-1.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1861-22-44-1.	2
2747	421	1861-22-95-I Zam.1.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1861-22-95-I	2
2748	422	1861-22-97-I_001.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\жб обделка\1861-22-97-	2
2749	423	1861-22-85-1_001-002.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\цементация\1861-22-85	2
2750	424	1861-22-86-I.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\цементация\1861-22-86-I.	2
2751	425	561ТП-4-2-297456.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-4\цементация\561ТП-4-2	2

Transportation Tunnels\T-5A **Total available files per this item** 5

n°	ID	File Name	Path	Group
2752	426	561ТК-4-VII-15541.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннелы\T-5A\561ТК-4-VII-15541.TIF	2

2753	427	561ТК-4-VII-15542.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-5А\561ТК-4-VII-15542.TIF	2
2754	428	561Ц-4-7111.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-5А\561Ц-4-7111.TIF	2
2755	429	561Ц-4-7114.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-5А\561Ц-4-7114.TIF	2
2756	430	561Ц-4-7115.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-5А\561Ц-4-7115.TIF	2

Transportation Tunnels\T-6 **Total available files per this item** 7

n°	ID	File Name	Path	Group
2757	431	561ТП-4-VII-116208A.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-6\временная крепь\561ТП-4-	2
2758	432	1861-22-140-1 _001.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-6\жб обделка\1861-22-140-1	2
2759	433	1861-22-140-1 _002.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-6\жб обделка\1861-22-140-1	2
2760	434	1861-22-140-1 _003.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-6\жб обделка\1861-22-140-1	2
2761	435	1861-22-140-1 _004.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-6\жб обделка\1861-22-140-1	2
2762	436	1861-22-140-1 _005.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-6\жб обделка\1861-22-140-1	2
2763	437	1861-22-164-1 .TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-6\цементация\1861-22-164	2

Transportation Tunnels\T-7 **Total available files per this item** 9

n°	ID	File Name	Path	Group
2764	438	561ОТК-4-VII-1815628.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561ОТК-4-VII-1815628.TIF	2
2765	439	561ОТК-4-VII-1815634.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561ОТК-4-VII-1815634.TIF	2
2766	440	561ОТК-4-VII-1815636.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561ОТК-4-VII-1815636.TIF	2
2767	441	561ОТК-4-VII-1815638.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561ОТК-4-VII-1815638.TIF	2
2768	442	561ОТК-4-VII-1815639.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561ОТК-4-VII-1815639.TIF	2
2769	443	561ОТК-4-VII-1815641.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561ОТК-4-VII-1815641.TIF	2
2770	444	561ОТК-4-VII-1815643.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561ОТК-4-VII-1815643.TIF	2
2771	445	561ТП-4-VII-116118.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561ТП-4-VII-116118.TIF	2
2772	446	561Ц-НПО-4-297394.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7\561Ц-НПО-4-297394.TIF	2

Transportation Tunnels\T-7A **Total available files per this item** 1

n°	ID	File Name	Path	Group
2773	447	561ТП-4-VII-11622 A.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-7А\561ТП-4-VII-11622 A.TIF	2

Transportation Tunnels\T-8 **Total available files per this item** 19

n°	ID	File Name	Path	Group
2774	448	1079-22-67_003.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-67\1079-22-67_003.	2
2775	449	20100803-082147.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-67\20100803	2
2776	450	20100803-082252.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-67\20100803	2
2777	451	20100803-082448.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-67\20100803	2
2778	452	20100803-082603.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-67\20100803	2
2779	453	20100803-082707.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-67\20100803	2
2780	454	20100803-082811.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-67\20100803	2
2781	455	20101123-093959.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-95\20101123	2
2782	456	20101123-094059.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\Т-8\1079-22-95\20101123	2

2783	457	20101123-094203.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\T-8\1079-22-95\20101123	2
2784	458	20101123-094324.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\T-8\1079-22-95\20101123	2
2785	459	1861-22-105-1_001.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\T-8\цементация\1861-22-105	2
2786	460	1861-22-105-1_002.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\T-8\цементация\1861-22-105	2
2787	461	1861-22-105-1_003.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\T-8\цементация\1861-22-105	2
2788	462	561Ц-НПО-4-297207.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\T-8\цементация\561Ц-НПО-4	2
2789	463	561Ц-НПО-4-297302.TIF	DRAWINGS 02\Transportation Tunnels - Транспортные туннели\T-8\цементация\561Ц-НПО-4	2
2790	388	561ТП-4-VII-11590.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-8\561ТП-4-VII-11590.PDF	4
2791	389	561ТП-4-VII-11592.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-8\561ТП-4-VII-11592.PDF	4
2792	390	561ТП-4-VII-13482.PDF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T-8\561ТП-4-VII-13482.PDF	4

Transportation Tunnels\T6 **Total available files per this item** 1

n°	ID	File Name	Path	Group
2793	391	1861-22-164-1 .TIF	DRAWINGS 04\Transportation Tunnels - Транспортные туннели\T6\цементация\1861-22-164-1 .	4

Updated Layout **Total available files per this item** 3

n°	ID	File Name	Path	Group
2794	464	1861-55-05_001.pdf	DRAWINGS 02\Updated Layout - материалы из Концепции\1861-55-05_001.pdf	2
2795	465	1861-55-06_001.pdf	DRAWINGS 02\Updated Layout - материалы из Концепции\1861-55-06_001.pdf	2
2796	466	1861-55-07_001.pdf	DRAWINGS 02\Updated Layout - материалы из Концепции\1861-55-07_001.pdf	2

Ventilation Tunnel **Total available files per this item** 6

n°	ID	File Name	Path	Group
2797	467	1101-55-12_001.tif	DRAWINGS 02\Ventilation Tunnel - Вентиляционный туннель\жб обделка\1101-55-12\1101-55	2
2798	468	1101-55-12_002.tif	DRAWINGS 02\Ventilation Tunnel - Вентиляционный туннель\жб обделка\1101-55-12\1101-55	2
2799	469	1101-55-12_003.tif	DRAWINGS 02\Ventilation Tunnel - Вентиляционный туннель\жб обделка\1101-55-12\1101-55	2
2800	470	1101-55-11_001.tif	DRAWINGS 02\Ventilation Tunnel - Вентиляционный туннель\жб обделка\1101-55-15\1101-55	2
2801	471	1101-55-11_002.tif	DRAWINGS 02\Ventilation Tunnel - Вентиляционный туннель\жб обделка\1101-55-15\1101-55	2
2802	472	1101-55-11_003.tif	DRAWINGS 02\Ventilation Tunnel - Вентиляционный туннель\жб обделка\1101-55-15\1101-55	2

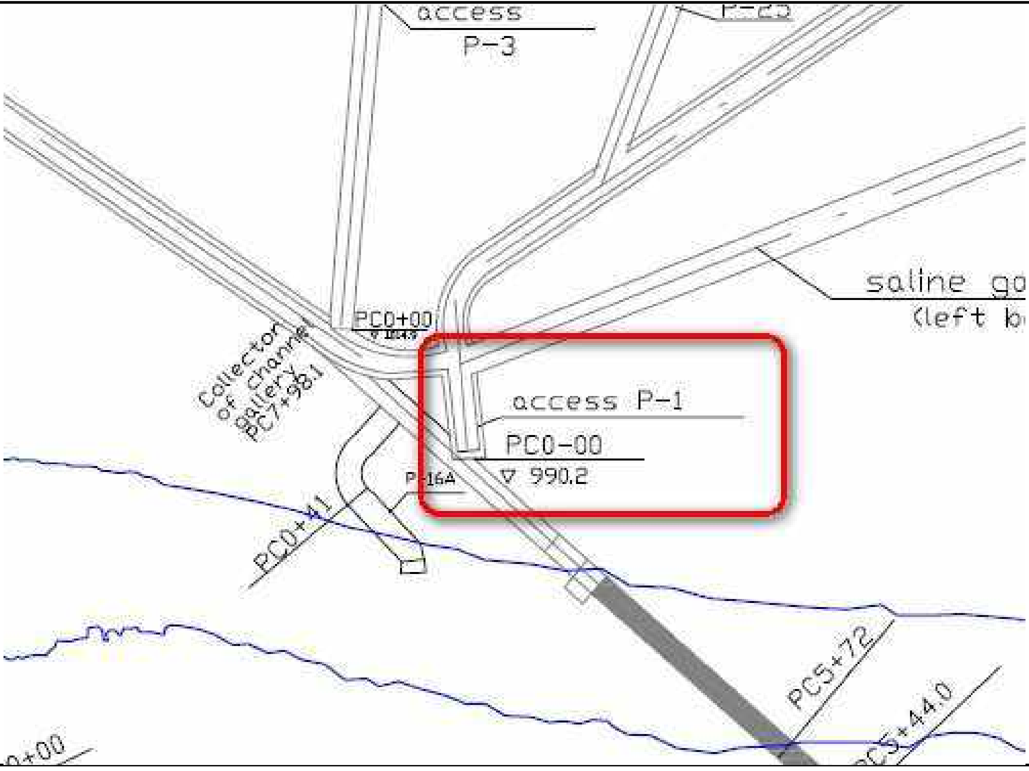
N° :	ITEM	CODE
1	Access Adit P1	P1
2	Access Adit P10	P10
3	Access Adit P10'	P10'
4	Access Adit P11	P11
5	Access Adit P12	P12
6	Access Adit P13	P13
7	Access Adit P14	P14
8	Access Adit P16	P16
9	Access Adit P16A	P16A
10	Access Adit P16B	P16B
11	Access Adit P17	P17
12	Access Adit P19	P19
13	Access Adit P1A	P1A
14	Access Adit P1B	P1B
15	Access Adit P1D	P1D
16	Access Adit P1E	P1E
17	Access Adit P2	P2
18	Access Adit P21	P21
19	Access Adit P22	P22
20	Access Adit P23	P23
21	Access Adit P25 & P25'	P25
22	Access Adit P25A	P25A
23	Access Adit P26	P26
24	Access Adit P27	P27
25	Access Adit P28	P28
26	Access Adit P28'	P28'
27	Access Adit P29	P29
28	Access Adit P3	P3
29	Access Adit P30	P30
30	Access Adit P33	P33
31	Access Adit P34	P34
32	Access Adit P35	P35
33	Access Adit P35A	P35A
34	Access Adit P36	P36
35	Access Adit P37	P37
36	Access Adit P38	P38

N° :	**ITEM**	**CODE**
37	Access Adit P4	P4
38	Access Adit P40	P40
39	Access Adit P6	P6
40	Access Adit P67	P67
41	Access Adit P68	P68
42	Access Adit P69	P69
43	Access Adit P80	P80
44	Access Adit P9	P9
45	Access to DG1 - P4	Acc DG1 P4
46	Auxiliary Tunnel	Aux T
47	Auxiliary Tunnel Adit - Abandoned	Aux. T Ad
48	Belt Gallery 3-T	BG 3-T
49	BUS Duct gallery	BDG
50	Cable Tunnel 1	K1
51	Cable Tunnel 2	K2
52	Collector of Draft Tubes 1-3 to Diversion Tunnels	COLL 1-3
53	Collector of Draft Tubes 4-6 to Diversion tunnels	COLL 4-6
54	Combined right bank channel gallery of saline	CRB SALINE
55	Connecting Tunnel T-3'	T3'
56	Connection 1 Cable Tunnels 1 & 2	Con K1-K2
57	Connection 2 Cable Tunnels 1 & 2	Con K1-K2_02
58	Connection K2-T4	K2-T4
59	Connection Tunnel n° 10	Con10
60	Connection Tunnel n° 3	Con 3
61	Connection Tunnel n° 4	Con 4
62	Connection Tunnel n° 5	Con 5
63	Connection Tunnel n° 6	Con 6
64	Construction Tunnel I - Diversion I	ST 1
65	Construction Tunnel I - OUTLET	ST1-OUT
66	Construction Tunnel II - Diversion II	ST-2
67	Construction Tunnel II - OUTLET	ST2-OUT
68	Construction Tunnels - Gate Chambers	ST_ME_GCH
69	Construction Tunnels - INTAKE	ST1 - I
70	Construction Tunnels - INTAKE	ST2 - I
71	Construction Tunnels Downstream Vent & Gate Chamber	ST_DGC
72	Conveyor Line 7A	Conveyor Line

N° :	ITEM	CODE
73	Conveyor Line 8A	Conveyor Line
74	Cross Slit n°1	CS
75	Curtain - Grouting Gallery - Joint Left - Right	CGJ_LR
76	Curtain - Grouting Gallery - left Bank - Passive Stretch	CG_L_P
77	Curtain - Grouting Gallery - Left bank . Active Stretch	CG_L_A
78	Curtain - Grouting Gallery - Right Bank	CG_R
79	Diversion I - Intake	
80	Diversion II - Intake	
81	Diversion tunnels - Mainten. gates chamber	ST_M_GCH
82	Draft Tube Tunnels	DRAFT_T
83	Drainage Gallery 1	DG1
84	Drainage Gallery 2	DG2
85	Drainage Gallery 3	DG3
86	Drainage Gallery 4	DG4
87	Drainage Gallery Powerhouse Medium	DGPH_M
88	Explosive Warehouse T4	Exp T4
89	Explosive Warehouse T5A	Exp T5A
90	Grouting Gallery 1	GG1
91	Grouting Gallery 2	GG2
92	Grouting Gallery 3	GG3
93	Joint Cable Tunnel	J_K1_K2
94	Junction T3-T3'	J_T3_T3'
95	Pedestrian Tunnel 1	PDT1
96	Pedestrian tunnel 2	PDT2
97	Powerhouse	PH
98	Powerhouse Drainage gallery high Level	DGPH_H
99	Powerhouse Drainage gallery low level	DGPH - L
100	Seismic Adit Sec. 1 at P19	Seismic Adit
101	Seismic Adit Sec. 2 at T2	Seismic Adit
102	Stage 1 Power Tunnel	S1PT
103	Stage 1 Power Tunnel Access from T-8 to Gate Chamber	S1PT_T8-GC
104	Stage 1 Power Tunnel Erection Chamber	S1PT_ECH
105	Stage 1 Power Tunnel Gate Chamber	S1PT_GCH
106	Stage 1 Power Tunnel Intake	S1PT_INTAKE
107	Stage 1 Power Tunnel Penstock	S1PT_P
108	Temporary Water Supply Line 5	TWS5

N° :	ITEM	CODE
109	Temporary Water Supply Line 6	TWS6
110	Test Chamber	Test Chamber
111	Transformer hall	TH
112	Transportation Tunnel Connection T37-T3’	Con T37-T3'
113	Transportation tunnel stretch from T3 to T37	T3-T37
114	Transportation Tunnel T 22	T22
115	Transportation Tunnel T2	T2
116	Transportation Tunnel T3	T3
117	Transportation Tunnel T3'	T3'
118	Transportation Tunnel T37	T37
119	Transportation Tunnel T37’	T37'
120	Transportation Tunnel T37A	T37A
121	Transportation Tunnel T4	T4
122	Transportation Tunnel T5A	T5A
123	Transportation Tunnel T6	T6
124	Transportation Tunnel T7	T7
125	Transportation Tunnel T7A	T7A
126	Transportation Tunnel T8	T8
127	Tunnel Seismic Adit 3 at GG3	Tunnel Seismic
128	Ventilation Adit - Parallel to T3	Vent_Adit
129	Ventilation shaft	Vent_Shaft

Stage 1 - Report name	**Item**	**Access Adit P1**	**n° :**	1
	Code	**P1**		



Stage 1 - Report name	**Item**	**Access Adit P10**	**n° :**	2
	Code	**P10**		

Stage 1 - Report name

Item Access Adit P10'

Code P10'

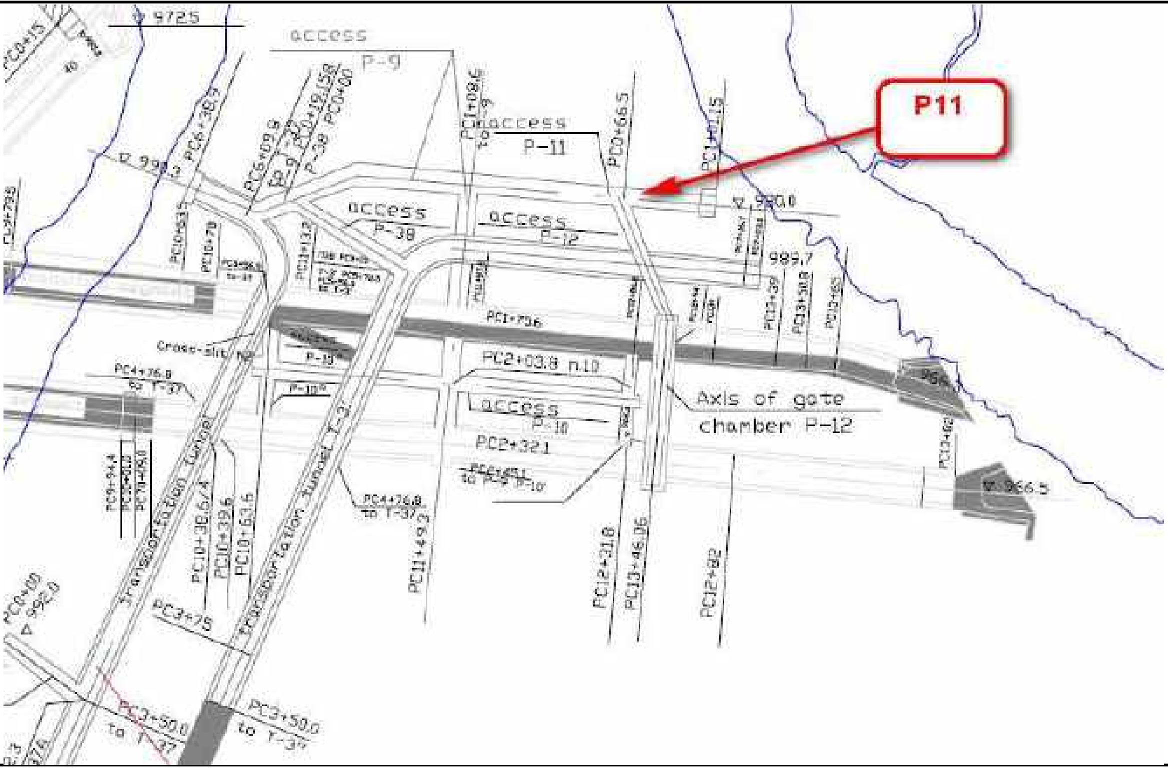
n° : 3

Stage 1 - Report name

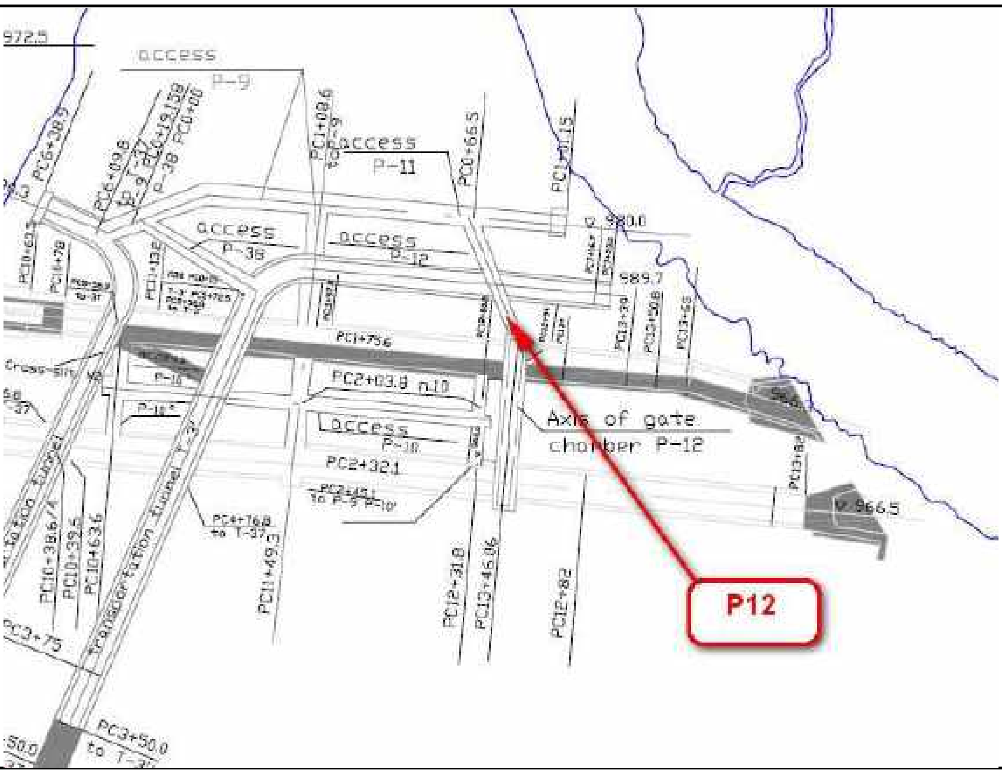
Item Access Adit P11

Code P11

n° : 4



Stage 1 - Report name	**Item**	Access Adit P12	**n° :** 5
	Code	P12	



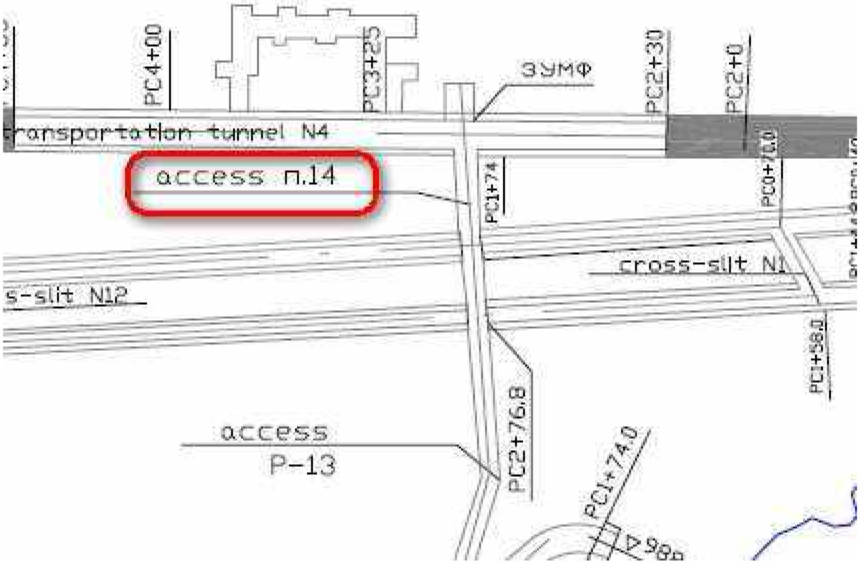
Stage 1 - Report name	**Item**	Access Adit P13	**n° :** 6
	Code	P13	

Stage 1 - Report name

Item Access Adit P14

Code P14

n° : 7

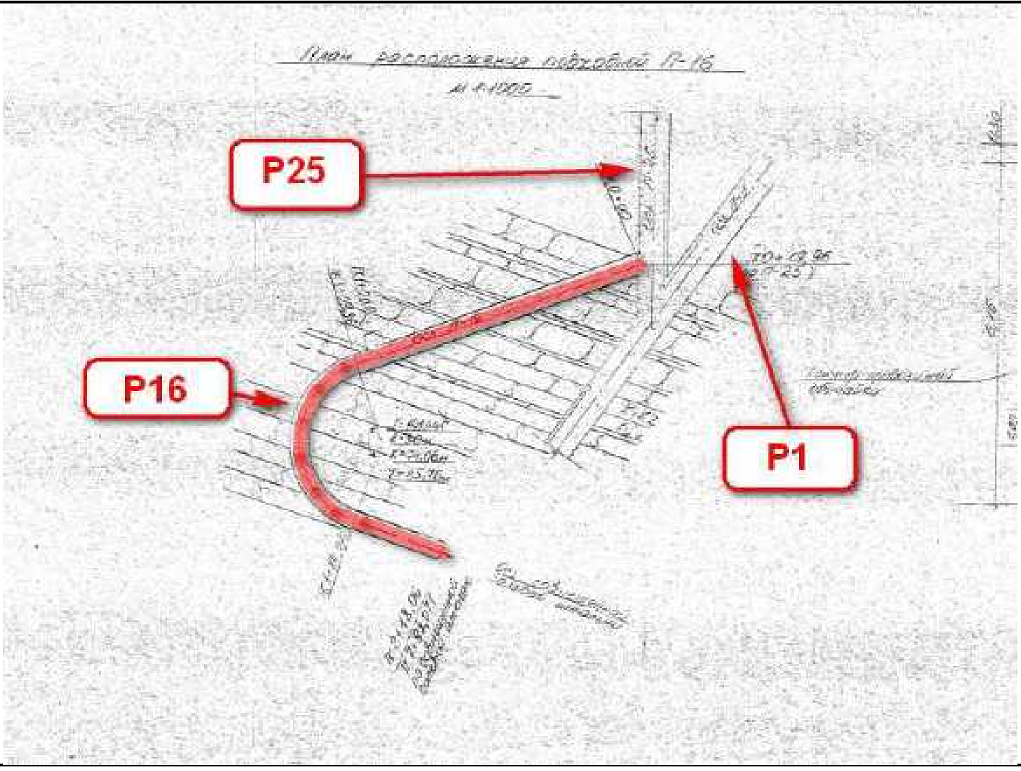


Stage 1 - Report name

Item Access Adit P16

Code P16

n° : 8

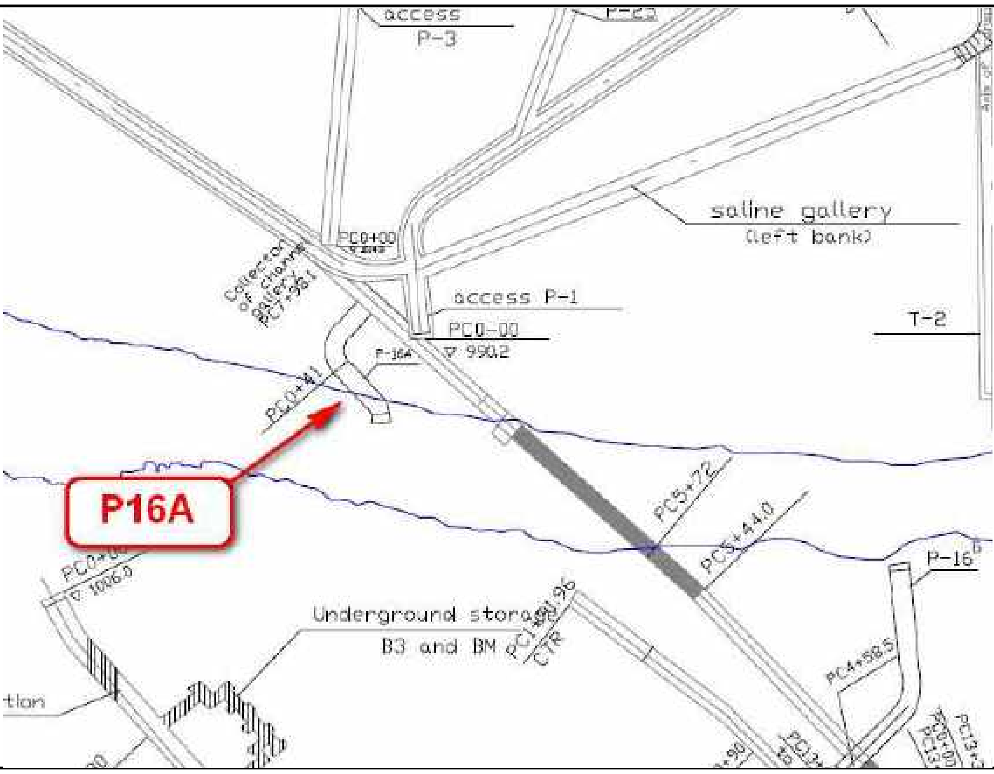


Stage 1 - Report name

Item **Access Adit P16A**

Code **P16A**

n° : **9**

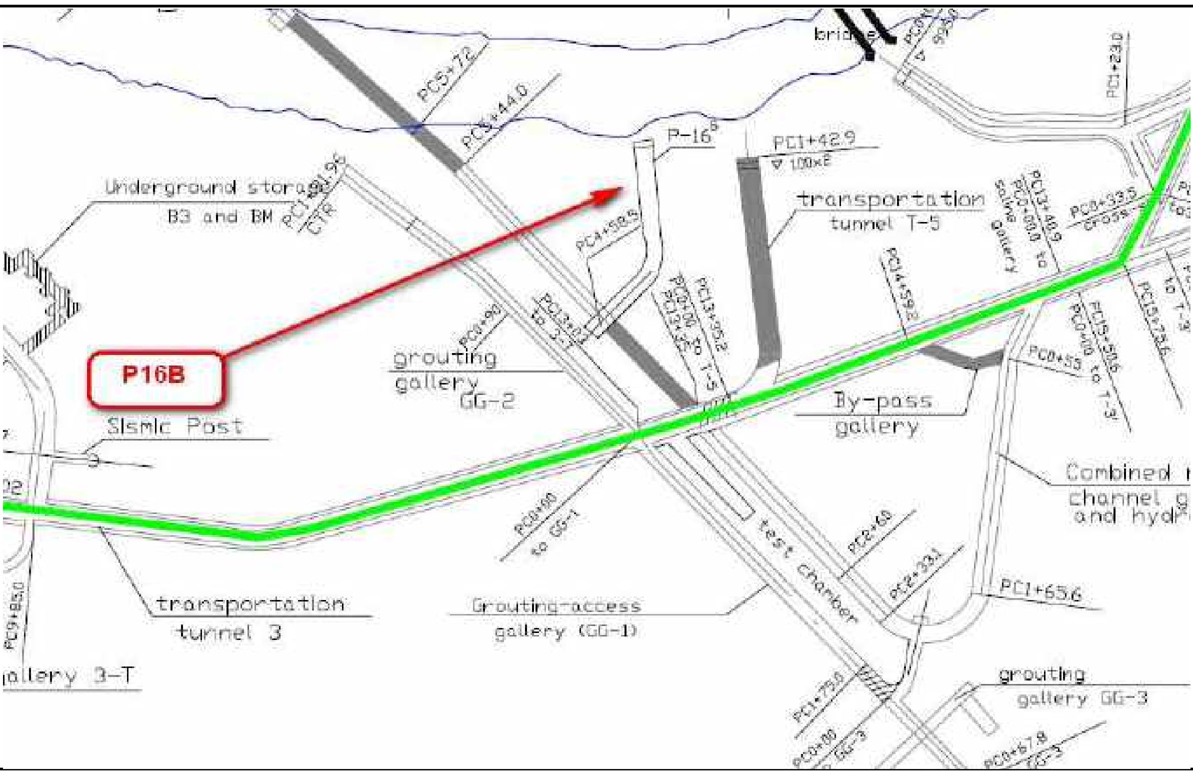


Stage 1 - Report name

Item **Access Adit P16B**

Code **P16B**

n° : **10**

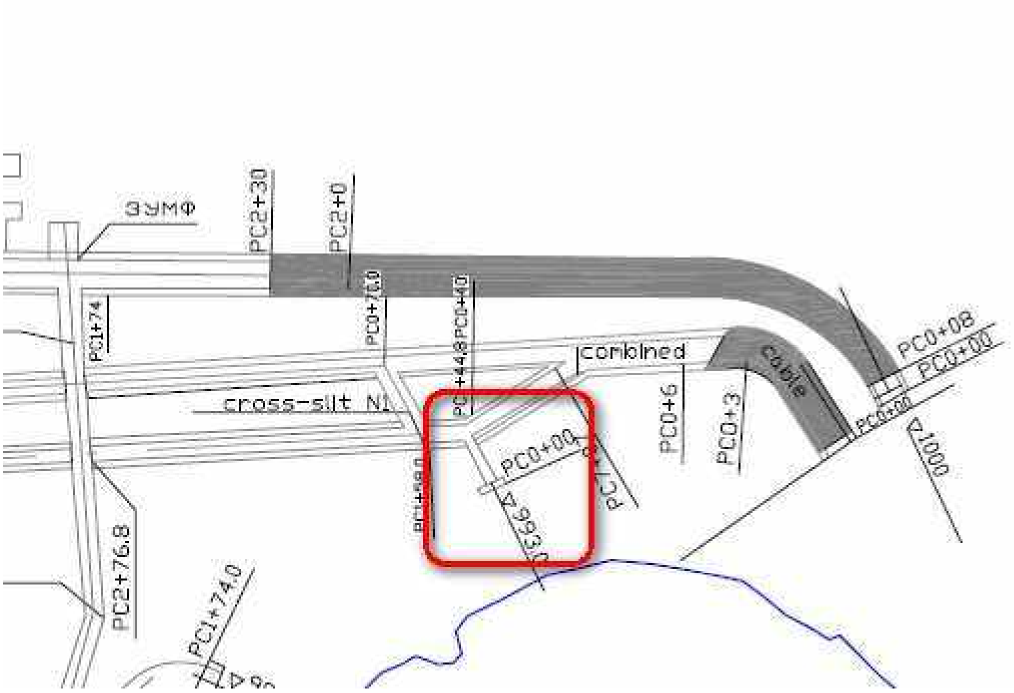


Stage 1 - Report name

Item Access Adit P17

Code P17

n° : 11

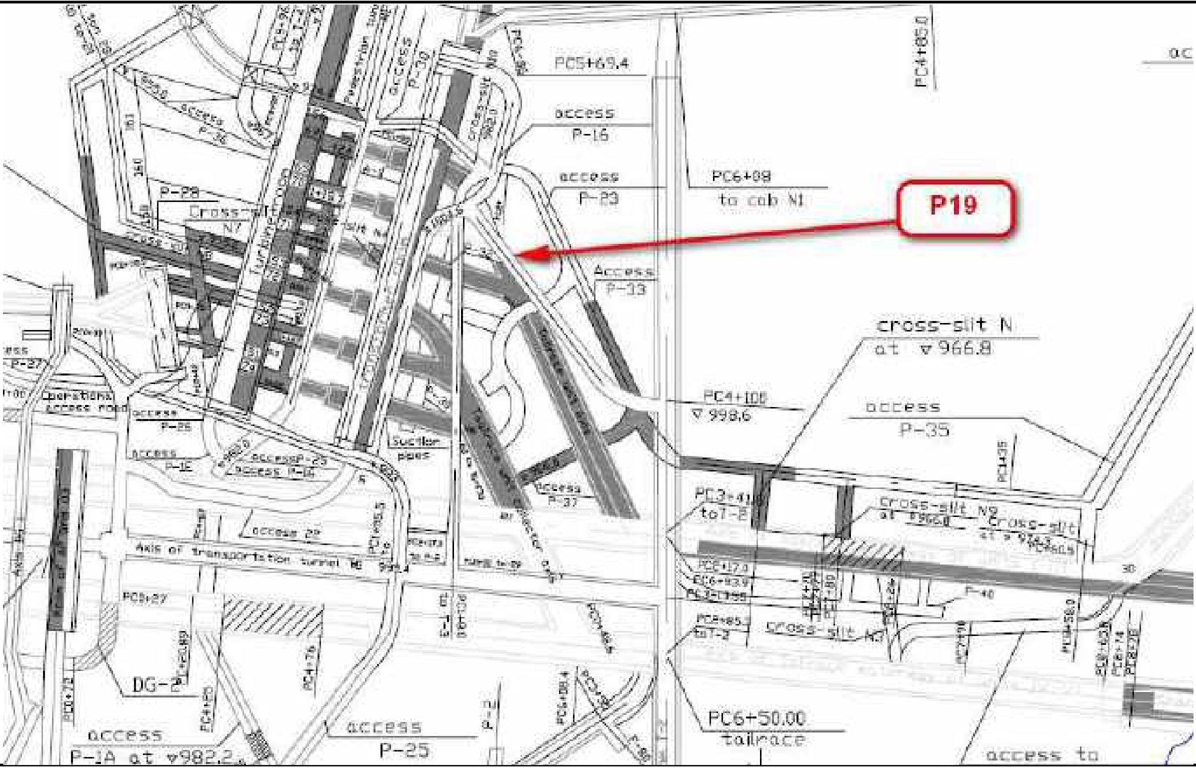


Stage 1 - Report name

Item Access Adit P19

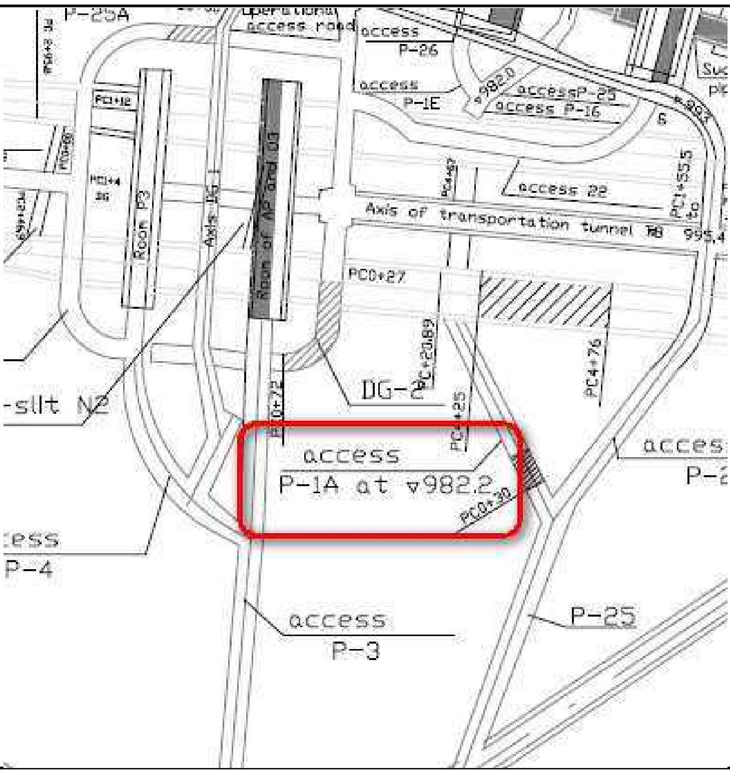
Code P19

n° : 12



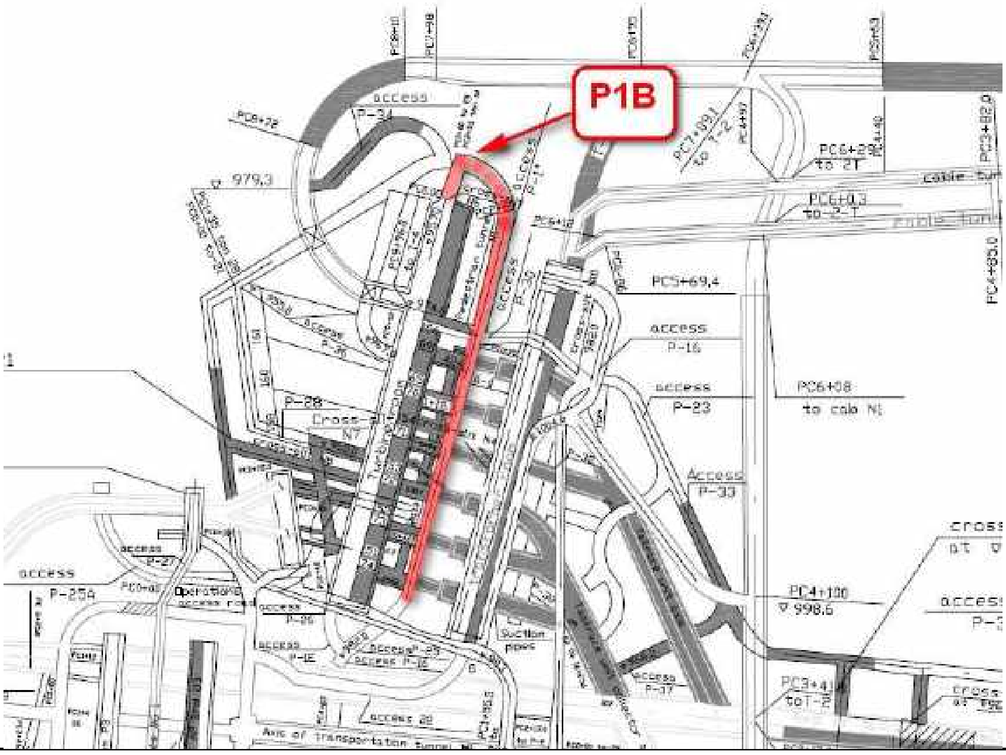
Stage 1 - Report name **Item** Access Adit P1A **n° :** 13

Code P1A



Stage 1 - Report name **Item** Access Adit P1B **n° :** 14

Code P1B

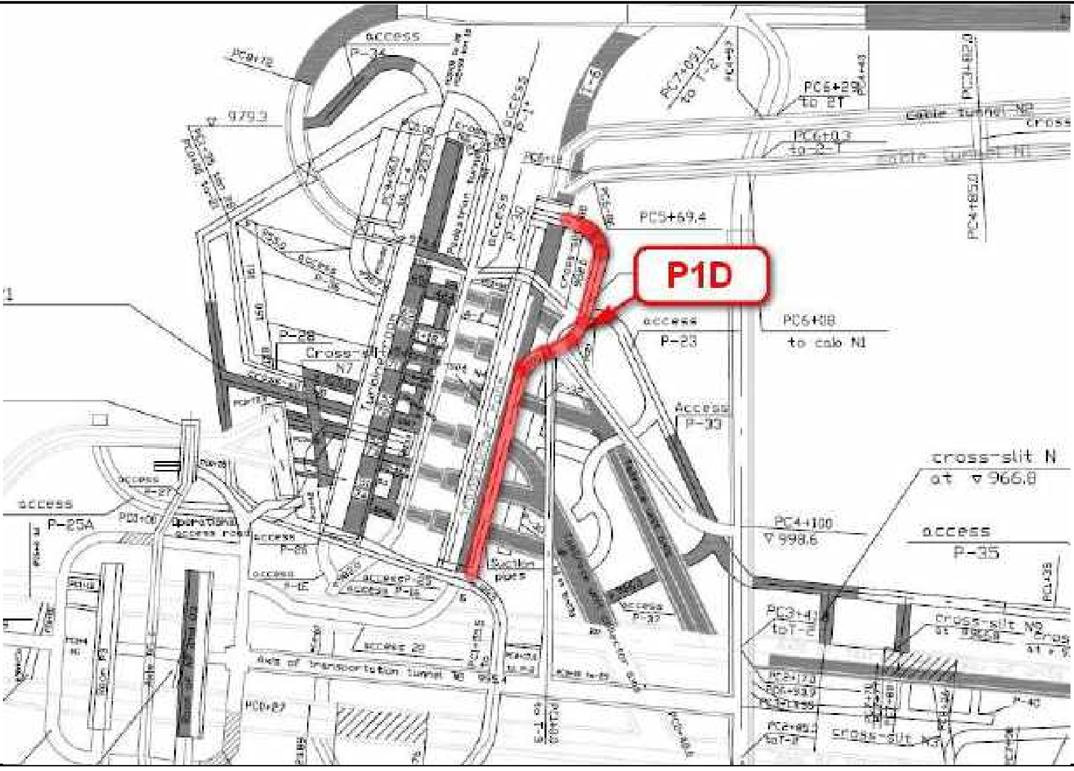


Stage 1 - Report name

Item **Access Adit P1D**

Code **P1D**

n° : 15

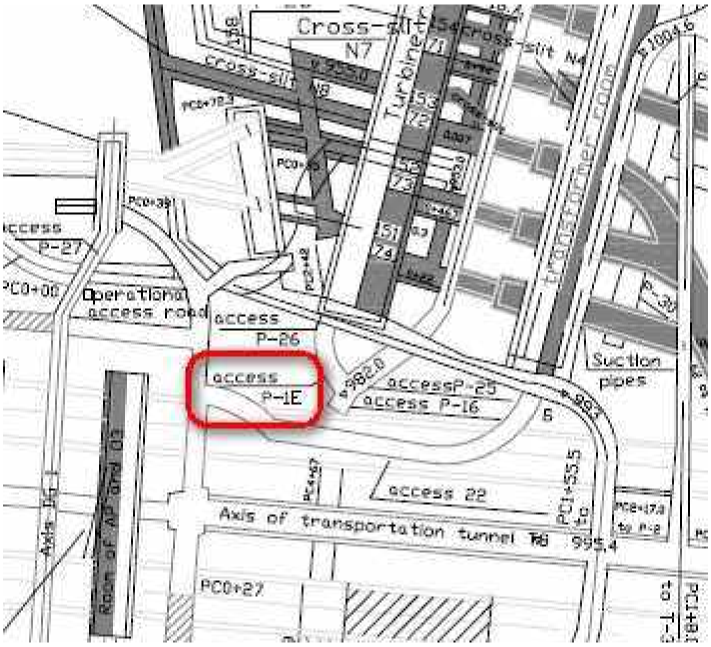


Stage 1 - Report name

Item **Access Adit P1E**

Code **P1E**

n° : 16

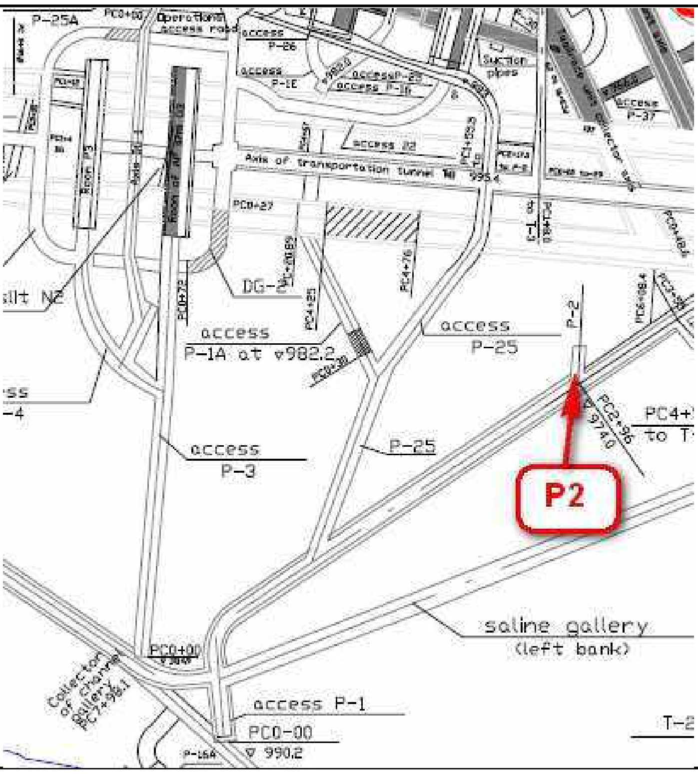


Stage 1 - Report name

Item Access Adit P2

Code P2

n° : 17

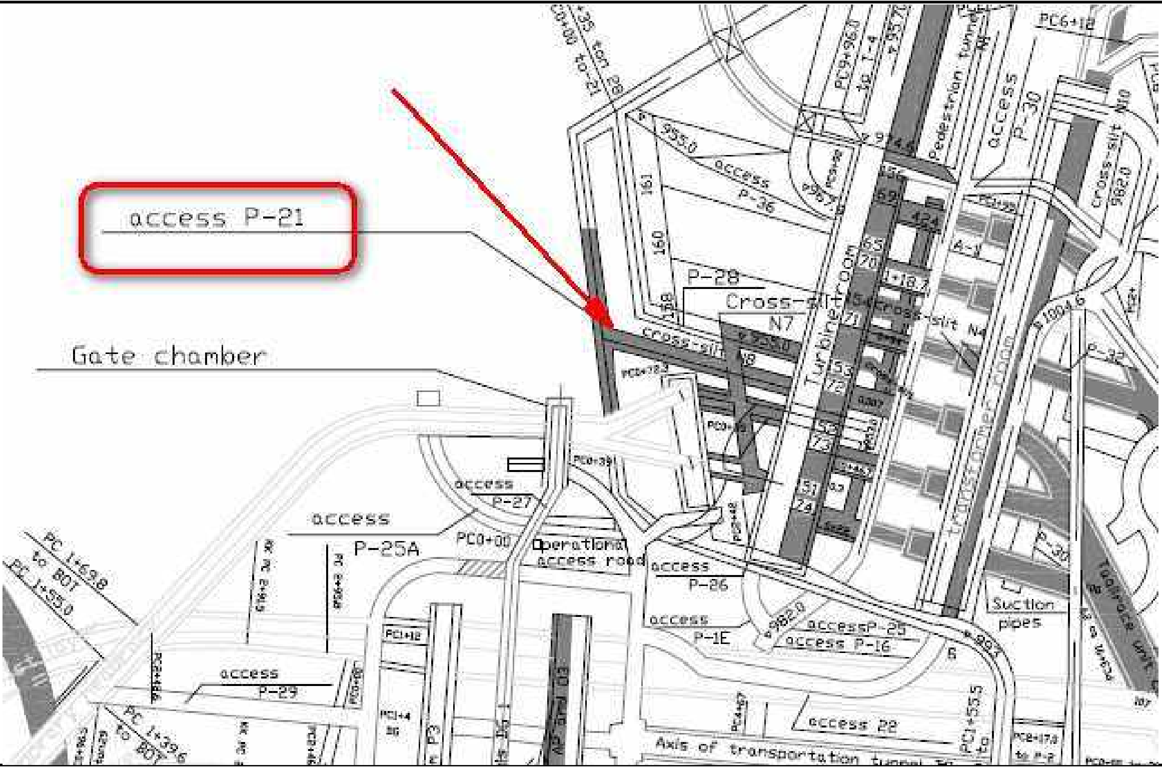


Stage 1 - Report name

Item Access Adit P21

Code P21

n° : 18

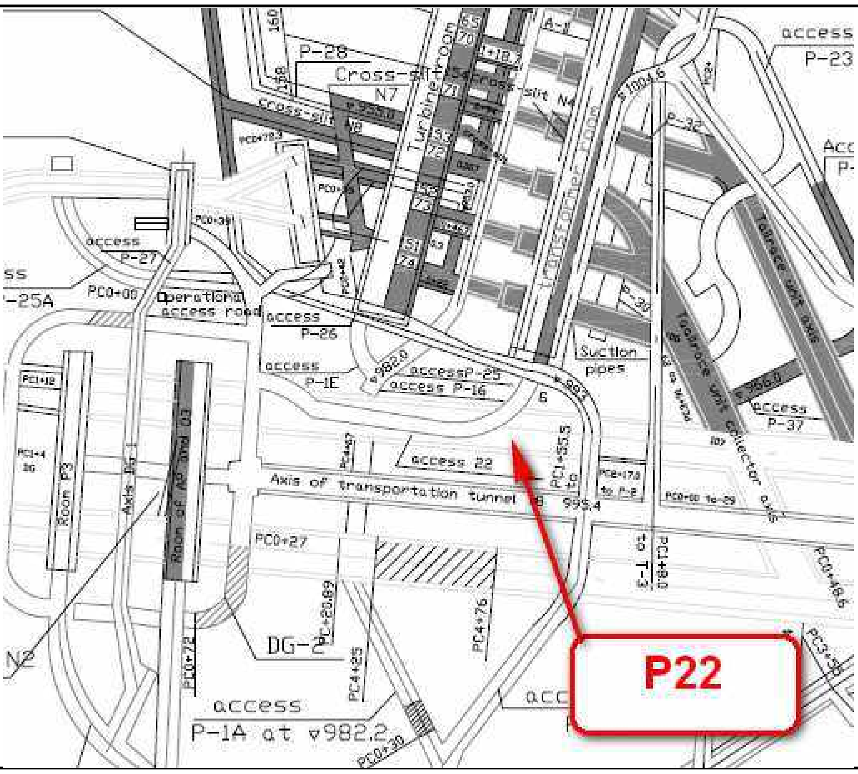


Stage 1 - Report name

Item Access Adit P22

Code P22

n° : 19

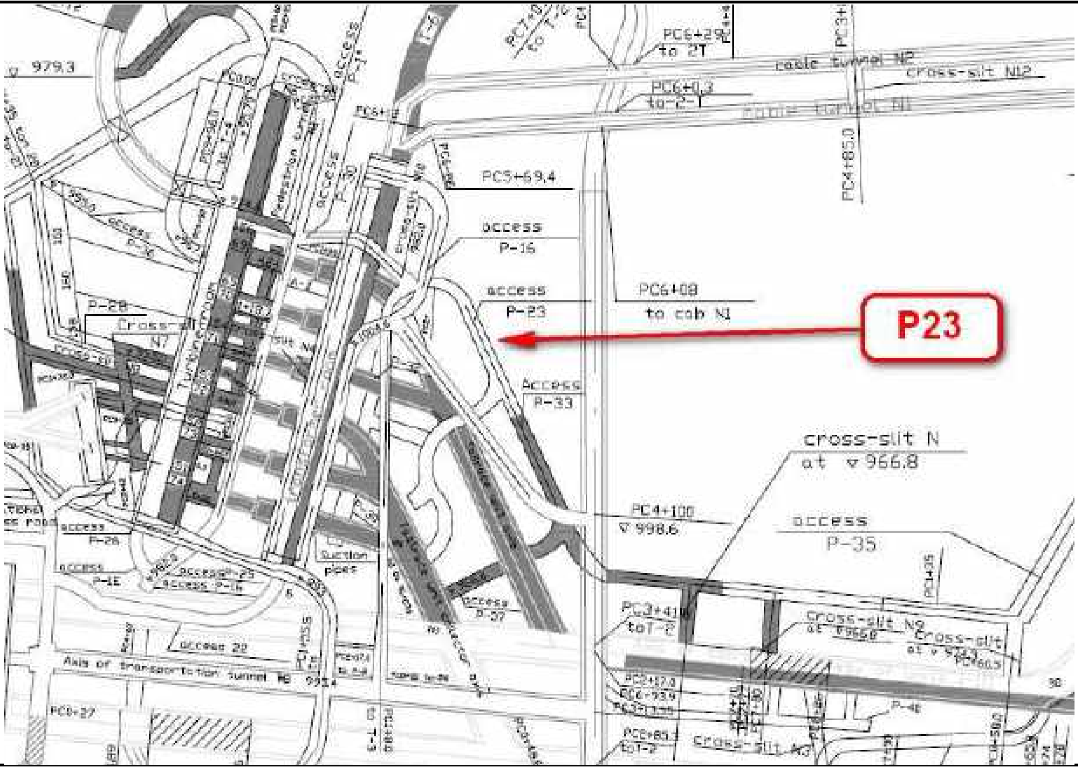


Stage 1 - Report name

Item Access Adit P23

Code P23

n° : 20

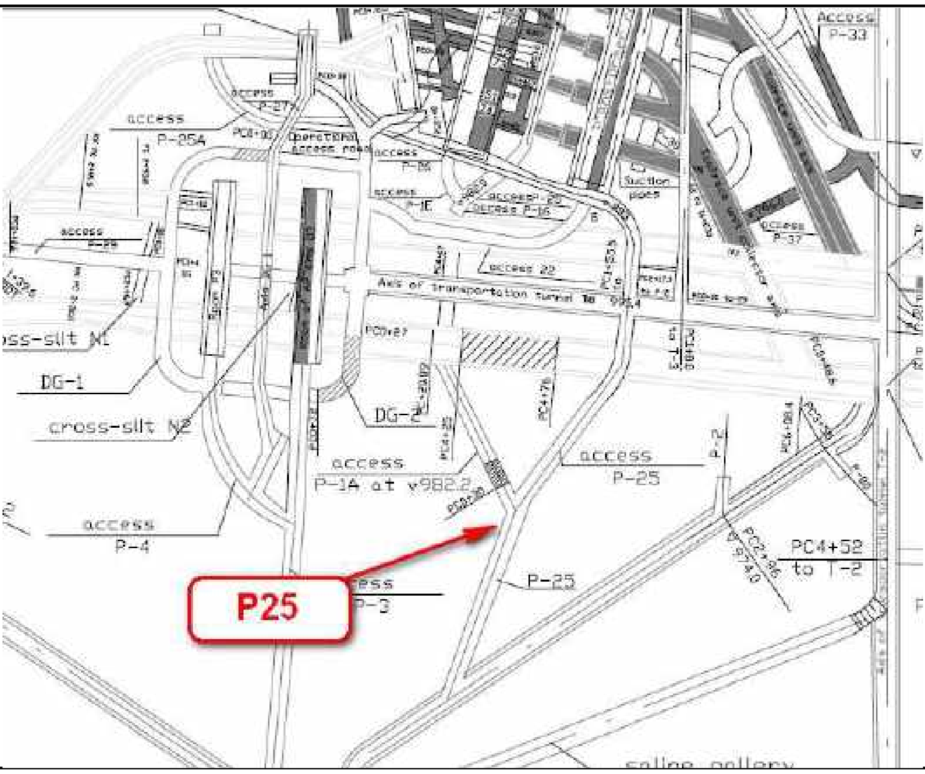


Stage 1 - Report name

Item Access Adit P25 & P25'

Code P25

n° : 21

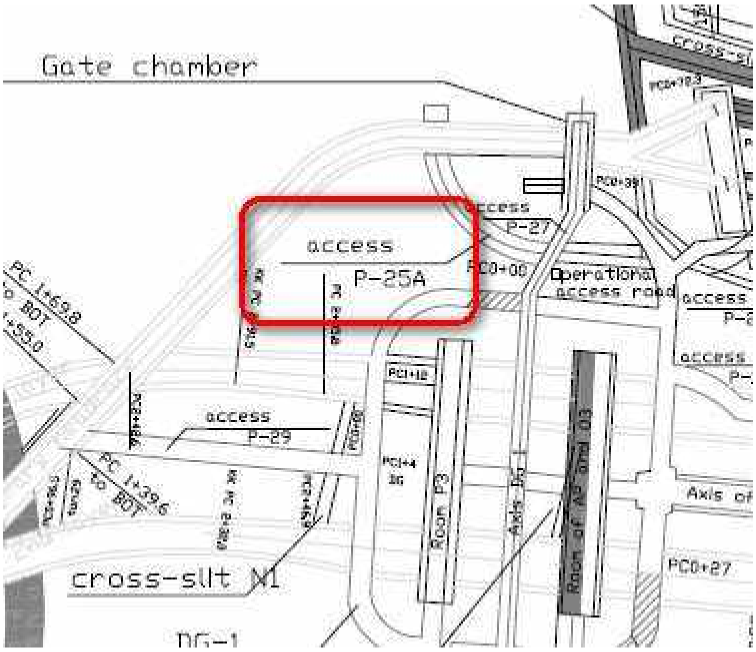


Stage 1 - Report name

Item Access Adit P25A

Code P25A

n° : 22

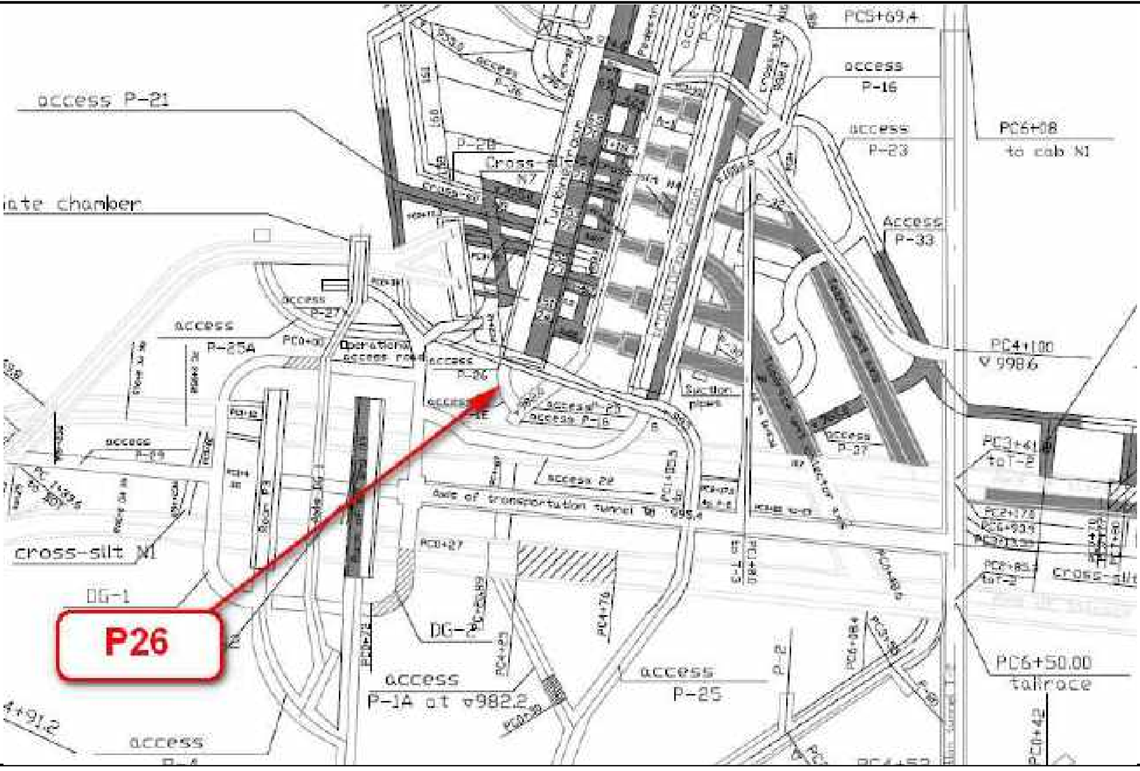


Stage 1 - Report name

Item **Access Adit P26**

Code **P26**

n° : **23**

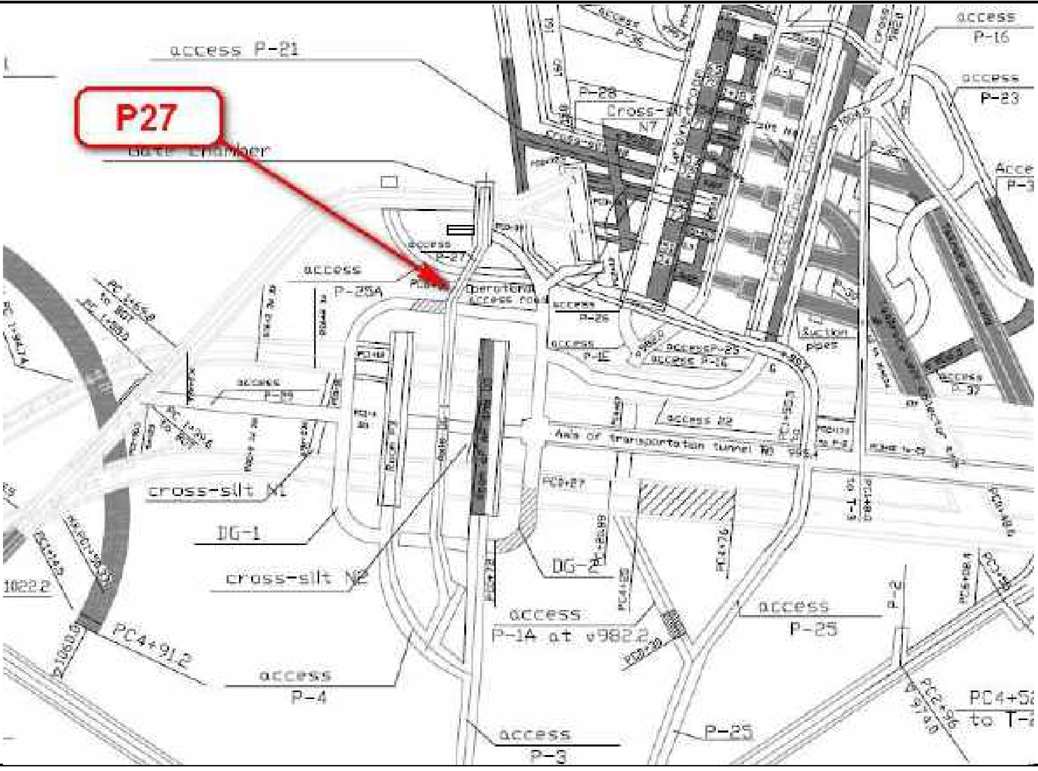


Stage 1 - Report name

Item **Access Adit P27**

Code **P27**

n° : **24**

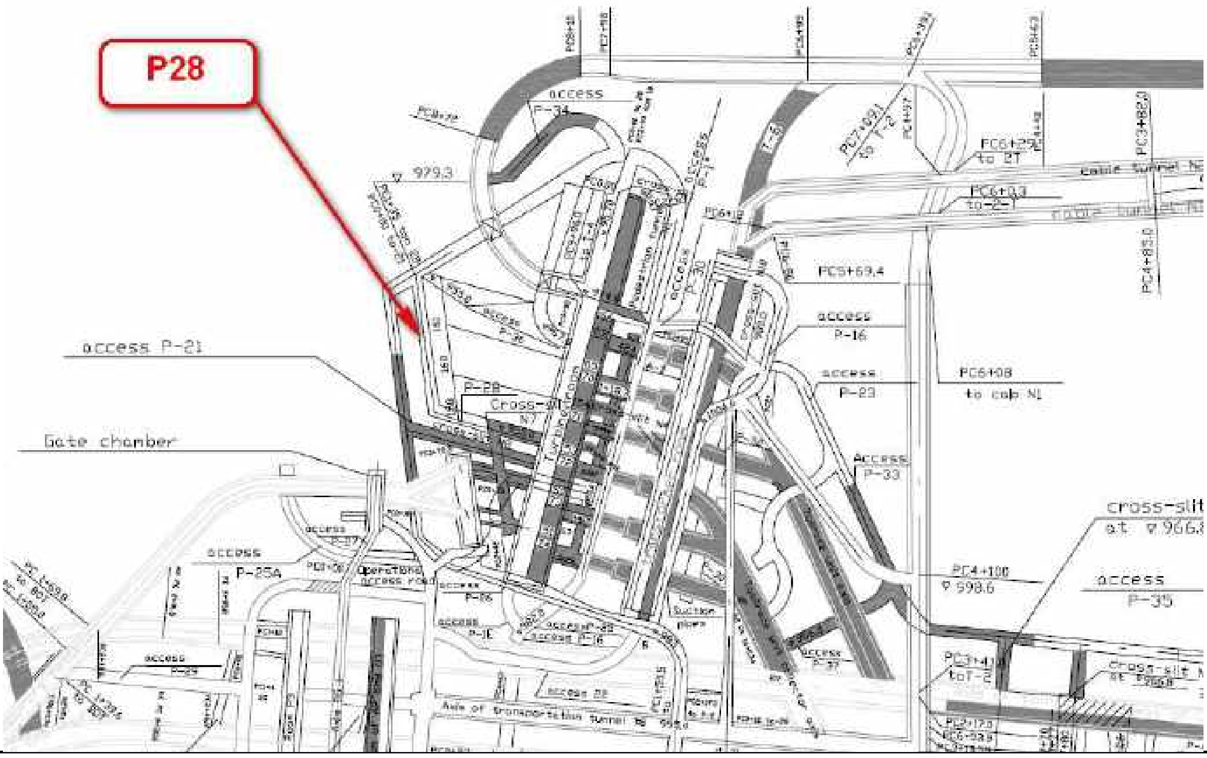


Stage 1 - Report name

Item Access Adit P28

Code P28

n° : 25

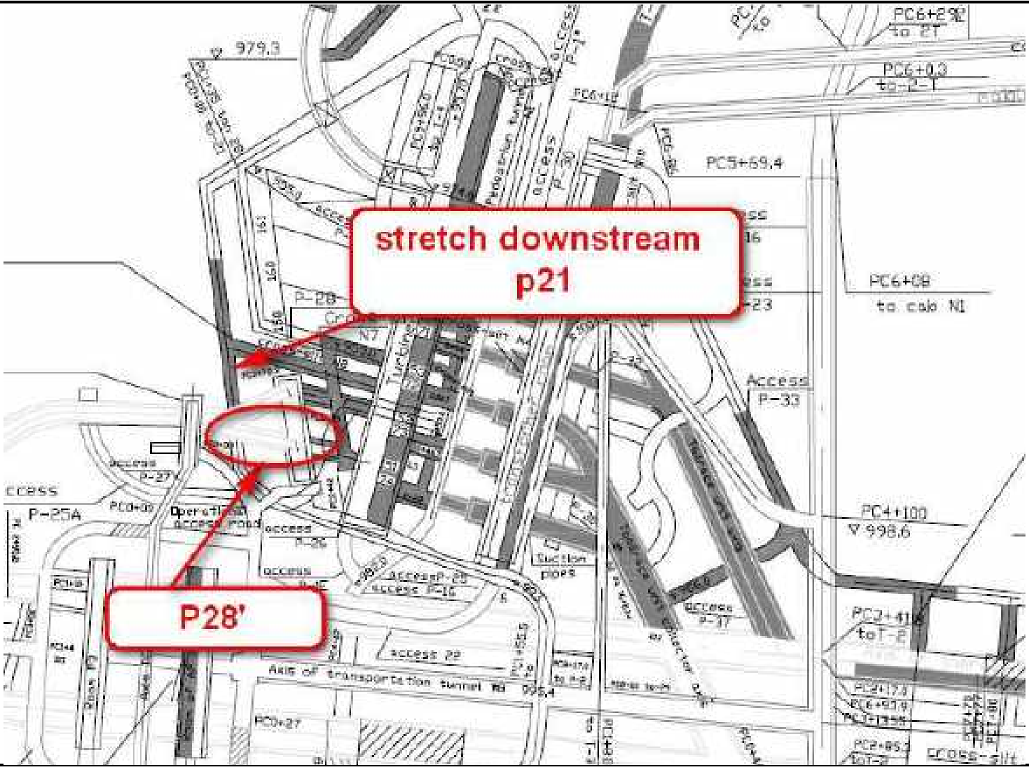


Stage 1 - Report name

Item Access Adit P28'

Code P28'

n° : 26

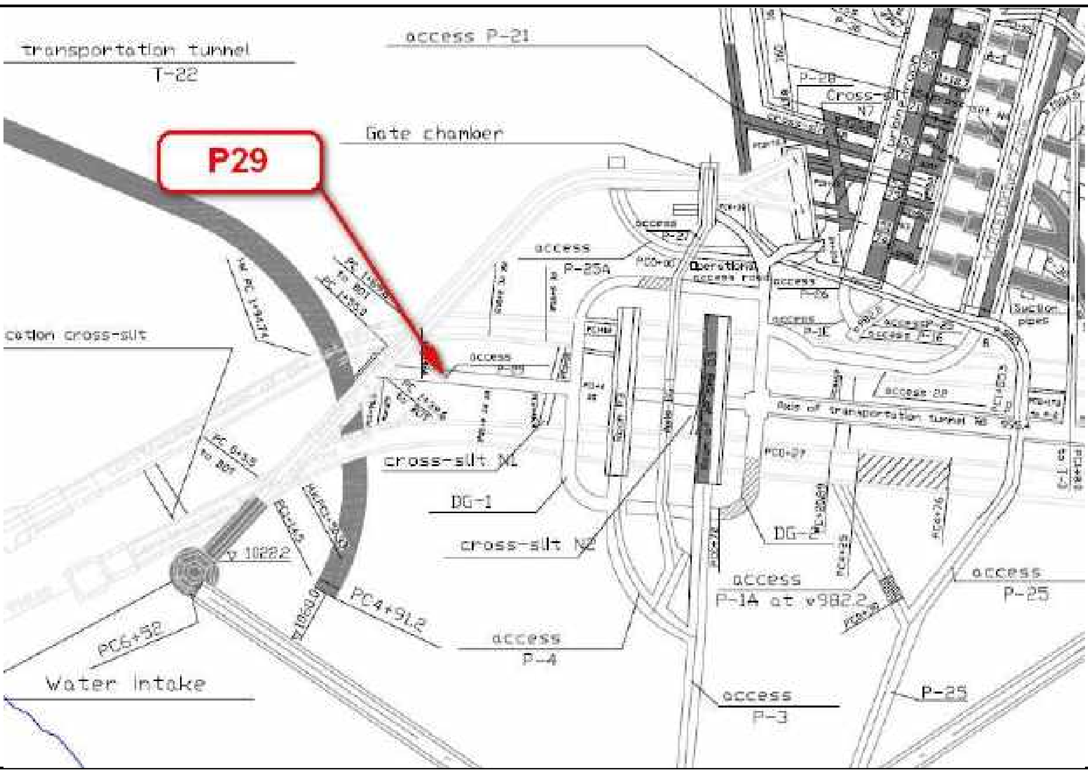


Stage 1 - Report name

Item Access Adit P29

Code P29

n° : 27

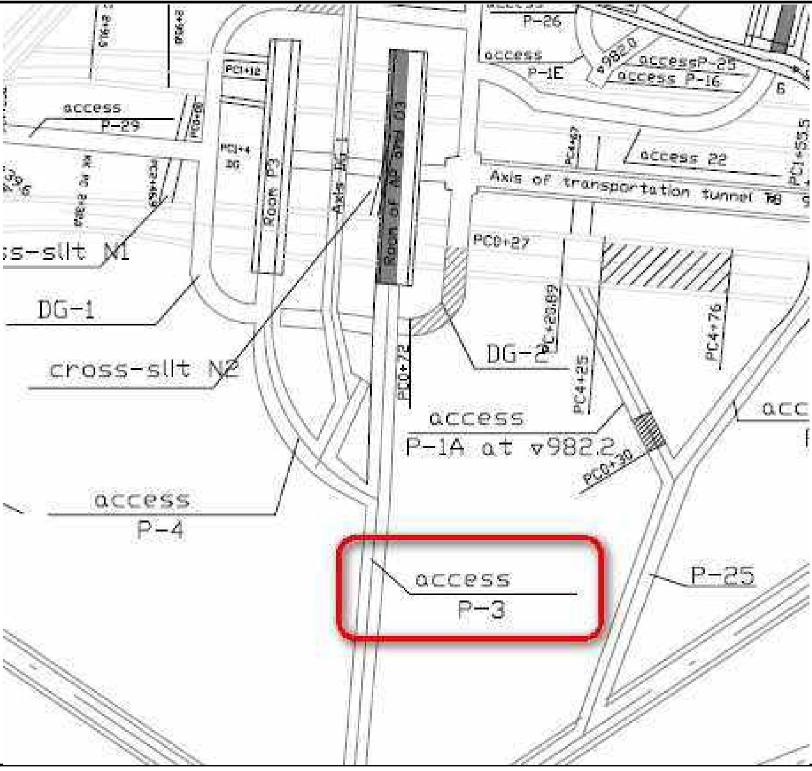


Stage 1 - Report name

Item Access Adit P3

Code P3

n° : 28

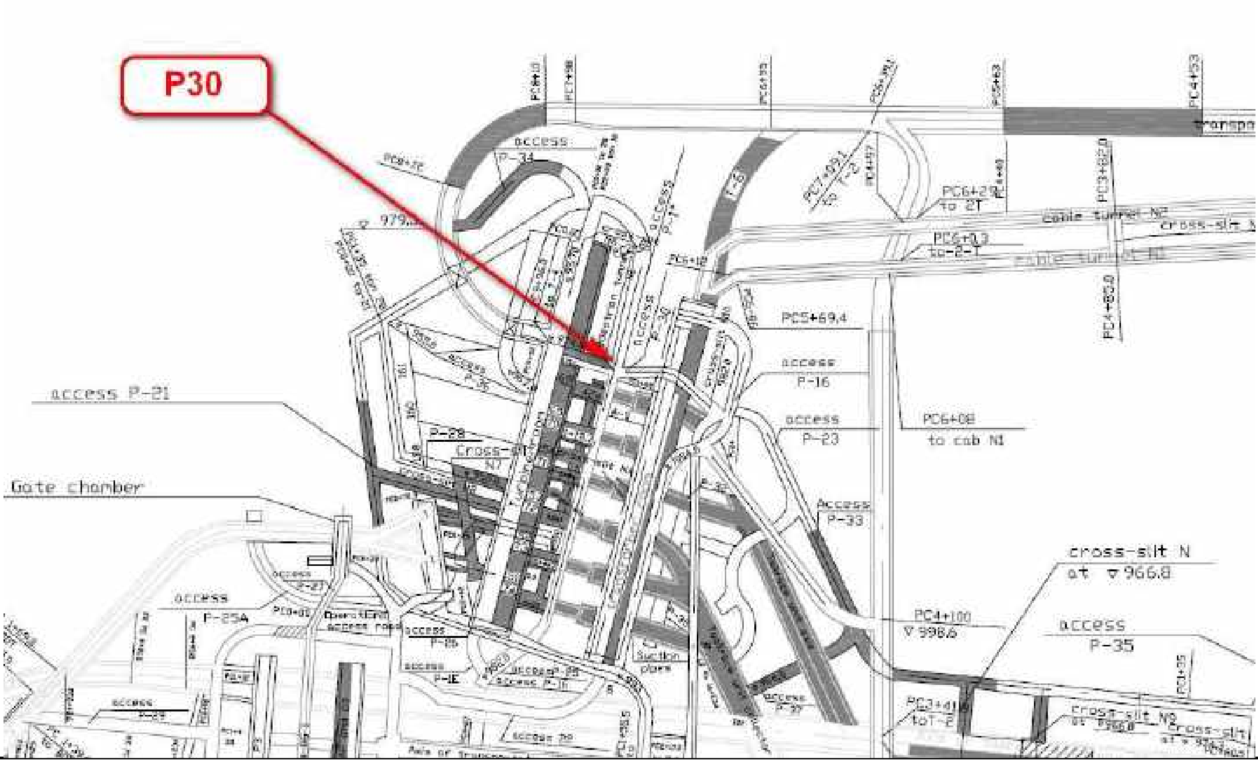


Stage 1 - Report name

Item Access Adit P30

Code P30

n° : 29

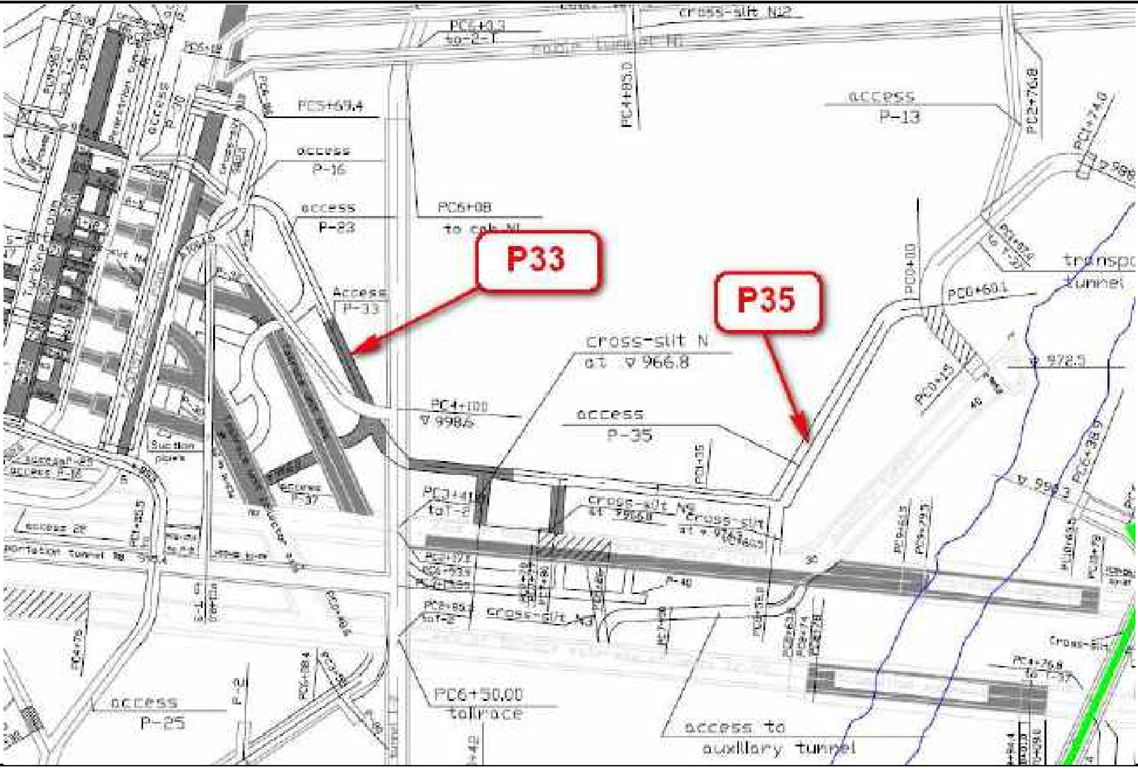


Stage 1 - Report name

Item Access Adit P33

Code P33

n° : 30

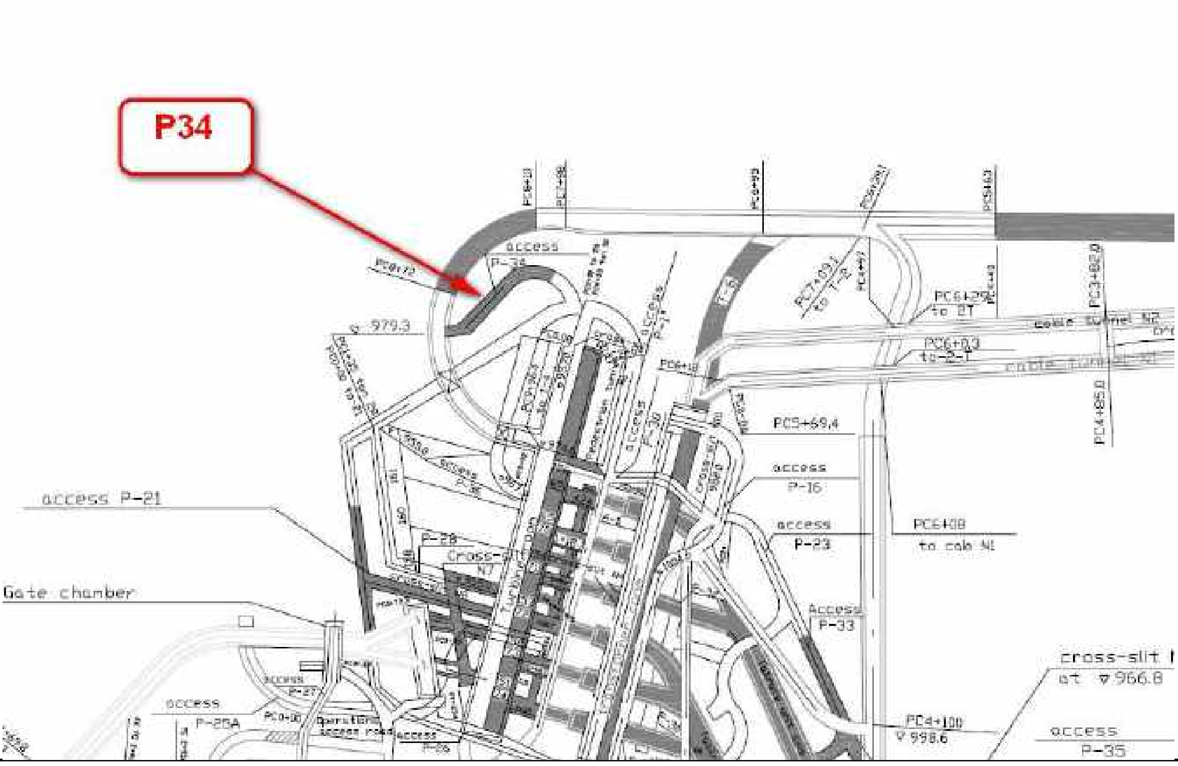


Stage 1 - Report name

Item Access Adit P34

Code P34

n° : 31

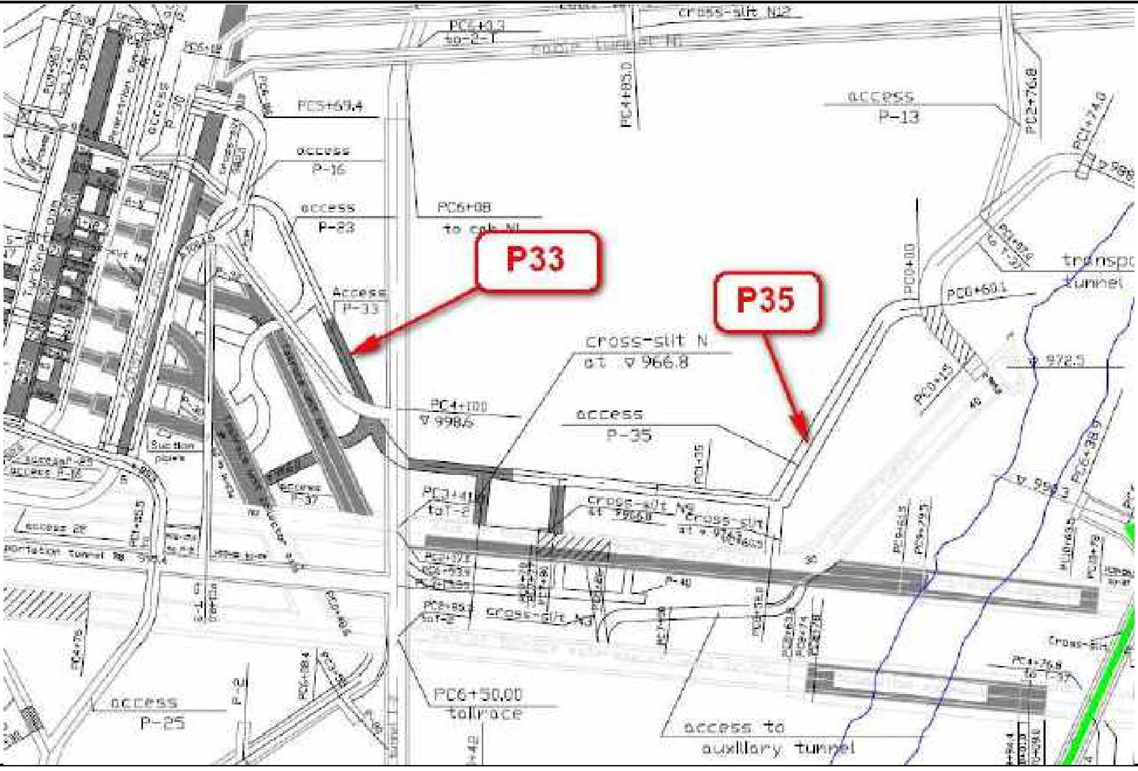


Stage 1 - Report name

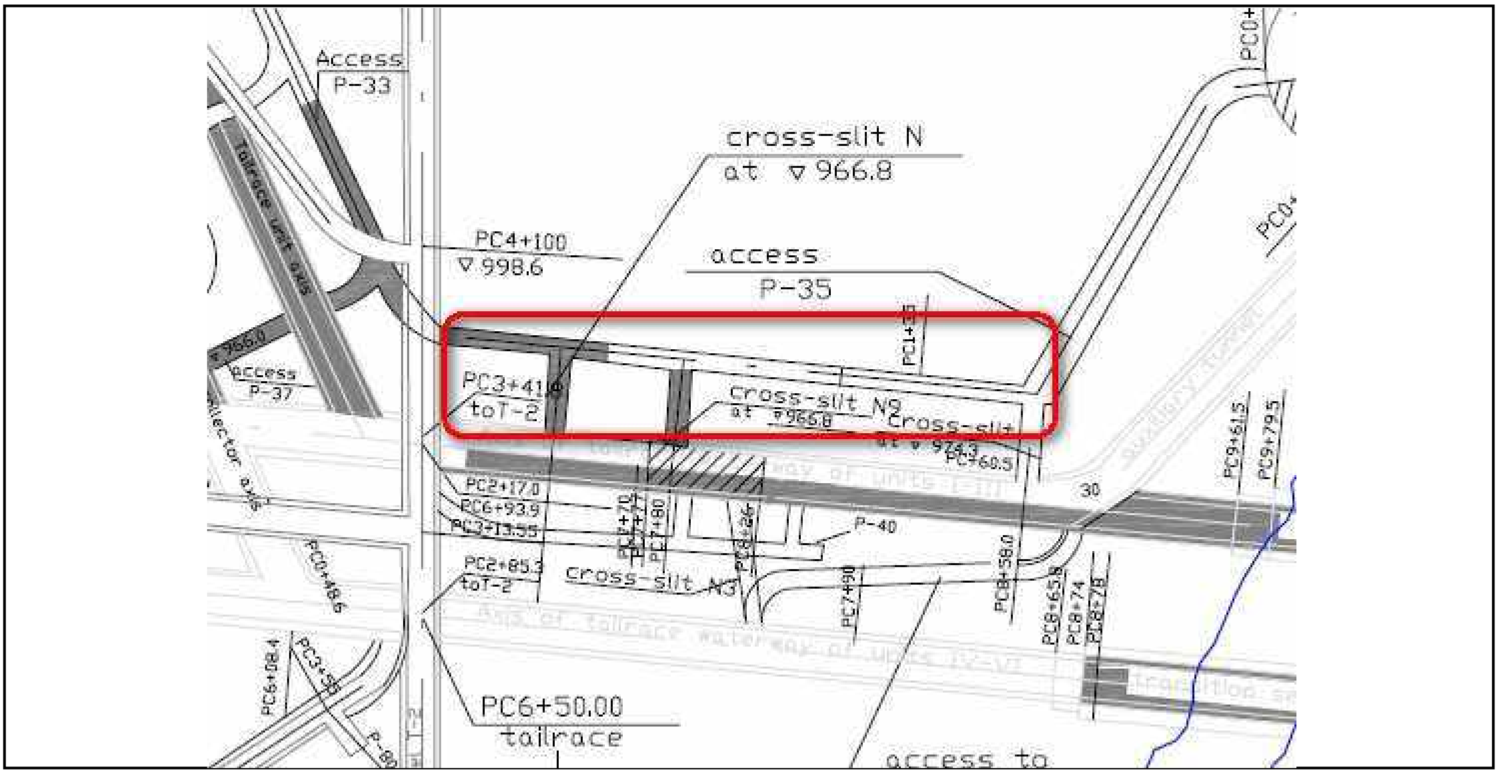
Item Access Adit P35

Code P35

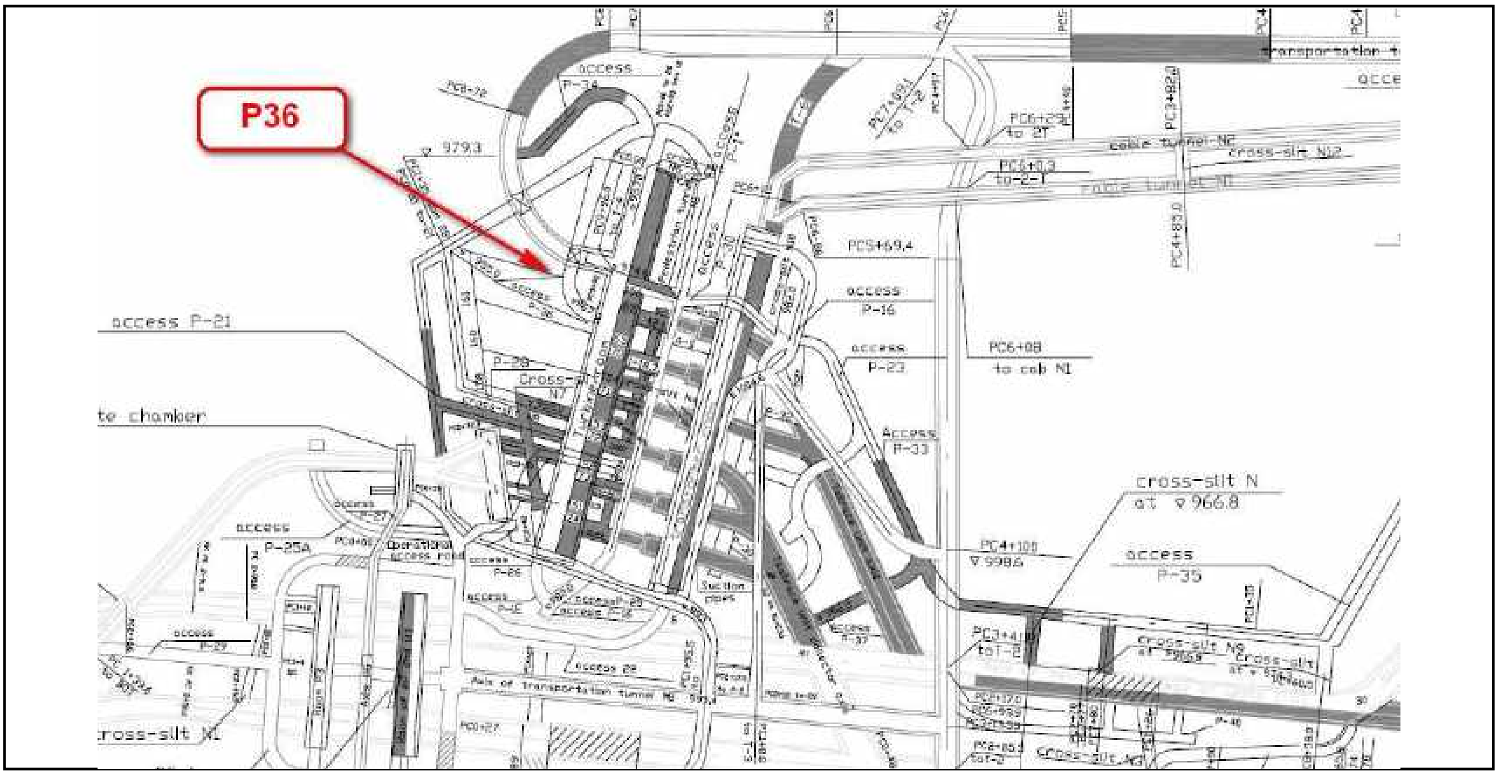
n° : 32



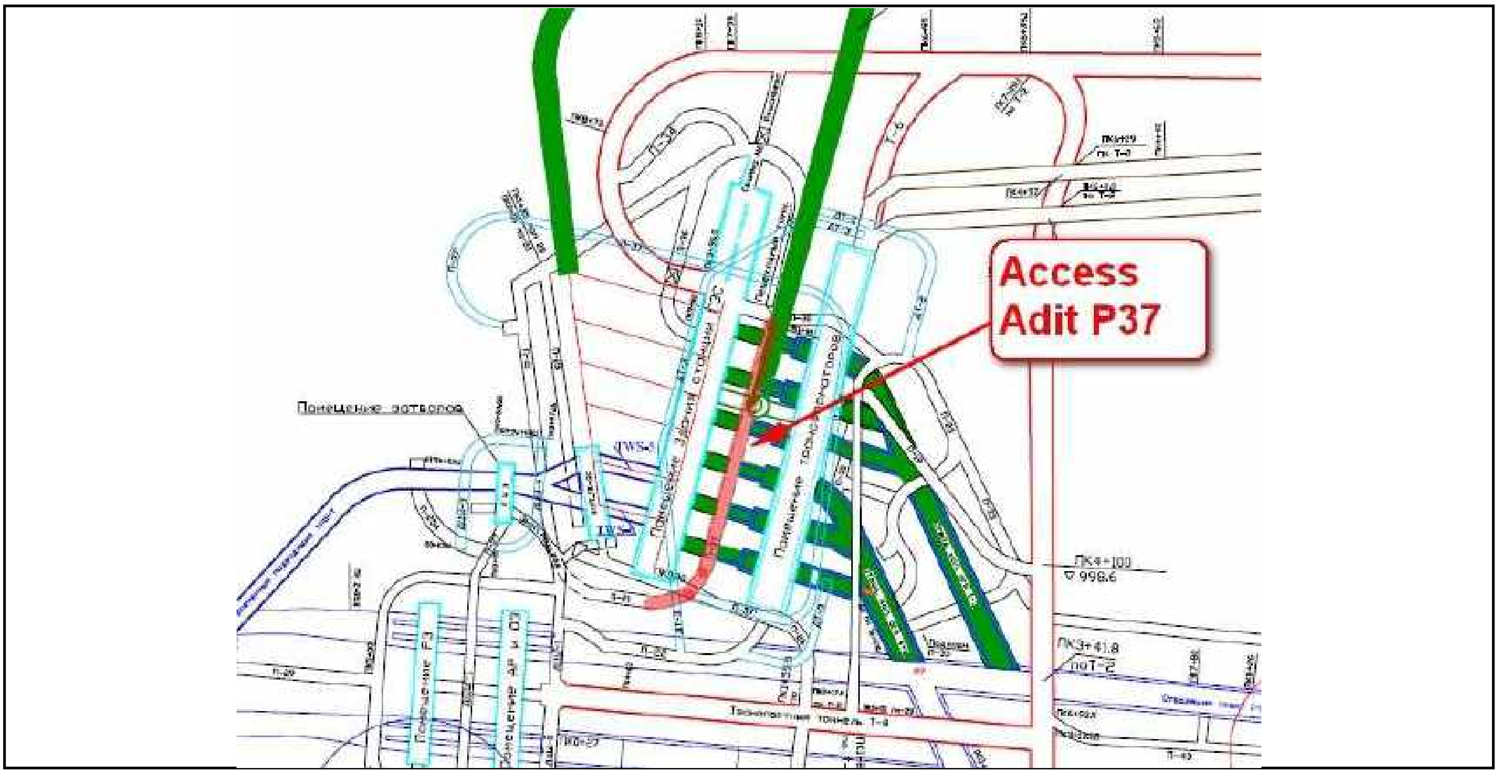
Stage 1 - Report name	**Item**	**Access Adit P35A**	**n° :**	33
	Code	**P35A**		



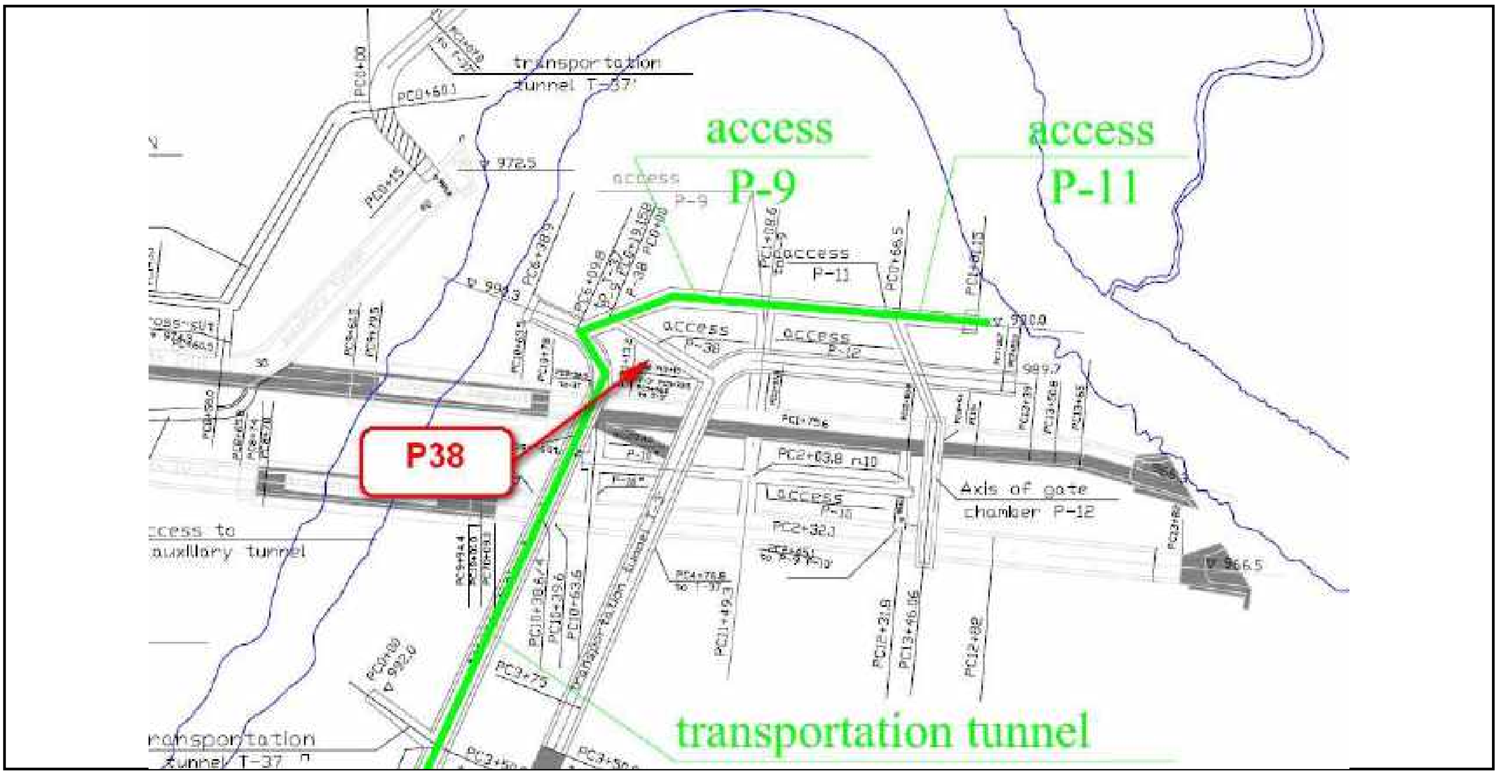
Stage 1 - Report name	**Item**	**Access Adit P36**	**n° :**	34
	Code	**P36**		



Stage 1 - Report name	**Item**	Access Adit P37	**n° :** 35
	Code	P37	



Stage 1 - Report name	**Item**	Access Adit P38	**n° :** 36
	Code	P38	

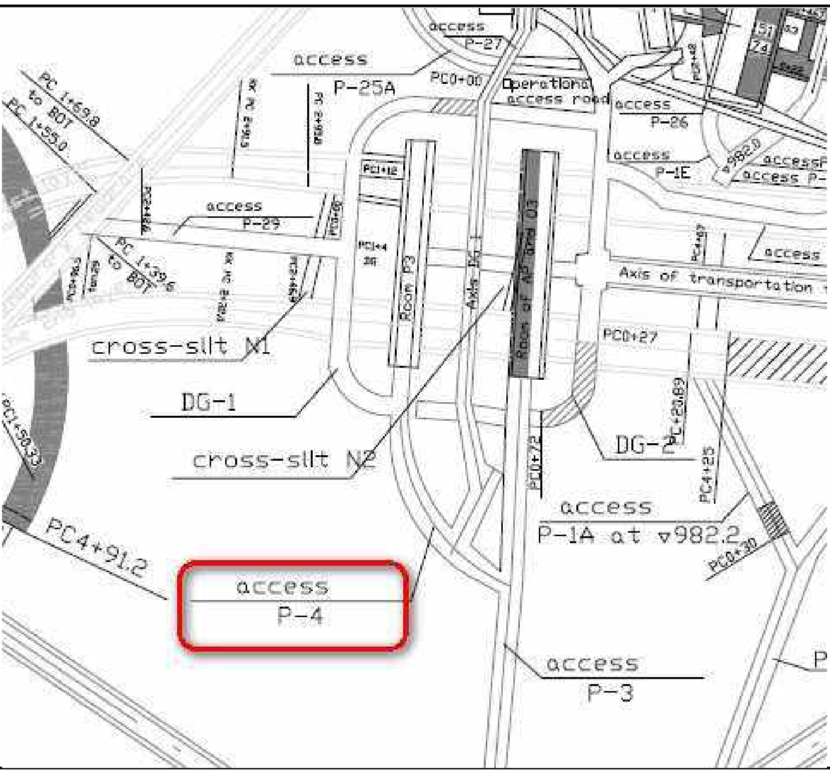


Stage 1 - Report name

Item Access Adit P4

Code P4

n° : 37

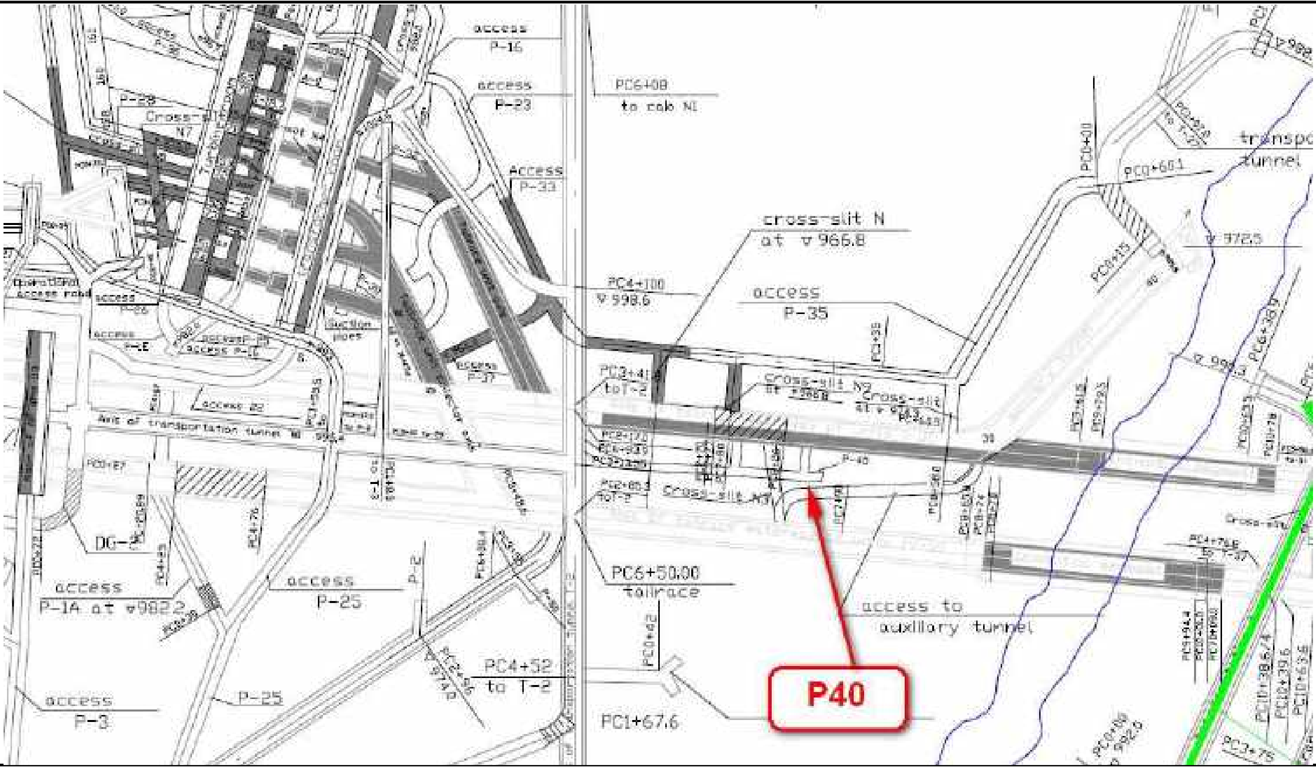


Stage 1 - Report name

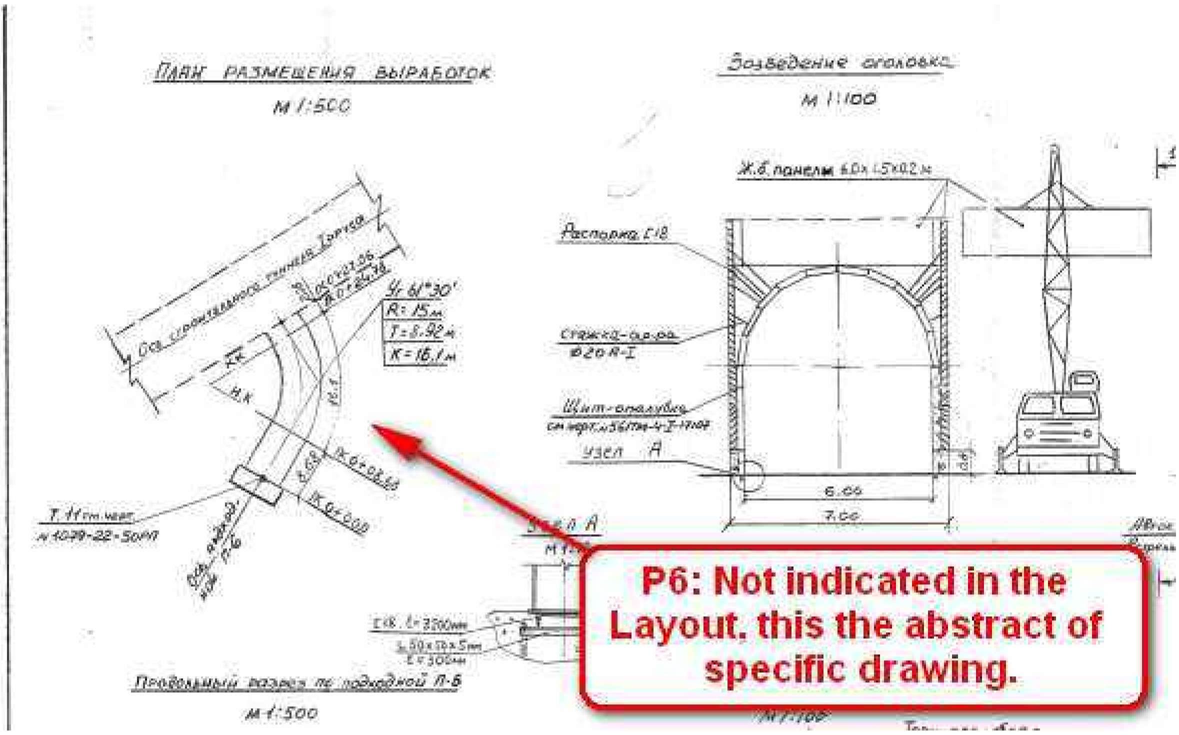
Item Access Adit P40

Code P40

n° : 38

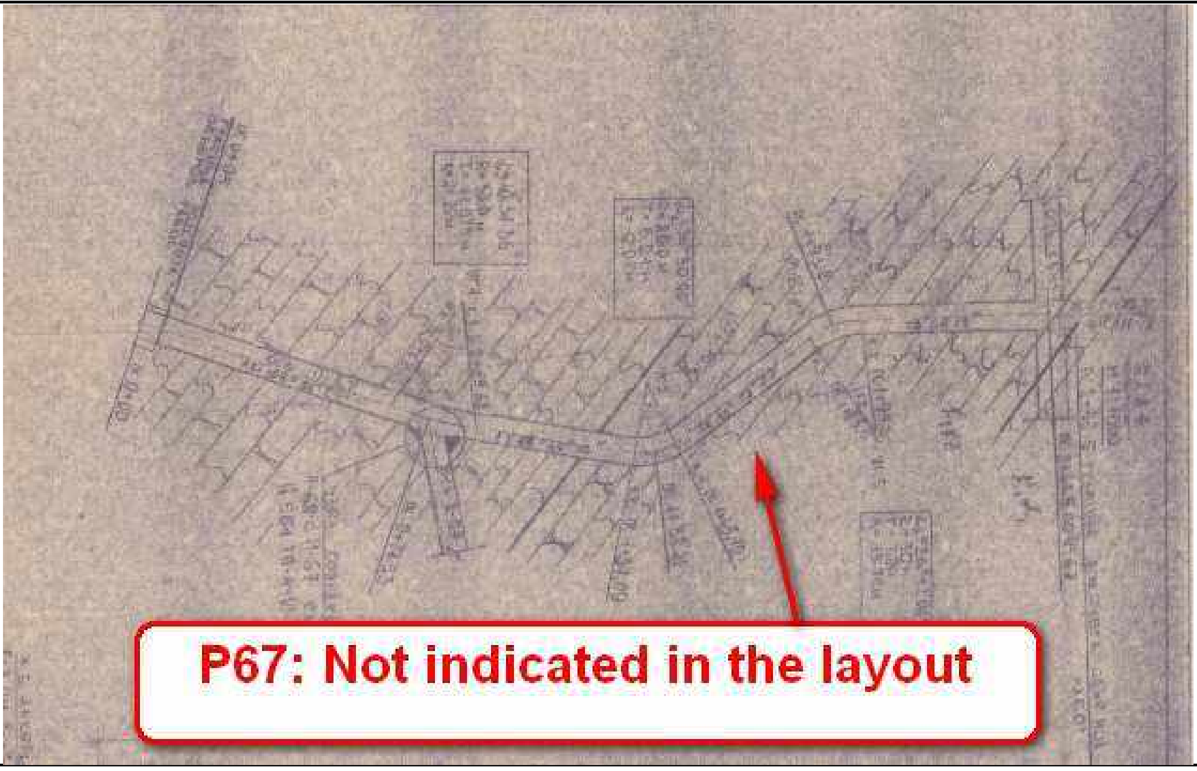


Stage 1 - Report name	**Item**	Access Adit P6	**n° :**	39
	Code	P6		



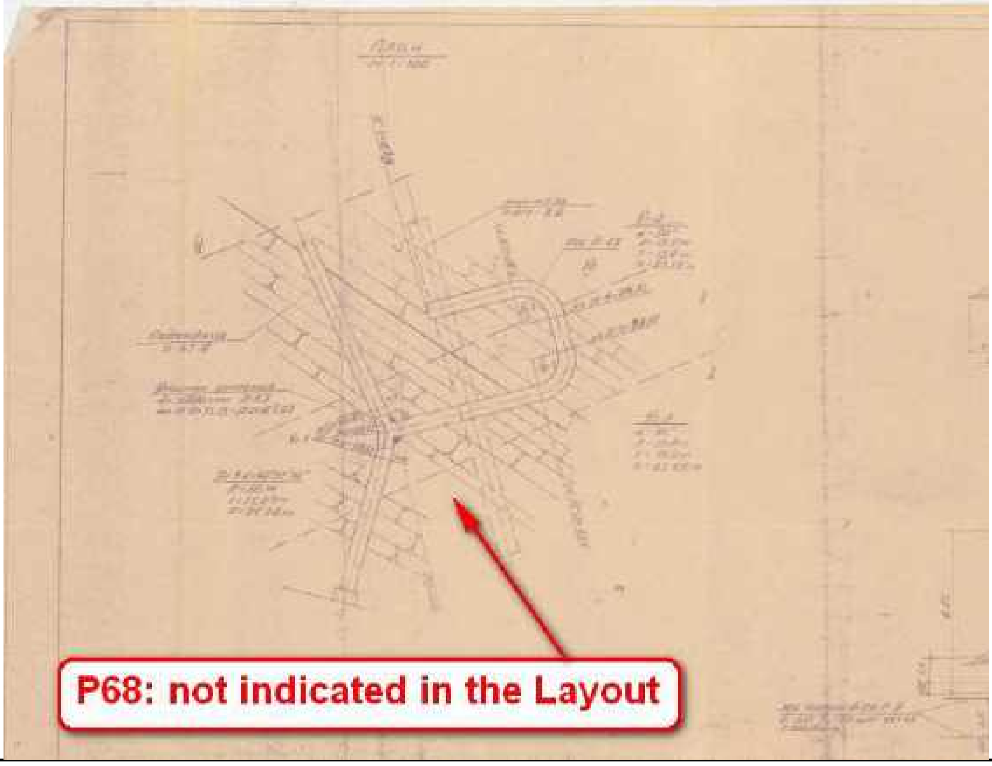
P6: Not indicated in the Layout. this the abstract of specific drawing.

Stage 1 - Report name	**Item**	Access Adit P67	**n° :**	40
	Code	P67		

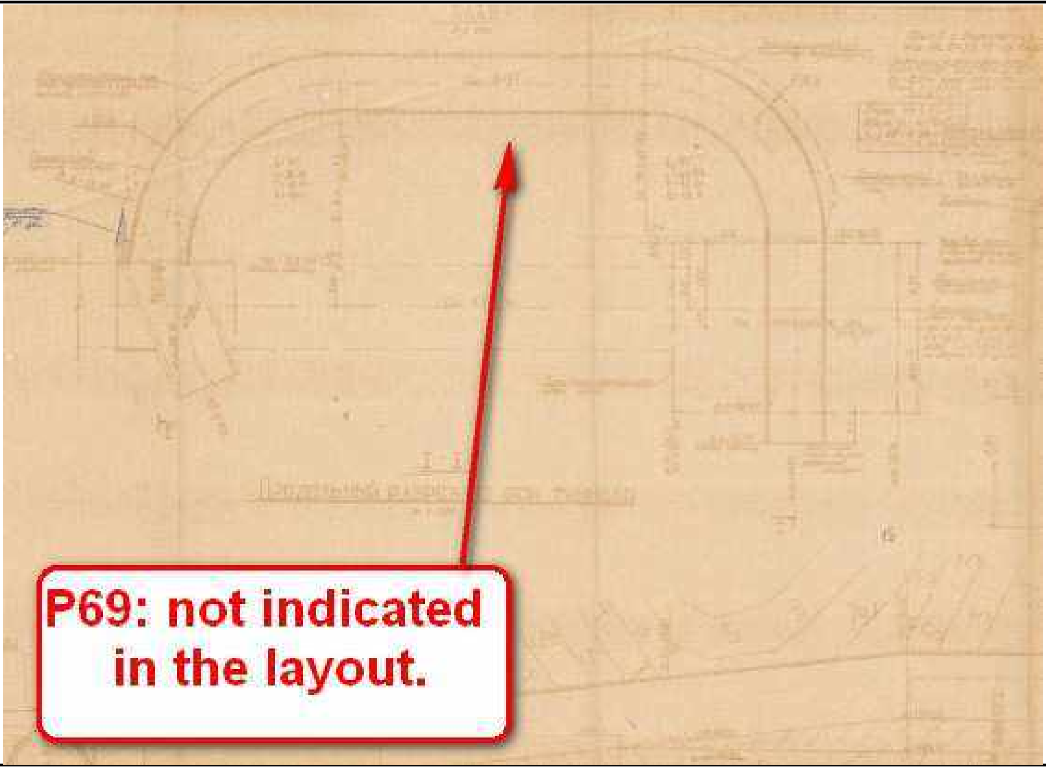


P67: Not indicated in the layout

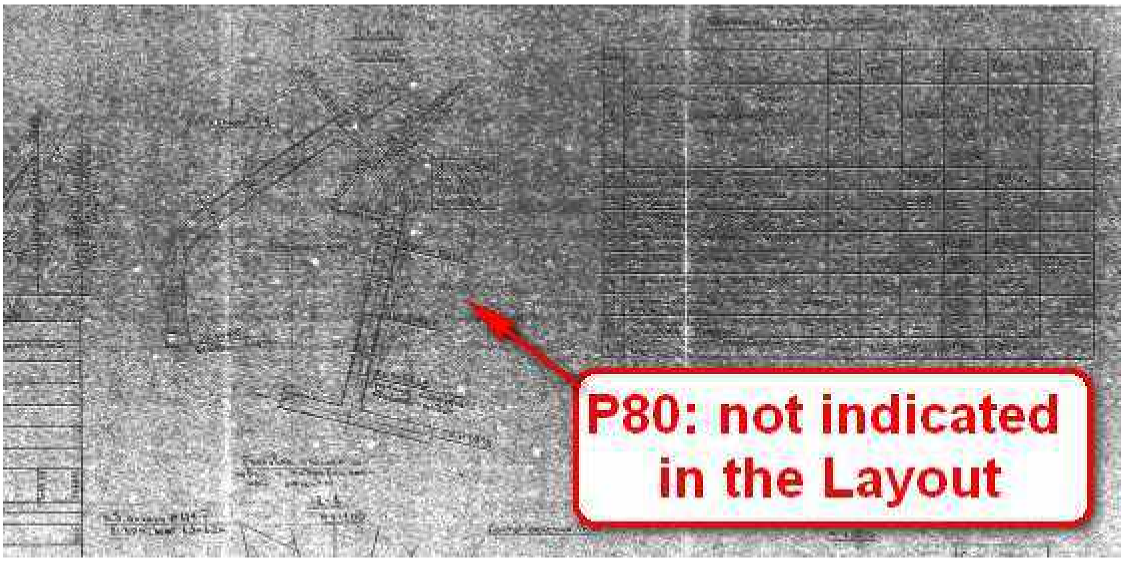
Stage 1 - Report name	**Item**	Access Adit P68	**n° :**	41
	Code	P68		


P68: not indicated in the Layout

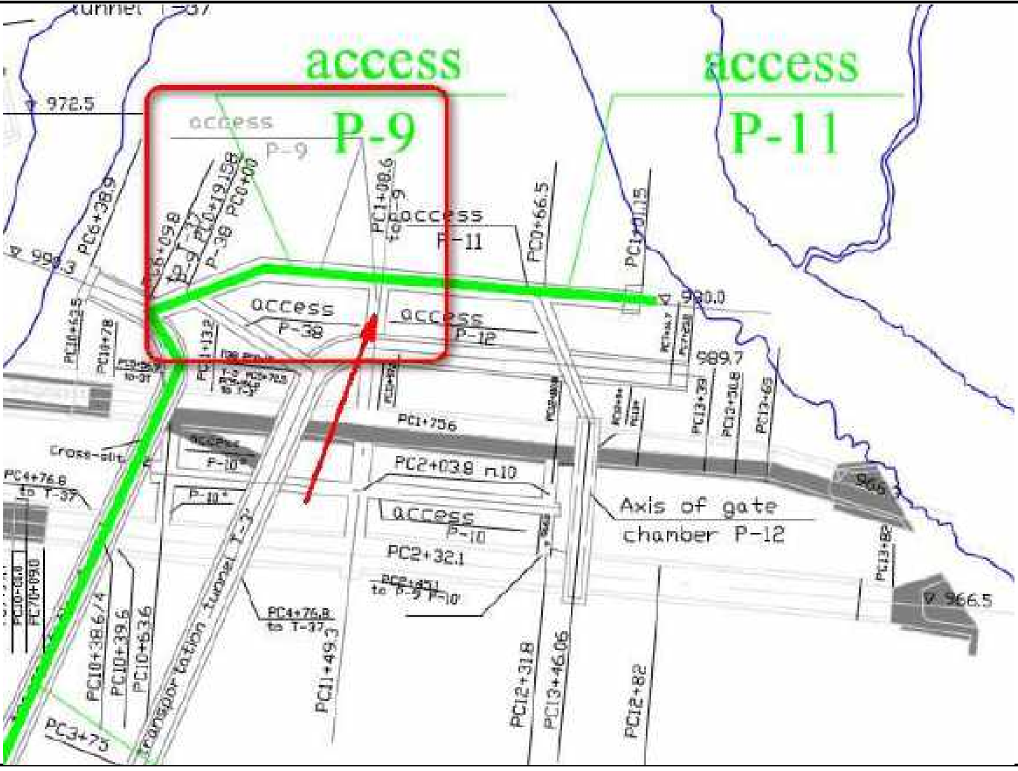
Stage 1 - Report name	**Item**	Access Adit P69	**n° :**	42
	Code	P69		


P69: not indicated in the layout.

Stage 1 - Report name	**Item**	Access Adit P80	**n° :**	43
	Code	P80		



Stage 1 - Report name	**Item**	Access Adit P9	**n° :**	44
	Code	P9		

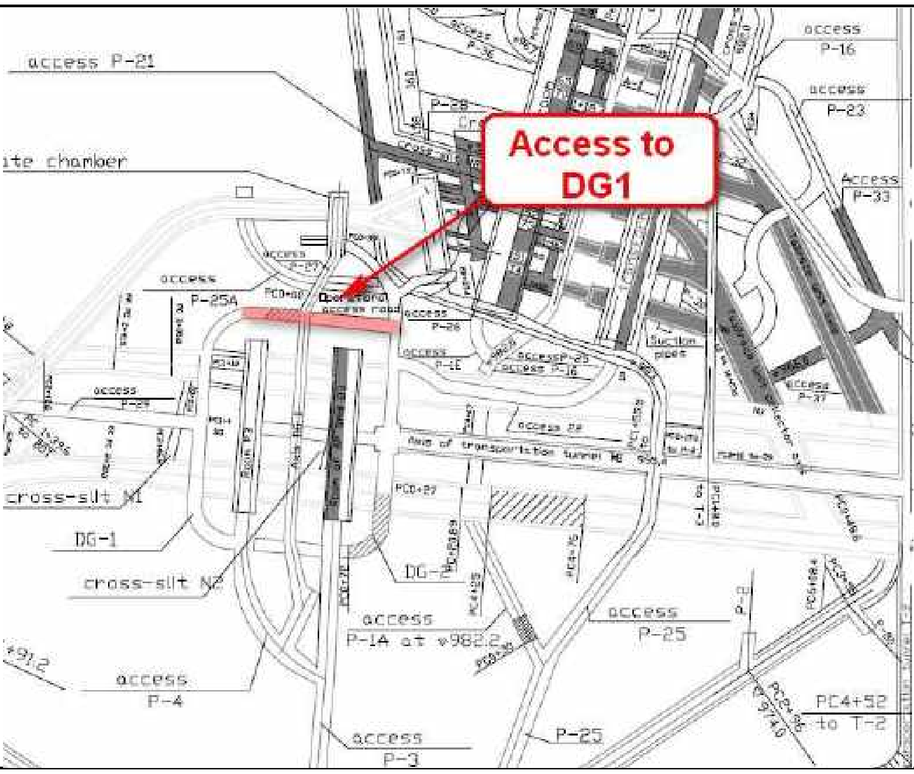


Stage 1 - Report name

Item **Access to DG1 - P4**

Code **Acc DG1 P4**

n° : **45**

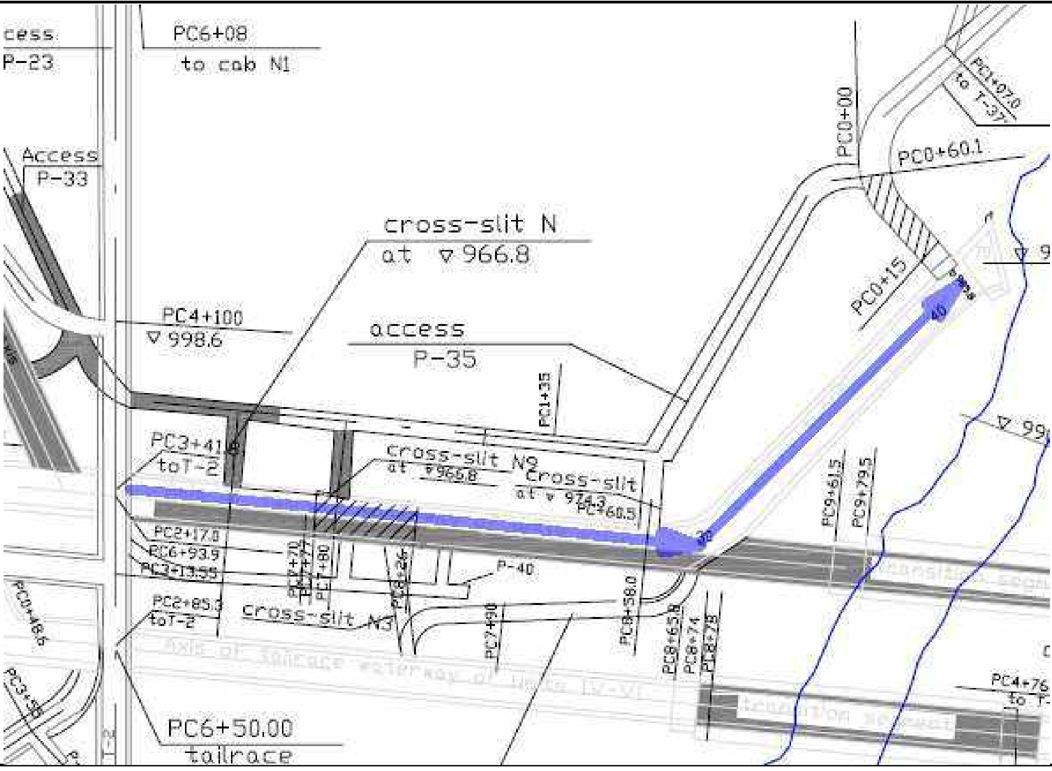


Stage 1 - Report name

Item **Auxiliary Tunnel**

Code **Aux T**

n° : **46**

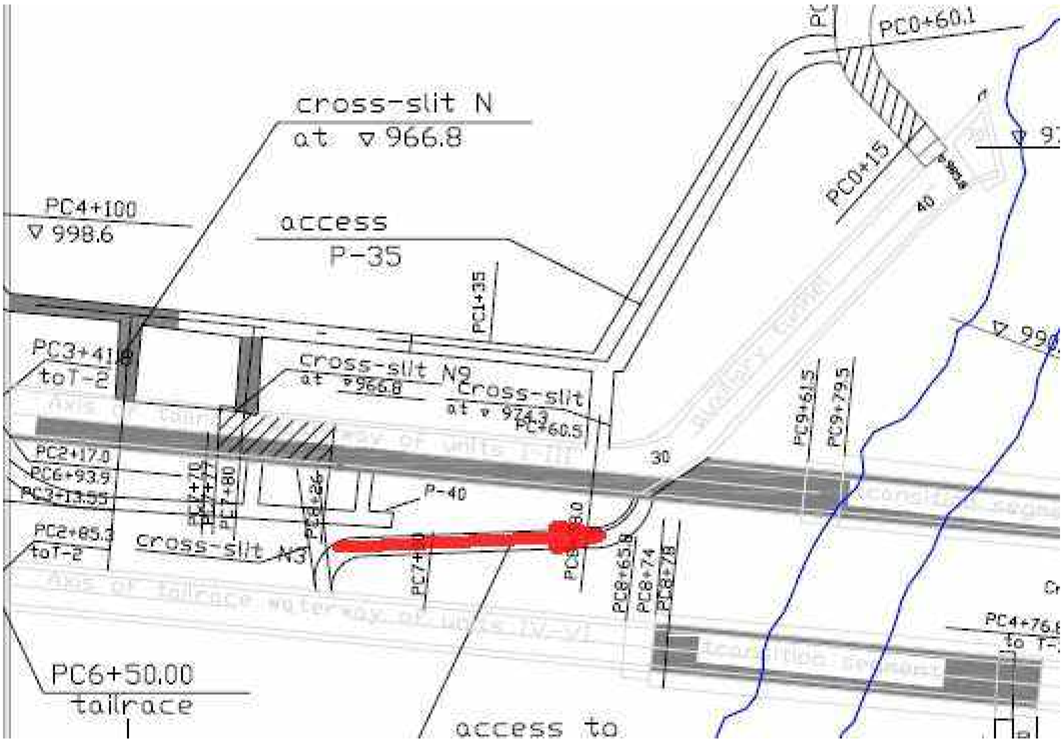


Stage 1 - Report name

Item **Auxiliary Tunnel Adit - Abandoned**

n° : **47**

Code **Aux. T Ad**

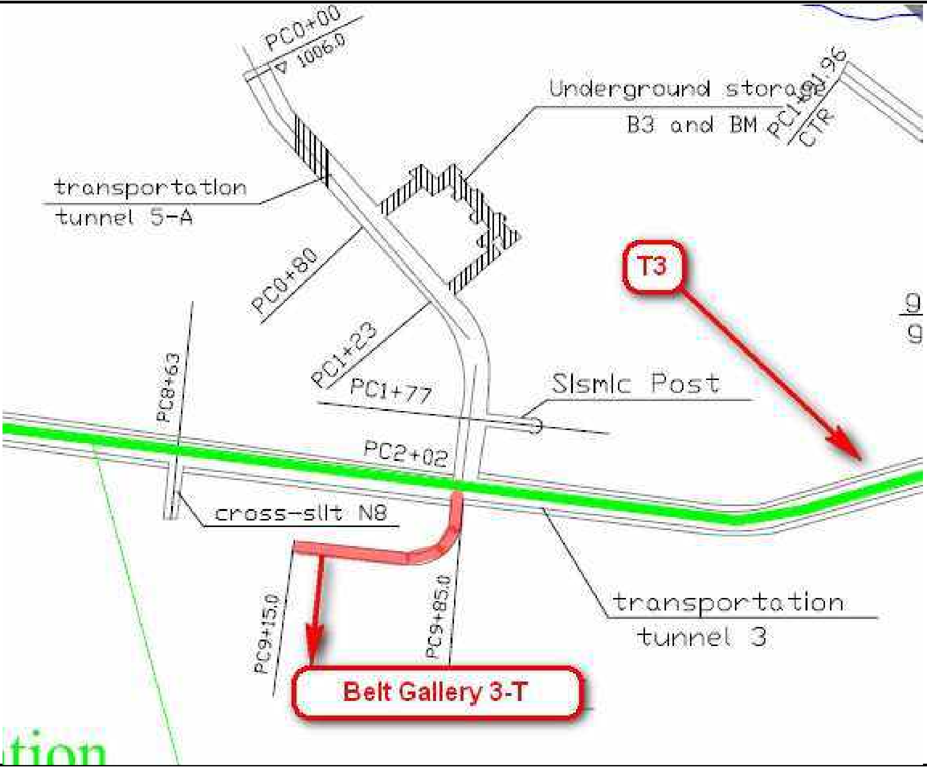


Stage 1 - Report name

Item **Belt Gallery 3-T**

n° : **48**

Code **BG 3-T**

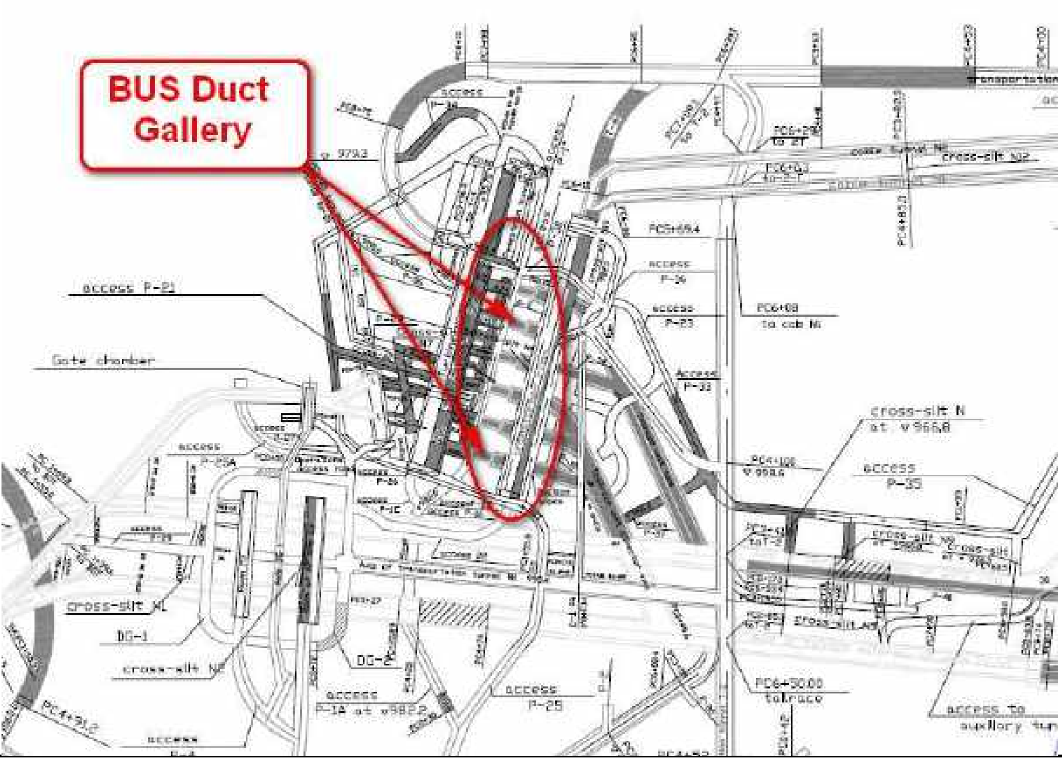


Stage 1 - Report name

Item BUS Duct gallery

Code BDG

n° : 49

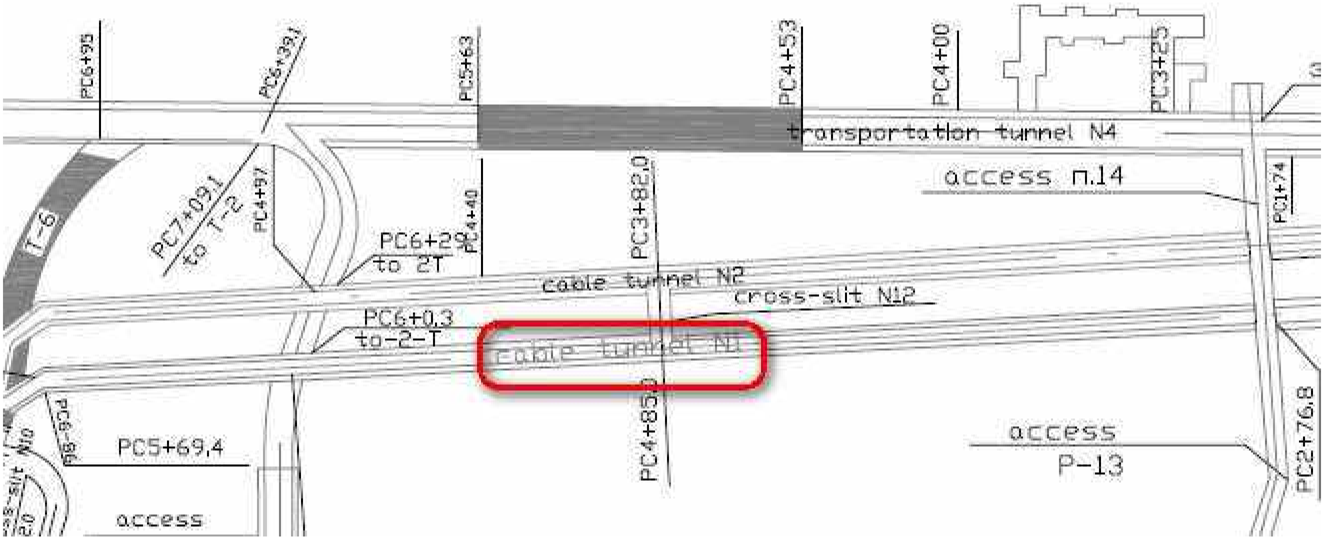


Stage 1 - Report name

Item Cable Tunnel 1

Code K1

n° : 50

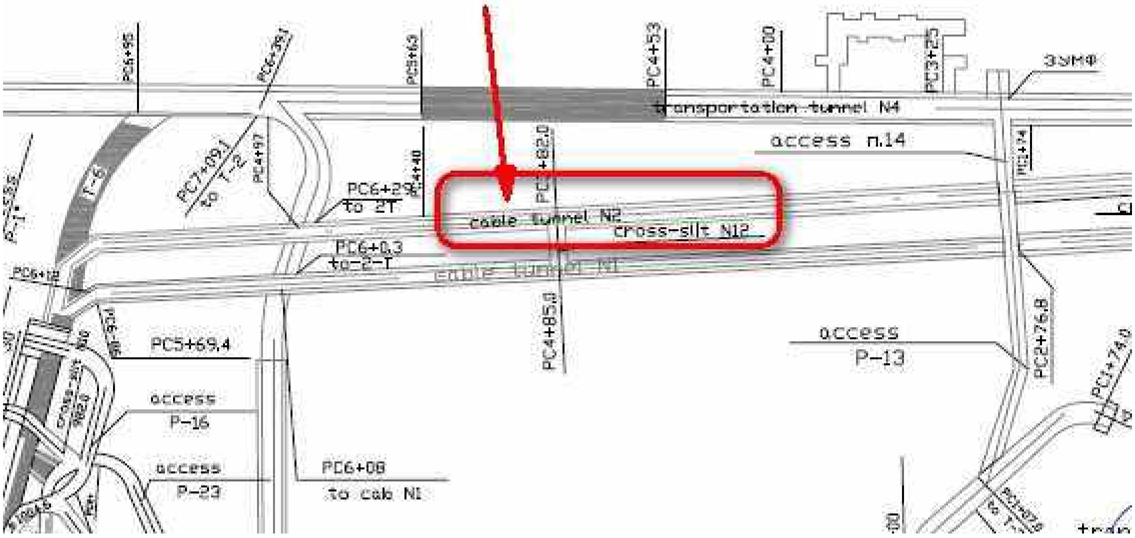


Stage 1 - Report name

Item Cable Tunnel 2

Code K2

n° : 51

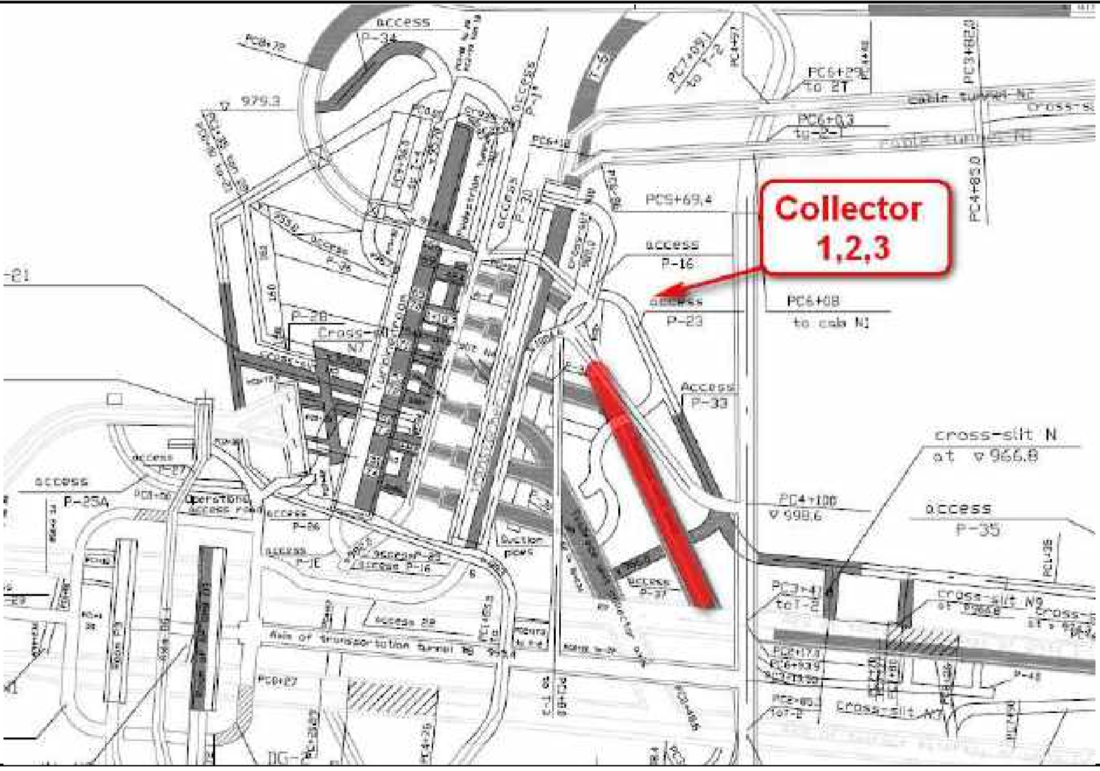


Stage 1 - Report name

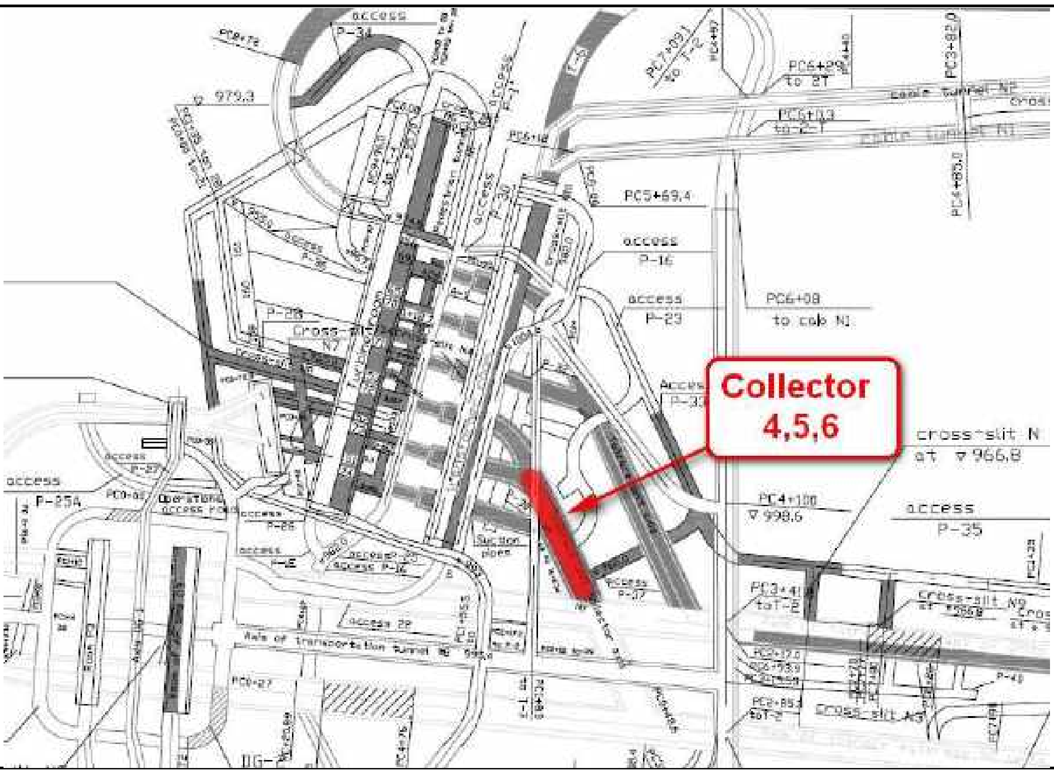
Item Collector of Draft Tubes 1-3 to Diversion Tunnels

Code COLL 1-3

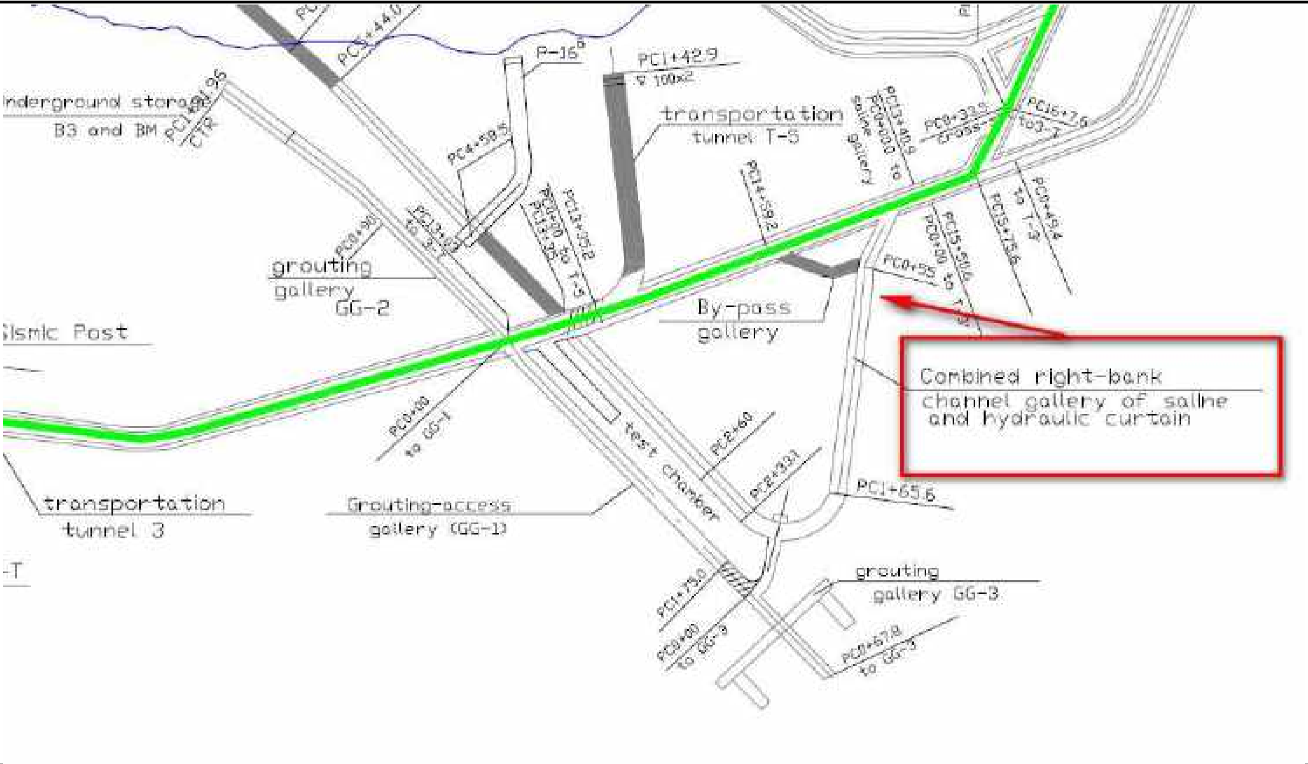
n° : 52



Stage 1 - Report name	**Item**	**Collector of Draft Tubes 4-6 to Diversion tunnels**	**n° :**	**53**
	Code	**COLL 4-6**		



Stage 1 - Report name	**Item**	**Combined right bank channel gallery of saline**	**n° :**	**54**
	Code	**CRB SALINE**		

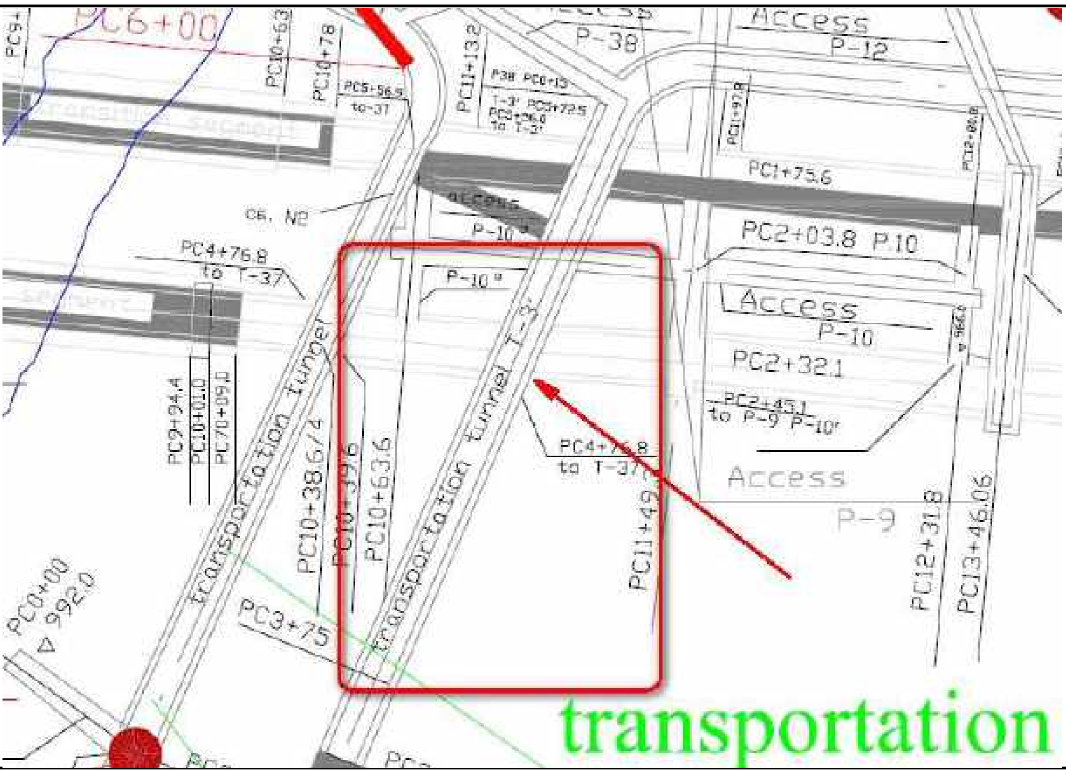


Stage 1 - Report name

Item Connecting Tunnel T-3'

Code T3'

n° : 55

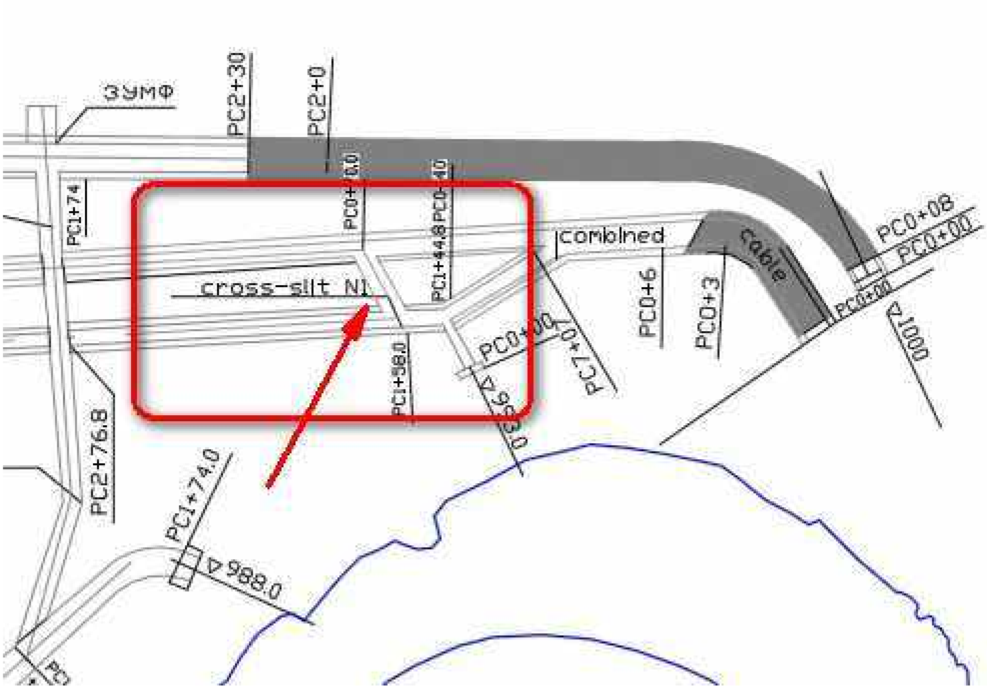


Stage 1 - Report name

Item Connection 1 Cable Tunnels 1 & 2

Code Con K1-K2

n° : 56

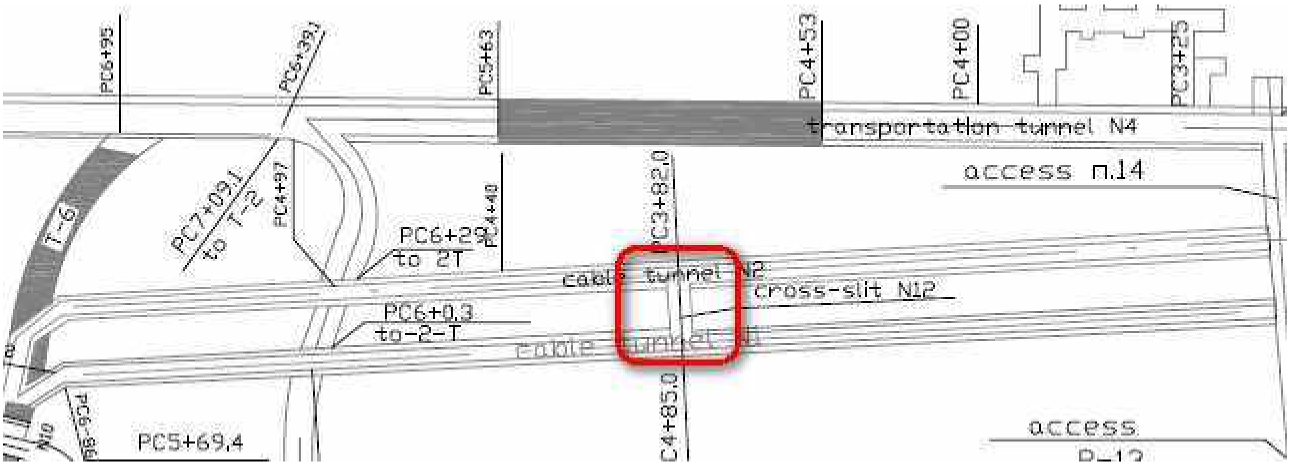


Stage 1 - Report name

Item Connection 2 Cable Tunnels 1 & 2

Code Con K1-K2_02

n° : 57

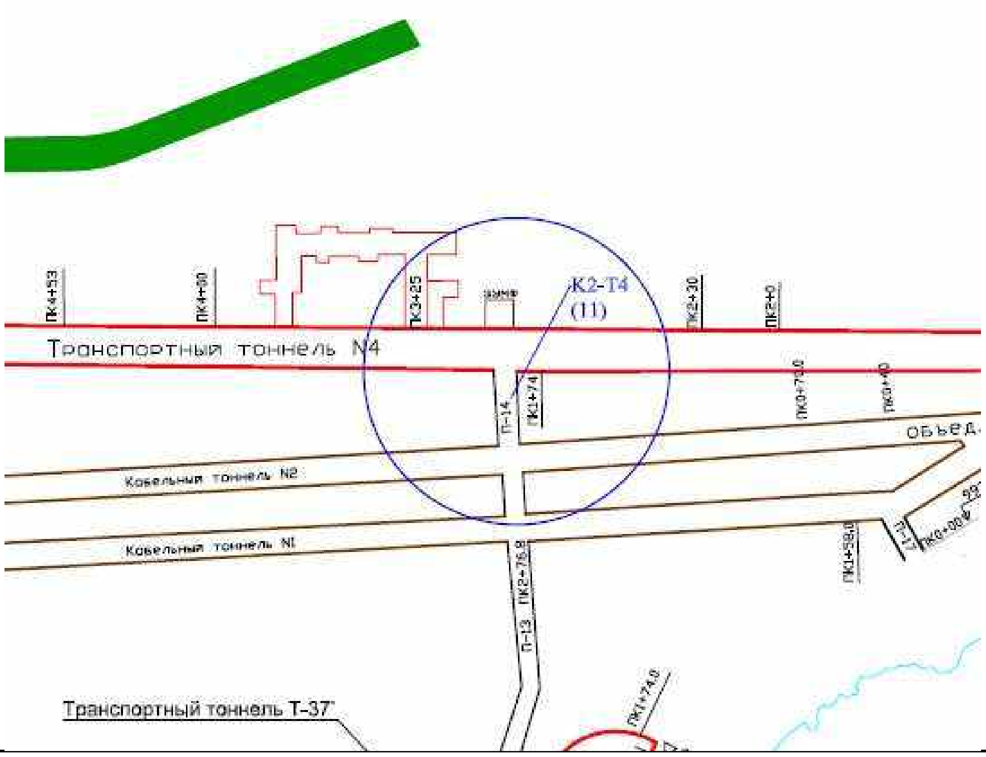


Stage 1 - Report name

Item Connection K2-T4

Code K2-T4 Connection

n° : 58

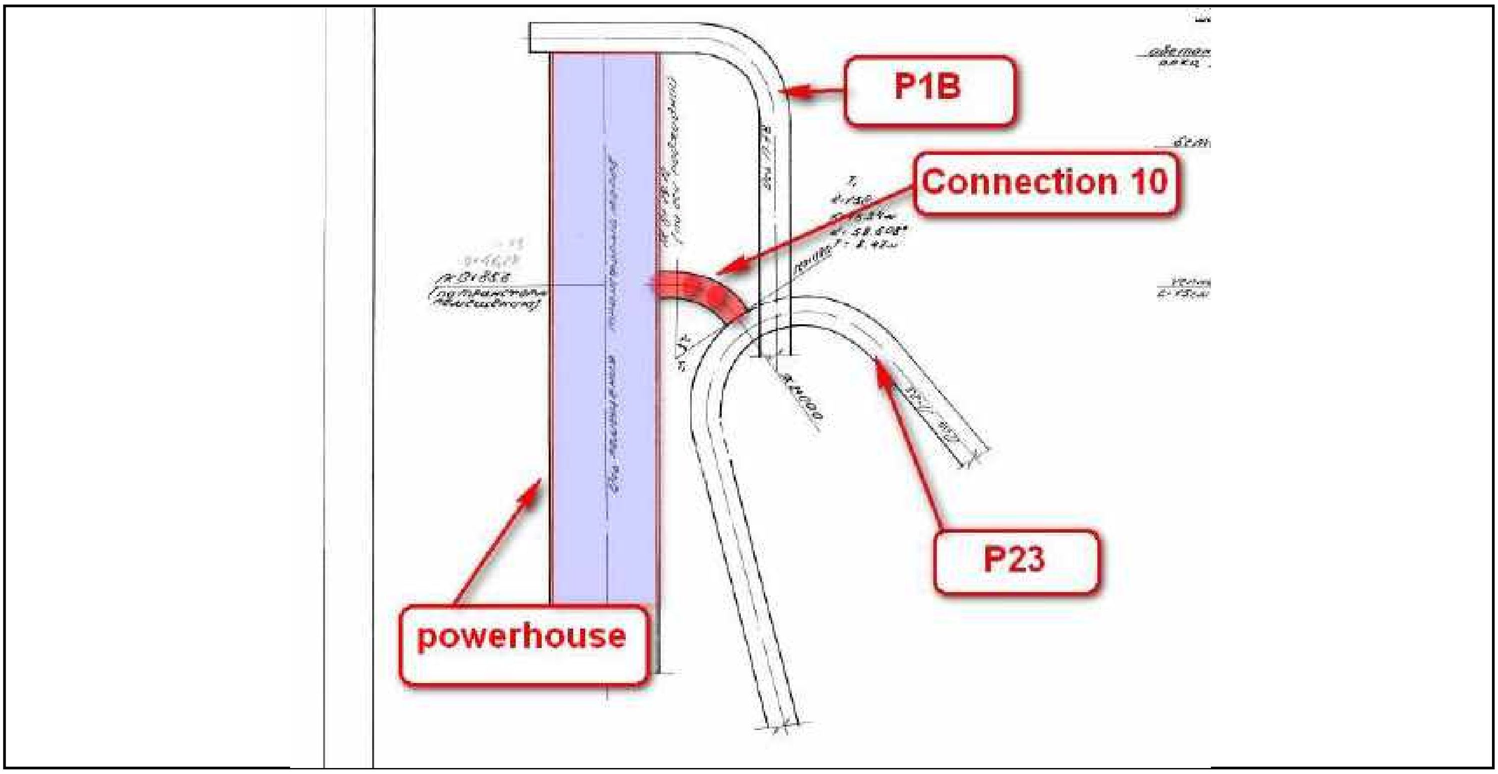


Stage 1 - Report name

Item Connection Tunnel n° 10

n° : 59

Code Con10

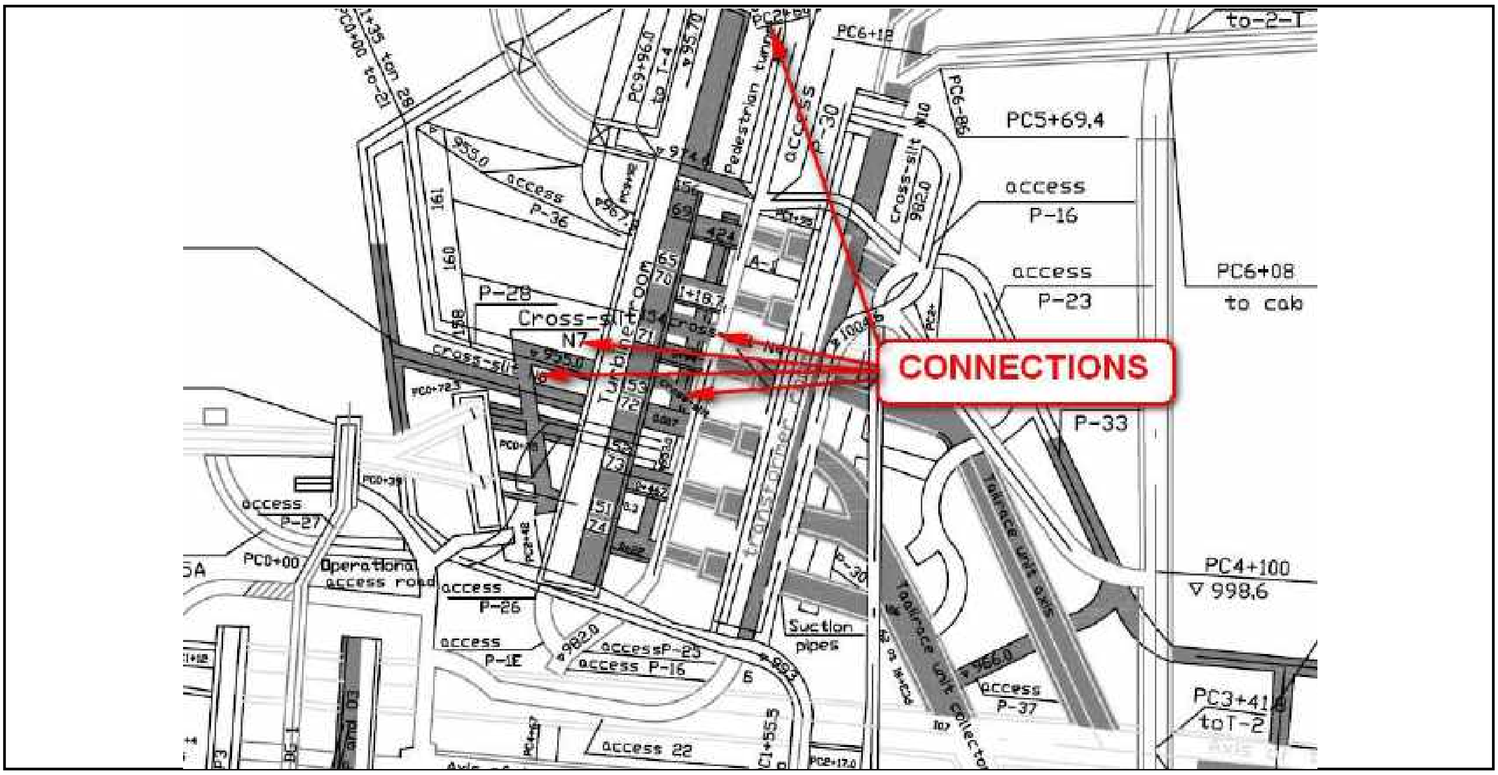


Stage 1 - Report name

Item Connection Tunnel n° 3

n° : 60

Code Con 3

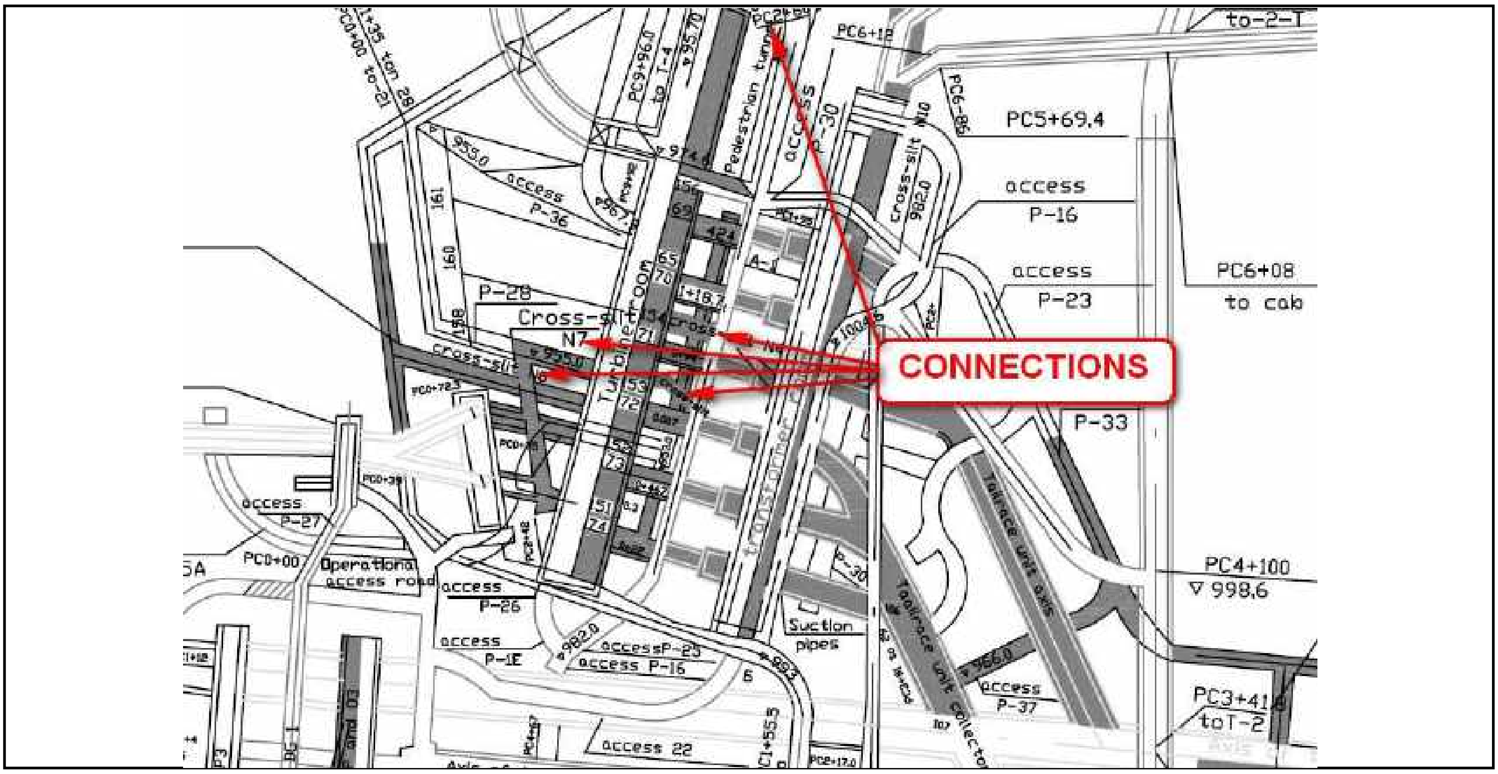


Stage 1 - Report name

Item Connection Tunnel n° 4

Code Con 4

n° : 61

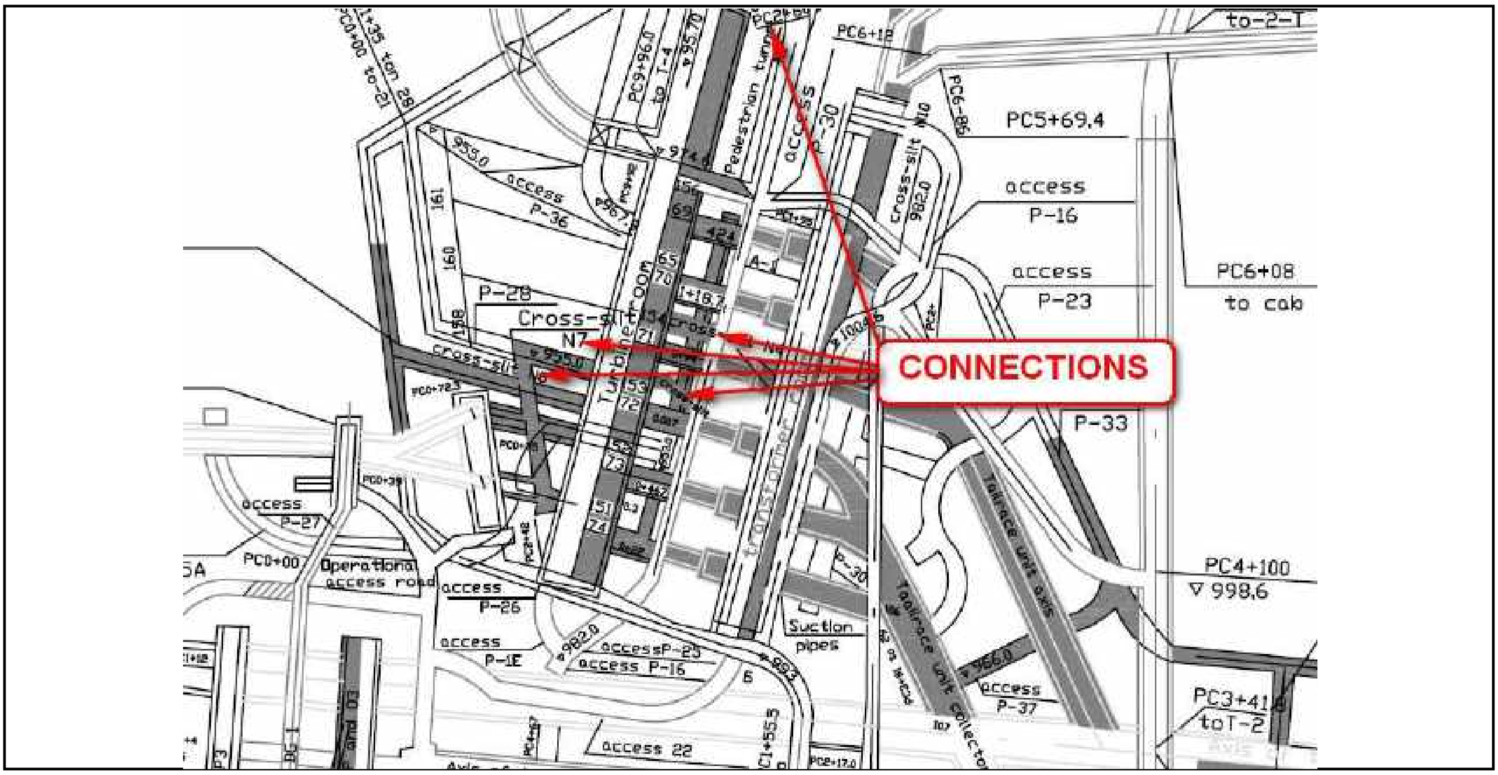


Stage 1 - Report name

Item Connection Tunnel n° 5

Code Con 5

n° : 62

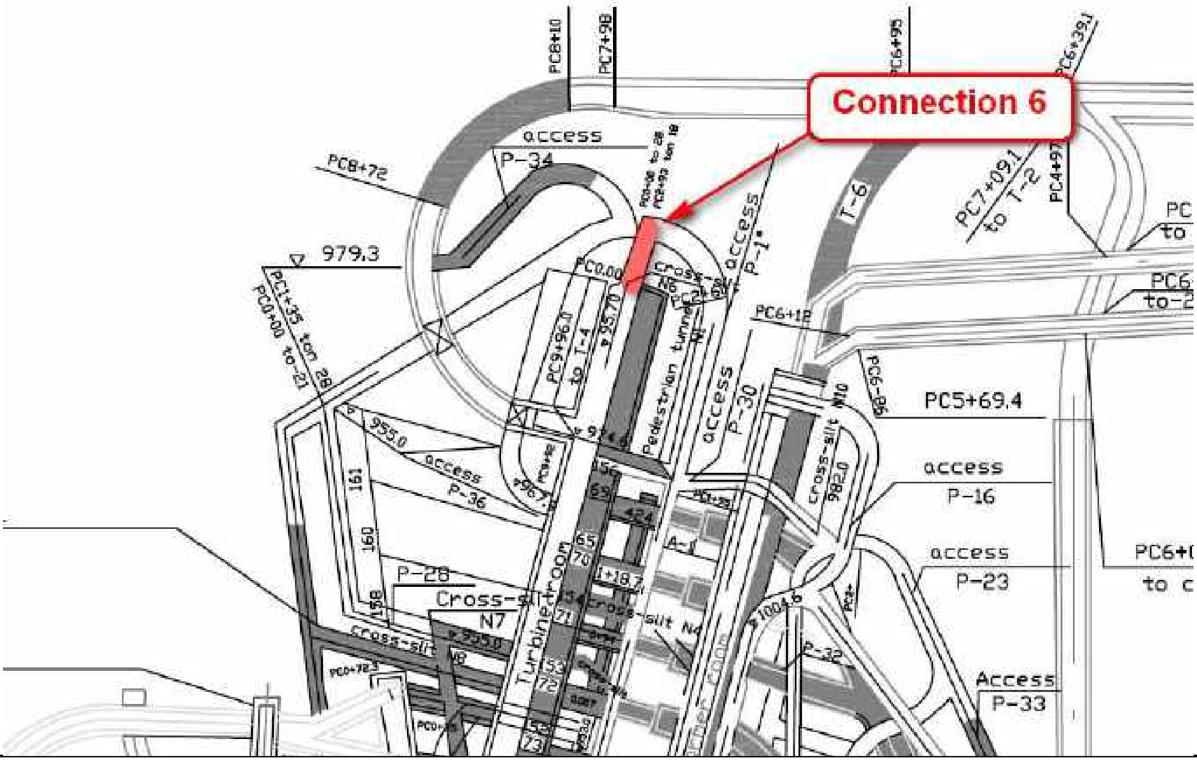


Stage 1 - Report name

Item Connection Tunnel n° 6

Code Con 6

n° : 63

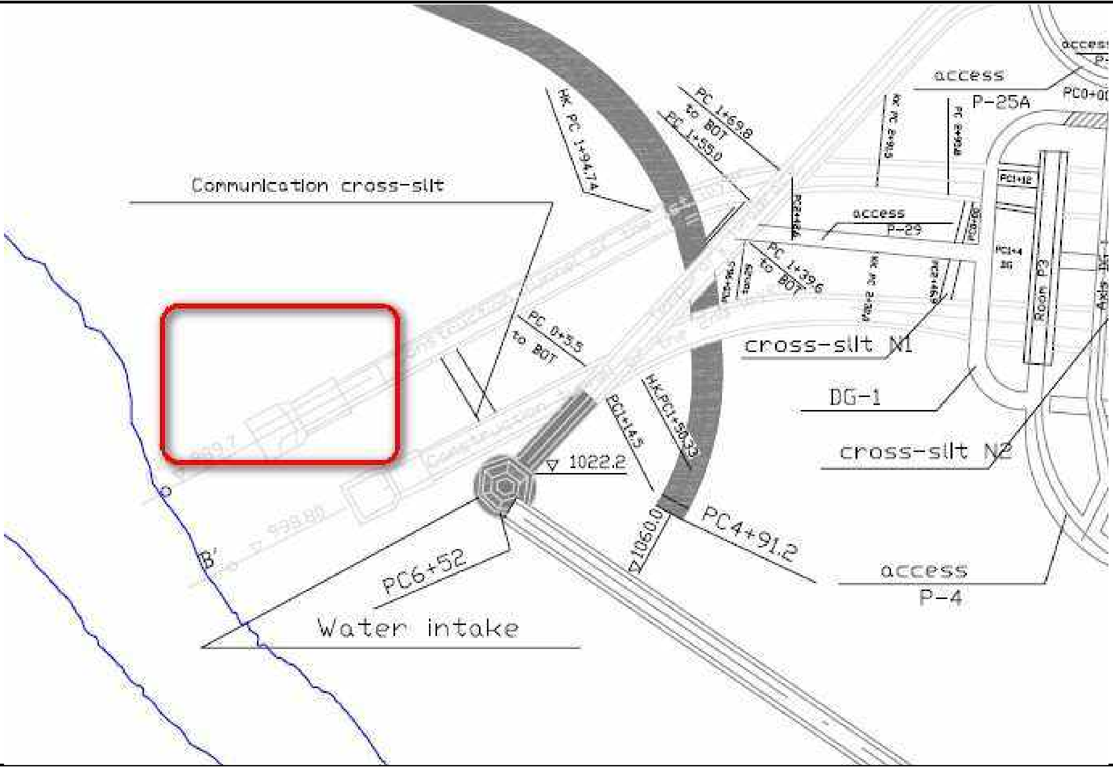


Stage 1 - Report name

Item Construction Tunnel I - Diversion I

Code ST 1

n° : 64

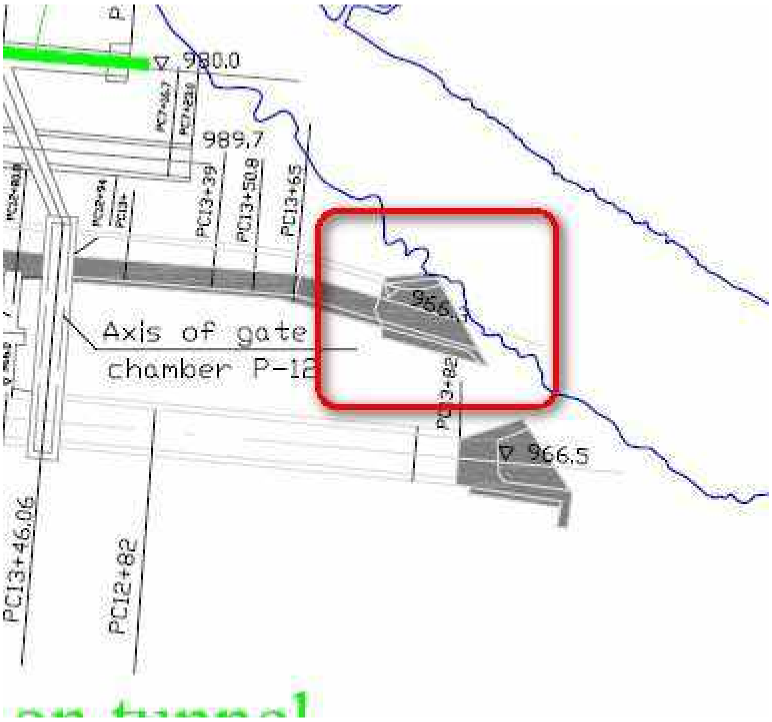


Stage 1 - Report name

Item Construction Tunnel I - OUTLET

Code ST1-OUT

n° : 65

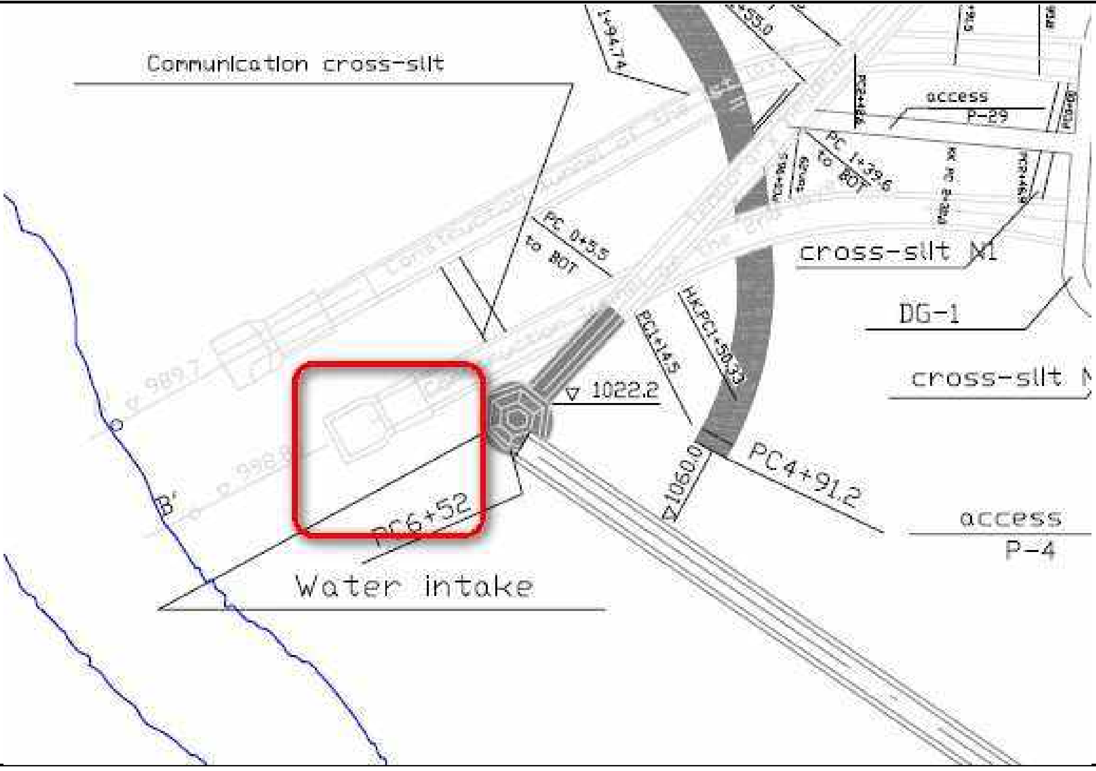


Stage 1 - Report name

Item Construction Tunnel II - Diversion II

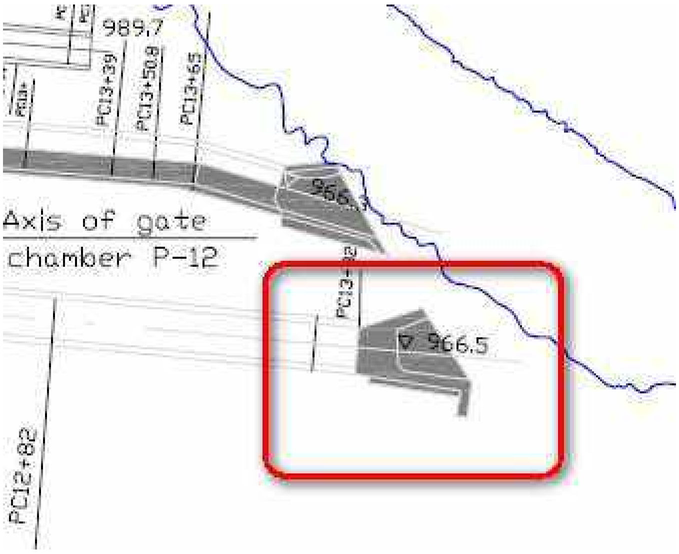
Code ST-2

n° : 66



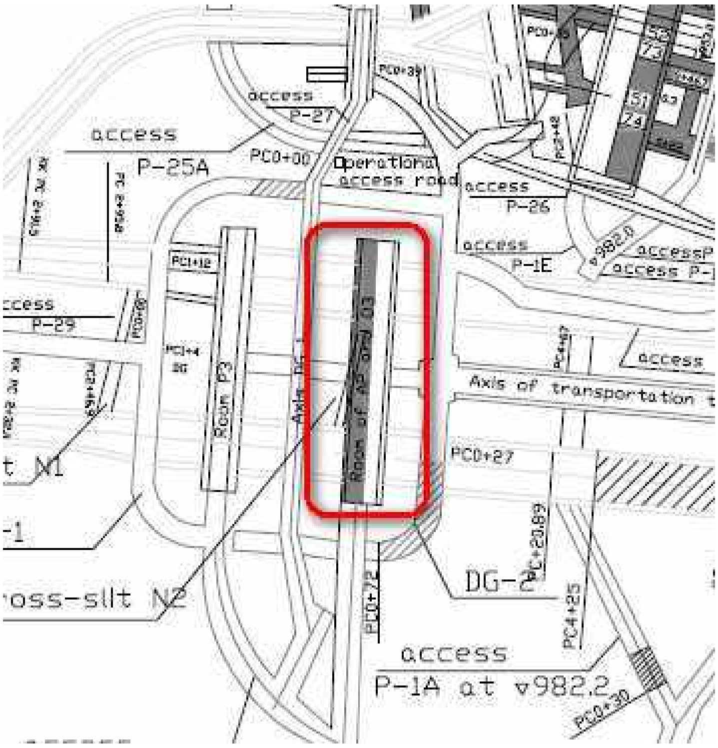
Stage 1 - Report name **Item** Construction Tunnel II - OUTLET **n° :** 67

Code ST2-OUT

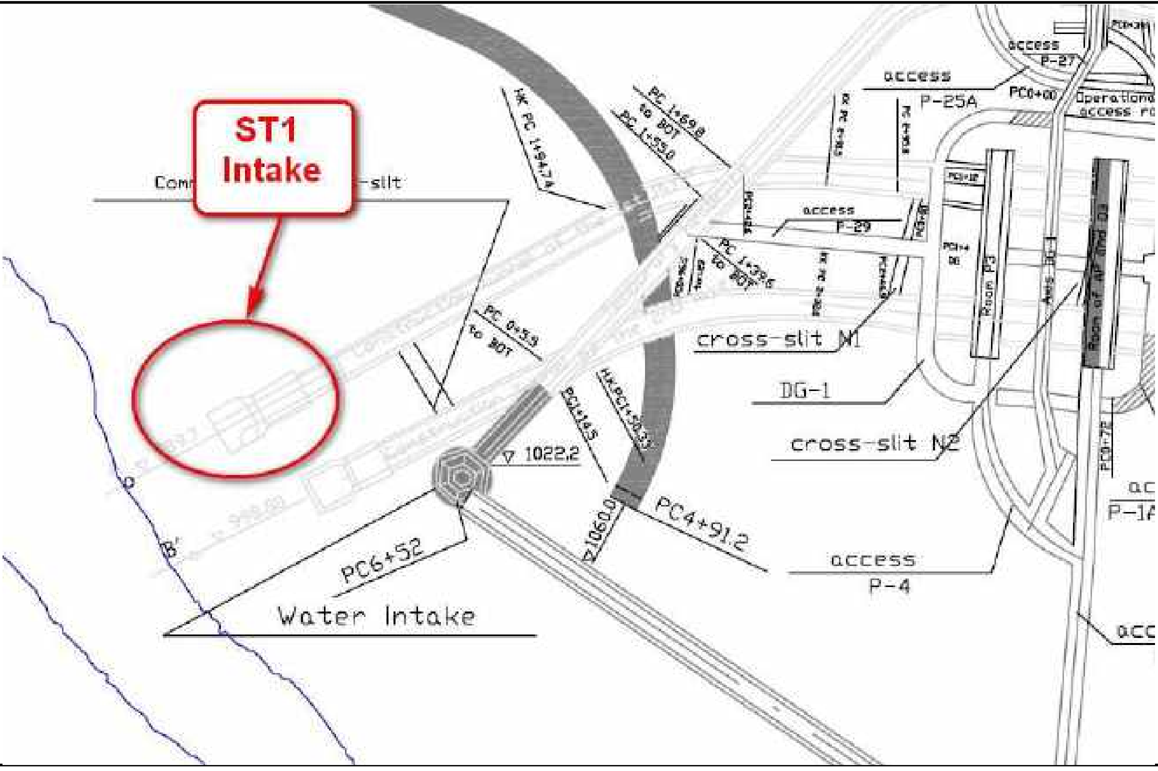


Stage 1 - Report name **Item** Construction Tunnels - Gate Chambers **n° :** 68

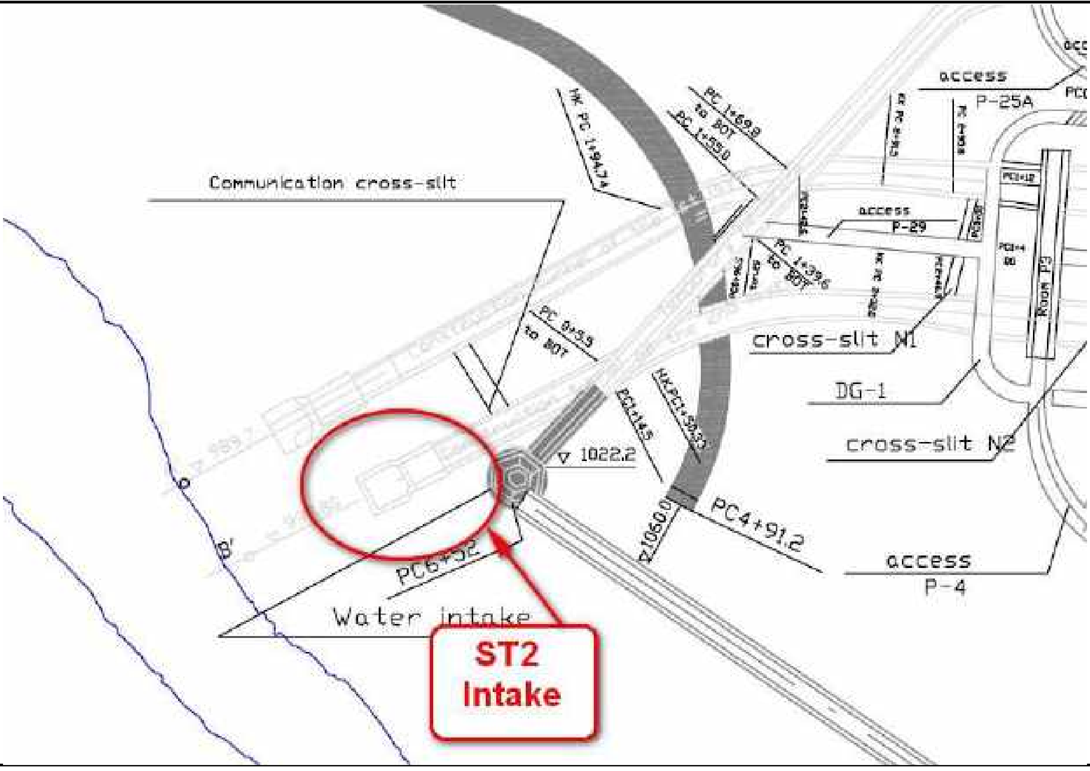
Code ST_ME_GCH



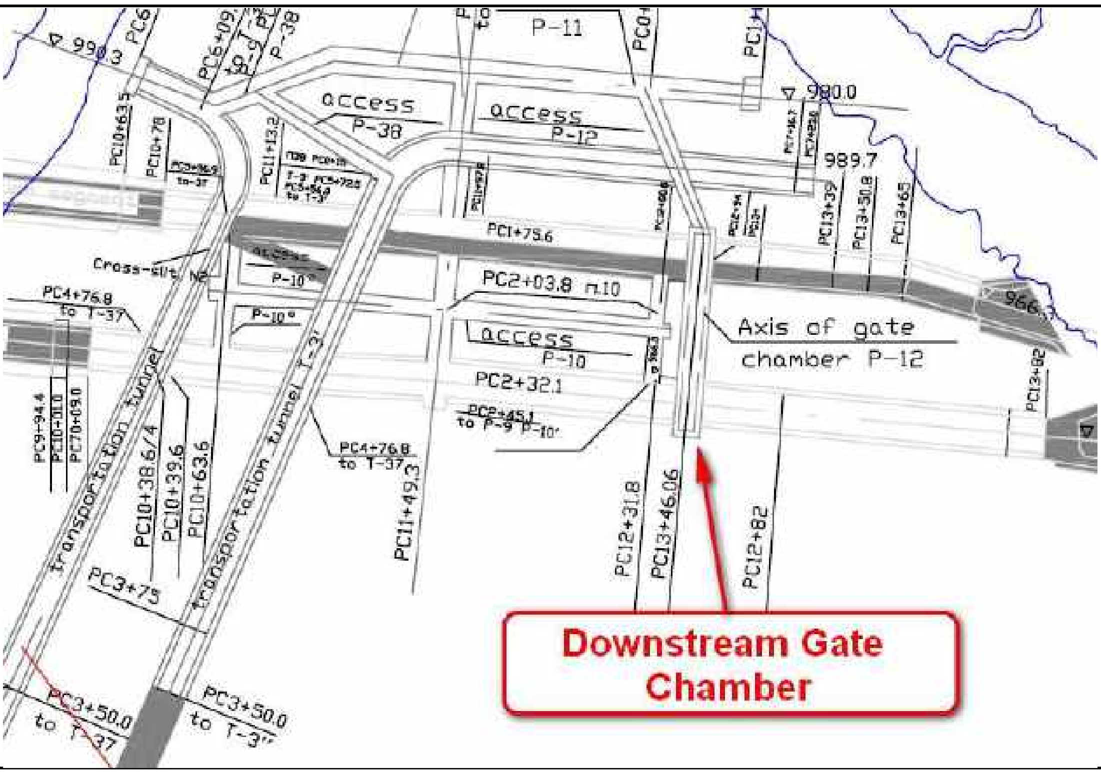
Stage 1 - Report name	**Item**	Construction Tunnels - INTAKE	**n° :**	69
	Code	ST1 - I		



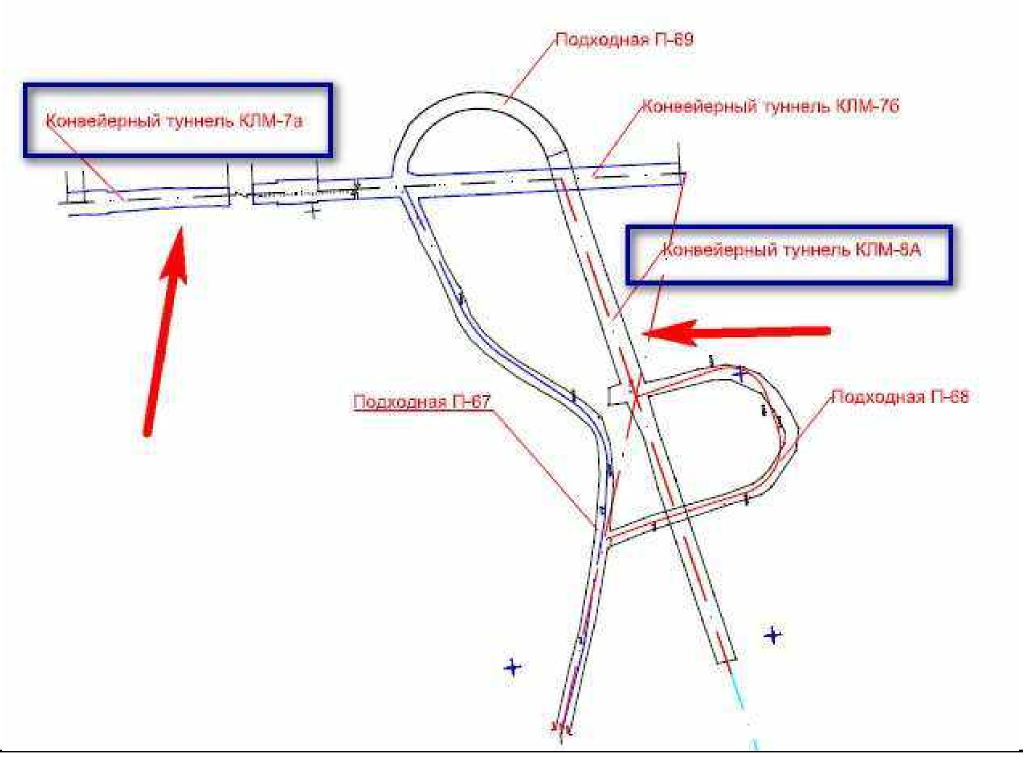
Stage 1 - Report name	**Item**	Construction Tunnels - INTAKE	**n° :**	70
	Code	ST2 - I		



Stage 1 - Report name	**Item**	Construction Tunnels Downstream Vent & Gate	**n° :** 71
	Code	ST_DGC	

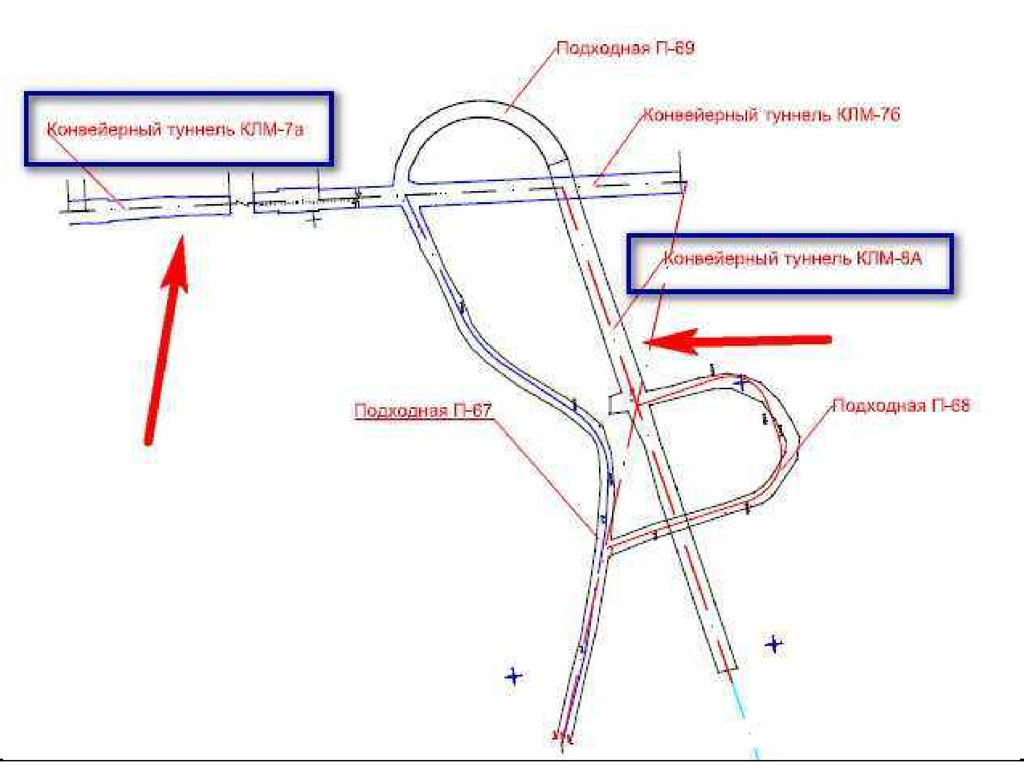


Stage 1 - Report name	**Item**	Conveyor Line 7A	**n° :** 72
	Code	Conveyor Line 7	



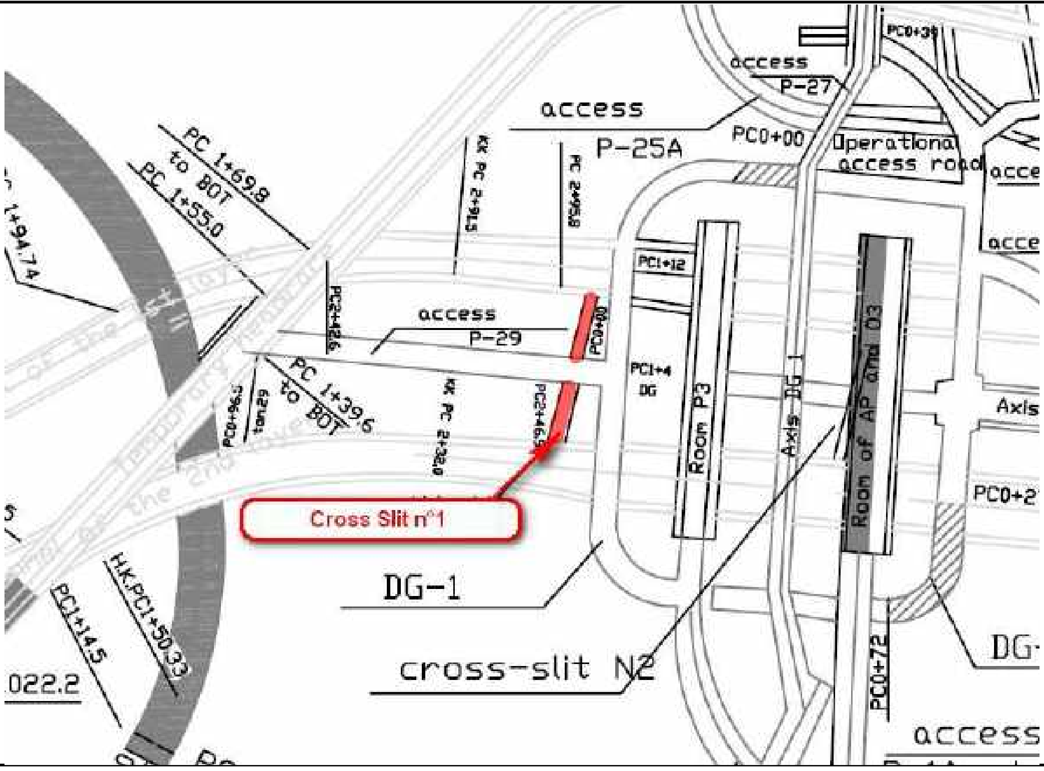
Stage 1 - Report name **Item** Conveyor Line 8A **n° :** 73

Code Conveyor Line 8A

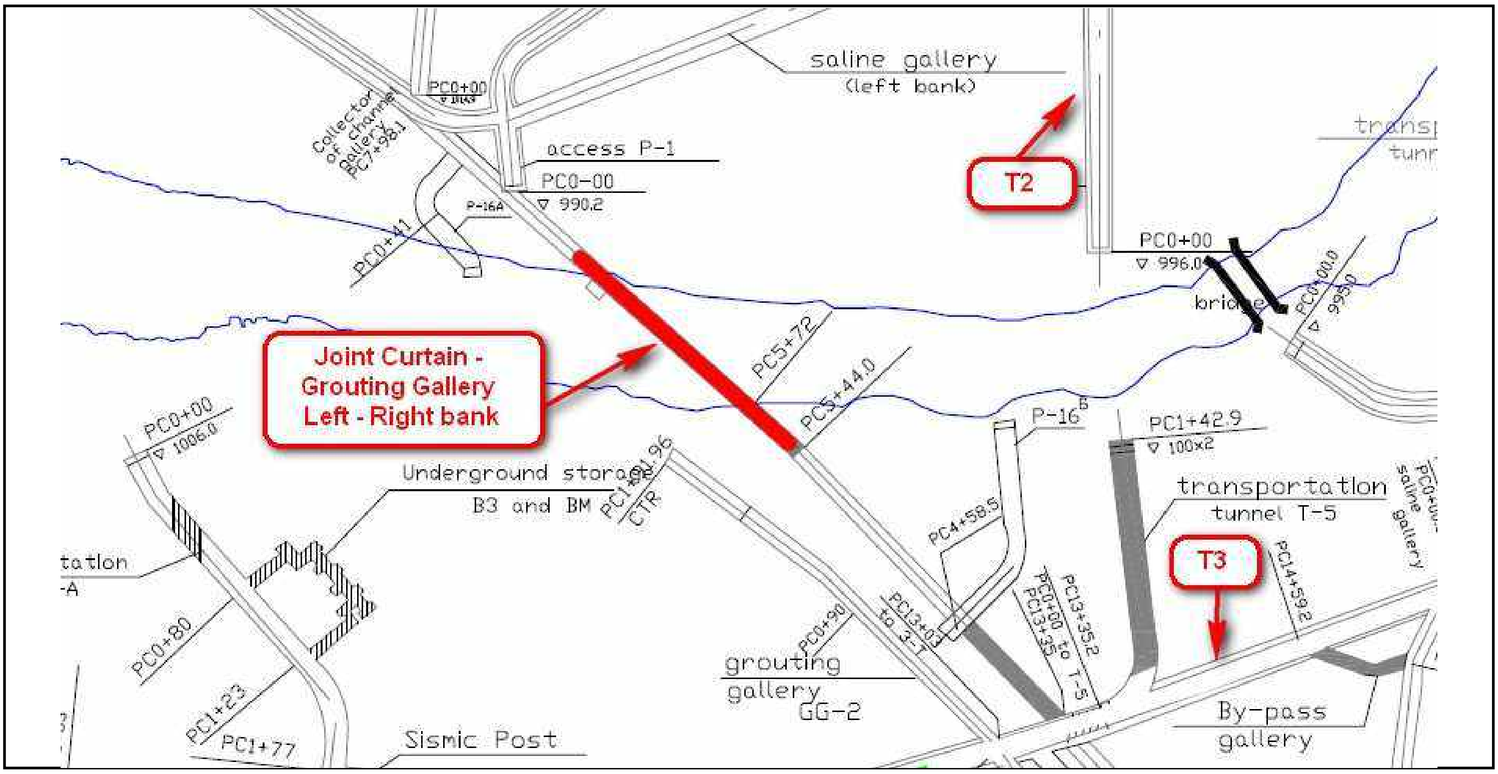


Stage 1 - Report name **Item** Cross Slit n°1 **n° :** 74

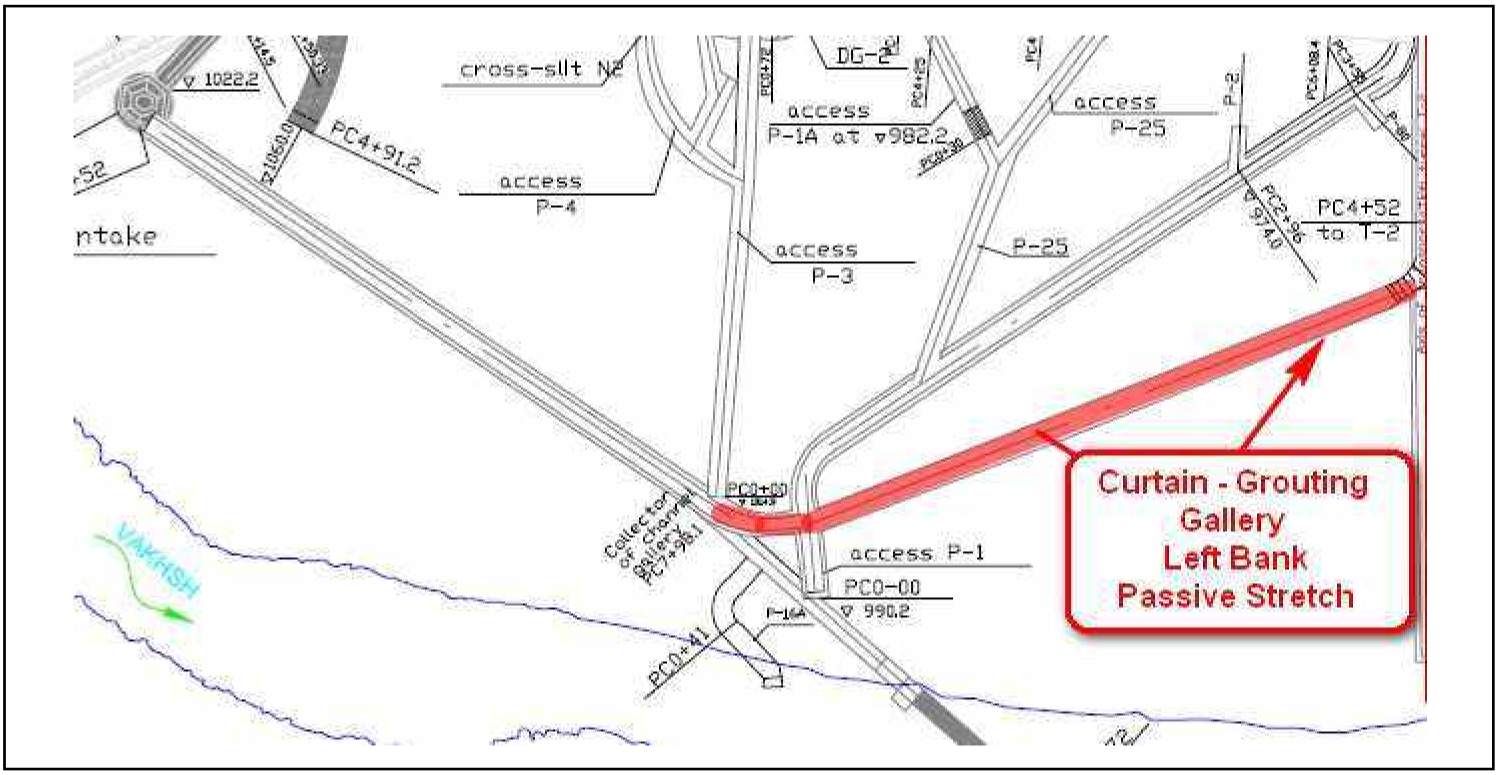
Code CS



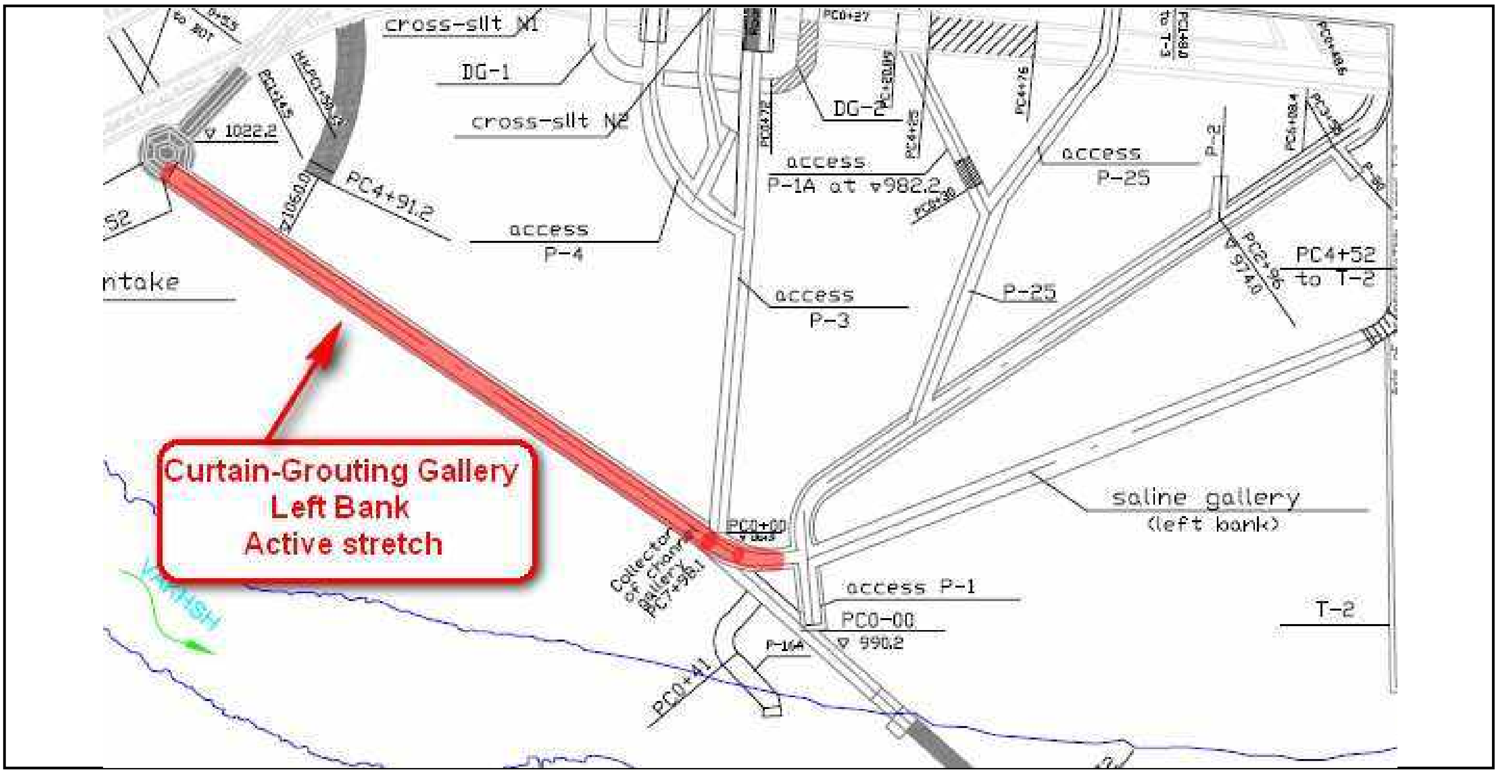
Stage 1 - Report name	**Item**	Curtain - Grouting Gallery - Joint Left - Right	**n° :**	75
	Code	CGJ_LR		



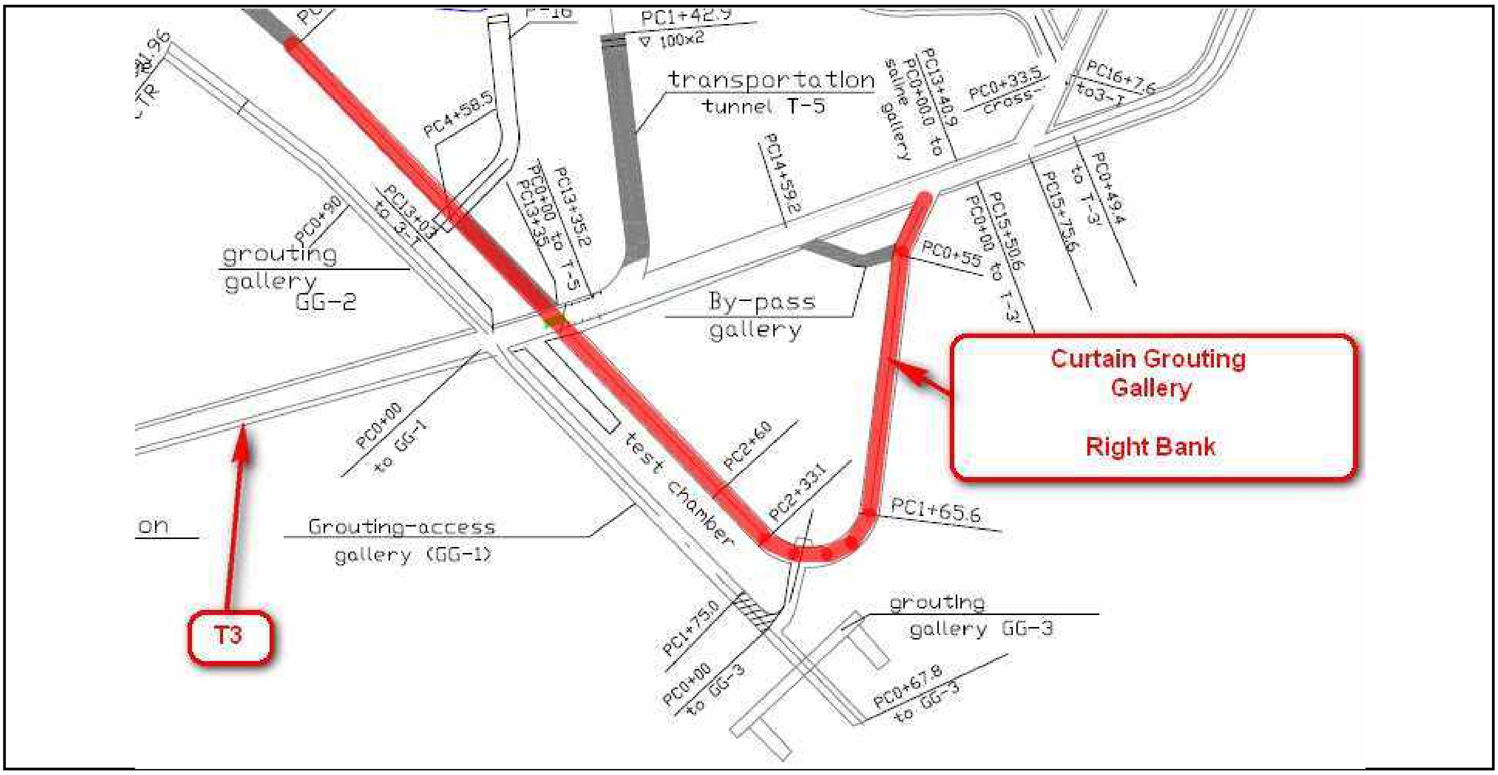
Stage 1 - Report name	**Item**	Curtain - Grouting Gallery - left Bank - Passive	**n° :**	76
	Code	CG_L_P		



Stage 1 - Report name	**Item**	**Curtain - Grouting Gallery - Left bank . Active**	**n° :** 77
	Code	**CG_L_A**	



Stage 1 - Report name	**Item**	**Curtain - Grouting Gallery - Right Bank**	**n° :** 78
	Code	**CG_R**	

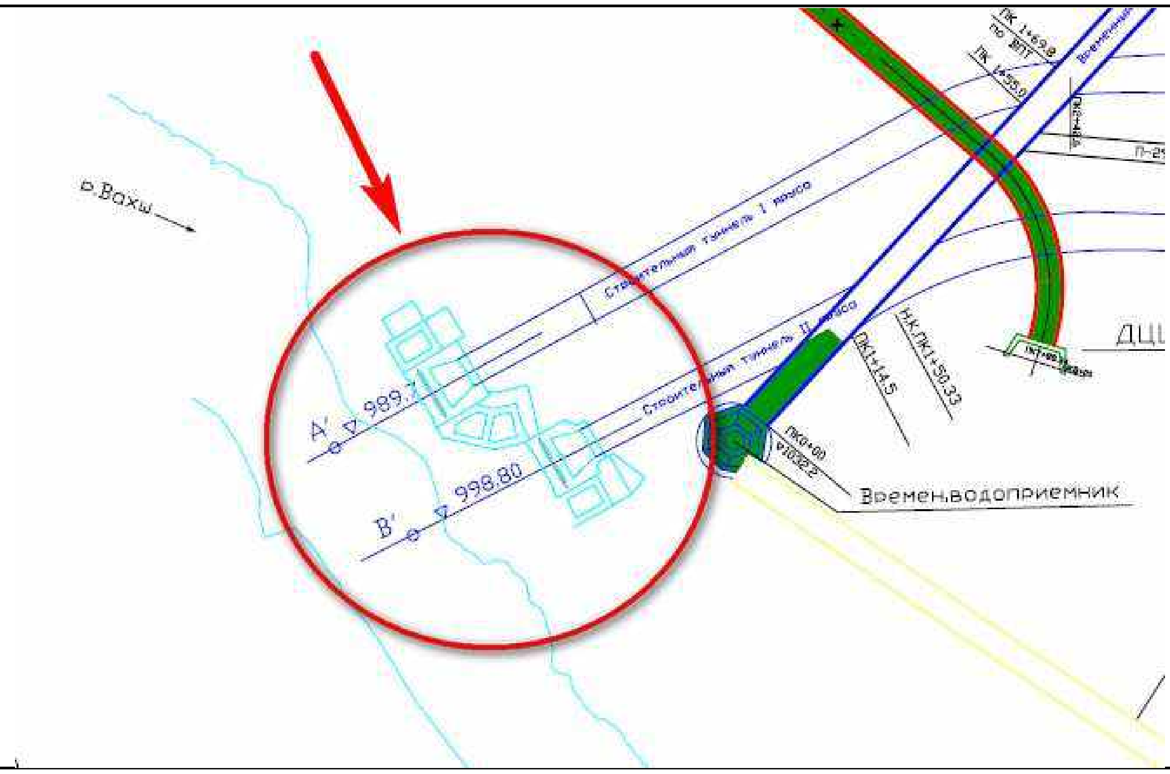


Stage 1 - Report name

Item Diversion I - Intake

n° : 79

Code

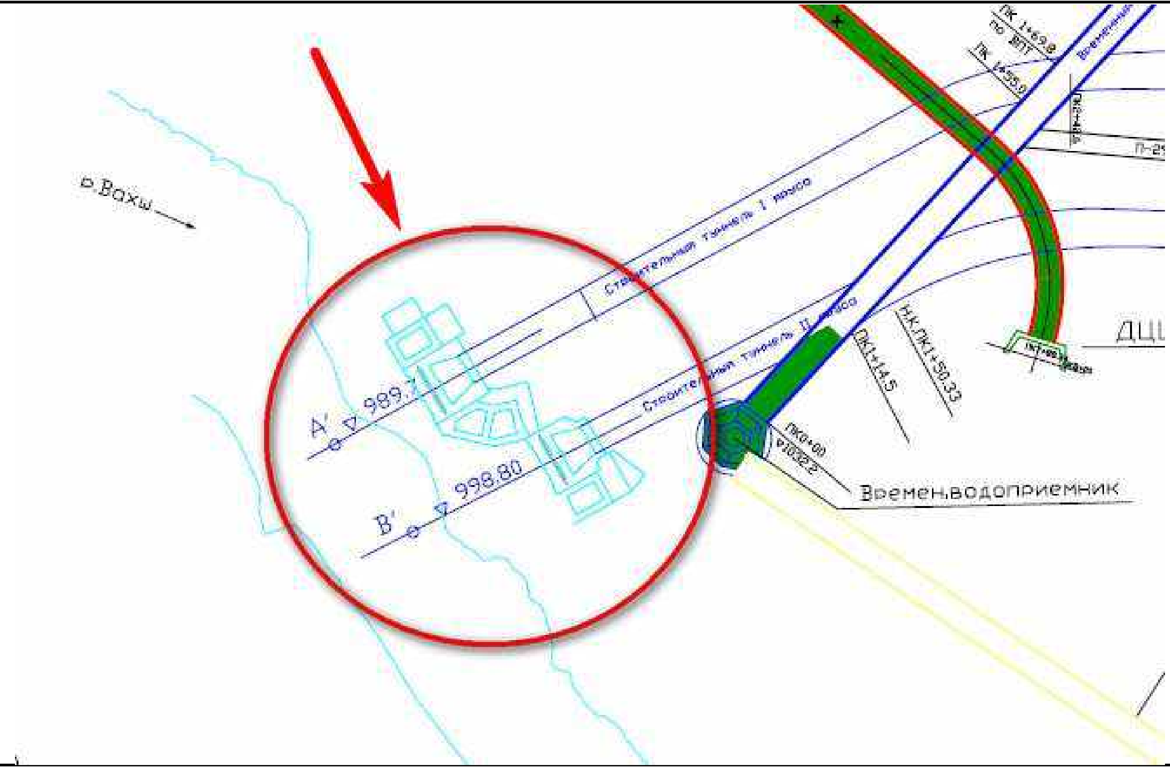


Stage 1 - Report name

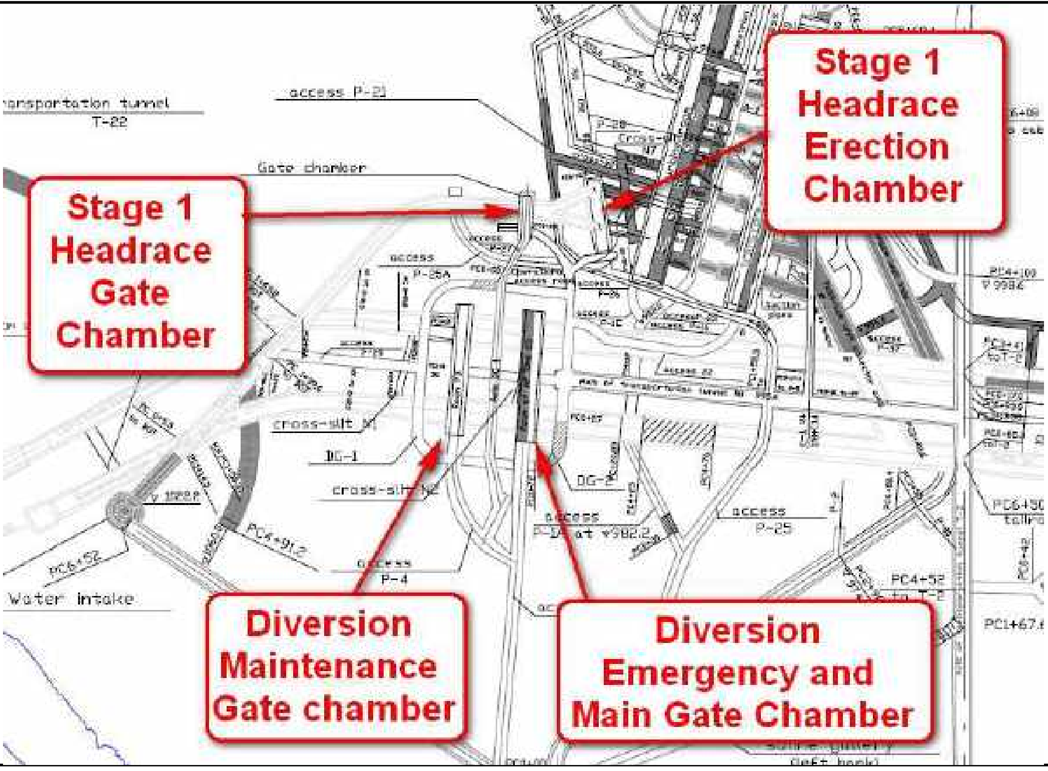
Item Diversion II - Intake

n° : 80

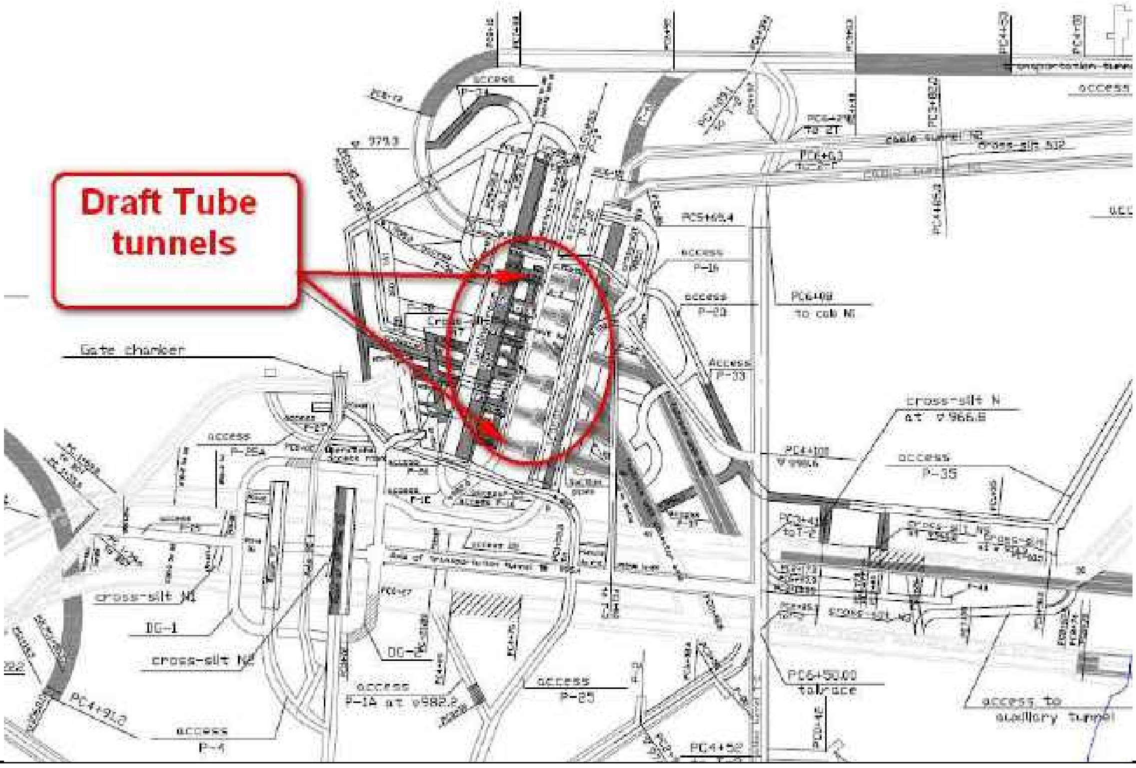
Code



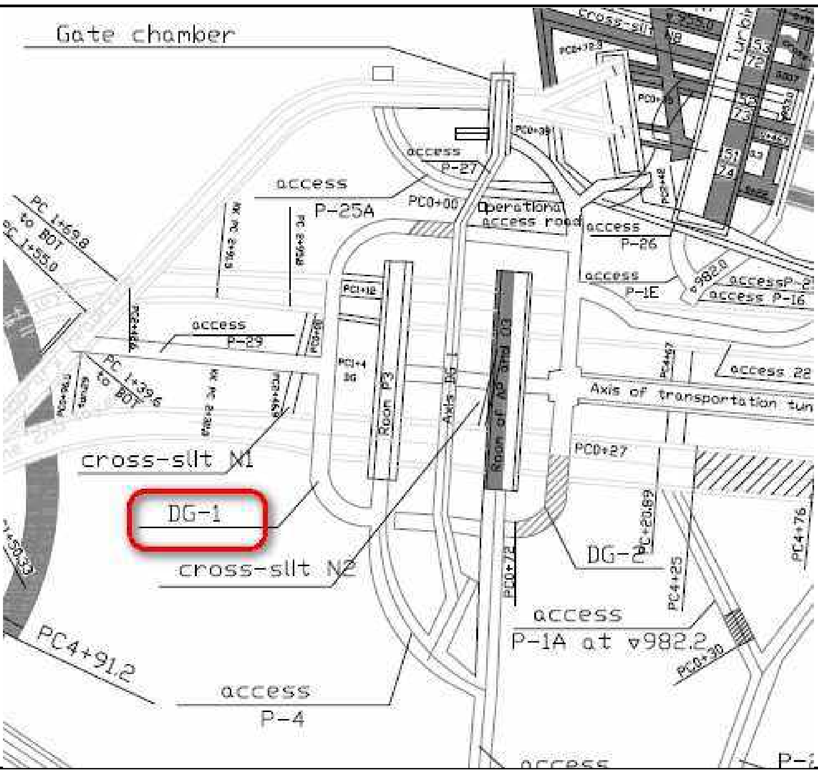
Stage 1 - Report name	**Item**	Diversion tunnels - Mainten. gates chamber	**n° :** 81
	Code	ST_M_GCH	



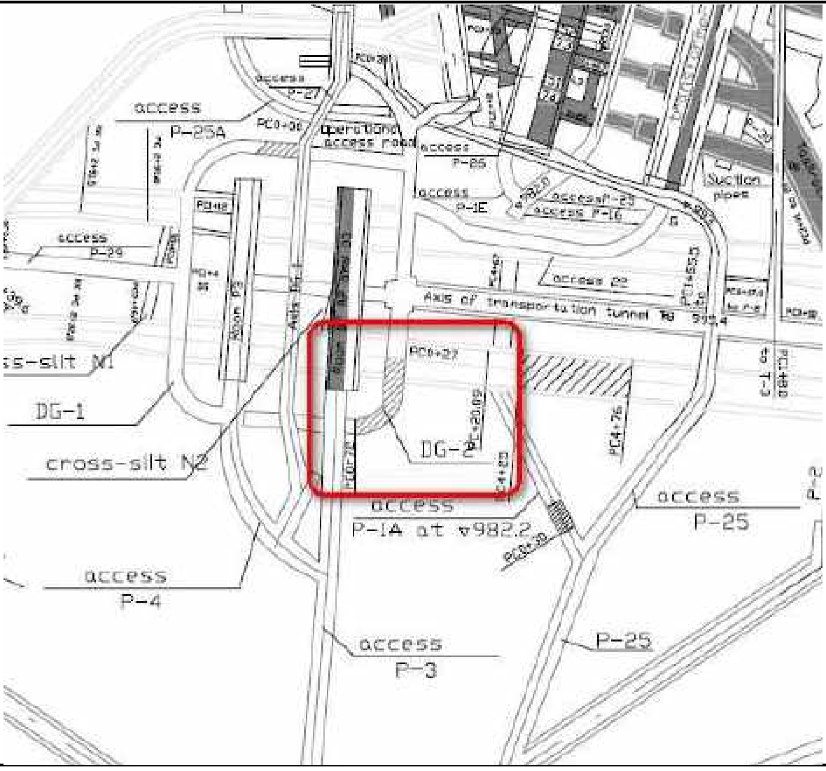
Stage 1 - Report name	**Item**	Draft Tube Tunnels	**n° :** 82
	Code	DRAFT_T	



Stage 1 - Report name	**Item**	Drainage Gallery 1	**n° :** 83
	Code	DG1	



Stage 1 - Report name	**Item**	Drainage Gallery 2	**n° :** 84
	Code	DG2	

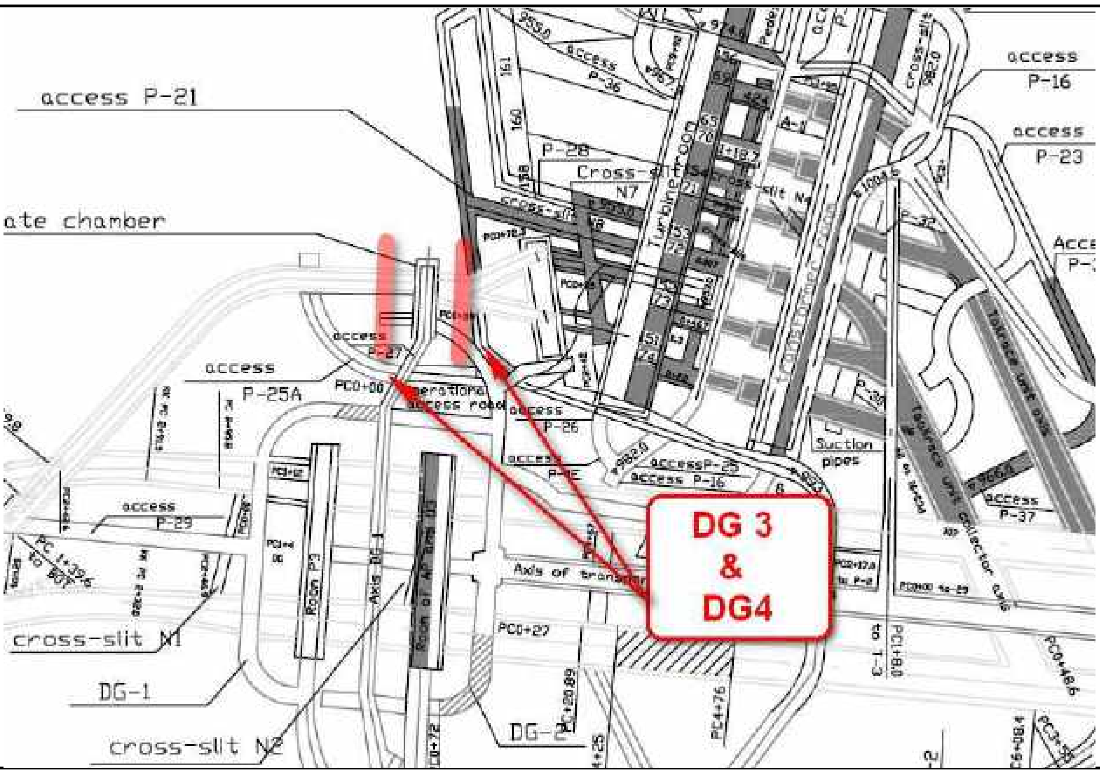


Stage 1 - Report name

Item Drainage Gallery 3

Code DG3

n° : 85

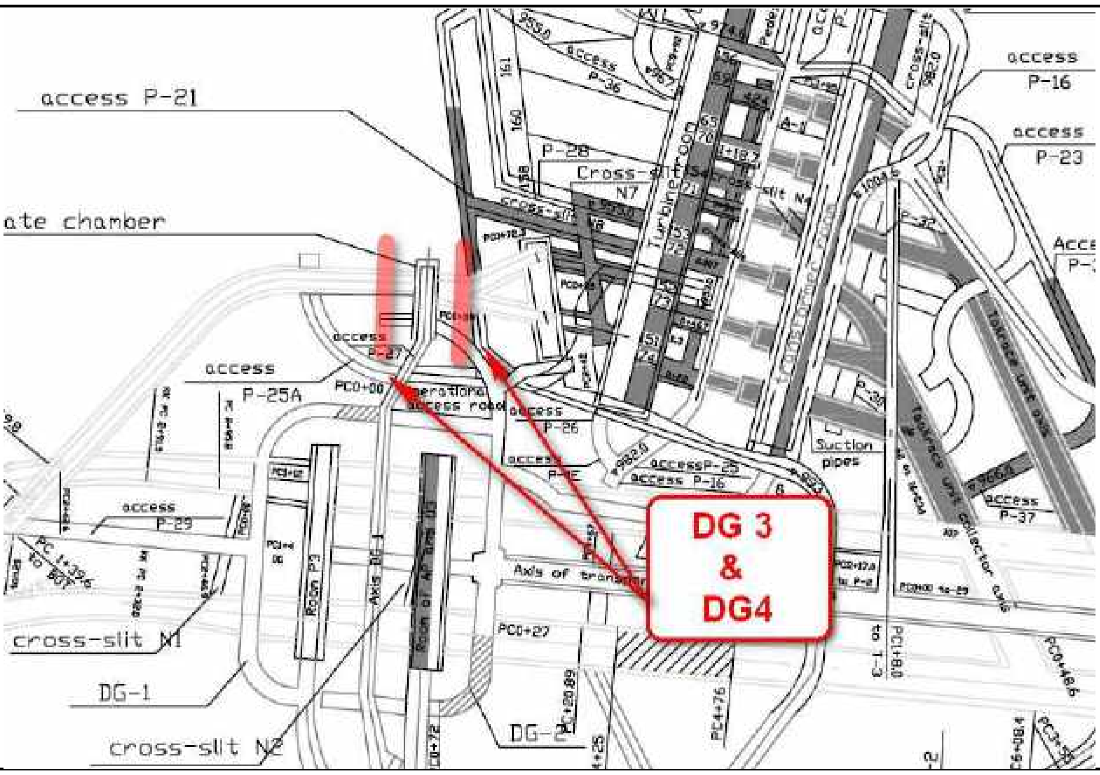


Stage 1 - Report name

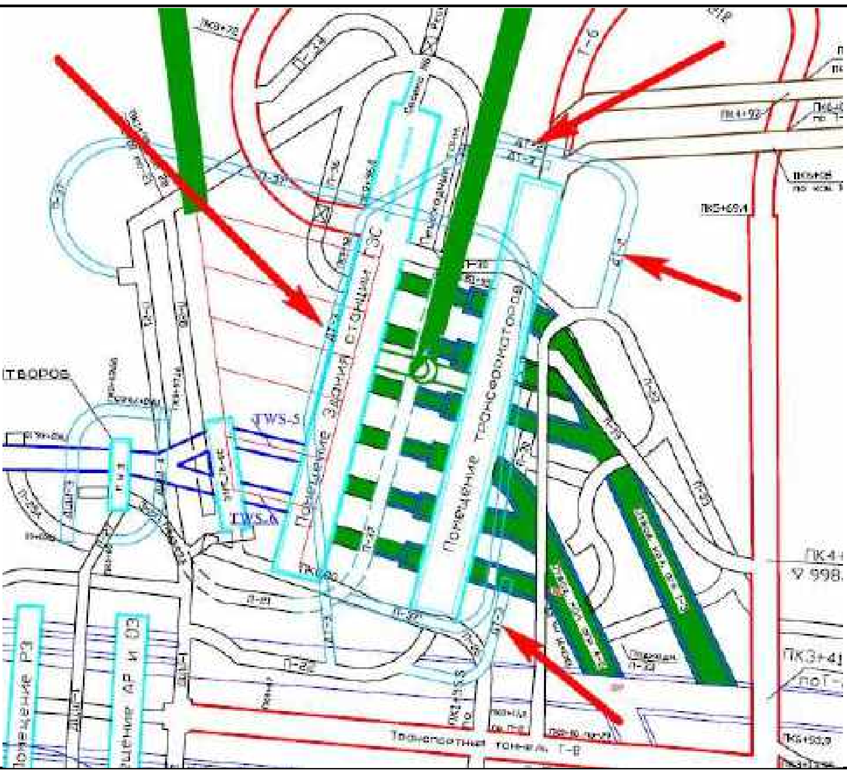
Item Drainage Gallery 4

Code DG4

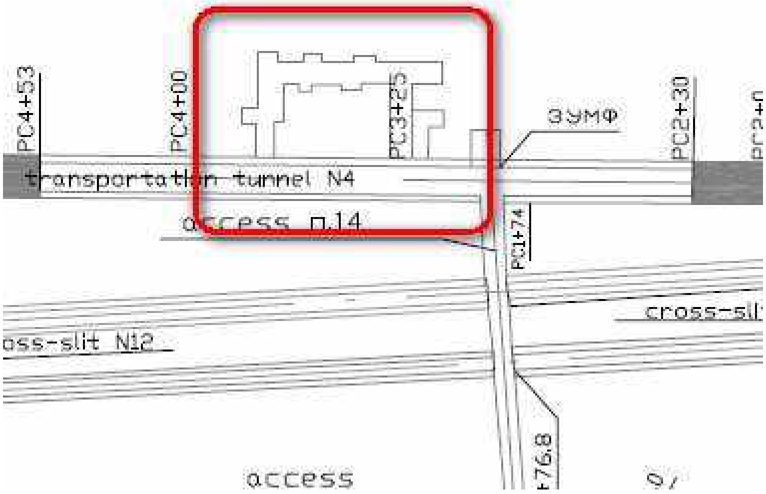
n° : 86



Stage 1 - Report name	**Item**	**Drainage Gallery Powerhouse Medium**	**n° :**	**87**
	Code	**DGPH_M**		



Stage 1 - Report name	**Item**	**Explosive Warehouse T4**	**n° :**	**88**
	Code	**Exp T4**		

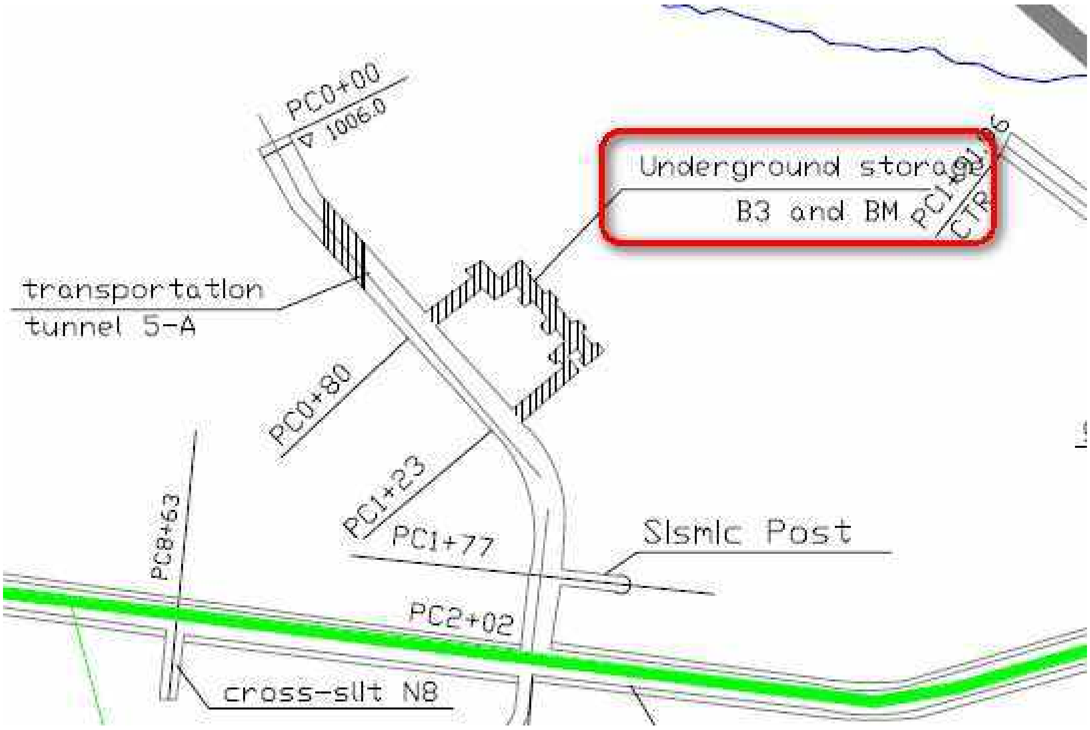


Stage 1 - Report name

Item **Explosive Warehouse T5A**

Code **Exp T5A**

n° : **89**

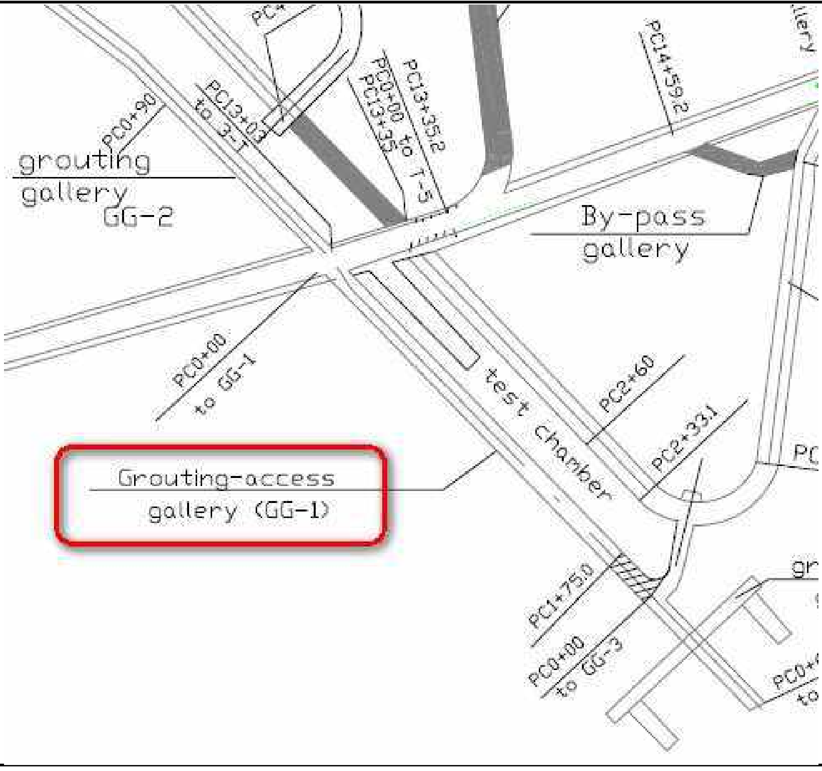


Stage 1 - Report name

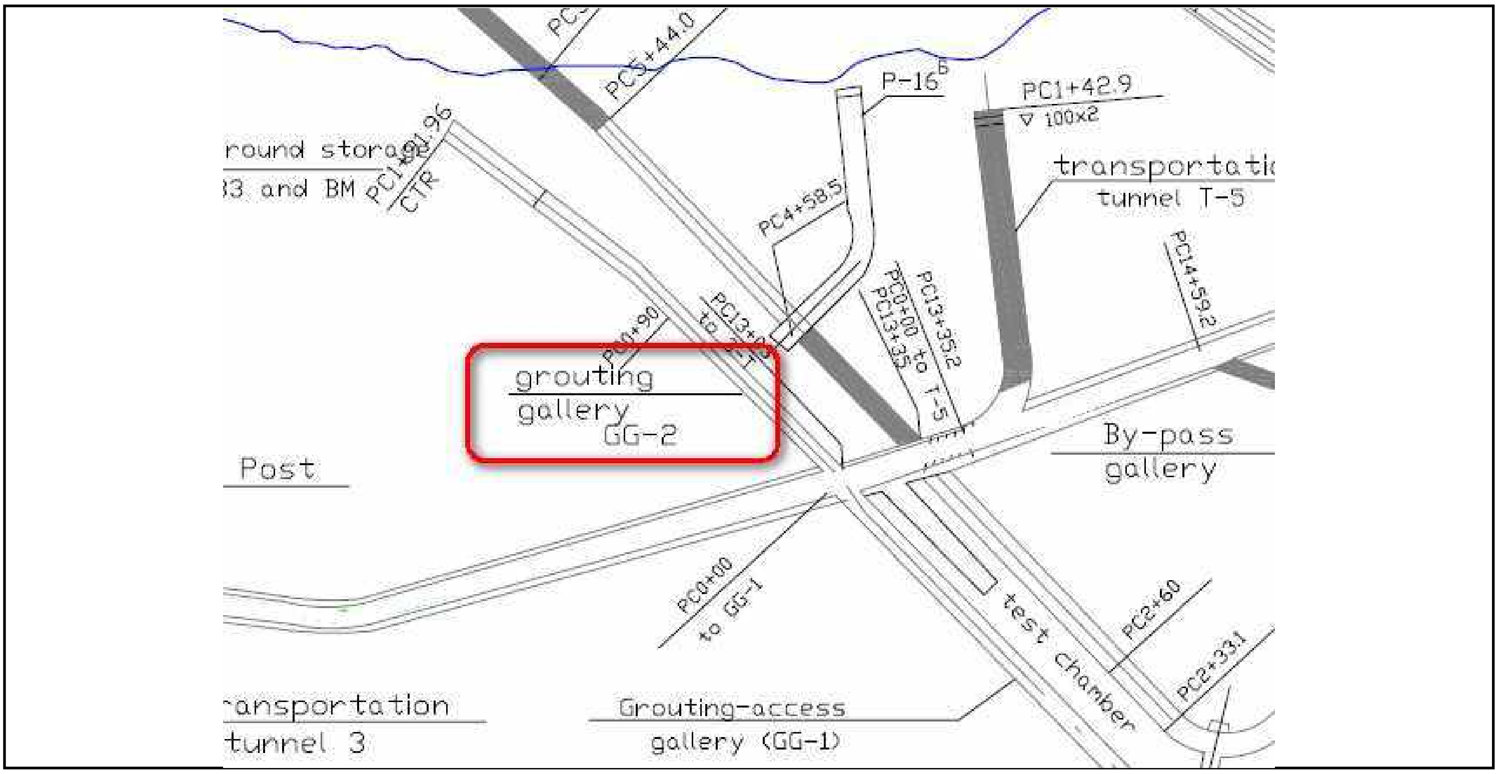
Item **Grouting Gallery 1**

Code **GG1**

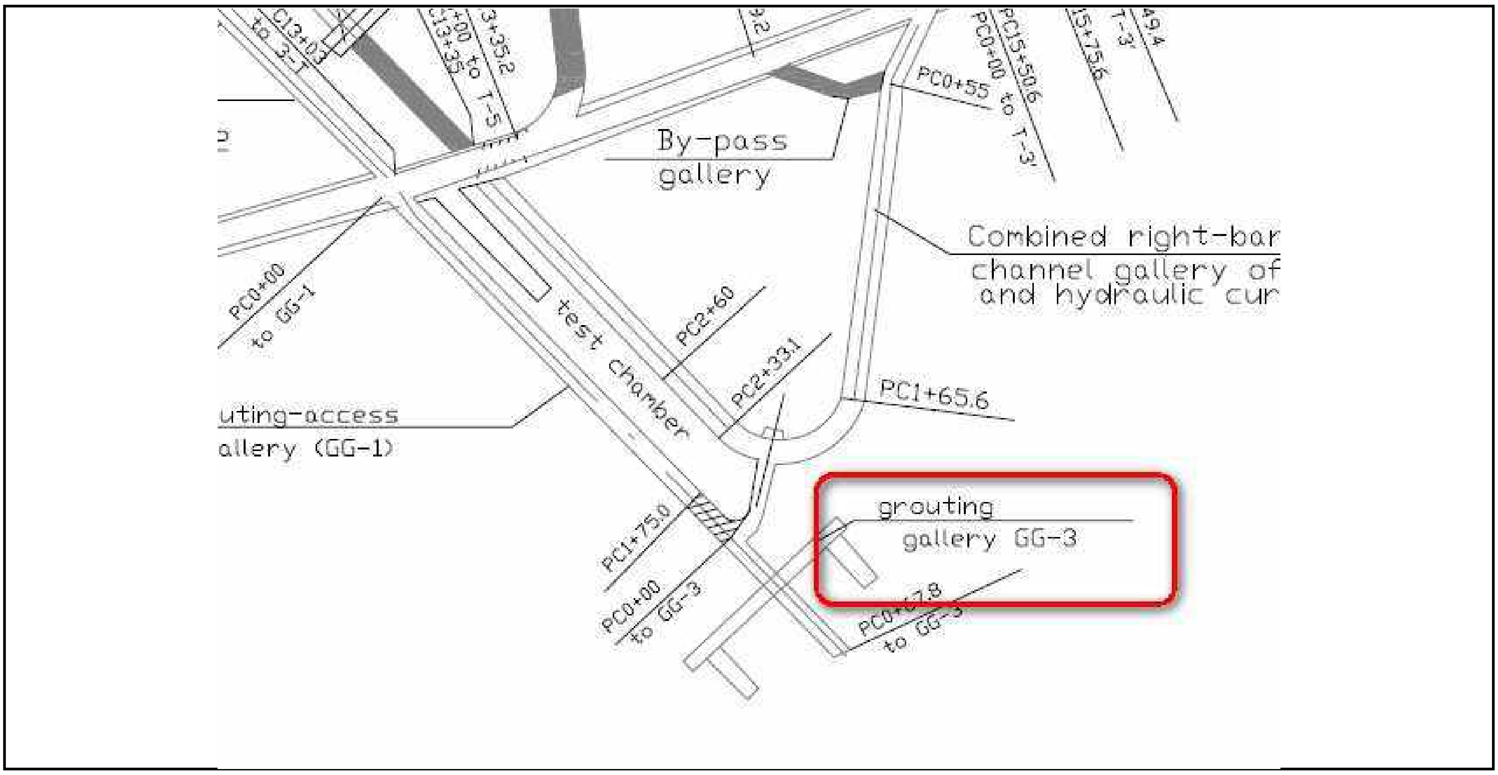
n° : **90**



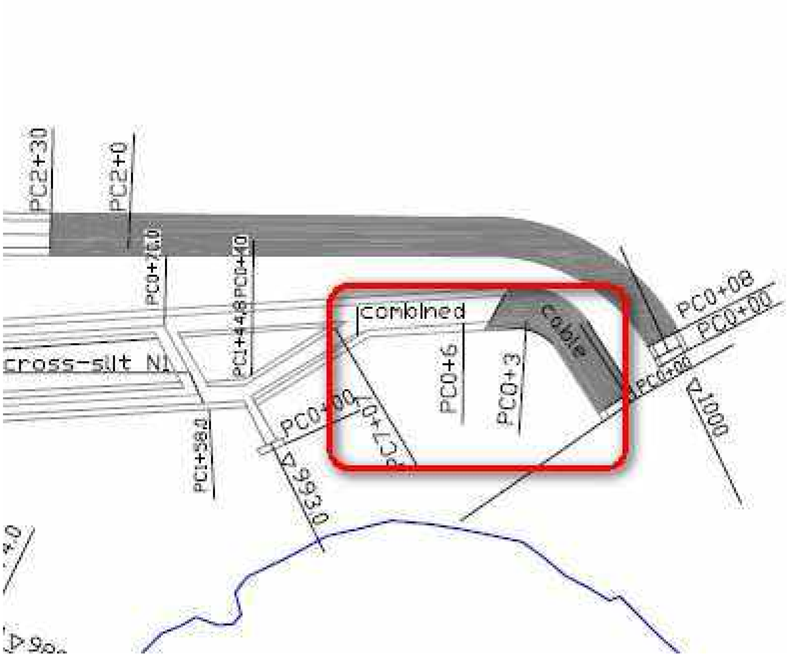
Stage 1 - Report name
Item Grouting Gallery 2
Code GG2
n° : 91



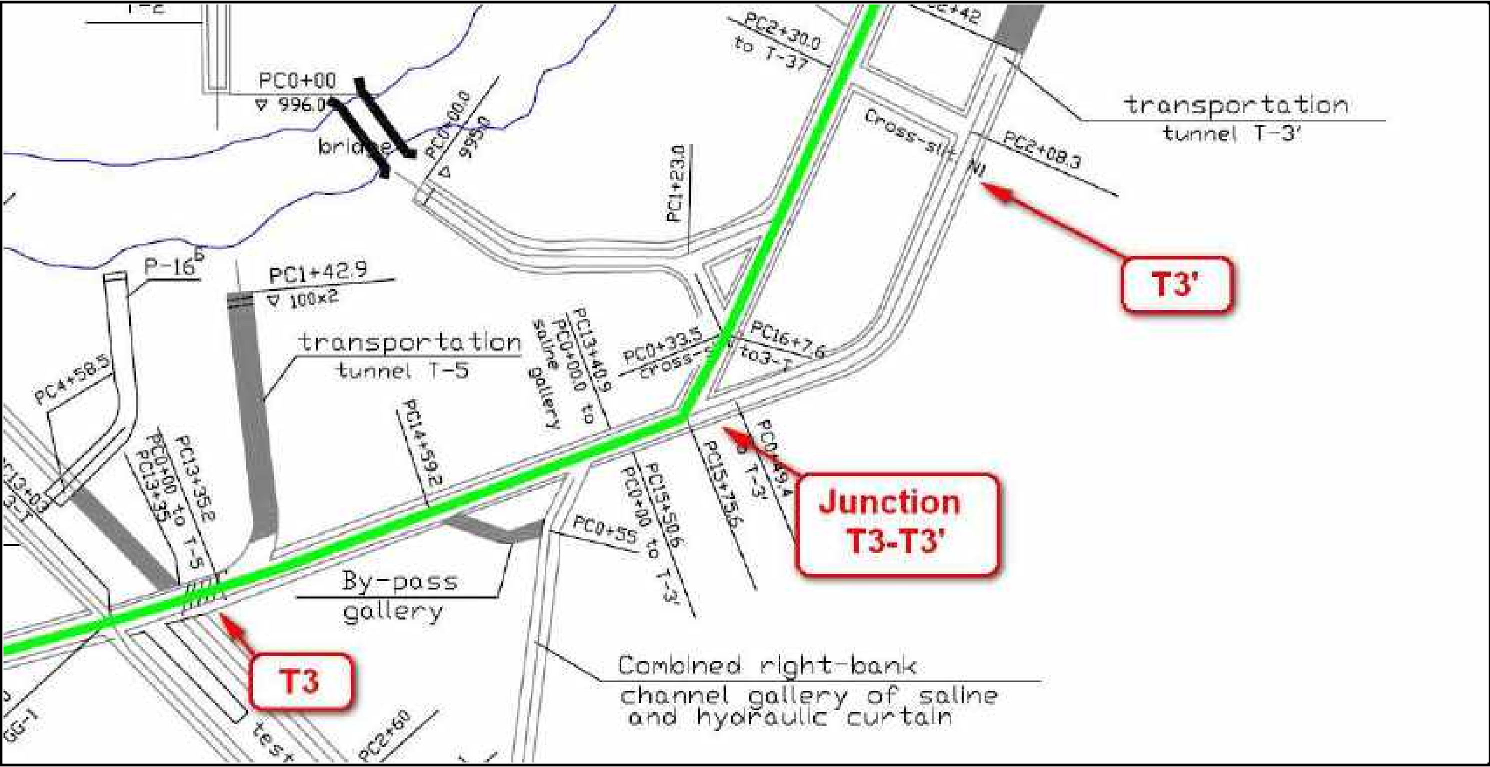
Stage 1 - Report name
Item Grouting Gallery 3
Code GG3
n° : 92



Stage 1 - Report name	**Item**	Joint Cable Tunnel	**n° :** 93
	Code	J_K1_K2	

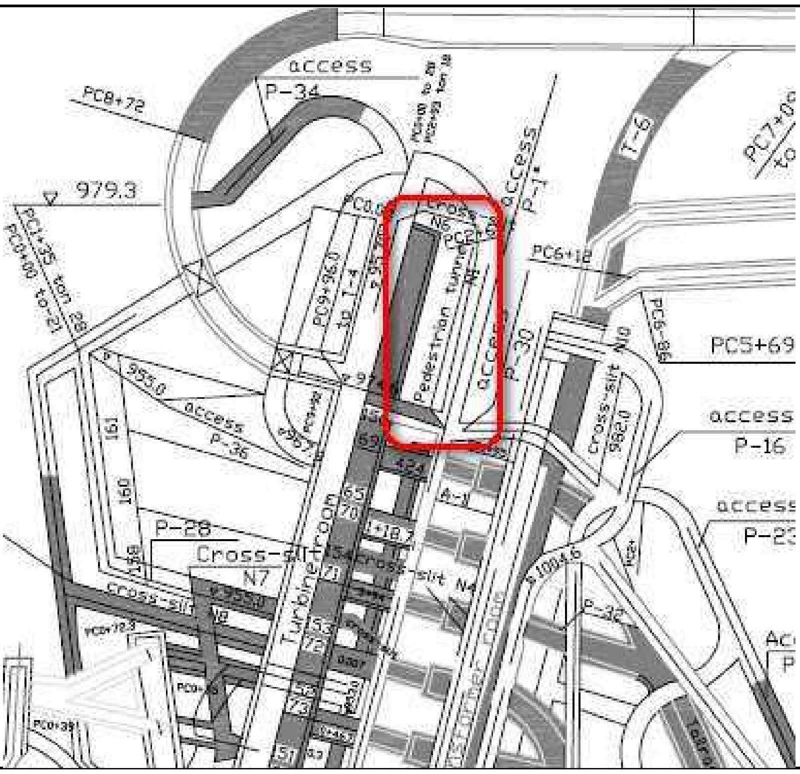


Stage 1 - Report name	**Item**	Junction T3-T3'	**n° :** 94
	Code	J_T3_T3'	



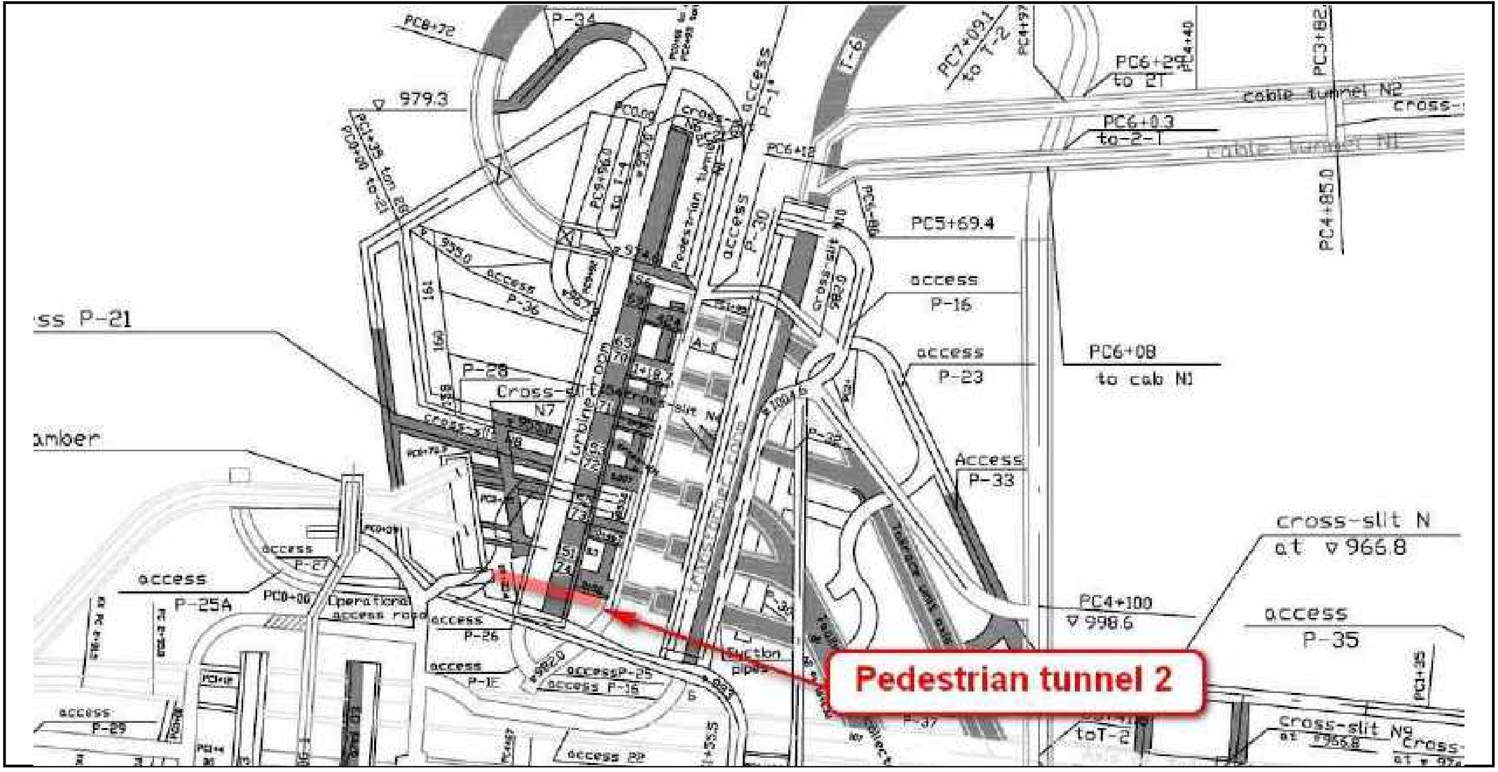
Stage 1 - Report name **Item** Pedestrian Tunnel 1 **n° :** 95

Code PDT1

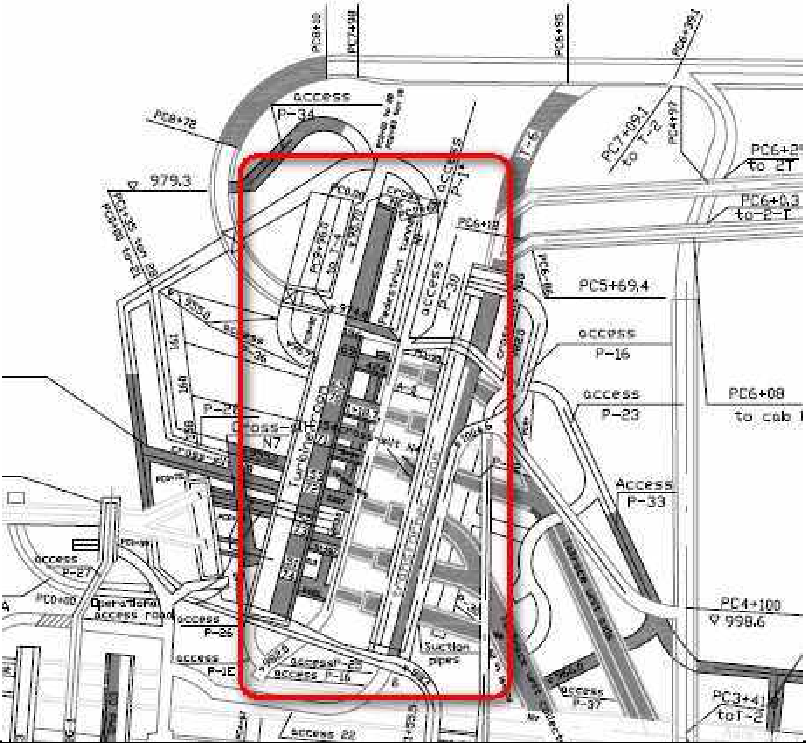


Stage 1 - Report name **Item** Pedestrian tunnel 2 **n° :** 96

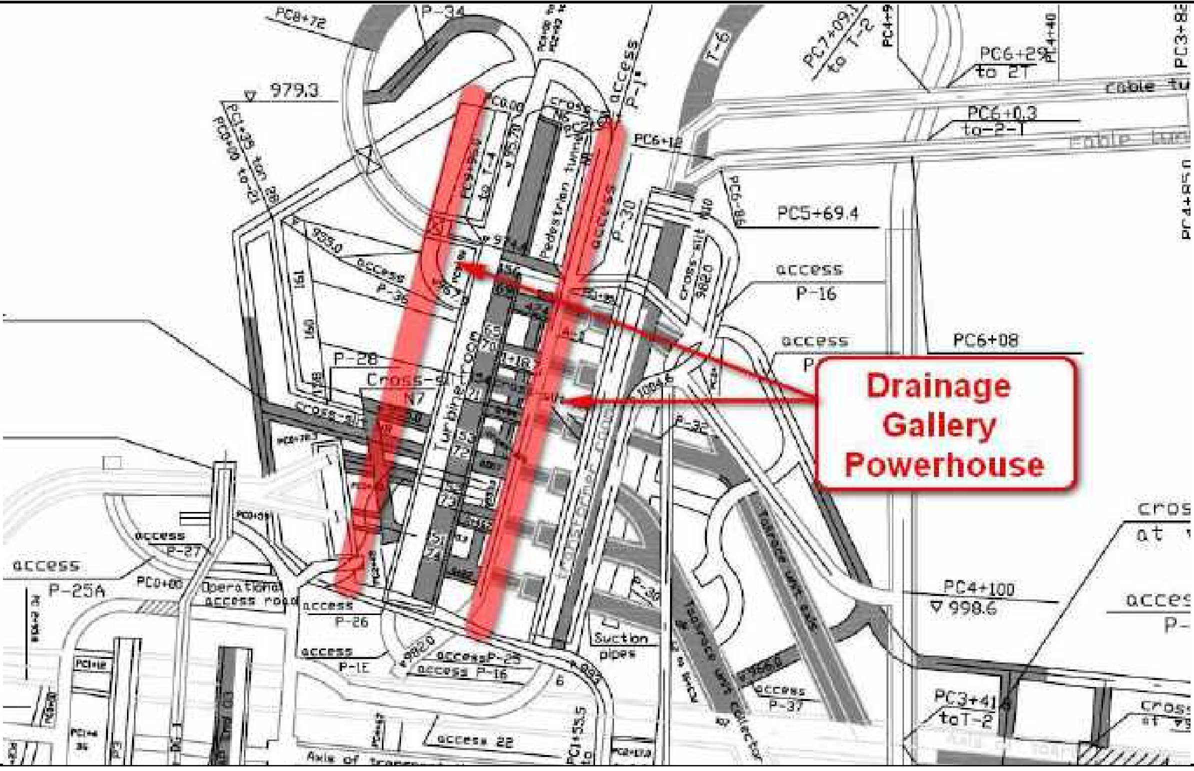
Code PDT2



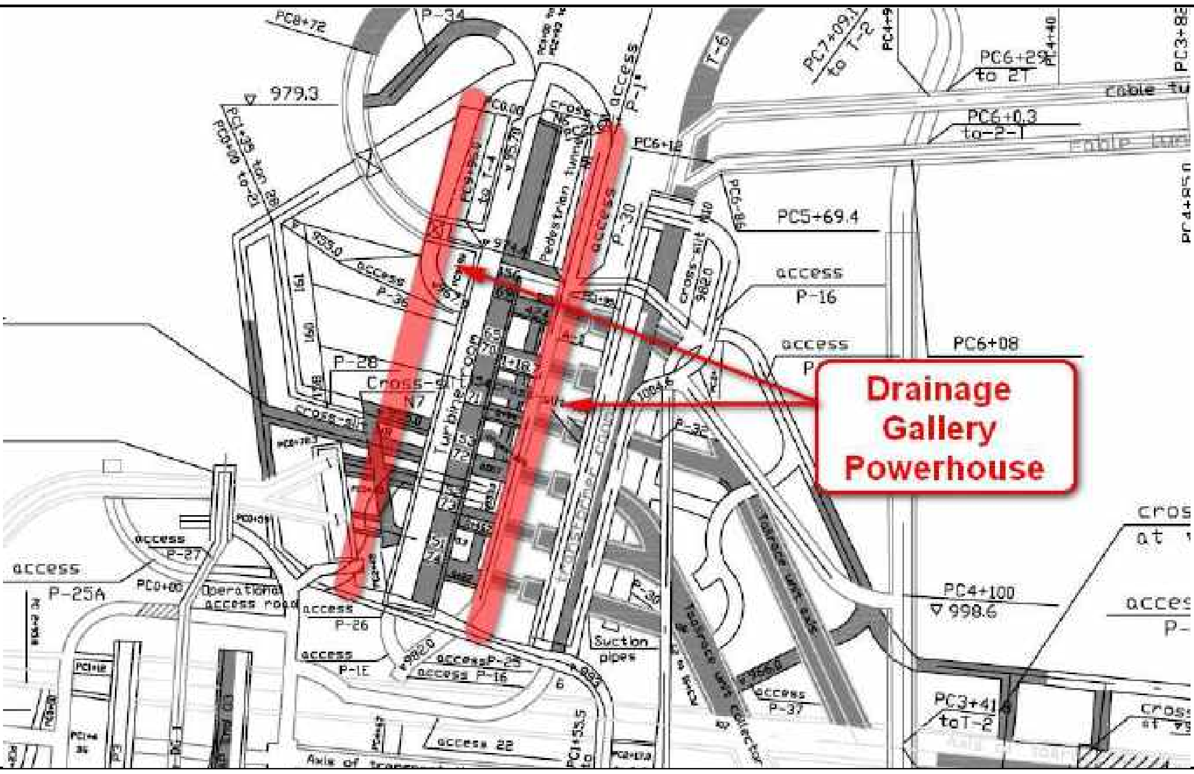
Stage 1 - Report name	**Item**	Powerhouse	**n° :** 97
	Code	PH	



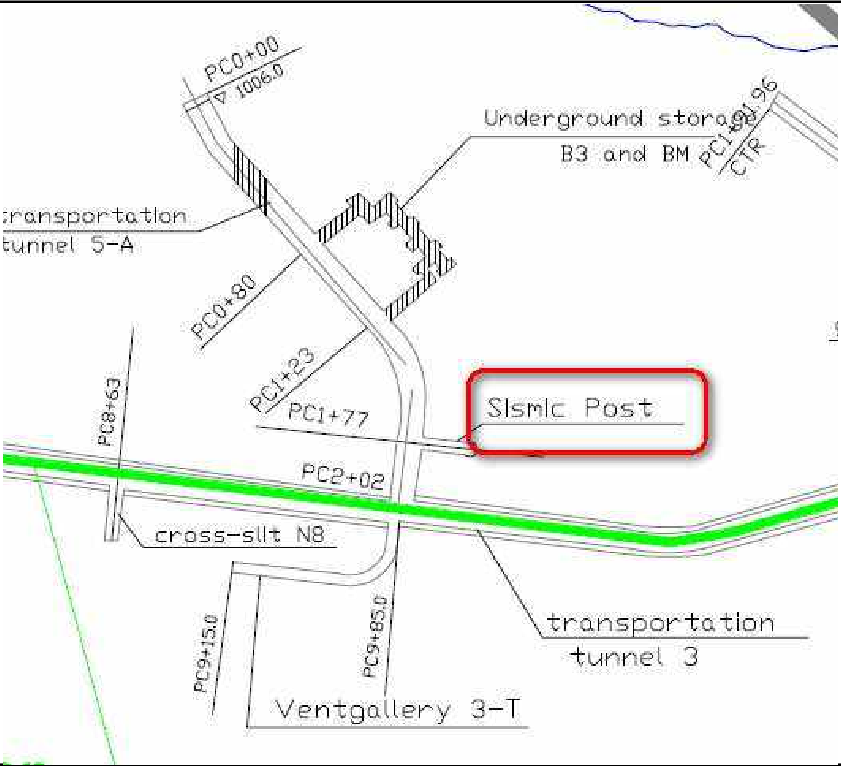
Stage 1 - Report name	**Item**	Powerhouse Drainage gallery high Level	**n° :** 98
	Code	DGPH_H	



Stage 1 - Report name | **Item** Powerhouse Drainage gallery low level | **n° :** 99
Code DGPH - L

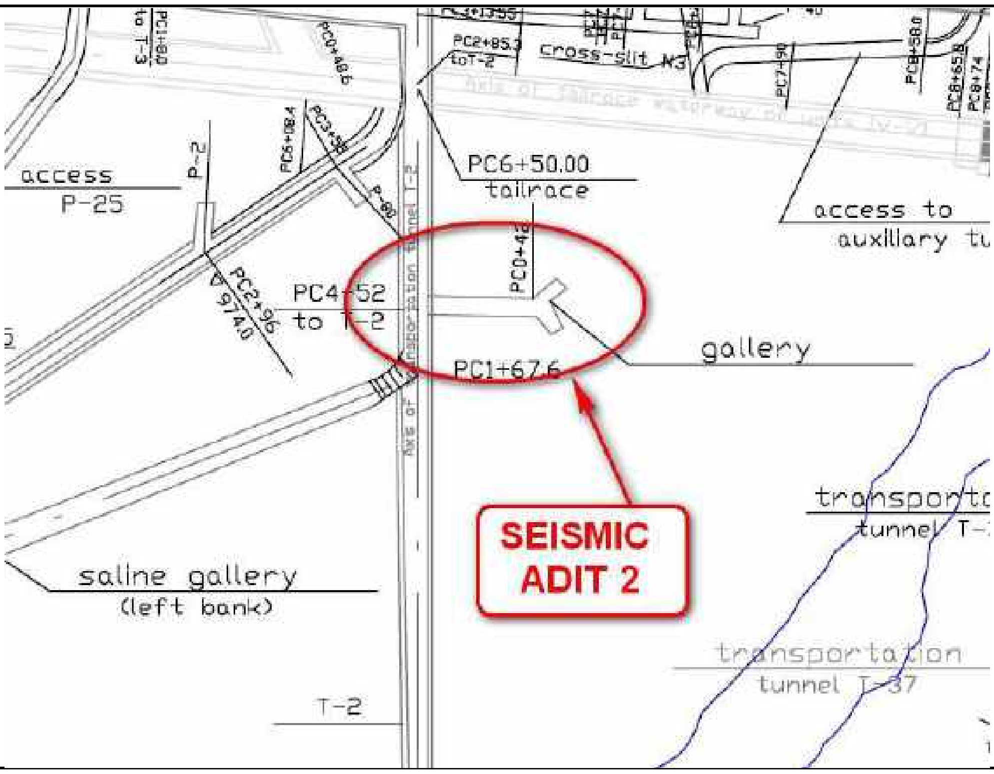


Stage 1 - Report name | **Item** Seismic Adit Sec. 1 at P19 | **n° :** 100
Code Seismic Adit Sec. 1



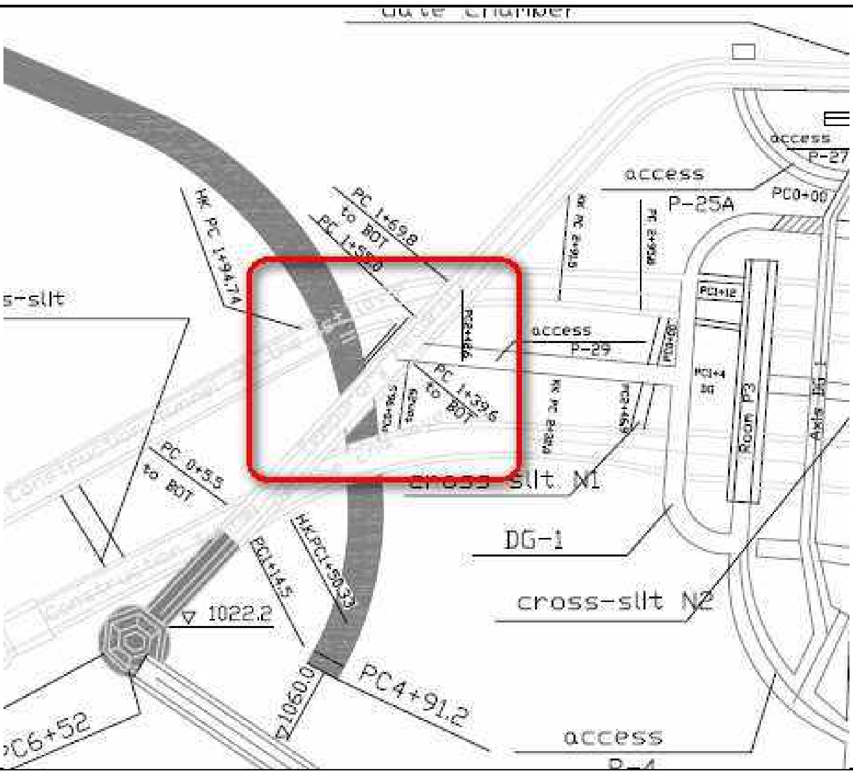
Stage 1 - Report name **Item** Seismic Adit Sec. 2 at T2 **n° :** 101

Code Seismic Adit Sec. 2



Stage 1 - Report name **Item** Stage 1 Power Tunnel **n° :** 102

Code S1PT

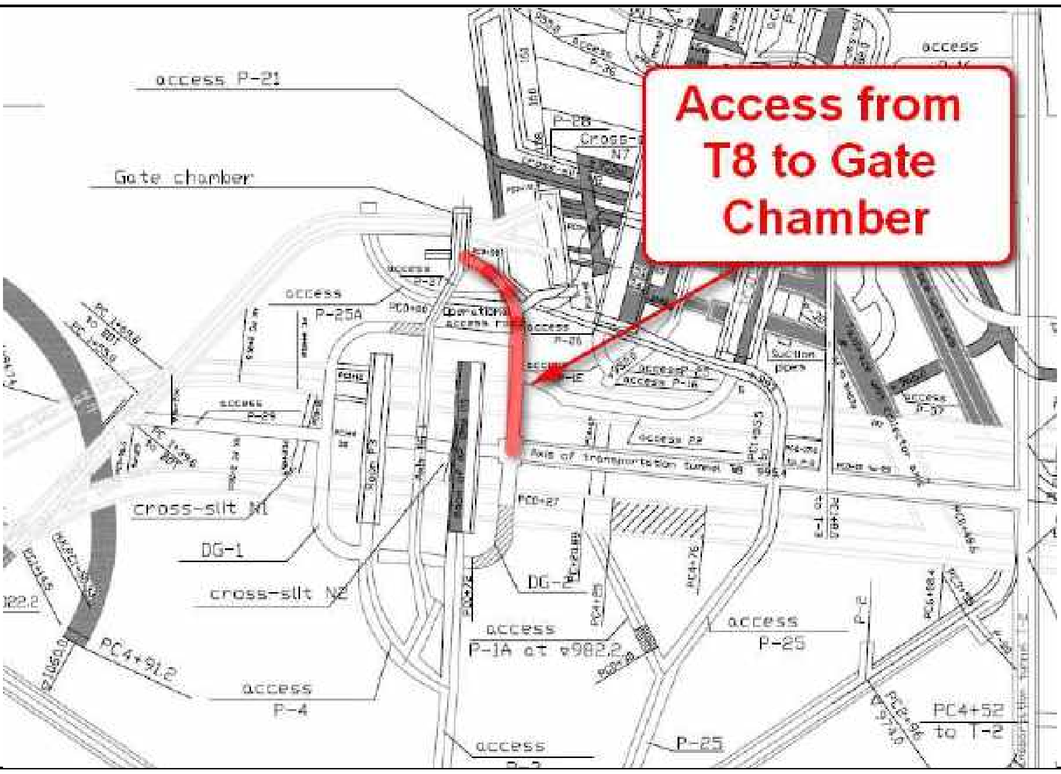


Stage 1 - Report name

Item Stage 1 Power Tunnel Access from T-8 to Gate

Code S1PT_T8-GC

n° : 103

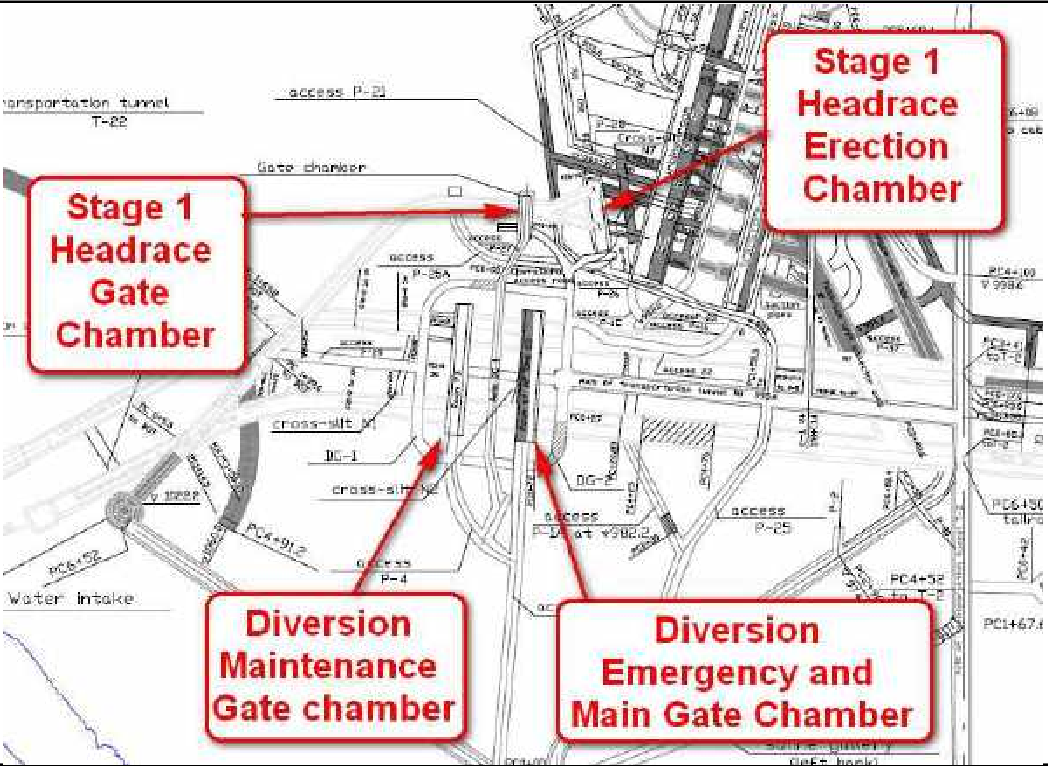


Stage 1 - Report name

Item Stage 1 Power Tunnel Erection Chamber

Code S1PT_ECH

n° : 104

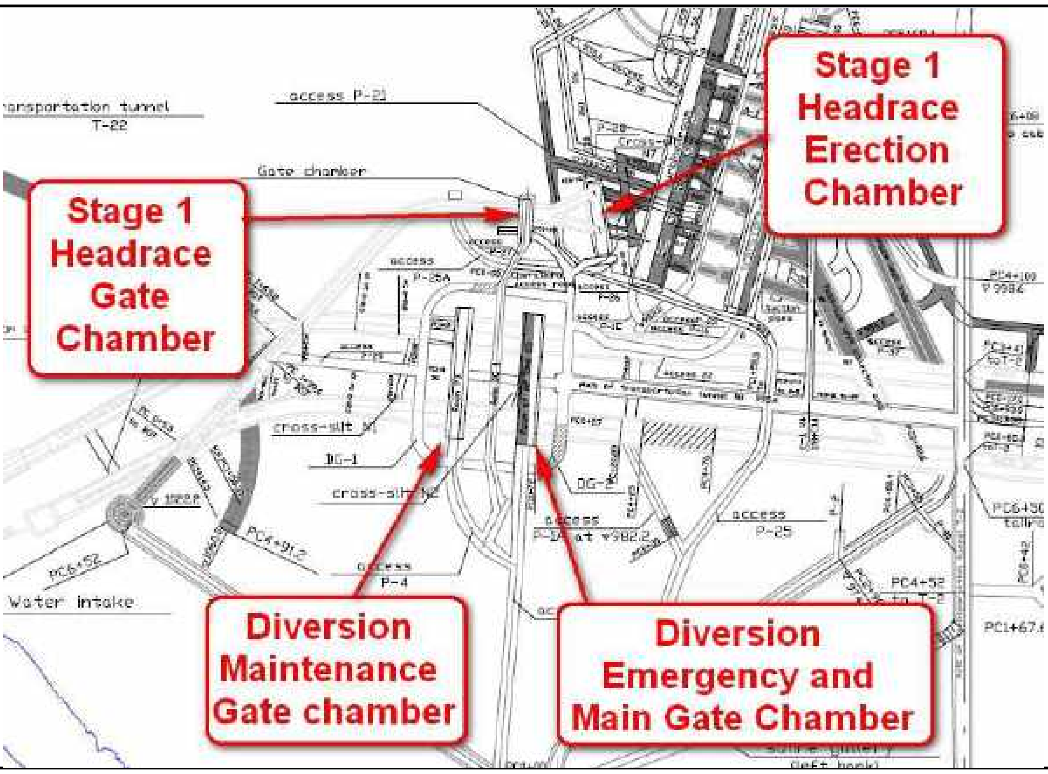


Stage 1 - Report name

Item Stage 1 Power Tunnel Gate Chamber

Code S1PT_GCH

n° : 105

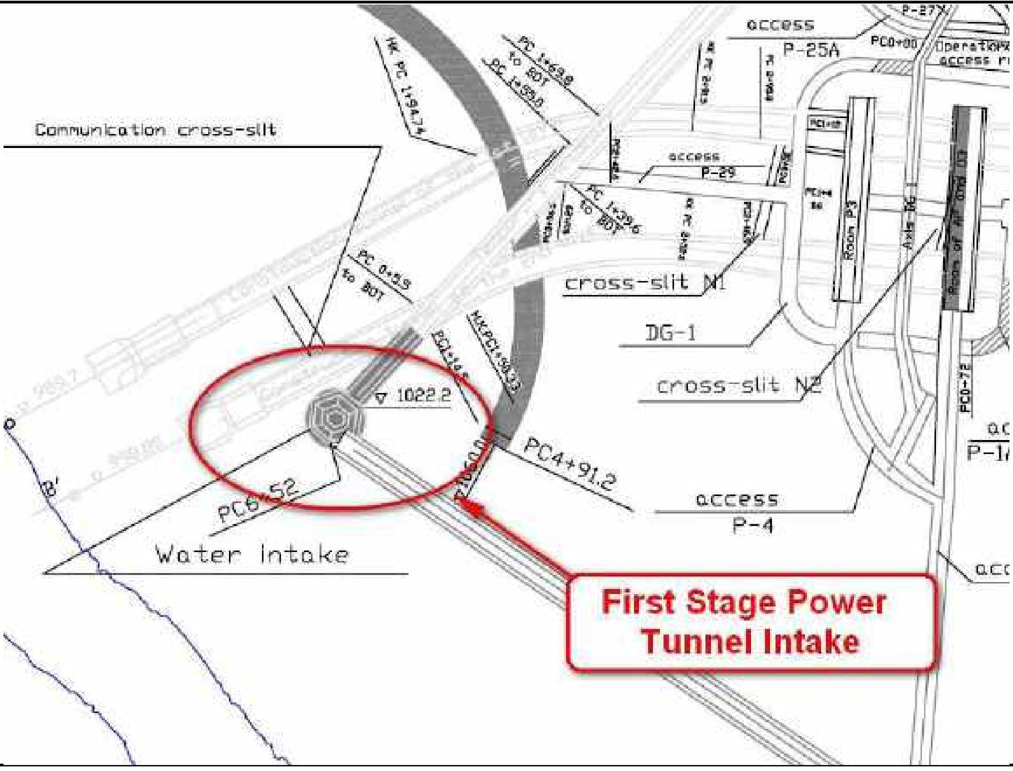


Stage 1 - Report name

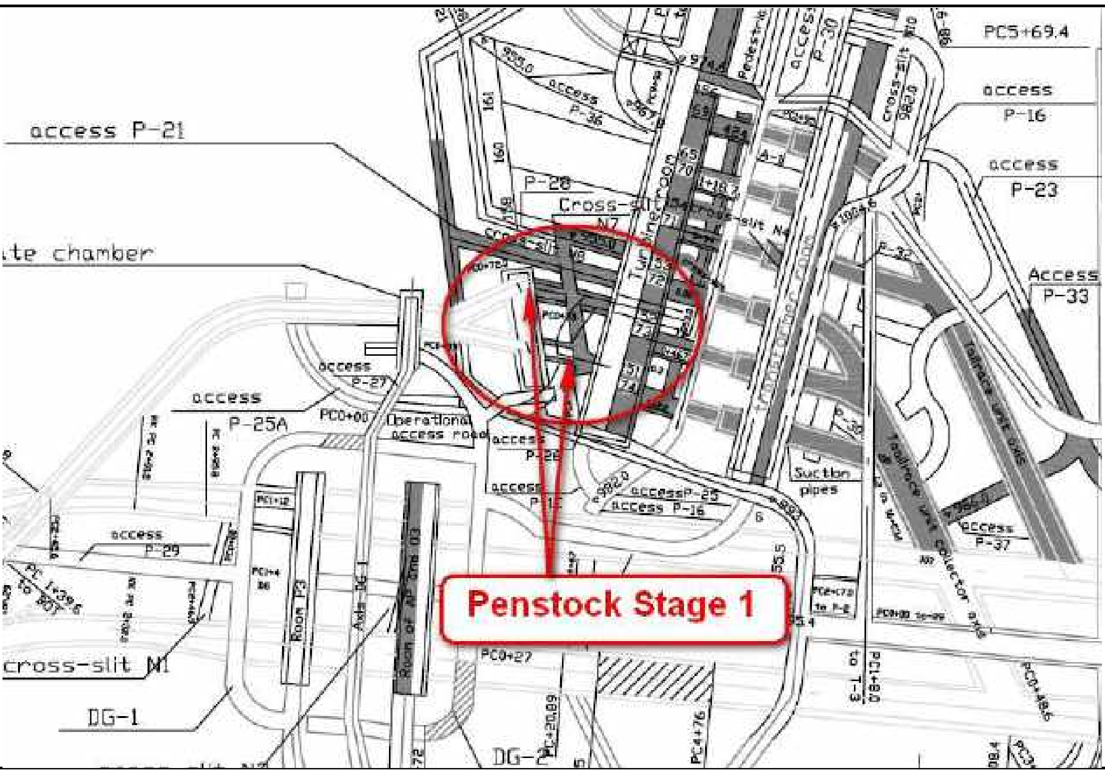
Item Stage 1 Power Tunnel Intake

Code S1PT_INTAKE

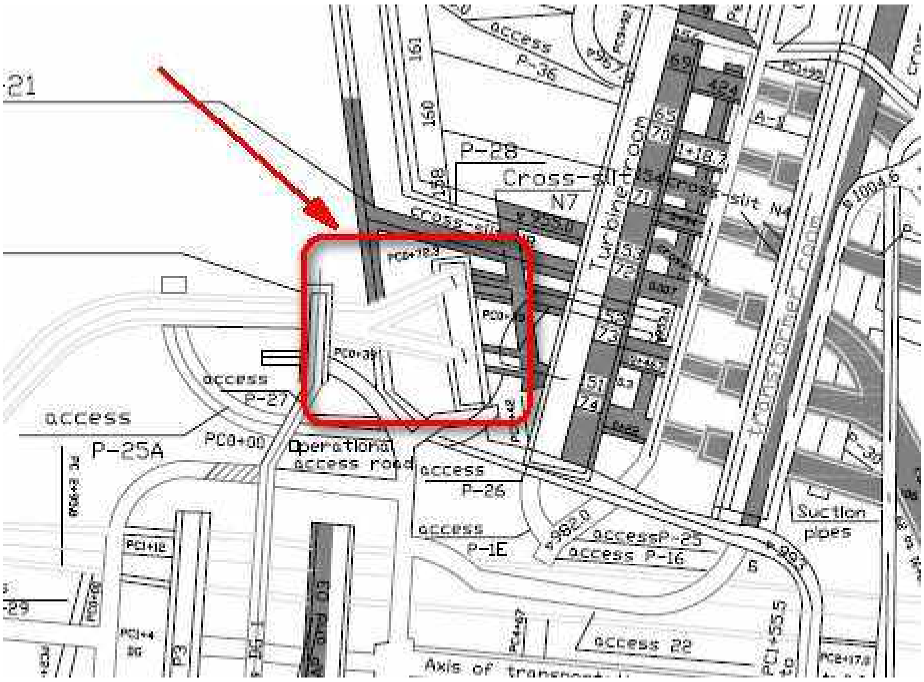
n° : 106



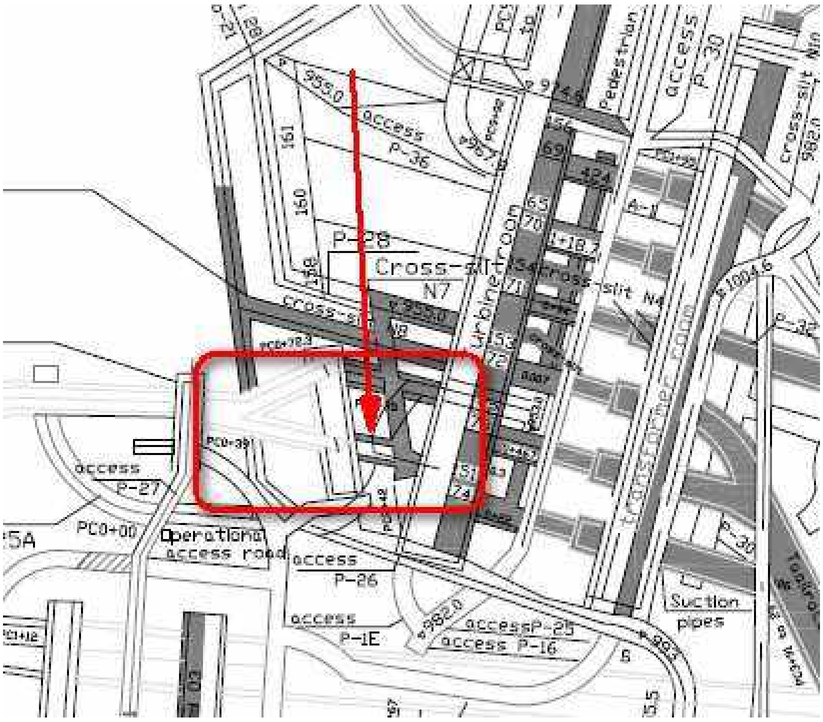
Stage 1 - Report name | **Item** Stage 1 Power Tunnel Penstock | **n° :** 107
Code S1PT_P



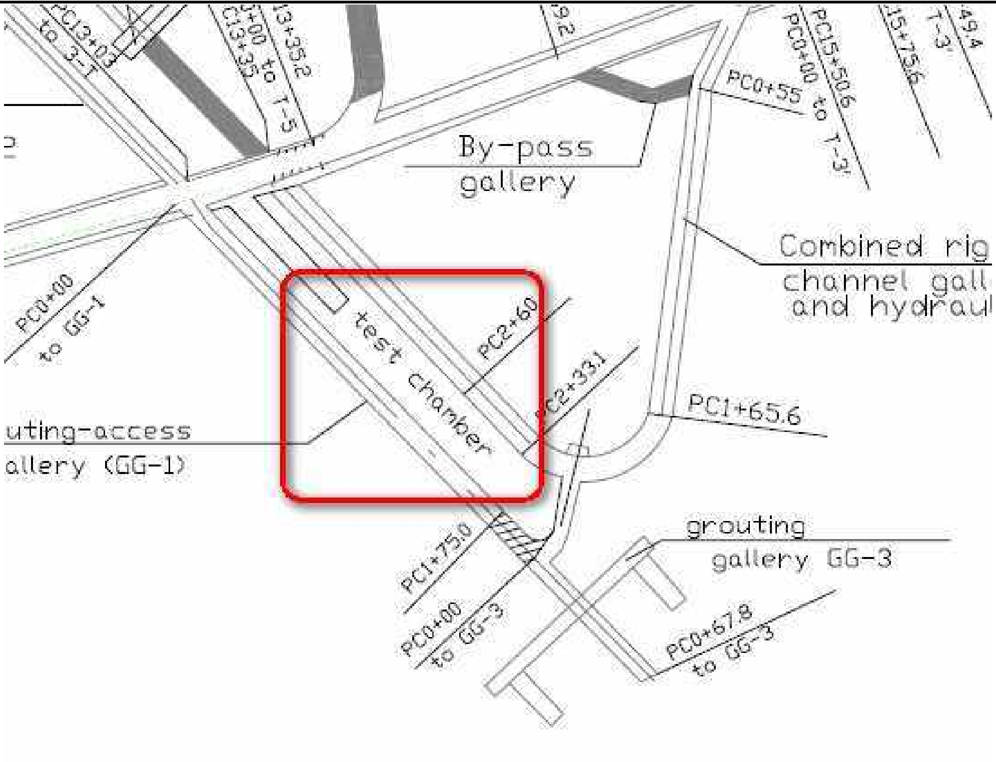
Stage 1 - Report name | **Item** Temporary Water Supply Line 5 | **n° :** 108
Code TWS5



Stage 1 - Report name	**Item**	Temporary Water Supply Line 6	**n° :** 109
	Code	TWS6	



Stage 1 - Report name	**Item**	Test Chamber	**n° :** 110
	Code	Test Chamber	

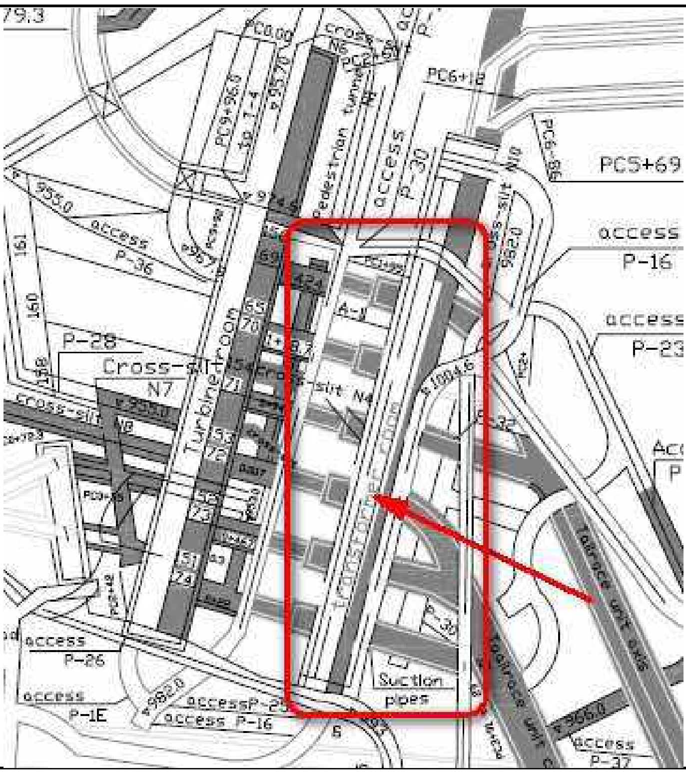


Stage 1 - Report name

Item Transformer hall

Code TH

n° : 111

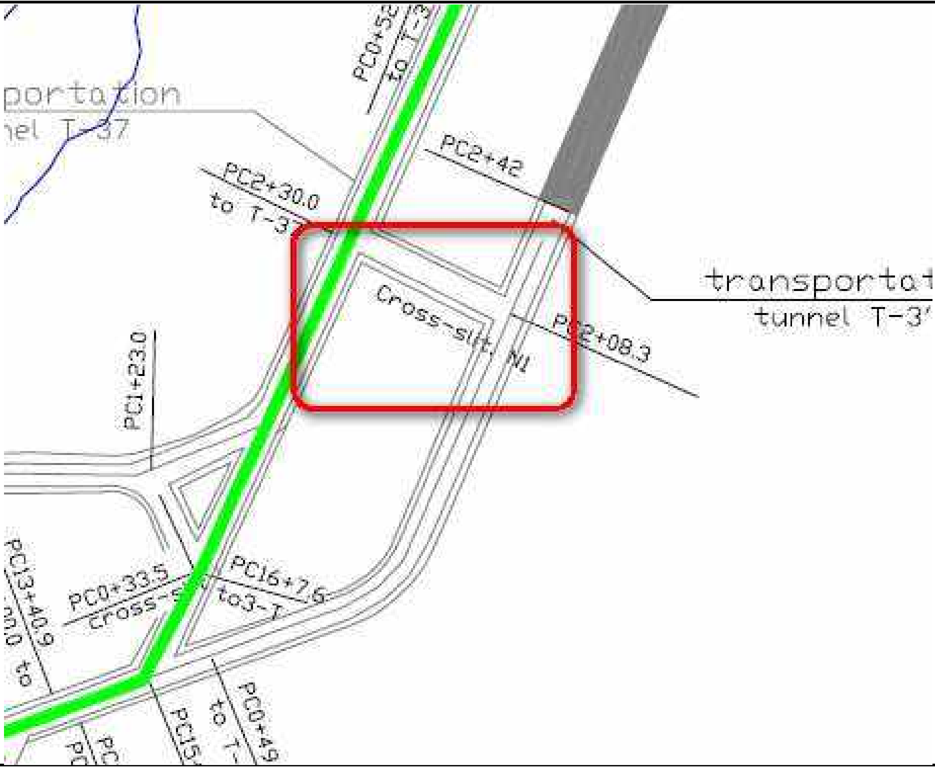


Stage 1 - Report name

Item Transportation Tunnel Connection T37-T3'

Code Con T37-T3'

n° : 112



Stage 1 - Report name

Item Transportation tunnel stretch from T3 to T37

n° : 113

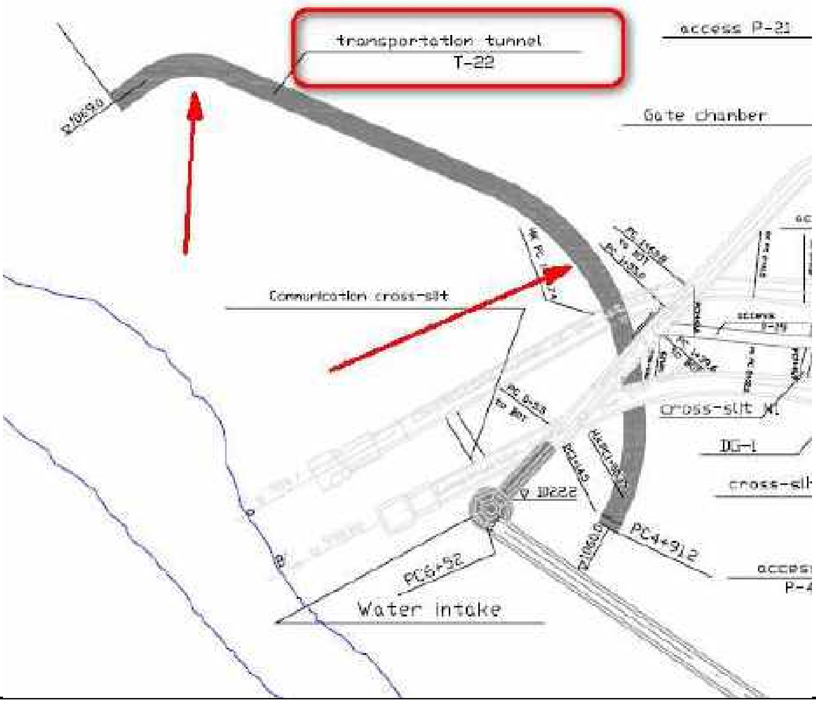
Code T3-T37

Stage 1 - Report name

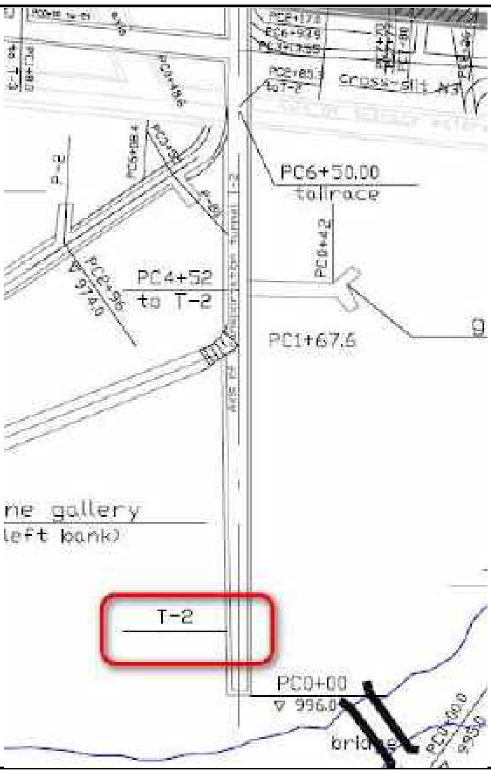
Item Transportation Tunnel T 22

n° : 114

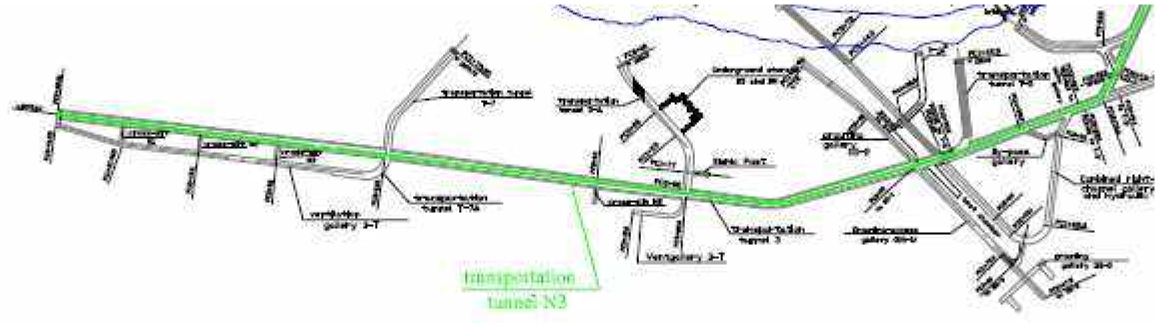
Code T22



Stage 1 - Report name	**Item**	**Transportation Tunnel T2**	**n° :**	115
	Code	**T2**		



Stage 1 - Report name	**Item**	**Transportation Tunnel T3**	**n° :**	116
	Code	**T3**		

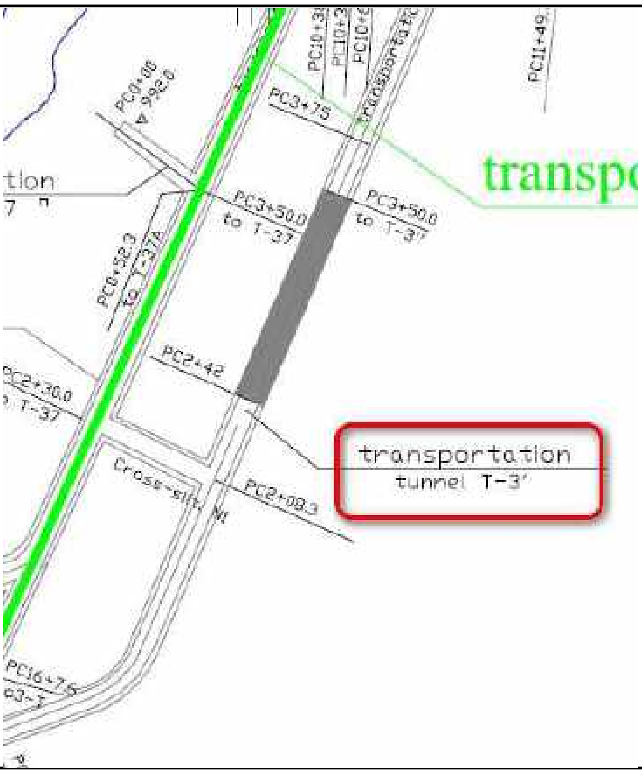


Stage 1 - Report name

Item Transportation Tunnel T3'

Code T3'

n° : 117

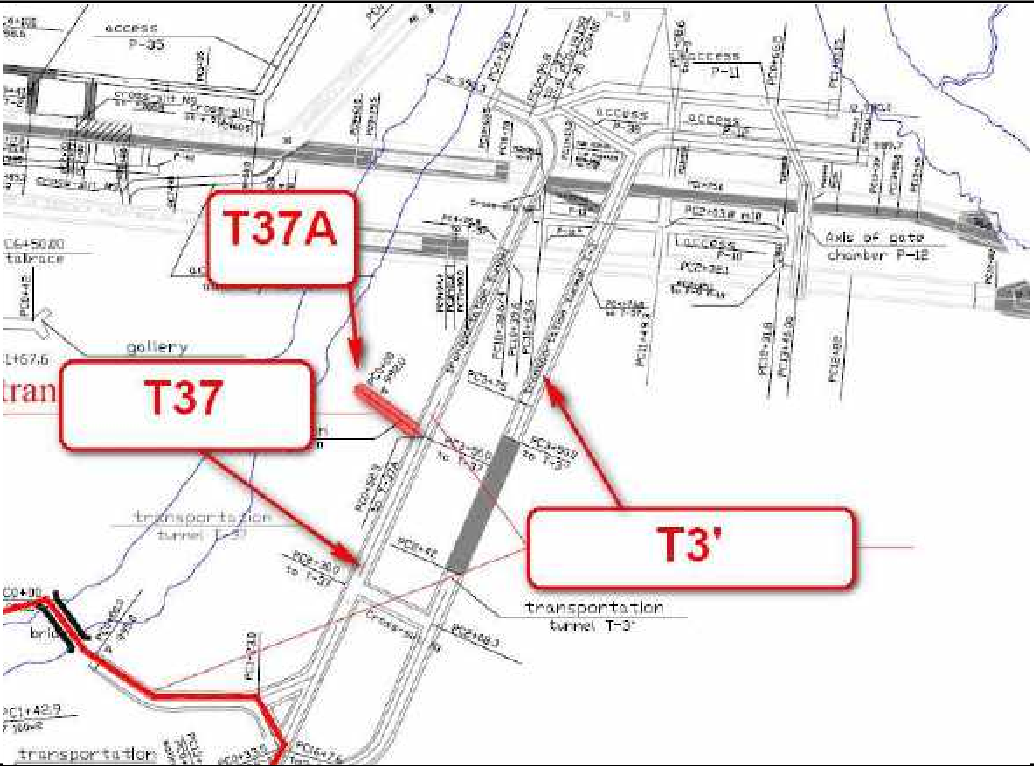


Stage 1 - Report name

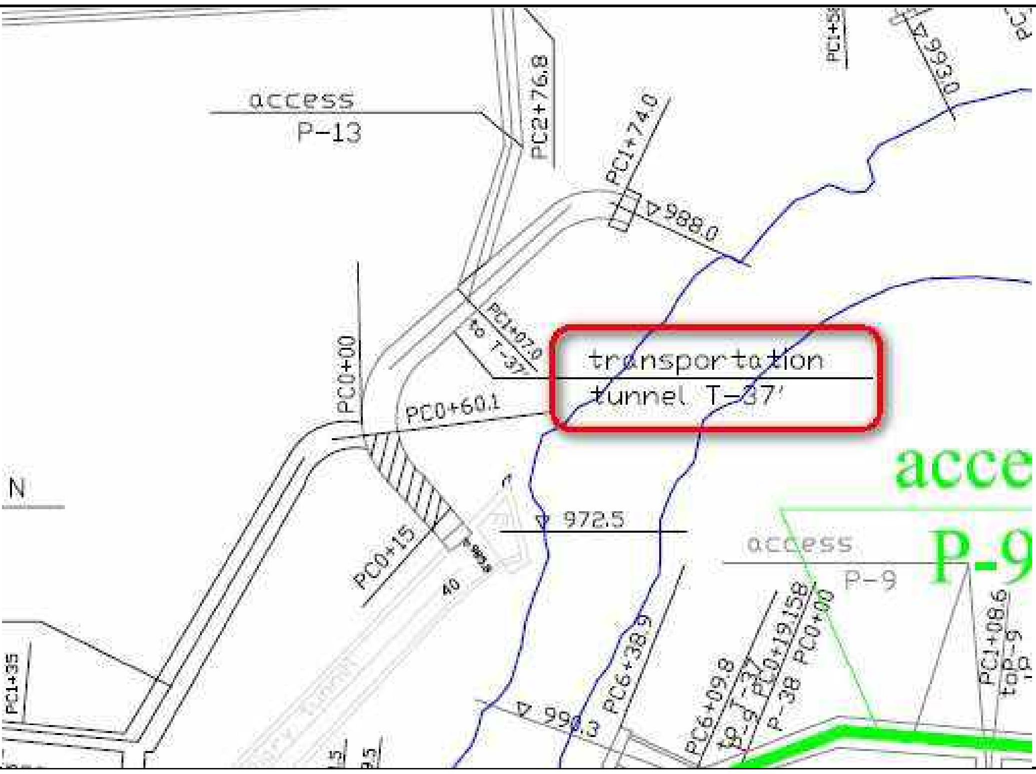
Item Transportation Tunnel T37

Code T37

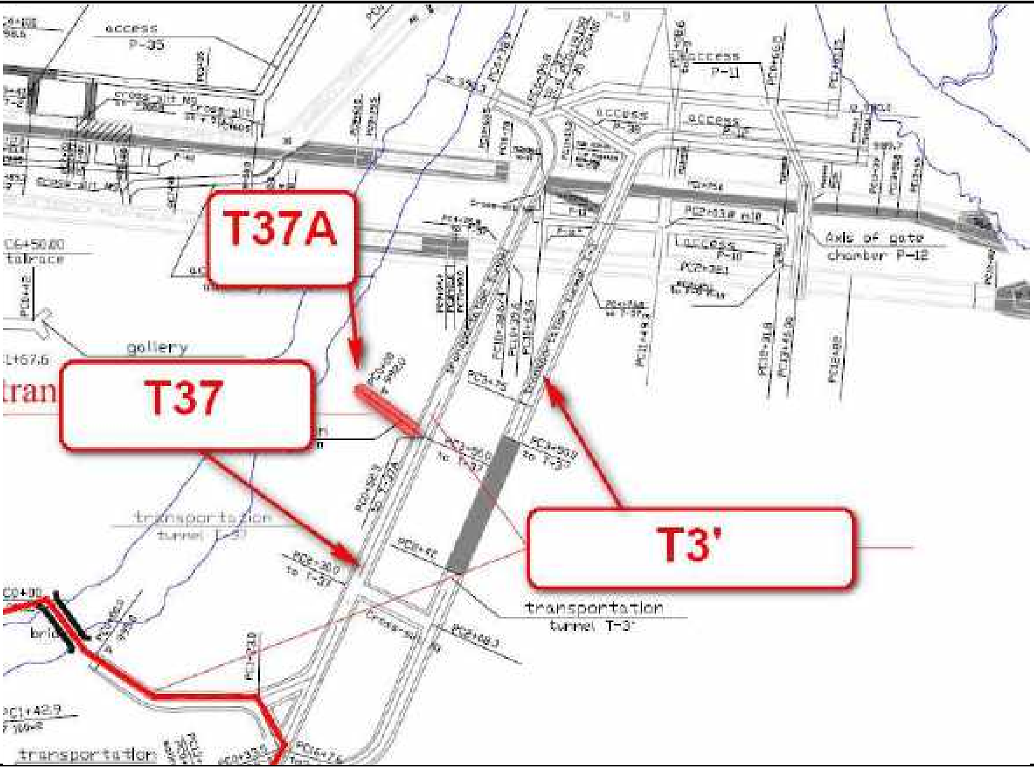
n° : 118



Stage 1 - Report name	**Item**	**Transportation Tunnel T37'**	**n° :**	119
	Code	**T37'**		

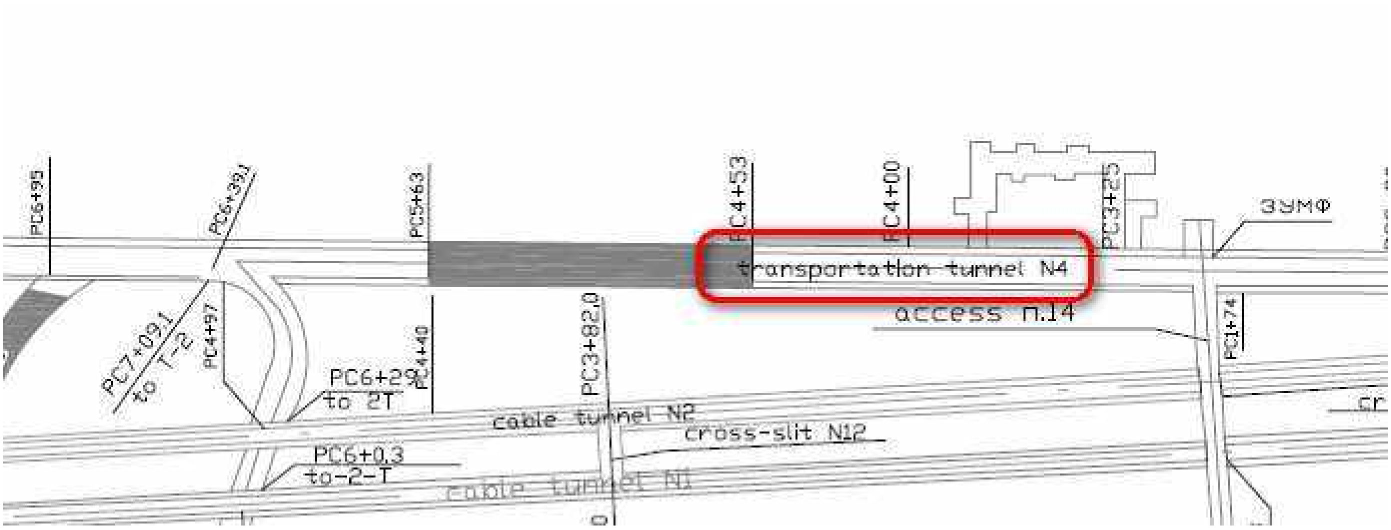


Stage 1 - Report name	**Item**	**Transportation Tunnel T37A**	**n° :**	120
	Code	**T37A**		



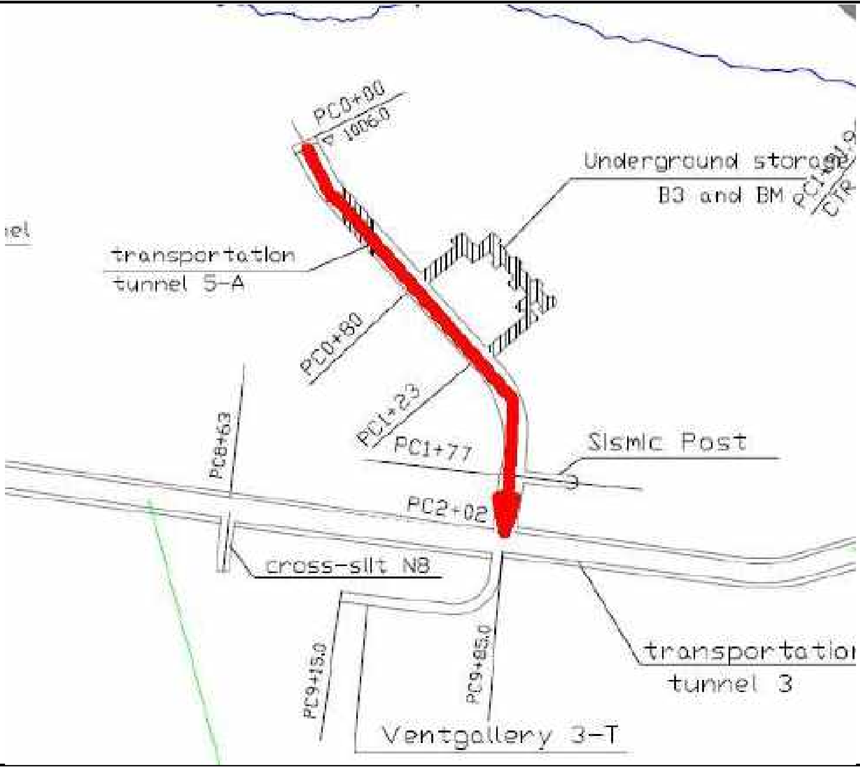
Stage 1 - Report name **Item** **Transportation Tunnel T4** **n° :** **121**

Code **T4**



Stage 1 - Report name **Item** **Transportation Tunnel T5A** **n° :** **122**

Code **T5A**

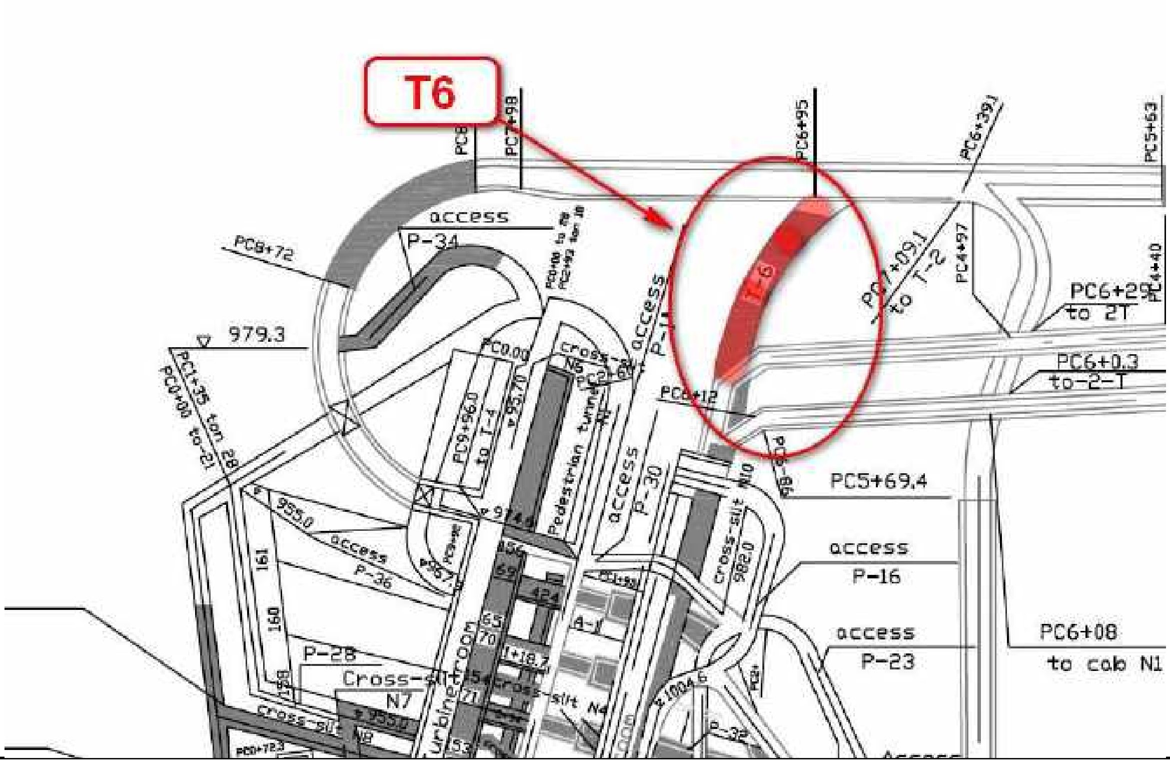


Stage 1 - Report name

Item Transportation Tunnel T6

Code T6

n° : 123

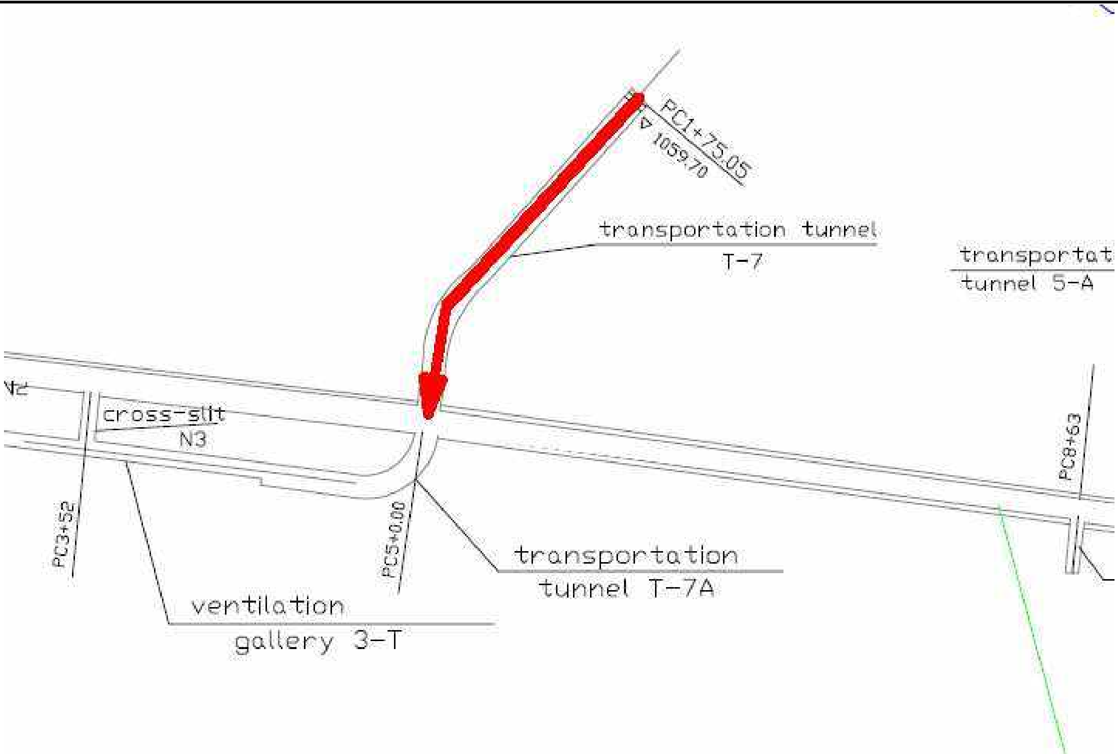


Stage 1 - Report name

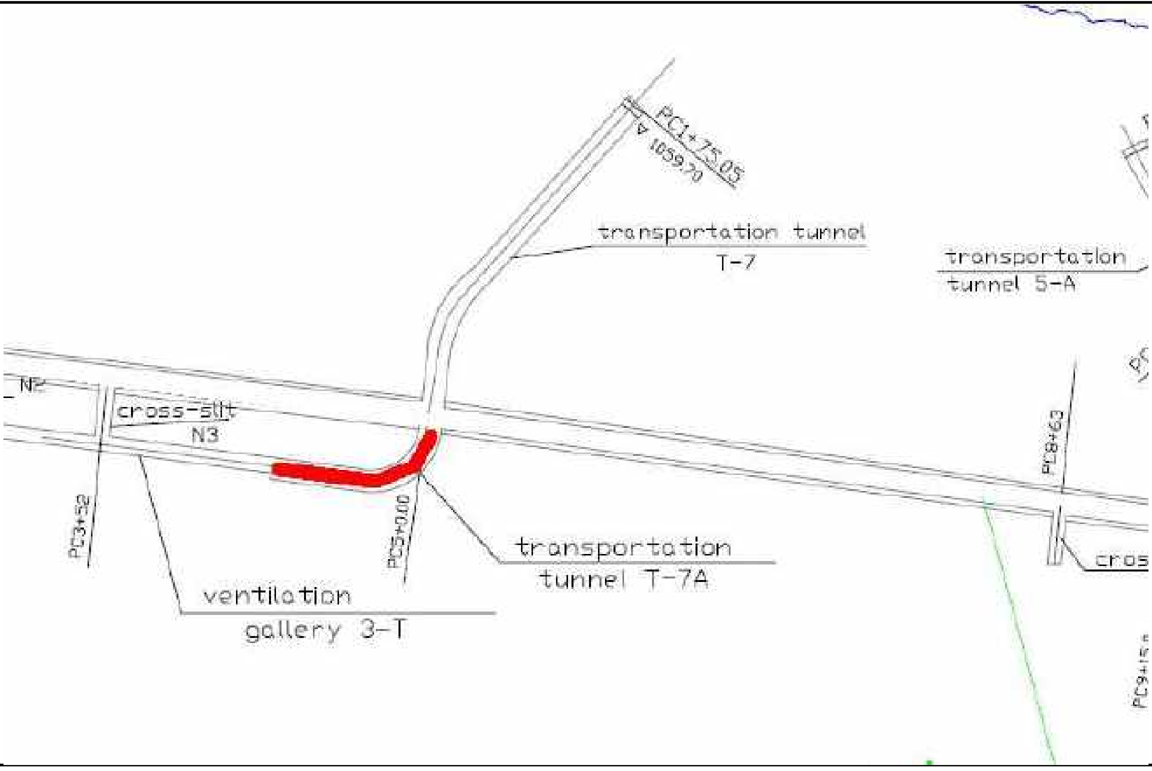
Item Transportation Tunnel T7

Code T7

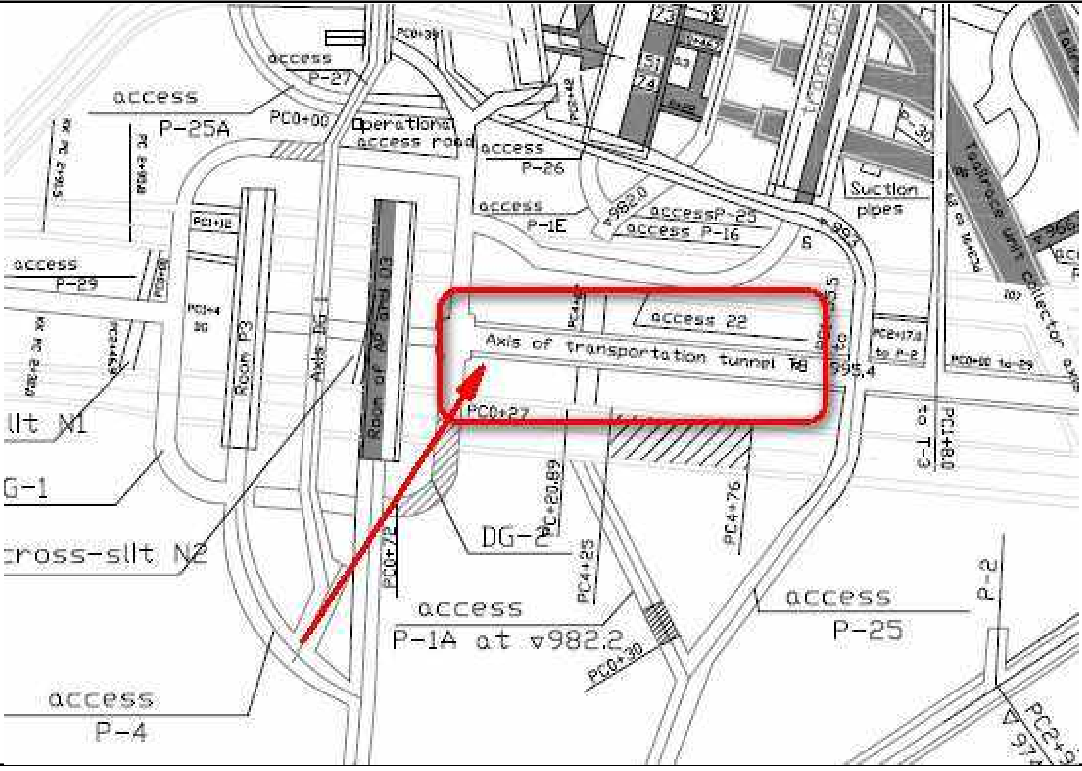
n° : 124



Stage 1 - Report name	**Item**	**Transportation Tunnel T7A**	**n° :**	**125**
	Code	**T7A**		



Stage 1 - Report name	**Item**	**Transportation Tunnel T8**	**n° :**	**126**
	Code	**T8**		

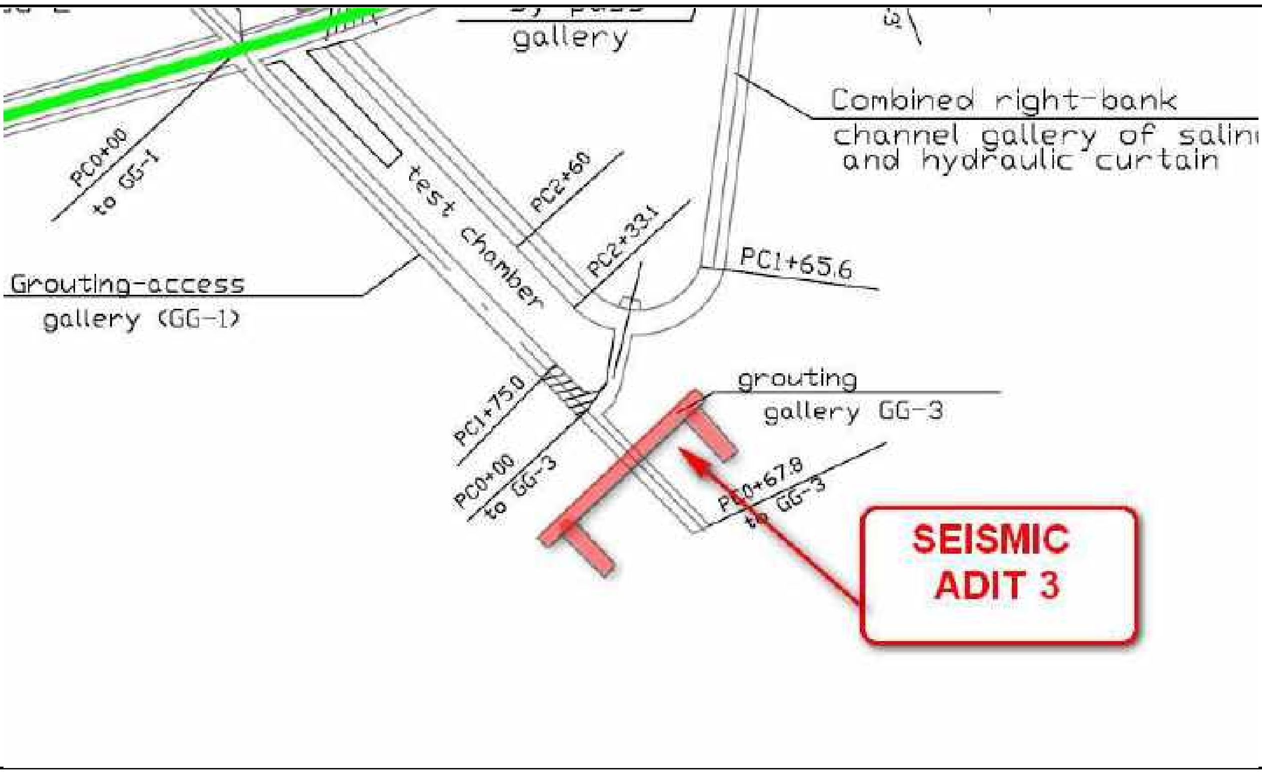


Stage 1 - Report name

Item **Tunnel Seismic Adit 3 at GG3**

Code **Tunnel Seismic Adit**

n° : **127**

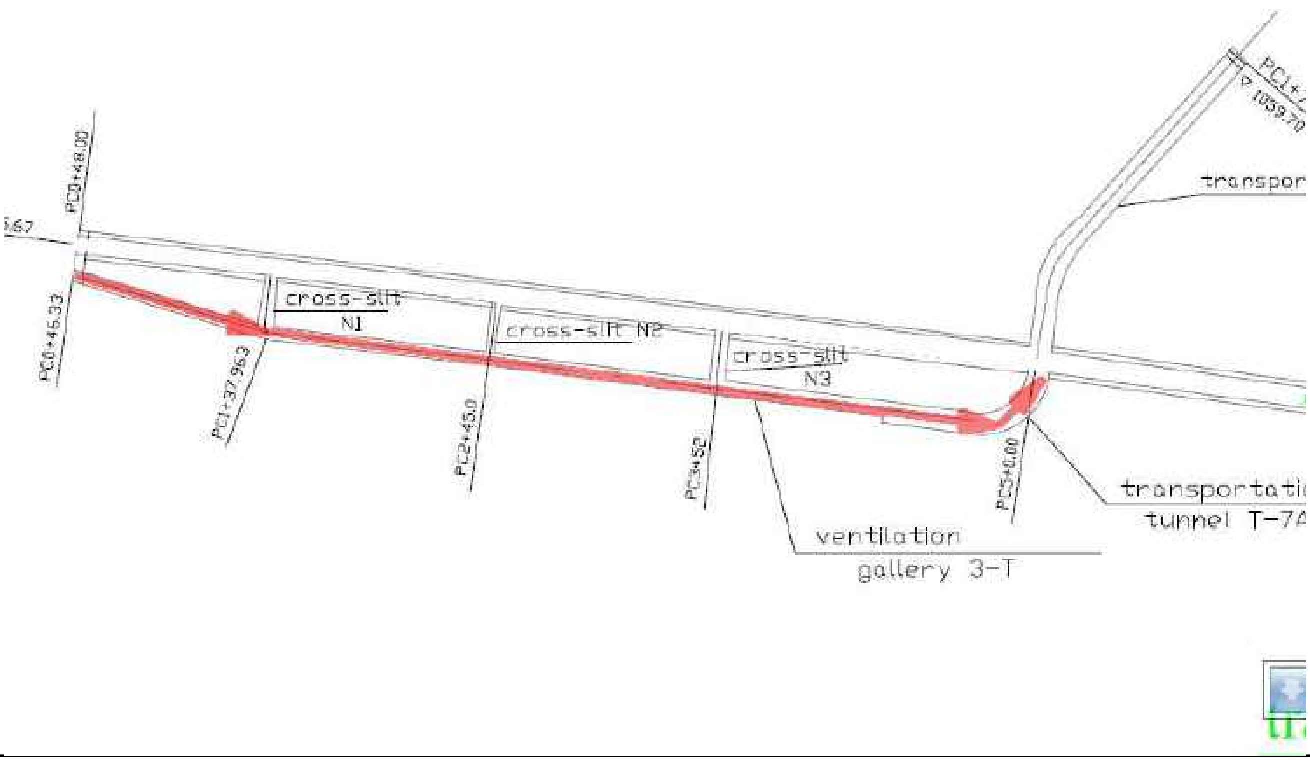


Stage 1 - Report name

Item **Ventilation Adit - Parallel to T3**

Code **Vent_Adit**

n° : **128**

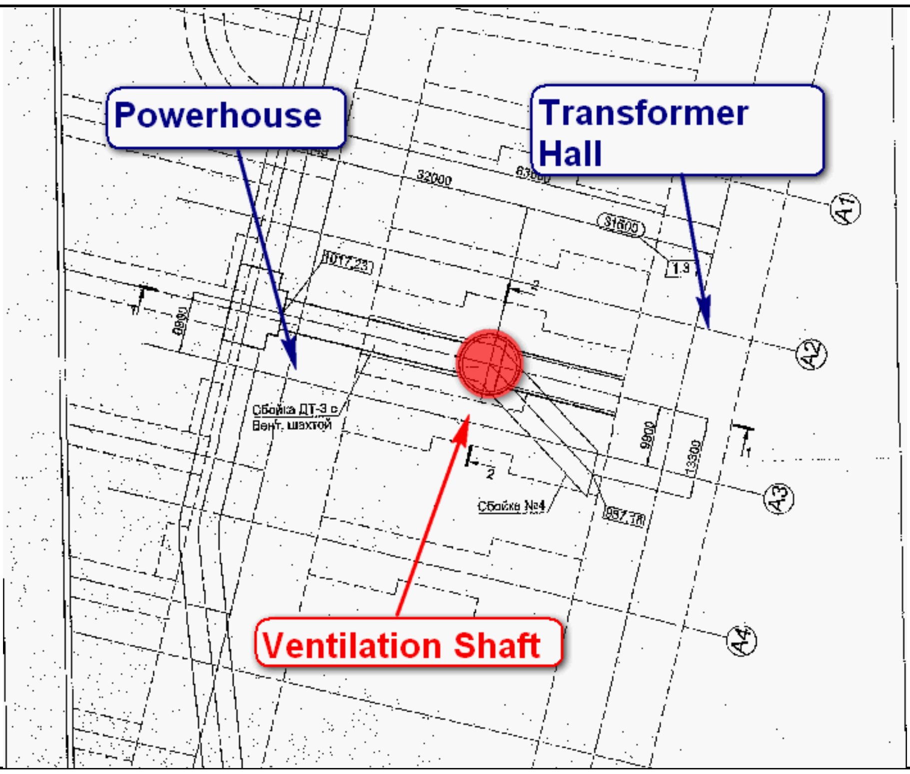


Stage 1 - Report name

Item Ventilation shaft

Code Vent_Shaft

n° : 129



Adit to P3

Adit to P3

Id Datum 1619

Chainage From: 0
Chainage To: 50

date 08/06/2011

Damages:

This is the connection between the Drainage gallery to the P3 tunnel. Along this stretch the tunnel have to be lined, only temporary suuports heve been placed. The adit is 5m large and 10m hight. Rock bolts with pattern 3 x 3 m are installed.

Adit to P3

Id Datum 1620

Chainage From: 50
Chainage To: 75

date 08/06/2011

Damages:

Starting from this chainage up to the junction with the tunnel P3 the works supports are incresed; installation of steel ribs IPE 300 @ 2 m are carried out.

Auxiliary tunnel

Auxiliary tunnel

Id Datum 1255

Chainage From: 865
Chainage To: 900

date 03/06/2011

Damages:

No evident damages for lining structure are detected

Auxiliary tunnel

Id Datum 1256

Chainage From: 900
Chainage To: 900

date 03/06/2011

Damages:

The lining does not evidence sign of degradation or overloading, minor water inflows are recorded in correspondence of the transversal joint between the lining segments.

Starting from this chainage the tunnel joints with the Auxiliary Tunnel by means of a curve stretch. In correspondence of the beginning of this curve stretch the elevation of the tunnel invert increases. It is deemed necessary the evaluation of the lining stability against the water erosion potential associated to the

Auxiliary tunnel

Id Datum 1257

Chainage From: 900
Chainage To: 950

date 03/06/2011

Damages:

No evident damages for lining structure are detected

Auxiliary tunnel

Id Datum 1258

Chainage From: 950
Chainage To: 960

date 03/06/2011

Damages:

Some fissures system affects the crown portion of the lining. Through this fissures some water inflows are recorded.

Auxiliary tunnel

Id Datum 1259

Chainage From: 960
Chainage To: 972

date 03/06/2011

Damages:

No evident damages for lining structure are detected

End of the tunnel stretch.

Auxiliary tunnel for grouting works of DT1 Collapse area

Auxiliary tunnel for grouting

Id Datum 1508

Chainage From: 0

Chainage To: 0

date 07/06/2011

Damages:

This tunnel has been created as explorartory geological adit and sucessively enlarged to allow the grouting works in correspondence of the Diversion tunnel 1 collapse area.

Auxiliary tunnel for grouting

Id Datum 1509

Chainage From: 0

Chainage To: 1

date 07/06/2011

Damages:

No evidence of lining overloading due the external load are detected

The gallery is caracterized by a d cross section 4 m span recenlty lined reinforced with steel ribs ipe 200 @ 1 m connected by rebars fi 18 @ 20 cm.

Auxiliary tunnel for grouting

Id Datum 1510

Chainage From: 1

Chainage To: 2

date 07/06/2011

Damages:

During the site inspection the II grouting works phase are ongoing . Some inspection hole in correspondence of the grouting treatment of the collapsed area has evidenced void presence. As a consequence some additional grouting have been foreseen

Auxiliary tunnel for grouting

Id Datum 1511

Chainage From: 2
Chainage To: 3

date 07/06/2011

Damages:

The grouting mix is composed by water, cement and sand in the ratio 1/2/1. The injection pressure is 4 bar. In the previous injection an amount of 3000 m^3 haa been accomplished.

Auxiliary tunnel for grouting

Id Datum 1512

Chainage From: 1
Chainage To: 40

date 07/06/2011

Damages:

In correspondece of this chainage there is a change of shape and narrowing of the cross section.

Cable tunnel N1

Cable tunnel N1

Id Datum 1364

Chainage From: 276

Chainage To: 276

date 04/06/2011

Damages:

The ispection starts from Chainage 276 and proceed in direction to the Powr House.

Cable tunnel N1

Id Datum 1365

Chainage From: 276

Chainage To: 276

date 04/06/2011

Damages:

The main section of the tunnel is oval. The thickness of the lining is almost 1 m. The main steel reinforcement is composed by rebars φ 18 @ 20 cm transverce smoth reinforcements φ 16 @ 40

Cable tunnel N1

Id Datum 1366

Chainage From: 276

Chainage To: 310

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N1

Id Datum 1367

Chainage From: 310
Chainage To: 310

date 04/06/2011

Damages:

Water inflow on sidewall in correspondence of the left side.

The Joint still represents the weakness workmaship pf the lining system, expecially with reference to the watrinflow.

Cable tunnel N1

Id Datum 1368

Chainage From: 310
Chainage To: 375

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N1

Id Datum 1369

Chainage From: 375
Chainage To: 375

date 04/06/2011

Damages:

Water inflow on sidewall in correspondence of the left side.

In this stretch of tunnel grouting works are on going. Injection are carried out in correspondence of the crown @ approx. 5 m.

Cable tunnel N1

Id Datum 1370

Chainage From: 375
Chainage To: 465

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N1

Id Datum 1371

Chainage From: 465
Chainage To: 465

date 04/06/2011

Damages:

Water inflow in corespondence of the right side of crown closest to the transversal joint are recorded

Cable tunnel N1

Id Datum 1372

Chainage From: 465
Chainage To: 485

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N1

Id Datum 1373

Chainage From: 485
Chainage To: 485

date 04/06/2011

Damages:

In correspondence of this chainage there is a junction withthe Cable tunnel N2 that is plugged.

Cable tunnel N1

Id Datum 1374

Chainage From: 485
Chainage To: 572

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N1

Id Datum 1375
Chainage From: 572
Chainage To: 572
date 04/06/2011

Damages:

Waterinflow recorded in correspondence of the crown

Cable tunnel N1

Id Datum 1376
Chainage From: 572
Chainage To: 662
date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N1

Id Datum 1377
Chainage From: 662
Chainage To: 662
date 04/06/2011

Damages:

Water inflow recorded on the left sidewall (damp condition)

Cable tunnel N1

Id Datum 1378
Chainage From: 662
Chainage To: 682
date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N1

Id Datum 1379

Chainage From: 682
Chainage To: 682

date 04/06/2011

Damages:

Water inflow recorded on the left and right sidewall (damp condition)

Cable tunnel N1

Id Datum 1396

Chainage From: 95
Chainage To: 75

date 04/06/2011

Damages:

Along this stretch a collpase occurred during the excavation phase. The excavation was recovered during the soviet works. Support works consist in IPE 200 @ 2m connected horizzontally with φ 26 @ 20 cm and vertically with φ 12 @ 10 cm

Cable tunnel N1

Id Datum 1397

Chainage From: 75
Chainage To: 75

date 04/06/2011

Damages:

From this section restsrts the conventional cross section

Along this stretch rehabilitation works are on going . Mainly they involve the rehabiltation of the transversal joints. The concrete structure appear to be in good condition.

Cable tunnel N1

Id Datum 1398

Chainage From: 75
Chainage To: 30

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N1

Id Datum 1399

Chainage From: 30

Chainage To: 0

date 04/06/2011

Damages:

Along this stretch a collpase occurred during the excavation phase. The excavation was therefore abandoned in the last portion and the tunnel was plugged.

Cable tunnel N2

Cable tunnel N2

Id Datum 1380

Chainage From: 612

Chainage To: 612

date 04/06/2011

Damages:

The inspection starts from the power house in the direction of the exit. The main section of the tunnel is oval. The thickness of the lining is almost 1 m.

Cable tunnel N2

Id Datum 1381

Chainage From: 612

Chainage To: 590

date 04/06/2011

Damages:

This tunnel stretch is supported by IPE 200 @ 1 m.

Cable tunnel N2

Id Datum 1382

Chainage From: 590

Chainage To: 580

date 04/06/2011

Damages:

Along this stretch some rehabilitation works of this tunne is on going that could be taken as exemplification of the woks methodology. Mainly the works are relevant to the rehabilitation of the transversal joints. The lining does not shows sign of overloading or degradation.

Cable tunnel N2

Id Datum 1383

Chainage From: 580
Chainage To: 560

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N2

Id Datum 1384

Chainage From: 560
Chainage To: 540

date 04/06/2011

Damages:

Water inflow (damp conditions) are recorded in correspondence of the left side wall transversal joint

Cable tunnel N2

Id Datum 1385

Chainage From: 540
Chainage To: 520

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N2

Id Datum 1386

Chainage From: 520
Chainage To: 520

date 04/06/2011

Damages:

Water inflow (damp conditions) are recorded in correspondence of the left sidewall up to the crown on transversal joint

Cable tunnel N2

Id Datum 1387 **Chainage From:** 520 **Chainage To:** 382 **date** 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N2

Id Datum 1388 **Chainage From:** 382 **Chainage To:** 382 **date** 04/06/2011

Damages:

Junction with the Cable tunnel N 1. This junction has been plugged. The tunnel permanent lining has not yet inslalled along this stretch. The present works support carried out are those used for junction section; i. e. IPE 300 @ 2 m connected orizzontally with φ 20 at 20 cm and vertically with φ 12 at 10 cm

Cable tunnel N2

Id Datum 1389 **Chainage From:** 382 **Chainage To:** 370 **date** 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N2

Id Datum 1390 **Chainage From:** 370 **Chainage To:** 355 **date** 04/06/2011

Damages:

Water inflow (dripping conditions) are recorded in correspondence of the left and right sidewall up to the crown on transversal joint

Cable tunnel N2

Id Datum 1391

Chainage From: 355
Chainage To: 350

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N2

Id Datum 1392

Chainage From: 350
Chainage To: 335

date 04/06/2011

Damages:

Water inflow (damp conditions) are recorded in correspondence of the left sidewall up to the crown on transversal joint

Cable tunnel N2

Id Datum 1393

Chainage From: 335
Chainage To: 240

date 04/06/2011

Damages:

In this stretch of tunnel contact grouting works are on going. Injection are carried out in correspondence of the crown @ approx. 5 m by means of 1,5m bore hole depht.

Cable tunnel N2

Id Datum 1394

Chainage From: 240
Chainage To: 128

date 04/06/2011

Damages:

No evident damages for lining structure are detected

Cable tunnel N2

Id Datum 1395

Chainage From: 128
Chainage To: 110

date 04/06/2011

Damages:

In correspondence of this chainage some collapse occurred during the excavation. The excavation was installalling special works supports IPE 200 @ 2 m connected with φ 26 @ 40 cm.

Geology - The rock mass exposed is sand stone RMC II - III. Main joint setting: dip direction 80°N dip 70° joint spacing 20-50 cm persistence 4-5 m dry condition.

Cable tunnel N2

Id Datum 1400

Chainage From: 187
Chainage To: 187

date 04/06/2011

Damages:

The inspection restart from this chainage and continue in the direction of the outlet. In correspondence of this stretch grouting works are on going. Mortar mix W/C= 1 + sand

Cable tunnel N2

Id Datum 1401

Chainage From: 150
Chainage To: 150

date 04/06/2011

Damages:

In correspondence of this chaiange it has been carried out a temporary adit to surface in order to garantee an access to the tunnel. In fact the final stretch of the original tunnel (portal) was collpsed and no access structure from this side was more stable.

Collector of Tail Race tunnel units 1-2-3

Collector of Tail Race tunnel

Id Datum 1640

Chainage From: 0

Chainage To: 0

date 08/06/2011

Damages:

The excavation of the junction stretch has been almost carried out, only 30 - 40 m of muck materials have to be removed, installation of provisional supprots works. Steel ribs IPE 400 @ 0,6 m and concrete lining of approx. 2 m thick have been installed. The excavation of the draft tunnels have not yet started.

Collector of Tail Race tunnel units 4-5-6

Collector of Tail Race tunnel

Id Datum 1641

Chainage From: 0

Chainage To: 0

date 08/06/2011

Damages:

The excavation of the junction stretch has been almost carried out. The excavation of the draft tunnel N° 6 has been completed while the excavation of draft tunnels 5 and 6 has been carried out for approx. 10 m each.

Diversion Tunnel Maintainance Gate Chamber

Diversion Tunnel Maintainance

Id Datum 1580

Chainage From: 0

Chainage To: 0

date 07/06/2011

Damages:

The cavern excavation works have been completed as well as the excavation relevant to the gates housing. The excavation support works, the provisional lining and the first and second phase concrete works have been carried out, most part of the electro-mechanical operational equipment relevant to the

Diversion Tunnels Mainn and emergency Gate Chamber

Diversion Tunnels Mainn and

Id Datum 1577
Chainage From: 0
Chainage To: 0
date 07/06/2011

Damages:

The excavation works are completed as well as the excavation relevant to the gates housing. The excavation support works, the provisional lining and the first phase concrete works have been carried out, part of the electro-mechanical equipment has been installed.

Diversion Tunnels Mainn and

Id Datum 1578
Chainage From: 0
Chainage To: 1
date 07/06/2011

Damages:

The present status of the concrete is quite poor, as welll as the workmanship of the transversal joint between the concrete blocks. Some other poor workmanship affects the concrete finishing, honeycomb and bar exposure have been detected. In any case no evidences of global instability due to the external

Diversion Tunnels Mainn and

Id Datum 1579
Chainage From: 1
Chainage To: 2
date 07/06/2011

Damages:

The contact between the bridge beam and the below sidewall lining wall is missing for a stretch of approximately 15 m in correspondence of the southern wall east side.

Diversion Tunnels Mainn and

Id Datum 1581

Chainage From: 0

Chainage To: 1

date 07/06/2011

Damages:

Poor concrete status particulary in correspondece of the crown transversal joint between the concrete blocks, where water inflow are detected. Some other poor workmanship affects the concrete finishing, honeycomb and bar exposure have been detected. No evidences of global instability of the cavern or

Down stream Construction tunnels Gate Chamber

Down stream Construction

Id Datum 1178 **Chainage From:** 0 **Chainage To:** 90 **date** 02/06/2011

Damages:

The lining of the gate chamber is carried out in correspondence of the crown and for the sidewall. Invert lining structure is missing. The Crane structure is not installed.

Down stream Construction

Id Datum 1179 **Chainage From:** 0 **Chainage To:** 90 **date** 02/06/2011

Damages:

The concrete thickness is in the range of 100 cm; the steel reinforcement is constituted by symmetrical layer of φ 18 @ 20 cm with secondary reinforcement. Since the invert structure is not yet carried out the side walls lining do not have any support on their toe (basement)

Down stream Construction

Id Datum 1180 **Chainage From:** 0 **Chainage To:** 20 **date** 02/06/2011

Damages:

Evaluation of the RMC - Class II. Work support installed; rock bolts 1,5 x 1,5 φ 20.

Drainage Gallery N°1

Drainage Gallery N°1

Id Datum 1600

Chainage From: 0
Chainage To: 0

date 08/06/2011

Damages:

The inspection starts from the junction with the Operational Access to Gate Chamber proceeding to the Diversions Tunnel Maintainance Gallery. The gallery is 5 m width and 7 m hight.

Drainage Gallery N°1

Id Datum 1601

Chainage From: 0
Chainage To: 15

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Drainage Gallery N°1

Id Datum 1602

Chainage From: 15
Chainage To: 25

date 08/06/2011

Damages:

waterinflow through the transversal joints on both sidewall

Drainage Gallery N°1

Id Datum 1603

Chainage From: 25
Chainage To: 40

date 08/06/2011

Damages:

The support works of this tunnel stretch is composed by steel ribs IPE 150 @ 1m connecte by fi 20 @ 10cm

Drainage Gallery N°1

Id Datum 1604

Chainage From: 40
Chainage To: 50

date 08/06/2011

Damages:

waterinflow through the transversal joints on both sidewall. The transversal joint workmanship is poor. The exposure of the steel reinforcement is frequent.

Drainage Gallery N°1

Id Datum 1605

Chainage From: 50
Chainage To: 95

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Drainage Gallery N°1

Id Datum 1606

Chainage From: 95
Chainage To: 95

date 08/06/2011

Damages:

In correspondence of this chainage starts a curve tunnel stretch. Along the curve problems related to the connection between the concrete lining blocks on the esternal side of the curve is sistematic. In correspondece of these joints rock mass is exposed

Drainage Gallery N°1

Id Datum 1607 **Chainage From:** 95 **Chainage To:** 145 **date** 08/06/2011

Damages:

No evident damages for lining structure are detected

Drainage Gallery N°1

Id Datum 1608 **Chainage From:** 145 **Chainage To:** 145 **date** 08/06/2011

Damages:

Intersection with tunnel P29

Drainage Gallery N°1

Id Datum 1609 **Chainage From:** 145 **Chainage To:** 155 **date** 08/06/2011

Damages:

The support works of this tunnel stretch is composed by steel ribs IPE 200 @ 1,5m connecte by fi 20 @ 10cm. In this stretch are ongoing the drilling works for grouting works and drainage installation

Drainage Gallery N°1

Id Datum 1610 **Chainage From:** 155 **Chainage To:** 220 **date** 08/06/2011

Damages:

No evident damages for lining structure are detected

Drainage Gallery N°1

Id Datum 1611

Chainage From: 220

Chainage To: 220

date 08/06/2011

Damages:

Intresecetion with tunel P4

Drainage Gallery N°1

Id Datum 1612

Chainage From: 220

Chainage To: 250

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Drainage Gallery N°1

Id Datum 1613

Chainage From: 250

Chainage To: 250

date 08/06/2011

Damages:

Intersection with adit to tunnel P3. It is noted that actual the lay out is different from what reported in the drawing. Actually the tunnel P4 has not been carried out.

Drainage Gallery N°1

Id Datum 1614

Chainage From: 250

Chainage To: 260

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Drainage Gallery N°1

Id Datum 1615

Chainage From: 260

Chainage To: 280

date 08/06/2011

Damages:

Concrete lining is installed

Drainage Gallery N°1

Id Datum 1616

Chainage From: 280

Chainage To: 280

date 08/06/2011

Damages:

waterinflow in correspondece of the drainage holes

Drainage Gallery N°1

Id Datum 1617

Chainage From: 280

Chainage To: 360

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Drainage Gallery N°1

Id Datum 1618

Chainage From: 360

Chainage To: 360

date 08/06/2011

Damages:

Rquest information conerning the type of drainage installation. Actually seems that the drain are constitued by simple drilled holes. The terminal portion of the drainage gallery ends in correspondece of the Hadrace Gate Chamber. Starting from this poit two drainage gallery are foreseen to be excavated parallel to the

Drainage Gallery N°2

Drainage Gallery N°2

Id Datum 1624

Chainage From: 0
Chainage To: 0

date 08/06/2011

Damages:

The inspection starts from the intesection with the T8 and proceeding in west dierection. The tunnel is approx. 6 m large and 5 m height.

Drainage Gallery N°2

Id Datum 1625

Chainage From: 0
Chainage To: 30

date 08/06/2011

Damages:

This tunnel stretch has been supported by steel ribs IPE 300 @ 1 m connected by rebars.

Drainage Gallery N°2

Id Datum 1626

Chainage From: 30
Chainage To: 30

date 08/06/2011

Damages:

On the left side it has been excavated a niche 3m large 3m height and 3m wide in which is located the ventialation shaft of the Diversion Tunnel N°2.

Drainage Gallery N°2

Id Datum 1627

Chainage From: 30

Chainage To: 110

date 08/06/2011

Damages:

In the terminal portion of the tunnel are located Gate Chamber drainage and grouting holes. Geology the rocl mass exposed is classified as RMC II

Headrace Gate Chamber

Headrace Gate Chamber

Id Datum 1574

Chainage From: 0

Chainage To: 1

date 07/06/2011

Damages:

in correspondece of adit to the chamber in correspondece of the crown a portion of approx. 10 m will be lined with steel lining. Presently steel ribs ipe 400 @ 1,5 m are installed.

Headrace Gate Chamber

Id Datum 1575

Chainage From:

Chainage To:

date 07/06/2011

Damages:

The cavern excavation works have been completed as well as the excavation relevant to the gates housing. The excavation support works, the concrete lining, the first and second phase concrete works have been carried out, most part of the electro-mechanical devices relevant to the gates has been installed

Headrace Gate Chamber

Id Datum 1576

Chainage From:

Chainage To:

date 07/06/2011

Damages:

The present status of the concrete does not shows particular signs of degradation.

Hydraulic and Curtain Gallery

Hydraulic and Curtain Gallery

Id Datum 1437

Chainage From: 0

Chainage To: 320

date 06/06/2011

Damages:

The steel lining thickness is approx. 40 mm with an internal profile of 3,70 m, in the internal portion of the steel lining is reinforced by circumferential ribs @ 40 cm of 40 mm thickness. The gap between the lining and the external excavation of the gallery is filled by concrete. The thickness of the gap is approx. 1 m.

Hydraulic and Curtain Gallery

Id Datum 1438

Chainage From: 0

Chainage To: 320

date 06/06/2011

Damages:

The steel lining has been painted. Sign of rust and corrosion process are evident with particular reference to the invert potion of the lining.

Hydraulic and Curtain Gallery

Id Datum 1439

Chainage From: 0

Chainage To: 320

date 06/06/2011

Damages:

In the invert potion of the gallery bore hole used for the saline dome monitoring have been located, presently this kind of installation are not yet available.

Hydraulic and Curtain Gallery

Id Datum	1440	**Chainage From:**	320	**date**	06/06/2011
		Chainage To:	320		

Damages:

The terminal portion of the gallery is plugged by a steel cup

Junction between T37A and bridge

Junction between T37A and

Id Datum 1147

Chainage From: 123

Chainage To: 110

date 02/06/2011

Damages:

Lining damaging/failure on the left sidewall. The joint between sidewalls and the relevant spring lines is missing.

3 - Cast in situ lining with an average thickness of 50 cm.

Junction between T37A and

Id Datum 1148

Chainage From: 110

Chainage To: 90

date 02/06/2011

Damages:

The joint between sidewalls and the relevant spring lines is missing.

Junction between T37A and

Id Datum 1149

Chainage From: 80

Chainage To: 80

date 02/06/2011

Damages:

Poor workmanship in the joint between to lining strokes.

Junction between T37A and

Id Datum 1150

Chainage From: 80

Chainage To: 123

date 02/06/2011

Damages:

No evident damages for lining structure are detected

Operational access to gate Chamber

Operational access to gate

Id Datum 1582

Chainage From: 0

Chainage To: 0

date 08/06/2011

Damages:

The inspection starts from the T8 and folowing in the east direction the Operational acces to Gat Chamber. The initial stretch of the tunnel is supported concrete lining reinforced by steel ribs ipe 400 @ 1 m connected by rebars fi 26 @ 20 cm.

Operational access to gate

Id Datum 1583

Chainage From: 0

Chainage To: 35

date 08/06/2011

Damages:

On the left side there is a niche for air ventilation of the Diversion Tunnel N°1

Operational access to gate

Id Datum 1584

Chainage From: 35

Chainage To: 40

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Operational access to gate

Id Datum 1585

Chainage From: 40

Chainage To: 40

date 08/06/2011

Damages:

The tunnel cross section shape change from circular to oval, the span is reduced from 10 to 8 m

Operational access to gate

Id Datum 1586

Chainage From: 40

Chainage To: 50

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Operational access to gate

Id Datum 1587

Chainage From: 50

Chainage To: 50

date 08/06/2011

Damages:

Junction with tunnel P22

Operational access to gate

Id Datum 1588

Chainage From: 50

Chainage To: 70

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Operational access to gate

Id Datum 1589 **Chainage From:** 70 **Chainage To:** 70 **date** 08/06/2011

Damages:

Intersection with grouting Gallery N°1

Operational access to gate

Id Datum 1590 **Chainage From:** 70 **Chainage To:** 90 **date** 08/06/2011

Damages:

No evident damages for lining structure are detected

Operational access to gate

Id Datum 1591 **Chainage From:** 90 **Chainage To:** 90 **date** 08/06/2011

Damages:

Poor lining workmanship evidence in correspondece of the tunnel crown

Operational access to gate

Id Datum 1592 **Chainage From:** 90 **Chainage To:** 400 **date** 08/06/2011

Damages:

No evident damages for lining structure are detected

Operational access to gate

Id Datum 1593

Chainage From: 400
Chainage To: 400

date 08/06/2011

Damages:

Intersecetion withadit to the Head Race Gate Chamber. The junction section is reinforced with IPE 200 @ 1 m conneceted with fi 26 rebars @ 20 cm

Operational access to gate

Id Datum 1594

Chainage From: 400
Chainage To: 500

date 08/06/2011

Damages:

No evident damages for lining structure are detected

Operational access to gate

Id Datum 1595

Chainage From: 500
Chainage To: 500

date 08/06/2011

Damages:

Intersection with Gate Chamber. Before the end of the tunnel there is an intersection with the Drainage gallery N° 4. The gallery is a 3 m width and 4m height. At the time of the inspection the excavation works were ongoing. The first stretch was concrete lined and the installation of IPE 100 @ 0,7m connected with

P1

P1

Id Datum 1441
Chainage From: 0
Chainage To: 0
date 06/06/2011

Damages:

The tunnel inspection starts from the intake proceeding in the direction of the Diversion tunnel. This is a transportation tunnel characterized by an hard traffic. The lining has been carried out proceeding by strokes.

P1

Id Datum 1442
Chainage From: 0
Chainage To: 30
date 06/06/2011

Damages:

No connection between the invert and the sidewalls have been carried out on both side.

P1

Id Datum 1443
Chainage From: 30
Chainage To: 40
date 06/06/2011

Damages:

No evident damages for lining structure are detected

P1

Id Datum 1444

Chainage From: 40
Chainage To: 50

date 06/06/2011

Damages:

In correspondence of the spring line the connection between the sidewall and the invert is missing on both side. The exposure of the rock mass is evident.

Geology: Sandstone strike N-S dip 80-85°; spacing 1 m, persistence 5 m closed without infilling material. In some location siltstone interbedded is present with a more jointed nature.

P1

Id Datum 1445

Chainage From: 50
Chainage To: 70

date 06/06/2011

Damages:

No evident damages for lining structure are detected

P1

Id Datum 1446

Chainage From: 70
Chainage To: 85

date 06/06/2011

Damages:

On the spring line left side the connection between the sidewall and the invert is missing.

From this chanage it is possible to evaluate the lining thickness that is in the rang of 1 - 1,5 m.

P1

Id Datum 1447

Chainage From: 85
Chainage To: 90

date 06/06/2011

Damages:

No evident damages for lining structure are detected

P1

Id Datum 1448
Chainage From: 90
Chainage To: 120
date 06/06/2011

Damages:

Along this tunnel stretch no lining has been installed, only temporary support have been installed, rock bolt and wire mesh without shotcrete.

Geology - RMC III sandstone with sub vertical dipping.

P1

Id Datum 1449
Chainage From: 120
Chainage To: 120
date 06/06/2011

Damages:

Restart of the lining installation

P1

Id Datum 1450
Chainage From: 120
Chainage To: 140
date 06/06/2011

Damages:

Junction with tunnel P25 - reinforced section. Steel ribs ipe 200 @ 1 m horizontally connected by fi 20 @ 40 cm and vertically by fi 16 @ 20 cm.

P1

Id Datum 1451
Chainage From: 140
Chainage To: 160
date 06/06/2011

Damages:

No evident damages for lining structure are detected

P1

Id Datum 1452

Chainage From: 160
Chainage To: 180

date 06/06/2011

Damages:

No connection between the invert and the sidewall on the right side have been carried out.

P1

Id Datum 1453

Chainage From: 180
Chainage To: 180

date 06/06/2011

Damages:

Poor workmanship in the lining execution in correspondence of the crown portion (rock mass exposed)

P1

Id Datum 1454

Chainage From: 180
Chainage To: 190

date 06/06/2011

Damages:

No connection between the invert and the right sidewall

P1

Id Datum 1455

Chainage From: 190
Chainage To: 210

date 06/06/2011

Damages:

No evident damages for lining structure are detected

P1

Id Datum 1456

Chainage From: 210
Chainage To: 210

date 06/06/2011

Damages:

No connection between the both sidewall and the invert have been carried out. Water inflow have been recorded in correspondence of the transversal joint of the crown

P1

Id Datum 1457

Chainage From: 210
Chainage To: 240

date 06/06/2011

Damages:

No evident damages for lining structure are detected

P1

Id Datum 1458

Chainage From: 240
Chainage To: 240

date 06/06/2011

Damages:

Poor workmanship in correspondence of the transversal joint

P1

Id Datum 1459

Chainage From: 240
Chainage To: 296

date 06/06/2011

Damages:

No evident damages for lining structure are detected

P1

Id Datum 1460 **Chainage From:** 296 **Chainage To:** 296 **date** 06/06/2011

Damages:

Junction with tunnel P2. The excavation is in progress (20 m). In correspondence of this excavation the rock mass is exposed. Geology: siltstone dip direction 135° N dip 70-80°. Closed joint with no infilling material, spacing 0,5 - 1 m, persistance > 5 m. Dry condition.

P1

Id Datum 1461 **Chainage From:** 296 **Chainage To:** 316 **date** 06/06/2011

Damages:

The sidewall lining is missing in correspondence of the lower sidewalls side. In some portion more than 2 m of lining have not been carried out.

P1

Id Datum 1462 **Chainage From:** 316 **Chainage To:** 355 **date** 06/06/2011

Damages:

No evident damages for lining structure are detected

P1

Id Datum 1463 **Chainage From:** 355 **Chainage To:** 355 **date** 06/06/2011

Damages:

P 80

P1

Id Datum 1464

Chainage From: 355

Chainage To: 365

date 06/06/2011

Damages:

On the left sidewall the lining is missing. The upper portion of the lining is stabilized by rock bolts. Approx 3 bolts per lining strokes (4-5 m wide) @ 3 m. The same occurence is detected some m after the junction with tunne P80 on the right side

Geology - RMC III

P1 b

P1 b

Id Datum 1643

Chainage From: 0
Chainage To: 30

date 08/06/2011

Damages:

The inspection proceed stating from the intersection with P30 and proceeding in east direction. The lining is carried out with 0,4 0,5 m of conventional cast in situ reinforced concrete.

P1 b

Id Datum 1644

Chainage From: 30
Chainage To: 40

date 08/06/2011

Damages:

Along this stretch the tunnel is not lined.

P1 b

Id Datum 1645

Chainage From: 40
Chainage To: 50

date 08/06/2011

Damages:

Along this stretch the lining is alternate to the natural rock mass.

P1 b

Id Datum 1646

Chainage From: 50

Chainage To: 70

date 08/06/2011

Damages:

No evident damages for lining structure are detected

P1 b

Id Datum 1647

Chainage From: 70

Chainage To: 80

date 08/06/2011

Damages:

Intrersection with Reciver Tunnel and subsequently with P34 (complitely excavated). P34 is approx. 5 m large and 6 m height and is supported by IPE 400 @ 2m connected by rebars.

P11

P11

Id Datum 1174

Chainage From: 0

Chainage To: 50

date 02/06/2011

Damages:

1 - 2 x 2 path of φ25 Rock bolts installed without anchor steel plate.

P11

Id Datum 1175

Chainage From: 50

Chainage To: 80

date 02/06/2011

Damages:

Evidence of collapsed area in correspondence of the left sidewall up to the crown

2 - support works installed in correspondence of the collapsed area: wire mesh and shotcrete

P11

Id Datum 1176

Chainage From: 80

Chainage To: 100

date 02/06/2011

Damages:

Small rock fall lies on the installed wire mesh

Estimation of RMC III - IV

P11

Id Datum 1177

Chainage From: 120
Chainage To: 150

date 02/06/2011

Damages:

3 - Portal structure: IPE 25 @ 1 m with wire mesh and concrete poured against the rock mass.

P21

P21

Id Datum 1648

Chainage From: 0
Chainage To: 0

date 08/06/2011

Damages:

The inspection starts from tunnel P1 b and move in the west direction. In correspondece of the first stretch the tunnel is supported by concrete lining reinforced with IPE 300 @ 1,5 m.

P21

Id Datum 1649

Chainage From: 0
Chainage To: 10

date 08/06/2011

Damages:

Water inflow detected in the crown protion flowing condition 0,3 l/s

P21

Id Datum 1650

Chainage From: 30
Chainage To: 30

date 08/06/2011

Damages:

The crown lining portion is characterized by cracks associated to water inflow (dripping to flowing condition).

Starting from this stretch the tunnel is supported by 0,4 - 0,5 m of conventional cast in situ reinforced concrete.

P21

Id Datum 1651 **Chainage From:** 30 **Chainage To:** 40 **date** 08/06/2011

Damages:

No evident damages for lining structure are detected

P21

Id Datum 1652 **Chainage From:** 40 **Chainage To:** 55 **date** 08/06/2011

Damages:

Additional support works is carried out. Rock bolts with pattern 1 x 2 has been installed.

P21

Id Datum 1653 **Chainage From:** 55 **Chainage To:** 65 **date** 08/06/2011

Damages:

No evident damages for lining structure are detected

P21

Id Datum 1654 **Chainage From:** 65 **Chainage To:** 65 **date** 08/06/2011

Damages:

Significant water inflow. Flowing condition.

In correspondece of the right side a niche has been carried out.

P21

Id Datum 1655

Chainage From: 65
Chainage To: 70

date 08/06/2011

Damages:

No evident damages for lining structure are detected

P21

Id Datum 1656

Chainage From: 70
Chainage To: 70

date 08/06/2011

Damages:

Starting from this stretch restarts the tunnel supports by 0,4 - 0,5 m of conventional cast in situ reinforced concrete.

P21

Id Datum 1657

Chainage From: 70
Chainage To: 90

date 08/06/2011

Damages:

No evident damages for lining structure are detected

P21

Id Datum 1658

Chainage From: 90
Chainage To: 90

date 08/06/2011

Damages:

Intersection with adit to Power House Penstok. The adit is 4 m large and 6 m height. The tunnel supports by 0,8 - 1 m of conventional cast in situ reinforced concrete.

P21

Id Datum 1659 **Chainage From:** 187 **Chainage To:** 187 **date** 08/06/2011

Damages:

Craks on crown portion and evidences of poor lining workmanship.

The chainage has been taken by indication on sidewall but should be cecked.

P21

Id Datum 1660 **Chainage From:** 242 **Chainage To:** 242 **date** 08/06/2011

Damages:

In correspondece of the left tunnelside is located the adit to the Penstok Chamber. From the Penstock Chamber it is noted that the in correspondece of the unit 6 shaft no evidence of excavation instability is detected. Some waterinflow is present. Elevation 955.

P21

Id Datum 1661 **Chainage From:** 95 **Chainage To:** 210 **date** 08/06/2011

Damages:

The inspection proceed from the previous bifurcation in direction of the Diversion tunnel. The first 120 m of tunnel is 4 m large and 6 m height, the tunnel supported by conventional cast in situ reinforced concrete. After this stretch the excavation is ongoing and only temporary supports are installed.

P22

P22

Id Datum 1596

Chainage From: 0

Chainage To: 20

date 08/06/2011

Damages:

The inspection starts from the operational access in the direction of the power house. The cross section in correspondence of the junction is caracterized by D shape and a span of 6 m lined with 1 m concrete thick renforced with steel ribs ipe 200 @ 1 m connected with rebars.

P22

Id Datum 1597

Chainage From: 20

Chainage To: 70

date 08/06/2011

Damages:

No evident damages for lining structure are detected

P22

Id Datum 1598

Chainage From: 70

Chainage To: 70

date 08/06/2011

Damages:

waterinflow

P22

Id Datum 1599

Chainage From: 72
Chainage To: 72

date 08/06/2011

Damages:

On the left side is ongoing the excavation of a grouting and drainage gallery tunnel. Main dimension 5,4 m span and 5,2 hight.

P23

P23

Id Datum 1628 **Chainage From:** 0 **Chainage To:** 20 **date** 08/06/2011

Damages:

The tunnel inspectionon starts from the intersection with tunnel T8 and proceed in the direction of the Transormer Cavern. The tunnel is 5m large and 6,5m height. The first tunnel stretch (junction secetion) is supported by 0,4 m of concrete reinforced with steel ribs IPE 300 @ 1,5 m connected with rebars fi 20 @

P23

Id Datum 1629 **Chainage From:** 20 **Chainage To:** 20 **date** 08/06/2011

Damages:

Starting from this chainage the lining is conventione renforced concete.

P23

Id Datum 1630 **Chainage From:** 20 **Chainage To:** 40 **date** 08/06/2011

Damages:

No evident damages for lining structure are detected

P23

Id Datum 1631

Chainage From: 40
Chainage To: 40

date 08/06/2011

Damages:

Some concrete detacment is deteceted in correspondece of the crown transversal joint.

P23

Id Datum 1632

Chainage From: 40
Chainage To: 55

date 08/06/2011

Damages:

No evident damages for lining structure are detected

P23

Id Datum 1633

Chainage From: 55
Chainage To: 55

date 08/06/2011

Damages:

Poor lining workmanship evidence in correspondece of the tunnel crown, opening in the range of 50-100 cm.

P23

Id Datum 1634

Chainage From: 55
Chainage To: 70

date 08/06/2011

Damages:

No evident damages for lining structure are detected

P23

Id Datum 1635 **Chainage From:** 70 **Chainage To:** 70 **date** 08/06/2011

Damages:

In correspondece of thi chainage starts a reduction of the tunnel section and a reinforcement with steel ribs IPE 200.

P23

Id Datum 1636 **Chainage From:** 70 **Chainage To:** 130 **date** 08/06/2011

Damages:

The steel ribs installation still persist.

P23

Id Datum 1637 **Chainage From:** 130 **Chainage To:** 130 **date** 08/06/2011

Damages:

Dripping water inflow is detected

P23

Id Datum 1638 **Chainage From:** 130 **Chainage To:** 150 **date** 08/06/2011

Damages:

No evident damages for lining structure are detected

P23

Id Datum 1639

Chainage From: 150
Chainage To: 150

date 08/06/2011

Damages:

On the right tunnel side is located the bifurcation with the Drainage Gallery N°2

P25

P25

Id Datum 1537

Chainage From: 0

Chainage To: 30

date 07/06/2011

Damages:

No evident damages for lining structure are detected

The inspection starts from the bifurcation with the with the tunnel P1 and proceed in the direction of the Powe House area. The lining is composed by cast in situ concrete of 80 - 100 cm thickness. This tunnel will allow for trasnportation of small mechanical equipment of the Prower House and Tranformer Cavern.

P25

Id Datum 1538

Chainage From: 30

Chainage To: 30

date 07/06/2011

Damages:

Poor workmaship of the transversal joint, the rock mass is exposed. The problem affects crown and sidewall.

P25

Id Datum 1539

Chainage From: 30

Chainage To: 50

date 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1540

Chainage From: 50
Chainage To: 70

date 07/06/2011

Damages:

Along this tunnel stretch no permanent concrete lining has been installed, only temporary rock mass supports are installed.

Geology Sandstone RMC II - III main joint spacing 50 -100 cm, persistance > 5 m, dip direction 280° N dip 85°, closed joint with no infilling material dry condition

P25

Id Datum 1541

Chainage From: 70
Chainage To: 70

date 07/06/2011

Damages:

Water inflow in correspondence of the transversal joint on the right side.

P25

Id Datum 1542

Chainage From: 70
Chainage To: 85

date 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1543

Chainage From: 85
Chainage To: 85

date 07/06/2011

Damages:

Junction with the tunnel P1A, this tunnel was foreseen as access at the Diversion Tunnel 1 collapsed area, actually a collapse in correspondence of the junction had jeopardized its function.

P25

Id Datum 1544
Chainage From: 85
Chainage To: 100
date 07/06/2011

Damages:

On the right side of the tunnel no connection between the sidewall lining and the invert has been carried out. In some stretch the portion that is missing is in the ranges of 2 m. From the exposed concrete structure in some cases the absence of steel reinforcement is detected

P25

Id Datum 1545
Chainage From: 100
Chainage To: 110
date 07/06/2011

Damages:

Some small rock mass collapse occurred in correspondece of this section

This stretch has been lined with a portal structure executed after the fisrt lining works.

P25

Id Datum 1546
Chainage From: 100
Chainage To: 120
date 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1547
Chainage From: 120
Chainage To: 135
date 07/06/2011

Damages:

Unlined stretch, only temporary excavation support have been installed, rock bolt pattern 1,5 x 1,5 m wire mesh and shotcrete.

P25

Id Datum 1548

Chainage From: 135
Chainage To: 150

date 07/06/2011

Damages:

Water flows through the transverse joint are detected, between the chainages 140 and 160 bad workmanship of the lining has been recorded.

This stretch the traditional lining has been istalled.

P25

Id Datum 1549

Chainage From: 150
Chainage To: 150

date 07/06/2011

Damages:

On the left side some dripping water inflow is recorded.

In correspondence of this chainage a reinforcement of the lining structure has been carried out. 2 m of additional lining with ipe 300 @ 1 m connected with fi 18 @ 20 cm has been carried out.

P25

Id Datum 1550

Chainage From: 150
Chainage To: 170

date 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1551

Chainage From: 170
Chainage To: 170

date 07/06/2011

Damages:

In correspondece of left side of the contact between the reinforced section and the original lining water inflow has recorded.

P25

Id Datum 1552

Chainage From: 170
Chainage To: 190

date 07/06/2011

Damages:

The lining is missing in correspondence of the spring line on both side.

P25

Id Datum 1553

Chainage From: 190
Chainage To: 190

date 07/06/2011

Damages:

In correspondece of the right side of tunnel curve a poor workmaship of the transversal joint is evident, rock mass is exposed

P25

Id Datum 1554

Chainage From: 190
Chainage To: 200

date 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1555

Chainage From: 200
Chainage To: 230

date 07/06/2011

Damages:

In correspondece of the right side of tunnel curve a poor workmaship of the transversal joint is evident, rock mass is exposed. The opening in correspondece of teh joint is approx. 1 m.

Geology - the rock mass exposed in correspondence of the joint could roughly classified as RMC III -IV

P25

Id Datum 1556

Chainage From: 230
Chainage To: 230

date 07/06/2011

Damages:

In correspondence of this chainage the tunnel crosses the tunnel T8. Along the crossing the siede walls lining at spring level have been rehabilitated with the construction of 1,5 m height and 1 m thick walls.

P25

Id Datum 1557

Chainage From: 230
Chainage To: 235

date 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1558

Chainage From: 235
Chainage To: 235

date 07/06/2011

Damages:

A detachment of concrete lining form the roof has been detected. Some rehabilitation works are needed. The transversal joint presents poor workmaship, poor quality of the concrete

P25

Id Datum 1559

Chainage From: 235
Chainage To: 255

date 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1560

Chainage From: 255
Chainage To: 260

date 07/06/2011

Damages:

Beginning of a tunnel curve stretch, poor workmanship of the transversal joint is evident, rock mass is exposed. The opening in correspondence of the joint is approx. 1 m.

P25

Id Datum 1561

Chainage From: 260
Chainage To: 260

date 07/06/2011

Damages:

In correspondence of this chainage a reinforcement of the lining structure has been carried out. 1 m of additional lining with ipe 300 @ 1,5 m connected with fi 26 @ 20 cm has been carried out.

P25

Id Datum 1562

Chainage From: 270
Chainage To: 270

date 07/06/2011

Damages:

End of a tunnel curve stretch, poor workmanship of the transversal joint is evident, rock mass is exposed. The opening in correspondence of the joint is approx. 1 m. Missing of the connection between the sidewall and the invert

P25

Id Datum 1563

Chainage From: 270
Chainage To: 300

date 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1564 **Chainage From:** 300 **Chainage To:** 320 **date** 07/06/2011

Damages:

Water inflow are recorded in correspondence of the tunnel crown.

Junction with the Transrmer Cavern. Starting from this chainage the cross section is reinforced by ipe 300 connected by rebars.

P25

Id Datum 1565 **Chainage From:** 340 **Chainage To:** 340 **date** 07/06/2011

Damages:

No lining has been installed in correspondece of the left sidewall.

The rock mass exposed is Siltstone.

P25

Id Datum 1566 **Chainage From:** 340 **Chainage To:** 350 **date** 07/06/2011

Damages:

In prossimity of the junction with the Power House the connection between the steel ribs and the invert is missing .

P25

Id Datum 1567 **Chainage From:** 350 **Chainage To:** 380 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1568 **Chainage From:** 380 **Chainage To:** 380 **date** 07/06/2011

Damages:

In correspondece of the left side is located the junction with the tunnel P1-E. This tunnel will be plugged.

P25

Id Datum 1569 **Chainage From:** 380 **Chainage To:** 400 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

P25

Id Datum 1570 **Chainage From:** 400 **Chainage To:** 400 **date** 07/06/2011

Damages:

In correspondence of this chainage the tunnel enters in the in the head race Shaft Chamber.

P25

Id Datum 1571 **Chainage From:** 0 **Chainage To:** 0 **date** 07/06/2011

Damages:

The shaft Chamber is lined. At the time of the inspection the excavation of the penstock are on going. No istallation of steel liing has been accomplished in this location. The bridge crane beam has been installed.

P25

Id Datum 1572

Chainage From: 0

Chainage To: 1

date 07/06/2011

Damages:

The excavation of one of the two penstock is ongoing, almost 15 m have been excavated proceeding from the top to the bottom. The much material is dropped from the provisionale hole loacte in the center of the excavtion. The excavation works supports are composed by rock bolts installed with a pattern 2 x 2 and

P25

Id Datum 1573

Chainage From: 0

Chainage To: 2

date 07/06/2011

Damages:

In correspondece of the nord side of the crowm (west portion) rehabiltation works are ongoing. Some other rehabiltation works involve the bridge crane beam

P3

P3

Id Datum 1621

Chainage From: 0
Chainage To: 0

date 08/06/2011

Damages:

The inspection starts from the junction and proceding in the direction of the Powerhouse.

P3

Id Datum 1622

Chainage From: 0
Chainage To: 1

date 08/06/2011

Damages:

The tunnel is 4 m large and 5 m height. It is concrete lined. The present shape is larger than the final one. It is froseen a final cross section 2,5m large and 3 m height taht will be obtained by filling with concrete.

P3

Id Datum 1623

Chainage From: 0
Chainage To: 3

date 08/06/2011

Damages:

The P3 tunnel stretch located downstream the connection with the adit will not be used after the construction period. It will be filled by muck material and plugged.

P3'

P3'

Id Datum 1181

Chainage From: 695
Chainage To: 680

date 02/06/2011

Damages:

In correspondence of this stretch portal works support are installed - 1: 20 x 20 wire mesh composed by φ 22 and φ 18 with concrete thicness of 50 cm is carried out.

P3'

Id Datum 1182

Chainage From: 680
Chainage To: 680

date 02/06/2011

Damages:

Change of typical cross section - 2: the reinforcement is the same of theprevious stretch, in addition to this final lining is istalled. The workmanship of the tranversal joint between lining strokes is still evident.

P3'

Id Datum 1183

Chainage From: 680
Chainage To: 623

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P3'

Id Datum 1184

Chainage From: 623
Chainage To: 623

date 02/06/2011

Damages:

In correspondence of the transersal joint between lining strokes steel reinforcement is exposed.

P3'

Id Datum 1185

Chainage From: 623
Chainage To: 580

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P3'

Id Datum 1186

Chainage From: 580
Chainage To: 580

date 02/06/2011

Damages:

Tunnel cross section enlargement in correspondence with T37A (tunnel P9)

P3'

Id Datum 1187

Chainage From: 580
Chainage To: 546

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P3'

Id Datum 1188

Chainage From: 546
Chainage To: 450

date 02/06/2011

Damages:

The tunnel cross section is reduced in dimension (check the comment with CIT records). It has to be noted the recovering works accomplished in corrspondence of the tranvesal joint.

P3'

Id Datum 1189

Chainage From: 450
Chainage To: 400

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P3'

Id Datum 1190

Chainage From: 400
Chainage To: 400

date 02/06/2011

Damages:

On theleft side of the tunnel a niche is present.

P3'

Id Datum 1191

Chainage From: 400
Chainage To: 330

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P3'

Id Datum 1192

Chainage From: 330
Chainage To: 330

date 02/06/2011

Damages:

Poor workmanship of transersal linin joint is detedcted

P3'

Id Datum 1193

Chainage From: 330
Chainage To: 220

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P3'

Id Datum 1194

Chainage From: 220
Chainage To: 220

date 02/06/2011

Damages:

Strating from this chainage up to ch 0 the final lining has not put in place

P3'

Id Datum 1195

Chainage From: 220
Chainage To: 200

date 02/06/2011

Damages:

2 - Stell ribs IPE 300 @ 1 m connected by a steel reinforcement net 20 x 20 cm of φ 18. The concrete is poured between this structure and the rock mass. No formorks is used.

P3'

Id Datum 1196

Chainage From: 200
Chainage To: 200

date 02/06/2011

Damages:

Junction with tunnel T37A

P3'

Id Datum 1197

Chainage From: 200
Chainage To: 125

date 02/06/2011

Damages:

The liningalong this tretch seems to be constituted by only concrete. If steel reinfornement is present is in a very low amount. Check with the as buit drawings

P3'

Id Datum 1198

Chainage From: 125
Chainage To: 120

date 02/06/2011

Damages:

On the right sidewall the lining has collapsed in corespondence of the transersal joint between two strokes

P3'

Id Datum 1199

Chainage From: 120
Chainage To: 90

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P3'

Id Datum 1200

Chainage From: 90
Chainage To: 50

date 02/06/2011

Damages:

On the left sidewaal of the tunnel up to the crown rock bolts are installed; pattern 2 x 2 m φ 20

P3'

Id Datum 1201

Chainage From: 50
Chainage To: 30

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P3'

Id Datum 1202

Chainage From: 30
Chainage To: 0

date 02/06/2011

Damages:

The works supports is composed by stell ribs IPE 300 connected by a steel reinforcement net 25 x 25 cm of φ 20. The concrete is poured between this structure and the rock mass. No formorks is used.

P30

P30

Id Datum 1642

Chainage From: 0
Chainage To: 40

date 08/06/2011

Damages:

In correspondence of intersection with tunnel P1 b, the invert basment of the steel ribs is missing. The P1 b tunnel stretch that strating from this intersection proceed in west direction has been plugged.

The tunel inspection strats from P23 and movin in the direction of the Power House. The tunnel is 5 m large and 6,5 m height and in correspondece of teh junction section is supported by IPE 400 @ 2m.

P9

P9

Id Datum 1171

Chainage From: 0
Chainage To: 200

date 02/06/2011

Damages:

No evident damages for lining structure are detected

On the map this tunnel is named as P11 but Mr Gafur informs that the right name of this tunnel is P9. 1 - Steel ribs IPE 200 @ 1m transversally connected by wire 20 x 20 cm mesh φ 18 and φ 16. The concrete is poured between steel ribs and rock mass without the use of formworks.

P9

Id Datum 1172

Chainage From: 200
Chainage To: 450

date 02/06/2011

Damages:

No evident damages for lining structure are detected

P9

Id Datum 1173

Chainage From: 450
Chainage To: 450

date 02/06/2011

Damages:

This tunnel stretch is not lined

The supports works consists in 2 x 2 m pattern of rock bolts installation with thin layer of shotcrete (less than 5 cm). The exposed rock is siltstone. RMC is estimated to be ranging between Class II and III

Power House

Power House

Id Datum 1337

Chainage From: 1
Chainage To: 1

date 04/06/2011

Damages:

The inspection starts from the west side of the cavern. The present elevation reached with the excavation is 964 m. Presently side supports works are on going. Mainly this works concerns in the installation of new anchor bolts and tendons.

Power House

Id Datum 1338

Chainage From: 1
Chainage To: 1

date 04/06/2011

Damages:

Geology- In correspondence of the bus duct gallery n° 6 the rock mass is exposed. Siltstone with ucs 10 -20 Mpa highly jointed with evidences of slickensid surface in correspondence of the joint. Dip direction 160° N dip 70°

Power House

Id Datum 1339

Chainage From: 1
Chainage To: 1

date 04/06/2011

Damages:

The tendons installed are 25 m long 7 strand type with a ultimate load capacity of 131 t. The work load condition is 86 ton.

Power House

Id Datum 1340

Chainage From: 1
Chainage To: 1

date 04/06/2011

Damages:

In correspondence of west side wall a fissure on the lining cross the wall starting from elevation 986 down to 964. This wall is supported by a pattern of 2 x 2 m anchor bolts. Details are reported in the as built drawings

Power House

Id Datum 1341

Chainage From: 2
Chainage To: 2

date 04/06/2011

Damages:

South sidewall - Starting from the west side up to the unit 5 location (silt stone stretch) the works supports are composed by a pattern of 2 x 2 m of 12 m long of passive rock bolt. Detail is reported on the as built drawing. The effectiveness of the old support has been assessed indicating their negligeble contribute in

Power House

Id Datum 1342

Chainage From: 2
Chainage To: 2

date 04/06/2011

Damages:

In correspondence of the pedestrian tunnel some collapse of the tunnel crown is evident. Photo

Power House

Id Datum 1343

Chainage From: 2
Chainage To: 2

date 04/06/2011

Damages:

A geophysics survey activity is on going in correspondence of the crown of the Cavern. The study has the task to asses the effectiveness of the rock bolt support in correspondence to the crown. The present installed supports are φ 36 mm passive 8 m long anchor bolts with a pattern 2 x 2 m.

Power House

Id Datum 1344

Chainage From: 2
Chainage To: 2

date 04/06/2011

Damages:

The power house span is approximately 25 m. The lining of the crown has been carried out by segments cast in situ that had followed the excavation phase. The length of each segment measured in the longitudinal direction is approx. 5 m. The transversal section of the whole crown is obtained by aggregating

Power House

Id Datum 1345

Chainage From: 2
Chainage To: 2

date 04/06/2011

Damages:

The power house is presently equipped with 1 crane beam with a capacity of 160 ton. In the 2 phase of the project 2 crane beam of 550 ton capacity each will be installed.

Power House

Id Datum 1346

Chainage From: 2
Chainage To: 2

date 04/06/2011

Damages:

Inspected the bas duct gallery of the unit n° 5. The excavation has been accomplished for almost 20 m. Some water inflow is detected in correspondence of the crown in the area closest to the power house. The support works installed are composed by concrete poured against the rock mass reinforced with steel ribs

Power House

Id Datum 1347

Chainage From: 2
Chainage To: 2

date 04/06/2011

Damages:

Bus duct unit n 4. Geology - In correspondence of the Bus duct gallery n° 5 there evidences of the transition between the siltstone formation and the sandstone one. The contact zone seems to be not heavy alterated. Some water inflow is detected. RMC II-III for Sandstone; RMC III for siltstone.

Power House

Id Datum 1348 **Chainage From:** 2 **Chainage To:** 2 **date** 04/06/2011

Damages:

Bus duct unit n° 3. Geology - Sandstone with joint trend similar to those recorded for the unit 6 (Dip direction 160° N dip 70°). RMC II joint spacing 30-50 cm persistency 8-10 m, joint closed. Recorded some thin layers of degradated rock mass

Power House

Id Datum 1349 **Chainage From:** 2 **Chainage To:** 2 **date** 04/06/2011

Damages:

Bus duct unit n° 2. This bus duct gallery is presently plugged. It seems that this is the condition in wich the bus ducts were left at time of the soviet works in order to protect the cave stability against the potential damaged due to the blasting oeration related to the other bus duct excavations. The excavtio will be

Power House

Id Datum 1350 **Chainage From:** 2 **Chainage To:** 2 **date** 04/06/2011

Damages:

Bus duct unit 1. The gallery has been excavtated during the soviet time, as of today no furter intervention has been carried out. The support works are constituted by steel ribs @ 1,5 m and wire mesh 20 x 20 cm φ 20 mm. Some shotcrete has been applied. Some inward displacement of the sidewall has been recorded.

Power House

Id Datum 1351 **Chainage From:** 3 **Chainage To:** 3 **date** 04/06/2011

Damages:

Assembly Bay. The Power House sector in correspondece of this area is almost completed. The civil concrete structure relevant to the workshop has been accomplished. In correspondence of this cavern portion no rock bolts intallation in correspondece of the crown has been accomplished.

Power House

Id Datum 1352 **Chainage From:** 3 **Chainage To:** 3 **date** 04/06/2011

Damages:

In correspondece of this location it is possible to appreciate the detail relevant to the crane beam supporting colunm. The colunm is caracterized by a 1 x 1 m square section with 10 φ 26 rebars. The distance between the colunm is almost 10 m.

Power House

Id Datum 1353 **Chainage From:** 4 **Chainage To:** 4 **date** 04/06/2011

Damages:

North Wall. The inspection is accomplished starting from the assembly bay and moving toward west direction. All along the sidewall scaffholding have been installed and operation of support works integration are on going. In fact the effectiveness of the old support has been assessed indicating their negligeble

Power House

Id Datum 1354 **Chainage From:** 4 **Chainage To:** 4 **date** 04/06/2011

Damages:

North Wall. On the upper part of the crane bridge beam installation of tendons and passive anchor bolts are on going. Details are provided on the as buit drawings.

Power House

Id Datum 1355 **Chainage From:** 4 **Chainage To:** 4 **date** 04/06/2011

Damages:

North wall. Along the sidewall niches are excavted. This works will constitute the passage connecting the different power house floor.

Power House

Id Datum 1356

Chainage From: 4

Chainage To: 4

date 04/06/2011

Damages:

North wall. The evidences of the high amount of sidewall convergence is evident in correspondence of the unit 5 and 6. Evidences of craks loacted in correspondence of the crane beam and on the sidewall are clearly shown.

Saline Gallery

Saline Gallery

Id Datum 1426

Chainage From: 0
Chainage To: 30

date 06/06/2011

Damages:

The steel lining thickness is approx. 10 mm the internal diameter is 5,70 m.

Saline Gallery

Id Datum 1427

Chainage From: 0
Chainage To: 260

date 06/06/2011

Damages:

In the lower part of the gallery are located drill holes to monitoring the status of the salt dome

Saline Gallery

Id Datum 1428

Chainage From: 30
Chainage To: 30

date 06/06/2011

Damages:

Starting from this chainage an additional internal concrete lining of 1 m thick is added inside the steel lining.
The reinforcement of the internal concrete lining is composed by external and internal reinforcement;
internal: fi 40 mm @ 20 cm in radial direction and fi 20 mm @ 50 in longitudinal direction. External fi 32 mm

Saline Gallery

Id Datum 1429

Chainage From: 30

Chainage To: 200

date 06/06/2011

Damages:

No evident damages for lining structure are detected

Saline Gallery

Id Datum 1430

Chainage From: 200

Chainage To: 215

date 06/06/2011

Damages:

Transversal joint poor workmanship, reinforced rebar exposed. Rehabilitation works are needed.

In correspondence of this chainage the gallery cross a fault zone.

Saline Gallery

Id Datum 1431

Chainage From: 215

Chainage To: 230

date 06/06/2011

Damages:

No evident damages for lining structure are detected

Saline Gallery

Id Datum 1432

Chainage From: 230

Chainage To: 230

date 06/06/2011

Damages:

Sign of degradation on right sidewall

Saline Gallery

Id Datum 1433

Chainage From: 230
Chainage To: 240

date 06/06/2011

Damages:

No evident damages for lining structure are detected

Saline Gallery

Id Datum 1434

Chainage From: 240
Chainage To: 240

date 06/06/2011

Damages:

Poor workmanship in correspondence of the sidewall, honeycomb and concrete detachment.

Saline Gallery

Id Datum 1435

Chainage From: 240
Chainage To: 260

date 06/06/2011

Damages:

No evident damages for lining structure are detected

Saline Gallery

Id Datum 1436

Chainage From: 260
Chainage To: 260

date 06/06/2011

Damages:

End of the gallery

ST1

ST1

Id Datum 1248

Chainage From: 811
Chainage To: 811

date 03/06/2011

Damages:

We reach this chainage in order to meet site instrumentation department personnel since at this chainage is installed one of the two monitoring stations foreseen in order to monitor the stress in the lining structure, the rock mass deformation and the water pressure at the interface between the lining and the rock mass.

ST1

Id Datum 1249

Chainage From: 819
Chainage To: 819

date 03/06/2011

Damages:

At this chainage is installed the second of the two monitoring stations foreseen in order to monitor the stress in the lining structure, the rock mass deformation and the water pressure at the interface between the lining and the rock mass.

ST1

Id Datum 1250

Chainage From: 770
Chainage To: 770

date 03/06/2011

Damages:

In correspondence of this chainage starts a transition stretch where original the cross section of the tunnel (straight sidewall horse shaped) changes in a sloped sidewall horse shaped section; detail of this new section is reported in the as built drawings. Mainly section thickness as well as the steel reinforcement

ST1

Id Datum 1251

Chainage From: 770

Chainage To: 850

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST1

Id Datum 1252

Chainage From: 850

Chainage To: 850

date 03/06/2011

Damages:

In correspondence of this chainage a scaffolding is installed where drilling works relevant to drain installation are on going.

ST1

Id Datum 1253

Chainage From: 850

Chainage To: 865

date 03/06/2011

Damages:

ST1

Id Datum 1254

Chainage From: 865

Chainage To: 865

date 03/06/2011

Damages:

In correspondence of this chainage ends the rehabilitation works accomplished in the collapsed area.

ST1

Id Datum 1260

Chainage From: 770
Chainage To: 770

date 03/06/2011

Damages:

No evident damages for lining structure are detected

The inspection restarts from this chainage moving in the direction of the intake.

ST1

Id Datum 1261

Chainage From: 770
Chainage To: 680

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST1

Id Datum 1262

Chainage From: 680
Chainage To: 680

date 03/06/2011

Damages:

On the left side junction with the draft tube tunnel excavation. The works are on going. Geology: sandstone RMC II-III. Joint: dip direction 110 dip 70 spacing 50-60 cm with persistence 5-8 m damp condition.

ST1

Id Datum 1263

Chainage From: 680
Chainage To: 640

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST1

Id Datum 1264

Chainage From: 640
Chainage To: 620

date 03/06/2011

Damages:

Intersection with the temporary connection between ST1 and ST2

ST1

Id Datum 1265

Chainage From: 620
Chainage To: 590

date 03/06/2011

Damages:

Water inflow in correspondence of the crown - damp conditions

The tunnel stretch between the junction and the gate chamber the tunnel cross section reduces its dimension. The invert slope increase in direction of the gate

ST1

Id Datum 1266

Chainage From: 590
Chainage To: 470

date 03/06/2011

Damages:

Along this tunnel stretch the invert and sidewall of concrete lining are lined with steel lining. On the sidewall the steel lining reach 5 m.

ST1

Id Datum 1267

Chainage From: 470
Chainage To: 470

date 03/06/2011

Damages:

The section change its cross section shape and a step is present in the invert.

ST1

Id Datum 1268

Chainage From: 470
Chainage To: 445

date 03/06/2011

Damages:

A shaft ventilation is located in correspondence of the crown, just downstream of the gates. Diameter of the shaft 2m.

ST1

Id Datum 1269

Chainage From: 435
Chainage To: 435

date 03/06/2011

Damages:

Gates location

ST1

Id Datum 1270

Chainage From: 435
Chainage To: 300

date 03/06/2011

Damages:

Square tunnel cross section. The internal section are fully lined with a double steel layer.

ST1

Id Datum 1271

Chainage From: 300
Chainage To: 70

date 03/06/2011

Damages:

Assessment of the contact and consolidation grouting works have to be accomplished, some water inflow have been recorded.

The lining does not shows evidence of load overstress. The construction joints are almost dry and carried out with good workmanship

ST1

Id Datum 1272

Chainage From: 70
Chainage To: 70

date 03/06/2011

Damages:

Some minor water inflow are recorded in correspondence of the grouting holes.

Short relief drainage are foreseen after the completion of the grouting campaign

ST1

Id Datum 1273

Chainage From: 70
Chainage To: 0

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST1

Id Datum 1326

Chainage From: 1340
Chainage To: 1340

date 03/06/2011

Damages:

Starting from the outlet section the first 5 crown segment are installed without the sidewall lining and are not reinforced. Rehabilitation works are foreseen in order to remove the old lining and to replace it with a new one

The inspection of this tunnel stretch starts from the outlet structure proceeding upstream

ST1

Id Datum 1327

Chainage From: 1340
Chainage To: 1300

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST1

Id Datum 1328

Chainage From: 1300
Chainage To: 1300

date 03/06/2011

Damages:

Junction

ST1

Id Datum 1329

Chainage From: 1300
Chainage To: 1232

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST1

Id Datum 1330

Chainage From: 1232
Chainage To: 1215

date 03/06/2011

Damages:

Along this stretch longitudinal cracks in correspondence of the crown is detected. Assessment of the lining effectiveness is requested.

ST1

Id Datum 1331

Chainage From: 1215
Chainage To: 1215

date 03/06/2011

Damages:

In correspondence of this section some rock mass is exposed

Geology. Rock mass exposed Sandstone RMC II-III

ST1

Id Datum 1332

Chainage From: 1190

Chainage To: 1100

date 03/06/2011

Damages:

The sidewall of the tunnel is not lined. The lining installed in correspondence of the crown shows variable steel reinforcement quantity.

The works in this section will proceed with the excavation in correspondence of the sidewall and the pouring of the sidewall and invert lining.

ST1

Id Datum 1333

Chainage From: 1100

Chainage To: 1092

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST1

Id Datum 1334

Chainage From: 1092

Chainage To: 1092

date 03/06/2011

Damages:

In correspondence of this stretch a segment is not installed, this fact allow to understand. The procedure consists in excavtion of the crown portion of the tunnel, installation of the temporary works supports (rock bolts and shotcrete) pouring of the crown lining. Second stage of excavation of the sidewall and invert.

ST1

Id Datum 1335

Chainage From: 1092

Chainage To: 1060

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST1

Id Datum 1336

Chainage From: 1060
Chainage To: 1060

date 03/06/2011

Damages:

Plug

ST2

ST2

Id Datum 1274

Chainage From: 878
Chainage To: 878

date 03/06/2011

Damages:

On the upper left side of the plug some water inflow is recorded.

The tunnel inspection starts from the provisional plug executed in correspondence of the tunnel stretch that cross the Vaksh river.

ST2

Id Datum 1275

Chainage From: 878
Chainage To: 840

date 03/06/2011

Damages:

No evident damages for lining structure are detected. Some minor works of removal of deposit from bottom level of the tunnel is foreseen.

ST2

Id Datum 1276

Chainage From: 840
Chainage To: 840

date 03/06/2011

Damages:

Left side of the tunnel - poor workmanship of the transversal joint between segment.

Some grouting works have been executed.

ST2

Id Datum 1277 **Chainage From:** 840 **Chainage To:** 780 **date** 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1278 **Chainage From:** 780 **Chainage To:** 780 **date** 03/06/2011

Damages:

Water inflow in correspondence of left side of the tunnel.

ST2

Id Datum 1279 **Chainage From:** 770 **Chainage To:** 770 **date** 03/06/2011

Damages:

Water inflow through the grouting holes - dripping.

ST2

Id Datum 1280 **Chainage From:** 770 **Chainage To:** 745 **date** 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1281

Chainage From: 745
Chainage To: 730

date 03/06/2011

Damages:

Water inflow are recorded in correspondence of the whole transversal joint between the segments.

ST2

Id Datum 1282

Chainage From: 730
Chainage To: 690

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1283

Chainage From: 690
Chainage To: 650

date 03/06/2011

Damages:

Water inflow are recorded in correspondence of the whole transversal joint between the segments.

ST2

Id Datum 1284

Chainage From: 650
Chainage To: 600

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1285

Chainage From: 600
Chainage To: 600

date 03/06/2011

Damages:

Water inflow in correspondence of the ventilation shaft

Junction with the connection with the Draft tube tunnel

ST2

Id Datum 1286

Chainage From: 595
Chainage To: 595

date 03/06/2011

Damages:

in correspondence of the junction section the transversal joint have to be rehabilitated

ST2

Id Datum 1287

Chainage From: 595
Chainage To: 575

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1288

Chainage From: 575
Chainage To: 575

date 03/06/2011

Damages:

Left side sidewall joint shows exposed steel reinforcement.

ST2

Id Datum 1289

Chainage From: 575
Chainage To: 550

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1290

Chainage From: 550
Chainage To: 480

date 03/06/2011

Damages:

Starting from chainage 550 on the lining crown a wide fissure is detected. The nature of the fissure indicates the reaching of the bending capability of the lining structure.

Detail of the visual survey of that cracks is recoded in a manual sketch. It is deemed that some assessment of the lining effectiveness of the lining section along this stretch have to be carried out

ST2

Id Datum 1291

Chainage From: 480
Chainage To: 435

date 03/06/2011

Damages:

The damages to the lining structure (collapsed area) involve, along this stretch, mainly half left section of the crown section. On the right side rock bolts φ 25 with pattern 1 x1 m are installed

Detail of the visual survey of that cracks is recoded in a manual sketch. It is deemed that some assessment of the lining effectiveness of the lining section along this stretch have to be carried out

ST2

Id Datum 1292

Chainage From: 435
Chainage To: 325

date 03/06/2011

Damages:

The fissure system present in the crown continues all along this stretch. The nature of the fissure indicates the reaching of the bending capability of the lining structure. In correspondence of the chainage 325 on sidewall reinforcement steel bar are exposed

Detail of the visual survey of that cracks is recoded in a manual sketch. It is deemed that some assessment of the lining effectiveness of the lining section along this stretch have to be carried out

ST2

Id Datum 1293

Chainage From: 325
Chainage To: 246

date 03/06/2011

Damages:

Gates structure location

ST2

Id Datum 1294

Chainage From: 246
Chainage To: 246

date 03/06/2011

Damages:

In correspondence of this chainage and the steel lining section of the tunnel

ST2

Id Datum 1295

Chainage From: 246
Chainage To: 220

date 03/06/2011

Damages:

No evidences of lining overstressing are detected. Some water inflow in correspondence of the transversal joint are recorded.

Photo - water inflow

ST2

Id Datum 1296

Chainage From: 220
Chainage To: 180

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1297

Chainage From: 180
Chainage To: 180

date 03/06/2011

Damages:

Water inflow is detected on the left sidewall from a drill hole.

ST2

Id Datum 1298

Chainage From: 180
Chainage To: 120

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1299

Chainage From: 120
Chainage To: 120

date 03/06/2011

Damages:

Water inflow is detected on the left sidewall from a drill hole.

ST2

Id Datum 1300

Chainage From: 120
Chainage To: 85

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1301 **Chainage From:** 85 **Chainage To:** 85 **date** 03/06/2011

Damages:

Water inflow is detected on the left sidewall from a drill hole.

ST2

Id Datum 1302 **Chainage From:** 85 **Chainage To:** 0 **date** 03/06/2011

Damages:

Along the portal section evidences of water inflow are recorded - damp

ST2

Id Datum 1303 **Chainage From:** 1364 **Chainage To:** 1364 **date** 03/06/2011

Damages:

The tunnel stretch downstream of the vakhsh river is inspected starting from the outlet up to the plug located in correspondence of the river

ST2

Id Datum 1304 **Chainage From:** 1364 **Chainage To:** 1350 **date** 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1305

Chainage From: 1350
Chainage To: 1345

date 03/06/2011

Damages:

On the crown section steel reinforcement is exposed. On the left side the joint between crown e sidewall has not been carried out where water inflow is also recorded.

ST2

Id Datum 1306

Chainage From: 1345
Chainage To: 1310

date 03/06/2011

Damages:

Some transversal fissure are detected in correspondence of the crown. Sign of calcium deposit are evident. Details relevant to visual survey of such cracks are provided in the sketch.

ST2

Id Datum 1307

Chainage From: 1310
Chainage To: 1300

date 03/06/2011

Damages:

Along this tunnel section some additional support are carried out. Anchor bolts and wire mesh is installed. The thickness of the shotcrete is sometime not enough to cover properly the wire mesh.

Anchor φ 25 bots with pattern 1 x1 m are installed on the crown portion of the lining.

ST2

Id Datum 1308

Chainage From: 1290
Chainage To: 1290

date 03/06/2011

Damages:

On the crown steel ribs ipe 300 installed @ 1 m have been installed.

ST2

Id Datum 1309 **Chainage From:** 1290 **Chainage To:** 1250 **date** 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1310 **Chainage From:** 1250 **Chainage To:** 1250 **date** 03/06/2011

Damages:

Junction with the Down stream Gate chamber

ST2

Id Datum 1311 **Chainage From:** 1250 **Chainage To:** 1235 **date** 03/06/2011

Damages:

No evident damages for lining structure are detected

Along this tunnel stretch rehabilitation works of the transversal joint is on going.

ST2

Id Datum 1312 **Chainage From:** 1235 **Chainage To:** 1235 **date** 03/06/2011

Damages:

On the right side of the crown lining some supports works have been installed, reduced thickness of shotcrete is detected.

Along this tunnel stretch rehabilitation works of the transversal joint is on going.

ST2

Id Datum 1313

Chainage From: 1235
Chainage To: 1180

date 03/06/2011

Damages:

No evident damages for lining structure are detected

Along this tunnel stretch rehabilitation works of the transversal joint is on going.

ST2

Id Datum 1314

Chainage From: 1180
Chainage To: 1180

date 03/06/2011

Damages:

In correspondence of the crown detachment of the lining concrete, steel reinforcement exposed

ST2

Id Datum 1315

Chainage From: 1180
Chainage To: 1160

date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1316

Chainage From: 1160
Chainage To: 1145

date 03/06/2011

Damages:

On the right side of the lining a rehabilitated portion of the lining is detected starting from the sidewall up to the middle of the crown

Along this stretch the matter related to the transversal joint poor workmanship had already been faced during the first stage works.

ST2

Id Datum 1317 **Chainage From:** 1145 **Chainage To:** 1120 **date** 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1318 **Chainage From:** 1120 **Chainage To:** 1110 **date** 03/06/2011

Damages:

Water inflow in correspondence of the transversal joint between two segment

ST2

Id Datum 1319 **Chainage From:** 1120 **Chainage To:** 1080 **date** 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1320 **Chainage From:** 1080 **Chainage To:** 1075 **date** 03/06/2011

Damages:

The joint between invert and sidewall has been partially rehabilitated. 1,5 m of invert section has been re-constructed.

The transversal joint between the segments is systematic.

ST2

Id Datum 1321
Chainage From: 1075
Chainage To: 1050
date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1322
Chainage From: 1050
Chainage To: 1050
date 03/06/2011

Damages:

Water inflow in correspondence of the transversal joint on the left side of the lining

ST2

Id Datum 1323
Chainage From: 1050
Chainage To: 1040
date 03/06/2011

Damages:

In correspondence of the crown a fissure is detected. Some detachment of concurred lining is also detected.

ST2

Id Datum 1324
Chainage From: 1040
Chainage To: 994
date 03/06/2011

Damages:

No evident damages for lining structure are detected

ST2

Id Datum 1325

Chainage From: 994

Chainage To: 994

date 03/06/2011

Damages:

Plug section

The plug has been treated with grouting injection. Water inflow is detected on the right side of the plug where a portion of rock mass is exposed.

T2

T2

Id Datum 1465

Chainage From: 0
Chainage To: 0

date 07/06/2011

Damages:

The inspection starts from the intake portal movin in the direction of the T4 (access to Power House). The tunnel is a temporary tunnel.

T2

Id Datum 1466

Chainage From: 1
Chainage To: 1

date 07/06/2011

Damages:

The inatke portal is constituted by 10 m of lining that shows some bad concrete pouring workmaship. Detachments of concrete lining are detected in the crown in correspondence teh two first lining blocks

T2

Id Datum 1467

Chainage From: 40
Chainage To: 50

date 07/06/2011

Damages:

Waterinflows through the transversal joint are detected

T2

Id Datum 1468

Chainage From: 60
Chainage To: 60

date 07/06/2011

Damages:

Adit for Geological inspection - Dip direction 30° N dip 80-85°. Sandstone with interbedding of Siltstone. RMC Sandstone II-III Joint spacing 50 - 100 cm persistance > 5 m, closed joint no infilling dry condition. RMC Siltstone III - IV joint spacing 20-30 cm persitance 1 -2 m joint slightly open 0,3 mm, waterinflow

T2

Id Datum 1469

Chainage From: 105
Chainage To: 110

date 07/06/2011

Damages:

Bad workmanship of the right sidewall joint.

in the tunnel there is installed a ventilation system

T2

Id Datum 1470

Chainage From: 115
Chainage To: 120

date 07/06/2011

Damages:

Water inflow (damp condition) on the right side in correspondence of the joint

T2

Id Datum 1471

Chainage From: 120
Chainage To: 120

date 07/06/2011

Damages:

poor workmanship in correspondence orf the connection between the sping line and sidewall on right side

T2

Id Datum 1472 **Chainage From:** 120 **Chainage To:** 130 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1473 **Chainage From:** 130 **Chainage To:** 130 **date** 07/06/2011

Damages:

Bad workmanship in the reparation works of the horizzontal joint between the sping line and the left sidewall.

T2

Id Datum 1474 **Chainage From:** 130 **Chainage To:** 160 **date** 07/06/2011

Damages:

In correspondence of the joint section poor workmanship of the crown transversal joint.

Junction with the Saline gallery

T2

Id Datum 1475 **Chainage From:** 160 **Chainage To:** 175 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1476 **Chainage From:** 175 **Chainage To:** 175 **date** 07/06/2011

Damages:

Tranversal joint bad workmanship in corresponence of crown

T2

Id Datum 1477 **Chainage From:** 175 **Chainage To:** 190 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1478 **Chainage From:** 190 **Chainage To:** 190 **date** 07/06/2011

Damages:

Junction with a tunnel that not reported in the map. Tunnel cross section caracterized by a oval shape with 4 m span and concrete reinforced lining thickness of 50 -80 cm.

T2

Id Datum 1479 **Chainage From:** 190 **Chainage To:** 210 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1480 **Chainage From:** 210 **Chainage To:** 210 **date** 07/06/2011

Damages:

Poor workmanship in correspondence orf the connection between the sping line and sidewall on right side

T2

Id Datum 1481 **Chainage From:** 210 **Chainage To:** 235 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1482 **Chainage From:** 235 **Chainage To:** 235 **date** 07/06/2011

Damages:

Lining stroke poor workmanship; in correspondence of the lining joint there are no evidences of steel reinforcement presence.

T2

Id Datum 1483 **Chainage From:** 235 **Chainage To:** 240 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1484

Chainage From: 240
Chainage To: 240

date 07/06/2011

Damages:

The lining is missing in correspondence of the spring line.

On the left side in correspondence of the invert a shaft has been excavted with investigantipon purpose.

T2

Id Datum 1485

Chainage From: 240
Chainage To: 255

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1486

Chainage From: 255
Chainage To: 270

date 07/06/2011

Damages:

poor workmanship in correspondence orf the connection between the sping line and sidewall on left side. The concrete thickness is somewere reduced and not uniform as a consequance of the poor excavation quality At ch 270 poor workmanship of the transversal joint

T2

Id Datum 1487

Chainage From: 270
Chainage To: 280

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1488 **Chainage From:** 280 **Chainage To:** 285 **date** 07/06/2011

Damages:

In correspondence of the reduced thickness of the corown lining the rock mass is exposed.

T2

Id Datum 1489 **Chainage From:** 285 **Chainage To:** 290 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1490 **Chainage From:** 290 **Chainage To:** 290 **date** 07/06/2011

Damages:

Junction with tunnel T8

T2

Id Datum 1491 **Chainage From:** 290 **Chainage To:** 350 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1492

Chainage From: 350

Chainage To: 365

date 07/06/2011

Damages:

In correspondence of this chainages an reinforcement of the existing lining has been carried out. The reinforcement is composed by steel ribs ipe 300 @ 1,5 m connected by rebars fi 36 @ 30 cm. The thicness of the additional lining is approx. 1 m.

T2

Id Datum 1493

Chainage From: 365

Chainage To: 370

date 07/06/2011

Damages:

In correspondece of this chainage 3 tendons are installed @ 3 m.

T2

Id Datum 1494

Chainage From: 370

Chainage To: 400

date 07/06/2011

Damages:

In correspondence of this stretch some grouting works has been carried out

On the left side an additional lining layer of 20 -25 cm thick has been added

T2

Id Datum 1495

Chainage From: 400

Chainage To: 400

date 07/06/2011

Damages:

Junction with tunnel P19 that allow for Transofrmer Cavern access.

T2

Id Datum 1496

Chainage From: 400

Chainage To: 420

date 07/06/2011

Damages:

End of the additional lining reinforcement

T2

Id Datum 1497

Chainage From: 420

Chainage To: 420

date 07/06/2011

Damages:

Degaradation evidences on the crown portion.

In correspondece of the left tunnel sidewall a pillar concrete structure has been carried out in order to reinforce the existing lining. The thickness of this structure is of approx. 2 m in correspondece of the invert; and decrese with the elevation accordingto the tunnel original profile since the inner face of the structure is

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T2

Id Datum 1498

Chainage From: 420

Chainage To: 445

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1499

Chainage From: 445

Chainage To: 480

date 07/06/2011

Damages:

In correspondence of this chainages an reinforcement of the existing lining has been carried out. The reinforcement is composed by steel ribs ipe 300-400 @ 1,5 m connected by rebars. The thicness of the additional lining is approx. 0,6 m

T2

Id Datum 1500

Chainage From: 480

Chainage To: 500

date 07/06/2011

Damages:

On the left side lining is missing in correspondece of the spring line

T2

Id Datum 1501

Chainage From: 500

Chainage To: 510

date 07/06/2011

Damages:

In correspondence of this chainages an reinforcement of the existing lining has been carried out. The reinforcement is composed by steel ribs ipe 300-400 @ 1,5 m connected by rebars. The thicness of the additional lining is approx. 0,6 m. In correspondence of the left sidewall tendons @ 3 m are installed

T2

Id Datum 1502

Chainage From: 510

Chainage To: 530

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1503

Chainage From: 530

Chainage To: 550

date 07/06/2011

Damages:

The joint between the sidewall and the sping line is missing.

T2

Id Datum 1504

Chainage From: 550
Chainage To: 560

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T2

Id Datum 1505

Chainage From: 560
Chainage To: 610

date 07/06/2011

Damages:

In correspondence of this section there is a narrowing (1 m from both side) of the excavation section, the tunnel cross section change from circular shape to d shape.

T2

Id Datum 1506

Chainage From: 610
Chainage To: 655

date 07/06/2011

Damages:

The joint between the sidewall and the sping line is missing on both sidewall.

T2

Id Datum 1507

Chainage From: 655
Chainage To: 690

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T3

T3

Id Datum 1072

Chainage From: 0
Chainage To: 75

date 02/06/2011

Damages:

Concrete Honey Comb, deterioration of the concrete lining, exposure of the reinforcement bars in correspondence of the stroke joints, presence of some cold joint within the single segment

On the left side of the tunnel there is a ventilation tunnel that runs parallel to the T3 for a total length of aprox 500. All along the tunnel the ventilation works naturally. 1 - The ventilation tunnel is lined by concrete the cavity appear stable; detail are reported on as built drawings

T3

Id Datum 1073

Chainage From: 75
Chainage To: 75

date 02/06/2011

Damages:

in addition to the above rock mass is exposed in correspondence of the crown?

T3

Id Datum 1074

Chainage From: 75
Chainage To: 190

date 02/06/2011

Damages:

Concrete Honey Comb, deterioration of the concrete lining, exposure of the reinforcement bars in correspondence of the stroke joints, presence of some cold joint within the single segment

T3

Id Datum 1075 **Chainage From:** 130 **Chainage To:** 130 **date** 02/06/2011

Damages:

On the left sidewall there is a adit to the ventilation tunnel

T3

Id Datum 1076 **Chainage From:** 190 **Chainage To:** 200 **date** 02/06/2011

Damages:

Concrete lining missing or collapse in correspondence of roof

T3

Id Datum 1077 **Chainage From:** 200 **Chainage To:** 250 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1078 **Chainage From:** 250 **Chainage To:** 250 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

in correspondence of this chainage there is a change of the lining cross section. The support works is increased. This is due to the junction wit tunnel T7

T3

Id Datum 1079

Chainage From: 250
Chainage To: 315

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1080

Chainage From: 315
Chainage To: 315

date 02/06/2011

Damages:

The lining is missing in correspondence of the crown. The rock mass exposed is highly fractured, support works for stabilization is needed

The local reduction or absence of lining thickness is probably due to the construction method and to the poor rock mass excavation.

T3

Id Datum 1081

Chainage From: 350
Chainage To: 355

date 02/06/2011

Damages:

Collapse on the right side (face on increasing chainage) rock mass exposed - Exposed steel reinforcement on left sidewall lining

Photo - The collapsed zone shows siltstone/mudstone highly fractured. Presently the exposed rock mass is stable. No support works is installed. Signs of water inflow are present as well as calcification deposit.

T3

Id Datum 1082

Chainage From: 350
Chainage To: 395

date 02/06/2011

Damages:

No evident damages for lining structure are detected

In correspondence to this adit junction the rock mass is exposed. It seems to be mud-siltstone brown to red with sign of calcium infilling- Photo

T3

Id Datum 1083 **Chainage From:** 395 **Chainage To:** 395 **date** 02/06/2011

Damages:

Collapse in correspondence of the tunnel left sidewall/crown. Damages to the lining

T3

Id Datum 1084 **Chainage From:** 395 **Chainage To:** 400 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1085 **Chainage From:** 400 **Chainage To:** 400 **date** 02/06/2011

Damages:

in correspondence of this chainage there is a change of the lining cross section. The support works is increased. This is due to the junction wit tunnel T7

T3

Id Datum 1086 **Chainage From:** 400 **Chainage To:** 500 **date** 02/06/2011

Damages:

The lining does not shows important sign of overloading but evidence quite poor execution (honey comb, degradation of concrete) maintenance is required.

T3

Id Datum 1087 **Chainage From:** 500 **Chainage To:** 500 **date** 02/06/2011

Damages:

Junction with tunnel T7

T3

Id Datum 1088 **Chainage From:** 500 **Chainage To:** 625 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1089 **Chainage From:** 625 **Chainage To:** 630 **date** 02/06/2011

Damages:

The lining shows misalignment between this stretch and the adjacent ones

Fault zone - lining section is increased

T3

Id Datum 1090 **Chainage From:** 630 **Chainage To:** 700 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1091 **Chainage From:** 700 **Chainage To:** 700 **date** 02/06/2011

Damages:

T3

Id Datum 1092 **Chainage From:** 700 **Chainage To:** 810 **date** 02/06/2011

Damages:

In correspondence of ch 745 for a stroke of 5 m no cast in situ lining is installed

Change on lining section. In this stretch concrete is applied instead of cast in situ concrete

T3

Id Datum 1093 **Chainage From:** 810 **Chainage To:** 830 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1094 **Chainage From:** 830 **Chainage To:** 835 **date** 02/06/2011

Damages:

Reduction of the lining thickness in correspondence of tunnel crown. Rock mass is exposed

This missing or reduced lining thickness should be attributed to the poor excavation quality, to the application of poor workmanship in formworks setting and in pouring operation.

T3

Id Datum 1095

Chainage From: 835
Chainage To: 835

date 02/06/2011

Damages:

Collapse in correspondence of the tunnel crown. Cavity with rock mass exposed.

The dimension of the cavity is roughly 3x1x1 m (depth, length and wide)- it is mandatory to kept in safety condition this stretch. Support works are necessary.

T3

Id Datum 1096

Chainage From: 835
Chainage To: 845

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1097

Chainage From: 845
Chainage To: 845

date 02/06/2011

Damages:

Cavity in correspondence of the right side. Rock mass exposed

Photo

T3

Id Datum 1098

Chainage From: 845
Chainage To: 880

date 02/06/2011

Damages:

Cavity on the right side wall

Photo - Setting of the main rock mass joining is shown. The Dip direction (30 ° with tunnel axis) dip 80°)

T3

Id Datum 1099 **Chainage From:** 880 **Chainage To:** 905 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1100 **Chainage From:** 905 **Chainage To:** 905 **date** 02/06/2011

Damages:

Lining damaging on the right side, detachment of crown lining

T3

Id Datum 1101 **Chainage From:** 905 **Chainage To:** 925 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1102 **Chainage From:** 925 **Chainage To:** 925 **date** 02/06/2011

Damages:

Detachment or reduced thickness of the lining correspondence of the crown.

Main dimension of the cavity 1x2x2. Support works are necessary.

T3

Id Datum 1103

Chainage From: 925
Chainage To: 970

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1104

Chainage From: 970
Chainage To: 970

date 02/06/2011

Damages:

Detachment or reduced thickness of the lining correspondence of the crown.

T3

Id Datum 1105

Chainage From: 970
Chainage To: 985

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1106

Chainage From: 985
Chainage To: 985

date 02/06/2011

Damages:

Tune junction with the tunnel T5A

The main tunnel section is increased in correspondence of the junction

T3

Id Datum 1107

Chainage From: 985

Chainage To: 990

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1108

Chainage From: 990

Chainage To: 990

date 02/06/2011

Damages:

Bad workmanship in the construction of the Joint connection between two strokes

T3

Id Datum 1109

Chainage From: 990

Chainage To: 1055

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1110

Chainage From: 1055

Chainage To: 1055

date 02/06/2011

Damages:

Roof collapse in correspondence of the stroke joint. In correspondence of the sidewall rock mass is exposed

T3

Id Datum 1111 **Chainage From:** 1055 **Chainage To:** 1075 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1112 **Chainage From:** 1075 **Chainage To:** 1075 **date** 02/06/2011

Damages:

Poor workmanship in correspondence of the spring line joint with sidewall concrete is missing or bad poured.

T3

Id Datum 1113 **Chainage From:** 1075 **Chainage To:** 1090 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1114 **Chainage From:** 1090 **Chainage To:** 1110 **date** 02/06/2011

Damages:

In correspondence of the lining crown some lining collapse occurred. It has been installed some work support (wire mesh and shotcrete). Drainage are installed but seems to be plugged. Water inflow are

T3

Id Datum 1115
Chainage From: 1110
Chainage To: 1125
date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1116
Chainage From: 1125
Chainage To: 1125
date 02/06/2011

Damages:

Deterioration of the lining stroke joint associated to water inflow

T3

Id Datum 1117
Chainage From: 1125
Chainage To: 1130
date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1118
Chainage From: 1130
Chainage To: 1130
date 02/06/2011

Damages:

Collapse in correspondence of the tunnel crown (joint between the two lining stroke)

T3

Id Datum 1119 **Chainage From:** 1130 **Chainage To:** 1160 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1120 **Chainage From:** 1160 **Chainage To:** 1160 **date** 02/06/2011

Damages:

Poor workmanship in correspondence joint. Rock mass is exposed.

The thickness of lining in this section is in the range of 10-15 cm. No steel reinforcement is detected. No rock bolt is installed. Drain is installed.

T3

Id Datum 1121 **Chainage From:** 1160 **Chainage To:** 1210 **date** 02/06/2011

Damages:

Collapse in correspondence of the right sidewall at spring line; rock mass is exposed. Similar but minor occurrence is detected on the left sidewall.

The exposed rock mass is constituted by fracrtured/higly jointed siltstone with water inflow presence (dripping). The joint spacing vary from 3 to 5 cm. The joint opening is less than 1 mm and shows presence of calcite infilling.

T3

Id Datum 1122 **Chainage From:** 1210 **Chainage To:** 1225 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1123 **Chainage From:** 1225 **Chainage To:** 1230 **date** 02/06/2011

Damages:

Evidence of significant spalling in correspondence of both the sidewall, involving two lining stroke. No support work are installed

Support works are required

T3

Id Datum 1124 **Chainage From:** 1230 **Chainage To:** 1230 **date** 02/06/2011

Damages:

On the right side a niche with concrete mix plant installed

T3

Id Datum 1125 **Chainage From:** 1230 **Chainage To:** 1250 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1126 **Chainage From:** 1250 **Chainage To:** 1250 **date** 02/06/2011

Damages:

Detachment or reduced thickness of the lining correspondence of the crown.

T3

Id Datum 1127

Chainage From: 1250
Chainage To: 1285

date 02/06/2011

Damages:

Bad workmanship in joint in correspondence of spring line on the right sidewall

T3

Id Datum 1128

Chainage From: 1285
Chainage To: 1300

date 02/06/2011

Damages:

Tunnel junction with the tunnel for the grouting of salt fault

T3

Id Datum 1129

Chainage From: 1300
Chainage To: 1320

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1130

Chainage From: 1320
Chainage To: 1330

date 02/06/2011

Damages:

Bad workmanship in joint in correspondence of spring line on the left sidewall

T3

Id Datum 1131 **Chainage From:** 1330 **Chainage To:** 1340 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1132 **Chainage From:** 1340 **Chainage To:** 1345 **date** 02/06/2011

Damages:

Lining damaging on the left side starting from the spring line up the crown

Sketch recorded on the field inspection book

T3

Id Datum 1133 **Chainage From:** 1345 **Chainage To:** 1365 **date** 02/06/2011

Damages:

Junction with tunnel T5, change of lining cross reinforced by steel ribs IPE 200 @ 1 m and wire mesh 25 x 25 cm φ 16

T3

Id Datum 1134 **Chainage From:** 1365 **Chainage To:** 1370 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1135

Chainage From: 1370
Chainage To: 1370

date 02/06/2011

Damages:

Poor workmanship in the crown joint between to lining stroke

T3

Id Datum 1136

Chainage From: 1370
Chainage To: 1380

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1137

Chainage From: 1380
Chainage To: 1380

date 02/06/2011

Damages:

Reduction of the lining thickness in correspondence of right sidewall. Rock mass is exposed

T3

Id Datum 1138

Chainage From: 1380
Chainage To: 1390

date 02/06/2011

Damages:

Reduction of the lining thickness in correspondence of the crown. Rock mass is exposed

T3

Id Datum 1139

Chainage From: 1390
Chainage To: 1400

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1140

Chainage From: 1400
Chainage To: 1400

date 02/06/2011

Damages:

Reduction of the lining thickness in correspondence of the joint between two lining stroke in the crown. Rock mass is exposed

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T3

Id Datum 1141

Chainage From: 1400
Chainage To: 1420

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1142

Chainage From: 1420
Chainage To: 1425

date 02/06/2011

Damages:

Change of lining cross reinforced by steel ribs IPE 200 @ 1 m and steel lining

T3

Id Datum 1143

Chainage From: 1425
Chainage To: 1550

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T3

Id Datum 1144

Chainage From: 1550
Chainage To: 1550

date 02/06/2011

Damages:

Reduction of the lining thickness in correspondence of the joint between two lining stroke in the crown. Rock mass is exposed

Junction with saline gallery. Change of lining section IPE 50 @1,5 m wire mesh 20 x20 φ20. In correspondence of the collapsed area the rock mass exposed is constituted by siltstone. A significant water inflows present (from dripping to flowing)

T37A

T37A

Id Datum 1145

Chainage From: 0
Chainage To: 40

date 02/06/2011

Damages:

No evident damages for lining structure are detected

1 - Cast in situ lining; IPE 500 @1.5 wire mesh 20 x 20 φ 20

T37A

Id Datum 1146

Chainage From: 40
Chainage To: 40

date 02/06/2011

Damages:

In correspondence of the junction with the tunnel to the bridge there is a collapse on the right sidewall of the tunnel

2 - Cast in situ concrete with poor workmanship of the joint between the strokes

T37A

Id Datum 1151

Chainage From: 130
Chainage To: 130

date 02/06/2011

Damages:

No evident damages for lining structure are detected

The tunnel inspection has been restarted from this chainage

T37A

Id Datum 1152

Chainage From: 130
Chainage To: 150

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T37A

Id Datum 1153

Chainage From: 150
Chainage To: 150

date 02/06/2011

Damages:

Collapse in correspondence of the crown joint between two lining strokes

Water inflow are present in correspondence of the collapse. There is a plugged drain installed in correspondence of the collapse.

T37A

Id Datum 1154

Chainage From: 150
Chainage To: 160

date 02/06/2011

Damages:

Poor workmanship in the construction of the joint between spring line and sidewall.

1 - Cast in situ concrete lining with a thickness of 10-20 cm, in some portion of the tunnel the rock mass is exposed.

T37A

Id Datum 1155

Chainage From: 160
Chainage To: 160

date 02/06/2011

Damages:

Collapse in correspondence of the crown joint between two lining strokes

T37A

Id Datum 1156

Chainage From: 160
Chainage To: 230

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T37A

Id Datum 1157

Chainage From: 230
Chainage To: 280

date 02/06/2011

Damages:

Spread water inflows. No drainage are installed in this tunnel stretch

Tranversaljunction with T3

T37A

Id Datum 1158

Chainage From: 280
Chainage To: 280

date 02/06/2011

Damages:

Spalling on the right sidewall. Exposure of the rock mass in correspondence of the crown. In correspondence of this stretch some rock bolt have been installed

Photo

T37A

Id Datum 1159

Chainage From: 280
Chainage To: 350

date 02/06/2011

Damages:

Junction section with T-37N -In correspondence of this section 2 x 2 m path of plated φ 25 rock bolt are installed

T37A

Id Datum 1160 **Chainage From:** 350 **Chainage To:** 430 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T37A

Id Datum 1161 **Chainage From:** 430 **Chainage To:** 445 **date** 02/06/2011

Damages:

Change in lining typical section

It has been checked if this section experienced a collapse during excavation. The work supports consist in IPE 400 @ 1 m. Two external section of 5 m are supported by steel ribs an the central section is supported by wire mesh.

T37A

Id Datum 1162 **Chainage From:** 445 **Chainage To:** 520 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T37A

Id Datum 1163 **Chainage From:** 520 **Chainage To:** 570 **date** 02/06/2011

Damages:

In correspondence of the right sidewall a niche is present. The lining section changes. Cast in situ lining composed by 50 cm of concrete with wire mesh 20 x 20 cm φ 18 - Photo

T37A

Id Datum 1164

Chainage From: 570
Chainage To: 580

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T37A

Id Datum 1165

Chainage From: 580
Chainage To: 580

date 02/06/2011

Damages:

On the right sidewall there are evidence of poor workmanship of the lining transversal joint.

This tunnel stretch is correspondence of a curve.

T37A

Id Datum 1166

Chainage From: 580
Chainage To: 590

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T37A

Id Datum 1167

Chainage From: 590
Chainage To: 590

date 02/06/2011

Damages:

In correspondence of the right sidewall and right portion of the crown the lining is missing.

This tunnel stretch is correspondence of a curve.

T37A

Id Datum 1168

Chainage From: 590
Chainage To: 610

date 02/06/2011

Damages:

No evident damages for lining structure are detected

T37A

Id Datum 1169

Chainage From: 610
Chainage To: 610

date 02/06/2011

Damages:

Tunnel cross section enlargement in correspondence with the bifurcation with Access P11

T37A

Id Datum 1170

Chainage From: 610
Chainage To: 660

date 02/06/2011

Damages:

The construction of the joint between spring line and sidewall is missing.

T4

T4

Id Datum 1203

Chainage From: 996

Chainage To: 960

date 02/06/2011

Damages:

The tunnel on the drawing is named N4 but it is inferred from site information that the correct name is T4.
1 - Approx 40 cm thick with stell bars reinforcement φ 16 @ 20 cm.

T4

Id Datum 1204

Chainage From: 960

Chainage To: 930

date 02/06/2011

Damages:

Along this stretch some work support are on going; 2 x 2 m path of 5-10 m long driling and installation of stell wire mesh and shotcrete

T4

Id Datum 1205

Chainage From: 930

Chainage To: 920

date 02/06/2011

Damages:

Along this stretch some work support are on going; pouring of the final lining is foreseen, in this case stell formorks is used. Geology notes: along this stretch rock mass is exposed; sandstone RMC II - III higly jointed. Joint spacing 10-15 cm, joint closed. No water inflow is evident

T4

Id Datum 1206

Chainage From: 920
Chainage To: 870

date 02/06/2011

Damages:

3 - First stage of works support are installed; with shotcrete and wire mesh 20 x 20 φ 20 and rock bolts with path 2 x 2 m. Presently the shotcrete is carryed out on the sidewall.

T4

Id Datum 1207

Chainage From: 870
Chainage To: 870

date 02/06/2011

Damages:

Junction with tunnel P34 (acces tunnel to the lower level of the Power House)

T4

Id Datum 1208

Chainage From: 870
Chainage To: 811

date 02/06/2011

Damages:

The transversal joint between the differentsrokes show poor workmaship, signs of water inflow are evident. Joints between sidewall and invert (sping line) have to be recovered

4 - The final ling is going to be pured. The process is achieved by means of a steel formorks. The works proceed by strokes of approx. 5 m. This methodolgy shows some limit in the achivement of a good quality of the transversal joint between the differents strokes. This fact do not impact on the lining stability for open

T4

Id Datum 1209

Chainage From: 811
Chainage To: 815

date 02/06/2011

Damages:

Spalling eviences on both sidewall lining of the tunnel

Approx. 2 m of lining is missing. This stretch is related to a curve of the tunnel allignment. This in genereal seems had been a systematic construction problem associated to the stroke lining construction procedure; as could be inferred no special formorks for curve section were available at site.

T4

Id Datum 1210
Chainage From: 815
Chainage To: 824
date 02/06/2011

Damages:

End of the curve stretch of the tunnel

T4

Id Datum 1211
Chainage From: 824
Chainage To: 780
date 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1212
Chainage From: 780
Chainage To: 780
date 02/06/2011

Damages:

Part of the crown lining of the tunnel has been collapsed - detched

T4

Id Datum 1213
Chainage From: 780
Chainage To: 760
date 02/06/2011

Damages:

Rock bolts with pattern of 2 x 2 installed on the right sidewall (observator face in the direction of the visit progress). In correspondence of this chainage there is a junction with a tunne acces taht will be used as feeder for comressed air for the draft tube turbine. At this junction level will be installed the reciver

T4

Id Datum 1214

Chainage From: 750

Chainage To: 745

date 02/06/2011

Damages:

5 - In correspondenc eof this chainage the tunnel cross section is enlarged. Works supports installed along this section are: steel ribs IPE 300 @ 1 m connected with rebar net 20 x 30 of φ 20. Gelogical note: this section is locae at the limit of the fault zone (n 35) that cross the tunnel from chainage 752 up to 578 .

T4

Id Datum 1215

Chainage From: 745

Chainage To: 723

date 02/06/2011

Damages:

The condition of the rock supports are qite poor it has been to be recovered.

Starting from this chainage the lining type 3 is caried out: shotcrete and wire mesh 20 x 20 φ 20 and rock bolts with path 2 x 2 m. Presently the shotcrete is carryed out on the sidewall.

T4

Id Datum 1216

Chainage From: 723

Chainage To: 699

date 02/06/2011

Damages:

No evident damages for lining structure are detected

5 - In correspondenc eof this chainage the tunnel cross section is enlarged. Works supports installed along this section are: steel ribs IPE 300 @ 1 m connected with rebar net 20 x 30 of φ 20.

T4

Id Datum 1217

Chainage From: 699

Chainage To: 670

date 02/06/2011

Damages:

5 - In correspondenc eof this chainage the tunnel cross section is enlarged. Works supports installed along this section are: steel ribs IPE 300 @ 1 m connected with rebar net 20 x 30 of φ 20.

T4

Id Datum 1218 **Chainage From:** 670 **Chainage To:** 670 **date** 02/06/2011

Damages:

Junction with tunnel T6; section type 5 contines:Works supports installed along this section are: steel ribs IPE 300 @ 1 m connected with rebar net 20 x 30 of φ 20.

T4

Id Datum 1219 **Chainage From:** 670 **Chainage To:** 640 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

section type 5 contines:Works supports installed along this section are: steel ribs IPE 300 @ 1 m connected with rebar net 20 x 30 of φ 20.

T4

Id Datum 1220 **Chainage From:** 640 **Chainage To:** 640 **date** 02/06/2011

Damages:

Tunnel juntion with tunnel T2 section type 5 contines:Works supports installed along this section are: steel ribs IPE 300 @ 1 m connected with rebar net 20 x 30 of φ 20.

T4

Id Datum 1221 **Chainage From:** 640 **Chainage To:** 611 **date** 02/06/2011

Damages:

Starting from this chainage ling type 3 - First stage of works support are installed; with shotcrete and wire mesh 20 x 20 φ 20 and rock bolts with path 2 x 2 m. Presently the shotcrete is carryed out on the sidewall.

T4

Id Datum 1222 **Chainage From:** 611 **Chainage To:** 560 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1223 **Chainage From:** 560 **Chainage To:** 560 **date** 02/06/2011

Damages:

Bad workmaship of this tunnel stretch in correspondence of the tranvesal joint between two strokes at crown

T4

Id Datum 1224 **Chainage From:** 560 **Chainage To:** 550 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1225 **Chainage From:** 550 **Chainage To:** 550 **date** 02/06/2011

Damages:

In this tunnel stretch are on going grouting injections. One injection point in the crown every 5 m.

T4

Id Datum 1226 **Chainage From:** 550 **Chainage To:** 510 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1227 **Chainage From:** 510 **Chainage To:** 510 **date** 02/06/2011

Damages:

Collapse or bad lining execution is located in the crown of the tunnel

General note: these kinds of missing/reduction of tunnel lining should be related to a bad warkmanship during the pouring activities in association to a poor quality of excavation.

T4

Id Datum 1228 **Chainage From:** 510 **Chainage To:** 440 **date** 02/06/2011

Damages:

The joint between sidewalls and the relevant spring lines is missing or bad executed

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T4

Id Datum 1229 **Chainage From:** 440 **Chainage To:** 440 **date** 02/06/2011

Damages:

In correspondence of this chainage a significant transversal joint misaglinment is detected

T4

Id Datum 1230 **Chainage From:** 440 **Chainage To:** 405 **date** 02/06/2011

Damages:

Poor lining workamship in correspondence of the crown is detected; rock mass is exposed

T4

Id Datum 1231 **Chainage From:** 405 **Chainage To:** 400 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1232 **Chainage From:** 400 **Chainage To:** 400 **date** 02/06/2011

Damages:

In correspondence of this section water inflow is recorded (dripping conditions) It is advisable to install some drain.

T4

Id Datum 1233 **Chainage From:** 400 **Chainage To:** 280 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1234 **Chainage From:** 280 **Chainage To:** 260 **date** 02/06/2011

Damages:

Poor workmanship in the esecution of the lining tranversal joint. Misaglinment of the lining segments in in correspondence of the transval joint the range of 40-50 cm.

T4

Id Datum 1235 **Chainage From:** 250 **Chainage To:** 250 **date** 02/06/2011

Damages:

Junction with tunnel N14. Lining type 3 is installed. In correspondence of the fule deposit niche the rock mass is exposed; sandstone RMC III. Works suport rock bolt 2 x 2. Rock mass higly frectured the joint openingis nthe range of 0.1 to 0.3 mm.

T4

Id Datum 1236 **Chainage From:** 260 **Chainage To:** 230 **date** 02/06/2011

Damages:

In correspondence of this tunnel stretch additional rock bolt support are installed with a pattern 2 x 2 on sidewall and crown. Some waterinflow is detected in correspondence of the joint.

T4

Id Datum 1237 **Chainage From:** 230 **Chainage To:** 210 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1238 **Chainage From:** 210 **Chainage To:** 210 **date** 02/06/2011

Damages:

Bad workmaship in correspondence of the crown, some shorcete has been applied.

General note: these kinds of missing/reduction of tunnel lining should be related to a bad warkmanship during the pouring activities in association to a poor quality of excavation.

T4

Id Datum 1239 **Chainage From:** 210 **Chainage To:** 190 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1240 **Chainage From:** 190 **Chainage To:** 175 **date** 02/06/2011

Damages:

Bad workmaship in correspondence of the crown.

Along this stretch waterinflow is detected in correspondence of the transversal lining joint. Exposed rock mass is highly fractured and seems to be siltstone.

T4

Id Datum 1241 **Chainage From:** 175 **Chainage To:** 170 **date** 02/06/2011

Damages:

No evident damages for lining structure are detected

T4

Id Datum 1242

Chainage From: 170
Chainage To: 170

date 02/06/2011

Damages:

Poor workmanship in the esecution of the lining tranversal joint.

T4

Id Datum 1243

Chainage From: 170
Chainage To: 145

date 02/06/2011

Damages:

Poor lining workamship in correspondence of the crown is detected; rock mass is exposed

T4

Id Datum 1244

Chainage From: 145
Chainage To: 135

date 02/06/2011

Damages:

No evident damages for lining structure are detected.

T4

Id Datum 1245

Chainage From: 135
Chainage To: 125

date 02/06/2011

Damages:

Poor lining workamship in correspondence of the crown is detected; rock mass is exposed

T4

Id Datum 1246

Chainage From: 125

Chainage To: 120

date 02/06/2011

Damages:

No evident damages for lining structure are detected.

T4

Id Datum 1247

Chainage From: 120

Chainage To: 0

date 02/06/2011

Damages:

6 - Portal section: Starting from this section the lining from cross section type 5 change in 6: IPE 300 @ 1 m orizzontally connected with φ 28 @ 40 cm and vertically with φ 20 @ 5 cm. Contact grouting holes injection in the crown @ 5 m.

T8

T8

Id Datum 1513

Chainage From: 280
Chainage To: 280

date 07/06/2011

Damages:

The inspection starts from the junction with the tunnel T2 and proceeding in the direction of the Gates Chamber.

T8

Id Datum 1514

Chainage From: 280
Chainage To: 240

date 07/06/2011

Damages:

The junction cross section lining between the T2 an T8 is composed by steel ribs ipe 400 @ 1 m connected by rebars fi 26 @ 30 cm. The liing thickness is approx. 1 m.

T8

Id Datum 1515

Chainage From: 240
Chainage To: 240

date 07/06/2011

Damages:

Water inflow is detecetd in correspondece of left side transversal joint in correspondece of ventilation niche

A niche is excavated in correspondence of the left side of the tunnel in order to allow for a ventilation shaft connecting the Divesion Tunnel N2.

T8

Id Datum 1516
Chainage From: 240
Chainage To: 230
date 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1517
Chainage From: 230
Chainage To: 230
date 07/06/2011

Damages:

Starting from this chainage starts the typical lining. End of the reinforcement located in correspondece of the junction section.

T8

Id Datum 1518
Chainage From: 230
Chainage To: 210
date 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1519
Chainage From: 210
Chainage To: 210
date 07/06/2011

Damages:

A niche is excavated in correspondence of the left side of the tunnel in order to allow for a ventilation shaft connecting the Divesion Tunnel N1.

T8

Id Datum 1520 **Chainage From:** 200 **Chainage To:** 200 **date** 07/06/2011

Damages:

Poor workmaship in correspondece on left sidewall and crown

T8

Id Datum 1521 **Chainage From:** 200 **Chainage To:** 198 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1522 **Chainage From:** 198 **Chainage To:** 198 **date** 07/06/2011

Damages:

Damages detected in correspondece of the right sidewall; steel reinforcement exposure.

T8

Id Datum 1523 **Chainage From:** 198 **Chainage To:** 180 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1524

Chainage From: 180

Chainage To: 180

date 07/06/2011

Damages:

Junction with the tunnel P23 (adit to the Transformer Cavern). The cross section is ellitical shaped section 5 m height and 3 m large. The average concrete thickness is approx. 50 - 80 cm reinforced with ipe 200 steel ribs @ 1,5 m.

T8

Id Datum 1525

Chainage From: 180

Chainage To: 165

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1526

Chainage From: 165

Chainage To: 165

date 07/06/2011

Damages:

Damages in correspondece of the left sidewall lining

T8

Id Datum 1527

Chainage From: 160

Chainage To: 130

date 07/06/2011

Damages:

Very poor lining condition, the lining thickness is reduced in crown portion.

T8

Id Datum 1528 **Chainage From:** 130 **Chainage To:** 125 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1529 **Chainage From:** 125 **Chainage To:** 125 **date** 07/06/2011

Damages:

Water inflow in correspondece of the upper portion of the left side

On the left side is located an exploratory adit for geological investigation purpose.

T8

Id Datum 1530 **Chainage From:** 125 **Chainage To:** 120 **date** 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1531 **Chainage From:** 120 **Chainage To:** 120 **date** 07/06/2011

Damages:

On the left side a niche has been excavated to allow access for the grouting treatment of the collapsed area of the Diversion Tunnel N° 2. Geology - Sandstone. Main joint dip diection 120°N dip 75-80° joint spacing 50-100 cm persistance 5 m closed joint dripping water inflow.

T8

Id Datum 1532

Chainage From: 120
Chainage To: 85

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1533

Chainage From: 85
Chainage To: 85

date 07/06/2011

Damages:

Poor workmanship in the transversal joint, rock mass exposed. The connection between the spring line and the side wall is missing on the right side

T8

Id Datum 1534

Chainage From: 85
Chainage To: 75

date 07/06/2011

Damages:

No evident damages for lining structure are detected

T8

Id Datum 1535

Chainage From: 75
Chainage To: 75

date 07/06/2011

Damages:

Dripping water inflow trought the construction transversal joint

T8

Id Datum 1536

Chainage From: 75
Chainage To: 65

date 07/06/2011

Damages:

The connection between the sidewall and the spring line is missing on both sidewall

Temporary Head race tunnel

Temporary Head race tunnel

Id Datum 1402

Chainage From: 1

Chainage To: 1

date 06/06/2011

Damages:

The inspection starts from the gate chamber bifurcation. The works relevant to the lining installation have been carried out; relevant x-ray tests on welding has been accomplished. The concrete works of this stretch has been accomplished during soviet time.

Temporary Head race tunnel

Id Datum 1403

Chainage From: 2

Chainage To: 2

date 06/06/2011

Damages:

The gate mechanical equipments installation are on going. The two penstocks have been excavated but lining has not jet started.

Temporary Head race tunnel

Id Datum 1404

Chainage From: 321

Chainage To: 321

date 06/06/2011

Damages:

The transversal joint connection between the steel lining section and the concrete lining of the tunnel presents poor workmanship and have to be rehabilitated. Particular reference is made to the sidewall. Along the concrete section the longitudinal joint between the invert and the sidewall shows bad

The inspection proceed starting from the gates proceeding to the intake.

Temporary Head race tunnel

Id Datum 1405

Chainage From: 321
Chainage To: 300

date 06/06/2011

Damages:

No evident damages for lining structure are detected

Temporary Head race tunnel

Id Datum 1406

Chainage From: 300
Chainage To: 290

date 06/06/2011

Damages:

The longitudinal joints between invert and sidewalls presents poor workmanship. The transversal joint continue to be a affected of poor workmanship.

Junction with the access tunnel P25A. This tunnel has been plugged. The plug has been carried out with wire mesh 20 x 20 φ 20.

Temporary Head race tunnel

Id Datum 1407

Chainage From: 290
Chainage To: 290

date 06/06/2011

Damages:

Contact grouting works are on going. The injection bore hole length is 7 m. The pattern of the injection is 2 x 2 m.

Temporary Head race tunnel

Id Datum 1408

Chainage From: 290
Chainage To: 248

date 06/06/2011

Damages:

No evident damages for lining structure are detected

Temporary Head race tunnel

Id Datum 1409 **Chainage From:** 248 **Chainage To:** 248 **date** 06/06/2011

Damages:

End of the curve stretch of the tunnel.

Temporary Head race tunnel

Id Datum 1410 **Chainage From:** 248 **Chainage To:** 210 **date** 06/06/2011

Damages:

No evident damages for lining structure are detected

Temporary Head race tunnel

Id Datum 1411 **Chainage From:** 210 **Chainage To:** 210 **date** 06/06/2011

Damages:

In correspondence of the crown some poor workmanship of the lining is evident. Concrete honeycomb are present and the concrete surface finishing is poor. No evidences of lining overstress are present.

Temporary Head race tunnel

Id Datum 1412 **Chainage From:** 210 **Chainage To:** 185 **date** 06/06/2011

Damages:

No evident damages for lining structure are detected

Temporary Head race tunnel

Id Datum 1413

Chainage From: 185
Chainage To: 185

date 06/06/2011

Damages:

Photo relevant to the poor concrete finishing.

Temporary Head race tunnel

Id Datum 1414

Chainage From: 185
Chainage To: 170

date 06/06/2011

Damages:

Poor workmanship of the transversal joint in correspondence of the left side wall.

Honeycomb are detected on the right side

Temporary Head race tunnel

Id Datum 1415

Chainage From: 170
Chainage To: 150

date 06/06/2011

Damages:

No evident damages for lining structure are detected

Temporary Head race tunnel

Id Datum 1416

Chainage From: 150
Chainage To: 150

date 06/06/2011

Damages:

Junction with tunnel P29

Temporary Head race tunnel

Id Datum 1417
Chainage From: 150
Chainage To: 140
date 06/06/2011

Damages:

No evident damages for lining structure are detected

Temporary Head race tunnel

Id Datum 1418
Chainage From: 140
Chainage To: 140
date 06/06/2011

Damages:

Poor workmanship of the transversal joint

Temporary Head race tunnel

Id Datum 1419
Chainage From: 140
Chainage To: 100
date 06/06/2011

Damages:

No evident damages for lining structure are detected

Temporary Head race tunnel

Id Datum 1420
Chainage From: 100
Chainage To: 50
date 06/06/2011

Damages:

The lining along this stretch have been rehabilitated but the general condition appear poor with particular reference to the construction joint

Temporary Head race tunnel

Id Datum 1421

Chainage From: 75
Chainage To: 75

date 06/06/2011

Damages:

The grouting works have been accomplished along this tunnel stretch but sign of water inflow are present. Evaluation of the documentation relevant to the quality assurance test has to be carried out. It is advisable to execute additional injection tests.

Temporary Head race tunnel

Id Datum 1422

Chainage From: 75
Chainage To: 50

date 06/06/2011

Damages:

No evident damages for lining structure are detected

Temporary Head race tunnel

Id Datum 1423

Chainage From: 50
Chainage To: 50

date 06/06/2011

Damages:

In correspondence of this chainage it is possible to appreciate the woks carried out to rehabilitate the original section. A lining of 50 cm thickness have been poured against the original one. The transversal joint has been rehabilitated.

Temporary Head race tunnel

Id Datum 1424

Chainage From: 50
Chainage To: 0

date 06/06/2011

Damages:

Approximately 15 m of tunnel and the inlet structure has still to be excavated.

Temporary Head race tunnel

Id Datum 1425

Chainage From: 0

Chainage To: 0

date 06/06/2011

Damages:

The slopes in correspondence of the intake structures shows evidences of local instability.

The intake structure excavation works are just started.

Transormer Hall

Transormer Hall

Id Datum 1357

Chainage From: 5
Chainage To: 5

date 04/06/2011

Damages:

The inspections starts from the west wall. The pattern of the rock bolts installed on the crown is 1 x 1 m, the distance between the rock bolts increase in correscpndence of the sandstone area. Some wterinflows are recorded in correspondence of the siltstone area.

Transormer Hall

Id Datum 1358

Chainage From: 5
Chainage To: 5

date 04/06/2011

Damages:

The excavation works are in progress, the most part of the bottom excavation are at elevation 993. Some excvation reaching the elevation of the 982 (bottom level ofthe bus duct gallery) is on going for the units 5 and 6.

Transormer Hall

Id Datum 1359

Chainage From: 5
Chainage To: 5

date 04/06/2011

Damages:

The excavation of the portal structure of the bus duct gallaery of the unit 5 and 6 are on going.

Transormer Hall

Id Datum 1360 **Chainage From:** 5 **Chainage To:** 5 **date** 04/06/2011

Damages:

On sidewall have been installed 10-12 m long of passive anchor bolts with a pattern of 1,5 x 1,5 m. relevant waterinflow is recorded in correspondence of the unit 4 and 3. Significant water inflow has been recorded also between units 5 and 6 in correspondece of the north sidewall.

Transormer Hall

Id Datum 1361 **Chainage From:** 6 **Chainage To:** 6 **date** 04/06/2011

Damages:

Unit 4 - The pattern of the supports works on the sidewall is 3 x 3 m.

Transormer Hall

Id Datum 1362 **Chainage From:** 7 **Chainage To:** 7 **date** 04/06/2011

Damages:

Unit 2 - In correspondence of the North sidewall some waterinflow is recorded.

Transormer Hall

Id Datum 1363 **Chainage From:** 8 **Chainage To:** 8 **date** 04/06/2011

Damages:

I correspondence of the south sidewall lining works are on going. The works starts from east to west. The lining is carried out puring the concrete agaist the rock mass. Some demolish works are on going in correspondence of the tempraray works are on going, in order to respect the inrenal dimension ov the

PHASE 1

ASSESSMENT OF EXISTING ROGUN HPP WORKS

ANNEX 7

UNDERGROUND STRUCTURES

INVESTIGATIONS – UCS TESTS AND LUGEON TESTS RESULTS

Table of Content

1 Introduction

During the Underground structures inspection performed on May 2011 uncertainties were noticed relevant the actual state of the concrete cast during the first works phase (about 30 years ago) and the scarcity of tests relevant to the effectiveness of the grouting works and the conditions of the rock mass surrounding the underground structures was highlighted.

The First aspect related to the Concrete Quality is related with the selection of the Material characteristics to be adopted for the structural verifications of the Tunnels and Caverns.

It is to be underlined that the scope of the tests on concrete specimens drilled from existing structures was to collect elements in order to be in the position to adopt for structural verifications conservative values for material properties characterizing the underground structures in the actual status of preservation.

The test, therefore, did not represent a systematic campaign with a number of samples sufficient for a probabilistic classification of concrete material in term of Cubic Characteristic Strength (Rck) because this kind of procedure would have been implied an activity out of the present scope of work.

As far as the evaluation of the waterways structures is concerned (stability and durability) another aspect to be assessed in association with the previous one (concrete lining quality) is that relevant to the grouting works effectiveness and rock mass conditions. In this regard several water pressure tests have been accomplished in the past, but the available information is not homogenous and quite often doesn’t provide a sufficient level of detail.

In any case, it wasn’t possible to interpret tests which have not been performed according to a clear procedure or to an internationally recognized standard.

The reference documents in which the development regarding the locations and the numbers of tests to be performed is detailed described are:

- RP 09 rev. B Phase 1 Preliminary Report - Status of Existing Rogun HPP Works and Status of Relevant Information
- RP 12 Existing Rogun HPP Underground Works - Investigations Required for the Assessment

2 Requested Investigations

Based on the above considerations, it was deemed necessary to execute some tests, at least in correspondence of the main existing Power Plant Waterways, i.e. Diversion Tunnels and Stage 1 Headrace Tunnel, caverns and of main access / transportation tunnels.

Basically two different kinds of tests were proposed: some tests have been established in order to assess the concrete quality, while others were aimed to assess the actual conditions of the rock mass surrounding the structures; in some cases the two tests may be associated.

The description and purpose of the tests (drillings with core recovery and water tests) required are hereafter reported.

2.1 Drillings with Core Recovery

These tests carried out in order to assess the concrete status were performed in the following structures:

- Powerhouse,
- Diversion Tunnels - Maintenance Gate Chamber,
- Diversion Tunnels - Main and Emergency Gate Chamber
- Diversion Tunnel 1 (Core Recovery tests made together with Lugeon Tests)
- Diversion Tunnel 2 (Core Recovery tests made together with Lugeon Tests)
- Stage 1 Headrace Tunnel (Core Recovery tests made together with Lugeon Tests)
- Stage 1 Headrace Tunnel - Main and Emergency Gate Chamber,
- Transportation Tunnels T4, T3

the tests consisted in recovering a core through a drilling with an anticipated length of 0.5 up to 1.5 m, depending upon the concrete structure thickness, entering into the rock for at least 0.5 m.

Uniaxial compression tests (UCS) were carried out on selected specimens to evaluate the present strength of the concrete and specific unit weight tests.

2.2 Core Tests on concrete in association with Water Pressure Tests for Diversion Tunnel 1, Diversion Tunnel 2 and Stage 1 Head Race Tunnel.

Both types of tests were carried out in the two Diversion Tunnels and in the Stage 1 Headrace Tunnel. They were aimed to assess the present status of the concrete lining system in respect to the following aspects:

- Concrete strength and possible degradation undergone by this material;
- Effectiveness of the contact grouting;
- Permeability of the surrounding rock mass, that has to be controlled and limited in order to allow, for the possible hydrostatic load on the lining in case of empty tunnel, to be actually relieved by the short drain pipes and to effectively control the leakage from the tunnels when in operation.

The campaign was based on:

- Core recovery tests;
- Water Injection Pressure Tests (Lugeon).

The drilling pattern presented in the next paragraphs served both for core recovery testing activity, with core logging, down to the depth mostly max 1.5 m with diameter 101 mm, and for water injection pressure tests, from the depth for core recovery test down to the full depth of the holes (3 m, diameter 76 mm).

2.2.1 Core Recovery Drillings

The core tests will interest the first portion of the drill holes; the length of this first portion ranging between 0.80 m to 1.50 m) is shown in the Figure below, and it is aimed to get core recovery samples of the: i) concrete lining, ii) the grouted gap between the concrete and rock mass and iii) a portion of the grouted rock mass (50 cm).

2.2.2 Water Injection Pressure Tests (Lugeon)

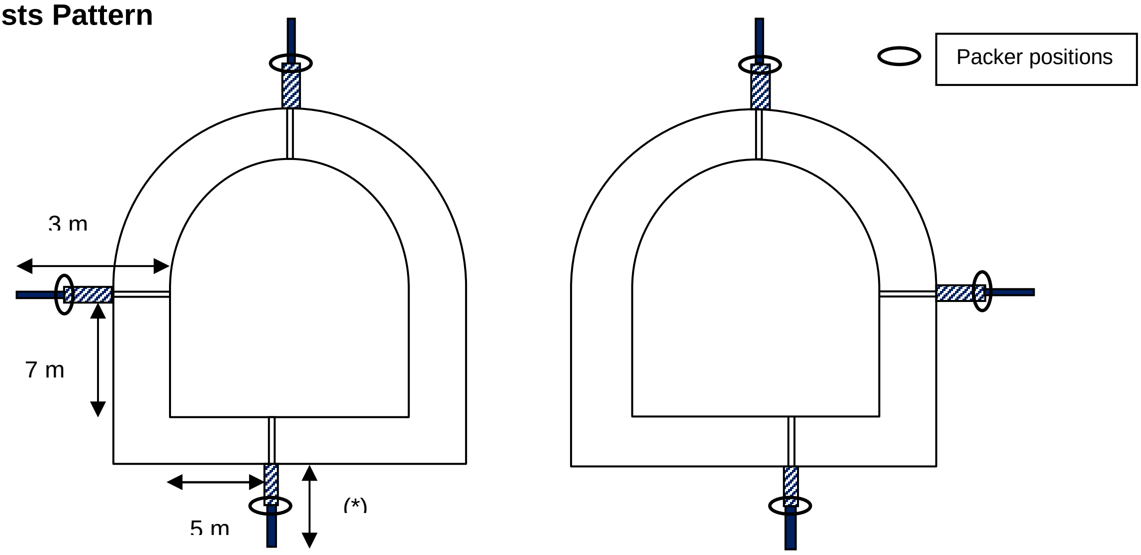
The Lugeon tests were performed in the second holes stretch down to the holes bottom, in one single stage and according to the section locations indicated in the following paragraph.

The Rock Mass Permeability Test, also named Packer Test, was performed according to the AFNOR P94-132-1994 Standard or equivalent and taking into consideration the following notes:

- Lugeon Test was performed on the second stretch of the drilled holes only, where a 76 mm diameter has been prescribed; max pressure value was 0.5 MPa.
- Installation of one inflatable packer at the top of the tested stretch in order to seal off the test section;

  Plugging of the neighboring drainage holes, already existing in the tunnel lining, in order to avoid the water reflux from those adjacent drainage holes, which would lead to a mistaken evaluation.

2.2.3 Tests Pattern



▨	First hole stretch – core recovery - 101 mm diameter
■	Second hole stretch – no core recovery - 76 mm diameter

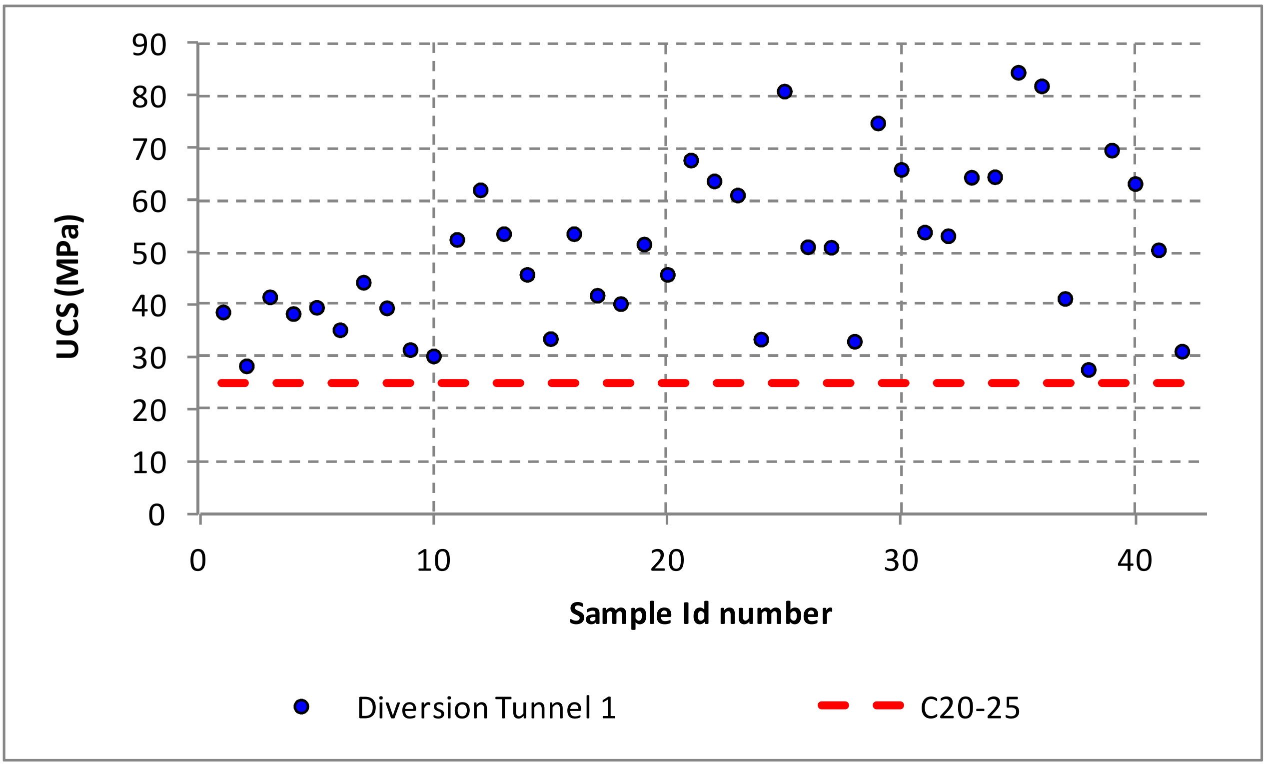
Core recovery drillings, patterns to be considered in alternate positions every 100 m or as otherwise indicated here below.

3 Presentation of the results

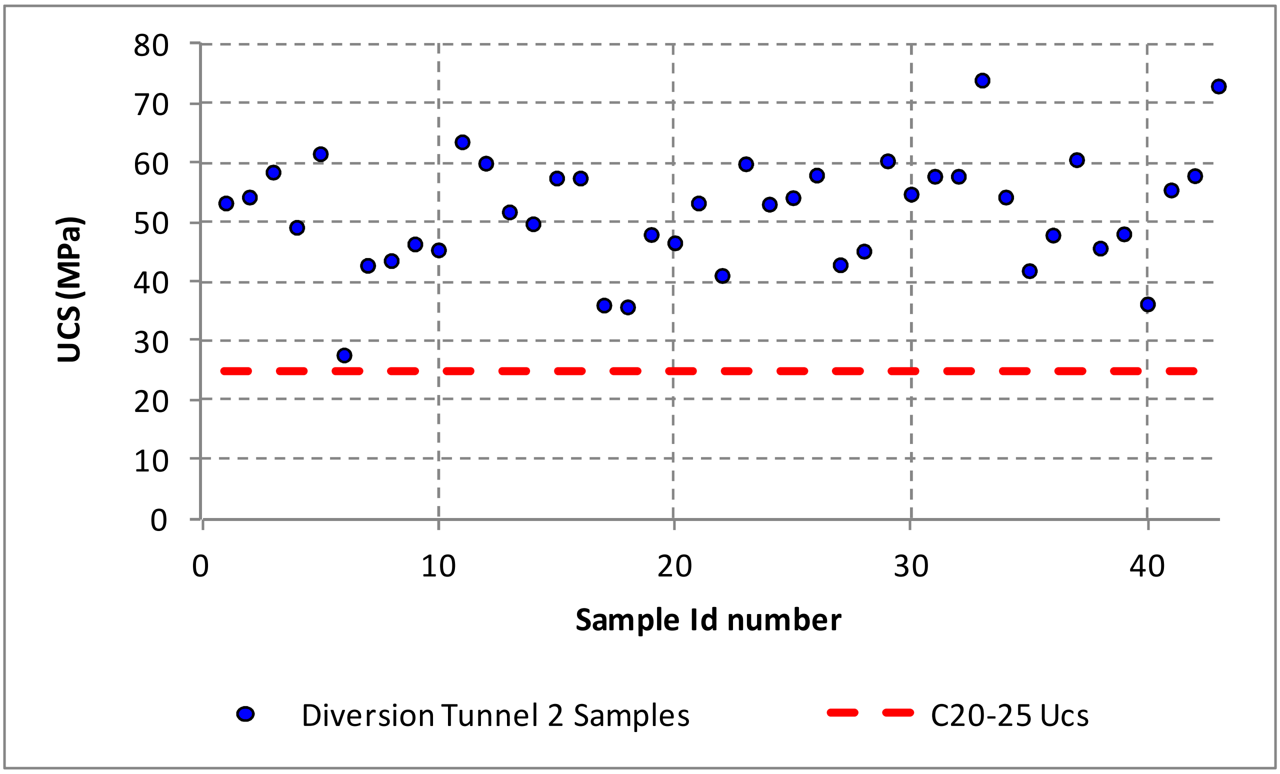
3.1 Concrete Samples: uniaxial Compression Tests

Diversion Tunnel 1

Section	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Sec 6	Sec 7	Sec 8
Chainage	**0+25**	**1+25**	**2+25**	**4+75**	**5+75**	**6+50**	**7+75**	**8+75**
UCS Sp. 1 invert (Mpa)	38.7	44.4	53.7	steel lining	steel lining	51.1	64.5	
UCS Sp. 2 invert (Mpa)	28.4	39.5	45.9	steel lining	steel lining	33.1	64.6	
UCS Sp. 1 Side wall (Mpa)	41.6	31.5	33.6	51.7	61.1	74.9	84.6	69.7
UCS Sp. 2 Side wall (Mpa)	38.4	30.3	53.7	45.9	33.5	66	82	63.3
UCS Sp. 1 Vault (Mpa)	39.6	52.6	41.9	67.8	81	54	41.3	50.6
UCS Sp. 2 Vault (Mpa)	35.3	62.1	40.3	63.8	51.2	53.3	27.7	31,2 - 26,9

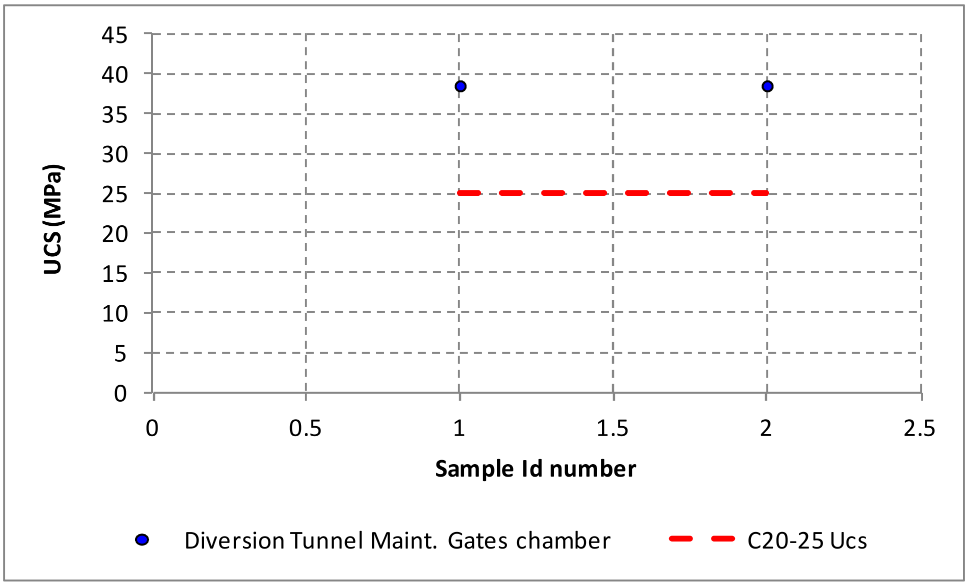


Diversion Tunnel 2								
Section	**Sec 1**	**Sec 2**	**Sec 3**	**Sec 4**	**Sec 5**	**Sec 6**	**Sec 7**	**Sec 8**
chainage	**0+25**	**1+05**	**1+85**	**4+20 4+00**	**5+20**	**6+20**	**7+05**	**8+20**
UCS Sp. 1 invert (Mpa)	53.3	42.8	51.8	steel lining	steel lining	42.9	74	48.1
UCS Sp. 2 invert (Mpa)	54.3	43.6	49.8	steel lining	steel lining	45.2	54.3	36.3
UCS Sp. 1 Side wall (Mpa)	58.5	46.4	57.5	48	59.9	60.4	41.9	55.5
UCS Sp. 2 Side wall (Mpa)	49.2	45.4	57.5	46.6	53.1	54.8	47.9	57.9
UCS Sp. 1 Vault (Mpa)	61.6	63.6	36.1	53.3	54.2	57.8	60.6	73
UCS Sp. 2 Vault (Mpa)	27.7	60	35.8	41.1	58	57.8	45.7	49.5



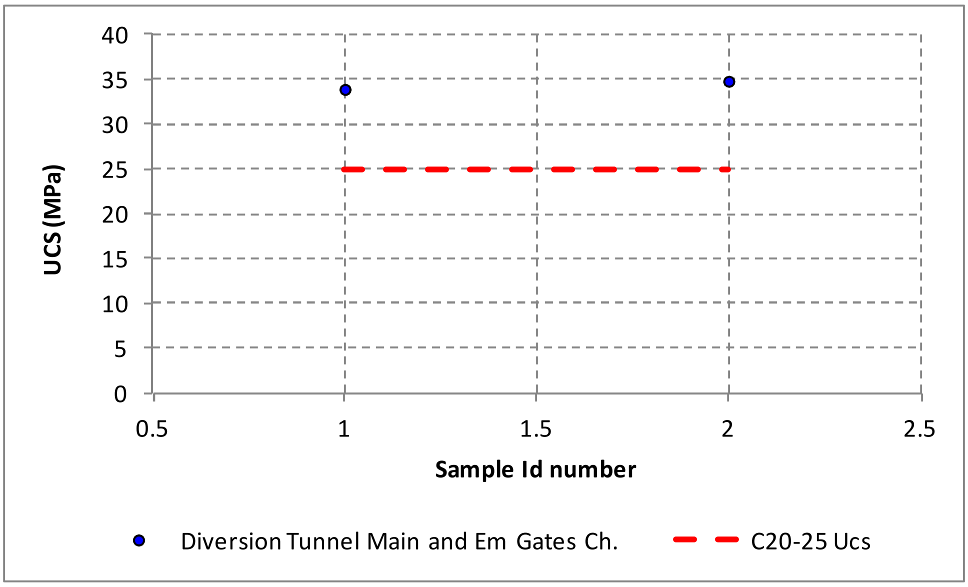
Diversion Tunnel Maintenance Gates chamber

Points	Point 1	Point 2
Schmidt Hammer (Mpa)	38.52	38.52



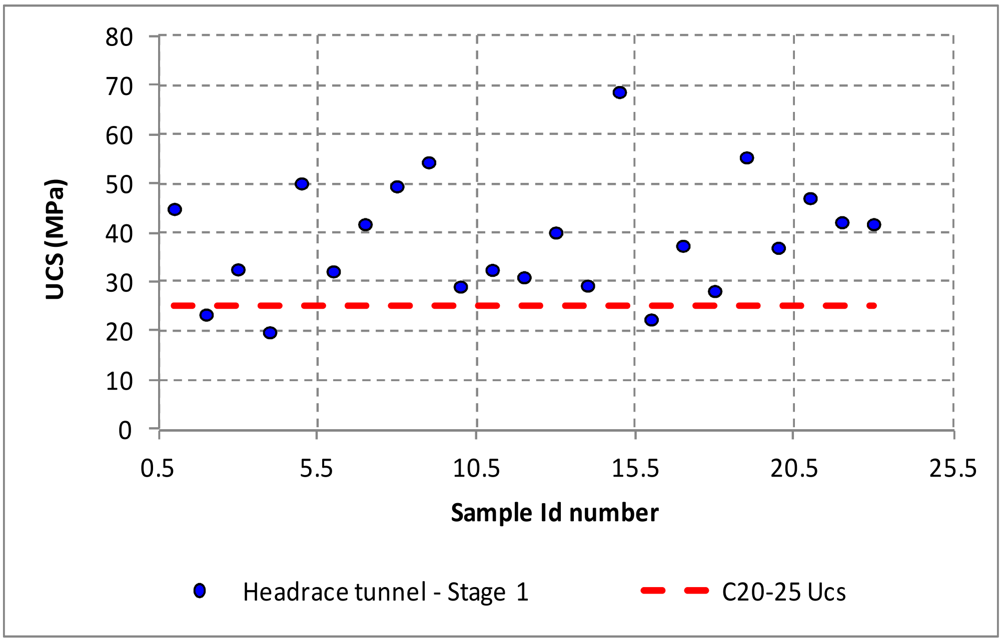
Diversion Tunnel Main and Emergency Gates Chamber

Points	Point 1	Point 2
Schmidt Hammer (Mpa)	33.9	34.8



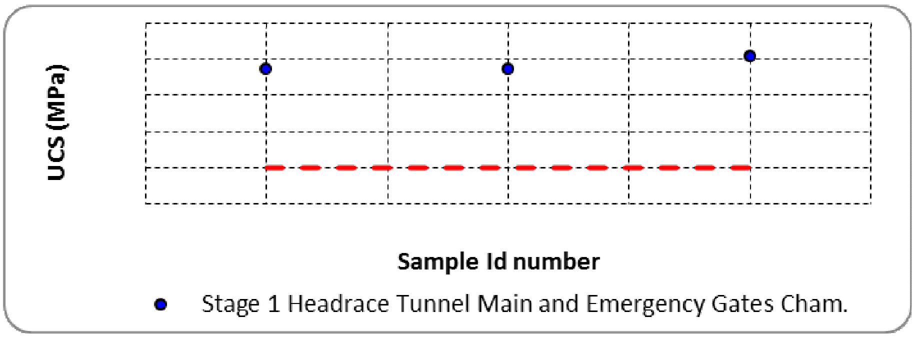
Headrace tunnel - Stage 1

Sections	Sec 1	Sec 2	Sec 3	Sec 4
Chainage	1+65	2+15	2+60	3+13
UCS Sp. 1 invert (Mpa)	45.1	32.4	31.2	28.4
UCS Sp. 2 invert (Mpa)		42	40.3	55.6
UCS Sp. 1 Side wall (Mpa)	23.6	49.7	29.5	37.2
UCS Sp. 2 Side wall (Mpa)	32.8	54.6	68.9	47.3
UCS Sp. 1 Vault (Mpa)	20	29.3	22.6	42.4
UCS Sp. 2 Vault (Mpa)	50.3	32.7	37.6	42



Stage 1 Headrace Tunnel Main and Emergency Gates Cham.

Points	Point 1	Point 2	Point 3
Schmidt Hammer (Mpa)	38.6	38.5	40.4



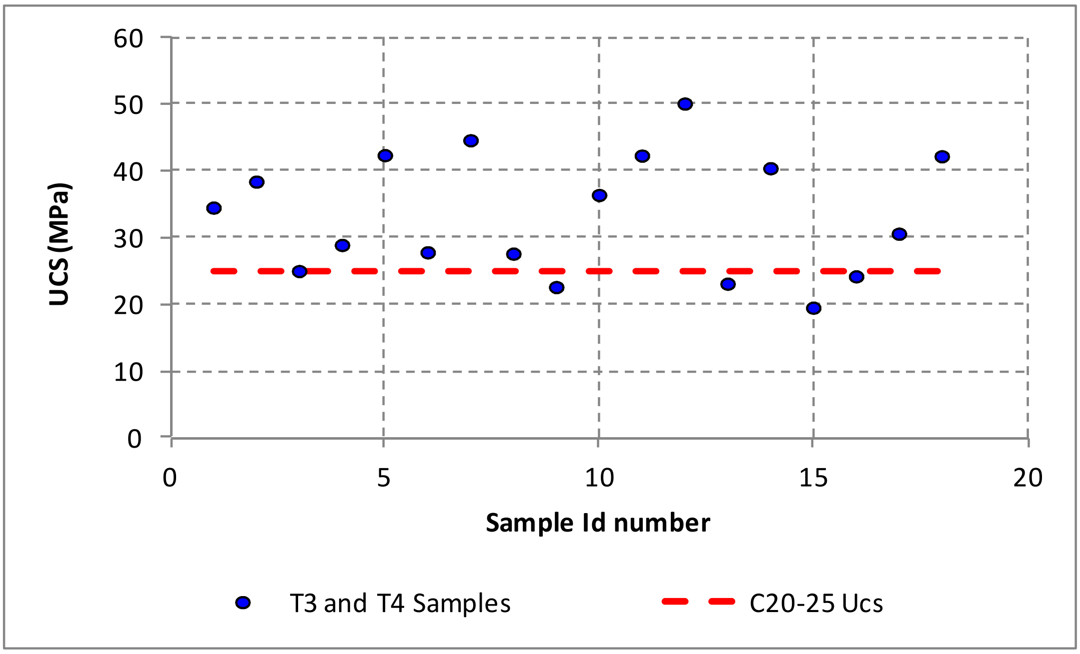
Transportation Tunnel T3

Chainage	4+43	8+60	10+60	11+95	12 +80
UCS Sp. 1 (Mpa)	34.6	25.1	29	27.9	27.7
UCS Sp. 2 (Mpa)	38.5	*	42.46	44.7	*

* Lining Thickness of 30 cm therefore only one specimen was obtained

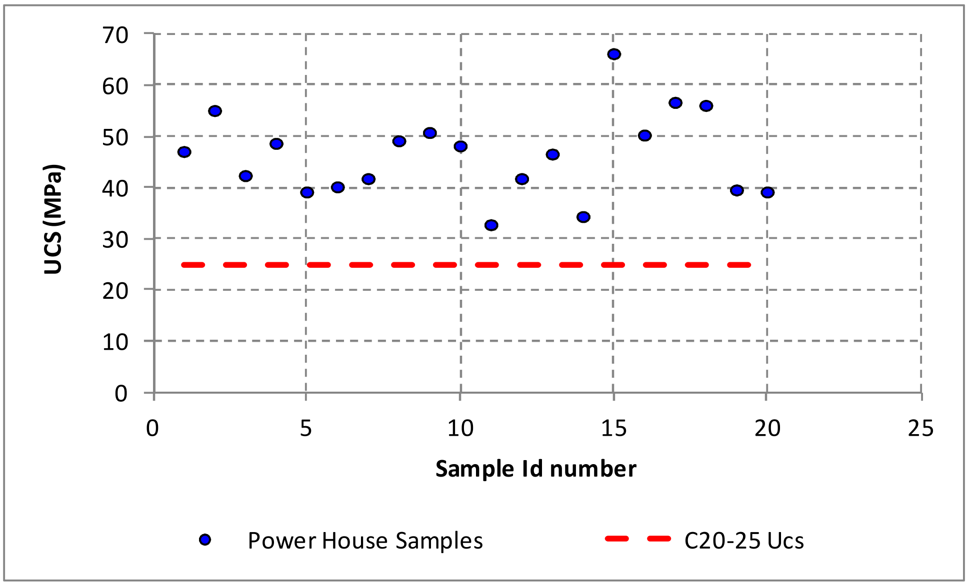
Transportation Tunnel T4

Chainage	2+05 left side	2+05 right side	3+05	4+70	7+10
UCS Sp. 1 (Mpa)	22.7	42.4	23.2	19.6	30.7
UCS Sp. 2 (Mpa)	36.5	50.2	40.5	24.3	42.3



Power House										
Sections	**Sec 1**			**Sec 2**			**Sec 3**			**Sec 4**
Chainage	**1+60 [V]**	**1+60 [SW – L]**	**1+60 [SW – R]**	**1 +80 [V]**	**1 +80 [SW – L]**	**1 +80 [SW – R]**	**2+00 [V]**	**2+00 [SW – L]**	**2 +00 [SW – R]**	**1 +90 [V]**
UCS-Sp.1 (MPa)	47.1	42.4	39.2	41.8	50.8	32.8	46.6	66.2	56.7	39.6
UCS-Sp.2 (MPa)	55.1	48.7	40.2	49.2	48.2	41.8	34.4	50.3	56.1	39.2

- [V] : Vault
- [SW – L] : Sidewall Left Side (North)
- [SW – R] : Sidewall Right Side (South)

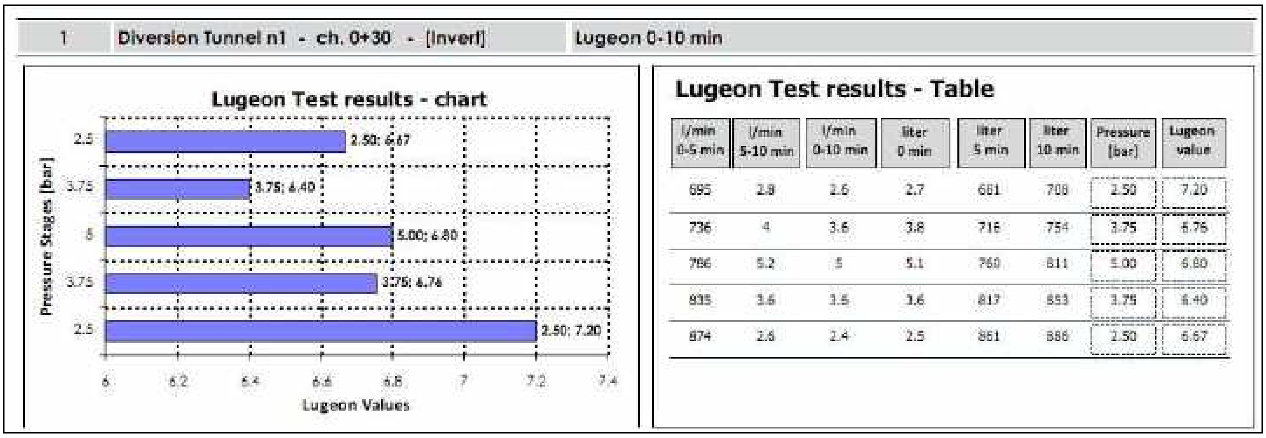


3.2 Lugeon Tests

3.2.1 Description of results

The results of the Lugeon Tests are shown in Annex 7 – part B – Lugeon Tests Results. For each test the values of injected water in term of volume were recorded in three different instants: once reaching the pressure step value, 5 minutes after having reached the pressure step value and ten minutes after having reached the pressure step values. The "0-5 min" , "0-10 min" and "5-10 min" labels the tests refers to the results obtained processing the recorded absorption values on the interval time specified in the label.

For each test the values Lugeon units are plotted in the graphs shown in the Annex 7 – part B



1 Diversion Tunnel n1 - ch. 0+30 - [Invert] Lugeon 0-10 min

Lugeon Test results - chart

Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
695	2.8	2.6	2.7	681	708	2.50	7.20
736	4	3.6	3.8	716	754	3.75	6.76
786	5.2	5	5.1	760	811	5.00	6.80
835	3.6	3.6	3.6	817	853	3.75	6.40
874	2.8	2.4	2.5	861	888	2.50	6.67

The sheet shows in the title:

The record number :	1
The structure:	Diversion tunnel n°1
The chainage of the test location:	0+30
The position in the section:	Invert
The time interval:	Lugeon 0-10 min

On the right side of each record the table with the complete set of tests values is shown and the bar chart on the right side plots the two last column of the table :

- Pressure stages
- Lugeon unit corresponding to the specific pressure stage

The tests performed in the Diversion Tunnel n°1, Diversion Tunnel n°2 and Stage 1 Head Race Tunnel are listed in the following paragraphs showing the chainage where the tests were performed, the location (invert, sidewall or crown) and the time interval adopted as reference for the calculation of the absorption rate.

3.2.2 Test performed in Diversion Tunnel n°1

The tests performed in the Diversion Tunnel n°1 are 24, and the results obtained for the different time interval are 72 :

Chainage	Lugeon 0-10 min	Lugeon 0-5 min	Lugeon 5-10 min	Total
0+30	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
1+30	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
2+30	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
4+75	**2**	**2**	**2**	**6**
Sidewall	1	1	1	3
Vault	1	1	1	3
5+75	**3**	**3**	**3**	**9**
Sidewall	2	2	2	6
Vault	1	1	1	3
6+50	**4**	**4**	**4**	**12**
Invert	1	1	1	3
Sidewall	2	2	2	6
Vault	1	1	1	3
7+60	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
8+70	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
Grand Total	**24**	**24**	**24**	**72**

3.2.3 Test performed in Diversion Tunnel n°2

The tests performed in the Diversion Tunnel n°2 are 23 and the results obtained for different time interval are 69:

Chainage	Lugeon 0-10 min	Lugeon 0-5 min	Lugeon 5-10 min	Grand Total
0+25	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
1+25	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
2+25	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
5+20	**2**	**2**	**2**	**6**
Sidewall	1	1	1	3
Vault	1	1	1	3
5+25	**1**	**1**	**1**	**3**
Sidewall	1	1	1	3
6+20	**3**	**3**	**3**	**9**
Sidewall	2	2	2	6
Vault	1	1	1	3
7+25	**2**	**2**	**2**	**6**
Invert	1	1	1	3
Vault	1	1	1	3
7+26	**1**	**1**	**1**	**3**
Sidewall	1	1	1	3
7+28	**1**	**1**	**1**	**3**
Sidewall	1	1	1	3
8+17	**1**	**1**	**1**	**3**
Sidewall	1	1	1	3
8+25	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
Grand Total	**23**	**23**	**23**	**69**

3.2.4 Test performed in the Stage 1 Head Race Tunnel

The tests performed in the Stage 1 headrace tunnel are 12 and the results obtained for different time interval are 32 because for two tests only the time interval 0-10 min was recorded:

Chainage	Lugeon 0-10 min	Lugeon 0-5 min	Lugeon 5-10 min	Grand Total
1+60	**3**	**3**	**3**	**9**
Invert	1	1	1	3
Sidewall	1	1	1	3
Vault	1	1	1	3
2+15	**3**	**2**	**2**	**7**
Invert	1			1
Sidewall	1	1	1	3
Vault	1	1	1	3
2+60	**3**	**2**	**2**	**7**
Invert	1			1
Sidewall	1	1	1	3
Vault	1	1	1	3
3+13	**1**	**1**	**1**	**3**
Vault	1	1	1	3
3+15	**2**	**2**	**2**	**6**
Invert	1	1	1	3
Sidewall	1	1	1	3
Grand Total	**12**	**10**	**10**	**32**

4 Conclusions and Recommendations

4.1 Uniaxial compression tests

Concerning the Uniaxial compression Tests on the concrete Samples drilled from a selected group of underground structures, the results are positive showing concrete compression strength values higher than 25 MPa.

Only three specimens of the Stage 1 Head Race Tunnel and 4 specimens on the Transportation Tunnel T4 gave strength values minor than 25 MPa.

As already stated in the introduction of this document the results of the tests cannot be used for defining the characteristic cubic compression strength of the concrete of the different structures due to the small number of samples in comparison with the total concrete volume to be tested. It is to be noted that a specific test campaign with the scope to determine the characteristic design values of the concrete in the present state was out of the scope of work.

The obtained results, however, give important elements for considering in the structural verifications as conservative value, a concrete compression strength of 25 MPa.

4.2 Lugeon Tests

The analysis of the results is performed on the data recorded on the 0-10 min time step; this time interval is deemed the most appropriate in order to achieve more reliable results in term of Lugeon Values giving the possibility to the flow to reach a condition closer to the Steady flow regimen.

The Lugeon tests were analyzed adopting the interpretation derived from Houlsby (1976). According to this Method the representative hydraulic conductivity values should be selected based on the behavior observed in the Lugeon values computed for the different pressure Stages. The typical behaviors observed are classified in the following groups:

- **Laminar Flow:** The hydraulic conductivity of the Rock Mass is independent of the water pressure applied. This behavior is characteristic of rock Mass with low conductivity values where seepage velocities are very slow. (i.e. less that 4 Lugeons).

In this case average of Lugeon Values for all stages should be selected as representative Lugeon value.

- **Turbulent Flow**: the hydraulic conductivity decreases as water pressure increases. This behavior is characteristic of rock masses with partly open to moderately wide cracks.

In this case the Lugeon value corresponding to the highest water pressure value should be selected as representative value.

- **Dilatation**: similar hydraulic conductivities are recorded at low and medium pressures; a much greater value is observed at maximum pressure value. This behavior occurs when applied water pressure is greater than minimum principal stress in the rock mass causing temporary dilatancy of the fissures. dilatancy causes an increase in the cross sectional area available for water flow with the consequence to increase the hydraulic conductivity of the rock mass.

In this case the lowest Lugeon value should be selected as representative value.

- **Wash-out**: hydraulic conductivity increases regardless of the variation of applied water pressure indicating that water pressure causes irrecoverable damages in the rock mass due to infilling wash-out or permanent rock movements.

In this case the highest Lugeon value should be selected as representative value

- **Void filling**: hydraulic conductivities decrease as the test proceeds independently on the changes observed in the water pressure applied. This behavior indicates that discontinuities and cavities are progressively clogged by fine material or by swelling phenomena in discontinuities.

In this case the Final Lugeon value should be selected as representative value.

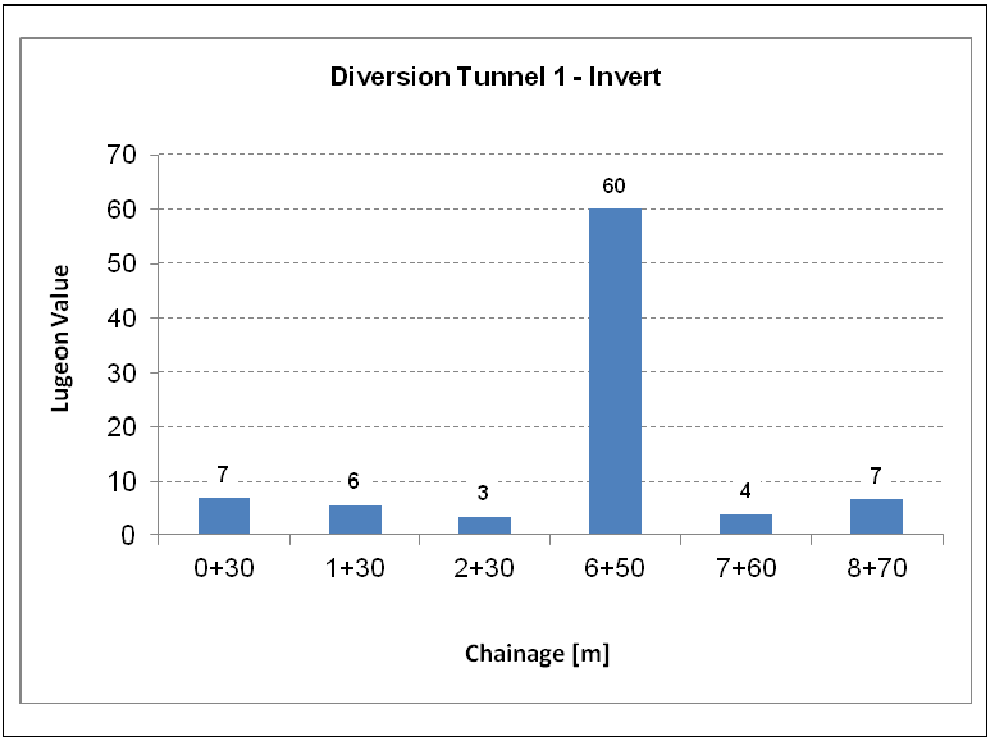
When Behavior is not declared in the tables means that values of Lugeon are not representative of one of the above mentioned cases.

The following tables and graphs shows the representative Lugeon values selected for the different chainage where the test were performed:

4.2.1 Diversion Tunnel n°1

Diversion Tunnel 1 - Invert					
ID	Chainage	Location	Behavior		
1	0+30	Invert	L	Laminar	7
10	1+30	Invert	L	Laminar	6
19	2+30	Invert	L	Laminar	3
43	6+50	Invert	A		60
55	7+60	Invert	L	Laminar	4
64	8+70	Invert	L	Laminar	7

[A] : Anomalous Value (one value different from the other but behavior not classified as above described standard behavior)



In correspondence of chainage 6+50 the Lugeon Value of 60 evidences a significant increment of the hydraulic conductivity of the rock mass surrounding the Tunnel lining. The section at Chainage 6+50 of Diversion Tunnel n° 1 is located between the junctions of the collector of units 4-5-6 and the collector of Units 1-2-3 with the Diversion tunnel. This section is the one analyzed both with the Rock Load approach and with the Rock –

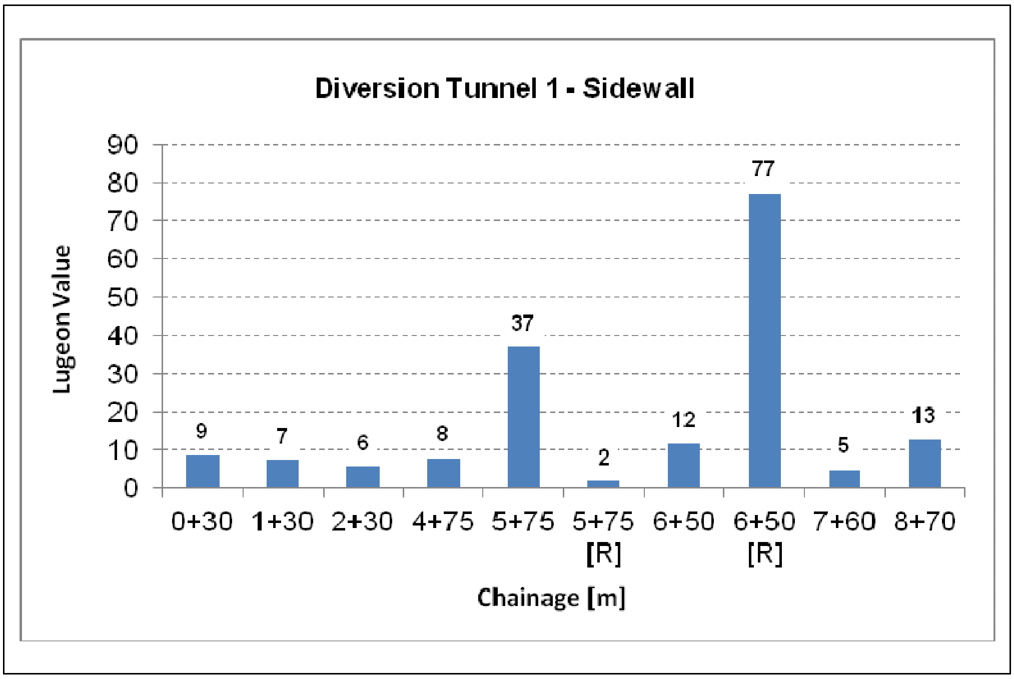
structure interaction approach and for which recommendations has been proposed for remedial works.

Grouting campaign is deemed necessary in order to decrease the hydraulic conductivity of the rock mass.

The following table shows the results of the Lugeon tests for Sidewall of the Diversion Tunnel 1:

Diversion Tunnel 1 - Sidewall

4	0+30	Sidewall	L	Laminar	9
13	1+30	Sidewall	L	Laminar	7
22	2+30	Sidewall	L	Laminar	6
28	4+75	Sidewall	A		8
34	5+75	Sidewall	L	Laminar	37
37	5+75 [R]	Sidewall	A		2
46	6+50	Sidewall	L	Laminar	12
49	6+50 [R]	Sidewall	L		77
58	7+60	Sidewall	L	Laminar	5
67	8+70	Sidewall	L	Laminar	13



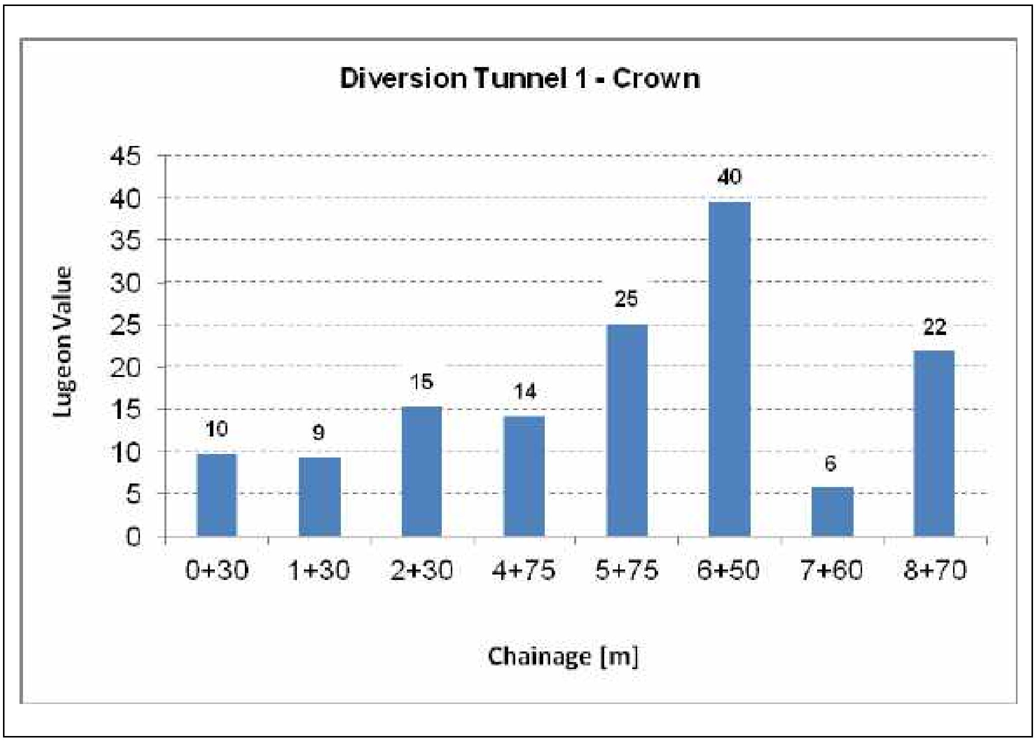
The same problem occurs at the Sidewall of sections at chainage 5+75 and 6+50. Because of these negative results obtained in the first test a second test was performed in section 5+75 and 6+50 extending the length of the injection tested hole to in order to verify if the high conductivity values were characteristic of the first three meter thickness of rock mass surrounding the tunnel or the same values were representative of the hydraulic conductivity of a wider rock portion.

The result obtained in the sidewall of section at chainage 5+75 the second test, indicated with 5+50 [R], indicate Lugeon Value lower than the first test. On the contrary the second test repeated in section at chainage 6+50 , indicated with 6+50 [R], evidences the persistency of high hydraulic conductivity of the lining surrounding rock mass also at wider distance from the lining extrados.

These results confirm the necessity of an additional grouting campaign in order to decrease the hydraulic conductivity of the rock mass.

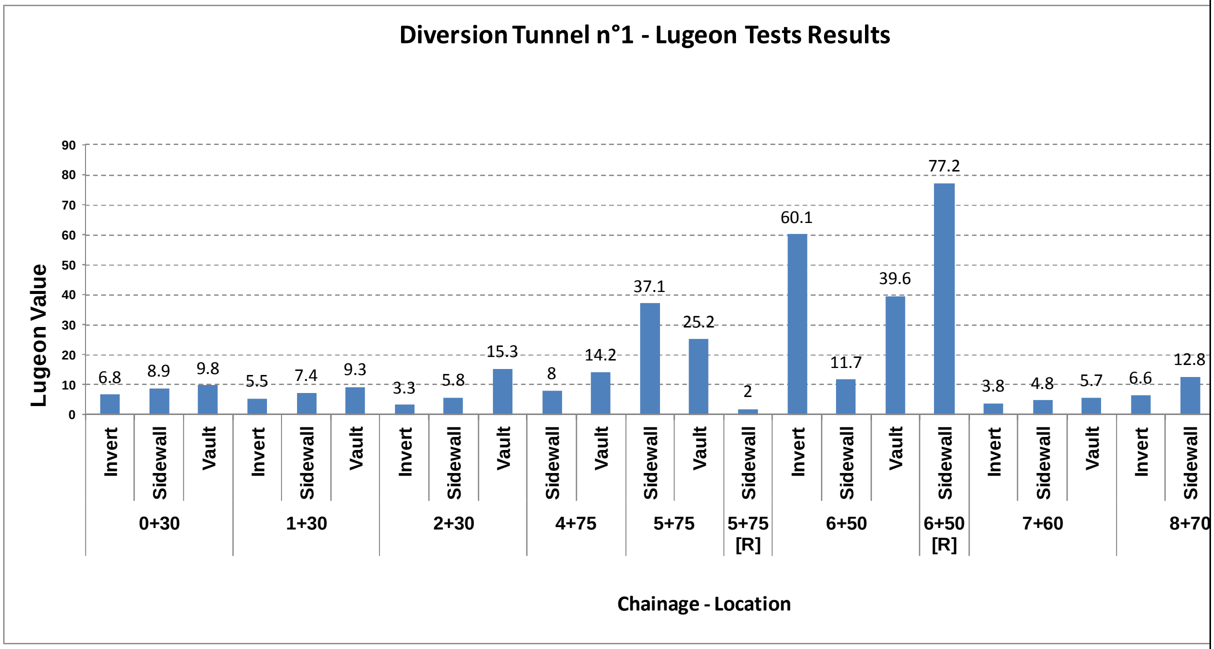
The following table shows the results of the tests performed in the Crown of the diversion tunnel 1

Diversion Tunnel 1 - Crown					
7	0+30	Vault	L	Laminar	10
16	1+30	Vault	L	Laminar	9
25	2+30	Vault	L	Laminar	15
31	4+75	Vault	A		14
40	5+75	Vault	L	Laminar	25
52	6+50	Vault	L	Laminar	40
61	7+60	Vault	L	Laminar	6
70	8+70	Vault	A		22



The results of the tests in the crown confirm the high hydraulic conductivity values for section at chainage 6+50 and show also values to be reduced with additional grouting injection in sections at chainage 5+75 and 8+70.

The following table summarizes the results for the diversion tunnel n°1 showing the representative Lugeon Values for the tested sections at different chainage and for each section the results for the invert, the Sidewall and the Crown are put in graph.



The table clearly shows that the tunnel stretches:

- from chainage 5+75 to chainage 6+50
- in correspondence of chainage 8+70

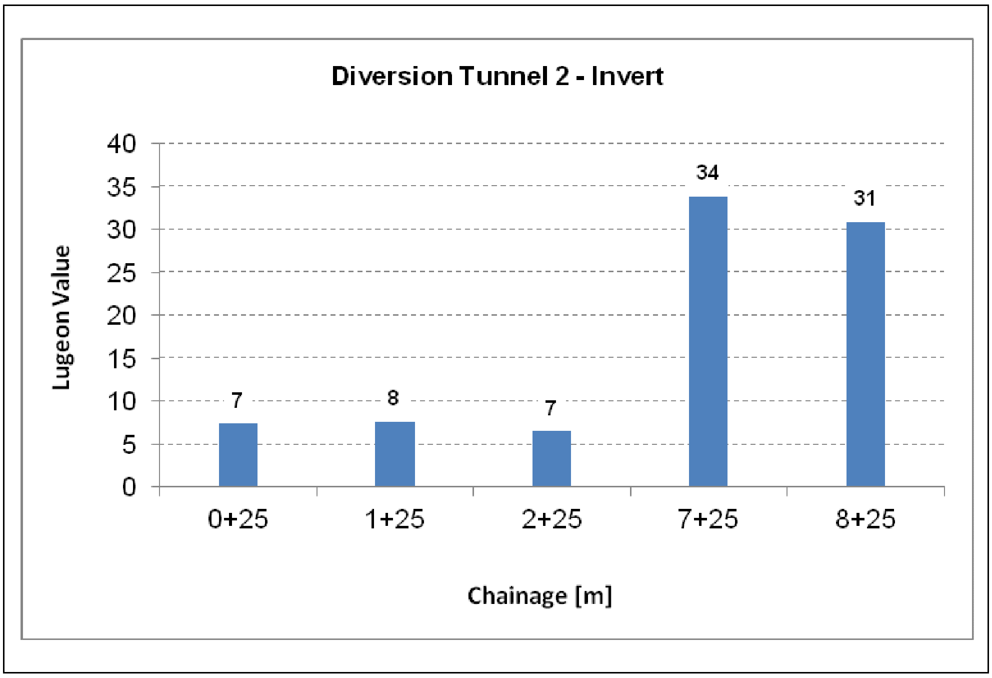
are characterized by high conductivity values and for these stretches a consolidation grouting treatment is deemed necessary extending the portion to be treated to an extent to be set with additional Lugeon tests because the available results do not give information for the tunnel portion intermediate to the tested ones but gave the possibility to evidence the existence of critical situations to be more detailed analyzed with further investigations.

4.2.2 Diversion Tunnel n°2

The following table show the results of tests performed in the Diversion Tunnel n°2 – Invert:

Diversion Tunnel n°2 - Invert

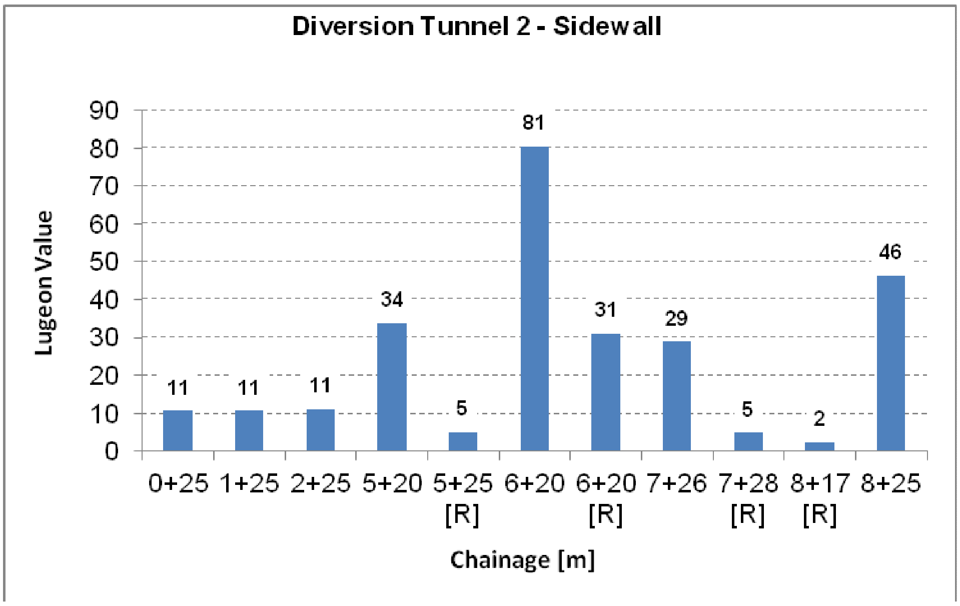
73	0+25	Invert	L	Laminar	7
172	1+25	Invert	A		8
89	2+25	Invert	L	Laminar	7
116	7+25	Invert	L	Laminar	34
131	8+25	Invert	L	Laminar	31



The results show high conductivity values for the stretch between chainage 7+25 and chainage 8+25. This stretch is located in correspondence of the Fault 35 (chainage 7+25) in the Lower Obigarm formation close to the concrete culvert that crosses the river (chainage 8+25).

The following table show the results of tests performed in the Diversion Tunnel n°2 – Sidewall

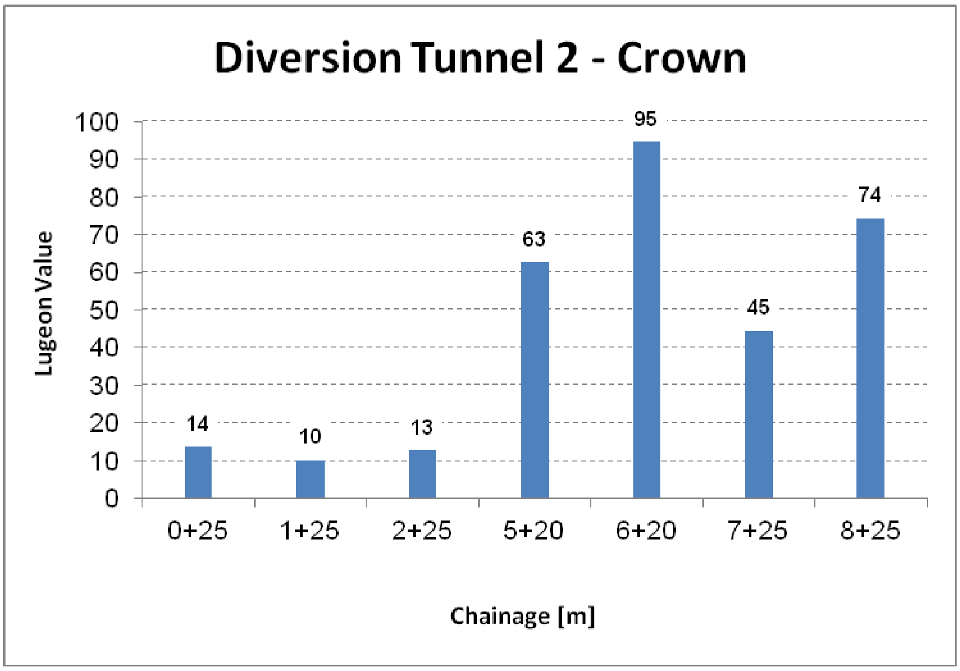
Diversion Tunnel 2 - Sidewall					
76	0+25	Sidewall	L	Laminar	11
83	1+25	Sidewall	L	Laminar	11
92	2+25	Sidewall	L	Laminar	11
98	5+20	Sidewall	L	Laminar	34
104	5+25 [R]	Sidewall	A		5
107	6+20	Sidewall	L	Lamianr	81
110	6+20 [R]	Sidewall	U		31
122	7+26	Sidewall	A		29
125	7+28 [R]	Sidewall	A		5
128	8+17 [R]	Sidewall	D	Dilatation	2
134	8+25	Sidewall	A		46



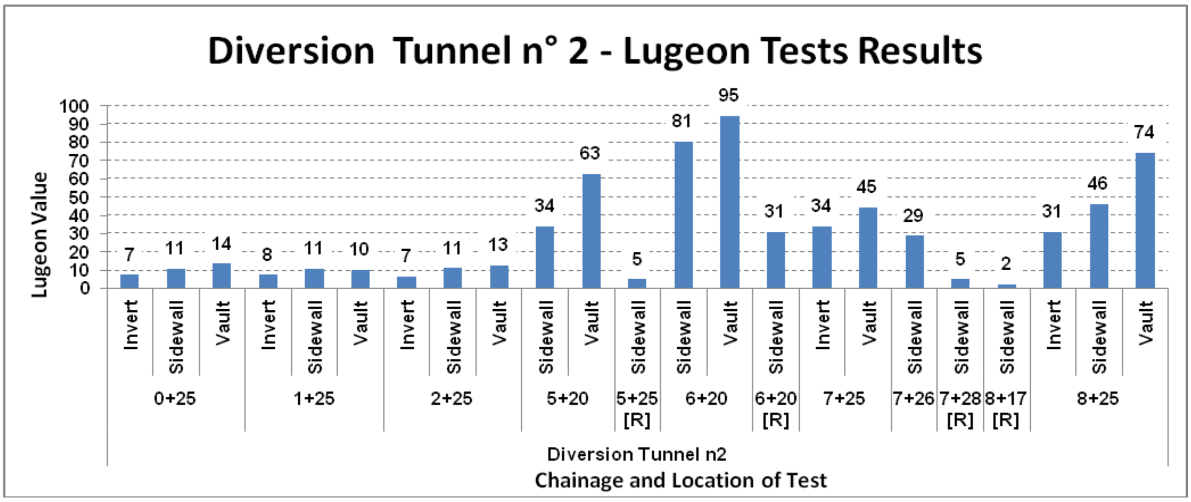
The Results on the tests performed on the sidewalls evidence high conductivity values at chainage 5+20, 6+20, 7+26 and 8+25. The additional tests repeated in the same borehole after having increased the depth of the tested portion confirm the high permeability value for section at chainage 6+20 while show that for chainage 7+26 the values obtained close to the tunnel lining significantly decrease with the radial distance from the lining itself.

The following table show the results of tests performed in the Diversion Tunnel n°2 – Crown:

Diversion Tunnel 2 - Crown					
79	0+25	Vault	A		14
86	1+25	Vault	L	Lamianr	10
95	2+25	Vault	L	Laminar	13
101	5+20	Vault	U		63
113	6+20	Vault	A		95
119	7+25	Vault	A		45
137	8+25	Vault	T	Turbulent	74



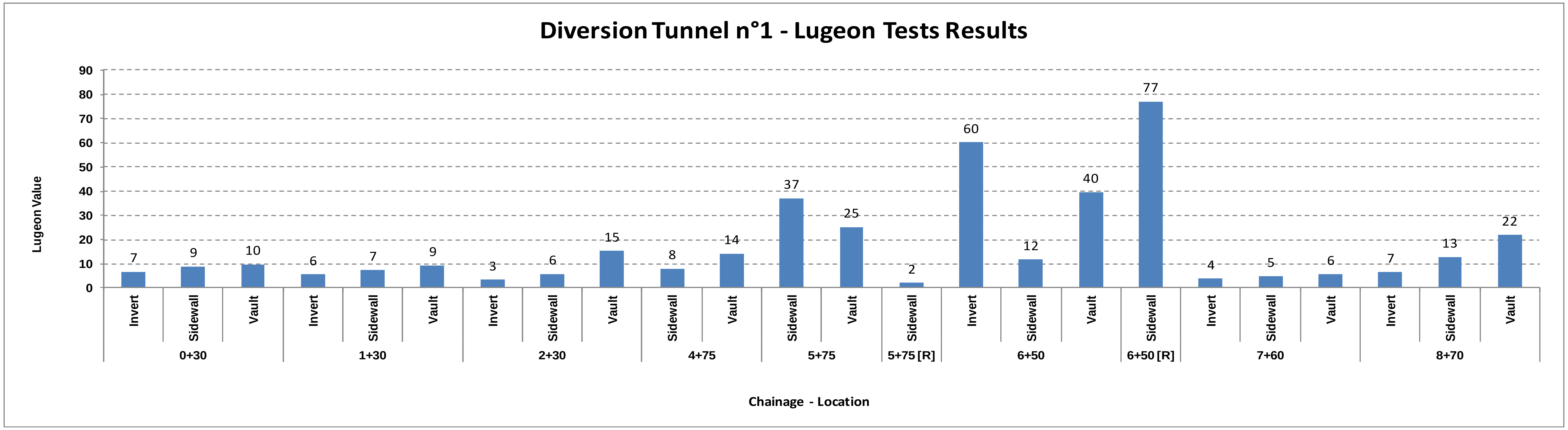
The results of tests performed on the Diversion 2 - Crown confirm the results already obtained for the invert and the sidewall. The stretch from chainage 5+20 to chainage 8+25 is characterized by high conductivity values and needs to be treated with additional consolidation grouting injections.

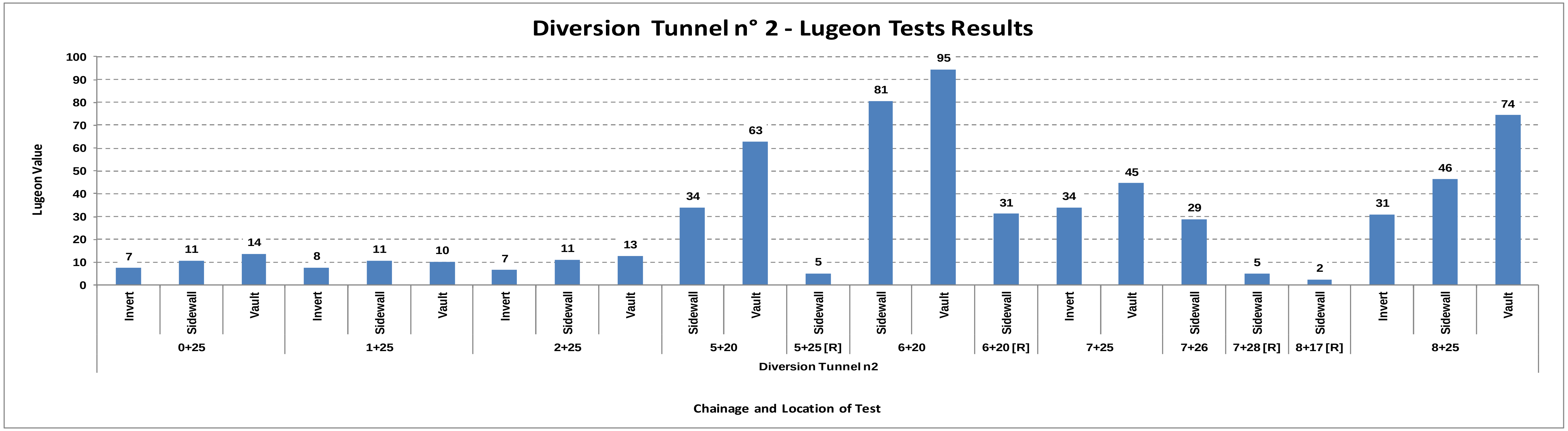


The graph summarizes the conductivity values along the Diversion Tunnel n°2. For each chainage the Lugeon Values of the tests performed at the Invert, sidewall and Crown are plotted.

It is evident the significant increase of hydraulic conductivity for the stretch from chainage 5+20 to chainage 8+25. For this stretch additional consolidation grouting treatment is deemed necessary in order to guarantee the effectiveness of the tunnel drainage system in controlling the values of hydrostatic pressure on lining extrados.

4.2.3 Comparison of Results Diversion 1 – Diversion 2





4.2.4 Summary of Recommendations for Diversion Tunnel 1 & 2

The comparison of the test results performed along the Diversion Tunnel 1 and 2 evidences that:

- In general the distribution of permeability values between the two diversion tunnel are substantially comparable even though the Lugeon values along Diversion n° 2 are systematically somewhat higher than the correspondent ones along the Diversion Tunnel n°1. This fact could be due to a more effective grouting treatment carried out along the Diversion Tunnel 1. In Particular along the stretch of Diversion Tunnel 1, from chainage 7+60 to chainage 8+70, where substantial remedial measures had been undertaken after the collapse, the recorded permeability values are very low.

- In general it is deemed necessary to decrease the rock mass permeability along those stretches characterized by values higher than 5 Lugeon Units, That means the need for additional consolidation grouting treatment especially from chainage 5+20 to chainage 8+70 of both tunnels excluding the stretch interested by repair works carried out in the Tunnel n°1.

- In particular for Tunnel n°1 and perhaps involving also Tunnel n° 2 the tests performed at chainage 6+50 show extremely high permeability values that are not in relation with geological features but are the results of the concentration of the effect of excavation activities concerning the intersection between the collector of Units 4-5-6, the Collector of units 1-2-3 and the Diversion Tunnels, that were not followed by suitable water-tightness restore through appropriate grouting injections.

- Another critical point that requires proper grouting treatment both for Diversion n°1 and n°2 is located at chainage 5+20 in correspondence of the Fault n°70. It is to be noted that in this section Lugeon Values up to 60 were recorded.

- Additional grouting treatment only for Diversion tunnel n°2 is necessary for section at chainage 8+25 in correspondence of the Fault n° 35. It is to be noted that in this section Lugeon Values up to 70 were recorded. This behavior is not present in Diversion Tunnel n°1 due to already mentioned grouting intervention carried out at the time of remedial works.

It is reiterated that additional grouting treatment, according to the above statements, are necessary to guarantee the effectiveness of the tunnel drainage system in controlling the values of hydrostatic pressure on lining extrados.

It is to be underlined that the control of the external pressure on the lining is one of the key points governing the future detailed design of the interventions, on the already constructed underground structures, recommended in the document at hand

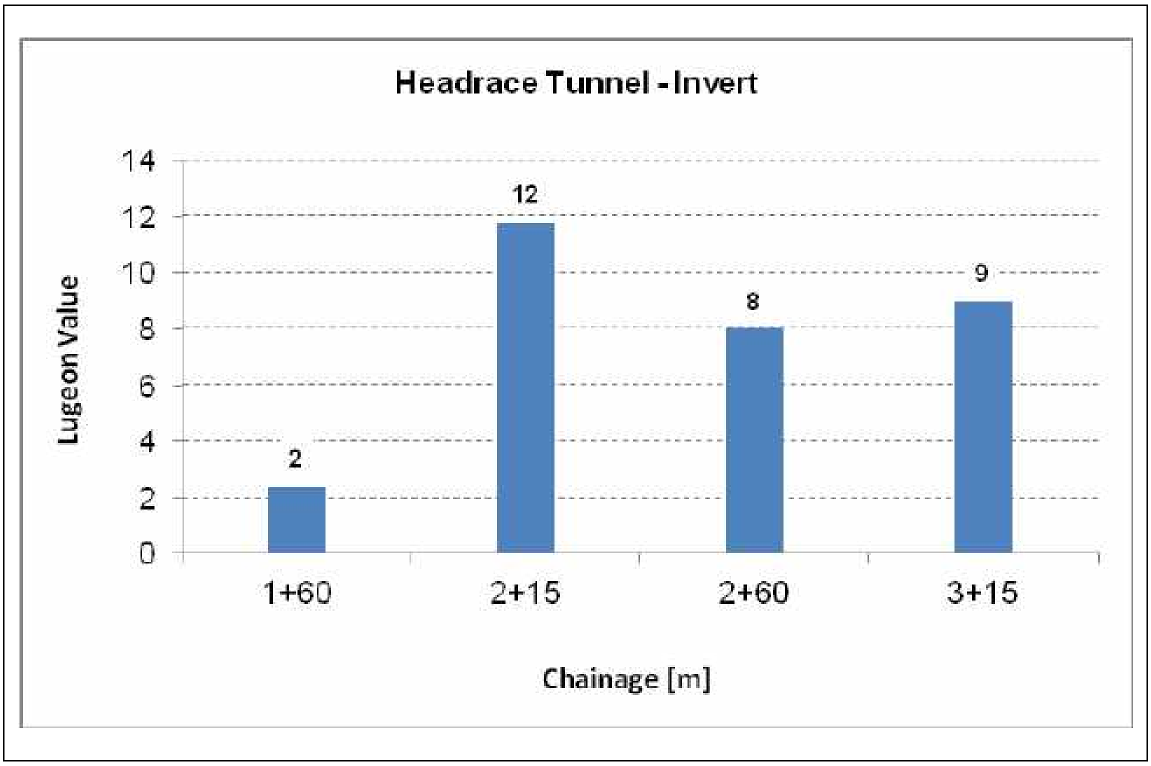
4.2.5 Headrace Tunnel

As far as the temporary headrace tunnel is concerned it is to be noted that it has been equipped with a drainage holes system and, therefore, the permeability of the surrounding rock mass is to be strictly controlled for two reasons:

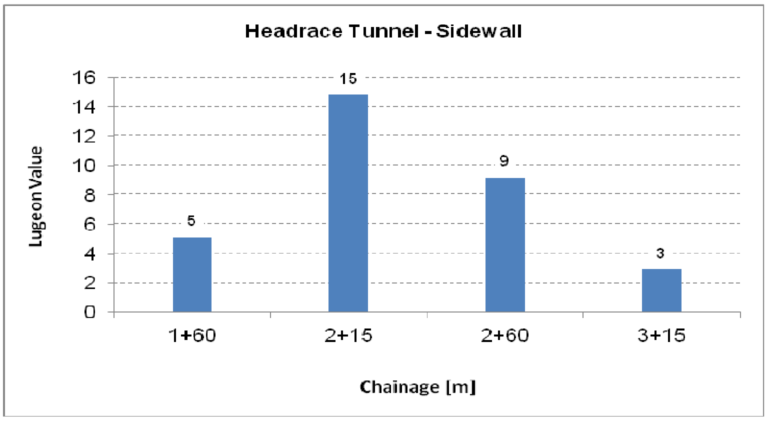
- The drainage system must work effectively in controlling the hydrostatic pressure in the case of tunnel emptying consequent to reservoir draw down.
- During the operation of the tunnel excessive leakage through the drainage holes is to be prevented/controlled

The following tables and graphs show the results of tests performed in the temporary headrace tunnel in the invert, sidewall and crown.

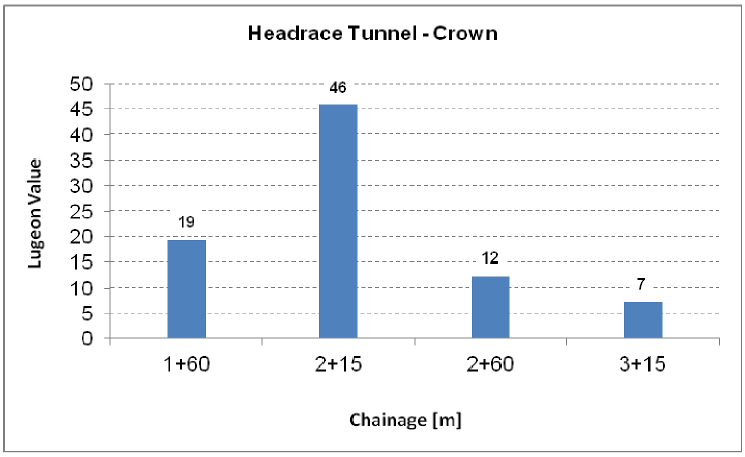
Headrace Tunnel - Invert					
140	1+60	Invert	T	Turbulent	2
174	2+15	Invert	W	Wash-out	12
175	2+60	Invert	L	Laminar	8
166	3+15	Invert	A		9



Headrace Tunnel - Sidewall					
143	1+60	Sidewall	L	Laminar	5
150	2+15	Sidewall	T	Turbulent	15
157	2+60	Sidewall	A		9
169	3+15	Sidewall	U		3

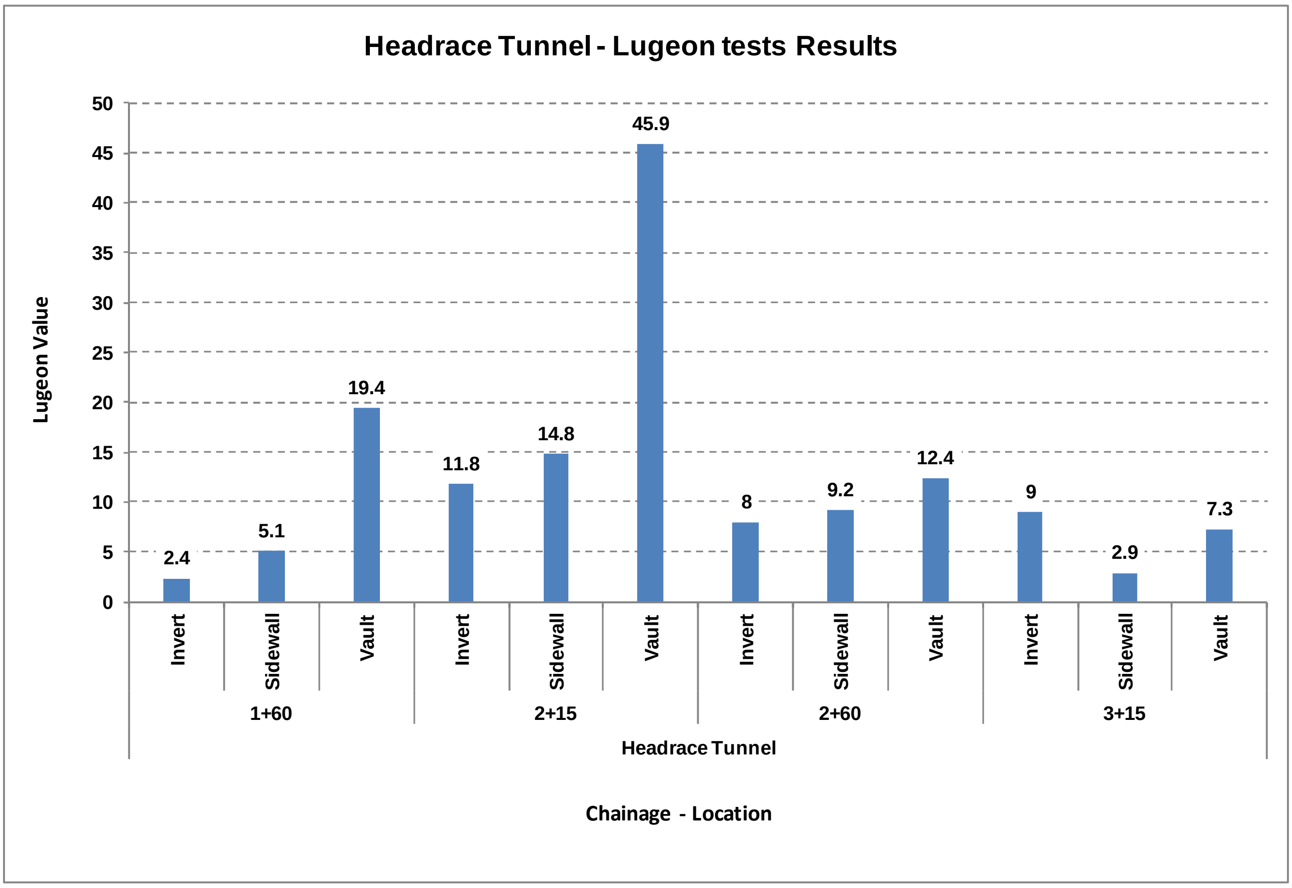


Headrace Tunnel - Crown					
146	1+60	Vault	A		19
153	2+15	Vault	A		46
160	2+60	Vault	A		12
163	3+15	Vault	T	Turbulent	7



4.2.6 Summary of recommendations on Headrace Tunnel

The following graph summarizes the tests results on the temporary headrace tunnel:



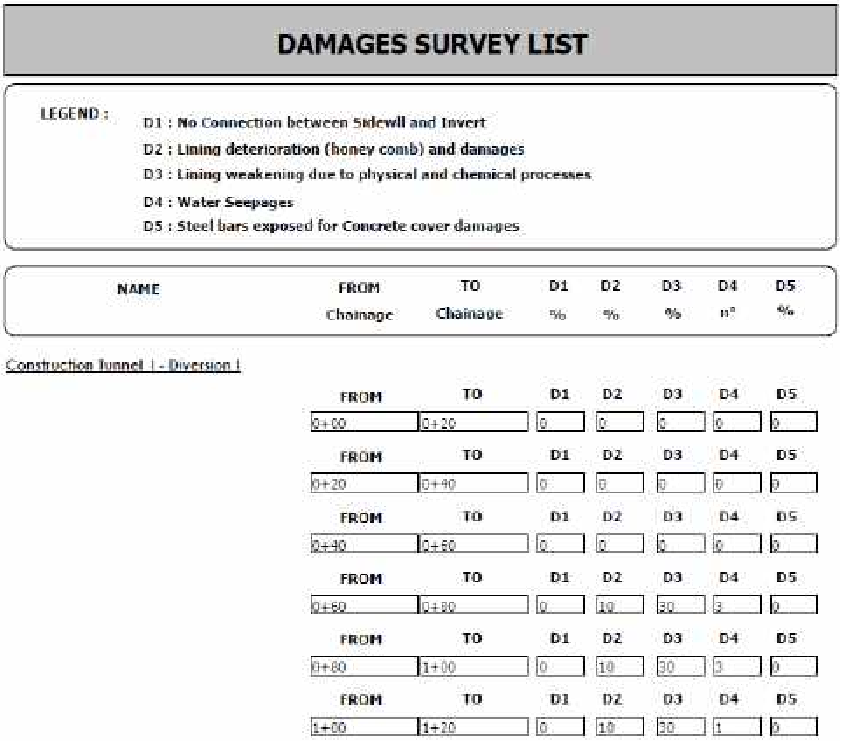
After having checked the recorded Lugeon Values it is evident that additional grouting is to be envisaged in the stretch between chainage 1+60 and 2+60; this intervention is further justified taking into account the trend evidenced by the Lugeon test cycle (chainage 2+15 – Invert) that shows wash-out behavior upon water pressure and flow application: this tendency in absence of any treatment would lead to increasing the permeability of the rock mass during tunnel operation with general worsening of tunnel behavior in relation with the points mentioned at the beginning of par. 4.2.5.

5 Tunnel inspection and defects identifications

During the same period in which Uniaxial compression tests and Lugeon tests were performed, inspections in the underground structures listed here below were carried out in order to record and describe the major construction defects present and the most evident damages occurred during the structures life time.

The inspections were carried out on:

- Diversion Tunnel n°1
- Diversion Tunnel n°2
- Transportation Tunnel T2
- Transportation Tunnel T3
- Transportation Tunnel T3'
- Transportation Tunnel T4
- Temporary headrace Tunnel



DAMAGES SURVEY LIST

LEGEND :
D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %

Construction Tunnel I - Diversion I

FROM	TO	D1	D2	D3	D4	D5
0+00	0+20	0	0	0	0	0
0+20	0+40	0	0	0	0	0
0+40	0+60	0	0	0	0	0
0+60	0+80	0	10	30	3	0
0+80	1+00	0	10	30	3	0
1+00	1+20	0	10	30	1	0

The results of these inspections are summarized in the annex 8. in sheets forms. The above figure shows the scheme of the forms. Each tunnel is divided in stretches 20 m long and damages are divided in different classes. For each stretch it is indicated the initial and final chainage, and the damages are indicated as occurrence in term of percentage of damaged area on the total area.

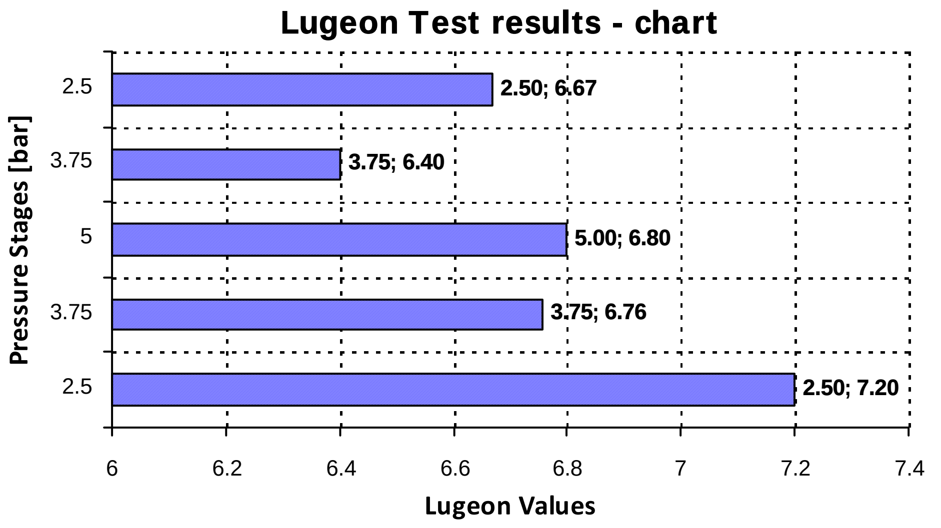
The damages detected are:

- D1: No connection between sidewall and invert
- D2. Lining Deterioration (honey combs) and local damages
- D3: Lining weakening to physical and chemical deterioration
- D4: Water Seepages
- D5: Steel bar exposed for concrete cover damages

The numbers shown in the sheet indicate the % of area interested by the specific damage on the total area of the stretch.

The following picture shows an abstract of the forms used for identifying the damages.

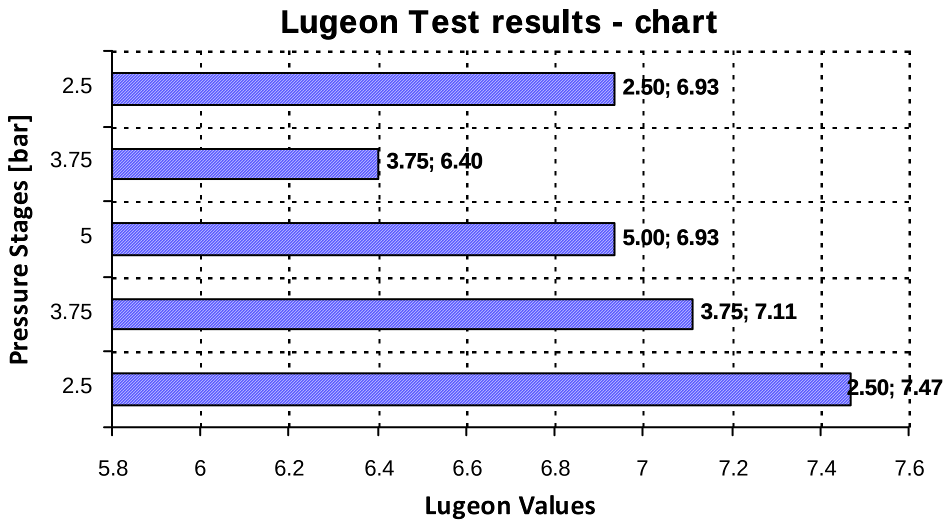
1 Diversion Tunnel n1 - ch. 0+30 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
695	2.8	2.6	2.7	681	708	2.50	7.20
736	4	3.6	3.8	716	754	3.75	6.76
786	5.2	5	5.1	760	811	5.00	6.80
835	3.6	3.6	3.6	817	853	3.75	6.40
874	2.6	2.4	2.5	861	886	2.50	6.67

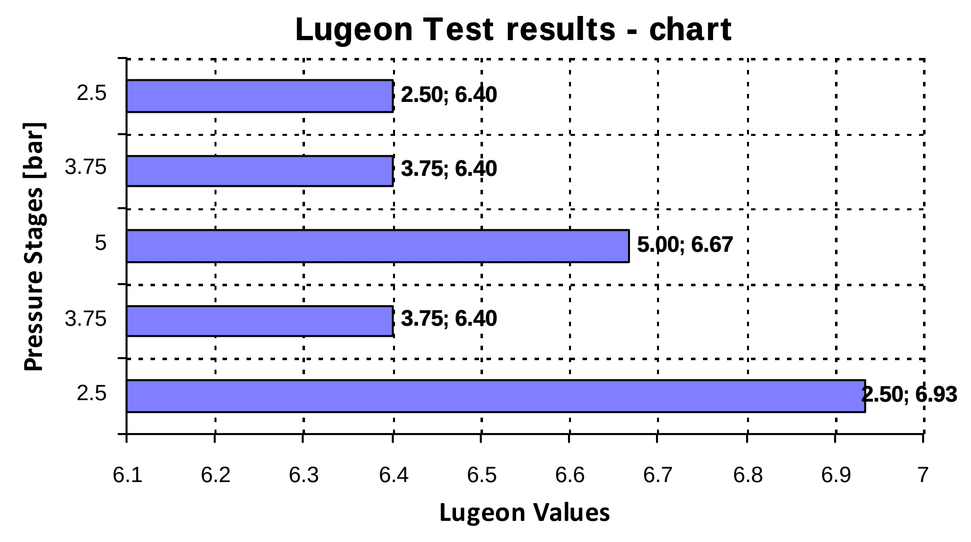
2 Diversion Tunnel n1 - ch. 0+30 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
695	2.8	2.6	2.7	681	708	2.50	7.47
736	4	3.6	3.8	716	754	3.75	7.11
786	5.2	5	5.1	760	811	5.00	6.93
835	3.6	3.6	3.6	817	853	3.75	6.40
874	2.6	2.4	2.5	861	886	2.50	6.93

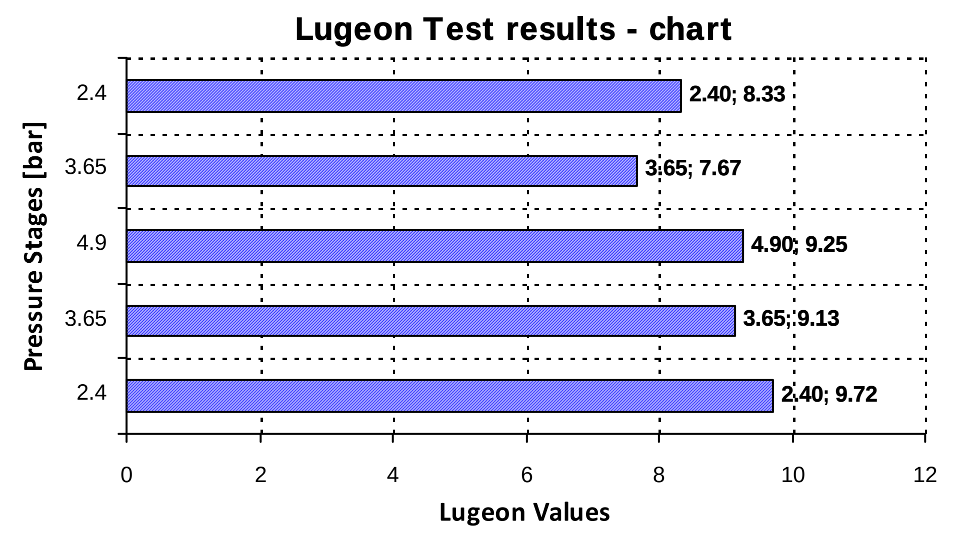
3 | Diversion Tunnel n1 - ch. 0+30 - [Invert] | Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
695	2.8	2.6	2.7	681	708	2.50	6.93
736	4	3.6	3.8	716	754	3.75	6.40
786	5.2	5	5.1	760	811	5.00	6.67
835	3.6	3.6	3.6	817	853	3.75	6.40
874	2.6	2.4	2.5	861	886	2.50	6.40

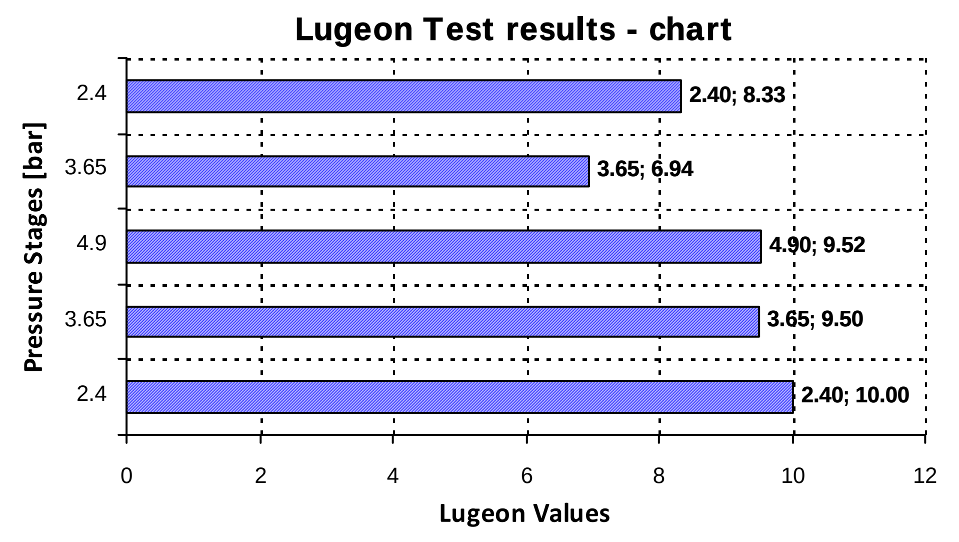
4 | Diversion Tunnel n1 - ch. 0+30 - [Sw] | Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
898	3.6	3.4	3.5	880	915	2.40	9.72
943	5.2	4.8	5	917	967	3.65	9.13
1005	7	6.6	6.8	970	1038	4.90	9.25
1062	3.8	4.6	4.2	1043	1085	3.65	7.67
1101	3	3	3	1086	1116	2.40	8.33

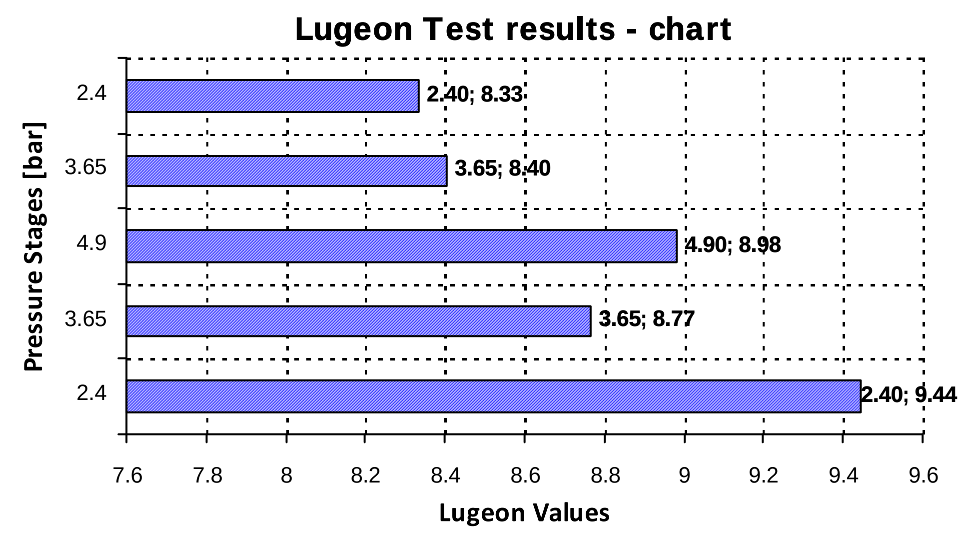
5 Diversion Tunnel n1 - ch. 0+30 - [Sw] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
898	3.6	3.4	3.5	880	915	2.40	10.00
943	5.2	4.8	5	917	967	3.65	9.50
1005	7	6.6	6.8	970	1038	4.90	9.52
1062	3.8	4.6	4.2	1043	1085	3.65	6.94
1101	3	3	3	1086	1116	2.40	8.33

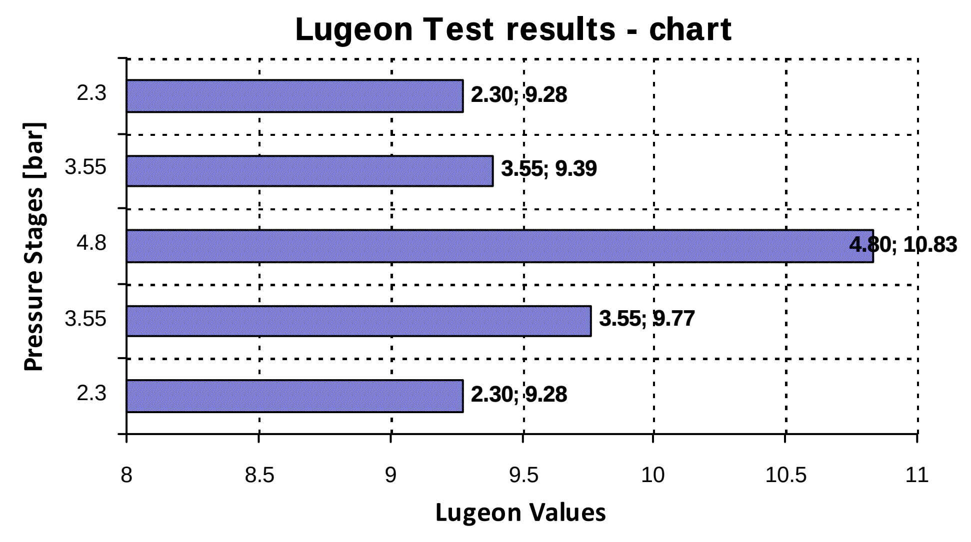
6 Diversion Tunnel n1 - ch. 0+30 - [Sw] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
898	3.6	3.4	3.5	880	915	2.40	9.44
943	5.2	4.8	5	917	967	3.65	8.77
1005	7	6.6	6.8	970	1038	4.90	8.98
1062	3.8	4.6	4.2	1043	1085	3.65	8.40
1101	3	3	3	1086	1116	2.40	8.33

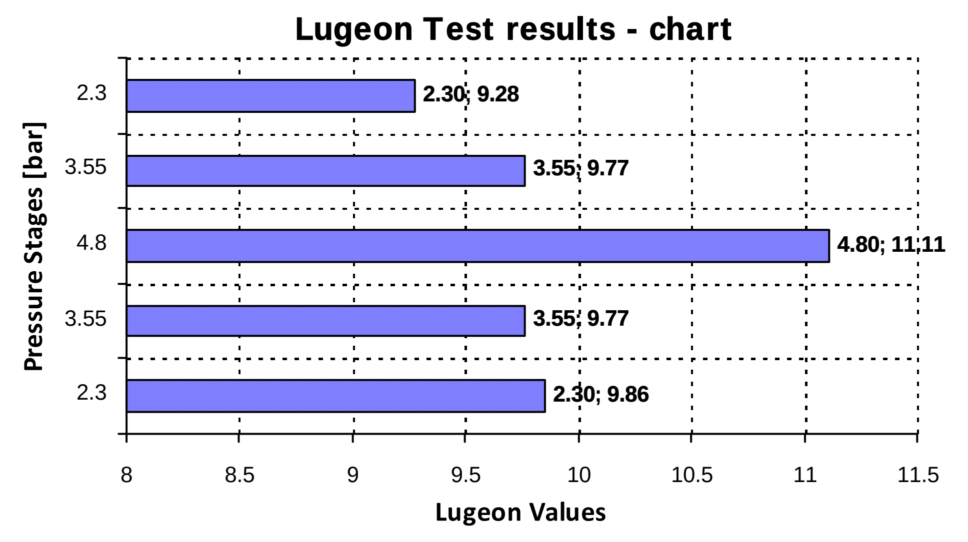
7 Diversion Tunnel n1 - ch. 0+30 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
107	3.4	3	3.2	90	122	2.30	9.28
154	5.2	5.2	5.2	128	180	3.55	9.77
231	8	7.6	7.8	191	269	4.80	10.83
296	5.2	4.8	5	270	320	3.55	9.39
337	3.2	3.2	3.2	321	353	2.30	9.28

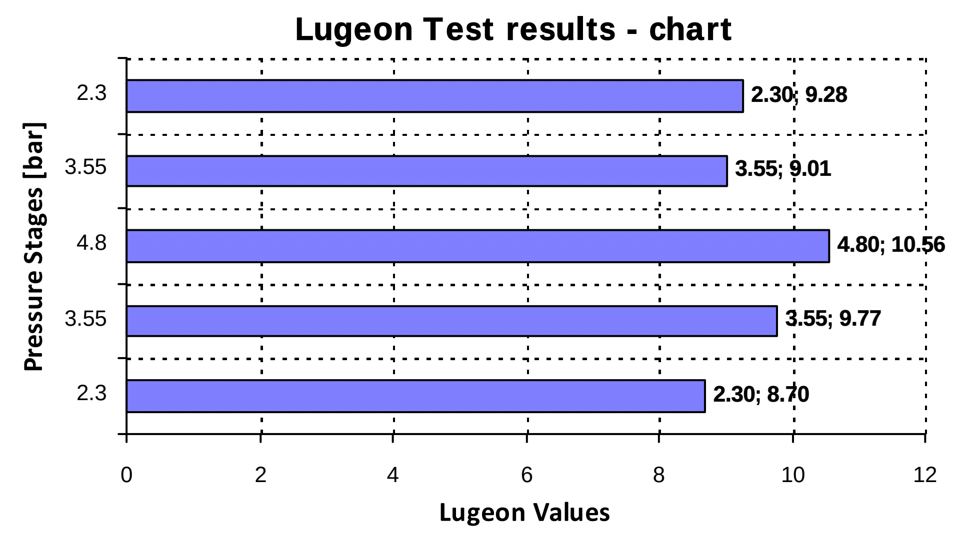
8 Diversion Tunnel n1 - ch. 0+30 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
107	3.4	3	3.2	90	122	2.30	9.86
154	5.2	5.2	5.2	128	180	3.55	9.77
231	8	7.6	7.8	191	269	4.80	11.11
296	5.2	4.8	5	270	320	3.55	9.77
337	3.2	3.2	3.2	321	353	2.30	9.28

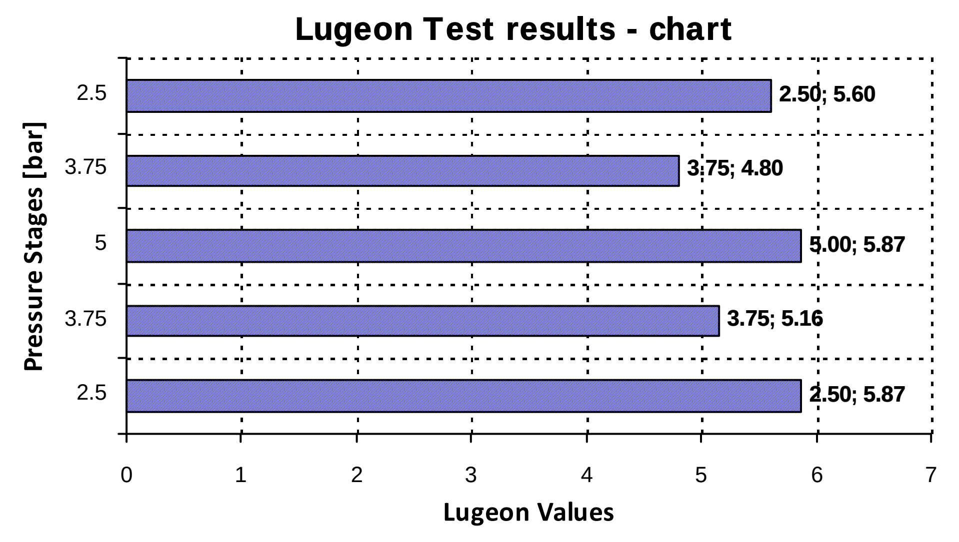
9 Diversion Tunnel n1 - ch. 0+30 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
107	3.4	3	3.2	90	122	2.30	8.70
154	5.2	5.2	5.2	128	180	3.55	9.77
231	8	7.6	7.8	191	269	4.80	10.56
296	5.2	4.8	5	270	320	3.55	9.01
337	3.2	3.2	3.2	321	353	2.30	9.28

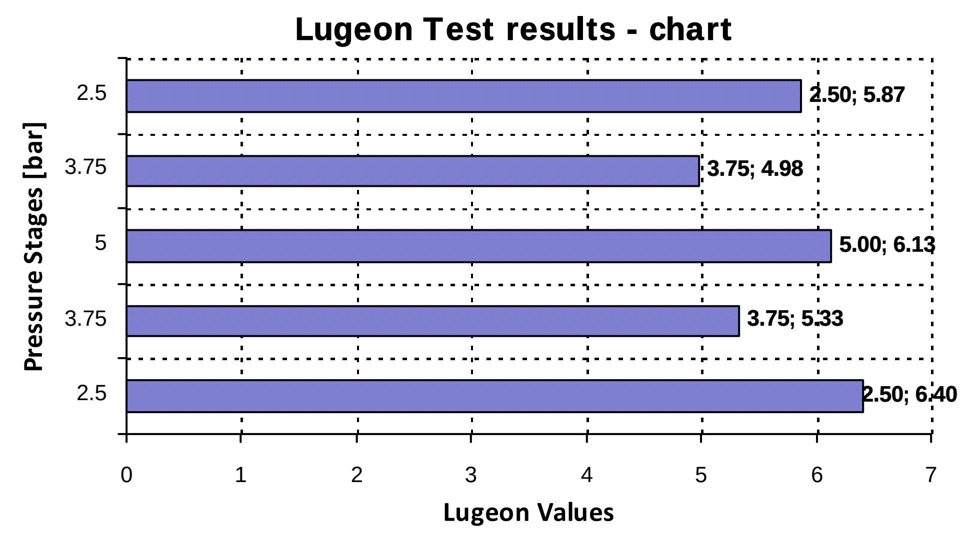
10 Diversion Tunnel n1 - ch. 1+30 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
682	2.4	2	2.2	670	692	2.50	5.87
710	3	2.8	2.9	695	724	3.75	5.16
753	4.6	4.2	4.4	730	774	5.00	5.87
790	2.8	2.6	2.7	776	803	3.75	4.80
815	2.2	2	2.1	804	825	2.50	5.60

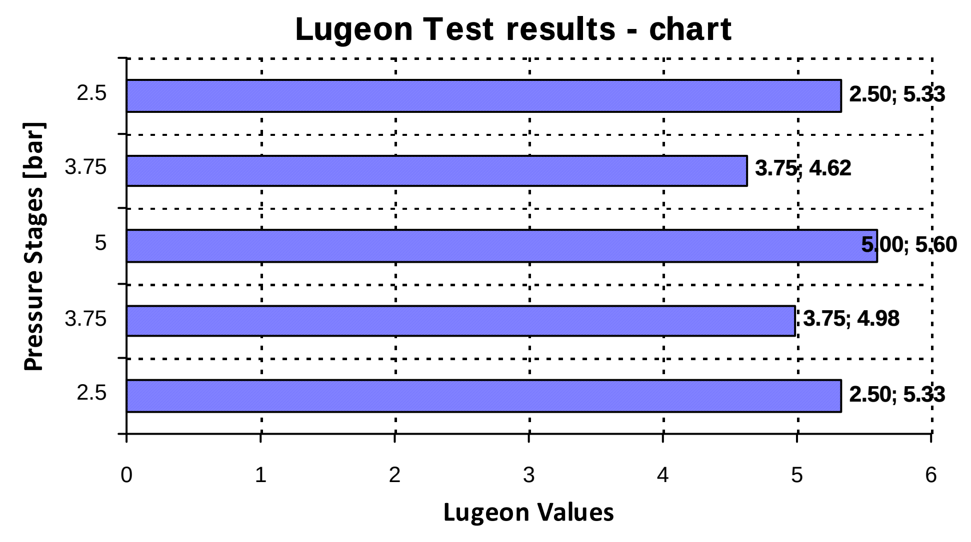
11 Diversion Tunnel n1 - ch. 1+30 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
682	2.4	2	2.2	670	692	2.50	6.40
710	3	2.8	2.9	695	724	3.75	5.33
753	4.6	4.2	4.4	730	774	5.00	6.13
790	2.8	2.6	2.7	776	803	3.75	4.98
815	2.2	2	2.1	804	825	2.50	5.87

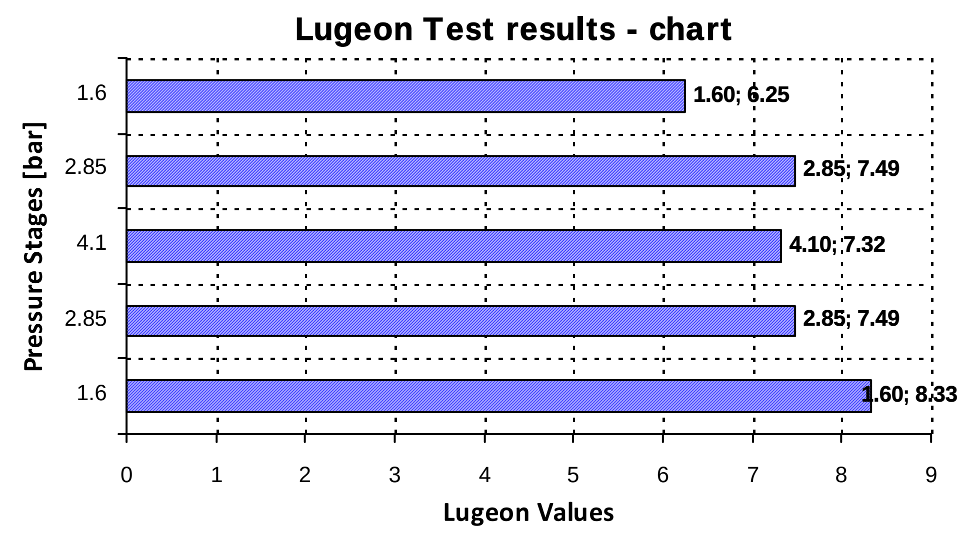
12 Diversion Tunnel n1 - ch. 1+30 - [Invert] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
682	2.4	2	2.2	670	692	2.50	5.33
710	3	2.8	2.9	695	724	3.75	4.98
753	4.6	4.2	4.4	730	774	5.00	5.60
790	2.8	2.6	2.7	776	803	3.75	4.62
815	2.2	2	2.1	804	825	2.50	5.33

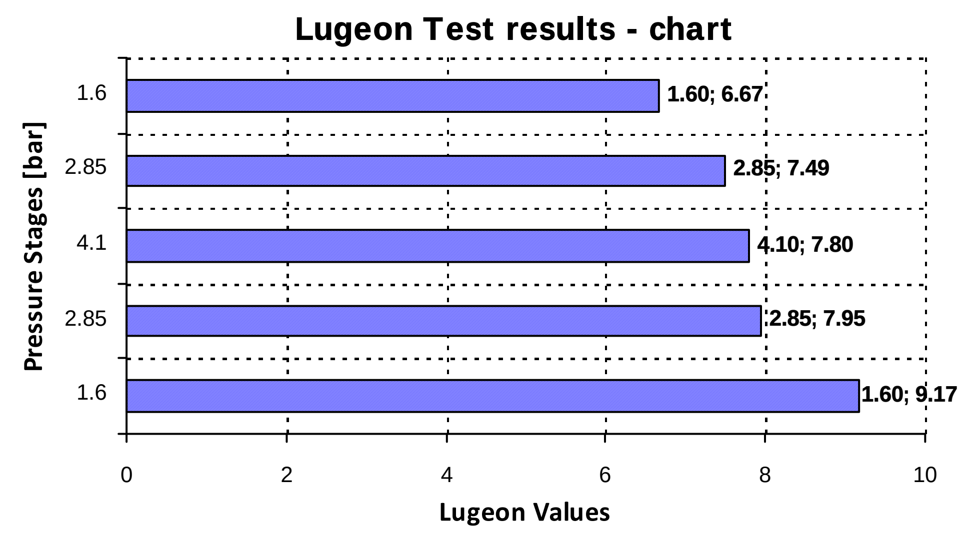
13 Diversion Tunnel n1 - ch. 1+30 - [Sidewall] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
826	2.2	1.8	2	815	835	1.60	8.33
854	3.4	3	3.2	837	869	2.85	7.49
897	4.8	4.2	4.5	873	918	4.10	7.32
939	3.2	3.2	3.2	923	955	2.85	7.49
967	1.6	1.4	1.5	959	974	1.60	6.25

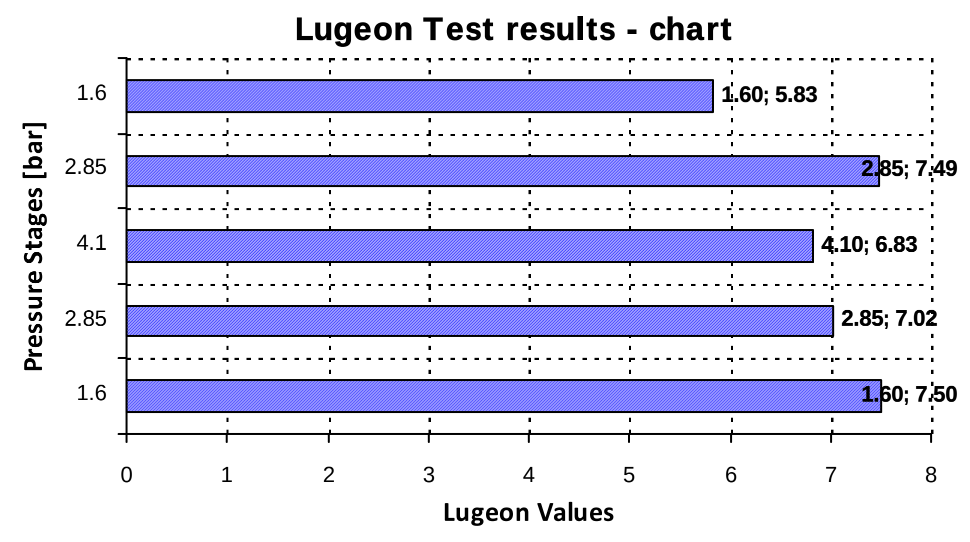
14 Diversion Tunnel n1 - ch. 1+30 - [Sidewall] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
826	2.2	1.8	2	815	835	1.60	9.17
854	3.4	3	3.2	837	869	2.85	7.95
897	4.8	4.2	4.5	873	918	4.10	7.80
939	3.2	3.2	3.2	923	955	2.85	7.49
967	1.6	1.4	1.5	959	974	1.60	6.67

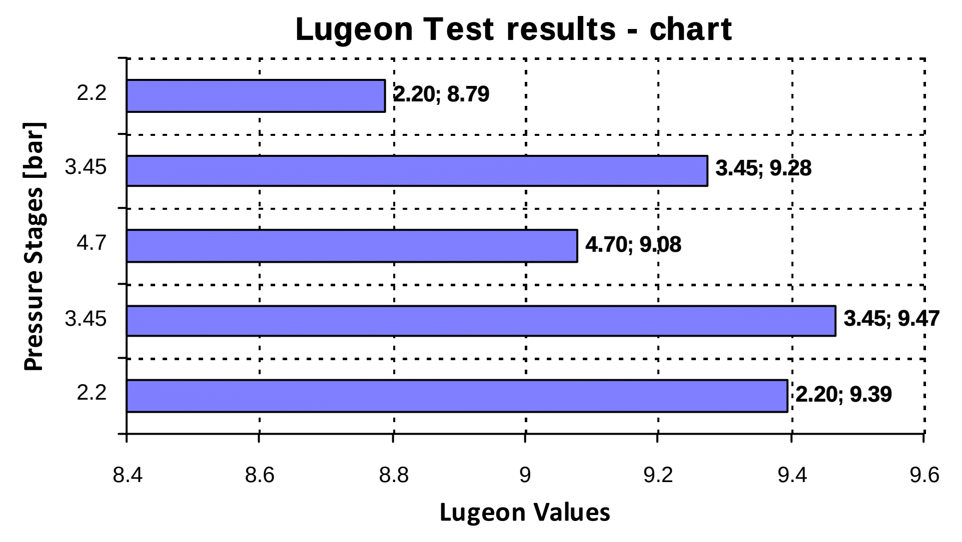
15 Diversion Tunnel n1 - ch. 1+30 - [Sidewall] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
826	2.2	1.8	2	815	835	1.60	7.50
854	3.4	3	3.2	837	869	2.85	7.02
897	4.8	4.2	4.5	873	918	4.10	6.83
939	3.2	3.2	3.2	923	955	2.85	7.49
967	1.6	1.4	1.5	959	974	1.60	5.83

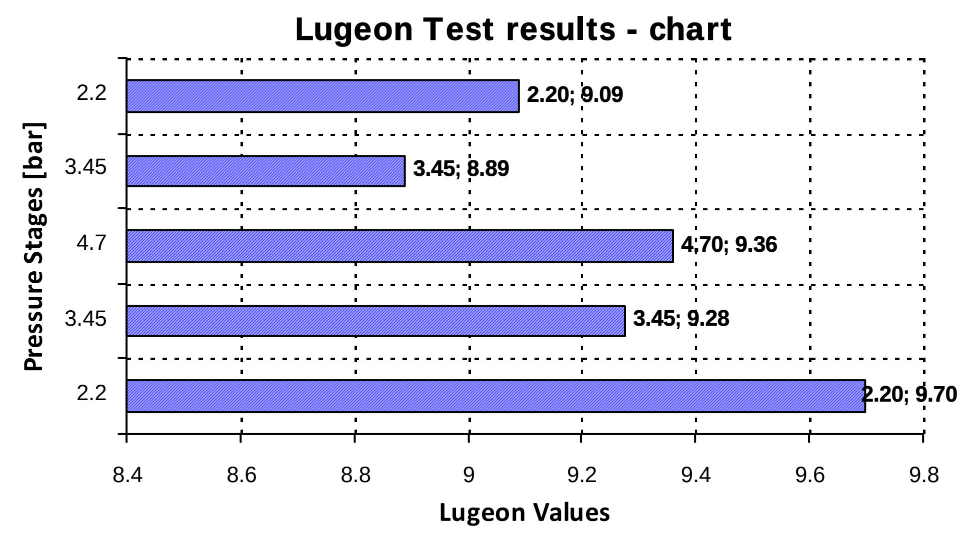
16 Diversion Tunnel n1 - ch. 1+30 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
116	3.2	3	3.1	100	131	2.20	9.39
160	4.8	5	4.9	136	185	3.45	9.47
220	6.6	6.2	6.4	187	251	4.70	9.08
279	4.6	5	4.8	256	304	3.45	9.28
324	3	2.8	2.9	309	338	2.20	8.79

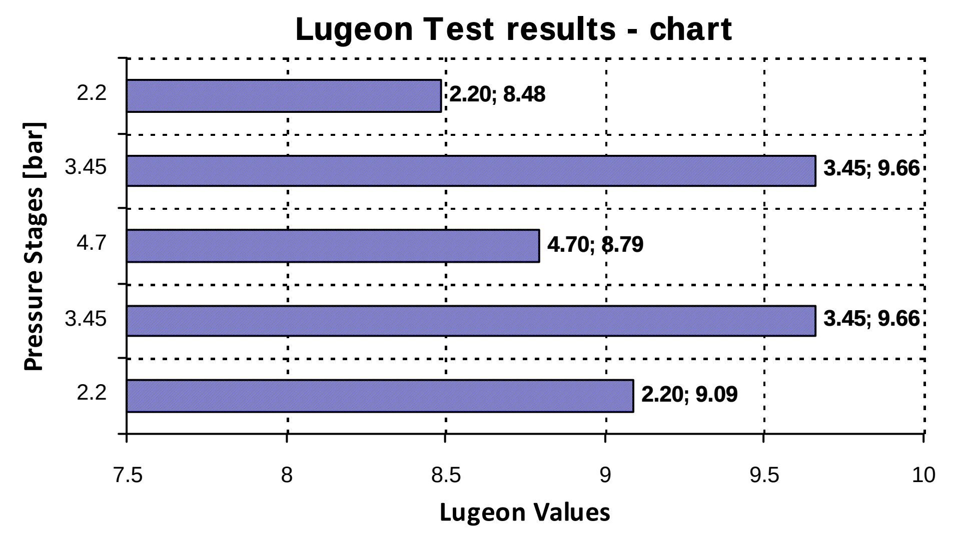
17 Diversion Tunnel n1 - ch. 1+30 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
116	3.2	3	3.1	100	131	2.20	9.70
160	4.8	5	4.9	136	185	3.45	9.28
220	6.6	6.2	6.4	187	251	4.70	9.36
279	4.6	5	4.8	256	304	3.45	8.89
324	3	2.8	2.9	309	338	2.20	9.09

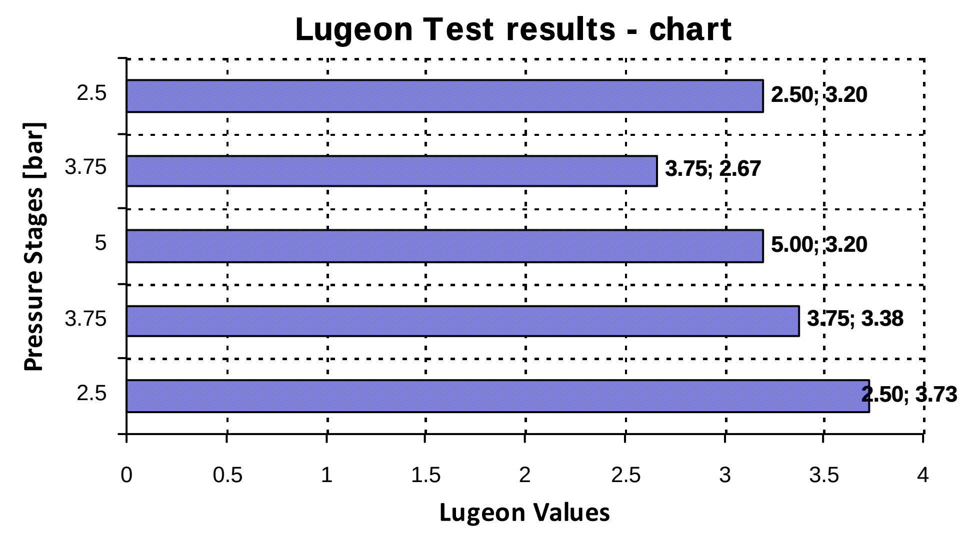
18 Diversion Tunnel n1 - ch. 1+30 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
116	3.2	3	3.1	100	131	2.20	9.09
160	4.8	5	4.9	136	185	3.45	9.66
220	6.6	6.2	6.4	187	251	4.70	8.79
279	4.6	5	4.8	256	304	3.45	9.66
324	3	2.8	2.9	309	338	2.20	8.48

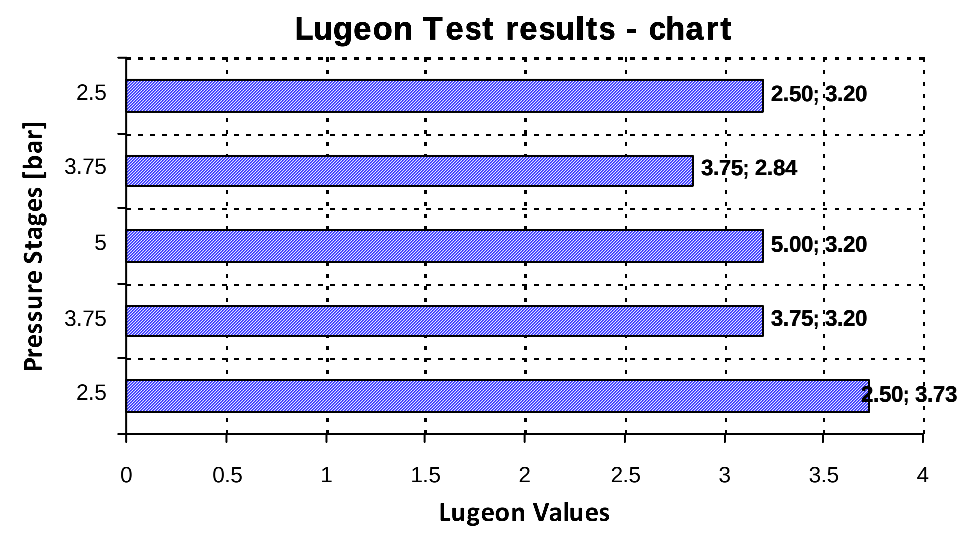
19	Diversion Tunnel n1 - ch. 2+30 - [Invert]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
113	1.4	1.4	1.4	106	120	2.50	3.73
130	1.8	2	1.9	121	140	3.75	3.38
154	2.4	2.4	2.4	142	166	5.00	3.20
175	1.6	1.4	1.5	167	182	3.75	2.67
189	1.2	1.2	1.2	183	195	2.50	3.20

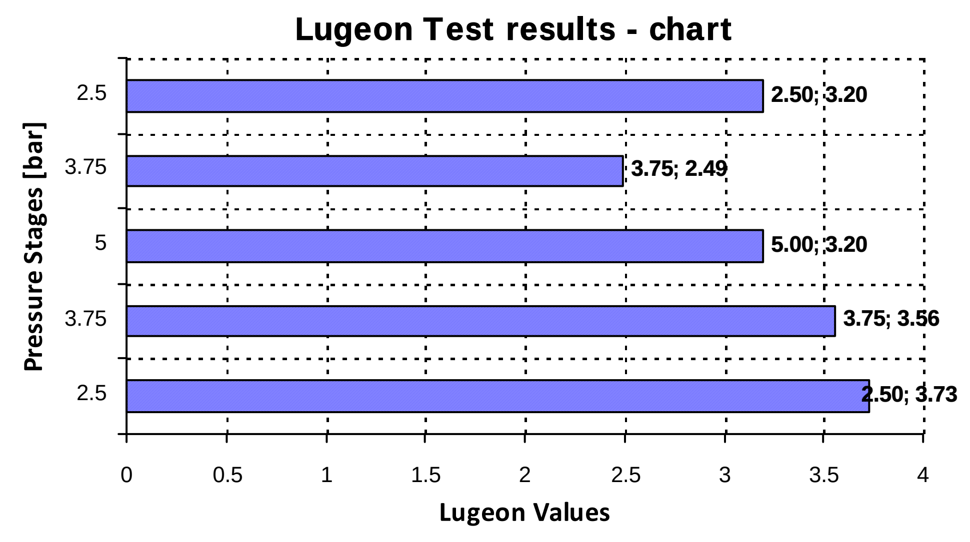
20	Diversion Tunnel n1 - ch. 2+30 - [Invert]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
113	1.4	1.4	1.4	106	120	2.50	3.73
130	1.8	2	1.9	121	140	3.75	3.20
154	2.4	2.4	2.4	142	166	5.00	3.20
175	1.6	1.4	1.5	167	182	3.75	2.84
189	1.2	1.2	1.2	183	195	2.50	3.20

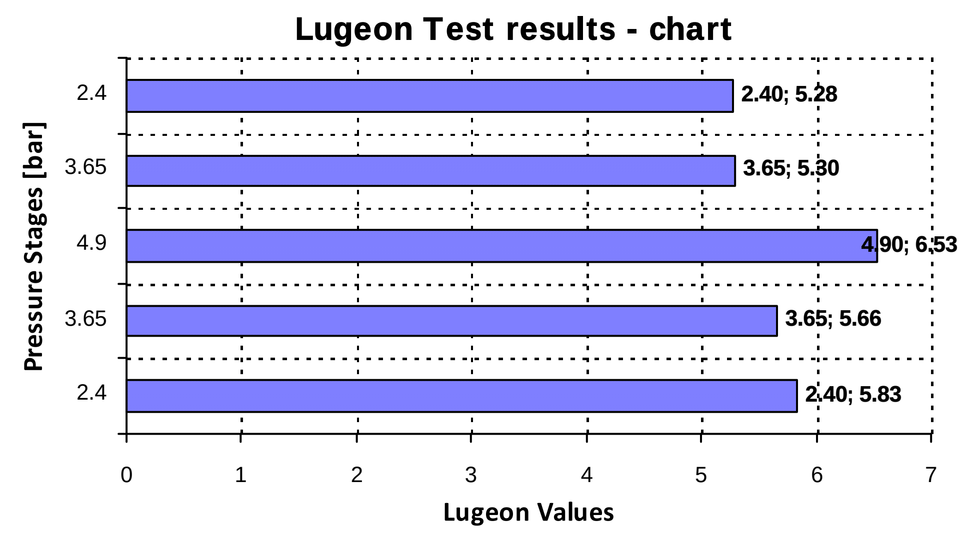
21 Diversion Tunnel n1 - ch. 2+30 - [Invert] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
113	1.4	1.4	1.4	106	120	2.50	3.73
130	1.8	2	1.9	121	140	3.75	3.56
154	2.4	2.4	2.4	142	166	5.00	3.20
175	1.6	1.4	1.5	167	182	3.75	2.49
189	1.2	1.2	1.2	183	195	2.50	3.20

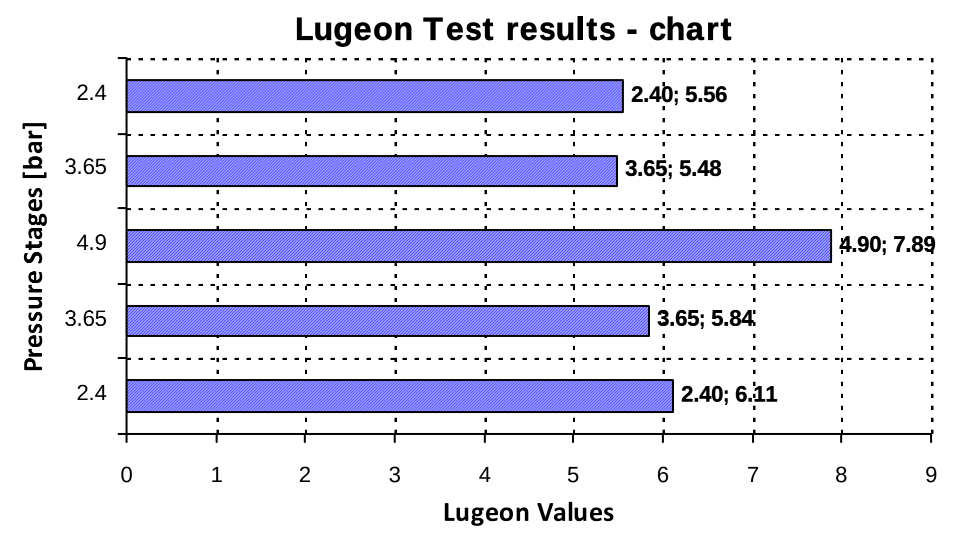
22 Diversion Tunnel n1 - ch. 2+30 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
161	2.2	2	2.1	150	171	2.40	5.83
188	3.2	3	3.1	172	203	3.65	5.66
235	5.8	3.8	4.8	206	254	4.90	6.53
271	3	2.8	2.9	256	285	3.65	5.30
296	2	1.8	1.9	286	305	2.40	5.28

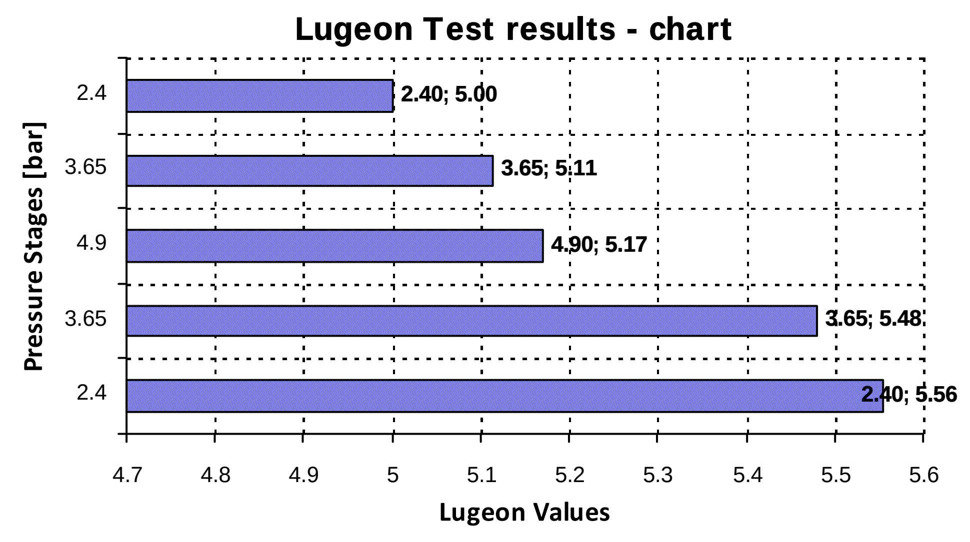
23 Diversion Tunnel n1 - ch. 2+30 - [Sw] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
161	2.2	2	2.1	150	171	2.40	6.11
188	3.2	3	3.1	172	203	3.65	5.84
235	5.8	3.8	4.8	206	254	4.90	7.89
271	3	2.8	2.9	256	285	3.65	5.48
296	2	1.8	1.9	286	305	2.40	5.56

24 Diversion Tunnel n1 - ch. 2+30 - [Sw] Lugeon 5-10 min

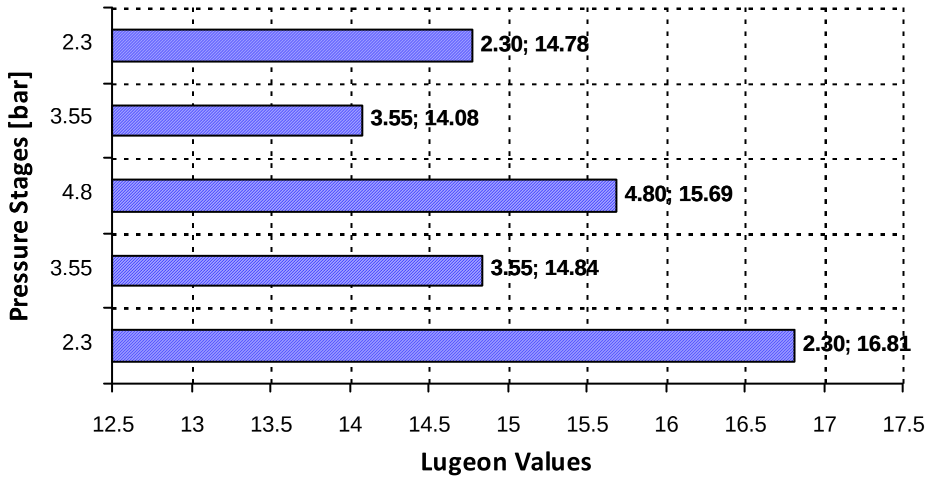


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
161	2.2	2	2.1	150	171	2.40	5.56
188	3.2	3	3.1	172	203	3.65	5.48
235	5.8	3.8	4.8	206	254	4.90	5.17
271	3	2.8	2.9	256	285	3.65	5.11
296	2	1.8	1.9	286	305	2.40	5.00

25 Diversion Tunnel n1 - ch. 2+30 - [Vault] Lugeon 0-10 min

Lugeon Test results - chart

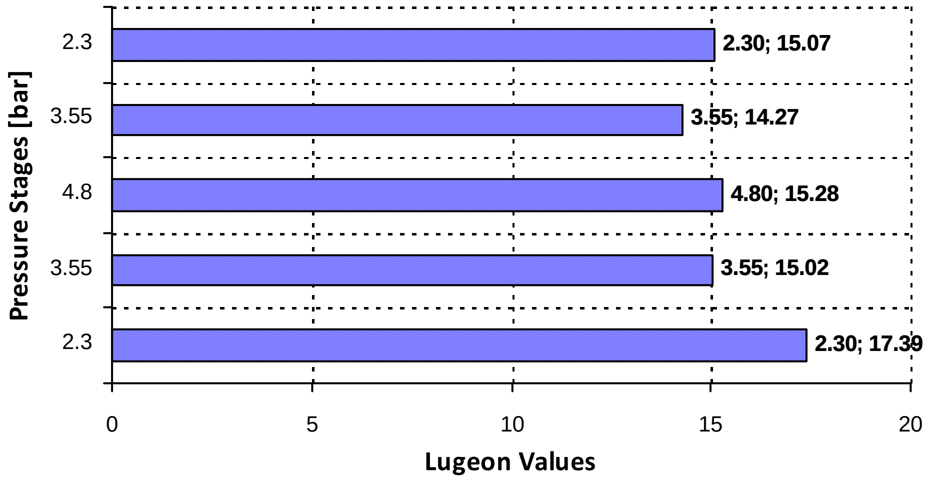


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
310	6	5.6	5.8	280	338	2.30	16.81
380	8	7.8	7.9	340	419	3.55	14.84
480	11	11.6	11.3	425	538	4.80	15.69
578	7.6	7.4	7.5	540	615	3.55	14.08
642	5.2	5	5.1	616	667	2.30	14.78

26 Diversion Tunnel n1 - ch. 2+30 - [Vault] Lugeon 0-5 min

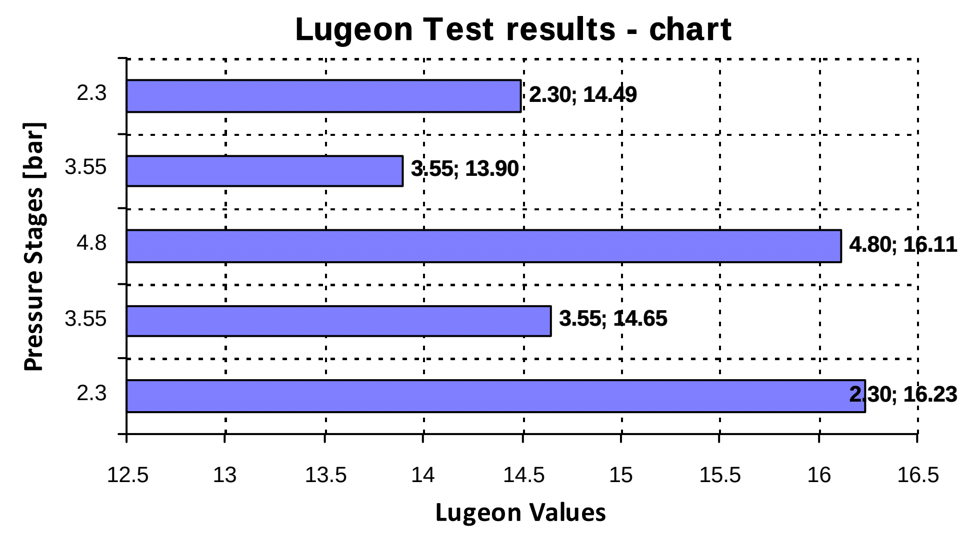
Lugeon Test results - chart



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
310	6	5.6	5.8	280	338	2.30	17.39
380	8	7.8	7.9	340	419	3.55	15.02
480	11	11.6	11.3	425	538	4.80	15.28
578	7.6	7.4	7.5	540	615	3.55	14.27
642	5.2	5	5.1	616	667	2.30	15.07

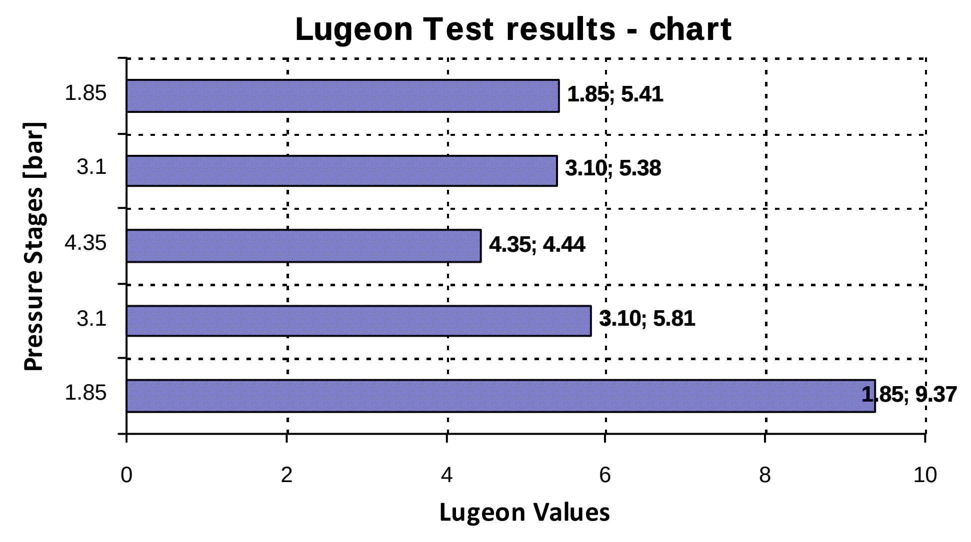
27	Diversion Tunnel n1 - ch. 2+30 - [Vault]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
310	6	5.6	5.8	280	338	2.30	16.23
380	8	7.8	7.9	340	419	3.55	14.65
480	11	11.6	11.3	425	538	4.80	16.11
578	7.6	7.4	7.5	540	615	3.55	13.90
642	5.2	5	5.1	616	667	2.30	14.49

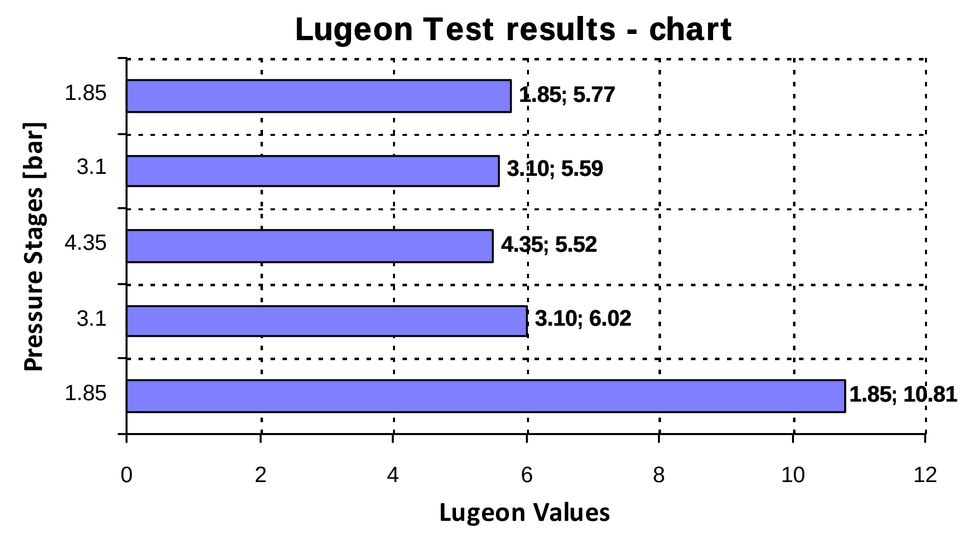
28	Diversion Tunnel n1 - ch. 4+75 - [Sw]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
644	3	2.2	2.6	629	655	1.85	9.37
671	2.8	2.6	2.7	657	684	3.10	5.81
707	3.6	2.2	2.9	689	718	4.35	4.44
743	2.6	2.4	2.5	730	755	3.10	5.38
768	1.6	1.4	1.5	760	775	1.85	5.41

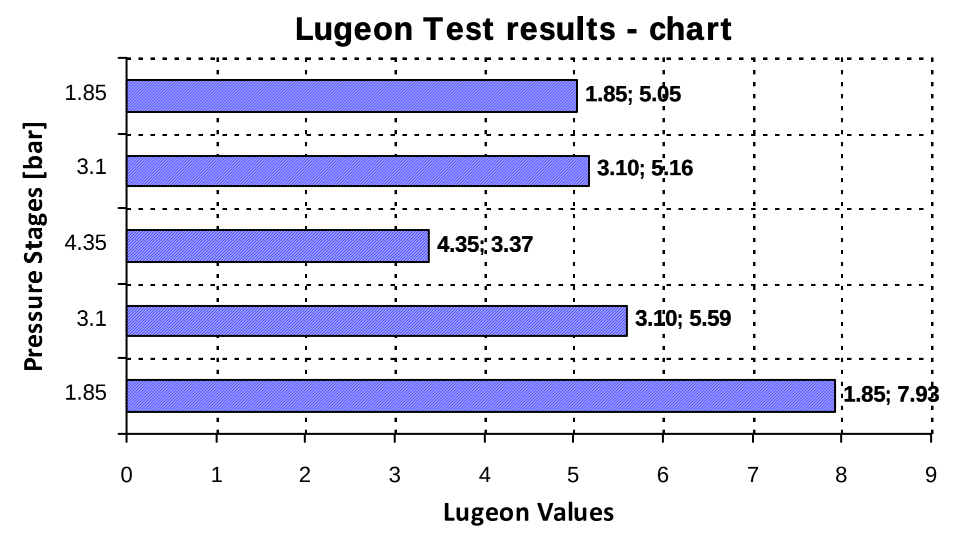
29 Diversion Tunnel n1 - ch. 4+75 - [Sw] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
644	3	2.2	2.6	629	655	1.85	10.81
671	2.8	2.6	2.7	657	684	3.10	6.02
707	3.6	2.2	2.9	689	718	4.35	5.52
743	2.6	2.4	2.5	730	755	3.10	5.59
768	1.6	1.4	1.5	760	775	1.85	5.77

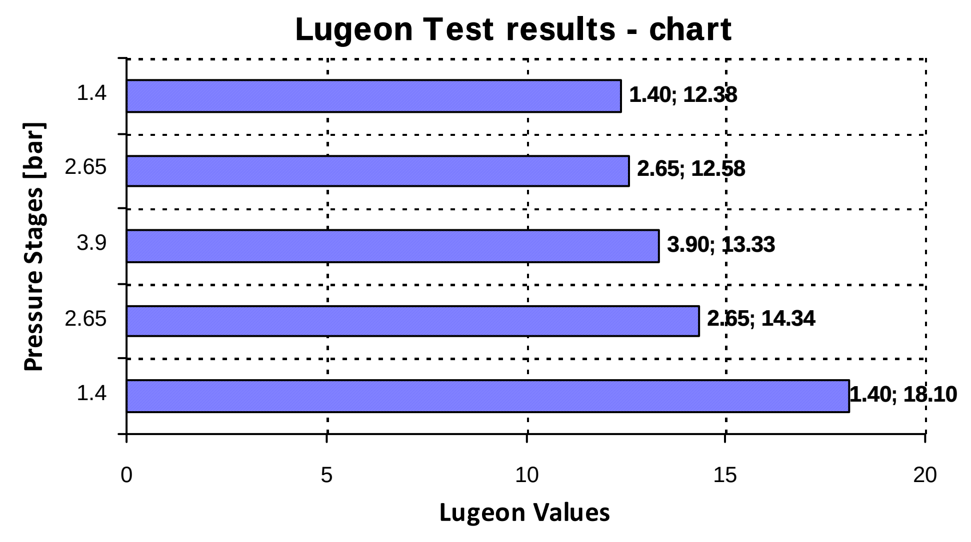
30 Diversion Tunnel n1 - ch. 4+75 - [Sw] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
644	3	2.2	2.6	629	655	1.85	7.93
671	2.8	2.6	2.7	657	684	3.10	5.59
707	3.6	2.2	2.9	689	718	4.35	3.37
743	2.6	2.4	2.5	730	755	3.10	5.16
768	1.6	1.4	1.5	760	775	1.85	5.05

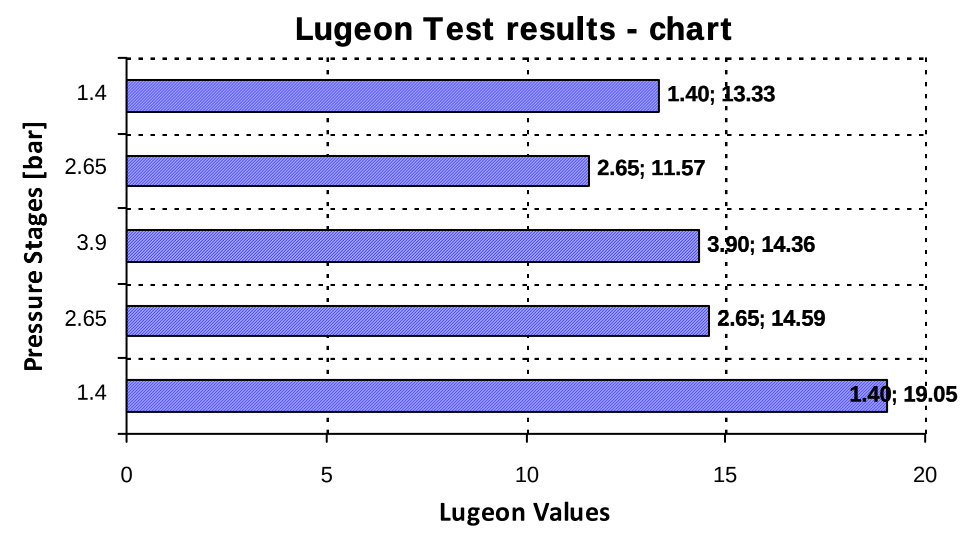
31	Diversion Tunnel n1 - ch. 4+75 - [Vault]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
893	4	3.6	3.8	873	911	1.40	18.10
942	5.8	5.6	5.7	913	970	2.65	14.34
1019	8.4	7.2	7.8	977	1055	3.90	13.33
1081	4.6	5.4	5	1058	1108	2.65	12.58
1125	2.8	2.4	2.6	1111	1137	1.40	12.38

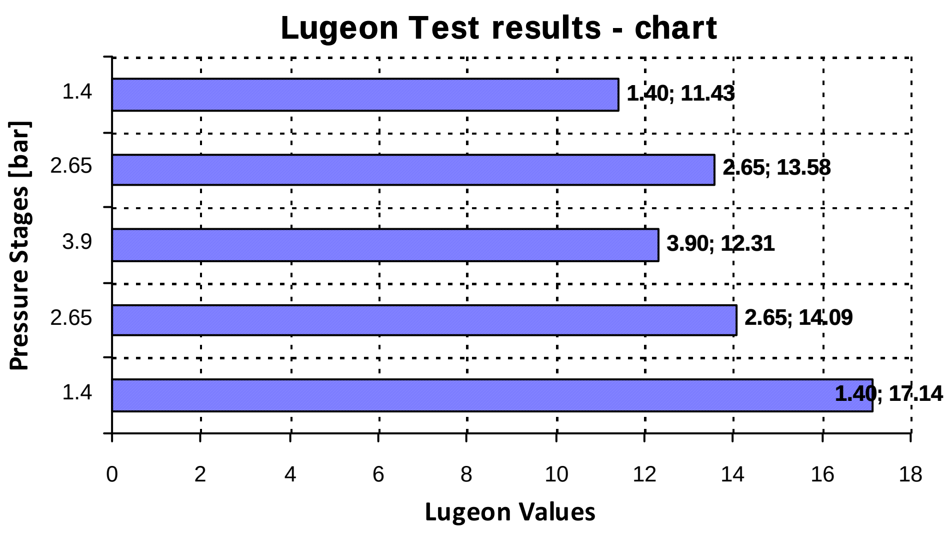
32	Diversion Tunnel n1 - ch. 4+75 - [Vault]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
893	4	3.6	3.8	873	911	1.40	19.05
942	5.8	5.6	5.7	913	970	2.65	14.59
1019	8.4	7.2	7.8	977	1055	3.90	14.36
1081	4.6	5.4	5	1058	1108	2.65	11.57
1125	2.8	2.4	2.6	1111	1137	1.40	13.33

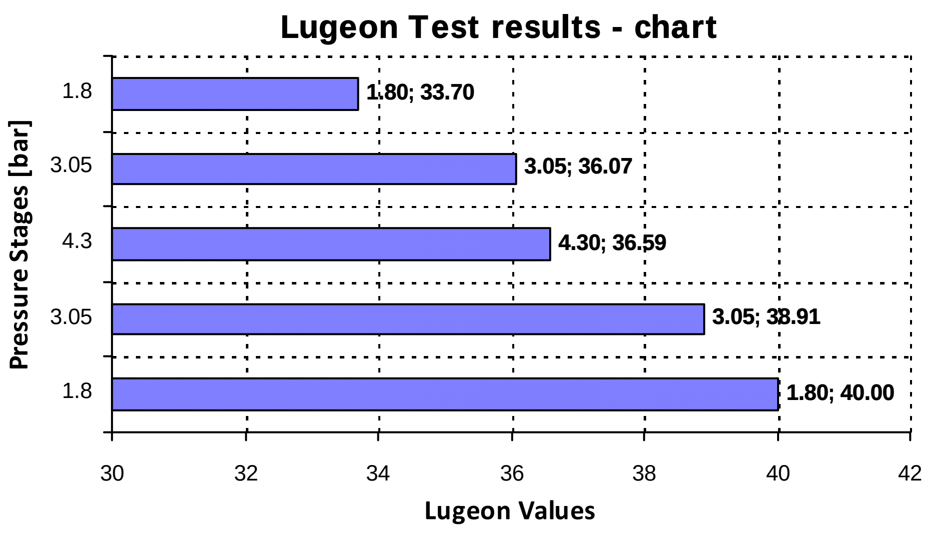
33 Diversion Tunnel n1 - ch. 4+75 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
893	4	3.6	3.8	873	911	1.40	17.14
942	5.8	5.6	5.7	913	970	2.65	14.09
1019	8.4	7.2	7.8	977	1055	3.90	12.31
1081	4.6	5.4	5	1058	1108	2.65	13.58
1125	2.8	2.4	2.6	1111	1137	1.40	11.43

34 Diversion Tunnel n1 - ch. 5+75 - [Sw] Lugeon 0-10 min

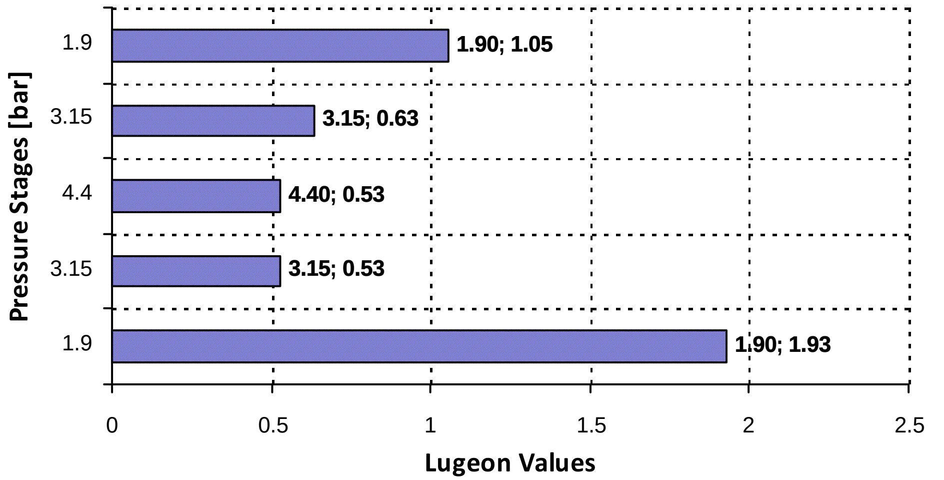


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
290	11	10.6	10.8	235	343	1.80	40.00
440	17.6	18	17.8	352	530	3.05	38.91
758	23.4	23.8	23.6	641	877	4.30	36.59
965	16.4	16.6	16.5	883	1048	3.05	36.07
1104	9.2	9	9.1	1058	1149	1.80	33.70

35	Diversion Tunnel n1 - ch. 5+75 - [Sw] repet.	Lugeon 0-10 min

Lugeon Test results - chart

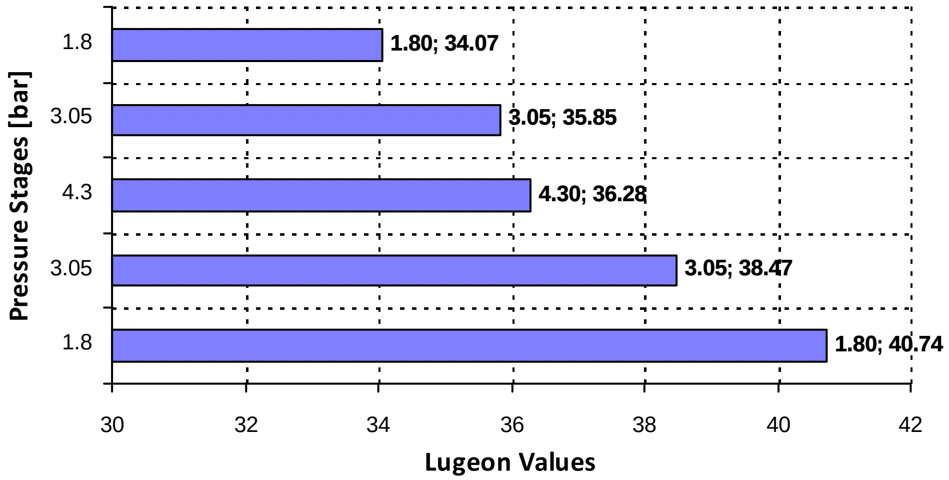


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
217	1.4	0.8	1.1	210	221	1.90	1.93
246	0.6	0.4	0.5	243	248	3.15	0.53
252	0.6	0.8	0.7	249	256	4.40	0.53
260	0.6	0.6	0.6	257	263	3.15	0.63
267	0.6	0.6	0.6	264	270	1.90	1.05

36	Diversion Tunnel n1 - ch. 5+75 - [Sw]	Lugeon 0-5 min

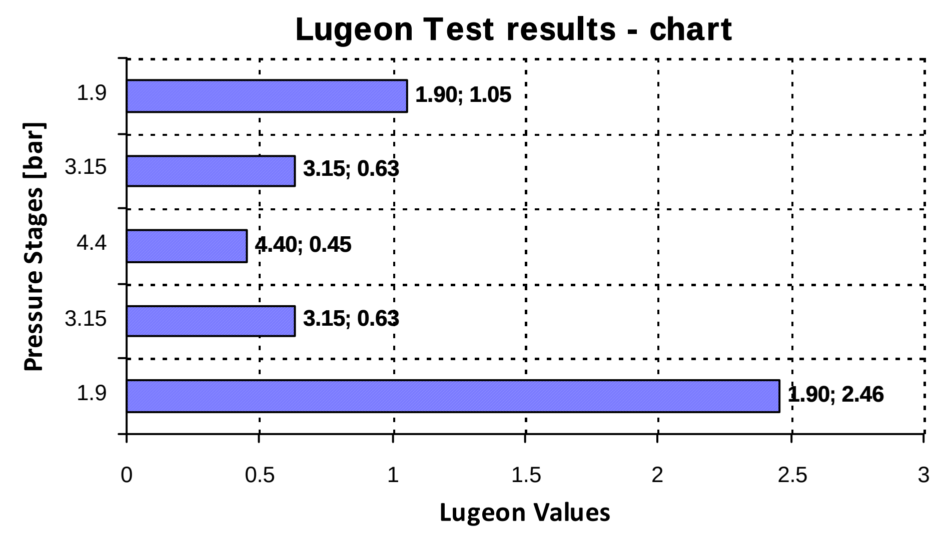
Lugeon Test results - chart



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
290	11	10.6	10.8	235	343	1.80	40.74
440	17.6	18	17.8	352	530	3.05	38.47
758	23.4	23.8	23.6	641	877	4.30	36.28
965	16.4	16.6	16.5	883	1048	3.05	35.85
1104	9.2	9	9.1	1058	1149	1.80	34.07

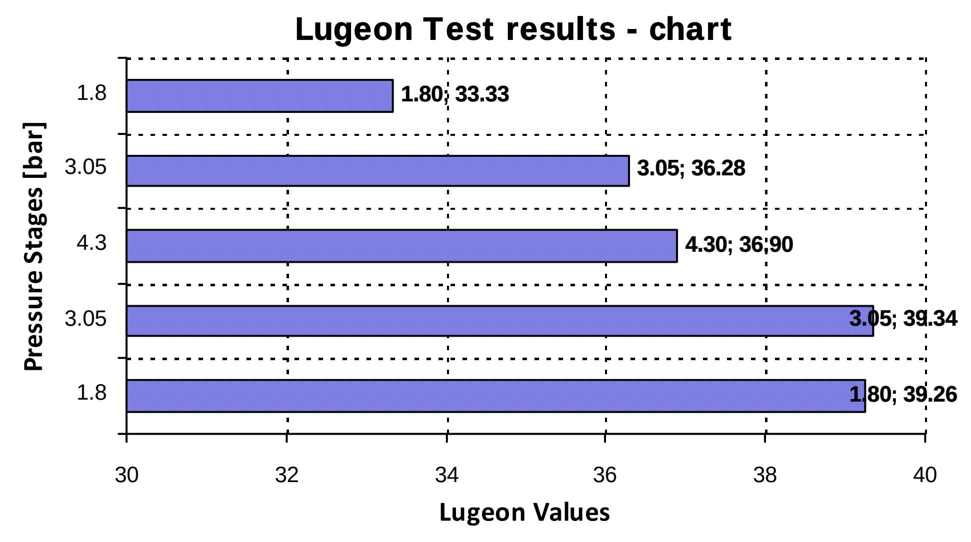
37 | Diversion Tunnel n1 - ch. 5+75 - [Sw] repet. | Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
217	1.4	0.8	1.1	210	221	1.90	2.46
246	0.6	0.4	0.5	243	248	3.15	0.63
252	0.6	0.8	0.7	249	256	4.40	0.45
260	0.6	0.6	0.6	257	263	3.15	0.63
267	0.6	0.6	0.6	264	270	1.90	1.05

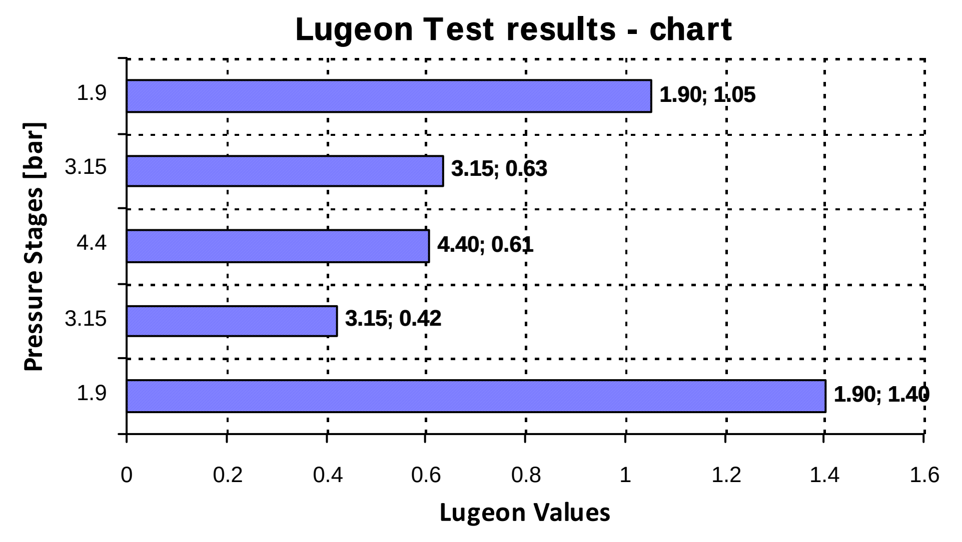
38 | Diversion Tunnel n1 - ch. 5+75 - [Sw] | Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
290	11	10.6	10.8	235	343	1.80	39.26
440	17.6	18	17.8	352	530	3.05	39.34
758	23.4	23.8	23.6	641	877	4.30	36.90
965	16.4	16.6	16.5	883	1048	3.05	36.28
1104	9.2	9	9.1	1058	1149	1.80	33.33

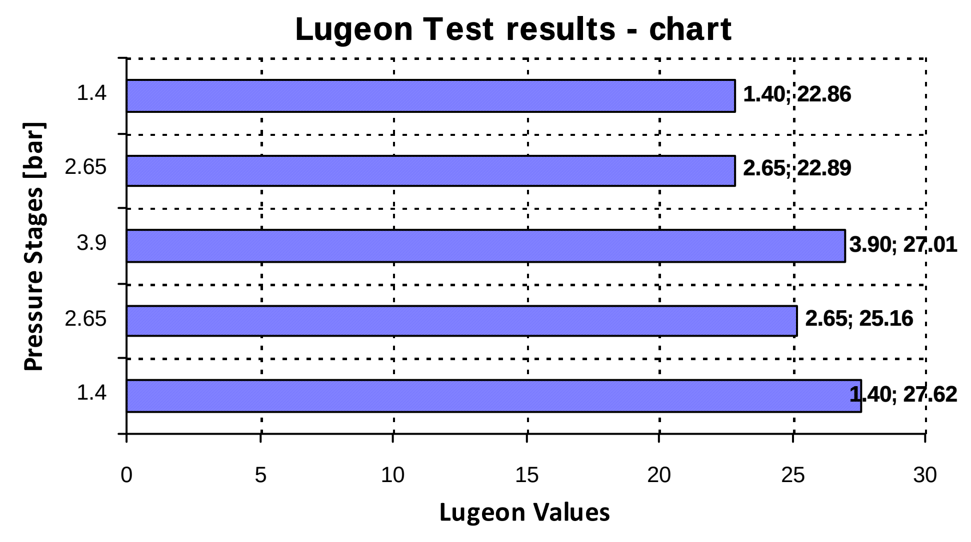
39	Diversion Tunnel n1 - ch. 5+75 - [Sw] repet.	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
217	1.4	0.8	1.1	210	221	1.90	1.40
246	0.6	0.4	0.5	243	248	3.15	0.42
252	0.6	0.8	0.7	249	256	4.40	0.61
260	0.6	0.6	0.6	257	263	3.15	0.63
267	0.6	0.6	0.6	264	270	1.90	1.05

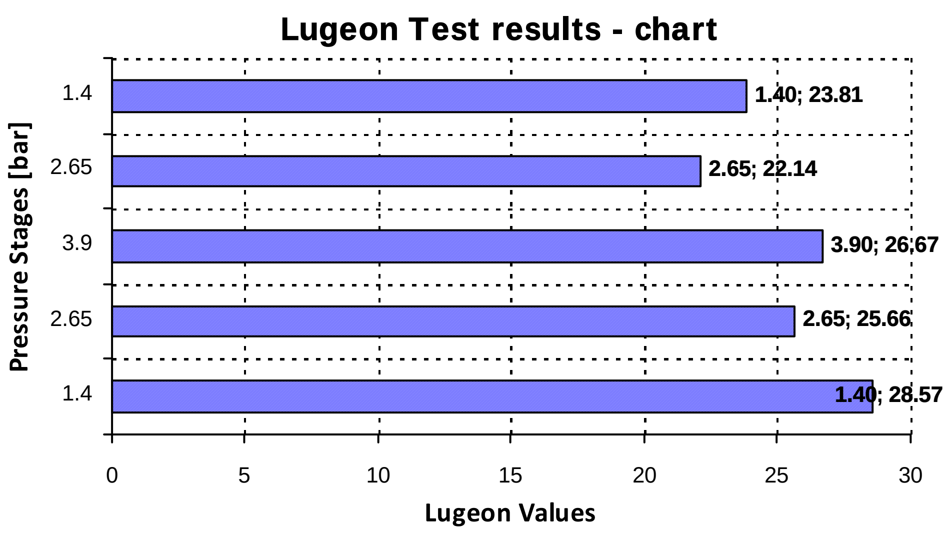
40	Diversion Tunnel n1 - ch. 5+75 - [Vault]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1111	6	5.6	5.8	1081	1139	1.40	27.62
1190	10.2	9.8	10	1139	1239	2.65	25.16
1317	15.6	16	15.8	1239	1397	3.90	27.01
1441	8.8	9.4	9.1	1397	1488	2.65	22.89
1513	5	4.6	4.8	1488	1536	1.40	22.86

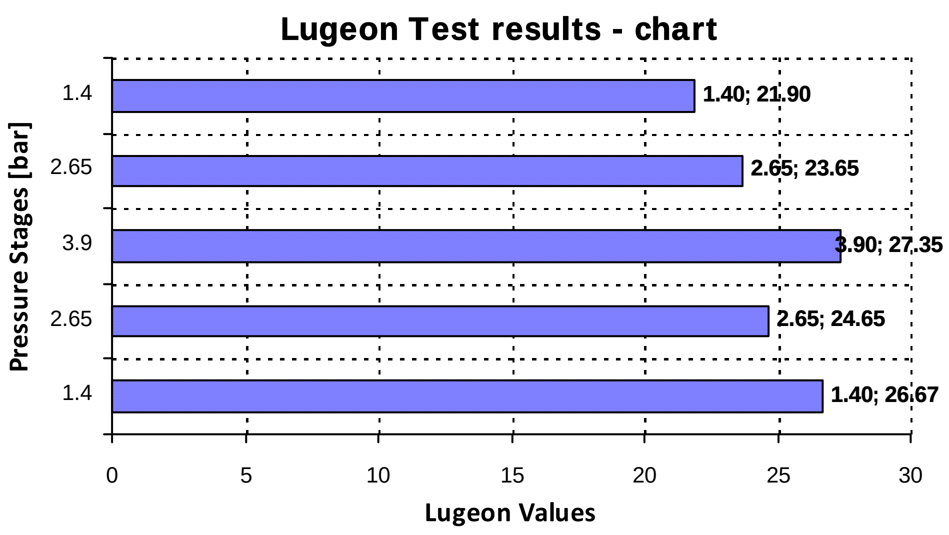
41 Diversion Tunnel n1 - ch. 5+75 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1111	6	5.6	5.8	1081	1139	1.40	28.57
1190	10.2	9.8	10	1139	1239	2.65	25.66
1317	15.6	16	15.8	1239	1397	3.90	26.67
1441	8.8	9.4	9.1	1397	1488	2.65	22.14
1513	5	4.6	4.8	1488	1536	1.40	23.81

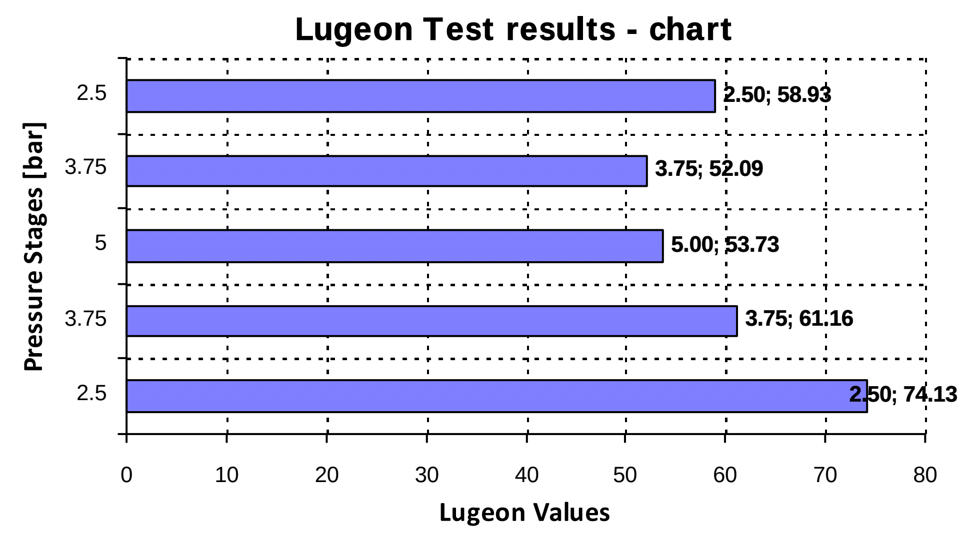
42 Diversion Tunnel n1 - ch. 5+75 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1111	6	5.6	5.8	1081	1139	1.40	26.67
1190	10.2	9.8	10	1139	1239	2.65	24.65
1317	15.6	16	15.8	1239	1397	3.90	27.35
1441	8.8	9.4	9.1	1397	1488	2.65	23.65
1513	5	4.6	4.8	1488	1536	1.40	21.90

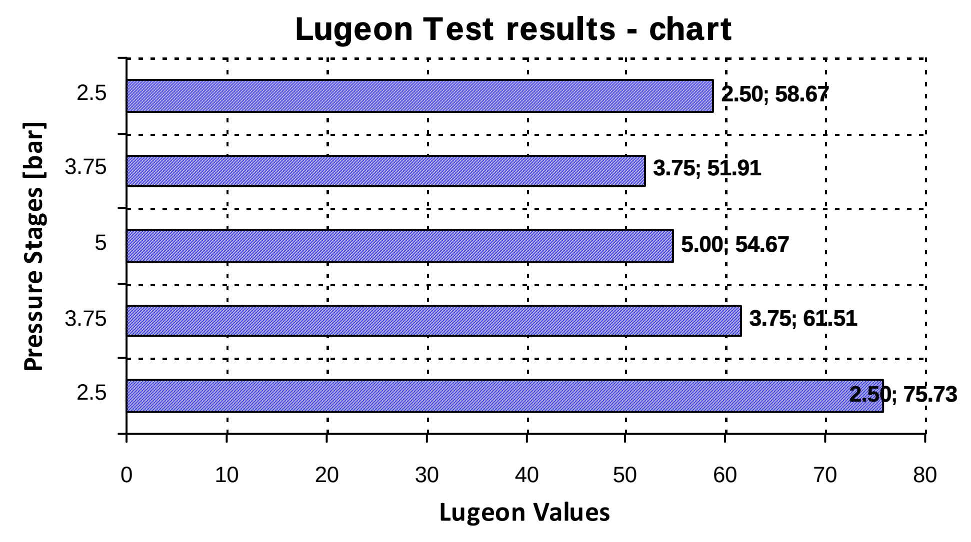
43 Diversion Tunnel n1 - ch. 6+50 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
206	28.4	27.2	27.8	64	342	2.50	74.13
568	34.6	34.2	34.4	395	739	3.75	61.16
985	41	39.6	40.3	780	1183	5.00	53.73
1713	29.2	29.4	29.3	1567	1860	3.75	52.09
2010	22	22.2	22.1	1900	2121	2.50	58.93

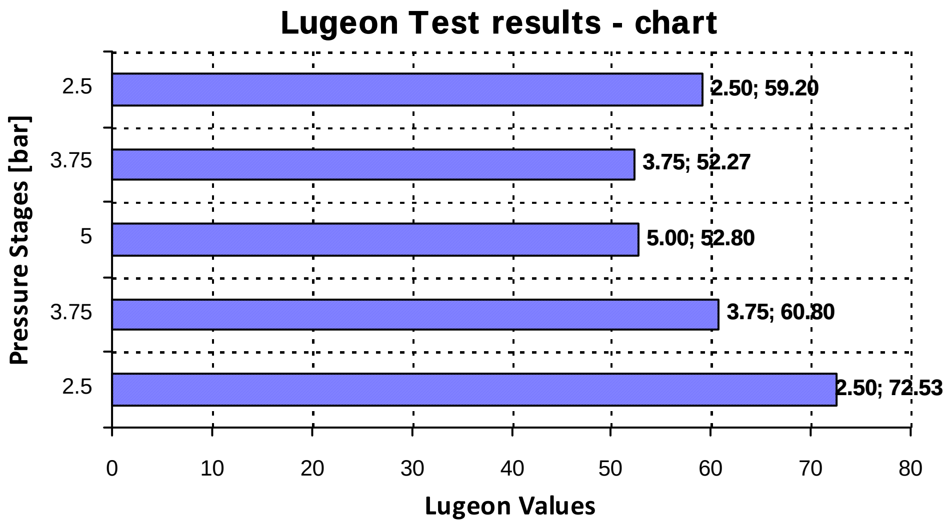
44 Diversion Tunnel n1 - ch. 6+50 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
206	28.4	27.2	27.8	64	342	2.50	75.73
568	34.6	34.2	34.4	395	739	3.75	61.51
985	41	39.6	40.3	780	1183	5.00	54.67
1713	29.2	29.4	29.3	1567	1860	3.75	51.91
2010	22	22.2	22.1	1900	2121	2.50	58.67

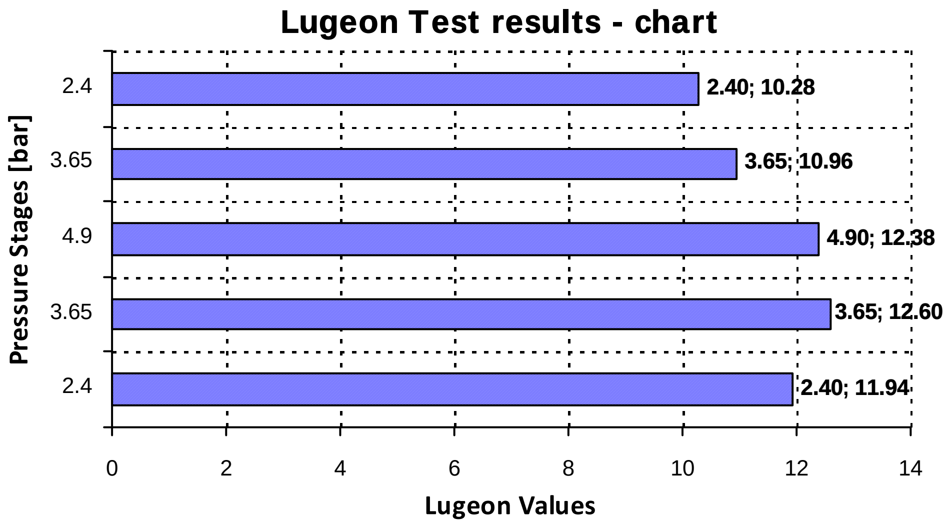
45 Diversion Tunnel n1 - ch. 6+50 - [Invert] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
206	28.4	27.2	27.8	64	342	2.50	72.53
568	34.6	34.2	34.4	395	739	3.75	60.80
985	41	39.6	40.3	780	1183	5.00	52.80
1713	29.2	29.4	29.3	1567	1860	3.75	52.27
2010	22	22.2	22.1	1900	2121	2.50	59.20

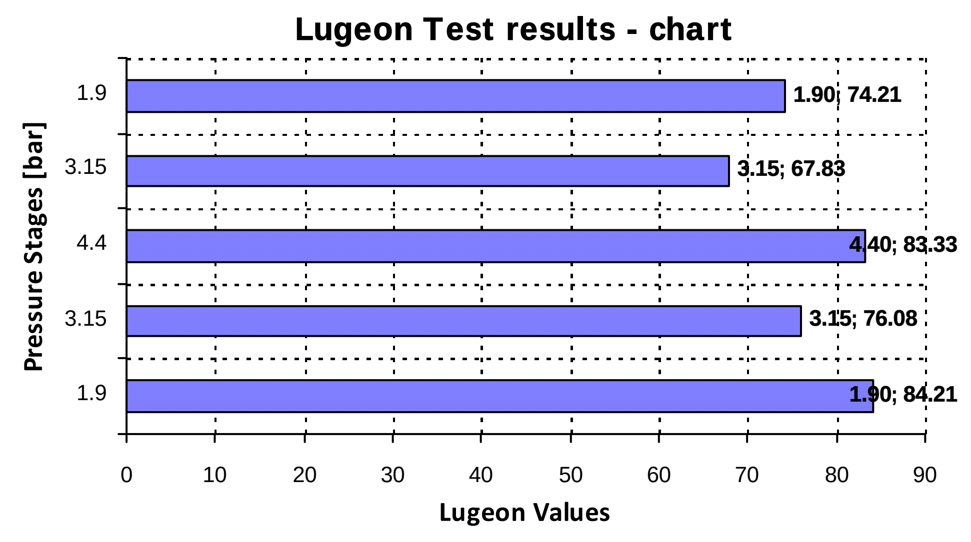
46 Diversion Tunnel n1 - ch. 6+50 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
195	4.2	4.4	4.3	174	217	2.40	11.94
257	6.8	7	6.9	223	292	3.65	12.60
341	8.8	9.4	9.1	297	388	4.90	12.38
425	6.2	5.8	6	394	454	3.65	10.96
487	3.8	3.6	3.7	468	505	2.40	10.28

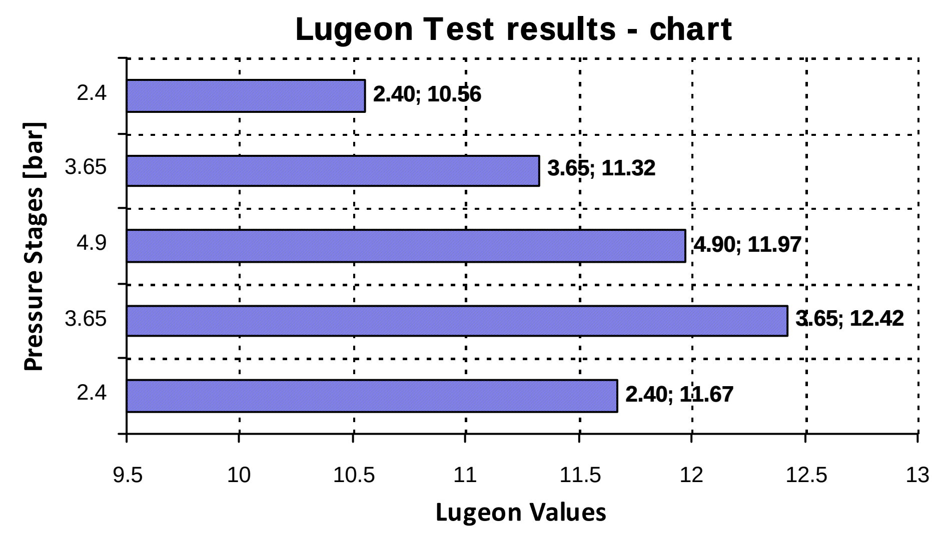
47 | Diversion Tunnel n1 - ch. 6+50 - [Sw] repet. | Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
860	51	45	48	605	1085	1.90	84.21
1515	66.4	77.4	71.9	1183	1902	3.15	76.08
2605	101	119	110	2100	3200	4.40	83.33
3620	64	64.2	64.1	3300	3941	3.15	67.83
4185	43	41.6	42.3	3970	4393	1.90	74.21

48 | Diversion Tunnel n1 - ch. 6+50 - [Sw] | Lugeon 0-5 min

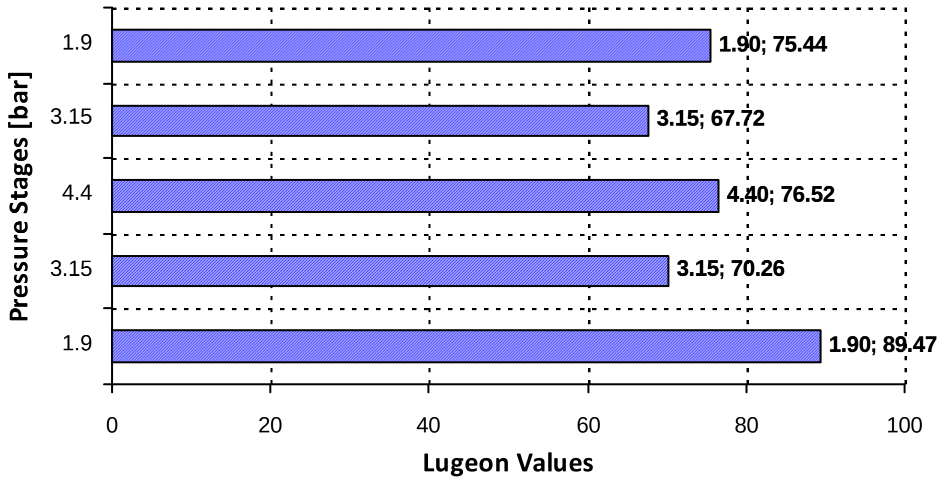


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
195	4.2	4.4	4.3	174	217	2.40	11.67
257	6.8	7	6.9	223	292	3.65	12.42
341	8.8	9.4	9.1	297	388	4.90	11.97
425	6.2	5.8	6	394	454	3.65	11.32
487	3.8	3.6	3.7	468	505	2.40	10.56

49 Diversion Tunnel n1 - ch. 6+50 - [Sw] repet. Lugeon 0-5 min

Lugeon Test results - chart

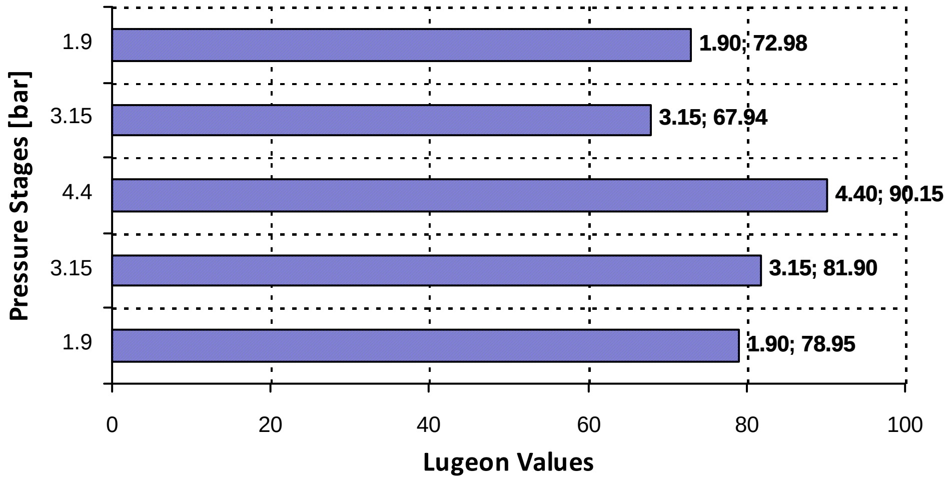


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
860	51	45	48	605	1085	1.90	89.47
1515	66.4	77.4	71.9	1183	1902	3.15	70.26
2605	101	119	110	2100	3200	4.40	76.52
3620	64	64.2	64.1	3300	3941	3.15	67.72
4185	43	41.6	42.3	3970	4393	1.90	75.44

50 Diversion Tunnel n1 - ch. 6+50 - [Sw] repet. Lugeon 5-10 min

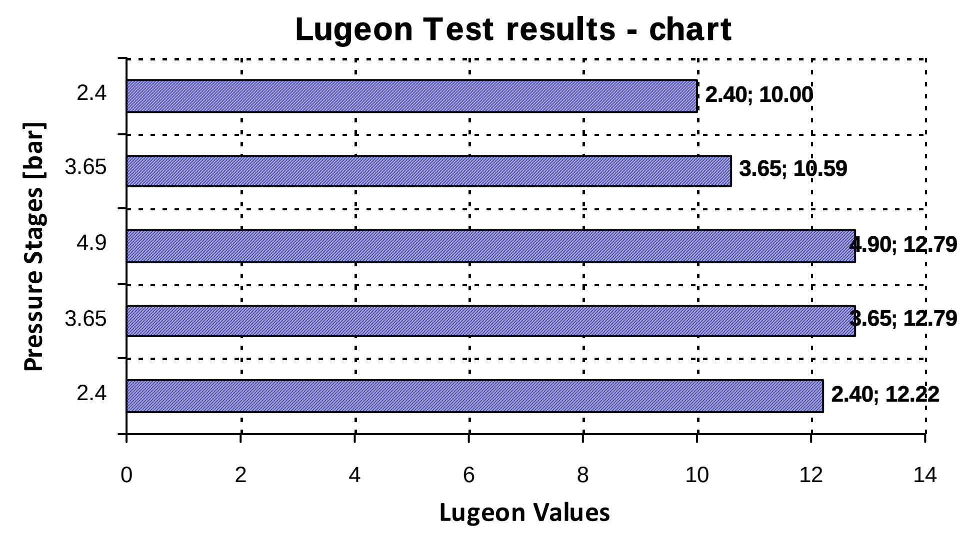
Lugeon Test results - chart



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
860	51	45	48	605	1085	1.90	78.95
1515	66.4	77.4	71.9	1183	1902	3.15	81.90
2605	101	119	110	2100	3200	4.40	90.15
3620	64	64.2	64.1	3300	3941	3.15	67.94
4185	43	41.6	42.3	3970	4393	1.90	72.98

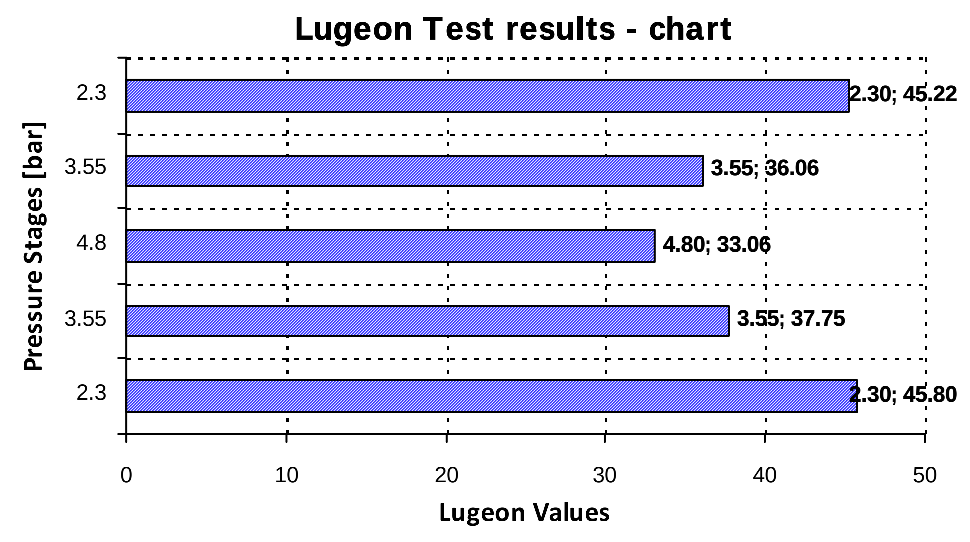
51 Diversion Tunnel n1 - ch. 6+50 - [Sw] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
195	4.2	4.4	4.3	174	217	2.40	12.22
257	6.8	7	6.9	223	292	3.65	12.79
341	8.8	9.4	9.1	297	388	4.90	12.79
425	6.2	5.8	6	394	454	3.65	10.59
487	3.8	3.6	3.7	468	505	2.40	10.00

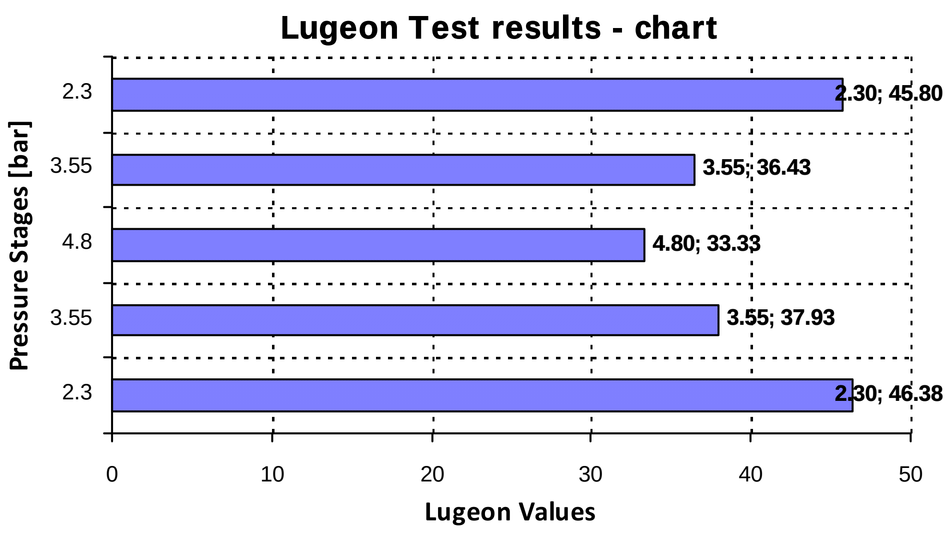
52 Diversion Tunnel n1 - ch. 6+50 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
178	16	15.6	15.8	98	256	2.30	45.80
371	20.2	20	20.1	270	471	3.55	37.75
600	24	23.6	23.8	480	718	4.80	33.06
822	19.4	19	19.2	725	917	3.55	36.06
1003	15.8	15.4	15.6	924	1080	2.30	45.22

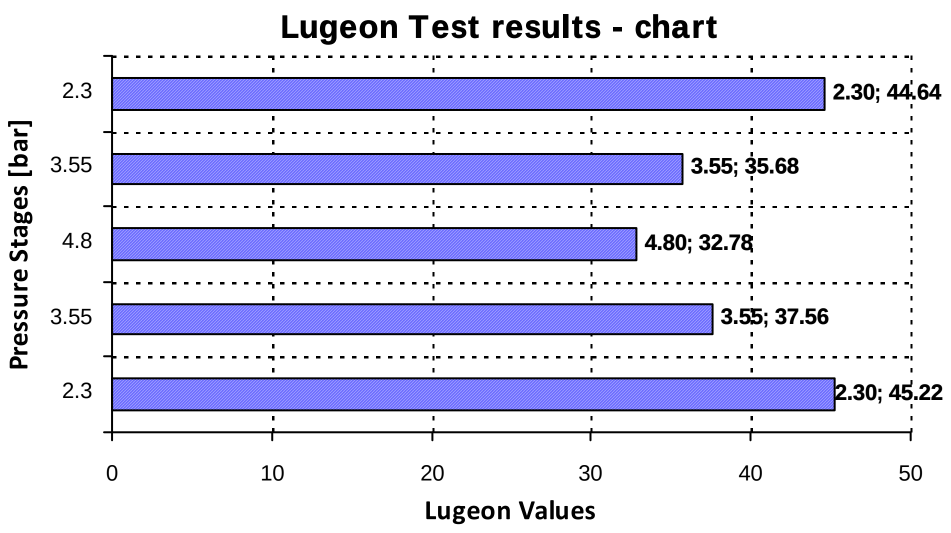
53 Diversion Tunnel n1 - ch. 6+50 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
178	16	15.6	15.8	98	256	2.30	46.38
371	20.2	20	20.1	270	471	3.55	37.93
600	24	23.6	23.8	480	718	4.80	33.33
822	19.4	19	19.2	725	917	3.55	36.43
1003	15.8	15.4	15.6	924	1080	2.30	45.80

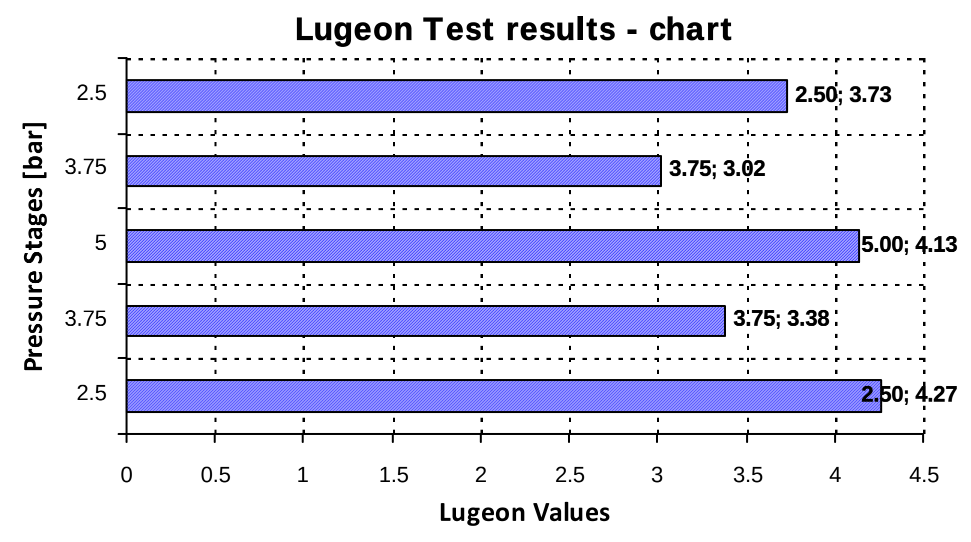
54 Diversion Tunnel n1 - ch. 6+50 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
178	16	15.6	15.8	98	256	2.30	45.22
371	20.2	20	20.1	270	471	3.55	37.56
600	24	23.6	23.8	480	718	4.80	32.78
822	19.4	19	19.2	725	917	3.55	35.68
1003	15.8	15.4	15.6	924	1080	2.30	44.64

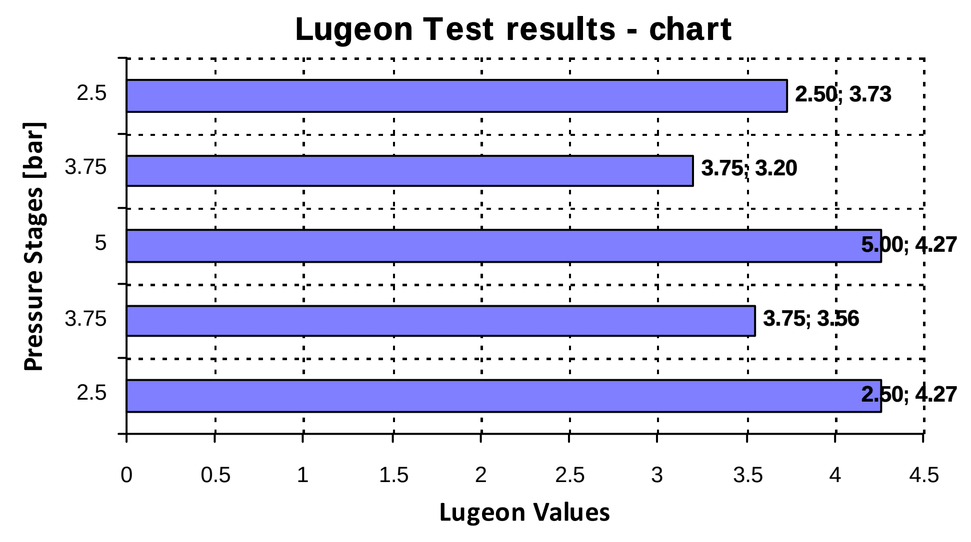
55 Diversion Tunnel n1 - ch. 7+60 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
118	1.6	1.6	1.6	110	126	2.50	4.27
137	2	1.8	1.9	127	146	3.75	3.38
166	3.2	3	3.1	150	181	5.00	4.13
192	1.8	1.6	1.7	183	200	3.75	3.02
208	1.4	1.4	1.4	201	215	2.50	3.73

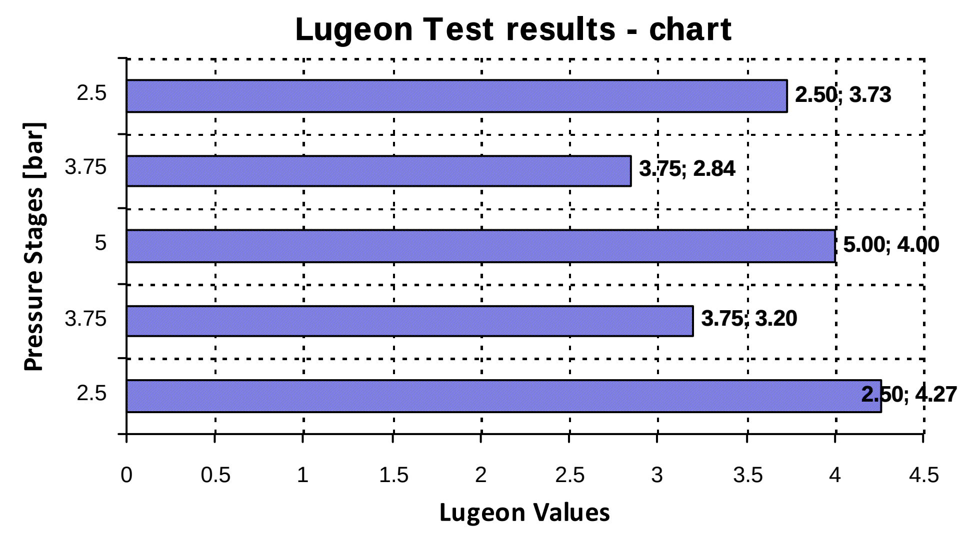
56 Diversion Tunnel n1 - ch. 7+60 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
118	1.6	1.6	1.6	110	126	2.50	4.27
137	2	1.8	1.9	127	146	3.75	3.56
166	3.2	3	3.1	150	181	5.00	4.27
192	1.8	1.6	1.7	183	200	3.75	3.20
208	1.4	1.4	1.4	201	215	2.50	3.73

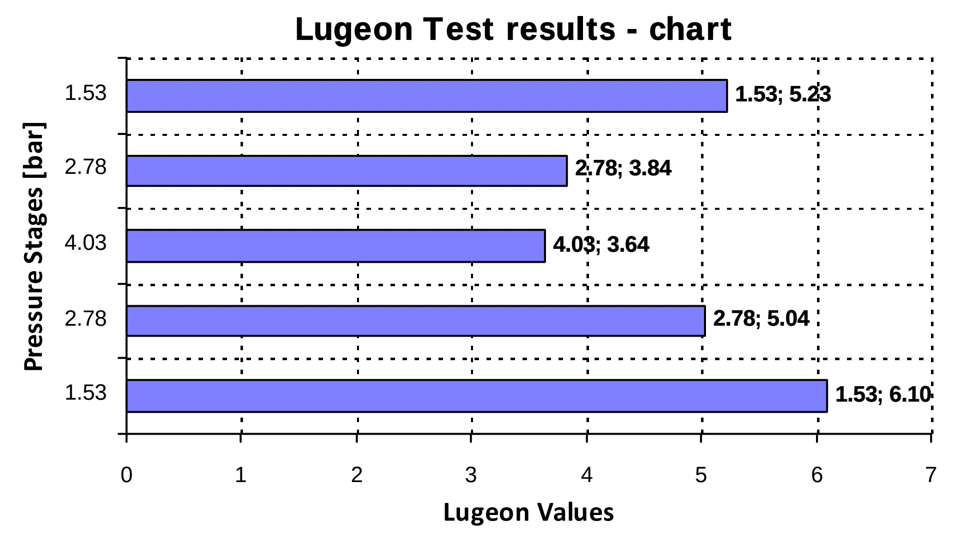
57 | Diversion Tunnel n1 - ch. 7+60 - [Invert] | Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
118	1.6	1.6	1.6	110	126	2.50	4.27
137	2	1.8	1.9	127	146	3.75	3.20
166	3.2	3	3.1	150	181	5.00	4.00
192	1.8	1.6	1.7	183	200	3.75	2.84
208	1.4	1.4	1.4	201	215	2.50	3.73

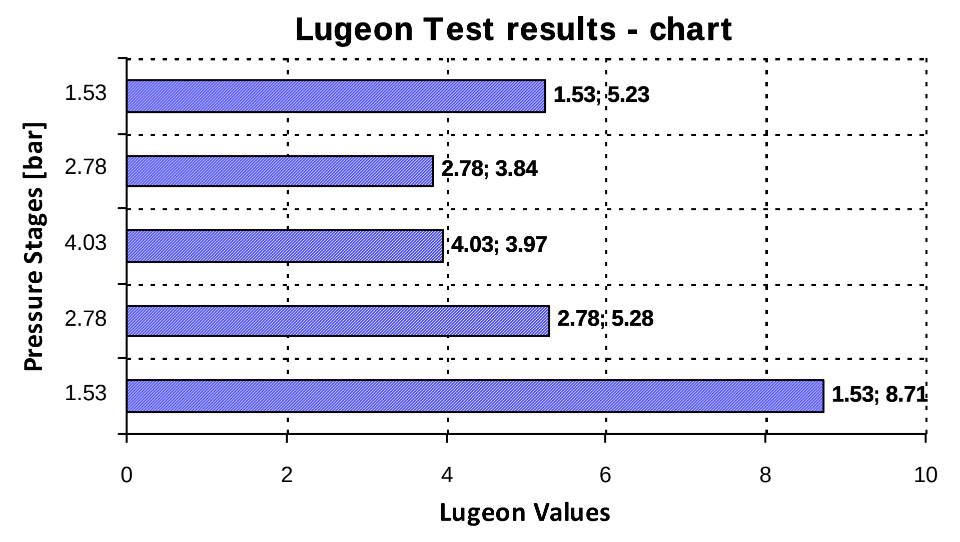
58 | Diversion Tunnel n1 - ch. 7+60 - [Sw] | Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
967	2	0.8	1.4	957	971	1.53	6.10
983	2.2	2	2.1	972	993	2.78	5.04
1007	2.4	2	2.2	995	1017	4.03	3.64
1026	1.6	1.6	1.6	1018	1034	2.78	3.84
1041	1.2	1.2	1.2	1035	1047	1.53	5.23

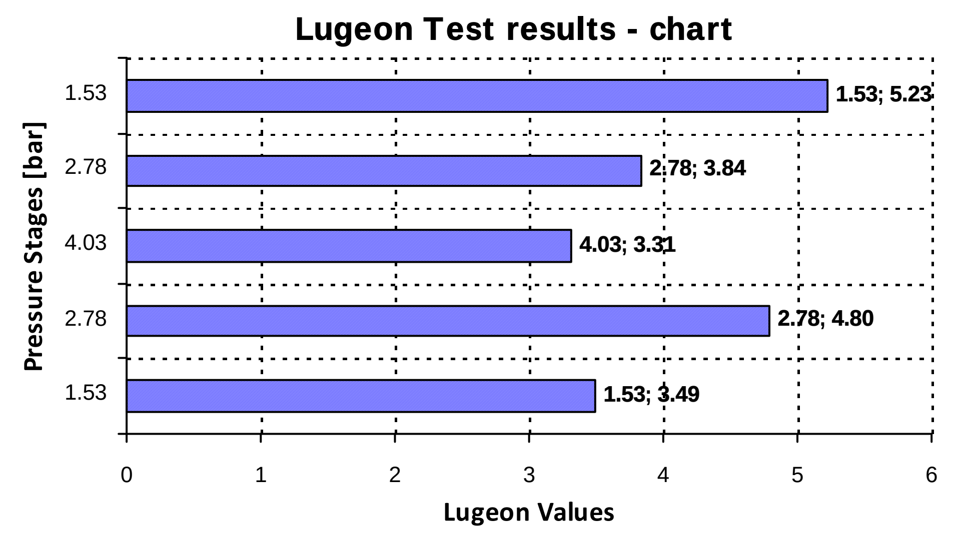
59 Diversion Tunnel n1 - ch. 7+60 - [Sw] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
967	2	0.8	1.4	957	971	1.53	8.71
983	2.2	2	2.1	972	993	2.78	5.28
1007	2.4	2	2.2	995	1017	4.03	3.97
1026	1.6	1.6	1.6	1018	1034	2.78	3.84
1041	1.2	1.2	1.2	1035	1047	1.53	5.23

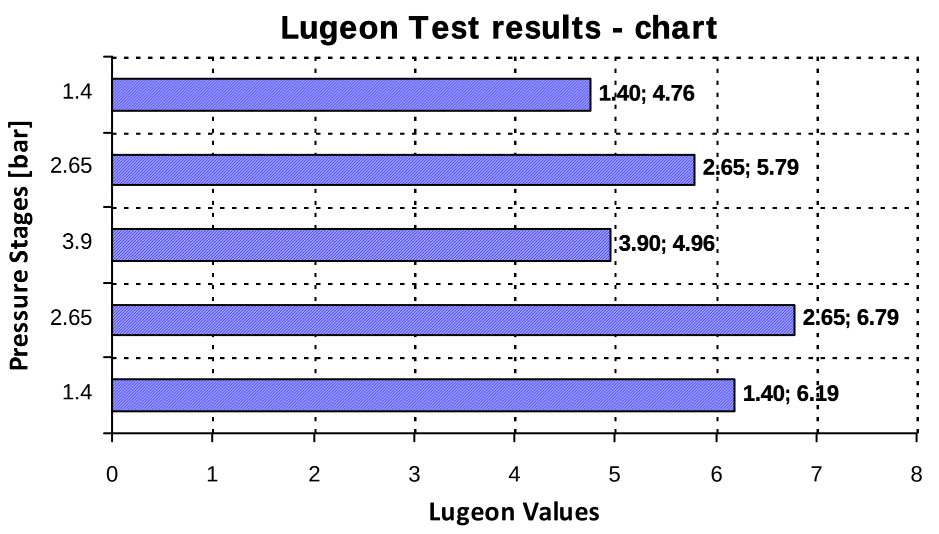
60 Diversion Tunnel n1 - ch. 7+60 - [Sw] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
967	2	0.8	1.4	957	971	1.53	3.49
983	2.2	2	2.1	972	993	2.78	4.80
1007	2.4	2	2.2	995	1017	4.03	3.31
1026	1.6	1.6	1.6	1018	1034	2.78	3.84
1041	1.2	1.2	1.2	1035	1047	1.53	5.23

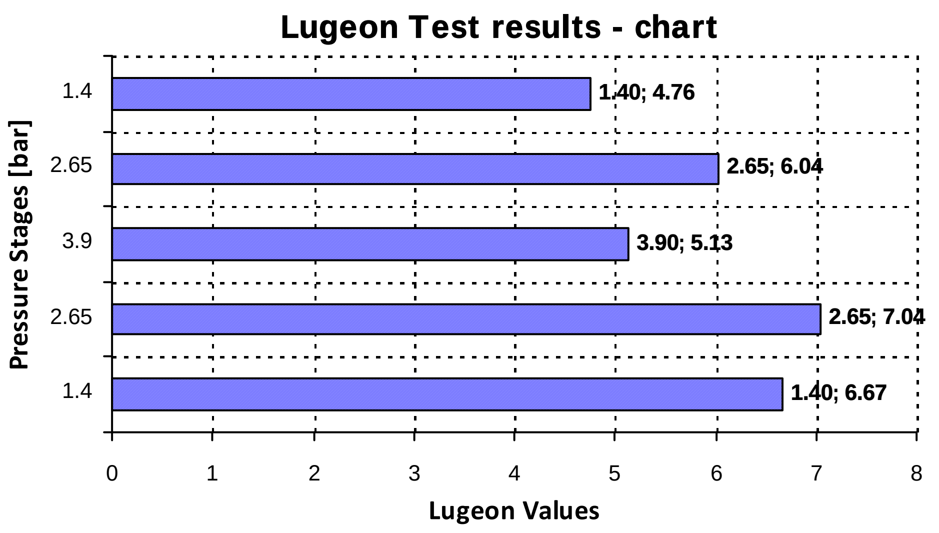
61 | Diversion Tunnel n1 - ch. 7+60 - [Vault] | Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
17	1.4	1.2	1.3	10	23	1.40	6.19
38	2.8	2.6	2.7	24	51	2.65	6.79
68	3	2.8	2.9	53	82	3.90	4.96
95	2.4	2.2	2.3	83	106	2.65	5.79
112	1	1	1	107	117	1.40	4.76

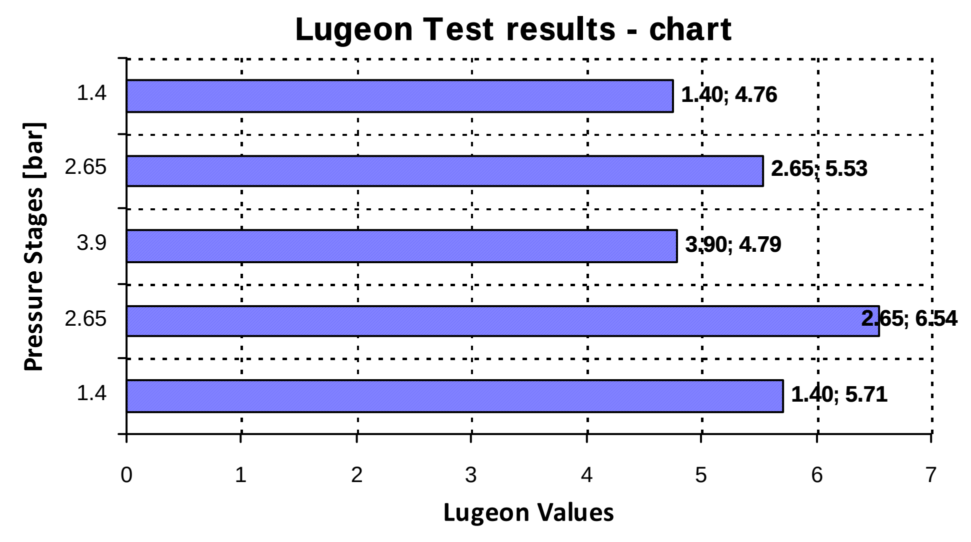
62 | Diversion Tunnel n1 - ch. 7+60 - [Vault] | Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
17	1.4	1.2	1.3	10	23	1.40	6.67
38	2.8	2.6	2.7	24	51	2.65	7.04
68	3	2.8	2.9	53	82	3.90	5.13
95	2.4	2.2	2.3	83	106	2.65	6.04
112	1	1	1	107	117	1.40	4.76

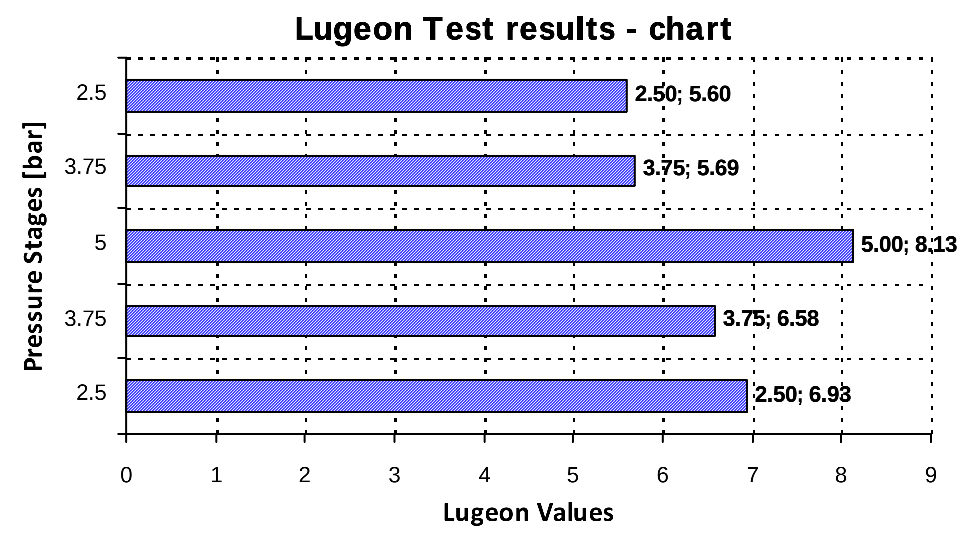
63	Diversion Tunnel n1 - ch. 7+60 - [Vault]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
17	1.4	1.2	1.3	10	23	1.40	5.71
38	2.8	2.6	2.7	24	51	2.65	6.54
68	3	2.8	2.9	53	82	3.90	4.79
95	2.4	2.2	2.3	83	106	2.65	5.53
112	1	1	1	107	117	1.40	4.76

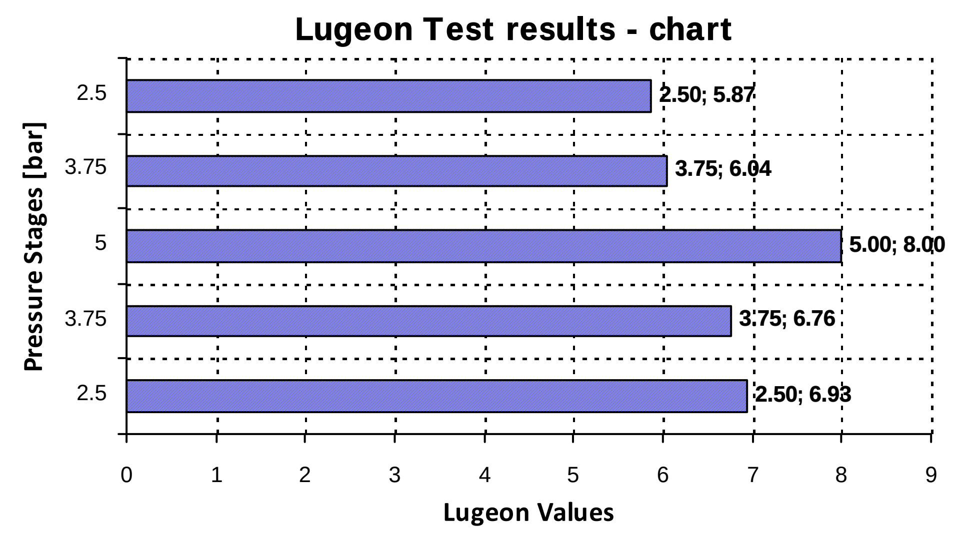
64	Diversion Tunnel n1 - ch. 8+70 - [Invert]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
123	2.6	2.6	2.6	110	136	2.50	6.93
157	3.8	3.6	3.7	138	175	3.75	6.58
210	6	6.2	6.1	180	241	5.00	8.13
260	3.4	3	3.2	243	275	3.75	5.69
288	2.2	2	2.1	277	298	2.50	5.60

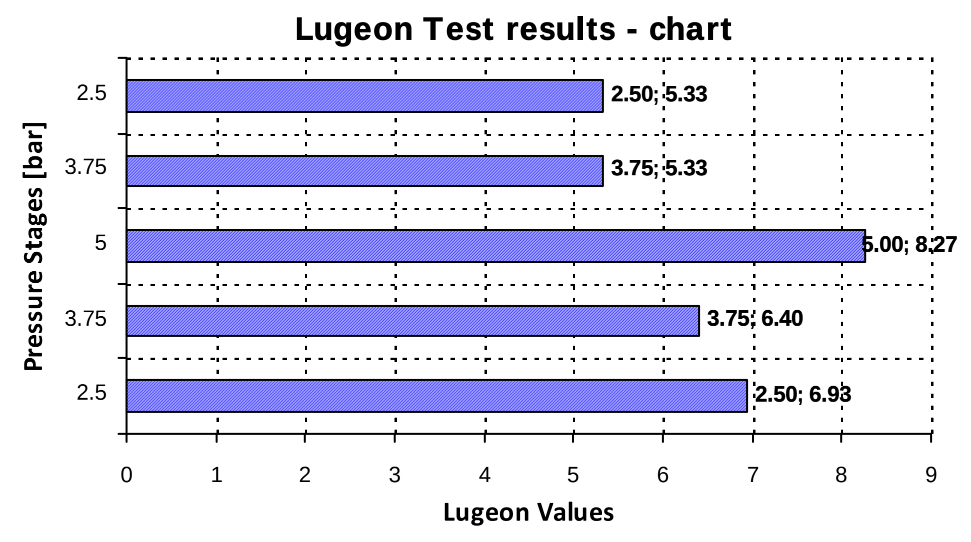
65 Diversion Tunnel n1 - ch. 8+70 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
123	2.6	2.6	2.6	110	136	2.50	6.93
157	3.8	3.6	3.7	138	175	3.75	6.76
210	6	6.2	6.1	180	241	5.00	8.00
260	3.4	3	3.2	243	275	3.75	6.04
288	2.2	2	2.1	277	298	2.50	5.87

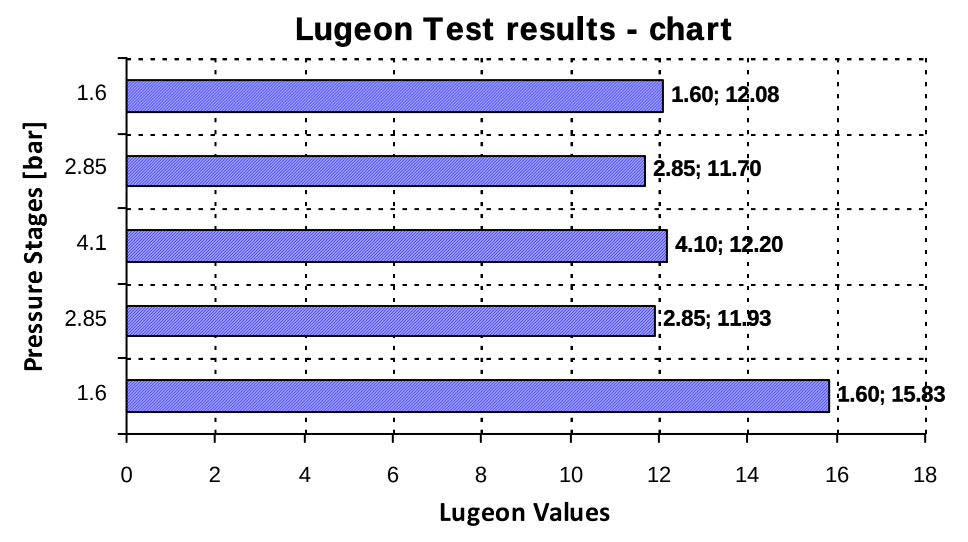
66 Diversion Tunnel n1 - ch. 8+70 - [Invert] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
123	2.6	2.6	2.6	110	136	2.50	6.93
157	3.8	3.6	3.7	138	175	3.75	6.40
210	6	6.2	6.1	180	241	5.00	8.27
260	3.4	3	3.2	243	275	3.75	5.33
288	2.2	2	2.1	277	298	2.50	5.33

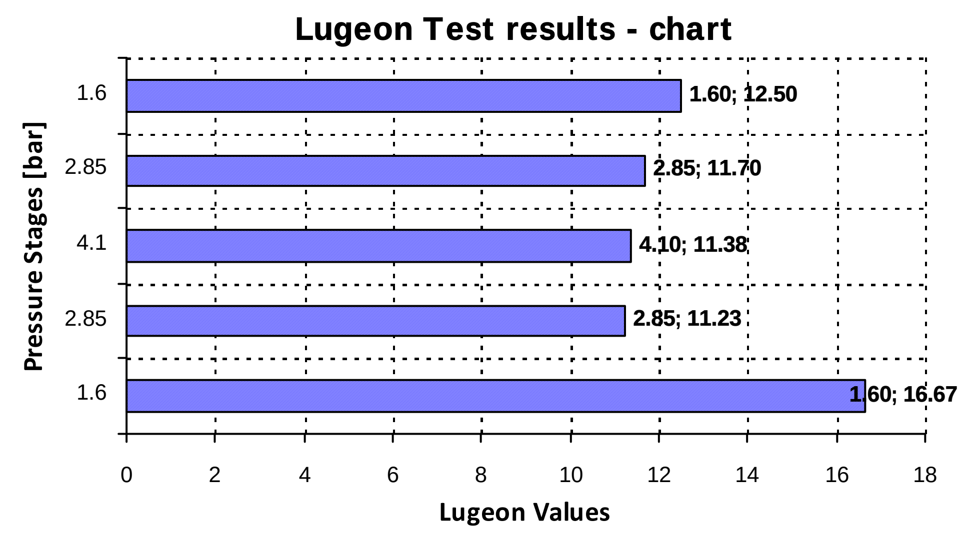
67	Diversion Tunnel n1 - ch. 8+70 - [sidewall]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
100	4	3.6	3.8	80	118	1.60	15.83
148	4.8	5.4	5.1	124	175	2.85	11.93
213	7	8	7.5	178	253	4.10	12.20
283	5	5	5	258	308	2.85	11.70
326	3	2.8	2.9	311	340	1.60	12.08

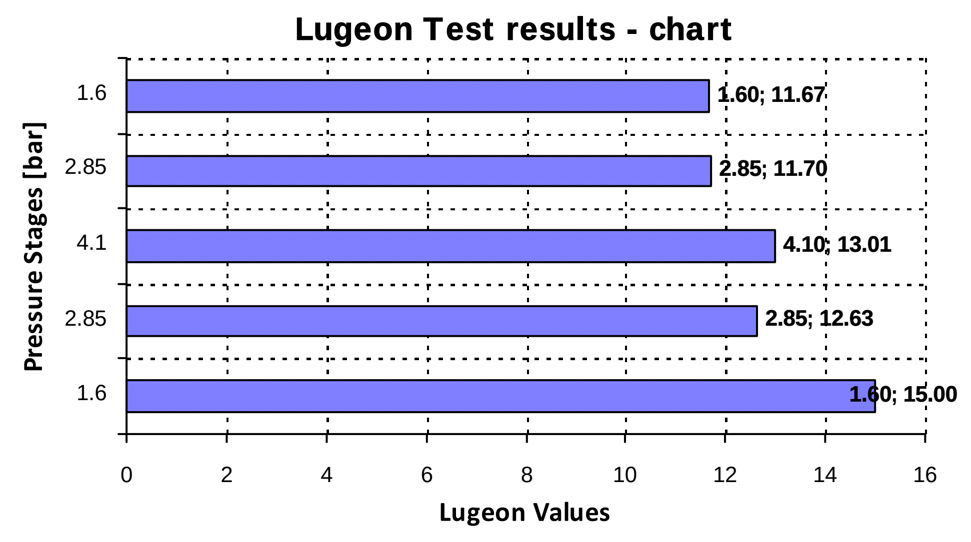
68	Diversion Tunnel n1 - ch. 8+70 - [sidewall]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
100	4	3.6	3.8	80	118	1.60	16.67
148	4.8	5.4	5.1	124	175	2.85	11.23
213	7	8	7.5	178	253	4.10	11.38
283	5	5	5	258	308	2.85	11.70
326	3	2.8	2.9	311	340	1.60	12.50

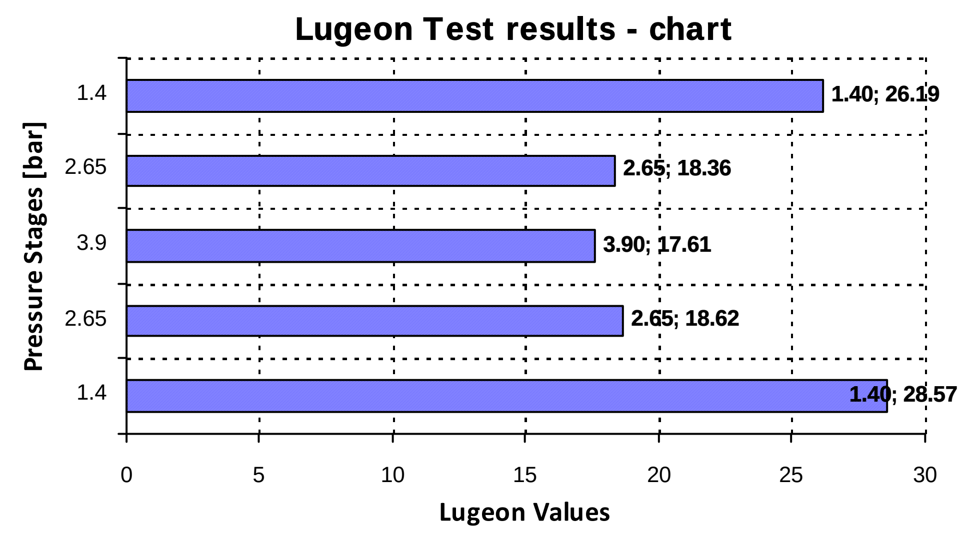
69 Diversion Tunnel n1 - ch. 8+70 - [sidewall] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
100	4	3.6	3.8	80	118	1.60	15.00
148	4.8	5.4	5.1	124	175	2.85	12.63
213	7	8	7.5	178	253	4.10	13.01
283	5	5	5	258	308	2.85	11.70
326	3	2.8	2.9	311	340	1.60	11.67

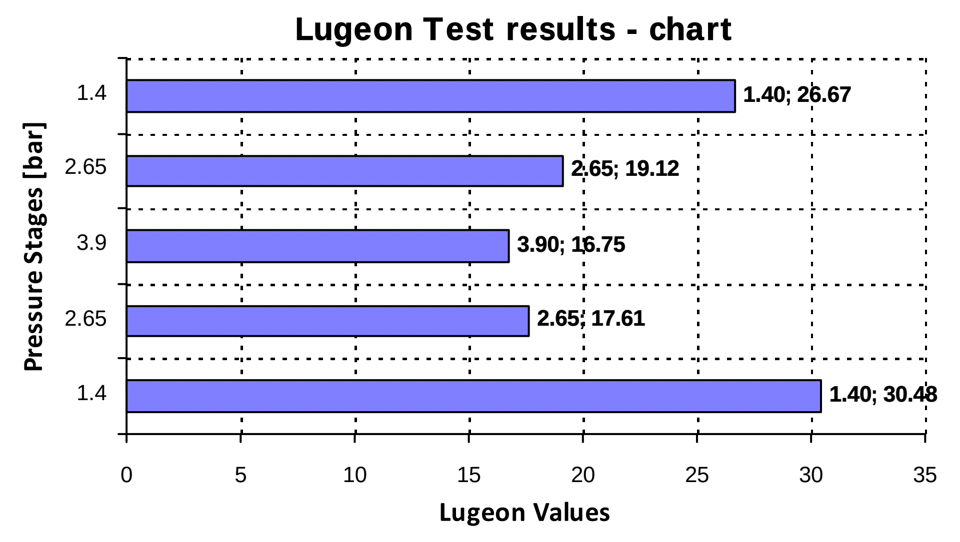
70 Diversion Tunnel n1 - ch. 8+70 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
342	6.4	5.6	6	310	370	1.40	28.57
410	7	7.8	7.4	375	449	2.65	18.62
504	9.8	10.8	10.3	455	558	3.90	17.61
598	7.6	7	7.3	560	633	2.65	18.36
663	5.6	5.4	5.5	635	690	1.40	26.19

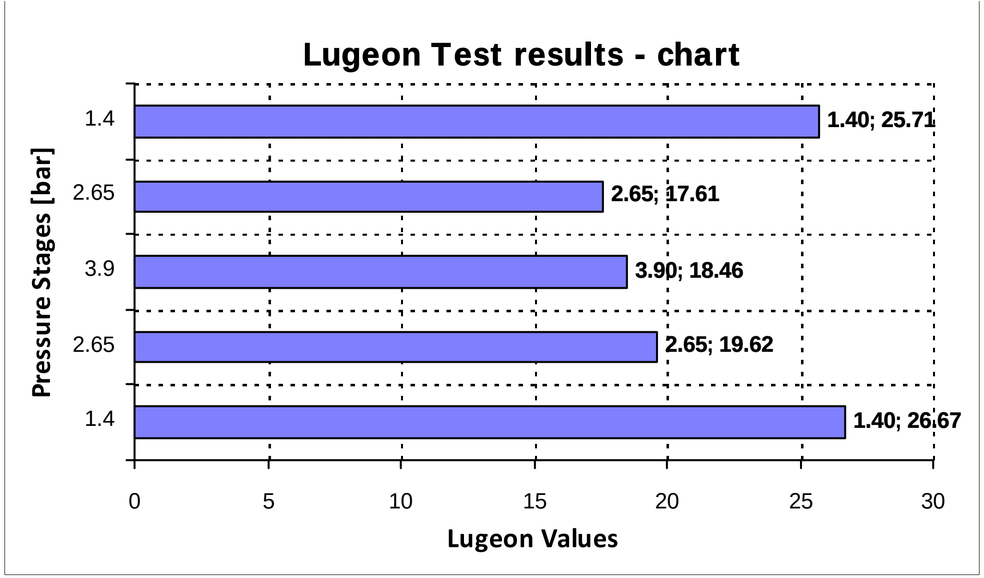
71 Diversion Tunnel n1 - ch. 8+70 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
342	6.4	5.6	6	310	370	1.40	30.48
410	7	7.8	7.4	375	449	2.65	17.61
504	9.8	10.8	10.3	455	558	3.90	16.75
598	7.6	7	7.3	560	633	2.65	19.12
663	5.6	5.4	5.5	635	690	1.40	26.67

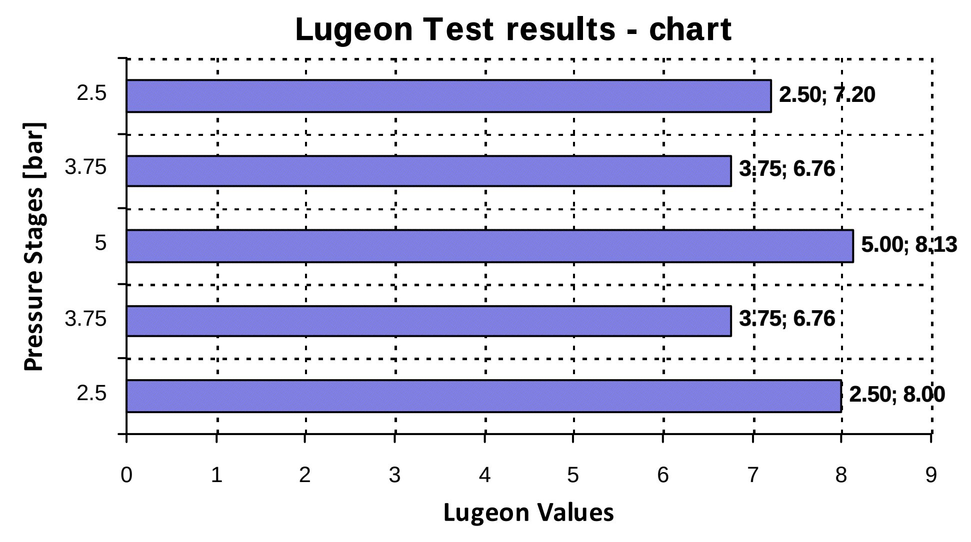
72 Diversion Tunnel n1 - ch. 8+70 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
342	6.4	5.6	6	310	370	1.40	26.67
410	7	7.8	7.4	375	449	2.65	19.62
504	9.8	10.8	10.3	455	558	3.90	18.46
598	7.6	7	7.3	560	633	2.65	17.61
663	5.6	5.4	5.5	635	690	1.40	25.71

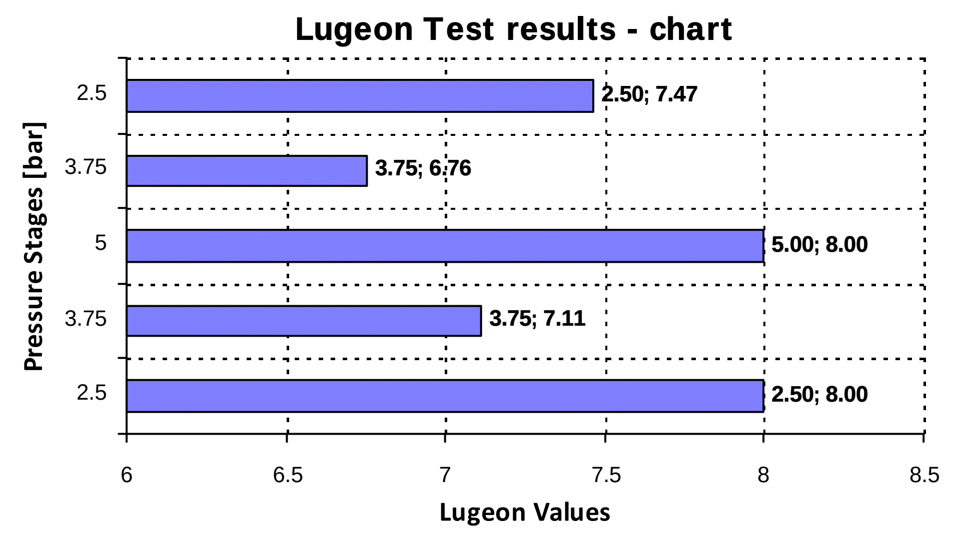
73 Diversion Tunnel n2 - ch. 0+25 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
355	3	3	3	340	370	2.50	8.00
395	4	3.6	3.8	375	413	3.75	6.76
445	6	6.2	6.1	415	476	5.00	8.13
497	3.8	3.8	3.8	478	516	3.75	6.76
532	2.8	2.6	2.7	518	545	2.50	7.20

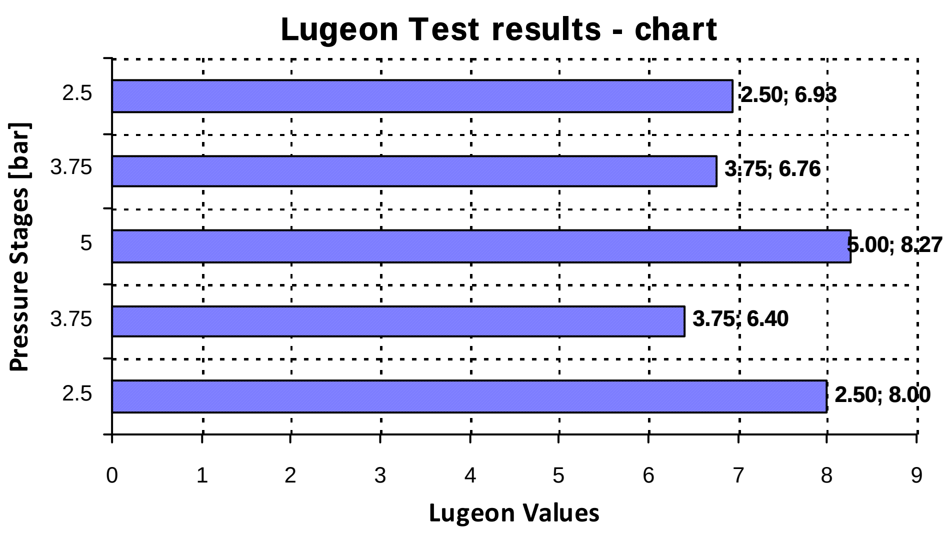
74 Diversion Tunnel n2 - ch. 0+25 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
355	3	3	3	340	370	2.50	8.00
395	4	3.6	3.8	375	413	3.75	7.11
445	6	6.2	6.1	415	476	5.00	8.00
497	3.8	3.8	3.8	478	516	3.75	6.76
532	2.8	2.6	2.7	518	545	2.50	7.47

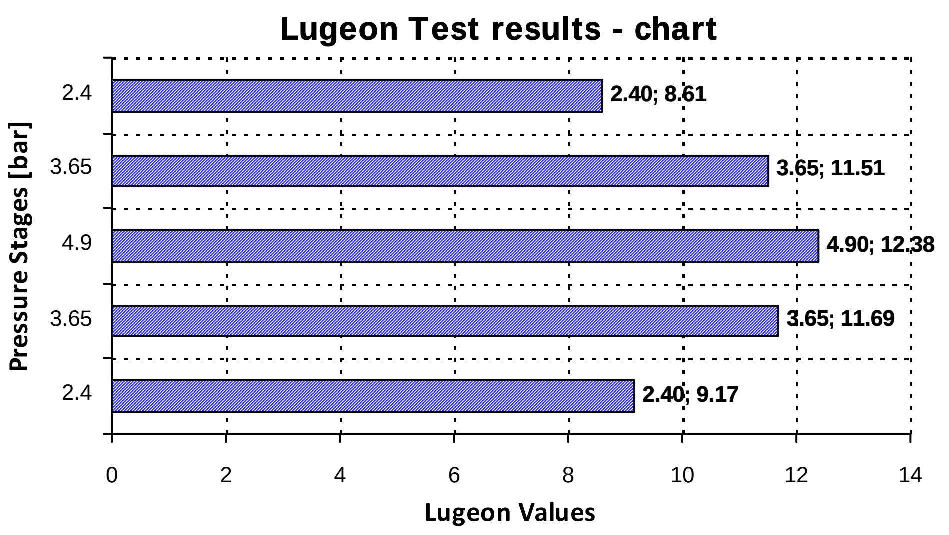
75 Diversion Tunnel n2 - ch. 0+25 - [Invert] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
355	3	3	3	340	370	2.50	8.00
395	4	3.6	3.8	375	413	3.75	6.40
445	6	6.2	6.1	415	476	5.00	8.27
497	3.8	3.8	3.8	478	516	3.75	6.76
532	2.8	2.6	2.7	518	545	2.50	6.93

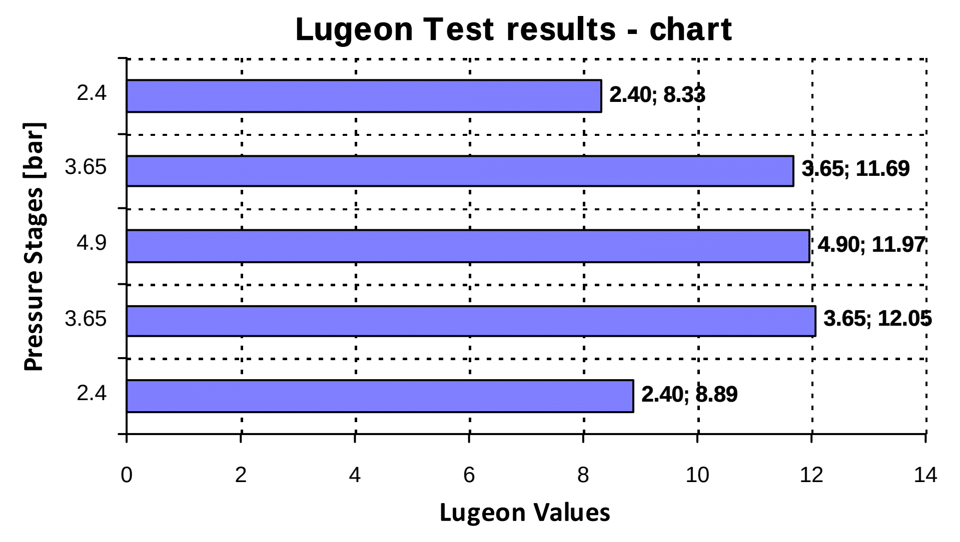
76 Diversion Tunnel n2 - ch. 0+25 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
555	3.2	3.4	3.3	539	572	2.40	9.17
612	6.6	6.2	6.4	579	643	3.65	11.69
694	8.8	9.4	9.1	650	741	4.90	12.38
776	6.4	6.2	6.3	744	807	3.65	11.51
824	3	3.2	3.1	809	840	2.40	8.61

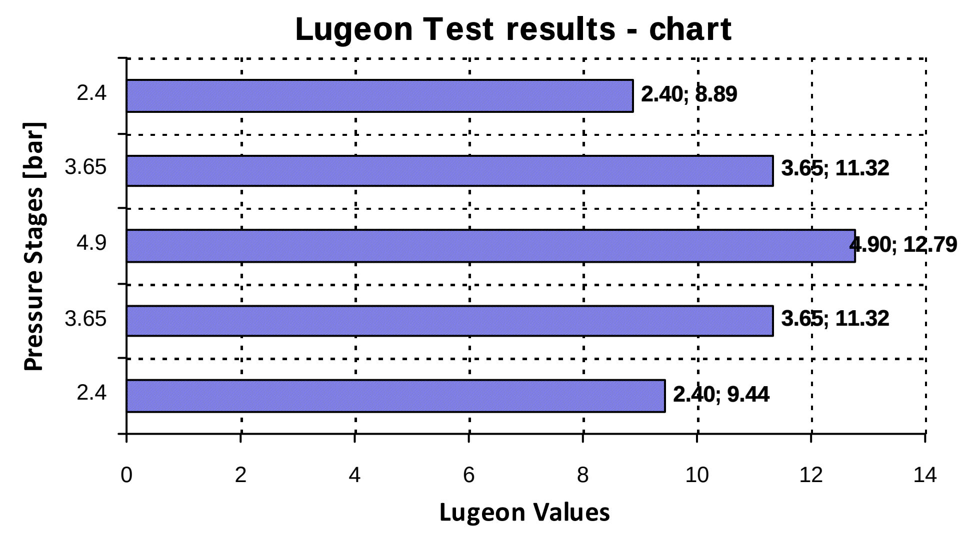
77	Diversion Tunnel n2 - ch. 0+25 - [Sw]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
555	3.2	3.4	3.3	539	572	2.40	8.89
612	6.6	6.2	6.4	579	643	3.65	12.05
694	8.8	9.4	9.1	650	741	4.90	11.97
776	6.4	6.2	6.3	744	807	3.65	11.69
824	3	3.2	3.1	809	840	2.40	8.33

78	Diversion Tunnel n2 - ch. 0+25 - [Sw]	Lugeon 5-10 min

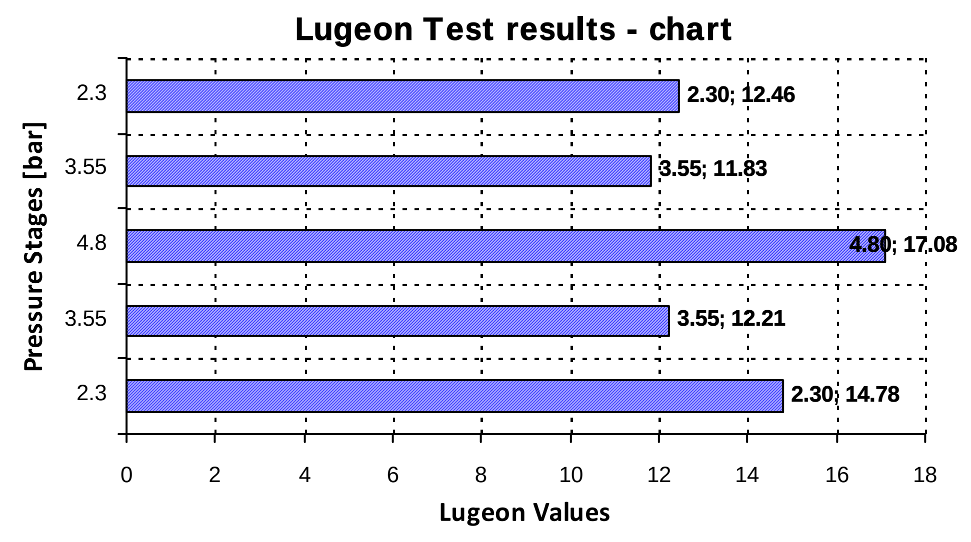


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
555	3.2	3.4	3.3	539	572	2.40	9.44
612	6.6	6.2	6.4	579	643	3.65	11.32
694	8.8	9.4	9.1	650	741	4.90	12.79
776	6.4	6.2	6.3	744	807	3.65	11.32
824	3	3.2	3.1	809	840	2.40	8.89

79 Diversion Tunnel n2 - ch. 0+25 - [Vault]

Lugeon 0-10 min

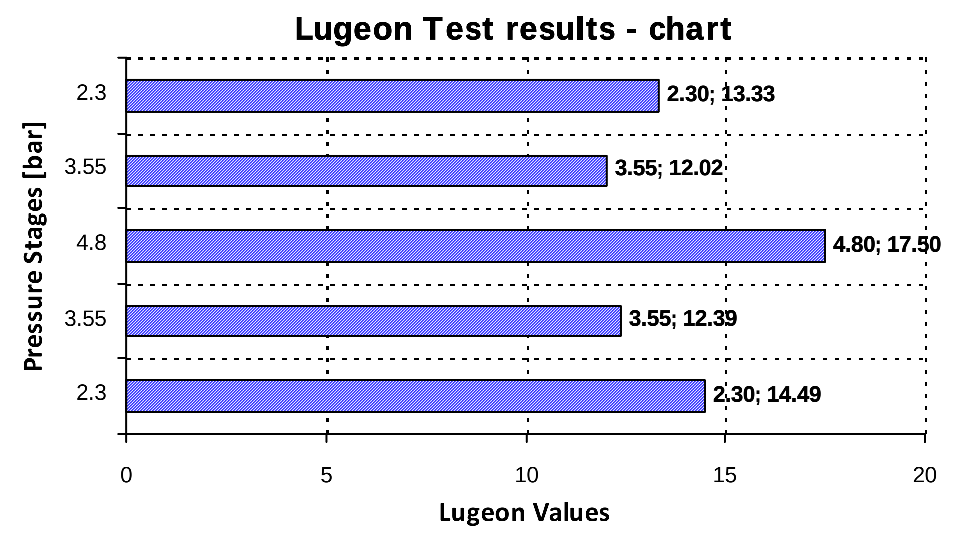


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
845	5	5.2	5.1	820	871	2.30	14.78
909	6.6	6.4	6.5	876	941	3.55	12.21
1012	12.6	12	12.3	949	1072	4.80	17.08
1122	6.4	6.2	6.3	1090	1153	3.55	11.83
1179	4.6	4	4.3	1156	1199	2.30	12.46

80 Diversion Tunnel n2 - ch. 0+25 - [Vault]

Lugeon 0-5 min

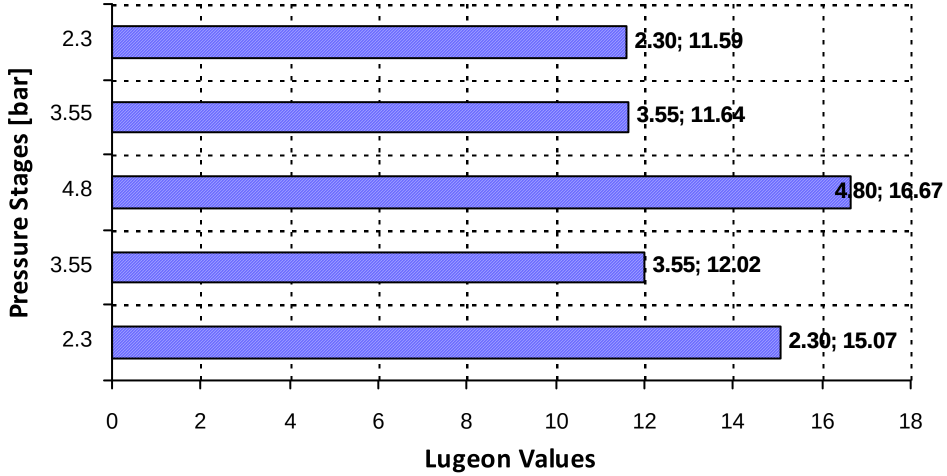


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
845	5	5.2	5.1	820	871	2.30	14.49
909	6.6	6.4	6.5	876	941	3.55	12.39
1012	12.6	12	12.3	949	1072	4.80	17.50
1122	6.4	6.2	6.3	1090	1153	3.55	12.02
1179	4.6	4	4.3	1156	1199	2.30	13.33

81 | Diversion Tunnel n2 - ch. 0+25 - [Vault] | Lugeon 5-10 min

Lugeon Test results - chart

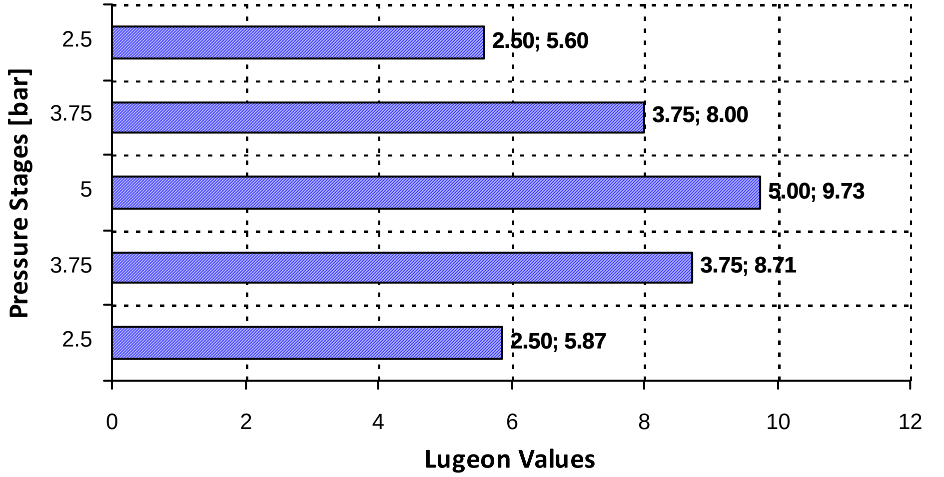


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
845	5	5.2	5.1	820	871	2.30	15.07
909	6.6	6.4	6.5	876	941	3.55	12.02
1012	12.6	12	12.3	949	1072	4.80	16.67
1122	6.4	6.2	6.3	1090	1153	3.55	11.64
1179	4.6	4	4.3	1156	1199	2.30	11.59

82 | Diversion Tunnel n2 - ch. 1+25 - [Invert] | Lugeon 0-10 min

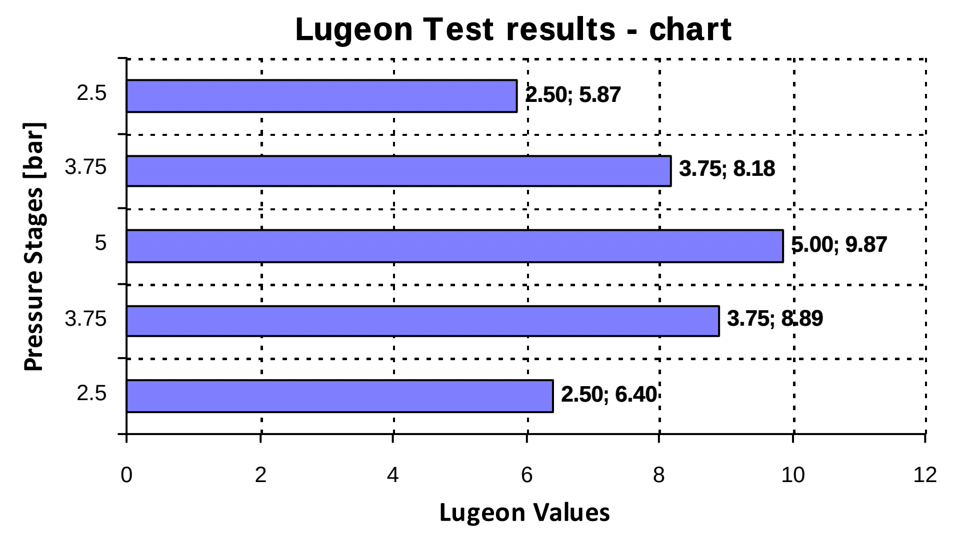
Lugeon Test results - chart



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
92	2.4	2	2.2	80	102	2.50	5.87
130	5	4.8	4.9	105	154	3.75	8.71
193	7.4	7.2	7.3	156	229	5.00	9.73
446	4.6	4.4	4.5	423	468	3.75	8.00
481	2.2	2	2.1	470	491	2.50	5.60

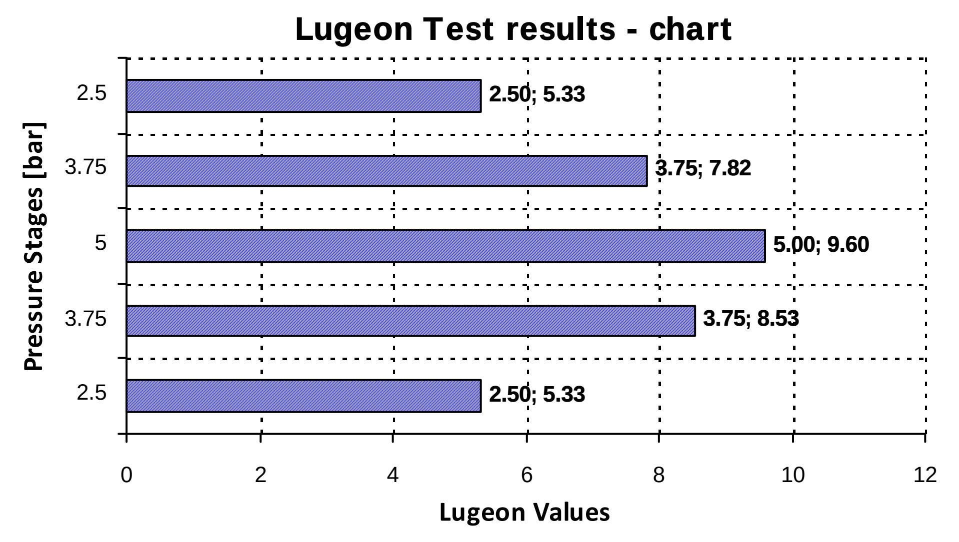
83 **Diversion Tunnel n2 - ch. 1+25 - [Invert]** **Lugeon 0-5 min**



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
92	2.4	2	2.2	80	102	2.50	6.40
130	5	4.8	4.9	105	154	3.75	8.89
193	7.4	7.2	7.3	156	229	5.00	9.87
446	4.6	4.4	4.5	423	468	3.75	8.18
481	2.2	2	2.1	470	491	2.50	5.87

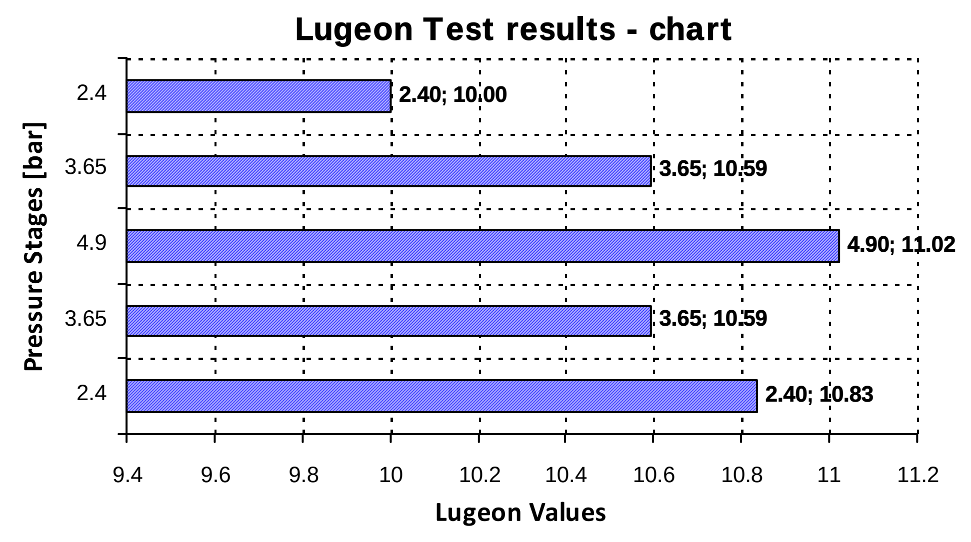
84 **Diversion Tunnel n2 - ch. 1+25 - [Invert]** **Lugeon 5-10 min**



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
92	2.4	2	2.2	80	102	2.50	5.33
130	5	4.8	4.9	105	154	3.75	8.53
193	7.4	7.2	7.3	156	229	5.00	9.60
446	4.6	4.4	4.5	423	468	3.75	7.82
481	2.2	2	2.1	470	491	2.50	5.33

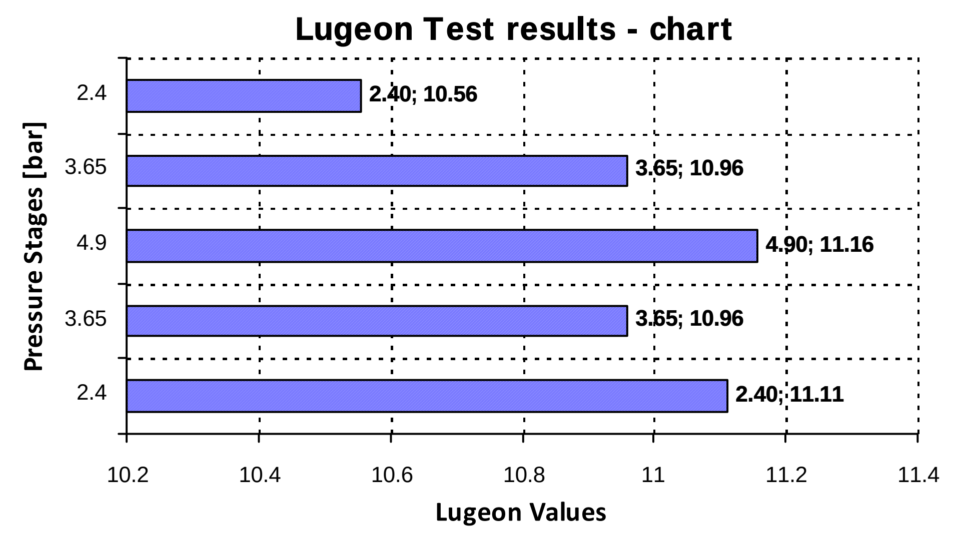
85 Diversion Tunnel n2 - ch. 1+25 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
520	4	3.8	3.9	500	539	2.40	10.83
573	6	5.6	5.8	543	601	3.65	10.59
650	8.2	8	8.1	609	690	4.90	11.02
723	6	5.6	5.8	693	751	3.65	10.59
778	3.8	3.4	3.6	759	795	2.40	10.00

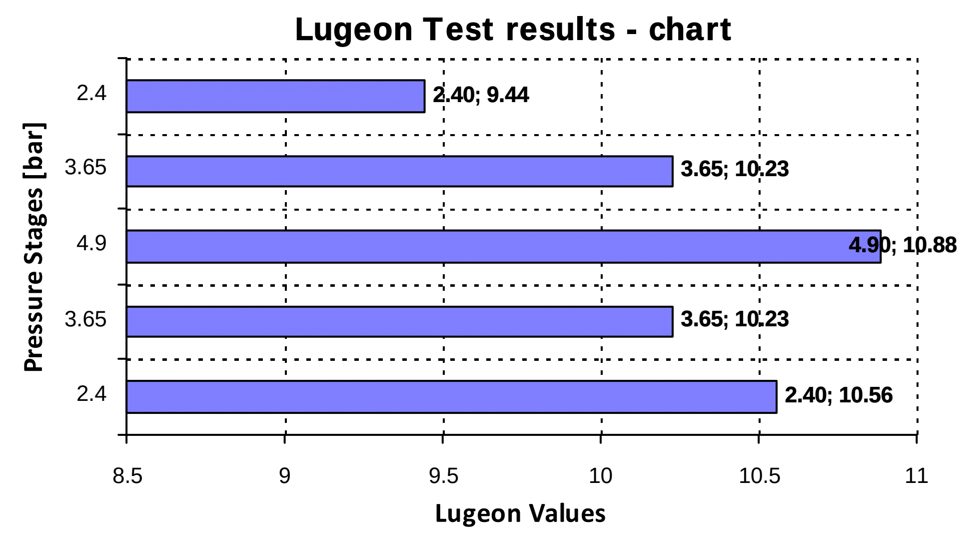
86 Diversion Tunnel n2 - ch. 1+25 - [Sw] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
520	4	3.8	3.9	500	539	2.40	11.11
573	6	5.6	5.8	543	601	3.65	10.96
650	8.2	8	8.1	609	690	4.90	11.16
723	6	5.6	5.8	693	751	3.65	10.96
778	3.8	3.4	3.6	759	795	2.40	10.56

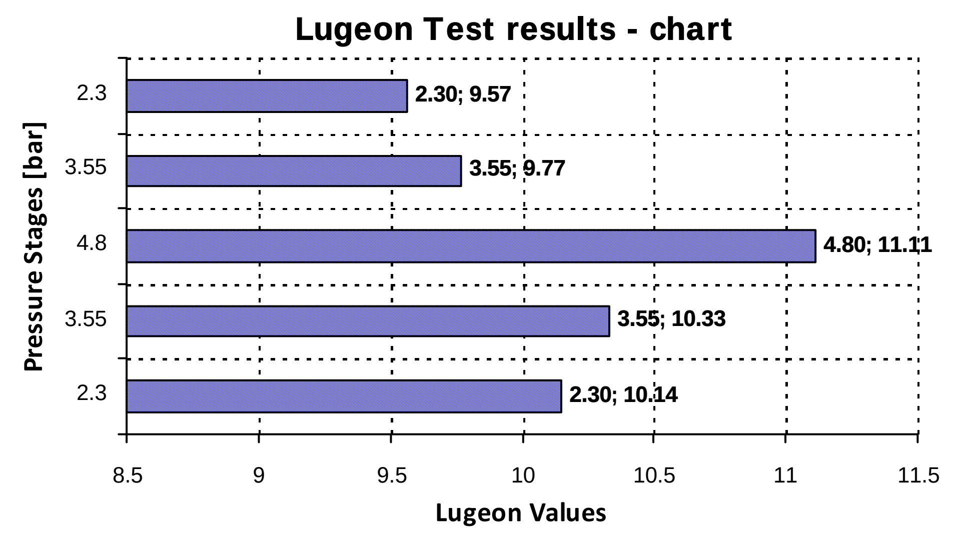
87 Diversion Tunnel n2 - ch. 1+25 - [Sw] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
520	4	3.8	3.9	500	539	2.40	10.56
573	6	5.6	5.8	543	601	3.65	10.23
650	8.2	8	8.1	609	690	4.90	10.88
723	6	5.6	5.8	693	751	3.65	10.23
778	3.8	3.4	3.6	759	795	2.40	9.44

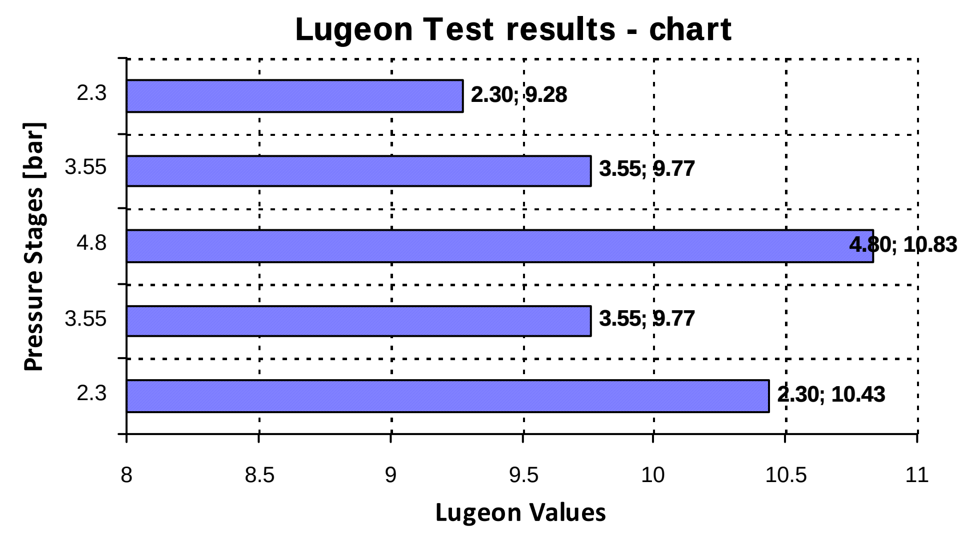
88 Diversion Tunnel n2 - ch. 1+25 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
799	3.6	3.4	3.5	781	816	2.30	10.14
847	5.2	5.8	5.5	821	876	3.55	10.33
922	7.8	8.2	8	883	963	4.80	11.11
992	5.2	5.2	5.2	966	1018	3.55	9.77
1038	3.2	3.4	3.3	1022	1055	2.30	9.57

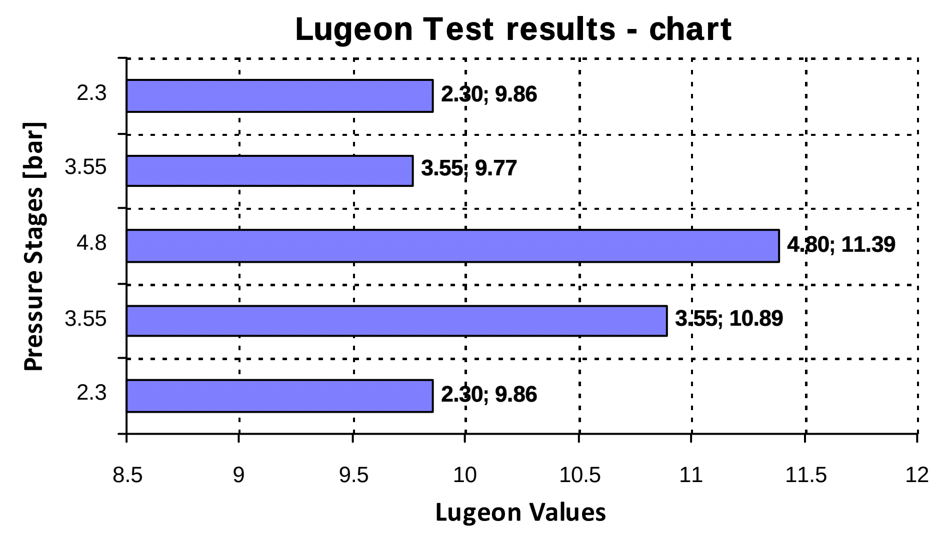
89 Diversion Tunnel n2 - ch. 1+25 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
799	3.6	3.4	3.5	781	816	2.30	10.43
847	5.2	5.8	5.5	821	876	3.55	9.77
922	7.8	8.2	8	883	963	4.80	10.83
992	5.2	5.2	5.2	966	1018	3.55	9.77
1038	3.2	3.4	3.3	1022	1055	2.30	9.28

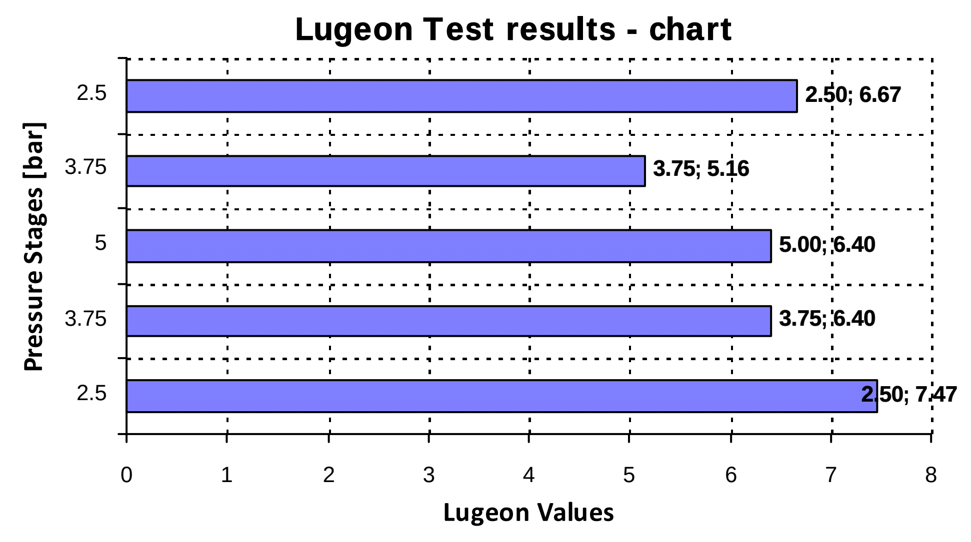
90 Diversion Tunnel n2 - ch. 1+25 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
799	3.6	3.4	3.5	781	816	2.30	9.86
847	5.2	5.8	5.5	821	876	3.55	10.89
922	7.8	8.2	8	883	963	4.80	11.39
992	5.2	5.2	5.2	966	1018	3.55	9.77
1038	3.2	3.4	3.3	1022	1055	2.30	9.86

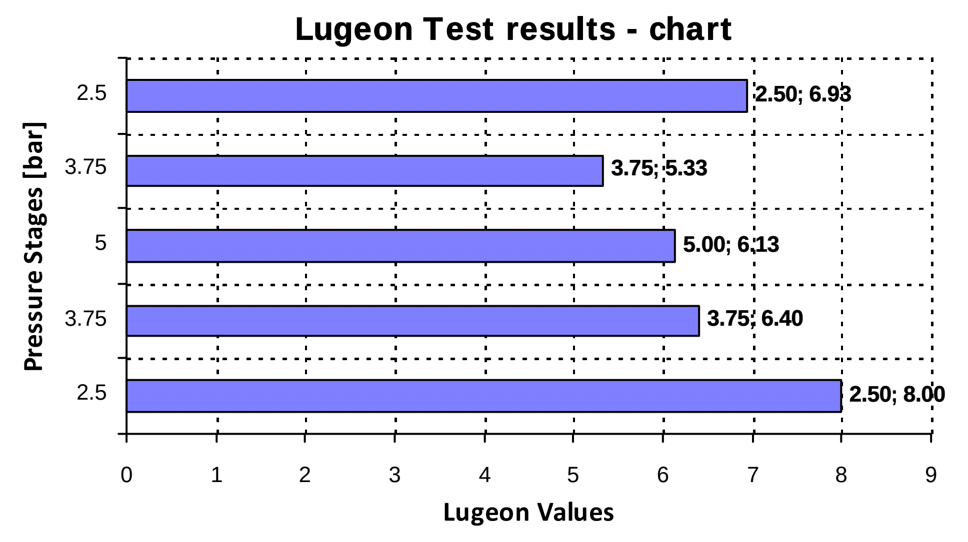
91	Diversion Tunnel n2 - ch. 2+25 - [Invert]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
515	3	2.6	2.8	500	528	2.50	7.47
548	3.6	3.6	3.6	530	566	3.75	6.40
593	4.6	5	4.8	570	618	5.00	6.40
639	3	2.8	2.9	624	653	3.75	5.16
668	2.6	2.4	2.5	655	680	2.50	6.67

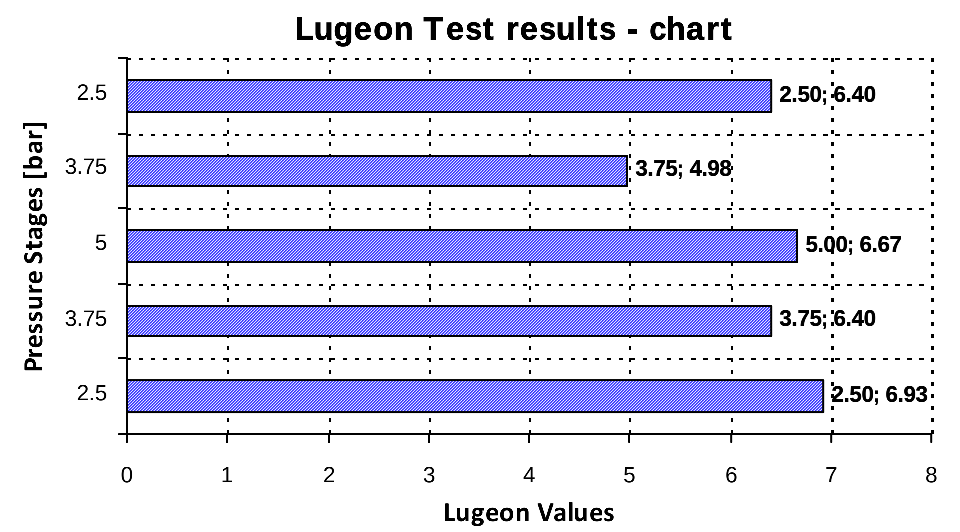
92	Diversion Tunnel n2 - ch. 2+25 - [Invert]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
515	3	2.6	2.8	500	528	2.50	8.00
548	3.6	3.6	3.6	530	566	3.75	6.40
593	4.6	5	4.8	570	618	5.00	6.13
639	3	2.8	2.9	624	653	3.75	5.33
668	2.6	2.4	2.5	655	680	2.50	6.93

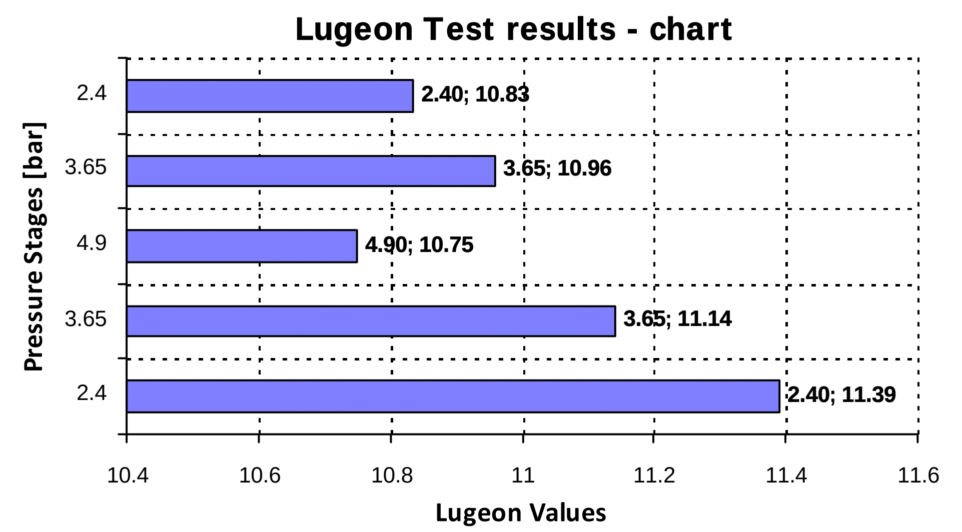
93	**Diversion Tunnel n2 - ch. 2+25 - [Invert]**	**Lugeon 5-10 min**



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
515	3	2.6	2.8	500	528	2.50	6.93
548	3.6	3.6	3.6	530	566	3.75	6.40
593	4.6	5	4.8	570	618	5.00	6.67
639	3	2.8	2.9	624	653	3.75	4.98
668	2.6	2.4	2.5	655	680	2.50	6.40

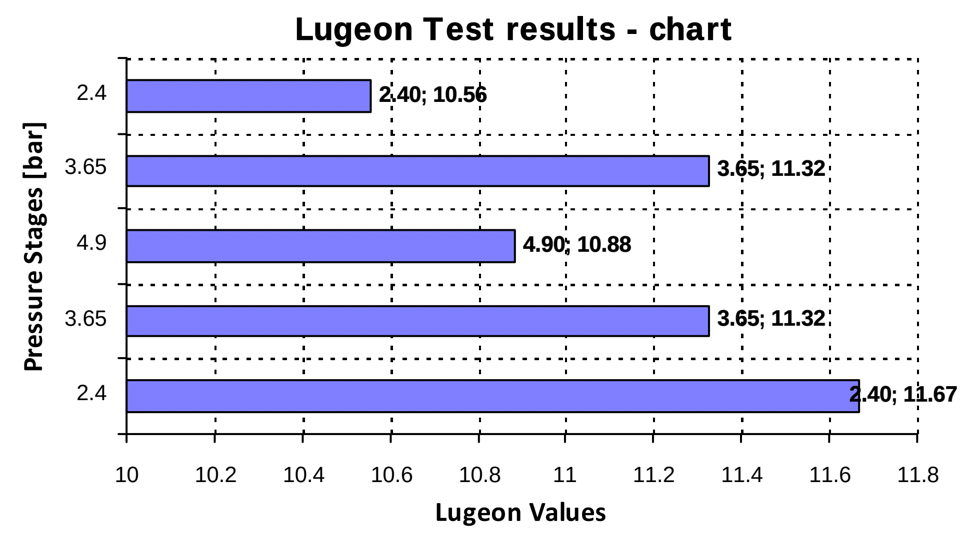
94	**Diversion Tunnel n2 - ch. 2+25 - [Sw]**	**Lugeon 0-10 min**



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
251	4.2	4	4.1	230	271	2.40	11.39
304	6.2	6	6.1	273	334	3.65	11.14
380	8	7.8	7.9	340	419	4.90	10.75
457	6.2	5.8	6	426	486	3.65	10.96
507	3.8	4	3.9	488	527	2.40	10.83

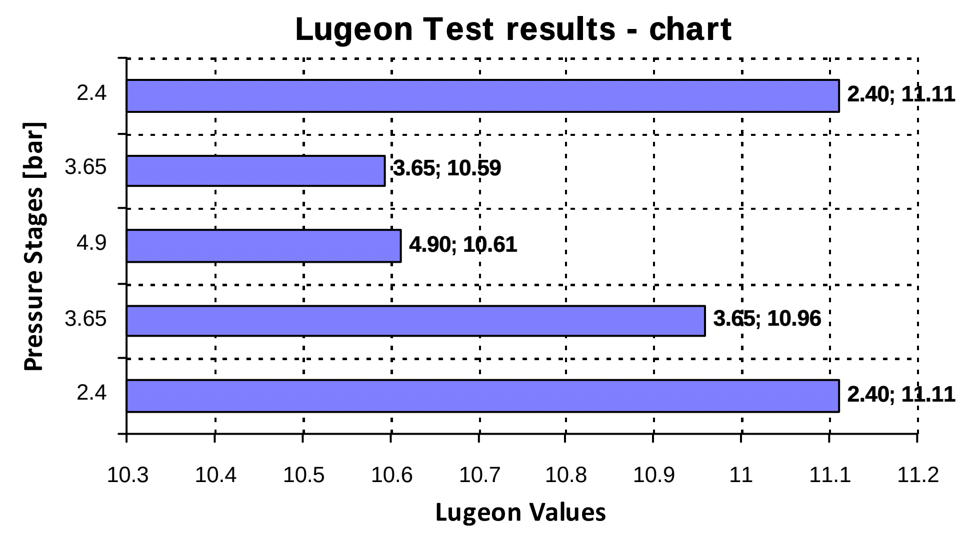
95	Diversion Tunnel n2 - ch. 2+25 - [Sw]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
251	4.2	4	4.1	230	271	2.40	11.67
304	6.2	6	6.1	273	334	3.65	11.32
380	8	7.8	7.9	340	419	4.90	10.88
457	6.2	5.8	6	426	486	3.65	11.32
507	3.8	4	3.9	488	527	2.40	10.56

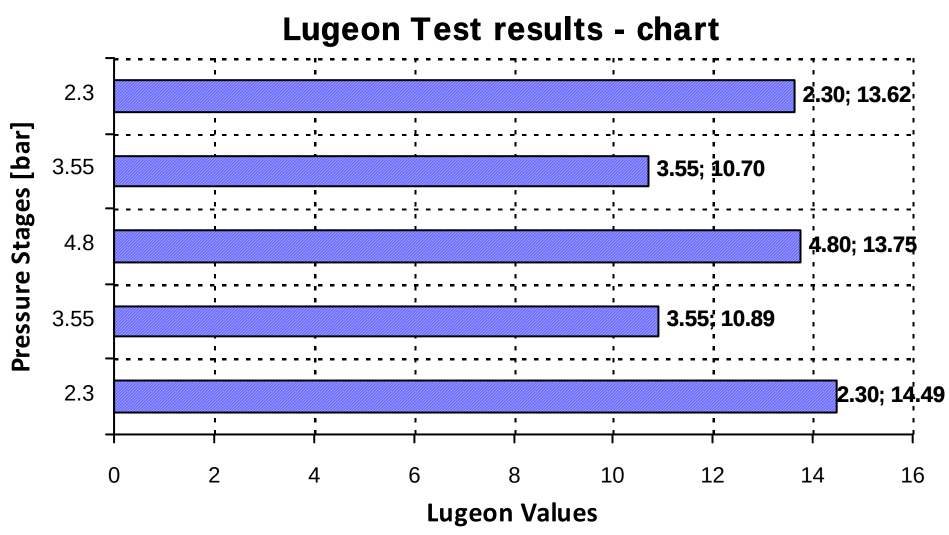
96	Diversion Tunnel n2 - ch. 2+25 - [Sw]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
251	4.2	4	4.1	230	271	2.40	11.11
304	6.2	6	6.1	273	334	3.65	10.96
380	8	7.8	7.9	340	419	4.90	10.61
457	6.2	5.8	6	426	486	3.65	10.59
507	3.8	4	3.9	488	527	2.40	11.11

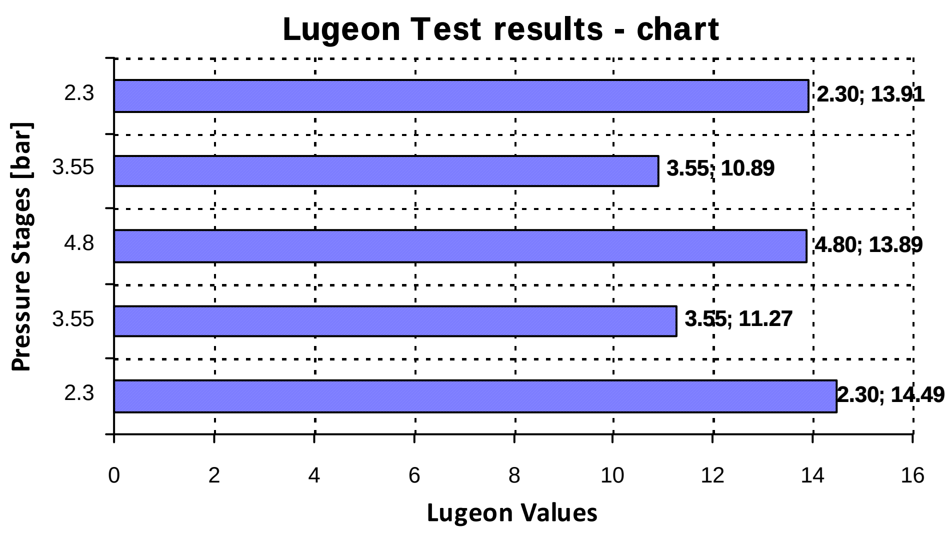
97 Diversion Tunnel n2 - ch. 2+25 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
675	5	5	5	650	700	2.30	14.49
740	6	5.6	5.8	710	768	3.55	10.89
825	10	9.8	9.9	775	874	4.80	13.75
1009	5.8	5.6	5.7	980	1037	3.55	10.70
1064	4.8	4.6	4.7	1040	1087	2.30	13.62

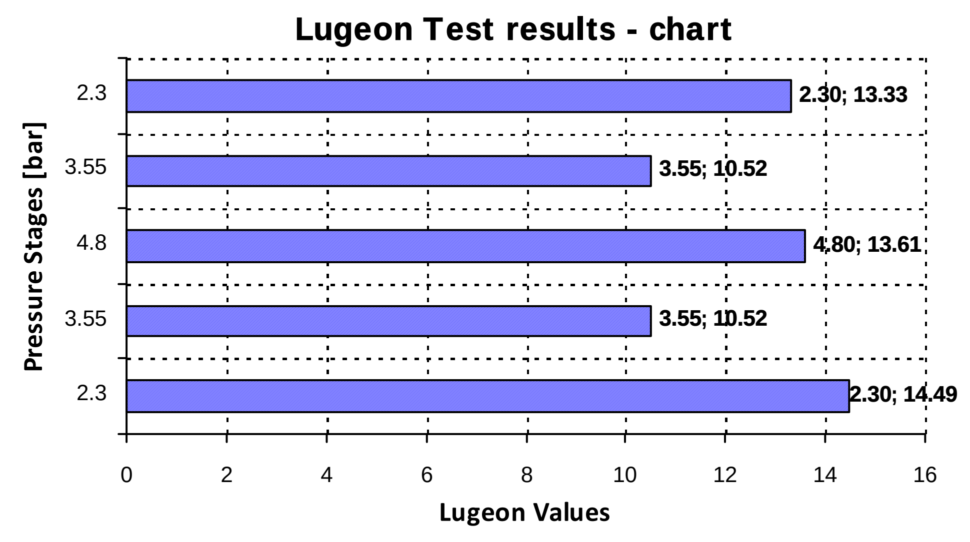
98 Diversion Tunnel n2 - ch. 2+25 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
675	5	5	5	650	700	2.30	14.49
740	6	5.6	5.8	710	768	3.55	11.27
825	10	9.8	9.9	775	874	4.80	13.89
1009	5.8	5.6	5.7	980	1037	3.55	10.89
1064	4.8	4.6	4.7	1040	1087	2.30	13.91

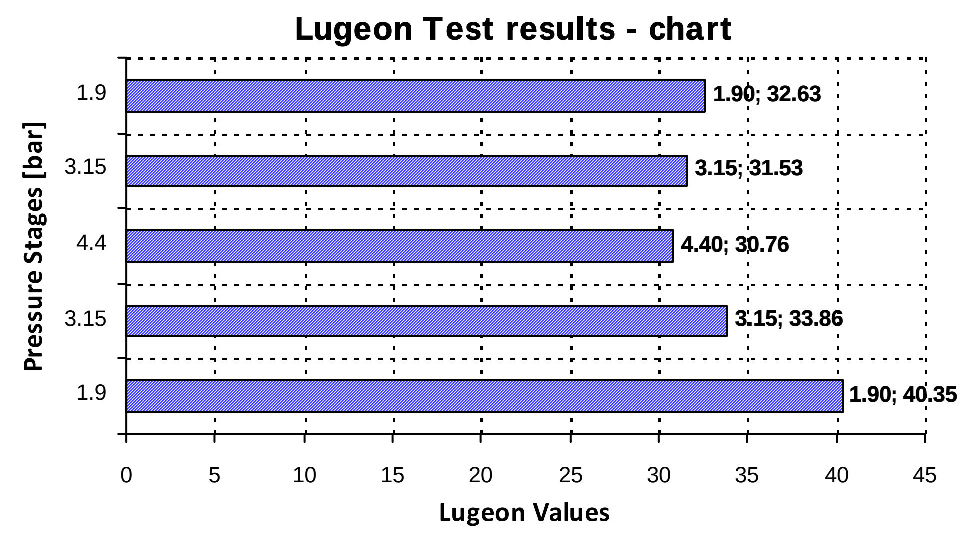
99	Diversion Tunnel n2 - ch. 2+25 - [Vault]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
675	5	5	5	650	700	2.30	14.49
740	6	5.6	5.8	710	768	3.55	10.52
825	10	9.8	9.9	775	874	4.80	13.61
1009	5.8	5.6	5.7	980	1037	3.55	10.52
1064	4.8	4.6	4.7	1040	1087	2.30	13.33

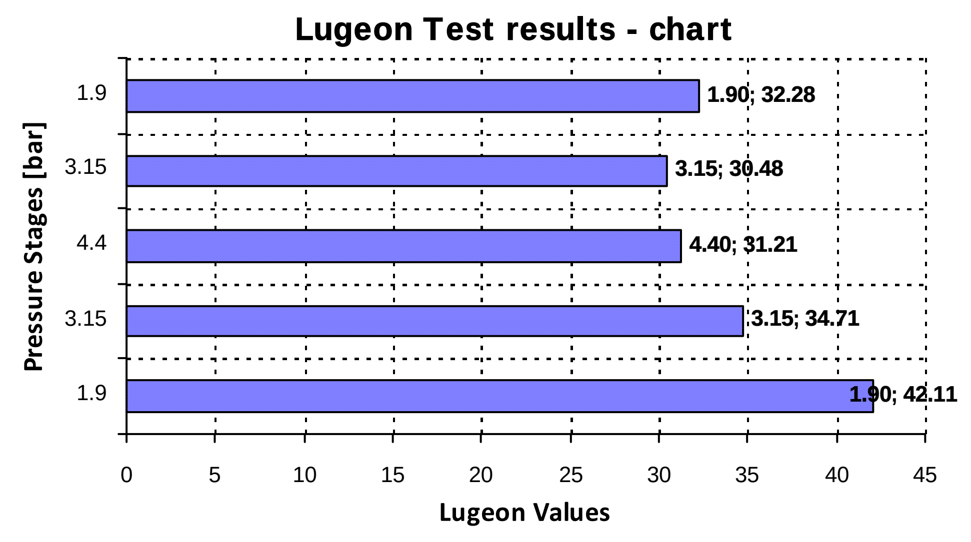
100	Diversion Tunnel n2 - ch. 5+20 - [Sw]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
656	12	11	11.5	596	711	1.90	40.35
815	16.4	15.6	16	733	893	3.15	33.86
1023	20.6	20	20.3	920	1123	4.40	30.76
1208	14.4	15.4	14.9	1136	1285	3.15	31.53
1339	9.2	9.4	9.3	1293	1386	1.90	32.63

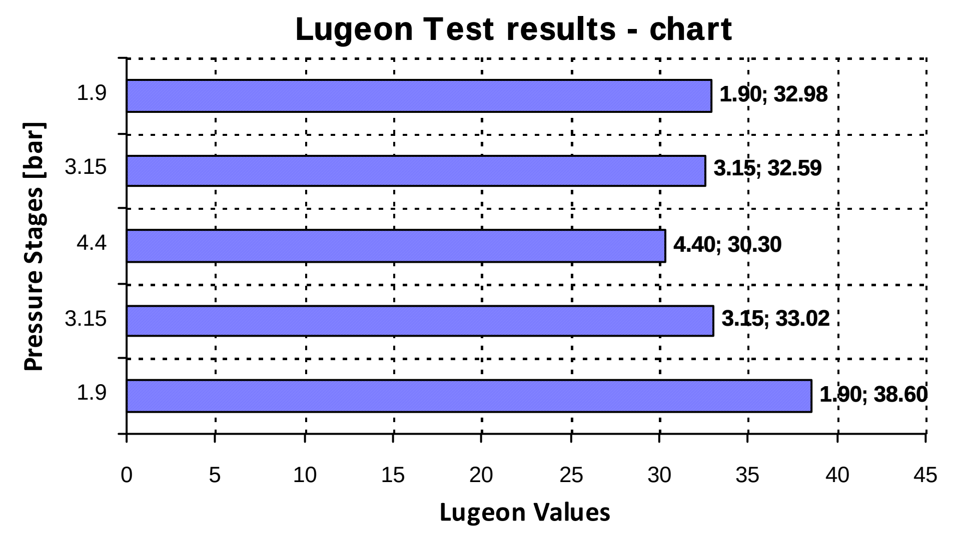
101	Diversion Tunnel n2 - ch. 5+20 - [Sw]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
656	12	11	11.5	596	711	1.90	42.11
815	16.4	15.6	16	733	893	3.15	34.71
1023	20.6	20	20.3	920	1123	4.40	31.21
1208	14.4	15.4	14.9	1136	1285	3.15	30.48
1339	9.2	9.4	9.3	1293	1386	1.90	32.28

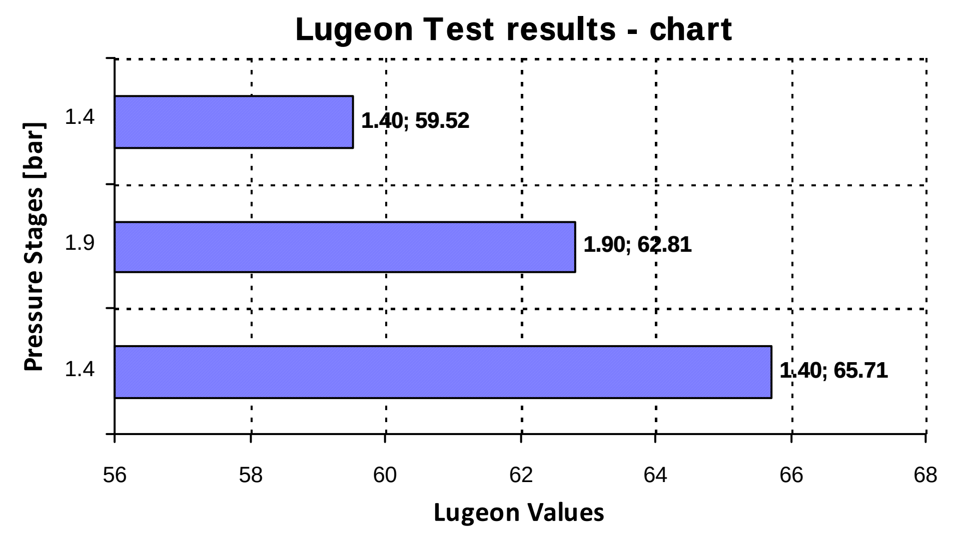
102	Diversion Tunnel n2 - ch. 5+20 - [Sw]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
656	12	11	11.5	596	711	1.90	38.60
815	16.4	15.6	16	733	893	3.15	33.02
1023	20.6	20	20.3	920	1123	4.40	30.30
1208	14.4	15.4	14.9	1136	1285	3.15	32.59
1339	9.2	9.4	9.3	1293	1386	1.90	32.98

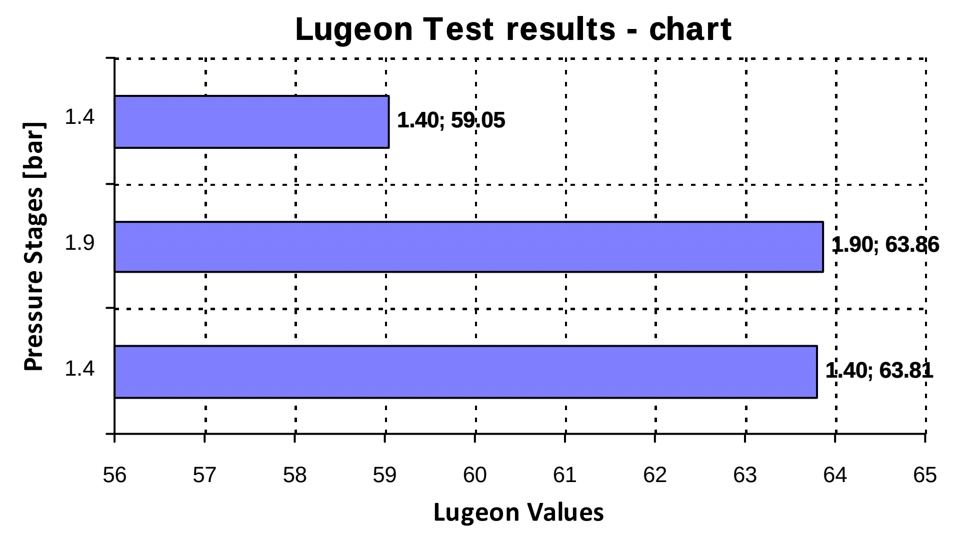
103 Diversion Tunnel n2 - ch. 5+20 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
77	13.4	14.2	13.8	10	148	1.40	65.71
250	18.2	17.6	17.9	159	338	1.90	62.81
409	12.4	12.6	12.5	347	472	1.40	59.52

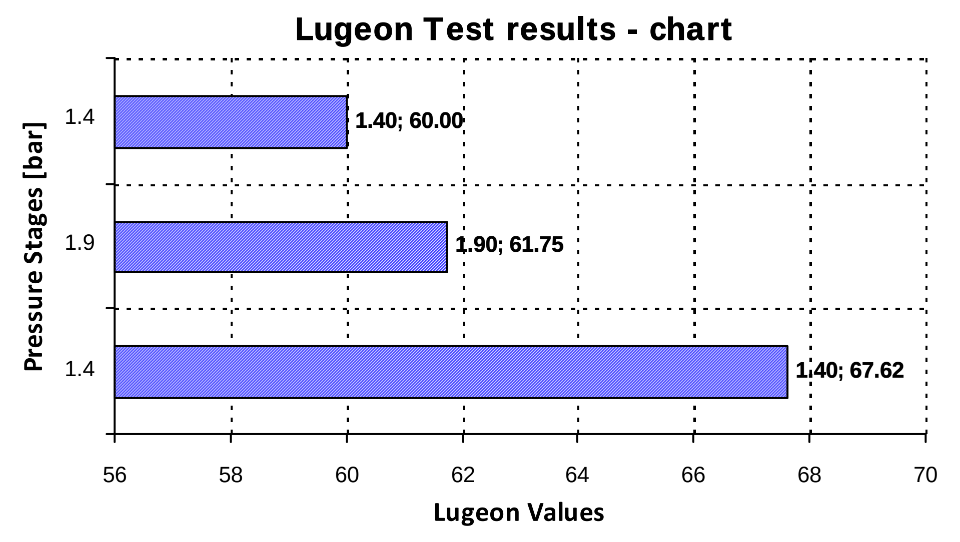
104 Diversion Tunnel n2 - ch. 5+20 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
77	13.4	14.2	13.8	10	148	1.40	63.81
250	18.2	17.6	17.9	159	338	1.90	63.86
409	12.4	12.6	12.5	347	472	1.40	59.05

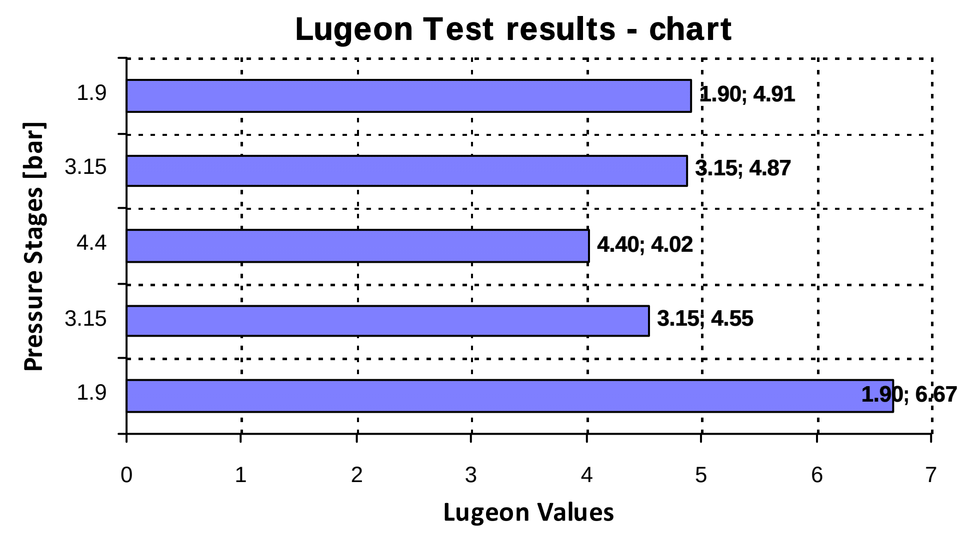
105 Diversion Tunnel n2 - ch. 5+20 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
77	13.4	14.2	13.8	10	148	1.40	67.62
250	18.2	17.6	17.9	159	338	1.90	61.75
409	12.4	12.6	12.5	347	472	1.40	60.00

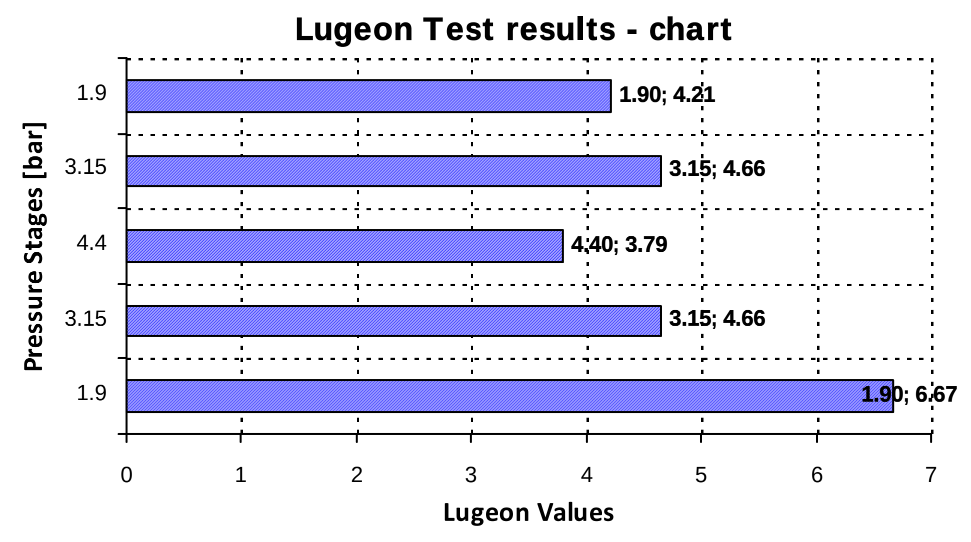
106 Diversion Tunnel n2 - ch. 5+25 - [Sw] repet. Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
646	3.8	3.8	3.8	627	665	1.90	6.67
691	4.4	4.2	4.3	669	712	3.15	4.55
744	5	5.6	5.3	719	772	4.40	4.02
796	4.4	4.8	4.6	774	820	3.15	4.87
833	2.4	3.2	2.8	821	849	1.90	4.91

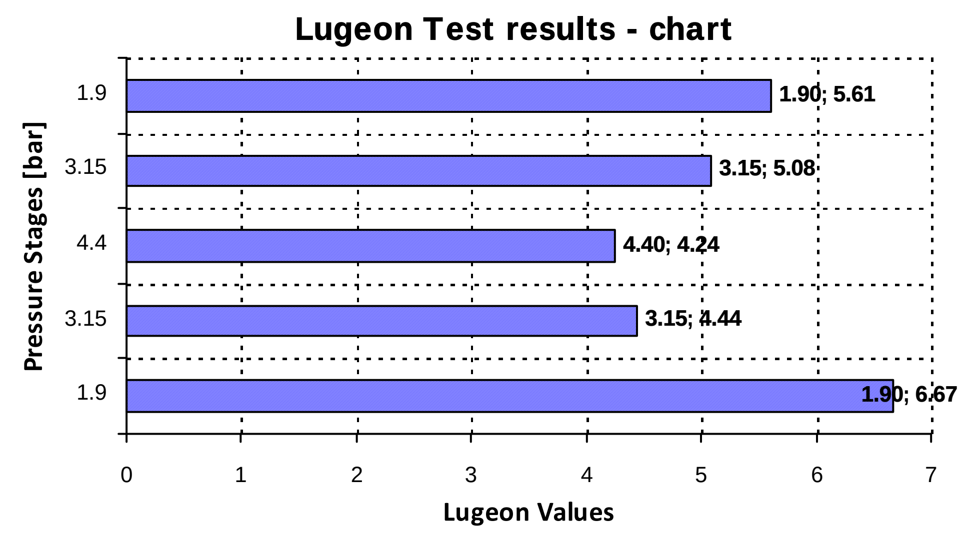
107	Diversion Tunnel n2 - ch. 5+25 - [Sw] repet.	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
646	3.8	3.8	3.8	627	665	1.90	6.67
691	4.4	4.2	4.3	669	712	3.15	4.66
744	5	5.6	5.3	719	772	4.40	3.79
796	4.4	4.8	4.6	774	820	3.15	4.66
833	2.4	3.2	2.8	821	849	1.90	4.21

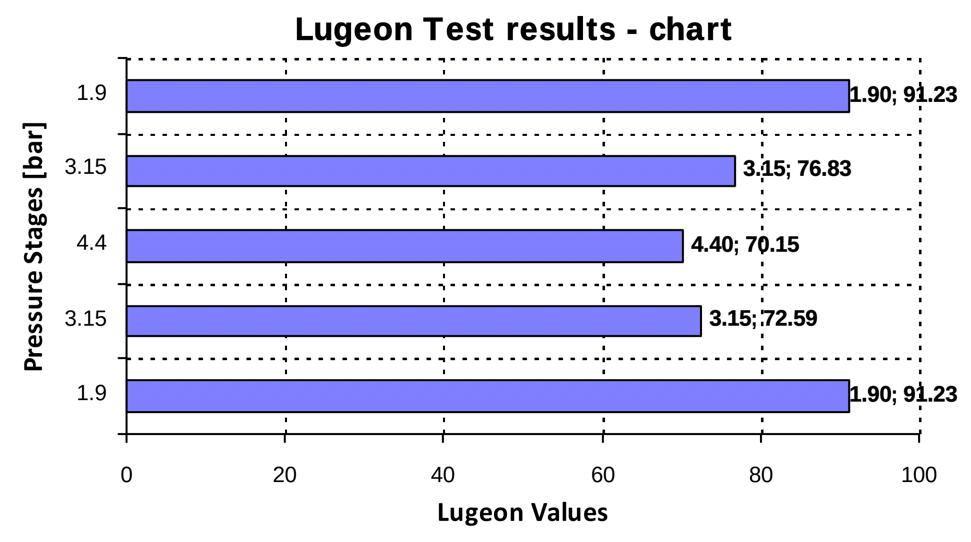
108	Diversion Tunnel n2 - ch. 5+25 - [Sw] repet.	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
646	3.8	3.8	3.8	627	665	1.90	6.67
691	4.4	4.2	4.3	669	712	3.15	4.44
744	5	5.6	5.3	719	772	4.40	4.24
796	4.4	4.8	4.6	774	820	3.15	5.08
833	2.4	3.2	2.8	821	849	1.90	5.61

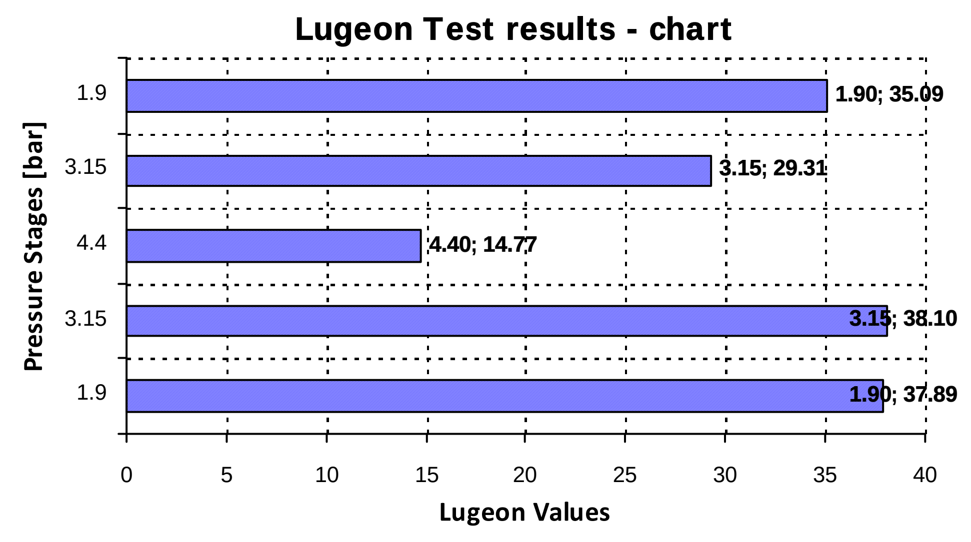
109 Diversion Tunnel n2 - ch. 6+20 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
152	26.4	25.6	26	20	280	1.90	91.23
500	34	34.6	34.3	330	673	3.15	72.59
962	47.8	44.8	46.3	723	1186	4.40	70.15
1443	36.6	36	36.3	1260	1623	3.15	76.83
1770	26	26	26	1640	1900	1.90	91.23

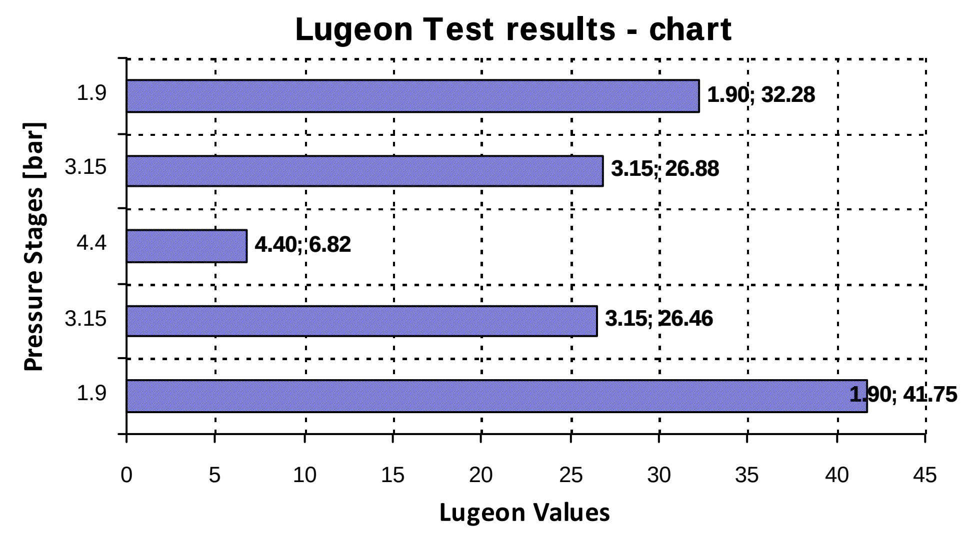
110 Diversion Tunnel n2 - ch. 6+20 - [Sw] repet. Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1103	23.8	19.4	21.6	984	1200	1.90	37.89
1345	25	47	36	1220	1580	3.15	38.10
1650	9	30	19.5	1605	1800	4.40	14.77
1950	25.4	30	27.7	1823	2100	3.15	29.31
2210	18.4	21.6	20	2118	2318	1.90	35.09

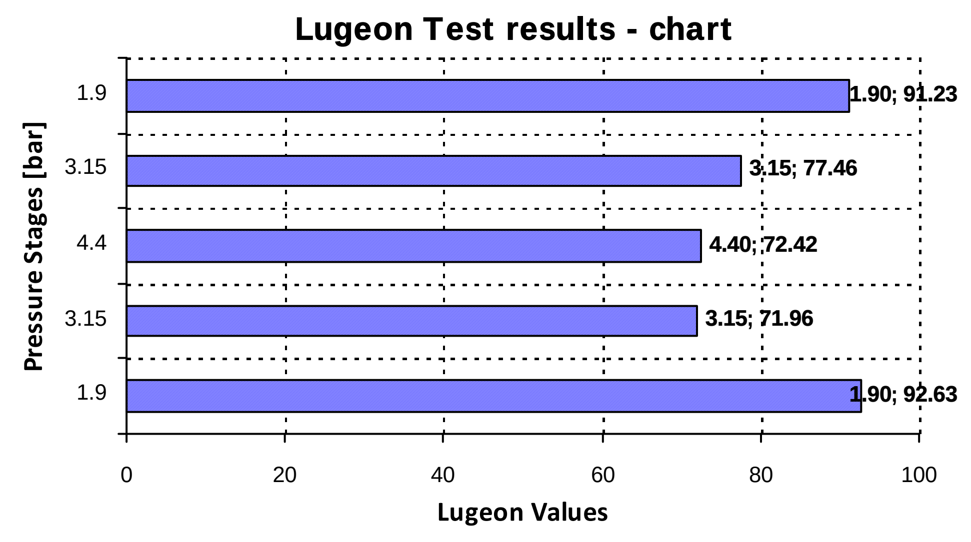
111 Diversion Tunnel n2 - ch. 6+20 - [Sw] repet. Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1103	23.8	19.4	21.6	984	1200	1.90	41.75
1345	25	47	36	1220	1580	3.15	26.46
1650	9	30	19.5	1605	1800	4.40	6.82
1950	25.4	30	27.7	1823	2100	3.15	26.88
2210	18.4	21.6	20	2118	2318	1.90	32.28

112 Diversion Tunnel n2 - ch. 6+20 - [Sw] Lugeon 0-5 min

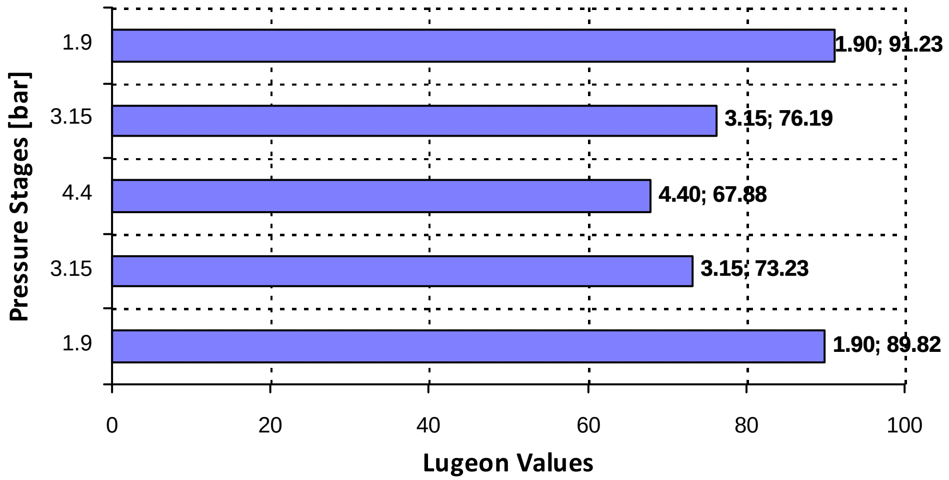


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
152	26.4	25.6	26	20	280	1.90	92.63
500	34	34.6	34.3	330	673	3.15	71.96
962	47.8	44.8	46.3	723	1186	4.40	72.42
1443	36.6	36	36.3	1260	1623	3.15	77.46
1770	26	26	26	1640	1900	1.90	91.23

113 Diversion Tunnel n2 - ch. 6+20 - [Sw] Lugeon 5-10 min

Lugeon Test results - chart

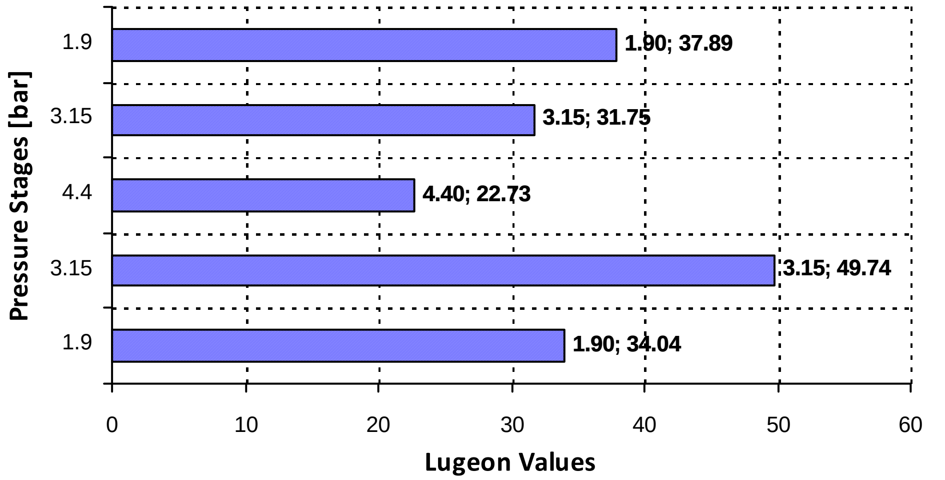


Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
152	26.4	25.6	26	20	280	1.90	89.82
500	34	34.6	34.3	330	673	3.15	73.23
962	47.8	44.8	46.3	723	1186	4.40	67.88
1443	36.6	36	36.3	1260	1623	3.15	76.19
1770	26	26	26	1640	1900	1.90	91.23

114 Diversion Tunnel n2 - ch. 6+20 - [Sw] repet. Lugeon 5-10 min

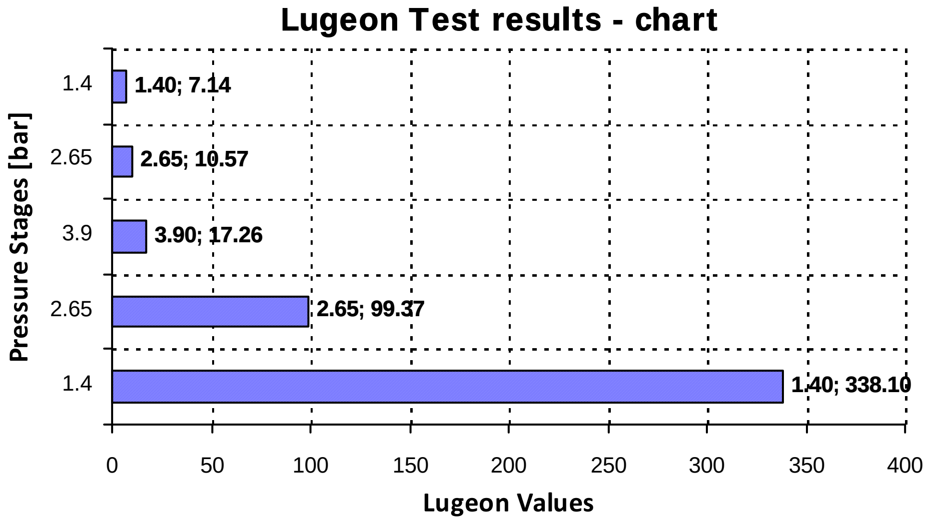
Lugeon Test results - chart



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1103	23.8	19.4	21.6	984	1200	1.90	34.04
1345	25	47	36	1220	1580	3.15	49.74
1650	9	30	19.5	1605	1800	4.40	22.73
1950	25.4	30	27.7	1823	2100	3.15	31.75
2210	18.4	21.6	20	2118	2318	1.90	37.89

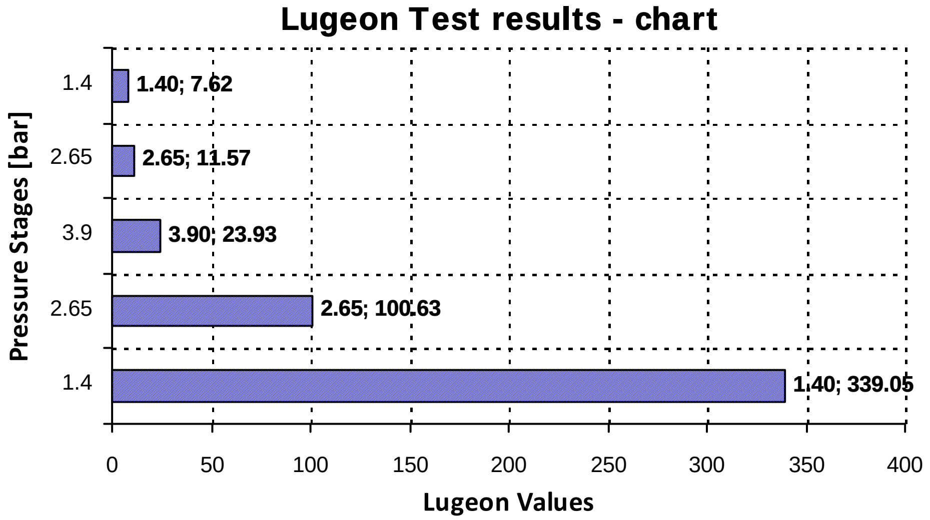
115 Diversion Tunnel n2 - ch. 6+20 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
406	71.2	70.8	71	50	760	1.40	338.10
980	40	39	39.5	780	1175	2.65	99.37
1250	14	6.2	10.1	1180	1281	3.90	17.26
1304	4.6	3.8	4.2	1281	1323	2.65	10.57
1333	1.6	1.4	1.5	1325	1340	1.40	7.14

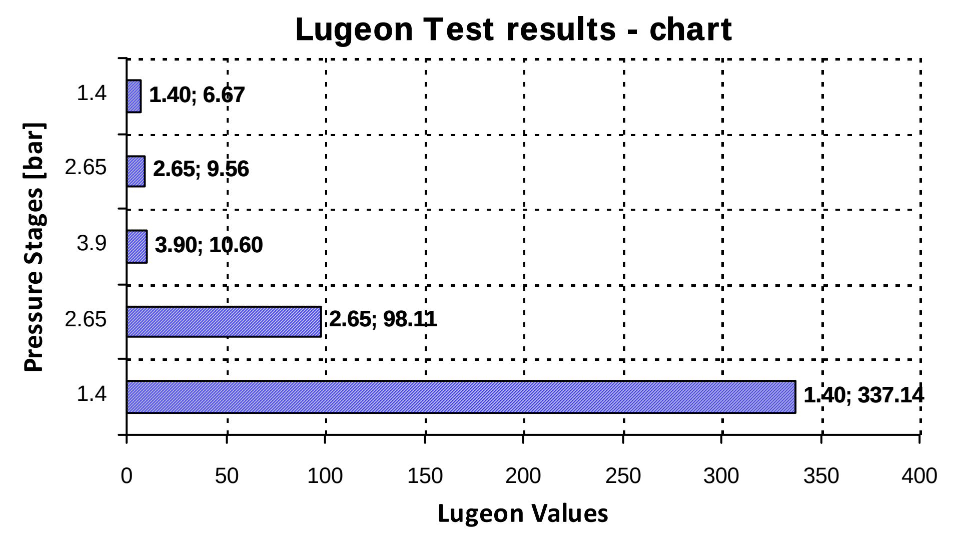
116 Diversion Tunnel n2 - ch. 6+20 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
406	71.2	70.8	71	50	760	1.40	339.05
980	40	39	39.5	780	1175	2.65	100.63
1250	14	6.2	10.1	1180	1281	3.90	23.93
1304	4.6	3.8	4.2	1281	1323	2.65	11.57
1333	1.6	1.4	1.5	1325	1340	1.40	7.62

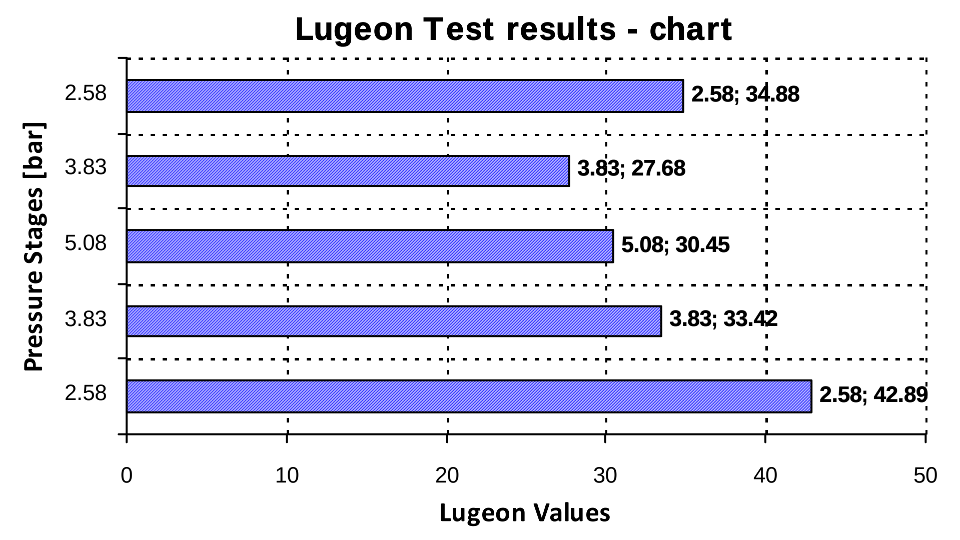
117	**Diversion Tunnel n2 - ch. 6+20 - [Vault]**	**Lugeon 5-10 min**



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
406	71.2	70.8	71	50	760	1.40	337.14
980	40	39	39.5	780	1175	2.65	98.11
1250	14	6.2	10.1	1180	1281	3.90	10.60
1304	4.6	3.8	4.2	1281	1323	2.65	9.56
1333	1.6	1.4	1.5	1325	1340	1.40	6.67

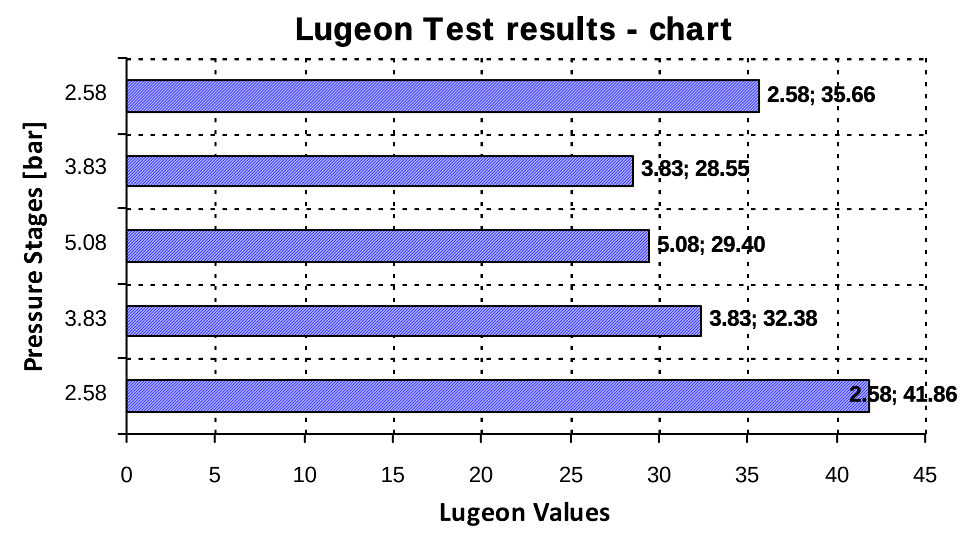
118	**Diversion Tunnel n2 - ch. 7+25 - [Invert]**	**Lugeon 0-10 min**



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
509	16.2	17	16.6	428	594	2.58	42.89
687	18.6	19.8	19.2	594	786	3.83	33.42
898	22.4	24	23.2	786	1018	5.08	30.45
1100	16.4	15.4	15.9	1018	1177	3.83	27.68
1246	13.8	13.2	13.5	1177	1312	2.58	34.88

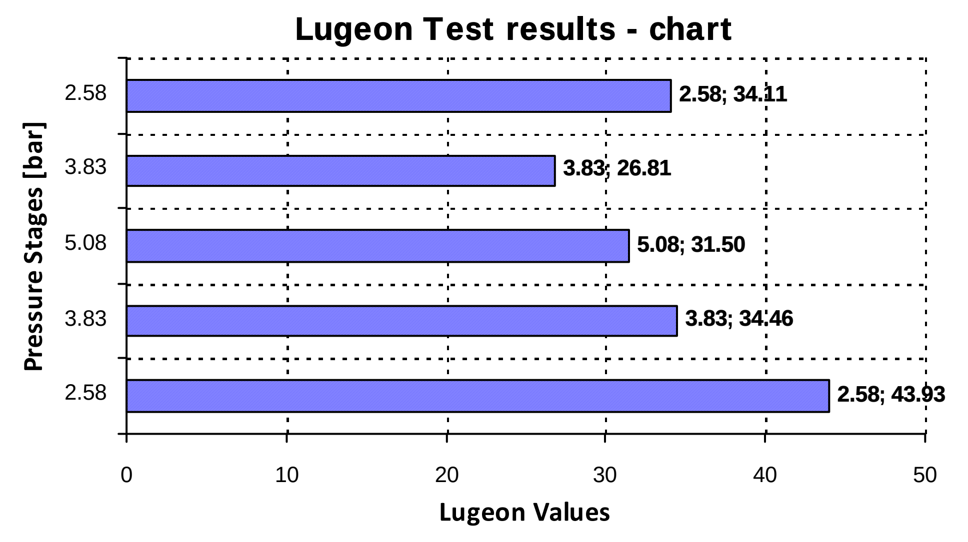
119 | **Diversion Tunnel n2 - ch. 7+25 - [Invert]** | **Lugeon 0-5 min**



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
509	16.2	17	16.6	428	594	2.58	41.86
687	18.6	19.8	19.2	594	786	3.83	32.38
898	22.4	24	23.2	786	1018	5.08	29.40
1100	16.4	15.4	15.9	1018	1177	3.83	28.55
1246	13.8	13.2	13.5	1177	1312	2.58	35.66

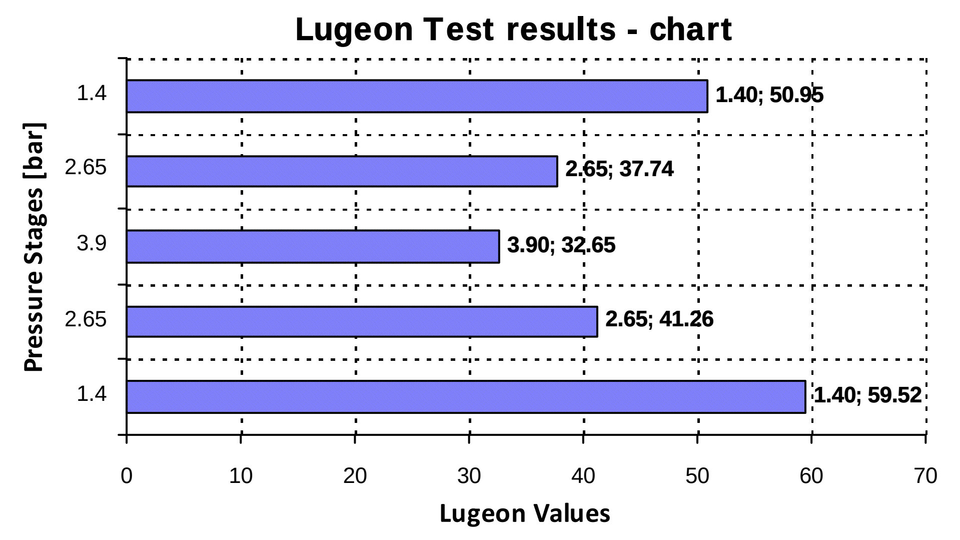
120 | **Diversion Tunnel n2 - ch. 7+25 - [Invert]** | **Lugeon 5-10 min**



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
509	16.2	17	16.6	428	594	2.58	43.93
687	18.6	19.8	19.2	594	786	3.83	34.46
898	22.4	24	23.2	786	1018	5.08	31.50
1100	16.4	15.4	15.9	1018	1177	3.83	26.81
1246	13.8	13.2	13.5	1177	1312	2.58	34.11

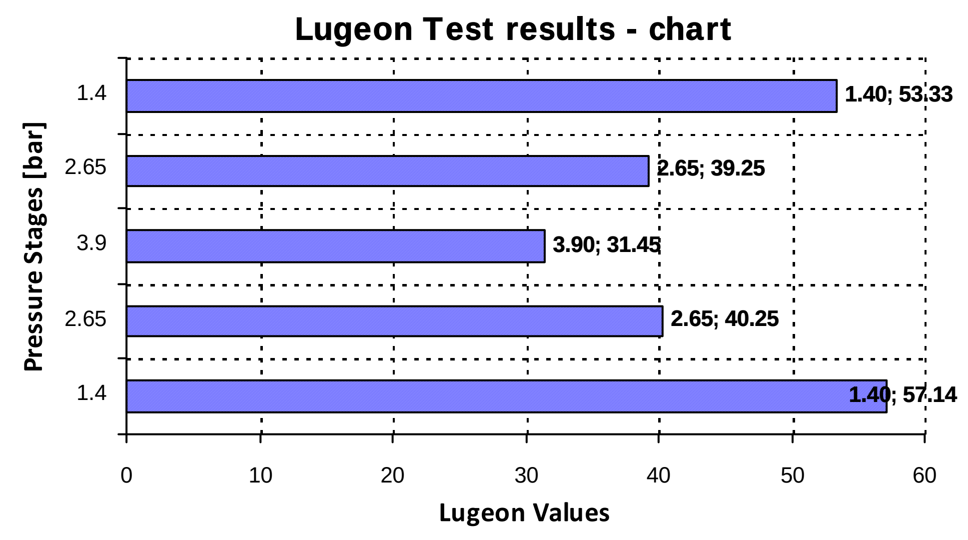
121 Diversion Tunnel n2 - ch. 7+25 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
265	12	13	12.5	205	330	1.40	59.52
410	16	16.8	16.4	330	494	2.65	41.26
586	18.4	19.8	19.1	494	685	3.90	32.65
763	15.6	14.4	15	685	835	2.65	37.74
891	11.2	10.2	10.7	835	942	1.40	50.95

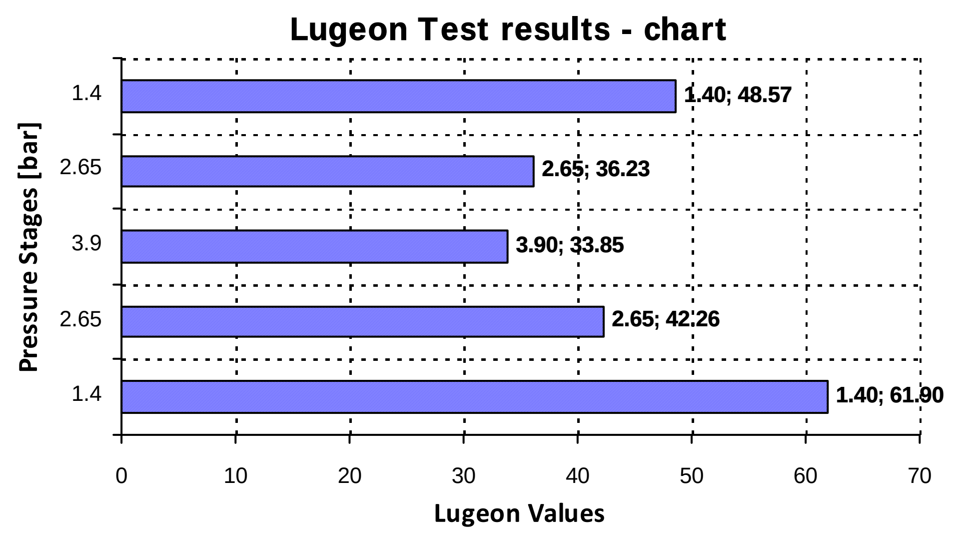
122 Diversion Tunnel n2 - ch. 7+25 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
265	12	13	12.5	205	330	1.40	57.14
410	16	16.8	16.4	330	494	2.65	40.25
586	18.4	19.8	19.1	494	685	3.90	31.45
763	15.6	14.4	15	685	835	2.65	39.25
891	11.2	10.2	10.7	835	942	1.40	53.33

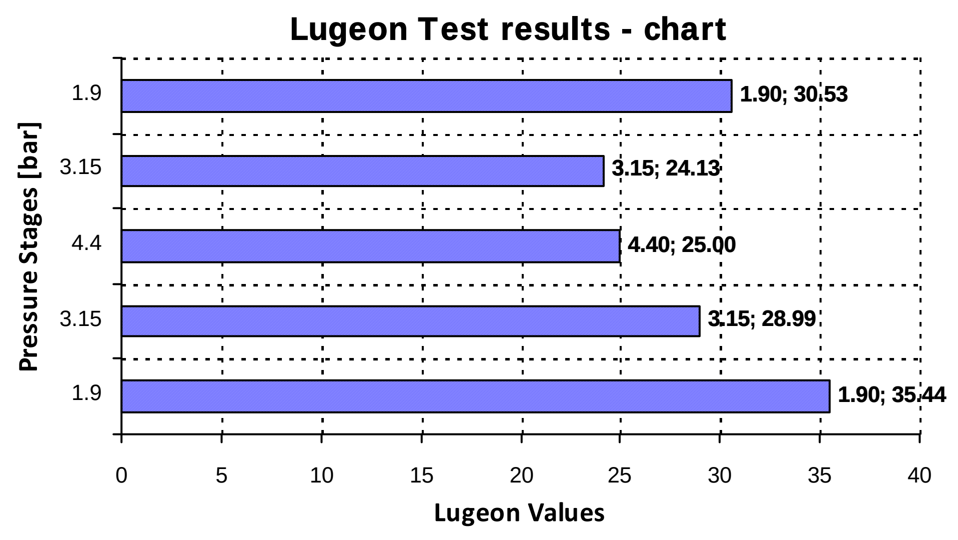
123 Diversion Tunnel n2 - ch. 7+25 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
265	12	13	12.5	205	330	1.40	61.90
410	16	16.8	16.4	330	494	2.65	42.26
586	18.4	19.8	19.1	494	685	3.90	33.85
763	15.6	14.4	15	685	835	2.65	36.23
891	11.2	10.2	10.7	835	942	1.40	48.57

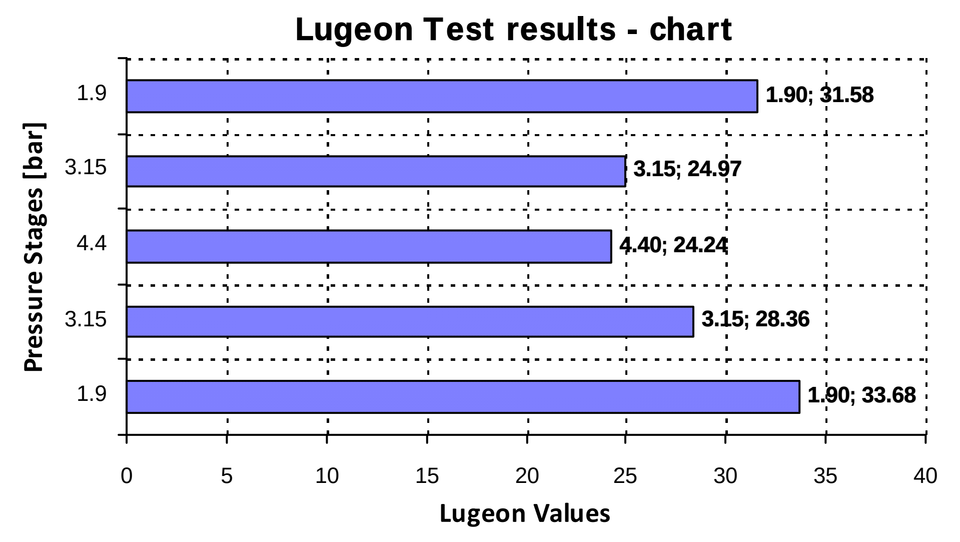
124 Diversion Tunnel n2 - ch. 7+26 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1104	9.6	10.6	10.1	1056	1157	1.90	35.44
1224	13.4	14	13.7	1157	1294	3.15	28.99
1375	16	17	16.5	1295	1460	4.40	25.00
1519	11.8	11	11.4	1460	1574	3.15	24.13
1619	9	8.4	8.7	1574	1661	1.90	30.53

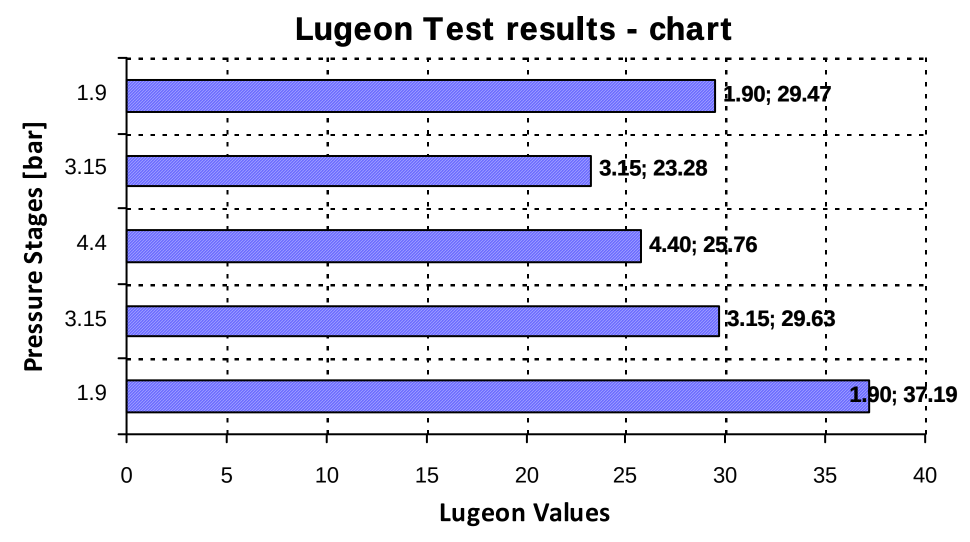
125	Diversion Tunnel n2 - ch. 7+26 - [Sw]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1104	9.6	10.6	10.1	1056	1157	1.90	33.68
1224	13.4	14	13.7	1157	1294	3.15	28.36
1375	16	17	16.5	1295	1460	4.40	24.24
1519	11.8	11	11.4	1460	1574	3.15	24.97
1619	9	8.4	8.7	1574	1661	1.90	31.58

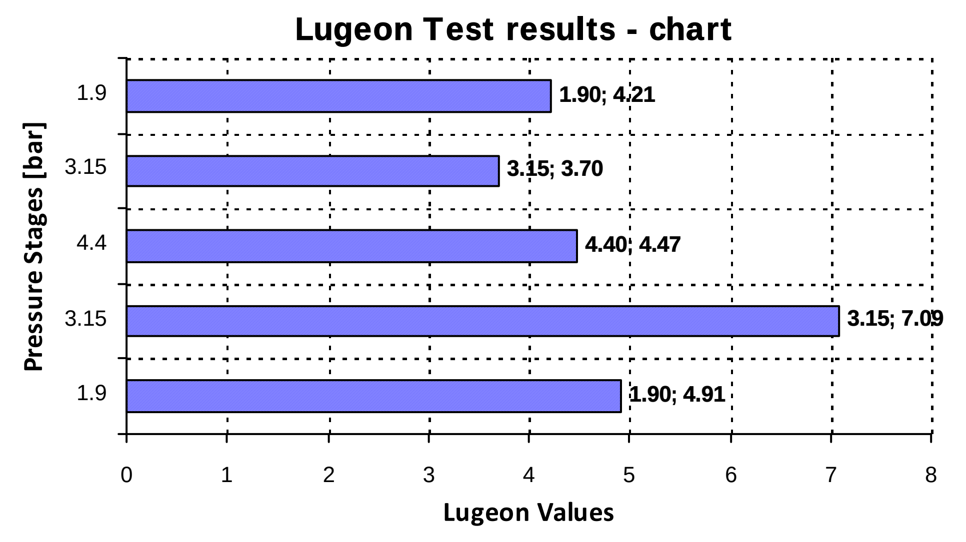
126	Diversion Tunnel n2 - ch. 7+26 - [Sw]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1104	9.6	10.6	10.1	1056	1157	1.90	37.19
1224	13.4	14	13.7	1157	1294	3.15	29.63
1375	16	17	16.5	1295	1460	4.40	25.76
1519	11.8	11	11.4	1460	1574	3.15	23.28
1619	9	8.4	8.7	1574	1661	1.90	29.47

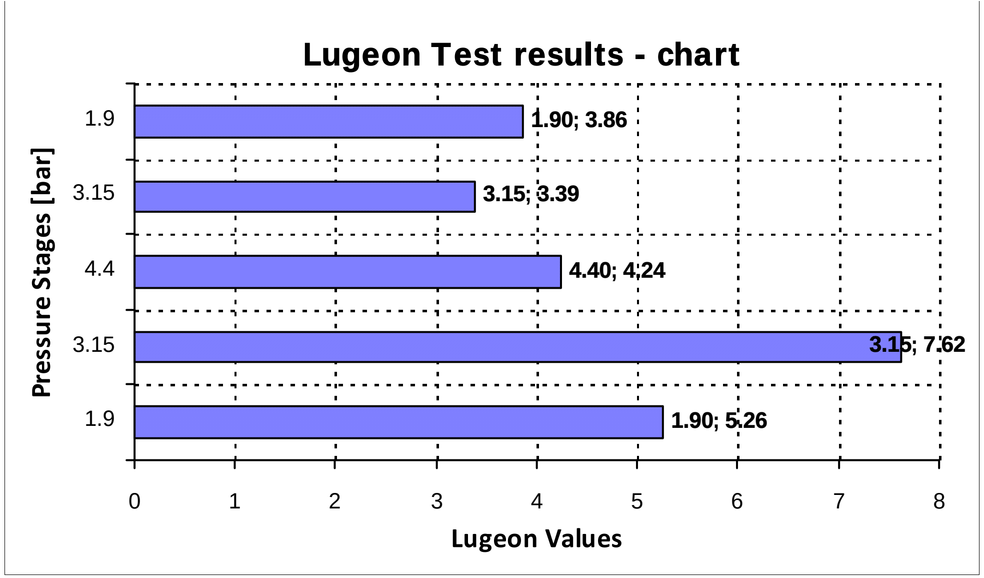
127 Diversion Tunnel n2 - ch. 7+28 - [Sw] repet. Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
390	3	2.6	2.8	375	403	1.90	4.91
439	7.2	6.2	6.7	403	470	3.15	7.09
498	5.6	6.2	5.9	470	529	4.40	4.47
545	3.2	3.8	3.5	529	564	3.15	3.70
575	2.2	2.6	2.4	564	588	1.90	4.21

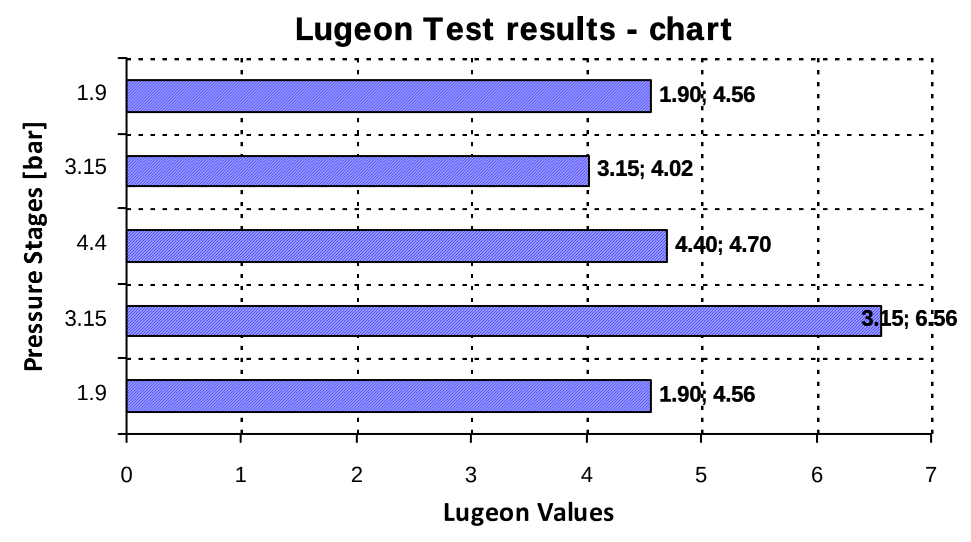
128 Diversion Tunnel n2 - ch. 7+28 - [Sw] repet. Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
390	3	2.6	2.8	375	403	1.90	5.26
439	7.2	6.2	6.7	403	470	3.15	7.62
498	5.6	6.2	5.9	470	529	4.40	4.24
545	3.2	3.8	3.5	529	564	3.15	3.39
575	2.2	2.6	2.4	564	588	1.90	3.86

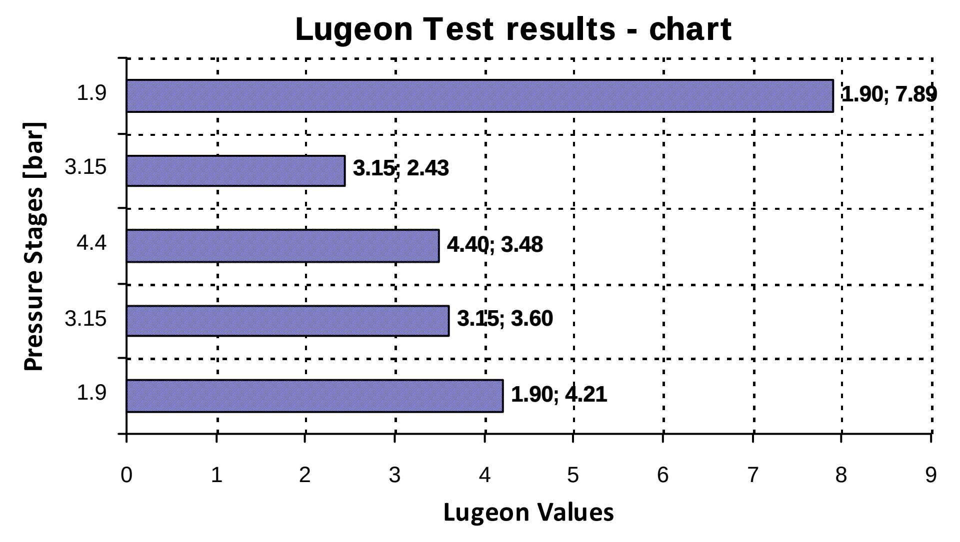
129 Diversion Tunnel n2 - ch. 7+28 - [Sw] repet. Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
390	3	2.6	2.8	375	403	1.90	4.56
439	7.2	6.2	6.7	403	470	3.15	6.56
498	5.6	6.2	5.9	470	529	4.40	4.70
545	3.2	3.8	3.5	529	564	3.15	4.02
575	2.2	2.6	2.4	564	588	1.90	4.56

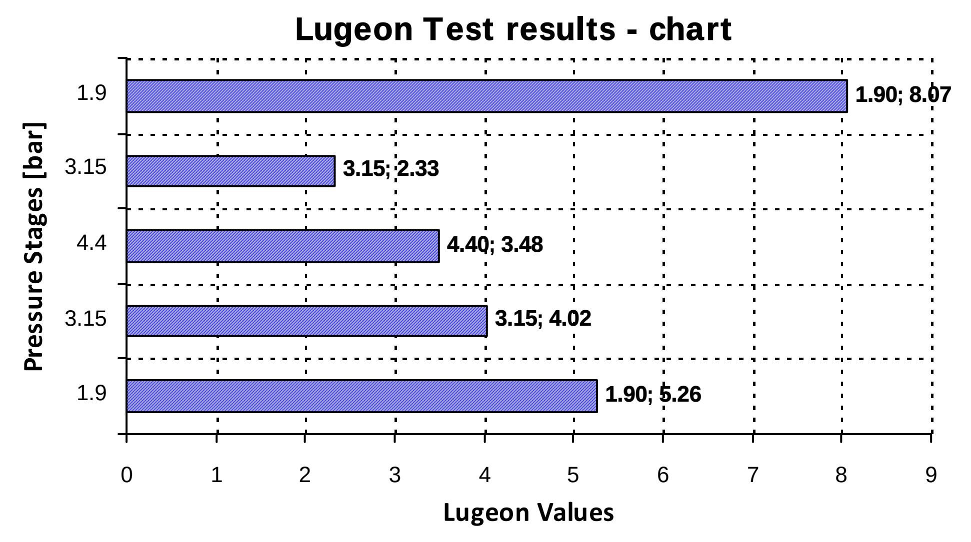
130 Diversion Tunnel n2 - ch. 8+17 - [Sw] repet. Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
773	3	1.8	2.4	758	782	1.90	4.21
801	3.8	3	3.4	782	816	3.15	3.60
839	4.6	4.6	4.6	816	862	4.40	3.48
873	2.2	2.4	2.3	862	885	3.15	2.43
917	4.6	4.4	4.5	894	939	1.90	7.89

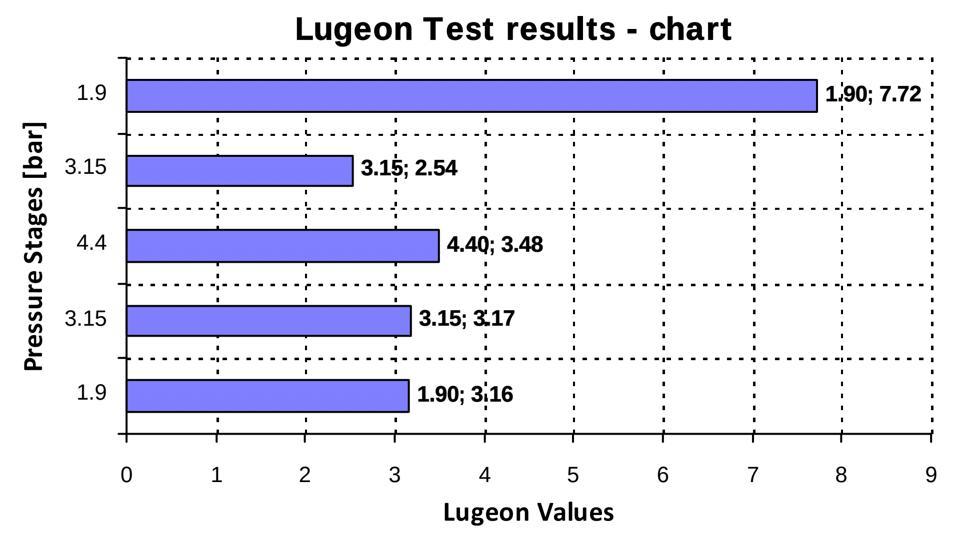
131	Diversion Tunnel n2 - ch. 8+17 - [Sw] repet.	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
773	3	1.8	2.4	758	782	1.90	5.26
801	3.8	3	3.4	782	816	3.15	4.02
839	4.6	4.6	4.6	816	862	4.40	3.48
873	2.2	2.4	2.3	862	885	3.15	2.33
917	4.6	4.4	4.5	894	939	1.90	8.07

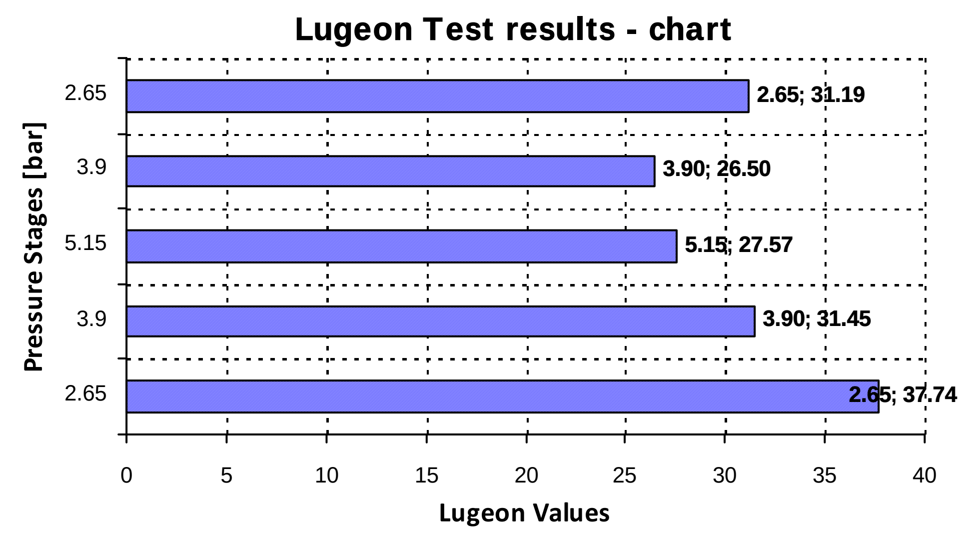
132	Diversion Tunnel n2 - ch. 8+17 - [Sw] repet.	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
773	3	1.8	2.4	758	782	1.90	3.16
801	3.8	3	3.4	782	816	3.15	3.17
839	4.6	4.6	4.6	816	862	4.40	3.48
873	2.2	2.4	2.3	862	885	3.15	2.54
917	4.6	4.4	4.5	894	939	1.90	7.72

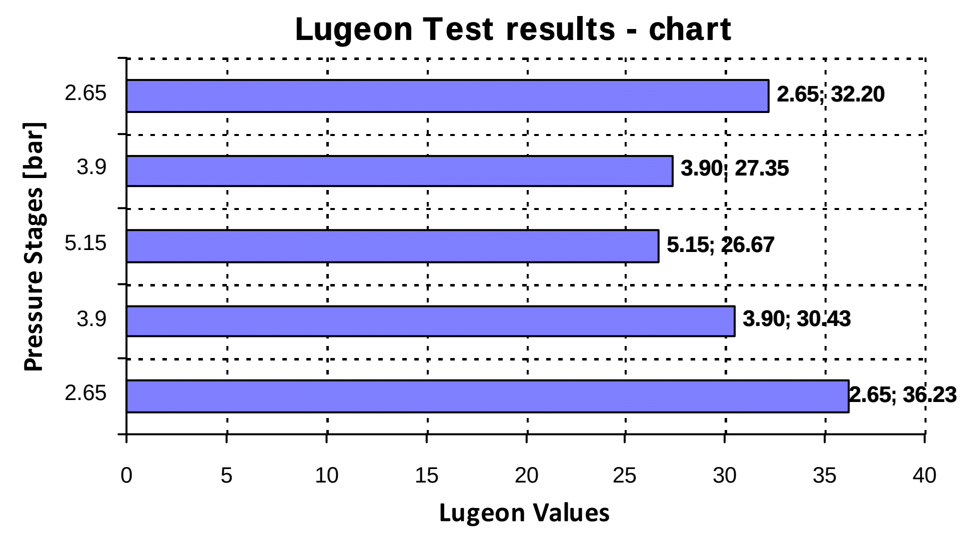
133 Diversion Tunnel n2 - ch. 8+25 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
199	14.4	15.6	15	127	277	2.65	37.74
366	17.8	19	18.4	277	461	3.90	31.45
564	20.6	22	21.3	461	674	5.15	27.57
754	16	15	15.5	674	829	3.90	26.50
893	12.8	12	12.4	829	953	2.65	31.19

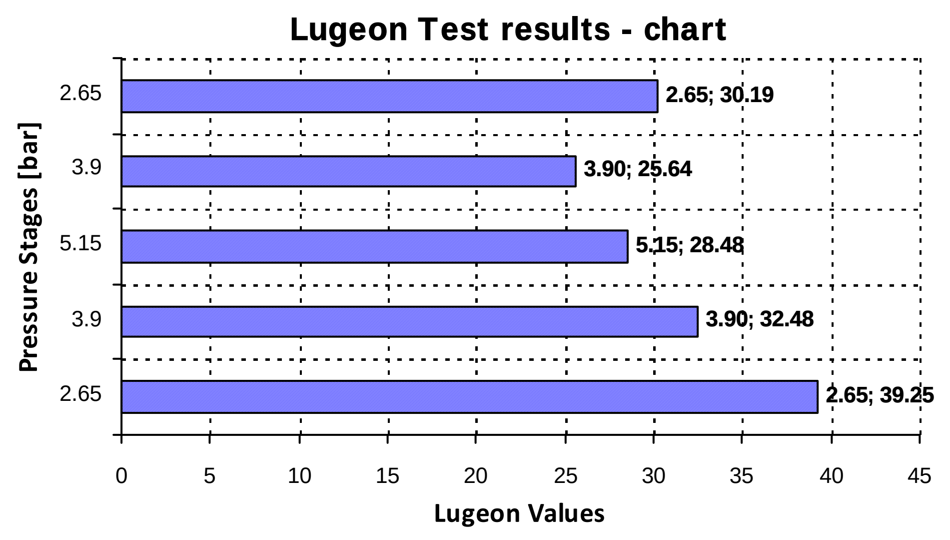
134 Diversion Tunnel n2 - ch. 8+25 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
199	14.4	15.6	15	127	277	2.65	36.23
366	17.8	19	18.4	277	461	3.90	30.43
564	20.6	22	21.3	461	674	5.15	26.67
754	16	15	15.5	674	829	3.90	27.35
893	12.8	12	12.4	829	953	2.65	32.20

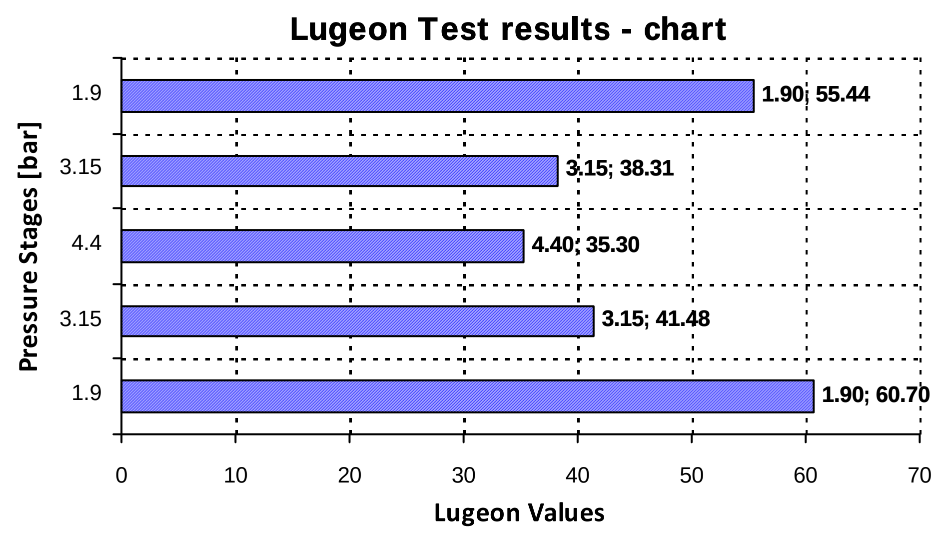
135	Diversion Tunnel n2 - ch. 8+25 - [Invert]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
199	14.4	15.6	15	127	277	2.65	39.25
366	17.8	19	18.4	277	461	3.90	32.48
564	20.6	22	21.3	461	674	5.15	28.48
754	16	15	15.5	674	829	3.90	25.64
893	12.8	12	12.4	829	953	2.65	30.19

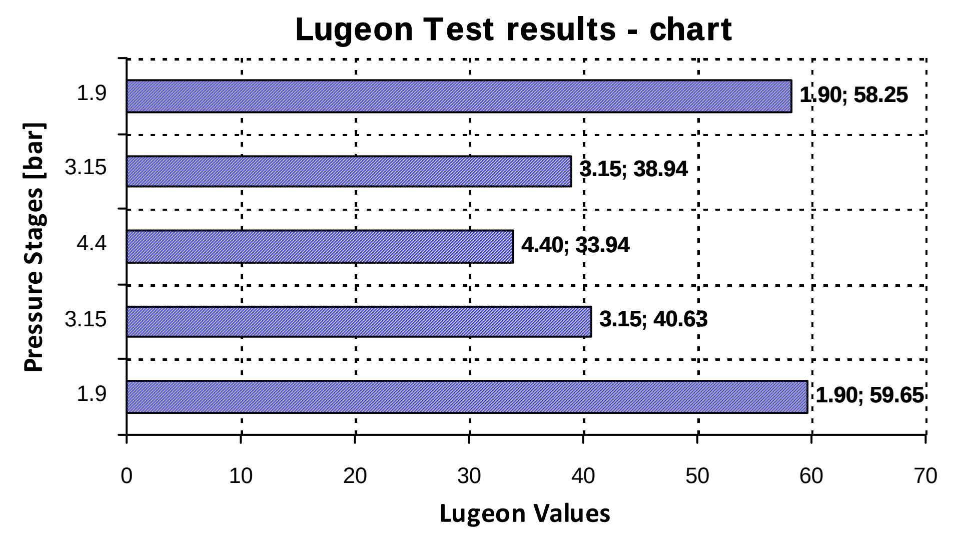
136	Diversion Tunnel n2 - ch. 8+25 - [Sw]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1803	17	17.6	17.3	1718	1891	1.90	60.70
1987	19.2	20	19.6	1891	2087	3.15	41.48
2199	22.4	24.2	23.3	2087	2320	4.40	35.30
2412	18.4	17.8	18.1	2320	2501	3.15	38.31
2584	16.6	15	15.8	2501	2659	1.90	55.44

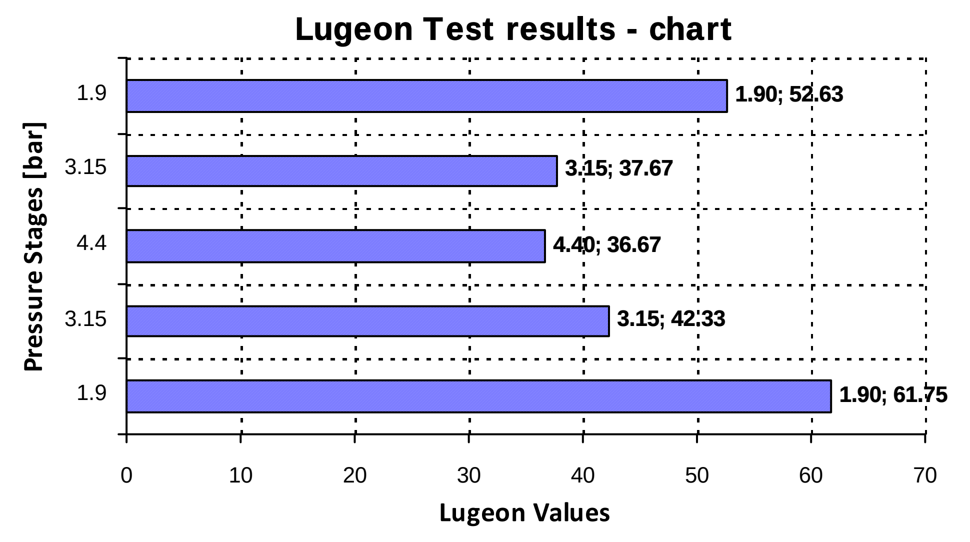
137	Diversion Tunnel n2 - ch. 8+25 - [Sw]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1803	17	17.6	17.3	1718	1891	1.90	59.65
1987	19.2	20	19.6	1891	2087	3.15	40.63
2199	22.4	24.2	23.3	2087	2320	4.40	33.94
2412	18.4	17.8	18.1	2320	2501	3.15	38.94
2584	16.6	15	15.8	2501	2659	1.90	58.25

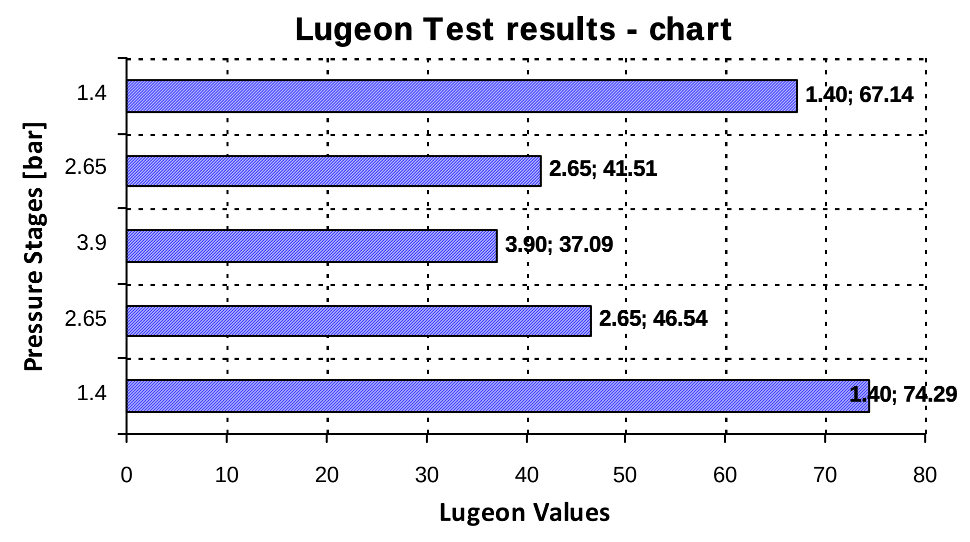
138	Diversion Tunnel n2 - ch. 8+25 - [Sw]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1803	17	17.6	17.3	1718	1891	1.90	61.75
1987	19.2	20	19.6	1891	2087	3.15	42.33
2199	22.4	24.2	23.3	2087	2320	4.40	36.67
2412	18.4	17.8	18.1	2320	2501	3.15	37.67
2584	16.6	15	15.8	2501	2659	1.90	52.63

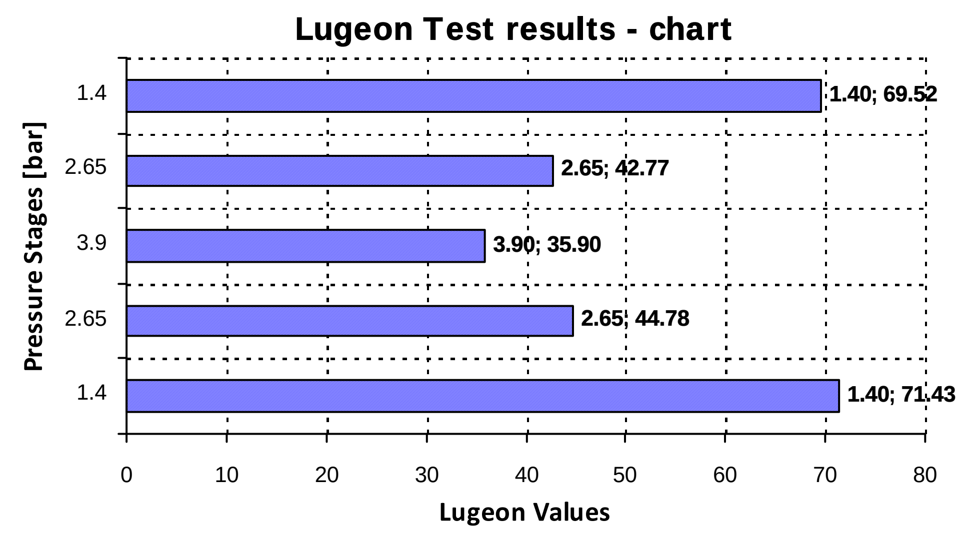
139 Diversion Tunnel n2 - ch. 8+25 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
198	15	16.2	15.6	123	279	1.40	74.29
368	17.8	19.2	18.5	279	464	2.65	46.54
569	21	22.4	21.7	464	681	3.90	37.09
766	17	16	16.5	681	846	2.65	41.51
919	14.6	13.6	14.1	846	987	1.40	67.14

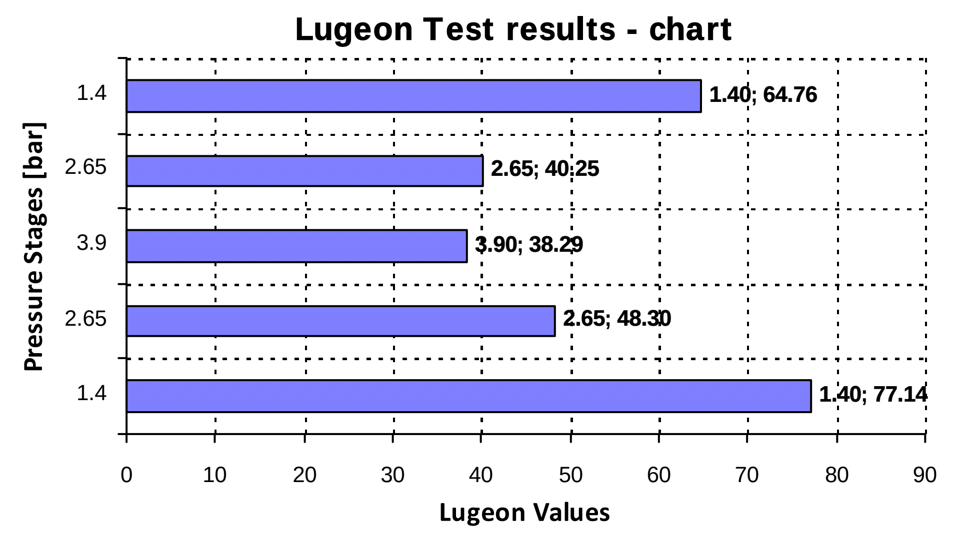
140 Diversion Tunnel n2 - ch. 8+25 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
198	15	16.2	15.6	123	279	1.40	71.43
368	17.8	19.2	18.5	279	464	2.65	44.78
569	21	22.4	21.7	464	681	3.90	35.90
766	17	16	16.5	681	846	2.65	42.77
919	14.6	13.6	14.1	846	987	1.40	69.52

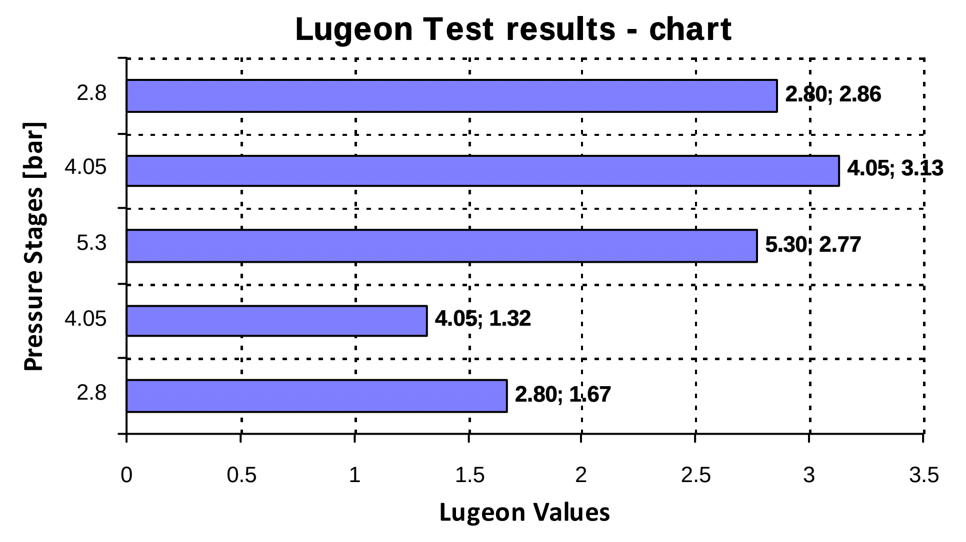
141 Diversion Tunnel n2 - ch. 8+25 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
198	15	16.2	15.6	123	279	1.40	77.14
368	17.8	19.2	18.5	279	464	2.65	48.30
569	21	22.4	21.7	464	681	3.90	38.29
766	17	16	16.5	681	846	2.65	40.25
919	14.6	13.6	14.1	846	987	1.40	64.76

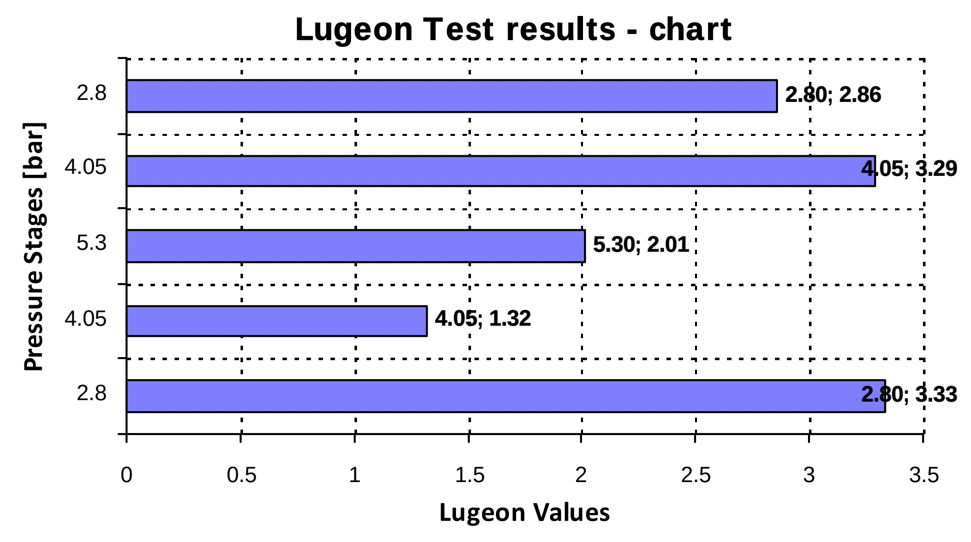
142 Headrace Tunnel - ch. 1+60 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
259	1.4	0	0.7	252	259	2.80	1.67
263	0.8	0.8	0.8	259	267	4.05	1.32
275	1.6	2.8	2.2	267	289	5.30	2.77
299	2	1.8	1.9	289	308	4.05	3.13
314	1.2	1.2	1.2	308	320	2.80	2.86

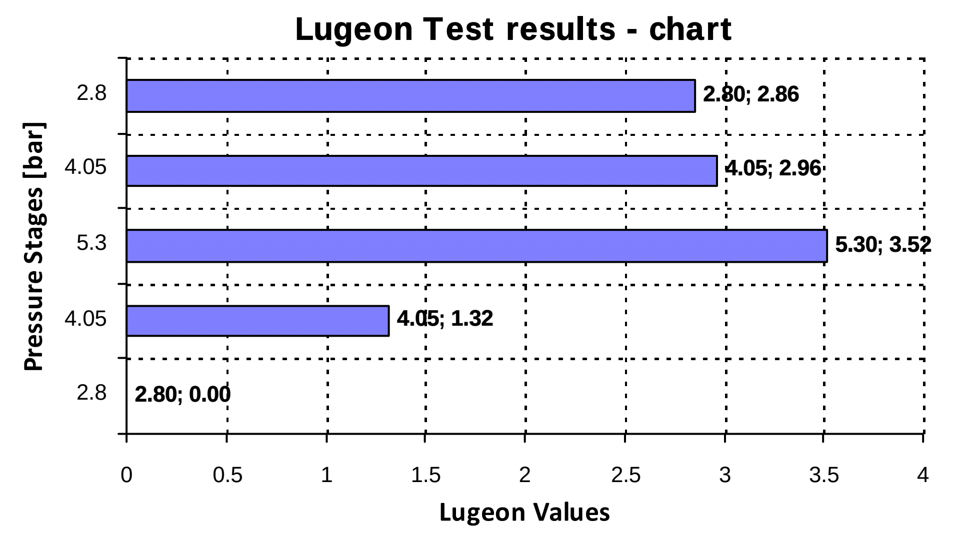
143 Headrace Tunnel - ch. 1+60 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
259	1.4	0	0.7	252	259	2.80	3.33
263	0.8	0.8	0.8	259	267	4.05	1.32
275	1.6	2.8	2.2	267	289	5.30	2.01
299	2	1.8	1.9	289	308	4.05	3.29
314	1.2	1.2	1.2	308	320	2.80	2.86

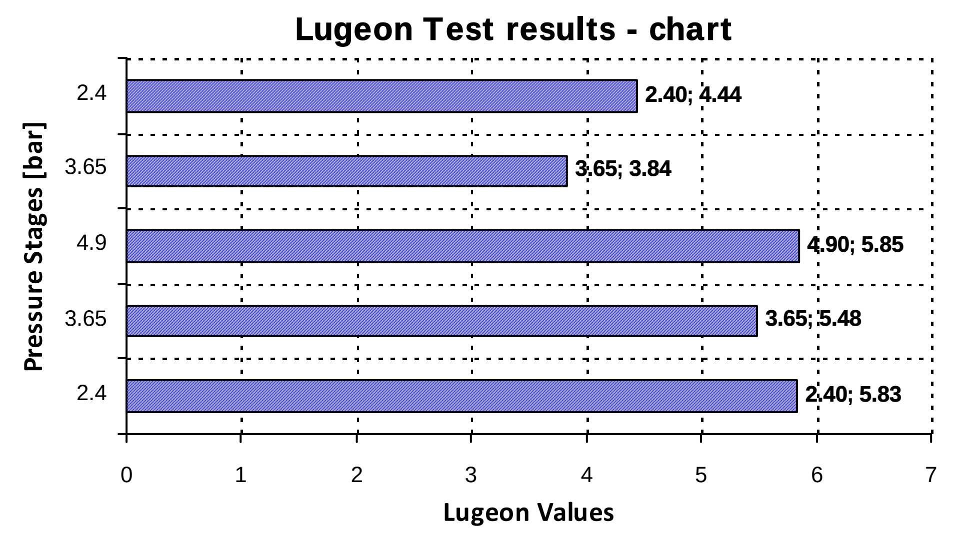
144 Headrace Tunnel - ch. 1+60 - [Invert] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
259	1.4	0	0.7	252	259	2.80	0.00
263	0.8	0.8	0.8	259	267	4.05	1.32
275	1.6	2.8	2.2	267	289	5.30	3.52
299	2	1.8	1.9	289	308	4.05	2.96
314	1.2	1.2	1.2	308	320	2.80	2.86

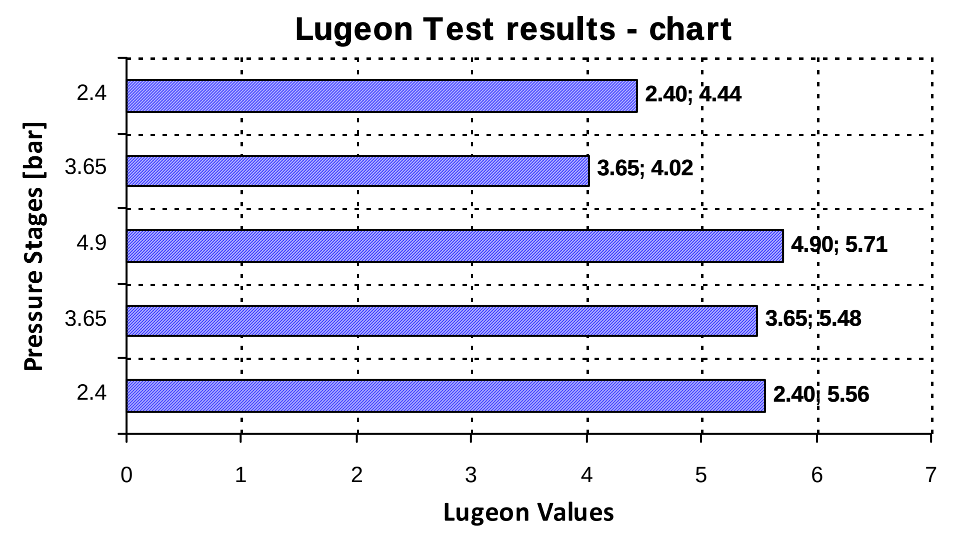
145 Headrace Tunnel - ch. 1+60 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
411	2	2.2	2.1	401	422	2.40	5.83
437	3	3	3	422	452	3.65	5.48
473	4.2	4.4	4.3	452	495	4.90	5.85
506	2.2	2	2.1	495	516	3.65	3.84
524	1.6	1.6	1.6	516	532	2.40	4.44

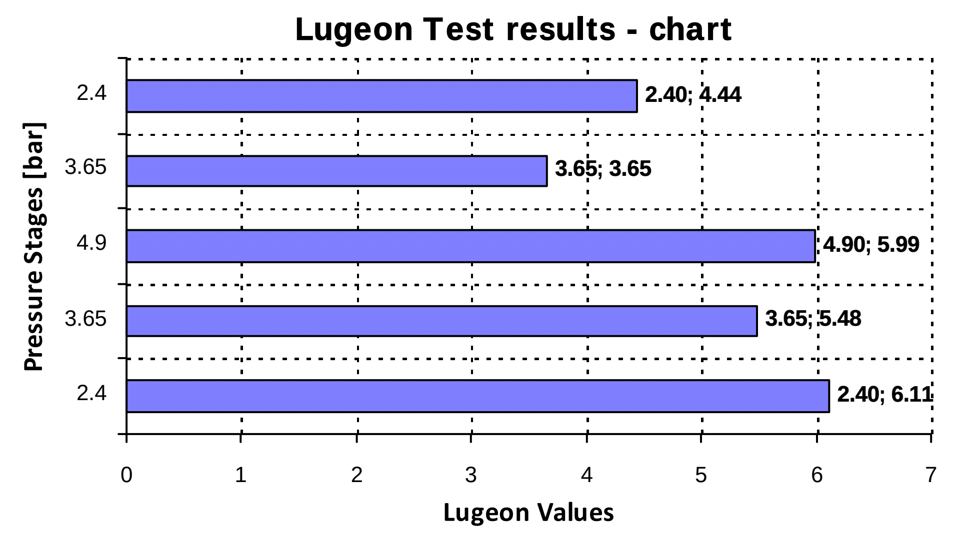
146 Headrace Tunnel - ch. 1+60 - [Sw] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
411	2	2.2	2.1	401	422	2.40	5.56
437	3	3	3	422	452	3.65	5.48
473	4.2	4.4	4.3	452	495	4.90	5.71
506	2.2	2	2.1	495	516	3.65	4.02
524	1.6	1.6	1.6	516	532	2.40	4.44

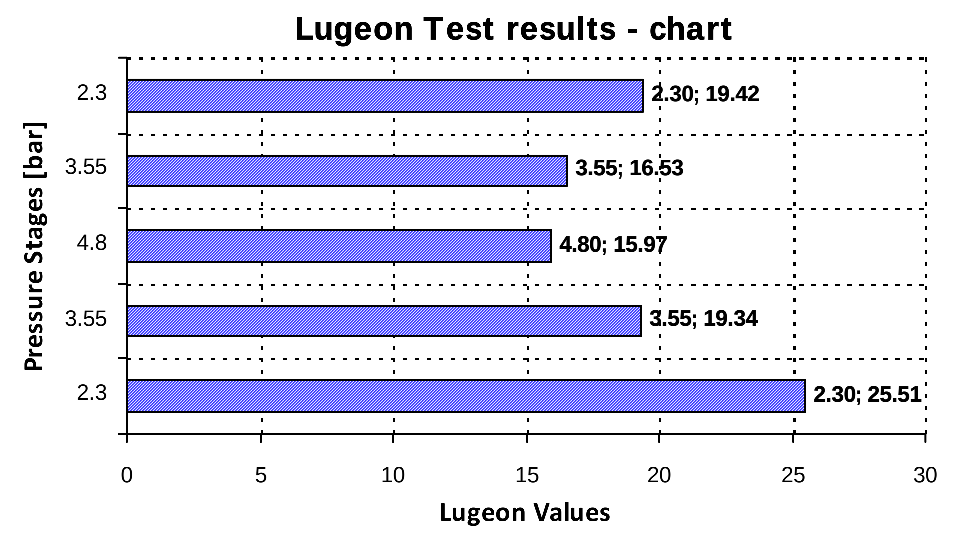
147 | Headrace Tunnel - ch. 1+60 - [Sw] | Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
411	2	2.2	2.1	401	422	2.40	6.11
437	3	3	3	422	452	3.65	5.48
473	4.2	4.4	4.3	452	495	4.90	5.99
506	2.2	2	2.1	495	516	3.65	3.65
524	1.6	1.6	1.6	516	532	2.40	4.44

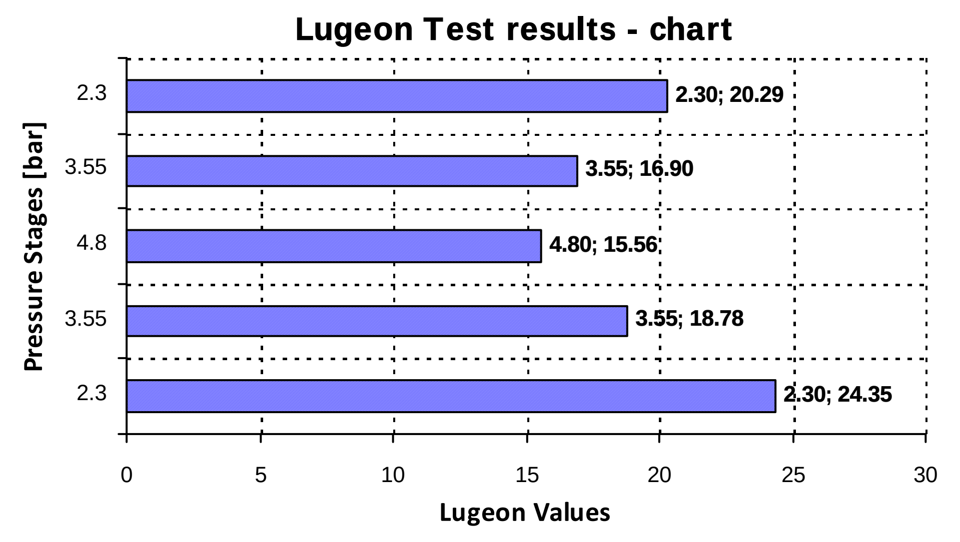
148 | Headrace Tunnel - ch. 1+60 - [Vault] | Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
250	8.4	9.2	8.8	208	296	2.30	25.51
346	10	10.6	10.3	296	399	3.55	19.34
455	11.2	11.8	11.5	399	514	4.80	15.97
559	9	8.6	8.8	514	602	3.55	16.53
637	7	6.4	6.7	602	669	2.30	19.42

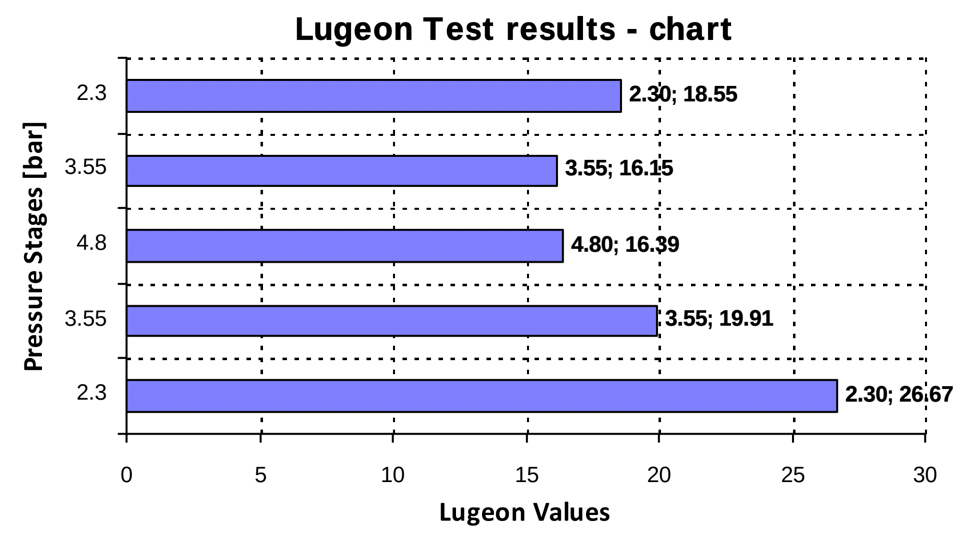
149 Headrace Tunnel - ch. 1+60 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
250	8.4	9.2	8.8	208	296	2.30	24.35
346	10	10.6	10.3	296	399	3.55	18.78
455	11.2	11.8	11.5	399	514	4.80	15.56
559	9	8.6	8.8	514	602	3.55	16.90
637	7	6.4	6.7	602	669	2.30	20.29

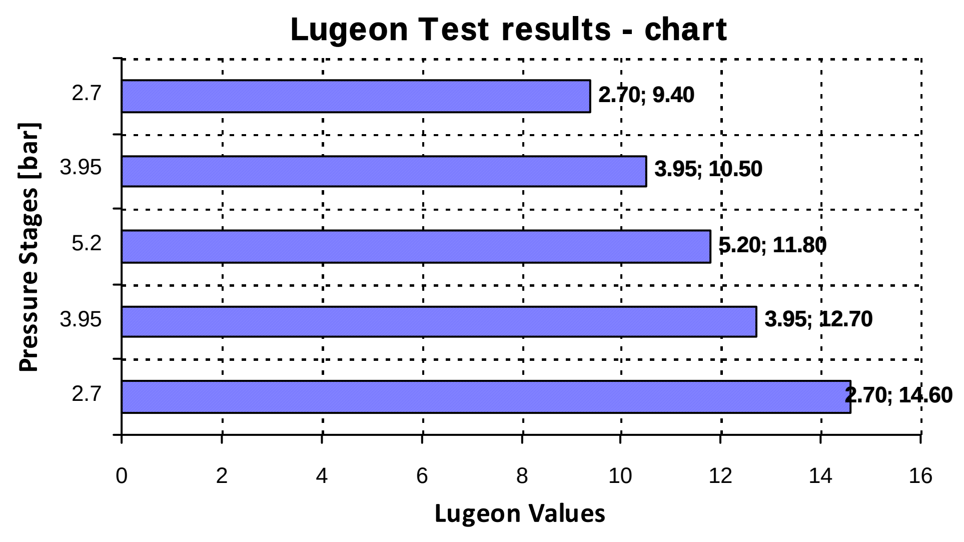
150 Headrace Tunnel - ch. 1+60 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
250	8.4	9.2	8.8	208	296	2.30	26.67
346	10	10.6	10.3	296	399	3.55	19.91
455	11.2	11.8	11.5	399	514	4.80	16.39
559	9	8.6	8.8	514	602	3.55	16.15
637	7	6.4	6.7	602	669	2.30	18.55

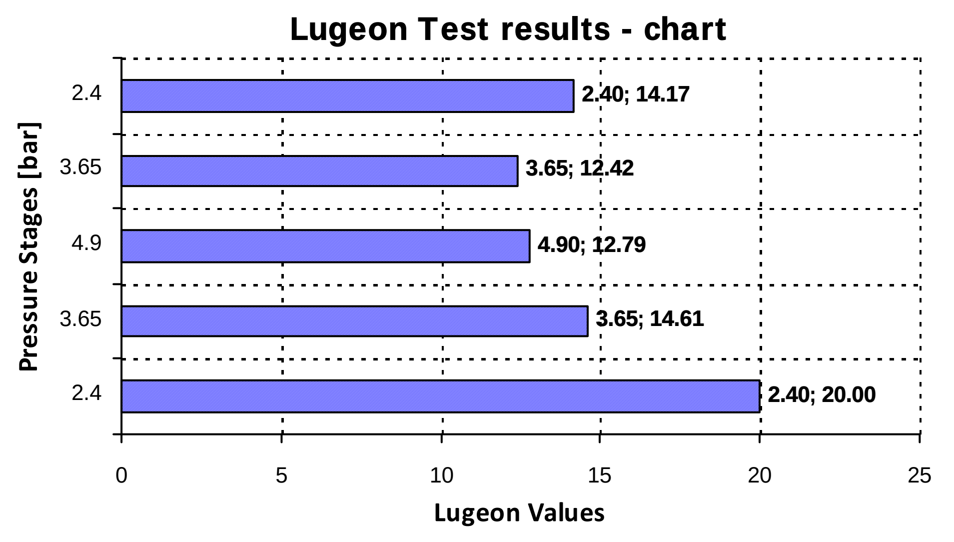
151 Headrace Tunnel - ch. 2+15 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
			5.9	1803	1862	2.70	14.60
			7.5	1878	1953	3.95	12.70
			9.2	1971	2063	5.20	11.80
			6.2	2077	2139	3.95	10.50
			3.8	2147	2185	2.70	9.40

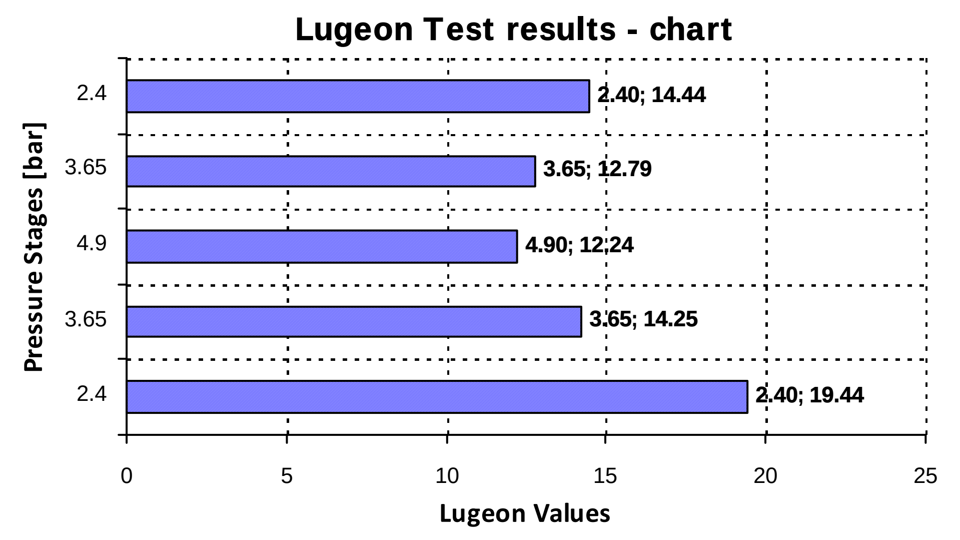
152 Headrace Tunnel - ch. 2+15 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
372	7	7.4	7.2	337	409	2.40	20.00
448	7.8	8.2	8	409	489	3.65	14.61
534	9	9.8	9.4	489	583	4.90	12.79
618	7	6.6	6.8	583	651	3.65	12.42
677	5.2	5	5.1	651	702	2.40	14.17

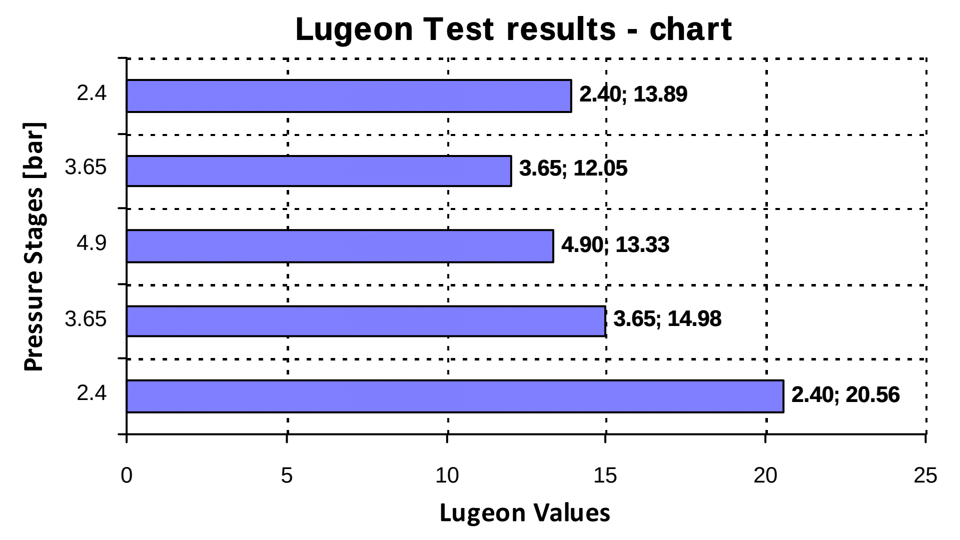
153 Headrace Tunnel - ch. 2+15 - [Sw] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
372	7	7.4	7.2	337	409	2.40	19.44
448	7.8	8.2	8	409	489	3.65	14.25
534	9	9.8	9.4	489	583	4.90	12.24
618	7	6.6	6.8	583	651	3.65	12.79
677	5.2	5	5.1	651	702	2.40	14.44

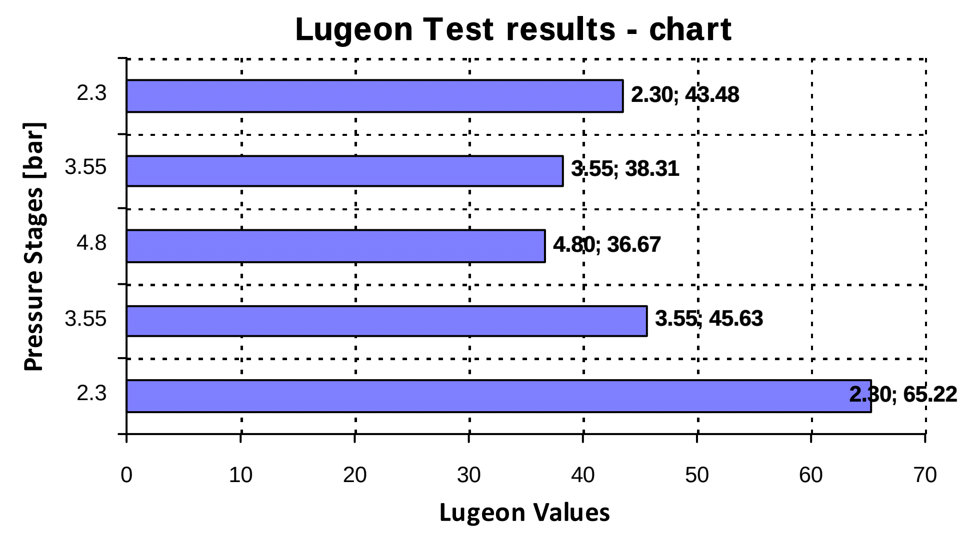
154 Headrace Tunnel - ch. 2+15 - [Sw] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
372	7	7.4	7.2	337	409	2.40	20.56
448	7.8	8.2	8	409	489	3.65	14.98
534	9	9.8	9.4	489	583	4.90	13.33
618	7	6.6	6.8	583	651	3.65	12.05
677	5.2	5	5.1	651	702	2.40	13.89

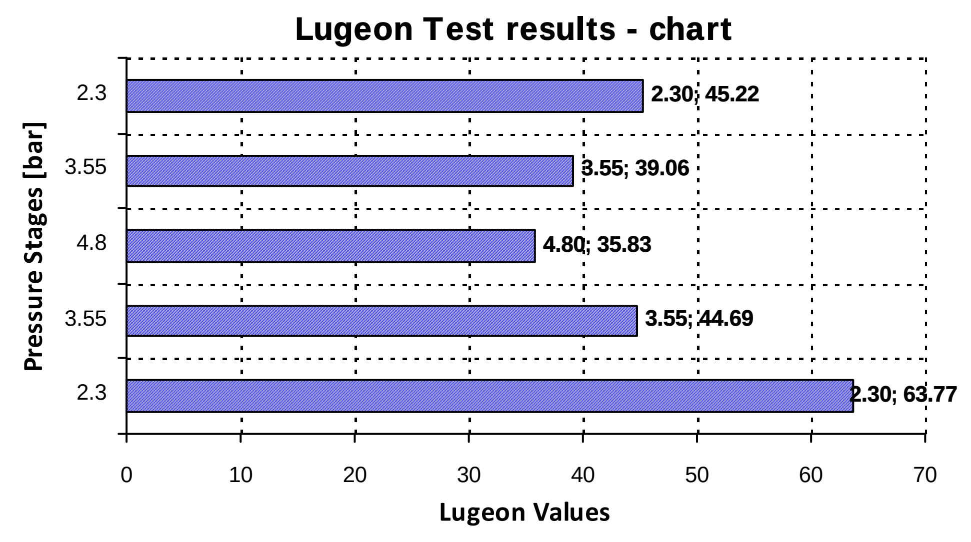
155 Headrace Tunnel - ch. 2+15 - [Vault] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
897	22	23	22.5	787	1012	2.30	65.22
1131	23.8	24.8	24.3	1012	1255	3.55	45.63
1384	25.8	27	26.4	1255	1519	4.80	36.67
1623	20.8	20	20.4	1519	1723	3.55	38.31
1801	15.6	14.4	15	1723	1873	2.30	43.48

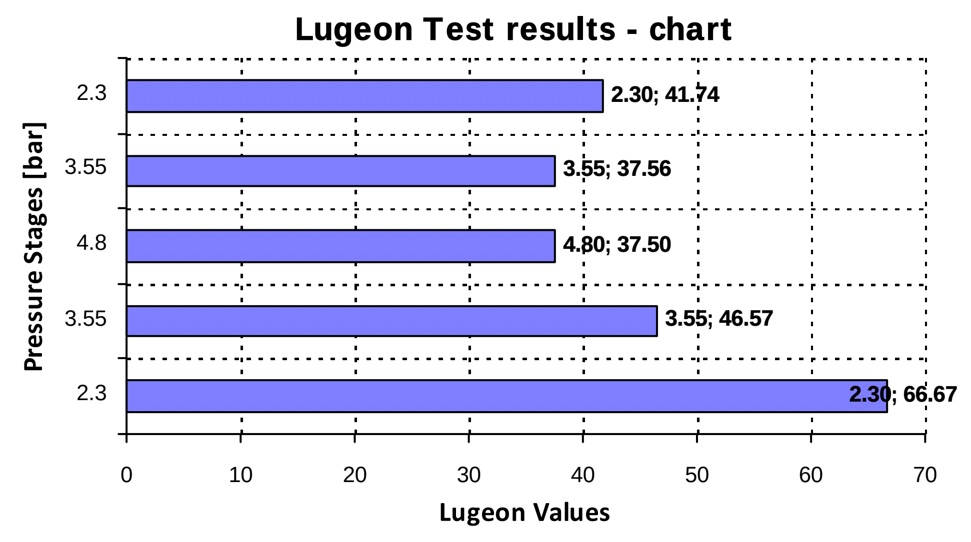
156 Headrace Tunnel - ch. 2+15 - [Vault] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
897	22	23	22.5	787	1012	2.30	63.77
1131	23.8	24.8	24.3	1012	1255	3.55	44.69
1384	25.8	27	26.4	1255	1519	4.80	35.83
1623	20.8	20	20.4	1519	1723	3.55	39.06
1801	15.6	14.4	15	1723	1873	2.30	45.22

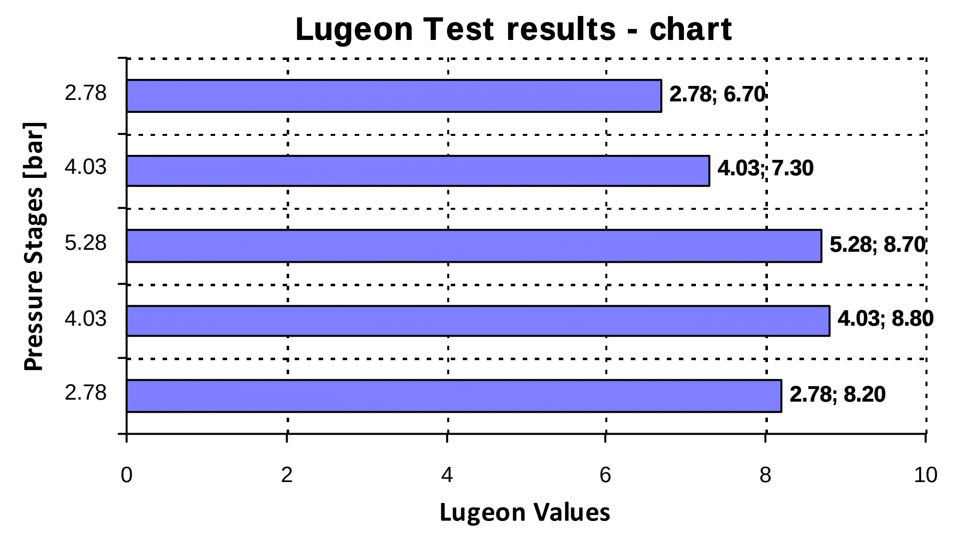
157 Headrace Tunnel - ch. 2+15 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
897	22	23	22.5	787	1012	2.30	66.67
1131	23.8	24.8	24.3	1012	1255	3.55	46.57
1384	25.8	27	26.4	1255	1519	4.80	37.50
1623	20.8	20	20.4	1519	1723	3.55	37.56
1801	15.6	14.4	15	1723	1873	2.30	41.74

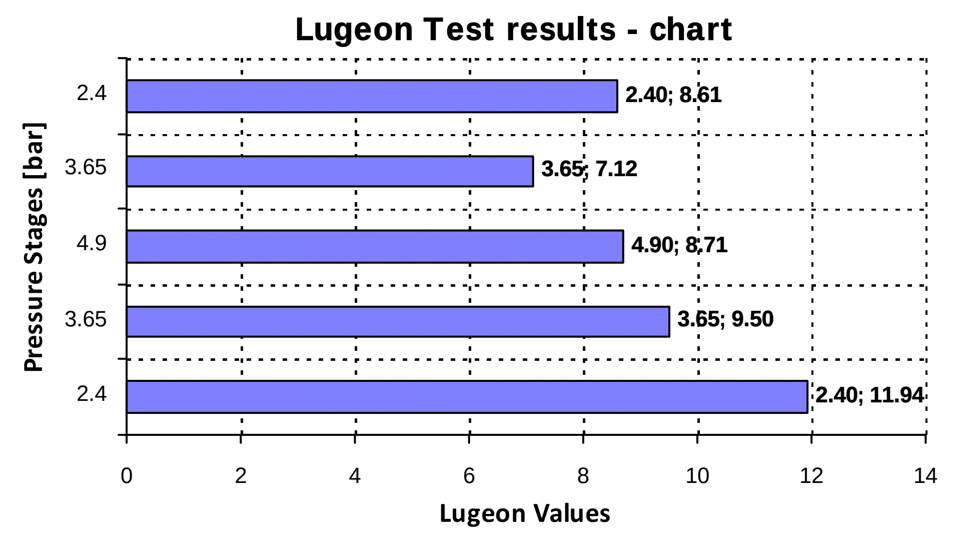
158 Headrace Tunnel - ch. 2+60 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
			3.4	1493	1527	2.78	8.20
			5.3	1533	1586	4.03	8.80
			6.9	1591	1660	5.28	8.70
			4.4	1672	1716	4.03	7.30
			2.8	1729	1757	2.78	6.70

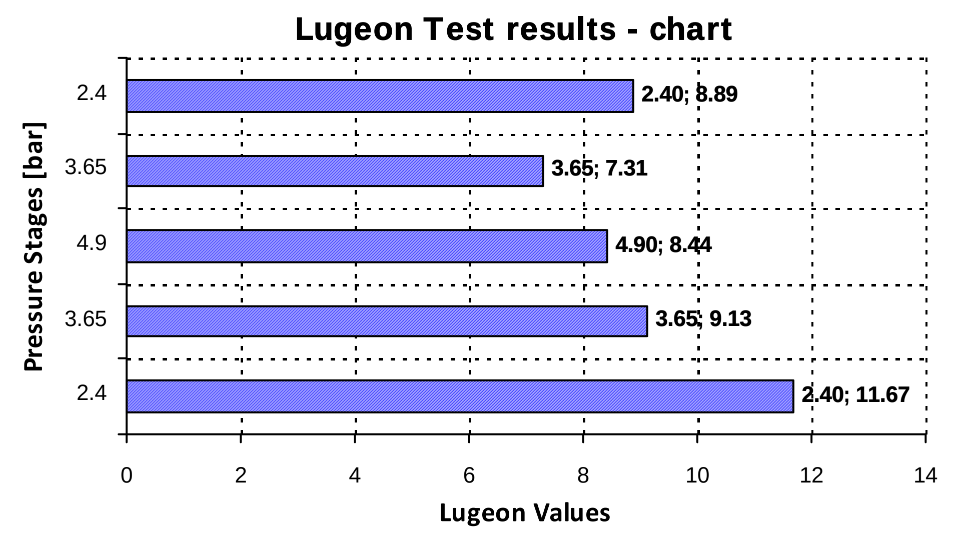
159 Headrace Tunnel - ch. 2+60 - [Sw] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
566	4.2	4.4	4.3	545	588	2.40	11.94
613	5	5.4	5.2	588	640	3.65	9.50
671	6.2	6.6	6.4	640	704	4.90	8.71
724	4	3.8	3.9	704	743	3.65	7.12
759	3.2	3	3.1	743	774	2.40	8.61

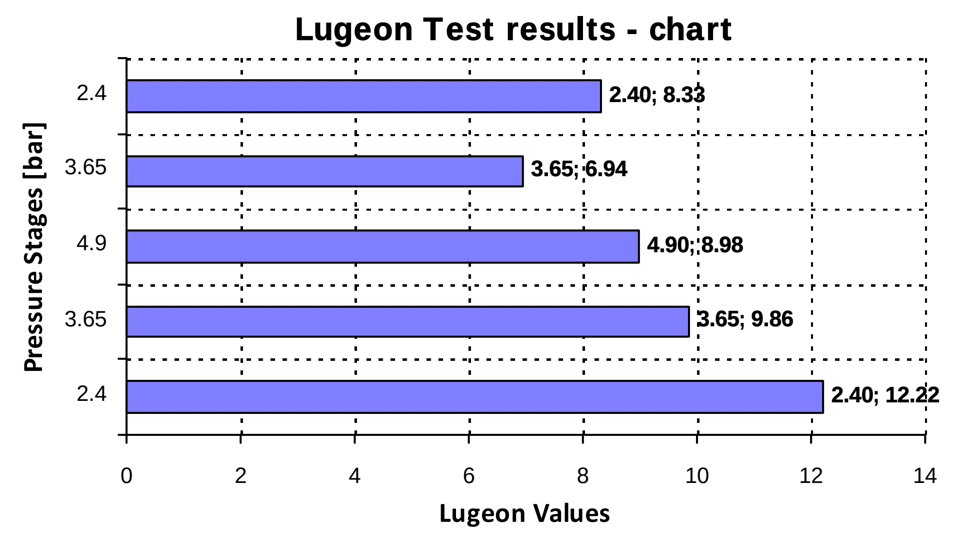
160 Headrace Tunnel - ch. 2+60 - [Sw] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
566	4.2	4.4	4.3	545	588	2.40	11.67
613	5	5.4	5.2	588	640	3.65	9.13
671	6.2	6.6	6.4	640	704	4.90	8.44
724	4	3.8	3.9	704	743	3.65	7.31
759	3.2	3	3.1	743	774	2.40	8.89

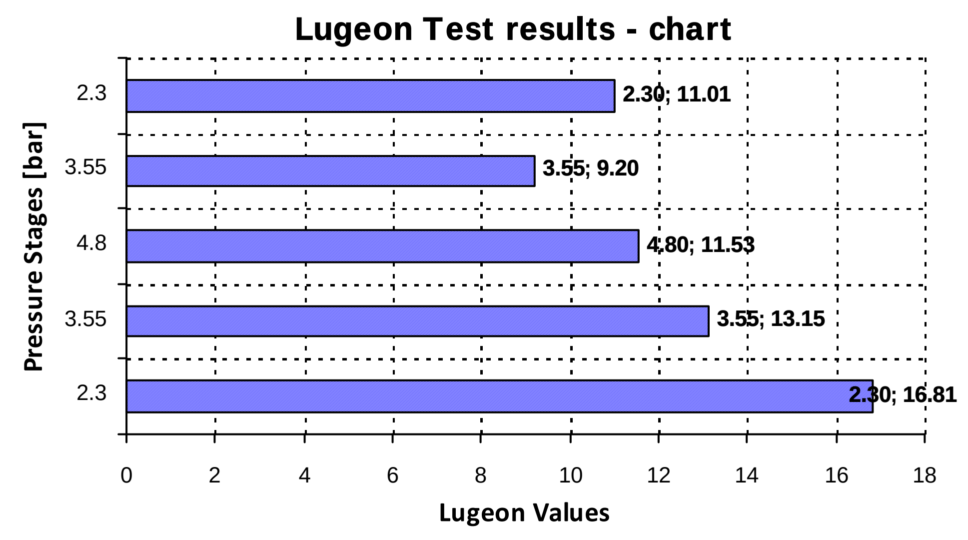
161	Headrace Tunnel - ch. 2+60 - [Sw]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
566	4.2	4.4	4.3	545	588	2.40	12.22
613	5	5.4	5.2	588	640	3.65	9.86
671	6.2	6.6	6.4	640	704	4.90	8.98
724	4	3.8	3.9	704	743	3.65	6.94
759	3.2	3	3.1	743	774	2.40	8.33

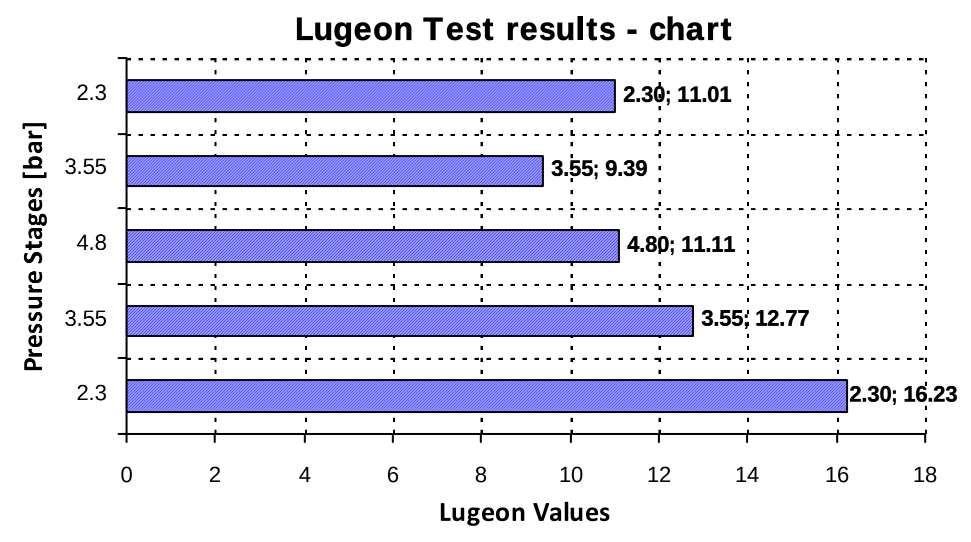
162	Headrace Tunnel - ch. 2+60 - [Vault]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
953	5.6	6	5.8	925	983	2.30	16.81
1017	6.8	7.2	7	983	1053	3.55	13.15
1093	8	8.6	8.3	1053	1136	4.80	11.53
1161	5	4.8	4.9	1136	1185	3.55	9.20
1204	3.8	3.8	3.8	1185	1223	2.30	11.01

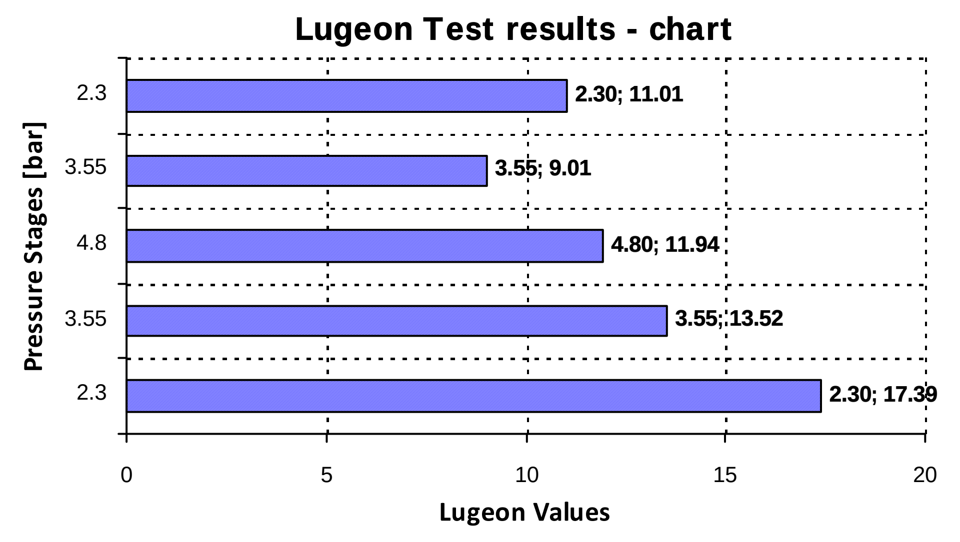
163	Headrace Tunnel - ch. 2+60 - [Vault]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
953	5.6	6	5.8	925	983	2.30	16.23
1017	6.8	7.2	7	983	1053	3.55	12.77
1093	8	8.6	8.3	1053	1136	4.80	11.11
1161	5	4.8	4.9	1136	1185	3.55	9.39
1204	3.8	3.8	3.8	1185	1223	2.30	11.01

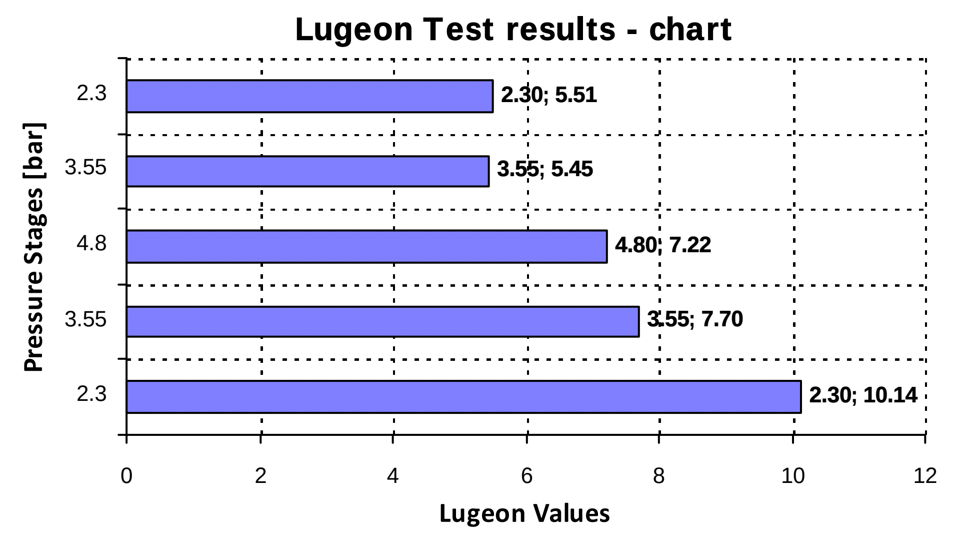
164	Headrace Tunnel - ch. 2+60 - [Vault]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
953	5.6	6	5.8	925	983	2.30	17.39
1017	6.8	7.2	7	983	1053	3.55	13.52
1093	8	8.6	8.3	1053	1136	4.80	11.94
1161	5	4.8	4.9	1136	1185	3.55	9.01
1204	3.8	3.8	3.8	1185	1223	2.30	11.01

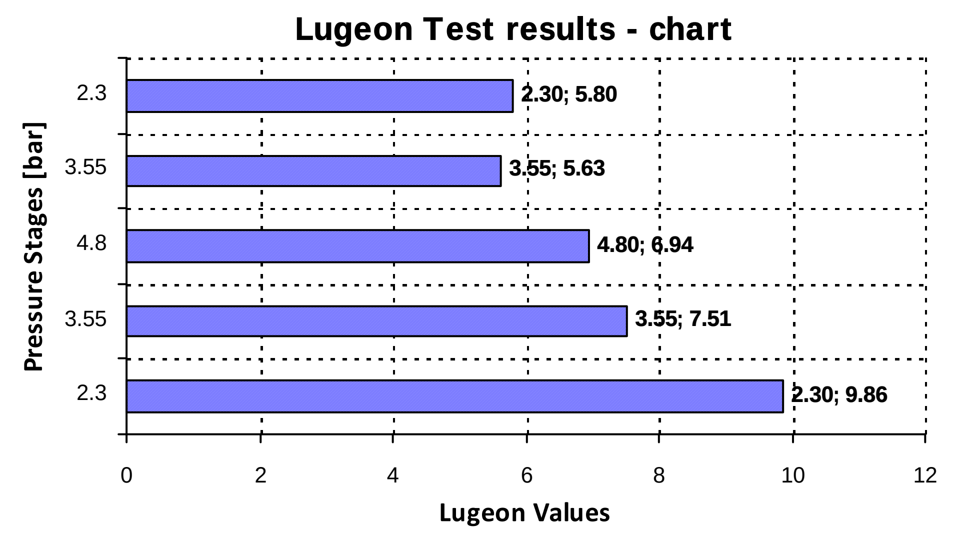
165	Headrace Tunnel - ch. 3+13 - [Vault]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
797	3.4	3.6	3.5	780	815	2.30	10.14
835	4	4.2	4.1	815	856	3.55	7.70
881	5	5.4	5.2	856	908	4.80	7.22
923	3	2.8	2.9	908	937	3.55	5.45
947	2	1.8	1.9	937	956	2.30	5.51

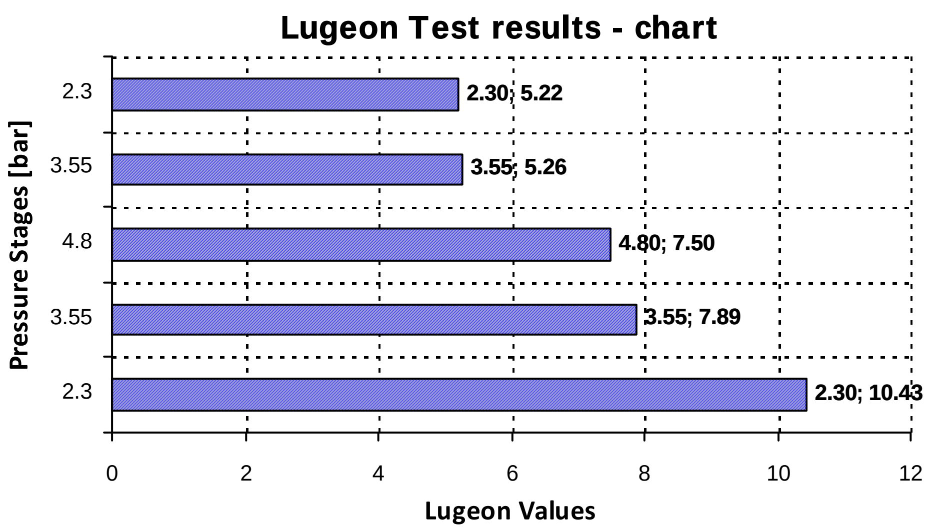
166	Headrace Tunnel - ch. 3+13 - [Vault]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
797	3.4	3.6	3.5	780	815	2.30	9.86
835	4	4.2	4.1	815	856	3.55	7.51
881	5	5.4	5.2	856	908	4.80	6.94
923	3	2.8	2.9	908	937	3.55	5.63
947	2	1.8	1.9	937	956	2.30	5.80

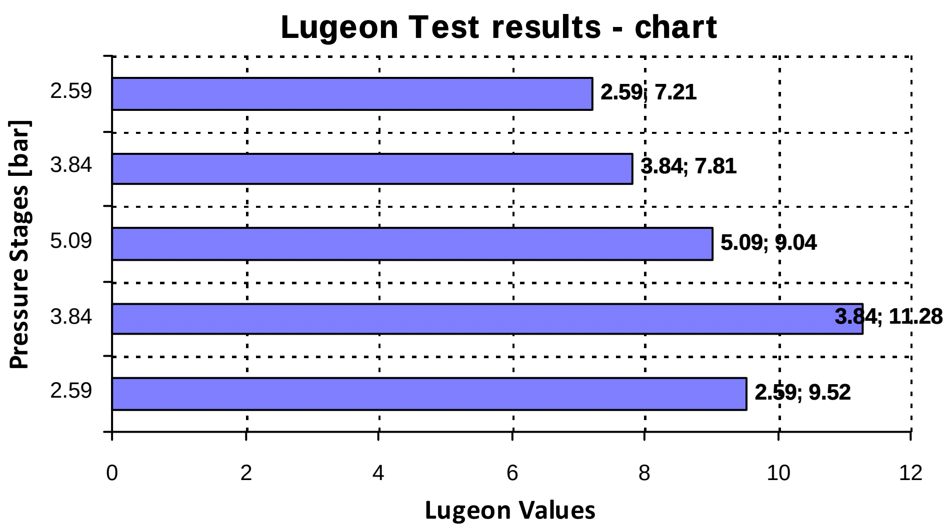
167 Headrace Tunnel - ch. 3+13 - [Vault] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
797	3.4	3.6	3.5	780	815	2.30	10.43
835	4	4.2	4.1	815	856	3.55	7.89
881	5	5.4	5.2	856	908	4.80	7.50
923	3	2.8	2.9	908	937	3.55	5.26
947	2	1.8	1.9	937	956	2.30	5.22

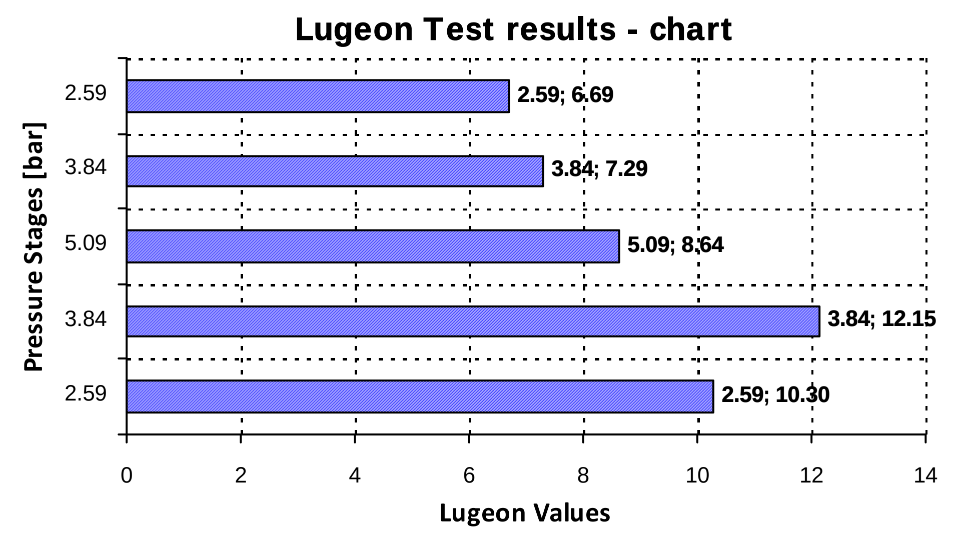
168 Headrace Tunnel - ch. 3+15 - [Invert] Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1181	4	3.4	3.7	1161	1198	2.59	9.52
1243	7	6	6.5	1208	1273	3.84	11.28
1314	6.6	7.2	6.9	1281	1350	5.09	9.04
1375	4.2	4.8	4.5	1354	1399	3.84	7.81
1413	2.6	3	2.8	1400	1428	2.59	7.21

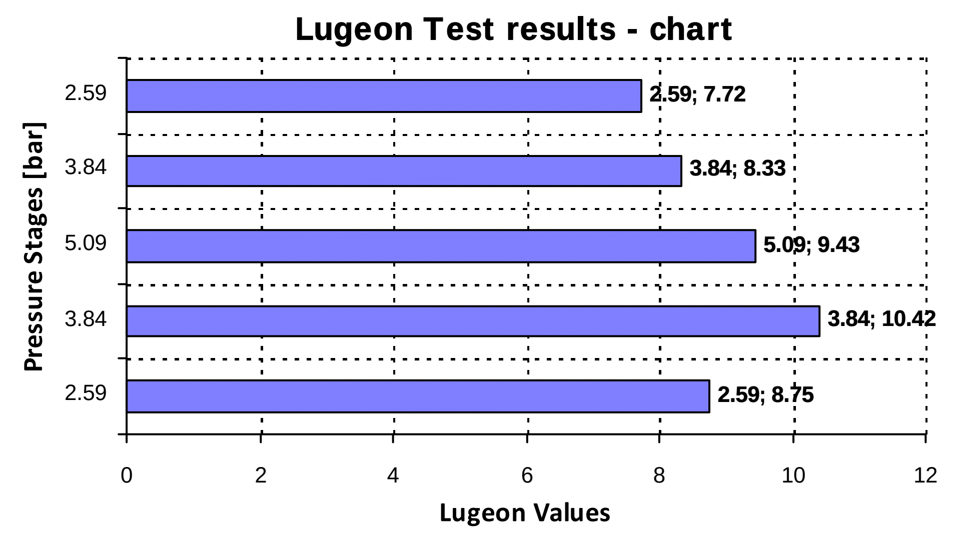
169 Headrace Tunnel - ch. 3+15 - [Invert] Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1181	4	3.4	3.7	1161	1198	2.59	10.30
1243	7	6	6.5	1208	1273	3.84	12.15
1314	6.6	7.2	6.9	1281	1350	5.09	8.64
1375	4.2	4.8	4.5	1354	1399	3.84	7.29
1413	2.6	3	2.8	1400	1428	2.59	6.69

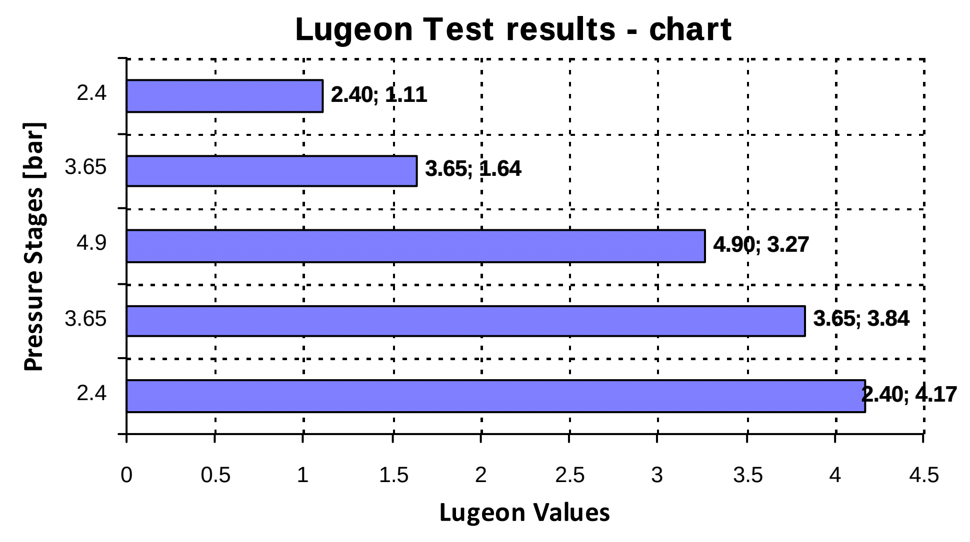
170 Headrace Tunnel - ch. 3+15 - [Invert] Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
1181	4	3.4	3.7	1161	1198	2.59	8.75
1243	7	6	6.5	1208	1273	3.84	10.42
1314	6.6	7.2	6.9	1281	1350	5.09	9.43
1375	4.2	4.8	4.5	1354	1399	3.84	8.33
1413	2.6	3	2.8	1400	1428	2.59	7.72

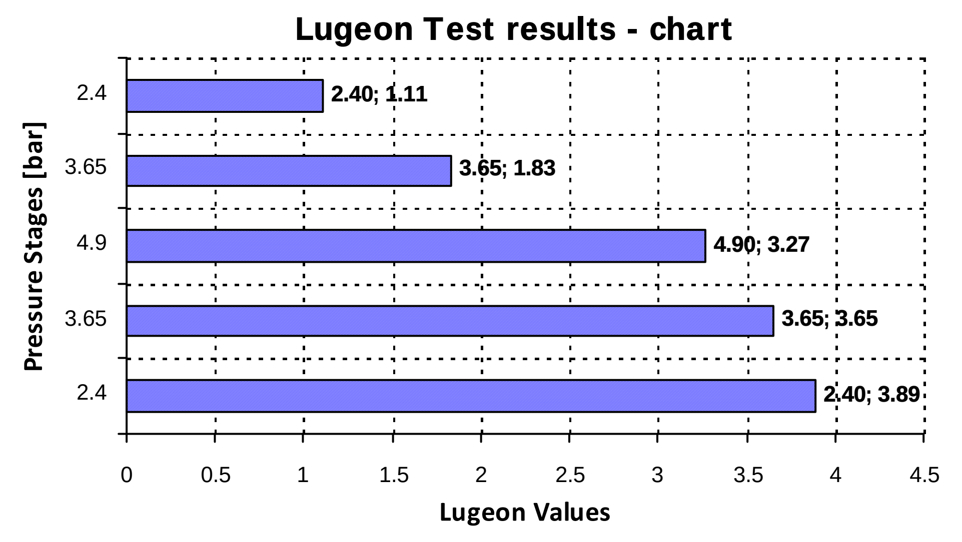
171	Headrace Tunnel - ch. 3+15 - [Sw]	Lugeon 0-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
678	1.4	1.6	1.5	671	686	2.40	4.17
696	2	2.2	2.1	686	707	3.65	3.84
719	2.4	2.4	2.4	707	731	4.90	3.27
736	1	0.8	0.9	731	740	3.65	1.64
742	0.4	0.4	0.4	740	744	2.40	1.11

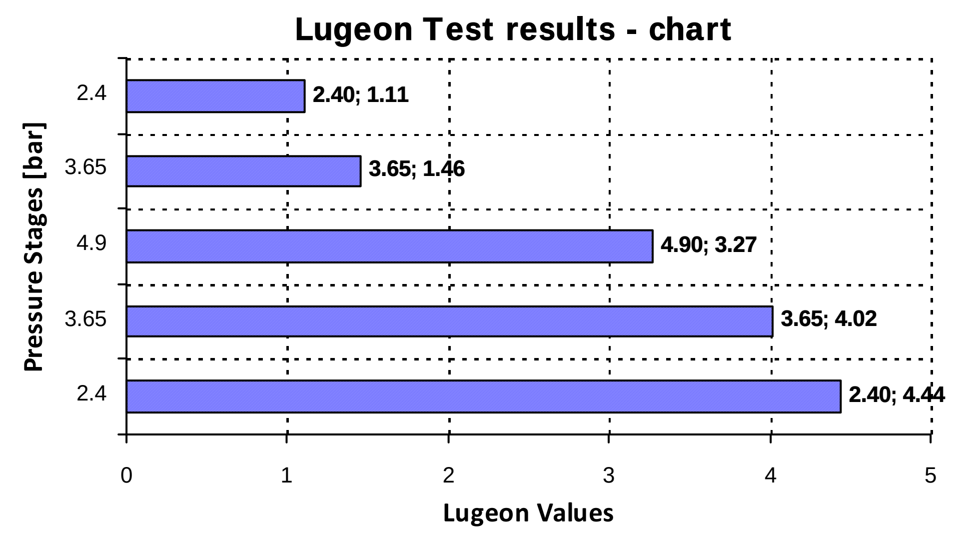
172	Headrace Tunnel - ch. 3+15 - [Sw]	Lugeon 0-5 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
678	1.4	1.6	1.5	671	686	2.40	3.89
696	2	2.2	2.1	686	707	3.65	3.65
719	2.4	2.4	2.4	707	731	4.90	3.27
736	1	0.8	0.9	731	740	3.65	1.83
742	0.4	0.4	0.4	740	744	2.40	1.11

173	Headrace Tunnel - ch. 3+15 - [Sw]	Lugeon 5-10 min



Lugeon Test results - Table

l/min 0-5 min	l/min 5-10 min	l/min 0-10 min	liter 0 min	liter 5 min	liter 10 min	Pressure [bar]	Lugeon value
678	1.4	1.6	1.5	671	686	2.40	4.44
696	2	2.2	2.1	686	707	3.65	4.02
719	2.4	2.4	2.4	707	731	4.90	3.27
736	1	0.8	0.9	731	740	3.65	1.46
742	0.4	0.4	0.4	740	744	2.40	1.11

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %

Construction Tunnel I - Diversion I   Строительный тоннель I -Входной порталь I

	FROM	TO	D1	D2	D3	D4	D5
Construction Tunnel I - Diversion I	0+00	0+20	0	0	0	0	0
Construction Tunnel I - Diversion I	0+20	0+40	0	0	0	0	0
Construction Tunnel I - Diversion I	0+40	0+60	0	0	0	0	0
Construction Tunnel I - Diversion I	0+60	0+80	0	10	30	3	0
Construction Tunnel I - Diversion I	0+80	1+00	0	10	30	3	0
Construction Tunnel I - Diversion I	1+00	1+20	0	10	30	1	0
Construction Tunnel I - Diversion I	1+20	1+40	0	0	20	2	0
Construction Tunnel I - Diversion I	1+40	1+60	0	0	20	1	0
Construction Tunnel I - Diversion I	1+60	1+80	0	0	20	1	0
Construction Tunnel I - Diversion I	1+80	2+00	0	0	30	0	0
Construction Tunnel I - Diversion I	2+00	2+20	0	0	20	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Construction Tunnel I - Diversion I	2+20	2+40	0	10	20	0	0
Construction Tunnel I - Diversion I	2+40	2+60	0	10	20	0	0
Construction Tunnel I - Diversion I	2+60	2+80	0	10	20	0	0
Construction Tunnel I - Diversion I	2+80	3+00	0	0	0	0	0
Construction Tunnel I - Diversion I	3+00	3+20	0	0	0	0	0
Construction Tunnel I - Diversion I	3+20	3+40	0	0	0	0	0
Construction Tunnel I - Diversion I	3+40	3+60	0	0	0	0	0
Construction Tunnel I - Diversion I	3+60	3+80	0	0	0	0	0
Construction Tunnel I - Diversion I	3+80	4+00	0	0	0	0	0
Construction Tunnel I - Diversion I	4+00	4+20	0	0	0	0	0
Construction Tunnel I - Diversion I	4+20	4+40	0	0	0	0	0
Construction Tunnel I - Diversion I	4+40	4+60	0	0	100	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Construction Tunnel I - Diversion I	4+60	4+80	0	0	50	0	0
Construction Tunnel I - Diversion I	4+80	5+00	0	0	60	0	0
Construction Tunnel I - Diversion I	5+00	5+20	0	0	60	0	0
Construction Tunnel I - Diversion I	5+20	5+40	0	0	40	0	0
Construction Tunnel I - Diversion I	5+40	5+60	0	0	20	0	0
Construction Tunnel I - Diversion I	5+60	5+80	0	0	20	2	0
Construction Tunnel I - Diversion I	5+80	6+00	0	0	20	2	0
Construction Tunnel I - Diversion I	6+00	6+20	0	0	20	1	50
Construction Tunnel I - Diversion I	6+20	6+40	0	0	20	0	0
Construction Tunnel I - Diversion I	6+40	6+60	0	0	20	1	0
Construction Tunnel I - Diversion I	6+60	6+80	0	10	20	0	0
Construction Tunnel I - Diversion I	6+80	7+00	0	10	20	2	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Construction Tunnel I - Diversion I	7+00	7+20	0	10	20	1	0
Construction Tunnel I - Diversion I	7+20	7+40	0	0	10	0	0
Construction Tunnel I - Diversion I	7+40	7+60	0	10	20	0	0
Construction Tunnel I - Diversion I	7+60	7+80	0	10	10	2	0
Construction Tunnel I - Diversion I	7+80	8+00	0	20	30	2	0
Construction Tunnel I - Diversion I	8+00	8+20	0	20	30	2	0
Construction Tunnel I - Diversion I	8+20	8+40	0	20	30	0	0
Construction Tunnel I - Diversion I	8+40	8+60	0	20	30	0	0
Construction Tunnel I - Diversion I	8+60	8+80	0	20	20	0	0
Construction Tunnel I - Diversion I	8+80	9+00	0	20	20	0	0
Construction Tunnel I - Diversion I	9+00	9+20	0	20	20	0	0
Construction Tunnel I - Diversion I	9+20	9+40	0	20	20	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert

D2 : Lining deterioration (honey comb) and damages

D3 : Lining weakening due to physical and chemical processes

D4 : Water Seepages

D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Construction Tunnel I - Diversion I	9+40	9+60	0	10	20	0	0
Construction Tunnel I - Diversion I	9+60	9+80	0	20	20	0	0
Construction Tunnel I - Diversion I	9+80	10+00	0	10	30	0	0
Construction Tunnel I - Diversion I	10+00	10+20	0	10	30	0	0
Construction Tunnel I - Diversion I	10+20	10+40	0	10	20	0	0
Construction Tunnel I - Diversion I	10+40	10+60	0	10	20	0	0

Construction Tunnel II - Diversion II Строительный тоннель II - Входной портал II

NAME	FROM	TO	D1	D2	D3	D4	D5
Construction Tunnel II - Diversion II	0+00	0+20	0	0	20	0	0
Construction Tunnel II - Diversion II	0+20	0+40	0	0	20	0	0
Construction Tunnel II - Diversion II	0+40	0+60	0	0	30	0	0
Construction Tunnel II - Diversion II	0+60	0+80	0	0	40	2	0
Construction Tunnel II - Diversion II	0+80	1+00	0	10	50	1	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Construction Tunnel II - Diversion II	1+00	1+20	0	10	40	0	0
Construction Tunnel II - Diversion II	1+20	1+40	0	10	40	0	0
Construction Tunnel II - Diversion II	1+40	1+60	0	10	40	0	0
Construction Tunnel II - Diversion II	1+60	1+80	0	10	30	0	0
Construction Tunnel II - Diversion II	1+80	2+00	0	0	30	1	0
Construction Tunnel II - Diversion II	2+00	2+20	0	0	30	2	0
Construction Tunnel II - Diversion II	2+20	2+40	0	0	30	2	0
Construction Tunnel II - Diversion II	2+40	2+60	0	0	0	0	0
Construction Tunnel II - Diversion II	2+60	2+80	0	0	0	0	0
Construction Tunnel II - Diversion II	2+80	3+00	0	0	0	0	0
Construction Tunnel II - Diversion II	3+00	3+20	0	0	0	0	0
Construction Tunnel II - Diversion II	3+20	3+40	0	0	0	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Construction Tunnel II - Diversion II	3+40	3+60	0	0	0	0	0
Construction Tunnel II - Diversion II	3+60	3+80	0	0	0	0	0
Construction Tunnel II - Diversion II	3+80	4+00	0	0	30	2	0
Construction Tunnel II - Diversion II	4+00	4+20	0	0	30	2	0
Construction Tunnel II - Diversion II	4+20	4+40	0	0	40	3	10
Construction Tunnel II - Diversion II	4+40	4+60	0	0	40	2	10
Construction Tunnel II - Diversion II	4+60	4+80	0	0	40	2	10
Construction Tunnel II - Diversion II	4+80	5+00	0	0	40	2	10
Construction Tunnel II - Diversion II	5+00	5+20	0	0	20	2	10
Construction Tunnel II - Diversion II	5+20	5+40	0	0	20	2	10
Construction Tunnel II - Diversion II	5+40	5+60	0	0	20	0	0
Construction Tunnel II - Diversion II	5+60	5+80	0	10	10	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Construction Tunnel II - Diversion II	5+80	6+00	0	10	10	0	0
Construction Tunnel II - Diversion II	6+00	6+20	0	0	10	0	10
Construction Tunnel II - Diversion II	6+20	6+40	0	0	20	0	0
Construction Tunnel II - Diversion II	6+40	6+60	0	0	20	3	0
Construction Tunnel II - Diversion II	6+60	6+80	0	0	20	0	0
Construction Tunnel II - Diversion II	6+80	7+00	0	0	10	2	0
Construction Tunnel II - Diversion II	7+00	7+20	0	0	10	1	0
Construction Tunnel II - Diversion II	7+20	7+40	0	0	10	2	0
Construction Tunnel II - Diversion II	7+40	7+60	0	0	20	3	0
Construction Tunnel II - Diversion II	7+60	7+80	0	0	20	2	0
Construction Tunnel II - Diversion II	7+80	8+00	0	0	20	3	0
Construction Tunnel II - Diversion II	8+00	8+20	0	0	30	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Construction Tunnel II - Diversion II	8+20	8+40	0	0	20	1	0

Stage 1 Power Tunnel **Временный подводящий тракт (ВПТ)**

NAME	FROM	TO	D1	D2	D3	D4	D5
Stage 1 Power Tunnel	0+00	0+10	0	0	0	0	0
Stage 1 Power Tunnel	0+10	0+30	0	0	0	0	0
Stage 1 Power Tunnel	0+30	0+50	0	0	0	0	0
Stage 1 Power Tunnel	0+50	0+70	0	0	0	0	0
Stage 1 Power Tunnel	0+70	0+90	0	0	0	1	0
Stage 1 Power Tunnel	0+90	1+10	0	0	0	0	0
Stage 1 Power Tunnel	1+10	1+30	0	0	0	0	0
Stage 1 Power Tunnel	1+30	1+50	0	0	0	0	0
Stage 1 Power Tunnel	1+50	1+70	0	0	0	0	0
Stage 1 Power Tunnel	1+70	1+90	0	0	0	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Stage 1 Power Tunnel	1+90	2+10	0	0	0	0	0
Stage 1 Power Tunnel	2+10	2+30	0	0	0	0	0
Stage 1 Power Tunnel	2+30	2+50	0	5	0	0	0
Stage 1 Power Tunnel	2+50	2+70	0	5	0	2	0
Stage 1 Power Tunnel	2+70	2+90	0	5	5	2	0
Stage 1 Power Tunnel	2+90	3+10	0	10	10	0	10
Stage 1 Power Tunnel	3+10	3+30	0	5	10	2	0

Transportation Tunnel T2 Транспортный тоннель Т2

	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T2	0+00	0+20	0	20	30	0	0
Transportation Tunnel T2	0+20	0+40	0	20	20	0	0
Transportation Tunnel T2	0+40	0+60	0	20	30	0	0
Transportation Tunnel T2	0+60	0+80	0	20	20	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T2	0+80	1+00	0	20	30	0	0
Transportation Tunnel T2	1+00	1+20	0	20	20	1	10
Transportation Tunnel T2	1+20	1+40	0	10	20	0	0
Transportation Tunnel T2	1+40	1+60	0	10	20	0	0
Transportation Tunnel T2	1+60	1+80	0	10	10	0	0
Transportation Tunnel T2	1+80	2+00	0	10	10	0	0
Transportation Tunnel T2	2+00	2+20	0	10	10	0	0
Transportation Tunnel T2	2+20	2+40	0	10	20	0	0
Transportation Tunnel T2	2+40	2+60	0	20	20	0	0
Transportation Tunnel T2	2+60	2+80	0	20	30	3	0
Transportation Tunnel T2	2+80	3+00	0	30	40	2	0
Transportation Tunnel T2	3+00	3+20	0	20	30	1	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert

D2 : Lining deterioration (honey comb) and damages

D3 : Lining weakening due to physical and chemical processes

D4 : Water Seepages

D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T2	3+20	3+40	0	20	30	0	50
Transportation Tunnel T2	3+40	3+60	0	10	20	0	50
Transportation Tunnel T2	3+60	3+80	0	0	0	0	0
Transportation Tunnel T2	3+80	4+00	0	20	20	0	0
Transportation Tunnel T2	4+00	4+20	0	20	10	0	0
Transportation Tunnel T2	4+20	4+40	0	0	0	0	100
Transportation Tunnel T2	4+40	4+60	0	0	0	0	100
Transportation Tunnel T2	4+60	4+80	0	10	10	0	50
Transportation Tunnel T2	4+80	5+00	0	10	10	0	80
Transportation Tunnel T2	5+00	5+20	0	20	20	0	0
Transportation Tunnel T2	5+20	5+40	0	20	20	0	0
Transportation Tunnel T2	5+40	5+60	0	30	30	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T2	5+60	5+80	0	20	20	0	0
Transportation Tunnel T2	5+80	6+00	0	20	20	0	0
Transportation Tunnel T2	6+00	6+20	0	10	10	0	0
Transportation Tunnel T2	6+20	6+40	0	10	10	0	0
Transportation Tunnel T2	6+40	6+60	0	10	10	0	50
Transportation Tunnel T2	6+60	6+80	0	0	0	0	0

Transportation Tunnel T3 Транспортный тоннель T3

NAME	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	0+47	0+60	0	10	40	3	0
Transportation Tunnel T3	0+60	0+80	0	20	50	2	0
Transportation Tunnel T3	0+80	1+00	0	30	40	0	0
Transportation Tunnel T3	1+00	1+20	0	10	30	1	0
Transportation Tunnel T3	1+20	1+40	0	10	30	3	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T3	1+40	1+60	0	10	30	1	0
Transportation Tunnel T3	1+60	1+80	0	5	20	1	0
Transportation Tunnel T3	1+80	2+00	0	10	20	0	0
Transportation Tunnel T3	2+00	2+20	0	10	10	0	0
Transportation Tunnel T3	2+20	2+40	0	10	10	0	0
Transportation Tunnel T3	2+40	2+80	0	10	10	0	0
Transportation Tunnel T3	2+80	3+00	0	0	0	0	0
Transportation Tunnel T3	3+00	3+20	0	0	10	0	0
Transportation Tunnel T3	3+20	3+40	0	10	20	0	0
Transportation Tunnel T3	3+40	3+60	0	10	10	0	0
Transportation Tunnel T3	3+60	3+80	0	20	20	0	0
Transportation Tunnel T3	3+80	4+00	0	30	30	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert

D2 : Lining deterioration (honey comb) and damages

D3 : Lining weakening due to physical and chemical processes

D4 : Water Seepages

D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	4+00	4+20	0	20	40	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	4+20	4+40	0	20	40	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	4+40	4+60	0	20	30	2	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	4+60	4+80	0	10	10	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	4+80	5+00	0	10	10	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	5+00	5+20	0	10	20	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	5+20	5+40	0	5	5	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	5+40	5+60	0	10	10	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	5+60	5+80	0	10	10	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	5+80	6+00	0	5	5	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	6+00	6+20	0	0	5	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	6+20	6+40	0	0	5	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
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D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T3	6+40	6+60	0	10	10	0	10
Transportation Tunnel T3	6+60	6+80	0	5	5	0	0
Transportation Tunnel T3	6+80	7+00	0	5	20	0	0
Transportation Tunnel T3	7+00	7+20	0	10	10	0	0
Transportation Tunnel T3	7+20	7+40	0	15	15	0	0
Transportation Tunnel T3	7+40	7+60	0	10	10	0	0
Transportation Tunnel T3	7+60	7+80	0	20	20	0	0
Transportation Tunnel T3	7+80	8+00	0	10	20	3	0
Transportation Tunnel T3	8+00	8+20	0	0	10	1	0
Transportation Tunnel T3	8+20	8+40	0	10	20	0	0
Transportation Tunnel T3	8+40	8+60	0	20	20	2	0
Transportation Tunnel T3	8+60	8+80	0	10	10	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert

D2 : Lining deterioration (honey comb) and damages

D3 : Lining weakening due to physical and chemical processes

D4 : Water Seepages

D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	8+80	9+00	0	10	20	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	9+00	9+20	0	20	40	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	9+20	9+40	0	10	20	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	9+40	9+60	0	20	20	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	9+60	9+80	0	10	20	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	9+80	10+00	0	10	20	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	10+00	10+20	0	5	5	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	10+20	10+40	0	10	10	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	10+40	10+60	0	10	20	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	10+60	10+80	0	10	30	0	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	10+80	11+00	0	20	30	3	0
	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T3	11+00	11+20	0	10	30	0	30

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
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D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T3	11+20	11+40	0	10	30	3	0
Transportation Tunnel T3	11+40	11+60	0	0	0	0	0
Transportation Tunnel T3	11+60	11+80	0	10	10	0	0
Transportation Tunnel T3	11+80	12+00	0	10	10	0	0
Transportation Tunnel T3	12+00	12+20	0	20	40	1	0
Transportation Tunnel T3	12+20	12+40	0	30	50	1	0
Transportation Tunnel T3	12+40	12+60	0	20	30	0	0
Transportation Tunnel T3	12+60	12+80	0	10	20	0	0
Transportation Tunnel T3	12+80	13+00	0	20	30	2	0
Transportation Tunnel T3	13+00	13+20	0	20	20	0	0
Transportation Tunnel T3	13+20	13+40	0	10	20	0	0
Transportation Tunnel T3	13+40	13+60	5	30	50	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T3	13+60	13+80	0	10	10	5	100
Transportation Tunnel T3	13+80	14+00	0	20	20	8	100
Transportation Tunnel T3	14+00	14+20	0	20	30	3	0
Transportation Tunnel T3	14+20	14+40	0	10	20	1	10
Transportation Tunnel T3	14+40	14+60	0	20	30	0	0
Transportation Tunnel T3	14+60	14+80	0	10	20	0	5
Transportation Tunnel T3	14+80	15+00	0	10	20	1	5
Transportation Tunnel T3	15+00	15+20	0	10	20	1	5
Transportation Tunnel T3	15+20	15+40	0	20	30	6	0
Transportation Tunnel T3	15+40	15+60	0	10	30	3	0
Transportation Tunnel T3	15+60	15+80	0	10	10	0	100

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

Transportation Tunnel T3' Транспортный тоннель T3'

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T3'	15+80	16+00	0	0	0	0	100
Transportation Tunnel T3'	16+00	16+20	0	0	10	0	50
Transportation Tunnel T3'	16+20	16+40	0	10	10	0	0
Transportation Tunnel T3'	16+40	16+60	0	10	10	0	0
Transportation Tunnel T3'	16+60	16+80	0	10	10	0	0
Transportation Tunnel T3'	16+80	17+00	0	10	10	0	0
Transportation Tunnel T3'	17+00	17+20	0	10	10	1	0
Transportation Tunnel T3'	17+20	17+40	0	10	10	1	0
Transportation Tunnel T3'	17+40	17+60	0	10	20	0	0
Transportation Tunnel T3'	17+60	17+80	0	10	10	0	20
Transportation Tunnel T3'	17+80	18+00	0	10	10	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T3'	18+00	18+20	0	0	10	0	0
Transportation Tunnel T3'	18+20	18+40	0	0	0	0	0
Transportation Tunnel T3'	18+40	18+60	0	0	0	0	0
Transportation Tunnel T3'	18+60	18+80	0	0	0	0	0
Transportation Tunnel T3'	18+80	19+00	0	0	0	0	0
Transportation Tunnel T3'	19+00	19+20	0	10	10	0	0
Transportation Tunnel T3'	19+20	19+40	0	10	10	0	0
Transportation Tunnel T3'	19+40	19+60	0	10	10	0	0
Transportation Tunnel T3'	19+60	19+80	0	10	10	0	0
Transportation Tunnel T3'	19+80	20+00	0	0	10	0	0
Transportation Tunnel T3'	20+00	20+20	0	0	10	0	0
Transportation Tunnel T3'	20+20	20+40	0	0	10	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T3'	20+40	20+60	0	0	10	0	0
Transportation Tunnel T3'	20+60	20+80	0	10	20	0	10
Transportation Tunnel T3'	20+80	21+00	0	10	10	1	10
Transportation Tunnel T3'	21+00	21+20	0	20	20	1	0
Transportation Tunnel T3'	21+20	21+40	0	20	20	2	0
Transportation Tunnel T3'	21+40	21+60	0	20	20	2	20
Transportation Tunnel T3'	21+60	21+80	0	0	0	1	100

Transportation Tunnel T4 Транспортный тоннель T4

	FROM	TO	D1	D2	D3	D4	D5
Transportation Tunnel T4	0+00	0+20	0	0	10	0	100
Transportation Tunnel T4	0+20	0+40	0	0	10	0	100
Transportation Tunnel T4	0+40	0+60	0	0	10	0	100
Transportation Tunnel T4	0+60	0+80	0	0	10	0	100

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T4	0+80	1+00	0	0	20	1	100
Transportation Tunnel T4	1+00	1+20	0	0	0	1	50
Transportation Tunnel T4	1+20	1+40	20	10	10	0	0
Transportation Tunnel T4	1+40	1+60	0	10	10	1	0
Transportation Tunnel T4	1+60	1+80	0	10	10	8	0
Transportation Tunnel T4	1+80	2+00	0	20	10	3	0
Transportation Tunnel T4	2+00	2+20	0	10	10	7	0
Transportation Tunnel T4	2+20	2+40	0	0	0	1	0
Transportation Tunnel T4	2+40	2+60	0	0	0	0	0
Transportation Tunnel T4	2+60	2+80	0	0	0	0	0
Transportation Tunnel T4	2+80	3+00	100	10	10	0	0
Transportation Tunnel T4	3+00	3+20	50	10	10	0	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T4	3+20	3+40	100	10	10	0	0
Transportation Tunnel T4	3+40	3+60	100	10	10	0	0
Transportation Tunnel T4	3+60	3+80	100	10	10	0	0
Transportation Tunnel T4	3+80	4+00	100	10	0	2	0
Transportation Tunnel T4	4+00	4+20	100	10	0	0	0
Transportation Tunnel T4	4+20	4+40	100	0	0	0	0
Transportation Tunnel T4	4+40	4+60	100	0	0	0	0
Transportation Tunnel T4	4+60	4+80	100	0	0	0	0
Transportation Tunnel T4	4+80	5+00	100	0	0	0	0
Transportation Tunnel T4	5+00	5+20	100	0	0	0	0
Transportation Tunnel T4	5+20	5+40	100	10	10	1	0
Transportation Tunnel T4	5+40	5+60	100	10	10	2	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert

D2 : Lining deterioration (honey comb) and damages

D3 : Lining weakening due to physical and chemical processes

D4 : Water Seepages

D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T4	5+60	5+80	100	10	10	1	0
Transportation Tunnel T4	5+80	6+00	100	10	10	0	0
Transportation Tunnel T4	6+00	6+20	100	10	10	0	50
Transportation Tunnel T4	6+20	6+40	100	10	0	0	100
Transportation Tunnel T4	6+40	6+60	100	0	0	0	100
Transportation Tunnel T4	6+60	6+80	100	0	0	0	100
Transportation Tunnel T4	6+80	7+00	100	0	0	0	100
Transportation Tunnel T4	7+00	7+20	0	0	0	0	0
Transportation Tunnel T4	7+20	7+40	0	0	0	0	10
Transportation Tunnel T4	7+40	7+60	60	0	0	0	50
Transportation Tunnel T4	7+60	7+80	50	0	0	2	30
Transportation Tunnel T4	7+80	8+00	50	10	20	3	0

DAMAGES SURVEY LIST

LEGEND :

D1 : No Connection between Sidewll and Invert
D2 : Lining deterioration (honey comb) and damages
D3 : Lining weakening due to physical and chemical processes
D4 : Water Seepages
D5 : Steel bars exposed for Concrete cover damages

NAME	FROM Chainage	TO Chainage	D1 %	D2 %	D3 %	D4 n°	D5 %
Transportation Tunnel T4	8+00	8+20	100	10	20	2	0
Transportation Tunnel T4	8+20	8+40	0	0	0	2	0
Transportation Tunnel T4	8+40	8+60	0	0	0	2	0
Transportation Tunnel T4	8+60	8+80	50	10	0	2	0
Transportation Tunnel T4	8+80	9+00	100	10	0	0	0
Transportation Tunnel T4	9+00	9+20	0	10	0	0	0
Transportation Tunnel T4	9+20	9+40	0	0	0	1	0
Transportation Tunnel T4	9+40	9+60	0	0	0	0	0
Transportation Tunnel T4	9+60	9+80	0	0	0	0	0
Transportation Tunnel T4	9+80	9+95	0	0	0	2	0

SECTIONAL VERIFICATIONS RESULTS FOR COMBINED AXIAL LOAD AND BENDING MOMENT

First Group comb.	Passed			x	x					x			x	x				x												6	Passed	First Group comb.
HPI1 HPI2 RS1	Failed	x	x			x	x	x	x		x	x			x	x	x		x	x	x	x	x	x	x	x	x-	x	x	21	Failed	HPI1 HPI2 RS1
Second Group Comb.	Passed			x	x								x	x				x												5	Passed	Second Group Comb.
EU1 EU2 EU3	Failed	x	x			x	x	x	x	x	x	x			x	x	x		x	x	x	x	x	x	x	x	x	x	x	23	Failed	EU1 EU2 EU3
Both Groups	Passed			x	x								x	x				x												5	Passed	Both Groups
	Failed	x	x			x	x	x	x	x	x	x			x	x	x		x	x	x	x	x	x	x	x	x	x	x	23	Failed	

SECTIONAL VERIFICATIONS RESULTS FOR SHEAR

First Group comb.	Passed			x	x																									2	Passed	First Group comb.
HPI1 HPI2 RS1	Failed	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	26	Failed	HPI1 HPI2 RS1
Second Group Comb.	Passed			x	x																									2	Passed	Second Group Comb.
EU1 EU2 EU3	Failed	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	26	Failed	EU1 EU2 EU3
Both Groups	Passed			x	x																									2	Passed	Both Groups
	Failed	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	26	Failed	

TUNNEL TRANSVERSAL SECTIONS ANALIZED

		DG1-DG2_01_F2	DG1-DG2_02_F2	DG3-DG4_01_F2	DG3-DG4_02_F2	DT123_02_F2	DT123_2_DITCH_F2	DT123_3_F2	DT123_5_F2	T2_1_F2	T2_1P_F2	T3_1_F2	T3_1_FIXED_F2	T3_2_F2	T3P_5_F35_F2	T3P_6_F2	T3P_6_FIXED_F2	T4_1_F2	T4_2_F2	T4_3_F2	T4_5_F2	T4_6_F2	T8_1_F2	T8_1_PINNED_F2	T8_2_F2	T37_2_F35_F2	T37_2_F35_FIXED_F2	T37_2_K1KZ_F2	T37_2_K1KZ_FIXED_F2			
Self Weight	(kN)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		(kN)	Self Weight
Vertical Rock Load	(kN/m)	51.0	49.0	13.5	14.6	86.3	86.3	78.5	95.7	84.5	27.8	121.9	121.9	29.0	102.0	30.1	30.1	90.2	57.3	207.5	52.1	27.9	31.5	31.5	31.5	75.8	75.8	78.0	78.0		(kN/m)	Vertical Rock Load
Horizontal Rock Load	(kN/m)	17.3	16.6	0.0	0.0	57.6	57.6	50.5	64.5	55.9	21.1	84.2	84.2	17.8	103.0	22.5	22.5	52.4	22.4	150.9	21.7	24.1	20.4	20.4	20.4	48.8	48.8	17.9	17.9		(kN/m)	Horizontal Rock Load
Water Load	(kN/m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**100.0**	**100.0**	**100.0**	**100.0**	0.0	**100.0**	**100.0**	0.0	0.0	0.0	0.0	**100.0**	**100.0**	**100.0**	**100.0**	0.0	0.0	**100.0**	**100.0**		(kN/m)	Water Load
Earthquake	(kN/m)	0.0	0.0	0.0	0.0	55.0	55.0	55.0	55.0	35.0	35.0	0.0	0.0	0.0	55.0	55.0	55.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	15.0	55.0	55.0	55.0	55.0		(kN/m)	Earthquake

Reduction Coefficients indicated in the HPI Report

Self Weight																													
Vertical Rock Load														50%			50%	50%	50%	50%	50%								
Horizontal Rock Load																													
Water Load																							50%	50%	50%				
Earthquake																													

LOADS COMBINATION COEFFICIENTS

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight		1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load		1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load		1.00	1.50	1.20	1.50	1.35	1.35
Water Load		1.00	1.00	1.10	1.35	1.50	1.35
Earthquake		1.00	1.20	1.00	1.00	1.00	1.50

DIVERSION TUNNELS

SECTIONAL VERIFICATIONS RESULTS FOR COMBINED AXIAL LOAD AND BENDING MOMENT

First Group comb.	Passed	x		x	x			x	x						5	Passed	First Group comb.
HPI1 HPI2 EU1	Failed		x			x	x			x	x	x			6	Failed	HPI1 HPI2 RS1
Second Group Comb.	Passed														0	Passed	Second Group Comb.
	Failed														0	Failed	EU1 EU2 EU3
Both Groups	Passed	x		x	x			x	x						5	Passed	Both Groups
	Failed		x			x	x			x	x	x			6	Failed	

SECTIONAL VERIFICATIONS RESULTS FOR SHEAR

First Group comb.	Passed			x				x							2	Passed	First Group comb.
HPI1 HPI2	Failed	x	x		x	x	x		x	x	x	x			9	Failed	HPI1 HPI2 RS1
Second Group Comb.	Passed			x				x							2	Passed	Second Group Comb.
EU1	Failed	x	x		x	x	x		x	x	x	x			9	Failed	EU1 EU2 EU3
Both Groups	Passed			x				x							2	Passed	Both Groups
	Failed	x	x		x	x	x		x	x	x	x			9	Failed	

TUNNEL TRANSVERSAL SECTIONS ANALIZED

		DIV_SEC_01_K1_B170_INV_F2	DIV_SEC_01_K1_B170_F2	DIV_SEC_01_K1_B350_F2	DIV_SEC_01_K1_ROOF_F2	DIV_SEC_01_K3_B170_F2	DIV_SEC_01_K3_B170_INV_F2	DIV_SEC_01_K3_B350_F2	DIV_SEC_01_K3_ROOF_F2	DIV_SEC_02_el_link_F2	DIV_SEC_02_no_link_F2	DIV_SEC_03_F2					
Self Weight	(kN)															(kN)	Self Weight
Outside Water Pressure	(kN/m)	900.0	900.0	900.0	900.0	900.0	900.0	900.0	900.0	200.0	200.0	200.0				(kN/m)	Outside Water Pressure
Inside Water Pressure	(kN/m)	1960.0	1960.0	1960.0	1960.0	1960.0	1960.0	1960.0	1960.0	0.0	0.0	0.0				(kN/m)	Inside Water Pressure
Earthquake	(kN/m)															(kN/m)	Earthquake

LOADS COMBINATION COEFFICIENTS

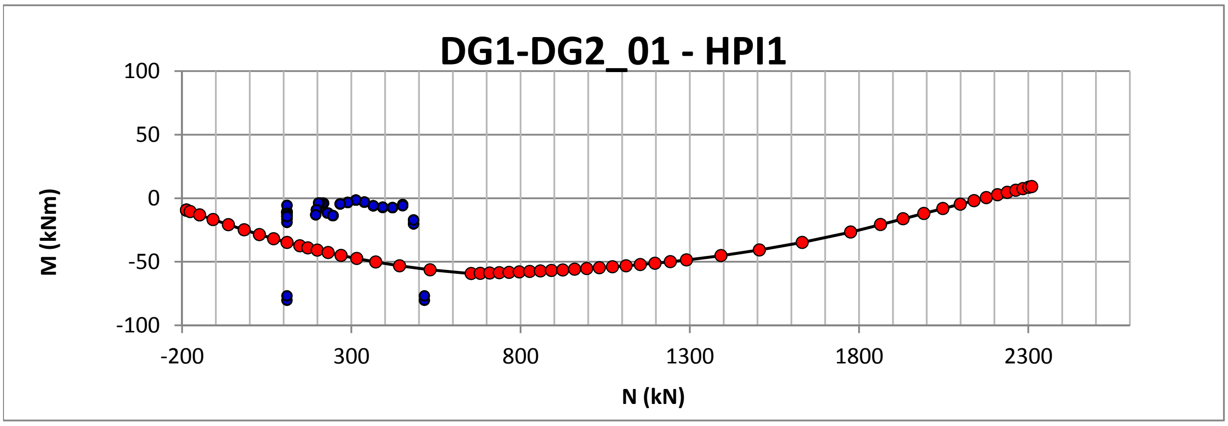
	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight		1.00	1.05	1.00
Outside Water Pressure		1.00	1.00	1.50
Inside water Pressure		1.00	1.00	1.50

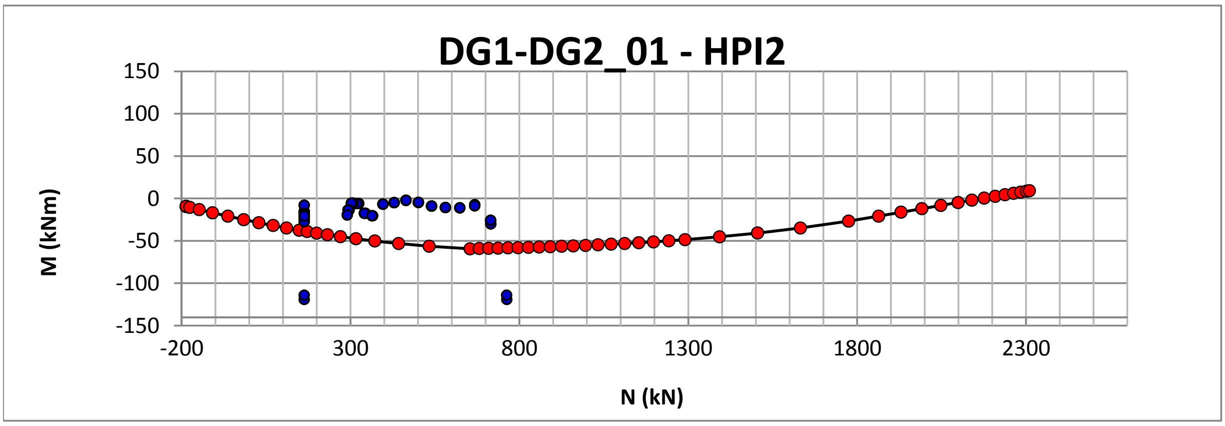
DG1-DG2_01

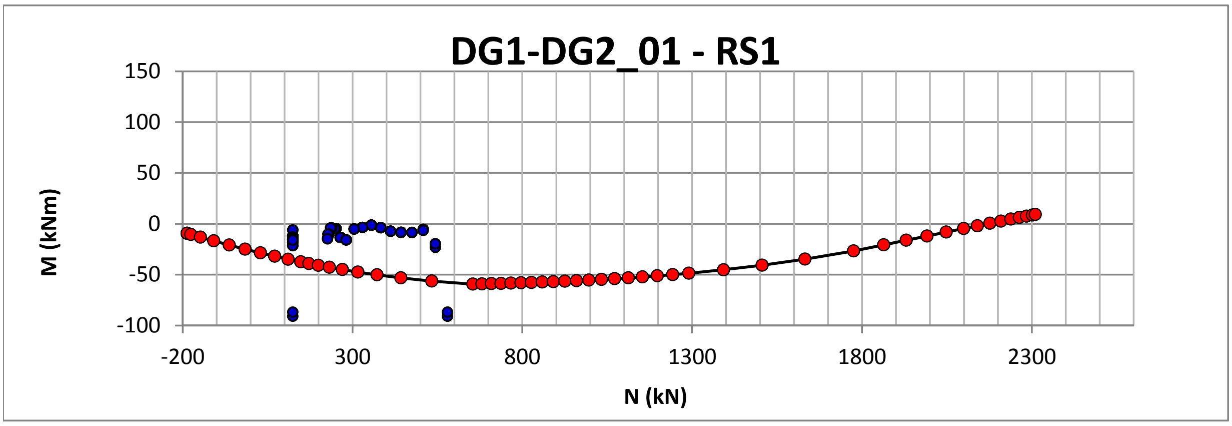
Passed	
Failed	x

No Water Considered
No Seism Considered

	hpi report	HPI (1)	HPI (2)	RS1	EU (1)	EU(2)	EU(3)
	Q	γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	51.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.3	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





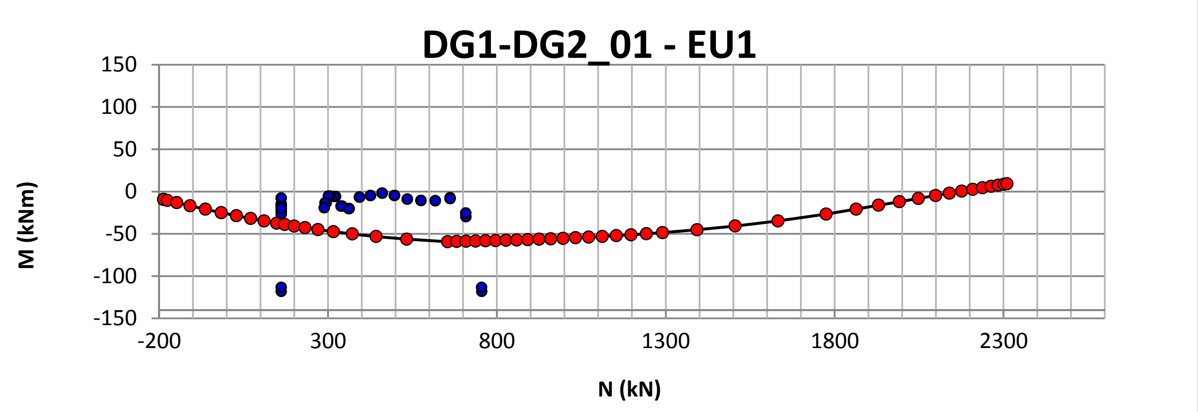


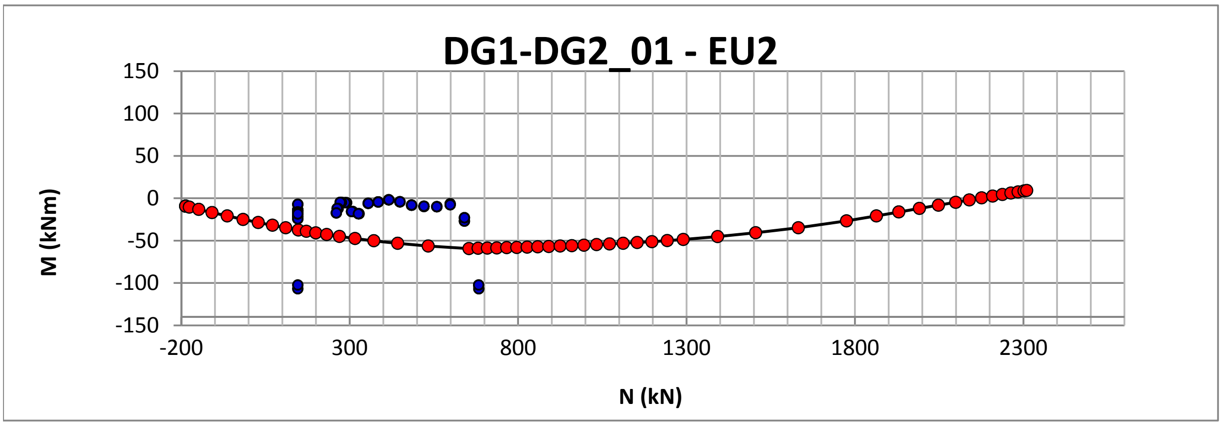
DG1-DG2_01

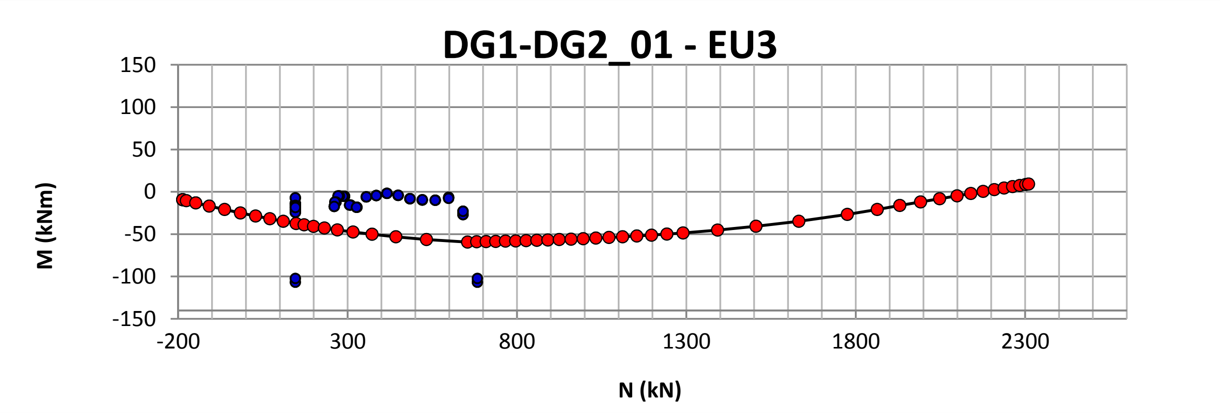
Passed	
Failed	x

No Water Considered
No Seism Considered

	hpi report	HPI (1)	HPI (2)	RS1	EU (1)	EU(2)	EU(3)
	Q	γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self weight	0.00	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	51.00	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.30	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.00	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.00	1.00	1.20	1.00	1.00	1.00	1.50







DG1-DG2_01

Shear Verification

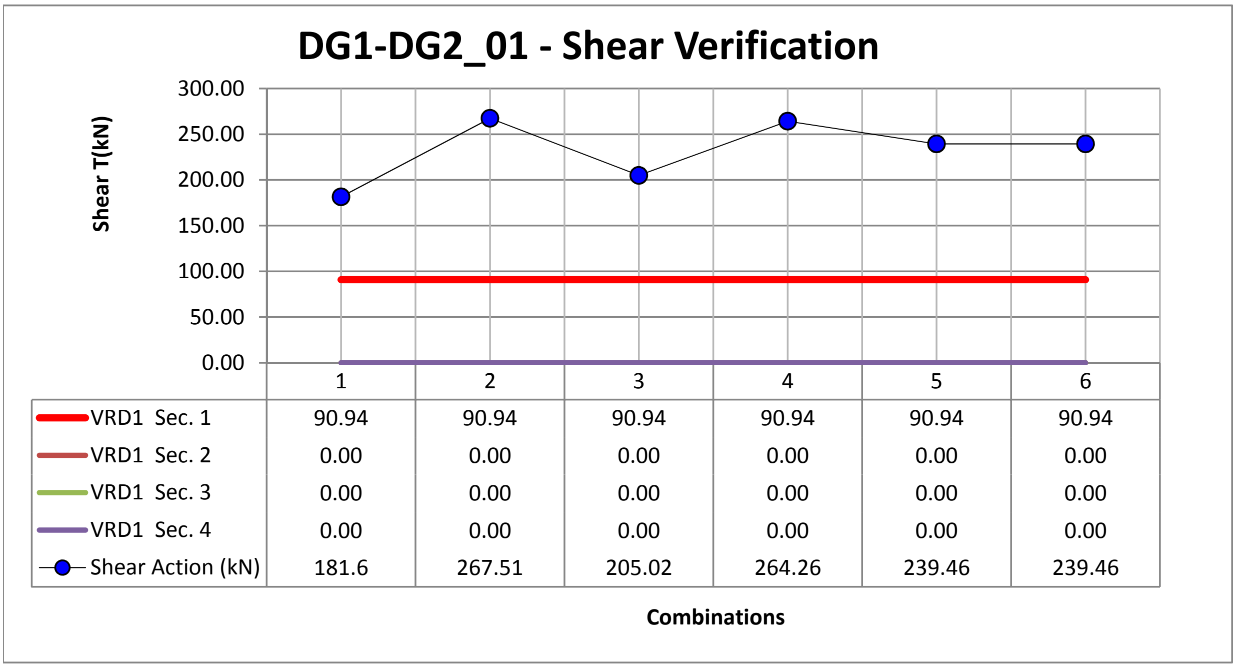
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.20			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	5.00			
		m^2/m	0.00050			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.0909	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	90.94	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	90.94	90.94	90.94	90.94	90.94	90.94
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**181.6**	**267.51**	**205.02**	**264.26**	**239.46**	**239.46**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

DG1-DG2_01 - Shear Verification



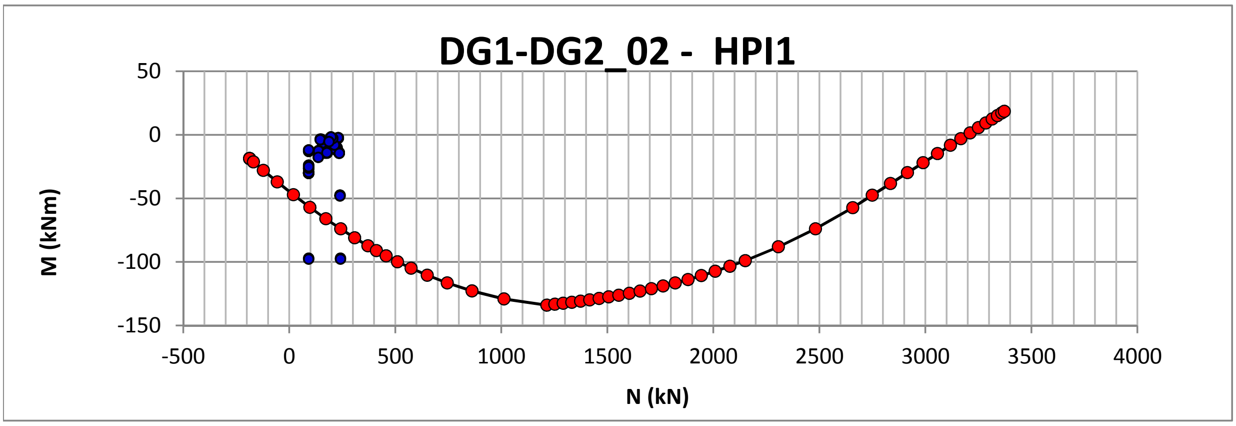
	1	2	3	4	5	6
VRD1 Sec. 1	90.94	90.94	90.94	90.94	90.94	90.94
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	181.6	267.51	205.02	264.26	239.46	239.46

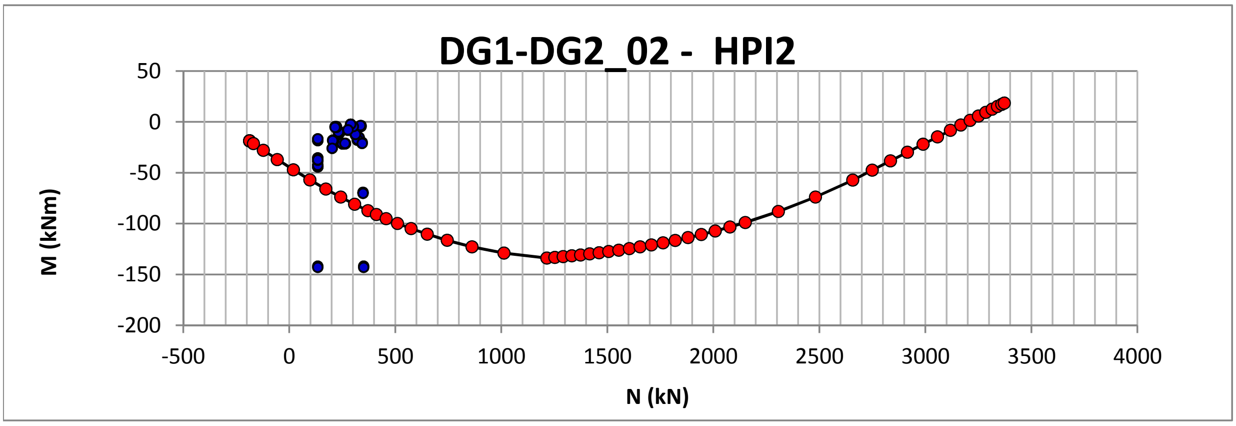
DG1-DG2_02

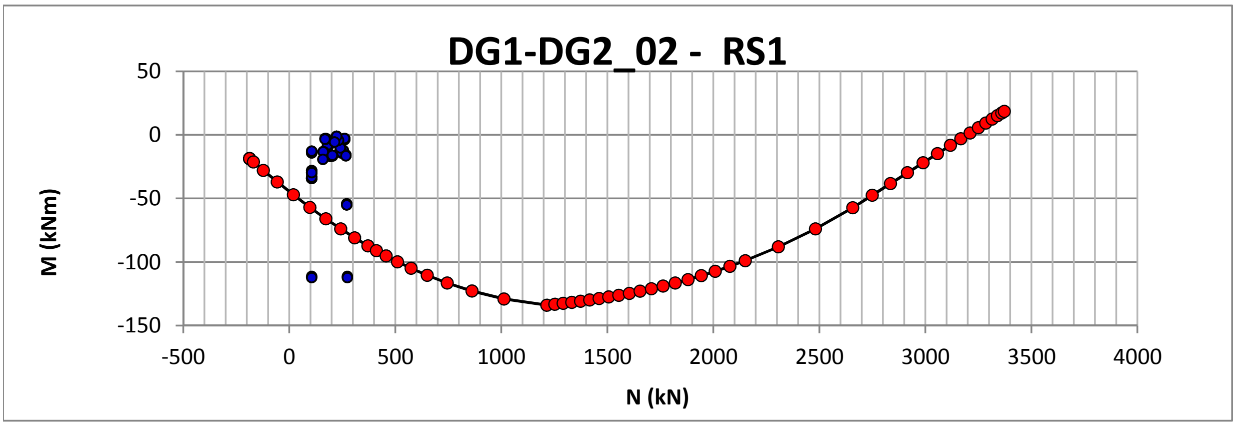
Passed	
Failed	x

No Water Considered
No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	49.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	16.6	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





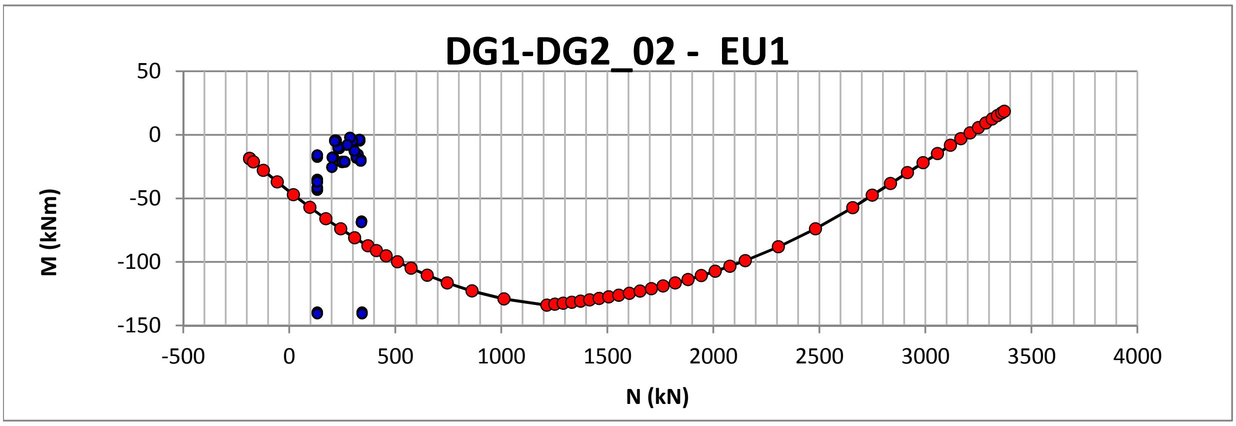


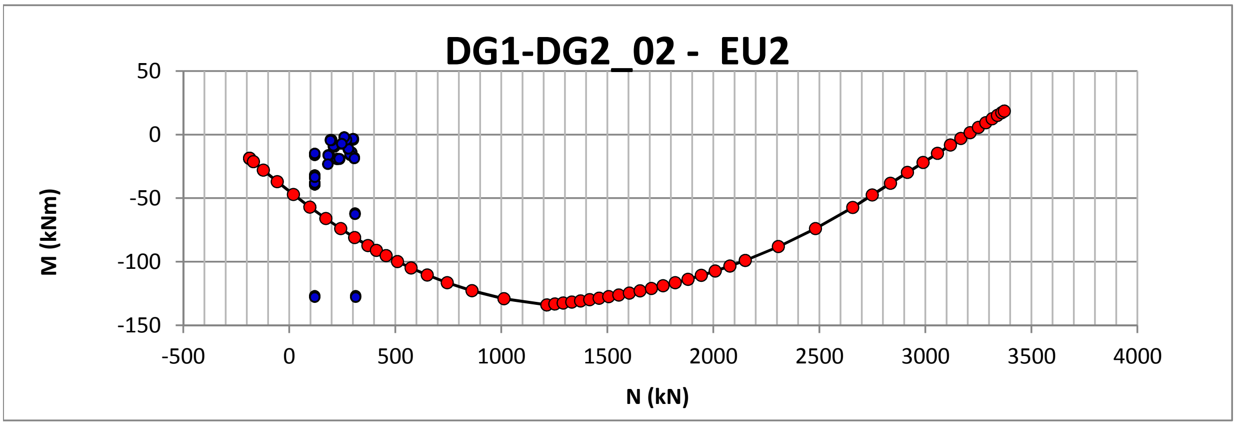
DG1-DG2_02

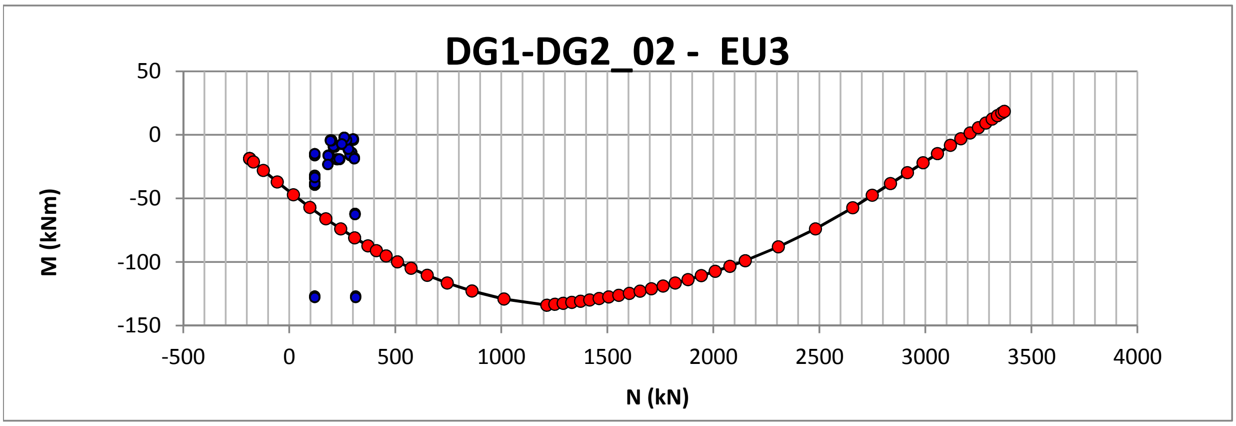
Passed	
Failed	x

No Water Considered
No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	49.00	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	16.60	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.00	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.00	1.00	1.20	1.00	1.00	1.00	1.50







DG1-DG2_01

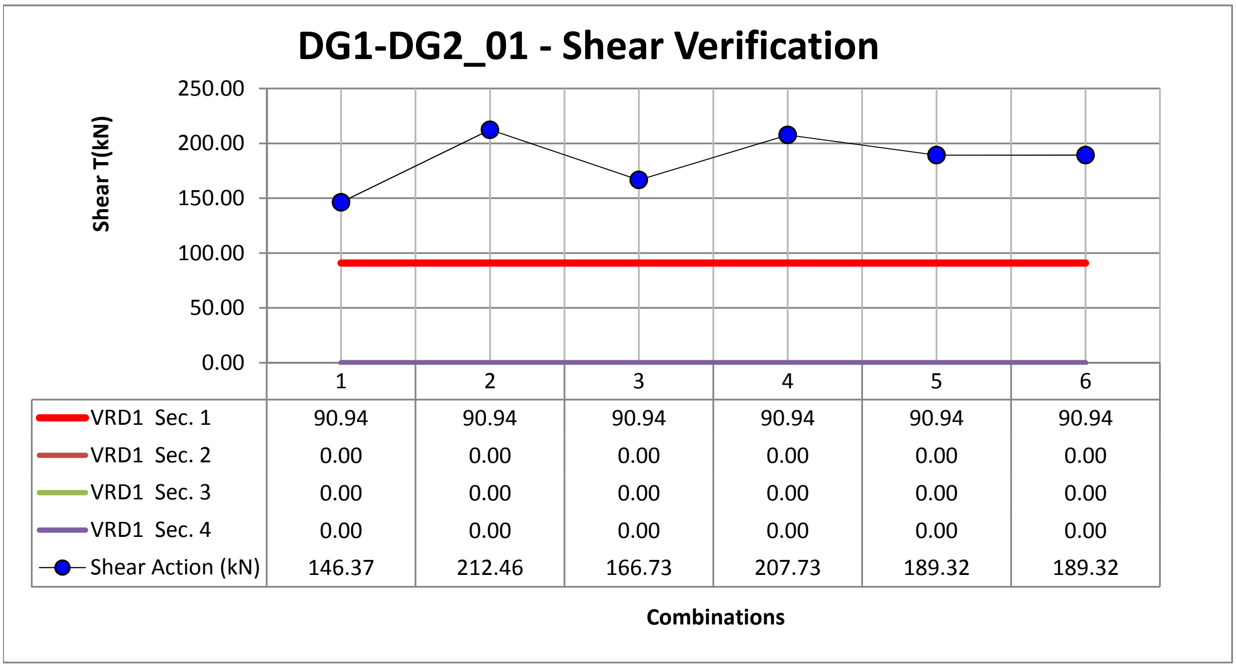
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.20			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	5.00			
		m^2/m	0.00050			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.0909	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	90.94	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	90.94	90.94	90.94	90.94	90.94	90.94		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**146.37**	**212.46**	**166.73**	**207.73**	**189.32**	**189.32**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

DG1-DG2_01 - Shear Verification



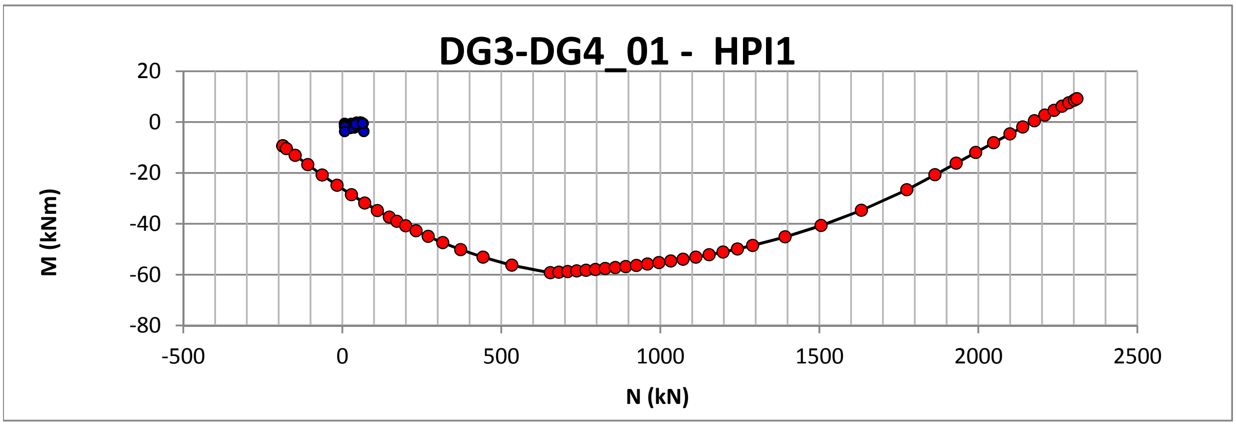
	1	2	3	4	5	6
🟥 VRD1 Sec. 1	90.94	90.94	90.94	90.94	90.94	90.94
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
🟩 VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
● Shear Action (kN)	146.37	212.46	166.73	207.73	189.32	189.32

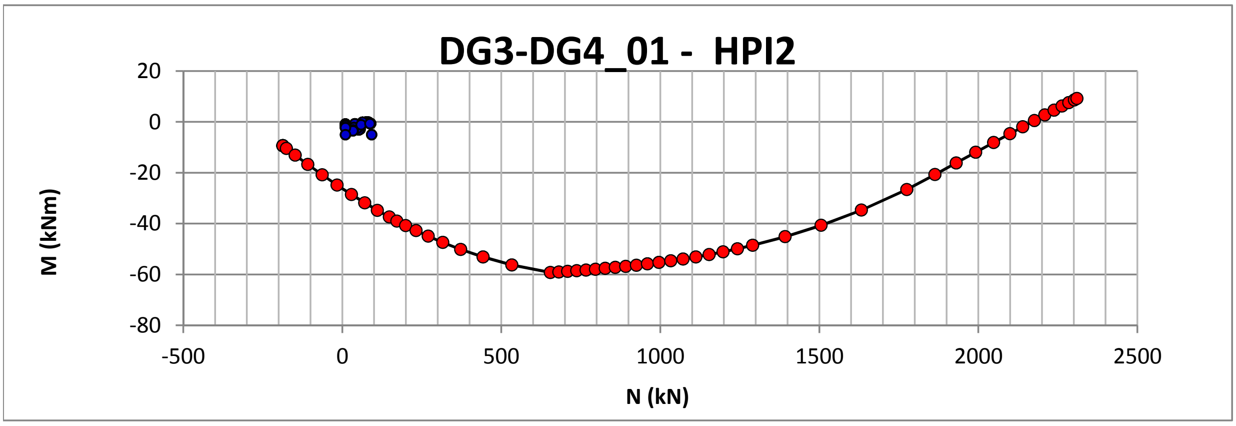
DG3-DG4_01

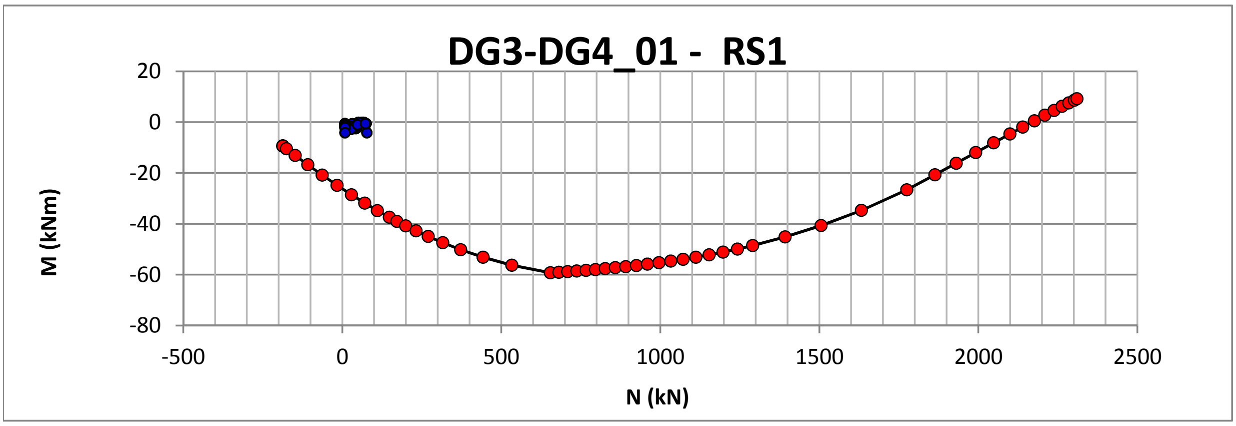
Passed	x
Failed	

No Water Considered
No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	13.5	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	0.0	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





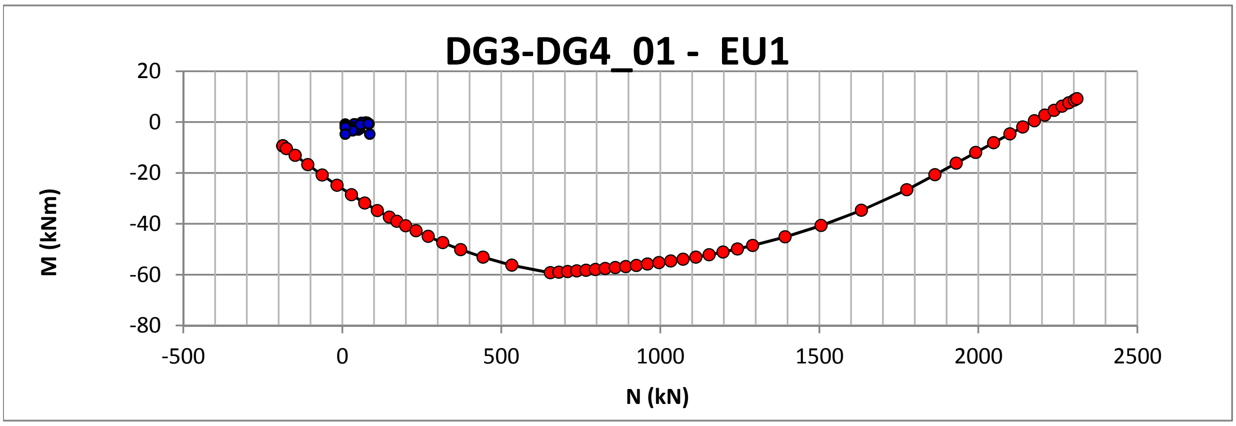


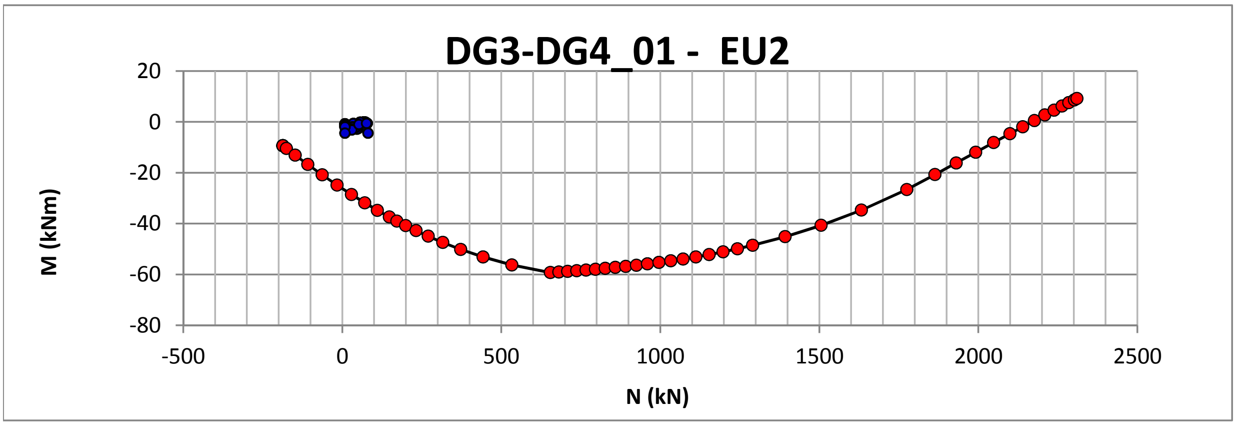
DG3-DG4_01

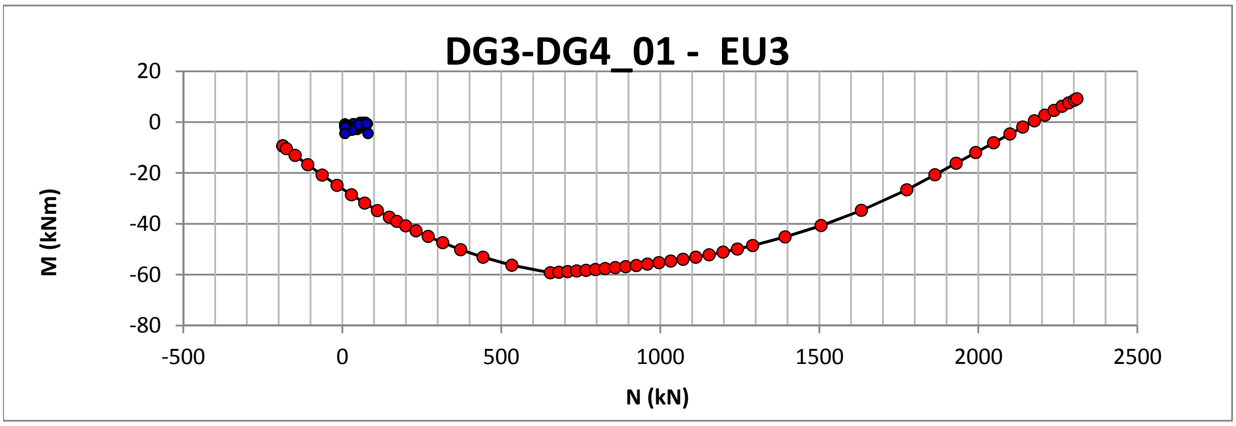
Passed	x
Failed	

No Water Considered
No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	13.5	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	0.0	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







DG3-DG4_01

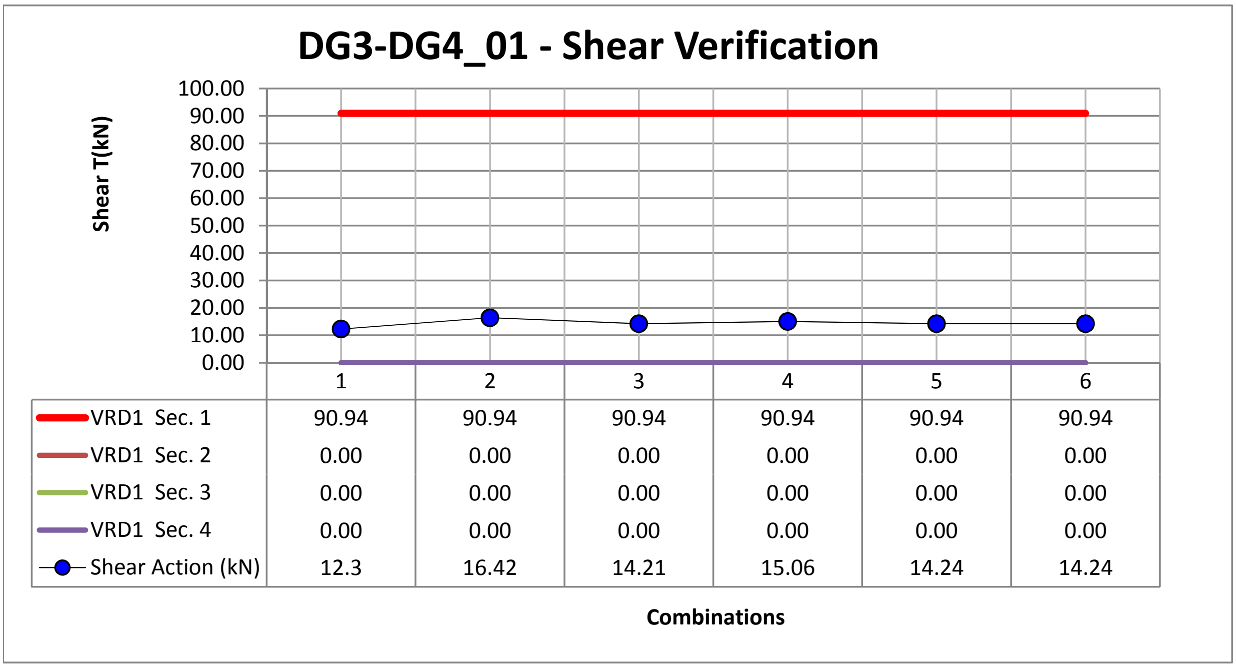
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.20			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	5.00			
		m^2/m	0.00050			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.0909	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	90.94	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	90.94	90.94	90.94	90.94	90.94	90.94		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**12.3**	**16.42**	**14.21**	**15.06**	**14.24**	**14.24**		
							Group 1	Group 2
Passed	x	x	x	x	x	x	x	x
Failed								

DG3-DG4_01 - Shear Verification



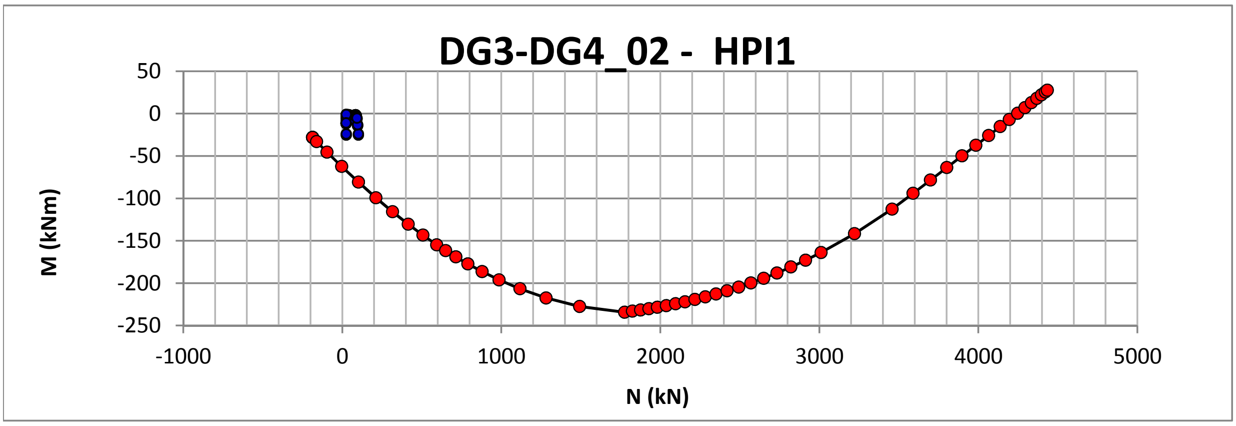
	1	2	3	4	5	6
VRD1 Sec. 1	90.94	90.94	90.94	90.94	90.94	90.94
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	12.3	16.42	14.21	15.06	14.24	14.24

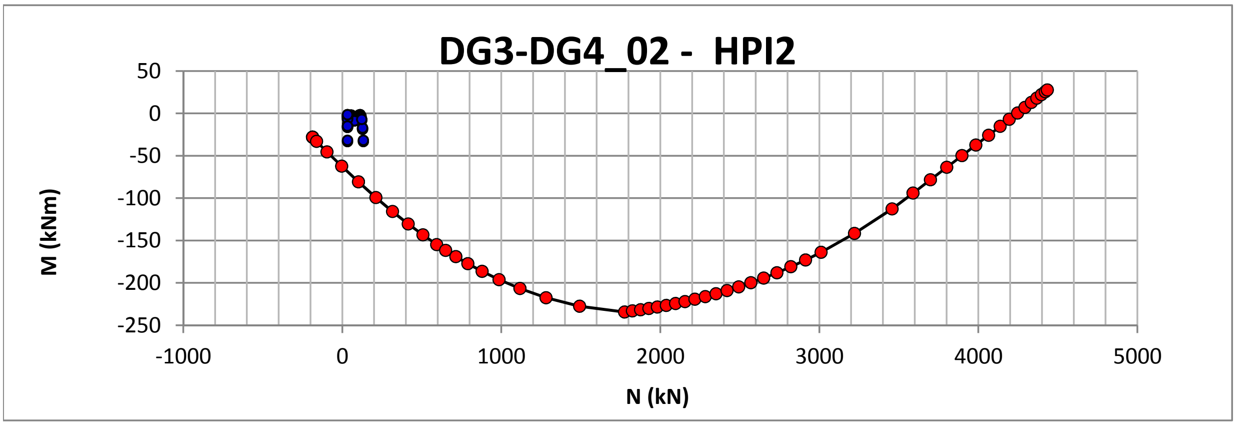
DG3-DG4_02

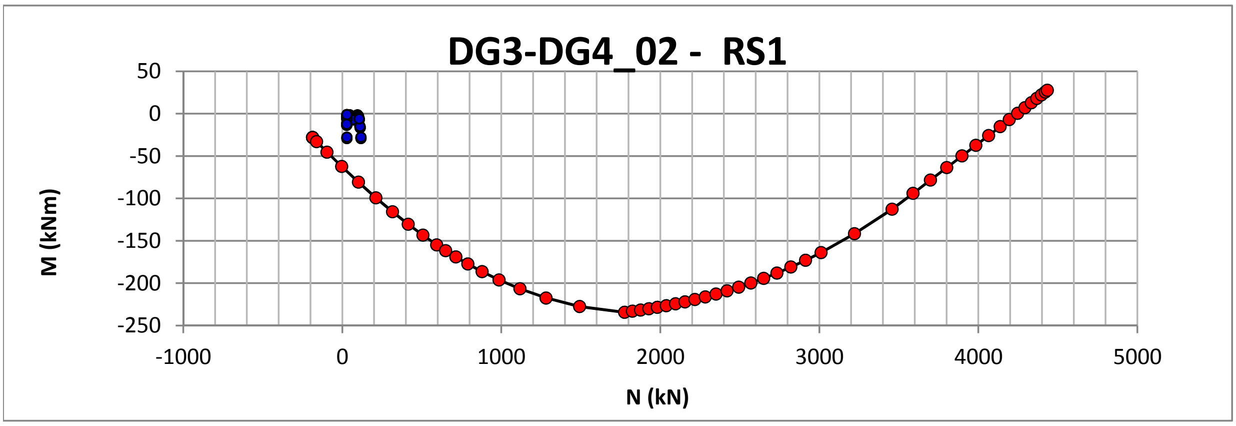
Passed	x
Failed	

No Water Considered
No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	14.6	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	0.0	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





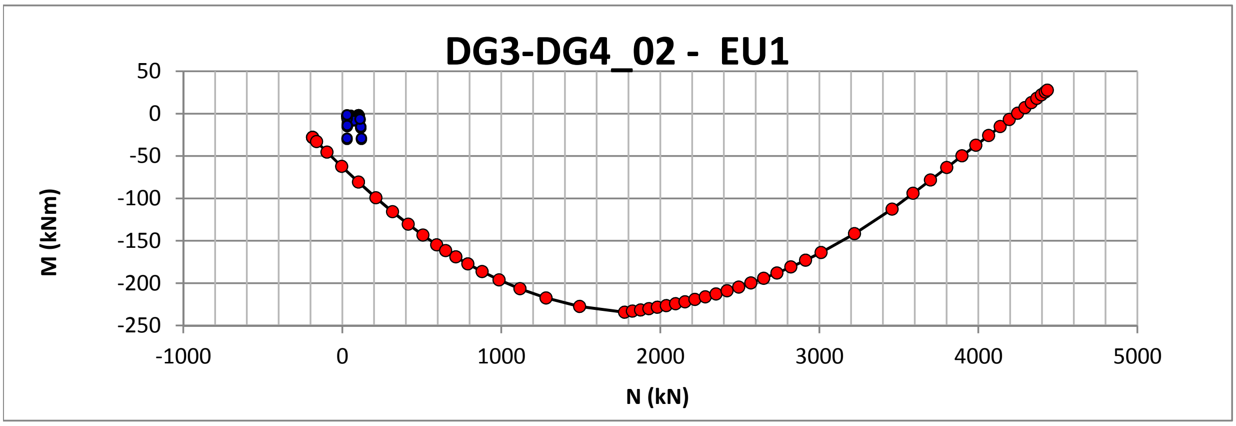


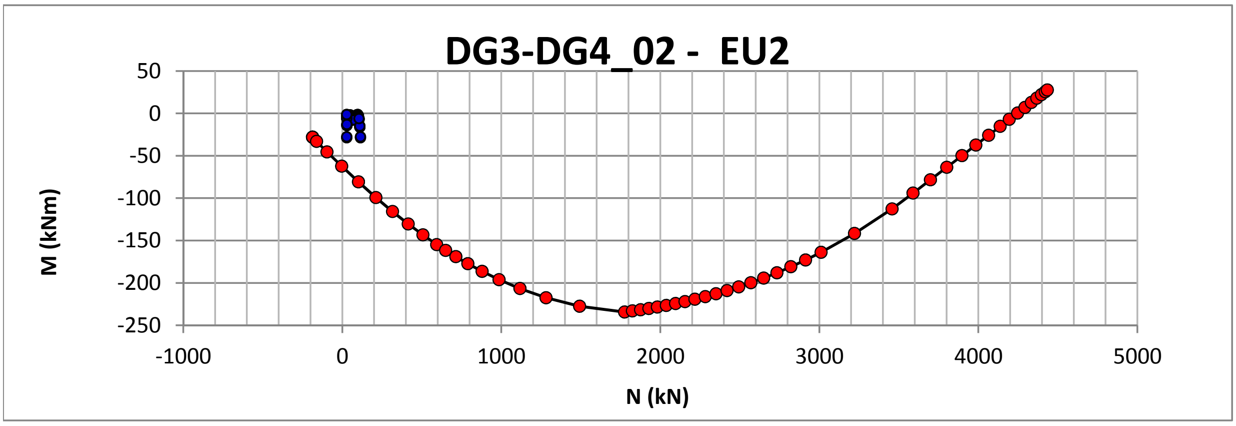
DG3-DG4_02

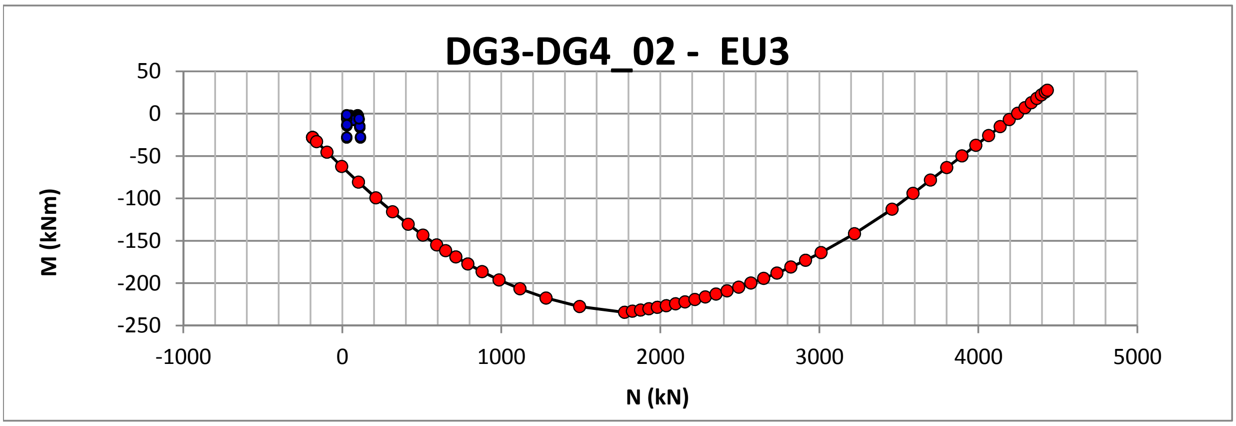
Passed	x
Failed	

No Water Considered
No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	14.6	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	0.0	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







DG3-DG4_02

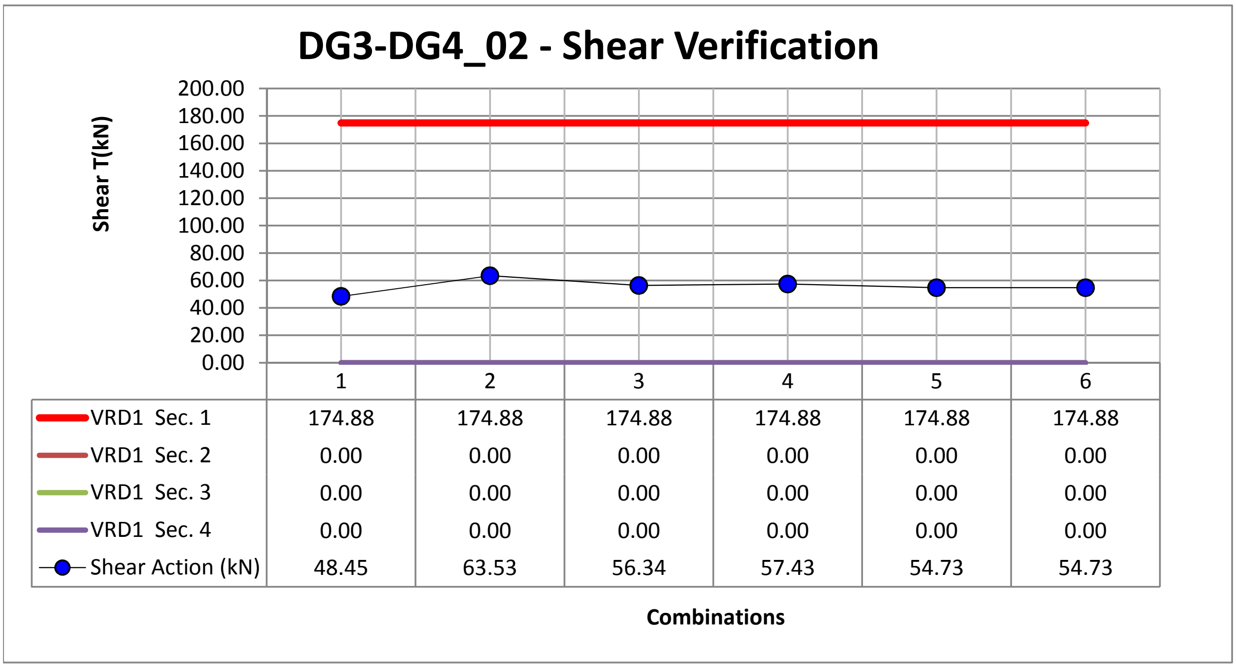
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	5.00			
		m^2/m	0.00050			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.1749	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	174.88	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	174.88	174.88	174.88	174.88	174.88	174.88		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**48.45**	**63.53**	**56.34**	**57.43**	**54.73**	**54.73**		
							Group 1	Group 2
Passed	x	x	x	x	x	x	x	x
Failed								

DG3-DG4_02 - Shear Verification



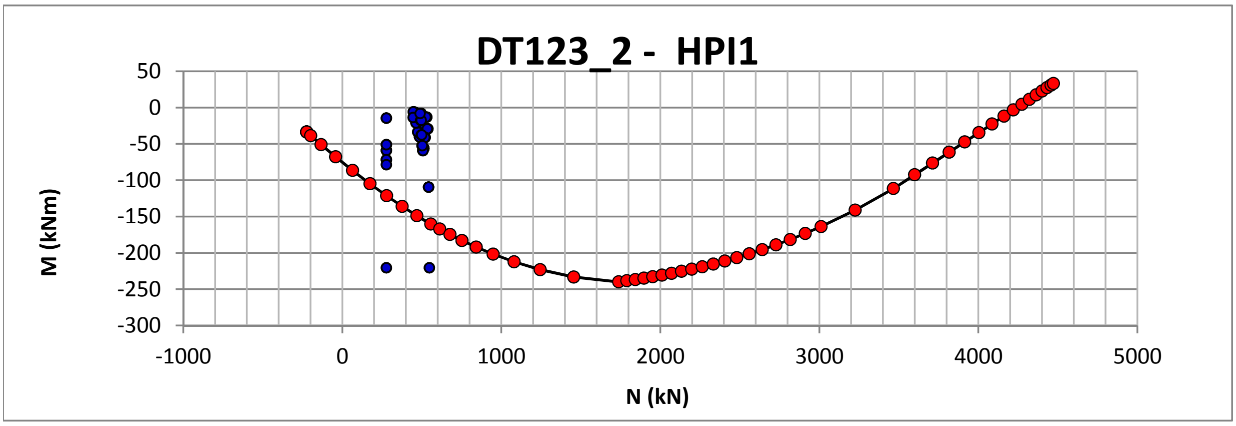
	1	2	3	4	5	6
VRD1 Sec. 1	174.88	174.88	174.88	174.88	174.88	174.88
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	48.45	63.53	56.34	57.43	54.73	54.73

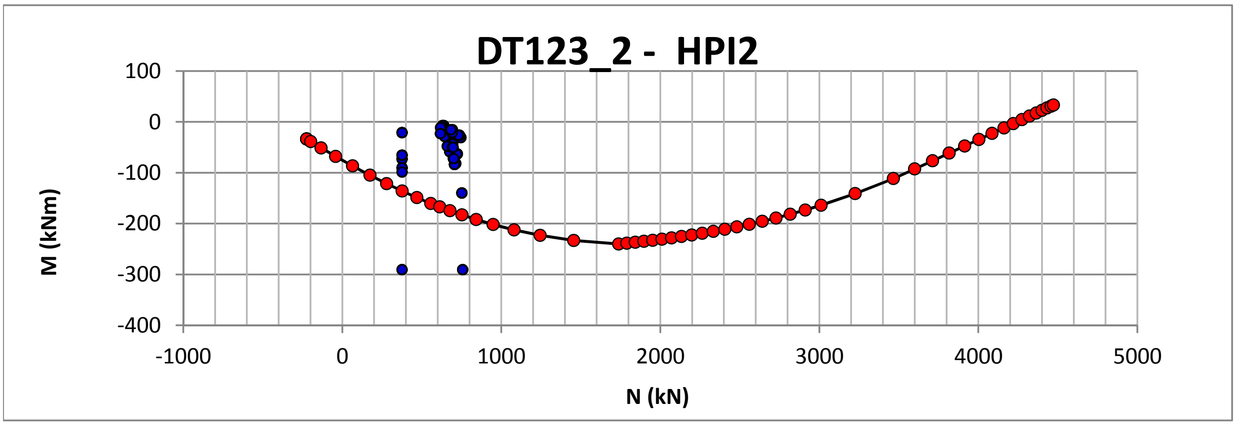
DT123_2

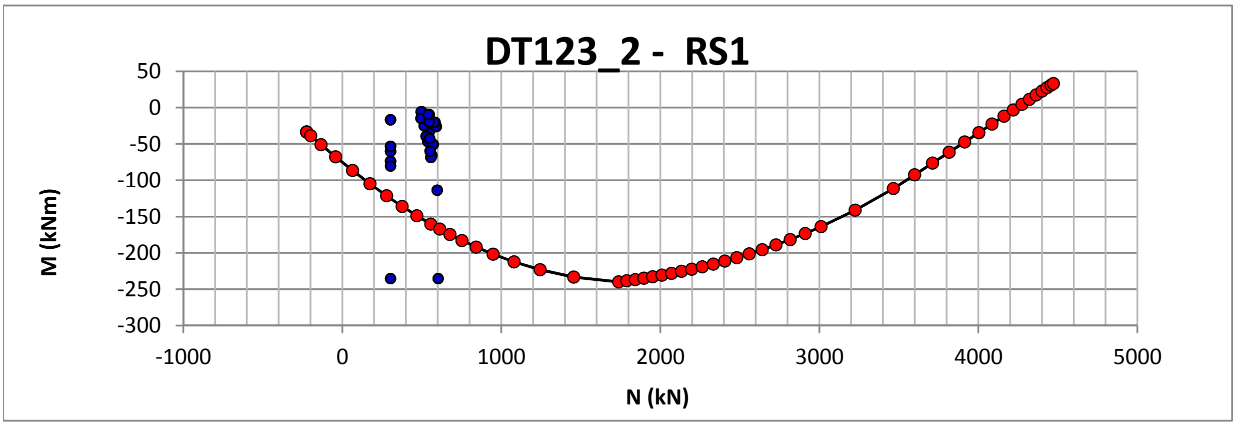
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	86.3	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	57.6	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50





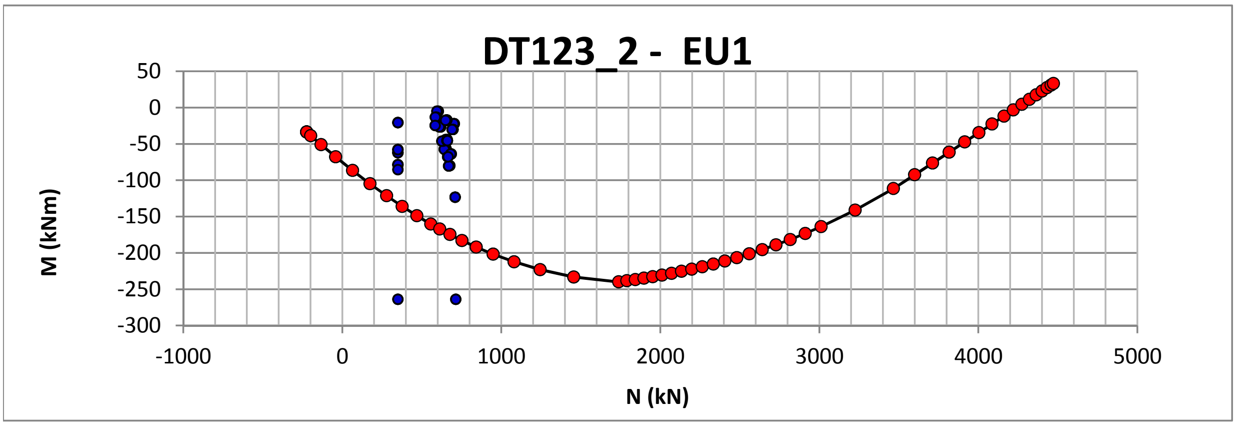


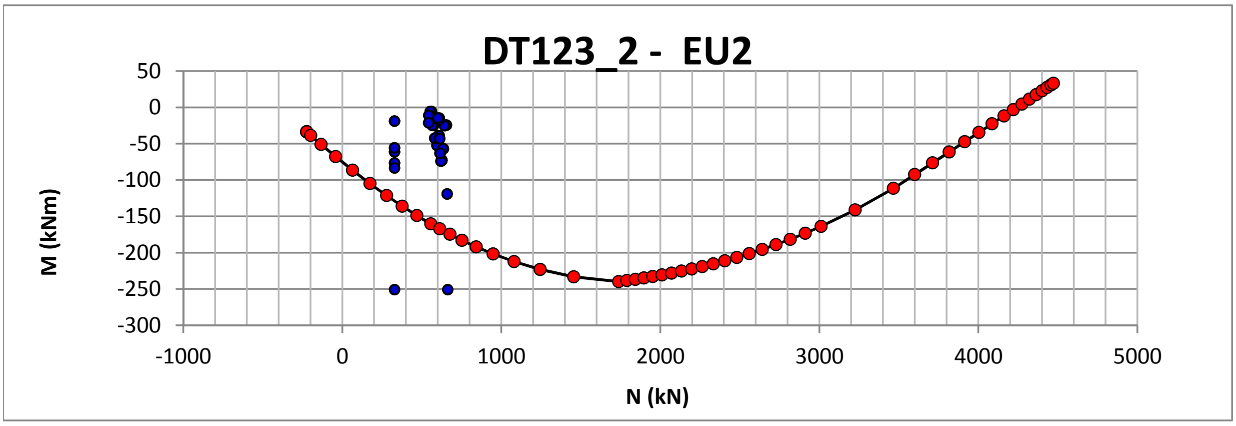
DT123_2

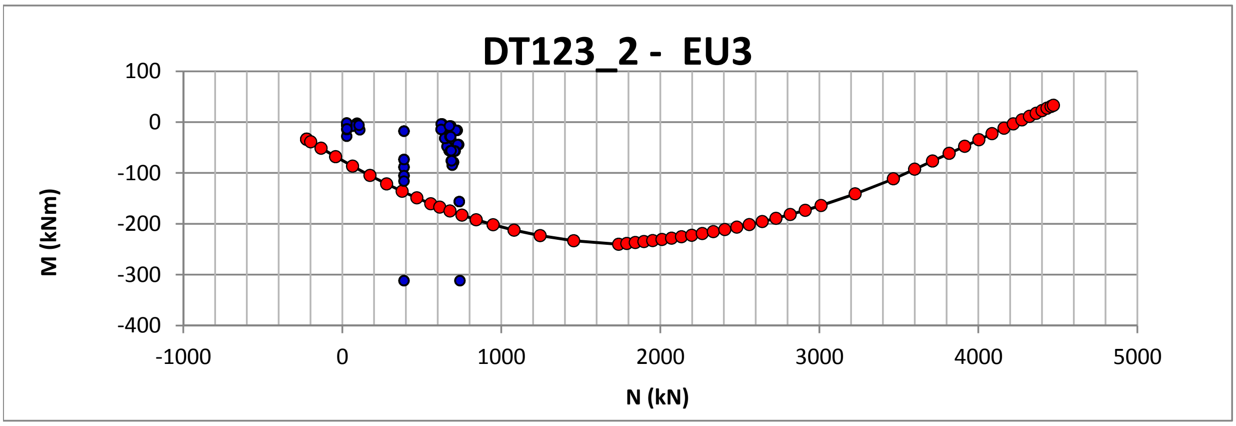
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	86.3	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	57.6	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







DT123_2

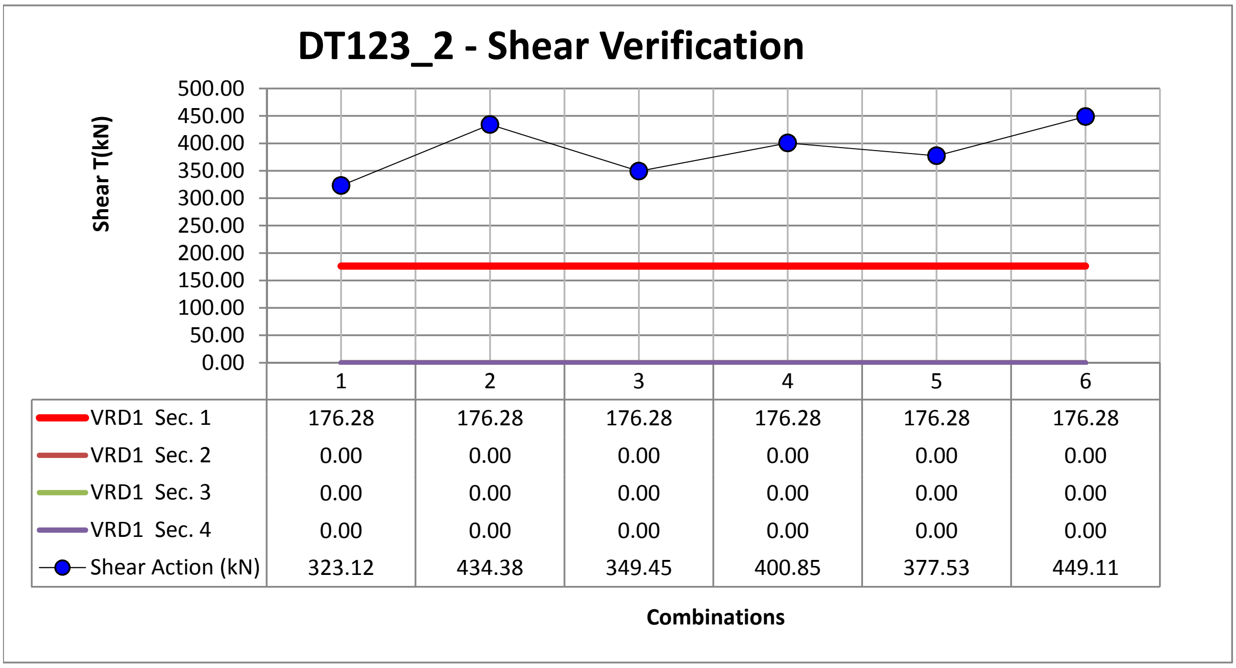
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	6.00			
		m^2/m	0.00060			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.1763	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	176.28	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	176.28	176.28	176.28	176.28	176.28	176.28		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**323.12**	**434.38**	**349.45**	**400.85**	**377.53**	**449.11**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

DT123_2 - Shear Verification



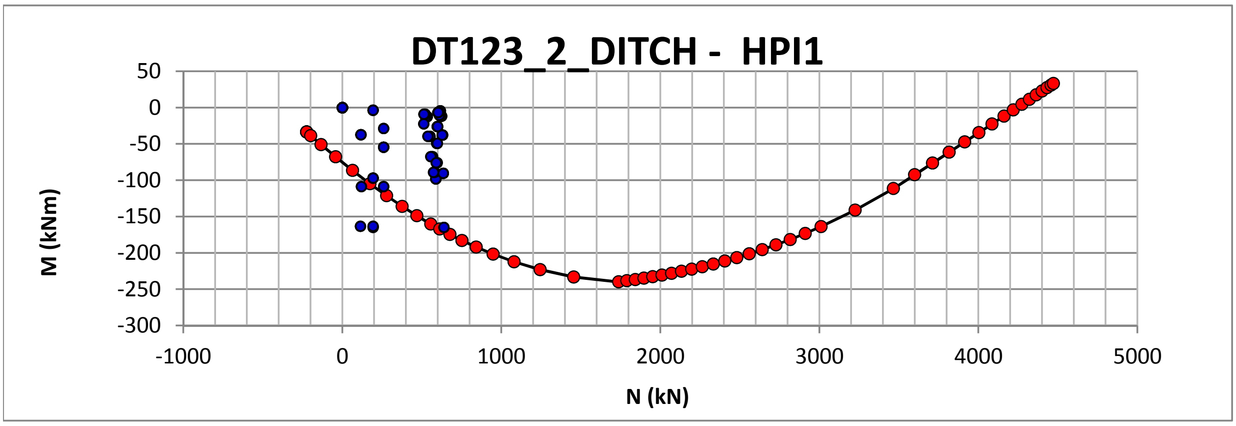
	1	2	3	4	5	6
VRD1 Sec. 1	176.28	176.28	176.28	176.28	176.28	176.28
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	323.12	434.38	349.45	400.85	377.53	449.11

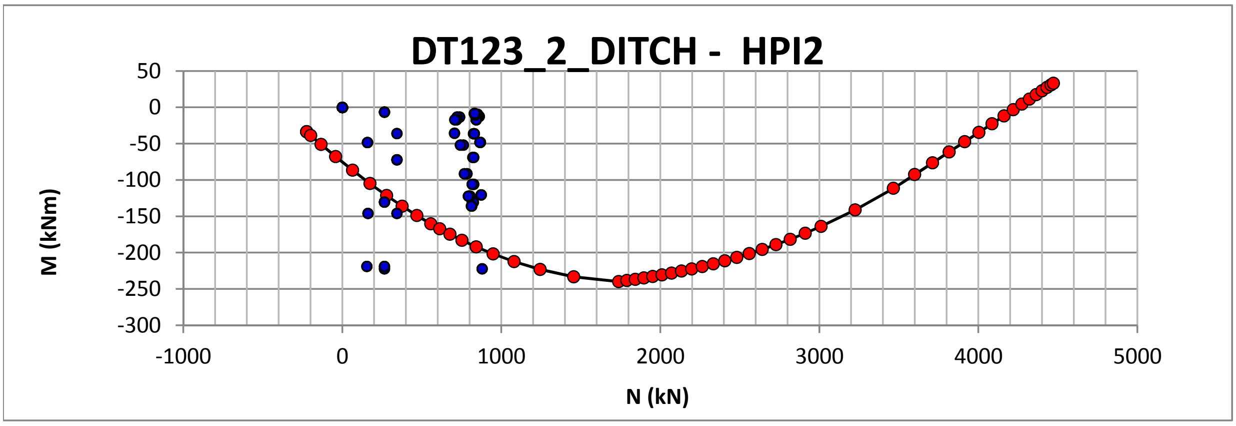
DT123_2_DITCH

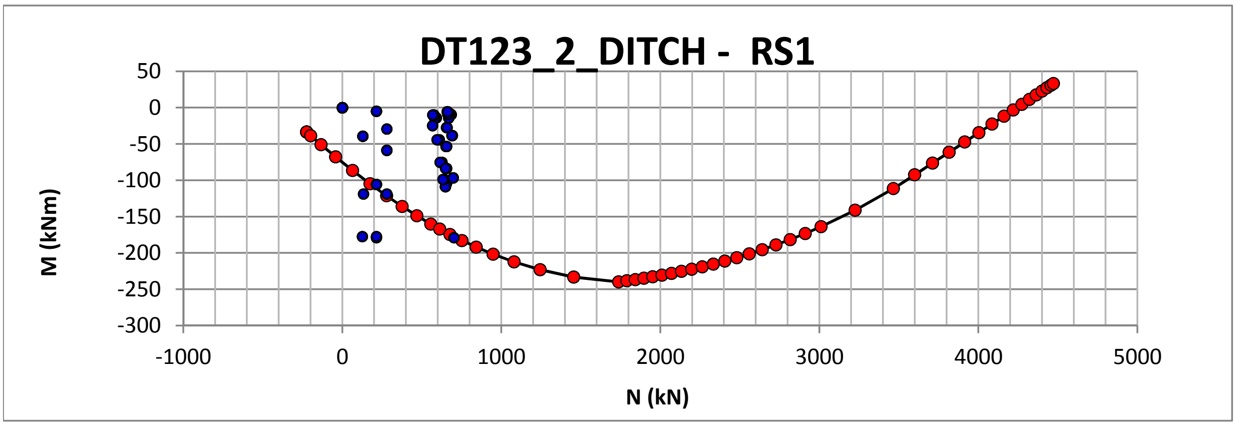
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	86.3	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	57.6	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50





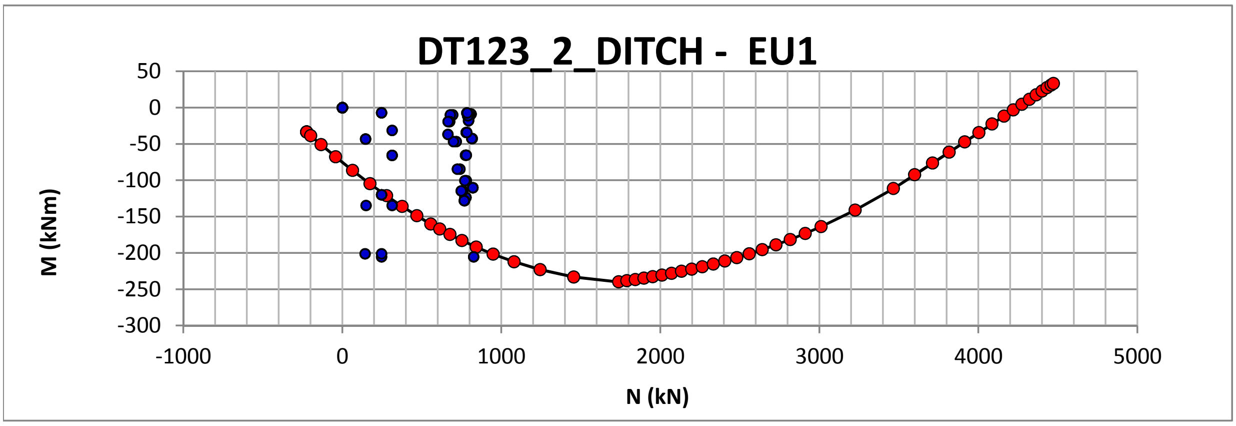


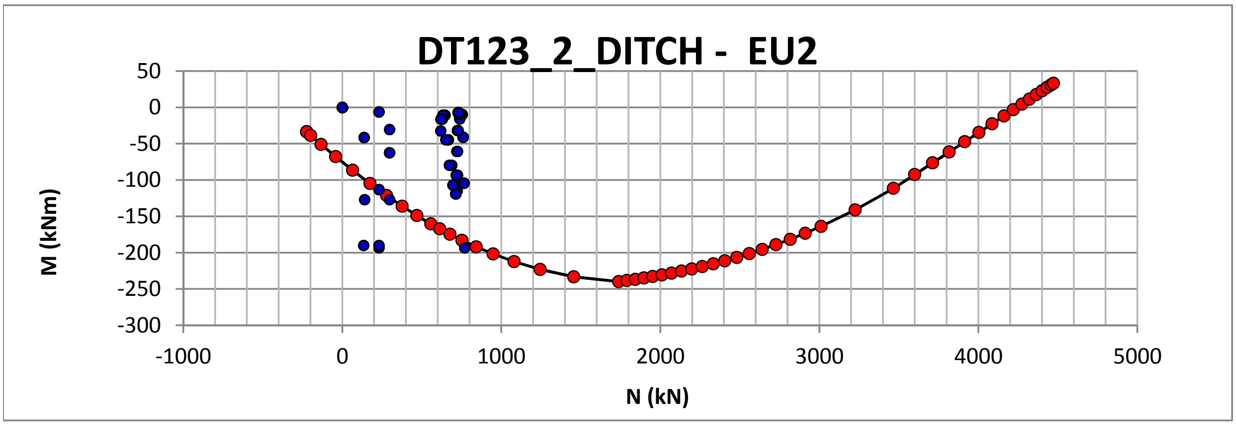
DT123_2_DITCH

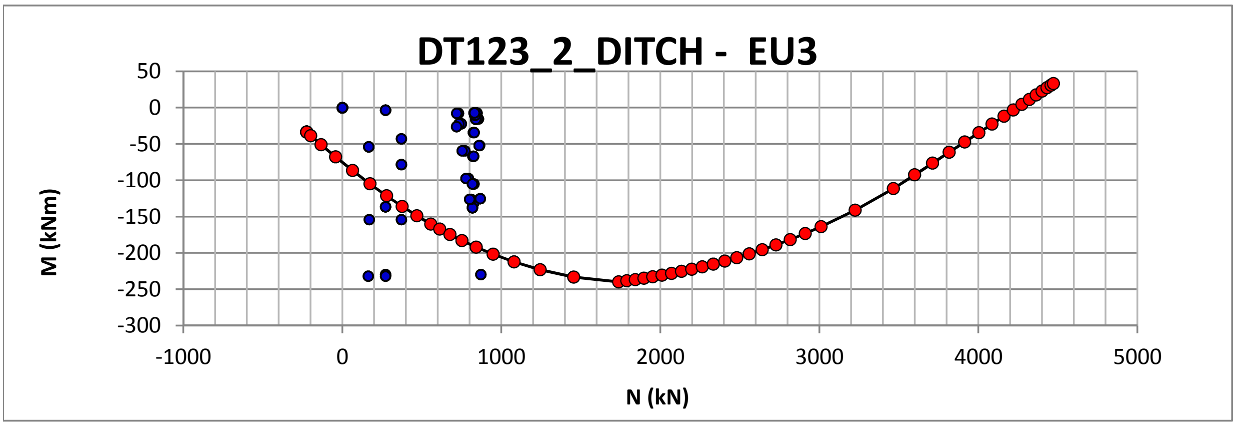
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	86.3	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	57.6	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







DT123_2_DITCH

Shear Verification

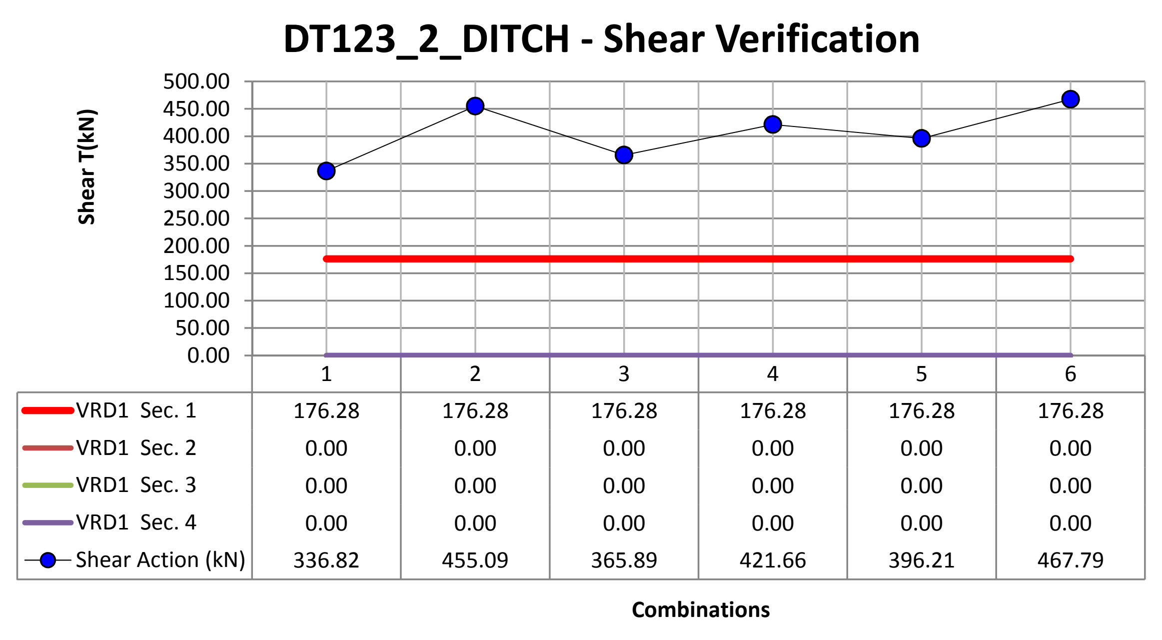
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	6.00			
		m^2/m	0.00060			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.1763	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	176.28	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	176.28	176.28	176.28	176.28	176.28	176.28
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**336.82**	**455.09**	**365.89**	**421.66**	**396.21**	**467.79**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

DT123_2_DITCH - Shear Verification

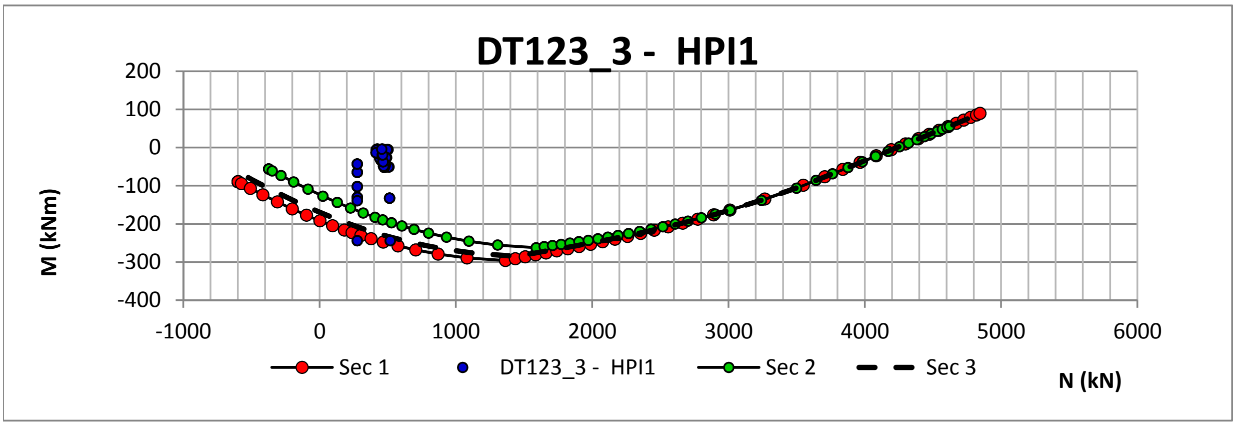


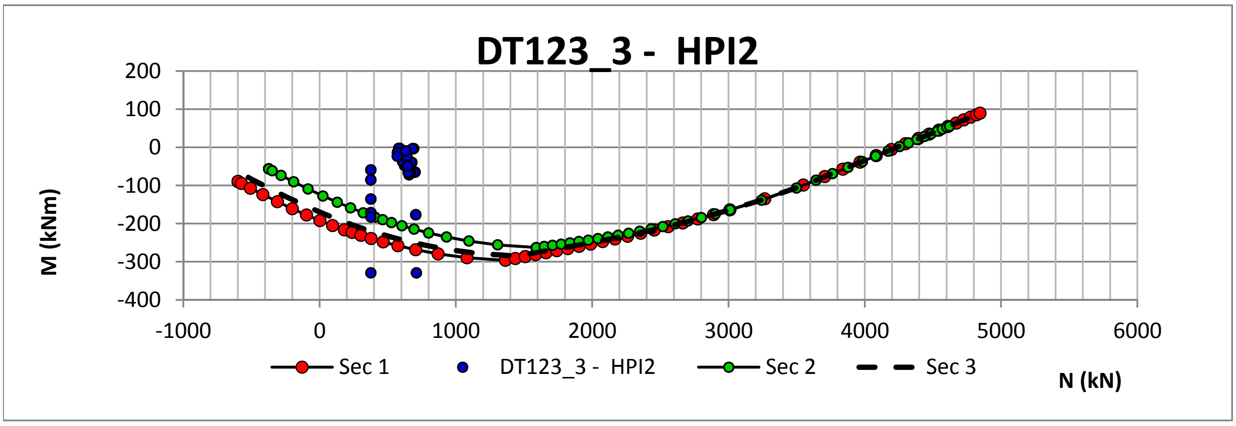
DT123_3

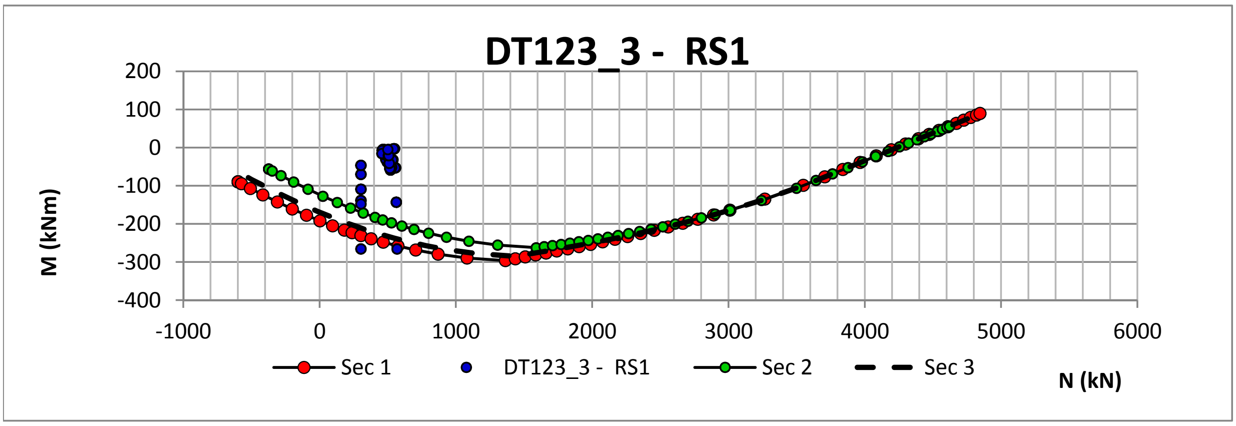
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	78.5	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	50.5	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50





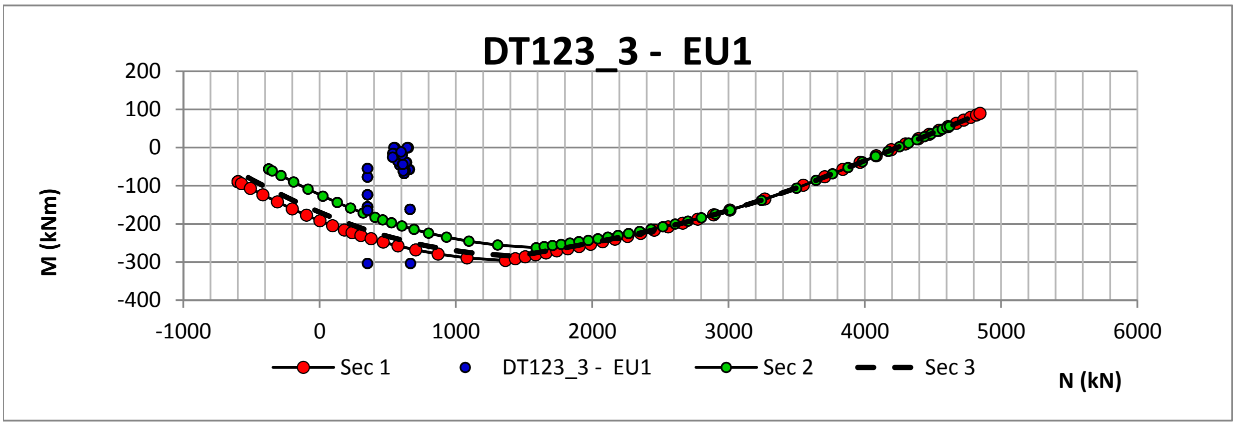


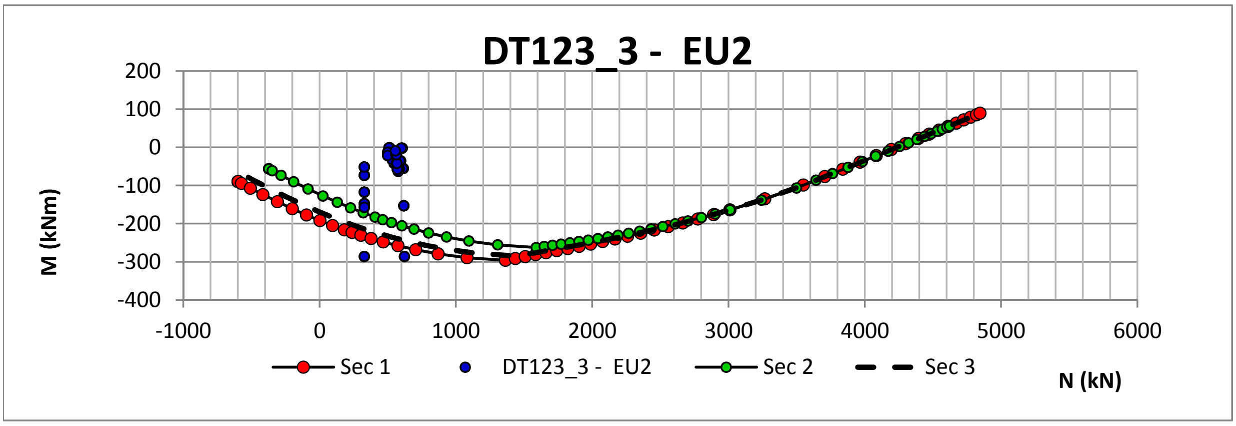
DT123_3

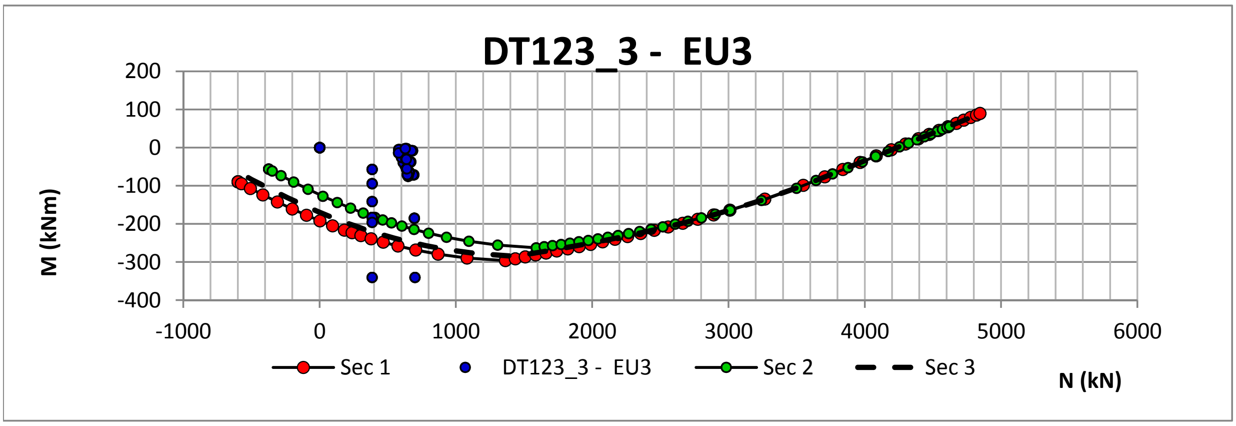
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	78.5	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	50.5	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







DT123_3

Shear Verification

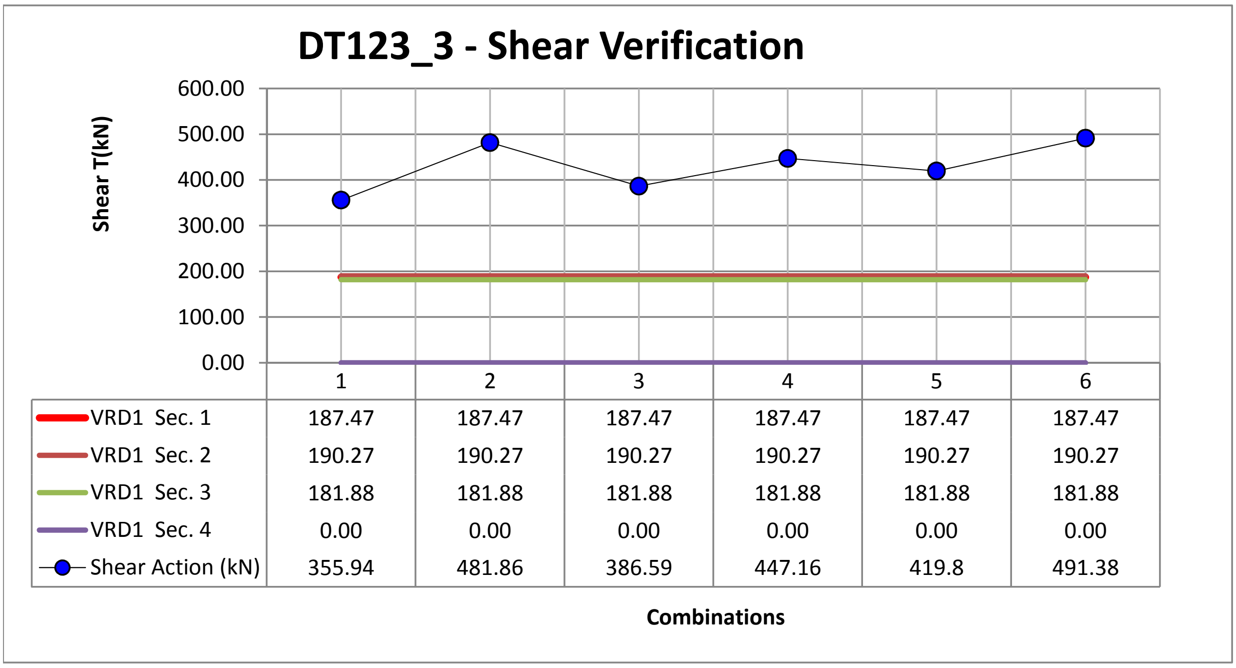
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00	37.00	
Section Width	b_w=	m	1.00	1.00	1.00	
Section height	d=	m	0.40	0.40	0.40	
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10	2.10	
Valore di k	k=		1.00	1.00	1.00	
Long. Tensile Reinforcement	Asl=	cm^2/m	14.00	16.00	10.00	
		m^2/m	0.00140	0.00160	0.00100	
Concrete coefficient	γ_c=		1.50	1.50	1.50	
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35	0.35	
Reinforcement ratio	ρ=	(< 0.02)	0.0035	0.0040	0.0025	

Shear Bearing Capability	V_{RD1}	MN	0.1875	0.1903	0.1819	0.0000
Shear Bearing Capability	V_{RD1}	kN	187.47	190.27	181.88	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	187.47	187.47	187.47	187.47	187.47	187.47
VRD1 Sec. 2	190.27	190.27	190.27	190.27	190.27	190.27
VRD1 Sec. 3	181.88	181.88	181.88	181.88	181.88	181.88
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**355.94**	**481.86**	**386.59**	**447.16**	**419.8**	**491.38**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

DT123_3 - Shear Verification



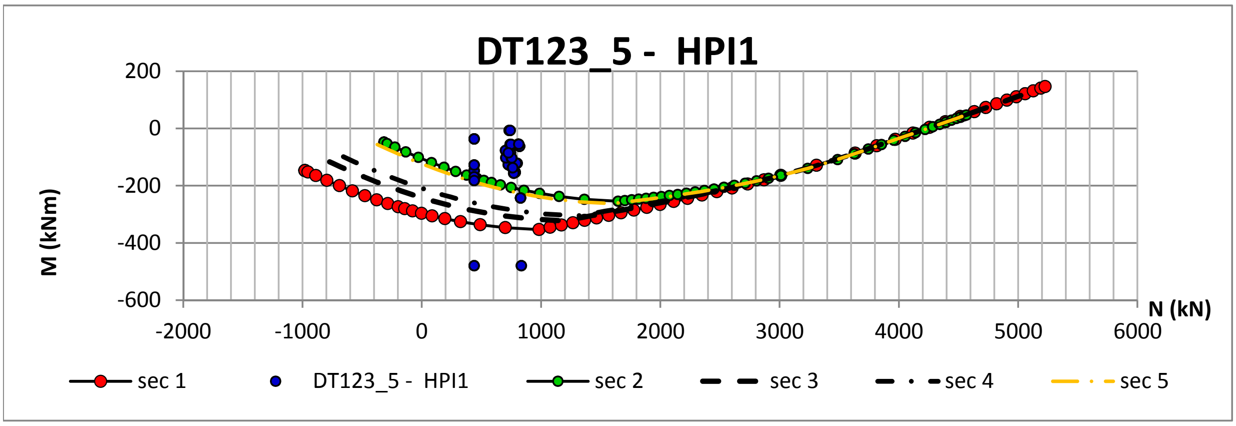
	1	2	3	4	5	6
VRD1 Sec. 1	187.47	187.47	187.47	187.47	187.47	187.47
VRD1 Sec. 2	190.27	190.27	190.27	190.27	190.27	190.27
VRD1 Sec. 3	181.88	181.88	181.88	181.88	181.88	181.88
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	355.94	481.86	386.59	447.16	419.8	491.38

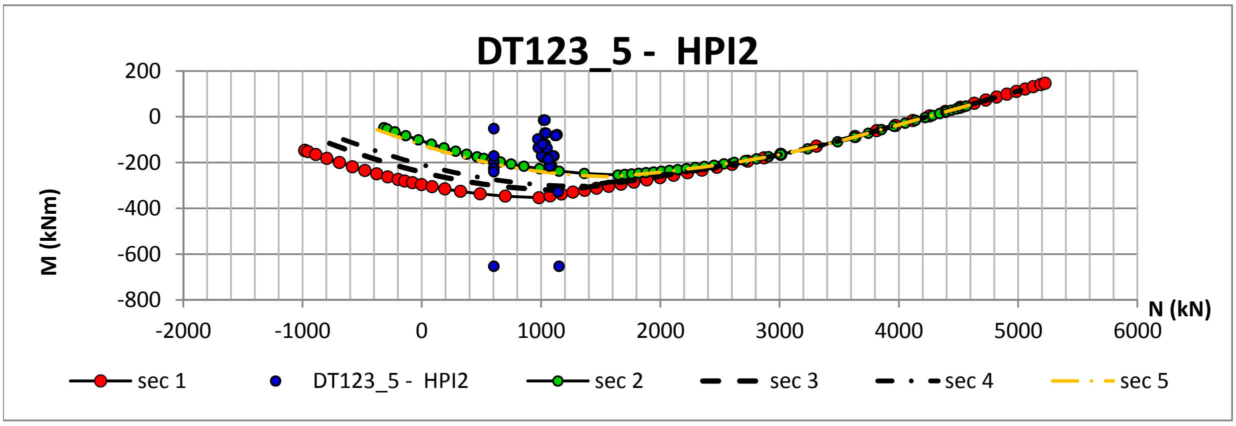
DT123_5

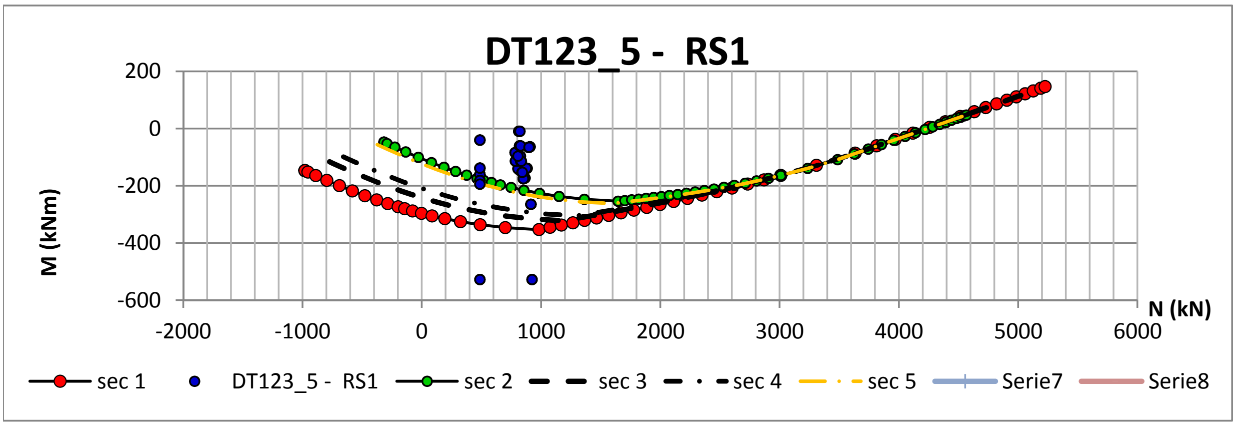
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	95.7	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	64.5	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50





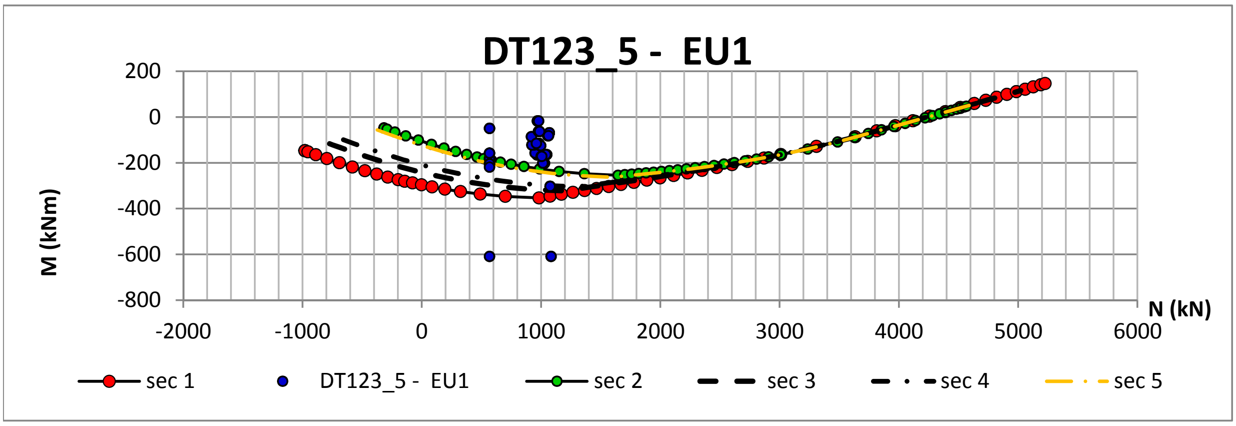


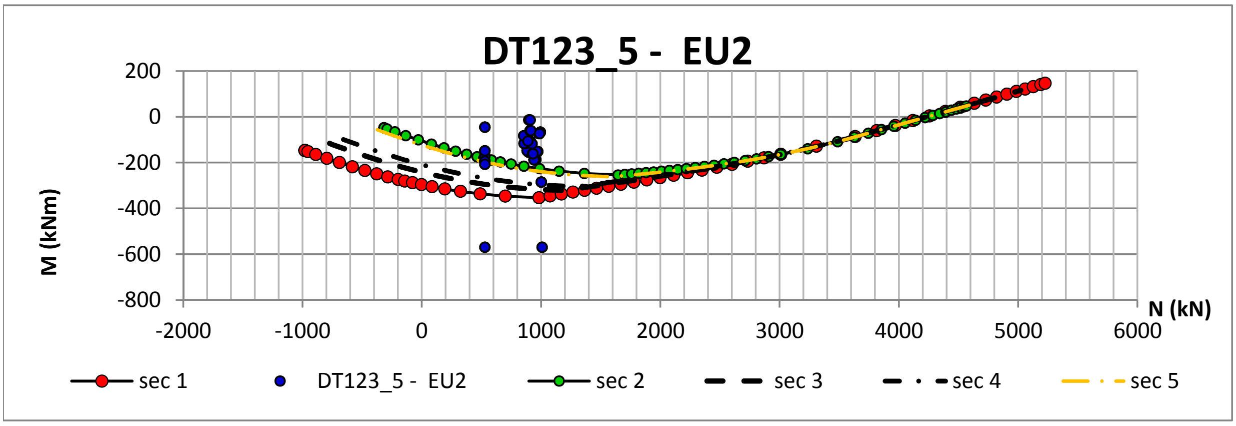
DT123_5

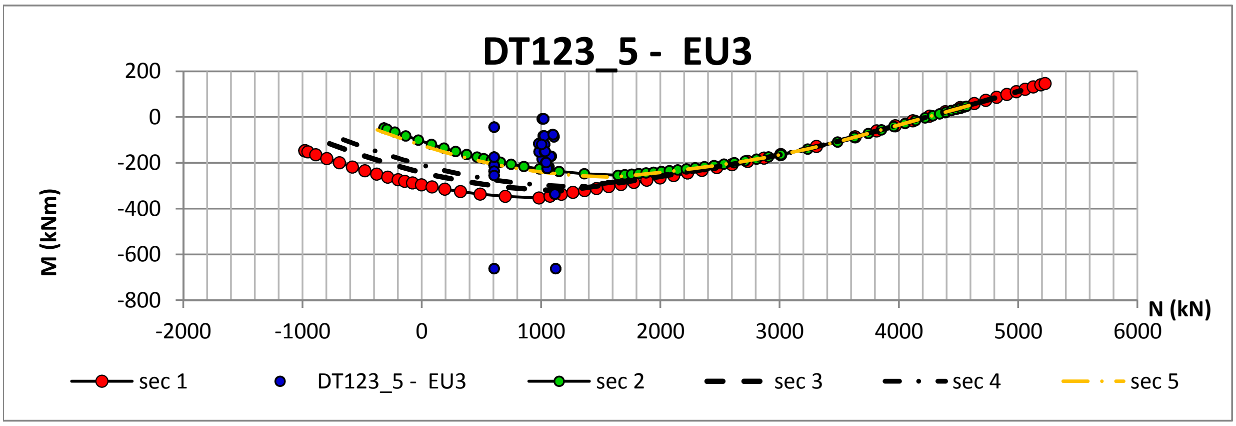
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	95.7	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	64.5	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







DT123_5

Shear Verification

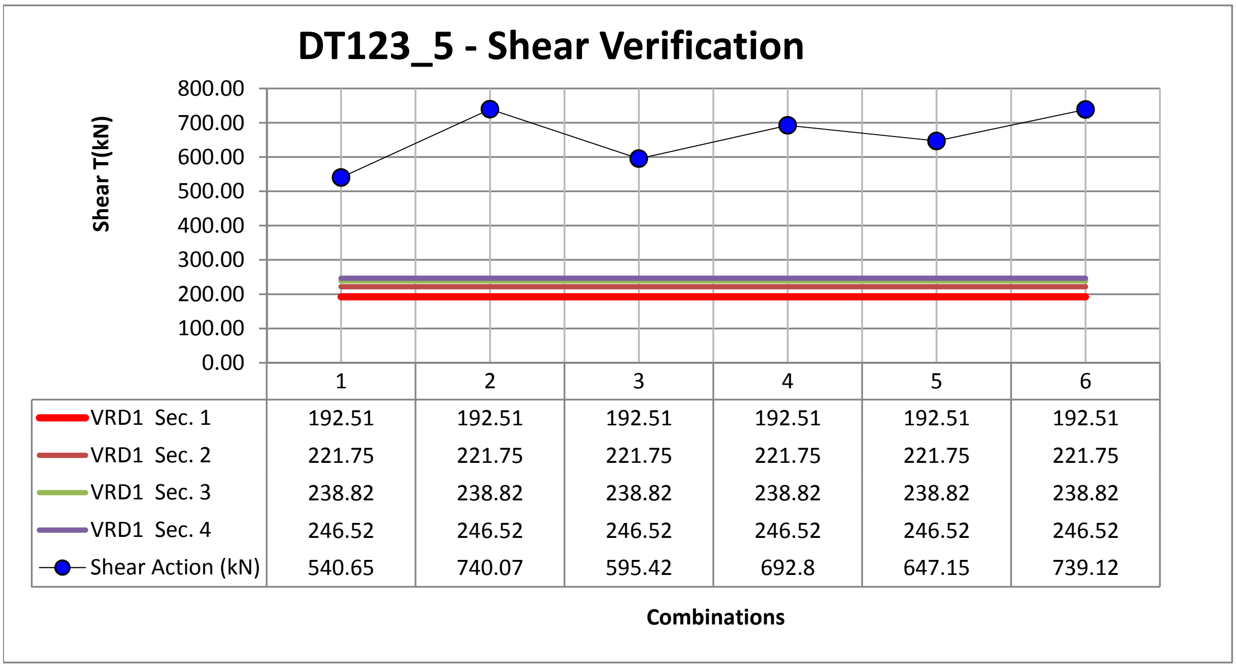
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00	37.00	37.00
Section Width	b_w=	m	1.00	1.00	1.00	1.00
Section height	d=	m	0.40	0.50	0.50	0.50
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10	2.10	2.10
Valore di k	k=		1.00	1.00	1.00	1.00
Long. Tensile Reinforcement	Asl=	cm^2/m	17.60	8.50	20.70	26.20
		m^2/m	0.00176	0.00085	0.00207	0.00262
Concrete coefficient	γ_c=		1.50	1.50	1.50	1.50
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35	0.35	0.35
Reinforcement ratio	ρ=	(< 0.02)	0.00	0.00	0.00	0.01

Shear Bearing Capability	V_{RD1}	MN	0.1925	0.2218	0.2388	0.2465
Shear Bearing Capability	V_{RD1}	kN	192.51	221.75	238.82	246.52

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	192.51	192.51	192.51	192.51	192.51	192.51
VRD1 Sec. 2	221.75	221.75	221.75	221.75	221.75	221.75
VRD1 Sec. 3	238.82	238.82	238.82	238.82	238.82	238.82
VRD1 Sec. 4	246.52	246.52	246.52	246.52	246.52	246.52
Shear Action (kN)	**540.65**	**740.07**	**595.42**	**692.8**	**647.15**	**739.12**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

DT123_5 - Shear Verification

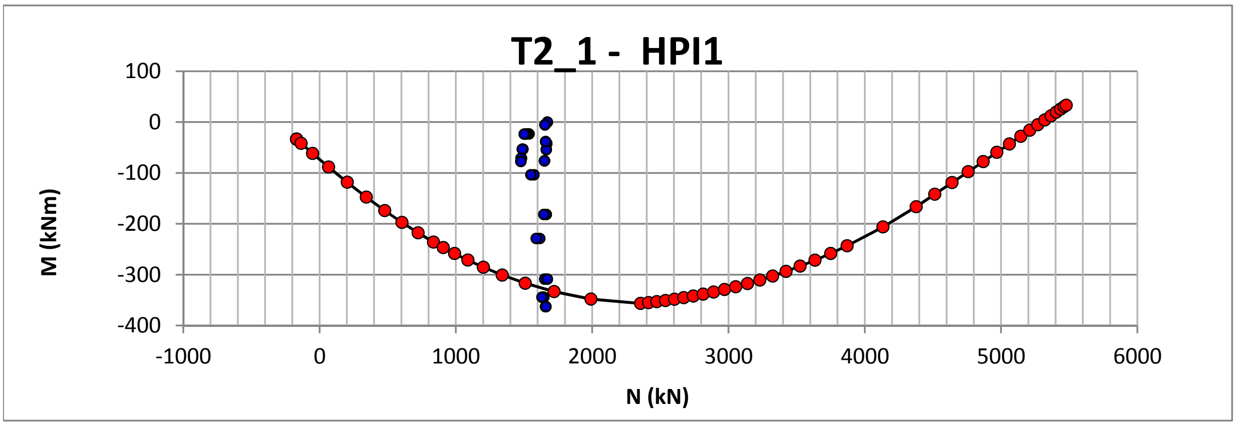


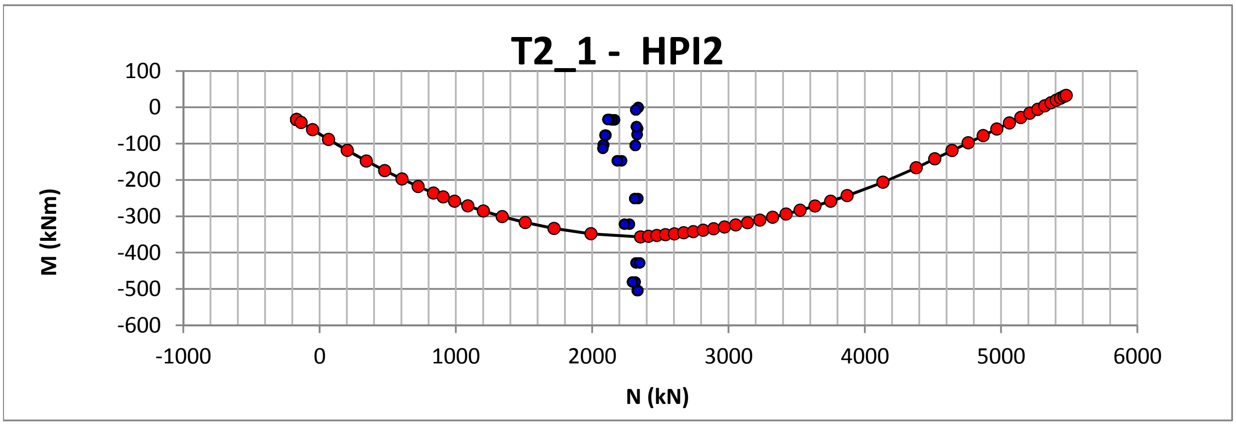
T2_1

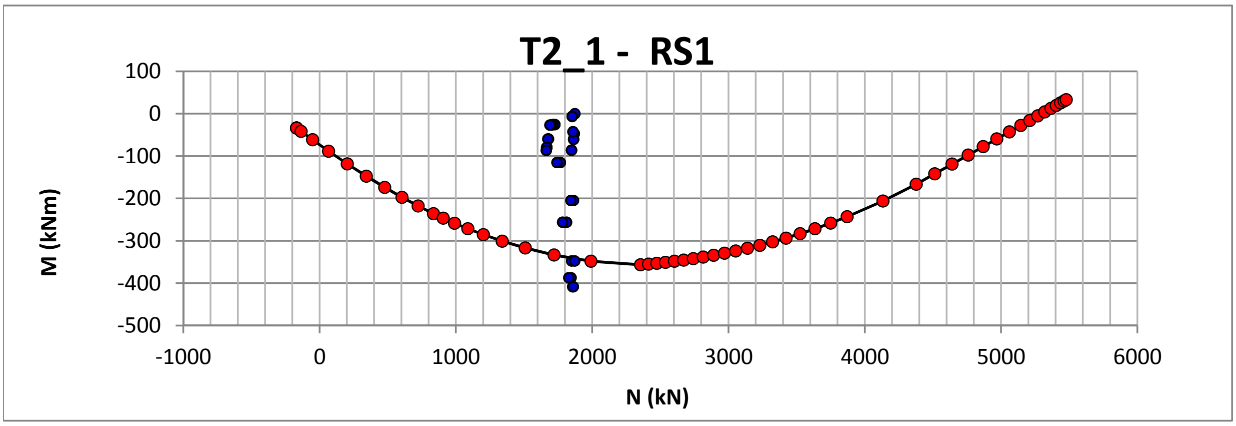
Passed	x
Failed	

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	84.5	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	55.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50





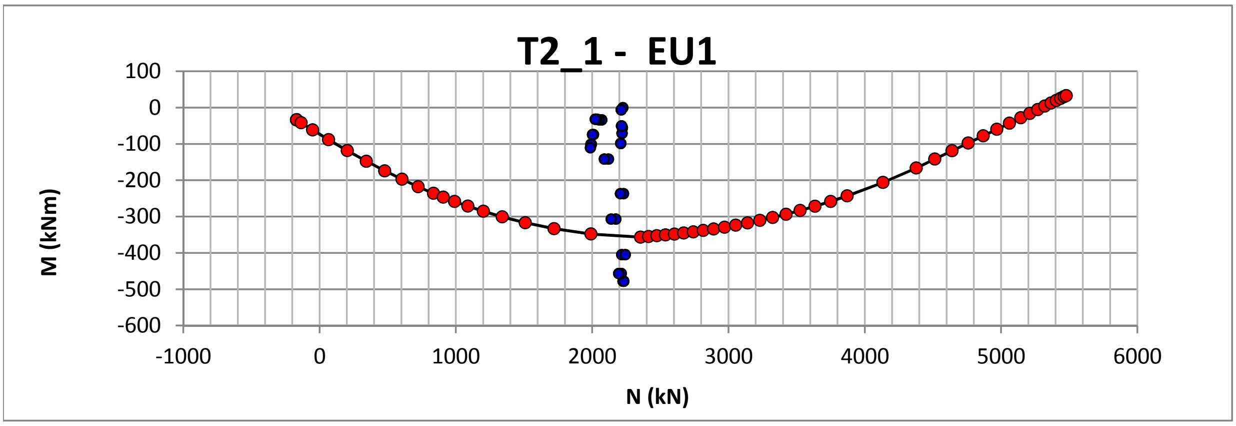


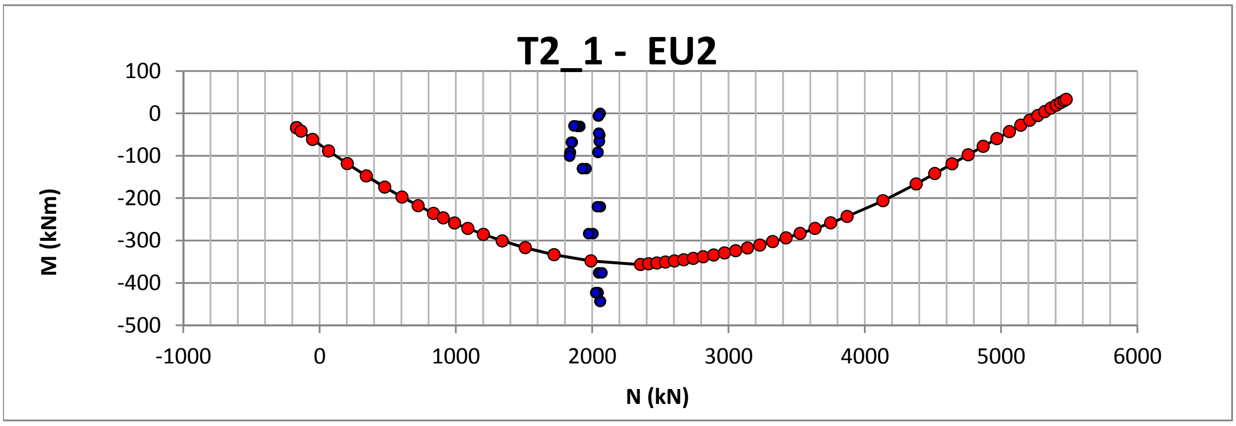
T2_1

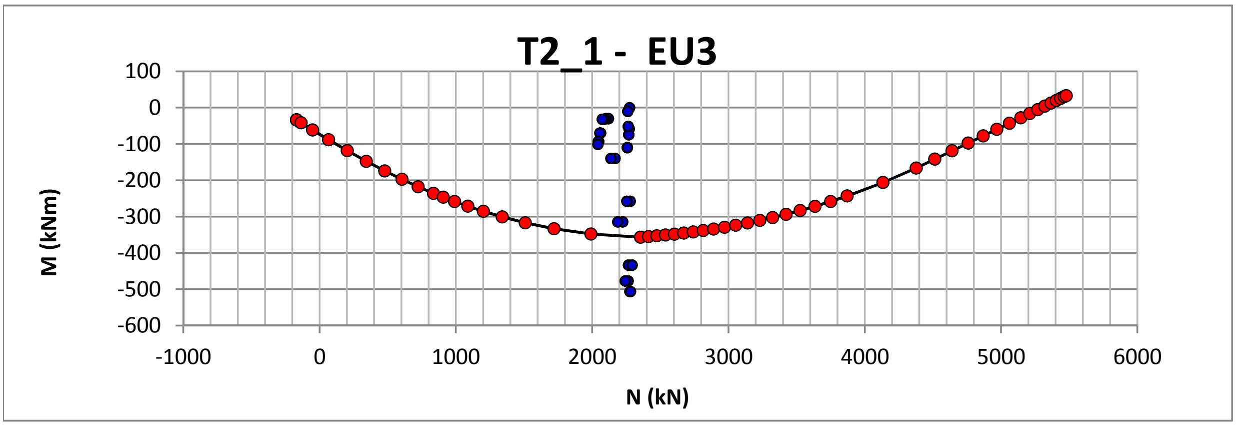
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	84.5	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	55.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50







T2_1

Shear Verification

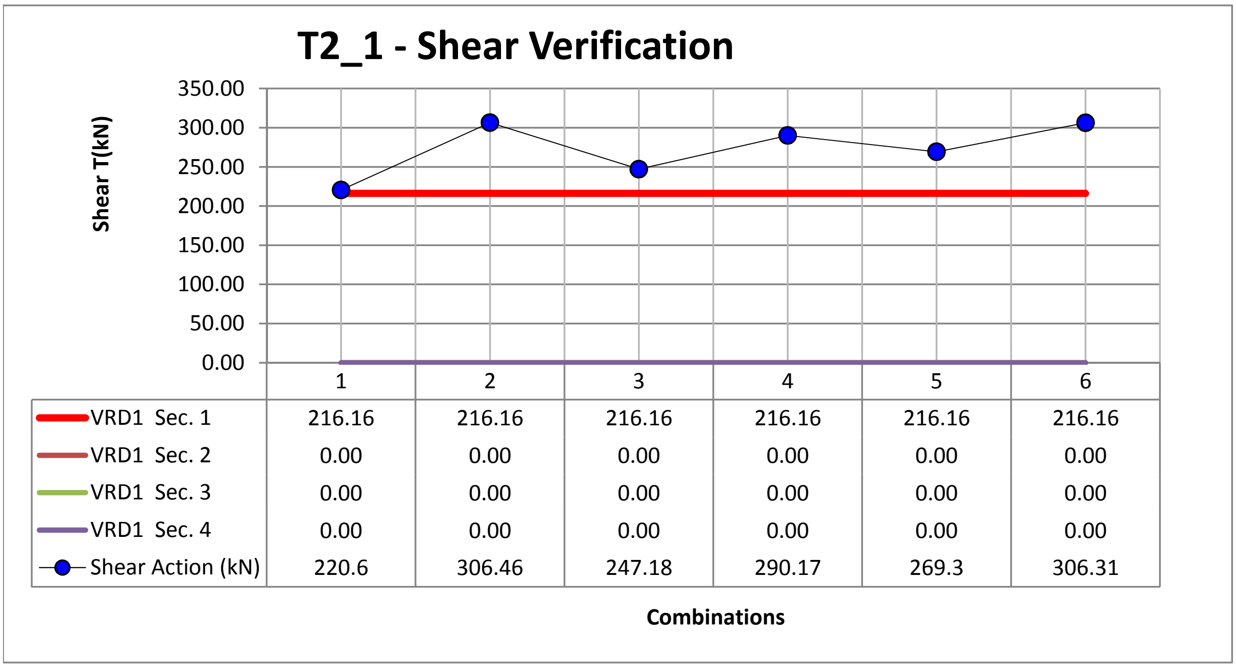
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.50			
Tensile caracteristic strength	$fc_{tk\,0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	4.50			
		m^2/m	0.00045			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00090			

Shear Bearing Capability	V_{RD1}	MN	0.2162	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	216.16	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	216.16	216.16	216.16	216.16	216.16	216.16
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**220.6**	**306.46**	**247.18**	**290.17**	**269.3**	**306.31**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

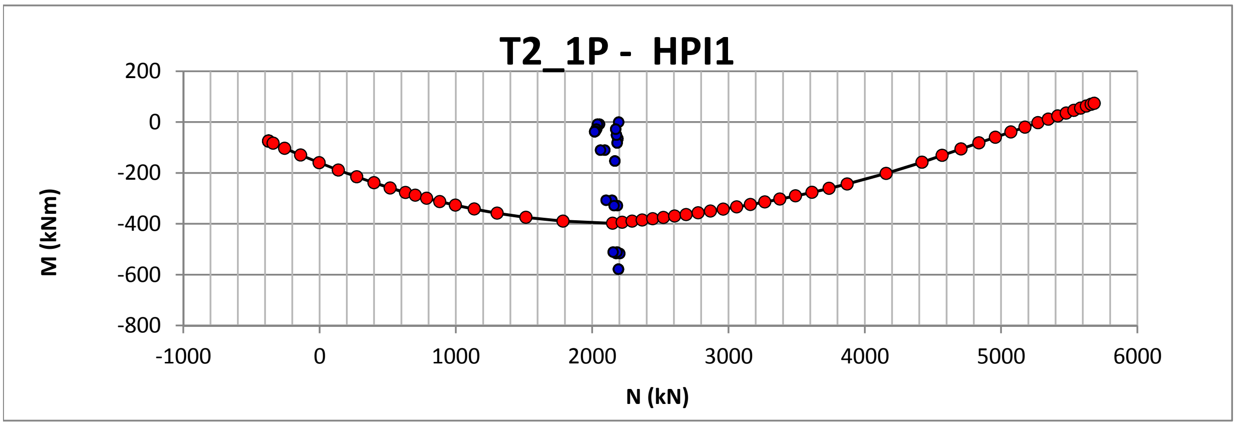
T2_1 - Shear Verification

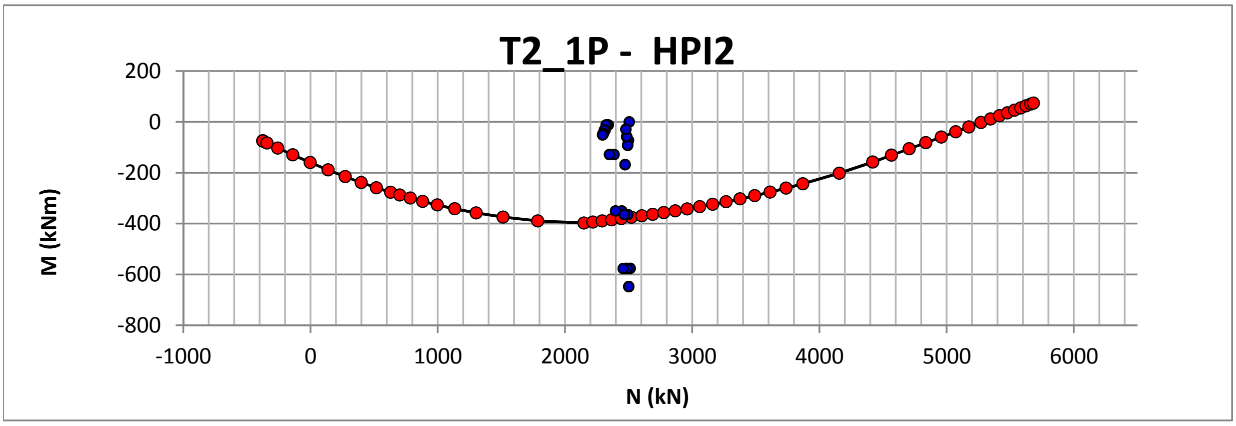


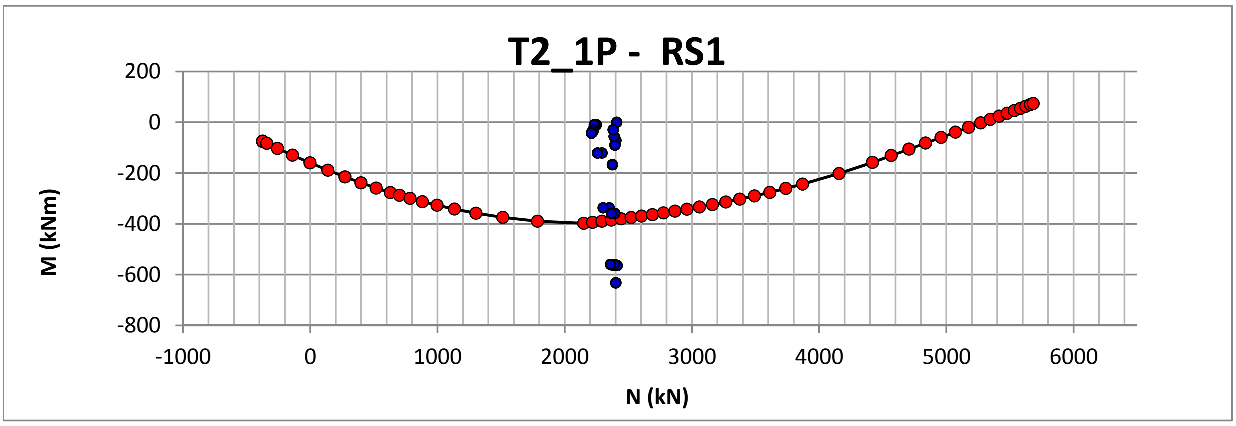
T2_1P

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	27.8	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	21.1	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50



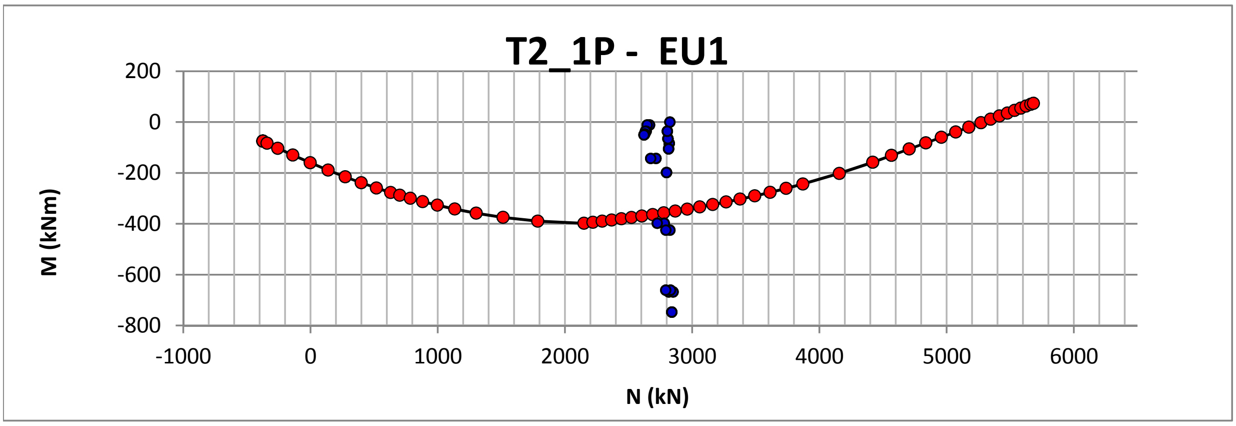


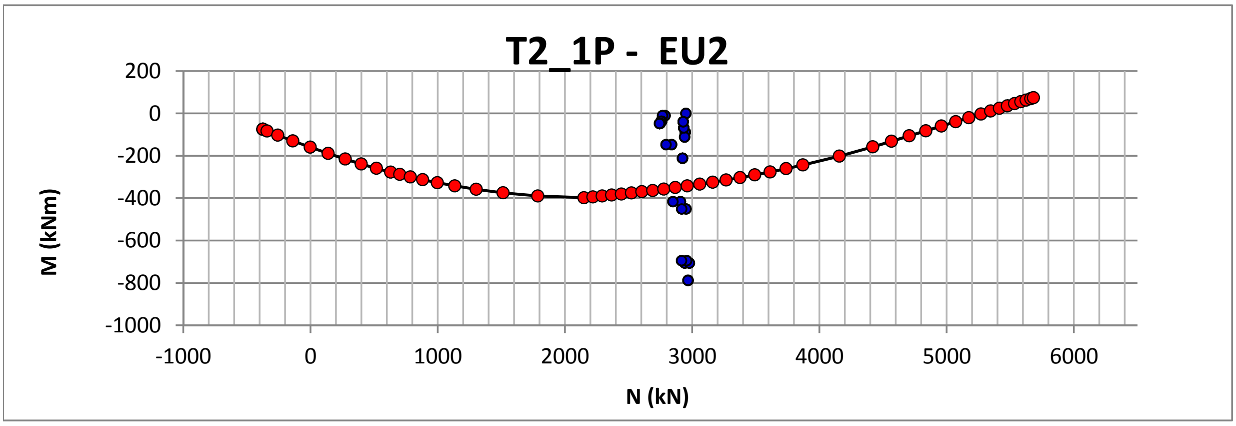


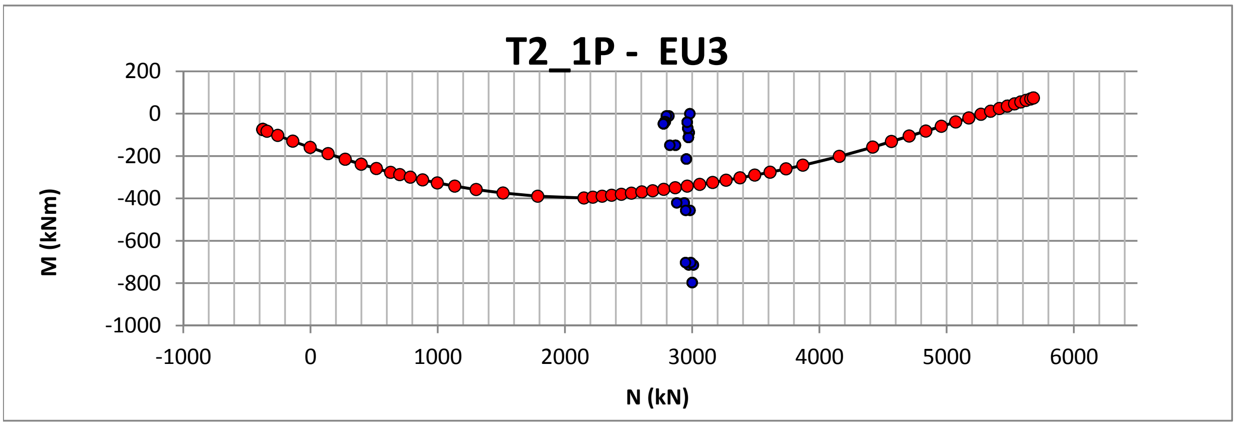
T2_1P

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	27.8	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	21.1	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50







T2_1P

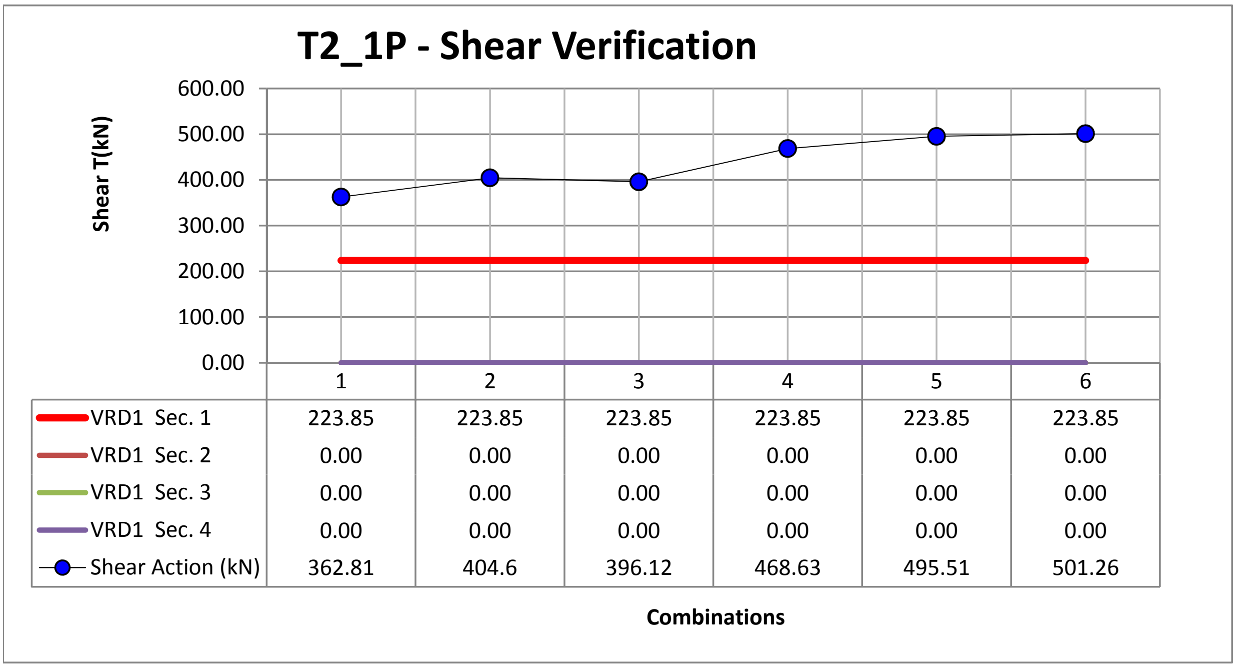
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.50			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	10.00			
		m^2/m	0.00100			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.2239	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	223.85	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3	Group 1	Group 2
VRD1 Sec. 1	223.85	223.85	223.85	223.85	223.85	223.85		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**362.81**	**404.6**	**396.12**	**468.63**	**495.51**	**501.26**		
Passed								
Failed	x	x	x	x	x	x	x	x

T2_1P - Shear Verification

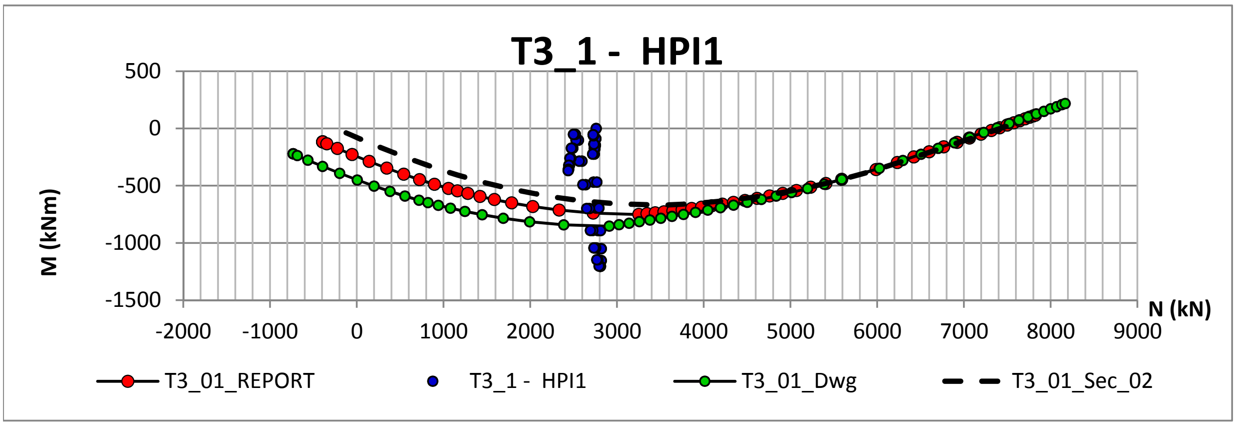


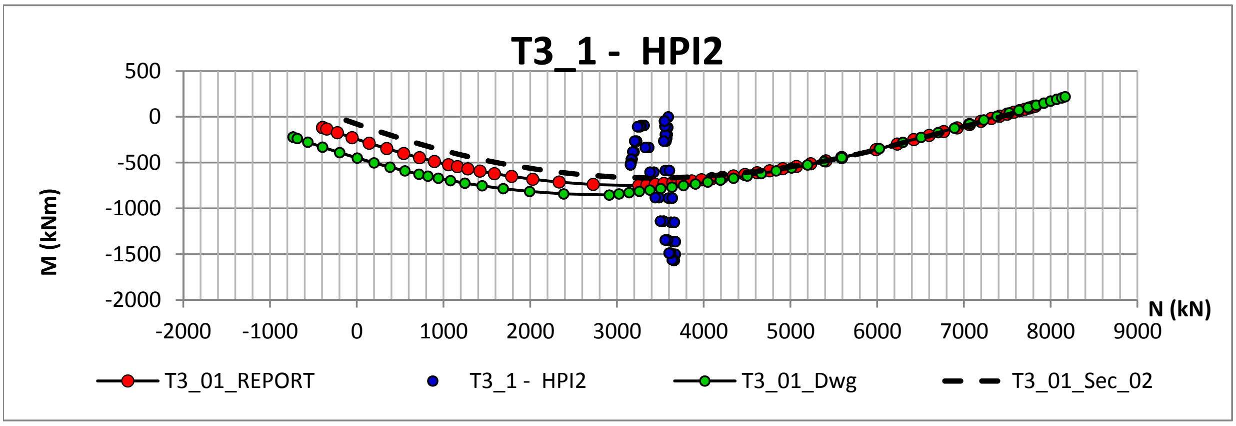
T3_1

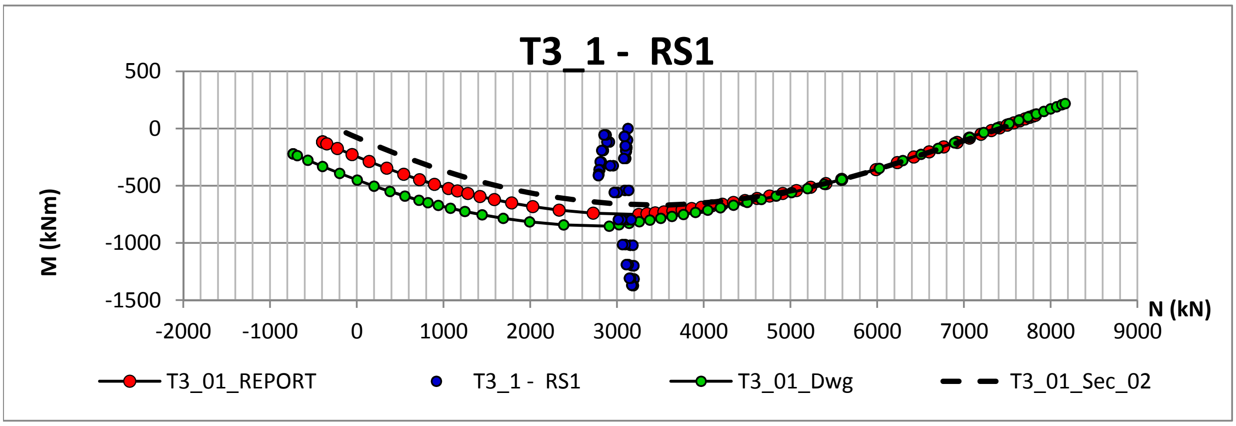
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	121.9	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	84.2	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





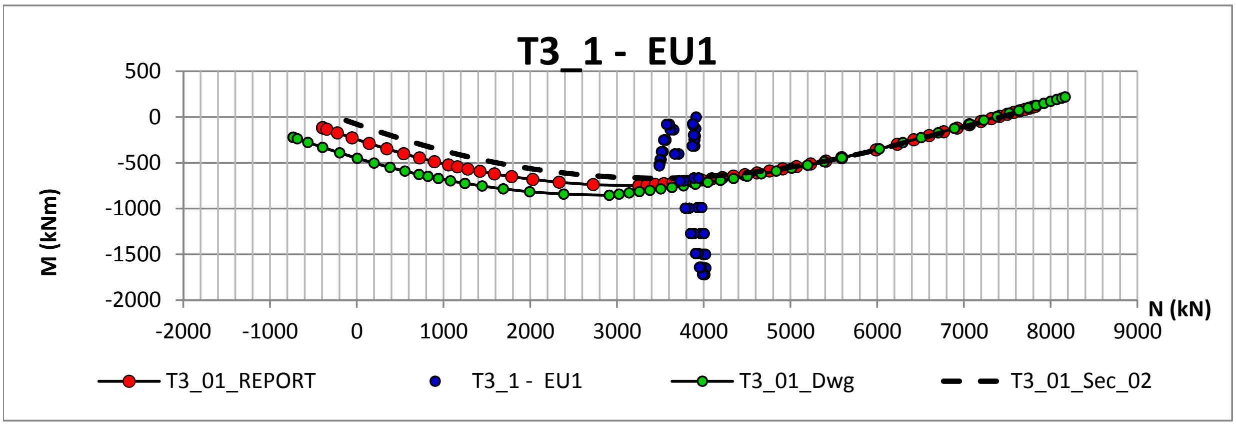


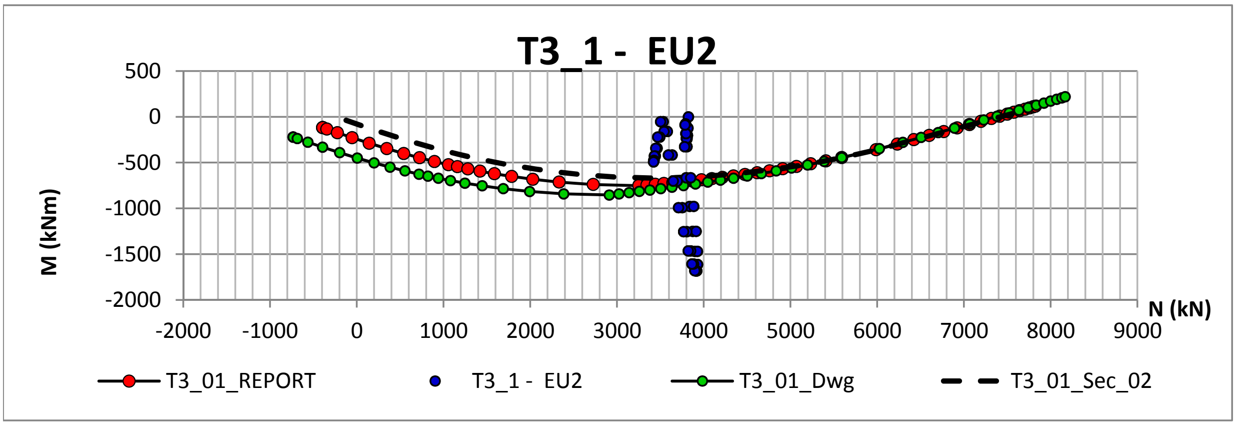
T3_1

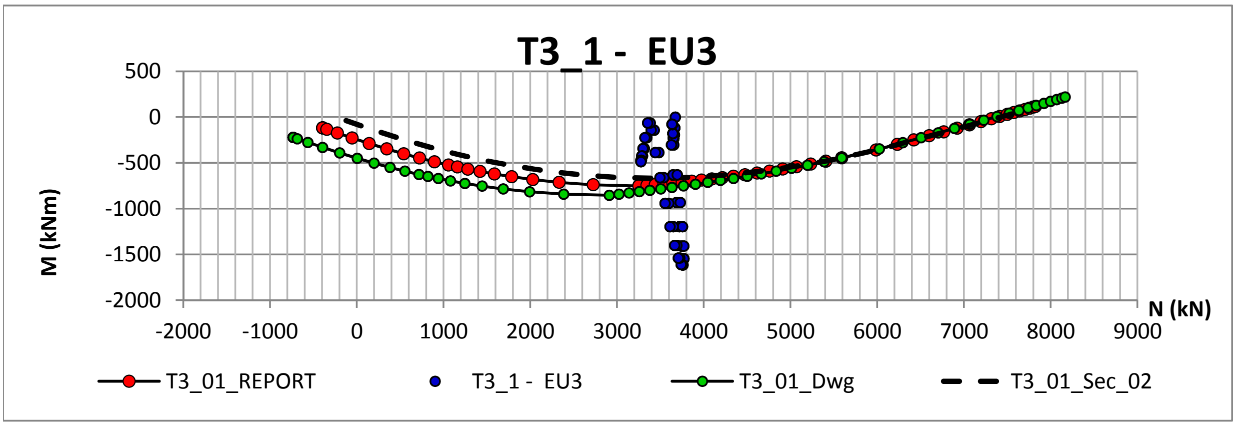
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	121.9	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	84.2	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







T3_1

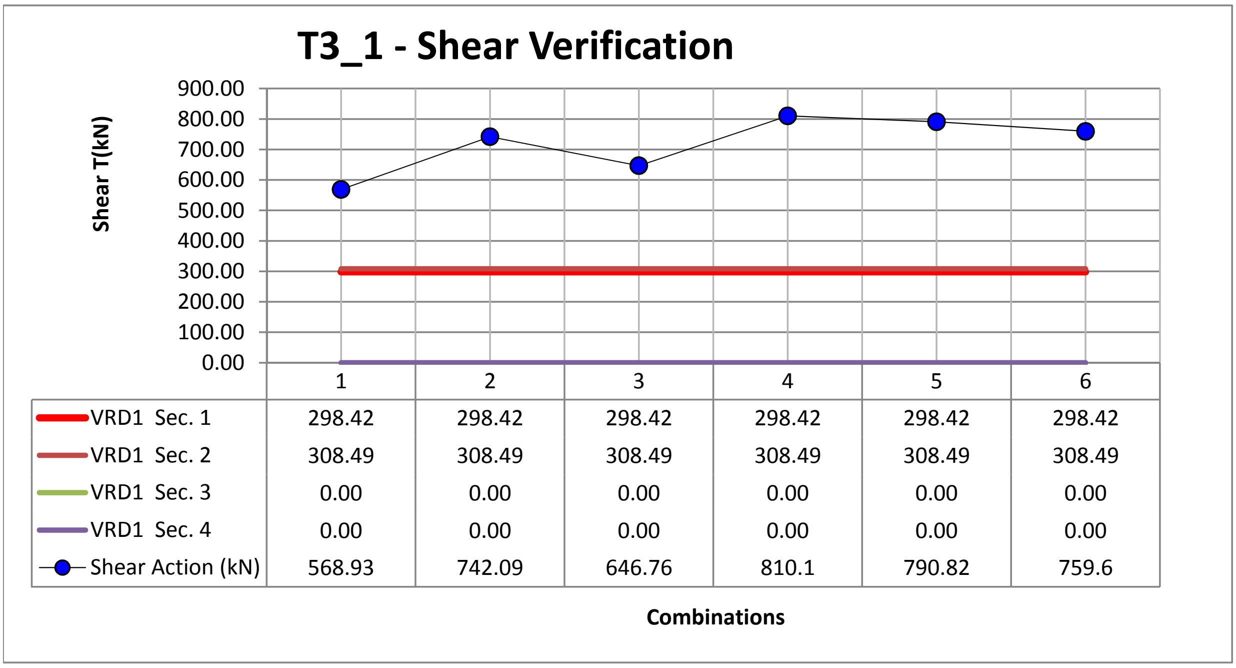
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00		
Section Width	b_w=	m	1.00	1.00		
Section height	d=	m	0.70	0.70		
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10		
Valore di k	k=		1.00	1.00		
Long. Tensile Reinforcement	Asl=	cm^2/m	3.30	10.50		
		m^2/m	0.00033	0.00105		
Concrete coefficient	γ_c=		1.50	1.50		
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35		
Reinforcement ratio	ρ=	(< 0.02)	0.00	0.00		

Shear Bearing Capability	V_{RD1}	MN	0.2984	0.3085	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	298.42	308.49	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	298.42	298.42	298.42	298.42	298.42	298.42		
VRD1 Sec. 2	308.49	308.49	308.49	308.49	308.49	308.49		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**568.93**	**742.09**	**646.76**	**810.1**	**790.82**	**759.6**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T3_1 - Shear Verification



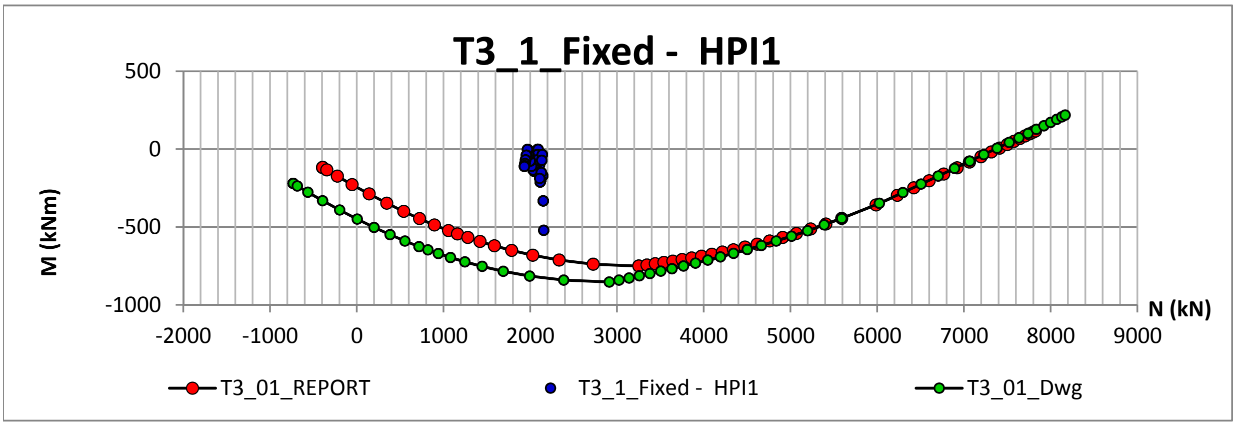
	1	2	3	4	5	6
VRD1 Sec. 1	298.42	298.42	298.42	298.42	298.42	298.42
VRD1 Sec. 2	308.49	308.49	308.49	308.49	308.49	308.49
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	568.93	742.09	646.76	810.1	790.82	759.6

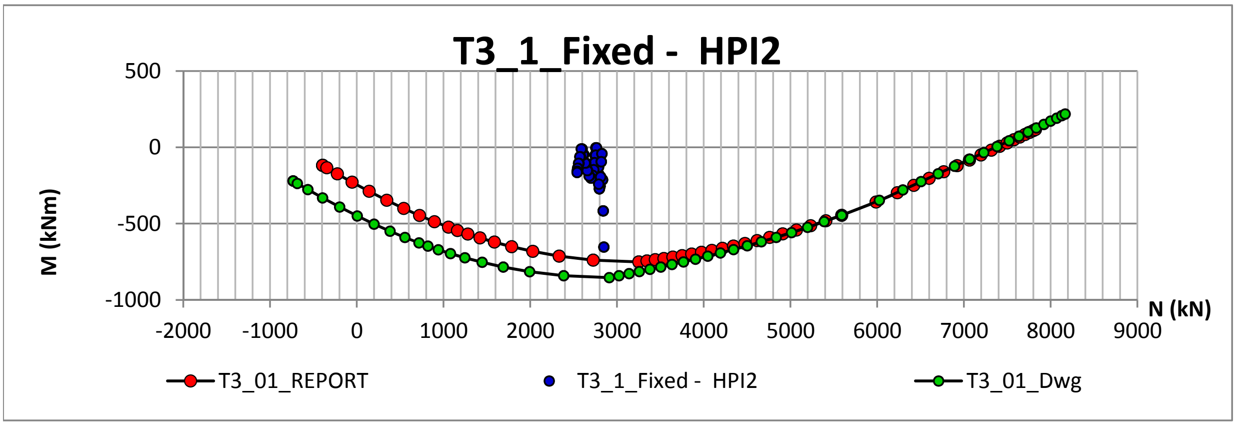
T3_1_Fixed

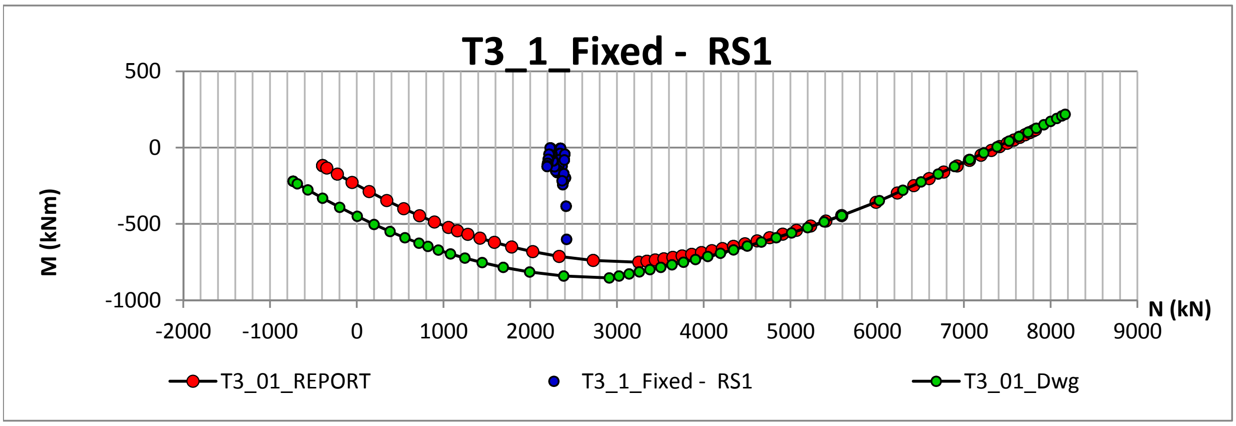
Passed	x
Failed	

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	121.9	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	84.2	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





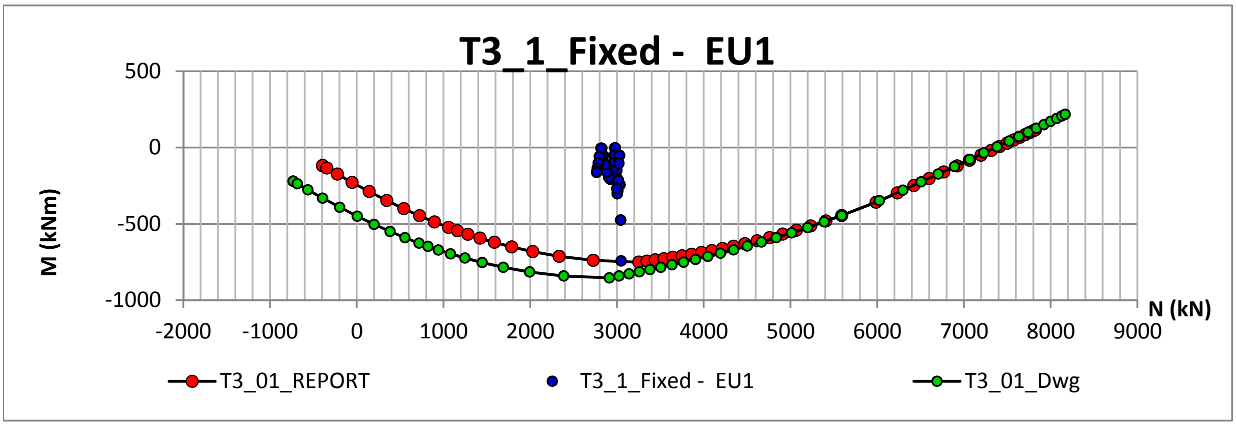


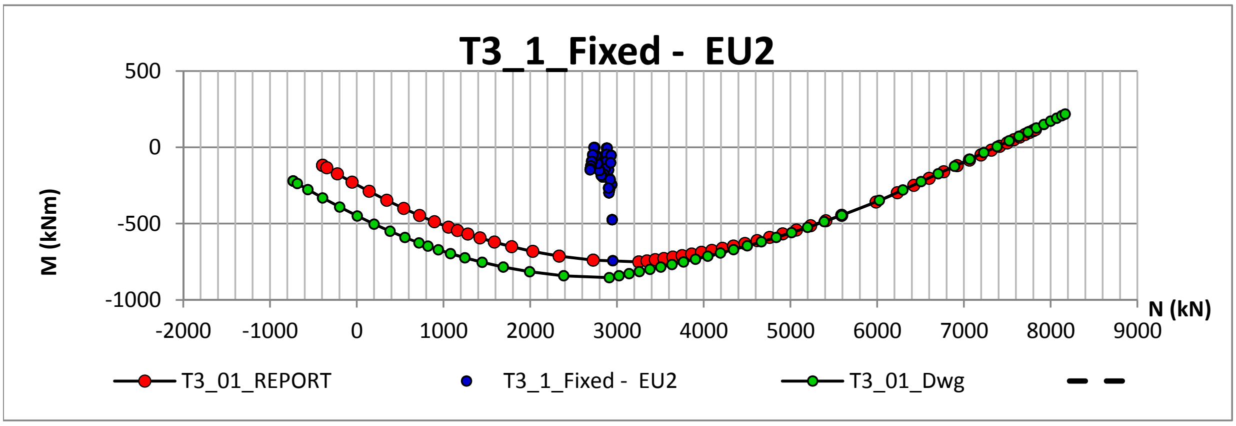
T3_1_Fixed

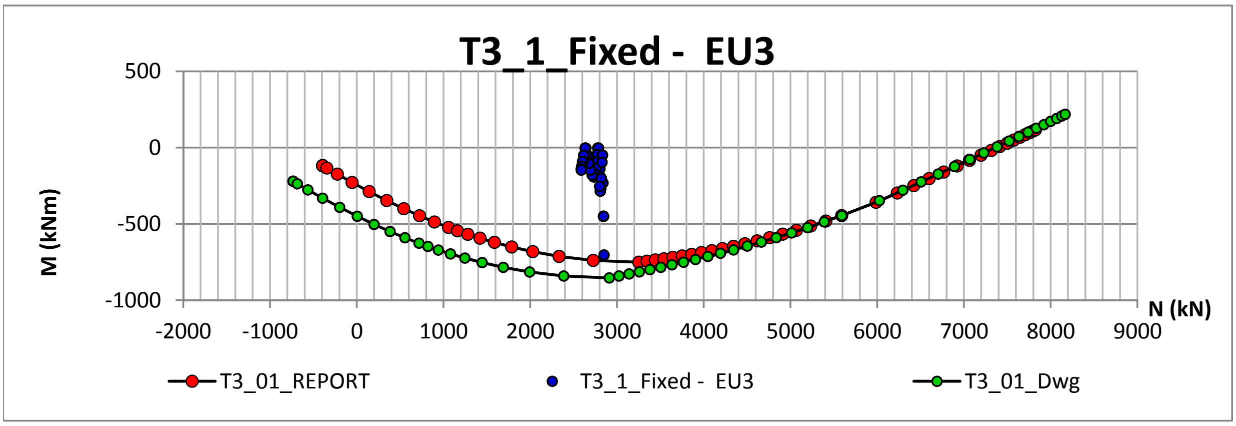
Passed	x
Failed	

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	121.9	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	84.2	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







T3_1_Fixed

Shear Verification

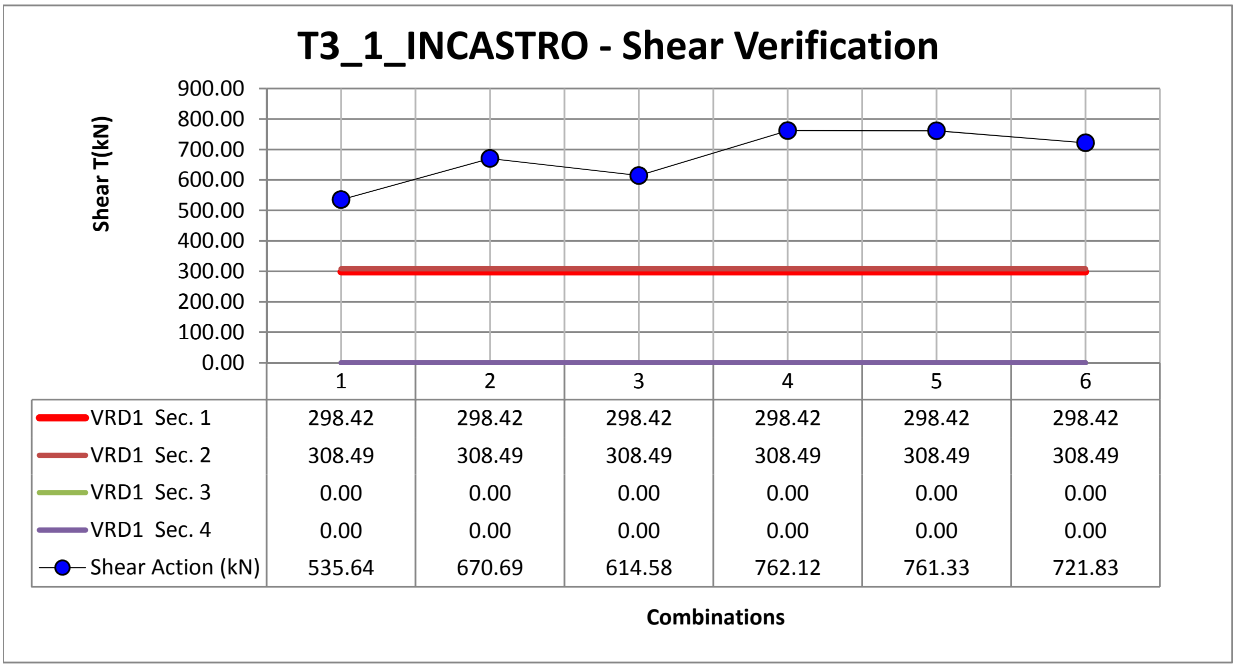
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00		
Section Width	b_w=	m	1.00	1.00		
Section height	d=	m	0.70	0.70		
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10		
Valore di k	k=		1.00	1.00		
Long. Tensile Reinforcement	Asl=	cm^2/m	3.30	10.50		
		m^2/m	0.00033	0.00105		
Concrete coefficient	γ_c=		1.50	1.50		
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35		
Reinforcement ratio	ρ=	(< 0.02)	0.00047	0.00150		

Shear Bearing Capability	V_{RD1}	MN	0.2984	0.3085	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	298.42	308.49	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	298.42	298.42	298.42	298.42	298.42	298.42
VRD1 Sec. 2	308.49	308.49	308.49	308.49	308.49	308.49
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**535.64**	**670.69**	**614.58**	**762.12**	**761.33**	**721.83**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T3_1_Fixed - Shear Verification

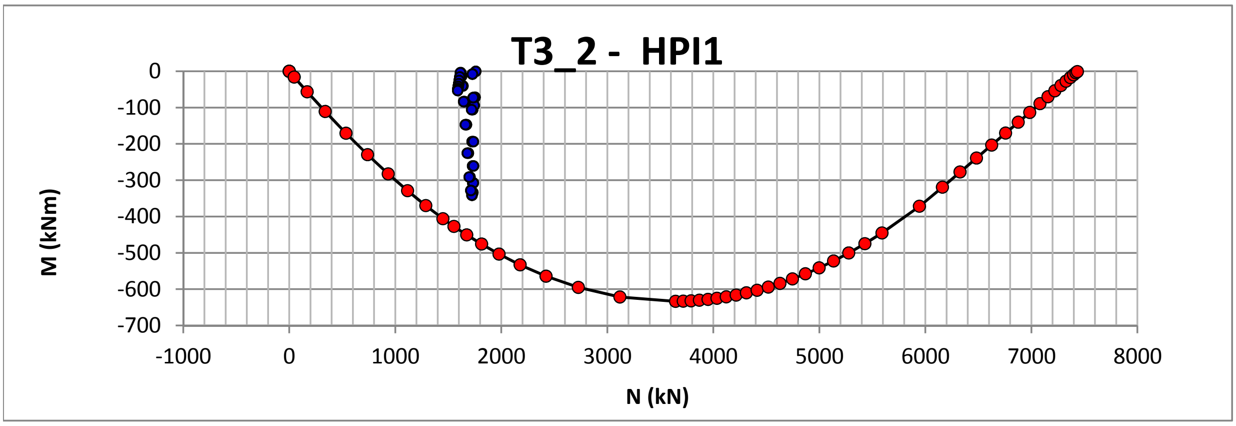


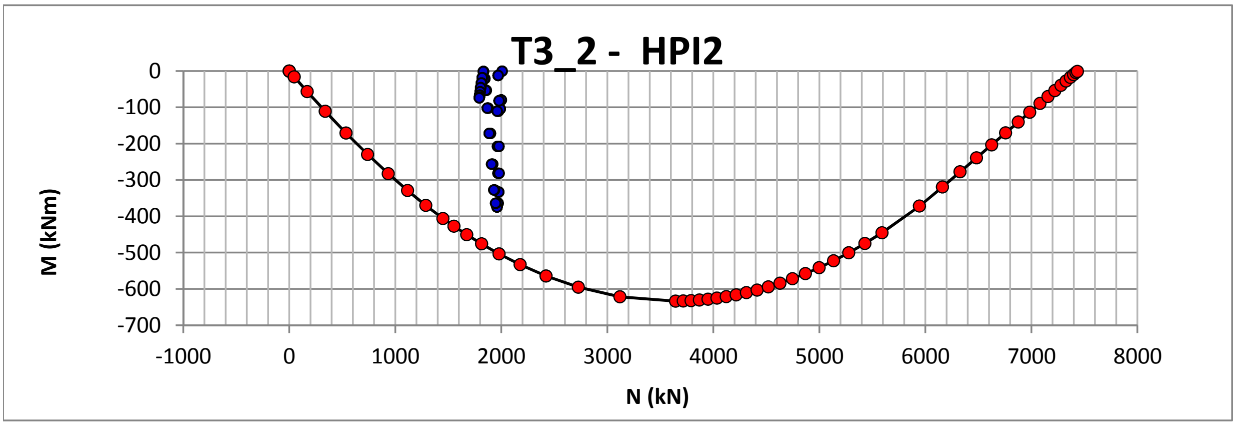
T3_2

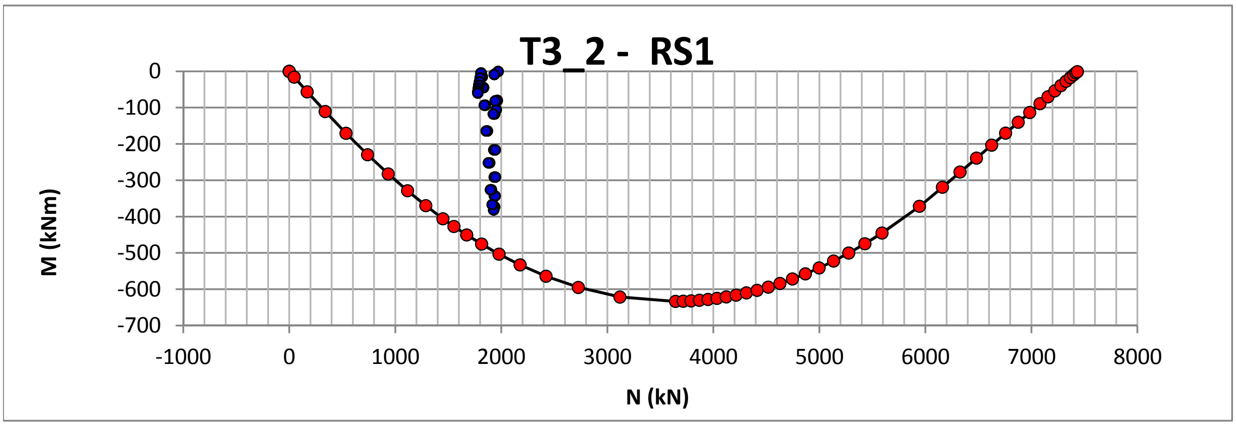
Passed	x
Failed	

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





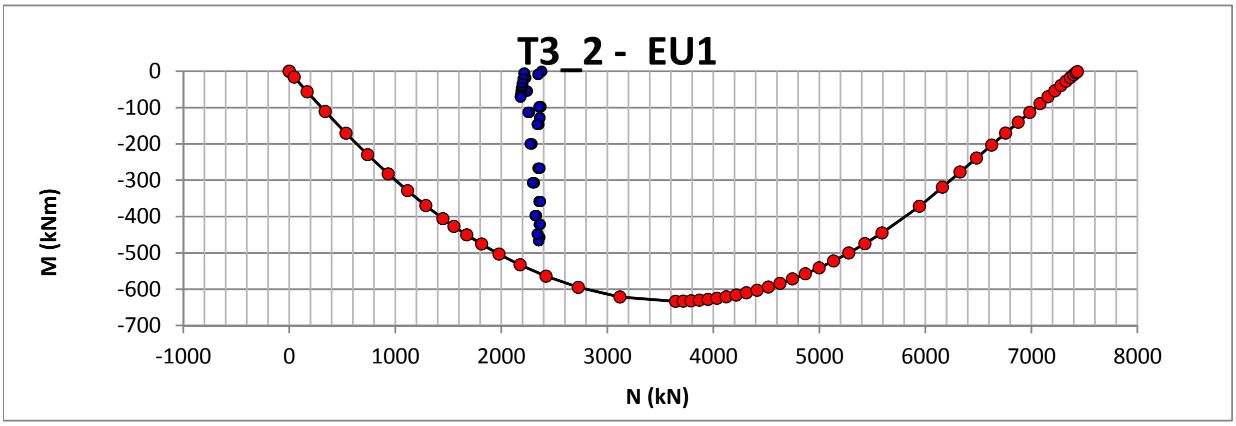


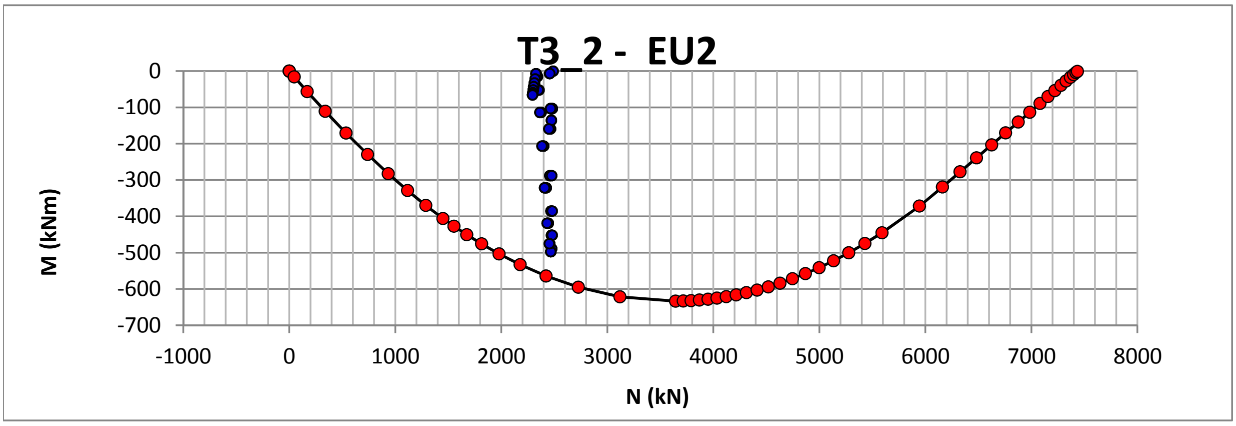
T3_2

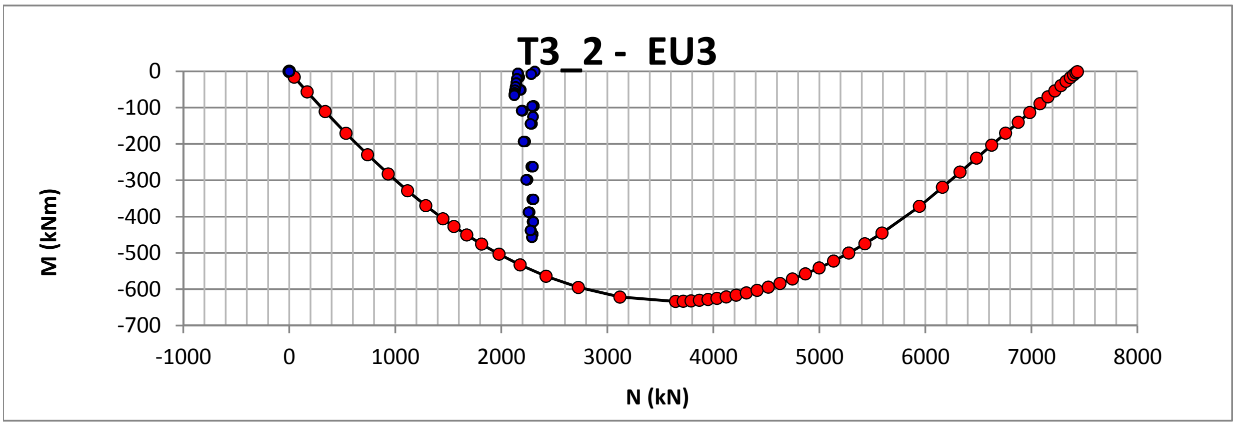
Passed	x
Failed	

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







T3_2

Shear Verification

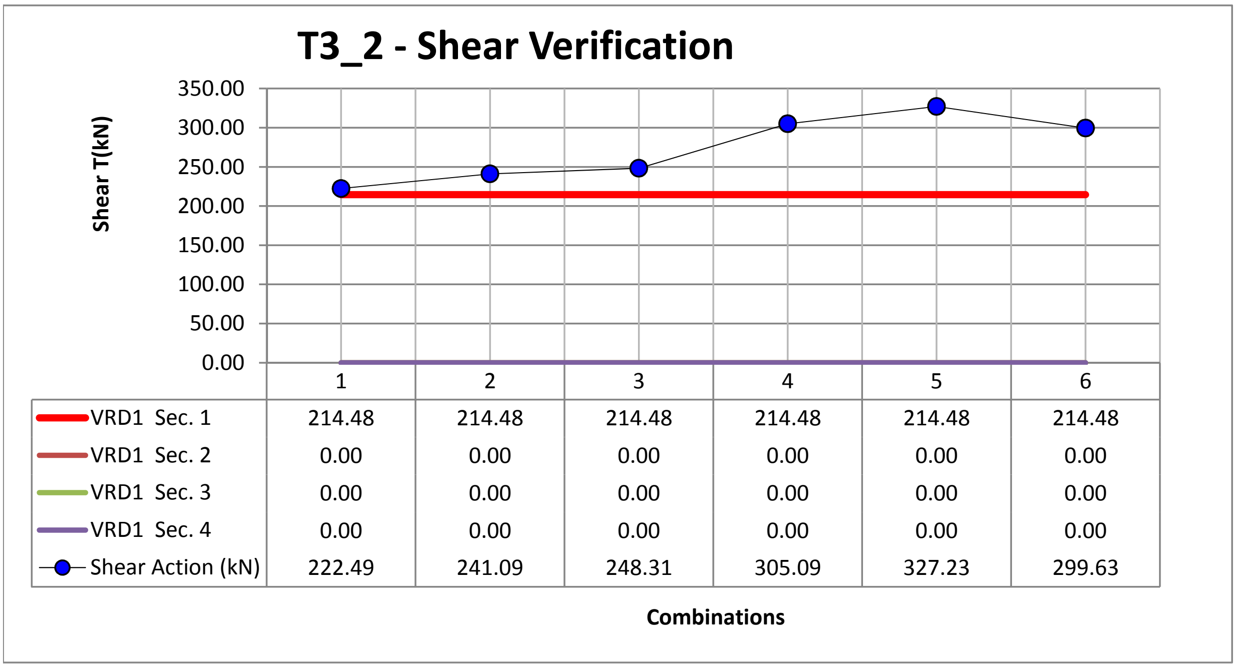
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.50			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	3.30			
		m^2/m	0.00033			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.2145	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	214.48	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	214.48	214.48	214.48	214.48	214.48	214.48
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**222.49**	**241.09**	**248.31**	**305.09**	**327.23**	**299.63**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T3_2 - Shear Verification

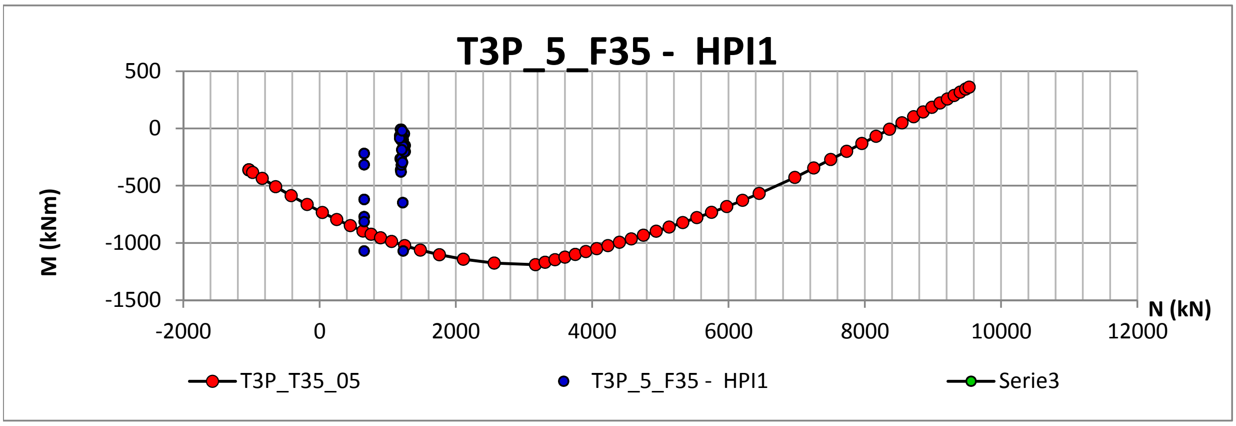


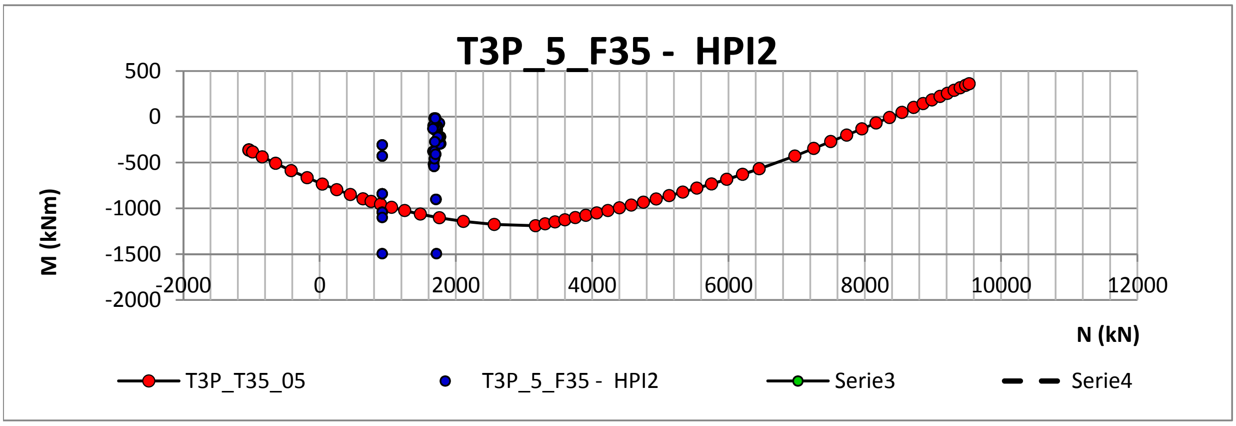
T3P_5_F35

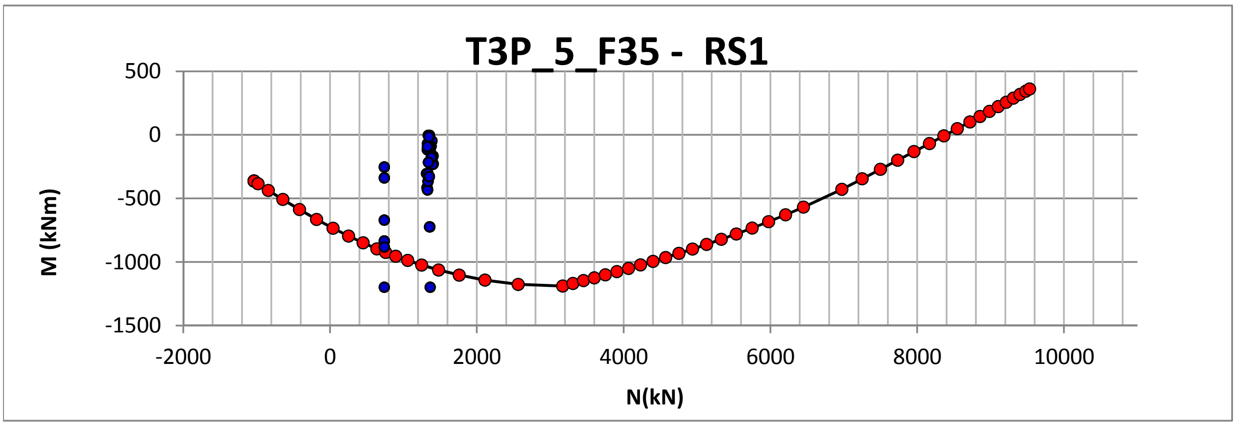
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	102.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	103.0	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50





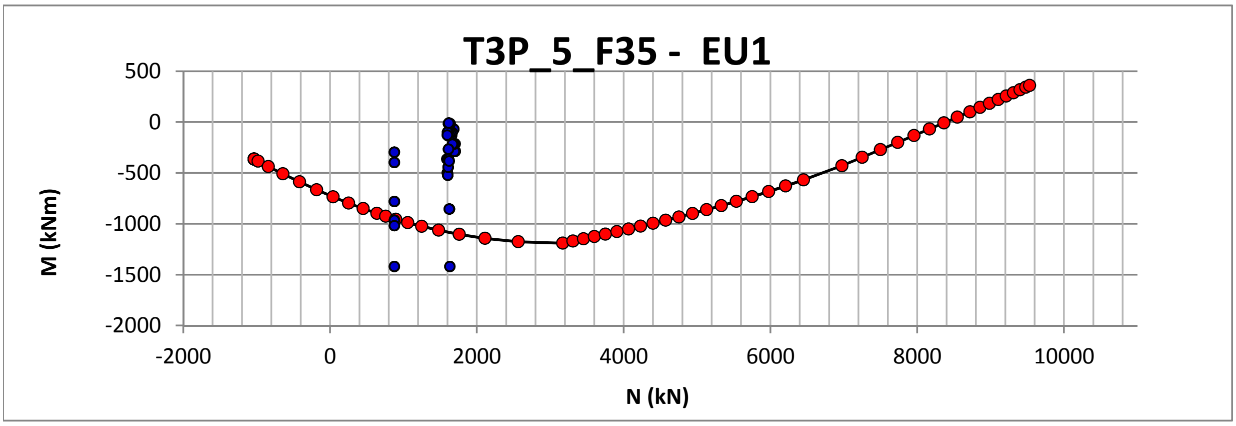


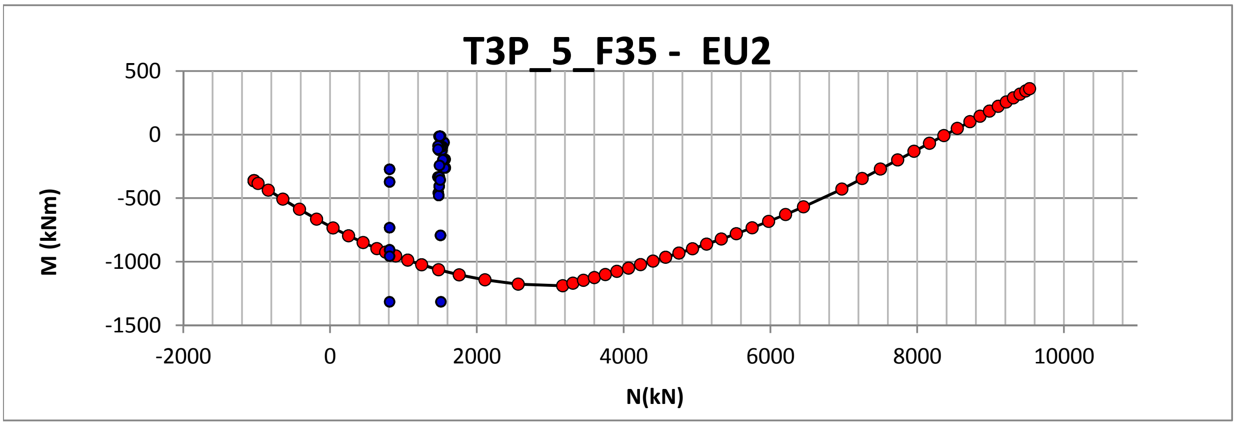
T3P_5_F35

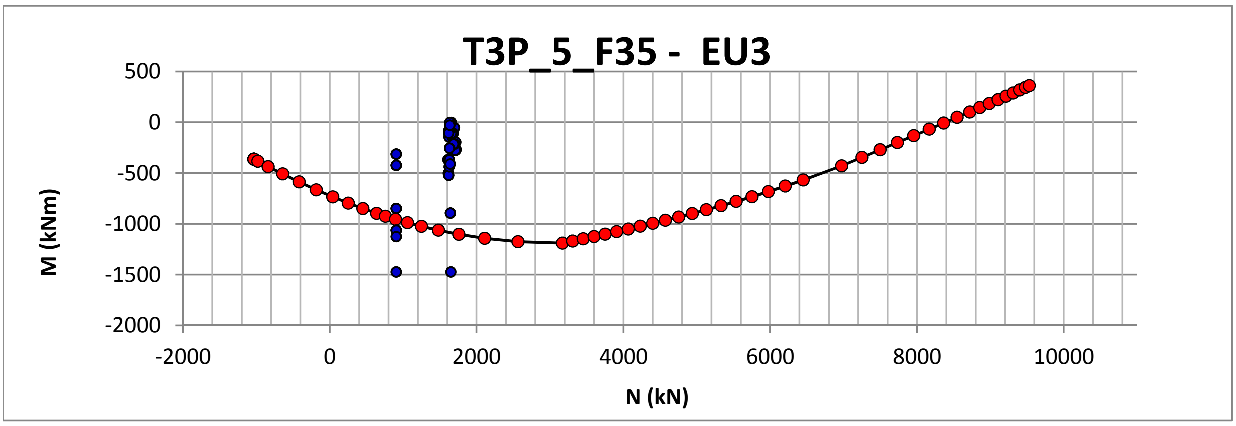
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	102.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	103.0	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







T3P_5_F35

Shear Verification

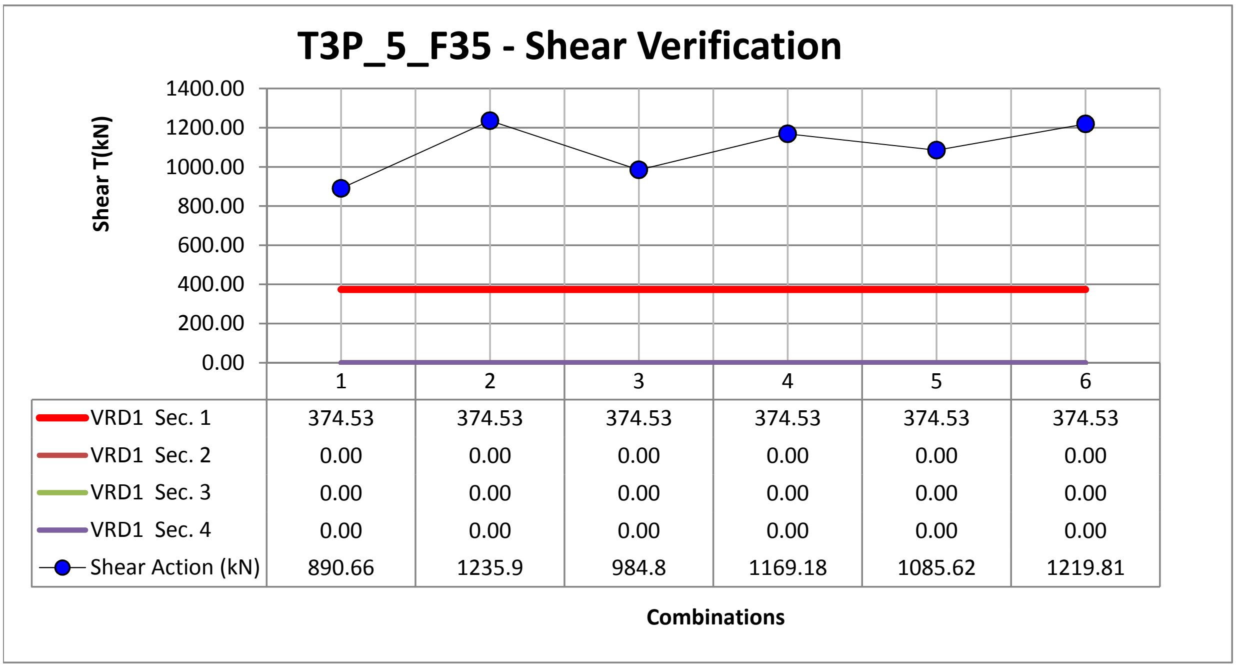
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.80			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	27.70			
		m^2/m	0.00277			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.0035			

Shear Bearing Capability	V_{RD1}	MN	0.3745	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	374.53	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	374.53	374.53	374.53	374.53	374.53	374.53
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**890.66**	**1235.9**	**984.8**	**1169.18**	**1085.62**	**1219.81**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

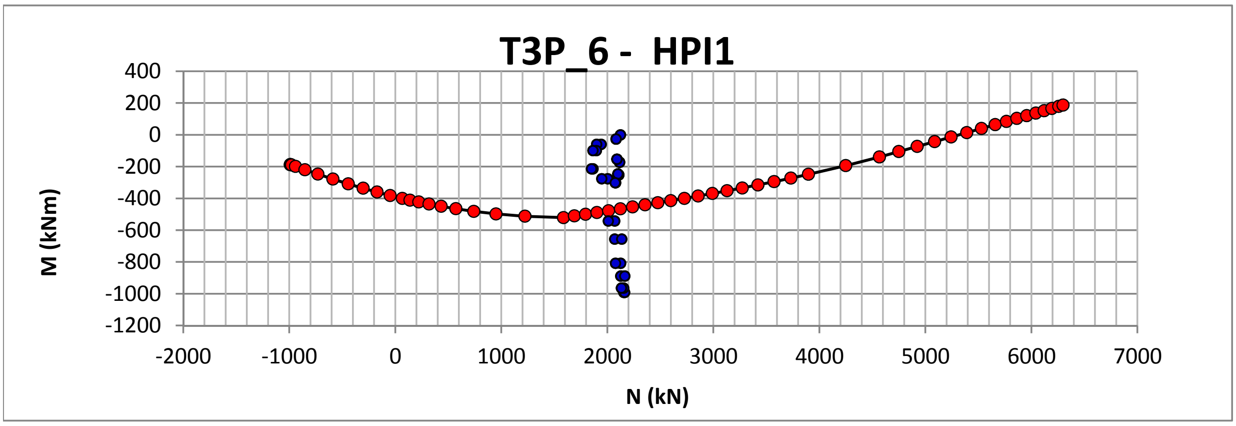
T3P_5_F35 - Shear Verification

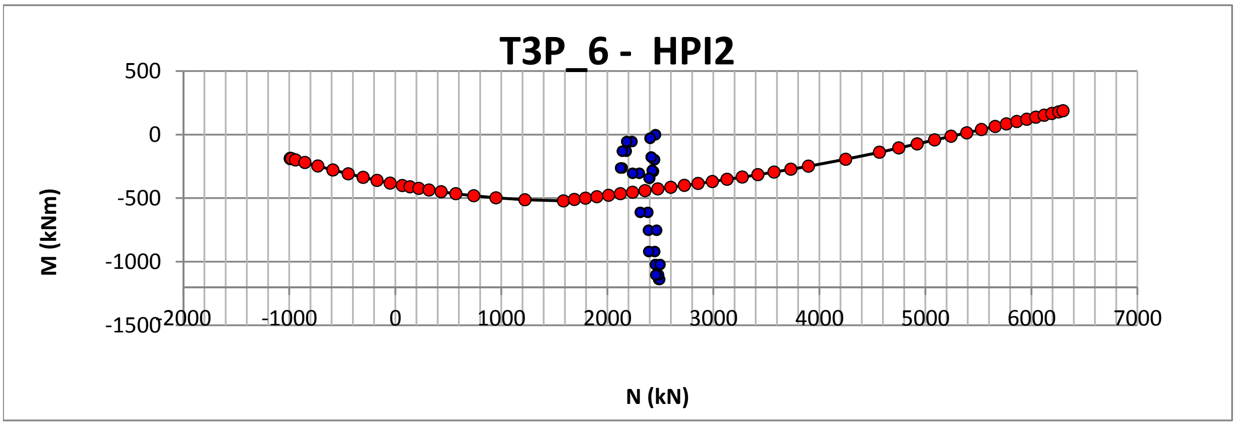


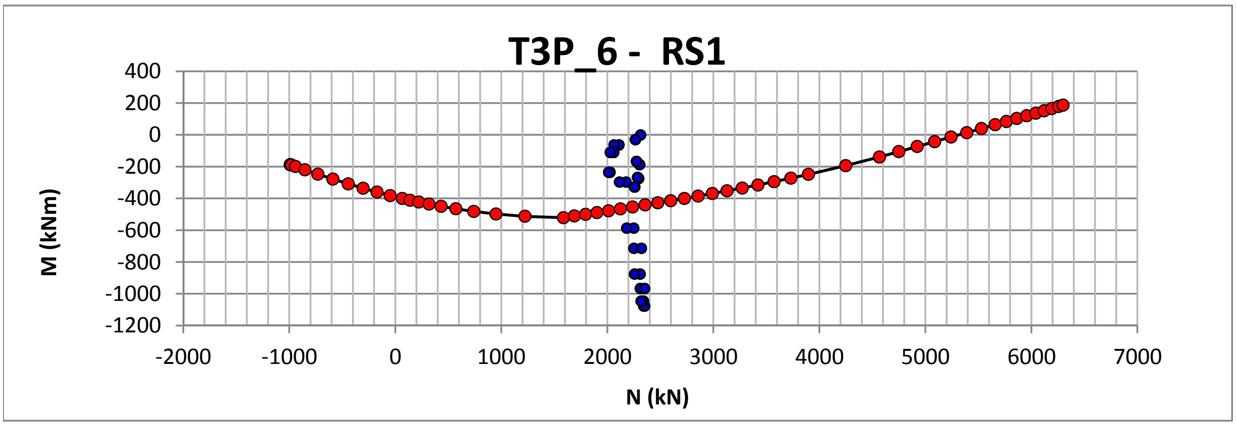
T3P_6

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	30.1	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	22.5	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50



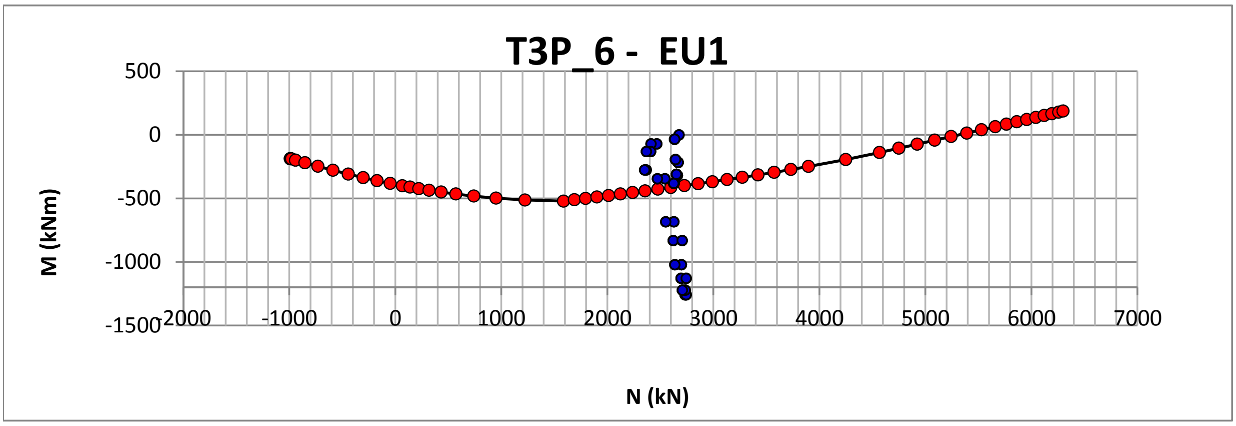


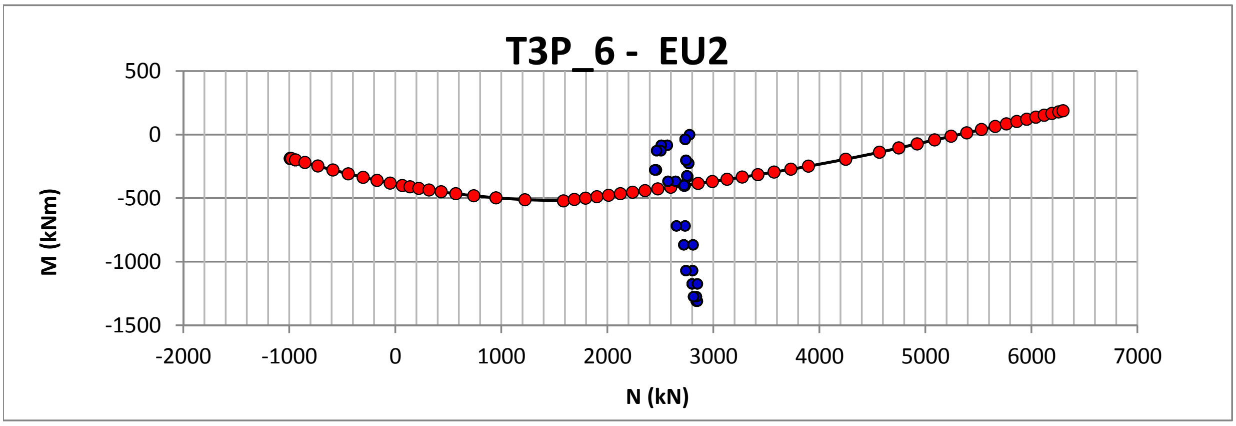


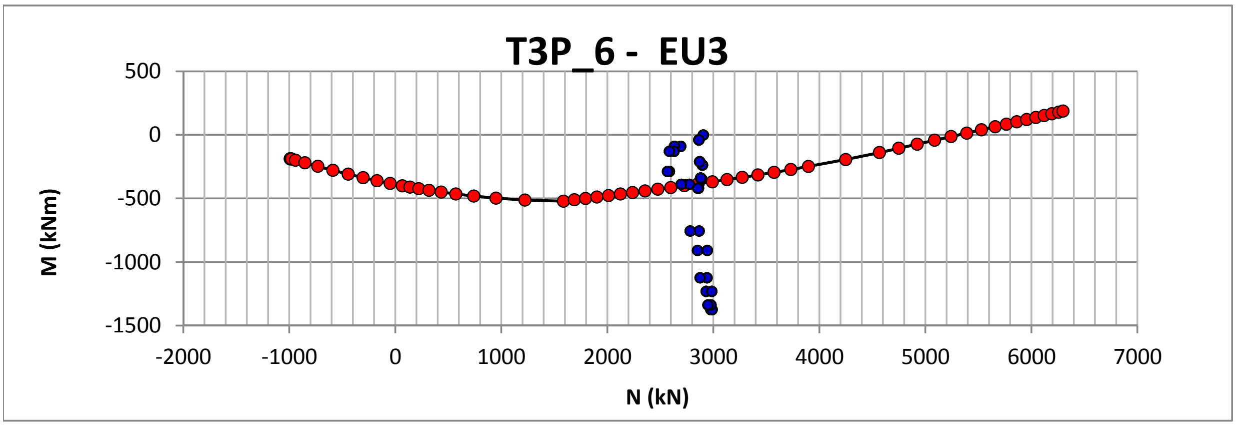
T3P_6

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	30.1	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	22.5	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







T3P_6

Shear Verification

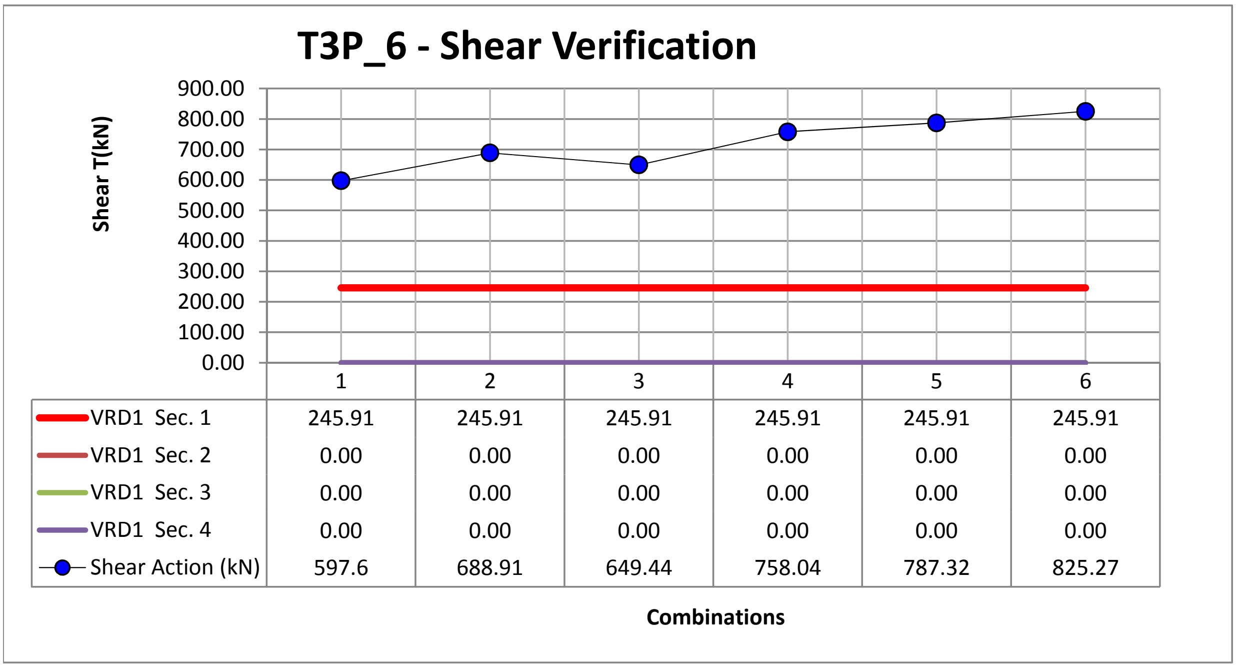
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.50			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	25.77			
		m^2/m	0.00258			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.01			

Shear Bearing Capability	V_{RD1}	MN	0.2459	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	245.91	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	245.91	245.91	245.91	245.91	245.91	245.91
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**597.6**	**688.91**	**649.44**	**758.04**	**787.32**	**825.27**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

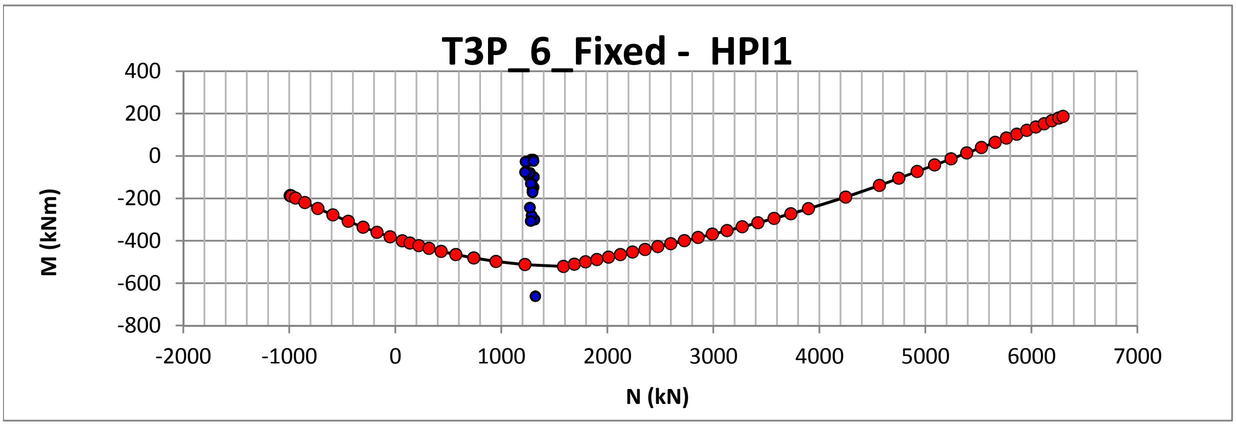
T3P_6 - Shear Verification

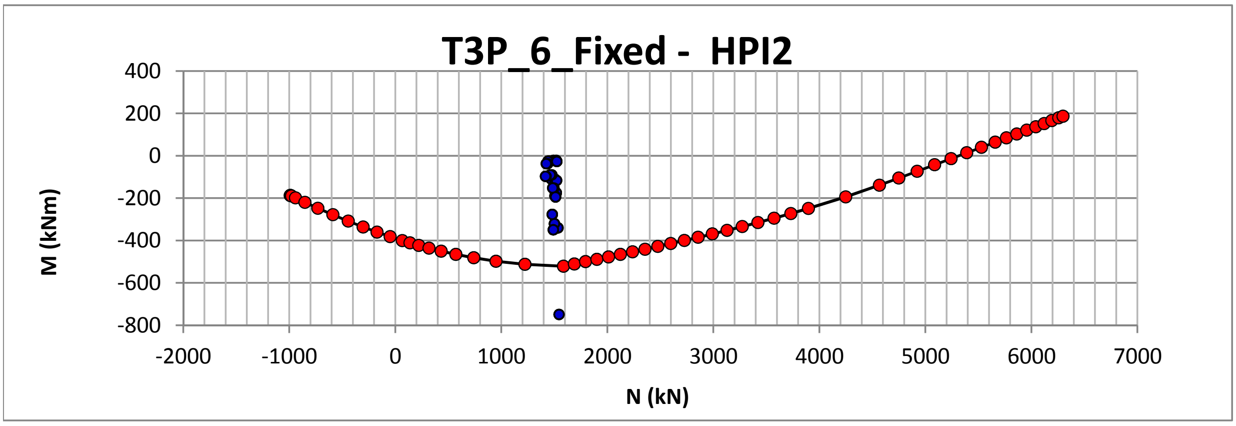


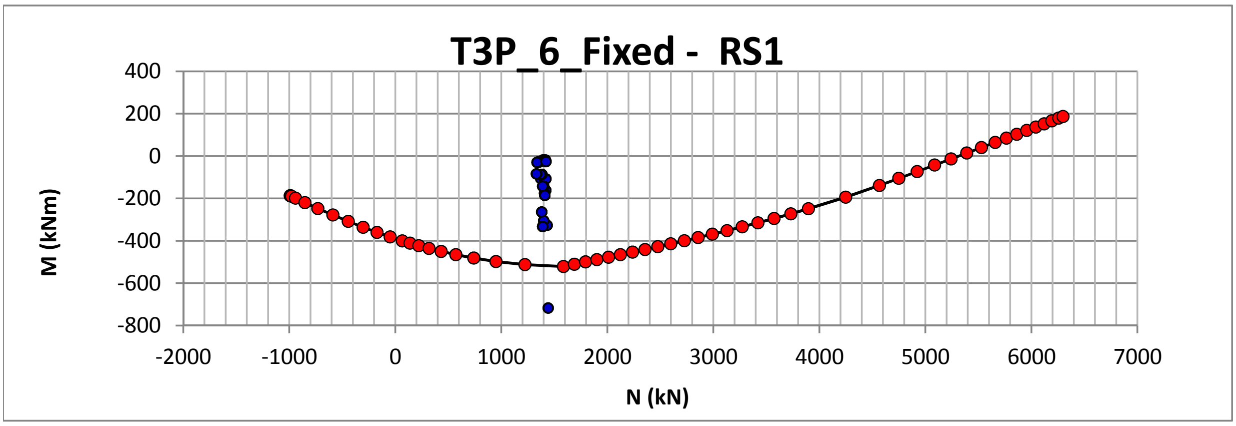
T3P_6_Fixed

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	30.1	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	22.5	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50



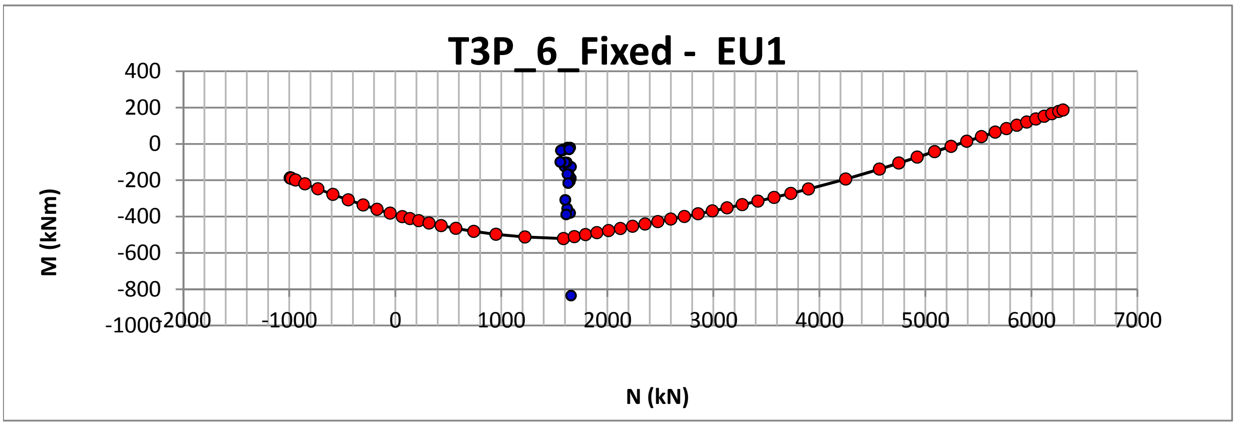


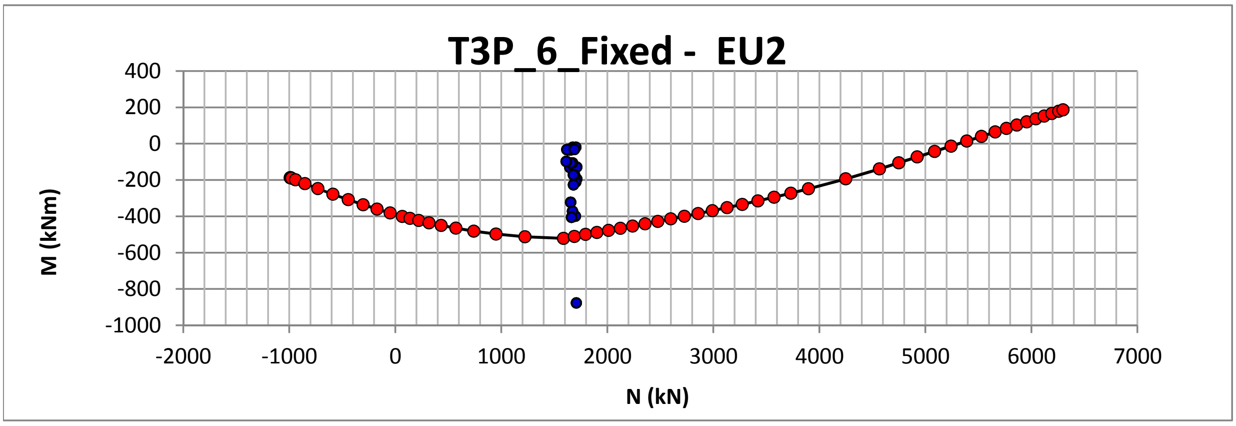


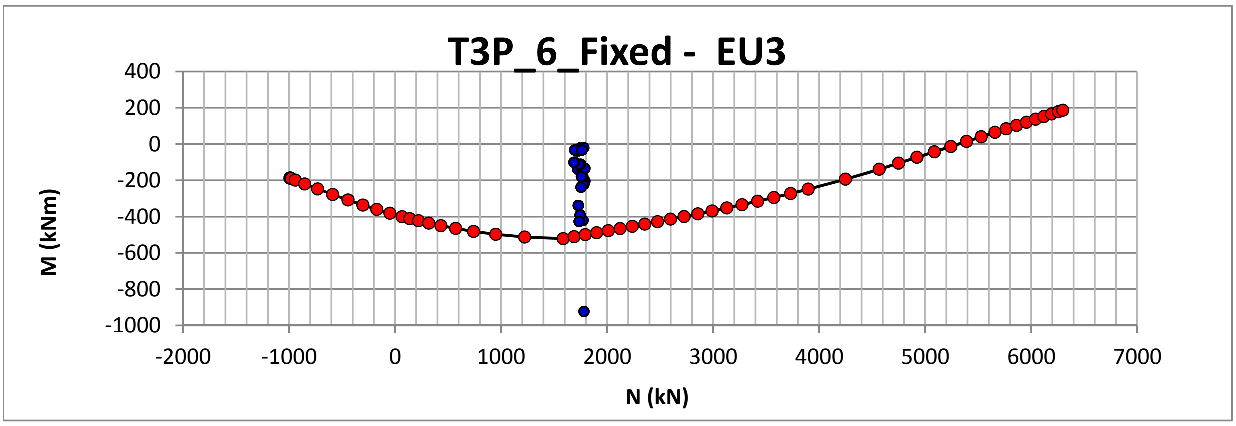
T3P_6_Fixed

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	30.1	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	22.5	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







T3P_6_Fixed

Shear Verification

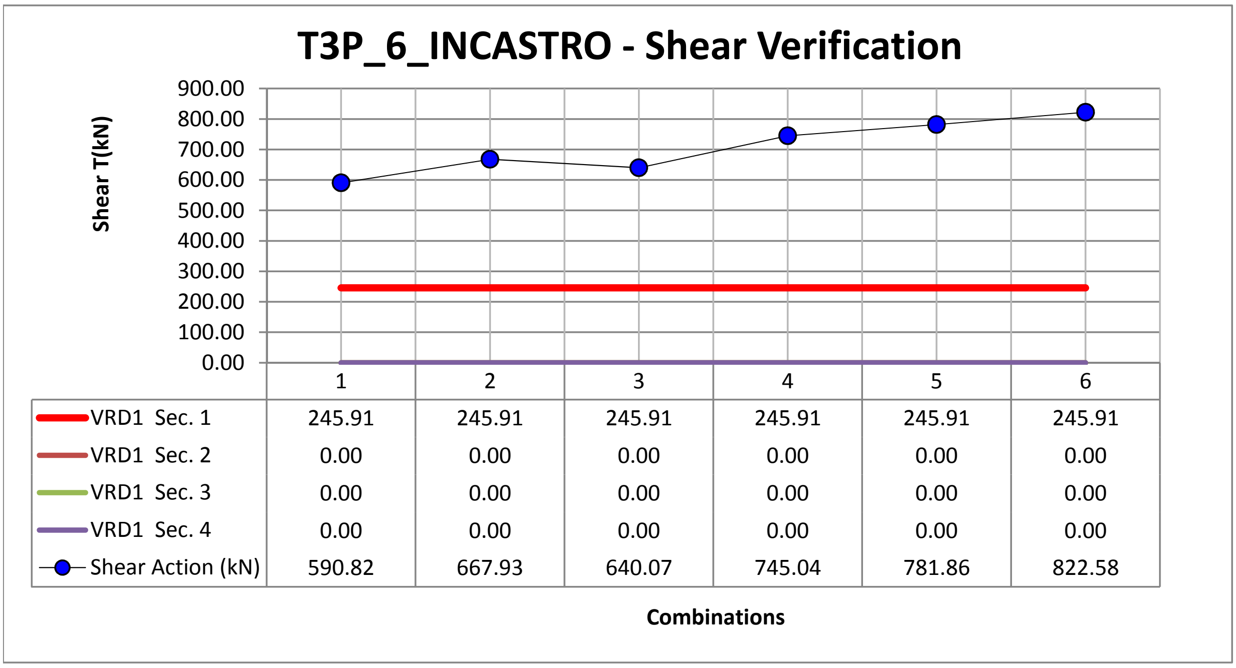
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.50			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	25.77			
		m^2/m	0.00258			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.01			

Shear Bearing Capability	V_{RD1}	MN	0.2459	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	245.91	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	245.91	245.91	245.91	245.91	245.91	245.91
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**590.82**	**667.93**	**640.07**	**745.04**	**781.86**	**822.58**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T3P_6_Fixed - Shear Verification



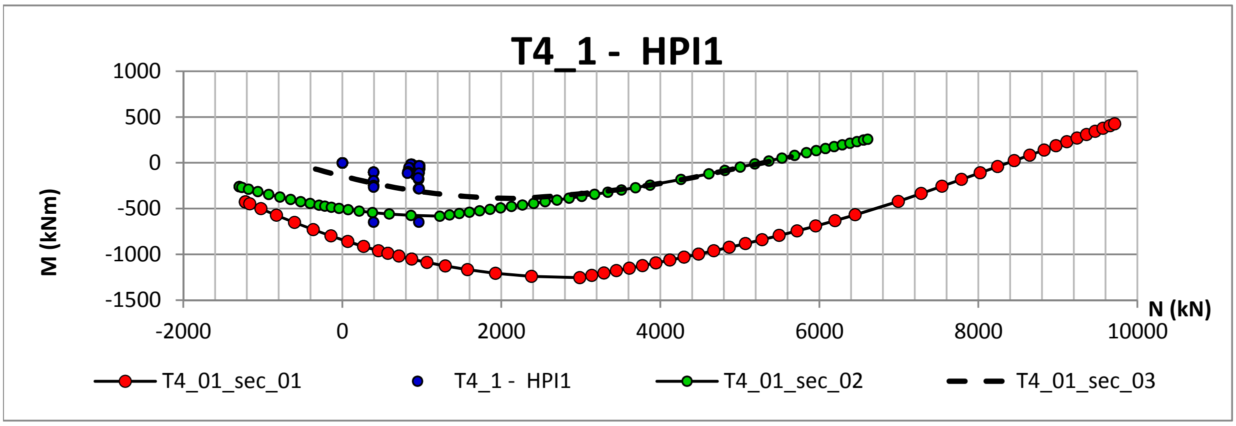
	1	2	3	4	5	6
VRD1 Sec. 1	245.91	245.91	245.91	245.91	245.91	245.91
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	590.82	667.93	640.07	745.04	781.86	822.58

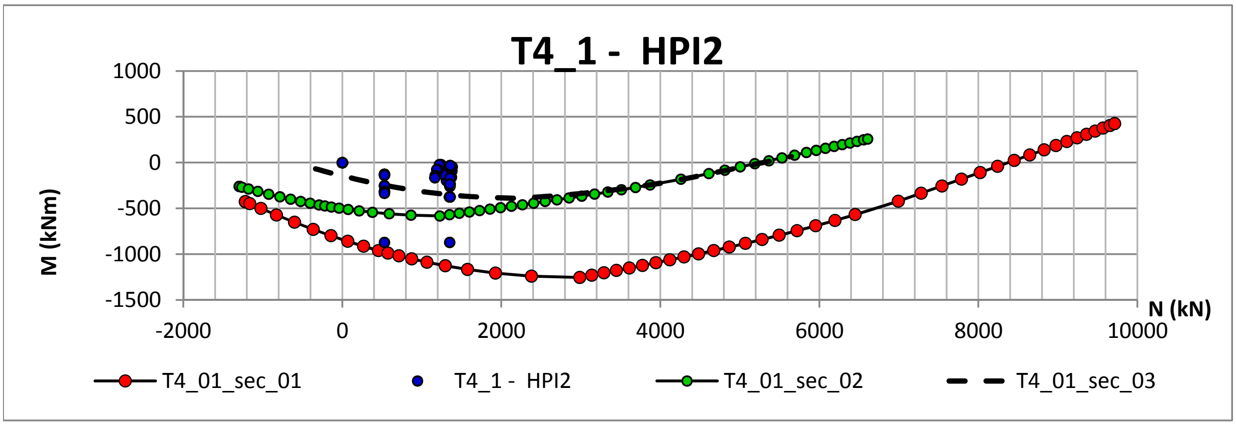
T4_1

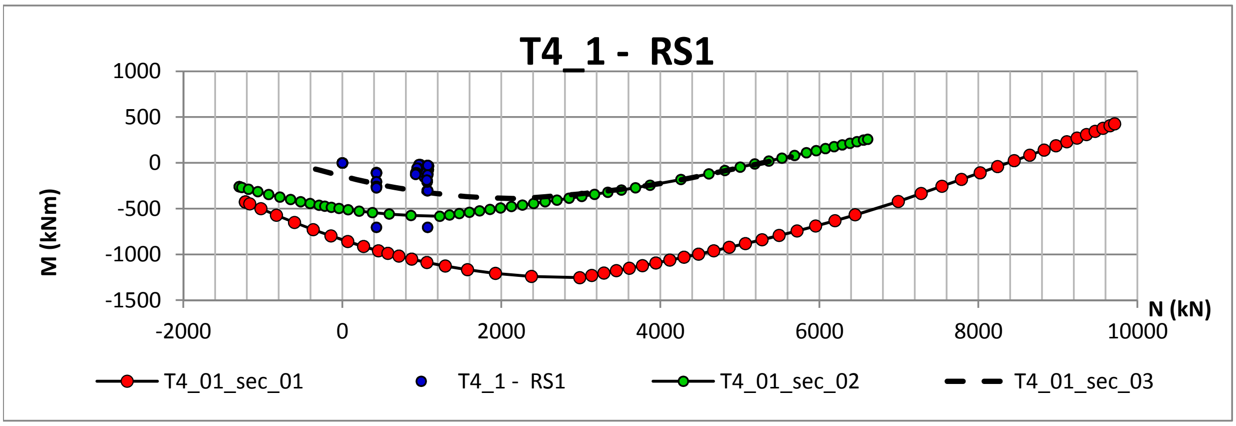
Passed	x
Failed	

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	90.2	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	52.4	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50





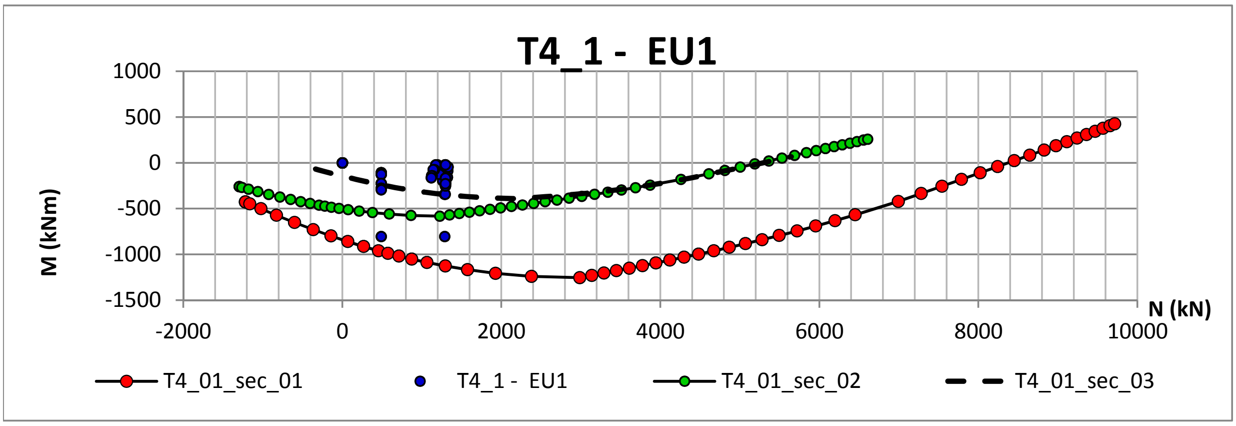


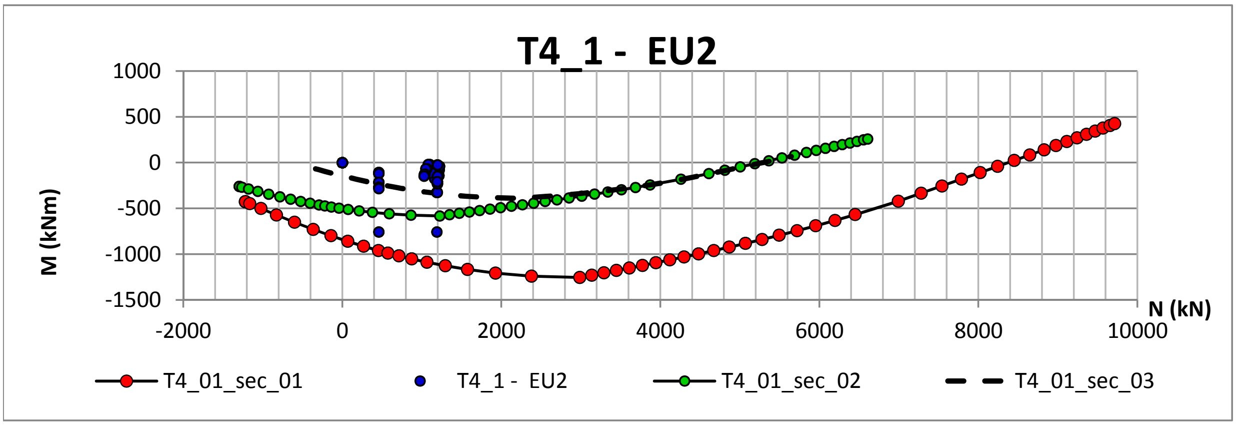
T4_1

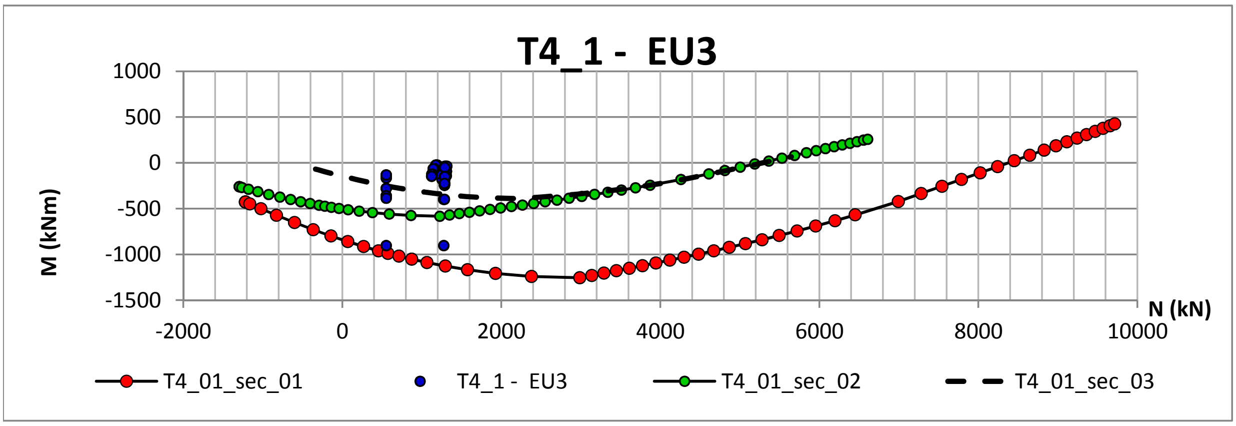
Passed	x
Failed	

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	90.2	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	52.4	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50







T4_1

Shear Verification

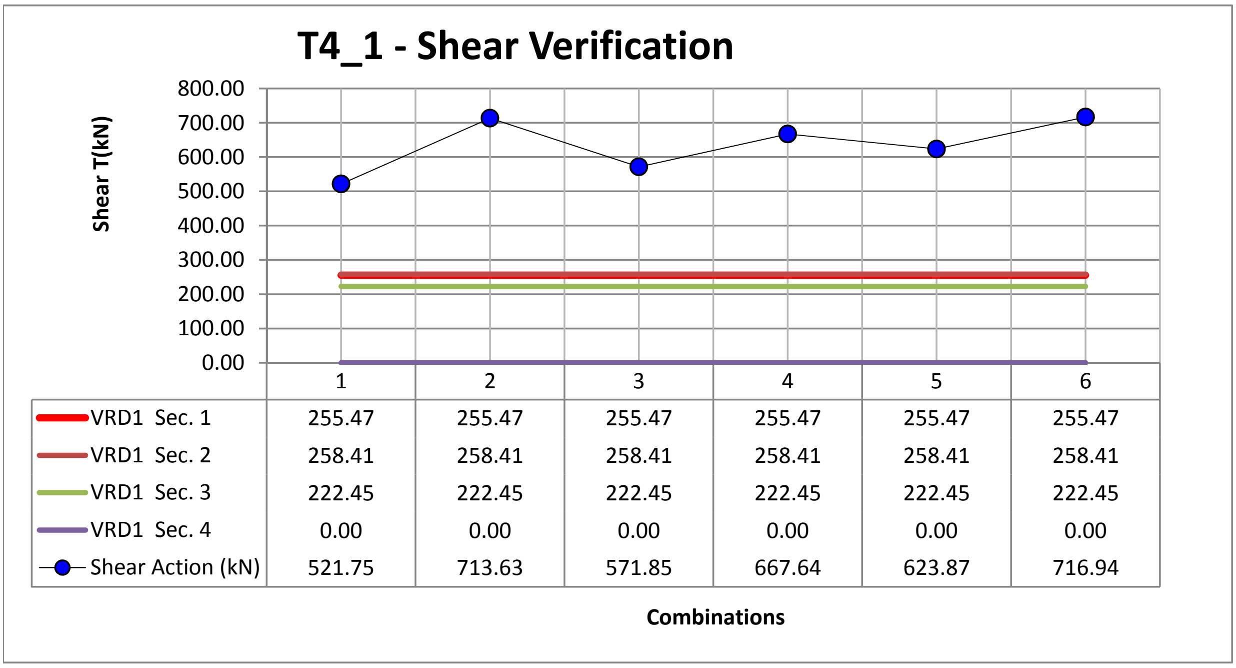
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00	37.00	
Section Width	b_w=	m	1.00	1.00	1.00	
Section height	d=	m	0.50	0.50	0.50	
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10	2.10	
Valore di k	k=		1.00	1.00	1.00	
Long. Tensile Reinforcement	Asl=	cm^2/m	32.60	34.70	9.00	
		m^2/m	0.00326	0.00347	0.00090	
Concrete coefficient	γ_c=		1.50	1.50	1.50	
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35	0.35	
Reinforcement ratio	ρ=	(< 0.02)	0.01	0.01	0.00	

Shear Bearing Capability	V_{RD1}	MN	0.2555	0.2584	0.2225	0.0000
Shear Bearing Capability	V_{RD1}	kN	255.47	258.41	222.45	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	255.47	255.47	255.47	255.47	255.47	255.47
VRD1 Sec. 2	258.41	258.41	258.41	258.41	258.41	258.41
VRD1 Sec. 3	222.45	222.45	222.45	222.45	222.45	222.45
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**521.75**	**713.63**	**571.85**	**667.64**	**623.87**	**716.94**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T4_1 - Shear Verification



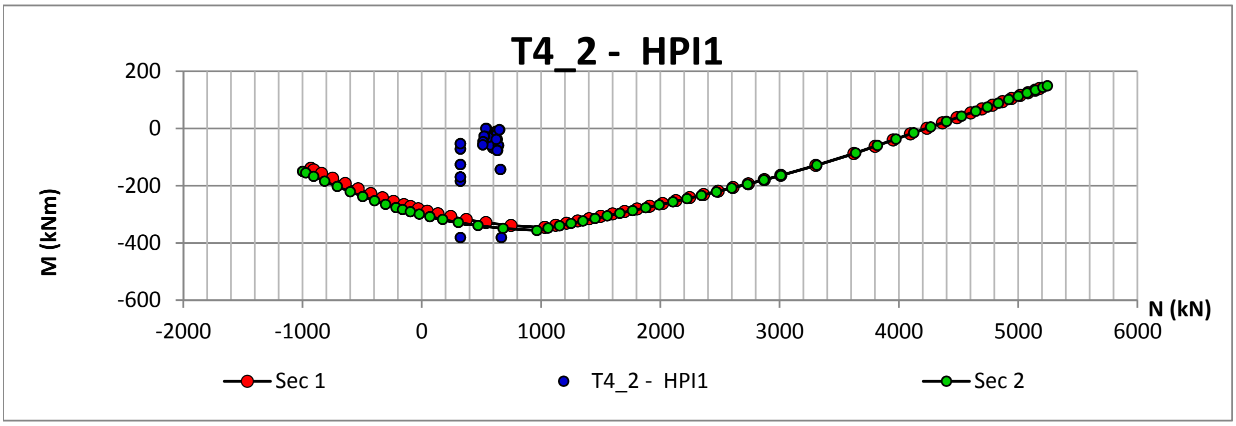
	1	2	3	4	5	6
VRD1 Sec. 1	255.47	255.47	255.47	255.47	255.47	255.47
VRD1 Sec. 2	258.41	258.41	258.41	258.41	258.41	258.41
VRD1 Sec. 3	222.45	222.45	222.45	222.45	222.45	222.45
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	521.75	713.63	571.85	667.64	623.87	716.94

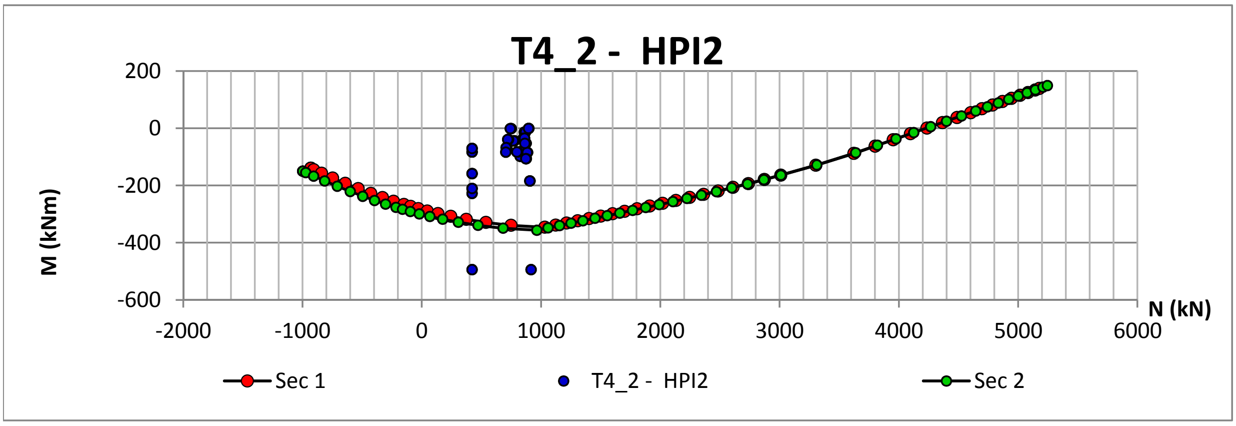
T4_2

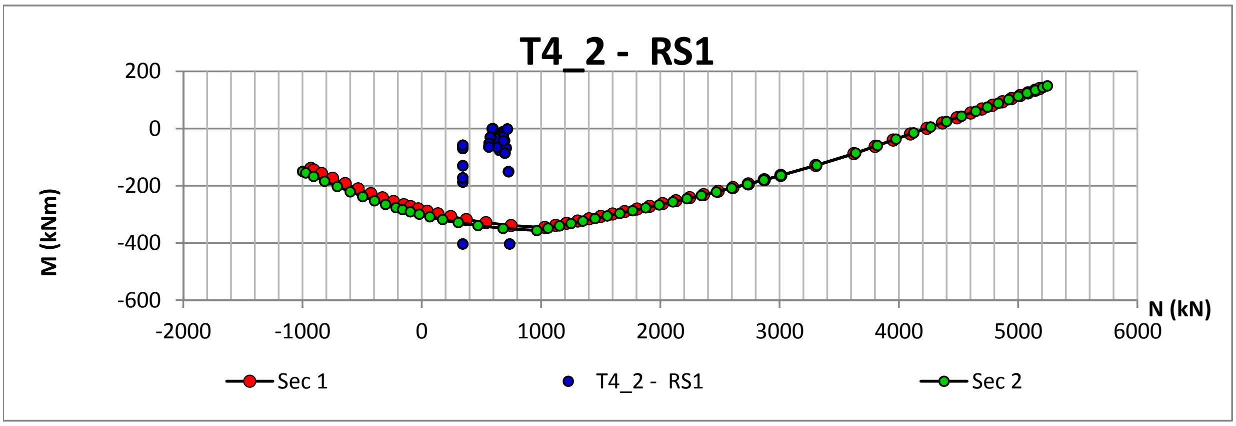
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	57.3	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	22.4	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50





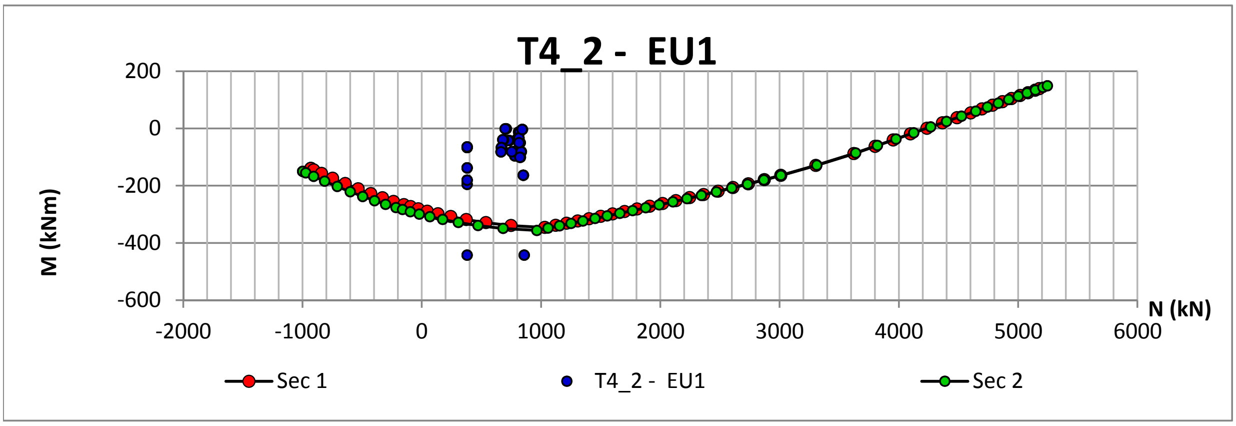


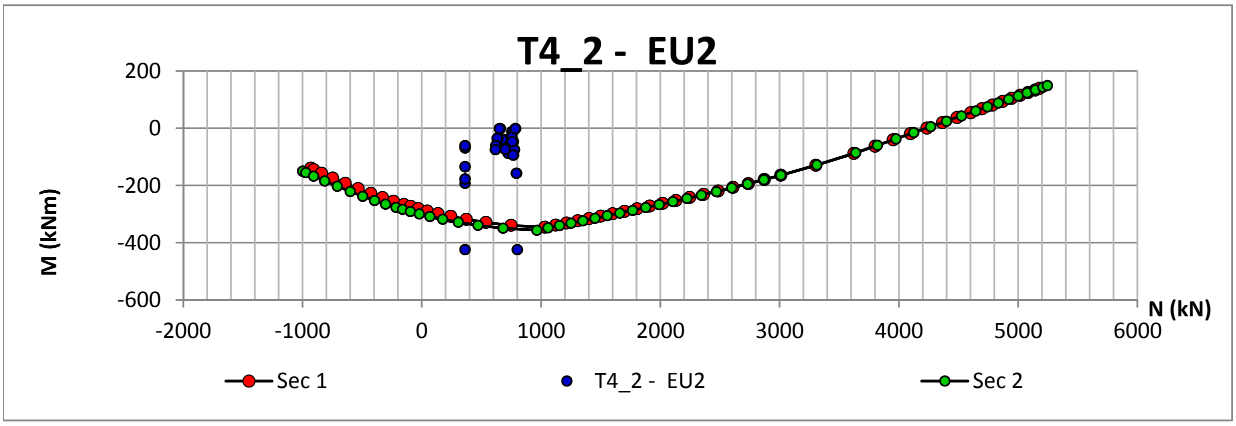
T4_2

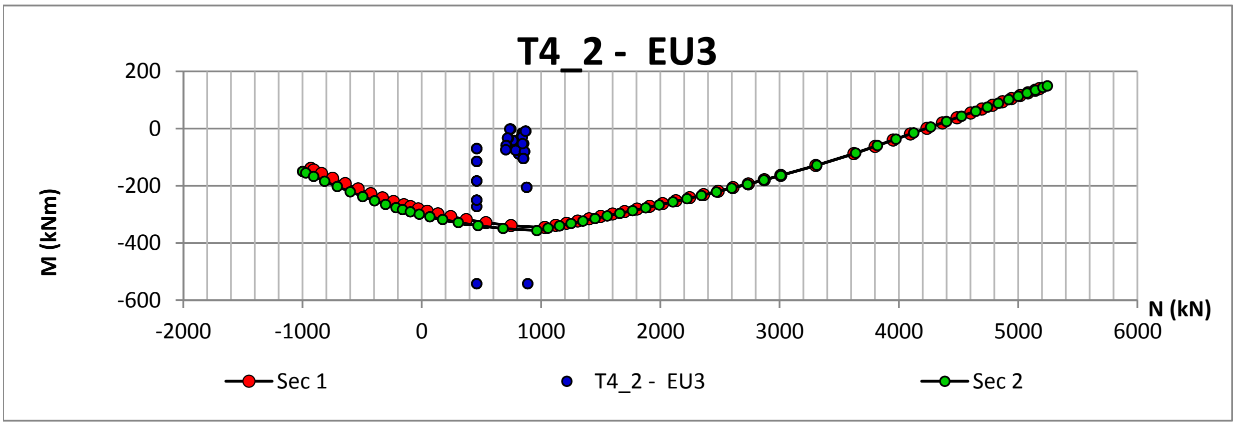
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	57.3	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	22.4	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50







T4_2

Shear Verification

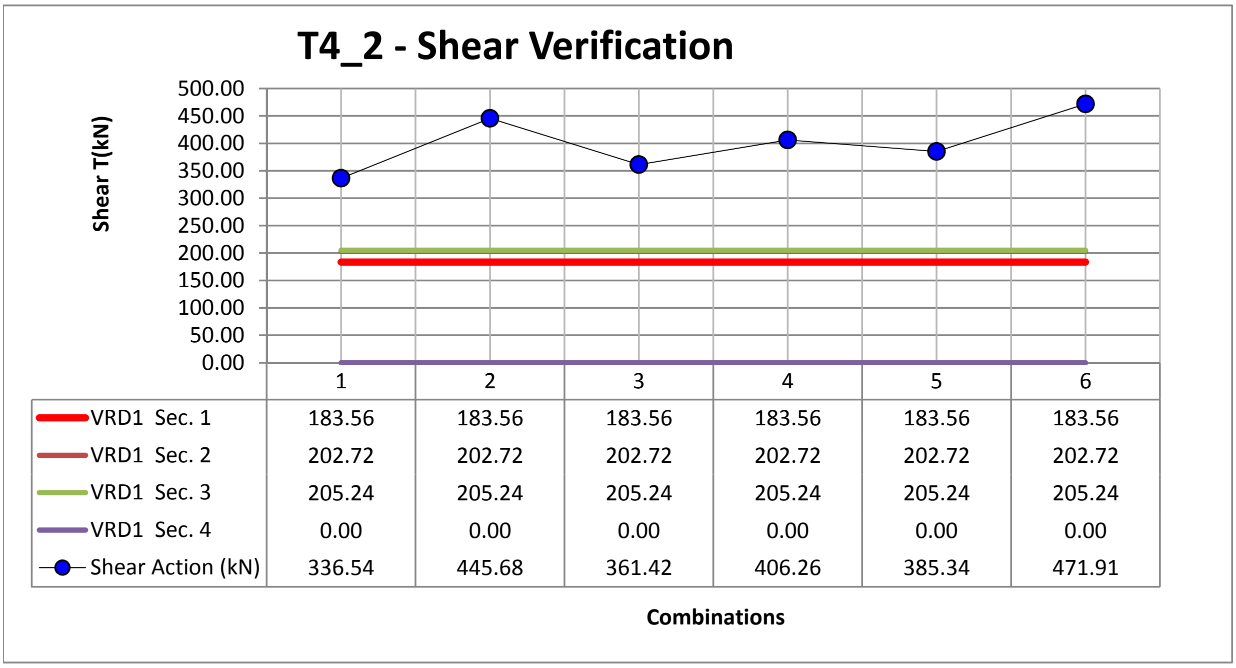
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00	37.00	
Section Width	b_w=	m	1.00	1.00	1.00	
Section height	d=	m	0.40	0.40	0.40	
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10	2.10	
Valore di k	k=		1.00	1.00	1.00	
Long. Tensile Reinforcement	Asl=	cm^2/m	11.20	24.90	26.70	
		m^2/m	0.00112	0.00249	0.00267	
Concrete coefficient	γ_c=		1.50	1.50	1.50	
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35	0.35	
Reinforcement ratio	ρ=	(< 0.02)	0.00	0.01	0.01	

Shear Bearing Capability	V_{RD1}	MN	0.1836	0.2027	0.2052	0.0000
Shear Bearing Capability	V_{RD1}	kN	183.56	202.72	205.24	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	183.56	183.56	183.56	183.56	183.56	183.56
VRD1 Sec. 2	202.72	202.72	202.72	202.72	202.72	202.72
VRD1 Sec. 3	205.24	205.24	205.24	205.24	205.24	205.24
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**336.54**	**445.68**	**361.42**	**406.26**	**385.34**	**471.91**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T4_2 - Shear Verification

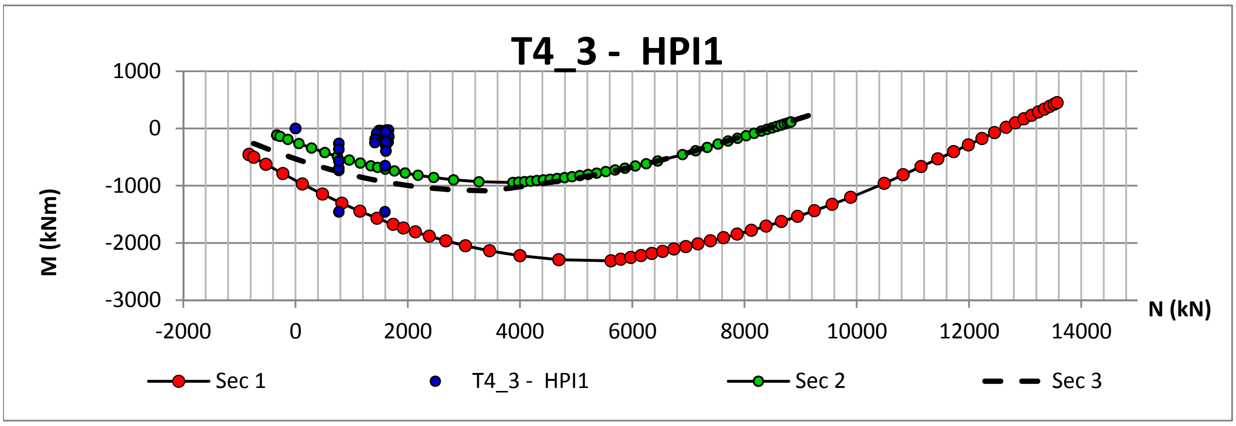


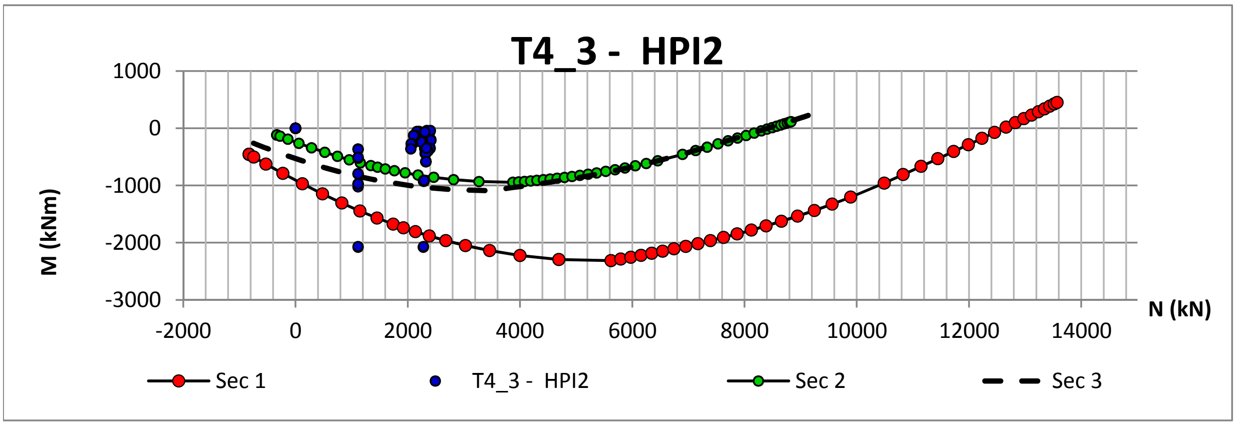
T4_3

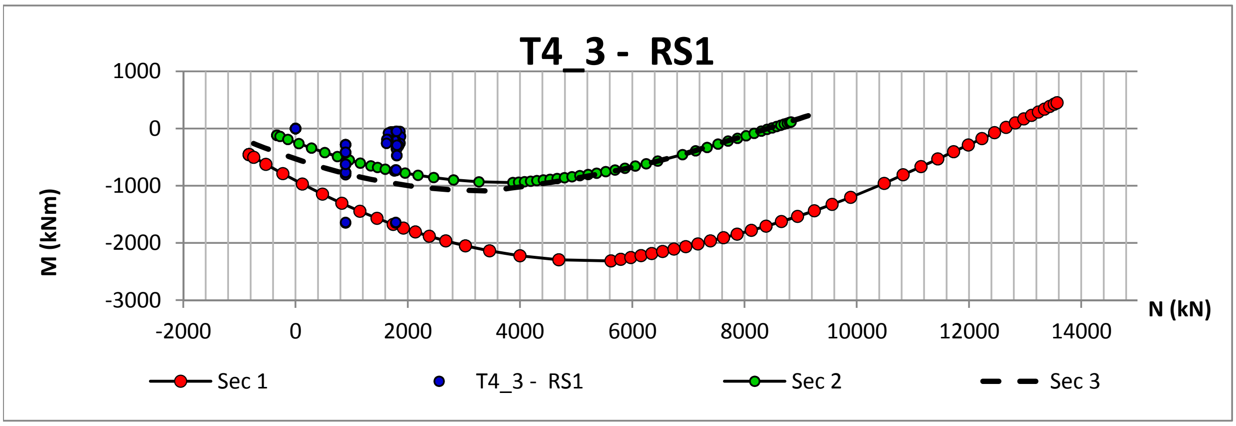
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γq	γq	γq	γq	γq	γq
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	207.5	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	150.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50





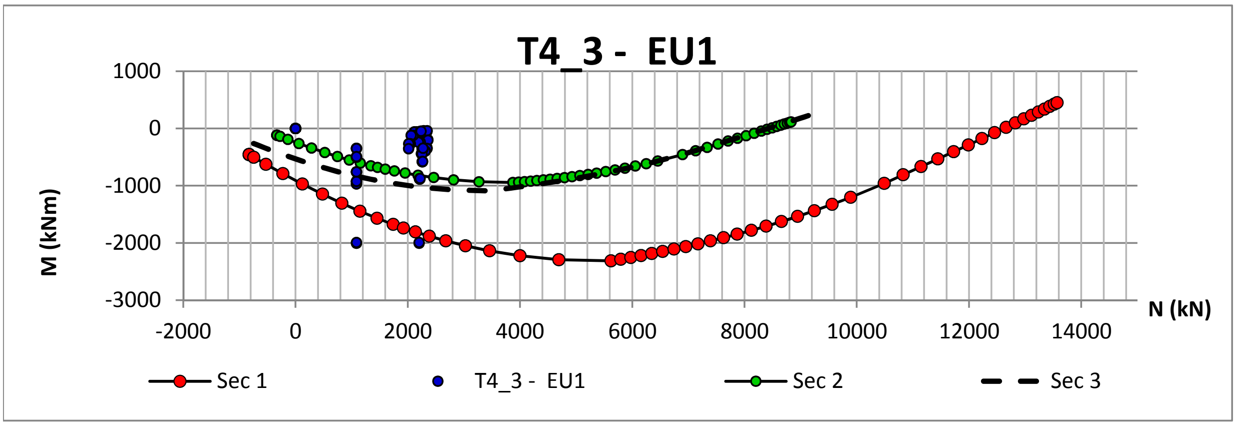


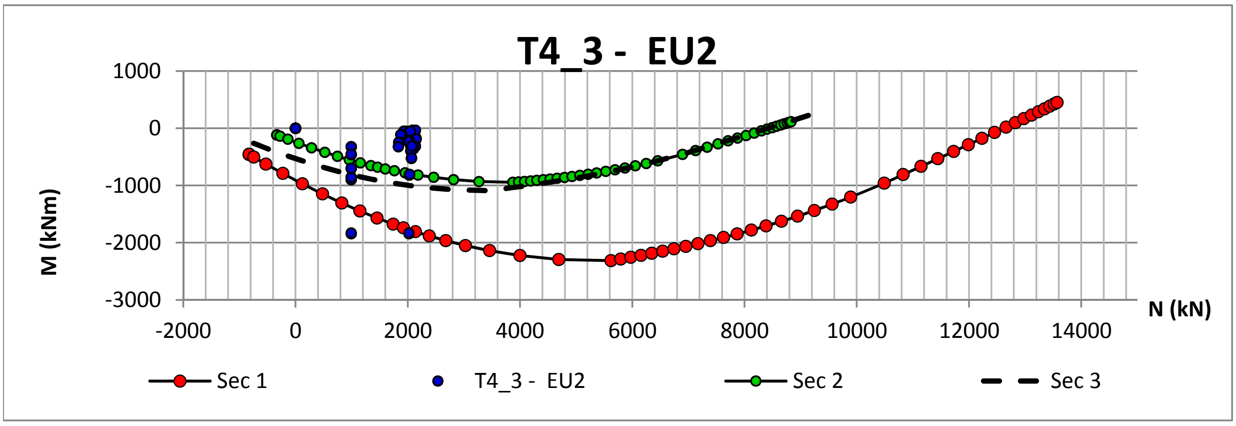
T4_3

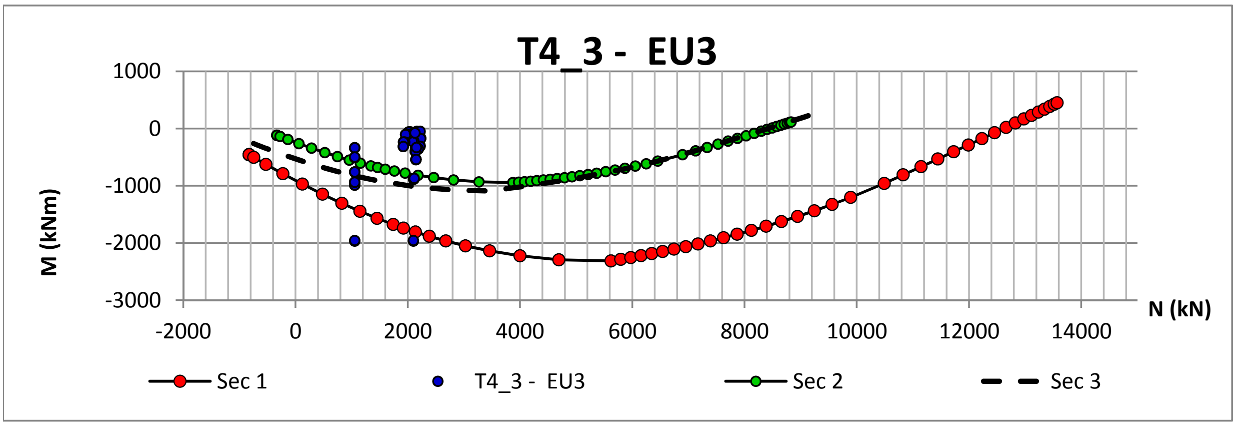
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	207.5	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	150.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50







T4_3

Shear Verification

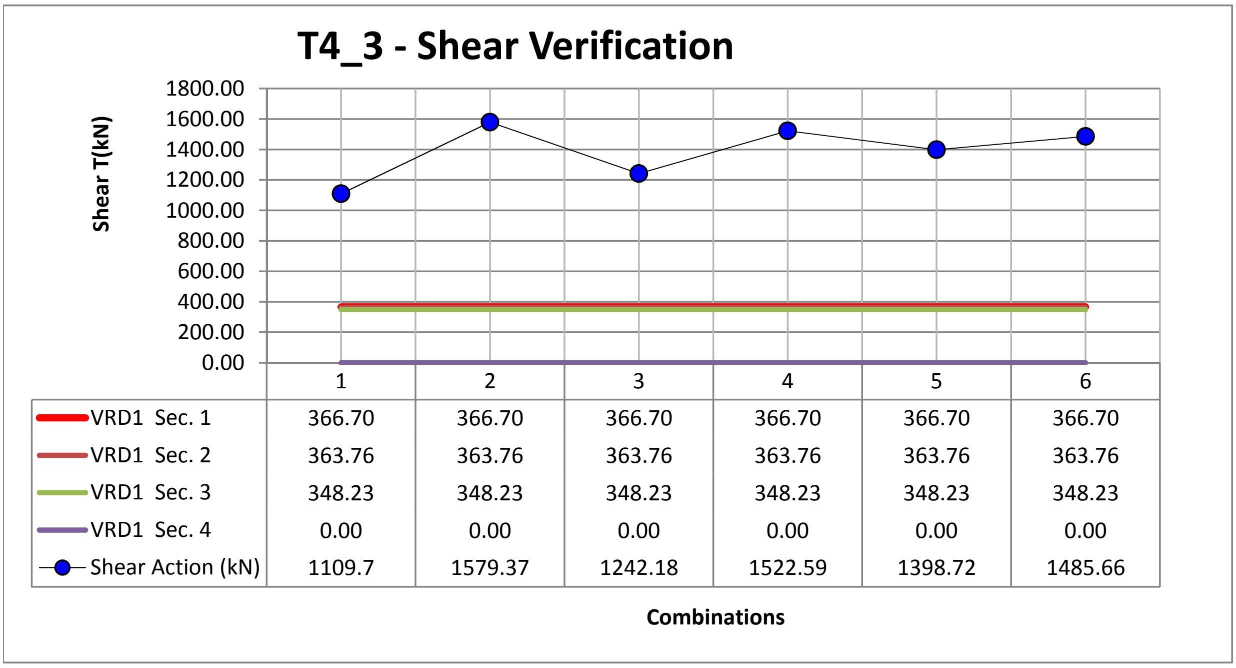
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00	37.00	
Section Width	b_w=	m	1.00	1.00	1.00	
Section height	d=	m	0.80	0.80	0.80	
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10	2.10	
Valore di k	k=		1.00	1.00	1.00	
Long. Tensile Reinforcement	Asl=	cm^2/m	22.10	20.00	8.90	
		m^2/m	0.00221	0.00200	0.00089	
Concrete coefficient	γ_c=		1.50	1.50	1.50	
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35	0.35	
Reinforcement ratio	ρ=	(< 0.02)	0.00	0.00	0.00	

Shear Bearing Capability	V_{RD1}	MN	0.3667	0.3638	0.3482	0.0000
Shear Bearing Capability	V_{RD1}	kN	366.70	363.76	348.23	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	366.70	366.70	366.70	366.70	366.70	366.70
VRD1 Sec. 2	363.76	363.76	363.76	363.76	363.76	363.76
VRD1 Sec. 3	348.23	348.23	348.23	348.23	348.23	348.23
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**1109.7**	**1579.37**	**1242.18**	**1522.59**	**1398.72**	**1485.66**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T4_3 - Shear Verification

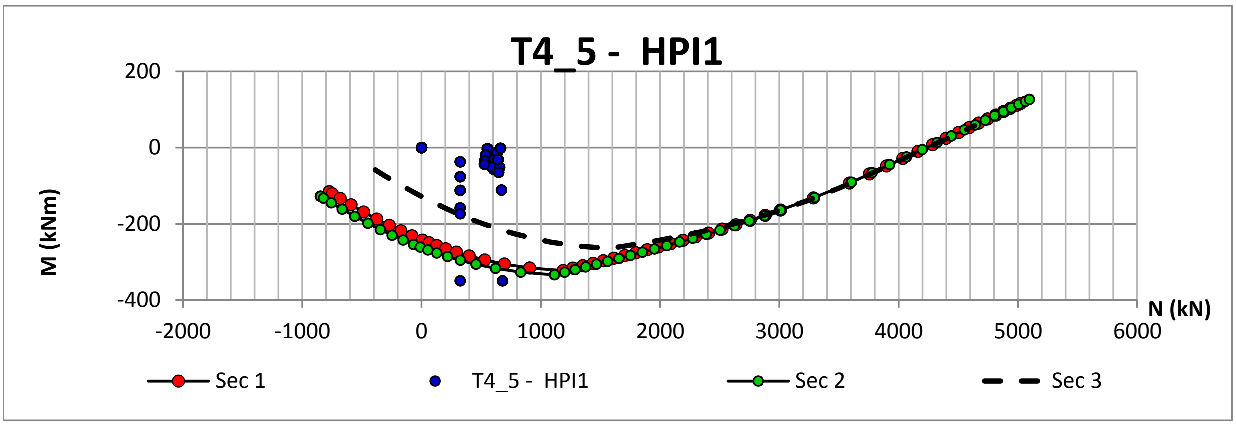


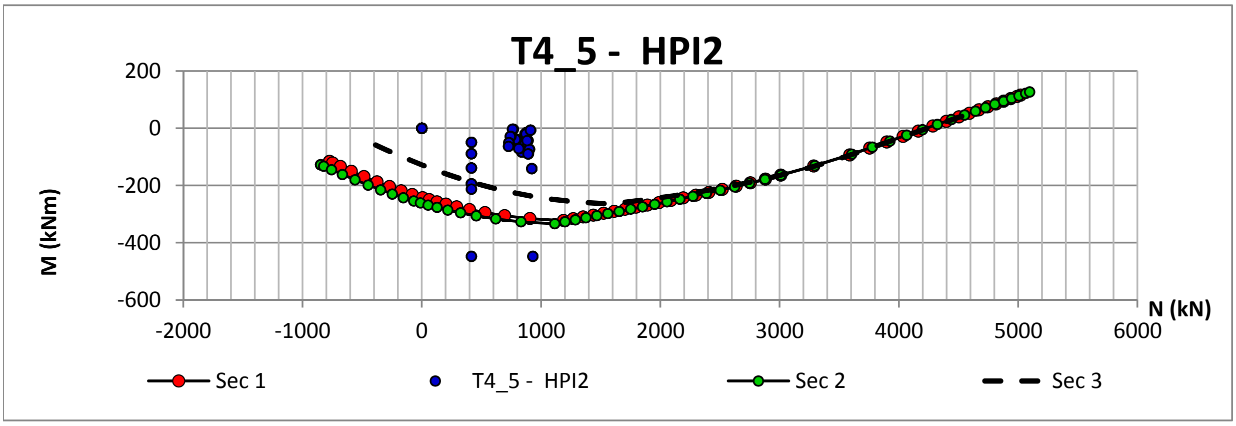
T4_5

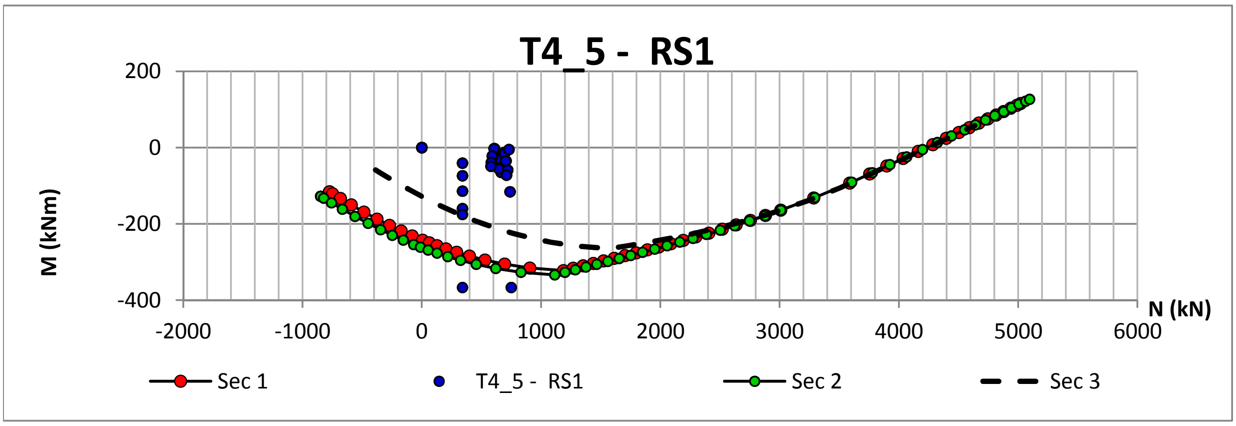
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	52.1	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	21.7	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50





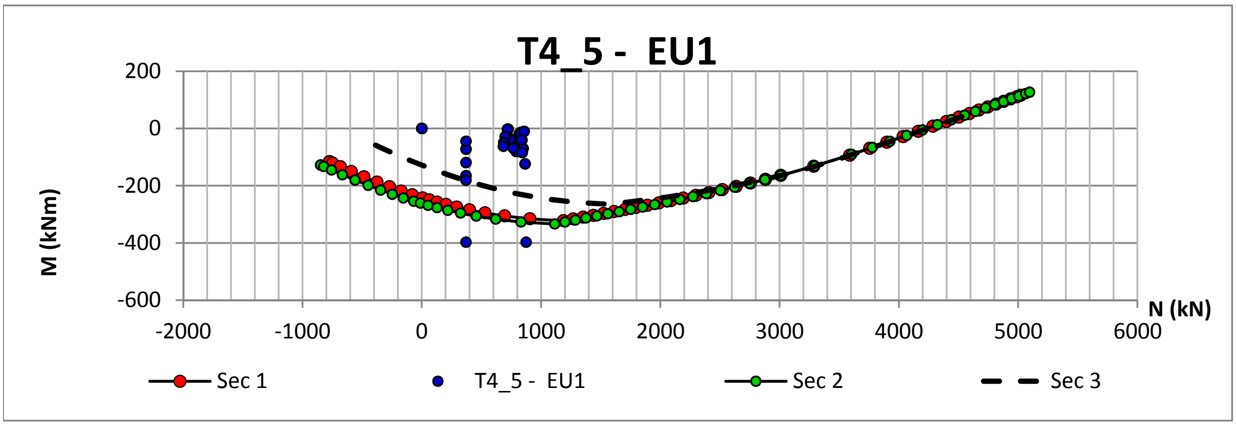


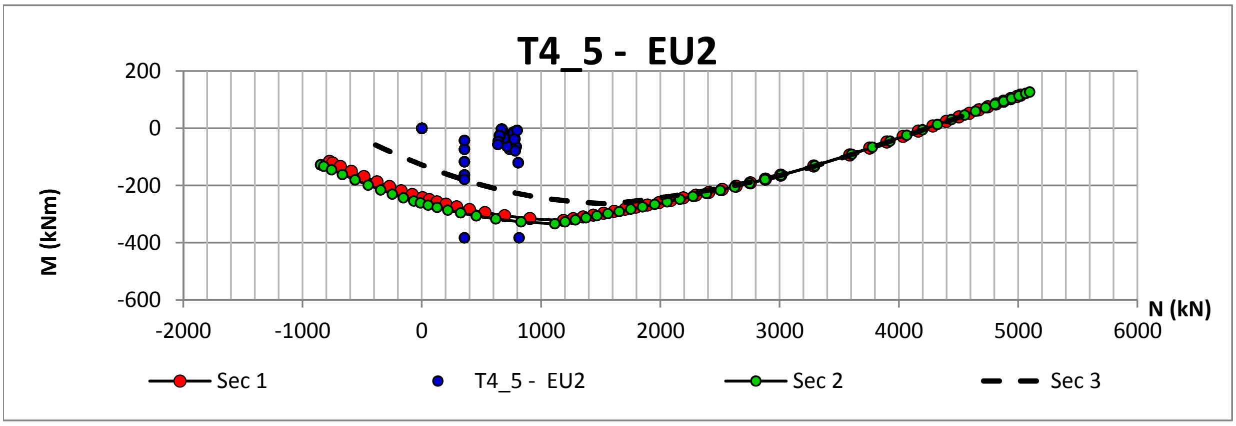
T4_5

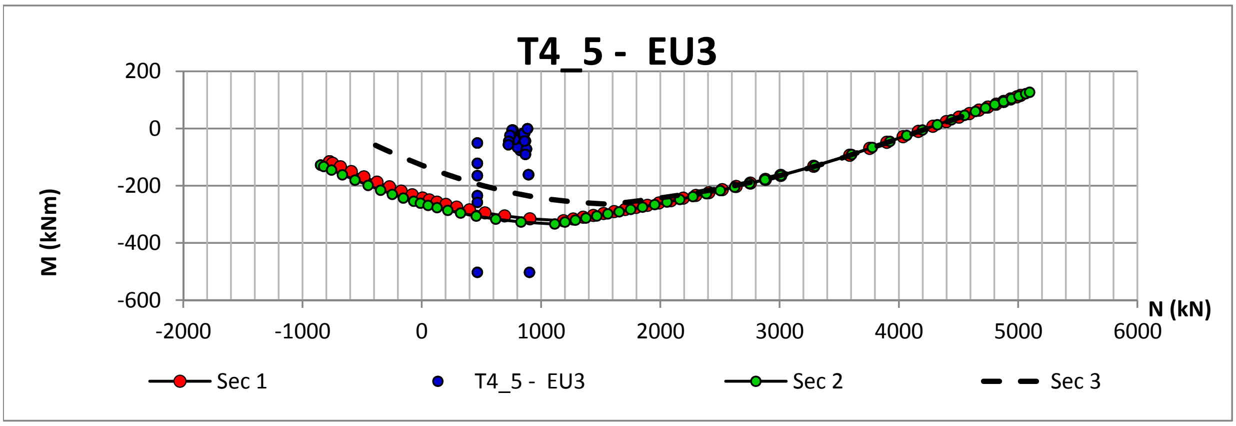
Passed	
Failed	x

No Water Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	52.1	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	21.7	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	0.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50







T4_5

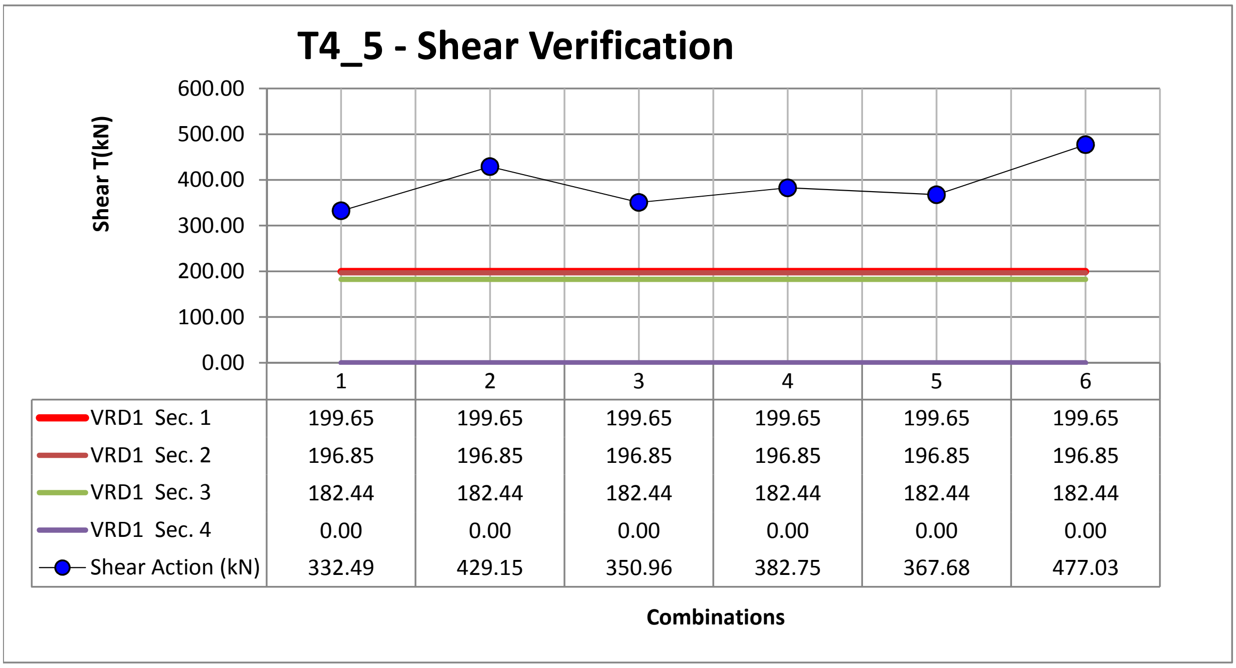
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00	37.00	
Section Width	b_w=	m	1.00	1.00	1.00	
Section height	d=	m	0.40	0.40	0.40	
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10	2.10	
Valore di k	k=		1.00	1.00	1.00	
Long. Tensile Reinforcement	Asl=	cm^2/m	22.70	20.70	10.40	
		m^2/m	0.00227	0.00207	0.00104	
Concrete coefficient	γ_c=		1.50	1.50	1.50	
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35	0.35	
Reinforcement ratio	ρ=	(< 0.02)	0.01	0.01	0.00	

Shear Bearing Capability	V_{RD1}	MN	0.1996	0.1968	0.1824	0.0000
Shear Bearing Capability	V_{RD1}	kN	199.65	196.85	182.44	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	199.65	199.65	199.65	199.65	199.65	199.65		
VRD1 Sec. 2	196.85	196.85	196.85	196.85	196.85	196.85		
VRD1 Sec. 3	182.44	182.44	182.44	182.44	182.44	182.44		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**332.49**	**429.15**	**350.96**	**382.75**	**367.68**	**477.03**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T4_5 - Shear Verification

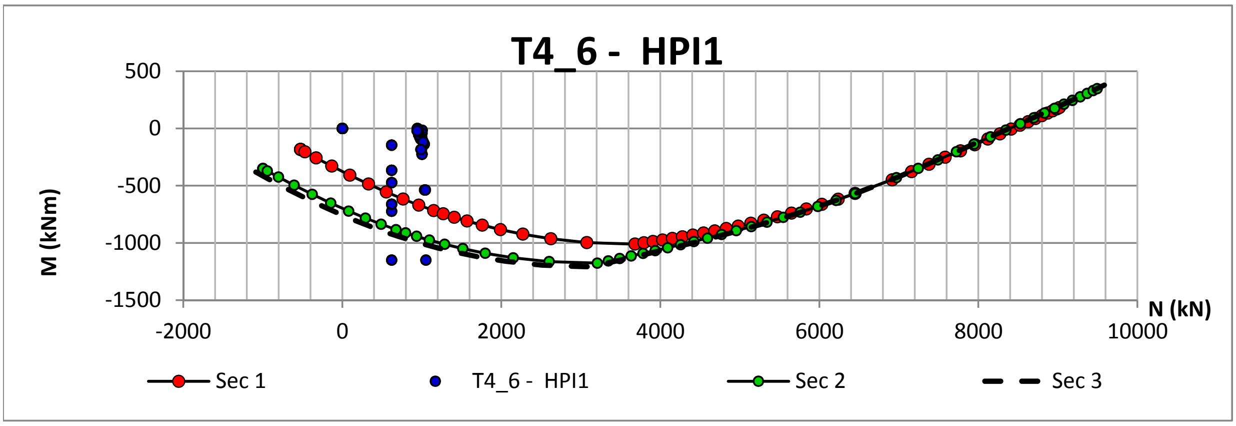


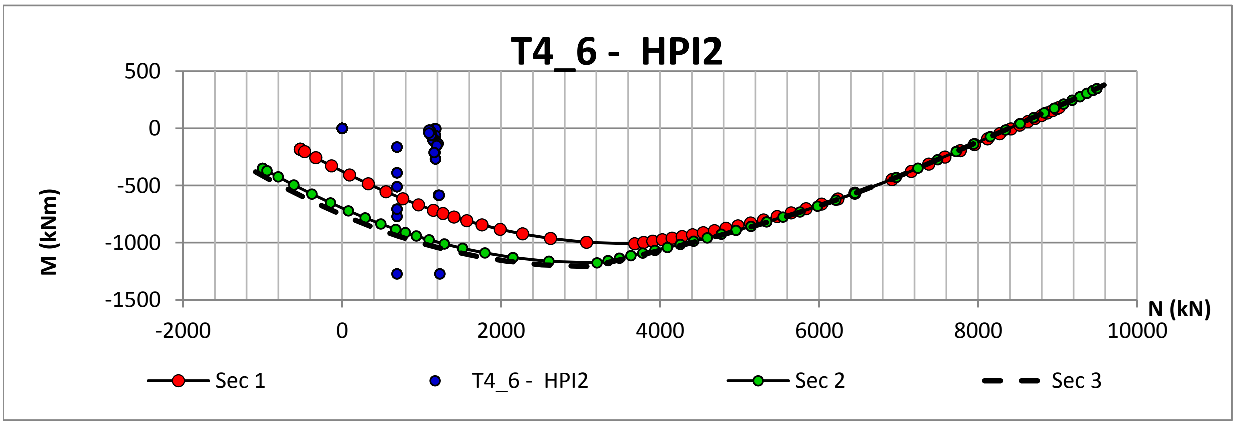
	1	2	3	4	5	6
VRD1 Sec. 1	199.65	199.65	199.65	199.65	199.65	199.65
VRD1 Sec. 2	196.85	196.85	196.85	196.85	196.85	196.85
VRD1 Sec. 3	182.44	182.44	182.44	182.44	182.44	182.44
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	332.49	429.15	350.96	382.75	367.68	477.03

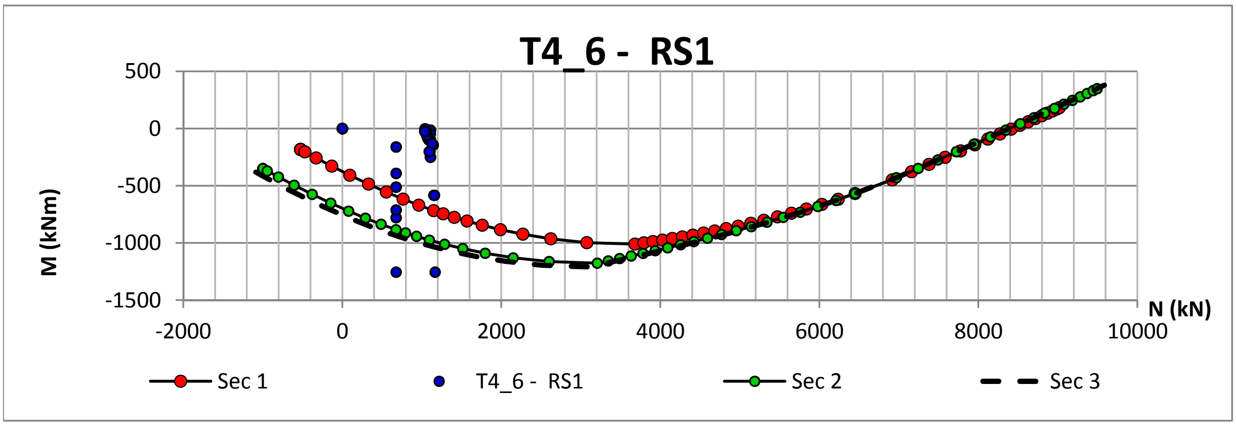
T4_6

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	27.9	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	24.1	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50



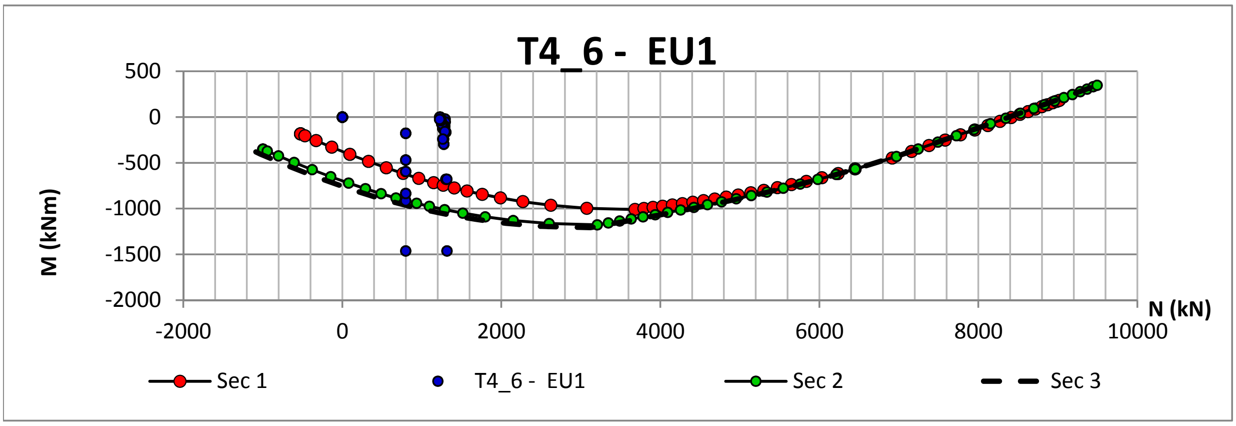


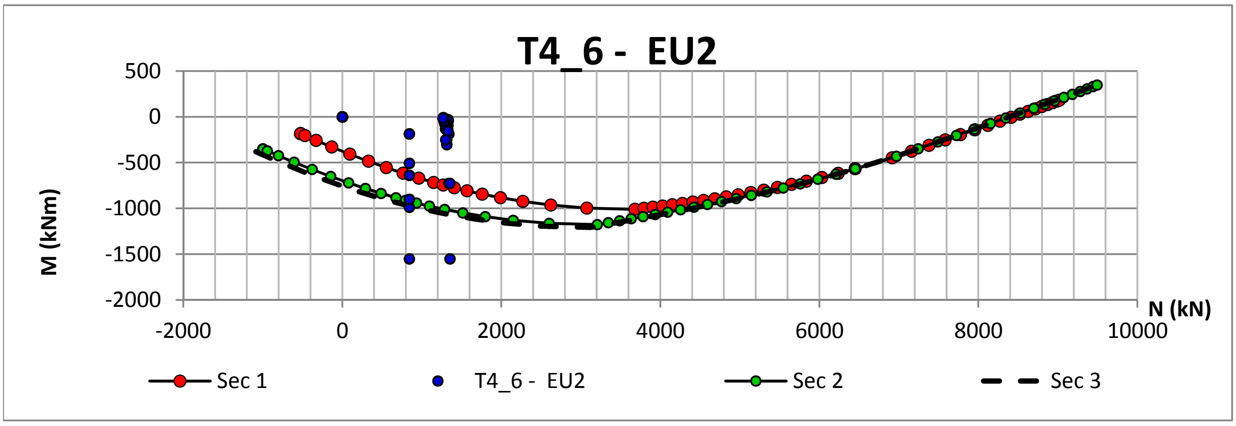


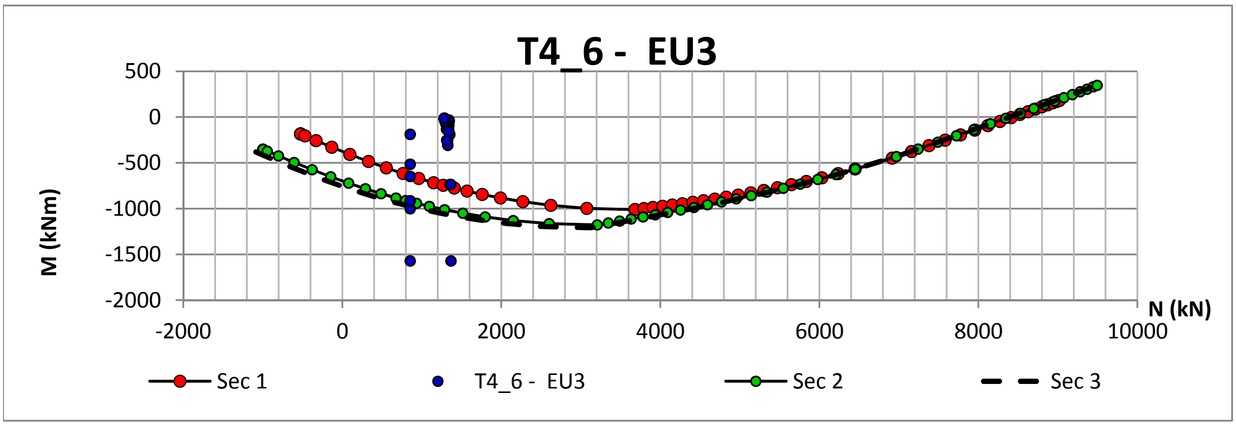
T4_6

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	27.9	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	24.1	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	35.0	1.00	1.20	1.00	1.00	1.00	1.50







T4_6

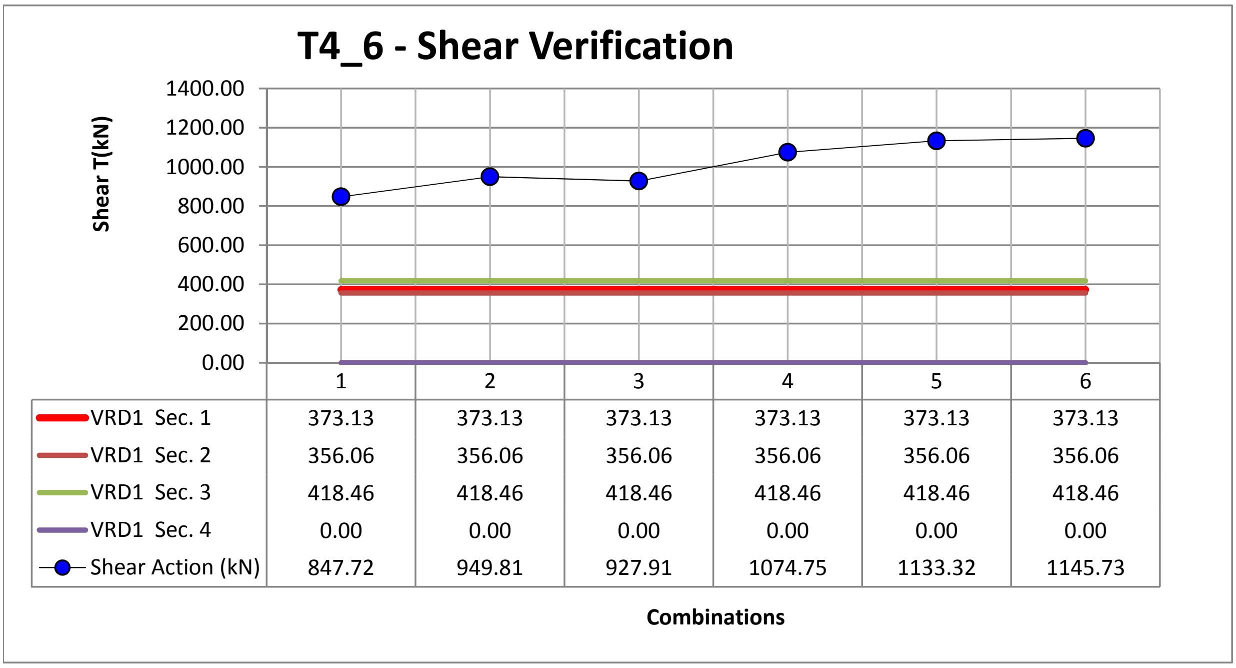
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00	37.00	37.00	
Section Width	b_w=	m	1.00	1.00	1.00	
Section height	d=	m	0.80	0.80	0.90	
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10	2.10	2.10	
Valore di k	k=		1.00	1.00	1.00	
Long. Tensile Reinforcement	Asl=	cm^2/m	26.70	14.50	29.10	
		m^2/m	0.00267	0.00145	0.00291	
Concrete coefficient	γ_c=		1.50	1.50	1.50	
Shear resistance for unit area	τ_{rd}=	Mpa	0.35	0.35	0.35	
Reinforcement ratio	ρ=	(< 0.02)	0.00	0.00	0.00	

Shear Bearing Capability	V_{RD1}	MN	0.3731	0.3561	0.4185	0.0000
Shear Bearing Capability	V_{RD1}	kN	373.13	356.06	418.46	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	373.13	373.13	373.13	373.13	373.13	373.13		
VRD1 Sec. 2	356.06	356.06	356.06	356.06	356.06	356.06		
VRD1 Sec. 3	418.46	418.46	418.46	418.46	418.46	418.46		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**847.72**	**949.81**	**927.91**	**1074.75**	**1133.32**	**1145.73**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

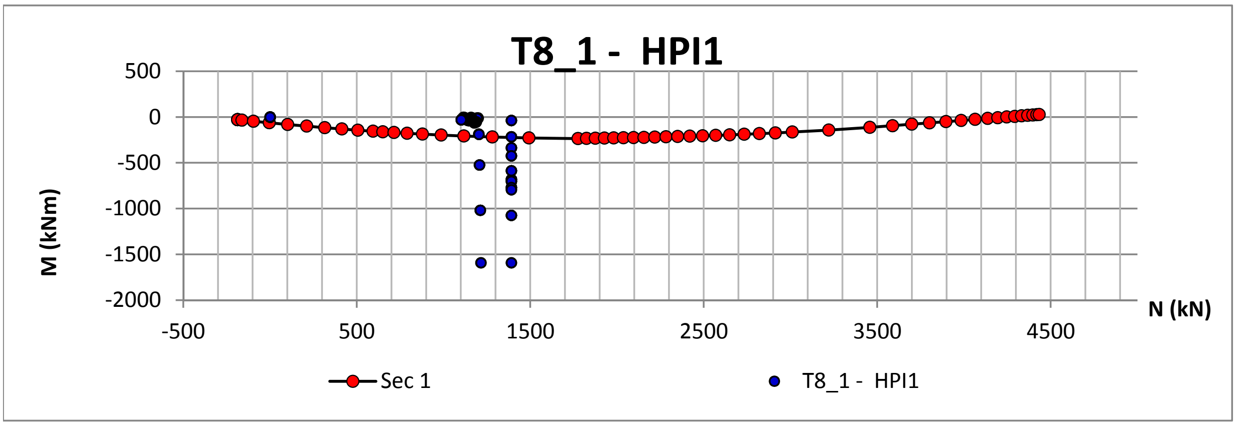
T4_6 - Shear Verification

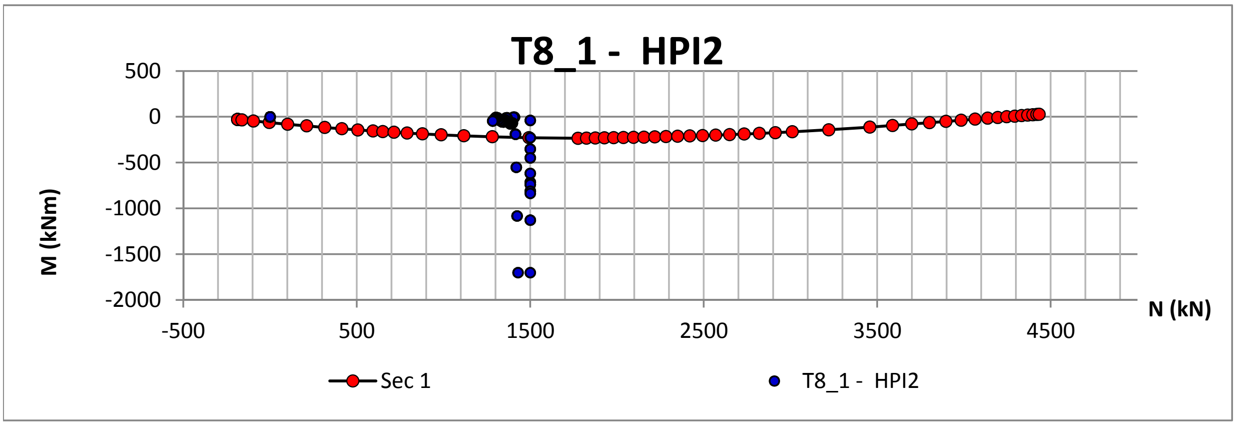


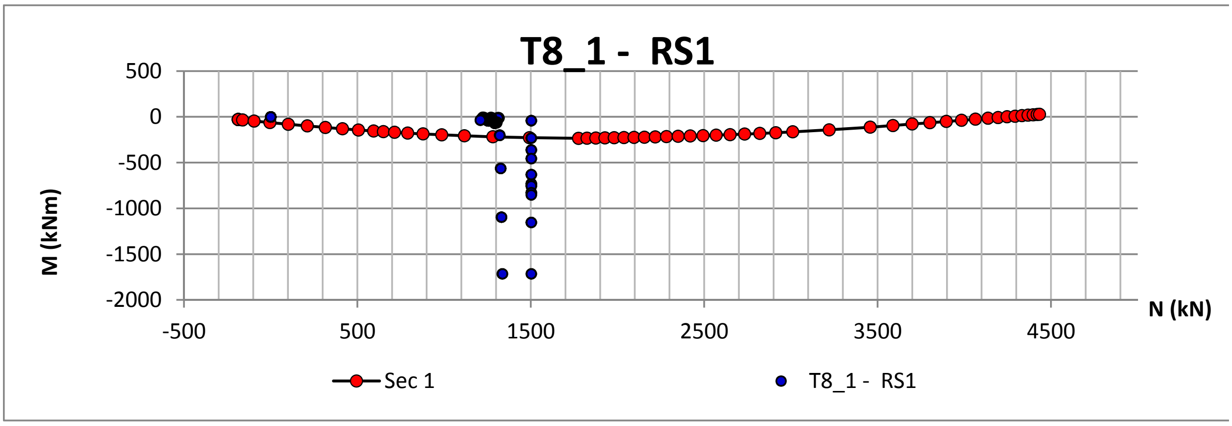
T8_1

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	78.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50



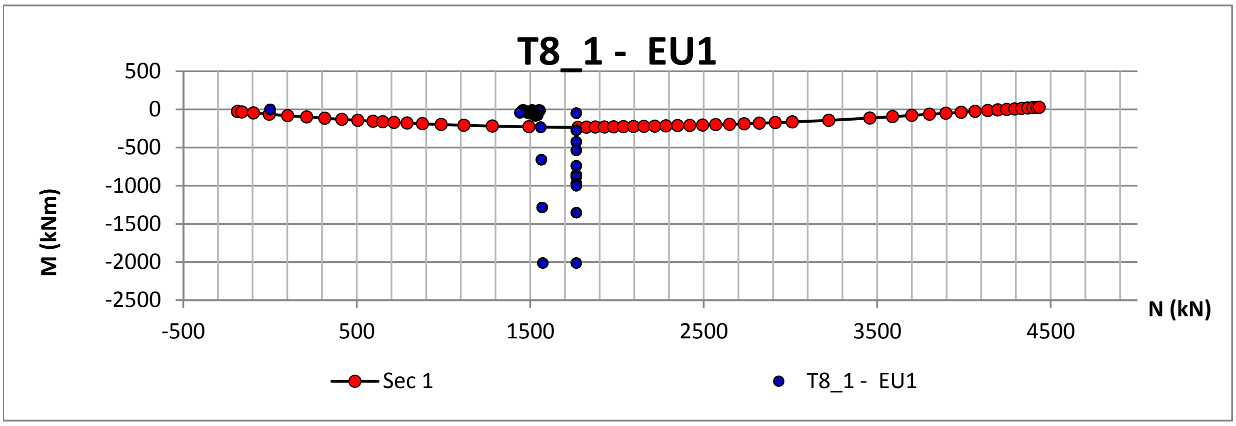


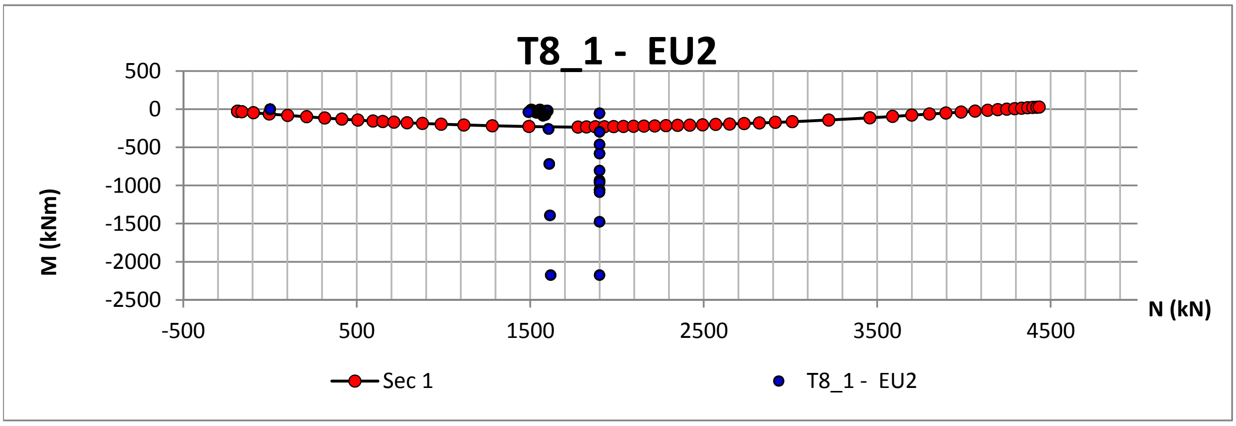


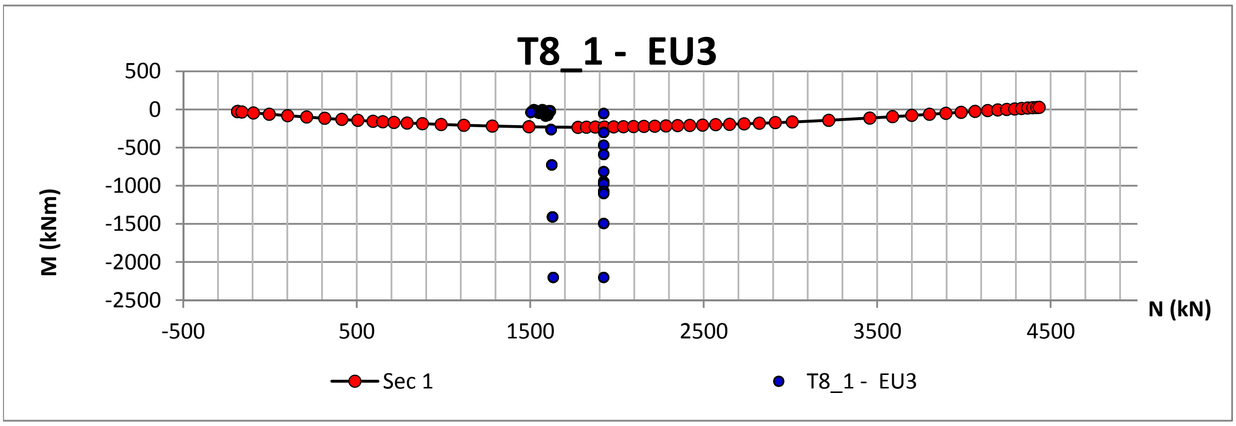
T8_1

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	78.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







T8_1

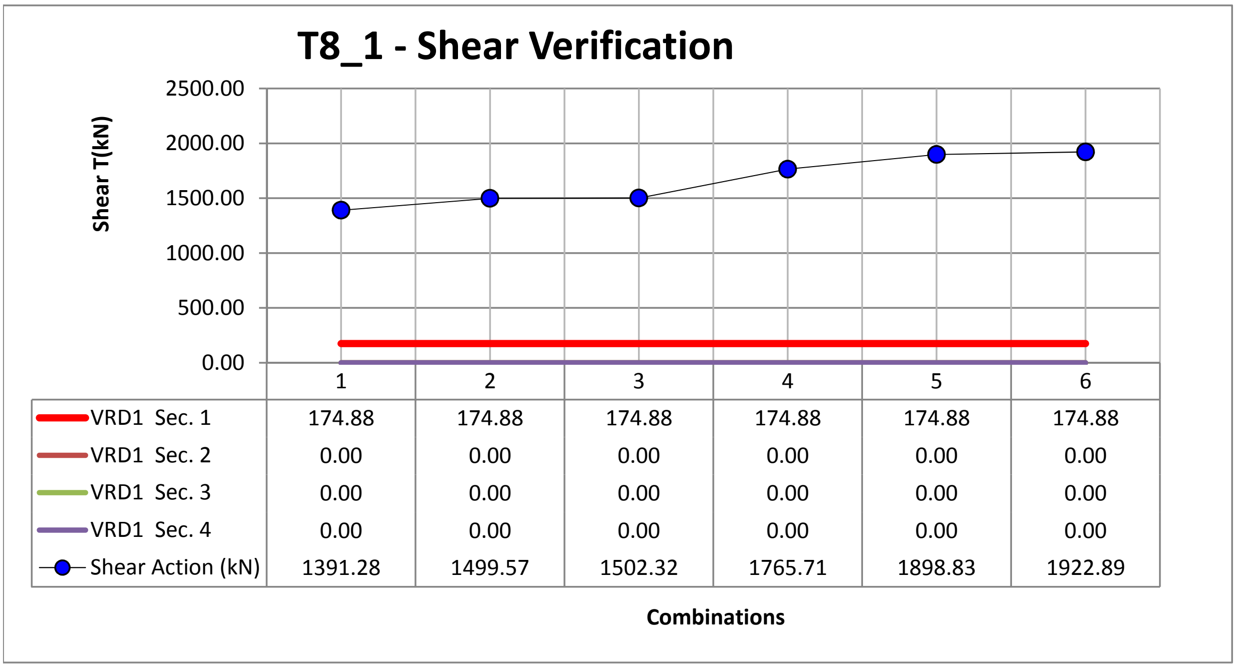
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	5.00			
		m^2/m	0.00050			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.1749	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	174.88	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	174.88	174.88	174.88	174.88	174.88	174.88		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**1391.28**	**1499.57**	**1502.32**	**1765.71**	**1898.83**	**1922.89**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T8_1 - Shear Verification

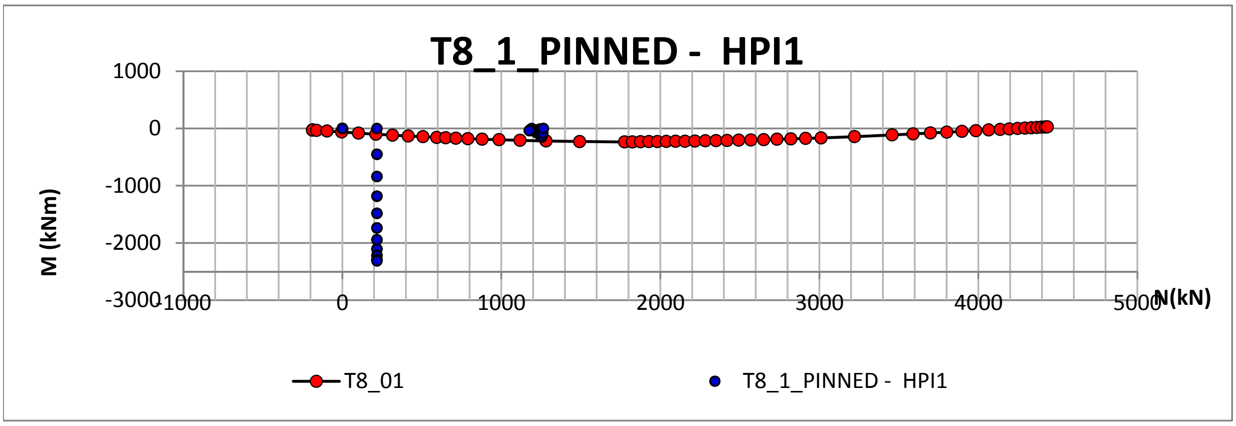


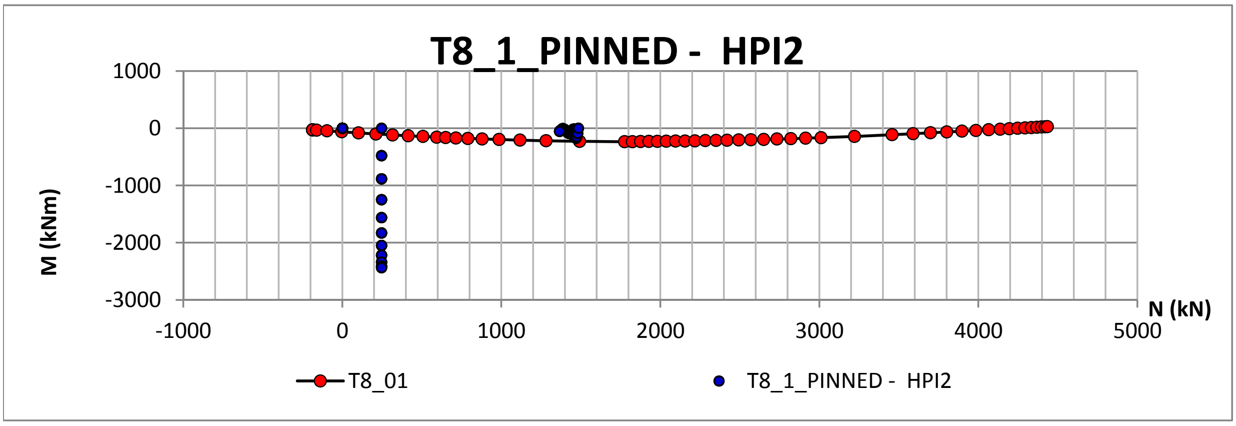
	1	2	3	4	5	6
VRD1 Sec. 1	174.88	174.88	174.88	174.88	174.88	174.88
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	1391.28	1499.57	1502.32	1765.71	1898.83	1922.89

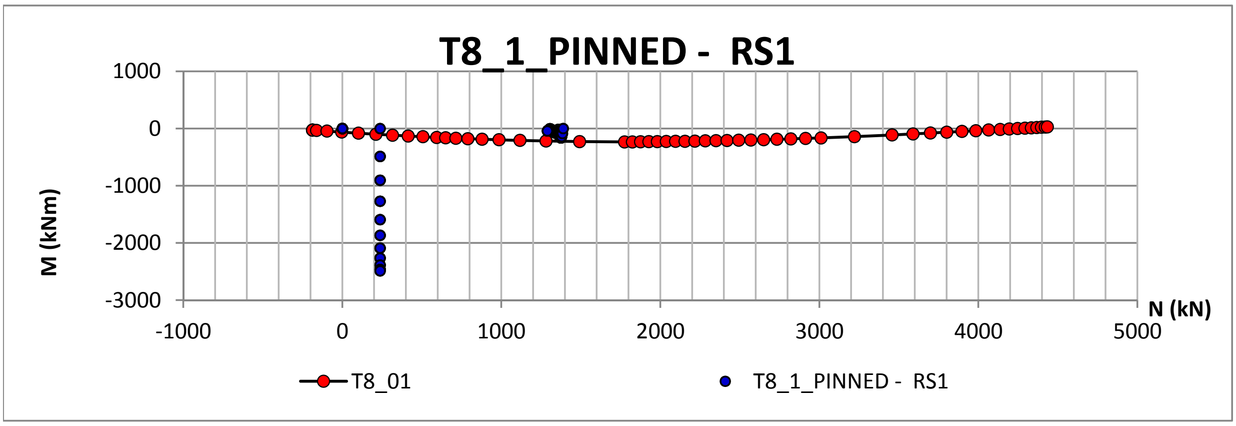
T8_1_PINNED

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	78.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50



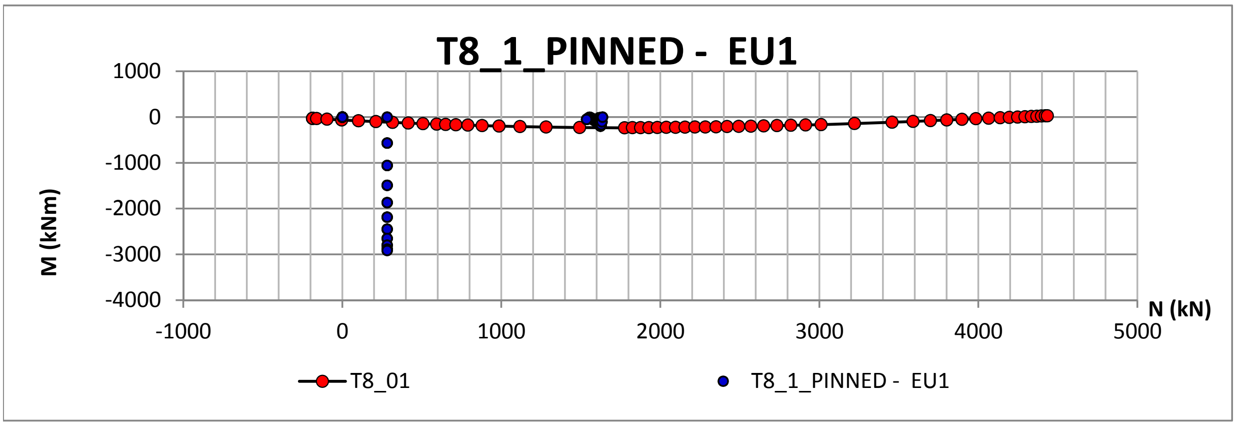


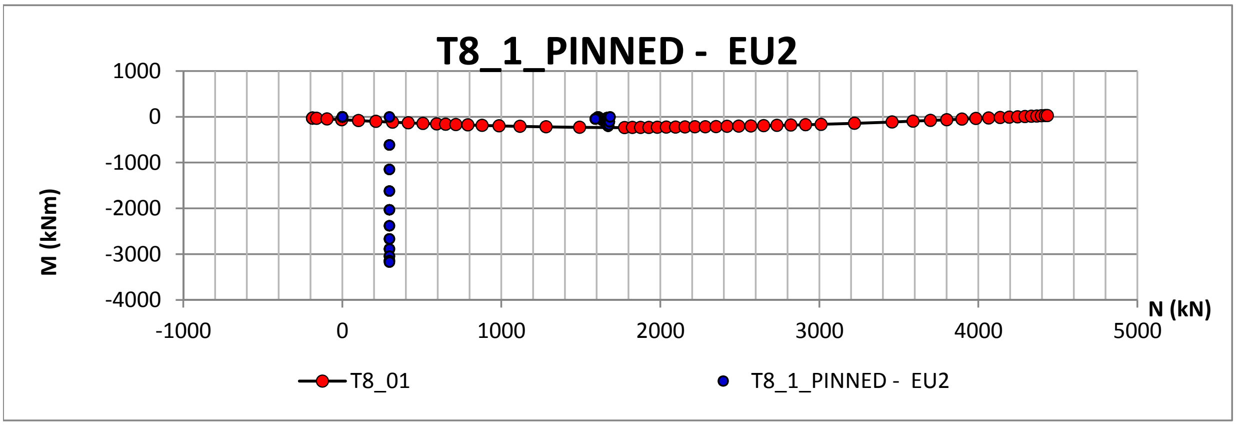


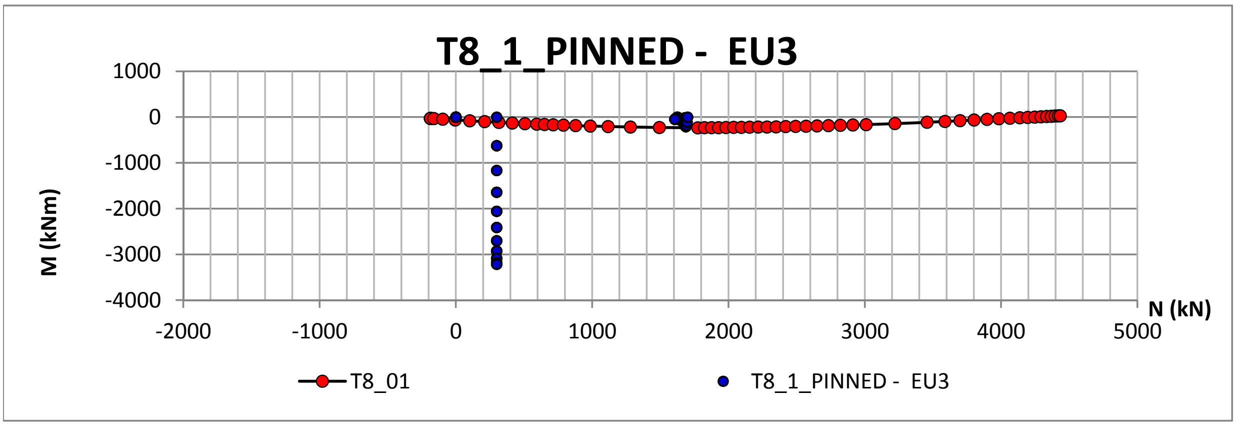
T8_1_PINNED

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	78.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







T8_1_PINNED

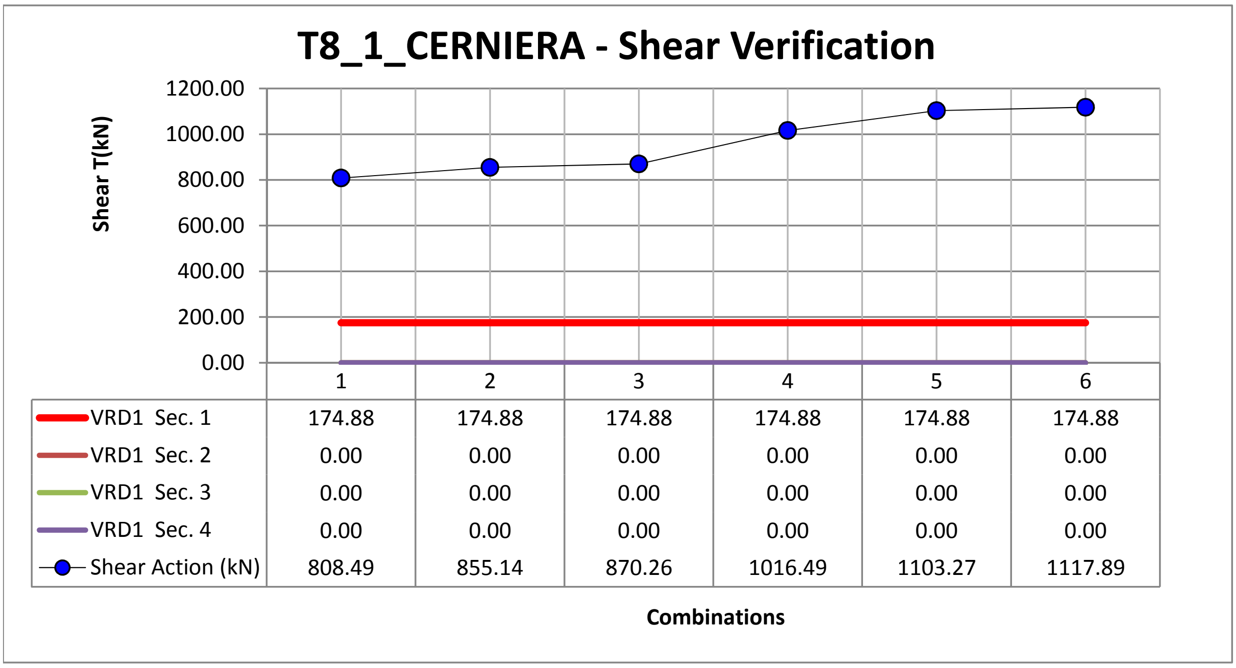
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	5.00			
		m^2/m	0.00050			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00125			

Shear Bearing Capability	V_{RD1}	MN	0.1749	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	174.88	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	174.88	174.88	174.88	174.88	174.88	174.88		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**808.49**	**855.14**	**870.26**	**1016.49**	**1103.27**	**1117.89**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T8_1_PINNED - Shear Verification

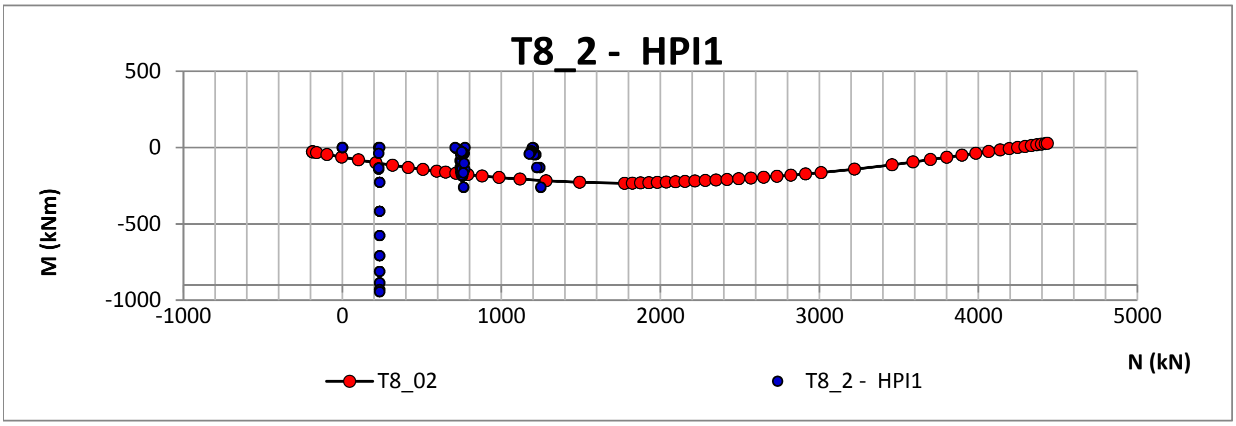


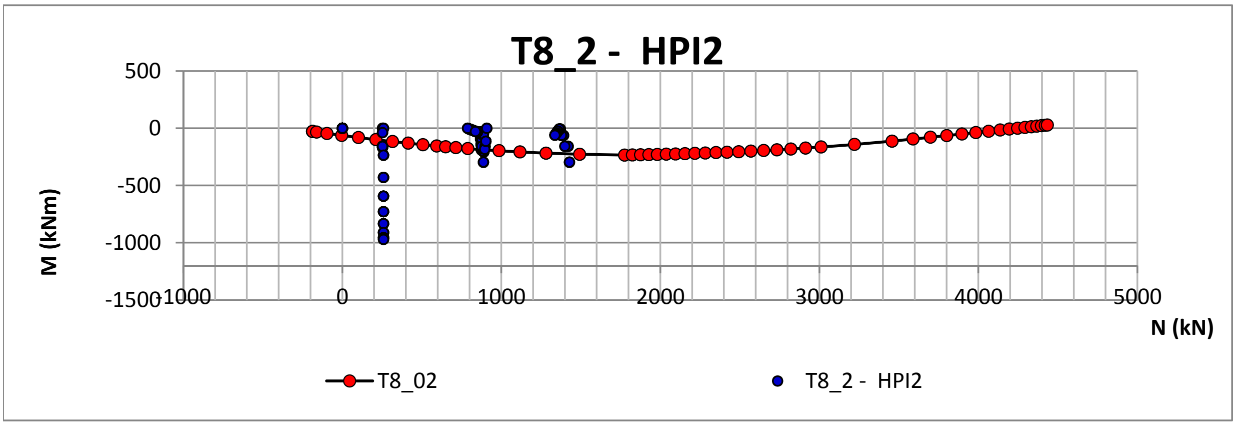
	1	2	3	4	5	6
VRD1 Sec. 1	174.88	174.88	174.88	174.88	174.88	174.88
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	808.49	855.14	870.26	1016.49	1103.27	1117.89

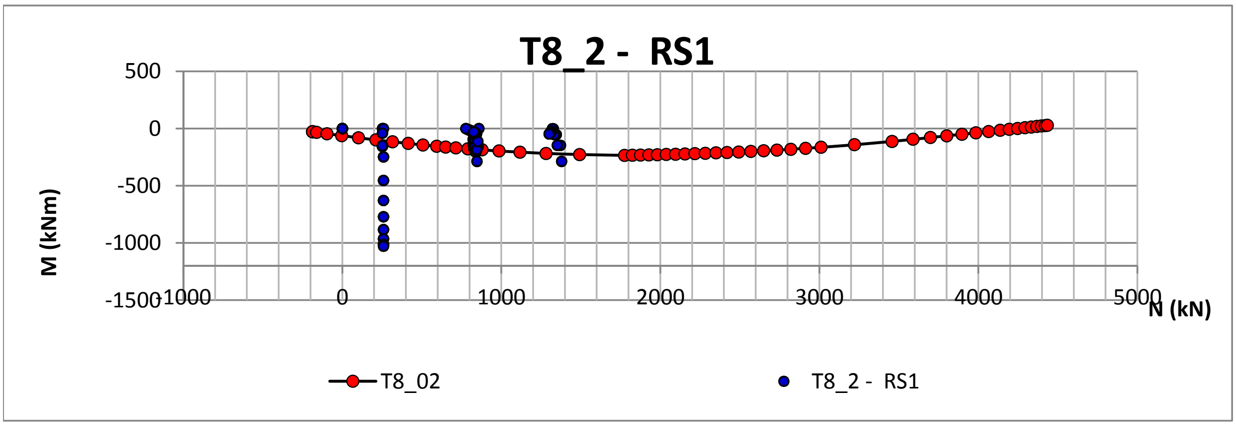
T8_2

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	78.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50



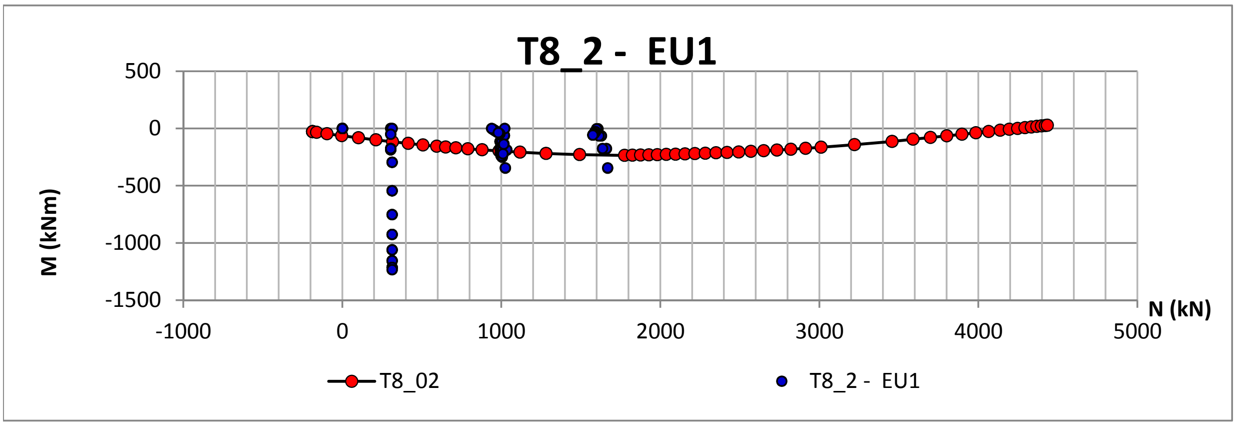


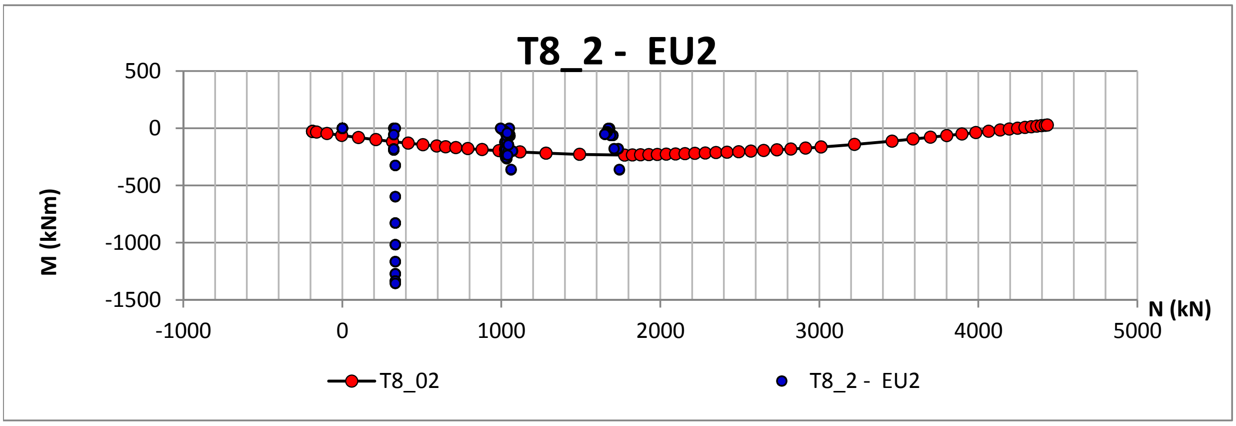


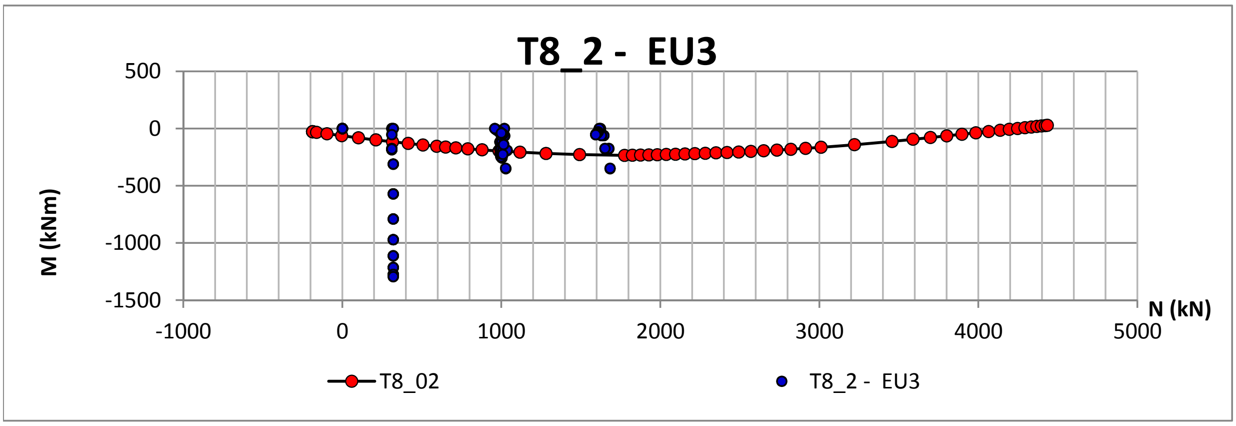
T8_2

Passed	
Failed	x

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	78.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.9	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	55.0	1.00	1.20	1.00	1.00	1.00	1.50







T8_2

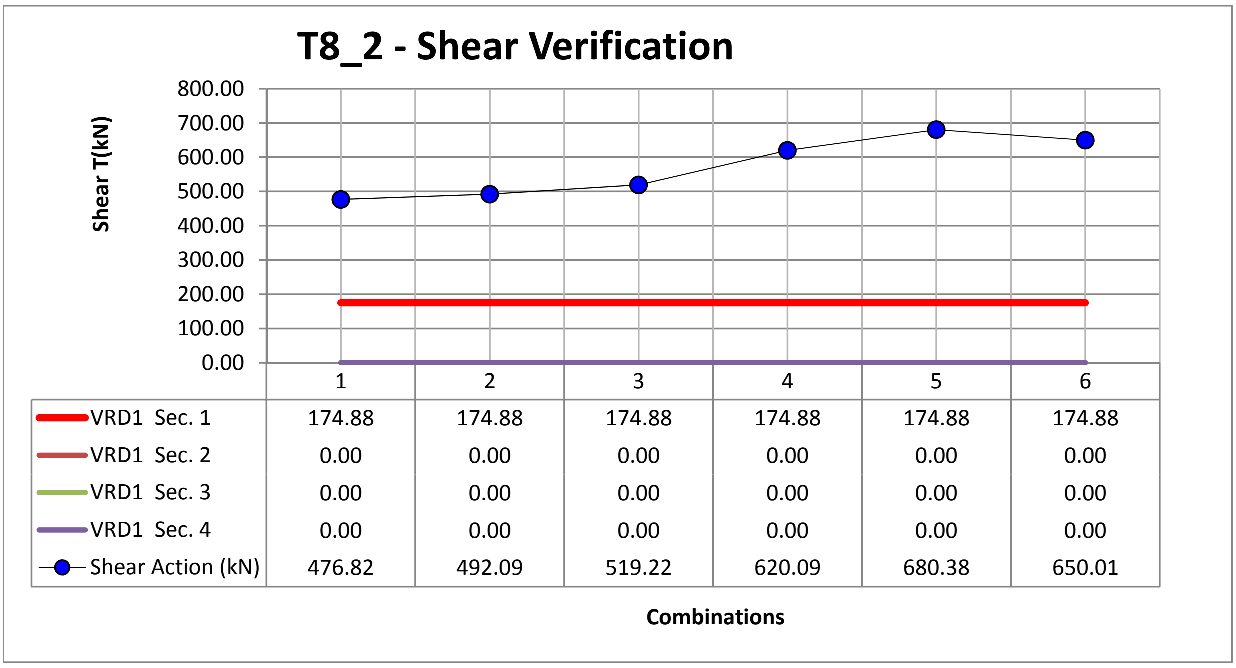
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	5.00			
		m^2/m	0.00050			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00			

Shear Bearing Capability	V_{RD1}	MN	0.1749	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	174.88	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3	Group 1	Group 2
VRD1 Sec. 1	174.88	174.88	174.88	174.88	174.88	174.88		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**476.82**	**492.09**	**519.22**	**620.09**	**680.38**	**650.01**		
Passed								
Failed	x	x	x	x	x	x	x	x

T8_2 - Shear Verification



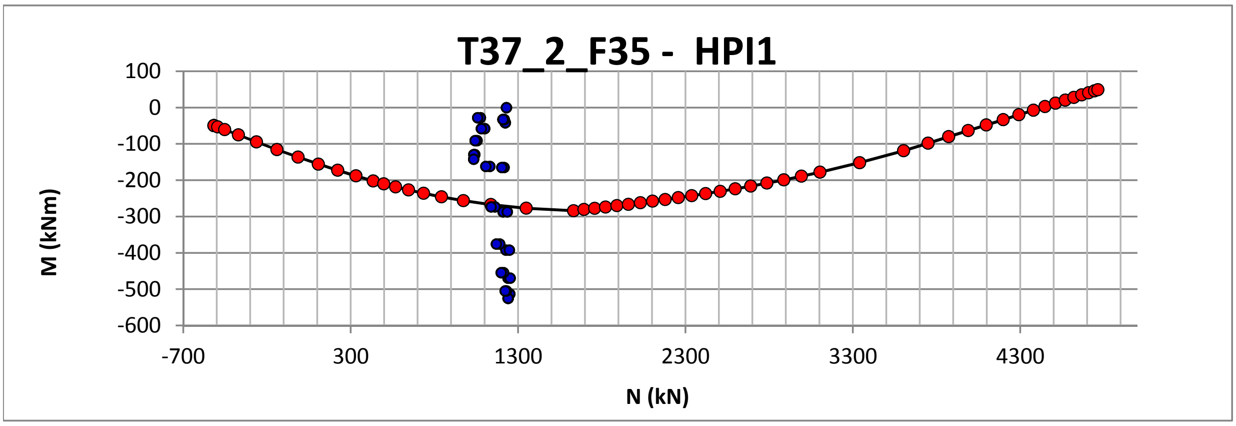
	1	2	3	4	5	6
VRD1 Sec. 1	174.88	174.88	174.88	174.88	174.88	174.88
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	476.82	492.09	519.22	620.09	680.38	650.01

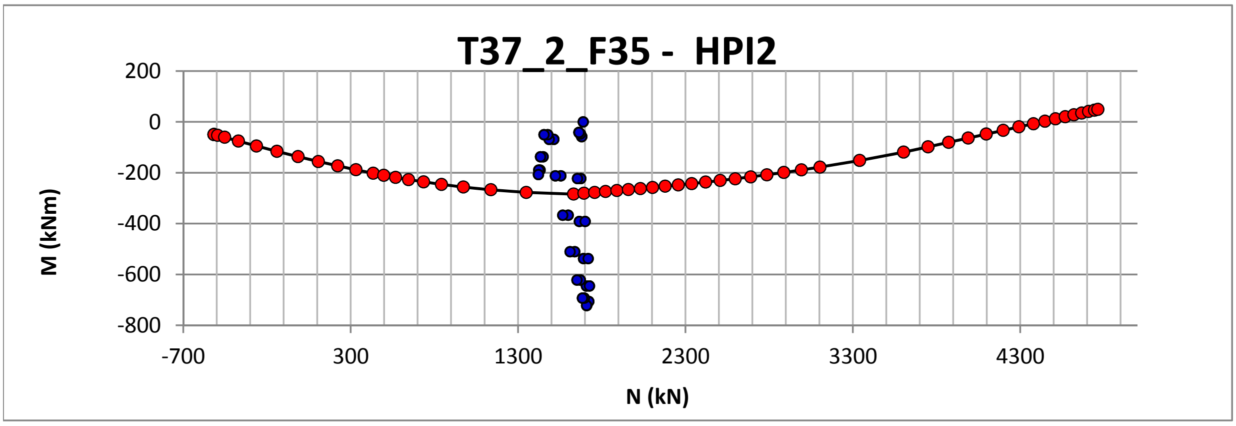
T37_2_F35

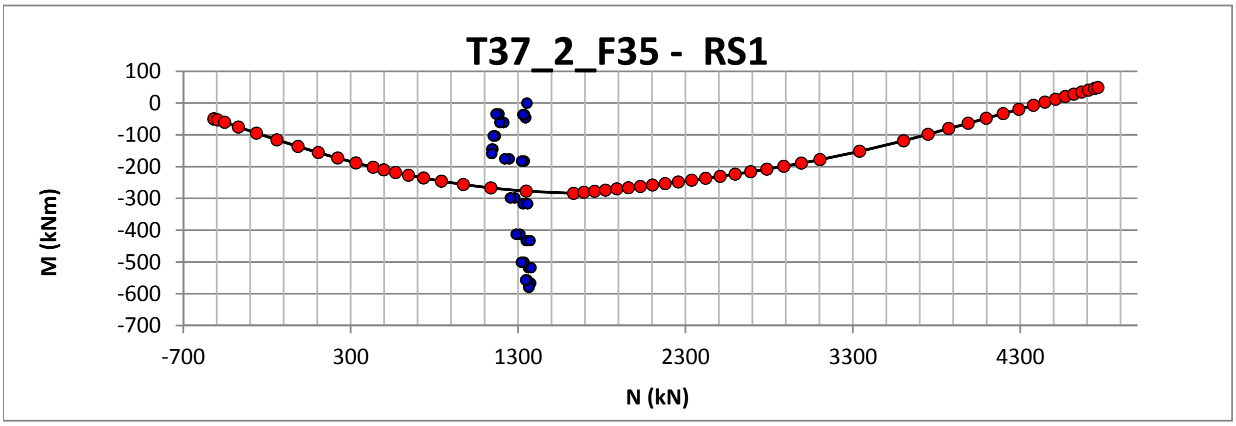
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





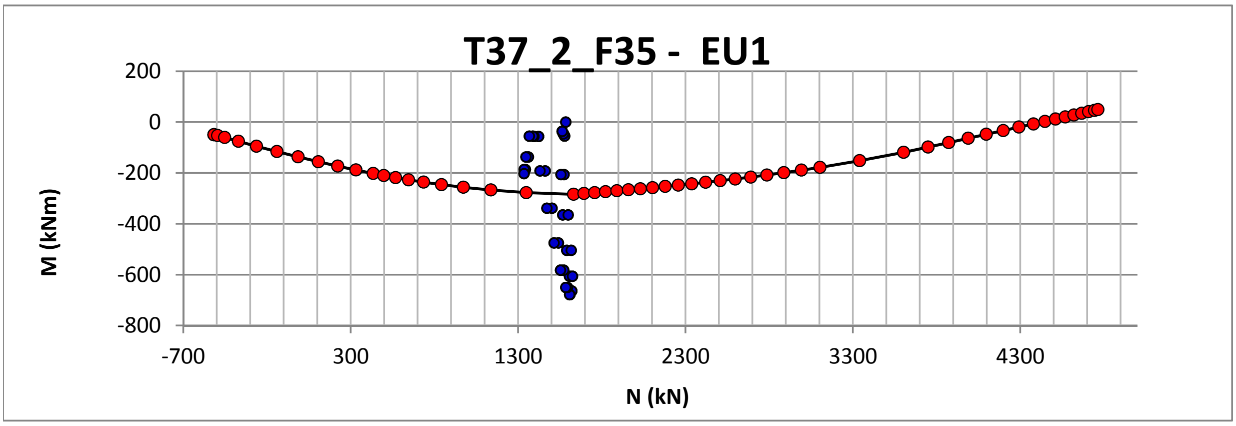


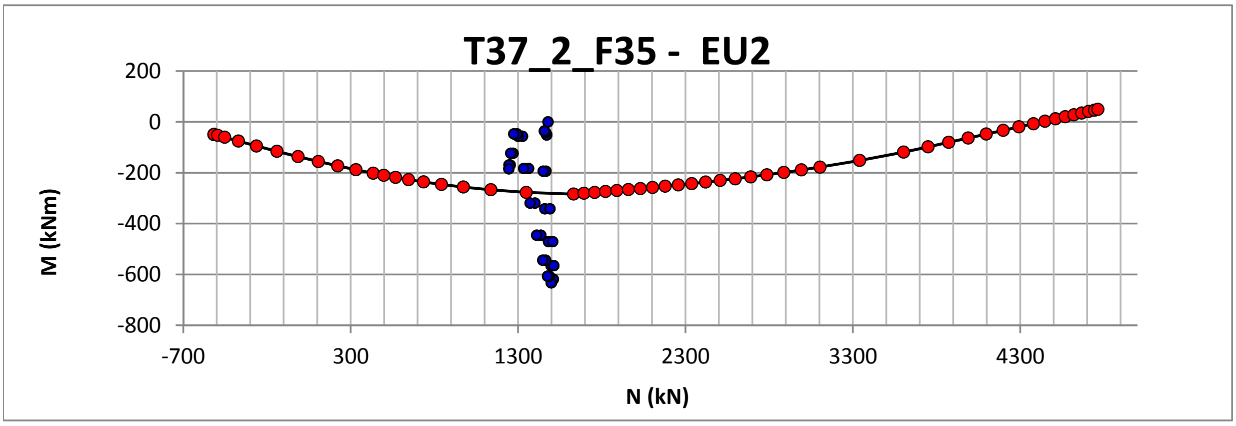
T37_2_F35

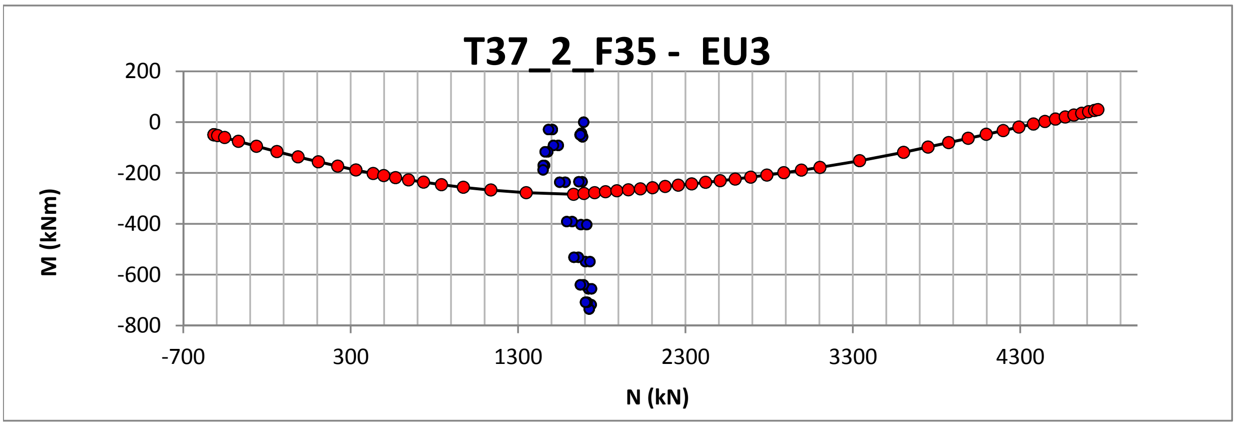
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







T37_2_F35

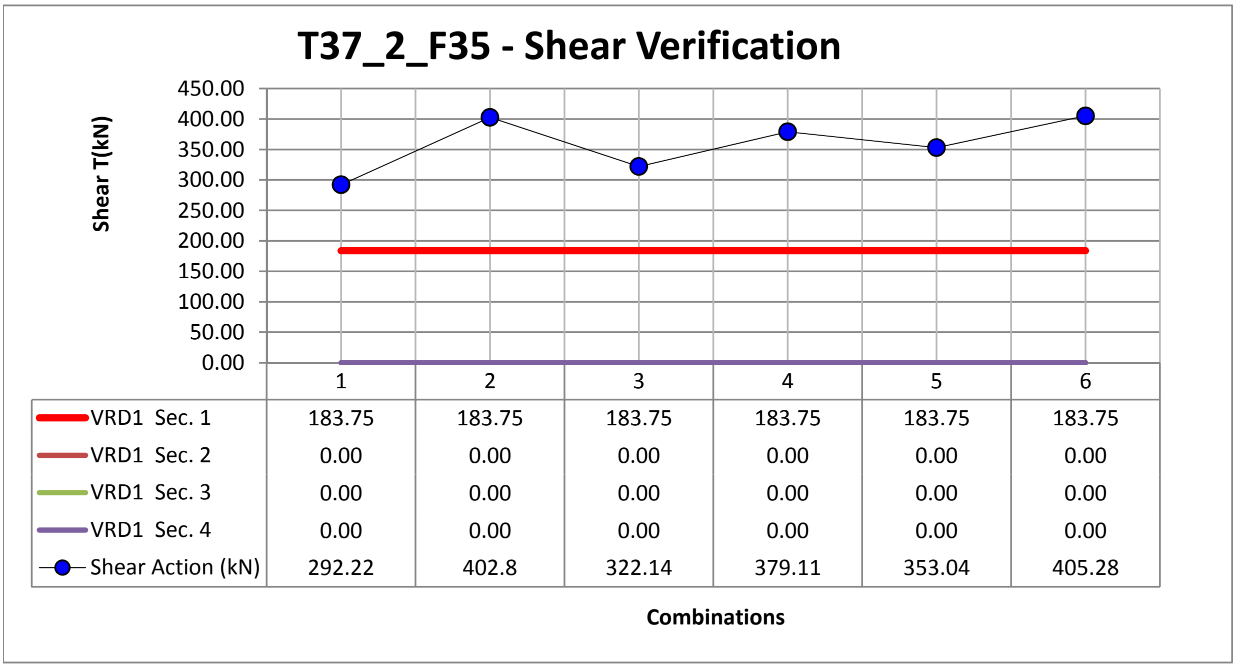
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	11.34			
		m^2/m	0.00113			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.0028			

Shear Bearing Capability	V_{RD1}	MN	0.1838	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	183.75	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	183.75	183.75	183.75	183.75	183.75	183.75		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**292.22**	**402.8**	**322.14**	**379.11**	**353.04**	**405.28**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T37_2_F35 - Shear Verification



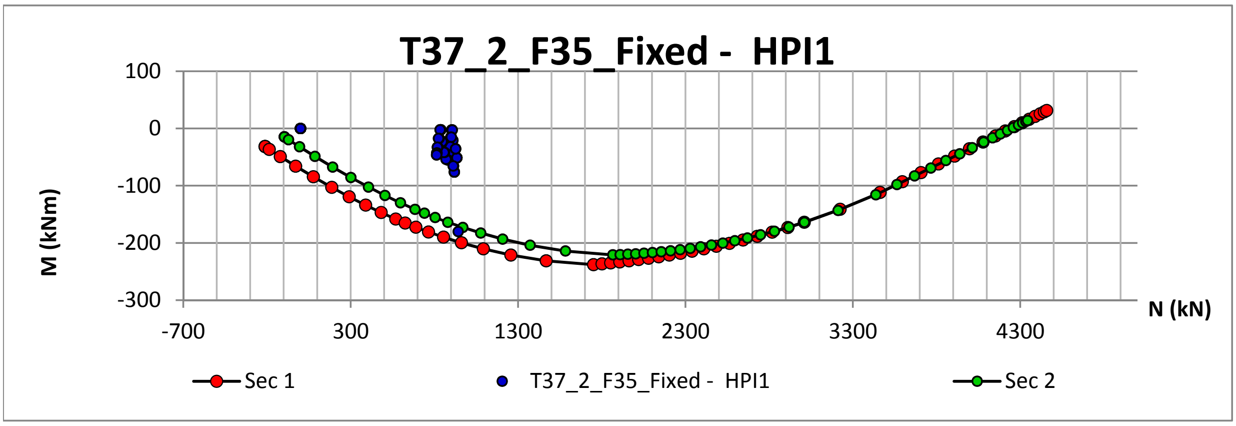
	1	2	3	4	5	6
VRD1 Sec. 1	183.75	183.75	183.75	183.75	183.75	183.75
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	292.22	402.8	322.14	379.11	353.04	405.28

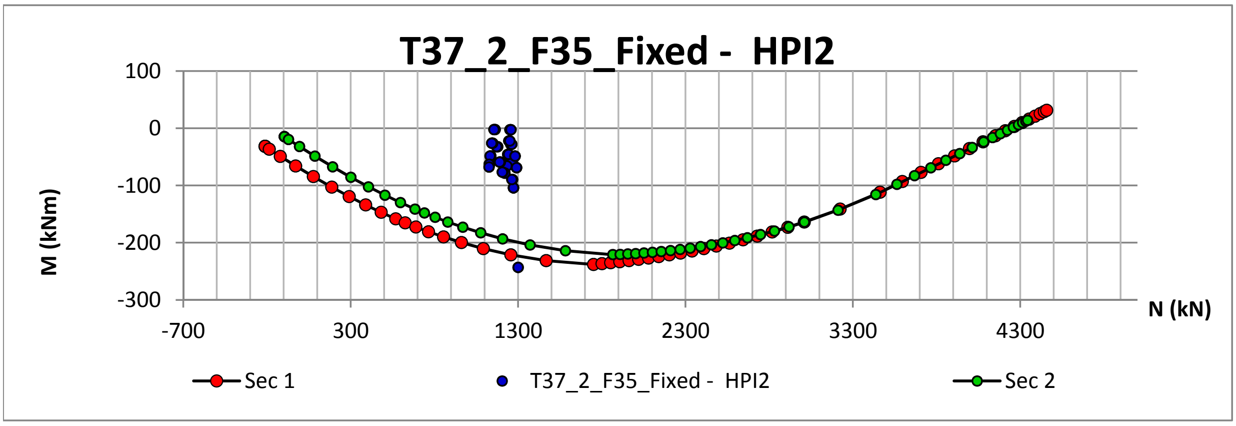
T37_2_F35_Fixed

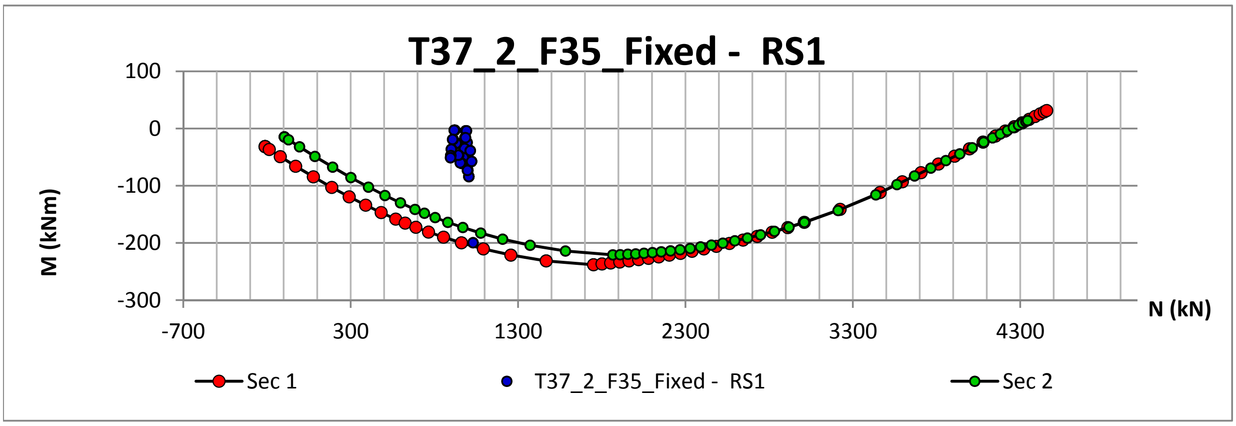
Passed	
Failed	x-

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





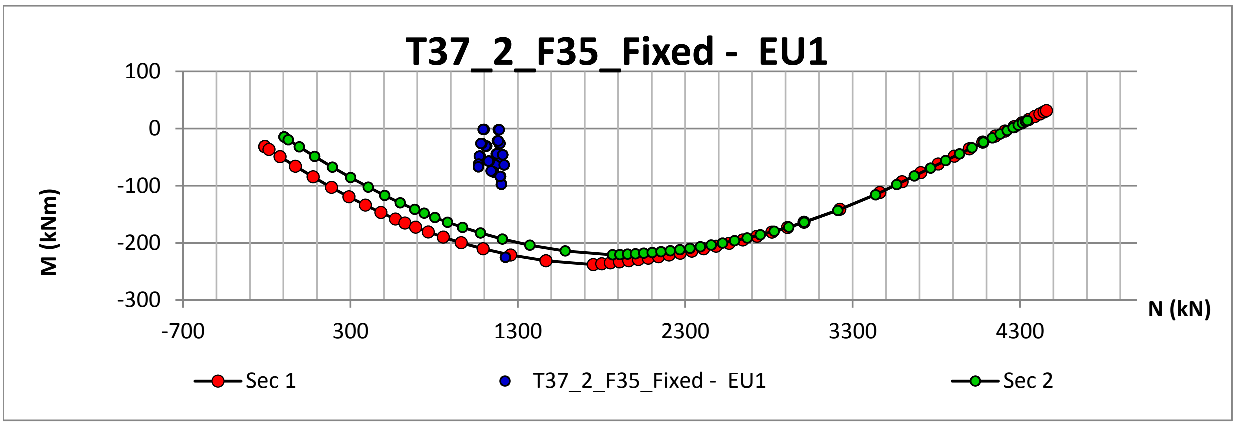


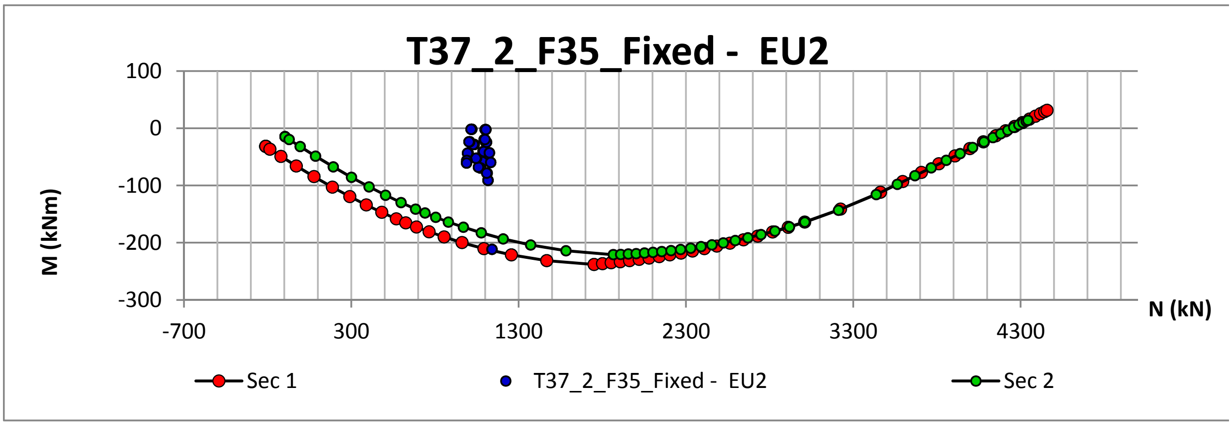
T37_2_F35_Fixed

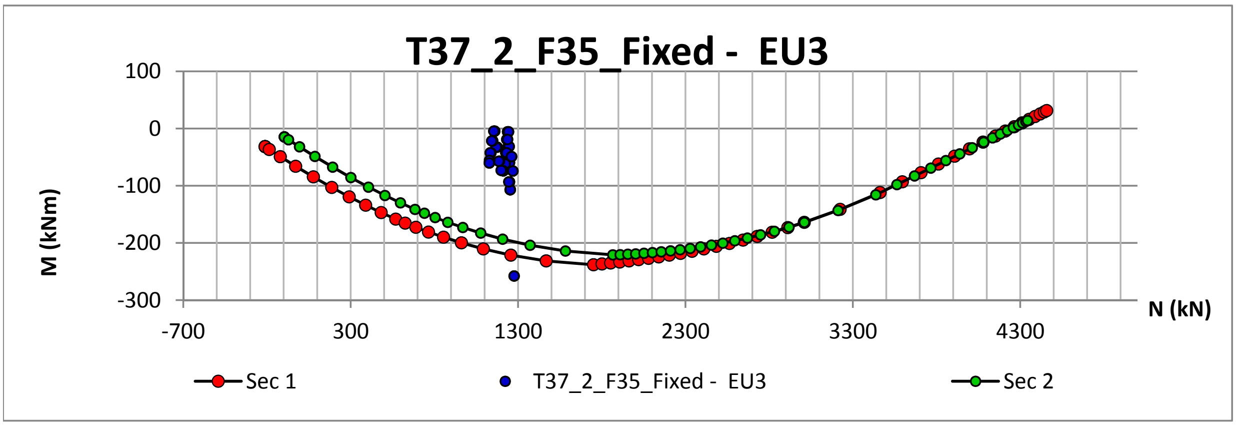
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







T37_2_F35_Fixed

Shear Verification

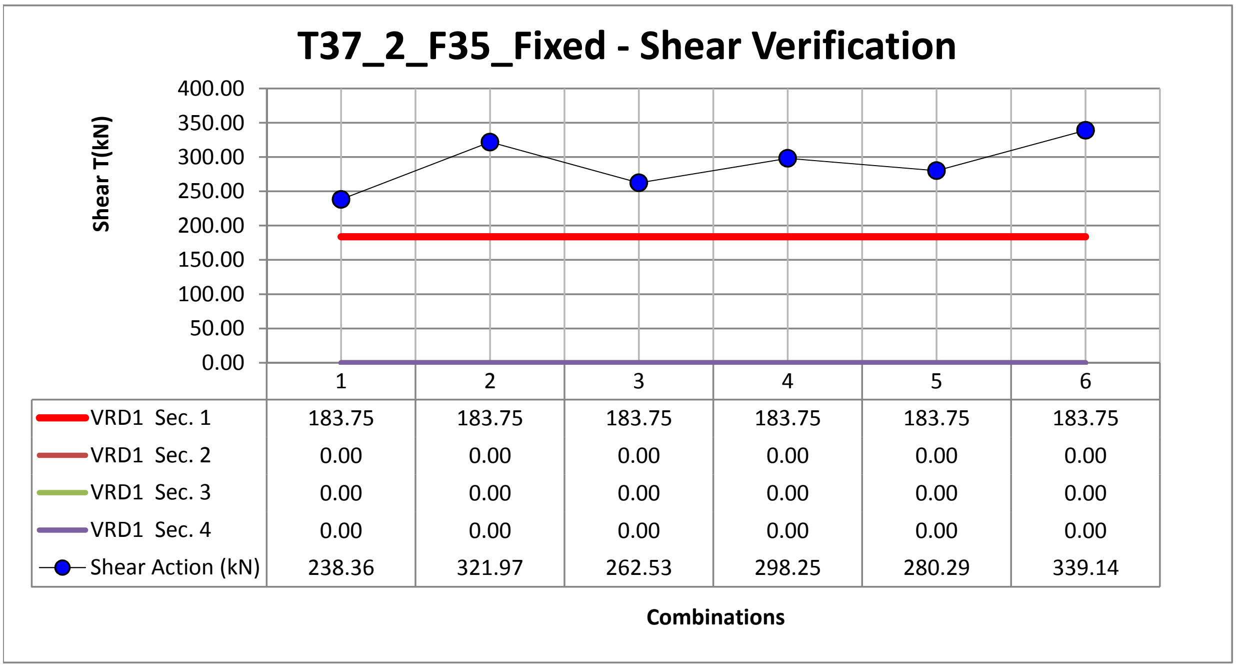
			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	11.34			
		m^2/m	0.00113			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00284			

Shear Bearing Capability	V_{RD1}	MN	0.1838	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	183.75	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3
VRD1 Sec. 1	183.75	183.75	183.75	183.75	183.75	183.75
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	**238.36**	**321.97**	**262.53**	**298.25**	**280.29**	**339.14**

							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T37_2_F35_Fixed - Shear Verification

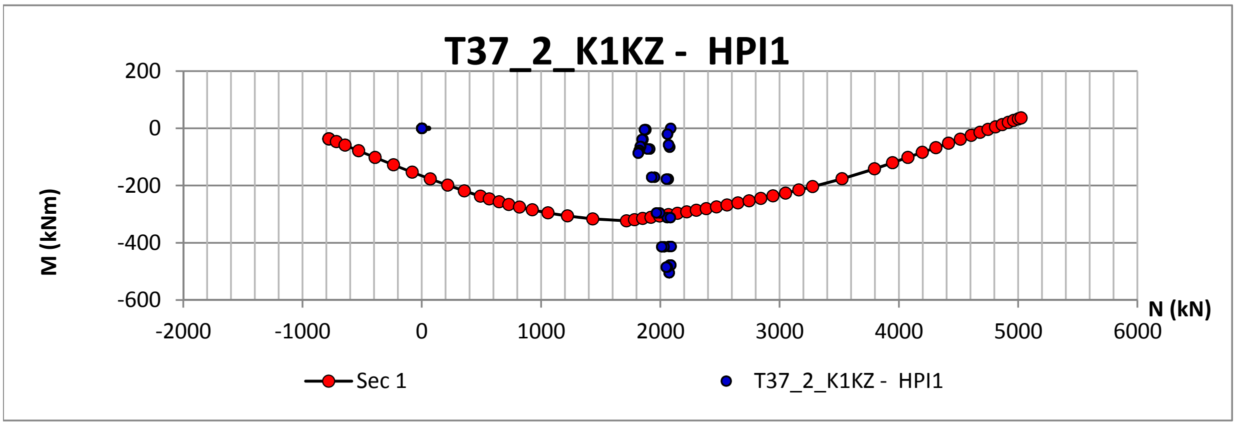


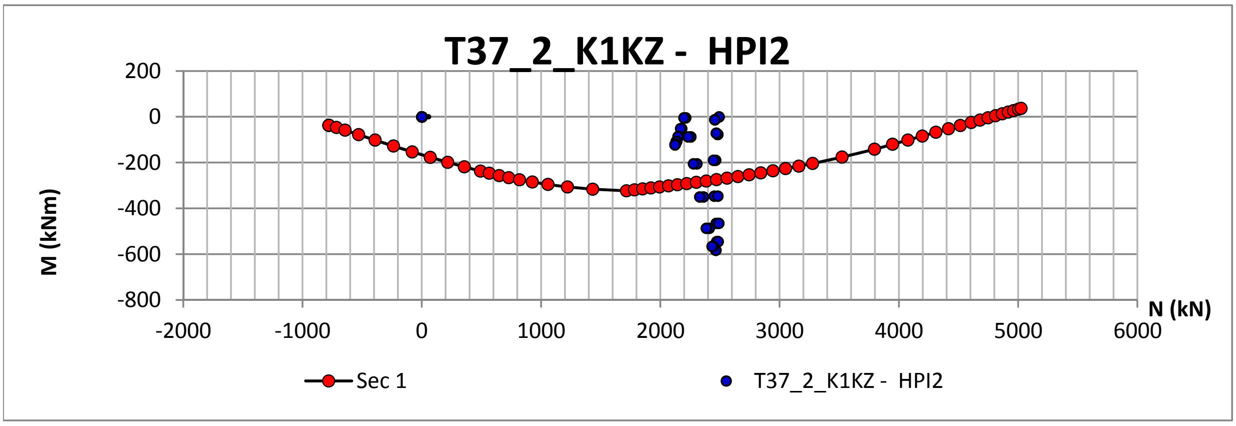
T37_2_K1KZ

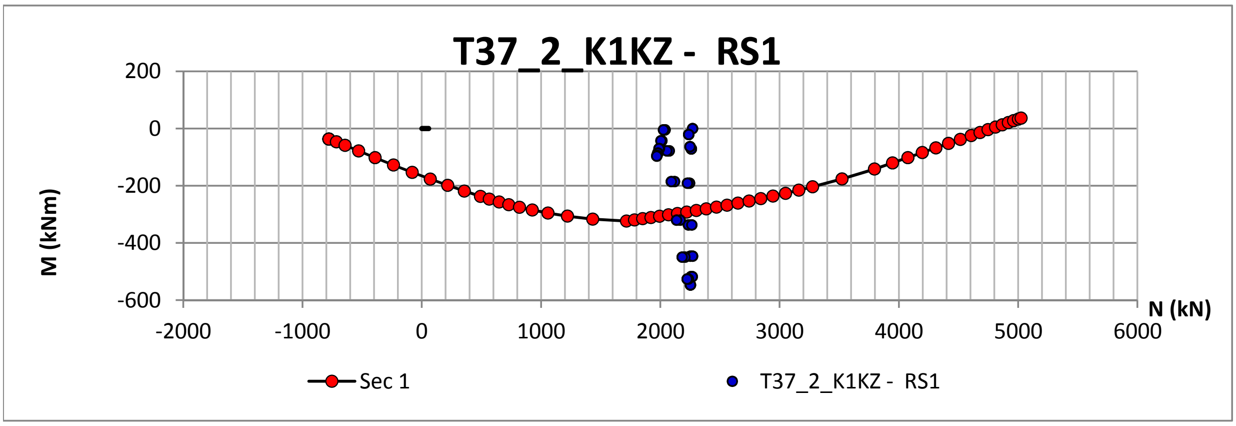
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





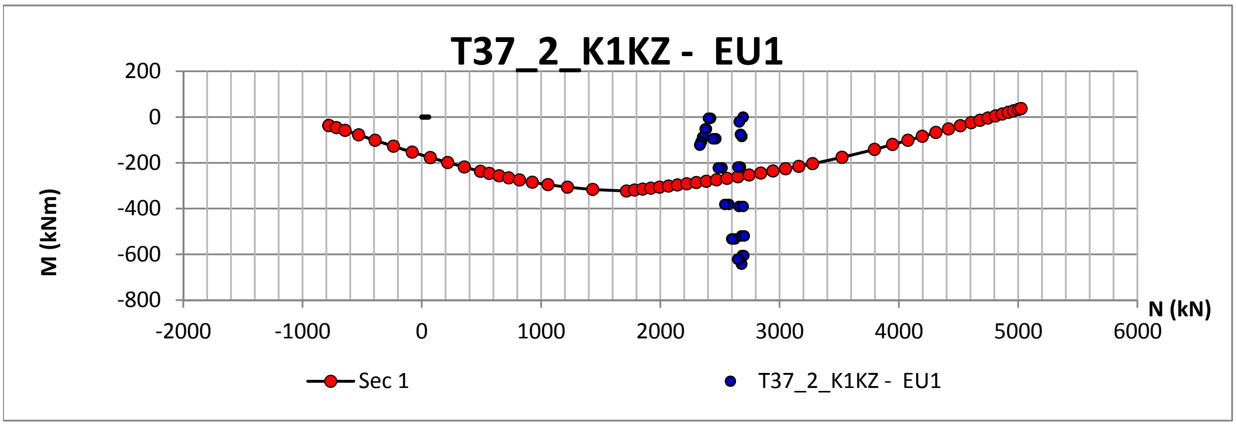


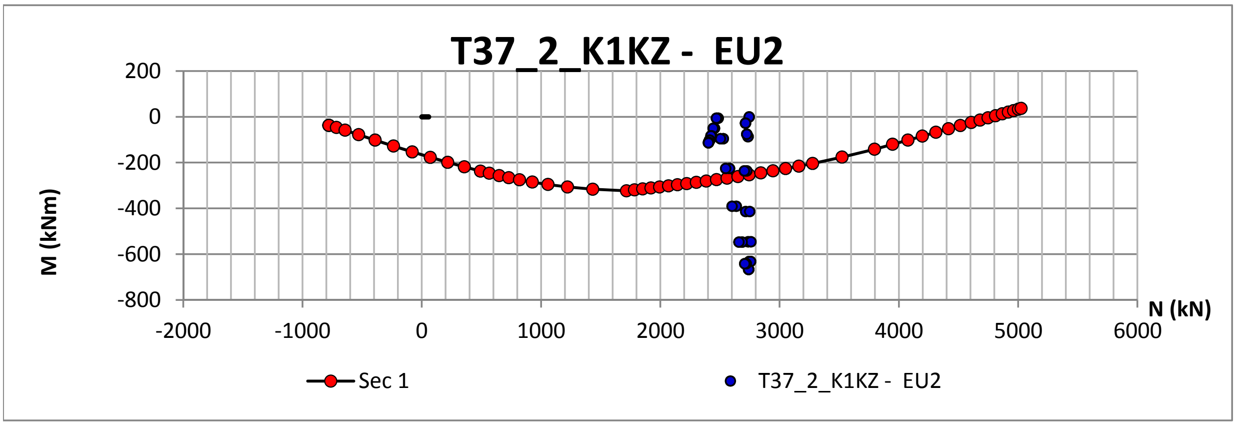
T37_2_K1KZ

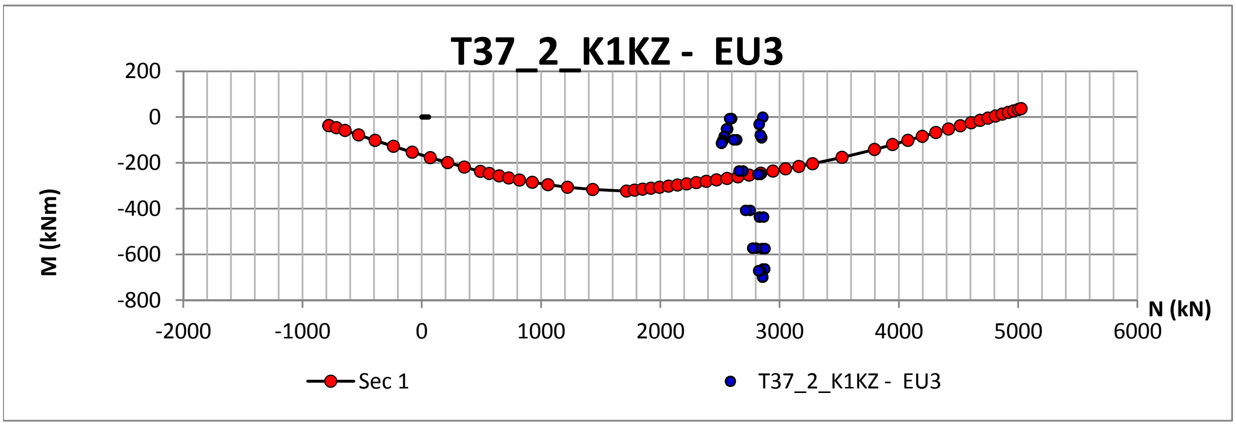
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







T37_2_K1KZ

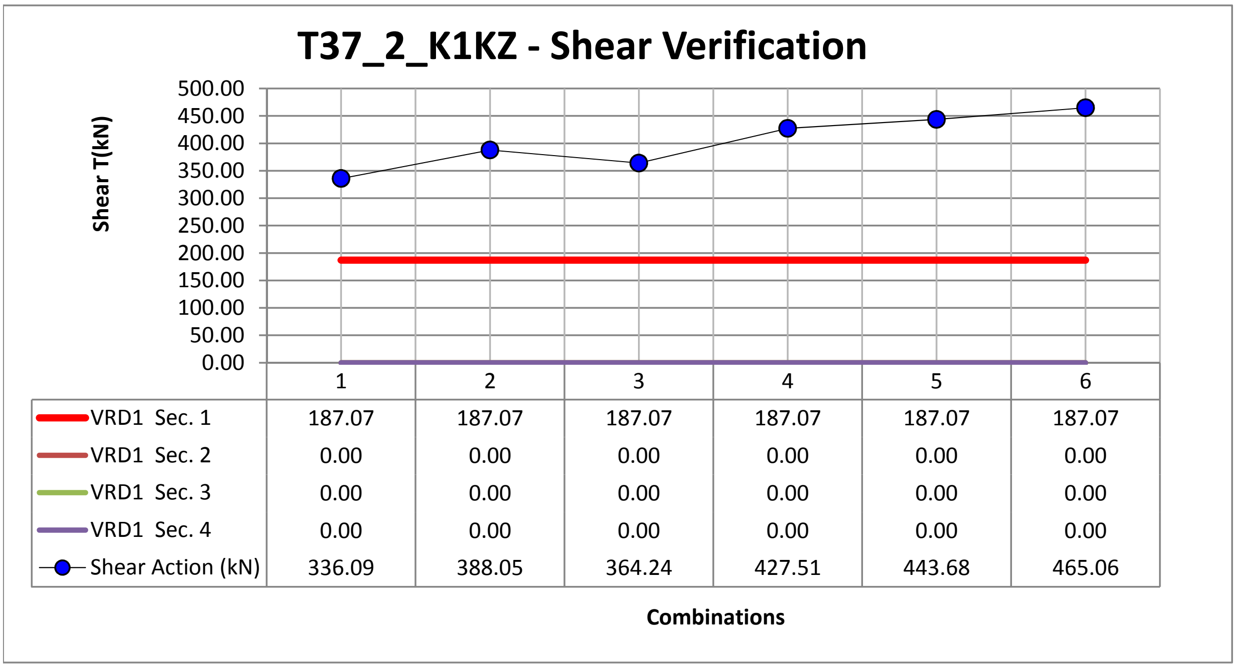
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	13.71			
		m^2/m	0.00137			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00343			

Shear Bearing Capability	V_{RD1}	MN	0.1871	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	187.07	0.00	0.00	0.00

	HPI1	HPI2	RS1	EU1	EU2	EU3		
VRD1 Sec. 1	187.07	187.07	187.07	187.07	187.07	187.07		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**336.09**	**388.05**	**364.24**	**427.51**	**443.68**	**465.06**		
							Group 1	Group 2
Passed								
Failed	x	x	x	x	x	x	x	x

T37_2_K1KZ - Shear Verification



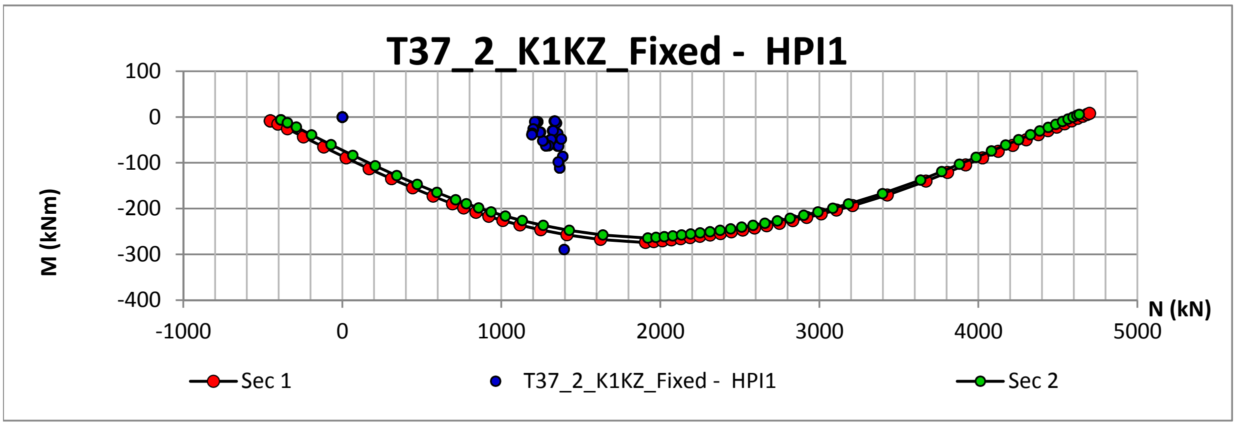
	1	2	3	4	5	6
VRD1 Sec. 1	187.07	187.07	187.07	187.07	187.07	187.07
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00
Shear Action (kN)	336.09	388.05	364.24	427.51	443.68	465.06

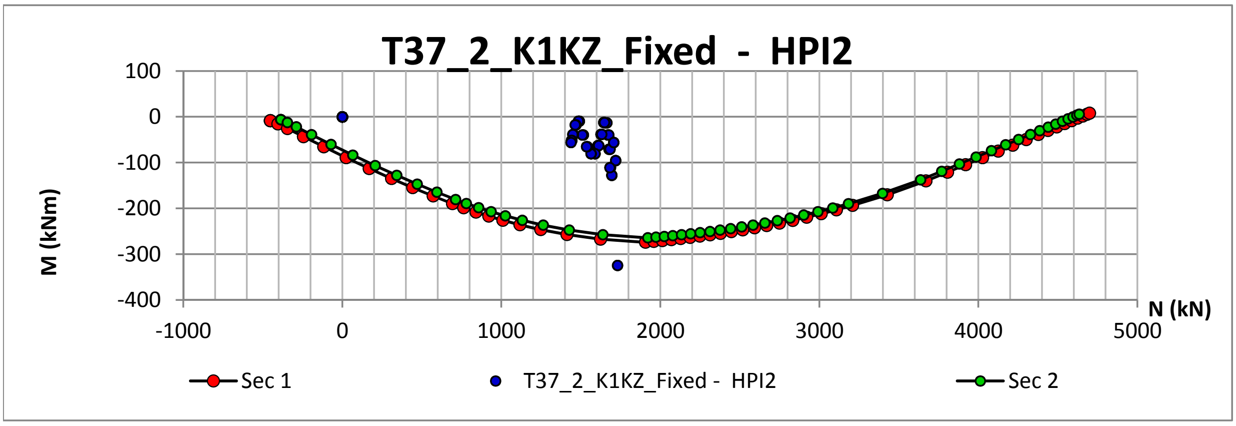
T37_2_K1KZ_Fixed

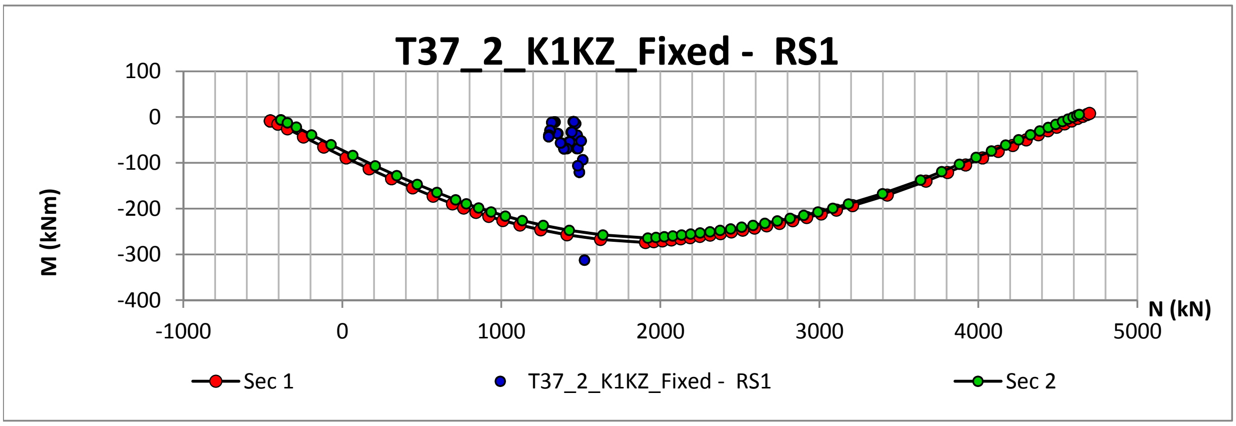
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50





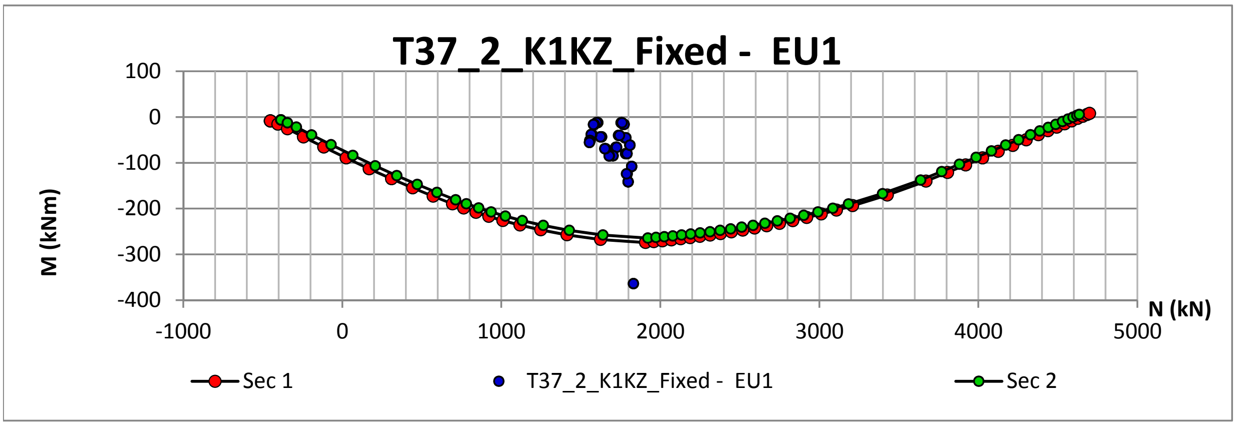


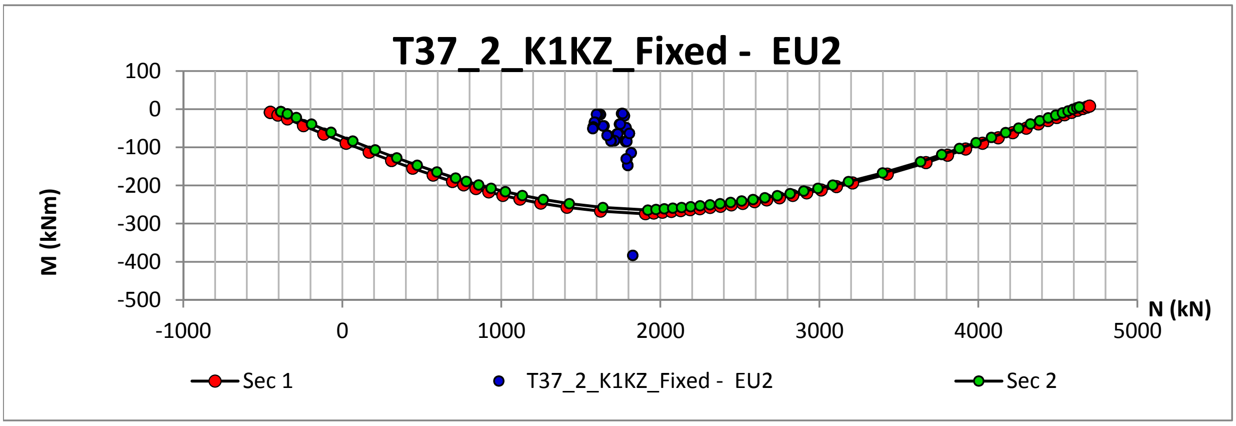
T37_2_K1KZ_Fixed

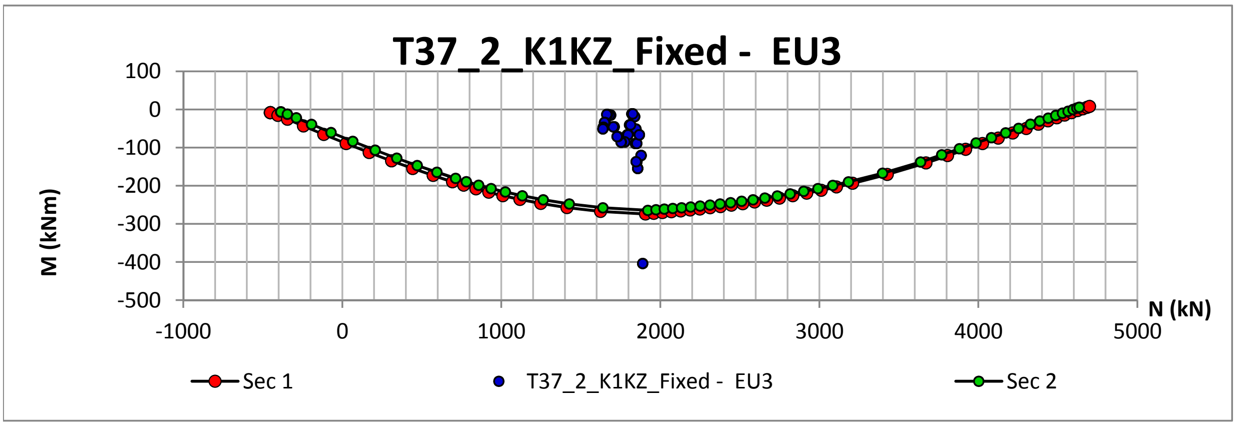
Passed	
Failed	x

No Seism Considered

	Q	HPI1	HPI2	RS1	EU1	EU2	EU3
		γ_q	γ_q	γ_q	γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.20	1.20	1.00	1.00	1.00
Vertical Rock Load	29.0	1.00	1.50	1.10	1.50	1.35	1.35
Horizontal Rock Load	17.8	1.00	1.50	1.20	1.50	1.35	1.35
Water Load	100.0	1.00	1.00	1.10	1.35	1.50	1.35
Earthquake	0.0	1.00	1.20	1.00	1.00	1.00	1.50







T37_2_K1KZ_Fixed

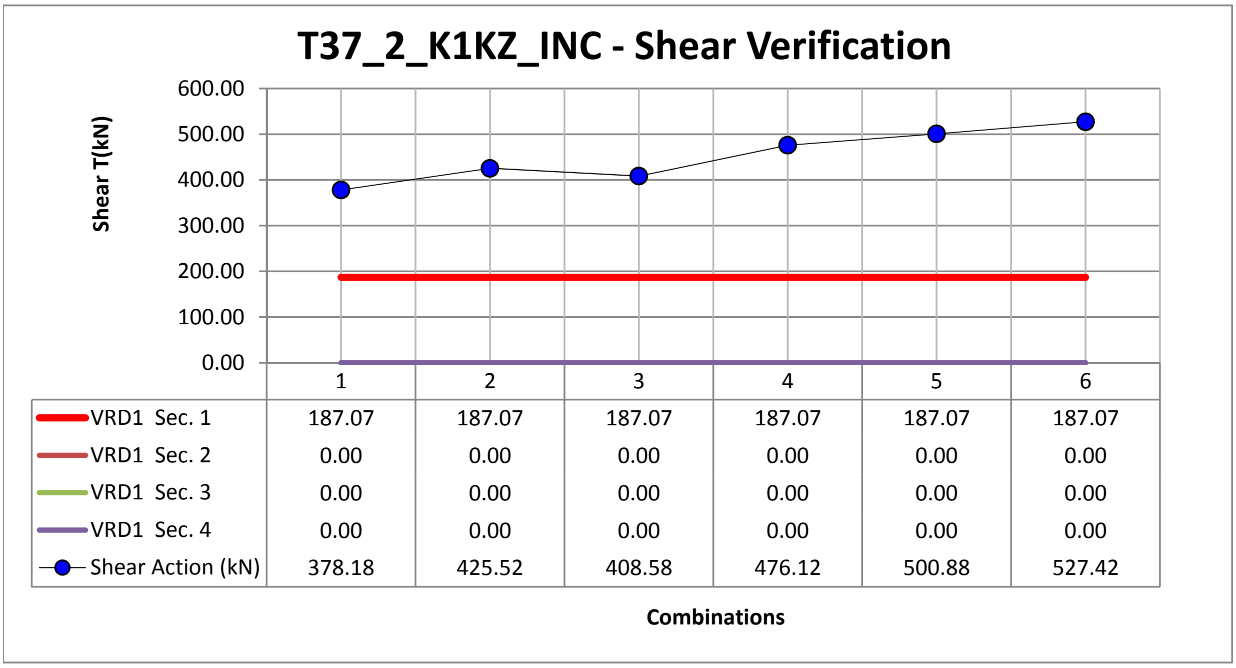
Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.40			
Tensile caracteristic strength	$fc_{tk\ 0.05}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=	cm^2/m	13.71			
		m^2/m	0.00137			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00343			

Shear Bearing Capability	V_{RD1}	MN	0.1871	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	187.07	0.00	0.00	0.00

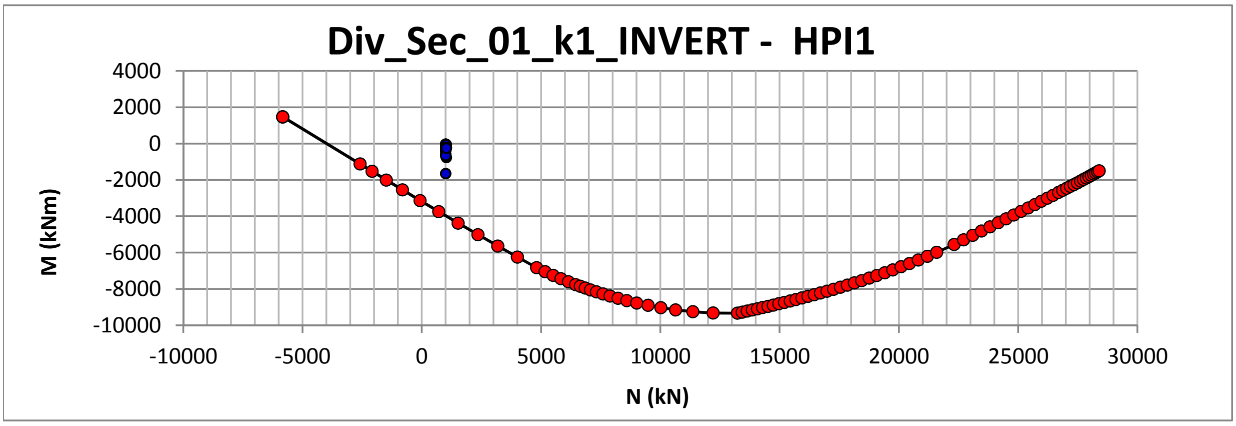
	HPI1	HPI2	RS1	EU1	EU2	EU3	Group 1	Group 2
VRD1 Sec. 1	187.07	187.07	187.07	187.07	187.07	187.07		
VRD1 Sec. 2	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 3	0.00	0.00	0.00	0.00	0.00	0.00		
VRD1 Sec. 4	0.00	0.00	0.00	0.00	0.00	0.00		
Shear Action (kN)	**378.18**	**425.52**	**408.58**	**476.12**	**500.88**	**527.42**		
Passed								
Failed	x	x	x	x	x	x	x	x

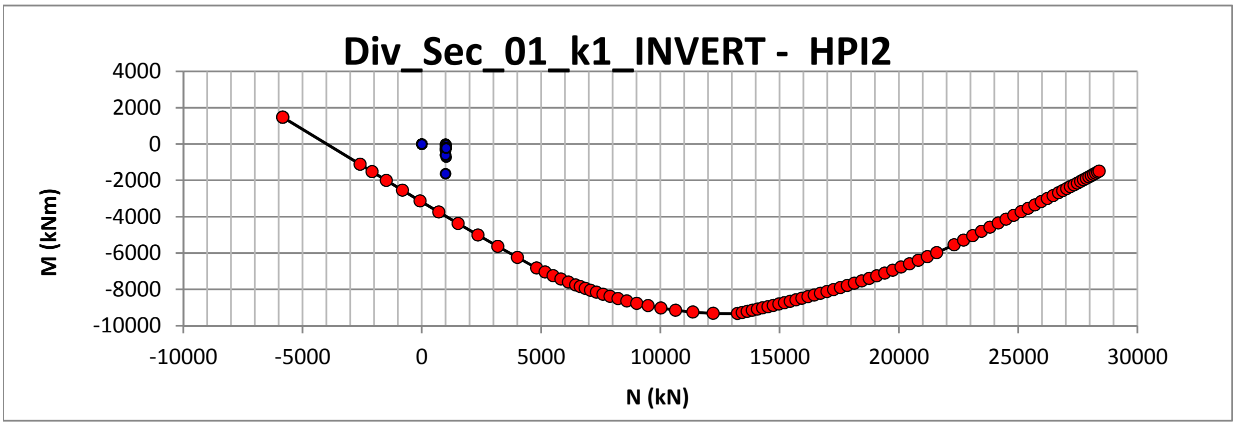
T37_2_K1KZ_Fixed - Shear Verification

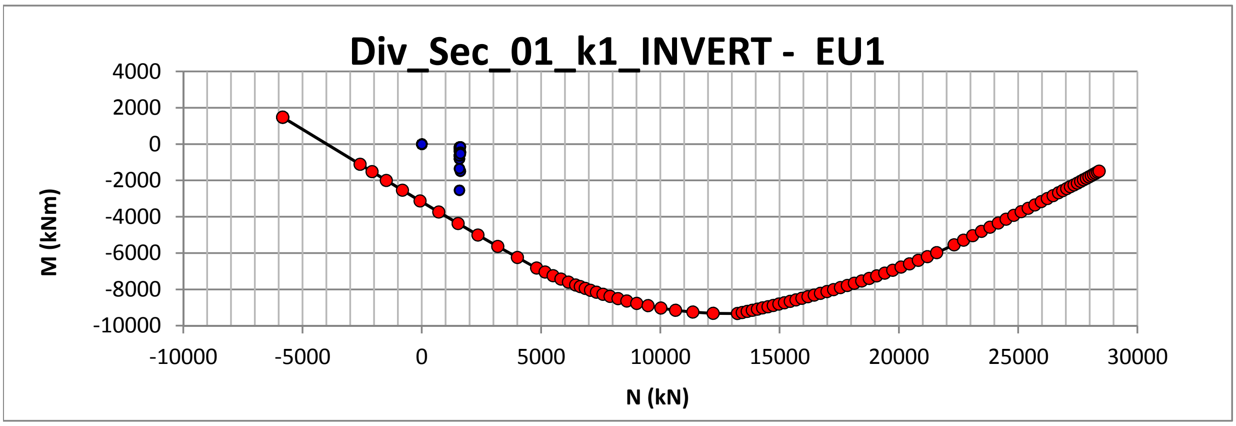


Div_Sec_01_k1_INVERT	Passed	x
	Failed	

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	1060.0	1.00	1.00	1.50







Div_Sec_01_k1_INVERT

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.70			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		98.00			
			0.00980			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00576			

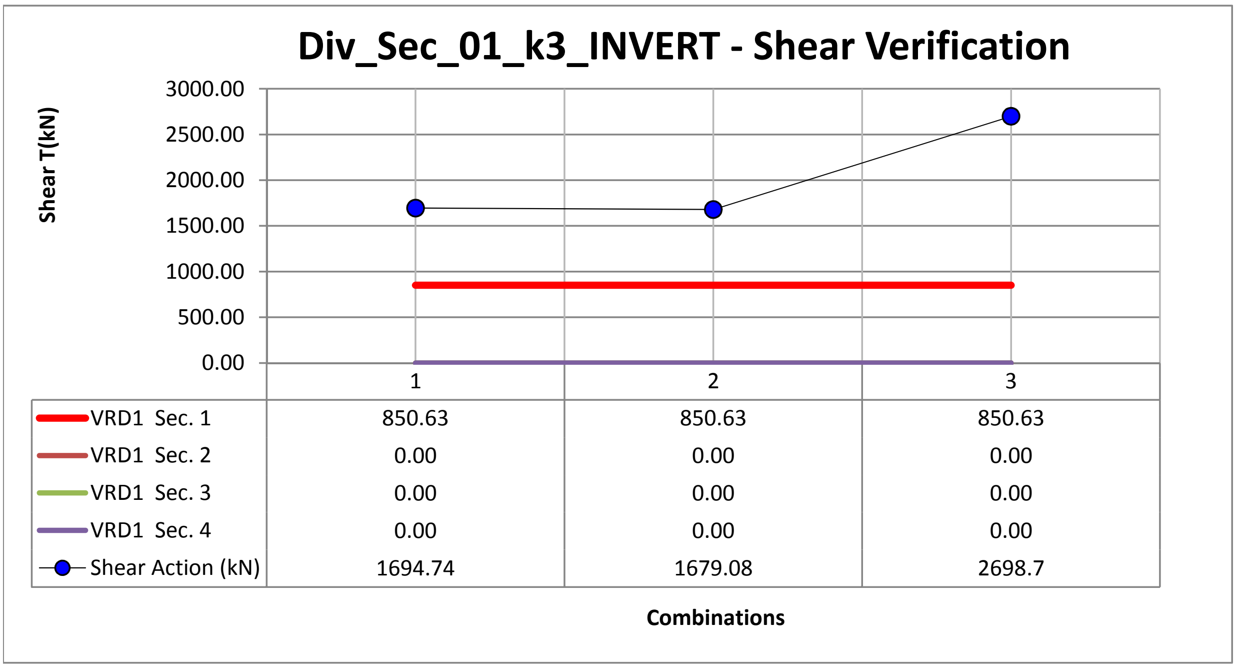
Shear Bearing Capability	V_{RD1}	MN	0.8506	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	850.63	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**1694.74**	**1679.08**	**2698.7**

Passed			
Failed	x	x	x

Group 1	Group 2
x	x

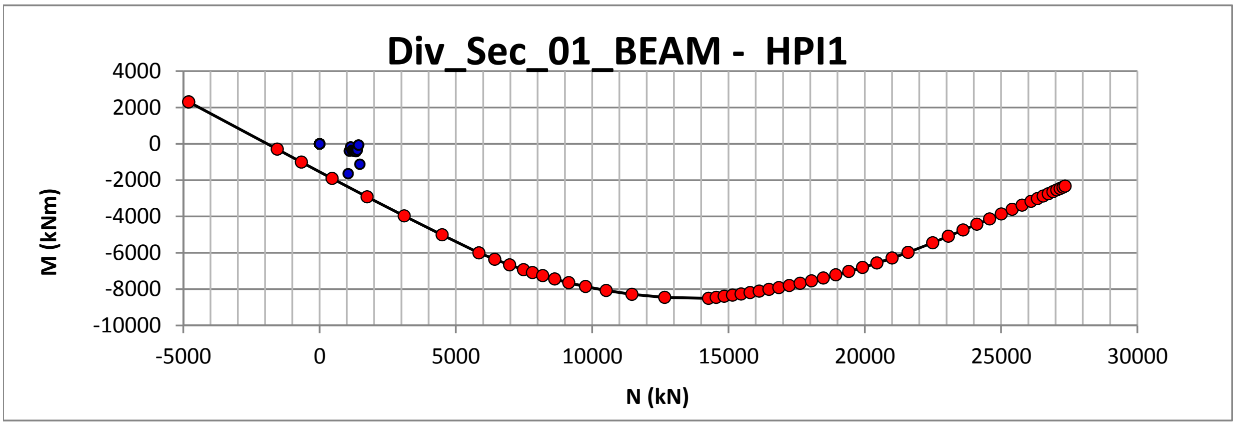
Div_Sec_01_k1_INVERT - Shear Verification

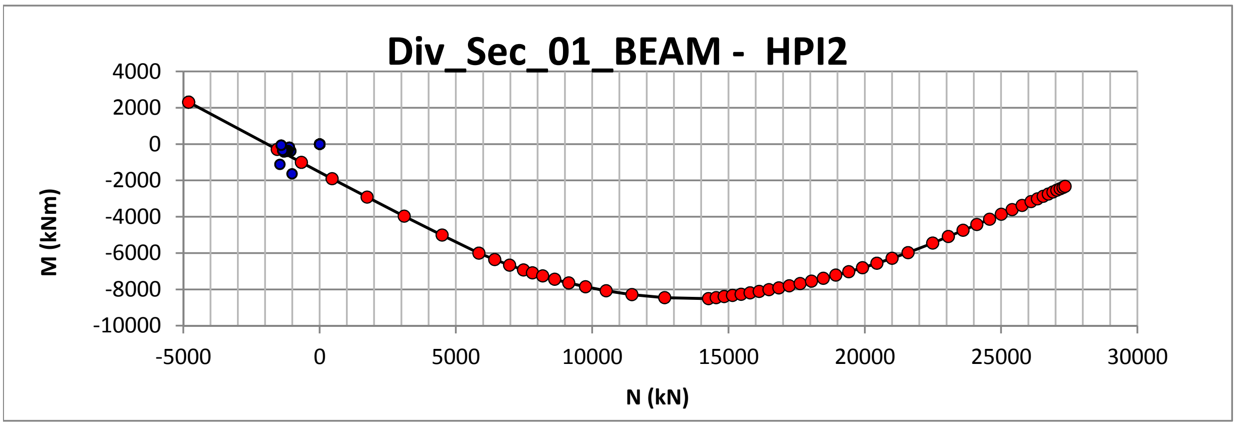


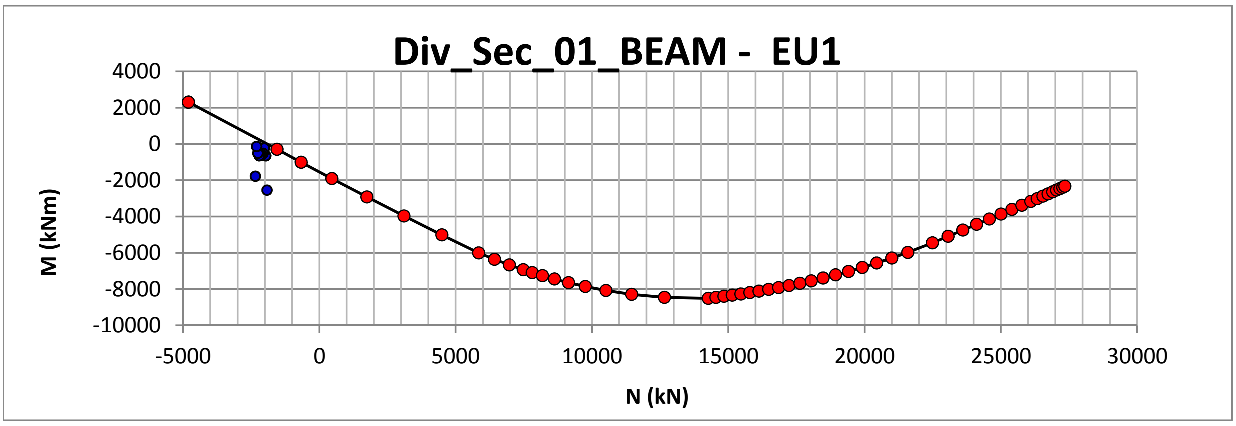
Div_Sec_01_Beam 17

Passed	
Failed	x

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	1060.0	1.00	1.00	1.50







Div_Sec_01_Beam 170

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.70			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		98.00			
			0.00980			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00576			

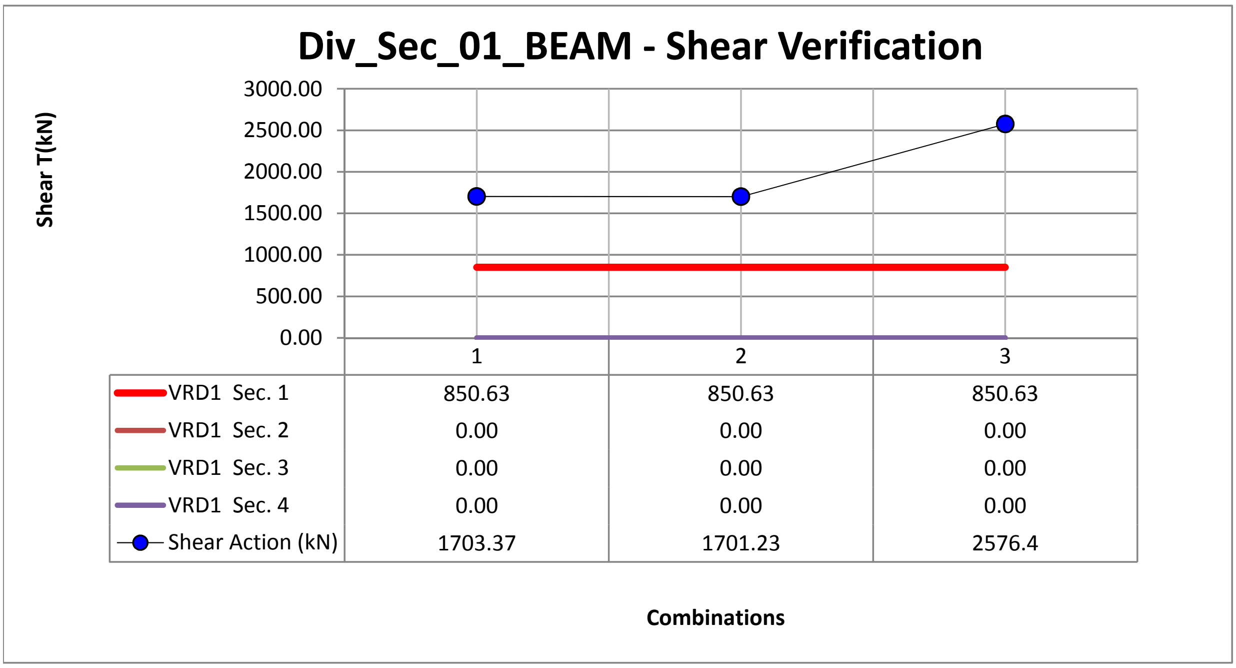
Shear Bearing Capability	V_{RD1}	MN	0.8506	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	850.63	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**1703.37**	**1701.23**	**2576.4**

Passed			
Failed	x	x	x

Group 1	Group 2
x	x

Div_Sec_01_Beam 170 - Shear Verification

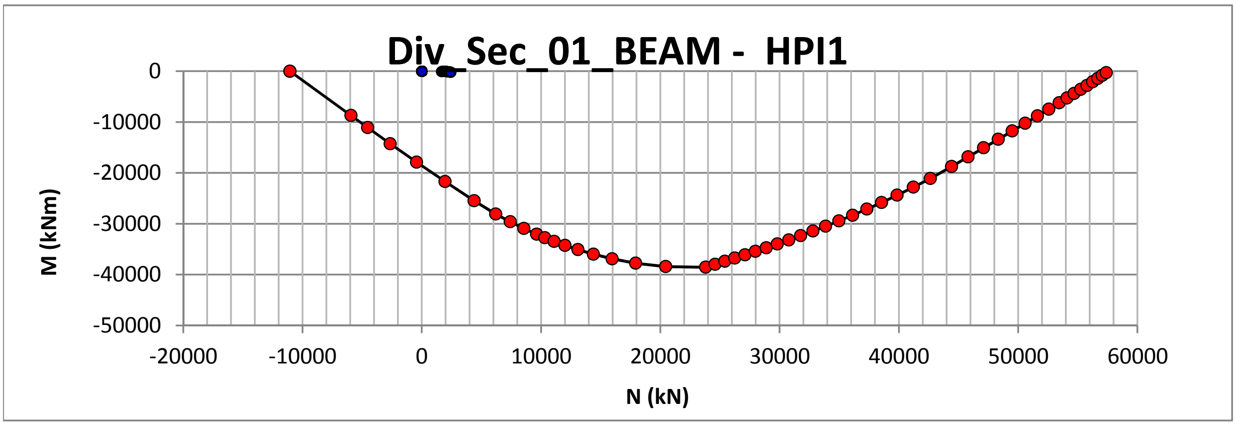


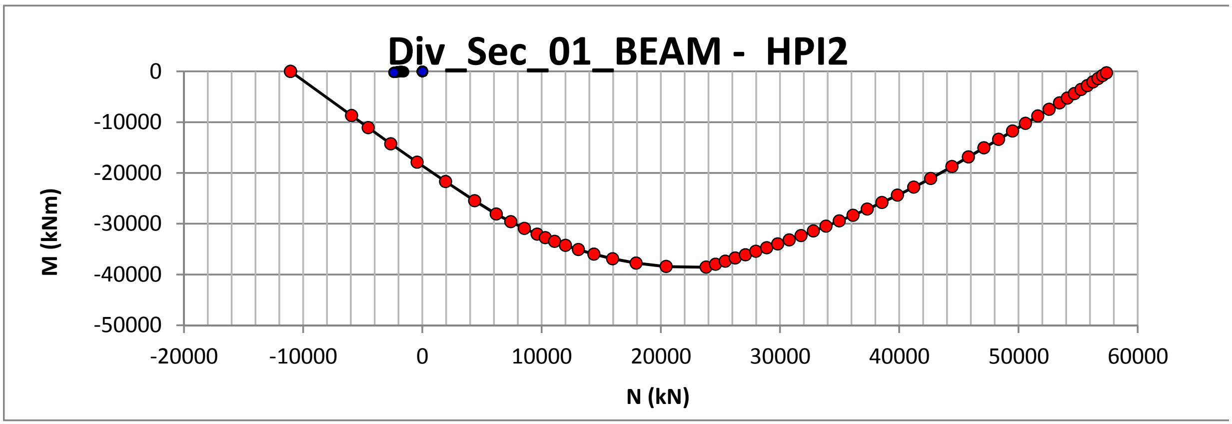
	1	2	3
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	1703.37	1701.23	2576.4

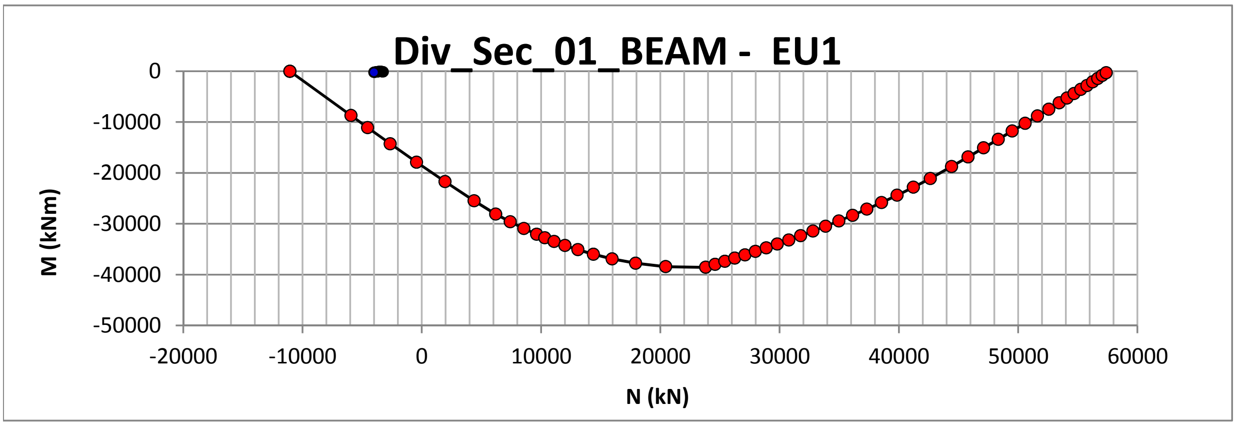
Div_Sec_01_Beam 350

Passed	x
Failed	

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	1060.0	1.00	1.00	1.50







Div_Sec_01_Beam 350

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.70			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		98.00			
			0.00980			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00576			

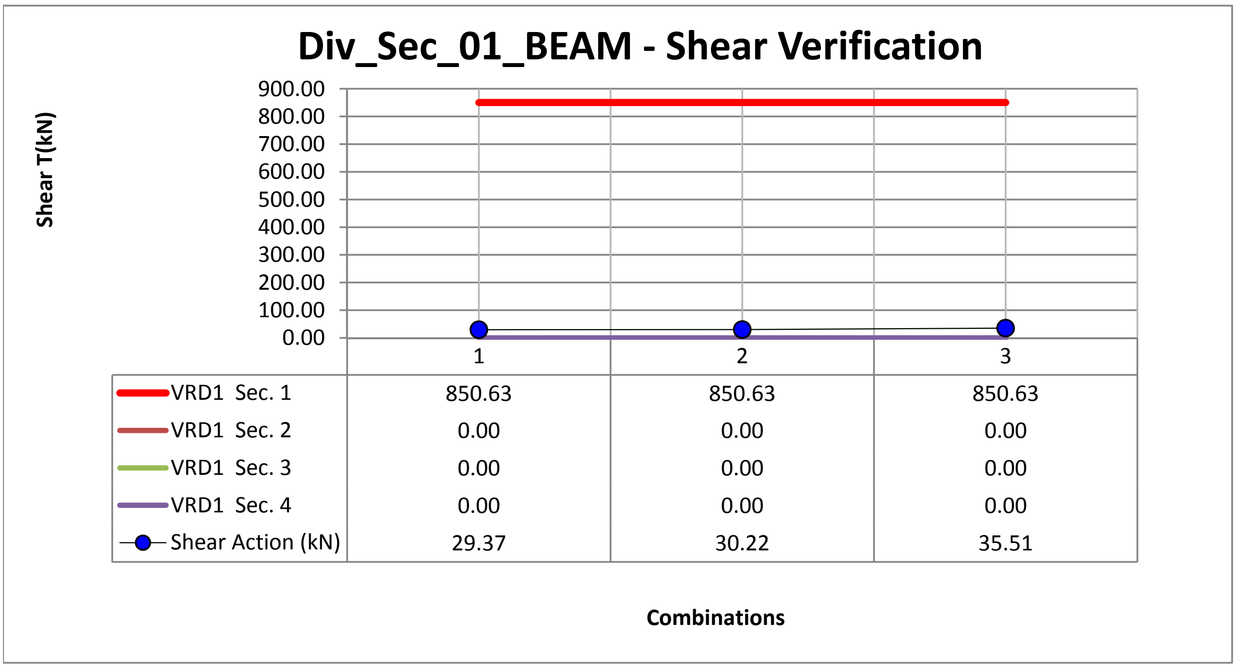
Shear Bearing Capability	V_{RD1}	MN	0.8506	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	850.63	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**29.37**	**30.22**	**35.51**

Passed	x	x	x
Failed			

Group 1	Group 2
x	x

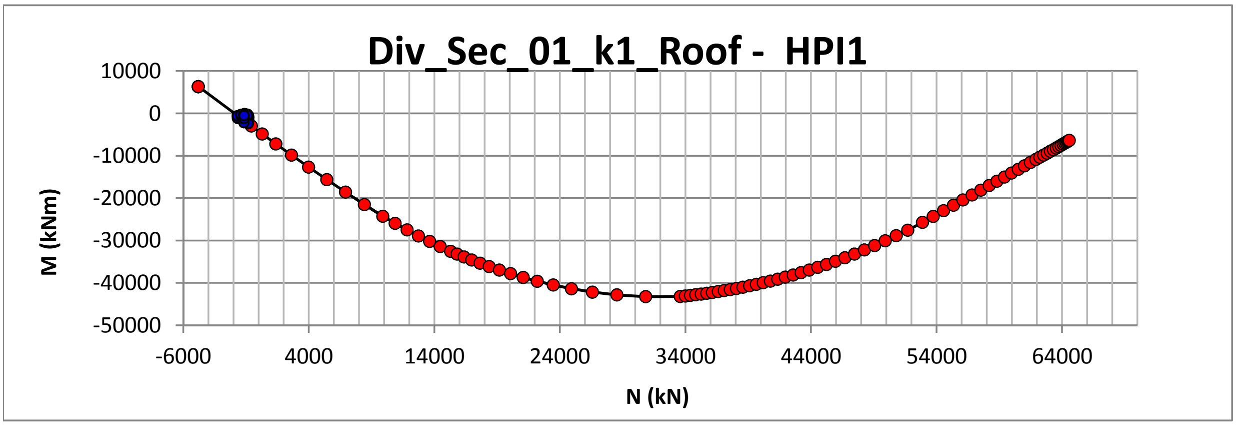
Div_Sec_01_Beam 350 - Shear Verification

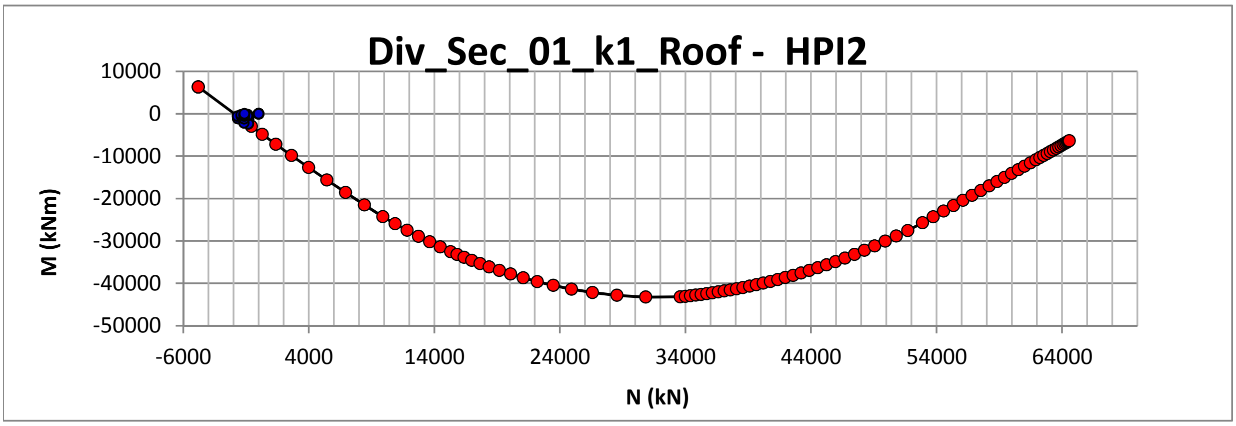


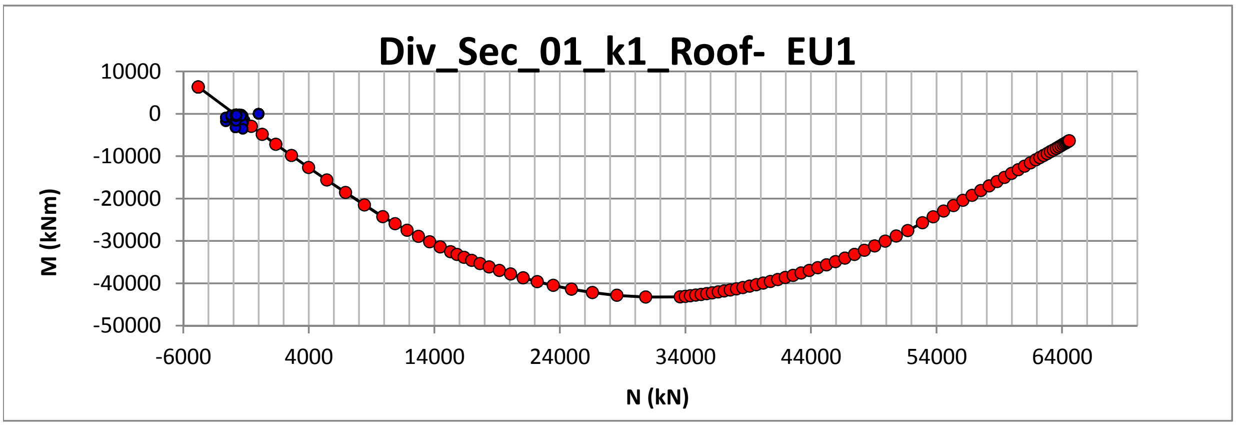
	1	2	3
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
● Shear Action (kN)	29.37	30.22	35.51

Div_Sec_01_k1_roof		Passed	x
		Failed	

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	1060.0	1.00	1.00	1.50







Div_Sec_01_k1_roof

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.70			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		98.00			
			0.00980			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00576			

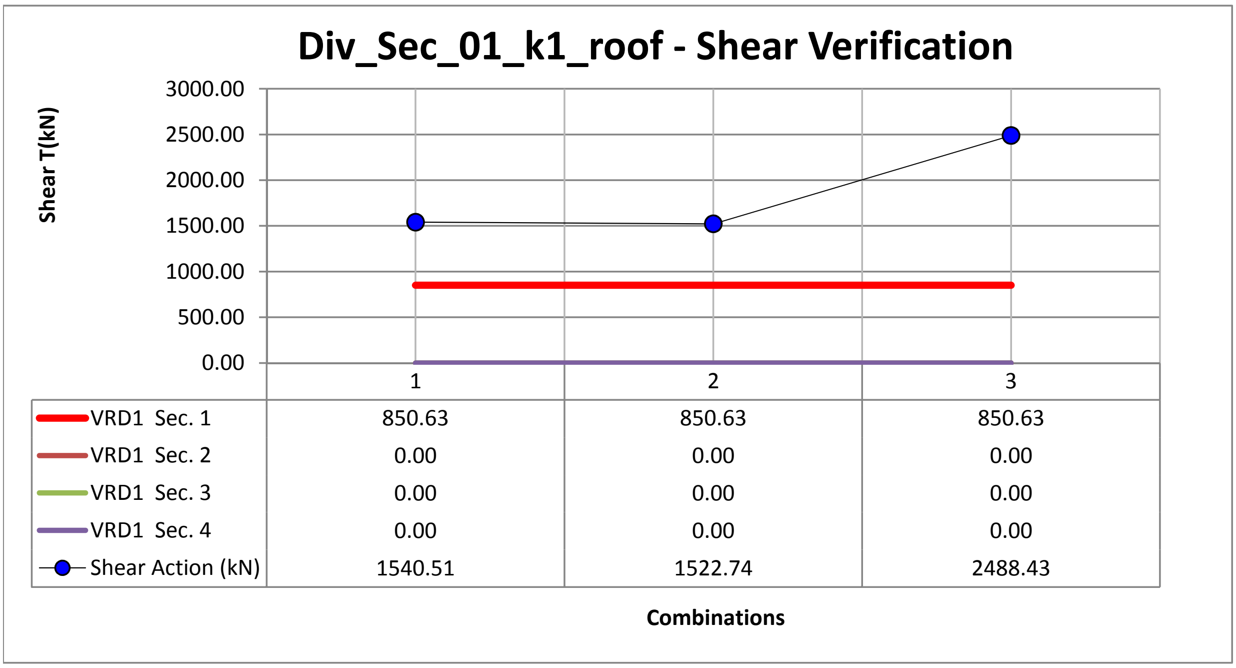
Shear Bearing Capability	V_{RD1}	MN	0.8506	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	850.63	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**1540.51**	**1522.74**	**2488.43**

Passed			
Failed	x	x	x

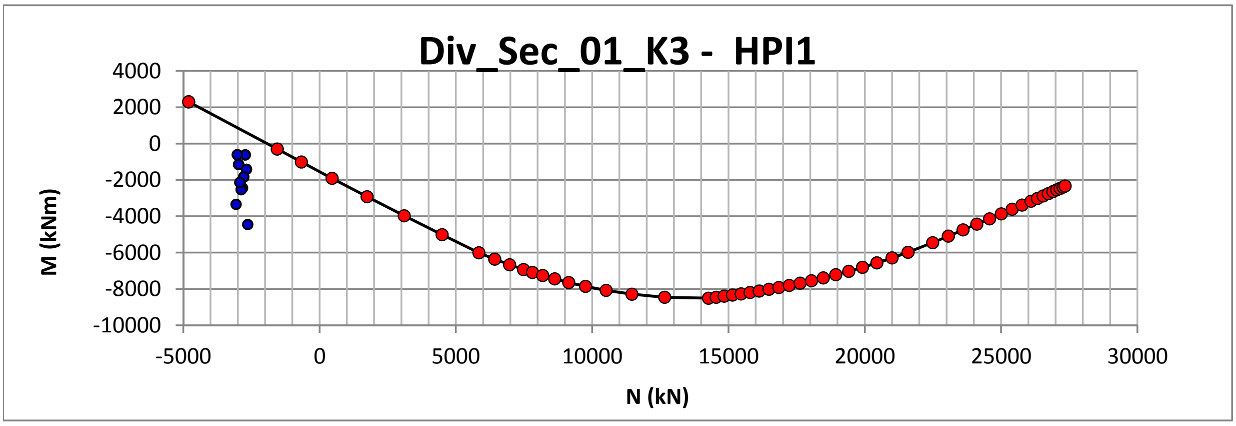
Group 1	Group 2
x	x

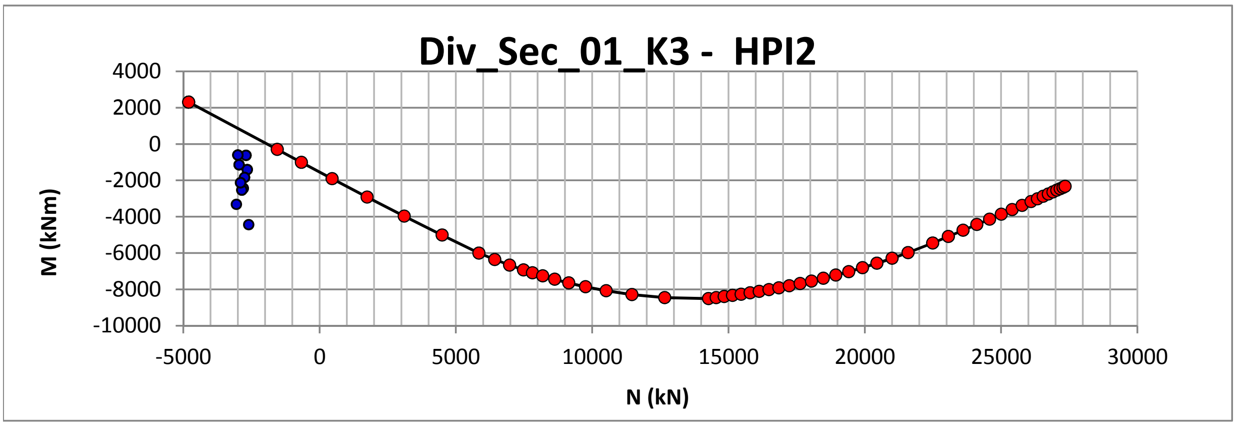
Div_Sec_01_k1_roof - Shear Verification

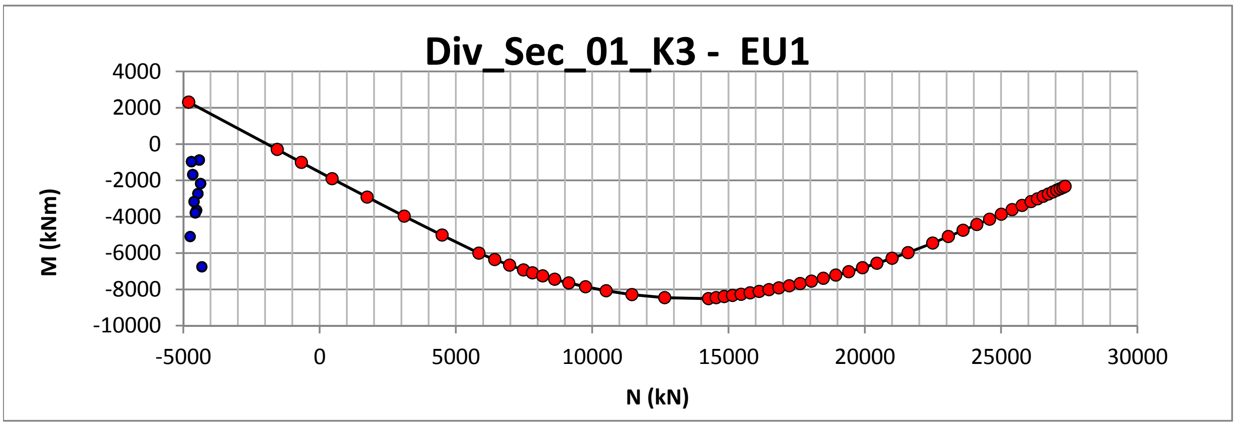


DIV_SEC_01_K3_beam 170	Passed	
	Failed	x

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	1060.0	1.00	1.00	1.50







DIV_SEC_01_K3_beam 170

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.70			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		98.00			
			0.00980			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00576			

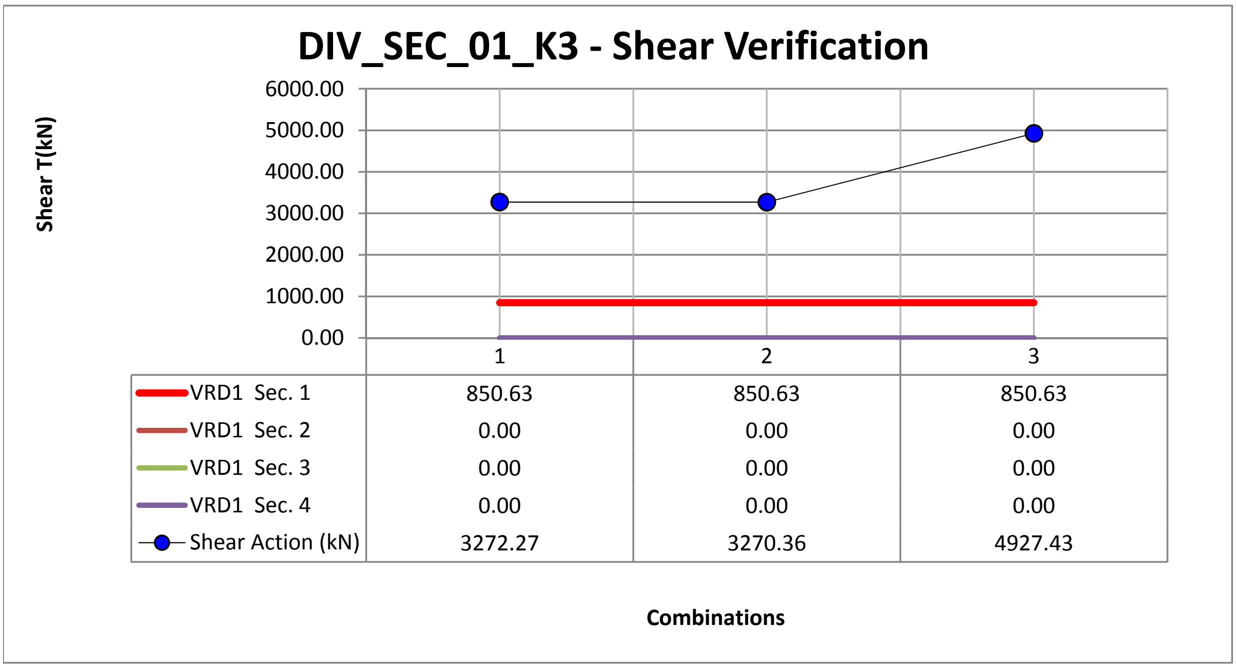
Shear Bearing Capability	V_{RD1}	MN	0.8506	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	850.63	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**3272.27**	**3270.36**	**4927.43**

Passed			
Failed	x	x	x

Group 1	Group 2
x	x

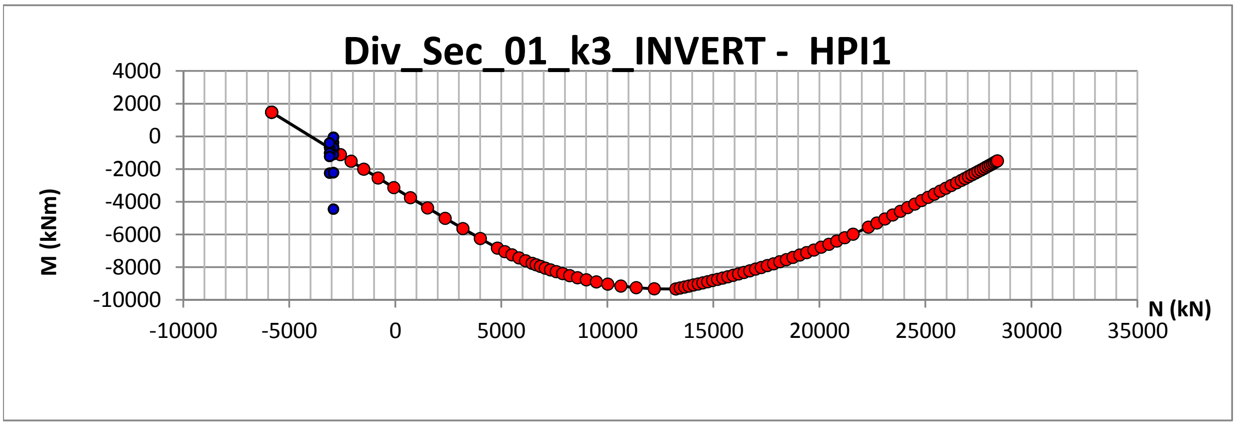
DIV_SEC_01_K3_beam 170 - Shear Verification

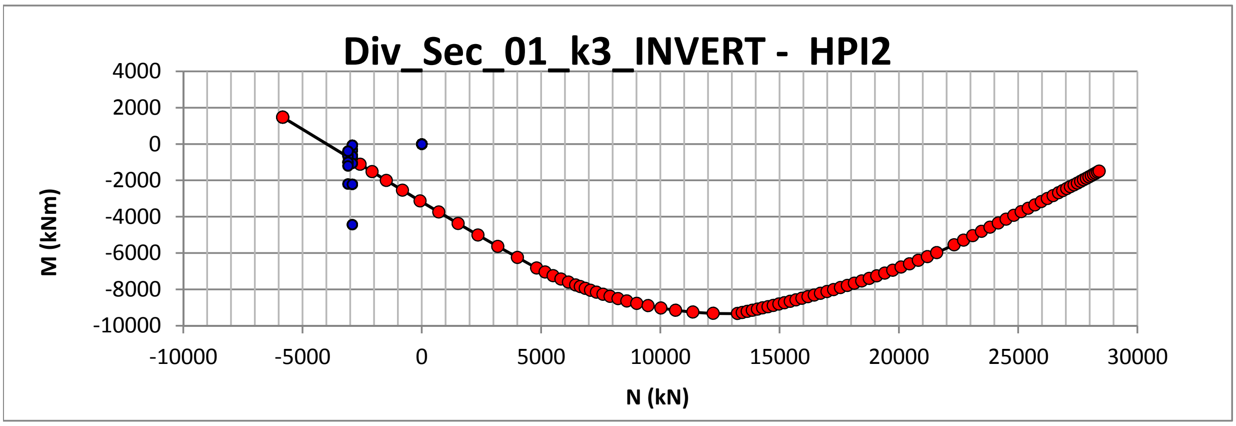


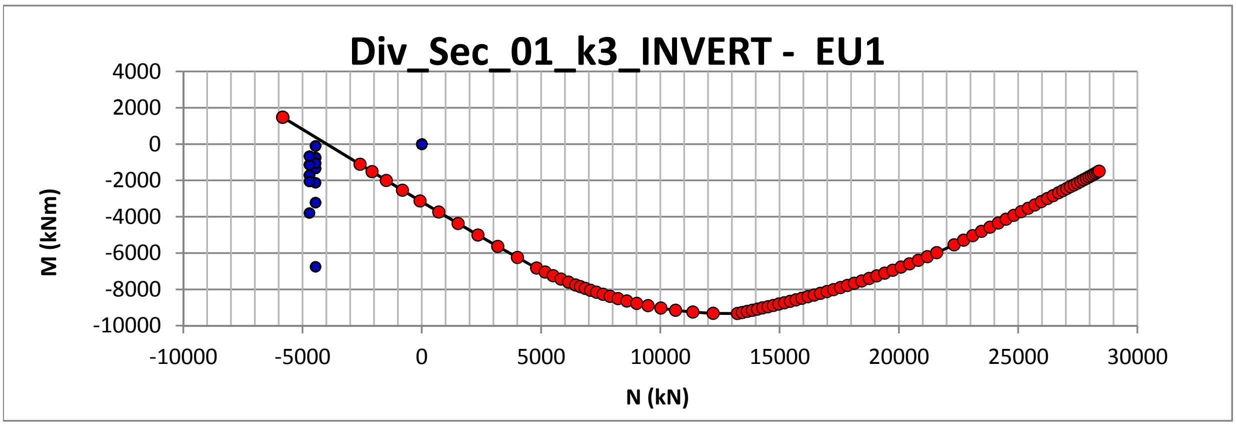
	1	2	3
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	3272.27	3270.36	4927.43

Div_Sec_01_k3_INVERT	Passed	
	Failed	x

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	1060.0	1.00	1.00	1.50







Div_Sec_01_k3_INVERT

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.70			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		98.00			
			0.00980			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00576			

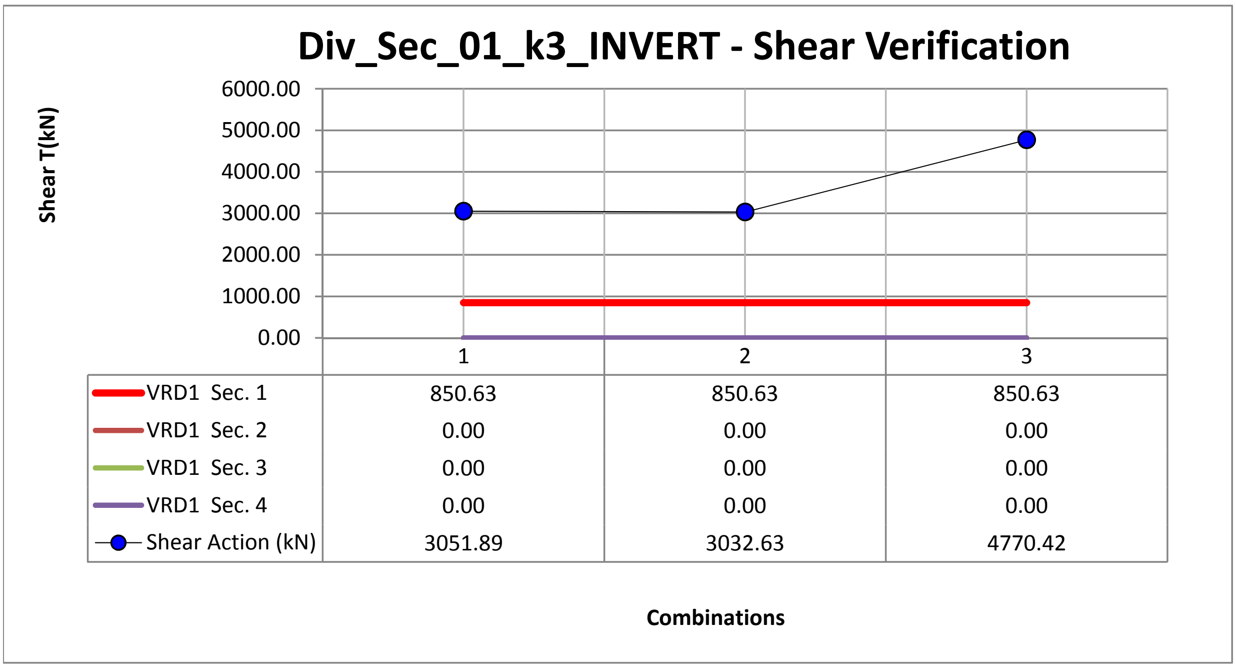
Shear Bearing Capability	V_{RD1}	MN	0.8506	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	850.63	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**3051.89**	**3032.63**	**4770.42**

Passed			
Failed	x	x	x

Group 1	Group 2
x	x

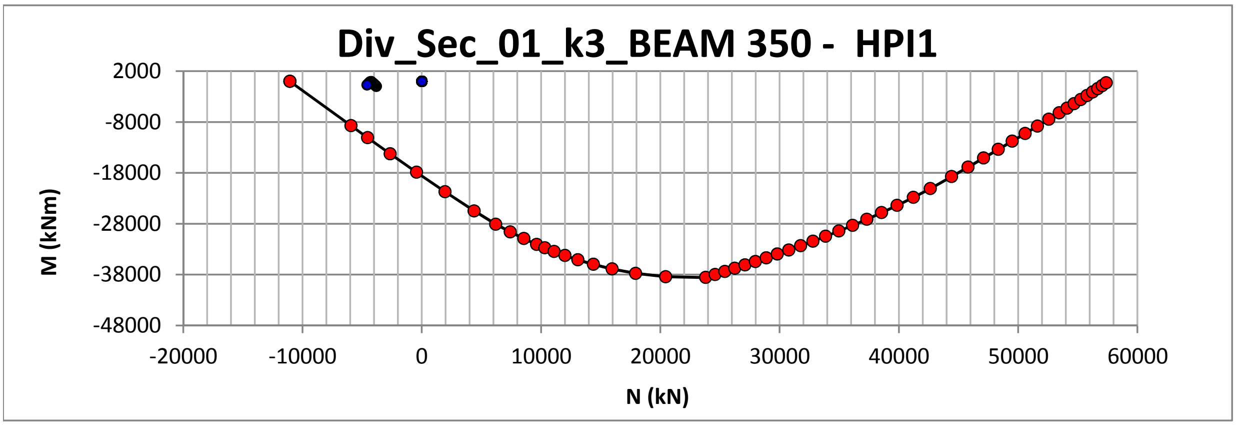
Div_Sec_01_k3_INVERT - Shear Verification

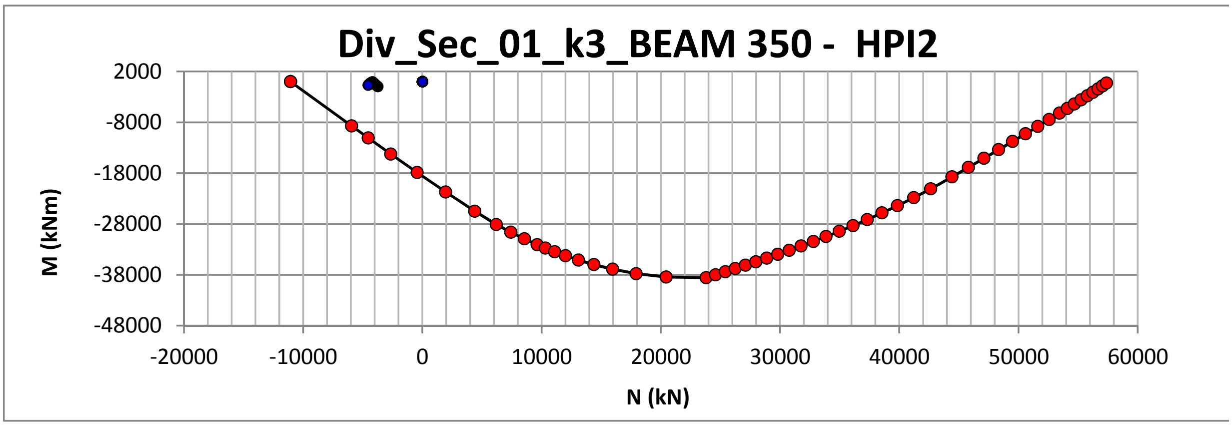


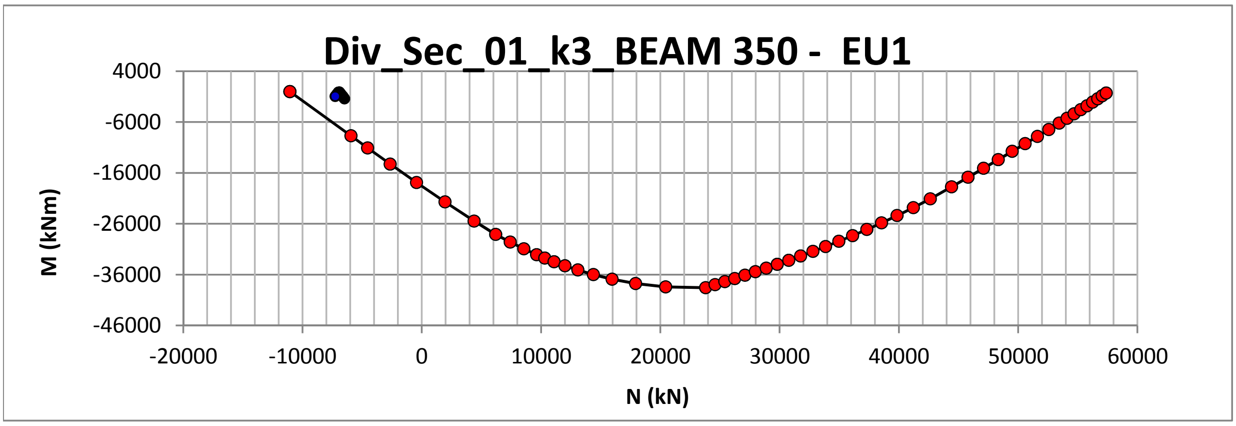
	1	2	3
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	3051.89	3032.63	4770.42

Div_Sec_01_k3_Beam 350		Passed	x
		Failed	

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	1060.0	1.00	1.00	1.50







Div_Sec_01_k3_Beam 350

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.70			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		98.00			
			0.00980			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00576			

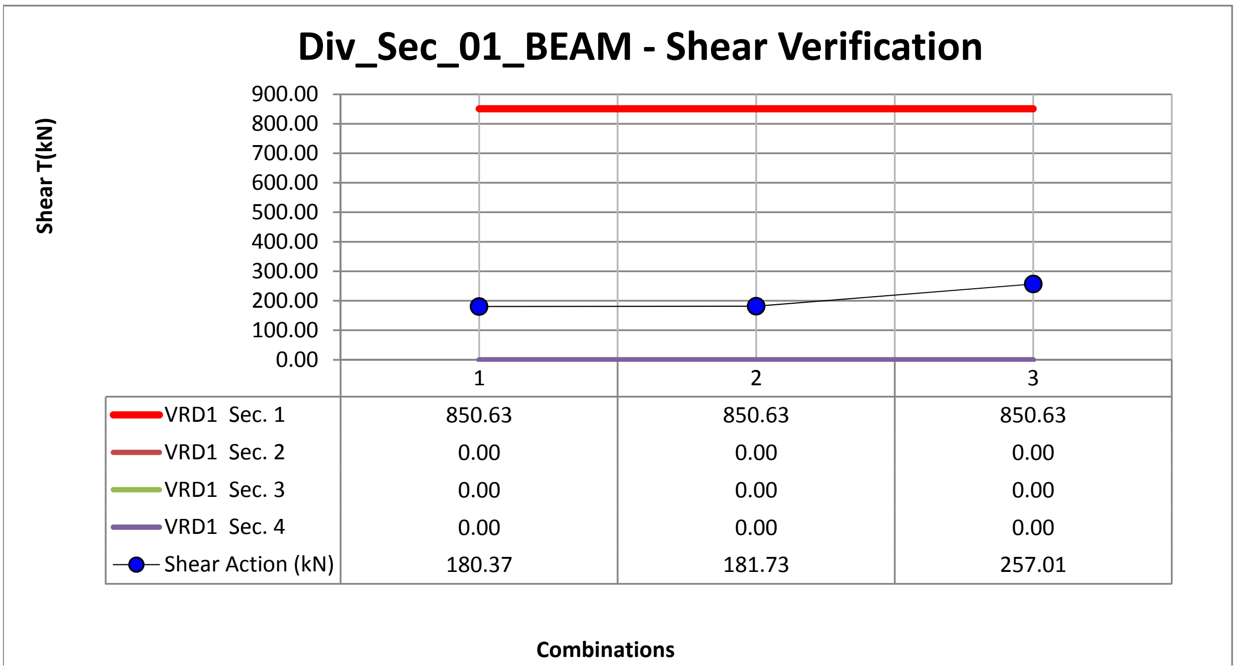
Shear Bearing Capability	V_{RD1}	MN	0.8506	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	850.63	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**180.37**	**181.73**	**257.01**

Passed	x	x	x
Failed			

Group 1	Group 2
x	x

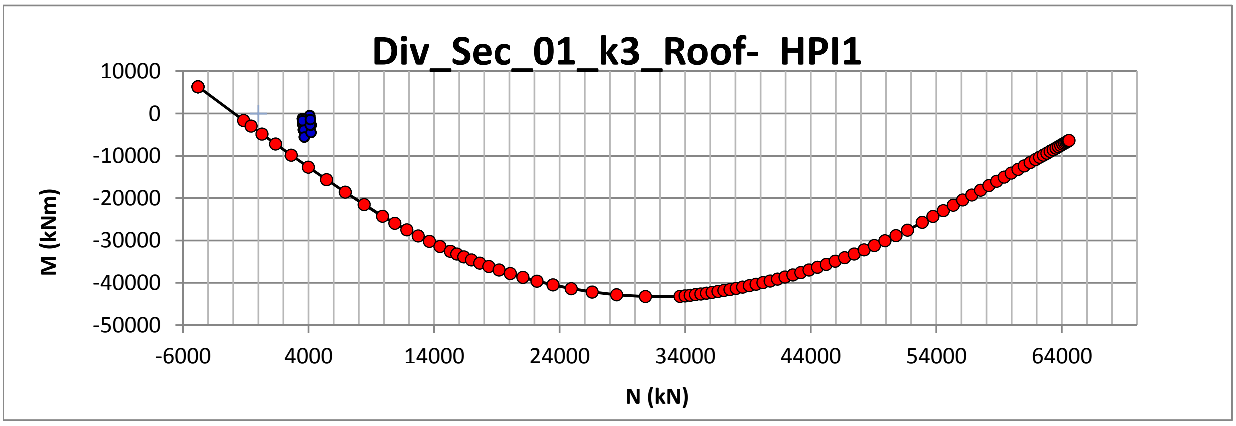
Div_Sec_01_k3_Beam 350 - Shear Verification

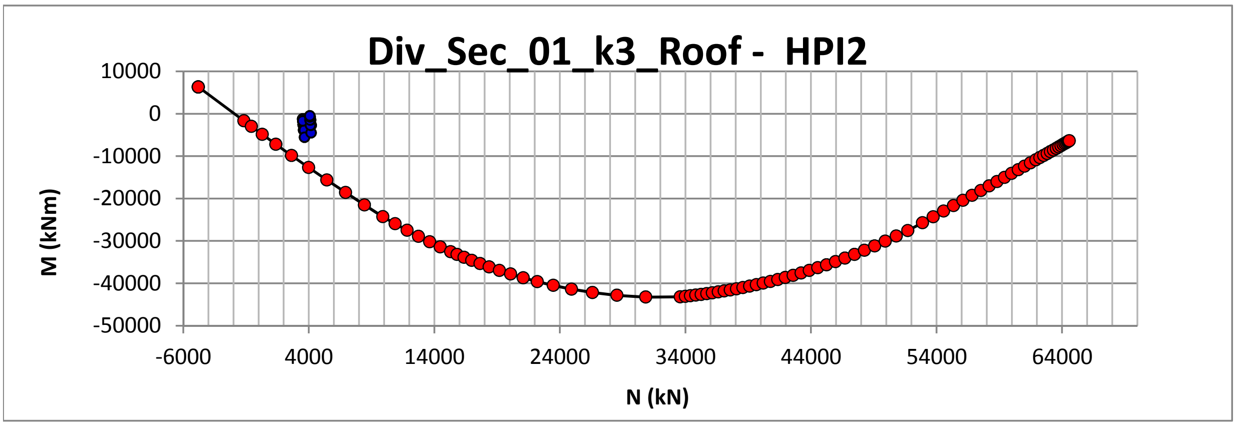


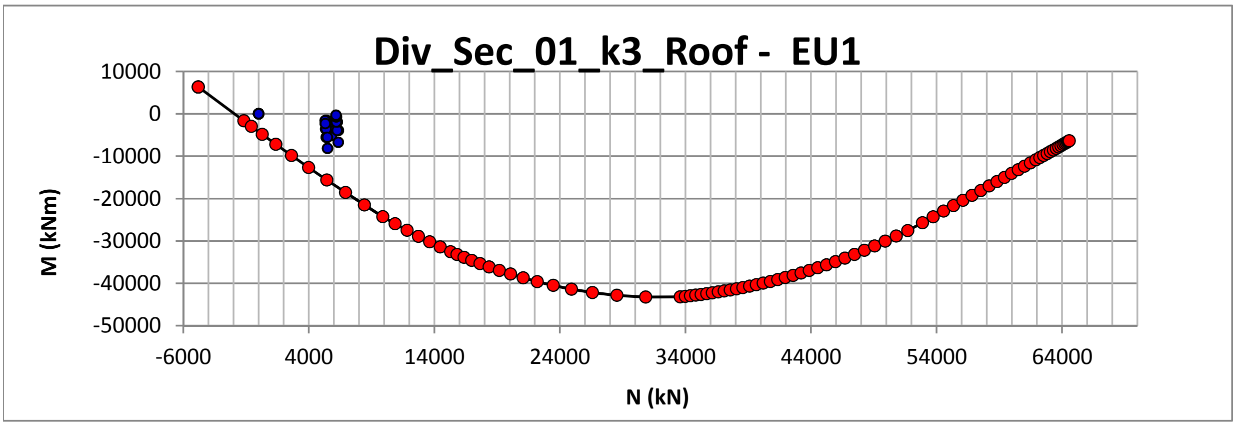
	1	2	3
🟥 VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
🟩 VRD1 Sec. 3	0.00	0.00	0.00
🟪 VRD1 Sec. 4	0.00	0.00	0.00
● Shear Action (kN)	180.37	181.73	257.01

Div_Sec_01_k3_roof		Passed	x
		Failed	

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	1060.0	1.00	1.00	1.50







Div_Sec_01_k3_roof

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.70			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		98.00			
			0.00980			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00576			

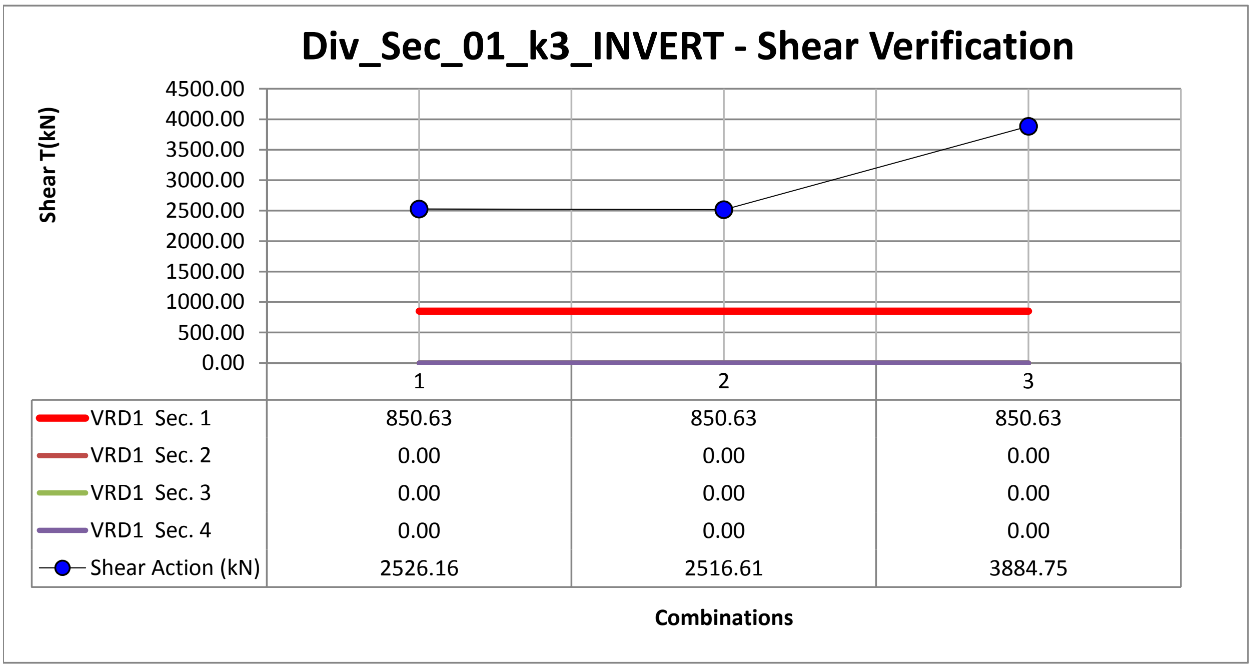
Shear Bearing Capability	V_{RD1}	MN	0.8506	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	850.63	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**2526.16**	**2516.61**	**3884.75**

Passed			
Failed	x	x	x

Group 1	Group 2
x	x

Div_Sec_01_k3_roof - Shear Verification

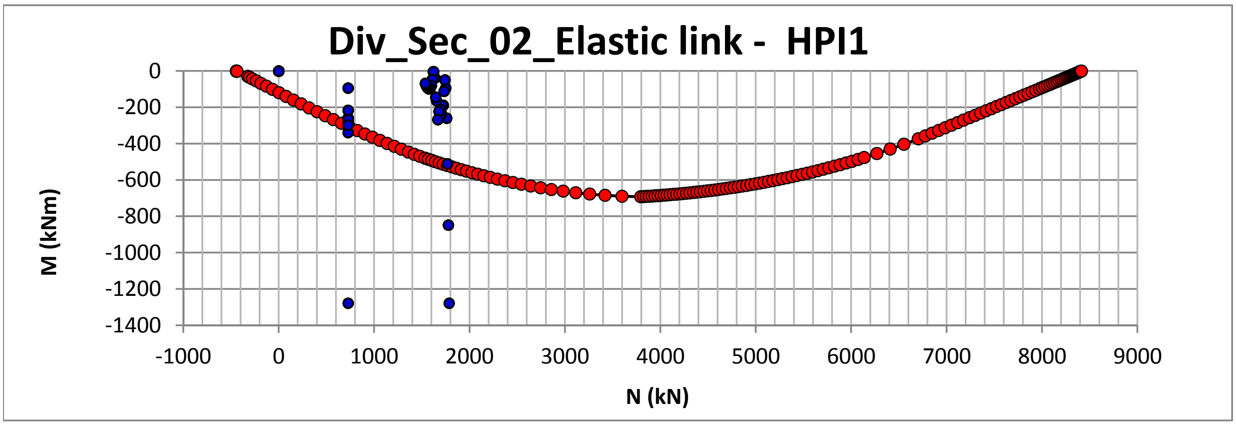


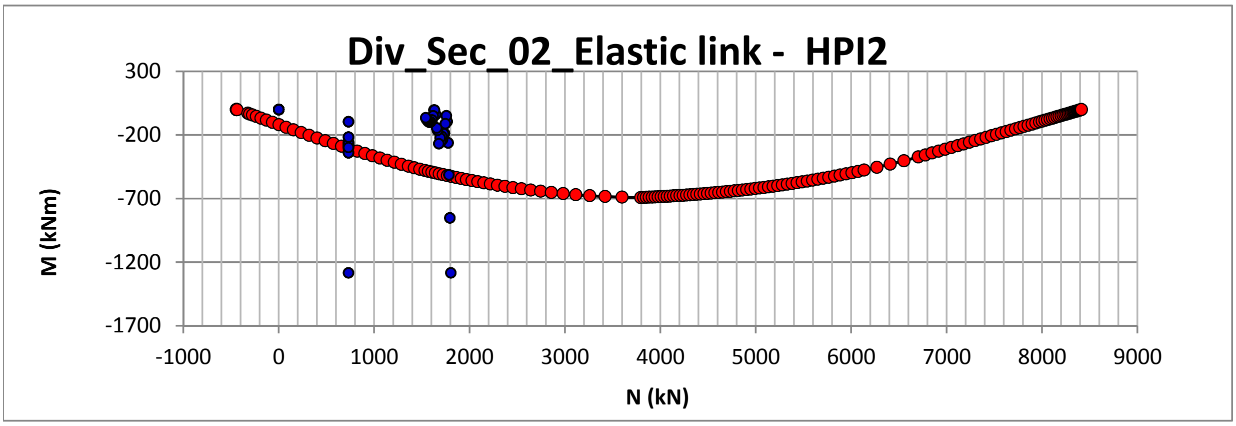
	1	2	3
VRD1 Sec. 1	850.63	850.63	850.63
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	2526.16	2516.61	3884.75

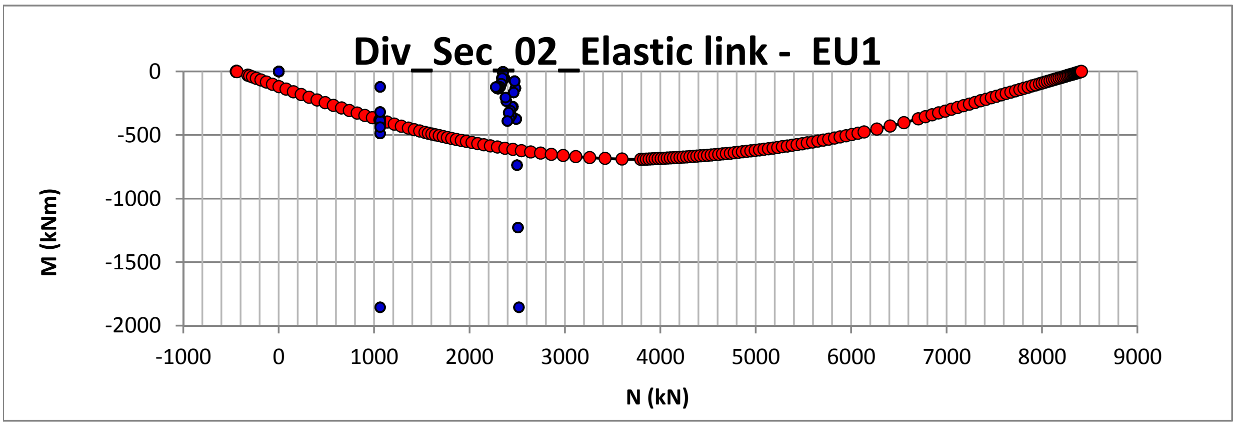
Div_Sec_02_elastic link

Passed	
Failed	x

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Inside	200.0	1.00	1.00	1.50







Div_Sec_02_elastic link

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.60			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		5.65			
			0.00057			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00094			

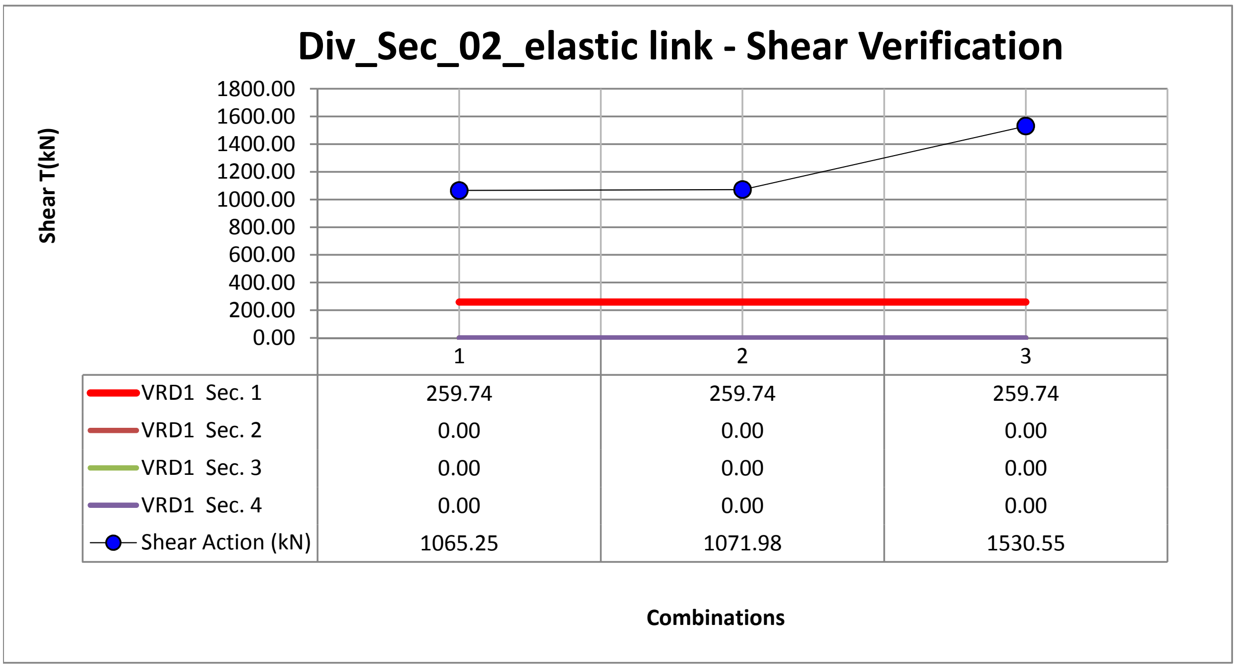
Shear Bearing Capability	V_{RD1}	MN	0.2597	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	259.74	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	259.74	259.74	259.74
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**1065.25**	**1071.98**	**1530.55**

Passed			
Failed	x	x	x

Group 1	Group 2
x	x

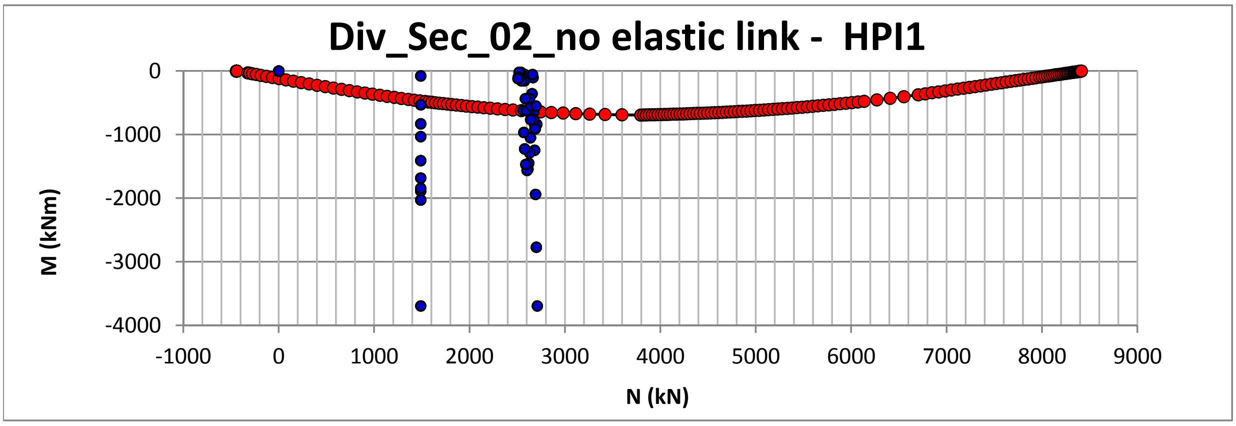
Div_Sec_02_elastic link - Shear Verification

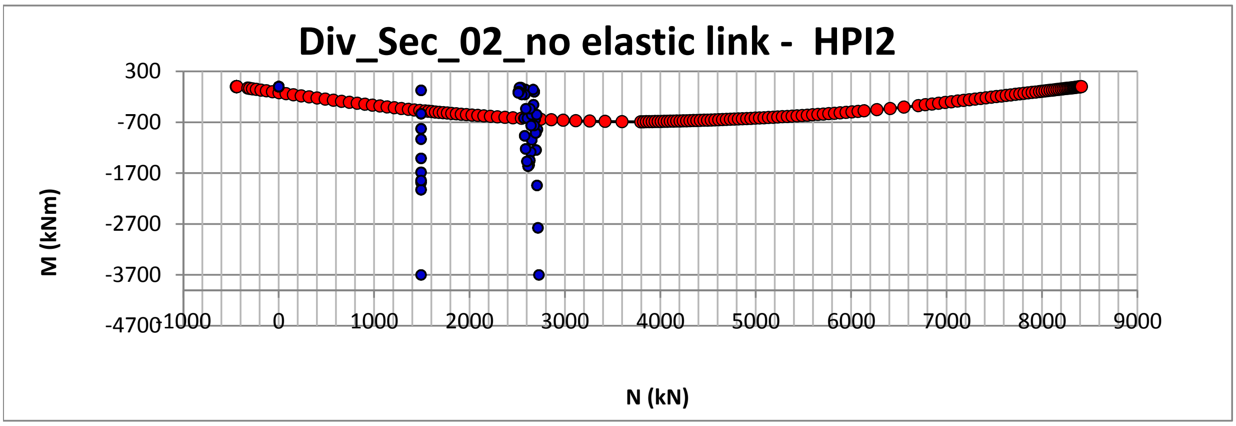


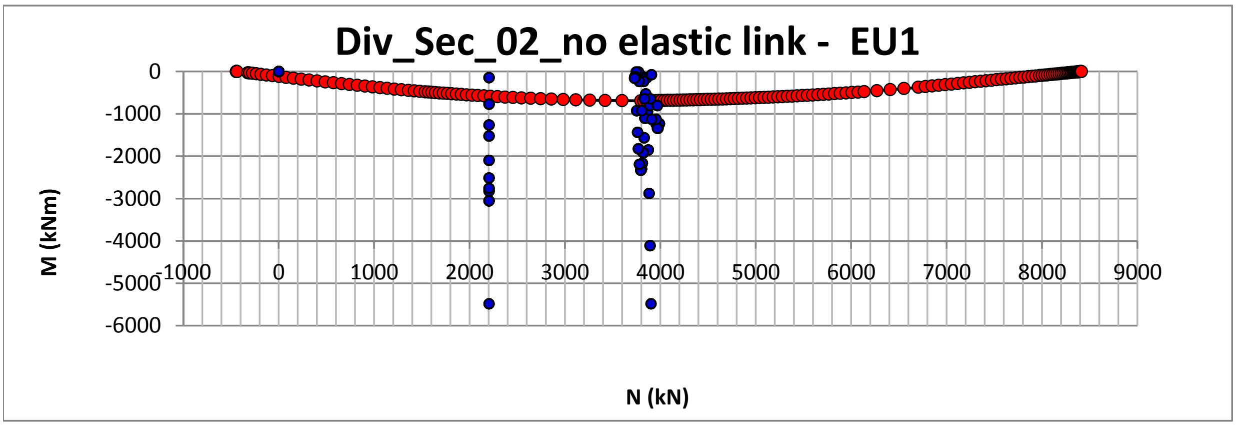
	1	2	3
VRD1 Sec. 1	259.74	259.74	259.74
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	1065.25	1071.98	1530.55

Div_Sec_02_no elastic link	Passed	
	Failed	x

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water ouside	200.0	1.00	1.00	1.50







Div_Sec_02_no elastic link

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	0.60			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		5.65			
			0.00057			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00094			

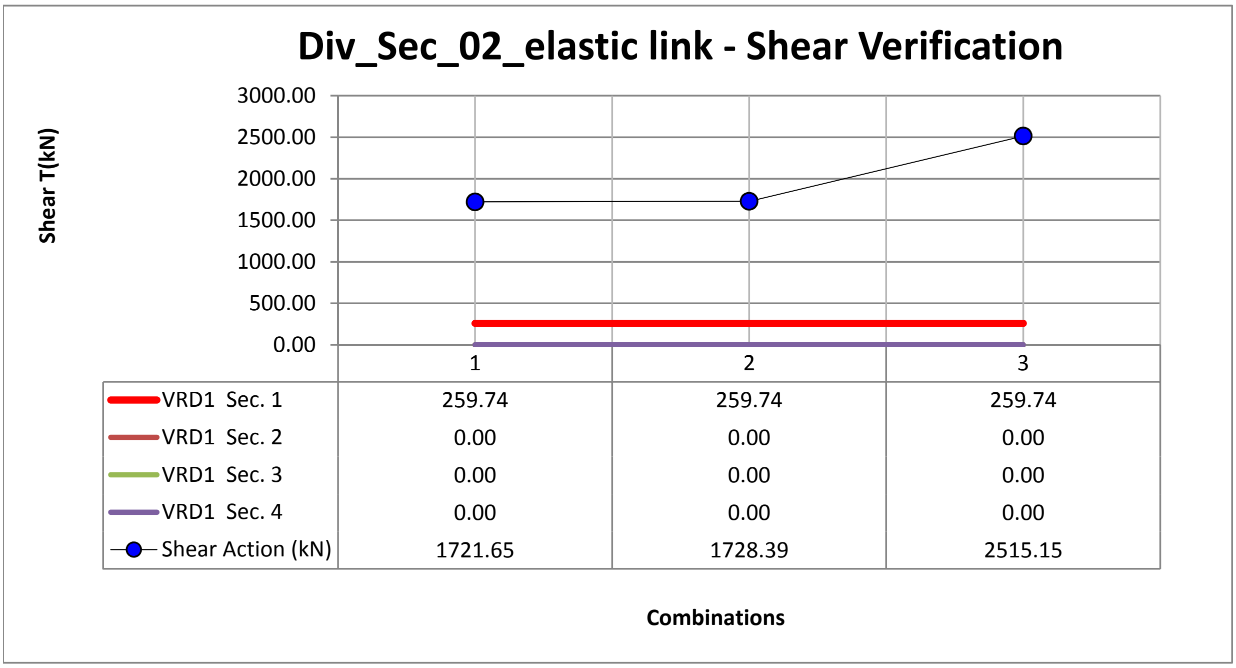
Shear Bearing Capability	V_{RD1}	MN	0.2597	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	259.74	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	259.74	259.74	259.74
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**1721.65**	**1728.39**	**2515.15**

Passed			
Failed	x	x	x

Group 1	Group 2
x	x

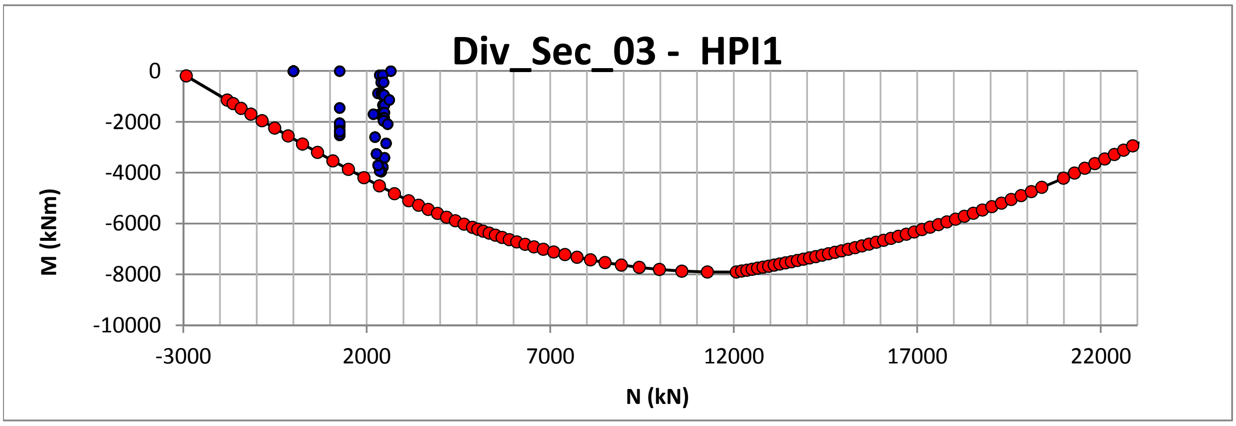
Div_Sec_02_no elastic link - Shear Verification

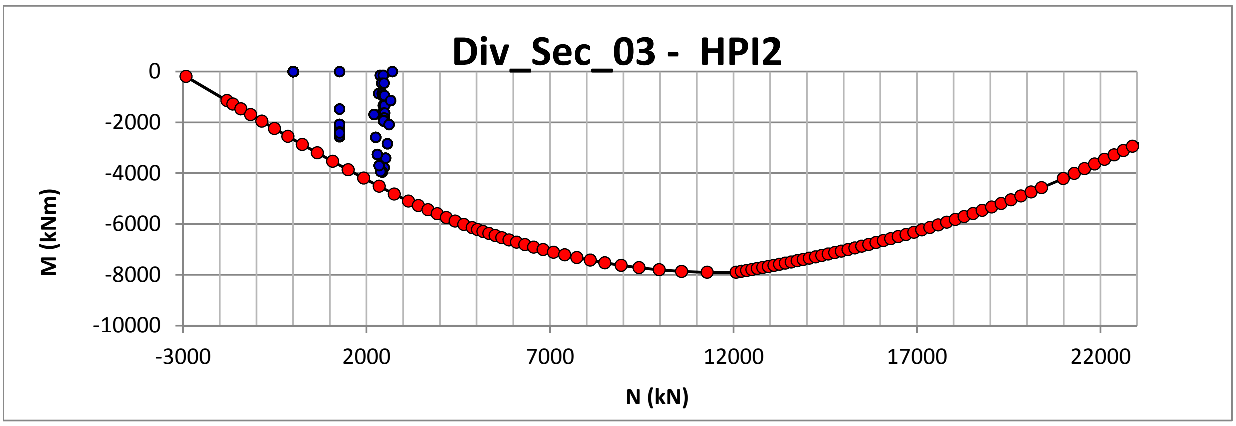


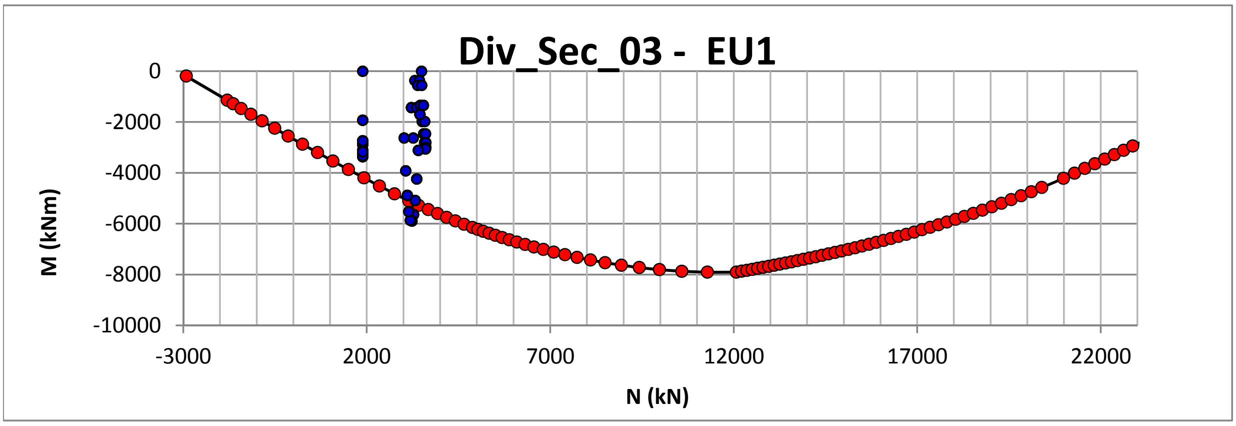
Div_Sec_03

Passed	
Failed	x

	Q	HPI1	HPI2	EU1
		γ_q	γ_q	γ_q
Self Weight	0.0	1.00	1.05	1.00
Water Outside	200.0	1.00	1.00	1.50







Div_Sec_03

Shear Verification

			Sec. 1	Sec. 2	Sec. 3	Sec. 4
Compression Caracteristick strength	R_{ck}=	Mpa	37.00			
Section Width	b_w=	m	1.00			
Section height	d=	m	1.80			
Tensile caracteristic strength	$fc_{tk\ 0.25}$=	MPa	2.10			
Valore di k	k=		1.00			
Long. Tensile Reinforcement	Asl=		40.00			
			0.00400			
Concrete coefficient	γ_c=		1.50			
Shear resistance for unit area	τ_{rd}=	Mpa	0.35			
Reinforcement ratio	ρ=	(< 0.02)	0.00222			

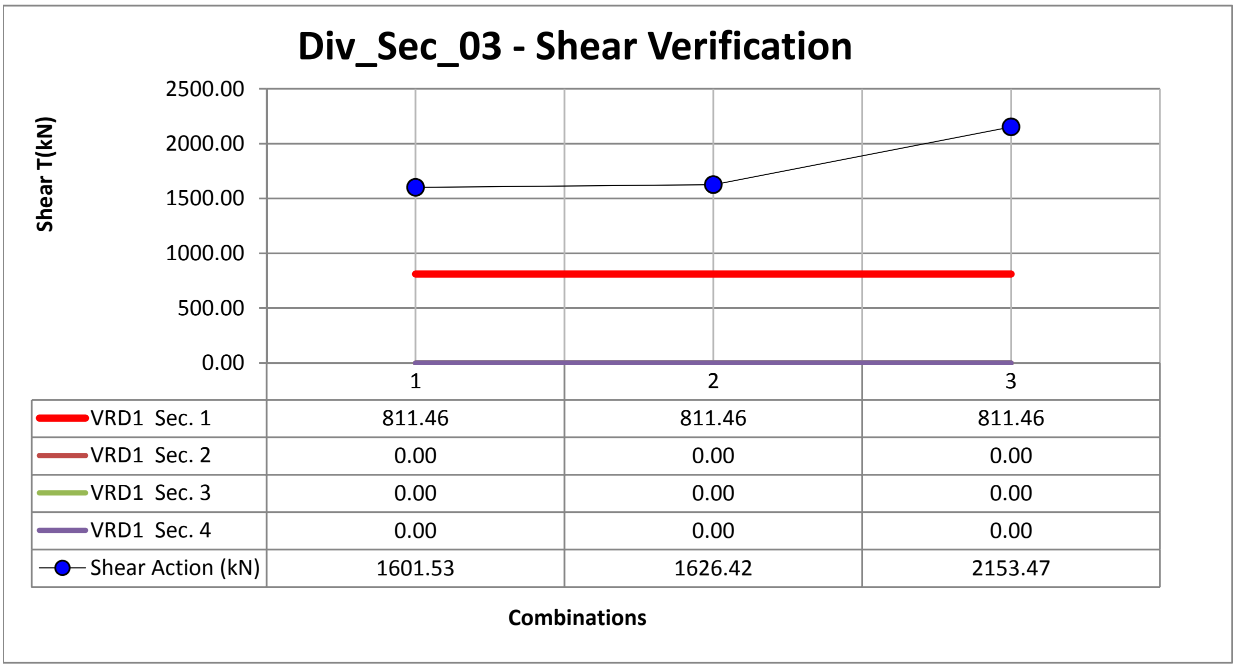
Shear Bearing Capability	V_{RD1}	MN	0.8115	0.0000	0.0000	0.0000
Shear Bearing Capability	V_{RD1}	kN	811.46	0.00	0.00	0.00

	HPI1	HPI2	EU1
VRD1 Sec. 1	811.46	811.46	811.46
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	**1601.53**	**1626.42**	**2153.47**

Passed			
Failed	x	x	x

Group 1	Group 2
x	x

Div_Sec_03 - Shear Verification



	1	2	3
VRD1 Sec. 1	811.46	811.46	811.46
VRD1 Sec. 2	0.00	0.00	0.00
VRD1 Sec. 3	0.00	0.00	0.00
VRD1 Sec. 4	0.00	0.00	0.00
Shear Action (kN)	1601.53	1626.42	2153.47

PHASE 1
ASSESSMENT OF EXISTING ROGUN HPP WORKS

ANNEX 10

DIVERSION TUNNEL N° 1

STRESS ANALYSIS OF PROPOSED DIVERSION TUNNELS STABILIZATION MEASURES

Prof. Giovanni Barla

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Figures

Appendix 1 – Earthquake loading – Maximum shear strain

Appendix 2 – Water loading – Effect of elevation changes

1. INTRODUCTION

This report is written on behalf of ELC-Electroconsult S.p.A. (partner of the Group of Consultants Coyne et Bellier, ELC, IPA for the Rogun Hydroelectric Construction Project) and is intended to analyze the rock mass response and structural behavior of the Diversion Tunnel 1, by taking the cross section at chainage 7+021 m, in a Sandstone Rock Mass (Zone 3, k_1ob_2, upper Obirgam Formation), with a depth of cover equal to 340 m approximately, as representative.

Following a few preliminary remarks on the site conditions, the assumptions introduced, and the computational method adopted, the results of two dimensional Finite Element analyses are described with the intent to study:

1. the rock mass response, based on the ground conditions assumed
2. the structural behavior of the present lining
3. the proposed rock support and stabilization measures.

2. PRELIMINARY REMARKS

2.1 Site Conditions and Assumptions

The Rogun diversion tunnels (Diversion Tunnel 1 and Diversion Tunnel 2) pass beneath the left abutment of the Rogun Dam and are each approximately 1000 m in length. The geology along the Diversion Tunnel 1 is shown in Figure 1 and is characterized by 4 typical zones from upstream to downstream. The tunnel horseshoe section 17 m high by 14 m wide is shown in Figure 2 where the type of support installed is also shown.

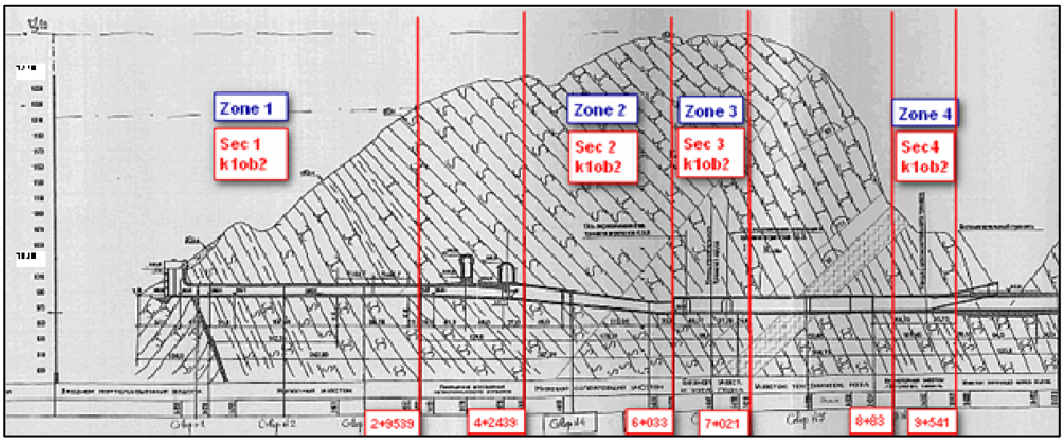


Figure 1: Geological profile and Zones 1 to 4 (Zone 3 is considered)

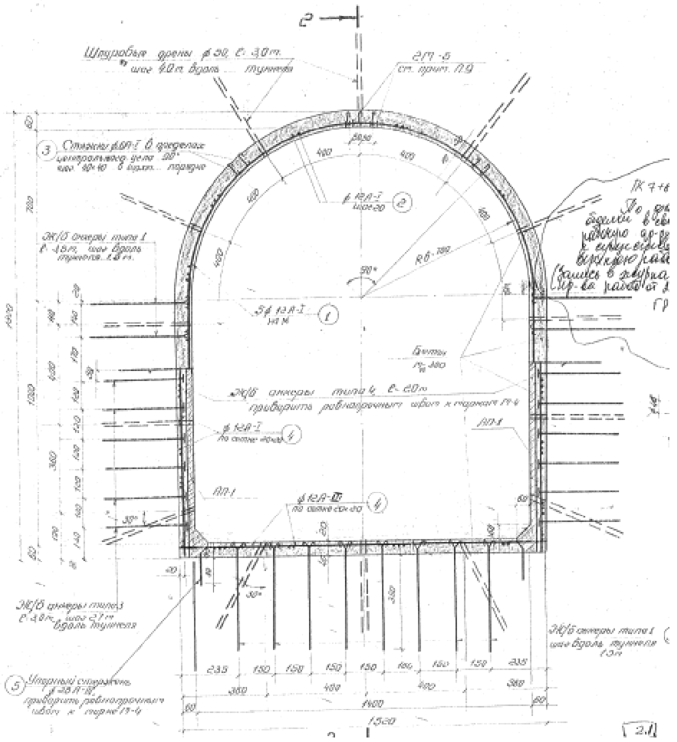


Figure 2: Geometry and rock support of Diversion Tunnel 1 in Zone 3 (Sandstone). Reference Drawings: 1079-14-78 (Sheet 2 of 2)

Based on the available information it is estimated that the sandstone rock mass within Zone 3 (Chainage 6+033-7+021 m) can be given the parameters tabled below (Table 1), with the rock mass strength properties defined with the Mohr-Coulomb failure criterion.

Table 1: Rock mass parameters for sandstone
Dilation angle 0°

Property	Short term		Long Term[1]	
	Peak	Residual	Peak	Residual
Deformation modulus (GPa)	9.0		5.0	
Poisson's ratio (-)	0.3		0.3	
Cohesion (MPa)	1.5	1.2	1.2	1.0
Friction Angle (°)	45	40	40	35

[1] Long term properties are activated in a 4 m-thick zone around the tunnel boundary

The stress regime for purpose of the stress analyses to be carried out is assumed to be characterised by the vertical stress σ_v= 8.50 MPa (unit weight 25 kN/m^3), with the horizontal stress in the range σ_h=1.70 - 12.75 MPa (with a Stress Ratio K_h= 0.2-1.5).

2.2 Finite Element Method (FEM) and Stress Analysis

The Finite Element Method (FEM) is used in the following for purpose of stress analysis. The FEM implies in all cases that the real problem be idealized or simplified by creating a model in two-dimensional or three-dimensional conditions which includes all features and details of rock mass response and of rock support.

The FEM analyses presented in this report have been carried out in plane strain conditions by using the computer program Phase2 of Rocscience, developed at the University of Toronto. This program allows a variety of material types to be included in the model representing the stress problem under study including rock, discontinuities, support measures and structural components.

One significant advantage of this program is that it is associated with user friendly graphical pre- and post- processors and allows for an effective simulation of the excavation/construction sequence and of the progressive failure of the rock mass surrounding the excavation. The failure taking place around the excavation is generated by a succession of calculations in which the excess load, which cannot be carried out by a failed element is transferred onto adjacent elastic elements.

If the total load carried out by these elements is too high, they fail and transfer the excess load onto the next elements. Starting from the excavation boundary where the stresses are the highest, failure propagates outwards until the excess load transferred is small enough that it can be carried by the surrounding elements without further failure. If such a condition of no failure propagation is attained in the rock mass surrounding the excavation and the numerical solution is not convergent, then instability will take place.

3. ASSESSMENT OF THE ROCK MASS RESPONSE

The failure of a rock mass around an underground opening depends on the in situ stress level (σ_v, σ_h , Stress Ratio $K_h = \sigma_h/\sigma_v$) and the characteristics of the rock mass. In order to study the rock-support interaction, a simple analytical model is used. This model involves a circular tunnel subjected to an isotropic stress field in which the horizontal and vertical stresses are equal. The rock mass is assumed to behave as an elastic-perfectly plastic or elastic-perfectly brittle material. The so called Ground Reaction Curve (GRC) can be obtained and some insights on the extent of the failure zone around the opening inferred.

If the tunnel is not circular and the stress field is not isotropic, one is in position to obtain the GRC in order to analyze the rock mass response by using the Finite Element Method. This was done for the Diversion Tunnel 1 as shown in Figure 3 which illustrates a detail of the FEM mesh used and the failure zone surrounding the unsupported horseshoe opening, when the rock mass is assumed to be elastic-perfectly plastic with the short term parameters (peak values) given in Table 1 and the stress ratio is 1.5.

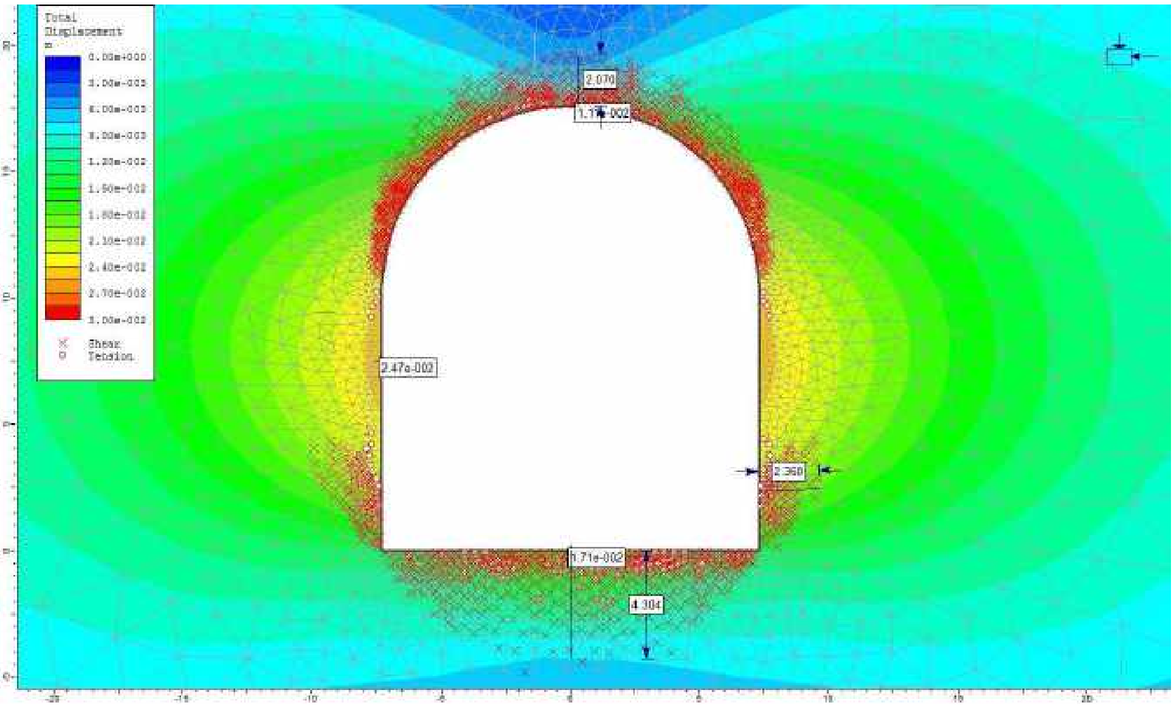
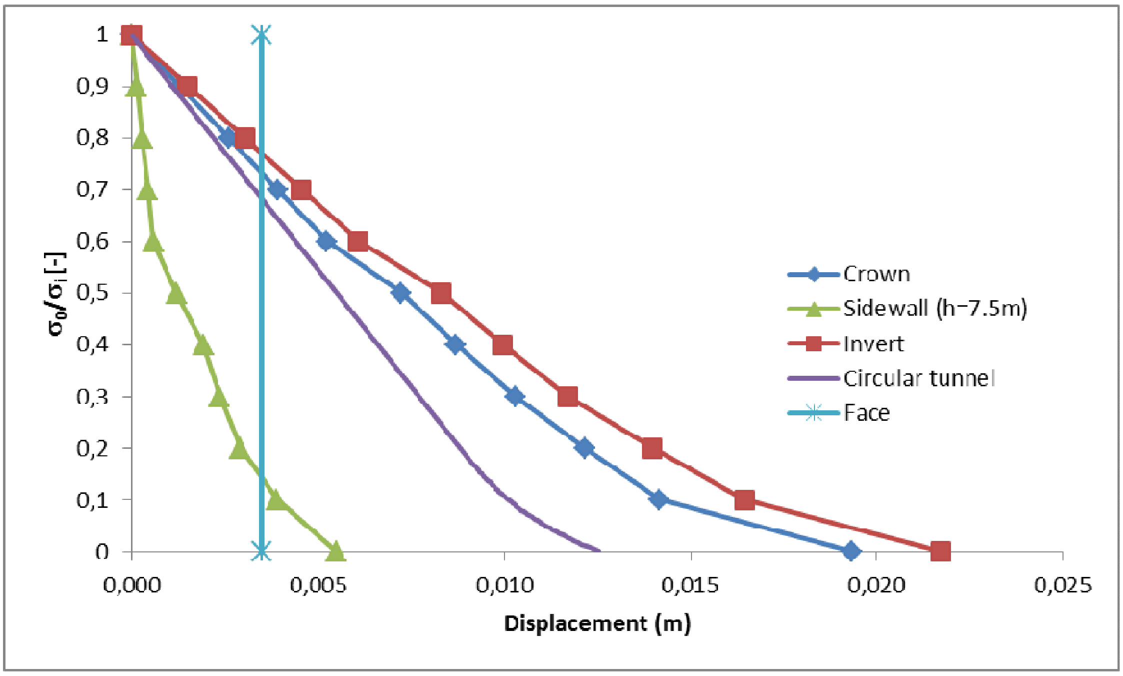
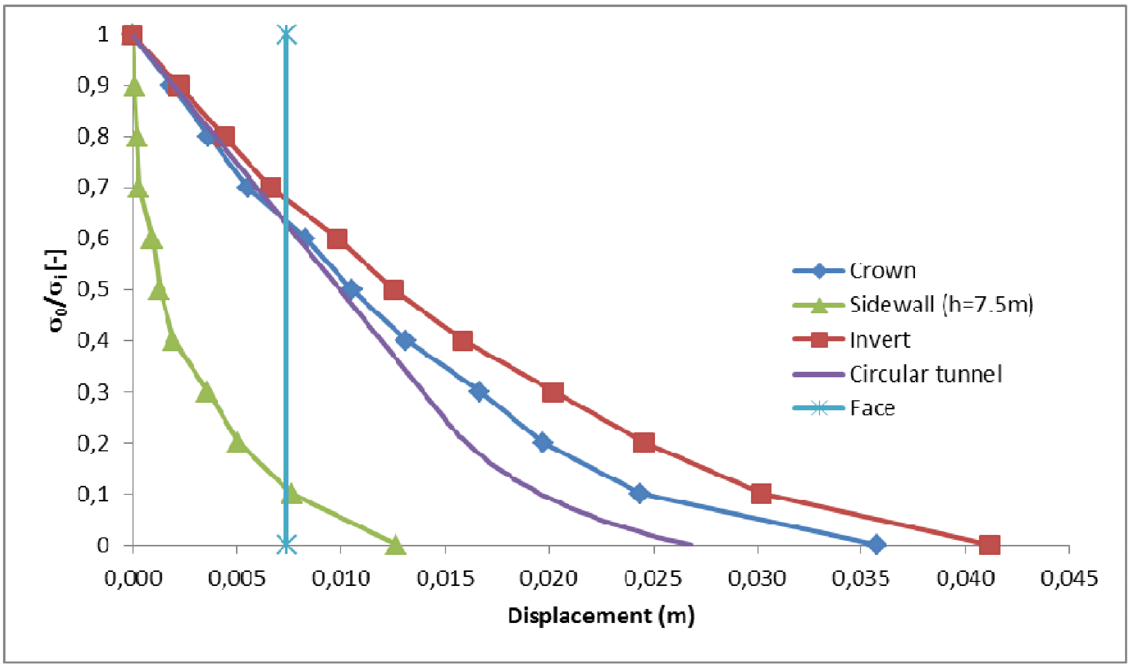


Figure 3: FEM mesh of the Diversion Tunnel 1. Failure zones surrounding the tunnel and maximum displacements (the rock mass is assumed to be elastic-perfectly plastic with the short term parameters-peak values given in Table 1)

With the main purpose to gain insights into the ground response around the tunnel for the set of parameters shown in Table 1, Figures 4 and 5 give the GRCs for different assumptions of the rock mass behavior and different K_h values. Similarly, Figure 6 and 7 illustrate the corresponding extent of the failure zones around the tunnel as the stresses at the boundary of the opening are being relieved.

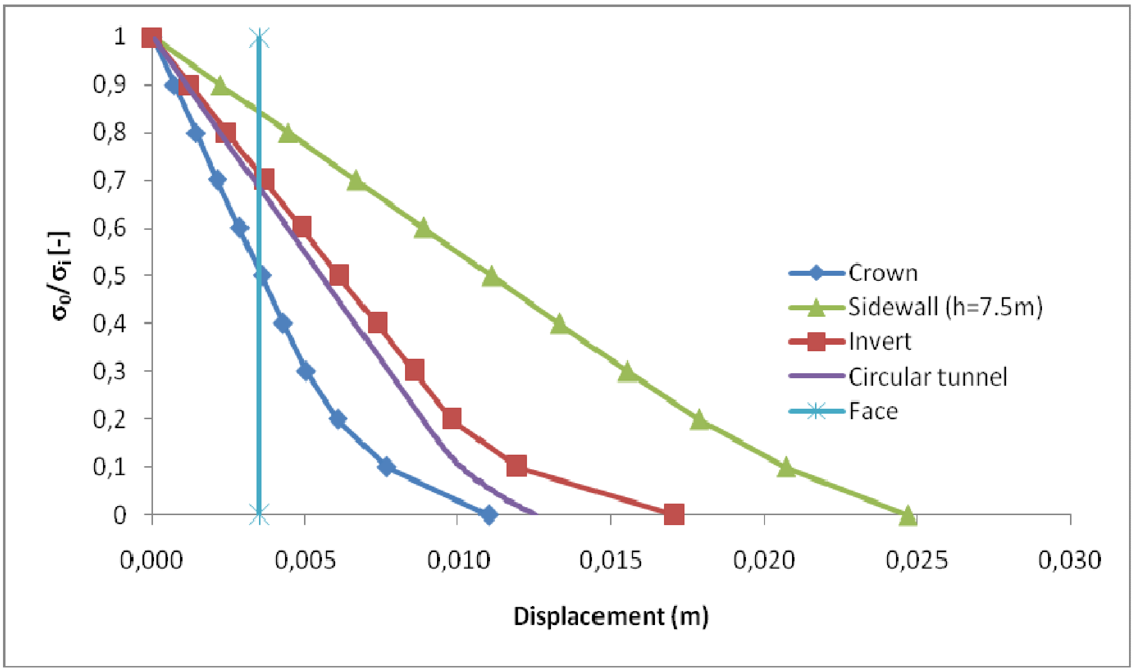


(a)

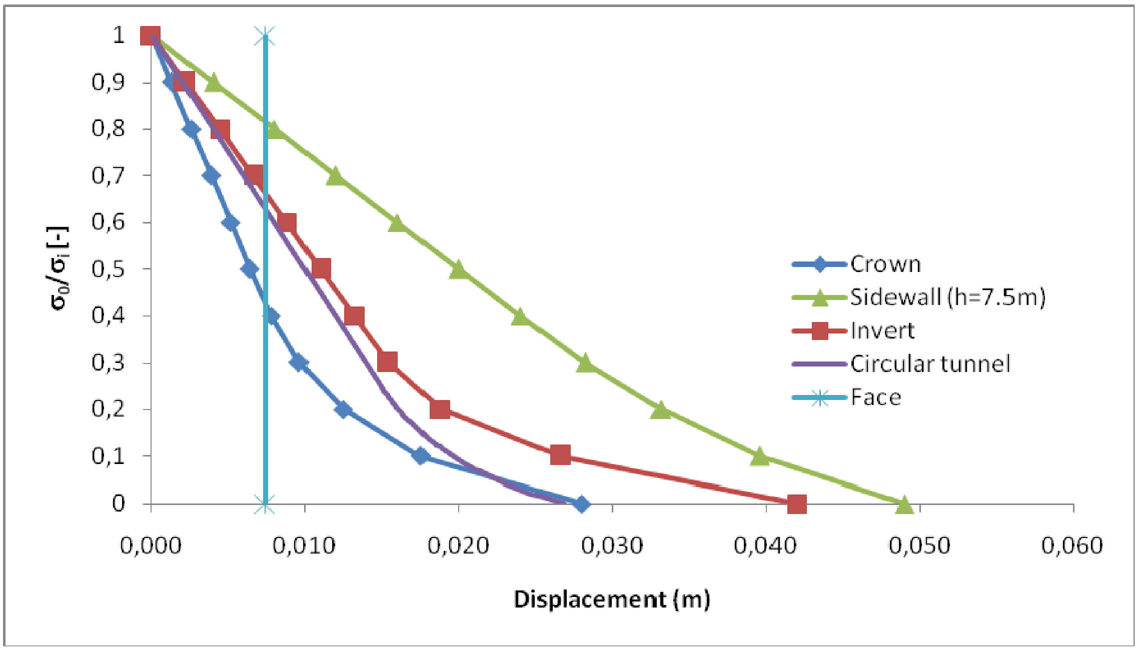


(b)

Figure 4: Ground Reaction Curves for Diversion Tunnel 1 (K_h = 0.2). (a) Short Term Parameters. (b) Long Term Parameters

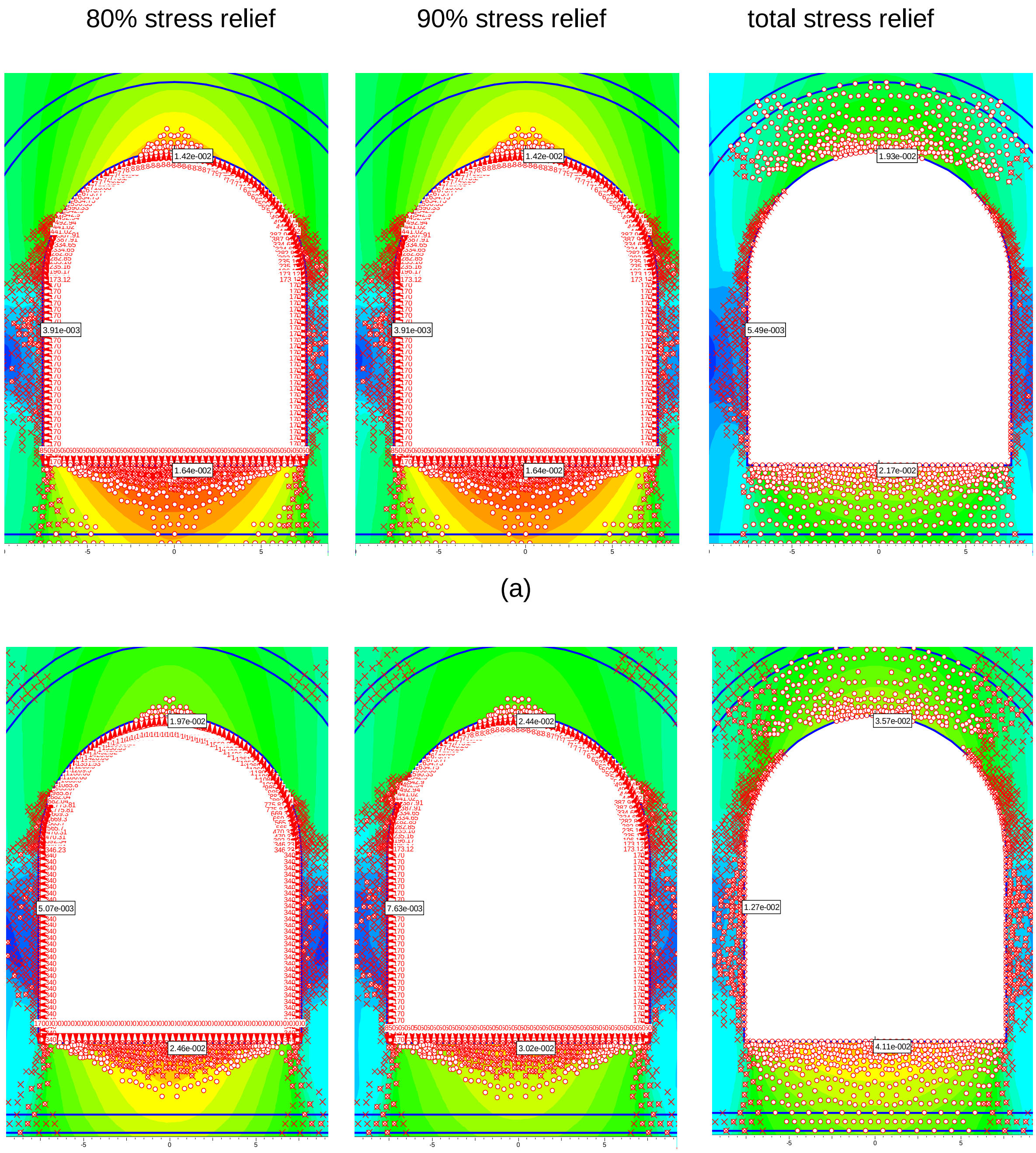


(a)



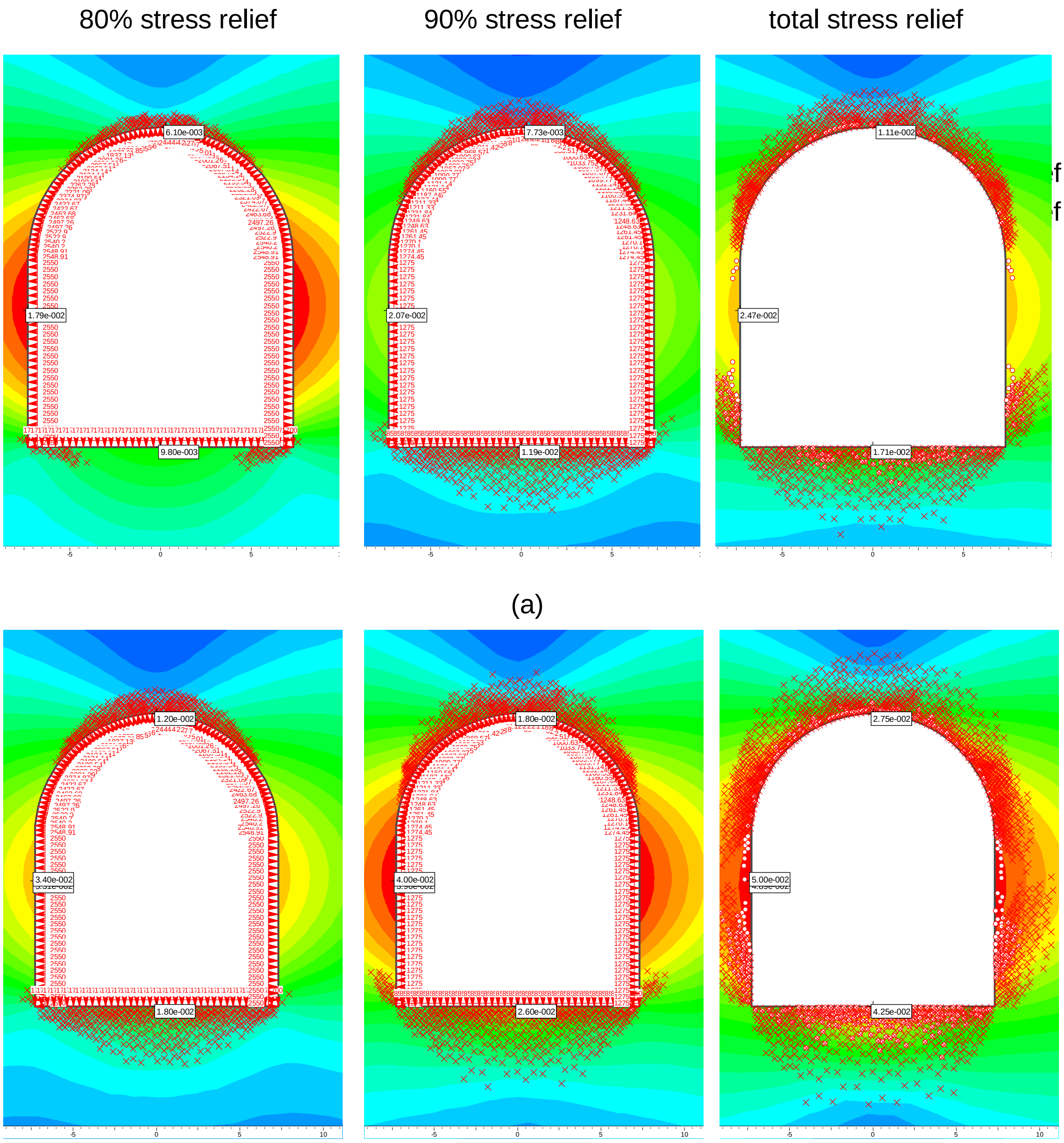
(b)

Figure 5: Ground Reaction Curves for Diversion Tunnel 1 (K_h = 1.5). (a) Short Term Parameters. (b) Long Term Parameters



(b)

Figure 6: Failure zone around the Diversion Tunnel 1 (K_h =0.2). (a) Short Term Parameters. (b) Long Term Parameters



(a)

(b)

Figure 7: Failure zones surrounding the Diversion Tunnel 1(K_h = 1.5). (a) Short Term Parameters. (b) Long Term Parameters

4. BEHAVIOR OF THE PRESENT LINING

With the intent to study the structural behavior of the Diversion Tunnel 1 in the cross section of interest, i.e. the rock-support interaction, a set of numerical analyses by using the Finite Element Method have been performed as a follow up of the preliminary analyses described above. The tunnel support taken into consideration is the present one as shown in Figure 2. It is noted that no effect of the rock dowels around the tunnel has been considered here due to the long time elapsed after their installation. Also, for sake of simplicity, only the case for K_h=1.5 is considered.

The material properties for the final lining, which is given a linearly elastic behavior, are assumed to be as follows:

- Concrete: type C25-30; Characteristic cubic compression strength R_{ck} = 30 MPa; Unit weight =24.52 kN/m^3; Young's modulus =31,220 MPa; Poisson's ratio = 0.2;
- Support Reinforcement: type Fe44k;diameter = 12 mm (0.2 × 0.2m), double layer-cross section; f_{yk} = 430 N/mm^2; Young's modulus = 200,000 N/mm^2; Allowable strength = 255 N/mm^2 .

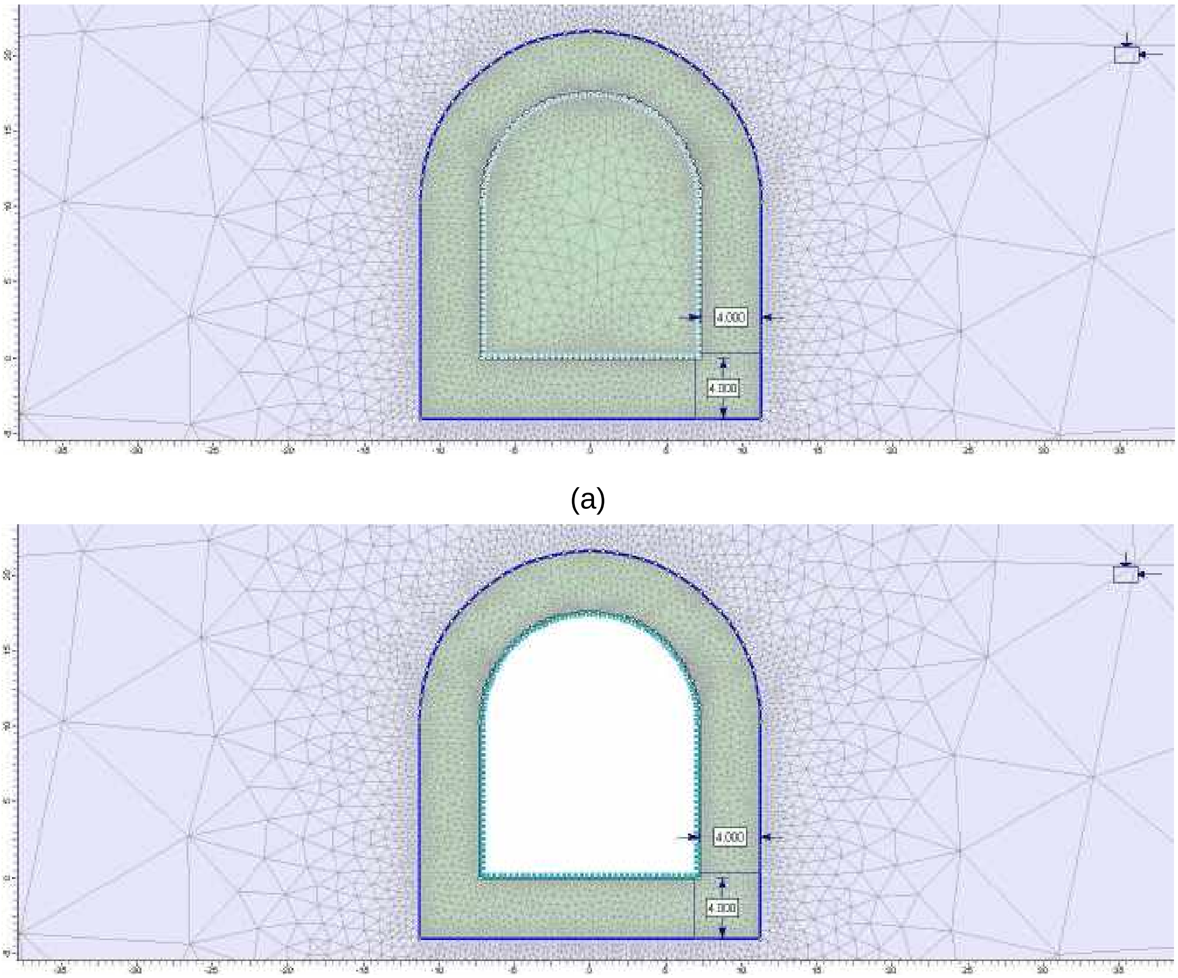
A detail of the automatically generated Finite Element mesh adopted is shown in Figure 8 a, b. It is noted that the rock mass is subdivided by using 6 node triangular elements, whereas beam elements are used to represent the concrete lining. A significant number of such elements is used on the opening boundary and a fine mesh is created in order to be able to show the details of the failure zones, as already noted above.

The FEM analyses have been carried out in sequential stages by reproducing the excavation process and the support installation prior to activating the desired loads:

- Water loads (in terms of a uniform pressure distribution applied to the lining).
- Seismic action (in terms of a deformation field associated with a pure shear condition based on the maximum shear strain induced during a seismic event, see Appendix 1 for details).

The stages considered are as follows:

1. Stage 1 - Activation of the in situ state of stress (σ_v, σ_h , Stress Ratio K_h= σ_h /σ_v).
2. Stage 2-12 - Step by step stress relief on the boundary of the opening up to excavation completion.
3. Stage 13 - Installation of the lining with Long Term parameters in the 4 m thick zone corresponding to the failure zone.
4. Stage 14 - Activation of the water load (represented with a uniform pressure distribution on the lining).
5. Stage 15 - Seismic action (obtained by applying an equivalent shearing force producing γ_{max} = 6.2x10^{-4}).



(a)

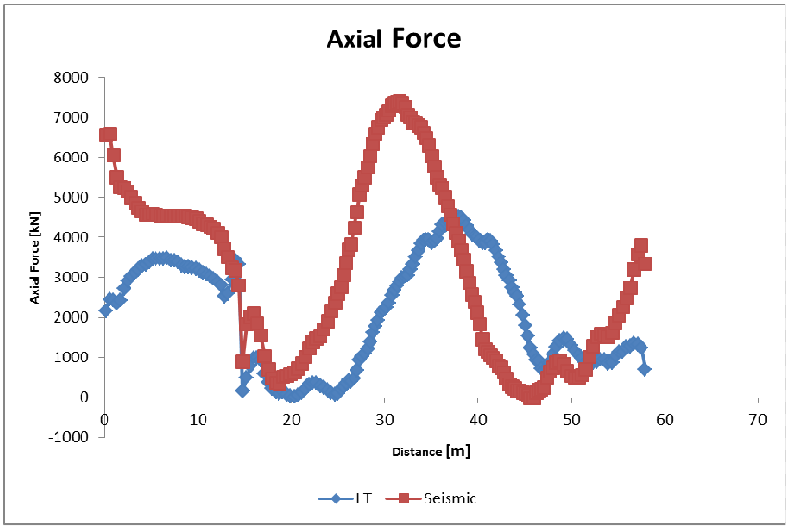
(b)

Figure 8: Automatically generated Finite Element Mesh adopted: (a) Details of the rock mass near the tunnel. (b) Beam elements used to represent the concrete lining

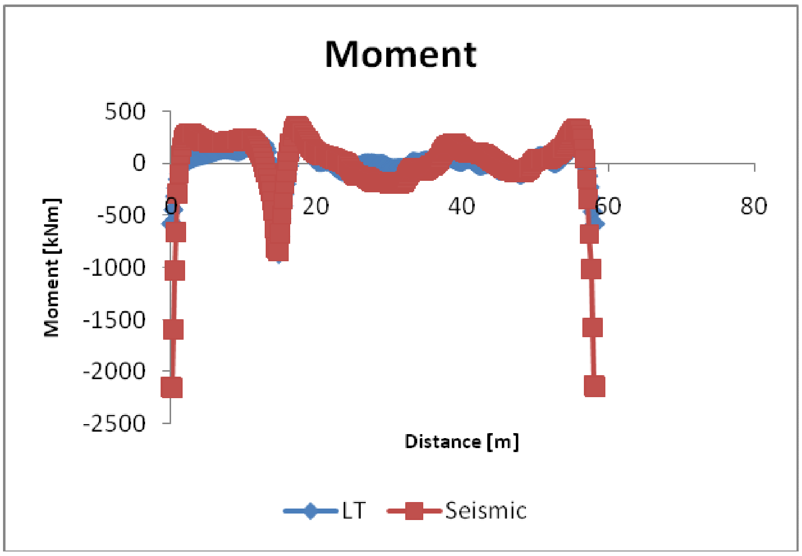
4.1 Analyses Performed and Results

Three different sequential analyses (with Stage 1 to 15 in each analysis) have been performed with the interest to evaluate the influence of the water load (Stage 14), with the water pressure uniformly distributed on the lining and ranging from 0 to 200 kPa. It is noted that a uniform pressure distribution surrounding the tunnel implies a very high efficiency of the drainage system installed around the tunnel. In fact, should such a system be totally inefficient at present or become so during its service life, this assumption would no longer be acceptable.

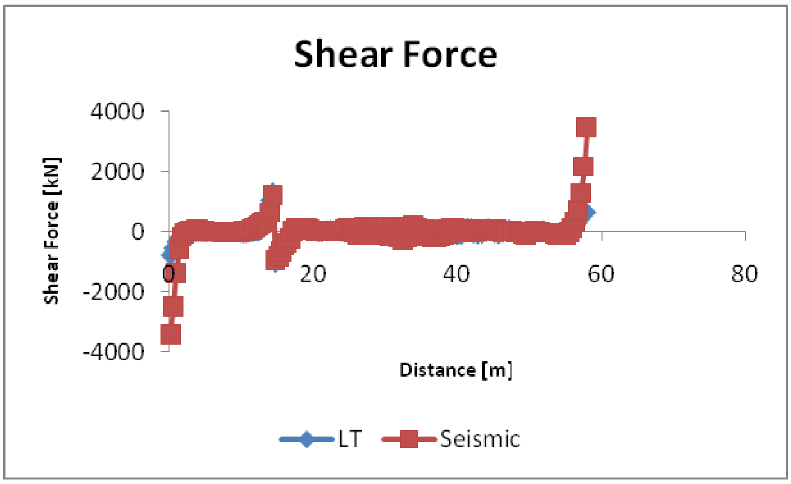
The results obtained are illustrated in Figures 9 to 11 by giving the computed Axial Force (a), Bending Moment (b) and Shear Force (c) in the concrete lining. The plots allow one to assess the influence of each loading condition separately (i.e. stress relief due to deterioration of the rock mass parameters from short to long term conditions in the failure zone; water load; seismic action).



(a)

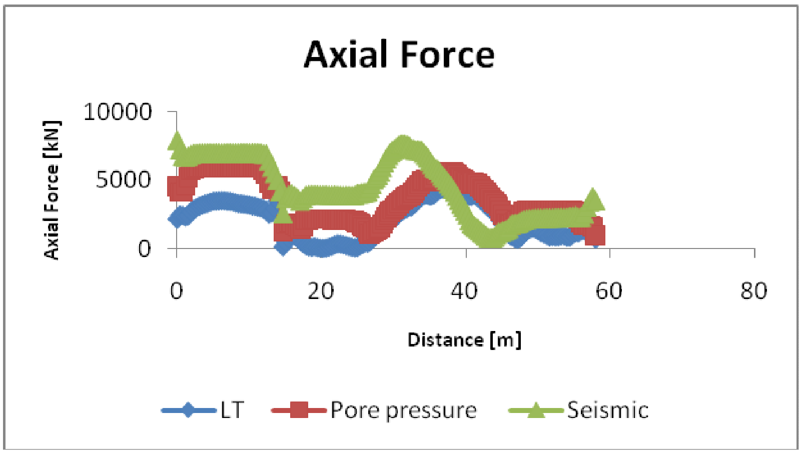


(b)

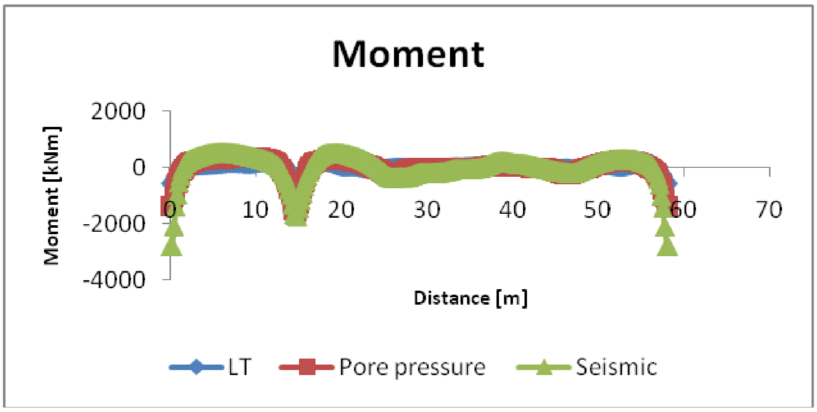


(c)

Figure 9: Axial thrust (a) Bending Moment. (b) Shear in the lining (no water pressure)



(a)



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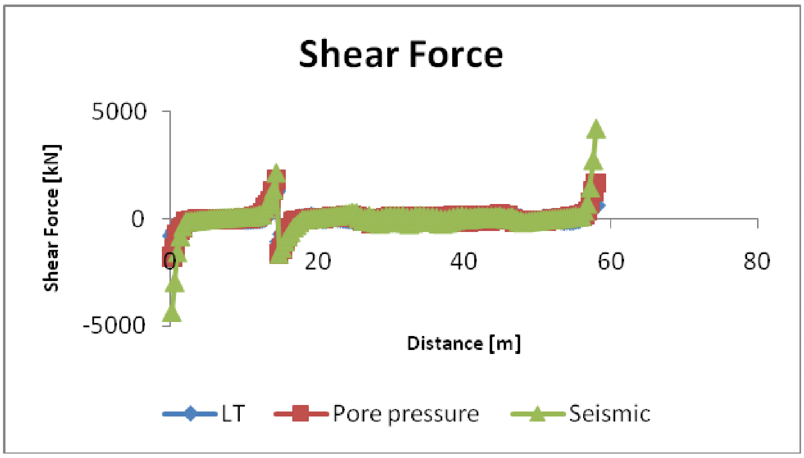
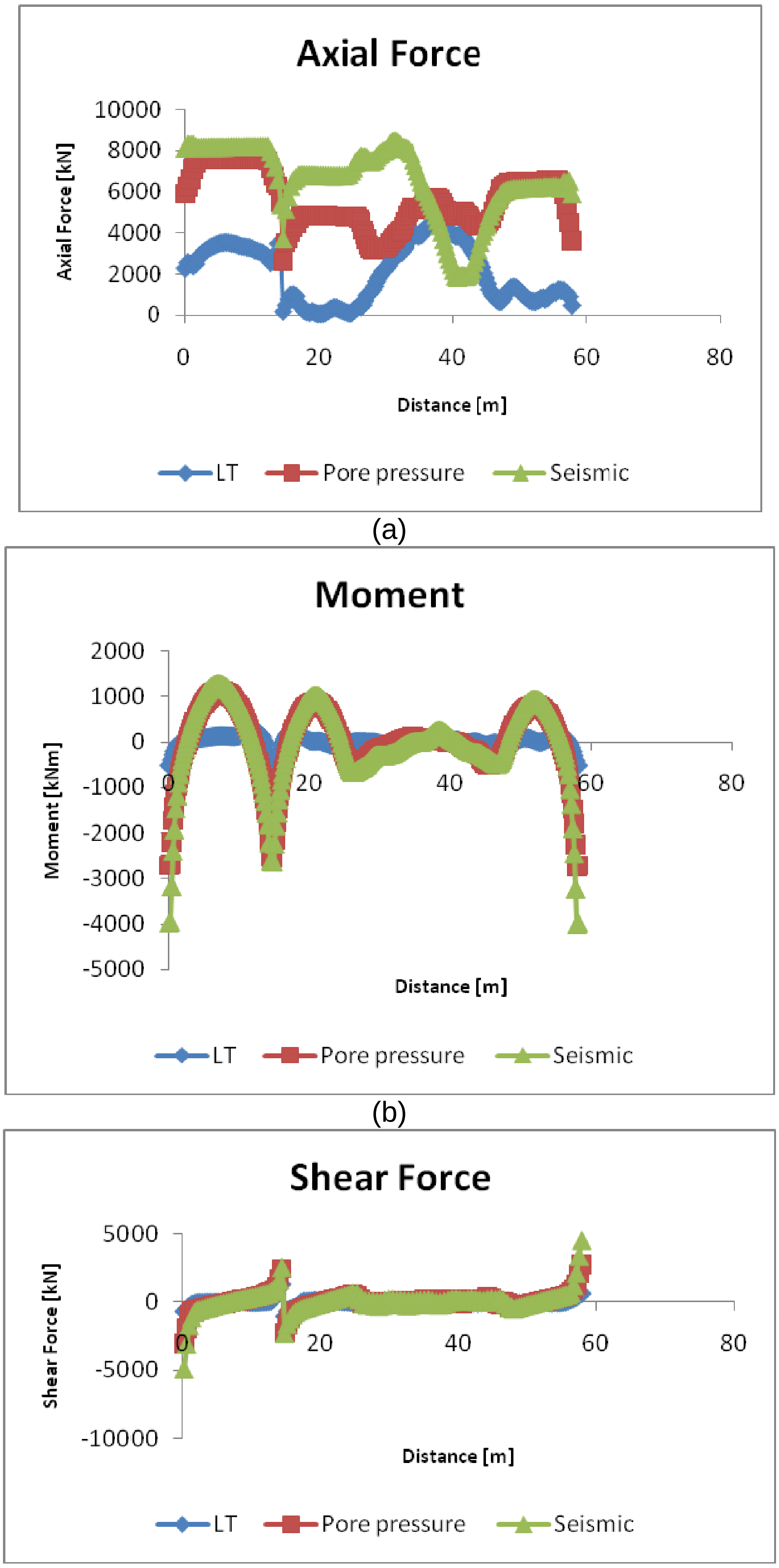


(c)

Figure 10: Axial thrust (a) Bending Moment. (b) Shear in the lining. (100 kPa water pressure)



(a)

(b)

(c)

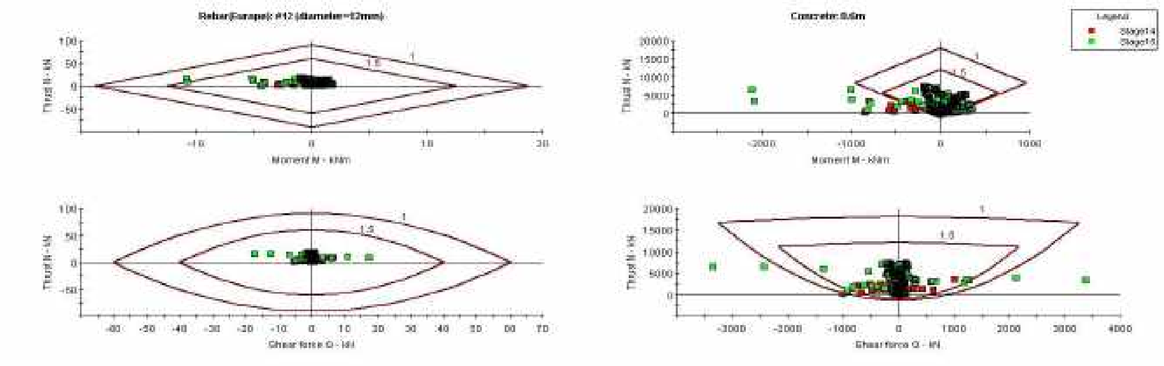
Figure 11: Axial thrust (a) Bending Moment. (b) Shear in the lining. (200 kPa water pressure)

For comparative purposes and in order to visualize the influence of the water pressure, Figures 12 shows the Support Capacity plots for the reinforced concrete lining. For simplicity, the factor of safety in these plots is assumed to be equal to 1. The Support Capacity plots are given as axial force versus moment space and axial force versus shear force space. Values of axial force, moment and shear force for the liner are then compared to the capacity envelopes.

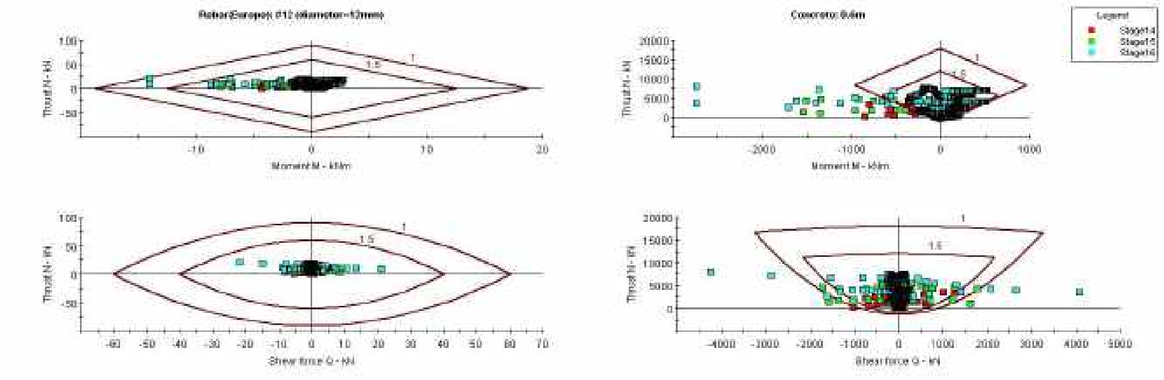
It is noted that in the structural analyses performed the properties of the final lining have been assumed to be the same as those of the initial shotcrete lining, as defined above. It has also been assumed that the final lining has been installed in a stable tunnel. Thus the loads imposed on it result from stress changes due to a stress distribution resulting from deterioration of the rock mass surrounding the tunnel (from the short to the long term conditions), changes in groundwater conditions, seismic loading.

It is also observed that the support capacity plots are based on elastic analysis of the lining, which implies that no tensile cracking or compressive crushing of the concrete elements is acceptable. These simplified calculations allow one to assess the behavior of the lining relatively quickly and efficiently. It has been demonstrated however that, where tensile cracking or lining deterioration becomes an important consideration, as may be the case of the tunnel under study, more sophisticated nonlinear structural design approaches, which allow for crack development, should be used.

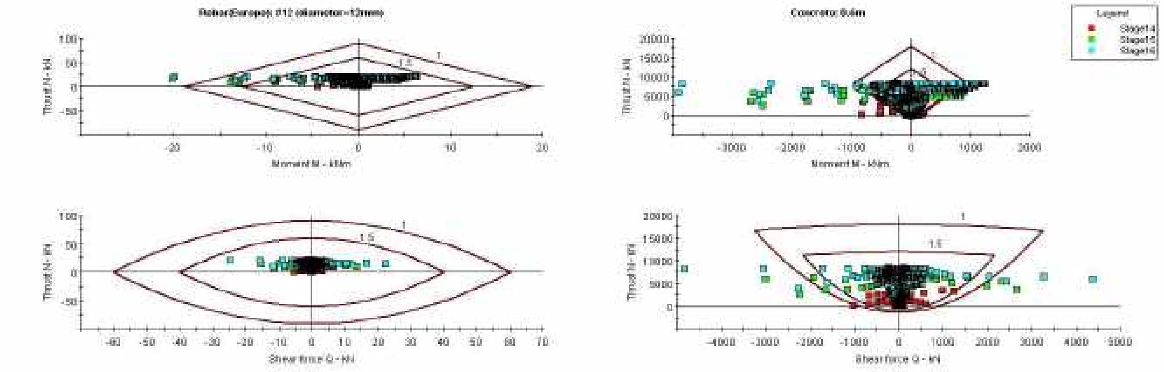
Under the conditions discussed above, Figure 13 depicts, for the two cases analyzed with the water pressure equal to respectively 100 and 200 kPa, the locations in the lining where failure would take place. It is well evidenced that, under the assumption that the factor of safety is equal to 1, no failure in the reinforced concrete lining would occur when the effects of the water pressure on the lining are neglected. In the other cases the lining would fail at the lower corners(contact between the sidewalls and the invert) and along the vertical sidewalls.



(a)

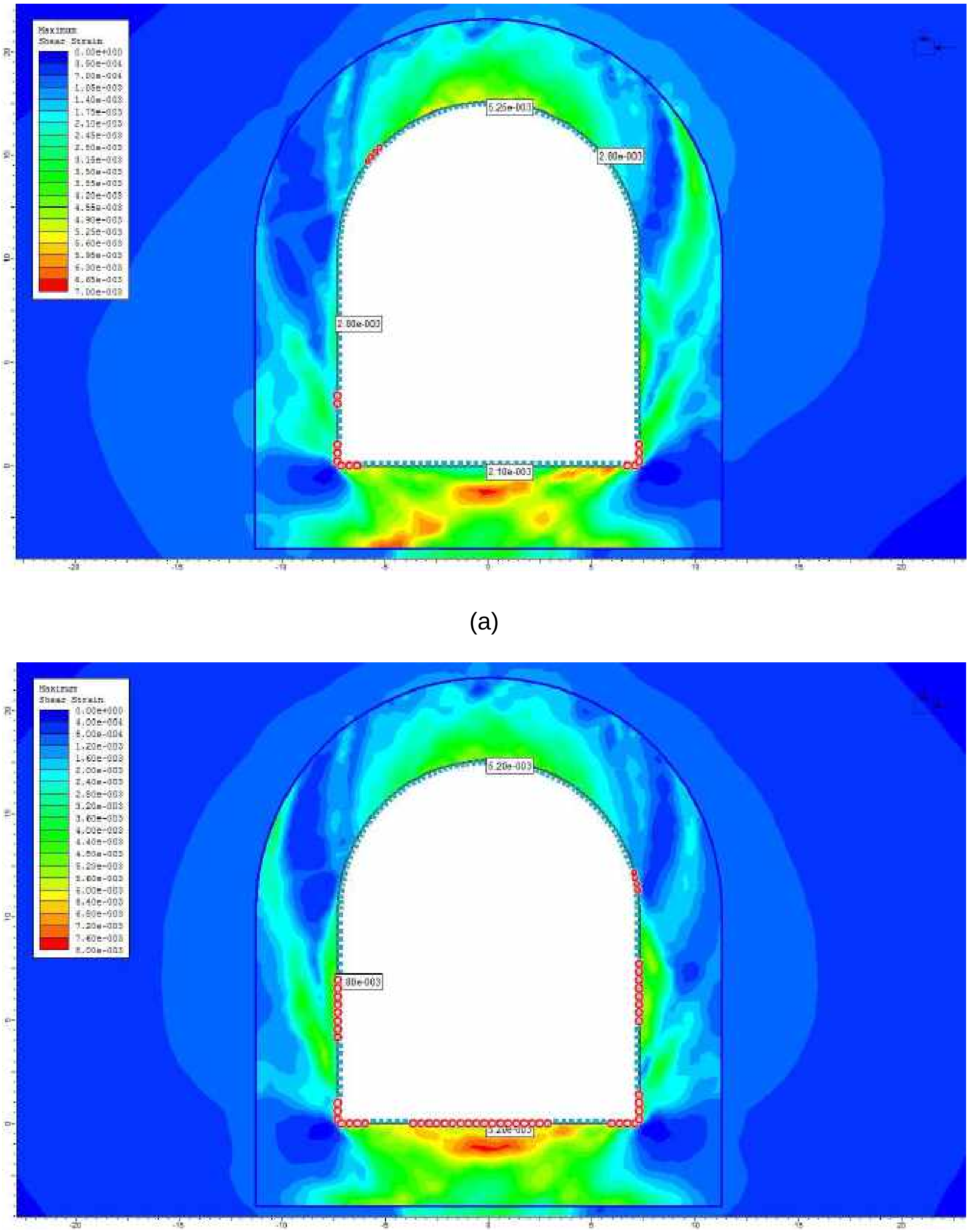


(b)



(c)

Figure 12: Support Capacity plots for the reinforced concrete lining. (a) no water pressure. (b) 100 kPa water pressure. (c) 200 kPa water pressure



(a)

(b)

Figure 13: Zones (red circles) in the reinforced concrete lining for different values of water pressure. (a) 100 kPa water pressure. (b) 200 kPa water pressure

5. THE PROPOSED SUPPORT - STABILIZATION SYSTEM

It has been demonstrated that under the loading conditions considered in the stress analyses performed (stress changes derived from a stress distribution resulting from deterioration of the rock mass surrounding the tunnel, changes in groundwater conditions, seismic loading) the present lining would not perform as desired. It is therefore reasonable to look for possible stabilization measures to be implemented in order to improve tunnel performance.

It is clear that the effect of water pressure on the lining is the predominant factor associated with its performance, given the uncertainties which characterize the assessment of the water load. The assumption of a uniform pressure applied on the lining, with values comprised between 100 and 200 kPa, is based on an ideal behavior of the drainage system installed around the tunnel and on the correctness of the estimate based on the specific three dimensional hydrogeological model developed for the project by Hydroproject.

Another point to underline based on the stress analyses performed is the very limited safety margin available with the present lining as designed, even when no water pressure is taken into account. In addition consideration should be given to the tunnel shape which has a strong impact on the lining stresses resulting from external water pressure. As noted in the calculations shown in Appendix 2, should water pressure change due to elevation changes between the crown and invert (i.e. the drainage relief holes are not effective), the structural behavior of the tunnel would be significantly impaired.

With the above points in mind, an additional support-stabilization system is proposed as shown in Figure 14 which comprises:

1. A systematic drainage system around the tunnel, invert and sidewalls included, consisting of a pattern of drainage holes, each having a 8 m length minimum.

2. A new support system in the form a pattern of rock dowels around the tunnel, each having a length of 6 m.

3. An additional reinforced concrete lining ring 40 cm thick minimum, well integrated with the existing 60 cm lining and the above rock dowels, placed around the tunnel.

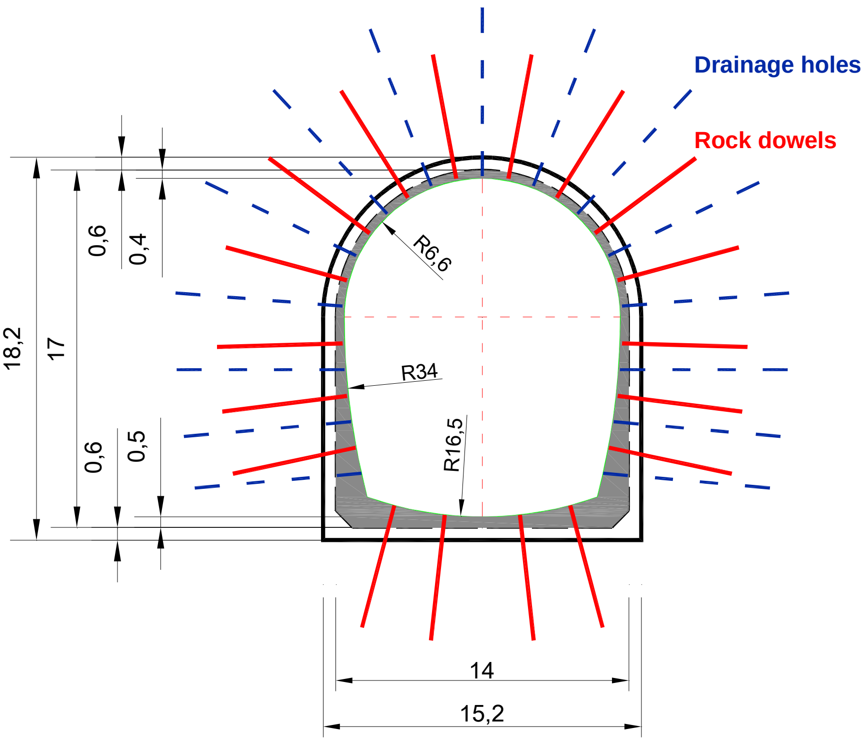
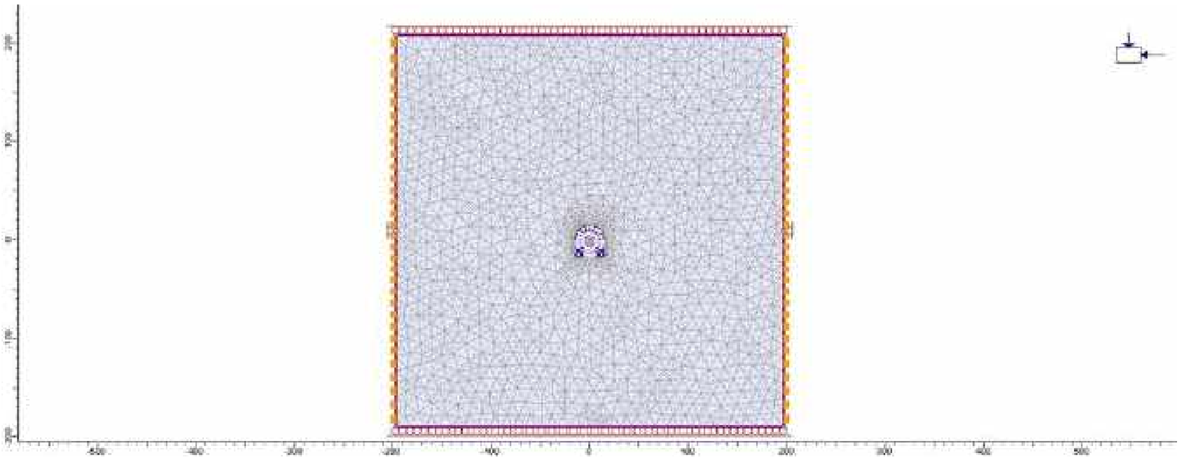


Figure 14: Schematic illustration of the additional support-stabilization system proposed

With the intent to study the structural behavior of the Diversion Tunnel 1 in the cross section of interest, by taking into account the additional support-stabilization system shown in Figure 14, numerical analyses by using the Finite Element Method have been performed. Figure 15 shows the automatically generated Finite Element mesh adopted and details of the same mesh with the additional support-stabilization system in place.

The model is to simulate the interaction between the rock mass and the present support. In addition the support-stabilization system (new internal lining, rock dowels and drainage system) is introduced. The reference section is the same as previously considered with 340 m overburden. The vertical stress is equal to 8.50 MPa. The horizontal stress ranges between a lower bound (1.70 MPa, K_h = 0.2) and an upper bound (12.75 MPa, K_h = 1.5). The out-of-plane stress refers to plane strain conditions ($\nu \cdot (\sigma_v + \sigma_h)$).



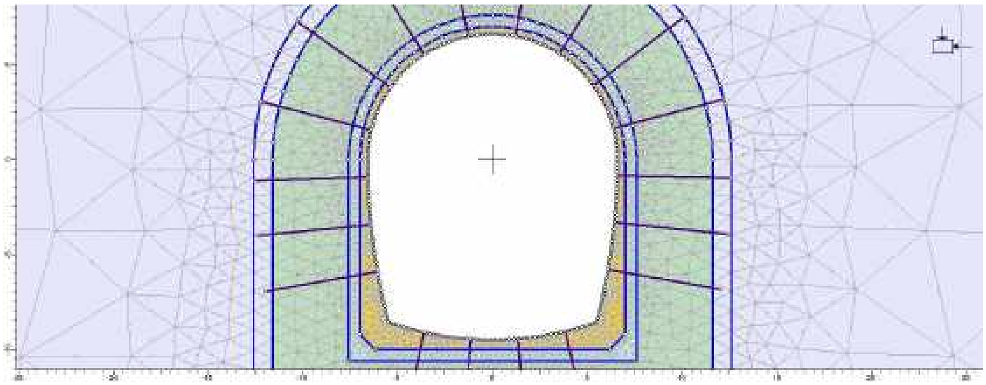


Figure 15: Automatically generated Finite Element Mesh adopted and details with the additional support-stabilization system proposed (drainage holes not shown)

As usual, a 4m-thick zone is set up around the tunnel which represents the rock mass influenced by the long term conditions. The present and new linings are now simulated by using 6-node triangular elements. Rock dowels are introduced as structural elements. It is noted that the linings are now simulated by using an elastic perfectly-plastic Mohr-Coulomb model with the material properties assigned as shown in Table 2 below. A 200 kPa uniformly distributed water pressure is activated on a boundary set 5 m far from the extrados of the lining.

Table 2: Lining material properties

Property	Present lining (C20/25)	New lining (C25/30)
Deformation modulus (GPa)	25	27
Uniaxial compressive strength (MPa)	20	25
Cohesion (kPa)	5.2	6.5
Friction Angle (°)	35	35
Tensile strength (MPa)	2.2	2.6

The rock dowels are assumed to be 6 m long, with in- and out-of-plane spacing equal to 2.5 m. The diameter of the steel rod is assumed to be 28 mm and the tensile capacity is taken as 150 kN

The construction and loading stages are as follows (see Figure 16 for Stage 15):

1. Stage 1 - Original state of stress.
2. Stage 2-12 - Step by step reduction of the internal forces applied on the boundary of the excavation up to total stress relief.
3. Stage 13 - Installation of the present lining and long term parameters in the 4 m-thick zone
4. Stage 14 - Installation of internal lining and dowels.
5. Stage 15 - Activation of the hydraulic head (200 kPa) on the 5m boundary.
6. Stage 16 - Seismic force (obtained by application of an equivalent shearing force producing γ_{max}= 6.2·10^{-4}).

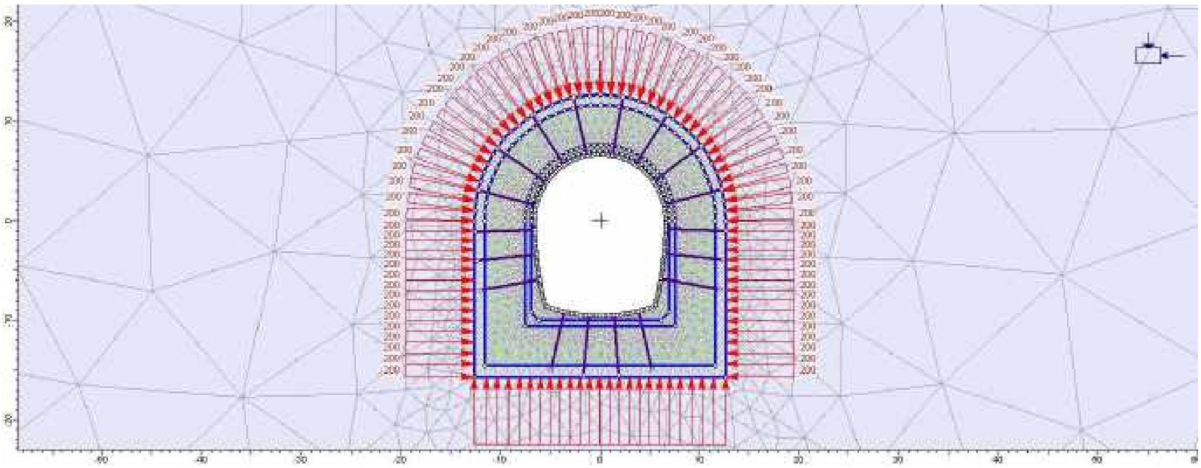


Figure 16: Illustration of Stage 15. Activation of the water pressure (200 kPa) on the 5 m boundary

5.1 Analyses Performed and Results

A set of numerical analyses have been performed according to the above simulation sequence by considering both the lower bound (1.70 MPa, K_h = 0.2) and the upper bound (12.75 MPa, K_h = 1.5) conditions for the initial state of stress in the rock mass around the tunnel. The results obtained are illustrated in Figures 17 to 23 by giving a set of selected illustrations showing:

- the plastic zones an total displacements around the tunnelin long term conditions with the present lining installed (Figures 17,K_h=0.2 and 20, K_h=1.5);

- the plastic zones and total displacements with water pressure and seismic action applied with the additional support-stabilization system installed (Figures 18,K_h=0.2 and 21,K_h=1.5);

- the plastic zones and maximum principal stress with water pressure and seismic action with the additional support-stabilization system installed (Figures 19, K_h=0.2 and 22, K_h=1.5);

- the axial force in the rock dowels with water pressure and seismic action with the additional support-stabilization system installed (Figures 23 and 24, K_h=0.2).

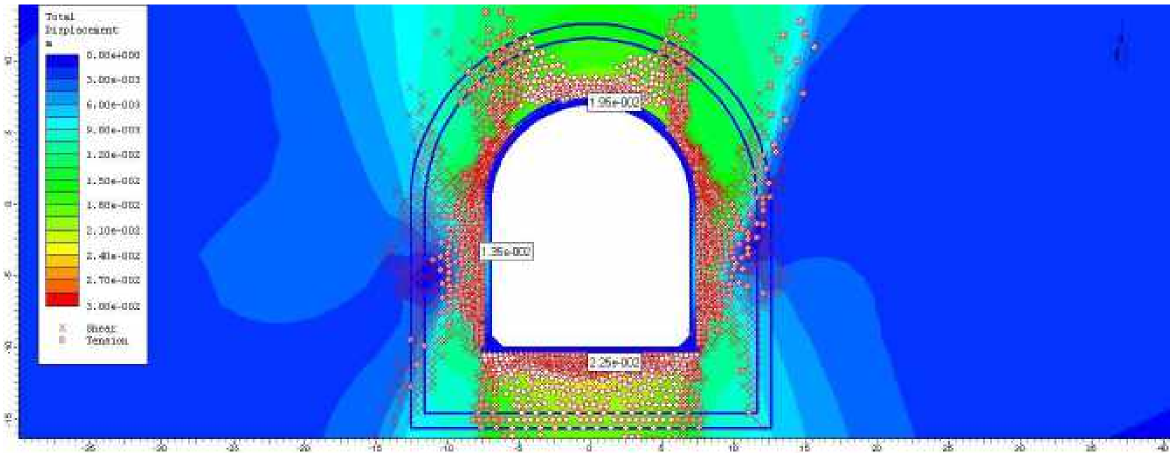
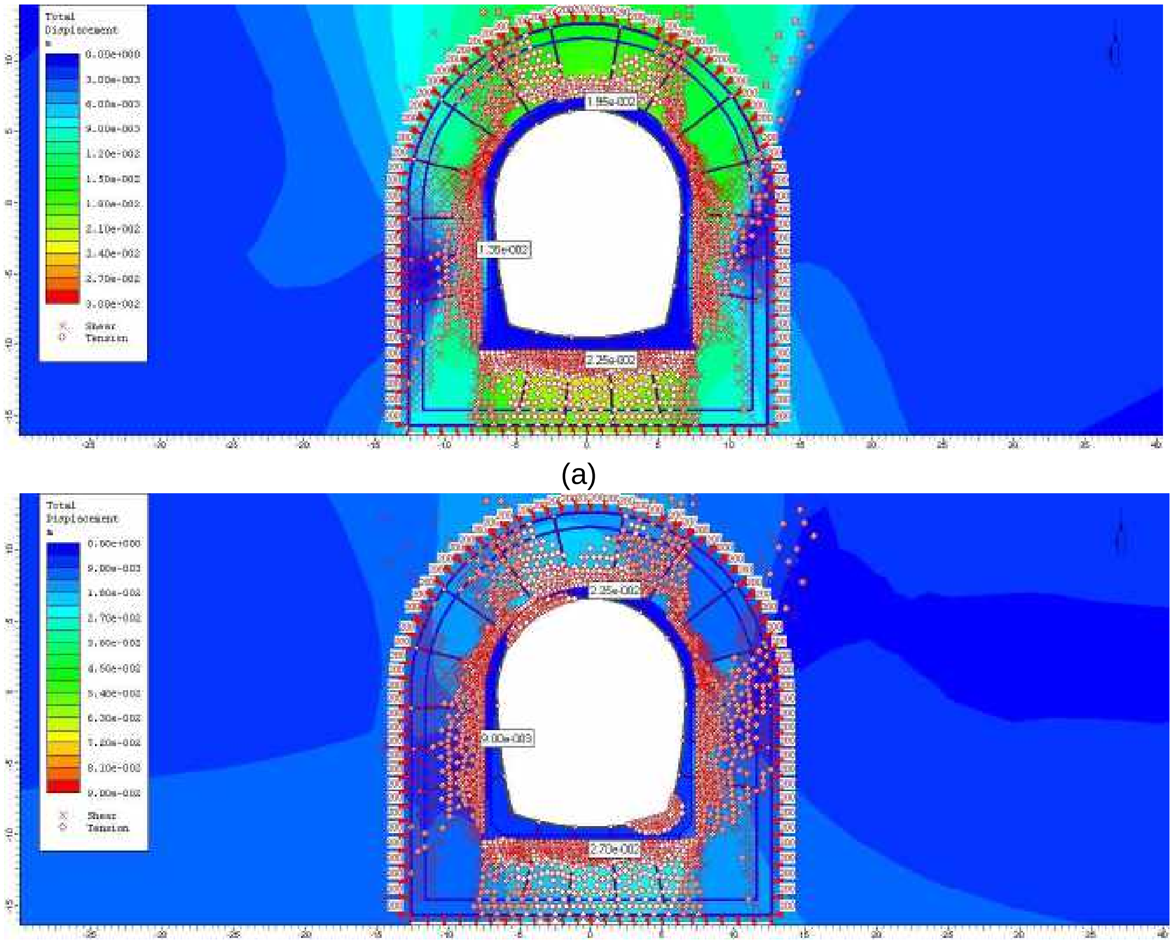


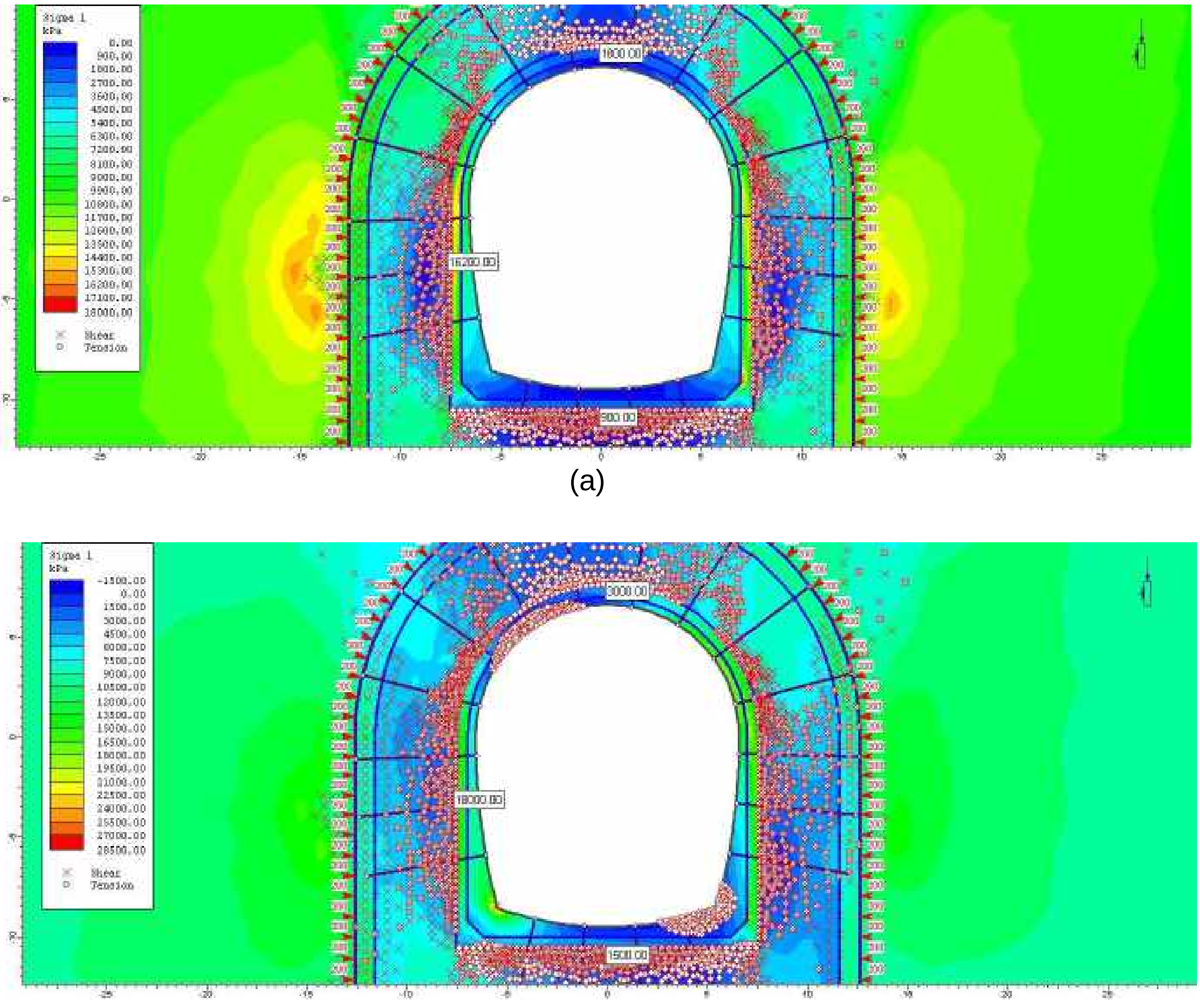
Figure 17: Illustration of plastic zones and total displacements. Long term conditions with present lining installed (K_h=0.2)



(a)

(b)

Figure 18: Illustration of plastic zones and total displacements. (a) 200 kPa water pressure. (b) Seismic action. With additional support-stabilization system installed (K_h=0.2)



(a)

(b)

Figure 19: Illustration of plastic zones and maximum principal stress distribution. (a) 200 kPa water pressure. (b) Seismic action. With additional support-stabilization system installed (K_h=0.2)

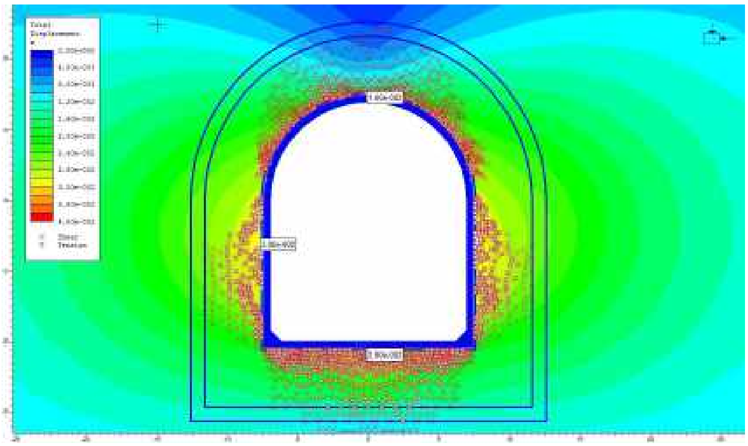
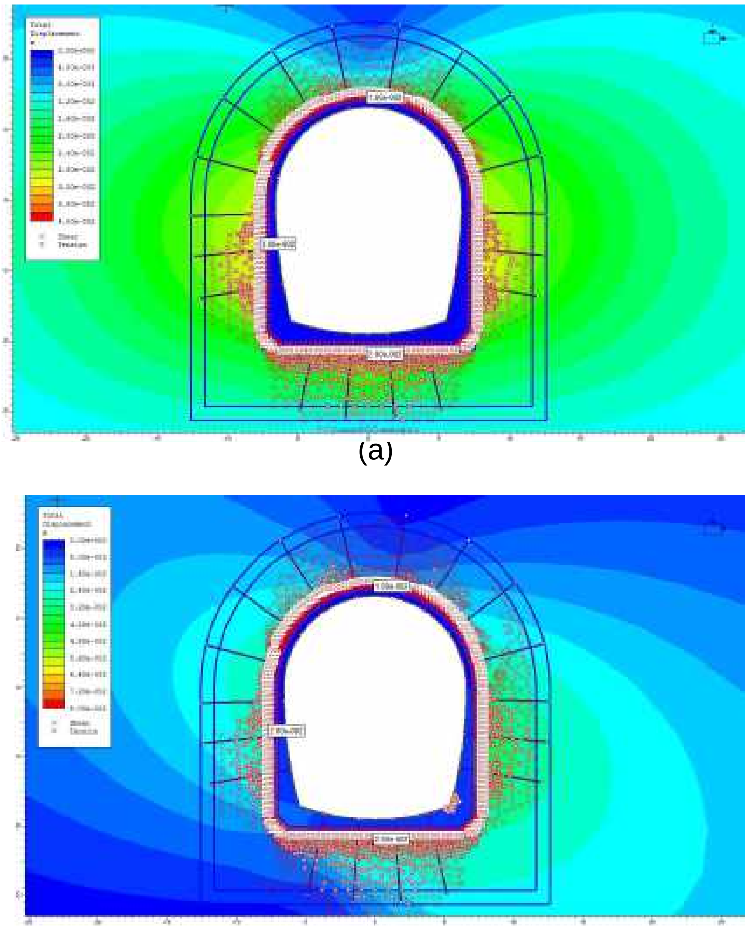


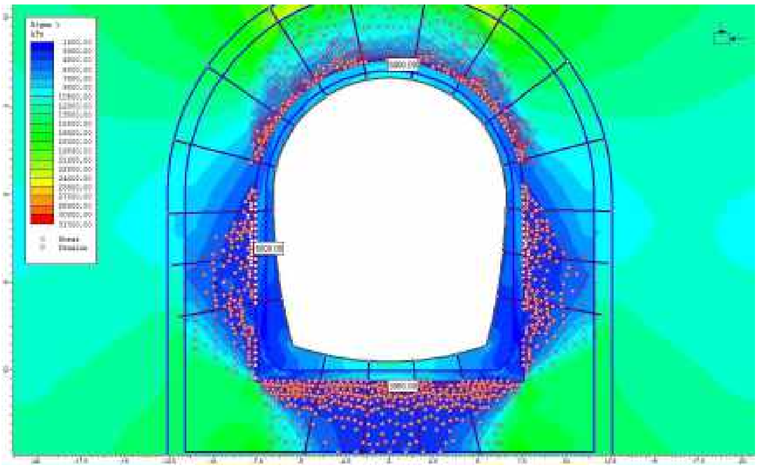
Figure 20: Illustration of plastic zones and total displacements. Long term conditions with present lining installed (K_h=1.5)



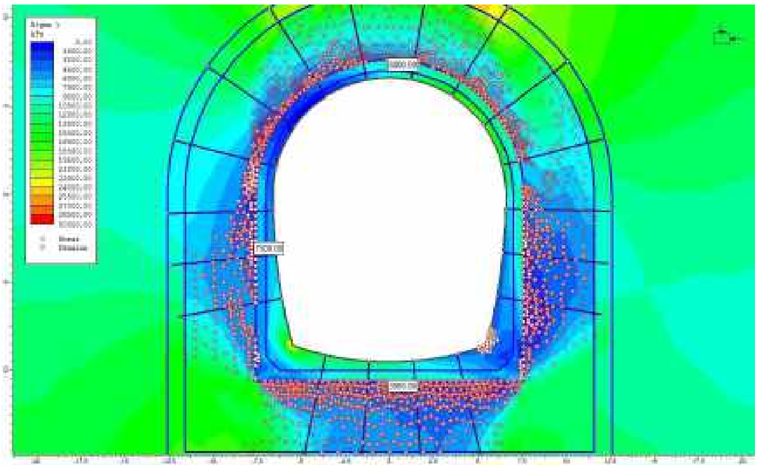
(a)

(b)

Figure 21: Illustration of plastic zones and total displacements. (a) 200 kPa water pressure. (b) Seismic action. With additional support-stabilization system installed (K_h=1.5)



(a)



(b)

Figure 22: Illustration of plastic zones and maximum principal stress distribution. (a) 200 kPa water pressure. (b) Seismic action. With additional support-stabilization system installed (K_h=1.5)

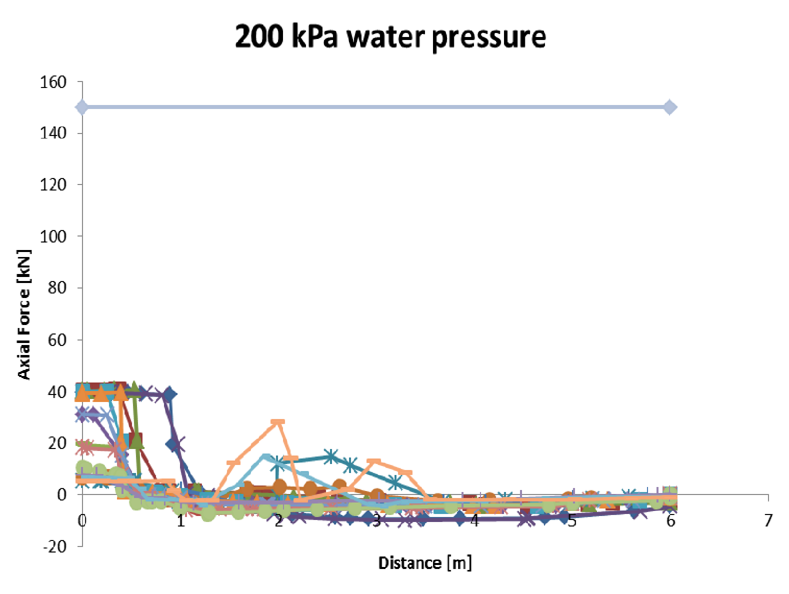


Figure 23: Illustration of the axial force in the rock dowels. 200 kPa water pressure. With additional support-stabilization system installed (K_h=0.2)

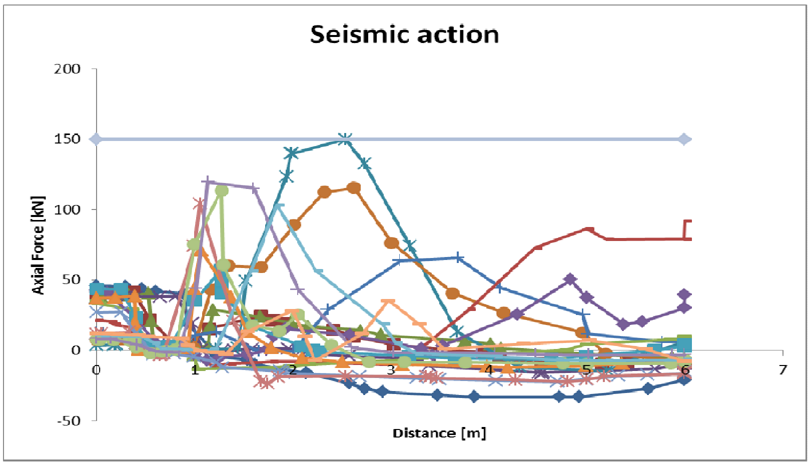


Figure 24: Illustration of the axial force in the rock dowels. 200 kPa water pressure and seismic action. With additional support-stabilization system installed (K_h=0.2)

The following conclusions can be drawn based on the results obtained:

The types of plastic zones around the tunnel are significantly dependent on the assumed stress ratio, with either tensile failure or shear failure taking place in the rock mass surround. In both cases (K_h= 0.2 and K_h= 1.5) the zone of failure where the rock mass conditions are assumed to deteriorate has a 4 m thickness approximately. In general, as expected, the condition with a higher horizontal stress exhibits overall a more favourable behaviour. However, one should be aware that a lower in situ horizontal stress is more likely to be present orthogonally to the diversion tunnel alignment.

In both cases, with the 200 kPa uniformly distributed water pressure applied 5 m away from the liner extrados, no failure occurs in the new lining installed and the rock dowels appear to perform satisfactorily. It is clear that the present and the new lining act jointly and contribute to the overall stability of the tunnel. Also to be pointed out is the good performance of the rock dowels, as expected, under static loading conditions, when rock mass deterioration from the short to the long term conditions is considered and water pressure is present.

The more favourable response of the inner lining under seismic conditions, when a higher horizontal in situ stress component is present, is evidenced with the calculations performed. Tensile failure develops in the same lining in such a case with a more extended zone in limit conditions when the horizontal in situ stress is small and provides a limited confinement action. It is to be noted that the computations performed do not account for the presence of steel reinforcement, which is to be defined with reference to the computed normal and tangential stresses which have been made available (1).

---

(1) Excel files for the stresses in the lining (present and new inner lining) have been made available based on the computed normal and shear stresses in the finite elements used for discretization. These can be used for computing the Axial Thrust, Bending Moment and Shear Force along radial directions in the linings.

With the main purpose to assess the expected performance of the support-stabilization system proposed, additional numerical analyses were carried out with the same assumptions considered above, however with a uniformly distributed water pressure of 200 kPa applied directly on the lining. The results obtained for the plastic zones and the axial force in the rock dowels are shown in Figures 25 and 26 respectively. No significant difference is observed between the two conditions, i.e. by applying the water pressure directly on the lining or far from it.

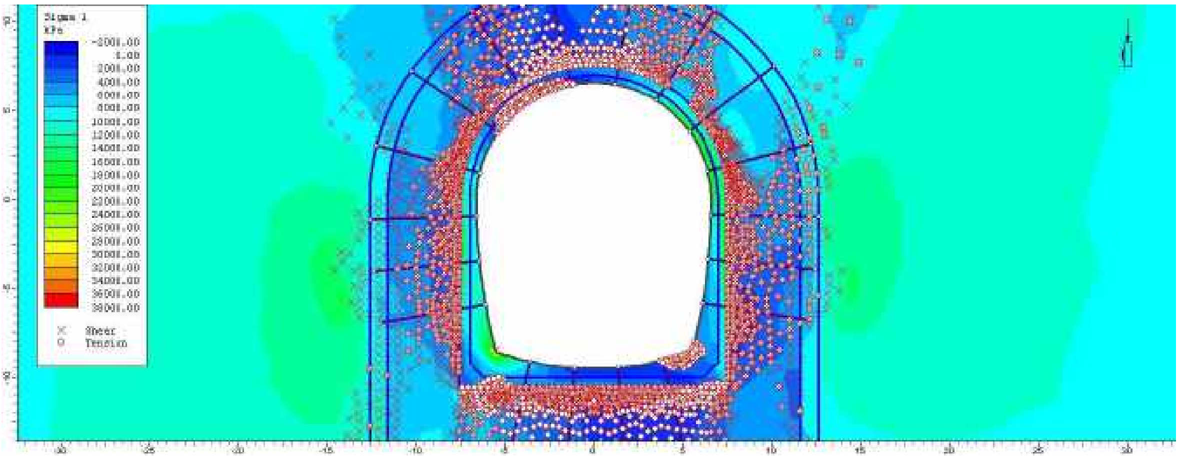


Figure 25: Illustration of plastic zones and maximum principal stress distribution. 200 kPa water pressure on the lining. Seismic action. With additional support-stabilization system installed (K_h=0.2)

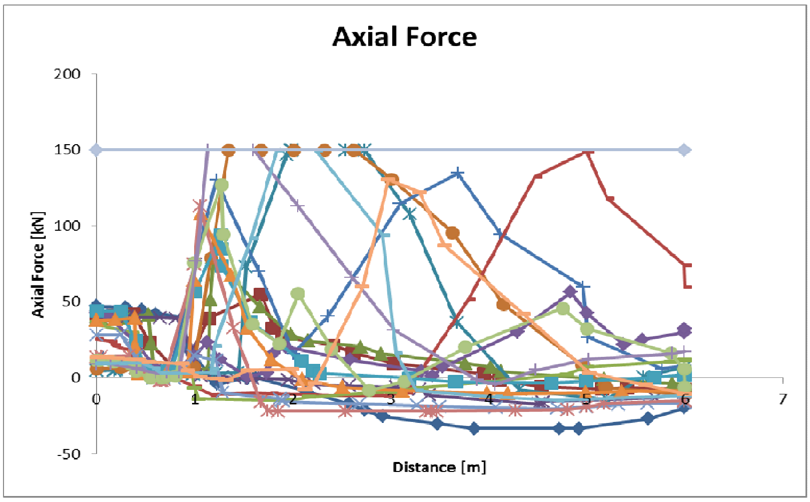


Figure 26: Illustration of the axial force in the rock dowels. 200 kPa water pressure on the lining and seismic action. With the additional support-stabilization system installed (K_h=0.2)

PHASE 1
ASSESSMENT OF EXISTING ROGUN HPP WORKS

DIVERSION TUNNEL N° 1

ANNEX 10
APPENDIX 1

EARTHQUAKE LOADING - MAXIMUM SHEAR STRAIN

Prof. Giovanni Barla

EARTHQUAKE LOADING - MAXIMUM SHEAR STRAIN

The effect of a vertical propagating shear wave may be simulated as a pure shear deformation applied in pseudo-static conditions. This assumption is possible for two reasons:

1. the size of the tunnel is small compared with the wavelength of the seismic wave (generally the wavelength is about 10 times the size of the tunnel cross-section);
2. the inertial effects in the covering and surrounding ground are traceable (Penzien, 2000).

The deformation field associated with the pure shear condition can be obtained by applying to an indefinite medium a state of stress with stress ratio K_0 equal to -1, as shown in Figure 1 for the case of a circular tunnel.

.

The value of the stress to impose to the boundaries of the model of Figure 1 can be computed with Equation (1) and based on the maximum shear strain induced during the seismic event:

$$\tau = \sigma_1 = -\sigma_2 = \frac{E_g}{2\left(1+v_g\right)}\gamma_{\max} \qquad (1)$$

where γ_{max} is the maximum shear strain estimated in free field conditions. This value, as also mentioned by Bobet (2003), can be computed in the far-field as the ratio between the peak ground velocity V_{max} and the apparent shear wave velocity C_S.

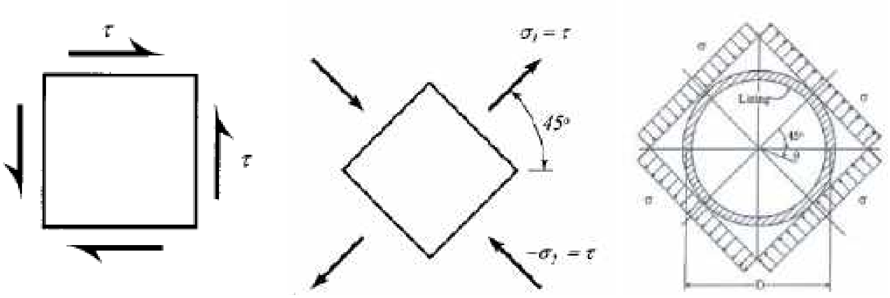


Figure 1: State of stress corresponding to a uniform pure shear deformation (Penzien, 1998)

It is noted that starting from these assumptions, several authors developed closed-form solutions to evaluate the axial force (*T*) and the bending moment (*M*) induced from seismic motion in the tunnel lining. Wang (1993), Penzien & Wu (1998) and Penzien (2000), Bobet (2003), Corigliano (2007) and Park (2009) proposed closed-form solutions for evaluating the effects in the tunnel lining due to a vertical S-wave.

The fundamental parameters, in all these analytical solutions, are the compressibility and the flexibility ratios and the shear strains induced in the ground from pure shear deformations. All the mentioned solutions consider the full-slip and no-slip interface ground-lining conditions.

The γ_{max} value can be computed in the far-field as the ratio between the peak ground velocity V_S and the shear wave velocity $\left(C_s = \sqrt{G_0/\rho}\right)$, where G_0 is the ground shear modulus and ρ the density:

$$\gamma_{\max} = \frac{V_S}{C_S}$$

The peak ground velocity V_S can be chosen based on the earthquake moment magnitude, the distance of the tunnel structure from the seismic source and the surface peak acceleration.

Another point to consider is that the shear wave velocity C_S is not necessarily equal to the apparent wave velocity. In fact, according to the available data C_S is in the range 2 to 5 km/s with a mean value equal to 3.4 km/s (O'Rourke & Liu, 1999; Power et al., 1996). A recent study based on both experimental and numerical results recommends a mean value in the range 1.0-1.2 km/s (Paolucci e Pitilakis, 2007). On the other end the AFPS/AFTES (2001) recommendations are for a C_S value equal to the minimum value between 1 km/s and the C_S value computed as $\left(C_s = \sqrt{G_0/\rho}\right)$-

In summary, the maximum shear strain γ_{max} can be computed as follows:

- Define the ground peak acceleration at the surface a_g (= 0.71g as indicated, for the Maximum Credible Earthquake (MCE), in the conclusion 7 of the report "Techno-economic assessment study for Rogun Hydroelectric Construction Project - Seismicity of Rogun Site - January 2013").
- Compute the site-specific Peak Ground Acceleration $a_{max,s}$ based on the soil factor S (EC8): $a_{max,s} = S \cdot a_g$ (S = 1.2 for ground type B and for a magnitude Mw ≥ 5.5).
- Apply the coefficient C based on the tunnel depth below surface (see Table 1) to account for the real location of the same tunnel: $a_{z,max} = C \cdot a_{max,s}$ (assumed C = 0.7 because the tunnel is at a depth greater than 30 m).
- Compute the maximum shear strain γ_{max} based on the ratio $k = V_s / a_{z,max}$ (see Table 2): $\gamma_{max} = k \cdot a_{z,max} / C_s = 6.20 \cdot 10^{-4}$ (k = 97 that is indentified assuming a moment magnitude of 7.5, a source-to-site distance less than 20 km and a rock mass; C_s = 1 km/s as prescribed by AFPS/AFTES (2001)).

Table 1. Suggested values for C Coefficient (Hashash, 2001).

Tunnel Depth (m)	Ratio of the seismic motion at tunnel depth and on ground surface
<6	1.0
6-15	0.9
15-30	0.8
>30	0.7

Table 2. Computation of the peak ground velocity V_S and the acceleration $a_{z,max}$ ratio (Power et al., 1996).

Moment Magnitude	Ratio of the peak ground velocity (cm/s) and the peak surface acceleration (g) Distance site-source (km) 0-20	 20-50	 50-100
Rock			
6.5	66	76	86
7.5	97	109	97
8.5	127	140	152
Stiff soil			
6.5	94	102	109
7.5	140	127	155
8.5	180	188	193
Soft soil			
6.5	140	132	142
7.5	208	165	201
8.5	269	244	251

PHASE 1
ASSESSMENT OF EXISTING ROGUN HPP WORKS

DIVERSION TUNNEL N° 1

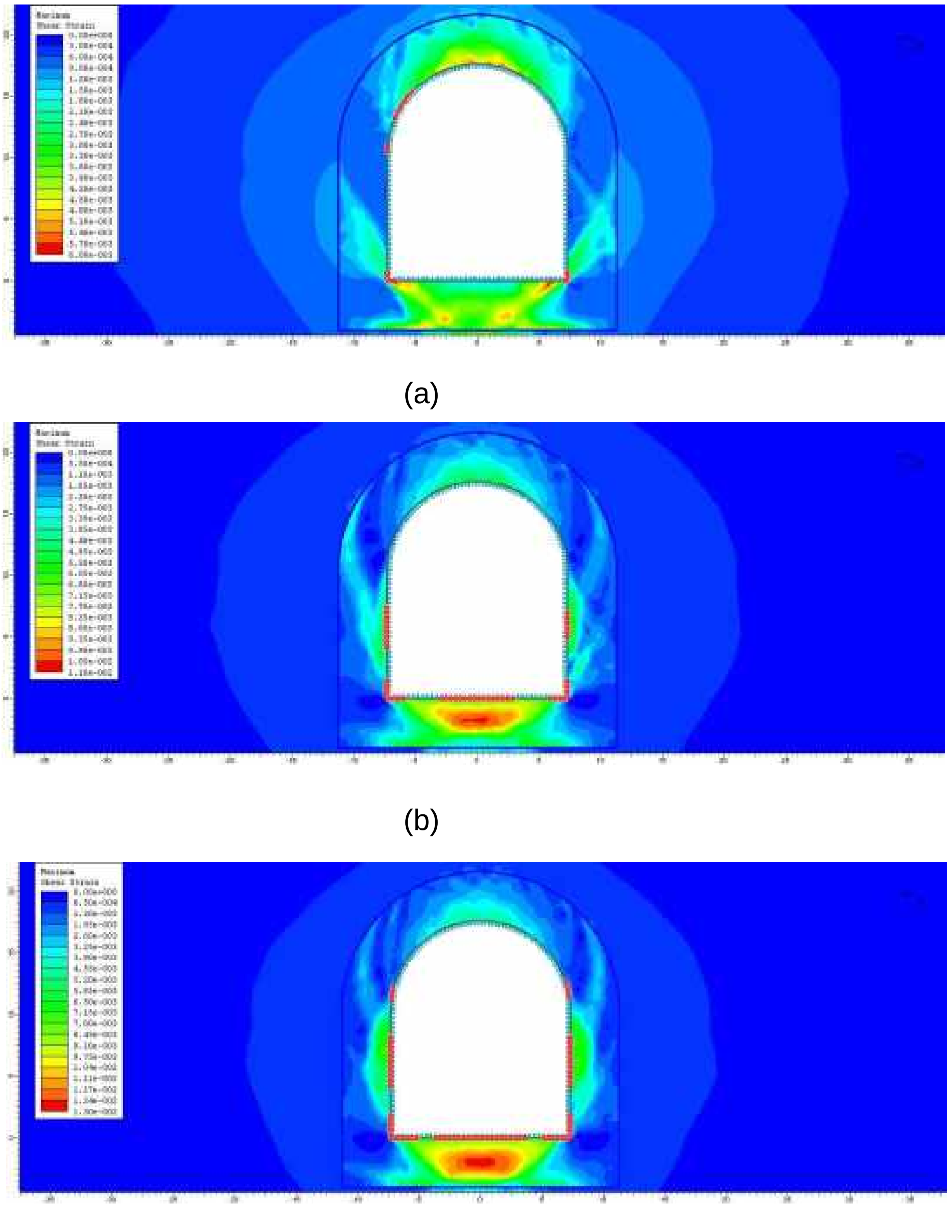
ANNEX 10
APPENDIX 2

WATER LOADING – EFFECT OF ELEVATION CHANGES

Prof. Giovanni Barla

WATER LOADING – EFFECT OF ELEVATION CHANGES

The present Appendix is intended to analyze, with the same methods adopted in the report, the impact on the lining stresses resulting from the external water pressure, when the influence of the pressure change due to elevation changes between the crown and invert (i.e. the drainage relief holes are not effective) is considered. The results obtained are shown in Figure 1 below by comparing the zones in the lining where failure would take place for different assumptions of the water head above the tunnel crown: (a) no presence of water; (b) water head = 10 m; (c) water head = 20 m).



(a)

(b)

(c)

Figure 1: Failure zones in the tunnel lining (factor of safety = 1)
(water pressure changes between the crown and invert is considered)
(a) No water pressure, (b) 10 m water head, (c) 20 m water head

OSHPC BARKI TOJIK

TECHNO-ECONOMIC ASSESSMENT STUDY FOR ROGUN HYDROELECTRIC CONSTRUCTION PROJECT

PHASE 1

ASSESSMENT OF THE EXISTING ROGUN HPP WORKS

Stress Analyses of the Diversion Tunnel 1 including unreinforced concrete lining

RP 39 – Annex 11

September 2013

TECHNO-ECONOMIC ASSESSMENT STUDY FOR ROGUN HYDROELECTRIC CONSTRUCTION PROJECT

PHASE 1

ASSESSMENT OF THE EXISTING ROGUN HPP WORKS

September 2013

Report No. P.002378 RP 39 rev. C – Annex 11

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B	June 2013	First Issue	BARLA	LCO/BARLA	LCO
Revision	**Date**	**Subject of revision**	**Drafted**	**Checked**	**Approved**

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Appendix 3– Normal and shear stresses in the new lining – Excel File

1. INTRODUCTION

This report is intended to analyze the rock mass response and structural behavior of the Diversion Tunnel 1, by taking the cross section at chainage 7+021 m, in a Sandstone Rock Mass (Zone 3, k_1ob_2, upper Obirgam Formation), with a depth of cover equal to 340 m approximately, as representative.

In line with the results of the Meeting in Milano on March 13-15 2013 and the Mission to Rogun Site on April 3-8 2013, the numerical analyses discussed in the present report are intended to account for rock structure interaction with the surrounding rock mass by introducing an unreinforced concrete primary lining, which was not taken into account in the previous reports dated February 8 and March 8 2013.

Following a few preliminary remarks on the site conditions, the assumptions introduced, and the computational method adopted, the results of two dimensional Finite Element analyses are described with the intent to study:

1. the rock mass response, based on the ground conditions assumed
2. the structural behavior of the existing lining
3. the structural behavior of the new lining.

2. PRELIMINARY REMARKS

2.1 Site Conditions and Assumptions

The Rogun diversion tunnels (Diversion Tunnel 1 and Diversion Tunnel 2) pass beneath the left abutment of the Rogun Dam and are each approximately 1000 m in length. The geology along the Diversion Tunnel 1 is shown in Figure 1 and is characterized by 4 typical zones from upstream to downstream. The tunnel horseshoe section 17 m high by 14 m wide is shown in Figure 2 where the type of final support installed is also shown, as based on Reference Drawings: 1079-14-78 (Sheet 2 of 2).

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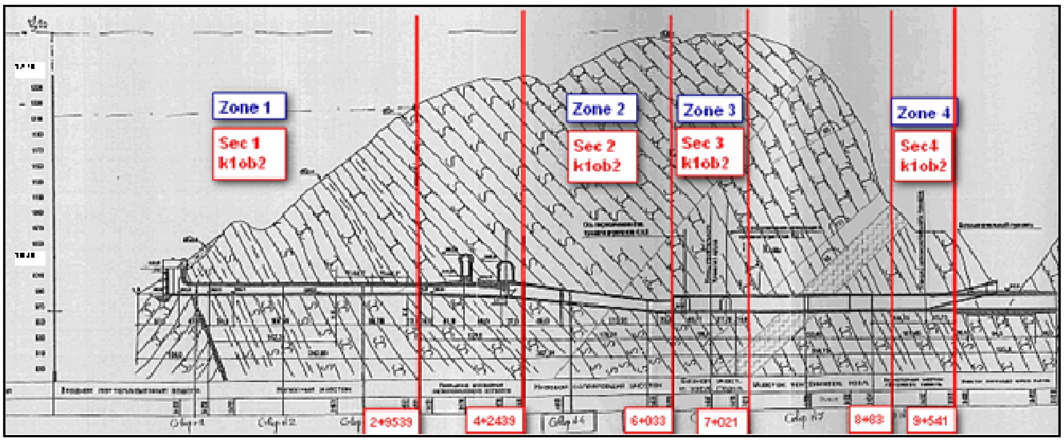


Figure 1: Geological profile and Zones 1 to 4 (Zone 3 is considered)

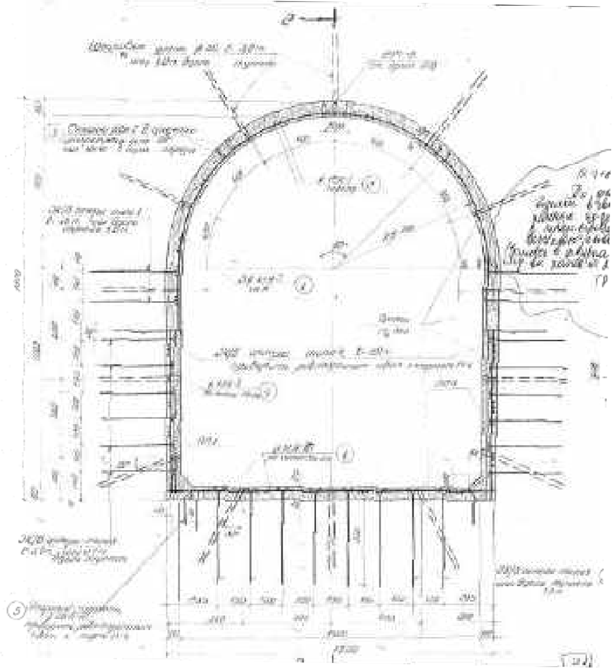


Figure 2: Geometry and rock support of Diversion Tunnel 1 in Zone 3 (Sandstone). Reference Drawings: 1079-14-78 (Sheet 2 of 2)

The new data recently made available on the presence of an unreinforced concrete lining around the tunnel, as shown in Figure 3 for two typical tunnel sections at the crown, will be considered. As a consequence the influence of a 1.0 m thick lining will be introduced in the new calculations performed on the basis of the schematic drawing reported in Figure 4.

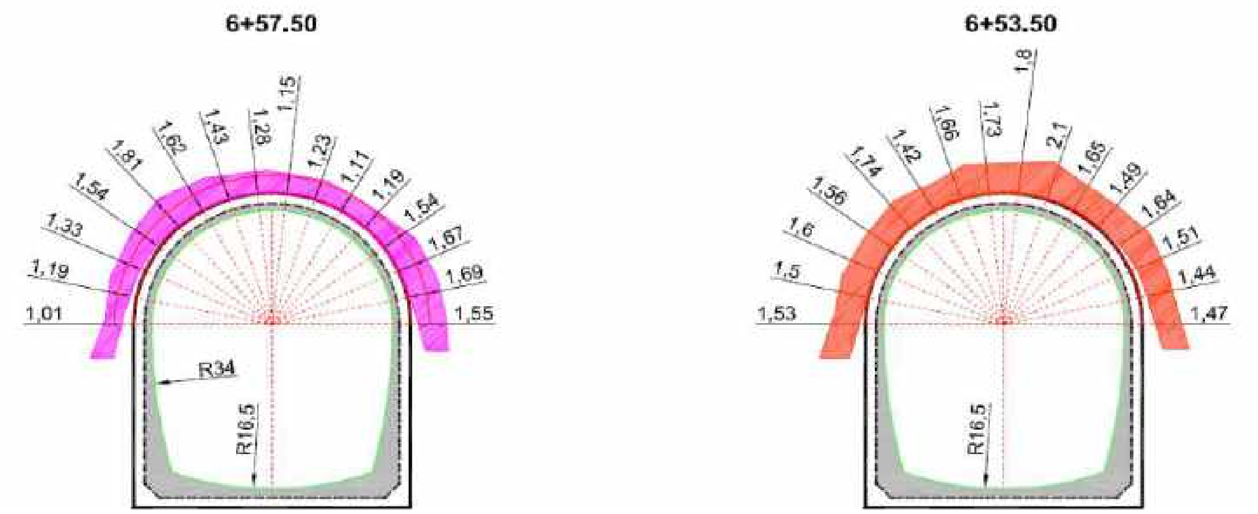


Figure 3: Geometry and rock support of Diversion Tunnel. Unreinforced concrete lining (only the thickness at the crown is shown)

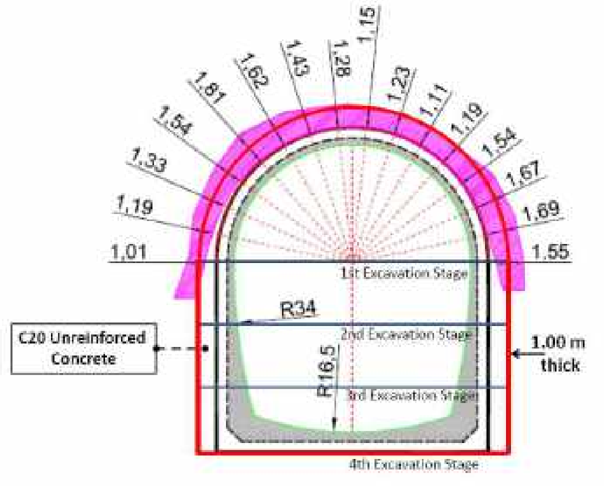


Figure 4: Geometry and rock support of the Diversion Tunnel considered in the new calculations (also included is the proposed stabilization support system).

Based on the available information it is estimated that the sandstone rock mass within Zone 3 (Chainage 6+033-7+021 m) can be given the parameters tabled below (Table 1), with the rock mass strength properties defined with the Mohr-Coulomb failure criterion.

Table 1: Rock mass parameters for sandstone
Dilation angle 0°

Property	Short term		Long Term[1]	
	Peak	Residual	Peak	Residual
Deformation modulus (GPa)	9.0		5.0	
Poisson's ratio (-)	0.3		0.3	
Cohesion (MPa)	1.5	1.2	1.2	1.0
Friction Angle (°)	45	40	40	35

[1] Long term properties are activated in a 4 m-thick zone around the tunnel boundary

The stress regime is assumed to be characterised by the vertical stress σ_v= 8.50 MPa (unit weight 25 kN/m^3), with the horizontal stress σ_h based on a Stress Ratio K_h= 0.2, 0.8 and 1.5, i.e. $\sigma_{h\,=}\,K_h\sigma_v$.

2.2 Finite Element Method (FEM) and Stress Analysis

The Finite Element Method (FEM) is used in the following for purpose of stress analysis. The FEM implies in all cases that the real problem be idealized or simplified by creating a model in two-dimensional or three-dimensional conditions which includes all features and details of rock mass response and of rock support.

The FEM analyses presented in this report have been carried out in plane strain conditions by using the computer program Phase2 of Rocscience, developed at the University of Toronto. This program allows a variety of material types to be included in the model representing the stress problem under study including rock, discontinuities, support measures and structural components.

One significant advantage of this program is that it is associated with user friendly graphical pre- and post- processors and allows for an effective simulation of the excavation/construction sequence and of the progressive failure of the rock mass surrounding the excavation. The failure taking place around the excavation is generated by a succession of calculations in which the excess load, which cannot be carried out by a failed element is transferred onto adjacent elastic elements.

If the total load carried out by these elements is too high, they fail and transfer the excess load onto the next elements. Starting from the excavation boundary where the stresses are the highest, failure propagates outwards until the excess load transferred is small enough that it can be carried by the surrounding elements without further failure. If such a condition of no failure propagation is attained in the rock mass surrounding the excavation and the numerical solution is not convergent, then instability will take place.

3. ASSESSMENT OF THE ROCK MASS RESPONSE

The failure of a rock mass around an underground opening depends on the in situ stress level (σ_v, σ_h , Stress Ratio $K_h = \sigma_h/\sigma_v$) and the characteristics of the rock mass. In order to study the rock-support interaction, a simple analytical model is used. This model involves a circular tunnel subjected to an isotropic stress field in which the horizontal and vertical stresses are equal. The rock mass is assumed to behave as an elastic-perfectly plastic or elastic-perfectly brittle material. The so called Ground Reaction Curve (GRC) can be obtained and some insights on the extent of the failure zone around the opening inferred.

If the tunnel is not circular and the stress field is not isotropic, one is in position to obtain the GRC in order to analyze the rock mass response by using the Finite Element Method. This was done for the Diversion Tunnel 1 as shown in Figure 5 which illustrates a detail of the FEM mesh used and the failure zone surrounding the unsupported horseshoe opening, when the rock mass is assumed to be elastic-perfectly plastic with the short term parameters (peak values) given in Table 1 and the stress ratio is 1.5.

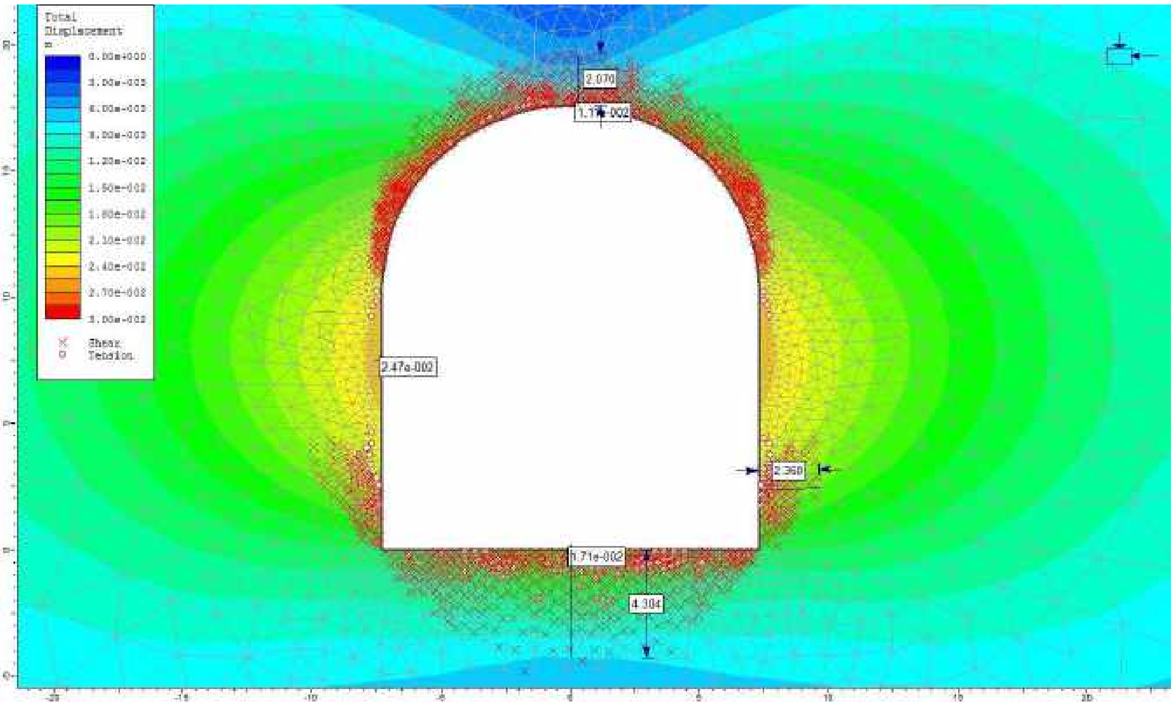
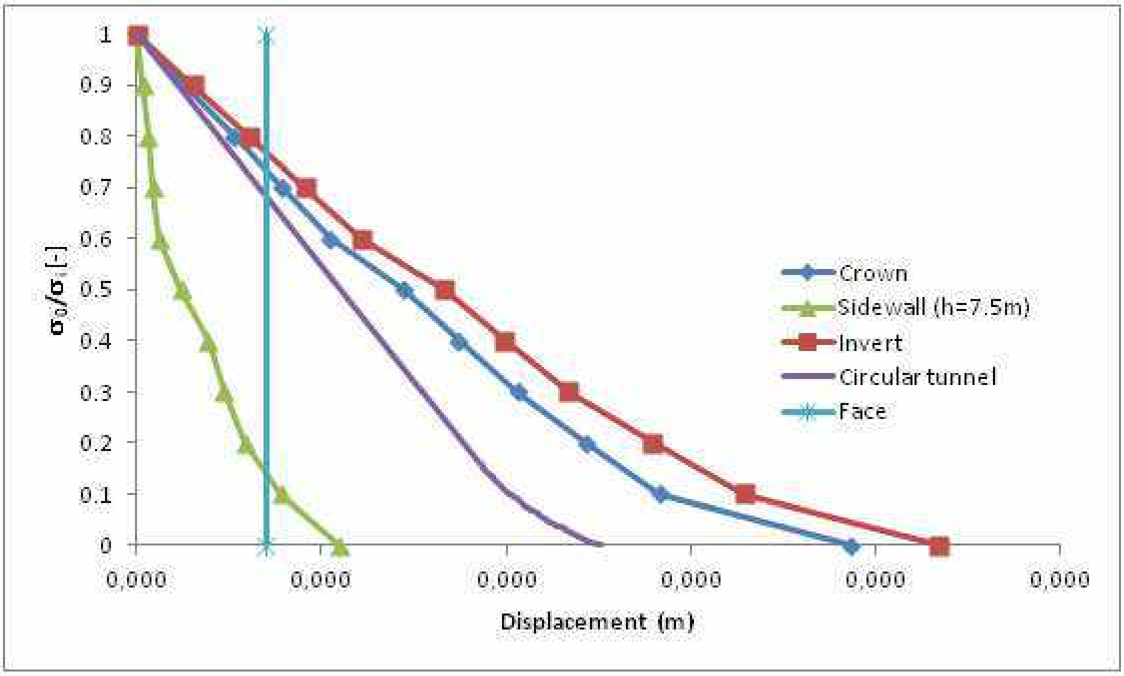
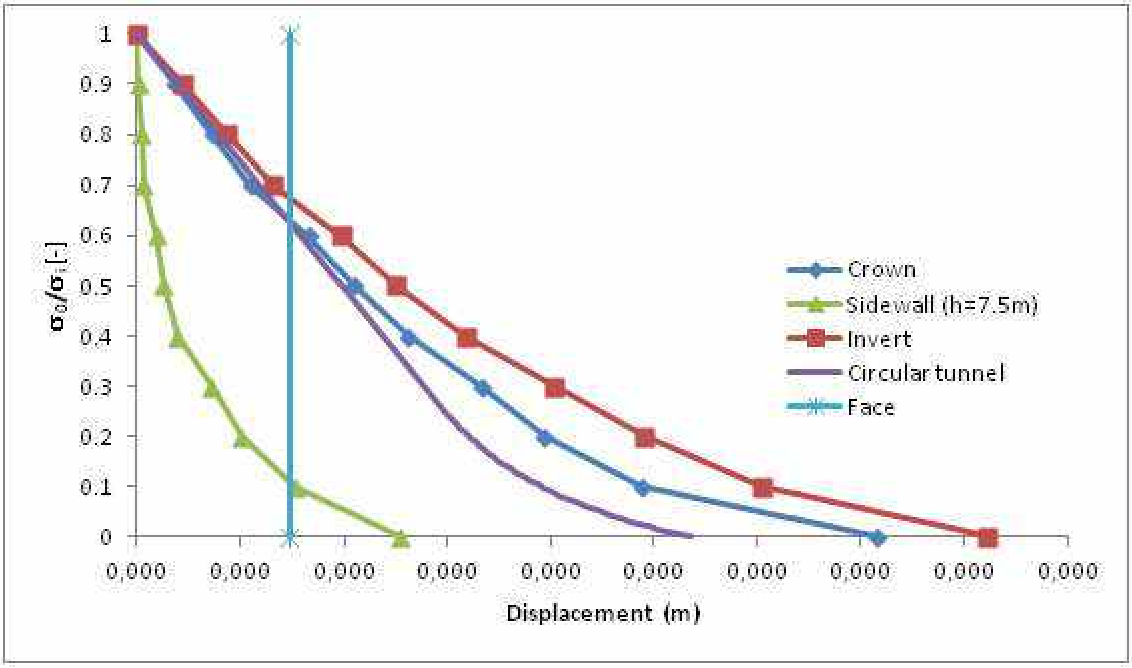


Figure 5: FEM mesh of the Diversion Tunnel 1. Failure zones surrounding the tunnel and maximum displacements (the rock mass is assumed to be elastic-perfectly plastic with the short term parameters-peak values given in Table 1)

With the main purpose to gain insights into the ground response around the tunnel for the set of parameters shown in Table 1, Figures 6 to 8 give the GRCs for different assumptions of the rock mass behaviour and different K_h values. Similarly, Figure 9 to 11 illustrate the corresponding extent of the failure zones around the tunnel as the stresses at the boundary of the opening are being relieved.

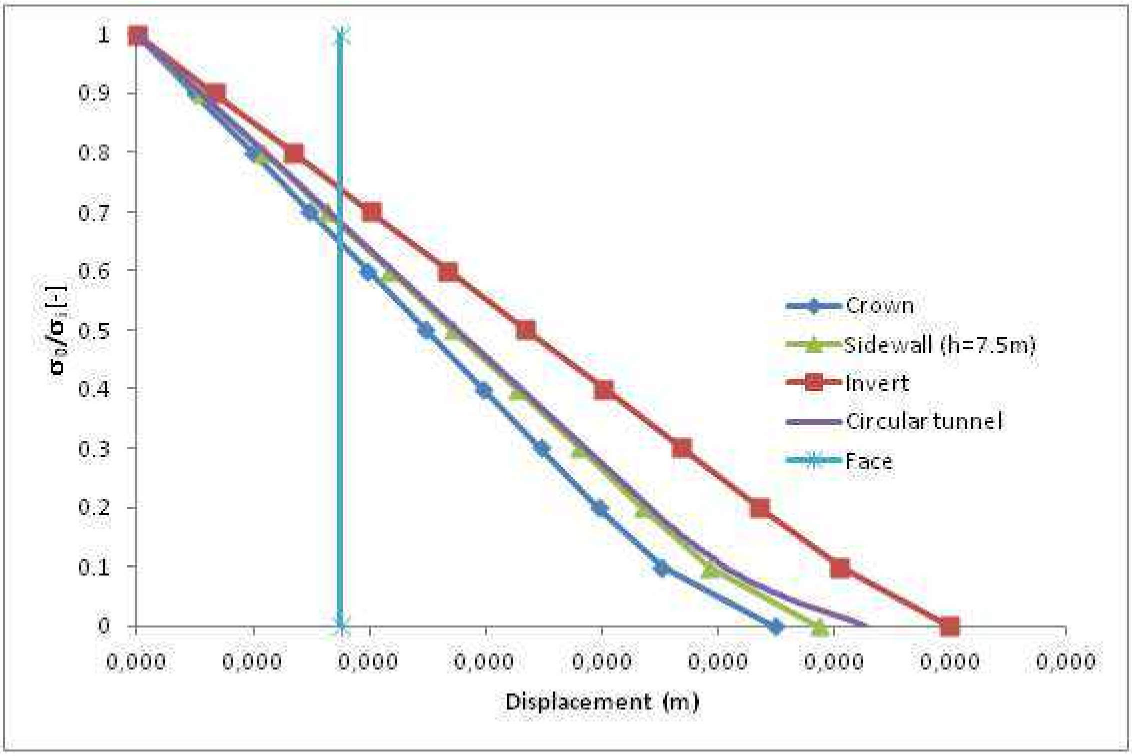


(a)

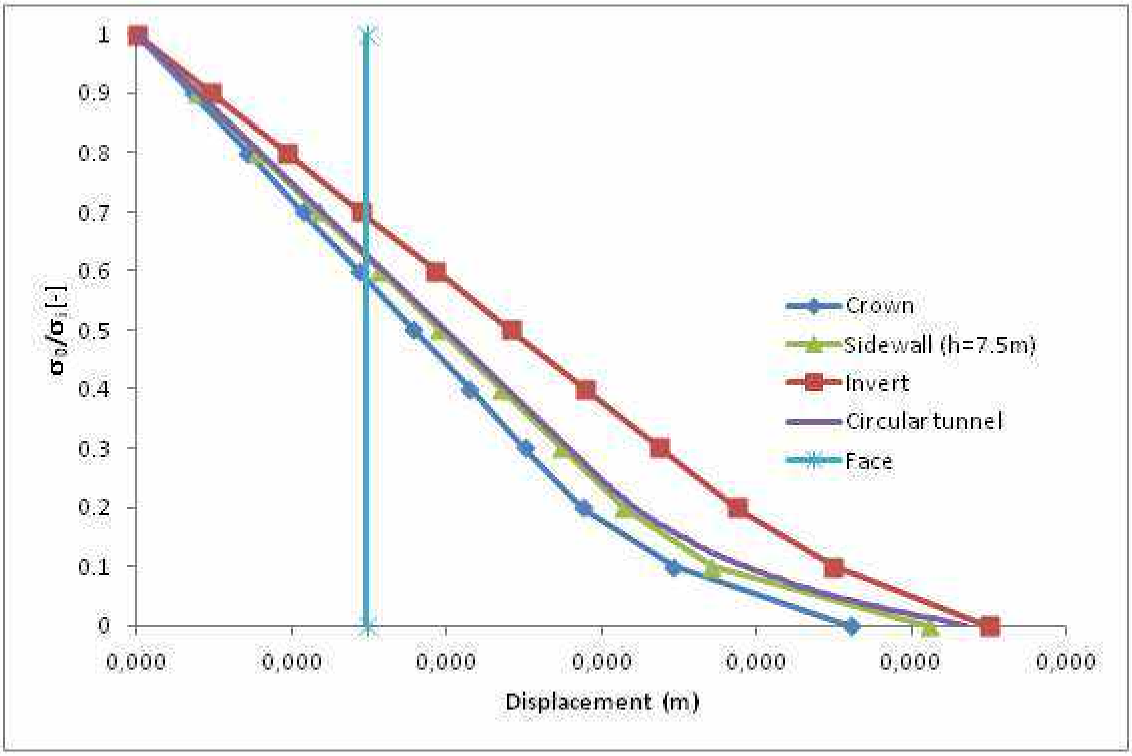


(b)

Figure 6: Ground Reaction Curves for Diversion Tunnel 1 (K_h = 0.2). (a) Short Term Parameters. (b) Long Term Parameters

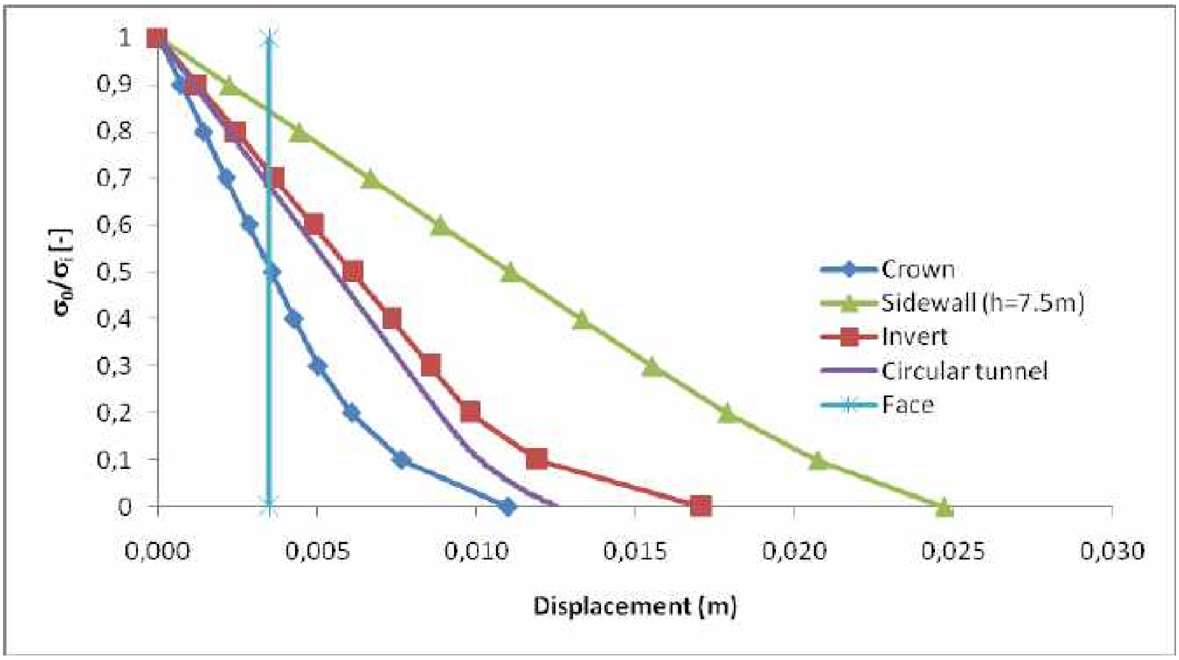


(a)

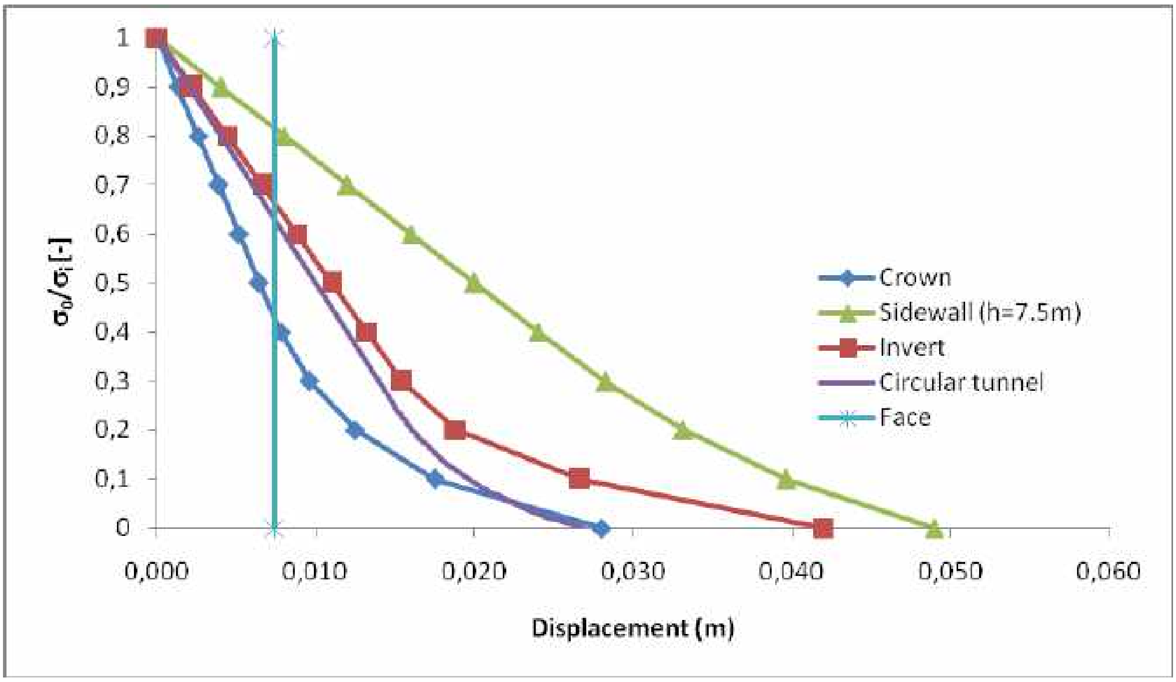


(b)

Figure 7: Ground Reaction Curves for Diversion Tunnel 1 (K_h = 0.8). (a) Short Term Parameters. (b) Long Term Parameters



(a)



(b)

Figure 8: Ground Reaction Curves for Diversion Tunnel 1 (K_h = 1.5). (a) Short Term Parameters. (b) Long Term Parameters

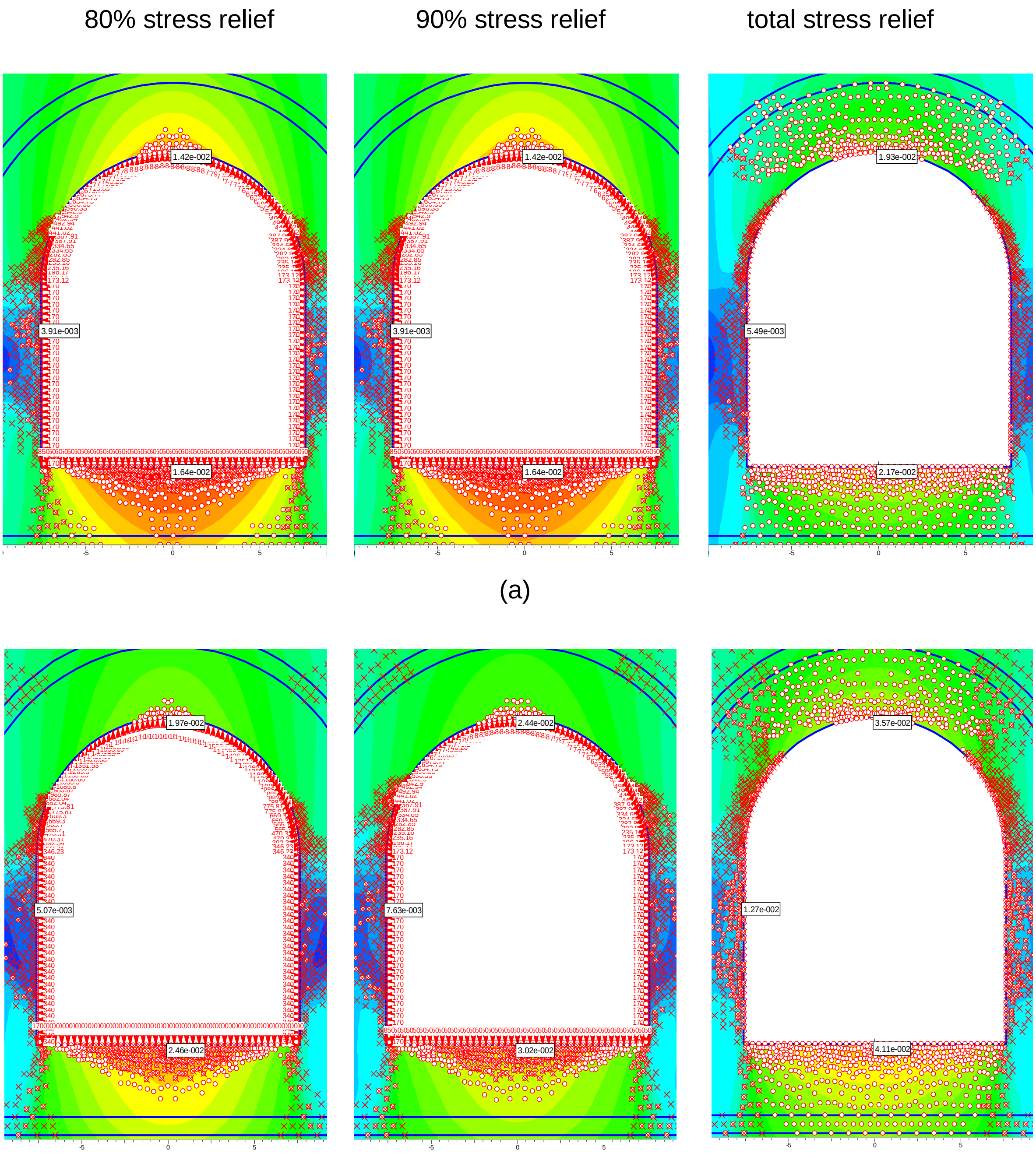
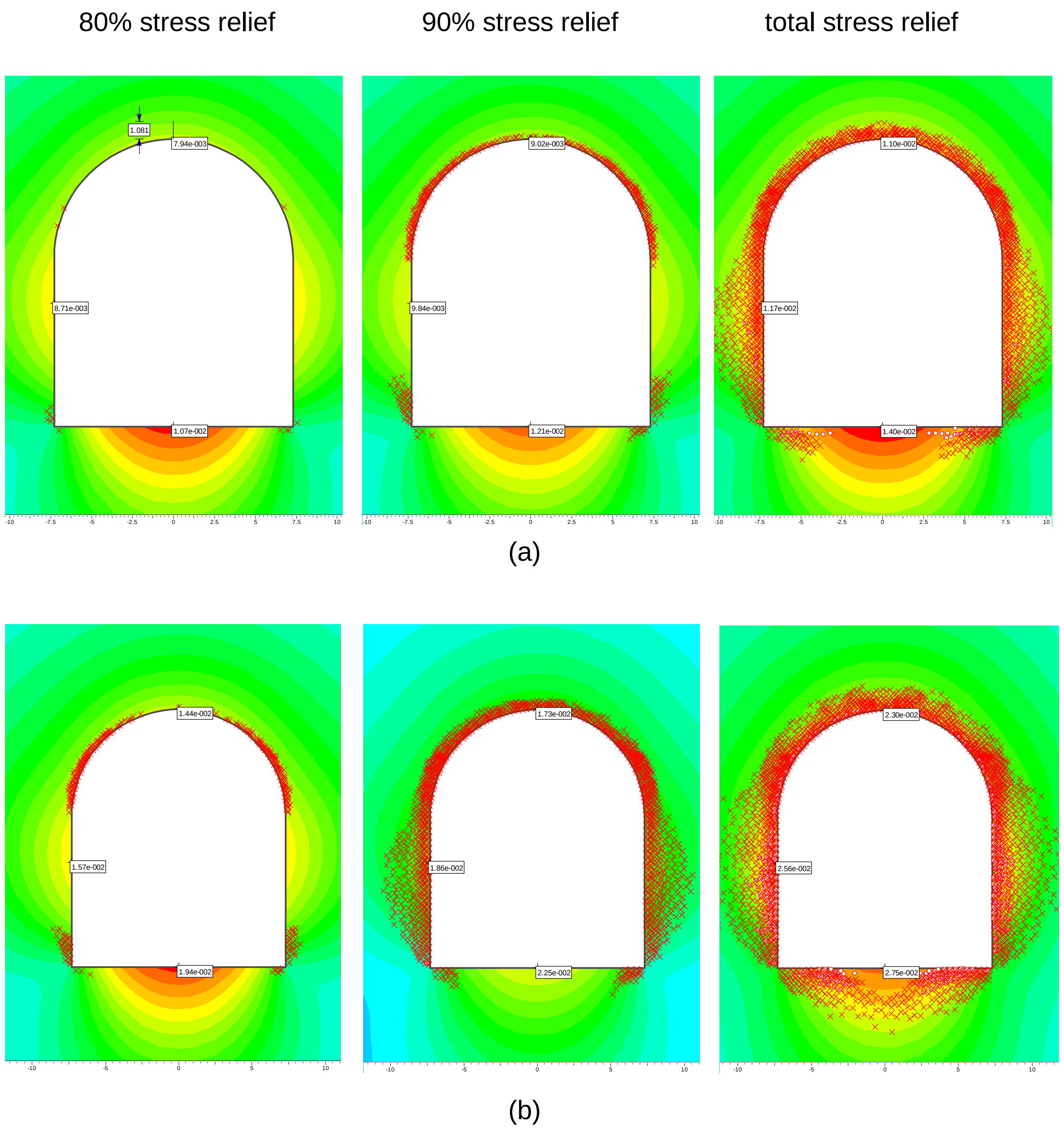


Figure 9: Failure zone around the Diversion Tunnel 1 (K_h =0.2). (a) Short Term Parameters. (b) Long Term Parameters



80% stress relief

90% stress relief

total stress relief

Figure 10: Failure zones surrounding the Diversion Tunnel 1(K_h = 0.8). (a) Short Term Parameters. (b) Long Term Parameters

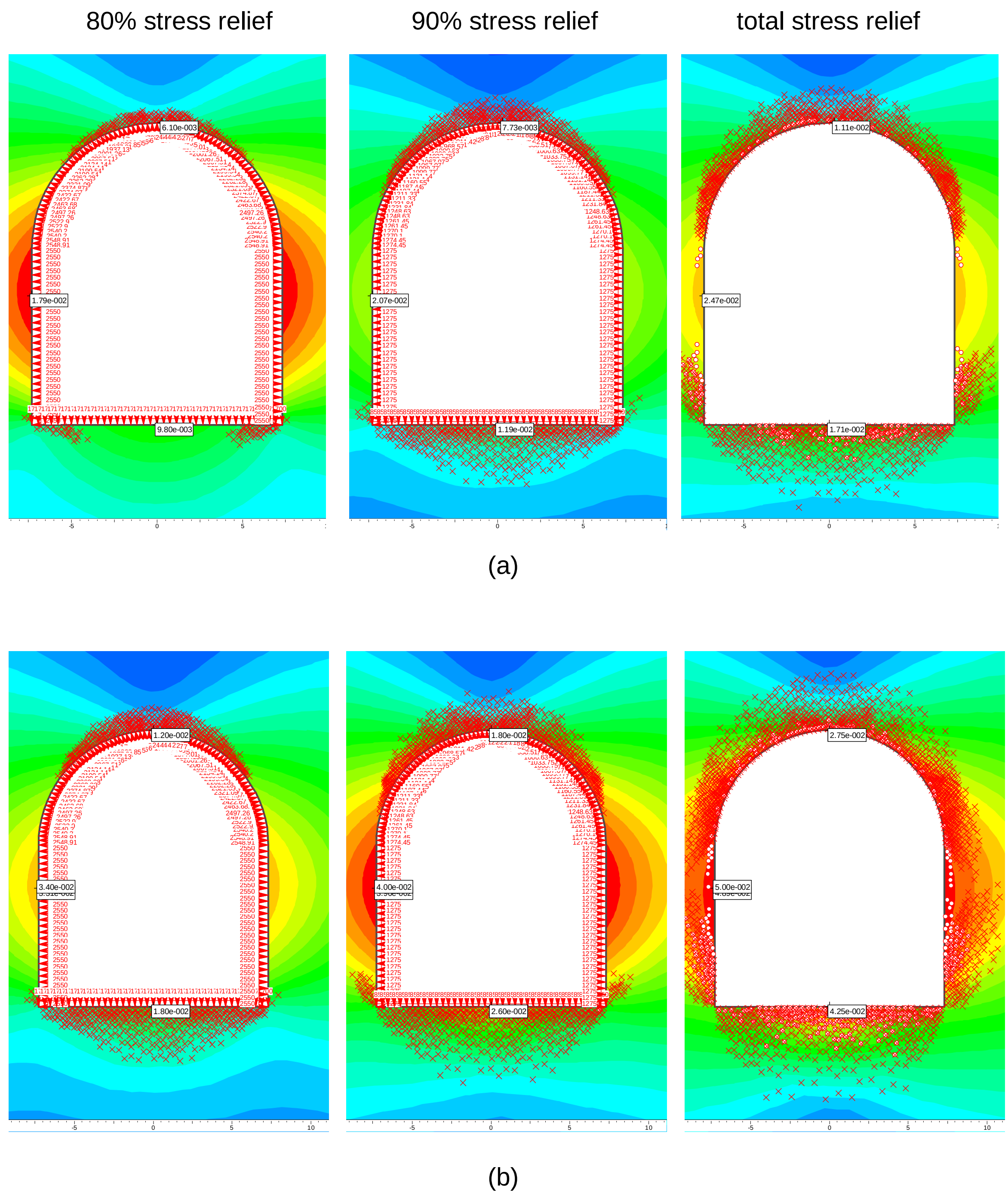


Figure 11: Failure zones surrounding the Diversion Tunnel 1(K_h = 1.5). (a) Short Term Parameters. (b) Long Term Parameters

4. STRESS ANALYSIS OF THE EXISTING LINING

With the intent to study the structural behavior of the Diversion Tunnel 1, i.e. rock-support interaction, a set of numerical analyses by using the Finite Element Method have been performed as a follow up of the preliminary analyses described above.

The tunnel support taken into consideration in this chapter is the existing lining as shown in Figure 2. It is noted that the influence of a 1.0 m thick unreinforced concrete lining is accounted for as shown in Figures 3 and 4. No effect of the rock dowels around the tunnel is considered due to both the type of support installed and the long time elapsed after installation.

The material properties of the unreinforced concrete 1.0 m thick lining and of the existing reinforced concrete final lining are as follows (in each case the constitutive model of behavior is indicated):

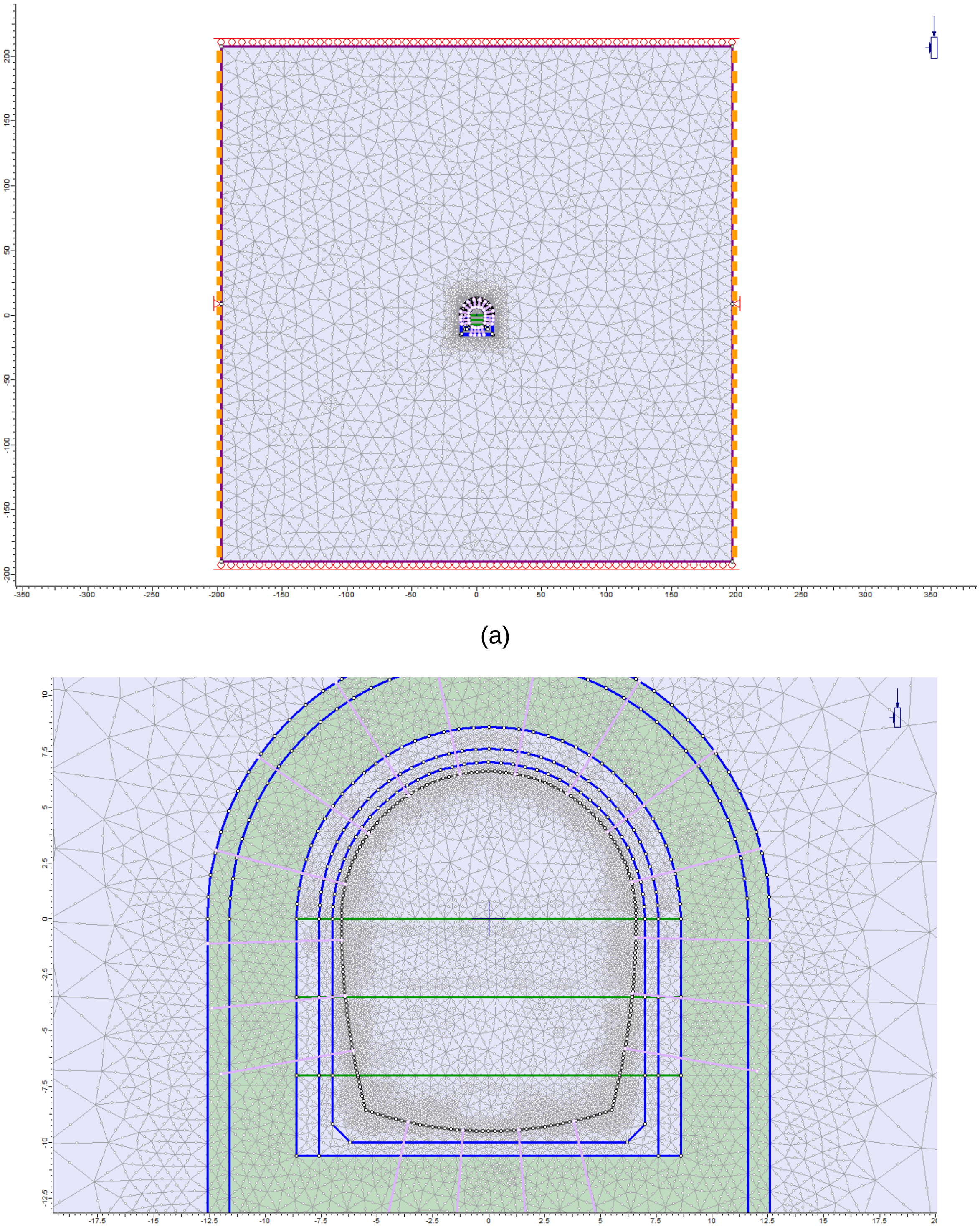
- Unreinforced Concrete Lining: Concrete type C20; Characteristic cubic compression strength R_{ck} = 20 MPa; Unit weight =24.5 kN/m^3; Young's modulus =20 GPa; Poisson's ratio = 0.2; Cohesive Strength = 5.0 MPa; Friction Angle = 35°(Elastic Perfectly Plastic Mohr-Coulomb Model)

- Reinforced Concrete Existing Lining: Concrete type C25; Characteristic cubic compression strength R_{ck} = 25MPa; Unit weight =24.5 kN/m^3; Young's modulus=25 GPa; Poisson's ratio = 0.2; Cohesive Strength = 5.2 MPa; Friction Angle = 35° (Elastic Perfectly Plastic Mohr-Coulomb Model)

The FEM analyses have been carried out in sequential stages by reproducing the excavation process and the support installation (Unreinforced Concrete Lining and Reinforced Concrete Existing Lining) as follows:

1. Stage 1 - Original state of stress, overburden 340 m, unit weight 25 N/m^3, plane strain conditions with activation of the Short Term Rock Mass Parameters
2. Stage 2-11 - Excavation of crown and three benching down stages with installation of unreinforced lining and reinforced concrete existing lining with activation of the Short Term Rock Mass Parameters
3. Stage 12 - Activation of the Long Term Rock Mass Parameters in a 4 m-thick zone.

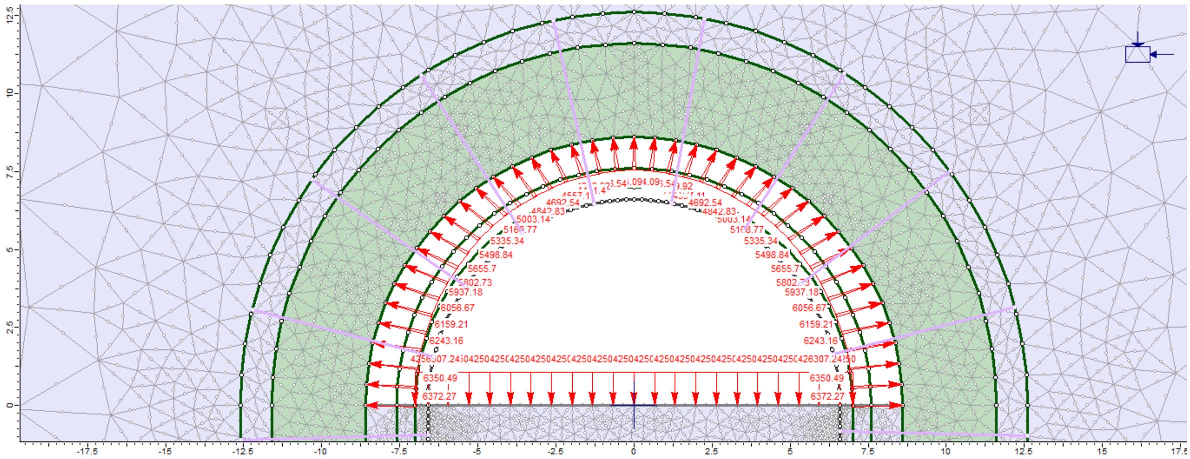
A detail of the automatically generated Finite Element mesh adopted is shown in Figure 12 a and b. It is noted that the rock mass, the unreinforced concrete lining and the reinforced concrete existing lining are subdivided by using 6 node triangular elements. A significant number of such elements is used on the opening boundary and a fine mesh is created in order to show the details of the failure zones, as already noted in chapter 3 above. Figure 13 to 16 illustrate the sequence of the excavation and construction stages simulated.



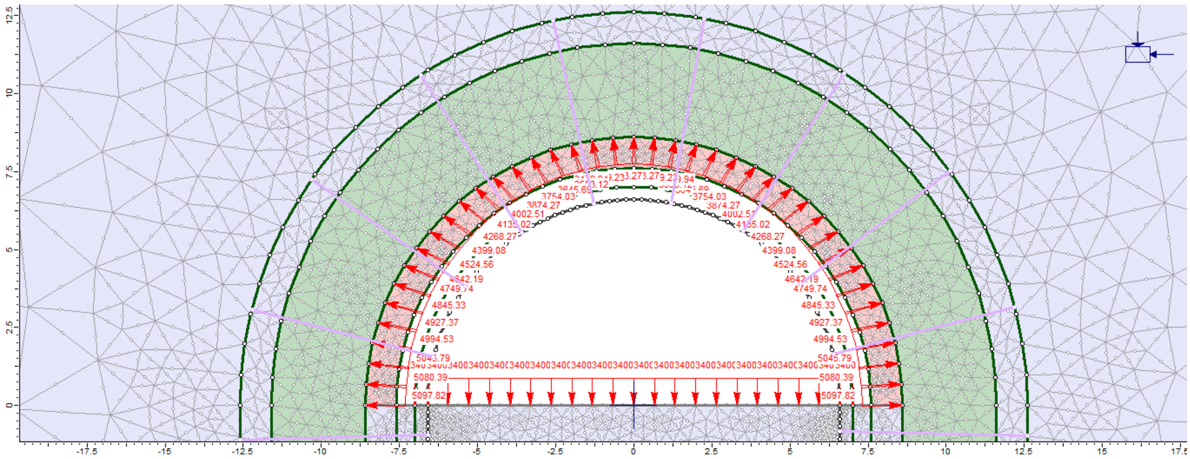
(a)

(b)

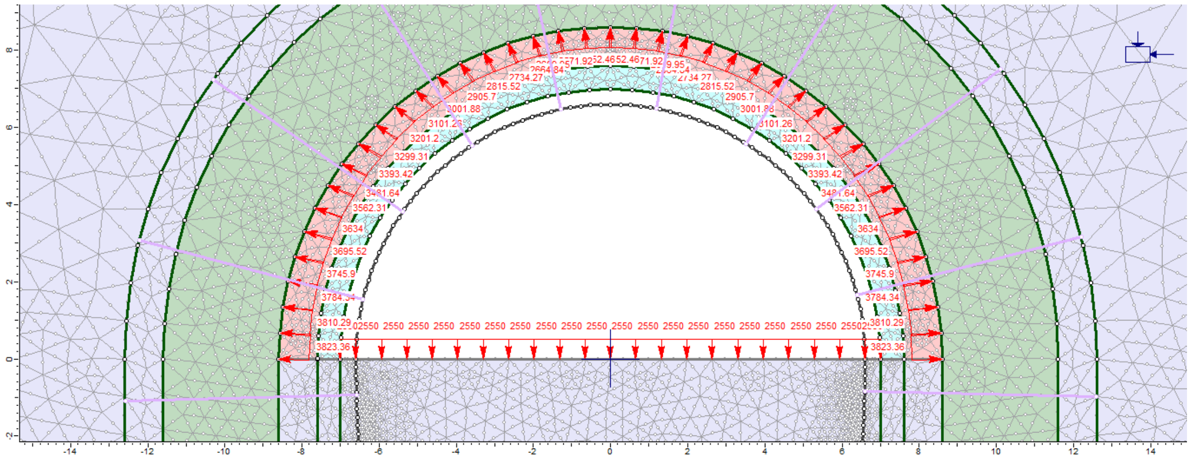
Figure 12: Automatically generated Finite Element Mesh adopted: (a) Complete Finite Element Model. (b) Details of the FEM Model around the tunnel (note that in addition to the Unreinforced Concrete layer and the Reinforced Concrete Existing Lining, also the Proposed Structural is also shown (see Chapter 5 for details).



(a) 50% Stress Relief (SR)at the tunnel contour

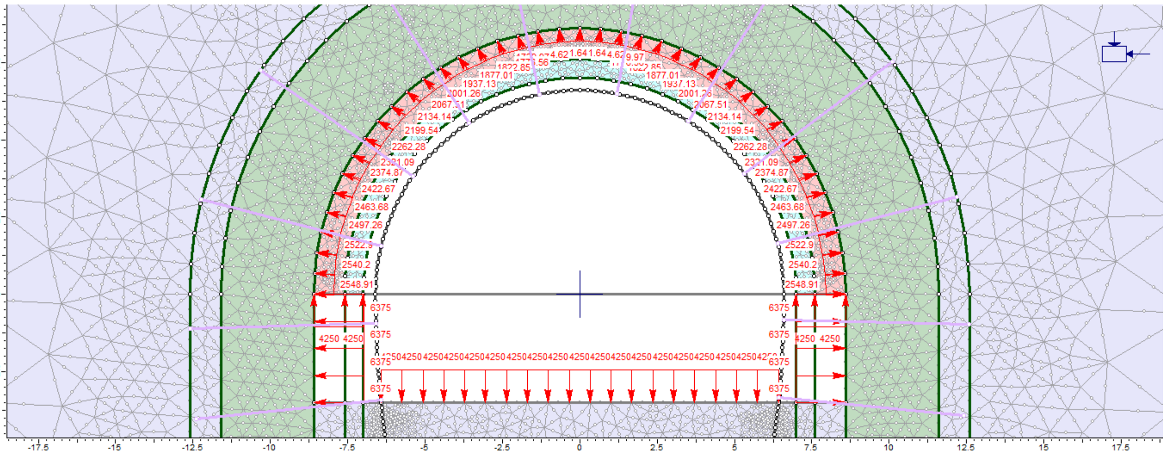


(b) Unreinforced Concrete Lining activated with an additional 10% SR at the tunnel contour(i.e. 60% SR total)

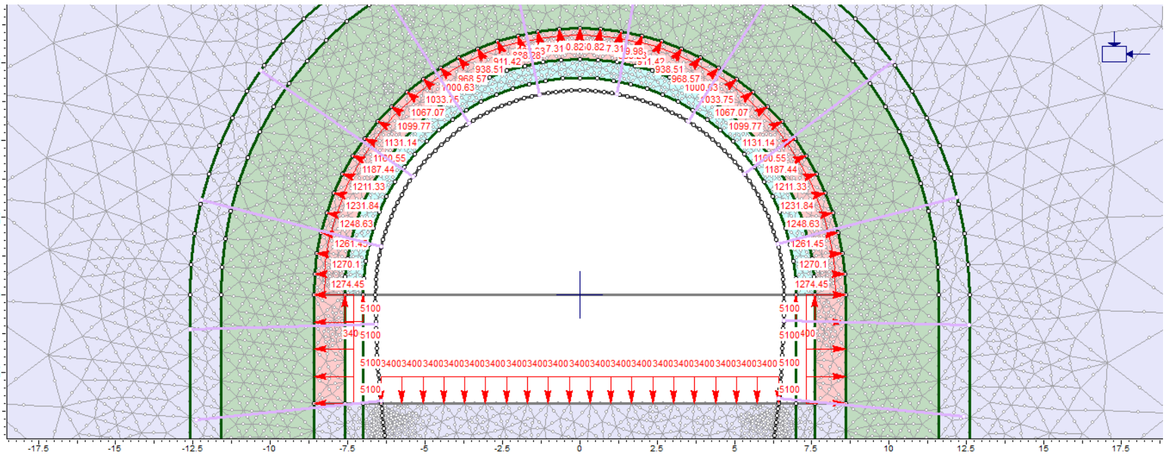


(c) Reinforced Concrete Lining activated with an additional 10 % SR at the tunnel contour(i.e. 70% total)

Figure 13: Opening of the tunnel crown with both the Unreinforced and the Reinforced Concrete Lining activated.

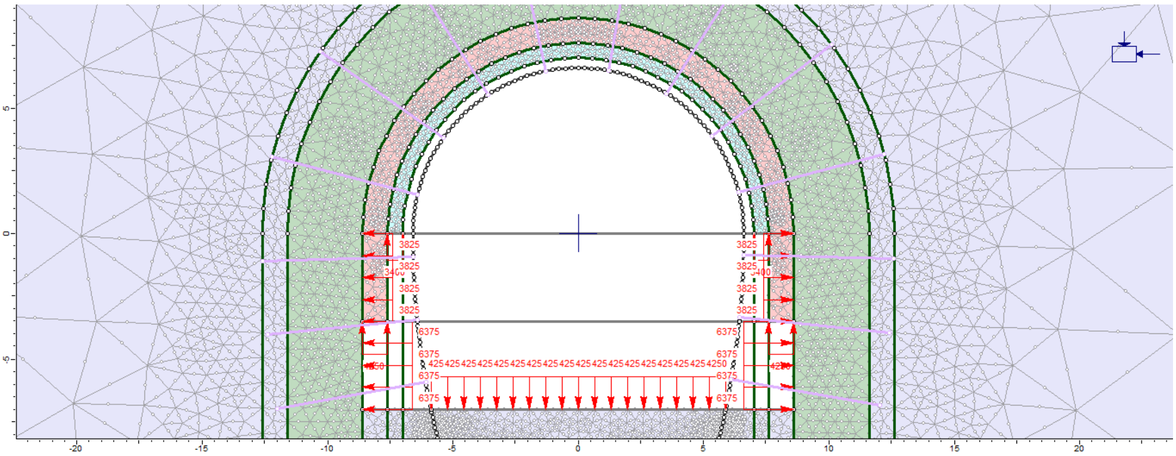


(a) Benching down with 50% Stress Relief (SR) at the sidewalls. Additional 10% SR at the crown (i.e. 80% total)

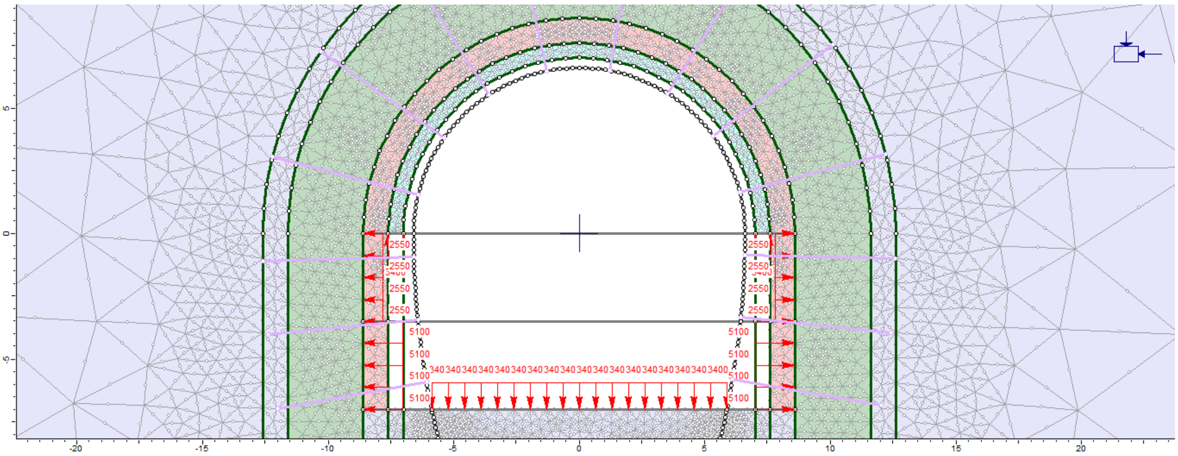


(b) Unreinforced Concrete Lining activated at the sidewalls (bench 1). Additional 10% SR at the sidewalls (i.e. 60% total). Additional 10% SR at the crown (i.e. 90% total)

Figure 14: Benching down with the Unreinforced Concrete Lining activated.

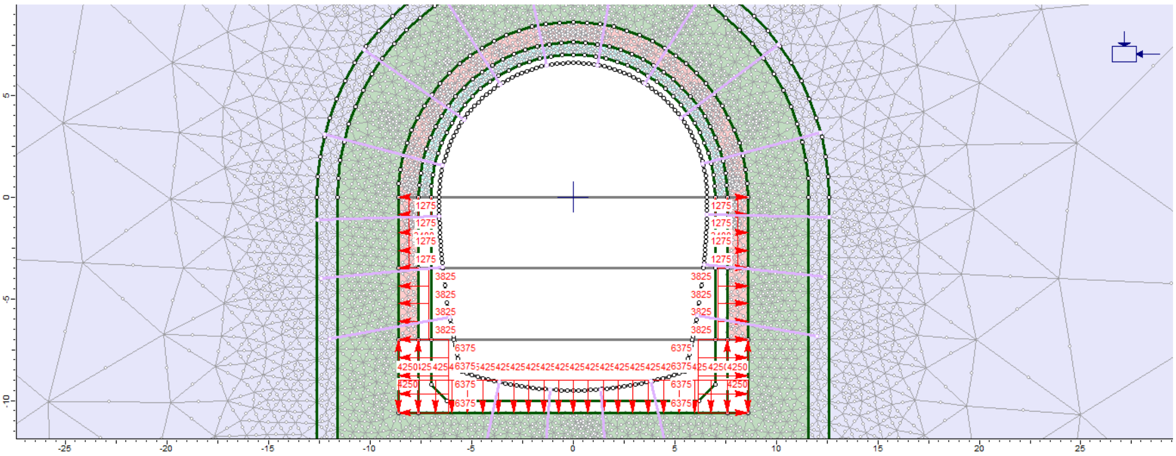


(a) Benching down with 50% Stress Relief (SR) at the sidewalls (bench 2). Additional 10% SR at the sidewalls (i.e. 70% total, bench 1). Additional 10% SR at the crown (i.e. 100% total)

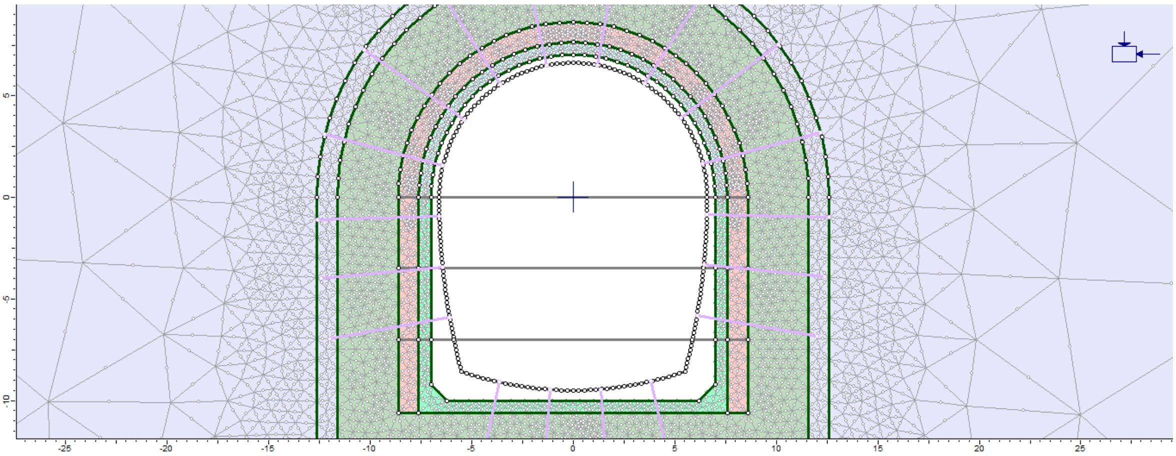


(b) Unreinforced Concrete Lining activatedat the sidewalls (bench 2). Additional 10% SR at the sidewalls (i.e. 80% total, bench 1). Additional 10% SR at the sidewalls (i.e. 60% total, bench 2)

Figure 15: Benching down with the Unreinforced Concrete Lining activated as shown.



(a) Benching down with 50% Stress Relief (SR) at the sidewalls (bench 3). Additional 10% SR at the sidewalls (i.e. 90% total, bench 1). Additional 10% SR at the sidewalls (i.e. 70% total, bench 2)



(b) Unreinforced and Reinforced Concrete Lining fully activated to complete the existing lining (SR fully activated to reach 100%). Unreinforced concrete lining completed (SR fully activated to reach 100%).

Figure 16: Benching down with the Unreinforced and Reinforced Concrete Linings fully activated as shown.

4.1 Analyses Performed and Results

Three different sequential analyses (Stage 1 to 12 included) have been performed with the interest to assess the state of stress in the existing lining based on the transition from the short term to the long term rock mass parameters in a 4 m thick zone around the tunnel (i.e. nearly equal to the extent to the plastic zone for the range of stress ratios K_h considered, i.e. 0.2, 0.8 and 1.5)).The results obtained for some selected and most representative simulation stages are illustrated in Figures 17 to 21 for K_h= 0.8 (see Appendix 1 for K_h= 0.2 and 1.5).

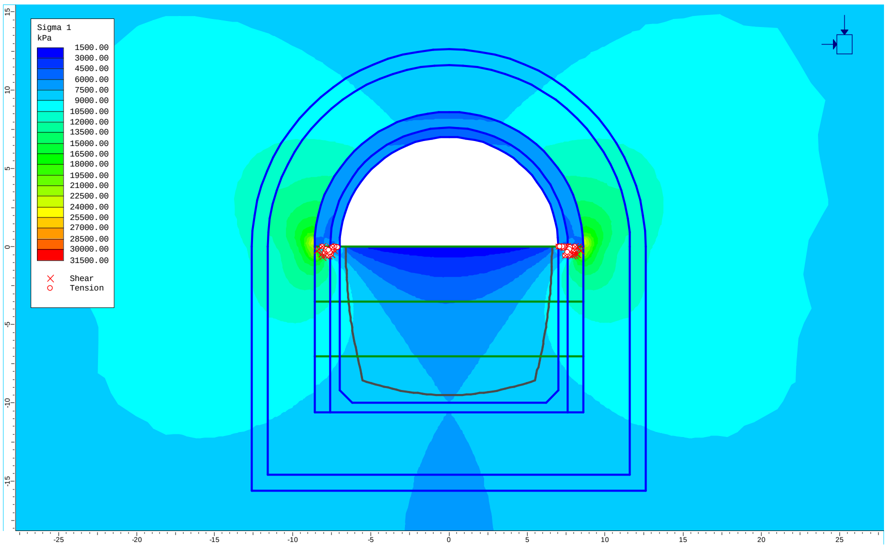


Figure 17: Maximum principal stress and failure zones with the existing lining installed at the crown(K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

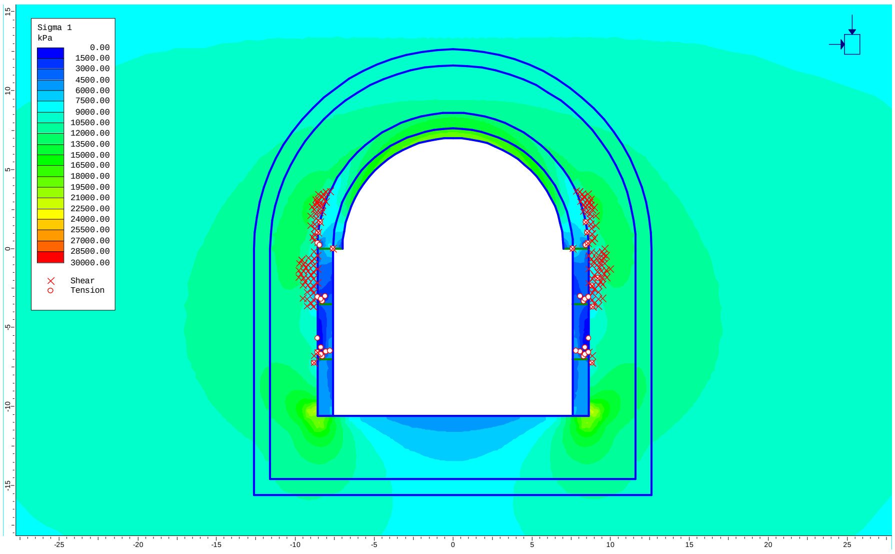


Figure 18: Maximum principal stress and failure zones with the existing unreinforced concrete lining installed (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

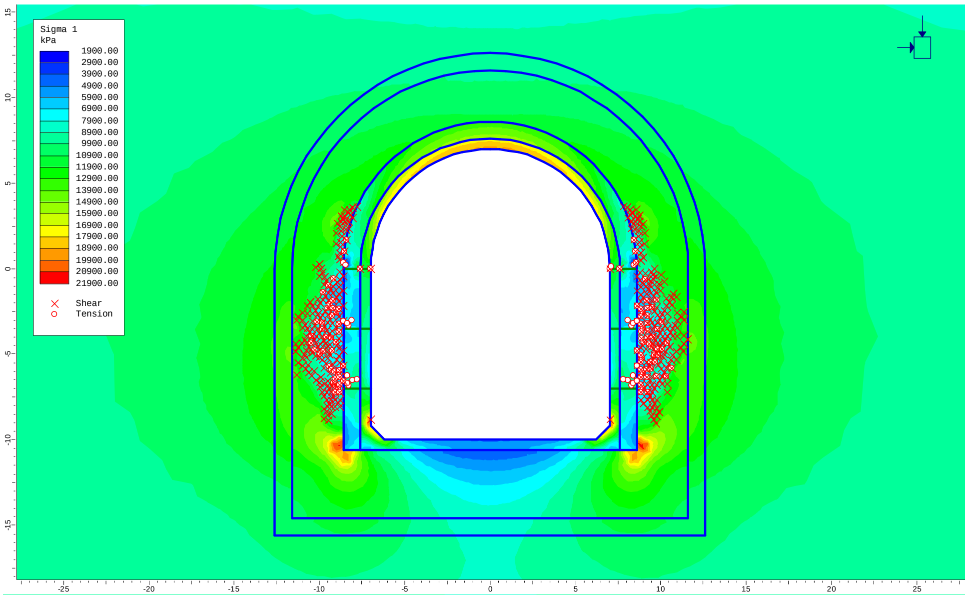


Figure 19: Maximum principal stress and failure zones plot for excavation completed with the existing reinforced concrete lining installed (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

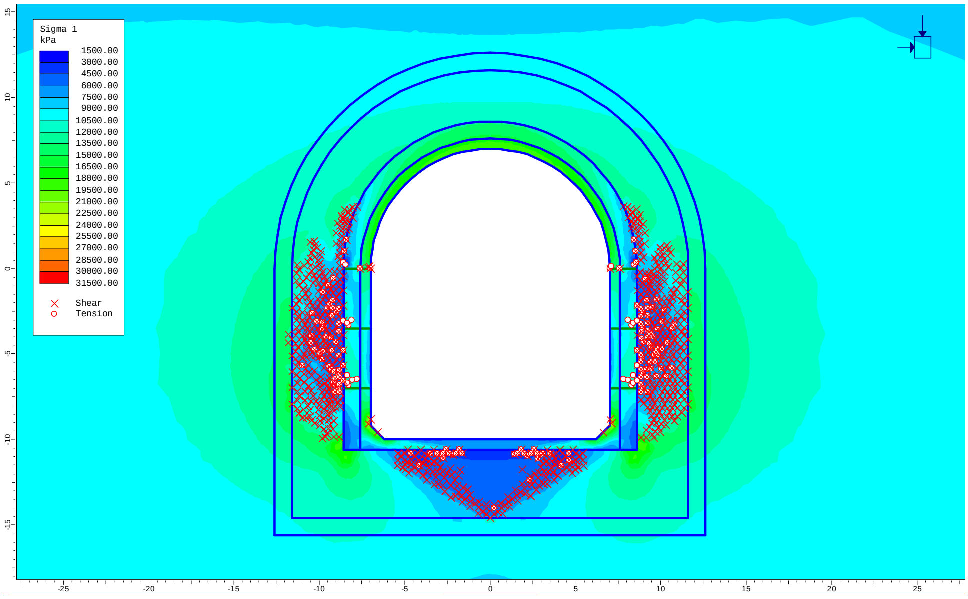


Figure 20: Maximum principal stress and failure zones plot for excavation completed with the existing reinforced concrete lining installed for long term conditions (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

It is noted that at the end of the simulation stages some localized zones of failure occur in the unreinforced 1.0 m thick lining, with the rock mass around the tunnel being in a plastic state both at the sidewalls and invert. The state of stress in the existing reinforced concrete lining is shown in Figure 21 by plotting the normal and shear stresses.

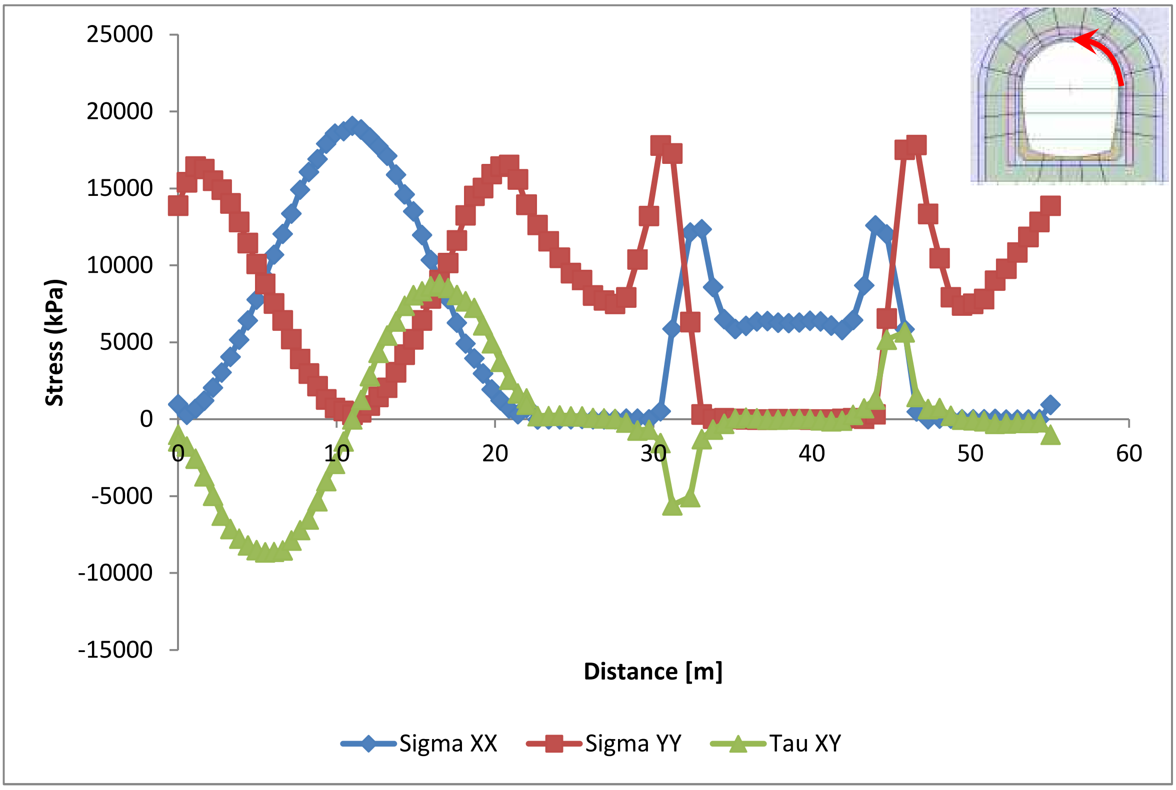


Figure 21: Normal and shear stresses in the existing reinforced concrete lining, starting from right first point of crown arch, counter clockwise (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

5. STRESS ANALYSIS OF THE NEW SUPPORT SYSTEM

The purpose of the present chapter is to illustrate the stress analyses performed with the new additional support system installed in the tunnel as described in the previous report dated March 8 2013. As shown in Figure 22, this system comprises:

1. A systematic drainage system around the tunnel, crown and sidewalls included, consisting of a pattern of drainage holes, each having a 8 m length minimum.
2. A new support system in the form a pattern of rock dowels around the tunnel, each having a length of 6 m.
3. An additional reinforced concrete lining ring 40 cm thick minimum, well integrated with the existing 60 cm lining and the above rock dowels, placed around the tunnel.

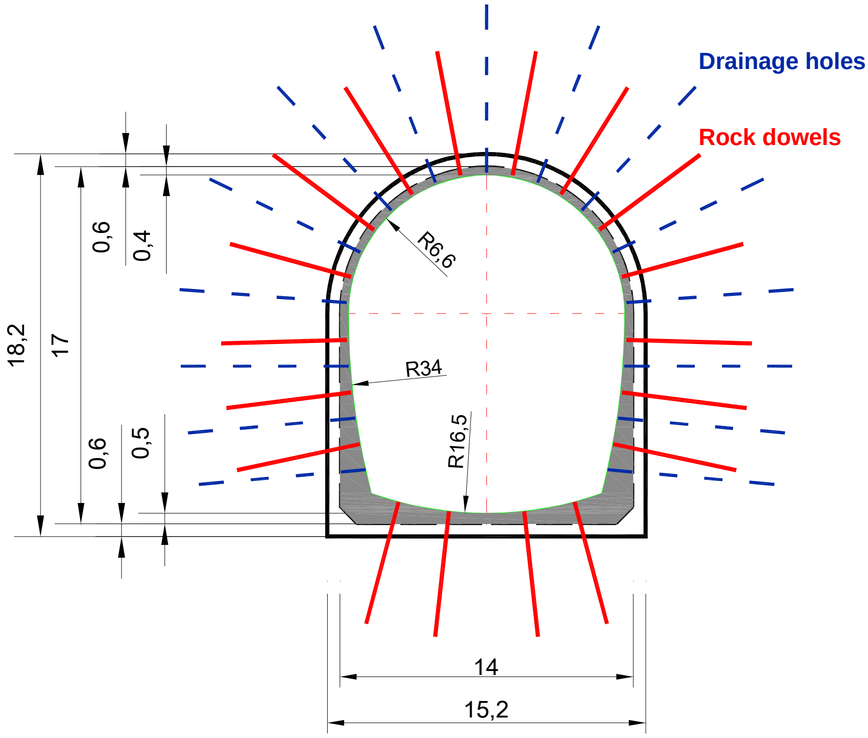


Figure 22: Schematic illustration of the additional support-stabilization system proposed (see report dated March 3 2013).

With the intent to study the structural behavior of the Diversion Tunnel 1 in the cross section of interest, the Finite Element Model described in chapter 3 was used by taking into account the additional support-stabilization system described above. The model is to simulate the interaction between the rock mass and the existing support (unreinforced and reinforced concrete lining). In addition the proposed support-stabilization system (new internal lining, rock dowels and drainage system) is introduced.

The existing and new linings are now simulated by using 6-node triangular elements. Rock dowels are introduced as structural elements. It is noted that the linings are now simulated by using an elastic perfectly-plastic Mohr-Coulomb model with the material properties assigned as shown in Table 2 below. A 200 kPa uniformly distributed water pressure is activated on the extrados of the new lining.

Table 2: Lining material properties

Property	New lining (C25/30)
Deformation modulus (GPa)	27
Uniaxial compressive strength (MPa)	25
Cohesion (kPa)	6.5
Friction Angle (°)	35
Tensile strength (MPa)	2.6

The rock dowels are assumed to be 6 m long, with in- and out-of-plane spacing equal to 2.5 m. The diameter of the steel rod is assumed to be 28 mm and the tensile capacity is taken as 150 kN.

As a follow-up of the computational stages described in Figures 13 to 16 the additional construction and loading stages considered are as follows:

1. Stage 13 - Installation of internal lining and dowels
2. Stage 14 - Activation of the hydraulic head (200 kPa) directly on the new lining
3. Stage 15 - Seismic loading (obtained by application of an equivalent shearing force producing $\gamma_{max} = 6.2{\cdot}10^{-4}$, see Appendix 2).

5.1 Analyses Performed and Results

A set of numerical analyses have been performed according to the above simulation sequence by considering the lower bound ($K_h = 0.2$), intermediate bound ($K_h = 0.8$), and upper bound ($K_h = 1.5$) conditions for the initial horizontal stress in the rock mass around the tunnel. The results obtained for the case $K_h = 0.8$ are illustrated in Figures 23 to 30 (see Appendix 1 for K_h= 0.2 and 1.5).

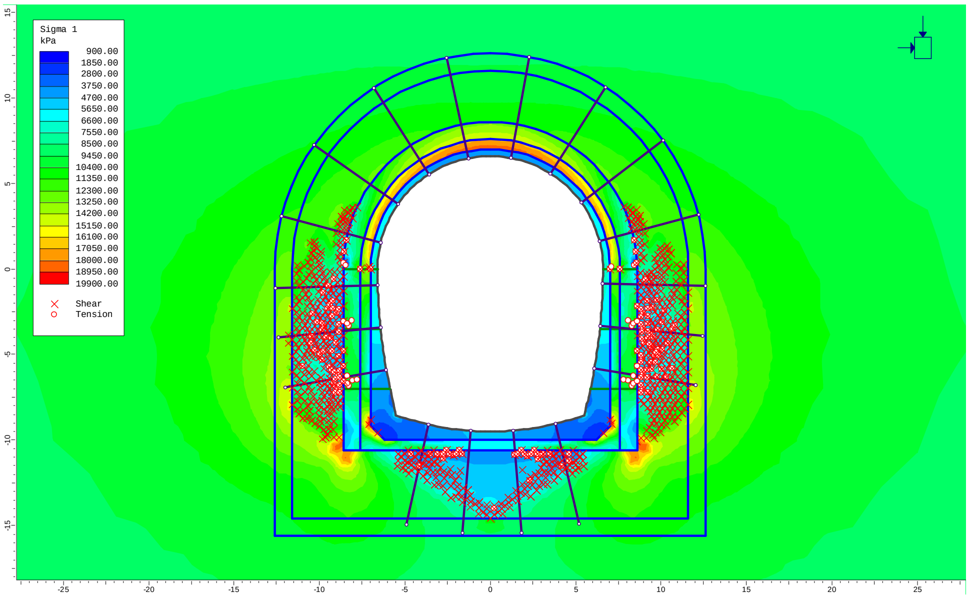


Figure 23: Maximum principal stress and failure zones plot for the new additional support system installed (Stage 13, activation of internal lining and bolts,K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

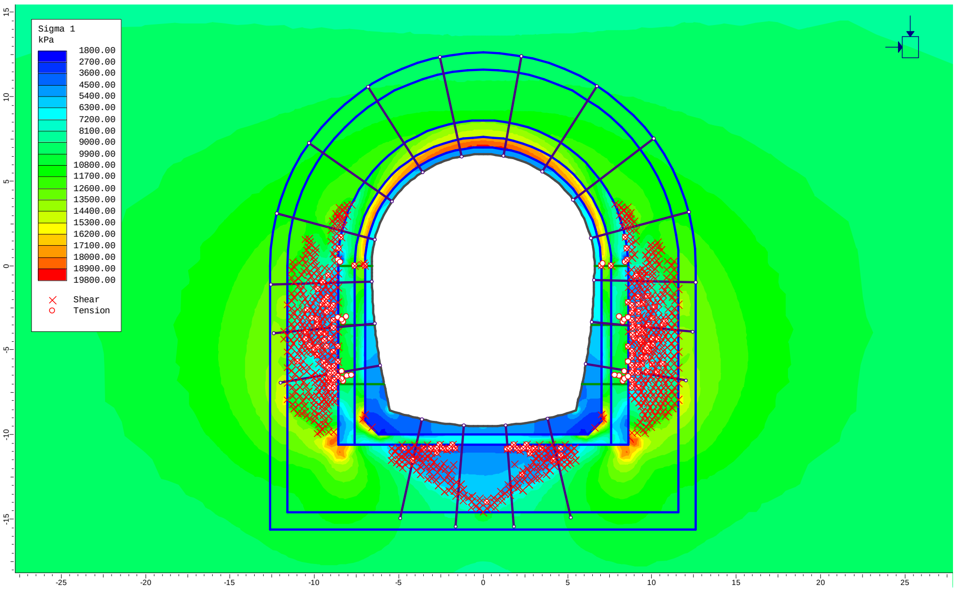


Figure 24: Maximum principal stress and failure zones plot for the new additional support system installed (Stage 14, activation of the hydraulic head of 200 kPa on the new lining,K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

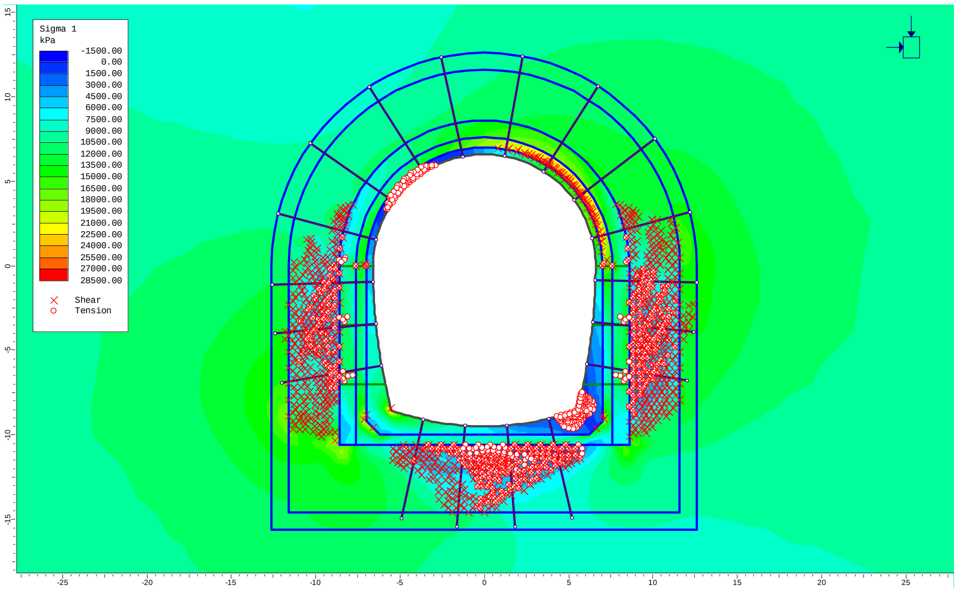


Figure 25: Maximum principal stress and failure zones plot for the new additional support system installed (Stage 15, activation of the seismic load,K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

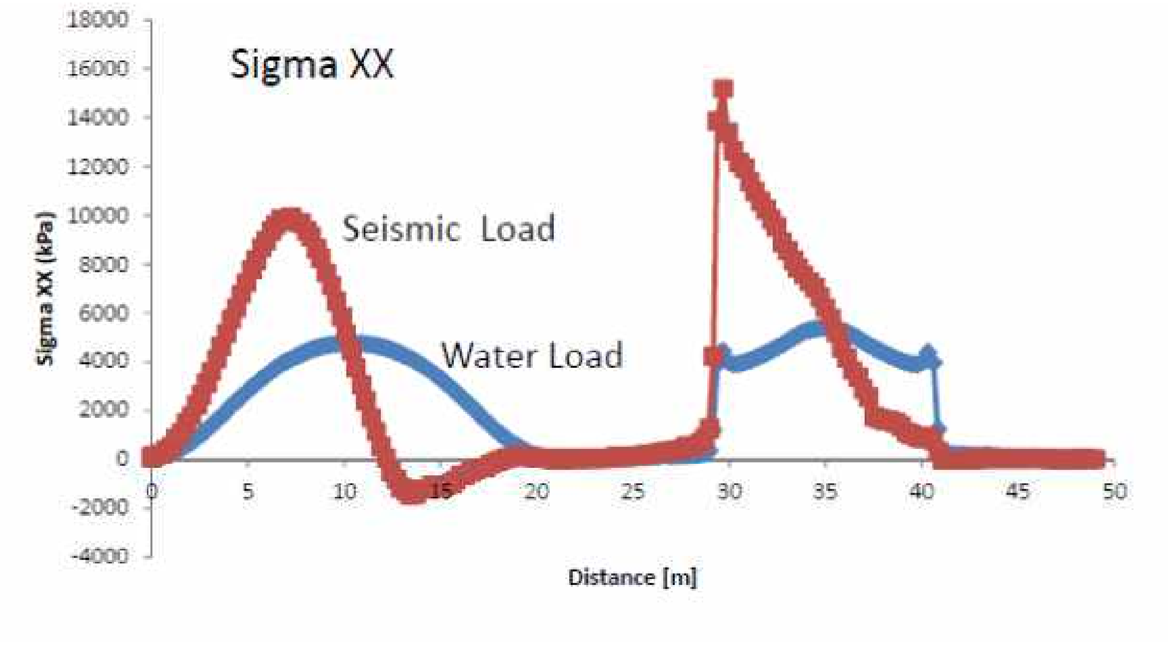


Figure 26: Normal stress in the new lining, starting from right first point of crown arch, counter clockwise (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

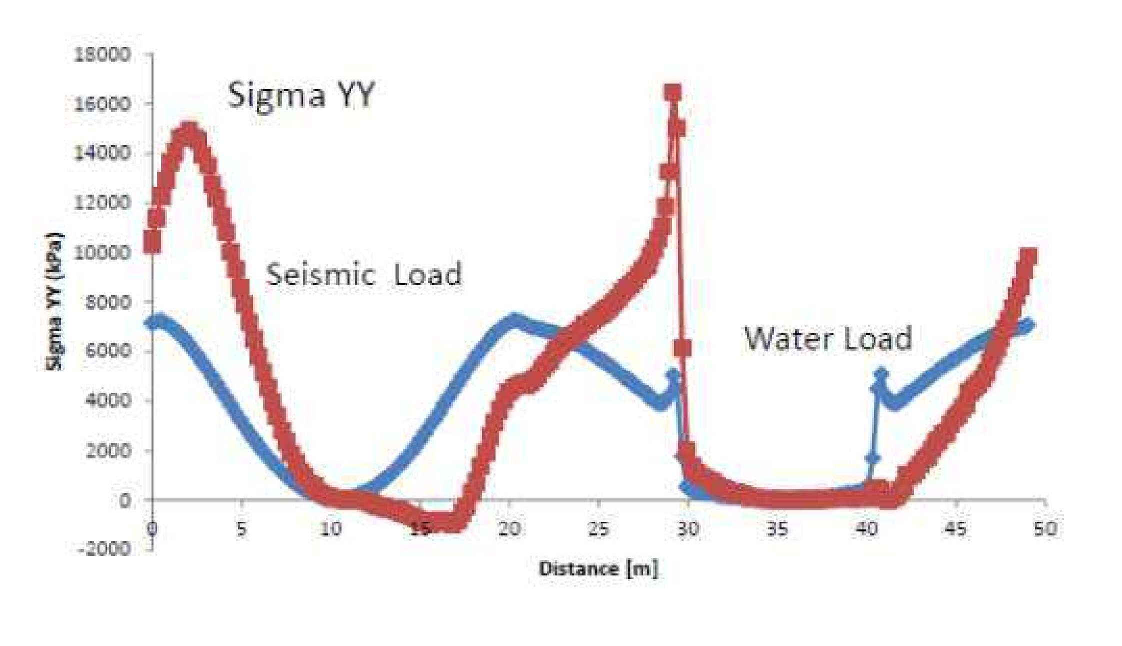


Figure 27: Normal stress in the new lining, starting from right first point of crown arch, counter clockwise (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

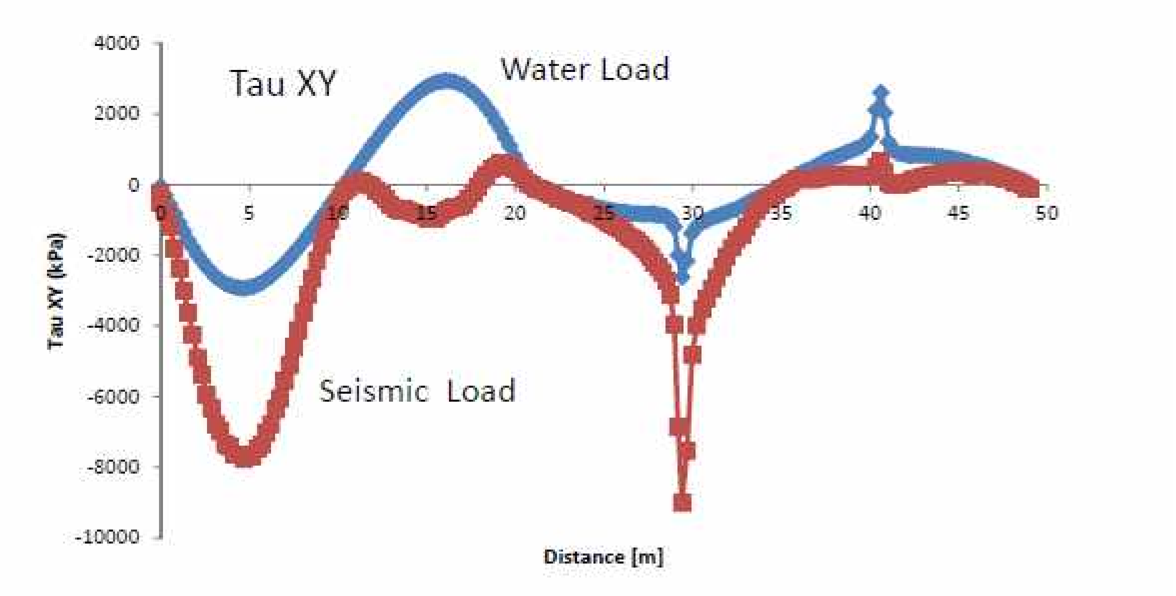


Figure 28: Shear stress in the new lining, starting from right first point of crown arch, counter clockwise (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

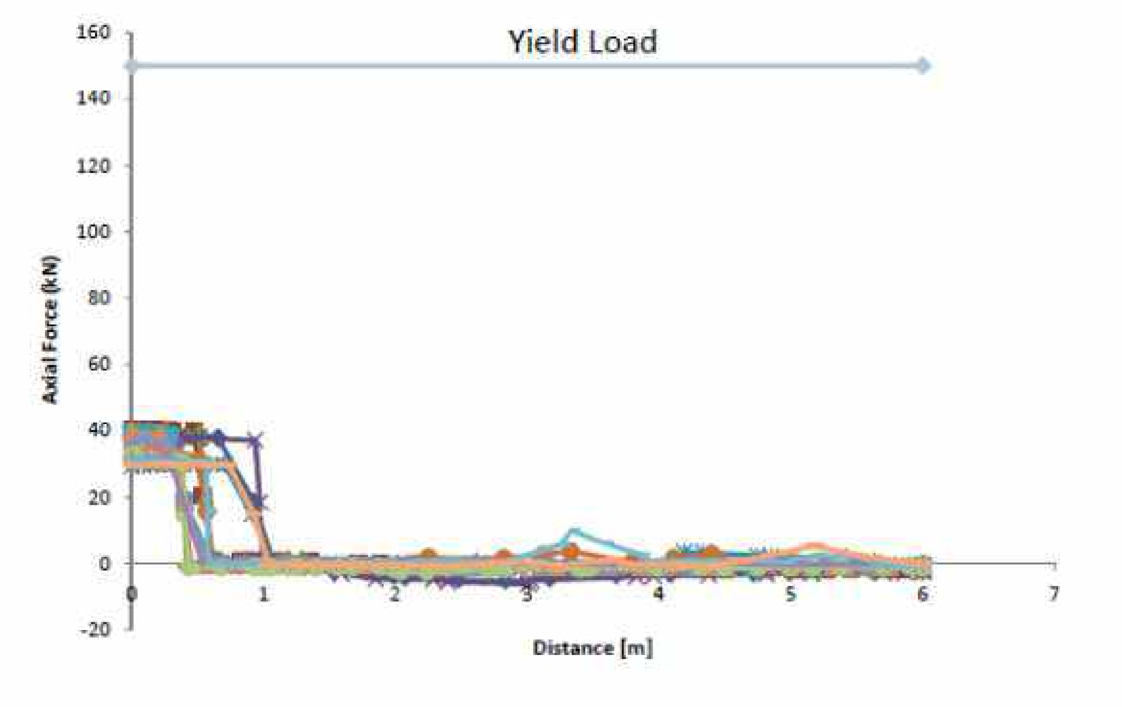


Figure 29: Axial force in the rock dowels. 200 kPa water pressure. (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

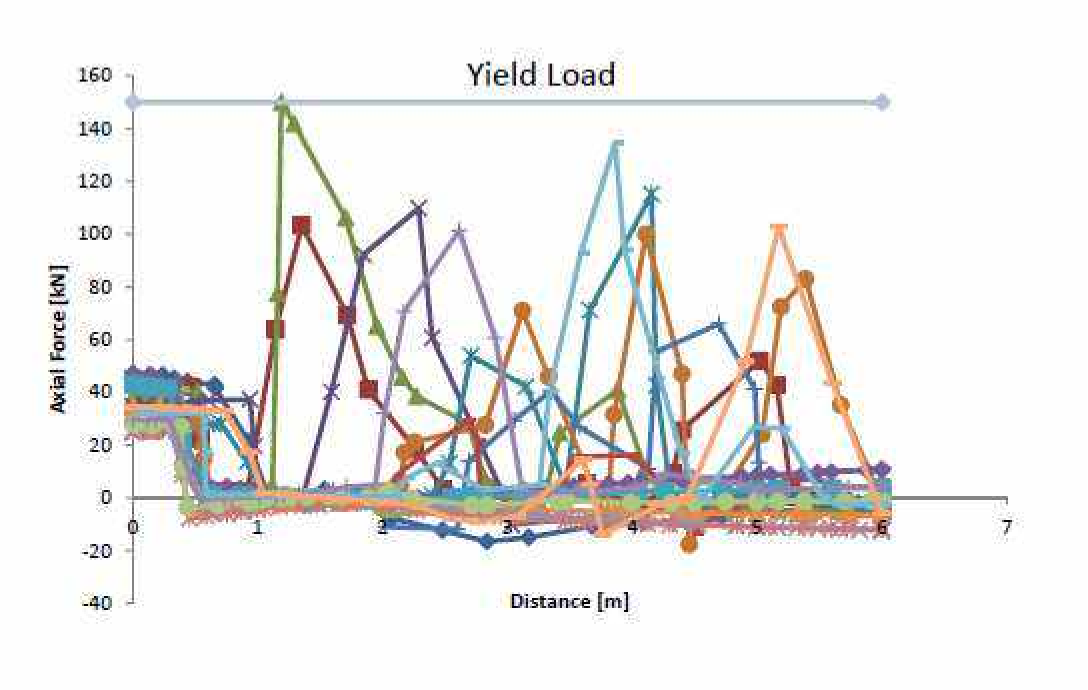


Figure 30: Axial force in the rock dowels. Seismic load. (K_h = 0.8, see Appendix 1 for K_h = 0.2 and 1.5).

The following conclusions can be drawn based on the results obtained:

The plastic zones around the tunnel are significantly dependent on the assumed stress ratio(see Appendix 1 for K_h = 0.2 and 1.5) , with either tensile failure or shear failure taking place in the rock mass surround. In general, as expected, the condition with a higher horizontal stress (K_h = 1.5) exhibits overall a more favourable behavior.

With the 200 kPa uniformly distributed water pressure applied on the lining, no failure occurs in the new lining installed and the rock dowels appear to perform satisfactorily. The present and the new lining act jointly and contribute to the overall stability of the tunnel. Also to be pointed out is the good performance of the rock dowels, as expected, under static loading conditions, when the water pressure is present.

Tensile failure develops in both the existing and new lining. It is to be noted that the computations performed do not account for the presence of steel reinforcement, which is to be defined with reference to the computed normal and tangential stresses which have been made available (1).

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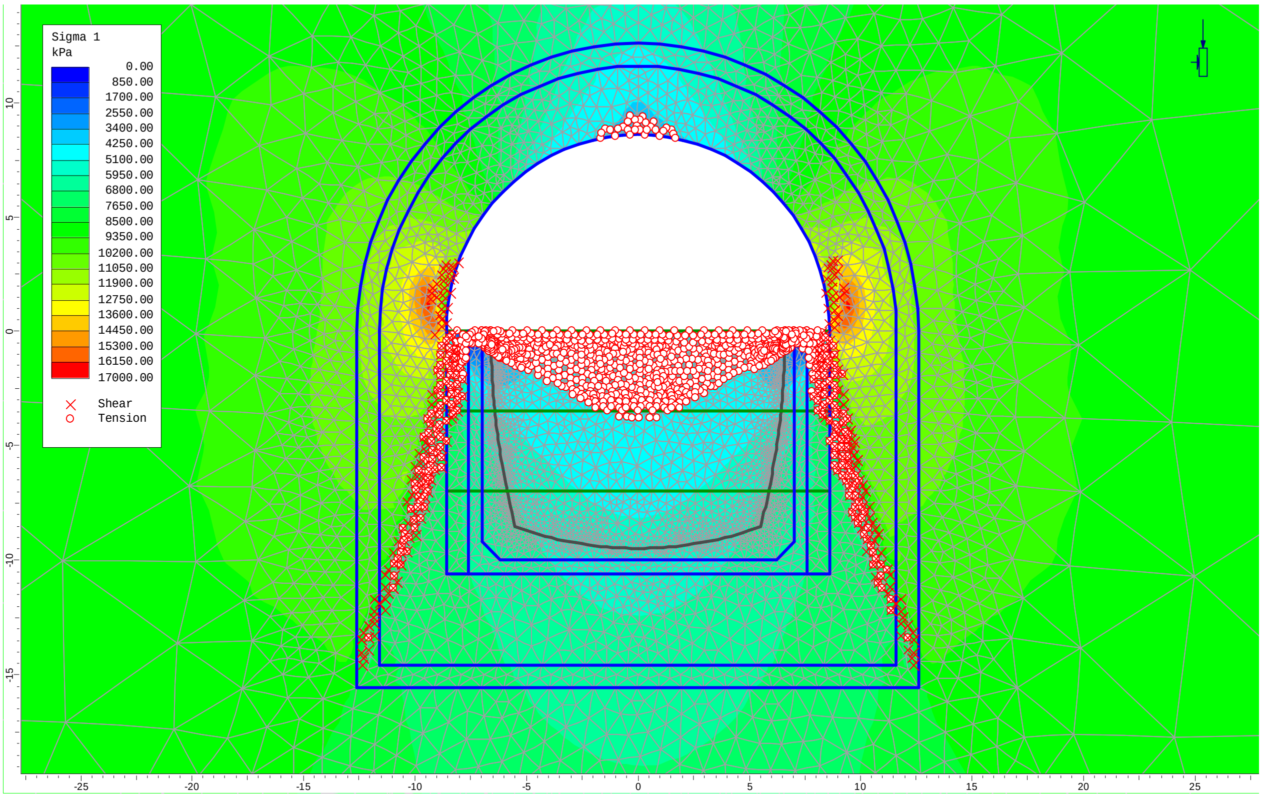
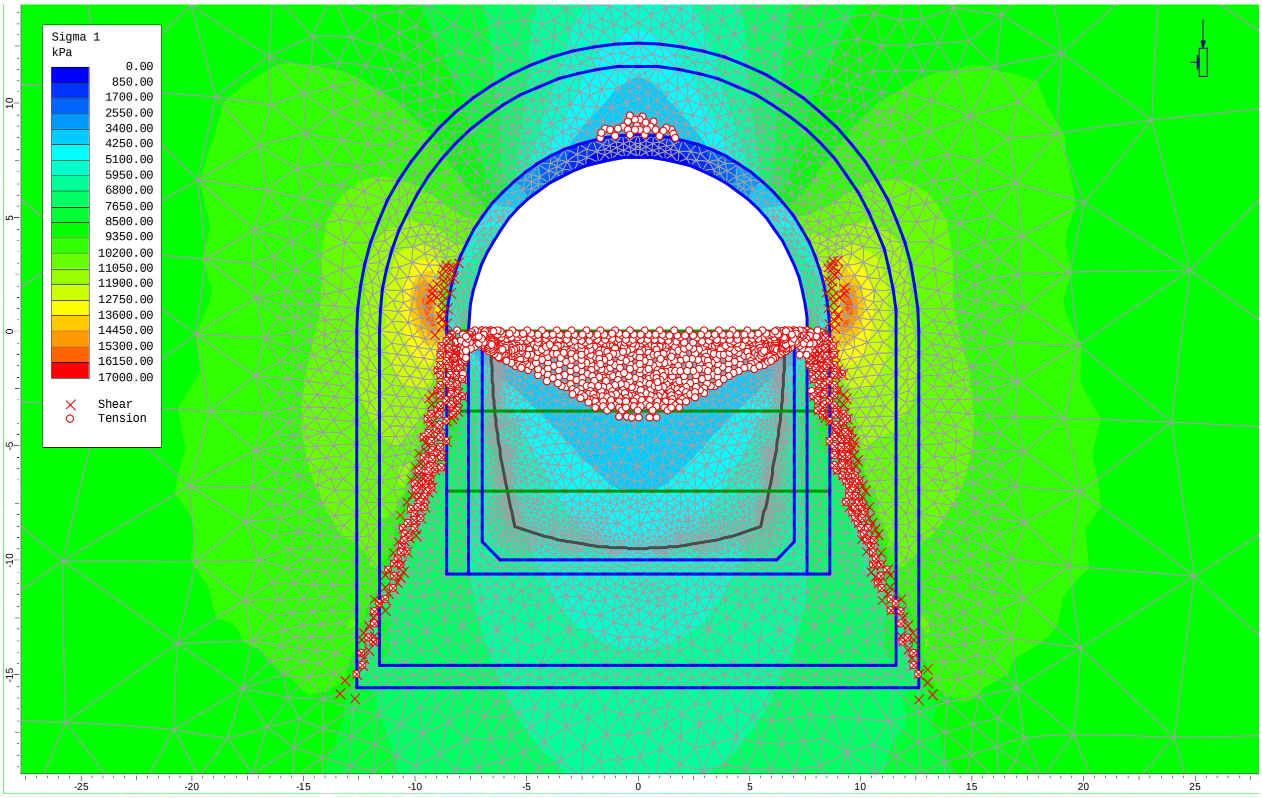
(1) Excel files for the stresses in the lining (present and new inner lining), shown in Appendix 3, have been made available based on the computed normal and shear stresses in the finite elements used for discretization. These can be used for computing the Axial Thrust, Bending Moment and Shear Force along radial directions in the linings.

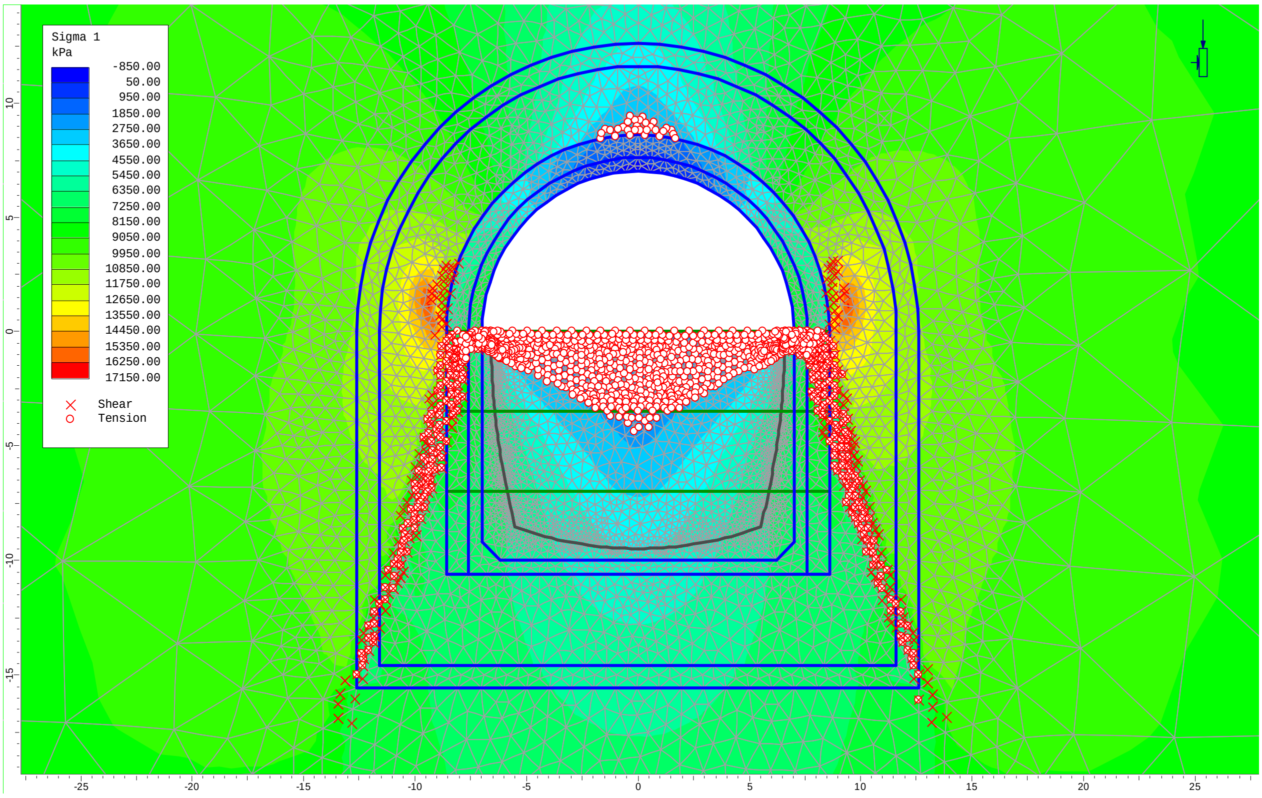
Stage 2 - Crown



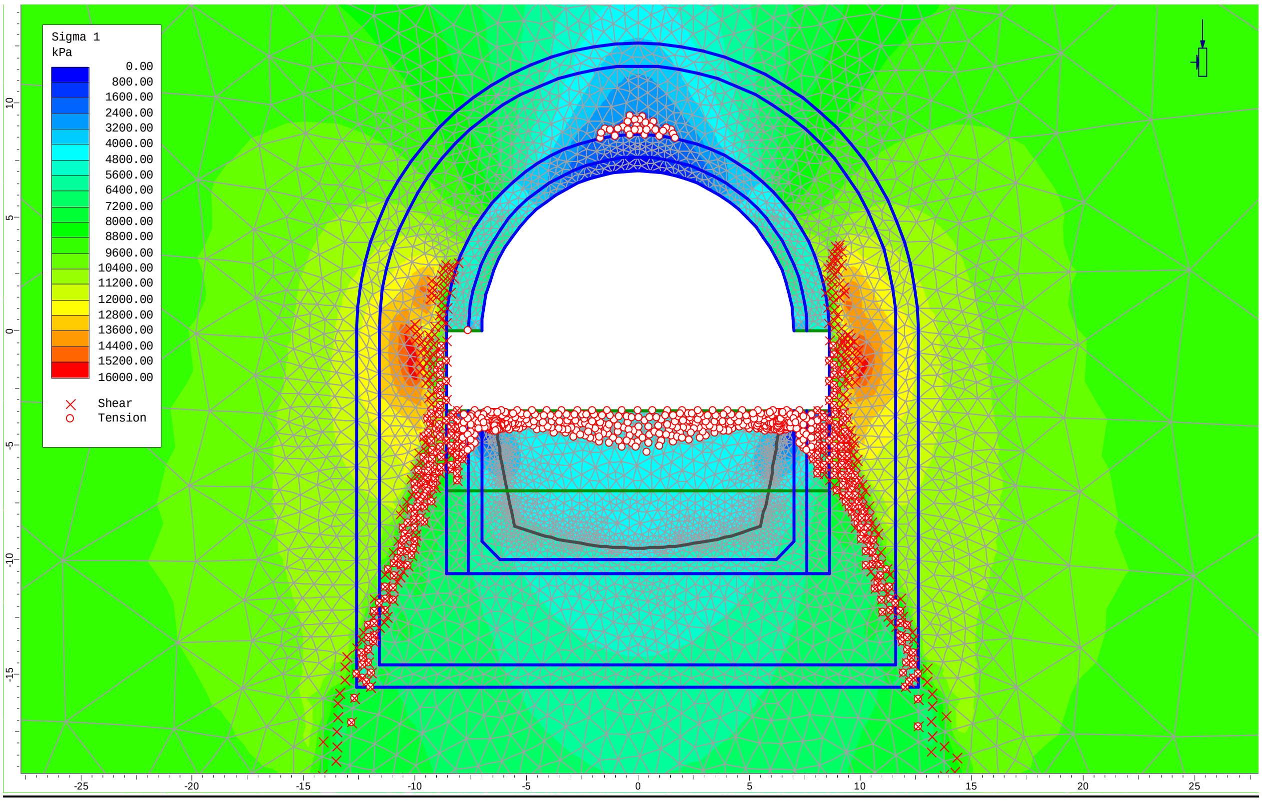
Stage 3 – Crown + Unreinforced concrete



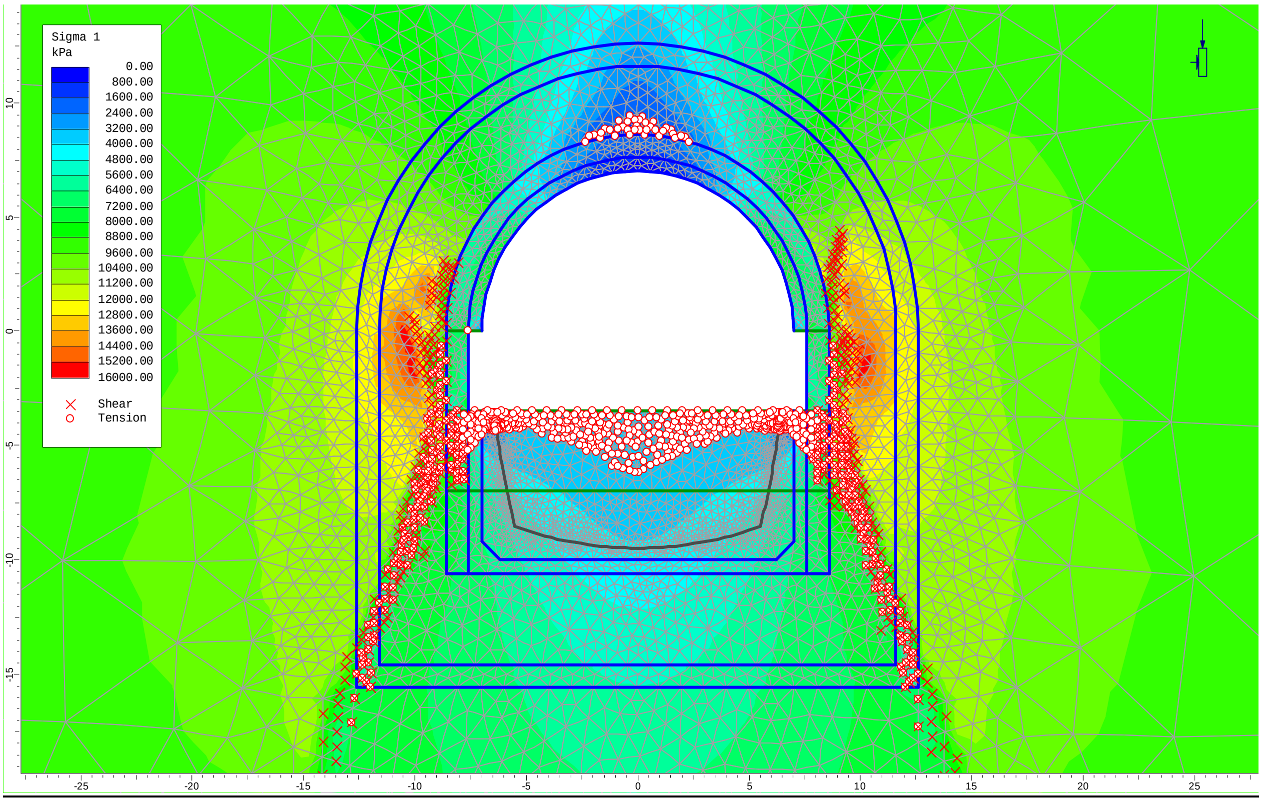
Stage 4 – Crown + Unreinforced and Reinforced concrete



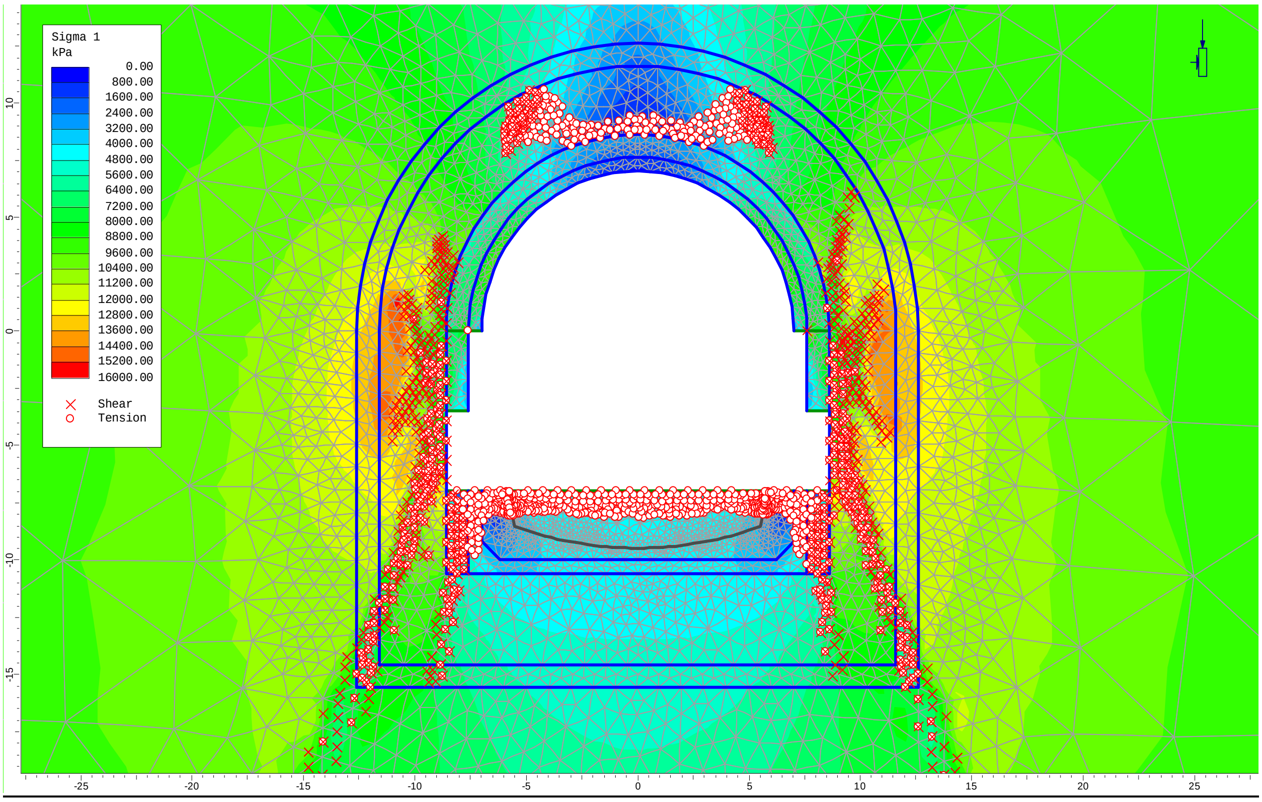
Stage 5 – Benching Down 1



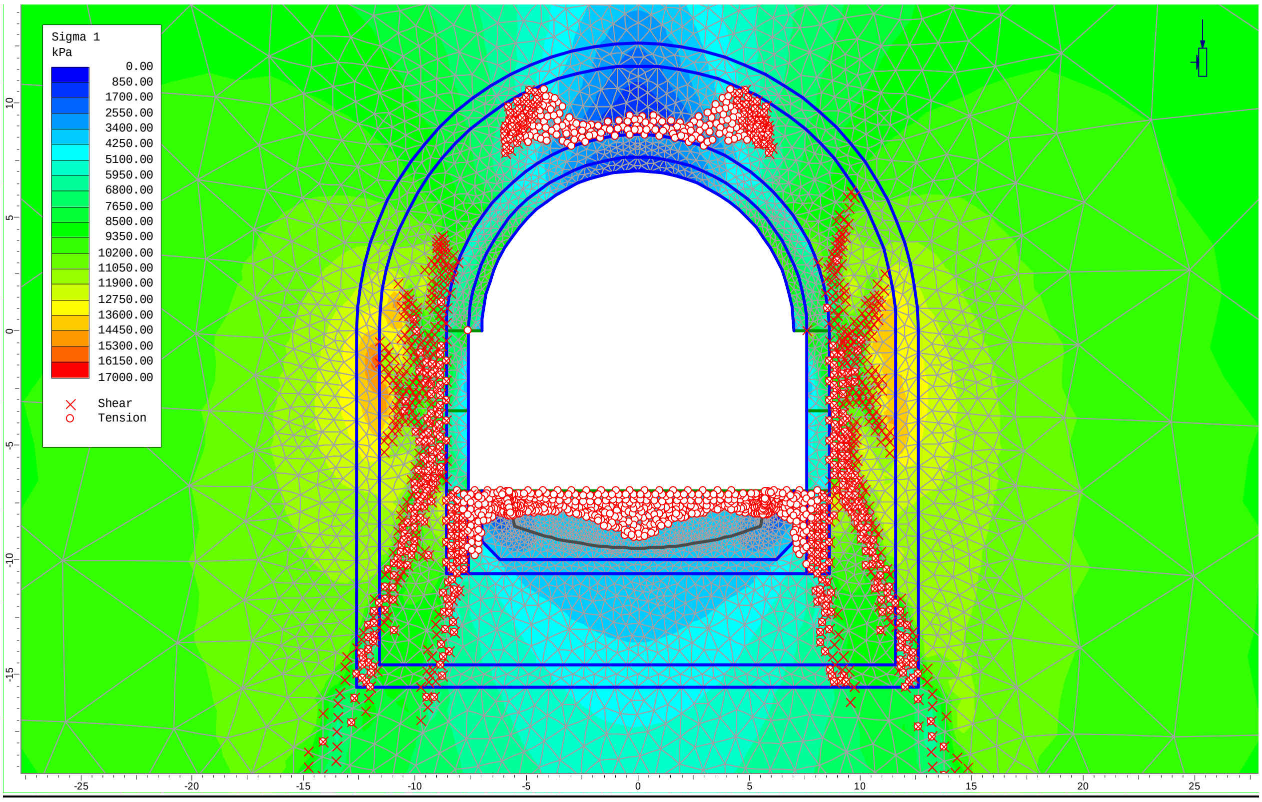
Stage 6 – Bench + Unreinforced concrete



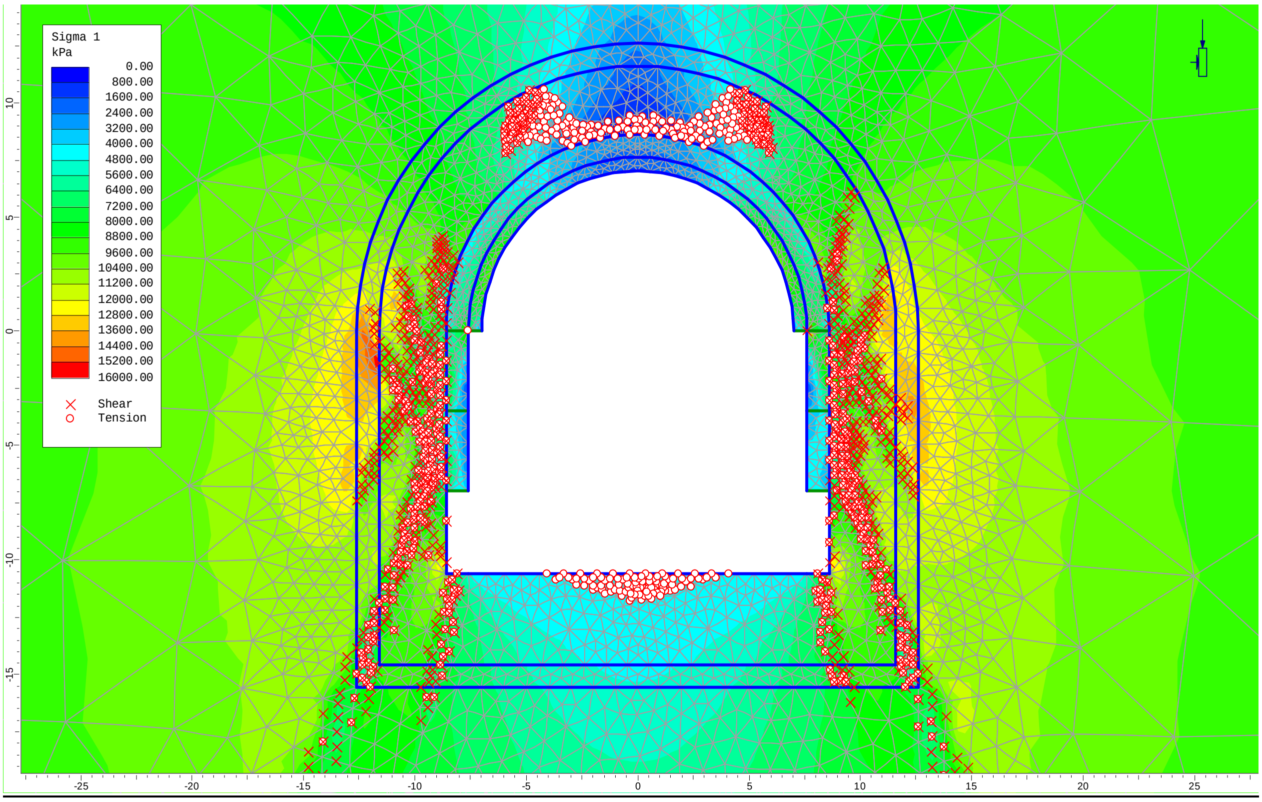
Stage 7 –Bench 2



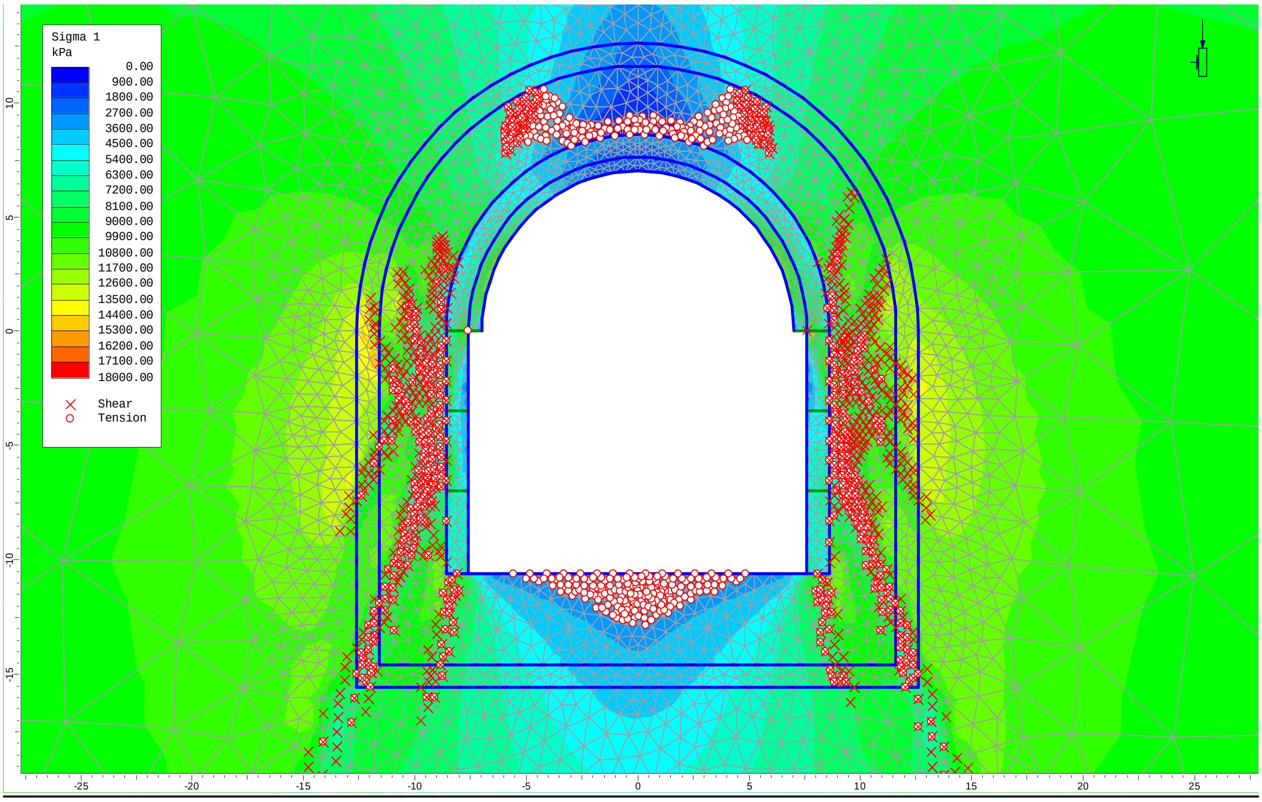
Stage 8 –Bench 2 + Unreinforced concrete



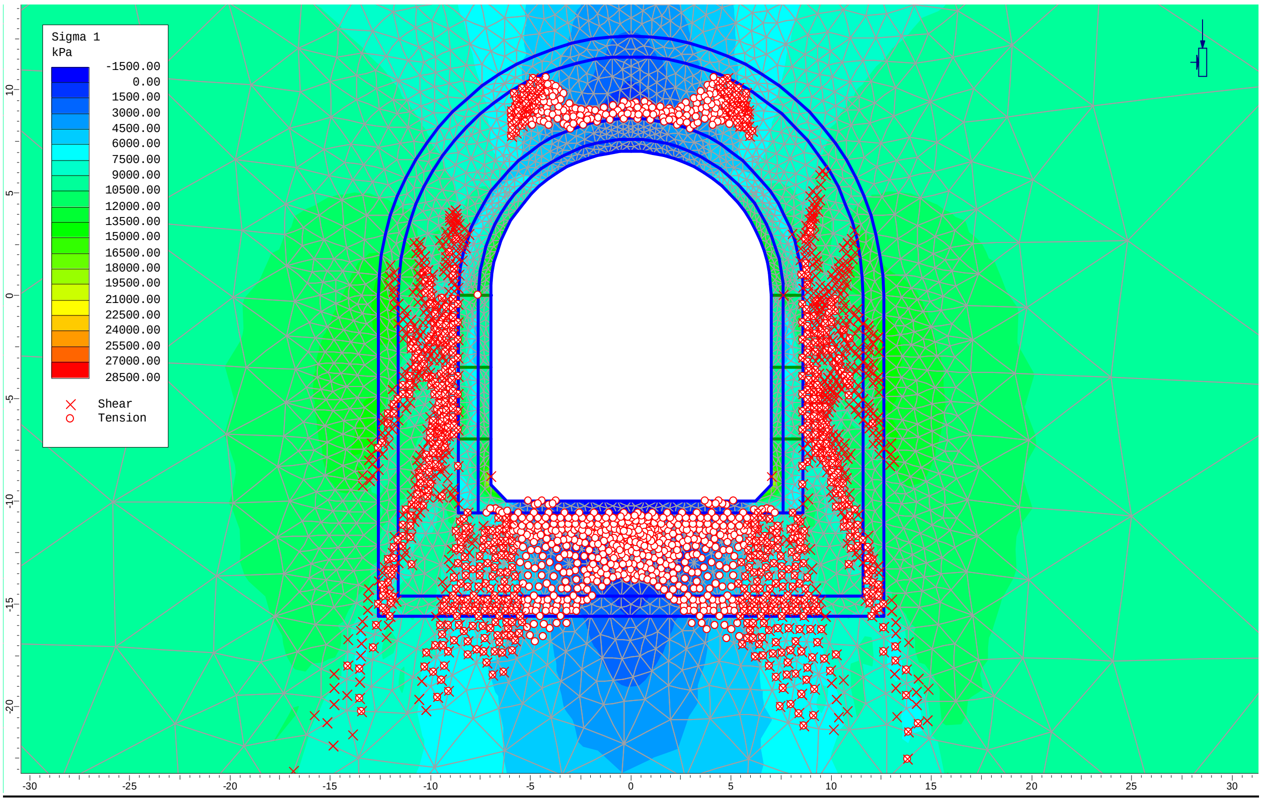
Stage 9 – Bench 3



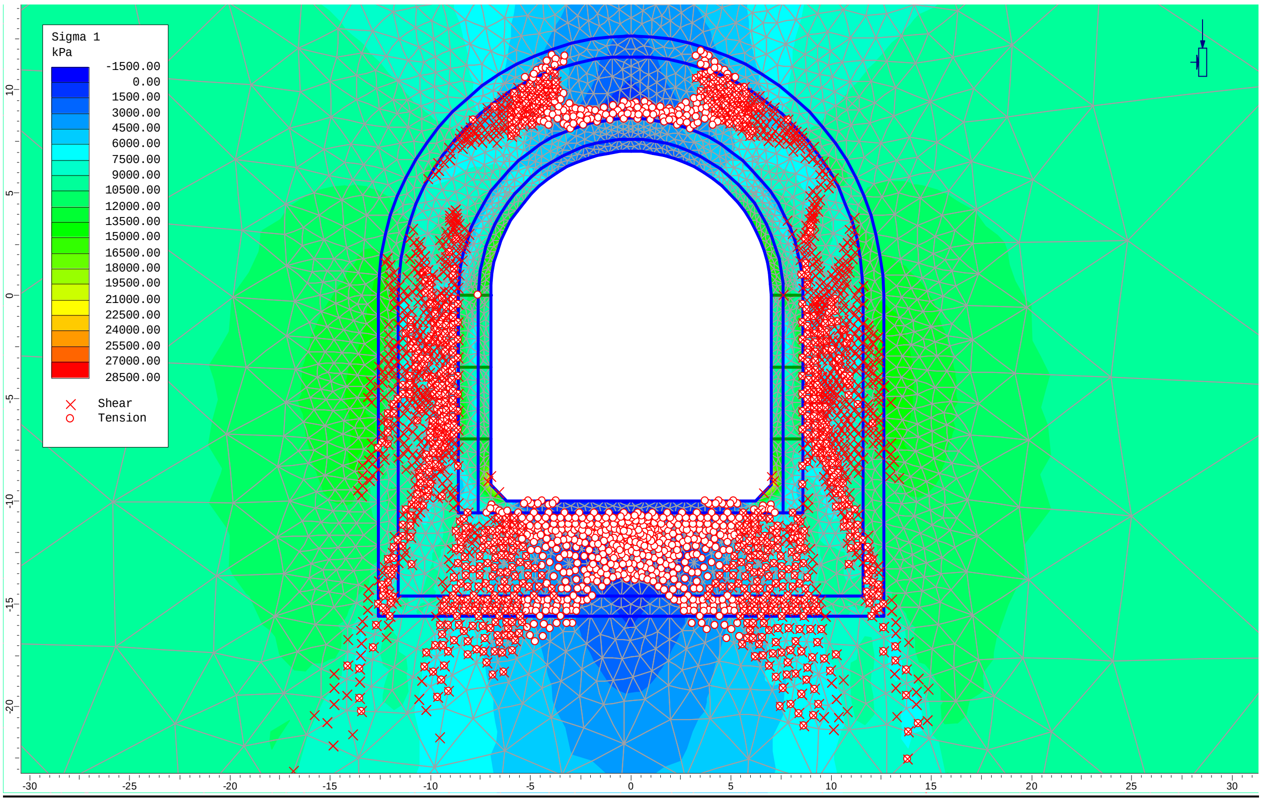
Stage 10 - Bench 3 + Unreinforced concrete



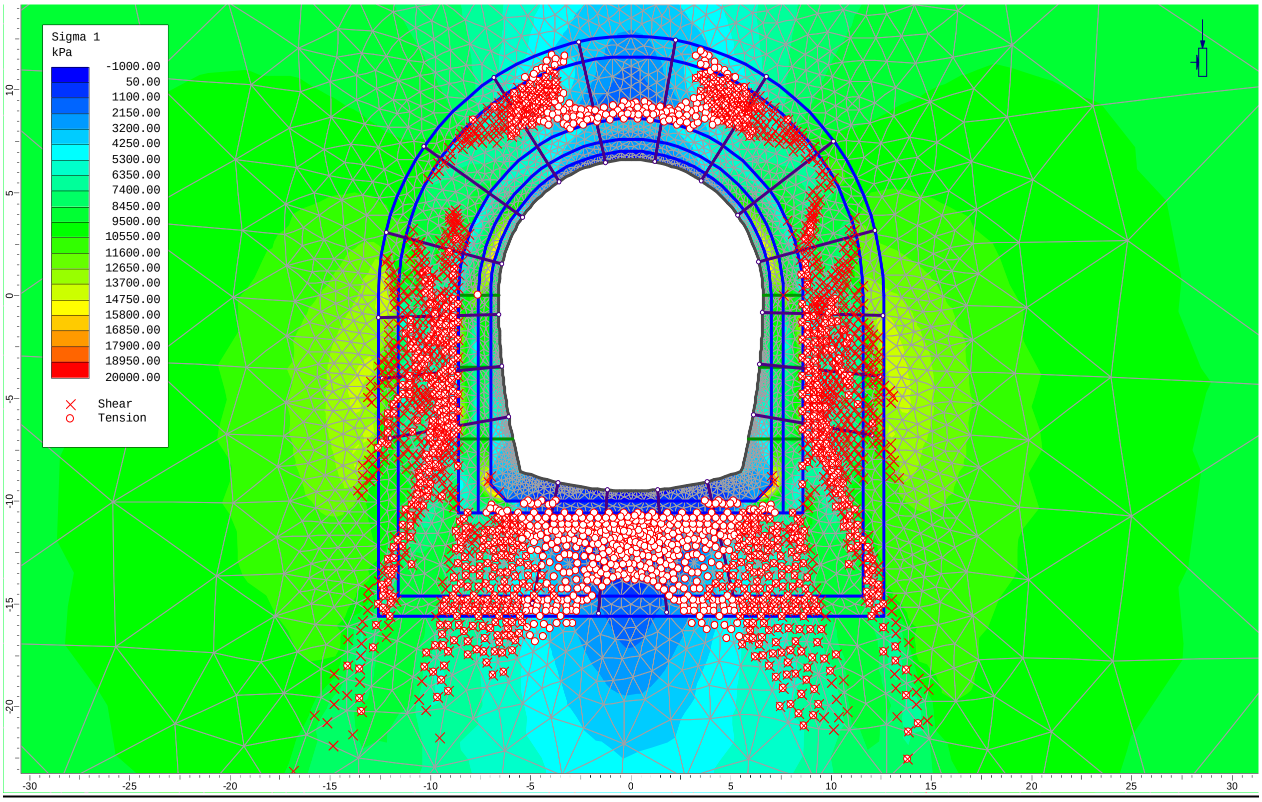
Stage 11 –Reinforced concrete on the sidewalls



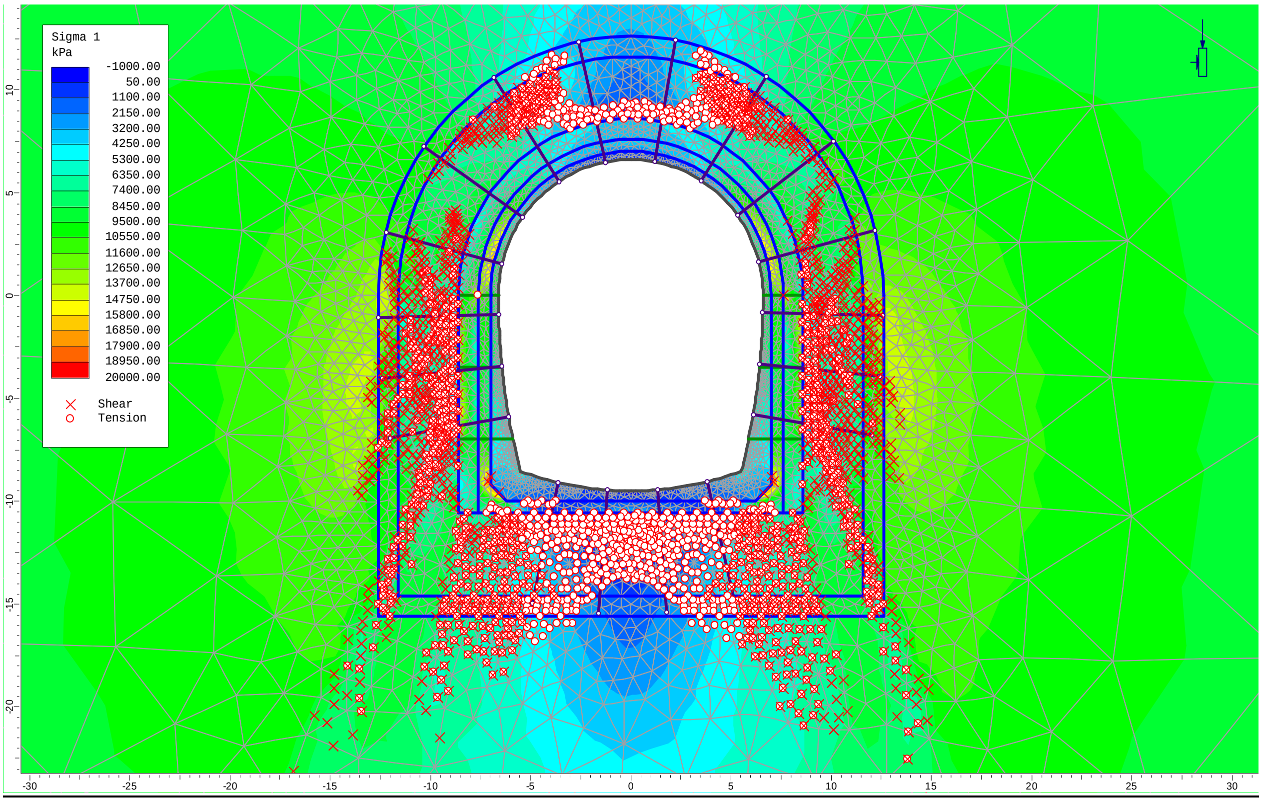
Stage 12 – Long Term Rock Mass Properties



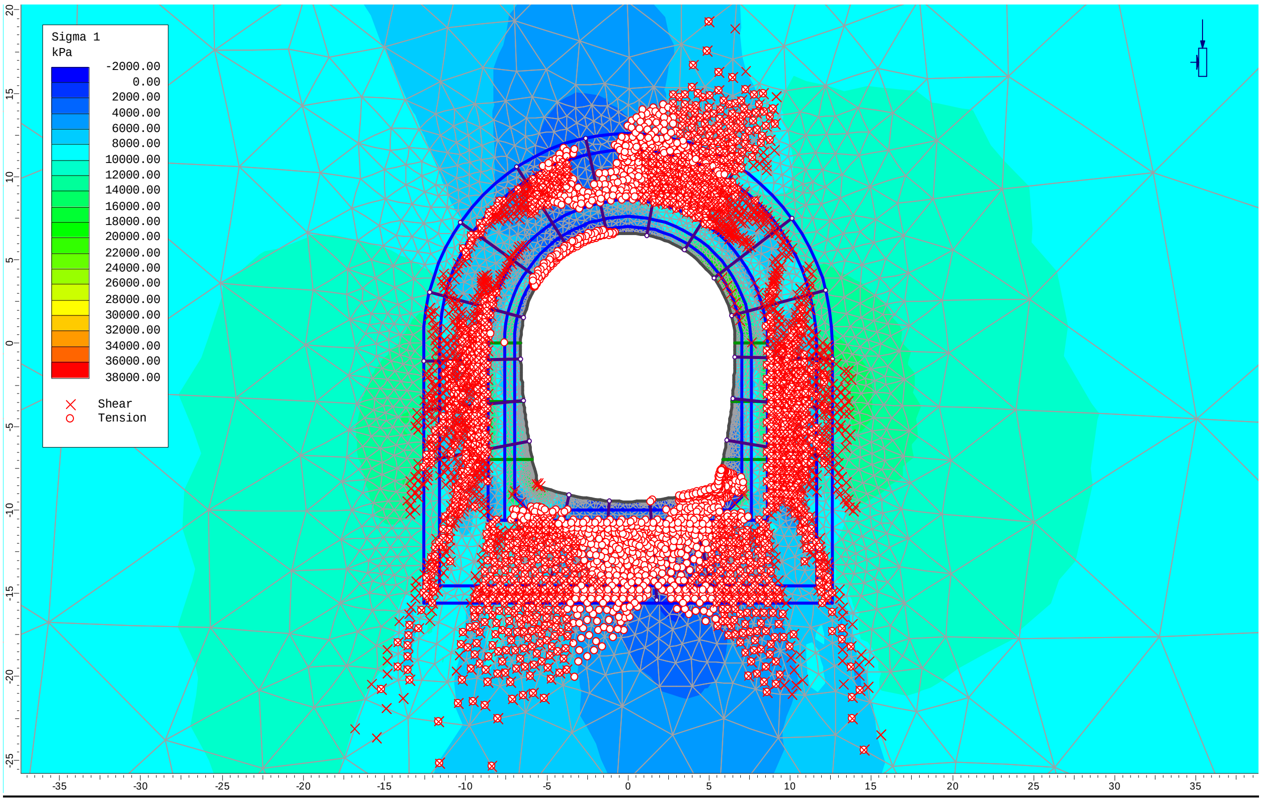
Stage 13 – Installation of new lining and reinforcement



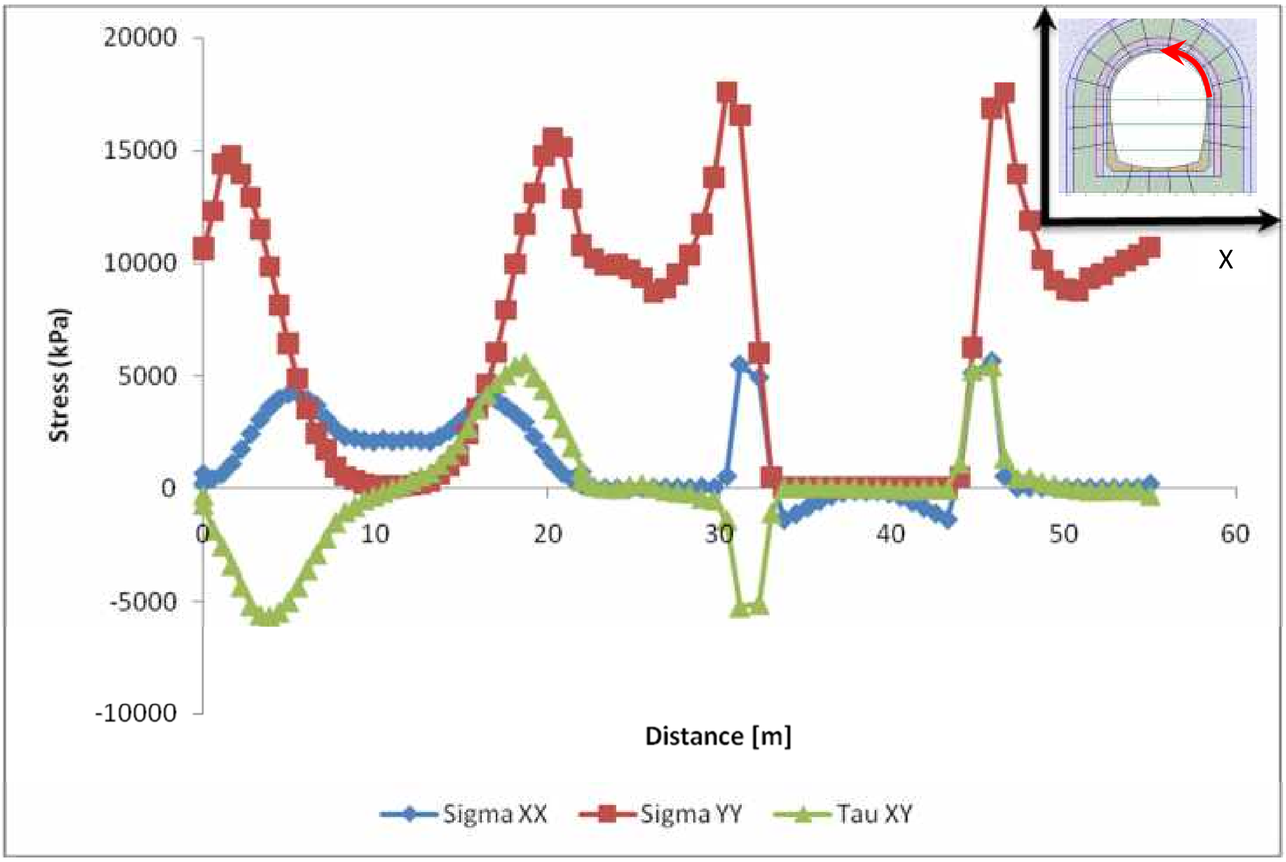
Stage 14 – Application of 200 kPa constant water pressure on new lining



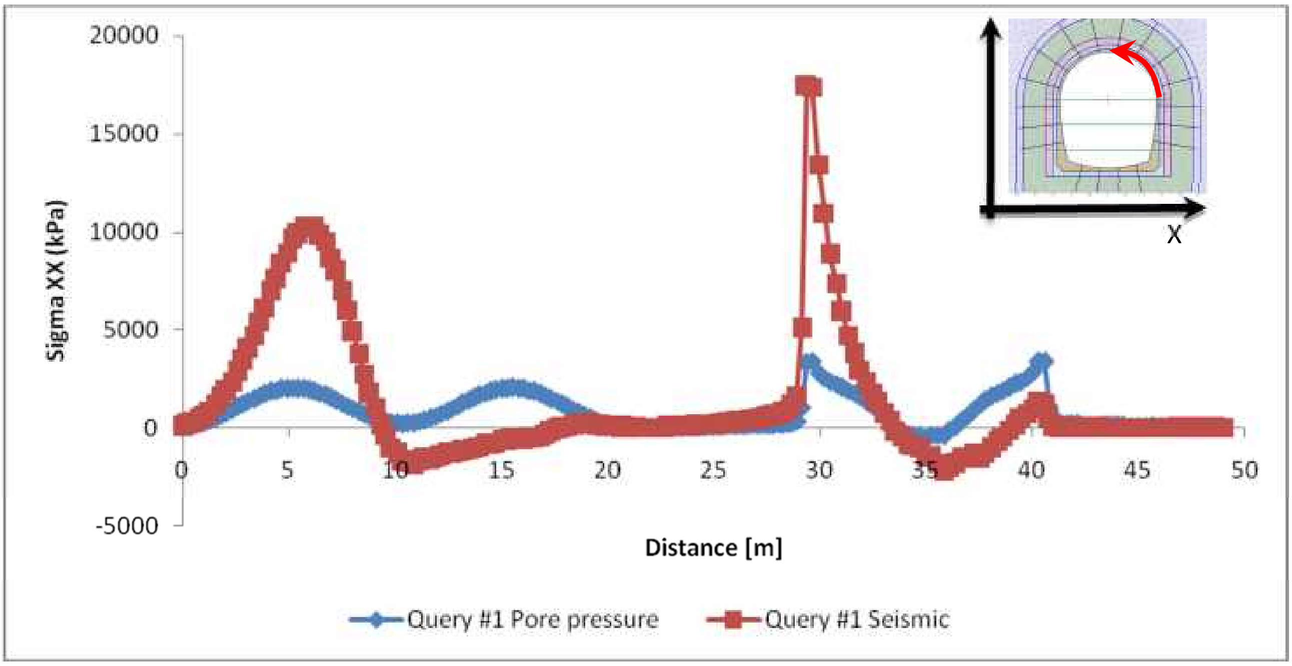
Stage 15 – Seismic Loading



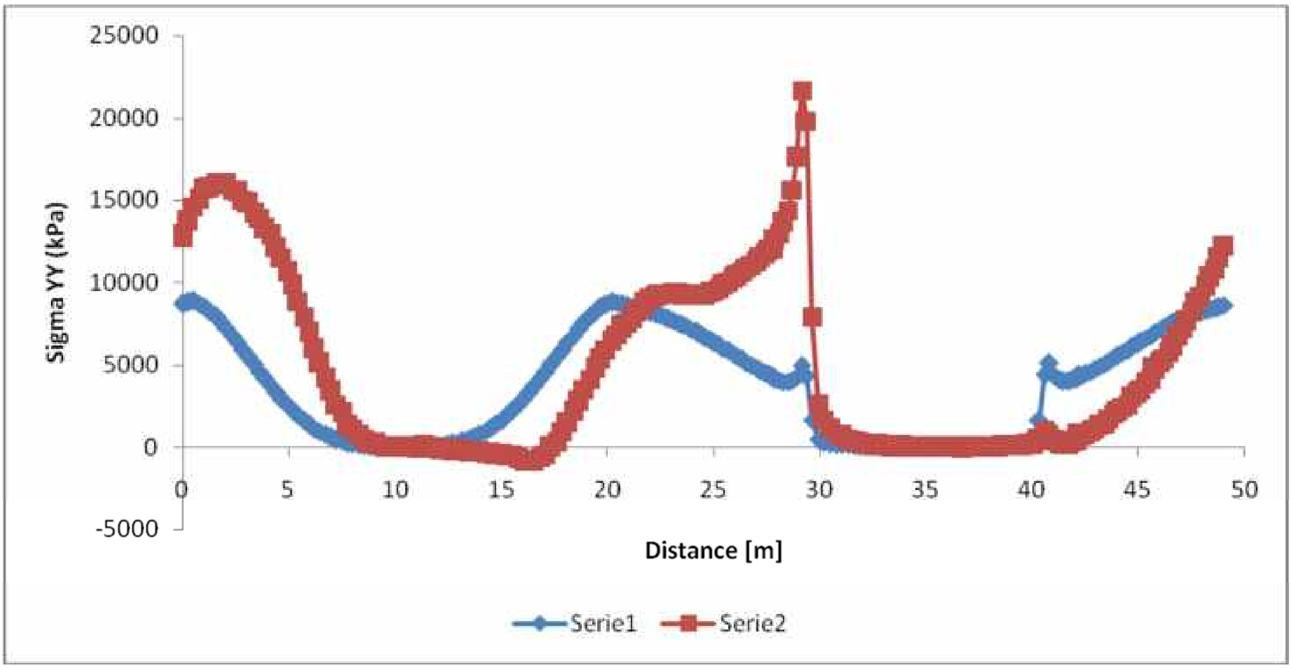
Stresses at the intrados of the existing reinforced concrete lining
(starting from right first point of crown arch, counter clockwise). Long Term Rock Mass Parameters



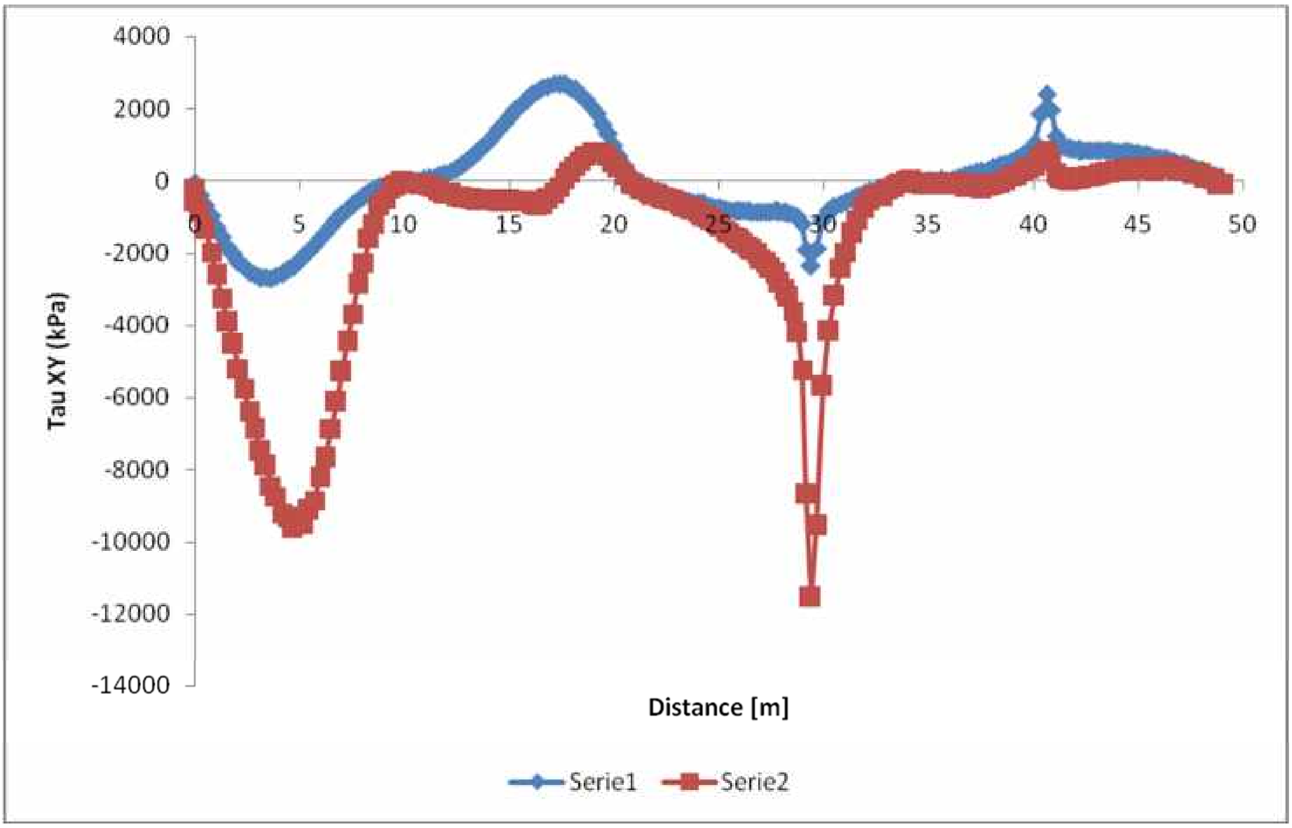
Normal Stress Sigma XX at the intrados of the new lining
(starting from right first point of crown arch, counter clockwise)



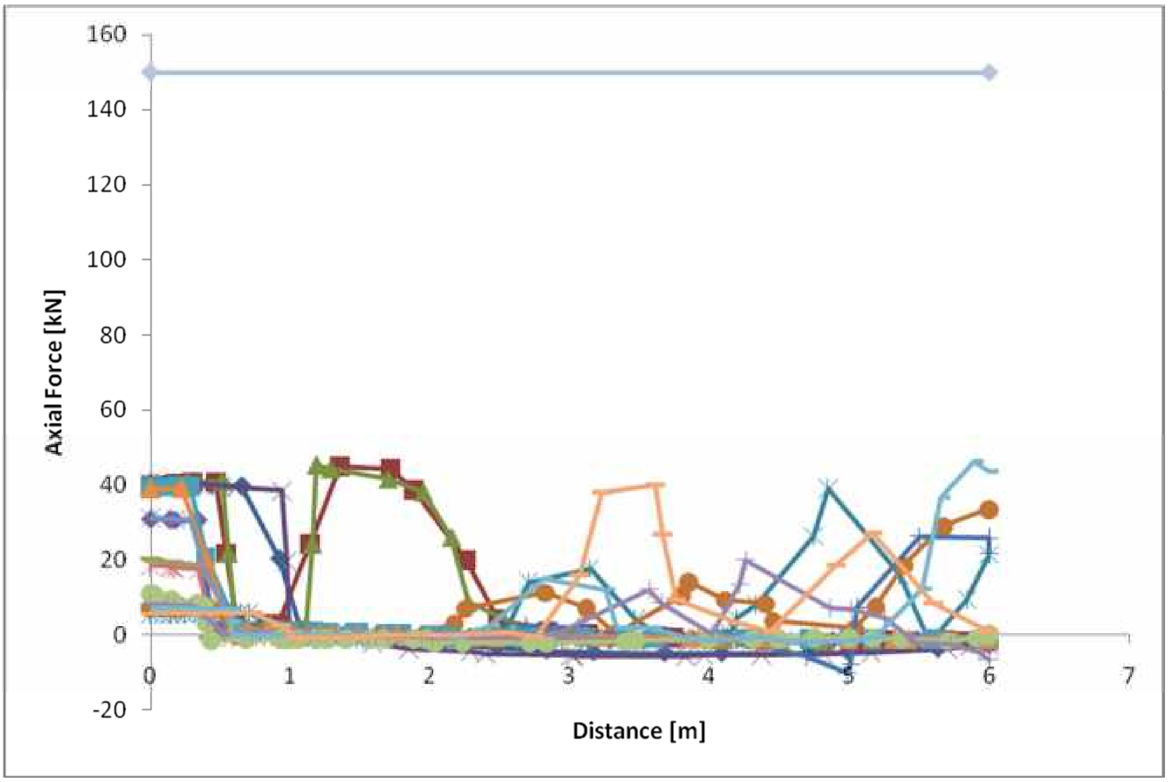
Normal Stress Sigma YY at the intrados of the new lining
(starting from right first point of crown arch, counter clockwise)



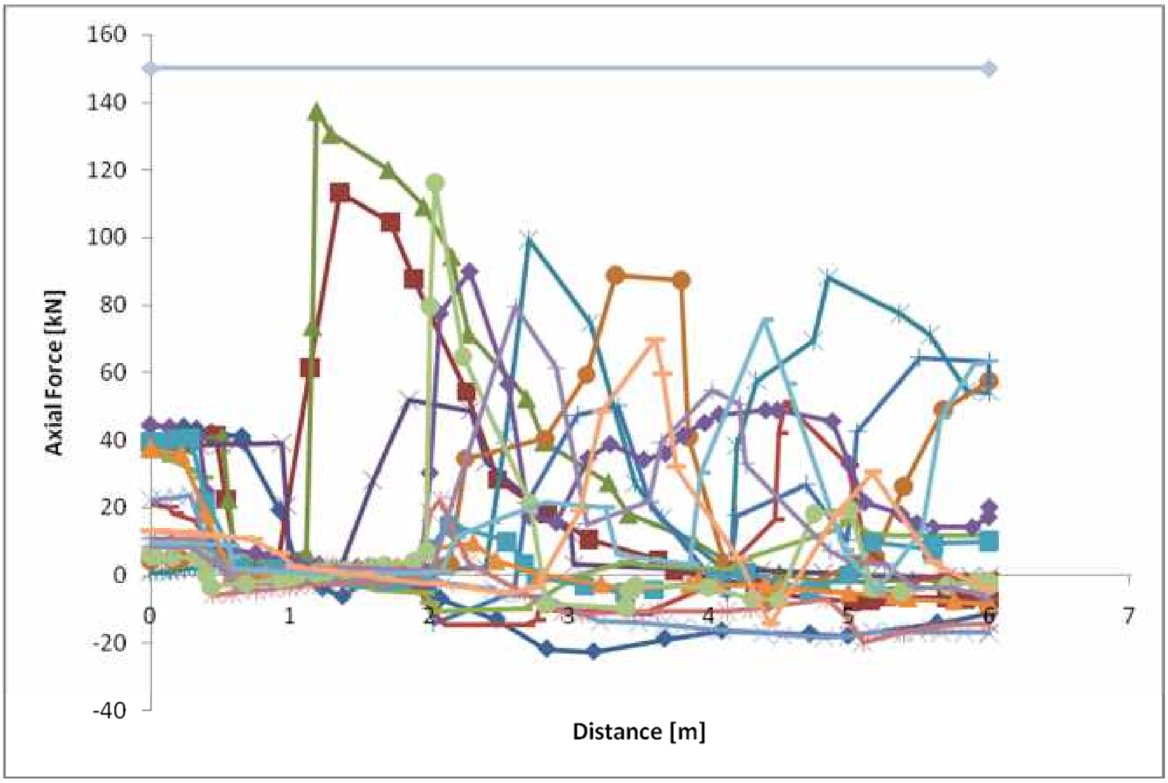
Shear Stress Tau XY at the intrados at the intrados of the new lining
(starting from right first point of crown arch, counter clockwise)



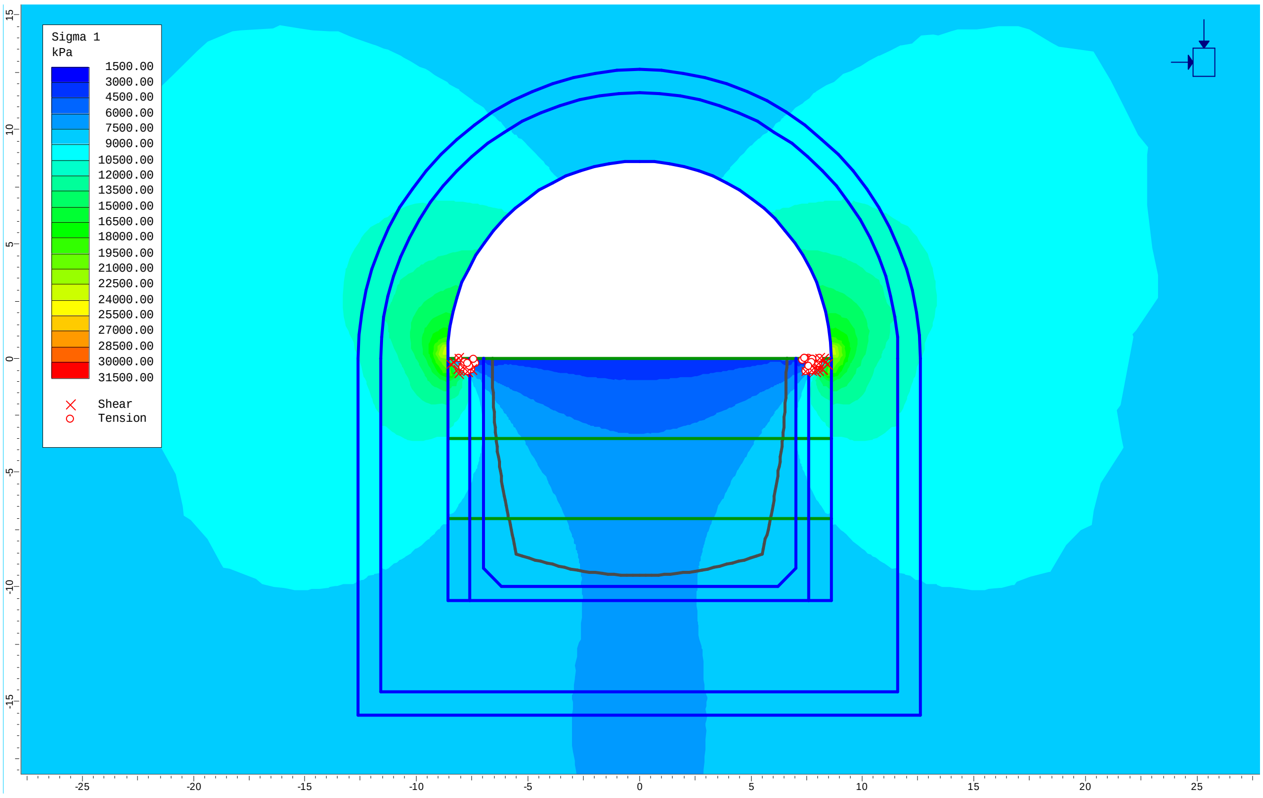
Axial Force in the dowels with 200 kPawater pressure applied



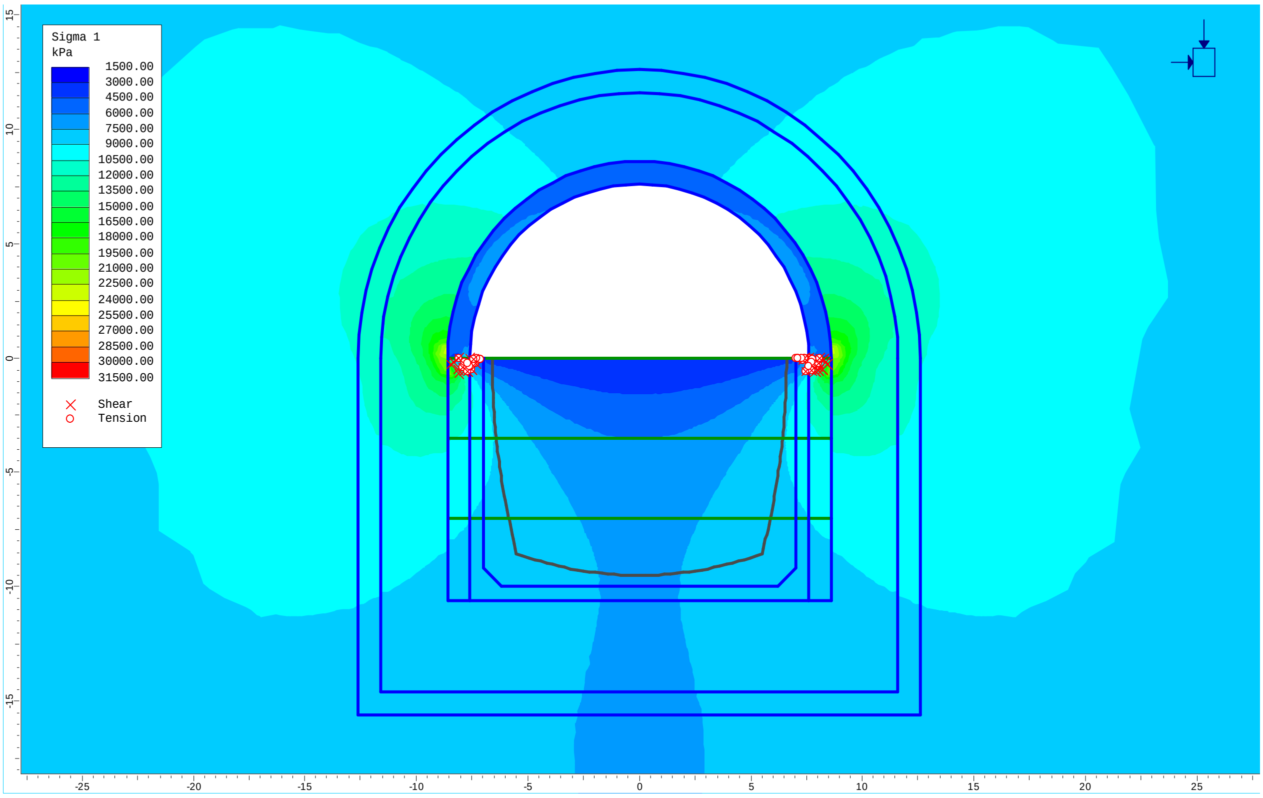
Axial Force in the dowels with seismic loading



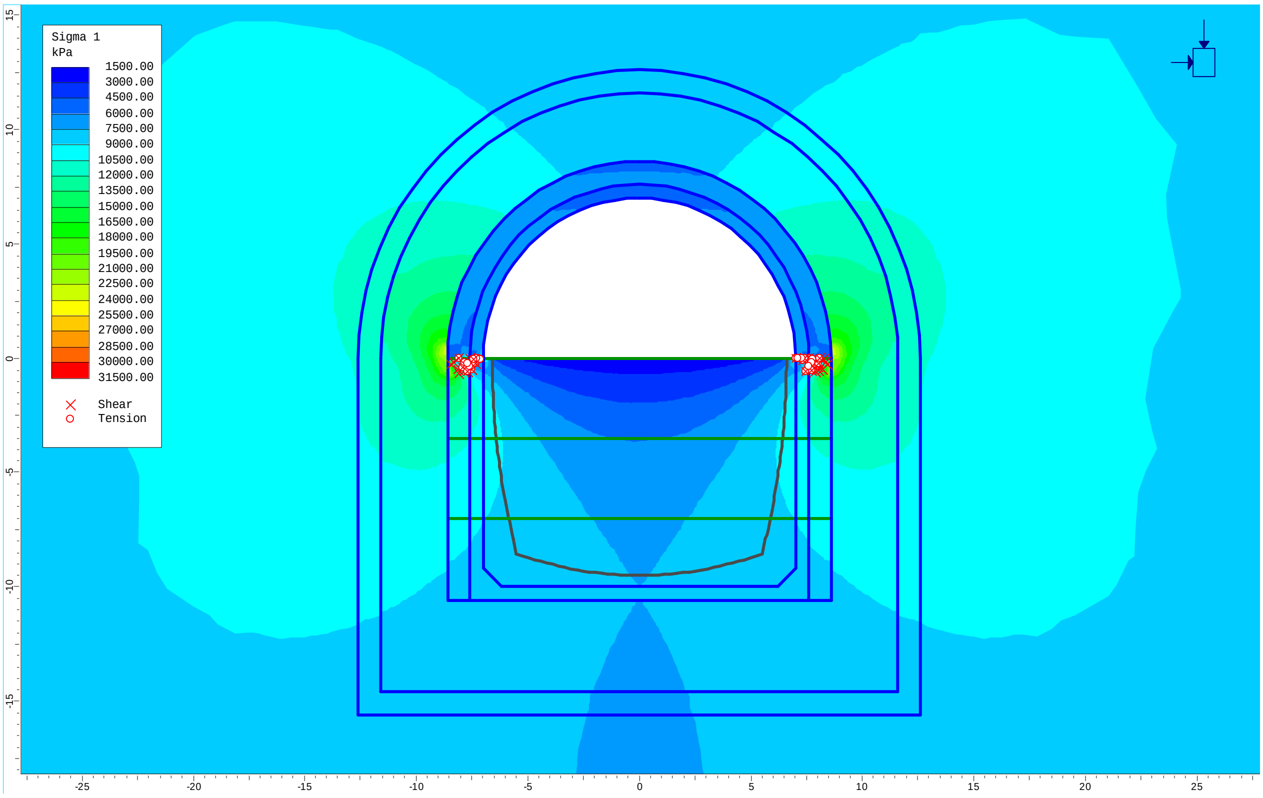
Stage 2 - Crown



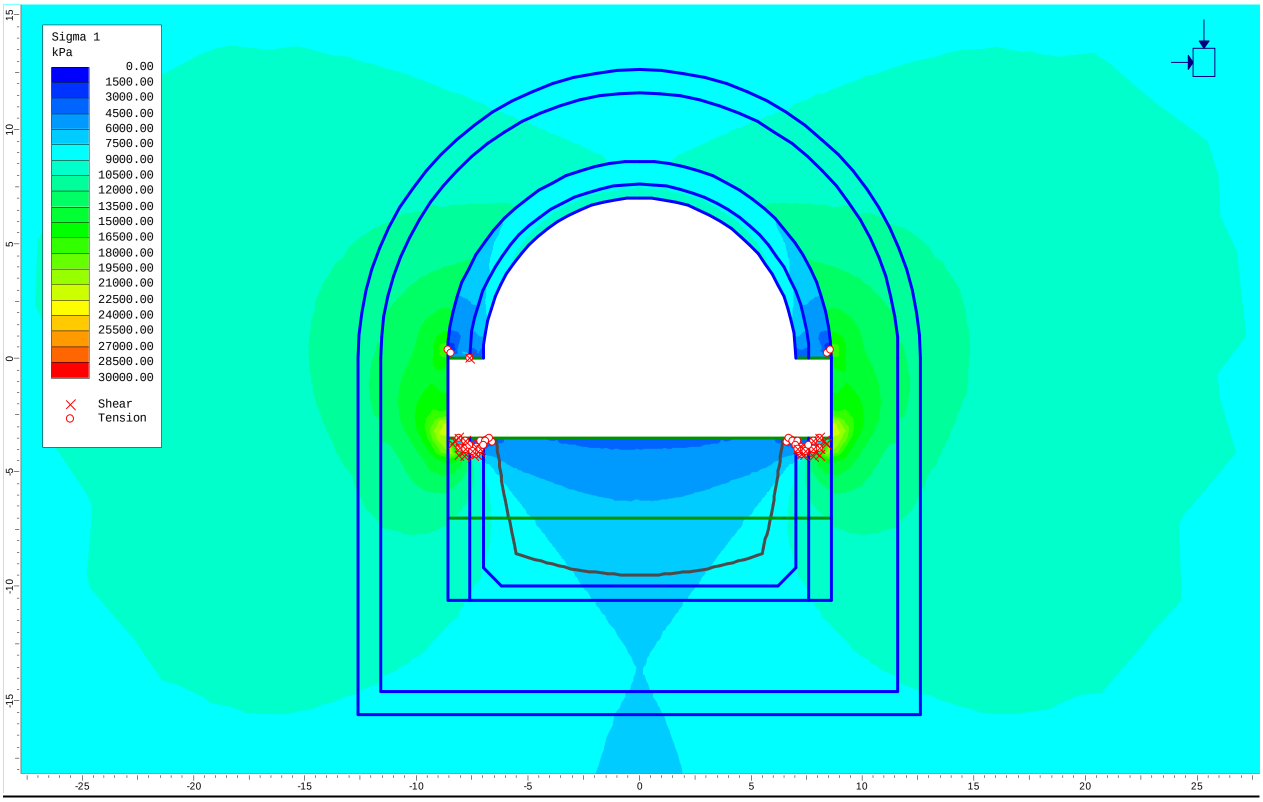
Stage 3 – Crown + Unreinforced concrete



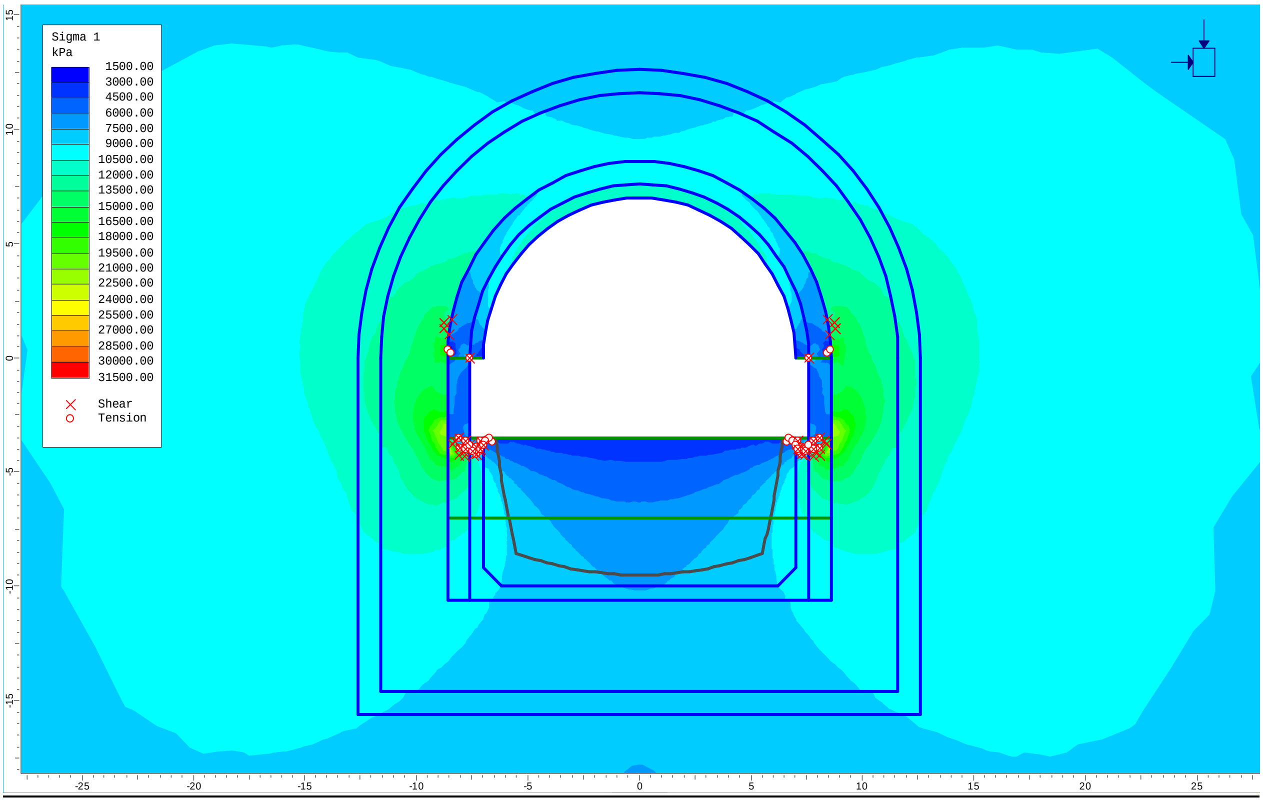
Stage 4 – Crown + Unreinforced and Reinforced concrete



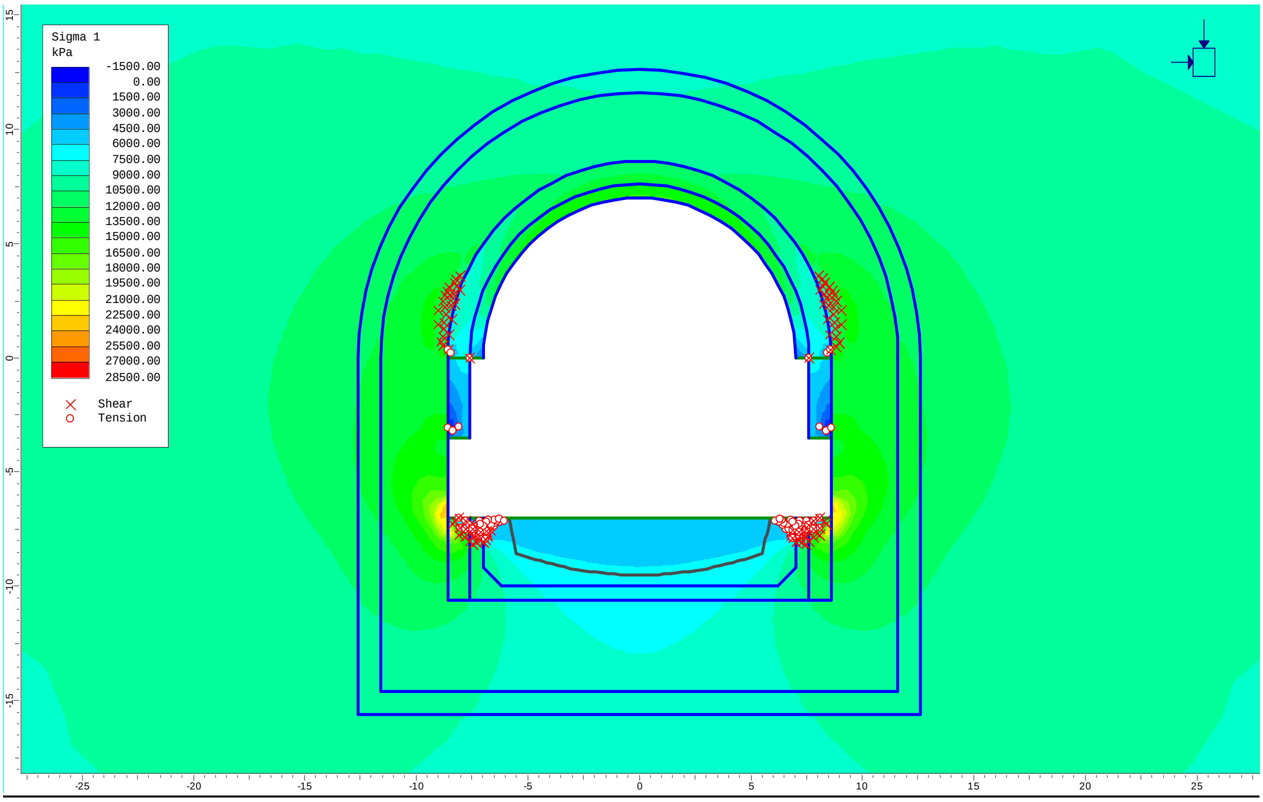
Stage 5 – Bench 1



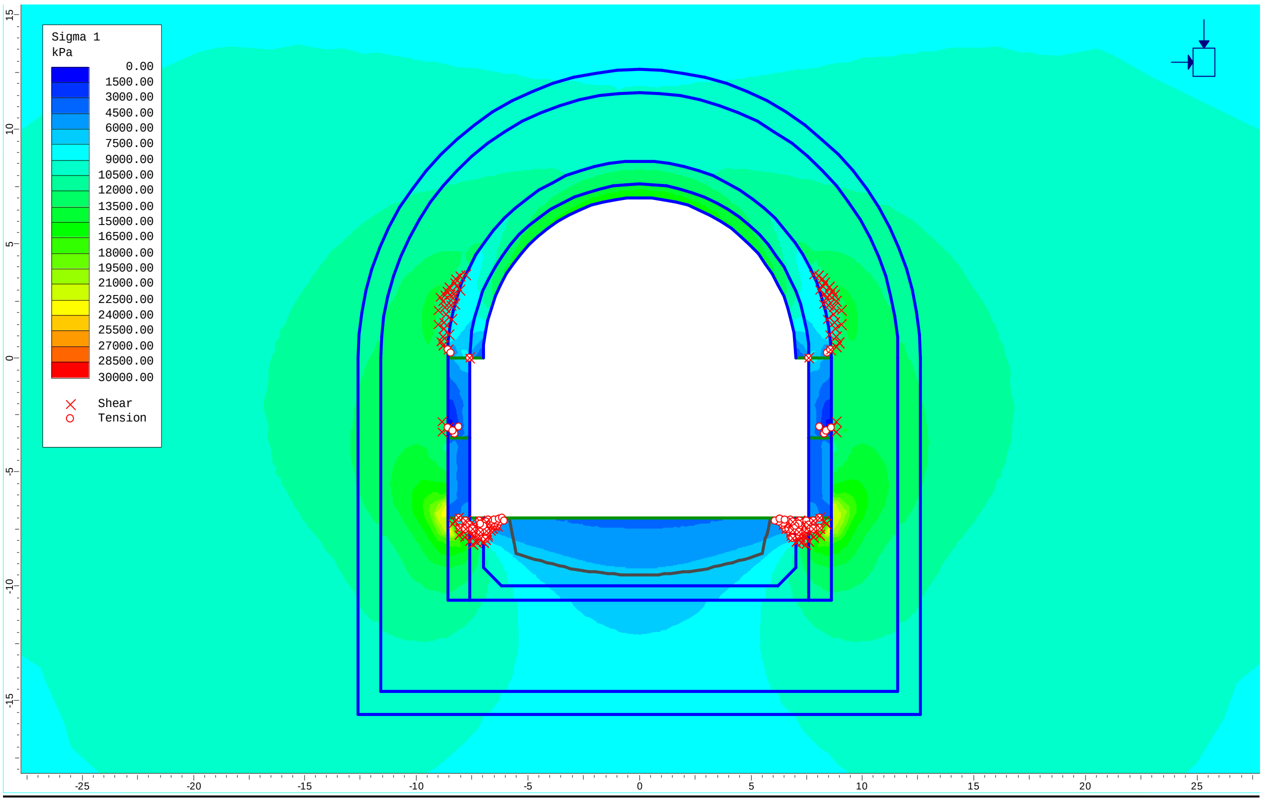
Stage 6 – Bench + Unreinforced concrete



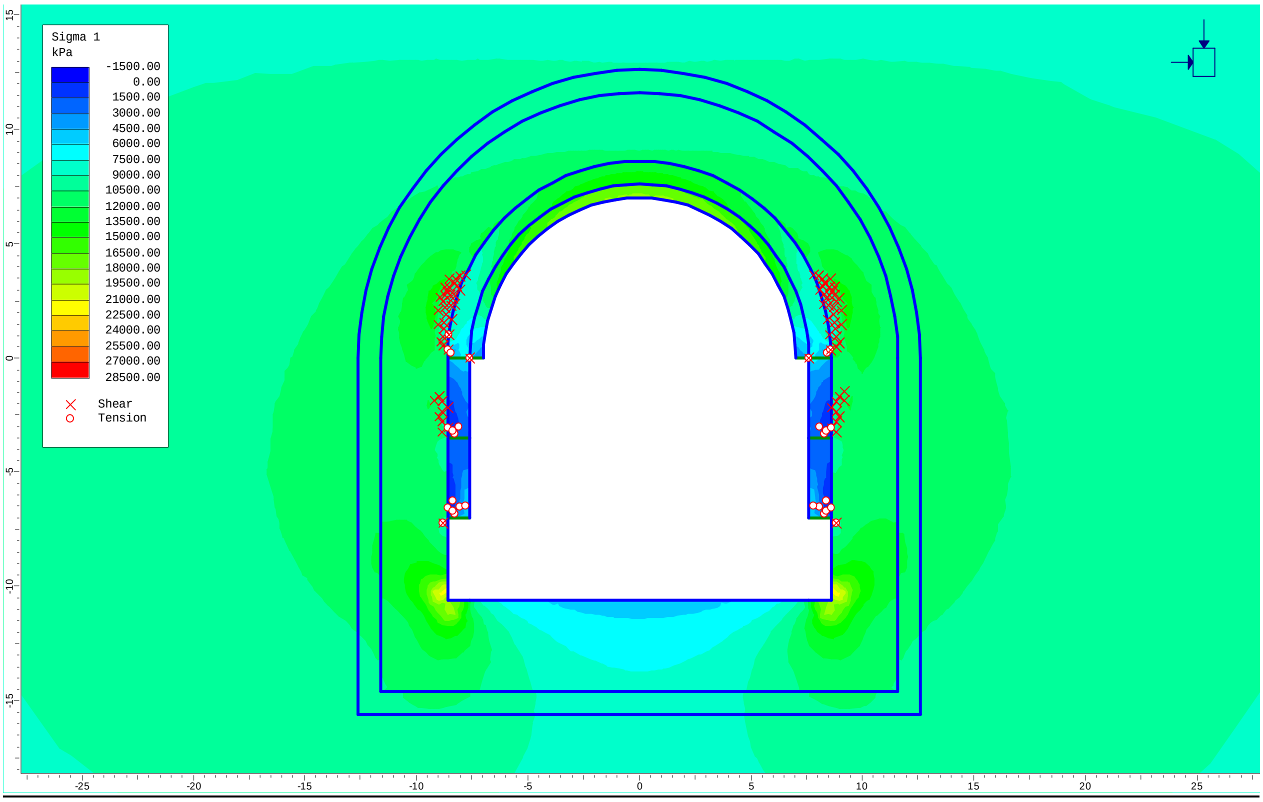
Stage 7 –Bench 2



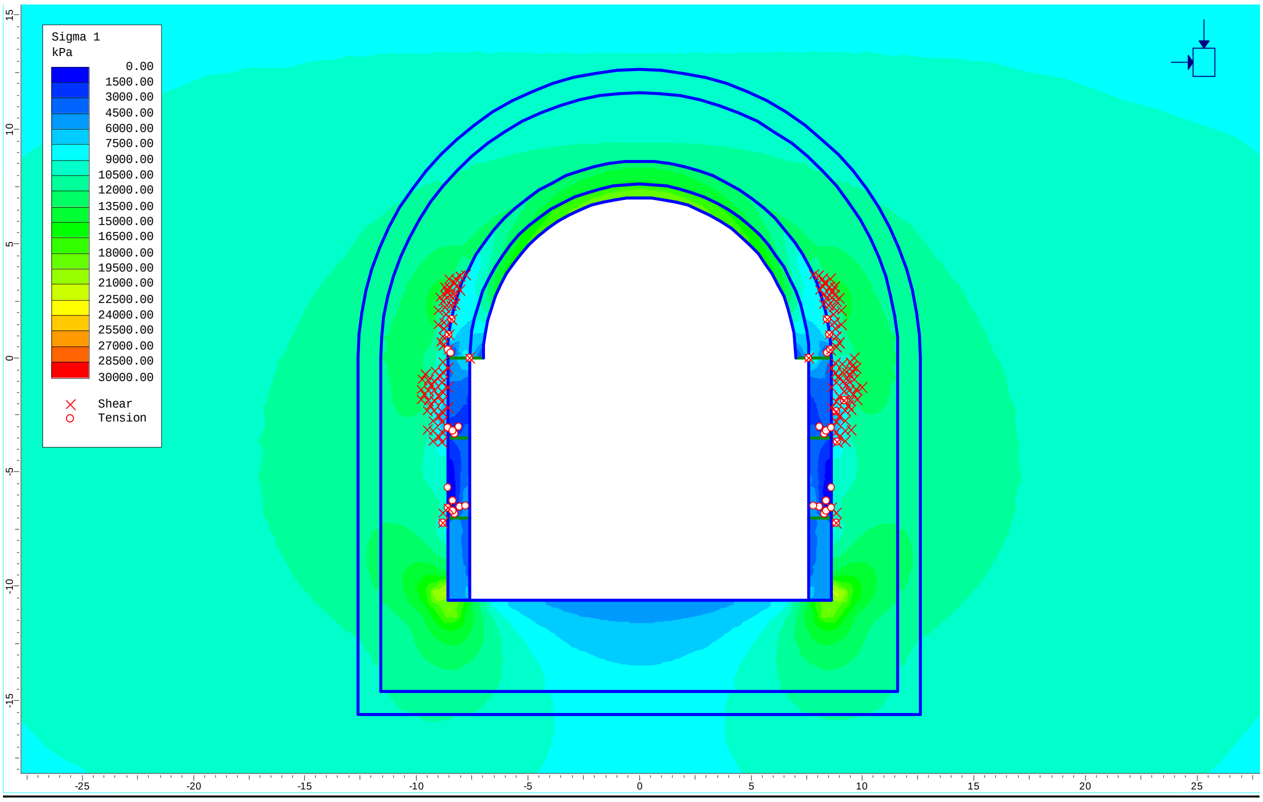
Stage 8 –Bench 2 + Unreinforced concrete



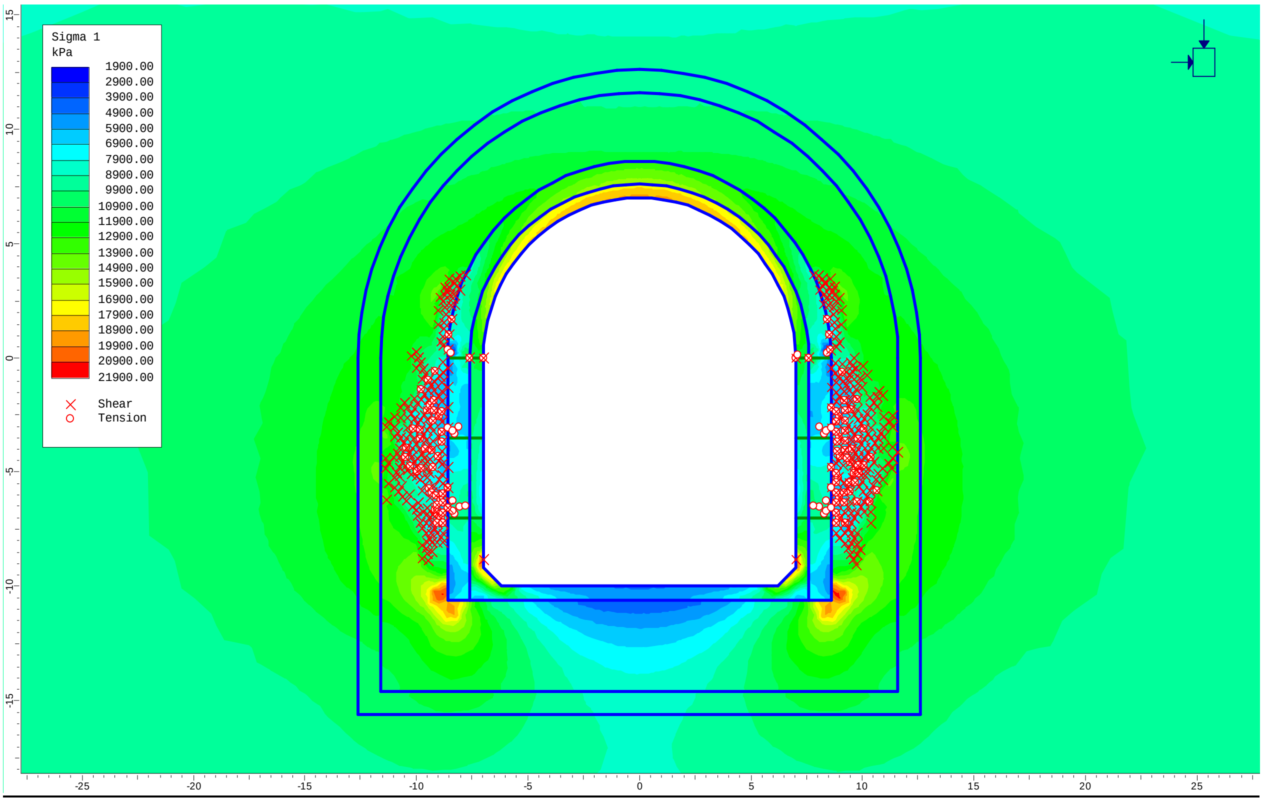
Stage 9 – Bench 3



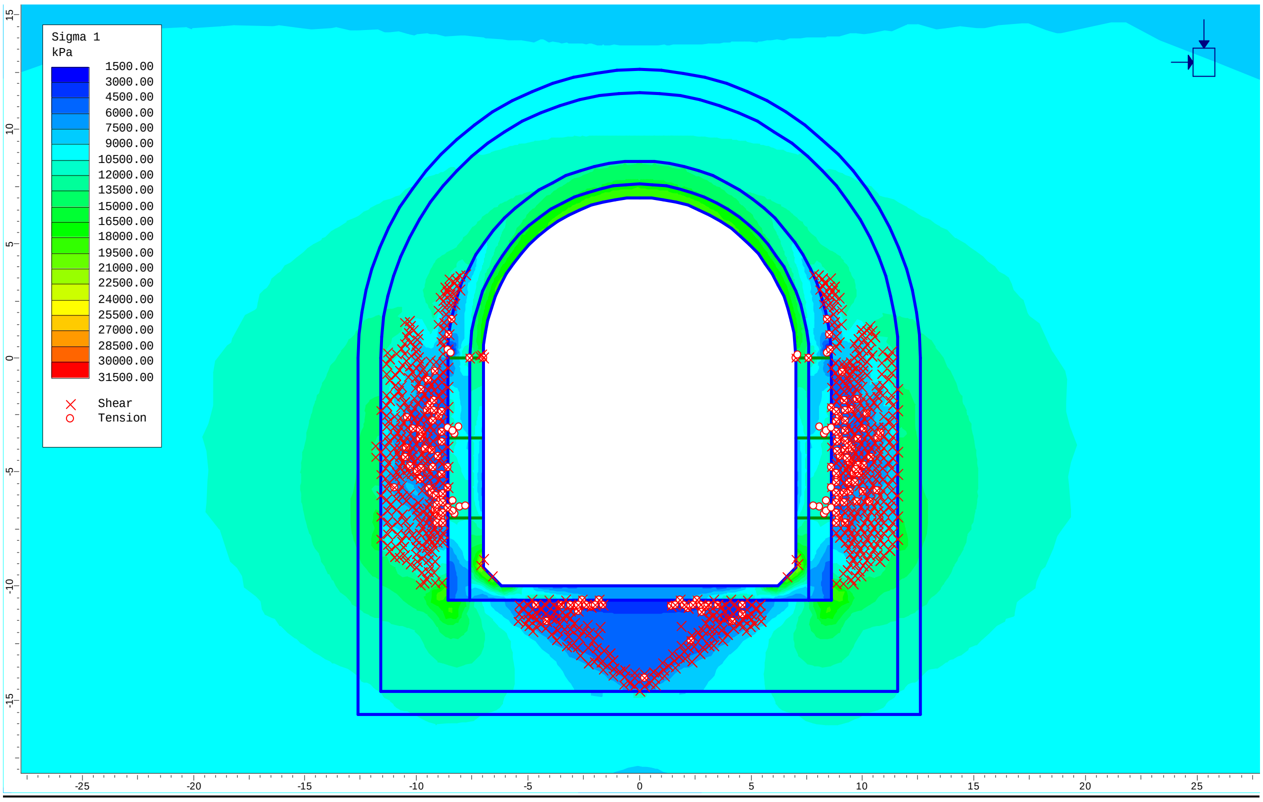
Stage 10 - Bench 3 + Unreinforced concrete



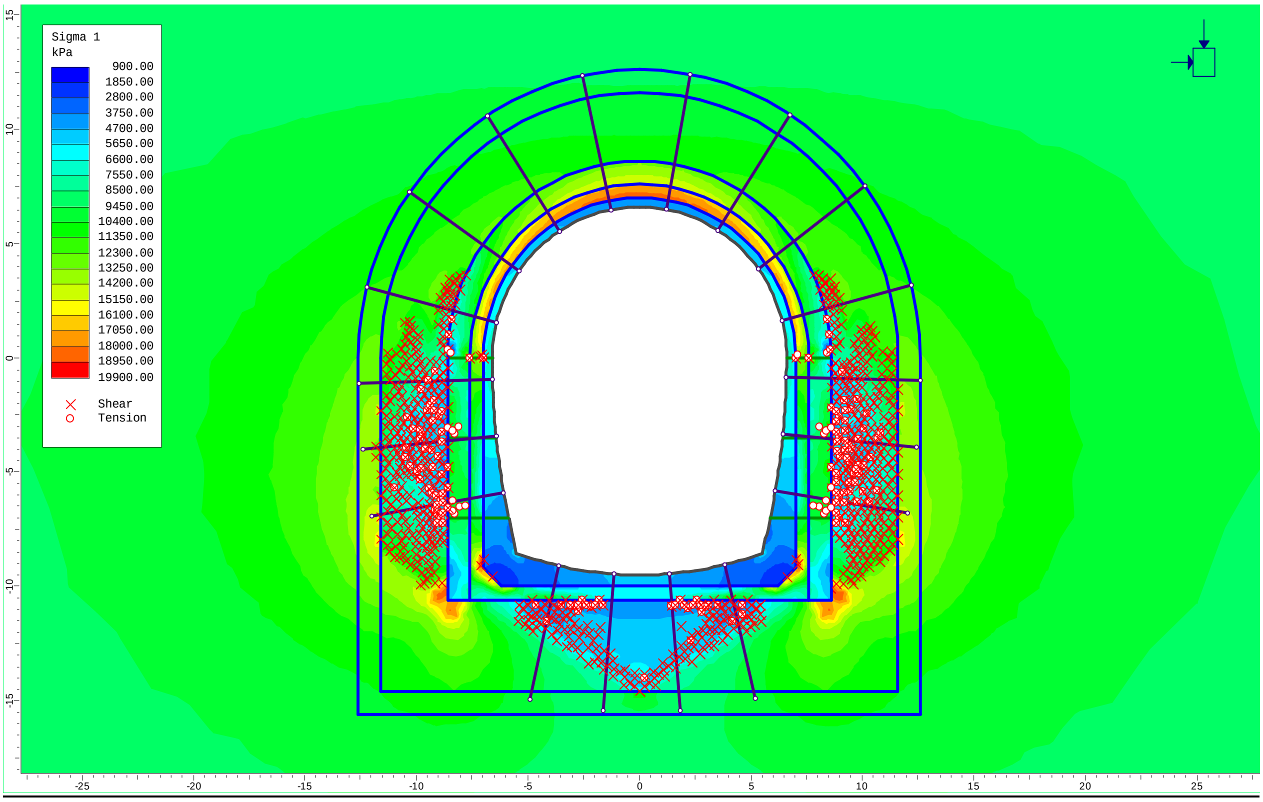
Stage 11 –Reinforced concrete on the sidewalls



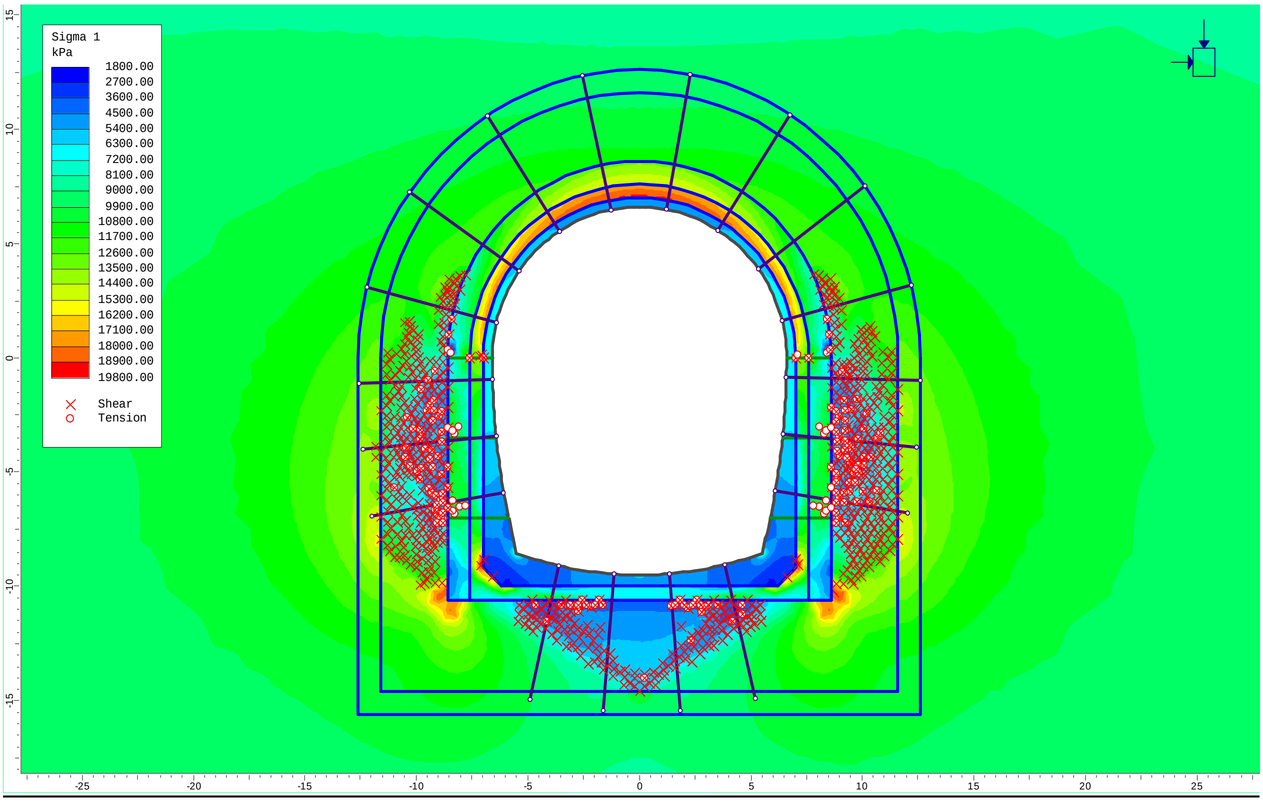
Stage 12 – Long Term Rock Mass Properties



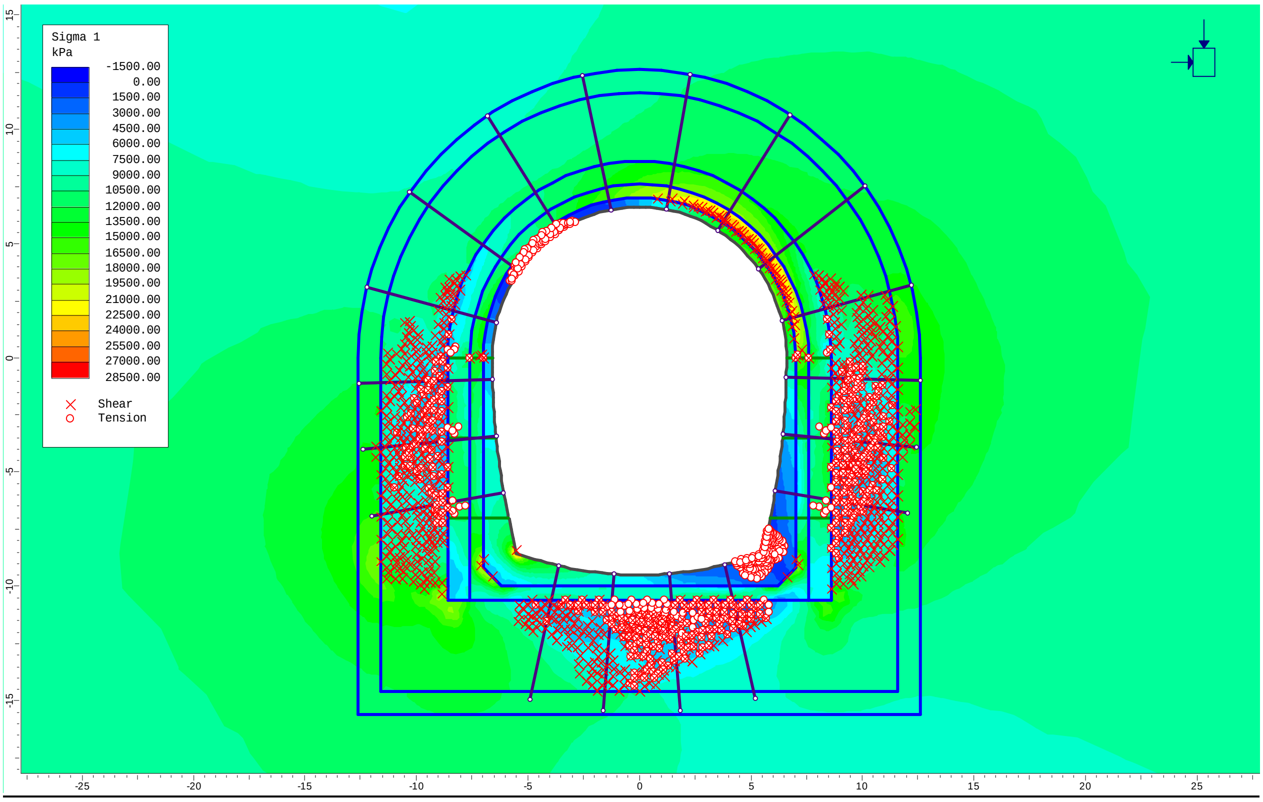
Stage 13 – Installation of new lining and reinforcement



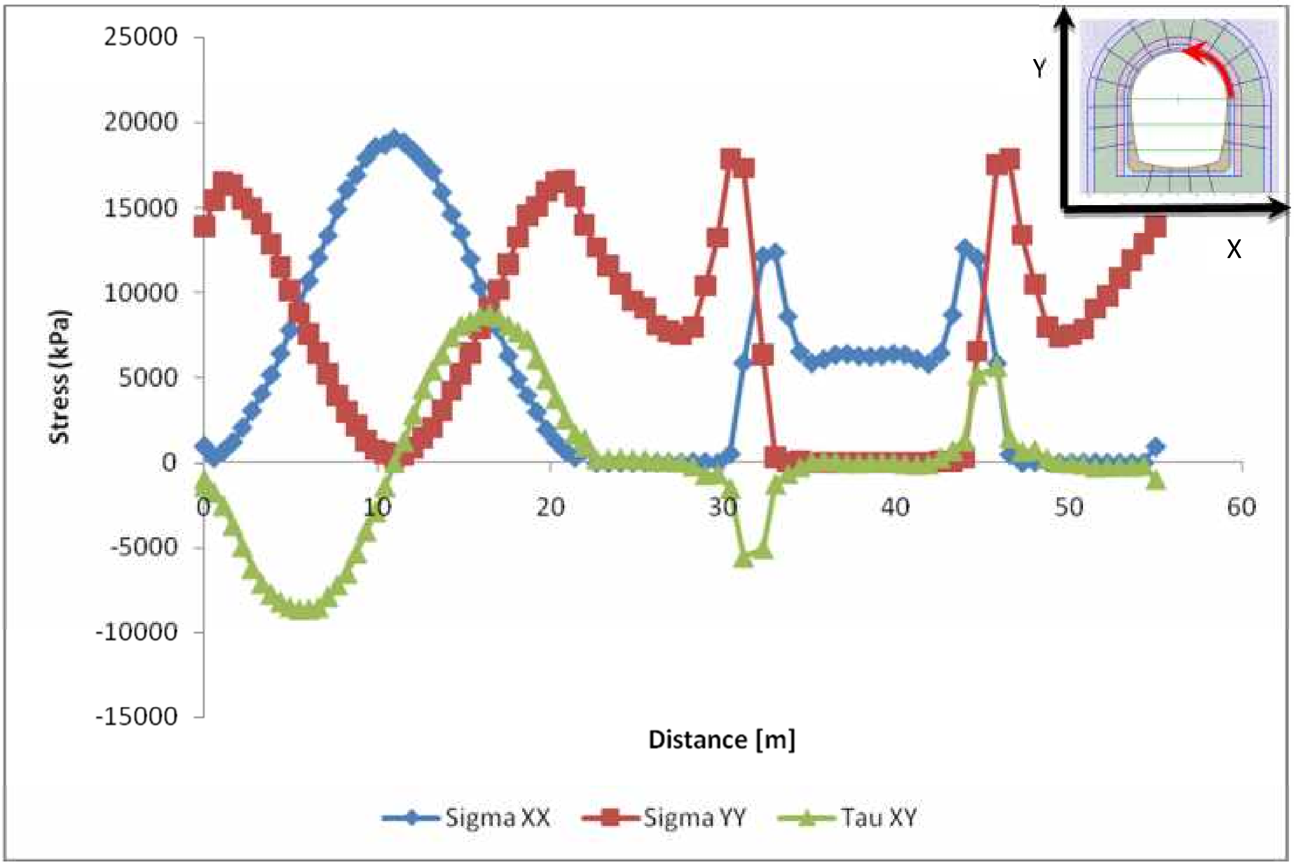
Stage 14 – Application of 200 kPa constant water load on the new lining



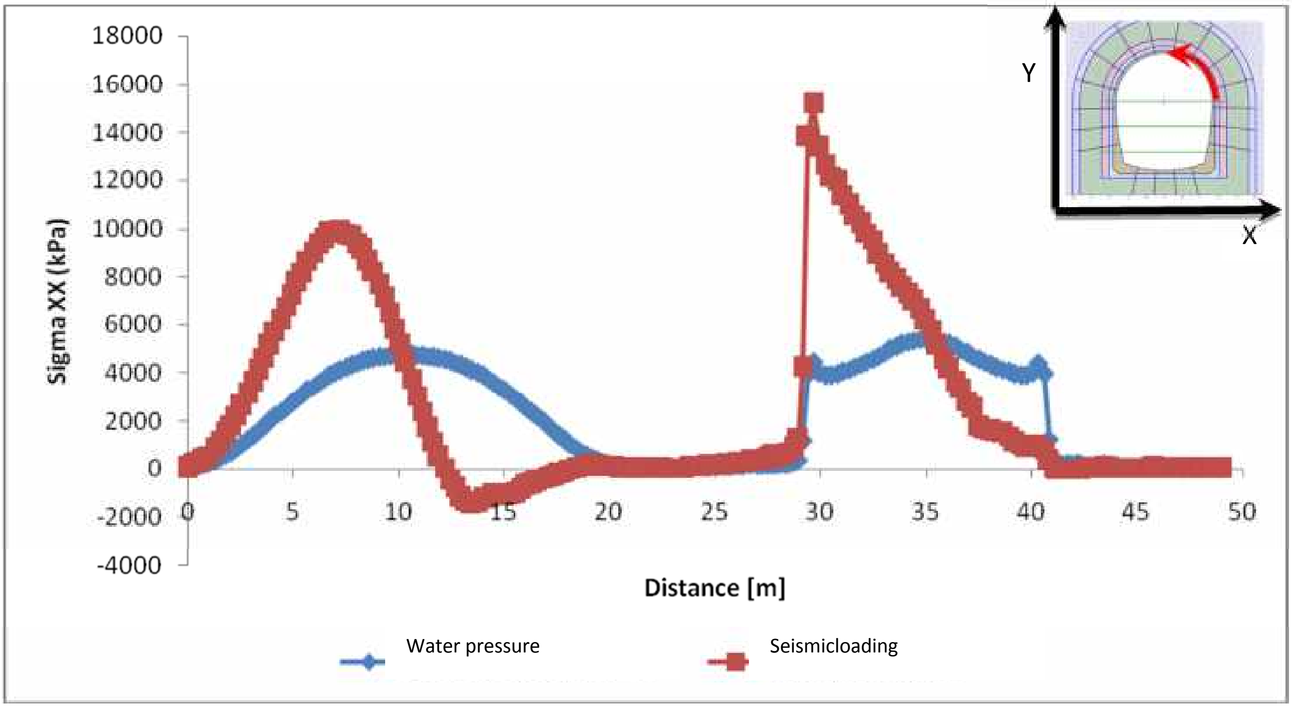
Stage 15 – Seismic Loading



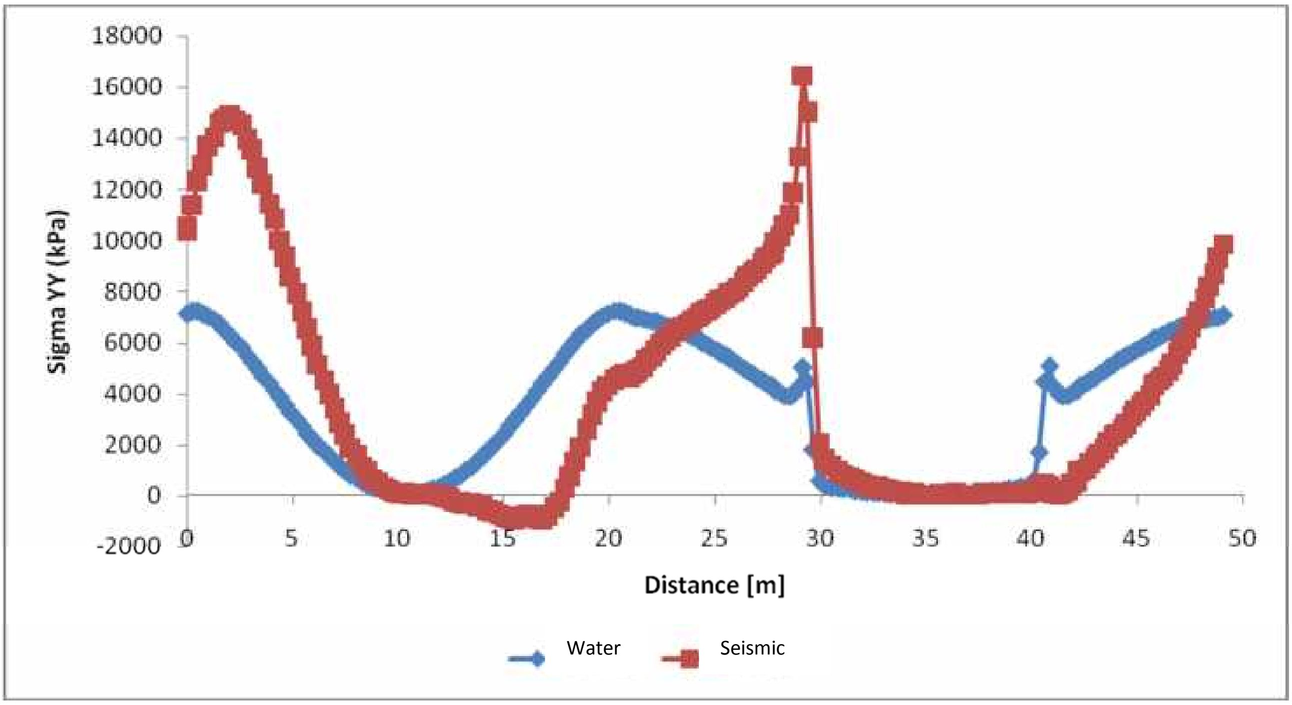
Stresses at the intrados of the existing reinforced concrete lining
(starting from right first point of crown arch, counter clockwise). Long Term Rock Mass Parameters



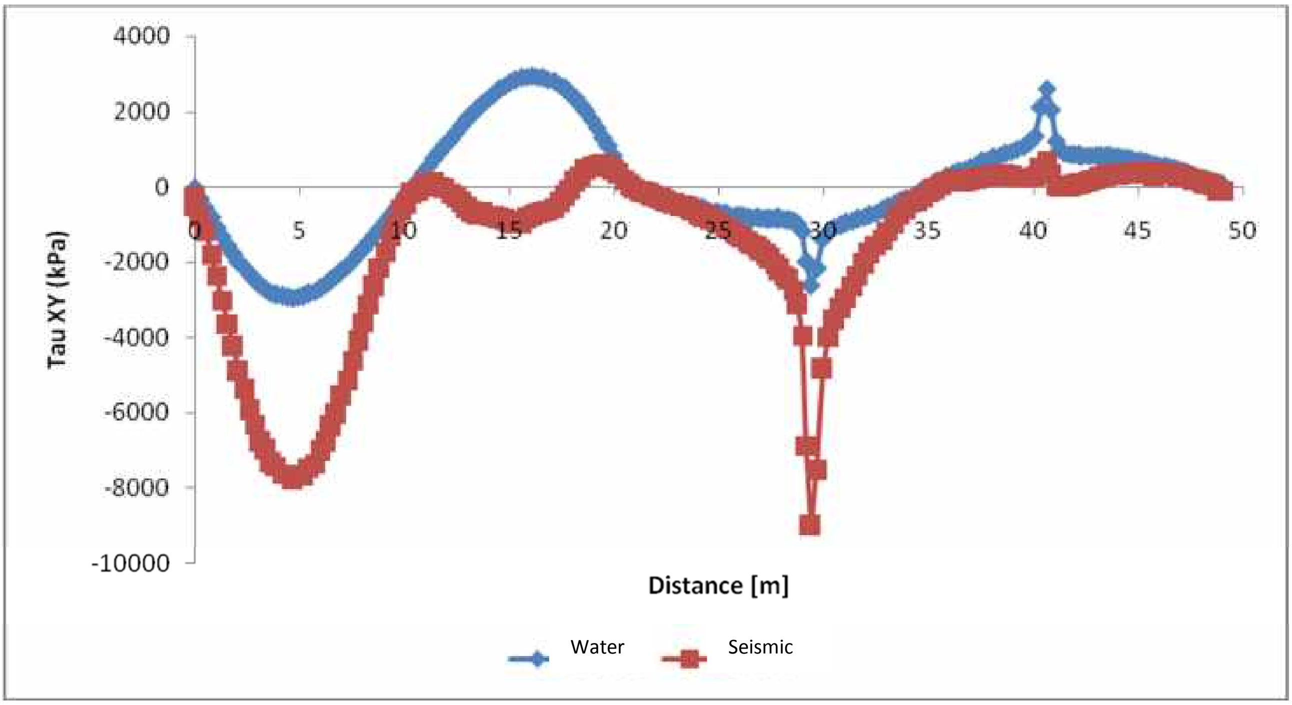
Normal Stress Sigma XX at the intrados of the new lining
(starting from right first point of crown arch, counter clockwise)



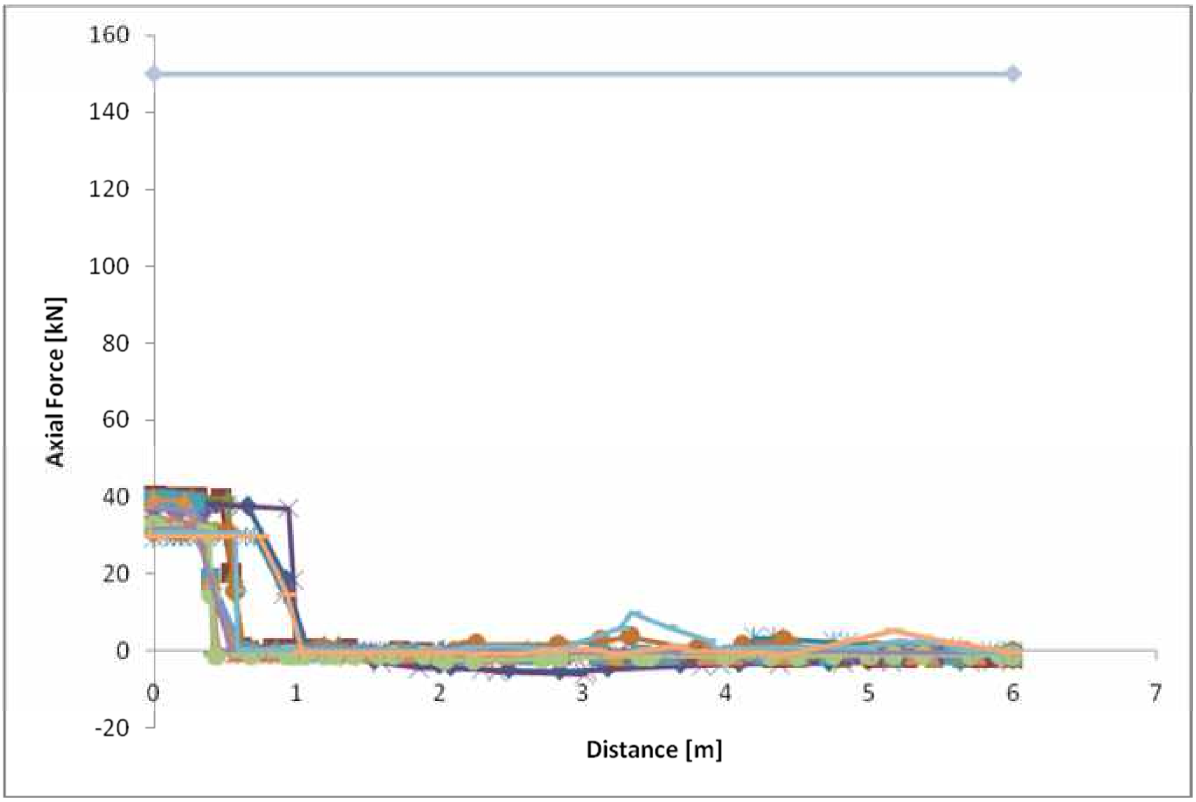
Normal Stress Sigma YY at the intrados of the new lining
(starting from right first point of crown arch, counter clockwise)



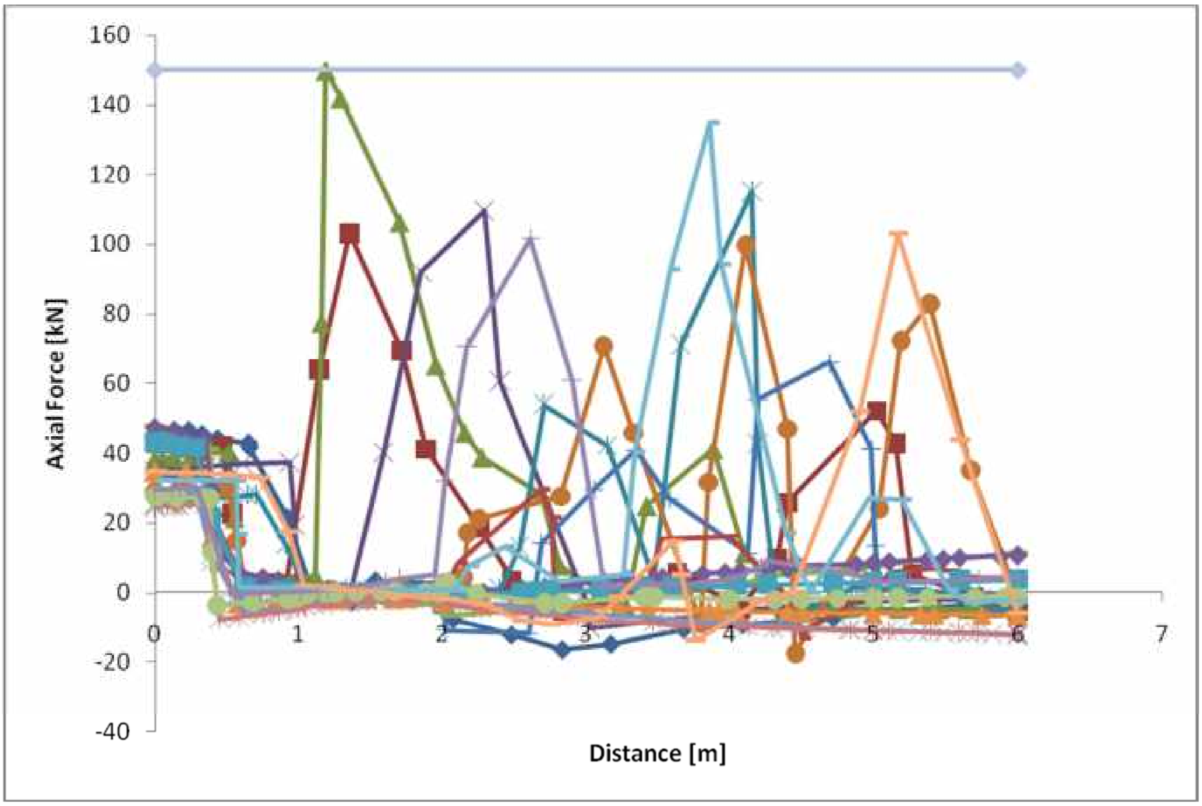
Shear Stress Tau XY at the intrados at the intrados of the new lining
(starting from right first point of crown arch, counter clockwise)



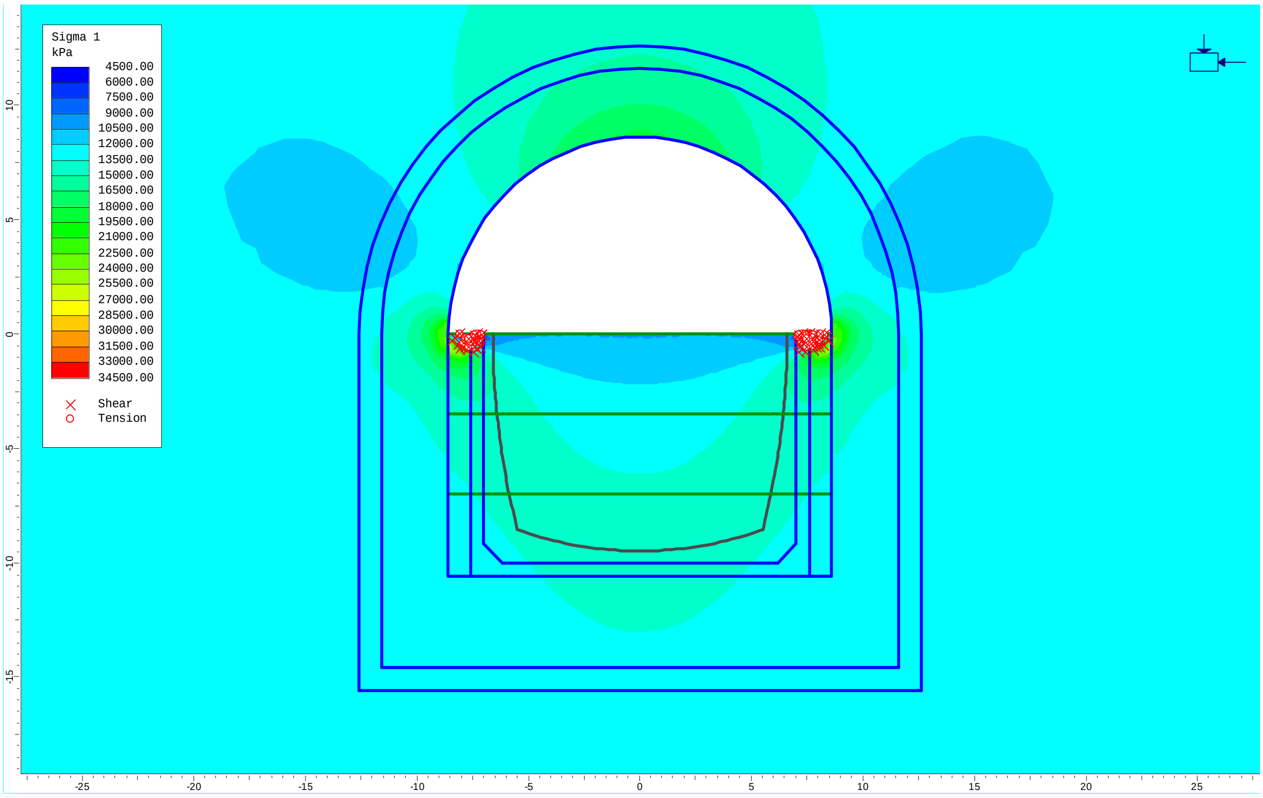
Axial Force in the dowels with 200 kPawater pressure applied



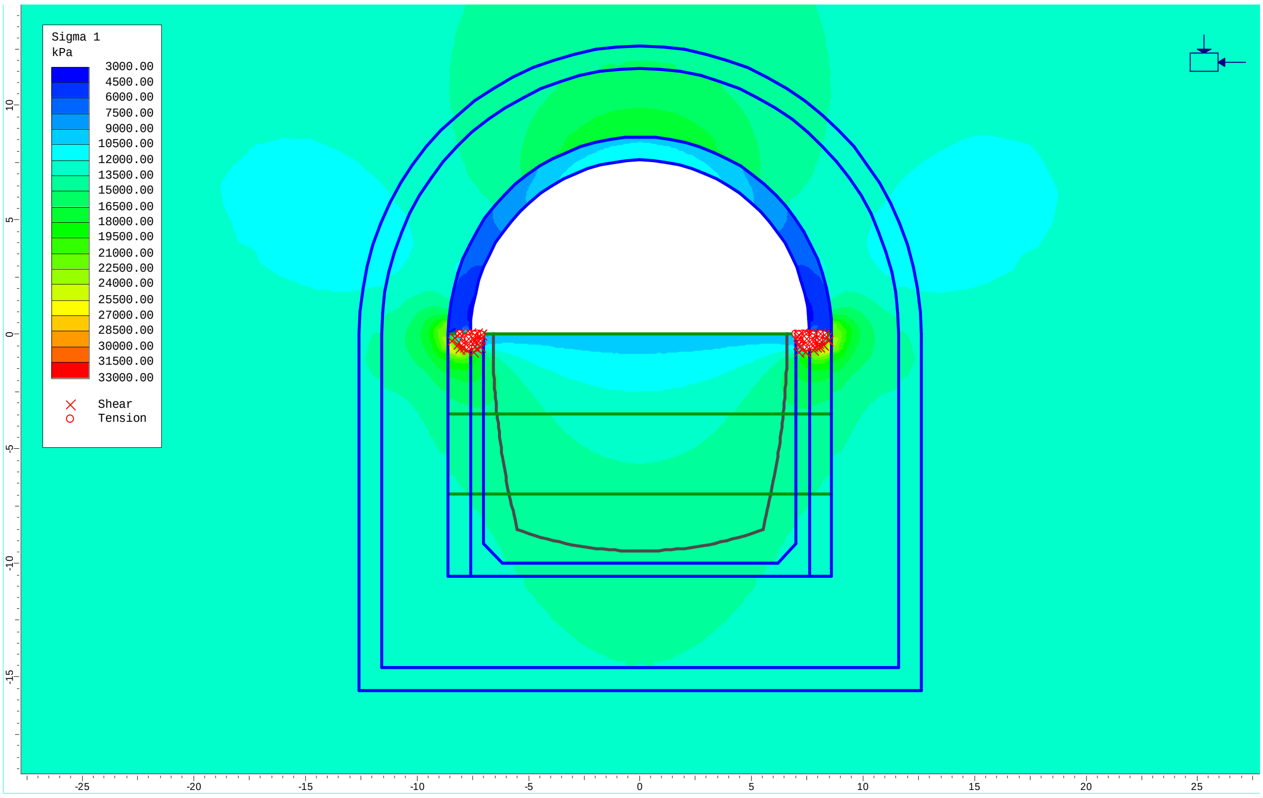
Axial Force in the dowels with seismic loading



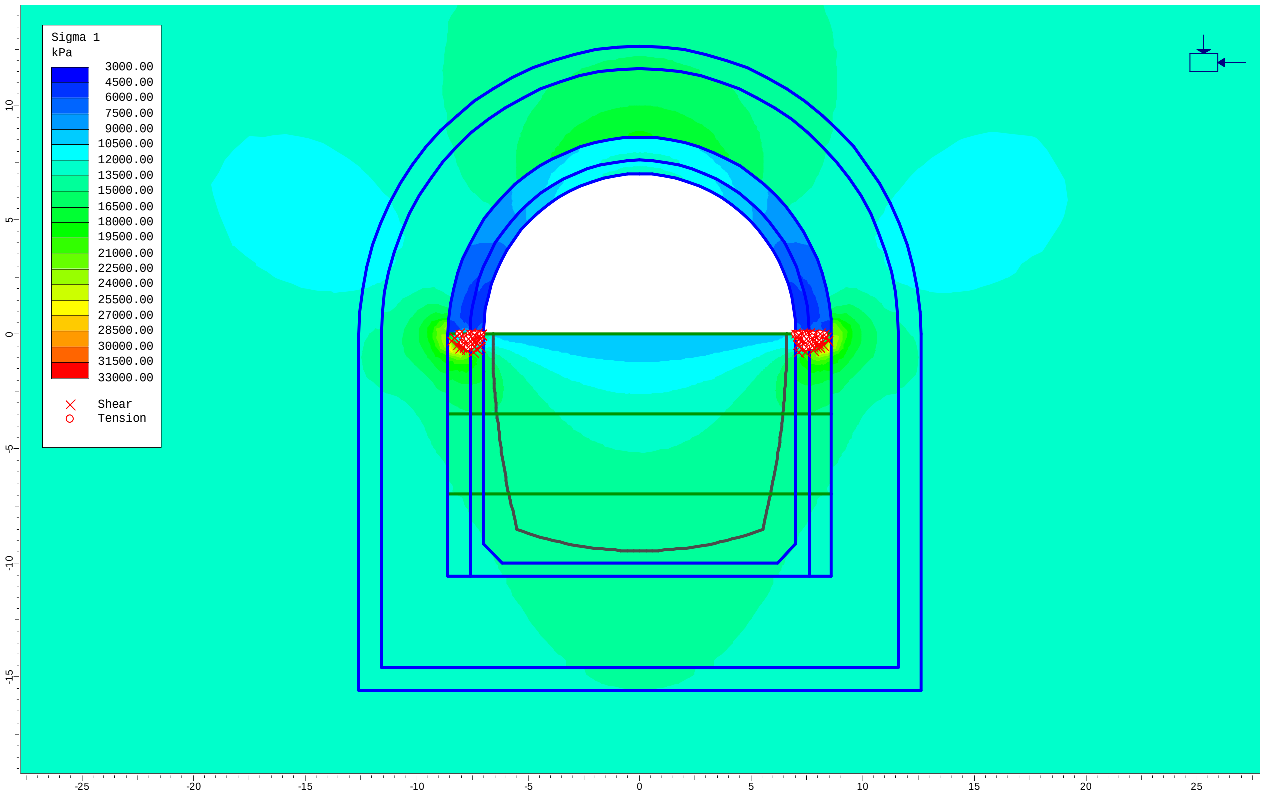
Stage 2 - Crown



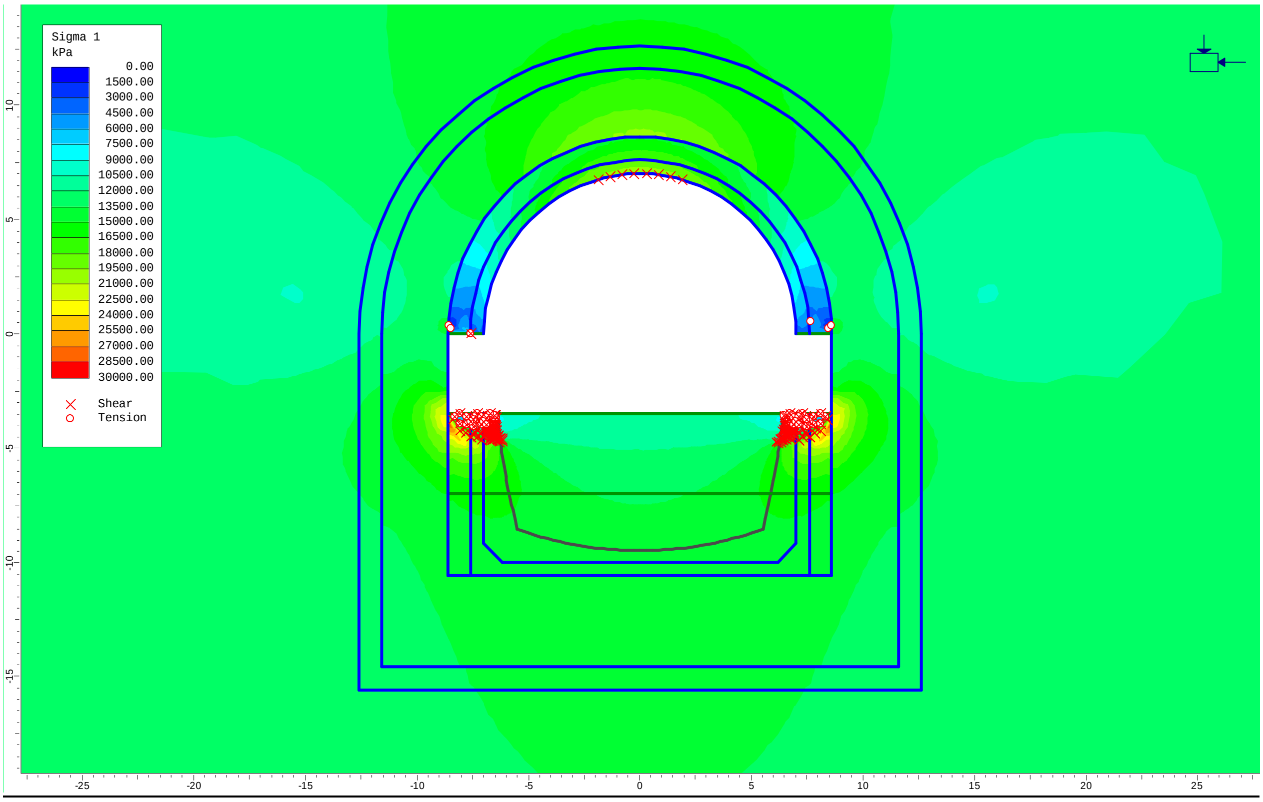
Stage 3 – Crown + Unreinforced concrete



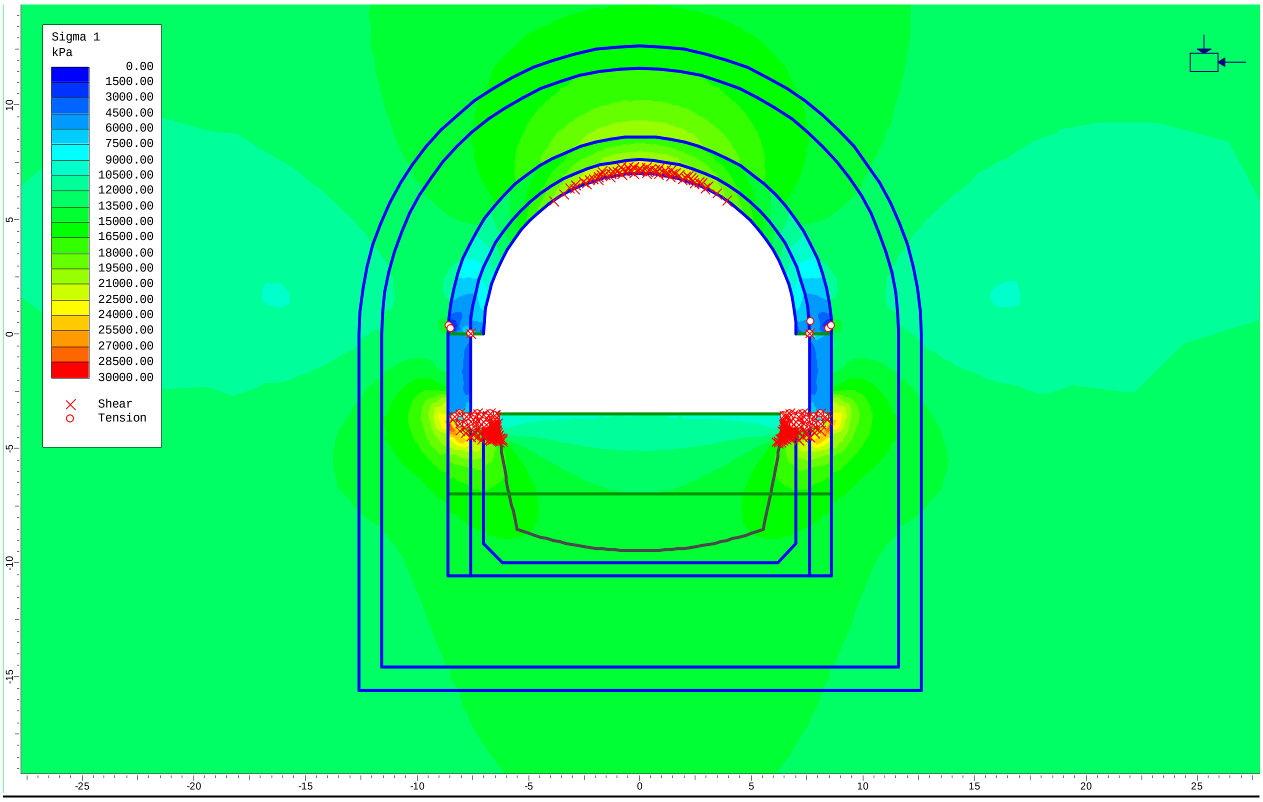
Stage 4 – Crown + Unreinforced and Reinforced concrete



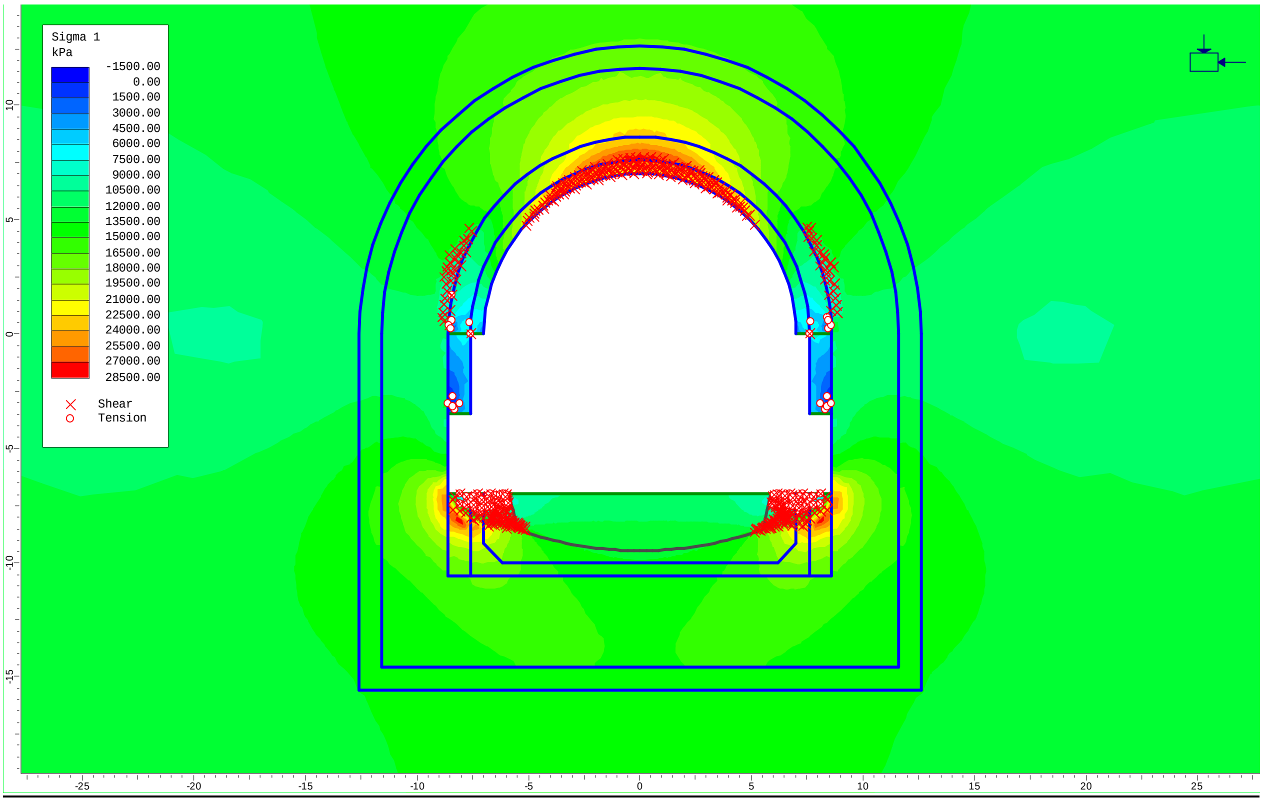
Stage 5 – Bench 1



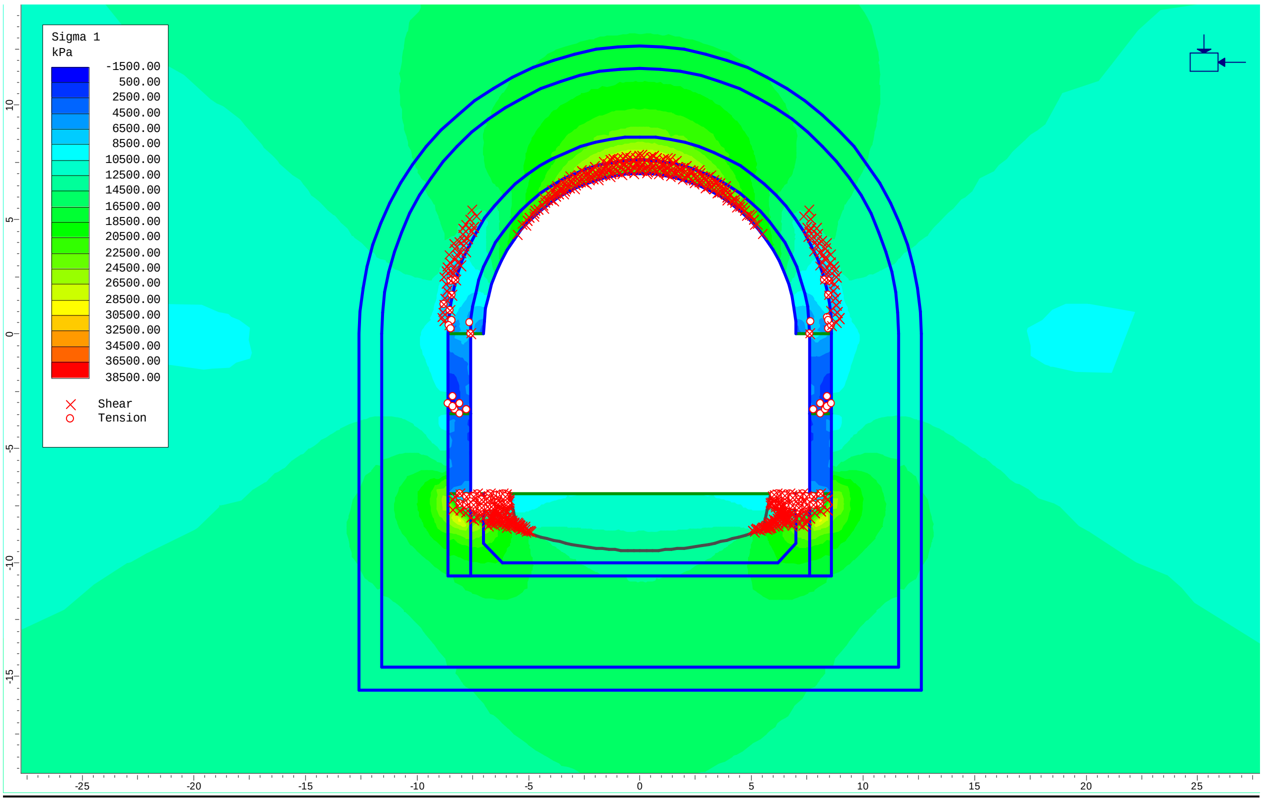
Stage 6 – Bench 1 + Unreinforced concrete



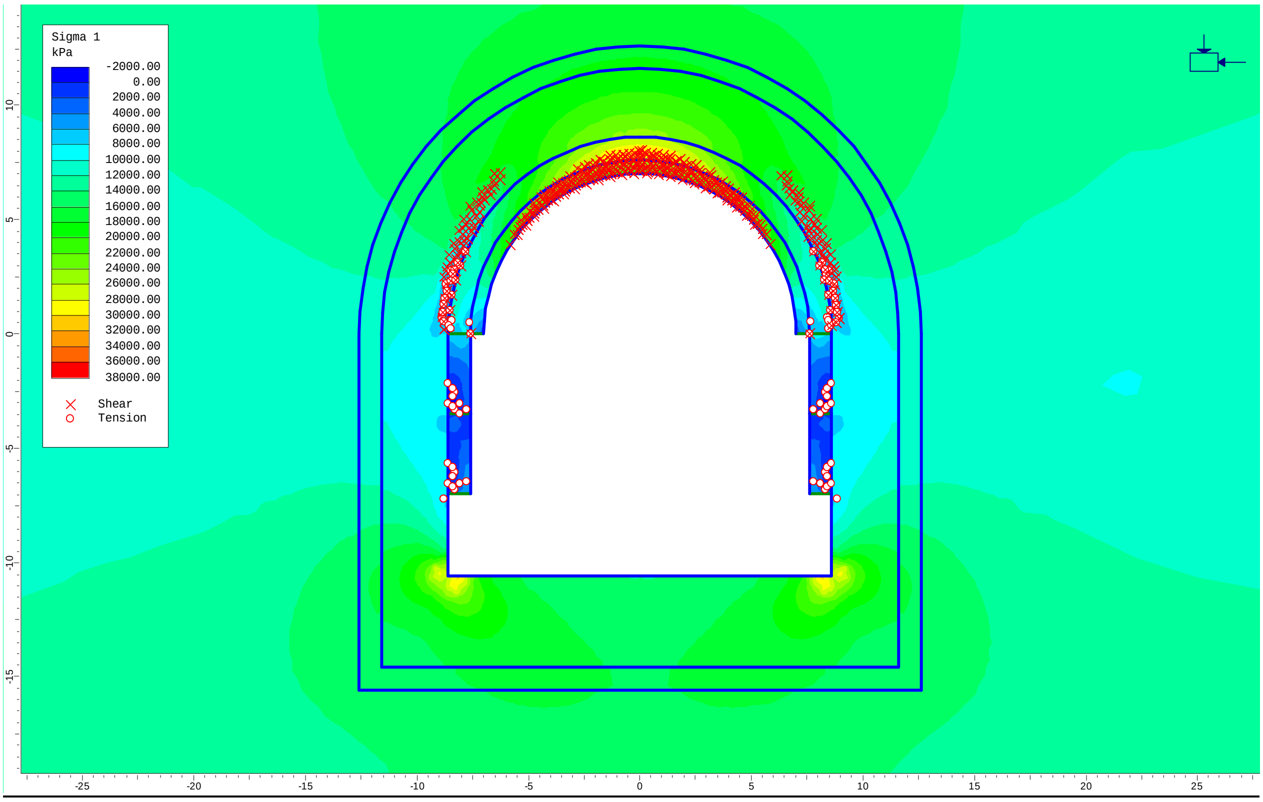
Stage 7 –Bench 2



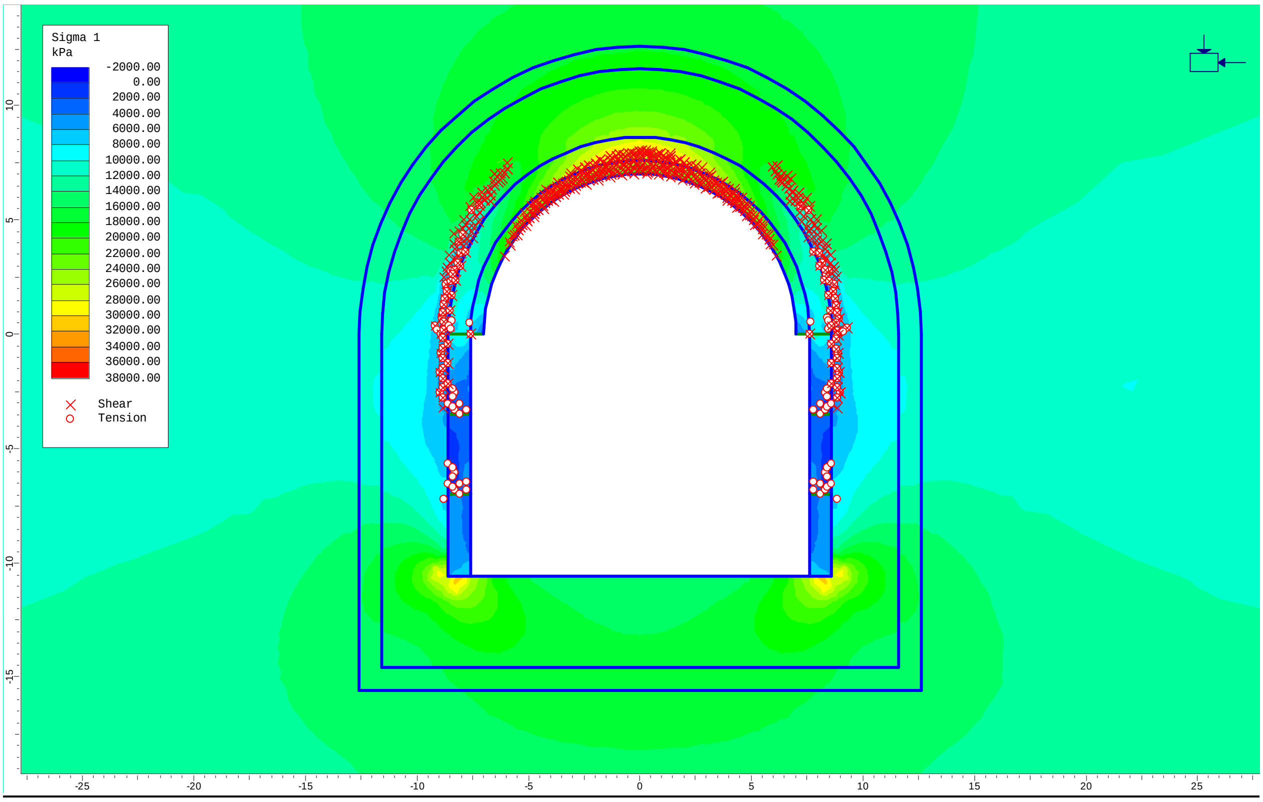
Stage 8 –Bench 2 + Unreinforced concrete



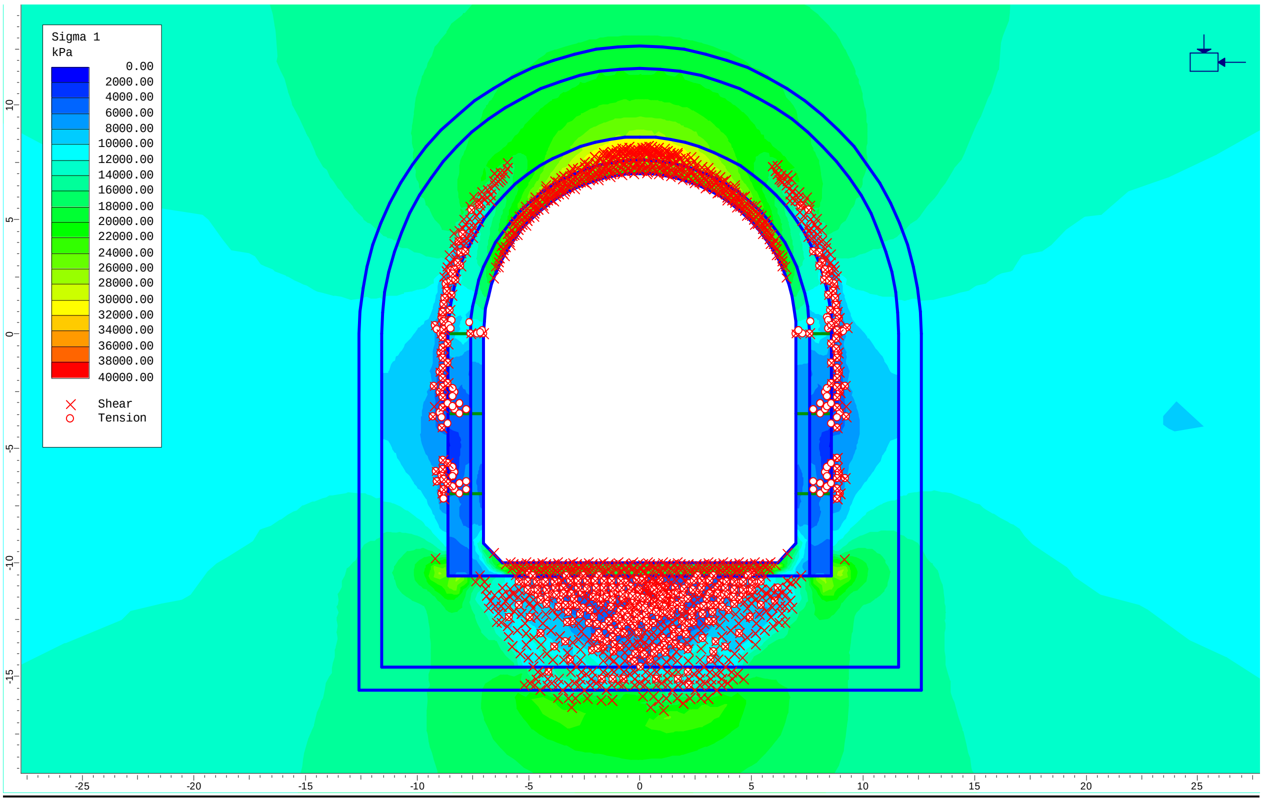
Stage 9 – Bench 3



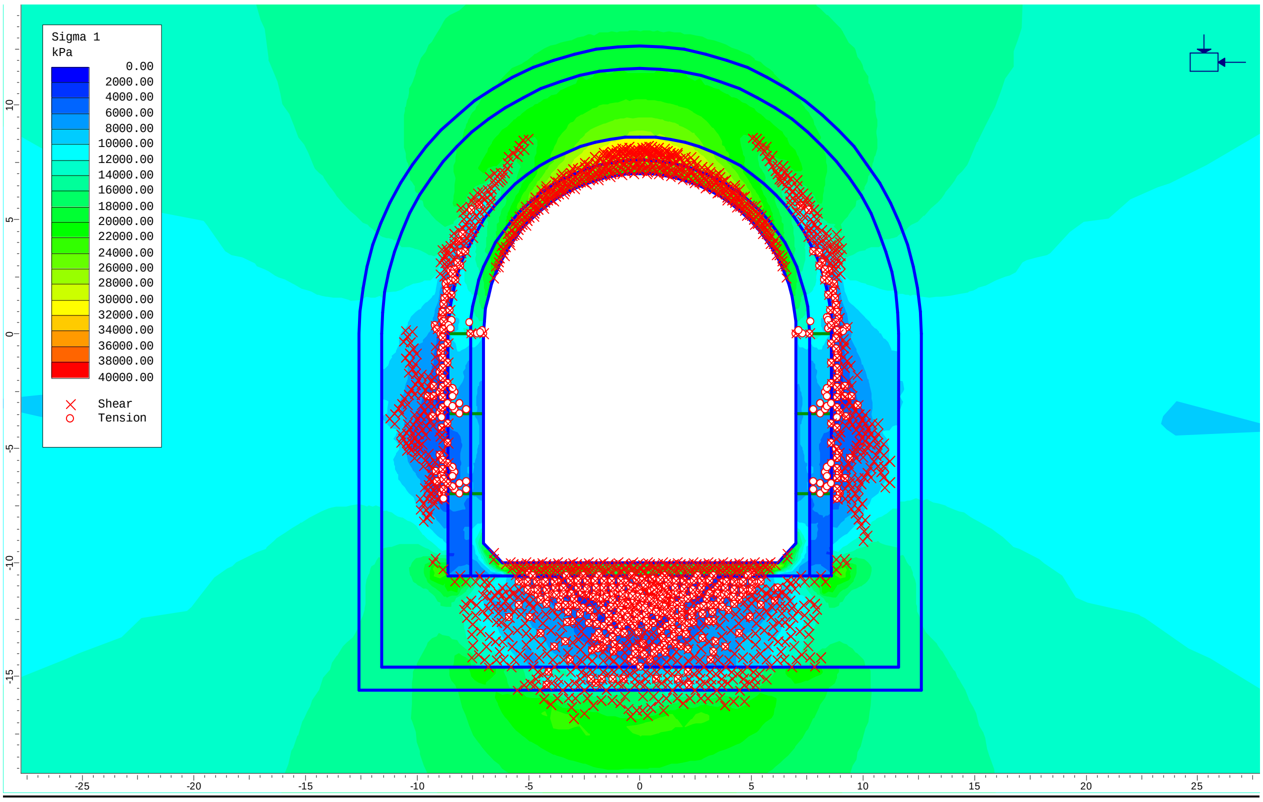
Stage 10 - Bench 3 + Unreinforced concrete



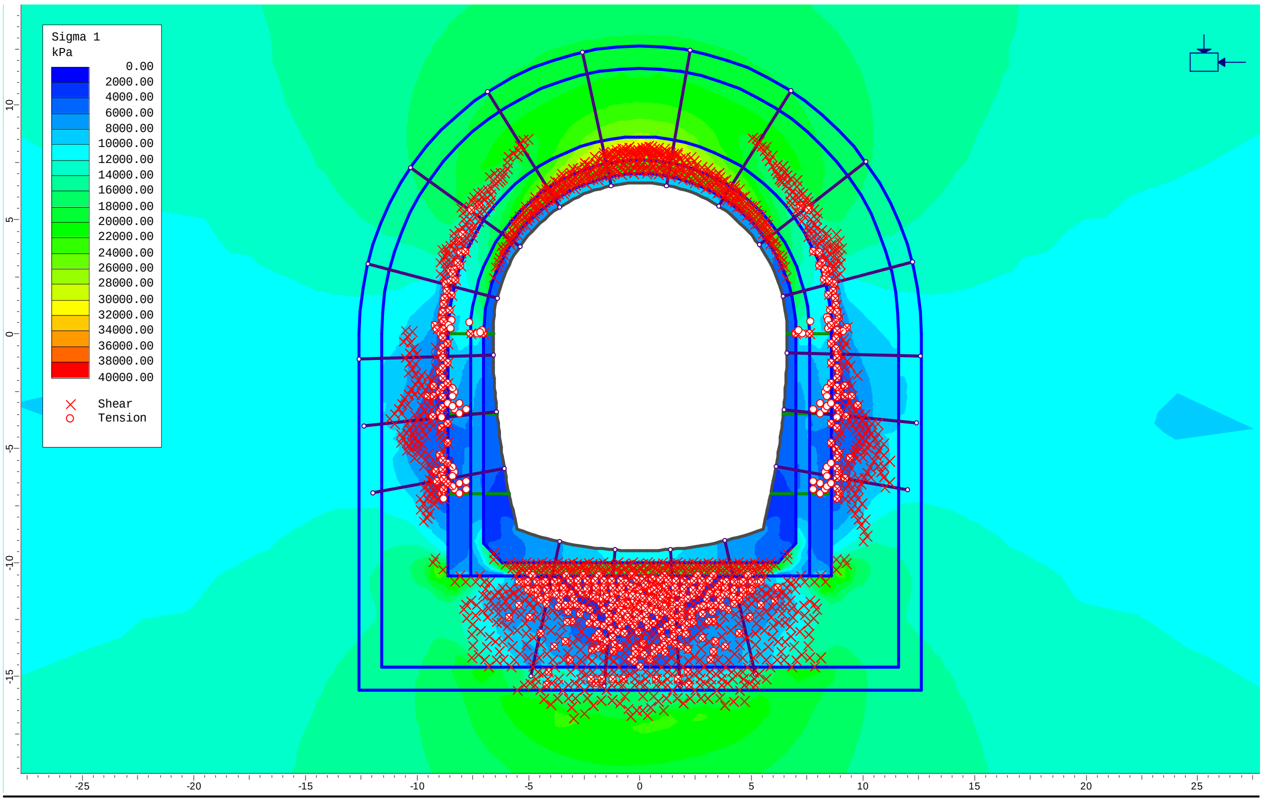
Stage 11 –Reinforced concrete on the sidewalls



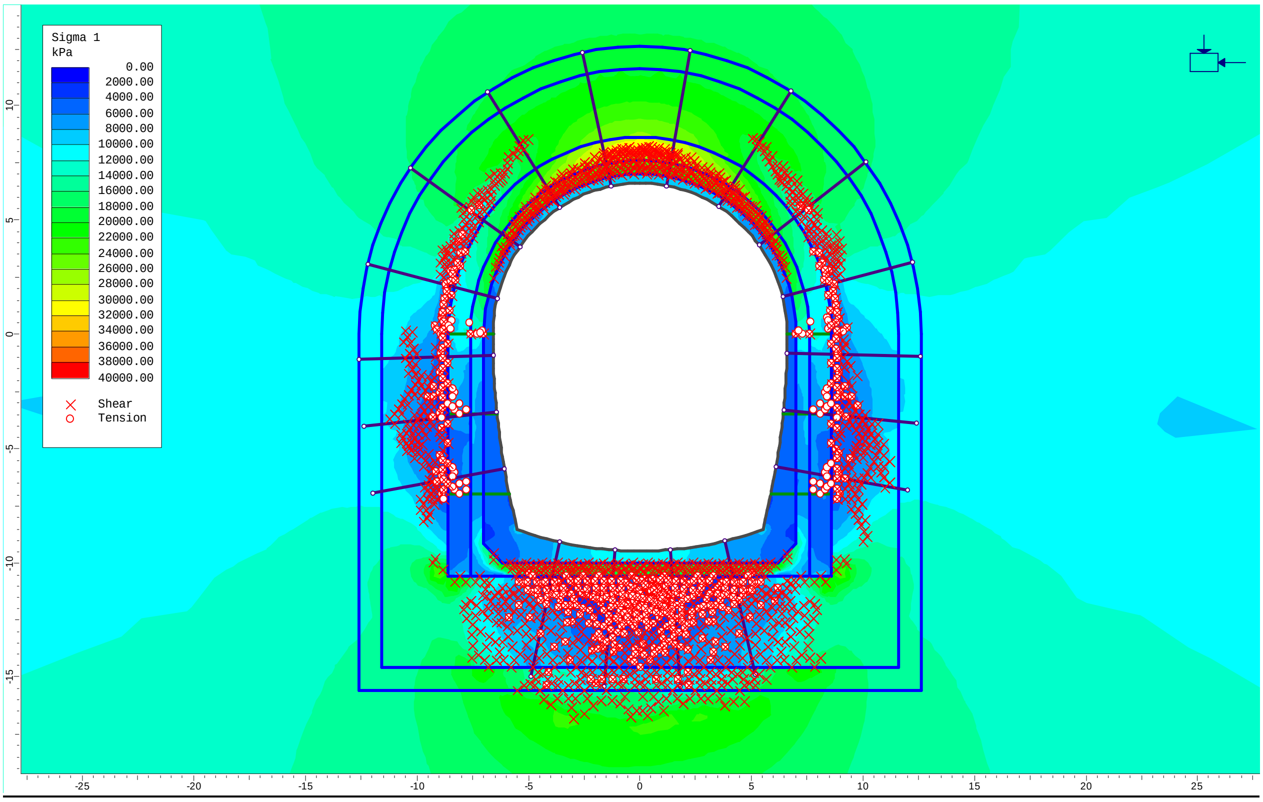
Stage 12 – Long Term Rock Mass Properties



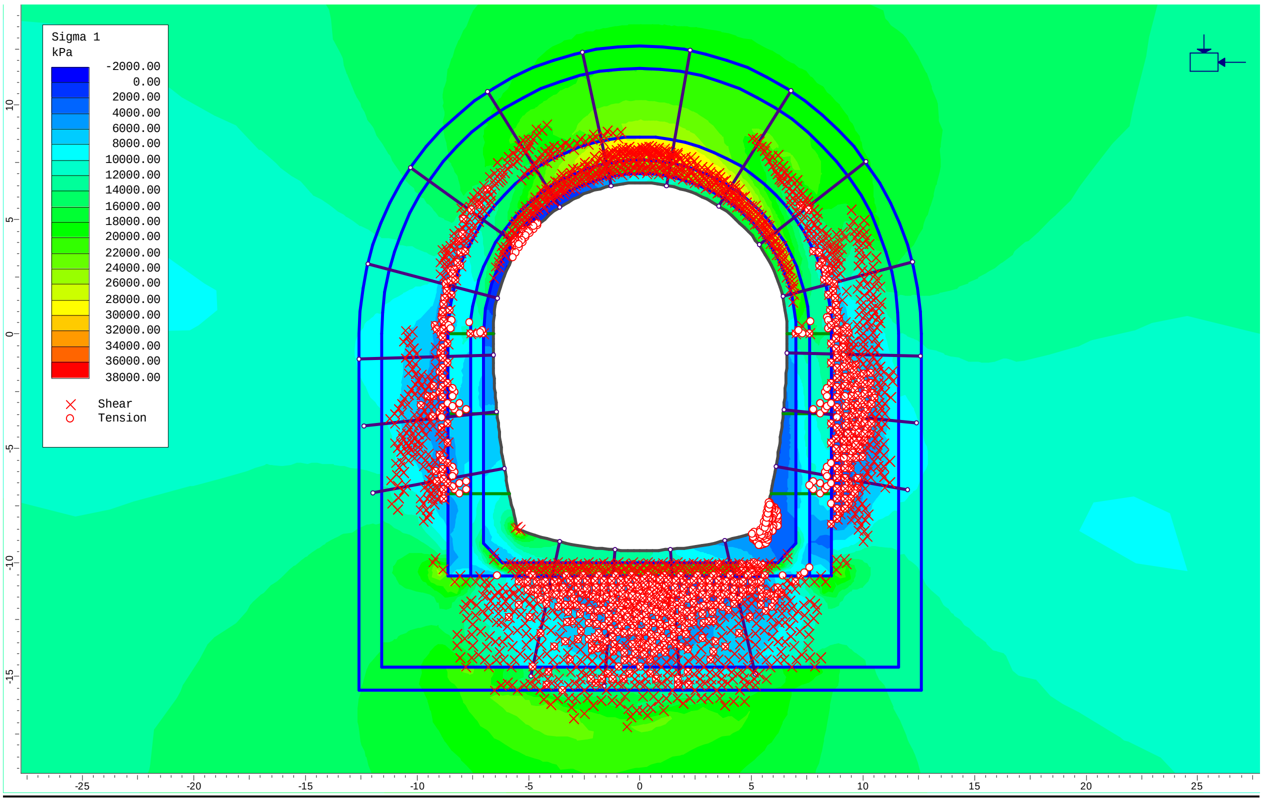
Stage 13 – Installation of new lining and reinforcement



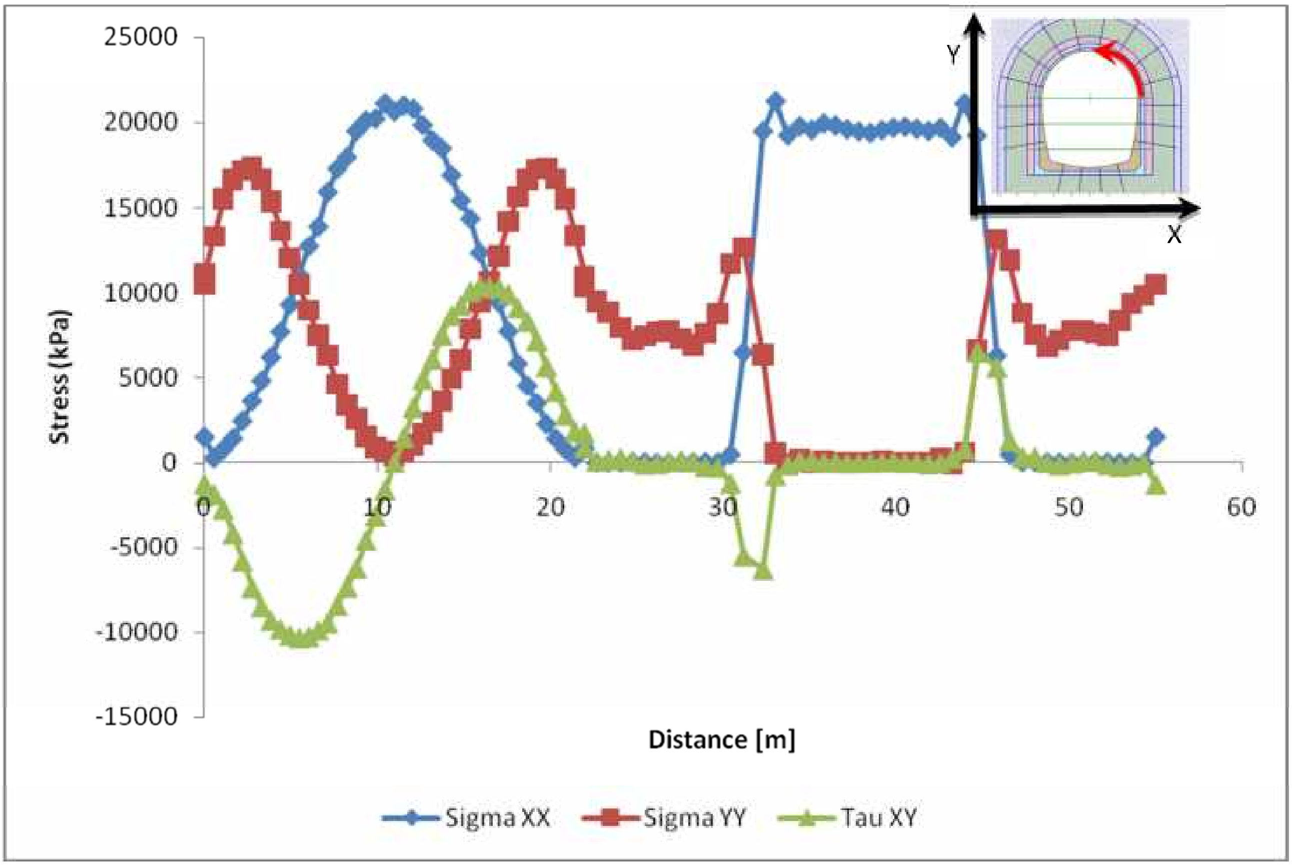
Stage 14 – Application of 200 kPa constant water load on the new lining



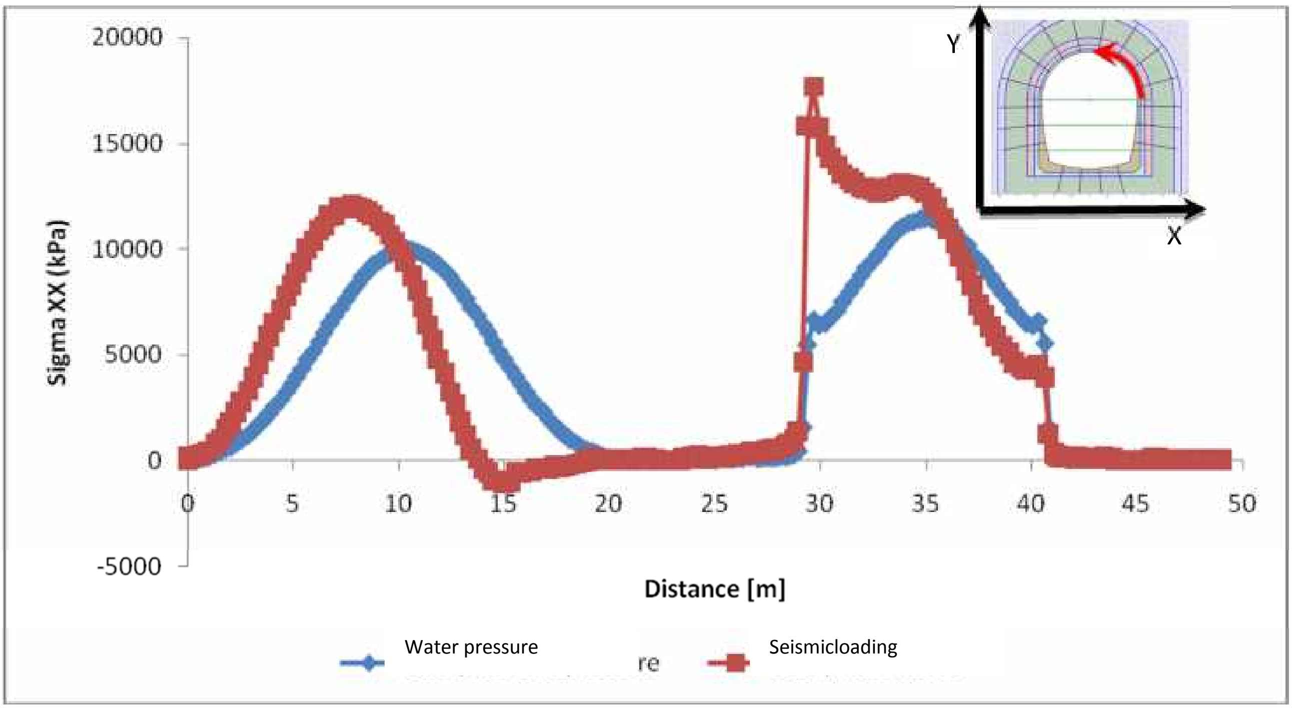
Stage 15 – Seismic Loading


Sigma 1
kPa
-2000.00
0.00
2000.00
4000.00
6000.00
8000.00
10000.00
12000.00
14000.00
16000.00
18000.00
20000.00
22000.00
24000.00
26000.00
28000.00
30000.00
32000.00
34000.00
36000.00
38000.00
Shear
Tension
10
5
0
-5
-10
-15
-25
-20
-15
-10
-5
0
5
10
15
20
25

Stresses at the intrados of the existing reinforced concrete lining
(starting from right first point of crown arch, counter clockwise). Long Term Rock Mass Parameters



Normal Stress Sigma XX at the intrados of the new lining
(starting from right first point of crown arch, counter clockwise)



Normal Stress Sigma YY at the intrados of the new lining
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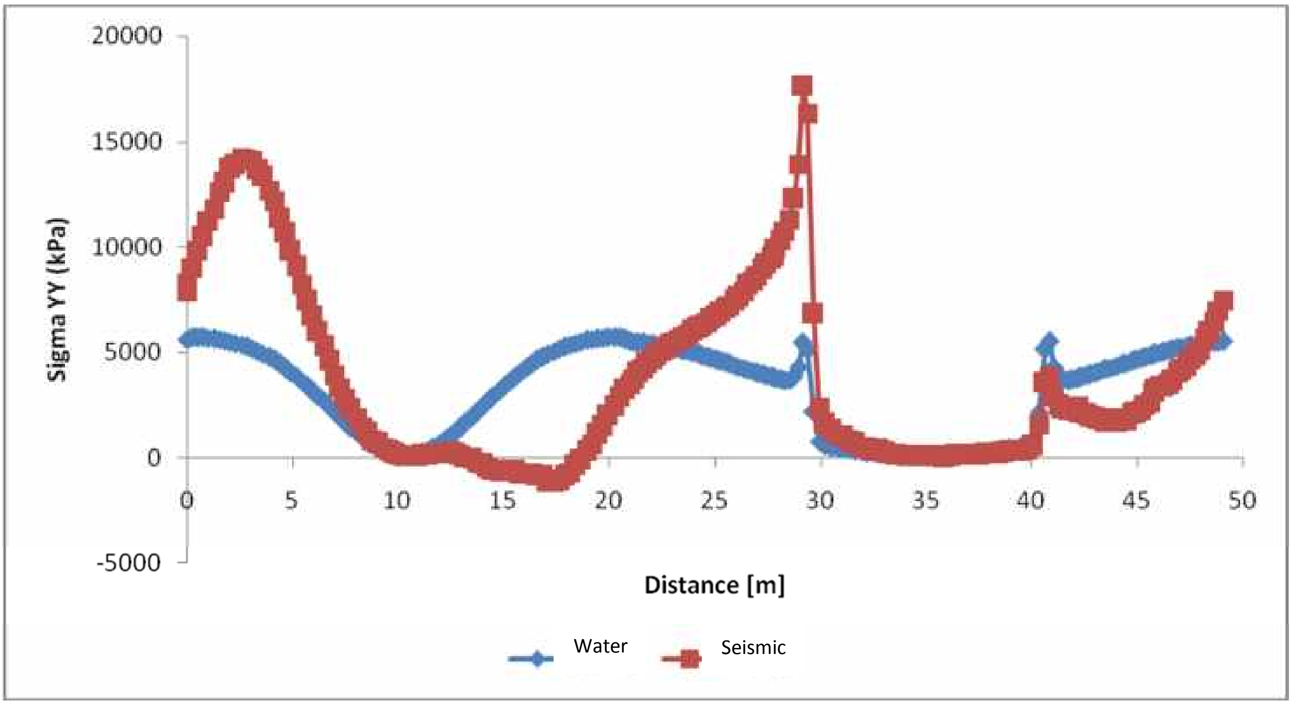
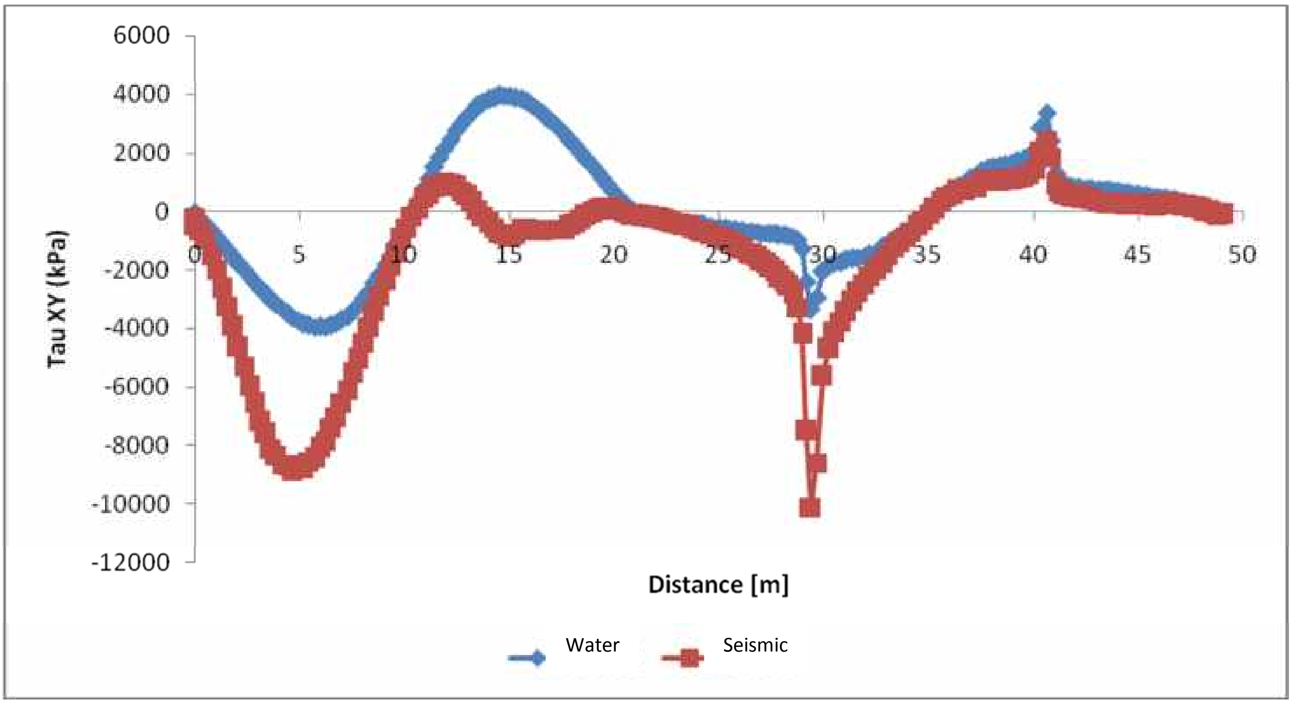
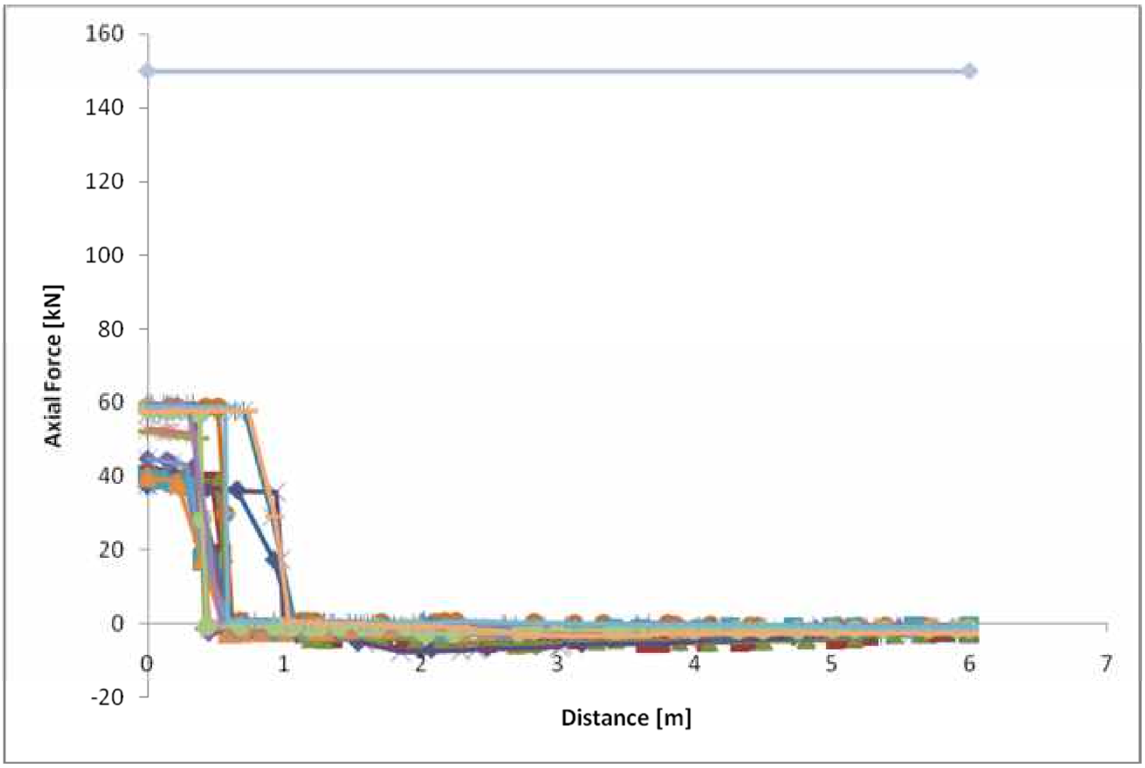


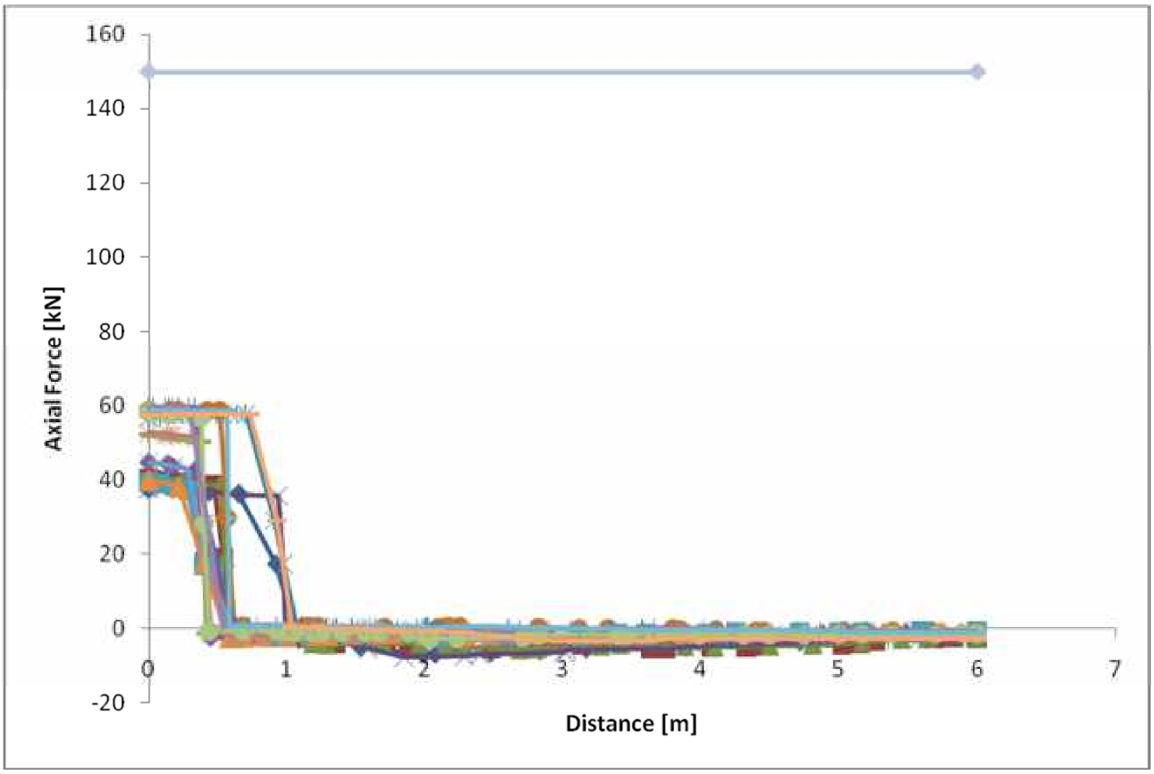
Shear Stress Tau XY at the intrados at the intrados of the new lining
(starting from right first point of crown arch, counter clockwise)



Axial Force in the dowels with 200 kPawater pressure applied



Axial Force in the dowels with seismic loading



APPENDIX 2

EARTHQUAKE LOADING - MAXIMUM SHEAR STRAIN

The effect of a vertical propagating shear wave may be simulated as a pure shear deformation applied in pseudo-static conditions. This assumption is possible for two reasons:

1. the size of the tunnel is small compared with the wavelength of the seismic wave (generally the wavelength is about 10 times the size of the tunnel cross-section);
2. the inertial effects in the covering and surrounding ground are traceable (Penzien, 2000).

The deformation field associated with the pure shear condition can be obtained by applying to an indefinite medium a state of stress with stress ratio K_0 equal to -1, as shown in Figure 1 for the case of a circular tunnel.

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The value of the stress to impose to the boundaries of the model of Figure 1 can be computed with Equation (1) and based on the maximum shear strain induced during the seismic event:

$$\tau = \sigma_1 = -\sigma_2 = \frac{E_g}{2\left(1+v_g\right)}\gamma_{\max} \qquad (1)$$

where γ_{max} is the maximum shear strain estimated in free field conditions. This value, as also mentioned by Bobet (2003), can be computed in the far-field as the ratio between the peak ground velocity V_{max} and the apparent shear wave velocity C_S.

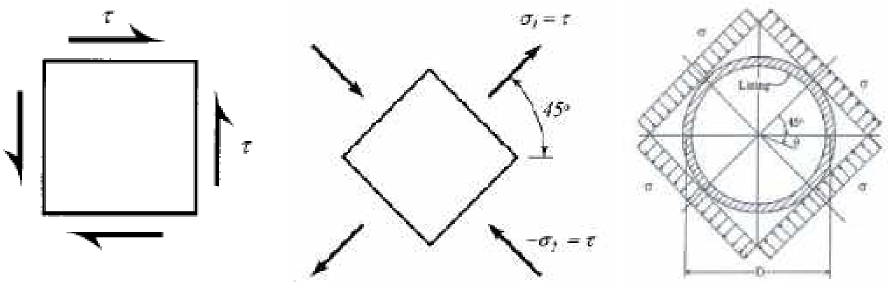

Figure 1: State of stress corresponding to a uniform pure shear deformation (Penzien, 1998)

It is noted that starting from these assumptions, several authors developed closed-form solutions to evaluate the axial force (*T*) and the bending moment (*M*) induced from seismic motion in the tunnel lining. Wang (1993), Penzien & Wu (1998) and Penzien (2000), Bobet (2003), Corigliano (2007) and Park (2009) proposed closed-form solutions for evaluating the effects in the tunnel lining due to a vertical S-wave.

The fundamental parameters, in all these analytical solutions, are the compressibility and the flexibility ratios and the shear strains induced in the ground from pure shear deformations. All the mentioned solutions consider the full-slip and no-slip interface ground-lining conditions.

The γ_{max} value can be computed in the far-field as the ratio between the peak ground velocity V_S and the shear wave velocity $\left(C_s = \sqrt{G_0/\rho}\right)$, where G_0 is the ground shear modulus and ρ the density:

$$\gamma_{\max} = \frac{V_S}{C_S}$$

The peak ground velocity V_S can be chosen based on the earthquake moment magnitude, the distance of the tunnel structure from the seismic source and the surface peak acceleration.

Another point to consider is that the shear wave velocity C_S is not necessarily equal to the apparent wave velocity. In fact, according to the available data C_S is in the range 2 to 5 km/s with a mean value equal to 3.4 km/s (O'Rourke & Liu, 1999; Power et al., 1996). A recent study based on both experimental and numerical results recommends a mean value in the range 1.0-1.2 km/s (Paolucci e Pitilakis, 2007). On the other end the AFPS/AFTES (2001) recommendations are for a C_S value equal to the minimum value between 1 km/s and the C_S value computed as $\left(C_s = \sqrt{G_0/\rho}\right)$-

In summary, the maximum shear strain γ_{max} can be computed as follows:

- Define the ground peak acceleration at the surface a_g (= 0.71g as indicated, for the Maximum Credible Earthquake (MCE), in the conclusion 7 of the report “Techno-economic assessment study for Rogun Hydroelectric Construction Project - Seismicity of Rogun Site - January 2013”).
- Compute the site-specific Peak Ground Acceleration $a_{max,s}$ based on the soil factor S (EC8): $a_{max,s} = S \cdot a_g$ (S = 1.2 for ground type B and for a magnitude Mw ≥ 5.5).
- Apply the coefficient C based on the tunnel depth below surface (see Table 1) to account for the real location of the same tunnel: $a_{z,max} = C \cdot a_{max,s}$ (assumed C = 0.7 because the tunnel is at a depth greater than 30 m).
- Compute the maximum shear strain γ_{max} based on the ratio $k = V_s / a_{z,max}$ (see Table 2): $\gamma_{max} = k \cdot a_{z,max} / C_s = 6.20 \cdot 10^{-4}$ (k = 97 that is indentified assuming a moment magnitude of 7.5, a source-to-site distance less than 20 km and a rock mass; C_s = 1 km/s as prescribed by AFPS/AFTES (2001)).

Table 1. Suggested values for C Coefficient (Hashash, 2001).

Tunnel Depth (m)	Ratio of the seismic motion at tunnel depth and on ground surface
<6	1.0
6-15	0.9
15-30	0.8
>30	0.7

Table 2. Computation of the peak ground velocity V_S and the acceleration $a_{z,max}$ ratio (Power et al., 1996).

	Ratio of the peak ground velocity (cm/s) and the peak surface acceleration (g)		
	Distance site-source (km)		
Moment Magnitude	0-20	20-50	50-100
Rock			
6.5	66	76	86
7.5	97	109	97
8.5	127	140	152
Stiff soil			
6.5	94	102	109
7.5	140	127	155
8.5	180	188	193
Soft soil			
6.5	140	132	142
7.5	208	165	201
8.5	269	244	251

Table 1 - Stresses in the existing lining

LONG TERM

X	Y	Distance [m]	Sigma XX [kPa]	Sigma YY [kPa]	Tau XY [kPa]
6.99961	-0.000645849	0	177.729	10677	-302.153
6.99958	9.79E-17	0.000646348	651.82	10590.3	-710.892
6.97803	0.548568	0.549637	407.535	12305.5	-1815.06
6.91342	1.0944	1.09927	635.7	14372.8	-2555.68
6.80619	1.63347	1.64891	1093.82	14770.8	-3407.07
6.657	2.16247	2.19855	1738.8	13926	-4333.34
6.46676	2.67814	2.74819	2430.82	12890.8	-5182.75
6.23665	3.17729	3.29782	3057.58	11465.3	-5577.4
5.96809	3.65684	3.84746	3597.3	9826.78	-5658.65
5.66272	4.11385	4.3971	3995.65	8097.1	-5447.37
5.32245	4.54549	4.94674	4206.97	6409.2	-4994.65
4.94935	4.9491	5.49637	4197.07	4864.22	-4359.37
4.54574	5.3222	6.04601	3974.6	3508.92	-3610.6
4.1141	5.66247	6.59565	3680.77	2424.73	-2903.87
3.6571	5.96784	7.14529	3112.76	1702.78	-2201.18
3.17754	6.2364	7.69492	2627.23	931.473	-1484.75
2.67839	6.46651	8.24456	2292.17	524.16	-1034.88
2.16272	6.65675	8.7942	2237.2	348.102	-780.074
1.63372	6.80594	9.34384	2138.93	166.03	-500.763
1.09465	6.91317	9.89347	2077.07	86.1243	-330.67
0.548819	6.97778	10.4431	2178.4	63.7622	-173.416
-0.000394726	6.99935	10.9927	2089.3	31.8087	-0.162123
-0.549608	6.97778	11.5424	2139.15	52.3967	145.896
-1.09544	6.91317	12.092	2172.58	109.655	347.374
-1.63451	6.80594	12.6417	2117.25	190.593	543.365
-2.16351	6.65675	13.1913	2077.93	280.203	700.92
-2.67918	6.46651	13.7409	2300.84	580.482	1059.68
-3.17833	6.2364	14.2906	2562.22	991.313	1513.4
-3.65788	5.96784	14.8402	2927.23	1423.7	1975.83
-4.11489	5.66247	15.3898	3303	2399.9	2701.54
-4.54653	5.3222	15.9395	3739.37	3544.37	3512.25
-4.95014	4.9491	16.4891	4028.53	4634.63	4200.17
-5.32324	4.54549	17.0388	3929.07	6013.23	4677.93
-5.66351	4.11385	17.5884	3631.9	7875.48	5071.64
-5.96888	3.65684	18.138	3308.15	9948.7	5441.68
-6.23744	3.17729	18.6877	2945.9	11736	5607.63
-6.46755	2.67814	19.2373	2288.58	13082	4986.84
-6.65779	2.16247	19.7869	1658.67	14736.5	4394.6
-6.80698	1.63347	20.3366	1119.57	15513	3540.6
-6.91421	1.0944	20.8862	662.6	15130.2	2697.08
-6.97882	0.548568	21.4359	391.325	12831.5	1864.34
-7.00037	9.66E-16	21.9849	735.296	10804.4	821.984
-7.00039	-0.000645849	21.9855	142.108	10747.7	337.093
-7.00039	-0.697397	22.6822	21.7291	10182.1	94.7577
-7.00039	-1.39493	23.3798	4.555	9870.73	10.2935
-7.00039	-2.09401	24.0789	-5.129	9919.63	5.0147
-7.00039	-2.79544	24.7803	-18.3789	9701.43	100.16

-7.00039	-3.5	25.4849	12.4767	9345.68	174.358
-7.00039	-4.18968	26.1745	21.2962	8664.63	40.0245
-7.00039	-4.88408	26.8689	18.0631	8844.95	-92.2523
-7.00039	-5.58401	27.5689	6.29927	9479.02	-171.79
-7.00039	-6.2903	28.2752	2.94725	10337	-195.15
-7.00039	-7	28.9849	50.0639	11736.7	-419.472
-7.00039	-7.72408	29.7089	14.0609	13761.8	-498.725
-7.00039	-8.45716	30.442	521.435	17589	-1392.92
-7.00039	-9.20065	31.1855	5504.82	16550.5	-5245.37
-6.20039	-10.0006	32.3169	4951.2	5997.72	-5117.3
-5.47971	-10.0006	33.0375	578.085	481.999	-1080.58
-4.7652	-10.0006	33.7521	-1375.82	0.0083	27.001
-4.06203	-10.0006	34.4552	-1134.64	3.00855	46.3258
-3.36853	-10.0006	35.1487	-842.05	5.61375	51.4687
-2.68311	-10.0006	35.8342	-568.937	-1.57135	64.878
-2.00416	-10.0006	36.5131	-346.615	-3.30357	46.0883
-1.33011	-10.0006	37.1872	-200.016	-2.5962	27.72
-0.659441	-10.0006	37.8578	-124.366	-2.19787	12.6342
0.00939423	-10.0006	38.5267	-144.434	-1.68667	-0.706767
0.677909	-10.0006	39.1952	-137.251	-2.58385	-17.1409
1.34762	-10.0006	39.8649	-232.188	-2.48902	-32.143
2.02006	-10.0006	40.5373	-393.018	-2.95797	-48.297
2.69674	-10.0006	41.214	-615.705	-0.93345	-62.1495
3.37924	-10.0006	41.8965	-857.938	13.6183	-32.4782
4.06913	-10.0006	42.5864	-1119.25	-1.33085	-23.801
4.76801	-10.0006	43.2853	-1382.62	21.622	-32.1573
5.47753	-10.0006	43.9948	547.107	500.215	1104.93
6.19961	-10.0006	44.7169	5156	6227.12	5249.42
6.99961	-9.20065	45.8482	5666.47	16847	5450.48
6.99961	-8.45716	46.5917	519.889	17556.7	1361.96
6.99961	-7.72408	47.3248	11.8354	13929.7	446.552
6.99961	-7	48.0489	17.2457	11875.2	489.697
6.99961	-6.2903	48.7586	19.5815	10132.4	262.705
6.99961	-5.58401	49.4649	17.6055	9203.05	129.761
6.99961	-4.88408	50.1648	11.1069	8811.15	31.3369
6.99961	-4.18968	50.8592	10.2267	8774.73	-38.0343
6.99961	-3.5	51.5489	5.91583	9321.72	-103.963
6.99961	-2.79544	52.2534	-3.71098	9482.57	-88.4527
6.99961	-2.09401	52.9549	-1.72495	9811.78	-65.684
6.99961	-1.39493	53.654	-1.73941	10079.6	-59.9218
6.99961	-0.697397	54.3515	18.8312	10335.8	-71.0223
6.99961	-0.000645849	55.0482	177.729	10677	-302.153

Table 2- Stresses in the new lining

			Water pressure	Seismic loading	Water pressure	Seismic loading	Water pressure	Seismic loading
X	Y	Distance [m]	Sigma XX	Sigma XX	Sigma YY	Sigma YY	Tau XY	Tau XY
6.59961	-0.000645849	0	48.0553	77.5337	8765.53	12717.7	-74.4403	-267.9
6.59959	1.22E-16	0.000645974	97.95	161.97	8711.68	12844	-173.133	-579.6
6.59452	0.258469	0.259165	116.918	208.459	8839.35	13734.8	-389.153	-877.2
6.57926	0.517184	0.518329	143.052	272.093	8888	14613	-684.347	-1349
6.55386	0.775101	0.777494	225.898	458.78	8697.13	15039.3	-981.89	-1983
6.51835	1.03182	1.03666	290.77	602.417	8549.8	15639	-1302	-2604
6.47279	1.28695	1.29582	408.86	892.202	8233.65	15746	-1554.8	-3252
6.41725	1.54009	1.55499	525.263	1160.82	7970.03	16072	-1837.2	-3917
6.35181	1.79086	1.81415	663.245	1550.63	7578.25	15902.2	-2025.68	-4526
6.27658	2.03887	2.07332	794.553	1899.13	7225.53	15978	-2255.5	-5205
6.19167	2.28373	2.33248	943.415	2389.45	6789.43	15606.7	-2376.25	-5750
6.09721	2.52506	2.59165	1098.57	2869.3	6382.43	15502.3	-2538.07	-6404
5.99335	2.76251	2.85081	1241.05	3451.65	5928.75	15001.7	-2589.8	-6877
5.88025	2.99569	3.10998	1398.57	4051.3	5490.8	14780.3	-2682.5	-7497
5.75808	3.22425	3.36914	1521.37	4719.57	5042.75	14199.7	-2670.1	-7893
5.62703	3.44784	3.62831	1666.5	5434.67	4596.87	13896	-2694.83	-8465
5.4873	3.66612	3.88747	1762.85	6164.35	4172.3	13242.8	-2626.15	-8755
5.33912	3.87874	4.14664	1895	6979.73	3746.67	12854	-2578.43	-9212
5.1827	4.08537	4.4058	1932.88	7642.75	3355.05	12084.8	-2471.6	-9340
5.01828	4.28571	4.66497	2014.83	8425.77	2940.53	11500	-2382.5	-9639
4.84613	4.47944	4.92413	2022.35	8958.02	2599.43	10609.5	-2235.35	-9503
4.66651	4.66626	5.18329	2063	9624.03	2231.53	9838.13	-2101.53	-9535
4.47969	4.84588	5.44246	2025.52	9880.58	1942.57	8857.88	-1935.5	-9125
4.28596	5.01803	5.70162	2019.67	10310.3	1624	7931.5	-1773.5	-8861
4.08563	5.18245	5.96079	1940.8	10210.6	1390.5	6951.13	-1602.93	-8215
3.87899	5.33887	6.21995	1888.07	10305.8	1126.83	5964.67	-1427.07	-7677
3.66637	5.48705	6.47912	1790.07	9836.8	958.175	5092.7	-1257	-6868
3.4481	5.62678	6.73828	1697.93	9541	766.627	4172.43	-1080.03	-6121
3.22451	5.75783	6.99745	1554.55	8685.2	611.37	3409.48	-946.56	-5293
2.99594	5.88	7.25661	1432.63	8020	454.537	2592.93	-784.363	-4451
2.76276	5.9931	7.51578	1288.48	6945.63	365.69	2062.5	-666.232	-3682
2.52532	6.09696	7.77494	1147.53	6009.07	258.387	1441.1	-525.59	-2869
2.28398	6.19142	8.03411	1007.36	4870.6	201.67	1102.7	-436.178	-2265
2.03912	6.27633	8.29327	860.503	3811.5	133.5	687.833	-323.23	-1586
1.79111	6.35156	8.55244	738.787	2781.03	99.7358	503.418	-261.897	-1185
1.54034	6.417	8.8116	601.133	1768.87	62.0833	267.323	-178.893	-701.6
1.2872	6.47254	9.07077	519.467	986.095	76.0583	217.967	-133.232	-486.7
1.03207	6.5181	9.32993	405.973	147.763	51.0277	101.744	-89.318	-217.9
0.775352	6.55361	9.5891	350.422	-372.17	13.637	43.9723	-64.386	-155.2

0.517435	6.57901	9.84826	272.257	-996.737	9.27937	9.00817	-32.981	-42.63
0.25872	6.59427	10.1074	266.95	-1273.68	3.69232	-4.9373	-18.3284	-69.7
-0.000394726	6.59935	10.3666	229.42	-1690.73	5.29743	-10.956	0.117763	-61.72
-0.25951	6.59427	10.6258	267.89	-1753.03	3.77705	-18.1867	18.7398	-102.9
-0.518225	6.57901	10.8849	274.41	-1857.33	9.39587	7.323	33.5597	-91.34
-0.776142	6.55361	11.1441	353.515	-1684.85	14.3952	-92.1385	65.5427	-149.7
-1.03286	6.5181	11.4032	405.733	-1460.33	29.5833	71.0507	90.5197	-179.8
-1.28799	6.47254	11.6624	523.887	-1584.28	78.631	-70.0133	135.995	-286.8
-1.54113	6.417	11.9216	613.483	-1459.17	64.0653	-75.5803	176.823	-354.7
-1.7919	6.35156	12.1807	745.012	-1417.4	100.739	-148.971	264.27	-364.7
-2.03991	6.27633	12.4399	867.963	-1287.6	134.47	-130.213	325.907	-421.2
-2.28477	6.19142	12.6991	1015.42	-1303.77	203.315	-204.628	439.518	-474.6
-2.52611	6.09696	12.9582	1156.93	-1200.1	260.737	-158.65	530.113	-451.9
-2.76355	5.9931	13.2174	1299.15	-1145.92	368.368	-254.425	671.643	-508.3
-2.99673	5.88	13.4766	1444.07	-1074.77	458.08	-276.733	790.313	-534.1
-3.22529	5.75783	13.7357	1566.05	-990.79	612.18	-301.32	953.34	-528.3
-3.44889	5.62678	13.9949	1705.93	-924.857	764.12	-331.137	1093.83	-551.3
-3.66716	5.48705	14.2541	1803.55	-833.343	972.002	-358.515	1261.65	-551.7
-3.87978	5.33887	14.5132	1901.97	-798.28	1134.43	-415.9	1436.1	-564.5
-4.08641	5.18245	14.7724	1953.25	-737.803	1398.55	-448.955	1613	-552.5
-4.28675	5.01803	15.0316	2031.87	-641.027	1632.9	-471.653	1783.53	-554.7
-4.48048	4.84588	15.2907	2036.67	-649.337	1952.07	-570.682	1945.75	-575.9
-4.6673	4.66626	15.5499	2073.53	-574.063	2241.13	-566.5	2111.4	-580.7
-4.84692	4.47944	15.809	2031.33	-555.97	2608.8	-704.505	2244.33	-586.4
-5.01907	4.28571	16.0682	2022.47	-539.397	2950.07	-874.467	2390.77	-651.3
-5.18349	4.08537	16.3274	1937.5	-492.265	3357.3	-857.095	2480.55	-672
-5.33991	3.87874	16.5865	1894.73	-503.15	3753.2	-833.517	2585.57	-654
-5.48809	3.66612	16.8457	1772	-410.86	4178.3	-599.265	2626.3	-508.2
-5.62782	3.44784	17.1049	1667.43	-296.183	4596.87	-424.737	2695.6	-368.5
-5.75887	3.22425	17.364	1521.83	-187.996	5039.87	13.3815	2669.98	-166.4
-5.88104	2.99569	17.6232	1398.13	-57.6375	5484.53	355.262	2680.43	26.462
-5.99414	2.76251	17.8824	1239.95	16.9858	5920.37	957.615	2586.7	218.65
-6.098	2.52506	18.1415	1096.9	115.794	6372.9	1457.3	2534.1	416.03
-6.19246	2.28373	18.4007	941.835	145.56	6780.28	2175	2372.75	551.56
-6.27737	2.03887	18.6599	793.377	199.153	7216.07	2787.4	2252.33	707.7
-6.3526	1.79086	18.919	657.812	192.22	7567.45	3524.3	2023.97	749.56
-6.41804	1.54009	19.1782	527.183	205.407	7956.5	4150.8	1833.27	817.92
-6.47358	1.28695	19.4374	410.29	171.235	8215.23	4797.98	1554.12	749.03
-6.51914	1.03182	19.6965	290.463	145.07	8522.9	5361.37	1300.3	703.47
-6.55465	0.775101	19.9557	225.712	119.656	8661	5906.63	981.282	522.3
-6.58005	0.517184	20.2148	142.794	85.8513	8840.8	6422.13	683.387	374.49
-6.59531	0.258469	20.474	116.649	80.2275	8785.65	6859.58	389.335	136.66
-6.60038	9.44E-16	20.7325	98.3125	78.3293	8655.05	7216	173.915	-79.83

-6.60039	-0.000645849	20.7332	48.3653	34.5237	8701.83	7371.03	75.1973	-54.05
-6.59971	-0.21682	20.9494	19.778	15.8947	8581.57	7538.07	-10.2027	-103.4
-6.59765	-0.432985	21.1655	24.7973	24.8128	8444.73	7826.85	-70.3437	-213.8
-6.59421	-0.649133	21.3817	20.1813	22.6873	8379.93	8195.37	-144.15	-260
-6.5894	-0.865255	21.5979	28.6867	31.6967	8335.97	8476.3	-191.86	-306.3
-6.58322	-1.08134	21.8141	34.3665	38.8203	8265.73	8741.05	-235.357	-379.1
-6.57566	-1.29738	22.0302	26.5417	32.606	8206.03	9000.63	-294.083	-408.1
-6.56673	-1.51337	22.2464	29.456	36.578	8142.13	9144.53	-333.387	-450
-6.55642	-1.7293	22.4626	37.6795	46.6922	8040.02	9233.4	-367.93	-508.6
-6.54474	-1.94516	22.6788	38.6703	49.1527	7939.77	9324.27	-421.457	-548.6
-6.53169	-2.16094	22.8949	42.8973	55.992	7839.7	9336.87	-456.25	-591.5
-6.51727	-2.37664	23.1111	50.2545	67.8493	7698.32	9313.45	-489.983	-648.3
-6.50148	-2.59224	23.3273	50.902	67.0167	7561.33	9298.23	-551.923	-707.1
-6.48432	-2.80773	23.5435	55.3637	73.3773	7435.53	9255.6	-587.23	-756.1
-6.46579	-3.02311	23.7596	62.8608	88.0065	7304.3	9216.23	-605.418	-806.1
-6.44588	-3.23837	23.9758	75.2975	117.15	7156.05	9199.73	-616.437	-874.8
-6.42461	-3.45349	24.192	87.7437	135.58	7029.7	9195.63	-642.453	-925.8
-6.41972	-3.5	24.2387	91.7938	168.316	6965.62	9218.26	-619.008	-978.7
-6.40198	-3.66848	24.4082	84.3637	129.89	6802.17	9209.17	-706.767	-1020
-6.37797	-3.88332	24.6243	90.6562	149.68	6666.35	9269.68	-722.295	-1095
-6.35261	-4.098	24.8405	97.0007	164.175	6508.2	9361.25	-749.228	-1171
-6.32587	-4.31251	25.0567	103.498	184.582	6359.45	9483.03	-766.547	-1254
-6.29777	-4.52686	25.2729	110.978	217.696	6191.6	9654.78	-776.35	-1366
-6.26832	-4.74101	25.489	117.963	220.05	6002	9847.3	-815.18	-1430
-6.2375	-4.95498	25.7052	123.682	255.522	5862.83	10020.5	-813.935	-1538
-6.20532	-5.16875	25.9214	130.283	276.077	5690.13	10227	-830.11	-1627
-6.17178	-5.3823	26.1376	135.02	319.32	5544.7	10398.5	-822.6	-1747
-6.13688	-5.59564	26.3537	143.01	345.425	5329.7	10652.3	-839.853	-1855
-6.10063	-5.80876	26.5699	156.72	370.413	5144.07	10886.3	-861.5	-1930
-6.06303	-6.02164	26.7861	158.68	409.725	5003.57	11043.8	-850.182	-2038
-6.02407	-6.23427	27.0023	158.973	437.945	4820.6	11254.2	-851.437	-2165
-5.98376	-6.44666	27.2184	164.43	476.438	4650.65	11481	-852.572	-2285
-5.9421	-6.65878	27.4346	169.105	531.638	4508.4	11702.5	-847.945	-2426
-5.89909	-6.87063	27.6508	174.367	596.977	4392.73	11924.7	-844.233	-2578
-5.87197	-7	27.783	183.142	749.636	4384.86	11985.4	-824.32	-2806
-5.85474	-7.08221	27.867	187.22	661.653	4153.97	12534.3	-861.41	-2825
-5.80904	-7.2935	28.0831	197.065	743.782	4070.93	12970.5	-872.232	-3035
-5.762	-7.5045	28.2993	205.913	786.81	3970.3	13629	-890.49	-3230
-5.71362	-7.71519	28.5155	227.587	943.923	3973.85	14379.5	-928.1	-3610
-5.6639	-7.92557	28.7317	269.448	1188.6	4051.38	15604.5	-1009.81	-4196
-5.61285	-8.13563	28.9478	375.165	1673.05	4306.6	17581.3	-1199.05	-5233
-5.56046	-8.34536	29.164	1091.42	5088.7	4994.85	21670.3	-1900.83	-8695
-5.50674	-8.55475	29.3802	3310.7	17436	4326.25	19802	-2347.98	-11545

-5.24134	-8.64617	29.6609	3422.34	17383.8	1653.36	7928.58	-1865.72	-9566
-4.97443	-8.73306	29.9416	2834.17	13442	473.308	2569.43	-1079.29	-5699
-4.70608	-8.8154	30.2223	2565.43	10949.8	302.178	1646.05	-844.953	-4166
-4.43637	-8.89316	30.503	2374.52	8854.7	238.145	1196.79	-723.94	-3191
-4.16537	-8.96633	30.7837	2261.97	7377.63	190.817	819.55	-635.59	-2407
-3.89317	-9.03487	31.0644	2075.58	5923.15	173.635	705.813	-558.327	-1977
-3.61984	-9.09877	31.3451	1931.77	4718.57	171.547	510.105	-485.745	-1453
-3.34547	-9.15801	31.6258	1784.2	3773.25	112.979	320.685	-430.377	-1079
-3.07012	-9.21258	31.9065	1621.43	2976.42	84.9768	204.475	-363.29	-772.6
-2.79389	-9.26245	32.1872	1408.5	2268.42	66.924	137.855	-302.76	-557.6
-2.51685	-9.30762	32.4679	1195.37	1685.6	48.443	84.1227	-238.613	-377.4
-2.23908	-9.34807	32.7486	910.168	1308.04	61.9862	125.209	-257.712	-438.3
-1.96067	-9.38379	33.0293	615.54	716.807	39.5317	62.1683	-177.073	-248.8
-1.68168	-9.41476	33.31	364.343	334.51	28.9676	41.344	-136.839	-178.6
-1.40221	-9.44099	33.5907	74.5863	-147.8	20.5765	20.984	-52.3643	-51.4
-1.12234	-9.46246	33.8714	-128.79	-433.762	48.333	47.1824	-39.6875	-41.41
-0.842134	-9.47916	34.1521	-364.247	-808.54	3.2088	2.15655	-13.1581	-11.47
-0.56169	-9.4911	34.4328	-363.158	-855.887	4.84295	2.19671	-29.9613	-64.85
-0.281083	-9.49826	34.7135	-394.452	-1046.98	4.37412	-1.43055	-19.6852	-89.41
-0.000394726	-9.50065	34.9942	-519.64	-1451.7	1.24783	-5.42313	-0.813733	-74.25
0.280293	-9.49826	35.2749	-397.447	-1477.42	4.76015	-7.08688	18.6353	-95.07
0.5609	-9.4911	35.5555	-367.473	-1790.75	4.8035	-9.17447	30.656	-97.14
0.841345	-9.47916	35.8362	-372.117	-2165.83	1.53975	-10.4729	10.651	-115.9
1.12155	-9.46246	36.1169	-131.26	-1961.03	22.6301	31.0785	46.9282	-73.86
1.40142	-9.44099	36.3976	90.6	-1820.57	54.445	10.214	57.9087	-71.49
1.68089	-9.41476	36.6783	389.46	-1551.67	35.5573	-50.8718	136.549	-168.2
1.95988	-9.38379	36.959	639.877	-1543.57	39.9683	-5.16203	181.277	-168
2.23829	-9.34807	37.2397	934.322	-1261.59	62.178	-6.46062	260.794	-102.6
2.51606	-9.30762	37.5204	1216.1	-1539.8	48.8317	-28.603	241.303	-198.4
2.7931	-9.26245	37.8011	1425.6	-1270.08	67.1712	-22.0837	304.76	-159.1
3.06933	-9.21258	38.0818	1633.62	-1013.11	84.9655	-14.3971	364.33	-122
3.34468	-9.15801	38.3625	1787.4	-714.722	107.548	3.254	425.488	-58.5
3.61905	-9.09877	38.6432	1931.67	-414.02	154.568	46.2755	492.345	18.377
3.89238	-9.03487	38.9239	2081.07	-93.6719	198.572	85.445	556.625	94.123
4.16458	-8.96633	39.2046	2266.93	157.615	191.303	64.3273	634.117	137.73
4.43558	-8.89316	39.4853	2381.03	455.723	238.708	103.55	725.76	245.17
4.70529	-8.8154	39.766	2582.55	760.577	300.748	130.401	847.855	330.68
4.97364	-8.73306	40.0467	2867.67	1027.85	447.217	153.718	1067.62	417.18
5.24055	-8.64617	40.3274	3398.52	1298.38	1612.47	572.088	1838.38	696.16
5.50595	-8.55475	40.6081	3373.38	1182.92	4402.85	919.762	2388.1	846.02
5.55967	-8.34536	40.8243	1146.21	463.577	5113.42	817.97	1964.67	561.72
5.61206	-8.13563	41.0405	385.695	82.1837	4378.7	369.475	1228.73	177.96
5.66311	-7.92557	41.2566	279.292	34.0285	4103.95	203.625	1032.36	76.478

5.71283	-7.71519	41.4728	234.537	12.2767	4017.28	162.039	943.732	35.485
5.76121	-7.5045	41.689	209.717	3.47963	4005.93	148.472	900.167	20.657
5.80825	-7.2935	41.9052	200.61	4.1853	4101.15	321.55	879.382	37.513
5.85395	-7.08221	42.1213	189.117	4.08957	4172.6	392.153	865.9	48.688
5.87118	-7	42.2053	186.114	2.15352	4388.98	879.12	832.42	68.357
5.8983	-6.87063	42.3375	176.21	8.24743	4382.2	690.293	848.1	80.712
5.94131	-6.65878	42.5537	170.223	11.6682	4484.2	782.502	848.673	100.68
5.98297	-6.44666	42.7699	164.755	16.6098	4609.93	911.64	849.725	125.93
6.02328	-6.23427	42.986	158.825	20.592	4762.4	1106.29	845.715	152.06
6.06224	-6.02164	43.2022	153.228	25.235	4926.63	1305.77	841.55	179.81
6.09984	-5.80876	43.4184	156.993	32.643	5053.5	1418.33	846.217	207.9
6.13609	-5.59564	43.6346	143.492	30.2837	5232.85	1731.2	827.998	222.49
6.17099	-5.3823	43.8507	133.223	30.6698	5441.17	2052.75	807.96	241.4
6.20453	-5.16875	44.0669	127.75	36.3707	5579.7	2169.43	813.31	271.56
6.23671	-4.95498	44.2831	121.1	36.59	5755.37	2442.35	797.102	285.83
6.26753	-4.74101	44.4993	115.417	40.8133	5895.8	2586.77	798.813	314.56
6.29699	-4.52686	44.7154	108.382	35.9768	6099.98	3010.62	760.336	305.7
6.32508	-4.31251	44.9316	101.179	38.3067	6278.03	3256.78	752.342	331.95
6.35182	-4.098	45.1478	94.9448	38.6093	6439.57	3528.22	736.742	346.01
6.37718	-3.88332	45.364	88.7875	37.3775	6613.73	3868.8	711.23	348.47
6.40119	-3.66848	45.5801	82.876	38.9253	6763.07	4117.87	698.313	366.96
6.41893	-3.5	45.7496	85.194	30.9664	6944.32	4797.78	607.462	247.7
6.42383	-3.45349	45.7963	81.153	32.6263	7015.13	4754.3	633.437	322.2
6.44509	-3.23837	46.0125	76.259	33.6617	7153.72	5099.48	609.137	312.76
6.465	-3.02311	46.2287	62.4585	32.7385	7314.47	5385.45	603.403	360.23
6.48353	-2.80773	46.4448	55.1473	32.5273	7454.7	5707.2	587.13	386.3
6.50069	-2.59224	46.661	50.754	29.9847	7586.5	6123.4	552.48	367.67
6.51648	-2.37664	46.8772	49.9982	26.287	7726.4	6721.7	490.572	275.47
6.53091	-2.16094	47.0934	42.9603	24.1357	7871.2	7224.67	457.683	283.52
6.54395	-1.94516	47.3096	38.8373	22.112	7972.73	7664.57	422.813	266.5
6.55563	-1.7293	47.5257	37.918	21.9987	8074.52	8238.52	368.525	192.58
6.56594	-1.51337	47.7419	29.609	20.6347	8181	8744.77	333.79	217.32
6.57487	-1.29738	47.9581	26.599	19.4343	8248.67	9189.37	294.173	186.99
6.58243	-1.08134	48.1743	30.535	26.78	8311.83	9754.1	234.405	87.394
6.58861	-0.865255	48.3904	31.281	34.0877	8389.2	10311.7	190.567	87.831
6.59342	-0.649133	48.6066	23.2017	25.62	8438.13	10796	145.39	33.899
6.59686	-0.432985	48.8228	24.5305	32.2898	8503.52	11444	70.4765	-98.4
6.59892	-0.21682	49.039	19.3977	29.8637	8644.73	12171.3	11.0242	-109.3

Table 1 - Stresses in the existing lining

X	Y	Distance [m]	Sigma XX [kPa]	Sigma YY [kPa]	Tau XY [kPa]
6.99961	-0.000645849	0	949.72	13880.3	-994.757
6.99958	9.79E-17	0.000646348	986.973	13906	-1421.18
6.97803	0.548568	0.549637	301.662	15412.8	-1761.95
6.91342	1.0944	1.09927	697.303	16432.3	-2545.7
6.80619	1.63347	1.64891	1221	16271.5	-3698.25
6.657	2.16247	2.19855	2061.14	15510.6	-4963.4
6.46676	2.67814	2.74819	3049.42	14931.5	-6254.55
6.23665	3.17729	3.29782	4063.43	14037.2	-7122.1
5.96809	3.65684	3.84746	5180	12828.8	-7742.95
5.66272	4.11385	4.3971	6425.15	11459.2	-8190.68
5.32245	4.54549	4.94674	7783.2	10105	-8493.98
4.94935	4.9491	5.49637	9222.4	8799.63	-8638.8
4.54574	5.3222	6.04601	10705.9	7527.95	-8611.1
4.1141	5.66247	6.59565	12056.7	6436.2	-8512.1
3.6571	5.96784	7.14529	13377.6	5219.58	-7875.36
3.17754	6.2364	7.69492	14922.3	3931.33	-7195.93
2.67839	6.46651	8.24456	16073.3	2975.87	-6510.43
2.16272	6.65675	8.7942	16914.2	2158.96	-5321.42
1.63372	6.80594	9.34384	17918.5	1298.39	-4014.1
1.09465	6.91317	9.89347	18576.7	750.043	-2885.87
0.548819	6.97778	10.4431	18727.4	547.966	-1432.54
-0.000394726	6.99935	10.9927	19081.7	295.35	-0.134887
-0.549608	6.97778	11.5424	18845.3	469.013	1269.34
-1.09544	6.91317	12.092	18333.4	897.496	2818.06
-1.63451	6.80594	12.6417	17748.2	1458.04	4328.6
-2.16351	6.65675	13.1913	17127	2057.17	5450.7
-2.67918	6.46651	13.7409	15904.4	3058.98	6367.76
-3.17833	6.2364	14.2906	14624.3	4207	7393.7
-3.65788	5.96784	14.8402	13520.7	5210.97	8073.9
-4.11489	5.66247	15.3898	11978.8	6435.94	8332.2
-4.54653	5.3222	15.9395	10361.7	7862.05	8659.92
-4.95014	4.9491	16.4891	9099.4	9047.63	8796.33
-5.32324	4.54549	17.0388	7811.9	10162.2	8542.72
-5.66351	4.11385	17.5884	6278.82	11625.2	8084.1
-5.96888	3.65684	18.138	4924.28	13262.5	7676.55
-6.23744	3.17729	18.6877	3964.13	14529	7251.6
-6.46755	2.67814	19.2373	2977.12	15037.8	6119.02
-6.65779	2.16247	19.7869	1944.3	15944.3	4948.95
-6.80698	1.63347	20.3366	1234.72	16434.5	3747.7
-6.91421	1.0944	20.8862	702.15	16543.5	2577.15
-6.97882	0.548568	21.4359	329.246	15599.2	1690.15
-7.00037	9.66E-16	21.9849	740.861	13949.8	1369.04
-7.00039	-0.000645849	21.9855	843.427	13956.7	960.1
-7.00039	-0.697397	22.6822	-9.88275	12632.8	210.52
-7.00039	-1.39493	23.3798	-2.339	11580.7	223.023
-7.00039	-2.09401	24.0789	9.82314	10512.1	255.172
-7.00039	-2.79544	24.7803	5.22807	9506.72	204.675

-7.00039	-3.5	25.4849	17.4292	9058.14	195.703
-7.00039	-4.18968	26.1745	6.81457	8058.88	99.4203
-7.00039	-4.88408	26.8689	2.22862	7731.37	75.9075
-7.00039	-5.58401	27.5689	13.3511	7503.42	34.7203
-7.00039	-6.2903	28.2752	53.9845	7929.33	-212.941
-7.00039	-7	28.9849	48.2664	10395	-720.757
-7.00039	-7.72408	29.7089	6.21525	13217	-669.893
-7.00039	-8.45716	30.442	531.051	17804.8	-1538.41
-7.00039	-9.20065	31.1855	5881.7	17284.5	-5582.85
-6.20039	-10.0006	32.3169	12146.9	6326.86	-5054.58
-5.47971	-10.0006	33.0375	12355.5	322.572	-1274.82
-4.7652	-10.0006	33.7521	8596.35	39.7344	-660.075
-4.06203	-10.0006	34.4552	6513.68	70.1748	-280.649
-3.36853	-10.0006	35.1487	5867.83	25.8898	56.3077
-2.68311	-10.0006	35.8342	6084.28	-4.53291	120.808
-2.00416	-10.0006	36.5131	6357.73	-14.0275	68.2153
-1.33011	-10.0006	37.1872	6391.32	-9.61662	-19.8503
-0.659441	-10.0006	37.8578	6283.15	4.37823	-22.9937
0.00939423	-10.0006	38.5267	6253.67	2.52007	1.35387
0.677909	-10.0006	39.1952	6295.52	4.21034	26.6483
1.34762	-10.0006	39.8649	6405.38	-10.6483	14.9622
2.02006	-10.0006	40.5373	6368.95	-12.1524	-64.9688
2.69674	-10.0006	41.214	6094.57	-9.8261	-126.112
3.37924	-10.0006	41.8965	5815.33	26.9314	-84.4044
4.06913	-10.0006	42.5864	6449.9	82.814	300.358
4.76801	-10.0006	43.2853	8706.62	36.2174	721.807
5.47753	-10.0006	43.9948	12605	328.375	1294.7
6.19961	-10.0006	44.7169	12027.7	6553.7	5182.42
6.99961	-9.20065	45.8482	5856.6	17522.2	5668.13
6.99961	-8.45716	46.5917	499.473	17835.2	1465.72
6.99961	-7.72408	47.3248	-0.503025	13360.2	672.727
6.99961	-7	48.0489	51.6491	10477.9	738.475
6.99961	-6.2903	48.7586	51.6318	7941.25	233.383
6.99961	-5.58401	49.4649	13.6352	7401.32	-6.97295
6.99961	-4.88408	50.1648	5.15247	7514.52	-55.9817
6.99961	-4.18968	50.8592	16.0207	7818.92	-117.869
6.99961	-3.5	51.5489	26.6299	9019.24	-284.846
6.99961	-2.79544	52.2534	-7.88888	9792.63	-258.912
6.99961	-2.09401	52.9549	-0.18106	10853.3	-218.603
6.99961	-1.39493	53.654	0.05961	11859	-229.968
6.99961	-0.697397	54.3515	1.53151	12840.5	-186.58
6.99961	-0.000645849	55.0482	949.72	13880.3	-994.757

Table 2- Stresses in the new lining

			Water pressure	Seismic loading	Water pressure	Seismic loading	Water pressure	Seismic loading
X	Y	Distance [m]	Sigma XX	Sigma XX	Sigma YY	Sigma YY	Tau XY	Tau XY
6.59961	-0.000645849	0	37.73	62.4597	7153.83	10339.7	-52.0061	-232.7
6.59959	1.22E-16	0.000645974	84.507	152.702	7136.58	10572.3	-132.914	-524.7
6.59452	0.258469	0.259165	95.3675	181.093	7216.6	11402.3	-313.168	-787.6
6.57926	0.517184	0.518329	119.557	242.353	7238.73	12289	-560.28	-1193
6.55386	0.775101	0.777494	188.455	419.013	7126.72	12909.2	-818.035	-1795
6.51835	1.03182	1.03666	246.307	553.18	7033.57	13678.3	-1086.76	-2356
6.47279	1.28695	1.29582	352.197	840.16	6856.07	14062.2	-1323.08	-3009
6.41725	1.54009	1.55499	477.943	1108.64	6707.43	14627.3	-1570.37	-3635
6.35181	1.79086	1.81415	605.675	1488.65	6488.78	14689.5	-1768.93	-4251
6.27658	2.03887	2.07332	715.953	1782.17	6279.77	14934.7	-1996.53	-4896
6.19167	2.28373	2.33248	876.305	2231.3	6030.27	14640	-2163.35	-5389
6.09721	2.52506	2.59165	1034.73	2642.47	5792.9	14502.7	-2346.53	-5953
5.99335	2.76251	2.85081	1213.1	3134.98	5519.12	13931	-2473.78	-6316
5.88025	2.99569	3.10998	1392.3	3608.3	5254.77	13518.7	-2617.77	-6772
5.75808	3.22425	3.36914	1581.65	4119.25	4969.38	12790.8	-2704.58	-6993
5.62703	3.44784	3.62831	1774.1	4636.8	4688.67	12222.7	-2807.27	-7339
5.4873	3.66612	3.88747	1975.9	5153.3	4400.5	11436	-2853.92	-7426
5.33912	3.87874	4.14664	2196.23	5728.97	4128	10808.7	-2897.77	-7635
5.1827	4.08537	4.4058	2362.97	6199.75	3837.05	10011.6	-2918.38	-7637
5.01828	4.28571	4.66497	2558.27	6756.27	3536.63	9325	-2942.57	-7772
4.84613	4.47944	4.92413	2741.75	7232.6	3262.15	8572.67	-2913.5	-7660
4.66651	4.66626	5.18329	2933.67	7777.03	2980.23	7896.33	-2893.87	-7678
4.47969	4.84588	5.44246	3104.43	8188.32	2719.63	7178.15	-2830.92	-7461
4.28596	5.01803	5.70162	3284.07	8677.43	2450.87	6498.67	-2775.17	-7356
4.08563	5.18245	5.96079	3438.35	8957.58	2210.5	5832.63	-2682.93	-7032
3.87899	5.33887	6.21995	3599.27	9345.33	1960.97	5145.4	-2594.97	-6774
3.66637	5.48705	6.47912	3751.8	9577.73	1757.82	4536.62	-2468.2	-6363
3.4481	5.62678	6.73828	3894.9	9846.87	1550.77	3959.9	-2351.23	-6047
3.22451	5.75783	6.99745	4001.17	9800.05	1332.05	3399.28	-2226.9	-5569
2.99594	5.88	7.25661	4124.93	9904.13	1130.43	2814.1	-2090.53	-5125
2.76276	5.9931	7.51578	4223.15	9729.2	969.98	2376.6	-1938.08	-4611
2.52532	6.09696	7.77494	4326.27	9664.23	800.647	1888.17	-1784.4	-4109
2.28398	6.19142	8.03411	4404.95	9361.98	669.322	1546.68	-1619.8	-3603
2.03912	6.27633	8.29327	4486.73	9139.97	530.407	1169.14	-1453.03	-3112
1.79111	6.35156	8.55244	4546.47	8630.78	428.55	940.94	-1279.73	-2643
1.54034	6.417	8.8116	4606.5	8233.07	321.273	652.85	-1103.5	-2142
1.2872	6.47254	9.07077	4656.77	7644.85	281.717	537.86	-915.527	-1736
1.03207	6.5181	9.32993	4698.57	7121.27	197.137	344.023	-743.967	-1308
0.775352	6.55361	9.5891	4718.92	6453	127.752	232.547	-556.687	-999.9
0.517435	6.57901	9.84826	4744.03	5831.53	81.6967	129.87	-372.363	-646.1
0.25872	6.59427	10.1074	4753.73	5135.27	68.981	93.6975	-186.471	-444.9
-0.000394726	6.59935	10.3666	4761.17	4448.97	52.0663	49.0767	-0.016371	-191
-0.25951	6.59427	10.6258	4753.67	3756.62	69.0237	35.445	186.495	-93.35
-0.518225	6.57901	10.8849	4744.23	3048.07	81.7607	24.2593	372.563	53.71
-0.776142	6.55361	11.1441	4719.32	2400.28	128.342	9.93535	557.237	53.301

-1.03286	6.5181	11.4032	4694.7	1712.53	175.5	12.6603	744.327	98.365
-1.28799	6.47254	11.6624	4656.5	1148.6	284.24	8.42228	916.832	10.871
-1.54113	6.417	11.9216	4613.03	521.54	322.677	-34.3161	1099.8	-34.82
-1.7919	6.35156	12.1807	4546.07	60.8688	428.742	-97.0752	1279.77	-163.7
-2.03991	6.27633	12.4399	4486.6	-463.973	530.37	-135.098	1453.07	-279.4
-2.28477	6.19142	12.6991	4405.03	-783.442	669.348	-221.823	1619.83	-428.7
-2.52611	6.09696	12.9582	4326.4	-1165.5	800.85	-282.223	1784.63	-570
-2.76355	5.9931	13.2174	4223.57	-1319.18	970.123	-354.313	1938.43	-674.3
-2.99673	5.88	13.4766	4125.53	-1461.8	1130.63	-341.263	2090.67	-723.7
-3.22529	5.75783	13.7357	4001.35	-1409.63	1327.97	-426.825	2226.78	-706.3
-3.44889	5.62678	13.9949	3889.83	-1221.47	1541.93	-461.81	2358.9	-762.8
-3.66716	5.48705	14.2541	3753.82	-1211.73	1767.2	-588.63	2464.2	-802.6
-3.87978	5.33887	14.5132	3601.43	-1072.07	1961.5	-657.467	2594.87	-853.6
-4.08641	5.18245	14.7724	3438.73	-1109.55	2211.02	-723.722	2683.6	-881
-4.28675	5.01803	15.0316	3284.83	-1133.13	2451.27	-839.34	2775.7	-956.2
-4.48048	4.84588	15.2907	3105	-1057.47	2720.5	-912.83	2831.63	-962.8
-4.6673	4.66626	15.5499	2934.53	-997.233	2981.13	-945.5	2894.77	-960
-4.84692	4.47944	15.809	2742.6	-863.297	3263.52	-871.025	2914.48	-846.3
-5.01907	4.28571	16.0682	2559.2	-670.363	3539.33	-794.2	2944.07	-752.9
-5.18349	4.08537	16.3274	2361.18	-626.778	3830.72	-829.375	2923.65	-687.3
-5.33991	3.87874	16.5865	2190.5	-510.643	4133.1	-914.173	2902.23	-654.2
-5.48809	3.66612	16.8457	1988.4	-395.697	4409.38	-942.095	2849.42	-620.4
-5.62782	3.44784	17.1049	1774.03	-348.79	4692.6	-814.717	2808.63	-550.9
-5.75887	3.22425	17.364	1582.7	-313.495	4974.8	-509.64	2707.08	-418.7
-5.88104	2.99569	17.6232	1393.73	-193.173	5261.3	-225.293	2620.77	-248.4
-5.99414	2.76251	17.8824	1214.42	-116.268	5527.03	282.08	2476.87	-67.9
-6.098	2.52506	18.1415	1036.14	-3.64233	5802.47	740.777	2350	133.54
-6.19246	2.28373	18.4007	877.537	37.328	6041.65	1371.47	2166.75	277.13
-6.27737	2.03887	18.6599	716.953	110.641	6293.93	1938.87	2000.17	448.86
-6.3526	1.79086	18.919	592.898	120.226	6502.55	2584	1775	506.24
-6.41804	1.54009	19.1782	486.223	172.09	6723.43	3143	1568.1	594.37
-6.47358	1.28695	19.4374	358.695	126.72	6873.65	3648.8	1328.6	570.09
-6.51914	1.03182	19.6965	246.783	112.546	7050.67	4052.4	1089.35	552.5
-6.55465	0.775101	19.9557	188.892	91.0293	7143.33	4337.3	820.23	439.22
-6.58005	0.517184	20.2148	119.845	68.9953	7254.63	4518.9	562	327.77
-6.59531	0.258469	20.474	95.5197	57.4432	7229.97	4620.3	314.745	174.08
-6.60038	9.44E-16	20.7325	84.7605	60.5915	7146.6	4711	135.039	44.323
-6.60039	-0.000645849	20.7332	38.4063	26.6057	7162.2	4624.2	53.6473	16.927
-6.59971	-0.21682	20.9494	16.0097	12.6896	7077.1	4614.17	-15.1929	-31.49
-6.59765	-0.432985	21.1655	19.8623	17.8414	6997.83	4766.83	-65.699	-97.97
-6.59421	-0.649133	21.3817	18.0203	17.1647	6959.67	4884.97	-125.493	-143
-6.5894	-0.865255	21.5979	48.8757	46.54	6940.23	5041.5	-166.837	-184.6
-6.58322	-1.08134	21.8141	49.117	50.0527	6895.27	5290.47	-197.285	-244.8
-6.57566	-1.29738	22.0302	22.705	25.063	6849.53	5456.87	-250.59	-279.1
-6.56673	-1.51337	22.2464	25.268	27.8747	6810.23	5639.77	-284.61	-317.6
-6.55642	-1.7293	22.4626	33.413	39.6223	6748.83	5894.23	-318.68	-388.7
-6.54474	-1.94516	22.6788	34.2353	40.17	6688.07	6065.97	-365.083	-415.9
-6.53169	-2.16094	22.8949	38.0583	44.9137	6630.23	6221.77	-397.47	-455.5
-6.51727	-2.37664	23.1111	45.2045	55.6755	6548.57	6413.15	-432.07	-516.5
-6.50148	-2.59224	23.3273	45.0263	52.6427	6471.57	6522.5	-481.65	-534.8
-6.48432	-2.80773	23.5435	48.9	57.3843	6399.2	6627.97	-513.337	-573

-6.46579	-3.02311	23.7596	56.011	70.6427	6319.2	6748.72	-534.475	-631.1
-6.44588	-3.23837	23.9758	80.6837	109.362	6227.9	6897.8	-557.302	-717
-6.42461	-3.45349	24.192	120.393	153.167	6155.37	6996.27	-570.213	-745.9
-6.41972	-3.5	24.2387	104.99	155.006	6101.2	7087.54	-556.896	-811.9
-6.40198	-3.66848	24.4082	77.0157	104.169	6006.87	7126.67	-632.07	-810.2
-6.37797	-3.88332	24.6243	82.8938	119.265	5914.25	7238.82	-652.092	-873.8
-6.35261	-4.098	24.8405	88.9633	130.107	5811.4	7358.7	-678.907	-930
-6.32587	-4.31251	25.0567	95.5965	145.303	5711.32	7478.35	-698.86	-992.4
-6.29777	-4.52686	25.2729	103.841	169.822	5594.24	7620.04	-714.758	-1076
-6.26832	-4.74101	25.489	109.65	172.067	5473	7755.73	-750.713	-1122
-6.2375	-4.95498	25.7052	116.705	199.468	5372.25	7880.68	-757.245	-1204
-6.20532	-5.16875	25.9214	123.477	215.877	5254.7	8024.97	-776.883	-1273
-6.17178	-5.3823	26.1376	130.43	251.475	5147.45	8163.42	-779.235	-1370
-6.13688	-5.59564	26.3537	140.268	274.52	5002.97	8361.2	-803.152	-1461
-6.10063	-5.80876	26.5699	180.237	320.717	4893.37	8555.9	-828.41	-1521
-6.06303	-6.02164	26.7861	177.668	347.095	4789.02	8707.28	-815.575	-1603
-6.02407	-6.23427	27.0023	156.95	347.918	4641.48	8884.68	-830.735	-1715
-5.98376	-6.44666	27.2184	163.115	378.11	4514.73	9081.92	-837.47	-1812
-5.9421	-6.65878	27.4346	168.122	419.69	4402.45	9272.33	-837.455	-1923
-5.89909	-6.87063	27.6508	172.64	466.21	4306.23	9452.9	-835.753	-2036
-5.87197	-7	27.783	181.098	576.118	4281.7	9540.64	-819.36	-2213
-5.85474	-7.08221	27.867	185.19	511.98	4109.6	9874.8	-852.33	-2206
-5.80904	-7.2935	28.0831	193.657	567.805	4026.57	10156.2	-861.232	-2349
-5.762	-7.5045	28.2993	201.737	596.84	3923.5	10546.3	-876.7	-2475
-5.71362	-7.71519	28.5155	221.298	704.44	3912.68	11027.7	-908.325	-2730
-5.6639	-7.92557	28.7317	263.32	883.323	3977.85	11841.7	-987.175	-3142
-5.61285	-8.13563	28.9478	379.787	1299.63	4245.85	13284.8	-1191	-3958
-5.56046	-8.34536	29.164	1203.13	4215.55	5038.35	16470	-2000.08	-6867
-5.50674	-8.55475	29.3802	3926.1	13835.7	4480.3	14998.7	-2611.13	-9010
-5.24134	-8.64617	29.6609	4430	15173	1788.82	6144.58	-2165.52	-7536
-4.97443	-8.73306	29.9416	3997.55	13378.7	561.825	2013.97	-1379.37	-4829
-4.70608	-8.8154	30.2223	3890.4	12639	388.403	1380.42	-1169.05	-3991
-4.43637	-8.89316	30.503	3908.35	12166.7	325.64	1122.79	-1075.92	-3543
-4.16537	-8.96633	30.7837	3963.1	11954.7	283.73	939.04	-1019.08	-3237
-3.89317	-9.03487	31.0644	4048.83	11385.7	262.002	849.407	-950.172	-2943
-3.61984	-9.09877	31.3451	4149.65	10977.5	257.663	747.907	-891.435	-2637
-3.34547	-9.15801	31.6258	4247.07	10578.2	196.665	586.415	-843.442	-2348
-3.07012	-9.21258	31.9065	4349.72	10210.3	163.785	461.76	-788.775	-2052
-2.79389	-9.26245	32.1872	4463.9	9819.75	139.937	367.565	-735.387	-1785
-2.51685	-9.30762	32.4679	4570	9535.4	118.497	284.943	-690.567	-1560
-2.23908	-9.34807	32.7486	4695.42	8902.06	115.705	303.002	-596.952	-1434
-1.96067	-9.38379	33.0293	4843.93	8556.4	89.755	216.71	-532.03	-1181
-1.68168	-9.41476	33.31	4977.38	8143.93	74.5213	176.865	-455.428	-982.3
-1.40221	-9.44099	33.5907	5104.6	7866.83	60.5357	111.62	-398.513	-734.8
-1.12234	-9.46246	33.8714	5212.45	7559	82.3413	120.52	-330.93	-584.9
-0.842134	-9.47916	34.1521	5294.17	7279.5	28.3957	46.0167	-266.207	-432.6
-0.56169	-9.4911	34.4328	5342	7015.4	33.8625	53.8935	-182.142	-368.8
-0.281083	-9.49826	34.7135	5387.25	6627.75	35.0678	46.562	-83.4592	-268.6
-0.000394726	-9.50065	34.9942	5412.1	6198.1	26.725	29.053	0.218187	-136.1
0.280293	-9.49826	35.2749	5384.82	5784.15	34.9835	30.2912	83.5988	-87.11
0.5609	-9.4911	35.5555	5335.9	5168.65	33.1572	20.7405	181.64	30.607

0.841345	-9.47916	35.8362	5279.7	4577.27	26.4437	15.061	261.917	151.59
1.12155	-9.46246	36.1169	5191.28	4156.1	55.7225	31.9227	334.183	162.58
1.40142	-9.44099	36.3976	5090	3628.53	93.9847	60.0733	399.47	180.18
1.68089	-9.41476	36.6783	4966.65	3377.82	81.2378	26.283	450.99	133.13
1.95988	-9.38379	36.959	4832.7	2837.13	89.996	26.1127	533.357	169.81
2.23829	-9.34807	37.2397	4688.1	2548.4	115.601	41.7808	597.536	191.09
2.51606	-9.30762	37.5204	4563.87	1779.1	118.427	38.9263	689.9	237.89
2.7931	-9.26245	37.8011	4457.93	1697.7	139.9	47.188	734.665	254.18
3.06933	-9.21258	38.0818	4343.75	1599.7	163.67	56.0492	787.945	275.42
3.34468	-9.15801	38.3625	4237	1570.5	191.543	62.5893	837.835	293.3
3.61905	-9.09877	38.6432	4140.15	1503.08	241.612	79.0472	897.135	295.31
3.89238	-9.03487	38.9239	4046.55	1370.13	285.525	83.713	948.113	264.27
4.16458	-8.96633	39.2046	3962.5	1117.78	284.027	61.8973	1017.2	249.89
4.43558	-8.89316	39.4853	3904.83	1025.66	325.207	67.256	1075.98	245.02
4.70529	-8.8154	39.766	3886.47	911.415	384.23	79.6267	1167.03	251.46
4.97364	-8.73306	40.0467	3991.67	884.535	527.922	103.825	1355.45	283.84
5.24055	-8.64617	40.3274	4376.4	948.7	1712.13	436.812	2102.02	478.47
5.50595	-8.55475	40.6081	3939.1	804.742	4483.23	489.03	2606.98	654.29
5.55967	-8.34536	40.8243	1239.93	357.25	5077.7	399.01	2031.33	355.6
5.61206	-8.13563	41.0405	383.79	19.9505	4255.73	60.6757	1201.3	44.133
5.66311	-7.92557	41.2566	268.9	4.53287	3980.4	23.3827	994.96	-3.291
5.71283	-7.71519	41.4728	224.572	-6.48593	3914.5	90.4565	911.445	-11.24
5.76121	-7.5045	41.689	202.553	-5.14363	3923.9	171.132	876.01	4.9457
5.80825	-7.2935	41.9052	194.27	-4.52035	4031.22	412.745	858.993	28.968
5.85395	-7.08221	42.1213	184.847	1.8253	4112.93	557.673	849.52	59.535
5.87118	-7	42.2053	180.492	-14.4104	4284.64	1008.22	816.416	53.593
5.8983	-6.87063	42.3375	172.22	7.2743	4306.8	925.787	834.827	107.38
5.94131	-6.65878	42.5537	167.887	16.8387	4405.17	1068.99	837.145	144.16
5.98297	-6.44666	42.7699	163.04	25.8005	4519.75	1240	837.803	181.73
6.02328	-6.23427	42.986	157.11	31.0662	4648.02	1451.68	831.45	212.29
6.06224	-6.02164	43.2022	153.52	39.0625	4792.4	1670	819.475	238.53
6.09984	-5.80876	43.4184	192.937	84.6957	4907.4	1808.17	819.06	268.88
6.13609	-5.59564	43.6346	151.628	52.4415	5020.2	2056.1	812.095	290.68
6.17099	-5.3823	43.8507	130.95	41.704	5160.25	2318.97	781.445	297.07
6.20453	-5.16875	44.0669	123.79	46.016	5267.67	2434.97	778.94	323
6.23671	-4.95498	44.2831	117.02	45.3407	5384.55	2653.5	759.325	331.19
6.26753	-4.74101	44.4993	109.96	47.7307	5484.6	2779.9	752.66	352.56
6.29699	-4.52686	44.7154	104.181	43.1428	5603.58	3094.62	716.718	340.38
6.32508	-4.31251	44.9316	95.8885	43.813	5718.63	3285.6	700.43	357.41
6.35182	-4.098	45.1478	89.2173	43.0515	5816.7	3484.22	680.12	364.28
6.37718	-3.88332	45.364	83.0922	41.186	5917.6	3723.55	652.99	362.2
6.40119	-3.66848	45.5801	76.607	41.225	6006.33	3891.13	633.827	370.75
6.41893	-3.5	45.7496	88.569	42.738	6098.88	4369.48	564.774	285.48
6.42383	-3.45349	45.7963	100.327	62.7457	6156.67	4328.03	568.75	326.91
6.44509	-3.23837	46.0125	93.183	59.6758	6229.75	4545.3	554.708	326.75
6.465	-3.02311	46.2287	57.1818	34.1148	6320.35	4699.12	535.335	346.01
6.48353	-2.80773	46.4448	48.8023	31.2283	6400.7	4880.17	512.717	352.64
6.50069	-2.59224	46.661	44.9067	28.965	6476.23	5135.47	481.18	333.88
6.51648	-2.37664	46.8772	45.1098	27.8005	6556.2	5538.3	431.315	267.88
6.53091	-2.16094	47.0934	37.9613	24.138	6641.53	5842.9	397.007	259.43
6.54395	-1.94516	47.3096	34.0943	22.3107	6701.93	6131.63	364.933	237.08

6.55563	-1.7293	47.5257	33.2205	22.9115	6763.63	6558.57	318.99	169.95
6.56594	-1.51337	47.7419	25.24	18.1713	6826.23	6909.7	285.51	174.72
6.57487	-1.29738	47.9581	22.5467	16.5983	6864.07	7260.97	252	145.11
6.58243	-1.08134	48.1743	34.0223	31.1195	6903.07	7762.68	197.955	51.369
6.58861	-0.865255	48.3904	58.6007	60.1693	6946.77	8225.83	163.933	53.775
6.59342	-0.649133	48.6066	29.8097	30.719	6967.13	8660.33	132.003	13.352
6.59686	-0.432985	48.8228	19.5029	23.8425	6994.45	9258.93	66.894	-99.38
6.59892	-0.21682	49.039	15.6092	24.5637	7070.3	9851.53	16.3353	-97.31

Table 1 - Stresses in the existing lining

LONG TERM

X	Y	Distance [m]	Sigma XX [kPa]	Sigma YY [kPa]	Tau XY [kPa]
6.99961	-0.000645849	0	1507.24	10468.1	-1288.32
6.99958	9.79E-17	0.000646348	1489.55	11097.3	-1950.05
6.97803	0.548568	0.549637	264.008	13287.8	-1863.38
6.91342	1.0944	1.09927	786.045	15498.5	-2763.65
6.80619	1.63347	1.64891	1411.2	16659.5	-4168.65
6.657	2.16247	2.19855	2439.98	17180.8	-5813.24
6.46676	2.67814	2.74819	3600.05	17387.3	-7356.1
6.23665	3.17729	3.29782	4810.8	16644	-8473.9
5.96809	3.65684	3.84746	6202.95	15349.8	-9286.75
5.66272	4.11385	4.3971	7679.2	13632.2	-9793.52
5.32245	4.54549	4.94674	9304.15	12019.8	-10143.1
4.94935	4.9491	5.49637	11024.8	10460.3	-10316.8
4.54574	5.3222	6.04601	12718	8935.72	-10242.8
4.1141	5.66247	6.59565	13897.3	7460.33	-9849.33
3.6571	5.96784	7.14529	15912.4	6281.78	-9438.92
3.17754	6.2364	7.69492	17277	4587.45	-8376.05
2.67839	6.46651	8.24456	17965	3334.6	-7319.53
2.16272	6.65675	8.7942	19511.2	2549.48	-6223.54
1.63372	6.80594	9.34384	20116.2	1485.53	-4578.38
1.09465	6.91317	9.89347	20221.7	820.76	-3156.83
0.548819	6.97778	10.4431	21117.4	607.39	-1633.95
-0.000394726	6.99935	10.9927	20642	312.437	-7.06967
-0.549608	6.97778	11.5424	20988	544.56	1465.22
-1.09544	6.91317	12.092	20796	1020.4	3224.26
-1.63451	6.80594	12.6417	19848.8	1637.75	4903.28
-2.16351	6.65675	13.1913	18967.7	2318.1	6079.77
-2.67918	6.46651	13.7409	18488	3599.04	7486.62
-3.17833	6.2364	14.2906	16899	4922.2	8618.35
-3.65788	5.96784	14.8402	15416	5984.43	9243.73
-4.11489	5.66247	15.3898	14356.4	7810.08	10066
-4.54653	5.3222	15.9395	12332.5	9439.87	10373
-4.95014	4.9491	16.4891	10644.6	10577	10298
-5.32324	4.54549	17.0388	9407.67	12142.5	10266.3
-5.66351	4.11385	17.5884	7709.34	14176.6	9903.3
-5.96888	3.65684	18.138	5814.9	15650.5	9089.7
-6.23744	3.17729	18.6877	4521.43	16658	8301.97
-6.46755	2.67814	19.2373	3489.22	17258.4	7164.12
-6.65779	2.16247	19.7869	2255.67	17283.5	5649.1
-6.80698	1.63347	20.3366	1405.2	16680	4158.45
-6.91421	1.0944	20.8862	767.048	15533	2773.45
-6.97882	0.548568	21.4359	307.595	13338.5	1818.18
-7.00037	9.66E-16	21.9849	853.588	10954	1705
-7.00039	-0.000645849	21.9855	811.737	10330.7	878.573
-7.00039	-0.697397	22.6822	-22.6528	9452.53	77.8657
-7.00039	-1.39493	23.3798	-8.10603	8805.3	165.649
-7.00039	-2.09401	24.0789	5.6783	7910.2	231.69
-7.00039	-2.79544	24.7803	31.4642	7166.15	100.318

-7.00039	-3.5	25.4849	32.5825	7416.2	-118.482
-7.00039	-4.18968	26.1745	-17.8737	7649.3	-85.4496
-7.00039	-4.88408	26.8689	-20.4945	7703.35	48.9111
-7.00039	-5.58401	27.5689	-2.28824	7257	129.082
-7.00039	-6.2903	28.2752	31.362	6899.67	19.5841
-7.00039	-7	28.9849	30.0498	7579.22	-265.917
-7.00039	-7.72408	29.7089	20.9111	8756.5	-298.093
-7.00039	-8.45716	30.442	480.783	11673.6	-1241.07
-7.00039	-9.20065	31.1855	6476.5	12639	-5506.27
-6.20039	-10.0006	32.3169	19484.6	6328.48	-6279.82
-5.47971	-10.0006	33.0375	21244.2	506.447	-781.318
-4.7652	-10.0006	33.7521	19250	-126.353	-152.68
-4.06203	-10.0006	34.4552	19787.5	132.475	81.2125
-3.36853	-10.0006	35.1487	19565.5	-43.682	83.9798
-2.68311	-10.0006	35.8342	19948.3	24.6602	5.88725
-2.00416	-10.0006	36.5131	19827.7	-7.77875	9.21675
-1.33011	-10.0006	37.1872	19611.5	-7.54025	-45.0867
-0.659441	-10.0006	37.8578	19479.5	-4.65175	-11.6506
0.00939423	-10.0006	38.5267	19396.7	-0.435533	-5.24567
0.677909	-10.0006	39.1952	19555	19.1338	19.7965
1.34762	-10.0006	39.8649	19701	-14.0374	47.3397
2.02006	-10.0006	40.5373	19756.5	-9.87394	-26.1995
2.69674	-10.0006	41.214	19640	-26.037	-27.9118
3.37924	-10.0006	41.8965	19511.3	-42.3068	-94.47
4.06913	-10.0006	42.5864	19694	186.195	-38.005
4.76801	-10.0006	43.2853	19140.7	-144.88	260.592
5.47753	-10.0006	43.9948	21129.7	575.965	761.845
6.19961	-10.0006	44.7169	19245.8	6573.48	6496.08
6.99961	-9.20065	45.8482	6285.53	13136.2	5630
6.99961	-8.45716	46.5917	486.505	11875.1	1286.19
6.99961	-7.72408	47.3248	22.272	8789.32	330.255
6.99961	-7	48.0489	33.7873	7508.13	289.632
6.99961	-6.2903	48.7586	35.6013	6757.57	-22.1578
6.99961	-5.58401	49.4649	-1.18755	7178.63	-155.366
6.99961	-4.88408	50.1648	-23.7167	7732.95	-66.1042
6.99961	-4.18968	50.8592	-17.3093	7730.88	80.1828
6.99961	-3.5	51.5489	39.4944	7568.52	90.4432
6.99961	-2.79544	52.2534	30.9693	7451.25	-138.351
6.99961	-2.09401	52.9549	-0.318775	8332.23	-253.957
6.99961	-1.39493	53.654	-20.6089	9334.55	-171.587
6.99961	-0.697397	54.3515	-16.5124	9837.02	-26.8832
6.99961	-0.000645849	55.0482	1507.24	10468.1	-1288.32

Table 2 - Stresses in the new lining

			Water pressure	Seismic Loading	Water pressure	Seismic Loading	Water pressure	Seismic Loading
X	Y	Distance [m]	Sigma XX	Sigma XX	Sigma YY	Sigma YY	Tau XY	Tau XY
6.59961	-0.000645849	0	28.148	49.2363	5603.43	7920.17	-37.4137	-208.7
6.59959	1.22E-16	0.000645974	72.342	136.734	5628.43	8289.6	-108.426	-476.2
6.59452	0.258469	0.259165	75.4225	143.106	5691.42	9019.08	-251.413	-675
6.57926	0.517184	0.518329	99.2577	201.247	5715.8	9819.23	-452.987	-991.7
6.55386	0.775101	0.777494	155.775	352.963	5700.25	10481.5	-677.728	-1508
6.51835	1.03182	1.03666	208.54	481.897	5679.27	11247	-900.14	-1995
6.47279	1.28695	1.29582	304.683	757.38	5644.05	11818.5	-1126.2	-2639
6.41725	1.54009	1.55499	446.21	1037.6	5616.43	12622	-1344.23	-3235
6.35181	1.79086	1.81415	565.86	1441.3	5565.63	13039.5	-1557.3	-3925
6.27658	2.03887	2.07332	656.443	1731.63	5498.17	13716.3	-1789.9	-4639
6.19167	2.28373	2.33248	833.055	2252.62	5428.68	13885.7	-2008.23	-5293
6.09721	2.52506	2.59165	1000.1	2728.07	5360.17	14233	-2219.5	-5996
5.99335	2.76251	2.85081	1221.25	3325.88	5261.68	14093.5	-2428.68	-6570
5.88025	2.99569	3.10998	1429.3	3897.5	5172.03	14097.7	-2631.77	-7188
5.75808	3.22425	3.36914	1694.53	4539.85	5046.65	13642	-2825.2	-7602
5.62703	3.44784	3.62831	1943.67	5186.03	4933.3	13348	-3014.33	-8108
5.4873	3.66612	3.88747	2264.25	5824.05	4779.28	12673	-3184.72	-8327
5.33912	3.87874	4.14664	2586.9	6543.57	4663.73	12184.3	-3328.7	-8645
5.1827	4.08537	4.4058	2897.68	7082.62	4470.92	11353.3	-3487	-8704
5.01828	4.28571	4.66497	3222.37	7739.53	4286.17	10670.7	-3635.83	-8897
4.84613	4.47944	4.92413	3603.55	8265.37	4075.5	9804.68	-3734.42	-8764
4.66651	4.66626	5.18329	3967.67	8910.97	3881.07	9048.53	-3840.5	-8790
4.47969	4.84588	5.44246	4373.73	9392.6	3644.55	8219.85	-3889.83	-8557
4.28596	5.01803	5.70162	4765.03	9970.23	3425.53	7460.93	-3951.93	-8442
4.08563	5.18245	5.96079	5184.1	10352.7	3172.28	6690.55	-3945.48	-8096
3.87899	5.33887	6.21995	5589.03	10840	2934.4	5941.07	-3955.23	-7842
3.66637	5.48705	6.47912	6027.98	11142.8	2688.45	5259.72	-3875.45	-7392
3.4481	5.62678	6.73828	6440.33	11526.3	2461.23	4598.93	-3825.53	-7039
3.22451	5.75783	6.99745	6832.32	11630.5	2167.78	3953.5	-3709.75	-6543
2.99594	5.88	7.25661	7237.8	11895	1912.67	3321.3	-3601.43	-6092
2.76276	5.9931	7.51578	7613.95	11898.3	1669.07	2815.7	-3408.6	-5544
2.52532	6.09696	7.77494	7996.13	12040.3	1427.47	2290.07	-3238.67	-5046
2.28398	6.19142	8.03411	8325.23	11919	1209.68	1892.4	-2986.47	-4485
2.03912	6.27633	8.29327	8668.23	11940	988.503	1466.93	-2756.4	-3957
1.79111	6.35156	8.55244	8936.77	11718.3	807.938	1175.33	-2453.52	-3413
1.54034	6.417	8.8116	9223.6	11624	620.09	853.69	-2169.3	-2881
1.2872	6.47254	9.07077	9427.45	11323	518.727	693.732	-1817.27	-2366
1.03207	6.5181	9.32993	9648.53	11119	365.46	463.753	-1498.5	-1866
0.775352	6.55361	9.5891	9758.83	10704.7	259.265	327.492	-1124.13	-1411
0.517435	6.57901	9.84826	9903.6	10380	165.17	194.83	-763.567	-941.3
0.25872	6.59427	10.1074	9932.72	9850.5	144.263	155.462	-380.192	-567
-0.000394726	6.59935	10.3666	9992.2	9365.07	106.014	96.96	-0.00541243	-160.2
-0.25951	6.59427	10.6258	9932.77	8682.77	144.31	103.444	380.238	108.89
-0.518225	6.57901	10.8849	9904	8004.07	165.267	102.068	763.843	427.82
-0.776142	6.55361	11.1441	9759.63	7208.58	259.855	131.27	1124.8	583.22
-1.03286	6.5181	11.4032	9645.17	6413.37	343.91	168.37	1498.93	801.63

-1.28799	6.47254	11.6624	9427.35	5628.63	521.657	224.505	1818.4	841.3
-1.54113	6.417	11.9216	9230.2	4817.93	621.44	234.79	2165.63	941
-1.7919	6.35156	12.1807	8936.23	4083.3	808.142	228.757	2453.47	880.45
-2.03991	6.27633	12.4399	8667.97	3269.47	988.527	245.143	2756.53	845.21
-2.28477	6.19142	12.6991	8325.32	2591.57	1209.53	185.657	2986.45	678.94
-2.52611	6.09696	12.9582	7995.83	1790.53	1427.33	154.517	3238.37	525.61
-2.76355	5.9931	13.2174	7613.35	1211.46	1669.15	38.1065	3408.5	298.88
-2.99673	5.88	13.4766	7237.7	504.913	1912.67	-48.6117	3601.47	69.509
-3.22529	5.75783	13.7357	6831.65	94.6875	2162.22	-200.483	3708.87	-154.6
-3.44889	5.62678	13.9949	6432.97	-426.003	2450.1	-305.513	3833.87	-401.1
-3.66716	5.48705	14.2541	6029.15	-626.95	2698.88	-449.905	3869.95	-568.4
-3.87978	5.33887	14.5132	5590.27	-945.613	2933.5	-604.83	3953.67	-751
-4.08641	5.18245	14.7724	5182.35	-977.04	3171.5	-689.87	3944.33	-808.8
-4.28675	5.01803	15.0316	4763.73	-1069.77	3424.3	-688.52	3950.73	-879.8
-4.48048	4.84588	15.2907	4372.33	-1021.81	3643.63	-675.497	3888.53	-798.3
-4.6673	4.66626	15.5499	3966.57	-624.767	3880.1	-618.44	3839.53	-637.8
-4.84692	4.47944	15.809	3602.72	-589.515	4074.88	-775.537	3733.5	-634.9
-5.01907	4.28571	16.0682	3221.53	-525.433	4287.1	-778.56	3635.4	-657
-5.18349	4.08537	16.3274	2892.95	-517.675	4458.1	-804.812	3492.32	-610.5
-5.33991	3.87874	16.5865	2577.3	-438.537	4668.03	-822.723	3332.13	-651.3
-5.48809	3.66612	16.8457	2282	-429.625	4787.85	-865.028	3174.62	-606
-5.62782	3.44784	17.1049	1941.5	-439.923	4933.33	-1137.54	3013.23	-600.6
-5.75887	3.22425	17.364	1694.38	-301.387	5047.28	-1127.98	2825.25	-614
-5.88104	2.99569	17.6232	1429.43	-337.037	5173	-1098.5	2632.13	-603.8
-5.99414	2.76251	17.8824	1221.45	-279.772	5262.95	-871.857	2429.12	-486.2
-6.098	2.52506	18.1415	1000.37	-198.933	5361.73	-710.487	2220.17	-380.1
-6.19246	2.28373	18.4007	833.287	-147.002	5431.22	-366.11	2008.5	-253.3
-6.27737	2.03887	18.6599	656.083	-77.5237	5503.67	-109.213	1790.43	-138.7
-6.3526	1.79086	18.919	541.173	-40.9493	5568.65	319.546	1562.82	-58.71
-6.41804	1.54009	19.1782	459.497	50.851	5621.67	653.96	1334.73	26.756
-6.47358	1.28695	19.4374	315.313	6.288	5651.25	1113.13	1131.7	74.035
-6.51914	1.03182	19.6965	208.523	17.7413	5684.37	1504.97	900.86	114.9
-6.55465	0.775101	19.9557	155.868	13.7938	5704.9	1992.75	678.542	78.173
-6.58005	0.517184	20.2148	99.371	23.3153	5719.27	2421.1	453.753	66.135
-6.59531	0.258469	20.474	75.5183	20.7137	5693.18	2865.07	252.065	-29.24
-6.60038	9.44E-16	20.7325	72.417	32.9232	5628.72	3223.23	109.471	-118.8
-6.60039	-0.000645849	20.7332	28.6407	13.9215	5602.93	3332.83	38.4174	-64.96
-6.59971	-0.21682	20.9494	12.3774	6.68697	5538.8	3502.03	-15.4359	-79.32
-6.59765	-0.432985	21.1655	14.9796	9.19227	5500	3765.63	-54.1912	-142
-6.59421	-0.649133	21.3817	15.9964	14.1332	5471.67	4044.4	-101.737	-153
-6.5894	-0.865255	21.5979	72.9637	71.1963	5467.17	4259.1	-137.143	-181.8
-6.58322	-1.08134	21.8141	66.7113	66.3025	5436.82	4476.9	-151.88	-217.6
-6.57566	-1.29738	22.0302	18.1373	20.1507	5393.67	4675.83	-200.347	-241
-6.56673	-1.51337	22.2464	19.9337	23.31	5369.83	4833.8	-227.177	-270.5
-6.55642	-1.7293	22.4626	26.8425	33.5265	5334.2	5014.25	-255.293	-329.3
-6.54474	-1.94516	22.6788	27.5273	34.4267	5290.73	5186.67	-291.93	-353.3
-6.53169	-2.16094	22.8949	30.6367	39.4813	5253.07	5318.83	-318.32	-389.3
-6.51727	-2.37664	23.1111	36.6962	50.069	5202.1	5480.75	-347.815	-447.8
-6.50148	-2.59224	23.3273	36.268	46.5267	5146.53	5627.23	-385.83	-466.2
-6.48432	-2.80773	23.5435	39.3387	50.6733	5098.57	5744.37	-411.427	-501.6
-6.46579	-3.02311	23.7596	45.192	62.7665	5049.07	5862.93	-430.4	-556.3

-6.44588	-3.23837	23.9758	82.5632	113.186	5001.33	6010.32	-459.797	-644.5
-6.42461	-3.45349	24.192	152.997	188.04	4962.5	6136.17	-455.537	-655.7
-6.41972	-3.5	24.2387	114.885	167.144	4930.3	6195.42	-448.086	-721.5
-6.40198	-3.66848	24.4082	64.1483	94.8657	4852.9	6306.97	-513.377	-722
-6.37797	-3.88332	24.6243	68.588	108.392	4793.63	6426.13	-534.82	-785.8
-6.35261	-4.098	24.8405	73.728	118.688	4729.4	6569.93	-558.078	-839.8
-6.32587	-4.31251	25.0567	79.7025	133.777	4667.55	6711.88	-577.175	-902.2
-6.29777	-4.52686	25.2729	87.5996	159.022	4596.46	6883.52	-595.428	-989.9
-6.26832	-4.74101	25.489	91.8457	160.147	4517.87	7070.13	-624.337	-1034
-6.2375	-4.95498	25.7052	99.1592	189.147	4458.38	7232.87	-635.995	-1124
-6.20532	-5.16875	25.9214	105.287	205.857	4386.07	7432.97	-655.517	-1197
-6.17178	-5.3823	26.1376	113.578	244.988	4325.38	7624.35	-666.31	-1309
-6.13688	-5.59564	26.3537	124.675	270.482	4241.77	7907.13	-693.358	-1409
-6.10063	-5.80876	26.5699	193.967	346.773	4195.63	8191.23	-718.097	-1473
-6.06303	-6.02164	26.7861	185.668	369.475	4139.92	8405.57	-702.783	-1559
-6.02407	-6.23427	27.0023	140.605	347.373	4034.73	8646.97	-733.035	-1692
-5.98376	-6.44666	27.2184	147.578	379.95	3962.78	8920.13	-746.45	-1802
-5.9421	-6.65878	27.4346	154.457	425.395	3904.2	9180.3	-756.388	-1929
-5.89909	-6.87063	27.6508	161.04	475.943	3856.5	9421.93	-765.01	-2058
-5.87197	-7	27.783	180.086	601.164	3874.24	9546	-778.048	-2273
-5.85474	-7.08221	27.867	173.78	524.203	3744.9	9961.57	-787.65	-2243
-5.80904	-7.2935	28.0831	184.667	584.932	3709.48	10304	-806.9	-2403
-5.762	-7.5045	28.2993	191.983	614.663	3651.43	10762.3	-824.873	-2538
-5.71362	-7.71519	28.5155	217.98	733.365	3701.5	11324.5	-875.795	-2823
-5.6639	-7.92557	28.7317	273.523	932.275	3857.35	12262.8	-987.978	-3284
-5.61285	-8.13563	28.9478	431.065	1389.32	4288.45	13916.8	-1272.13	-4199
-5.56046	-8.34536	29.164	1544.73	4686.42	5454.65	17602.5	-2388.67	-7503
-5.50674	-8.55475	29.3802	5474.5	15852.5	5131.27	16328.7	-3352.6	-10120
-5.24134	-8.64617	29.6609	6636.6	17690.6	2209.18	6832.98	-2924.9	-8593
-4.97443	-8.73306	29.9416	6383.08	15690.2	788.198	2312.6	-2062.58	-5631
-4.70608	-8.8154	30.2223	6489.55	14813.5	588.88	1618.68	-1855.13	-4685
-4.43637	-8.89316	30.503	6780.1	14265.2	513.605	1321.5	-1774.55	-4158
-4.16537	-8.96633	30.7837	7097.6	13974.7	469.563	1097.51	-1751.6	-3775
-3.89317	-9.03487	31.0644	7501.4	13549	431.75	993.098	-1667.3	-3445
-3.61984	-9.09877	31.3451	7939.35	13275.5	420.345	855.025	-1624.1	-3080
-3.34547	-9.15801	31.6258	8345.3	13075	352.157	672.952	-1585.3	-2769
-3.07012	-9.21258	31.9065	8737.5	12936.5	309.5	539.352	-1536	-2479
-2.79389	-9.26245	32.1872	9126.7	12829	272.455	441.36	-1467.4	-2223
-2.51685	-9.30762	32.4679	9467.7	12780.7	237.857	355.847	-1408.63	-2006
-2.23908	-9.34807	32.7486	9769.88	12679	224.11	371.142	-1197.86	-1785
-1.96067	-9.38379	33.0293	10187	12741.3	180.91	268.147	-1094.4	-1505
-1.68168	-9.41476	33.31	10515.2	12819.5	151.615	215.695	-946.215	-1261
-1.40221	-9.44099	33.5907	10842.3	12977.7	116.277	145.713	-852.39	-1068
-1.12234	-9.46246	33.8714	11068.5	13036	127.658	151.564	-704.595	-882
-0.842134	-9.47916	34.1521	11262.3	13053	58.9923	73.313	-565.733	-690.3
-0.56169	-9.4911	34.4328	11325	12981	71.824	88.4815	-389	-501.4
-0.281083	-9.49826	34.7135	11400.8	12850	74.9425	79.344	-177.653	-289.2
-0.000394726	-9.50065	34.9942	11470	12668.7	57.1537	64.6593	0.995533	-78.53
0.280293	-9.49826	35.2749	11399.3	12340.8	75.1305	75.3592	180.078	91.645
0.5609	-9.4911	35.5555	11323.8	11910.8	71.4313	56.936	390.997	302.76
0.841345	-9.47916	35.8362	11257.3	11501	57.225	49.0513	563.233	503.36

1.12155	-9.46246	36.1169	11059	10901.5	101.157	84.413	709.71	589.84
1.40142	-9.44099	36.3976	10840.3	10241.6	149.953	127.417	855.02	705.05
1.68089	-9.41476	36.6783	10513.5	9655.22	158.708	116.785	943.658	702.37
1.95988	-9.38379	36.959	10185	8933.83	181.063	123.95	1097.03	812.99
2.23829	-9.34807	37.2397	9766.64	8251.64	222.992	139.528	1197	829.04
2.51606	-9.30762	37.5204	9464.97	7322.4	237.473	162.45	1407.03	1017.6
2.7931	-9.26245	37.8011	9117.58	6810.33	272.142	177.14	1464.95	1009.8
3.06933	-9.21258	38.0818	8724.88	6252.35	309.162	198.307	1533.6	1025
3.34468	-9.15801	38.3625	8327.57	5819.52	346.79	222.475	1578.18	1038.5
3.61905	-9.09877	38.6432	7921.67	5423.7	404.125	265.057	1627.65	1067.8
3.89238	-9.03487	38.9239	7489.7	5035.02	454.35	303.063	1663.62	1086.7
4.16458	-8.96633	39.2046	7087.07	4595.43	469.727	306.893	1748.57	1130.4
4.43558	-8.89316	39.4853	6766.17	4433.13	513.79	352.08	1775.25	1180.2
4.70529	-8.8154	39.766	6474.85	4288.78	586.065	414.543	1856.7	1267.9
4.97364	-8.73306	40.0467	6371.53	4332.07	753.982	562.53	2045.4	1450.1
5.24055	-8.64617	40.3274	6590.44	4562.44	2117.39	1594.46	2851.84	2062.9
5.50595	-8.55475	40.6081	5505.17	3893.48	5147.95	3539.1	3348.12	2433.5
5.55967	-8.34536	40.8243	1593.77	1281.18	5521.53	3781.98	2431.93	1839.6
5.61206	-8.13563	41.0405	437.012	333.05	4318.82	2845.73	1288.65	899.25
5.66311	-7.92557	41.2566	282.002	191.07	3879.9	2478.75	1002.87	658.06
5.71283	-7.71519	41.4728	223.67	145.805	3721.9	2327.52	885.685	567.19
5.76121	-7.5045	41.689	194.41	123.353	3667.47	2229.8	829.47	517.02
5.80825	-7.2935	41.9052	187.205	121.37	3727.77	2239.27	810.578	512.27
5.85395	-7.08221	42.1213	174.773	111.047	3759	2172	789.317	487.54
5.87118	-7	42.2053	180.668	130.636	3884.7	2377.82	779.22	540.91
5.8983	-6.87063	42.3375	161.253	108.002	3864.53	2133.17	766.453	467.27
5.94131	-6.65878	42.5537	154.747	95.6715	3912.57	2037.75	758.023	432.04
5.98297	-6.44666	42.7699	147.917	84.3497	3970.95	1937.85	748.23	396.76
6.02328	-6.23427	42.986	141.228	77.417	4040.77	1873.32	734.675	371.35
6.06224	-6.02164	43.2022	139.202	73.8545	4134.43	1816.82	709.513	330.33
6.09984	-5.80876	43.4184	218.237	143.3	4205.83	1708.7	698	288.71
6.13609	-5.59564	43.6346	146.48	82.302	4254.68	1768.15	708.528	322.66
6.17099	-5.3823	43.8507	114.397	54.7195	4326.02	1810.27	667.9	290.53
6.20453	-5.16875	44.0669	105.417	42.278	4383.53	1700.93	655.75	253.76
6.23671	-4.95498	44.2831	99.242	38.8937	4453.68	1788.65	635.98	244.85
6.26753	-4.74101	44.4993	91.8227	32.8167	4511.03	1751.43	623.81	229.01
6.29699	-4.52686	44.7154	87.6378	32.3254	4587.8	2053.78	594.966	229.96
6.32508	-4.31251	44.9316	79.6472	28.087	4656.88	2131.3	576.257	225.39
6.35182	-4.098	45.1478	73.646	26.2148	4717.47	2280.23	556.88	227.07
6.37718	-3.88332	45.364	68.4465	24.8858	4780.98	2507.3	533.455	228.4
6.40119	-3.66848	45.5801	62.9833	25.5927	4835.2	2633.17	514.237	234.14
6.41893	-3.5	45.7496	82.923	35.246	4911.7	3309.76	460.394	182.86
6.42383	-3.45349	45.7963	114.456	72.3223	4951.03	3134.87	450.693	199.79
6.44509	-3.23837	46.0125	105.762	68.1445	4991.55	3340.73	453.42	226.17
6.465	-3.02311	46.2287	47.252	23.141	5037.35	3378	431.138	243.47
6.48353	-2.80773	46.4448	39.0777	21.3267	5085.7	3470.33	409.47	249.77
6.50069	-2.59224	46.661	35.9947	20.281	5136.93	3665.7	384.363	241.7
6.51648	-2.37664	46.8772	36.5168	20.094	5195.1	4031.65	346.593	210.52
6.53091	-2.16094	47.0934	30.5283	18.6133	5247.97	4166.13	317.32	201.55
6.54395	-1.94516	47.3096	27.4187	18.3737	5287.27	4332.63	291.07	182.56
6.55563	-1.7293	47.5257	26.7805	20.5788	5332.55	4667.45	254.393	130.8

6.56594	-1.51337	47.7419	19.9153	14.533	5370.27	4830.6	226.413	118.49
6.57487	-1.29738	47.9581	17.7737	13.1357	5395.33	5096.23	200.097	89.873
6.58243	-1.08134	48.1743	38.3443	37.1315	5434.38	5583.7	149.4	-1.433
6.58861	-0.865255	48.3904	91.091	91.6883	5469.77	5953.2	128.57	1.0437
6.59342	-0.649133	48.6066	37.9008	36.7119	5483.97	6378.9	110.93	-26.66
6.59686	-0.432985	48.8228	14.1576	13.1385	5501.07	6990.03	53.621	-117.6
6.59892	-0.21682	49.039	11.9933	19.3968	5539.63	7464.23	15.8906	-94.75

PHASE 1

ASSESSMENT OF EXISTING ROGUN HPP WORKS

ANNEX 12

COST ESTIMATE AND VALUE ESTIMATION METHODOLOGY

TABLE OF CONTENTS

The present document describes the methodology used for the evaluation of the cost of construction of each alternative of ROGUN dam and HPP:

- The part 1 describes the inputs used and necessary to calculate the cost,
- The part 2 presents the methodology that will be used for the valuation of the existing works.
- The part 3 links the cost estimate work with the economic and financial studies also part of the Contract.
- The part 4 describes the steps of deliverables according to the Contract Terms of Reference and in order to get, at the end of the study, the value of existing works, the cost of rehabilitation and the cost of future works for completion of the project

1 PRESENTATION OF THE COST ESTIMATE METHODOLOGY FOR PHASE 1 AND PHASE 2 STUDIES

These costs will be established with international prices and modern and international construction methods, according to the following methodology.

1.1 General layout / Construction methodology

Project characteristics and construction methodologies will impact the unit prices of the cost estimates. All necessary information on the project cost evaluation and construction methodology shall be defined and presented in this section.

1.2 Basic Costs / Equipment Supply Costs

1.2.1 Equipment cost

The cost of supply and transport to Tajikistan of modern equipments shall be determined (Caterpillar type machines).

1.2.2 Local and foreign materials

Every price shall be international, except for some of the explosive items that are manufactured in Tajikistan.

1.2.3 Labour costs

These costs have been defined according to information given by local agencies and the consultant database.

1.3 Equipment rates

The equipment rates are composed of "owning costs" and "operating costs". The combination presented below allows the definition of the hourly rates, which describes the overall cost of machine use.

- "owning costs", includes:
  - The delivered price, that is to say supply and transportation to the Site (CIF price).
  - Depreciation, insurance, interest, recover of price escalation, residual value at replacement all based on the delivered price of each unit.
  - The operating life time (number of working hours, defined by the type of work to be carried out (i.e. if moderate, average or severe) and other working characteristics.
- "operating costs" includes:
  - Basic material and labour consumption (fuel, electric power, filters and other spare parts),
  - Repair (based on a percentage of the equipment value according to its lifetime and work performed),
  - Replacement of items subject to wear as well as tire replacement and tire repair, if any.

The result of the addition of these two costs is:

- a unique hourly cost for the mobile equipment,
- two separate costs for the stationary/appointed equipment, i.e. a montly cost which includes the owning costs and a hourly cost which includes the operating costs.

1.4 Unit prices

A unit price corresponds to the cost of a complete process.

- All equipments used during this process must be defined, according to the quantities, rates, duration of the works.
- Afterwards, the Unit price for the process is analyzed according to equipment rates and quantities, operating factors and hourly costs defined above.

The number of unit prices will be limited: similar processes will have a common unit price.

Quantities will be derived for each unit price.

2 PRESENTATION OF THE VALUE ESTIMATION METHODOLOGY FOR EXISTING WORKS

2.1 General

The methodology for the evaluation of the existing Rogun HPP works, as indicated in the Scope of Services of the Contract for Consultant's Services, is presented in the following paragraphs, describing in detail the underlying principles of the selected valuation method and the main customizations required.

2.2 The Valuation Method

Three are the principal valuation methods generally internationally recognised (see publications from the International Valuation Standards Council or IVSC), i.e. Sales Comparison Approach (SCA), Income Capitalisation Approach (ICA) and Cost Approach or Depreciated Replacement Cost (DRC).

All methods are based on the economic theory of substitution, since they involve comparing the asset being valued with another, and all may be used to assess different kinds of valuation, including Market Value. When used to assess Market Value, the objective is to establish the price that would be paid between a willing buyer and willing seller acting at arm's length.

Out of the above methods, the Cost Approach or Depreciated Replacement Cost (DRC) has been selected to carry out the Rogun HPP existing works evaluation, due to the peculiarity of the asset under scrutiny.

The IVSC defines the Depreciated Replacement Cost (DRC) as *"the current cost of replacing an asset with a modern equivalent asset less deductions for physical deterioration and all relevant forms of obsolescence and optimization".*

DRC is normally used in situations where there is no directly comparable alternative, due to the specialised nature of the asset.

A particular case of specialized asset is the specialized property, which is defined as *"real property that is rarely, if ever, sold in the market, except by way of a sale of the business or* *entity of which it is part, due to the uniqueness arising from its specialised nature and design, its configuration, size, location, or otherwise".* Rogun HPP can be considered a specialised asset.

The comparison therefore has to be made with a hypothetical substitute, described as the modern equivalent asset.

The underlying theory is that the potential buyer in the exchange described in the Market Value definition would not pay the asset being valued to acquire more than the cost of acquiring an equivalent new one. The technique involves assessing all the costs of providing a modern equivalent asset using pricing at the date of valuation.

In order to assess the price that the buyer would pay for the actual asset, depreciation adjustments have to be made to the gross replacement cost to reflect the differences between the actual asset and the modern equivalent. These differences can reflect factors such as the comparative age or remaining economic life of the actual asset, the comparative running costs and the comparative efficiency and functionality.

2.3 Description of the Valuation Method

The Depreciated Replacement Cost (DRC) can be written as:

DRC = RC – (PD + FO + OD)

The terms are described in the following.

2.3.1 The Replacement Cost (RC)

The Replacement Cost (RC) reflects the cost of a modern equivalent asset. The modern equivalent asset is an alternative asset providing the utility equivalent to the asset being valued.

In assessing the cost of the replacement asset for Rogun HPP, due account will be taken of all the costs that would be incurred by a potential buyer at the date of valuation. These could include the costs of delivery, transportation, installation, construction, commissioning, design and other fees.

This cost will include the specific environment in the country, such as manpower cost, possible construction methodologies considering climate, topographical and other local conditions.

2.3.2 The principal types of depreciation

The hypothetical buyer has the option of procuring either the modern equivalent or the actual asset. If the modern equivalent provides the ideal facility for the buyer, the price paid for the actual asset is expected to reflect all the disadvantages that it suffers in comparison to the modern equivalent.

The principal types of depreciation allowance or “obsolescence” are the following:

- Physical deterioration (PD),
- Functional obsolescence (FO),
- Other types of depreciation.

2.3.2.1 Physical deterioration (PD)

The Physical deterioration (PD) is the result of wear and tear over the years, which may be combined with a lack of maintenance. In the case of Rogun HPP, this is expected to represent the major component of the composite obsolescence. The Physical deterioration may be evaluated by:

- measuring by reference to the anticipated physical life of the asset. IVSC indicates as possible techniques the “straight line” approach, the “reducing balance” approach, the “S-curve” approach. In the case of Rogun HPP, the “straight line” and the “reducing balance” approaches will be used, where appropriate, when assessing the physical depreciation of the equipment.
- evaluating the cost of the works required to recover the effects of the wear and tear over the years, which may be combined with a lack of maintenance (typically, repair works). The evaluation accounts for costs that would be incurred by a potential buyer at the date of valuation. In the case of Rogun HPP, this evaluation will be carried out, where appropriate, when assessing the physical depreciation of civil works.

Also, the Physical deterioration is not to be viewed in absolute terms, but within the context (for some types of assets, a degree of physical deterioration will not adversely affect the value; in other cases it will). This aspect will be taken into account.

2.3.2.2 Functional or “technical” obsolescence (FO)

The Functional obsolescence (FO), also called technical obsolescence, arises where:

- the design or specification of the asset no longer fulfils the function for which it was originally designed,
- there are advances in technology,
- there are advances in legislation.

The depreciation adjustment will reflect either the cost of upgrading or, if this is not possible, the financial consequences of the reduced efficiency compared with the modern equivalent (excess operating cost, in terms of labour, inefficiency or consumption of raw materials).

In the case of Rogun HPP, this obsolescence will be taken into account, where appropriate.

2.3.2.3 Other types of depreciation (OD)

The two above headings described in the previous paragraphs, simply illustrate common reasons for the actual asset being worth less than the modern equivalent, not necessarily they are the only reasons.

These types of depreciation assume that the actual asset, prior to undergoing any of the effects of the wear and tear over the years, combined or not with a lack of maintenance, was:

- supported by sound engineering design, aimed at assuring the structural stability, the serviceability and the durability of the works as per scope of work of the project,
- built in accordance with the above mentioned design,
- accompanied by an appropriate set of “as-built” documents, to be preserved in time.

In principle, inadequacy of design and/or relevant construction of the actual asset may require to introduce additional type(s) of depreciation, to be identified case by case.

The effect of this depreciation will be quantified by the costs for additional design activities and the cost for interventions on existing works.

In the case of Rogun HPP, based on the thorough analysis of the extensive information collected from the project archives and from the field, the consultant will carefully evaluate the need to account for additional types of depreciation.

Then, if necessary, the Parties may envisage verifying at what extent any information, additional to the extensive one already utilized by the Consultant, may be useful to refine the analysis. Such additional information may come, again, from the Rogun HPP archives or, alternatively, from the evidences of additional specific investigations in the field to be envisaged for the purpose. For the benefit of the Project and in the interest of the Client, any additional information should be systematically collected and made available to the Consultant in intelligible and duly organized form. If not, then, this will be recommended in the final discussions/recommendations to be part of the assessment.

3 ECONOMIC AND FINANCIAL STUDIES

The value evaluations and the future works cost estimates will be used appropriately for the economical and financial studies.

4 DESCRIPTION OF THE DELIVERABLES

According to the Terms of Reference 5.3, “Assessment of the value of the infrastructure already constructed at the Rogun HEP would be part of the Feasibility Study”. This feasibility study will be carried out during phase 0, 1 and 2. Moreover, the alternatives will be defined in phase 2 only, so, the detailed rehabilitation works will be known during Phase 2. As a consequence, the value of existing works can be calculated in Phase 2 only.

However, according to the description of the content expected in Phase 1 report (Terms of reference 5.3), the “detailed estimate of investment made (sunk cost at current price level)” as well as recommendation of possible rehabilitation and reuse of existing works will be presented in phase1.

The content of cost estimate for Phase 1 and Phase 2 is as follows:

4.1 Phase 1 report

Volume 1 will include the investment made estimation (E).

This volume will be divided in six parts as follows:

- Part I: Introduction, cost summary of the investment made (E), general plan view and time construction schedule. Reference price level, exchange rate,
- Part II: Basic costs of labour and materials in the current conditions.
- Part III: Construction equipment rates based on nowadays equipments capacity and efficiency
- Part IV: Construction methods based on modern approach
- Part V: Price list
- Part VI Priced Bill of Quantities of the construction works and general costs of the existing works
- Part VII General costs, that will detail:
  - Assumptions and estimates for:
    - engineering, supervision, hydraulic, structural model tests, topography and mapping, geological, geotechnical and geophysical field investigations
    - administration, legal costs, land acquisition, resettlement, environmental

Volume 2 will include:

- The analysis of main items in regard to their usefulness. This will allow the definition of the replacement cost (RC) in phase 2 of the study.
- The analysis of the need for repair works.

4.2 Phase 2 report

The future works cost, and the value assessment will be presented in this report as follows:

Volume 1 will include the overall future investment necessary to complete the project (D)+(F), with:

- (D): The necessary repair works costs
- (F): The future work costs necessary to complete the project.

This volume will be divided in six parts as follows:

- Part I: Introduction and cost summary of each dam alternative, general plan view and time construction schedule. Reference price level, exchange rate,
- Part II: Basic costs of labour and materials in the current conditions
- Part III: Construction equipment rates based on nowadays equipments capacity and efficiency
- Part IV: Construction methods
- Part V: Price list
- Part VI Priced Bill of Quantities and General Costs of Project Alternatives with the necessary sub-sections:
    - General Costs etc...
    - Repair works,
    - Works for Plant Completion,
- Part VIII General costs for Phase 2 construction, that will details:
    - Assumptions and estimates for:
        - engineering, supervision, hydraulic, structural model tests, topography and mapping, geological, geotechnical and geophysical field investigations
        - administration, legal costs, land acquisition, resettlement, environmental,
    - Criteria and assumption of contingencies for the various components
    - Criteria for price escalation during construction
    - Criteria and estimate of Financial charges during construction
    - Estimate of the annual operation and maintenance
    - Schedule of expenses

Volume 2 will include:

- The investment made estimation (E)

- The replacement cost (RC)
- The depreciation cost (D)
- The future works cost to complete the project (F)
- The overall future investment necessary to complete the project (D)+(F)
- The existing works value estimation:

$$DRC = RC - D$$

OSHPC BARKI TOJIK

TECHNO-ECONOMIC ASSESSMENT STUDY FOR ROGUN HYDROELECTRIC CONSTRUCTION PROJECT

PHASE 1

ASSESSMENT OF THE POWERHOUSE CAVERN STABILITY

Two dimensional Design Analyses

RP 39 – Annex 13

September 2013

COYNE ET BELLIER
Ingénieurs Conseils

ELECTROCONSULT

IPA
Energy + Water Economics

TECHNO-ECONOMIC ASSESSMENT STUDY FOR ROGUN HYDROELECTRIC CONSTRUCTION PROJECT

PHASE 1
ASSESSMENT OF THE POWERHOUSE CAVERN STABILITY

SEPTEMBER 2013

Report No. P.002378 RP 39 rev. C – Annex 13

C	Sep 2013	Final Assessment with PH Cavern	BAR	BAR/CIS/LGR	LCO
A	21 Jun 2013	First Issue as RP 50	BAR	BAR/CIS/LGR	LCO
Revision	**Date**	**Subject of revision**	**Drafted**	**Checked**	**Approved**

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Appendix 2 – Geotechnical logs BH1, BH2

1. INTRODUCTION

This report is intended to assess the stability conditions of the Underground Cavern Complex (Machine Hall, Transformer Hall and Assembly Hall) with reference to the zone where Units 5 and 6 are located, in the western end of the Machine Hall (Chainage 0+00 m to 0+50/0+70 m). The progress of the excavation down to the base of the turbine pits has been analyzed with due consideration given to the existing rock support at the crown and sidewalls and the additional support measures envisaged by the Designers of the Moscow Hydroproject Institute.

In line with the results of the Meeting held in Dushanbe on February 14-17 2013 and the Mission at the Rogun Site on April 3-8 2013, a simplified two dimensional numerical model of the underground caverns has been implemented. The purpose has been first to back analyze the convergence data available and recorded so far in the Machine Hall cavern at approximate elevation 986 m. Then, also based on the information provided on the geological and rock mass conditions, and the proposed future excavation and support sequence, comprehensive numerical analyses have been performed to analyze the post-failure behavior of rock masses and interaction with support systems.

With due attention also paid to the time dependent deformational response observed in the Machine Hall cavern, in siltstone, the modeling studies have addressed the issue of the stability conditions of cavern excavation. Finally, recommendations are given for the additional rock support and stabilization measures of the siltstone zone in order to minimize further movements in the Machine Hall as a result of the excavation to be carried out in the future.

2. GENERAL

The Rogun HPP scheme is located about 110 km East-North East of Dushanbe. It incorporates a large storage reservoir on the Vakhsh River and the underground infrastructures which comprise the underground cavern complex (the Assembly Hall - AH, the Machine Hall - MH and the Transformer Hall - TH), many underground openings and tunnels (Figure 1). A significant extent of the underground works has been completed by 1992, when the site was abandoned up to 2005, with construction works restricted to care and maintenance as far as possible.

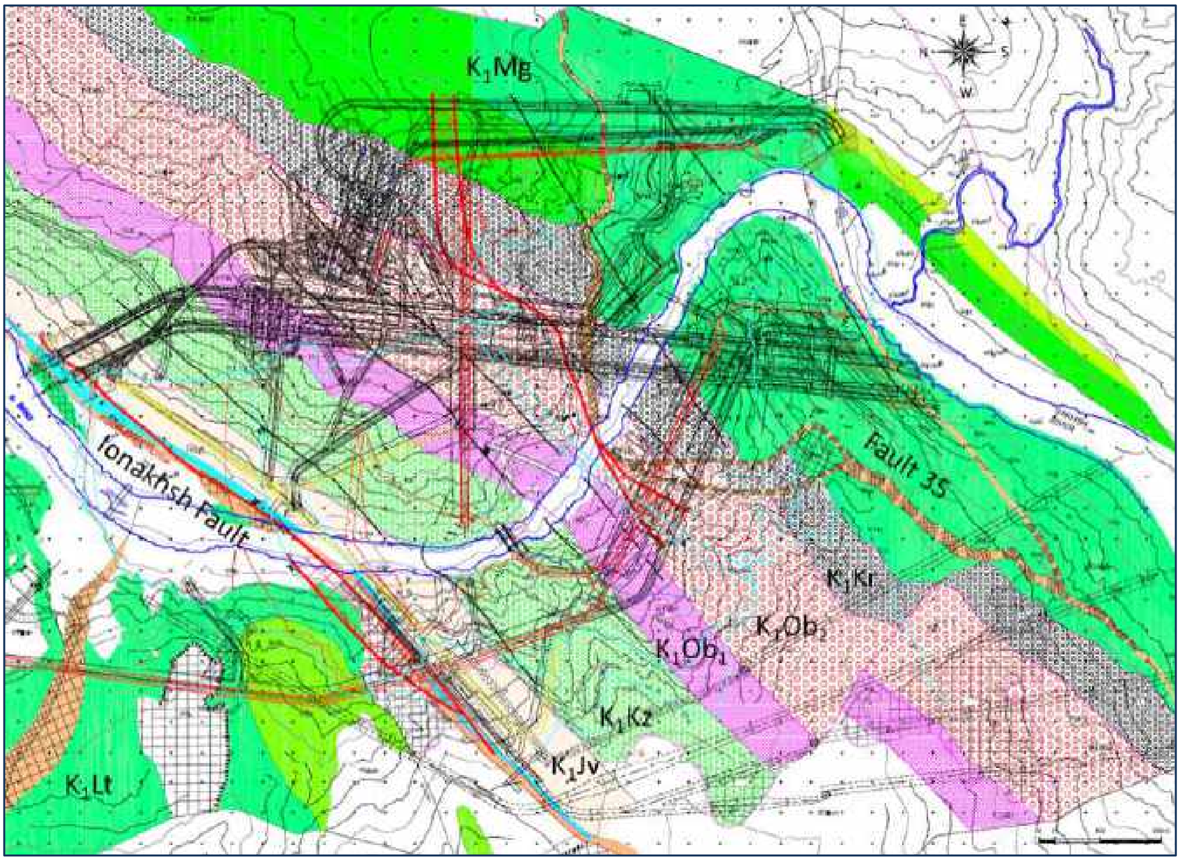
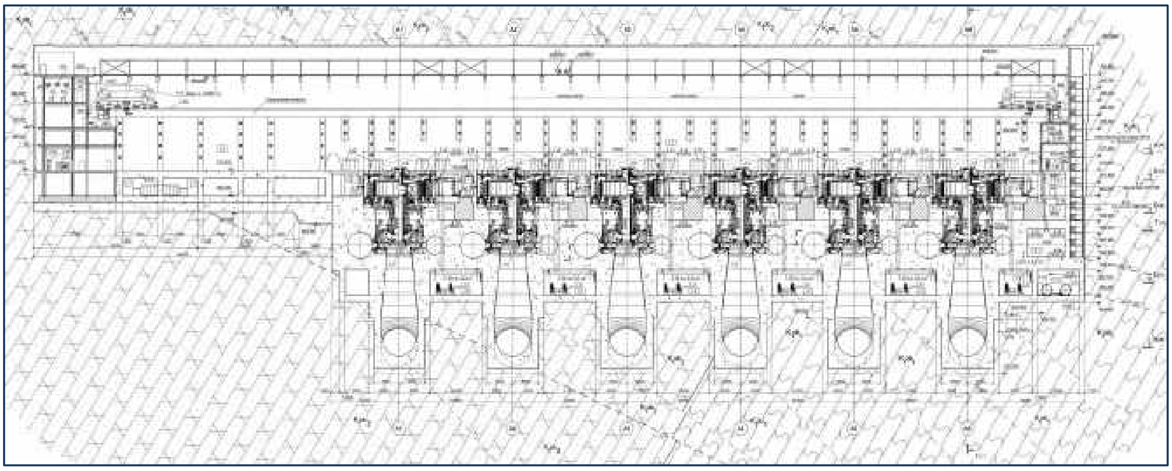
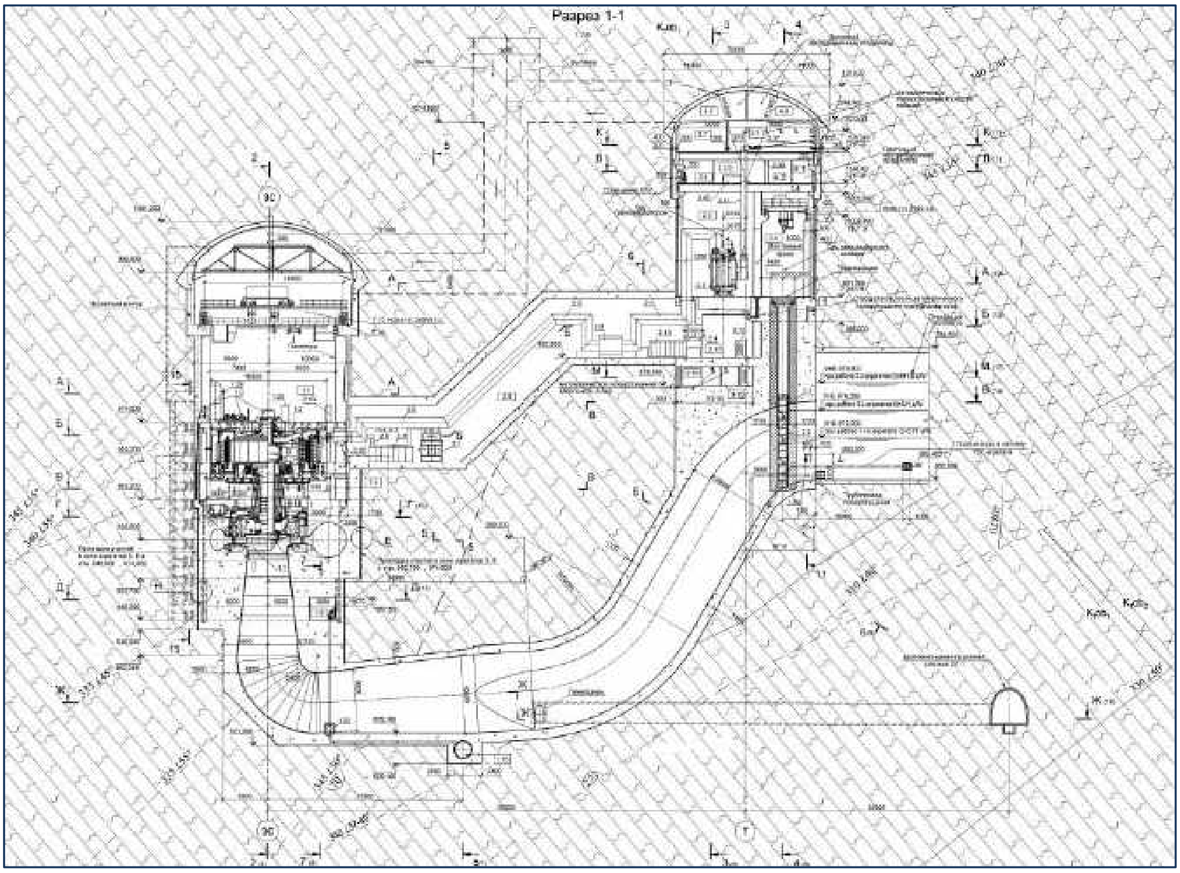


Figure 1: General layout of scheme showing the underground cavern complex (Assembly Hall - AH, Machine Hall - MH, and Transformer Hall (TH). Also shown are the main geological formations and Geological structures (Ionakhsh and 35 Faults)

As illustrated in Figure 2, the Machine Hall is a large size cavern with length 220 m, width approximately 20 m, with a maximum height to the invert of the turbine pits of approximately 72 m. The arched roof of the MH rises approximately 7.5 m from the sidewalls and the span at the arch springing point is approximately 25.6 m. The width, which is approximately 23 m at the same point, it reduces further down to 20 m approximately below the crane beam. The transformer Hall, located at 42.7 m distance from the Machine Hall, has length 200 m, width 19 m and approximately 44 m height. These two major caverns are at a depth of 350-400 m in a single tectonic block and are separated by active faults from the surrounding rock mass consisting of sandstones and siltstones.



(a)



(b)

Figure 2: Machine Hall longitudinal section (a) and cross section through Unit 6 (b). The geological formations (K_1ob_2, Sandstone and K_1ob_1, Siltstone) are also shown

The presently available geological data indicate that the caverns are mainly located within the Upper Obigarm Sandstone (K_1ob_2), except for a part of the Machine Hall towards its western end, where Units 5 and 6 are located, which is in the Lower Obigarm Siltstone (K_1ob_1) (1). The transition between the sandstone and siltstone formations crosses the Machine Hall and the siltstone formation is present from the western end wall to Chainage 0+70 m on the upstream sidewall and Chainage 0+40 m on the downstream sidewall with a trend of the transition 055°-235°.

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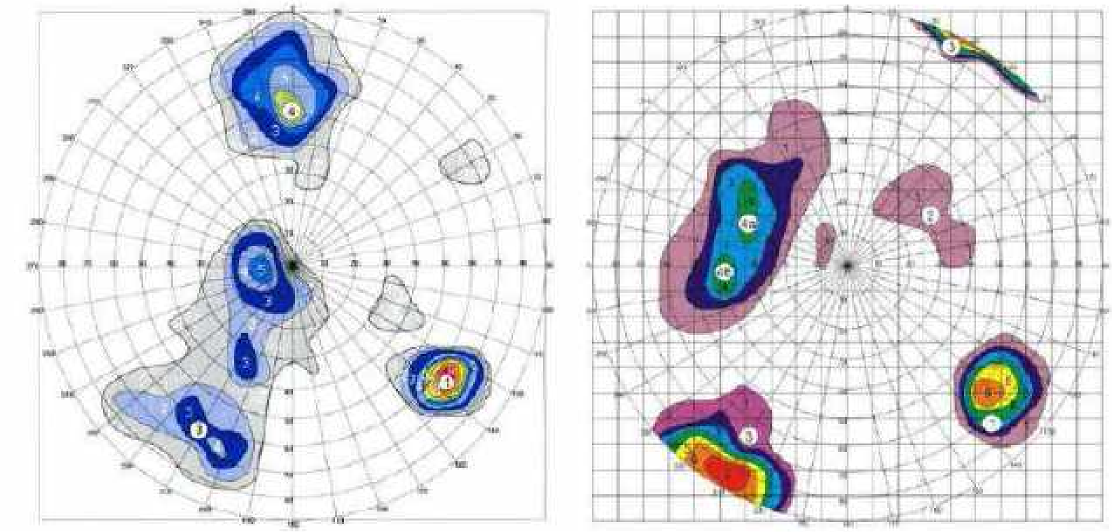
(1) In cases the “Silstone“ is named “Aleurolite”, from the Russian word used in many translations. The two names are considered to be equivalent

3. GEOLOGICAL AND ROCK MASS CONDITIONS

The Upper Obigarm Formation (K_1ob_2) comprises mainly brownish-reddish sandstone with brownish-grey and light-grey interlayers, whereas the Lower Obigarm Formation (K_1ob_1) is composed of brown, dark-grey, green siltstone with white gypsum interlayers in the middle part and light-grey sandstone interlayers in the upper part of the sequence. The K_1ob_2, Sandstone, based on the available data on the rock type percentages, is formed of 96% sandstone, 2.5% siltstone and 1.5% argillite. The K_1ob_1, siltstone consists of 85% siltstone, 14.6% argillite, 0.3% gypsum and 0.1% sandstone.

Mapping of the top heading driven in the Machine Hall and exploratory tunnels near the Machine Hall and Transformer Hall, carried out at different time, has allowed to obtain the orientation of discontinuities in the rock mass (bedding planes, joints, faults) and other characteristics such as joint aperture, spacing and continuity. Figure 3 gives the pole density contour plots for K_1ob_2, Sandstone and K_1ob_1, Siltstone respectively in (a) and (b). Tables 1 and 2 below summarise the geological characteristics which are available for the joint systems shown in the same figure.



(a) (b)

Figure 3: Pole density contour plot. Joint sets: (a) in K_1ob_2, Sandstone; (b) K_1ob_1, Siltstone (Coyne et Bellier 2013)

Given the interest in this report in the part of the Machine Hall towards its western end, which is prevalently in the Lower Obigarm Siltstone (K_1ob_1), between Chainage 0+00 to 0+70 m, the specific discontinuity data available for this zone are summarised in Table 3.

Table 1: Discontinuity data and characteristics for K_1ob_2, Sandstone ((Coyne et Bellier 2013)

Joint Set	Dip Direction (°)	Dip (°)	Joint Aperture (mm)	Continuity (cm)	Filling
S1	110-140/49-74	49-74	0.1-0.25	5 - 140	Gypsum, clay
S2	29-70/52-90	80-90	0.2-0.4	10-60	Gypsum
S3	184-265	44-90	0.1-0.45	5-70	Gypsum
S3a	160-278	26-50	0.1-0.3	15-105	Gypsum
S4	310-360/0-29	29-90	0.1-0.4	10-150	Gypsum

Table 2: Discontinuity data and characteristics for K_1ob_1, Siltstone (Coyne et Bellier 2013)

Joint Set	Dip Direction (°)	Dip (°)	Joint Aperture (mm)	Continuity (cm)	Filling
S1	115-145	50-85	0.1-0.2	20 to >3000	Gypsum, clay only for the most persistent
S2	35-92	19-41	0.1-2.25	10-50	Gypsum
S3	195-232/15-50	52-90/ 80-90	0.1-0.5	10-160	Gypsum
S4a	280-350	25-60	0.1-0.5	10-90	Gypsum
S4b	245-280	22-62	0.1-0.95	15-115	Gypsum

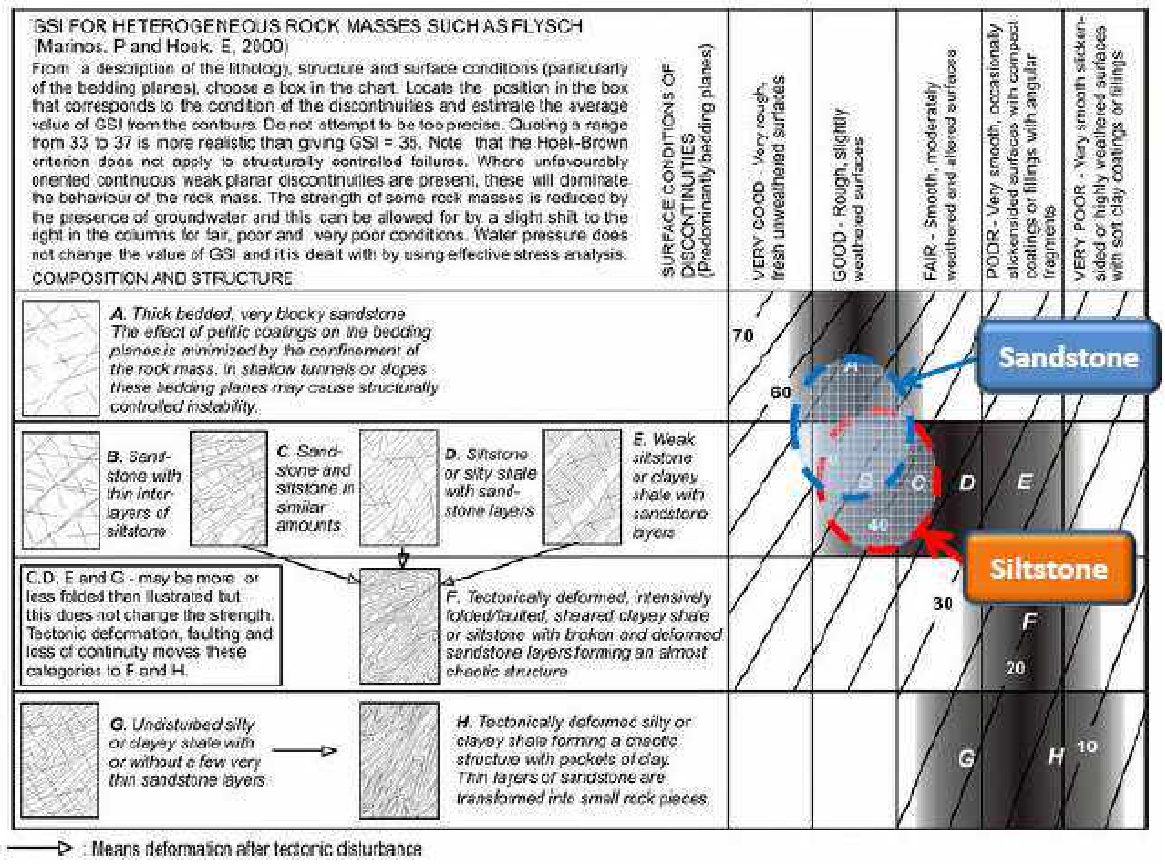
Table 3: Discontinuity data and characteristics for K_1ob_1, Siltstone (Chainage 0+0 to 0+70 m), Golder (2010)

Joint Set	Dip Direction (°)	Dip (°)	Joint Aperture (mm)	Spacing (m)	Continuity (m)
S1	125-130	60-65	<1.0	1.5-2.0	1-10
S2	40	30-35	<1.0	0.4	0.7
S3	225	40	<1.0	0.15-0.20	0.5-0.7
S4	335	20	<1.0	0.15-0.20	3-4
S4a	325	40	<1.0	0.07-0.20	0.1-1.5

The Rock mass quality has been determined at the site as shown in a report by the Moscow Hydroproject Institute in 2009 for both the sandstone and silstone rock masses based on the Rock Mass Rating system of Bieniawski (1989). The summary data used for such assessment are given in Table 4. One may also use for the purpose of rock mass classification the Geological Strength Index GSI of Hoek (1994) in the form developed specifically for heterogeneous rock masses such as flysch by Marinos and Hoek (2001) as illustrated in Figure 4.

Table 4: RMR determination for K_1ob_2, Sandstone and K_1ob_1, Siltstone (Golder 2010)

Parameter	**Description** K_1ob_2, **Sandstone**	**Description** K_1ob_1, **Siltstone**	**Rating** K_1ob_2, **Sandstone**	**Rating** K_1ob_1, **Siltstone**
Rock strength (MPa)	90	50	7	4
RQD (%)	40/50	40/50	8	8
Fracture frequency (mm)	250-300	100-200	10	8
Joint characteristics	Rough, planar, tight	Rough, planar, tight	25	20
Groundwater l/min/10m	10	10	10	10
Joint orientation	Good	Good	-2	-2
Total			58	48



GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos. P and Hoek. E, 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

A. Thick bedded, very blocky sandstone
The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.

B. Sand-stone with thin inter-layers of siltstone

C. Sand-stone and siltstone in similar amounts

D. Siltstone or silty shale with sand-stone layers

E. Weak siltstone or clayey shale with sandstone layers

C, D, E and G - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to F and H.

F. Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure

G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers

H. Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.

Figure 4: Geological Strength Index (GSI) estimated for K_1ob_2, Sandstone and K_1ob_1, Siltstone

4. GEOTECHNICAL PARAMETERS

Geotechnical studies have been performed within the area of the underground caverns from 1976 up to the present by the Moscow Hydroproject Institute and have been subject of critical revision and updating through the years. More recently, also involved in the characterization studies has been the Geodynamics Research Center which has carried out and is carrying out a series of geophysical tests with the main purpose to determine the rock mass conditions in the zone surrounding the underground caverns.

For the purpose of the present report, the discussion below is carried out with reference to the major components of the system which need be considered in order to estimate the strength and deformation properties of the in situ rock masses, which from a design point of view need to be as realistic and reliable as possible. Also to be considered are the available data on the in situ stress field, i.e. the magnitudes and directions of the in situ stresses in the area of the underground works.

In line with the above concepts, consideration will be given to

- The intact rock properties, i.e. the un-fractured blocks which occur between structural discontinuities in a typical rock mass
- The joints and geological discontinuities which comprise all types of structural weaknesses in the rock mass, such as bedding planes, fractures, cleavage, cracks, joints, or faults
- The rock mass properties, i.e. the deformability and strength characteristics and behaviour at the scale of the underground openings to be considered for design purposes.

4.1 Intact rock parameters

Based on the Moscow Hydroproject Institute (2009a) – also see Golder (2010), the intact rock properties (unit weight, longitudinal and shear wave velocities, uniaxial compressive strength, elastic modulus, Poisson's ratio, tensile strength, cohesive strength, and friction angle) are summarised for K_1ob_2, Sandstone and K_1ob_1, Siltstone as shown in Table 5.

It is noted that in defining the shear strength properties (cohesive strength and friction angle) reference is made to the Mohr-Coulomb failure criterion, which implies a linear fitting of the laboratory data, instead of the more frequently used Hoek and Brown failure criterion (Hoek and Brown 1980a, 1980b) which allows one to account for the nonlinear behaviour, as observed in sedimentary rocks such as sandstones and siltstones.

Table 5: Summary of intact rock properties for K_1ob_2, Sandstone and K_1ob_1, Siltstone

Parameter	**Description** **K_1ob_2, Sandstone**	**Description** **K_1ob_1, Siltstone**
Unit weight (kN/m^3)	2.59-2.64	2.66-2.72
Longitudinal wave velocity (m/s)	5200-5400	5500
Shear wave velocity (m/s)	3000	3000
Uniaxial compressive strength (MPa)	120-130 (dry) 90 (saturated)	70-90 (dry) 90 (saturated)
Elastic modulus (GPa)	30-40	45
Poisson's ratio	0.26	0.26
Tensile strength (MPa)	8.5	5.0
Cohesive strength (MPa)	24	59
Friction angle (°)	59	53

4.2 Joint shear strength parameters

It is to be underlined that the available database for the joints and geological discontinuities is indeed very limited. This aspect is relevant in relation to the sandstone and siltstone rock masses, where the persisting discontinuities such as the bedding planes may play a significant role in determining an anisotropic rock mass response. This issue is to be further discussed in the following (see Chapter 7). In all cases, with the above uncertainties kept in mind, Table 6 gives a summary of the available data in terms of joint shear strength characteristics, i.e. cohesive strength and friction angle.

It is clear from these data that at present no indication can be derived on the peak and ultimate or residual strength properties of the bedding planes and joints. At the same time, no information is available in the case of rough or non-planar joints on non-linear shear strength envelopes which may be more representative of the test results. In this case, it is possible to evaluate c and φ over a limited range of normal stresses (Barton 1976, Barton and Choubey 1977).

Table 6: Summary of the joint shear strength properties for K_1ob_2, Sandstone and K_1ob_1, Siltstone

Parameter	**Description** **K_1ob_2, Sandstone**	**Description** **K_1ob_1, Siltstone**
Cohesive strength (MPa)	0.41-0.70	0.41-0.70
Friction angle (°)	32-48	32-48

4.3 Rock mass parameters

Data are available in the Moscow Hydroproject Institute (2009a) report – also see Golder (2010), where the deformation modulus is given for different conditions such as “undisturbed”, “disturbed” and “blast damaged” rocks masses. It is inferred that these data are derived on the basis of the in situ longitudinal and shear wave velocity values. Also cited are the deformation moduli obtained on the basis of correlations with the Rock Mass Rating index due to Bieniawski (1989). A summary of these data is given in Table 7.

Table 7: Summary of the rock mass deformation modulus for K_1ob_2, Sandstone and K_1ob_1, Siltstone in different conditions

Parameter	Description K_1ob_2, Sandstone	Description K_1ob_1, Siltstone
Deformation modulus (GPa) – “undisturbed”	11.0-13.0	7.5-9.0
Deformation modulus (GPa) – “disturbed”	8.5-10.5	5.0-6.0
Deformation modulus (GPa) – “blast damaged”	4.0	1.5
Longitudinal wave velocity (m/s) – “undisturbed”	4000	3800-4000
Shear wave velocity (m/s) – “undisturbed”	2300	2000-2200
Longitudinal wave velocity (m/s) – “disturbed”	3500-3800	3400-3600
Shear wave velocity (m/s) – “disturbed”	1800-1200	1750-1850
Longitudinal wave velocity (m/s) – “blast damaged”	2800	2200
Shear wave velocity (m/s) – “blast damaged”	1500	1000
Deformation modulus (GPa) – “undisturbed” – RMR based	13.0	7.5
Deformation modulus (GPa) – “disturbed” – RMR based	8.5-10.5	5-6

If consideration is given to the strength rock mass properties in terms of the cohesive strength and friction angle, i.e. by using the Mohr-Coulomb failure criterion, the values of these parameters have been assessed on the basis of a series of back analyses of the excavation and reinforcement sequence. Two dimensional and three dimensional conditions have been considered by using different computer codes (for the two dimensional analyses, the Marc and Phase2 softwares; for the three dimensional analyses, the Z-soil and GeoMigg softwares). A summary of the results obtained is given in Table 8, where also reported are the corresponding values of the deformation modulus and Poisson’s ratio.

It is noted that an obvious difference in the values inferred for the different parameters is shown to occur due to a number of motivations which can be briefly summarized as follows: different computer codes being used, different mesh in the models in either 2D or 3D conditions, different simulation stages of the excavation-reinforcement sequences, different constitutive equations being used, i.e. elastic perfectly plastic or strain hardening, etc. At the same time, one is to be aware that the back analysis procedure adopted in the various cases is rather a parametric/sensitivity analysis, meaning that no optimization procedure is applied which minimizes the difference between the computed and the observed variables.

Table 8: Summary of the rock mass parameters determined on the basis of back analysis and by using different softwares in 2D and 3D conditions (deformation modulus, Poisson's ratio, cohesive strength and friction angle for K_1ob_2, Sandstone and K_1ob_1, Siltstone)

Parameter	**Description K_1ob_2, Sandstone**	**Description K_1ob_1, Siltstone**	**Analysis and Software used (reference)**
Deformation modulus (GPa) - "undisturbed-disturbed"	9.0-6.0	5.5-4.0	2D analyses, Marc (Hydrospetproyekt 2005)
Poisson's ratio (-) - "undisturbed-disturbed"	0.22	0.3	
Cohesive strength (MPa) - "undisturbed-disturbed"	3.0	2.0	
Friction angle (°) - "undisturbed-disturbed"	50	45	
Deformation modulus (GPa) - "undisturbed-disturbed"	11.0/6.0-1.8	5.9-5.0	2D analyses, Phase2 (Golder 2010)
Poisson's ratio (-) - "undisturbed-disturbed"	0.3	0.3	
Cohesive strength (MPa) - "undisturbed-disturbed"	1.94-0.96	0.98-0.50	
Friction angle (°) - "undisturbed-disturbed"	48-36	30-20	
Deformation modulus (GPa) - "undisturbed-disturbed"	9.0/7.0-6.0/2.5	5.5/2.5-4.0/1.67	3D analyses, Z-soil (Bronshteyn 2007)
Poisson's ratio (-) - "undisturbed-disturbed"	0.22-0.30	0.30-0.33	
Cohesive strength (MPa) - "undisturbed-disturbed"	3.0/1.64-2.0/1.2	2.0/0.75-1.5/0.66	
Friction angle (°) - "undisturbed-disturbed"	50/42-45/38	45/36-40/32.5	
Deformation modulus (GPa) - "undisturbed-disturbed"	9.0-3.0	5.5-1.8	3D analyses, Geo-Migg (Hydroproject 2012)
Poisson's ratio (-) - "undisturbed-disturbed"	0.22-0.30	0.28-0.33	
Cohesive strength (MPa) - "undisturbed-disturbed"	2.0-1.0	1.2-0.5	
Friction angle (°) - "undisturbed-disturbed"	55-42	45-47	

4.4 In situ state of stress

The in situ state of stress is a basic parameter for the design of underground openings. The stresses induced in the rock mass surrounding the excavation and consequently the stability conditions depend significantly on the magnitudes and directions of the in situ principal stresses. A quantitative evaluation of these stresses is not easily made and requires direct measurements in the field. In the case of the underground cavern complex at the Rogun site such measurements have been carried out as summarized in the Moscow Hydroproject Institute (2009b) report.

In addition to hydro-fracture tests performed in a number of horizontal and vertical boreholes in the Machine Hall area, also performed were geophysical tests. Although some uncertainties remain on the principal stress components, it has been ascertained that the vertical stress component σ_v is equal to 14.5 MPa and the corresponding horizontal stress component σ_h is 17.0 MPa, with an estimated stress ratio (σ_h/σ_v) equal to 1.15 approximately. Based on the available data, it has been ascertained that the two principal stresses (σ_H and $\sigma_{h)}$ are not significantly different so that a nearly isotropic stress field in the horizontal plane can be assumed.

5. UNDERGROUND ROCK SUPPORT

In line with the purpose of the present report, where the focus is on the stability assessment of the Machine Hall in the siltstone rock mass, the rock support system to be discussed in the present chapter is referred to the zone where Units 5 and 6 are to be located. It is known that the MH cavern excavation started in September 1986 and was carried out in benches 6-11 m high along the total width of the cavern. By the beginning of 1990, the MH cavern had been excavated to a depth of 36 m and the TH cavern to a depth of 16 m (Bronshteyn et al. 2007).

The first phase of excavation and construction continued through until 1992, when all the activities at the site were stopped. The spring flood of 1993 drowned most of the existing underground structures and in the MH cavern water reached the crane beam level. Activities at the site were resumed only in 2005 when water was pumped out. It is to be noted that in 2009 the Moscow Hydroproject Institute (2009c) submitted a report on the conditions of the existing rock support based on a thorough inspection of the MH, TH and AH caverns and came to the conclusion that the existing support in the arch and sidewalls had to be replaced before further excavation could take place to deepen the MH cavern.

5.1 Initial crown and sidewall support

Figure 5 (for details see Drawing 1 in Appendix 1) illustrates the crown and sidewall support initially installed in the MH and TH caverns based on the following reference documents: Main Hall cavern, Drawing 1079-14- 137 B, pages 2 and 3 of 6; Main Hall and Transformer Hall caverns; Drawing 1079-14-159. It is to be noted that the level of support shown in this figure is characterized by some uncertainties. In all cases this will be assumed to be representative of the support conditions in the zone of study before replacing the existing support, with the understanding that this will not impair the scope of work.

The support system down to elevation 964.20 m (no details are given below for the concreted arch and sidewalls) shown in Figure 5 can be described as follows.

- Machine Hall

1. The reinforcement system at the crown, down to elevation 992.17 m, consists of 8 m long dowels, installed with a 2x2 m square grid. The diameter of the steel rods is 36 mm.

2. The first and second row of reinforcement below the crown on the upstream sidewall (from elevation 992.17 m down to 987.51 m) consists of dowels (1 and 2 in Figure 5) 11 and 15 m long, installed at a distance of 2.5 m, with a 2.0 m longitudinal spacing. The diameter of the steel rods is 50 mm.

3. The first and second row of reinforcement below the crown on the downstream sidewall (from elevation 992.17 m down to 987.51 m) consists of dowels (1 and 2 in Figure 5) 20 and 10 m long, installed at a distance of 2.5 m, with a 2.0 m longitudinal spacing. The diameter of the steel rods is 50 mm.

4. The dowels below elevation 987.51 m on the upstream sidewall are 20 m long (3 to 6a in Figure 5). The vertical and longitudinal spacing is as shown. The diameter of the steel rods is 50 mm.

5. The dowels below elevation 987.51 m on the downstream sidewall are 10 m long (3 to 5 in Figure 5). The vertical and longitudinal spacing is as shown. The diameter of the steel rods is 50 mm.

6. Below elevation 979 m approximately, on the upstream sidewall, 20 m long 7 strand anchors (7 to 9 in Figure 5) are installed at 3 m longitudinal spacing with vertical spacing as shown. These anchors were not tensioned.

7. Below elevation 982 m approximately, on the downstream sidewall, 10 m long dowels (6 to 8 in Figure 5) are installed at 3 m longitudinal spacing with vertical spacing as shown. The diameter of the steel rods is 50 mm.

8. Below elevation 969 m approximately, on the upstream sidewall, 15 m long 7 strand anchors (10 to 12 in Figure 5) are installed at 3 m longitudinal spacing with vertical spacing as shown. These anchors were not tensioned.

9. Below elevation 974.60 m approximately, on the downstream sidewall, 15 m long 7 strand anchors (10 to 12 in Figure 5) are installed at 3 m longitudinal spacing with vertical spacing as shown. These anchors were not tensioned.

- Transformer Hall

1. The reinforcement system at the crown consists of 7 m long dowels, installed with a 1.5x1.5 m square grid. The diameter of the steel rods is 36 mm.

2. The 5 rows of dowels below elevation 1011 m approximately, (1 to 5 in Figure 5), on the upstream sidewall, with length 11-13 m, have vertical spacing as shown and longitudinal spacing 3 m. The diameter of the steel rods is 40 mm.

3. The rows 6 to 9 below elevation 1001 m approximately, on the upstream sidewall, down to elevation 991.2 m consists of dowels 13 m long, with 3x3m square grid. The diameter of the steel rods is 40 mm.

4. The 9 rows of dowels below elevation 1011 m approximately, (1 to 9 in Figure 5), on the downstream sidewall, with length 10 m and vertical spacing as shown. The longitudinal spacing is 3 m. The diameter of the steel rods is 36 mm.

5. The rows 10 to 12 below elevation 991.2 m, on the upstream sidewall, down to elevation 983.2 m consists of dowels 7 m long, with 3x3m square grid. The diameter of the steel rods is 36 mm.

6. The rows 10 to 13 below elevation 991.2 m, on the downstream sidewall, down to elevation 980.2 m consists of dowels 7 m long, with 3x3m square grid. The diameter of the steel rods is 36 mm.

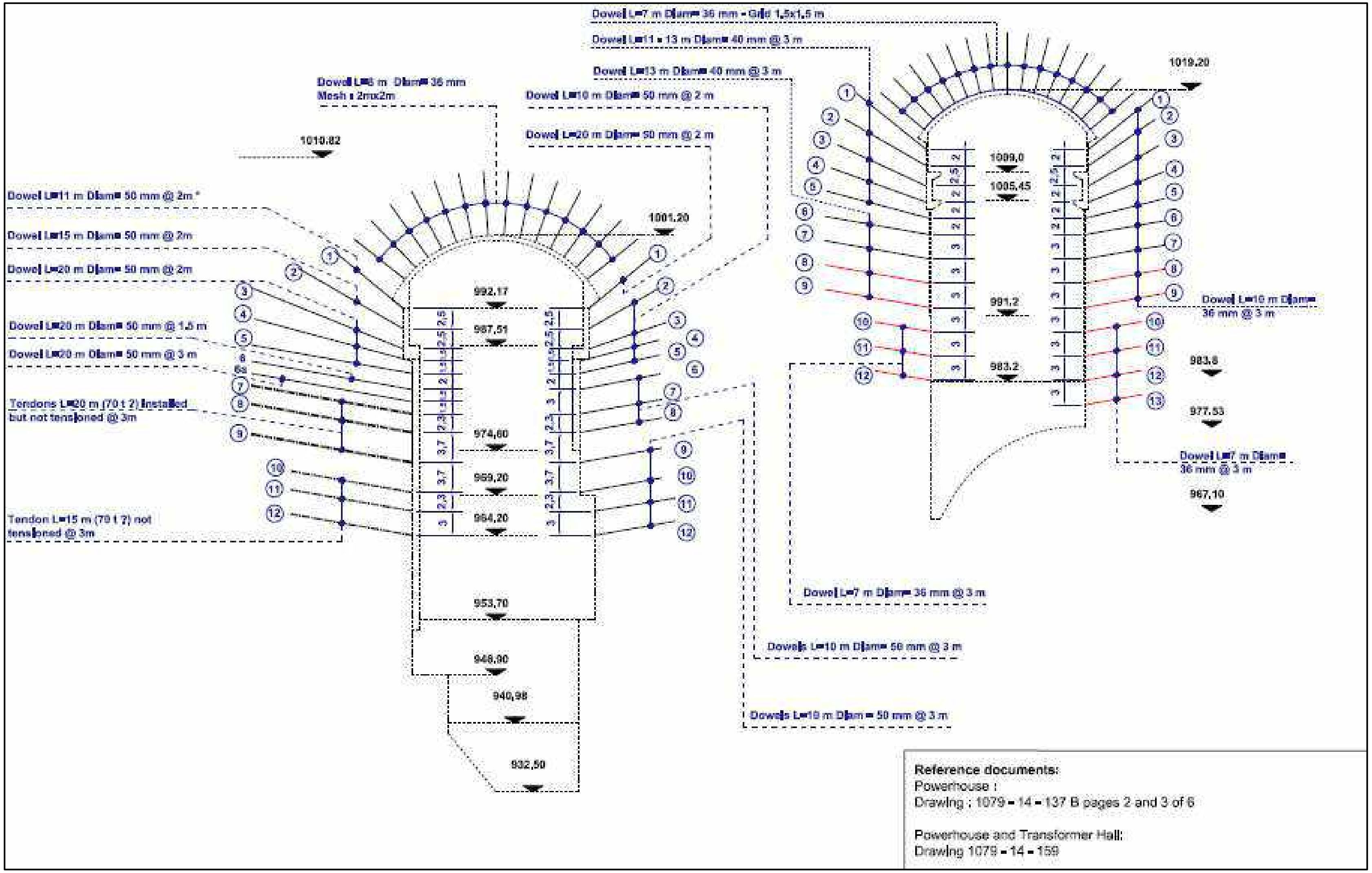


Figure 5: Support system initially installed in the MH and TH caverns (for details see Drawing 1 enclosed)

5.2 Replaced crown and sidewall support

Figure 6 (for details see Drawing 1 in Appendix 1) illustrates the crown and sidewall support as replaced systematically following year 2009, with the excavation bottom level being maintained down to elevation 964.2 and 1004.3 m in the MH and TH caverns respectively. The following documents have been used as reference: Drawing 1861-14-7 sheet 2 for Main Hall cavern; Drawing 1861-14-7 sheet 2 for Transformer Hall cavern, Drawing 1079-14-159. It is to be noted that the level of support shown in this figure has been based on the drawings cited above and has been updated using the information included in Drawing 1079-14-159 submitted to the Consultant on March 2013. In addition the same replaced support system has been checked and agreed upon, during the site visit of 4-6 April 2013.

The replaced support system down to elevation 964.20 m (no details are given below for the concreted arch and sidewalls) shown in Figure 6 can be described as follows.

- Machine Hall

1. The reinforcement system at the crown consists of the original 8 m long dowels, i.e. for the crown the 10 m long dowels shown in Figure 6 have not yet been installed.

2. The first row of reinforcement below the crown on both the downstream and upstream sidewalls (at elevation 992.17 m) consists of dowels having 14 m length; the longitudinal spacing is 2.3 m. The diameter of the steel rods is 36 mm.

3. The following two rows of reinforcement, down to elevation 987.51 m, on both the downstream and upstream sidewalls, consist of 7 strand anchors, installed according to 2.3x2.3 m grid.

4. Below elevation 985 m approximately and down to elevation 964.20 m, on both the downstream and upstream sidewalls, 14 m long dowels are installed; the grid size is 2.5X2.5 m on the downstream wall and 3.0x3.0 m on the upstream sidewall. The diameter of the steel rods is 36 mm.

5. Two rows of 7 strand anchors are installed between the first 2 rows of dowels below elevation 985 m. These placed in between the dowels, are 18.8 m long both on the downstream and upstream sidewalls.

- Transformer Hall

1. The reinforcement system at the crown consists of the original 6 m long dowels.

2. The two rows of reinforcement below elevation 1011 m approximately consist of dowels with length 14.5 m and 12.5 m respectively on the upstream and downstream sidewalls, installed according to 1.5x1.5m grid. The diameter of the steel rods is 36 mm.

3. A row of 7 strand anchors is installed just below the above dowels, centred with the crane beam, both on the downstream and upstream sidewalls, however with different length equal to 19 m and 17 m respectively.

4. The dowels below elevation 1005.45 m and down to elevation 991.2 m are 14.5 m and 12.5 m long, respectively on the upstream and downstream sidewalls. Except for the first and second row which are 2.7 m apart, the other dowels are installed according to 1.5x1.5m grid size. The diameter of the steel rods is 36 mm.

5. The dowels below elevation 991.2 m are 14.5 m and 12.5 m long, respectively on the upstream and downstream side. They dowels are installed according to 2.5x2.5m grid size. The diameter of the steel rods is 36 mm.

5.3 Support for excavation below elevation 964.2 m in MH cavern

The design of the support system to be installed below elevation 964.2 m in the MH cavern, in order to complete excavation down to elevation 932.5 m, is at present being carried out by the Moscow Hydroproject Institute. Indeed, the support system envisaged in year 2009 as illustrated in Figure 7, which called for the use of upward inclined at 10° strand anchors with a 3x3 m grid size is being revised.

It is understood that in the meantime, with due consideration and concern given to the significant deformations which developed in the siltstone area, the decision was taken to introduce, as a means to provide protection against further convergence, 6 reinforced concrete struts between elevation 969.2 m and 964.2 m approximately, as shown in Figure 8. These struts were effectively implemented between 2011 and 2012 and excavation down to elevation 958.2 m took place in the area of Unit 6 as visible in Figure 9.

At present, a final decision on the type of support below elevation 964.2 m in the MH cavern has not yet been reached. It is understood, based on the Moscow Hydroproject Institute (2012) report, that further studies are being carried out to this end by using the three dimensional mathematical model developed by Professors Zaretsky and Karabaev. The aim of these studies is to be able to assess the “strengthening” of the rock mass provided by the type of support anticipated and to make it available an “optimized and reliable design solution”.

For the purpose of the present report, as shown in Figure 6, the support to be installed in the MH cavern below elevation 964.20 m, on both the upstream and downstream sidewalls, will consist of 14 m long dowels. The longitudinal spacing will be 2.5 m and 3.0 m on the upstream and downstream sidewalls, with the vertical spacing 2.5-3.2 m and 3.0 m respectively as shown in the figure. The diameter of the steel rods is 36 mm.

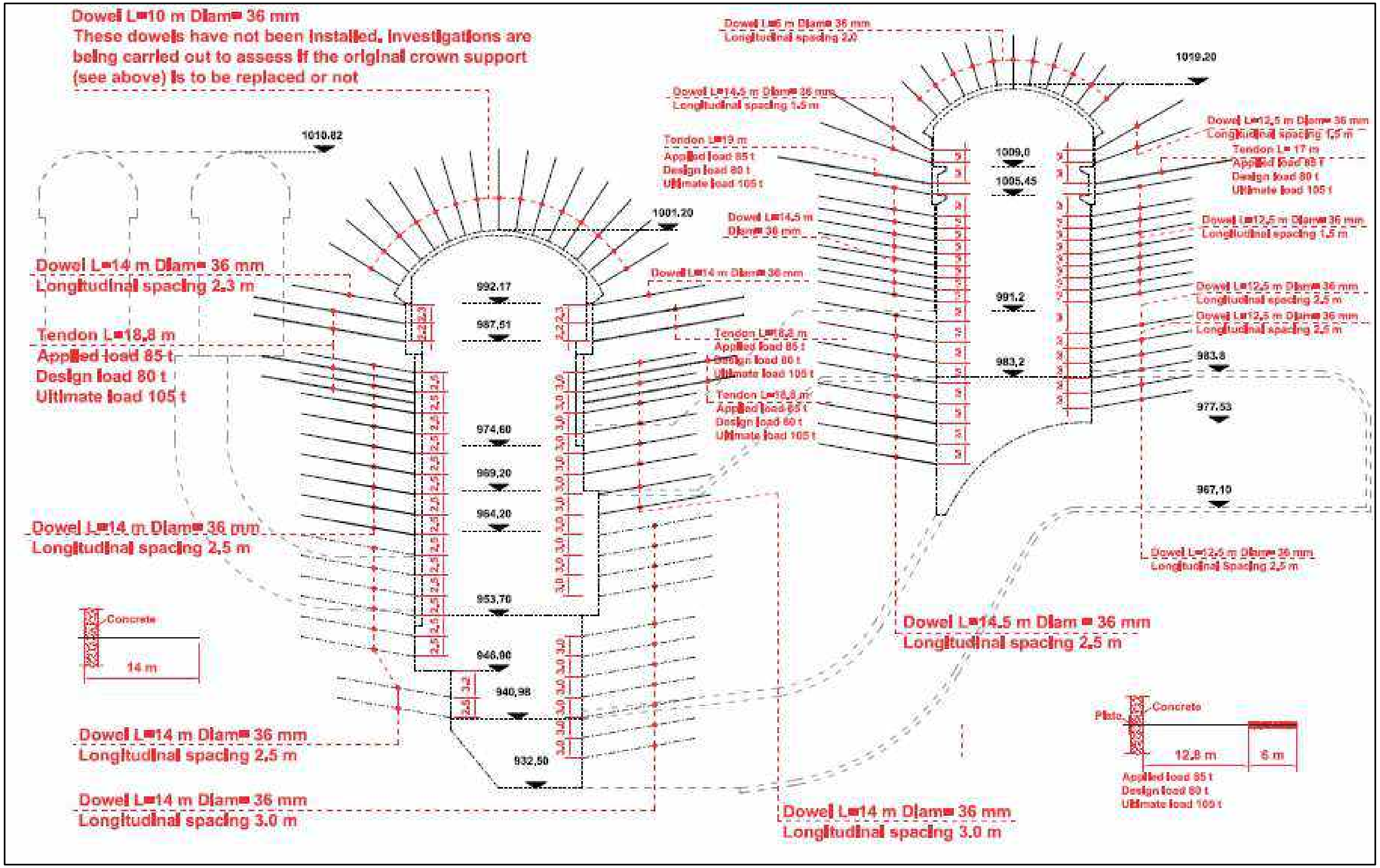


Figure 6: Replaced support system installed and to be installed in the MH and TH (see Drawing 1 for details)

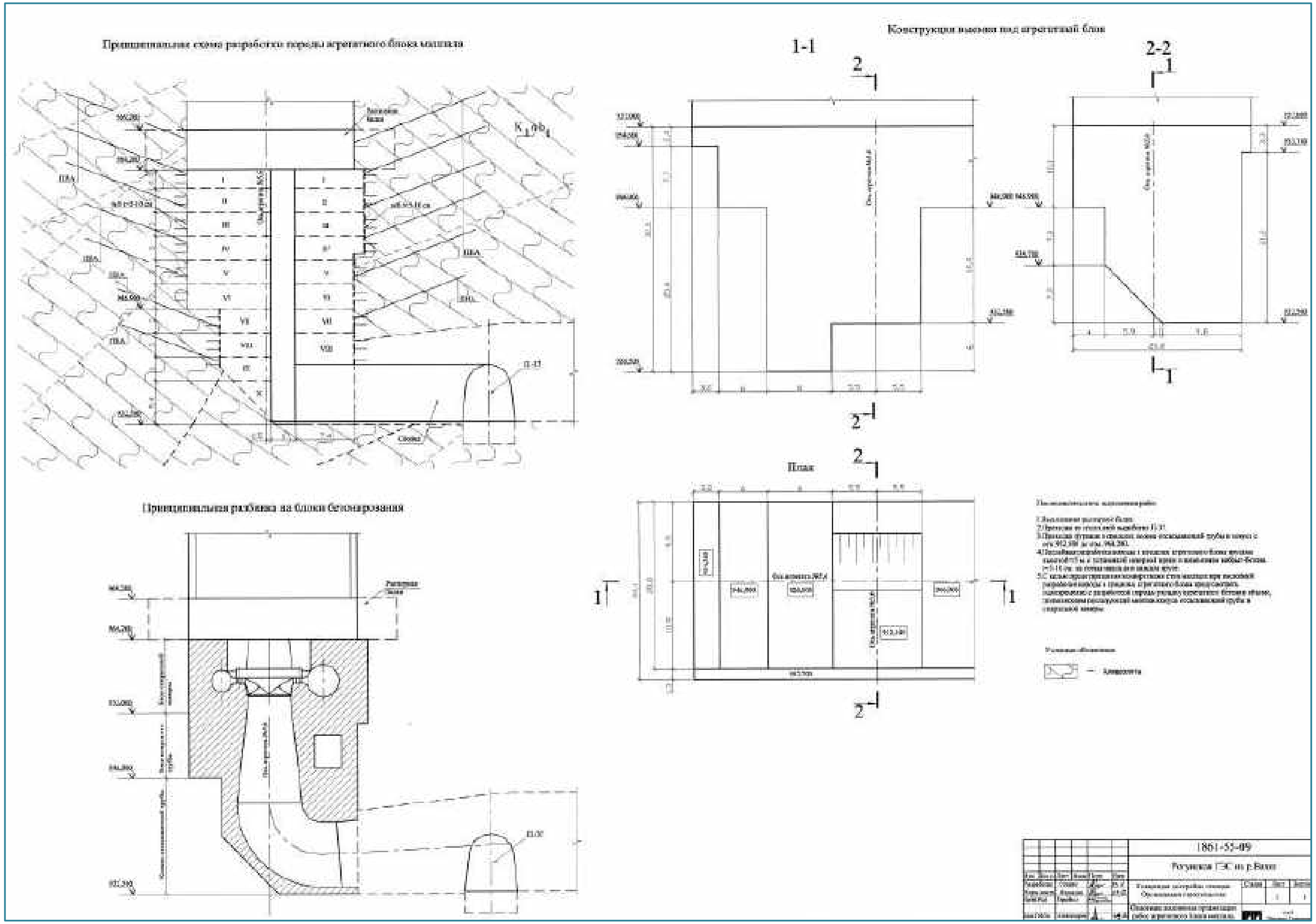


Figure 7: Support system to be installed in the MH cavern below elevation 964.20 m

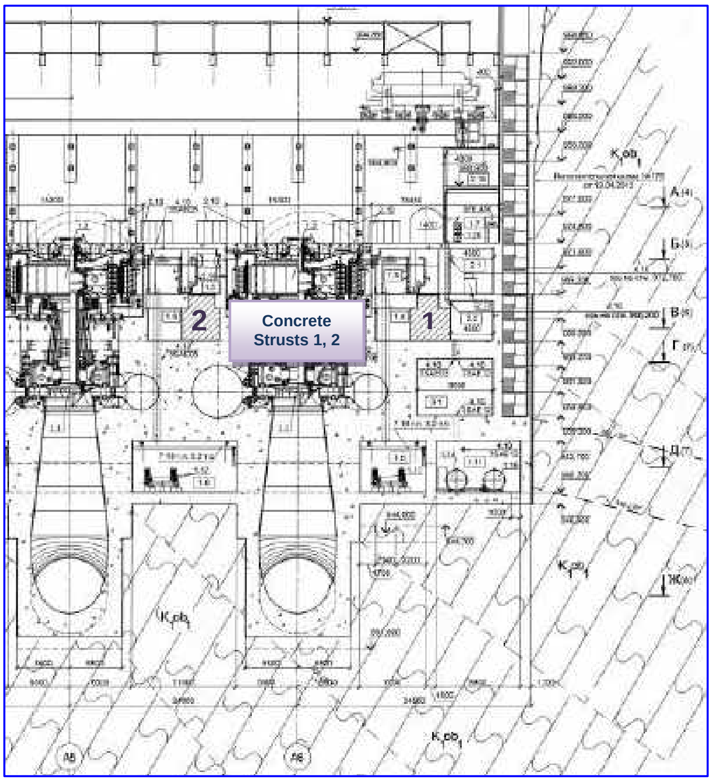


Figure 8: Longitudinal section. View of the zone in siltstone area with Units 5 and 6. Reinforced concrete struts 1, 2

Figure 9: Photograph of reinforced concrete strut 2 between Units 6 and 5 (taken during the site visit of April 4-6 2013)

6. MONITORING DATA

In underground excavation monitoring is an essential component of the interactive observational design approach (“Observational Method” in Eurocode 7), which need be applied for assessing continuously and in “real time” the response and stability of the excavation, the support installed and the rock mass surround. This method, when properly applied, implies that monitoring plays a very active role in both the design and construction, allowing planned modifications to be carried out within an agreed contractual framework that involves all the main parties (client, designer and contractor).

In the Rogun large size caverns construction, monitoring has been limited to convergence measurements in the MH cavern along its length on the sidewalls above the crane beam at elevation 986 m approximately. The location of each station is at the following chainages: 0+23, 0+47, 0+71, 0+95, 1+18, 1+43, 1+67 and 1+90 m. The data set as available was established in March 1989 and monitoring continued as shown in Figure 10 according to the data provided by the Moscow Hydroproject Institute in Excel file format for the period March 1989 to August 2012.

6.1 Convergence in the MH cavern

Based on the information available, excavation of the MH cavern second level (to elevation 986 m) was completed at the end of May 1988 (Moscow Hydroproject Institute 1990). As a consequence no convergence data are available between May 1988 and March 1989. It is estimated (Kolichko 2000) that the amount of convergence actually not monitored is 70 mm in sandstone and 150 mm in siltstone. This is like to say that the curves plotted in Figure 10 should account for an additional 150 mm convergence, in stations at chainage 0+23 and 0+47 m which are located in siltstone, and an additional 90 mm in stations at chainages 0+71, 0+95, 1+18, 1+43, 1+67 and 1+90 m which are located in sandstone.

The diagram of Figure 10 shows that the station at chainage 0+23 m in siltstone exhibits a trend of continuous movement reaching in August 2008 a total measured convergence equal to 600 mm approximately. On the contrary, at chainage 0+47 m in siltstone, convergence increases up to June 1995, when a trend towards stabilization is noted, up to December 2008. In all cases, an increase in convergence for all the stations is well visible in both siltstone and sandstone during the period of active underground excavation as shown in detail in Figure 11.

With excavation being stopped, convergence kept increasing with a nearly constant displacement rate in both stations in siltstone up to June 1995. After this time, with stabilization being reached in station at chainage 0+47 m, deformation kept increasing at a nearly constant displacement rate at station 0+23 m. On the contrary, all the stations in sandstone reached a nearly stable conditions. It is of interest to note, as also shown in detail in Figure 12, that between August 2008 and August 2012 both the stations in siltstone showed an increase in convergence of 200 mm approximately. This phenomenon is a clear consequence of underground excavation being resumed in both the MH and TH caverns and in neighboring tunnels.

6.2 Observed behavior in the MH cavern

The trend of the observed deformations in the MH cavern, with very significant and unusual convergence values being reached in the siltstone zone in particular, became soon matter of concern in relation to the rock mass behavior and its response to excavation and versus time. This concern is indeed closely related to the further excavation to be carried out in the MH cavern to the invert of the turbine pits.

The question is if the observed time dependent behavior of the siltstone rock mass, when no excavation activities did take place underground (i.e. under constant stress state and with no change in the boundary conditions), is a creep deformation, i.e. a tendency for the rock mass to move slowly or deform permanently under the influence of stress. As observed in the following Chapter 7, during the site visit of April 4-6 1013 no signs could be found in the cavern of deterioration of the petrographic quality of the siltstone rock mass (Barla 2013 and Marinos 2013); rather, a de-stressed condition could be noted in places.

At the same time, although experimental data are not available, to rule out completely that the siltstone could undergo a limited time dependent deformation (creep) is not possible. Consideration is to be given to the weakening along the bedding planes and clay infilling. However, the limited in situ stress field in the cavern zone (with stresses in the range 14.5 to 17 MPa) compared to the rock strength makes this not to be realistic. This somewhat intuitive observation seems to be confirmed by the recent convergence data monitored between January and March 2013 in the MH cavern at elevation 989.50 m as shown in Figure 13.

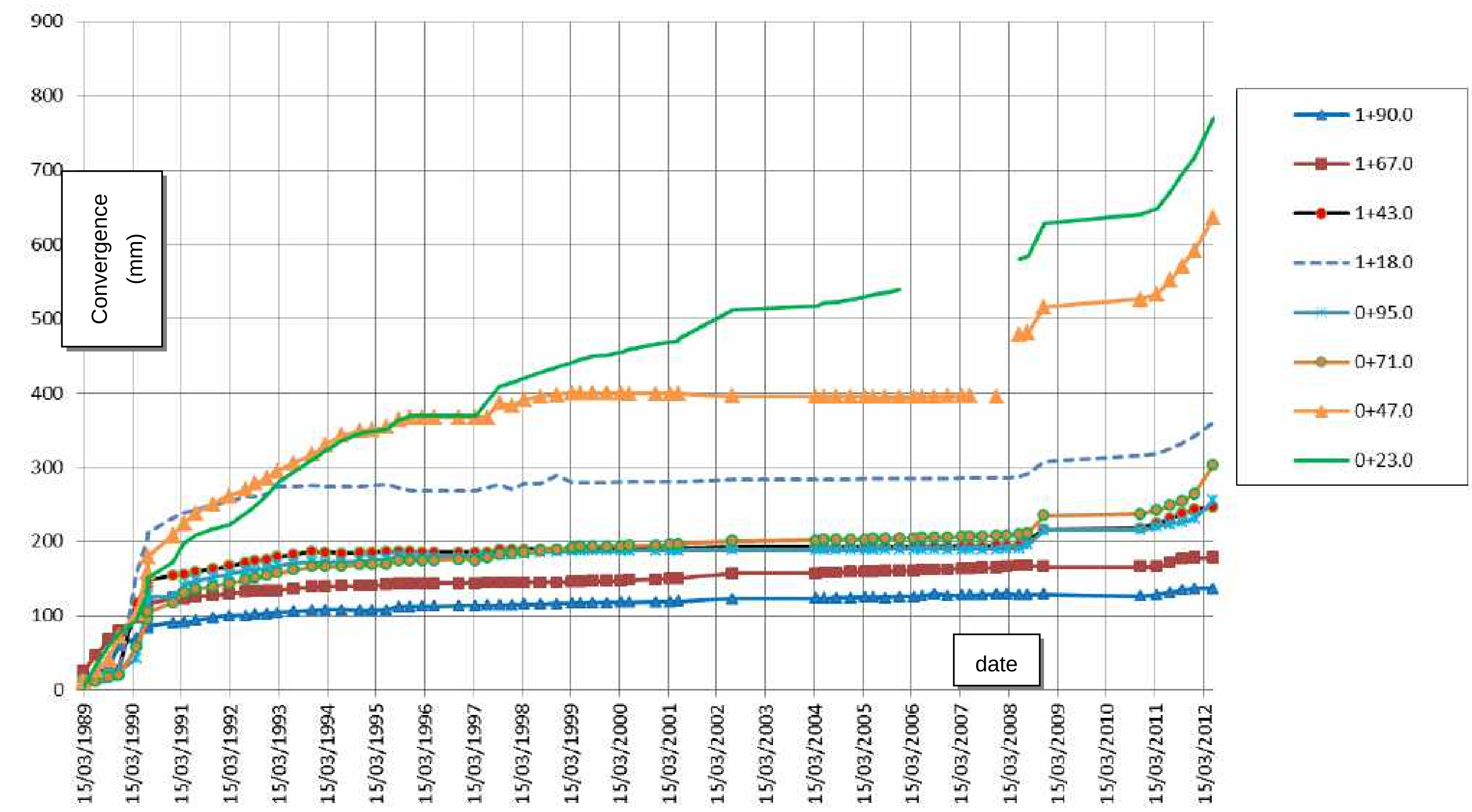


Figure 10: Plot of convergence history in the MH cavern as monitored at elevation 986 m between March 1989 and March 2012

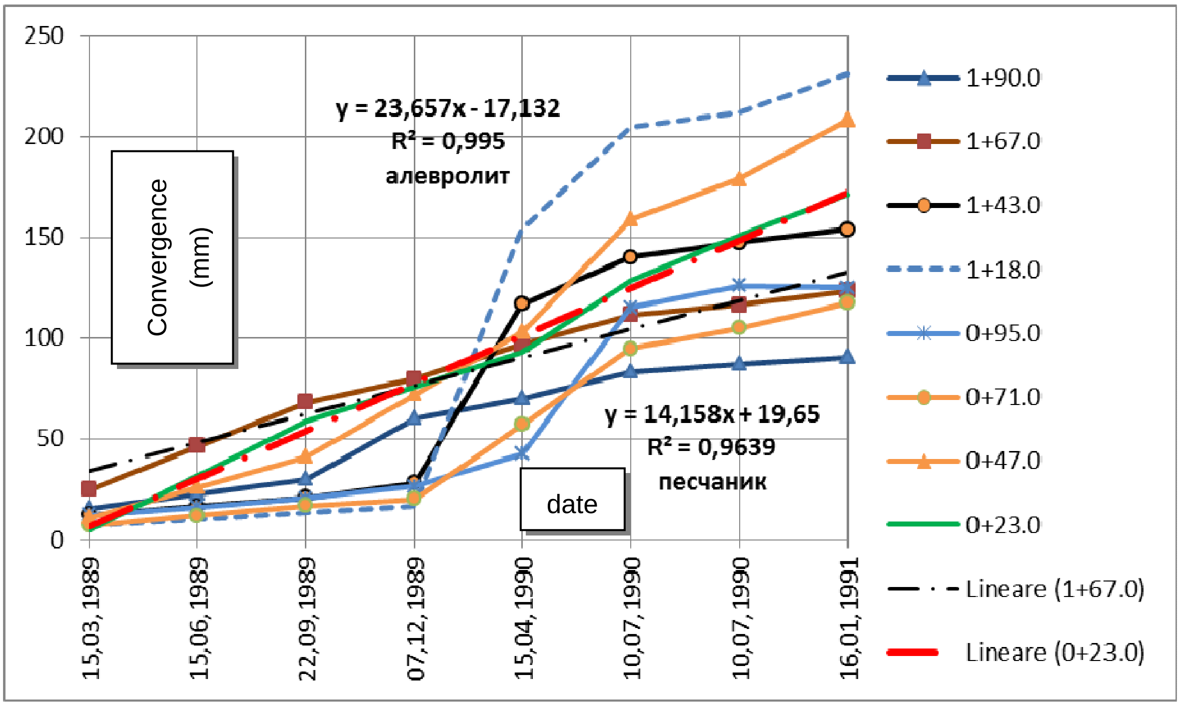


Figure 11: Convergence as monitored in the MH cavern at elevation 986 m between March 1989 and January 1991 (first excavation stage)

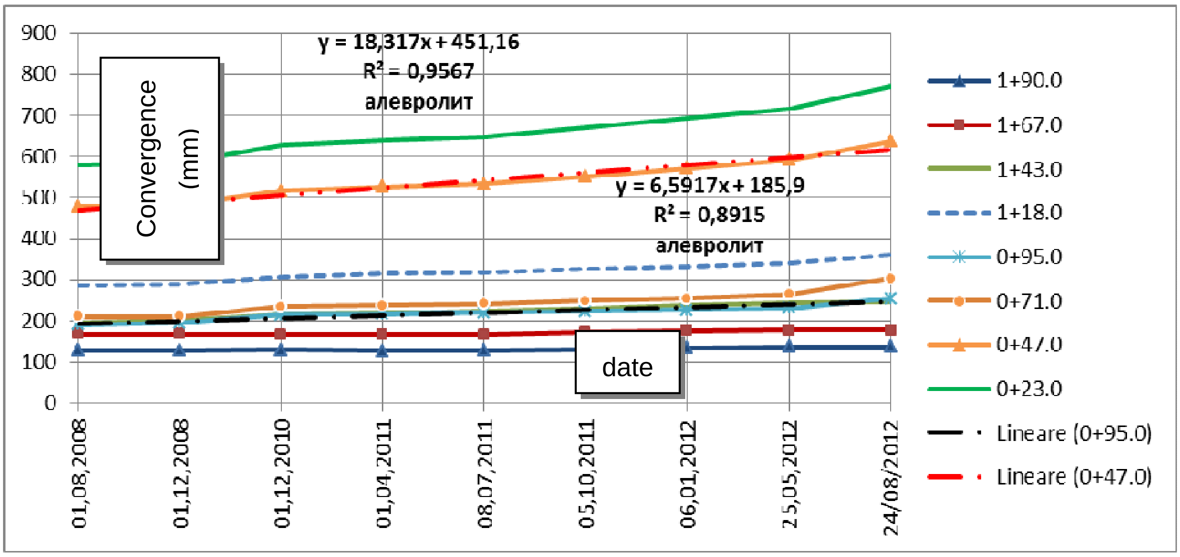


Figure 12: Convergence as monitored in the MH cavern at elevation 986 m between August 2008 and August 2012 (new excavation stage)

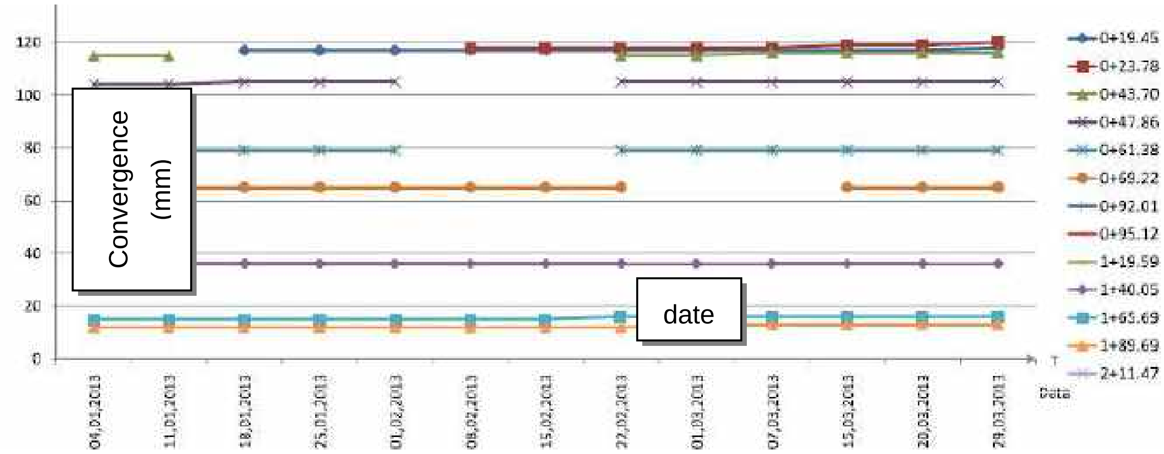


Figure 13: Convergence monitoring in the MH cavern between January to March 2013 at elevation 989.50 m

7. ADDITIONAL INVESTIGATIONS IN THE MH CAVERN

Laboratory data on siltstone are very limited and where the results of testing are reported the range of values for strength and deformability properties is rather wide and uncertain. At the same time, the type of behavior exhibited by siltstone and the large convergence values, measured in the MH cavern during excavation, make it imperative to perform additional characterization studies. It was therefore decided to drill two boreholes in the zone of Unit 6 in the MH cavern for the purpose of obtaining representative samples for laboratory testing. The work done so far is briefly described in the present chapter.

7.1 Sampling of siltstone rock

Two boreholes have been drilled in the MH cavern in siltstone, approximately where Unit 6 is to be located as per instructions provided with Report 138 dated February 22 2013 (Barla 2013). During the visit to the site of April 4 2013 drilling of the first borehole was started and detailed procedures to be followed were agreed with the Drilling Contractor’s representative on site. The locations of the two boreholes BH1 and BH2 are shown in the sketch of Figure 14 which gives a plane view at elevation 986.5 m. It is interesting to note that the orientation of the two boreholes has been defined based on the orientation (Dip and Dip Direction) of the bedding planes as depicted in the stereographic plot.

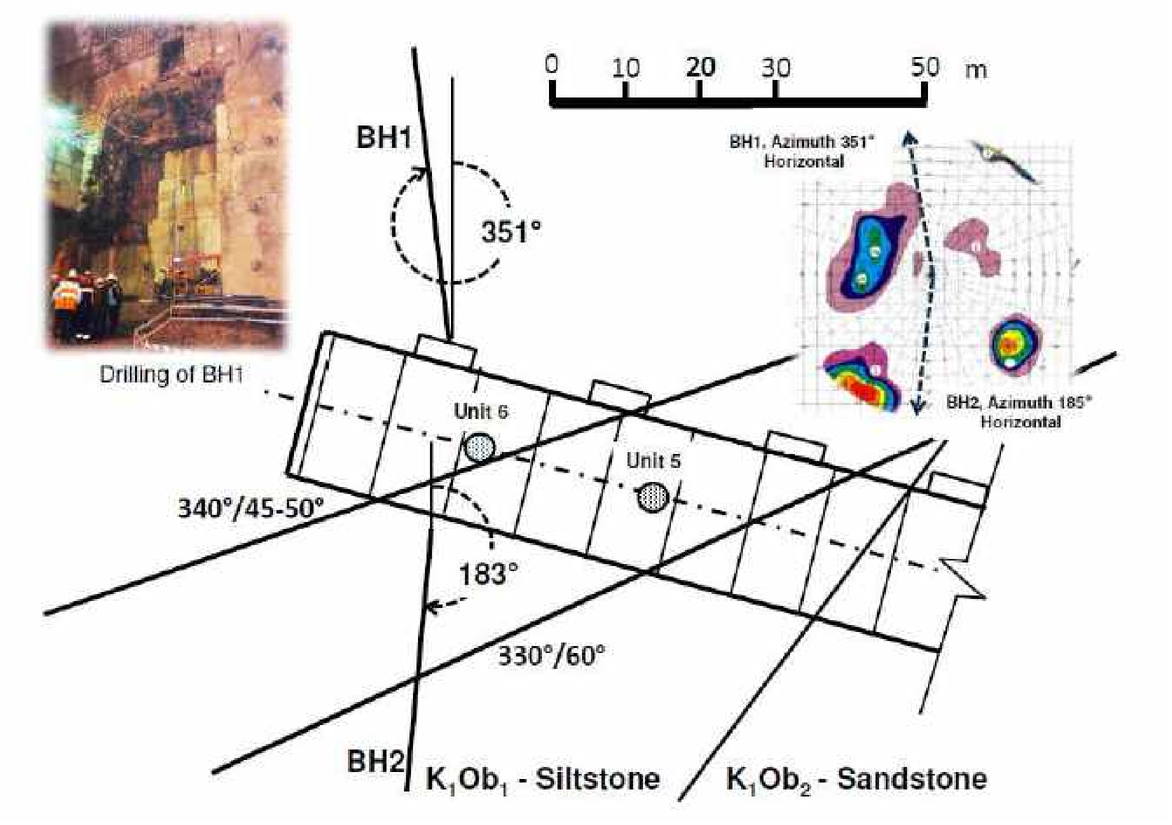


Figure 14: Sketch showing the locations of BH1 and BH2 in the zone of Unit 6 in siltstone

The samples obtained with coring have been collected as follows (Figure 15):

- Triple Core Barrel (TCB) Samples, each run 1.5 m long, placed in wooden boxes, 2 samples per box (for a total of 8 samples per borehole)

- Double Core Barrel (DCB) Samples, each run 3.0 m long; at least 3 samples, each having a length greater than 25 cm, for a total of approximately 20 samples per borehole also placed in wooden boxes.

At the same time, the remaining DCB cores have been placed in wooden boxes for appropriate future reference. A detailed record of the activities (Core Recovery, RQD, etc.) has been made as shown in Appendix 2.

Figure 15: Photographs of: (left) Location of borehole 1, (right) Box containing 2 TCB samples

In addition, 3 cubic samples have been obtained by using a saw machine in two different sites along the downstream cavern sidewall in the Unit 6 (siltstone) area (Figure 16). The main purpose has been to make available undisturbed cubic blocks to be used for oriented coring in the laboratory to obtain specimens for shear testing along bedding planes and natural discontinuities.

7.2 Laboratory testing program

The laboratory testing program, which is being carried at the Politecnico di Torino Geomechanics Laboratory and at the University of Teheran Rock Mechanics Laboratory under the supervision of the writer of this report, has been planned in relation to the need of design modelling studies. In general the following main tasks are being undertaken:

- preparation of rock specimens for laboratory tests
- classification tests consisting of unit weight measurement, P-wave velocity measurement, uniaxial compression strength tests, Brazilian tests

- triaxial compression tests with the main purpose to obtain peak and residual strength properties, by using both the conventional and multistage procedures
- direct shear tests on bedding planes, saw cut surfaces and natural rock discontinuities with the main purpose to obtain peak and residual strength properties
- triaxial multistage tests on saturated specimens, implying that the above tests will be run in near natural water content conditions
- triaxial creep test by using the multistage procedure.

Testing is being carried out according to the ISRM Suggested Methods (when available) and with modern up to date equipment which should allow for testing in closely controlled conditions (servo-controlled/stiff equivalent loading machines with continuous real-time data acquisition, etc.). Details of the testing procedures have been made available.

Figure 16: Photographs of: (left) Location for sampling the cubic blocks, (right) The cubic blocks

7.3 Preliminary results

At the time of writing of this report some “preliminary results” of the tests run at the University of Teheran Rock Mechanics Laboratory are available and will be given below. The tests run so far comprise indirect tensile Brazilian tests, uniaxial compression and triaxial compression tests, in addition to unit weight determinations.

As a first attempt of assessing the deformability and strength parameters of the siltstone rock mass, also in view of the modelling studies described in Chapters 8 and 9, these data will be used for “preliminary rock mass characterization” also based on the results of rock core logging of boreholes BH1 and BH2.

Based on the results of uniaxial compression tests the rock properties are as follows:

- Unit weight (mean value +/- standard deviation) γ = 2730 +/- 7.0 kg/m^3;
- Uniaxial Compressive Strength (mean value +/- standard deviation) σ_c= 37.6 MPa +/- 7.5 MPa;
- Modulus of elasticity (mean value +/- standard deviation) E_t= 20 +/- 4.0 GPa.

These values indicate that siltstone can be classified as a "Moderately Strong" rock with modulus ratio slightly higher than 500, which is a high modulus ratio.

As shown in Figure 17, where the results of indirect tensile Brazilian tests, uniaxial compression and triaxial compression tests are reported and both the Hoek-Brown and Mohr-Coulomb failure criteria are plotted (e.g. Hoek and Brown (1980 a, 1980 b), the following intact rock parameters are obtained:

- Uniaxial Compressive Strength (mean value +/- standard deviation) σ_{ci} = 29.9 MPa
- Hoek-Brown constant m_i = 12.8
- Cohesion c_i = 5.6 MPa
- Friction angle φ_i= 46.1°

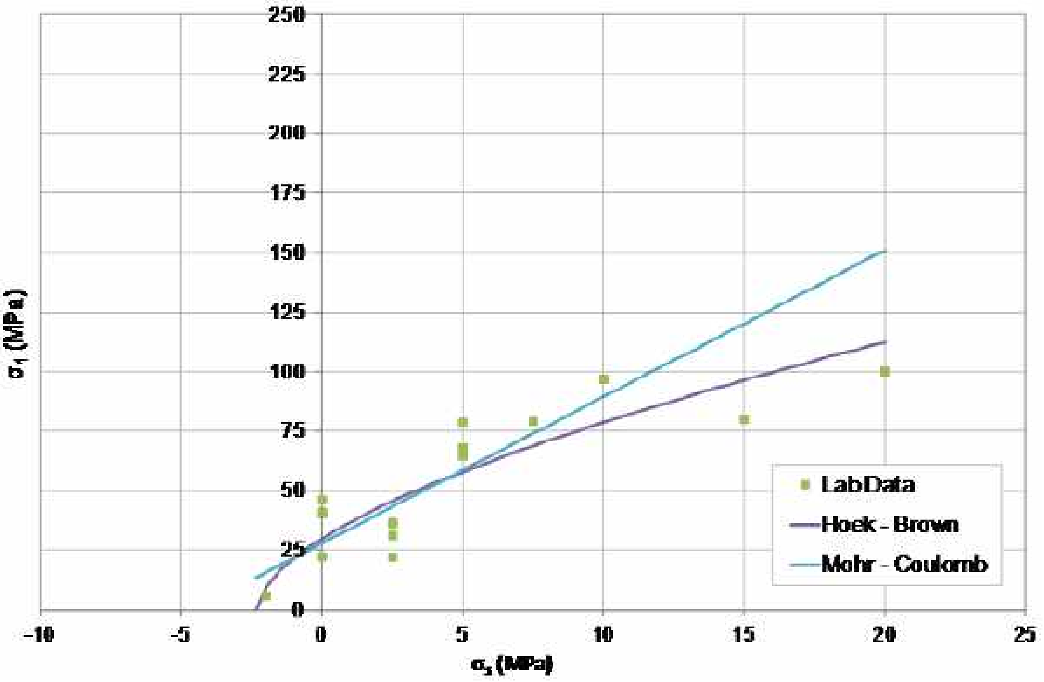


Figure 17: Results of laboratory tests on silstone intact rock specimens in axial strength versus confining pressure plot. The Hoek-Brown and Mohr-Coulomb failure criteria also shown

With the above data being available on the siltstone intact rock properties, one may proceed to obtain the rock mass strength parameters and deformation modulus based on the Geological Strength Index GSI. For the purpose of this report and as a “preliminary estimate” only, the logs of the boreholes BH1 and BH2 drilled in the MH cavern in the Unit 6 zone (Figure 14) can be used to determine the Bieniawski’s 1989 Rock Mass Rating RMR. The following results are obtained.

➢ BH1 Borehole:

- Strength of intact rock material, Uniaxial compressive strength (mean value +/- standard deviation) σ_c= 37.6 MPa +/- 7.5 MPa: RMR Rating = 4;
- Drill core quality, Rock Quality Designation (mean value +/- standard deviation) RQD = 57.8 +/- 21.5; RMR Rating = 13;
- Spacing of discontinuities (mean value); Spacing = 200-600 mm; RMR Rating = 10;
- Condition of discontinuities (mean value); RMR Rating = 13;
- Ground water, RMR Rating = 15

$\underline{RMR_{89} = 55}$

➢ BH2 Borehole:

- Strength of intact rock material, Uniaxial compressive strength (mean value +/- standard deviation) σ_c= 37.6 MPa +/- 7.5 MPa: RMR Rating = 4;
- Drill core quality, Rock Quality Designation (mean value +/- standard deviation) RQD = 63.7 +/- 30.9; RMR Rating = 13;
- Spacing of discontinuities (mean value); Spacing = 60-200 mm; RMR Rating = 8;
- Condition of discontinuities (mean value); RMR Rating = 13;
- Ground water, RMR Rating = 15

$\underline{RMR_{89} = 53}$

❖ Rock Mass Parameters ($GSI = RMR_{89} – 5 = 48-50$)

Peak

- Hoek-Brown constant for undisturbed rock (D=0) m = 1.8 - 2.1
- Hoek-Brown constant for undisturbed rock (D=0) s = 0.0022 - 0.0039
- Deformation modulus for undisturbed rock E_{dp} = 2.5 - 3.4 GPa
- Cohesion for undisturbed rock c_p = 1.3 -1.4 MPa
- Friction angle for undisturbed rock φ_p = 32.6 - 34.1°

Residual

- Hoek-Brown constant for disturbed rock (D=0.5) m = 0.9 - 1.2
- Hoek-Brown constant for disturbed rock (D=0.5) s = 0.0007 - 0.0013
- Deformation modulus for disturbed rock E_{dr} = 1.3 -1.7 GPa
- Cohesion for disturbed rock c_r = 1.0 -1.1 MPa
- Friction angle for disturbed rock φ_r = 27.3 - 29.2 °.

8. TWO DIMENSIONAL MODELING

Two dimensional modeling studies have been carried out with the main purpose to assess the stability conditions of the HP underground cavern complex with the most attention paid to the MH cavern and its interaction with the TH cavern in the siltstone zone, where Units 5 and 6 have to be located. Both the present and future configurations reached with excavation down to the invert of the turbine pit are analyzed in detail. The present chapter is to describe the main features of the numerical model. The analyses performed and the results obtained are illustrated in the following chapter.

In Rock Mechanics and Rock Engineering different numerical modeling methods and computer codes have been developed and are available for the study of underground excavations and the analysis of stress driven problems. These are generally divided into two classes, Boundary methods (i.e. Boundary Element Method - BEM) and Domain Methods (i.e. Finite Element Method - FEM, Finite Difference Method - FDM, and Distinct Element Method - DEM). In the present report the Finite Difference Method and the FLAC code (Itasca 2012) have been used which allow one to perform realistic analyses with attention paid to both the post-failure conditions of rock mass and its interaction with the support system installed.

8.1 Finite Difference Method and FLAC code

When the rock mass is represented as an equivalent continuum, as it is the case of our modeling studies, either the FEM or the FDM is used. In the FEM the field quantities (stress, displacement) vary throughout each element in a prescribed fashion, in the mesh used for representing the zone of interest, using specific functions controlled by parameters. In contrast, in the FDM every derivative in the set of governing equations is replaced directly by an algebraic expression written in terms of the field variables (stress or displacement) at discrete points in space; these variables are undefined within elements of the grid.

In all cases the two methods produce a set of algebraic equations to solve. Even though these equations are derived in different ways, it is easy to show (in specific cases) that the resulting equations are identical for the two methods. FEM programs often combine the element matrices into a large global stiffness matrix, whereas this is not normally done with FDM, because it is relatively efficient to generate the finite difference equations at each step. FLAC uses an “explicit” time marching method to solve the algebraic equations, but “implicit”, matrix-oriented schemes are more common in finite elements.

With reference to FLAC one may also note that It is easy to update coordinates at each time step in large strain models. This is due to the fact that one does not need to form a global stiffness matrix. The incremental displacements are added to the coordinates so that the grid moves and deforms with the material it represents. The constitutive formulation at each step is a small strain one, but is equivalent to a large strain formulation over many steps.

8.2 Details of rock mass modeling and constitutive models

The FLAC code is characterized by a high number of built-in constitutive models that can be used in Geotechnical Engineering, as well shown in the FLAC User's Manual (Itasca 2012), which will be used as reference for the short description below. The models are divided into three groups: null model, elastic models (isotropic and transversely isotropic) and plastic models (Drucker-Prager, Mohr-Coulomb, ubiquitous joint, strain-hardening/softening, bilinear strain-hardening/softening ubiquitous joint, double yield, modified Cam-clay, Hoek-Brown, cap-yield, chsoil and modified Hoek-Brown). In the present study, in addition to the null model, which is used to represent material that is removed or excavated, both the elastic model and the Mohr-Coulomb model will be used for describing the rock mass behavior.

It is noted that in the Mohr-Coulomb model, according to the formulation being used, the failure envelope corresponds to a Mohr-Coulomb criterion (shear yield function) with tension cut-off (tensile yield function). The shear flow rule is non-associated and the tensile flow rule is associated. With the ordering conventions (recall that the compressive stresses are negative) $\sigma_1 \leq \sigma_2 \leq \sigma_3$, the Mohr-Coulomb failure criterion may be represented in the plane (σ_1, σ_3) as illustrated in Figure 18.

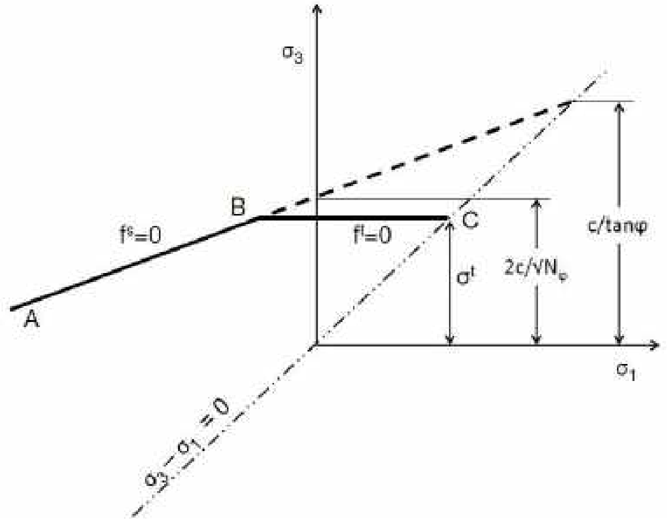


Figure 18: Mohr-Coulomb failure criterion in FLAC rule (redrawn from FLAC User's manual, Itasca 2012)

The failure envelope is defined from point A to point B by the Mohr-Coulomb yield function (Figure 18),

$$f^s = \sigma_1 - \sigma_3 N_\varphi + 2c \sqrt{N_\varphi}$$

and from B to C by a tension yield function of the form

$$f^t = \sigma^t - \sigma_3$$

where φ is the friction angle, c the cohesion, σ^t is the tensile strength and

$$N_\varphi = (1 + \sin\varphi) / (1 - \sin\varphi)$$

Note that only the major and minor principal stresses are active in the shear yield formulation; the intermediate principal stress has no effect. For a material with friction, $\varphi \neq 0$ and the tensile strength of the material cannot exceed the value $\sigma^t{}_{max}$ given by

$$\sigma^t{}_{max} = c/\tan\varphi$$

The shear potential function g^s corresponds to a non-associated flow rule and has the form

$$g^s = \sigma_1 - \sigma_3 N_\psi$$

where ψ is the dilation angle and

$$N_\psi = (1 + \sin\psi) / (1 - \sin\psi)$$

The associated flow rule for tensile failure is derived from the potential function g^t with

$$g^t = - \sigma_3$$

The flow rules for this model are given a unique definition in the vicinity of an edge of the composite yield function in three-dimensional stress space by application of a technique (illustrated below) for the case of a shear-tension edge. A function h (σ_1, σ_3) is defined (Figure 19) which has the form

$$h = \sigma_3 - \sigma^t + \alpha^P (\sigma_1 - \sigma^P)$$

where α^P and σ^P are constants defined as

$$\alpha^P = \sqrt{(1+ N^2{}_\varphi)} + N_\varphi$$

and

$$\sigma^P = \sigma^t N_\varphi - 2c \sqrt{N_\varphi}$$

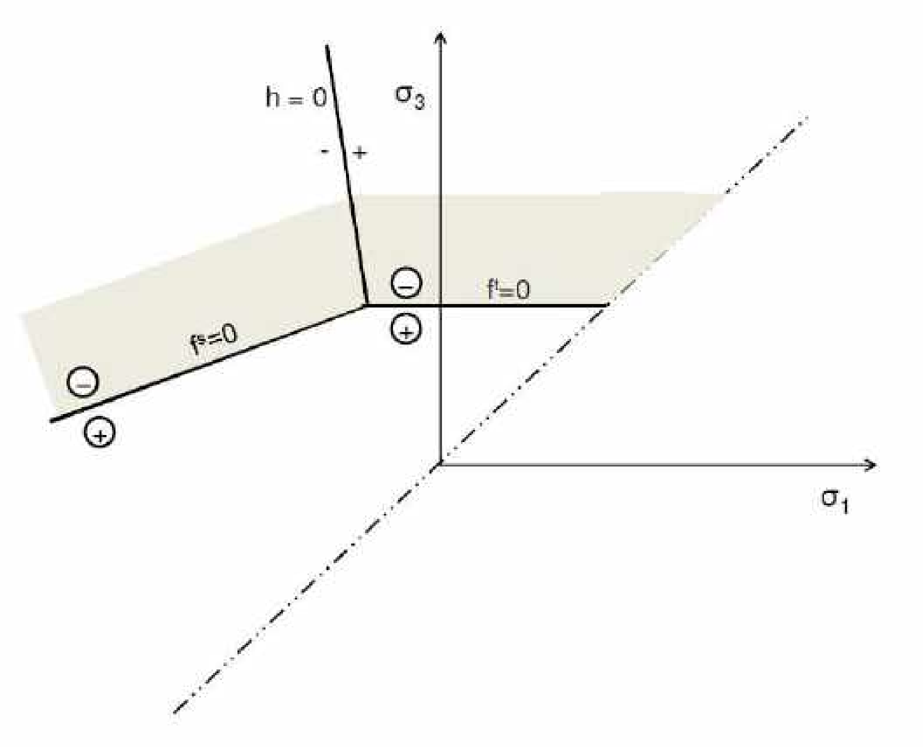


Figure 19: Mohr-Coulomb model. Domains used in FLAC in the definition of the flow rule (redrawn from FLAC User's manual, Itasca 2013)

It is noted that in the numerical implementation of the plasticity models, in FLAC an elastic trial (or elastic guess) for the stress increment is first computed from the total strain increment using the incremental form of Hooke's law. The corresponding stresses are then evaluated. If they violate the yield criteria (i.e. the stress point representation lies above the yield function in the generalized stress space), plastic deformations take place. In this case, only the elastic part of the strain increment can contribute to the stress increment; the latter is corrected by using the plastic flow rule to ensure that the stresses lie on the composite yield function.

As shown in Figure 19, an elastic guess violating the failure criterion is represented by a point in the (σ_1, σ_3) plane, located either in domain 1 or 2, corresponding to negative or positive domains of h=0, respectively. If in domain 1, shear failure is declared, and the stress point is brought back to the curve f^s=0 using a flow rule derived using the potential function g^s. If in domain 2, tensile failure takes place, and the stress point is brought back to the curve f^t=0 using a flow rule derived using the potential function g^t.

There are two additional points to stress here in relation to the choice of the writer of this report of using the FLAC code, which may become extremely important should one proceed with additional studies by using three dimensional modeling, with obvious implications in favor of using the FLAC3D code (Itasca 2012). These deal with the difficulties faced in numerical simulations in Rock Mechanics and Rock Engineering, i.e. physical instability, path dependence, and implementation of extremely nonlinear constitutive models. Also important is the specific feature available in FLAC where the plasticity models produce localization, i.e. the development of families of discontinuities such as shear bands in a material that starts as a continuum.

The difficulties mentioned above are dealt with in FLAC by using the explicit, dynamic solution scheme provided, which allows the numerical analysis to follow the evolution of a geologic system in a realistic manner, without concerns about numerical instability problems. In the explicit dynamic solution scheme the full dynamic equations of motion are included in the formulation. By using this approach, the numerical solution is stable even when the physical system being modeled is unstable. With nonlinear materials, there is always the possibility of physical instability. In real life, some of the strain energy of the system is converted into kinetic energy, which then radiates from the source and dissipates. The explicit dynamic solution approach models this process directly, because inertial terms are included - kinetic energy is generated and dissipated.

8.3 Simulation of excavation and reinforcement sequence

In view of the two dimensional design analyses to be performed, in line with the above concepts and criteria, a clear and confident understanding of the complexities involved in the construction of the HP cavern complex was needed in relation to: the excavation sequence, the placing and replacing of the reinforcement system (rock dowels and rock anchors), the reinforcement system envisaged in relation to deepening the excavation of the MH cavern and related openings, etc. To this purpose, it is important to refer to the meeting held on 5 April 2013, the previous correspondence on the subject (see Reports 139 and 142, dated respectively March 3 and 30, 2013) and to the site visit (see Report 144, dated April 2013).

As shown in Figure 20 (for details see Drawing 1 in Appendix 1), modelling considers a total of 16 stages, where concurrent excavation and installation of the support system in the MH cavern and TH cavern have taken place in the past and will take place in the future according to the Designers of the Moscow Hydroproject Institute. In stages 1 to 6 the original support system will be activated. With stage 7 deactivation of the original support system will be simulated, as intended in the period between 1990 to 2007, and the newly designed support system will be installed. Modelling will continue in stages 7 to 10, when excavation will continue in the TH cavern with the installation of the support system as detailed in the same drawing. The new support system installed in the MH cavern will be active, whereas the original support system will no longer exist.

Stages 11 to 13 will then be run in sequence up to reaching the present conditions (2013) for depth of excavation and supports installed in the underground complex. Future excavation and support installation will be simulated in stages 14 to 16 according to the available 2009 drawings of the Moscow Hydroproject Institute (Figure 20 and Drawing 1 in Appendix 1). It is to be understood that the model has been set up so that intermediate excavation and reinforcement stages can always be considered if one wishes to obtain more detailed information on a given computer run.

8.4 Simulation of reinforcement

As described above, in addition to the presence of the concrete lining in both the MH and TH cavern which is simulated as usual in numerical modeling, by activating/deactivating plane elements in the grid, consideration is to be given below to the simulation of reinforcement, i.e. rock dowels and rock anchors. This is an essential step in the model which has been implemented, given that a detailed representation of such elements may contribute significantly to add value to the simulation studies being carried out. Structures of arbitrary geometry and properties, and their interaction with a rock mass may be modeled with FLAC as briefly described below.

Cable elements have been used to model the rock anchors and rock dowels. These elements are one-dimensional axial elements that may be anchored at a specific point in the grid (point-anchored) or grouted so that the cable element develops forces along its length as the grid deforms. Cable elements can yield in tension or compression, but they cannot sustain a bending moment. If desired, cable elements may be initially pre-tensioned. Cable elements allow the modeling of a shearing resistance along their length, as provided by the shear resistance (bond) between the grout and the cable or the grout and the host medium.

The cable element formulation considers more than just the local effect of the reinforcement - its effect in resisting deformation is accounted for along its entire length. The cable element formulation is useful in modeling reinforcement systems in which the bonding agent (grout) may fail in shear over some length of the reinforcement (Hutchinson and Diederichs 1996; Ruest and Martin 2002).

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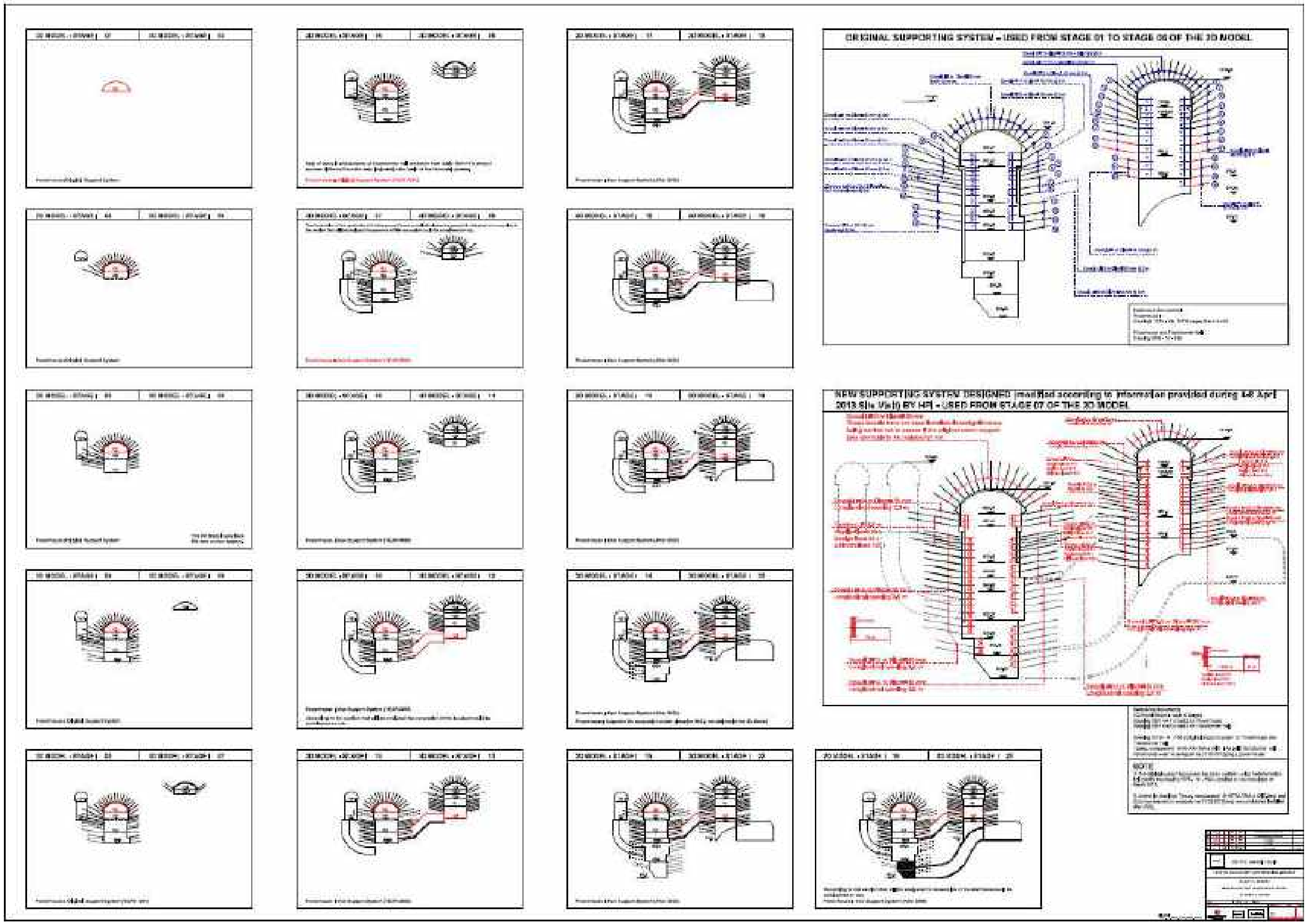

Figure 20: Description of the excavation and reinforcement stages in the two dimensional FDM model (for details see Drawing 1 in Appendix 2)

9. NUMERICAL ANALYSES

In line with the description of the main features of the modeling method adopted and the FLAC code, the purpose of the present chapter is to present the numerical analyses performed and the results obtained (2). Following a description of the FDM grid and boundary conditions, the rock mass properties taken as reference for back analysis are also introduced.

9.1 FDM grid and boundary conditions

The complete FDM grid, developed for the purpose of two dimensional modeling in plane strain conditions, with the plane of analysis normal to the main caverns (MH and TH caverns) axis, is shown in Figure 21. As the figure indicates, the mesh has been created with increasing zone size away from the MH and TH caverns, and in line with the excavation and construction stages to be simulated as discussed above. Special care in defining the grid size has also been taken in order to allow for the appropriate introduction of the reinforcement system. One should notice that this is a rather complex task due to the need to introduce in the model the original reinforcement system and the replaced one.

The grid contains 127 224 zones, and the boundaries of the model are located at a sufficient distance from the cavern complex so as to ensure that the boundary effects can be considered as negligible in the zone of interest, i.e. in the rock mass surrounding the MH and TH caverns and the pillar between them. It should be noted that, as shown in Figure 21, also introduced in the model is the presence of the Assembly Hall (AH). Given its limited extent along the normal to the plane of analysis, the influence of the AH cavern has been taken into account by assuming for the zones representing such a cavern a 30% decrease in the deformation modulus of the rock mass.

With the main purpose to illustrate the details of the FDM grid which has been developed with the excavation and reinforcement stages in mind, Figures 22 to 24 give an illustration of the model in three typical conditions for the MH cavern excavation: the excavation level is at elevation 964.2 m (Figure 22), which corresponds to excavation stage 6; the excavation level is at 958.2 m elevation which represents a typical excavation level below the reinforced concrete struts (Figure 23); the excavation works have been completed (Figure 24).

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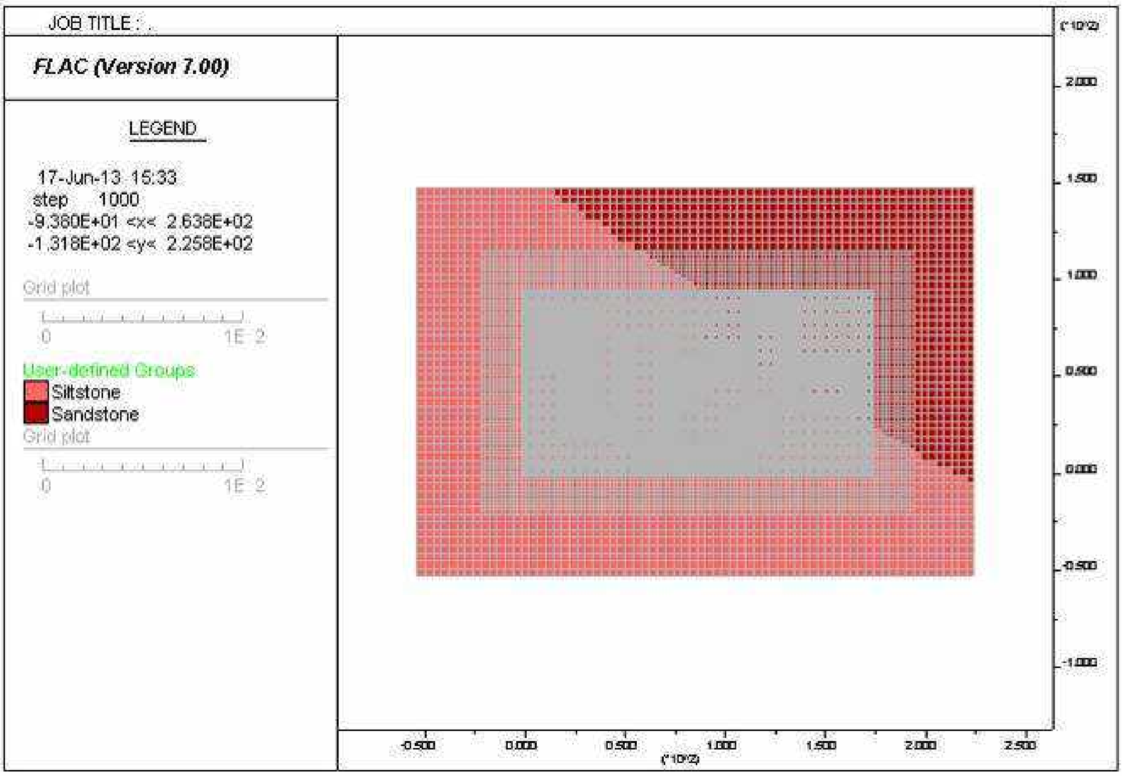
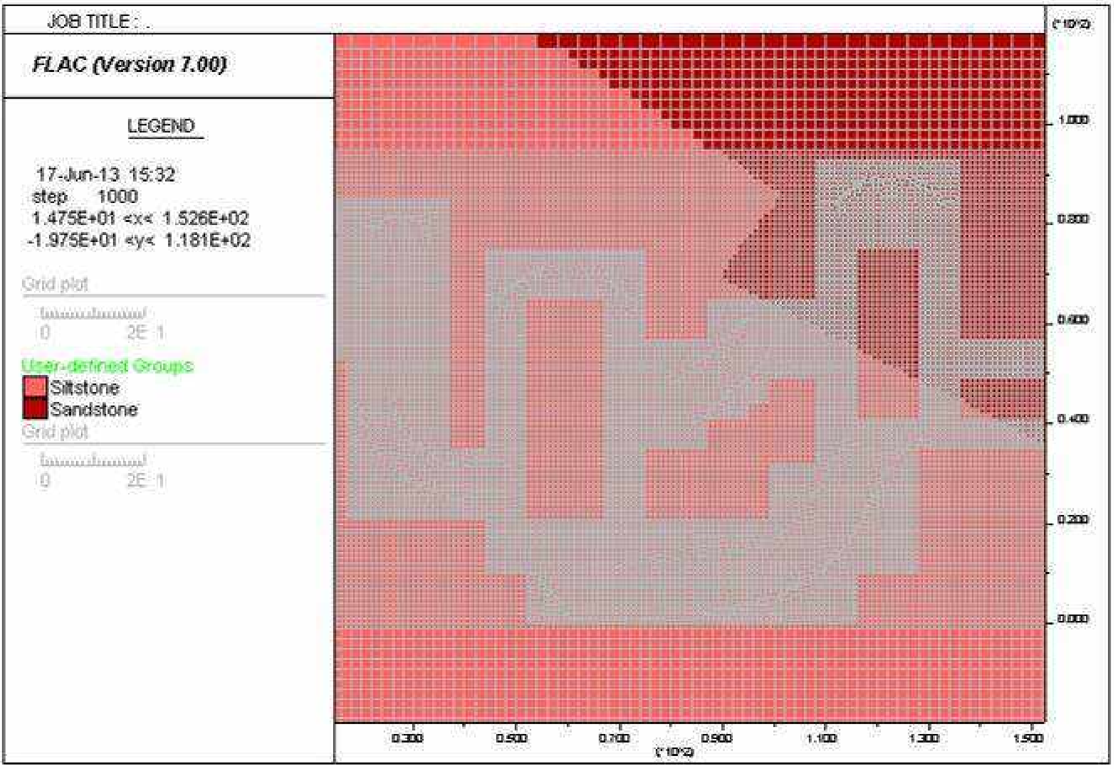
(2) The numerical analyses with the FLAC code have been carried out with the help of Dr. A. Perino and D. Debernardi, Resolving s.r.l. (Spin-Off of the Politecnico di Torino)



(a)



(b)

Figure 21: Illustration of the FDM grid. The geological cross section is also shown. (a) Complete FDM model, (b) Detail of the cavern complex

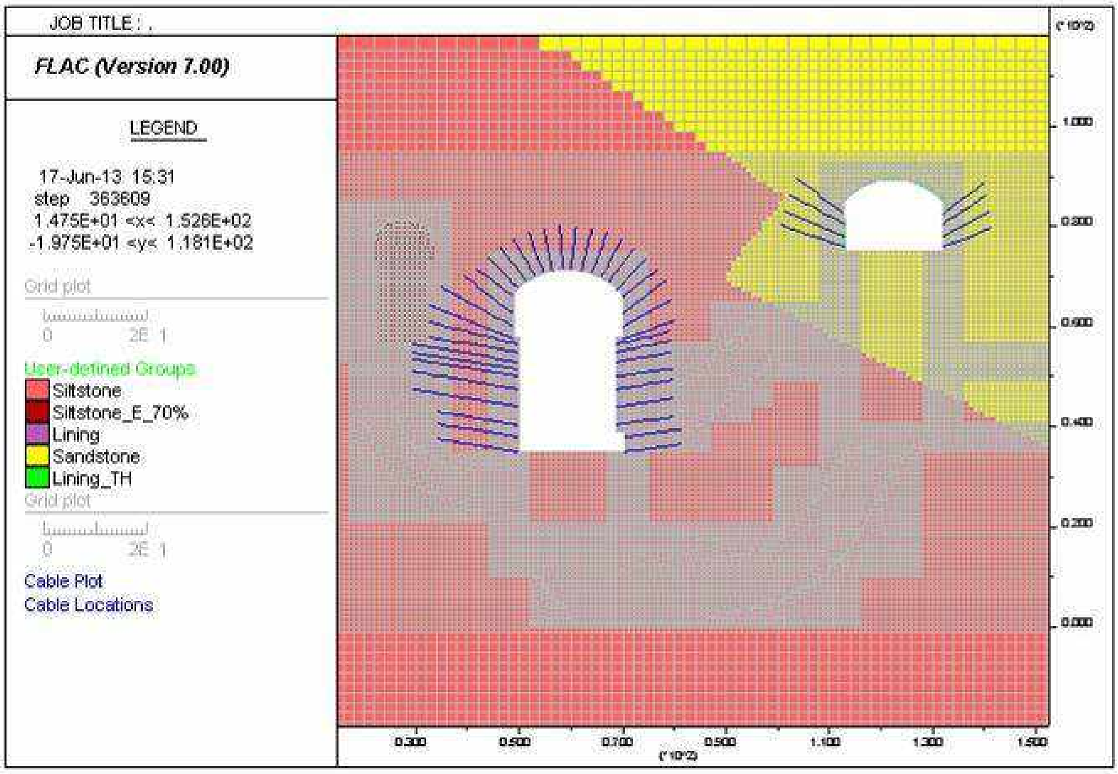


Figure 22: Illustration of the FDM mode with support included. Excavation in MH cavern to elevation 964.2 m and in TH cavern to elevation 1004.3 m

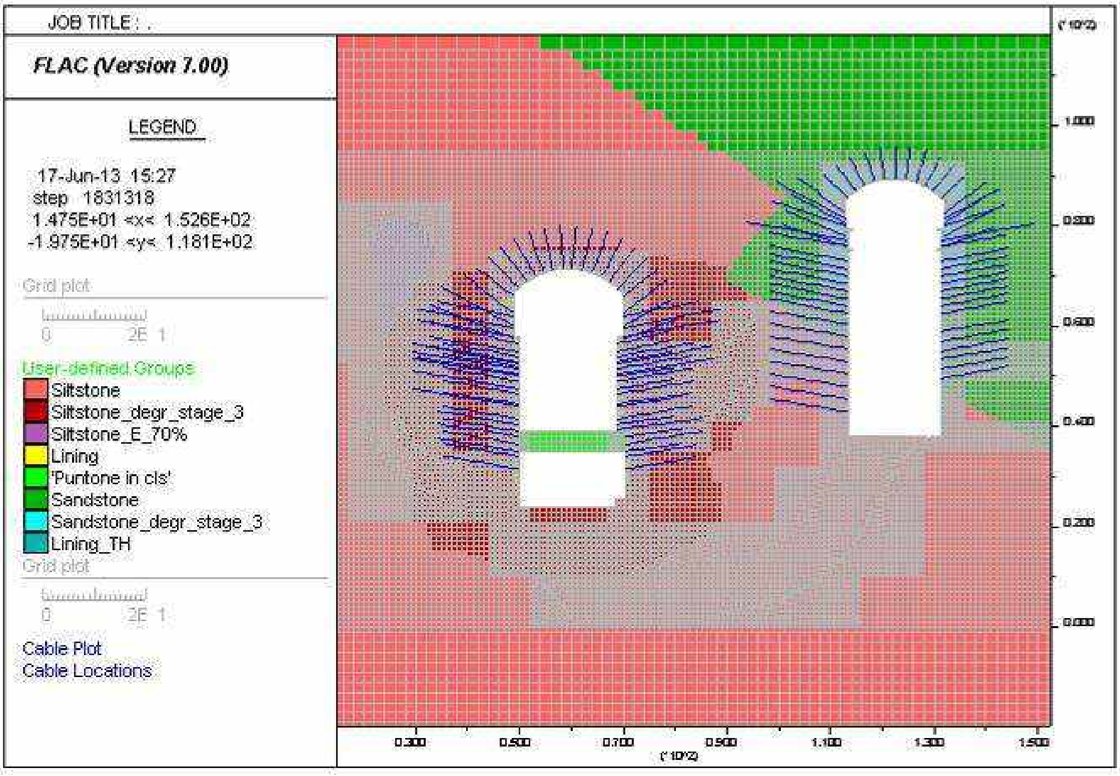


Figure 23: Illustration of the FDM model with support included. Excavation in MH cavern to elevation 958.2 m and in TH cavern to elevation 966.2 m

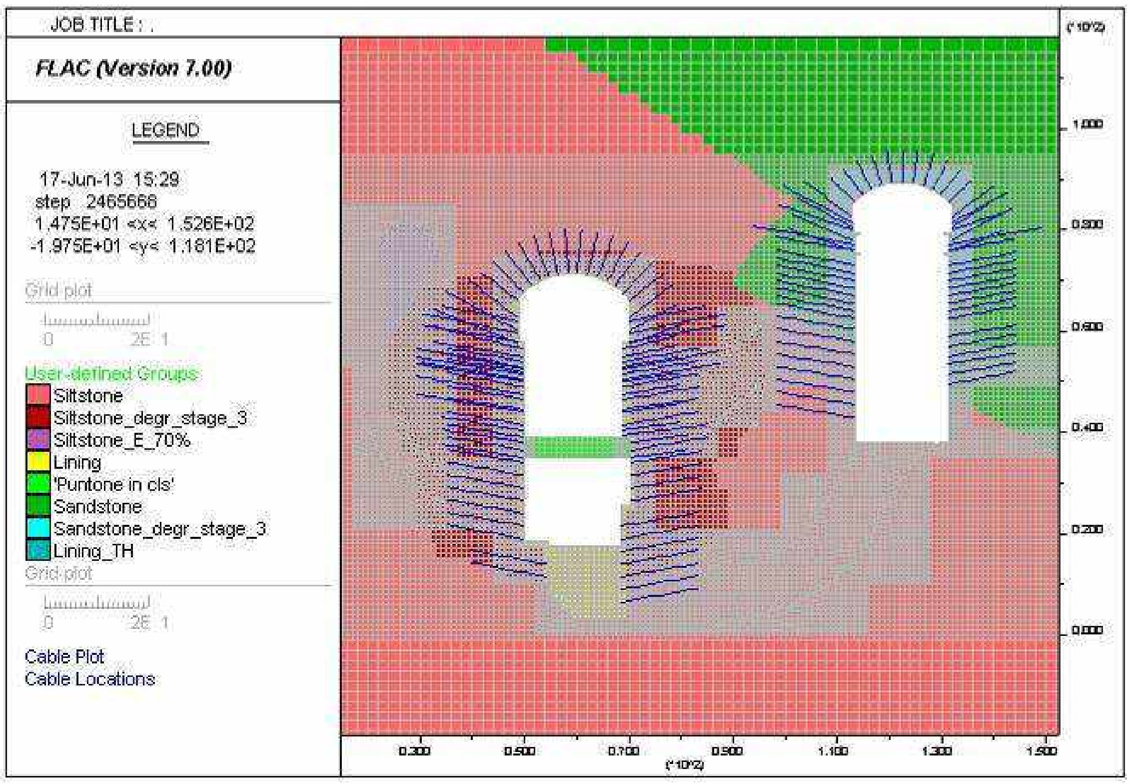


Figure 24: Illustration of the FDM model with support included. Excavation in MH cavern to elevation 932.5 m and in TH cavern to elevation 966.2 m. Concreting of MH cavern pit

9.2 Rock mass parameters

The rock mass has been modeled by using, for both the siltstone (K_1ob_1) and sandstone (K_1ob_2) rock masses, the elastic plastic Mohr-Coulomb model as discussed in paragraph 8.2 above. A back analysis procedure has been applied in order to be able to mimic the convergence history monitored in the MH cavern at elevation 986 m. As a starting point for such analysis, the data summarized in Tables 7 and 8 and derived from the available database on rock properties and previous numerical analyses has been taken as a reference as summarized below:

- $K_1ob_{2,}$ Sandstone:

Deformation modulus (GPa) - “undisturbed-disturbed” 11.0/9.0 - 6.0/2.5 GPa
Poisson’s ratio 0.2 - 0.3
Friction angle “undisturbed-disturbed” 50/42°- 45/ 36°
Cohesive strength (MPa) - “undisturbed-disturbed” 3.0/2.0 - 2.0/1.0 MPa
Dilation angle 0°

- K_1ob_1, Siltstone:

Deformation modulus (GPa) - “undisturbed-disturbed” 6.0/2.5 - 5.0/2.0 GPa
Poisson’s ratio 0.2 - 0.3
Friction angle “undisturbed-disturbed” 45/30°- 40/ 20°
Cohesive strength (MPa) - “undisturbed-disturbed” 2.0/1.0 - 1.5 /0.5 MPa
Dilation angle 0°

Based on the available data, the field stresses in the plane of analysis normal to the cavern axis have been assumed to be given as follows:

Vertical stress 14 MPa
Horizontal stress 16 MPa
Stress ratio 1.14.

9.3 Present design of reinforcement system – Numerical analyses

The first series of analyses has been finalized to describe the MH and TH caverns response to excavation and placing of the rock reinforcement, including the concrete lining, up to stage 6. This is intended to represent the conditions prior to the stop of the construction activities at the site, with the excavation levels being at 964.2 m and 1004.3 m in the MH cavern and in the TH cavern, respectively. In all cases the convergence monitoring data at elevation 986 m (Figure 10) are taken as a reference for comparing the computed with the monitored values.

With the bottom excavation levels kept fixed, the purpose of the numerical analyses following stage 6 has been to reproduce the observed time dependent behavior of the MH cavern in the siltstone rock mass, with the reinforcement system in place as originally installed. In accordance with the elastic plastic Mohr-Coulomb model used for representing the rock mass behavior, a progressive reduction of the rock mass deformation modulus (E_d) and of the strength properties, cohesion (c) and friction angle (φ), due to overstressing has been assumed. This has been associated with a loss of strength of the reinforcement system consisting of rock dowels and a limited number of rock anchors.

Once the computed convergence values due the above simulated degradation process of both the rock mass properties and of the reinforcement system are found to match satisfactorily the monitored values (say in March 2008 approximately), the reinforcement system is replaced in stage 7, in accordance with the design of the Moscow Hydroproject Institute as explained in paragraph 8.3 above and illustrated in Figure 20 (for details see Drawing 1 in Appendix 2). Then, the excavation and reinforcement sequence is simulated from stage 8 through stage 16 to the completion of the cavern complex.

As well known in the numerical modeling of underground excavations, one is to account for the stress relief which takes place at the contour of the opening which is being excavated prior to introducing the rock support, which in the present case is represented by the rock dowels, the rock anchors and the concrete lining. This process is to be simulated with great care in view of the geometrical complexities associated with the FDM grid being used and the high number of stages being simulated. Not to be neglected in the present case study is the fact that numerical modeling is being carried out in two dimensional plane strain conditions.

With this in mind, each excavation stage has been simulated by allowing first a given percentage of stress relief at the opening contour. This has been assumed to be equal to 60 % of the initial/induced state of stress in the rock mass surrounding the opening being excavated, in line with the conventional excavation and support method being used at the site.

Following this stage, the support system has been activated including the rock dowels, the rock anchors, and the concrete lining, in accordance with the construction sequence shown in Figure 20 (for details see Drawing 1 in Appendix 2). Table 9 below gives a summary of all the excavation and construction stages, including installation of reinforcements and concrete lining.

The concrete lining is simulated as a linear elastic material with the following parameters:

- Elastic modulus = 30 GPa
- Poisson’s ratio = 0.24.

The rock dowels and rock anchors, which have been simulated with the cable element option available in FLAC and previously described, implies the definition of the following parameters:

- Cross sectional area, defined for the element considered
- Tensile yield strength, defined for the element considered (Ultimate Strength 800 MPa)
- Grout stiffness, computed as suggested by Ruest and Martin (2011) for given hole diameter, grout thickness, grout shear modulus (12 GPa), grout compressive strength (25 MPa)
- Ultimate bond strength 200 kN/m, for a water/cement ratio equal to 0.35, computed according to Hutchinson and Diederichs (1966).

Table 9: Summary of simulation stages

Stage Nr.	Description
0	Equilibrium before starting of construction (initial in-situ stress σ_V = 14 MPa, σ_H = 16 MPa)
1	Excavation of MH to el. 992 m with 60% stress relief
2	Installation of reinforcements and 20% stress relief of MH to el. 992 m
3	Complete stress relief of MH to el. 992 m + Excavation of MH to el. 986 m with 60% stress relief + reduction of 30% of deformation modulus of AH to el. 1001.5 m
4	Installation of reinforcements and 20% stress relief of MH to el. 986 m
5	Complete stress relief of MH to el. 986 m + Excavation of MH to el. 973 m with 60% stress relief and reduction of 30% of the deformation modulus of AH to el. 985 m
6	Installation of reinforcements and 20% stress relief of MH to el. 973 m
7	Complete stress relief of MH to el. 973 m + Excavation of MH to el. 964.2 m with 60% stress relief
8	Installation of reinforcements and 20% stress relief of MH to el. 964.2 m
9	Complete stress relief of MH to el. 964.2 m + excavation of TH to el. 1012.5 m with 60% stress relief
10	Installation of reinforcements and 20% stress relief of TH to el. 1012.5 m
11	Complete stress relief of TH to el. 1012.5 m + excavation of TH to el. 1008.9 m with 60% stress relief
12	Installation of reinforcements and 20% stress relief of TH to el. 1008.9 m
13	Complete stress relief of TH to el. 1008.9 m + excavation of TH to el. 1004.3 m with 60% stress relief
14	Installation of reinforcements and 20% stress relief of TH to el. 1004.3 m
15	Complete stress relief of TH to el. 1004.3 m
16	1st parameter degradation
17	2nd parameter degradation
18	3rd parameter degradation
19	Installation of new support system (after 2009)
20	Excavation of TH to el. 997 m with 60% stress relief
21	Installation of reinforcements and 20% stress relief of TH to el. 997 m
22	Complete stress relief of TH to el. 997 m + Excavation of TH to el. 986.7 m with 60% stress relief
23	Installation of reinforcements and 20% stress relief of TH to el. 986.7 m
24	Complete stress relief of TH to el. 986.7 m + Excavation of TH to el. 983.2 m with 60% stress relief
25	Installation of reinforcements and 20% stress relief of TH to el. 983.2 m + Installation of concrete strut at 964.2 in MH
26	Complete stress relief of TH to el. 983.2 m + Excavation of TH to el. 974.7 m with 60% stress relief
27	Installation of reinforcements and 20% stress relief of TH to el. 974.7 m
28	Complete stress relief of TH to el. 974.7 m + Excavation of TH to el. 966.2 m with 60% stress relief
29	Installation of reinforcements and 20% stress relief of TH to el. 966.2 m + Excavation of MH to el. 958.2 m with 60% stress relief
30	Complete stress relief of TH to el. 966.2 m + Installation of reinforcements and 20% stress relief of MH to el. 958.2 m
31	Complete stress relief of MH to el. 958.2 m + Excavation of MH to el. 953.2 m with 60% stress relief
32	Installation of reinforcements and stress relief of 20% of MH to el. 953.2 m
33	Complete stress relief of MH to el. 953.2 m + Excavation of MH to el. 946.9 m with 60% stress relief
34	Installation of reinforcements and 20% stress relief of MH to el. 946.9 m
35	Complete stress relief of MH to el. 946.9 m + Excavation of MH to el. 940.9 m with 60% stress relief
36	Installation of reinforcements and 20% stress relief of MH to el. 940.9 m
37	Complete stress relief of MH to el. 940.9 m + Excavation of MH to el. 932.5 m with 60% stress relief
38	Installation of reinforcements and 20% stress relief of MH to el. 932.5 m
39	Complete stress relief of MH to el. 932.5 m
40	Concreting of MH between 946.9 m and 932.5 m

9.3.1 Results and Discussion

- *Back analysis*

The results of the numerical analyses performed are presented below by reporting first the most significant excavation and construction stages, for selected sets of rock mass parameters which allow for a progressively better simulation of the deformation process observed in the MH cavern through the convergence monitoring at elevation 986 m. Figure 25 compares the corresponding computed and monitored convergence values.

Table 10 shows the rock mass parameters for Analysis Step FLAC E 6 - 3.5 GPa which as result of back analysis are recognized to be the most appropriate for reproducing the monitoring data on a very significant time span encompassing all the construction stages in the MH and TH caverns.

Table 10: Summary of the rock mass parameters. Analysis Step FLAC E 6 - 3.5 GPa

Conditions	Degradation Step	Ed (GPa)	v (-)	c (MPa)	φ (°)	Rock Mass
Short Term		6.00	0.35	1.00	30	Siltstone
Long Term	1	5.17	0.35	0.92	30	
	2	4.33	0.35	0.83	30	
	3	3.500	0.35	0.75	30	
Short Term		10,000	0,25	2,000	45	Sandstone
Long Term	1	8,125	0,25	1,750	45	
	2	6,250	0,25	1,500	45	
	3	4,375	0,25	1,250	45	

- *Failure zones*

For the set of rock mass parameters shown in Table 9, Figures 26 to 30 illustrate the failure zones around the MH and TH caverns as excavation proceeds concurrent with the installation of the support. In order to allow for appropriate visualization of the different simulation stages, the plots are shown in sequence and the different excavation levels being reached in both the caverns are also shown. In this manner one is able to appreciate the growing of the failure zones around the openings and in particular in the pillar between the two caverns.

It is shown that a failure zone starts from the excavation boundary (initially the MH cavern), where the stress concentrations are the highest and propagates away from it until the excess load transferred is small enough that it can be carried out by the surrounding elements in elastic state. It is relevant to underline that with the excavation level at elevation 964.2 m in the MH cavern (Figure 26, bottom right plot) the failure zone has propagated outwards and has reached an extent which is equal to or greater than the length of the reinforcement. This is in particular the case of the downstream sidewall of the MH cavern.

Of particular relevance is the influence of the excavation of the TH cavern top heading, when failure around the MH cavern extends further and zones of tensile failure (destressing associated with the vertical sidewalls) develop on both the sidewalls and in particular in the pillar between the two caverns (Figure 27, top left plot). Also evidenced in the same plot is the development of shear bands in the rock mass (at yield in shear or volume change) which are a clear indication of the inadequacy of the stabilization measures adopted so far.

As expected, with the degradation of the rock mass properties and the progressive loosening of the support system, which has been introduced in order to mimic the time dependent behavior of the siltstone rock mass, the failure zone extends further and shear bands keep being present in the openings surround (Figure 27, bottom right plot and Figure 28, top left and right plots). As the excavation of the TH cavern is deepened, with the support system replaced, the failure zones around the two caverns propagate outwards into the pillar between them, as well illustrated in Figure 29.

Of particular interest is the condition reached in the rock mass as excavation in the MH cavern is deepened down to elevation 958.2 m (below the reinforced concrete strut installed at elevation 964.5 m), which is the present level of excavation in the zone where Unit 6 is to be located (Figure 29, bottom right plot). It is shown that new shear bands develop in the pillar, in particular in the vicinity of the upstream sidewall of the TH cavern. The failure zone is now localized in the pillar between the two caverns and some shear bands initiate to develop below the excavation levels reached.

Figure 30 illustrates how the failure zone propagates around the MH cavern as the excavation is deepened progressively to reach full depth down to elevation 932.5 m, when concrete filling of the bottom pit takes place. It is important to underline that the extent of the failure zone is greater than the length of the rock dowels installed on the upstream sidewall. Also the interaction between the MH and TH caverns is well evidenced, not only in the pillar between them, but also at greater depth below the excavation level reached, with some new shear bands appearing in the rock mass.

Finally, Figure 31 shows detailed plots of the maximum shearing strains and localization of the shear bands which occur in the upper portion of the pillar, between the MH and TH caverns, at completion of excavation and following concreting of the turbine pit. The superposition on the same diagram of the deformed grid, which is further to be discussed in the following, renders with clear evidence the critical stability conditions of the cavern complex.

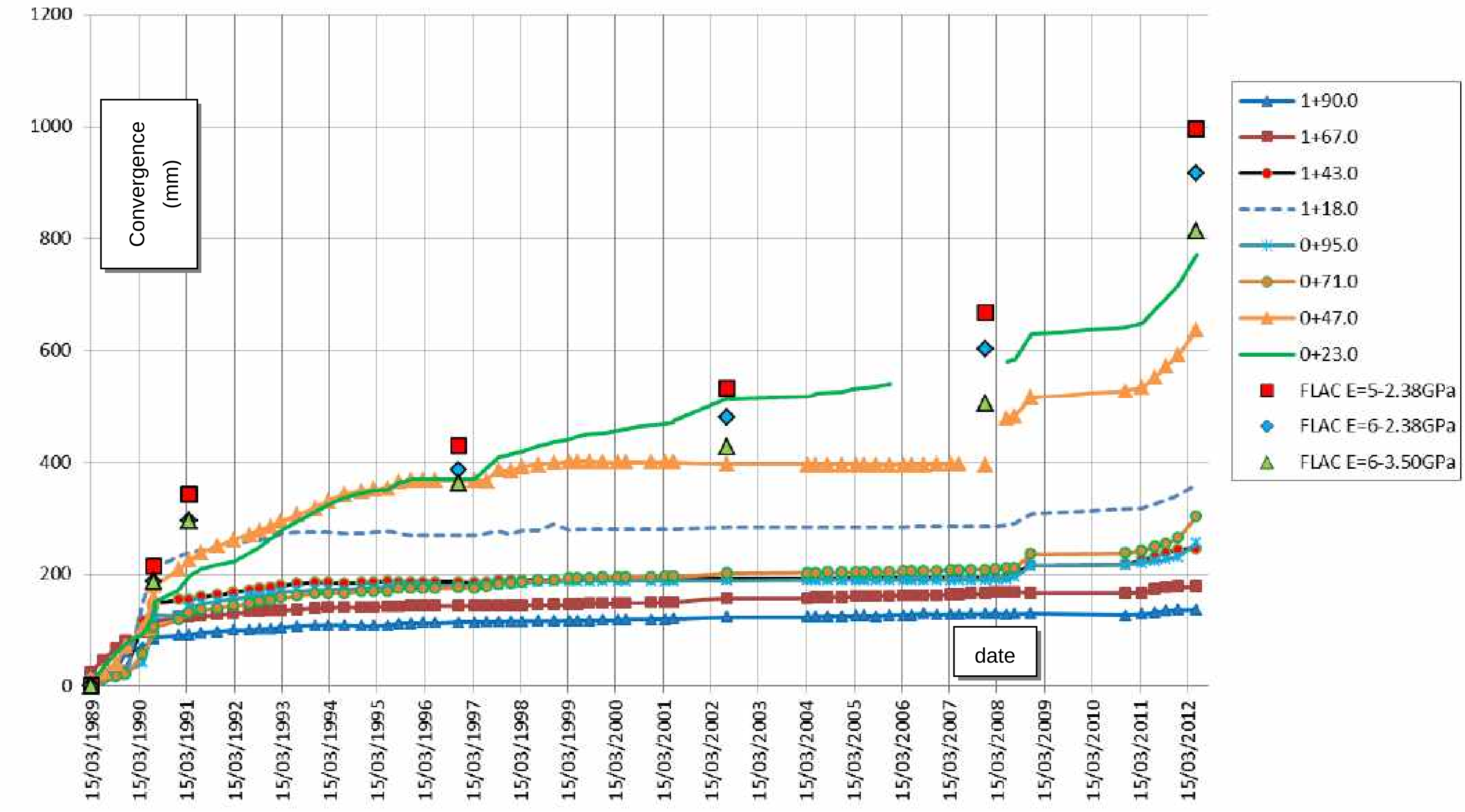
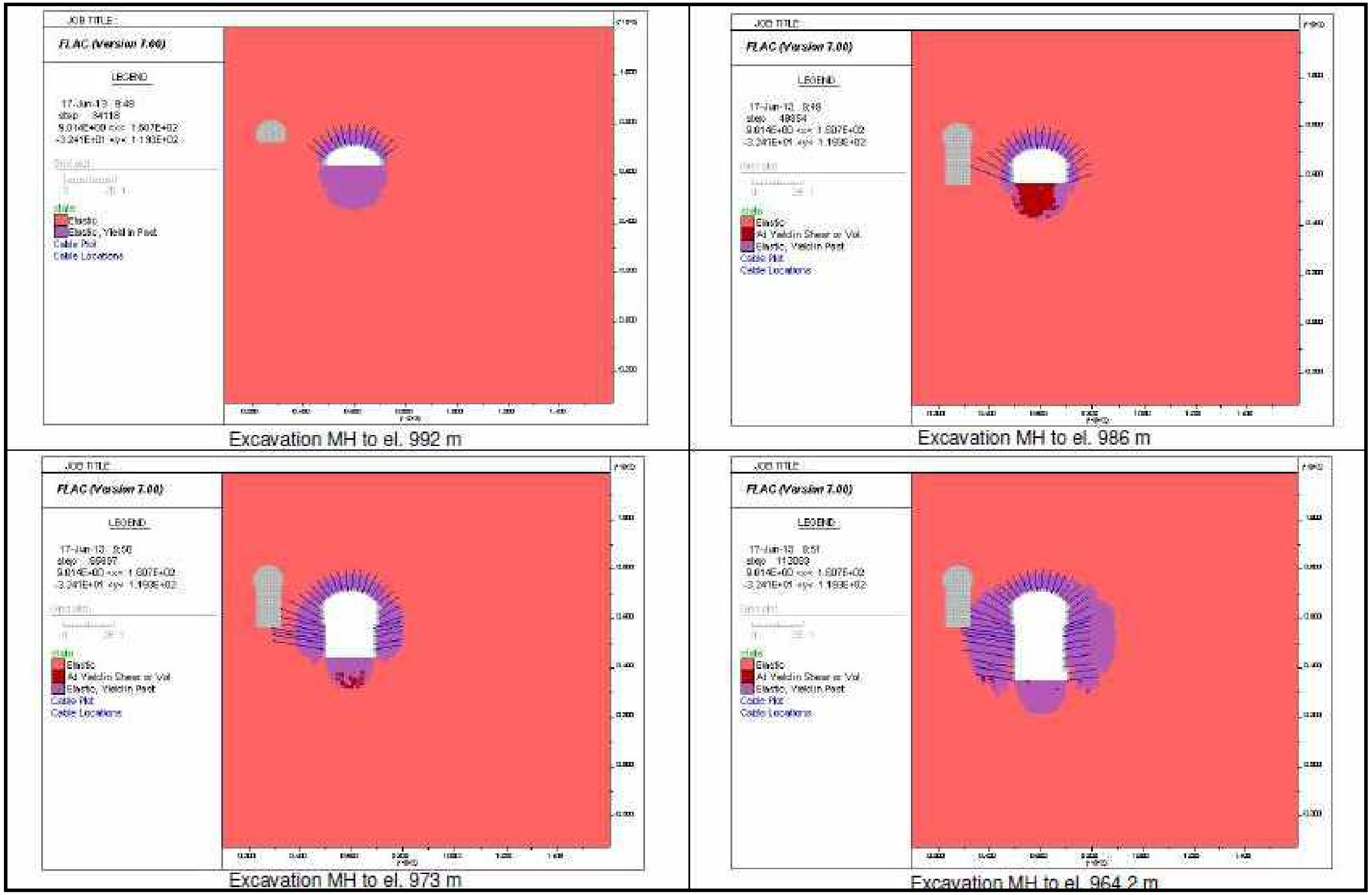


Figure 25: Computed and monitored convergence history from 1989 to 2012 at elevation 986 m in the MH cavern. The vertical axis gives the convergence values (computed and monitored) in mm. The horizontal axis shows the corresponding time when a measurement is taken



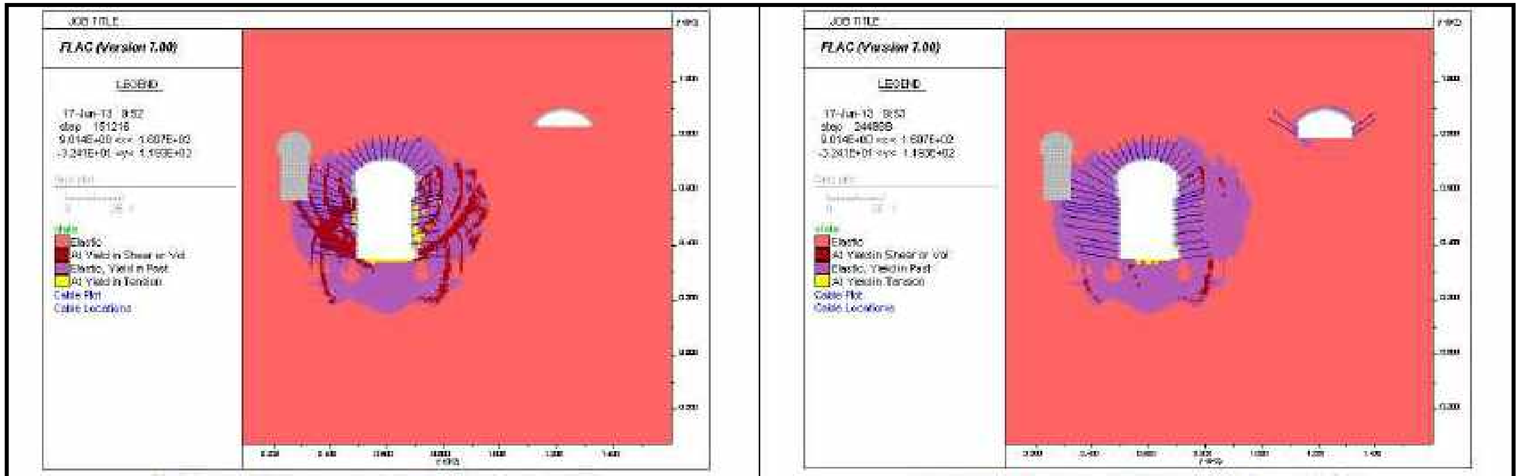
Excavation MH to el. 992 m

Excavation MH to el. 986 m

Excavation MH to el. 973 m

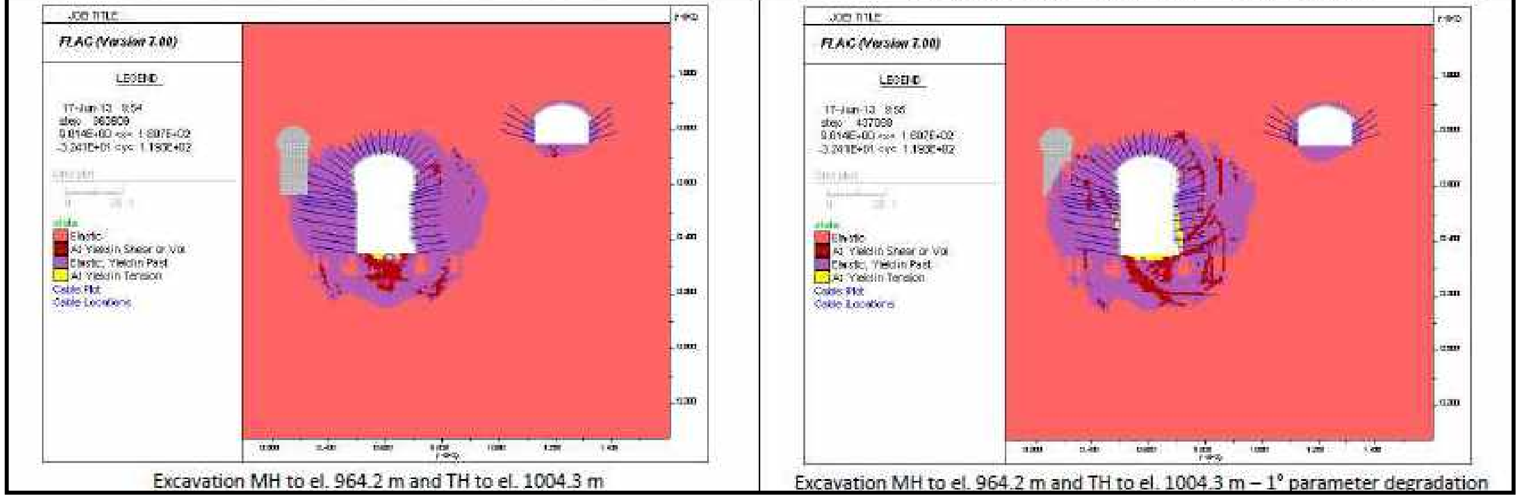
Excavation MH to el. 964.2 m

Figure 26: Illustration of the plastic zones for excavation level in the MH cavern at 992, 986, 973, 964.2 m



Excavation MH to el. 964.2 m and TH to el. 1012.5 m

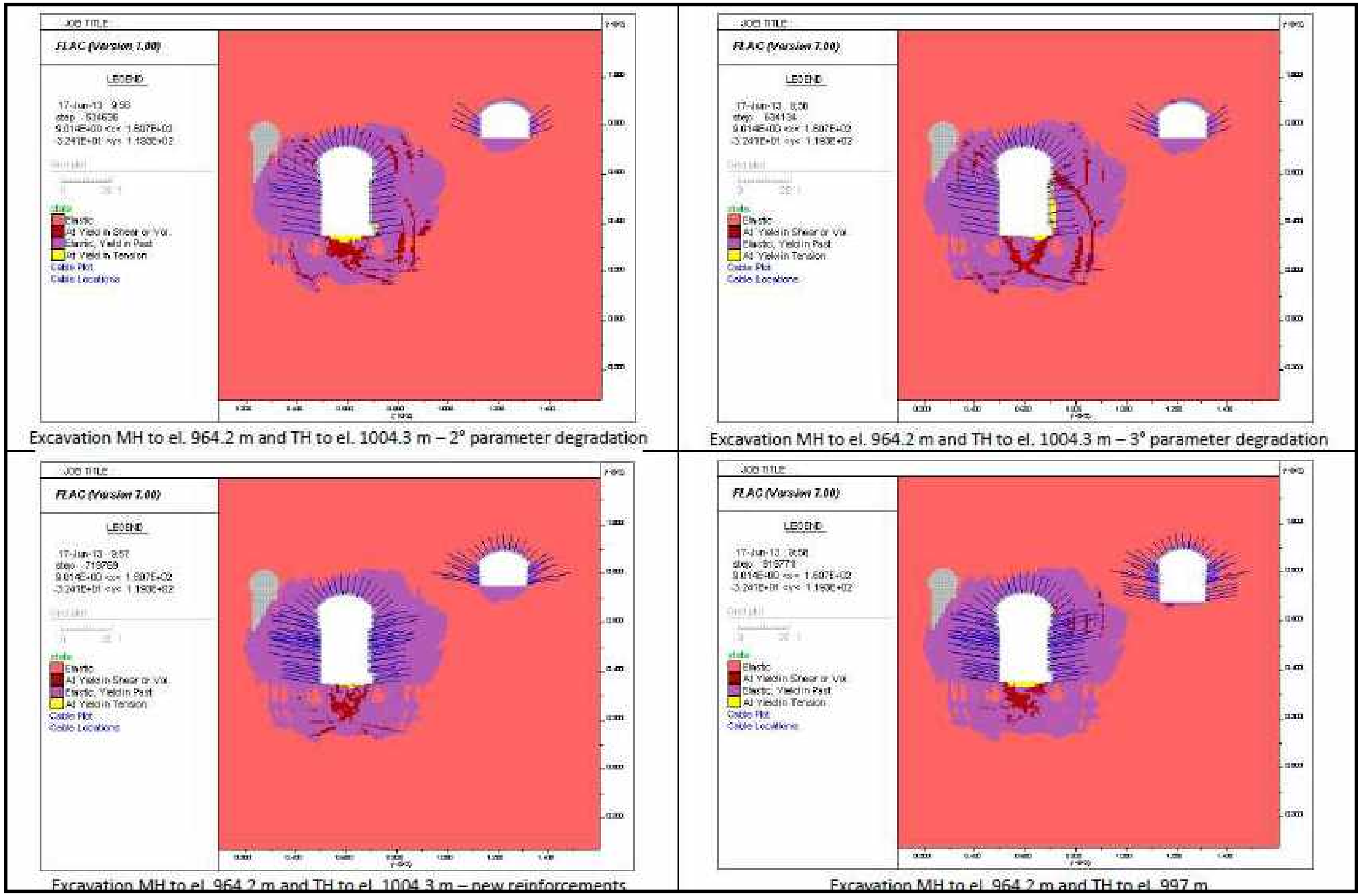
Excavation MH to el. 964.2 m and TH to el. 1008.9 m



Excavation MH to el. 964.2 m and TH to el. 1004.3 m

Excavation MH to el. 964.2 m and TH to el. 1004.3 m – 1° parameter degradation

Figure 27: Illustration of the plastic zones for excavation level in the MH cavern at 964.2 m and in the TH cavern down to 1004.3 m and 1st parameter degradation



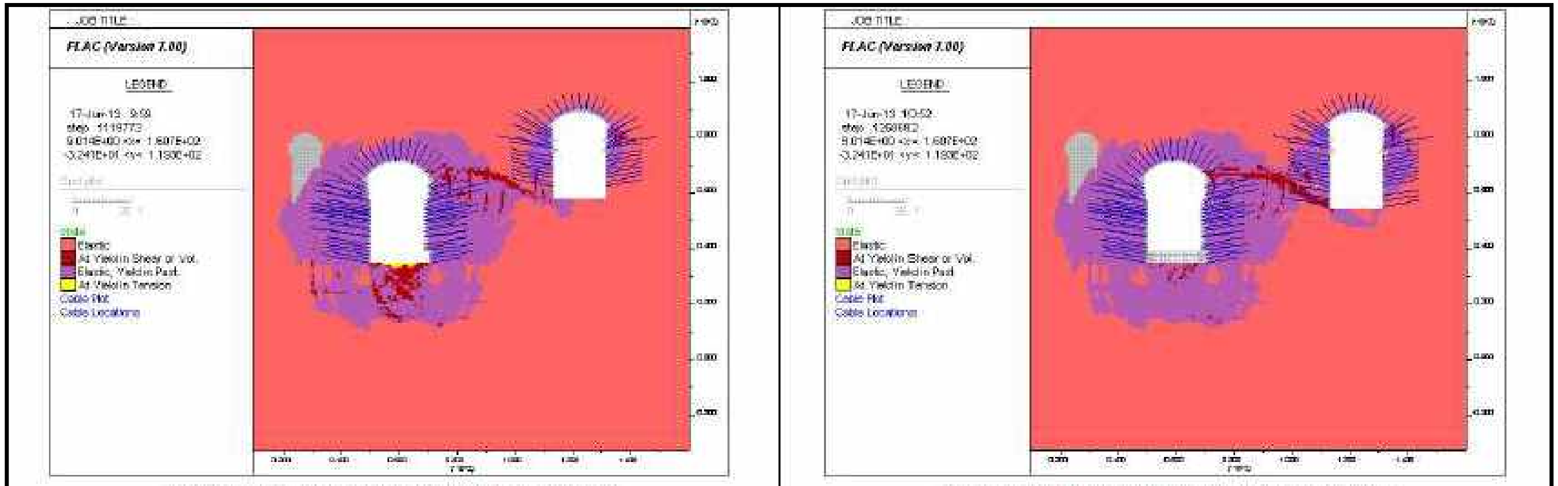
Excavation MH to el. 964.2 m and TH to el. 1004.3 m – 2° parameter degradation

Excavation MH to el. 964.2 m and TH to el. 1004.3 m – 3° parameter degradation

Excavation MH to el. 964.2 m and TH to el. 1004.3 m – new reinforcements

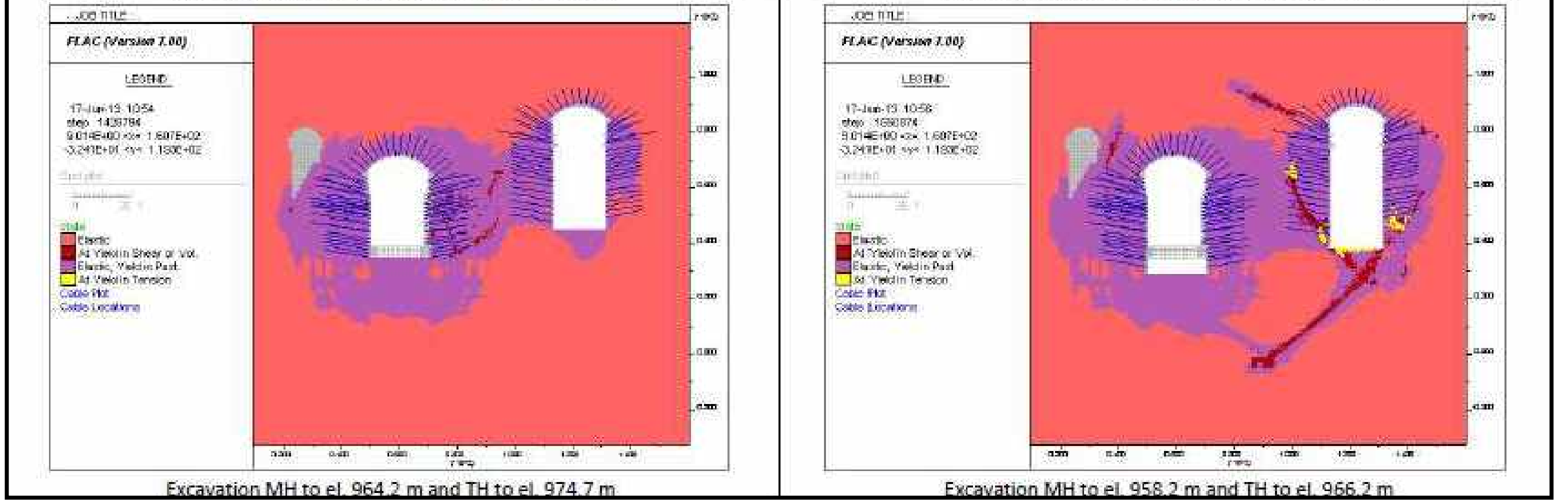
Excavation MH to el. 964.2 m and TH to el. 997 m

Figure 28: Illustration of the plastic zones for excavation level in the MH cavern at 964.2 m and in the TH cavern down to 1004.3 m with 2nd and 3rd parameter degradation. Reinforcement system replaced with excavation deepened in the TH cavern down to 997 m



Excavation MH to el. 964.2 m and TH to el. 986.7 m

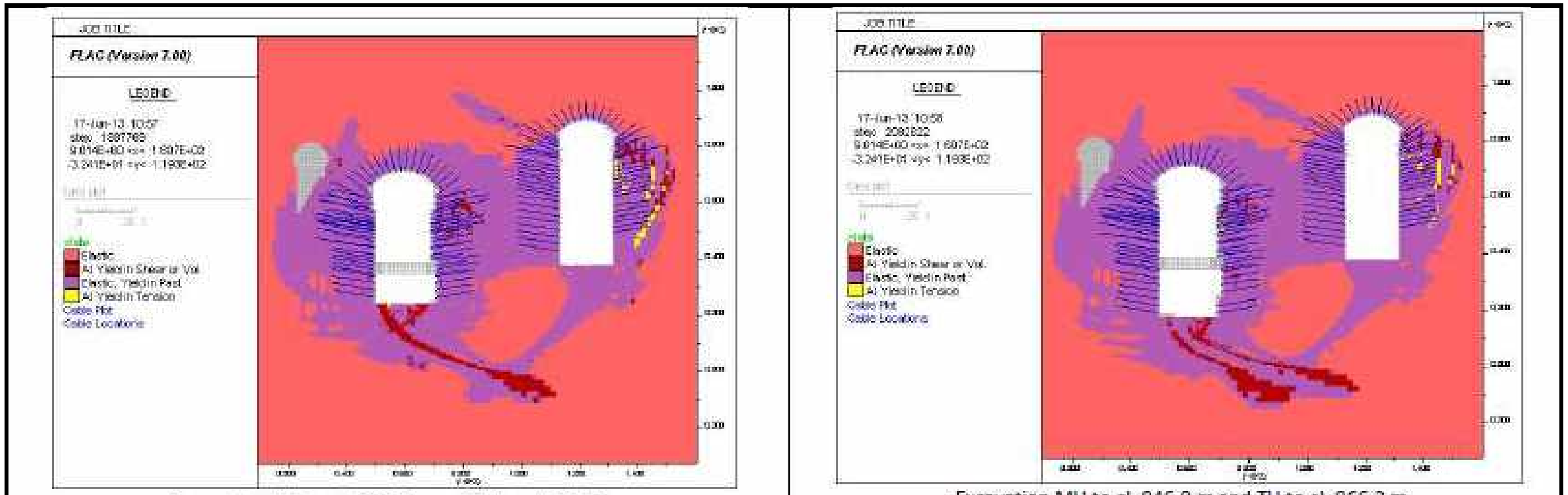
Excavation MH to el. 964.2 m and TH to el. 983.2 m



Excavation MH to el. 964.2 m and TH to el. 974.7 m

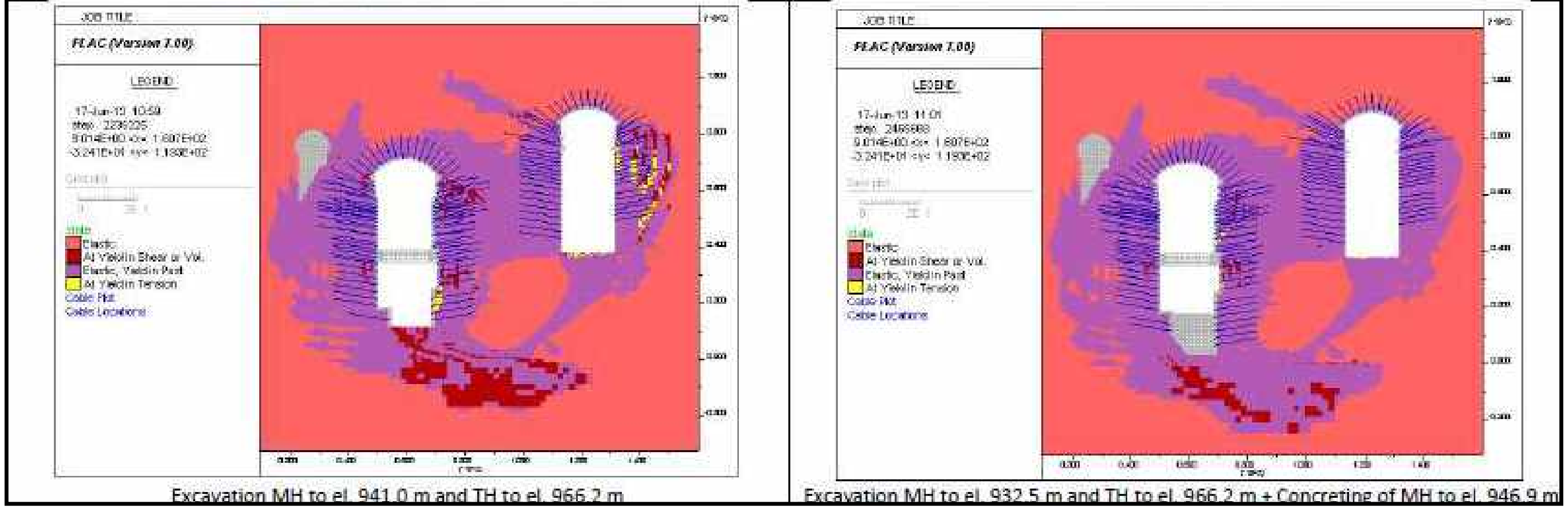
Excavation MH to el. 958.2 m and TH to el. 966.2 m

Figure 29: Illustration of the plastic zones for excavation level in the MH cavern at 964.2 m and placement of the reinforced concrete strut. Excavation continues in the MH cavern down to 985.2 m and in the TH cavern down to 966.2 m



Excavation MH to el. 953.2 m and TH to el. 966.2 m

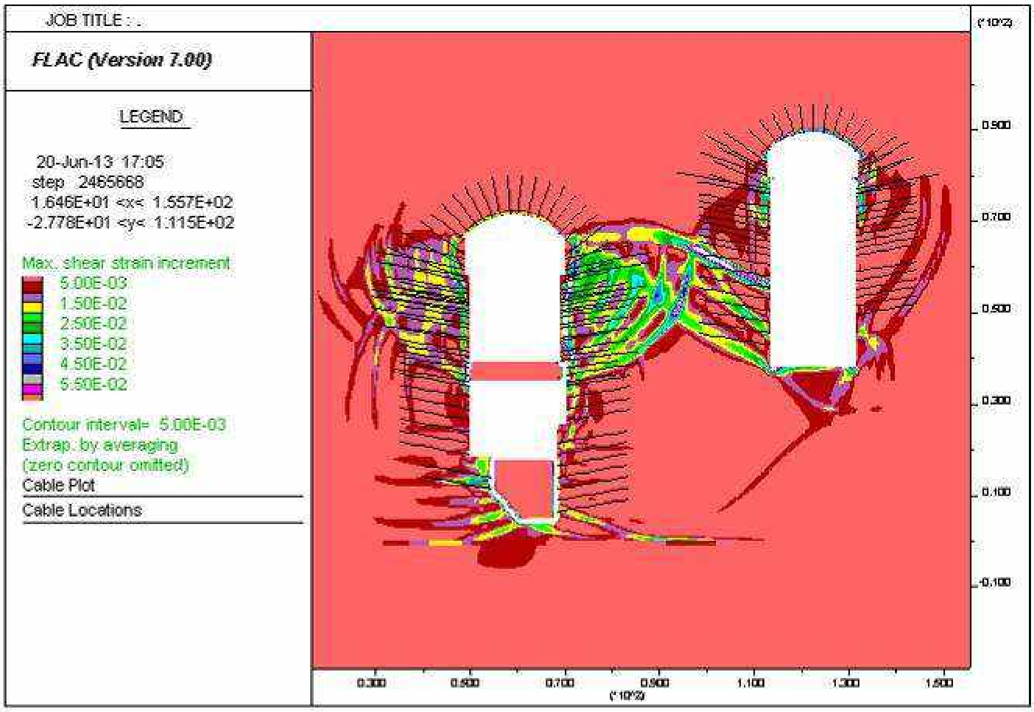
Excavation MH to el. 946.9 m and TH to el. 966.2 m



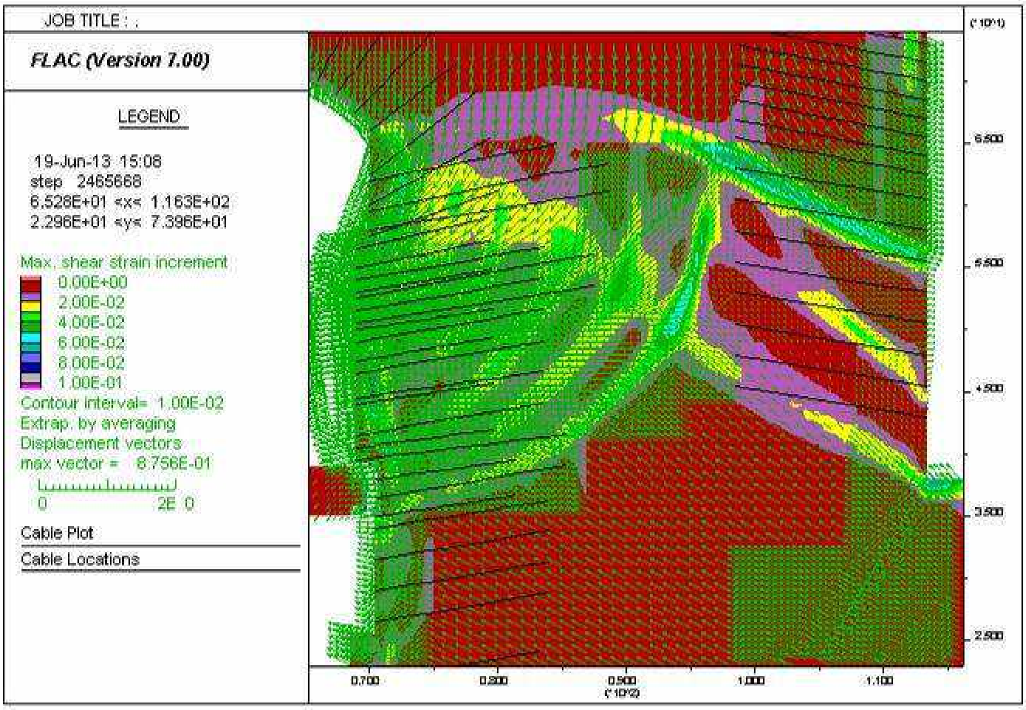
Excavation MH to el. 941.0 m and TH to el. 966.2 m

Excavation MH to el. 932.5 m and TH to el. 966.2 m + Concreting of MH to el. 946.9 m

Figure 30: Illustration of the plastic zones for excavation level in the MH cavern at 953.2, 946.9, 941 m and 932.5 m with pit concrete filling



(a)

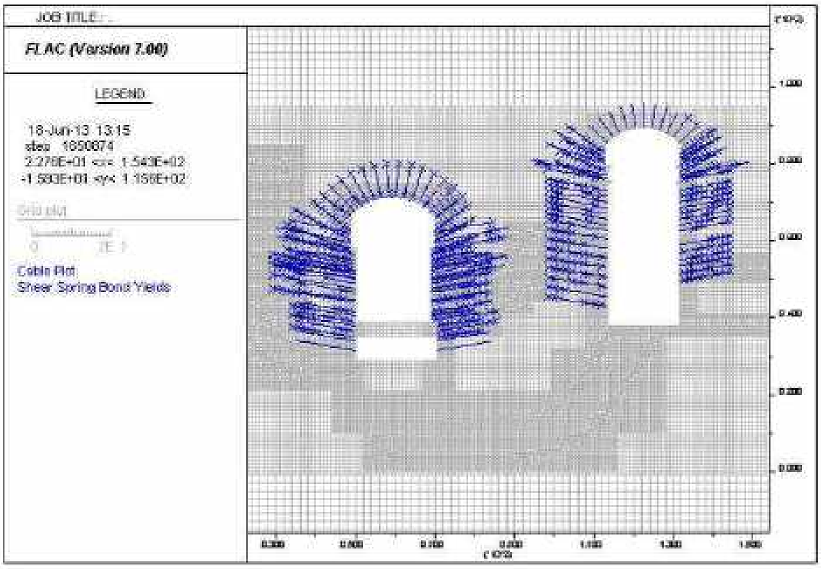


(b)

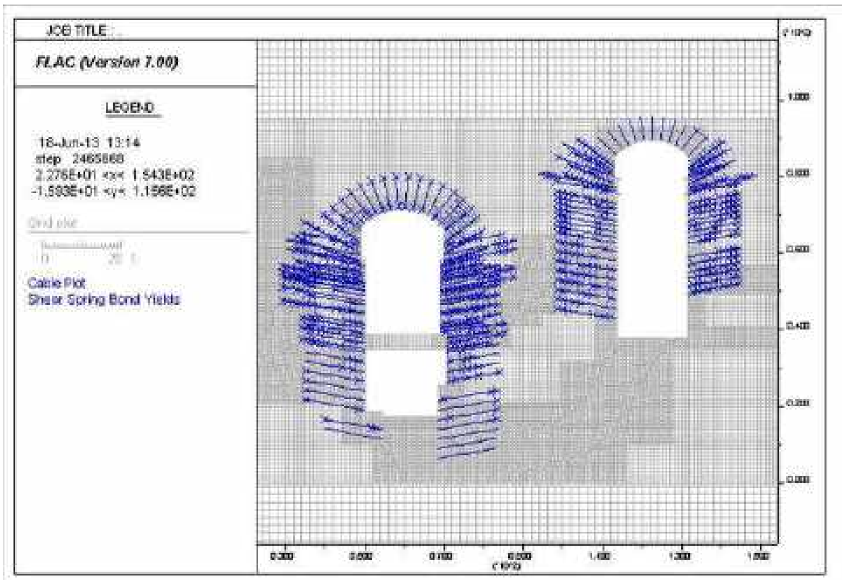
Figure 31: Illustration of the maximum shear strain and localization of shear bands in the pillar between the MH and TH caverns: (a) overall view, (b) detailed view

- *State of stress in the reinforcement, in the concrete lining, and in the concrete struts*

Figure 32 shows, for two selected excavation stages, the zones of shear failure along the bonding length in the reinforcement system, i.e. rock dowels and rock anchors. It is noted that in the FDM model the ultimate cohesive bond strength is evaluated to be equal to 200 kN/m (Hutchinson and Diederichs 1996). Under such conditions assumed, the rock support installed above level 964.2 m in the MH cavern would have undergone a localized bond failure, in particular on the upstream sidewall. Localized failures are also shown to take place on both the downstream and upstream sidewalls in the TH cavern. A more favorable performance is exhibited by the reinforcement system below the reinforced concrete strut as the excavation is deepened.



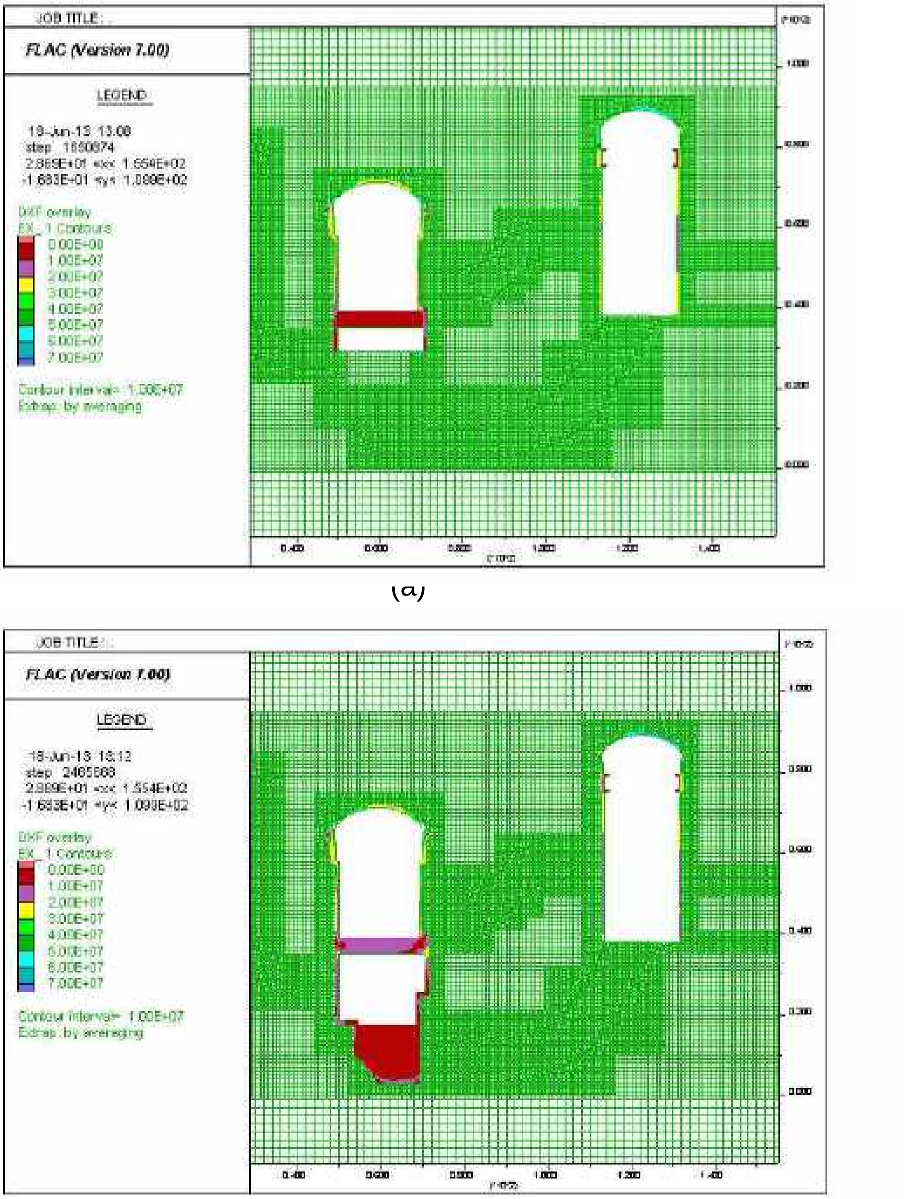
(a)



(b)

Figure 32: Shear failure along the bonding length in the reinforcement system. Excavation level in the MH cavern: (a) at elevation 958.2 m, and (b) at elevation 932.5 m

For the same excavation stages discussed above, Figure 33 illustrates the state of stress in the concrete lining. It is observed that this need be taken with great caution given that in the FDM model the concrete lining has been given a linear elastic behavior. This implies that no stress redistribution takes place in the lining as an overstressing condition may be reached and no consideration is given to possible delays in casting and most of all to the construction stages. The only interest here is to note that the state of stress in the reinforced concrete strut, introduced at elevation 964.2 m, increases very dramatically as the excavation is deepened, reaching a failure condition for concrete with compressive strength equal to 25 MPa.



(a)

(b)

Figure 33: State of stress in the concrete lining. Excavation level in the MH cavern: (a) at elevation 958.2 m, and (b) at elevation 932.5 m

- *Patterns of deformation*

With the intent to provide some insights into the patterns of deformation around the MH cavern, based on the rock mass parameters inferred with the back analysis described above, Figures 34 and 35 show the computed increase in convergence at elevations 986 m and 958.2 m respectively. In addition, Figures 36 to 40 depict the “exaggerated grid distortion”, with 5.0 magnification, as excavation and construction proceed through the different stages already considered above, when analyzing the propagation of the failure zones in the rock mass surrounding the two caverns.

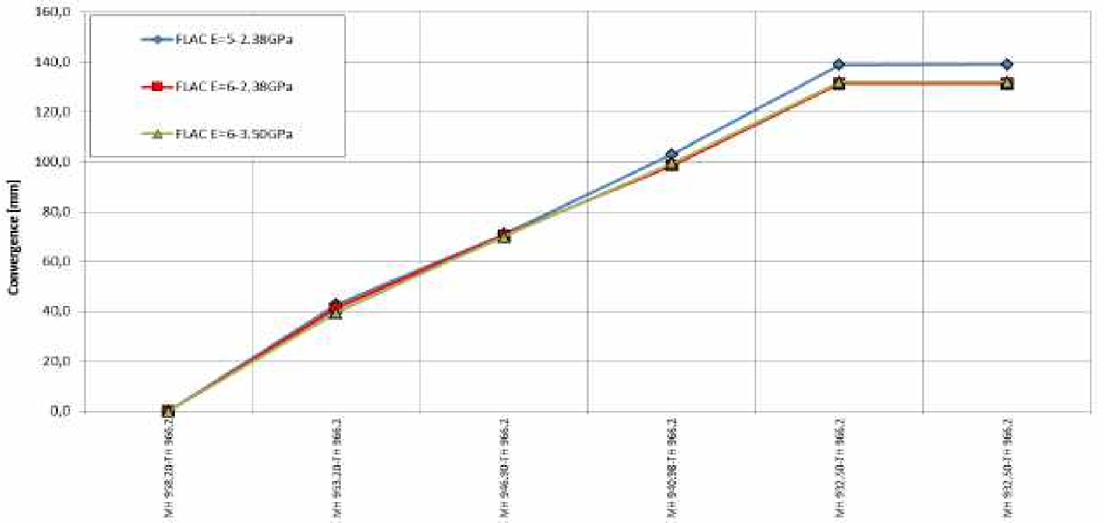


Figure 34: Computed increase in convergence at elevations 986 m as excavation proceeds up to the completion of the cavern complex

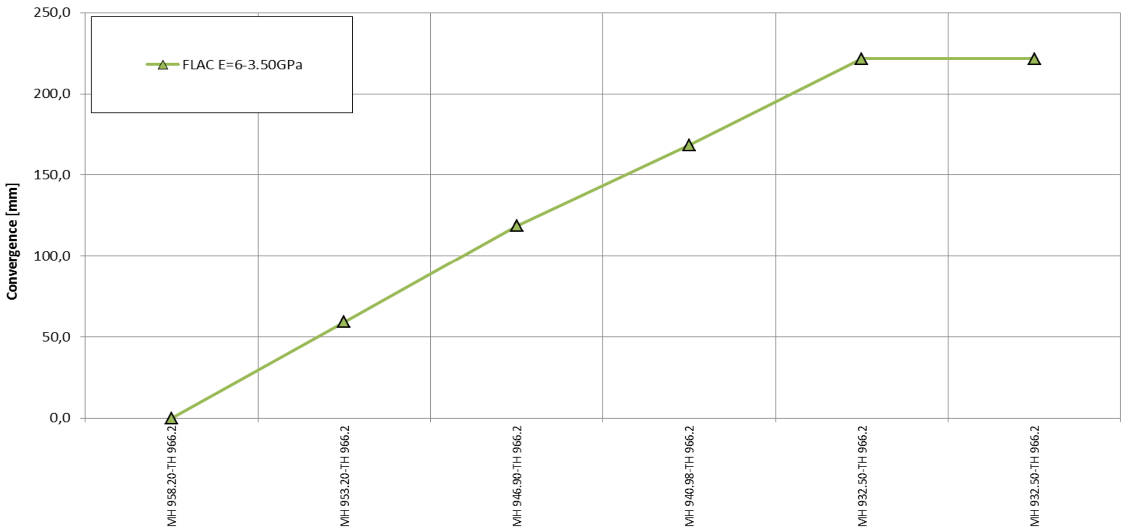
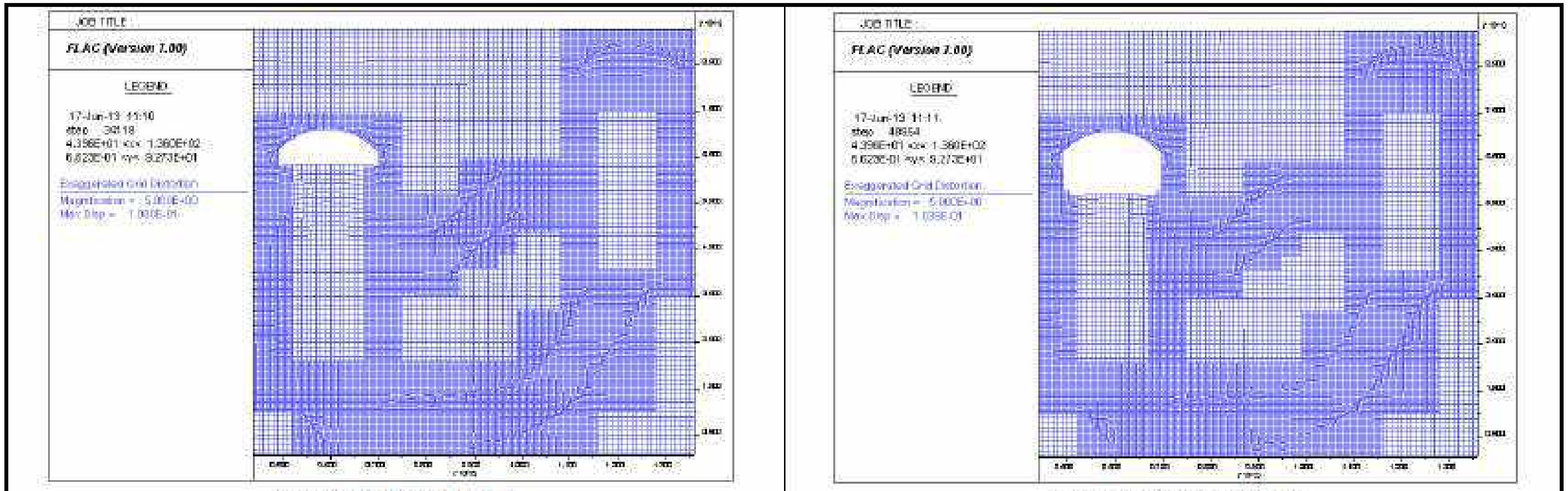


Figure 35: Computed increase in convergence at elevations 958.2 m as excavation proceeds up to the completion of the cavern complex

It is of interest to note that the predicted increase in convergence at elevation 986 m (at the base of the concrete arch of the MH cavern) is equal to 140 mm (Figure 34). A greater convergence increase, up to 225 mm, is expected to take place at elevation 958.2 m (Figure 35). This gives clear evidence of the significant stress increase which is occurs in the reinforced concrete strut placed at elevation 964.2 m (Figure 33).

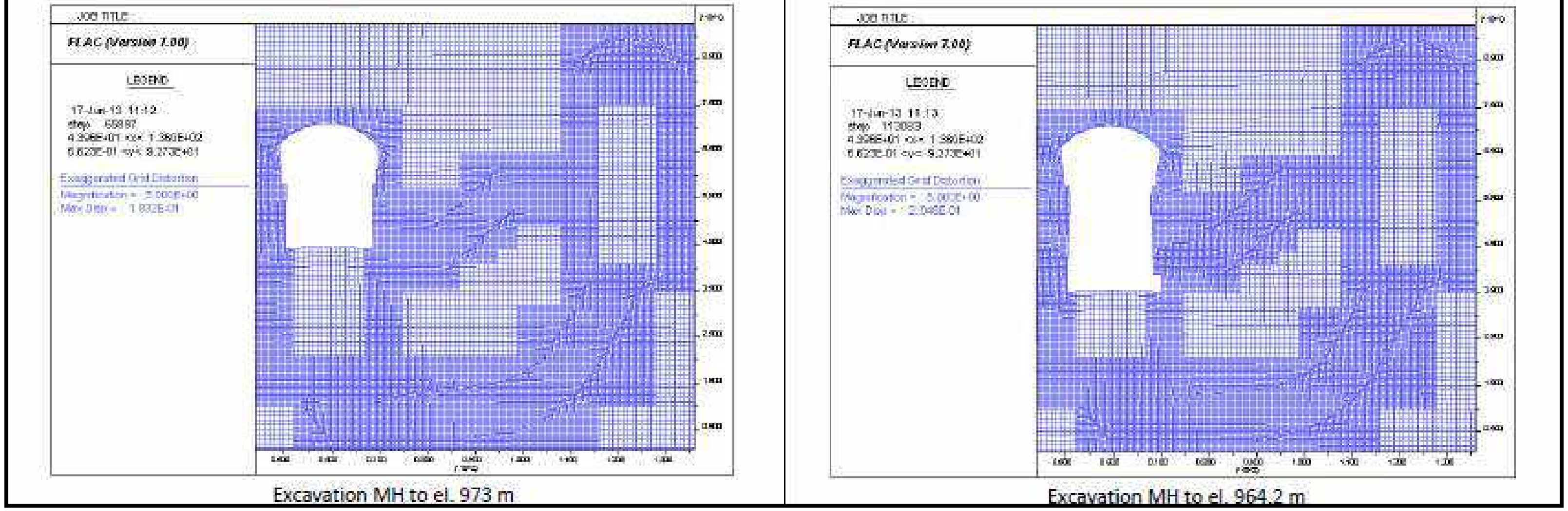
The patterns of expected deformation around the MH and TH caverns, which are well visualized in Figures 36 to 40, show that the vertical sidewalls continue to displace concurrently with the propagation of the failure zones around the two caverns. It is well evidenced that the downstream sidewall of the MH cavern undergoes the most significant displacements as the rock pillar between them is progressively weakened. At the same time, this is emphasized once the MH cavern excavation level reaches elevation 958.2 m, below the reinforced concrete strut (Figure 38, top left plot).

As the excavation is deepened below this level down to the invert of the turbine pit (Figures 39 and 40), the upstream sidewall of the MH cavern deforms dramatically as the reinforced concrete strut starts to bend upwards. It is observed that once again, as failure propagated into the pillar between the two caverns, the TH cavern undergoes deformation and the most significant displacements occur on the upstream sidewall.



Excavation MH to el. 992 m

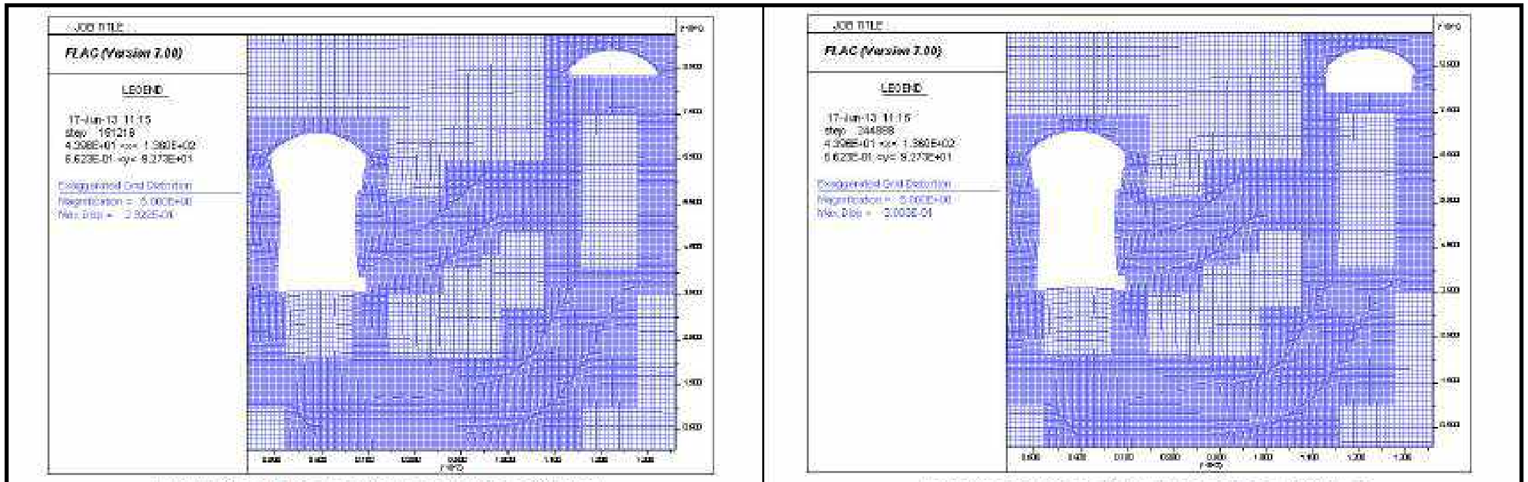
Excavation MH to el. 986 m



Excavation MH to el. 973 m

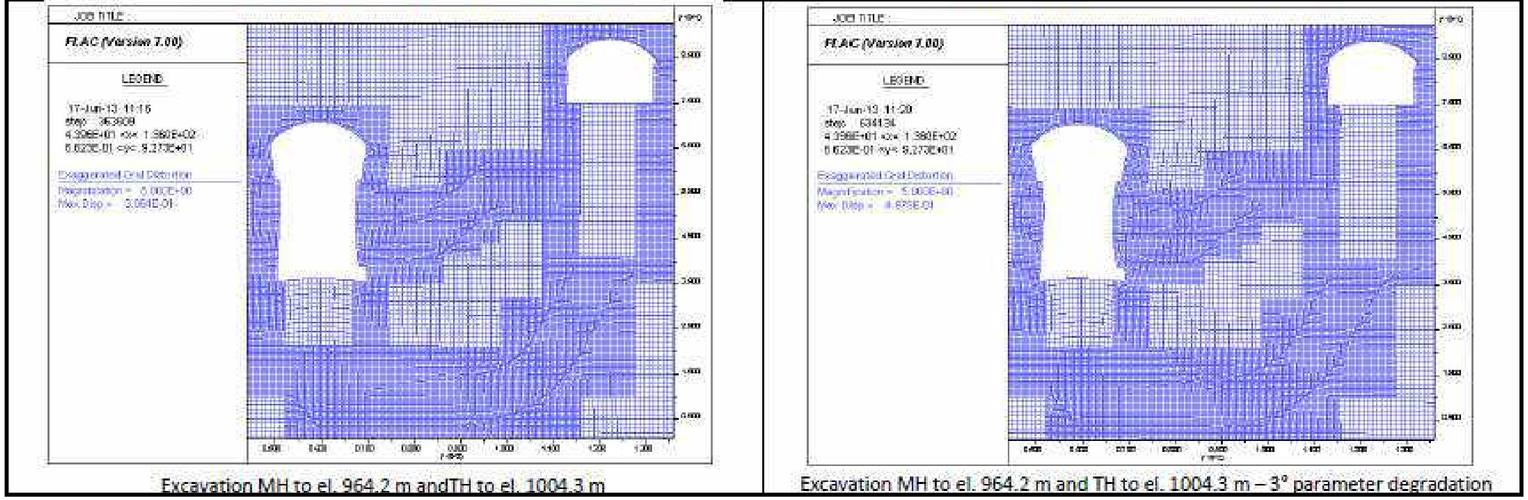
Excavation MH to el. 964.2 m

Figure 36: Illustration of the deformed grid for excavation level in the MH cavern at 992, 986, 973, 964.2 m



Excavation MH to el. 964.2 m and TH to el. 1012.5 m

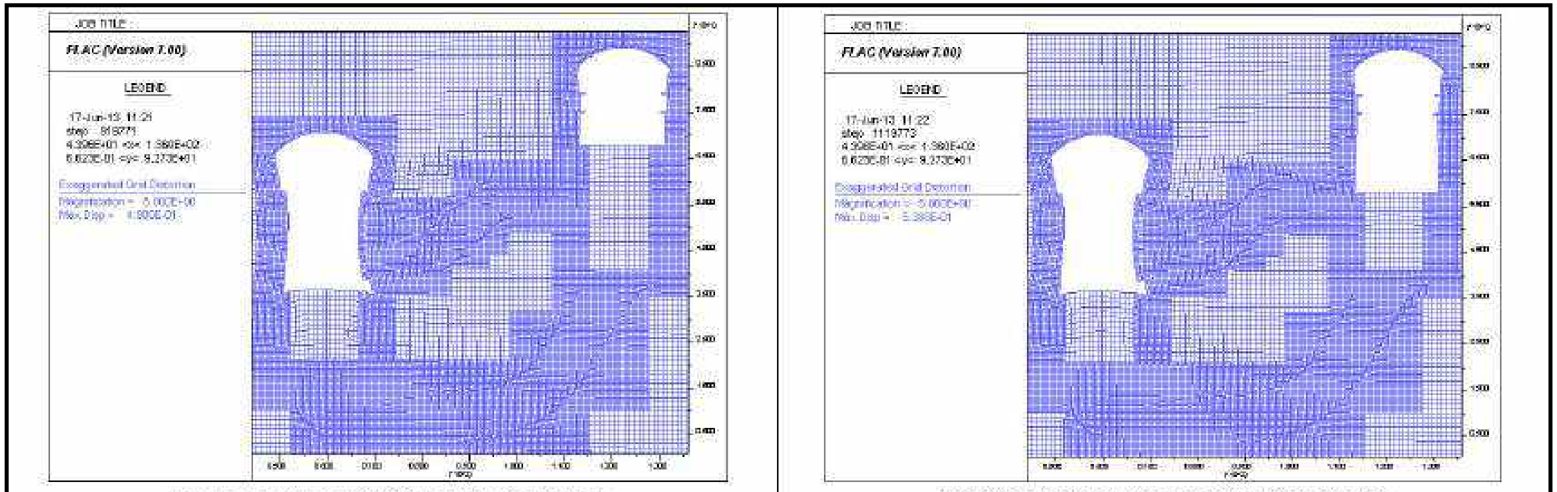
Excavation MH to el. 964.2 m and TH to el. 1008.9 m



Excavation MH to el. 964.2 m andTH to el. 1004.3 m

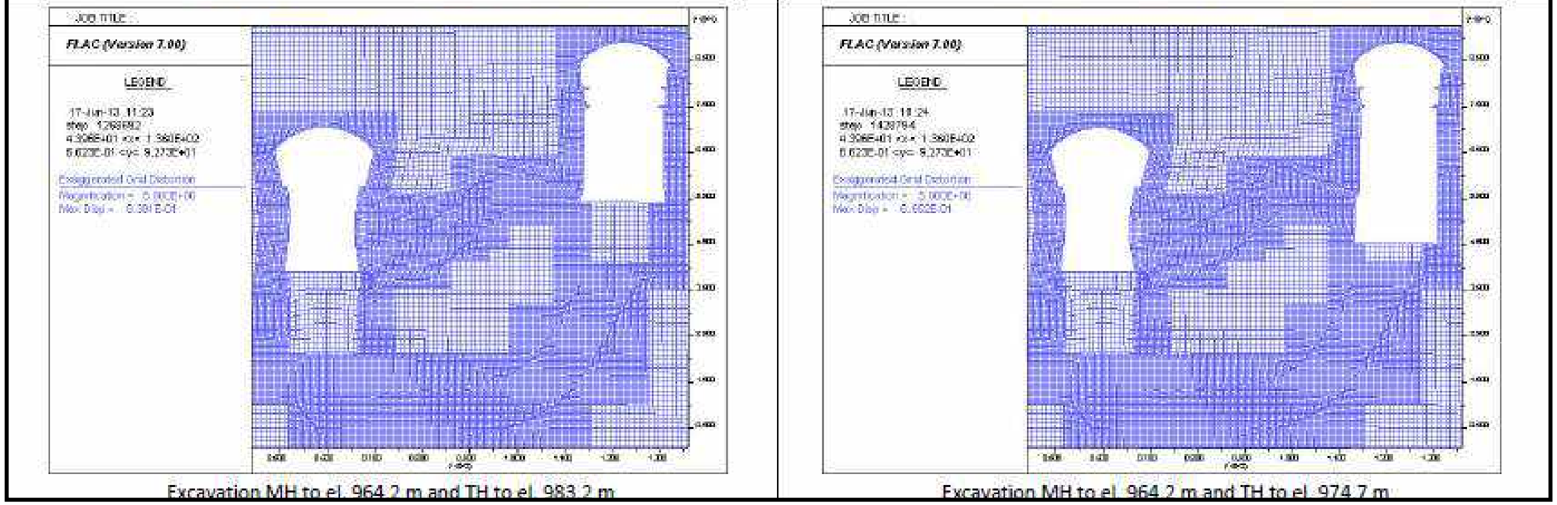
Excavation MH to el. 964.2 m and TH to el. 1004.3 m – 3° parameter degradation

Figure 37: Illustration of the deformed grid for excavation level in the MH cavern at 964.2 m and in the TH cavern down to 1004.3 m and 3rd parameter degradation



Excavation MH to el. 964.2 m and TH to el. 997 m

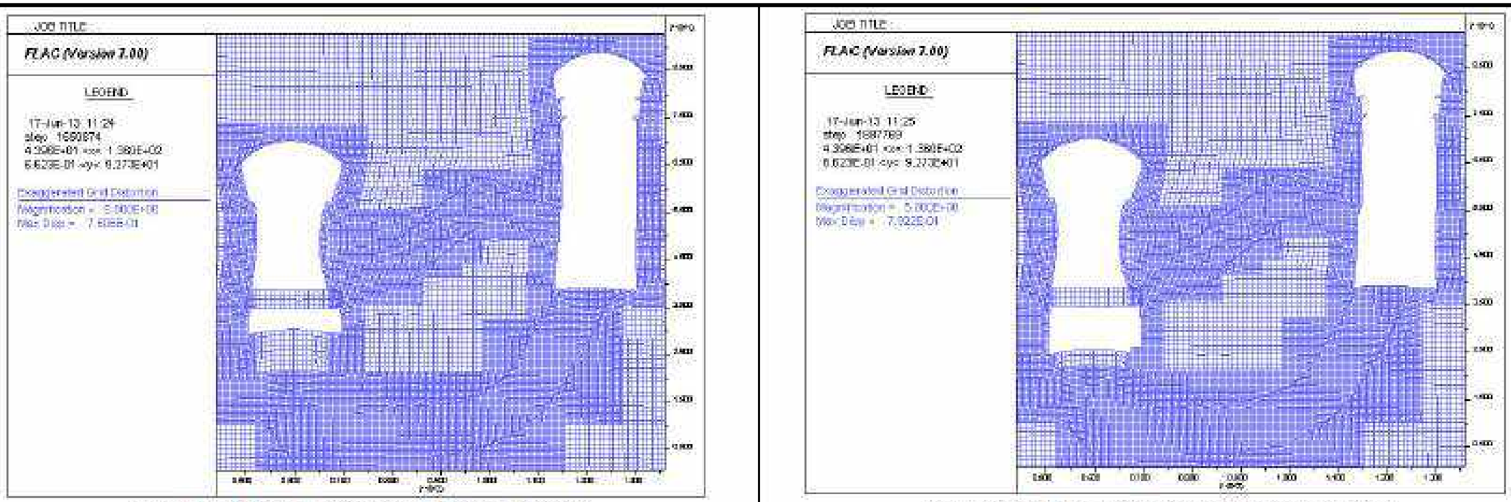
Excavation MH to el. 964.2 m and TH to el. 986.7 m



Excavation MH to el. 964.2 m and TH to el. 983.2 m

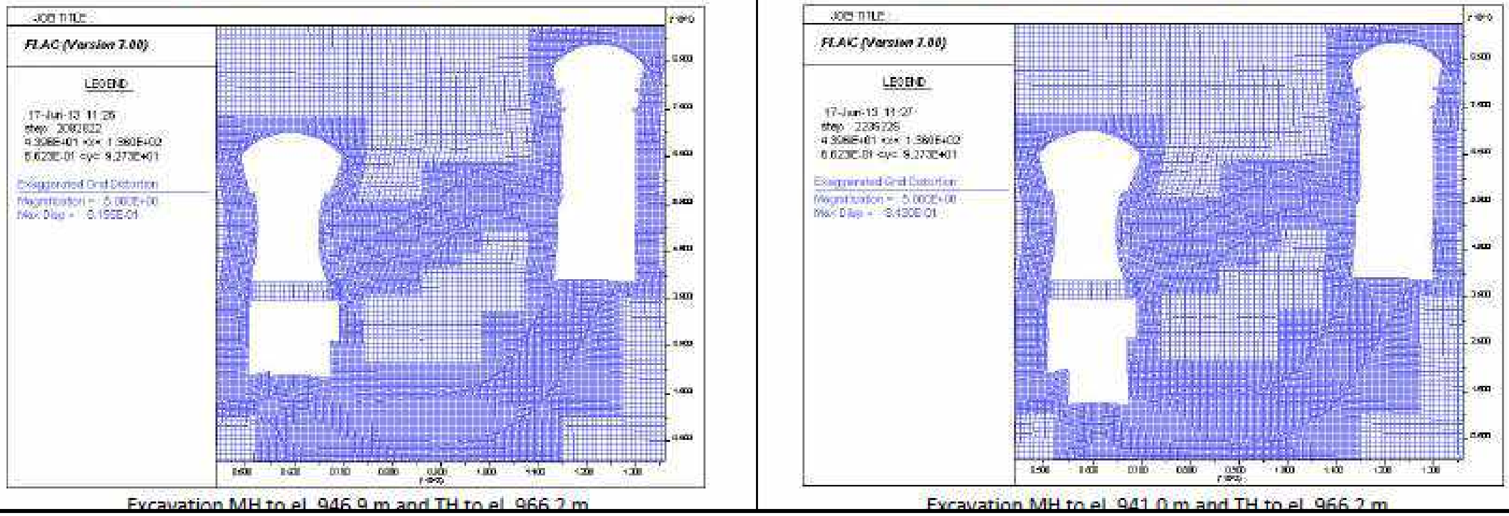
Excavation MH to el. 964.2 m and TH to el. 974.7 m

Figure 38: Illustration of deformed grid for excavation level in the MH cavern at 964.2 m and placement of the reinforced concrete strut. Excavation continues in the TH cavern down to 947.7 m



Excavation MH to el. 958.2 m and TH to el. 966.2 m

Excavation MH to el. 953.2 m and TH to el. 966.2 m



Excavation MH to el. 946.9 m and TH to el. 966.2 m

Excavation MH to el. 941.0 m and TH to el. 966.2 m

Figure 39: Illustration of deformed grid for excavation level in the MH cavern down to 941 m and in the TH cavern down to 966.2 m

Figure 40: Illustration of deformed grid for excavation level in the MH cavern down to 932.5 m with pit concrete filling

9.4 Suggested reinforcement and stabilization measures - Numerical analyses

The results of the numerical analyses and simulation studies described in the previous pages give clear evidence of the critical stability conditions of the MH cavern in the siltstone rock mass, in the zone where Units 5 and 6 have to be located. With the rock mass properties realistically estimated, based on a comprehensive back analysis, the rock pillar between the two caverns is shown to be in a failure state, with evidence of shear bands being formed between the downstream and upstream sidewall of the MH and TH cavern respectively.

As the excavation is deepened below the level presently reached, with the original reinforcement system replaced in the MH cavern and in the neighboring TH cavern, the increase in convergence at the base of the MH cavern arch and below it is computed to be significant, with consideration given to the unusual deformations already experienced by the underground cavern complex. Concurrently with the increase in deformation, the failure zone propagates further into the rock mass around the caverns and below, with clear evidence of progressive interaction between them.

With these conditions in mind, independent of the obvious and well recognized simplifications introduced in the two dimensional plane strain modeling described above, the writer of this report is of the opinion that additional reinforcement and stabilization measures need be implemented, before any further deepening of the excavation level in the MH cavern is to take place. Such reinforcement and stabilization measures are briefly described below, as suggestions and recommendations only, in anticipation to the detailed design studies that need be undertaken.

9.4.1 Suggested reinforcement and stabilization measures

According with the above line of thoughts, Figure 41 illustrates the reinforcement and stabilization system which is envisaged in order to improve the present stability conditions of the underground cavern complex. This system is superposed on the FDM grid that will be used to perform some preliminary numerical analyses which are intended to describe the beneficial effects that can be achieved.

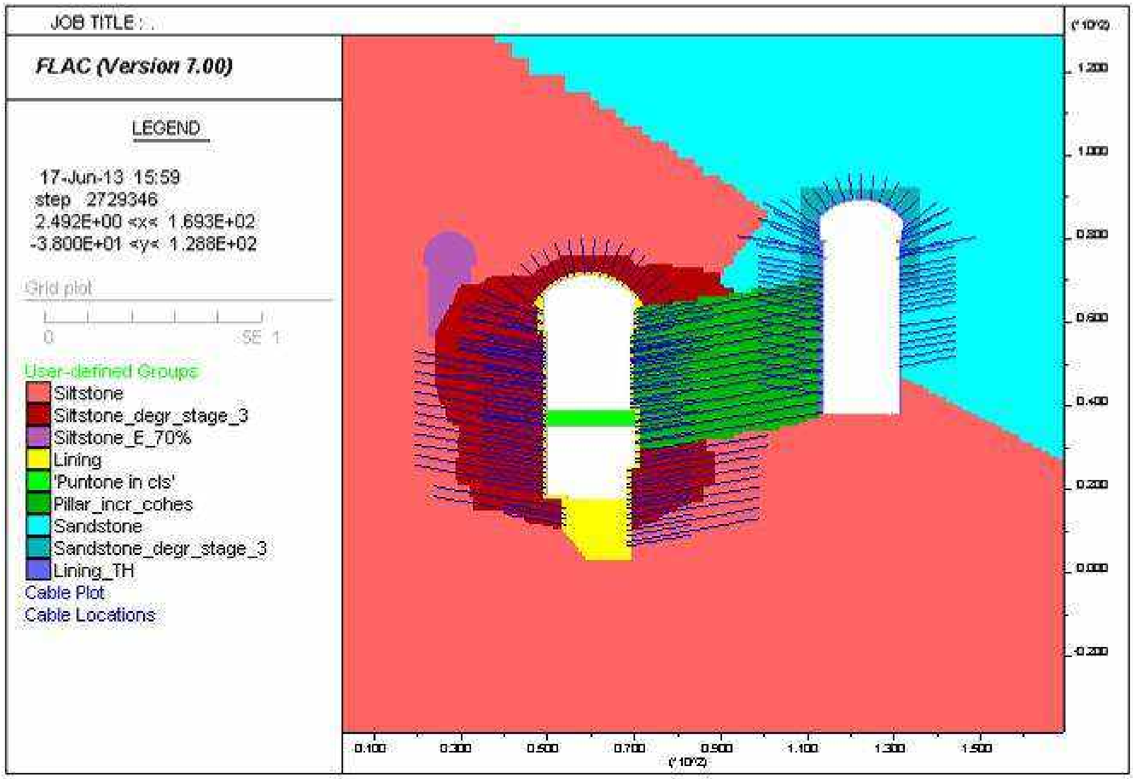


Figure 41: Illustration of the suggested reinforcement stabilization measures superposed on the FDM grid used for modelling purposes.

The suggested reinforcement and stabilization measures will consist of:

1. Installation of rock anchors on both the downstream and upstream sidewalls as shown schematically in Figure 41, between the rock dowels already in place above the present excavation level in the Units 5 and 6 zone. These rock anchors will be of the same characteristics as those already installed in the MH cavern, although their length is estimated to be 35 m approximately. The main purpose of this additional reinforcement is to transfer the interaction loading with the rock mass away from the near vicinity of the cavern periphery, where the rock dowels will form a ring of reinforcement well integrated with the concrete lining (Barla et al. 2008).

2. Stabilization of the highly de-stressed rock mass in the pillar between the MH and TH caverns, with the intent to increase its strength properties. This is to be achieved by installing steel piles (micro-piles) with properly spaced valves (“tube à manchette” - sleeved pipe), to allow for consolidation grouting at predetermined pressure levels. The “manchette” is a simple valve which allows the cement grout to leave the pipe but not to return. Contrary to what is commonly done in soil grouting with the usual pipe sleeve, the suggestion here is use the Multiple Packer Sleved Pipe (MPSP) system developed in the early 1990 by Rodio (Bruce and Gallavresi 1988, Barla and Jarre 1986) and successfully applied in a number of projects.

It is noted that the MPSP system in principle is similar to the “tube à manchette” system, however in this case no annulus grout is used. Instead the grouting pipe is retained and centralised in each borehole by collars-fabric bags inflated in situ with cement grout. These collars are positioned along the length of each grout pipe at regular interval (say 3 to 6 m) to isolate zones where intensive treatment of the rock mass can be carried out. The system permits the use of all grout types.

9.4.2 Numerical analyses and results

With the intent to provide a quantitative proof of the advantages that can be gained by adopting the reinforcement and stabilization system envisaged above, some additional numerical analyses have been carried by using the developed FDM model. The modeling studies started with the simulation of the present conditions in the cavern with the excavation level at elevation 958.2 m approximately (see Figure 29, bottom right plot).

With these conditions being established, the rock anchors on the upstream side of the MH cavern above elevation 958.2 m have been activated. At the same time, the rock mass in the pillar has been given an increase of cohesive strength (shown by the green zones in the model of Figure 41), associated to a low pre-stressing of the pipes, which are provided with bearing plates at the inner surface of the concrete lining in the MH and TH caverns.

Then, as in the previous studies, the excavation and reinforcement stages have been simulated in sequence down to the invert of the turbine pit. It is noted that in the present simulation stages both the rock dowels and the additional rock anchors are activated according to the scheme shown in Figure 41. The results obtained are illustrated in Figures 42 to 44 by comparing the horizontal stress in the pillar prior to and following the treatment; more significantly, this comparison is shown for the expected convergence values at elevations 986 and 958.2 m respectively.

It is of interest to note that with the applied reinforcement and stabilization measures, a more favorable distribution in the state of stress in the pillar between the two caverns takes place with an increase in the confinement action (Figure 42). In terms of convergence values, the computed convergence at elevation 986 m results to be equal to 80 mm with respect to the 140 mm predicted with the reinforcement as in the present design (Figure 43). Similarly, at elevation 958.2 m the convergence is evaluated to decrease from 225 mm down to 175 mm (Figure 44).

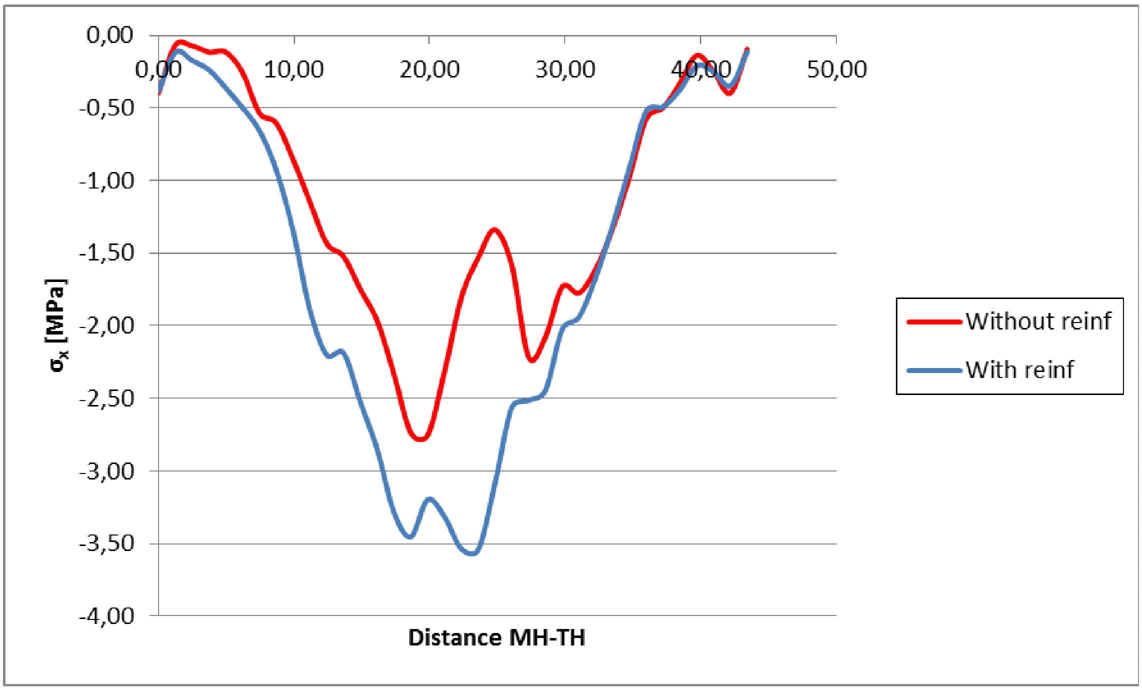


Figure 42: Horizontal stress in the pillar between the MH and TH caverns. Computed values “with” and “without” the reinforcement and stabilization measures shown in Figure 41

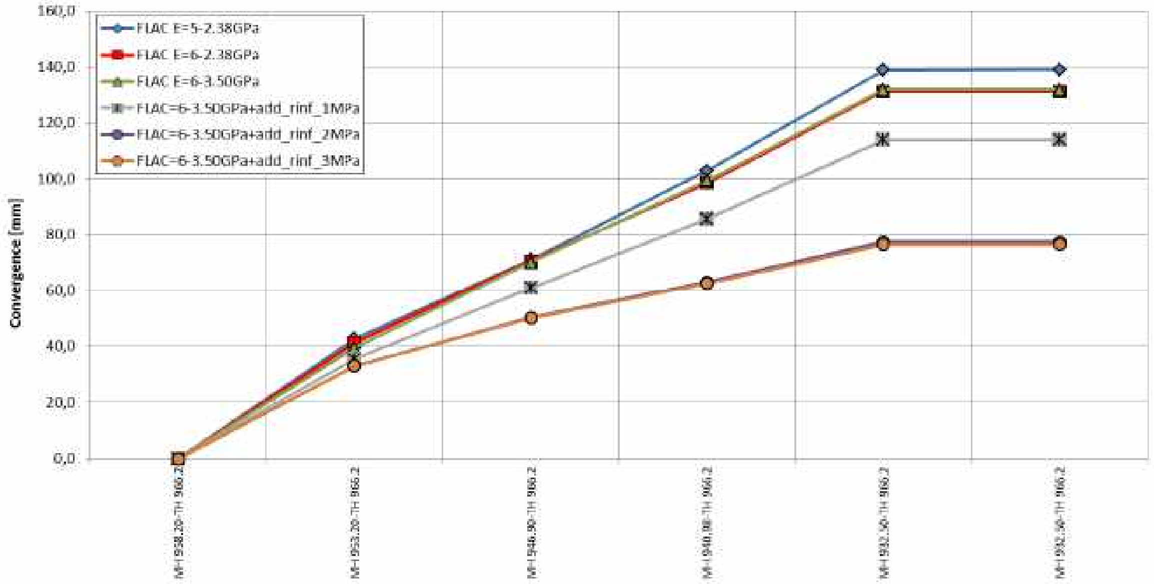


Figure 43: Computed increase in convergence at elevations 986 m as excavation proceeds up to the completion of the cavern complex. Computed values “with” and “without” the reinforcement and stabilization measures shown in Figure 41

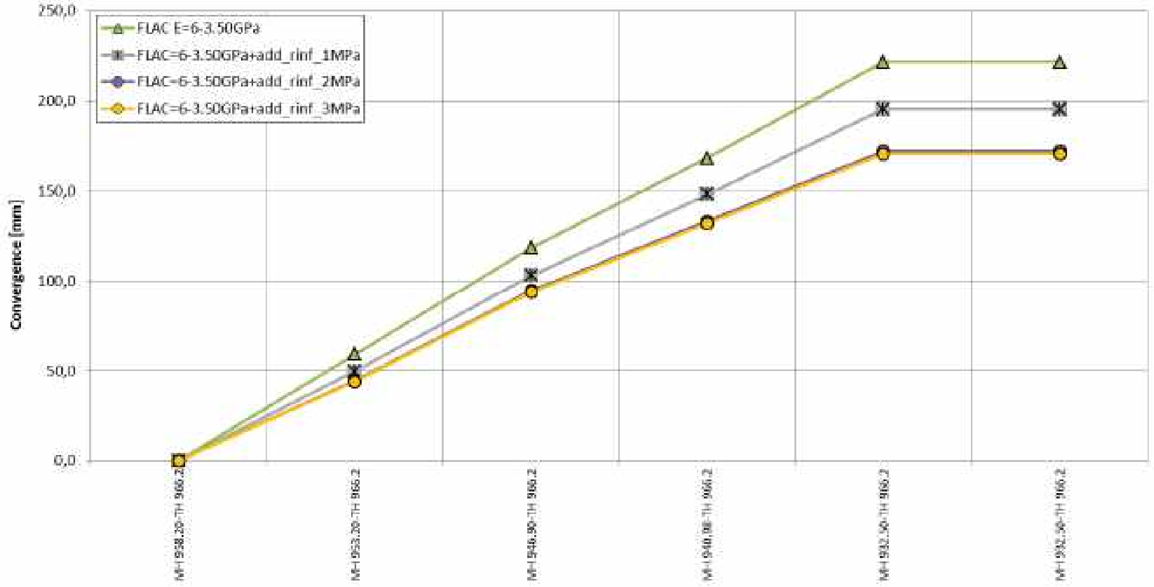


Figure 44: Computed increase in convergence at elevations 958.2 m as excavation proceeds up to the completion of the cavern complex. Computed values “with” and “without” the reinforcement and stabilization measures shown in Figure 41

10. CONCLUSIONS AND RECOMMENDATIONS

The main conclusions of the present report, in relation to the review studies carried out and the two dimensional design analyses performed, are the following.

1. The presently available geological data indicate that the caverns are mainly located within the Upper Obigarm Sandstone (K_1ob_2), except for a part of the Machine Hall towards its western end, where Units 5 and 6 are located, which is in the Lower Obigarm Siltstone (K_1ob_1). The transition between the sandstone and siltstone formations crosses the Machine Hall and the siltstone formation is present from the western end wall to Chainage 0+70 m on the upstream sidewall and Chainage 0+40 m on the downstream sidewall, with a trend of the transition 055°- 235°. In general, the geological conditions are well understood and the discontinuity sets have been identified with confidence based on geological mapping, including the part of the Machine Hall where excavation has been carried out in siltstone.

2. Geotechnical studies have been performed within the area of the underground caverns. Rock and rock mass data have been subject of critical revision and updating through the years. More recently, also geophysical tests have been carried out with the main purpose to determine the rock mass conditions in the zone surrounding the underground works. The rock mass deformability (i.e. the deformation modulus) has been determined through seismic velocity measurements, empirical correlations with intact rock properties and back analysis based on the available convergence monitoring data. As usual in rock engineering, more uncertainties exist in relation to the assessment of the rock mass strength, which has been inferred on the basis of back analysis and modeling of the cavern response in both two dimensional and three-dimensional conditions.

3. The available monitoring data through the life of the underground cavern complex (essentially the convergence measurements in the MH cavern along its length, at elevation 986 m) show a trend of deformation in the MH cavern versus time, in the siltstone zone in particular. This is matter of serious concern in relation to the further excavation to be carried out in the MH cavern to the invert of the turbine pits. The question relates to the observed time dependent behavior of the siltstone rock mass, when no excavation activities did take place underground, and a possible creep deformation, i.e. a tendency for the rock mass to move slowly or deform permanently under the influence of stress. The low in situ stress field in the cavern zone, compared to rock strength, makes this not to be realistic and more likely due to the de-stressing of the rock mass, because of lack of support and degradation of the reinforcement systems versus time.

4. With consideration given to the above aspects and the recognized, limited data base available for siltstone, the decision was taken to drill two boreholes in the zone of Unit 6 in the MH cavern with the purpose of obtaining representative samples for testing. A comprehensive laboratory testing program is well underway and is intended to provide data on the intact rock properties and the rock discontinuities under different states of stress. Special attention will be given during testing to the characterization of the bedding planes and joints in order to derive their peak and ultimate or residual strength properties. This is a relevant point in relation to design studies of the cavern response to be carried in the future, with consideration given to the siltstone rock mass anisotropic response. Also, given the time dependent behavior observed in situ in siltstone, long duration creep tests are to be performed in order to ascertain if such a behavior is evidenced at laboratory scale under the field stress state.

5. Two dimensional modeling studies have been carried out in order to assess the stability conditions of the HP underground cavern complex, with the most attention paid to the MH cavern and its interaction with the TH cavern in the siltstone zone. Both the present and future configurations reached, with excavation down to the invert of the turbine pit, have been analyzed in detail. The Finite Difference Method and the FLAC code have been used to perform realistic analyses with attention paid to both the post-failure conditions of rock mass and its interaction with the support system installed. The modeling has successfully described the MH and TH caverns deformation response to excavation and placing of the rock reinforcement prior to and during the stop of the construction activities at the site, with the excavation level kept at 964.2 m elevation in the MH cavern. Also analyzed have been the subsequent excavation and reinforcement stages up the completion of the excavation in the MH cavern and following concreting of the turbine pit.

6. The predicted failure zones around the MH and TH caverns, as excavation proceeds concurrent with the installation of the support, have been described in detail. Through the plots made available one is able to appreciate the growing of the failure zones around the openings and in particular in the pillar between the two caverns. It is shown that a failure zone starts from the excavation boundary (initially the MH cavern), where the stress concentrations are the highest, and propagates away from it until the excess load transferred is small enough that it can be carried out by the surrounding elements in elastic state. It is relevant to underline that, with the excavation level at elevation 964.2 m in the MH cavern, the failure zone has propagated outwards and has reached an extent which is equal or greater than the length of the reinforcement. This is the case of the downstream sidewall of the MH cavern.

7. As expected, with the degradation of the rock mass properties and the progressive loosening of the support system, which has been introduced in order to mimic satisfactorily the time dependent behavior of siltstone, the failure zone extends around the

openings with evidence of localization of shear bands in the rock mass. As the excavation in the MH cavern is deepened down to elevation 958.2 m (below the reinforced concrete strut installed at elevation 964.5 m), these shear bands develop in the pillar, in particular in the vicinity of the upstream sidewall of the TH cavern. The presence of these shear bands, which propagate in the rock mass and in particular in the pillar, is to be interpreted as a clear indication of the inadequacy of the stabilization measures adopted so far and to be adopted in the future according to the present support design.

8. Based on the rock mass parameters inferred with the back analysis performed, some insights into the patterns of deformation around the MH and TH caverns have been provided with plots of “exaggerated grid distortion”, as excavation and construction proceed. The predicted increase in convergence at elevation 986 m (at the base of the concrete arch of the MH cavern) is equal to 140 mm. A greater convergence increase, up to 225 mm, is anticipated to take place at elevation 958.2 m. This gives clear evidence of the significant stress increase which occurs in the reinforced concrete strut placed at elevation 964.2 m. As the excavation is deepened down to the invert of the turbine pit, the sidewalls of the MH cavern deform dramatically as the concrete strut starts to bend upwards.

9. The results of the numerical analyses and simulation studies performed give clear evidence of the critical stability conditions of the MH cavern in the siltstone rock mass, with the present level of rock support installed and to be installed in the future according to the available design. With the rock mass properties realistically estimated, the rock pillar between the two caverns shows localization of shear bands between the downstream and upstream sidewalls of the MH and TH caverns. As the excavation is deepened below the level presently reached, the increase in convergence at the base of the MH cavern arch and below it is computed to be significant and not acceptable, if one considers the unusual deformations already experienced by the underground cavern complex. It is therefore recommended that additional reinforcement and stabilization measures be implemented, before any further deepening of the excavation level in the MH cavern is to take place.

10. The suggested reinforcement and stabilization measures consist of: (a) installation of rock anchors at the sidewalls, above the present excavation level, in order to transfer the interaction loading with the rock mass away from the near vicinity of the cavern periphery; (b) stabilization of the highly de-stressed rock mass in the pillar between the MH and TH caverns, with the intent to increase its strength properties. This is to be achieved by installing steel piles to allow for consolidation grouting at predetermined pressure levels, by using the Multiple Packer Sleeved Pipe (MPSP) system. The modelling studies performed show that with these reinforcement and stabilization measures, a more favorable distribution in the state of stress in the pillar between the

two caverns is achieved. A decrease in the computed increment of convergence value is anticipated at elevation 986 m down to 80 mm with respect to the 140 mm predicted with the reinforcement as in the present design. Similarly, at elevation 958.2 m, the convergence increment is evaluated to decrease from 225 mm down to 175 mm.

11. A suitable continuous monitoring system consisting of convergence and multi-position borehole extensometer stations is considered to be mandatory for the future excavation stages. As the cavern excavation and support sequence takes place in line with the design procedures, the monitoring data need be interpreted and analysed continuously. The cavern deformational response and performance is to be compared with the results of design analyses so as to ascertain that the observed behaviour is in accordance with predictions. Monitoring is to be considered to be an essential component of the interactive observational design approach (“Observational Method” in Eurocode 7), which needs be applied for assessing continuously and in “real time” the response and stability of the excavation, the support installed and the rock mass surround. This method, when properly applied, implies that monitoring plays a very active role in both the design and construction stages, allowing planned changes to be implemented within an agreed contractual framework that involves all the main parties (client, designer and contractor).

12. It is to be remarked that until the immediately needed stabilization measures are completely installed and a fully functioning monitoring system has been provided, the excavation activities in the Cavern shall not be resumed.

11. REFERENCES

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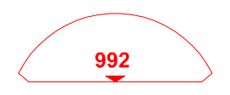
PHASE 1
ASSESSMENT OF THE POWERHOUSE CAVERN STABILITY

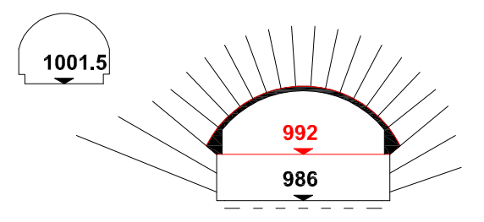
APPENDIX 01

2D MODEL - STAGE : 01 | **3D MODEL - STAGE : 03**



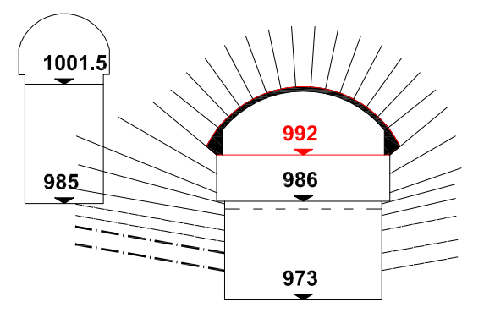
Powerhouse: Original Support System

2D MODEL - STAGE : 02 | **3D MODEL - STAGE : 04**



Powerhouse: Original Support System

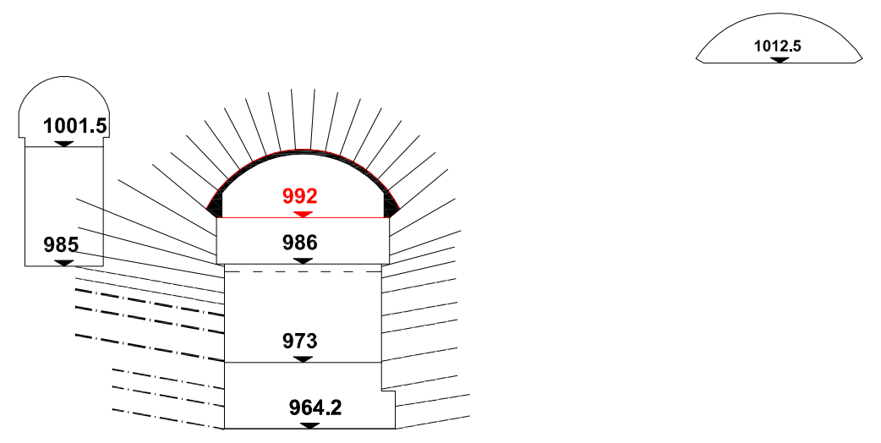
2D MODEL - STAGE : 03 | **3D MODEL - STAGE : 05**



Powerhouse: Original Support System

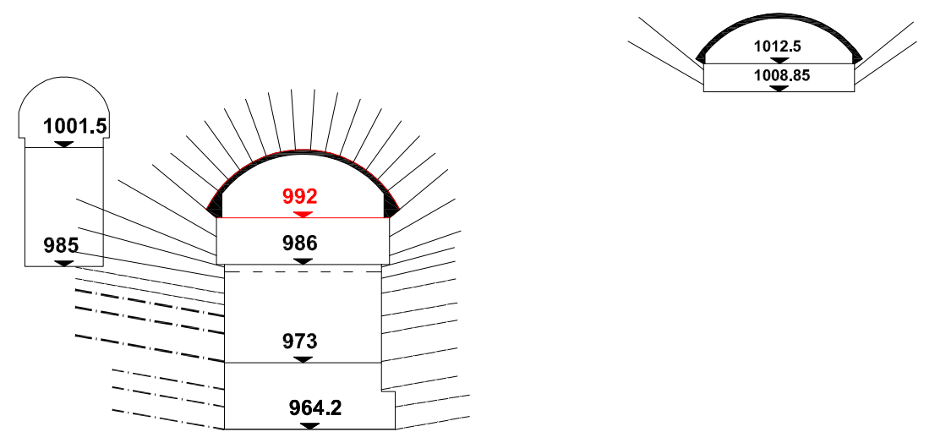
The 3D Model considers the new anchor system.

2D MODEL - STAGE : 04 | **3D MODEL - STAGE : 06**



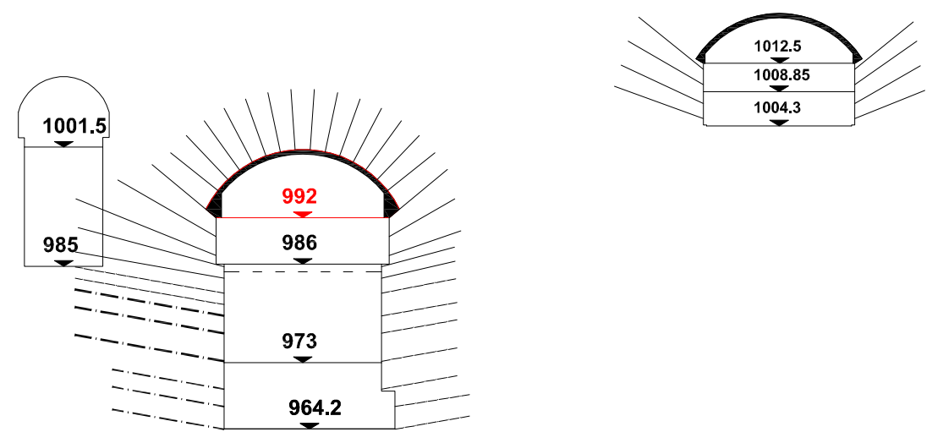
Powerhouse : Original Support System

2D MODEL - STAGE : 05 | **3D MODEL - STAGE : 07**



Powerhouse : Original Support System (YEAR 1991)

2D MODEL - STAGE : 06 | **3D MODEL - STAGE : 08**

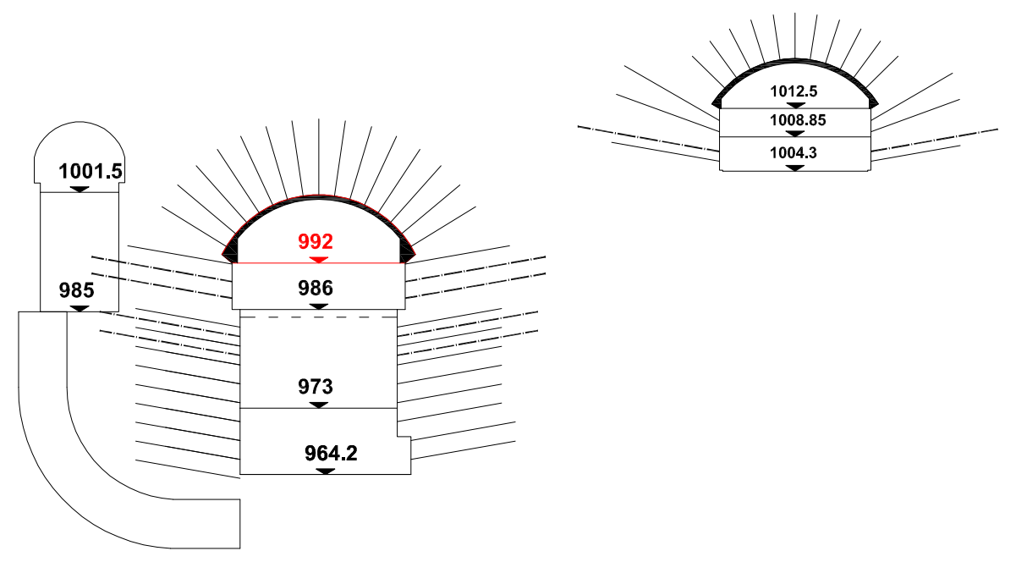


Data of dowels and tendons of transformer hall are taken from table 1861-14-6 sheet 2 and are different from the data included in the table of the 3d model phases.

Powerhouse : Original Support System (YEAR 1991)

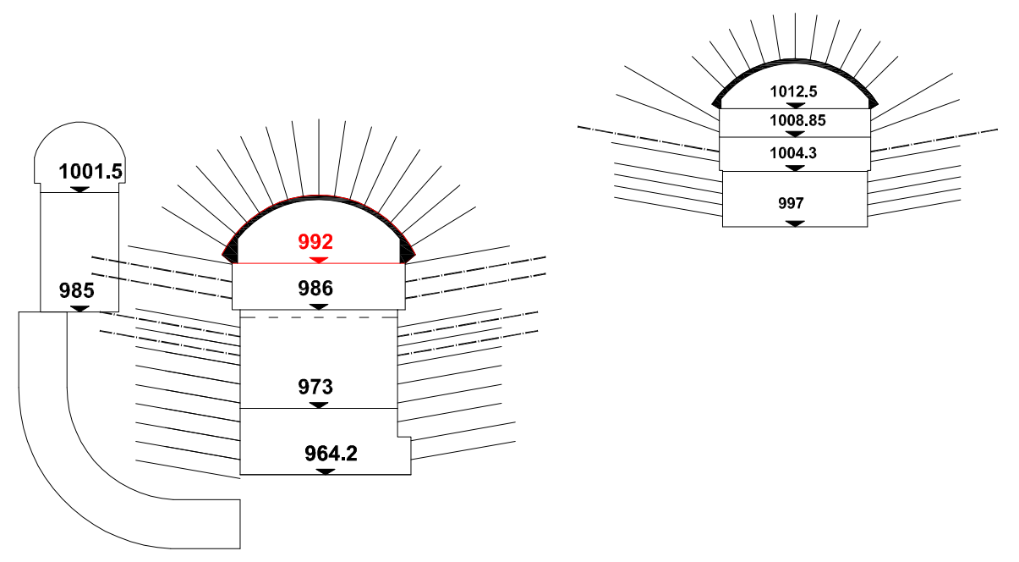
2D MODEL - STAGE : 07 | **3D MODEL - STAGE : 09**

The Excavation of the penstocks of the temporary Power tunnel is Indicated as geometric reference but according to the section that will be analyzed the presence of this excavation could be considered or not.



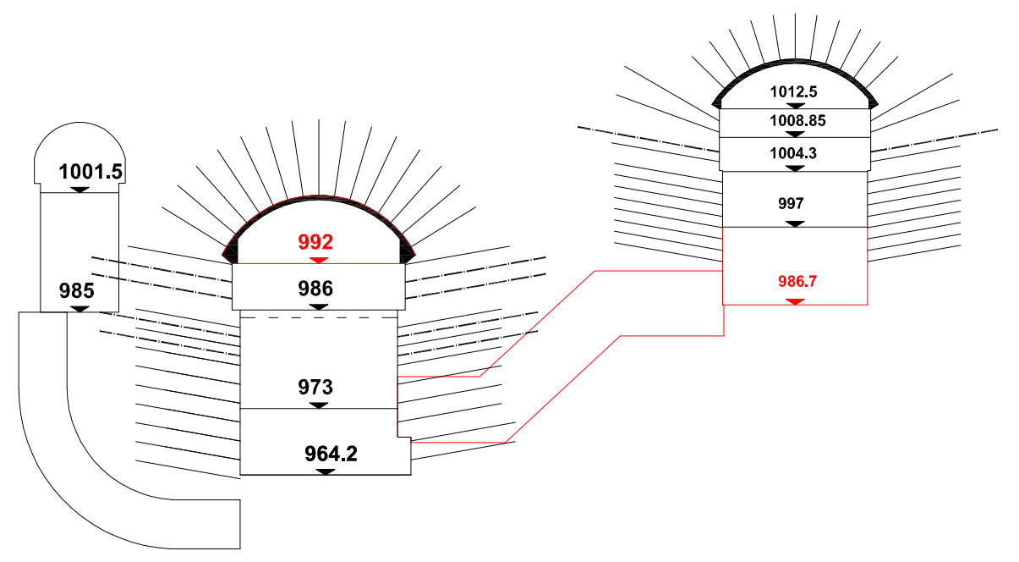
Powerhouse : New Support System (YEAR 2009)

2D MODEL - STAGE : 08 | **3D MODEL - STAGE : 11**



Powerhouse : New Support System (YEAR 2009)

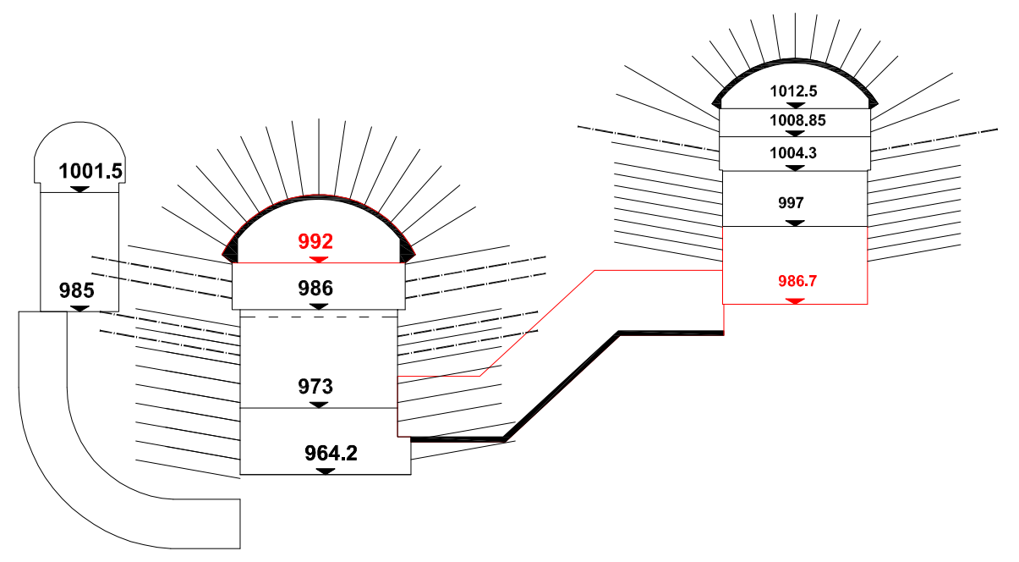
2D MODEL - STAGE : 09 | **3D MODEL - STAGE : 12**



Powerhouse : New Support System (YEAR 2009)

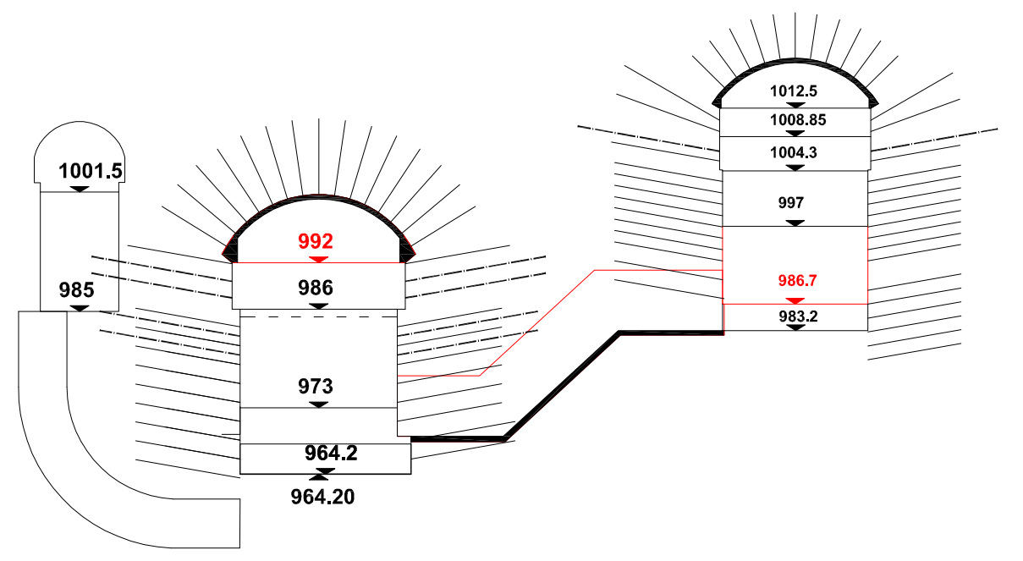
According to the section that will be analyzed the excavation of the busduct could be considered or not.

2D MODEL - STAGE : 10 | **3D MODEL - STAGE : 13**



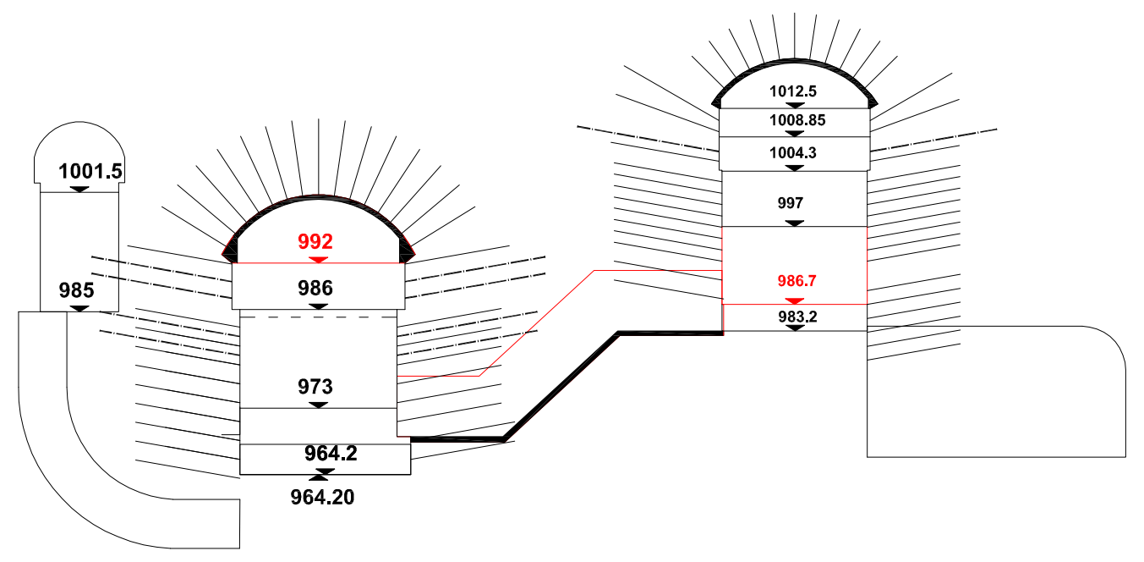
Powerhouse : New Support System (YEAR 2009)

2D MODEL - STAGE : 11 | **3D MODEL - STAGE : 15**



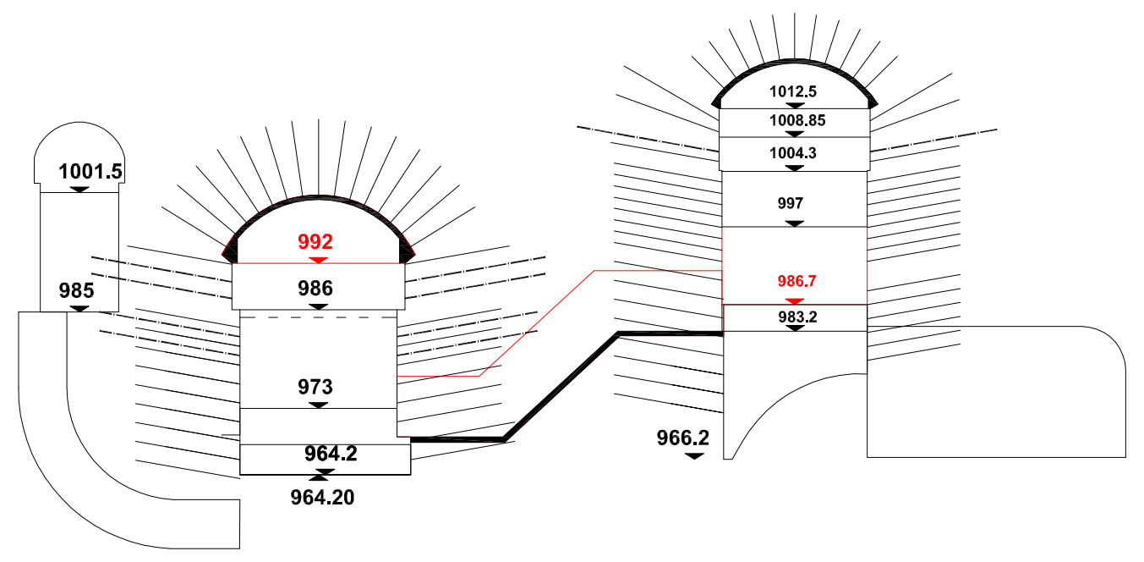
Powerhouse : New Support System (After 2009)

2D MODEL - STAGE : 12 | **3D MODEL - STAGE : 16**



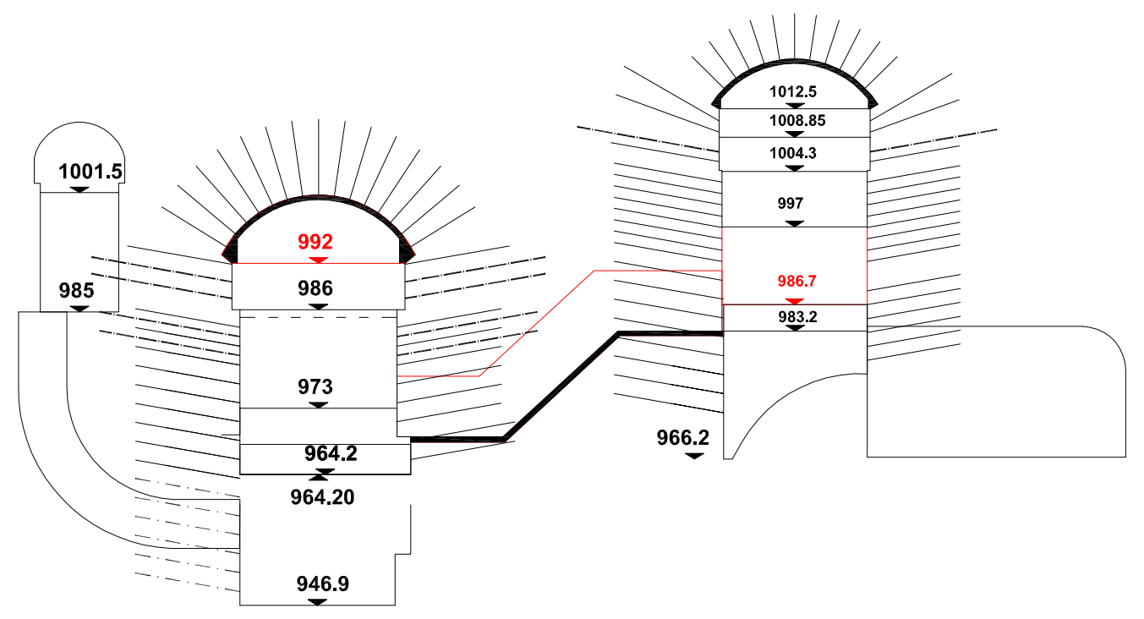
Powerhouse : New Support System (After 2009)

2D MODEL - STAGE : 13 | **3D MODEL - STAGE : 19**



Powerhouse : New Support System (After 2009)

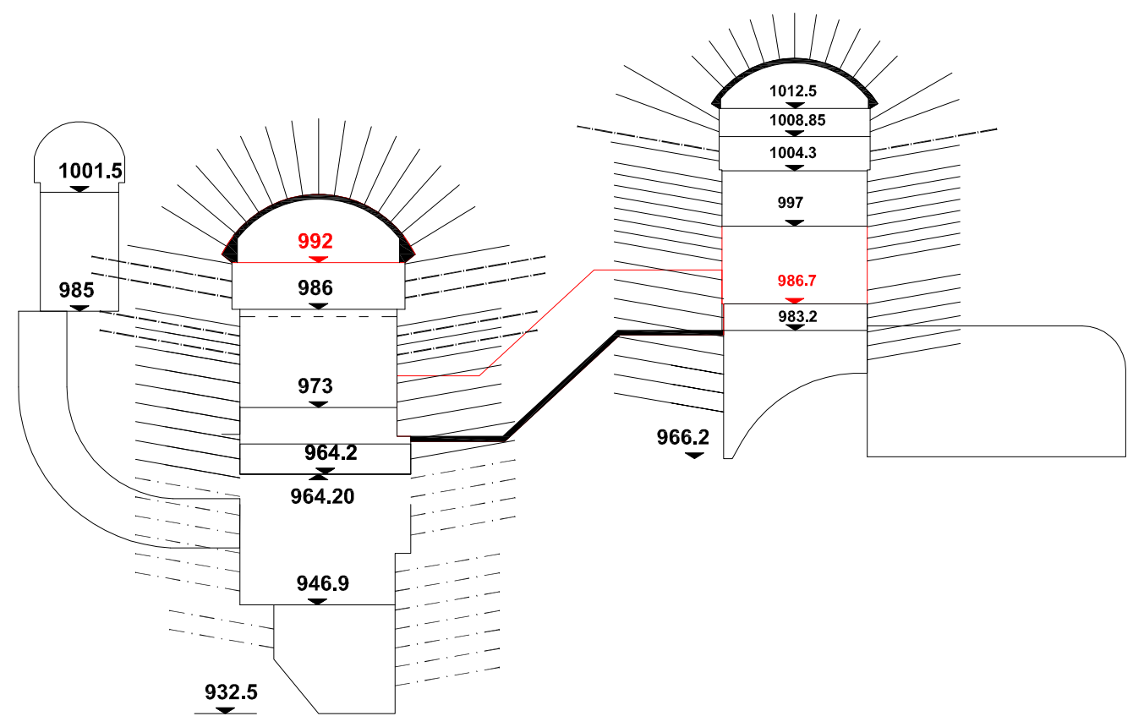
2D MODEL - STAGE : 14 | **3D MODEL - STAGE : 20**



Powerhouse : New Support System (After 2009)

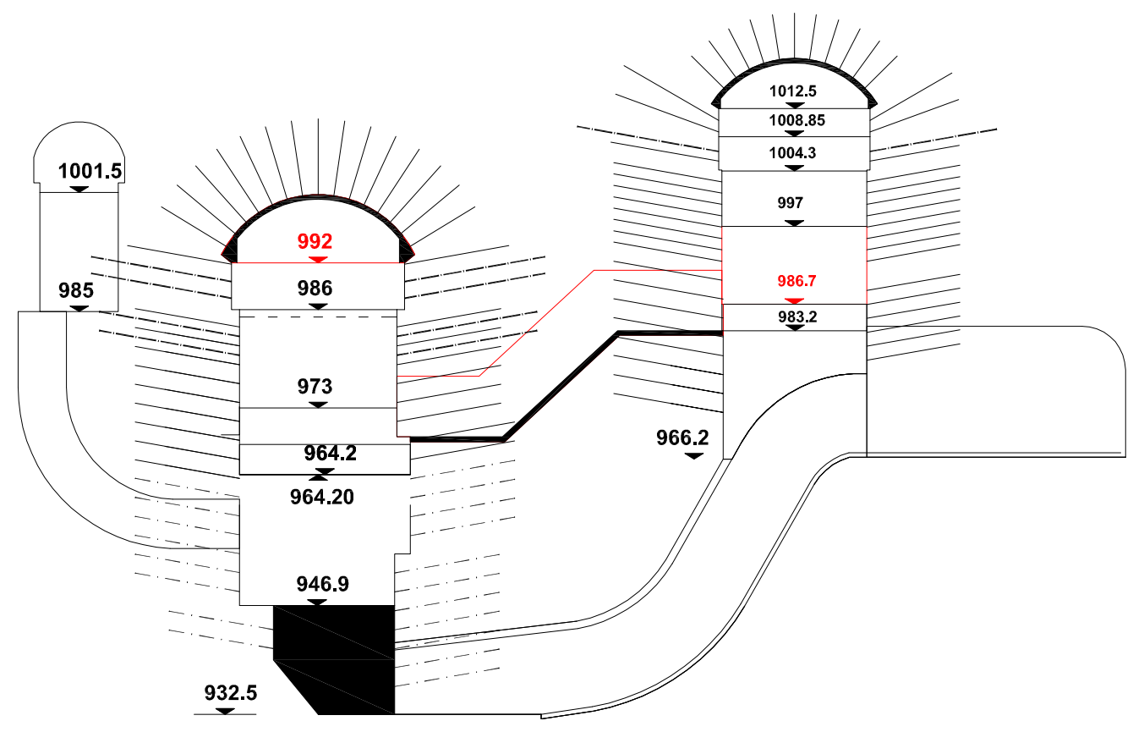
Powerhouse: Supports for excavation under elevation 964.2 not defined in the 3D Model

2D MODEL - STAGE : 15 | **3D MODEL - STAGE : 22**



Powerhouse : New Support System (After 2009)

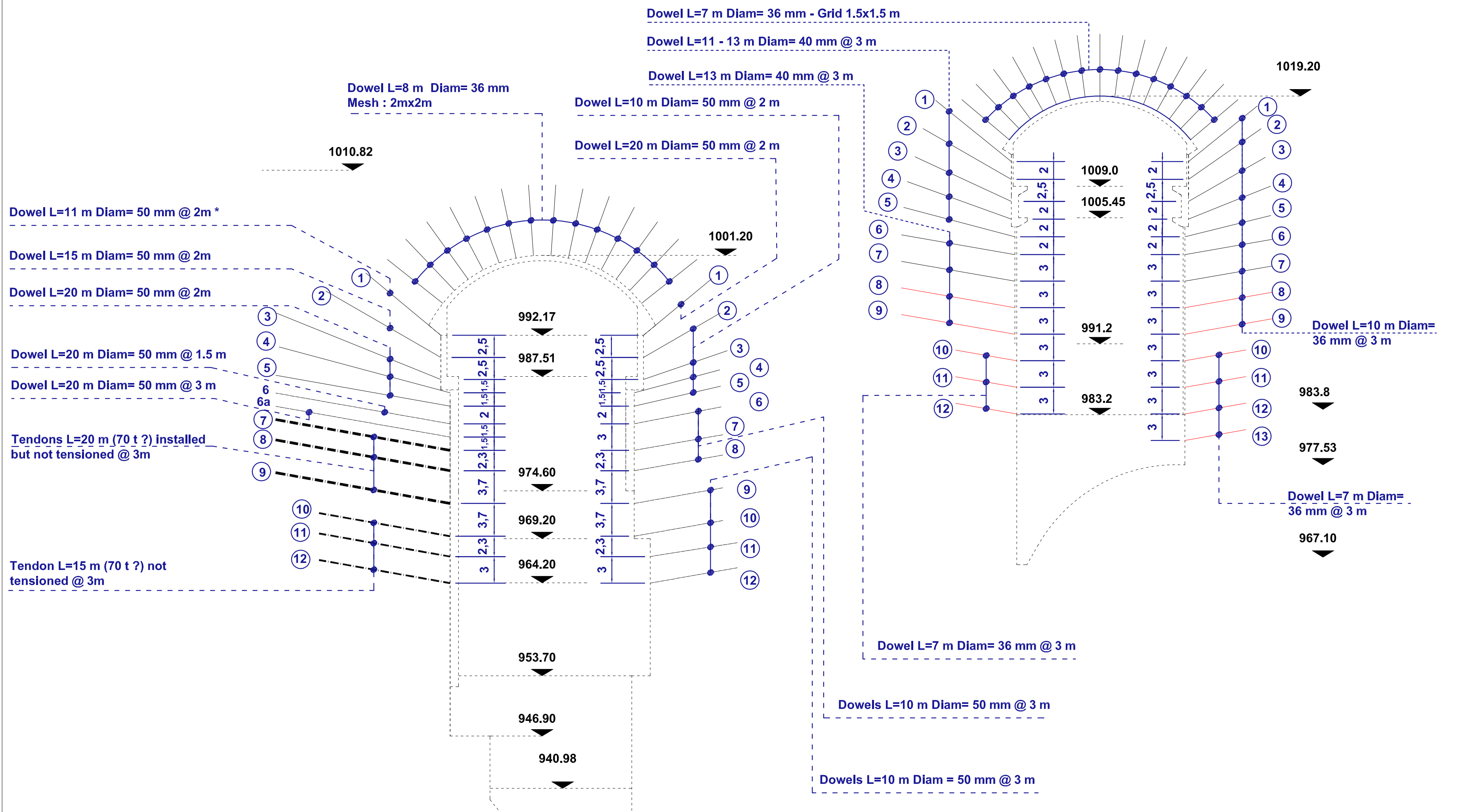
2D MODEL - STAGE : 16 | **3D MODEL - STAGE : 23**



According to the section that will be analyzed the excavation of the draft tube could be considered or not.

Powerhouse : New Support System (After 2009)

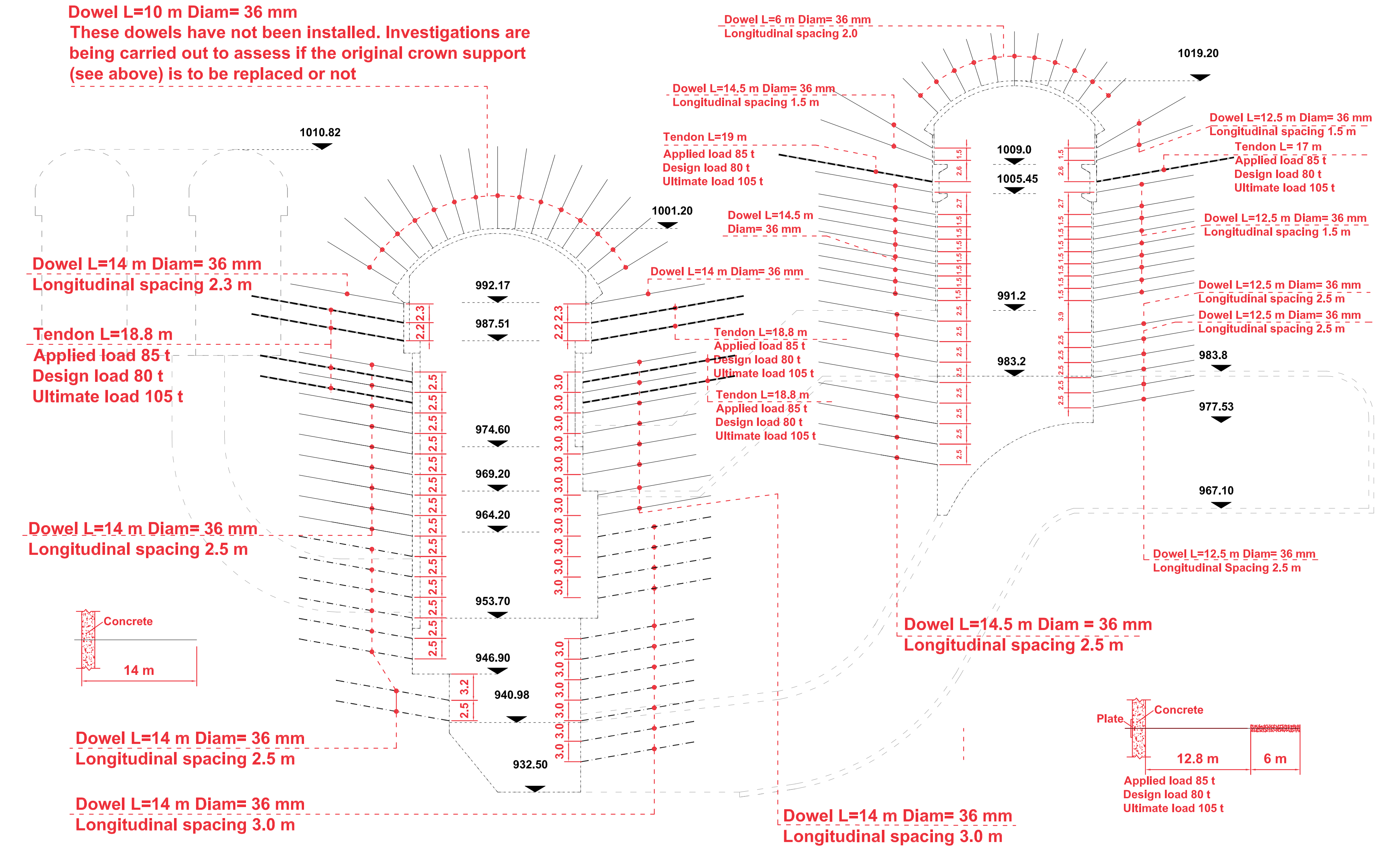
ORIGINAL SUPPORTING SYSTEM - USED FROM STAGE 01 TO STAGE 06 OF THE 2D MODEL



Reference documents:
Powerhouse :
Drawing : 1079 - 14 - 137 B pages 2 and 3 of 6

Powerhouse and Transformer Hall:
Drawing 1079 - 14 - 159

NEW SUPPORTING SYSTEM DESIGNED (modified according to information provided during 4-8 April 2013 Site Visit) BY HPI - USED FROM STAGE 07 OF THE 2D MODEL



Reference document:
3D Model Report - table of stages
Drawing 1861-14-7 sheet 2 for Powerhouse
Drawing 1861-14-6 sheet 2 for Transformer Hall

Drawing 1079 - 14 - 159 (Original Support system for Powerhouse and Transformer Hall)
Транс. помещения1 АНКЕРА ПНА и АЖГ : Aa built Transformer Hall
Исполнительная по анкерам на 01 02 2013.dwg : powerhouse

NOTE

1) The original supporting system has been updated using the information included in the drawing 1079 - 14 - 159 submitted to the consultant on March 2013.

2) Anchor in drawings Транс. помещения1 АНКЕРА ПНА и АЖГ.dwg and Исполнительная по анкерам на 01 02 2013.dwg are considered installed after 2009.

Revis.	DATE	DRAWN BY	CHECKED BY	APPROVED BY	NATURE OF REVISION	STATUS
03	03/2013	CIS	----	-----	For 2D PowerHouse Model Implementation	
02	03/2013	CIS	----	-----	For 2D PowerHouse Model Implementation	
01	03/2013	CIS	----	-----	For Comments	
0	02/2013	CIS	----	-----	For Comments	

OSHPC BARKI TOJIK

TEAS for ROGUN HPP CONSTRUCTION PROJECT

PHASE 2 - REPORT
POWERHOUSE AND TRANSFORMER CAVERN
2D MODEL - STAGES

Scale : | Format : A0 | Plate :
Computer File : | Project N° : 1730 | Revision
No : X X X X X | 0

COYNE ET BELLIER
Ingénieurs Conseils

File name:
130321_2d_model_Geom_Stages_03.dwg

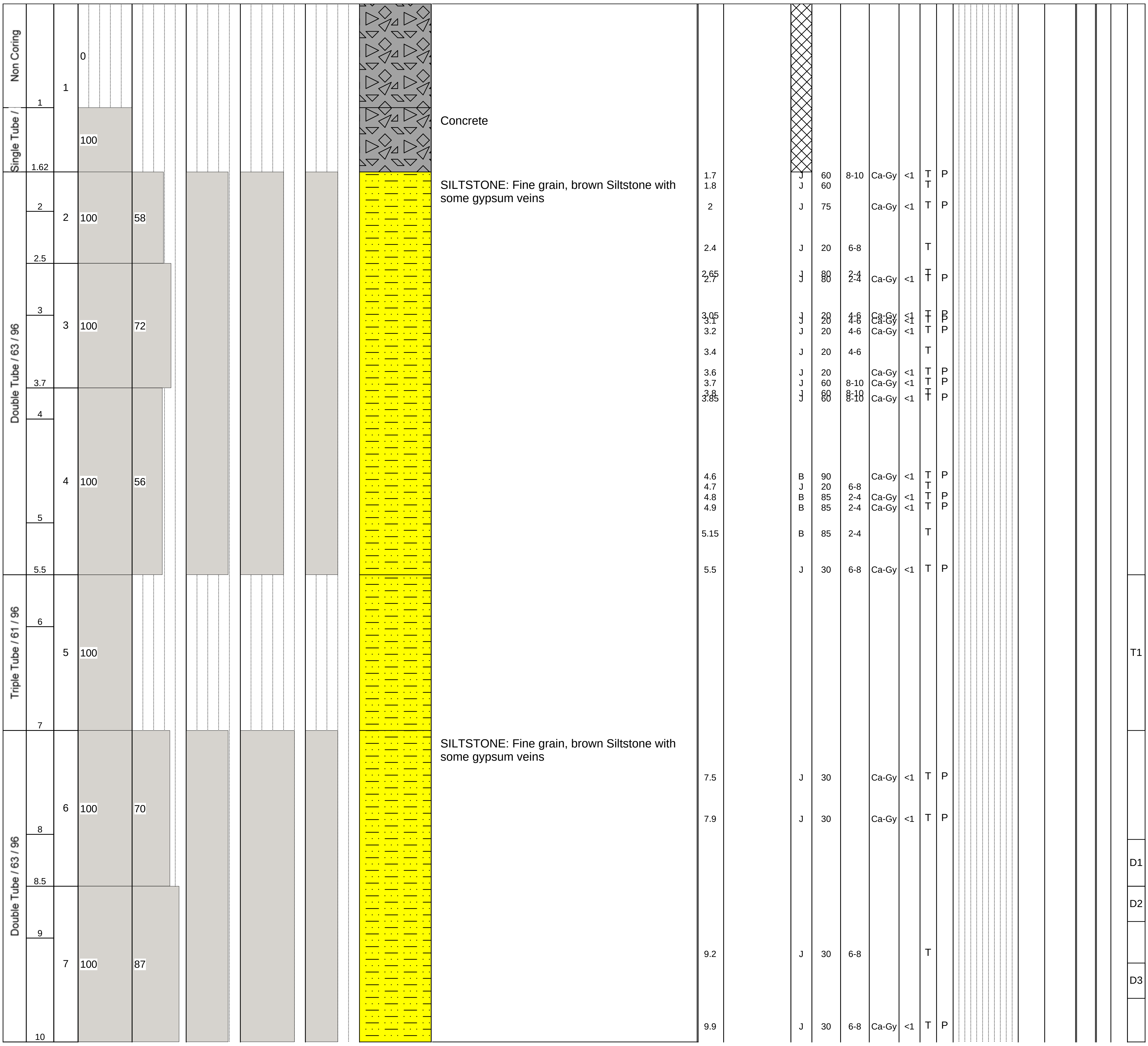
PHASE 1
ASSESSMENT OF THE POWERHOUSE CAVERN STABILITY

APPENDIX 02

STARTED DATE: 05 - 04 - 2013
FINISHED DATE: 11 - 04 - 2013
DRILLING METHOD: Rotary
RIG TYPE: D 900
TOTAL LENGTH (m): 35.85
GROUND WATER LEVEL (m.a.s.l): NA

JOINT STOCK COMPANY " ROGUN HPP "
Rogun Hydroelectrical Power Plant Project

ENGINEERING GEOLOGICAL LOG OF: **BH1**
LOCATION: Power House
COORDINATE X:27597.254 Y:23345.66
ELEVATION (m.a.s.l): 960.579
AZIMUTH: 030
INCLINATION (From Vertical): 90



Drill Method/CoreSize/RimeSize(mm)	Core Depth (m)	Core Run No	Core Recovery(%)	R.Q.D(%)	Geological Description	Sample/ Test
Non Coring	1	1	0		Concrete	
Single Tube /	1.62		100			
Double Tube / 63 / 96	2 2.5	2	100	58	SILTSTONE: Fine grain, brown Siltstone with some gypsum veins	
	3 3.7	3	100	72		
	4 5 5.5	4	100	56		
Triple Tube / 61 / 96	6 7	5	100			T1
Double Tube / 63 / 96	8 8.5	6	100	70	SILTSTONE: Fine grain, brown Siltstone with some gypsum veins	D1
	9 10	7	100	87		D2 D3

Depth (m)	Remarks	Type	Inclination to Core Axis	J.R.C	Fill Type	Fill Thickness(mm)	Aperture	Healed
1.7		J	60	8-10	Ca-Gy	<1	T	P
1.8		J	60				T	
2		J	75		Ca-Gy	<1	T	P
2.4		J	20	6-8			T	
2.65		J	80	2-4			T	
2.7		J	80	2-4	Ca-Gy	<1	T	P
3.05		J	20	4-6	Ca-Gy	<1	T	P
3.1		J	20	4-6	Ca-Gy	<1	T	P
3.2		J	20	4-6	Ca-Gy	<1	T	P
3.4		J	20	4-6			T	
3.6		J	20		Ca-Gy	<1	T	P
3.7		J	60	8-10	Ca-Gy	<1	T	P
3.8		J	60	8-10			T	
3.85		J	60	8-10	Ca-Gy	<1	T	P
4.6		B	90		Ca-Gy	<1	T	P
4.7		J	20	6-8			T	
4.8		B	85	2-4	Ca-Gy	<1	T	P
4.9		B	85	2-4	Ca-Gy	<1	T	P
5.15		B	85	2-4			T	
5.5		J	30	6-8	Ca-Gy	<1	T	P
7.5		J	30		Ca-Gy	<1	T	P
7.9		J	30		Ca-Gy	<1	T	P
9.2		J	30	6-8			T	
9.9		J	30	6-8	Ca-Gy	<1	T	P

Rock Mechanical Test: UCS (MPa) | Young's Modulus / Poison Ratio | C (MPa) / Phi (Degree) | Vp & Vs (m/s) | Water Content-Saturation Degree | Porosity / Unit Weight

Discontinuity Type
J: Joint
B: Bedding
F: Fault
Sl: Slickenside
St: Stylolite
V: Vein
SJ: Solution Joint
SC: Solution Cavity
Vu: Vugg
VJ: Vuggy Joint
FZ: Fault Zone ▨
FrZ: Fractured Zone ﹏
BZ: Broken Zone ▩
Inclination to Core Axis RO: Randomly Oriented

Fill Type
C: Clay
Fe: Fe Oxide
Mn: Mn Oxide
Bi: Bitumen
Ca: Calcite
Cl: Clean
My: Mylonite
G: Gypsum
Ce: Cement vein

Weathering
FR: Fresh
SW: Slightly Weathered
MW: Moderately Weathered
HW: Highly Weathered
CW: Completely Weathered
RS: Residual Soil

Aperture
O: Open
T: Tight

Strength
SR: Strong Rock
MVR: Medium Weak Rock
WR: Weak Rock
VWR: Very Weak Rock
EVR: Extremely Weak Rock

Healed
M: Mostly
P: Partially

Sampling
D : Double Tube
T : Triple Tube

Borehole No. BH1
Sheet 1 of 4

INSPECTOR:

CONTRACTOR:
ARIANA T. D. Co.
LOGGED BY: Sh. Yaghouti

STARTED DATE: 05 - 04 - 2013
FINISHED DATE: 11 - 04 - 2013
DRILLING METHOD: Rotary
RIG TYPE: D 900
TOTAL LENGTH (m): 35.85
GROUND WATER LEVEL (m.a.s.l): NA

JOINT STOCK COMPANY " ROGUN HPP "
Rogun Hydroelectrical Power Plant Project

ENGINEERING GEOLOGICAL LOG OF: **BH1**
LOCATION: Power House
COORDINATE X:27597.254 Y:23345.66
ELEVATION (m.a.s.l): 960.579
AZIMUTH: 030
INCLINATION (From Vertical): 90

Drill Method/CoreSize/RimeSize(mm)	Core Depth (m)	Core Run No	Core Recovery(%) 20 40 60 80 100	R.Q.D(%) 20 40 60 80 100	Joint Frequency (Joint/m) 10 8 6 4 2	Weathering RS CW HW MW SW FR	Strength EVR VWR WR MVR SR	Graphic Log	Geological Description
Triple Tube / 61 / 96	11 11.5	8	100						
Double Tube / 63 / 96	12 13	9	100	28					SILTSTONE: Fine grain, brown Siltstone with some gypsum veins - clay silty to silty clay (11.5 to11.7) & (12.5 to 12.6)
	14 14.5	10	100	77					
Triple Tube / 61 / 96	15 16	11	100						
Double Tube / 63 / 96	17 17.5	12	100	64					SILTY SAND: Silty Sandstone to Sandstone with gypsum veins,dark brown with ca vein
	18 19	13	100	50					
e Tube / 61 / 96	20	14	100						

Discontinuity Description / **Rock Mechanical Test**

Depth (m)	Remarks	Type	Inclination to Core Axis	J.R.C	Fill Type	Fill Thickness(mm)	Aperture	Healed	UCS (MPa) 5 10 25 50 100 >100	Young's Modulus / Poison Ratio	C (MPa) / Phi (Degree)	Vp & Vs (m/s)	Water Content-Saturation Degree	Porosity / Unit Weight	Sample/ Test
															T2
11.8		J	10	6-8			T								
11.9		J	10	6-8	Ca-Gy	<1	T	P							
12.1		J	60	2-4			T								
12.9		J	30		Ca-Gy	<1	T	P							
13		J	60	2-4			T								
13.2		B	85				T								
															D4
13.9		J	30	2-4			T								
															D5
															T3
16.1		J	30	2-4			T								
16.8		B	85				T								
16.9		J	60	4-6			T								
															D6
															T4

Discontinuity Type		*Fill Type*	*Weathering*	*Strength*	Sampling
J: Joint	Vu: Vugg	C: Clay	FR: Fresh	SR: Strong Rock	D : Double Tube
B: Bedding	VJ: Vuggy Joint	Fe: Fe Oxide	SW: Slightly Weathered	MVR: Medium Weak Rock	T : Triple Tube
F: Fault	FZ: Fault Zone ▨	Mn: Mn Oxide	MW: Moderately Weathered	WR: Weak Rock	
Sl: Slickenside	FrZ: Fractured Zone 〰	Bi: Bitumen	HW: Highly Weathered	VWR: Very Weak Rock	
St: Stylolite	BZ: Broken Zone ▩	Ca: Calcite	CW: Completely Weathered	EVR: Extremely Weak Rock	
V: Vein		Cl: Clean	RS: Residual Soil		
SJ: Solution Joint		My: Mylonite	*Aperture*	*Healed*	
SC: Solution Cavity		G: Gypsum	O: Open	M: Mostly	
Inclination to Core Axis	RO: Randomly Oriented	Ce: Cement vein	T: Tight	P: Partially	

Borehole No. *BH1*
Sheet 2 of 4

INSPECTOR:

CONTRACTOR:
ARIANA T. D. Co.

LOGGED BY: Sh. Yaghouti

A.T.D
ARIANA T. D.

STARTED DATE: 05 - 04 - 2013
FINISHED DATE: 11 - 04 - 2013
DRILLING METHOD: Rotary
RIG TYPE: D 900
TOTAL LENGTH (m): 35.85
GROUND WATER LEVEL (m.a.s.l): NA

JOINT STOCK COMPANY " ROGUN HPP "

Rogun Hydroelectrical Power Plant Project

ENGINEERING GEOLOGICAL LOG OF: **BH1**
LOCATION: Power House
COORDINATE X:27597.254 Y:23345.66
ELEVATION (m.a.s.l): 960.579
AZIMUTH: 030
INCLINATION (From Vertical): 90

Drill Method/CoreSize/RimeSize(mm)	Core Depth (m)	Core Run No	Core Recovery(%)	R.Q.D(%)	Sample/ Test
Tripl	20.5				
Double Tube / 63 / 96	21	15	100	90	
	22				
		16	100	92	D7
	23				
	23.5				
Triple Tube / 61 / 96	24	17	100		T5
	25				
Double Tube / 63 / 96		18	100	56	
	26				D8
	26.5				
	27	19	100	71	
					D9
	28				
Triple Tube / 61 / 96	29	20	100		T6
	29.5				
	30				

Geological Description:

SILTY SAND: Silty Sandstone to Sandstone with gypsum veins,dark brown with ca vein

SILTY SAND: Silty Sandstone to Sandstone with gypsum veins,dark brown with ca vein

SILTY SAND: Silty Sandstone to Sandstone with gypsum veins,dark brown with ca vein

Discontinuity Description

Depth (m)	Remarks	Type	Inclination to Core Axis	J.R.C	Fill Type	Fill Thickness(mm)	Aperture	Healed
20.9		J	60	4-6			T	
21.2		J	60	4-6			T	
21.35		B	85				T	
25.1		J	15	6-8			T	
25.3		J	15	6-8			T	
26.15		J	30	4-6			T	
26.5		J	60				T	
26.6		J	60				T	
27		J	5	6-8			T	
27.9		J	80				T	

Rock Mechanical Test: UCS (MPa); Young's Modulus / Poison Ratio; C (MPa) / Phi (Degree); Vp & Vs (m/s); Water Content-Saturation Degree; Porosity / Unit Weight

Joint Frequency (Joint/m): 10 8 6 4 2 — Weathering: RS CW HW MW SW FR — Strength: EVR VWR WR MVR SR — Graphic Log

Discontinuity Type		*Fill Type*	*Weathering*	*Strength*	Sampling
J: Joint B: Bedding F: Fault Sl: Slickenside St: Stylolite V: Vein SJ: Solution Joint SC: Solution Cavity	Vu: Vugg VJ: Vuggy Joint FZ: Fault Zone FrZ: Fractured Zone BZ: Broken Zone	C: Clay Fe: Fe Oxide Mn: Mn Oxide Bi: Bitumen Ca: Calcite Cl: Clean My: Mylonite G: Gypsum Ce: Cement vein	FR: Fresh SW: Slightly Weathered MW: Moderately Weathered HW: Highly Weathered CW: Completely Weathered RS: Residual Soil	SR: Strong Rock MVR: Medium Weak Rock WR: Weak Rock VWR: Very Weak Rock EVR: Extremely Weak Rock	D : Double Tube T : Triple Tube
Inclination to Core Axis	RO: Randomly Oriented		*Aperture* O: Open T: Tight	*Healed* M: Mostly P: Partially	*Borehole No.* *BH1* *Sheet 3 of 4*

INSPECTOR:

CONTRACTOR:
ARIANA T. D. Co.

LOGGED BY: Sh. Yaghouti

ARIANA T. D.

STARTED DATE: 05 - 04 - 2013
FINISHED DATE: 11 - 04 - 2013
DRILLING METHOD: Rotary
RIG TYPE: D 900
TOTAL LENGTH (m): 35.85
GROUND WATER LEVEL (m.a.s.l): NA

JOINT STOCK COMPANY " ROGUN HPP "
Rogun Hydroelectrical Power Plant Project

ENGINEERING GEOLOGICAL LOG OF: **BH1**
LOCATION: Power House
COORDINATE X:27597.254 Y:23345.66
ELEVATION (m.a.s.l): 960.579
AZIMUTH: 030
INCLINATION (From Vertical): 90

Drill Method/CoreSize/RimeSize(mm)	Core Depth (m)	Core Run No	Core Recovery(%) 20 40 60 80 100	R.Q.D(%) 20 40 60 80 100	Joint Frequency (Joint/m) 10 8 6 4 2	Weathering RS CW HW MW SW FR	Strength EVR VWR WR MVR SR	Graphic Log	Geological Description
Double Tube / 63 / 96		21	100	31					
	31	22	100	33					
	32								
	32.5								
Triple Tube / 61 / 96	33	23	100	34					
	34								
Double Tube / 63 / 96		24	100	35					SILTY SAND: Silty Sandstone to Sandstone with gypsum veins,dark brown with ca vein
	34.5	25	100	36					
	35								
	35.85								

Depth (m)	Remarks	Type	Inclination to Core Axis	J.R.C	Fill Type	Fill Thickness(mm)	Aperture	Healed
31.1		J	80				T	
31.3		J	5	6-8			T	
31.8		J	30	4-6			T	
34.15		B	85				T	
34.2		B	85				T	
34.5		J	75				T	
35		J	75				T	
35.85		J	75				T	

Discontinuity Description

Rock Mechanical Test

UCS (MPa) 5 10 25 50 100 >100	Young's Modulus / Poison Ratio	C (MPa) / Phi (Degree)	Vp & Vs (m/s)	Water Content-Saturation Degree	Porosity / Unit Weight	Sample/ Test
						D10
						D11
						T7
						D12
						D13

Discontinuity Type

J: Joint
B: Bedding
F: Fault
Sl: Slickenside
St: Stylolite
V: Vein
SJ: Solution Joint
SC: Solution Cavity
Vu: Vugg
VJ: Vuggy Joint
FZ: Fault Zone
FrZ: Fractured Zone
BZ: Broken Zone

Inclination to Core Axis RO: Randomly Oriented

Fill Type

C: Clay
Fe: Fe Oxide
Mn: Mn Oxide
Bi: Bitumen
Ca: Calcite
Cl: Clean
My: Mylonite
G: Gypsum
Ce: Cement vein

Weathering

FR: Fresh
SW: Slightly Weathered
MW: Moderately Weathered
HW: Highly Weathered
CW: Completely Weathered
RS: Residual Soil

Strength

SR: Strong Rock
MVR: Medium Weak Rock
WR: Weak Rock
VWR: Very Weak Rock
EVR: Extremely Weak Rock

Sampling

D : Double Tube
T : Triple Tube

Aperture

O: Open
T: Tight

Healed

M: Mostly
P: Partially

Borehole No. BH1
Sheet 4 of 4

INSPECTOR:

CONTRACTOR:
ARIANA T. D. Co.

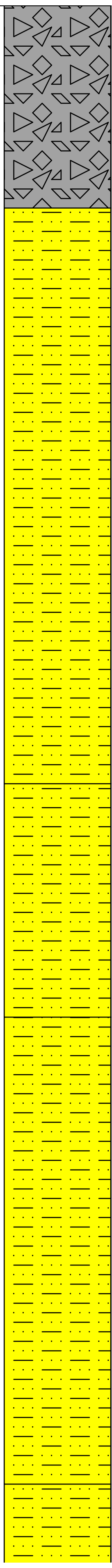
LOGGED BY: Sh. Yaghouti

STARTED DATE: 12 - 04 - 2013
FINISHED DATE: 17 - 04 - 2013
DRILLING METHOD: Rotary
RIG TYPE: D 900
TOTAL LENGTH (m): 35
GROUND WATER LEVEL (m.a.s.l): NA

JOINT STOCK COMPANY " ROGUN HPP "
Rogun Hydroelectrical Power Plant Project

ENGINEERING GEOLOGICAL LOG OF: **BH2**
LOCATION: Power House
COORDINATE X:27594.685 Y:23319.562
ELEVATION (m.a.s.l): 960.185
AZIMUTH: 030
INCLINATION (From Vertical): 90

Drill Method/CoreSize/RimeSize(mm)	Core Depth (m)	Core Run No	Core Recovery(%) 20 40 60 80 100	R.Q.D(%) 20 40 60 80 100	Joint Frequency (Joint/m) 10 8 6 4 2	Weathering RS CW HW MW SW FR	Strength EVR VWR WR MVR SR	Geological Description
Single Tube / 65 / 96	1 1.7	1	100					Concrete
Double Tube / 63 / 96	2 2.4	2	100	0				SILTSTONE: Fine grain, brown Siltstone with some gypsum veins
	3 3.9	3	100	53				
	4 5	4	100	56				
Triple Tube / 61 / 96	6 6.5	5	100					
Double Tube / 63 / 96	7 7.5	6	100	56				SILTSTONE: Fine grain, brown Siltstone with some gypsum veins
	8 9	7	100	53				
	9.5	8	100	100				
/ 96	10							



Discontinuity Description

Depth (m)	Remarks	Type	Inclination to Core Axis	J.R.C	Fill Type	Fill Thickness(mm)	Aperture	Healed
2.4		▨						
3								
3.3		▨						
3.6		▨						
3.85		B	30	4-6	Ca-Gy	<1	T	P
4.3		B	30	4-6	Ca-Gy	<1	T	P
4.7		J	80	6-8	Ca-Gy	<1	T	P
4.9		B	30	4-6	Ca-Gy	<1	T	P
7.5		B	30	4-6	Ca-Gy	<1	T	P
7.7		B	30	4-6	Ca-Gy	<1	T	P
7.75		B	30	4-6	Ca-Gy	<1	T	P
8		▨						
8.3		▨						

Rock Mechanical Test

UCS (MPa) 5 10 25 50 100 >100	Young's Modulus / Poison Ratio	C (MPa) / Phi (Degree)	Vp & Vs (m/s)	Water Content-Saturation Degree	Porosity / Unit Weight	Sample/ Test
						T8
						D14
						D15

Discontinuity Type

J: Joint
B: Bedding
F: Fault
Sl: Slickenside
St: Stylolite
V: Vein
SJ: Solution Joint
SC: Solution Cavity

Vu: Vugg
VJ: Vuggy Joint
FZ: Fault Zone ▨
FrZ: Fractured Zone 〰
BZ: Broken Zone ▨

Inclination to Core Axis RO: Randomly Oriented

Fill Type

C: Clay
Fe: Fe Oxide
Mn: Mn Oxide
Bi: Bitumen
Ca: Calcite
Cl: Clean
My: Mylonite
G: Gypsum
Ce: Cement vein

Weathering

FR: Fresh
SW: Slightly Weathered
MW: Moderately Weathered
HW: Highly Weathered
CW: Completely Weathered
RS: Residual Soil

Aperture

O: Open
T: Tight

Strength

SR: Strong Rock
MVR: Medium Weak Rock
WR: Weak Rock
VWR: Very Weak Rock
EVR: Extremely Weak Rock

Healed

M: Mostly
P: Partially

Sampling

D : Double Tube
T : Triple Tube

Borehole No. *BH2*
Sheet 1 of 4

INSPECTOR:

CONTRACTOR:
ARIANA T. D. Co.

LOGGED BY: Sh. Yaghouti

STARTED DATE: 12 - 04 - 2013
FINISHED DATE: 17 - 04 - 2013
DRILLING METHOD: Rotary
RIG TYPE: D 900
TOTAL LENGTH (m): 35
GROUND WATER LEVEL (m.a.s.l): NA

JOINT STOCK COMPANY " ROGUN HPP "

Rogun Hydroelectrical Power Plant Project

ENGINEERING GEOLOGICAL LOG OF: **BH2**
LOCATION: Power House
COORDINATE X:27594.685 Y:23319.562
ELEVATION (m.a.s.l): 960.185
AZIMUTH: 030
INCLINATION (From Vertical): 90

Drill Method/CoreSize/RimeSize(mm)	Core Depth (m)	Core Run No	Core Recovery(%)	R.Q.D(%)	Geological Description	Sample/ Test
Triple Tube / 61	11	9	100			T9
Double Tube / 63 / 96	12 12.5	10	100	41	SILTSTONE: Fine grain, brown Siltstone with some gypsum veins	
Double Tube / 63 / 96	13 14	11	100	100		D16 D17
Triple Tube / 61 / 96	15 15.5	12	100			T10
Double Tube / 63 / 96	16 17	13	100	28	SILTSTONE: Fine grain, brown Siltstone with some gypsum veins	
Double Tube / 63 / 96	18 18.5	14	100	40		
Triple Tube / 61 / 96	19 20	15	100			T11

Joint Frequency (Joint/m): 10 8 6 4 2 — Weathering: RS CW HW MW SW FR — Strength: EVR VWR WR MVR SR — UCS (MPa): 5 10 25 50 100 >100

Graphic Log

Rock Mechanical Test: UCS (MPa) | Young's Modulus / Poison Ratio | C (MPa) / Phi (Degree) | Vp & Vs (m/s) | Water Content-Saturation Degree | Porosity / Unit Weight

Discontinuity Description

Depth (m)	Remarks	Type	Inclination to Core Axis	J.R.C	Fill Type	Fill Thickness(mm)	Aperture	Healed
11.5		J	80	6-8	Ca-Gy	<1	T	P
13.5		B	30	4-6	Ca-Gy	<1	T	P
15.7		J	5	10-12			T	
16.2		B	30	4-6	Ca-Gy	<1	T	P
16.4		B	30	4-6	Ca-Gy	<1	T	P
16.5		B	30	4-6	Ca-Gy	<1	T	P
17.1		B	30	4-6	Ca-Gy	<1	T	P
17.2		B	30	4-6	Ca-Gy	<1	T	P
17.45		J	80	6-8	Ca-Gy	<1	T	P
17.5		J	80	6-8	Ca-Gy	<1	T	P
17.6		J	80	6-8	Ca-Gy	<1	T	P
17.7		J	80	6-8	Ca-Gy	<1	T	P
18								
18.3		B	15	4-6	Ca-Gy	<1	T	P
20		B	15	4-6	Ca-Gy	<1	T	P

Discontinuity Type		Fill Type	Weathering	Strength	Sampling
J: Joint	Vu: Vugg	C: Clay	FR: Fresh	SR: Strong Rock	D : Double Tube
B: Bedding	VJ: Vuggy Joint	Fe: Fe Oxide	SW: Slightly Weathered	MVR: Medium Weak Rock	T : Triple Tube
F: Fault	FZ: Fault Zone ▨	Mn: Mn Oxide	MW: Moderately Weathered	WR: Weak Rock	
Sl: Slickenside	FrZ: Fractured Zone	Bi: Bitumen	HW: Highly Weathered	VWR: Very Weak Rock	
St: Stylolite	BZ: Broken Zone ▩	Ca: Calcite	CW: Completely Weathered	EVR: Extremely Weak Rock	
V: Vein		Cl: Clean	RS: Residual Soil		
SJ: Solution Joint		My: Mylonite	**Aperture**	**Healed**	
SC: Solution Cavity		G: Gypsum	O: Open	M: Mostly	
Inclination to Core Axis	RO: Randomly Oriented	Ce: Cement vein	T: Tight	P: Partially	

Borehole No. BH2
Sheet 2 *of* 4

INSPECTOR:

CONTRACTOR:
ARIANA T. D. Co.

LOGGED BY: Sh. Yaghouti

A.T.D
ARIANA T. D.

STARTED DATE: 12 - 04 - 2013
FINISHED DATE: 17 - 04 - 2013
DRILLING METHOD: Rotary
RIG TYPE: D 900
TOTAL LENGTH (m): 35
GROUND WATER LEVEL (m.a.s.l): NA

JOINT STOCK COMPANY " ROGUN HPP "
Rogun Hydroelectrical Power Plant Project

ENGINEERING GEOLOGICAL LOG OF: **BH2**
LOCATION: Power House
COORDINATE X:27594.685 Y:23319.562
ELEVATION (m.a.s.l): 960.185
AZIMUTH: 030
INCLINATION (From Vertical): 90

Drill Method/CoreSize/RimeSize(mm)	Core Depth (m)	Core Run No	Core Recovery(%) 20 40 60 80 100	R.Q.D(%) 20 40 60 80 100	Joint Frequency (Joint/m) 10 8 6 4 2	Weathering RS CW HW MW SW FR	Strength EVR VWR WR MVR SR	Graphic Log
Double Tube / 63 / 96	21 21.5	16	100	0				
	22 23	17	100	100				
Triple Tube / 61 / 96	24 24.5	18	100					
Double Tube / 63 / 96	25 26	19	100	70				
	27 27.5	20	100	38				
Triple Tube / 61 / 96	28 29	21	100					
	30	22	100	91				

Geological Description

SILTSTONE: Fine grain, brown Siltstone with some gypsum veins

SILTSTONE: Fine grain, brown Siltstone with some gypsum veins

SILTSTONE: Fine grain, brown Siltstone with some gypsum veins

Depth (m)	Remarks	Type	Inclination to Core Axis	J.R.C	Fill Type	Fill Thickness(mm)	Aperture	Healed
20.3								
21.3		B	15	4-6	Ca-Gy	<1	T	P
25		J	60	6-8	Ca-Gy	<1	T	P
25.15		J	60	6-8	Ca-Gy	<1	T	P
25.3		J	60	6-8	Ca-Gy	<1	T	P
25.4								
25.45		J	60	6-8	Ca-Gy	<1	T	P
26.3								
26.6		J	60	6-8	Ca-Gy	<1	T	P
27		B	15	4-6	Ca-Gy	<1	T	P

Rock Mechanical Test: UCS (MPa) 5 10 25 50 100 >100 | Young's Modulus / Poison Ratio | C (MPa) / Phi (Degree) | Vp & Vs (m/s) | Water Content-Saturation Degree | Porosity / Unit Weight | Sample/ Test

Sample/ Test
D18
D19
D20
T12
D21
D22
T13
D23

Discontinuity Type			*Fill Type*	*Weathering*	*Strength*	Sampling
J: Joint	Vu: Vugg		C: Clay	FR: Fresh	SR: Strong Rock	D : Double Tube
B: Bedding	VJ: Vuggy Joint		Fe: Fe Oxide	SW: Slightly Weathered	MVR: Medium Weak Rock	T : Triple Tube
F: Fault	FZ: Fault Zone	▨	Mn: Mn Oxide	MW: Moderately Weathered	WR: Weak Rock	
Sl: Slickenside	FrZ: Fractured Zone	﹏	Bi: Bitumen	HW: Highly Weathered	VWR: Very Weak Rock	
St: Stylolite	BZ: Broken Zone	▦	Ca: Calcite	CW: Completely Weathered	EVR: Extremely Weak Rock	
V: Vein			Cl: Clean	RS: Residual Soil		
SJ: Solution Joint			My: Mylonite			
SC: Solution Cavity			G: Gypsum			
			Ce: Cement vein			

Inclination to Core Axis RO: Randomly Oriented

Aperture	*Healed*
O: Open	M: Mostly
T: Tight	P: Partially

Borehole No. *BH2*
Sheet 3 of 4

INSPECTOR:

CONTRACTOR:
ARIANA T. D. Co.

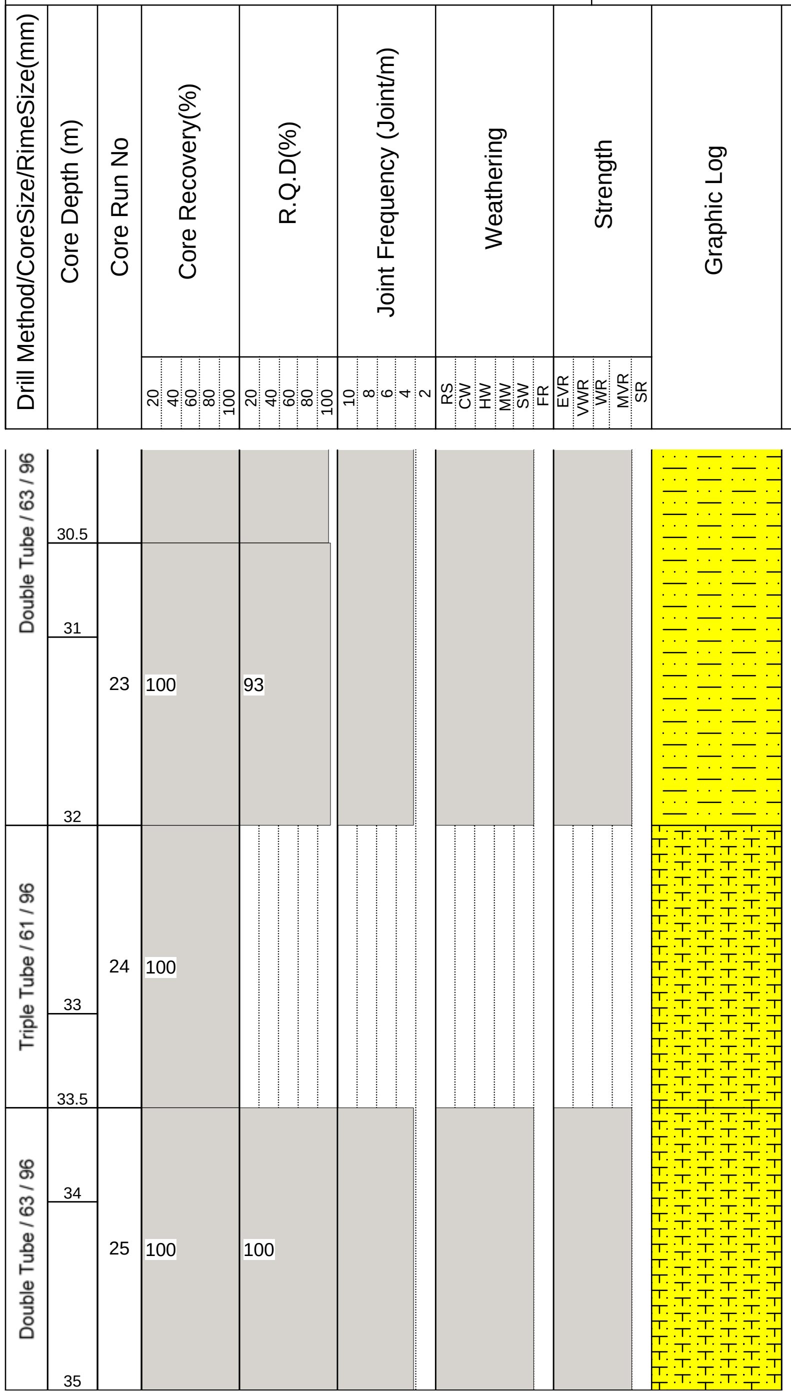
LOGGED BY: Sh. Yaghouti

STARTED DATE: 12 - 04 - 2013
FINISHED DATE: 17 - 04 - 2013
DRILLING METHOD: Rotary
RIG TYPE: D 900
TOTAL LENGTH (m): 35
GROUND WATER LEVEL (m.a.s.l): NA

JOINT STOCK COMPANY " ROGUN HPP "

Rogun Hydroelectrical Power Plant Project

ENGINEERING GEOLOGICAL LOG OF: **BH2**
LOCATION: Power House
COORDINATE X:27594.685 Y:23319.562
ELEVATION (m.a.s.l): 960.185
AZIMUTH: 030
INCLINATION (From Vertical): 90



Geological Description

SILTY SAND: Silty Sandstone to Sandstone with gypsum veins,dark brown with ca vein

Discontinuity Description

Depth (m)	Remarks	Type	Inclination to Core Axis	J.R.C	Fill Type	Fill Thickness(mm)	Aperture	Healed
33.6		B	15	4-6	Ca-Gy	<1	T	P
33.7		J	60	6-8	Ca-Gy	<1	T	P
34		B	15	4-6	Ca-Gy	<1	T	P
34.1		B	15	4-6	Ca-Gy	<1	T	P
34.2		B	15	4-6	Ca-Gy	<1	T	P

Rock Mechanical Test

UCS (MPa)	Young's Modulus / Poison Ratio	C (MPa) / Phi (Degree)	Vp & Vs (m/s)	Water Content-Saturation Degree	Porosity / Unit Weight	Sample/ Test
5 10 25 50 100 >100						D24
						D25
						D26
						T14
						D27
						D28

Discontinuity Type

J: Joint
B: Bedding
F: Fault
Sl: Slickenside
St: Stylolite
V: Vein
SJ: Solution Joint
SC: Solution Cavity
Vu: Vugg
VJ: Vuggy Joint
FZ: Fault Zone ▨
FrZ: Fractured Zone ∿
BZ: Broken Zone ▩

Inclination to Core Axis RO: Randomly Oriented

Fill Type

C: Clay
Fe: Fe Oxide
Mn: Mn Oxide
Bi: Bitumen
Ca: Calcite
Cl: Clean
My: Mylonite
G: Gypsum
Ce: Cement vein

Weathering

FR: Fresh
SW: Slightly Weathered
MW: Moderately Weathered
HW: Highly Weathered
CW: Completely Weathered
RS: Residual Soil

Aperture

O: Open
T: Tight

Strength

SR: Strong Rock
MVR: Medium Weak Rock
WR: Weak Rock
VWR: Very Weak Rock
EVR: Extremely Weak Rock

Healed

M: Mostly
P: Partially

Sampling

D : Double Tube
T : Triple Tube

Borehole No. *BH2*
Sheet 4 of 4

INSPECTOR:

CONTRACTOR:
ARIANA T. D. Co.

LOGGED BY: Sh. Yaghouti