LIST OF DRAWINGS FOR MAIN ACCESS TUNNEL TENDERING PURPOSE

S.N.	Name of Drawing Sheet	Design Stage	Building	Name of Drawing		Scale	Paper Size
				Plan Type	Details		
1	UAHEP_XX_350_CI_JVTTW_0001	Issued for Information/ WIP	Access Tunnel	Layout Plan	Main Access Tunnel	1:2,000 & 1: 200	A3
2	UAHEP_XX_350_CI_JVTTW_0002	Issued for Information/ WIP	Access Tunnel	Longitudinal Section	Main Access Tunnel	1:3,000	A3
3	UAHEP_XX_350_CI_JVTTW_0003	Issued for Information/ WIP	Access Tunnel	Layout Plan of Portal	Detail at A	1:300	A3
4	UAHEP_XX_350_CI_JVTTW_0004	Issued for Information/ WIP	Access Tunnel	Portal Plan View and Sections		1:100	A3
5	UAHEP_XX_350_CI_JVTTW_0005	Issued for Information/ WIP	Access Tunnel	Portal L-Section	Rock Support Details	1:200	A3
6	UAHEP_XX_350_CI_JVTTW_0006	Issued for Information/ WIP	Access Tunnel	Portal View	Rock Support Details	1:250, 1:150, & 1:100	A3
7	UAHEP_XX_350_CI_JVTTW_0007	Issued for Information/ WIP	Access Tunnel	Typical Sections	Rock Support Details	1:200	A3
8	UAHEP_XX_350_CI_JVTTW_0008	Issued for Information/ WIP	Access Tunnel	Details of Typical Sections	Rock Support Details	1:20	A3
9	UAHEP_XX_350_CI_JVTTW_0009	Issued for Information/ WIP	Access Tunnel	Details of Steel Ribs	Rock Support Details	1:100 & 1:10	A3
10	UAHEP_XX_350_CI_JVTTW_0010	Issued for Information/ WIP	Access Tunnel	Rock Support Details	At Section B-B	1:200, 1:100, 1:20, & 1:10	A3
11	UAHEP_XX_350_CI_JVTTW_0011	Issued for Information/ WIP	Access Tunnel	Rock Support Details for	RS V with Convergence Over 5 cm	1:200, 1:100, 1:20, & 1:10	A3

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. THE COORDINATES SYSTEM USED IN MODIFIED UNIVERSAL TRANSVERSE MERCATOR SYSTEM i.e. MUTM 87.
4. THE ABOVE LISTED DRAWINGS ARE ONLY FOR TENDERING PURPOSE OF MAIN ACCESS TUNNEL.

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED
(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)
UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

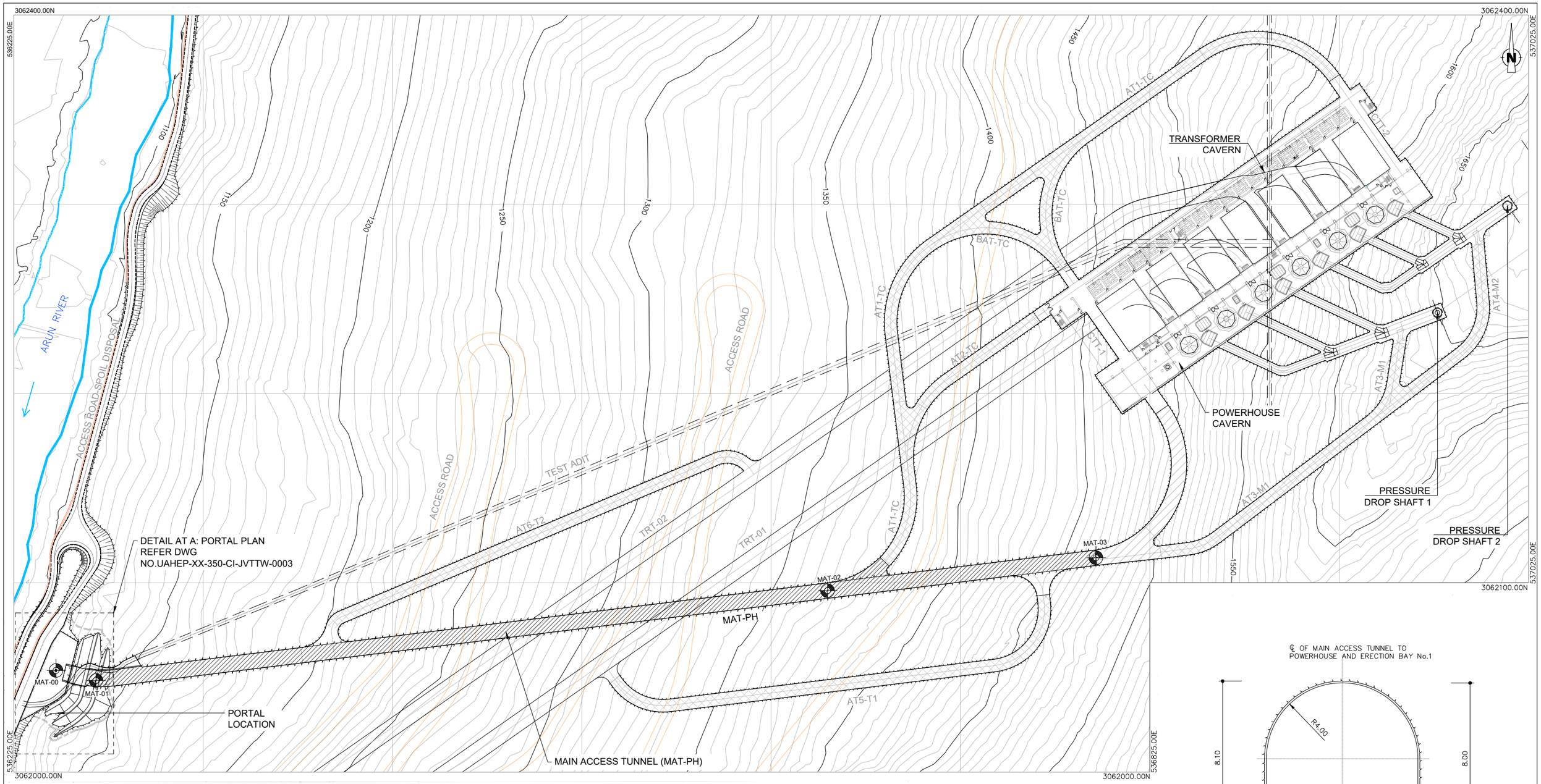
ISSUED FOR INFORMATION / WIP
ACCESS TUNNEL
LIST OF DRAWINGS
MAIN ACCESS TUNNEL

DRAWN		CHECKED		APPROVED	
N.N.		N.N.		N.N.	

SCALE: -
SUPERSEDES DRAWING NO.: -

PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO.	REV.
UAHEP	XX	350	CI	JVTTW	0000	02

This document is the property of Joint Venture Lahmeyer International



LAYOUT OF MAIN ACCESS TUNNEL

SCALE 1:2000

SCALE 1:2000

-20 0 20 40 60 80 100 [m]

LEGENDS

- FIX POINT
- CONNECTING TUNNEL
- MAIN ACCESS TUNNEL (MAT)

TABLE OF COORDINATES			
CO-ORDINATE POINTS	X-EASTING	Y-NORTHING	DESIGN EL (INVERT)
MAT-00	536247.2740	3062053.6939	1105.00
MAT-01	536268.3944	3062048.4280	1105.126
MAT-02	536654.7549	3062095.8671	1110.418
MAT-03	536796.5065	3062113.2720	1111.955

TYPICAL CROSS SECTION OF MAIN ACCESS TUNNEL

SCALE 1:200

SCALE 1:200

-10 0 2 4 6 8 10 [m]

NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. THE COORDINATES SYSTEM USED IN MODIFIED UNIVERSAL TRANSVERSE MERCATOR SYSTEM i.e. MUTM 87.
4. THE REFERENCE GRID DISTANCE IS 100 METERS.
5. MAJOR CONTOUR INTERVAL IS 50 M AND MINOR CONTOUR INTERVAL IS 10M.
6. FOR DETAIL A , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0003.
6. FOR LONGITUDINAL SECTION OF MAIN ACCESS TUNNEL , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0002.

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED
(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)
UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP

ACCESS TUNNEL

LAYOUT PLAN

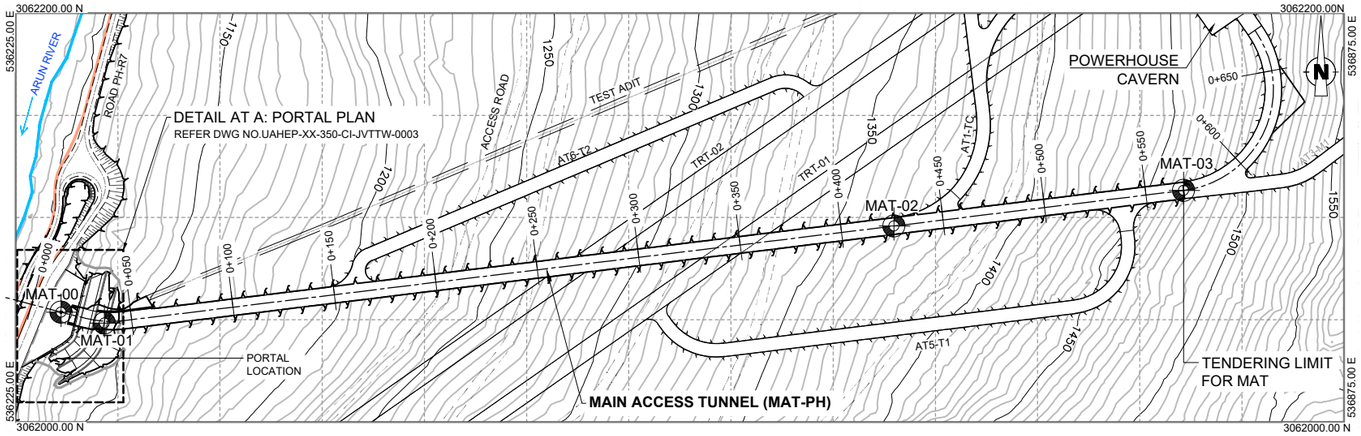
MAIN ACCESS TUNNEL

DRAWN		CHECKED		APPROVED	
N.N.		N.N.		N.N.	

SCALE: 1:2000 & 1:200 — SUPERSEDES DRAWING NO.: -

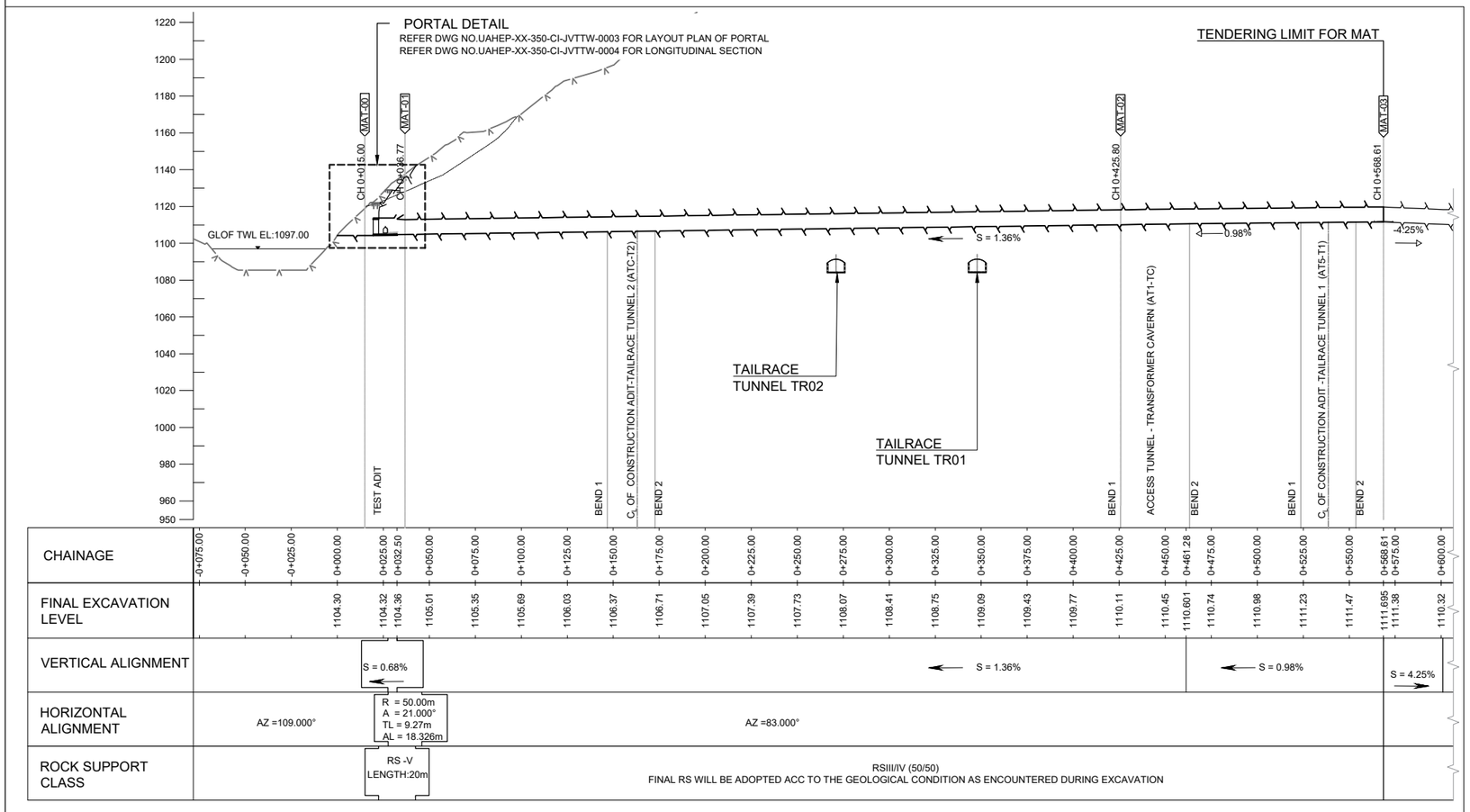
PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO.	REV.
UAHEP	XX	350	CI	JVTTW	0001	02

This document is the property of Joint Venture Lahmeyer International/ Tractebel France– WAPCOS India. Any duplication or transmission to third parties is forbidden without its prior approval.



LAYOUT PLAN OF MAIN ACCESS TUNNEL UP TO MAT-03

SCALE 1:3000

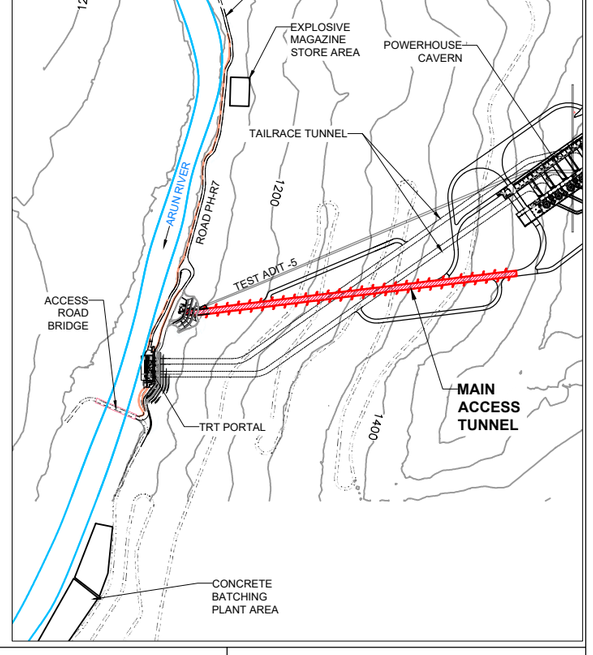


LONGITUDINAL SECTION OF MAIN ACCESS TUNNEL UP TO MAT-03

SCALE 1:3000

TABLE OF COORDINATES			
CO-ORDINATE POINTS	X-EASTING	Y-NORTHING	EXCAVATION LEVEL
MAT-00	536247.2740	3062053.6939	1104.30
MAT-01	536268.3944	3062048.4280	1104.826
MAT-02	536654.7549	3062095.8671	1110.118
MAT-03	536796.5065	3062113.2720	1111.655

KEY PLAN



NOTE

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. FOR PORTAL PLAN VIEW , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0003.
6. FOR SECTION AND DETAILS OF MAIN ACCESS TUNNEL PORTAL , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0004.

SCALE 1:3000

-30 0 30 60 90 120 150 [m]

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED
(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)
UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP
ACCESS TUNNEL
LONGITUDINAL SECTION
MAIN ACCESS TUNNEL

DRAWN		CHECKED		APPROVED	
N.N.		ML	-	N.N.	

SCALE 1:3000 SUPERSEDES -

PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0002	02

This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.

This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.

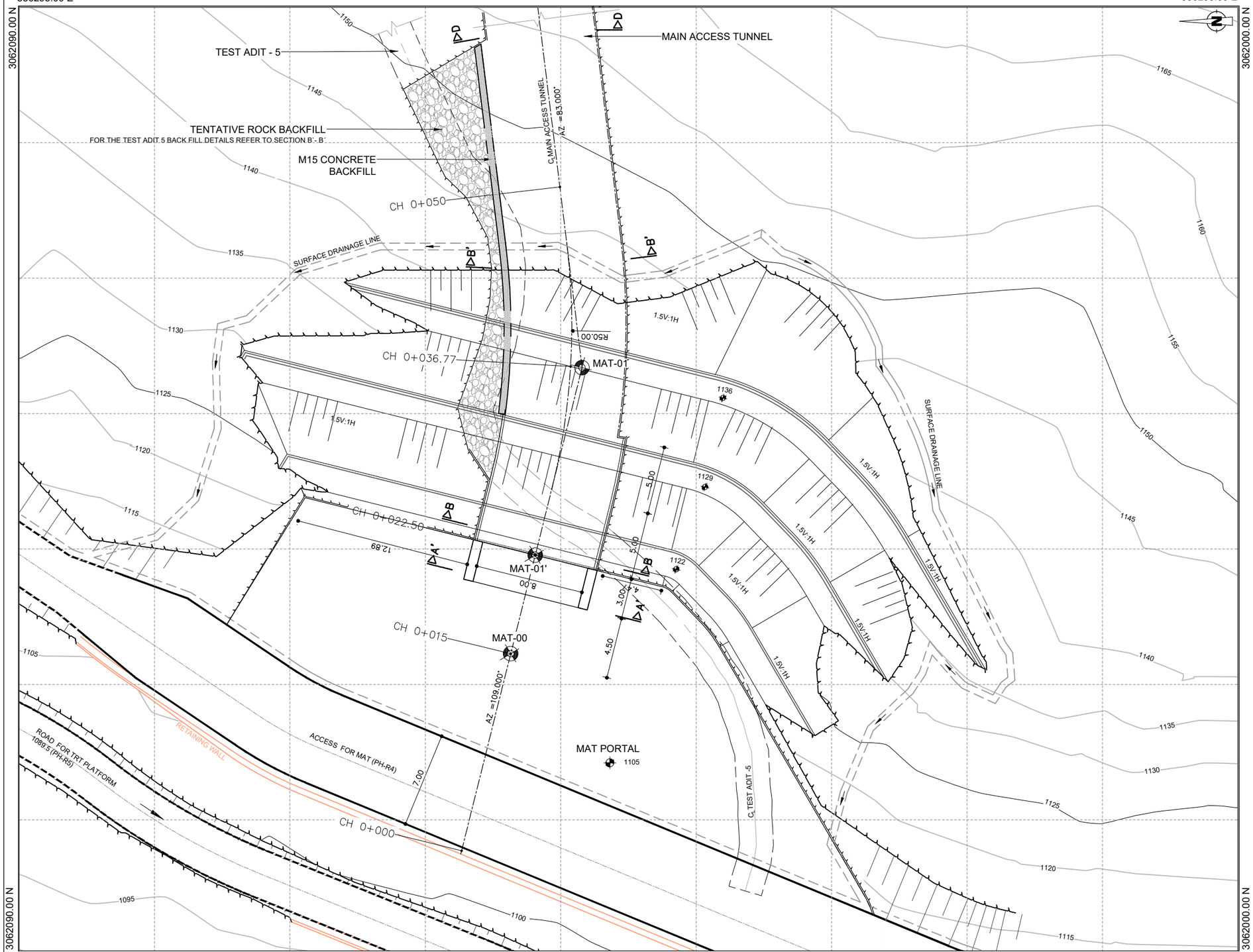
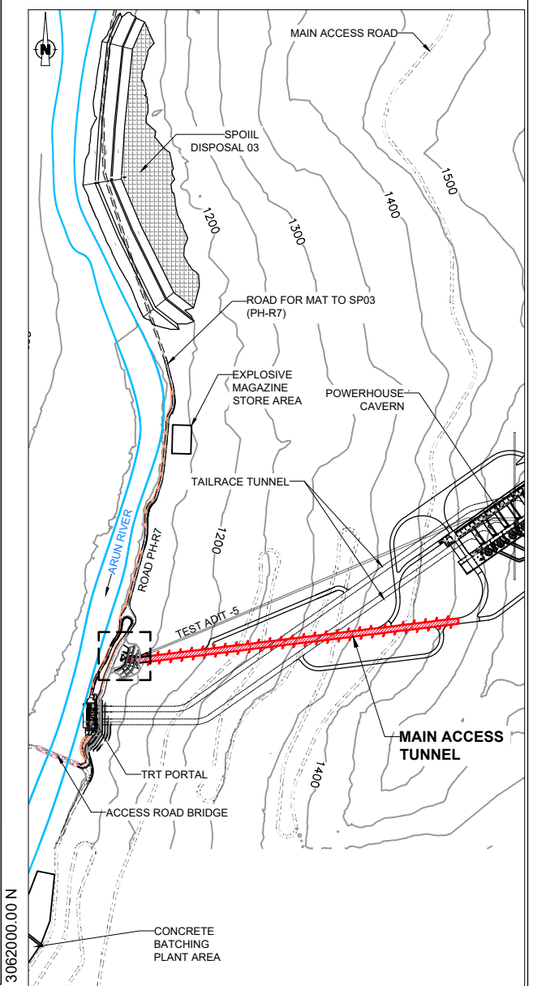


TABLE OF COORDINATES			
CO-ORDINATE POINTS	X-EASTING	Y-NORTHING	EXCAVATION LEVEL
MAT-00	536247.2740	3062053.6939	1104.30
MAT-01	536268.3944	3062048.4280	1104.826

NOTE FOR PORTAL EXCAVATION

A. THE EXCAVATION SLOPE MAY BE CHANGED AS PER SITE CONDITIONS OR INSTRUCTION PROVIDED BY ENGINEER.

KEY PLAN



DETAIL A: LAYOUT PLAN OF MAIN ACCESS TUNNEL PORTAL

SCALE 1:300

NOTE

1. ALL DIMENSIONS ARE IN METERS [M] UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE ABOVE MEAN SEA LEVEL.
3. CO-ORDINATES BASED ON NATIONAL GEODETIC NETWORK SYSTEM (EVEREST 1830).
4. FOR SECTION AT A'-A', B-B , B'-B', AND D-D , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0004.
5. FOR SECTION AT LONGITUDINAL SECTION ALONG MAT NEAR PORTAL , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0005.

SCALE 1:300

-3 0 3 6 9 12 15 [m]

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED

(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)

UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP

ACCESS TUNNEL

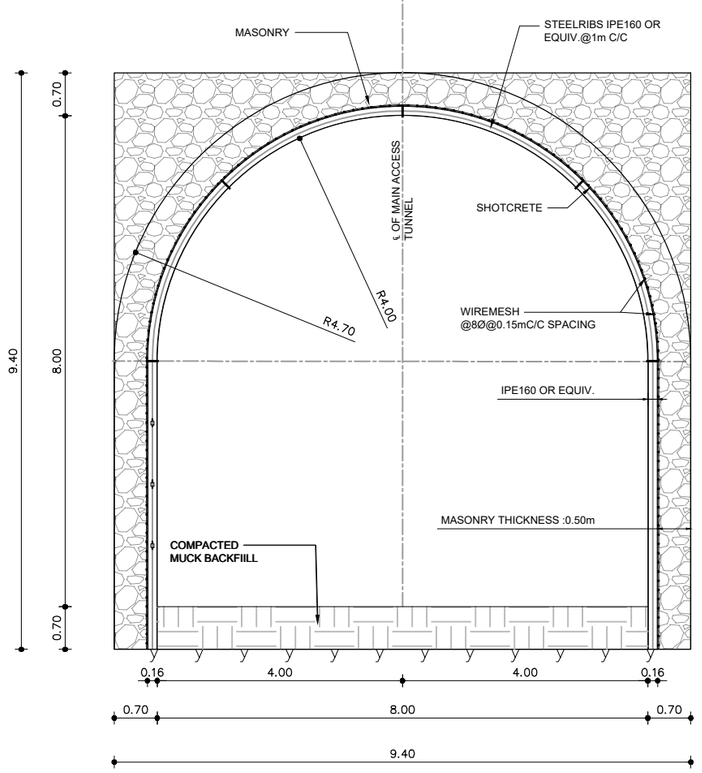
LAYOUT PLAN OF PORTAL

DETAIL AT A

DRAWN	CHECKED		APPROVED	
MN		N.N.		N.N.	

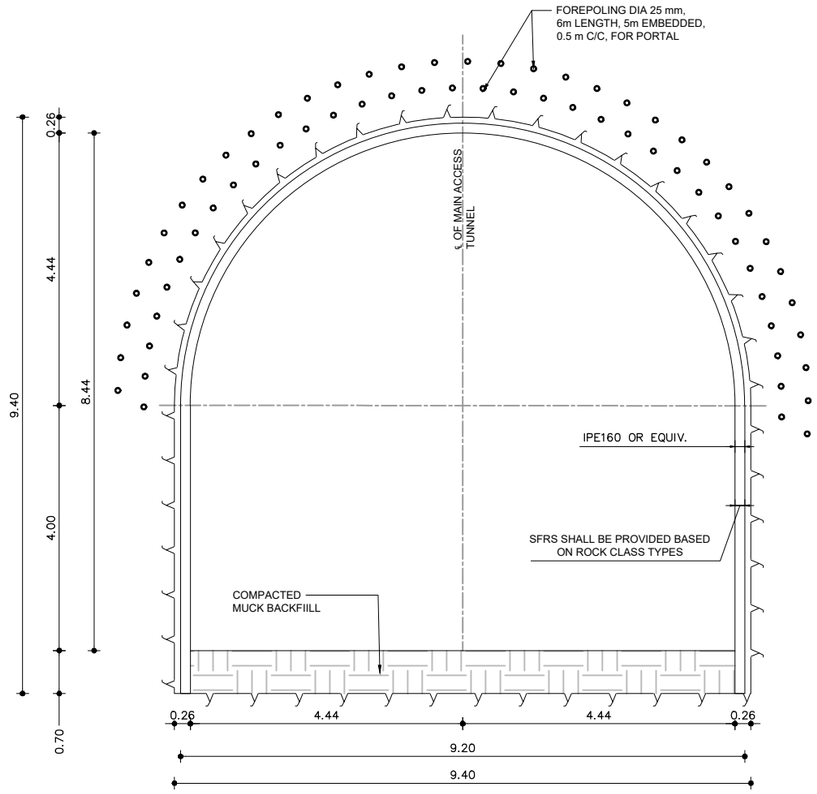
SCALE 1:300 SUPERSEDES

PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0003	02



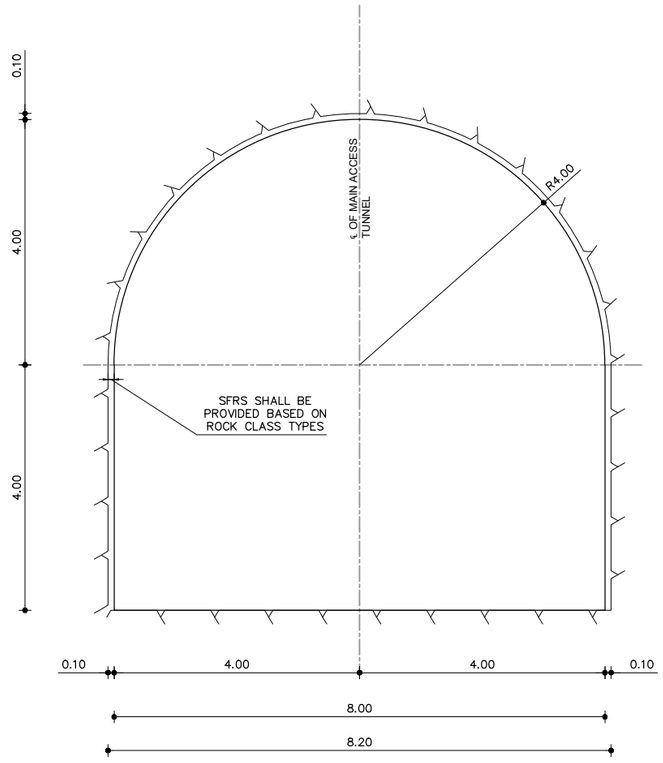
SECTION AT A'-A'

SCALE 1:100



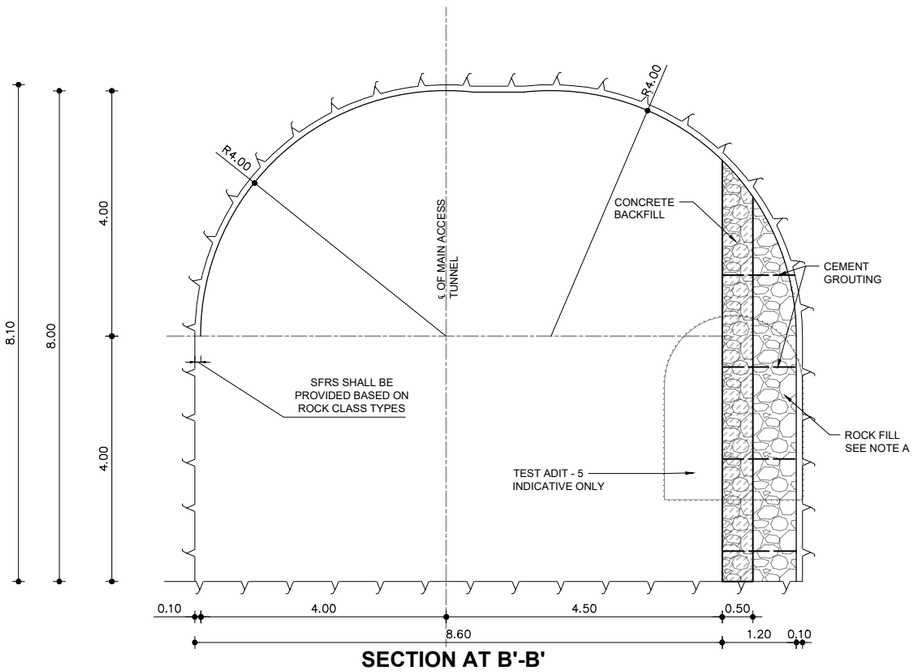
SECTION AT B-B

SCALE 1:100



SECTION AT D-D

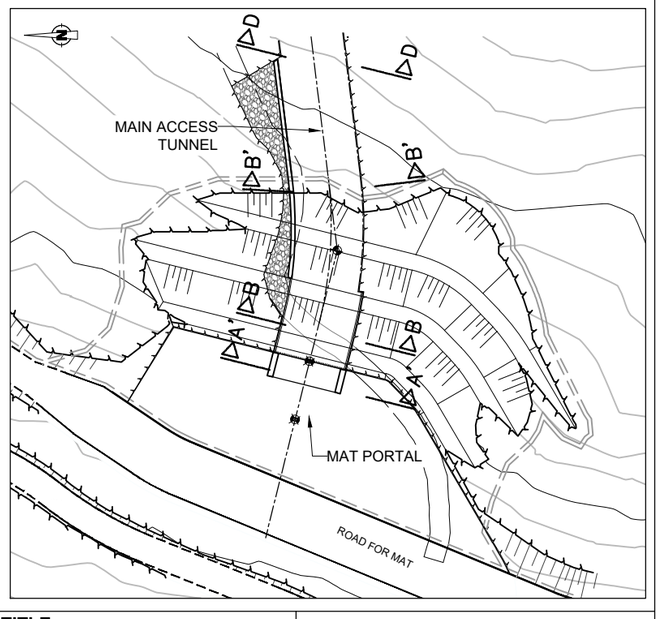
SCALE 1:100



SECTION AT B'-B'

SCALE 1:100

KEY PLAN



NOTE ABOUT TEST ADIT - 5 BACK FILL

A. ONCE THE ACTUAL LAYOUT AND CONDITIONS OF THE TEST ADIT -5 ARE VERIFIED AND ITS FINAL PURPOSE DETERMINED, THE FINAL BACKFILL LAYOUT, DIMENSIONS AND TYPES, AS WELL AS THE SPECIFICATIONS AND CHARACTERISTICS OF THE REINFORCEMENT SYSTEM SHOULD BE SPECIFIED IN AGREEMENT WITH THE CLIENT.

NOTE

1. ALL DIMENSIONS ARE IN METERS [M] UNLESS MENTIONED OTHERWISE.
2. ALL ELEVATIONS ARE ABOVE MEAN SEA LEVEL.
3. FOR ROCK SUPPORT DETAILS,
   - 3.1. REFER NO. UAHEP-XX-350-CI-JVTTW-0005 FOR LONGITUDINAL SECTION DETAILS NEAR PORTAL.
   - 3.2. REFER NO. UAHEP-XX-350-CI-JVTTW-0006 FOR ROCK SUPPORT ARRANGEMENT AT PORTAL.
   - 3.3. REFER NO. UAHEP-XX-350-CI-JVTTW-0007 FOR TYPICAL SECTION DETAILS AT VARIOUS ROCK CLASS CONDITIONS.

SCALE 1:100

-1 0 1 2 3 4 5 [m]

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED

(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)

UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP

ACCESS TUNNEL

PORTAL PLAN VIEW AND SECTIONS

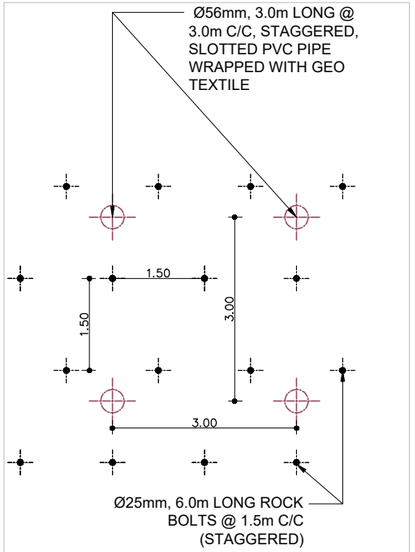
DRAWN		CHECKED		APPROVED	
MN		N.N.	.	N.N.	.

SCALE: 1:100 — SUPERSEDES:

PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0004	02

This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.

This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.



ARRANGEMENTS OF ROCK BOLTS AND DRAINAGE PATTERNS

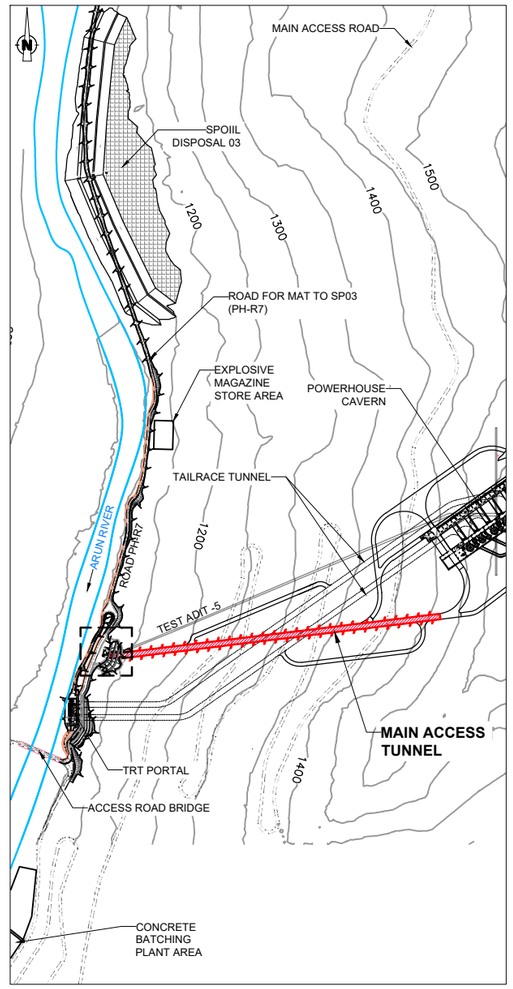
SCALE 1:100

NOTE A:
THE **EXCAVATION SLOPE** MAY BE CHANGED AS PER SITE CONDITIONS OR INSTRUCTION PROVIDED BY ENGINEER.

LONGITUDINAL SECTION DETAILS AT PORTAL

SCALE 1:200

KEY PLAN



NOTES

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 mm
   - YIELD STRENGTH 500 N/mm²
2. THE STEEL FIBER REINFORCED SHOTCRETE (SFRS) MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 25MPa (C_{25}).
3. STEEL RIBS SHALL CONFORM TO EN 10365/10025 OR EQUIVALENT TO IS:226-1975.
4. AN ADDITIONAL LAYER OF 50mm THICK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREAS WITH HIGH WATER INFLOW WHERE FULLY GROUTED BOLTS CANNOT BE INSTALLED, SWELLEX ANCHORS OF EQUIVALENT PATTERN MAY BE USED AS TEMPORARY SUPPORT UNTIL WATER INFLOW DECREASES TO A LEVEL THAT PERMITS SHOTCRETING AND INSTALLATION OF FULLY GROUTED BOLTS.
10. DRIPPING OR FLOWING WATER SHALL BE COLLECTED USING AND ADEQUATE DRAINAGE SYSTEM PRIOR TO SHOTCRETING. WHERE NECESSARY, ADDITIONAL DRAIN HOLES SHALL BE INSTALLED.
11. THE USE, IF NECESSARY, OF FOREPOLING AS A SUPPORT SYSTEM FOR TYPE IV ("POOR") AND TYPE V ("VERY POOR") ROCK CLASSES, INCLUDING ITS PATTERN AND SPECIFICATIONS, WILL BE INDICATED BY THE ENGINEER.
12. DRAIN HOLES SHALL BE 3.00 m LONG, INCLINED AT 5°, AND DRILLED WITH A DIAMETER OF 56 MM; EACH HOLE SHALL BE FITTED WITH SLOTTED PVC FILTER PIPES WRAPPED IN GEOTEXTILE. THE TYPICAL PATTERN IS 4 M SPACING ALONG THE MAT AXIS, 4 PIECES ON THE PERIPHERY, AT WALLS 0.75 m ABOVE FLOOR, AND AT CROWN POSITIONS 9:30 AND 2:30; HOLES SHALL BE DRILLED AFTER BOLT INSTALLATION WITH A MINIMUM 1.00 m CLEARANCE. THE PATTERN MAY BE ADJUSTED ON SITE TO SUIT WATER INFLOW FROM PERMEABLE STRATA, AND ADDITIONAL HOLES SHALL BE PROVIDED AS REQUIRED OR DIRECTED BY THE ENGINEER. ALL DRAIN HOLES SHALL BE CONNECTED WITH DRAIN PIPES AT THE MAT SURFACE AND DISCHARGED DIRECTLY TO THE FLOOR.
13. ALL EXPOSED ROCK BOLTS, BOLT HEADS, AND BEARING PLATES SHALL BE COVERED WITH SHOTCRETE TO PROVIDE CORROSION PROTECTION.

NOTE

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. FOR PLAN VIEW OF MAIN ACCESS TUNNEL PORTAL , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0003.
4. FOR SECTION A'-A', SECTION B-B, SECTION B'-B' AND SECTION D-D, REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0004.

SCALE 1:200
-2 0 2 4 6 8 10 (m)

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED
(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)
UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS
JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

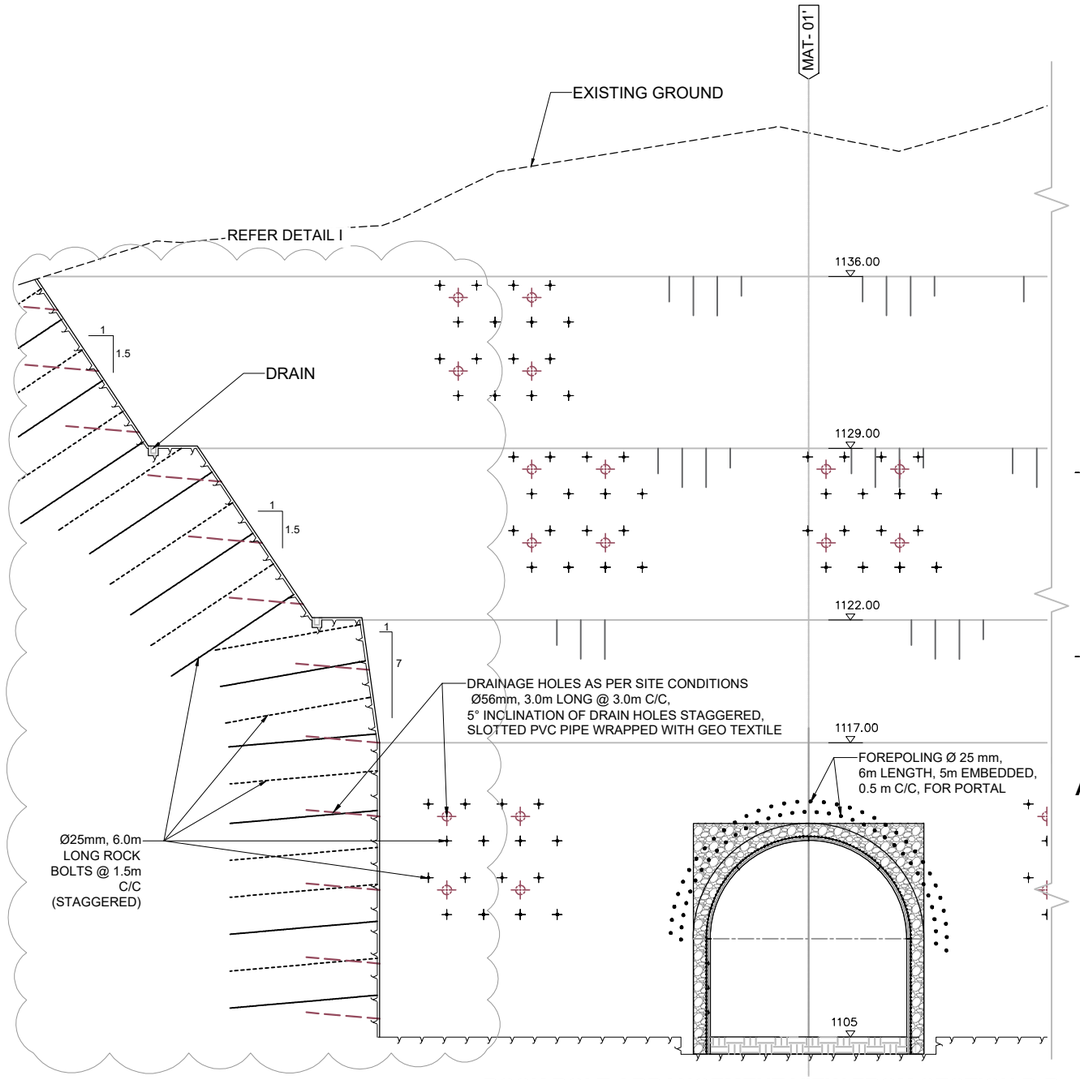
ISSUED FOR INFORMATION / WIP
ACCESS TUNNEL
PORTAL L-SECTION
ROCK SUPPORT DETAILS

DRAWN	CHECKED	APPROVED

SCALE 1:200 SUPERSEDES

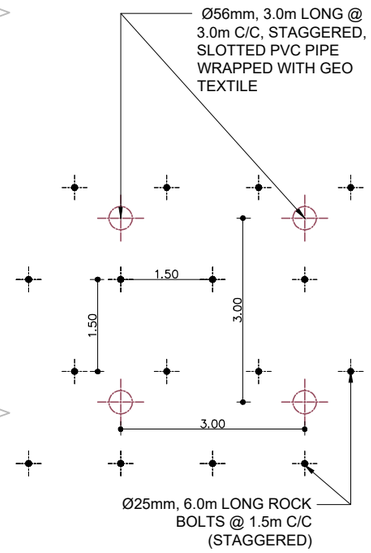
PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0005	02

This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.



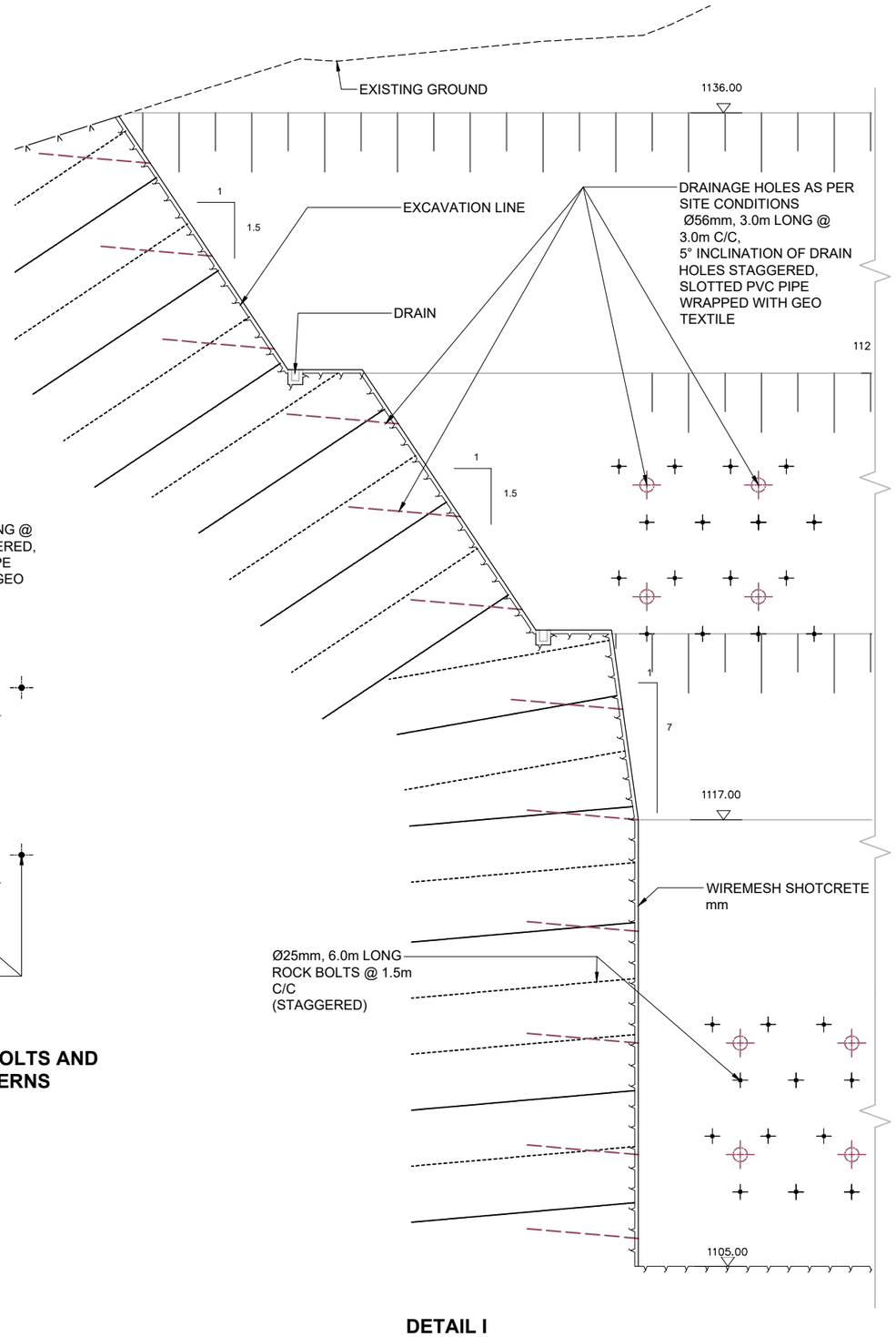
ROCK BOLT ARRANGEMENT VIEW FROM SECTION B-B

SCALE 1:250



ARRANGEMENTS OF ROCK BOLTS AND DRAINAGE HOLES PATTERNS

SCALE 1:100



DETAIL I
ARRANGEMENTS OF ROCK BOLTS AND DRAINAGE HOLES PATTERNS OF PORTAL AREA

SCALE 1:150

NOTE

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. FOR PLAN VIEW OF MAIN ACCESS TUNNEL PORTAL , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0003.
4. FOR LONG SECTION OF PORTAL AREA, REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0005.

SCALE 1:200

-2 0 2 4 6 8 10 (m)

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED

(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)

UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP

ACCESS TUNNEL

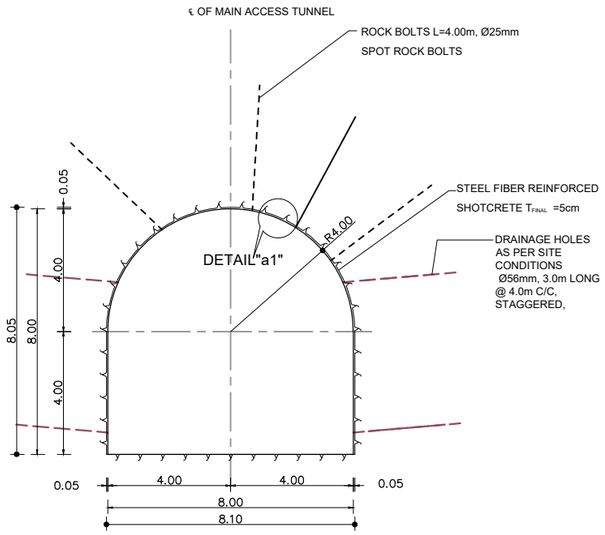
PORTAL VEIW

ROCK SUPPORT DETAILS

DRAWN		CHECKED		APPROVED	
MN		N.N.		N.N.	

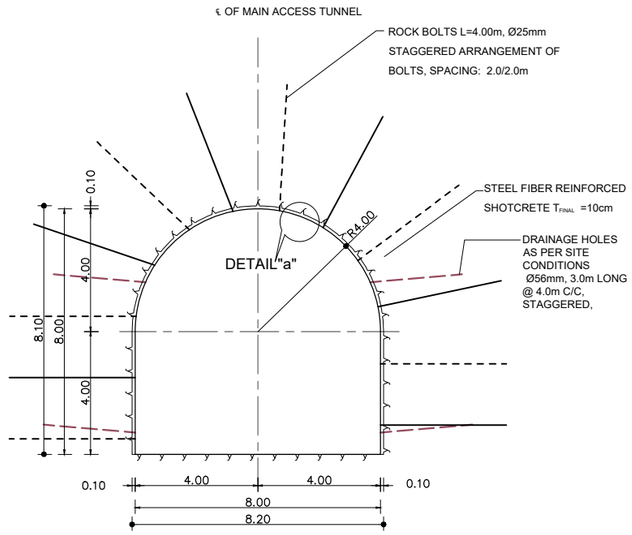
SCALE 1:250 SUPERSEDES

PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0006	02



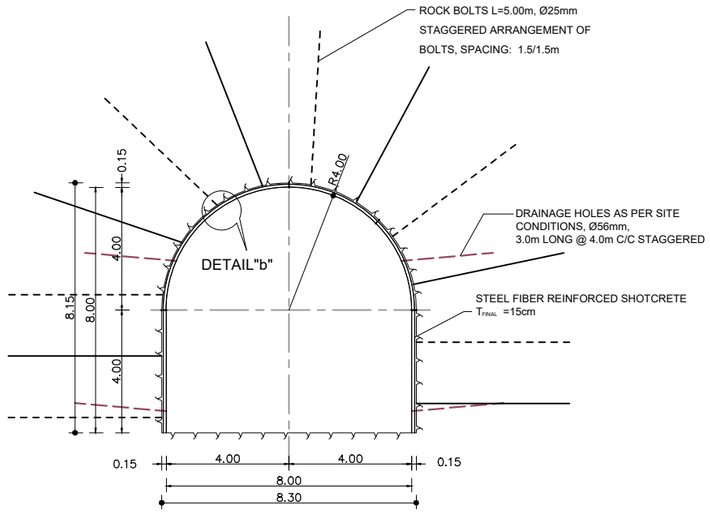
ROCK SUPPORT RS II

SCALE 1:200



ROCK SUPPORT RS III- FAIR ROCK

SCALE 1:200

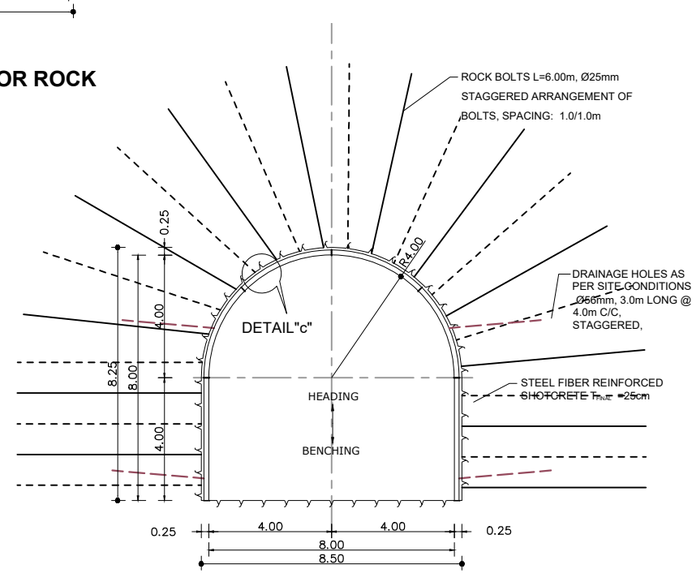


ROCK SUPPORT RS IV- POOR ROCK

SCALE 1:200

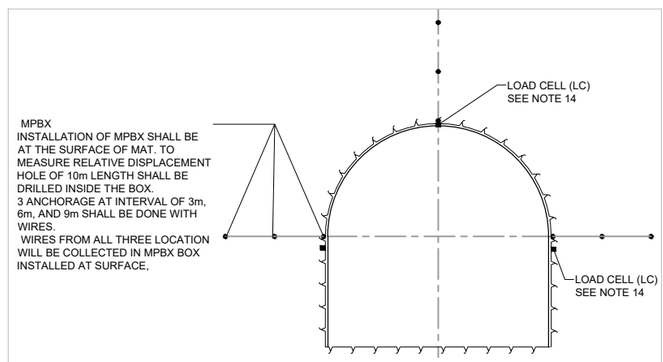
TABLE: ROCK SUPPORT DETAILS

ROCK/ SUPPORT CLASS	ROCK MASS RATING (RMR) RANGE	STEEL FIBER REINFORCED SHOTCRETE (C25) IN cm	STEEL RIB	ROCKBOLTS (FULLY CEMENT GROUTED)	FOREPOLING	TUNNEL ADVANCE
I	NOT CONSIDERED	-	-	-	-	-
II	60 -80	5	-	L=4.00 m, DIA (Ø) 25 mm, SPOT ROCK BOLTS	-	FULL FACE
III - FAIR ROCK	40 - 60	10	-	L=4.00 m, DIA (Ø) 25 mm, GRID 2.0m, STAGGERED ARRANGEMENT	-	FULL FACE
IV - POOR ROCK	20 - 40	15	IPE100 STEEL RIB (OR EQUIV.) SPACING 1.5m	L=5.00 m, DIA (Ø) 25 mm, GRID 1.5m, STAGGERED ARRANGEMENT	AS REQUIRED	FULL FACE TOP HEAD+BENCH IF REQUIRED
V - VERY POOR ROCK	0 -20 (PORTAL AREA)	25	IPE160 STEEL RIB (OR EQUIV.) SPACING 1m	L=6.00 m, DIA (Ø) 25 mm, GRID 1.0m, STAGGERED ARRANGEMENT	AS REQUIRED	FULL FACE TOP HEAD+BENCH IF REQUIRED



ROCK SUPPORT RS V- VERY POOR ROCK

SCALE 1:200



ARRANGEMENT OF MPBX AND LOAD CELL

NOT TO SCALE

NOTES ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 mm
   - YIELD STRENGTH 500 N/mm²
2. THE STEEL FIBER REINFORCED SHOTCRETE (SFRS) MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 25MPa (C_{25}).
3. STEEL RIBS SHALL CONFORM TO EN 10365/10025 OR EQUIVALENT TO IS:226-1975.
4. AN ADDITIONAL LAYER OF 50mm THK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREAS WITH HIGH WATER INFLOW WHERE FULLY GROUTED BOLTS CANNOT BE INSTALLED, SWELLEX ANCHORS OF EQUIVALENT PATTERN MAY BE USED AS TEMPORARY SUPPORT UNTIL WATER INFLOW DECREASES TO A LEVEL THAT PERMITS SHOTCRETING AND INSTALLATION OF FULLY GROUTED BOLTS.
10. DRIPPING OR FLOWING WATER SHALL BE COLLECTED USING AND ADEQUATE DRAINAGE SYSTEM PRIOR TO SHOTCRETING. WHERE NECESSARY, ADDITIONAL DRAIN HOLES SHALL BE INSTALLED.
11. THE USE, IF NECESSARY, OF FOREPOLING AS A SUPPORT SYSTEM FOR TYPE IV ("POOR") AND TYPE V ("VERY POOR") ROCK CLASSES, INCLUDING ITS PATTERN AND SPECIFICATIONS, WILL BE INDICATED BY THE ENGINEER.
12. DRAIN HOLES SHALL BE 3.00 m LONG, INCLINED AT 5°, AND DRILLED WITH A DIAMETER OF 56 mm; EACH HOLE SHALL BE FITTED WITH SLOTTED PVC FILTER PIPES WRAPPED IN GEOTEXTILE. THE TYPICAL PATTERN IS 4 m SPACING ALONG THE MAT AXIS, 4 PIECES ON THE PERIPHERY, AT WALLS 0.75 m ABOVE FLOOR, AND AT CROWN POSITIONS 9:30 AND 2:30; HOLES SHALL BE DRILLED AFTER BOLT INSTALLATION WITH A MINIMUM 1.00 m CLEARANCE. THE PATTERN MAY BE ADJUSTED ON SITE TO SUIT WATER INFLOW FROM PERMEABLE STRATA, AND ADDITIONAL HOLES SHALL BE PROVIDED AS REQUIRED OR DIRECTED BY THE ENGINEER. ALL DRAIN HOLES SHALL BE CONNECTED WITH DRAIN PIPES AT THE MAT SURFACE AND DISCHARGED DIRECTLY TO THE FLOOR.
13. MULTI-POINT BOREHOLE EXTENSOMETERS (MPBX) SHALL BE INSTALLED AS REQUIRED, BASED ON THE SITE GEOLOGY AND ROCK MASS BEHAVIOR, IN CONSULTATION WITH THE SITE GEOLOGISTS.
14. LOAD CELL (LC) SHALL BE INSTALLED AS REQUIRED, BASED ON THE SITE GEOLOGY AND ROCK MASS BEHAVIOR, IN CONSULTATION WITH THE SITE GEOLOGISTS.

NOTE

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. FOR DETAIL a, DETAIL a1, DETAIL b, AND DETAIL c , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0008.

SCALE 1:200

-2 0 2 4 6 8 10 (m)

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED
(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)
UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP
ACCESS TUNNEL
TYPICAL SECTIONS
ROCK SUPPORT DETAILS

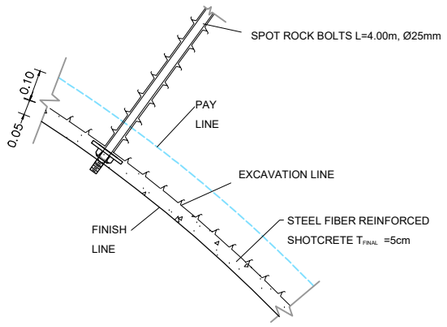
DRAWN	CHECKED	APPROVED
MN	N.N.	N.N.

SCALE 1:200 SUPERSEDES

PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0007	02

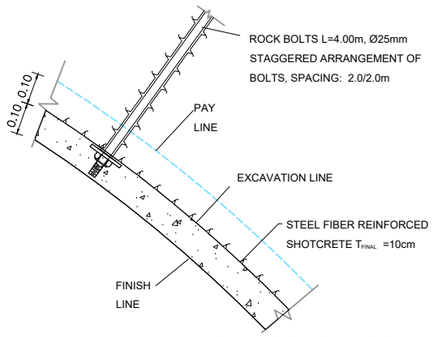
This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.

This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.



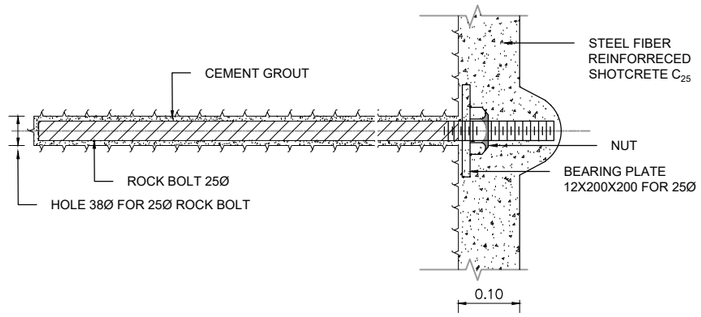
DETAIL AT a1 FOR ROCK CLASS II

SCALE 1:20



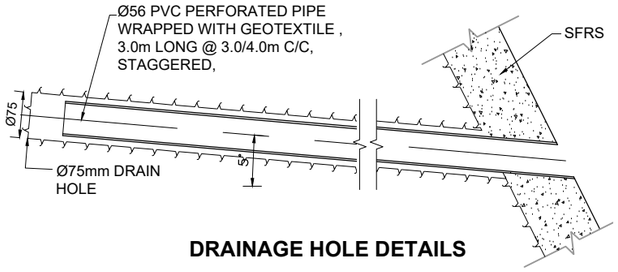
DETAIL AT a FOR ROCK CLASS III

SCALE 1:20



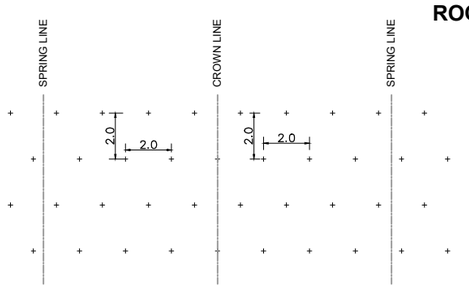
ROCK DOWEL DETAILS

NOT TO SCALE



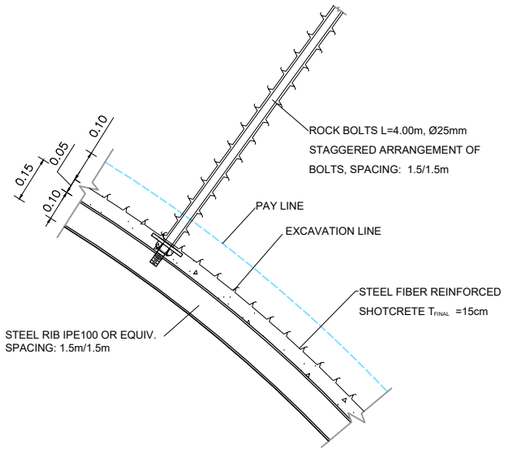
DRAINAGE HOLE DETAILS

NOT TO SCALE



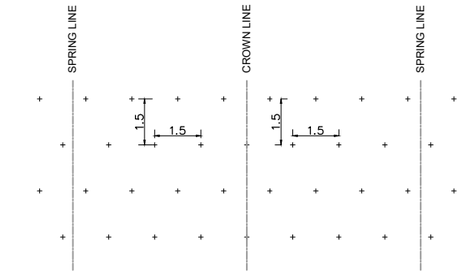
TYPICAL DETAILS OF ROCK BOLTS IN CROWN AND WALLS FOR ROCK CLASS III

(DEVELOPED VIEW) NOT TO SCALE



DETAIL AT b FOR ROCK CLASS IV- POOR ROCK

SCALE 1:20



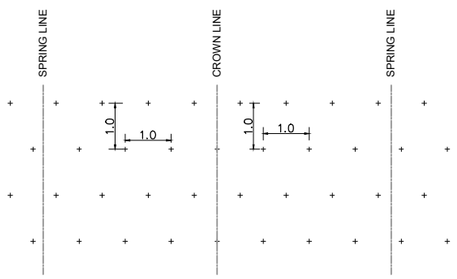
TYPICAL DETAILS OF ROCK BOLTS IN CROWN AND WALLS FOR ROCK CLASS IV

(DEVELOPED VIEW) NOT TO SCALE



DETAIL AT c FOR ROCK CLASS V- VERY POOR ROCK

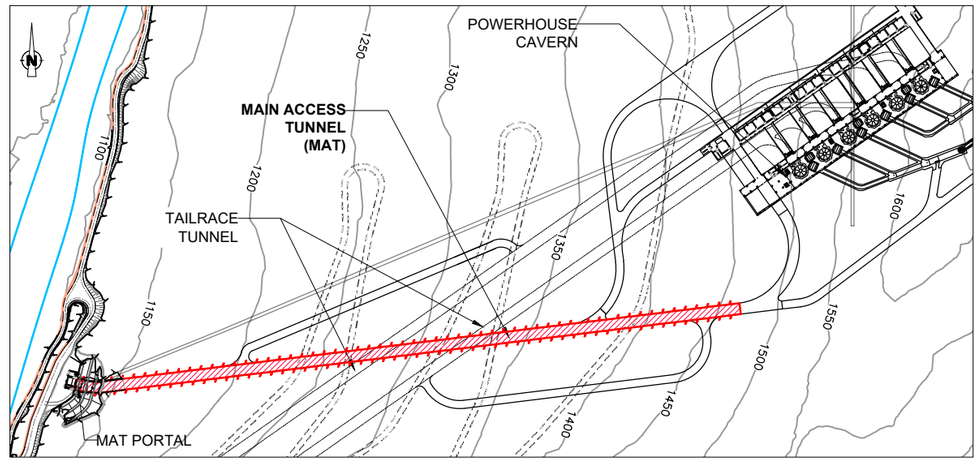
SCALE 1:20



TYPICAL DETAILS OF ROCK BOLTS IN CROWN AND WALLS FOR ROCK CLASS V

(DEVELOPED VIEW) NOT TO SCALE

KEY PLAN



NOTES ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 mm
   - YIELD STRENGTH 500 N/mm²
2. THE STEEL FIBER REINFORCED SHOTCRETE (SFRS) MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 25MPa (C_{25}).
3. STEEL RIBS SHALL CONFORM TO EN 10365/10025 OR EQUIVALENT TO IS:226-1975.
4. AN ADDITIONAL LAYER OF 50mm THK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREAS WITH HIGH WATER INFLOW WHERE FULLY GROUTED BOLTS CANNOT BE INSTALLED, SWELLEX ANCHORS OF EQUIVALENT PATTERN MAY BE USED AS TEMPORARY SUPPORT UNTIL WATER INFLOW DECREASES TO A LEVEL THAT PERMITS SHOTCRETING AND INSTALLATION OF FULLY GROUTED BOLTS.
10. DRIPPING OR FLOWING WATER SHALL BE COLLECTED USING AND ADEQUATE DRAINAGE SYSTEM PRIOR TO SHOTCRETING. WHERE NECESSARY, ADDITIONAL DRAIN HOLES SHALL BE INSTALLED.
11. THE USE, IF NECESSARY, OF FOREPOLING AS A SUPPORT SYSTEM FOR TYPE IV ("POOR") AND TYPE V ("VERY POOR") ROCK CLASSES, INCLUDING ITS PATTERN AND SPECIFICATIONS, WILL BE INDICATED BY THE ENGINEER.
12. DRAIN HOLES SHALL BE 3.00 m LONG, INCLINED AT 5°, AND DRILLED WITH A DIAMETER OF 56 mm; EACH HOLE SHALL BE FITTED WITH SLOTTED PVC FILTER PIPES WRAPPED IN GEOTEXTILE. THE TYPICAL PATTERN IS 4 m SPACING ALONG THE MAT AXIS, 4 PIECES ON THE PERIPHERY, AT WALLS 0.75 m ABOVE FLOOR, AND AT CROWN POSITIONS 9:30 AND 2:30; HOLES SHALL BE DRILLED AFTER BOLT INSTALLATION WITH A MINIMUM 1.00 m CLEARANCE. THE PATTERN MAY BE ADJUSTED ON SITE TO SUIT WATER INFLOW FROM PERMEABLE STRATA, AND ADDITIONAL HOLES SHALL BE PROVIDED AS REQUIRED OR DIRECTED BY THE ENGINEER. ALL DRAIN HOLES SHALL BE CONNECTED WITH DRAIN PIPES AT THE MAT SURFACE AND DISCHARGED DIRECTLY TO THE FLOOR.
13. ALL EXPOSED ROCK BOLTS, BOLT HEADS, AND BEARING PLATES SHALL BE COVERED WITH SHOTCRETE TO PROVIDE CORROSION PROTECTION.

NOTE

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. FOR DETAILS REGARDING STEEL RIBS, REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0009, UAHEP-XX-350-CI-JVTTW-0010, AND UAHEP-XX-350-CI-JVTTW-0011.

SCALE 1:20

-0.2 0 0.2 0.4 0.6 0.8 1 (m)

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED

(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)

UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP

ACCESS TUNNEL

DETAILS OF TYPICAL SECTIONS

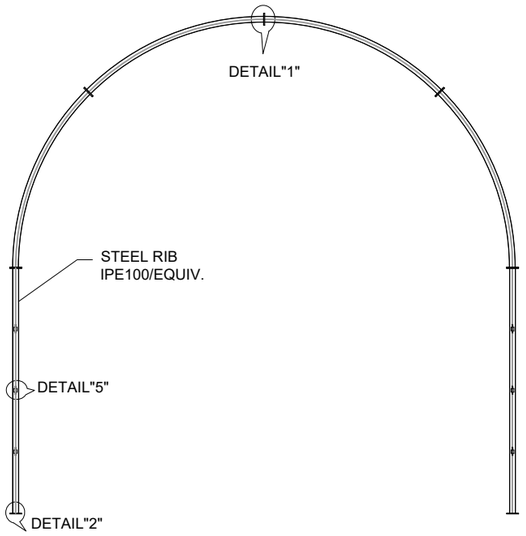
ROCK SUPPORT DETAILS

DRAWN		CHECKED		APPROVED	
MN		N.N.	.	N.N.	.

SCALE: 1:20 SUPERSEDES:

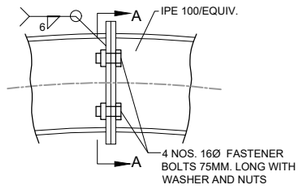
PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0008	02

This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.



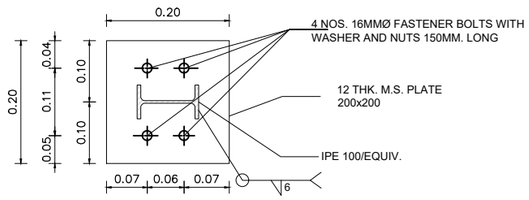
MEMBER OF STEEL RIBS IV-POOR ROCK

SCALE: 1:100



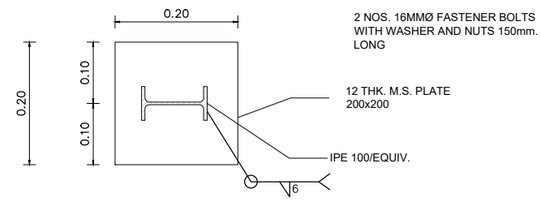
DETAIL AT 1

SCALE 1:10



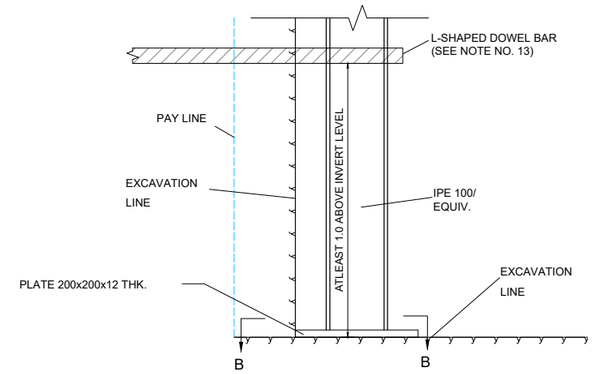
SECTION AT A-A

SCALE 1:10



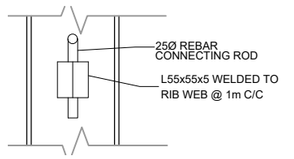
SECTION AT B-B

SCALE 1:10



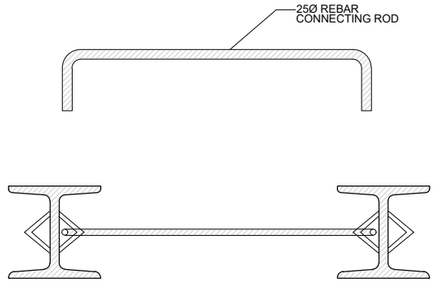
DETAIL AT 2

SCALE 1:10



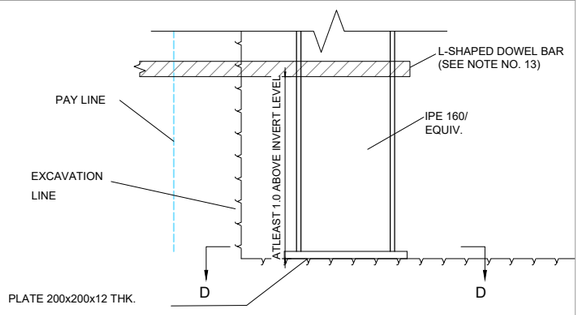
DETAIL AT 5

NOT TO SCALE



ARRANGEMENT OF CONNECTION RODS AT DETAIL 5

NOT TO SCALE

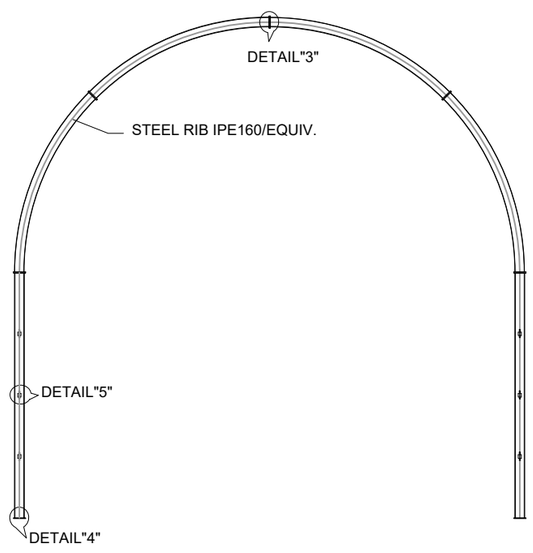


DETAIL AT 4

SCALE 1:10

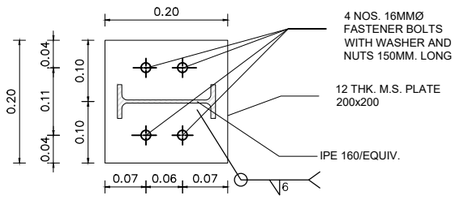
DETAIL AT 3

SCALE 1:10



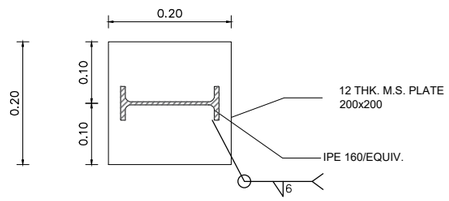
MEMBER OF STEEL RIBS V-VERY POOR ROCK

SCALE: 1:100



SECTION AT C-C

SCALE 1:10



SECTION AT D-D

SCALE 1:10

NOTES ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 mm
   - YIELD STRENGTH 500 N/mm²
2. THE STEEL FIBER REINFORCED SHOTCRETE (SFRS) MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 25MPa (C_{25}).
3. STEEL RIBS SHALL CONFORM TO EN 10365/10025 OR EQUIVALENT TO IS:226-1975.
4. AN ADDITIONAL LAYER OF 50mm THK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREAS WITH HIGH WATER INFLOW WHERE FULLY GROUTED BOLTS CANNOT BE INSTALLED, SWELLEX ANCHORS OF EQUIVALENT PATTERN MAY BE USED AS TEMPORARY SUPPORT UNTIL WATER INFLOW DECREASES TO A LEVEL THAT PERMITS SHOTCRETING AND INSTALLATION OF FULLY GROUTED BOLTS.
10. DRIPPING OR FLOWING WATER SHALL BE COLLECTED USING AND ADEQUATE DRAINAGE SYSTEM PRIOR TO SHOTCRETING. WHERE NECESSARY, ADDITIONAL DRAIN HOLES SHALL BE INSTALLED.
11. THE USE, IF NECESSARY, OF FOREPOLING AS A SUPPORT SYSTEM FOR TYPE IV ("POOR") AND TYPE V ("VERY POOR") ROCK CLASSES, INCLUDING ITS PATTERN AND SPECIFICATIONS, WILL BE INDICATED BY THE ENGINEER.
12. DRAIN HOLES SHALL BE 3.00 m LONG, INCLINED AT 5°, AND DRILLED WITH A DIAMETER OF 56 mm; EACH HOLE SHALL BE FITTED WITH SLOTTED PVC FILTER PIPES WRAPPED IN GEOTEXTILE. THE TYPICAL PATTERN IS 4 m SPACING ALONG THE MAT AXIS, 4 PIECES ON THE PERIPHERY, AT WALLS 0.75 m ABOVE FLOOR, AND AT CROWN POSITIONS 9:30 AND 2:30; HOLES SHALL BE DRILLED AFTER BOLT INSTALLATION WITH A MINIMUM 1.00 m CLEARANCE. THE PATTERN MAY BE ADJUSTED ON SITE TO SUIT WATER INFLOW FROM PERMEABLE STRATA, AND ADDITIONAL HOLES SHALL BE PROVIDED AS REQUIRED OR DIRECTED BY THE ENGINEER. ALL DRAIN HOLES SHALL BE CONNECTED WITH DRAIN PIPES AT THE MAT SURFACE AND DISCHARGED DIRECTLY TO THE FLOOR.
13. L-SHAPED DOWEL BARS (25mmØ- m LONG) SHALL BE INSTALLED HORIZONTALLY TO ANCHOR AND STABILIZE STEEL RIBS AGAINST THE SURROUNDING ROCK MASS DURING INSTALLATIONS. THE DOWEL BARS SHALL BE SECURELY FIXED TO THE RIBS AND FULLY GROUTED UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.THE NUMBER, SPACING, LOCATION, AND INSTALLATION OF THE DOWEL BARS SHALL BE DIRECTED BY THE ENGINEER BASED ON THE SITE CONDITIONS.

NOTE

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. FOR TYPICAL MAT SECTIONS OF ROCK SUPPORT AT VARIOUS ROCK CLASS , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0007.

SCALE 1:100
-1 0 1 2 3 4 5 (m)

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED
(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)
UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

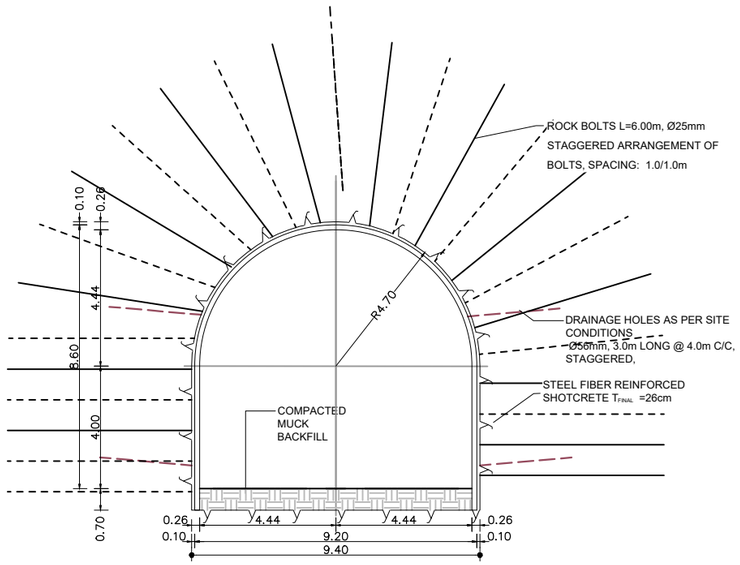
ISSUED FOR INFORMATION / WIP
ACCESS TUNNEL
DETAILS OF STEEL RIBS
ROCK SUPPORT DETAILS

DRAWN	CHECKED	APPROVED
MN	N.N.	N.N.

SCALE: 1:100 & 1:10 — SUPERSEDES:

PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0009	02

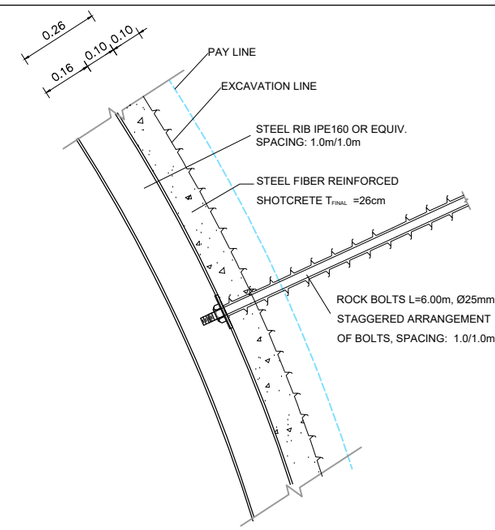
This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.



ROCK SUPPORT AT B-B

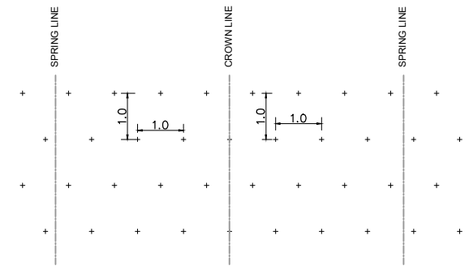
ROCK CLASS V- VERY POOR ROCK

SCALE 1:200



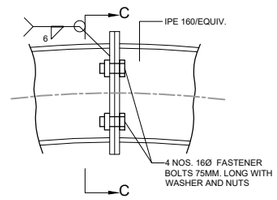
DETAIL AT c FOR ROCK CLASS V- VERY POOR ROCK

SCALE 1:20



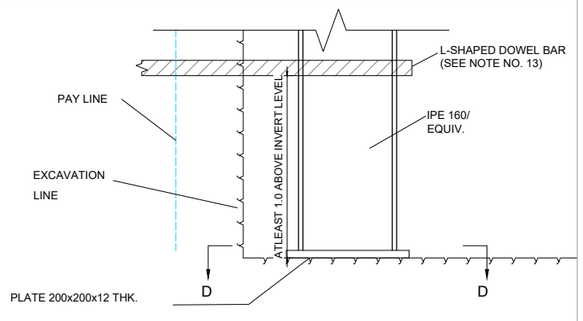
TYPICAL DETAILS OF ROCK BOLTS IN CROWN AND WALLS FOR ROCK CLASS V

(DEVELOPED VIEW) NOT TO SCALE



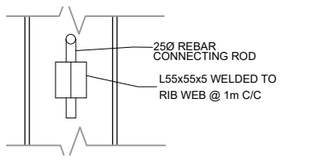
DETAIL AT 3

SCALE 1:10



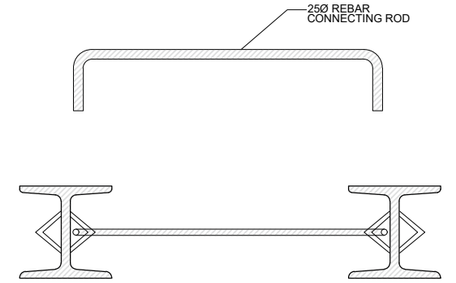
DETAIL AT 4

SCALE 1:10



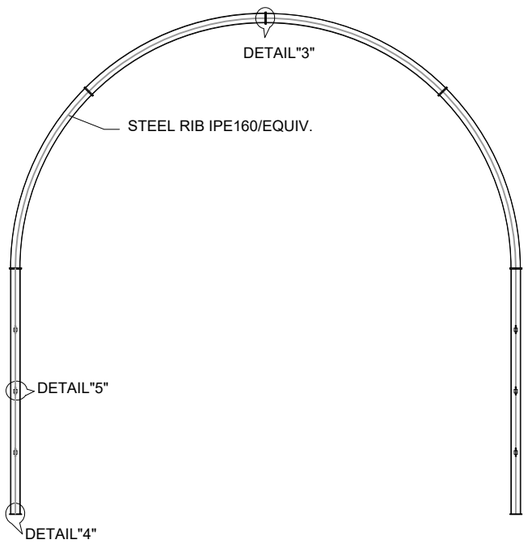
DETAIL AT 5

NOT TO SCALE



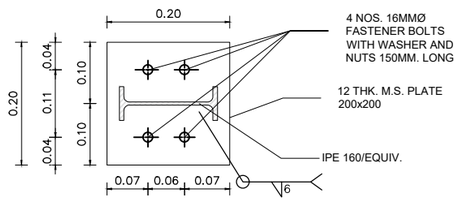
ARRANGEMENT OF CONNECTION RODS AT DETAIL 5

NOT TO SCALE



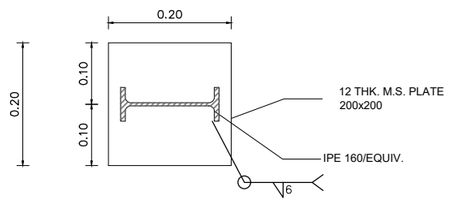
MEMBER OF STEEL RIBS V-VERY POOR ROCK

SCALE: 1:100



SECTION AT C-C

SCALE 1:10



SECTION AT D-D

SCALE 1:10

NOTES ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 mm
   - YIELD STRENGTH 500 N/mm²
2. THE STEEL FIBER REINFORCED SHOTCRETE (SFRS) MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 25MPa (C_{25}).
3. STEEL RIBS SHALL CONFORM TO EN 10365/10025 OR EQUIVALENT TO IS:226-1975.
4. AN ADDITIONAL LAYER OF 50mm THK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREAS WITH HIGH WATER INFLOW WHERE FULLY GROUTED BOLTS CANNOT BE INSTALLED, SWELLEX ANCHORS OF EQUIVALENT PATTERN MAY BE USED AS TEMPORARY SUPPORT UNTIL WATER INFLOW DECREASES TO A LEVEL THAT PERMITS SHOTCRETING AND INSTALLATION OF FULLY GROUTED BOLTS.
10. DRIPPING OR FLOWING WATER SHALL BE COLLECTED USING AND ADEQUATE DRAINAGE SYSTEM PRIOR TO SHOTCRETING. WHERE NECESSARY, ADDITIONAL DRAIN HOLES SHALL BE INSTALLED.
11. THE USE, IF NECESSARY, OF FOREPOLING AS A SUPPORT SYSTEM FOR TYPE IV ("POOR") AND TYPE V ("VERY POOR") ROCK CLASSES, INCLUDING ITS PATTERN AND SPECIFICATIONS, WILL BE INDICATED BY THE ENGINEER.
12. DRAIN HOLES SHALL BE 3.00 m LONG, INCLINED AT 5°, AND DRILLED WITH A DIAMETER OF 56 mm; EACH HOLE SHALL BE FITTED WITH SLOTTED PVC FILTER PIPES WRAPPED IN GEOTEXTILE. THE TYPICAL PATTERN IS 4 m SPACING ALONG THE MAT AXIS, 4 PIECES ON THE PERIPHERY, AT WALLS 0.75 m ABOVE FLOOR, AND AT CROWN POSITIONS 9:30 AND 2:30; HOLES SHALL BE DRILLED AFTER BOLT INSTALLATION WITH A MINIMUM 1.00 m CLEARANCE. THE PATTERN MAY BE ADJUSTED ON SITE TO SUIT WATER INFLOW FROM PERMEABLE STRATA, AND ADDITIONAL HOLES SHALL BE PROVIDED AS REQUIRED OR DIRECTED BY THE ENGINEER. ALL DRAIN HOLES SHALL BE CONNECTED WITH DRAIN PIPES AT THE MAT SURFACE AND DISCHARGED DIRECTLY TO THE FLOOR.
13. L-SHAPED DOWEL BARS (25mmØ- m LONG) SHALL BE INSTALLED HORIZONTALLY TO ANCHOR AND STABILIZE STEEL RIBS AGAINST THE SURROUNDING ROCK MASS DURING INSTALLATIONS. THE DOWEL BARS SHALL BE SECURELY FIXED TO THE RIBS AND FULLY GROUTED UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.THE NUMBER, SPACING, LOCATION, AND INSTALLATION OF THE DOWEL BARS SHALL BE DIRECTED BY THE ENGINEER BASED ON THE SITE CONDITIONS.

NOTE

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. FOR LAYOUT PLAN OF PORTAL , REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0003.
4. FOR LONGITUDINAL SECTION DETAIL AT PORTAL, REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0005.

SCALE 1:200

-2 0 2 4 6 8 10 (m)

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED

(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)

UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP

ACCESS TUNNEL

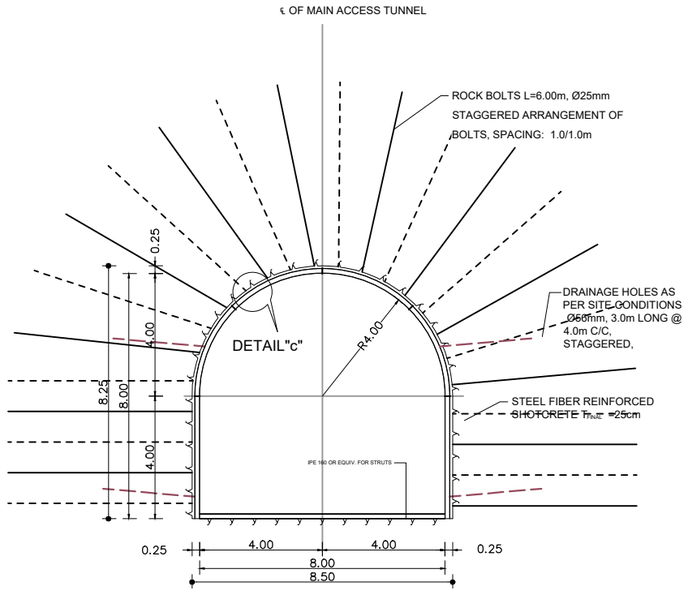
ROCK SUPPORT DETAILS AT SECTION B-B

DRAWN	CHECKED		APPROVED	
MN		N.N.	.	N.N.	.

SCALE: SHOWN — SUPERSEDES:

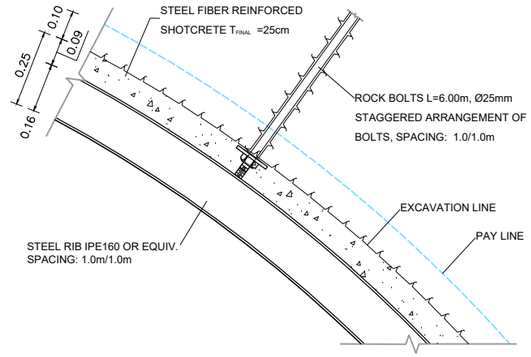
PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0010	02

This document is the property of JVTTW, any duplication or transmission to third parties is forbidden without its prior approval.



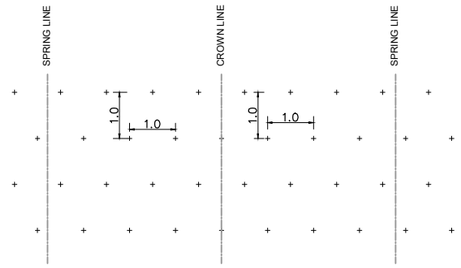
ROCK SUPPORT RS V- VERY POOR ROCK FOR AREA HAVING CONVERGENCE >5cm

SCALE 1:200



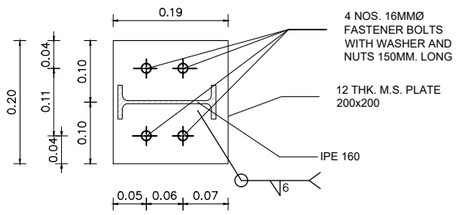
DETAIL AT c

SCALE 1:20



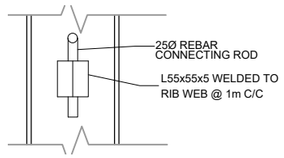
TYPICAL DETAILS OF ROCK BOLTS IN CROWN AND WALLS FOR ROCK CLASS V

(DEVELOPED VIEW) NOT TO SCALE



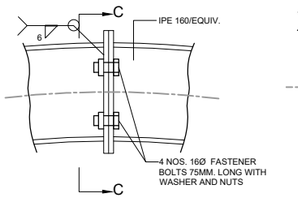
SECTION AT E-E

SCALE 1:10



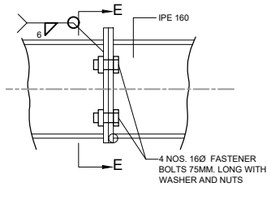
DETAIL AT 5

NOT TO SCALE



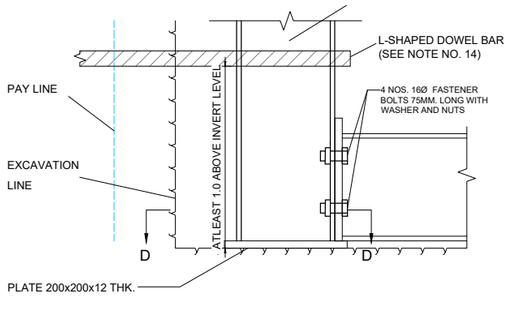
DETAIL AT 3

SCALE 1:10



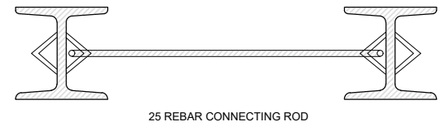
DETAIL AT 7

SCALE 1:10



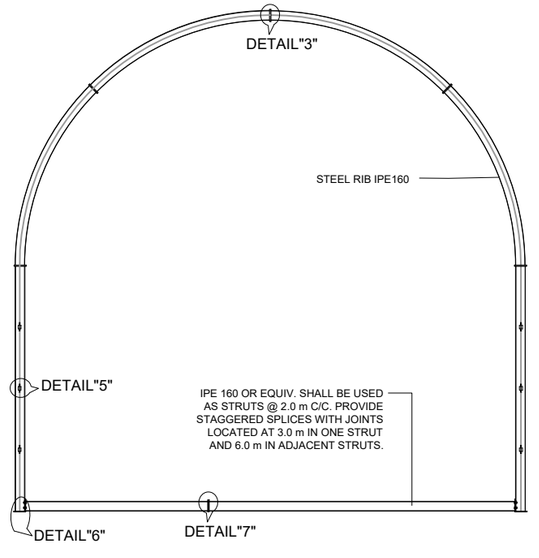
DETAIL AT 6

SCALE 1:10



ARRANGEMENT OF CONNECTION RODS AT DETAIL 5

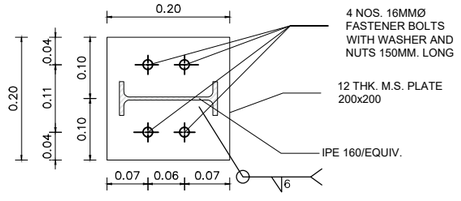
NOT TO SCALE



MEMBER OF STEEL RIBS

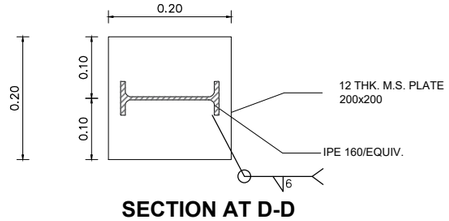
FOR ROCK CLASS V-VERY POOR ROCK AREA HAVING CONVERGENCE OVER 5cm

SCALE: 1:100



SECTION AT C-C

SCALE 1:10



SECTION AT D-D

SCALE 1:10

NOTES ROCK SUPPORT:

1. ROCK BOLTS SHALL HAVE THE FOLLOWING CHARACTERISTICS:
   - DIA. 25 mm
   - YIELD STRENGTH 500 N/mm²
2. THE STEEL FIBER REINFORCED SHOTCRETE (SFRS) MIX SHALL HAVE 28 DAYS OF COMPRESSIVE STRENGTH OF 25MPa (C_{25}).
3. STEEL RIBS SHALL CONFORM TO EN 10365/10025 OR EQUIVALENT TO IS:226-1975.
4. AN ADDITIONAL LAYER OF 50mm THK PLAIN SHOTCRERE SHALL BE APPLIED ON THE EXPOSED PARTS OF STEEL RIBS FOR PROTECTION AGAINST CORROSION.
5. ROCK SUPPORT MEASURES SHOWN ON THIS DRAWING ARE PRELIMINARY ONLY. FINAL ARRANGEMENT OF ROCK SUPPORT (SHOTCRETE THICKNESSES; LENGTH, ORIENTATION AND GRID OF ROCK BOLTS) HAVE TO BE ADOPTED TO ACTUAL GEOTECHNICAL CONDITIONS, SUBJECT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR.
6. THE APPLICATION OF ROCK SUPPORT CLASSES (RSC) DEPENDS ON THE ACTUALLY ENCOUNTERED CONDITIONS AND GEOTECHNICAL MONITORING AND SHALL BE DECIDED BY THE RESPONSIBLE SECTION ENGINEER/GEOLOGIST.
7. CONTOUR BLASTING HAS TO BE DONE SMOOTHLY WITH MINIMUM DAMAGE TO THE REMAINING ROCKMASS AND AVOIDING OVERBREAKS AS MUCH AS POSSIBLE.
8. BOLT ORIENTATION SHALL BE ADAPTED TO ENCOUNTERED REQUIREMENTS, INSTALLED PERPENDICULAR TO THE PROFILE, IF DEVIATION FROM VERTICALITY REQUIRED SHALL BE RESTRICTED BELOW 30°.
9. IN AREAS WITH HIGH WATER INFLOW WHERE FULLY GROUTED BOLTS CANNOT BE INSTALLED, SWELLEX ANCHORS OF EQUIVALENT PATTERN MAY BE USED AS TEMPORARY SUPPORT UNTIL WATER INFLOW DECREASES TO A LEVEL THAT PERMITS SHOTCRETING AND INSTALLATION OF FULLY GROUTED BOLTS.
10. DRIPPING OR FLOWING WATER SHALL BE COLLECTED USING AND ADEQUATE DRAINAGE SYSTEM PRIOR TO SHOTCRETING. WHERE NECESSARY, ADDITIONAL DRAIN HOLES SHALL BE INSTALLED.
11. THE USE, IF NECESSARY, OF FOREPOLING AS A SUPPORT SYSTEM FOR TYPE IV ("POOR") AND TYPE V ("VERY POOR") ROCK CLASSES, INCLUDING ITS PATTERN AND SPECIFICATIONS, WILL BE INDICATED BY THE ENGINEER.
12. DRAIN HOLES SHALL BE 3.00 m LONG, INCLINED AT 5°, AND DRILLED WITH A DIAMETER OF 56 mm; EACH HOLE SHALL BE FITTED WITH SLOTTED PVC FILTER PIPES WRAPPED IN GEOTEXTILE. THE TYPICAL PATTERN IS 4 m SPACING ALONG THE MAT AXIS, 4 PIECES ON THE PERIPHERY, AT WALLS 0.75 m ABOVE FLOOR, AND AT CROWN POSITIONS 9:30 AND 2:30; HOLES SHALL BE DRILLED AFTER BOLT INSTALLATION WITH A MINIMUM 1.00 m CLEARANCE. THE PATTERN MAY BE ADJUSTED ON SITE TO SUIT WATER INFLOW FROM PERMEABLE STRATA, AND ADDITIONAL HOLES SHALL BE PROVIDED AS REQUIRED OR DIRECTED BY THE ENGINEER. ALL DRAIN HOLES SHALL BE CONNECTED WITH DRAIN PIPES AT THE MAT SURFACE AND DISCHARGED DIRECTLY TO THE FLOOR.
13. THE EXCAVATION PROFILE FOR THE LOWER REINFORCEMENT STRUTS FOR ROCK TYPE V MUST BE LARGE ENOUGH TO ACCOMMODATE THE IPE 160 PROFILE PLUS THE FINAL SHOTCRETE LAYER WHILE MAINTAINING THE SPECIFIED DIMENSIONS OF 9 m.
14. L-SHAPED DOWEL BARS (25mmØ- m LONG) SHALL BE INSTALLED HORIZONTALLY TO ANCHOR AND STABILIZE STEEL RIBS AGAINST THE SURROUNDING ROCK MASS DURING INSTALLATIONS. THE DOWEL BARS SHALL BE SECURELY FIXED TO THE RIBS AND FULLY GROUTED UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.THE NUMBER, SPACING, LOCATION, AND INSTALLATION OF THE DOWEL BARS SHALL BE DIRECTED BY THE ENGINEER BASED ON THE SITE CONDITIONS.

NOTE

1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE MENTIONED.
2. ALL ELEVATIONS ARE IN (masl).
3. FOR LONGITUDINAL SECTION OF MAT, REFER DRAWING NO. UAHEP-XX-350-CI-JVTTW-0002.

SCALE 1:200

-2 0 2 4 6 8 10 (m)

CLIENT

UPPER ARUN HYDRO ELECTRIC LIMITED

(A SUBSIDIARY COMPANY OF NEPAL ELECTRICITY AUTHORITY, NEA)

UPPER ARUN HYDRO ELECTRIC PROJECT

CONSULTANT

LAHMEYER INTERNATIONAL TRACTEBEL ENGIE WAPCOS

JOINT VENTURE LAHMEYER INTERNATIONAL – TRACTEBEL FRANCE – WAPCOS INDIA

TITLE

ISSUED FOR INFORMATION / WIP

ACCESS TUNNEL

ROCK SUPPORT DETAILS FOR

RS V WITH CONVERGENCE OVER 5cm

DRAWN		CHECKED		APPROVED	
MN	29.07.25	N.N.	.	N.N.	.

SCALE: 1:200 — SUPERSEDES:

PROJECT	ST.	SYS.	DISC.	ORG.CODE	SEQ.NO	REV.
UAHEP	XX	350	CI	JVTTW	0011	02