SDCS-02

SECTION 19

Rev.00

GUIDELINES FOR CONCRETE DUCTBANK & MANHOLE

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1.0 SCOPE

This standard specifies the design, and installation practices to be applied in the construction of concreate cable ducts banks system. It is intended to guide the designers, engineers and field personnel to achieve standardization in construction and to ensure a satisfactory and economical level of service without operating restrictions so that the operational errors should be minimum for safety and reliability.

2.0 CROSS REFERENCES

This Distribution Material Standard Specification shall be read in conjunction with the latest revision of Distribution General Specification titled "01-SDMS-01" which shall be considered as an integral part of this standard.

The latest revision/amendments of the following codes and standards shall be applicable for the equipment/material covered in this Distribution Material Standard Specification. In case of any conflict, the vendor/manufacturer may propose equipment/material conforming to one group of industry codes and standards quoted hereunder without jeopardizing the requirements of this standard specification.

11-SDMS-03	XLPE Insulated Power Cables For Rated Voltages From 15 KV up to 36 KV (Um)
11-SDMS-04	Specification for Aluminum Unarmored XLPE/LLDPE Insulated Power Cables For Rated Voltages From 15kv Up To 36kv
SDCS-03-01	Underground Network Grounding
SDCS-03-03	Grounding Resistance Measurement and Improvement
TCS-Q-113.02	Earthworks
70-TMSS-03	Normal Weight Ready Mix Cement Concrete
23-TMSS-01	PVC Conduits and Fittings for UG Ducts
23-TMSS-02	Duct Sealing Units
ASTM C94	Specification for Ready Mix Concrete
ASTM C858-83	Standard Specification for Underground Pre-cast Concrete Utility Structures
ASTM A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
SDCS-02-17	Construction Standards for Underground Distribution Network Part 17: Cable Trenches
12-SDMS-04	SPECIFICATION FOR CABLE CLAMPS FOR POWER CABLES.
12-SDMS-01	Cable Joints, Terminations and Accessories Up to 36 KV.
24-TMSS-01	Metallic Cable Tray Systems

3.0 GENERAL REQUIREMENTS

3.1 Medium voltage underground cable circuits shall be installed directly buried, or in ducts or in a combination of them. In addition to meeting the physical requirements of the concrete duct's installation, all necessary precautions to insure the safety of personnel working in the ducts and the safety of the general public must be ascertained. All civil works of the cable ducts shall be performed in a manner, which will not damage the cable during the installation. The replacement of all backfilling material and final restoration shall be equal to or better than the original condition that existed prior to the trenching operation.

3.2 All cables inside the manhole shall be painted by approved fire rated paints.

3.3 Floor & wall should be painted by epoxy paints with gray color.

3.4 Every cable shall be tagged with 3 layers, engraving plastic tag or both sides of manholes.

3.5 All ducts inside the manholes shall be labelled of numbering sequence.

3.6 All manhole shall have Single Line Diagram or Cable arrangement drawings.

3.7 Every manhole will be tag, to be include project no., manhole no., circuit information and with dimension not less than 10 cm * 15 cm.

3.8 Cable De-rating calculation shall be provided by contractor for initial approval by SEC.

3.9 All joints & termination shall perform inside the manholes; no any joints are allowed to be inside the ducts.

3.10 25% of ducts shall be keep empty, minimum 1 pipe/duct bank, for emergency use.

3.11 The manhole shall be water treatment inside & outside, inside the manhole should be cover by epoxy paint (gray color).

3.12 The maximum of cable joints in each side is 30% of the cable numbers.

3.13 Manhole cover drawing is referring in fig 14.

4.0 SAFETY REQUIREMENTS

4.1 Safety Rules and Regulations

The construction of cable duct banks shall conform to the rules and regulations pertaining to safety established by the concerned Government agencies, Municipalities and Saudi Electricity Company Accident Prevention and Construction Safety Manuals (Safety Requirements Latest Revision).

4.2 Shoring or Bracing

Where cable ducts are excavated to a depth of 0.90 meter or more, shoring or bracing shall be installed to prevent cave-ins of unstable soil and to prevent rock debris falling from top and walls of the trench. Where the trench walls are sloped at a 35° angle or less from horizontal, shoring or bracing may be omitted.

4.3 Roads and Highways

Where cable ducts cross or are in close proximity to vehicular traffic roads and highways, all necessary barriers, steel plates, warning lights and signs shall be installed to protect the general public from any hazards associated with the open trenches.

4.4 Residential Gateways

Where cable ducts block residential gateways, stable and safe bridges shall be provided with all necessary barriers.

4.5 Restricted Areas

In restricted areas, the work shall be carried out under the Work Permit Procedure and as per the right-of-way approval and conditions. Mechanized trenching equipment are prohibited in areas within the proximity of energized cables, flammable liquids/gas pipelines, up to 1.5 meters outside substations where grounding grid is present and under overhead transmission lines

4.6 Housekeeping

Good housekeeping shall be strictly observed. Materials/equipment being used shall be arranged so as not to cause obstruction to traffic or to the public.

4.7 Signboards

The contractor shall provide cable trenching signboards on every trench/road crossing and 200 meters on straight run.

4.8 Clearance from Underground Utilities

It is a requirement to take clearance for excavation on designated cable routes from all Underground Utilities like Water, Telephone etc.

5.0 MATERIAL

5.1 Minimal Concrete Specifications

5.1.1 Cast-in-Place or Pre-Cast concrete may be used.

5.1.2 The minimum 28-day concrete compressive strength for concrete shall be 5000 psi.

5.1.3 Only ready mixed concrete shall be used. Ready mixed concrete shall be mixed and transported to the job site in accordance with ASTM C94 "Specifications for Ready Mixed Concrete".

5.1.4 Manholes shall be manufactured in accordance with ASTM C858-83, "Standard Specifications for Underground Pre-cast Concrete Utility Structures".

5.1.5 Concrete Thermal Resistivity should not more than 1.0 ^{o}C.m / W

5.1.6 Admixtures

5.1.6.1 Air-entraining mixture shall be used for all exterior concrete and shall conform to ASTM C260.

5.1.6.2 All concrete shall be compacted by the use of poker type vibrator until a dense solid mass without voids is obtained.

5.1.6.3 Admixture should be use for enhance the soil thermal resistivity.

5.1.7 Mixing concrete in the site is not acceptable.

5.2 Reinforcement

5.2.1 All concrete used in the construction of the manholes shall contain steel reinforcing bars to conform to all applicable building codes. All reinforcing steel shall conform to SASO 2/1979, grade 60 with minimum yield strength of 420MPa. Deformation shall conform to ASTM A615M.

5.2.2 Re-bars shall be cut only by bar cutter or hacksaw.

5.3 Accessories

5.3.1 Cable installations shall be Base on IEEE std. 576-2000 or approved equal.

5.3.2 Manhole Covers and Frames

5.3.2.1 Manhole Cover size shall be 1000mm diameter.

5.3.2.2 Manhole access is refer to Fig. 11

5.3.2.3 Manhole covers shall consist of a solid circular gravity lid and frame. The lid and frame shall be heavy duty type, fabricated from gray cast iron.

5.3.2.4 Manhole lids shall have a checkered design with the standard LOGO of the company with the word SEC DISTRIBUTION MANHOLE cast into the top surface. (refer to Fig. 14)

5.3.2.5 Manhole frames shall provide a 1200mm diameter opening. (refer to fig. 11).

5.3.2.6 Manhole frames and covers shall be approved material by SEC. The cover shall have two (2) pick holes 25.4mm diameter located 180° apart

5.3.2.7 Manhole shall have two (2) entering/access.

5.3.3 All conduit and end bells shall be 200mm² diameter, and use (PVC) or (HDPE) class 4 or equivalent, cast in place in the concrete wall of the manhole.

5.3.4 End bell shall be glued to the front and back of each Rigid PVC, HDPE conduit class 4 or equivalent.

5.3.5 Manhole cable duct interface shall be sealed with approved sealant prior to waterproofing.

5.3.6 Cable racks & Cable support arms shall be heavy duty, referring to the latest revision for the MV cable tray specifications.

5.3.7 Cable Ladder should have minimum diameter 19.05mm (round metal rungs). And the finished ladder shall be Hot-Dip galvanized conforming to ASTM A123.

5.3.8 Cable clamps should be as per 12-SDMS-04 (latest revision)

5.3.9 Grounding

5.3.9.1 Grounding shall follow SEC grounding Specs. For grounding materials (Rods, conductors, …)

5.3.9.2 Grounding resistances shall be less than 5 Ohm.

5.3.9.3 Grounding conductors (70mm2, CU) shall be thermal welding with steel Structural.

5.3.9.4 One grounding point at each side shall be provided for metal accessories and testing devices.

6.0 MANHOLE REQUIREMENTS

6.1 The minimum inside dimensions for a manhole was shown in the fig 11, Fig 12 and fig 13.

6.2 Support the heaviest anticipated vehicular traffic weight of 40 Tons

6.3 Manholes shall be designed in compliance with ASTM C857-87, “Standard Practice for Minimum Structural Design Loading for Underground Pre-cast Concrete Utility Structures”. Wheel loading shall be HS-20.

6.4 Shall be designed per ACI 318-02 "Building Code Requirements for Structural Concrete." 4.6. Design loads shall consist of dead load, live load, impact, surcharge load, and any other loads which may be imposed upon the structure.

6.5 Application of manhole type relative to site condition and soil bearing capacity shall be specified.

6.6 The manhole floor should be sloped to the sump pit that have a concrete bottom and located in the middle of floor below the entry hole and to be connected to drain system.

6.7 Contractor shall verify all dimension and site condition prior to construction.

6.8 Structural calculation shall be prepared by the contractor and submit to SEC for review and approval. Contractor shall verify all dimension and site condition prior to construction.

6.9 Minimum Compressive Strength of Concrete at 28 Days as follows:

6.9.1 Blinding Concrete – **17.2MPa**

6.9.2 Reinforced concrete for Structural Members – **34.5 MPa**

6.10 A Hock eye to be add in each side, and 3 Hocks eye in the sealing roof as per fig 11, fig 12 and fig 13.

7.0 CABLE DUCTS REQUIREMENTS

7.1 General Requirements

7.1.1 Cable ducts shall be installed in those areas where access to the cables for maintenance or repair is restricted. Such locations include areas beneath existing or future roads and highways, areas in near proximity to structures or footings where future excavations would be difficult and areas where additional physical protection to the cables is required and inside the substation also.

7.1.2 Spacers shall be installed with a maximum horizontal interval of 1.5 meter.

7.1.3 Ducts shall be free from all substances which may injuriously affect any wire or cable sheath or jacket. The duct shall have a dense, uniform and homogeneous wall with a smooth interior surface free from obstructions, rough or flaky areas. The duct shall be non-magnetic, resistant to corrosive action, unaffected by electrolysis and shall not soften, deform or deteriorate when exposed to maximum safe operating temperature of cables or upon immersion for long periods of time in ground water. The bore of the duct shall be straight and circular in cross section.

7.1.4 Fittings and couplings shall be made of the same grade material as straight lengths.

7.1.5 The duct and fittings shall be of the tapered sleeve joint type. A coupling shall be provided for each joint of conduit. Joints for plastic conduit shall

be made with solvent cement after the conduit has been cut square, deburred, cleaned and dried. The joints shall be manufactured so that they are sufficiently tight to prevent water, silt or concrete from entering the duct.

7.1.6 The length for each size duct shall be standard with the manufacturer. Each length shall be marked with the manufacturer's name or trade-mark.

7.1.7 Structural calculation shall be prepared by the contractor and submit to SEC for review and approval.

7.1.8 A detailed de-rating calculation study for real case should be submitted for SEC review and approval.

7.1.9 The maximum length of the duct bank between 2 manholes is 150 m or in every corner bending on the road /unite substation/RMU.

7.2 Specific Requirements

7.2.1 All cable ducts, couplings and accessories shall be installed in strict compliance with the manufacturer's instructions.

7.2.2 The ducts material, size, class and type shall conform to 23-TMSS-01. The system or manner of burial will depend on required physical protection or loading of structures above the ducts, which shall be specified by Saudi Electricity Company.

7.2.3 Both ends of all ducts runs shall have end-bells to prevent damage to the cables during installation.

7.3 Installation

7.3.1 Clean the ducts with swab.

7.3.2 After the ducts are laid and concrete encased, they shall be rodded by the contractor. A flexible mandrel, 6mm less in diameter than the bore of the duct shall then be drawn through followed by a wire brush cleaner 6mm larger in diameter than the bore. All foreign matter shall be removed. If obstructions are found which cannot be removed by cleaning so as to pass the mandrel, the ducts shall be removed and re-laid at the expense of the contractor.

7.3.3 The testing and cleaning of a concrete encased duct shall be done on the day after the concrete has been poured to remove any concrete splash or spills in the ducts. Construction drawings, which indicate duct line length and routing shall be verified and field noted in conjunction with duct testing operations.

7.3.4 Install a pull rope for future cable installation. The pull rope shall be of nylon with 13 mm diameter in every empty ducts.

7.3.5 Plug the ends with ducts Seals. Duct sealing unit shall be as per 23-TMSS-02. The installation and removal of any duct sealing unit shall comply with the manufacturer's recommendations.

7.3.6 For the selection of the type of conduits to be used, the following factors shall be considered:

a) The lower coefficient of friction available. Refer to TES-P104.05.
b) Heat transfer ability of the material
c) Resistance to deformation and fusion when cables are short circuited
d) Dimensions of the conduit shall be according to NEMA.

7.3.7 Duct banks shall be run as straight as possible from termination to termination. Ducts shall be laid in the excavated trenches in continuous alignment and in the formation required.

7.3.8 Concrete Encased Duct Bank – Ducts shall be installed as a self-supporting structure before pouring the concrete. The ducts shall be securely fastened in place with heavy twine or steel wire and anchored so as to maintain accurate position during the concrete pour. Concrete shall be placed as soon as practicable after ducts have been secured in place, checked for alignment and grade, and approved by Saudi Electricity Company. The ducts shall be protected so that they are not damaged during the pour.

7.3.9 Concrete for encasement shall attain a 20N/mm2 strength at 28days, refer to 70-TMSS-03 and shall be colored with tile – red cement color.

7.4 Reinforced Concrete Cable Trench

The Contractor is responsible for the construction of cable duct banks and manhole where necessary. It should conform to the applicable established standards, the reinforced concrete cable ducts shall be designed to provide natural ambient air cooling to the cables. The cable duct shall be provided with cover that will not impede the natural air circulation and offer easy access to cables during maintenance/ inspection procedures.

7.5 Duct Sealing Requirements

The duct sealing units shall be of the manufacturer's standard design and shall meet or exceed the requirements mentioned in 23-TMSS-02. Cable duct sealing units shall be designed for the expected cable jacket temperature in addition to the service conditions specified in 01-SDMS-01.

The duct sealing units shall be designed and constructed to maintain sealing efficiency for a period of 20 years under a constant pressure of 69 kPa (10 psig, 7.05 m of water head) under service conditions.

8.0 DRAWINGS:

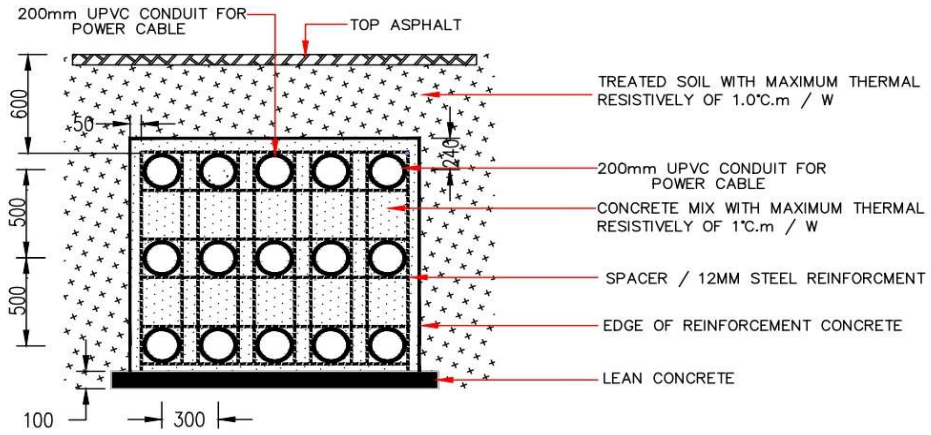


FIG.1– 5 X 3 DUCT BANK DETAIL

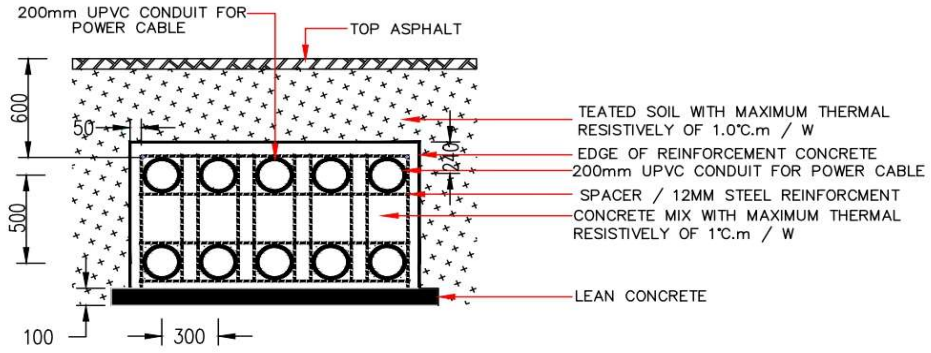


FIG.2– 5 X 2 DUCT BANK DETAIL

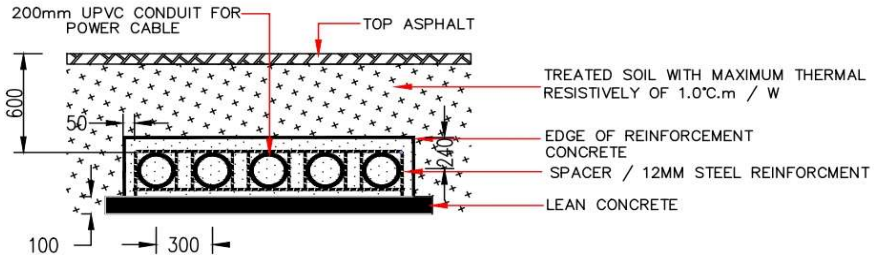


FIG.3– 5 X 1 DUCT BANK DETAIL

ALL DIMENSION ARE IN MILLIMETER

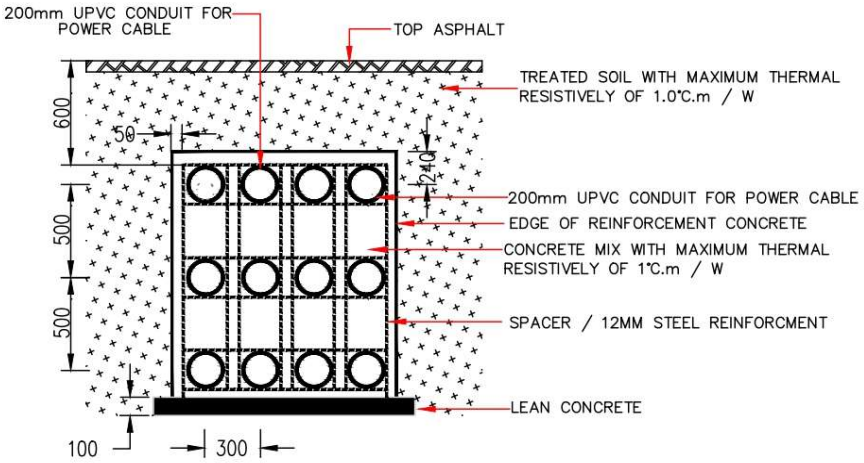


FIG.4– 4 X 3 DUCT BANK DETAIL

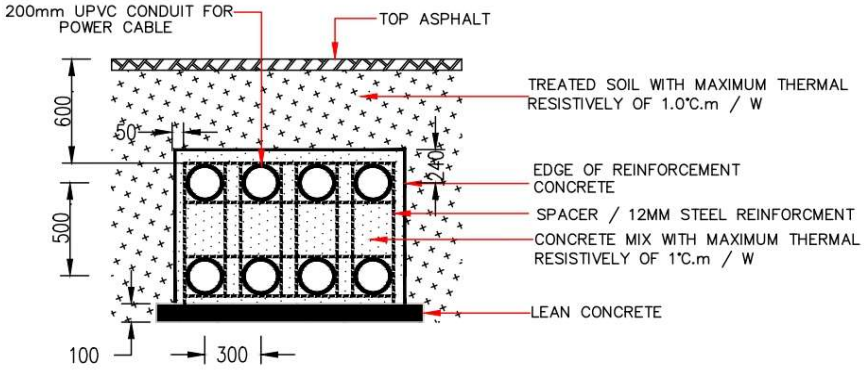


FIG.5– 4 X 2 DUCT BANK DETAIL

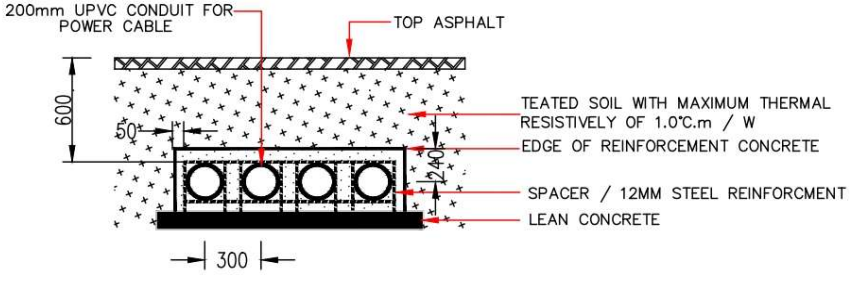


FIG.6– 4 X 1 DUCT BANK DETAIL

ALL DIMENSION ARE IN MILLIMETER

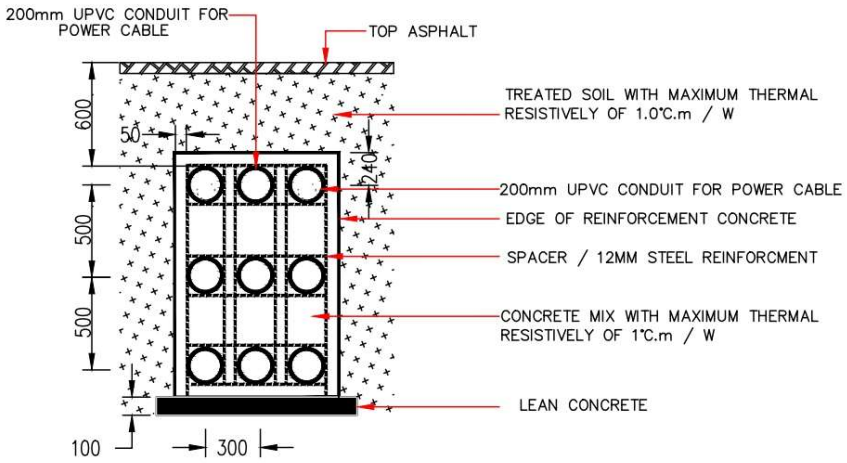


FIG.7– 3 X 3 DUCT BANK DETAIL

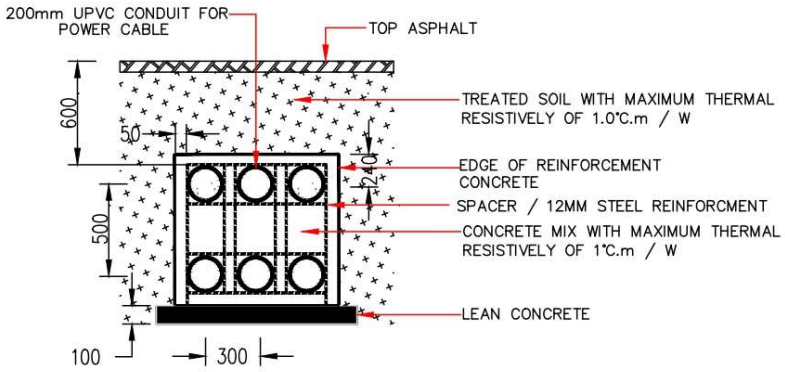


FIG.8– 3 X 2 DUCT BANK DETAIL

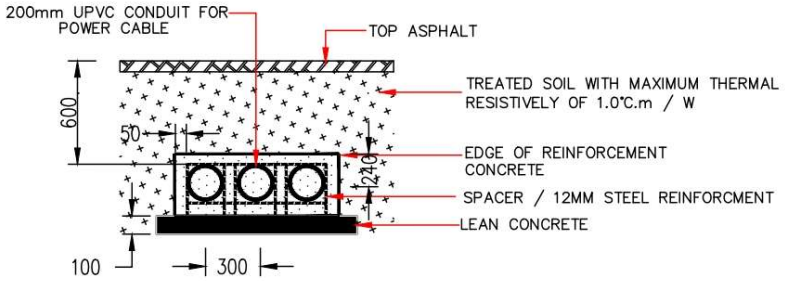


FIG.9– 3 X 1 DUCT BANK DETAIL

ALL DIMENSION ARE IN MILLIMETER

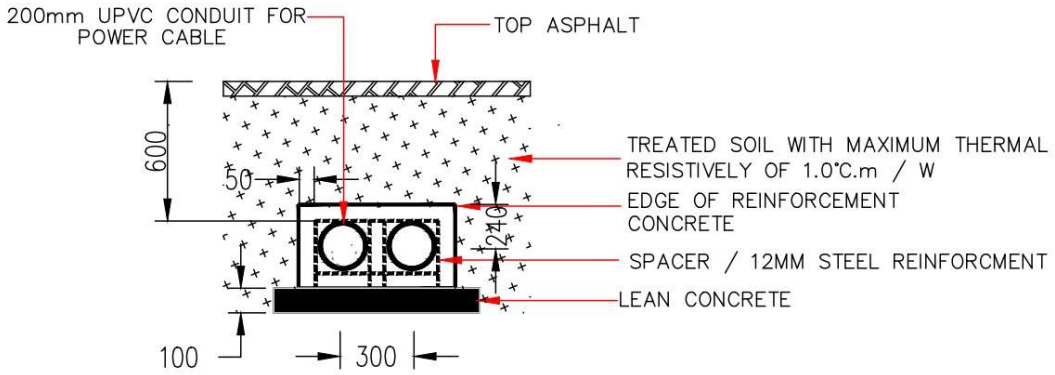
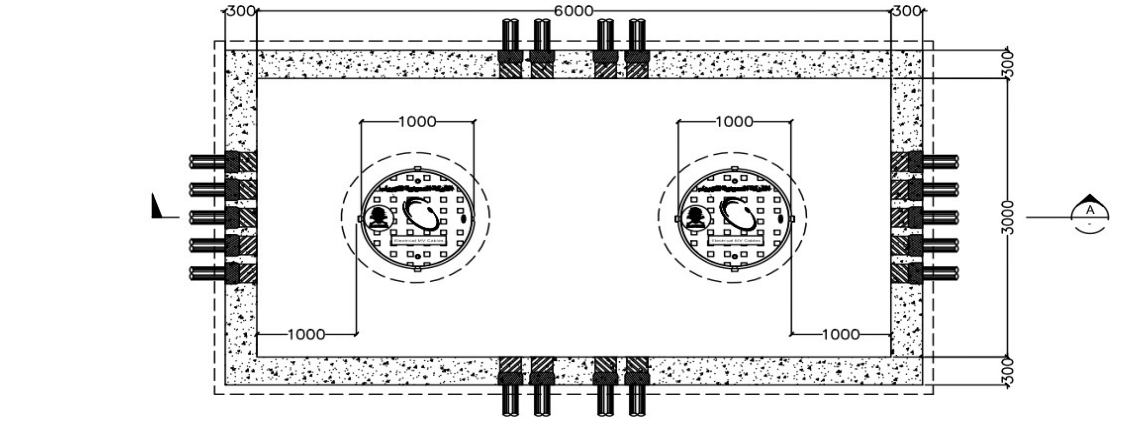
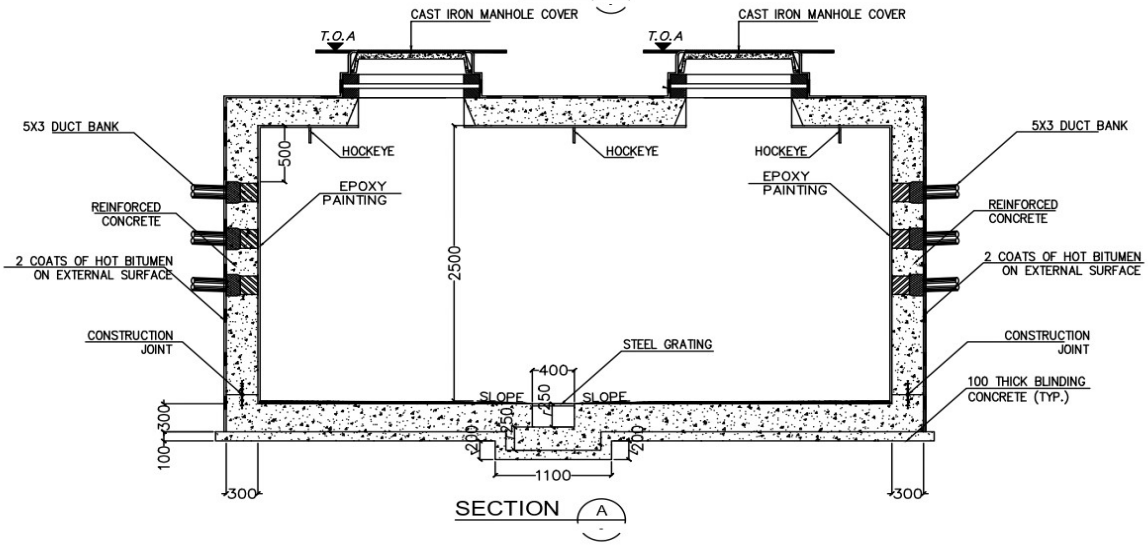


FIG.10– 2 X 1 DUCT BANK DETAIL

ALL DIMENSION ARE IN MILLIMETER

FIG. 11- 6M X 3M MANHOLE





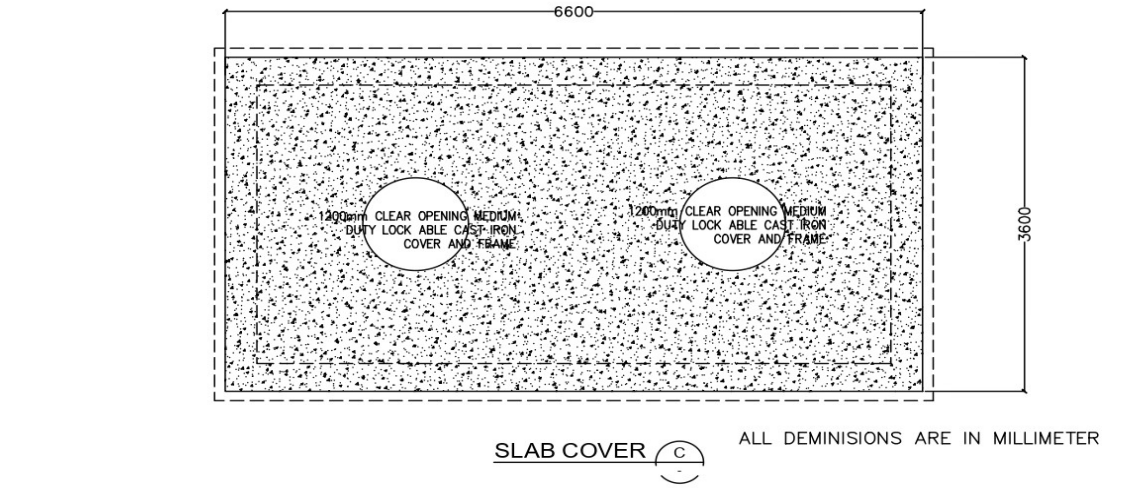


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FIG. 12 – 6M X 3M MANHOLE WITH RMU DUCT

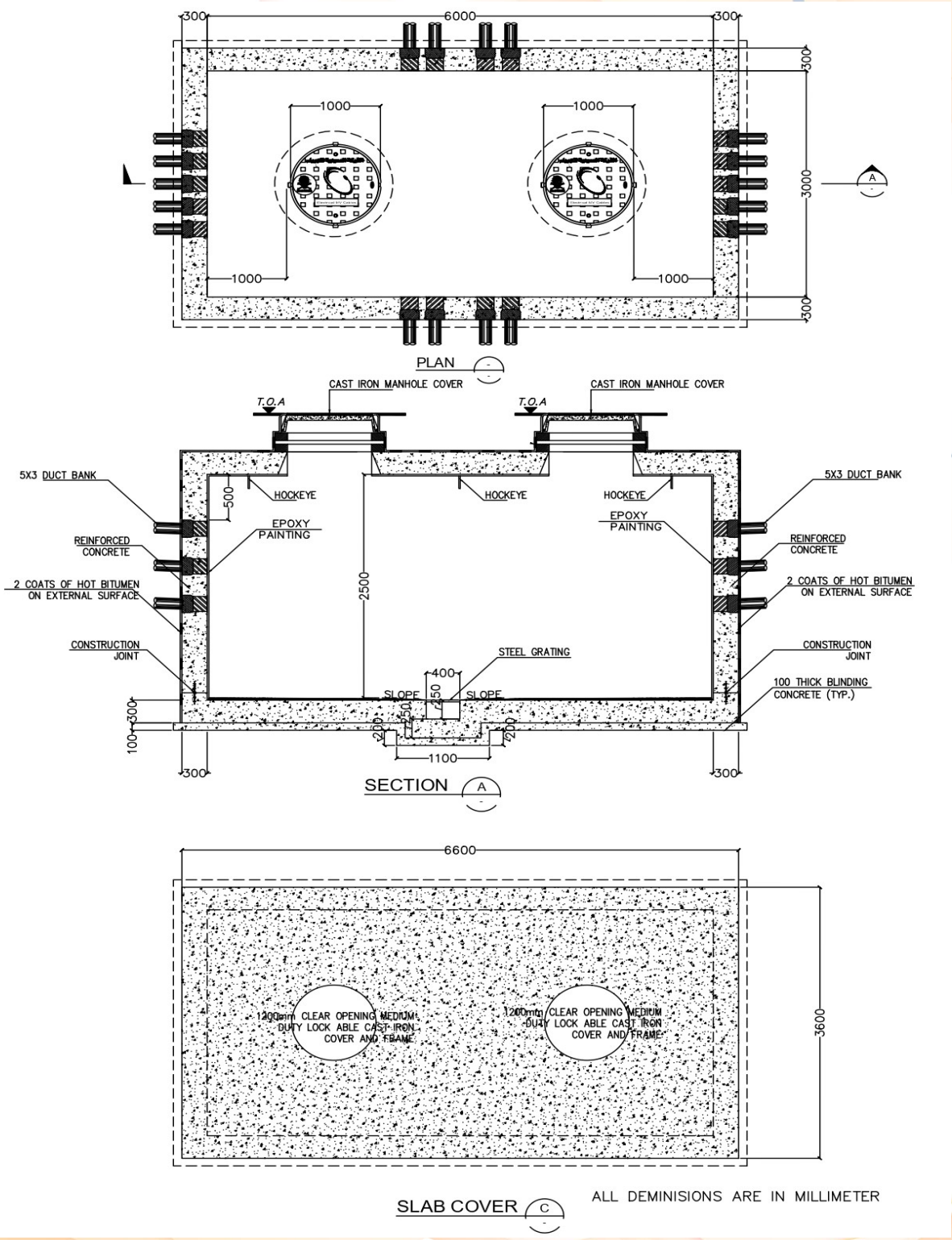

FIG. 13 – 5M X 5M MANHOLE

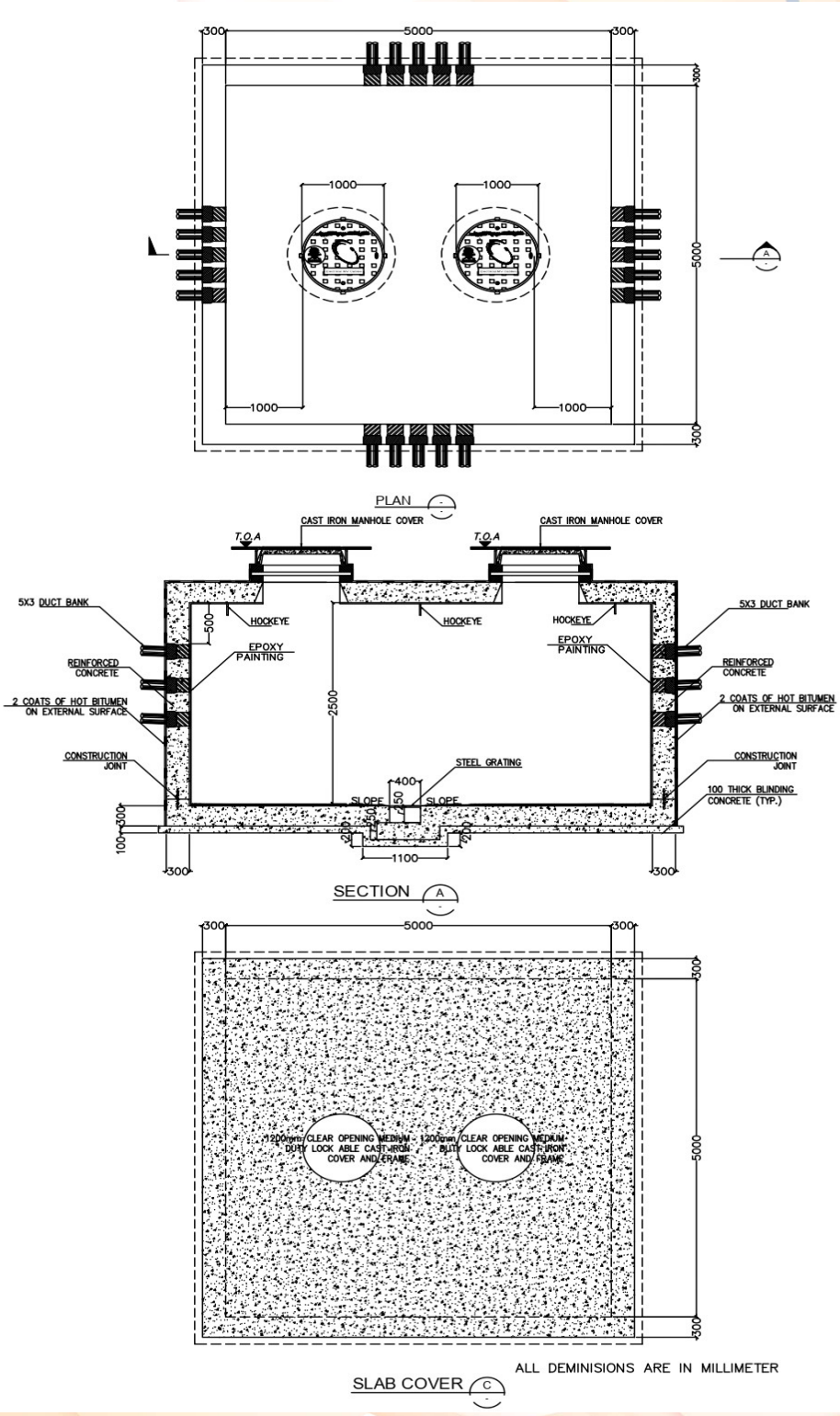

FIG. 14 – MANHOLE COVER

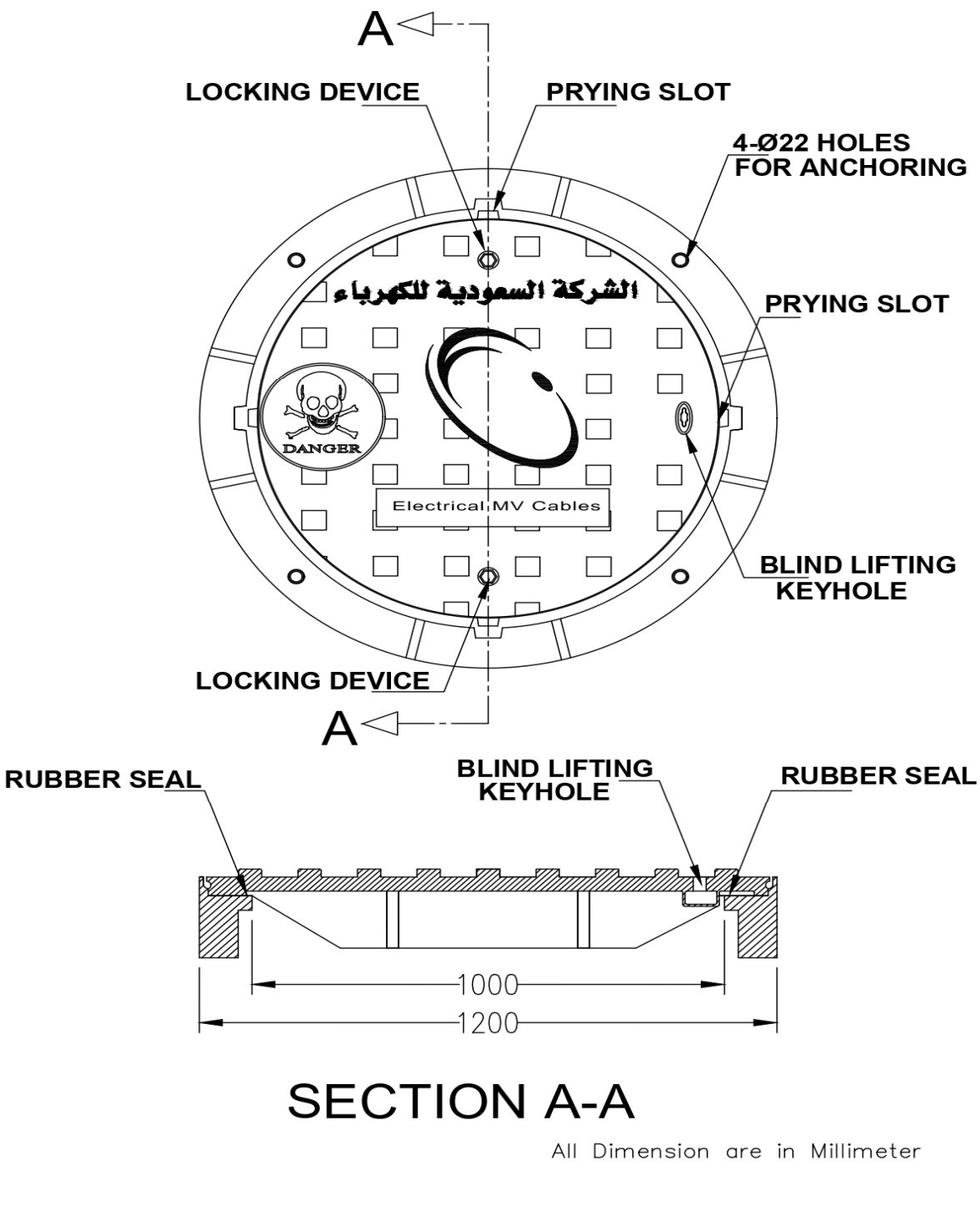

FIG. 15 – MANHOLE & DUCTBANK SECTION