TECHNICAL SPECIFICATION

FOR

LAYING OF

11 KV, 33KV AND 66 KV CABLE

Prepared by	Reviewed by	Approved by	Rev	02
			Date	18th March 2019
AV	GS	AA	Page	1 of 42

INDEX

1. REFERENCE STANDARDS

i) IS 1255: Code of practice for installation and maintenance of power cable up to and including 33kV rating.

ii) IS 1554: PVC Insulated Electrical Cables upto 11KV

iii) IS 2274: Code of Practice for electrical wiring installation – system voltage exceeding 650V

iv) IS 7098 Part II: Cross linked Polyethylene Insulated PVC sheathed cables for working voltages from 3.3KV up to and including 33KV

v) IS 7098 Part III: Cross linked Polyethylene Insulated PVC sheathed cables for working voltages from 66KV up to and including 220KV

vi) IS 5820: Specification of precast concrete Cable cover.

vii) Indian Electricity Rules 1956.

2. CABLE LAYING

2.1. SELECTION OF THE ROUTE

The cable route selection shall be done by the concerned supervising engineer by first conducting route survey and selecting a route along with contractor keeping followings in mind-

i) The side of road, which presents the least obstacles and the fewest roadways crossings.

ii) The future consumers and existing cables in the route may influence the cable route.

iii) Railway, road crossings, MCD and other government agencies may also influence in selection of cable route.

iv) Plans for future building projects should be considered.

The route shall be as far as possible away from parallel running gas, water pipes and telephone/telecommunication cables.

2.2. CLEARANCES

The desired minimum clearances are as follows –

i) Power cable to power cable – A minimum clearance equal to diameter shall be maintained. Trench drawings shall be referred for guidance.

ii) Power Cable to control cables – 0.2 M

iii) Power cable to communication cable – 0.3M

iv) Power cable to gas/water main – 0.3 M

2.3. DEPTH OF CABLE LAYING

The desired minimum depth of laying from ground surface to the top of cable shall be

i)	650 / 1100V grade XLPE Cable	-	75 cm
ii)	Low voltage and Control Cable	-	75 cm
iii)	6.35 / 11KV grade XLPE Cable	-	90 cm
iv)	19 / 33KV grade XLPE Cable	-	1.05 M
v)	38 / 66KV grade XLPE Cable	-	1.20 M
vi)	Cables at Road crossing	-	1.0 M (min)
vii)	Cables at railways level crossings (measured from bottom of sleepers to the top of Pipe)	-	1.0 M (min)

Whenever there is any obstacle at the laying depth, the cable should be lowered/ raised to cross the obstacle. However variation in the depth is to be approved by BSES. The Contractor shall provide the same in deviation report.

2.4. WIDTH OF CABLE TRENCHES

The width and depth of Cable Trenches shall depend upon number of circuits and Voltage Grade. Drawings of this specification are shown in the document itself.

2.5. BENDING RADIUS OF CABLES

While pulling of the Cable from the drum or during laying following minimum bending radius shall be maintained so that the cable, in particular the insulation does not get damaged.

i) Single Core Cables (PVC & XLPE)

a) Up to 11KV grade – 15 X D

b) Above 11KV grade - 20 X D

ii) Multi Core Cables (PVC & XLPE)

a) Up to 1.1KV grade - 12 X D

b) Above 1.1KV grade – 15 X D

Where 'D' is overall diameter of the cable

2.6. MAXIMUM PERMISSIBLE TENSILE STRENGTH FOR CABLES

i) For cables pulled with Stocking

a) PVC and XLPE SWA Armoured cables P = 30 X D

b) PVC and XLPE AWA Armoured cables P = 20 X D

Where P= pulling force in Kgm, D= Diameter of Cable in mm

ii) For Cables pulled by Cable eyes

a) Aluminium conductor – 30 N/mm2 = 3 Kg/sq. mm

b) Copper conductors - 50N/mm2 = 5 Kg/sq. mm

Permissible force is calculated by multiplying the above values by cross sectional area (CSA) of conductor of each core and then number of cores.

2.7. METHODS OF LAYING

i) Cables shall be laid in direct in ground, in trenches excavated therein and shall be protected with covers as given in the drawing. Cables shall also be drawn into pipes of ducts or laid in the formed trenches or troughs or on racks or supported in trays or cleats as required by the site exigencies. Where the cables are laid in the formed trenches, the installation shall include removal and replacement of the trench covers and the provision of temporary protective covers on the trenches where they cross the access ways.

ii) HDPE (200 mm) pipes shall be used where cable cross roads and railways tracks. Spare ducts for future extensions should be provided. Spare duct should be sealed off. Buried ducts or ducting blocks shall project into footpath or up to the edge of road, where there is no footpath, to permit smooth entry of cable without un-due bending. The diameter of the cable conduit or pipe or duct should be at least 1.5 times the outer diameter of the cable. Angular alignment of the duct across road crossings shall be predetermined to maintain safe bending radius when direction of cable trench changes before or after the road.

iii) The contractor shall lay cable by horizontal direct drilling (HDD) in main roads and highway with heavy traffic, passage to public

property where excavation is not possible. Contractor shall take approval for laying of cable by means of HDD wherever required from the supervising engineer. The cable laid by HDD shall be minimized so that it doesn't exceed by 12% of total route length. This is to avoid De-rating of Cables.

iv) Unless approved by BSES, the contractor shall lay the cables, direct in ground, in single layer. The cables shall be laid with the pre-determined and approved cable route.

v) Spacing shall be maintained uniformly between the cables all along the length including the bends, as approved by BSES. To maintain the spacing, suitable non-metallic formers shall be placed uniformly with spacing not exceeding 5 meters. Every bend shall have at least one spacer.

vi) 75 mm of the sand bed shall be placed at the bottom of cable trench.

vii) After the cables have been laid the trench shall be filled with the sand and shall be well rammed to a level not less than 75 mm above the top of the cables all throughout the route.

viii) To protect the cables against external mechanical damage, which may be caused by other agencies, the cable shall be protected by suitable cover.(for dimensions of RCC cable cover refer cable laying drawing)

The type of the covers shall be as under

a) 1.1KV Cables – Single layer of brick thickness not less than 75 mm (3 inch)

b) 11KV Cables – sand stone of thickness not less than 75mm (3 inch).

c) 33KV Cables shall be protected by reinforced concrete cover of width 300 mm as per attached drawing with thickness not less than 50mm.

d) 66KV Cables shall be protected by reinforced concrete cover as per attached drawing with thickness not less than 50mm.

The RCC cable cover shall be embossed as “BYPL 66/33/11 KV CABLE” whichever is applicable.

ix) Back fill to be filled up to 75mm and the warning tape shall be installed continuously. The tape shall be yellow in colour with Black / Red lettering of minimum 20mm height. The approved warning message shall be written in English and Hindi/ local language. The minimum thickness and width of the tape should be 300 microns and 150 mm respectively.

x) The trench shall be filled-up by soft soil (300mm) and Excavated soil as indicated in drawings.

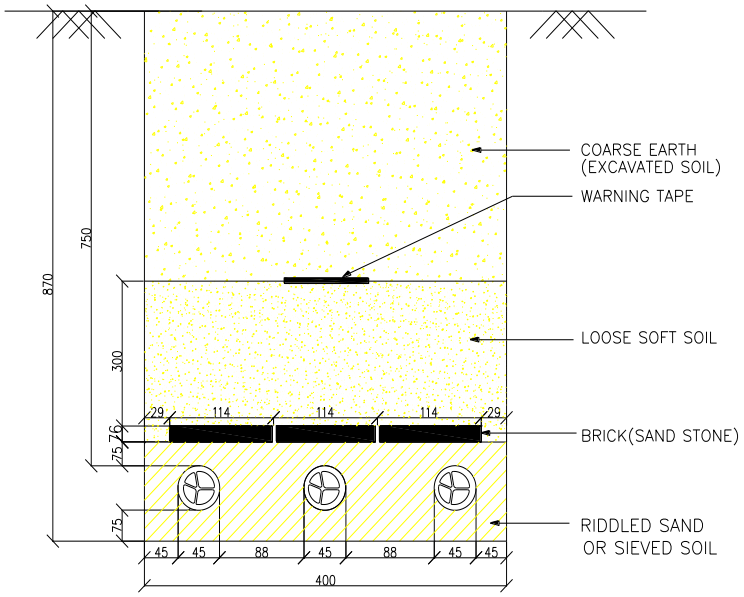

Figure 1.1 – 1.1kV, 150sqmm Buried Cable

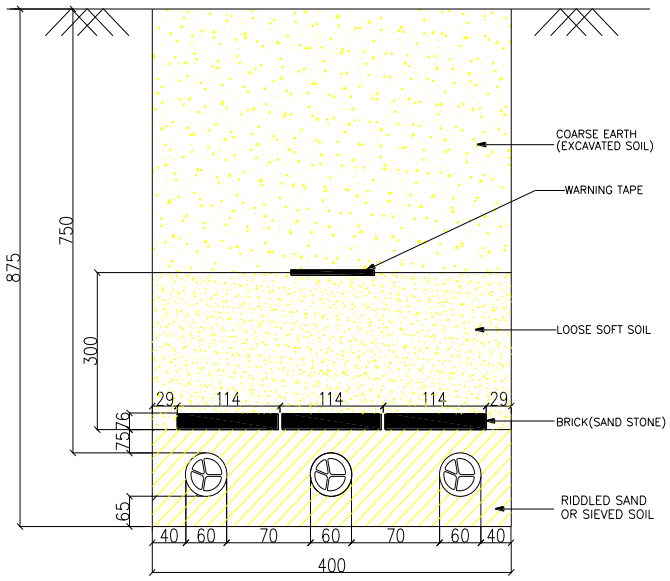

Figure 1.2 – 1.1kV, 300sqmm Buried Cable

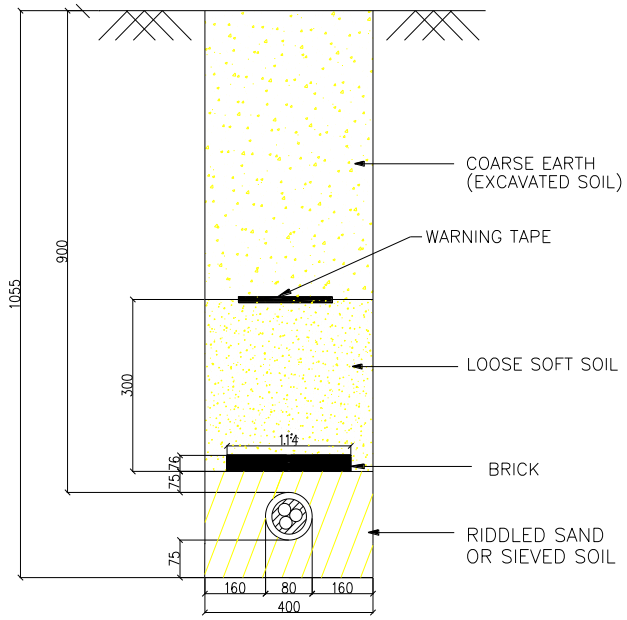

Figure 1.3 – 11kV Buried Cable for Single Circuit

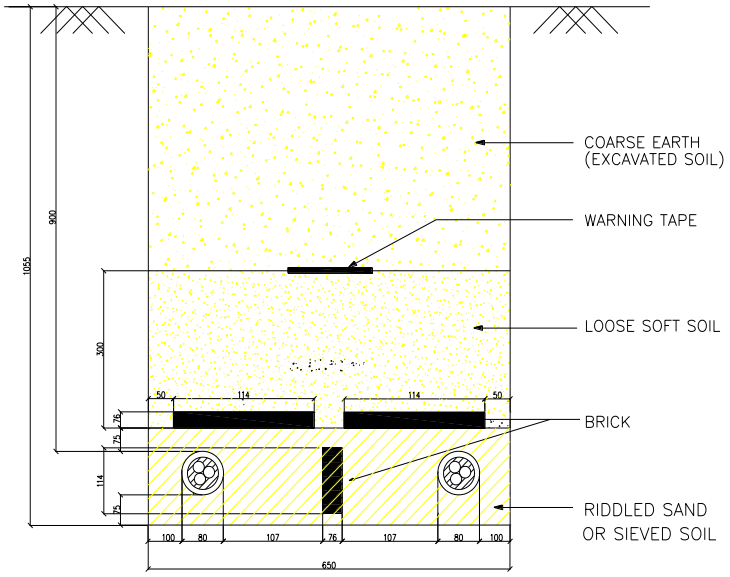

Figure 1.4 – 11kV Buried Cable for Double Circuit

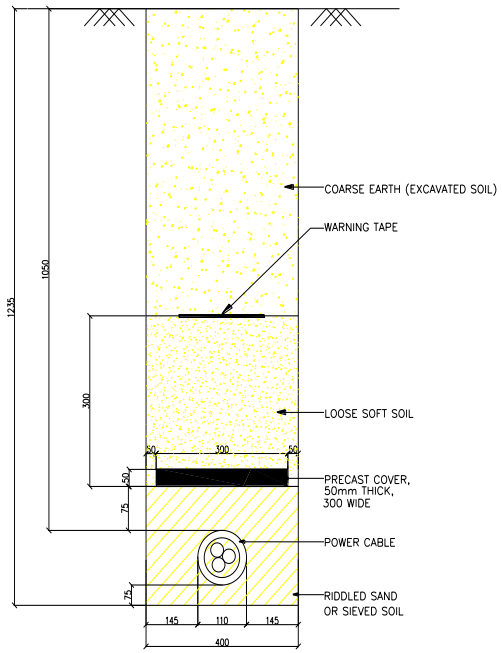

Figure 1.5 – 33kV Buried Cable for Single Circuit

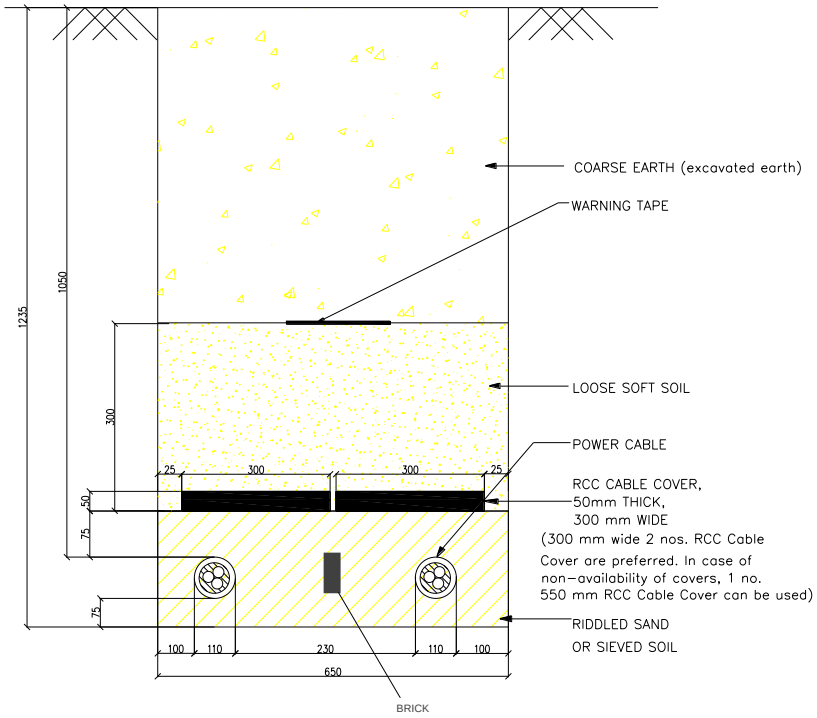

Figure 1.6 – 33kV Buried Cable for Double Circuit

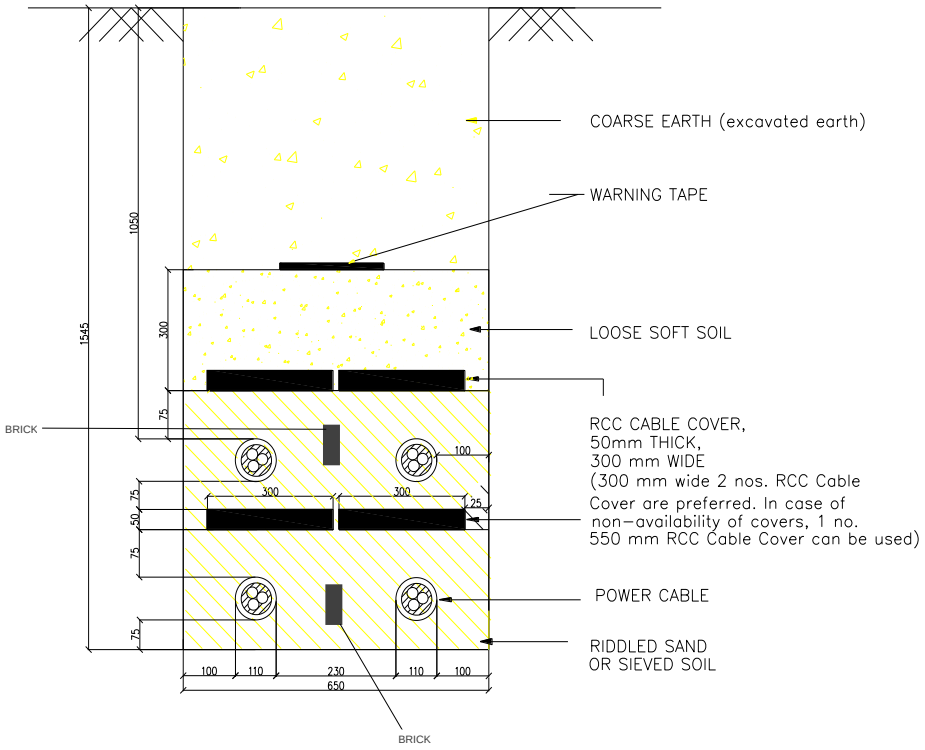

Figure 1.7 – 33kV Buried Cable Option-1 for Four Circuits

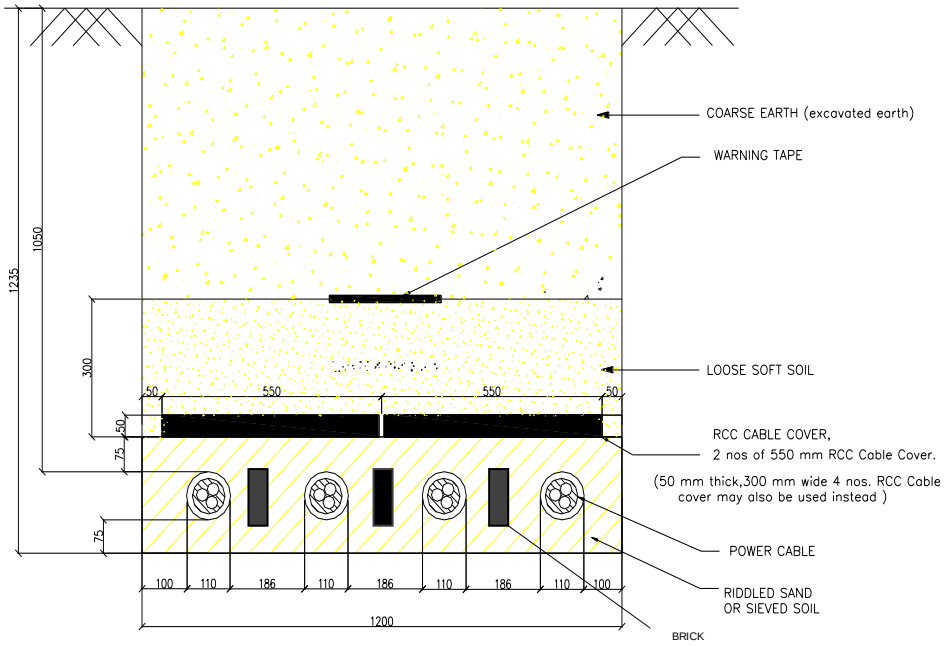

Figure 1.8 – 33kV Buried Cable Option-2 for Four Circuits

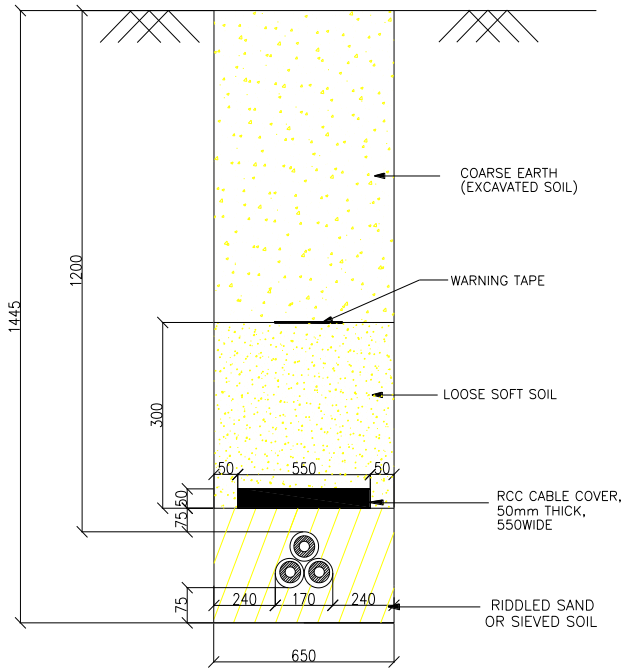

Figure 1.9 – 66kV Buried Cable for Single Circuit

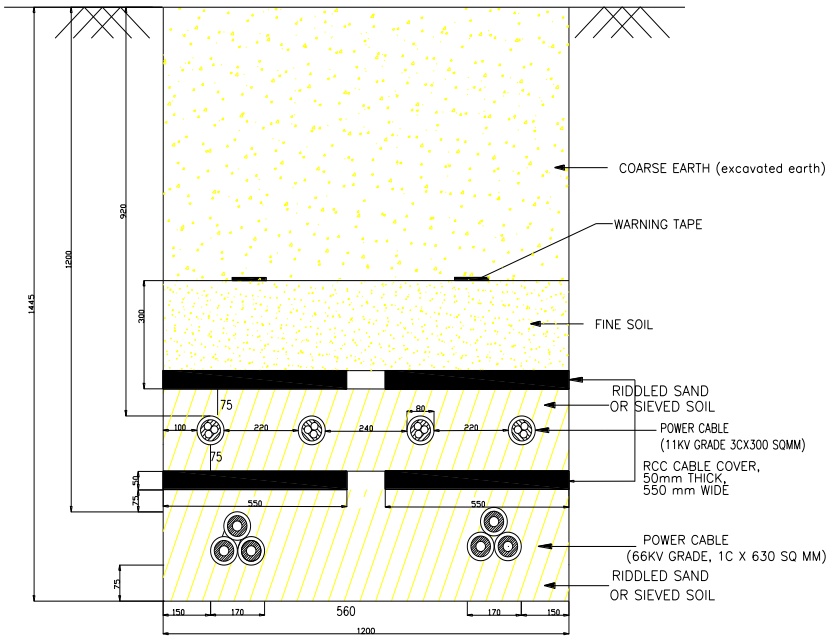

Figure 1.10 – 66kV Double Circuit and 11kV Circuits

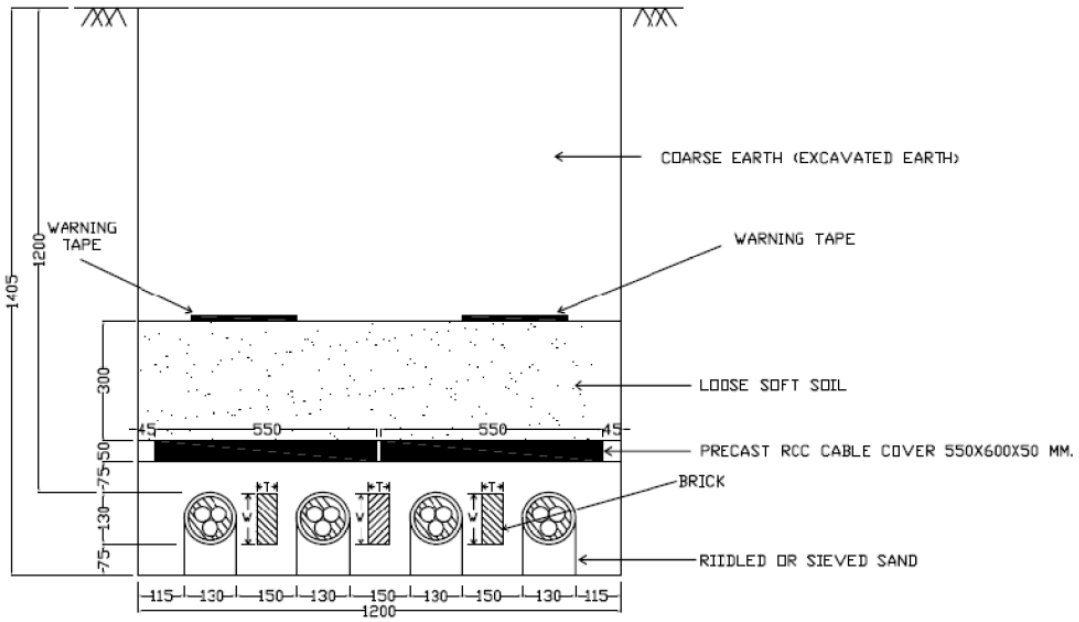

Figure 1.11 – 66kV 3Cx300 sq mm Four No's Cable Runs

2.8 CABLE OVER BRIDGES

On Bridges the cables are generally supported on HDPE cleats and clamped on steel supports at regular intervals. Approval from appropriate authorities (PWD/railways) as applicable shall be taken by contractor.

2.9 LAYING OF SINGLE CORE CABLES

a) The single core cables shall be laid in trefoil formation. Single core cables can be laid individually in 200mm HDPE pipe in case of HDD only.

b) For single core cables laid in trefoil formation, plastic cable ties shall be used at interval of 1.0 (one) meter throughout the cable length to maintain the trefoil arrangement.

c) To prevent magnetic losses (eddy current and hysteresis losses), the base plate of the panels or the terminal box of the equipments, shall have aluminum plate. Incase the entry into the building is through GI pipe; a “slit” in the GI pipe shall be necessary. Alternatively GI pipes may altogether be avoided and non-metallic pipes such as PVC or HDPE pipe shall be used. Concrete pipes having steel reinforcement (RCC pipe) are not to be used.

2.10 EARTHING OF SINGLE CORE CABLES

i) Single point bonded earthing shall be employed to prevent flow of induced circulating current in the armour and screen and consequential de-rating of cables for feeder less than 2.0 KM.

ii) For feeder length more than 2 KM, cross bonding shall be provided.

2.11 GENERAL GUIDELINES FOR LAYING CABLES

i) Laying of the cables and handling of the same shall be undertaken, at all times, by adequate staff suitably trained and supplied with all the necessary plant, equipment and tools.

ii) The contractor shall be responsible for all the route survey, establishment of the position of the joints as per the site requirement and the drum lengths of cables to be laid. While carrying out the route survey the contractor shall take into account the obstacles on the route whether above or below ground. The cable shall be planned to be laid in an orderly formation, free from unnecessary bends and crossings

iii) The contractor shall submit a drawing for the complete scheme showing the entire route, road crossings, location of joints and also the arrangement of cables to be laid. In case due to site exigencies, cables have to cross over within the trench, the same shall be shown in the drawing. For each and every job, this drawing shall be approved by BSES, prior to commencement of work.

iv) Contractor shall arrange for all the material and manpower required for jointing and end termination. The Contractor shall provide pit, carry out excavation for creation of working space required for jointing by the jointer. The contractor shall carry out all civil works, structural work, clamping and earthing, so that the cables and accessories perform satisfactorily during the entire lifetime.

v) The entry and exit of the cables into the building shall be through RCC or GI pipe except for single core cables, which shall be properly sealed and shall be duly supported as per the method and technique approved by BSES, so that the outer sheath of the cable does not get damaged at the entry and exit points. The sealing should be of adequate length so that it minimizes the risk of spreading of fire or ingress of water.

2.12 HANDLING AND STORAGE OF CABLE DRUMS

i) The cable drums shall be transported upright, so that the weight is distributed on both the flanges. Under no circumstances the cable drum may be laid on its side. During transportation the drums must be properly secured. The cable drums should never be dropped from Lorry or a trailer, so as to prevent damage to the cable drum and also to the cable. Ramp may be used for unloading. The drums may be rolled over short distance, provided the correct direction of rolling as provided on the drum is observed. Alternatively, a mobile crane should be used for lifting and lowering the drum. A chain-pulley arrangement may also be used to lift the drums and deposit the same on ground if required.

ii) In case the drums are to be stored prior to cable laying, they should be arranged in such a way to leave some space between them for air circulation. It is desirable that the drums stand on battens placed directly under the flanges. Overhead covering is not essential except in heavy rainfall areas or during monsoon. Cable should however be protected from direct rays of sun by leaving the battens on or by providing some form of sunshade. In no case the drums shall be stored in a flat position with flanges horizontal.

iii) For transportation of the cable drums from storage site to work site, the drum should be mounted on a trailer or an open lorry and unloaded by mobile cranes.

2.13 PROCEDURE OF LAYING

i) The ground over which the drum is positioned at site should be properly consolidated and jacks placed on both sizes of the drum to make the pay-off arrangement stable. Suitable arrangement be made to stop the drum rotation, during cable laying preferably by square wooden poles kept temporarily pivoted over cable roller under the flanges which when required can be applied on the flange as a brake by personnel manning the drum.

ii) The cable should always be paid off from the top of the drum. The drum must be positioned in such a way that the arrow on the drum points opposite to the direction of rotation marked on the drum.

iii) It must be ensured that the cable is not dragged over sharp object or on the road surface, so as to avoid damage to the outer sheath of the cable.

iv) The pulling method to be used shall be approved by BSES. Cable supplier's recommended maximum pulling tension shall not be exceeded.

v) Rollers shall be placed at intervals and the cable shall be pulled over the rollers. The rollers shall be kept lubricated so that they rotate freely, minimize friction to the cable in motion. Rollers shall be positioned at the bends to minimize sidewall friction. The contractor shall ensure that PVC/HDPE sheath of cable is free from damage due to abrasion.

vi) The cable should not be pulled out from the drum by lifting of the coil while the drum is lying flat on the flange. This leads to twisting of the armour and cores resulting in permanent damage to the cable.

vii) To avoid ingress of moisture, it must be observed that the end capping of the cables is not damaged. Cut pieces of the cables must be capped immediately, before laying of the same is taken-up.

2.14 EXCAVATION OF THE TRENCHES

i) The excavation of the trenches shall be commenced, with proper approvals from various authorities well in time.

ii) Before opening of the section of the trench, the contractor shall satisfy himself that the line of the trench is clear of underground obstructions, by taking out trial pits on the line of the trench.

iii) The exact location of each trench shall be approved on site by BSES. The trenches shall be kept as straight as possible and each trench shall be excavated to approved formation and dimensions. If necessary, the trenches shall be adequate shored by wooden planks and bracing to avoid trench cave-ins which would cause injury to the persons and also damage the cables laid.

iv) The bottom of each trench shall be firm and of smooth contour. The contractor shall take reasonable precautions to prevent damage to the highway or ground surface from a slip or breaking away of the sides of the trench.

v) The trench excavation and filling in shall be so executed that all walls, roads, sewers, drains, pipes, cables, structures, places and things shall be reasonably secured against risk of subsidence or injury and shall be carried out to the satisfaction of the authorities concerned. Should, however, a damage to an existing or other services be made, the Contractor will arrange and pay for any necessary repair, to make good the damages.

vi) Where trenches pass from a footway to a roadway or at other positions where a change of level is necessary, the bottom of the trench shall rise or fall gradually. The rate of rise or fall shall be approved by BSES.

vii) Contractor shall ensure that during excavation and until restoration has been completed, for reasonable access of persons and vehicles to property or places adjacent to the route.

viii) When the excavation of the trenches has been accurately executed, the contractor shall inform BSES for approval. Laying of cables or building of structure shall not be started until the contractor has been advised by BSES to proceed with the work.

2.15 EXCAVATED MATERIAL

i) The materials excavated from each trench shall be placed so as to prevent nuisance or damage to adjacent ditches, drains fences, gateways and other property or things. Excavated material shall be stacked so as to avoid undue interference with traffic.

ii) Where, owing to traffic or for reasons of safety or other considerations, this is not permissible, the excavated material shall be removed from the site and returned for refilling the trench on completion of laying; surplus material shall be disposed off by the contractor at his own cost.

2.16 PIPES AND DUCTS

i) Care shall be taken to make the bend of the pipes or duct lines as easy as practicable and in no case of radius less than 3 meters. Where approved, split pipes may be used on bends, the pipes being fitted round the cable after laying.

ii) All road crossings shall be ducted. This applies to present and future roads as indicated on the route plans. The pipes and the ducts shall be laid in an approved manner and shall be surrounded by 150 mm of PCC (1:2:4)

iii) Ducts under the road shall be provided by the contractor, by non-disruptive method, if road cutting is not permitted by the concerned authorities Cable laying shall be done by Horizontal Direct drilling method (HDD).

iv) The cables shall be suitably protected at entry and exit from the pipes, so that the outer sheath does not come in contact with the edges of the pipes / ducts. The pipes and ducts shall have slope so that the seepage water can drain through the small opening provided on the lower side of the pipe sealing.

v) The pipes and ducts shall be secured to the base at both ends and at regular interval, throughout the length, so that at no point the ducts or pipes get suspended over the threaded cable, and damage the same, thus defeating the very purpose of providing the pipe / duct.

vi) At all road crossings at least one spare duct / pipe shall be provided for future use. The pipe shall be thoroughly cleaned of obstructions. A draw wire or rope shall be left in each pipe to facilitate the drawing in of the cables. The duct end shall be sealed temporarily to prevent the entry of foreign matter. End caps and permanent markers shall be placed flush with footpath / roadways at both the ends. The pipes

and ducts shall be cleaned again immediately before the cables are drawn in.

vii) The internal diameter of the pipe / duct should be such that the cables occupy only 40% of the area of the pipe / duct to avoid de-rating.

3. JOINTING OF CABLES

3.1 TYPES OF ACCESSORIES

i) Straight Through / Transition Joints - These Joints are used for connecting two cables in the run.

ii) Termination or sealing end – This is generally used to connect a cable to switchgear terminals, H.T. pillars, transformer boxes and OH lines etc. GIS End termination should be used wherever required.

3.2 REQUIREMENTS OF CABLE JOINTS

i) Resistance of the jointed conductor should be equal to or less than resistance of the conductor of the same length.

ii) Connector & lug should have a mechanical strength should be comparable to that of the conductor.

iii) Thickness of built up insulation should be equal to or more than thickness of insulation of cable.

iv) The Joint should provide proper mechanical protection to the insulated cores against damage by impact.

v) The joints should ensure the continuity of metallic sheath or armour.

vi) Proper stress control shall be provided to eliminate occurrences of high electrical stresses at screen cut points and over crimped connector.

vii) The Joints shall be provided with an outermost layer resistant to corrosion by chemical effect

For joints of screened cables, following additional features must be considered

i) Electric stress relief at termination of screen

ii) Ionization and corona discharge

Besides the above requirement, cable joints should be simple and compact. It should require minimum time for jointing. It should be mechanically strong to

withstand dynamic stresses due to short circuit current and impacts. The joints should further be resistant to corrosion and other chemical effects.

3.3 PREPARATION BEFORE JOINTING

A proper joint position should be selected for jointing. The joint pit should be of sufficient dimensions as to allow jointers to work. Sides of the pit should be well covered with tarpaulin sheets to prevent loose earth from falling. When jointing cables in water logged ground or under monsoon conditions, sump hole should be excavated at one end of the joint pit in such a position so that the accumulating water can be pumped out or baled out without causing interference to the jointing operation. The jointing as far as possible is to be carried out inside a tent. Before proceeding for jointing, on the existing cable, it is very essential to identify the cable to be jointed. For jointing of high tension cables, the cable should be made dead and earthed before commencement of the jointing. This should be confirmed by spiking method.

Cleanliness is the most important factor in all jointing work. All tools should be clean and dry at the time of the jointing process. Cleanliness while handling the insulation is very important. Any contamination of the insulation by dust or moisture is detrimental to the joint. In case of paper cables, the cable seals should be examined for any damage or puncture. The paper insulation should then be tested for the presence of moisture. This is done by dipping the insulation paper in hot G-38 compound (110 Deg - 120 deg.C). Care should be taken not to touch the paper with hand. Paper should be held with a plier which

should be slightly warm. If moisture is present in the sample, it will be detected easily by a bubbling or crackling sound. In case of faulty cable, if on test moisture is detected, then further test would have to be carried out to arrest moisture. The cables to be jointed should then be meggered to check the condition of the insulation and a further check of further continuity of cables and tracing out cables to be jointed is necessary. Number on cores represents the phases. But these should never be taken for granted. Crossing of the core should be avoided in a joint.

3.4 PROCESS OF JOINTING

The process of jointing mainly consist of

i) Connecting conductors together

ii) Replacing the machine applied insulation

iii) Providing earth continuity

iv) Providing mechanical protection

Conductor joints should satisfy the following basic requirements.

i) Ensure conductivity of the conductor by proper crimping.

ii) Leave a reasonably smooth finish and profile on the conductor joint so as to avoid under stress concentration.

4. BACK FILLING TRENCHES AND TEMPORARY REINSTATEMENT

i) Filling in of trenches shall not be commenced until BSES has inspected and approved the cables and accessories at site. The inspection should be done on daily basis so that the trenches do not remain open unnecessarily, to avoid inconvenience to public.

ii) Where cables routes are in public highways, footpaths, gardens etc., the method of reinstatement will be subject to approval by MCD. All costs incurred will be at the contractor's expenses.

iii) The contractor shall be responsible for proper permanent reinstatement of the upper levels, which shall be carried out to the satisfaction of BSES and the MCD authorities concerned.

iv) Before finally leaving site, permanent reinstatement shall be executed by the contractor to the approval of MCD and the property owners and all costs incurred shall be to the contractor's account.

5. PERMANENT REINSTATEMENT OF PUBLIC ROAD, FOOT PATH ETC

i) In public roads and footways the surfaces and foundations shall be temporarily reinstated by the contractor. After settlement, temporary reinstatement material shall be removed as necessary and the permanent reinstatement shall be carried out to the approval of the appropriate highway authority / MCD. Stone and pre-cast concrete paving kerbs and channels shall also be finally reinstated by the contractor.

ii) Temporary reinstatement shall be maintained by the contractor until commencement of final reinstatement to ensure that the surface is always safe for the passage of pedestrians and vehicular traffic**.**

6. IDENTIFICATION

All cables shall be identified below the gland at each end, at joint position and at approved positions by means of bands engraved or punched with cable no. feeder name, size of cable, number of cores, phase colour etc. The bands shall be secured fastened in a permanent manner, and shall be made of material able to resist corrosion, dampness and mechanical damage.

7. CABLE ROUTE MARKERS

All cables routes shall have markers at suitable location with a gap not exceeding 30 meters. The route markers shall be approved design. Additional markers shall be provided at joint locations with approved markings.

8. CABLE SUPPORTS / CLAMPS

i) The contractor shall supply and install all the supports, racks, trays, cleats, saddles, clips and other parts required to carry and secure the cables, without risk so that there is no undue mechanical load or stress due to weight of the cable at each end. Cleats, saddles and clips shall be of the design as approved by BSES. No cable shall be laid on the trench floor. They shall be run in a neat and orderly manner and the crossing of cables within the trench shall be avoided as far as possible. Where cable runs unavoidably cross, a suitable supporting arrangement shall be provided to maintain an adequate gap between the cables.

ii) Every cable shall be supported at a point not more than 500 mm from its termination.

9. INSTALLATION OF CABLES IN TUNNELS / BASEMENT / BELOW THE PANELS

i) The design of cable support for cables installed in air in cable tunnels, basements etc. shall consist of vertical steel members spaced at approved interval and secured to the walls, floors and ceilings as necessary by means of bolts either cemented in position or expanded into cored holes. Each vertical support shall have bolted to it a number of steel brackets spaced at the intervals and designed to support and retain trays constructed of galvanized sheet steel of adequate section to carry the weight of the cables, plus space for an additional quantity of future cables at least 25% by weight and dimensions in excess of the cables installed under the contract and an additional load of 100 kg at the extremity without distortion. The trays shall be designed with raised edges to retain the cables and shall incorporate an interlocking feature so as to prevent movement between supports.

ii) The design and construction of all cable cleating and supporting arrangements shall suit the cable system design. The spacing of cable supports shall be approved by BSES.

iii) Cable run on trays shall be neatly dressed and where not provided with cleats shall be secured by heavy gauge, type approved metal reinforced, clips or saddles. Not more than six cables shall be embraced by one clip.

iv) Mild steel of appropriate sections, duly painted in an approved manner, shall be used for fabrication of cable supports. The steel shall be free from blisters, scales, laminations or other defects. Before final painting, the steel sections shall be provided with double coat of red primer.

10. CABLE PROTECTION AT OVERHEAD TOWERS OR POLES

Where the cables terminate on overhead line poles or towers located outside substation compounds the contractor shall provide suitable cable supporting galvanized steel work attached to the pole or tower and comprising backboard, runners, sheet, steel cover of not less than 3.0mm thickness, stays, cable cleats, anti climbing guard and all incidental items to provide secure protection for the cables. Isolators and Lightning arrestor. The erection and steel structure required shall also be in scope of the contractor.

11. SUN SHADES

All cables shall be protected from direct solar radiation by ventilated sun shields as approved by BSES.

12. ROUTE PLAN

i) Contractor should get updated the GIS map of BSES of route along with joints and other obstructions.

ii) During the progress of the contract works the contractor shall record on a set of route plans and cross section drawings of an approved

form, these details so that the same can be transferred on the GPS maps. Such particulars will allow an accurate reference to be made in the case of any fault or projected modification. These records shall show, amongst other data, both indoors and outdoors the exact position of every joint, cable end termination and also the particulars of the depth of the trench, the arrangement of the cables, with cable numbers and the position of all obstructions revealed during the course of excavations. These completed records shall be submitted to BSES within 15 days of completion of any particular route/feeder.

13. SITE FACILITIES TO BE MAINTAINED BY THE CONTRACTOR

i) The contractor shall arrange for all the tools and tackles required for cable laying, jointing testing and commissioning as per this specification.

ii) The contractor shall arrange illumination and Power supply so that the work can be carried out round the clock.

iii) The contractor shall maintain functional dewatering pumping facility with suitable power supply so as to protect the cables and the joints from ingress of water due to rain or otherwise

iv) The contractor shall make arrangement to provide suitable scaffolding arrangement to carry out the termination work

v) The contractor shall carry out proper barricading of the dug cable route and the joint bays and shall take all necessary precautions to avoid any public hazard.

14. TESTING

Following tests are to be carried out during and after completion of Cable Laying:

i) Testing of cable before jointing –Cable shall be tested for Insulation Resistance prior to laying by opening the end and resealing end properly.

ii) Testing on complete Cable Installation –

a. Insulation resistance of each core shall be measured against all the other cores and the metal screen connected to earth.

b. The resistance of the conductor shall be measured.

c. High voltage – Very Low frequency (VLF) kit shall be used for high voltage testing of complete cables length. Testing voltage and duration shall be as per IEEE 400.2 standards.

d. Partial discharge test shall be carried on complete cable length.

e. Charging of Cable at No-Load at Nominal working voltage for 24 Hours.

f. After laying and before termination of cable a sheath test shall be conducted for 66KV Single core Cable as under:-

At both ends the cable shall be raised from ground. From the end graphite coat over the outer PVC jacket shall be removed with a piece of glass for a length of 300mm. A spiked steel rod with an eye for attaching a wire shall be driven into the ground and connected to a nearby water or hydrant pipe. Insulation resistance of PVC

jacket shall be measured between the aluminum wire armour and the spike with a 500/1000V insulation tester. Measured resistance shall not be less than 2.5 mega ohm / KM. Thereafter 10KV DC shall be applied for one minute in the same way. After the test the armour shall be kept earthed to the steel spike for 15 minutes for discharging residual charge.

g. Any other testing required to complete the job shall be performed as per IEC standards.

15. BARRICADING AND SAFETY REQUIREMENT

a. Dimensions of barricading- Height- 2 mtr, Length- 1.5 mtr.
b. There shall not be any gap in between two barricades.
c. LED Bacon light shall be placed at 1st and every 4th barricade
d. Name, painting, color, cleanliness etc. shall be done on regular basis.
e. Vendor to ensure that traffic management shall not be excuse of work execution. The contactor shall not undertake loading and unloading at carriageways obstructing the free flow of vehicular traffic.
f. Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the working area from the risk of accidents due to speedy vehicular movement. In same way barricades shall protect the road users from the danger due to construction equipment and temporary structures.
g. The structure dimensions of the barricades , material and composition, its color scheme, BSES logo and details shall be in

accordance with specification and drawing laid down in the tender documents.

h. All the barricades shall be erected as per the design requirements of employer, numbered painted and shall be maintained in good condition. Barricading In-charge shall maintain barricade register at site.

i. All barricades shall be easily seen in the dark/night time by the road users so that no vehicle hits the barricades. Night vision shall be ensured by affixing retro reflective strips of required size and shape at appropriate angle at bottom and middle portion of the barricades at a minimum gap of 1000 mm. In addition minimum one red light /red blinker and red beacon light shall be placed at the top of each barricade.

j. No dust deposit is permitted at the front side of barricades.

k. Cable drum shall be returnable and vendor shall take it back (by buy back process or as per PO agreement) from site at their own risk and cost.

l. Once cable lying of a drum is completed, within two days, empty drum shall be removed from site.

m. Trained traffic marshal with all PPE and traffic control light (Red and Green) shall be placed at site for 24x7 hours.

n. During execution of job, any damage to other agency's properties shall be counted in vendor account and necessary action shall be taken by vendor to immediate recover, repair etc.

o. Excess earth shall be removed from site after back filling. Site to be cleared to avoid flowing of dust. Barricades to be removed from site within 24 hrs after completion of job.

p. During non working hrs vendor to ensure presence of supervisor for controlling any event from locals.

q. PPEs

   a. Helmets
   b. Mask
   c. Jacket
   d. Safety Shoes
   e. First Aid Box etc.

   Above mentioned PPEs shall be available at site 24x7. Zero tolerance on absence of PPEs to the working personnel. No excuse shall be acceptable in this regards.

r. EPR/Scanning shall be done by vendor of whole the route and same shall be submitted to BYPL. This work shall be done by vendor before execution of job.

s. Lifting of cable drums with hydraulic machine, pulling of cable from top end of drum with pulling machine (hydraulic winch) is mandatory.

t. Violation on barricading guideline and safety norms, a fine of Rs.5000 /day shall be imposed. BYPL inspector/engineer in-charge shall be empowered to impose the above penalty.

u. Artwork & Text to be printed on barricading sheet shall be approved by BYPL prior to start of work