BIA and BMP for 400 kV Transmission Line Corridor Passing through Protected area of Goa State

M/s. Goa Tamnar Transmission Project Limited (GTTPL)

Final Report

7 March 2019

Project No.: 0476969

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BIA and BMP for 400 kV Transmission Line Corridor Passing through Protected area of Goa State

Final Report

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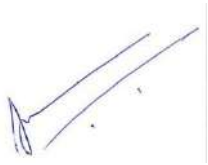

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Acronyms and Abbreviations

Name	Description
ATV	All-Terrain Vehicle
BIA	Biodiversity Impact Assessment
BMP	Biodiversity Management Plan
BMWS	Bhagwan Mahaveer Wildlife Sanctuary
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CR	Critically Endangered
DD	Data Deficient
EHV	Extra High Voltage
EN	Endangered
EPMs	Environmental Protection Measures
EPS	Electric Power Survey
ERM	ERM India Private Limited
GoI	Government of India
GTTPL	Goa Tamnar Transmission Projects Limited
IUCN	International Union for Conservation of Nature
IVI	Importance value Index
KPTCL	Karnataka Power Transmission Corporation Limited
LC	Least Concern
LILO	Line In Line Out
NA	Not assessed
NGO	Non-Governmental Organisation
NT	Near Threatened
PCCF (WL)	Principal Chief Conservator of Forests (Wieldlife)
PGCIL	Power Grid Corporation of India Limited
ROW	Right of Way
SPV	Special Purpose Vehicle
VU	Vulnerable
WLS	Wildlife sanctuary

1. INTRODUCTION

Sterlite Powergrid Ventures Limited by its subsidiary company Goa Tamnar Transmission Projects Limited (GTTPL) is developing the project, “Additional 400 kV feed to Goa and Additional System for Power Evacuation from Generation Projects pooled at Raigarh (Tamnar) Pool” which is awarded to them through tariff based competitive bidding process.

The transmission line proposed route is passing through the Bhagwan Mahaveer Wildlife Sanctuary which requires wildlife clearance from the State Wildlife Board of Goa and National Wildlife Board at Ministry of Environment, Forest and Climate Change, Government of India.

GTTPL has entrusted ERM India Private Limited (ERM) to undertake a Biodiversity Impact Assessment study and prepare a biodiversity management plan for the project. The current study assess the biological impacts (BIA) of the transmission line project of the flora and fauna of the wildlife sanctuary and presents the biodiversity management plans (BMP) to be implemented during the construction and operation phase of the project.

1.1 Project Background

The peak demand met by Goa during the year 2014-15 was 489 MW and as per the 18th EPS, the peak demand of 815 MW was expected by the end of 12th Plan (2016-17) and 1192 MW by the end of 13th plan (2021-22).

At present demand of Goa is mainly catered through Mapusa 3x315 MVA, 400/220 kV substation, which gets feed from Kolhapur 400 kV substation through a 400 kV D/c line. The Goa system is also connected with Maharashtra and Karnataka through 220 kV lines.

To supply the projected power requirement of Goa with reliability, an additional 400 kV in feed to Goa was required. The matter was discussed in the 38th meeting of Standing Committee on Power System Planning in Western Region, held on 17th July 2015 at New Delhi wherein the provision for a new 400kV S/s in Goa at Xeldem along with its interconnections with the Inter State Transmission System was agreed. Accordingly, following transmission system was discussed and approved in the 39th & 40th SCM of WR held on 30th November 2015 & 01st June 2016 respectively and 39th & 40th SCM of SR held on 28th and 29th December 2015 and 19th November 2016 respectively.

1.2 Project Brief

The project is a part of “Additional 400 kV feed to Goa and Additional system for Power Evacuation from Generation Projects Pooled at Rajgarh (Tamnar) Pool”. PFC Consulting Limited (A Wholly owned subsidiary of Power Finance Corporation Limited) on behalf of Ministry of Power (GoI) entrusted Goa Tamnar Transmission Project Ltd. to construct the transmission projects in Goa, Karnataka & Chhattisgarh state for “Additional Feed of 400 kV to Goa State”.

1.3 Project Justification

The construction of 400 kV D/C Xeldem-Mapusa is an additional feed to Goa State to meet arising power deficit through present network system. During survey of this transmission line we came to know that the line passes through several forest patches of North Goa Forest Division.

Although, this is despite trying to ensure that the transgressed forest area should be minimum & unavoidable to the extent possible. To confirm the forest area is minimum & unavoidable, three (03) possible alternate routes from generating to terminating end of the transmission line was determined and the least impacting route was selected. The route comparison of the 3 routes are given below:

The Project shall be implemented through the Special Purpose Vehicle (SPV) named Goa-Tamnar Transmission Project Limited which shall be the complete owner and operator of the project. This project is part of National Grid Development.

Transmission line projects are environmentally friendly and do not involve any disposal of solid effluents and hazardous substances in land, air and water. The constructional features of 400 kV Transmission line is such that it is not affecting the environment as it's not dividing the existing forest because of the long spans between the towers (400 Mtrs) of the transmission line follows the forest road / forest block boundary thus involving minimum tree felling and also allowing minimal impact to bird movement due to high towers. The ground clearance for lower most conductors is 8.84 Meters. The spacing between the phase conductors is (4 Mtrs) as well. A very small space is required for the construction of tower foundations (maximum 20 X 20 Mtrs). The tower foundations are under the ground (3.5 Mtrs) and a small portion of 0.50X0.50 Mtrs are elevated as plinth.

The 400 kV D/C Narendra (Karnatka) – Xeldem (Goa) Transmission Line starts from Narendra village in Dharwad District, Karnatka by tapping the existing 400 kV Narendra line of PGCIL by LILO and terminating at 400/220 kV substation at Xeldem in Goa. The line will be passing through Dharwad, Belgaum and Uttar Kannada District of Karnataka and South Goa District of Goa.

Three alternative route corridors were identified largely by maximizing linear opportunities, such as following existing roadways and power line corridors and negotiating rivers, railway and road crossings. All efforts have been made to provide a minimum no of angle points. Power line crossings have been fixed as close as possible to a right angle.

In Karnataka the total length of the proposed route is 77.631 Km. Out of this only 28.740 Km is forest land and 6.61 Km falls in Dandeli Wild Life Sanctuary and the remaining 42.281 Km is Non Forest Land. In Dandeli Wild Life Sanctuary, there is one 220 kV line and one 110 kV line of KPTCL feeding Goa. The 110 kV line is defunct from the border of Goa to Anmod village. Beyond Anmod this 110 kV line is charged and is feeding Anmod Substation so cannot be used. As per the directions of PCCF (WL) and Chief Wild Life Warden Karnataka, proposed route has been aligned such that our 400 kV transmission line will be using the defunct 110 kV corridor thus avoiding new corridor where ever possible. The comparative statatement of three alternative lines considered is provided in ***Table 1.1***.

The total Bee Line Length in Karnataka is 75.645 Km. The line length of Alternate – I (Proposed Line) is 77.63 Km. Alternate – II is 79.1 Km. Alternate – III is 79.855 Km.

- Alternate Route I- The length of forest and wild life in alternate – I is 35.35 Km (Forest –28.74 Km and WL – 6.61 Km).
- Alternate Route II- The length of forest and wildlife in alternate – II is 51.5 Km (Forest – 43.40 Km and WL 8.1 Km).
- Alternate Route III- The length of forest & wildlife in alternate – III is 48.96 Km (Forest – 41.91 Km and WL 7.035 Km).

In view of above facts, it is evident that alternate – I involves the minimum forest and Wild Life Sanctuary land as well non-forest land.

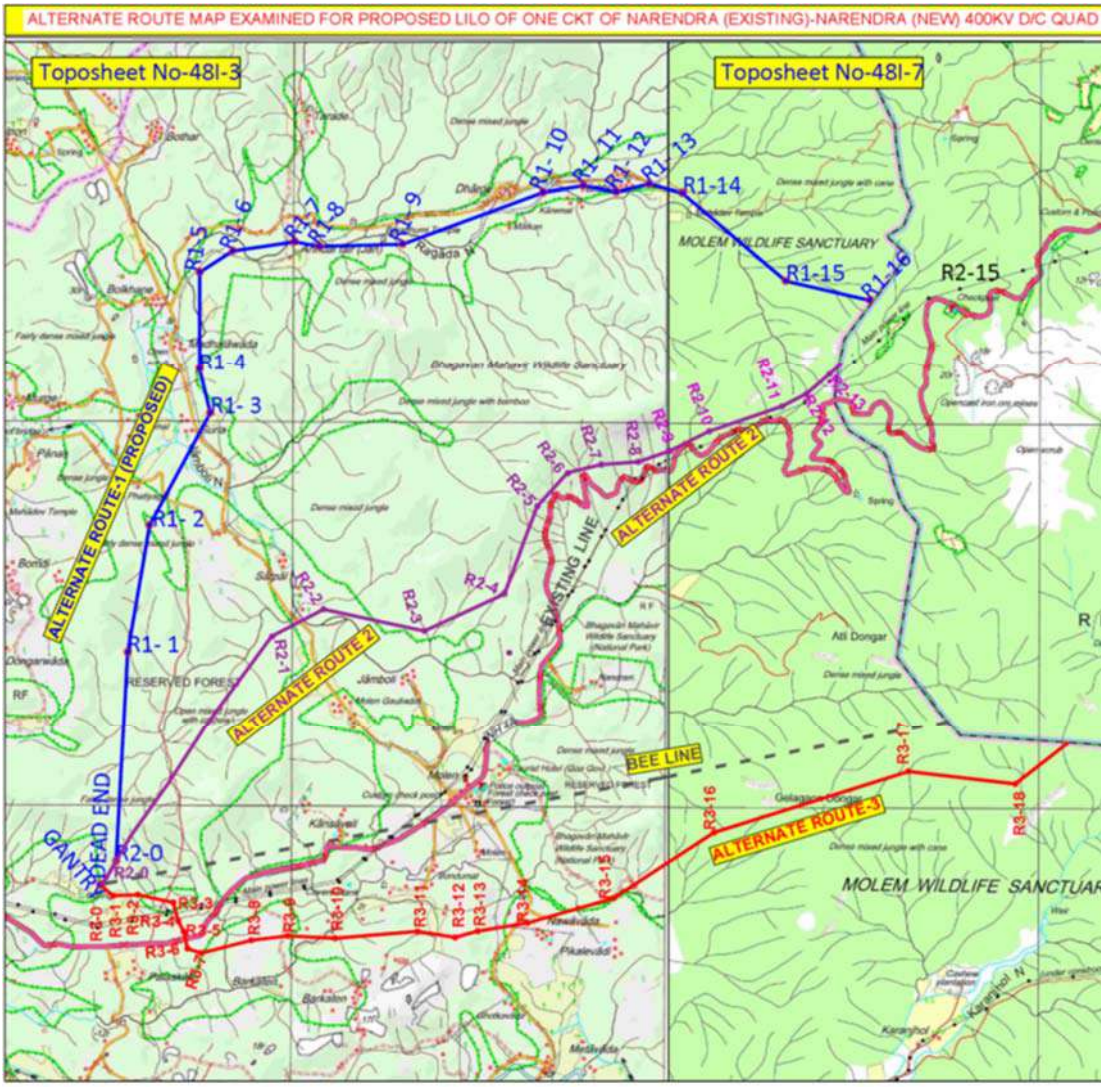
Table 1.1 Comparative Statement of Three Alternative Routes

Description	Alternate Route 1 *(Proposed Route)*	Alternate Route 2	Alternate Route 3
Bee Line Length	68.74Km	68.74Km	68.74Km
Line Length	77.63 Km	79.1 Km	79.85 Km
Angle Points	47	60	54

Description	Alternate Route 1 *(Proposed Route)*	Alternate Route 2	Alternate Route 3
Forest Length	28.74 Km	43.40 Km	41.91 Km
Wildlife Length	6.61 Km	8.1 Km	7.035 Km
Total Forest & WL Length	35.35 Km	51.5 Km	48.96 Km
Forest Area (Ha)	132.205 Ha	199.64 Ha	192.79 Ha
Wildlife & NP Area	30.412 Ha	37.26 Ha	32.36 Ha
Total Forest & WL Area	162.617 Ha	236.9 Ha	225.15 Ha
Density of Forest Area	Moderate Dense	High Dense	Moderate Dense

After detailed analysis as per ***Table 1.2*** above, it is observed that the alternative – I has the least route length and has minimum crossings in terms of rail, road and existing power line. Keeping the above points in consideration, we propose Alternative – I to be taken as final proposed route alignment. The area falling in Goa section is presented below (Refer ***Figure 1.1***).

Figure 1.1 Alternate Routes for Xeldem Narendra Line within Goa



1.4 Report Layout

The report is presented in following format.

Section	Name
Chapter 1 (This Section)	Introduction
Chapter 2	Project Description
Chapter 3	Ecological Baseline
Chapter 4	Impact Assessment of Transmission line on Biodiversity
Chapter 5	Mitigation Measures
Chapter 6	Biodiversity Management Plan

2. PROJECT DESCRIPTION

The project is a part of "Additional 400 kV feed to Goa and Additional system for Power Evacuation from Generation Projects Pooled at Rajgarh (Tamnar) Pool". PFC Consulting Limited (A Wholly owned subsidiary of Power Finance Corporation Limited) on behalf of Ministry of Power (GoI) entrusted Goa Tamnar Transmission Project Ltd. to construct the transmission projects in Goa, Karnataka & Chhattisgarh state for "Additional Feed of 400 kV to Goa State".

The project component for this transmission line project is presented in the ***Table 2.1*** below

Table 2.1 Transmission Line Project Components

Sn	Transmission System for "Additional 400kV feed to Goa"
1.	LILO of one ckt. of Narendra (existing) – Narendra (New) 400kV D/c quad line at Xeldem
2.	Xeldem – Mapusa400kV D/c (quad) line
3.	Establishment of 2x500MVA, 400/220kV substation at Xeldem 400kV ■ ICTs : 2x500MVA, 400/220kV ■ ICT bays: 2 nos. ■ Line bays: 4 nos. (2 nos. for Xeldem – Mapusa (Goa State) 400kV D/c (quad) line & 2 nos. for LILO of one ckt of Narendra (existing) – Narendra (New) (Karnataka State) 400kV D/c quad line at Xeldem) ■ Bus Reactor: 1x125MVAR ■ Bus Reactor Bay: 1 no ■ Space for 2x500MVA, 400/220kV ICTs (future) ■ Space for ICT bays (future): 2 nos. ■ Space for Line bays along with Line Reactors (future): 4 nos. ■ 1x63MVAR switchable line reactor along with 500 Ohms NGR and its auxiliaries (for Narendra (existing) – Xeldem 400kV line formed after LILO of one ckt of Narendra (existing) – Narendra (New) 400kV D/c quad line at Xeldem) ■ 1x80MVAR switchable line reactor along with 500 Ohms NGR and its auxiliaries (for Narendra (New) –Xeldem 400kV (quad) line formed after LILO of one ckt of Narendra (existing) – Narendra (New) 400kV D/c quad line at Xeldem) 220kV ■ 220kV inter-connection with Xeldem (existing) substation ■ ICT bays: 2 nos. ■ Line bays: 6 nos. ■ Space for ICT bays (future): 2 nos. ■ Space for Line bays (future): 6 nos.

2.1 Transmission Line Route in Goa State Protected Areas

The Transmission line route passes through the Bhagwan Mahaveer Wildlife Sanctuary (BMWS). It Intercepts BMWS in two sections. At first it enters the BMWS near Surla Village and then secondly it enters ahead of Tambdi Surla Temple and enters in Karnataka. The location map of the transmission line in protected area of Goa State is provided in ***Figure 2.1***. and ***Figure 2.2***.

Figure 2.1 Layout Map of Transmission Line rote in Protected Area of Goa State (Section 1)

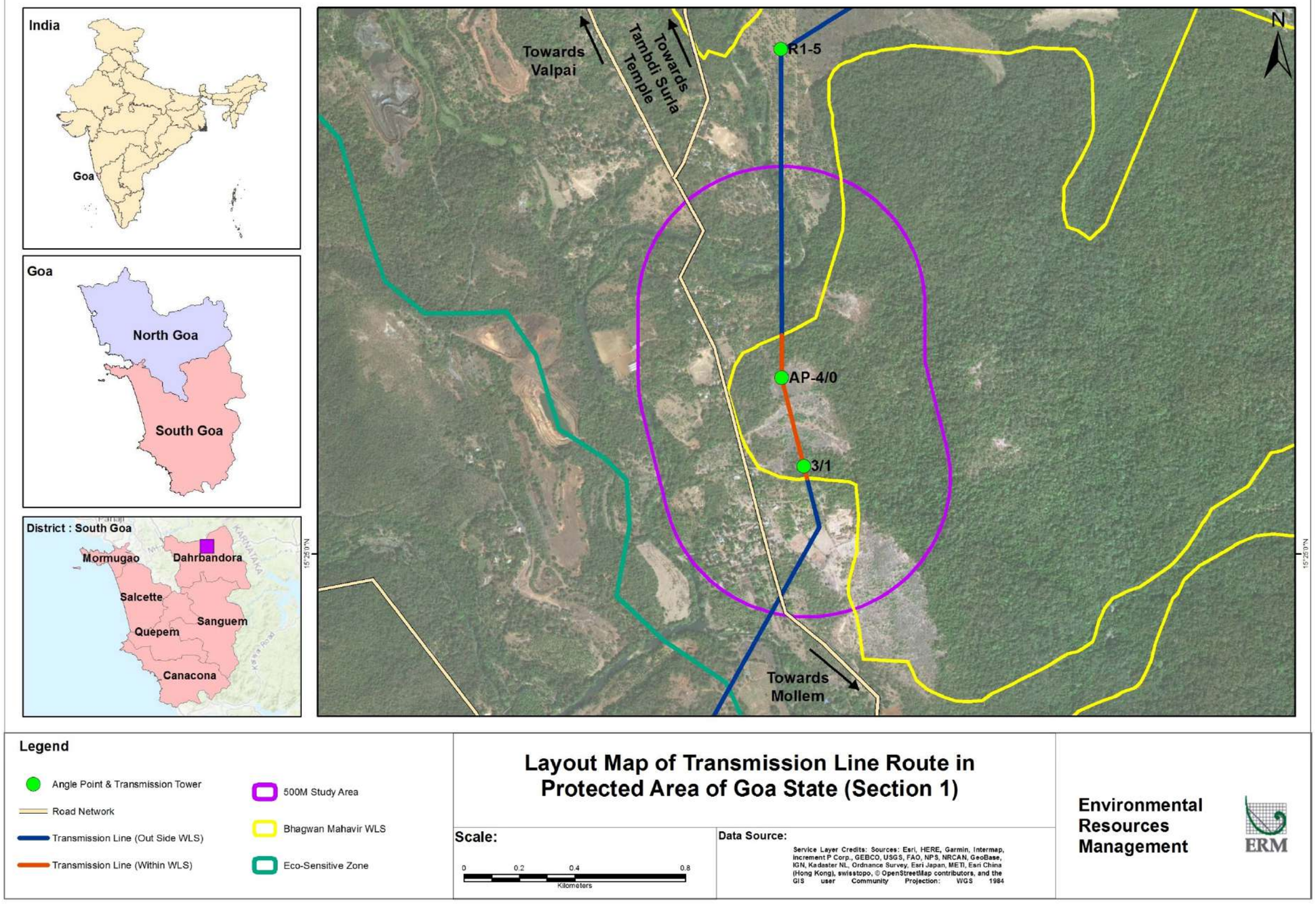
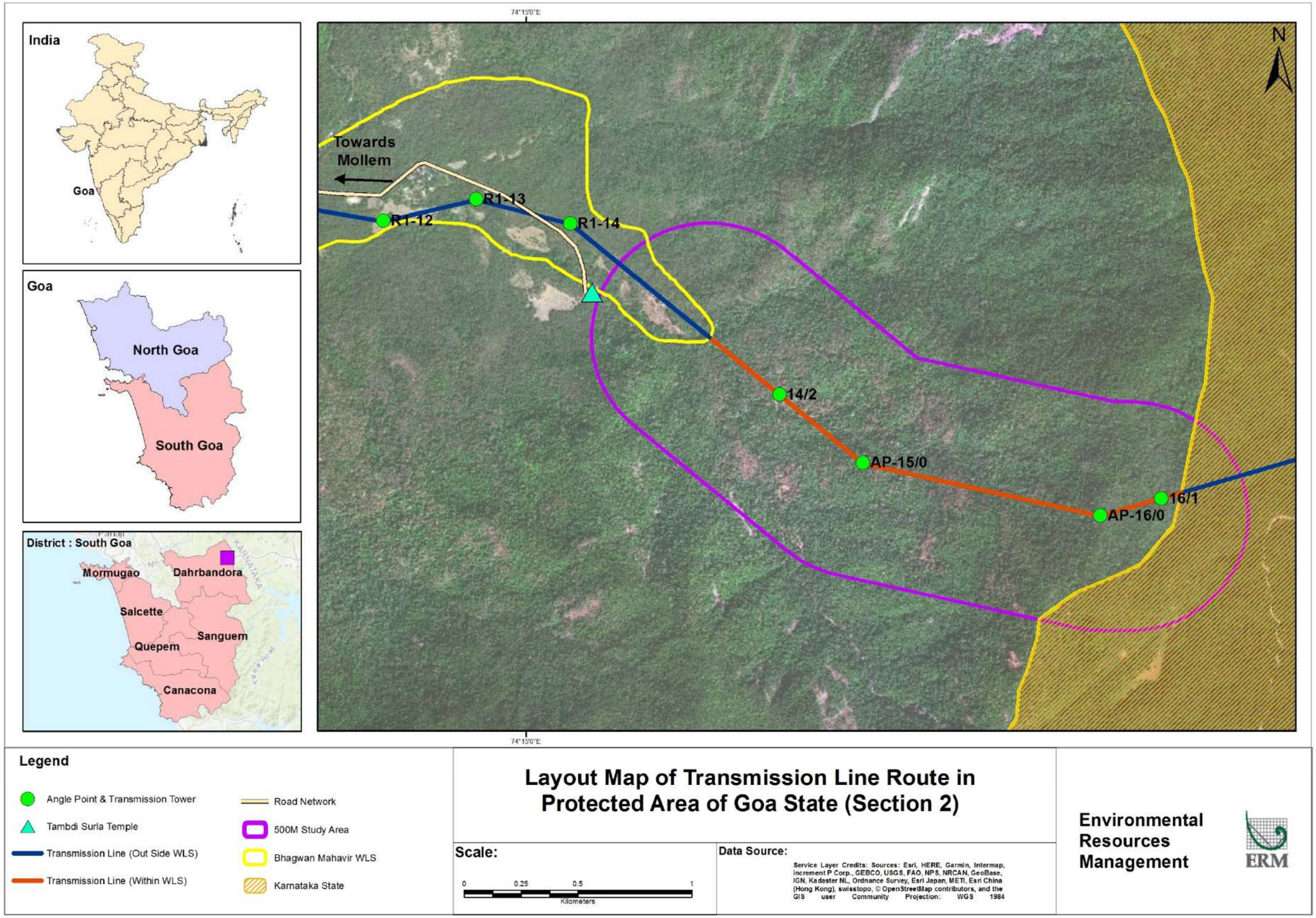


Figure 2.2 Layout Map of Transmission Line rote in Protected Area of Goa State (Section 2)



The total length of the Transmission Line within BMWS, falls in two Surveys numbers/Forest compartments. The details are given in ***Table 2.2.***

Table 2.2 Coordinate Statement of required area of Wildlife Division, North Goa

DGPS No.	UTM		Degree, Minute Second		Wildlife Division	Village Name	Compartment /Survey No.	Area (Ha.)	Legal Status of Land
	Easting	Northing	Longitude	Latitude					
40	413914	1705355	74°11'51.64"	15°25'25.47"	North Goa	Surla	S.No. 23	2.53	BMWS
41	413960	1705379	74°11'53.18"	15°25'26.26"					BMWS
42	413914	1705204	74°11'51.65"	15°25'20.56"					BMWS
43	413960	1705210	74°11'53.2"	15°25'20.76"					BMWS
44	413992	1704836	74°11'54.32"	15°25'08.59"					BMWS
45	414054	1704821	74°11'56.4"	15°25'08.11"					BMWS
60	420372	1706810	74°15'28.13"	15°26'13.58"			S.No. 73	9.01	BMWS
61	420298	1706811	74°15'25.65"	15°26'13.6"					BMWS
62	420616	1706542	74°15'36.35"	15°26'04.88"					BMWS
63	420657	1706567	74°15'37.72"	15°26'05.7"					BMWS
64	420969	1706299	74°15'48.22"	15°25'57.01"					BMWS
65	420958	1706257	74°15'47.86"	15°25'55.65"					BMWS
67	421968	1706025	74°16'21.77"	15°25'48.21"					BMWS
68	421967	1706073	74°16'21.73"	15°25'49.77"					BMWS
69	422070	1706049	74°16'25.19"	15°25'49"					BMWS
70	422112	1706113	74°16'26.59"	15°25'51.09"					BMWS
							Total	**11.54**	

2.2 Tower Details

Tower detailed for the transmission line are presented in the ***Table 2.3.*** A total of 25 transmission towers are to be erected for the entire stretch within Bhagwan Mahaveer Wildlife Sanctuary (BMWS).

Table 2.3 Tower Details

Tower Parameter	Tower Details
Type of the Towers	WZ-1 DA,DB,DC,DD WZ-2 DA,DB,DC,DD
Total height of the tower above the ground level	46.40 m
Average distance between the Towers	400 m
Total no. of towers installed within the Sanctuary area	06 (Including angle & suspension)
Foundation area for each tower	20 X 20 m
Elevated Plinth area	0.50X0.50 m
Type of basement	Concrete (RCC/PCC)
Depth	3.5 m
Mode of pit digging for basement construction	Drilling & Manual excavation

The first section within the near the Surla village next to Darbandora-Sancodemo-Mollem-Collem road bears one angle tower (A/P-4/0) and one extension tower (3/1). The terrain in this region is undulating plateau with open grassland and rocky outcrops with dense vegetation in the fringes. (Refer ***Figure 2.1).***

The second section where the transmission line enters the BMWLS is ahead of Tambdi Surla Temple are two angle towers (AP-15/0 and AP-16/0) and two extension tower ((14/2 and 15/1). The terrain is hilly with gentle gradient at tower 14/2 and it gets steeper till AP-16/0. After AP-16/0 the terrain is cliff shaped and transmission line enters Karnataka border connecting at AP-17. (Refer ***Figure 2.2)***

Tower design diagrams are presented in ***Annex A*****,** and foundation design diagrams are presented in ***Annex B*****.**

2.3 Conductor Details

The horizontal distance between two conductors vary from 11 m. The lowest conductor from ground will be providing ground clearance of 8.84 m. he conductor arrangement is present in ***Table 2.4.***

Table 2.4 Conductor Details

Conductor Details	
Distance between the two conductors	
Phase to Phase	11 m
Mid Span Clearance	9 m
Ground Clearance	8.84 m

2.4 Siting Criteria for Transmission Line

The siting criteria[1] for transmission line sector is given in the following bullets

- The alignment of the transmission line should be most economical from the point of view of construction and maintenance.
- The alignment of the transmission line selected should be the shortest route possible.
- Routing of transmission line through protected/reserved forest area should be avoided. In case it is not possible to avoid the forests or areas having large trees, the route should be aligned in such a way that cutting of trees is minimum.
- The route should have minimum crossings of major rivers, railway lines, national/state highways, overhead EHV power line and communication lines.
- The number of angle points shall be kept at a minimum.
- Marshy and low lying areas, river beds and earth slip zones shall be avoided to minimize risk to the foundations.
- It would be preferable to utilize the ground level for the alignment.
- Crossing of power lines shall be minimum. In case it is required, a gap of a minimum distance of 300 m between powerlines to avoid induction problems on the lower voltage lines.
- Crossing of communication line shall be minimized and if crossings do occur they shall be cross preferably at right angles Proximity and parallelism with telecom lines shall be eliminated to avoid danger of induction to them.
- Areas subjected to flooding such as ditches (nullahs) shall be avoided.
- Restricted areas such as civil and military airfield shall be avoided. Care shall also be taken to avoid aircraft landing approaches.
- All alignment should be easily accessible both in dry and rainy seasons to enable maintenance throughout the year.
- Certain areas such as quarry sites, tea, tobacco plantations and saffron and rice fields and gardens & nurseries which will result in problems of right of way during construction and maintenance of towers, should be avoided.
- Angle points should be selected such that shifting of the point within 100 m radius is possible at the time of construction of the transmission line.
- The line routing should avoid large habitations, densely populated areas, forest, animal/bird sanctuaries , reserve coal belt areas, oil pipe line/underground inflammable pipe lines etc. to the extent possible.
- The areas requiring special foundations and those prone to flooding should be avoided.

2.5 Construction Activities and Methods

2.5.1 Installation of 400 kV steel tower foundations

The foundations will be excavated manually using manual or mechanised tools and plants and concrete will be mixed manually by hand mixing at the same location.

([1]) Siting Criterial for Transmission Line MoEF&CC

The standard foundation practice is to have four individual footings for each tower leg. The tower foundation area will be set out and pegged prior to foundation excavation. All such removals are restored upon completion of foundation works. Excavations are set out specifically for the type of tower and the type of foundation required for each specific site.

When each leg is excavated the formation levels (depths) are checked by the onsite engineer. A Prop technique is used to set and hold the tower stubs in position while the concrete is being poured and cured.

After concrete is poured the remaining part of the foundation, the shear block or neck, is shuttered. Once the shuttering is complete more concrete may be poured and the foundation completed. The tower foundations are backfilled one leg at a time usually with the material already excavated. The backfill is placed and compacted in layers. (Refer ***Figure 2.3***)

Figure 2.3 Photograph setting template being prepared for final concreting

Foundation size

The average foundation size for each tower leg used on the 400kV transmission system is 5.3m x 5.3m x 3.6m for single circuit angle tower, 5.1m x 5.1m x 4m for double circuit angle tower and 3.4m x 3.4m x 2.8m for double circuit intermediate tower.

Working area

The average working area for construction of a 400 kV tower will extend 10 metres all around the footprint of the base of the tower.

Construction equipment to be used for foundation

- 4x4 vehicle
- Concrete vibrator
- Water pump
- Timber or other Shuttering boxes
- 360˚ tracked excavator (7 ton normally).
- Transit van
- Chains another small tools
- Concrete Mixer (200Kgs)

Duration of foundation work

- Tower foundation work 4-6 days
- Crew size 18-20 workers

2.5.2 Erection of Tower Body

The most common and effective method of constructing a transmission line of this nature is a “derrick pole”. The methodologies are outlined below.

Derrick Pole Methodology

The tower can be erected using a derrick / gin pole and tractor. The derrick pole is a very simple and straight forward way to build the tower where small sections of steel are lifted into place using the derrick and a winch. As illustrated the derrick consists of a solid steel pole which is held in position using guy ropes anchored to the ground (Refer ***Figure 2.4***).

Figure 2.4 Model visual: Derrick pole at tower base

Construction equipment to be used for tower erection.

- 4x4 vehicle
- Winch
- Tractor
- Derrick pole
- Transit van
- Chains and other small tools

Duration of tower erection works

The average duration of tower building works is as follows:

- Each Tower erection: 6-8 days
- Crew size: 35 workers

2.5.3 Stringing of Conductor

Stringing of overhead lines refers to the installation of phase conductions and shield-wires on the supporting pole-set or tower structures. The conductor is kept clear of all obstacles along the straight by applying sufficient tension. This method of the pulling of a light pilot line (nylon rope) which is normally carried by hand into the stringing wheels. This in turn is used to pull a heavier pilot line (Steel rope) which is subsequently used to pull in the conductors from the drum stands using specifically designed “puller – tensioner” machines, see photograph below (Refer ***Figure 2.5***). The main advantages with this method are (a) the conductor is protected from surface damage and (b) major obstacles such as road and rail crossings can be completed without the need for major disruption.

Figure 2.5 Puller – Tensioner machine

Once the conductor has been pulled into position, one end of the straight is terminated on the appropriate tension fittings and insulator assemblies. The free end of the straight is then placed in temporary clamps called “come-alongs” which take the conductor tension. The conductor is then cut from the puller-tensioner and the conductor is sagged using a chain hoist.

Construction equipment to be used during stringing of conductor and earth wire

- 4x4 vehicles
- Puller - tensioner X 2 (see appendix 4 for details)
- Tractor
- Drum stands X 2
- Drum carriers X 2
- Stringing wheels
- Conductor drums
- Compressor & head
- Transit vans
- Chains and other small tools

Duration of stringing works

The average duration of stringing works is typically 1 week per straight. This figure is approximately the same for all straights regardless of length as the most time consuming aspect is the movement and setup of stringing equipment. Stringing crews are typically quite large and could have as many as 65 workers.

2.6 Construction Period

The proposed construction is scheduled to start from September 2019 and likely to be completed by March 2020 (Refer ***Table 2.5***) in Bhagwan Mahaveer Wildlife Sanctuary.

Table 2.5 Proposed Construction Period

SN.	Area of Construction	Tentative Period (month and year)
1	Total period for the construction of the project	Mar '19 to Jan'21
2	Construction along the Bhagwan Mahaveer Wildlife Sanctuary	Sep '19 to Mar'20

2.7 Employment

A total of 138 man power is expected to be deployed for the Goa section of the transmission line passing through Bhagwan Mahaveer Wildlife Sanctuary. This includes 10 skilled man power, 8 semi-skilled man power and 120 unskilled manpower. (Refer ***Table 2.6)***

Table 2.6 Employment Generation

Source of Manpower	Skilled	Semi-skilled	Unskilled	Total
On Roll Company	4	0	0	4
On roll of EPC contractor	6	4	0	10
Involvement of locals- non-technical people	0	4	120	124
Total	10	8	120	138

2.8 Operation and Maintenance

Activities for routine patrols, inspections, or scheduled maintenance, are planned in advance. However, there will be an occasional need for emergency response in cases where safety and property are threatened, to prevent imminent damage to the transmission line and ancillary facilities, or to restore service in the event of an outage. Routine, corrective, and emergency response activities will be conducted in accordance with typical O&M schedules.

Routine Maintenance (Preventative Maintenance)

Routine maintenance activities are conducted on a regular basis and have been carried out historically to identify and repair any deficiencies. These activities do not damage vegetation or soil and do not adversely impact sensitive resources including known federal and state listed species, waters and cultural resources. Personnel are generally present in any one area for less than one day. The following are examples of routine maintenance activities:

- Routine air patrols to inspect for structural and conductor defects, conductor clearance problems and hazardous trees.

- Routine ground patrols to inspect structural and conductor components. Such inspections generally require either an all-terrain vehicle (ATV) or pickup and possibly additional support vehicles traveling on access and service roads and may rely on either direct line-of-sight or binoculars. In some cases, the inspector may walk the ROW. Follow-up maintenance is scheduled depending on the severity of the problem either as soon as possible or as part of routine scheduled maintenance.
- Climbing surveys may be necessary to inspect hardware or make repairs. Personnel generally access these structures by pickup, ATV, or on foot.
- Structure or conductor maintenance typically occurs manually. The maintenance vehicle may be located on or off a road, and no-to-minimal grading is necessary to create a safe work area.
- Cathodic protection surveys to check the integrity and functionality of the anodes and ground beds. These surveys typically require personnel to use an ATV or pickup and make brief stops.
- Routine cyclical vegetation clearing to trim or remove tall shrubs and trees to ensure adequate ground-to-conductor clearances. Vegetation clearing cycles vary from 3 to 5 years or as needed (dependent upon the vegetation present). Personnel generally access the area by pickup, ATV, or on foot; use chainsaws to clear the vegetation; and typically spend less than half a day in any one specific area. In some cases vegetation may be cleared using mechanical means.
- Removal of individual trees or snags (hazard trees) that pose a risk of falling into conductors or structures and causing outages or fires. Personnel generally access hazard trees by truck, ATV, or by foot from an access or service road, and cut them with a chainsaw or similar tool. Any felled trees or snags are left in place as sources of large woody debris or as previously directed by the land management agency. Felled green trees are limbed to reduce fire hazard.

Corrective maintenance

Corrective maintenance activities are relatively large-scale efforts that occur infrequently, may result in more extensive vegetation clearing or earth movement, and may include rehabilitation seeding and associated activities. Personnel are generally present in any one location or area for a prolonged time, generally more than one day. The following are examples of corrective maintenance:

- Non-cyclical vegetation clearing to remove saplings or larger trees in the ROW.
- Structure or conductor maintenance in which earth must be moved, such as the creation of a landing pad for construction or maintenance equipment.
- Structure (e.g., cross-arm, insulator, structure) replacement.
- Follow-up restoration activities, such as seeding, noxious weed control, and erosion control.
- Conductor repair or replacement, which requires the use of several types of trucks and equipment and grading to create a safe work area to hang and pull the conductor into place.

Emergency situations

Emergency situations are those conditions that may result in imminent or direct threats to public safety or threaten' ability to provide reliable transmission service to its customers. Emergency situations may include:

- Failure of conductor splices.
- Damage to structures or conductors from wildfire, high winds, ice, or other weather related conditions.
- Line or system outages or fire hazards caused by trees falling into conductors.

- Breaking or imminent failure of cross-arms or insulators, which could, or does, cause conductor failure.
- Damage to structures or conductors from vandalism In the case of an emergency where life or substantial property is at risk or there is a potential or actual interruption in service, the Companies will promptly respond to the emergency and conduct any and all activities, including emergency repair requiring heavy equipment access to the structures or other ancillary facilities, needed to remedy the emergency and will implement feasible and practicable Environmental Protection Measures (EPMs).

3. ECOLOGICAL BASELINE

3.1 Physiographic Unit

The entire Goa state can be divided into three main physiographic units viz, the mountainous region of the Sahyadri in the east, the middle level plateaus in the centre and the low-lying river basins with coastal plains. Goa includes a portion of the Western Ghats, a range of mountains 1,600 km long extending from north of Mumbai to Cape of Comorin (Kanyakumari), which is identified as one of the `hotspots' of biological diversity and endemism in the world.[1] [2]

The Ghats extend in the north south direction, and exhibit rise in altitude. Goa has a hilly terrain especially on its eastern side where lies the southern end of the northern part of the Western Ghats.

3.2 Climate

The State of Goa is situated in the tropics and has profound orographic influence. The climate is humid throughout the year, with humidity level ranging from 75% to 95% in the monsoon. The main feature of the Goa climate is the south-west monsoon, which occurs between June and September. The average rainfall is 2500 mm to 3000 mm, although in Western Ghats the downpour is considerably high (over 4000 mm) than on the coast. In addition there are pre-monsoon (May) and post-monsoon (October) showers as a result of the north-east monsoon. Goa receives rain from the south-west monsoon, thereby experiencing a dry period lasting from November to May [November to February (winter) and March to May (summer)]. There is a slight variation in temperature through the seasons. May is the relatively warmest month and the mean daily temperature is around 30° C and maximum temperature rises to 36° C. January is the coolest with mean daily temperature of about 25° C. The average temperature ranges between 21° C and 30° C.[3]

During the survey, the weather was sunny with at least two incidents of thunderstorm and heavy rains in evening and night.

3.3 The Study Area

The proposed transmission line intersects the Bhagwan Mahaveer Wildlife Sanctuary at two locations as presented in ***Figure 2.1*** and ***Figure 2.2*** **of Chapter 2.** The entire stretch of transmission line route is a green field area. The core and buffer areas are demarcated as following.

Core Area: The transmission line route, the tower locations (with activity areas of 10 m radius) and the Right of Way (23 m on each side from median of the line route) is considered as Core area for biodiversity assessments.

Buffer Area: Buffer areas are considered 500 m radius areas from the transmission tower locations and the transmission route.

3.4 Study Duration

The ERM team comprising of three members undertook a 5 day reconnaissance survey of the transmission line route from 19th September to 24rd September 2018. The reconnaissance survey

(1) Myer, N. (1990): The biodiversity challenge: Expanded hot spots analysis. Environmentalist. 10: 243-256.

(2) Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B and Kent, J. (2000): Biodiversity hotspots for conservation priorities. Nature. 403: 853-858.

(3) Joshi, V. C and Janarthanam, M. K. (2004): The diversity of life forms type, habitat preference and phenology of the endemics in the Goa region of Western Ghats, India. Journal of Biogeography. 31: 1227-1237.

identiifed habitats and approaches to the transmission line route. Based on the reconnaissance survey, plan was developed to undertake a detailed survey. Interactions with the proponent was also undertaken on the different alternatives of the transmission line routes.
The detailed 7 day ecological survey was commissioned from 2nd October to 9th October 2018. The survey team has ERM team member and external species experts from various groups of flora and fauna to establish the ecological baseline of the study area.

3.5 Survey Team

The survey team had following members for the enumerating flora and fauna of the transmission line corridor. The team composition is given in ***Table 3.1.***

Table 3.1 Ecological Survey Team

Name of the Expert	Area of Specialization
ERM Team	
Dr. Rahul Srivastava (Senior Consultant)	Avifauna and Mammal Expert
Mr. Saumabha Bhattacharya (Consultant)	Avifauna Expert
Dr. Omesh Bajpai (Consultant)	Plant Taxonomist
Mr. Suhas Fuladi (Assistant Consultant)	Mammal Expert
External Expert	
Mr. Nilim Kumar Khaire (Herpetological Society of India, Pune)	Herpetofauna Expert (Snakes)
Dr. Varad B Giri (Herpetological Society of India, Pune)	Herpetofauna Expert (Amphibians and Reptiles)
Dr. Mandar N Datar (Agharkar Research Institute, Pune)	Plant Taxonomist
Mr. Vijay Patil (Herpetological Society of India, Pune)	Field Support & Data Collection
Mr. Aamatya Sharma (Herpetological Society of India, Pune)	Field Support (Data and Photography)

3.6 Scope of Work for Study

The Study was undertaken to achieve the following scope of work,

- Establish a preliminary baseline of terrestrial and aquatic floral and faunal species within the study area (Length ~ 3 km in WLS in Goa (approx.) with 46 m width[1]) and immediate vicinity based on primary survey along with review of secondary literature.'
- Assess the status of major habitats/forests and associated floral species along the proposed transmission line passing through the WLS/Tiger Reserve/Elephant Reserve;
- Identify flagship species corridors, through primary surveys and reiew of relevant management plans, such as those for tiger and elephant likely impacted by the proposed project associated activities;
- Identify & evaluate the likely impacts of the proposed transmission line during the construction and operation phase on the habitat and wildlife species found in the area;
- Suggest mitigation measures and a BMP to minimize the likely impact on protected area, its habitat values and overall ecology of the wildlife/Tiger/Elephant reserve corridors.

The approach and methodology for the above scope of work is discussed hereunder

[1] http://mofpi.nic.in/sites/default/files/GUIDELINES_06.11.2015.pdf

3.7 Approach and Methodology

3.7.1 Approach

Following step wise approach was followed in order to achieve the conformity with the scope of work for baseline data collection

Step 1: Reconnaissance Survey- A reconnaissance survey to understand the complexity of terrain, habitats available, approach for various locations enroute to transmission line corridor and potential areas for species enumeration.

Step 2: Secondary Data Collection- Available secondary data through published research papers, books and periodicals and PhD thesis from the area was reviewed and enlisted to confirm the presence of species. Secondary data was also collected on the historical surveys in the area. Management plan of the protected area was also reviewed. Consultation with the locals and forest officials were also made.

Step 3: Primary Data Collection-Primary surveys were undertaken to understand the actual baseline and analyse the impacts of the proposed project on ecological baseline.

Step 4: Biodiversity Impact Assessment- Assessment of impact of the various construction and operation activities on the ecological baseline.

Step 5: Biodiversity Management Plan-Preparation of Management plan for mitigation of major impacts of construction and operation activities

3.7.2 Methodology of Primary Data Collection

Primary data collection methods for flora and fauna species are discussed hereunder

Floral Assessment

Floral assessment were focused on

- Enumeration of Trees, Shrubs, Herbs, climbers and orchids likely to encounter on the transmission line route and its immediate vicinity;
- Undertake phytosociology along the transmission line corridor to calculate frequency, density and abundance for plant species along with the IVI and calculation of species richness and species diversity;
- The enumerated list of floral species will be compared to Indian Red Data Book and species listed in the IUCN Red data list to confirm their conservation status.
- Following will be emphasized;
    - Species with conservational significance (Indian Red Data Book)
    - Endemic flora species
    - Species with high commercial value

The detailed methodology for data collection for each floral groups (Habit) are presented here under

Trees: Quantitative data was collected using standard quadrate methods of sample plot size 10 m x 10 m for trees in various habitat types along the transmission line route and immediate vicinity.

Shrubs: Quantitative data was collected using standard quadrate methods of sample plot size 10 m x 10 m for shrubs in various habitat types along the transmission line route and immediate vicinity.

Annuals (Herbs, Grasses, Pteridophytes, etc.): Quantitative data was collected on plateaus associated with transmission line using standard quadrate methods of sample plot size 1 m x 1 m for herbs, grasses.

Climbers: Quantitative data was collected using standard quadrate methods of sample plot size 10 m x 10 m for large climbers (lianas) in various habitat types along the transmission line route and immediate vicinity.

Details of the quadrates is presented in Refer **Table 3.2** and sampling photographs in ***Figure 3.1***

Table 3.2 Details of Floral Survey Quadrates

S.N.	Quadrat Size	Number of Quadrates		
		Core Zone	Buffer Zone	Study Area
1.	Trees, shrubs and lianas	5	2	7
2.	Annuals (Herbs, Grasses, Pteridophytes, etc.) and climbers	1	4	5

Faunal Assessment

- Faunal assessment was carried out through enumeration of herpetofauna amphibians and reptiles), avifauna (resident and migratory) and mammals likely to encounter on the transmission line route and its immediate vicinity;
- Assessment of various faunal habitats;
- The enumerated list of faunal species will be compared to Indian Wildlife Protection Act, 1971 schedules and species listed in the IUCN Red -List v.2018.2 to confirm their conservation status.
- Following will be emphasized;
  - Species with conservational significance (Sch. I of IWPA,1972, IUCN v2018.2 Red -List species
  - Endemic faunal species
  - Species listed in CITES Appendix I & II

The detailed methodology for data collection for each faunal groups are presented here under,

Four Transects were laid to enumerate

Herpetofauna: In view of the activity pattern of herpetofauna, diurnal and nocturnal surveys were carried out in the study area. Amphibians and reptiles are known to inhabit various habitats and remain among leaf litter or under rocks and thus special efforts were taken to locate and study those using following methods:

- ***Direct Search Method:*** This method involves searching thoroughly the known habitats of amphibians and reptiles. Intensive searching was carried out in most of the habitats by removing stones, logs, among leaf litter and on trees. This is not a time constrained method so considerable and roughly equal amount of time was spent in most of the habitats.
- ***Searching streams:*** This method was utilized to study amphibians and certain reptiles which are closely associated with aquatic habitats. The surveys were conducted mostly during the night. A few streams coming in or close to the Transmission Line route were surveyed.
- ***Opportunistic records:*** The local nature enthusiasts are photographing amphibians and reptiles and posting these images on social networking sites. A few of them send these images for identification to us. This network of local contacts was used to understand the

herpetofauna diversity in the study area. The identifications of images taken by locals were confirmed by detailed observations.

- ***Systematic Analysis:*** In the study area except a few frogs and lizards, there is less ambiguity in the taxonomy of most of the known amphibians and reptiles. A through taxonomic examination was carried out for most of the herpetofauna encountered during field surveys. The identification was based on recent and historical publications.

Avifauna: In view of the activity of the Avifaunal species early morning and evening surveys were undertaken for enumerating species presence along the transmission line route and buffer area. Day surveys were undertaken to enumerate the soring birds. Following methods were implied

- Total or flock / block count method: Sridharan 1989[1], Bhupathy 1991[2], Thompson 2002)[3] were adopted to assess the status of aquatic birds in dam /water bodies and point count method in the riparian forest along stream / river side (Gregory et al. 2002)[4] of the project area. Birds in the riparian forests were recorded and enumerated within 50 m radius as part of point count.
- Point Count (Hutto et al. 1986[5], Bibby et al. 1992[6], Rosentod et al. 2002[7], Salim and Rahul 2002[8]) and area search (Dieni and Jones 2002[9]) techniques were applied to assess the status of terrestrial birds. Point counts in the forest and allied habitats were made within 50 m radius, while in agriculture that include fallow lands, and scrub / grassland / barren area habitats, birds were recorded within 100 m radius.
- Additional effort was made to locate/identify the presence of any breeding/nesting sites / roosting sites of avifauna.
- Species identification was confirmed using the field guides for the avifaunal species

Mammals

Mammalian fauna was assessed at each sampling locations in different habitats through recording both direct and indirect evidences.

- Status and distribution of different mammalian fauna was quantified using direct count covering all the terrestrial habitats of the transmission line and Right of way areaadopting road count (Burnham et al. 1980[10], Sale and Berkmuller 1988[11], Rodgers 1991[12]). These

[1] Sridharan, U. 1989. Comparative ecology of resident ducks in Keoladeo National Park, Bharatpur. Ph.D. Dissertation, University of Bombay, Bombay.

[2] Bhupathy, S. 1991. Blotch structure in individual identification of the Indian Python (Python molurus molurus Linn.) and its possible usage in population estimation. Journal of Bombay Natural History Society 87: 399–404. 85

[3] Thompson, W.L. 2002.Towards reliable bird surveys: accounting for individuals present but not detected. The Auk. 119:18-25.

[4] Gregory, R. D., Gibbons, D. W. and Donald, P. F. 2002. Bird census and survey techniques. Pp:17-56. In: Bird Ecology and Conservation: A Handbook of Techniques. (Eds.) W. J. Sutherland, I. Newton and R. E. Green. Oxford University Press, Oxford. 386 p.

[5] Hutto, R.L., S.M. Pletsechel and P. Hendrick. 1986. A fixed radius point count method for non breeding season use. The Auk. 103: 593-602.

[6] Bibby, C.J., N.D., Burgerss and D.A. Hill. 1992. Bird Census techniques, Academic Press, London.

[7] Rosentod, S.S., Anderson, B.R., Giesenk. N, Leukerig, T., and Carter, M.F. 2002. Land bird counting techniques: Current practises and an alternative. The Auk 119(1):46-53

[8] Salim, J. and Rahul, K. 2002. Field methods for bird surveys. Bombay Natural History Society; Department of Wildlife Sciences, Aligarh Muslim University, Aligarh, and world Pheasant association, South Asia Regional Office (SARO), New Delhi, India. 61 p.

[9] Dieni, J.S. and Jones, S.L. 2002. A field test of the area search method for measuring breeding birds population. J. Field Ornithology, 73: 253-257.

[10] Burnham, K.P., D.R. Andreson., and J.L. Laake. 1980. Estimation of density from line transect sampling of biological population. Wildl. Mongr. No. 72. The Wildlife Society, Washington D.C. 202p

[11] Sale, J.B. and K. Berkmuller, 1988. Manual of Wildlife Techniques for India. FAO, United Nation's India Establishment of Wildlife Institute of India Dehra Dun.

[12] Rodgers, W.A. 1991. Technique for Wildlife Census in India, A field Manual. Technical Manual. TM2. Wildlife Institute of India, Dehra Dun. India.81pp.

survey routes were the area between two sample points and the forest trails that traverse across different habitats and land uses.

- In addition indirect evidences (pellets, dungs, droppings, scats and other tracks and signs), were searched within circular (25m radius) plots at each sampling location, which provide relative abundance of presence of mammalian fauna (Thompson et al. 1989[1], Rodgers 1991, Henke and Knowlton 1995[2], Allen et al. 1996[3]).
- Further presence of different faunal species was also ascertained and substantiated by interviewing the local people with the pictures of the mammals from the field guides that could probably occur in the area and discussion with local experts.

Field Survey pictorial representation are provided in ***Figure 3.1***

[1] Thommpson, I.D., Davidson, I.J., O' Donnell, S. and Brazeau, F. 1989. Use of track transect to measure the relative occurrence of some arboreal mammals in uncut forest and regeneration stands. Canadian Journal of Zoology. 67: 1816-1823.

[2] Henke, S.E. and knowlton, F.F. 1995. Techniques for estimating Coyote abundance. Pp; 71-78. In: Proceedings of the symposium: Coyotes in the southwest. Parks and wildlife Department: Austin, Texas.

[3] Allen, L., Engeman, R. and Krupa, H. 1996 Evaluation of three relative abundance indices for assessing dingo population. Wildlife Research. 23 197-206.

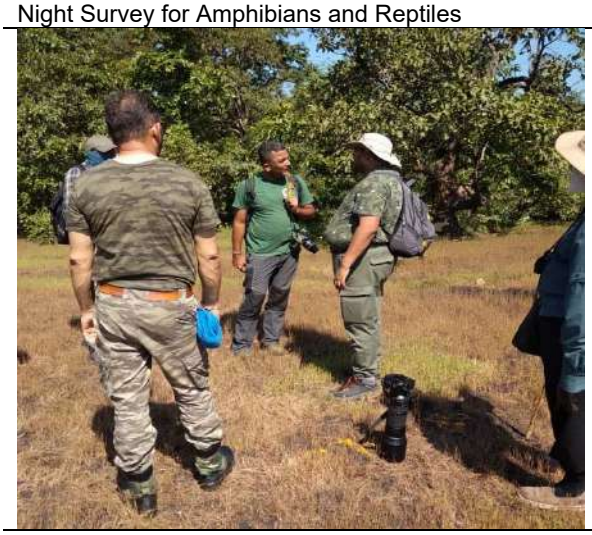
Figure 3.1 Ecological Baseline Field Surveys

Flora Survey around Tower Location 14/2

Flora Survey around Tower Location AP-4/0

Night Survey for Amphibians and Reptiles

Night Survey for Amphibians and Reptiles



Site Discussions for Habitat Selection

Transect Surveys

Floral Survey

Stream Surveys

3.8 Floral Assessment

3.8.1 Vegetation Profile in Study Area

The vegetation[1] of the study area is a mosaic of tropical evergreen, tropical semi-evergreen and moist deciduous forests along with the lateritic plateaus or lateritic outcrops. The higher altitudinal area and the area along the riverbanks have tropical evergreen forests; while the area of lower altitude and more towards the plains comprises tropical moist deciduous type of forests. The tropical semi-evergreen forests are transitional between evergreen forests and moist deciduous forests. Beside these three forest types, lateritic plateaus or lateritic outcrops also occurs in patches in the area. The brief account of these vegetation types is given below and pictorial representation is provided in ***Figure 3.2***.

West Coast Tropical Evergreen Forests

The evergreen type of forests is mainly seen on higher altitudes and along the riverbanks, because of the perennial sources of water within the study area. The tall and lofty components here are *Actinodaphne angustifolia, Canarium strictum, Diospyros buxifolia, Diospyros pruriens, Garcinia gummi-gutta, Holigarna grahamii, Knema attenuata, Mammea suriga, Polyalthia fragrans, Syzygium laetum, Vitex altissima,* etc. The middle-sized trees are composed of *Litsea coriacea, Aporusa cardiosperma, Antidesma acidum, Blachia andamanica* subsp. *denudata, Ixora nigricans, Psychotria dalzellii, Memecylon terminale, Dracaena terniflora.* The trees found in the riparian forests are *Calophyllum calaba, Lophopetalum wightianum* and *Hydnocarpus pentandrus. Arenga wightii*, a common palm can be seen near streams and rivers. Along the rivers shrubs like *Melastoma malabathricum* and *Wendlandia thyrsoidea* can also be seen. Some woody climbers or lianas found in this type of forest are *Entada rheedei, Gnetum ula, Chonemorpha fragrans, Ancistrocladus heyneanus, Luvunga eleutherandra, Paramignya monophylla* and *Toddalia asiatica*. Undergrowth is formed by shrubby species like *Dracaena terniflora, Ixora coccinea* and herbaceous species of families Cyperaceae, Zingiberaceae, Commelinaceae and Asteraceae.

Epiphytic plants in evergreen forests are restricted to family Orchidaceae (belonging to the genera like *Aerides, Bulbophyllum, Cymbidium, Eria* and *Vanda*) and Apocynaceae (*Hoya wightii).* Other epiphytes or lithophytes like *Utricularia striatula* and *Argostemma courtallense* are also found in the crevices of rocks and on trunks of tall trees where there is little soil and moisture. Common epiphytic ferns growing on trees are *Drynaria quercifolia* and *Pyrrosia adnascens.* The herbaceous flora includes *Costus speciosus, Impatiens* sp., *Phyllanthus* sp., *Urena lobata, Gynura nitida,* etc.

West Coast Semi-Evergreen Forests

These forests are transitional between moist deciduous forests and evergreen forests and found in the upper parts of ghats and lower elevations near stream beds. The semi-evergreen formations are seen with isolated patches of evergreen forests in ravines and valleys.

The following two edaphic types are found depending on local variation in soil and moisture within semi-evergreen forests.

Cane Breaks- These occur on the slopes of the ghat region. *Calamus thwaitesii* is more common in lower elevation areas. *Calamus pseudotenuis* is more common on higher elevations.

Lateritic Semi-evergreen forests- These forests are distributed over elevations above 200 m. Important species found in these areas are *Actinodaphne angustifolia*, *Canthium dicoccum*, *Macaranga peltata*, *Careya arborea*, *Lagerstroemia lanceolata*, *Pterospermum diversifolium*, etc. The second storey includes *Glochidion hohenackeri*, *Olea dioica*, *Ixora nigricans*, *Celtis timorensis*, etc.

[1] Datar, M. N., & Lakshminarasimhan, P. (2013). *Flora of Bhagwan Mahavir (Molem) National Park and Adjoinings, Goa*. Botanical Survey of India

The shrubs found in undergrowth are *Chassalia curviflora* var. *ophioxyloides*, *Glycosmis pentaphylla*, *Maesa indica*, *Leea asiatica*, *Leea indica*, *Crotalaria retusa* and *Gnidia glauca*. These species are often associated with climbing shrubs like *Connarus monocarpus* and *Clematis gouriana*. Some of the common herbs include *Impatiens balsamina*, *Cyperus* sp., *Asystasia dalzelliana*, *Cynarospermum asperrimum*, *Lindernia* sp., and grasses such as *Apluda mutica*, *Eragrostis unioloides*, *Garnotia arboreum* and *Ischaemum* sp.

Moist Deciduous Forests- Most of the forests in the study area fall in this category. This type of forest is mostly found in the plains between the altitudes from 80 to 200 m. Important floristic elements found in these areas are *Careya arborea, Dillenia pentagyna, Grewia tiliifolia, Lannea coromandeliaca, Terminalia* sp*., Schleichera oleosa, Xylia xylocarpa, Haldina cordifolia,* etc*.* Other trees found in moist deciduous forests are *Falconeria insignis, Wrightia* sp*., Flacourtia montana,* etc. The dominant families are Rubiaceae (*Ixora, Mitragyna),* Bignoniaceae (*Heterophragma, Stereospermum, Oroxylum)* Euphorbiaceae (*Mallotus, Glochidion, Antidesma, Briedelia)* and Leguminosae (*Dalbergia, Acacia, Albizia).* These elements are sometimes intermixed with species of *Dendrocalamus* and *Bambusa.* In the riparian patches, *Hopea ponga* and *Crateva magna* are seen. The shrubs or second storey of trees includes *Catunaregam spinosa, Flemingia strobilifera, Canthium* sp., *Strychnos nux-vomica, Meyna laxiflora, Ziziphus xylopyrus, Xantolis tomentosa.* Common epiphyte, especially on most of the *Terminalia* sp. is *Rhynchostylis retusa. Aerides crispa* and *Aerides maculosa* are also found epiphytic on many trees.

The ground flora in forest clearings and exposed situations comprises members of Leguminosae: Papilionoideae (*Geissaspis, Crotalaria, Indigofera, Alysicarpus, Desmodium, Tadehagi*), Acanthaceae (*Justicia, Lepidagathis, Rungia*), Rubiaceae (*Spermacoce, Neanotis, Hedyotis*), Euphorbiaceae (*Euphorbia)*, Asteraceae (*Blumea, Elephantopus, Senecio, Phyllocephalum)* and Lamiaceae (*Leucas, Platostoma, Pogostemon, Hyptis*). In open areas climbers and twiners of Convolvulaceae, Leguminosae: Papilionoideae, Smilacaceae, Ranunculaceae have been recorded.

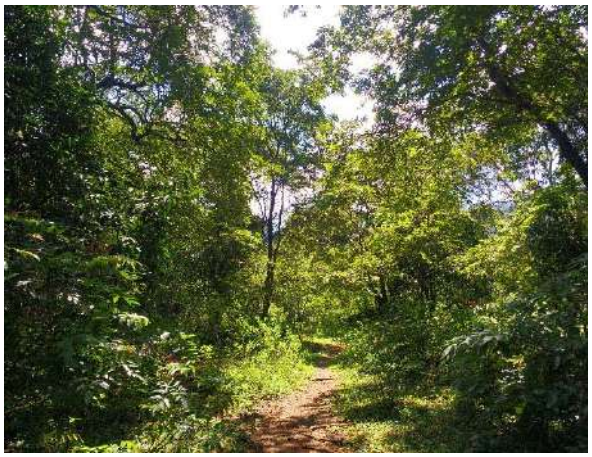
The Plateaus:- Lateritic plateaus or lateritic outcrops are of common occurrence in Western Ghats of Goa. They are very specific as far as their floristic composition and geology are concerned. These outcrops are dry and barren during most of the year, but after the arrival of monsoon many tiny plants start appearing on them. *Utricularia lazulina, Utricularia uliginosa* and *Utricularia reticulata* are the common insectivorous species on the outcrops. In addition, *Eriocaulon* sp*., Lindernia ciliata, Impatiens minor, Fimbristylis* sp*., Rhamphicarpa longiflora* and *Jansenella griffithiana* are also seen on plateaus. Most of the vegetation on plateaus sustain till September only.

Figure 3.2 Vegetation Types in the Study Area

West Coast Semi-Evergreen Forests

Moist Deciduous Forests

West Coast Tropical Evergreen Forests



Moist Deciduous Forests

West Coast Tropical Evergreen Forests

Lateritic Plateau Vegetation

Lateritic Plateau Vegetation

Lateritic Plateau Ground Cover

Cane Breaks-West Coast Semi-Evergreen Forests

Tambdi Surla Waterfall- Lateritic Semi-evergreen forests

Following quadrates (Refer ***Table 3.3***) were laid in the core and buffer zone of the Transmission line corridor. The quadrates location is shown in ***Figure 3.3*** and ***Figure 3.4***

Table 3.3 Details of the Quadrate Surveyed and its Distribution

Quadrates in Core Zone			Quadrates in Buffer Zone		
Q11:	43 P 413994.88 m E; 1704898.54 m N	Lateritic Plateau Vegetation	Q12:	43 P 413956.80 m E 1704872.58 m N	Moist Deciduous Forests
Q16:	43 P 413943.56 m E 1705206.48 m N	Lateritic Plateau Vegetation	Q13:	43 P 413935.33 m E 1704899.98 m N	Lateritic Plateau Vegetation
Q17:	43 P 413916.26 m E 1705225.60 m N	Moist Deciduous Forests	Q14:	43 P 413986.83 m E 1705186.19 m N	Lateritic Plateau Vegetation
Q18:	43 P 420489.54 m E 1706658.67 m N	Moist Deciduous Forests	Q15:	43 P 413971.41 m E 1705222.75 m N	Moist Deciduous Forests
Q19:	43 P 420576.37 m E 1706572.20 m N	West Coast Tropical Evergreen Forests	Q20:	43 P 420605.24 m E 1706509.50 m N	West Coast Tropical Evergreen Forests
Q22:	43 P 420314.00 m E 1706804.00 m N	Moist Deciduous Forests	Q21:	43 P 420410.80 m E 1706663.15 m N	West Coast Tropical Evergreen Forests

Figure 3.3 Floral and Faunal Survey locations (Section 1)

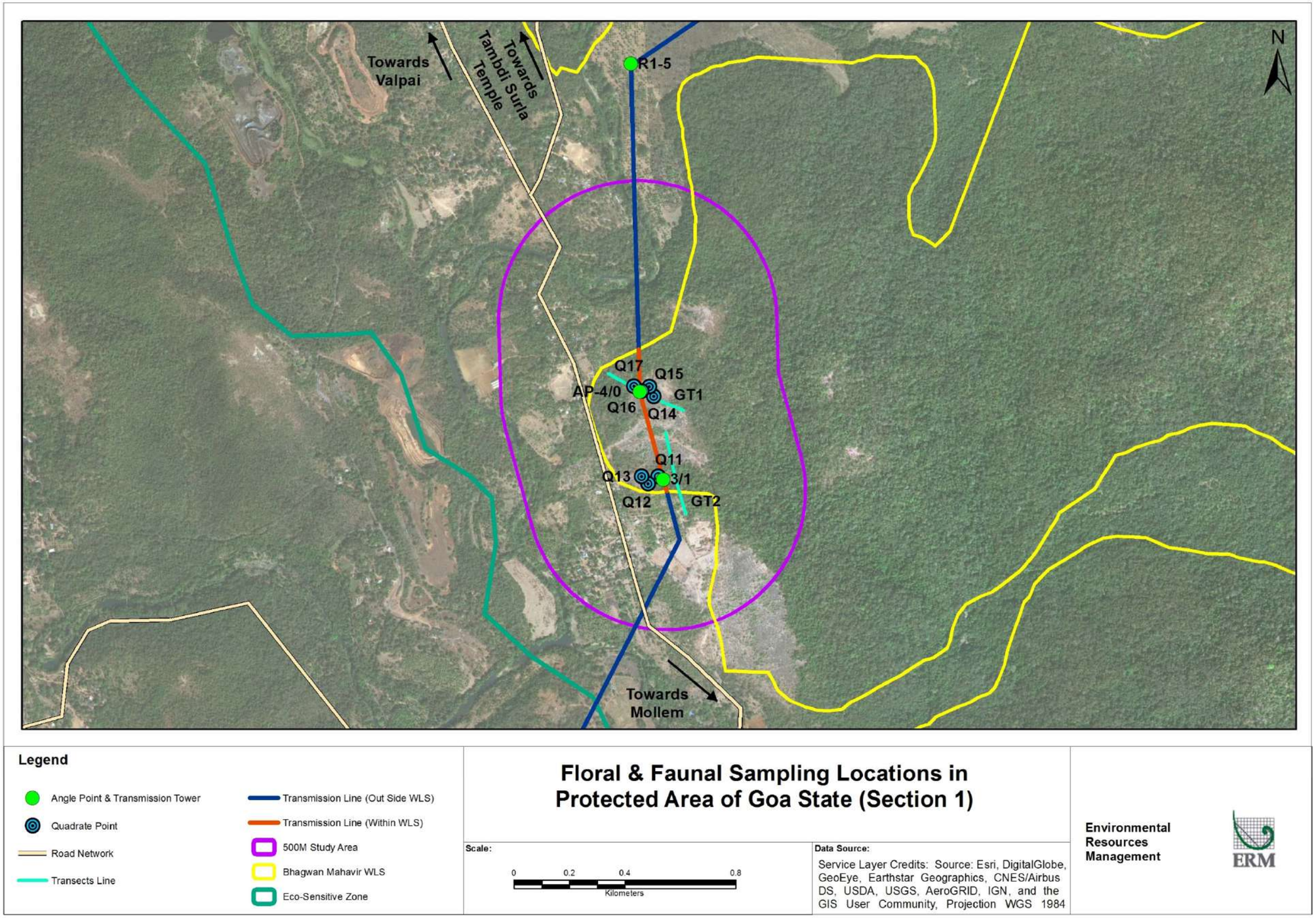
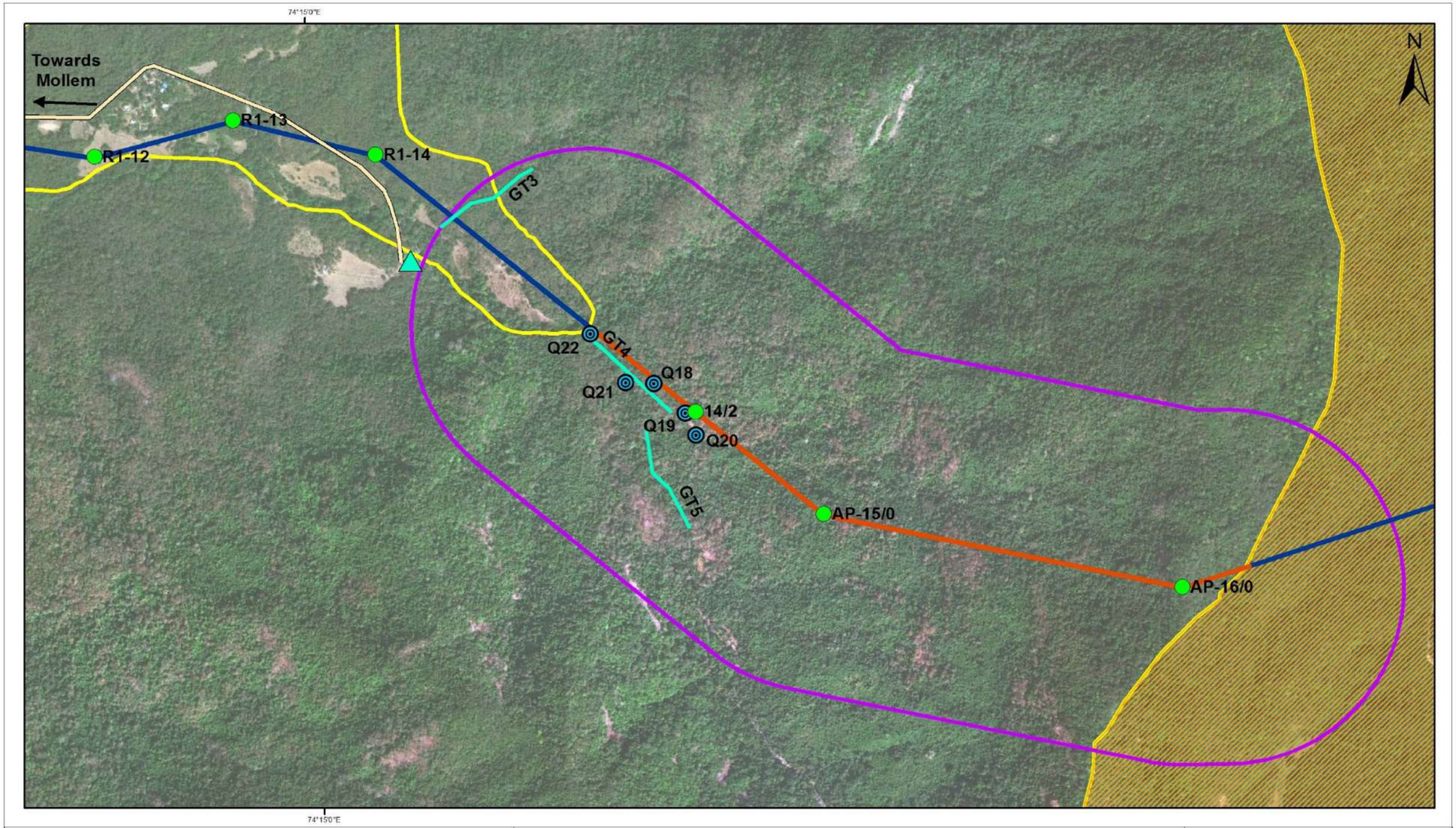


Figure 3.4 Floral and Faunal Survey locations (Section 2)



3.8.2 Taxonomic Status-Species Richness

In core zone of Goa, sampling was done in only one vegetation type i.e forest. The diversity is represented by 19 families 26 genera and 27 species.

In buffer zone two vegetation types were surveyed yielding 11 families 14 genera and 15 species from forests and 5 families 7 genera and 7 species from plateaus. Overall diversity is represented by 28 families 42 genera and 45 species. (Refer ***Table 3.4***)

Table 3.4 Taxonomic Status of Flora along the Proposed Transmission line route

Taxa	Core Zone			CT	Buffer Zone			BT	SAT
	FT1 (Forests)	FT2	FT3		FT1 (Forests)	FT2 (Plateaus)	FT3		
Family	19	0	0	19	11	5	0	16	28
Genus	26	0	0	26	14	7	0	21	42
Species	27	0	0	27	15	7	0	22	45

Note1: FT1- West Coast Semi-Evergreen Forests, FT2-Lateritic plateaus; CT-Core Zone Total, BT-Buffer Zone Total, SAT-Study Area Total

3.8.3 Status of Growth Forms

Various growth forms studied are discussed hereunder;

- **Tree:** A woody, perennial plant, having a single trunk (bole) with multiple branches.
- **Shrub:** A woody, perennial plant, generally smaller than a tree, and with several stems arising from the ground level.
- **Herb:** A non-woody plant other than grasses.
- **Grass:** Plant belonging to the grass families Poaceae, Cyperaceae and Juncaceae.
- **Pteridophyte:** The vascular plant (with xylem and phloem) that disperses spores
- **Climber:** Plant, which climb up trees and other tall objects.

Study area is represented by twenty five (25) trees species; three (3)species of shrubs and eleven (11) species of lianas/climbers in forests and four (4) species of herbs and three (3) species of grasses. Details are provided in ***Table 3.5.***

Table 3.5 Status of Floral Growth forms along the Proposed Transmission Line Route

Growth forms	Core Zone			CT	Buffer Zone			BT	SAT
	FT1(Forest)	FT2	FT3		FT1(Forests)	FT2(Plateaus)	FT3		
Tree	15	0	0	15	10	0	0	10	25
Shrub	3	0	0	3	0	0	0	0	3
Herb	0	0	0	0	0	4	0	4	4
Grass	0	0	0	0	0	3	0	3	3
Climber	9	0	0	9	5	0	0	5	11
Total Species	27	0	0	27	15	7	0	22	45

Note1: FT1- West Coast Semi-Evergreen Forests*, FT2-Lateritic plateaus; CT-Core Zone Total, BT-Buffer Zone Total, SAT-Study Area Total*

Note2: Lianas are treated here under shrubs and climbers based on their habit.

3.8.1 Status of Tree species

A total of 38 trees and liana species were recorded from study area. Based on IVI values *Lagerstroemia microcarpa* and *Memecylon umbellatum* were found to be dominant amongst trees, while amongst lianas *Getonia floribunda* was dominant. The details are presented in ***Table 3.6.***

Table 3.6 Important Value Index (IVI) and Rank Order of Tree Species and lianas in Study Area

S. N.	Tree Species	RF (%)	RDN (%)	RA (%)	IVI	RO
Core Zone						
1	*Allophylus cobbe* (L.) Raeusch.	2.63	1.61	2.37	6.62	10
2	*Beilschmiedia dalzellii* (Meisn.) Kosterm.	5.26	3.23	2.37	10.86	8
3	*Calamus thwaitesii* Becc.	2.63	3.23	4.74	10.60	9
4	*Careya arborea* Roxb.	2.63	1.61	2.37	6.62	10
5	*Catunaregam spinosa* (Thunb.) Tirveng.	2.63	1.61	2.37	6.62	10
6	*Combretum latifolium* Blume	2.63	1.61	2.37	6.62	10
7	*Dalbergia horrida* (Dennst.) Mabb.	7.89	4.84	2.37	15.10	6
8	*Dillenia pentagyna* Roxb.	5.26	6.45	4.74	16.46	5
9	*Diploclisia glaucescens* (Blume) Diels	2.63	3.23	4.74	10.60	9
10	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC.	2.63	1.61	2.37	6.62	10
11	*Flacourtia montana* J. Graham	2.63	1.61	2.37	6.62	10
12	*Getonia floribunda* Roxb.	7.89	6.45	3.16	17.51	4
13	*Hopea ponga* (Dennst.) Mabb.	2.63	1.61	2.37	6.62	10
14	*Ixora brachiata* Roxb.	2.63	1.61	2.37	6.62	10
15	*Lagerstroemia microcarpa* Wight	2.63	9.68	14.23	26.54	2
16	*Leea indica* (Burm. f.) Merr.	2.63	1.61	2.37	6.62	10
17	*Lepisanthes tetraphylla* (Vahl) Radlk.	2.63	3.23	4.74	10.60	9
18	*Memecylon umbellatum* Burm. f.	5.26	9.68	7.11	22.06	3
19	*Moullava spicata* (Dalzell) Nicolson	2.63	1.61	2.37	6.62	10
20	*Olea dioica* Roxb.	2.63	1.61	2.37	6.62	10
21	*Schleichera oleosa* (Lour.) Oken	2.63	1.61	2.37	6.62	10
22	*Tabernaemontana heyneana* Wall.	5.26	4.84	3.56	13.66	7
23	*Terminalia bellirica* (Gaertn.) Roxb.	2.63	3.23	4.74	10.60	9
24	*Terminalia elliptica* Willd.	7.89	16.13	7.91	31.93	1
25	*Ventilago denticulata* Willd.	2.63	1.61	2.37	6.62	10
26	*Xantolis tomentosa* (Roxb.) Raf.	5.26	3.23	2.37	10.86	8
27	*Ziziphus rugosa* Lam.	2.63	1.61	2.37	6.62	10
Buffer zone		**RF (%)**	**RDN (%)**	**RA (%)**	**IVI**	**RO**
1	*Albizia odoratissima* (L. f.) Benth.	6.25	2.50	2.94	11.69	4
2	*Bombax ceiba* L.	6.25	2.50	2.94	11.69	4

S. N.	Tree Species	RF (%)	RDN (%)	RA (%)	IVI	RO
3	*Calamus thwaitesii* Becc.	12.50	30.00	17.65	60.15	2
4	*Derris heyneana* (Wight & Arn.) Benth.	6.25	2.50	2.94	11.69	4
5	*Dillenia pentagyna* Roxb.	6.25	2.50	2.94	11.69	4
6	*Diospyros paniculata* Dalzell	6.25	5.00	5.88	17.13	3
7	*Diospyros pruriens* Dalzell	6.25	5.00	5.88	17.13	3
8	*Grewia tiliifolia* Vahl	6.25	2.50	2.94	11.69	4
9	*Holigarna grahamii* (Wight) Kurz	6.25	2.50	2.94	11.69	4
10	Hopea ponga (Dennst.) Mabb.	6.25	30.00	35.29	71.54	1
11	*Lophopetalum wightianum* Arn.	6.25	2.50	2.94	11.69	4
12	*Paramignya monophylla* Wight	6.25	2.50	2.94	11.69	4
13	*Pterospermum diversifolium* Blume	6.25	2.50	2.94	11.69	4
14	*Sterculia guttata* Roxb. ex DC.	6.25	2.50	2.94	11.69	4
15	*Ventilago denticulata* Willd.	6.25	5.00	5.88	17.13	3
Study Area		**C-IVI**	**B-IVI**	**TOTAL**		
1	*Albizia odoratissima* (L. f.) Benth.		2.94	2.94		
2	*Allophylus cobbe* (L.) Raeusch.	6.62		6.62		
3	*Beilschmiedia dalzellii* (Meisn.) Kosterm.	10.86		10.86		
4	*Bombax ceiba* L.		2.94	2.94		
5	*Calamus thwaitesii* Becc.	10.60	17.65	28.25		
6	*Careya arborea* Roxb.	6.62		6.62		
7	*Catunaregam spinosa* (Thunb.) Tirveng.	6.62		6.62		
8	*Combretum latifolium* Blume	6.62		6.62		
9	*Dalbergia horrida* (Dennst.) Mabb.	15.10		15.10		
10	*Derris heyneana* (Wight & Arn.) Benth.		2.94	2.94		
11	*Dillenia pentagyna* Roxb.	16.46	2.94	19.40		
12	*Diospyros paniculata* Dalzell		5.88	5.88		
13	*Diospyros pruriens* Dalzell		5.88	5.88		
14	*Diploclisia glaucescens* (Blume) Diels	10.60		10.60		
15	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC.	6.62		6.62		
16	*Flacourtia montana* J. Graham	6.62		6.62		
17	*Getonia floribunda* Roxb.	17.51		17.51		
18	*Grewia tiliifolia* Vahl		2.94	2.94		
19	*Holigarna grahamii* (Wight) Kurz		2.94	2.94		
20	*Hopea ponga* (Dennst.) Mabb.	6.62	35.29	41.91		
21	*Ixora brachiata* Roxb.	6.62		6.62		
22	*Lagerstroemia microcarpa* Wight	26.54		26.54		
23	*Leea indica* (Burm. f.) Merr.	6.62		6.62		

S. N.	Tree Species	RF (%)	RDN (%)	RA (%)	IVI	RO
24	*Lepisanthes tetraphylla* (Vahl) Radlk.	10.60		10.60		
25	*Lophopetalum wightianum* Arn.		2.94	2.94		
26	*Memecylon umbellatum* Burm. f.	22.06		22.06		
27	*Moullava spicata* (Dalzell) Nicolson	6.62		6.62		
28	*Olea dioica* Roxb.	6.62		6.62		
29	*Paramignya monophylla* Wight		2.94	2.94		
30	*Pterospermum diversifolium* Blume		2.94	2.94		
31	*Schleichera oleosa* (Lour.) Oken	6.62		6.62		
32	*Sterculia guttata* Roxb. ex DC.		2.94	2.94		
33	*Tabernaemontana heyneana* Wall.	13.66		13.66		
34	*Terminalia bellirica* (Gaertn.) Roxb.	10.60		10.60		
35	*Terminalia elliptica* Willd.	31.93		31.93		
36	*Ventilago denticulata* Willd.	6.62	5.88	12.50		
37	*Xantolis tomentosa* (Roxb.) Raf.	10.86		10.86		
38	*Ziziphus rugosa* Lam.	6.62		6.62		

Notes: RF- Relative Frequency, RDN- Relative Density, RDO- Relative Dominance, C-IVI- Core Important Value Index, B-IVI- Buffer Important Value Index, RO- Rank Order (based on the relative frequency of each species, highest being 1 and lowest being 5).

3.8.2 Status of Annuals (Herbs and Grasses species)

Total of seven species were recorded from lateritic plateaus of buffer zones. Of these seven species three are grasses. Based on IVI values *Eriocaulon eurypeplon* and *Glyphochloa henryi* are dominant species. The details are presented in ***Table 3.7.***

Table 3.7 Important Value Index (IVI) and Rank Order of Herbs and Grass Species

Herb Species	RF (%)	RDN (%)	RA (%)	IVI	RO
Eriocaulon eurypeplon Koern.	20	220.8	47.52	288.325	1
Lepidagathis prostrata Dalzell	20	16	3.444	39.444	4
Glyphochloa henryi Janarth., V.C.Joshi, S.Rajkumar	20	102.8	22.126	144.927	2
Geissaspis tenella Benth.	16	1.6	0.431	18.031	5
Murdannia semiteres (Dalzell) Santapau	12	1.2	0.431	13.631	6
Dimeria sp.	8	46.8	25.183	79.983	3
Indopoa paupercula (Stapf) Bor ex Ramamoorthy	4	0.8	0.861	5.661	7

3.8.3 Status of Medicinal Plants

The medicinal plants observed within transmission line route are detailed in the ***Table 3.8*** and represented in ***Figure 3.5.***

Table 3.8 Medicinal Plants recorded from Transmission Line Route

S.N.	Species	Habit	CZ	BZ	Medicinal use
1	*Bombax ceiba* L.	Tree		@	Skincare
2	*Catunaregam spinosa* (Thunb.) Tirveng.	Shrub	@		Diarrhoea and dysentery
3	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC.	Shrub	@		Vermifuge
4	*Ixora brachiata* Roxb.	Tree	@		Antimicrobial
5	*Moullava spicata* (Dalzell) Nicolson	Liana	@		Pneumonia, skin diseases
6	*Schleichera oleosa* (Lour.) Oken	Trees	@		skin diseases
7	*Tabernaemontana heyneana* Wall.	Tree	@		Antibacterial
8	*Terminalia bellirica* (Gaertn.) Roxb.	Tree	@		In Triphala
		Total	7	1	

Source: Datar and Lakshminarasimhan, 2013
Notes: CZ- Core Zone, BZ- Buffer Zone, CS- Common Species, @-Presence

Figure 3.5 Medicinal Plants recorded from Transmission Line Route

Terminalia bellirica

Catunaregam spinos

Moullava spicata

3.8.4 Status of Threatened Plants

In study area six (06) species were found to be threatened of which four (04) arboreal species occur in forests and two (02) herbaceous species were observed growing on lateritic outcrops. The species are listed in ***Table 3.9*** and represented in ***Figure 3.6***

Table 3.9 Threatened Species

S. N.	Name of species	Habit	Zones (Core Zone/ Buffer Zone)	IUCN,V2018.2
1	*Diospyros paniculata* Dalzell	Tree	BZ	VU
2	*Holigarna grahamii* (Wight) Kurz	Tree	BZ	LC
3	*Hopea ponga* (Dennst.) Mabb.	Climber	CZ,BZ	EN
4	*Tabernaemontana heyneana* Wall.	Tree	CZ,BZ	NT
5	*Eriocaulon eurypeplon* Koern.	Herb	CZ	LC
6	*Geissaspis tenella* Benth.	Herb	CZ	LC

Notes: CZ– Core Zone, BZ- Buffer Zone, Source-Secondary Data

Source: Nayar, T. S., Garden, J. N. T. B., Research Institute, Beegam, A. R., & Sibi, M. (2014). Flowering plants of the Western Ghats, India. Jawaharlal Nehru Tropical Botanic Garden and Research Institute.

Figure 3.6 Threatened Species

Eriocaulon eurypeplon

Holigarna grahamii

Hopea ponga

Tabernaemontana heyneana

3.8.5 Status of Endemic Species

The Western Ghats region have higher endemicity within floral species. A total of 12 endemic plants were reported of which four (04) are herbaceous; three (03) are climbers and five (05) are tree species. The endemic species are listed in ***Table 3.10*** and presented in ***Figure 3.7.*** These species are endemic to Western Ghats of India.

Table 3.10 Endemic Species

S. N.	Name of species	Family	Local Name	Habit	Zones (CZ, BZ)
1	*Derris heyneana* (Wight & Arn.)Benth.	Leguminosae	-	C	BZ
2	*Diospyros paniculata* Dalzell	Ebenaceae	-	T	BZ
3	*Eriocaulon eurypeplon* Koern.	Eriocaulaceae	-	H	
4	*Flacourtia montana* J. Graham	Flacourtiaceae	Chaper	T	CZ
5	*Geissaspis tenella* Benth.	Leguminosae	-	H	
6	*Glyphochloa henryi* Janarth., V.C.Joshi , S.Rajkumar	Poaceae	-	H	
7	*Holigarna grahamii* (Wight) Kurz	Anacardiaceae	-	T	BZ
8	*Hopea ponga* (Dennst.) Mabb.	Dipterocarpaceae	Kaushi	C	CZ
9	*Indopoa paupercula* (Stapf) Bor ex Ramamoorthy	Poaceae	-	H	
10	*Ixora brachiata* Roxb.	Rubiaceae	-	T	CZ
11	*Moullava spicata* (Dalzell) Nicolson	Leguminosae	Shamachi vel	C	CZ
12	*Tabernaemontana heyneana* Wall.	Apocynaceae	Nagkuda	T	CZ

Figure 3.7 Endemic Species

Eriocaulon eurypeplon

Geissaspis tenella

Holigarna grahamii

Tabernaemontana heyneana

Hopea ponga

Indopoa paupercula

3.8.6 Overall Species Richness

The study area is represented by 38 species 36 genera and 25 families while associated 60 species belong to 55 genera and 37 family. Overall diversity comprises of 60 species 55 genera and 37 families. The details are presented in ***Table 3.11.***

Table 3.11 Overall Species Richness of Flora along the transmission line route

Parameters	Study Area List	SS	Overall
Family	25	37	37
Genus	36	55	55
Species	38	60	60

Notes: SS-taxa which were documented as associated species. Study area list contains taxa documented in quadrats.

3.8.7 Species Diversity and Species Evenness

The species diversity is represented by Shannon Weiner Diversity Index[1] and Simpson Diversity Index[2] along with Species evenness from the data collected from the study area. The species diversity and species evenness are presented in ***Table 3.12***.

Table 3.12 Species Diversity and Species Evenness

Species	Core Zone	Buffer Zone
Shannon Weiner Index of Diversity (H')	2.99	2.094
Simpson Index of Diversity	0.373	0.432
Species Evenness	0.907	0.773

[1] Shannon, C. E. (1948) A mathematical theory of communication. The Bell System Technical Journal, 27, 379–423 and 623–656.

[2] Simpson, E. H. (1949). "Measurement of diversity". Nature. 163: 688.

3.8.8 Overall Species list

The overall species list is presented as hereunder in ***Table 3.13***;

Table 3.13 Overall List of Flora (Botanical name, Family, Local name, Locality, Local name, Growth form, Vegetation/Forest type) along the Proposed Transmission line

S.N.	Species name	Family	Habitat	Habit	Threatened status
1	*Aerides maculosa* Lindl.	Orchidaceae	Forest	Epiphytic	Endemic
2	*Albizia odoratissima* (L. f.) Benth.	Leguminosae	Forest	Tree	
3	*Allophylus cobbe* (L.) Raeusch.	Sapindaceae	Forest	Tree	
4	*Beilschmiedia dalzellii* (Meisn.) Kosterm.	Lauraceae	Forest	Tree	
5	*Bombax ceiba* L.	Malvaceae	Forest	Tree	
6	*Calamus thwaitesii* Becc.	Arecaceae	Forest	Liana	
7	*Careya arborea* Roxb.	Lecythidaceae	Forest	Tree	
8	*Catunaregam spinosa* (Thunb.) Tirveng.	Rubiaceae	Forest	Tree	
9	*Chamaecrista absus* (L.) H. S. Irwin & Barneby	Leguminaceae	Forest	Herb	
10	*Cissus repanda* Vahl	Vitaceae	Forest	Shrub	
11	*Combretum latifolium* Blume	Combretaceae	Forest	Liana	
12	*Dalbergia horrida* (Dennst.) Mabb.	Leguminosae	Forest	Liana	
13	*Derris heyneana* (Wight & Arn.) Benth.	Leguminosae	Forest	Liana	Endemic
14	*Dillenia pentagyna* Roxb.	Dilleniaceae	Forest	Tree	
15	*Dimeria* sp.	Poaceae	Plateau	Herb	
16	*Dioscorea bulbifera* L.	Dioscoriaceae	Forest	Climber	
17	*Diospyros paniculata* Dalzell	Ebenaceae	Forest	Tree	Endemic
18	*Diospyros pruriens* Dalzell	Ebenaceae	Forest	Tree	
19	*Diploclisia glaucescens* (Blume) Diels	Menispermaceae	Forest	Liana	
20	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC.	Myrsinaceae	Forest	Tree	
21	*Eriocaulon dalzellii* Koern.	Eriocaulaceae	Plateau	Herb	Endemic
22	*Eriocaulon eurypeplon* Koern.	Eriocaulaceae	Plateau	Herb	Endemic
23	*Flacourtia montana* J. Graham	Flacourtiaceae	Forest	Tree	Endemic
24	*Geissaspis tenella* Benth.	Leguminaceae	Plateau	Herb	Endemic
25	*Getonia floribunda* Roxb.	Combretaceae	Forest	Liana	
26	*Glyphochloa henryi* Janarth., V.C.Joshi, S.Rajkumar	Poaceae	Plateau	Herb	Endemic

S.N.	Species name	Family	Habitat	Habit	Threatened status
27	*Grewia nervosa* (Lour.) Panigrahi	Tiliaceae	Forest	Shrub	
28	*Grewia tiliifolia* Vahl	Malvaceae	Forest	Tree	
29	*Holigarna grahamii* (Wight) Kurz	Anacardiaceae	Forest	Tree	Endemic
30	*Hopea ponga* (Dennst.) Mabb.	Dipterocarpaceae	Forest	Tree	Endemic
31	*Indigofera dalzellii* T. Cooke	Leguminaceae	Plateau	Herb	Endemic
32	*Indopoa paupercula* (Stapf) Bor ex Ramamoorthy	Poaceae	Plateau	Herb	Endemic
33	*Ischaemum semisagittatum* Roxb.	Poaceae	Plateau	Herb	
34	*Ixora brachiata* Roxb.	Rubiaceae	Forest	Tree	Endemic
35	*Lagerstroemia microcarpa* Wight	Lythraceae	Forest	Tree	
36	*Leea indica* (Burm. f.) Merr.	Leeaceae	Forest	Tree	
37	*Lepidagathis prostrata* Dalzell	Acanthaceae	Plateau	Herb	
38	*Lepisanthes tetraphylla* (Vahl) Radlk.	Sapindaceae	Forest	Tree	
39	*Lophopetalum wightianum* Arn.	Celastraceae	Forest	Tree	
40	*Memecylon umbellatum* Burm. f.	Melastomataceae	Forest	Tree	
41	*Moullava spicata* (Dalzell) Nicolson	Leguminosae	Forest	Liana	Endemic
42	*Murdannia semiteres* (Dalzell) Santapau	Commelinaceae	Plateau	Herb	
43	*Olea dioica* Roxb.	Oleaceae	Forest	Tree	
44	*Ophiorrhiza rugosa* Wall. var. *prostrata* (D. Don) Deb & D. C. Monda	Rubiaceae	Forest	Herb	
45	*Paramignya monophylla* Wight	Rutaceae	Forest	Tree	
46	*Pterospermum diversifolium* Blume	Malvaceae	Forest	Tree	
47	*Rhamphicarpa longiflora* (Arn.) Benth.	Schrophulariaceae	Plateau	Herb	
48	*Rhynchostylis retusa* (L.) Blume	Orchidaceae	Forest	Epiphtic	
49	*Schleichera oleosa* (Lour.) Oken	Sapindaceae	Forest	Tree	
50	*Smithia salsuginea* Hance	Legumiaceae	Plateau	Herb	Endemic
51	*Sterculia guttata* Roxb. ex DC.	Sterculiaceae	Forest	Tree	
52	*Strychnos nux-vomica* L.	Loganiaceae	Forest	Tree	
53	*Tabernaemontana heyneana* Wall.	Apocynaceae	Forest	Tree	Endemic
54	*Tephrosia coccinea* Wall.	Leguminaceae	Forest	Herb	Endemic
55	*Terminalia bellirica* (Gaertn.) Roxb.	Combretaceae	Forest	Tree	
56	*Terminalia elliptica* Willd.	Combretaceae	Forest	Tree	
57	*Ventilago denticulata* Willd.	Rhamnaceae	Forest	Liana	

S.N.	Species name	Family	Habitat	Habit	Threatened status
58	*Xantolis tomentosa* (Roxb.) Raf.	Sapotaceae	Forest	Tree	
59	*Ziziphus oenoplia* (L.) Mill.	Rhamnaceae	Forest	Shrub	
60	*Ziziphus rugosa* Lam.	Rhamnaceae	Forest	Tree	

3.9 Faunal Assessment

Faunal Assessments were focused on the faunal groups such as Herpetofauna (Amphibians and Reptiles), Avifauna and Mammals. Details of these groups are discussed in below sections.

The faunal species survey were made along the transects locations mostly around 50 m width on either side. The location of the transects are discussed as below and presented in ***Table 3.14*** below

Table 3.14 Transects for Faunal Survey

Transect No.	Habitats
Section 1: GT1	Intersecting the Lateritic Plateau and Moist Deciduous Forest at Tower LocationAP-4/0
Section 1: GT2	Running parallel to transmission line adjacent to Tower location 3/1 between the Lateritic Plateau and Moist Deciduous Forest
Section 2: GT3	Intersecting the Transmission line between Tower location R1-14 and 14/2 within the buffer area
Section 2: GT4	Runs parallel to the transmission line in Moist Deciduous Forest
Section 2: GT5	Runs diverging from the transmission line in the buffer area

The location of the transects are provided in ***Figure 3.3*** and ***Figure 3.4***.

3.9.1 Herpetofauna

Most of the amphibians and reptiles are generalist and occur in various habitats and a few are habitat specific. There are burrowing, terrestrial, aquatic and arboreal species of amphibians and reptiles. Most of the amphibians and a few reptiles are only active during the monsoon season and a few species are active throughout the year.

The burrowing species mostly occupy habitats with good canopy cover and thus confined to the forests. Although there are a few exceptions. Most of the burrowing herpetofauna is thus active during monsoon season. The terrestrial species mostly confined to forest floor and are seen among leaf litter, under logs or rocks. These species are considerably sturdy and are seen throughout the year. Aquatic species are mostly seen close to streams, pools and rivers and are solely depend on these water sources for majority of their activities. Due to this specific requirement, they are mostly encountered during monsoon season. Many aquatic amphibians utilize stagnant pools and a few are only seen in the forest streams. The arboreal forms are also mostly seen in the forest habitats. Arboreal reptiles are seen throughout the year but amphibians and mostly seen during rainy season.

Many of the endemic herpetofauna is confined to natural and less disturbed forest habitats. The species which are widely distributed are mostly seen in the disturbed habitats as well.

Past Records of Herpetofauna from the region

Western Ghats of Goa –Brief Details

The Western Ghats region in Goa, although rich in floral and faunal diversity, the herpetofauna is poorly studied. Except a few anecdotal studies describing new species in the recent past, this region is grossly understudied for the amphibians and reptiles. Most of the present day understanding of the herpetofauna of this region is based on historical reports. In the last two decades, a few new species of amphibians and reptiles were described from the Western Ghats region of Goa. This region is a northernmost distribution limit for a few species of herpetofauna viz. *Ophiophagus hannah* (King cobra), *Hypnale hypnale* (Hump-nosed pit viper) and *Draco dussumieri* (Draco).

All these species are commonly seen in Goa but are uncommon or absent in the adjacent Western Ghats region of Maharashtra. Another endemic and Engangered species *Pedostibes tuberculosus* (Malabar tree toad) is also commonly seen in a few pockets in the Western Ghats region of Goa. Two species of caecilians *Gegeneophis goaensis* and *G. pareshi*, two species are frogs *Minervarya gomantaki* and *M. goemchi* and one species of lizard *Cnemaspis goaensis* are presently only known from the Western Ghats region of Goa.

Habitats in Transmission Line Route

Forest Near Tambdi Surla

The habitat near Tambdi Surla in Goa is mostly composed of tropical evergreen to tropical semi-evergreen forest over an elevation gradient. The forest at the lower altitude is slightly disturbed due to human interference but on higher reaches it is pristine. There are series of perennial streams in this patch and many of them were active during the study period. Some of these smaller streams forms cascades on higher riches and on lower altitude they are open and wider. Due to the presence of cane, thick undergrowth and steep terrain, a few places are inaccessible in this landscape. The pristine, less disturbed natural forest, rich undercover and presence of perennial streams are ideal requirements for the herpetofauna. The habitat in Goa is thus rich due to above mentioned ideal requirements and supports important herpetofaunal elements like *Ophiophagus hanna* (King cobra), *Python bivattatus* (Burmese python) and *Pedostibes tuberculosus* (Malabar tree toad).

Lateritic plateau

The other patch in the study area is a lateritic plateau, surrounded by thick vegetation. These plateaus appear barren during dry seasons but in monsoon they are the abode to many species of herpetofauna. They are also the breeding ground for many endemic amphibians and reptiles. These plateaus are highly exposed due to the lack of tree cover and appear less productive. But they are abode to many dry adapted species of herpetofauna like Saw-scaled viper, *Echis carinatus* and *Ophisops*. Two recently described species of frogs *Minervarya gomantaki* and *M. cepfi* was also predominantly seen on these lateritic plateaus.

Status of Amphibians

Amphibians are poikilothermic vertebrates, primarily depend of fresh water for their survival. Hence major activities of many amphibians and confined to rainy season. Although this rapid assessment survey was conducted after the rainy season we reported eight species of amphibians. Based on secondary reports and personal observations in the past, about 25 species of amphibians are reported from this region (Table 3.15).

The species commonly seen in the study area were Amboli bush frog, *Pseudophilautus amboli* and Netravali leaping frog, *Indirana salelkari*. Both these species were seen in the forest. Amboli bush frog was one of the commonest amphibians seen among dry leaf litter during the daytime also. The juveniles were also observed in the similar habitat. A few males were heard calling during the night. The other species frequently encountered during the survey period were *Indosylvirana* cf. *caeseri* and *Minervarya cepfi*. Other species were sighted ones or twice during the survey.

Most of the species encountered during this survey were known to occur in forest habitats with a few exceptions. The species like Amboli bush frog, Netravali leaping frog mostly seen in the forest and

close to human habitation as well. These frogs breed during the early monsoon months. Bush frogs mostly lay their eggs among moss on trees and leaping frogs lay terrestrial eggs on the forest floor or among open rocks. In bush frogs, free living tadpole stage is missing and babies hatch from eggs. In leaping frog tadpoles are also terrestrial and seen in damp places, many a times away from water sources as well.

The forest streams are abode to endemic lineages of frogs like Night frogs, *Nyctibatrachus*. In one of the cascades close to transmission line, many smaller sized *Nyctibatrachus* were observed. These appear to be an undescribed species based on their smaller size. Further studies in this regard is warranted. The other species, *Nyctibatrachus patreaus* was also observed in the other stream. This species is endemic to the northern Karnataka, Goa and southern Maharashtra.

The other endemic and uncommon species, *Indosylvirana* cf. *caesiri* was also observed near Tambdi Surla. These frogs also breed in forest streams. Interestingly, a few adults were observed among leaf litter in the forest away from the streams during the day. The common species like Indian bull frog *Hoplobatrachus tigerinus*, Ornate narrow-mouthed frog *Microhyla ornata*, cricket frogs *Minervarya* spp., Common Indian toad *Duttaphrynus melanostictus* are seen in less numbers. Most of these are terrestrial anurans and their poor encounter rate can be attributed to late monsoon season.

All the 25 species enlisted in the ***Table 3.15*** may not occur along the transmission line but are reported from this landscape. Species observed are presented in ***Figure 3.8.***

Table 3.15 Amphibians reported & recorded from the Transmission Line Route

SN	Family	Full taxon	English Name	IWPA	IUCN. V2018-2
1.	Bufonidae	*Duttaphrynus melanostictus*	Common Indian Toad*	Schedule IV	LC
2.	Bufonidae	*Pedostibes tuberculosus*	Malabar Tree Toad	Schedule IV	EN
3.	Dicroglossidae	*Euphlyctis cyanophlyctus*	Five-fingered Frogs*	Schedule IV	LC
4.	Dicroglossidae	*Fejervarya cepfi*	CEPF Burrowing Frog*	Schedule IV	NA
5.	Dicroglossidae	*Minervarya gomantaki*	Goan Cricket Frog*	Schedule IV	NA
6.	Dicroglossidae	*Minervarya goemchi*	Goan Cricket Frog	Schedule IV	NA
7.	Dicroglossidae	*Hoplobatrachus tigerinus*	Indian Bull Frog*	Schedule IV	LC
8.	Dicroglossidae	*Sphaerotheca breviceps*	Indian Burrowing Frog	Schedule IV	LC
9.	Microhylidae	*Microhyla ornata*	Ornate Narrow-mouthed Frog*	Schedule IV	LC
10.	Microhylidae	*Microhyla rubra*	Reddish Narrow-mouthed Frog	Schedule IV	LC
11.	Microhylidae	*Uperodon globulosus*	Indian Balloon Frog	Schedule IV	LC
12.	Microhylidae	*Uperodon mormorata*	Marbled Ramanella	Schedule IV	EN
13.	Nyctibatrachidae	*Nyctibatrachus petraeus*	Castle Rock Night Frog	Schedule IV	LC
14.	Nyctibatrachidae	*Nyctibatrachus* sp.	*Not identified*		
15.	Ranidae	*Hydrophylax bahuvistara*	Wide-spread Fungoid Frog	Schedule IV	NA
16.	Ranidae	*Indosylvirana* cf. *caesari*	Maharashtra Golden-backed Frog	Schedule IV	NA
17.	Ranixalidae	*Indirana chiravasi*	Amboli Leaping Frog	Schedule IV	NA
18.	Ranixalidae	*Indirana salelkari*	Netravali Leaping Frog*	Schedule IV	NA

SN	Family	Full taxon	English Name	IWPA	IUCN. V2018-2
19.	Rhacophoridae	*Polypedates maculatus*	Common Indian Tree Frog*	Schedule IV	LC
20.	Rhacophoridae	*Pseudophilautus amboli*	Amboli Bush Frog	Schedule IV	CR
21.	Rhacophoridae	*Raorchestes bombayensis*	Maharashtra Bush Frog	Schedule IV	VU
22.	Rhacophoridae	*Rhacophorus malabaricus*	Malabar Gliding Frog	Schedule IV	LC
23.	Ichthyophiidae	*Ichthyophis bombayensis*	Bombay Caecilian	Schedule IV	LC
24.	Ichthyophiidae	*Ichthyophis davidi*	Chorla giant striped caecilian	Schedule IV	NA
25.	Indotyphlidae	*Gegeneophis danieli*	Daniel's Caecilian	Schedule IV	DD

* Species encountered during the survey

LC - Least Concerned, EN - Endangered, CR - Critically Endangered, NA - Not assessed

Figure 3.8 Amphibians recoded from the Study Area

Amboli Bush Frog *Pseudophilautus amboli*

Indian Bull Frog *Hoplobatrachus tigerinus*

Common Indian Toad *Duttaphrynus melanostictus*

Netravali Leaping Frog* *Indirana salelkari*

Castle Rock Night Frog *Nyctibatrachus petraeus*

Chorla giant striped caecilian *Ichthyophis davidi*

Status of Reptiles

Reptiles are also poikilothermic vertebrates, but they are known to occur in varied habitats. Although there is no seasonality in many reptiles, a few species are active during the monsoon. In view of the rich diversity of flora and availability of good micro-habitats, there is rich diversity of reptiles in the study area.

The commonest species of reptile encountered during this study was Sahyadri Forest Lizard *Monilesaurus rouxii*. The juveniles and adults of this agamid lizards were encountered in most of the study sites. Interestingly only a few juvenile individuals of Common garden lizard *Calotes versicolor* were encountered during this survey. Other lizards commonly encountered during the study is Asian house gecko *Hemidactylus frenatus*. This landscape also harbours a good population of Prashad's geko *Hemidactyus prashadi*. Earlier considered as Endangered by IUCN due to its restricted range, t in recent years the range of this species was revised based on fresh reports from Maharashtra and Goa and now is considered as Least Concerned. This species was seen on trees in the forest and in the human settlement as well. The dwarf gecko *Cnemaspis* sp. is considerably common but a single individual was recorded in the study site during this survey. Three species of skinks and a species of gecko was recorded on the plateau. Among skinks, three specimens of Gunther's supple skink *Lygosoma guentheri* were seen under the rocks on the plateau. Seven individuals of gecko, *Hemidactylus murrayi* were also encountered under rocks on the plateau. This species is commonly seen in the forest, disturbed habitats and human settlement.

Among snakes, Green vine snake *Ahaetulla nasuta* was a common species encountered during the study period. This arboreal species prefers bushes and trees and seen in pristine and disturbed habitats and seen in Tambdi Surla and plateau as well. A juvenile inidvidual of Indian rock python was seen near the Tambdi Surla temple during one of the night surveys. This region has a good population of this species and juveniles are often seen during the monsoon. The other uncommon species observed during this survey was Hump-nosed pit viper *Hypnale hypnale*. Unlike other pit vipers, this species is terrestrial and seen among the leaf litter in the forest. two adult individuals of Common wolf snake *Lycodon aulicus* was seen close to a stream near Tambdi Surla. In the same stream a juvenile Cheqered keelback *Xenochorphis piscator* was also recorded.

Although not a single individual of Malabar pit viper *Trimeresurus malabaricus* was recorded during the study period, this place has a good population of this species. The King cobra, *Ophiophagus hannah* is also reported from this forest and they are frequently seen close to the forest streams during monsoon. Previously, other endemic species of snakes like Aquatic *Rhabdops Rhabdops aquaticus* and Khaire's black shieldtail *Melanophidium khairei* were also reported from this habitat.

The species description is provided in ***Table 3.16*** and pictorial representation is given in ***Figure 3.9.***

Table 3.16 Reptiles recorded from the Study Area

Sn	Family	Full taxon	English Name	IWPA,1971	IUCN v2018-2
1.	Geomydidae	*Melanochelys trijuga*	Indian black turtle	Schedule IV	NT
2.	Trionychidae	*Lissemys punctata*	Indian flapshell turtle	Schedule I Part II	LC
3.	Agamidae	*Monilisaurus rouxii*	Sahyadri Forest Lizard*	Schedule IV	LC
4.	Agamidae	*Calotes versicolor*	Indian Garden Lizard*	Schedule IV	LC
5.	Agamidae	*Draco dussumieri*	South Indian Flying Lizard	Schedule IV	LC
6.	Gekkonidae	*Cnemaspis* cf. *indraneildasii*	Indraneil's Day Gecko*	Schedule IV	VU
7.	Gekkonidae	*Cyrtodactylus albofasciatus*	Boulenger's Indian Gecko	Schedule IV	LC
8.	Gekkonidae	*Hemidactylus flaviviridis*	Yellow Green House Gecko*	Schedule IV	LC
9.	Gekkonidae	*Hemidactylus frenatus*	Asian House Gecko*	Schedule IV	LC
10.	Gekkonidae	*Hemidactylus leschenaultii*	Bark Gecko	Schedule IV	LC
11.	Gekkonidae	*Hemidactylus murrayi*	Murray's Gecko*	Schedule IV	LC
12.	Gekkonidae	*Hemidactylus prashadi*	Prashad's Gecko*	Schedule IV	LC
13.	Gekkonidae	*Hemidactylus triedrus*	Termite Hill Gecko	Schedule IV	LC
14.	Lacertidae	*Ophisops beddomei*	Beddome's Lacerta	Schedule IV	LC
15.	Mabuyidae	*Eutropis carinata*	Common Keeled Skink*	Schedule IV	LC
16.	Mabuyidae	*Eutropis macularia*	Bronze Grass Skink*	Schedule IV	LC
17.	Lygosomidae	*Lygosoma goaensis*	Goan Supple Skink	Schedule IV	DD
18.	Lygosomidae	*Lygosoma guentheri*	Günther's Supple Skink*	Schedule IV	LC
19.	Lygosomidae	*Lygosoma lineata*	Lined Supple Skink	Schedule IV	LC
20.	Lygosomidae	*Lygosoma punctata*	Spotted Supple Skink	Schedule IV	LC
21.	Ristellidae	*Ristella beddomii*	Beddome's Cat Skink	Schedule IV	LC
22.	Varanidae	*Varanus bengalensis*	Bengal Monitor Lizard	Schedule I Part II	LC
23.	Uropeltidae	*Melanophidium khairei*	Khaire's Black shieldtail	Schedule IV	NA
24.	Uropeltidae	*Uropeltis macrolepis*	Large-scaled shieldtail	Schedule IV	LC
25.	Pythonidae	*Python molurus*	Indian rock python*	Schedule I Part II	VU
26.	Erycidae	*Eryx conicus*	Common sand boa	Schedule IV	NA
27.	Erycidae	*Eryx johnii*	Red sand boa	Schedule IV	NA
28.	Erycidae	*Eryx whitakeri*	Whitaker's boa	Schedule IV	NA
29.	Colubridae	*Ahaetulla nasuta*	Green vine snake*	Schedule IV	LC
30.	Colubridae	*Ahaetulla pulverulenta*	Brown vine snake	Schedule IV	LC
31.	Colubridae	*Chrysopelea ornata*	Ornate flying snake	Schedule IV	LC
32.	Colubridae	*Dendrelaphis girii*	Giri's bronzeback tree snake	Schedule IV	LC
33.	Colubridae	*Dendrelaphis tristis*	Common bronzeback tree snake	Schedule IV	LC
34.	Colubridae	*Argyrogena fasciolata*	Banded racer	Schedule IV	LC
35.	Colubridae	*Boiga beddomei*	Beddome's Cat snake	Schedule IV	LC
36.	Colubridae	*Boiga ceylonensis*	Ceylon Cat snake	Schedule IV	LC
37.	Colubridae	*Boiga forsteni*	Forsten's Cat snake	Schedule IV	LC
38.	Colubridae	*Boiga trigonata*	Common Cat snake	Schedule IV	LC

Sn	Family	Full taxon	English Name	IWPA,1971	IUCN v2018-2
39.	Colubridae	*Coelognathus helena monticollaris*	Montane trinket snake	Schedule IV	LC
40.	Colubridae	*Lycodon* cf. *aulicus*	Common wolf snake*	Schedule IV	LC
41.	Colubridae	*Lycodon striatus*	White-banded wolf snake	Schedule IV	LC
42.	Colubridae	*Lycodon travancoricus*	Travancore wolf snake	Schedule IV	LC
43.	Colubridae	*Oligodon arnensis*	Banded kukri snake	Schedule IV	LC
44.	Colubridae	*Oligodon taeniolatus*	Variegated kukri snake	Schedule IV	LC
45.	Colubridae	*Ptyas mucosa*	Oriental rat snake	Schedule II Part II	LC
46.	Colubridae	*Rhabdops aquaticus*	Aquatic rhabdops	Schedule IV	NA
47.	Colubridae	*Sibynophis subpunctatus*	Dumeril's black-headed snake	Schedule IV	LC
48.	Colubridae	*Amphiesma stolatum*	Striped keelback	Schedule IV	LC
49.	Colubridae	*Hebius beddomei*	Beddome's keelback	Schedule IV	LC
50.	Colubridae	*Macropisthodon plumbicolor*	Green keelback	Schedule IV	LC
51.	Colubridae	*Xenochrophis piscator*	Checkered keelback*	Schedule II Part II	LC
52.	Elapidae	*Bungarus caeruleus*	Common Indian krait	Schedule IV	LC
53.	Elapidae	*Calliophis castoe*	Castoe's coral snake	Schedule IV	DD
54.	Elapidae	*Calliophis nigrescens*	Striped coral snake	Schedule IV	LC
55.	Elapidae	*Naja naja*	Spectacled cobra	Schedule II Part II	LC
56.	Elapidae	*Ophiophagus hannah*	King cobra	Schedule II Part II	LC
57.	Viperidae	*Hypnale hypnale*	Hump-nosed pit viper*	Schedule IV	LC
58.	Viperidae	*Trimeresurus gramineus*	Bamboo pit viper	Schedule IV	LC
59.	Viperidae	*Trimeresurus malabaricus*	Malabar pit viper	Schedule IV	LC
60.	Viperidae	*Daboia russelii*	Russell's viper	Schedule II Part II	LC
61.	Viperidae	*Echis carinatus*	Indian saw-scaled viper	Schedule IV	LC
62.	Typhlopidae	*Grypotyphlops acutus*	Beaked Worm snake	Schedule IV	LC
63.	Typhlopidae	*Indotyphlops braminus*	Brahminy Worm snake	Schedule IV	LC

***** Species encountered during the survey
LC - Least Concerned, EN - Endangered, CR - Critically Endangered, NA - Not assessed

Figure 3.9 Reptiles recoded from the Study Area

Common Keeled Skink *Eutropis carinata*

Asian House Gecko *Hemidactylus frenatus*

Roadkill of Checkered Keelback Snake

Prashad's Gecko *Hemidactylus prashadii*

Günther's Supple Skink *Lygosoma guentheri*

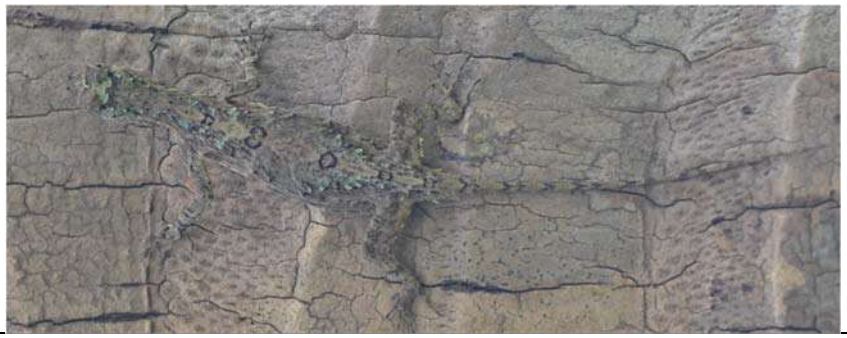
Sahyadri Forest Lizard *Monilesaurus rouxii*

Malabar pit viper *Trimeresurus malabaricus*

Common wolf snake *Lucodon* cf *aulicus*

Hump-nosed pit viper *Hypnale hypnale*

Green vine snake *Ahaetulla nasuta*



South Indian Flying Lizard *Draco dussumieri*

Threatened Species

This region is known to inhabit 88 species of amphibians and reptiles of which seven species are in the threatened category of IUCN and remaining are either Least Concerned or Dada Deficient. There are a few species which are not yet assessed as they are recently described. These threatened species are listed in ***Table 3.17***.

Table 3.17 Threatened Species

Sn	Family	Full taxon	English Name	IUCN v2018-2
1.	Rhacophoridae	*Pseudophilautus amboli*	Amboli Bush Frog	CR
2.	Bufonidae	*Pedostibes tuberculosus*	Malabar Tree Toad	EN
3.	Microhylidae	*Uperodon mormorata*	Marbled Ramanella	EN
4.	Rhacophoridae	*Raorchestes bombayensis*	MaharashtraBush Frog	VU
5.	Geomydidae	*Melanochelys trijuga*	Indian Black Turtle	NT
6.	Gekkonidae	*Cnemaspis* cf. *indraneildasii*	Indraneil's Day Gecko	VU
7.	Pythonidae	*Python molurus*	Indian rock python	VU

Endemic Species

None of the listed species of amphibian and reptile is endemic to this part of the Western Ghats of Goa.

3.9.2 Avifauna

Avifaunal surveys were undertaken along the 5 transects within a study area. Point counts were made in 50 m radius plots at

Species Richness

Total bird species richness, i.e. total number of species recorded from the transects recorded were Twenty Five (25), representing Twenty Four (22) genus from Seventeen families (16). Out of twenty five species, ten species were recorded from transects located at the edge of forest and grasslands and rest fifteen species were recorded from transects located in forested habitats.

Pompadour green pegion (*Treron pompadora*), White rumped shama (*Copsychus malabaricus*), red-whiskered bulbul (*Pycnonotus jocosus*), Malabar Pied Hornbill (*Anthracoceros coronatus*) etc. were recorded from the mosaic of grassland and forest habitat at the edge of forest. Species like Malabar Trogon (*Harpactes fasciatus*), Malabar grey Hornbill (*Ocyceros griseus*), Asian Paradise flycatcher (*Terpsiphone paradise*), Crimson Backed sunbird (*Leptocoma minima*), Malabar woodshrike (*Tephrodornis sylvicola*) etc. were recorded from forested habitat.

Most of the species were recorded during diurnal survey, but Jungle Owlet (*Glaucidium radiatum*) and Sri Lanka frogmouth (*Batrachostomus moniliger*) were recorded during night survey.

Details of all the species recorded during the transect survey is provided in ***Table3.18*** and pictorial representation is provided in ***Figure 3.10***.

Table 3.18 Details of Species Recorded from the Study Area

SNo.	Family	Scientific Name	Common Name	Food Habit	Numbers Recorded	Transect Recorded from	Sch. of IWPA, 1972	IUCN (v2018-1)
1	Phasianidae	*Gallus sonneratti*	Grey Junglefowl	GR	2	GT3	II	LC
2	Columbidae	*Streptopelia chinensis*	Spotted Dove	GR	3	GT1, GT2	IV	LC
3		*Treron pompadora*	Pompadour green pegion	FR	4	GT1, GT2	IV	LC
4	Cuculidae	*Surniculus lugubris*	Drongo Cuckoo	I	1	GT2	IV	LC
5	Cuculidae	*Eudynamys scolopacea*	Asian Koel	FR	2	GT1	IV	LC
6	Dicruidae	*Dicrurus paradiseus*	Greater Racket-tailed drongo	I	2	GT3	IV	LC
7	Strigidae	*Glaucidium radiatum*	Jungle Owlet	CR	2	GT5	IV	LC
8	Trogonidae	*Harpactes fasciatus*	Malabar Trogon	I	4	GT3, GT5	IV	LC
9	Alcedinidae	*Alcedo atthis*	Small blue kingfisher	CR	1	GT3	IV	LC
10		*Ceyx erillzacus*	Oriental dwarf kingfisher	CR	1	GT2	IV	LC
11	Bucerotidae	*Ocyceros griseus*	Malabar grey Hornbill	FR	3	GT4, GT5	IV	LC
12		*Anthracoceros coronatus*	Malabar Pied Hornbill	OM	1	GT2	I	NT
13	Capitonldae	*Psilopogon viridis*	White checked Barbet	FR	1	GT4	IV	LC
14		*Dinopium javanense*	Common golden backed woodpecker	I	1	GT4	IV	LC
15	Vabgidae	*Tephrodornis sylvicola*	Malabar woodshrike	I	11	GT3, GT4	IV	LC
16	Pycnonotidae	*Iole indica*	Yellow browed bulbul	FR	2	GT3, GT5	IV	LC
17		*Pycnonotus gularis*	flame-throated bulbul	FR	5	GT3, GT4	IV	LC
18		*Pycnonotus jocosus*	red-whiskered bulbul	FR	1	GT1	IV	LC
19	Muscicapidae	*Copsychus saularis*	oriental magpie-robin	I	1	GT1	IV	LC
20		*Copsychus malabaricus*	White rumped shama	I	2	GT1	IV	LC
21	Monarchidae	*Terpsiphone paradisi*	Asian Paradise flycatcher	I	1	GT3	IV	LC
22	Nectariniidae	*Leptocoma zeylonica*	Purple rumped sunbird	N	2	GT4	IV	LC

23		*Leptocoma minima*	Crimson Backed sunbird	N	7	GT4, GT5	IV	LC
24		*Cinnyris asiaticus*	Purple Sunbird	N	1	GT2	IV	LC
25	Podargidae	*Batrachostomus moniliger*	Sri Lanka frogmouth	I	1	GT5	I (part III)	LC

Source – ERM Primary Survey

Food Habit: Aq A- Aquatic Animals, GR– Granivorous, FR- Frugivorous, CR- Carnivorous, I- Insectivorous, N- Nectar eater, OM- Omnivorous.

IUCN Status: LC- Least Concern, NT- Near Threatened

Figure 3.10 Avifauna Recorded During Survey

Malabar Pied Hornbill

Pompadour green pigeon

Malabar Trogon

Malabar grey Hornbill

Red-whiskered bulbul

Flame-throated bulbul

Grey Junglefowl

Common golden backed woodpecker

Crimson backed Sunbird

Purple Sunbird

Black Hooded Oriole

Malabar Woodshrike

Magpie Robin

Grey Wagtail

Overall Species Richness

To overcome the limitations of this particular survey and to have an understanding of the overall species richness of the study area, a cumulative list of all the species found in the study area was prepared based on Zoological Survey of India archive[1]. Based on this secondary information, overall species richness i.e. total number of species that can be found in the study area is one hundred and four (104). Secondary information was found to complement the primary survey, as all 25 species recorded were reported to be present in the study area. The details are presented in ***Table 3.19***.

Table 3.19 Potential Species List likely to be observed from the Study Area

SNo.	Family	*Scientific name*	Common name	Residential status	Endemic to Western Ghats	Food habits	Breeding season	Numbers Recorded	Schedule of WPA, 1972	IUCN status (v2018-1)
1.	Ardeidae	*Ardeolo grayii*	Indian Pond Heron	R/LM	No	Aq A	November to February	0	IV	LC
2.		*Gorsacllius melanoloplzus*	Malayan Night Heron	R	No	Aq A	May to August	0	IV	LC
3.	Ciconlidae	*Ciconia episcopus*	Wooly-necked stork	R	No	Aq A, I	December to March	0	IV	VU
4.		*Ciconia cicollia*	White stork	WV	No	AqA, CR	Extralimital	0	IV	LC
5.	Thresklornithidae	*Pseudibis papillosa*	Red Naped Ibis	R	No	OM	March to October	0	IV	LC
6.		*Platalea leucorodia*	Eurasian Spoonbill	WV/R (Partly Nomadic)	No	Aq A & Vg M	Extralimital/November to January	0	I (part III)	LC
7.	Accipitridae	*Ariceda leuphotes*	Black Baza	R	No	CR	February to July	0	I (part III)	LC
8.		*Penlis ptilorhyncus*	Oriental Honey Buzzard	R/LM	No	CR	February to June	0	I (part III)	LC
9.		*Elanus careleus*	Black shouldered Kite	R	No	1 &CR	Entire year	0	I (part III)	LC
10.		*Spilornis cheela*	Crested Serpent eagle	R	No	CR	December to March	1	I (part III)	LC
11.		*Accipiter trivirgatus*	Crested Goshawk	R	No	CR	March to May	0	I (part III)	LC
12.		*Accipiter badius*	Shikra	R	No	CR	March to June	0	I (part III)	LC
13.		*Accipiter virgatus*	Besra Sparrow Hawk	R	No	CR	March to May	0	I (part III)	LC

1 Fauna of Goa, State Fauna Series 16, Zoological Survey of India; January, 2008

SNo.	Family	*Scientific name*	Common name	Residential status	Endemic to Western Ghats	Food habits	Breeding season	Numbers Recorded	Schedule of WPA, 1972	IUCN status (v2018-1)
14.		*Accipiter nisus*	Eurasian Sparrowhawk	WV	No	CR	Extralimital	0	I (part III)	LC
15.		*Butastur teesa*	White eyed Buzzard	R	No	CR	February to May	0	I (part III)	LC
16.		*Icrillaellts malyanensis*	Black Eagle	R	No	CR, I	November to March	1	I (part III)	LC
17.		*Aquila rapax*	Tawny Eagle	R	No	CR	November to April	0	I (part III)	LC
18.	Falconidae	*Falco tinunculus*	Common Krestel	WV, R (Breeding)	No	CR, I	January to March (W. Ghats)	0	IV	LC
19.		*Falco peregrillus*	Peregrine falcon	WV, R	No	CR	Extralimital, March to May in Himalayas	0	I (part III)	LC
20.	Phasianidae	*Perdicula argoondah*	Rock Bush-Quail	R	No	GR	March to November	0	IV	LC
21.		*Galloperdix .spadicea*	Red spurfowl	R	No	GR	January to June	0	IV	LC
22.		*Galoperdix lunulata*	Painted spurfowl	R	No	OM	January to June	0	IV	LC
23.		*Gallus sonneratti Temminck*	Grey Junglefowl	R	No	GR	February to May	2	IV	LC
24.	Rallidae	*Amaurornis phoenicurus*	White Breasted Waterhen	R	No	OM	April to October	0	IV	LC
25.	Charadriidae	*Vanellus indicus*	Red-Wattled Lapwing	R	No	Vg M, I	March to September	0	IV	LC
26.	Scolopacidae	*Gallinago gallinago*	Common Snipe	WV	No	Aq A	Extralimital	0	IV	LC
27.		*Lymnocryptesminimus*	Jack Snipe	WV	No	Aq A, I	Extralimital	0	IV	LC
28.		*Tringa stagnatilis*	Marsh Sandpiper	WV	No	Aq A	Extralimital	0	IV	LC
29.		*Tringa nebularia*	Commom Greenshank	WV	No	Aq A	Extralimital	0	IV	LC
30.		*Tringa ochropus Linnaeus*	Green Sandpiper	WV	No	AQ A	Extralimital	0	IV	LC
31.		*Actitis hypoleucos Linnaeus*	Commom sandpiper	WV	No	AQ A	Extralimital	0	IV	LC
32.	Columbidae	*Columba eiphinstonii*	Nilgiri wood pegion	R/LM	Yes	FR	April to June	0	IV	VU
33.		*Streplopelia orienlalis*	Oriental turtle dove	SM (wintering)	No	GR	May to July	0	IV	LC

SNo.	Family	*Scientific name*	Common name	Residential status	Endemic to Western Ghats	Food habits	Breeding season	Numbers Recorded	Schedule of WPA, 1972	IUCN status (v2018-1)
34.		*Streptopelia chinensis*	Spotted Dove	R/LM	No	GR	All over the year	3	IV	LC
35.		*Chalcophapsindica*	Emerald Dove	R	No	GR	All over the year	0	IV	LC
36.		*Treron bicincta*	Orange breasted green pigeon	R/SM/LM	No	FR	March to September	0	IV	LC
37.		*Treron pompadora*	Pompadour green pegion	R/LM	No	FR	December to March	4	IV	LC
38.		*Ducula aenea*	Greem Imperial Pegion	R/LM	No	FR	February to June	0	IV	LC
39.		*Ducula badia*	Mountain Imperial Pegion	R/SM/LM	No	FR	January to May	0	IV	LC
40.	Psittacidae	*Psinacula cyanocephala*	Plum Headed Parakeet	R/LM	No	FR, N	December to April	0	IV	LC
41.		*Psittacula columboides*	Blue winged Parakeet	R (Nomadic)	Yes	FR & GR	January to March	0	IV	LC
42.	Cuculidae	*Clamator jacobinus*	Pied Crested Cuckoo	MV	No	I	June to September	0	IV	LC
43.		*Cuculus poliocephalus*	Lesser Cuckoo	Wintering/PM	No	I	May to July	0	IV	LC
44.		*Cacomantis sonneratii*	Banded Bay Cuckoo	R/SM/LM	No	I	February to August	0	IV	LC
45.		*Cacomantis passerinus*	Indian Plainitive cuckoo	R/LM/Nomadic	No	I	June to September	0	IV	LC
46.		*Surniculus lugubris*	Drongo Cuckoo	R/LM/Nomadic	No	I	March to October	1	IV	LC
47.		*Eudynamys scolopacea*	Asian Koel	R/LM/Nomadic	No	FR	March to August	2	IV	LC
48.	Dicruidae	*Dicrurus paradiseus*	Greater Racket-tailed drongo	R	No	I	April to August	2	IV	LC
49.	Strigidae	*Otus sunia*	Oriental scops owl	R	No	I & CR	February to May	0	IV	LC
50.		*Otus bakkamoena*	Collard Scops Owl	R	No	I & CR	January and February	0	IV	LC
51.		*Glaucidium radiatum*	Jungle Owlet	R	No	I & CR	March to May	2	IV	LC
52.	Apodidae	*Collocalia unicolor*	Indian edible nest swiftlet	R	Yes	I	March to June	0	I (part III)	LC
53.		*Apus affinis*	House Swift	R/LM	No	I	All year except November to February	0	IV	LC

SNo.	Family	*Scientific name*	Common name	Residential status	Endemic to Western Ghats	Food habits	Breeding season	Numbers Recorded	Schedule of WPA, 1972	IUCN status (v2018-1)
54.	Hemiprocnidae	*Hemiprocne coronata*	Crested Tee swift	R/SM/LM	No	I	December to July	0	IV	LC
55.	Trogonidae	*Harpactes fasciatus*	Malabar Trogon	R	Yes	I	February to May	4	IV	LC
56.	Alcedinidae	*Alcedo atthis*	Small blue kingfisher	R	No	Aq A	February to September	1	IV	LC
57.		*Alcedo meninting*	Blue eared Kingfisher	R	No	Aq A	May to June	0	IV	LC
58.		*Ceyx erillzacus*	Oriental dwarf kingfisher	R/MV	No	Aq A	July to September	1	IV	LC
59.		*Halcyon smyrnensis*	White breasted kingfisher	R/LM	No	OM	January to August	0	IV	LC
60.	Meropidae	*Nyctyornis athertoni*	Blue beared bee eater	R	No	I	February to August	0	IV	LC
61.		*Merops leschenaulti*	Chestnut headed bee eater	R/SM	No	I	February to June	0	IV	LC
62.	Coraciidae	*Coracias garrulus*	European Roller	PM	No	I	Extralimital	0	IV	LC
63.	Upupidae	*Upupa epops*	Common Hoopoe	R/WV	No	I	January to April	0	IV	LC
64.	Bucerotidae	*Ocyceros griseus*	Malabar grey Hornbill	R	Yes	FR	January to March	3	IV	LC
65.		*Ocyceros birosIris*	Indian grey hornbill	R/LM	No	OM	March to June	0	IV	LC
66.		*Anlhracoceros coronatus*	Malabar Pied Hornbill	R/LM	Yes	FR, CR	March and April	1	I (part III)	NT
67.		*Buceros bicornis*	Great pied Hornbill	R/LM	No	FR	February to April	0	I (part III)	NT
68.	Capitonlidae	*A1egalaima virdis*	White checked Barbet	R	Yes	FR	December to March	1	IV	LC
69.		*Picunmus innominatus*	Spekled Piculet	R	No	I	January to March	0	IV	LC
70.		*Dendrocopos nanus*	Brown capped pygmy wood pecker	R	No	I	February to July	0	IV	LC
71.		*Celeus brachyurus*	Rufous woodpecker	R	No	I	February to April	0	IV	LC
72.		*Dryocopus javensis*	White Bellied woodpecker	R	No	I	January to March	0	IV	LC

SNo.	Family	*Scientific name*	Common name	Residential status	Endemic to Western Ghats	Food habits	Breeding season	Numbers Recorded	Schedule of WPA, 1972	IUCN status (v2018-1)
73.		*Picus cholorolophus*	Small yellow napped woodpecker	R	No	I	January to May	0	IV	LC
74.		*Dinopium javanense*	Common golden backed woodpecker	R	No	I	January to May	1	IV	LC
75.	Vabgidae	*Tephrodornis sylvicola*	Malabar woodshrike	R	Yes	I	-	11	IV	LC
76.	Alaudidae	*Calandrella brachydactyla*	Greater short toed lark	WV	No	GR,I	Extralimital	0	IV	LC
77.	Hirundinidae	*Riparia riparia*	Sand martin	wintering	No	I	October to March	0	IV	LC
78.		*Riparia paludicola*	Plain martin	Wintering	No	I	October to May (in N. India)	0	IV	LC
79.		*Hirundo fluvicola*	Streak throated swallow	wintering	No	I	All year	0	IV	LC
80.		*Delichon urbica*	Northern house martin	WV	No	I	Extralimital	0	IV	LC
81.	Motacillidae	*Dendronanthus indius*	Forest wagtail	WV	No	I	Extralimital	0	IV	LC
82.		*Anthus richardi*	Richard's Pipit	WV	No	I	Extralimital	0	IV	LC
83.		*Anthus godlewskii*	Blyth's Pipit	WV	No	I	Extralimital	0	IV	LC
84.	Campephagidae	*Coracina macei*	Large cuckoo shrike	R/LM	No	I	January to October	0	IV	LC
85.	Pycnonotidae	*Pycnonotu.· priocephalus*	Grey-headed Bulbul	R	Yes	FR	March to july	0	IV	NT
86.		*lole indica*	Yellow browed bulbul	R	Yes	FR	February to May	2	IV	LC
87.		*Pycnonotus gularis*	flame-throated bulbul	R	Yes	FR	February to April	5	IV	LC
88.		*Pycnonotus jocosus*	red-whiskered bulbul	R	No	FR	March to October	1	IV	LC
89.	Laniidae	*Lanius cristatus*	Brown shrike	WV	No	I	Extralimital	0	IV	LC
90.		*Lanius schach*	Long Tailed shrike	R/SM	No	OM	March to June	0	IV	LC
91.	Muscicapidae	*Monticola cinclorhynchus*	Blue headed Rock thrush	Wintering	No	OM	May to July	0	IV	LC
92.		*Luscinia brunnea*	Indian blue robin	WV	No	I	extralimital	0	IV	LC

SNo.	Family	*Scientific name*	Common name	Residential status	Endemic to Western Ghats	Food habits	Breeding season	Numbers Recorded	Schedule of WPA, 1972	IUCN status (v2018-1)
93.		*Copsychus saularis*	oriental magpie-robin	R	No	I	March to July	1	IV	LC
94.		*Copsychus malabaricus*	White rumped shama	R	No	I	April to June	2	IV	LC
95.	Timaliinae	*Garrulax delesserti*	Wynaad Laughingthrush	R	Yes	I	July to September	0	IV	LC
96.		*Pellomeum ruficeps*	Spotted babbler	R	No	I	April to September	0	IV	LC
97.		*RhopociclrIa alriceps*	Dark Fronted babbler	R	Yes	I	March to July	0	IV	LC
98.		*Turdoides subrufus*	Indian rufous babbler	R	Yes	I	February to November	0	IV	LC
99.		*Alcippe poioicephala*	Brown cheeked fulvetta	R	No	I	January to May	0	IV	LC
100.	Monarchidae	*Terpsiphone paradisi*	Asian Paradise flycatcher	R	No	I	-	1	IV	LC
101.	Nectariniidae	*Leptocoma zeylonica*	Purple rumped sunbird	R	No	N	February to April	2	IV	LC
102.		*Leptocoma minima*	Crimson Backed sunbird	R	Yes	N	September to April	7	IV	LC
103.		*Cinnyris asiaticus*	Purple Sunbird	R	No	N	February to April	1	IV	LC
104.	Podargidae	*Batrachostomus moniliger*	Sri Lanka frogmouth	R	Yes	I	-	1	I (part III)	LC
105	Oriolidae	*Oriolus xanthornus*	Black-Hooded oriole	R	No	I, FR	February to April	1	IV	LC

Notes: Food Habit: Aq A- Aquatic Animals, GR– Granivorous, FR- Frugivorous, CR- Carnivorous, I- Insectivorous, N- Nectar eater, OM- Omnivorous.
IUCN Status: LC- Least Concern, NT- Near Threatened, VU- Vulnerable

Endemism

Out of all the 104 recorded and reported species, sixteen (16) species are endemic to Western Ghats. Nine (9) endemic avian species were recorded during primary survey. Details of endemic species recorded and reported from the study are provided below in ***Table 3.20***

Table 3.20 Endemic Avian Species of the Study Area

SNo.	*Scientific name*	Common name	Recorded during Primary survey	Schedule of WPA, 1972	IUCN status (v2018-1)
1.	*Columba eiphinstonii*	Nilgiri wood pegion	No	IV	VU
2.	*Psittacula columboides*	Blue winged Parakeet	No	IV	LC
3.	*Collocalia unicolor*	Indian edible nest swiftlet	No	I	LC
4.	*Harpactes fasciatus*	Malabar Trogon	Yes	IV	LC
5.	*Ocyceros griseus*	Malabar grey Hornbill	Yes	IV	LC
6.	*Anlhracoceros coronatus*	Malabar Pied Hornbill	Yes	I	NT
7.	*A1egalaima virdis*	White checked Barbet	Yes	IV	LC
8.	*Tephrodornis sylvicola*	Malabar woodshrike	Yes	IV	LC
9.	*Pycnonotu.· priocephalu s*	Grey-headed Bulbul	No	IV	NT
10.	*lole indica*	Yellow browed bulbul	Yes	IV	LC
11.	*Pycnonotus gularis*	flame-throated bulbul	Yes	IV	LC
12.	*Garrulax delesserti*	Wynaad Laughingthrush	No	IV	LC
13.	*RhopociclrIa alriceps*	Dark Fronted babbler	No	IV	LC
14.	*Turdoides subrufus*	Indian rufous babbler	No	IV	LC
15.	*Leptocoma minima*	Crimson Backed sunbird	Yes	IV	LC
16.	*Batrachostomus moniliger*	Sri Lanka frogmouth	Yes	I	LC

Status of Bird Migration

All 25 species of birds recorded from the study area are residential birds, no migratory birds were recorded during the primary survey. However of a total 104 species reported from the study area, Twenty six (26) migratory species can be found in the study area, viz. White stork, Eurasian Sparrowhawk, Common Snipe, Jack Snipe, Marsh Sandpiper, Commom Greenshank, Green Sandpiper, Commom sandpiper, Lesser Cuckoo, Greater short toed lark, Sand martin, Plain martin Streak throated swallow, Northern house martin, Forest wagtail, Richard's Pipit, Blyth's Pipit, Brown shrike, Blue headed Rock thrush, Indian blue robin.

Status of Foraging Guild

The foraging guide is derived from what the bird species predominantly feeds on. Out of thwenty five species recorded from primary survey, maximum nine species were found to be Insectivorous (36%). Seven species were frugivorous (28%). Three species were found to be carnivorous (12%). Three species were nectar eater (12%). Two are granivorous (8%) and one Omnivorous (4%).

3.9.3 Mammals

Species Richness

In the Goa section of the study area, a total eight (8) species of eight (8) different genera were recorded through direct sightings and signs of species presence. The species recorded through direct sighting include Gaur (*Bos gaurus),* Grey Mongoose *(Herpestes edwardsii),* Bonnet Macaque *(Macaca radiate),* Malabar Giant Squirrel *(Ratifa indica),* Southern Plains Langur *(Semnopithecus entellus)*. Signs such as pellet of Sambar (*Rusa unicolor)*, quills of Indian Porcupine (*Hystrix indica),* and resting places of Wild Pig *(Sus scrofa)* were also recorded during transects. All the eight species recorded from Goa section belong to seven (7) families namely, *Herpestidae, Bovidae, Cercopithecidae, Sciuridae, Cervidae, Hystricidae,* and *Suidae.* Malabar Giant Squirrel *(Ratifa indica)* and Bonnet Macaque *(Macaca radiate)* were the species sighted most frequently across the study area.

Table 3.21 Details of Sightings in Transmission Line Corridor

SNo.	Common Name	Scientific Name	Number Recorded	Recorded from Transect	IUCN Status	WPA Status	Type of Sighting/Sign
1	Gaur	*Bos gaurus*	1		VU	Sch I (Part I)	Direct
2	Grey Mongoose	*Herpestes edwardsii*	1	GT3	LC	Sch II (Part I)	Direct
3	Bonnet Macaque	*Macaca radiate*	8	GT1, GT3, GT4	LC	Sch II (Part I)	Direct
4	Indian/Malabar Giant Squirrel	*Ratufa indica*	5	GT1, GT2, GT5	LC	Sch II (Part I)	Direct
5	Southern Plains Langur	*Semnopithecus entellus*	4	GT2	LC	Sch II (Part I)	Direct
6	Sambar	*Rusa unicolor*	1	GT3	VU	Sch III	Pellets
7	Indian Porcupine	*Hystrix indica*	1	GT5	LC	Sch IV	Quills
8	Wild Boar	*Sus scrofa*	3	GT1, GT5	LC	Sch III	Resting Place

Source: ERM Primary Survey

Figure 3.11 Mammal Species recorded in Transmission Line Corridor

Malabar Giant Squirrel

Bonnet Macaque

Black-faced Langur

Indian Porcupine (Quill)

Overall Species Richness of Mammals

Secondary information collected from forest department and previous studies /reports in the study area were used for preparing the complete checklist of the mammals. In the Goa, a total 41 species of mammals belonging to 35 genera of 20 families have been reported. The details are presented in ***Table 3.22*** and ***Table 3.23***.

Table 3.22 Taxonomic Status of Mammals

Taxonomic group	Goa Section D/ID Sighting	Goa Section Overall
Species	8	41
Genus	8	35
Family	7	20

Threatened Species

Out of which 41 species recorded from Bhagwan Mahaveer Wildlife Sanctuary, 8 species are protected under Schedule I of Wildlife (Protection) Act 1972 and are of conservation significance. These species include Leopard (*Panthera pardus*), Gaur (*Bos gaurus*), Slender Loris (*Loris tardigradus),* Indian Pangolin (*Manis crassicaudata),* Sloth Bear (*Melursus ursinus)*, Mouse Deer (*Moschiola indica)*, Leopard Cat (*Prionailurus bengalensis)* and Fishing Cat (*Prionailurus viverrinus*).

Slender Loris (*Loris tardigradus)* and Indian Pangolin (*Manis crassicaudata)* are EN (IUCN Red-List V2018-2)" while other species viz. Gaur (*Bos gaurus*), Common Leopard (*Panthera pardus*), Sloth Bear (*Melursus ursinus)* and Fishing Cat (*Prionailurus viverrinus*) are listed as "VU in the IUCN Red List. Mouse Deer (*Moschiola indica)* and Leopard Cat (*Prionailurus bengalensis)* are listed as LC.

Table 3.23 Checklist of Mammals in Bhagwan Mahaveer Wildlife Sanctuary, Goa

SNo	Family	Common Name	Scientific Name	Preferred Habitat	Recorded in T/L Route	IUCN Status	WPA Status
1	*Cervidae*	Spotted Deer/Chital	*Axis axis*	Dense moist evergreen forest, deciduous forest	N	LC	Sch III
2	*Cervidae*	Sambar	*Cervus unicolor*	Moist and dry deciduous forest	Y	VU	Sch III
3	*Cervidae*	Indian Muntjac/Barking Deer	*Muntiacus muntjak*	Dense/open, deciduous/evergreen forest	N	LC	Sch III
4	*Bovidae*	Gaur	*Bos gaurus*	Evergreen and moist deciduous	Y	VU	Sch I (Part I)
5	*Canidae*	Golden Jackal	*Canis aureus*	Scrubland, Grassland/Savannah	N	LC	Sch II (Part I)
6	*Canidae*	Dhole	*Cuon alpinus*	Dry/moist deciduous forest, evergreen/semi evergreen forest	N	EN	Sch II (Part I)
7	*Ursidae*	Sloth Bear	*Melursus ursinus*	Subtropical/tropical forest, scrubland	N	VU	Sch I (Part I)
8	*Felidae*	Leopard Cat	*Prionailurus bengalensis*	Tropical forest, scrubland	N	LC	Sch I (Part I)
9	*Felidae*	Fishing Cat	*Prionailurus viverrinus*	Marshland, lowland areas	N	VU	Sch I (Part I)
10	*Felidae*	Leopard	*Panthera pardus*	Wide range of forest types, scrubland, grassland, rocky areas	Y	VU	Sch I (Part I)
11	*Felidae*	Jungle Cat	*Felis chaus*	Grassland, Scrubland, desert	N	LC	Sch II (Part I)
12	*Cercopithecidae*	Bonnet Macaque	*Macaca radiate*	All forest types, plantation, agricultural lands	Y	LC	Sch II (Part I)
13	*Cercopithecidae*	Hanuman/Black-faced Langur	*Semnopithecus entellus*	Urban environment, near human habitations	Y	LC	Sch II (Part I)
14	*Herpestidae*	Grey Mongoose	*Herpestes edwardsii*	Subtropical/tropical dry forest, Scrubland, grassland	Y	LC	Sch II (Part I)
15	*Herpestidae*	Ruddy Mongoose	*Herpestes smithii*	Subtropical/tropical dry forest, Scrubland	N	LC	Sch II (Part I)
16	*Herpestidae*	Stripe-necked Mongoose	*Herpestes vitticollis*	Deciduous/evergreen forest, scrubland	N	LC	Sch II (Part I)
17	*Hystricidae*	Indian Porcupine	*Hystrix indica*	Tropical/temperate scrubland, forest, grassland	Y	LC	Sch IV

SNo	Family	Common Name	Scientific Name	Preferred Habitat	Recorded in T/L Route	IUCN Status	WPA Status
18	*Suidae*	Wild Boar	*Sus scrofa*	Tropical , temperate forest, scrubland, grassland, agricultural landscape	N	LC	Sch III
19	*Tragulidae*	Mouse Deer	*Moschiola meminna*	Tropical deciduous and moist evergreen forest	N	LC	Sch I (Part I)
20	*Viverridae*	Common Palm Civet	*Paradoxurus hermaphroditus*	Deciduous/ evergreen forest, village/urban environments	N	LC	Sch II (Part I)
21	*Leporidae*	Indian/Black-naped Hare	*Lepus nigricollis*	Subtropical/tropical scrubland, forest	N	LC	Sch IV
22	*Lorisidae*	Slender Loris	*Loris tardigradus*	Subtropical/tropical forest, artificial plantations	N	EN	Sch I
23	*Manidae*	Indian Pangolin	*Manis crassicaudata*	Subtropical/tropical forest, scrubland, grassland	N	EN	Sch I (Part I)
24	*Muridae*	Lesser Bandicoot Rat	*Bandicota bengalensis*	Agricultural landscape, dry deciduous forest	N	LC	Sch IV
25	*Muridae*	Large Bandicoot Rat	*Bandicota indica*	Agricultural landscape, grassland dry deciduous forest	N	LC	Sch IV
26	*Muridae*	White-tailed Wood Rat	*Cremnomys blanfordi*	Tropical/sub-tropical dry deciduous scrub	N	LC	Sch V
27	*Muridae*	Indian Gerbil	*Tatera indica*	Dry deciduous, scrub forest, grassland	N	LC	Sch IV
28	*Muridae*	Long-tailed Tree Mouse	*Vandeleuria oleracea*	Dry, moist deciduous forest, grassland, scrubland	N	LC	Sch V
29	*Muridae*	Little Indian Field Mouse	*Mus booduga*	Croplands, dry and deciduous forest	N	LC	Sch IV
30	*Muridae*	Spiny Field Mouse	*Mus platythrix*	Dry deciduous, scrub forest, cropland	N	LC	Sch IV
31	*Muridae*	House Rat	*Rattus rattus*	Grassland, scrubland, natural/semi-natural habitat	N	LC	Sch IV
32	*Vespertilionidae*	Indian Pipistrelle	*Pipistrellus coromandra*	Forest, agricultural landscape, subterranean habitat	N	LC	-
33	*Vespertilionida*	Indian Pygmy Bat	*Pipistrellus tenuis*	Wet/humid forest, urban environment	N	LC	-
34	*Pteropodidae*	Lesser Dog-faced Fruit Bat	*Cynopterus brachyotis*	Rural/urban landscape, forested areas	N	LC	Sch IV
35	*Tupaiidae*	South Indian Tree Shrew	*Ananthana elliotti*	Scrubland, dry and moist deciduous forest	N	LC	-

SNo	Family	Common Name	Scientific Name	Preferred Habitat	Recorded in T/L Route	IUCN Status	WPA Status
36	*Megadermatidae*	Lesser False Vampire	*Megaderma spasma*	Forest, rocky areas, caves, subterranean habitat	N	LC	-
37	*Sciuridae*	Indian Giant Flying Squirrel	*Petaurista philippensis*	Dry deciduous and evergreen forest	N	LC	Sch II (Part I)
38	*Sciuridae*	Indian/Malabar Giant Squirrel	*Ratufa indica*	Tropical evergreen, semi evergreen, deciduous forest	Y	LC	Sch II (Part I)
39	*Sciuridae*	Three-striped Palm/Jungle Striped Squirrel	*Funambulus palmarum*	Forest, Scrubland, inland wetlands	N	LC	Sch IV
40	*Pteropodidae*	Fulvous Fruit Bat	*Rousettus leschenaultia*	Tropical moist forest, urban environment	N	LC	Sch IV
41	*Soricidae*	House Shrew	*Suncus murinus*	Scrubland, forest, grassland, cultivated fields	N	LC	Sch V

Source: India Biodiversity Portal, ENVIS Database, IUCN

IUCN Status: LC- Least Concern, NT- Near Threatened, VU- Vulnerable

4. IMPACT ASSESSMENT

4.1 Impacts on Biodiversity

The impacts on biodiversity of the proposed transmission line corridor passing through Bhagwan Mahaveer Wildlife Sanctuary has been categorized into the following categories

- Impacts during Construction Phase
- Impacts during Operation Phase

4.2 Impacts during Construction Stage

Following impacts are envisaged during the construction stage on the biodiversity of the Transmission Line route

- Impacts during route survey and planning
- Impacts during vegetation clearance on approach roads
- Impacts during vegetation clearance on tower locations
- Impacts during man and material transportation on each of the tower location
- Impacts during storage of construction material
- Impacts during construction activities
- Impacts during stringing of conductor

4.3 Impacts during operation Stage

Following impacts are envisaged during the operation Phase

- Mortality due to Electrocution and Collision of Avifaunal species
- Mortality due to Electrocution and Collision of arboreal mammalian species

4.4 Impact Assessment Criteria

ERM Impact Assessment Standards defines sensitivity of ecological receptors by determining the significance of effects on species and habitats separately. The significance tables for species and habitats are given in and Table 4.2 respectively.

Table 4.1 Habitat Impact Assessment Criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation	Affects only a small area of habitat, such that there is no loss of viability/ function of the habitat	Affects part of the habitat but does not threaten the long-term viability/ function of the habitat	Affects the entire habitat, or a significant portion of it, and the long-term viability/ function of the habitat is threatened.
Negligible	Habitats with negligible interest for biodiversity.	**Not significant**	**Not significant**	**Not significant**	**Not significant**
Low	Habitats with no, or only a local designation / recognition, habitats of significance for species listed as of Least Concern (LC) on IUCN Red List of Threatened Species, habitats which are common and widespread within the region, or with low conservation interest based on expert opinion.	**Not significant**	**Not significant**	**Minor**	**Moderate**
Medium	Habitats within nationally designated or recognised areas, habitats of significant importance to globally Vulnerable (VU), Near Threatened (NT), or Data Deficient (DD) species, habitats of significant importance for nationally restricted range species, habitats supporting nationally significant concentrations of migratory species and / or congregatory species, and low value habitats used by species of medium value.	**Not significant**	**Minor**	**Moderate**	**Major**
High	Habitats within internationally designated or recognised areas; habitats of significant importance to globally Critically Endangered (CR) or Endangered (EN) species, habitats of significant importance to endemic and/or globally restricted-range species, habitats supporting globally significant concentrations of migratory species and / or congregatory species, highly threatened and/or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species.	**Not significant**	**Moderate**	**Major**	**Critical**

Table 4.2 Species impact assessment criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Species			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation for the population of the species	Effect does not cause a substantial change in the population of the species or other species dependent on it	Effect causes a substantial change in abundance and/or reduction in distribution of a population over one, or more generations, but does not threatened the long term viability/ function of that population dependent on it.	Affects entire population, or a significant part of it causing a substantial decline in abundance and/or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas).
Negligible	Species with no specific value or importance attached to them.	**Not significant**	**Not significant**	**Not significant**	**Not significant**
Low	Species and sub-species of Least Concern (LC) on the IUCN Red List, or not meeting criteria for medium or high value.	**Not significant**	**Not significant**	**Minor**	**Moderate**
Medium	Species on IUCN Red List as Vulnerable (VU), Near Threatened (NT), or Data Deficient (DD), species protected under national legislation, nationally restricted range species, nationally important numbers of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species.	**Not significant**	**Minor**	**Moderate**	**Major**
High	Species on IUCN Red List as Critically Endangered (CR), or Endangered (EN). Species having a globally restricted range (ie plants endemic to a site, or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) less than 50,000 km2), internationally important numbers of migratory, or congregatory species, key evolutionary species, and species vital to the survival of a high value species.	**Not significant**	**Moderate**	**Major**	**Critical**

4.5 Impact Assessment

4.5.1 Impacts during Construction Phase

Context

Context for impacts of various activities are provided as per ***Table 4.3***

Table 4.3 Context of various impacts during construction phase

Impacts during construction phase	Context
Impacts during Route Survey and Planning	Route survey and planning involves surveying the transmission line route and identifying transmission tower location. Survey identifies the probable approach route to tower locations, feasibility for tower erection, soil testing etc. This will involve vegetation clearance enroute and at tower locations
Impacts during vegetation clearance on approach roads	Approach roads will be required to reach at the tower locations, where possible through tractor trolley with limited vegetation clearance and minimal levelling and where not, on foot by making a small 3-4 m wide forest trail to get access the tower location.
Impacts during vegetation clearance at Tower locations	The tower erection area will need to be cleared for construction activities. An area of 10 m radius will be required to be cleared at each of the tower locations and levelled.
Impacts during man and material transportation on each of the tower location	The transportation of construction workers and construction material at the tower location will be required during the construction phase. While workers transportation facility will be provided till the nearest road end, material transportation will be made through tractor and trolley till the place it is feasible with minimum requirement of vegetation clearance and levelling, it will be further transported on head load by workers to the construction site. Locations which involve larger vegetation clearance, alternate arrangements such as material transportation through rope ways will be explored.
Impacts during storage of construction material	The civil work for foundation and erection of each transmission tower will require the storage of tower components and foundation materials at tower location. This will lead to additional clearance of vegetation in the construction area.
Impacts during construction activities	Foundation and Erection of transmission tower will involve deployment of manpower, excavation of foundation, civil works. This will create temporary habitat disturbance.
Impacts during stringing of conductor	Once the transmission tower erection is completed, conductor stringing will be undertaken. During the stringing all tall trees and branches will be loped and pruned where minimum ground clearance to conductor will be maintained.

Receptors

The receptors in the transmission line route are 45 species of floral species, 25 species of herpetofauna, 105 species of avifauna and 41 species of mammals.

Out of forty five (45) floral species six (06) species are listed as threatened as per IUCN Red list v1.2018, eight (08) species of medicinal importance having commercial value and twelve (12) endemic species from the Western Ghats region.

Faunal species comprised twenty five (25) species of amphibians, sixty three (63) species of reptiles, one hundred and five (105) species of avifauna and forty one (41) species of mammalsin the study area.

Of the above listed species the following IUCN Red- Listed threatened species were recorded: such amphibians; Amboli Bush Frog *Pseudophilautus amboli* (IUCN CR v2018-2), Malabar Tree Toad

Pedostibes tuberculosus and Marbled Ramanella *Uperodon mormorata (* IUCN EN v2018-2.) and Maharashtra Bush Frog *Raorchestes bombayensis(* IUCN VU v2018-2).

In reptiles, Indraneil's Day Gecko (*Cnemaspis cf. indraneildasii*) and Indian rock python (*Python molurus*) are listed as IUCN VU v2018-2 and are either observed or reported from the study area.

There is significant presence of Sch. I species OF Indian Wildlife Protection Act, 1971 in each faunal group (Refer ***Section 3.9***)

In avifauna, species such as Nilgiri wood pegion (*Columba eiphinstonii*) (IUCN VU v2018-2) is reported from the study area. Out of total 105 species, 16 avifaunal species are endemic to Western Ghats.

A total of 41 mammals' species reported from the study area, Slender Loris (*Loris tardigradus*) and Indian Pangolin (*Manis crassicaudata*) are listed as IUCN EN v.2018.2, while species such as Gaur (*Bos gaurus*), Common Leopard (*Panthera pardus*), Sloth Bear (*Melursus ursinus*) and Fishing Cat (*Prionailurus viverrinus*) are listed as IUCN VU v2018-2. These species can be potentially impacted.

Impact Significance

Vegetation clearance along the access road and transmission tower locations for the various construction activities as described in ***Table 4.3*** will lead to habitat loss, habitat disturbance to faunal species. It will also lead to loss of natural vegetation which will lead to reduced vegetal cover, shrinkage in natural forest cover, loss of nesting and foraging for avifaunal species, arboreal amphibians, reptiles and movement pattern of mammal species in the study area.

The excavation, levelling and removal of vegetation will also result in soil erosion which will be washed and drained and with the occurrence of rains, will run into the natural streams and change the stream characteristics, impacting the aquatic habitat associated amphibians and reptile and mammalian species.

The study area falls within the Bhagwan Mahaveer Wildlife Sanctuary with presence of significant number of Sch. I species along with presence of IUCN listed CR, EN and VU species, the resource sensitivity is **High** for habitats and species. The impacts described above will not cause a significant change in the population of these species and therefore the impact magnitude has been deemed **Small.** The construction period is suggested is of 6 months hence the impact duration suggested is **Short term. (**Refer ***Table 4.4***). The Overall impact significance is **Moderate** for habitats and species.

Residual Impacts

Removal of vegetation, development of approach roads and construction activities can have a direct and indirect impact on the local ecology. The impact is limited to the construction phase of the Project, following which the vegetation can recover, however, recovery as back to original stage will require significant duration of undisturbed state. The significance of the residual impacts is **Minor** for habitats and species. **(**Refer ***Table 4.4***)

Table 4.4 Impact significance of Overall Construction Activities

Impact	During Construction Phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Limited to tower location, approach roads and immediate surroundings				
Frequency	Construction phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Agricultural lands)	Low	Medium	High		
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Not Significant	Minor	Moderate	Major	
	Significance of impact is considered **Moderate** for habitat and species.				
Residual Impact Significance					
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Not Significant	Minor	Moderate	Major	
	Significance of impact is considered **Minor** for habitats and species.				

4.5.2 Impacts during operation Phase

The context to the operation phase impacts are

Context

Context for impacts of various activities are provided as per ***Table 4.3***

Table 4.5 Context of various impacts during operation phase

Impacts during operation phase	Context
Impacts due to electrocution and collision of avifaunal species with conductor	Mortality by Electrocution: Electrocution may happen if the avifaunal species sitting on the conductor and touching two phase
	Mortality by collision Mortality by collision may happen if the avifauna flying near the conductor did not spot the conductor and collides with it in full force, leading to physical injury (Like broken wings etc) resulting into death.
Disturbance to vegetation during maintenance of required ground clearance	Preventive and Corrective Maintenance of the transmission line and for maintenance of the mandatory vertical clearance between vegetation and lowest point of conductor sag. This will involve lopping and pruning of existing tree species leading to loss of nesting and perching sites
Electrocution of Arboreal mammals	The arboreal mammals in the study area may face changes in the movement within traditional corridors and mortality due to electrocution while moving from one canopy to another canopy with transmission line as barrier in between.

Receptors

The avifaunal species reportedly present within the study area and in the larger landscape of the wildlife sanctuary such as White stork (*Ciconia cicollia*), Eurasian Spoonbill (*Platalea leucorodia*), Malabar grey Hornbill (*Ocyceros griseus*)* Western Ghats endemic, Indian grey hornbill (*Ocyceros birosIris*) and Malabar Pied Hornbill (*Anlhracoceros coronatus*) and Great pied Hornbill (*Buceros bicornis*) have larger wingspan and face risk of electrocution while perching on the conductor and mortality due to collision while flying into conductor and getting injured.

Raptor species listed in Sch.I of the Indian Wildlife Protection Act, 1972 such as Black Baza (*Ariceda leuphotes),* Oriental Honey Buzzard (*Pernis ptilorhyncus*), Black winged Kite (*Elanus careleus*), Crested Serpent eagle (*Spilornis cheela*), Crested Goshawk (*Accipiter trivirgatus*), Shikra (Accipiter badius), Besra Sparrow Hawk (*Accipiter virgatus*), Eurasian Sparrowhawk (*Accipiter nisus*), White eyed Buzzard (*Butastur teesa*), Black Eagle (*Icrillaellts malyanensis*), Tawny Eagle(*Aquila rapax*) from the study area and larger landscape have a perching behaviour on the transmission line and may nest in transmission line tower. These are also under potential risk of mortality due to electrocution and collision with conductors.

Arboreal (Tree Dwelling) mammals such as Slender Loris (*Loris tardigradus*) Indian Giant Flying Squirrel (*Petaurista philippensis*), Indian/Malabar Giant Squirrel (*Ratufa indica*), Bonnet Macaque (*Macaca radiate),* Hanuman /Black-faced Langur (*Semnopithecus entellus*) may face barrier in movement due to transmission line.

Aerial mammalian species such as Fulvous Fruit Bat (*Rousettus leschenaultia*), Lesser False Vampire (*Megaderma spasma*), Indian Pipistrelle (*Pipistrellus coromandra*), Indian Pygmy Bat (*Pipistrellus tenuis*) and Lesser Dog-faced Fruit Bat (*Cynopterus brachyotis*) are also likely to get impacted due to collision with transmission line conductor.

Few IUCN listed species such as Dhole (*Cuon alpinus*), Slender Loris (*Loris tardigradus*), Indian Pangolin (*Manis crassicaudata*), listed as EN v2018-2 and Gaur (Bos gaurus), Sloth Bear (*Melursus ursinus*), Fishing Cat (*Prionailurus viverrinus*), Leopard (Panthera pardus) are listed as VU as per v2018-2 may be impacted for habitat disturbance due to routine and corrective maintenance.

Impact Significance

There is a potential of impacts on IUCN listed EN and VU species, Schedule I species of Indian Wildlife Protection Act, 1971 and endemic species from Western Ghats. The study area falls within the Bhagwan Mahaveer Wildlife Sanctuary with presence of significant number of Sch. I species, IUCN listed CR, EN and VU species, the resource sensitivity is **High** for habitats and species. The impacts described above will not cause a significant change in the population of these species as sufficient habitat is present in the study area and the larger landscape. The impact duration is **Long term** as the impacts will be applicable for entire project cycle. Hence the impact magnitude is deemed **medium** as effect may causes a substantial change in abundance and/or reduction in distribution of a population over one, or more generations, but does not threatened the long term viability/ function of that population dependent on it. Overall impact assessed for the operational phase is **Major** for habitat and species**.**

Residual Impacts

The residual impacts for the operational phase impacts are deemed as **Moderate** as the implementation of mitigation measures suggested will lower the impact magnitude from medium to **small**. **(**Refer ***Table 4.6***)

Table 4.6 Impact significance of Operational Activities

Impact	During Operation Phase				
Impact Nature	Negative	Positive	Neutral		
Impact Type	Direct	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	Permanent	
Impact Extent	Local	Regional	International		
Impact Scale	Routine and Corrective Maintenance				
Frequency	Operation phase				
Likelihood	Likely				
Impact Magnitude	Positive	Negligible	Small	Medium	Large
Resource Sensitivity (Agricultural lands)	Low	Medium	High		
Resource Sensitivity (Species)	Low	Medium	High		
Impact Significance	Not Significant	Minor	Moderate	Major	
	Significance of impact is considered **Major** for habitat and species.				
Residual Impact Significance					
Residual Impact Magnitude	Positive	Negligible	Small	Medium	Large
Residual Impact Significance	Not Significant	Minor	Moderate	Major	
	Significance of impact is considered **Moderate** for habitats and species.				

5. MITIGATION MEASURES

5.1 INTRODUCTION

"Mitigation Measures," refer to the actions that can be implemented to minimize the magnitude of the project related detrimental impacts on different physical, biological and social environments of the project area. Mitigation can carry on along three possible courses of actions, either by changing (1) at source, (2) path (3) and at the receiving end.

Overall impact statement identified impacts in construction and operation phase. The impact summary prom the previous chapter is provided in ***Table 5.1.***

Table 5.1 Impact Summary

Impact Description	Impact Nature	Impact Significance	
		Without Mitigation	Residual (With Mitigation)
Construction Phase	Negative	Moderate	Minor
Operation Phase	Negative	Major	Moderate

The mitigation measures for the construction phase and operation phase as discussed hereunder;

5.2 Construction Phase Mitigation Measures

The proposed transmission line project is estimated to acquire a total of 11.54 ha. area of Bhagwan Mahaveer Wildlife Sanctuary which would result in the loss of forest habitat, change in species composition and change in abundance of faunal groups of the overall project area.

Section 1 of Transmission line (Refer **Figure 2.1**) falls in the lateritic plateaus habitat with west coast semi evergreen forest areas in fringes. The transmission tower locations are in the forest habitat. This section requires 2.53 ha. of forest land to be diverted.

Section 2 of the transmission line project (Refer **Figure 2.2**) falls in west coast semi evergreen forest and west coast tropical evergreen and moist deciduous forest area. The tower locations are in the dense to very dense forest area. This section required diversion of 9.01 ha of forest land area.

Mitigation measures suggested in the construction phase are discussed below;

- Habitat disturbances to be kept at minimum by using existing trails for transportation of man material and machinery;
- Any vegetation clearance required should be limited to the minimum area required for such passages;
- Compensatory afforestation in the area as instructed by the Forest department as per forest clearance conditions should be undertaken
- Alternate mode of transportation such as Rope-ways should be considered were ever feasible to the maximum extent;
- Tree enumeration for clearance should be undertaken in presence of trained botanist in order to seek guidance to avoid, restore and replant species of conservation significance such as IUCN listed threatened species, endemic species and medicinal plants as per ***section 3.8*;**
- Construction activity, man and material movement should be limited to the day time and early morning, late evening and night activity should be completely avoided to allow the unrestricted wildlife movement;
- No night stay at the construction site should be planned, proper planning of day work should be done;

- Movement within the wildlife area should be entirely regulated, each work force should be trained in do's and don't's and how to deal in a situation of wildlife encounter before entering the wildlife area,
- Tree felling should be in compliance of all the statutory requirements, tree felling in the nesting season (Refer ***Table 3.19***) should carefully examine the active nest on trees before felling, relocation of active nest should be undertaken with the help of State Forest Department and/or wildlife NGO;
- Hunting, trapping and poaching by the employed work force should be completely banned and no poaching tolerance strategy should be covered under contractual obligations;
- On the approach road to the road end (Tambdi Surla Temple End) from the Sancordem to Mollem road, the driving speed of vehicle should be kept below 30km/hr as there are chances of road kills in this stretch;
- The vegetation clearance along the RoW of the transmission line will create a canopy break for the arboreal mammals (Tree dwelling) construction of canopy bridges at key locations (where such canopy breaks are very evident) are suggested. (Figure 5.1 b.)
- Proper housekeeping of the construction areas should be followed during and after construction phase is completed.
- Slope protection and soil conservation measures such as working in non rainly season, contour ploughing and mulching should be undertaken so that contamination of natural streams in the vicinity are not impacted;
- Construction noise from working of man and machine should be regulated. Working hours within the sanctuary area should be from morning 8 am to evening 5 pm.
- Independent monitoring agency (preferably a local wildlife NGO) should be appointed to oversee and guide the mitigation measure implementation during the construction phase and should periodically update the higher official of GTTPL.

5.3 Mitigation for Operational Phase

Operational Phase impacts will be associated to the routine and corrective maintenance, potential risk of electrocution and collision for avifaunal species and electrocution for arboreal mammalian species. In the routine maintenance, in order to require the mandatory vertical clearance, pruning and lopping of trees may be required within the RoW.

Mitigation measures suggested in the operation phase are discussed below;

- Any routine and corrective maintenance schedule planned should be undertaken only after prior information to the forest department;
- GTTPL should make arrangements for dedicated personal from forest department, trained in dealing situations of wildlife encounters, movement, rescue and rehabilitation (preferably reptiles and mammalians) while under taking such routine visits ;
- Pre nest search before commencing any pruning and lopping to be undertaken;
- Artificial nest boxes along the transmission line route to mitigate the loss of nesting sites along the transmission line route;(Figure 5.1 a.)
- Periodic review of condition of canopy bridges and undertake required maintenance;
- Installation of bird diverters on the conductor and perch rejecters on transmission tower along the transmission line corridor; (Figure 5.1 c &d.)
- In addition to the above artificial nesting platform for raptor species to be built along the transmission line at a distance of 200 m;

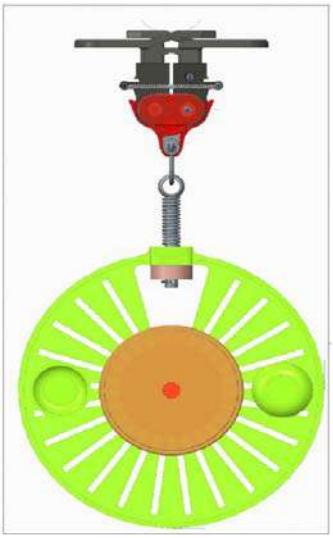
- Structures to climb transmission towers should have a restriction guards (to avoid access to for arboreal species (Maccaques, Langurs, Loris, Giant Squirrels etc.)
- Rapid carcass search along the transmission line corridor for possible victims of collision and electrocution

The suggested mitigation structures are depicted in ***Figure 5.1.***

Figure 5.1 Mitigation Structures for Transmission Line

a. Artificial nesting platforms reduce electrical hazards and enhance habitat for breeding and roosting

b. Canopy bridge construction for arboreal mammals movement in canopy break area



c. Power line Bird Diverters

d. High temperature Power line Markers

6. BIODIVERSITY MANAGEMENT PLAN

6.1 Introduction

Where biodiversity values of importance to conservation are associated with a project site or its area of influence, the preparation of a Biodiversity Management Plan (BMP) provides a useful means to focus a project's mitigation and management strategy. The development of a BMP for transmission line project is a requirement for regulatory clearances as it documents the process, actions, responsibilities and budget allocation. It also gives the opportunities to investigate the effectiveness of the mitigation measures suggested and provides as chance to revisit them and make timely changes to update/upgrade the mitigation actions for better management of biodiversity.

6.2 BIODIVERSITY MANAGEMENT PLAN

The biodiversity management plan has been devised on the following aspects;

- Ecological Sensitivities along the transmission line corridor;
- Species of conservational significance along the transmission line corridor;
- Impacts during the construction and operation phase;
- Proposed mitigation measures;
- Parameters to be monitored;
- Measurement and frequency;
- Institutional responsibility;
- Implementation schedule

6.2.1 Ecological Sensitivity

The ecological sensitivities along the transmission line are;

Habitats: The transmission line passes through protected area, "**Bhagwan Mahaveer Wildlife Sanctuary**". This sanctuary contains pristine vegetation classified as West Coast tropical evergreen forests, West Coast semi-evergreen forests and moist deciduous forests. The evergreen forests are mainly seen at higher altitudes and along the river banks.

Species of Conservational Significance: The species of conservational significance (IUCN listed Critically Endangered, Endangered and Vulnerable species, Indian Wildlife Protection Act, 1971 listed Schedule I species observed and reported from the transmission line corridor are listed in ***Table 6.1.***

The threatened species observed in the transmission line corridor and the buffer area are given as per ***Table 6.1***;

Table 6.1 Threatened Species

Common Name	Scientific Name	IUCN v.2018.1	IWPA,1971	Observed /Reported
Plants				
Tree	*Diospyros paniculata* Dalzell	VU		Observed
Climber	*Hopea ponga* (Dennst.) Mabb.	EN		Observed
Amphibian				
Malabar Tree Toad	*Pedostibes tuberculosus*	EN	IV	Observed
Marbled Ramanella	*Uperodon mormorata*	EN	IV	Reported
Amboli Bush Frog	*Pseudophilautus amboli*	CR	IV	Observed
Maharashtra Bush Frog	*Raorchestes bombayensis*	VU	IV	Observed

Common Name	Scientific Name	IUCN v.2018.1	IWPA,1971	Observed /Reported
Reptiles				
Indian flapshell turtle	*Lissemys punctata*	LC	I	Reported
Indraneil's Day Gecko	*Cnemaspis cf. indraneildasii*	VU	IV	Observed
Bengal Monitor Lizard	*Varanus bengalensis*	LC	I	Reported
Indian rock python	*Python molurus*	VU	I	Observed
Avifauna				
Wooly-necked stork	*Ciconia episcopus*	VU	IV	Reported
Eurasian Spoonbill	*Platalea leucorodia*	LC	I	Reported
Black Baza	*Ariceda leuphotes*	LC	I (part III)	Reported
Oriental Honey Buzzard	*Penlis ptilorhyncus*	LC	I (part III)	Reported
Black shouldered Kite	*Elanus careleus*	LC	I (part III)	Reported
Crested Serpent eagle	*Spilornis cheela*	LC	I (part III)	Reported
Crested Goshawk	*Accipiter trivirgatus*	LC	I (part III)	Reported
Shikra	*Accipiter badius*	LC	I (part III)	Reported
Besra Sparrow Hawk	*Accipiter virgatus*	LC	I (part III)	Reported
Eurasian Sparrowhawk	*Accipiter nisus*	LC	I (part III)	Reported
White eyed Buzzard	*Butastur teesa*	LC	I (part III)	Reported
Black Eagle	*Icrillaellts malyanensis*	LC	I (part III)	Reported
Tawny Eagle	*Aquila rapax*	LC	I (part III)	Reported
Peregrine falcon	*Falco peregrillus*	LC	I (part III)	Reported
Nilgiri wood pegion	*Columba eiphinstonii*	VU	IV	Reported
Indian edible nest swiftlet	*Collocalia unicolor*	LC	I (part III)	Reported
Malabar Pied Hornbill	*Anlhracoceros coronatus*	NT	I (part III)	Observed
Great pied Hornbill	*Buceros bicornis*	NT	I (part III)	Reported
Sri Lanka frogmouth	*Batrachostomus moniliger*	LC	I (part III)	Observed
Mammals				
Sambar	*Cervus unicolor*	VU	III	Observed
Gaur	*Bos gaurus*	VU	I (Part I)	Observed
Dhole	*Cuon alpinus*	EN	II (Part I)	Reported
Sloth Bear	*Melursus ursinus*	VU	Sch I (Part I)	Reported
Leopard Cat	*Prionailurus bengalensis*	LC	Sch I (Part I)	Reported
Fishing Cat	*Prionailurus viverrinus*	VU	Sch I (Part I)	Reported
Leopard	*Panthera pardus*	VU	Sch I (Part I)	Reported
Mouse Deer	*Moschiola meminna*	LC	Sch I (Part I)	Reported
Slender Loris	*Loris tardigradus*	EN	Sch I	Reported
Indian Pangolin	*Manis crassicaudata*	EN	Sch I (Part I)	Reported

The plan is described in ***Table 6.2*** below

Table 6.2 Biodiversity Management Plan

Activity	Impact	Target species groups	Phase (Construction/ Operation)	Proposed mitigation measures	Parameters to be monitored	Measurement and frequency	Institutional responsibility
Route Survey and Planning	Habitat disturbance due to clearance of bushes while new	Faunal groups (Herpetofauna, Avifauna and Mammals)	Construction Phase	▪ Habitat disturbances to be kept at minimum by using existing trails for transportation of man material and machinery; ▪ Any vegetation clearance required should be limited to the minimum area required for such passages; ▪ Alternate mode of transportation such as Rope-ways should be considered were ever feasible to the maximum extent	Physical demarcation of the Right of Way before the vegetation clearance	Visual inspection on monthly basis during the construction phase	Third Party Inspection report to GTTPL
Impacts during vegetation clearance on approach roads and RoW	Habitat Loss and habitat disturbance, loss of nesting sites	Flora and Faunal groups	Construction Phase	▪ Tree cutting for the approach roads and RoW should be undertaken where it is only absolute necessary, ▪ Tree enumeration for clearance should be undertaken in presence of trained botanist/forest department in order to seek guidance to avoid, restore and replant species of conservation significance such as IUCN listed threatened species, endemic species and medicinal plants as per section 3.8; ▪ Tree felling should be in compliance of all the statutory requirements, tree felling in the nesting season (Refer **Table 3.19**) should carefully examine the active nests on trees before felling, relocation of active nest should be undertaken with the help of State Forest Department and/or wildlife NGO; ▪ Cleared wood material removal should be undertaken as per guidance of the state forest department; ▪ The ground dwelling fauna in the area should be approached carefully and removed from the direct path under trained experts, no direct attendance of the wildlife encounters	Physical demarcation of the vegetation in approach roads before clearance	Visual inspection on weekly basis during the construction phase	Third Party Inspection report to GTTPL, GTTPL to prepare a clearance schedule based on tree enumeration survey

Activity	Impact	Target species groups	Phase (Construction/ Operation)	Proposed mitigation measures	Parameters to be monitored	Measurement and frequency	Institutional responsibility
Impacts during vegetation clearance on Tower locations	Habitat loss and Habitat disturbance	Floral and faunal groups	Construction phase	▪ The tower location needs 10 m radius working area for tower erection, vegetation clearance will be required. Clearance should be confinedwithin the designated area ▪ The various componenets of tower will be stored in the tower locations resulting in additional areas for clearance, the site manager will ensure that minimum area disturbance is made during tower erection; ▪ No night stays should be made inside the Sanctuary area, entire day activities should be planned in a way, early morning, night and late evening time is avoided. ▪ No blasting within the sanctuary area should be made for excavation of rocks for foundation, alternative less disruptive methods should be avaoided; ▪ The cleared vegetation should be removed from the construction area, a designated place for the storage of the cleared wood as per direction of forest department should be made; ▪ No wildlife should be harmed by the work force in the forest and sanctuary area.	Third party verification during construction period	Visual inspection on weekly basis during the construction phase	Third Party Inspection report to GTTPL
Impacts during man and material transportation on each of the tower location	Habitat disturbances	Fauna group	Construction phase	▪ Material movement will be through trucks till the road end and further on tractor trolleys.. In case the last location is not approachable then material will be transported either on foot by labourers or through rope way lokely to be erected for transporation which required minimum disturbances; ▪ Man movement will be on foot, damage to flora and fauna should be avoided to maximum extent, ▪ Contractual obligations should clearly define zero tolearance to hunting, trapping and poaching.	Material movement at each tower location	Visual inspection on weekly basis during the construction phase	Third Party Inspection report to GTTPL
Impacts during	Habitat disturbances	Fauna group	Construction phase	▪ Stringing on conductor will involve vegetation clearance for any construction during stringing and trees will be chopped, lopped and pruned as per	Stringing the towers	Visual inspection	Third Party Inspection

Activity	Impact	Target species groups	Phase (Construction/ Operation)	Proposed mitigation measures	Parameters to be monitored	Measurement and frequency	Institutional responsibility
stringing of conductor				requirement. Before undertakeing such activity, it is to be ensured that the remaing tree left will grow further; ▪ .Nesting sites of avifaunal species to be avoided to the extent possible, if not then the nest translocation should be undertaken by trained wildlife personels, pre identification of nesting site should be under taken;		during stringing	report to GTTPL
Risk of mortality due to electrocution and collision	mortality in Species of conservational significance	Avifauna and Arboreal mammals	Operation Phase	▪ Any routine and corrective maintenance schedule planned should be undertaken only after pre informing the forest department; ▪ GTTPL should make an arrangement for dedicated personal from forest department, trained in dealing situations of wildlife encounters, movement, rescue and rehabilitation (preferably reptiles and mammalians) while under taking such routine visits ; ▪ Structures to climb transmission towers should have a restriction guards (to avoid access to for arboreal species (Maccaques, Langurs, Loris, Giant Squirrels etc.) ▪ Rapid carcass search along the transmission line corridor for possible victims of collision and electrocution ▪ Installation of canopy bridges in the canopy break areas for zero hinderance movement of arboreal mammals. Periodic review of condition of canopy bridges and undertake required maintenance; ▪ Installation of bird diverters on the conductor and perch rejecters on transmission tower along the transmission line corridor; ▪ In addition to the above artificial nesting platform for raptor species to be built along the transmission line at a distance of 200 m;	Species mortality and effectiveness to mitigation measures	Quaterly during first two years of energization and then six monthly during next two years	External Consultant and GTTPL
Vegetation removal for maintaining mandatory	Habitat loss and habitat disturbances	Floral and faunal groups	Operation Phase	▪ Pre nest search before commencing any pruning and lopping to be undertaken;	Nesting frequency of avifaunal species	Quarterly during first two years of energization	External Consultant and GTTPL

Activity	Impact	Target species groups	Phase (Construction/ Operation)	Proposed mitigation measures	Parameters to be monitored	Measurement and frequency	Institutional responsibility
electrical safety vegetation clearance				▪ Suggesting artificial nest boxes along the transmission line route to mitigate the loss of nesting sites along the transmission line route;		and then six monthly during next two years	

6.3 Cost of the Biodiversity Management Plan

The cost for the implementation of the conservation plan is provided in ***Table 6.3*** below. There cost are indicative and will be updated in consultation of the state forest and wildlife department.

Table 6.3 Cost of Implementation of BMP

Sn.	Activity	Budget in Rupees
1.	Professional and administrative support from Forest Department for vegetation clearance, monitoring and implementation and overall guidance	Rs. 20 Lakhs
2.	Biodiversity Monitoring during construction and operation phase	Rs.15.0 Lakhs
3.	Creation of Nest boxes nesting platforms and canopy bridges	Rs. 2.5 Lakhs
4.	Bird diverters along the transmission line	Rs. 15 .0 Lakhs
	Total	Rs. 52.5 Lakhs

APPENDIX A TOWER DESIGN DETAILS

To,

Mr. Rajiv Ranjan,
M/s Larsen & Toubro Ltd.
Power Transmission & Distribution,
Mount Poonamallee Road, Manapakkam,
P.B. No. 979, Chennai -600089

Ref No: SPGVL/GTTPL/ENGG/L&T/22
Dated: 10th August'2018

PROJECT: 765 kV, 400 kV & 220 kV Transmission lines associated with Goa Tamnar Transmission Project Limited
LOA No: SPGVL/17-18/LOA/009 Dated: 29-12-2017.

Subject: Issuance of Final Approved Tower Spotting data for 400kV D/C Quad AAAC Moose T/L (WZ-1 & WZ-2) including additional family of Towers.

Dear Sir,

This is with reference to 400kV D/C Quad AAAC Moose T/L (WZ-1 & WZ-2) for GTTPL Project. We are hereby releasing the below mentioned approved documents for your reference and use in same: -

Sr.No	Description	Document No.	Rev. No.
Tower Spotting Data for WZ-1			
1.	400kV D/C Quad AAAC Moose T/L	DS-1003	1
Tower Spotting Data for WZ-2			
1.	400kV D/C Quad AAAC Moose T/L	DS-1008	1

Approval conveyed herein neither relieve M/s L&T of his contractual obligation & his responsibilities for correctness of dimension, materials of construction, weights, designed details, assembly fits, performance particulars & conformity of the supplies with the Indian statutory laws as may be applicable, nor does it limit the SPGVL rights under the contract.

Regards

for Dr. Deepak Lakhapati
Chief Design Officer

Encl: As Above
Copy to:
1. Mr. Amitanshu along with Encl

Sterlite Power

Project : **400 KV D/C TRANSMISSION LINE**

Line : **Xeldam- Narendra 400 KV D/C Transmission Line with Quad AAAC Moose Conductor (WZ-1)**

Wind Zone : **I (33 m/s)**

Owner : **Sterlite Power Grid Ventures Limited**

Description : **TOWER SPOTTING DATA (Upto +9M)**

ERLITE POWER GRID VENTURES LTD
RELEASED FOR CONSTRUCTION
ONTROLLED COPY
Approved Vide Ref. Letter No. SPGVL/GTTPL/ENGG/L&T/22 Date 10/08/2018
Engineering Deptt.
The above does not relieve the contractor from their contractual obligations

Document no.	Date	Rev no.	Remarks if any	Desn by	STATUS
DS-1003	10-08-2018	01	Additional Tower Families Included	AM	

TOWER SPOTTING DATA FOR XELDAM- NARENDA 400 KV D/C TRANSMISSION LINE (WZ-1)
(QUAD AAAC MOOSE CONDUCTOR)

SR. NO.	DESCRIPTION	DA (0-2 DEGREE)		DBN (0-8 DEGREE)		DB (0-15 DEGREE)		DC (15-30 DEGREE)		DDN (30-45 DEGREE)		DD (30-60 DEGREE)		DE (0-15 DEGREE)	
1	MAX ANGLE OF DEVIATION	2		8		15		30		45		60		15	
2	VERTICAL LOAD LIMITATION ON WEIGHT SPAN	DOWNWARDS ONLY		DOWNWARD	UPWARD	DOWNWARD	UPWARD	DOWNWARD	UPWARD	DOWNWARD	UPWARD	DOWNWARD	UPWARD	DOWNWARD	UPWARD
		MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
2.1	GROUNDWIRE EFFECT														
	(I) ON BOTH SPAN (M)	600	200	600	-200	600	-200	600	-200	600	-200	600	-200	600	-200
	(II) ONE SPAN (M)	360	100	360	-100	360	-100	360	-100	360	-100	360	-100	360	-100
2.2	CONDUCTOR EFFECT														
	(I) ON BOTH SPAN (M)	600	200	600	-200	600	-200	600	-200	600	-200	600	-200	600	-200
	(II) ONE SPAN (M)	360	100	360	-100	360	-100	360	-100	360	-100	360	-100	360	-100
3	WEIGHTS														
3.1	GROUNDWIRE EFFECT														
	(I) ON BOTH SPAN (KG)	290	97	290	-97	290	-97	290	-97	290	-97	290	-97	290	-97
	(II) ONE SPAN (KG)	174	49	174	-49	174	-49	174	-49	174	-49	174	-49	174	-49
3.2	CONDUCTOR EFFECT														
	(I) ON BOTH SPAN (KG)	1000	334	1000	-334	1000	-334	1000	-334	1000	-334	1000	-334	1000	-334
	(II) ONE SPAN (KG)	600	167	600	-167	600	-167	600	-167	600	-167	600	-167	600	-167
4	PERMISSIBLE SUM OF ADJACENT SPANS IN M FOR VARIOUS DEVIATION ANGLES. PERMISSIBLE ONE SPAN FOR VARIOUS DEVIATION ANGLES SHOULD NOT EXCEED 60% OF THE VALUE SHOWN FOR THE SUM OF ADJACENT SPANS SUBJECTED TO AVAILABILITY OF GROUND CLERANCES.	DEVN ANGL	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN
		2	800	8	800	15	800	30	800	45	800	60	800	0	400
		1	850	7	861	14	860	29	860	44	857	59	853	15	400
		0	900	6	922	13	921	28	920	43	914	58	906		
				5	984	12	982	27	979	42	971	57	959		
				4	1044	11	1042	26	1039	41	1028	56	1012		
				3	1105	10	1104	25	1098	40	1084	55	1064		
				2	1166	9	1164	24	1158	39	1141	54	1118		
				1	1227	8	1225	23	1216	38	1198	53	1171		
				0	1288	7	1285	22	1276	37	1254	52	1224		
						6	1347	21	1335	36	1311	51	1278		
						5	1407	20	1393	35	1367	50	1330		
						4	1469	19	1453	34	1425	49	1384		
						3	1529	18	1512	33	1482	48	1438		
						2	1590	17	1572	32	1540	47	1493		
						1 & below	1651	16	1631	31	1598	46	1548		
								15	1691	30	1656	45 & below	1603		
5	DESIGN LOAD TENSION														
5.1	OPGW -(32C AND Full Wind)	2374.00 Kg													
	OPGW -(32C AND 75% of Full Wind)	2045.00 Kg													
	OPGW -(0C AND 36% of Full Wind)	1748.00 Kg													
5.2	CONDUCTOR-(32C AND Full Wind)	5694.00 Kg													
	CONDUCTOR-(32C AND 75% of Full Wind)	5024.00 Kg													
	CONDUCTOR-(0C AND 36% of Full Wind)	5035.00 Kg													
6	BROKEN WIRE CONDITION (BROKEN ON THE SAME SIDE ON THE SAME SPAN)	GW/ANY ONE CONDUCTOR		GW+ANY ONE CONDUCTOR OR ANY TWO CONDUCTORS						GW+ANY TWO CONDUCTORS OR ALL THREE CONDUCTORS					

PROJECT DETAILS : 400 KV D/C TRANS. LINE WITH QUAD AAAC MOOSE CONDUCTOR (WZ-1)
OWNER: STERLITE POWER GRID VENTURES LIMITED - NEW DELHI

SAG TENSION CALCULATIONS

Ruling span: (L)	400.00 m	
Design Wind Pressure: (Pd) :	346.00 N/Sq.mt 35.30 kg/Sq.mt	
Gust response factor (for wire) : Gc:	2.22	2.30
Final wind pressure (for wire) :	79.00 kg/Sq.mt 2.52 kg/m	98.00 kg/Sq.mt 1.18 kg/m
Final wind pressure (for Insulator) :	106.00 kg/Sq.mt	

Particulars	**Conductor**	**Earth-wire**
Code :	AAAC Moose	OPGW (24F)
Area, (A) :	6.040 sq.cm	0.7737 sq.cm
Unit Wt :	1.666 kg/m	0.483 kg/m
Diameter : (D)	3.195 cms	1.200 cms
Tensile strength: (T)	17130.00 kgs	8410.00 kgs
Elast. Mod : (E)	.5508E+06 kg/sq.cm	.1417E+07 kg/sq.cm
Expns. Coef : (∞)	.2300E-04 /Deg.Cnt	.1380E-04 /Deg.Cnt

BASIC EQUATION OF SAG TENSION CALCULATIONS :-
F^2 [F - {K-∞*t*E)] = Z

STARTING CASE - (CASE : 1)

TEMP	32	0
WIND	0	0
K CAL BY FOS OR SAG	FOS	SAG
FOS OR SAG REQ.	4.55	6.399

Loading Conditions		Conductor sag (m)	Conductor Ult. Tension	Conductor % OF UTS	Earth-wire sag (m)	Earth-wire Ult. Tension	Earth-wire % OF UTS
0 - Dgr.	No - Wind	7.110	4686.07	27.36 %	6.399	1509.52	17.95 %
0 - Dgr.	36% - Wind	-	5034.25	29.39 %	-	1747.99	20.78 %
32 - Dgr.	No - Wind	8.841	3768.60	22.00 %	7.462	1294.54	15.39 %
32 - Dgr.	75% - Wind	-	5023.37	29.32 %	-	2044.76	24.31 %
32 - Dgr.	Full - Wind	-	5693.07	33.23 %	-	2373.67	28.22 %
53 - Dgr.	No - Wind	-	-		8.178	1181.29	14.05 %
85 - Dgr.	No - Wind	11.621	2867.16	16.74 %	-	-	

TOWER SPOTTING DATA FOR XELDAM- NARENDA 400 KV D/C TRANSMISSION LINE (WZ-1)
(QUAD AAAC MOOSE CONDUCTOR)

(I) GENERAL DETAILS:

Normal Span (M) = **400**

Design Wind Span (M) =

Type of Condition	DA	DBN	DB	DC	DDN	DD	DE
NC	400	400	400	400	400	400	260
BWC	240	240	240	240	240	240	156

(II) TOWER TYPES:

a) Tower type "DA" Shall be used as Tangent tower with Double Suspension Insulator String.
b) Tower type "DBN/DB/DC/DDN/DD" Shall be used as Tension tower with Quad Tension Insulator String.
c) Tower type "DBN/DB" Shall also be used as Section tower.
d) Dead End tower shall have provision of 0 to 15 Degree deviation on line side as well as slack side.
e) Suitable Pilot String Shall be Used for Tower type "DC". DC Tower shall not use as section tower.

(III) ELECTRICAL CLERANCES FOR RAILWAY CROSSING

a) Crossing should be done with DDN/DD type tower with Quad tension insulator string with limiting span as 300m.

b) The crossing shall normally be at right angle to the railway track.

Minimum Clerance between lowest point of 400 KV line conductor & Rail level shall be as below.

(1) For Existing Power Line Crossings :- 17.90 m

(2) For New Power Line Crossings or Alteration to Existing Power Line Crossing in Electrified Sections :- 18.26 m (Clearance at OHE structures in mm)
15.434 m (Clearance at Mid OHE span in mm)

(3) For Power Line Crossings in Non-Electrified Sections :- 14.46 m (Line is not anticipated to be electrified)
18.26 m (Line to be electrified in future)

(4) For Highest Traction Conductor & Lowest crossing conductor :- 5.49 m

However, approval of Railway Crossing from railway authority has to be obtained in each case.

(IV) MINIMUM CLERANCE FOR POWER LINE CROSSING WHEN CROSSING EACH OTHER

For System 400 KV

For 11KV to 66 KV	5.49 m
For 110KV to 132 KV	5.49 m
For 220 KV	5.49 m
For 400 KV	5.49 m
For 765 KV	7.94 m
For 1200 KV	10.44 m
For 500 KV HVDC	6.79 m
For 800 KV HVDC	9.04 m

(V) TELECOMMUNICATION LINE CROSSING

The angle of crossing shall be as near to 90 deg as possible. However deviation to the extent of 30 deg may be permitted under exceptional difficult situation.

For 400 KV 4.48 m

(VI) SECTION TOWER

The No. of consective spans between the section points shall not exceed 15 or 5kms in plain terrain & 10 spans or 3kms in hilly terrain. A section point shall comprise of tension point with DBN/DB type tower.

(VII) Minimum ground clerance required = 8840 mm.

(VIII) For all national highways crossings, tension towers is to be used and crossing span is not to exceed 250 m

(IX) Way leave clerance: 26 m from the cl of tower on either side of tower.

(X) Maximum span of adjucent spans for various angle of deviation are subjected to the condition that minimum specified live metal clerances and minimum around clerances are available.

(XI) suspension towers shall be spotted such that vertical load of individual spans shall be acting downwards only. no uplift is permitted in suspension towers.

(XII) tower type "DC" shall be used for transposition with 0 deg. deviation with modification of cross arms.

(XIII) Intermediate spans in a section shall be as near as possible to the normal span.

(XIV) For Body & Leg Extensions Arrangement - Refer attached Annexture - I
Body Extensions : - -3MBE, +0M BE, +3M BE & +6M BE
Leg Extensions : - -3.0M LE, -1.5M LE, +0.0M LE, +1.5M LE, +3.0M LE
These positive and negative extensions shall be used to achieve required ground clearance.
Maximum allowable difference in two legs at one tower is 4.5m.

(XV) Normal tower consists of Basic Body + (+0M B.E.) + (+0M L.E.).

(XVI) Height of bottom conductor from ground level for tower combination Basic Body + (+0M B.E.) + (+0M L.E.) is 20.900m.

Max. Individual Span Calculation

L = Normal Span (m) — 400

V = System voltage in kVs — 400

S = Max. Sag (incliding Sag errror) (m) — 11.621

$$L_{max} = L\sqrt{\frac{K}{S}}$$

K = Max. Sag factor corresponding to Max.
Individual span & is given by the equation written Below

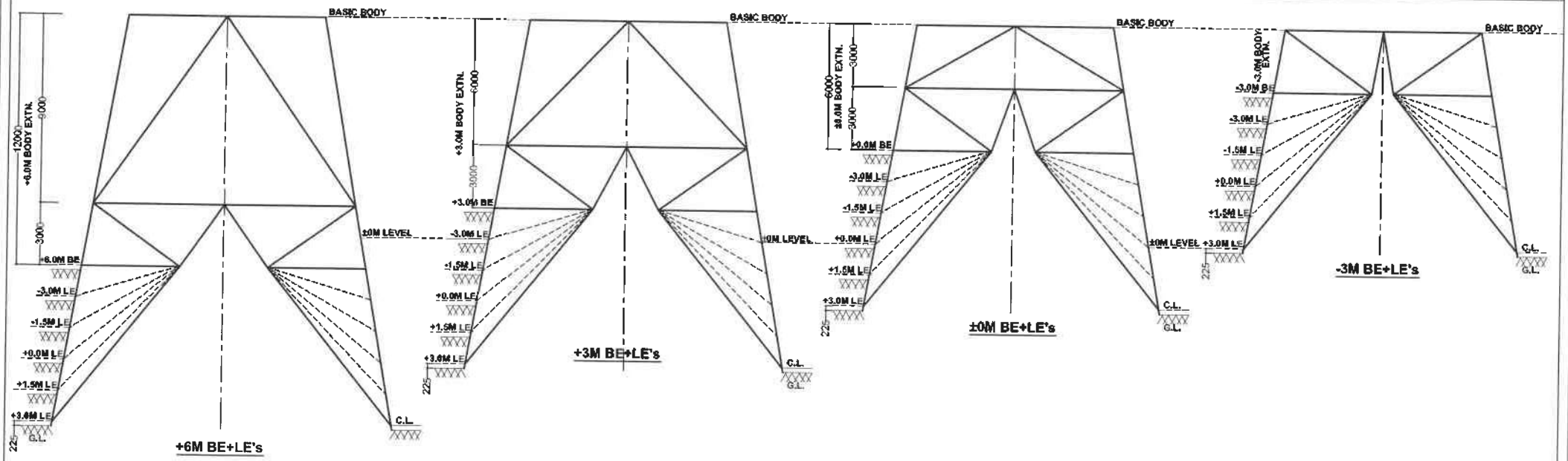
$$VS = 0.75\sqrt{K - SI} + \frac{V}{150}$$

VS = Vertical Seperation

SI = Suspension insulator Assembly Length

TOWER	VS	SI	K	L_{max} (m)	Span limit for permissible sum of adjacent span (m) (L_{max} x 2)
DA	8.45	4.8	54.661	868.0	1736.0
DBN	8.00	0	50.568	834.0	1668.0
DB	8.00	0	50.568	834.0	1668.0
DC	8.20	0	54.432	866.0	1732.0
DDN	8.35	0	57.423	889.0	1778.0
DD	8.35	0	57.423	889.0	1778.0

ANNEXURE - 1



Notes:-

1. Body Extensions: -3M BE, -+0M BE, +3M BE & 6M BE.
2. Leg Extensions: -3.0M LE, -1.5M LE, +0.0M LE, +1.5M LE, +3.0M LE.
3. These positive and negative extensions shall be used to achieve required ground clearance.
4. Maximum allowable difference in two legs at one tower is 4.5m.
5. Normal tower consists of Basic Body + (+0M B.E.) + (+0M L.E.).
6. Height of bottom conductor from ground level for tower combination Basic Body + (+0M B.E.) + (+0M L.E.) is 20.900m.

GENERAL ARRANGEMENT FOR UNIVERSAL BODY & LEG EXTENSION COMBINATION

Sterlite Power

Project : **400 KV D/C TRANSMISSION LINE**

Line : **Xeldam- Mapusha 400 KV D/C Transmission Line with Quad AAAC Moose Conductor (WZ-2)**

Wind Zone : **II (39 m/s)**

Owner : **Sterlite Power Grid Ventures Limited**

Description : **TOWER SPOTTING DATA (Upto +9M)**

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Approved Vide Ref. Letter No. SPGVL/GTTPL/ENGG/L&T/22 Date: 10/08/2018
Engineering Deptt.
the above does not relieve the contractor from their contractual obligations

Document no.	Date	Rev no.	Remarks if any	Desn by	STATUS
DS-1008	10-08-2018	01	Additional Tower Families Included	AM	

TOWER SPOTTING DATA FOR XELDAM - MAPUSHA 400 KV D/C TRANSMISSION LINE (WZ-2)
(QUAD AAAC MOOSE CONDUCTOR)

SR. NO.	DESCRIPTION	DA (0-2 DEGREE)		DBN (0-8 DEGREE)		DB (0-15 DEGREE)		DC (15-30 DEGREE)		DDN (30-45 DEGREE)		DD (30-60 DEGREE)		DE (0-15 DEGREE)	
1	MAX ANGLE OF DEVIATION	2		8		15		30		45		60		15	
2	VERTICAL LOAD LIMITATION ON WEIGHT SPAN	DOWNWARDS ONLY		DOWNWARD	UPWARD	DOWNWARD	UPWARD	DOWNWARD	UPWARD	DOWNWARD	UPWARD	DOWNWARD	UPWARD	DOWNWARD	UPWARD
		MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
2.1	GROUNDWIRE EFFECT														
	(I) ON BOTH SPAN (M)	600	200	600	0	600	0	600	0	600	0	600	0	300	0
	(II) ONE SPAN (M)	360	100	360	-200	360	-200	360	-200	360	-300	360	-300	300	0
2.2	CONDUCTOR EFFECT														
	(I) ON BOTH SPAN (M)	600	200	600	0	600	0	600	0	600	0	600	0	300	0
	(II) ONE SPAN (M)	360	100	360	-200	360	-200	360	-200	360	-300	360	-300	300	0
3	WEIGHTS														
3.1	GROUNDWIRE EFFECT														
	(I) ON BOTH SPAN (KG)	350	117	350	0	350	0	350	0	350	0	350	0	175	0
	(II) ONE SPAN (KG)	210	59	210	-117	210	-117	210	-117	210	-175	210	-175	175	0
3.2	CONDUCTOR EFFECT														
	(I) ON BOTH SPAN (KG)	1000	334	1000	0	1000	0	1000	0	1000	0	1000	0	500	0
	(II) ONE SPAN (KG)	600	167	600	-334	600	-334	600	-334	600	-500	600	-500	500	0
4	PERMISSIBLE SUM OF ADJACENT SPANS IN M FOR VARIOUS DEVIATION ANGLES. PERMISSIBLE ONE SPAN FOR VARIOUS DEVIATION ANGLES SHOULD NOT EXCEED 60% OF THE VALUE SHOWN FOR THE SUM OF ADJACENT SPANS SUBJECTED TO AVAILABILITY OF GROUND CLERANCES.	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN	DEVN ANGLE	SPAN
		2	800	8	800	15	800	30	800	45	800	60	800	0	800
		1	840	7	851	14	851	29	850	44	848	59	844	15	800
		0	881	6	902	13	902	28	901	43	896	58	889		
				5	954	12	953	27	951	42	943	57	933		
				4	1004	11	1003	26	1001	41	991	56	977		
				3	1056	10	1055	25	1050	40	1038	55	1021		
				2	1107	9	1105	24	1100	39	1086	54	1066		
				1	1158	8	1156	23	1149	38	1133	53	1110		
				0	1209	7	1207	22	1199	37	1180	52	1154		
						6	1258	21	1248	36	1228	51	1199		
						5	1309	20	1297	35	1274	50	1243		
						4	1360	19	1346	34	1322	49	1288		
						3	1411	18	1396	33	1370	48	1333		
						2	1462	17	1446	32	1418	47	1378		
						1 & below	1513	16	1496	31	1467	46	1424		
								15	1546	30	1515	45 & below	1470		
5	DESIGN LOAD TENSION														
5.1	7/3.66 -(32C AND Full Wind)	3014.00 Kg													
	7/3.66 -(32C AND 75% of Full Wind)	2588.00 Kg													
	7/3.66 -(0C AND 36% of Full Wind)	2147.00 Kg													
5.2	OPGW - (32C AND Full Wind)	2880.00 Kg													
	OPGW - (32C AND 75% of Full Wind)	2442.00 Kg													
	OPGW - (0C AND 36% of Full Wind)	1921.00 Kg													
5.2	CONDUCTOR-(32C AND Full Wind)	6766.00 Kg													
	CONDUCTOR-(32C AND 75% of Full Wind)	5814.00 Kg													
	CONDUCTOR-(0C AND 36% of Full Wind)	5317.00 Kg													
6	BROKEN WIRE CONDITION (BROKEN ON THE SAME SIDE ON THE SAME SPAN)	GW/ANY ONE CONDUCTOR		GW+ANY ONE CONDUCTOR OR ANY TWO CONDUCTORS						GW+ANY TWO CONDUCTORS OR ALL THREE CONDUCTORS					

Xeldam- Mapusha 400 KV D/C Transmission Line with Quad AAAC Moose Conductor (WZ-2)

OWNER: STERLITE POWER GRID VENTURES LIMITED - NEW DELHI

SAG TENSION CALCULATIONS

Ruling span: (L)	400.00 m	
Design Wind Pressure: (Pd) :	483.00 N/Sq.mt 49.20 kg/Sq.mt	
Gust response factor (for wire) : Gc:	2.22	2.30
Final wind pressure (for wire) :	110.00 kg/Sq.mt 3.51 kg/m	136.00 kg/Sq.mt 1.49 kg/m
Final wind pressure (for Insulator) :	148.00 kg/Sq.mt	

Particulars	Conductor	Earth-wire
Code :	AAAC Moose	7/3.66
Area, (A) :	6.040 sq.cm	0.7365 sq.cm
Unit Wt :	1.666 kg/m	0.583 kg/m
Diameter : (D)	3.195 cms	1.098 cms
Tensile strength: (T)	17130.00 kgs	6973.00 kgs
Elast. Mod : (E)	.5508E+06 kg/sq.cm	.1936E+07 kg/sq.cm
Expns. Coef : (∞)	.2300E-04 /Deg.Cnt	.1150E-04 /Deg.Cnt

BASIC EQUATION OF SAG TENSION CALCULATIONS :-

F^2 [F - (K-∞*t*E)] = Z

STARTING CASE - (CASE : 1)

TEMP	32	0
WIND	0	0
K CAL BY FOS OR SAG	FOS	SAG
FOS OR SAG REQ.	4.55	6.399

Loading Conditions		Conductor sag (m)	Conductor Ult. Tension	Conductor % OF UTS	Earth-wire sag (m)	Earth-wire Ult. Tension	Earth-wire % OF UTS
0 - Dgr.	No - Wind	7.110	4686.07	27.36 %	6.399	1822.05	26.13 %
0 - Dgr.	36% - Wind	-	5316.60	31.04 %	-	2146.42	30.78 %
32 - Dgr.	No - Wind	8.841	3768.60	22.00 %	7.312	1594.66	22.87 %
32 - Dgr.	75% - Wind	-	5814.00	33.94 %	-	2587.54	37.11 %
32 - Dgr.	Full - Wind	-	6765.07	39.49 %	-	3013.72	43.22 %
53 - Dgr.	No - Wind	-	-		7.923	1471.62	21.10 %
85 - Dgr.	No - Wind	11.621	2867.16	16.74 %	-	-	

Xeldam- Mapusha 400 KV D/C Transmission Line with Quad AAAC Moose Conductor (WZ-2)
OWNER: STERLITE POWER GRID VENTURES LIMITED - NEW DELHI

SAG TENSION CALCULATIONS

Ruling span: (L)	400.00 m	
Design Wind Pressure: (Pd) :	483.00 N/Sq.mt 49.20 kg/Sq.mt	
Gust response factor (for wire) : Gc:	2.22	2.30
Final wind pressure (for wire) :	110.00 kg/Sq.mt 3.51 kg/m	136.00 kg/Sq.mt 1.66 kg/m
Final wind pressure (for Insulator) :	148.00 kg/Sq.mt	

Particulars	Conductor	Earth-wire
Code :	AAAC Moose	OPGW (24F)
Area, (A) :	6.040 sq.cm	0.7565 sq.cm
Unit Wt :	1.666 kg/m	0.483 kg/m
Diameter : (D)	3.195 cms	1.220 cms
Tensile strength: (T)	17130.00 kgs	9032.00 kgs
Elast. Mod : (E)	.5508E+06 kg/sq.cm	.1417E+07 kg/sq.cm
Expns. Coef : (∞)	.2300E-04 /Deg.Cnt	.1380E-04 /Deg.Cnt

BASIC EQUATION OF SAG TENSION CALCULATIONS :-
F^2 [F - (K-∞*t*E)] = Z

STARTING CASE - (CASE : 1)

TEMP	32	0
WIND	0	0
K CAL BY FOS OR SAG	FOS	SAG
FOS OR SAG REQ.	4.55	6.399

Loading Conditions		Conductor sag (m)	Conductor Ult. Tension	Conductor % OF UTS	Earth-wire sag (m)	Earth-wire Ult. Tension	Earth-wire % OF UTS
0 - Dgr.	No - Wind	7.110	4686.07	27.36 %	6.399	1509.52	16.71 %
0 - Dgr.	36% - Wind	-	5316.60	31.04 %	-	1920.80	21.27 %
32 - Dgr.	No - Wind	8.841	3768.60	22.00 %	7.451	1296.43	14.35 %
32 - Dgr.	75% - Wind	-	5814.00	33.94 %	-	2441.18	27.03 %
32 - Dgr.	Full - Wind	-	6765.07	39.49 %	-	2879.04	31.88 %
53 - Dgr.	No - Wind	-	-		8.161	1183.71	13.11 %
85 - Dgr.	No - Wind	11.621	2867.16	16.74 %	-	-	

TOWER SPOTTING DATA FOR XELDAM- MAPUSHA 400 KV D/C TRANSMISSION LINE (WZ-2)
(QUAD AAAC MOOSE CONDUCTOR)

(I) GENERAL DETAILS:

Normal Span (M) = **400**

Design Wind Span (M) =

Type of Condition	DA	DBN	DB	DC	DDN	DD	DE
NC	400	400	400	400	400	400	260
BWC	240	240	240	240	240	240	156

(II) TOWER TYPES:

a) Tower type "DA" Shall be used as Tangent tower with Double Suspension Insulator String.
b) Tower type "DBN/DB/DC/DDN/DD" Shall be used as Tension tower with Quad Tension Insulator String.
c) Tower type "DBN/DB" Shall also be used as Section tower.
d) Dead End tower shall have provision of 0 to 15 Degree deviation on line side as well as slack side.

(III) ELECTRICAL CLERANCES FOR RAILWAY CROSSING

a) Crossing should be done with DDN/DD type tower with Quad tension insulator string with limiting span as 300m.

b) The crossing shall normally be at right angle to the railway track.

Minimum Clerance between lowest point of 400 KV line conductor & Rail level shall be as below.

(1) For Existing Power Line Crossings :- 17.90 m

(2) For New Power Line Crossings or Alteration to Existing Power Line Crossing in Electrified Sections :- 18.26 m (Clearance at OHE structures in mm)
15.434 m (Clearance at Mid OHE span in mm)

(3) For Power Line Crossings in Non-Electrified Sections :- 14.46 m (Line is not anticipated to be electrified)
18.26 m (Line to be electrified in future)

(4) For Highest Traction Conductor & Lowest crossing conductor :- 5.49 m

However, approval of Railway Crossing from railway authority has to be obtained in each case.

(IV) MINIMUM CLERANCE FOR POWER LINE CROSSING WHEN CROSSING EACH OTHER

For System 400 KV	
For 11KV to 66 KV	5.49 m
For 110KV to 132 KV	5.49 m
For 220 KV	5.49 m
For 400 KV	5.49 m
For 765 KV	7.94 m
For 1200 KV	10.44 m
For 500 KV HVDC	6.79 m
For 800 KV HVDC	9.04 m

(V) TELECOMMUNICATION LINE CROSSING

The angle of crossing shall be as near to 90 deg as possible. However deviation to the extent of 30 deg may be permitted under exceptional difficult situation.

For 400 KV	4.48 m

(VI) SECTION TOWER

The No. of consective spans between the section points shall not exceed 15 or 5kms in plain terrain & 10 spans or 3kms in hilly terrain. A section point shall comprise of tension point with DBN/DB type tower.

(VII) Minimum ground clerance required = 8840 mm.

(VIII) For all national highways crossings, tension towers is to be used and crossing span is not to exceed 250 m

(IX) Way leave clerance: 26 m from the cl of tower on either side of tower.

(X) Maximum span of adjucent spans for various angle of deviation are subjected to the condition that minimum specified live metal clerances and minimum around clerances are available.

(XI) suspension towers shall be spotted such that vertical load of individual spans shall be acting downwards only. no uplift is permitted in suspension towers.

(XII) tower type "DC" shall be used for transposition with 0 deg. deviation with modification of cross arms.

(XIII) Intermediate spans in a section shall be as near as possible to the normal span.

Max. Individual Span Calculation

L = Normal Span (m) — 400

V = System voltage in kVs — 400

S = Max. Sag (incliding Sag errror) (m) — 11.621

$$L_{max} = L\sqrt{\frac{K}{S}}$$

K = Max. Sag factor corresponding to Max.
Individual span & is given by the equation written Below

$$I'S = 0.75\sqrt{K - SI} + \frac{V}{150}$$

VS = Vertical Seperation

SI = Suspension insulator Assembly Length

TOWER	VS	SI	K	L_{max} (m)	Span limit for permissible sum of adjacent span (m) (L_{max} x 2)
DA	8.45	4.8	54.661	868.0	1736.0
DB	8.00	0	50.568	834.0	1668.0
DC	8.20	0	54.432	866.0	1732.0
DD	8.35	0	57.423	889.0	1778.0

REDUNDANT TABLE	
S1	L40x3tk
S2	L40x6tk
S3	L50x6tk
S4	L50x8tk
S5	L60x6tk
S6	L60x8tk
S7	L60x10tk
S8	L65x8tk
S9	L65x10tk
S10	L70x8tk
S11	L80x8tk
S12	L80x10tk

Group Label	Group Desc.	Angle Size	Steel Strength (MPa)	No. Of Bolts	DIA Of Bolts
+3M LEG EXTENSION					
1-LR	L.BRG	L65x65x5	250	3	16
1-L	LEG	L120x120x10H	350	10	16DS
1-TR	T.BRG	L65x65x5	250	3	16
1-PR	P.BRG	L60x60x5H	350	2	16
1-LB	L.BELT	L65x65x5H	350	2	16
1-TB	T.BELT	L65x65x5H	350	2	16
+1.5M LEG EXTENSION					
2-LR	L.BRG	L65x65x5	250	3	16
2-L	LEG	L120x120x10H	350	10	16DS
2-TR	T.BRG	L65x65x5	250	3	16
2-PR	P.BRG	L60x60x5H	350	2	16
2-LB	L.BELT	L65x65x5H	350	2	16
2-TB	T.BELT	L65x65x5H	350	2	16
+0M LEG EXTENSION					
3-LR	L.BRG	L65x65x5	250	3	16
3-L	LEG	L120x120x10H	350	10	16DS
3-TR	T.BRG	L65x65x5	250	3	16
3-PR	P.BRG	L60x60x5H	350	2	16
3-LB	L.BELT	L65x65x5H	350	2	16
3-TB	T.BELT	L65x65x5H	350	2	16
-1.5M LEG EXTENSION					
4-LR	L.BRG	L65x65x5	250	3	16
4-L	LEG	L120x120x10H	350	10	16DS
4-TR	T.BRG	L65x65x5	250	3	16
4-PR	P.BRG	L60x60x5H	350	2	16
4-LB	L.BELT	L65x65x5H	350	2	16
4-TB	T.BELT	L65x65x5H	350	2	16
-3M LEG EXTENSION					
5-LR	L.BRG	L65x65x5	250	3	16
5-L	LEG	L120x120x10H	350	10	16DS
5-TR	T.BRG	L65x65x5	250	3	16
5-PR	P.BRG	L60x60x5H	350	2	16
5-LB	L.BELT	L65x65x5H	350	2	16
5-TB	T.BELT	L65x65x5H	350	2	16
-3M BODY EXTENSION					
7-LR1	L.BRG	L50x50x5	250	2	16
7-LR2	L.BRG	L60x60x5	250	2	16
7-LB	L.BELT	L65x65x5H	350	2	16
7-L	LEG	L120x120x10H	350	10	16DS
7-LGR	L.GBRG	L75x75x5H	350	2	16
7-TGR	T.GBRG	L75x75x5H	350	2	16
7-TR1	T.BRG	L50x50x5	250	2	16
7-TR2	T.BRG	L60x60x5	250	2	16
7-TB	T.BELT	L65x65x5H	350	2	16
+0M BODY EXTENSION					
8-LR1	L.BRG	L50x50x5	250	2	16
8-LR2	L.BRG	L60x60x5	250	2	16
8-LB	L.BELT	L65x65x5H	350	2	16
8-L	LEG	L120x120x10H	350	10	16DS
8-LGR	L.GBRG	L75x75x5H	350	2	16
8-TGR	T.GBRG	L75x75x5H	350	2	16
8-TR1	T.BRG	L50x50x5	250	2	16
8-TR2	T.BRG	L60x60x5	250	2	16
8-TB	T.BELT	L65x65x5H	350	2	16
9-LR	L.BRG	L65x65x5	250	3	16
9-LB	L.BELT	L65x65x5H	350	2	16
9-L	LEG	L120x120x10H	350	10	16DS
9-TR	T.BRG	L65x65x5	250	3	16
9-TB	L.BELT	L65x65x5H	350	2	16
+3M BODY EXTENSION					
10-LR1	L.BRG	L50x50x5	250	2	16
10-LR2	L.BRG	L50x50x5	250	2	16
10-LB	L.BELT	L65x65x5H	350	2	16
10-L	LEG	L120x120x10H	350	10	16DS
10-LGR	L.GBRG	L75x75x5H	350	2	16
10-TGR	T.GBRG	L75x75x5H	350	2	16
10-TR1	T.BRG	L50x50x5	250	2	16
10-TR2	T.BRG	L60x60x5	250	2	16
10-TB	T.BELT	L65x65x5H	350	2	16
11-LR	L.BRG	L75x75x5	250	3	16
11-LB	L.BELT	L65x65x5H	350	2	16
11-L	LEG	L120x120x10H	350	10	16DS
11-TR	T.BRG	L70x70x5	250	3	16
11-TB	L.BELT	L65x65x5H	350	2	16
+6M BODY EXTENSION					
12-LR1	L.BRG	L50x50x5	250	2	16
12-LR2	L.BRG	L50x50x5	250	2	16
12-LB	L.BELT	L65x65x5H	350	2	16
12-L	LEG	L120x120x10H	350	10	16DS
12-LGR	L.GBRG	L75x75x5H	350	2	16
12-TGR	T.GBRG	L75x75x5H	350	2	16
12-TR1	T.BRG	L50x50x5	250	2	16
12-TR2	T.BRG	L50x50x5	250	2	16
12-TB	T.BELT	L65x65x5H	350	2	16
13-LR	L.BRG	L75x75x5	250	3	16
13-LB	L.BELT	L65x65x5H	350	2	16
13-L	LEG	L120x120x10H	350	10	16DS
13-TR	T.BRG	L70x70x5	250	3	16
13-TB	L.BELT	L65x65x5H	350	2	16

Group Label	Group Desc.	Angle Size	Steel Strength (MPa)	No. Of Bolts	DIA Of Bolts
NORMAL TOWER					
15-LR	L.BRG	L70x70x5	250	2	16
15-L	LEG	L120x120x10H	350	10	16DS
15-TR	T.BRG	L65x65x5	250	2	16
16-LR	L.BRG	L70x70x5	250	2	16
16-L	LEG	L120x120x10H	350	10	16DS
16-TR	T.BRG	L75x75x5H	350	2	16
17-LR	L.BRG	L75x75x5	250	3	16
17-L	LEG	L120x120x10H	350	10	16DS
17-TR	T.BRG	L70x70x5	250	3	16
18-GR	T.GBRG	L75x75x5H	350	2	16
18-LR	L.BRG	L70x70x5H	350	3	16
18-LB	L.BELT	L70x70x5H	350	2	16
19-L	LEG	L120x120x10H	350	10	16DS
19-PR	P.BRG	L65x65x5H	350	2	16
19-TR	T.BRG	L70x70x5H	350	3	16
19-TB	T.BELT	L75x75x5H	350	4	16
20-LR	L.BRG	L70x70x5H	350	3	16
20-LB	L.BELT	L65x65x5H	350	2	16
20-L	LEG	L120x120x8H	350	8	16DS
20-TR	T.BRG	L65x65x5H	350	4	16
20-TB	T.BELT	L70x70x5H	350	4	16
21-CAL-B	CA-BOT	L80x80x8H	350	5	16
21-CAL-T	CA-TOP	L75x75x5H	350	4	16
22-CAR-B	CA-BOT	L80x80x8H	350	5	16
22-CAR-T	CA-TOP	L75x75x5H	350	4	16
23-LR	L.BRG	L75x75x5H	350	3	16
23-L	LEG	L120x120x8H	350	8	16DS
23-TR	T.BRG	L50x50x5H	350	4	16
24-LR	L.BRG	L70x70x5H	350	3	16
24-L	LEG	L110x110x8H	350	8	16DS
24-TR	T.BRG	L75x75x5	250	4	16
25-DR	D.BRG	L50x50x5H	350	1	16
25-LR	L.BRG	L70x70x5H	350	3	16
25-LB	L.BELT	L60x60x5H	350	2	16
25-L	LEG	L110x110x8H	350	8	16DS
25-PR	P.BRG	L50x50x5H	350	2	16
25-TR	T.BRG	L60x60x5H	350	4	16
25-TB	T.BELT	L60x60x5H	350	3	16
26-LR	L.BRG	L75x75x5H	350	3	16
26-LB	L.BELT	L60x60x5H	350	2	16
26-L	LEG	L90x90x8H	350	8	16DS
26-TR	T.BRG	L75x75x5H	350	4	16
26-TB	T.BELT	L65x65x5H	350	4	16
27-CAL-B	CA-BOT	L60x60x8H	350	4	16
27-CAL-T	CA-TOP	L70x70x5H	350	4	16
28-CAR-B	CA-BOT	L60x60x8H	350	4	16
28-CAR-T	CA-TOP	L70x70x5H	350	4	16
29-LR	L.BRG	L75x75x5H	350	3	16
29-L	LEG	L120x120x8H	350	8	16DS
29-TR	T.BRG	L75x75x5H	350	4	16
30-LR	L.BRG	L70x70x5H	350	3	16
30-L	LEG	L80x80x8H	350	8	16DS
30-TR	T.BRG	L75x75x5H	350	4	16
31-DR	D.BRG	L45x45x5H	350	1	16
31-LR	L.BRG	L75x75x5H	350	3	16
31-LB	L.BELT	L60x60x5H	350	2	16
31-L	LEG	L80x80x8H	350	8	16DS
31-PR	P.BRG	L45x45x5H	350	2	16
31-TR	T.BRG	L60x60x5H	350	4	16
31-TB	T.BELT	L65x65x5H	350	4	16
32-LR	L.BRG	L60x60x5	250	2	16
32-LB	L.BELT	L60x60x5H	350	2	16
32-L	LEG	L80x80x8H	350	8	16DS
32-TR	T.BRG	L70x70x5H	350	2	16
32-TB	T.BELT	L60x60x5H	350	3	16
33-CAL-B	CA-BOT	L80x80x8H	350	5	16
33-CAL-T	CA-TOP	L70x70x5H	350	4	16
34-CAR-B	CA-BOT	L80x80x8H	350	5	16
34-CAR-T	CA-TOP	L70x70x5H	350	4	16
35-LB	L.BELT	L80x80x5H	350	2	16
35-CL	L.BRG	L45x45x5H	350	2	16
35-L	LEG	L120x120x8H	350	8	16DS
36-PCL-B	PCA-BOT	L80x80x8H	350	3	16
36-PCL-T	PCA-TOP	L60x60x5H	350	2	16
37-PCR-B	PCA-BOT	L80x80x8H	350	3	16
37-PCR-T	PCA-TOP	L60x60x5H	350	2	16

NOTES:

1). ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2). ALL TOWER WORKS ARE TO BE TAKEN AS CG TO CG DIMENSIONS.
3). LL, CL AND GL DENOTES LATTICES LEVEL, CONCRETE LEVEL AND GROUND LEVEL RESPECTIVELY.
4). MILD STEEL SHALL CONFORM TO IS 2062:2011 PERTAINING TO GRADE E250A.
5). HIGH TENSILE STEEL SHALL CONFORM TO IS 2062:2011 PERTAINING TO GRADE E350A.
6). SECTIONS PREFIXED WITH 'H' REFERS TO HIGH TENSILE STEEL.
7). BOLTS SHALL CONFORM TO IS 1367(PART 3):2002 PERTAINING TO PROPERTY CLASS 5.6.
8). STEP BOLTS ARE PROVIDED ON DIAGONALLY OPPOSITE LEGS, 16 mm ø AND SHALL CONFIRM TO IS 10238:2001.
9). GALVANISING SHALL CONFIRM TO IS 2629:1985.
10). ①,②,③,.... REFERS TO PANEL NUMBER.
11). S1, S2, S3, ... REFERS TO SUB BRACINGS IN ACCORDANCE WITH REDUNDNT TABLE.
12). MINIMUM THICKNESS OF GUSSET PLATE USED IS 8 mm AND SHALL CONFIRM TO IS 2062:2006.
13). THE SUBBRACING MEMBER SECTIONS INDICATED IN THIS LINE DIAGRAM ARE LIKELY SUBJECTED TO CHANGE BASED ON THE ACTUAL MEMBER LENGTH AS PER GA DRAWING (M/R NOTED CRITERIA).
14). ALL THE JOINTS ARE "BUTT JOINTS" UNLESS OTHERWISE SPECIFIED.
15). -●-●- REFERS THAT THE PARTICULAR MEMBER HAS TO BE CONNECTED BY 2 BOLT IN ONE END & 1 BOLT IN OTHER END

TRANSVERSE FACE

VIEW 7-7 VIEW 8-8 VIEW 9-9

VIEW 5-5 VIEW 6-6

VIEW 3-3 VIEW 4-4

VIEW 1-1 VIEW 2-2

VIEW 10-10 VIEW 11-11 VIEW 12-12 VIEW 13-13 VIEW 14-14

VIEW A-A VIEW B-B VIEW C-C VIEW D-D VIEW E-E VIEW F-F VIEW G-G VIEW H-H

+6M BODY EXTENSION +3M BODY EXTENSION +0M BODY EXTENSION -3M BODY EXTENSION +3M LEG EXTENSION +1.5M LEG EXTENSION +0M LEG EXTENSION -1.5M LEG EXTENSION -3M LEG EXTENSION

VIEW S-S VIEW T-T VIEW U-U VIEW V-V VIEW W-W VIEW X-X VIEW Y-Y VIEW Z-Z VIEW AA-AA VIEW AB-AB VIEW AC-AC VIEW M-M VIEW N-N VIEW P-P VIEW Q-Q VIEW R-R

DATE	REV.NO.	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
17.05.18	C	REVISED AS PER COMMENT MAIL DATED ON 15.05.2018	SA	ABS	MTR/RK	DK
25.04.18	B	REVISED AS PER COMMENT MAIL DATED ON 18.04.2018	SA	MP	MTR/RK	DK
12.04.18	A	ISSUED FOR APPROVAL	SA	VC	MTR/RK	DK

CLIENT : Sterlite Power — STERLITE POWER GIRD VENTURES LIMITED

CONSULTANT : 4A — 4A DESIGN & ENGINEERING PVT. LTD. CHENNAI

PROJECT : ELDAM-- NARENDRA 400 KV D/C TRANSMISSION LINE WITH QUAD AAAC MOOSE CONDUCTOR (WZ-1)

JOB No. :

	NAME	DATE
DESN	SA	12.04.18
DRWN	VC	12.04.18
CHKD	MTR/RK	12.04.18
APPD	DK	12.04.18

TITLE : SINGLE LINE DIAGRAM FOR TOWER TYPE "DA" (0°-2°)

SCALE	1:100
SIZE	A0
REV.	B

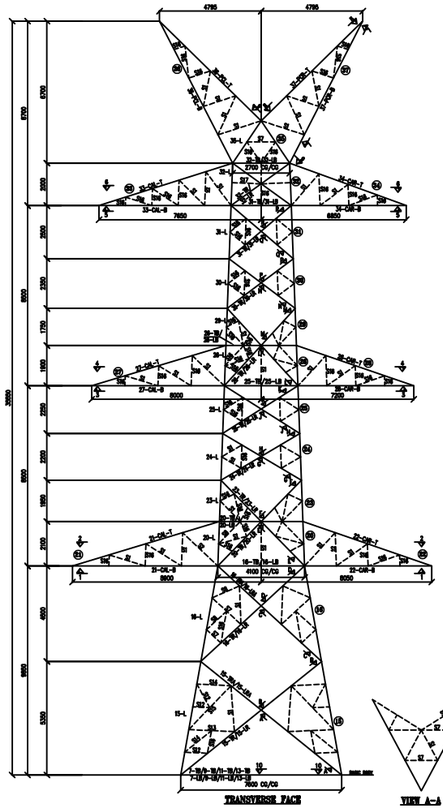
REDUNDANT TABLE	
S1	L45x45x4
S2	L50x50x4
S3	L55x55x4
S4	L60x60x4
S5	L65x65x4
S6	L70x70x4/5
S7	L75x75x5/6
S8	L80x80x5
S9	L90x90x6
S10	L90x90x8/10
S11	L65x65x5/6
S12	L45x45x5/6
S13	L50x50x5/6
S14	L55x55x5/6
S15	L60x60x5/6
S16	L45x30x4
S17	L45x30x4/6

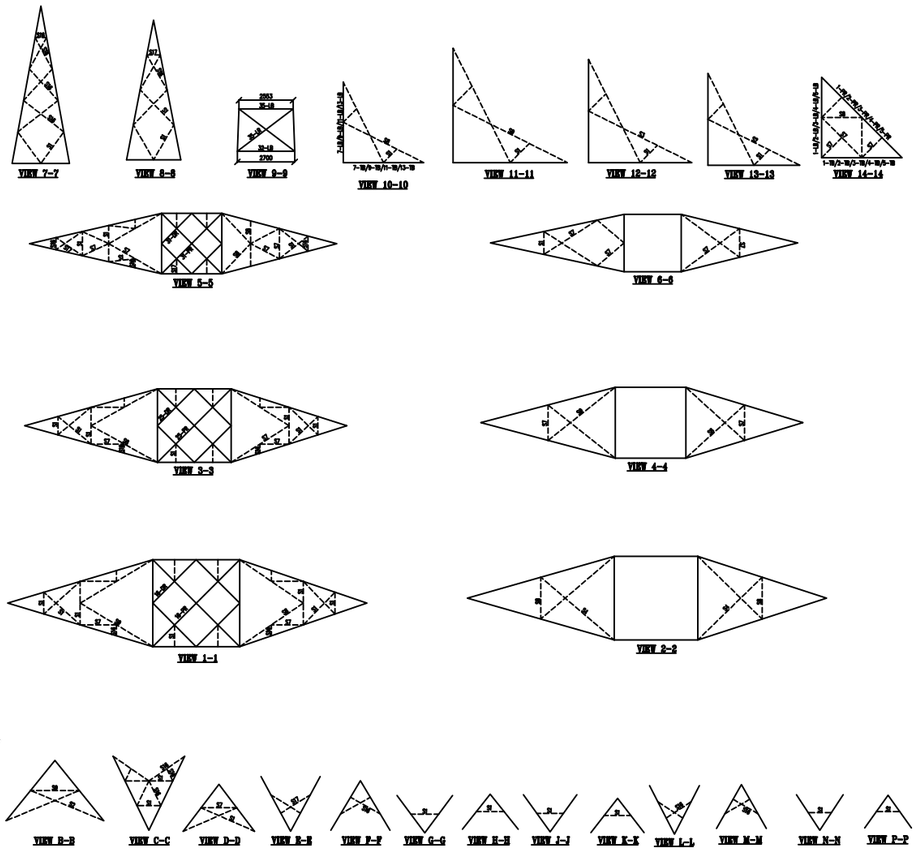
Group Label	Group Desc.	Angle Size	Steel Strength (MPa)	No. Of Bolts	DIA OF BOLTS
+3M LEG EXTENSION					
1-LR	L.BRG	L100x100x7/H	350	5	16
1-L	LEG	L150x150x18H	350	16	16 DS
1-TR	T.BRG	L100x100x7/H	350	5	16
1-PR	P.BRG	L80x80x5H	350	2	16
1-LB	L.BELT	L75x75x5H	350	3	16
1-TB	T.BELT	L75x75x5H	350	3	16
+1.5M LEG EXTENSION					
3-LR	L.BRG	L100x100x8H	350	4	16
3-L	LEG	L150x150x18H	350	16	16 DS
3-TR	T.BRG	L100x100x8H	350	4	16
3-PR	P.BRG	L80x80x5H	350	2	16
3-LB	L.BELT	L75x75x5H	350	3	16
3-TB	T.BELT	L75x75x5H	350	3	16
+0M LEG EXTENSION					
3-LR	L.BRG	L100x100x8	250	4	16
3-L	LEG	L150x150x18H	350	16	16 DS
3-TR	T.BRG	L100x100x8	250	4	16
3-PR	P.BRG	L80x80x5H	350	2	16
3-LB	L.BELT	L75x75x5H	350	3	16
3-TB	T.BELT	L75x75x5H	350	3	16
-1.5M LEG EXTENSION					
4-LR	L.BRG	L100x100x8H	350	4	16
4-L	LEG	L150x150x18H	350	16	16 DS
4-TR	T.BRG	L100x100x8H	350	4	16
4-PR	P.BRG	L80x80x5H	350	2	16
4-LB	L.BELT	L75x75x5H	350	3	16
4-TB	T.BELT	L75x75x5H	350	3	16
-3M LEG EXTENSION					
5-LR	L.BRG	L80x80x8	250	4	16
5-L	LEG	L150x150x18H	350	16	16 DS
5-TR	T.BRG	L80x80x8	250	4	16
5-PR	P.BRG	L80x80x5H	350	2	16
5-LB	L.BELT	L75x75x5H	350	3	16
5-TB	T.BELT	L75x75x5H	350	3	16
-3M BODY EXTENSION					
7-LR1	L.BRG	L80x80x7H	350	3	16
7-LR2	L.BRG	L80x80x7H	350	3	16
7-LB	L.BELT	L80x80x7H	350	3	16
7-L	LEG	L150x150x18H	350	16	16 DS
7-LGR	L.G.BRG	L110x110x8	250	5	16
7-TGR	T.G.BRG	L110x110x8H	350	5	16
7-TR1	T.BRG	L80x80x8H	350	3	16
7-TR2	T.BRG	L80x80x8	250	3	16
7-TB	T.BELT	L80x80x7H	350	3	16
+0M BODY EXTENSION					
8-LR1	L.BRG	L80x80x8H	350	3	16
8-LR2	L.BRG	L80x80x8H	350	3	16
8-LB	L.BELT	L75x75x8H	350	3	16
8-L	LEG	L150x150x18H	350	16	16 DS
8-LGR	L.G.BRG	L110x110x8	250	5	16
8-TGR	T.G.BRG	L100x100x8H	350	4	16
8-TR1	T.BRG	L75x75x8H	350	3	16
8-TR2	T.BRG	L75x75x8H	350	3	16
8-TB	T.BELT	L75x75x8H	350	3	16
9-LR	L.BRG	L80x80x7H	350	4	16
9-L	LEG	L150x150x18H	350	16	16 DS
9-TR	T.BRG	L80x80x8H	350	3	16
9-TB	T.BELT	L80x80x7H	350	3	16
+3M BODY EXTENSION					
10-LR1	L.BRG	L75x75x8H	350	2	16
10-LR2	L.BRG	L75x75x8H	350	2	16
10-LB	L.BELT	L75x75x8H	350	3	16
10-L	LEG	L150x150x18H	350	16	16 DS
10-LGR	L.G.BRG	L100x100x8H	350	5	16
10-TGR	T.G.BRG	L100x100x7H	350	4	16
10-TR1	T.BRG	L75x75x8H	350	2	16
10-TR2	T.BRG	L70x70x8H	350	2	16
10-TB	T.BELT	L75x75x8H	350	3	16
11-LR	L.BRG	L100x100x7H	350	5	16
11-LB	L.BELT	L80x80x7H	350	3	16
11-L	LEG	L150x150x18H	350	16	16 DS
11-TR	T.BRG	L100x100x7	250	5	16
11-TB	T.BELT	L80x80x7H	350	3	16
+6M BODY EXTENSION					
12-LR1	L.BRG	L75x75x8H	350	2	16
12-LR2	L.BRG	L70x70x8	250	2	16
12-LB	L.BELT	L80x80x8H	350	3	16
12-L	LEG	L150x150x18H	350	16	16 DS
12-LGR	L.G.BRG	L110x110x8	250	4	16
12-TGR	T.G.BRG	L100x100x8	250	4	16
12-TR1	T.BRG	L75x75x8H	350	2	16
12-TR2	T.BRG	L70x70x8	250	2	16
12-TB	T.BELT	L80x80x8H	350	3	16
13-LR	L.BRG	L110x110x8H	350	6	16
13-LB	L.BELT	L80x80x7H	350	3	16
13-L	LEG	L150x150x18H	350	16	16 DS
13-TR	T.BRG	L100x100x8H	350	5	16
13-TB	T.BELT	L80x80x7H	350	3	16

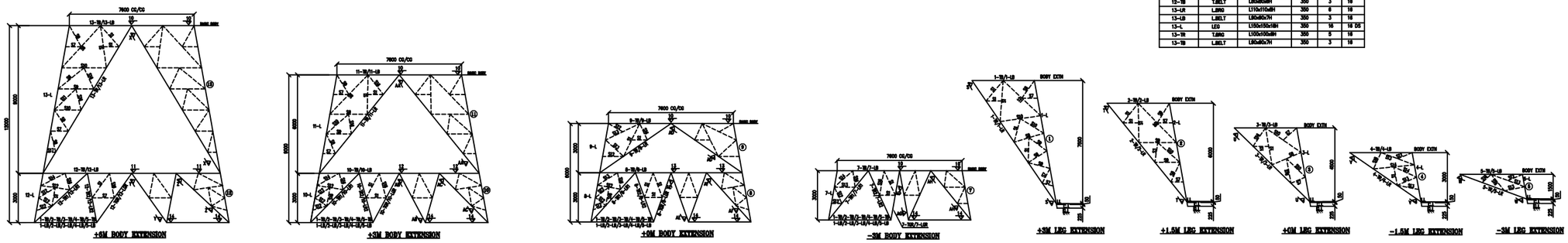
Group Label	Group Desc.	Angle Size	Steel Strength (MPa)	No. Of Bolts	DIA OF BOLTS
NORMAL TOWER					
15-LR	L.BRG	L110x110x8	250	5	16
15-LRA	L.BRGA	L110x110x8	250	5	16
15-L	LEG	L150x150x18H	350	16	16 DS
15-TR	T.BRG	L100x100x7	250	5	16
15-TRA	T.BRGA	L100x100x7	250	5	16
16-OR	D.BRG	L65x65x5H	350	1	16
16-LR	L.BRG	L120x120x8H	350	7	16
16-LRA	L.BRGA	L120x120x8H	350	7	16
16-LB	L.BELT	L70x70x8H	350	3	16
16-L	LEG	L150x150x18H	350	16	16 DS
16-PR	P.BRG	L75x70x8H	350	2	16
16-TR	T.BRG	L110x110x8H	350	7	16
16-TRA	T.BRGA	L110x110x8H	350	7	16
16-TB	T.BELT	L100x100x8H	350	5	16
20-LR	L.BRG	DL80x80x8H	350	5	16 DS
20-LB	L.BELT	L65x65x6H	350	3	16
20-L	LEG	L150x150x12H	350	12	16 DS
20-TR	T.BRG	DL75x75x8H	350	5	16 DS
20-TB	T.BELT	L80x80x8H	350	5	16
21-CAL-9	CA-BOT	L110x110x10H	350	7	16
21-CAL-7	CA-TOP	L80x80x7H	350	5	16
22-CAR-9	CA-BOT	L100x100x8H	350	7	16
22-CAR-7	CA-TOP	L80x80x8H	350	5	16
23-LR	L.BRG	DL80x80x8H	350	5	16 DS
23-L	LEG	L150x150x12H	350	12	16 DS
23-TR	T.BRG	DL75x75x8H	350	5	16 DS
24-LR	L.BRG	DL70x70x8H	350	5	16 DS
24-L	LEG	L150x150x12H	350	10	16 DS
24-TR	T.BRG	DL75x75x8H	350	5	16 DS
25-OR	D.BRG	L80x80x8H	350	1	16
25-LR	L.BRG	DL75x75x8H	350	5	16 DS
25-LB	L.BELT	L70x70x8H	350	3	16
25-L	LEG	L110x110x10H	350	10	16 DS
25-PR	P.BRG	L65x65x5	350	2	16
25-TR	T.BRG	DL75x75x8H	350	5	16 DS
25-TB	T.BELT	L75x75x8H	350	3	16
26-LR	L.BRG	L80x80x8H	350	6	16
26-LB	L.BELT	L65x65x5H	350	3	16
26-L	LEG	L110x110x10H	350	10	16 DS
26-TR	T.BRG	L80x80x8H	350	7	16
26-TB	T.BELT	L80x80x8H	350	5	16
27-CAL-9	CA-BOT	L110x110x10H	350	8	16
27-CAL-7	CA-TOP	L80x80x7H	350	6	16
28-CAR-9	CA-BOT	L100x100x8H	350	7	16
28-CAR-7	CA-TOP	L80x80x8H	350	5	16
29-LR	L.BRG	L80x80x7H	350	5	16
29-L	LEG	L100x100x8H	350	8	16 DS
29-TR	T.BRG	L80x80x8H	350	6	16
30-LR	L.BRG	L80x80x7H	350	5	16
30-L	Leg	L100x100x8H	350	8	16 DS
30-TR	T.BRG	L100x100x8H	350	5	16
31-OR	D.BRG	L45x45x5H	350	1	16
31-LR	L.BRG	L80x80x7H	350	5	16
31-LB	L.BELT	L80x80x8H	350	2	16
31-L	LEG	L100x100x8H	350	8	16 DS
31-PR	P.BRG	L80x80x5	250	2	16
31-TR	T.BRG	L100x100x8H	350	6	16
31-TB	T.BELT	L80x80x7H	350	5	16
33-LB	L.BRG	L75x75x8	250	4	16
33-LB	L.BELT	L80x80x8H	350	2	16
33-L	LEG	L100x100x8H	350	8	16 DS
33-TR	T.BRG	L80x80x8H	350	4	16
33-TB	T.BELT	L70x70x8H	350	4	16
33-CAL-9	CA-BOT	L100x100x10H	350	8	16
33-CAL-7	CA-TOP	L80x80x7H	350	6	16
34-CAR-9	CA-BOT	L100x100x8H	350	7	16
34-CAR-7	CA-TOP	L80x80x7H	350	5	16
35-LR	L.BRG	L65x65x6	250	2	16
35-LB	L.BELT	L60x60x5	250	2	16
35-L	LEG	L100x100x8H	350	6	16 DS
36-PCL-9	PCA-BOT	L70x70x8H	350	4	16
36-PCL-7	PCA-TOP	L60x60x5H	350	3	16
37-PCR-9	PCA-BOT	L70x70x8H	350	4	16
37-PCR-7	PCA-TOP	L60x60x5H	350	3	16

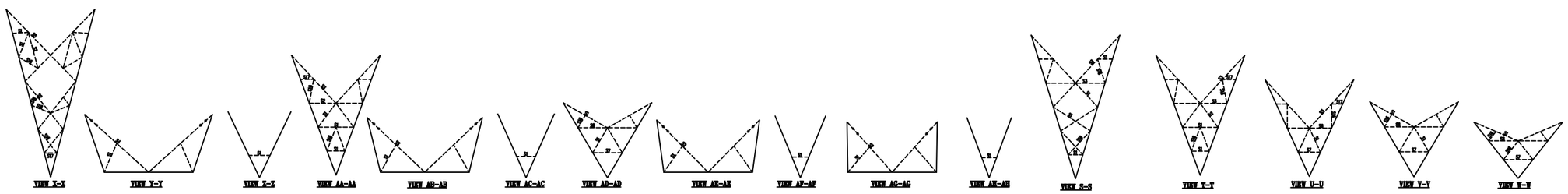
NOTES:

1). ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2). ALL TOWER MEMBERS ARE TO BE TAKEN AS CG TO CG DIMENSIONS.
3). LL, CL AND GL DENOTES LATTICES LEVEL, CONCRETE LEVEL AND GROUND LEVEL RESPECTIVELY.
4). MILD STEEL SHALL CONFORM TO IS 2062:2011 PERTAINING TO GRADE E250A.
5). HIGH TENSILE STEEL SHALL CONFORM TO IS 2062:2011 PERTAINING TO GRADE E300A.
6). SECTIONS PREFIXED WITH 'H' REFERS TO HIGH TENSILE STEEL.
7). BOLTS SHALL CONFORM TO IS 1367(PART 3):2002 PERTAINING TO PROPERTY CLASS 5.6.
8). STEP BOLTS ARE PROVIDED ON DIAGONALLY OPPOSITE LEGS, 16 mm ø AND SHALL CONFIRM TO IS 10238:2001.
9). GALVANISING SHALL CONFIRM TO IS 2629:1985.
10). 1 , 2 , 3 .... REFERS TO PANEL NUMBER.
11). S1, S2, S3 .... REFERS TO SUB BRACINGS IN ACCORDANCE WITH REDUNDANT TABLE.
12). MINIMUM THICKNESS OF GUSSET PLATE USED IS 5 mm AND SHALL CONFIRM TO IS 2062:2006.
13). THE SUBBRACING MEMBER SECTIONS INDICATED IN THIS LINE DIAGRAM ARE LIKELY SUBJECTED TO CHANGE BASED ON THE ACTUAL MEMBER LENGTH AS PER G.A DRAWING (UR RATIO CRITERIA).
14). ALL THE JOINTS ARE "BAT JOINTS" UNLESS OTHERWISE SPECIFIED.
15). -●-●- REFERS THAT THE PARTICULAR MEMBER HAS TO BE CONNECTED BY 2 BOLT IN ONE END & 1 BOLT IN OTHER END









17.05.18	C	REVISED AS PER COMMENTS DATED ON 15.05.2018	CK	MP	MTR/RK	DK
27.04.18	B	REVISED AS PER COMMENTS DATED ON 19.04.2018	CK	MP	MTR/RK	DK
11.04.18	A	ISSUED FOR APPROVAL	CK	VG	MTR/RK	DK
DATE	REV.NO.	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED

CLIENT : STERLITE POWER GIRD VENTURES LIMITED

CONSULTANT : 4A DESIGN & ENGINEERING PVT. LTD. CHENNAI

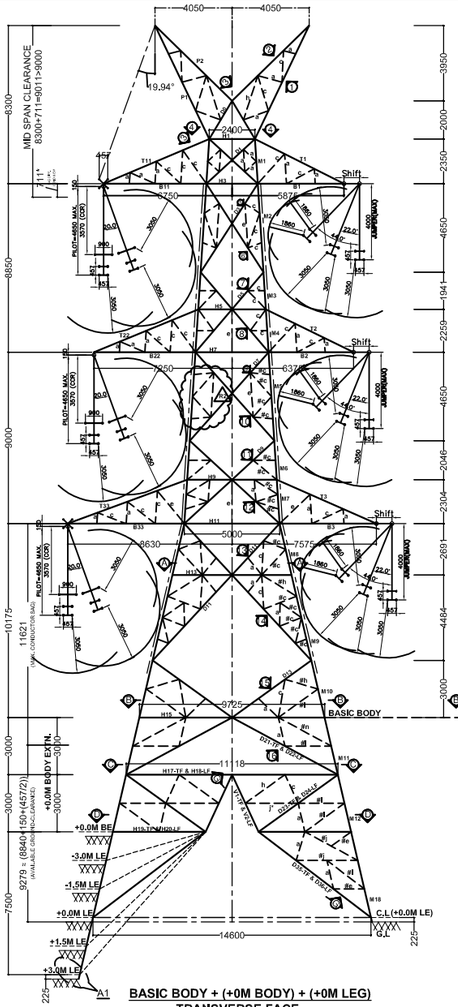
PROJECT : XELDAM- NARENDRA 400 KV D/C TRANSMISSION LINE WITH QUAD AAAC MOOSE CONDUCTOR (WZ-1)

JOB No.:		
	NAME	DATE
DESN	CK	11.04.18
DRWN	VG	11.04.18
CHKD	MTR/RK	11.04.18
APPD	DK	11.04.18

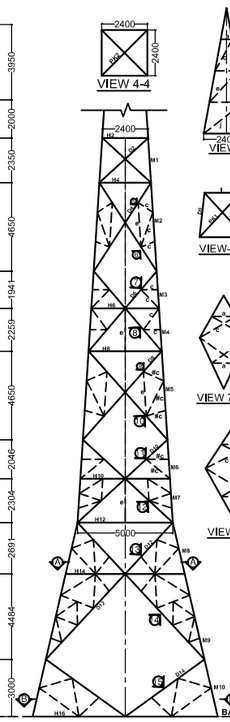
TITLE : SINGLE LINE DIAGRAM FOR TOWER TYPE "DS" (0°-15°)

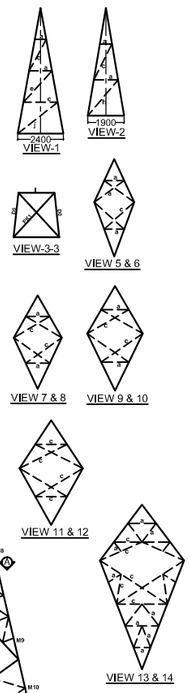
SCALE 1 :100 | SIZE A0 | REV. B

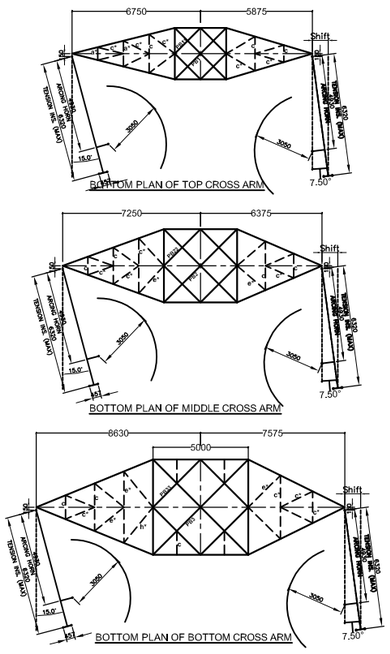
841 X 594 - A1

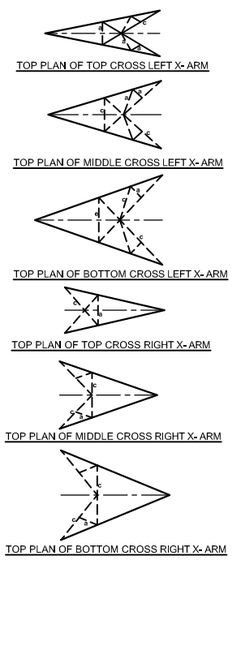


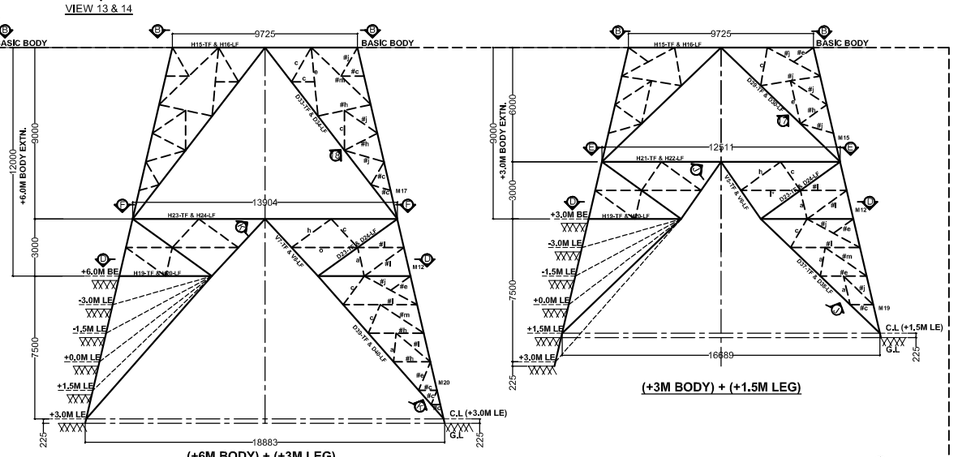
BASIC BODY + (+0M BODY) + (+0M LEG)
TRANSVERSE FACE
NORMAL TOWER









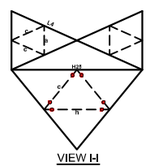


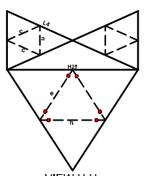
(+6M BODY) + (+3M LEG)

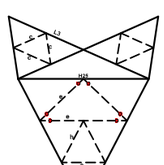
(+3M BODY) + (+1.5M LEG)

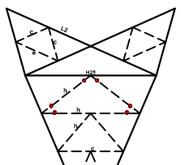
DETAIL AT 'A1'

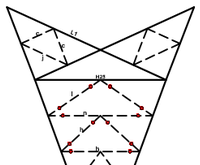
Sr. No.	Group Label	Angle Type	Angle Size	Steel Strength (MPa)	No. Of Bolts	Bolt Size (mm)	Type of Connection
1	M1	A	100X100X7	250	6	16 MM	SS
2	M2	A	100X100X7	250	6	16 MM	SS
3	M3	A	110X110X10	350	12	16 MM	SS
4	M4	A	110X110X10	350	12	16 MM	SS
5	M5	A	130X130X12	350	16	16 MM	SS
6	M6	A	150X150X15	350	12	16 MM	DS
7	M7	A	150X150X15	350	12	16 MM	DS
8	M8	A	150X150X18	350	14	16 MM	DS
9	M9	A	150X150X18	350	14	16 MM	DS
10	M10	A	150X150X20	330	14	16 MM	DS
11	M11	A	150X150X20	330	14	16 MM	DS
12	M12	A	150X150X20	330	14	16 MM	DS
13	M14	A	150X150X20	330	14	16 MM	DS
14	M15	A	150X150X20	330	14	16 MM	DS
15	M16	A	150X150X20	330	14	16 MM	DS
16	M17	A	150X150X20	330	14	16 MM	DS
17	M18	A	150X150X20	330	14	16 MM	DS
18	M19	A	150X150X20	330	14	16 MM	DS
19	M20	A	150X150X20	330	14	16 MM	DS
20	D1	A	75X75X5	250	3	16 MM	SS
21	D2	A	65X65X5	250	3	16 MM	SS
22	D0	A	50X50X5	250	2	16 MM	SS
23	D1	A	75X75X5	250	2	16 MM	SS
24	D2	A	75X75X5	250	3	16 MM	SS
25	D3	A	110X110X10	350	8	16 MM	SS
26	D4	A	110X110X8	350	6	16 MM	SS
27	D5	A	100X100X7	350	5	16 MM	SS
28	D6	A	100X100X7	350	5	16 MM	SS
29	D7	A	120X120X10	350	9	16 MM	SS
30	D8	A	110X110X10	350	8	16 MM	SS
31	D9	A	110X110X10	350	8	16 MM	SS
32	D10	A	110X110X8	350	6	16 MM	SS
33	D11	A	100X100X7	350	6	16 MM	SS
34	D12	A	110X110X8	350	7	16 MM	SS
35	D13	A	80X80X6	250	4	16 MM	SS
36	D14	A	100X100X7	250	4	16 MM	SS
37	D21	A	110X110X8	250	4	16 MM	SS
38	D22	A	110X110X10	250	4	16 MM	SS
39	D23	A	90X90X7	250	3	16 MM	SS
40	D24	A	100X100X7	250	3	16 MM	SS
41	D27	A	90X90X7	250	4	16 MM	SS
42	D28	A	100X100X7	250	4	16 MM	SS
43	D29	A	110X110X8	250	4	16 MM	SS
44	D30	A	110X110X10	250	4	16 MM	SS
45	D31	A	100X100X8	250	4	16 MM	SS
46	D32	A	110X110X8	250	4	16 MM	SS
47	D33	A	100X100X7	250	5	16 MM	SS
48	D34	A	110X110X8	250	5	16 MM	SS
49	D35	A	90X90X7	250	4	16 MM	SS
50	D35	A	100X100X7	250	4	16 MM	SS
51	D37	A	90X90X6	250	4	16 MM	SS
52	D38	A	100X100X7	250	4	16 MM	SS
53	D39	A	90X90X6	250	4	16 MM	SS
54	D40	A	100X100X7	250	4	16 MM	SS
55	H1	A	75X75X5	350	3	16 MM	SS
56	H2	A	65X65X5	350	2	16 MM	SS
57	H3	A	110X110X8	350	6	16 MM	SS
58	H4	A	65X65X5	350	2	16 MM	SS
59	H5	A	75X75X5	350	4	16 MM	SS
60	H6	A	70X70X5	350	2	16 MM	SS
61	H7	A	100X100X8	350	5	16 MM	SS
62	H8	A	65X65X5	350	2	16 MM	SS
63	H9	A	75X75X5	350	4	16 MM	SS
64	H10	A	75X75X5	350	2	16 MM	SS
65	H11	A	110X110X10	350	7	16 MM	SS
66	H12	A	100X100X8	350	4	16 MM	SS
67	H13	A	65X65X5	350	2	16 MM	SS
68	H14	A	65X65X5	350	2	16 MM	SS
69	H15	A	90X90X6	350	3	16 MM	SS
70	H16	A	100X100X7	350	3	16 MM	SS
71	H17	A	90X90X6	350	3	16 MM	SS
72	H18	A	100X100X7	350	3	16 MM	SS
73	H19	A	75X75X6	350	3	16 MM	SS
74	H20	A	75X75X6	350	3	16 MM	SS
75	H21	A	90X90X7	350	3	16 MM	SS
76	H22	A	100X100X7	350	3	16 MM	SS
77	H23	A	100X100X8	350	3	16 MM	SS
78	H24	A	110X110X8	350	3	16 MM	SS
79	H25	A	80X80X6	350	2	16 MM	SS
80	B1	A	100X100X8	350	9	16 MM	SS
81	B11	A	110X110X10	350	9	16 MM	SS
82	B2	A	100X100X7	350	7	16 MM	SS
83	B22	A	110X110X8	350	7	16 MM	SS
84	B3	A	100X100X7	350	7	16 MM	SS
85	B33	A	110X110X8	350	7	16 MM	SS
86	T1	A	90X90X6	350	5	16 MM	SS
87	T11	A	90X80X6	350	5	16 MM	SS
88	T2	A	80X80X6	350	5	16 MM	SS
89	T22	A	80X80X6	350	5	16 MM	SS
90	T3	A	90X90X6	350	5	16 MM	SS
91	T33	A	80X80X6	350	5	16 MM	SS
92	PK1	A	50X50X4	250	2	16 MM	SS
93	PK2	A	55X55X5	350	2	16 MM	SS
94	PB1	A	60X60X5	350	2	16 MM	SS
95	PB11	A	55X55X5	350	2	16 MM	SS
96	PB2	A	70X70X5	350	2	16 MM	SS
97	PB22	A	70X70X5	350	2	16 MM	SS
98	PB3	A	90X90X6	350	2	16 MM	SS
99	PB33	A	75X75X5	350	2	16 MM	SS
100	V1	A	80X80X6	250	4	16 MM	SS
101	V2	A	90X90X6	250	4	16 MM	SS
102	V3	A	90X90X7	250	4	16 MM	SS
103	V4	A	100X100X7	250	4	16 MM	SS
104	V5	A	90X90X6	250	4	16 MM	SS
105	V6	A	90X90X6	250	4	16 MM	SS
106	V7	A	90X90X6	250	4	16 MM	SS
107	V8	A	90X90X7	250	4	16 MM	SS
108	Z1	A	70X70X5	250	2	16 MM	SS
109	Z2	A	65X65X4	250	2	16 MM	SS
110	Z3	A	60X60X4	250	2	16 MM	SS
111	Z4	A	60X60X4	250	2	16 MM	SS

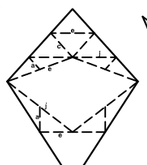


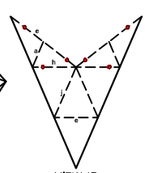


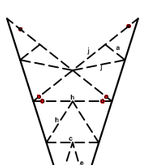


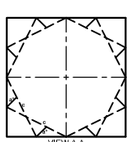


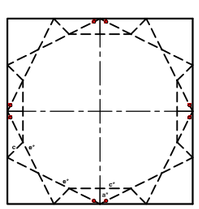


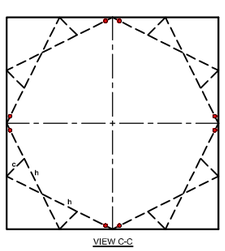


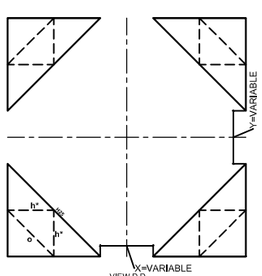


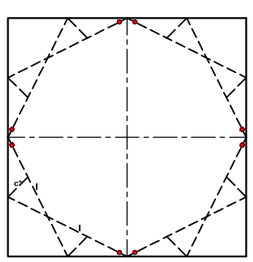


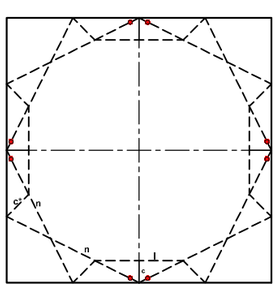


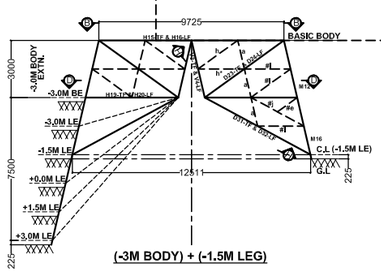




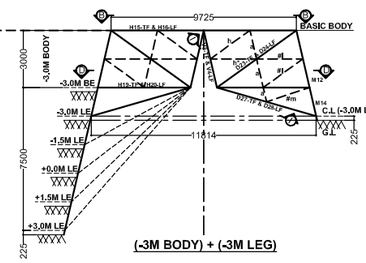








(-3M BODY) + (-1.5M LEG)



(-3M BODY) + (-3M LEG)

REDUNTANT TABLE

RED MKD	SECTION	MAX LENTH IN mm L/r MIN < 250	L/r MED < 250	MAX LENTH IN mm FOR 150 Kg Bend
a	45x30x4	1575	2100	624
a*	HT-45x30x4	1575	2100	864
b	45x30x5	1575	2075	763
b*	HT-45x30x5	1575	2075	1056
c	45x45x4	2175	3425	1387
c*	HT-45x45x4	2175	3425	1920
d	45x45x5	2175	3400	1733
e	50x50x4	2425	3825	1733
e*	HT-50x50x4	2425	3825	2400
f	50x50x5	2425	3800	2149
g	50x50x6	2400	3775	N.C.
h	55x55x4	2650	4175	2052
h*	HT-55x55x4	2650	4175	2841
i	55x55x5	2650	4175	2565
j	60x60x4	2975	4625	2538
j*	HT-60x60x4	2975	4625	3696
k	60x60x5	2900	4550	N.C.
l	65x65x4	3150	4975	2894
l*	HT-65x65x4	3150	4975	3993
m	65x65x5	3150	4975	N.C.
n	70x70x5	3400	5375	N.C.
o	75x75x5	3650	5775	N.C.
p	75x75x6	3650	5750	N.C.
q	80x80x6	3900	6150	N.C.
r	90x90x6	4375	6925	N.C.
s	100x100x6	4875	7725	N.C.
t	110x110x8	5450	8500	N.C.

NOTES >
1) ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED
2) MILD STEEL - AS PER IS 2062:2011 OF GRADE E250 & YIELD STRENGTH = 250N/SQ.MM
3) (A) HIGH TENSILE STEEL - AS PER IS 2062:2011 OF GRADE E350 & YIELD STRENGTH = 350N/SQ.MM FOR T <20MM THICK.
(B) HIGH TENSILE STEEL - AS PER IS 2062:2011 OF GRADE E350 & YIELD STRENGTH = 330N/SQ.MM FOR T >20MM THICK.
4) BOLTS AND NUTS WITH MILD STEEL - AS PER IS 12427 : 2003(GRADE - 5.6) ULTIMATE SHEAR STRESS = 316KG/SQ.CM
ULTIMATE BEARING STRESS = 525KG/SQ.CM.
5) THE TOWER DESIGN IS AS PER IS:802 (PART 1 / SEC 2) & IS:802 (PART 1 / SEC 1) - 2015.
6) ELECTRICAL CLEARANCE AND SWING ANGLES ARE AS PER SPECIFICATIONS
7) HT - INDICATE HIGH TENSILE STEEL SECTION.
8) SS & DS - INDICATES SINGLE SHEAR & DOUBLE SHEAR RESPECTIVELY
9) AHD = ARCING HORN DISTANCE
10) C.L = CONCRETE LEVEL, G.L = GROUND LEVEL
11) A = SINGLE ANGLE
12) BM = BACK MARK, CLT = CLEAT ANGLE
13) ALL WIDTH DIMENSIONS ARE FROM C.G TO C.G OF ANGLES.
14) "" SAG DIFF. BETWEEN CONDUCTOR & EW @ MINIMUM TEMPERATURE NO WIND CONDITION
15) CONNECTION OF REDUNDANT MEMBERS WITH LEG OF SECTION L130 AND ABOVE SHALL BE DONE WITH TWO BOLTS.
16) # - INDICATES 2 BOLT CONNECTION WITH LEG SECTION
17) * - INDICATES HT SECTION
18) STUB = HT-L150X150X20.
19) TOWER IS DESIGNED FOR A BASIC WIND SPEED OF 33M/S (WZ=1).

D = INDICATES = TWO BOLT CONNECTION

REV	DATE	DESCRIPTION	DRAWN	CHKED	APPD
2	23-08-18	REVISED AS PER CLIENT'S COMMENTS	AM	DL	DL
1	26-03-18	LEG DIFFERENCE REVISED TO 4.5M	AM	DL	DL

OWNER :- STERLITE POWER GRID VENTURES LIMITED

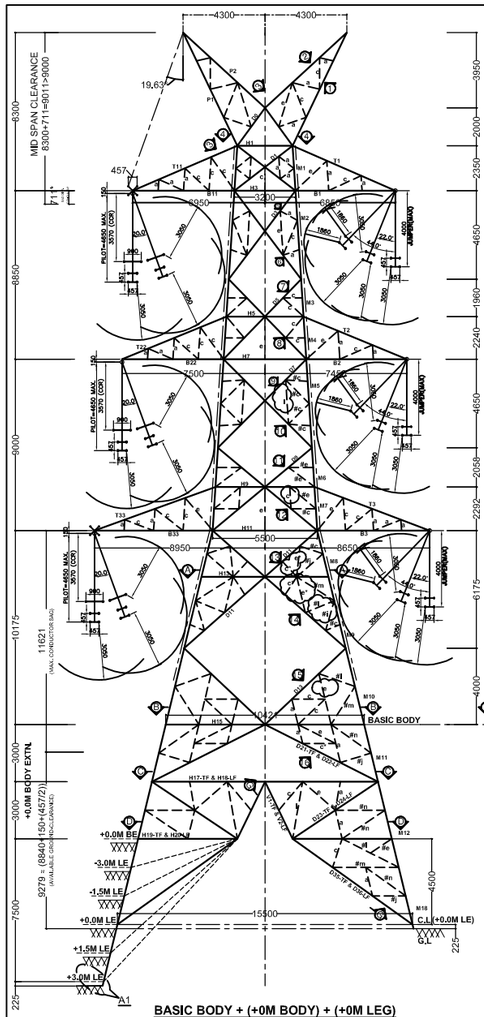
LINE :- Xeldam - Narendra 400kV D/C
Transmission Line with Quad AAAC Moose Conductor

WIND ZONE :- I (33 m/s)

PROJECT :- Xeldam - Narendra 400kV D/C
Transmission Line with Quad AAAC Moose Conductor
For wind Zone-1

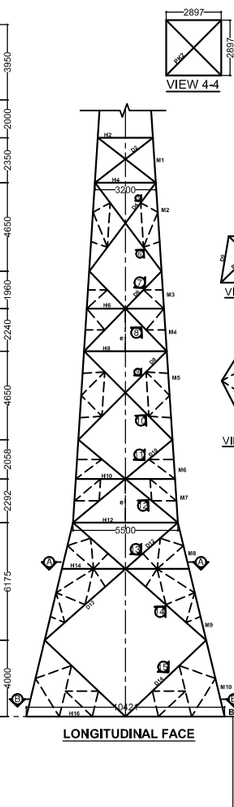
TITLE:- LINE DIAGRAM FOR
" T.T-DC (15° - 30° DEV.)"(MEDIUM ANGLE TENSION TOWER)

DRAWN BY	AM	26.03.18	SCALE		
DESIGN BY	AM	26.03.18		DESIGN NO.:-	SHEET NO.:
CHECKED BY	DL			DS-1007	1 OF 1
APPD. BY	DL			REVISION 0 / 2	

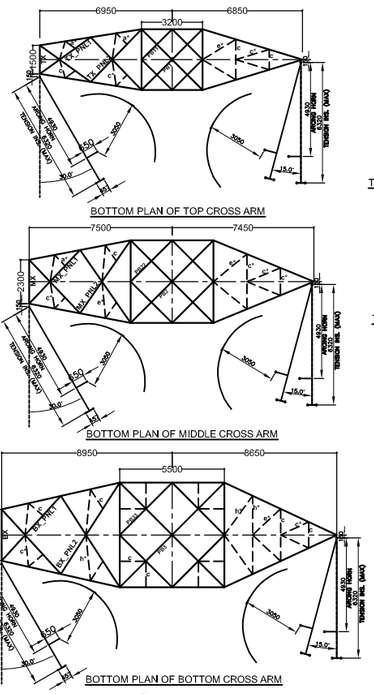


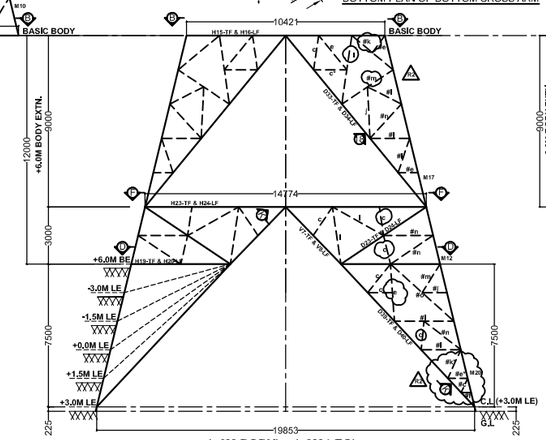
BASIC BODY + (+0M BODY) + (+0M LEG)
TRANSVERSE FACE
NORMAL TOWER

DETAIL AT 'A1'

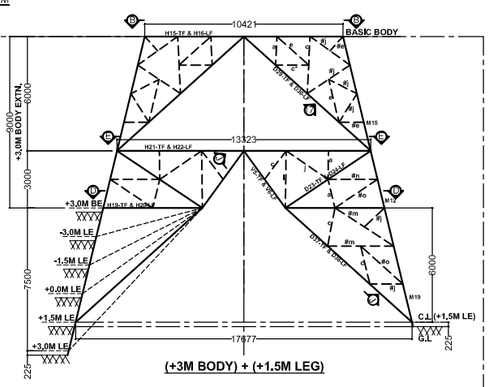


LONGITUDINAL FACE



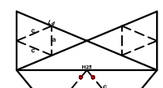


(+6M BODY) + (+3M LEG)

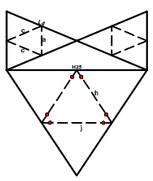


(+3M BODY) + (+1.5M LEG)

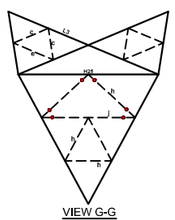
Sr No.	Group Label	Angle Type	Angle Size	Steel Strength (MPa)	No. Of Bolts	Bolt Size (mm)	Type of Connection	Sr No.	Group Label	Angle Type	Angle Size	Steel Strength (MPa)	No. Of Bolts	Bolt Size (mm)	Type of Connection
1	V1	A	100X100X7	350	8	16 MV	SS	66	H12	A	110X110X10	350	7	16 VM	SS
2	V2	A	100X100X7	350	8	16 MV	SS	67	H13	A	65X65X5	250	2	16 VM	SS
3	V3	A	120X120X12	350	16	16 MV	SS	68	H14	A	65X65X5	250	2	16 VM	SS
4	V4	A	120X120X12	350	16	16 MV	SS	69	H15	A	90X90X6	350	3	16 VM	SS
5	V5	A	150X150X15	350	20	16 MV	SS	70	H16	A	90X90X6	350	3	16 VM	SS
6	V6	A	150X150X20	330	16	16 MV	DS	71	H17	A	90X90X6	350	3	16 VM	SS
7	V7	A	150X150X20	330	16	16 MV	DS	72	H18	A	90X90X6	350	3	16 VM	SS
8	V8	A	200X200X15	350	18	16 MV	DS	73	H19	A	90X90X6	350	3	16 VM	SS
9	V9	A	200X200X16	350	18	16 MV	DS	74	H20	A	90X90X6	350	3	16 VM	SS
10	M10	A	200X200X20	330	20	16 MV	DS	75	H21	A	90X90X6	350	3	16 VM	SS
11	M11	A	200X200X20	330	20	16 MV	DS	76	H22	A	90X90X6	350	3	16 VM	SS
12	M12	A	200X200X20	330	20	16 MV	DS	77	H23	A	100X100X7	350	3	16 VM	SS
13	M14	A	200X200X20	330	20	16 MV	DS	78	H24	A	100X100X7	350	3	16 VM	SS
14	M15	A	200X200X20	330	20	16 MV	DS	79	H25	A	90X90X6	250	2	16 VM	SS
15	M16	A	200X200X20	330	20	16 MV	DS	80	B1	A	110X110X10	350	9	16 VM	SS
16	M17	A	200X200X20	330	20	16 MV	DS	81	B11	A	120X120X10	350	9	16 VM	SS
17	M18	A	200X200X20	330	20	16 MV	DS	82	B2	A	100X100X10	350	8	16 VM	SS
18	M19	A	200X200X20	330	20	16 MV	DS	83	B22	A	110X110X8	350	8	16 VM	SS
19	M20	A	200X200X20	330	20	16 MV	DS	84	B3	A	100X100X8	350	8	16 VM	SS
20	D1	A	75X75X5	250	3	16 MV	SS	85	B33	A	120X120X10	350	8	16 VM	SS
21	D2	A	65X65X5	250	3	16 MV	SS	86	I1	A	90X90X6	350	5	16 VM	SS
22	D3	A	55X55X5	250	2	16 MV	SS	87	T11	A	75X75X5	350	4	16 VM	SS
23	D31	A	90X90X6	250	3	16 MV	SS	88	I2	A	90X90X6	350	5	16 VM	SS
24	D32	A	75X75X5	250	3	16 MV	SS	89	I22	A	75X75X5	350	4	16 VM	SS
25	D33	A	110X110X10	350	8	16 MV	SS	90	I3	A	90X90X6	350	5	16 VM	SS
26	D4	A	100X100X8	350	6	16 MV	SS	91	I33	A	75X75X5	350	4	16 VM	SS
27	D5	A	110X110X8	350	6	16 MV	SS	92	PK1	A	55X55X4	250	2	16 VM	SS
28	D6	A	90X90X8	350	5	16 MV	SS	93	PK2	A	60X60X5	350	2	16 VM	SS
29	D7	A	130X130X12	350	11	16 MV	SS	94	PB1	A	65X65X5	350	2	16 VM	SS
30	D8	A	100X100X10	350	7	16 MV	SS	95	PB11	A	60X60X5	350	2	16 VM	SS
31	D9	A	120X120X12	350	10	16 MV	SS	96	PB2	A	75X75X5	350	2	16 VM	SS
32	D10	A	100X100X10	350	7	16 MV	SS	97	PB22	A	70X70X5	350	2	16 VM	SS
33	D11	A	110X110X8	350	6	16 MV	SS	98	PB3	A	100X100X7	350	2	16 VM	SS
34	D12	A	110X110X8	350	6	16 MV	SS	99	PB33	A	75X75X5	350	2	16 VM	SS
35	D13	A	100X100X8	250	4	16 MV	SS	100	V1	A	90X90X7	250	4	16 VM	SS
36	D14	A	100X100X8	250	4	16 MV	SS	101	V2	A	90X90X6	250	4	16 VM	SS
37	D21	A	100X100X7	250	4	16 MV	SS	102	V3	A	100X100X7	250	4	16 VM	SS
38	D22	A	100X100X7	250	4	16 MV	SS	103	V4	A	90X90X7	250	4	16 VM	SS
39	D23	A	100X100X8	250	3	16 MV	SS	104	V5	A	90X90X7	250	4	16 VM	SS
40	D24	A	100X100X7	250	3	16 MV	SS	105	V6	A	90X90X6	250	4	16 VM	SS
41	D27	A	110X110X8	250	5	16 MV	SS	106	V7	A	100X100X7	250	4	16 VM	SS
42	D28	A	100X100X8	250	4	16 MV	SS	107	V8	A	90X90X7	250	4	16 VM	SS
43	D25	A	100X100X8	250	4	16 MV	SS	108	L1	A	90X90X6	250	2	16 VM	SS
44	D30	A	100X100X8	250	4	16 MV	SS	109	L2	A	75X75X5	250	2	16 VM	SS
45	D31	A	120X120X12	250	4	16 MV	SS	110	L3	A	65X65X4	250	2	16 VM	SS
46	D32	A	110X110X8	250	4	16 MV	SS	111	L4	A	60X60X4	250	2	16 VM	SS
47	D33	A	120X120X12	250	5	16 MV	SS	112	TX	A2L	65X65X5	350	4	16 VM	DS
48	D34	A	110X110X8	250	5	16 MV	SS	113	MX	A2L	65X65X5	350	4	16 VM	DS
49	D35	A	110X110X8	250	4	16 MV	SS	114	BX	A2L	65X65X5	350	4	16 VM	DS
50	D36	A	100X100X7	250	4	16 MV	SS	115	TX_PNL1	A	90X90X6	350	4	16 VM	SS
51	D37	A	120X120X12	250	4	16 MV	SS	116	TX_PNL2	A	75X75X5	250	3	16 VM	SS
52	D38	A	110X110X8	250	4	16 MV	SS	117	TX_PNL3	A	50X50X4	350	-	16 VM	SS
53	D39	A	100X100X8	250	4	16 MV	SS	118	TX_PNL7	A	45x45X4	250	-	16 VM	SS
54	D40	A	90X90X7	250	4	16 MV	SS	119	TX_PNL8	A	45X45X4	250	-	16 VM	SS
55	H1	A	75X75X6	250	3	16 MV	SS	120	MX_PNL1	A	90X90X6	350	4	16 VM	SS
56	H2	A	75X75X6	250	3	16 MV	SS	121	MX_PNL2	A	80X80X6	350	3	16 VM	SS
57	H3	A	130X130X12	350	7	16 MV	SS	122	MX_PNL11	A	55X55X4	350	-	16 VM	SS
58	H4	A	70X70X5	350	2	16 MV	SS	123	MX_PNL12	A	50X50X4	250	-	16 VM	SS
59	H5	A	90X90X6	350	4	16 MV	SS	124	MX_PNL13	A	45x45X4	250	-	16 VM	SS
60	H6	A	75X75X6	350	2	16 MV	SS	125	BX_PNL1	A	90X90X6	250	4	16 VM	SS
61	H7	A	130X130X12	350	8	16 MV	SS	126	BX_PNL2	A	90X90X6	250	3	16 VM	SS
62	H8	A	75X75X5	350	2	16 MV	SS	127	BX_PNL7	A	60X60X4	350	-	16 VM	SS
63	H9	A	90X90X6	350	4	16 MV	SS	128	BX_PNL2	A	60X60X4	250	-	16 VM	SS
64	H10	A	80X80X6	350	2	16 MV	SS	129	BX_PNL3	A	50X50X4	250	-	16 VM	SS
65	H11	A	130X130X12	350	10	16 MV	SS								



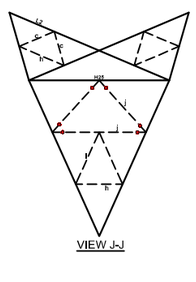
VIEW I-I



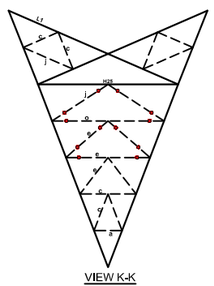
VIEW H-H



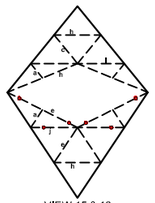
VIEW G-G



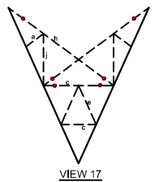
VIEW J-J



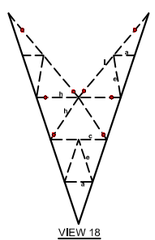
VIEW K-K



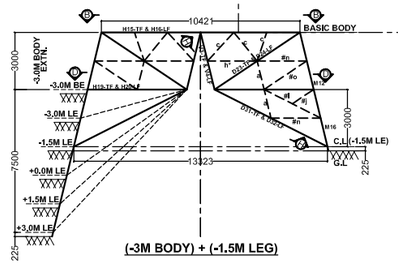
VIEW 15 & 16



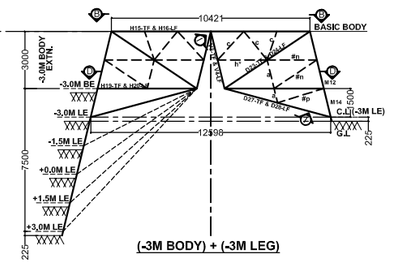
VIEW 17



VIEW 18



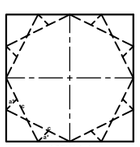
(-3M BODY) + (-1.5M LEG)



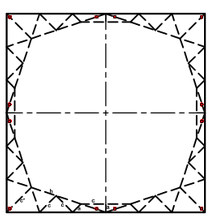
(-3M BODY) + (-3M LEG)

REDUNTANT TABLE

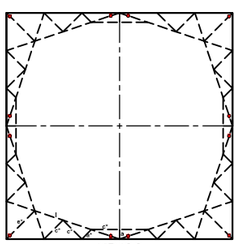
RED MKD	SECTION	MAX LENTH IN mm		MAX LENTH IN mm
		L/r MIN < 250	L/r NED < 250	FOR 150 KG (MIN)
a	45x30x4	1575	2100	624
a*	HT-45x30x4	1575	2100	864
b	45x30x5	1575	2075	763
b*	HT-45x30x5	1575	2075	1056
c	45x45x4	2175	3425	1357
c*	HT-45x45x4	2175	3425	1920
d	45x45x5	2175	3400	1733
e	50x50x4	2425	3825	1733
e*	HT-50x50x4	2425	3825	2400
f	50x50x5	2425	3800	2149
g	50x50x6	2400	3775	N.C.
h	55x55x4	2650	4175	2092
h*	HT-55x55x4	2650	4175	2841
i	55x55x5	2650	4175	2565
j	60x60x4	2975	4625	2538
j*	HT-60x60x4	2975	4625	3696
k	60x60x5	2900	4550	N.C.
l	65x65x4	3150	4975	2884
l*	HT-65x65x4	3150	4975	3993
m	65x65x5	3150	4975	N.C.
n	70x70x5	3400	5375	N.C.
o	75x75x5	3650	5775	N.C.
p	75x75x6	3650	5750	N.C.
q	80x80x6	3900	6150	N.C.
r	90x90x6	4375	6925	N.C.
s	100x100x6	4875	7725	N.C.
t	110x110x8	5450	8500	N.C.



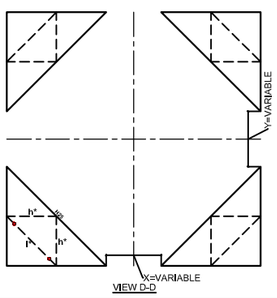
VIEW A-A



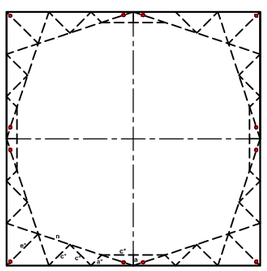
VIEW B-B



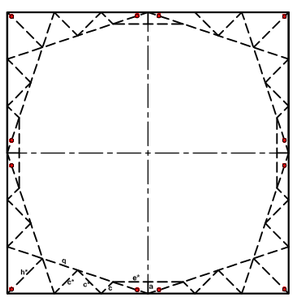
VIEW C-C



VIEW D-D



VIEW E-E



VIEW F-F

NOTES :-
1) ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED
2) MILD STEEL - AS PER IS 2062:2011 OF GRADE E250 & YIELD STRENGTH = 250N/SQ.MM
3) (A) HIGH TENSILE STEEL - AS PER IS 2062:2011 OF GRADE E350 & YIELD STRENGTH = 350N/SQ.MM FOR T <20MM THICK
(B) HIGH TENSILE STEEL - AS PER IS 2062:2011 OF GRADE E350 & YIELD STRENGTH = 330N/SQ.MM FOR T >20MM THICK
4) BOLTS AND NUTS WITH MILD STEEL - AS PER IS 12427 - 2001(GRADE - 5.6) ULTIMATE SHEAR STRESS = 3160KG/SQ.CM
ULTIMATE BEARING STRESS = 5200KG/SQ.CM.
5) THE TOWER DESIGN IS AS PER IS:802 (PART 1 / SEC 2) & IS:802 (PART 1 / SEC 1) - 2015.
6) ELECTRICAL CLEARANCE AND SWING ANGLES ARE AS PER SPECIFICATIONS
7) HT - INDICATE HIGH TENSILE STEEL SECTION.
8) SS & DS - INDICATES SINGLE SHEAR & DOUBLE SHEAR RESPECTIVELY
9) AHD = ARCING HORN DISTANCE.
10) CL = CONCRETE LEVEL, GL = GROUND LEVEL
11) A = SINGLE ANGLE
12) BM = BACK MARK, CLT = CLEAT ANGLE
13) ALL WIDTH DIMENSIONS ARE FROM C.G TO C.G OF ANGLES.
14) "" SAG DIFF. BETWEEN CONDUCTOR & EW @ MINIMUM TEMPERATURE NO WIND CONDITION
15) CONNECTION OF REDUNDANT MEMBERS WITH LEG OF SECTION L130 AND ABOVE SHALL BE DONE WITH TWO BOLTS.
16) # - INDICATES 2 BOLT CONNECTION WITH LEG SECTION
17) * - INDICATES HT SECTION
18) STUB - HT-L200X200X20.
19) TOWER IS DESIGNED FOR A BASIC WIND SPEED OF 33M/S (WZ=1).

● - INDICATES - TWO BOLT CONNECTION

REV	DATE	DESCRIPTION	DRAWN	CHKED	APPD
2	03-08-18	REVISED AS PER CLIENT'S COMMENTS	AM	DL	DL
1	06-04-18	LEG DIFFERENCE REVISED TO 4.5M	AM	DL	DL

OWNER :- STERLITE POWER GRID VENTURES LIMITED

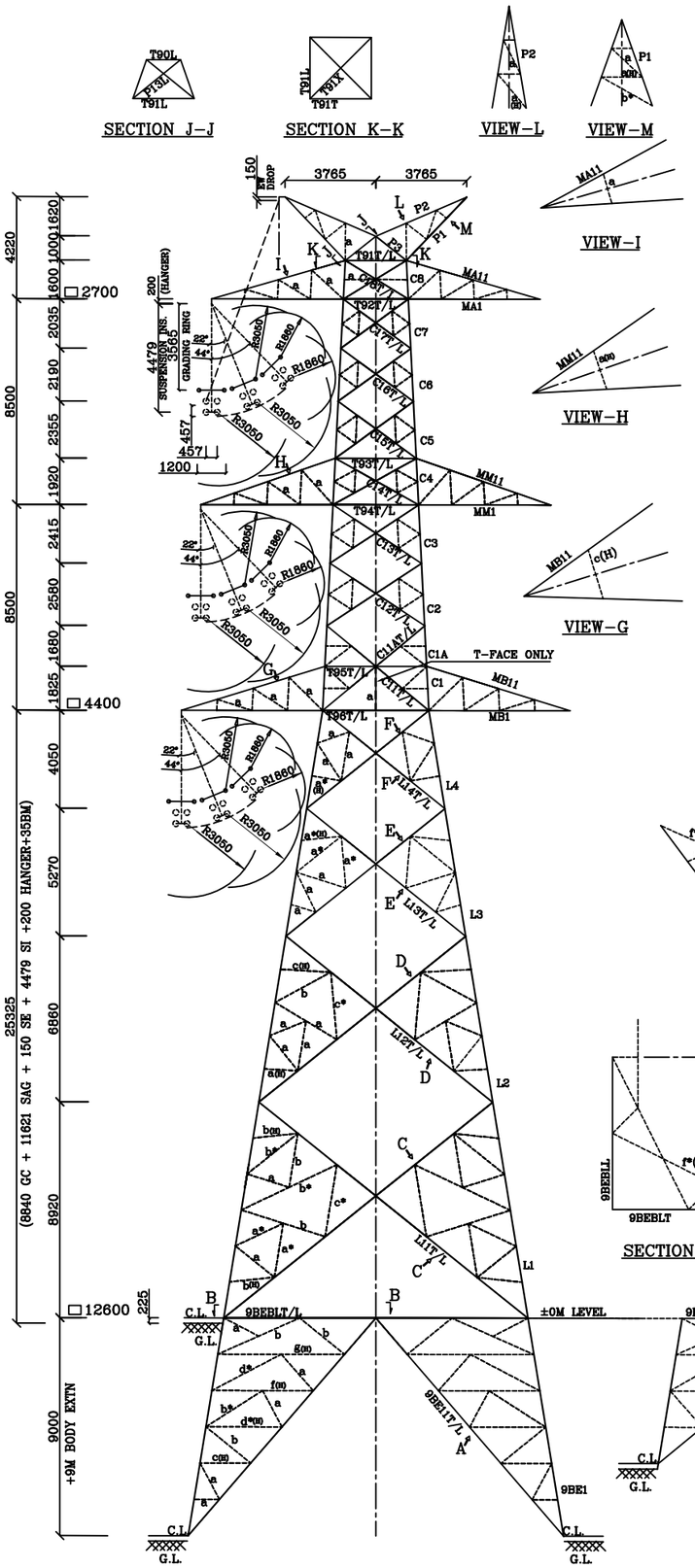
LINE :- Xeldam - Narendra 400kV D/C
Transmission Line with Quad AAAC Moose Conductor

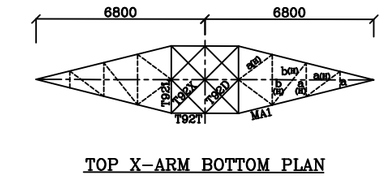
WIND ZONE :- I (33 m/s)

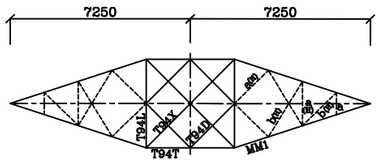
PROJECT :- Xeldam - Narendra 400kV D/C
Transmission Line with Quad AAAC Moose Conductor
For wind Zone-1

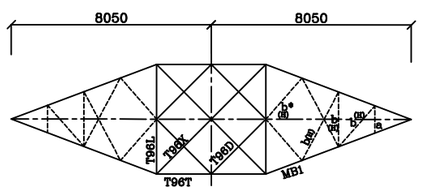
TITLE:- LINE DIAGRAM FOR
" T.T-DD/DE (30° - 60° DEV.)"
(LARGE ANGLE TENSION TOWER)

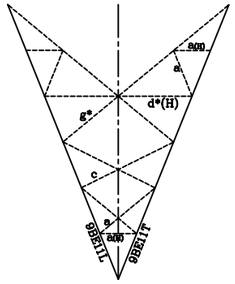
DRAWN BY	AM	06.04.18	SCALE		
DESIGN BY	AM	06.04.18		DESIGN NO.:- DS-1007	SHEET NO.: 1 OF 1
CHECKED BY	DL				
APPD. BY	DL			REVISION 02	

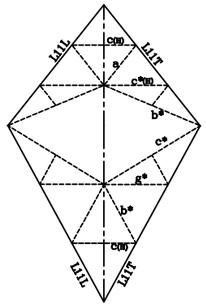


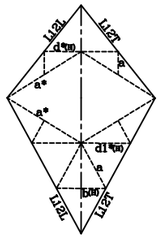


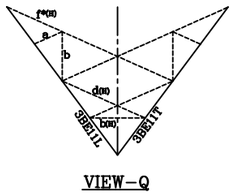


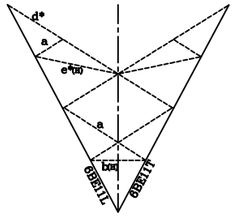


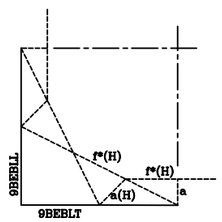


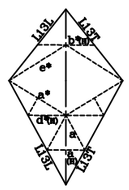


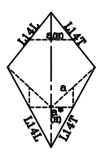




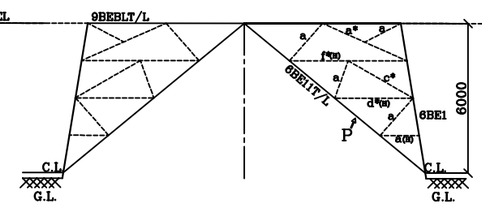


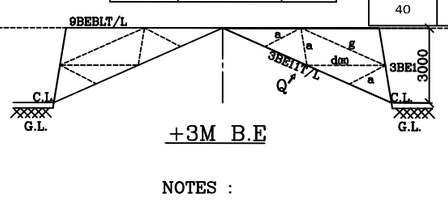






REDUNDANT MEMBERS		
SYMBOL	ANGLE SECTION	BOLTS
UNNOTED	L 45X30X4	16ø–1
a	L 45X45X4	16ø–1
b	L 50X50X4	16ø–1
c	L 55X55X4	16ø–1
d	L 60X60X4	16ø–1
d1	L 60X60X5	16ø–1
e	L 65X65X4	16ø–1
f	L 65X65X5	16ø–1
g	L 70X70X5	16ø–1
h	L 75X75X5	16ø–1
i	L 75X75X6	16ø–1





NOTES :
1. ALL DIMENSIONS ARE IN MM.
2. ELECTRICAL CLEARANCES ARE AS PER SPECIFICATION.
3. DOTTED MEMBERS INDICATE SECONDARY MEMBERS.
4. UNDER COLUMN "SHEAR","DS" INDICATES DOUBLE SHEAR.
5. MATERIALS USED – MILD STEEL – IS–2062:2011 (E250A).
   HIGH TENSILE STEEL – IS–2062:2011 (E350A).
6. BOLTS & NUTS – IS 12427 –16ø–GRADE 5.6/5.
7. (H)– HIGH TENSILE STEEL.

STUB: HL130x130x12

S.No.	Member Code	Section mm x mm x mm	fy N/mm2	Bolt	Qty Nos	Shear	S.No.	Member Code	Section mm x mm x mm	fy N/mm2	Bolt	Qty Nos	Shear
1	P1	L55x55x5	350	M16	3		41	C2	L110x110x10	350	M16	6	DS
2	P2	L55x55x4	350	M16	2		42	C12T	L80x80x6	350	M16	3	
3	T90L	L50x50x4	250	M16	1		43	C12L	L75x75x6	350	M16	3	
4	P3	L55x55x4	350	M16	2		44	C1A	L110x110x10	350	M16	6	DS
5	P13L	L45x45x4	250	M16	1		45	C11AT	L90x90x6	350	M16	3	
6	C8	L75x75x6	350	M16	6		46	C11AL	L80x80x6	350	M16	3	
7	C18T	L60x60x5	250	M16	2		47	C1	L110x110x10	350	M16	6	DS
8	C18L	L60x60x4	250	M16	2		48	C11T	L90x90x6	350	M16	3	
9	T91T	L75x75x5	350	M16	3		49	C11L	L80x80x6	350	M16	3	
10	T91L	L75x75x6	250	M16	2		50	T95T	L75x75x6	350	M16	3	
11	T91X	L60x60x4	350	M16	1		51	T95L	L75x75x5	250	M16	2	
12	MA11	L75x75x6	350	M16	4		52	MB11	L75x75x6	350	M16	4	
13	MA1	L90x90x7	350	M16	5		53	MB1	L90x90x7	350	M16	5	
14	T92T	L90x90x7	350	M16	4		54	T96T	L90x90x7	250	M16	3	
15	T92L	L60x60x4	350	M16	2		55	T96L	L70x70x5	350	M16	3	
16	T92D	L50x50x4	350	M16	1		56	T96D	L60x60x4	350	M16	1	
17	T92X	L60x60x5	350	M16	2		57	T96X	L75x75x5	350	M16	2	
18	C7	L75x75x6	350	M16	6		58	L4	L130x130x10	350	M16	8	DS
19	C17T	L75x75x6	350	M16	3		59	L14T	L75x75x6	250	M16	2	
20	C17L	L75x75x5	350	M16	3		60	L14L	L75x75x6	250	M16	2	
21	C6	L90x90x6	350	M16	6		61	L3	L130x130x10	350	M16	10	DS
22	C16T	L75x75x6	350	M16	3		62	L13T	L75x75x5	250	M16	2	
23	C16L	L75x75x5	350	M16	3		63	L13L	L75x75x5	250	M16	2	
24	C5	L90x90x6	350	M16	6		64	L2	L130x130x12	350	M16	10	DS
25	C15T	L75x75x5	350	M16	3		65	L12T	L75x75x6	250	M16	2	
26	C15L	L75x75x5	350	M16	2		66	L12L	L75x75x6	250	M16	2	
27	C4	L100x100x8	350	M16	6	DS	67	L1	L130x130x12	350	M16	10	DS
28	C14T	L75x75x6	250	M16	3		68	L11T	L75x75x6	250	M16	2	
29	C14L	L80x80x6	250	M16	2		69	L11L	L75x75x5	250	M16	2	
30	T93T	L75x75x5	350	M16	3		70	9BE1	L130x130x12	350	M16	10	DS
31	T93L	L75x75x5	250	M16	2		71	9BE11T	L75x75x6	250	M16	2	
32	MM11	L75x75x5	350	M16	4		72	9BE11L	L75x75x6	250	M16	2	
33	MM1	L90x90x7	350	M16	5		73	9BEBLT	L100x100x6	250	M16	3	
34	T94T	L90x90x7	250	M16	3		74	9BEBLL	L100x100x6	250	M16	3	
35	T94L	L60x60x5	350	M16	2		75	6BE1	L130x130x12	350	M16	10	DS
36	T94D	L55x55x4	350	M16	1		76	6BE11T	L75x75x6	250	M16	2	
37	T94X	L65x65x5	350	M16	2		77	6BE11L	L75x75x6	250	M16	2	
38	C3	L100x100x8	350	M16	6	DS	78	3BE1	L130x130x12	350	M16	10	DS
39	C13T	L90x90x6	350	M16	4		79	3BE11T	L75x75x6	250	M16	2	
40	C13L	L75x75x6	350	M16	3		80	3BE11L	L75x75x6	250	M16	2	

REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED

PROJECT : 400KV D/C TRANSMISSION LINE

CLIENT : SPGVL

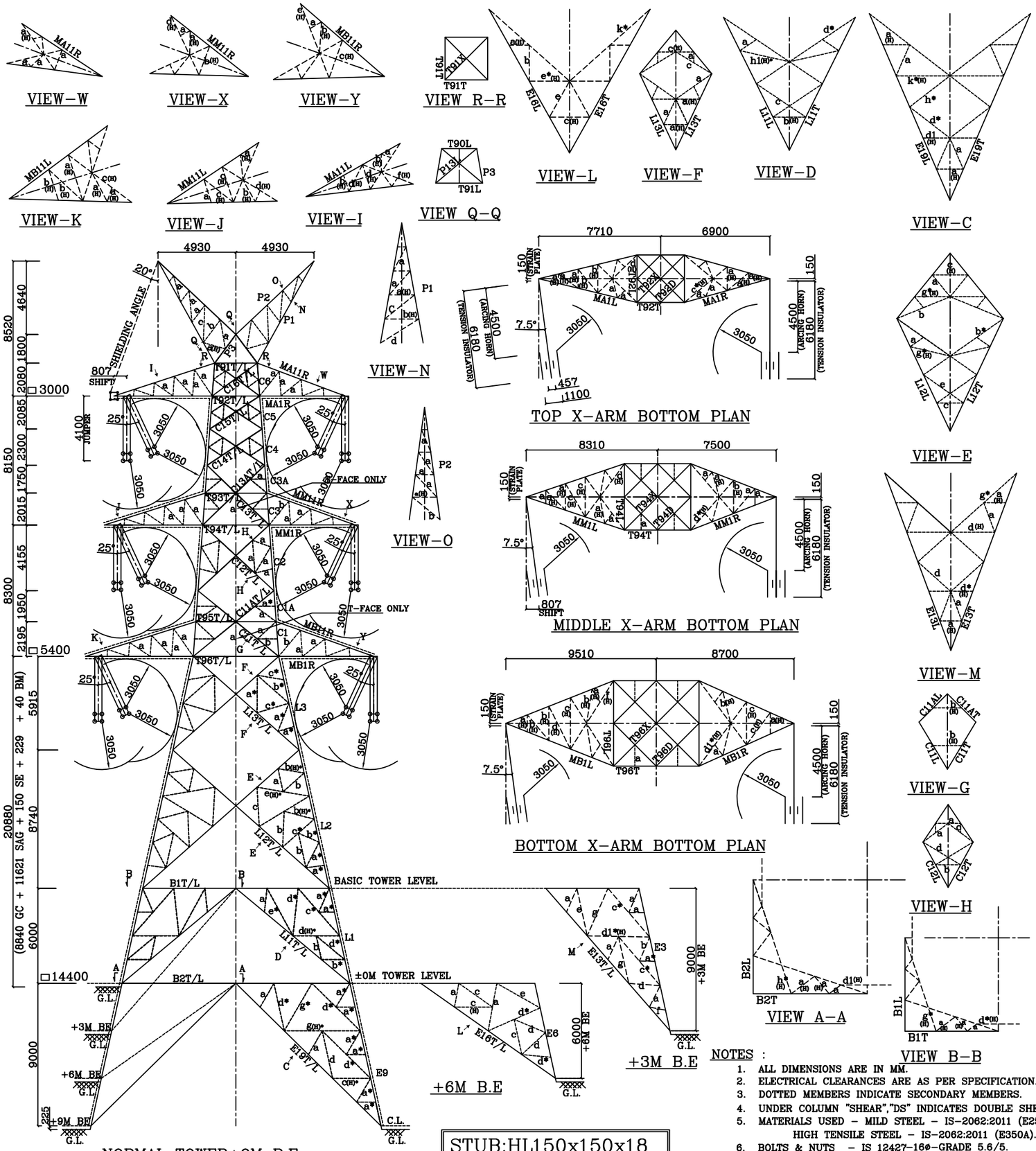
CONTRACTOR : SPGVL

DESIGNER : TRUCON ASSOCIATES, NAGPUR

DRAWN	RAHUL	
CHECKED	MKM	
APPROVED		

LINE DIAGRAM FOR 400KV D/C TANGENT TOWER TYPE – "DA"

DATE : 31/12/16 | DRAWING NO : C243/SGPVL/400KVDC/DA | SHEET. NO. : 1/1 | REV. : 0



NOTES :

1. ALL DIMENSIONS ARE IN MM.
2. ELECTRICAL CLEARANCES ARE AS PER SPECIFICATION.
3. DOTTED MEMBERS INDICATE SECONDARY MEMBERS.
4. UNDER COLUMN "SHEAR","DS" INDICATES DOUBLE SHEAR.
5. MATERIALS USED – MILD STEEL – IS–2062:2011 (E250A).
   HIGH TENSILE STEEL – IS–2062:2011 (E350A).
6. BOLTS & NUTS – IS 12427–16Ø–GRADE 5.6/5.
7. (H)– HIGH TENSILE STEEL.
8. * –INDICATES 2 BOLTS CONNECTION

S.No.	Member Code	Section mm x mm x mm	fy N/mm2	Bolt	Qty Nos	Shear
1	P1	L65x65x5	250	M16	2	DS
2	P2	L60x60x5	250	M16	2	
3	T90L	L60x60x4	250	M16	2	
4	P3	L65x65x5	350	M16	2	
5	P13L	L60x60x4	250	M16	2	
6	C6	L100x100x8	350	M16	3	DS
7	C16T	L75x75x5	250	M16	3	
8	C16L	L60x60x5	250	M16	2	
9	T91T	L90x90x6	350	M16	4	
10	T91L	L75x75x5	250	M16	2	
11	T91X	L60x60x5	350	M16	2	
12	MA11L	L100x100x7	350	M16	6	
13	MA1L	L120x120x10	350	M16	9	
14	MA11R	L90x90x7	350	M16	6	
15	MA1R	L110x110x8	350	M16	9	
16	T92T	L100x100x8	350	M16	6	
17	T92L	L75x75x6	350	M16	3	
18	T92D	L60x60x5	250	M16	2	
19	T92X	L75x75x5	350	M16	3	
20	C5	L100x100x8	350	M16	6	DS
21	C15T	L100x100x8	350	M16	6	
22	C15L	L100x100x7	350	M16	6	
23	C4	L100x100x8	350	M16	6	DS
24	C14T	L100x100x7	350	M16	5	
25	C14L	L100x100x7	350	M16	5	
26	C3A	L110x110x8	350	M16	8	DS
27	C13AT	L110x110x8	350	M16	6	
28	C13AL	L110x110x8	350	M16	6	
29	C3	L110x110x8	350	M16	8	DS
30	C13T	L110x110x8	350	M16	6	
31	C13L	L110x110x8	350	M16	6	
32	T93T	L80x80x6	350	M16	5	
33	T93L	L75x75x6	250	M16	2	
34	MM11L	L100x100x7	350	M16	6	
35	MM1L	L110x110x10	350	M16	8	
36	MM11R	L90x90x7	350	M16	6	
10	MM1R	L100x100x8	350	M16	8	
38	T94T	L110x110x8	350	M16	5	
39	T94L	L75x75x6	250	M16	2	
40	T94D	L65x65x5	250	M16	2	
41	T94X	L80x80x6	250	M16	2	

S.No.	Member Code	Section mm x mm x mm	fy N/mm 2	Bolt	Qty Nos	Shear
42	C2	L130x130x10	350	M16	10	DS
43	C12T	L120x120x10	350	M16	8	
44	C12L	L120x120x10	350	M16	8	
45	C1A	L150x150x12	350	M16	12	DS
46	C11AT	L120x120x8	350	M16	7	
47	C11AL	L120x120x8	350	M16	7	
48	C1	L150x150x12	350	M16	12	DS
49	C11T	L110x110x8	350	M16	7	
50	C11L	L120x120x8	350	M16	7	
51	T95T	L90x90x7	250	M16	5	
52	T95L	L90x90x6	250	M16	2	
53	MB11L	L100x100x7	350	M16	6	
54	MB1L	L110x110x8	350	M16	7	
55	MB11R	L90x90x7	350	M16	6	
56	MB1R	L100x100x8	350	M16	7	
57	T96T	L120x120x8	350	M16	7	
58	T96L	L110x110x8	250	M16	4	
59	T96D	L75x75x5	250	M16	2	
60	T96X	L90x90x6	250	M16	2	
61	L3	L150x150x16	350	M16	16	DS
62	L13T	L110x110x8	350	M16	6	
63	L13L	L120x120x8	350	M16	6	
64	L2	L150x150x18	350	M16	16	DS
65	L12T	L100x100x7	250	M16	4	
66	L12L	L110x110x8	250	M16	5	
67	L1	L150x150x18	350	M16	16	DS
68	L11T	L100x100x7	250	M16	4	
69	L11L	L100x100x7	250	M16	4	
70	B1T	L100x100x8	250	M16	5	
71	B1L	L100x100x8	250	M16	5	
72	E9	L150x150x18	350	M16	16	DS
73	E19T	L100x100x7	250	M16	4	
74	E19L	L100x100x7	250	M16	4	
75	B2T	L110x110x8	250	M16	5	
76	B2L	L110x110x8	250	M16	5	
79	E6	L150x150x18	350	M16	16	DS
77	E16T	L100x100x7	250	M16	4	
78	E16L	L100x100x7	250	M16	4	
79	E3	L150x150x18	350	M16	16	DS
80	E13T	L100x100x7	250	M16	4	
81	E13L	L100x100x7	250	M16	4	

REDUNDANT MEMBERS		
SYMBOL	ANGLE SECTION	BOLTS
UN–NOTED	L 45X30X4	16Ø–1
a	L 45X45X4	16Ø–1
b	L 50X50X4	16Ø–1
c	L 55X55X4	16Ø–1
d	L 60X60X4	16Ø–1
d1	L 60X60X5	16Ø–1
e	L 65X65X4	16Ø–1
f	L 65X65X5	16Ø–1
g	L 70X70X5	16Ø–1
h	L 75X75X5	16Ø–1
h1	L 75X75X6	16Ø–1
k	L 80X80X6	16Ø–1
m	L 90X90X6	16Ø–1
n	L 100X100X7	16Ø–1

REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
01	1/3/2017	Revised	RAHUL	MKM	

PROJECT : 400KV DC TRANSMISSION LINE

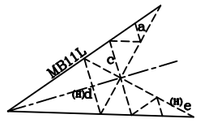
CLIENT : SPGVL

CONTRACTOR : SPGVL

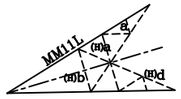
DESIGNER : TRUCON ASSOCIATES, NAGPUR

DRAWN	RAHUL		LINE DIAGRAM FOR 400KV D/C ANGLE TOWER TYPE "DB"
CHECKED	MKM		
APPROVED			

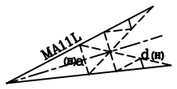
DATE : 11/02/17 | DRAWING NO : C243/SGPVL/400KVDC/DB | SHEET. NO. : 1/1 | REV. :01



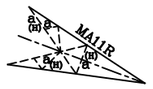
VIEW–K



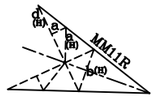
VIEW–J



VIEW–I



VIEW–W



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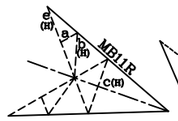
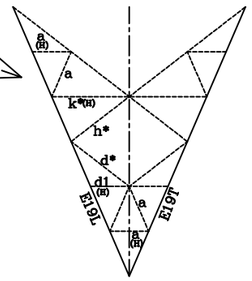
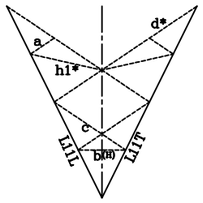


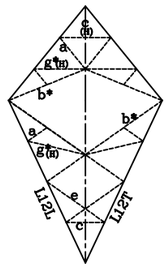
VIEW–Y



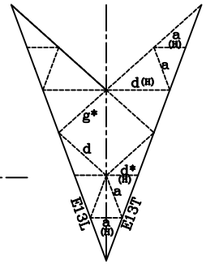
VIEW–C



VIEW–D



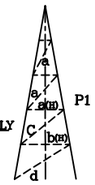
VIEW–E



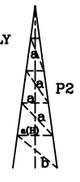
VIEW–M

VIEW R–R

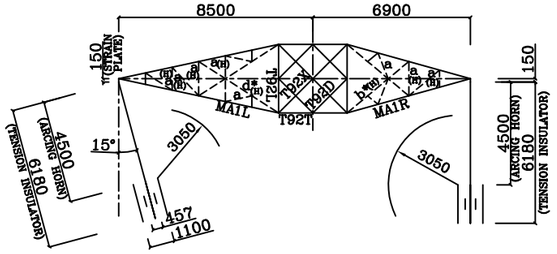
VIEW Q–Q



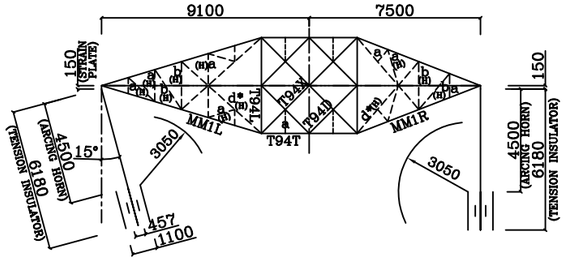
VIEW–N



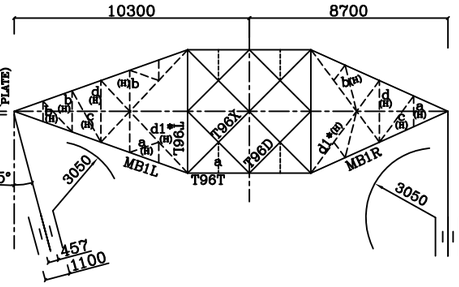
VIEW–O



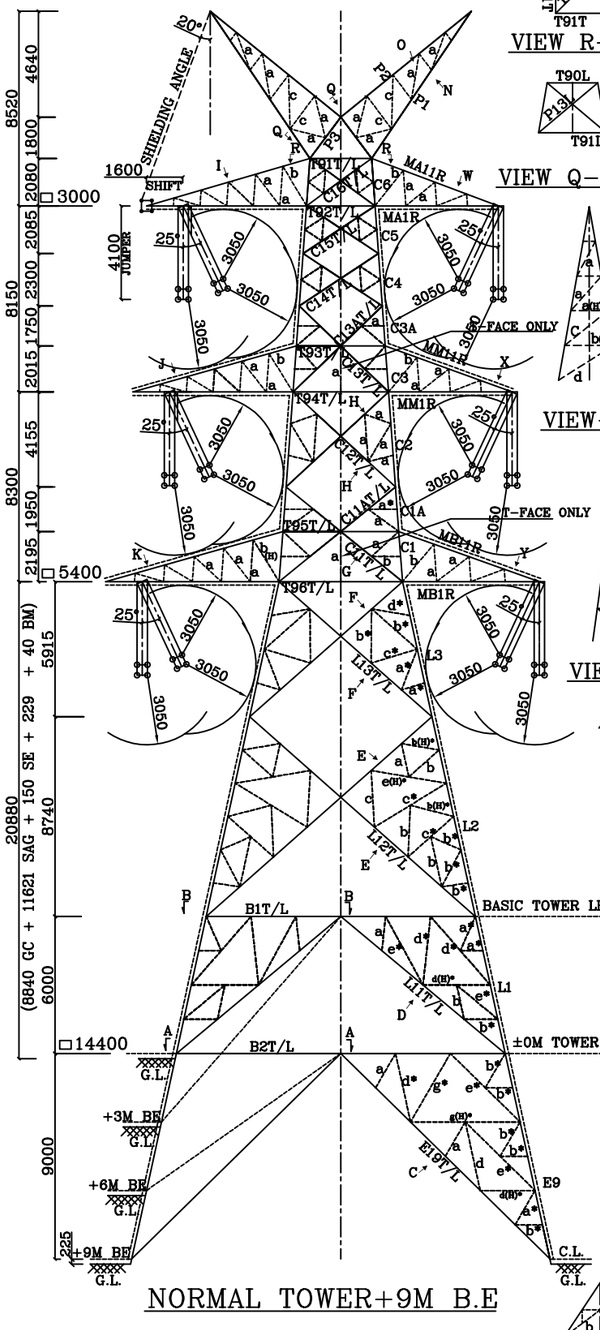
TOP X–ARM BOTTOM PLAN



MIDDLE X–ARM BOTTOM PLAN



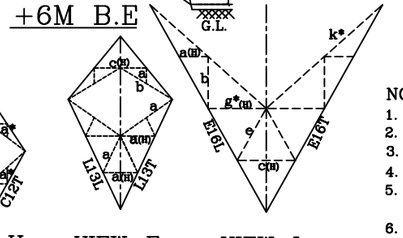
BOTTOM X–ARM BOTTOM PLAN



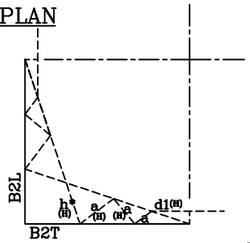
NORMAL TOWER+9M B.E

+3M B.E

+6M B.E

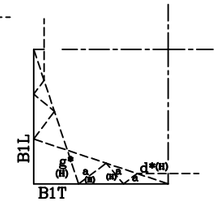


VIEW–H VIEW–F VIEW–L



VIEW A–A

VIEW–G



VIEW B–B

NOTES :
1. ALL DIMENSIONS ARE IN MM.
2. ELECTRICAL CLEARANCES ARE AS PER SPECIFICATION.
3. DOTTED MEMBERS INDICATE SECONDARY MEMBERS.
4. UNDER COLUMN "SHEAR","DS" INDICATES DOUBLE SHEAR.
5. MATERIALS USED – MILD STEEL – IS–2062:2011 (E250A).
   HIGH TENSILE STEEL – IS–2062:2011 (E350A).
6. BOLTS & NUTS – IS 12427 BOLTS & NUTS–16ø–GRADE 5.6/5.
7. (H)– HIGH TENSILE STEEL.
8. *–indicates 2 bolts connection

STUB:HL200x200x16

S.No.	Member Code	Section mm x mm x mm	fy N/mm2	Bolt	Qty Nos	Shear
1	P1	L70x70x5	250	M16	2	DS
2	P2	L60x60x5	250	M16	2	
3	T90L	L60x60x4	250	M16	2	
4	P3	L70x70x5	350	M16	2	
5	P13L	L60x60x5	250	M16	2	
6	C6	L90x90x6	350	M16	4	DS
7	C16T	L80x80x6	250	M16	3	
8	C16L	L65x65x5	250	M16	2	
9	T91T	L90x90x6	350	M16	4	
10	T91L	L70x70x5	250	M16	2	
11	T91X	L60x60x5	250	M16	2	
12	MA11L	L100x100x8	350	M16	7	
13	MA1L	L120x120x10	350	M16	10	
14	MA11R	L90x90x7	350	M16	7	
15	MA1R	L110x110x8	350	M16	8	
16	T92T	L110x110x8	350	M16	5	
17	T92L	L75x75x6	350	M16	3	
18	T92D	L65x65x5	250	M16	2	
19	T92X	L80x80x6	350	M16	2	
20	C5	L110x110x8	350	M16	6	DS
21	C15T	L110x110x8	350	M16	7	
22	C15L	L100x100x8	350	M16	6	
23	C4	L110x110x8	350	M16	6	DS
24	C14T	L100x100x8	350	M16	7	
25	C14L	L100x100x8	350	M16	6	
26	C3A	L110x110x10	350	M16	6	DS
27	C13AT	L120x120x8	350	M16	6	
28	C13AL	L110x110x8	350	M16	6	
29	C3	L110x110x10	350	M16	6	DS
30	C13T	L120x120x8	350	M16	6	
31	C13L	L110x110x8	350	M16	6	
32	T93T	L90x90x6	350	M16	6	
33	T93L	L75x75x6	250	M16	2	
34	MM11L	L100x100x7	350	M16	7	
35	MM1L	L110x110x10	350	M16	9	
36	MM11R	L90x90x7	350	M16	7	
37	MM1R	L100x100x8	350	M16	8	
38	T94T	L100x100x8	350	M16	6	
39	T94L	L75x75x6	250	M16	2	
40	T94D	L65x65x5	250	M16	2	
41	T94X	L90x90x6	250	M16	2	
42	C2	L150x150x12	350	M16	10	DS

S.No.	Member Code	Section mm x mm x mm	fy N/mm2	Bolt	Qty Nos	Shear
43	C12T	L130x130x10	350	M16	10	
44	C12L	L120x120x10	350	M16	9	
45	C1A	L150x150x15	350	M16	14	DS
46	C11AT	L110x110x10	350	M16	8	
47	C11AL	L110x110x10	350	M16	8	
48	C1	L150x150x15	350	M16	14	DS
49	C11T	L110x110x10	350	M16	8	
50	C11L	L110x110x10	350	M16	8	
51	T95T	L100x100x7	350	M16	5	
52	T95L	L90x90x6	250	M16	2	
53	MB11L	L100x100x7	350	M16	7	
54	MB1L	L110x110x10	350	M16	9	
55	MB11R	L90x90x7	350	M16	7	
56	MB1R	L100x100x8	350	M16	8	
57	T96T	L120x120x10	250	M16	8	
58	T96L	L120x120x8	350	M16	4	
59	T96D	L75x75x5	250	M16	2	
60	T96X	L90x90x7	250	M16	2	
61	L3	L200x200x16	350	M16	18	DS
62	L13T	L120x120x8	350	M16	7	
63	L13L	L110x110x10	350	M16	7	
64	L2	L200x200x16	350	M16	18	DS
65	L12T	L100x100x8	250	M16	5	
66	L12L	L110x110x8	250	M16	5	
67	L1	L200x200x16	350	M16	18	DS
68	L11T	L100x100x8	250	M16	4	
69	L11L	L100x100x8	250	M16	4	
70	B1T	L100x100x8	250	M16	5	
71	B1L	L100x100x8	250	M16	5	
72	E9	L200x200x16	350	M16	18	DS
73	E19T	L100x100x8	250	M16	4	
74	E19L	L100x100x8	250	M16	4	
75	B2T	L110x110x8	250	M16	5	
76	B2L	L110x110x8	250	M16	5	
77	E6	L200x200x16	350	M16	18	DS
78	E16T	L100x100x8	350	M16	4	
79	E16L	L100x100x8	350	M16	4	
80	E3	L200x200x16	350	M16	18	DS
81	E13T	L100x100x8	350	M16	4	
82	E13L	L100x100x8	350	M16	4	

REDUNDANT MEMBERS		
SYMBOL	ANGLE SECTION	BOLTS
UN–NOTED	L 45X30X4	16ø–1
a	L 45X45X4	16ø–1
b	L 50X50X4	16ø–1
c	L 55X55X4	16ø–1
d	L 60X60X4	16ø–1
d1	L 60X60X5	16ø–1
e	L 65X65X4	16ø–1
f	L 65X65X5	16ø–1
g	L 70X70X5	16ø–1
h	L 75X75X5	16ø–1
h1	L 75X75X6	16ø–1
k	L 80X80X6	16ø–1
m	L 90X90X6	16ø–1
n	L 100X100X7	16ø–1

REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
01	28/02/2017	Revised	RAHUL	MKM	

PROJECT : 400KV DC TRANSMISSION LINE

CLIENT : SPGVL

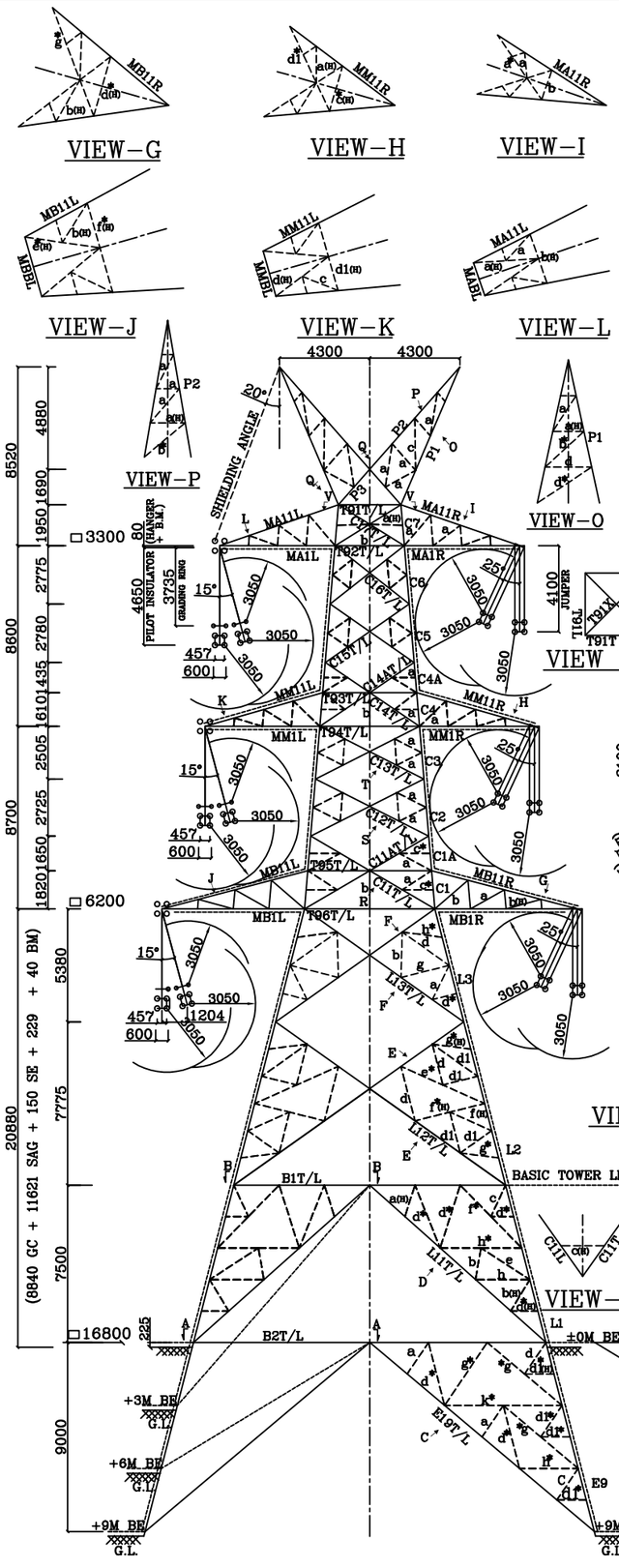
CONTRACTOR : SPGVL

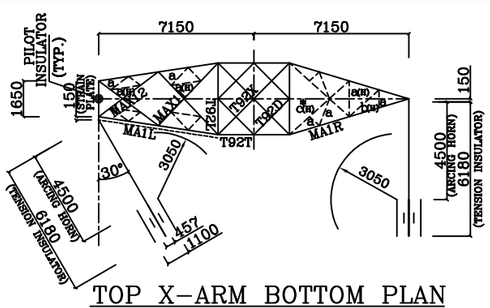
DESIGNER : TRUCON ASSOCIATES, NAGPUR

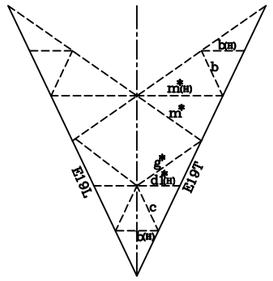
DRAWN	RAHUL	
CHECKED	MKM	
APPROVED		

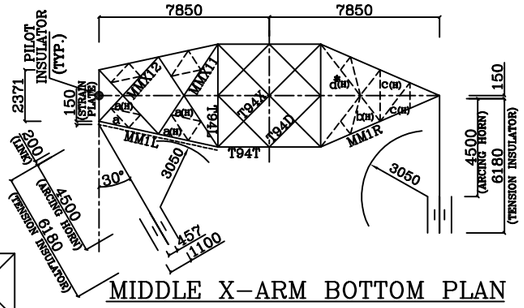
LINE DIAGRAM FOR 400KV DC MEDIUM ANGLE TOWER TYPE "DC"

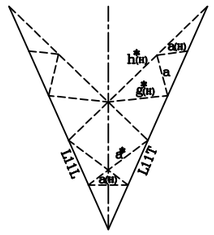
DATE : 08/02/17 | DRAWING NO : C243/SGPVL/400KVDC/DC | SHEET. NO. : 1/1 | REV. :00

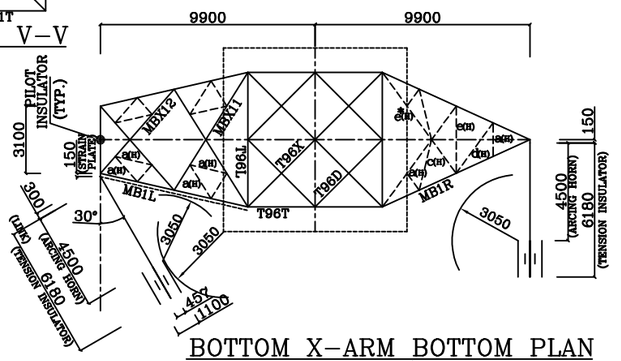


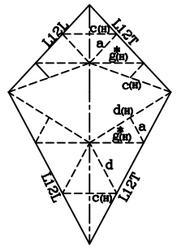


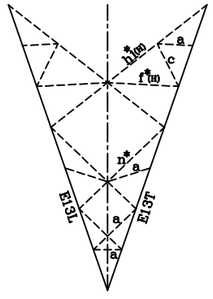


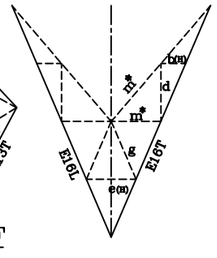












NOTES :

1. ALL DIMENSIONS ARE IN MM.
2. ELECTRICAL CLEARANCES ARE AS PER SPECIFICATION.
3. DOTTED MEMBERS INDICATE SECONDARY MEMBERS.
4. UNDER COLUMN "SHEAR","DS" INDICATES DOUBLE SHEAR.
5. MATERIALS USED – MILD STEEL – IS–2062:2011 (E250A).
   HIGH TENSILE STEEL – IS–2062:2011 (E350A).
6. BOLTS & NUTS – IS 12427 –16ø–GRADE 5.6/5.
7. (H)– HIGH TENSILE STEEL.
8. *–indicates 2 bolts connection

S.No.	Member Code	Section mm x mm x mm	fy N/mm2	Bolt	Qty Nos	Shear
48	C3	L150x150x12	350	M16	12	DS
49	C13T	L130x130x12	350	M16	9	
50	C13L	L120x120x10	250	M16	8	
51	C2	L200x200x15	350	M16	16	DS
52	C12T	L130x130x10	350	M16	9	
53	C12L	L120x120x10	250	M16	7	
54	C1A	L200x200x15	350	M16	16	DS
55	C11AT	L130x130x10	350	M16	8	
56	C11AL	L120x120x10	350	M16	7	
57	C1	L200x200x15	350	M16	16	DS
58	C11T	L130x130x10	350	M16	8	
59	C11L	L120x120x10	350	M16	7	
60	T95T	L90x90x6	350	M16	4	
61	T95L	L100x100x7	250	M16	3	
62	MB11R	L90x90x7	350	M16	6	
63	MB1R	L110x110x08	350	M16	6	
64	MB11L	L90x90x7	350	M16	6	
65	MB1L	L120x120x10	350	M16	8	
66	MBBL	BL65x65x5	350	M16	4	
67	MBX11	L100x100x7	250	M16	3	
68	MBX12	L100x100x8	250	M16	3	
69	T96T	L150x150x12	250	M16	9	
70	T96L	L130x130x12	250	M16	6	
71	T96D	L65x65x5	350	M16	1	
72	T96X	L100x100x8	250	M16	2	
73	L3	L200x200x22	330	M24	10	DS
74	L13T	L120x120x10	250	M16	8	
75	L13L	L110x110x10	250	M16	7	
76	L2	L200x200x22	330	M24	10	DS
77	L12T	L120x120x8	350	M16	5	
78	L12L	L120x120x8	250	M16	5	
79	L1	L200x200x24	330	M24	10	DS
80	L11T	L110x110x8	250	M16	5	
81	L11L	L100x100x8	250	M16	5	
82	B1T	L110x110x8	350	M16	5	
83	B1L	L110x110x8	350	M16	5	
84	E9	L200x200x24	330	M24	10	DS
85	E19T	L110x110x8	250	M16	5	
86	E19L	L110x110x8	250	M16	5	
87	B2T	L110x110x10	350	M16	5	
88	B2L	L110x110x10	350	M16	5	
89	E6	L200x200x24	330	M24	10	DS
90	E16T	L110x110x8	250	M16	5	
91	E16L	L110x110x8	250	M16	5	
92	E3	L200x200x24	330	M24	10	DS
93	E13T	L110x110x8	250	M16	5	
94	E13L	L110x110x8	250	M16	5	

S.No.	Member Code	Section mm x mm x mm	fy N/mm2	Bolt	Qty Nos	Shear
1	P1	L75x75x5	350	M16	2	DS
2	P2	L70x70x5	350	M16	2	
3	T90L	L50x50x4	350	M16	1	
4	P3	L55x55x5	350	M16	2	
5	P13L	L55x55x5	250	M16	1	
6	C7	L120x120x10	350	M16	6	DS
7	C17T	L80x80x6	250	M16	3	
8	C17L	L75x75x5	250	M16	2	
9	T91T	L65x65x4	350	M16	3	
10	T91L	L70x70x5	250	M16	2	
11	T91X	L65x65x4	350	M16	2	
12	MA11R	L80x80x6	350	M16	4	
13	MA1R	L110x110x10	350	M16	8	
14	MA11L	L80x80x6	350	M16	4	
15	MA1L	L130x130x10	350	M16	10	
16	MABL	BL65x65x5	350	M16	5	
17	MAX11	L90x90x7	250	M16	3	
18	MAX12	L100x100x8	250	M16	4	
19	T92T	L110x110x10	350	M16	7	
20	T92L	L75x75x6	250	M16	3	
21	T92D	L55x55x4	350	M16	1	
22	T92X	L75x75x6	250	M16	2	
23	C6	L120x120x10	350	M16	6	DS
24	C16T	L120x120x8	350	M16	8	
25	C16L	L100x100x7	350	M16	5	
26	C5	L120x120x10	350	M16	6	DS
27	C15T	L110x110x8	350	M16	6	
28	C15L	L100x100x7	350	M16	5	
29	C4A	L150x150x12	350	M16	12	DS
30	C14AT	L100x100x8	350	M16	5	
31	C14AL	L100x100x7	250	M16	4	
32	C4	L150x150x12	350	M16	12	DS
33	C14T	L100x100x8	350	M16	5	
34	C14L	L100x100x7	250	M16	4	
35	T93T	L80x80x6	350	M16	4	
36	T93L	L90x90x6	250	M16	3	
37	MM11R	L90x90x7	350	M16	5	
38	MM1R	L110x110x08	350	M16	7	
39	MM11L	L90x90x7	350	M16	5	
40	MM1L	L120x120x10	350	M16	9	
41	MMBL	BL65x65x5	350	M16	4	
42	MMX11	L100x100x7	250	M16	3	
43	MMX12	L100x100x7	250	M16	4	
44	T94T	L110x110x08	250	M16	5	
45	T94L	L80x80x6	250	M16	3	
46	T94D	L65x65x4	350	M16	2	
47	T94X	L90x90x6	250	M16	2	

REDUNDANT MEMBERS		
SYMBOL	ANGLE SECTION	BOLTS
UN–NOTED	L 45X30X4	16ø–1
a	L 45X45X4	16ø–1
b	L 50X50X4	16ø–1
c	L 55X55X4	16ø–1
d	L 60X60X4	16ø–1
d1	L 60X60X5	16ø–1
e	L 65X65X4	16ø–1
f	L 65X65X5	16ø–1
g	L 70X70X5	16ø–1
h	L 75X75X5	16ø–1
h1	L 75X75X6	16ø–1
k	L 80X80X6	16ø–1
m	L 90X90X6	16ø–1
n	L 100X100X6	16ø–1

REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
02	27/12/2016	AS PER COMMENTS	RAHUL		
01	20/12/2016	AS PER COMMENTS	RAHUL		

PROJECT : 400KV D/C TRANSMISSION LINE

CLIENT : SPGVL

CONTRACTOR : SPGVL

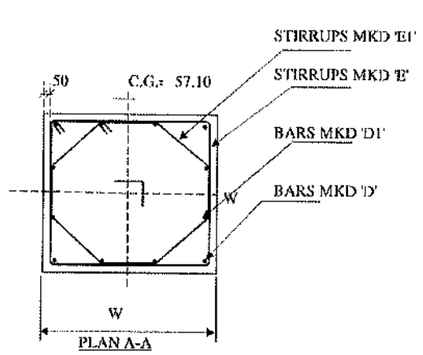
DESIGNER : TRUCON ASSOCIATES, NAGPUR

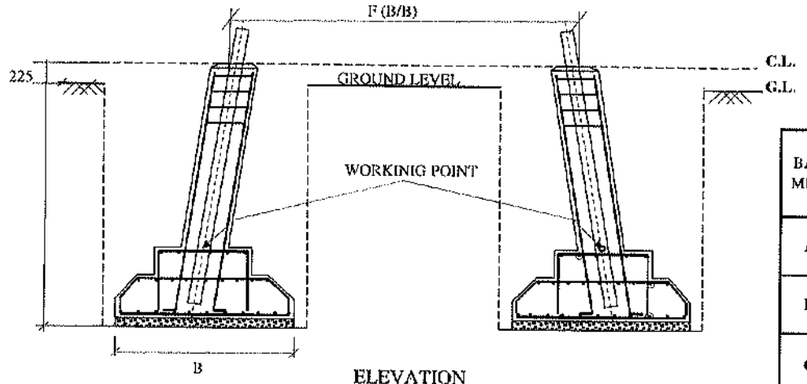
DRAWN	RAHUL	
CHECKED	MKM	
APPROVED		

LINE DIAGRAM FOR 400KV D/C ANGLE /DEAD END TOWER TYPE –"DD"

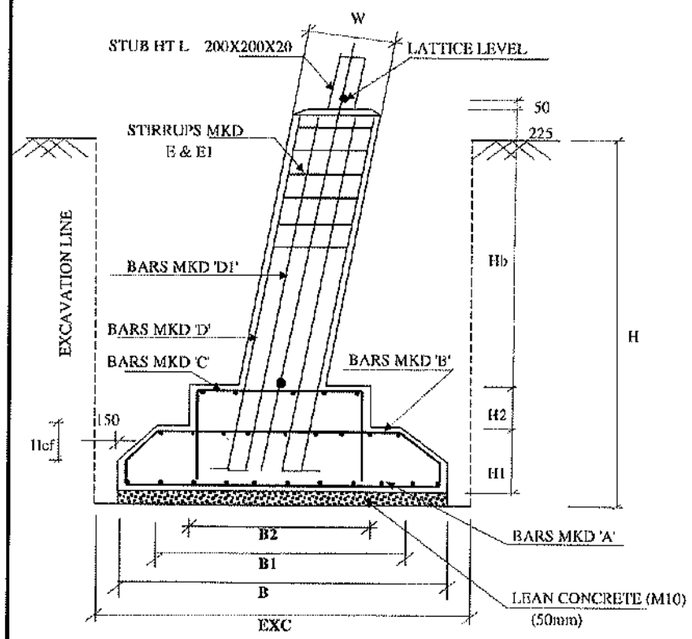
DATE : 22/11/16 | DRAWING NO : C243/SGPVL/400KVDC/DA | SHEET. NO. : 1/1 | REV. :02

APPENDIX B FOUNDATION DESIGN DETAILS



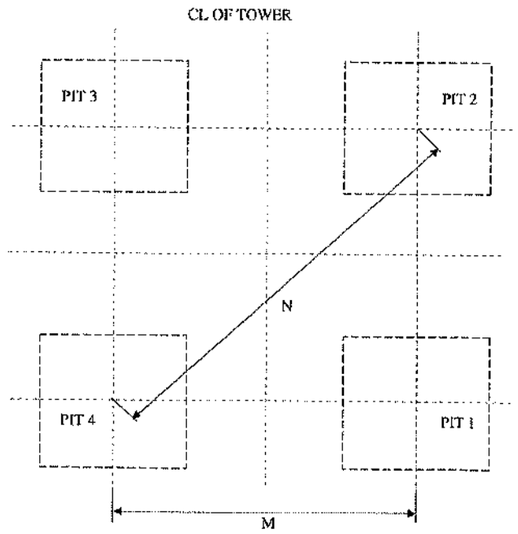


ELEVATION



FOUNDATION ELEVATION (CROSS SECTION)

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409



PIT MARKING PLAN

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	FULLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	15
WATER TABLE (m) :	0m BELOW G.L.
FOUNDATION DEPTH (m):	3.5

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
7530	7230	3500	700	6630	2000	400	300	300	2750

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	7130	PAD REINFORCEMENT	20	72	7130	2.46	1265.44	5061.76
B	6530: 50, 354, 354, 50	PAD REINFORCEMENT	16	76	7337	1.58	879.72	3518.86
C	1900: 560, 50, 50, 560	PAD REINFORCEMENT	16	20	3120	1.58	98.47	393.87
D	3503	CHIMNEY BAR	32	4	4003	6.31	101.04	404.17
D1	500	CHIMNEY BAR	28	8	4003	4.83	154.71	618.88
E	600, 600	CHIMNEY SQUARE SPACER	8	13	2592	0.39	13.29	53.18
E1	200, 283	CHIMNEY SQUARE SPACER	8	13	2123	0.39	10.89	43.57
						TOTAL REINFORCEMENT/ TOWER=		10094.3

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	89.21
CONCRETE (M10) m^3	10.45
TOTAL CONCRETE m^3	99.66
EXCAVATION m3	793.81
REINFORCEMENT Kg	10094.3

Approved for Railway purpose

Sterlite Power Grid Ventures * New Delhi *

REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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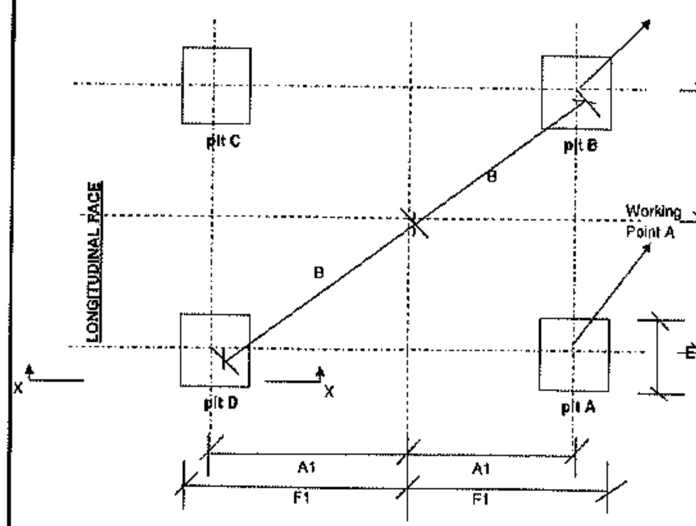
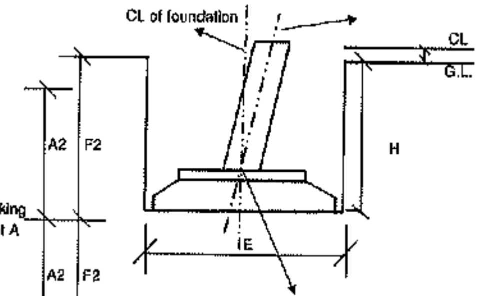
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD				
CLIENT	STERLITE POWER GRID VENTURES LIMITED				
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED				
DRWN	RT	21-09-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) FULLY SUBMERGED SOIL (3.5M DEPTH)		
CHKD	AM	21-09-18			
APPD	DL	21-09-18			
DATE	21-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-004A	SHEET NO.	1/2 REV 0

Project GOA	400 KV D/C -X-M & X-N (WZ-1) - TT "DD" SOIL TYPE - FS (3.5M DEPTH) PIT DIMENSION TABLE	Client: SPGVL

400 KV D/C-X-M & X-N- TT "DD"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12713		12713		200X200X20		50	67.1	1.028857	0.483931204	1.028857	0.4839312
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	7230	2750	225	7031	7031	9944	7530	10796	10796	3500
-3MBE (+) -1.5M LE	1500	13349	13349	7230	2750	225	7394	7394	10457	7530	11159	11159	3500
-3MBE (+) +0M LE	3000	14074	14074	7230	2750	225	7757	7757	10970	7530	11522	11522	3500
-3MBE (+) +1.5M LE	4500	14800	14800	7230	2750	225	8120	8120	11483	7530	11885	11885	3500
-3MBE (+) +3M LE	6000	15526	15526	7230	2750	226	8483	8483	11997	7530	12248	12248	3500
+0MBE (+) -3M LE	3000	14074	14074	7230	2750	225	7757	7757	10970	7530	11522	11522	3500
+0MBE (+) -1.5M LE	4500	14800	14800	7230	2750	225	8120	8120	11483	7530	11885	11885	3500
+0MBE (+) +0M LE	6000	15526	15526	7230	2750	225	8483	8483	11997	7530	12248	12248	3500
+0MBE (+) +1.5M LE	7500	16252	16252	7230	2750	225	8846	8846	12510	7530	12611	12611	3500
+0MBE (+) +3M LE	9000	16978	16978	7230	2750	225	9209	9209	13023	7530	12974	12974	3500
+3MBE (+) -3M LE	6000	15526	15526	7230	2750	225	8483	8483	11997	7530	12248	12248	3500
+3MBE (+) -1.5M LE	7500	16252	16252	7230	2750	225	8846	8846	12510	7530	12611	12611	3500
+3MBE (+) +0M LE	9000	16978	16978	7230	2750	225	9209	9209	13023	7530	12974	12974	3500
+3MBE (+) +1.5M LE	10500	17704	17704	7230	2750	225	9572	9572	13537	7530	13337	13337	3500
+3MBE (+) +3M LE	12000	18430	18430	7230	2750	225	9935	9935	14050	7530	13700	13700	3500
+6MBE (+) -3M LE	9000	16978	16978	7230	2750	225	9209	9209	13023	7530	12974	12974	3500
+6MBE (+) -1.5M LE	10500	17704	17704	7230	2750	225	9572	9572	13537	7530	13337	13337	3500
+6MBE (+) +0M LE	12000	18430	18430	7230	2750	225	9935	9935	14050	7530	13700	13700	3500
+6MBE (+) +1.5M LE	13500	19156	19156	7230	2750	225	10298	10298	14563	7530	14063	14063	3500
+6MBE (+) +3M LE	15000	19882	19882	7230	2750	225	10661	10661	15076	7530	14426	14426	3500





SEC X-X Working Point A

Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	0.0M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857804
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300 mm

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

Sterlite Power Grid Ventures Ltd * New Delhi *

Approved for Railway Crossing proposal

REV NO	DATE	DESCRIPTION		DRAWN	CHKD	APPD
PROJECT		400KV D/C XELDAM-NARENDRA TRANSMISSION LTD				
CLIENT		STERLITE POWER GRID VENTURES LIMITED				
DESIGNER:		STERLITE POWER GRID VENTURES LIMITED				
DRWN	RT	21-09-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) FULLY SUBMERGED SOIL (3.5M DEPTH)			
CHKD	AM	21-09-18				
APPD	DL	21-09-18				
DATE	21-09-18	DRAWING NO.	GTTPL/400DCWZ-1/DD/F-004A	SHEET NO. 2/2	REV	0

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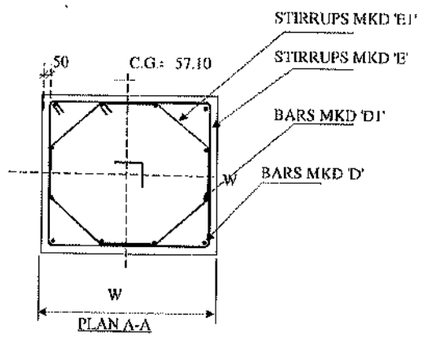
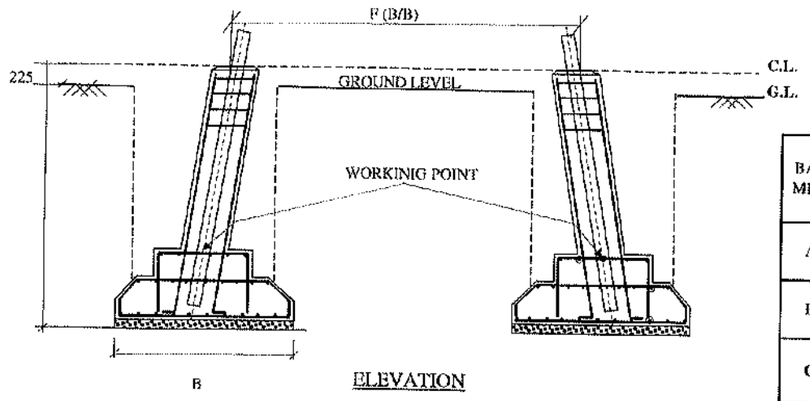
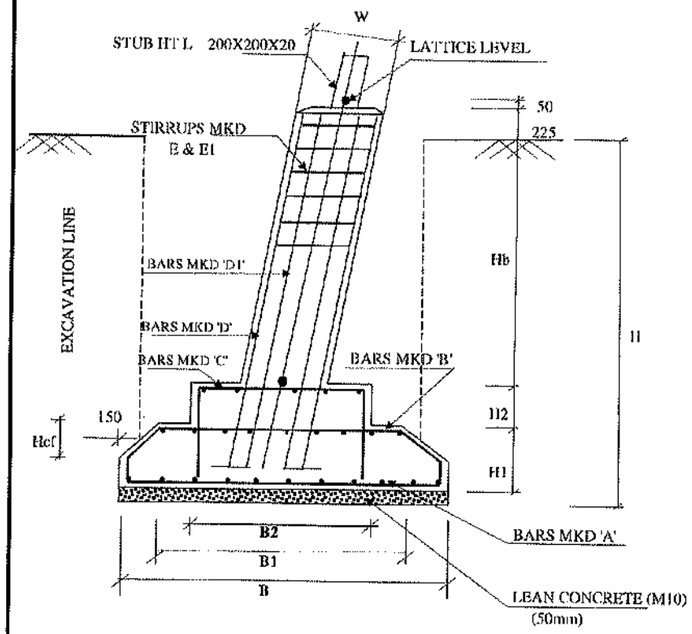




B	H	W	B1	B2	H1	H2	Hcf	Hb
4860	3500	700	4260	2000	400	300	300	2750

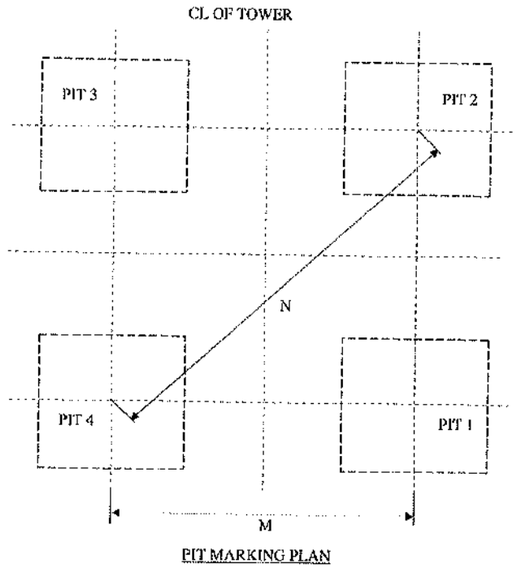
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	4760	PAD REINFORCEMENT	16	68	4760	1.58	510.68	2042.71
B	4160 (50, 354, 354, 50)	PAD REINFORCEMENT	16	32	4967	1.58	250.80	1003.18
C	1900 (568, 50, 50, 568)	PAD REINFORCEMENT	16	18	3136	1.58	89.08	356.32
D	3511	CHIMNEY BAR	32	4	4011	6.31	101.24	404.98
D1	500	CHIMNEY BAR	28	8	4011	4.83	155.02	620.11
E	600, 600	CHIMNEY SQUARE SPACER	8	13	2592	0.39	13.29	53.18
E1	200, 283	CHIMNEY SQUARE SPACER	8	13	2123	0.39	10.89	43.55
						TOTAL REINFORCEMENT/ TOWER=		4524.0



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY FISSURED ROCK
UNIT WEIGHT (Kg/m^3):	1700
LIMIT BEARING CAPACITY (Kg/m2) :	62500
ANGLE OF REPOSE :	20
WATER TABLE (m) :	BELOW 3.5m FROM G.L.
FOUNDATION DEPTH (m):	3.5

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	45.07
CONCRETE (M10) m^3	4.72
TOTAL CONCRETE m^3	49.79
EXCAVATION m3	293.64
REINFORCEMENT Kg	4524.0

Sterlite Power Grid Ventures Ltd. * New Delhi *

Approved for Railway Crossing proposal.

REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	21-09-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) DRY FISSURED ROCK SOIL (3.5M DEPTH)				
CHKD	AM	21-09-18					
APPD	DL	21-09-18					
DATE	21-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-005A	SHEET NO.	1/2	REV	0

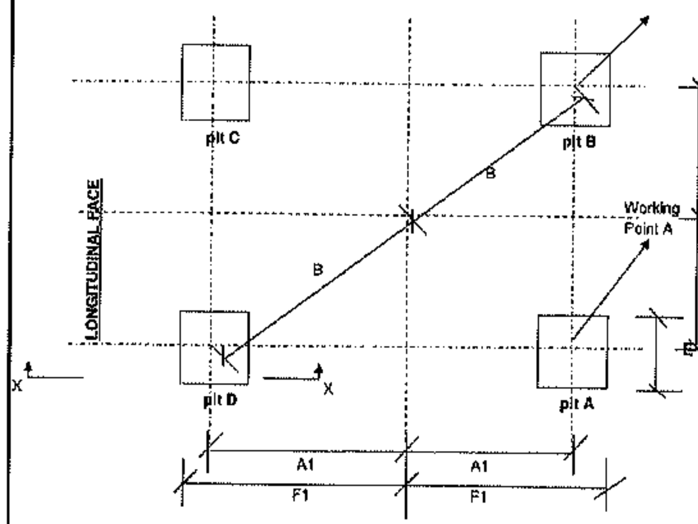
Project GOA

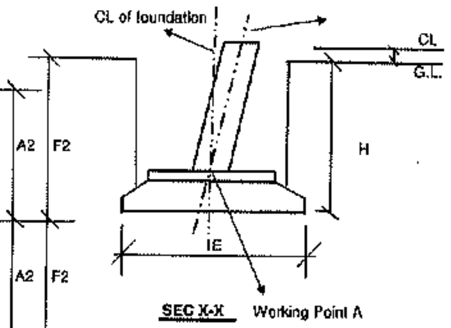
400 KV D/C -X-M & X-N (WZ-1) - TT "DD" SOIL TYPE - DFR (3.5M DEPTH)

PIT DIMENSION TABLE

Client: SPGVL

400 KV D/C-X-M & X-N- TT "DD"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12713		12713		200X200X20		50	57.1	1.028857	0.483931204	1.028857	0.4839312
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	4860	2750	225	7031	7031	9944	4860	9461	9461	3500
-3MBE (+) -1.5M LE	1500	13349	13349	4860	2750	225	7394	7394	10457	4860	9824	9824	3500
-3MBE (+) +0M LE	3000	14074	14074	4860	2750	225	7757	7757	10970	4860	10187	10187	3500
-3MBE (+) +1.5M LE	4500	14800	14800	4860	2750	225	8120	8120	11483	4860	10550	10550	3500
-3MBE (+) +3M LE	6000	15526	15526	4860	2750	225	8483	8483	11997	4860	10913	10913	3500
+0MBE (+) -3M LE	3000	14074	14074	4860	2750	225	7757	7757	10970	4860	10187	10187	3500
+0MBE (+) -1.5M LE	4500	14800	14800	4860	2750	225	8120	8120	11483	4860	10550	10550	3500
+0MBE (+) +0M LE	6000	15526	15526	4860	2750	225	8483	8483	11997	4860	10913	10913	3500
+0MBE (+) +1.5M LE	7500	16252	16252	4860	2750	225	8846	8846	12510	4860	11276	11276	3500
+0MBE (+) +3M LE	9000	16978	16978	4860	2750	225	9209	9209	13023	4860	11639	11639	3500
+3MBE (+) -3M LE	6000	15526	15526	4860	2750	225	8483	8483	11997	4860	10913	10913	3500
+3MBE (+) -1.5M LE	7500	16252	16252	4860	2750	225	8846	8846	12510	4860	11276	11276	3500
+3MBE (+) +0M LE	9000	16978	16978	4860	2750	225	9209	9209	13023	4860	11639	11639	3500
+3MBE (+) +1.5M LE	10500	17704	17704	4860	2750	225	9572	9572	13537	4860	12002	12002	3500
+3MBE (+) +3M LE	12000	18430	18430	4860	2750	225	9935	9935	14050	4860	12365	12365	3500
+6MBE (+) -3M LE	9000	16978	16978	4860	2750	225	9209	9209	13023	4860	11639	11639	3500
+6MBE (+) -1.5M LE	10500	17704	17704	4860	2750	225	9572	9572	13537	4860	12002	12002	3500
+6MBE (+) +0M LE	12000	18430	18430	4860	2750	225	9935	9935	14050	4860	12365	12365	3500
+6MBE (+) +1.5M LE	13500	19156	19156	4860	2750	225	10298	10298	14563	4860	12728	12728	3500
+6MBE (+) +3M LE	15000	19882	19882	4860	2750	225	10661	10661	15076	4860	13091	13091	3600





Limit Bearing Capacity	62500	Kg/Sqm
Weight of soil (Dry portion)	1700	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	20	Deg
Angle of Repose (Wet portion)	10	Deg
Water Table	3.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235176971
SEC B =	1.027282409

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300 mm

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

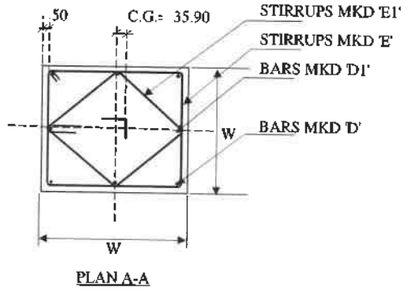
Sterlite Power Grid Ventures Ltd. * New Delhi *

Approved for railway crossing proposal

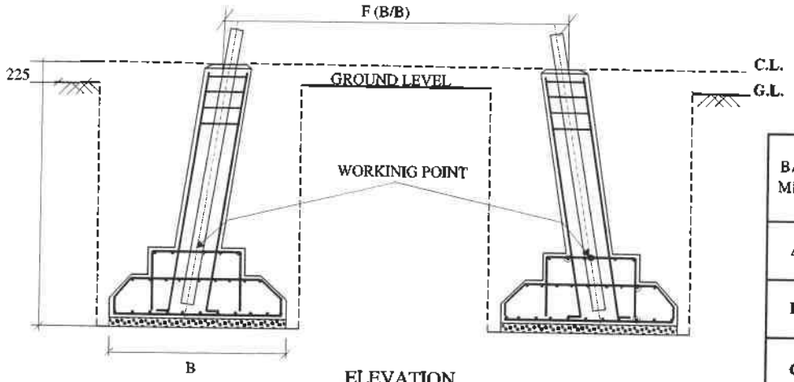
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	21-09-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) DRY FISSURED ROCK SOIL (3.5M DEPTH)
CHKD	AM	21-09-18	
APPD	DL	21-09-18	
DATE	21-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-005A — SHEET NO. 2/2 — REV 0



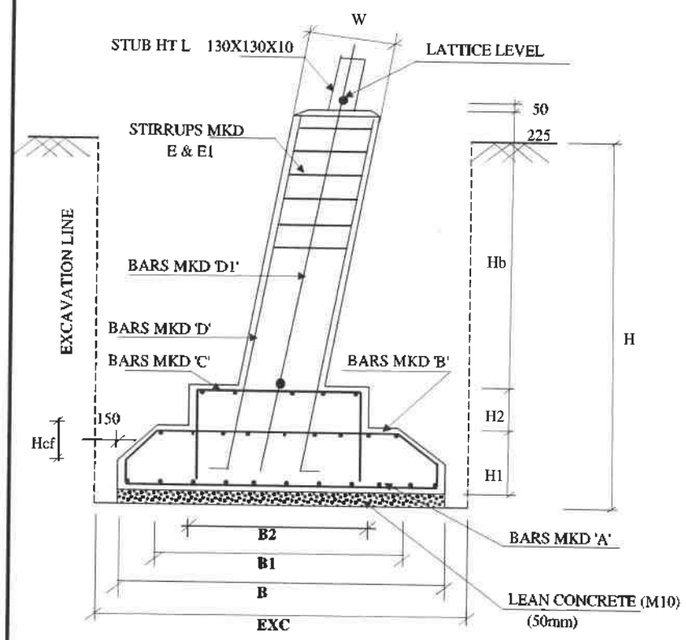
PLAN A-A



ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
3250	2950	3500	420	2650	1410	250	200	150	3000

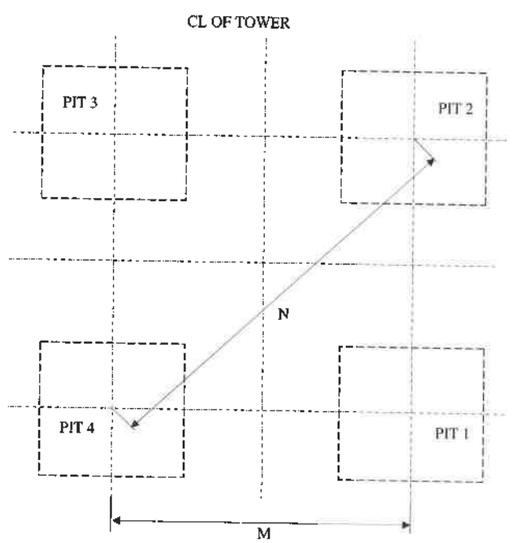
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	2850	PAD REINFORCEMENT	12	30	2850	0.89	75.93	303.72
B	2550: 50, 141, 141, 50	PAD REINFORCEMENT	10	24	2933	0.62	43.42	173.70
C	1310: 326, 50, 50, 326	PAD REINFORCEMENT	10	18	2062	0.62	22.90	91.61
D	3531, 300	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
D1		CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
E	320, 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226, 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.52
						TOTAL REINFORCEMENT/ TOWER=		924.0



FOUNDATION ELEVATION (CROSS SECTION)

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	WET
UNIT WEIGHT (Kg/m^3):	1440 / 940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	30 / 15
WATER TABLE (m) :	1.50 BELOW G.L.
FOUNDATION DEPTH (m):	3.5



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	12.06
CONCRETE (M10) m^3	1.74
TOTAL CONCRETE m^3	13.8
EXCAVATION m3	147.88
REINFORCEMENT Kg	924.0

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Engineering Deptt.
the above does not relieve the contractor from their contractual obligations

REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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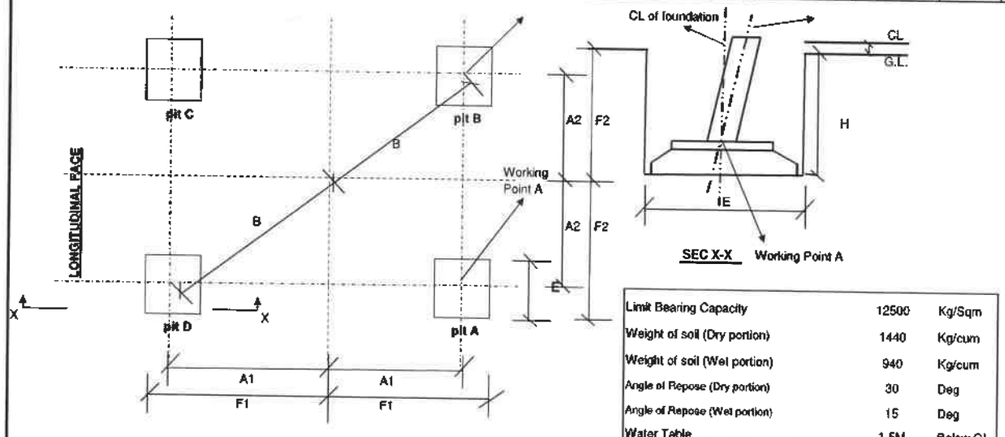
REV N0	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) WET SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-002	SHEET NO.	1/2	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DAL" SOIL TYPE - WET	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DAL"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)	" F " B/B of Tower at 3MBE(+)-3MLE (LF)	Stub Section (HT)	Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		9432	9432	130X130X10	50	35.9	1.011445	0.303448276	1.011445	0.3034483
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	9375	9375	2950	3000	225	5177	5177	7321	3250	6802	6802	3500
-3MBE (+) -1.5M LE	1500	9830	9830	2950	3000	225	5404	5404	7643	3250	7029	7029	3500
-3MBE (+) +0M LE	3000	10285	10285	2950	3000	225	5632	5632	7965	3250	7257	7257	3500
-3MBE (+) +1.5M LE	4500	10741	10741	2950	3000	225	5860	5860	8287	3250	7485	7485	3500
-3MBE (+) +3M LE	6000	11196	11196	2950	3000	225	6087	6087	8609	3250	7712	7712	3500
+0MBE (+) -3M LE	3000	10285	10285	2950	3000	225	5632	5632	7965	3250	7257	7257	3500
+0MBE (+) -1.5M LE	4500	10741	10741	2950	3000	225	5860	5860	8287	3250	7485	7485	3500
+0MBE (+) +0M LE	6000	11196	11196	2950	3000	225	6087	6087	8609	3250	7712	7712	3500
+0MBE (+) +1.5M LE	7500	11651	11651	2950	3000	225	6315	6315	8930	3250	7940	7940	3500
+0MBE (+) +3M LE	9000	12106	12106	2950	3000	225	6542	6542	9252	3250	8167	8167	3500
+3MBE (+) -3M LE	6000	11196	11196	2950	3000	225	6087	6087	8609	3250	7712	7712	3500
+3MBE (+) -1.5M LE	7500	11651	11651	2950	3000	225	6315	6315	8930	3250	7940	7940	3500
+3MBE (+) +0M LE	9000	12106	12106	2950	3000	225	6542	6542	9252	3250	8167	8167	3500
+3MBE (+) +1.5M LE	10500	12561	12561	2950	3000	225	6770	6770	9574	3250	8395	8395	3500
+3MBE (+) +3M LE	12000	13016	13016	2950	3000	225	6998	6998	9896	3250	8623	8623	3500
+6MBE (+) -3M LE	9000	12106	12106	2950	3000	225	6542	6542	9252	3250	8167	8167	3500
+6MBE (+) -1.5M LE	10500	12561	12561	2950	3000	225	6770	6770	9574	3250	8395	8395	3500
+6MBE (+) +0M LE	12000	13016	13016	2950	3000	225	6998	6998	9896	3250	8623	8623	3500
+6MBE (+) +1.5M LE	13500	13472	13472	2950	3000	225	7225	7225	10218	3250	8850	8850	3500
+6MBE (+) +3M LE	15000	13927	13927	2950	3000	225	7453	7453	10540	3250	9078	9078	3500



Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	1.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885

NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3300 mm
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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Engineering Deptt.
the above does not relieve the contractor from their contractual obligations

REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD					
CLIENT	STERLITE POWER GRID VENTURES LIMITED					
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED					
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) WET SOIL (3.5M DEPTH)			
CHKD	AM	03-08-18				
APPD	DL	03-08-18				
DATE	03-08-18	DRAWING NO	GTTPL/400DC/WZ-1/DAL/F-002	SHEET NO.	2/2	REV 0

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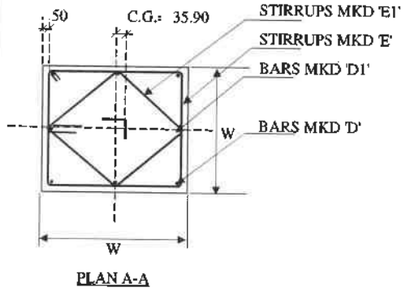
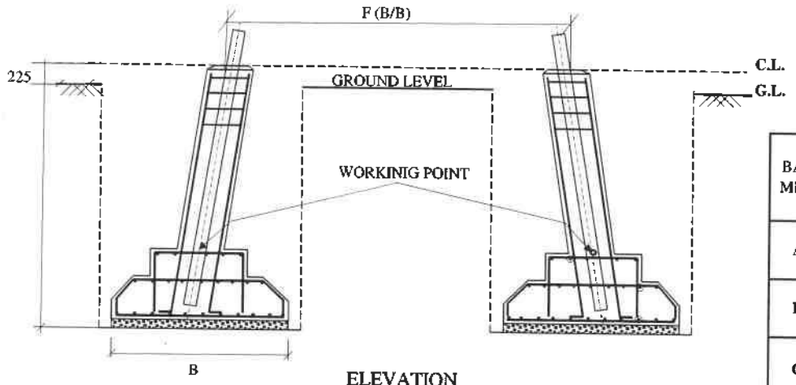


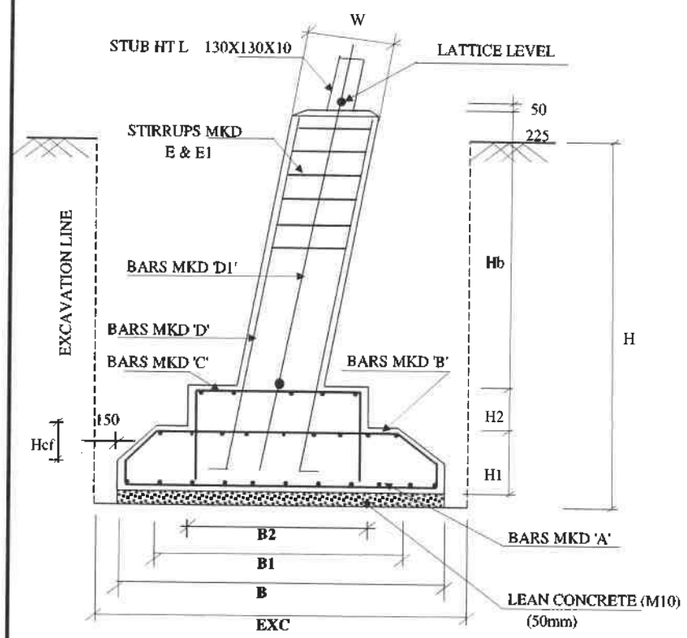
PLAN A-A



ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
2450	2150	3500	420	1850	1410	250	200	150	3000

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	2050	PAD REINFORCEMENT	12	24	2050	0.89	43.72	174.87
B	1750; 50, 141, 141, 50	PAD REINFORCEMENT	10	14	2133	0.62	18.45	73.80
C	1310; 326, 50, 50, 326	PAD REINFORCEMENT	10	18	2062	0.62	22.90	91.61
D	3531	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
D1	300	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
E	320, 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226, 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.52
						TOTAL REINFORCEMENT/ TOWER=		695.2



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY
UNIT WEIGHT (Kg/m^3):	1440
LIMIT BEARING CAPACITY (Kg/m2) :	25000
ANGLE OF REPOSE :	30
WATER TABLE (m) :	BELOW 3.5m FROM G.L.
FOUNDATION DEPTH (m):	3.5

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

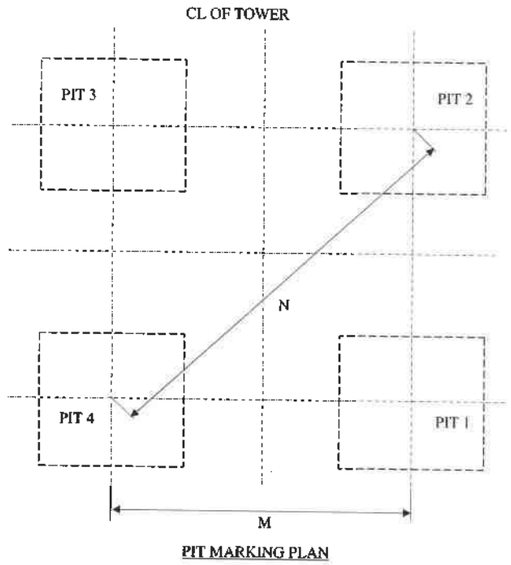
8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	8.12
CONCRETE (M10) m^3	0.92
TOTAL CONCRETE m^3	9.04
EXCAVATION m3	84.04
REINFORCEMENT Kg	695.2

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885



PIT MARKING PLAN

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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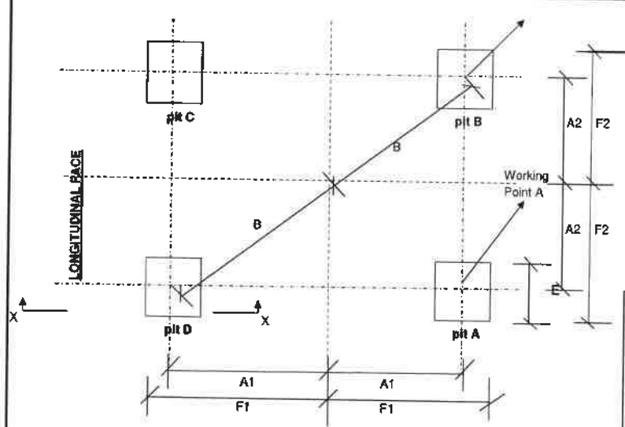
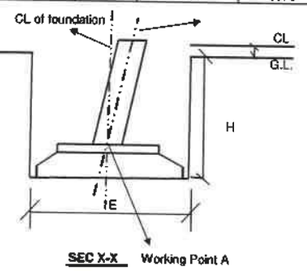
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) DRY SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-001	SHEET NO.	1/2	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DAL" SOIL TYPE - DRY	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DAL"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		9432		9432		130X130X10		S0	35.9	1.011445	0.303448276	1.011445	0.3034483
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	9375	9375	2150	3000	225	5177	5177	7321	2450	6402	6402	3500
-3MBE (+) -1.5M LE	1500	9830	9830	2150	3000	225	5404	5404	7643	2450	6629	6629	3500
-3MBE (+) +0M LE	3000	10285	10285	2150	3000	225	5632	5632	7965	2450	6857	6857	3500
-3MBE (+) +1.5M LE	4500	10741	10741	2150	3000	225	5860	5860	8287	2450	7085	7085	3500
-3MBE (+) +3M LE	6000	11196	11196	2150	3000	225	6087	6087	8609	2450	7312	7312	3500
+0MBE (+) -3M LE	3000	10285	10285	2150	3000	225	5632	5632	7965	2450	6857	6857	3500
+0MBE (+) -1.5M LE	4500	10741	10741	2150	3000	225	5860	5860	8287	2450	7085	7085	3500
+0MBE (+) +0M LE	6000	11196	11196	2150	3000	225	6087	6087	8609	2450	7312	7312	3500
+0MBE (+) +1.5M LE	7500	11651	11651	2150	3000	225	6315	6315	8930	2450	7540	7540	3500
+0MBE (+) +3M LE	9000	12106	12106	2150	3000	225	6542	6542	9252	2450	7767	7767	3500
+3MBE (+) -3M LE	6000	11196	11196	2150	3000	225	6087	6087	8609	2450	7312	7312	3500
+3MBE (+) -1.5M LE	7500	11651	11651	2150	3000	225	6315	6315	8930	2450	7540	7540	3500
+3MBE (+) +0M LE	9000	12106	12106	2150	3000	225	6542	6542	9252	2450	7767	7767	3500
+3MBE (+) +1.5M LE	10500	12561	12561	2150	3000	225	6770	6770	9574	2450	7995	7995	3500
+3MBE (+) +3M LE	12000	13016	13016	2150	3000	225	6998	6998	9896	2450	8223	8223	3500
+6MBE (+) -3M LE	9000	12106	12106	2150	3000	225	6542	6542	9252	2450	7767	7767	3500
+6MBE (+) -1.5M LE	10500	12561	12561	2150	3000	225	6770	6770	9574	2450	7995	7995	3500
+6MBE (+) +0M LE	12000	13016	13016	2150	3000	225	6998	6998	9896	2450	8223	8223	3500
+6MBE (+) +1.5M LE	13500	13472	13472	2150	3000	225	7225	7225	10218	2450	8450	8450	3500
+6MBE (+) +3M LE	15000	13927	13927	2150	3000	226	7453	7453	10540	2450	8678	8678	3500





Limit Bearing Capacity	25000	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	3.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300 mm

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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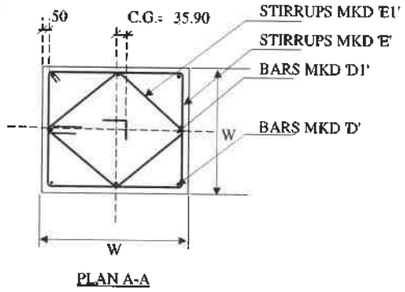
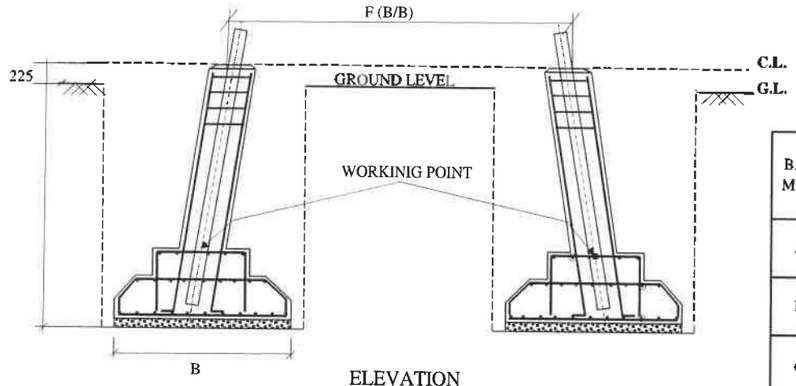
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD					
CLIENT	STERLITE POWER GRID VENTURES LIMITED					
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED					
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) DRY SOIL (3.5M DEPTH)			
CHKD	AM	03-08-18				
APPD	DL	03-08-18				
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-001	SHEET NO	2/2	REV 0



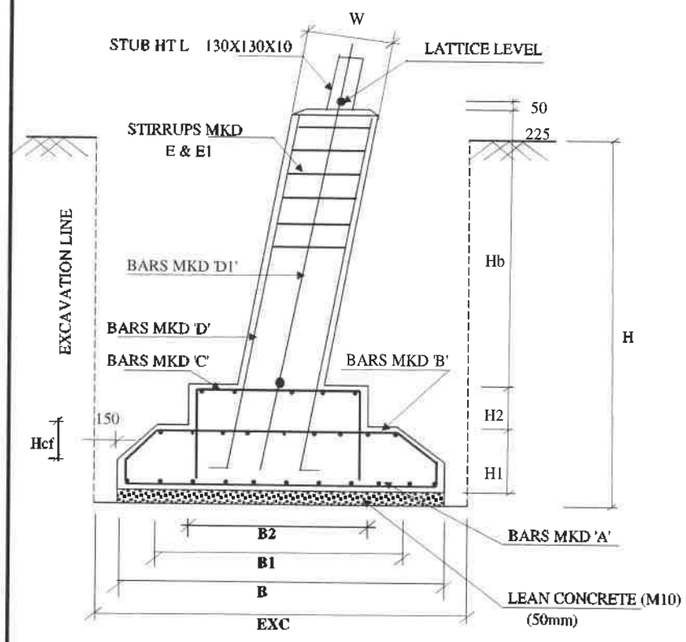
PLAN A-A



ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
3550	3250	3500	420	2950	1410	250	200	150	3000

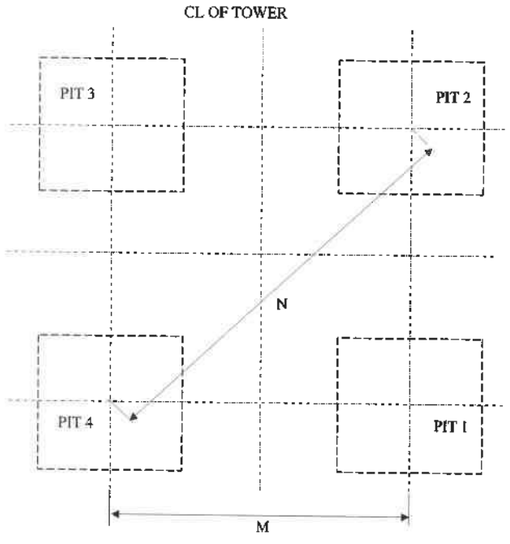
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER	NO. OF BARS PER FDN	LENGTH	UNIT WEIGHT	WEIGHT PER LEG	WEIGHT PER TOWER
			(mm)	(no)	(mm)	('kg/m)	(kg)	(kg)
A	3150	PAD REINFORCEMENT	12	36	3150	0.89	100.69	402.75
B	2850: 50, 141, 141, 50	PAD REINFORCEMENT	10	28	3233	0.62	55.83	223.32
C	1310: 326, 50, 50, 326	PAD REINFORCEMENT	10	18	2062	0.62	22.90	91.61
D	3531	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
D1	300	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
E	320, 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226, 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.52
						TOTAL REINFORCEMENT/ TOWER=		1072.6



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	PARTIALLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	1440 / 940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	30 / 15
WATER TABLE (m) :	0.75 BELOW G.L.
FOUNDATION DEPTH (m):	3.5

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	13.86
CONCRETE (M10) m^3	2.11
TOTAL CONCRETE m^3	15.97
EXCAVATION m3	176.44
REINFORCEMENT Kg	1072.6

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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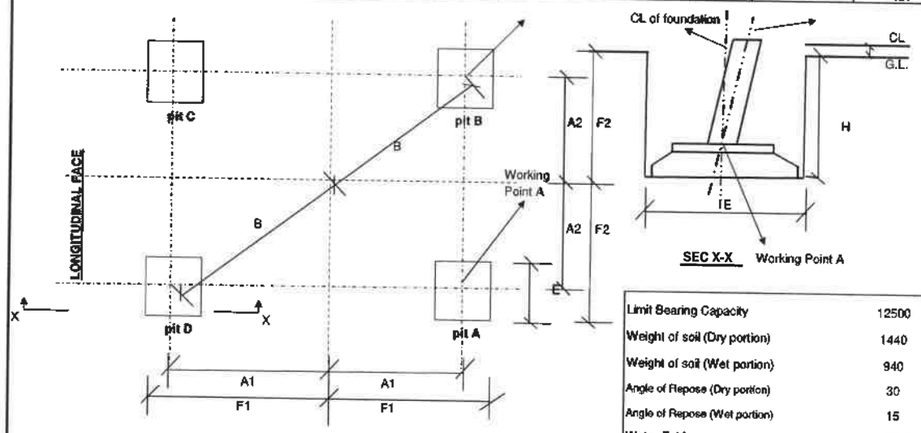
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) PARTIALLY SUBMERGED SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-003	SHEET NO.	1/1	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DAL" SOIL TYPE - PS	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DAL"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)	Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		9432		9432		130X130X10	50	35.9	1.011445	0.303448276	1.011445	0.3034483
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	9375	9375	3250	3000	225	5177	5177	7321	3550	6952	6952	3500
-3MBE (+) -1.5M LE	1500	9830	9830	3250	3000	225	5404	5404	7643	3550	7179	7179	3500
-3MBE (+) +0M LE	3000	10285	10285	3250	3000	225	5632	5632	7965	3550	7407	7407	3500
-3MBE (+) +1.5M LE	4500	10741	10741	3250	3000	225	5860	5860	8287	3550	7635	7635	3500
-3MBE (+) +3M LE	6000	11196	11196	3250	3000	225	6087	6087	8609	3550	7862	7862	3500
+0MBE (+) -3M LE	3000	10285	10285	3250	3000	225	5632	5632	7965	3550	7407	7407	3500
+0MBE (+) -1.5M LE	4500	10741	10741	3250	3000	225	5860	5860	8287	3550	7635	7635	3500
+0MBE (+) +0M LE	6000	11196	11196	3250	3000	225	6087	6087	8609	3550	7862	7862	3500
+0MBE (+) +1.5M LE	7500	11651	11651	3250	3000	225	6315	6315	8930	3550	8090	8090	3500
+0MBE (+) +3M LE	9000	12106	12106	3250	3000	225	6542	6542	9252	3550	8317	8317	3500
+3MBE (+) -3M LE	6000	11196	11196	3250	3000	225	6087	6087	8609	3550	7862	7862	3500
+3MBE (+) -1.5M LE	7500	11651	11651	3250	3000	225	6315	6315	8930	3550	8090	8090	3500
+3MBE (+) +0M LE	9000	12106	12106	3250	3000	225	6542	6542	9252	3550	8317	8317	3500
+3MBE (+) +1.5M LE	10500	12561	12561	3250	3000	225	6770	6770	9574	3550	8545	8545	3500
+3MBE (+) +3M LE	12000	13016	13016	3250	3000	225	6998	6998	9896	3550	8773	8773	3500
+6MBE (+) -3M LE	9000	12106	12106	3250	3000	225	6542	6542	9252	3550	8317	8317	3500
+6MBE (+) -1.5M LE	10500	12561	12561	3250	3000	225	6770	6770	9574	3550	8545	8545	3500
+6MBE (+) +0M LE	12000	13016	13016	3250	3000	225	6998	6998	9896	3550	8773	8773	3500
+6MBE (+) +1.5M LE	13500	13472	13472	3250	3000	225	7225	7225	10218	3550	9000	9000	3500
+6MBE (+) +3M LE	15000	13927	13927	3250	3000	225	7453	7453	10540	3550	9228	9228	3500



Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	0.75M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885

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NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3300 mm
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) PARTIALLY SUBMERGED SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-003	SHEET NO.	2/2	REV	0

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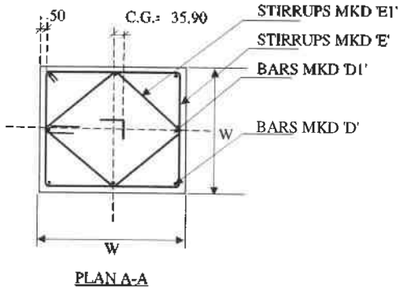
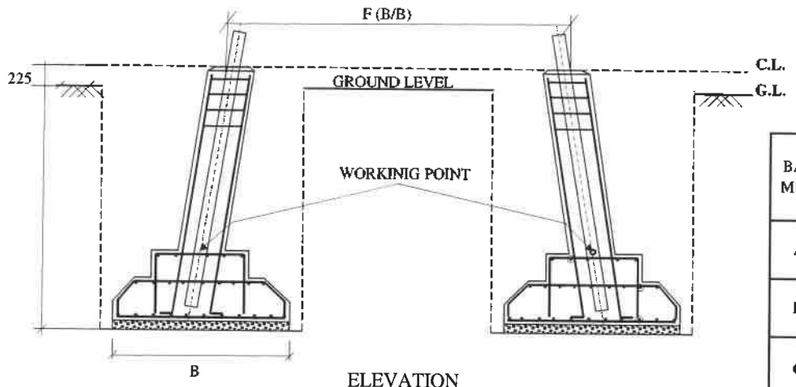


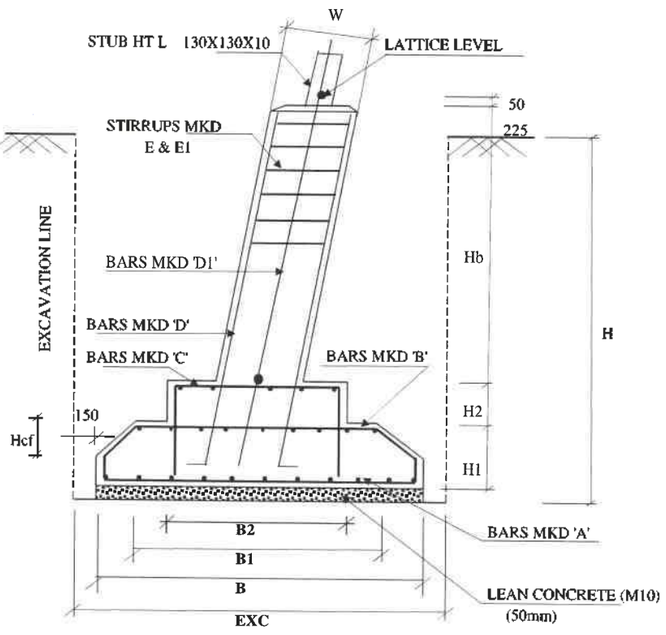
PLAN A-A



ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
3940	3640	3500	420	3340	1410	250	200	150	3000

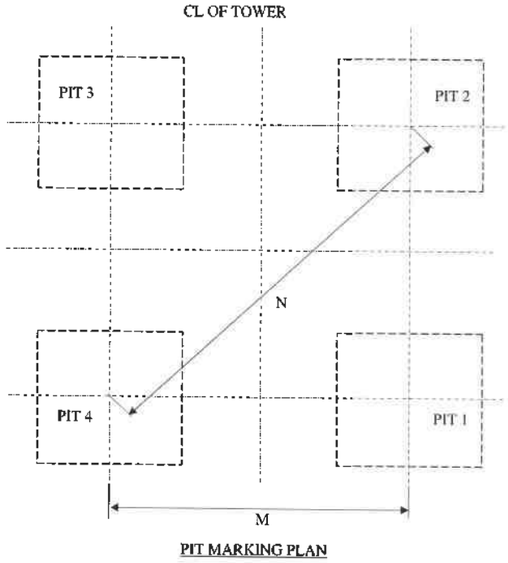
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER	NO. OF BARS PER FDN	LENGTH	UNIT WEIGHT	WEIGHT PER LEG	WEIGHT PER TOWER
			(mm)	(no)	(mm)	(kg/m)	(kg)	(kg)
A	3540	PAD REINFORCEMENT	12	42	3540	0.89	131.99	527.97
B	3240 (50, 141, 141, 50)	PAD REINFORCEMENT	12	26	3623	0.89	83.63	334.54
C	1310 (326, 50, 50, 326)	PAD REINFORCEMENT	12	14	2062	0.89	25.65	102.59
D	3531, 300	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
D1		CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
E	320, 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226, 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.52
						TOTAL REINFORCEMENT/ TOWER=		1320.0



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	FULLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	15
WATER TABLE (m) :	0m BELOW G.L.
FOUNDATION DEPTH (m):	3.5

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	16.48
CONCRETE (M10) m^3	2.65
TOTAL CONCRETE m^3	19.13
EXCAVATION m3	217.33
REINFORCEMENT Kg	1320.0

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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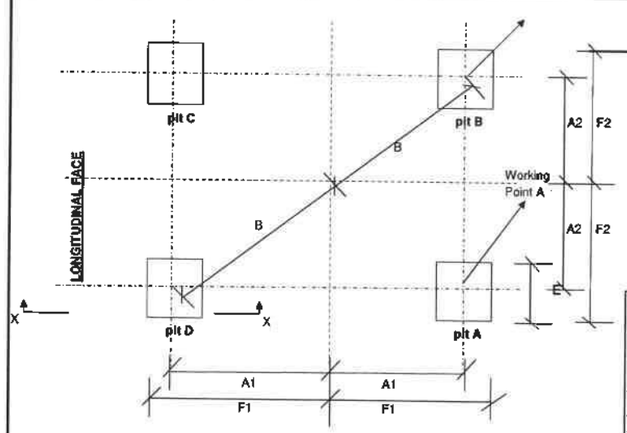
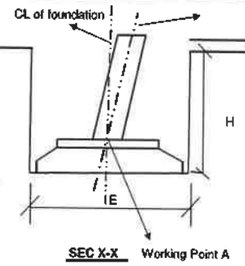
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) FULLY SUBMERGED SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-004	SHEET NO.	1/2	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DAL" SOIL TYPE - FS	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DAL"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		9432		9432		130X130X10		50	35.9	1.011445	0.303448276	1.011445	0.3034483
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	9375	9375	3640	3000	225	5177	5177	7321	3940	7147	7147	3500
-3MBE (+) -1.5M LE	1500	9830	9830	3640	3000	225	5404	5404	7643	3940	7374	7374	3500
-3MBE (+) +0M LE	3000	10285	10285	3640	3000	225	5632	5632	7965	3940	7602	7602	3500
-3MBE (+) +1.5M LE	4500	10741	10741	3640	3000	225	5860	5860	8287	3940	7830	7830	3500
-3MBE (+) +3M LE	6000	11196	11196	3640	3000	225	6087	6087	8609	3940	8057	8057	3500
+0MBE (+) -3M LE	3000	10285	10285	3640	3000	225	5632	5632	7965	3940	7602	7602	3500
+0MBE (+) -1.5M LE	4500	10741	10741	3640	3000	225	5860	5860	8287	3940	7830	7830	3500
+0MBE (+) +0M LE	6000	11196	11196	3640	3000	225	6087	6087	8609	3940	8057	8057	3500
+0MBE (+) +1.5M LE	7500	11651	11651	3640	3000	225	6315	6315	8930	3940	8285	8285	3500
+0MBE (+) +3M LE	9000	12106	12106	3640	3000	225	6542	6542	9252	3940	8512	8512	3500
+3MBE (+) -3M LE	6000	11196	11196	3640	3000	225	6087	6087	8609	3940	8057	8057	3500
+3MBE (+) -1.5M LE	7500	11651	11651	3640	3000	225	6315	6315	8930	3940	8285	8285	3500
+3MBE (+) +0M LE	9000	12106	12106	3640	3000	225	6542	6542	9252	3940	8512	8512	3500
+3MBE (+) +1.5M LE	10500	12561	12561	3640	3000	225	6770	6770	9574	3940	8740	8740	3500
+3MBE (+) +3M LE	12000	13016	13016	3640	3000	225	6998	6998	9896	3940	8968	8968	3500
+6MBE (+) -3M LE	9000	12106	12106	3640	3000	225	6542	6542	9252	3940	8512	8512	3500
+6MBE (+) -1.5M LE	10500	12561	12561	3640	3000	225	6770	6770	9574	3940	8740	8740	3500
+6MBE (+) +0M LE	12000	13016	13016	3640	3000	225	6998	6998	9896	3940	8968	8968	3500
+6MBE (+) +1.5M LE	13500	13472	13472	3640	3000	225	7225	7225	10218	3940	9195	9195	3500
+6MBE (+) +3M LE	15000	13927	13927	3640	3000	225	7453	7453	10540	3940	9423	9423	3500





Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	0.0M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN β =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885

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NOTES:

1.DRAWING NOT TO SCALE
2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5.STUB BELOW GROUND LEVEL = 3300 mm
6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8.CLEAR COVER TO REINFORCEMENT IS 50MM
9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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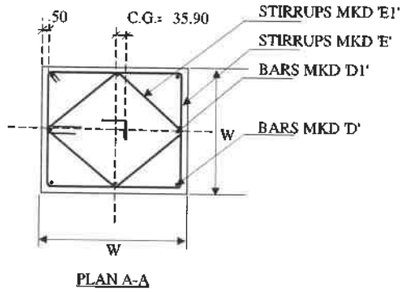
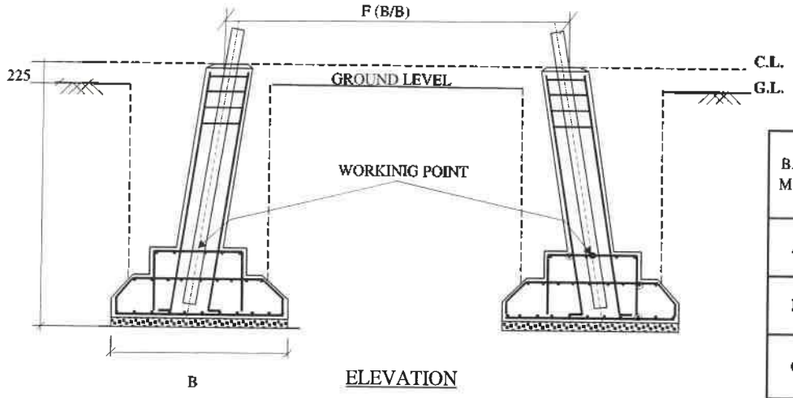
RBV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

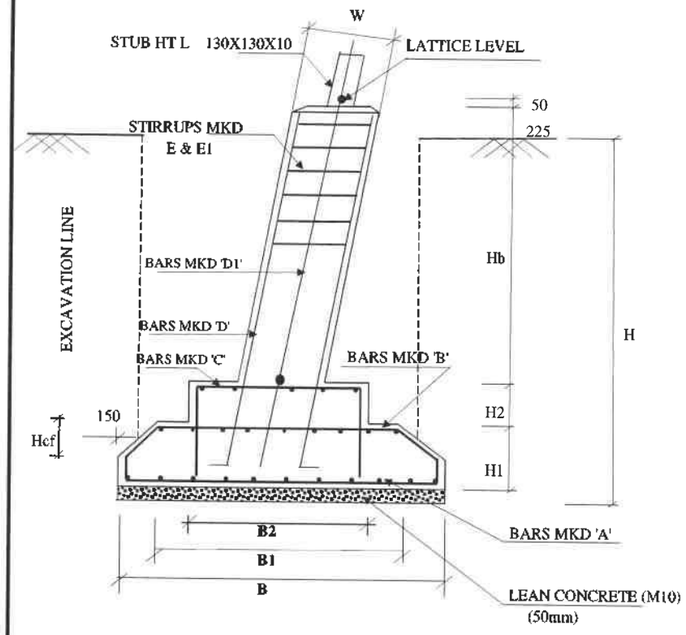
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) FULLY SUBMERGED SOIL (3.5M DEPTH)			
CHKD	AM	03-08-18				
APPD	DL	03-08-18				
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-004	SHEET NO.	2/2	REV 0



PLAN A-A



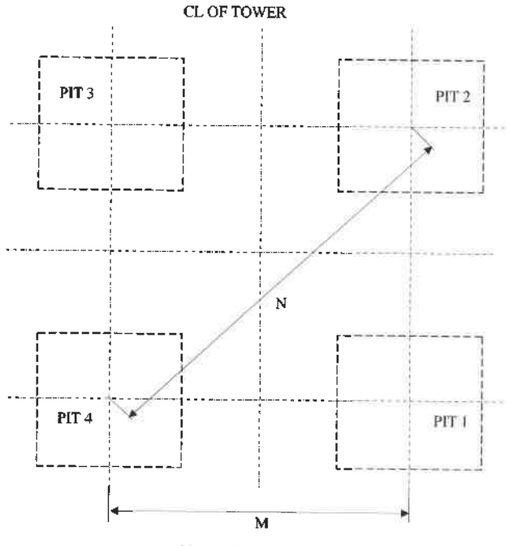
ELEVATION



FOUNDATION ELEVATION (CROSS SECTION)

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY FISSURED ROCK
UNIT WEIGHT (Kg/m^3):	1700
LIMIT BEARING CAPACITY (Kg/m2) :	62500
ANGLE OF REPOSE :	20
WATER TABLE (m) :	BELOW 3.5m FROM G.L.
FOUNDATION DEPTH (m):	3.5



PIT MARKING PLAN

B	H	W	B1	B2	H1	H2	Hcf	Hb
2170	3500	420	1870	1410	250	200	150	3000

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT ('kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	2070	PAD REINFORCEMENT	10	26	2070	0.62	33.23	132.90
B	1770 (50, 141, 141, 50)	PAD REINFORCEMENT	10	16	2153	0.62	21.28	85.10
C	1310 (330, 50, 50, 330)	PAD REINFORCEMENT	10	18	2070	0.62	22.99	91.96
D	3535	CHIMNEY BAR	20	4	3835	2.46	37.81	151.27
D1	300	CHIMNEY BAR	20	4	3835	2.46	37.81	151.27
E	320 / 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226 / 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.50
						TOTAL REINFORCEMENT/ TOWER=		665.2

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	8.2
CONCRETE (M10) m^3	0.94
TOTAL CONCRETE m^3	9.14
EXCAVATION m3	50.04
REINFORCEMENT Kg	665.2

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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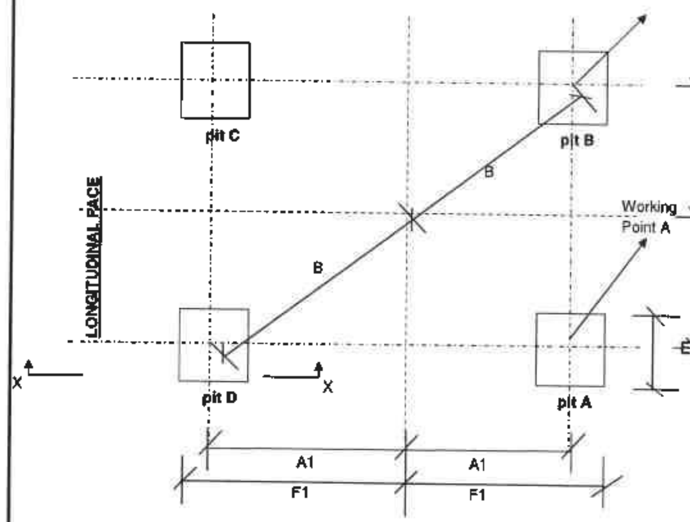
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

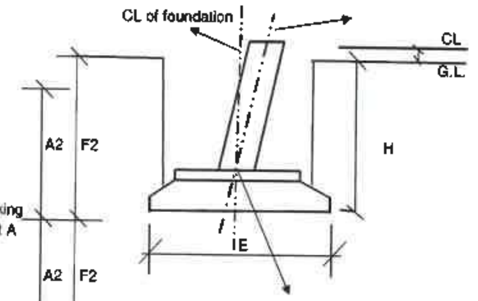
PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) DRY FISSURED ROCK SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-005	SHEET NO.	1/2	REV	0

Project GOA	400 KV D/C -X-M & X-N (WZ-1) - TT "DAL" SOIL TYPE - DFR PIT DIMENSION TABLE	Client: SPGVL

400 KV D/C-X-M & X-N- TT "DAL"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		9432		9432		130X130X10		50	35.9	1.011445	0.303448276	1.011445	0.3034483
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	9375	9375	2170	3000	225	5177	5177	7321	2170	6262	6262	3500
-3MBE (+) -1.5M LE	1500	9830	9830	2170	3000	225	5404	5404	7643	2170	6489	6489	3500
-3MBE (+) +0M LE	3000	10285	10285	2170	3000	225	5632	5632	7965	2170	6717	6717	3500
-3MBE (+) +1.5M LE	4500	10741	10741	2170	3000	225	5860	5860	8287	2170	6945	6945	3500
-3MBE (+) +3M LE	6000	11196	11196	2170	3000	225	6087	6087	8609	2170	7172	7172	3500
+0MBE (+) -3M LE	3000	10285	10285	2170	3000	225	5632	5632	7965	2170	6717	6717	3500
+0MBE (+) -1.5M LE	4500	10741	10741	2170	3000	225	5860	5860	8287	2170	6945	6945	3500
+0MBE (+) +0M LE	6000	11196	11196	2170	3000	225	6087	6087	8609	2170	7172	7172	3500
+0MBE (+) +1.5M LE	7500	11651	11651	2170	3000	225	6315	6315	8930	2170	7400	7400	3500
+0MBE (+) +3M LE	9000	12106	12106	2170	3000	225	6542	6542	9252	2170	7627	7627	3500
+3MBE (+) -3M LE	6000	11196	11196	2170	3000	225	6087	6087	8609	2170	7172	7172	3500
+3MBE (+) -1.5M LE	7500	11651	11651	2170	3000	225	6315	6315	8930	2170	7400	7400	3500
+3MBE (+) +0M LE	9000	12106	12106	2170	3000	225	6542	6542	9252	2170	7627	7627	3500
+3MBE (+) +1.5M LE	10500	12561	12561	2170	3000	225	6770	6770	9574	2170	7855	7855	3500
+3MBE (+) +3M LE	12000	13016	13016	2170	3000	225	6998	6998	9896	2170	8083	8083	3500
+6MBE (+) -3M LE	9000	12106	12106	2170	3000	225	6542	6542	9252	2170	7627	7627	3500
+6MBE (+) -1.5M LE	10500	12561	12561	2170	3000	225	6770	6770	9574	2170	7855	7855	3500
+6MBE (+) +0M LE	12000	13016	13016	2170	3000	225	6998	6998	9896	2170	8083	8083	3500
+6MBE (+) +1.5M LE	13500	13472	13472	2170	3000	225	7225	7225	10218	2170	8310	8310	3500
+6MBE (+) +3M LE	15000	13927	13927	2170	3000	225	7453	7453	10540	2170	8538	8538	3500





SEC X-X Working Point A

Limit Bearing Capacity	62500	Kg/Sqm
Weight of soil (Dry portion)	1700	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	20	Deg
Angle of Repose (Wet portion)	10	Deg
Water Table	3.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.151724138
2 TAN B =	0.303448276
FACE =	1.011444617
DEV =	1.022761178
IN FACE SLOPE	
TAN B =	0.150003
SEC B =	1.0111885

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NOTES:

1.DRAWING NOT TO SCALE
2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5.STUB BELOW GROUND LEVEL = 3300 mm
6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8.CLEAR COVER TO REINFORCEMENT IS 50MM
9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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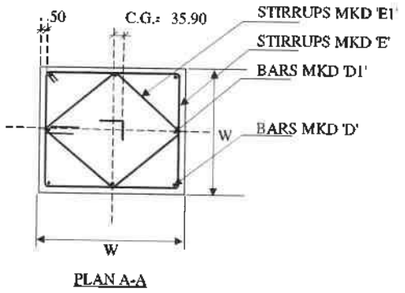
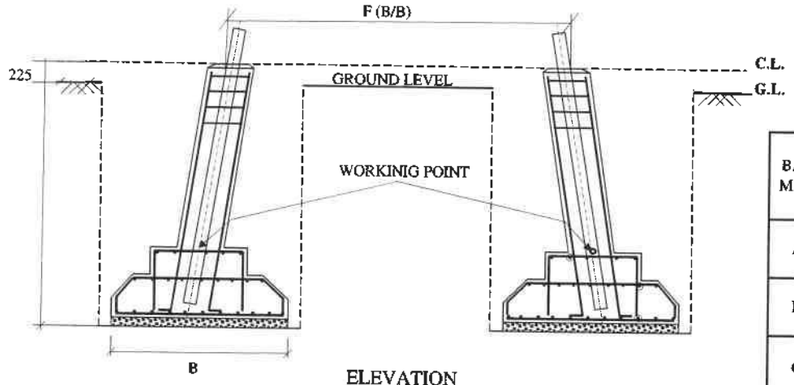
REV NO	DATE	DESCRIPTION		DRAWN	CHKD	APPD
PROJECT		400KV D/C XELDAM-NARENDRA TRANSMISSION LTD				
CLIENT		STERLITE POWER GRID VENTURES LIMITED				
DESIGNER:		STERLITE POWER GRID VENTURES LIMITED				
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DAL-3/+0/+3/+6M 400KV D/C (WZ-1) DRY FISSURED ROCK SOIL (3.5M DEPTH)			
CHKD	AM	03-08-18				
APPD	DL	03-08-18				
DATE	03-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DAL/F-005	SHEET NO. 2/2	REV	0



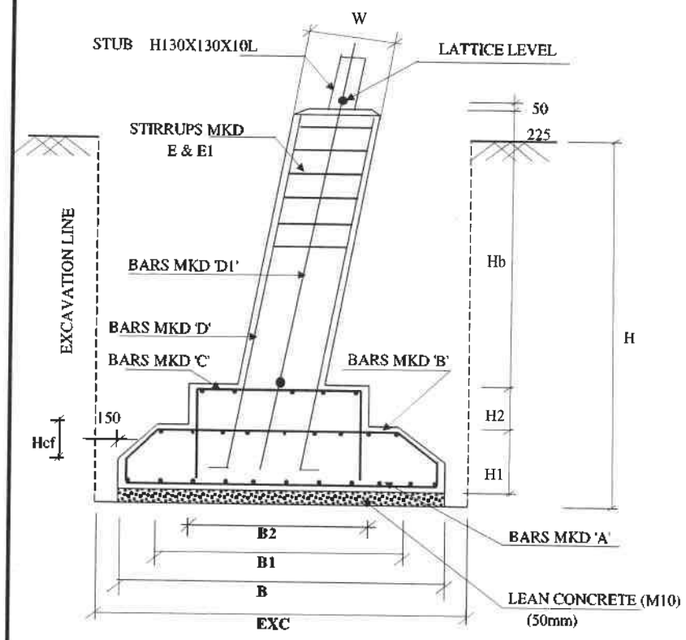
PLAN A-A



ELEVATION

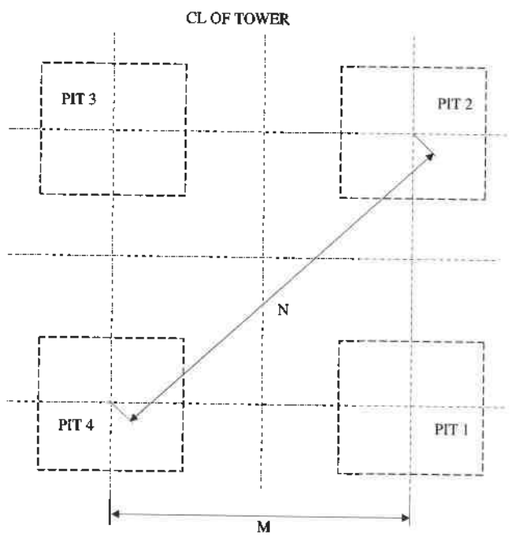
EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
2400	2100	3500	420	1800	1410	250	200	150	3000

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	2000	PAD REINFORCEMENT	10	26	2000	0.62	32.10	128.41
B	1700 (50, 141, 141, 50)	PAD REINFORCEMENT	10	14	2083	0.62	18.02	72.08
C	1310 (330, 50, 50, 330)	PAD REINFORCEMENT	10	18	2070	0.62	22.99	91.96
D	3535	CHIMNEY BAR	20	4	3835	2.46	37.81	151.27
D1	300	CHIMNEY BAR	20	4	3835	2.46	37.81	151.27
E	320 / 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226 / 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.52
						TOTAL REINFORCEMENT/ TOWER=		647.7



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY
UNIT WEIGHT (Kg/m^3):	1440
LIMIT BEARING CAPACITY (Kg/m2) :	25000
ANGLE OF REPOSE :	30
WATER TABLE (m) :	BELOW 3.5m FROM G.L.
FOUNDATION DEPTH (m):	3.5



PIT MARKING PLAN

EXCAVATION PLAN DETAIL			
STUB =	H130X130X10L		
TOWER SLOPE =	9.26	2*TAN α=	0.32620278
B/B WIDTH AT C.L.(mm) =	11588.3		
CG OF STUB(mm) =	35.9		
CG TO CG WIDTH AT C.L.(mm) =	11517		

TOWER TYPE	F B/B AT C.L.	M (CG TO CG) AT WORKING POINT	N
N = NORMAL TOWER	11588	12569	17775
3M BE = ATTACHED TO NT	12567	13548	19160
6M BE = ATTACHED TO NT	13546	14526	20543
9M BE = ATTACHED TO NT	14524	15505	21928

NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3300
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	7.92
CONCRETE (M10) m^3	0.88
TOTAL CONCRETE m^3	8.8
EXCAVATION m3	80.64
REINFORCEMENT Kg	647.7

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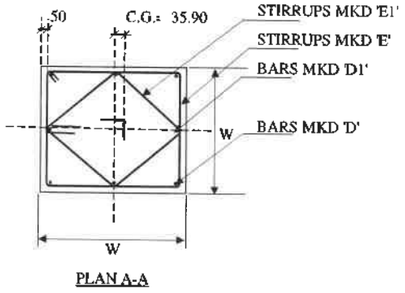
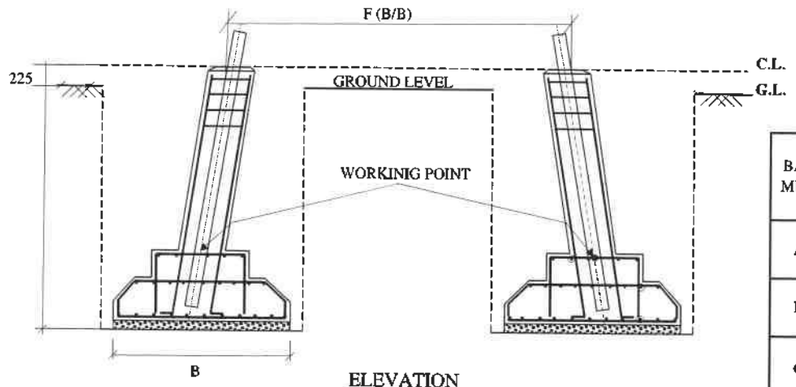
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM - NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DA+0/+3/+6/+9M 400KV D/C (WZ-1) DRY SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	KTL/400DC/WZ-1/DA/F-001	SHEET NO.	1/1	REV	0



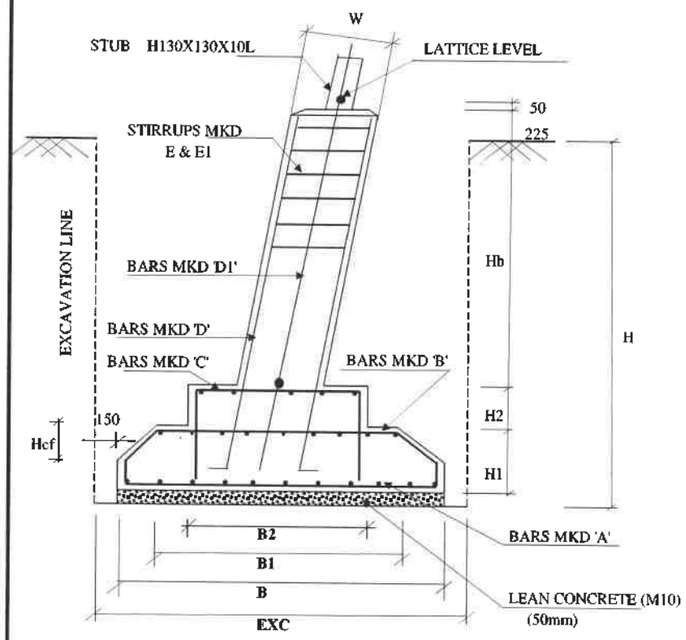
PLAN A-A



ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
3150	2850	3500	420	2550	1410	250	200	150	3000

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT ('kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	2750	PAD REINFORCEMENT	12	26	2750	0.89	63.51	254.03
B	2450 (50, 141, 141, 50)	PAD REINFORCEMENT	10	20	2833	0.62	34.96	139.85
C	1310 (326, 50, 50, 326)	PAD REINFORCEMENT	10	18	2062	0.62	22.90	91.61
D	3531	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
D1	300	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
E	320 / 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226 / 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.52
						TOTAL REINFORCEMENT/ TOWER=		840.4



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	WET
UNIT WEIGHT (Kg/m^3):	1440 / 940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	30 / 15
WATER TABLE (m) :	1.50 BELOW G.L.
FOUNDATION DEPTH (m):	3.5

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

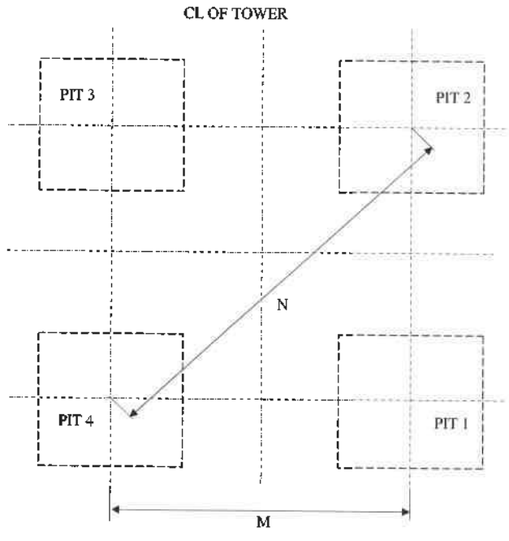
9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	11.49
CONCRETE (M10) m^3	1.62
TOTAL CONCRETE m^3	13.11
EXCAVATION m3	138.92
REINFORCEMENT Kg	841.0

EXCAVATION PLAN DETAIL			
STUB =	H130X130X10L		
TOWER SLOPE =	9.26	2*TAN α=	0.32620278
B/B WIDTH AT C.L.(mm) =	11588.3		
CG OF STUB(mm) =	35.9		
CG TO CG WIDTH AT C.L.(mm) =	11517		

TOWER TYPE	F B/B AT C.L	M (CG TO CG) AT WORKING POINT	N
N = NORMAL TOWER	11588	12569	17775
3M BE = ATTACHED TO NT	12567	13548	19160
6M BE = ATTACHED TO NT	13546	14526	20543
9M BE = ATTACHED TO NT	14524	15505	21928



PIT MARKING PLAN

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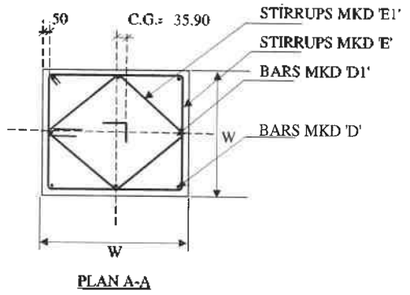
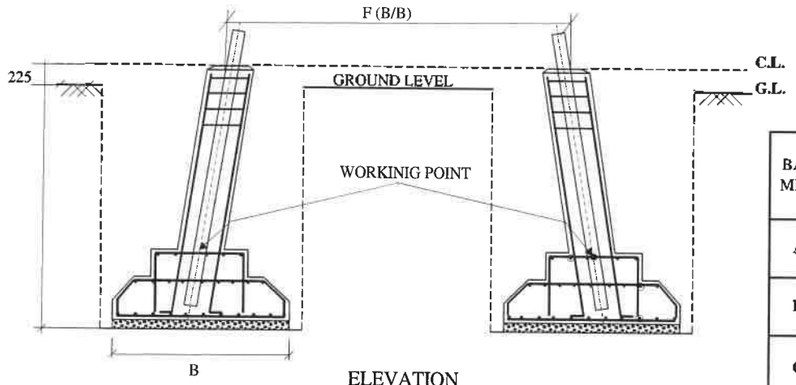
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM - NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DA+0/+3/+6/+9M 400KV D/C (WZ-1) WET SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	KTL400DC/WZ-1/DA/F-002	SHEET NO.	1/1	REV	0



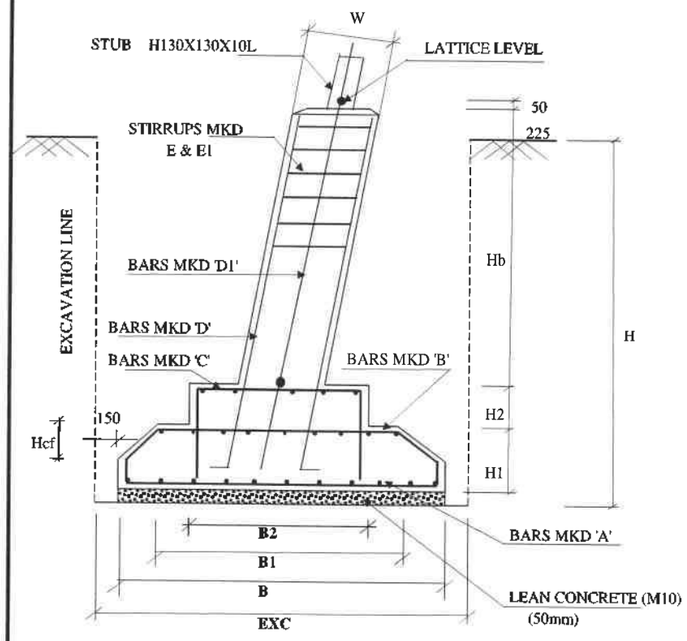
PLAN A-A



ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
3280	2980	3500	420	2680	1410	250	200	150	3000

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	2880	PAD REINFORCEMENT	12	30	2880	0.89	76.73	306.91
B	2580: 50, 141, 141, 50	PAD REINFORCEMENT	10	20	2963	0.62	36.57	146.26
C	1310: 326, 50, 50, 326	PAD REINFORCEMENT	10	18	2062	0.62	22.90	91.61
D	3531	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
D1	300	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
E	320, 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226, 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.52
						TOTAL REINFORCEMENT/ TOWER=		899.7



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	PARTIALLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	1440 / 940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	30 / 15
WATER TABLE (m) :	0.75 BELOW G.L.
FOUNDATION DEPTH (m):	3.5

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

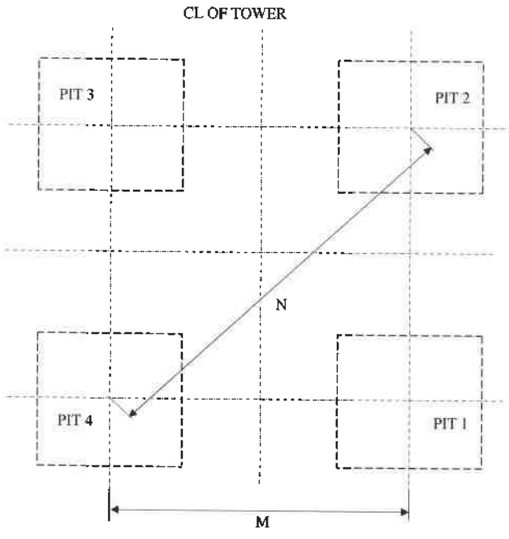
9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	12.23
CONCRETE (M10) m^3	1.78
TOTAL CONCRETE m^3	14.01
EXCAVATION m3	150.62
REINFORCEMENT Kg	899.7

EXCAVATION PLAN DETAIL			
STUB =	H130X130X10L		
TOWER SLOPE =	9.26	2*TAN α=	0.32620278
B/B WIDTH AT C.L.(mm) =	11588.3		
CG OF STUB(mm) =	35.9		
CG TO CG WIDTH AT C.L.(mm) =	11517		

TOWER TYPE	F B/B AT C.L	M (CG TO CG) AT WORKING POINT	N
N = NORMAL TOWER	11588	12569	17775
3M BE = ATTACHED TO NT	12567	13548	19160
6M BE = ATTACHED TO NT	13546	14526	20543
9M BE = ATTACHED TO NT	14524	15505	21928



PIT MARKING PLAN

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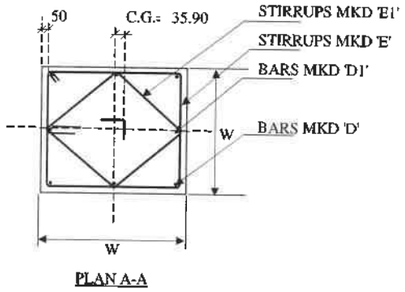
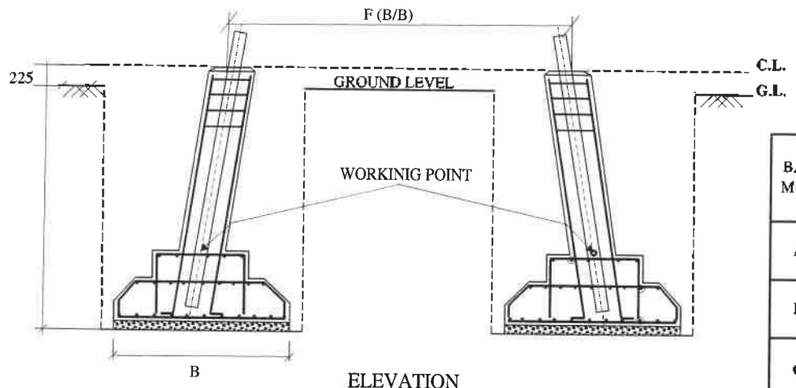
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM - NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DA+0/+3/+6/+9M 400KV D/C (WZ-1) PARTIALLY SUBMERGED SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	KTL/400DC/WZ-1/DA/F-003	SHEET NO.	1/1	REV	0



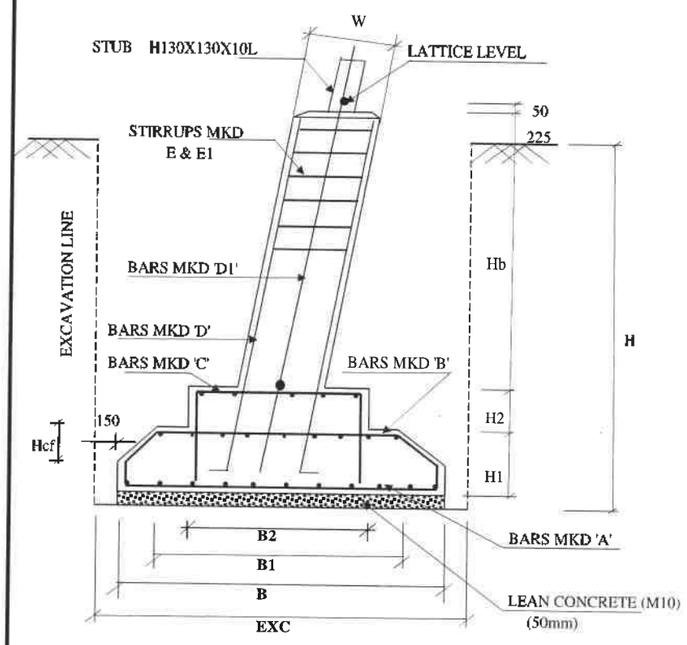
PLAN A-A



ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
3650	3350	3500	420	3050	1410	250	200	150	3000

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	3250	PAD REINFORCEMENT	12	32	3250	0.89	92.35	369.38
B	2950: 50, 141, 141, 50	PAD REINFORCEMENT	10	26	3333	0.62	53.45	213.79
C	1310: 326, 50, 50, 326	PAD REINFORCEMENT	10	18	2062	0.62	22.90	91.61
D	3531	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
D1	300	CHIMNEY BAR	20	4	3831	2.46	37.77	151.11
E	320, 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226, 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.52
						TOTAL REINFORCEMENT/ TOWER=		1029.7



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	FULLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	15
WATER TABLE (m) :	0m BELOW G.L.
FOUNDATION DEPTH (m):	3.5

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

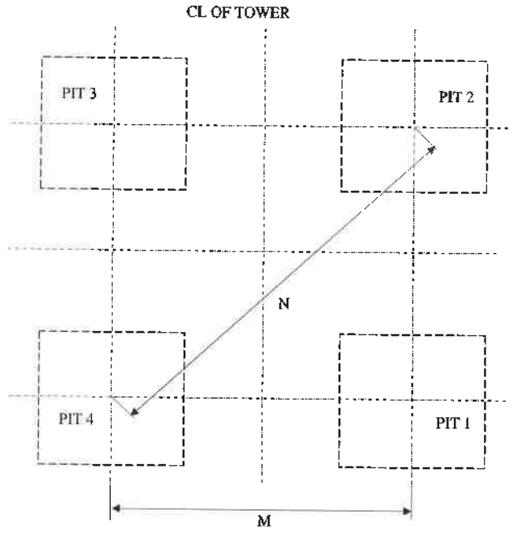
9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	14.5
CONCRETE (M10) m^3	2.24
TOTAL CONCRETE m^3	16.74
EXCAVATION m3	186.52
REINFORCEMENT Kg	1029.7

EXCAVATION PLAN DETAIL			
STUB =	H130X130X10L		
TOWER SLOPE =	9.26	2*TAN α=	0.32620278
B/B WIDTH AT C.L.(mm) =	11588.3		
CG OF STUB(mm) =	35.9		
CG TO CG WIDTH AT C.L.(mm) =	11517		

TOWER TYPE	F B/B AT C.L	M (CG TO CG) AT WORKING POINT	N
N = NORMAL TOWER	11588	12569	17775
3M BE = ATTACHED TO NT	12567	13548	19160
6M BE = ATTACHED TO NT	13546	14526	20543
9M BE = ATTACHED TO NT	14524	15505	21928



PIT MARKING PLAN

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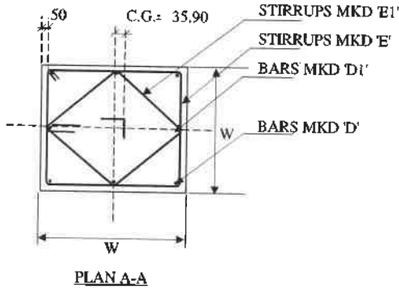
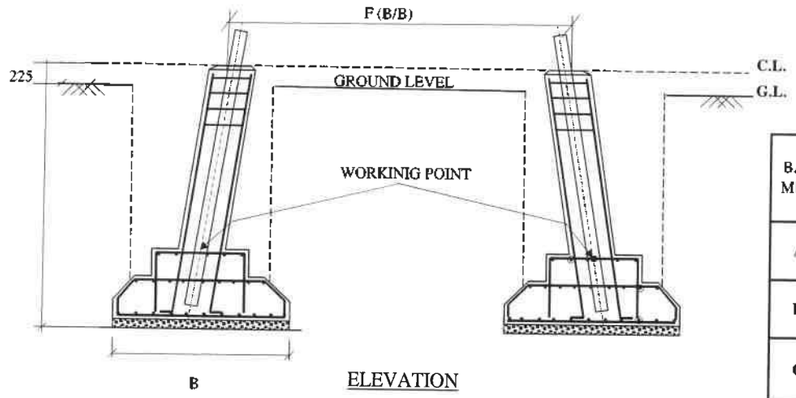
REV N0	DATE	DESCRIPTION	DRAWN	CHKD	APPD

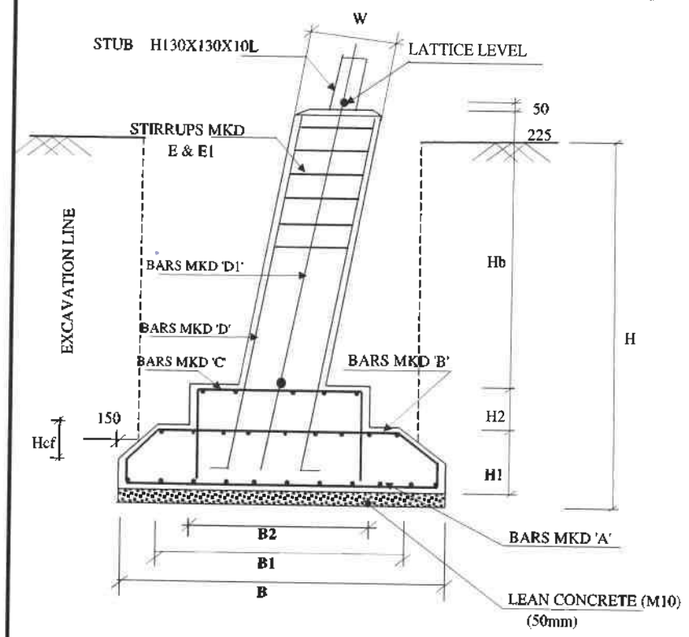
PROJECT	400KV D/C XELDAM - NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DA+0/+3/+6/+9M 400KV D/C (WZ-1) FULLY SUBMERGED SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	KTL/400DC/WZ-1/DA/F-004	SHEET NO.	1/1	REV	0



PLAN A-A



ELEVATION



FOUNDATION ELEVATION (CROSS SECTION)

B	H	W	B1	B2	H1	H2	Hcf	Hb
2000	3500	420	1700	1410	250	200	150	3000

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	1900	PAD REINFORCEMENT	10	26	1900	0.62	30.50	122.01
B	1600; 50, 141, 141, 50	PAD REINFORCEMENT	10	14	1983	0.62	17.16	68.63
C	1310; 330, 50, 50, 330	PAD REINFORCEMENT	10	18	2070	0.62	22.99	91.96
D	3535	CHIMNEY BAR	20	4	3835	2.46	37.81	151.27
D1	300	CHIMNEY BAR	20	4	3835	2.46	37.81	151.27
E	320, 320	CHIMNEY SQUARE SPACER	8	13	1472	0.39	7.55	30.21
E1	226, 226	CHIMNEY SQUARE SPACER	8	13	1097	0.39	5.62	22.50
						TOTAL REINFORCEMENT/ TOWER=		637.8

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY FISSURED ROCK
UNIT WEIGHT (Kg/m^3):	1700
LIMIT BEARING CAPACITY (Kg/m2) :	62500
ANGLE OF REPOSE :	20
WATER TABLE (m) :	BELOW 3.5m FROM G.L.
FOUNDATION DEPTH (m):	3.5

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	7.52
CONCRETE (M10) m^3	0.8
TOTAL CONCRETE m^3	8.32
EXCAVATION m3	41.44
REINFORCEMENT Kg	637.8

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3300

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

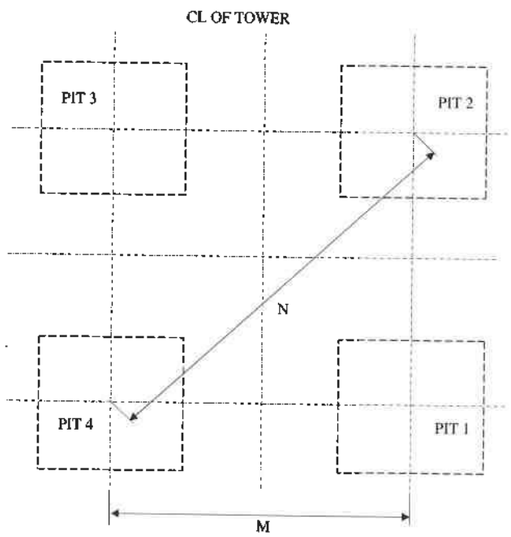
8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

EXCAVATION PLAN DETAIL			
STUB =	H130X130X10L		
TOWER SLOPE =	9.26	2*TAN α=	0.32620278
B/B WIDTH AT C.L.(mm) =	11588.3		
CG OF STUB(mm) =	35.9		
CG TO CG WIDTH AT C.L.(mm) =	11517		

TOWER TYPE	F B/B AT C.L	M (CG TO CG) AT WORKING POINT	N
N = NORMAL TOWER	11588	12569	17775
3M BE = ATTACHED TO NT	12567	13548	19160
6M BE = ATTACHED TO NT	13546	14526	20543
9M BE = ATTACHED TO NT	14524	15505	21928



PIT MARKING PLAN

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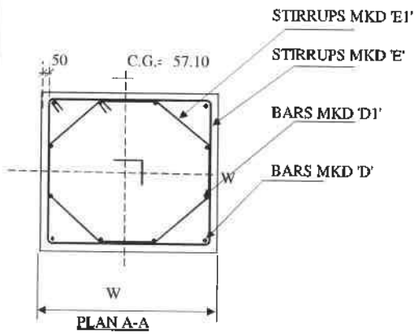
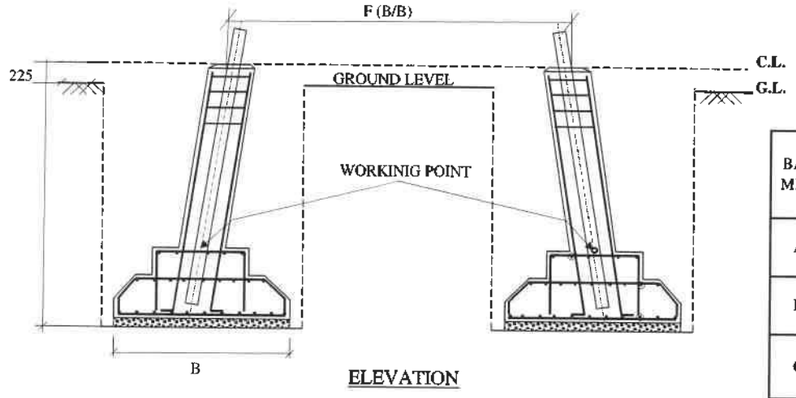
REV N0	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM - NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	03-08-18	FOUNDATION DRAWING FOR TOWER TYPE DA+0/+3/+6/+9M 400KV D/C (WZ-1) DRY FISSURED ROCK SOIL (3.5M DEPTH)				
CHKD	AM	03-08-18					
APPD	DL	03-08-18					
DATE	03-08-18	DRAWING NO.	KTL/400DC/WZ-1/DA/F-005	SHEET NO.	1/1	REV	0

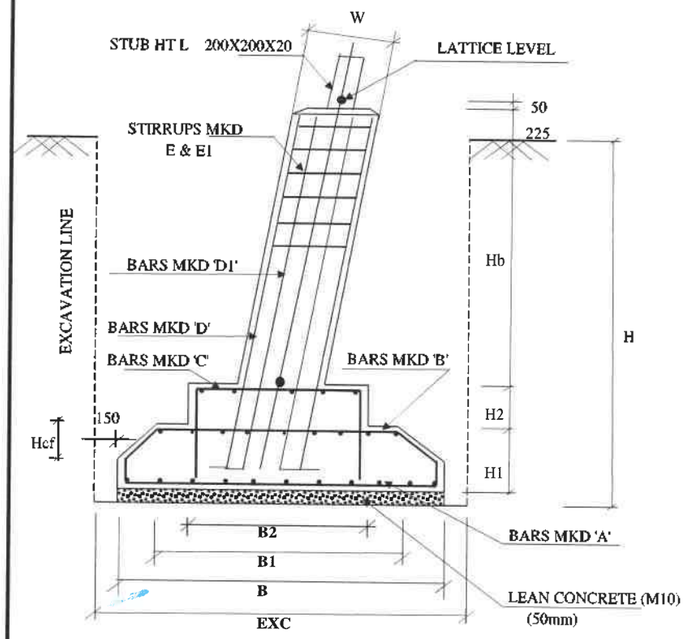




ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
4400	4100	4000	700	3500	2000	400	300	300	3250

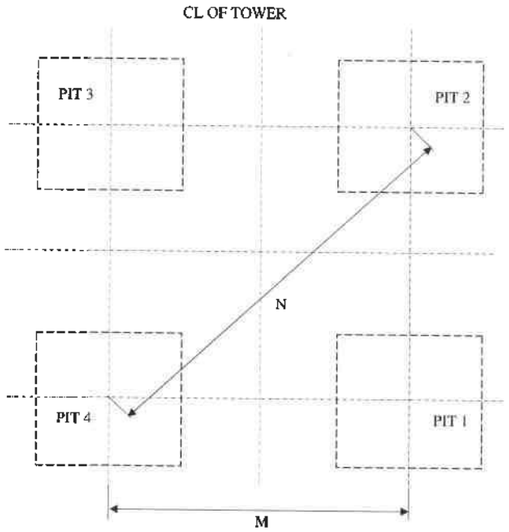
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	4000	PAD REINFORCEMENT	16	50	4000	1.58	315.57	1262.27
B	3400: 50, 354, 354, 50	PAD REINFORCEMENT	12	36	4207	0.89	134.45	537.79
C	1900: 568, 50, 50, 568	PAD REINFORCEMENT	16	16	3136	1.58	79.18	316.74
D	4011	CHIMNEY BAR	32	4	4511	6.31	113.86	455.46
D1	500	CHIMNEY BAR	32	8	4511	6.31	227.72	910.90
E	600, 600	CHIMNEY SQUARE SPACER	8	14	2592	0.39	14.31	57.27
E1	200, 283	CHIMNEY SQUARE SPACER	8	14	2123	0.39	11.72	46.92
						TOTAL REINFORCEMENT/ TOWER=		3587.3



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY
UNIT WEIGHT (Kg/m^3):	1440
LIMIT BEARING CAPACITY (Kg/m2) :	25000
ANGLE OF REPOSE :	30
WATER TABLE (m) :	BELOW 3.5m FROM G.L.
FOUNDATION DEPTH (m):	4

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	35.7
CONCRETE (M10) m^3	3.36
TOTAL CONCRETE m^3	39.06
EXCAVATION m3	309.76
REINFORCEMENT Kg	3587.3

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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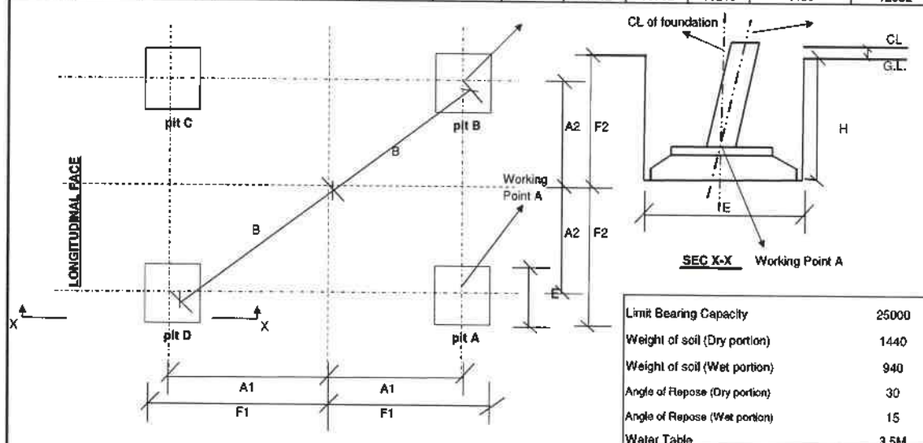
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) DRY SOIL (4.0M DEPTH)				
CHKD	AM	13-08-18					
APPD	DL	13-08-18					
DATE	13-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-001	SHEET NO.	1/2	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DD" SOIL TYPE - DRY (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DD"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)	Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12713		12713		200X200X20	50	57.1	1.028857	0.483931204	1.028857	0.4839312
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	4100	3250	225	7152	7152	10115	4400	9352	9352	4000
-3MBE (+) -1.5M LE	1500	13349	13349	4100	3250	225	7515	7515	10628	4400	9715	9715	4000
-3MBE (+) +0M LE	3000	14074	14074	4100	3250	225	7878	7878	11141	4400	10078	10078	4000
-3MBE (+) +1.5M LE	4500	14800	14800	4100	3250	225	8241	8241	11655	4400	10441	10441	4000
-3MBE (+) +3M LE	6000	15526	15526	4100	3250	225	8604	8604	12168	4400	10804	10804	4000
+0MBE (+) -3M LE	3000	14074	14074	4100	3250	225	7878	7878	11141	4400	10078	10078	4000
+0MBE (+) -1.5M LE	4500	14800	14800	4100	3250	225	8241	8241	11655	4400	10441	10441	4000
+0MBE (+) +0M LE	6000	15526	15526	4100	3250	225	8604	8604	12168	4400	10804	10804	4000
+0MBE (+) +1.5M LE	7500	16252	16252	4100	3250	225	8967	8967	12681	4400	11167	11167	4000
+0MBE (+) +3M LE	9000	16978	16978	4100	3250	225	9330	9330	13194	4400	11530	11530	4000
+3MBE (+) -3M LE	6000	15526	15526	4100	3250	225	8604	8604	12168	4400	10804	10804	4000
+3MBE (+) -1.5M LE	7500	16252	16252	4100	3250	225	8967	8967	12681	4400	11167	11167	4000
+3MBE (+) +0M LE	9000	16978	16978	4100	3250	225	9330	9330	13194	4400	11530	11530	4000
+3MBE (+) +1.5M LE	10500	17704	17704	4100	3250	225	9693	9693	13708	4400	11893	11893	4000
+3MBE (+) +3M LE	12000	18430	18430	4100	3250	225	10056	10056	14221	4400	12256	12256	4000
+6MBE (+) -3M LE	9000	16978	16978	4100	3250	225	9330	9330	13194	4400	11530	11530	4000
+6MBE (+) -1.5M LE	10500	17704	17704	4100	3250	225	9693	9693	13708	4400	11893	11893	4000
+6MBE (+) +0M LE	12000	18430	18430	4100	3250	225	10056	10056	14221	4400	12256	12256	4000
+6MBE (+) +1.5M LE	13500	19156	19156	4100	3250	225	10419	10419	14734	4400	12619	12619	4000
+6MBE (+) +3M LE	15000	19882	19882	4100	3250	225	10782	10782	15248	4400	12982	12982	4000



Limit Bearing Capacity	25000	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	3.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

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NOTES:

1.DRAWING NOT TO SCALE
2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5.STUB BELOW GROUND LEVEL = 3800 mm
6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8.CLEAR COVER TO REINFORCEMENT IS 50MM
9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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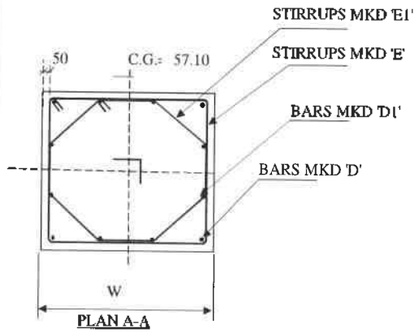
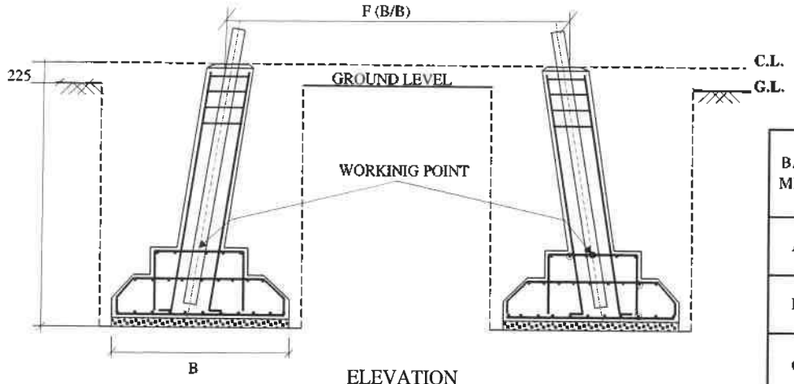
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

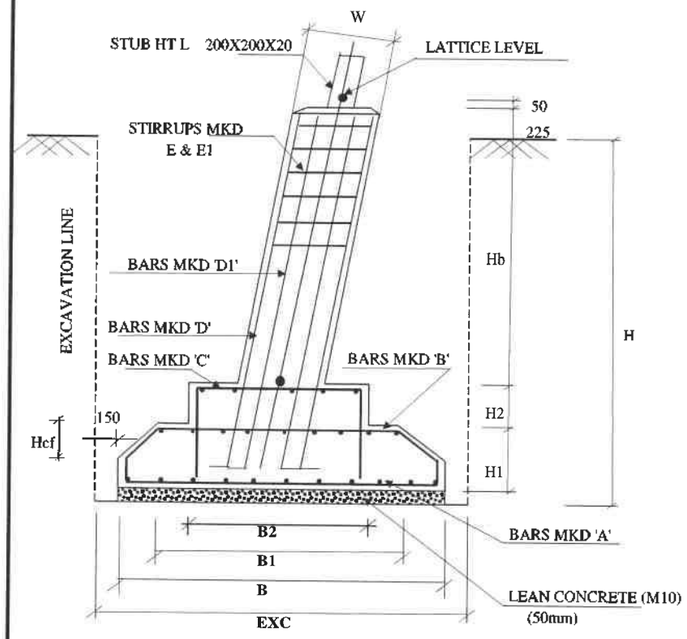
PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD					
CLIENT	STERLITE POWER GRID VENTURES LIMITED					
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED					
DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) DRY SOIL (4.0M DEPTH)			
CHKD	AM	13-08-18				
APPD	DL	13-08-18				
DATE	13-08-18	DRAWING NO.	GTTPL/400DCWZ-1/DD/F-001	SHEET NO.	2/2	REV 0





EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
5900	5600	4000	700	5000	2000	400	300	300	3250

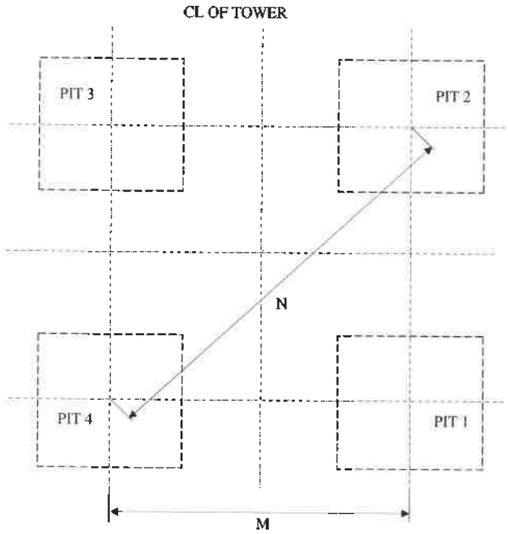
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	5500	PAD REINFORCEMENT	16	72	5500	1.58	624.76	2499.06
B	4900: 50, 354, 354, 50	PAD REINFORCEMENT	16	44	5707	1.58	396.19	1584.76
C	1900: 568, 50, 50, 568	PAD REINFORCEMENT	16	16	3136	1.58	79.18	316.74
D	4011	CHIMNEY BAR	32	4	4511	6.31	113.86	455.46
D1	500	CHIMNEY BAR	32	8	4511	6.31	227.72	910.90
E	600 × 600	CHIMNEY SQUARE SPACER	8	14	2592	0.39	14.31	57.27
E1	200, 283	CHIMNEY SQUARE SPACER	8	14	2123	0.39	11.72	46.92
						TOTAL REINFORCEMENT/ TOWER=		5871.1



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	WET
UNIT WEIGHT (Kg/m^3):	1440 / 940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	30 / 15
WATER TABLE (m) :	1.50 BELOW G.L.
FOUNDATION DEPTH (m):	4

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	57.9
CONCRETE (M10) m^3	6.27
TOTAL CONCRETE m^3	64.17
EXCAVATION m3	556.96
REINFORCEMENT Kg	5872.0

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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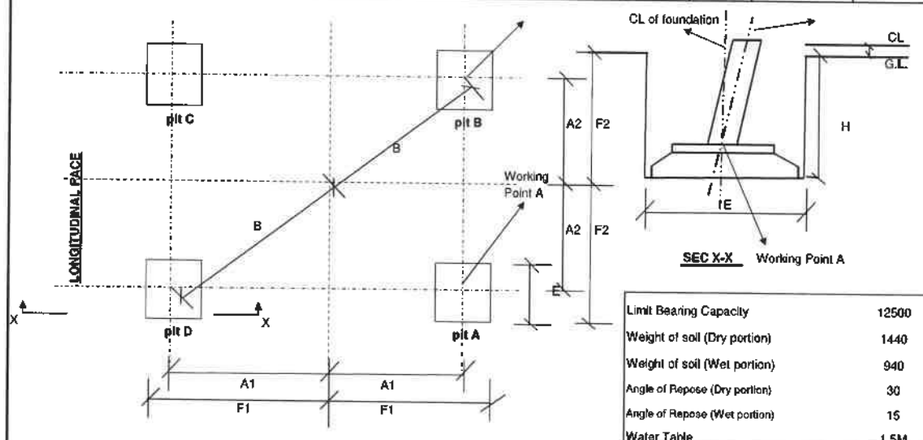
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) WET SOIL (4.0M DEPTH)				
CHKD	AM	13-08-18					
APPD	DL	13-08-18					
DATE	13-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-002	SHEET NO.	1/2	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DD" SOIL TYPE - WET (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DD"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)	Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12713		12713		200X200X20	50	57.1	1.028857	0.483931204	1.028857	0.4839312
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	5600	3250	225	7152	7152	10115	5900	10102	10102	4000
-3MBE (+) -1.5M LE	1500	13349	13349	5600	3250	225	7515	7515	10628	5900	10465	10465	4000
-3MBE (+) +0M LE	3000	14074	14074	5600	3250	225	7878	7878	11141	5900	10828	10828	4000
-3MBE (+) +1.5M LE	4500	14800	14800	5600	3250	225	8241	8241	11655	5900	11191	11191	4000
-3MBE (+) +3M LE	6000	15526	15526	5600	3250	225	8604	8604	12168	5900	11554	11554	4000
+0MBE (+) -3M LE	3000	14074	14074	5600	3250	225	7878	7878	11141	5900	10828	10828	4000
+0MBE (+) -1.5M LE	4500	14800	14800	5600	3250	225	8241	8241	11655	5900	11191	11191	4000
+0MBE (+) +0M LE	6000	15526	15526	5600	3250	225	8604	8604	12168	5900	11554	11554	4000
+0MBE (+) +1.5M LE	7500	16252	16252	5600	3250	225	8967	8967	12681	5900	11917	11917	4000
+0MBE (+) +3M LE	9000	16978	16978	5600	3250	225	9330	9330	13194	5900	12280	12280	4000
+3MBE (+) -3M LE	6000	15526	15526	5600	3250	225	8604	8604	12168	5900	11554	11554	4000
+3MBE (+) -1.5M LE	7500	16252	16252	5600	3250	225	8967	8967	12681	5900	11917	11917	4000
+3MBE (+) +0M LE	9000	16978	16978	5600	3250	225	9330	9330	13194	5900	12280	12280	4000
+3MBE (+) +1.5M LE	10500	17704	17704	5600	3250	225	9693	9693	13708	5900	12643	12643	4000
+3MBE (+) +3M LE	12000	18430	18430	5600	3250	225	10056	10056	14221	5900	13006	13006	4000
+6MBE (+) -3M LE	9000	16978	16978	5600	3250	225	9330	9330	13194	5900	12280	12280	4000
+6MBE (+) -1.5M LE	10500	17704	17704	5600	3250	225	9693	9693	13708	5900	12643	12643	4000
+6MBE (+) +0M LE	12000	18430	18430	5600	3250	225	10056	10056	14221	5900	13006	13006	4000
+6MBE (+) +1.5M LE	13500	19156	19156	5600	3250	225	10419	10419	14734	5900	13369	13369	4000
+6MBE (+) +3M LE	15000	19882	19882	5600	3250	225	10782	10782	15248	5900	13732	13732	4000



Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	1.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

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NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20.LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3800 mm
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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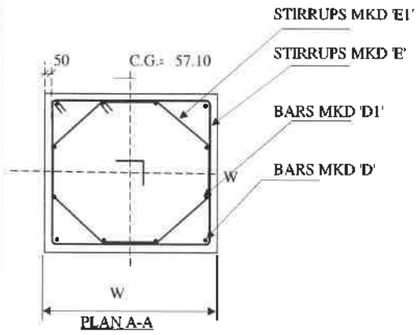
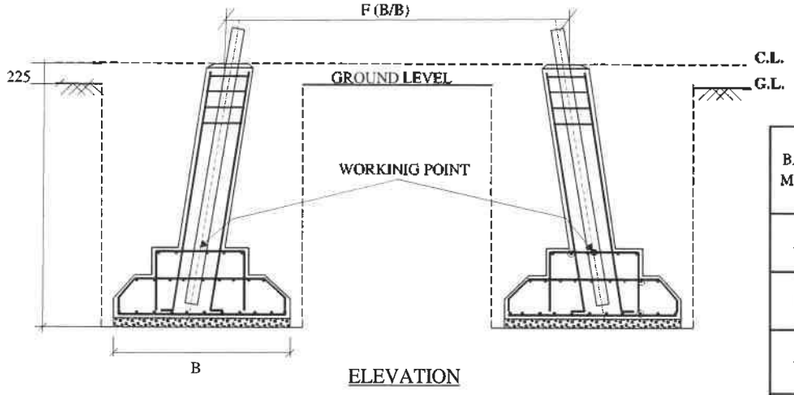
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

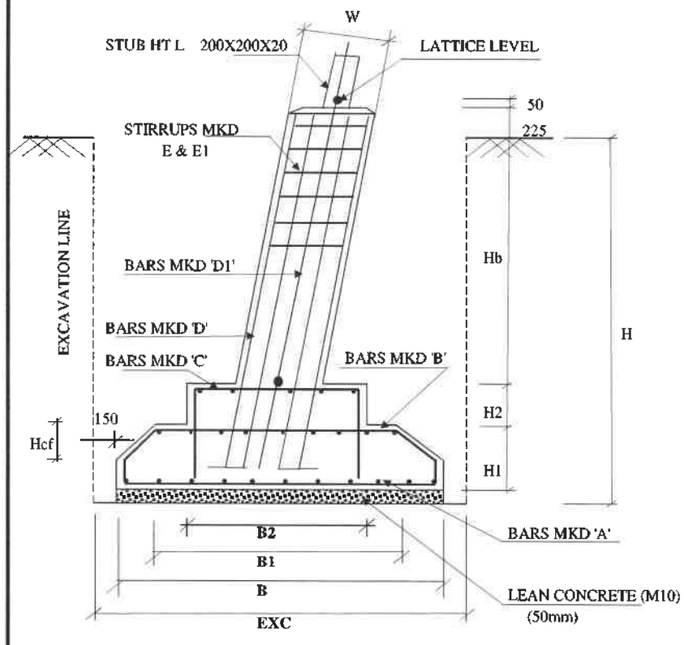
PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD					
CLIENT	STERLITE POWER GRID VENTURES LIMITED					
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED					
DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) WET SOIL (4.0M DEPTH)			
CHKD	AM	13-08-18				
APPD	DL	13-08-18				
DATE	13-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-002	SHEET NO.	2/2	REV 0





EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
6400	6100	4000	700	5500	2000	400	300	300	3250

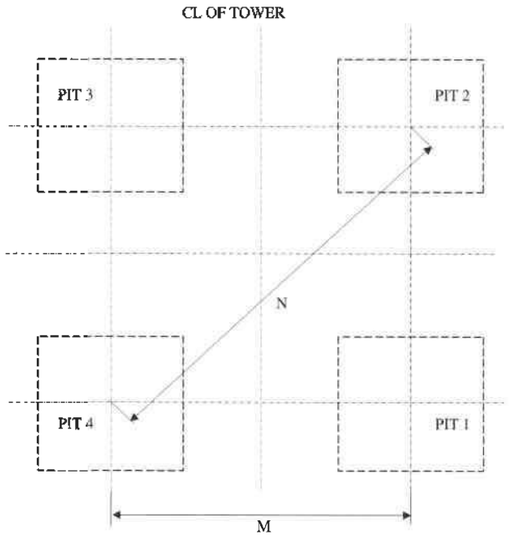
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	6000	PAD REINFORCEMENT	16	80	6000	1.58	757.28	3029.11
B	5400 (50, 354, 354, 50)	PAD REINFORCEMENT	16	52	6207	1.58	509.23	2036.92
C	1900 (568, 50, 50, 568)	PAD REINFORCEMENT	16	18	3136	1.58	89.08	356.32
D	4011 / 500	CHIMNEY BAR	32	4	4511	6.31	113.86	455.46
D1		CHIMNEY BAR	32	8	4511	6.31	227.72	910.90
E	600 / 600	CHIMNEY SQUARE SPACER	8	14	2592	0.39	14.31	57.27
E1	200 / 283	CHIMNEY SQUARE SPACER	8	14	2123	0.39	11.72	46.92
						TOTAL REINFORCEMENT/ TOWER=		6892.9



FOUNDATION ELEVATION (CROSS SECTION)

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	PARTIALLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	1440 / 940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	30 / 15
WATER TABLE (m) :	0.75 BELOW G.L.
FOUNDATION DEPTH (m):	4



PIT MARKING PLAN

NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3800
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	66.9
CONCRETE (M10) m^3	7.44
TOTAL CONCRETE m^3	74.34
EXCAVATION m3	655.36
REINFORCEMENT Kg	6892.9

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) PARTIALLY SUBMERGED SOIL (4.0M DEPTH)				
CHKD	AM	13-08-18					
APPD	DL	13-08-18					
DATE	13-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-003	SHEET NO.	1/1	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DD" SOIL TYPE - PS (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DD"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12713		12713		200X200X20		50	57.1	1.028857	0.483931204	1.028857	0.4839312
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	6100	3250	225	7152	7152	10115	6400	10352	10352	4000
-3MBE (+) -1.5M LE	1500	13349	13349	6100	3250	225	7515	7515	10628	6400	10715	10715	4000
-3MBE (+) +0M LE	3000	14074	14074	6100	3250	225	7878	7878	11141	6400	11078	11078	4000
-3MBE (+) +1.5M LE	4500	14800	14800	6100	3250	225	8241	8241	11655	6400	11441	11441	4000
-3MBE (+) +3M LE	6000	15526	15526	6100	3250	225	8604	8604	12168	6400	11804	11804	4000
+0MBE (+) -3M LE	3000	14074	14074	6100	3250	225	7878	7878	11141	6400	11078	11078	4000
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+0MBE (+) +1.5M LE	7500	16252	16252	6100	3250	225	8967	8967	12681	6400	12167	12167	4000
+0MBE (+) +3M LE	9000	16978	16978	6100	3250	225	9330	9330	13194	6400	12530	12530	4000
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+3MBE (+) +1.5M LE	10500	17704	17704	6100	3250	225	9693	9693	13708	6400	12893	12893	4000
+3MBE (+) +3M LE	12000	18430	18430	6100	3250	225	10056	10056	14221	6400	13256	13256	4000
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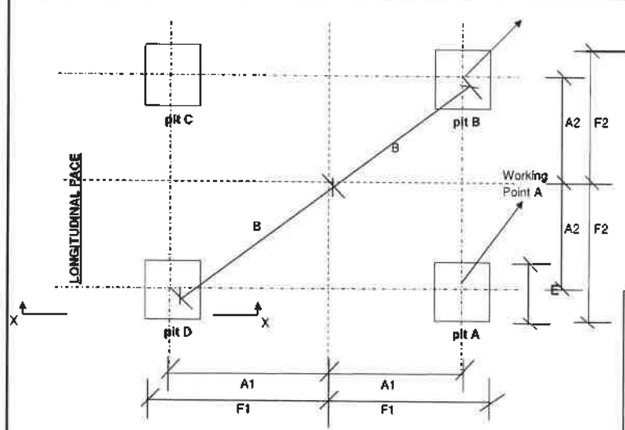
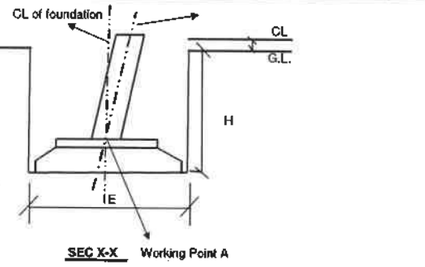
+6MBE (+) +1.5M LE	13500	19156	19156	6100	3250	225	10419	10419	14734	6400	13619	13619	4000
+6MBE (+) +3M LE	15000	19882	19882	6100	3250	225	10782	10782	15248	6400	13982	13982	4000





Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	0.75M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

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NOTES:

1.DRAWING NOT TO SCALE
2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5.STUB BELOW GROUND LEVEL = 3800 mm
6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
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9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
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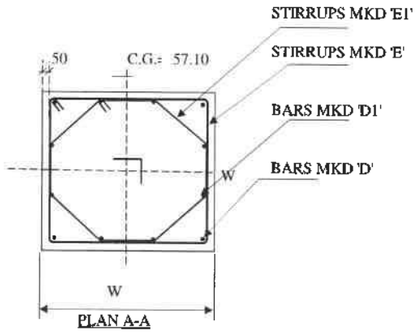
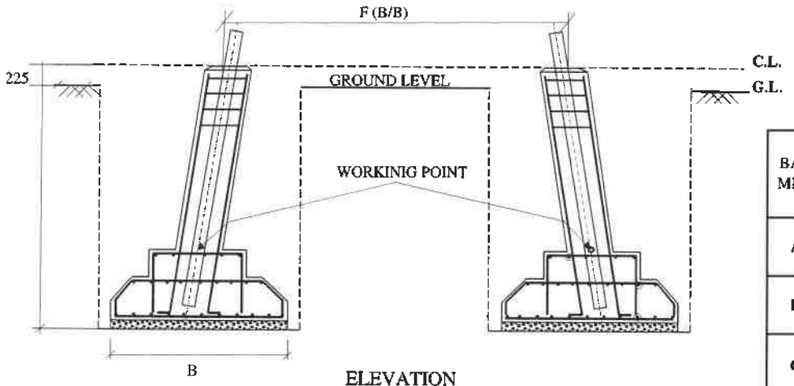
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) PARTIALLY SUBMERGED SOIL (4.0M DEPTH)				
CHKD	AM	13-08-18					
APPD	DL	13-08-18					
DATE	13-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-003	SHEET NO.	2/2	REV	0

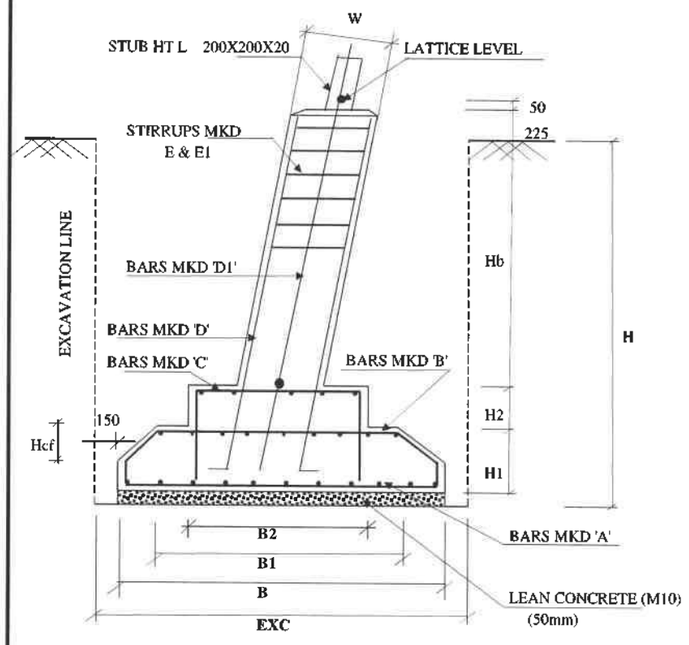




ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
6880	6580	4000	700	5980	2000	400	300	300	3250

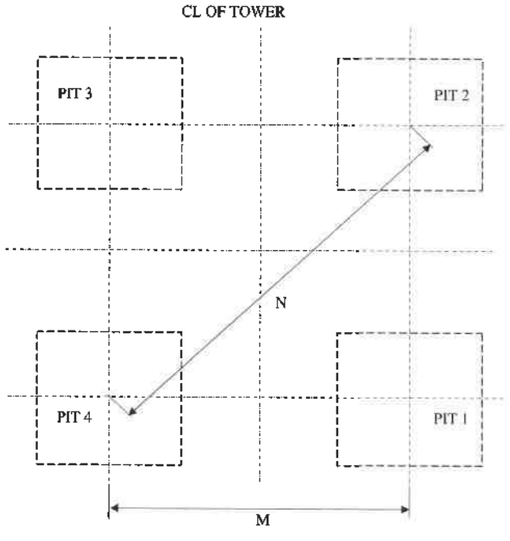
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	6480	PAD REINFORCEMENT	20	60	6480	2.46	958.41	3833.65
B	5880: 50, 354, 354, 50	PAD REINFORCEMENT	16	62	6687	1.58	654.10	2616.39
C	1900: 560, 50, 50, 560	PAD REINFORCEMENT	16	18	3120	1.58	88.62	354.50
D	4003	CHIMNEY BAR	32	4	4503	6.31	113.66	454.65
D1	500	CHIMNEY BAR	32	8	4503	6.31	227.32	909.29
E	600, 600	CHIMNEY SQUARE SPACER	8	13	2592	0.39	13.29	53.18
E1	200, 283	CHIMNEY SQUARE SPACER	8	13	2123	0.39	10.89	43.57
						TOTAL REINFORCEMENT/ TOWER=		8265.2



FOUNDATION ELEVATION (CROSS SECTION)

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	FULLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	15
WATER TABLE (m) :	0m BELOW G.L.
FOUNDATION DEPTH (m):	4



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	76.29
CONCRETE (M10) m^3	8.66
TOTAL CONCRETE m^3	84.95
EXCAVATION m3	757.35
REINFORCEMENT Kg	8265.2

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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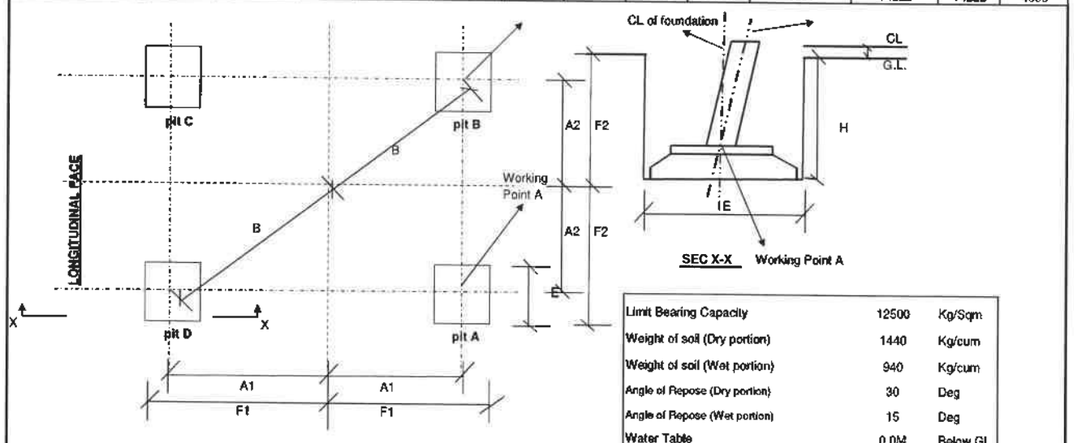
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) FULLY SUBMERGED SOIL (4.0M DEPTH)				
CHKD	AM	13-08-18					
APPD	DL	13-08-18					
DATE	13-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-004	SHEET NO.	1/2	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DD" SOIL TYPE - FS (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DD"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)	Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12713		12713		200X200X20	50	57.1	1.028857	0.483931204	1.028857	0.4839312
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	6580	3250	225	7152	7152	10115	6880	10592	10592	4000
-3MBE (+) -1.5M LE	1500	13349	13349	6580	3250	225	7515	7515	10628	6880	10955	10955	4000
-3MBE (+) +0M LE	3000	14074	14074	6580	3250	225	7878	7878	11141	6880	11318	11318	4000
-3MBE (+) +1.5M LE	4500	14800	14800	6580	3250	225	8241	8241	11655	6880	11681	11681	4000
-3MBE (+) +3M LE	6000	15526	15526	6580	3250	225	8604	8604	12168	6880	12044	12044	4000
+0MBE (+) -3M LE	3000	14074	14074	6580	3250	225	7878	7878	11141	6880	11318	11318	4000
+0MBE (+) -1.5M LE	4500	14800	14800	6580	3250	225	8241	8241	11655	6880	11681	11681	4000
+0MBE (+) +0M LE	6000	15526	15526	6580	3250	225	8604	8604	12168	6880	12044	12044	4000
+0MBE (+) +1.5M LE	7500	16252	16252	6580	3250	225	8967	8967	12681	6880	12407	12407	4000
+0MBE (+) +3M LE	9000	16978	16978	6580	3250	225	9330	9330	13194	6880	12770	12770	4000
+3MBE (+) -3M LE	6000	15526	15526	6580	3250	225	8604	8604	12168	6880	12044	12044	4000
+3MBE (+) -1.5M LE	7500	16252	16252	6580	3250	225	8967	8967	12681	6880	12407	12407	4000
+3MBE (+) +0M LE	9000	16978	16978	6580	3250	225	9330	9330	13194	6880	12770	12770	4000
+3MBE (+) +1.5M LE	10500	17704	17704	6580	3250	225	9693	9693	13708	6880	13133	13133	4000
+3MBE (+) +3M LE	12000	18430	18430	6580	3250	225	10056	10056	14221	6880	13496	13496	4000
+6MBE (+) -3M LE	9000	16978	16978	6580	3250	225	9330	9330	13194	6880	12770	12770	4000
+6MBE (+) -1.5M LE	10500	17704	17704	6580	3250	225	9693	9693	13708	6880	13133	13133	4000
+6MBE (+) +0M LE	12000	18430	18430	6580	3250	225	10056	10056	14221	6880	13496	13496	4000
+6MBE (+) +1.5M LE	13500	19156	19156	6580	3250	225	10419	10419	14734	6880	13859	13859	4000
+6MBE (+) +3M LE	15000	19882	19882	6580	3250	225	10782	10782	15248	6880	14222	14222	4000



Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	0.0M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

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NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3800 mm
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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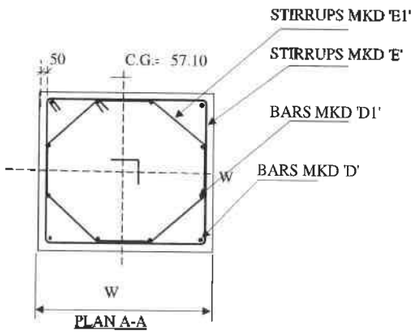
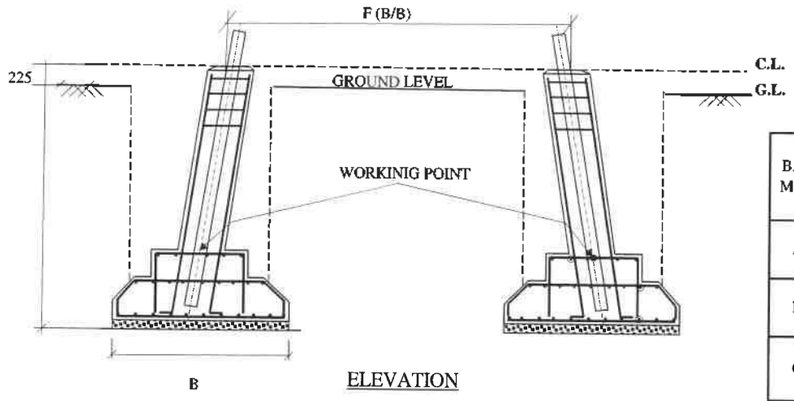
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

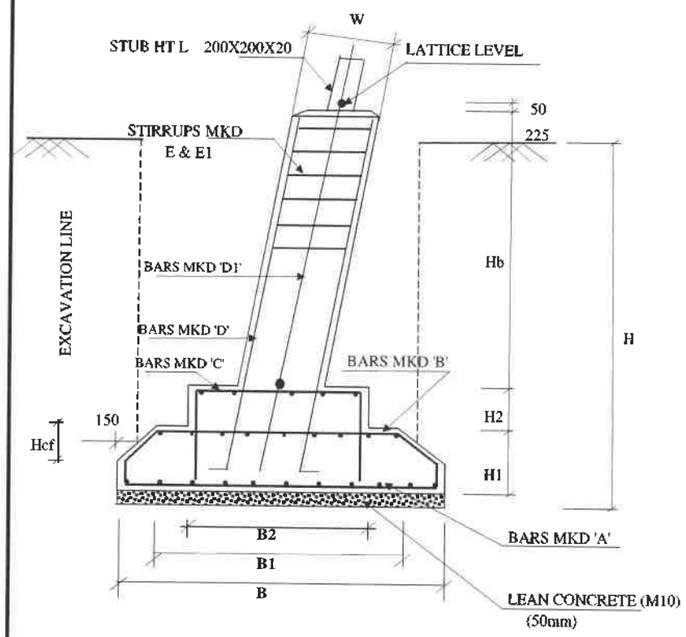
DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) FULLY SUBMERGED SOIL (4.0M DEPTH)				
CHKD	AM	13-08-18					
APPD	DL	13-08-18					
DATE	13-08-18	DRAWING NO.	GTTPL/400DCWZ-1/DD/F-004	SHEET NO.	2/2	REV	0





B	H	W	B1	B2	H1	H2	Hcf	Hb
4300	4000	700	3700	2000	400	300	300	3250

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	4200	PAD REINFORCEMENT	16	54	4200	1.58	357.85	1431.38
B	3600: 50, 354, 354, 50	PAD REINFORCEMENT	12	40	4407	0.89	156.48	625.91
C	1900: 568, 50, 50, 568	PAD REINFORCEMENT	16	16	3136	1.58	79.18	316.74
D	4011, 500	CHIMNEY BAR	32	4	4511	6.31	113.86	455.46
D1		CHIMNEY BAR	32	8	4511	6.31	227.72	910.90
E	600, 600	CHIMNEY SQUARE SPACER	8	14	2592	0.39	14.31	57.27
E1	200, 283	CHIMNEY SQUARE SPACER	8	14	2123	0.39	11.72	46.90
						TOTAL REINFORCEMENT/ TOWER=		3844.6



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY FISSURED ROCK
UNIT WEIGHT (Kg/m^3):	1700
LIMIT BEARING CAPACITY (Kg/m2) :	62500
ANGLE OF REPOSE :	20
WATER TABLE (m) :	BELOW 3.5m FROM G.L.
FOUNDATION DEPTH (m):	4

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

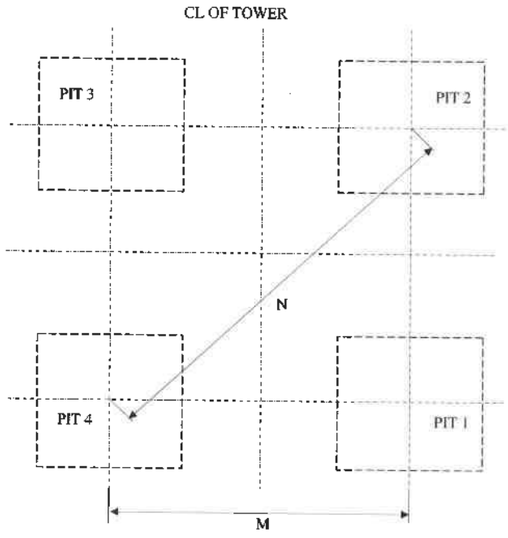
7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	38.24
CONCRETE (M10) m^3	3.7
TOTAL CONCRETE m^3	41.94
EXCAVATION m3	258.24
REINFORCEMENT Kg	3844.6



PIT MARKING PLAN

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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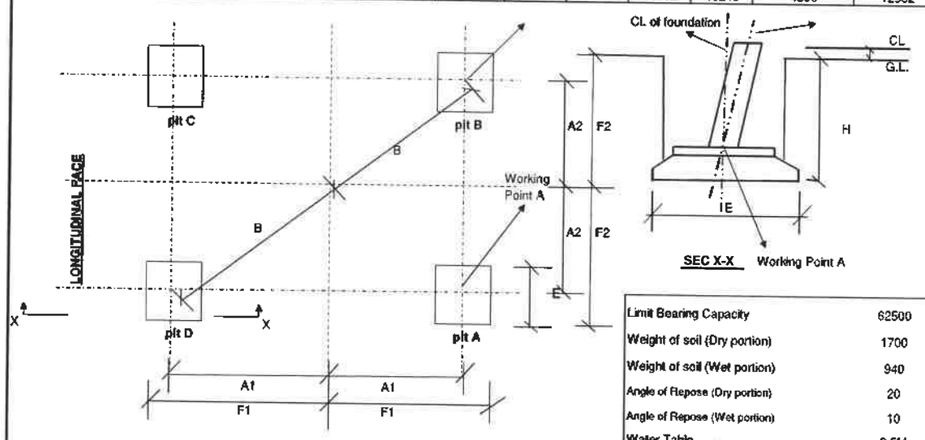
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) DRY FISSURED ROCK SOIL (4.0M DEPTH)				
CHKD	AM	13-08-18					
APPD	DL	13-08-18					
DATE	13-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-005	SHEET NO.	1/2	REV	0

Project	400 KV D/C -X-M & X-N (WZ-1) - TT "DD" SOIL TYPE - DFR (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C-X-M & X-N- TT "DD"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12713		12713		200X200X20		50	57.1	1.028857	0.483931204	1.028857	0.4839312
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	4300	3250	225	7152	7152	10115	4300	9302	9302	4000
-3MBE (+) -1.5M LE	1500	13349	13349	4300	3250	225	7515	7515	10628	4300	9665	9665	4000
-3MBE (+) +0M LE	3000	14074	14074	4300	3250	225	7878	7878	11141	4300	10028	10028	4000
-3MBE (+) +1.5M LE	4500	14800	14800	4300	3250	225	8241	8241	11655	4300	10391	10391	4000
-3MBE (+) +3M LE	6000	15526	15526	4300	3250	225	8604	8604	12168	4300	10754	10754	4000
+0MBE (+) -3M LE	3000	14074	14074	4300	3250	225	7878	7878	11141	4300	10028	10028	4000
+0MBE (+) -1.5M LE	4500	14800	14800	4300	3250	225	8241	8241	11655	4300	10391	10391	4000
+0MBE (+) +0M LE	6000	15526	15526	4300	3250	225	8604	8604	12168	4300	10754	10754	4000
+0MBE (+) +1.5M LE	7500	16252	16252	4300	3250	225	8967	8967	12681	4300	11117	11117	4000
+0MBE (+) +3M LE	9000	16978	16978	4300	3250	225	9330	9330	13194	4300	11480	11480	4000
+3MBE (+) -3M LE	6000	15526	15526	4300	3250	225	8604	8604	12168	4300	10754	10754	4000
+3MBE (+) -1.5M LE	7500	16252	16252	4300	3250	225	8967	8967	12681	4300	11117	11117	4000
+3MBE (+) +0M LE	9000	16978	16978	4300	3250	225	9330	9330	13194	4300	11480	11480	4000
+3MBE (+) +1.5M LE	10500	17704	17704	4300	3250	225	9693	9693	13708	4300	11843	11843	4000
+3MBE (+) +3M LE	12000	18430	18430	4300	3250	225	10056	10056	14221	4300	12206	12206	4000
+6MBE (+) -3M LE	9000	16978	16978	4300	3250	225	9330	9330	13194	4300	11480	11480	4000
+6MBE (+) -1.5M LE	10500	17704	17704	4300	3250	225	9693	9693	13708	4300	11843	11843	4000
+6MBE (+) +0M LE	12000	18430	18430	4300	3250	225	10056	10056	14221	4300	12206	12206	4000
+6MBE (+) +1.5M LE	13500	19156	19156	4300	3250	225	10419	10419	14734	4300	12569	12569	4000
+6MBE (+) +3M LE	15000	19882	19882	4300	3250	225	10782	10782	15248	4300	12932	12932	4000



Limit Bearing Capacity	62500	Kg/Sqm
Weight of soil (Dry portion)	1700	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	20	Deg
Angle of Repose (Wet portion)	10	Deg
Water Table	3.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241955602
2 TAN B =	0.483931204
FACE =	1.028857904
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.235178971
SEC B =	1.027282409

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NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3800 mm
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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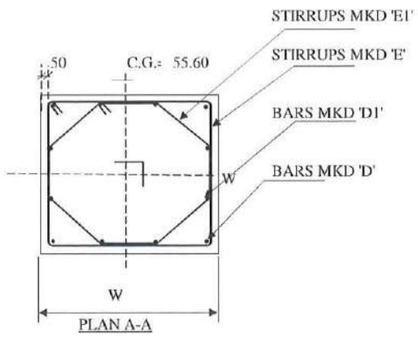
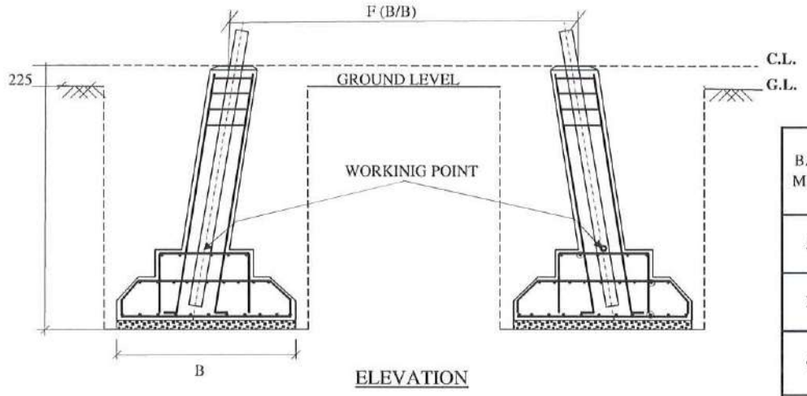
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	13-08-18	FOUNDATION DRAWING FOR TOWER TYPE DD-3/+0/+3/+6M 400KV D/C (WZ-1) DRY FISSURED ROCK SOIL (4.0M DEPTH)			
CHKD	AM	13-08-18				
APPD	DL	13-08-18				
DATE	13-08-18	DRAWING NO.	GTTPL/400DC/WZ-1/DD/F-005	SHEET NO.	2/2	REV 0

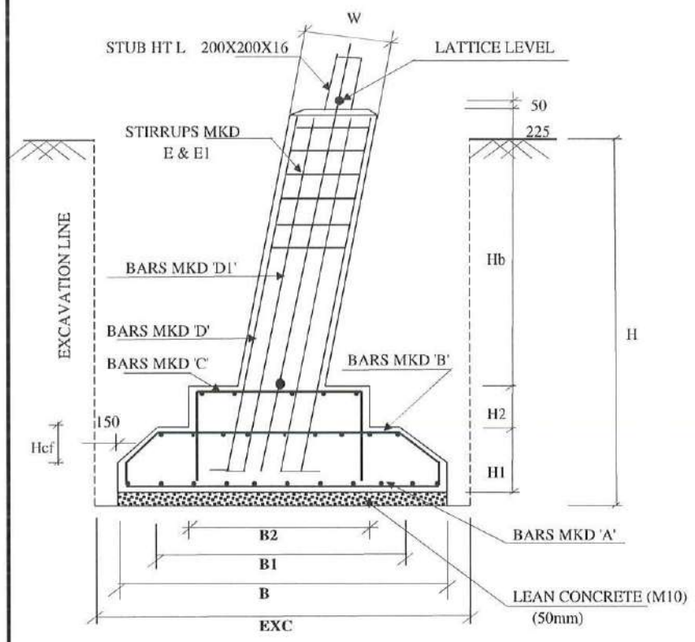




ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
4200	3900	4000	700	3300	2000	400	300	300	3250

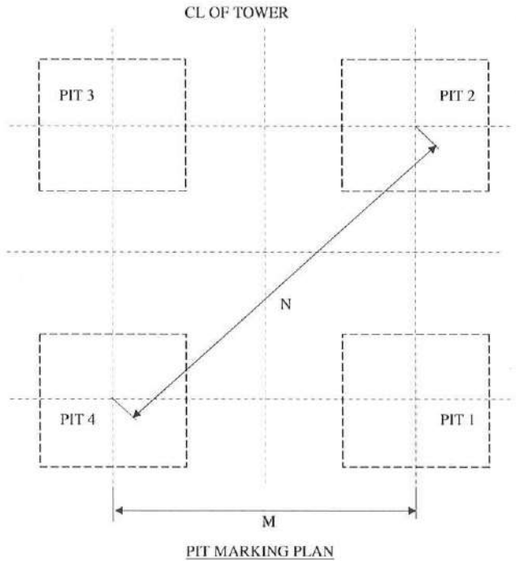
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	3800	PAD REINFORCEMENT	16	42	3800	1.58	251.83	1007.34
B	3200 (50, 354, 354, 50)	PAD REINFORCEMENT	12	28	4007	0.89	99.61	398.45
C	1900 (568, 50, 50, 568)	PAD REINFORCEMENT	12	28	3136	0.89	77.95	311.79
D	4011	CHIMNEY BAR	32	4	4511	6.31	113.86	455.46
D1	500	CHIMNEY BAR	32	8	4511	6.31	227.72	910.90
E	600 / 600	CHIMNEY SQUARE SPACER	8	14	2592	0.39	14.31	57.27
E1	200 / 283	CHIMNEY SQUARE SPACER	8	14	2123	0.39	11.72	46.92
						TOTAL REINFORCEMENT/ TOWER=		3188.1



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY
UNIT WEIGHT (Kg/m^3):	1440
LIMIT BEARING CAPACITY (Kg/m2) :	25000
ANGLE OF REPOSE :	30
WATER TABLE (m) :	BELOW 4.0m FROM G.L.
FOUNDATION DEPTH (m):	4

VERTICAL SLOPE	
TAN B =	0.241837837
2 TAN B =	0.483675674
FACE =	1.028827264
DEV =	1.056868525
IN FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	33.28
CONCRETE (M10) m^3	3.04
TOTAL CONCRETE m^3	36.32
EXCAVATION m3	282.24
REINFORCEMENT Kg	3188.1

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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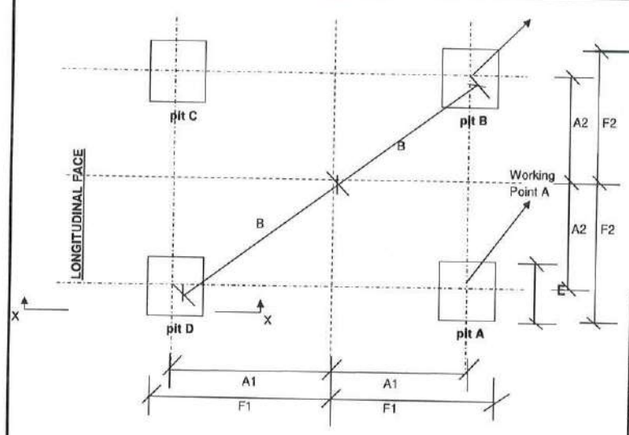
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

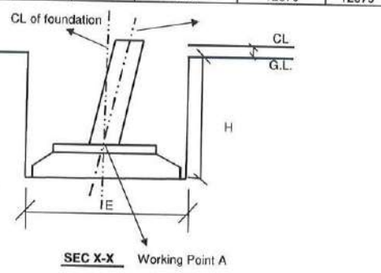
PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) DRY SOIL (4.0M DEPTH)				
CHKD	AM	20-09-18					
APPD	DL	20-09-18					
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/F-001	SHEET NO.	1/2	REV	0

Project	400 KV D/C X-N (WZ-1) TT "DDN" (30-45 DEG. DEV.) SOIL - DRY (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C -X-N- TT "DDN"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)	Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12710		12710		200X200X16	50	55.6	1.028827	0.483675674	1.028827	0.4836757
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	3900	3250	225	7152	7152	10114	4200	9252	9252	4000
-3MBE (+) -1.5M LE	1500	13348	13348	3900	3250	225	7515	7515	10627	4200	9615	9615	4000
-3MBE (+) +0M LE	3000	14074	14074	3900	3250	225	7877	7877	11140	4200	9977	9977	4000
-3MBE (+) +1.5M LE	4500	14800	14800	3900	3250	225	8240	8240	11653	4200	10340	10340	4000
-3MBE (+) +3M LE	6000	15525	15525	3900	3250	225	8603	8603	12166	4200	10703	10703	4000
+0MBE (+) -3M LE	3000	14074	14074	3900	3250	225	7877	7877	11140	4200	9977	9977	4000
+0MBE (+) -1.5M LE	4500	14800	14800	3900	3250	225	8240	8240	11653	4200	10340	10340	4000
+0MBE (+) +0M LE	6000	15525	15525	3900	3250	225	8603	8603	12166	4200	10703	10703	4000
+0MBE (+) +1.5M LE	7500	16251	16251	3900	3250	225	8966	8966	12679	4200	11066	11066	4000
+0MBE (+) +3M LE	9000	16976	16976	3900	3250	225	9328	9328	13192	4200	11428	11428	4000
+3MBE (+) -3M LE	6000	15525	15525	3900	3250	225	8603	8603	12166	4200	10703	10703	4000
+3MBE (+) -1.5M LE	7500	16251	16251	3900	3250	225	8966	8966	12679	4200	11066	11066	4000
+3MBE (+) +0M LE	9000	16976	16976	3900	3250	225	9328	9328	13192	4200	11428	11428	4000
+3MBE (+) +1.5M LE	10500	17702	17702	3900	3250	225	9691	9691	13705	4200	11791	11791	4000
+3MBE (+) +3M LE	12000	18427	18427	3900	3250	225	10054	10054	14218	4200	12154	12154	4000
+6MBE (+) -3M LE	9000	16976	16976	3900	3250	225	9328	9328	13192	4200	11428	11428	4000
+6MBE (+) -1.5M LE	10500	17702	17702	3900	3250	225	9691	9691	13705	4200	11791	11791	4000
+6MBE (+) +0M LE	12000	18427	18427	3900	3250	225	10054	10054	14218	4200	12154	12154	4000
+6MBE (+) +1.5M LE	13500	19153	19153	3900	3250	225	10417	10417	14731	4200	12517	12517	4000
+6MBE (+) +3M LE	15000	19878	19878	3900	3250	225	10779	10779	15244	4200	12879	12879	4000





Limit Bearing Capacity	25000	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	3.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241837837
2 TAN B =	0.483675674
FACE =	1.028827264
DEV =	1.056868525
IN FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576

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NOTES:

1.DRAWING NOT TO SCALE
2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5.STUB BELOW GROUND LEVEL = 3800 mm
6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8.CLEAR COVER TO REINFORCEMENT IS 50MM
9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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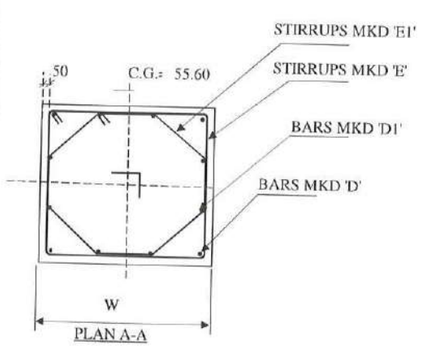
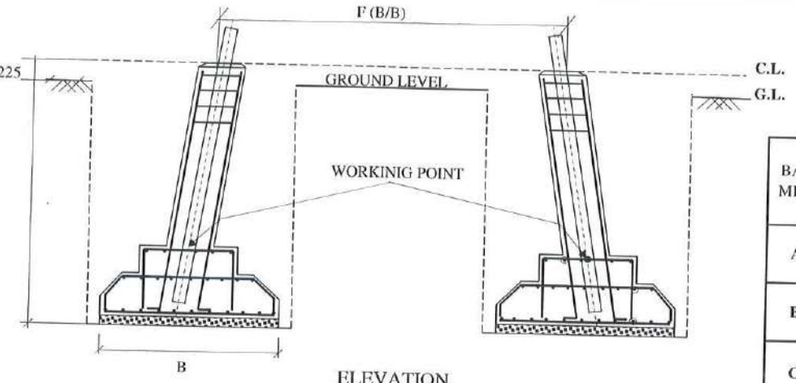
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

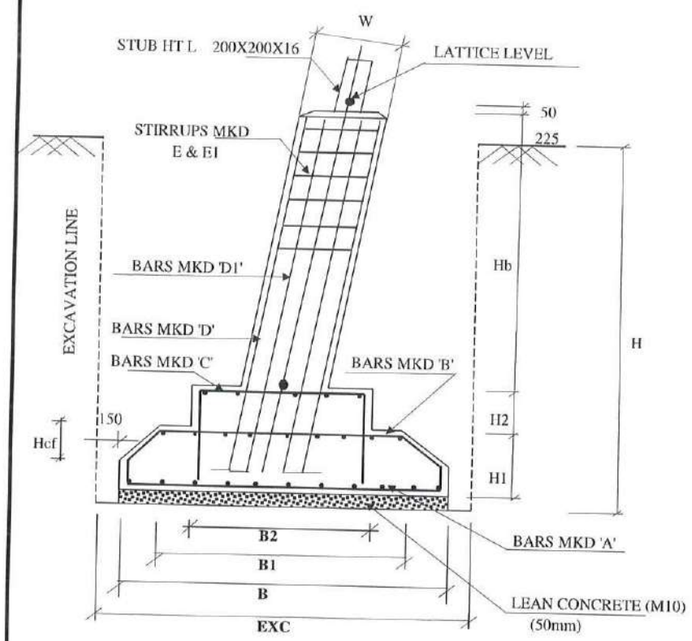
PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD				
CLIENT	STERLITE POWER GRID VENTURES LIMITED				
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED				
DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) DRY SOIL (4.0M DEPTH)		
CHKD	AM	20-09-18			
APPD	DL	20-09-18			
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/F-001	SHEET NO. 2/2	REV 0





EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
5450	5150	4000	700	4550	2000	400	300	300	3250

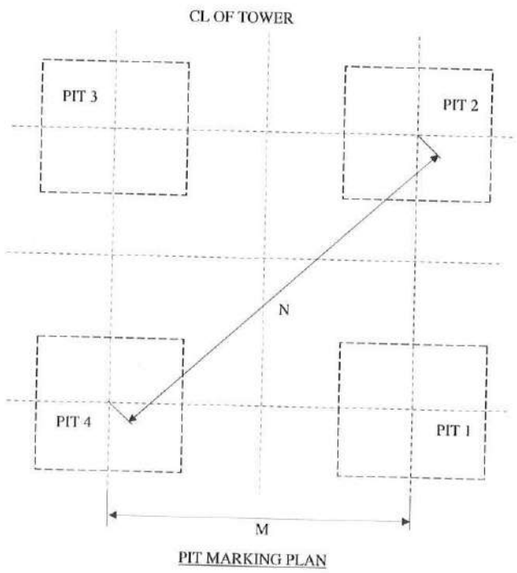
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER (mm)	NO. OF BARS PER FDN (no)	LENGTH (mm)	UNIT WEIGHT (kg/m)	WEIGHT PER LEG (kg)	WEIGHT PER TOWER (kg)
A	5050	PAD REINFORCEMENT	16	58	5050	1.58	462.12	1848.48
B	4450: 50, 354, 354, 50	PAD REINFORCEMENT	12	54	5257	0.89	251.96	1007.83
C	1900: 568, 50, 50, 568	PAD REINFORCEMENT	12	28	3136	0.89	77.95	311.79
D	4011, 500	CHIMNEY BAR	32	4	4511	6.31	113.86	455.46
D1		CHIMNEY BAR	32	8	4511	6.31	227.72	910.90
E	600, 600	CHIMNEY SQUARE SPACER	8	14	2592	0.39	14.31	57.27
E1	200, 283	CHIMNEY SQUARE SPACER	8	14	2123	0.39	11.72	46.92
						TOTAL REINFORCEMENT/ TOWER=		4638.6



FOUNDATION ELEVATION (CROSS SECTION)

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	WET
UNIT WEIGHT (Kg/m^3):	1440 / 940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	30 / 15
WATER TABLE (m) :	1.50 BELOW G.L.
FOUNDATION DEPTH (m):	4

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	50.48
CONCRETE (M10) m^3	5.3
TOTAL CONCRETE m^3	55.78
EXCAVATION m3	475.24
REINFORCEMENT Kg	4639.0

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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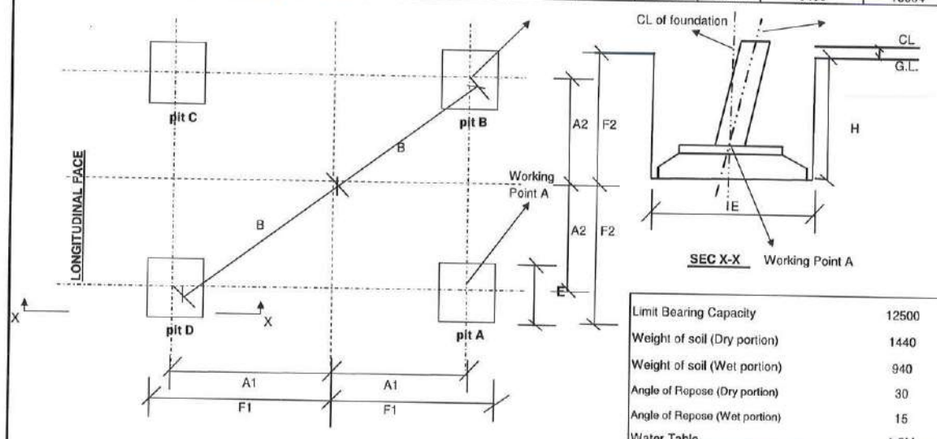
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) WET SOIL (4.0M DEPTH)				
CHKD	AM	20-09-18					
APPD	DL	20-09-18					
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/F-002	SHEET NO.	1/2	REV	0

Project	400 KV D/C X-N (WZ-1) TT "DDN" (30-45 DEG. DEV.) SOIL - WET (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C -X-N- TT "DDN"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12710		12710		200X200X16		50	55.6	1.028827	0.483675674	1.028827	0.4836757
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	5150	3250	225	7152	7152	10114	5450	9877	9877	4000
-3MBE (+) -1.5M LE	1500	13348	13348	5150	3250	225	7515	7515	10627	5450	10240	10240	4000
-3MBE (+) +0M LE	3000	14074	14074	5150	3250	225	7877	7877	11140	5450	10602	10602	4000
-3MBE (+) +1.5M LE	4500	14800	14800	5150	3250	225	8240	8240	11653	5450	10965	10965	4000
-3MBE (+) +3M LE	6000	15525	15525	5150	3250	225	8603	8603	12166	5450	11328	11328	4000
+0MBE (+) -3M LE	3000	14074	14074	5150	3250	225	7877	7877	11140	5450	10602	10602	4000
+0MBE (+) -1.5M LE	4500	14800	14800	5150	3250	225	8240	8240	11653	5450	10965	10965	4000
+0MBE (+) +0M LE	6000	15525	15525	5150	3250	225	8603	8603	12166	5450	11328	11328	4000
+0MBE (+) +1.5M LE	7500	16251	16251	5150	3250	225	8966	8966	12679	5450	11691	11691	4000
+0MBE (+) +3M LE	9000	16976	16976	5150	3250	225	9328	9328	13192	5450	12053	12053	4000
+3MBE (+) -3M LE	6000	15525	15525	5150	3250	225	8603	8603	12166	5450	11328	11328	4000
+3MBE (+) -1.5M LE	7500	16251	16251	5150	3250	225	8966	8966	12679	5450	11691	11691	4000
+3MBE (+) +0M LE	9000	16976	16976	5150	3250	225	9328	9328	13192	5450	12053	12053	4000
+3MBE (+) +1.5M LE	10500	17702	17702	5150	3250	225	9691	9691	13705	5450	12416	12416	4000
+3MBE (+) +3M LE	12000	18427	18427	5150	3250	225	10054	10054	14218	5450	12779	12779	4000
+6MBE (+) -3M LE	9000	16976	16976	5150	3250	225	9328	9328	13192	5450	12053	12053	4000
+6MBE (+) -1.5M LE	10500	17702	17702	5150	3250	225	9691	9691	13705	5450	12416	12416	4000
+6MBE (+) +0M LE	12000	18427	18427	5150	3250	225	10054	10054	14218	5450	12779	12779	4000
+6MBE (+) +1.5M LE	13500	19153	19153	5150	3250	225	10417	10417	14731	5450	13142	13142	4000
+6MBE (+) +3M LE	15000	19878	19878	5150	3250	225	10779	10779	15244	5450	13504	13504	4000



Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	1.5M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241965602
2 TAN B =	0.483931204
FACE =	1.028857304
DEV =	1.05692701
IN FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576

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NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3800 mm
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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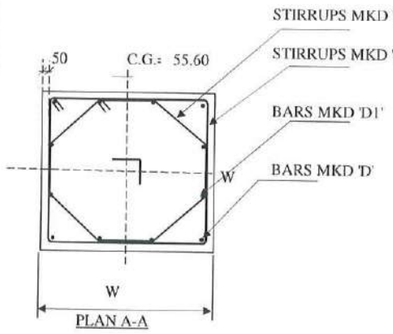
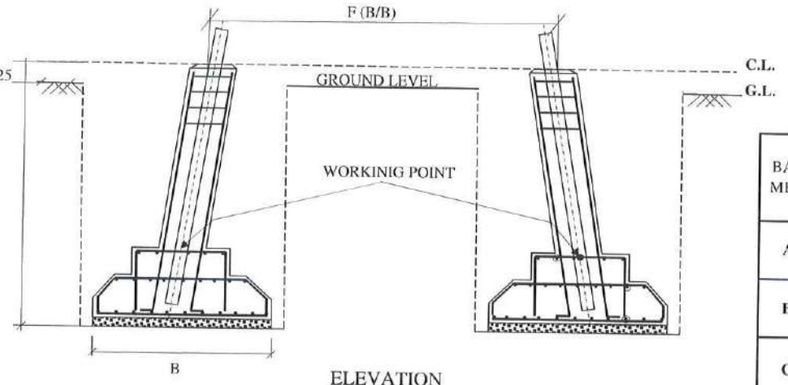
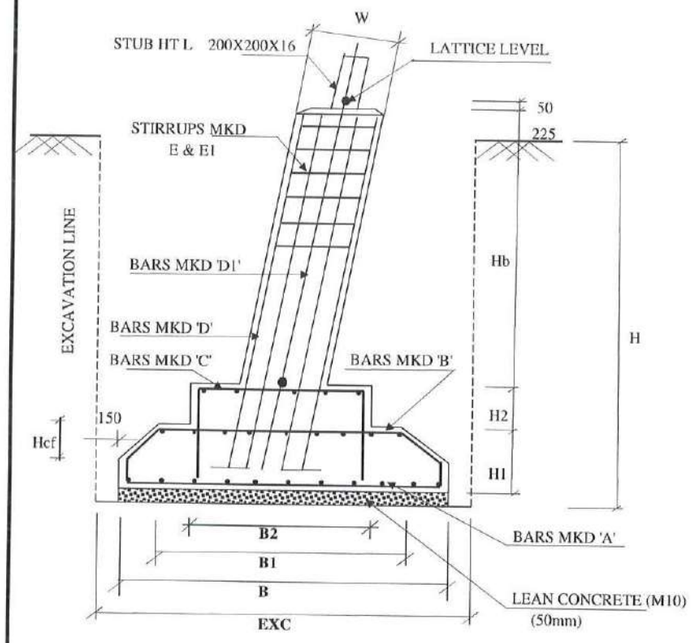
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD
PROJECT		400KV D/C XELDAM-NARENDRA TRANSMISSION LTD			
CLIENT		STERLITE POWER GRID VENTURES LIMITED			
DESIGNER:		STERLITE POWER GRID VENTURES LIMITED			
DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) WET SOIL (4.0M DEPTH)		
CHKD	AM	20-09-18			
APPD	DL	20-09-18			
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/F-002	SHEET NO. 2/2	REV 0





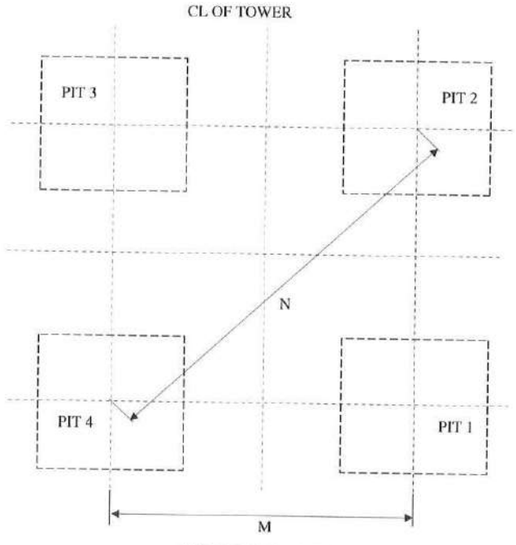
ELEVATION



FOUNDATION ELEVATION (CROSS SECTION)

VERTICAL SLOPE	
TAN B =	0.241837837
2 TAN B =	0.483675674
FACE =	1.028827264
DEV =	1.056868525
IN FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	PARTIALLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	1440 / 940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	30 / 15
WATER TABLE (m) :	0.75 BELOW G.L.
FOUNDATION DEPTH (m):	4



PIT MARKING PLAN

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
5930	5630	4000	700	5030	2000	400	300	300	3250

BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER	NO. OF BARS PER FDN	LENGTH	UNIT WEIGHT	WEIGHT PER LEG	WEIGHT PER TOWER
			(mm)	(no)	(mm)	(kg/m)	(kg)	(kg)
A	5530	PAD REINFORCEMENT	16	62	5530	1.58	540.93	2163.74
B	4930: 50, 354, 354, 50	PAD REINFORCEMENT	12	68	5737	0.89	346.23	1384.93
C	1900: 568, 50, 50, 568	PAD REINFORCEMENT	12	28	3136	0.89	77.95	311.79
D	4011 / 500	CHIMNEY BAR	32	4	4511	6.31	113.86	455.46
D1		CHIMNEY BAR	32	8	4511	6.31	227.72	910.90
E	600 / 600	CHIMNEY SQUARE SPACER	8	14	2592	0.39	14.31	57.27
E1	200 / 283	CHIMNEY SQUARE SPACER	8	14	2123	0.39	11.72	46.92
						TOTAL REINFORCEMENT/ TOWER=		5331.0

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	58.42
CONCRETE (M10) m^3	6.34
TOTAL CONCRETE m^3	64.76
EXCAVATION m3	562.64
REINFORCEMENT Kg	5331.0

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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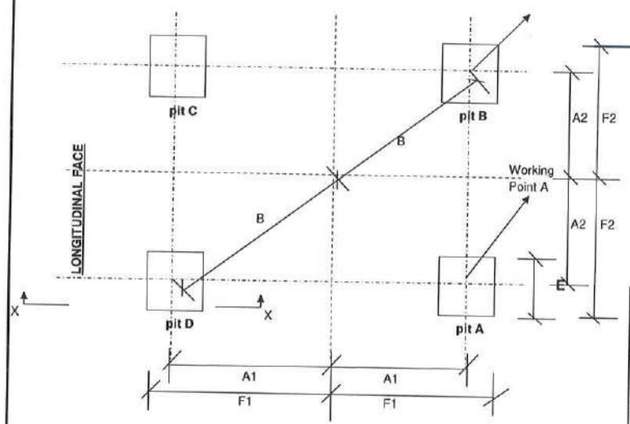
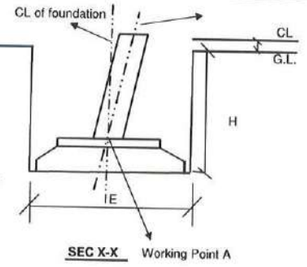
REV N0	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD						
CLIENT	STERLITE POWER GRID VENTURES LIMITED						
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED						
DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) PS SOIL (4.0M DEPTH)				
CHKD	AM	20-09-18					
APPD	DL	20-09-18					
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/F-003	SHEET NO.	1/2	REV	0

Project	400 KV D/C X-N (WZ-1) TT "DDN" (30-45 DEG. DEV.) SOIL - PS (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C -X-N- TT "DDN"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)	" F " B/B of Tower at 3MBE(+)-3MLE (LF)	Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12710	12710	200X200X16		50	55.6	1.028827	0.483675674	1.028827	0.4836757
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	5630	3250	225	7152	7152	10114	5930	10117	10117	4000
-3MBE (+) -1.5M LE	1500	13348	13348	5630	3250	225	7515	7515	10627	5930	10480	10480	4000
-3MBE (+) +0M LE	3000	14074	14074	5630	3250	225	7877	7877	11140	5930	10842	10842	4000
-3MBE (+) +1.5M LE	4500	14800	14800	5630	3250	225	8240	8240	11653	5930	11205	11205	4000
-3MBE (+) +3M LE	6000	15525	15525	5630	3250	225	8603	8603	12166	5930	11568	11568	4000
+0MBE (+) -3M LE	3000	14074	14074	5630	3250	225	7877	7877	11140	5930	10842	10842	4000
+0MBE (+) -1.5M LE	4500	14800	14800	5630	3250	225	8240	8240	11653	5930	11205	11205	4000
+0MBE (+) +0M LE	6000	15525	15525	5630	3250	225	8603	8603	12166	5930	11568	11568	4000
+0MBE (+) +1.5M LE	7500	16251	16251	5630	3250	225	8966	8966	12679	5930	11931	11931	4000
+0MBE (+) +3M LE	9000	16976	16976	5630	3250	225	9328	9328	13192	5930	12293	12293	4000
+3MBE (+) -3M LE	6000	15525	15525	5630	3250	225	8603	8603	12166	5930	11568	11568	4000
+3MBE (+) -1.5M LE	7500	16251	16251	5630	3250	225	8966	8966	12679	5930	11931	11931	4000
+3MBE (+) +0M LE	9000	16976	16976	5630	3250	225	9328	9328	13192	5930	12293	12293	4000
+3MBE (+) +1.5M LE	10500	17702	17702	5630	3250	225	9691	9691	13705	5930	12656	12656	4000
+3MBE (+) +3M LE	12000	18427	18427	5630	3250	225	10054	10054	14218	5930	13019	13019	4000
+6MBE (+) -3M LE	9000	16976	16976	5630	3250	225	9328	9328	13192	5930	12293	12293	4000
+6MBE (+) -1.5M LE	10500	17702	17702	5630	3250	225	9691	9691	13705	5930	12656	12656	4000
+6MBE (+) +0M LE	12000	18427	18427	5630	3250	225	10054	10054	14218	5930	13019	13019	4000
+6MBE (+) +1.5M LE	13500	19153	19153	5630	3250	225	10417	10417	14731	5930	13382	13382	4000
+6MBE (+) +3M LE	15000	19878	19878	5630	3250	225	10779	10779	15244	5930	13744	13744	4000





Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	0.75M	Below GL

NOTE:

1. BEFORE START OF THE FOUNDATION ACTIVITY, ALL THE RELEVENT INFORMATION PROVIDED IN THE TECHNICAL NOTES AND FOUNDATION DRAWINGS SHALL BE READ AND UNDERSTOOD. IF ANY ERROR OR CHANGES ARE OBSERVED, SAME SHALL BE INTIMATED TO ENGINEERING TEAM FOR CORRECTIVE ACTION.
2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241837837
2 TAN B =	0.483675674
FACE =	1.028827264
DEV =	1.056868525
1N FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576

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NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3800 mm
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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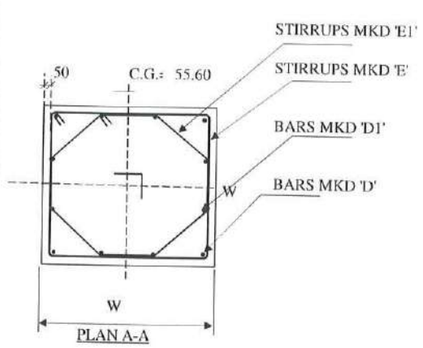
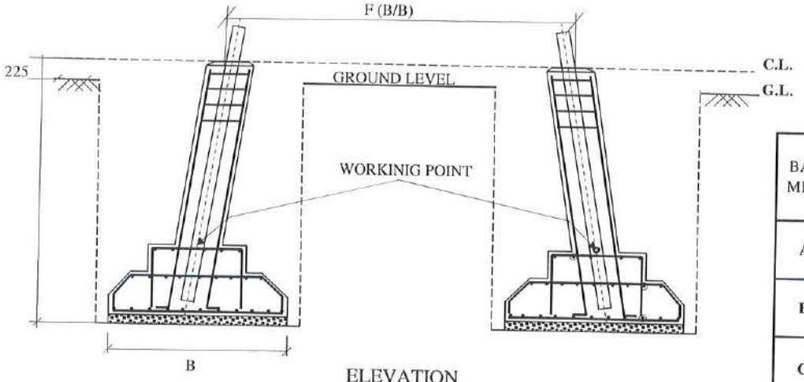
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) PS SOIL (4.0M DEPTH)			
CHKD	AM	20-09-18				
APPD	DL	20-09-18				
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/T-003	SHEET NO.	2/2	REV 0

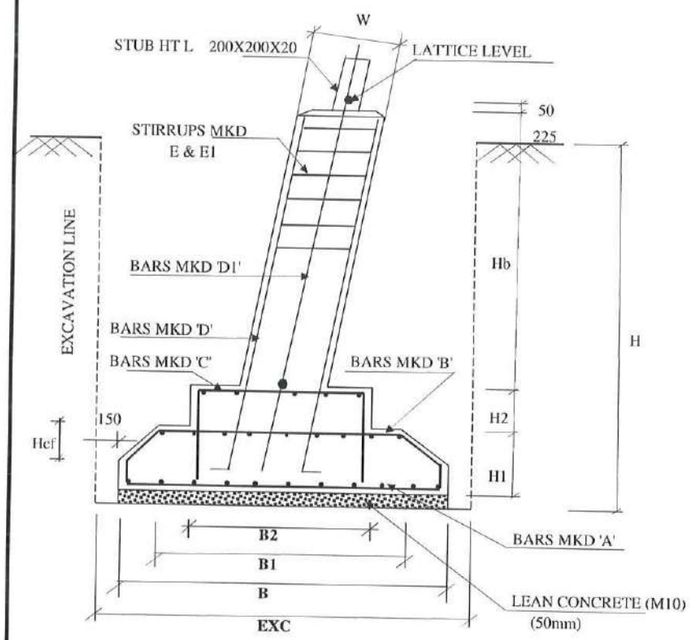




ELEVATION

EXC	B	H	W	B1	B2	H1	H2	Hcf	Hb
6400	6100	4000	700	5500	2000	400	300	300	3250

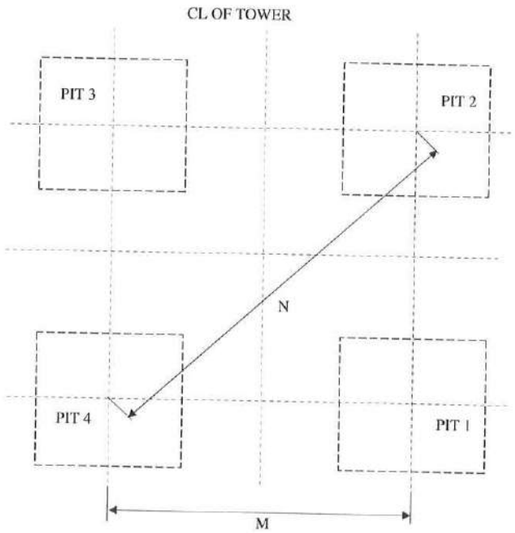
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER	NO. OF BARS PER FDN	LENGTH	UNIT WEIGHT	WEIGHT PER LEG	WEIGHT PER TOWER
			(mm)	(no)	(mm)	('kg/m)	(kg)	(kg)
A	6000	PAD REINFORCEMENT	20	62	6000	2.46	917.00	3668.01
B	5400: 50, 354, 354, 50	PAD REINFORCEMENT	12	82	6207	0.89	451.70	1806.81
C	1900: 560, 50, 50, 560	PAD REINFORCEMENT	12	28	3120	0.89	77.55	310.20
D	4003, 500	CHIMNEY BAR	32	4	4503	6.31	113.66	454.65
D1		CHIMNEY BAR	32	8	4503	6.31	227.32	909.29
E	600, 600	CHIMNEY SQUARE SPACER	8	13	2592	0.39	13.29	53.18
E1	200, 283	CHIMNEY SQUARE SPACER	8	13	2123	0.39	10.89	43.57
						TOTAL REINFORCEMENT/ TOWER=		7245.7



FOUNDATION ELEVATION (CROSS SECTION)

VERTICAL SLOPE	
TAN B =	0.241837837
2 TAN B =	0.483675674
FACE =	1.028827264
DEV =	1.056868525
IN FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	FULLY SUBMERGED
UNIT WEIGHT (Kg/m^3):	940
LIMIT BEARING CAPACITY (Kg/m2) :	12500
ANGLE OF REPOSE :	15
WATER TABLE (m) :	0m BELOW G.L.
FOUNDATION DEPTH (m):	4



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	66.9
CONCRETE (M10) m^3	7.44
TOTAL CONCRETE m^3	74.34
EXCAVATION m3	655.36
REINFORCEMENT Kg	7245.7

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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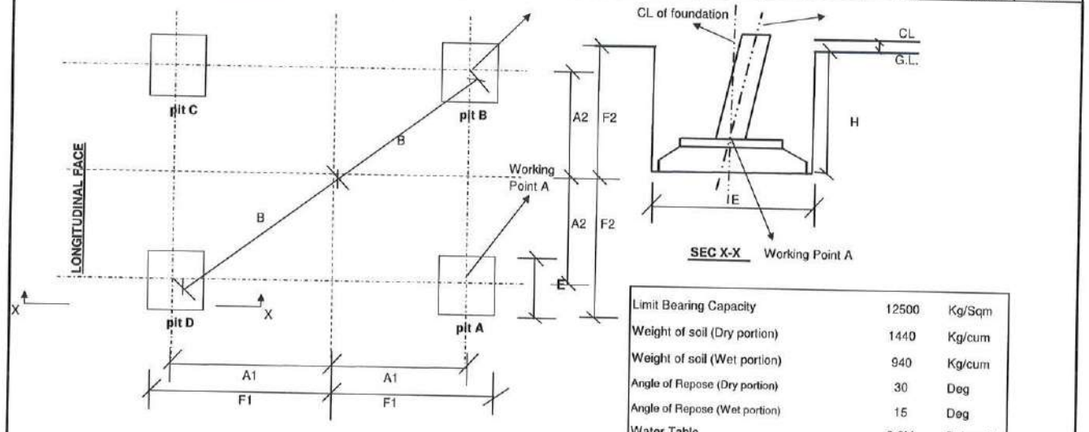
REV N0	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) FS SOIL (4.0M DEPTH)				
CHKD	AM	20-09-18					
APPD	DL	20-09-18					
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/F-004	SHEET NO.	1/2	REV	0

Project	400 KV D/C X-N (WZ-1) TT "DDN" (30-45 DEG. DEV.) SOIL - FS (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C -X-N- TT "DDN"		" F " B/B of Tower at 3MBE(+)-3MLE (TF)		" F " B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12710		12710		200X200X16		50	55.6	1.028827	0.483675674	1.028827	0.4836757
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	6100	3250	225	7152	7152	10114	6400	10352	10352	4000
-3MBE (+) -1.5M LE	1500	13348	13348	6100	3250	225	7515	7515	10627	6400	10715	10715	4000
-3MBE (+) +0M LE	3000	14074	14074	6100	3250	225	7877	7877	11140	6400	11077	11077	4000
-3MBE (+) +1.5M LE	4500	14800	14800	6100	3250	225	8240	8240	11653	6400	11440	11440	4000
-3MBE (+) +3M LE	6000	15525	15525	6100	3250	225	8603	8603	12166	6400	11803	11803	4000
+0MBE (+) -3M LE	3000	14074	14074	6100	3250	225	7877	7877	11140	6400	11077	11077	4000
+0MBE (+) -1.5M LE	4500	14800	14800	6100	3250	225	8240	8240	11653	6400	11440	11440	4000
+0MBE (+) +0M LE	6000	15525	15525	6100	3250	225	8603	8603	12166	6400	11803	11803	4000
+0MBE (+) +1.5M LE	7500	16251	16251	6100	3250	225	8966	8966	12679	6400	12166	12166	4000
+0MBE (+) +3M LE	9000	16976	16976	6100	3250	225	9328	9328	13192	6400	12528	12528	4000
+3MBE (+) -3M LE	6000	15525	15525	6100	3250	225	8603	8603	12166	6400	11803	11803	4000
+3MBE (+) -1.5M LE	7500	16251	16251	6100	3250	225	8966	8966	12679	6400	12166	12166	4000
+3MBE (+) +0M LE	9000	16976	16976	6100	3250	225	9328	9328	13192	6400	12528	12528	4000
+3MBE (+) +1.5M LE	10500	17702	17702	6100	3250	225	9691	9691	13705	6400	12891	12891	4000
+3MBE (+) +3M LE	12000	18427	18427	6100	3250	225	10054	10054	14218	6400	13254	13254	4000
+6MBE (+) -3M LE	9000	16976	16976	6100	3250	225	9328	9328	13192	6400	12528	12528	4000
+6MBE (+) -1.5M LE	10500	17702	17702	6100	3250	225	9691	9691	13705	6400	12891	12891	4000
+6MBE (+) +0M LE	12000	18427	18427	6100	3250	225	10054	10054	14218	6400	13254	13254	4000
+6MBE (+) +1.5M LE	13500	19153	19153	6100	3250	225	10417	10417	14731	6400	13617	13617	4000
+6MBE (+) +3M LE	15000	19878	19878	6100	3250	225	10779	10779	15244	6400	13979	13979	4000



Limit Bearing Capacity	12500	Kg/Sqm
Weight of soil (Dry portion)	1440	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	30	Deg
Angle of Repose (Wet portion)	15	Deg
Water Table	0.0M	Below GL

NOTE:

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2. FOUNDATION SHALL BE EXECUTED IN THE PRESENCE OF SITE ENGINEER ONLY.
3. DIMENSIONS OF BACK TO BACK OF STUB AT CONCRETE LEVEL SHALL BE READ CHECKED WITH FOUNDATION DRAWINGS PIT DIMENSION TABLE FURNISED IN THE SHEET 2 OF 2 OF THIS DRAWINGS BEFORE START OF THE FOUNDATION PIT MARKING.

VERTICAL SLOPE	
TAN B =	0.241837837
2 TAN B =	0.483675674
FACE =	1.028827264
DEV =	1.056868525
IN FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576

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NOTES:

1. DRAWING NOT TO SCALE
2. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
3. CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.
4. REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)
5. STUB BELOW GROUND LEVEL = 3800 mm
6. WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.
7. FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.
8. CLEAR COVER TO REINFORCEMENT IS 50MM
9. STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.
10. AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

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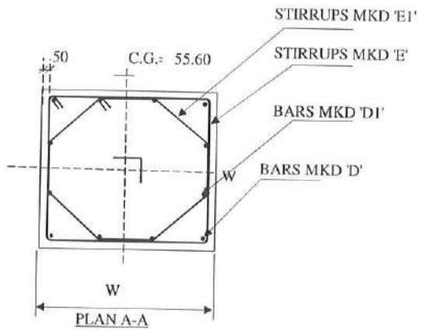
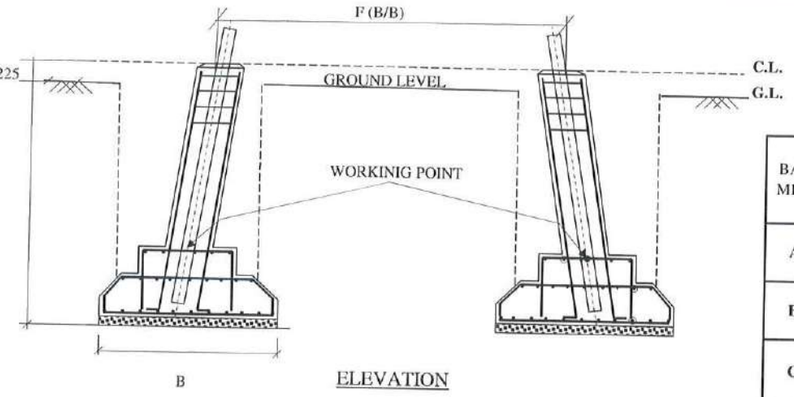
REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD
CLIENT	STERLITE POWER GRID VENTURES LIMITED
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED

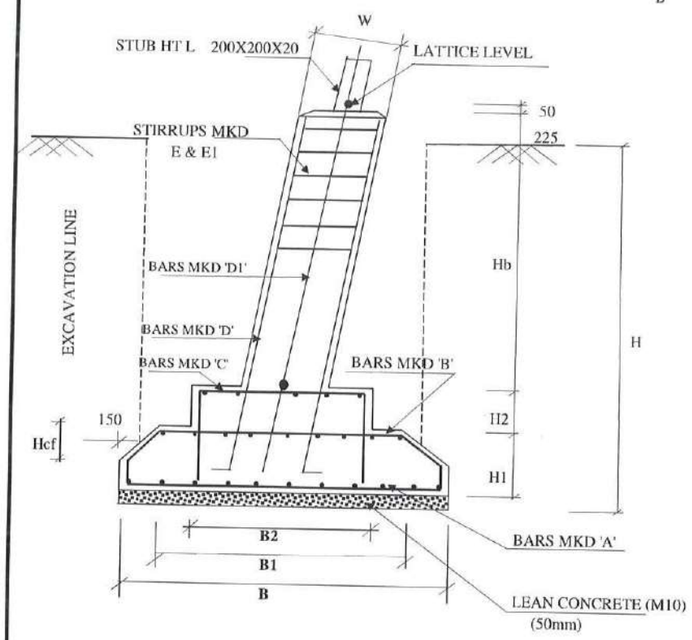
DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) FS SOIL (4.0M DEPTH)			
CHKD	AM	20-09-18				
APPD	DL	20-09-18				
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/F-004	SHEET NO.	2/2	REV 0





B	H	W	B1	B2	H1	H2	Hcf	Hb
3910	4000	700	3310	2000	400	300	300	3250

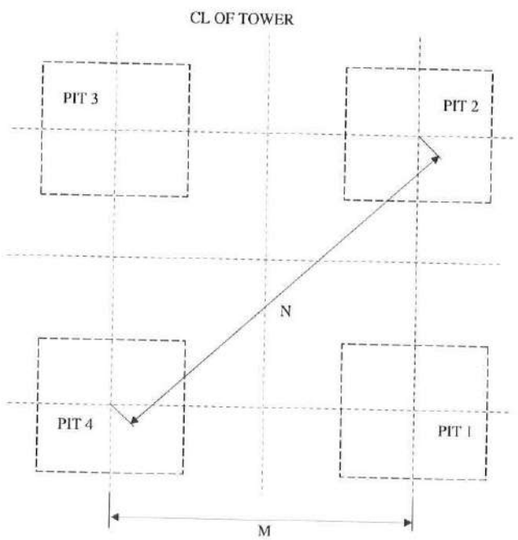
BAR MKD	BAR BENDING SKETCH	BAR DETAILS	SECTION DIAMETER	NO. OF BARS PER FDN	LENGTH	UNIT WEIGHT	WEIGHT PER LEG	WEIGHT PER TOWER
			(mm)	(no)	(mm)	(kg/m)	(kg)	(kg)
A	3810	PAD REINFORCEMENT	16	42	3810	1.58	252.50	1009.99
B	3210: 50, 354, 354, 50	PAD REINFORCEMENT	12	28	4017	0.89	99.86	399.44
C	1900: 568, 50, 50, 568	PAD REINFORCEMENT	12	28	3136	0.89	77.95	311.79
D	4011, 500	CHIMNEY BAR	32	4	4511	6.31	113.86	455.46
D1		CHIMNEY BAR	32	8	4511	6.31	227.72	910.90
E	600, 600	CHIMNEY SQUARE SPACER	8	14	2592	0.39	14.31	57.27
E1	200, 283	CHIMNEY SQUARE SPACER	8	14	2123	0.39	11.72	46.90
						TOTAL REINFORCEMENT/ TOWER=		3191.7



FOUNDATION ELEVATION (CROSS SECTION)

VERTICAL SLOPE	
TAN B =	0.241837837
2 TAN B =	0.483675674
FACE =	1.028827264
DEV =	1.056868525
IN FACE SLOPE	
TAN B =	0.241837837
SEC B =	1.027254576

FOUNDATION DESIGN PARAMENTERS:	
TYPE OF SOIL :	DRY FISSURED ROCK
UNIT WEIGHT (Kg/m^3):	1700
LIMIT BEARING CAPACITY (Kg/m2) :	62500
ANGLE OF REPOSE :	20
WATER TABLE (m) :	BELOW 4.0m FROM G.L.
FOUNDATION DEPTH (m):	4



PIT MARKING PLAN

NOTES:

1.DRAWING NOT TO SCALE

2.ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.

3.CONCRETE MIX USED M20,LEAN CONCRETE MIX M10.

4.REINFORCEMENT ARE HIGH STRENGTH DEFORMED BARS CONFIRMING TO IS 1139/1786(Grade Fe - 500N/mm^2)

5.STUB BELOW GROUND LEVEL = 3800

6.WHENEVER NECESSARY TO CLEAR STUB CLEAT FROM BARS & STIRRUPS SAME IS TO BE ADJUSTED AT SITE.

7.FOR FOUNDATION DESIGN REFER DESIGN DOCUMENTS.

8.CLEAR COVER TO REINFORCEMENT IS 50MM

9.STUB SETTING/PROP SETTING TEMPLATE HAS TO BE USED IN EACH LOCATION OF TOWER.

10.AT SITE PROPER COMPACTION OF THE BACK FILLED EARTH MUST BE DONE.

QUANTITIES/ STRUCTURE	
CONCRETE (M20) m^3	33.4
CONCRETE (M10) m^3	3.06
TOTAL CONCRETE m^3	36.46
EXCAVATION m3	210.52
REINFORCEMENT Kg	3191.7

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REFER SHEET 2 OF 2 FOR PIT DIMENSION TABLE FOR SETTING OF STUB FOR BODY AND LEG EXTENSIONS.

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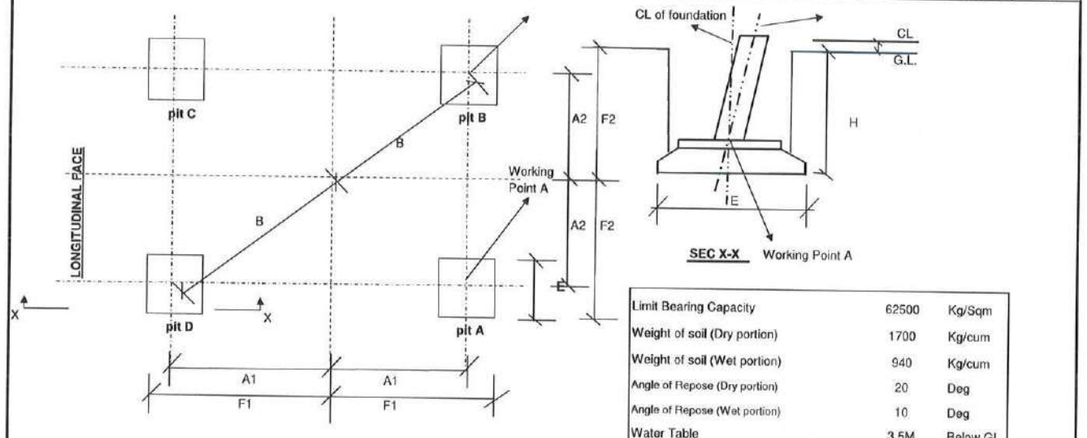
REV N0	DATE	DESCRIPTION	DRAWN	CHKD	APPD
PROJECT		400KV D/C XELDAM-NARENDRA TRANSMISSION LTD			
CLIENT		STERLITE POWER GRID VENTURES LIMITED			
DESIGNER:		STERLITE POWER GRID VENTURES LIMITED			
DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) DFR SOIL (4.0M DEPTH)		
CHKD	AM	20-09-18			
APPD	DL	20-09-18			
DATE	20-09-18	DRAWING NO. GTTPL/400DC/WZ-1/DDN/F-005	SHEET NO. 1/2	REV 0	

Project	400 KV D/C X-N (WZ-1) TT "DDN" (30-45 DEG. DEV.) SOIL - DFR (4.0M DEPTH)	Client:
GOA	PIT DIMENSION TABLE	SPGVL

400 KV D/C -X-N- TT "DDN"		* F * B/B of Tower at 3MBE(+)-3MLE (TF)		* F * B/B of Tower at 3MBE(+)-3MLE (LF)		Stub Section (HT)		Lattice Level to CL	cg	sec B1	2*Tan B1	sec B2	2*Tan B2
		12710		12710		200X200X16		50	55.6	1.028827	0.483675674	1.028827	0.4836757
Tower Detail	Extn from -3MBE(+)-3MLE (mm)	cg-cg dim at CL (TF)	cg-cg dim at CL (LF)	Foundation Base Width	work pt	G.L. TO C.L.	A1	A2	B	E	F1	F2	H
-3MBE (+) -3M LE	0	12623	12623	3910	3250	225	7152	7152	10114	3910	9107	9107	4000
-3MBE (+) -1.5M LE	1500	13348	13348	3910	3250	225	7515	7515	10627	3910	9470	9470	4000
-3MBE (+) +0M LE	3000	14074	14074	3910	3250	225	7877	7877	11140	3910	9832	9832	4000
-3MBE (+) +1.5M LE	4500	14800	14800	3910	3250	225	8240	8240	11653	3910	10195	10195	4000
-3MBE (+) +3M LE	6000	15525	15525	3910	3250	225	8603	8603	12166	3910	10558	10558	4000
+0MBE (+) -3M LE	3000	14074	14074	3910	3250	225	7877	7877	11140	3910	9832	9832	4000
+0MBE (+) -1.5M LE	4500	14800	14800	3910	3250	225	8240	8240	11653	3910	10195	10195	4000
+0MBE (+) +0M LE	6000	15525	15525	3910	3250	225	8603	8603	12166	3910	10558	10558	4000
+0MBE (+) +1.5M LE	7500	16251	16251	3910	3250	225	8966	8966	12679	3910	10921	10921	4000
+0MBE (+) +3M LE	9000	16976	16976	3910	3250	225	9328	9328	13192	3910	11283	11283	4000
+3MBE (+) -3M LE	6000	15525	15525	3910	3250	225	8603	8603	12166	3910	10558	10558	4000
+3MBE (+) -1.5M LE	7500	16251	16251	3910	3250	225	8966	8966	12679	3910	10921	10921	4000
+3MBE (+) +0M LE	9000	16976	16976	3910	3250	225	9328	9328	13192	3910	11283	11283	4000
+3MBE (+) +1.5M LE	10500	17702	17702	3910	3250	225	9691	9691	13705	3910	11646	11646	4000
+3MBE (+) +3M LE	12000	18427	18427	3910	3250	225	10054	10054	14218	3910	12009	12009	4000
+6MBE (+) -3M LE	9000	16976	16976	3910	3250	225	9328	9328	13192	3910	11283	11283	4000
+6MBE (+) -1.5M LE	10500	17702	17702	3910	3250	225	9691	9691	13705	3910	11646	11646	4000
+6MBE (+) +0M LE	12000	18427	18427	3910	3250	225	10054	10054	14218	3910	12009	12009	4000
+6MBE (+) +1.5M LE	13500	19153	19153	3910	3250	225	10417	10417	14731	3910	12372	12372	4000
+6MBE (+) +3M LE	15000	19878	19878	3910	3250	225	10779	10779	15244	3910	12734	12734	4000



Limit Bearing Capacity	62500	Kg/Sqm
Weight of soil (Dry portion)	1700	Kg/cum
Weight of soil (Wet portion)	940	Kg/cum
Angle of Repose (Dry portion)	20	Deg
Angle of Repose (Wet portion)	10	Deg
Water Table	3.5M	Below GL

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REV NO	DATE	DESCRIPTION	DRAWN	CHKD	APPD

PROJECT	400KV D/C XELDAM-NARENDRA TRANSMISSION LTD					
CLIENT	STERLITE POWER GRID VENTURES LIMITED					
DESIGNER:	STERLITE POWER GRID VENTURES LIMITED					
DRWN	RT	20-09-18	FOUNDATION DRAWING FOR TOWER TYPE DDN-3/+0/+3/+6M (30-45 DEG. DEV. ANGLE) 400KV D/C (WZ-1) DFR SOIL (4.0M DEPTH)			
CHKD	AM	20-09-18				
APPD	DL	20-09-18				
DATE	20-09-18	DRAWING NO.	GTTPL/400DC/WZ-1/DDN/F-005	SHEET NO.	2/2	REV 0

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