Eskom	**METHOD STATEMENT** **Assembly and Erection of Towers**	**RTB NED** **NWOU** **Rev 0**

INDEX

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SCOPE OF WORK OVERVIEW

Please refer to the design document

Revision Details: Rev.1	

Compiled By			
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1. Method Statement for Construction

All precautionary measures must be exercised to ensure safety during the construction phase. The authorised person shall be on site during construction to ensure safety measures are adhered to at all times. The line is to be built in accordance with **TRMSCAAC1** Transmission Line Towers and Line Construction as well as Construction Regulations and OHS Act 85 of 1993, in which the responsibilities of the designer and those of the contractor are discussed. The SHE spec shall also be included in the design document and it outlines possible risks and mitigation actions that are to be taken on site. It will cover all road crossings, river crossings, sensitive environmental areas, etc. which are some of the issues on this line.

The contractor shall be responsible for but not limited to:

- Establish and maintain the necessary Site Offices and facilities.
- Communicate with all landowners along the line route advising them of work to be done and the contractors' presence.
- Drill or excavate all foundations for the new structures and reinstate on completion of foundation installation.
- Pending Procurement's contract strategy the following shall be determined to be supplied at the new engineering contracts meeting:
  - All foundation materials and transport of such materials to site.
  - Supply and install formwork as required/specified by the Geotech.
  - Supply, layout, assemble and erect all structures as specified.
- String, join, make off, regulate, clamp in and install jumpers on all phase and shieldwire conductors. Install vibration dampers as per specification.
- Complete all quality documentation and mark up any changes to drawings.
- Clear and rehabilitate the site.
- Liaise with property owners to obtain Clearance Certificates on completion of the contract.
- Provide the employer with completed contract documentation, including 'As Built' drawings.
- Construction may not commence unless the contractor has a valid statutory approval from the municipality and adheres to all approval conditions.

1.1 Assembly of structures

- Flanged and slip joints should be aligned such that there is minimum pole deflection around the joint.
- The actual slip length shall not differ more than 100mm from the designed slip length.
- Slip joints shall be cleaned and soaped before assembly to ensure ease of obtaining necessary slip lengths. Oil or grease shall not be permitted for use.
- The jacking load shall be specified by the pole manufacturer

1.2 Erection of structures

- All structures have been designed based on a wind loading of 1170 Pa; shape factor of 0.6 for monopoles and a gust factor of 0.6. The tension on both shield wire and conductor has been confined to a catenary value of 1800m.

- The structures to be used will be indicated in the section: Structure schedule and drawings
- Monopoles are to be constructed in accordance with Eskom Distribution Specification:DSP-34-1683 and TRMSCAAC1
- Non- terminal strain poles shall be adequately back-stayed to prevent longitudinal deflections during stringing and erection.
- The contractor will be required to erect all structures. The types and quantities shall be as indicated in the staking table. The contractor shall adhere to the method statement of the pole manufacturer regarding jacking of structure member sections together. The contractor shall jack the sections together with the force specified by the pole manufacturer.
- An absolute construction 1.5% deflection limit (of pole length) applies to erected poles after stringing. The contractor may be required to rake terminal or bend point structures that are predicted by theoretical calculation to deflect by more than 1.0% of pole length. The location and magnitude of raking on poles shall be confirmed by the line designer/pole manufacturer, based on everyday service loads at zero Pa wind, and initial conductor tensions at 15 degrees C.
- Raking of poles may be achieved through tilting of base plates, tilting of the HD bolts arrangement or by adjusting tensions in stays supporting the bend structures. Practical raking guidelines are provided in Annex I - Practical Raking Guidelines in the Distribution standard (DST 34-1683)
- The positions and levels of the foundations for structures are surveyed and marked accordingly.
- The ground will be excavated according to the soil type and structure that that will be erected in that soil type.
- The amount of soil to be excavated will amount to approximately 45m^3 for each tower.
- Shuttering will be installed to prevent collapsing of the excavation. This will either be wooden shutters or steel shutters.
- The re-enforcement steel and stubs will be assembled in accordance with the design.
- Pre-mixed concrete will then be poured into the excavation.
- The estimated amount of concrete required for each tower foundation is approximately 12m^3.
- All concrete work will be smoothened out and finalised.
- The surrounding area will be restored to its natural state.
- The structure will be pre-assembled and mounted onto the foundation stubs.
- The towers will be dressed with appropriate hardware assemblies.
- Where foundations for the proposed power line structures are to be placed in a wetland, watercourse or the associated buffer zone, excavated topsoil should be stockpiled separately from subsoils so that it can be replaced in the correct order for rehabilitation purposes.
- Usually, wetland soils are inappropriate to provide suitable stable infill and will need to be removed and replaced by imported soil of suitable grade. Wetland soil will be removed only if is absolutely required. Furthermore, any removed soil and vegetation that are not required should be taken to a registered landfill site that has sufficient capacity to assimilate the spoil.
- The topsoil is to be used for rehabilitation purposes and should not be removed unless there is surplus that cannot be utilised. It is important that when the soils are reinstated, the sub soils are to be backfilled first followed by the topsoil. The topsoil contains a natural seedback from which the affected wetland, watercourse or buffer zone can naturally rehabilitate.
- Where the soil is excavated from the sensitive areas, it will be preferred for them to be stockpiled adjacent to the excavation pit to limit vehicle and any other movement activities around the excavation areas.

- Cement mixing will take place over the bin lined surface or alternatively in the load bin of a vehicle to prevent the mixing of cement with the ground of the wetland, watercourse or associated buffer zone. Importantly, no mixing of cement directly on the surface is allowed in the sensitive and RoW areas.
- Stockpiled soil will be protected from wind and water erosion. Stockpiled soils are not to exceed a 2m height and are to be bunded by suitable materials. Stacked bricks surrounding the stockpiled soils can be adopted. Alternatively, wooden planks pegged around the stockpiled soils can be used.
- When stringing of the proposed power lines takes place through the wetland or watercourse areas, it is to be undertaken by hand. Vehicles must not be used for this exercise in order to limit compaction impacts to the soils of the wetland.
- The affected RoW zones in the sensitive areas must be reinstated with the wetland soil where possible, and the affected areas must be levelled or appropriately sloped and scarified to loosen the soil and allow seeds contained in the natural seed bank to re-establish.
- An appropriate storm water management plan formulated by a suitable qualified professional must accompany the design.

1.3 Construction notes on Foundations (see Annexure A)

The foundations have been designed to counter the total resultant forces (at critical conditions) which are imposed by wind and conductor tension on the structure. The wind forces are induced on both the adjacent spans and the structure; the wind load on the structure is always perceived to be acting on the structure centre of mass (centroid). Every conductor connected to the structure contributes a share of tension which combined yields a total resultant force in-line with the angle bisector. Combined all these forces induce a total moment which finally determine the foundation size of the structure; and this means the foundation that will be able to keep the structure upright on the ground in spite of the load. For angle strains stays will be used to counter these forces

Structure Schedule and Drawings


7611.pdf


7649.pdf


7615.pdf


7618.pdf

ANNEXURE A

Concrete/Foundation

1. BACKGROUND

A tower is only as stable as its foundation. Therefore the strength of the concrete / reinforcing, that constitutes the foundation, is of utmost importance.

2. BATCH MIX

This is the preferred method of mixing to be used as it guarantees the required strength.

Concrete strength is normally specified as a certain strength after 28 days. The 28 days create a problem as Construction cannot afford to wait this long before commencing with erection work.

To overcome the problem, a stronger strength concrete must be ordered, as concrete reaches 60% of its 28 day strength after 7 days.

	MPa Concrete Ordered		
	35	**42**	**50**
7 Day strength MPa	20	25	30

NOTE:

(a) Never add any additional water if the concrete has been batch-mixed, as this weakens the concrete considerably.

(b) Order 13mm stone concrete for foundations with steel reinforcing.

(c) Records must be kept (delivery notes) of all batch mix deliveries.

(d) Take a random sample from such deliveries periodically and allow sample to cure for 28 days. Then get it tested at a reputable laboratory.

3. HAND MIX

Hand-mixed concrete should be avoided as far as possible as it is difficult to control the mixing ratios.

However, if concrete must be hand-mixed, the following precautions should be taken:

(a) Order 13mm stone.

(b) Adhere to the given ratio's.

(c) Do a slump test to prove your mix.

(d) Do not over vibrate!

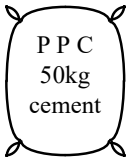
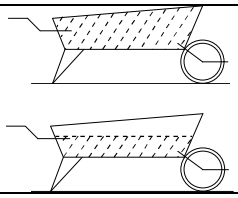
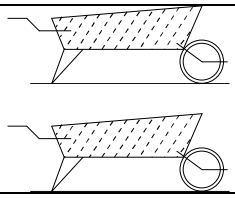
3.1 Ratios

1 Sack Cement	=	33 Litres	=	50kg
1 Wheelbarrow	=	65 Litres		
1kg Sand	=	0.8 Litres		
1kg 19mm Stone	=	0.75 Litres		
1kg 13mm Stone	=	0.73 Litres		

3.2 Hand mix 20Mpa concrete mechanically vibrated

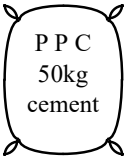
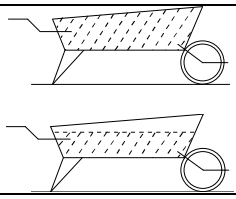
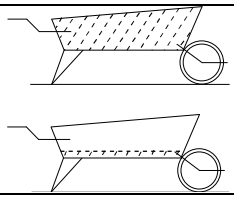
3.2.1 <u>19mm Stone: 20Mpa</u>

1m^3 concrete = 10 bags cement + 0.7m^3 sand + 0.92m^3 stone

Water	Cement	Sand	Stone 19mm
			
24 litres	1 bag	1 + ½ wheelbarrows	2 wheelbarrows
24 litres	33 litres	95 litres	125 litres
		12 + 6 shovels	12 + 12 shovels

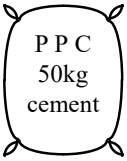
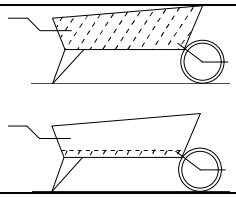
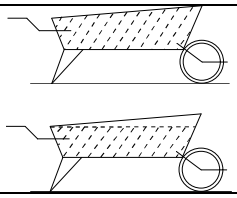
3.2.2 9.5 to 13.2mm Stone: 20Mpa

1m^3 concrete = 10 bags cement + 0.77m^3 sand + 0.6m^3 stone

Water	Cement	Sand	Stone 9.5 to 13.2mm
			
23.5 litres	1 bag	1.6 wheelbarrows	1.2 wheelbarrows
23.5 litres	33 litres	105 litres	80 litres
		12 + 7 shovels	12 + 2 shovels

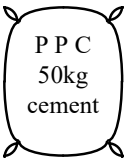
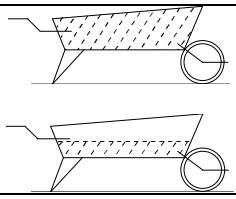
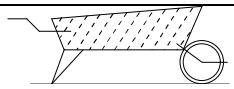
3.2.3 19mm Stone: 25Mpa

1m^3 concrete = 10 bags cement + 0.6m^3 sand + 0.81m^3 stone

Water	Cement	Sand	Stone 19mm
			
21.5 litres	1 bag	1.2 wheelbarrows	1.7 wheelbarrows
21.5 litres	33 litres	80 litres	110 litres
		12 + 2 shovels	12 + 8 shovels

3.2.4 9.5 to 13.2mm Stone: 25Mpa

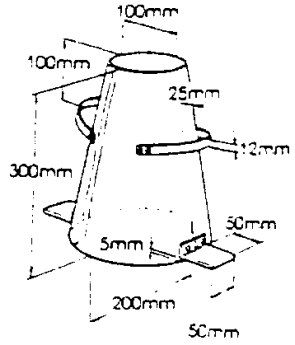
1m^3 concrete = 10 bags cement + 0.66m^3 sand + 0.6m^3 stone

Water	Cement	Sand	Stone 19mm
			
21 litres	1 bag	1.4 wheelbarrows	1 wheelbarrows
21 litres	33 litres	90 litres	70 litres
		12 + 5 shovels	12 shovels

4. TESTS ON CONCRETE: SLUMP TEST

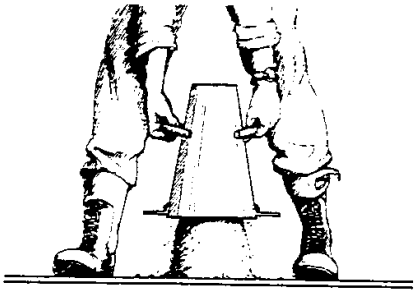
4.1 Materials and tools

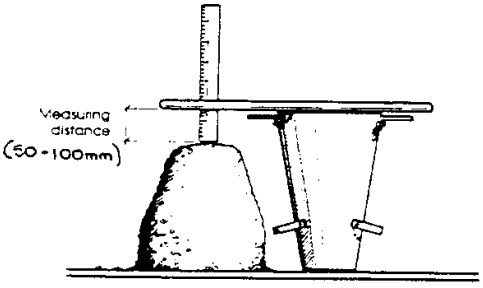
a) A wheelbarrow and shovel
b) A sample of freshly mixed concrete (about half a wheelbarrow full)
c) A flat steel plate about 600 x 600mm by 3mm thick
d) A metric rule or tape measure
e) A scoop
f) A steel tamping rod, 16mm in diameter by 600mm long with one end rounded
g) A small trowel (gauging trowel)
h) A standard slump cone



4.2 How to measure the slump

1) Mix the concrete in the wheelbarrow.
2) Wipe all the tools with a damp cloth.
3) Put the steel plate down on a level place so that it is firm, and then put the slump cone in the footpieces.
4) Fill the slump cone in four layers of about 75mm. Tamp through each layer 25 times with the rounded end of the tamping rod.
5) The last layer should more than fill the cone. After tamping the last layer, use the trowel to smooth off the top of the concrete so that it is level with the top of the cone.
6) Hold the cone by the handles to keep it steady while you step off the footpieces.
7) Slowly lift the slump cone straight up and off.
8) Turn the slump cone upside down and place it on the plate, next to the concrete.





ANNEXURE B

Footing Resistance Measurement Guideline

This guideline provides the minimum requirements for the measuring of the footing resistance of concrete poles and steel towers.

1. METHOD

Short fall-of-potential

The short version fall-of-potential method can be used by the contractor. The drawings show the equipment layout and how the measurements must be taken.

Three resistance values are measured, namely R1, R2 and R3. If the three values agree reasonably, the average can be calculated for the final resistance value. If not, the 61,8% method must be used.

61.8% Method

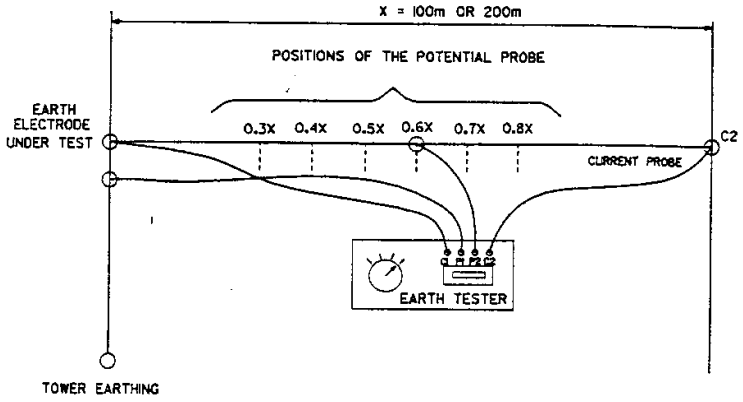


FIGURE 1: CONNECTIONS FOR EARTH ELECTRODES RESISTANCE MEASUREMENT - 61.8% METHOD

DEFINITION	POSITION	DISTANCE (m)	RESISTANCE (Ohm)
R_1	0.2X		
R_2	0.4X		
R_3	0.5X		
R_4	0.6X		
R_5	0.8X		

TABLE 1: EARTH ELECTRODE RESISTANCE - 61.8% METHOD MEASUREMENT RESULTS

R	=	-	0,1187 R_1	-	0,4667 R_2	+	1,9816 R_4	-	0.3961 R_6	=	_____ Ω
R	=	-	2,6108 R_2	+	4,0508 R_3	-	0,1626 R_4	-	0,2774 R_6	=	_____ Ω
R	=	-	1,8871 R_2	+	1,1148 R_3	+	3,6837 R_4	-	1,9114 R_5	=	_____ Ω
R	=	-	6,5225 R_3	+	13,6816 R_4	-	6,8803 R_5	+	0,7210 R_6	=	_____ Ω
									Total	=	_____ Ω
									Average	=	_____ Ω

TABLE 2: EARTH ELECTRODE RESISTANCE - 61.8% METHOD CALCULATED RESULTS

2. CONCRETE POLES

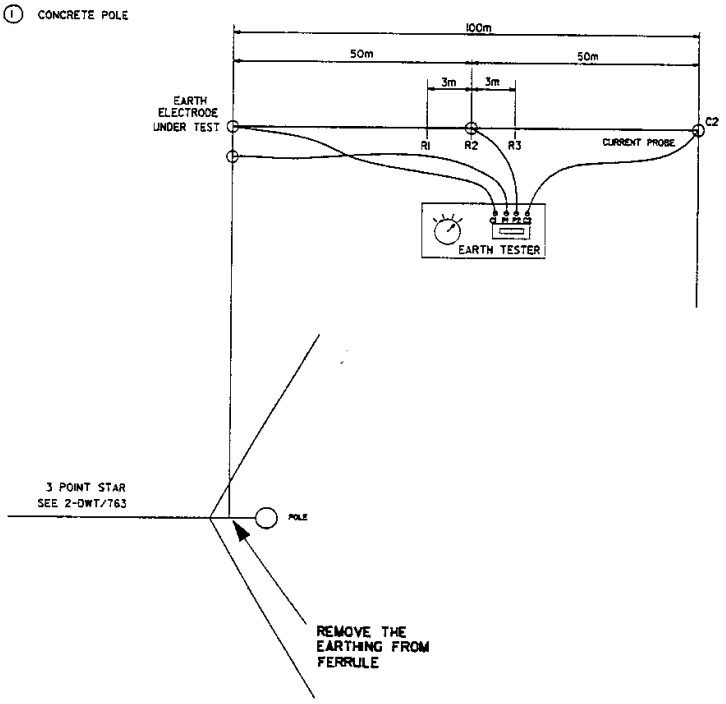


FIGURE 2: CONNECTIONS FOR EARTH ELECTRODE RESISTANCE MEASUREMENTS FALL-OF-POTENTIAL METHOD

3. STEEL TOWER

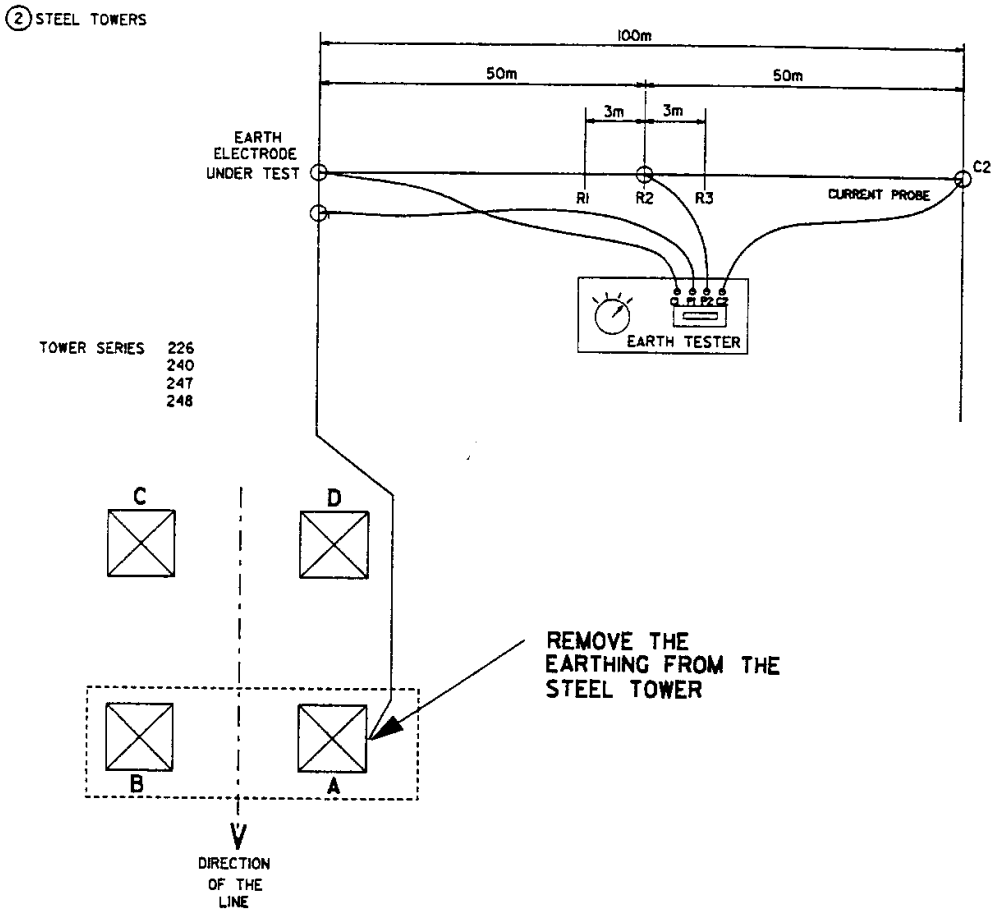


FIGURE 3: CONNECTIONS FOR EARTH ELECTRODE RESISTANCE MEASUREMENTS FALL-OF-POTENTIAL METHOD

Only one leg's footing resistance must be measured. If this value exceeds 30Ω, all the other legs must also be measured.

4. STEEL TOWER WITH 10m COUNTER POISE

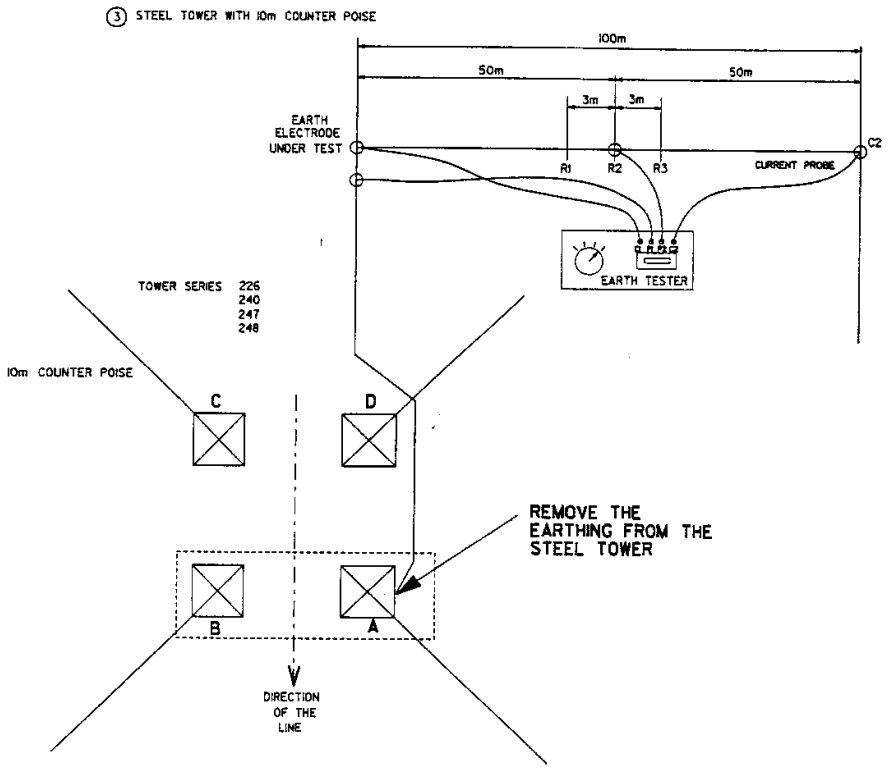


FIGURE 4: CONNECTIONS FOR EARTH ELECTRODE RESISTANCE MEASUREMENTS FALL-OF-POTENTIAL METHOD

Only one leg's footing resistance must be measured. If this value exceeds 30Ω, all the other legs must also be measured.

2. Summary of notes from TRMSCAAC1, Section 4)

1.2.1 General

a) Bush clearing

No bush clearing shall be done without consulting the Environmental Impact Study or Environmental Management Plan done by Survey.

Bush clearing in sensitive areas shall only be done with the approval of the **landowner**. The owner must sign this document to confirm his approval of the planned bush clearing.

b) Use of roads

When privately owned roads need to be used, the owner must be approached and permission requested. The landowner must give his approval in writing. The roads shall be left in the same condition as before Construction started using the road.

c) New roads

If a new road needs to be built, the landowner is to give his approval before any work commences. The Project Co-ordinator will give a site instruction to build the new road. If the landowner wishes the ground surface to be restored after the line has been built, it shall be done and the landowner must accept the restoration.

d) Additional gates (other than servitude gates)

No new gates will be installed without the landowner's approval and site instruction by the Project Co-ordinator. The contractor will take full responsibility for the installation of the new gates. The contractor shall repair any damaged fences.

e) Road/Line crossings

The Project Co-ordinator will make all the necessary arrangements with all the appropriate authorities when Construction needs to string across any road or existing power line.

1.2.2 Building of the line

The building of the line is sub-divided into:

- Foundations
- Tower installation
- Stringing of the phase and earth conductors
- Earthing

Checklists are provided for the Construction Supervisor, Construction officials and Project Co-ordinator to highlight some of the areas seen by the Project Engineer as critical when a line is built.

The information which should be provided by the Project Engineer is the tower structure number, tower type and the predicted foundation type (drawing number).

a) Foundations

(See TMRSCAAC1, Section 7)

The foundation types specified by the Project Engineer are based on Type 2 soil. As soon as the excavation for each tower is completed, the Construction Supervisor, or his delegate, must do a soil classification to ensure that the correct foundation type has been specified in the Design.

If a different type of soil is discovered, the appropriate foundation type must be used.

The Project Engineer must be contacted if the soil cannot be classified with certainty. If necessary, a competent Civil Engineer will be consulted.

All concrete work will be done according to the foundation drawing specified. (See Annexure A).

The Construction Supervisor must confirm that excavation work is done properly, backfilling is done with appropriate material and correct compacting procedures are followed. The material used for the backfilling must be identified and noted in the Tower Installation Handbook (excavated soil, soil from a burrow pit or soil/cement mix).

A certificate, confirming that all the above was done as specified on all the towers for this line, shall be completed by the Construction Supervisor or his delegate.

b) Tower Installation

(See TRMSCAAC1, Section 6.18)

Fasteners:

All bolts and nuts shall be punched after final tensioning. The nuts and exposed bolts shall be painted with an acceptable plumbate-based galvanised iron primer.

Stay assemblies:

Stay layout and planting of the stay rod is critical and the Construction Supervisor must ensure that it is done according to provided drawings.

The towers must be plumb.

Ensure that all electrical clearances are met. (**See the Information Sheet**).
A certificate, confirming that all the above was completed according to Specifications, shall be completed by the Construction Supervisor or his delegate.

1.2.3 Earthing

(See TRMASAAJ7)

a) Pole Number:

The pole numbers will be provided, as described in the Design Document.

b) Tower Type:

The tower types will be provided, as described in the Design Document.

c) Earthing Description:

If the tower/pole position requires that the specified earthing be modified, or that alternative earthing be installed, the changes must be noted in this document.

c) Footing Resistance:

(See Annexure B)

Footing resistance will be measured as described in Annexure B. **Note that all footing resistance must be measured before any stringing is done**. If, however, the stringing is completed (on existing lines), the earthing must be disconnected before the footing resistance is measured.

d) Confirmation:

The Construction Supervisor must accept the earthing installation.

e) Approval:

The Project Engineer or his/her delegate will approve the results provided by the Construction Supervisor.