

**PART B-09**

**TITLE:** CIVIL ENGINEERING WORKS

**SPECIFICATION NO:** B-09

**INCEPTION DATE:** AFTER GAZETTING (WORKING DOCUMENT FOR A 3 YEAR PERIOD)

**AMENDMENTS / REVISIONS**

DATE	PAGE	PARAGRAPH	DESCRIPTION	ORIGINATOR	APPROVED

**TABLE OF CONTENTS**

	<u>PAGE</u>
<b>1.1 SCOPE .....</b>	<b>3</b>
<b>1.2 GENERAL .....</b>	<b>4</b>
<b>1.3 EXCAVATIONS.....</b>	<b>4</b>
<b>1.4 INSTALLATION OF CABLES AND PIPES.....</b>	<b>6</b>
1.4.1 <i>Clearing of site</i> .....	9
<b>1.5 CONCRETE WORKS, GROUTING AND SCREEDING.....</b>	<b>10</b>
1.5.1 <i>General</i> .....	10
1.5.2 <i>Concrete mix</i> .....	10
1.5.3 <i>Reinforcing</i> .....	11
<b>1.6 DIMENSIONS.....</b>	<b>11</b>
<b>1.7 FORMWORK.....</b>	<b>11</b>
<b>1.8 FINISHING.....</b>	<b>11</b>
<b>1.9 TESTING OF CONCRETE .....</b>	<b>11</b>
<b>1.10 GROUTING .....</b>	<b>12</b>

**1.1 SCOPE**

This section covers the principles, responsibilities and requirements applicable to certain civil-engineering works of a minor nature that are included in the scope of this Standard. General standards applicable to this part of the standard are listed below:

**PAINT AND FINISHING**

- NRS 002 : Graphical Symbols and Labelling for electrical diagrams
- SANS 1091 : National colour standards for paints
- SANS 935 : Hot dip galvanised zinc coatings on steel wire
- SANS 121 : Hot dip galvanised coatings on fabricated iron and steel articles.
- SANS 10064 : The preparation of steel surfaces for coating
- SANS 679 : Zinc chromate primers for steel.
- BS 183 : Specification for galvanized steel wire.
- BS 381 : Paint
- BS 2569 : Zinc Metal Spraying

**WELDING**

- SANS 10044 : Arc Welding
- BS 4360 : Welding Structural Sheets
- BS 5135 : Metal Arc Welding of Carbon Steels

**CONCRETE WORKS**

- SANS 878 : Ready mixed concrete
- SANS 920 : Steel bars for concrete reinforcement
- SANS 927 : Precast concrete kerbs, edgings and channels
- SANS 1058 : Concrete paving blocks
- SANS 451 : Precast concrete paving slabs

**EQUIPMENT STANDARDS**

- SANS 10142 : Electrical Equipment

## **1.2 GENERAL**

Civil works of a minor nature such as concrete bases, plinths, route markers, grouting, screening and earthworks such as the excavation and backfilling of trenches for electrical cables and pipelines are required.

In all such cases where it is not clearly shown on the drawings that such work is to be executed by others, it will be the responsibility of the contractor. If the contractor is not equipped to execute such work, he will appoint specialists, some of who may be other contractors already on the site and who are readily available. The selection of such specialists will be subject to approval by the engineer.

## **1.3 EXCAVATIONS**

### **(a) General**

The contractor will preserve the site as far as possible. Only the minimum of trees, shrubs, rocks, etc will be removed and cleared for the cable route.

Where surplus material has to be disposed of the contractor will dump the material in the area provided by him.

The contractor will at his own cost load and transport to the above mentioned site all surplus material, unsuitable material for backfilling etc.

### **(b) Trench routes**

The cable and pipe trench will be excavated along the routes indicated on the plan.

The trench will be absolutely straight and will comply with all requirements. The Engineer will determine the length of the trench to be excavated.

If any obstacle or interference should be encountered which may require alterations to the trench or routes, such alterations will receive prior written approval of the engineer.

### **(c) Cable and pipe trench**

The trench will be excavated to a depth indicated on the drawings for the different cables.

The excavation of all trenches for the high voltage and low voltage distribution cables and the street lighting cables will be undertaken by the contractor.

The contractor will excavate by hand where he cannot excavate by means of machines due to limited access and the proximity of other services, miniature substations and distribution kiosks.

The bottom of the trench will be level and will follow the contours of the final road level. Where the excavation is in excess of the required depth, the excavation will be backfilled and compacted with suitable material to the required depth.

**PART B-09: CIVIL ENGINEERING WORKS**

---

The contractor will trim the trenches and clean up the bottom of the trenches after he has completed the required excavation. Bedding and cables will not be laid until the trench has been approved by the engineer. Where bedding has already been laid the engineer may instruct the contractor to demonstrate that the minimum thickness of bedding has been provided for before authorizing cable laying to proceed.

The contractor will remove all sharp projections which could damage the cable where the trench is excavated through rocky formations, and will remove all loose rocks, material, etc from the bottom of the trench.

(d) Excavation of jointing chambers

Jointing pits will be excavated to a depth of 1200mm and will be rectangular in shape and large enough for the cable jointers to work comfortably and in an efficient manner. Where more than one joint is to be made in the same position the joint pit will be large and long enough to allow staggered joints to be made. The minimum size of a joint pit will be as follows:

- One joint : 2500mm long x 1250mm wide
- Two joints : 3000mm long x 1500mm wide

(e) Excavated material

No excavated material will be left closer than 300 mm from the side of the excavation. The excavated material which is considered by the engineer to be suitable for bedding material for the cable will be placed separately on one side of the trench so that it is available when required. The excavated material will take up as small an area as possible with the safety of the workmen and works taken into consideration.

(f) Inspection and measurement of excavations

Once the excavations for cable and pipe trenches and joint pits have been completed, the contractor will give the engineer 24 hours notice to inspect the trench and to be present when the measurements are made. No inspections will be undertaken on Saturdays, Sundays and public holidays.

(g) Maintenance of excavations

The contractor will maintain the excavation in a good condition, free of water, mud, loose ground, rocks, stones, gravel and other strange material until the cables are installed and the excavation is backfilled and compacted.

**1.4 INSTALLATION OF CABLES AND PIPES**

(a) Sand bed for cables and pipes

A sand bed layer of soft soil will be installed and levelled at the bottom of each trench after the trench has been approved by the Engineer, and prior to cable laying.

The minimum thickness of the sand bed layer is 50mm below the cables.

If the material that has been excavated is not suitable for the sand bed layer then suitable soil will be imported for this purpose. The cost thereof will be included in the unit price for the excavation unless otherwise specified.

An adequate quantity of soil similar to the sand bed material will be available next to the excavation for the sand bed cover before an inspection of the cables is called for. The sand bed cover will be a minimum of 150mm thick and will be placed directly after the cable has been inspected.

If the soil for the sand bed and sand cover has to be sifted, a sieve with holes not larger than 6 mm will be used.

(b) Cables and pipes will be laid without delay

The cables and pipes will, after the completion of the trench, be laid with the minimum of delay so that the trench can be backfilled. The contractor will, however, not backfill the trench until each length of cable has been inspected and approved by the engineer.

Only one cable or pipe will be laid at a time and the contractor will take precautions that the cables or pipes which are already installed are not damaged.

All cables will enter the miniature substations from the back. High-voltage cables will be laid so that there is at least 1 m slack for use in the event of a termination being damaged.

(c) Laying of cables

The method to be used for laying cables will be approved by the Engineer prior to the commencement of the laying of the cables.

Cable rollers will be used when cables are drawn into trenches. The cable rollers will be placed so that the cable does not touch the bottom or the sides of the trench. The rollers will be of an approved construction without any sharp metal parts which could damage the cables.

If the contractor intends using a winch to draw the cable into the trench, a cable stocking will be used or the draw wires will be soldered to the cable so that the tension is exerted on all the cores, lead sheath and/or steel wire armouring at the same time.

The maximum tension on a cable during laying operations will not exceed the value specified by the manufacturer.

Should the engineer not be satisfied with the manner or method employed to lay the cable he will have the authority to instruct the contractor to lay the cable by hand or in accordance with approved standards.

**PART B-09: CIVIL ENGINEERING WORKS**

---

The high-voltage cables will be laid in such a manner that the beginning of a drum will be laid from the end of the previous drum to ensure that the lay of the cores remain the same.

High voltage cables will overlap by at least 1000mm, but not more than 1500mm at joints.

Sufficient lengths of cable will be left at the beginning and end of the cable routes to allow for the termination of the cables. Where necessary the engineer will decide on what length of cable is to be left. The contractor will take the necessary precautions to protect the cable ends until they are terminated. The cables ends will be sealed by means of lead or heat shrink sealing caps to ensure that the cable is waterproof.

No cables will be laid unless the plinths for the miniature substations have been completed.

Where cables are drawn through sleeves, care will be taken that they are not kinked or excessively bent. No bend in a cable will have a radius less than the minimum bending radius specified by the cable manufacturer.

The contractor will keep accurate records of each length of cable laid. The following information will be recorded:

- Cable drum number
- Size of cable
- Laid from where to where
- Length of cable
- Date laid.

The contractor will be liable for the repair of the cable due to the faulty manufacture of the cable, should this information not be recorded directly after the cable has been laid.

Every cable will be marked by means of an aluminium label on which the size of cable and its source or destination is punched. The label will be installed around the inner PVC sheath immediately above the cable gland.

(d) Road crossings

The cable sleeves will be installed a minimum depth of 1000mm below ground level to avoid damage when the roads are constructed.

Unless otherwise specified, two additional sleeves will be installed for future use at each road crossing.

Sleeves used for crossings will be straight and undamaged. Bends will not be allowed in road crossings.

After the installation of the sleeves, the sleeves will be meticulously backfilled so that no air pockets are left. The trench will thereafter be backfilled in layers of 150 mm and compacted with mechanical vibrators to 95% modified AASHTO density.

The contractor will lay and join the cable sleeves and compact the trench to the satisfaction of the engineer. After installation, the sleeves will be cleaned and a galvanized steel draw wire installed in the sleeve prior to the sleeve ends being sealed by means of plastic plugs.

**PART B-09: CIVIL ENGINEERING WORKS**

Cable route markers will be installed to indicate the cable route and positions of cable joints and cable sleeves. The markers will be buried in the ground directly over the cable, joint, sleeve, or where the cable crosses a known service, with the top protruding 50 mm above the finished ground level. Route markers will be placed at every change in direction and at 100 m intervals on straight runs.

(e) Crossing of other services

Where a cable crosses over other services, the cable will not be installed at a depth less than 900 mm below ground level and if this is not possible the cable will be installed underneath the other service and will be protected in the prescribed manner by means of concrete slabs. The depth of the cable will be maintained for one metre on either side of the crossing.

If it is not possible to cross over or underneath a service in the prescribed manner, the matter will be referred to the engineer for a decision.

The following minimum clearances will be maintained between electrical cables and other services:

	<u>Vertical</u>	<u>Horizontal</u>
GPO Cables	0,3 m	0,3 m
Water pipes	0,3 m	0,3 m
Sewer pipes	0,3 m	0,8 m
Storm water pipes	0,3 m	0,6 m
Other electrical cables	0,15 m	0,15 m

(f) Backfilling of trenches

When the cable has been laid, inspected and approved and the sand bed cover as specified has been installed, the trench will be backfilled with soil containing not more than 40% rock or shale which will be able to pass through a 100 mm sieve and which is approved by the engineer.

Where more than 40%, but less than 70% rock occurs, the contractor will replace the rock with imported soil. However, should more than 70% rock occur then all the back-filling material will be imported.

- The contractor may import further stone-free material to the site or sieve the excavated material for sand bedding and cover but payment will only be compensated for the actual quantity of imported material required as determined by the engineer. The quantity of imported material required will be calculated from the nominal trench width.
- The excavated material will be backfilled in layers of 150 mm and will be well compacted and consolidated to 90% modified AASHTO. Where necessary the engineer may require that a mechanical vibrator be used for compacting the trench.
- The contractor will maintain the completed sections of the cable and pipe trench in a proper safe condition for the duration of the contract. The contractor will refill and compact the trench where subsidence occurs.



- After completion of the work the route of the cable and pipe trench will be neatly finished off and cleared. All stones bigger than 25 mm as well as all loose organic material and rubble will be removed.

(g) Installation of concrete slabs and cable markers

Where cables cross other services such as water pipes, sewage pipes and other cables or where the chance exists that the cable may be damaged as a result of excavation by others, the cable will be protected by means of reinforced concrete slabs. The slabs will protect the cable for a distance of 500 mm on either side of the crossing.

1.4.1 Clearing of site

The contractor will remove everything that he brought onto the site or handled on the site in the execution of the contract as well as all excess excavated material and rubble so as to leave the site in a neat and clean condition to the satisfaction of the engineer after the completion of the contract and after the engineer's approval has been obtained.

**1.5 CONCRETE WORKS, GROUTING AND SCREEDING**

1.5.1 General

This section covers the construction of cast in situ reinforced concrete slabs and plinths onto which mechanical/electrical equipment is to be fixed, concrete slabs used for the protection of cables as well as grouting and screeding.

Concreting

All concrete units will be solidly formed using concrete and steel reinforcing as indicated on drawings which will be submitted to the engineer for approval within 30 days of the contract having been awarded. Drawings will be submitted in threefold.

Each unit will have rectangular sides.

In general the edges of pockets for holding-down bolts or the centre-lines of holes drilled for expansion bolts will not be closer than 100 mm to any concrete edge. The concrete unit will furthermore be designed to be adequate to carry and distribute all live and imposed loads.

For concrete units to be constructed in situ, the excavation will be made 600 mm wider than the outside dimensions of the unit and to a minimum depth of 200 mm below the lowest point of the finished ground level (measured along the perimeter of the concrete unit). The bottom of the excavation will be levelled and compacted to 93% of modified AASHTO density. A 50 mm thick level concrete blinding layer will be cast covering the entire bottom of the excavation and will be allowed to set for at least one day, after which the construction of the concrete unit (fixing of reinforcement, erection of formwork, casting of concrete, etc) will take place. The top of the concrete unit will protrude for a minimum of 200 mm above the highest point of the finished ground level (measured along the perimeter of the unit). No concrete will be cast without the engineer having had the opportunity to inspect and approve the formwork and reinforcing. The formwork will not be removed before 7 days, and installation of mechanical/electrical equipment will not commence until 28 days after the concrete have been cast. Backfilling of the excavation will be in accordance with the relevant clause of this section.

For concrete units constructed on floors which have been constructed by others, adequate dowelling and bonding of the surfaces of the concrete unit and the existing floor will be included.

1.5.2 Concrete mix

The following concrete mix will be used:

- Cement (dry) 1 part per volume
- Clean dry river sand 3 parts per volume
- Crushed stone (10 mm) 6 parts per volume

The concrete will have a 28-day minimum cube strength of 10 MPa.

**1.5.3 Reinforcing**

Standard brickforce as used in 230 mm brick walls will be used as reinforcing and will be indicated on the drawings to be submitted by the contractor to the engineer.

All reinforcing will be inspected by the engineer prior to the concrete being cast.

**1.6 DIMENSIONS**

The dimensions will be as indicated on the drawings provided.

**1.7 FORMWORK**

The contractor will be responsible for the design, supply, erection and removal of all falsework and formwork used in the construction of in situ concrete units. At all corners that are exposed after backfilling, the concrete will be chamfered 25 mm x 25 mm.

**1.8 FINISHING**

The concrete will be well vibrated to eliminate cavities or honeycombing. Unformed horizontal surfaces (top of concrete) will be floated with a wooden trowel to render a uniform, skid resistant, horizontal surface.

**1.9 TESTING OF CONCRETE**

A sample from each batch of concrete will be taken by the Engineer or his representative for testing purposes.

## 1.10 GROUTING

Grout under base plates and machine bases which are subjected only to gravity loading will consist of 1:1 sand, cement semi-dry mortar well caulked into the grouting space, unless otherwise specified by the supplier of the equipment. The contractor will first prepare the relevant concrete surfaces by scabbling and cleaning them. The mortar grout will consist of an approved mixture of cement, sand, water, and admixture, and will be so rammed under each base or bedplate (as applicable) that all voids and pockets are completely filled around the bolt or between the top of the concrete and the underside of the metalwork, and, in the case of a base or a bedplate, that the grout projects beyond the base or bedplate. After the void has been completely filled, the edges of the mortar grout will be trimmed at an angle of 45° outward from the bottom edges of each base or bedplate and the trimmed edge wood-floated to a neat finish.

Grout used in bolted fastenings which are subjected to tensile, shear and/or vibration loads will be an approved epoxy mortar well caulked into the grouting space, bolt hole pocket or sleeve, unless otherwise specified by the supplier of the equipment.

Grouting will be included in the tendered rates of the contractor who may, if necessary, appoint a specialist to carry out this work. However, the responsibility for correctness of line and level after grouting will remain with the contractor.