**TENDER NO: RW?????/??**

**TENDER FOR THE CONSTRUCTION OF A STANDBY GENERATOR SLAB AT ZUIKERBOSCH PUMPING STATION (SYSTEM 2)**

**TECHNICAL PART**

**MINIMUM CIDB CONTRACTOR GRADING: ???/ ??? ??**

TENDER SUBMITTED BY:

|  |  |
| --- | --- |
| National Treasury Central Supplier Database Number | MAAA…………………………………… |

Registered Name of Company:

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**SECTION D**

**SPECIFICATIONS**

**SPECIFICATIONS**

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Record of Revisions

Rev Date Details of Revision

A 06-04-2020 Internal Review

|  |  |  |
| --- | --- | --- |
| **Name** | **Capacity** | **Signature** |
| Kaveer Sukkhu | Civil Technologist |  |
| Maurice Chibu  | Lead Civil Engineer |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Persons responsible for compilation of this document:

1. **PART 1 - PROJECT SCOPE AND GENERAL SPECIFICATIONS**

**BACKGROUND**

Rand Water is a public utility wholly owned by the Department of Water Affairs. It is the largest bulk water utility in Africa supplying just under 4000 Mℓ/d to over 11 million consumers. Rand Water has a total number of 59 reservoirs with a total pipeline length of 3 056 km.

Approximately ninety nine and a half per cent of all water abstracted and treated by Rand Water from the Vaal Dam. This water is supplied from the Vereeniging and Zuikerbosch purification plant situated at Vereeniging, 60 km South of Johannesburg. The remaining half percent is obtained from underground sources at Zuurbekom to the West of Johannesburg.

This project is for the construction of a reinforced concrete foundation and steel structure to house a generator to be installed at the flocculators at Zuikerbosch System 2.

# PART 2 - PROJECT TECHNICAL SPECIFICATIONS

**GENERAL NOTE:**

THIS SPECIFICATION IS TO BE READ IN CONJUNCTION WITH OTHER DISCIPLINE SPECIFIC PROJECT SPECIFICATIONS REFERED TO HEREIN.

## CIVIL/STRUCTURAL SPECIFICATIONS

### TERMINOLOGY, ABBREVIATIONS AND APPLICABLE DRAWINGS

The following terminology shall apply:

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Engineer | As defined in the commercial document. |
| Employer | Shall mean the same as the “client”, with the client being the owner of the Cathedral Header project |
| Contractor | Shall mean the legal entity under the employ of the Client who enters into a binding Contract to undertake part of or the entirety of the Works described in this and other Contract documents. |

 The following abbreviations shall apply:

|  |  |
| --- | --- |
| **Abbreviation** | **Definition** |
| GA | General Arrangement |
| SANS | South African National Standards |
| SABS | South African Bureau of Standards |

This document shall be read in conjunction with the following drawings:

|  |  |
| --- | --- |
| **Drawing Number** | **Drawing Title** |
| R0 29329/005 | Stand-by generator structure, concrete, steel general arrangements and connection details |
| RA 29329/001 | Architectural layout and details  |

### General Requirements

Civil and Structural works are to be carried out as per the requirements of the SANS 2001 “Construction Works Standards” and SANS 1200 “The Standardized Specification for Civil Engineering Construction”.

### Service Water Supply

Connection points (water source)

The position of the potable water connections will be pointed out to the contractor on site, by the client or the client’s representatives.

The operating pressure for the existing connection point, are to be confirmed by the Contractor.

The Contractor shall make allowance for installing a water meter connection on the water connection point. Water for construction shall be to the Contractor’s account and shall be deemed to be included in the tendered rates.

### SCOPE OF WORK

### The Civil scope of works for the project, to be effected by the contractor, is as follows:

The Contractor’s obligations under this project shall include, but not be limited to the following principal items (the exact extent for the scope of works shall be verified by the contractor with the Engineer prior to tendering):

1. Fencing and hoarding off of site
2. Detection and protection of existing services on site
3. Clearing and making good of site
4. Dewatering of site
5. Compaction control and other relevant soil testing
6. Removing of paving
7. Excavation for new foundations, apron slab and ramp
8. Stabilising and compaction of in-situ material for new foundations
9. Importing, backfilling and compaction of G7 quality material new foundations
10. Construction of a new steel roof structure and foundation slab at Zuikerbosch Flocculators System 2
11. Back-filling, stabilising and compacting of material for exposed services
12. Disposal of surplus material
13. The rectification of defects during the “Defects Liability Period”

### For the Automation and Electrical scope of works for this project, please refer to the specific folders provided per discipline. For Architecture, the specification is as per details provided on the tender drawings.

### VARIATIONS AND ADDITIONS TO STANDARDIZED SPECIFICATIONS

The variations and additions to the applicable standardized specifications have been compiled to provide supplemental site and project specific information, and in that regard are intended to supplement and not replace the other related specification, most notably: SANS 1200; SANS 10120; SANS 2001 and the Technical Specifications contained in this document.

The variations and additions below are provided, to varying extents, some of the following specifications applicable to this project:

|  |  |
| --- | --- |
| **Specification No.** | **Description** |
| SANS 1200 - A | Standardized Specification for Civil Engineering Construction – General  |
| SANS 1200 - D | Standardized Specification for Civil Engineering Construction – Earthworks |
| SANS 2001 – BE1 | Construction Works – Earthworks (General) |
| SANS 2001 – BS1 | Construction Works – Site Clearance |
| SANS 2001 – CC1 | Construction Works – Concrete Works (Structural) |
| SANS 2001 – CS1 | Construction Works – Structural Steelwork |

**A GENERAL - (SABS1200AA – 1986)**

**A 3 MATERIALS**

**A 3.1 QUALITY AND SAMPLES**

Substitute the second sentence of the first paragraph of “A3.1” with the following:

“Materials shall bear the official mark of the appropriate standard.”

Also add the following as a second paragraph:

“The Contractor is responsible for the cost of all testing to ascertain that all construction materials comply with the relevant minimum requirements, and all costs associated with testing of the materials shall be deemed to be included in the tendered rates. Samples on which control testing is required by the Engineer, shall be delivered free of charge to an approved laboratory. The cost of control tests done by the Engineer and of which the results do not comply with the minimum requirements shall be for the Contractor's account.

The Contractor shall inform the Engineer of any control testing/site inspections to be done at least 48 hours before such tests/inspections are required, and the contractor must allow in his/her programme for the time necessary for the tests/inspections to be undertaken, and the processing of the results thereof.

The handling, storage, transport and erection of equipment, machinery and materials shall be strictly in accordance with the requirements of the supplier and or manufacturer.

All materials shall be new and of the best quality available unless otherwise specified. Materials must function satisfactorily under prevailing climate and weather conditions at the place of installation.

All materials shall comply with the SANS applicable to them.”

**A 3.3 DELAY DUE TO SUPPLY OF MATERIALS**

Add new sub-clause “A 3.3”:

“The Contractor shall ensure that the work is not delayed, due to a lack of materials on site, by placing orders with suppliers for the required materials timeously.”

**A 4 PLANT**

**A 4.1 CONTRACTOR'S OFFICE, STORES AND SERVICES**

Add the following to “A 4.2”:

“Security of the Contractor’s camp and construction site will be the Contractor’s own responsibility and no additional payment will be made if additional security measures (crime prevention, etc.) need to be employed during the contract period.

The Contractor shall make his own arrangements for housing his employees and transporting them to and from the site – such housing, shall however; meet the relevant requirements for temporary housing. The Contractor is responsible in all respects for the housing and transporting of his employees and for the arrangement thereof, and no extension of time due to any delays resulting from this will be granted.”

**A 4.3 HAND TOOLS**

Add new sub-clause “A 4.3”:

“The Contractor shall provide and maintain all hand tools required for the execution of the Works and all such costs shall be deemed to be included in the tendered rates and no separate payment will be made for it.”

**A 4.4 MEDICAL FACILITIES AND SAFETY EQUIPMENT**

Add new sub-clause “A 4.4”:

“The Contractor shall provide a First Aid cabinet fully equipped and maintained with the minimum contents as listed in the Annexure (Regulation 3) to the General Safety Regulations of the Occupational Health and Safety Act (Act 85 of 1993), to deal with accidents and ailments which are likely to occur during the construction period.

The Contractor shall provide personal safety equipment and facilities as required by Regulation 2 of the General Safety Regulations of the Occupational Health and Safety Act (Act 85 of 1993).

The Contractor shall designate his Safety Officer and Qualified First Aider. The Contractor shall give copies of the minutes of the site safety meetings to the Engineer.”

**A 5 CONSTRUCTION**

**A 5.1 SURVEY**

**A 5.1.2 Preservation and Replacement of Beacons and Pegs Subject to the Land Survey Act**

Add the following paragraph at the end of sub clause “A 5.1.2”:

“Before the commencement of construction work, the Contractor, in consultation and liaison with the Engineer, shall search for plot pegs where boundaries have not been established by the erection of walls or fences (e.g. between two adjacent undeveloped even or on an undeveloped corner erf) and the Contractor shall compile a list of such pegs that are apparently in their correct positions. Where pegs are not in their correct positions this should be noted by the Contractor and the Engineer should be notified immediately”.

**A 5.2 WATCHING, BARRICADING, LIGHTING AND TRAFFIC CROSSINGS**

Add the following to the end of “A 5.2”:

“Where no minimum requirements for watching, barricading, lighting and traffic crossings for work on public roads are specified in the project or earthworks specifications then the requirements set out in SABS 1200 AA-1986 for ‘Watching, Barricading, Lighting and Traffic Crossings’ shall apply.”

**A 5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES**

Add the following to “A 5.4”:

“It can be expected that existing services will be encountered during the course of construction. The Contractor must determine as far as is possible in conjunction with the relevant authorities the location of the various services. Special care must be taken to avoid disrupting these services. The cost of locating and protecting the services shall be deemed to have been included in the rates. All services must be detected and exposed before any bulk excavation may start.”

**A 5.5 DEALING WITH WATER ON WORKS**

Add the following to the end of “A 5.5”:

“Dedicated dewatering measures must be provided for in the event of a high/perched water table.

Over and above his general obligations in regard to dealing with water as specified in SANS 1200 A, the Contractor shall deal with and dispose of all water so as to ensure that the Works are kept sufficiently dry at all times so that they can be properly executed, and he shall protect them against flood damage. For this purpose the Contractor shall provide sufficient pumps, pipes and other equipment that may be necessary. Payment for dealing with water shall be included in the Contractor’s rates for foundations, except in so far as special provision for dealing with water may be made elsewhere in the Specifications.”

**A 5.6 POLLUTION**

Replace “A 5.6” with the following:

“The Contractor shall take all reasonable measures to minimize any dust nuisance, pollution of streams and inconvenience to or interference with the public (or others) or machinery as a result of the execution of the Works (including excessive vibration of machinery caused by construction equipment).”

**A 5.8 GROUND AND ACCESS TO WORKS**

Add the following to “A 5.8”:

“The Contractor shall maintain adequate access to all public and private property at all times unless otherwise sanctioned by the Engineer. Details of the proposed methods of providing access shall be submitted to the Engineer for approval before such access is restricted. Any claims arising from impeded accesses shall wholly be the responsibility of the Contractor.

Construction along existing roads should be executed in such a manner that both pedestrian and vehicular traffic can be accommodated at all times.

Road traffic signs shall comply with the requirements of the “South African Road Traffic Signs Manual” and shall be approved by the Engineer before construction commences.”

**A 7 TESTING**

**A 7.1 PRINCIPLES**

Add the following to the end “A 7.1.1”:

“The Contractor is expected to anticipate any tests which may be reasonably requested by the Engineer which are not included in the technical specifications or bills of quantities. The rates for the tests and all costs thereof shall be deemed to be included in the contractor’s tendered rates.”

**A 7.4 STATISTICAL ANALYSIS OF CONTROL TESTS**

Add sub-clause “A 7.4” as follows:

“Test results shall not be evaluated by statistical methods. All results shall comply with the specified minimum requirements and Standardized Specifications of the materials concerned.”

**A 7.5 PROCESS CONTROL**

Add new sub-clause “A 7.5”:

“All test results obtained by the Contractor in the course of his process control of the Works shall be submitted to the Engineer or his representative prior to requesting inspection of the relevant portions of the Works. Any request for inspection shall be submitted on the prescribed forms which will be provided by the Engineer – any request for inspection shall be sent to the Engineer at least 48 hours before the intended completion date of the works.

The Contractor shall make suitable arrangements for process control prior to commencement with the Works. Should he intend using site personnel for this purpose he shall ensure that suitably trained and competent personnel take charge of the necessary test work and that the necessary equipment is at their disposal prior to commencement of the Works. Failure to comply with these requirements shall be just cause for the Engineer to order suspension of the works without additional remuneration or for the Engineer to recommend termination to the Employer.”

**A 8 MEASUREMENT AND PAYMENT**

Add the following sub-clause

**“PSA 8.3.5 Provision for Health and Safety Measures**

**T**he rate shall cover the cost to provide a health and safety plan as well as any additional safety measures and or appointments as may be required in terms of SSA 4.4. Individual items may be scheduled separately.

 Unit: Sum”

**BE1 EARTHWORKS - (SUPPLEMENT TO SANS 2001-BE1: 2008)**

The following specification is drawn up with SANS 1200 D as a basis and supplements the provisions of SANS 2001-BE1: 2008.

**BE1 - 4 REQUIREMENTS**

**BE1 - 4.1 MATERIALS**

**BE1 - 4.1.6 Contamination of Suitable Fill Material**

Add the following sub-clause to section BE1 sub-clause 4.1.

“The Contractor shall deal with materials from all excavations for structures in such a way as to ensure that usable material is not contaminated with unsuitable material. If usable material is contaminated, such contaminated material shall be removed and replaced with material of standard at least equal to the in situ usable material, all at the Contractor's expense. No additional payment shall be made in respect of this and all relevant costs shall be deemed to be included in the tendered rates.”

**BE1 - 4.2 METHODS AND PROCEDURES**

**BE1 - 4.2.2 Excavations**

**BE1 - 4.2.2.4 Detection, Location and Exposure of Existing Services**

Add the following sub-clause to BE1 4.2.2.

“The provisions of Sub-clause 5.2 of SANS 1200 AA shall apply, in addition to the requirements of this sub-clause.

The drawings showing the position of known existing services shall be issued to the contractor by the Engineer. The Contractor shall verify the position of all services and all other obstacles and existing works on the Site. Manholes, valve boxes and the like will be regarded as known services. Prior to the commencement of any construction in any particular area, the Contractor shall verify the positions of services and report to the Engineer any that are missing.

Where any subterranean services are shown on drawings, the Contractor shall have the suitable detection equipment available on Site for as long as it necessary to detect and locate such services. The Engineer may instruct the Contractor to undertake hand excavation to expose services.

If existing services are not shown on the drawings, but the existence thereof can be reasonably expected, the Contractor shall, in conjunction with all relevant authorities, determine the exact path and location of such services before the commencement of construction. After locating the exact position of services, whether indicated on the drawings or not, such services shall be deemed to be known services and the Contractor shall be liable for all costs and subsequent costs arising from the damage thereof as a result of the Contractor’s activities. These services must also be indicated on the ‘Record drawings’.”

**BE1 - 4.2.2.5 Protection of cables**

Add the following sub-clause to BE1 4.2.2.

“The Contract shall advise the Engineer at least 7 days in advance of the actual date on which he proposes to excavate near any cable. The Contractor shall not use mechanical equipment to excavate within 3 m of the estimated position of any cable and shall, if necessary, expose the cable by means of hand excavation carried out under proper supervision (complying with all necessary Occupational Health and Safety requirements and standards). When the Contractor is instructed to use hand excavation, the Contractor shall backfill such cable trenches with approved material to the compaction density ordered.

Where a service is damaged due to the Contractor’s negligence, the contractor shall bear the cost of the repairs of the service. Any penalty incurred by the Client from the owner/custodian of the damaged service shall be transferred to the Contractor.”

**BE1 - 4.2.3 Disposal**

Substitute the first sentence of sub-clause BE1-4.2.3 with the following:

“All surplus material which is suitable for fill shall be spread and compacted as fill within a designated area of the site. All material unsuitable for fill shall be transported to an approved dumping site decided upon by the Contractor; the Engineer will not be liable for and disposed materials by Contractor.

Disposal of rubble/surplus material or any other debris/material to be removed from site should be undertaken when said material reaches 6 m3 or has been kept on site for a week, whichever is reached first. The Employer/Engineer may impose fines on the Contractor for the late removal of material from site.”

**BE1 - 4.2.7 Dust**

Add the following sub-clause:

“Wherever dust from any of Works or construction activities becomes a nuisance to the public or damages adjacent properties, the Contractor shall, at the instruction of the Engineer, apply sufficient water or take other measures to lay the dust. The cost of dealing with dust (including, but not limited to, suppression) shall be included rates for construction.”

**BE1 - 4.2.8 Excavated material not to endanger or interfere**

Add the following sub-clause BE1-4.2.8 to SANS 2001-BE1:

“All excavated material shall be so deposited as not to interfere with or endanger the Works (for example, by causing the sides of an excavation to collapse), other property or traffic. The Engineer may order the Contractor to remove any material that the Engineer considers liable to endanger or to interfere with the Works, private property, traffic or pedestrians, and to place such material at some other approved location. If the necessity for such removal is, in the opinion of the Engineer, a result of some fault on the part of the Contractor, the cost of removal shall be borne by the Contractor, but otherwise it will be borne by the Employer.

All surplus material not required for backfilling or forming embankments as indicated elsewhere in the Contract or as may be ordered by the Engineer, and material unsuitable for backfilling, forming embankments or topsoiling shall be deposited on a site or sites as described under BE1 4.2.3.”

**BE1 - 5 COMPLIANCE WITH THE REQUIREMENTS**

**BE1 - 5.2 TOLERANCES**

**BE1 - 5.2.1 Position, dimension and levels**

Replace the first sentence of sub-clause 5.2.1 with the following:

“The earthworks shall be finished to within the limits given in table 1 to a degree of accuracy II for both *‘Excavations for structural foundations’* and *‘Terraces and embankments’*”.

**BE1 - 6 SAFETY**

Add the following clause and sub-clauses to SANS2001-BE1: 2008

**“BE1 – 6.1** Barricading and lighting

In terms of the applicable regulation of the Machinery and Occupational Safety Act, 1983 (Act 6 of 1983), every excavation that is accessible to the public or that is adjacent to a public road or thoroughfare or by which the safety of persons may be endangered, shall be

1. Adequately protected by a barrier or fence of height at least 1 000mm and as close to the excavation as practicable; and
2. Provided with red warning lights at night

In addition to the requirements of Act 6 of 1983, the Contractor is required to comply with the requirements set out in the “Contractor’s Agreement (which forms part of this Contract) – Agreement for Qualification of and Code of Conduct for Contractors, sub-Contractors and Owner Builders within the Development known as The Falls” (entered into between the Client, the Contractor and Century Property Developments) sub-clause 3.1.9 “screening of building sites”.

The Contractor may not provide a watchman for the safeguarding of excavations after hours – and as such all excavations are to be left safely barricaded from the public and from tampering.

**BE1 – 6.2** Safeguarding of excavations

The provisions of SANS 1200 D-1988 sub-clause 5.1.1.2 are applicable.

Insert the following after paragraph (b)(2), before paragraph (c) of sub-clause 5.1.1.2:

“The Contractor or his agent or his representative shall not require or allow any person to work under unsupported overhanging material or in an excavation which is more than 1,5m deep, and any excavation which has not been adequately supported or braced if there is a danger of the overhanging material or the sides of the excavation collapsing. The support, shoring or bracing to be designed and constructed by the Contractor, shall be strong and sturdy enough to support the sides of the excavation in question.

The Engineer may request that trenches must be barricaded due to reasons that he sees fit. The barricade will be at least 1.2 metres high and the distance between wire strands will not exceed 200 mm if a wire fence is erected. If a barricade net is erected the openings in the net will not exceed 100 x 100 mm. The barricade (net or wire fence) will be supported at distances not greater than 1 metres with suitable sturdy supports. After completion of the work(s) the barricades must be removed completely and no barricading material may be left on site. The barricade will be erected on both sides of the trench with a minimum distance of 5 metres and a maximum distance of 10 metres from the side of the trench.”

Add the following to SANS 2001 BE1:

**“BE1 - 7 SCHEDULED ITEMS**

The entire provisions of SANS 1200 DA:1990 part 8 (Measurement and Payment) shall apply and where reference is made to clauses/sub-clauses in SANS 1200 DA:1990 (Or any other part of SANS 1200) the equivalent clauses in SANS 2001-BE1 shall be applicable instead – where reference is made to other parts of SANS 1200 then the relevant SANS 2001 standard (where applicable) shall be applicable instead.”

**DA EARTHWORKS (SMALL WORKS) - (SABS1200D – 1988)**

**DA 2 INTERPRETATIONS**

**DA 2.3 DEFINITIONS**

Add the following to D 2.3:

Sand (cohesionless and non-cohesive)

For the purpose of the compaction requirements, a non-plastic material of which not less than 95 % by mass passes a sieve of nominal aperture size 4,75 mm, and not more than 10 % passes a sieve of nominal aperture size 0,075 mm.

**DA 3 MATERIALS**

**DA 3.1.2 Classes of Excavation**

Add the following to D 3.1.2:

Under this contract soft and intermediate excavation shall be classified together as soft excavation, and hard rock and boulder excavation, where boulders are larger than 1 m3, shall be classified together as hard rock excavation. Boulders smaller than 1 m3 shall be classified together with soft excavation.

**DA 4 PLANT**

**DA 4.4 DETECTORS**

REPLACE THE CONTENTS OF SUBCLAUSE 4.4 WITH THE FOLLOWING:

“The Contractor shall, for the purposes of detecting and locating underground services in accordance with the provisions of Sub-clause 5.2 of SANS 1200 AA and Sub-clause 5.1.3 of SANS 1200 DA, at its own cost, provide and use detecting equipment which is suitable for the detection of underground cables and pipes.”

**DA 5 CONSTRUCTION**

**DA 5.1 PRECAUTIONS**

**DA 5.1.2 Existing Services**

DA 5.1.2.2 Detection, location and exposure

Add the following to D 5.1.2.2:

The requirements of AA 5.4 shall apply mutatis mutandis. If existing services are not shown on the drawings but the existence thereof can be reasonably expected, the Contractor shall, in conjunction with all relevant authorities, determine the exact path and location of such services before the commencement of construction. After locating the exact position of services, whether indicated on the drawings or not, such services shall be deemed to be known services and the Contractor shall be liable for all costs and subsequent costs arising from the damage thereof as a result of the Contractor’s activities. These services must also be indicated on the “Record” drawings.

**DA 5.1.2.3 Protection of cables**

Substitute "estimated position" in the second sentence of D 5.1.2.3 with "actual or exposed position".

**DA 5.1.4 Nuisance**

**DA 5.1.4.1 Dust Nuisance**

Add the following to D 5.1.4.1:

The Contractor is responsible for dust control and is liable for all claims that may result from dust nuisance on all parts of the site and at all times from the date of handing over of the site to the completion date of the contract. No payment regarding the above-mentioned will be made and all costs shall be deemed to be covered by the tendered rates.

**DA 5.2 METHODS AND PROCEDURES**

**DA 5.2.1 Site Preparation**

DA 5.2.1.2 Conservation of topsoil

Add the following to D 5.2.1.2:

Removal of topsoil shall only occur in areas as approved by the Engineer. The topsoil shall be conserved for use elsewhere. Topsoil shall be deposited from the excavations and stockpiled separately in temporary stockpiles. In order to conserve the bacteriological life in the topsoil the storage heaps, strips or layers shall not exceed 1.5 m in total depth.

**DA 5.2.2 Excavation**

DA 5.2.2.1 Excavations for general earthworks and for structures

Add the following to D 5.2.2.1:

To the maximum extent possible all suitable materials excavated shall be used in the construction of the works. Such materials shall be selected from the unsuitable materials and stockpiled separately in temporary stockpiles on sites to be negotiated by the Contractor and approved by the Engineer. The assessment of the quantity of suitable material to be stockpiled for filling shall be the responsibility of the Contractor entirely and any deficit shall be made good by the Contractor without cost to Rand Water. The balance of the suitable material for filling which is assessed as surplus to the requirements of the work may be removed from the sites as excavations proceed. Strip foundations and encasement of pipes shall be cast directly against excavated surfaces. Materials under foundations and floors of structures, which are regarded by the Engineer as unsuitable for the bearing of such structures shall be removed to the depths and widths, ordered. The excavated voids shall then be filled with sand compacted to 100 % of MAASHTO density, to the underside of such foundation or floors, unless a soil cement mixture in terms of SSDA 5.2.3.2 is ordered by the Engineer.

**DA 5.2.2.3 Disposal**

Substitute the second sentence of D 5.2.2.3 with the following:

All surplus material which is suitable for fill shall be transported to an open site, to be designated by the Engineer, spread and compacted as fill. All material unsuitable for fill shall be transported to the municipal dumping site.

**DA 5.2.3.2 Backfilling of trenches and backfilling against structures**

Add to the end:

Unless otherwise authorised by the Engineer no backfilling or filling against structures shall commence until the concrete has been in place for at least 14 days. Backfilling of all pipe trenches and around structures shall be performed layers with material approved by the Engineer. Each layer shall be compacted at optimum moisture content with sufficient water added uniformly to ensure that the specified density will be achieved for each layer. Each layer shall be completed before the next is added. Backfilling is not measured separately but is included in the tariff for the chambers and structures. All over-excavation must be backfilled by the Contractor with mass concrete of the specified grade at his/her own cost. Where such over-excavation has been ordered by the Engineer, the backfilling with concrete will be measured and paid separately.

**DA 5.2.4 Finishing**

**DA 5.2.4.1 Final grading**

Add the following to D 5.2.4.1:

Terraces shall be trimmed to an even grade of 1 in 2.

**DA 5.2.4.2 Top soiling**

Add the following to D 5.2.4.2:

Topsoil shall be placed on the sides and on the tops of embankments and other terraces where no paving is specified, or in areas where directed by the Engineer.

**DA 5.2.5.1 Freehaul**

Add the following to 5.2.5.1(1):

All haul distances for the duration of construction shall be taken as Freehaul and the Contractor shall include all costs associated with this specification into their earthworks rates.

**DA 5.2.6 Removal of Unsuitable Material**

The provision of SANS 1200 DM : Earthworks (Roads) clause DM 5.2.3.2 shall apply.

SSDA 5.2.7 Dewatering of foundation excavations

Over and above his general obligations in regard to dealing with water as specified in SANS 1200 A, the Contractor shall deal with and dispose of all water so as to ensure that the Works are kept sufficiently dry at all times so that they can be properly executed, and he shall protect them against flood damage. For this purpose the Contractor shall provide sufficient pumps, pipes and other equipment that may be necessary. Payment for dealing with water shall be included in the Contractor’s rates for foundations, except in so far as special provision for dealing with water may be made elsewhere in the Specifications.

**DA 7.7.4 Setting out of excavations**

The Contractor shall set out the excavations accurately in accordance with the drawings and data approved by the Engineer. The Contractor shall provide, erect, set to line and level and maintain approved substantial working profiles on the perimeter of excavations and along the length of the trench at changes of grade and direction. Each working profile shall be fitted with a horizontal cross-bar set at a predetermined height above the designed excavation profiles to which excavations are to be carried out and have setting marks which will define the local setting out lines and the centre line of the trench. Where required by the Engineer the Contractor shall provide a working profile with the cross-bar extending across the full width of the trench. A working profile shall remain in position during all stages of the excavations until the concrete is placed or the pipe is laid past the chainage of the working profile.

The Contractor shall provide sets of boning rods, templates and piano wire, for the sole use of the Engineer, for checking the profiles of the excavations. The Contractor shall also provide, set and level all the pegs required to transfer lines and levels to the excavation floor in order to control the preparation of the prescribed profiles. Excavation will be required to expose existing pipelines to allow the installation of the drainage and sewer lines. In exposing existing pipelines the Contractor shall excavate by machine, or by hand if necessary, around and under the pipelines taking care to avoid damage to the bitumen, cement mortar or epoxy coated pipes. Any damage caused to pipe coatings during excavations will be made good by Rand Water and any costs so incurred will be deducted from moneys due to the Contractor. The Contractor shall provide and use equipment and machinery of adequate capacity and suitable type and quality for the efficient and expeditious execution of the work.

**DA 7.7.5 Overbreak and over excavation**

It is to be expected that during excavations material will be removed from below the prescribed profiles. In the cases where the excavation floor is formed of materials classified as Rock the additional depth will for purposes of this contract be termed overbreak and can be expected to vary according to the nature of the rock, the jointing planes, the extent of weathering of the rock, the methods and procedures used in the blasting of the rock and the expertise of the personnel undertaking the blasting. In the case where the excavation floor is formed in materials classified as Soft, the additional depth will for purposes of this contract be termed over excavation.

**DA 7.7.6 Safety of excavations**

Excavations shall be undertaken in a safe manner in compliance with the regulations promulgated under the Occupational Health and Safety Act (Act 85 of 1993) or any amendment thereof. Safety precautions to be observed by the Contractor shall include the sloping, stepping or benching or shoring, timbering or otherwise supporting the sides of the excavations or any other provision as stipulated in Regulation 13 of the aforesaid act, with which the Contractor declares himself to be conversant. The shoring method adopted shall be compatible with the excavating, backfilling and construction method and shall not restrict the installation and construction. Shores shall be designed to withstand the earth pressures exerted upon them from the side of the excavation which shall include the superimposed loading of construction and pipelaying equipment. The Engineer may call upon the Contractor to timber the sides of the excavation at any point, without cost to Rand Water that he may consider in any way dangerous. Such timbering shall be left in place until the completion of the work at the point affected.

Timbering shall consist of open planning, walings and substantial struts and shall be carried out in a workmanlike manner and to the satisfaction of the Engineer. The Contractor shall allow for the removal of timbering immediately prior to backfilling or on the instructions of the Engineer.

**DA 7.7.7 Maintaining the sides of the excavations**

Maintaining the sides of the excavations in a safe condition shall at all times be the sole responsibility of the Contractor. No under-cutting of the sides will be allowed.

**DA 7.7.8 Protection of work**

The Contractor shall provide, at his own expense, all measures necessary for the protection of the excavations during the progress of the work, and shall be solely responsible for securing, lighting and watching all places dangerous to traffic, persons, animals or property, and shall be liable for all claims arising therefrom.

The excavations shall be maintained until the structures are completed and backfilled.

Should the sides fall in or any debris or water accumulate in the excavations due to any cause the excavation shall be cleaned out and any damage arising therefrom made good by the Contractor at his own cost as directed by the Engineer.

**DA 7.7.9 Material for filling**

All material used in the filling beneath structures, behind walls, for formation of terraces and embankments and backfilling of pipes shall be suitable material as defined in the following clause. Suitable material for filling beneath structures, behind walls, formation of terraces and embankments etc and for stage ll backfill in drain pipe trenches shall comprise loose, fine soil or powdered soft shales which on excavation, handling and compaction break down into a soil like texture and shall have the characteristics of a sandy silt or clayey sand material with a plasticity index not exceeding 15. The fill shall contain no ouklip or materials deleterious to concrete and shall be free of pebbles, stones and fragments of shattered rock with maximum dimensions exceeding 50 mm. The material used shall have a uniform moisture content and be free from roots and deleterious proportions of organic matter. The material shall not be too wet for practical drying to the required moisture content. Alternatively, where instructed by the Engineer, loose fine soil with a plasticity index exceeding 15 shall be used as suitable material for filling beneath structures and behind walls in association with cement or lime stabilization. Suitable material for drain pipe bed and for stage l backfilling in drain pipe trenches shall comprise loose, fine soil or powdered soft shales which on which on excavation, handling and compaction break down into a soil like texture and shall have the characteristics of a sandy silt or clayey sand material with a plasticity index not exceeding 15. The fill shall contain no ouklip or materials deleterious to bitumen wrapped steel pipes and shall be free of pebbles, stones and fragments of shattered rock with maximum dimensions exceeding 10 mm. The material used shall have a uniform moisture content and be free from roots and deleterious proportions of organic matter. The material shall not be too wet for practical drying to the required moisture content

Suitable material for use in road subbase and base layers in drainage pipeline trench at road crossings shall comprise selected graded crushed stone Class G1 as specified in terms of TRH14 – Guidelines for Road Construction Materials.

**DA 7.7.10 Source of materials**

Unless authorized by the Engineer, suitable material shall be selected from materials excavated under the contract. If insufficient suitable material for filling is available for selection from the excavations the Contractor shall with the approval of the Engineer, supplement the available suitable material for filling by importing suitable material approved by the Engineer. The Contractor shall negotiate for, obtain, load and transport to site the supplementary requirements for filling.

**DA 7.7.11 Compaction of in situ material**

Where required the in situ material at the excavation profile or at the surface exposed after the removal of unsuitable foundation material shall be compacted to 93% (ninety-three percent) of the Modified AASHTO to a depth of at least 150 mm below the exposed surface. Compaction shall be carried out between optimum moisture content and optimum moisture content plus 2% (two percent). Density testing of the compacted in situ material shall be carried out in accordance with Clause E17.

**DA 7.7.12 Filling topsoil**

After the backfilling of the excavations has been completed to the subsoil surface the topsoil shall be returned to the upper 300 mm layer from which it was removed to restore the natural ground surface. The topsoil shall be evenly spread and lightly compacted to leave the upper ground surface in a neat and tidy condition as near as may be to the original condition encountered before excavation commenced or to such details for the embankments as are indicated on the drawings

**BS1 SITE CLEARANCE – (SUPPLEMENT TO SANS 2001-BS1: 2008)**

The following specification is drawn up with SANS 1200 C as a basis and supplements the provisions of SANS 2001-BS1: 2008.

The Contractor shall program his work in such a manner that re-clearing will not be necessary. The cost of re-clearing shall be borne by the Contractor.

Where suitable topsoil exists within the limits of the area to be excavated, the Contractor shall remove the topsoil to an average depth of 150 mm together with any veld grasses and other similar vegetation as directed by the Engineer. The topsoil shall be transported and deposited in temporary stockpiles in an area which is to be confirmed with the Engineer prior to stockpiling.

Add the following sub-clauses to SANS 2001-BS1: 2008

**“BS1 - 6 MEASUREMENT AND PAYMENT**

The items scheduled for clearance and demolition will be classified according to the nature of the materials involved and the methods of their disposal.

Only those areas designated to be cleared as per the guidelines of SANS 2001-BS1: 2008 will be measured for payment. The area of surfaced roads, paved areas, railway formations, and major structures falling within such areas, designated to be cleared, will normally be deducted from such measurement.

Where conservation of topsoil without prior clearing is ordered, the removal of topsoil form the specified area will be measured as excavation and no payment will be made for clearing and grubbing.

**BS1 - 7 SCHEDULED ITEMS**

The entire provisions of SANS 1200 C (latest amendment) part 8 (Measurement and Payment) shall apply and where reference is made to clauses/sub-clauses in SANS 1200 C (Or any other part of SANS 1200) the equivalent clauses in SANS 2001-BE1 shall be applicable instead – where reference is made to other parts of SANS 1200 then the relevant SANS 2001 standard (where applicable) shall be applicable instead.”

**C SITE CLEARANCE – (SABS 1200C – 1986)**

**C 3 MATERIALS**

**C 3.1 DISPOSAL OF MATERIAL**

Substitute the first sentence of C 3.1 with the following:

An area for the disposal of material obtained from clearing and grubbing shall be disposed off site to the municipal dumping site. The use of the disposal area must be confirmed with the Employer prior to disposal.

**C 5 CONSTRUCTION**

**C 5.1 AREAS TO BE CLEARED AND GRUBBED**

Substitute the first sentence of C 5.1 with the following:

Clearing and grubbing shall only be done in areas as instructed in writing by the Engineer.

The Contractor may proceed with clearing and grubbing after hand-over of the site.

Substitute the last paragraph with the following:

The Contractor shall program his work in such a manner that re-clearing will not be necessary. The cost of reclearing shall be borne by the Contractor.

Where suitable topsoil exists within the limits of the area to be excavated the Contractor shall remove the topsoil to an average depth of 150 mm together with any veld grasses and other similar vegetation as directed by the Engineer. The topsoil shall be transported and deposited in temporary stockpiles.

**C 5.2 CUTTING OF TREES**

Trees outside the area to be excavated for the new structures must be left standing and undamaged, except when otherwise ordered, in writing, by the Engineer.

A penalty of R1000-00 per tree for trees damaged and/or removed will be charged.

**C 5.2.3.2 Individual trees**

Care shall be taken to protect indigenous trees. The Contractor shall replace any tree damaged or removed outside the areas to be cleared and grubbed. A tree is defined as having a trunk diameter of more than 150 mm at a height of more than 0,3 m above ground level.

**CC1 CONCRETE WORKS (STRUCTURAL) - (SUPPLEMENT TO SANS 2001-CC1: 2012)**

The following specification is drawn up with SANS 1200 G as a basis and supplements the provisions of SANS 2001-CC1: 2012

**CC1- 4 REQUIREMENTS**

**CC1- 4.2 MATERIALS**

**CC1- 4.2.1 Cementitious binders**

Add the following sentence to the end of 4.2.1.2:

“Where the manufacturer of a cementitious binder specifies more stringent storage conditions to those prescribed by this sub-clause then the manufacturer’s requirements shall take precedence

Where the cement is supplied in bags, the bags shall be closely and neatly stacked to a height not exceeding 12 bags with different brands and/or types of the same brand stored separately.”.

Substitute 4.2.1.3 with the following:

“4.2.1.3 Cement shall not be kept in storage on site for longer than eight weeks or the storage time prescribed by the manufacturer whichever is less”.

**CC1- 4.2.3 Aggregates**

Add the following sentence to the end of 4.2.3.7:

“In addition to the above, sand is to be stored in such a way that contamination by foreign matter is prevented.”

**CC1- 4.3 FORMWORK**

**CC1- 4.3.2 Design and Construction of Formwork and Falsework**

**CC1- 4.3.2.1 General**

Add the following sub-clause to the end of 4.3.2.1:

“4.3.2.1.7 The design and construction of formwork and Falsework will be the responsibility of the Contractor, however, the Engineer shall review the design and construction thereof for approval. The design and construction of Formwork and Falsework shall comply with all Occupational Health and Safety Act and accompanying regulatory requirements – in addition to the requirements contained in CC1:2012”.

**CC1- 4.7 QUALITY OF CONCRETE**

**CC1- 4.7.8 Mixing**

Add the following before section 4.7.8.1:

“The concrete mix shall be designed by a specialist organization. No concrete shall be placed until the Contractor’s concrete mix design has been approved by the Engineer. The Contractor shall submit to the Engineer a statement of the mix proportion proposed, together with a report from the specialist organization, showing the 28 day concrete strength obtained when using the material proposed for the work. The cost of the concrete mix design shall be borne by the Contractor and shall be deemed to be included in the rates for concrete work.

Admixtures may be used to increase the workability of the concrete but only with the express approval of the Engineer and when the details of the active ingredients of the admixture and their effects are supplied to the Engineer for approval before use. No additives likely to impair low permeability of the concrete will be approved.”

**CC1- 4.8 PRECAST CONCRETE**

Add the following before section 4.8.1:

“The client employer is indemnified against all claims resulting/which may result from or for infringement of patent rights, design or trademarks in respect of any precast system used in connection with the works and the payment of any royalties due, or that might become due, as a result of the use of such a system.”

**CC1- 4.10 HANDLING AND ERECTION OF PRECAST CONCRETE UNITS**

Replace the first sentence of sub-clause 4.10.3.1 with the following:

“4.10.3.1. Temporary supports shall be so designed and arranged, by the Contractor and reviewed by the Engineer for Approval, that account is taken of: ”

Add the following sub-clause to SANS 2001-CC1:2012:

“**CC1 - 6 MEASUREMENT AND PAYMENT**

The entire provisions of SANS 1200 G:1982 part 8 (Measurement and Payment) shall apply and where reference is made to clauses/sub-clauses in SANS 1200 G:1982 the equivalent clauses in SANS 2001-CC1:2012 shall be applicable instead – where reference is made to other parts of SANS 1200 then the relevant SANS 2001 standard (where applicable) shall be applicable instead.”

**CS1 STRUCTURAL STEELWORK - (SUPPLEMENT TO SANS 2001-CS1: 2017)**

**CS1- 4 REQUIREMENTS**

**CS1- 4.2 DRAWINGS**

**CS1- 4.2.5 Erection drawings**

Add the following sentence to the end of sub-clause 4.2.5.1:

“All temporary steelwork necessary for erection purposes shall be designed by a relevant competent person, registered as such with the Engineering Council of South Africa as a Professional Engineer or Engineering Technologist, in the employ of the Contractor.”

**CS1 - 6 MEASUREMENT AND PAYMENT**

The entire provisions of SANS 1200 H:1990 part 8 (Measurement and Payment) shall apply and where reference is made to clauses/sub-clauses in SANS 1200 H:1990 the equivalent clauses in SANS 2001-CS1:2017 shall be applicable instead – where reference is made to other parts of SANS 1200 then the relevant SANS 2001 standard (where applicable) shall be applicable instead.

### TECHNICAL SPECIFICATIONS

### Rand Water technical specifications that shall apply to this contract are listed in this section.

## EXCAVATIONS AND EARTHWORKS

### Clearing

### Prior to carrying out excavation the Contractor shall clear such areas of the sites as are necessary for the proper execution of the works of all shrubs, bushes, other vegetation, fences, rubbish, debris and other obstructive material.

### Where suitable topsoil exists within the limits of the area to be excavated the Contractor shall remove the topsoil to an average depth of 100 mm together with any veld grasses and other similar vegetation as directed by the Engineer. The topsoil shall be transported and deposited in temporary stockpiles.

### All organic material and combustible rubbish shall with the prior written approval of the Engineer be burnt on the site. Care shall be taken to observe the provisions of the Atmospheric Pollution Act, 1965 (Act 45 of 1965) and any regulation published in terms of the Act. Care shall be taken to prevent fire from spreading to adjacent areas.

### Fencing wire shall be neatly wound on suitable reels and all such wire together with all fence posts and other usable material from structures etc. shall be stacked at sites indicated by the Engineer.

## WORKING IN ROADS

Before excavating the trench along or across any road the Contractor shall notify the property owners and the Engineer that the work is to be commenced and ascertain and comply with the conditions that have been imposed for working in or across the road.

The Contractor shall arrange the work to ensure a minimum of interruption to traffic and shall be liable for any injury to persons or animals and for any damage to property or things due to negligence on the part of the Contractor or his employees.

### Approval of Operations

Prior to the commencement of each section or type of excavation the Contractor shall submit to the Engineer for approval a detailed programme of operations, methods and plant to be used for executing that section or type of excavation, including details of dewatering, pumping, shoring, drilling patterns, etc. The Engineer's approval will not be unreasonably withheld provided the method and equipment proposed can be expected to produce an acceptable end result and such approval shall not relieve the Contractor of his/her responsibilities for safety, programme or any other requirements of the contract.

The Contractor may use any method he chooses to excavate any class of material, but his/her chosen method of excavation shall not determine the classification of the excavation. The Engineer will decide and approve the classification of the material to be excavated.

### Classification of Material

Material to be excavated shall be classified as follows:

Class B material shall be hard material and boulders greater than 1 m3 that, in the opinion of the Engineer, requires the use of explosives for its excavation. Material that can be ripped by a Caterpillar D8'H' machine (or similar machine with a minimum mass of 35 000 kg and

flywheel power in excess of 220 kW) fitted with a single tine rear mounted ripper suitable for heavy ripping or a back-acting excavator of flywheel power exceeding 0,20 kW for each millimetre of tined-bucket width will not be classified in this category.

Class A material shall be all material that is not classified by the Engineer as Class B material.

### Explosives

The Contractor shall be responsible for the acquisition, custody, control and use of explosives on the contract and shall comply with the requirements of the Minerals Act of 1991, and Regulations, the Explosives Act of 1956 and Regulations and all amendments thereto and to the relevant requirements of the South African Police and other Authorities where blasting is in the vicinity of their installations and property. Copies of all returns, reports and applications to, and licences, permits and authorities issued by such Statutory Bodies shall be furnished to the Engineer by the Contractor. Nothing contained in this contract nor any approval of instruction by the Engineer shall relieve the Contractor of any of his/her obligations and responsibilities under any Statutory Acts or Regulations existing or introduced during the period of contract.

The Contractor shall be responsible for the siting, erection, fencing, maintenance and licensing of explosive and detonator magazines required for the satisfactory performance of the Contract. Proposals for the siting shall in the first instance be submitted to and receive the approval of the Engineer prior to any approach being made to the authorities concerned.

The Contractor shall be responsible for the guarding of magazines in terms of any regulations which may be in force or come into force during the period of contract and shall comply with any instructions given from time to time by any statutory or local authority in this connection.

### Blasting

All blasting shall be carried out under proper control, by licensed persons, and shall be adequately protected by steel mats and/or other approved methods. The Contractor shall be responsible for any damage of any nature caused by such blasting to persons, animals, materials, structures surrounding properties, etc and shall observe all government and/or local regulations.

Before blasting work commences the procedure to be adopted shall be submitted in writing for approval by the Engineer.

No blasting shall be carried out until permission in writing has been obtained from the Engineer (who may prohibit the use of explosives in close proximity to pipelines, cables, roads and concrete already placed and who may restrict the size of charges used) and the Contractor has obtained the necessary clearances in respect of safety requirements from the Government Inspector of Explosives.

If concrete construction work commences before the excavations are complete, blasting will be permitted provided only light charges in small quantities are used within a distance of 50m of any concrete work. No blasting will be allowed within 20m of concrete work.

No blasting will be permitted within 30m of existing structures or of Rand Water's existing pipelines until a specific report containing the recommendations of the Explosives Division of AECI Ltd is approved by the Engineer. The report shall recommend the detailed procedures for blasting in the various conditions encountered so that no damage can occur to the structures and/or pipelines. Any blasting which is to be undertaken at a distance greater than 30m from existing structures shall be carried out in accordance with the general recommendations of AECI Ltd contained in published information sheets.

### Limits of Excavation

The bottom and sides of excavations in contact with concrete surfaces shall be finished sufficiently true to give the minimum thickness of concrete specified for the various structures. These excavation surfaces shall be free from loose, soft or friable material. No material shall remain within such lines.

### Excavations to Be Approved

In no case shall excavations be filled in or covered in any way until the excavated surfaces have been inspected and approved by the Engineer.

The Contractor shall advise the Engineer whenever the excavations are ready for inspection or whenever it is necessary to cover up the work. In default of such notice the work so covered shall, on order of the Engineer, be uncovered by the Contractor and reinstated without extra charge.

### Excavation

Topsoil is defined for the purposes of this contract as the upper layer of soft material with a depth not exceeding 300 mm below the natural ground surface in which veld or cultivated grass is growing.

Before proceeding with the bulk excavation the Contractor shall strip the topsoil over the area to be excavated plus a further width of 5m outside the payment lines.

The use of rippers will not be permitted in Class A material within 200 mm of the excavation profile.

Any excavation in Class B material below or outside excavation profiles, (overbreak), for surfaces against which geofabric, site, porous, mass or reinforced concrete is to be placed shall be filled with Grade 15 concrete to the general excavation profile. The finished surface of this concrete filling shall not be above or inside the general excavation profiles.

### Trimming

Site or porous concrete shall be placed on a trimmed section in Class A material or backfill within 3 (three) days of achieving the final trim.

Trimming to the excavation profiles shall be sufficiently true to give the minimum thickness of concrete specified for the various elements of the structures. No material shall remain above or within the excavation profile.

Should the Contractor trim Class A material below or outside excavation profiles, (over excavation), in respect of surfaces against which geographic, piping, site, porous, mass or reinforced concrete is to be placed he shall fill in the volume so excavated with suitable material to a height 80 mm above the excavation profile compacted in horizontal layers not exceeding 150 mm finished thickness to 95% (ninety-five per cent) of the Modified AASHTO density at optimum moisture content and subsequently trim to the correct profile.

Alternatively the Contractor may, with the Engineer's permission, fill over‑trimmed volumes by increasing the thickness of the porous concrete layer by up to 30 mm.

Trench excavation shall be carried out in all materials between the subsoil surface or the natural ground surface and trench excavation profiles as determined from the drawings.

The drainage pipe trenches shall, except in restricted areas, be excavated by machine in combination with the use of explosives and mechanical breakers where necessary from top to bottom to the trench excavation profiles or as instructed by the Engineer except as otherwise determined by the Contractor.

The profiles of the side walls of trench excavations shall be the safe slope profiles determined by the Contractor.

The excavation surfaces on the floor of the trench which are to receive the pipe bed or pipe support cradle shall, after completion, be free from loose, soft or friable material and no material shall remain above or within the trench excavation profiles.

If the trench is dug to a depth in excess of that required, in Class A material (over excavation) or Class B material (overbreak), the Contractor shall backfill suitable material, in layers of not more than 200 mm finished thickness, and compact these layers to 93% (ninety-three per cent) Modified AASHTO density at optimum moisture content.

The drainage pipeline to be laid across any road designated as a "minor road" shall be installed in a trench of normal width and depth for the full width of the road in accordance with the details shown on the drawings.

Excavation of unsuitable foundation materials is defined, for the purposes of this contract, as the removal of in situ materials at or below excavation profiles which, in the opinion of the Engineer, are unsuitable as foundation materials in terms of design requirements.

Unsuitable foundation materials will include Class A materials which have the potential for collapse or are unacceptably compressible or Class B materials which form local pinnacles or plateaux at or near the prescribed profiles whose presence will result in substantial differential settlements of the structure founded in part on Class A and in part on Class B materials.

Excavation of unsuitable foundation material shall be carried out below excavation profiles over the areas and to the depths instructed by the Engineer but not exceeding 1 m depth.

The profiles of the sides of excavations carried out to remove unsuitable foundation materials shall be the safe slope profiles determined by the Contractor.

### Generally

The Contractor shall set out the excavations accurately in accordance with the drawings and data supplied by the Engineer.

The Contractor shall provide, erect, set to line and level and maintain approved substantial working profiles on the perimeter of excavations and along the length of the trench at changes of grade and direction. Each working profile shall be fitted with a horizontal cross‑bar set at a predetermined height above the designed excavation profiles to which excavations are to be carried out and have setting marks which will define the local setting out lines and the centre line of the trench. Where required by the Engineer the Contractor shall provide a working profile with the cross‑bar extending across the full width of the trench. A working profile shall remain in position during all stages of the excavations until the concrete is placed or the pipe is laid past the chainage of the working profile.

The Contractor shall provide sets of boning rods, templates and piano wire, for the sole use of the Engineer, for checking the profiles of the excavations. The Contractor shall also provide, set and level all the pegs required to transfer lines and levels to the excavation floor in order to control the preparation of the prescribed profiles.

Excavation will be required to expose existing pipelines to allow the installation of the drainage line. In exposing existing pipelines the Contractor shall excavate by machine, or by hand if necessary, around and under the pipelines taking care to avoid damage to the bitumen or cement mortar coated pipes. Any damage caused to pipe coatings during excavations will be made good by Rand Water and any costs so incurred will be deducted from moneys due to the Contractor.

The Contractor shall provide and use equipment and machinery of adequate capacity and suitable type and quality for the efficient and expeditious execution of the work.

### Over-break and Over-excavation

It is to be expected that during excavations material will be removed from below the prescribed profiles. In the cases where the excavation floor is formed of materials classified as Class B the additional depth will for purposes of this contract be termed over-break and can be expected to vary according to the nature of the rock, the jointing planes, the extent of weathering of the rock, the methods and procedures used in the blasting of the rock and the expertise of the personnel undertaking the blasting. In the case where the excavation floor is formed in materials classified as Class A, the additional depth will for purposes of this contract be termed over excavation.

### Safety of Excavations

Excavations shall be undertaken in a safe manner in compliance with the regulations promulgated under the Occupational Health and Safety Act (Act 85 of 1993) or any amendment thereof. Safety precautions to be observed by the Contractor shall include the sloping, stepping or benching or shoring, timbering or otherwise supporting the sides of the excavations or any other provision as stipulated in Regulation 11 of the aforesaid act, with which the Contractor declares himself to be conversant.

The shoring method adopted shall be compatible with the excavating, backfilling and construction method and shall not restrict the installation and construction.

Shores shall be designed to withstand the earth pressures exerted upon them from the side of the excavation which shall include the superimposed loading of construction and pipelaying equipment.

The Engineer may call upon the Contractor to timber the sides of the excavation at any point, without cost to Rand Water, which he may consider in any way dangerous. Such timbering shall be left in place until the completion of the work at the point affected.

Timbering shall consist of open planking, walings and substantial struts and shall be carried out in a workmanlike manner and to the satisfaction of the Engineer.

The Contractor shall allow for the removal of timbering immediately prior to backfilling or on the instructions of the Engineer.

MAINTAINING THE SIDES OF THE EXCAVATIONS IN A SAFE CONDITION SHALL AT ALL TIMES BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. NO UNDER‑CUTTING OF THE SIDES WILL BE ALLOWED

### Protection of Work

The Contractor shall provide, at his/her own expense, all measures necessary for the protection of the excavations during the progress of the work, and shall be solely responsible for securing, lighting and watching all places dangerous to traffic, persons, animals or property, and shall be liable for all claims arising therefrom.

The excavations shall be maintained until the structures are completed and backfilled. Should the sides fall in or any debris or water accumulate in the excavations due to any cause the excavation shall be cleaned out and any damage arising therefrom made good by the Contractor at his/her own cost as directed by the Engineer.

### Depositing Spoil from Excavations

Spoil is defined for the purpose of this contract as material excavated from the works and is to be dealt with in accordance with the following:

Topsoil shall be deposited from the excavations and stockpiled separately in temporary stockpiles. In order to conserve the bacteriological life in the topsoil the storage heaps, strips or layers shall not exceed 1,5m in total depth.

To the maximum extent possible all suitable materials excavated shall be used in the construction of the works. Such materials shall be selected from the unsuitable materials and stockpiled separately in temporary stockpiles on sites to be negotiated by the Contractor and approved by the Engineer.

Surplus spoil, rubble and debris from the excavations shall be loaded up and transported from the sites to a dumping site or sites, to be negotiated by the Contractor and approved by the Engineer, dumped, levelled and spread, all to the satisfaction of the Engineer.

No dumping site shall be used without the prior written approval of the Engineer and the owner of the property on which it is proposed to dump spoil.

The assessment of the quantity of suitable material to be stockpiled for filling shall be the responsibility of the Contractor entirely and any deficit shall be made good by the Contractor without cost to Rand Water. The balance of the suitable material for filling which is assessed as surplus to the requirements of the work may be removed from the sites as excavations proceed.

No material shall be stockpiled in violation of any Statute or ordinance or to obstruct any watercourse or drainage channel.

In the case of trench excavations, the spoil bank shall be trimmed well back from the edge of the excavation so as to leave the minimum of 1,0 m clear between the edge of the spoil bank and the edge of the trench, provided that sufficient space is available on the opposite side of the trench for pipelaying purposes. Where this is not the case, the spoil bank shall be a minimum of 7 m clear of the excavation. The Contractor shall keep these strips clear of spoil at all times.

The top surface of all permanent spoil dumps shall be left smooth and even and side-slopes, where required, are to be stable for the material concerned. Adequate drainage to the top surface and side-slopes shall be provided to prevent future erosion.

### Material for Filling

All material used in the filling beneath structures, behind walls, for formation of terraces and embankments and backfilling of pipes shall be suitable material as defined in the following clause.

Suitable material for filling beneath structures, behind walls, formation of terraces and embankments etc. and for stage II backfill in drain pipe trenches shall comprise loose, fine soil or powdered soft shales which on excavation, handling and compaction break down into a soil like texture and shall have the characteristics of a sandy silt or clayey sand material with a plasticity index not exceeding 15.

The fill shall contain no ouklip or materials deleterious to concrete and shall be free of pebbles, stones and fragments of shattered rock with maximum dimensions exceeding 50 mm. The material used shall have a uniform moisture content and be free from roots and deleterious proportions of organic matter.

The material shall not be too wet for practical drying to the required moisture content. Alternatively, where instructed by the Engineer, loose fine soil with a plasticity index exceeding 15 shall be used as suitable material for filling beneath structures and behind walls in association with cement or lime stabilization.

Suitable material for drain pipe bed and for stage I backfilling in drain pipe trenches shall comprise loose, fine soil or powdered soft shales which on excavation, handling and compaction break down into a soil like texture and shall have the characteristics of a sandy silt or clayey sand material with a plasticity index not exceeding 15. The fill shall contain no ouklip or materials deleterious to bitumen wrapped steel pipes and shall be free of pebbles, stones and fragments of shattered rock with maximum dimensions exceeding 10 mm. The material used shall have a uniform moisture content and be free from roots and deleterious proportions of organic matter. The material shall not be too wet for practical drying to the required moisture content.

Suitable material for use in road subbase and base layers in drainage pipeline trench at road crossings shall comprise selected graded crushed stone Class G1 as specified in terms of TRH14 - Guidelines for Road Construction Materials.

### Source of Materials

Unless authorized by the Engineer, suitable material shall be selected from materials excavated under the contract.

If insufficient suitable material for filling is available for selection from the excavations the Contractor shall with the approval of the Engineer, supplement the available suitable material for filling by importing suitable material approved by the Engineer. The Contractor shall negotiate for, obtain, load and transport to site the supplementary requirements for filling.

### Compaction of In-Situ Material

Where required the in situ material at the excavation profile or at the surface exposed after the removal of unsuitable foundation material shall be compacted to 93% (ninety-three per cent) of the Modified AASHTO to a depth of at least 150 mm below the exposed surface.

Compaction shall be carried out between optimum moisture content and optimum moisture content plus 2% (two per cent). Density testing of the compacted in situ material shall be carried out in accordance with Clause E17.

### Filling

1. Filling Below Structures

The material used for filling below structures shall be suitable material in accordance with Clause E14.

After the excavation profile or the surface exposed after removal of unsuitable foundation material has been accepted in terms of Clause E8 and where required, in terms of Clause E16, the filling below structures may commence.

All filling below structures shall be placed in 150 mm finished thickness layers compacted to 95% (ninety-five per cent) of the Modified AASHTO maximum dry density at moisture contents in the range between optimum moisture content and optimum moisture content plus 2% (two per cent).

The filling shall be installed such that the final layer shall be at a level at least 80 mm above and subsequently trimmed back to the required profile.

1. Filling Behind Walls and Structures

The material used for filling behind walls and structures shall be suitable material in accordance with Clause E14.

When the concrete in structures below natural ground surfaces has attained adequate strength the space between the concrete structures and the excavation face shall be filled in with suitable material.

The filling shall be compacted to a minimum of 90% (ninety per cent) of the Modified AASHTO density at optimum moisture content, as directed by the Engineer, in layers not exceeding 200 mm in thickness after compaction. Compaction shall be carried out with mechanical runners and vibrating rollers in a series of continuous operations over the full width of the layer concerned.

Fill shall not be returned against the walls until permission has been obtained from the Engineer.

The filling shall be taken up to natural ground surface or, where applicable, to the subsoil surface.

1. Filling In Trenches

The material used for filling below drain pipe bed shall be suitable material in accordance with Clause E14.

The filling below pipe bed or pipe support cradle shall be placed in 200 mm finished thickness layers compacted to 90% (ninety per cent) of the Modified AASHTO maximum dry density at moisture contents in the range between optimum moisture content and optimum moisture content plus 2% (two per cent).

The filling shall be installed such that the final layer shall be at a level at least 80 mm above and subsequently trimmed back to the trench excavation profile.

The pipe bed and pipe support cradle shall be installed on the floor of the trench excavation profile in accordance with the details shown on the drawings.

As the valve chambers and other structures are completed the Contractor shall fill in the trench without delay either to the full extent or partially as and when directed by the Engineer in accordance with the details shown on the drawings.

The earth filling under, around and over the pipe up to 300 mm above the pipe shall be of suitable Stage I material defined in Clause E14 material compacted by mechanical rummers in 150 mm finished thickness layers to 90% (ninety per cent) of Modified AASHTO density.

The remainder of the backfilling, to natural ground surface or the subsoil surface shall be suitable Stage II material as defined in Clause E14 placed in the trench in layers not greater than 300 mm finished thickness and compacted by mechanical rummers and vibrating rollers to 90% (ninety per cent) of Modified AASHTO density.

1. Filling in Trenches at Road Crossings

The material used for filling below drain pipe bed, under, around and over the pipe up to the subbase level specified on the drawings shall be of suitable Stage I material defined in Clause E14 material compacted by mechanical rammers in 150 mm finished thickness layers to 95% (ninety-five per cent) of Modified AASHTO density at optimum moisture content.

1. Filling Topsoil

After the backfilling of the excavations has been completed to the subsoil surface the topsoil shall be returned to the upper 300 mm layer from which it was removed to restore the natural ground surface. The topsoil shall be evenly spread and lightly compacted to leave the upper ground surface in a neat and tidy condition as near as may be to the original condition encountered before excavation commenced or to such details for embankments as are indicated on the drawings.

1. GENERALLY

Any surface on which a layer of filling is to be placed shall be clean, firm and suitable for the bonding of a successive layer of filling.

If, in the opinion of the Engineer, the surface to receive any layer of filling is too smooth or dry to bond properly with the next layer, it shall be moistened and scarified to the satisfaction of the Engineer before the next layer is placed.

All suitable material for filling shall be brought within the required uniform moisture content range by methods approved by the Engineer. The required moisture content range shall be determined by the Contractor.

The filling of compacted material shall be carried out in horizontal layers of even thickness for the full area being refilled, or such portion of that area as the Engineer may approve, such that, after compaction, all intermediate completed layers are constructed to within a 30 mm tolerance of the thickness specified.

In order to ensure that the refilling is carried out in accordance with Clause E17 the Contractor shall establish levels, working profiles, lines, etc for the use of the Engineer in checking the accuracy of the work and shall not proceed with the construction of successive layers until the Engineer has accepted the accuracy of the work and the degree of compaction achieved in the layer under construction.

Moisture/density tests on all compacted material below structures and behind walls shall be conducted by the Contractor. Further density tests may be ordered by the Engineer.

Such tests shall be done in situ using the sand replacement method or by other approved methods. All test results shall be submitted to the Engineer for approval.

The crusher run fill shall be placed in the trench and compacted as required at the optimum moisture content. The Contractor shall take all necessary measures to prevent drying out of the material prior to the completion of compaction.

1. Crusher Run Fill

Crusher run fill shall comprise a stable mixture of fragmented rock and fine binder material complying with the following grading requirements:

|  |  |
| --- | --- |
| **Sieve size****mm** | **Percentage passing** |
|
| 26,5 | 100 |
| 19 | 85 | - | 95 |
| 13,2 | 71 | - | 84 |
| 4,75 | 42 | - | 60 |
| 2,0 | 27 | - | 45 |
| 0,425 | 13 | - | 27 |
| 0,075 | 5 | - | 12 |

The following indices and limits shall not be exceeded:

Maximum flake index: 35; Atterberg limits: 25; Plasticity index: 6 and linear shrinkage: 3.

The crusher run fill shall be thoroughly mixed to provide a homogeneously graded material and the quantity of water to provide the optimum moisture content for compaction to the required density shall then be added and the material again thoroughly mixed.

## CONCRETE, FORMWORK AND REINFORCEMENT

## Cement

The cement used for all portions of the structures (except where otherwise stated) shall be one of the following:

1. A mixture in equal proportions by mass of Portland cement complying with SABS ENV 197 1 - 1992 and milled granulated blastfurnace slag ground to a fineness not less than 3 500 cm2/g and having a glass count not less than 95% (ninety five per cent) by mass.
2. Portland cement complying with SABS ENV 197 1 - 1992.
3. A mixture of approved proportions by mass of Portland cement complying with SABS ENV 197 1 - 1992 and pulverised fly ash from an approved source complying with ASTM C618.

If required by the Engineer, the Contractor shall provide certificates of tests showing that the cement on the site conforms to these Specifications and requirements. All cement used on the work shall at all times be subject to the approval of the Engineer and any cement rejected shall be immediately removed from the site.

Aluminous cement shall not be used.

No cement from broken sacks shall be used on the works. All cement spilled on the floors of the storage sheds shall be swept up weekly and removed from the works together with all broken sacks of cement.

## Aggregates

1. Fine Aggregate

Fine aggregate shall be clean, coarse, sharp drift, pit or river sand entirely free from vegetable or any other foreign matter and shall be in accordance with SABS 1083 (latest edition). It shall be screened and washed if directed by the Engineer. No dump or crusher sand shall be used.

Samples of fine aggregate proposed to be used are to be submitted to and approved by the Engineer.

Fine aggregate shall be stored on a concrete surface and washed sand shall be allowed to drain for at least 24 (twenty four) hours before use. The Engineer may require the Contractor to test the sand daily (or more frequently if necessary) for moisture content, impurities and grading before use. Water demand shall not exceed 195 l/m;.

Coarse Aggregate

Coarse aggregate for concrete shall be hard, non-friable quartzite or other suitable rock, in accordance with SABS 1083 (latest edition) crushed and screened to the specified sizes, of good shape, clean and free from dust.

The maximum size of aggregate shall be 25 mm in floor and walls and 19 mm in roof slab.

Coarse aggregate containing more than 19% (nineteen per cent) shale will not be accepted.

Samples of coarse aggregate proposed to be used shall be submitted to and approved by the Engineer. Any broken stone delivered to the site which contains 5% more flaky and/or 10% more elongated particles than the approved sample will be condemned and shall be removed from the site. Voids ratio shall not exceed 47% (forty seven per cent).

Chemical Properties of Aggregates

When tested in accordance with SANS 202 and 5850, as appropriate, the total acid-soluble chloride content and acid-soluble sulphate of the aggregates shall not exceed the following limits:

Chloride Content (expressed as percentage of chloride-ion by weight of aggregate)

Fine Aggregate 0.03% by weight of fine aggregate.

Coarse Aggregate 0.3% weight of coarse aggregate.

Provided always that, for the combined fine and coarse aggregates, the total acid-soluble chloride, expressed as percentage of chloride-ion by weight of fine and coarse aggregate combined, shall not exceed 0.03, and that for the hardened concrete, the total acid-soluble chloride, expressed as the percentage of chloride-ion by weight of cement, shall not exceed 0.15

Sulphate content (expressed as percentage of sulphuric anhydride (803) by weight of aggregate).

Course and fine aggregate 0.4% weight of aggregate.

Provided always that, for the hardened concrete, the total acid-soluble sulphates, except that present in the cement, expressed as the percentage of 803 by weight of cement shall not exceed 2.5

Alkali Reactivity

When tested in accordance with ASTM C289 and ASTM C295 all aggregates for use in the works shall have negligible alkali reactivity.

## Water

Water for concrete shall be obtained only from the potable water supply, and shall conform to the requirements of SANS 10100-2 and SANS 51008. The quantity of water used in each batch of concrete shall be carefully adjusted to maintain the water cement ratio required for the particular mix. The quantity of water added to each batch shall be fixed by an automatic attachment on the concrete mixing machine and shall not be added by means of hand buckets, hoses or any other method by which the quantity is not accurately determinable. The water shall be carefully measured so as to ensure the same quantity being used in each batch of concrete.

The quantity of water used for concrete shall be carefully adjusted so that the consistency is such that the concrete can be compacted effectively with a minimum of bleeding and segregation. The slump, as measured in accordance with SABS Method 862, shall be used as the means of controlling the consistency of every batch of concrete. The average slump for each mix shall be determined and fixed at the time the trail concrete mixes are made and approved. Batches of concrete of any particular mix are to have a slump within ± 10 mm of the slump determined from the trail mix.

## Admixtures

Admixtures shall be used only if approved in writing by the Engineer.

## Gauging and Proportioning

The material to be used for concrete shall be accurately gauged in correctly designed watertight gauging boxes so proportioned that the cement is measured by whole sacks; portions of sacks will not be allowed.

Gauging boxes shall be submitted to the Engineer for approval.

## Concrete Strength Requirements

The concrete mix for each portion of the work shall be specially designed by the Contractor to comply with the following requirements and shall be subject to the prior approval in writing of the Engineer:

|  |  |  |
| --- | --- | --- |
| **Portion of Works** | **Minimum Cube Compressive Strength at 28 Days in MPa** | **Maximum Aggregate Size** |
| Mass filling below floors and foundations | 15 | 38 |
| Blinding layers | 15 | 19 |
| Benching, screeds and encasing of pipes | 20 | 19 |
| Piles | 30 | 38 |
| Footings, pipe caps and valve chambers | 30 | 19 |
| Floor and roof slabs, beams, columns and walls  | 30 | 19 |
| All reinforced concrete | 30 | 19 |
| All pre-stressed concrete | 40 | 19 |

## Testing of Concrete

During the progress of construction, tests shall be made under the direction of the Engineer to determine whether the concrete being produced complies with the standards of quality, durability and strength specified. The Contractor shall be responsible for testing of concrete on site or an approved laboratory, as per instruction by the Engineer, and shall submit test results to the Engineer.

1. Frequency

Unless otherwise directed by the Engineer, for each class of concrete, one sample shall be taken from each day's casting and one sample from at least every 50 m3 of each grade of concrete placed for the purpose of compressive strength testing. Only one sample shall be drawn from any one batch of concrete and no sample shall be taken of any grade until at least 3 batches of such grade have been mixed and discharged for that particular pour.

Test Cubes and Cylinders

The Contractor shall prepare 6 test cubes, 150 mm nominal size, from each sample for compressive strength testing. Three of each set of six test cubes shall be tested at 7 days after making and the remaining three cubes at 28 days after making. The average of the results for three cubes will be taken as the test result.

The Contractor shall prepare 3 cylinders, 150 mm diameter by 300 mm long from each 500m3 of grade 30 concrete placed, in accordance with SABS Test Methods 861, 862 and 863, for the purpose of permeability tests. The cylinders shall be cured and stored in accordance with the requirements of the NBRI (National Building Research Institute).

Compressive Strength Tests

If the tests disclose a consistent relationship between the 7-day and 28-day strengths of the concrete, the 7-day strength may be used as a basis for the assessment of the 28-day strength. Both 7-day and 28-day strength tests shall be carried out regularly throughout the contract to provide a record of any seasonal variation in the relation between the 7-day and 28-day strengths.

Until such a relationship has been established on site the 28-day strength shall be taken to be not more than 1,67 times the 7-day test result in the case of ordinary Portland cement (and twice in the case of a mixture of ordinary Portland cement and milled granulated blast furnace slag or pulverized fuel ash).

If a 28-day strength assessed from a 7-day test result fails to meet the acceptance criteria for the concrete, the Contractor may at his/her discretion, demolish and re-construct at his/her own expense the volume of concrete affected; or, alternatively he/she may elect to extend the time for removal of formwork and/or curing. The acceptance criteria for the concrete will be as specified and based on the 28-day test results.

Acceptance criteria for concrete

If the average of the results of the tests on three test cubes from any sample of a specific class of concrete is more than 3 MPa below the specified 28-day works cube strength, then the concrete represented by such result/s will be deemed not to satisfy the requirements of the Specification.

The average of any 3 consecutive test results of a specific class of concrete shall exceed the specified 28-day works cube strength by at least 2 MPa. If the average lies between the specified 28-day works cube strength and the specified strength plus 2 MPa, then the concrete represented by such results will be deemed not to satisfy the requirements of the Specification

The degree of control on the batching of concrete shall be such that the standard deviation of the most recent 30 of 30 or more test results (i.e. the average of 3 cubes each) does not exceed 5 MPa.

The average strength of the most recent 30 of 30 or more test results shall not be less than the specified strength plus 1,64 standard deviations. If this average fails to meet this requirement, or if it becomes clear from plots of the moving average of 6 test results that this situation is approaching, the mix design shall be adjusted at the cost of the Contractor to ensure compliance with this criterion.

No more than 5 per cent of all test results shall exceed the specified strength plus 16,5 MPa. If these requirements are exceeded when considering the most recent 30 of 30 or more test results, the mix design shall be adjusted at the cost of the Contractor to ensure compliance. Alternatively, the Engineer may require that the area of reinforcement at any particular location in the structure be increased at the cost of the Contractor to control potential increased shrinkage cracking.

If cracking in excess of that permitted by BS 8007:1987 or any revision thereof occurs in any part of the structure where the concrete was found not to comply with standard deviation requirements and reinforcement had not been increased to minimise cracking, then the Contractor shall repair such cracks at his own expense to the satisfaction of the Engineer.

If the evaluation of test results indicates that the concrete represented by such results does not satisfy the requirements of the Specification, the Engineer in his sole discretion may adopt one or more of the following procedures in the sequence given to determine whether replacement or strengthening of the structure is necessary :-

Non-destructive testing, subject to similar concrete of proven acceptable quality being available in comparable members in the same construction as a reference. (Impact hammers and ultrasonic testing are two examples of such techniques which may be used provided that such apparatus has been previously calibrated.)

The testing of drilled cores in accordance with current SANS standard methods.

Where cube test results shows the concrete strength to be unacceptable, or if a tested portion of the structure fails to pass the tests, the Contractor shall, on the instructions and directions of the Engineer, either replace or strengthen by approved means :-

1. each section that contains concrete that failed;
2. any other section, the functional purpose of which is affected by the concrete that failed.

If on the basis of cube test results the concrete does not meet the requirements of the Specification, but non-destructive testing or testing of drilled cores shows that the concrete strength is acceptable: then if the Engineer shall be satisfied that the structural adequacy and durability of that part of the structure in which the concrete has been used is not seriously impaired, the concrete shall be deemed to be acceptable, but the mix design and other factors influencing the quality shall be reviewed in order to ensure that further concrete cast will meet the requirements of the Specification.

Permeability Tests

The permeability coefficient of the test cylinders, as tested by the NBRI of the CSIR, shall not be greater than 5 × 10-7 mm/second. If the permeability coefficient exceeds this value, the Contractor shall show that the permeability of the concrete placed in the work complies with the Specification, failing which, the work will be rejected.

Other Tests

The Contractor shall be responsible for conducting the following tests, at the instruction of the Engineer, and submit the results to the Engineer:

* apparent density
* UCS (Unconfined Compressive Strength)
* Phenolphthalein indicator (or Carbonation depth) test
* Cover test
* Durability tests: water sorptivity, oxygen permeability and chlorine conductivity

## Mixing

All concrete is to be mixed in a mechanical concrete mixer of approved design.

No ready mixed concrete will be allowed for water retaining or water excluding structures. Site concrete and concrete for mass filling may be purchased ready mixed.

Ready mixed concrete shall be used only if approved in writing by the Engineer.

Mixing shall be continued for not less than 12 (twelve) minutes or more than ten minutes after all materials, including water, are in the mixer. The minimum time of 12 (twelve) minutes for mixing may be increased at the discretion of the Engineer.

## Placing Concrete

No concrete shall be mixed until the foundations, ground water handling arrangements, reinforcement, joint treatment, clean up, formwork and concrete mixing, handling and placing equipment have been approved by the Engineer.

Concrete shall be placed in position immediately after it is mixed and before any initial set has taken place. Leavings shall not be used in any way but shall be discarded and immediately removed from the site.

Concrete shall be placed so as to prevent the separation of constituents and shall be thoroughly rammed and compacted while being placed.

Concrete shall surround the reinforcing bars completely. The reinforcing bars shall not be displaced when depositing or ramming concrete. While concrete is setting it shall not be disturbed or shaken and shall be kept saturated for 7 (seven) days after placing.

## Concrete during Cold Weather

During cold weather no material having a temperature

below 5°C shall be used for making concrete.

No concrete shall be placed when the ground or air temperature is below 2°C or if the ground or air temperature is likely to fall below 2°C within 6 (six) hours after placing the concrete.

## Protection

Concrete shall be kept damp and protected against the action of sun, wind and frost by means of wet sacks, wet sand or other approved method, for at least 7 (seven) days after being placed in position.

## Finishing

Concrete shall be clean, hard, non-porous and entirely free from honeycombing.

The Contractor shall cut away, remove and replace, without compensation, any concrete that is honeycombed or porous, or that the Engineer may consider in any way of inferior quality.

All top surfaces of floors, slabs or beams shall be puddled until the fines rise to the surface.

## Construction Joints

The surface of any concrete against which new concrete will be laid shall first be well hacked so that the stones in the concrete project beyond the surrounding matrix to form a key for the new concrete and then well wetted.

Suitable openings shall be left in the shuttering temporarily to facilitate the removal of sawdust, shavings, nails, debris etc.

A grout made of 2:1 cement mortar shall be run along the joint as the new concrete is being placed.

The Tenderer shall include for the cost of shuttering, hacking and preparing all surfaces for construction joints in the schedule rates for concrete.

## Formwork

Correctly designed shuttering, centring, and casing, rigidly supported and braced, shall be erected. Particular care shall be taken that no movement of the formwork takes place while the concrete is being placed in position or after it has been placed in position.

Forms shall be of good material of uniform thickness and width, strongly made and held in place by external bracing so that no distortion can occur. The use of damaged forms is prohibited.

All clear-spanning beams and lintels shall have a camber of 6 mm to every 3 m of length.

Joints between forms shall be sufficiently tight to prevent leakage of fines and cement. Forms shall be thoroughly cleaned down before they are re-used.

All formwork shall be approved by the Engineer before any concrete is placed.

Any runways required for the placing of concrete shall be so constructed as to be entirely independent and free from the concrete forms.

## Stripping Of Formwork

Formwork shall be removed carefully so as not to damage the concrete and the minimum periods during which formwork shall remain in position after concreting are:

|  |  |  |
| --- | --- | --- |
| Sides of slabs, beams and walls  | - | 24 (twenty-four) hours |
| Slab soffits | - | 10 (ten) days |
| Cantilever slab soffits | - | 15 (fifteen) days |
| Beam soffits: props left under | - | 7 (seven) days |
| Removal of beam props | - | 14 (fourteen) days |

The Engineer may order forms to be left in position for periods of at least 50% (fifty per cent) longer than those given above at no extra charge to Rand Water IF, IN HIS/HER DISCRETION, HE/SHE CONSIDERS THE WEATHER TO BE VERY COLD.

## Steel Reinforcement in Concrete

The bars for reinforcement shall be of high tensile and mild steel and shall conform in every respect to the latest appropriate standard specification; welded fabric shall be manufactured from high tensile steel wire. All bars shall be clean and free from scale, loose rust or grease and shall not be oiled or galvanised. The size, length and bending of the reinforcement shall be strictly in accordance with the bending schedule and detail drawings supplied to the Contractor. All bending shall be done cold.

## Placing Steel Reinforcement

The reinforcing bars shall be placed accurately in the exact positions shown on the detail drawings. The bars shall be wired together with 1,6 mm diameter black wire at every second point of intersection and shall be fixed so as to prevent any displacement during concreting.

All placing of reinforcement shall be done well in advance of the concrete and no concrete shall be placed until the reinforcement in position has been inspected and passed by the Engineer.

The cover shall be measured from the face of the concrete to the outside of main reinforcement nearest the face of the concrete and is exclusive of any plaster or finishing material.

The use of plastic spacer blocks will not be permitted.

## Inspection of Work

All erection of formwork, placing of reinforcement, chipping of concrete, etc. shall be completed by 14:00 on the afternoon proceeding the day on which it is proposed to cast concrete, to enable the Engineer to inspect the works during normal working hours.

The Engineer may increase this notice period up to 24 (twenty four) hours before concreting of work commences, where large sections of work are involved.

## STRUCTURAL STEELWORK AND SUNDRY ITEMS

## General Requirements

The Contractor shall supply and install access ladders to valve chambers, grab rails at manholes, access manhole covers and frames and all other items shown in the construction drawings. The steelwork shall be supplied completed with plates, bolts, trimmers, etc., necessary for the completion of the contract.

## Sub-Contractors

The Contractor shall satisfy the Engineer that any proposed Sub-Contractors for e.g. fabrication, erection etc., have the necessary facilities to carry out the work to the standards and at the rate of progress required.

## Materials and Standards

All structural steel materials shall be new Grade S355JR and shall be in accordance with SANS 50025. The Contractor shall, if necessary, satisfy the Engineer from his/her records that all materials meet the above requirements.

All bolts and nuts shall be of the class specified by the Contractor in construction drawings and shall be in accordance with the relevant SANS or ISO standards. Electrodes for welding shall comply with requirements of SANS 2001-CSI and SANS 10162: Part 1.

Stair treads and landings shall be Rectagrid open-grid flooring.

## Drawings

The Contractor shall prepare and submit a full set of fabrication drawings including the design of connections to the Engineer for approval. No fabrication shall be put in hand until the necessary approval has been given.

The Contractor shall allow in his/her programme a period of two weeks for the approval of any drawing.

The final drawings shall be blackline unfolded, untearable, 0.075 mm thick transparency film, polyester base, matt finish on both sides, bearing Rand Water standard drawing title block. The size of the final drawings to be supplied shall comply with the ISO A series of drawing paper.

## Workmanship

Steelwork shall be of welded or bolted construction and shall comply with the requirements of SANS 10162. All steelwork welded or bolted together shall be in full contact over the whole of the meeting surfaces.

All welding shall be shielded metal arc welding (SMAW) complying with the requirements of SANS 2001-CSI and SANS 10162: Part 1. Highly skilled welders are required to execute all welding, under the most careful and expert supervision.

The prepared fusion faces of the weld shall be free from all irregularities, slag, oil, paint or any substance which may affect the quality of the weld. Components to be welded shall be securely held in their correct relative positions during welding and the welding sequence adopted shall be such that distortion is reduced to a minimum.

All connection shall be designed by the Contractor and shall develop the full strength of the members connected. Unless otherwise stated, the Contractor shall provide for suitable field connections that will, in his/her opinion, afford the greatest overall economy consistent with design requirements.

## Fabrication Tolerances

Completed members shall be free from twists, bends and open joints. Sharp kinks or bends shall be cause for rejection of material.

Straightness of compression members shall not deviate by more than 1/1000 of the axial length between points which are to be laterally supported.

A variation in length of not greater than 1 mm is permissible in the overall length of members with both ends finished for contact bearing. Members without ends finished for contact bearing, which are to be framed to other steel parts of the structure, may have a variation from the detailed length not greater than 2 mm for members 10 m or less in length and not greater than 3 mm for members over 10 m in length.

Open grid flooring shall be panels, either riveted or welded at each intersection and of approved type. The pattern of the grid is to be uniform and the flooring is to be secured to the supporting steelwork either by welding or with suitable clips and/or bolts, as directed. Securing clips must be of such design that they will not work under vibration of the structure. The bars forming the grid shall be straight, free from defects and set square and/or parallel to each other.

The Engineer shall be advised as soon as the fabrication of steelwork is in hand so that he may inspect and examine the materials and workmanship during fabrication. The Engineer or his duly authorized representative shall have access to the Contractor’s premises for all reasonable times for the purpose of inspection.

## Protection of Steelwork

All steelwork shall be inspected at the maker’s works by Rand Water’s Inspector before shot-blasting, galvanizing or painting.

After inspection all fabricated steelwork shall be cleaned by steel shot-blasting to produce a matt surface of even texture, free from rust and scale and without sharp peaks of metal which may protrude through subsequent paint coatings. Preparation of steelwork shall be generally in accordance with SABS 064. Care shall be taken to remove all abrasive residues prior to priming.

All steelwork for internal stairs and ladders and handrailing shall be hot-dip galvanized to SANS 121 after fabrication. All bolts and fastenings shall be corrosion resistant.

Grating sump covers shall be hot-dipped galvanized after fabrication.

## Drawings and Information to be provided after acceptance of the Tender

All drawings shall be subject to approval by the Engineer and shall be submitted for such approval as soon as possible after the contract has been placed.

Rand Water will not be responsible for any delays, loss or inconvenience to the Contractor through failure to comply with this requirement.

The Contractor shall prepare and submit to the Engineer for approval, all the necessary working and detail drawings and schedules of steel reinforcement to meet his approved progress schedule. The Contractor shall allow at least two weeks for approval by the Engineer of any drawings or schedule, and shall not be entitled to claim extra payment in respect of extra cost arising from delay in the approval of drawings or schedules.

Any delays due subsequent modification of these drawings or schedules shall not be a cause for extending the time for completion of the contract; adequate notice of any modification shall be given by the Contractor to enable all necessary drawings and information to be produced and approved so that the work can proceed without delays.

The Contractor shall be responsible for any errors that may rise from any defects in the drawings supplied by him and for any loss, damage or expense sustained by Rand Water in making good such errors.

Final drawings shall be on unfolded, untearable transparent film, with a polyester base, having a matt finish on both sides and a thickness of 0.075 mm. These Drawings shall bear Rand Water’s contract number (i.e. RA 21290/0##). In addition where drawings have been completed using CAD programme, compact disc copies of each drawing shall be provided either on AUTOCAD or DXF format.

Drawings shall not be larger than size A0 in accordance with SANS 10111-2011. In all cases the drawing is to be in accordance with this standard.

## MECHANICAL SPECIFICATIONS

{Mechanical Specifications – Not Applicable}

## ELECTRICAL SPECIFICATIONS (SP & L)

{Electrical Specifications – See Electrical folder for Spec}

## AUTOMATION SPECIFICATION

{Automations Specifications – See Automation folder for Spec}

## PIPELINES SPECIFICATION

{Pipelines Specifications – Not Applicable}