TANA WATER WORKS DEVELOPMENT AGENCY

CONSTRUCTION OF MITHERU WATER PROJECTS CLUSTER

TENDER NO: TWWDA/T/049/2020-2021

TECHNICAL SPECIFICATIONS VOLUME 2

APRIL 2021

Employer

Tana Water Works Development Agency
P. O. Box 1292 – 10100
NYERI

ABBREVIATIONS AND ACRONYMS

CDS Contract Data Sheet

GCC General Conditions of Contract

IFT Invitation for Tender

ITT Instruction to Tenderers

PE Procuring Entity

PM Project Manager

PPADA 2015 Public Procurement and Asset Disposal Act, 2015 **PPADR**

PPADR 2020 Public Procurement and Asset Disposal Regulations, 2020

PPRA Public Procurement Regulatory Authority

STD Standard Tender Documents

SOR Statement of Requirements

SP Service Provider

TDS Tender Data Sheet

VAT Value Added Tax

SECTION I: TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS.

1. GENERAL SPECIFICATIONS

1.1 Introduction

These specifications cover the construction of the works as shown on the drawings and listed in the Bills of Quantities and shall be read in conjunction with the Contract Documents as listed in Volume I, Instructions to Tenderers.

All references given are intended solely for the convenience of those using the above documents and shall be in no way exclude the application of the other clauses in the documents which may, in the opinion of the Engineer have any bearing on the point in question.

1.1.1 Location

The site for the proposed Mitheru water projects Cluster is in Maara Constituency, Tharaka Nithi County.

1.1.2 Scope of Works

The Works consist of:

1. Pipeline Laying ranging from 225mm to 63mm
2. Construction/Rehabilitation of Intakes
3. Construction of office building

1.2 Extent of Contracts

The works specified under this contract shall include all general works preparatory to the construction of the works and materials and work of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the intent and meaning of the Drawings and this specifications and further Drawings and instructions that may be issued by the Engineer from time to time whether specifically mentioned or not into the clauses of this specification.

1.3 Precedence of Contract Documents

Should the provisions of any clauses of any or all of the Contract Documents to be shown to be mutually at variance or exclusive, the following order of precedence shall be applied in order to establish which of the said provisions mutually at variance or exclusive, shall be deemed to be true and correct intent of the contract entered into by Employer, and the Contractor shall forthwith be absolved from any liability under the provisions not so proved to be the true and correct intent of the contract, provided that in the execution of the contract the Contractor has, or shall have complied with such true and correct intent.

(i) Provision of the Standard or Special Specifications shall take precedence over those of the General Conditions of Contract.

(ii) Provision of the Special Specifications shall take precedence over the Standard Specifications unless otherwise indicated.

(iii) Details shown or noted on the Contract drawings shall take precedence over the requirements of both the Standard and the Special Specifications.

(iv) Detail Drawings shall take precedence over General Drawings.

(v) Within the Standard Specifications, the provisions of any section particular to the provisions at variance shall take precedence over the General Section, and within any section clauses particular to the provisions at variance shall take precedence over those not so particular. The foregoing order of precedence shall apply also to sections and clauses of the Special Specifications.

(vi) Where there is conflict in units of measurement quoted in Standard Specifications and units quoted in Bills of Quantities the units in latter will apply.

Notwithstanding any fore-written provisions, should the application of the foregoing order of precedence fail to resolve any variance or mutual exclusions as to the true and correct intent of the contract to the satisfaction of the Engineer, the Engineer may exercise the right to arbitrarily give a ruling as to the true and correct intention of the contract, and the Contractor shall have the right to claim additional payment for any additional expenses incurred by him as a consequence of such variance or exclusion and arbitrary ruling.

1.4 Standards

In the specifications, Bills of Quantities, and Drawing reference has been made to relevant British Standard Specifications and Codes of Practice- to which the materials and workmanship should comply with. However, the materials and workmanship complying with equivalent Kenya Bureau of Standards (KEBS) or International Standards Organization (I.S.O) standard for that particular material or workmanship will also be acceptable.

Mixture of different Standards in one trade will not be allowed. For instance, if pipes are to be provided to KEBS Standard, then all the pipes in the works are to be to KEBS Standard.

Where the dimension in one standard does not completely correspond to the dimension of the other standard which is being used for construction of works, ruling of the Engineer will be sought and any decision given by the Engineer will be final and binding upon the Contractor.

1.5 Quality of Materials and Workmanship

The materials and workmanship shall be of the best of their respective kinds and shall be to the approval of the Engineer. In reading of these Specifications, the words "to the approval of the Engineer" shall be deemed to be included in the description of all materials incorporated in the works, whether manufactured or natural, and in the description of all operations for the due execution of the works.

No materials of any description shall be used without prior approval by the Engineer and any condemned as unfit for use in the works shall be removed immediately from the site, and without recompense to, the Contractor. All works or parts thereof shall be in accordance with the latest edition of either Kenya Bureau of Standards (KEBS) Specification or British Standard (B.S) Specifications and British Codes of Practices (C.P) as published by British Standard Institution.

All materials shall be of approved manufacture and origin and the best quality of their respective kind, equal to sample and delivered on to the site a sufficient period before they are required to be used in the works to enable the Engineer to take such samples as he may require for testing or approval, and the Contractor shall furnish any information required by the Engineer as to the quality, weight, strength, description, etc. of the materials. No materials of any description shall be used without prior approval by the Engineer and any condemned as unfit for use in the works shall be removed immediately from the site by, and without recompense to, the Contractor.

1.6 Trade Names

Trade Names and Catalogue References are given solely as the guide to the quality and alternative manufacturers of the materials or goods of equivalent quality will be accepted at the discretion of the Engineer.

1.7 Samples

Samples of all materials shall be deposited with the Engineer and approved prior to ordering or delivery to site. The Engineer reserves his right to test any sample to destruction and retain samples until the end of the maintenance period. No payment will be made for samples and the Contractor must in the rates of prices allow for costs of samples. All materials delivered to site shall be equal or better in all respects than the samples delivered to the Engineer.

All sampling of materials on the site must be done by or in the presence of the Engineer. All other samples will be deemed not to be valid under the contract.

All material delivered to the site or intended for the works not equal or better than the samples approved by the Engineer shall be removed and replaced at the Contractor's expense.

1.8 Testing

As provided in Clause 36 of the Conditions of Contract and in accordance with the Specification quoted for any material used on works of this contract, tests may be called upon by the Engineer to be carried out at the place of manufacture or on the site. The Contractor may assume that the tests will be required on soils, workmanship, and materials whether natural or manufactured to verify their compliance with the specifications. Samples of all such materials and manufactured articles together with all necessary labour, materials, plant and apparatus for sampling and for carrying out of the tests shall be supplied by the Contractor at his own expense.

A Provisional Sum item has been included in Bills of Quantities for testing of materials and workmanship as directed by the Engineer at the Independent Laboratory.

The Contractor will be reimbursed receipted cost of testing carried out by the laboratory as the work progresses.

1.9 Programme for the Execution of Works

(i) In accordance with Clause 14 of the Conditions of Contract, the Contractor upon receiving Engineer's order to commence shall within 7 days draw up a working programme setting out order in which the works are to be carried out with appropriate dates thereof together with delivery dates for materials. The Contractor shall together with his work programme supply an expenditure chart showing monthly anticipated expenditure.

(ii) The programme shall be deemed to have taken into account normal variations in climatic conditions to provide for completion of the works in the order and within the times specified therein.

(iii) The order in which it is proposed to execute the permanent works shall be subject to adjustment and approval by the Engineer, and Contractor's price shall be held to include for any reasonable and necessary adjustment required by the Engineer during the course of the works.

(iv) The Contractor shall carry out the contract in accordance with the programme agreed with the Engineer, but he shall in no manner be relieved by the Engineer's approval of the programme of his obligations to complete the works in the prescribed order and by the prescribed completion date and he shall from time to time review his progress and make such amendments to his rate or executions of the works as may be necessary to fulfil these obligations.

(v) Once the proposed programme is approved by the Engineer, the Contractor shall not depart from the programme without the written

consent of the Engineer. In the event of unforeseen difficulties or disturbances arising, which forces the Contractor to depart from the approved programme of works, he shall advise the Engineer in writing of such occurrences without delay and submit proposals for any necessary remedial measures, for which he shall obtain the Engineer's approval before putting such measures into effect.

(vi) The Contractor shall furnish the Engineer with a monthly statement of all works done on the contract and of all materials on site.

1.10 Substantial (Practical) Completion

Substantial or Practical Completion of Works is to be understood as a state of completion, which leaves out only minor outstanding items that can be readily completed within a period of less than 1 month without interfering with the normal operation of the works.

The works will not be considered as substantially or practically completed without the works being capable of being used by the Employer in accordance with the purpose of the works. This means amongst other things and where relevant, that all final tests have been carried out, the pumping stations and treatment plant fully operational to the required capacity, all storage tanks filled up, operation manuals provided, and clearance of the site upon completion of the works has been carried out, all to the satisfaction of the Engineer.

The Contractor shall allow for a period of one month for the completion by others of as built drawings before the works are handed over to the Employer.

1.11 Nominated Sub-Contractors and Nominated Supplies

The Contractor shall be responsible for Nominated Sub-Contractor in responsibility to ensure that each Sub-Contractor commences and completes the work in a manner so as to conform with the working programme, as specified above.

It is also the responsibility of the Contractor to ensure a satisfactory progress of the works and to ensure that the works are completed to a standard satisfactory to the Engineer.

The Contractor shall accept liability for and bear the cost of General and Specific Attendance on Nominated Sub-Contractors which shall be deemed to include for:-

(i) Allowing the use of standing scaffolding, providing special scaffolding, maintenance and alteration of all scaffolding, retention of all scaffolding until such time as all relevant Sub-Contractor's works are complete and removal of all scaffolding on completion.

(ii) Providing equipment and labour for unloading and hoisting Sub-Contractor's materials.

(iii) Providing space for office accommodation, and for storage of plant and materials; allowing use of sanitary accommodation; the supply of all necessary water, power, lighting and watching and clearing away all rubbish.

Carting away for and making good after the work of Sub-Contractors as may be required will be measured and valued separately in the Bills of Quantities.

Before placing any orders with nominated Sub-Contractors or nominated Suppliers, the Contractor should enter into an agreement with the nominated Sub-Contractor/nominated Suppliers to ensure that the Conditions and delivery of materials to site comply with the conditions of contract and the working programme.

Particular clause should be inserted in the agreement with the nominated Suppliers ensuring the validity of the rates for the supply of materials as per the delivery schedule.

Nominated Suppliers who are unable to meet the delivery schedule will not be given allowance for any increases in prices incurred after the delivery time agreed in the delivery schedule.

1.12 Entry upon Land, Working Site and Adjoining Lands

The Employer shall provide land, right of ways and way leaves for work specified in the contract.

If nothing else is mentioned, the Contractor will be allotted for execution of the works only the actual area as necessary for the extent of the construction.

The Contractor shall give notice to the Engineer at least 14 days before he wishes to enter onto the land required to carry out the Contract.

The Contractor shall not enter onto any land or commence any operations until such time as he receives formal confirmation from the Engineer that all necessary compensation formalities have been completed and that permission has been obtained from the landowner to enter the land and commence operations. Should the Contractor enter onto any land or commence operations without first obtaining this confirmation, he shall be liable in whole or in part, at the sole discretion of the Engineer, for all additional costs and/or legal charges which might arise therefore.

The Contractor shall on his own accord obtain rights of admission, and Right of using all other areas which are necessary for storing and manufacturing, or

for setting up site offices and Resident Engineer's office or whatsoever will be necessary.

No separate payment will be made to the Contractor on account of these items and the Contractor must make due allowance for them in his rates.

The Contractor shall take care to prevent injury, damage and trespass on lands, fences and other properties near and adjacent to the works and must in this connection make all necessary arrangements with adjoining landowners, or into the case of Government Property with officers appointed for this purpose, and ensure the Workmen's observance of all Government rules and Ordinances regarding game protection and other matters and provide, maintain and clear away on completion of the Works, all temporary fencing which may be required for execution of the works.

Before completion of the works, the Contractor must make good or compensate any such injury, damage or trespass on Lands, fences and other properties which have no otherwise been provided for in the Contract.

1.13 Preservation of Survey Beacons

Ordinance Survey Beacons, Bench marks, etc., or around the site of the works shall not be disturbed unless permission has been obtained by the Engineer from the Survey of Kenya.

In the event of unauthorized disturbance of such beacons, bench marks etc., in the course of the works being carried out, the Contractor shall be responsible for reporting same to the Engineer and the Survey of Kenya, and for payment of any fees due to said Survey of Kenya for replacement of such disturbed beacons, bench marks, etc. The Contractor shall not replace such disturbed beacons bench marks, etc. on his own accord.

1.14 Land for Camp Site

The Employer shall make available free of charge to the Contractor all land on under or through which the works other than Temporary Works are to be executed or carried out all as indicated in the Drawings or as detailed in the Specifications. Such land shall exclude land for Resident Engineer's offices and land required by the Contractor for his own camps, offices, houses, temporary works or any other purpose.

1.15 Existing Services

Drains, pipes, cables and similar services encountered in the course of the Works shall be guarded from damage by the Contractor at his own cost to safeguard a continued uninterrupted use to the satisfaction of the owners thereof, and the Contractor shall not store materials or otherwise occupy any part of the site in the manner likely to hinder the operation of such services.

The Contractor shall on the Engineer's direction arrange for the construction of permanent or temporary diversions of the said drains etc.,together with their reinstatement in liaison with the respective Departments, Bodies, Corporations

or Authorities. The cost of such works or diversions including reinstatement shall be charged against the appropriate provision sum provided into the Bills of Quantities. The Contractor shall be at liberty, subject to the approval of the works, bear the cost of reinstatement of addition diversion. No services may be tampered with by the Contractor and all works in connection with any kind of services shall be carried out by their respective owners.

It is the responsibility of the contractor to inform the Engineer immediately any existing service is exposed.

1.16 Damage to Services

The Contractor shall be held liable for all damage and interference to mains and pipes, to electric cables or lines of any kind either above or below ground caused by him or his Sub-contractors in execution of the Works, whether such services are located on the Contractor's Drawings or not. The contractor must make good or report to the appropriate authorities the same without delay and do any further work considered by the Engineer or owner. The Contractor shall provide for these contingencies in the rates inserted in the Bills of Quantities.

1.17 Temporary Roads and Traffic Control

The contractor shall provide and maintain all temporary roads, bridges and other work required for the construction of the Work including the access to quarries, borrow-pits, accommodation etc.

1.18 Road Closure

Where a road used by the Contractor for delivery of any materials used in the works is closed under Section 71 of the Traffic Ordinance Act 1962 or amendments thereto, the contractor shall obey such closure order and use alternative roads.

1.19 Road and Railway Crossing and Traffic Control

Whether the pipeline is crossing the classified roads and railway line, the Contractor will contact the relevant authorities in advance and obtain necessary permission to dig across the road and railway line in accordance with requirement of the authorities concerned and shall pay any royalties connected with this work, and the Contractor will provide temporary detour road together with any warning signs necessary. There will be no separate payment for this and cost of all expenses connected with road and railway crossing for which no separate items have been included in the Bills of Quantities.

1.20 Protection from Water

Unless otherwise mentioned, Contractor shall keep the whole of the Works free from water and allow in his rates for all dams, coffer, dams pumping,

piling, shoring, temporary drains, slumps, etc., necessary for this purpose and shall make good at his own cost all damage caused thereby.

1.21 Weather Conditions

The Contractor shall be deemed to take into account all possible weather conditions when preparing his tender and he shall not be entitled for extra payment by the reason of the occurrence or effect of high winds, excessive rainfall, temperature or any other meteorological phenomena.

1.22 Protection from Weather

All materials shall be stored on site in a manner approved by the Engineer and the Contractor shall carefully protect from the weather all works and materials which may be affected thereby.

No separate payment will be made for this and Contractor will allow in his rate for this.

1.23 Explosive and Blasting

At works requiring the use of explosives, the Contractor shall employ men experienced in blasting, and these men must be in possession of a current blasting certificate. The purchase, transport, storage, and use of explosive shall be carried out in accordance with the most recent Explosives Ordinance and Rules issued by the Government and the Contractor shall allow in his rates for excavation and quarrying for all expenses incurred in meeting these requirements, including the provision of suitable stores. Blasting operations shall be carried out with as little interference as possible to traffic or persons and the rates shall include for all flagging, watching barricade and clearance of debris.

In all cases previous permission from the Engineer must be obtained before commencing any blasting operation.

If, in the opinion of the Engineer, blasting would be dangerous to persons or property, or it is carried out in a reckless manner, the Engineer can prohibit any further use of explosives.

1.24 Liaison with Police, etc.

The Contractor shall keep himself in close contact with the Police, Labour Officers and other officials in the areas concerned regarding their requirements in the control of workmen, passage through townships, or other matters and shall provide all assistance and/or facilities which may be required by such officials in execution of their duties in connection with the works. Any instruction given by the traffic police concerning fencing off of trenches or other excavations must be followed explicitly.

1.25 Provision of Water

The Contractor shall provide water for use in the Works. He shall supply all hydrants, hose, vessels and appliances necessary for the distribution there-of and shall provide pumps, tanks, carts, vessels and appliances, transport and labour when and where-ever it is necessary for water to be carted for use at the works. All water used in connection with the works shall if possible be obtained from a public water supply and the Contractor shall make all necessary arrangements and pay all the charges for connection to main and for water used.

1.26 Temporary Lighting

The Contractor shall provide all artificial lighting and power for use on the works, including all sub-contractors and specialists requirements and including all temporary connections, wiring, fittings, etc., and clear away on completion. The contractor shall pay all fees and charges and obtain all permits in connections there with.

1.27 Sanitation

The medical Officer of health or other Sanitary Authority shall be informed when Works are contemplated and when works are about to commence.

The site shall be kept in a clean and proper sanitary condition. No nuisance shall be committed on or around work, and latrines for the workmen and staff shall provided in accordance with the requirements of the medical officer or Sanitary Authorities. The Contractor shall be responsible for the sanitary discipline of his labour.

The Engineer's representative has the right to order, who in the opinion of the Engineer's representative does not have a satisfactory sanitary discipline, off the site with immediate effect. The Contractor shall make sure that his personnel working on the site are medically fit, and he shall bear the cost of any medical test required to determine that his personnel are free from infectious diseases.

The Contractor shall follow the safety rules set down by the Factories Inspectorate, Ministry of Labour.

1.28 Medical Facilities

Contractors attention is drawn to Legal Notice No. 79 of 22nd September 1978 by which it is mandatory that every Contractor employing more than twenty people should appoint (in writing) a safety supervisor. A safety supervisor advice the management on all matters regarding safety, hygiene and welfare of the people affected by the Contractor's undertaking on the site. The safety officer may in addition carry out other duties. The contractor shall provide adequate first-aid equipment on the site and ensure that at least two of his site staff are completely trained in first aid.

1.29 Signboards

The contractor shall erect signboards as shown on the drawing in prominent positions adjacent to the works to the satisfaction of the Engineer. The location of the signboards shall be specified by the Resident Engineer.

1.30 Setting Out and Survey Equipment

The Contractor must before commencing any construction works, make sure that levels shown on the drawings correspond with levels found on the site.

Should any discrepancy be discovered between the level shown on the drawings and those found on the site, which may affect the level and dimensions of any part of the works, the Contractor shall notify the Engineer, who if necessary, will issue drawings showing the amended level and dimensions.

The Contractor shall allow for in his rates, the cost of the necessary qualified and experienced staff to set out the works and during the continuance of the Contract for the sole use of the Engineer, provide approved new and accurate instruments together with all other requisites, all necessary chainmen and other attendance and transport required for setting out and checking the works or purpose in connection therewith.

The major requirements are as minimum but not limited to following:

	Description	No.
(a)	2 m ranging rods	6
(b)	Modern Universal Theodolite and Tripod	1
(c)	Automatic level and Tripod	1
(d)	4 level staff with levelling bubble	2
(e)	100 m steel tape	2
(f)	50 m steel tape	2
(g)	3 m pocket tapes	3

The contractor shall clear the site and set out the Works well in advance to enable the Engineer to inspect and approve the setting out prior to commencement of the Works. The Contractor shall amend at his own cost any error due to inaccurate setting out.

Any checking or approval by the Engineer of the setting out, bench marks, plans or schedule will not relieve the Contractor of his responsibilities under the Contract. The Contractor shall provide plan showing the position of his site offices, storage, sheds, accommodation, Engineer's Representatives office etc., to the permanent works for the approval of the Engineer before commencing erection of his camp.

1.31 Backfilling of Holes and trenches

The Contractor shall immediately upon approval of any work at his own expense and to the satisfaction of the Engineer backfill all holes trenching and temporary quarries which have been made (except permanent borrow pits), level all moulds or heaps of earth that may have been raised or made and clear away all rubbish caused by the execution of the work. The Contractor shall bear and pay all costs charges damages and expenses of any kind whatsoever which may occur by reason of holes and trenches connected with the works or materials, tools or plant being left or placed in improper situation.

1.32 Inspection of Works

No part of the works shall be built in or covered over until it has been inspected and approved by the Engineer and the Contractor must give due notice in writing to the Engineer's representative when any part of the works are ready for inspection.

1.33 Cleaning Up of Site

Before final acceptance upon the completion of the Works, the Contractor shall, at his own expenses, remove and dispose of all rubbish and remove all equipment, surplus materials camp and buildings, which the contractor has provided, and temporary works ordered by the Engineer and shall leave the Site absolutely clear thereof and in good order and condition to the entire satisfaction of the Engineer.

1.34 Testing of Water-Retaining Structure

All water-retaining structures shall on completion be tested for water tightness in the following manner. The structure shall be filled with potable water in stage and held at each stage for such time as the Engineer may require. Should any dampness or leakage occur at any stage, the water shall be drained off and the defects made good. The procedure shall be continued and finally the structure shall after a period allowed for absorption remain full for seven days. Within those seven days, the level of the surface of the water should be recorded and measurements made at intervals of 24 hours. The total leak must not exceed 0.3% of the total volume of water in the tested structure.

If the structure does not satisfy the Condition of the test, and the daily drop in water level is decreasing, the period of test may be extended for a further 7 days, and if the specified limit is then not exceeded, the structure may be considered as satisfactory.

Should any dampness or leakage or other defects occur they shall be made good and the structure re-tested until the water tightness is approved by the Engineer. Faces of submerged structures may not be covered before testing.

The Contractor shall allow in his rates for all expenses and shall provide water and all necessary labour and materials for testing the structures.

1.35 Testing of Roofs

Where structures are used for storage of potable water adequate precautions should be taken to ensure that the roof is watertight in order to give projection against a potential sources of pollution.

The roof should be tested by lagooning the concrete slab to a minimum depth of 75 mm for a period of 3 days; the roof slab should be regarded as satisfactory if no damp patches occur on the soffit. The roof screed should be completed immediately after testing.

All water, labour and materials for the test are to be provided by the contractor who shall allow for this in his rates.

1.36 Cleaning and Sterilizing Water-Retaining Structures

The interior of all potable water-retaining structure shall be thoroughly cleaned and washed after the water tightness test has been approved by the Engineer in order to remove all contamination.

The structure shall then be filled to overflow level with clean water containing 50 parts per million of chlorine and left for a period of at least 24 hours. The chlorinated water shall then be drained away and the structure refilled with clean water from which samples shall be taken for bacteriological examination and for tests of residual chlorine. If any of the results of the tests are unsatisfactory when compared with those of the control sample of the supply water, the sterilizing process shall be repeated until the results of the tests are satisfactory.

The costs of the initial sampling, analysis and preparing on the bacteriological quality of the water shall be borne by the employer, but should the initial report be unsatisfactory, the costs of any subsequent sampling analysis and preparing reports shall be borne by the Contractor.

The Contractor shall allow for - in his rates providing water, all labour, materials, chemicals and other things necessary for cleaning and sterilizing the water-retaining structures.

1.37 Contractor's Superintendence

The Contractor shall give or provide all necessary superintendence during the execution of the works and as long thereafter as the Engineer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor or his competent and authorized Agent or representative approved in writing by the Engineer (which approval may at any time be withdrawn) is to be constantly on the works and shall give his while time to the superintendence of the same. If such approval shall be

withdrawn by the Engineer, the Contractor shall after receiving written notice or such withdrawal, remove the Agent from the Site within the time stated in the notice and shall replace him by another Agent approved by the Engineer.

1.38 Transport of Workmen

The Contractor shall include in his rates for all transport of staff and workmen to and from and in connection with the various parts of the works, and all costs incurred in recruiting and transporting labour to the site, where such labour is from outlying areas and costs of returning labour on termination of the contract.

1.39 Normal Working Hours

The contractor shall inform the Engineer in writing, at the time of submitting the work programme, the normal working hours. The Contractor shall respect all Public Holidays. Where the Contractor wishes to work outside these hours, he shall request the Engineer in writing at lease 24 hours in advance for consideration.

1.40 Transport, Travelling and Leave

In his rates, the contractor shall allow for and be responsible for all charges which may arise out of the transport to the site of materials, plant or equipment from any source, all applicable customs duties, all licences or other costs whatsoever together with all handling, packing and insurances. The prices shall also include all charges arising out of the provision of transport to the site of staff and labour from any source and shall include all costs in respect of fares, insurances, customs, medical or other fees, subsistence, leave and all other matters.

1.41 Compliance with Statutes and Local Regulations

In addition to requirements of Clause 26 of the Conditions of Contract, the Contractor shall be responsible for acquainting himself with all current valid Statute Ordinance or Bye-Laws or Regulations provided in the Bills of Quantities. This applies to training Levy and other similar taxes for which no claims on the part of the Contractor other than the one inserted in the Bills of Quantities will be allowed.

1.42 Accommodation for Workmen

The Contractor shall provide and maintain suitable shelters and mess facilities for his workmen and supervisory staff. The facilities shall be of sufficient size and to a standard considered satisfactory by the Engineer. The Contractor shall throughout the contract provide an adequate supply of potable water for the workmen.

1.43 Storage Space and Sheds

Suitable temporary stores and workshop shall be erected and later removed on completion of the works. All building shall be adequate for protection of the equipment or materials to be kept there-in and shall be constructed and located to the satisfaction of the Engineer

1.44 Office for the Contractor

The Contractor shall erect an office near the works on the site to be kept open at all hours during which the work is in progress.

Any notice to be given to or served upon the Contractor shall be deemed and taken to be effectively given or served upon by the delivery there-of at such office on the Site.

1.45 Office for the Engineer's Representative

The contractor shall if required by special specification rent and maintain offices, laboratories, survey and laboratory equipment and furniture for the Engineer and his staff.

1.46 Housing for the Engineers Staff

The employer shall provide housing for Engineers Staff

1.47 Maintenance of the Resident Engineer's Staff Houses, Offices, Furniture and Equipment

For the entire duration of the contract the Contractor will:-

i) For rented houses, ensure that the landlord attends to any maintenance problems regularly. The furniture shall be maintained by the Contractor.

ii) Keep all buildings provided by him, for the use of the Resident Engineer and his Staff, in well maintained, clean and fully habitable condition, and shall maintain all access roads, car parks, footpaths, fences, gates, drains, potable water supplies, gas, electricity and water-borne sewage disposal system in good stage of repair, all to the satisfaction of the Engineer.

iii) The Contractor shall also provide an adequate refuse collection for all houses and offices provided by him.

iv) The Contractor shall maintain all furniture and equipment provided by him in reasonable state of repair and usable condition and shall replace promptly any item which becomes unserviceable or is lost.

v) The Contractor shall provide day and night watchmen for the Resident Engineer's staff houses whether rented or constructed by him.

The Contractor shall insert his rate against lump sum item included in Bills of Quantities for the maintenance of offices, houses equipment and furniture.

Payment for the maintenance of resident Engineer's staff houses, offices furniture and equipment will be spread over in equal monthly instalments, spread over from the time houses or offices as appropriate are taken over by the Engineer until the end of the Contract. (In the event, no interim certificate is issued in any month then the instalment shall be added to subsequent certificate).

1.48 Attendance upon Resident Engineer and Resident Engineer's Staff

For duration of the Contract.

i) The Contractor shall provide all assistance including labourers, chainmen, clerks and junior staff as and when required by the resident Engineer for checking, setting out surveying measuring or for testing of work. The Contractor shall also provide a full time typist in Resident Engineer's office.

ii) The Contractor shall provide all tools and protective clothing, wooden pegs, iron pins and pickets, water cement and aggregate for concreting, transport for labourers and materials as may be required by the resident Engineer and his staff for checking, settling out, surveying, measuring or testing or the work.

An item has been included in Bills of Quantities for the above, which shall include all expenses including housing etc. which are due to the manpower. No further payment will be made for attendance upon the Engineer and Contractor shall include other costs elsewhere in his rates.

Payment for the attendance will be spread over in equal monthly instalments over the contract period. (In event, no interim certificate is issued in any month, then the instalment shall be added to the subsequent certificate).

1.49 Insurance

All buildings, furniture and equipment provided by the Contractor for the Engineer's representative shall be insured by the Contractor against loss or damage by accident, fire, theft and other risks ordinarily insured against for the duration of the contract. The theft shall include personal belongings of the tenants in the Resident Engineer's staff houses.

1.50 Transport for Engineer's Representative

The Employer shall provide transport for the Engineer's Representative.

The Contractor shall as stated in the Bills of Quantities provide maintenance, fuel and lubricants and must keep the vehicle clean and in a good roadworthy condition throughout the contract.

All maintenance shall be carried out at the prescribed intervals by an approval dealer.

In the event of service and repair with a duration of more than one day, the Contractor shall provide suitable replacement vehicle to the approval of the Engineer.

The costs of the above shall upon presentation of receipts be paid against the Provisional sums entered in the Bill of Quantities.

1.51 Removal of Camps

On the completion of the contract, the contractor shall, if so requested take down and remove all structures connected with his camp and shall take up all pipes, drains and culverts, backfill trenches, fill up all latrine pits, soak ways and other sewage disposal excavations and shall restore the site as far as practicable to its origin condition and leave it neat and tidy to the satisfaction of the Engineer.

1.52 Site Meetings

Site meetings will normally be held monthly, but will be called for wherever the progress of works so require or when demanded by the Engineer.

The Contractor shall at all meetings be represented by a responsible representative other than the site Agent, who has the powers to commit the Contractor in all matters concerning the Contract.

In the event, no responsible representative of the Contractor is present at the meetings, any decision taken by the Engineer at the meeting will be binding upon the Contractor.

2. SITE CLEARANCE

2.1 Clearance of Trees, Bushes, Scrub, etc.

The contractor shall unless otherwise directed cut down all trees remove bushes, plantations, crops and other vegetable growth and grub up all roots, take down all huts, buildings, wall fence and any other obstruction except services mentioned in Clause 2.13 and handle and transport salvaged usable materials, to a site approved by the Engineer. All salvaged and usable

materials are the property of the respective owners. The clearing and demolition here-in described shall be carried out to a width of the minimum excavation plus 1.50 m on either side.

With exception of the salvaged material fore-mentioned, the Contractor shall destroy or otherwise remove the whole of the rubbish from the site to an approved tip or number of tips provided by him.

Trees shall be cut down to as near the ground level as possible and the rate entered in the Bill of Quantities shall include for cutting down, removing branches and foliage, cutting into suitable lengths, grubbing up stumps and roots, stacking up, burning or disposing off as directed.

Before commencing any site clearance, general clearance, clearance of pipelines etc., the contractor shall inform the Engineer's Representative of his intention. The Engineer's Representative will by visiting the section of works concerned, determine the extent of the clearance expressly required.

Payment for clearance will be authorized on the basis of what is expressly required and at the discretion of the Engineer's Representative.

2.2 Damage to Land, etc.

Except where necessary for the proper execution of the Works, the Contractor shall not interfere with any fence, hedge, trees, land or crop forming the boundary of the site, or elsewhere. In the event of any interference, the Contractor shall make good any damage to such fence, hedges, trees, land or crop to the satisfaction of the Engineer and the owner thereof.

Where the work is to be executed in private land, the Employer will be responsible for negotiating and obtaining rights of way and the serving of all notices as may be required upon the owners and/or occupiers of the land and it shall be the obligation of the Contractor to keep the Employer and the Engineer fully informed concerning the rate of progress and of his intention to enter and begin work with any way leave as provided for under the Conditions of Contract and required by this Specification.

2.3 Clearing the Site on Completion

On completion of the Work, the Contractor shall clear the Site of all plant, building, spoils, dumps, rubbish, etc. and leave the Site to the satisfaction of the Employer.

Borrow pits and temporary quarries shall be made good and covered with vegetable soil. Dumps for waste materials shall be covered with at least 0.5 m of soil of which at least a 0.1m layer in top shall be vegetable soil.

3. EARTHWORKS.

3.1General

Excavation shall be made to such lengths, depths and inclinations as may be necessary for construction of the works or as shown on the drawings or as the Engineer may direct.

3.2 Definitions of Materials

For the purpose of these specifications, materials of earthworks are defined as follows:

(a) **Rock:** Solid mass of mineral material, exceeding 0.25 m cubic metres in volume, such hardness and texture that it cannot be broken down with a hand-drifting pick.

(b) **Common Material:** All earth materials which do not meet the common requirement of rock as defined in "Rock" above.

3.3 Classification of Excavation

The Engineer or his representative and the Contractor or his representative shall be present during classification of materials.

Where the terms "Rock excavation" and "Common excavation" or "Excavation" are used in these specifications the following definitions shall apply.

3.3.1 Rock Excavation

Rock excavation includes all solid rock in place which cannot be removed until loosed by blasting, barring, wedging, and all boulders or detached pieces of solid rock more than 0.25 cubic metres in volume. Solid rock under this class, is defined as sound rock of such hardness and texture that it cannot be loosened or broken down by hand-drifting picks

All materials containing more than 50 per cent by volume of boulders exceeding 0.25 cubic metre in volume shall be classified as rock excavation.

3.3.2 Common Excavation

Common excavation includes all material other than rock excavation including, but not restricted to earth, gravel, and also such hard and soft or disintegrated rock together with all boulders or detached pieces of solid rock not exceeding 0.5 cubic metre in volume.

3.4 Stripping of Topsoil

3.4.1 Stripping

Stripping shall consist of removing transporting and disposing of topsoil, stumps, roots buried logs, debris humus and similar objectionable matter. Areas to be stripped are all areas required for permanent constructional works, borrow-pits and embankment fills.

The limits of stripping shall extend 2 metres beyond the limits of excavation or toes of fills. The depth of stripping shall normally be 0.2m, but deeper stripping might be needed to remove stumps

3.4.2 Disposal

Materials from stripping suitable as topsoil shall be spread in approved areas. All other non-combustible materials shall be buried in approved disposal are, covered with minimum of 0.5 m of excavation spoil. These disposal areas shall be left with neatly graded surfaces and stable slopes that assure drainage. Alternatively, the non-combustible material shall be removed from the area by the Contractor.

3.5 Excavation in Open Cut

3.5.1 General

All open cut excavation shall be performed in accordance with this section to the lines, grades and dimensions shown on the drawings or as directed by the Engineer. The Engineer reserves his right to at any time during the progress of the work to vary the slopes or dimensions of the excavation from those previously specified.

All necessary precautions shall be taken to preserve the material below and beyond the lines of all excavation in the soundest possible condition. Any damage to the work due to the Contractor's operations, including shattering of the material beyond the required excavation lines, shall be repaired at the expense of and by the Contractor. Any and all excess excavation for the convenience of the Contractor for any purpose or reason, except as may be ordered in writing by the Engineer and whether or not due to the fault of the contractor shall be at the expense of the Contractor. Where required to complete the work, all such excess excavation and over-excavation shall be filled with compacted concrete Grade concrete 10 furnished and placed at the expenses of and by the Contractor.

All excavations for structure foundations shall be performed in the dry.

If excavations are carried out in roads, footpaths, separators or within 5m of buildings, the contractor is requested to execute the work in a way that will minimise damage and disturbances. In general vertically sided excavation will be required in such places and the necessary timbering or other support must be provided. The Undercutting of excavation sides will not be permitted.

The Engineer reserves his right to direct the contractor as to the length of trenches or parts of bulk excavations which shall be opened up at any one time. In case of excavations in roads, and in other cases which in the opinion of the Engineer are likely to cause interference to the public, the Contractor shall organize his operations in such a way as to reduce to a minimum the interval between opening up and Backfilling the excavations.
No permanent work shall commence until the Engineer has inspected and approved the excavation.

3.5.2 Mechanical Excavation

(a) A mechanical excavator shall be employed only if the sub-
Soil is suitable and will allow timbering of trenches or other excavations to be kept sufficiently closed up to ensure that no slips fall or disturbance of the ground takes place or there are no pipes, cables, mains or other services or property which may be disturbed or damaged by its use.

(b) When mechanical excavators are used, a sufficient depth
Of materials shall be left over the bottom of the excavation to ensure that the ground at finished excavation level is not damaged or disturbed in any way. The excavations shall then be completed by hand to the finished levels required.

3.5.3 Rock Excavation

The Contractor shall notify the Engineer on each occasion when he considers that he is entitled to payment of excavation in rock and shall not fill in any excavation concerned, until it has been inspected by the Engineer.

No payment for excavation in rock shall be made unless the Engineer has inspected the excavation and certified in writing the quantities involved.

The Contractor shall trim all rock faces in cutting according to the dimensions shown on the drawings and upon completion leave them safe from rock falls to the satisfaction of the Engineer.

On any work requiring the use of explosives, the Contractor shall employ men experienced in blasting and these men must be in possession of current blasting certificate. The purchase, transport, storage and use of explosives shall be carried out in accordance with the most recent Explosives Ordinance and Rules issued by the Government, and the Contractor shall allow in his rate for excavation and quarrying, for all expenses incurred in meeting these operations shall be carried out with as little interference as possible to traffic or persons and the rates shall include for all flagging, watching, barricade and clearance of debris, and the contractor shall take all practical precautions for the protection of persons, properties and the Works.

Slopes shattered or loosened by blasting shall be taken down at the expenses of and by the Contractor. The Contractor's blasting and other operations in excavation shall be such that they will yield as much suitable material as possible for the construction.

3.5.4 Foundation for Structures

(a) **Common materials:** The bottom and site slopes of common material upon or against which concrete is to be placed shall be finished accurately to the established lines and grades, and loose materials on surfaces so prepared shall be moistened with water and stamped or rolled with suitable tools and equipment to form a firm foundation for the concrete structure. If, at any point in common material, material is excavated beyond the established excavation lines, for any reason except by written orders from excavation lines, for reason except by written orders from the Engineer, then the over-excavation resulting voids shall be filled with consolidated concrete Grade 10 at the Contractors expenses. If the excavation is carried out in advance a protective layer of 150 mm thickness shall be left above the foundation level until immediately before the Contractor is ready to pour the blinding concrete.

(b) **Rock materials**: The bottom and side slopes of rock material upon or against which concrete is to be placed shall be excavated to the required dimensions as shown on the drawings or established by the Engineer. No material will be permitted to extend within the neat lines of the structure. If, at any point in the rock material, material is excavated beyond limits required to receive the structure, the additional excavation shall be filled solidly with concrete Grade 10.

All soft or loose material shall be removed by the use of stiff brooms, picks, hammer or jets and any cavities backfilled with concrete Grade 10, grout or compacted rock fill as directed.

(c) **Level and Dimensions of foundations**: Levels and dimensions of foundation shown on the drawings may be changed by the Engineer to suit actual site conditions. The additional volume shall be measured net and paid according to the rate in the Bills of Quantities.

3.5.5. Trench Excavations for Pipe Laying

All surface material including top soil which differs in any nature whatsoever from the sub-strata, shall in every case be carefully set aside and stored separately from other excavated material. No extra claim will be allowed for setting aside surface mater or topsoil for later use.

Trench excavation shall be carried out with great care, true to line and gradient and as near as practicable to the size required for construction of the permanent work. Nowhere shall the external dimensions of the excavations be

less than the dimensions of the permanent work shown on the Drawings or directed by the Engineer.

If the bottom of the excavation becomes weathered prior to pipe laying, due to fault of the contractor, the weather soil shall be replaced with suitable compacted material to the original formation level at the contractor's expenses. The pipe trench shall be excavated to a depth of 150 mm below the invert level of the pipe and refilled with sand, gravel or other selected material free from stones and well rammed in order to provide a smooth bed for the pipes.

Where concrete pipes are laid in concrete, the pipe trench shall be excavated to a depth of 150 mm below the invert level or the pipe and the width shall be equal to breadth of concrete bedding for the pipes plus 150 mm on either side.

Excavation for pipe trenches shall be of sufficient depth to give a minimum cover of 800 mm over the top of the pipe. Where pipes/sewers cross under roads, minimum cover shall be 1 mm or such cover as may directed by the Road Authority.

Where the pipeline is required to be laid at depth, which does not satisfy the minimum cover conditions set out above, the ground surface shall be brought up to the required level by banking the backfill or as directed by the Engineer.

No pipes shall be laid and no excavation filled in or covered with concrete until the formation has been inspected and permission to proceed with the work obtained.

Where P.V.C. or Polythene pipes are being laid, the bottom of the trench must be completely free from stones, and a smooth bed of fine material must be provided. Where the bed of the trench for P.V.C of polythene pipes is excavated in rock, it must be excavated to a depth of not less than 100mm below the bottom of the pipe, and refilled with selected fine granular material to make a smooth bed for the pipe.

The width of the trench to be excavated will depend on the size and type of pipe being laid. Sufficient width must be excavated to allow the pipe to be correctly bedded and aligned, and to allow for the joints to be correctly made. Generally, the grade of the pipe will conform to the grade of the ground, but the excavation must be deepened where necessary to avoid backfill in any section. Generally, the pipeline will slope downwards. Minimum gradients are shown on the drawings.

Any Excavated material stored on site for Backfilling or other purpose shall be deposited alongside the excavation at a minimum distance of 0.5m on such a manner that it will cause no damage and as little inconvenience as possible.

3.5.5 Timbering of Excavations

The Contractor shall supply and fix aside the limits of the permanent works all the timber necessary for support of sides and bottoms of the excavation, for security of adjacent structures and properties and for every other purpose for which it may be required, all to the satisfaction of the Engineer. The Contractor shall maintain such supports until in the opinion of the Engineer, the works is sufficiently advanced to permit the withdrawal of the support. Such withdrawal shall be executed only under the personal supervision of a competent foreman.

The Engineer may order excavations to be timbered or to be closed timbered or may order timbering to be driven ahead of the excavation, or may order the adoption of any other method of supporting the sides and bottoms of the excavation as may appear to be necessary, and the Contractor shall adopt and shall make no charge for executing the adopted method.

The contractor shall be responsible for any injury to the work and any consequential dame caused by or arising out of the insufficiency of the support he provides for his excavations or caused by or arising out of the removal of that support, and any advice permission approval or instruction given by the Engineer relative to the support or removal thereof shall not relieve the Contractor of his responsibility.

Any instruction given by the Engineer will be directed to the provision of stronger support than that proposed by the contractor, and will be given only when, in the opinion of the Engineer, the support proposed by the Contractor is insufficient.

Where timber has been used in excavation any such timber left in position shall be at the expense of the contractor except where the Engineer has ordered the timber to be left in place with the prior approval of the Engineer. The timber approved or ordered to be left in place will be paid for at the rates entered in the Bills of Quantities.

For the purpose of this Clause the words "timber" and timbering be construed to include trench sheeting and steel or concrete sheet pilling or any other means adopted by the Contractor for supporting excavations.

3.5.6. Excavation to be kept Free from Water

Where excavations are required below the existing water level, the Contractor shall make arrangements to keep the excavation dry and shall produce drawings and written explanations of the method to be used to enable the Engineer to determine the adequacy of the method, before commencing the excavation.

The Contractor shall give due regard to the possibility of floods and provide all pumps, timbering, coffer dams, sheet piling and other equipment necessary for keeping the excavations free from water.

Every precaution shall be taken not to diminish the bearing capacity of the soil below foundation. Well points or pump pits are to be outside the foundation area to prevent flows in upward direction.

All sumps and drains are to be filled in or otherwise made good as directed by the Engineer on completion of the relevant part of the works.

The costs of all the above precautions shall be allowed for in the rates inserted in the Bills of Quantities.

3.5.7. Refilling Excavations

No Backfilling or refilling shall commence without the Engineer's approval

The refilling of excavation shall be commenced as soon as practicable after the permanent works have been tested where so required and inspected and approved by the Engineer. In particular, the back filling of trenches shall be carried out expeditiously to reduce lengths of trenches open at any one time.

As soon as P.V.C. or polythene pipes are laid and joined in their final positions, they should be protected from possible damage by carefully back filling of line with granular material brought up to about 150 mm over the top of the pipe, for the full width of the trench, and well compacted.

Joints must be left open for inspection until the pressure test is completed.

Backfilling shall be executed with selected materials in 150mm layers (300 mm layers if a mechanical hammer is used) each layer being well rammed and watered to obtain maximum compaction. Care shall be taken to ensure that no stone or other work, is placed within 300 mm of such work.

Water in excess shall not be used in settling of the back filling.

Back filling over steel pipes shall be generally as described above, except that the initial protective filling around the pipe is not necessary.

Regardless of the means of backfilling adopted, it is the Contractor's responsibility to ensure that he satisfactorily backfills all excavations and causes no damage to permanent work or adjacent structures, and he shall at his own expense take all steps necessary to comply with this obligation.

The Contractor shall at all times be responsible for damage caused to permanent work through his back filling operations or throughout his premature opening to traffic of a backfilled surface.

3.5.9 Reinstatement of Surfaces

Generally all trenches and backfilled excavations shall be reinstated to equal surface as before excavation.

Trenches in any existing road shall be refilled to the level of natural soil below the road with sub-soil in 75mm layers, each layer being carefully tamped with hammers. The remaining top layer shall be filled to the road surface with materials equal in type, quantity and compaction to materials used for the existing road.

The trench shall then be left to settle for 30 days. At the expiration of this period, the surface shall be made up to level and tamped or rolled to the approval of the Engineer, who will decide on the particular surfacing employed in accordance with the existing surface of the road.

Before expiration of the maintenance period, the Contractor shall make good any defaults in reinstatements.

3.5.10 Removal of Surplus Excavated

Excavated material, which is not added either for backfilling trenches or other excavations or use in embankments or otherwise, shall be removed and disposed of to tipping places obtained by the Contractor. All rubbish and waste material shall similarly be removed by the Contractor. All surplus excavated material shall be spread and levelled in the tipping places in accordance with such directions as the Engineer may give, and the Contractor's rate for disposal shall include for the costs of such operations.

The contractor shall take every practical precaution against causing any nuisance, damage, injury or inconvenience in handling stacking, carting or disposal of excavated materials or any other operations matter or thing in connection therewith.

No excavated material shall be placed in any position here it may be washed away or may be liable to fall or spread into any private property or across a road or footpath, should such occur, the Contractor shall forthwith remove the same at his own costs.

Should the Engineer direct the Contractor to tip surplus excavated materials in a particular place (other than the tipping places obtained by the Contractor) the Contractor shall abide by such instruction and shall make no charge in consequence thereof unless the place specified entails a longer haul than what would be incurred by tipping at the place or places obtained by the Contractor.

Where excavation lines are not shown on the drawings, the excavation will be measured to the most practicable lines, grades, and dimensions as directed by the Engineer.

In the case of bulk excavations, the Contractor shall unless otherwise directed by the Engineer prior to the commencement of any excavation prepare grid plans of the various sites showing the existing ground levels at intervals of not more than 10m. For any particular part of excavation the mean ground level shall be determined from the above aforesaid grid plan and the depth shall be calculated from the above mean ground level.

Pipe trenches are measured in linear metres as one item for each pipe size with a minimum width and depth as indicated on the drawings. Extra excavation for deeper trenches will be measured on cubic metres and paid for where ordered by the Engineer.

Rates for excavation shall include for all labour, equipment; preparation of bottoms for receiving concrete or granular soul beds; for forming joint holes where applicable, for preserving surfaces of excavation; for returning excavated material as rammed backfill and for carting away surplus to dump.

Rate for excavation shall also include for working in a manner that causes no interference with the stability of adjacent structure and properties, for the cost of all timber or other support left in place unless ordered or approved to left in place unless ordered or approved to be left in place by the Engineer; for ground stabilization by means of de-watering, chemical processed or other approved method whether effected by floods, storms or otherwise for the provision and sealing of temporary channels, drains and dumps; ;for temporarily storing excavated materials required for backfill or other purposes; for temporarily supporting, protecting, diverting, maintaining utility services; for maintaining flows in sewers and water found necessary for the proper execution and safety of the works.

Further, the rates in the Bills of Quantities for excavation in open cut shall include the entire cost of:

(a) Transportation of material from the excavation to points Of final use, to disposal areas, to temporary stockpiles and from temporarily stockpiles to points of final use.

(b) Rehandling excavated materials which have been deposited temporarily in stockpiles.

(c) Removal of oversize materials from otherwise suitable material disposal for the same.

No extra payment shall be made to the Contractor for working in confined space or if the position of the works as set out or ordered will not allow the use of mechanical excavators.

50% of the rate for excavation, backfilling and disposal of surplus material will become due for payment when trenches have been backfilled to a dept of 150mm over the pipe barrel. Excavation for structure foundations will be

authorized for payment of 50% of the rate, when the excavation has been approved and the surface blinded.

3.6 Borrow Pits

No borrow pits will be allowed to be opened on the site unless permission in writing has been obtained from the Engineer.

Before the excavation of an approved borrow area is commenced, the Contractor shall clear the surface and strip the topsoil in accordance with Clause 3 & 4.4.

Borrow excavation shall be regular in width and shape and shall be properly graded and drained and finished with neatly trimmed slope, and if so directed soiled and grassed.

The Contractor shall not be entitled to any additional allowance above the unit prices on accounts of any changes ordered by the amounts of materials to be secured from any borrow area, or on account of the designation by the Engineer of the various portions of the borrow areas from which materials are to be obtained, or on account of the depths of cut which are required to be made.

Measurement for payment of excavation in borrows areas will only include for the quantities of materials utilized for construction of embankments etc. Any costs of excess excavated material, except if directed by the Engineer shall be borne fully by the contractor.

3.6 Hardcore Filling

Hardcore fill shall consist of clean hard broken stone or rubble with measurements not exceeding 150mm in any one direction with sufficient murram added to fill the interstices. The hardcore shall be well packed, rammed and where possible rolled with a 5 ton a roller. Where rolling is impossible, compaction shall be by hand or by mechanical tampers. Before any concrete is laid on hardcore, the hardcore shall be levelled and blinded with fine stone chipping, rolled and watered as necessary. Hardcore filling is measured after compaction.

3.8 Earth Filling

3.8.1 General

Earth not suitable to be used in filling may at any time be rejected by the Engineer. If there is a deficit of soil, the Contractor shall from approved borrow pits supply selected material in the ordered amount.

Before commencement of filling the topsoil shall be removed, if so ordered by the Engineer. The removal of this layer will be separately priced in the Bills

of Quantities. The Contractor shall carry out the forming of embankments in accordance with the drawing and shall adhere to the slopes, levels, depths and heights shown thereof.

Before earth filling, the sand or gravel bedding of the pipes, according to the drawings shall be made. Soil filled to 500mm over the top of pipes shall be free from stones and be filled in by hand with the utmost care to avoid replacement of pipes.

3.8.2 Compaction of Fill

The 500mm fill over the pipe shall be compacted carefully by hand. In other areas, after removal of topsoil as specified, fill material shall be spread in even layers over the full width of the area to be filled. Each layer shall not exceed 300mm in thickness after compaction.

The water content of the earth fill material prior to and during compaction shall be distributed uniformly throughout each layer of the material. The allowable ranges of placement water content are based on design considerations. In general, the average placement water content will be required to be maintained at the Proctor Laboratory Standard Optimum Condition. This standard optimum water content is defined as "That water content which will result in a maximum dry unit weight of the soil when subjected to the standard Proctor Compaction Test".

Proctor compaction tests are to be carried out in accordance with BS 1377 and the Contractor shall provide the Engineer with facilities to carry out such tests, or cover the cost of tests carried out elsewhere.

As far as practicable, the material shall be brought to the proper water content in the borrow pit before excavation. Supplementary water, if required, shall be added to the material by sprinkling on the earth fill and shall be mixed uniformly throughout the layer.

Compaction of fill shall be carried out to 95 per cent standard proctor if not otherwise indicated on the drawings.

In case of unsatisfactory compaction test results, the Contractor shall re-compact or remove the fill to the satisfaction of the Engineer.

The number of tests to be made shall be agreed upon by the Engineer and the Contractor at commencement of the work..

The machinery the Contractor intends to use for compaction (pneumatic, vibrating, static or other rollers) must be approved by the Engineer before employment.

The Contractor shall take care that each separate layer is formed with side slopes to ensure that water cannot gather on the surface, thus causing softening

of the soil. Compaction shall start from the side of the embankment and continue towards the middle.

On completion of the embankment to formation level and stipulated side slopes, the layer of topsoil mentioned in Clause 4.9 shall be applied.

Earth fill is measured after compaction.

3.9 Grass Planting and Top Soil

Top soil shall be selected vegetable soil, well compacted and except where otherwise specified of 150 mm thickness.

The Contractor shall trim the faces of the side slopes to open channels and elsewhere where directed to the dimensions, inclinations and curves shown on the Drawings, remove all excess material and make good all depressions with suitable material.

Where instructed by the Engineer, the Contractor shall plant Kikuyu or other approved grass at the rate of 16 plants per m corresponding to 250mm c/c. The Engineer shall satisfy himself that natural growth of grass will not take place within a reasonable time before instructing the Contractor to grass specified areas.

The Contractor shall be responsible for obtaining suitable grass plants and for making all necessary arrangements with the owners and/or occupiers of the land from which they are to be obtained. The Contractor shall be responsible for the preparation of the embankment for the planting, and for maintaining adequate grass cover and necessary watering during the Contract and maintenance period.

Topsoiling and grassing are measured in square metres.

3.10 Ant-Proofing

Where an ant-proof course has been specified, it should be made by application of Rentokil termite soil concentrate or equal dilute one part concentrate to forty parts water (by weight) at the rate of 5 litres solution to 1 sq. metre to the whole area of the building immediately before (36 hours maximum) the concrete is poured. Additionally to all critical areas, i.e both sides of wall foundations, piers and porches the application should be 5 litres per running metre. Treatment should not be made when the soil is excessively wet. Precautions should be taken to prevent disturbance of the treated areas before they are covered.

Ant-proofing is measured in square metres

4. CONCRETE WORKS

4.1 All materials and workmanship for concrete shall comply with BS 8110 and BS 8007 where applicable.

4.2 Materials and Tests.

4.2.1 Cement

Cement shall be ordinary Portland cement complying with BS 12. The cement shall be delivered in properly sealed, unbroken bags.

Rapid hardening Portland cement complying with BS 12 may be used with the approval of the Engineer.

Quantities in excess of one ton shall be stored in a water-proof shed with a raised floor. The cement shall be used in the order in which it has been received.

Quantities of less than one tonne for early use may be stored on a raised floor and covered by water-proof tarpaulin.

Any cement damaged by water or proving defective shall be removed from the site immediately.

4.2.2. Aggregates for Concrete

The aggregates shall comply in all respects with the requirements of BS 882.

The aggregates shall be free from dust, decomposed material, clay, earthly matter, and foreign substances or friable, then or laminated material. The fine aggregate shall be of approved river sand.

Coarse and fine aggregates shall be stored on the sites in separate heaps so that no possibility of any intermixing of the two shall occur. Any materials, which have become intermixed, shall be removed by the Contractor forthwith.

A sample of all aggregates shall be delivered to the site for the approval of the Engineer, and it shall remain on the site until all concrete work is finished.

Should the Engineer so require, the Contractor shall furnish a certificate from an approved testing laboratory in connection with each source of fine and coarse aggregate showing that materials comply with the specification. All such testing shall be carried out at the Contractor's expenses.

4.2.3 Water

All water to be used for concrete, motor and curing shall be of good drinkable quality, free from humus acid, chemicals, salts or other matters that in any way whatsoever may be harmful to the concrete either by diminishing the strength or causing a discoloration of the concrete.

Generally, water from Public mains shall be used, but if this is not possible, the contractor shall obtain water from other sources approved by the Engineer. The Contractor may be requested to provide test analysis according to BS 3148 from an approved laboratory.

4.2.4 Admixture

Admixture of any kind of accelerating the setting of cement, plasticisers, water proofers, etc. shall not be used except by written permission of the Engineer. The Contractor must request supply all details of any admixture.

4.2.5 Concrete Mixture

Concrete shall be "Designed Mixes" for reinforced concrete and "Nominal Mixes for mass Concrete" to BS 8110 and used as shown on the drawings and in the Bills of Quantities. The concrete mixes, maximum aggregate sizes, maximum water/cement ratio and minimum cement content shall be in accordance with the following table.

Concrete Grade	Maximum size of Coarse Aggregate	Minimum Cement Content	Maximum Water/Cement Ratio
10	40 mm	210 kg/m³	0.5
15	40 mm	250 kg/m³	0.5
20	20 mm	350 kg/m³	0.5
25	14 mm	390 kg/m³	0.5

4.2.6 Trial Mixes

The actual concrete mixes shall be determined prior to starting of concrete works according to BS 8110.

For each grade of concrete three separate batches shall be made using the actual aggregates

The workability of each of the trial batches should be determined and two times three cubes made from each batch for test at 7 days and 28 days.

The average strength of the nine cubes shall exceed the following values

Concrete grade	Minimum average of 9 cubes At 7 days	Minimum average of 9 cubes at 28 days
20	21 N/mm²	31.5N/mm²
25	24.5N/mm²	36.5 N/mm²

For the trial mixes the mix proportions shall be specified under clause 6.3 of BS 8110.

4.2.7. Testing of concrete shall comply with BS 8110

All test cubes shall be manufactured, cured and tested as detailed in BS 1881.

The Contractor shall provide at his own expense all the necessary labour, equipment, moulds, transport, etc., required for manufacture of the test cubes. All test cubes requested by the Engineer shall be tested by Ministry of Works, Materials Branch, and the contractor shall allow in his rates for concrete for all costs in relation with the test cubes.

Should the Contractor require independent tests, he shall make them at his own expense, and the results of such tests shall not be valid unless test cubes are manufactured in the presence of the Engineer and tested by an approved agency and to the requirements in all details of the BS mentioned above.

Sufficient moulds and equipment shall be provided to enable a minimum of six test cubes to be prepared on each day when concrete is being mixed or such other number as the Engineer may direct. The Contractor shall be responsible for delivery of the test cubes to the Ministry of Works, materials Branch, or other approved testing laboratory.

The precise location of the concrete, which the test cubes represent and the time of Placing, shall be noted on the drawings or elsewhere.

Where the concrete in the work is compacted by mechanical vibration, the test cubes shall be compacted by mechanical vibration, and where the concrete in the work is compacted by hand, the test cubes shall also be compacted by hand as specified in BS 1881.

The Engineer may in the Laboratory make test cubes for any purpose from site materials, and the contractor shall supply such materials as required free of charge.

The test cubes shall be store at the site of construction at a place free from vibration under damp sacks for 24 hours after which time they shall be removed from their moulds, marked and buried in damp sand or under water until the time for delivery to the testing laboratory.

The cubes shall then be placed in damp sand or another suitable damp material and sent to the testing laboratory, where they shall be similarly stored until the date of test. Test cubes shall be kept on the site for as long as practicable but for at least three-fourths of the period before testing, except for tests at ages less than seven days.

4.28 Standards for Acceptance of Cube Tests.

The results of all cubes shall be accepted by the contractor and Engineer as true results of the crushing strength of the cubes. The cube strength shall be calculated from the maximum load sustained by the cube at failure.

The appropriate strength required may be considered to be satisfied if the requirements in BS5328 : Part 4, clause 3.16, are fulfilled.

If the tests fail to give the required strength, further testing of the concrete shall be carried out. If these tests fail to prove the strength of the concrete used, the contractor shall at his own expense remove and replace all such concrete as directed by the Employer.

4.2.9 Slump Tests

Concrete consistency shall be determined by a test carried out in accordance with BS 1881 and at the Contractor's expense.
Unless otherwise specified by the Engineer, the following are the slumps for the particular class of work.

	Compaction by vibrator	Compaction by hand
Reinforced concrete		30 to 60mm
Mass concrete	0 to 30 mm	30 to 80mm

Concrete having a slump test value exceeding the values here-in specified may be rejected by the Engineer.

4.2.10 Steel Reinforcement

Steel for reinforced concrete shall be store under cover clear of ground and shall comply with BS 4449, BS 4461 and BS 4483

All steel reinforcement shall be supplied by and approved manufacturer, and the Contractor may be required to obtain a manufacturer's test certificate in respect of steel reinforcement supplied. In the absence of such a test certificate, the Contractor may be required to submit samples to be tested at the Contractors expense in such a manner as the Engineer may determine.

4.3 Precast Concrete Units

Precast concrete shall be cast in properly made strong moulds true to the shape required. For work described "Finished Fair" the moulds shall be lined hardboard, sheet metal or other approved material.

The Concrete shall be thoroughly tamped in the moulds and shall not be removed from then until 7 days after placing the concrete, but the sides may be removed after 3 days, provided the moulds are such that the sides are easily removable without damaging the concrete.

The precast work shall be cast under sheds and shall remain under same for 7 days in the moulds and further 7 days after removal from the moulds. During the whole of this period the concrete shall be shielded by sacking or other approved materials kept wet. It shall then be removed from the sheds and stacked in the open for at least 7 days to season.

All precast work shall be cast in lengths convenient for handling unless otherwise described.

Prices are to include for handling reinforcement, hoisting, fixing and bedding in cement mortar, and for finishing exposed surface fair where described.

4.4 Workmanship

4.4.1. Inspection of Reinforcement and Formwork

No concreting shall commence until the reinforcement and formwork have been inspected and approved by the Engineer, Reinforcement in walls and columns shall be inspected and approved before being enclosed in the formwork. Before concreting any part of the Work, the Contractor shall give at least 24 hours notice in writing to the Engineer and obtain his approval.

4.4.2 Mixing of Concrete

Concrete for grade 20 and grade 25 shall be mixed by weight batching only, unless approval has been obtained from the Engineer for the concrete materials to be mixed by volume. Concrete for grade 10 and 15 can be mixed by volume.

The weight of coarse and fine aggregates in each batch shall be so computed that each batch contains one or more full 50 kg bags of cement.

All concrete is to be mechanically mixed in a batch mixer of an approved type. The dry materials for concrete shall be mixed in the mixer until a uniform colour is obtained after which the gauged quantity of water shall be gradually added. After all the water has been added, the mixer shall continue to mix for a period of not less than two minutes.

The mixers shall be equipped with an adjustable device capable of supplying a predetermined amount of water.

On the completion of each mixed batch of concrete, the mixer drum shall be completely emptied before a fresh batch is placed therin. On the cessation of work, the mixer add all handling plant shall be washed out and shall always be left clean and free from hardened concrete.

Any mix considered to be unsatisfactory by the Engineer for any reason, will be discharged to waste at the Contractor's expense, as and where directed by the Engineer, well clear of all mixed and placing operations in such a manner as to avoid the risk of defective concrete being incorporated in the Works.

The mixer shall be maintained in a first class condition throughout the Contract and any mixer or plant, which is faulty in any respect, shall not be used. The drums of all mixers shall revolve at the speed recommended by the makers. A mixer which has been out of use for more than 20 minutes shall be thoroughly cleaned out before any fresh concrete is mixed.

The Contractor shall always have one spare mixer ready on the site to avoid interruption in the mixing a casting of concrete.

4.4.3 Transport and Placing of Concrete

Concrete shall be transported in a manner which will avoid a segregation of the constituent material, and placing in the forms shall be completed before the concrete has taken its initial set. In no case shall concrete be place dint he Works more than 30 minutes after mixing. Concrete shall not be dropped through a height greater than 1.2m. Chutes may be used if they are constantly kept free from coatings of hardened concrete or other obstructions. Pumping of concrete through delivery pipes may be used, but only with the prior approval of the Engineer.

Concrete of any unit or section of the work shall be carried out in one continuous operation, and no interruption of the concreting will be allowed without the approval of the Engineer

The concrete shall be paced in layers as directed by the Engineer over the whole area to be concreted and the second layer shall not be commenced until the first is completed. Sloping beds will not be allowed when placing concrete. Should any accidental segregation occur, the affected area shall be thoroughly turned over by hand until a homogeneous mix has been obtained.

When concreting walls and columns, the mix proportions of the first 250mm depth of concrete placed in contact with the horizontal joint should be adjusted by reducing the amount of coarse aggregate.

4.4.4 Compaction

After the concrete has been placed in a position it shall be compacted by vibration with a rigid poker type with internal vibrator approved by the Engineer. The Concrete shall be worked well up against the form, joints and around the reinforcement and be free form voids and other imperfections. Under no circumstances shall the concrete be shifted or transported inside the form with vibrator.

The Contractor shall always have one spare vibrator ready on the site to avoid interruption in the mixing, casting and vibrating of concrete.

In the case of reinforced concrete, a competent steel fixer shall be in constant attendance during the placing of concrete to adjust and correct the position of the reinforcement, if so required, immediately before the concrete is placed. In no case shall the vibrators be attached to or be allowed to come into contact with the reinforcement.

Each freshly placed layer of concrete must be thoroughly compacted and worked into the preceding one but care shall be taken that no damage is done to previous work that has already set. Excessive compaction of concrete shall be avoided.

The upper surface of slabs shall be compacted cyan approved external vibrator.

4.4.5 Placing of Concrete under Water

Concrete shall only be placed under water with the prior approval of the Engineer who shall likewise approve the method to be used and the precautions necessary to prevent loss of material. In no circumstances shall concrete be dropped or placed in water in a loss condition or be placed in flowing water. In all cases the cement content shall be increased by 25 per cent for each class of concrete at the Contractor’s Expense.

4.4.6 Placing of Concrete on Earth Surfaces

Earth surfaces on which concrete is to be placed shall be clean, firm and free from standing or flowing water. After the excavation has been completed to the approved lines levels and

4.4.7 Construction and Expansion Joints

The position and arrangement of construction and expansion joints shall be as shown on the drawings. Where additional joints are requested, the positions must be approved by the Engineer.

All construction joints shall be rebated to form a key with subsequent work. Concreting of any unit or section of the work shall be carried out in one continuous operation up to construction joints and no interruption of the concreting will be allowed without approval.

Where shown on the drawings construction and expansion joints shall be provided with water bars of P.V.C. or other approved material. The widths and shapes of the water bars shall be as specified on the drawings and all joints shall be sued. The trade mark of the water bars shall be approved by the Engineer before commencement of work, and fixing and jointing of water bars shall be approved by the Engineer before commencement of work, and fixing and jointing of water bars shall be approved by the Engineer before casting.

The fusing of water bars shall be performed in a way so as to secure that the two bars joined over the entire width. The fused joint shall be able to withstand tension and shall be intact after 10 consecutive bendings. The Engineer may request that the fusing is carried out by specialists.

Where shown on the drawings, joints shall be provided with a joint sealing compound. The sealing compound shall be a two component polysulphide rubber sealing compound complying with BS 4254, and the trade mark shall be approved by the Engineer. The compound shall be placed in a chase made by a fillet strip in the formwork. The concrete shall be dry and suitable primer shall be applied to the joint before applying the sealant. The procedure for the workmanship shall be approved by the Engineer before commencement of work, but the contractor shall have the full responsibility for the water tightness of the joints.

It should be noted that the lower part of the concrete walls shall be cast together with the floor slab and no joint directly on the slab will be permitted.

Before depositing fresh concrete against concrete which has already set, the face of the latter shall be roughened to expose the coarse aggregate, all cement latency removed whilst the concrete is still green and the surface thoroughly wetted with water and cleared of foreign matter. Cement mortar grout mixed in the proportion of one part of cement to two parts of sand shall be spread to a thickness of 5 mm over the face of the set concrete before the fresh concrete is deposited.

4.4.8 Curing and Protection of Concrete

Curing shall begin as soon as the surface of the concrete has hardened sufficiently. All exposed concrete surfaces shall be cured for a period of seven days by covering them with a layer of sand, hessian canvas or other approved materials kept damp. Concrete shall be protected from sun, wind, heavy rains and flowing water for at least three days after placing.

4.4.9 Finishes of Horizontal Surfaces

Concrete surfaces for floors shall be true to level and falls as shown on the drawings. Water coming to the surface when vibrating shall be removed. After casting the surface shall be smoothened with a wooden flat. After some hours, when the surface has dried up, the surface shall be trowelled smooth with a steel trowel.

All other horizontal surfaces shall have the same surface finish except for the final trowelling with steel trowel.

4.4.10 Finishes of Vertical Surfaces

The shuttering for exposed concrete faces shall be so constructed that the latter shall be true to line and surface. The concrete shall be consolidated as specified against the shuttering to keep the face of the work free from honeycombing and other blemishes.

After removal of the shattering, no concrete surfaces shall be treated in any way until they have been inspected by the Engineer.

If upon removal of the shuttering, the line or surface of the work is, in the opinion of the Engineer, unsightly and not in accordance with the requirements of the Contract, the Contractor shall at his own expense cut out and make good such portions of the work as the Engineer directs.

Rendering over defective surfaces shall not be permitted. Areas of honeycombing shall with the approval of the Engineer be made good immediately upon removal of the shuttering, and isolated superficial air and water holes shall be filled. Care shall be taken not to leave mortar or cement on parts of the surface which have been cast smooth and without pores.

Unless otherwise instructed, the face of exposed concrete placed against shuttering shall after removal of the shuttering be rubbed down with a carborundum stone or in other approved manner to remove fins and other irregularities, and washed perfectly clean.

Concealed concrete faces shall be left as from the shuttering, except that surfaces with honeycombing shall be made good.

4.4.11 Accuracy of Finish

The arrangement of all formwork shall be made in such a way that all dimensions shall comply as exactly as possible with those given on the drawings. The following tolerances shall be respected:

Foundations	50 mm
Position of columns and Walls	5 mm
Thickness of walls	5 mm
Lateral dimensions of columns	5 mm
Level of slabs, beams	5 mm
Slab thickness	5 mm
Lateral dimension of beams	5 mm
Plumb of columns and walls	3 mm in each storey(non/accumulative)
Window and door opening sizes	5 mm

Surfaces and edges must not show any noticeable warping. On a length of less than 10 m the deviation may be 10 mm at the most.

The Contractor shall be responsible for the cost of all corrective measurers required by the Engineer to rectify work which is not constructed within the tolerance set out above.

4.4.12 Construction of Formwork.

All formwork shall be substantially and rigidly constructed of timber or steel or pre-cast concrete or other approved material and shall be true to the shape, line, level and dimensions shown on the Drawings.

Timber shall be well seasoned, free from loose knots and or Formwork of exposed concrete faces be planned to thickness. Faces in contact with concrete shall be free from adhering grout, projecting nails, splits, or other defects that will make the concrete surface. Formwork for foundations and other concealed work may be undresses or rough timber.

All joints shall be sufficiently tight to prevent leakage of cement grout and to avoid the formation of fins or other blemishes, and all faulty joints shall be caulked.

All formwork shall be thoroughly cleaned and coated with an approved type of oil before it is fixed in position. Immediately before concreting the formwork shall be watered thoroughly and washed out to remove sawdust, shav or other rubbish. Where the appearance of the concrete face is important, the position and direction of the joints shall be as directed.

Fillet strips shall be fixed in the formwork to form a chamfer 20 mm by 20 mm on all external corners of the concrete.

Openings for inspection of the inside of the formwork for walls, beams and similar work and for the escape of wash water shall be formed in such a way that they can be conveniently closed before starting to place the concrete.

Connections between formwork elements shall be constructed to allow for easy removal of the formwork, and shall be either nailed, screwed, bolted, clamped, braced or otherwise fixed securing a sufficient strength to retain the correct shape and line during compaction of the concrete.

Bracing members placed in the formwork to keep two sides of formwork in exact position shall be approved by the Engineer. Holes in the concrete after bracing arrangement shall be made good by plugging with approved material.

Top Formwork shall be provided to concrete faces where the slope exceeds 1 vertical to 2½ horizontal. Such formwork shall be counterweighed or otherwise anchored against floating.

The formwork shall be so designed that the formwork for soffits of slabs and for sides of beams, columns and walls may be removed first leaving the formwork for the soffits of beams and their supports in position. Wedging or other suitable ways of adjustment shall be provided to allow accurate adjustments of the formwork and to allow a gradual removal of the same without jarring the concrete.

On demand the Contractor shall provide such drawings and calculations as necessary for determination of the structural strength of the formwork. The Engineer's approval of such drawings and calculations will not relieve the Contractor of his responsibilities under the Contract.

Formwork shall be erected true to line and braced and strutted to prevent deformation under the weight and pressure of the wet concrete, soffits shall be erected with an upward camber as shown on the Drawings or as directed by the Engineer or of 2 mm for each 1 m of horizontal sdam.

Re-propping of beams will not be approved except when props are reinstated to relieve the beams of loads in excess of the design load. Vertical props shall be supported on folding wedges on sole-plates, or other measures shall be taken whereby the props can be gently lowered vertically when commencing to remove the formwork.

If, in the opinion of the Engineer, the formwork is faulty, inadequate or does not comply with the specifications, then the Contractor shall at his own cost modify the formwork until it meets the approval of the Engineer.

4.4.13 Mould Oil

All faces of formwork that will come in contact with wet concrete shall be treated with approved mould oil or other coating to prevent adherence to the concrete. Such coatings shall be insoluble in water, non-staining, nor injurious to the concrete, shall not become flaky and shall not be removable by rain or

wash-water. Liquids that retard the setting of cement shall only be applied to the shuttering when applied to the shuttering when approved. Mould oils and similar coatings shall be kept free from contact with the reinforcement.

4.4.14 Holes for Pipes, Cast-in Items etc., General

The Contractor shall be responsible for the co-ordination with the Sub-Contractors for the setting out and fixing of all pipes and holes, pockets and chases for pipes. Sleeves provided by the sub-contractors are to be accurately set out and cast in and cutting away in completed concrete work is to be minimized.

Details of all holes etc. required in a structural work for services must be submitted to the Engineer who will assess the necessity for extra trimming reinforcement.

No openings, holes, chases, etc., are to be formed in the concrete without the approval of the Engineer and details of fixtures or fixings to be cast in must be approved.

4.4.15 Pipes through Water Retaining Walls

Pipes passing through water retaining walls and floors shall, wherever possible, be built into the structure in-situ. Shuttering shall be formed closely to the outside of the pipe, and concrete shall be placed and compacted thoroughly round the pipe.

Pipes, bolts or other steel items cast into the concrete in water retaining structures must not in any way be in contact with the steel reinforcement.

When not possible to build in place, pipes shall pass through preformed holes. Holes shall be formed with formwork which shall be stripped cleanly and without shock to the concrete. As soon as the shuttering is stripped, the hole shall be thoroughly wire brushed to expose the aggregate. The hole shall be as neat as possible to allow the pipe to be passed through the wall, while the corners shall be chamfered or rounded.

The pipe shall be set and the hole filled up as soon as possible. Immediately before filling, the hole shall be continuously soaked so as jto saturate the concrete, and the surface coated with a stiff mix of 1:1 sand grout. Shutters shall be fixed true to the faces of the wall, and a stiff mix of concrete packed in until the hold is completely filled, particular care to be taken to ensure that the spaces beneath the invert of the pipe and beneath the slopping soffit of the hole are completely filled. Shuttering shall be stripped as soon as possible and the filling rubbed smooth. The filling and the surrounding concrete shall be kept wet for 7 days after filling.

4.4.16 Removal of Formwork

Formwork shall be left in position until the concrete has attained sufficient strength to be self-supporting. The Contractor shall be responsible for the safe removal of the formwork without shock or vibration – which would damage the concrete.

Any work showing sign of damage through premature removal of formwork or though premature loading shall be entirely reconstructed at the Contractor's expense. The Engineer may delay the time of removal of formwork if necessary. Subject to the above, the minimum period for removal of formwork shall generally be as follows:

Slabs	Soffits (props left under)	7 days
" "	Props	21 days
Beams	Sides	3 days
" "	Soffits	21 days
Walls and Columns	(unloaded)	2 days

When formwork is removed after 3 days, it will be necessary o ensure that the exposed surfaces of the concrete are kept thoroughly wet for the period of curing.

4.4.17 Reinforcement

All bending, cutting and fixing to comply with BS 8110 and BS 4466. Normally Bending schedules are incorporated into the Contract Drawings, but the Contractor shall satisfy himself about their accuracy and about their complete coverage of the work involved. Any omission, inaccuracy or other errors observed by the Contractor shall be reported to the Engineer before commencement of the work.

In case of errors in Bending Schedules, no extra payment will be approved, provided the reinforcement is shown correctly on the Contract Drawings.

The number, size, shape and position of all the reinforcement shall, unless otherwise directed or permitted by the Engineer, be strictly in accordance with the drawings.

Bars shall be of the shown lengths, and lapping, except where indicated on the Drawings, is not permitted unless approved by the Engineer.

Spacing between bars shall not differ more than 5 mm from the required spacing. Any inaccuracy in the total length of a bar as cut shall be compensated for in the end hooks or other approved parts of the bar.

The internal radius of a bend shall neither be less than allowed by BS 4466 nor less the radius given in the Bending Schedule. The steel reinforcement shall

be assembled and fixed in the form of a rigid case. To prevent displacement before or during concreting the bars shall be secured one to the other with approved binding wire at each intersection. In slabs and walls binding at every second intersection is sufficient.

Concrete cover blocks (mix 1:3) shall unless otherwise directed be used between the reinforcement, the bottoms and sides of the forms to ensure the specified concrete cover to the bars. Variations of cover shall be kept within plus/minus 3 mm from the specified cover.

The minimum clear horizontal distance between adjacent bars shall be of 25 mm or the diameter of the bars whichever is the biggest, and 25 mm vertically. Space bars shall be inserted at such intervals that the bars so not perceptibly sag. Projecting bars shall be adequately protected against displacement both during and after concreting.

At the time of fixing and when concrete is being placed, all reinforcement shall be free from oil, painting, grease, dust and scale or any other coating which would destroy and bond with the concrete. The Contractor must obtain the Engineer's approval of the reinforcement when places, before any concreting is commenced.

5 BUILDERS WORK.

5.1 Concrete Block Walling.

5.1.1 Precast Concrete Blocks.

Concrete block shall comply with BS 6073. The blocks shall be solid or hollow, as specified on drawings, with a minimum compressive strength of 3.5 N/mm^2, tested as described in BS 6073.

All blocks must be left with good sharp edges. The standard face size of blocks for use in the works shall be 440 mm x 190 mm x 190 mm and this size of blocks shall be used wherever practicable.

No work with concrete blocks shall commence prior to a test report being presented to and accepted by the Engineer.

The contractor shall be responsible for making test blocks and experimenting with available materials to ascertain what mix will be necessary to attain the required strengths. If suitable materials are not available locally, the Contractor shall obtain them from other approved sources.

Manufacture shall be carried out under shelter and after casting, the blocks shall be stacked under shelter to protect them from sun and weather, and properly cured by covering with sand or sacks and sprayed daily for not less than 14 days.

5.1.2 Wall Reinforcement.

Reinforcement in walls made of solid blocks shall, where so specified, consist of a 25mm wide strip of "Exmet" or similar brick reinforcement centrally in joints at approximately 450mm centres (vertically) for the full length of the walls, lapped and crimped 300 mm at running joints and full width of walls at angles and intersections.

5.1.3 Cement.

The cement shall be as described in " Concrete Work".

5.1.4 Sand.

The sand for mortars shall be as described in "Concrete work", except that it shall be fine sand.

5.1.5 Mortar.

The cement mortar shall consist of one part of Portland cement to three parts of sand by volume.

The ingredients of mortar shall be measured in proper gauge boxes on a boarded platform, the ingredients being thoroughly mixed dry, and again whilst adding water. In the case of cement/lime mortar the sand and lime shall be mixed first, and then the cement added. All mortar is to be thoroughly mixed to a uniform consistency with only sufficient water to obtain a plastic condition suitable for trowelling. No mortar, that has commenced to seep, is to be used or remixed for use.

5.1.6 Damp-proof course.

All damp-proof courses shall be of bituminous felt to BS 743 weighing not less than 3 Kg per m^2, free from tears and holes, lapped 150mm at running joints and for full width of wall at angles and intersections and bedded on an including a 12mm levelled screed of cement mortar.

5.1.7 Workmanship.

Blocks shall be laid in regular even courses and shall be bedded in cement mortar consisting of one part of cement to three parts of sand. Before being laid all blocks shall be immersed in water for at least 12 hours. All beds and vertical joints shall be filled completely with mortar when the blocks are laid, and no flushing up will be permitted. No vertical joint in any one course shall be within 100mm of a similar joint in adjacent courses. Beds and joints shall be not less than 10 mm or more than 15mm thick. (Blockwork Tanks accepted).

The courses shall be laid parallel and all perpendiculars shall be truly kept. Reveals and internal and external angles shall be perfectly square and true.

All walls throughout the work shall be carried up evenly, no part being carried up more than 1 m higher than any other part.

The Contractor shall provide proper setting out rods and set out on the same all work showing openings, heights, sills and lintels and shall build the various walls and piers to the thicknesses, widths and heights shown upon the drawings.

All exposed faces of walls for plastering are to be left rough and the joints raked out while mortar is green to form adequate key.

All other faces shall be cleaned down on completion with a wire brush or as necessary and mortar droppings, smear marks, etc., removed and rates must include for this.

Where block work faces are to be left exposed blocks shall be chosen for their uniformity unmarked faces and shall be finished with a fair face and pointed with a neat joint recessed from the face of the blocks.

Where shown on the Drawings, walls are to be carried up to the underside of the roof sheets and are to be cut on top edge to suit roof slope and flushed up in cement motar.

All putlog holes shall not less than one course deep and carefully filled with a block cut to fit size of opening with beds and joints filled with mortar well tamped in after scaffolding is removed.

In the case of walls receiving plaster, or other in situ facings, put log holes must be filled before any facing is applied and prices must include for additional cost of free-standing scaffolding.

Tolerances as for concrete works.

5.1.8 Blockwork Tanks.

The concrete blocks shall be solid, type A with a minimum compressive strength of 7 N/mm^2, tested as described in BS 2028.

For circular blockwork tanks the blocks shall be manufactured in the required shape to fit the curvature of the tank, and all blocks shall be immersed in water for 24 hours before being laid.

Care must be taken to ensure that all joints are filled up completely. The horizontal joints to be reinforced as shown on the Drawings, with the reinforcement covered on all sides at least 6 mm of mortar, thus giving a thickness of horizontal joints of approximately 20mm.

No parts of the wall shall be carried up more than one course above any other part of the wall.

Reinforcement and holes for pipes passing through walls and floors shall meet the requirements as specified in Section 4.

Internal plaster shall be of mix 1:2, made water proof by use of approved additive.

5.2 Plasterwork and other Floor, Wall and Ceiling Finishes.

5.2.1 Cement.

The cement shall be as previously described in "Concrete works".

5.2.2 Sand.

The sand shall be as described for fine aggregate, but that for plastering shall be light in colour and well graded to a suitable fineness in accordance with the nature of the work in order to obtain the finish directed.

5.2.3 Lime.

The lime for plastering shall comply with BS 890 Clause "A" for non-hydraulic lime and shall be as rich as obtainable and to approval. It must be freshly burnt and shall be slaked at least one month before being used by drenching with water, well broken up and mixed and the wet mixture shall be passed through a sieve of 3 mm meshes. Lime putty shall consist of freshly slaked lime as described above, saturated with water until semi -fluid and passed through a fine sieve; it shall be allowed to stand until surplus water has evaporated and it has become of the consistency of thick paste, in no case for a shorter period than one month before being used, during which time it must be kept damp and clean and no portion of it allowed to become dry.

Alternatively, hydrated lime with 70% average calcium oxide content may be used and it must be protected from damp until required for use. It shall be soaked to a putty at least 24 hours before use.

5.2.4 Composition of plasters etc.

A mix referred as 1:4 shall mean 1 cubic metre of cement to 4 cubic metres of sand. All other mixes shall be construed in a like manner.

5.2.5 Hacking etc.

The prices for all screed, paving and plastering, etc. shall include for hacking concrete surfaces and for raking out joints of walls 15mm deep and for cross scoring undercoats to form a proper key. Plastering on walls shall be generally being taken to include faces of lintels, beams, etc. in same.

5.2.6 Surfaces.

All surfaces to be paved or plastered must be brushed clean and well wetted before each coat is applied. All cement pavings and plaster shall be kept continuously damp in the interval between application of coats and for seven days after the application of the final coat.

5.2.7 Partially or wholly set materials.

Partially or wholly set material will not be allowed to be used or remixed. The plaster mixes etc. must be used within one hour of being combined with water .

5.2.8 Samples.

The Contractor shall prepare sample areas of the screed, pavings and plastering as directed until the quality, texture and finish required is obtained and approved by the Engineer, after which all work executed shall conform with the respective approved samples.

5.2.9 Finish generally.

All screed and pavings shall be finished smooth, even and truly level unless otherwise specified.

Rendering and plastering shall be finished plumb, square, smooth and even.

All surfaces to be plastered shall be thoroughly wetted before any plastering is commenced.

No plastering will be allowed to take place until all chases for services have been cut, services installed and chased made good.

On no account may finished plaster surface be chased and made good.

All work shall be to the approval of the Engineer and any work not complying with the above shall be hacked away and replaced at the Contractor's expense.

5.2.10 Arises and angles.

All arises and angles shall be clean and sharp or slightly rounded or thumb-coved as directed including neatly forming mitres.

5.2.11 Making good.

All making good shall be cut out to a rectangular shape, the edges undercut to form dovetail key and fished flush with the face of surrounding paving or plaster. All cracks, blisters and other defects shall be cut out and made good and the whole of the works shall be perfect on completion.

5.2.12 Prices to include.

In addition to the fore-going, prices are to include for all labour, angles and arises, all fair edges, for making good up to or stopping to a line and the required level at top of skirtings or angles where directed and for making good up to windows, door frames and similar.

The prices for all linear items unless otherwise measured are to include for all short lengths, lengths, angles and arises, mitres and ends of every description.

5.2.13 Cement pavings, screed etc.

Cement screed shall consist of cement and sand mix 1:2 laid in damels and finished with a steel trowel if not otherwise specified.

Where specified as waterproof "Puddlo" or similar waterproofing compound shall be added to the cement paving or screed strictly in accordance with the Manufacturer's instructions.

Where practicable, screed is to be laid while the concrete is still green. When this is not practicable, the concrete is to be well washed and brushed perfectly clean with a steel wire brush, to remove laitance and to give a roughened face as a key and then kept wet for at least seven days before the screed is laid. On the day of laying the surface is to be only damp with all surplus water removed and has to be painted with cement and sand mix 1:1 grout immediately before commencing laying of the screed. The grout is to be applied continuously in front of the screed, and not in large areas that will dry out before the screed is applied.

Screed shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, rain or water. In exposed positions, the screed shall be covered with a well wetted layer of sawdust, hessian or other approved material, and this layer shall be damp for at least seven days, during which period no traffic is to be allowed over the screed.

5.2.14 Cement rendering.

Cement rendering shall consist of cement and sad mix 1:4 to not less than 15mm finished thickness and be finished to a true and even surface.

5.2.15 Protection.

All work shall be adequately protected against damage, to the satisfaction of the Engineer until the works are handed over to the Engineer.

5.2 Carpentry and Joinery

5.3.1 Timber materials.

All timber shall be in accordance with the latest approved Grading rules issued by the Government of Kenya or other competent authority (Legal Notice No. 358). The quality shall be as First (or Prime) Grade.

All timber work to be carried out in accordance with BS 1186 and CP 112.

Any of the following timber may be used:

Standard Common Name	**Botanical Name**
Podocarpus	Podocarpus Spp
Cedar	Juniperus Procera
African mahogany (Munyama)	Khaya anthotheca
Mininga	Pterocarpus Angloensis
Mvule	Chrophora Excelsa

All timber, as it arrives on the site, shall be inspected by the Engineer, and any timber brought on the site and not complying with the specification or not approved, must be removed forthwith from the site, and only timber as approved shall be used in the works.

The Contractor shall upon signing the Contract, purchase sufficient supplies of specified hardwoods to avoid possible shortages at a later date.

All timber shall be free of live borer beetle or other insect attack when brought upon the Site. The Contractor shall be responsible up to the end of the maintenance period for executing at his own cost all work necessary to eradicate insect attack of timber which becomes evident-including the replacement of timber attacked or suspected of being attacked, notwithstanding that the timber concerned may have already been inspected and passed as fit for use.

All timber shall be seasoned to a moisture content of not more than 15%.

5.3.2 Boards and sheets.

Fibreboard shall be 12mm "Celotex" or other approved fibreboard complying with BS 1142, Part 3.

Plywood shall be laminated board faced on in both sides with 4mm plywood. Exposed edges shall be lipped with 20mm hardwood and rates shall include for leaping.

Plastic Sheeting shall be "Formica" sheeting, 1.5mm thick and securely fixed with approved type waterproof adhesive, and in the colours approved by the Engineer.

Flush doors shall be 445mm thick, and shall be obtained from an approved manufacturer. The doors shall comply with BS 459, Part 2. External doors shall be framed, ledged and braced as shown on the drawings, and they shall comply with BS 459, Part 4.

5.3.3 Workmanship.

All timber shall be as long as possible and practicable to eliminate joints. Where joints are unavoidable, surfaces shall be in contact over the whole area of the joint before fastenings are applied.

No nails, screws or bolts are to be fixed in any split end. If splitting is likely, or is encountered in the course of the work, holes for nails must be bent at right angles to the grain.
Lead holes are to be bored for all screws. When the use of bolts is specified, the holes are to be bored from both sides of the timber. Nuts must be brought up tight, but care is to be taken to avoid crushing of the timber under the washers.

All joiner's work shall be accurately set out on boards to full size for the information and guidance of the artisans before commencing the before commencing the respective works, with all joints, iron work and other works connected therewith fully delineated. Such setting out must be shown to the Engineer and approved before such respective works are commenced.

All joiner's work shall be cut out and framed together as soon after the commencement of the building as is practicable, but not to be wedged up or glued until the building is ready for fixing same. Any portions that wrap, wind or develop shakes or other defects within twelve months after completion of the works shall be removed and new ones fixed in their place together with all other work which may be affected thereby, all at the Contractor's own expense.

All work shall be properly mortised, tenoned, housed, shouldered, dovetailed, notched, pinned, braided, etc., as directed and to the satisfaction of the Engineer and all properly glued up with the best quality glue.

Joints in joinery must be as specified or detailed, and so designed and secured as to resist or compensate for any stresses to which they may be subjected. All nails, springs, etc., are to be punched and puttied. Loose joints are to be made where provision must be made for shrinkage, glued joints where shrinkage need not be considered and where sealed joints are required. Glue for load

bearing joints or where conditions may be damp must be of the resin type. For non-load bearing joints, or where dry conditions may be guaranteed, casein or Organic glues may be used.

All exposed surfaces of joinery work shall be wrought and all arises "eased of" by planning and sand papering to an approved finish suitable to the specified treatment.

Round wood plugs shall not be used. All work described as plugged shall be fixed with screws to plugs formed by drilling concrete, walls, etc., with a proper tool of suitable size and filling the holes completely with "Exdamdet" raw plastic or "Rawplugs" in accordance with the Manufacturer's instructions.

Where intended to be in contact with stone, concrete blocks , cement or plaster, the backs and other faces of all doors, windows and other frames and linings, posts, architectural skirtings, fillets and fascias shall be treated with two coats of wood preservative before fixing.

Bottom edges of doors shall be painted with one coat of approved primer before fixing.

Any fixed joinery which in the opinion of the Engineer is liable to become bruised or damaged in any way shall be completely cased and protected by the Contractor until the completion of the works.

5.3.4 Inspection and Testing.

The Engineer shall be given facilities for inspection of all works in progress whether in workshop or on site. The Contractor is to allow for testing of prototypes of special construction units and the Engineer shall be at liberty to select any samples he may require for the purpose of testing, i.e. for moisture content, identification, species, strength, etc. Such tests will be carried out by the Forestry Department.

5.3.5 Clearing Up.

The Contractor is to clear out and destroy or remove all cut ends, shavings and other wood waste from all parts of the building and the Site as the work progresses and at the conclusion of the work. This is to prevent accidental borer infestation and to discourage termites and decay.

5.3.6 Prices to Include.

Prices of items shall include for the foregoing labours, etc. and in addition the prices for linear items are to include all internal and external angles, either mitres or tongued all fair, fitted, stopped, notched or returned ends, all similar incidental labours and all short lengths.

The Contractors rates must also include for bedding frames, sills, etc., in mortar or dressing surfaces of walls etc.

5.4 Roofing.

The roof covering and fittings shall be as specified in the drawings or in the bill of quantities. The roofing material should be laid and fixed in strict accordance with the manufacturer's instructions.

Fixing to be of approved type and quality.

5.4.1 Protection.

All roof surfaces shall be kept clean and protected and handed over watertight at completion.

5.5 Steelwork.

5.5.1 Materials.

All materials shall be the best of their respective kinds and free from defects. The materials in all stages of transportation handling and stacking shall be kept clean and injury from breaking, bending and distortion prevented.

All steel and steel sections shall comply with BS 4, BS 4360 and BS 4848.

All steel shall be of approved manufacture and the Contractor shall on request deliver to the Engineer a manufacturer's test certificate for all steel used.

All structural steel shall be of grade 43A according to BS 4360.

Steel for handrails, screens etc. can be of a lower grade, but all steel shall be weldable and the grade shall be approved by the Engineer.

Electrodes shall be according to BS 639.

All electrodes shall be of a class appropriate to the steel. Bolts and nuts shall be according to BS 4190.

5.5.2 Workmanship.

Workmanship for all steelwork shall generally follow the requirements in BS 449 and BS 5135.

The contractor shall prepare all the necessary workshop drawings, which shall be approved by the Engineer. The Engineer's approval shall not in any way relieve the Contractor of his responsibility for the workshop drawings in accordance with the contract drawings and specifications

All welding of structural steel shall be carried out in the Contractors workshop and the whole structure or parts thereof shall be test assembled in the workshop before delivery to the site.

Should any doubt arise as to the quality of the steel or the welds, the Engineer may require testing carried out. If the results show insufficient quality of materials or workmanship, the Contractor shall cover all expenses related to the tests and shall replace all materials and welds found unsatisfactory.

5.5.3 Ladders.

All ladders in tanks etc shall be galvanized steel pipes in accordance with BS 1387 "medium class", and shall be made to the dimensions shown on the drawings.

5.6 Ironmongery and other Fittings.

All ironmongery shall be approved by the Engineer. The approved samples shall be regarded as the standard for work.

5.6.1 Locks.

All locks and ironmongery shall be with screws, etc. to match. Before the door etc. is painted, handles shall be removed, carefully stored and refixed after completion of painting. Locks shall be oiled and left in perfect working order.

25 mm diameter rubber door stops shall be provided at all doors and securely plugged and screwed to floors or walls.

All external doors shall be provided with locks of cylinder type. All internal doors to be provided with approved latch locks and handles. All locks shall have two keys with attached labels with door references before being handed over to the Engineer.

5.6.2 Sanitary Fittings.

All sanitary fittings shall be approved manufacture and installed in accordance with the manufacturer's recommendations.

5.7 Glazing.

5.7.1 Glass.

All glass shall comply with BS 952 and be free from flaws, bubbles, specks and other imperfections.

Glass dames shall be cut to sizes to fit the opening with not more than 2 mm play all round and where puttied shall be clipped to the frames.

Clear sheet glass shall be ordinary glazing quality.

5.7.2 Cleaning.

On completion, remove all broken, scratched or cracked dames and replace with new to the satisfaction of the Engineer. Clean inside and out with approved liquid cleaner. On no account shall windows be cleaned by scraping with glass.

5.8 Painting, Decorating and other Surface Treatment.

5.8.1 Approved Specialist.

All work under this trade must be executed by an approved specialist unless the Engineer agrees otherwise. Paint shall be of approved manufacture.

5.8.2 General.

The Contractor shall so arrange his programme of work that all other trades are completed and the workmen are away from the area to be painted, when painting begins. Before painting, the Contractor must remove all concrete and mortar dropping and the like from all work to be decorated and remove all stains as to obtain uniform colour to work to be oiled and polished.

All plaster, metal, wood and other surfaces which are to receive finishes of paint, stain, distemper or paint work of any description are to be carefully inspected by the Contractor before he allows any of his painters to commence work. The Contractor will be held solely responsible for all defective work condemned as a result of his painter's failure to insist on receiving from the other trades surfaces in the proper condition to allow first class finishes of the various kinds specified being applied to them.

5.8.3 Painting generally.

All materials to be applied externally shall be of exterior quality and/or recommended by the manufacturers for external use, all in accordance with BS 4800 or similar.

All materials shall be delivered on site intact in the original sealed drums of tins and shall be mixed and applied strictly in accordance with the manufacturer's instruction and to the approval of the Engineer.

Unless specially instructed or approved by the Engineer, no paints are to be thinned or otherwise adulterated, but are to be used as supplied by the manufacturers and direct from the tins.

The priming, undercoats and finishing coats shall each be of differing tints and the priming and undercoats shall be the correct brands and tints to suit the respective finishing coats in accordance with the manufacturer's instruction. All finishing coats shall be of colours and tints selected by the Engineer. Each coat must be approved by the Engineer before the next coat is applied.

All paints, emulsion paints and distempers shall be applied by means of a brush or spray gun or rollers of an approved type where so agreed by the Engineer.

No painting is to be done in wet weather or on surfaces which are not thoroughly dry.

Each coat shall be properly dry and in the case of oil or enamel paints shall be well rubbed down with fine glass paper before the next coat is applied. The paint work shall be finished smooth and free from brush marks.

The rates for painting shall include for preparation of surfaces, rubbing down between each coat, stopping, knotting, etc. and all other work in connection and as described and as necessary to obtain a first class and proper finish to the Engineer's approval.

5.8.4 Samples.

The Contractor shall furnish at the earliest possible opportunity before work commences and at his own cost, samples of painting for the Engineer's approval and any further samples in the case of rejection.

Such samples when approved, shall be the minimum standard for the work to which they apply. If required by the Engineer, the Contractor is to provide at his own expense samples of paints, etc., with containers and cases to be forwarded carriage paid by the Contractor for analysis at a laboratory.

Colour cards of all paints, etc. shall be submitted to the Engineer.

The Engineer may reject any materials or workmanship not in his opinion up to the approved sample, and these must be removed from the site without delay.

5.8.5 Preparation and Priming of Plaster etc . Surfaces.

Surfaces shall be perfectly smooth, free from defects and ready for decoration. All such surfaces shall be allowed to dry for a minimum period of six weeks, stopped with approved plaster compound stopping and rubbed down flush, as necessary, and then be thoroughly brushed down and left free from all efflorescence, dirt and dust immediately prior to decorating.

Plaster surfaces, which are to be finished with emulsion, oil or enamel paint, shall be primed with an alkali resisting primer complying with the particular paint Manufacturer's specification and applied in accordance with their instructions.

Fibreboard or similar surfaces shall be lightly brushed down to remove all dirt, dust and loose particles and have all nail holes or other defects stopped with an approved plaster compound stopping rubbed down flush and left with a texture to match surrounding material.

5.8.6 Preparation and Priming of Metalwork.

All surfaces shall be thoroughly brushed down with wire brushes and scraped where necessary to remove all scale, rust, etc. immediately prior to decorating. Where severe rust exists and if approved by the Engineer, a proprietary de - rusting solution may be used in accordance with the manufacturer's instructions.

Shop primed and unprimed surfaces shall be given one coat of metal chromate primer or lead oxide primer.

Galvanized surfaces shall be treated before priming with an approved proprietary mordant or de-greasing solution. The surfaces shall be thoroughly washed down with water, allowed to dry and primed as last.

Coated surfaces already treated with bituminous solution, shall be scraped to remove soft parts and then receive two isolating coats of aluminium primer or other approved anti-tar primer.

5.8.7 Preparation and Priming Woodwork.

All woodwork shall be rubbed down, all knots, covered with a thick coat of good shellac or aluminium knotting; primed with one coat of approved ready-mixed proprietary wood primer and all cracks, nail holes, defects and uneven surfaces, etc., stopped and faced up with hard stopping rubbed down flush.

5.8.8 Wood preservative.

All woodwork in contact with walling or plaster shall be treated after cutting and preparation but before assembly or fixing with one coat of approved wood preservative. The solution is to be brushed on all faces of all timbers, unless exposed to view and painted.

5.8.9 Cement Paint.

Shall be super snowcem or equal and approved. Two coats shall be applied after preparation as specified above.

5.8.10 Emulsion Paint.

After preparation as specified above a minimum of three coats shall be applied using a thinning medium or water only as recommended by the Manufacturer.

An approved plaster primer tinted to match may be substituted for the first coat.

5.8.11 Enamel Paint.

Apply two undercoats and one finishing coat, after preparation and priming as specified above.

5.8.12 Ironmongery.

Where instructed, all ironmongery shall be removed from joinery, steel windows and louvres before damting is commenced, and shall be cleaned and renovated if necessary and refixed after completion of painting.

5.8.13 Painting Items.

As billed here- after shall include for preparing and priming surfaces as above described.

5.8.14 Lining of Chemical Tanks.

The lining of chemical tanks with "EPOBOND" and "EPOFLOOR" shall be carried out by specialists approved for such work by the manufacturer or his agent.

The preparation of the surface to receive the above products must either be carried out by specialist or by the Contractor in which case the manufacturers or his agents written approval of the preparation of the surface shall be obtained prior to the application of the product.

5.8.14 Cover Up.

Cover all floors, fittings, etc. with dust sheets when executing all painting and decorating work.

5.8.15 Clean and Touch Up.

Paint splashes. Spots and stains shall be removed from, floors. Wood-work, etc., any damaged surfaces touched up and the whole of the work left clean and perfect upon completion and during the maintenance period.

6 PIPEWORK

General

All pipes, couplings gaskets lubricants seals, coupling machinery etc; necessary for the proper construction of the pipe work as detailed in the Bill of Quantities and drawings shall be supplied by the contractor.

The contractor shall be responsible for ensuring that the pipes, couplings and other fittings laid or installed on each section of the work are of the standard

and pressure classifications specified as appropriate to the circumstances, and are manufactured of the specified materials.

The Engineer reserves his right to refuse any materials that in his opinion is inferior.

The Engineer has the right to test any material upon delivery and materials found defective shall be replaced forthwith by the contractor.

If the contractor procures materials of different specifications in respect of flanges and threads etc, he shall at his own cost provide all adaptors and other fittings necessary to make connections to the satisfaction of the Engineer.

All materials shall be marked as specified in the relevant current British or ISO standards for easy identification.

6.1 Handling and Storing of Pipes and Fittings

The method of transportation, handling and storing of pipes and fittings shall be in accordance with the manufacturer's recommendations.

Pipes valves and other fittings shall be handled, moved, lifted or lowered with the least possible impact. Handling equipment shall be of approved type. In slinging pipes, only flat slings shall be used and the use of chain slings hooks or other devices working on scissors or grab principles shall not be permitted. Pipes shall be slung from two or more points as the Engineer may direct and the slinging, lifting and lowering shall be in the hands of a competent and experienced man.

Pipes storage shall be supported clear of the ground on approved supports adequately braced to prevent rolling. They shall not be stacked more than four tiers high without the approval of the Engineer. Materials of different classification shall be stored separately. All pipes and associated materials shall at all times be protected from sun and dirt to the satisfaction of the Engineer.

No valves shall be lifted by the spindle. Valves and other fittings shall not be stacked more than one tier high without the permission of the Engineer and they shall not be stored in a dirty place or condition.

Shortly before laying or fixing any valve, pipes or fitting the contractor shall in the presence of the Engineer or his representative carefully examine each valve, pipe and fitting to ascertain damage or defect occasioned to the valves, pipes and fittings during loading, unloading, handling, storage and transportation. All damage and all defects revealed by this examination shall be repaired and remedied by the contractor.

6.2 Laying and Jointing of Pipes

All laying and jointing of pipes except jointing of PVC and polythene pipes shall be in conformity with BS 6700 and BS 8010.

The bottom of the trench or surface of the bed shall be finished to a smooth even surface at the correct level to permit the barrel of the pipe to rest on the surface throughout its whole length between joint and sling holes. If considered necessary by the Engineer, fine-screened material shall be placed and consolidated in the trench bottom to provide such a bed. In general the preparation of the trench bottom and bed shall be completed for a length of one pipe in advance of the pipe-laying.

The bottom of the trench and pipe bed shall be inspected by the Engineer, and only when passed as satisfactory shall pipe-laying commence.

Each pipe shall be laid accurately to line, level and gradient so that, except where otherwise directed, the finished pipeline shall be in a straight line both in horizontal and vertical plans. The levels and gradients shown on the drawings shall be rigidly adhered to unless otherwise ordered by the Engineer.

Notwithstanding any flexibility provided in pipe joints, pipes must be securely positioned to prevent movement during and after the making of a joint. On screw and socket joints, threads shall be coated with an approved tape to ensure water tightness. The contractor shall take care that all pipes and couplings are clean and free of foreign matter before subsequent sections are jointed.

The contractor shall obtain from the manufacturer or other approved supplier the necessary tackle required for the proper jointing of the pipes. The contractor shall make himself and his employers acquainted with and comply with instructions issued by the manufacturers of the various types of proprietary joints and couplings for incorporation on the works. The contractor shall be responsible for obtaining copies of such instructions.

No person shall be employed on the jointing of pipes that is not thoroughly experienced and skilled in the particular work in hand.

Pipes shall not be cut without the permission of the Engineer. The cut shall be made with an approved mechanical pipe cutter and the edges of the cut shall be clean, true and square. Threading of steel pipes shall be done with an approved device.

Subject to the permission of the Engineer, pipes shall be covered over with approved fill material upon successful completion of laying and jointing. Joints shall be left exposed until completion of the test. The fill for surrounding and cushioning shall consist of uniformly readily compatible material free from tree roots, vegetable matter, building rubbish and excluding clay lumps retained on 75 mm sieve and stone retained on a 25 mm sieve.

The materials for bedding shall, where ordered, consist of suitable selected materials obtained from the excavations or from approved borrow pits and transported to the location where they are required. Upon successful completion of the pressure test the pipeline shall be back-filled as specified.

The contractor shall provide concrete indicator posts at every place where the change in class of pipe occurs with engraved marking on the post indicating class of pipe and direction.

The rate for pipework shall include for supplying, storing, handling, laying and jointing of pipes and is measured in linear metres. The rates shall also include for leveling of the trench bottom, compacting the foundation, and embedding the pipe together with the materials used for bedding all to the satisfaction of the Engineer.

6.3 Valves and Fittings

Unless otherwise directed all valves and other fittings and specials shall be individually supported and their weight shall not be borne by the pipeline joints or couplings etc. All supports for valves and fittings shall be of concrete grade 20.

Air valves shall be installed at high points in the pipeline as shown on the drawings. Before the valves are installed all the air nozzles shall be probed to see that they are clear. No air valves shall be stored before erection in the open in sunlight, or upside down to expose the balls and air cavities.

Scour valves shall be installed at low points in the pipelines as shown on the drawings. The contractor shall be in agreement with the Engineer on the exact position of scour valves in particular situations. Scour valves shall, where possible, discharge in the direction of natural drainage and at such a distance from the works as to preclude erosional effects.

Unless otherwise directed the controlling valve for a scour shall be installed not more than 1.5m from the main pipeline.

Ends of all scours shall be protected from intrusion of animals and other foreign matter by suitable screening securely fixed to the pipe end.

Valve penstocks and other fittings shall be securely fixed and where required extension spindles and headstocks shall be properly aligned and fixed in a vertical position unless otherwise directed.

Before each valve is put into service all gears bearings and spindles shall be oiled with approved oil as recommended by the valve manufacturers. All valves, fittings specials shall be fixed with proper sealing tape, gaskets, washers etc as necessary to the satisfaction of the Engineer. The valves shall be with non-rising spindle and shall if not otherwise stated be supplied with handwheels.

The rates in the Bill of Quantities shall cover for the supply, storing, handling, installation and jointing, together with all bolts, washers, gaskets and lubricants, painting of all fittings with 2 coats of approved oil paints etc.

6.4 Flanges

Where flanged joints are used flanges shall be in accordance with the requirements of BS 4504: Part 1 or BS 4772. Where crewed joints are used, thread shall comply with BS 21.

The minimum pressure rating shall be for a working pressure of 1.0 N/mm^2 (approximately 100 metres head) corresponding to NP 10 flanges. The hydraulic test pressure shall not exceed 1.6 N/mm^2.

Flanges in pipelines with higher-pressure rating shall be for the ratings specified in the Bill of Quantities.

Bolts nuts and washers shall comply with the requirements of BS 4190 and BS 4320. Gaskets shall fulfill the requirements of BS 2494 and shall have a minimum thickness of 2mm. The names of manufacturers and specifications of the products offered shall be provided at the time of tender.

6.5 Ductile Iron

Ductile iron pipes and fittings shall comply with BS 4772 or ISO 2531. The pressure rating of the pipes shall be for a minimum working pressure of 2.5 N/mm^2. Care should be taken when testing, not to exceed the permissible test pressure for the fittings installed.

Joints shall be either “Viking Johnson” or flanged joints as specified in the drawings and the bill of quantities.

Before any other joint is used written approval of the Engineer must be obtained. Pipes and fittings shall be coated inside and outside with a hot material complying with the requirements of BS 4164 or with cold applied material complying with BS 3416 type II material.

A. 6.6 Grey Iron or Cast-Iron

Grey iron or cast iron pipes and fittings shall comply with BS 4622 or ISO/R13. The pressure rating of the pipes shall be for a minimum working pressure of 1.0 N/mm^2 (approximately 100 metres head) and a hydraulic test pressure of 1.6N/mm^2.

Joints, internal and external coatings to be as specified in clause 505, Ductile Iron.

6.7 Steel

Steel pipes and fittings shall comply with BS 534, BS 1387 or BS 3601.Pipes complying with BS 1387 shall be of "Medium" or "Heavy" classes as specified in the Bills of Quantities and Drawings.

6.8 Unplasticised Polyvinyl Chloride Pipes

All uPVC pipes and fittings shall comply with KS ISO 1452-2:2009,

Pipes indicated with a pressure class shall conform to the following minimum working pressures:

PN 6 – 0.6 N/mm^2

PN 8 – 0.8 N/mm^2

PN 10 – 1.0 N/mm^2

PN 16 – 1.6 N/mm^2

All fittings shall be of pressure class “PN 16” and be manufactured of cast iron, PVC or steel. Joints to be plain sockets for gluing with solvent cement for nominal sizes equal to or smaller than – 50mm and mechanical joints (Rubber ring) for nominal sizes equal to or bigger than – 90 mm.

For both types of joints the manufacturer’s jointing instructions must be strictly adhered to. PVC pipes and fittings shall be stored under cover, which fully protects the material from sunlight.

6.9 Precast Concrete

Precast concrete pipes and fittings shall comply with BS 556: Part 2.

Minimum crushing test loads shall be as specified in Table 2, standard pipes. The laying and jointing of the pipes shall comply with BS 8301.

The contractor shall adopt such measure as may be approved by the Engineer to ensure that every newly laid pipe is concentric with previously laid pipes with which it joins.

Unless otherwise approved by the Engineer pipes shall be laid in an upstream direction and the socket ends shall point upstream.

6.10 Protection of Pipes

The concrete used for bedding, haunching and surrounding the pipes shall be concrete “Grade 10” unless otherwise ordered by the engineer. The concrete protection shall have total dimensions not less than given below:

(i) Bedding concrete shall have a width of at least 300mm bigger than the external diameter of the pipe and shall support at least the bottom quarter of the pipe circumference. It shall have a minimum depth of 150 mm measured under the pipe throughout.

(ii) Bedding and hunching shall comprise a concrete bed with a minimum width of 300 mm more than the external diameter of the pipe and a minimum thickness of 150 mm below the pipe, and haunching with a minimum thickness of 150 mm on both sides of the pipe. The top of the hunching to be flush with the top of the pipe.

(iii) Surrounding concrete shall comprise a concrete be as described above together with 150 mm concrete on both sides and on top of the pipe, giving a pipe protection of at least 150 mm concrete everywhere around the pipe.

Concreting of bedding, haunching or surround shall not be done until the pipes have been jointed, inspected and tested.

PVC pipes shall be protected with polythene or roofing felt wrapping before concreting.

6.11 Testing of Pressure Mains

Pressure pipelines (together with all fittings and valves incorporated in the mains) shall, before being covered, be tested with water as specified in BS 6700.

At least two days notice must be given in writing to the Engineer before pressure testing is commenced.

6.12 Water Pressure Test

The water test pressure to be applied will be 1.5 times the nominal working pressure for the class of pipe being tested. The Engineer, however, reserves the right to alter this figure.

Mainwork shall be filled and tested in sections of convenient length which must not exceed 500 metres where pipes are laid with steep gradients the length of pipes tested at any time shall be as directed by the Engineer.

The ends of pipes under test shall be closed by means of caps or blank flanges provided by the contractor. Gate valves must not be used for this purpose. All scour valves and airvalves shall be replaced by blank flanges before commencement of the test.

After laying, jointing and anchoring, the main should be slowly and carefully charged with water so that all air is expelled, allowed to stand full for several days and then tested under pressure. The test pressure shall be applied by means of a manually-operated test pump connected to the main and to two

parallel installed pressure gauges calibrated at an approved testing laboratory. The test pressure shall be maintained for 24 hours, and if there is any leakage or any other defects, the contractor should rectify as directed by the Engineer at his own cost. Water drained from the pipes shall be discharged in a way that does not affect the stability of the works or adjacent structures. The contractor shall provide all necessary equipment, water and labour to test the pipes to the approval of the Engineer.

The contractor shall allow for all expenses in connection with testing in the Bill of Quantities for the appropriate item.

6.13 Cleaning and Sterilisation of Water Supply Pipes

The contractor shall before handing over and during the maintenance period clean pipeline, chambers and manholes for all dirt and rubbish.

All pipes shall be thoroughly cleaned and washed out to remove all contamination, and all water from these operations shall be removed and drained away.
Sterilization should be carried out in accordance with BS 6700.

Following the satisfactory cleaning the contractor shall with the use of a portable dosage system or by some other approved method introduce a solution of a sterilizing chemical containing chlorine into the pipeline. The solution shall be introduced at a very slow rate and shall be of such strength as to give a chlorine concentration of not less than 50 parts per million throughout the length of the pipelines. The whole system shall then remain charged for 24 hours, after which a test shall be made for residual chlorine. If no residual chlorine is found, the sterilization process will have to be carried out again, until a satisfactory result is obtained.

Finally, the pipes shall be thoroughly flushed out and recharged with supply water. On completion of the sterilization process the pipes shall be left full of water.

The contractor shall in his rates for pipeline sterilization include for all costs of labour, transport, materials, equipment, chemicals and water necessary for the satisfactory completion of the cleansing and sterilization operations.

6.14 Auxilliary Works

(a) Valve Chamber

Unless otherwise directed or detailed all valves, meters and other mechanical fittings shall be housed in chambers with lockable covers. Valve work shall be so placed in chambers as to facilitate operation, meter reading etc. through the cover opening. Chambers are measured in numbers and shall be priced as lump sum items covering all composite work to completion as specified on the drawings or as instructed by the Engineer inclusive of excavations in excess of trench

excavation, concrete supports for valves and backfilling around the chambers.

(b) Thrust Blocks and Anchors

The contractor shall provide thrust blocks at all bends, tees and whenever else instructed by the Engineer or indicated in the drawing.

Enlargements shall be excavated in sides and bottom of the trench to accommodate anchorages and thrust blocks.

Concrete thrust and anchor blocks shall be formed in accordance with the typical sections shown on the drawings or as directed by the Engineer. Additional excavation shall be made after the bends etc. Have been jointed and the concrete shall be placed immediately after the completion of the excavation.

The concrete used for thrust and anchor blocks shall be grade 15 and shall after placing be kept in view for not less than six hours. No pressure shall be applied in any section of mains until the concrete has cured at least three days.

All PVC material shall be wrapped with two layers of bituminous felt for the entire length in contact with concrete. Thrust blocks are measured in numbers and shall be priced as lump sum items covering all necessary works and materials together with excavation, backfiling and formwork.

(c) Road Crossings

When the contractor encounters a road where a "Road Crossing" is indicated on the drawings or where to his opinion, such a crossing is required, he shall immediately inform the Engineer. On the receipt of the above information, the Engineer will issue appropriate instructions. The contractor shall include in his rates any royalty/fees to be paid to the Ministry of Transport and Communication or Local authorities.

(d) Painting

Painting and other protection of the external and internal pipe surfaces shall be in accordance with manufacturer's recommendations.
Painting on all other works especially in buildings will be as specified in the Bill of Quantities or as directed by the Engineer.

(e) Indicator Posts

Indicator posts should be erected on the pipeline as per the Engineer's instructions.

All indicator posts for sluice valves, air valves, change in directions for pipeline, change in class of pipes, washouts etc should be painted with blue gloss paint (2 coats). The engraved letters to be painted with white gloss paint.

7 ELECTRICAL-MECHANICAL

WORKS B. 7.1 Motors

All motors shall unless otherwise stated be suitable for a 415/240 volt, 3

phase, 50 cycles, wire power supply, and shall be operated through star delta start control system.

The motors shall be constructed in accordance with CP 1015, and shall be protected as per the Government Electrical Specifications.

The motor speed shall be 1450 or 2900 RPM as specified. The motor shall be foot mounted squirrel cage, drip-proof, or totally enclosed suitable for an ambient temperature of 30 ^{o}C. The motor shall be designed for continuous running. Each motor shall be capable of an overlaid of 10% above its rated output at the rated voltage for a period of one hour without sustaining damage.

The rate output of the motor shall be the maximum house power absorbed by the pump under the described condition of head and discharge, plus an allowance for loss of power in couplings etc.

Electrically drives pumps, shall, if not otherwise stated be directly coupled via flexible couplings to the motors. Motors and pumps shall be fitted to common rigid steel frames bolted to concrete plinths.

Proper alignment of motor and pump must be guaranteed.

C. 7.2 Pumps

The pumps shall be of the centrifugal type with cast iron casings. The shaft shall be prepared for direct connection via flexible couplings to the electrical motors.

Pump casing shall have interchangeable bronze wear rings. The impellers shall be of bronze or high-grade cast iron dynamically balanced to ensure smooth running. The impeller shaft shall be of steel and fitted with renewable bronze protecting sleeves wherever it is in contact with the pumped water. Mechanical seals shall be provided unless approved otherwise. It shall be stated in the tender documents if other materials are offered.

For horizontal type pumps, the impeller shaft shall be carried by oil or grease lubricated ball roller bearings of heavy-duty type.

The pump casings, bearings, shaft, impellers and gaskets must be executed of materials suitable for many years continuous operation in a water system.

If materials other than cast iron, bronze or stainless steel are included in the pump, it cannot be approved unless a written guarantee for 10 years performance is produced, giving free replacement including labour in case of fault.

All pipe connections shall be flanged, and prices shall include for the necessary tapers, gaskets, bolts etc. for connecting up to the pipe diameters and to the extent shown on the drawings or instructed by the Engineer.

The pump type and size shall be chosen so as to ensure that the pump is working with an efficiency of not less than 90% of the peak efficiency. Performance curves, efficiency curves and power demand curves shall accompany the Tender, with clear indication of the capacity and efficiency for the pump with the specified head.

The high lift pumps shall be horizontal multi-stage centrifugal pumps of approved manufacture. The capacity for each pump shall be approximately $101m^3$/hr at a total head of 30m and one pump standby in parallel at the same head.

Two pressure gauges in metric units are to be provided at each pump. The pressure gauges are to be connected to the delivery and suction sides of the pump by use of approved copper pipes fitted with an isolating cock.