COOPI-COOPERAZIONALE INTERNAZIONALE

CDEL PROJECT

AGRO PROCESSING HUB

Technical Specifications

Construction of Agro processing Hub in Katsina and Kaduna state.

Through

International Competitive Bidding (ICB)

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SECTION I: SPECIFICATIONS

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1 GENERAL

1.1 General Description of the Works

The works comprise for the **Construction of an Agro processing Hub at Shinkafi, Katsina State.**

(a) Key point identified.

The Contractor shall fulfil all the requirements and obligations of the Clauses in the Specification applicable to the construction works involved in the Contract. Neither the following Clauses of these specifications nor the detailed description therein nor the Bill of Quantities (BOQ) shall limit the obligations of the Contractor under the accompanying Conditions of Contract. Where items are not provided in the Bill of Quantities (BOQ) for any such requirements or obligations shall be deemed to be included in the Tender rate and prices and shall not be paid separately unless otherwise stated.

Shinkafi was studied and the agro hub was designed and detailed based on the project requirements, findings and existing conditions. The net area to be developed is 2500m^2, however this only serves as a basis. A rescoping can be considered following appropriate measures and conditions under the Infrastructure Engineer's approval.

At present, some part of TKIS irrigation area is under farming, this part of the "Tunga Kawo irrigation scheme" shall be taken care and scheduled properly not to interrupt the farmers' activities.

b) Purpose of the Works

The purpose of the works is to construct a fully functional 12mx24m agro processing hub with about 300m^2
Are alongside wash, security post and water supply system to enhance agricultural practices.

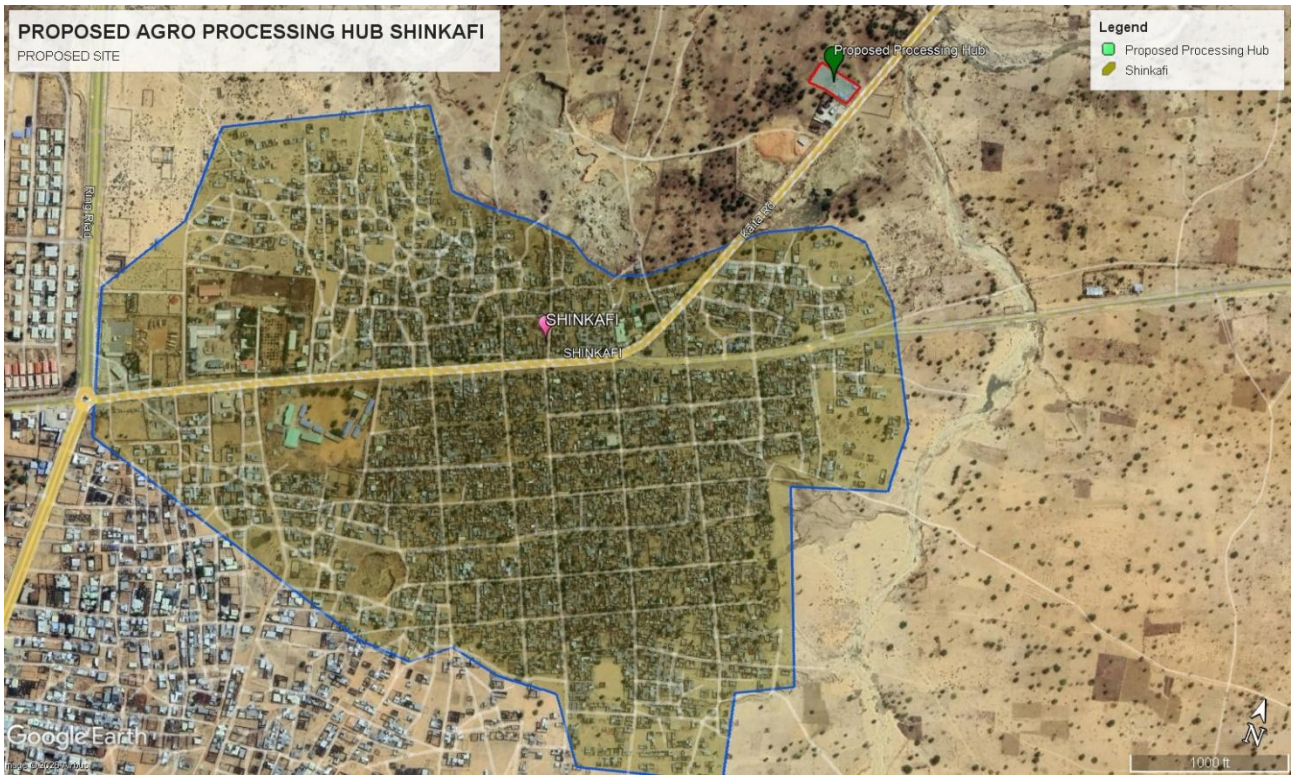
c) Brief Description of the Contract Work

The major components of the works included in the Construction of the agro processing hub Project are as follows:

- Construction new structure
- Construction and rehabilitation of perimeter fence
- Supply and fixing of plumbing systems
- Provision of water borehole and construction of stanchion support
- Construction of perimeter fence
- Construction of apron

The Contractor should note that the quantities stated in the Bill of Quantities are estimates only and the Infrastructure Development Engineer may alter the quantities and/or design as the work progresses.

General Layout of shinkafi Site



1.2 Location of the Works

The project is located at shinkafi A of katsina Local Government Area of Katsina State.

1.3 Drawings and Documents

The drawings in the Tender Documents and any other modifications to those drawings and any other drawings that may be prepared by the Contractor and approved by the Project Manager/Engineer/ shall subsequently become the Contract Drawings.

For the purpose of carrying out the Contract, the Contractor will be provided with 1 set of the Contract Document and full size (A3) Contract Drawings for each of the scheme.

1.4 Standard Specifications

In referring to Standard Specifications, the following abbreviations are used:

BS	British Standard
ISO	International Organisation for Standardisation
AASHTO	American Association of State Highways and Transportation Officials
ASTM	American Society for Testing and Materials
ASA	American Standards Association

If the Contractor proposes to use a Standard Specification other than that specified, three copies

of the proposed Standard Specification, in the English Language, shall be submitted to the Project Manager/Engineer not less than 28 days before approval of the Standard Specification is required.

1.5 Drawings Designed by the Contractor

All drawings, calculations, plans, reports, instruction manuals, pamphlets, data and all other documents required to be submitted by the Contractor under the Contract shall be clear and readable. The Contractor shall submit this drawings and documents in a logical order to the Project Manager for review or approval prior to execution of the Works.

All shop drawings, including field erection, layout and construction details shall be furnished by the Contractor for the approval of the Project Manager/Engineer.

All the drawings and calculation to substantiate the design shall be checked, signed and approved by the Contractor prior to submission. The drawings shall also be signed by a qualified engineer responsible for the design.

Approval of the drawings by the Project Manager shall not be construed as a complete check but will indicate only that the general method and detailing is satisfactory. The approval by the Project Manager shall not relieve the Contractor of the requirement of the Contract or responsibility for correct installation and assembly of parts in final position or responsibility for the adequacy of method of construction.

All the cost thereof will be deemed to be included in the Contractor's unit rates and Contract Sum.

1.6 As Built Drawings

Within 10 (10) days after the receipt of the Completion Certificate, the Contractor shall submit to the Project Manager all the approved drawings and documents (including operation and maintenance manuals), clearly revised and brought up to date by the Contractor to show the permanent construction actually made. The submission shall be made in the following manner and quantity:

(a) One (1) set of the A3 size reproducible drawings on high-quality polyester transparent film or similar material,
(b) One (1) set of the A3 size blue print.

The submission shall contain the drawing index.

No separate payments will be made for the provision of the drawings as the cost thereof shall be deemed to be included in the unit rates and the Contract Sum.

1.7 Site Meetings

The Contractor shall be obliged to attend all meetings at the appointed time. The discussions of such meetings shall include but not be limited to the progress of work and problems having direct bearing on the immediate and long-term activities (construction, procurement, transport, labour etc.).

Site meetings shall be hosted by the contractor on Site.

The Project Manager/Engineer shall invite the Employer for such meetings.

1.8 Progress Photographs

The Contractor shall furnish the Project Manager/Engineer with coloured photographs (not less 8 cm x 120 cm size) of the work in progress throughout the Contract period. The photographs shall be taken at the start, during and at the completion of each major task of the work as directed by the Project Manager. A brief description and date of each photograph shall be included.

All digital negatives shall be numbered, retained on the site and on completion of the Works the digital negatives shall become the property of the Employer.

1.9 Level Datum

The bench marks shown on the drawings shall be handed over to the Contractor as basis for surveying and setting out of Works and if such benchmarks are unavailable, the contractor shall establish them under the approval and supervision of the Infrastructure Engineer/Project manager. The Contractor shall be responsible for carrying out the field surveys for the performance of the Works.

Before using the bench marks for setting out of the Works, the Contractor shall carry out a check survey thereon and satisfy himself as to their accuracy, and if, there are no Benchmarks fixed new Benches shall be networked together with the Engineer prior to the commencement of the works under caption. The Employer shall bear no responsibility for the accuracy of any bench mark.

The Contractor may establish additional temporary bench marks for his own convenience but each temporary bench mark shall be of a design and in a location approved by the Project Manager/Engineer and shall be accurate in relation to the bench marks established by the Project Manager/Engineer or established together with the Contractor in the absence of pre-established Benchmarks/Beacons.

The Contractor shall protect the reference points and level bench marks and in the event of any damage he shall re-survey and re-establish the points and bench marks.

1.10 Setting Out

The Contractor shall appoint and employ the necessary qualified and experienced staff to set out the Works accurately. The Contractor shall establish and locate all lines and levels and be responsible for the correct location of all Works.

Where directed by the Engineer/Project Manager, the Contractor shall take such levels and dimensions as may be required for the purposes of measurements prior to disturbance of the ground. These shall be agreed between the Contractor and the Project Manager in writing before any of the surface is disturbed or covered up.

1.11 Construction and Checking of Work

No operatives shall be allowed to execute any type of work, which is normally carried out by a skilled tradesman, unless the operative is thoroughly experienced and proficient in the trade

concerned. Supervisors and operatives may be required to demonstrate their proficiency or produce certificate of competence to the satisfaction of the Project Manager.

As each part of the work is carried out it shall be subject to the approval by the Project Manager.

1.12 Supervision and Labour

The Contractor will be required to maintain a competent supervising Site Agent and staff on site throughout the construction period until completion of the Works, and thereafter as may be required during the period of maintenance. The Project Manager/Engineer shall give prior approval to the appointment of this supervising Site Agent and the key staff and shall have authority to withdraw the approval at any time in accordance with the Conditions of Contract.

All staff and labour employed on the Works shall be employed in accordance with the local labour and employment laws and regulations.

1.13 Works Executed by the Employer or by other Contractors

The Employer reserves the right to execute, on the site, works not included under this Contract and to employ for this purpose either his own employees or other contractors whose contracts may be either a sub-contract under this Contract, or an entirely separate contract. The Contractor shall ensure that neither his own operations nor trespass by his employees shall interfere with the operations of the Employer, or his contractors employed on such works and the same obligations shall be imposed on the Employer or other contractors in respect of work being executed under this Contract.

1.14 Contractor's Site Offices, Workshops, Storage and Working Areas

The Employer shall provide, free of charge, areas of land where the Contractor shall establish the office, housing, workshop, stores, accommodation and camp for himself and his employees, if indicated in the BoQ of general items. The Contractor shall provide, erect, service and maintain all necessary buildings as offices, housing or workshop/stores for himself, his staff and his employees. These buildings shall from the time of their erection until the completion of the Contract, be the property of the Employer and the Contractor shall not demolish or remove any buildings or part of any buildings without the written permission of the Project Manager/Engineer.

All huts, buildings, fixtures and fittings provided by the Contractor shall be removed and the site reinstated at the end of the Contract.

The Employer reserves the right to allocate areas of land less than the Contractor may require. In such case, the Contractor shall make his own arrangement for obtaining the additional areas that he requires.

The location of all the offices, stores and the like, shall be to the approval of the Project Manager/Engineer.

1.15 Definition and Use of the Site

1.15.1 Definition of the Site

The Site shall include all those areas of land which, being public or private:

(a) Are being provided by the Employer for the purpose of constructing the permanent works.

(b) Are being provided by the Employer for Temporary Works, including camps, offices and stores.

(c) Are acquired, leased, or operated by the Contractor as borrow pits or spoil tips for the Permanent Works, including all access roads.

1.15.2 Use of the Site

The lands and other places outside the Site which are the property of or under the control of the Employer shall not be used except with the approval of the Project Manager/Engineer.

The Contractor shall at any time remove any vehicle or vessel or any other obstruction under his control that may be required to be removed by the Project Manager for any purpose. The Contractor shall move such obstruction promptly on instruction being given.

The Contractor shall maintain access for the inspection, operation and maintenance of any of the Employer's plant or works which lies within the Site or elsewhere.

The Contractor shall not use any portion of the Site for any purpose not connected with the Works unless the written permission of the Project Manager/Engineer has been obtained.

Except with the written permission of the Employer, to be given when necessary for the execution of the Works, the Contractor's employees will not be permitted to enter any of the Employer's buildings or lands or sites under the control of other contractors or the Project Manager/Engineer. The Contractor shall warn his employees that any person found within such buildings or sites without authority is labile to be removed from the Works in accordance with the Conditions of Contract.

1.16 Possession of the Site

The Contractor shall restrict his activities to those areas of the Site adjacent to the works being executed and shall avoid any encroachment upon lands outside the areas for which possession has been given. Any trespass or damage or any claim arising from such encroachment shall be the Contractor's sole responsibility and he shall hold the Employer indemnified against all claims arising from such trespass or damage.

1.17 Interference with the Works

The Contractor shall not interfere in any way with any existing works, whether the property of the Employer or of a third party, whether or not the position of such works is indicated to the Contractor by the Project Manager, except where such interference is specifically described as part of the Works, either in the Contract or in an instruction from the Project Manager/Engineer.

1.18 Material for the Works

All materials shall comply with the appropriate Standard Specifications unless otherwise required hereinafter.

The Contractor shall, before placing any order of materials, manufactured articles or machinery for incorporation in the Works, submit for the approval of the Project Manager /Engineer the names of the suppliers from whom he proposes to obtain such materials, manufactured articles or machinery, together with a list of the same, giving the origin, quality, weight, strength, description and other relevant details. No materials, manufactured articles or machinery shall be ordered or obtained from any suppliers which the Project Manager /Engineer has not approved in writing.

All materials shall be delivered to the Site a sufficient period of time before they are required for use in the Works, to enable the Project Manager/Engineer to take such samples as he may wish for testing and approval.

Notwithstanding the fact that approval has been given to the source of supply, the Project Manager may forbid the use of any materials if, upon delivery, they are found to be defective, or he considers them unsuitable for incorporation in the Works. Such rejected materials shall be removed from the site forthwith.

The Contractor may propose alternative materials of equivalent quality to those specified, and subject to the approval, such materials may be used in the Works.

The Contractor shall have no claim against the Employer in respect of any financial loss which he may suffer as a result of the rejection of any such materials, and he shall also bear the cost of removing them from the Site.

The Project Manager/Engineer shall have the right to inspect materials and plant for the permanent works during the course of manufacture. The Contractor shall arrange for the right of access to manufacturing premises for the Project Manager and his staff during normal working hours. The Project Manager shall be given sufficient notice by the Contractor to allow him to observe the testing of any materials for the works at the place of manufacture. The Project Manager shall also be given the opportunity to inspect any material or plant in their completed state prior to packing for transport to the site.

If requested by the Project Manager/Engineer, the Contractor shall provide to the Project Manager/Engineer copies of orders for the supply of goods or materials required in connection with the works.

1.19 Rejected Materials and Defective Work

Materials or work which, in the opinion of the Project Manager/Engineer, do not comply with the Specification, shall be classified as rejected materials or defective work, and shall be cut out and removed from the Works and replaced as directed by the Project Manager/Engineer.

1.20 Existing Works and Services

The Contractor shall acquaint himself with the positions of all existing works and services including water mains, stormwater drains, cables, and service poles before any excavation is commenced.

The Contractor will be held responsible for any damage, however caused, in the course of the execution of the Works, to such existing works and services.

Such existing works and services, where exposed by the execution of the works, shall be properly shored, hung-up and supported to the satisfaction of the Project Manager/Engineer and of the authority concerned.

Poles supporting cables and the like adjacent to the Works shall be kept securely in place until the Works are completed and shall then be made as safe and permanent as before.

Notwithstanding the foregoing requirements and without lessening the Contractor's responsibility, the Contractor shall inform the Project Manager/Engineer immediately any existing works have been exposed and shall comply with any requirements of the authority concerned.

Only when and as directed by the Project Manager/Engineer shall the position of existing works or services be changed by the Contractor to meet the requirements of the proposed work.

The Contractor shall make adequate provision so that when carrying out his work, no interference, damage or pollution is caused to roads and footpaths, or to any mains, drains, and the like or other parts of the Works. Wherever loads have to be carried over ground in which pipes, valves, culverts, and the like are buried, the Contractor shall take all precautions including where necessary, the provision and use of sleepered roads, light gauge railways or other means to prevent damage occurring to such underground works. The Contractor shall not store any plant or materials or spoil heaps over existing water mains, or in such positions that interference with access to the mains, control gates and the like, is created. Approval by the Project Manager/Engineer to the means of protection employed shall not relieve the Contractor of any responsibility in respect of damage occasioned by his operations.

The laying of pipework, ducts, drains, and the like shall be arranged so as to cause as little interference as possible with the smooth operation of existing works.

When breaking out and making good existing structures, the Contractor shall disturb the existing structures as little as possible. All structures shall be made good with materials similar to those used in the existing works, or such materials which are considered by the Project Manager/Engineer to be of similar appearance and suitable in all other respects.

1.21 Existing Access

Existing access to lands, property and all other places shall be maintained by the Contractor during the continuance of the Works to the Project Manager/Engineer's satisfaction.

1.22 Liaison with Police and other Officials

The Contractor shall keep in close contact with the police and other officials in the areas concerned regarding their requirements for the control of workmen, movement of traffic, or other matters and shall provide all assistance and facilities which may be required by such officials in the execution of their duties.

1.23 Water and Power for Use on the Works

The Contractor shall be solely responsible for the location, procurement and maintenance of a water supply adequate in quality and quantity to meet his obligations under the Contract.

The Contractor shall be solely responsible for the location and continuity of the supply of water for use on the Works. Supplies may be derived from rivers and streams, but shall in all cases to be to the Project Manager/Engineer's approval, and the abstraction of water from any sources shall not interfere with any permanent water supply. The Contractor shall be solely responsible for the transporting of water from its source to the point at which it is required for construction purposes, and in such quantities and quality as to enable the Works to proceed without hinderance due to the shortage of adequate water supplies.

The Contractor shall make his own arrangements for power supplies and shall be solely responsible for the location, procurement and maintenance of a power supply, adequate to meet his obligations under the Contract.

The Contractor shall make his own arrangements for the supply of adequate safe drinking water, electricity and other services to the Permanent Works, Temporary Works and plant and shall provide and maintain all pipes, cables and fittings which may be necessary to carry such services to his operations

1.24 Employer as a Supplier of Water and Power

The position of the Employer or his Agent as a supplier of water or power shall be identical with that of other suppliers, and quite separate from his position as Employer under the Contract. As in the case of a supplier, a failure on the part of the Employer or his Agent to supply water or power will not relieve the Contractor of any of his obligations under the Contract, nor, in respect of any such failure, shall the Contractor have any claim under the Contract against the Employer.

1.25 Inspection by Project Manager/Engineer during Period of Maintenance

The Project Manager/Engineer will give the Contractor due notice of his intention to carry out any inspection during the period of maintenance. The Contractor shall, upon receipt of such notice, arrange for a responsible representative to be present at the times and dates named by the Project Manager/Engineer. This representative shall render all necessary assistance and shall take note of all matters and things to which his attention is directed by the Project Manager/Engineer.

1.26 Site Offices for the Project Manager/Engineer (Optional)

The Contractor shall supply, erect and maintain offices for the sole use of the Project Manager/Engineer and his staff, if included in the BOQ, for the duration of the Contract in a position to be designated by the Project Manager/Engineer.

The offices shall be soundly constructed of approved materials upon concrete bases, and shall be fully weatherproof. The exterior and interior faces of walls and ceilings shall be given two coats of emulsion paint of an approved colour or other approved finish. The offices shall be made dust, insect and vermin proof as far as possible.

The floor areas of the offices shall be as detailed in Appendix B to this Specification, if proposed. Each room shall have a suitable lockable door and windows. The rooms shall either open onto a common internal passageway or onto a concrete floored covered walkway. Separate washing and toilet facilities shall be provided connected to a mains water supply and a suitable septic tank or sewage disposal system.

The Contractor shall arrange, provide and pay, all charges in connection with water, electricity and telephone supplies to the offices.

Each room shall be wired for electric light, power points, all to approved standards. The Contractor shall be responsible for a continuous supply of potable water, sufficient 240-volt electricity for the office and waterborne sanitation facilities to the office.

The Contractor shall provide and install furniture and equipment as detailed in Appendix C, if included in the BEME, to this Specification, which shall revert to the Employer at the end of the Contract period.

The Contractor shall arrange for all offices and toilets to be cleaned each day and shall provide clean towels daily and an adequate supply of soap and toilet paper. The offices and contents shall be insured by the Contractor against fire, burglary, latency and other risks ordinarily insured by a householder.

Hardstanding for three vehicles shall be provided adjacent to the offices. This area shall be covered with corrugated iron sheets of gauge 28.

At the end of the Contract Period the offices shall be removed and the site reinstated to the satisfaction of the Project Manager/Engineer.

1.27 Time for Erection of Site Offices for the Project Manager/Engineer

The Contractor shall bear all expenses incurred by the Employer due to the failure of the Contractor to complete and hand over to the Project Manager/Engineer, the offices, furniture and equipment required within the six weeks of handing over of the scheme to the Contractor.

1.28 Survey Instruments and Chainmen for the Project Manager/Engineer

The Contractor shall provide and maintain in first class working order, for the sole use of the Project Manager/Engineer and his staff for the duration of the Contract, the following minimum survey instruments complete with all accessories, tapes, poles, staves, stagings, moulds, templates, profiles, and requisites necessary for checking and setting out, and measurement of the Works. The equipment shall revert to the Contractor at the end of the Contract Period.

The survey equipment shall include the following or similar approved as a minimum:

Description	Quantity
Auto level	1
Plumbing pole 4.6 m length	1
Wooden Tripod	1
Plumbing pole tripod with bubble	1
Ranging rods	1
5 m steel tape	1
50 m glass fibre tape	1
Camera	1

The Contractor shall provide the services of up to four experienced chainmen per scheme as and when required by the Project Manager/Engineer. Wherever possible the same personnel shall act as chainmen throughout the Contract Period.

It shall be the responsibility of the Contractor to ensure that all the necessary survey equipment is available at site as and when required by the Project Manager/Engineer. This shall be done at no extra cost to the Employer.

1.29 Sign Boards

Before the erection of any sign boards or posters by the Contractor, the Contractor shall obtain the approval of the Employer and the Project Manager/Engineer to the size, location and wording of such sign boards or posters.

Unless otherwise agreed, the signboard shall be in three sections. Section One shall contain:

Name of the Project

in back lettering on a white background.

The second section shall bear the words:

Name of the Employer

in Blue lettering on a white background.

The third section shall bear the words:

Name of the Contractor

in blue lettering on a white background.

Lettering on these boards shall be 150mm high.

Further boards may be added with the names of sub-contractors.

1.30 Fuel Supplies

The Contractor shall arrange for obtaining, storing and distributing all fuel oils required for the completion of the Works. The storage of fuel on site shall comply with the Petroleum Act and/or Factories Act applicable in Nigeria.

1.31 Telephone and Communications

The Contractor shall obtain suitable means of communications during the course of the Contract. The use of radio communications may be permitted but the Contractor shall be responsible for obtaining all the necessary permission and licences. The Project Manager /Engineer's office shall be facilitated WiFi and other current systems.

1.32 Preservation of Trees

No tree shall be removed without prior written permission of the Project Manager/Engineer who will limit the removal of trees to the minimum necessary to accommodate the Permanent Works.

If trees are removed or damaged by the Contractor or his employees, without approval, then the Contractor shall replace such trees.

Replacement of trees shall not be with seedlings less than two years of age, obtained from a reputable nursery and of a species approved by the Project Manager/Engineer. The Contractor shall plant, water and ensure that the replacement trees are properly established, all at his own costs.

1.33 Protection from Water

The Contractor shall keep the whole of the Works free from water and shall be deemed to have included in his Contract Sum all costs for pumping, shoring, temporary drains, sumps and other measures and provisions necessary for such purposes and for clearing away and making good to the satisfaction of the Project Manager/Engineer any damage caused thereby.

1.34 Protection Against Fires

The Contractor is advised that, at all times, it is necessary to guard against fires starting within the Site or in the environs thereof, particularly as the result of the Works or from the actions of his employees. The Contractor shall have available, at all times, a trained fire-fighting team provided with adequate fire-fighting equipment and shall deal with all fires on the Site howsoever caused.

The Contractor shall be responsible for maintaining qualified fire-fighting crew on the Site at all times as well as maintaining an efficient fire alarm system. The Contractor shall also submit a fire prevention and fire-fighting program for the Project Manager/Engineer's approval.

The Contractor shall provide suitable and adequate fire-fighting equipment, to the satisfaction of the Project Manager/Engineer, for ready use at all the times in all the Project Manager/Engineer's site establishment including Contractor's residential quarters, labour camps and ancillary buildings. These shall be maintained until the completion of the construction and handing over of the works to the Employer.

The Contractor shall comply with laws and regulations regarding fires and with respect to the prevention of fires. No fire may be lit in the dry season without written permission from the Project Manager/Engineer and/ or the relevant Authority.

1.35 Safety Precautions

The Contractor shall appoint a Safety Supervisor who shall be qualified in safety and familiar with the works being performed. The Safety Officer shall ensure that adequate measures and rules for the protection of health and safeguarding against accidents are enforced.

The Contractor shall take all necessary precautions against risks of loss of life or of injury to any person employed on the Works or to employees of the Employer and to the Project Manager/Engineer or to visitors or to persons having good and sufficient reasons to be about

the Works, and to this end he shall properly safeguard the Works to the satisfaction of the Project Manager/Engineer.

The Contractor shall at all times comply with any accident prevention regulations and any safety regulations peculiar to the various trades employed on the Works, and any safety regulations published by the Government.

The Contractor shall report promptly to the Project Manager/Engineer all accidents involving the death of or serious injury to any person on the Site or resulting from the Contractor's operations.

The Contractor shall, at his own expense, educate all his employees on safety precautions based on good practice on site. This shall be done in both English and local languages. Safety instructions shall deal with all safety measures including but not be limited to the following; protective clothing, helmets and footwear, use of lifting equipment, precautions against electrical shock, welding, routine procedures in case of accidents, fires, etc., watchmen, warning notices and barriers, use of drilling equipment and dust suppression and use and storage of explosive.

1.36 Explosives and Fuels

The Contractor shall make arrangements to transport, store and handle explosives and fuels in a safe manner for protecting the public in accordance with the laws and security regulations in force in Nigeria. In this regard, he shall submit a program to the Project Manager/Engineer for approval for the safe handling and storage of explosives and fuels. When approved, the Contractor shall issue a copy to each of his personnel involved with the handling of explosives and fuels.

The Contractor shall obtain all necessary licenses and shall pay all fees and charges in respect of the same as may be necessary for the purpose of moving explosives and fuels from place to place and storing the same, and shall make all applications and obtain approvals from the relevant authorities of the Government of Nigeria.

The Contractor shall construct his explosives magazines at locations and in a manner complying with the relevant regulations of Nigeria and approved by the Project Manager/Engineer. Detonators and fuse shall be stored in a separate magazine away from explosives. In no case shall they be transported in the same vehicle with explosives.

The Contractor shall provide adequate protective facilities to safely store and to prevent the loss or theft of explosives. Overnight storage of explosives and detonators outside of the magazines will not be permitted. Magazines shall be securely locked when not in use.

The Contractor shall maintain an inventory record of storage and withdrawal of all explosives including detonators. This record shall be available to the Project Manager/Engineer, and the Project Manager/Engineer shall be promptly notified of any loss or theft of explosives.

The Contractor shall supply and install sirens and loudspeakers systems, so that adequate warning may be given to all persons who may be endangered when explosives charges are to be fired. The Contractor shall ensure, prior to discharging explosives, that the area to be blasted is clear of all workmen, residents, pedestrians etc. in addition he shall post flagmen on each of the roads entering the said area so as to stop and prevent any traffic from entering into the area until "all clear" notification is given.

During thunderstorms and other electrical disturbances, no charging and firing will be permitted.

1.37 Watching, Fencing and Lighting the Spoil Banks

The Contractor shall employ competent watchmen to guard the Works both by day and night.

Any excavations, material dumps, spoil dumps or other obstructions likely to cause injury to any person or thing shall be suitably fenced off and at night marked by red warning lights.

Fences shall consist of at least three 15 millimetres diameter hemp ropes or 4 mm diameter wires, or more if required, stretched tightly between poles, and standards securely planted in solid ground, well clear of the excavation. The poles, and standards shall not be more than 15 metres apart, and where circumstances require, they shall be placed closer. Ropes or wires shall be stretched tight approximately 0.4 metres, 0.8 metres and 1.2 metres respectively above the ground. Banks of spoil may be accepted by the Project Manager/Engineer in lieu of fencing if of suitable height and form.

Fences and spoil banks shall be clearly marked at the ends, all corners, and along the length at intervals of not more than 15 metres by means of white limewashed boards, discs, stones or oil drums during the daytime and by red lamps burning at night. Markers shall be freshly limewashed at regular intervals to ensure that they are white and clean.

If a road is closed, or partly closed to traffic, temporary traffic and barricades shall be erected by the Contractor to the satisfaction of the Project Manager/Engineer and the police, or other relevant authority, to give proper warning to traffic and the public. Lettering on road signs shall be black on a yellow background and shall incorporate reflective material. The signs shall be adequately illuminated at night.

1.38 Soil Conservation

All precautions shall be taken by the Contractor to prevent the erosion of soil from any lands used or occupied by the Contractor for the purpose of the execution of the Temporary Works.

If in the opinion of the Project Manager/Engineer, the Contractor's operations in areas other than the permanent works caused soil erosion, the Contractor shall undertake soil conservation measures in these areas as directed by the Project Manager/Engineer. The details of the proposed soil conservation measures shall be submitted by the Contractor for the Project Manager/Engineer's approval prior to the execution of the said works.

All soil conservation measures shall be carried out at the earliest possible time, as approved by the Project Manager/Engineer, to ensure that the required protection is established most effectively during the progress of Works.

No separate payment will be made for the soil conservation measures and such costs shall be deemed to be included in the respective unit rates and the Contract Sum

1.39 Dust Abatement

During the performance of the work the Contractor shall carry out proper and efficient measures wherever and as often as necessary to reduce the dust nuisance resulting from his operations. Measures shall include, but not be limited, to installation of dust suppression units on his rock drilling equipment, watering down of excavated material during loading operations, and use of water tankers to sprinkle access roads, disposal areas, etc.

The Contractor shall be held liable for any damage to crops, cultivated fields and dwellings of persons in the neighbourhood of the Works resulting from his operations.

No separate payment will be made for the dust abatement measures and the costs thereof shall be deemed to be included in the respective unit rates and the Contract Sum

1.40 Noise Control

All work shall be carried out without unreasonable noise. Compressors used on site shall be silenced either by using only full silenced models or fitted with effective exhaust silencers and properly lined and scaled acoustic covers all to the design of the manufacturers of the compressor or by the use of effective acoustic screens to enclose the noise source. Pneumatic percussion tools used on Site shall be fitted with silencers of a type recommended by the manufacturers of the tools. Compressors, silencers or other equipment shall be maintained in good and efficient working order.

No separate payment will be made for noise suppression measures and the costs thereof shall be included in the unit rates and the Contract Sum.

1.41 Sanitation

The Contractor shall provide adequate sanitation and refuse collection and disposal facilities complying with state laws and local by-laws for all houses, offices, workshops, and the like, erected on the site, all to the satisfaction of the Project Manager/Engineer.

The toilet facilities provided at the site by the Contractor shall be made available, free of charge, to the employees of the Contractor and any of his subcontractors.

The Contractor shall warn his employees and sub-contractors that any employee found fouling the site shall be removed from the site immediately in accordance with the Conditions of Contract.

The Contractor shall remove all rubbish and to this end shall provide adequate number of covered garbage bins/containers placed at convenient points around the site establishments. The Contractor shall institute and maintain a regular garbage collection and disposal system. Garbage shall be disposed of by burning, by burial or by other means approved by the Project Manager/Engineer.

No separate payment will be made for such sanitary arrangements and all such costs will be deemed to be included in the unit rates and Contract Sum.

1.42 First Aid and Medical Services

The Contractor shall provide and maintain all equipment necessary to render first aid in case of accidents, snake bites or other emergencies. This equipment shall be kept in readiness at the sites of the works, at camps and wherever the Contractor's staff may regularly live and work. The Contractor shall ensure that there are persons available to all such places with a knowledge of simple first aid procedures and able to administer snake bite treatment.

Notwithstanding the minimum requirements prescribed above, the Contractor shall be responsible for the adequacy of all the arrangements made.

1.43 HIV/AIDS and Corona Awareness

The Contractor shall implement an HIV/AIDS awareness programme.

1.44 Pollution

During the execution of the Works, the Contractor shall ensure that no pollution of existing watercourses is allowed to take place as a result of his operations. The Contractor shall take all reasonable steps to protect the environment on and off the site and to avoid damage or nuisance to persons or to property of the republic or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

1.45 Site Clearance

On completion of the Works, the Contractor shall clear the site and remove all temporary buildings, equipment and debris. The Contractor shall level off and grade all areas used for haul roads and all building, store and workshop areas. The whole of the site shall be left in a clean and tidy condition.

1.46 Weather Records

The Contractor shall erect a rain gauge ("Nylex 600" or similar approved) and a double bulb, minimum/maximum thermometer (0.1⌗C accuracy) at a site agreed with the Project Manager/Engineer. The Contractor shall be responsible for the daily measurement of rainfall and minimum and maximum temperature to be taken at 8:00am of concrete pour day

1.47 Tolerances

All works shall be constructed to the tolerances shown in these Specifications.

1.48 Units and Abbreviations

The units of measurement used in these Contract Documents are metric.

The following abbreviations have been used for units and for other words or phrases as indicated.

Abbreviations in the Contract Documents shall have the following meanings:

mm	millimetre
m	meter
km	kilometre
sq.m,m^2	square metre
ha	hectare
cu m,m^3	cubic metre
sec, s	second
hr	hour

min	minute
wk	week
l	litre
gm	gram
kg	kilogram
t	tonne
No	Number
nr	Number (in bill of quantities)
dia	diameter
max	maximum
min	minimum
AD	above datum (levels in metres)
eo	extra over
e	exceeding
ne	not exceeding
PQ	Provisional Quantity
PS	Provincial Sum
Do	Ditto
fob	free on board
cif	cost, insurance, freight
wt	weight
%	percent
mh	manhole
ic	inspection chamber
HYS	high yield steel
PCC	precast concrete
uPVC	uplasticised polyvinylchloride
GMS	galvanised mild steel
ISO	International Standards Organisation
BS	British Standard

2 EARTHWORKS

2.1 Site Clearance and Stripping

General clearance is defined as the clearing, grubbing, removal and disposal of all vegetation, grass, debris, bushes, dense bush, trees, hedges, undergrowth, stumps, roots, shrubs plants and backfilling of holes left by the removal of stumps and roots.

The widths and length over which site clearance is to be carried out shall be instructed by the Project Manager/Engineer. Site clearance over the area of quarries, borrow pits, stockpiles and spoil tips shall be carried out where instructed by the Project Manager/Engineer. The Project Manager/Engineer may give instructions that specific trees, stumps or objects shall not be removed during site clearance operation.

If termite moulds are excavated, the whole of the mould shall be removed.

Where the Project Manager/Engineer instructs that site clearance is required, the entire area shall be cleared and all materials thus cleared shall become the property of the Employer. Unless otherwise instructed, vegetation and perishable materials shall be disposed of by burning safely. Burning shall be confined to the specific material. Where material or debris cannot be burnt, it shall be carted to spoil areas, which spoil areas shall be provided in accordance with requirement of this Specification.

If the Contractor clears the Site in advance of the main Works such that the grass and other vegetation re-grows prior to the main Works commencing at any particular location then any additional, or repeating of, site clearance required shall be at the Contractor's expense.

When instructed by the Project Manager/Engineer, the Contractor shall demolish wholly or in part, remove and dispose of all buildings, foundations, structures, fences and any other obstructions which have not been designed to remain.

The Contractor shall carefully take down such buildings, structures, fences etc. and the components shall be dismantled, cleaned and stacked in separate heaps. All materials which, in the opinion of the Project Manager/Engineer, are not fit for re-use shall be removed from the site to spoil areas provided in accordance with the requirements of this Specification. All materials, which are re-usable, shall remain the property of the Employer and shall be preserved and protected by the Contractor until removed by the Employer or until the expiry of the Period of Maintenance.

All existing paths, fences, walls, hedges, trees, shrubs, lawn and other features which the Project Manager/Engineer instructs not to be removed or otherwise dealt with, shall be protected from the damage, and any damage which occurs due to the Contractor's failure to take adequate precautions shall be repaired at the Contractor's expense.

Site clearance shall be measured in square metre, calculated as the plan area instructed by the Project Manager/Engineer to be cleared.

Stripping work shall basically consist of removal of top soil, grasses, vegetative material to a depth of 150 mm below ground level and its disposal to a stockpile. Stripping shall include for removal, stockpiling and for reinstatement or spreading as directed by the Project Manager/Engineer. Measurement and payment of this shall be in square metres, calculated as the plan area instructed by the Project Manager/Engineer.

2.2 Surface Levels

After the area of any section of the Works has been cleared and after trees have been felled, stumps removed and termite moulds excavate to the satisfaction of the Project Manager/Engineer, but before any other work is commenced, surface levels of the ground shall be taken. The levels shall be taken at spacings agreed with the Project Manager/Engineer. Levels shall similarly be taken on the surface of the ground after the removal of unsuitable overburden prior to placing fill and at the interface between natural ground, rock or artificial hard material layers. The levels shall be agreed with the Project Manager/Engineer. The Contractor shall prepare plans and sections which shall, when finally and mutually agreed, be signed by the Project Manager/Engineer and Contractor as truly representing the configurations of the areas in question at the commencement of excavation or fill construction.

2.3 Definition of Earthwork Materials

The following definitions of earthworks materials shall apply to this and other Clauses of the Specification in which reference is made to the defined materials:

(a) "top soil" shall mean the top layer of soil that can support vegetation

(b) "suitable material" shall comprise all material which arises from excavations within the Site and which is approved by the Project Manager/Engineer as acceptable for use in the works

(c) "unsuitable material" shall mean material other than suitable material and shall comprise:

- material from swamps, marshes and bogs
- logs, stumps and perishable materials
- material susceptible to spontaneous combustion
- clay of liquid limit exceeding ninety (90) and/or plasticity index exceeding sixty five (65)

(d) "rock" or "hard material

Rock or hard material shall be material which cannot be ripped to an average depth of greater than 300mm by a track type crawler tractor complying with the following:

- in good order complete with all equipment and accessories as supplied;
- rated 300 BHP flywheel power or over;
- with an operating weight of not less than 37.2 tonnes;
- equipped with a hydraulically operated single tine ripper compatible with the tractor used; and
- operated by a qualified operator in accordance with the manufacturer's recommendations and to the satisfaction of the Project Manager/Engineer.

Where it is impractical to prove hard material by the above method then the quantity of hard material, if any, shall be determined by the Project Manager/Engineer.

Where excavation contains individual boulders of hard material greater than 0.3 m^3 each in volume then such boulders shall be classified as hard material.

(d) "soft material" material shall mean all material other than that defined as "rock" or "hard material".

2.4 Removal of Unsuitable Material

Where directed by the Project Manager/Engineer the Contractor shall remove unsuitable material to the depth as ordered or agreed by the Infrastructure Development Engineer /Project Manager and shall dispose of it in approved spoil tips.

2.5 Excavation General

Excavation shall be carried out with the allowances for working space given in the Method of Measurement to the Bill of Quantities, unless otherwise shown as lines, levels and profiles on the Drawings or to such other lines, levels and profiles as the Project Manager/ Infrastructure Development Engineer may direct or approve in writing. The work shall be carried out by the Contractor in such a way as to avoid disturbance to the surrounding ground. Particular care shall be taken to maintain stability when excavating in close proximity to existing works.

The work shall be carried out in a careful manner to ensure that the exposed surfaces are as sound as the nature of the material permits and that no point shall protrude inside the lines shown on the Drawings except as otherwise specified or agreed by the Project Manager/Engineer. In soft excavation, which is to remain open permanently, exposed faces shall be formed accurately to the required slopes and profiles. Excavations in rock where the faces shall remain open permanently shall be trimmed so that no point protrudes within the required profile.

The Contractor shall examine all excavated faces regularly and shall remove all insecure material or materials resulting from any falls. Where instructed in writing by the Project Manager/Engineer, the Contractor shall wash down exposed surfaces of excavated rock for inspection.

The Contractor shall dispose of all material arising from excavations. If it is suitable and required for the Permanent Works it shall be placed directly in such Works or set aside for use as and when required in suitable approved dumps, otherwise it shall be removed to tips provided by the Contractor unless otherwise provided or directed by the Project Manager/Engineer.

The Contractor shall be responsible for keeping all excavations free from water from whatever cause arising and shall provide such pumping capacity and other measures as may be necessary for this purpose. The Contractor shall make good any damage that may result from his failure to keep the excavations free from water.

All excavation shall be carried out with care and the method and plant to be used in execution thereof shall be to the satisfaction of the Project Manager/Engineer. The Contractor shall be responsible for the safety and security of all excavations at all times during the execution of the contract and where necessary shall provide timbering, shoring or other measures required by the Project Manager/ Infrastructure Development Engineer to prevent movement or loss of ground outside the boundaries, settlement of or damage to property, or injury to persons. The Contractor shall make good any damage to structures, services or other properties caused by such movement, loss of ground and settlement. The Contractor shall also take precautions to route his plant in such a manner as to minimise the likelihood of slips occurring due to vibration or surcharge from the working or movement of heavy machinery.

The Contractor will be permitted, subject to the approval of the Project Manager/Engineer, to adjust side slopes of excavations in soft materials which are to remain open temporarily in preference to shoring or strutting. However, no payment shall be made for extra excavation volume as a result of these measures.

The Contractor shall notify the Project Manager/Engineer without delay of any permeable strata, fissures or unusual ground encountered during excavation.

2.6 Blasting

The Contractor shall not be permitted to use explosives for rock excavation without the approval of the Project Manager/ Infrastructure Development Engineer. The Contractor shall only employ suitably qualified and experienced personnel to manage and supervise blasting operations. For each blasting operation, the Contractor shall submit to the Project Manager/ Infrastructure Development Engineer for approval a statement detailing the type of explosives to be used, method of transport, storage, blasting procedures, safety precautions to be observed and the names and experience of the personnel who will supervise the work. Notwithstanding the Project Manager/Engineer's approval, the Contractor will be responsible for the blasting operations and shall accept full and absolute liability for any claims resulting either directly or indirectly from the use of explosives on the Site.

The blasting operations shall comply in every respect with the regulations and laws covering the use of explosives and the Contractor shall be responsible for obtaining all necessary permits.

2.7 Excavation Beyond Line or Level

If from any cause whatsoever excavations are carried out beyond their true line and level other than on the instructions of the Project Manager/ Infrastructure Development Engineer, the Contractor shall make good to the required line and level with the appropriate grade of filling to be contained in the true excavation, or with concrete or other approved material in such a manner as the Project Manager/Engineer may direct. This shall be at the Contractor’s expense.

2.8 Approval of Excavation

When excavations have been taken out accurately to the profiles or dimensions required for the work the Contractor shall inform the Project Manager/ Infrastructure Development Engineer who shall carry out an inspection of the excavation. If, after his inspection the Project Manager/Engineer requires additional excavation to be carried out, the Contractor shall do so to such new profiles or dimensions as the Project Manager/Engineer may direct.

2.9 Excavation for Structures

Open excavation to form a foundation for a structure shall be carried out to the lines necessary to permit the proper construction of the structure to the approval of the Project Manager/ Infrastructure Development Engineer.

Where a structure is to be founded on soft ground, the excavation shall be taken down until the required formation is exposed and prepared to the approval of the Project Manager/Engineer. Where concrete has to be placed on a soft foundation, the Project Manager/Engineer may direct that a blinding layer of lean concrete be placed beneath the structural concrete immediately after completion and approval of the excavation, or require the Contractor to remove the last 100 mm of excavation immediately prior to placing the concrete. If foundation conditions are very soft the Project Manager/Engineer may instruct that additional material be excavated and replaced with compacted gravel or hardcore.

Where a structure is required to be founded on rock but is not required to penetrate into it, all soft overburden shall be removed and the surface of the rock cleared of any loose material by barring and wedging. Where the foundation is required to penetrate into the rock, excavation of the rock may be carried out by blasting but in such a manner as to prevent the shattering of the rock which is to remain. The Project Manager/Engineer may direct that the last 300 mm of rock be left and be removed by barring and wedging or by the use of approved pneumatic tools so that the exposed surface is sound.

The Contractor shall report to the Project Manager/ Infrastructure Development Engineer whenever excavations are ready to receive concrete. No concrete shall be placed in the foundations until the Contractor has obtained the Project Manager/Engineer's agreement that a secure foundation has been reached and that the excavation has been carried out to the lines and levels required.

2.10 Excavation for Fill Foundation

Foundations for embankments shall be excavated to the depths or to the soil or rock grade indicated on the Drawings or described in the Specification. The suitability of each part of the foundation for placing fill thereon shall be determined by the Infrastructure Development Engineer /Project Manager. No fill shall be placed before acceptance of the foundation by the Project Manager/Engineer and recording of the geology.

Where specified in the Drawings or Specification or directed by the Project Manager/Engineer, seams and other defects below the general level of the foundations shall be excavated and filled or covered with materials including mortar and concrete to the satisfaction of the Project Manager/Engineer before fill is placed thereon.

Where embankments are to be constructed on sloping ground, and where shown on the Drawings, benches shall be excavated in the foundations to the dimensions shown on the Drawings.

Except where specifically permitted by the Project Manager/Engineer all foundations for fill shall be kept free of water when placing fill thereon.

Earth foundations shall have the top 150 mm sufficiently moistened and, if necessary, harrowed or scarified and compacted to at least ninety five per cent (95%) of the maximum dry density as determined by the AASHTO T99. Material too wet to be so compacted shall, as directed by the Project Manager/Engineer, be allowed to dry, harrowed or scarified to reduce the moisture content to the required amount and then be re-compacted.

2.11 Trench Excavation

Trench excavation shall be performed by the use of hand tools and approved mechanical equipment, in such manner as to minimise disturbance of the sides and bottom of the excavation.

Trenches for pipes shall be excavated to a sufficient depth to enable the pipe and the specified joint, bedding, haunching and surround to be accommodated. Unless otherwise stated, the width of the trench shall be equal to the nominal diameter of the pipe plus 600 mm.

The Contractor shall fill any over excavation beneath the pipe or bedding at his own cost with well rammed selected general excavation material as per requirement of this Specification. The Contractor shall dispose of surplus excavated material not required for backfill to spoil tips.

The sides of trenches shall be adequately supported at all times. Alternatively, where the Contractor has to excavate the trenches in open cut the Contractor shall ensure that the side slopes of the excavation are sufficient for stability.

Where rock or boulders are present in the sides or base of a trench in which a pipe is to be installed, the trench shall be trimmed so that when the pipeline is laid, no projection of rock comes within 200 mm of the outside of the pipe at any point. The over excavated portion shall be backfilled as set out in this Specification with approved granular material at the Contractor's expense.

The Contractor shall be entirely responsible for the sufficiency of all temporary supports and side slopes to the excavations. The excavation shall be carried out in such a way as to maintain the stability of all roads and other adjacent structures or works.

2.12 Disposal of Excavated Material

Material obtained from excavations which is suitable other fill areas shall be placed directly in the Works or set aside for use as and when required in suitable approved dumps. Any such suitable material which may be surplus to the total requirements of the Works shall be taken to spoil in tips provided by the Contractor, unless otherwise provided or permitted by the Project Manager/Engineer.

If the Contractor is permitted to remove suitable material from the site to suit his operational procedure or to take such material for purposes other than forming embankments or other fill areas, he shall make good any consequent deficit of filling arising there from, unless otherwise agreed by the Project Manager/Engineer.

All material not suitable for embankments or other filling shall, unless otherwise directed by the Project Manager/Engineer, be taken to separate spoil tips provided by the Contractor.

The cost of disposal of surplus or unsuitable materials shall be deemed to be included in the respective unit rates for the excavation work and the Contract Sum.

2.13 Spoil Tips

The Contractor shall be responsible for the provision and sufficiency of tips for the permanent disposal of spoil and shall select their location within the general areas indicated on the Drawings or as otherwise designated or approved by the Project Manager/Engineer. The Contractor shall submit his proposals for the locations and detailed treatment of tips to the Project Manager/Engineer for approval, which will in no way relieve the Contractor of his responsibilities and obligations under the Contract, whether or not locations are shown on the Drawings or otherwise designated.

No spoil shall be permanently deposited elsewhere than on approved spoil tips unless approved by the Project Manager/Engineer. Spoil tips shall be built up and compacted and trimmed and regulated to levels and profiles approved by the Project Manager/Engineer. Where directed by the Project Manager/Engineer, upper surfaces and slopes of the tips shall be soiled to specified thickness.

2.14 Borrow Pits and Quarries

Where there may be an insufficiency of suitable material from excavations for filling or is specified on the drawings, the Contractor shall obtain such material from borrow pits or quarries approved by the Project Manager/Engineer where the filling is required for Permanent Works. The Project Manager/Engineer may propose a borrow pit for exploration by the Contractor, however, it shall be entirely the responsibility of the Contractor to locate suitable sources of borrow material for fills.

The Contractor shall investigate the site or sites which they propose to open up and shall provide full and detailed information by means of boreholes, trial pit testing reports, etc. to satisfy the Project Manager/Engineer that the quality of the material meets Specification requirements and that the quantity is adequate for the Works.

Notwithstanding the foregoing, the Project Manager/Engineer shall have the right to order the Contractor to obtain materials from a particular designated source or by widening cuttings for permanent works beyond specified profiles.

The Contractor shall provide plant and equipment and make all other arrangements for excavating, loading and transporting material of the specified quality for completion of the Works in accordance with the agreed programme. These provisions shall include where necessary for any operations involving selection, stockpiling and rehandling of suitable material, the disposal of unsuitable material or overburden and any other operations which may be found necessary due to the nature and disposition of the excavated materials.

The pits and quarries shall be operated in a safe manner provided with ample drainage leaving no stagnant pools. On completion of the Works they shall be left free-draining and in a tidy and regular state. All loose material shall be barred down and no face shall be left overhanging except with the approval of the Project Manager/Engineer.

The removal of vegetation, topsoil and overburden at the borrow pits shall not be paid for separately. Contractor will be deemed to have allowed for the costs elsewhere in his rates. The same applies to any works required to access the borrow pits.

The rate for fill shall include for the supply of material inclusive of extraction, loading and transportation to Site for a maximum haulage distance of 10 km, one way. Where suitable borrow pit is not available within this distance, overhaul will be paid for. Measurement shall be the product of the volume of compacted material insitu and the haulage distance in excess of 10 km, one way, along the shortest route, as determined by the Project Manager/ Infrastructure Development Engineer. The Contractor shall be responsible for the maintenance of this selected route, at his own cost.

2.15 Earth Filling

Material for filling shall be obtained from approved sources and shall not contain more than 1% of vegetation matter, rubbish and humus material and shall contain no boulders or rock of a size greater than half the compacted thickness of the layer.

Unless otherwise specified the fill material shall meet the following requirements:

(a) CBR after 4 days soaking compacted to 100% of AASHTO T99 at optimum moisture content of not more than 3%.

(b) Plasticity Index (PI) of more than 40%.

(c) Permeability of less than 1 x 10^{-6} mm/s

Prior to commencement of filling, the Contractor shall submit in writing to the Project Manager/ Infrastructure Development Engineer for approval his proposals for carrying out the work such that the optimum use may be made of excavated material as far as possible. The proposals shall include the compaction plant and methods for adjusting the moisture content of the material which he intends to use. No filling shall be carried out until the proposals and the material intended to be used are approved by the Project Manager/Engineer.

Fill shall be placed in layers not exceeding 150 mm compacted thickness, each layer being scarified and thoroughly compacted to obtain a dry density not less than 95% of the maximum dry density as determined by AASHTO T99. The moisture content shall be adjusted as necessary to achieve the compaction standards.

The Contractor shall take all necessary measures to prevent any damage or defects to the Works which may be caused by settlements, slips or falls of embankments and shall make good such damage or defects as may occur to the satisfaction of the Project Manager/ Infrastructure Development Engineer, all at his own cost.

Any instability of any adjacent excavation formed to the lines, levels and profile shown in the Drawings or as ordered by the Project Manager/ Infrastructure Development Engineer will be the responsibility of the Contractor. Where double-handling of excavated material is necessary, the Contractor will be responsible for the temporary disposition of the material such that it does not endanger the stability of the excavation.

2.16 Backfilling of Structural Excavations

Backfilling of structural excavations shall be carried out with excavated material selected or approved by the Project Manager/ Infrastructure Development Engineer. The material shall be placed in layers not exceeding 150 mm compacted thickness or such other thickness as the Project Manager/Engineer may approve or direct and shall be compacted as specified in Clause 2.16.

When material is filled up to or over any structure, the filling shall be brought up equally on each side or as otherwise agreed by the Project Manager/Engineer so that no unequal pressures likely to cause damage to the structure are applied.

2.17 Filling under raised foundations

The material to be used as filling under raised foundations shall consist of suitable material obtained from adjacent excavations or approved borrow sources, and shall be placed in layers not exceeding 100 mm compacted thickness. The material shall be compacted in accordance with Clause 2.16.

2.18 Frequency of Testing

Testing will be carried out as instructed by the Project Manager/Engineer.

All results of these tests shall be submitted to the Project Manager/Engineer with the least possible delay.

2.19 Granular Bedding

Granular bedding material shall comply with BS 882 for aggregates within the sizes range 14 mm to 5 mm. Material complying with BS 882 except in respect of grading may be used provided that it has a maximum size not exceeding 14 mm.

2.20 Vegetation and Grassing

Before planting trees or grass, all areas to be planted shall be cleared of stones and any other non-organic matter.
Any plant or grassed areas that have failed to grow, after four weeks of the same season, shall be replanted, and if necessary watered to ensure that they grow.

2.21 Slopes and Batters

Where a slope is given in the Specification or on the Drawings as a ratio of vertical and horizontal components, it shall be understood that the first component is vertical in all cases eg. a "slope of 1 in 2" will mean one vertical in two horizontal and a "batter of 4 to 1" will mean four verticals to one horizontal. This meaning will be attributed to all other terms such as "inclination" and "gradient".

2.22 Trial Pits

The Contractor shall excavate, maintain and afterwards refill any trial pits ordered by the Infrastructure Development Engineer/Project Manager. The sides of the pits shall, where deemed necessary by the Infrastructure Development Engineer/Project Manager for safety

purposes, be supported by sheeting or boarding with adequate framing. A ladder shall be provided for inspection purposes.

3 CONCRETE

3.1 Concrete General

Concrete shall consist of cement, graded aggregate and water carefully proportioned, thoroughly mixed, placed and compacted as specified.

The Contractor shall obtain formal approval from the Infrastructure Development Engineer /Project Manager before pouring any concrete for the permanent works. The Project Manager/Engineer shall allow concreting after ascertaining the required lines and levels, suitability of formwork, availability of required plant and labour, proper fabrication and spacing of the steel bars and quality and quantity of cement and aggregates.

3.2 Cement

Cement for use in the permanent works shall be Ordinary Portland Cement from approved manufacture and shall comply with BS 12. Where sulphate-resisting cement is specified, it shall comply with BS.4027.

All cements shall be certified by the manufacturers as complying with the requirements of the specification. Before orders are placed the Contractor shall submit details of the proposed supplier(s) together with such information on the proposed methods of transport, storage and certification so that the Infrastructure Development Engineer /Project Manager may satisfy himself that the quantity and quality required can be supplied and maintained throughout the construction period. Where necessary the Project Manager/Engineer may require representative samples of the proposed cement to be taken and forwarded to a nominated laboratory for analysis and testing before the source is approved.

No cement shall be used in the Works until deemed satisfactory by the Project Manager/Engineer.

3.3 Supply of Cement

Cement shall be obtained from one manufacturer unless otherwise authorised by the Project Manager/Engineer. Should the use of cement from different manufacturers be authorised, the different supplies of cement shall be stored separately and shall not be mixed.

The Contractor shall supply to the Infrastructure Development Engineer /Project Manager copies of the manufacturer's test certificates certifying that each consignment of cement has been tested and analysed, and that the results comply in all respects with the above standards. Each certificate shall state clearly the date of despatch and the number of bags despatched in each consignment.

Bagged cement shall be delivered in sealed 50 kilogrammes sacks. Each bag shall be marked with the parcel number of the cement contained. Bagged cement shall be transported so that at no time is it exposed to damp and so that moisture cannot be absorbed from the atmosphere. Cement in bulk shall be transported in totally enclosed water tight and sealed containers.

If cement is obtained from an intermediate agent, such agent's arrangements for transporting and storing cement shall be to the approval of the Project Manager/Engineer.

3.4 Storage of Cement

The Contractor shall provide sufficient storage capacity on Site to ensure that his anticipated programme of work is not interrupted due to lack of cement. Factors outside the Contractor's control such as transport, weather conditions, holidays and breakdowns shall be taken into account.

Cement delivered to the Site in bulk shall be stored in dry, well-ventilated weather proof silos or bins which shall be self-clearing. Cement delivered to the Site in bags shall be stored in dry, weather-proof sheds which shall have floors of damp proof construction raised at least 150 millimetres above the surrounding ground.

Cement of different consignments shall be stored separately and consignments shall be used in the same order as they are delivered to the site. No cement shall be stored on the site for longer than three months from the date of despatch by the manufacturer. If not used within that period, the cement shall be removed from the site.

Any bag of cement which is damaged or found to contain cement which has set or partly set, shall be discarded and not used in the Permanent Works.

3.5 Testing of Cement

Cement shall be tested by the manufacturer. If the manufacturer's test certificate is not made available, representative samples shall be taken from different bags or containers of each consignment. They shall be suitably packed and sent to an approved laboratory for testing to prove the cement's compliance with the specified standards.

The Project Manager/Engineer may require cement to be tested after its delivery to the site. Any cement which has been in store at the site for longer than one month shall be re-tested.

The Project Manager/Engineer may take samples of cement from cement bins or bagged cement, from a parcel of cement after its delivery to the site, or from a parcel of cement which has been stored at the site for longer than one month.

In addition to the manufacturer's tests the Project Manager/Engineer may require the following tests to be carried out:

(a) Comprehensive strength on mortar cubes in accordance with Method 1 of Clause 6A of BS.12

(b) Soundness in accordance with Clause 9 of BS.12.

Any cement which fails to meet the specified requirements shall not be used in the Permanent Works.

3.6 Aggregate for Concrete

3.6.1 General

Aggregates for concrete shall comply with BS 822, and shall be obtained from a source or sources approved by the Project Manager/Engineer and shall be transported and stored in such a manner as will prevent:

(a) Contamination of the aggregates from the ground, rubbish, vegetation, dust or any other foreign material.

(b) Segregation.
(c) Intermixing of aggregates of differing characteristics.

Before aggregates from each source are approved for use in the Permanent Works, tests shall be carried out at an approved testing laboratory on representative samples submitted by the Contractor to check that the aggregates comply with the requirements of the Specification.

During concreting operations, tests shall be carried out to check that aggregates delivered for use in the Permanent Works comply with the requirements of the Specification.

Sampling and testing of aggregates for concrete shall be carried out in accordance with the requirements of BS 812 except where described otherwise.

Moisture contents of aggregates shall be determined as the moisture content of the aggregate compared with that of the aggregate in the saturated surface-dry condition. Specific gravities of aggregate shall be determined on aggregate in the saturated surface-dry condition.

Aggregates shall be stored on a clean, free draining surface. The various types and sizes of aggregates shall be kept separate from each other and each stockpile shall be kept as large as possible to maintain a reasonably uniform content in the aggregate.

3.6.2 Fine Aggregates

Fine aggregates shall be clean and durable and shall be natural sand, crushed gravel sand or crushed rock sand complying with BS 882. All the material shall pass through a 5 millimetre BS sieve and the grading shall be in accordance with Zones 1, 2 or 3 of BS 882. In order to achieve an acceptable grading, it may be necessary to blend materials from more than one source.

As an alternative, fine aggregate for mortar only shall comply with BS 1199 and 1200.

The fine aggregate shall not contain iron pyrites or iron oxides. It shall not contain mica, shale, coal or other laminar, soft or porous materials unless the Contractor can show by tests on finished concrete as set out in BS 1881 that the presence of such materials does not adversely affect the properties of the concrete.

The proportion of clay, silt and other impurities passing a 75 microns BS sieve shall not exceed three per cent for natural or crushed gravel sand or 15 per cent for crushed rock sand. The shell content shall not exceed 15 per cent by weight.

Chlorides soluble in a 10 per cent solution by weight of nitric acid shall not exceed 0.05 per cent by weight expressed as chloride ion when tested as set out in BS 812, subject to the further restriction given in the note on total chloride content in sub-clause 3.5.5.

Soundness: After five cycles of the test set out in ASTM C88-76, the aggregate shall not show a weight loss of more than 10 per cent.

Samples taken from the fine aggregate shall pass the colour test for organic impurities described in sub-clause 3.6.4.

Tests on fine aggregates shall be carried out daily or as required by the Project Manager/Engineer on site during concreting operations as follows:

(a) Sieve analysis

(b) Moisture content. An approved "rapid" test may be used for this test.

(c) Percentage of material passing a 75 microns BS sieve by the Field Settling Test, checked when necessary by the Decantation Method.

(d) Test for organic impurities as described in sub-clause 3.5.4.

The Contractor shall arrange to carry out the following tests when requested by the Project Manager/Engineer:

(e) Specific gravity and water absorption.

(f) Bulk density.

(g) Other tests described in BS 812.

3.6.3 Coarse Aggregates

Coarse aggregates shall be clean, hard and durable crushed rock, crushed gravel or natural gravel complying with the requirements of BS 882. The material shall be frost resistant and shall not contain any iron pyrites, iron oxides, flaky or laminated material, hollow shells, coals or other soft or porous material, or organic matter. The pieces shall be predominantly angular, rounded or irregular as defined in BS 812.

Coarse aggregate shall be supplied in the nominal sizes called for in the Contract and shall be graded in accordance with BS 882 for each nominal size.

The proportions of clay, silt and other impurities passing a 75 microns BS sieve shall be not more than one per cent by weight.

The content of hollow and flat shells shall not be such as will adversely affect the concrete quality when tested as set out in BS 1881. The total shell content shall not be more than the following:

40mm nominal size and above	2 per cent of dry weight
20mm nominal size	5 per cent of dry weight
10mm nominal size	15 per cent of dry weight

Chlorides soluble in a 10 percent solution by weight of nitric acid shall not exceed 0.03 per cent by weight, expressed as chloride ion when tested as set out in BS 812 but subject also to the further restriction on total chloride content given in sub-clause 3.5.5.

When tested in accordance with ASTM C289, the aggregate shall be non-reactive.

Soundness: After 5 cycles of the test set out in ASTM C88-76, the aggregate shall not show a weight loss of more than 12 per cent.

Flakiness Index: When tested in accordance with BS 812 shall be as set out hereunder:

40mm nominal size and above	Not more than 40
20mm nominal size and below	Not more than 34

If the flakiness index of the coarse aggregate varies more than five units from the average value of the aggregate used in the approved trial mix, a new set of trial mixes shall be carried out in the workability of the mixes have been adversely affected by such variation.

Impact Value: Not more than 45 per cent when tested in accordance with BS 812.

Ten per cent fines value: Not less than 50 kilonewtons when tested in accordance with BS 812.

Shrinkage: When mixed with other ingredients in the approved proportions for concrete and tested as set out in BS 1881, the shrinkage factor shall not exceed 0.05 per cent.

Water absorption: The aggregate shall not have a water absorption of more than 2.5 per cent when tested as described in BS 812.

Tests on coarse aggregate shall be carried out daily or as required by the Project Manager/Engineer on site during concreting operations as follows:

(a) Sieve analysis

(b) Moisture content: An approved "rapid" test may be used for this test.

(c) Percentage of materials passing a 75 microns BS sieve by the Field Settling Test, checked when necessary by the Decantation Method.

The Contractor shall arrange to carry out the following tests when requested by the Project Manager/Engineer:

(d) Determination of flakiness index.

(e) Specific gravity and water absorption.

(f) Determination of "ten per cent fines" and of Los Angeles Abrasion.

(g) Other tests described in BS 812.

3.6.4 Test for Organic Impurities

Aggregates shall be tested for organic impurities by means of discoloration of a sodium hydroxide solution as follows:

A 340-millilitres graduated prescribed bottle shall be filled to the 123 millilitres mark with a sample of the aggregate to be tested. A 3 per cent solution of sodium hydroxide in water shall be added until the volume of the aggregate and liquid after shaking gives a total volume of 194 millilitres. The bottle shall be stoppered, shaken thoroughly and allowed to stand for 24 hours. Should the liquid then be darker than the standard colour solution the aggregate shall not be used for making concrete.

The standard colour solution shall be prepared in a 340 millilitres prescription bottle as follows:

2.5 millilitres of a 2 per cent solution of tannic acid in 10 per cent alcohol shall be added to 97.5 millilitres of a 3 per cent solution of sodium hydroxide in water. The mixture shall be shaken and allowed to stand for 24 hours.

A glass of the standard colour may be used in place of the standard solution.

3.6.5 Total Chloride and Sulphate Contents

The total chloride content arising from all ingredients in a mix, expressed as chloride ions as a percentage of the weight of cement in a mix, shall not exceed 0.5 per cent in any one sample nor 0.3 per cent in 95 per cent of the samples tested. For prestressed concrete, steam cured concrete or concrete containing sulphate resisting cement or supersulphated cement, the total chloride content shall not exceed 0.5 per cent of the weight of cement in the mix.

The total sulphate content arising from all ingredients in a mix shall not exceed 0.4 per cent by weight of the aggregates or 4 per cent of the weight of cement in the mix, whichever is less. For this purpose the sulphate contents shall be expressed as SO_3 and shall be calculated form the sulphate contents of the cement, aggregates and any admixtures. Where applicable, sulphate contents shall be determined in accordance with tests described in BS 1047 and 3892.

Pulverised fuel ash shall not be used in conjunction with a cement complying with the requirements of BS 4027 in concrete required to be resistant to sulphates.

3.7 Admixtures

Admixtures for improving workability, accelerating or retarding setting of concrete, or for any other purpose, shall only be used with the Project Manager/Engineer's written approval. Calcium chloride or admixture containing chlorides will, however, not be approved.

The Contractor shall submit samples of the admixtures he proposes to use to the Project Manager/Engineer for testing. If an admixture is approved for use it shall be obtained from an approved supplier and the Contractor's arrangement for measuring, mixing and adding the admixture to the concrete batch shall be strictly in accordance with the manufacturer's instructions or recommendations and subject to the approval of the Project Manager/Engineer.

The proportions of the concrete mixes and water/cement ratio shall be adjusted to the satisfaction of the Project Manager/Engineer so that the strength of the concrete with admixture is at least equal to the strength of the equivalent concrete without admixture.

3.8 Water for Concrete

Clean fresh water is to be used for the mixing of all concrete and mortar, and is to be from a source approved by the Project Manager/Engineer. If required by the Project Manager/Engineer, samples shall be taken from the proposed source of supply and submitted to a nominated laboratory for testing in accordance with BS 3148, "Methods of test for water for making concrete" and on the results of these tests the Project Manager/Engineer will decide whether the source is acceptable.

3.9 Concrete Mixes

The design of concrete mixes shall be the sole responsibility of the Contractor, but may be undertaken in conjunction with the Project Manager/Engineer. Concrete mixes shall be designed mixes in accordance with the requirements of BS 5328 having the characteristics specified in Table 3.1 of this Specification. Concrete for use in water retaining structures shall comply with BS 8007.

Evidence shall be submitted to the Project Manager/Engineer, for all classes of concrete to be used, showing that at the intended workability the proposed mix proportions and production methods will produce concrete of the required quality.

The following information shall be provided before any designed mix is supplied:

(a) Nature and source of each material.

(b) Full details of tests on trial mixes including workability.

(c) Proposed quantities of each ingredient for one cubic metre of fully compacted concrete.

No change in the approved mix design will be permitted, unless the Contractor carries out trials on the proposed mix design to show that compliance with this Specification can be maintained.

Mix design shall in all cases be subject to the approval of the Project Manager/Engineer, but such approval shall in no way relieve the Contractor of his responsibility for the design and production of concrete in compliance with this Specification.

3.10 Trial Mixes

The workability of each of the trial batches shall be determined and three (3) cubes made from each batch for testing. A further three (3) cubes made from each batch may be made for tests at an earlier age if required.

The trial mix proportions shall be approved if the average compressive strength of the nine (9) cubes tested at 28 days exceeds the specified characteristic strength by 3 newtons per square millimetre, or if nine tests at an earlier age indicate that it is likely to be exceeded by this amount.

To demonstrate that the maximum free water/cement ratio is not exceeded, two batches of concrete shall be made in a laboratory with cement and surface-dry aggregate known from past records of the supplier of the material to be typical. The proposed mix proportions will not be accepted unless both batches have the cement content specified and free water/cement ratio below the maximum specified in Table 3.1.

Table 3.1 - Classes of Concrete

Class	Characteristic Compressive Strength N/mm^2	Maximum Free Water/cement Ratio	Minimum Cement Content kg/m^3	Maximum Cement Content kg/m^3	Maximum Aggregate Size mm
C25/10/A	25	0.55	360	400	10
C25/20/A	25	0.55	360	400	20
C25/20/B	25	0.55	290	400	20
C25/20/C	25	-	240	540	20
C20/20/B	20	0.55	290	400	20
C20/40/B	20	0.55	260	400	40
C20/40/C	20	-	220	540	40
C15/40/C	15	-	180	540	40
C15/20/C	15	-	180	540	20
C10/40/C	10	-	150	540	40

A, B and C denote exposure conditions for the finished concrete as defined in BS 8007.

3.11 Testing of Concrete

3.11.1 General

All concrete shall be sampled and tested in accordance with the requirements of BS 1881 unless otherwise stated in this Specification or instructed by the Infrastructure Development Engineer/ Project Manager/Engineer.

The Contractor shall allow for all the necessary labour, materials, plant and equipment necessary for the regular sampling and testing of concrete to be placed in the Works.

3.11.2 Cement Content

Tests shall be carried out as required by the Infrastructure Development Engineer Project Manager/Engineer to determine the cement content of the mix. The cement content of any batch of concrete shall not be less than the specified minimum value minus 5 per cent of that value nor more than the specified maximum value plus 5 per cent of that value.

3.11.3 Workability

The workability of the concrete shall be measured as required by the Project Manager/Engineer by slump tests or compaction factor tests and shall be within the following limits:

Slump	±	25mm or ± one third of required value whichever is greater.
Compacting Factor	±	0.03 where required value is 0.90 or more
	±	0.04 where required value is 0.90 to 0.80
	±	0.05 where required value is 0.80 or less

The required value shall be that which has been accepted under Clause 3.8 of this Specification.

3.11.4 Water/Cement Ratio

The water/cement ratio shall be determined as required by the Project Manager/Engineer and shall not exceed the specified maximum value by more than 5 per cent of that value.

3.11.5 Compressive Strength

Samples of concrete shall be taken for compressive strength at a rate of one sample per 15 cubic metres of concrete placed or 15 batches of concrete placed whichever is the lesser volume. A greater frequency of sampling may be instructed by the Project Manager/Engineer until compliance with specified strength requirements has been confirmed for each class of concrete used in the Works.

Two test specimens shall be prepared from each sample and shall be cured for 28 days, or by any other method approved by the Project Manager/Engineer that enables the prediction of 28 day strength at an earlier time.

On completion of curing, the two test specimens shall be tested. Provided the difference between the two results does not exceed 14 per cent of the mean of the two results, the mean shall be taken as the test result. Where the difference between the two results exceeds 14 per cent of their mean, the lower of the two results shall be taken as the test result.

Compliance with the specified strength may be assumed if the conditions given in both (a) and (b) below are satisfied.

(a) The average compressive strength determined from any one group of four consecutive 28-day test results exceeds the specified characteristic strength by not less than 3 newtons per square millimetre for classes of concrete C20, C25 and C30 and not less than 2 newtons per square millimetre for class C15 concrete.

(b) Each individual 28-day test results is greater than the specified characteristic strength minus 3 newtons per square millimetre for classes of concrete C20, C25 and C30 or 2 newtons per square millimetre for class C15 concrete.

If only one tests result fails to meet the second requirement, then that result may be considered to represent only the particular batch of concrete from which that sample was taken provided the average strength of the group satisfies the first requirement.

If more than one result in a group fails to meet the second requirement or if the average strength of any group of four consecutive test results fails to meet the first requirement, then all the concrete in all the batches represented by all such results shall be deemed not to comply with the strength requirements. For the purposes of this Clause, the batches of concrete represented by a group of four consecutive test results shall include the batches from which samples were taken to make the first and the last tests in the group of four, together with all the intervening batches.

3.12 Failure to Comply with Specified Requirements

Failure of concrete to comply with the specified requirements will result in it being classified as defective work. Immediately on notification by the Infrastructure Development Engineer/Project Manager/Engineer that concrete work is defective, the Contractor shall take all measures necessary to improve concrete quality before further concrete is placed in the Works. If required by the Infrastructure Development Engineer /Project Manager/Engineer, the rate of sampling of concrete shall be increased until adequate control is again established. Tests shall be carried out on the defective concrete or test cores taken from it to establish its in-situ strength. If the results of these tests satisfy the Project Manager/Engineer that the defective concrete will fulfil its design function then it may be accepted. If not, the Contractor shall propose strengthening or remedial work where possible or shall remove the defective concrete from the Works.

3.13 Concrete Returns and Records

The Contractor shall send weekly to the Project Manager/Engineer a return showing the quantities of cement and the number of mixings of each class of concrete used in each section of the Works.

Records shall be kept by the Contractor of the positions in the Works of all batches of concrete, of their class and of all test cubes or other specimens taken from them. Copies of these records shall be supplied to the Project Manager/Engineer.

3.14 Plant, Equipment and Construction Procedure

The design, layout, installation and operation of plant and equipment for processing, handling, transporting, storing and proportioning concrete ingredients and for mixing, transporting and placing concrete shall be to the satisfaction of the Project Manager/Engineer. Before the plant and equipment is ordered or delivered to site, the Contractor shall submit to the Project Manager/Engineer drawings showing the proposed arrangements of the plant together with detailed descriptions of the equipment proposed

3.15 Batching

The aggregates and cement shall be proportioned by means of efficient weigh batching machines except when the Project Manager/Engineer has approved the use of volume batching. The machines shall be carefully maintained and cleaned and they shall be provided with simple and convenient means of checking the accuracy of the weighing mechanism, and they shall be checked when required by the Project Manager/Engineer.

For volume batching suitable gauge boxes shall be used.

3.16 Mixing Concrete by Machine

Where the concrete is to be mixed in machines, these shall be of the batch mixing or other approved type. The machines shall ensure that all the concreting materials including the water are thoroughly mixed together before any portion of the mixture is discharged. The mixing time shall not be less than thirty seconds per cubic foot (30sec/cft) of concrete, with a minimum of

three minutes (3min) mixing time per batch. The machines must be capable of discharging their contents while running.

3.17 Mixing Concrete by Hand

Where it is not possible to employ machine mixing and approval has been obtained from the Project Manager/Engineer, concrete shall be mixed by hand as near as practicable to the site where it is to be deposited. Clean mixing bankers or platforms of sufficient area for the proper execution of the work shall be provided. These platforms if constructed of timber shall consist of planks closely jointed so as to avoid the loss of any grout or liquid from the wet concrete. The whole of the aggregate and cement shall be turned over on the banker in a dry state at least twice. The water shall then be added gradually through a rose head, after which the materials shall again be entirely turned over in a wet state at least three times.

3.18 Preparation of Surface to Receive Concrete

Foundations which are to receive concrete shall be properly drained and dewatered so that no water runs over or stands on a surface on which concrete is being placed. If required by the Project Manager/Engineer drains provided through or beneath concrete for the temporary conveyance of water shall afterwards be completely sealed to the Infrastructure Development Engineer/Project Manager's approval.

Before deposition of concrete against rock, the rock surface shall be thoroughly wetted and cleaned by the application of water, or of water and air, under pressure. No concrete shall be deposited until the surface has been cleaned and passed as satisfactory by the Project Manager/Engineer.

Faults or seams in the rock shall be cleaned to a depth satisfactory to the Project Manager/Engineer and if necessary, stemmed with cement mortar of an approved mix.

Before any steel reinforcement is embedded in the concrete any loose mill scale, loose rust and any oil, grease or other deleterious matter shall be removed. Partially set concrete which may adhere to the exposed bars during concreting operations shall likewise be removed.

3.19 Authority to Commence Placing of Concrete

The Contractor shall give the Pro Infrastructure Development Engineer jat least 24-hours' notice of his intention to place concrete in a particular section of the Works. Before concrete is placed the Contractor shall apply to the Project Manager/Engineer for approval of the cleanliness, alignment and suitability of surfaces against which the new concrete is to be placed and of the fixing of formwork, reinforcement, embedded parts and the like and he shall obtain written permission from the Project Manager/Engineer to proceed with concreting.

The Contractor shall carefully plan his concreting operation to ensure, where possible, that these operations are completed within the normal working day.

3.20 Dimension of Concrete Pours and Programme of Placing

Unless otherwise approved by the Infrastructure Development Engineer /Project Manager concrete shall be cast in one operation between external faces of concrete and joints shown on the Drawings or between construction joints or both.

The Contractor shall submit and obtain the Infrastructure Development Engineer /Project Manager's approval to a detailed concreting programme and his proposals for the location of construction joints.

3.21 Transport and Deposition of Concrete

Concrete shall be transported and deposited in such manner as to prevent segregation, loss of materials or contamination with foreign matter. The means of transport of concrete shall be subject to the approval of the Infrastructure Development Engineer/Project Manager. The containers for conveying the concrete shall be thoroughly cleaned immediately after use and sides dampened before work is started or restarted to prevent cement and fine material in the first batch adhering to the sides. Adequate precautions shall be taken to protect the concrete against wetting or drying out through exposure to the weather and to prevent segregation and consolidation of the mix due to prolonged jolting of the concrete. Concrete shall be placed in its final position and fully compacted before the onset of initial set. Wherever possible, concrete shall be deposited vertically in the final position required and shall not be dropped through a greater height than 1.5 m. Where necessary, bins, drop chutes, downpipes or baffles shall be provided to prevent segregation of the material. Drying out of fresh concrete before deposition shall be prevented by the provision where necessary of suitable covers. Loss of slump during transport and deposition of the concrete shall not exceed 25 millimetres.

Concrete shall not be placed in standing or running water unless so specified. Where concrete has to be placed under water, the Contractor shall submit to the Project Manager/Engineer his proposals indicating the methods and equipment to be employed. The concrete shall be deposited by bottom discharging watertight containers or through funnel shaped tremies which are kept continuously full with concrete up to a level above the water and which shall have the discharging bottoms immersed in the concrete in order to reduce to a minimum the contact of the concrete with the water. Special care shall be taken to avoid segregation and additional cement of about 25% must be added.

3.22 Distribution and Spreading of Concrete

Concrete shall be placed in layers not exceeding 500 millimetres in depth approximately parallel to the horizontal or inclined construction joint planes. These layers shall be deposited from one face to the other until the full height of the lift is reached. Each layer shall be deposited on the previous one before the latter has taken its initial set and the exposed area of fresh concrete shall be maintained to the practical minimum. In order to accomplish this timing a new layer may be started before the previous layer is completed.

The face from which placing of concrete is to commence shall be selected so that if an emergency should occur which prevents the layer being completed the vertical construction joint will be formed in a structurally acceptable position.

Concrete shall not be placed during rain sufficiently heavy or prolonged to wash mortar form coarse aggregate on the exposed sloping faces of fresh concrete unless adequate shelter is provided.

Concrete shall not be placed against any surface (including formwork, reinforcement, embedded steelwork, adjacent concrete or rock) which during hot weather is not adequately dampened to prevent excessive absorption of water from the fresh concrete.

Once commenced, concreting shall be carried on as continuous operation between pre-arranged construction, expansion or contraction joints save only if an emergency occurs and interruption is unavoidable. The Contractor shall have readily available suitable prefabricated formwork for stop ends to form emergency vertical construction joints and, in the event of such an interruption

occurring, the concrete already placed shall be properly finished up to the stop end and to a horizontal or inclined surface as directed by the Project Manager/Engineer. In water retaining structures the Contractor shall propose methods of making the joint watertight.

Concrete shall be placed carefully so as not to displace the formwork or reinforcement.

3.23 Compaction of Concrete

The Contractor shall thoroughly compact all concrete immediately after it has been placed in position. Unless otherwise authorised by the Project Manager/Engineer, compaction shall be accomplished with the aid of immersion vibrators as specified below, together, if necessary, with rods, shovels and the like. Particular care shall be taken to fill all voids and to work the concrete against rock and existing concrete surfaces, round any reinforcement and embedded fixtures and into the corners of the formwork.

If the Contractor does not wish to use immersion vibrators for any portion of the works he shall submit his proposals for alternative vibrators or compaction equipment and shall receive the Project Manager/Engineer's approval to the equipment before commencing to concrete the portion concerned.

Vibrators shall be of a type and size adequate for the portion placed. Vibrators shall operate at a frequency of between 7000 and 10000 impulses per minute. The Contractor shall ensure that vibrators are operated at pressures and voltages not less than those recommended by the manufacturer in order to ensure that the compactive effort is not reduced.

A sufficient number of vibrators shall be operated to enable the entire quantity of concrete being placed to be vibrated for the necessary period and in addition stand-by vibrators shall be available for instant use at each concreting place. The length and diameter of the vibrating element of immersion vibrators shall be sufficient to penetrate through the layer of concrete being placed and re-vibrate the upper portion of the underlying layer of concrete.

Only men experienced in the use of vibrators shall be employed on this type of work.

Vibration shall be continued at each point until the concrete ceases to contract, a thin layer of mortar has appeared on the surface and air bubbles have ceased to appear. The period of vibration necessary shall be determined by trial in the presence of the Project Manager/Engineer. Vibration shall then be continued for this period at each point before any further concrete is superimposed.

Immersion vibrators shall be inserted vertically to penetrate into the layer underneath at regular intervals, which shall not exceed the distance from the element over which vibration is visibly effective and, in any case, shall not exceed 700 millimetres. Vibrators shall not be used to move concrete laterally and shall be withdrawn slowly to prevent the formation of voids. Vibrators shall not be applied to reinforcement or other embedded items.

3.24 Protection of Concrete

Freshly placed concrete shall be protected from hot sun, rainfall and from water running over the surface until it is sufficiently hard to resist damage from this cause.

No traffic shall be allowed on any concrete surface until such time as it is hard enough to resist damage by such traffic.

Concrete placed in the Permanent Works shall not be subjected to any structural loading until it has attained at least its nominal strength.

If the Contractor desires to impose structural loads on newly placed concrete, he shall make at least three test cubes and cure them in the same conditions as the concrete they represent. These cubes shall be tested singly at suitable intervals in order to estimate the time at which the nominal strength is reached.

3.25 No Partially Set Concrete Shall be Used

All concrete must be placed and compacted in its final position within thirty minutes (30min) of discharge from the mixer unless otherwise approved. partially set material shall not be used in this work.

3.26 Plum Concrete

Plums shall be hard clean natural stones embedded in mass concrete during the placing of the concrete. Unless otherwise shown on the drawings, the plums shall not be larger than one third of the cross section of the concrete and should not be placed closer than 150 mm to each other vertically and 100mm horizontally. The volume of plums shall unless otherwise specified, not exceed forty per cent (40%) of the mass concrete volume and care shall be taken to ensure that the minimum cover over any plums is 100mm.

3.27 Concreting in Adverse Weather

No concreting will be allowed to take place in the open during storms or heavy rains. Where strong winds are likely to be experienced additional precautions to ensure protection from driving rain and dust shall also be taken.

The Infrastructure Development Engineer/Project Manager may withhold approval of commencement of concreting until he is satisfied that full and adequate arrangements have been made.

3.28 Concreting at Night or in the Dark

Where approval has been given for continuous concreting operations or at night or in places where daylight is excluded, the Contractor is to provide adequate security and lighting at all points where mixing, transportation and placing of concrete are in progress.

3.29 Concreting in High or Low Ambient Temperature

Where the ambient temperature exceeds thirty-two degrees Celsius (28^{o}C), the Contractor shall take special measures in the mixing, placing and curing of concrete. The temperature of the concrete when deposited shall not exceed thirty degrees Celsius (30^{o}C). The Contractor shall carry out all necessary special measures to ensure that the maximum concrete temperature after placing shall not exceed twenty-eight degrees Celsius (28^{o}C) or thirty degrees Celsius (30^{o}C) above the concrete temperature at the time of placing, whichever is lower.

During placing suitable means shall be provided to prevent premature stiffening of the concrete placed in contact with hot surfaces.

The Contractor shall not mix and place concrete when the ambient temperature falls below three degrees Celsius (3°C).

3.30 Curing and Protection

Concrete shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, cold, rain or running water. The Contractor shall pay particular attention to the need to protect concrete immediately after the finishing operation and prior to its final set and shall submit their proposals to achieve this protection for the Project Manager/Engineer's approval. Protection of concrete which has achieved its final set shall consist of one or more of the following:

(a) A layer of sacking, canvas, hessian, straw mats or similar absorbent material or a layer of sand, kept constantly moist by spraying with water as necessary for fourteen (14) days or such periods as may be directed by the Infrastructure Development Engineer/Project Manager.

(b) After thoroughly wetting, a layer of approved waterproof paper or plastic membrane kept in contact with the concrete for fourteen (14) days or such period as may be directed by the Project Manager/Engineer.

The use of saline water for curing purposes will not be permitted.

3.31 Steel Reinforcement

3.31.1 Materials

Unless otherwise directed or otherwise shown on the Drawings, hot rolled high yield reinforcement shall be used throughout the works.

Where required, mild steel reinforcement, medium tensile steel reinforcement and high tensile steel reinforcement shall comply with BS 4449. Cold twisted steel wire for the reinforcement of concrete shall comply with BS 4482.

All reinforcement shall from an approved manufacturer and, if required by the Project Manager/Engineer, the Contractor shall submit a test certificate of the rollings. The Contractor shall, when requested by the Project Manager/Engineer, provide sample pieces 1.0 metre long for testing.

Tying wire shall be 1.6 mm diameter soft annealed iron wire.

Before any steel reinforcement is embedded in the concrete any loose mill scale, loose rust and any oil, grease or other deleterious matter shall be removed. Partially set concrete which may adhere to the exposed bars during concreting operations shall likewise be removed.

3.31.2 Fabricating Reinforcement

Bar reinforcements shall be bent to the shapes shown on the Drawings and bending schedules. All bars shall be bent cold, unless otherwise permitted by the Infrastructure Development Engineer/Project Manager. All hooks, bends, and the like, unless otherwise shown on the Drawings, shall be to BS 8666. The Contractor shall satisfy himself as to the accuracy of any bar bending schedules supplied and shall provide all reinforcement in accordance with the Drawing. Bar reinforcement shall be bundled and each bundle of steel shall be tagged with identifying tags, showing the size and mark of the bar. The bundles shall be stacked clear of the ground in easily accessible positions that do not in any way hinder the progress of work and shall be kept clean.

3.31.3 Fixing Reinforcement

When placed in the work reinforcement shall be free from coatings or dirt, detrimental scale, paint, oil or other foreign substances. When steel has on its surface rust, loose scale and dust which is easily removable, it may be cleaned by a method approved by the Project Manager/Engineer.

All reinforcing bars, ties, links and fabric shall be fixed in the positions shown on the Drawings within the tolerances specified in BS 8666. In no case shall the cover specified on the Drawings be increased by more than 5 millimetres.

Displacement of reinforcement beyond the specified tolerance shall be prevented by supporting the bars sufficiently and securely fixing them together at intersections where necessary.

The ends of all tying wires shall be turned into the body of the concrete and not allowed to project towards the surfaces of the concrete.

Spacers shall be used to maintain the cover to all steel and shall be made of dense cement mortar of one part cement and two parts sand.

Spacers shall be triangular in section and only one acute edge shall bear against the formwork, the flat side shall bear against the steel. Wire cast into the blocks to fix them to the reinforcement shall be 1.6 millimetres diameter soft annealed iron. Spacers shall not be used on the wet face of water retaining or water excluding structures. Chairs, stools, etc. shall be used to maintain clearance between two or more layers of reinforcement.

Nothing shall be allowed to interfere with the specified position of reinforcement. The fixing of reinforcement shall be checked before and during concreting, and particular attention shall be given to the position of top steel in cantilever sections. During concrete placing a competent steel fixer shall be in attendance to adjust and correct the position of any reinforcement which may be displaced.

3.31.4 Splicing and Lapping

All reinforcement shall be provided in full lengths as indicated on the Drawings or bending schedules. Splicing of bars, except were shown on the Drawings, shall not be permitted without the approval of the Infrastructure Development Engineer. Splices shall be staggered as far as possible. Bar reinforcement shall not be welded without the Project Manager/Engineer's written permission.

In lapped splices, the bars shall be placed in contact and wired together in such manner as to maintain a clearance between bars of not less than 50 millimetres.

Mesh or bar reinforcement shall overlap sufficiently to maintain a uniform strength and shall be securely fastened at ends and edges. The edge lap shall not be less than 40 diameters of the mesh reinforcement bar or two mesh widths whichever is greater

3.32 Cover to reinforcement

The concrete cover to reinforcement shall be as follows unless otherwise shown on the Drawings.

Member	Concrete cover (mm)
Foundations	50mm
Columns	30
Beams	30
Slabs	25

The Contractor shall provide any necessary concrete pads for ensuring the cover is attained and in no case shall timber packing be used.

3.33 Formwork

3.33.1 Definitions

Forms, formwork or shuttering shall mean all temporary moulds forming the concrete to the required shape together with any special lining that may be required to produce the concrete finish specified.

Falsework or centering shall mean the furnishing, placing and removal of all temporary construction such as framing, props and struts required for the support of forms.

3.33.2 Materials

The formwork may of seasoned, planed, tongued and grooved timber, plywood, blockboard, tempered hardboard, steel or as specified on the Drawings.

All timber used for formwork shall be sound wood, well seasoned and free from loose knots, shakes, large checks, warping and other defects. Before use on the work, it shall be properly stacked and protected from injury from any source. Any timber which becomes badly warped or cracked, prior to the placing of concrete shall be rejected. All formwork for outside surfaces before final ground level shall be either tongued and grooved or provided with a suitable lining to produce a smooth surface finish.

3.33.3 Forms

All forms shall be of wood or metal and shall be built grout-tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the openings of joints due to shrinkage of the timber.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration of concrete as it is placed.

All formwork shall, unless otherwise directed, be provided with 25 millimetres by 25 millimetres angle fillets (chamfers) so as to form splays on internal and external angles.

A grout check formed from 25 millimetres square hardwood timber shall be incorporated in the formwork to provide a clean, level, horizontal joint on exposed concrete surfaces at the top of each lift.

All joints in the formwork shall be either horizontal or vertical. End formwork shall be square across the mass of concrete.

Where concrete is to be deposited to a slope steeper than 20 degrees to the horizontal, top formwork shall be used to enable the concrete to be properly compacted unless the Project Manager/Engineer agrees otherwise.

Openings for the inspection and cleaning of the inside of formwork for walls, piers and columns shall be formed in such a way that they can be closed conveniently before commencing to place concrete.

Form clamps, tie bolts and anchors shall be used to fasten forms. The use of wire ties to hold forms in position during placing of concrete will not be permitted. Tie bolts and clamps shall be positive in action and of sufficient strength and number to prevent spreading or springing of the

forms. They shall be of such type that no metal part shall be left within the specified concrete cover. For water retaining sections, methods of fixing the forms which result in holes through the concrete section when the formwork is removed shall not be used and built-in wall ties shall be fitted with water baffles.

All forms for outside surfaces shall be constructed with stiff wales at right angles to the studs and all form clamps shall extend through and fasten such wales.

The shape, strength, rigidity, grout tightness and surface smoothness of forms which are re-used shall be maintained at all times. Any warped, bulged or otherwise damaged timber shall be replaced. Forms which are unsatisfactory shall not be re-used. If the surface finish on the formed concrete deteriorates as a result of deterioration of the faces of the forms, the Project Manager/Engineer shall instruct that forms be resurfaced, or discarded.

All forms shall be treated with approved mould or similar oil or be soaked with water immediately before placing concrete to prevent adherence of concrete. Any materials which adhere to or discolour concrete shall not be used.

All forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Forms shall remain in place for periods which shall be as specified in Clause 3.34. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Project Manager/Engineer shall order the work stopped until the defects have been corrected.

All formwork shall be approved by the Infrastructure Development Engineer /Project Manager before concrete is placed within it. The Contractor shall, if required by the Project Manager/Engineer, provide copies of calculations of the strength and stability of the formwork and falsework. Notwithstanding the Project Manager/Engineer's approval of these calculations, the Contractor shall be held responsible for the safety and adequacy of formwork.

3.33.4 Falsework and Centering

Detailed plans for a falsework or centering shall be supplied by the contractor to the Project Manager/Engineer at least 7 days in advance of the time the Contractor begins construction of the falsework. Notwithstanding the approval of the Project Manager/Engineer of any designs for falsework submitted by the Contractor, the Contractor shall be solely responsible for the strength, safety and adequacy of the falsework or centering.

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads from the weight of green concrete and shuttering and incidental construction loads.

Falsework or centering shall be founded upon a solid footing safe against undermining and protected from softening. Falsework which cannot be founded on satisfactory footings shall be supported on piling which shall be spaced, driven and removed in a manner approved by the Project Manager/Engineer. The Project Manager/Engineer may require the Contractor to employ screw jacks, or hard wood wedges to take up any settlement in the formwork either before or during the placing of concrete.

Falsework shall be set to give the finished structure the required grade and camber shown on the Drawings.

3.33.5 Forms for Joints

Where permanent or temporary joints are to be made in horizontal or inclined members, stout stopping off boards shall be securely fixed across the mould to form a water-tight joint. The form of the permanent joint shall be as shown on the Drawings.

Where reinforcement or waterstops pass through the face of a joint the stopping off board shall be drilled so that the bars or waterstop can pass through, or the board shall be made in sections with a half round indentation in the joint faces for each bar so that when placed the board is neat

and accurate fit and no grout leaks from the concrete through the bar holes, joints or around the waterstop.

3.33.6 Release Agents

Only approved chemical release agents, mould creams (emulsions of water in oil) or oils containing a proportion of surfactant not exceeding 2 percent will be permitted. Water soluble emulsions and oils without surfactant shall not be used. Oil based release agents shall be applied at a rate of 7 square metres per litre one day in advance of concreting, preferably by spray or roller. Chemical release agents shall be applied in accordance with the manufacturer's recommendations.

New timber face work shall be given three coats of release agent before use on the work to ensure uniformity of porosity on the surface.

On no account shall the release agent come into contact with the reinforcement.

3.34 Removal of Formwork

Formwork shall be carefully removed without shock or disturbance to the concrete. No formwork shall be removed until the concrete has gained sufficient strength to withstand safely any stresses to which it may thereby be subjected.

The minimum periods which shall elapse between completion of placing concrete and removal of forms are given in the following Table 3.2, and apply to ambient temperatures higher than 10^{o}C. At lower temperatures or if cements other than ordinary Portland are involved, the Project Manager/Engineer may instruct longer periods.

Compliance with these requirements shall not relieve the Contractor of his obligation to delay removal of formwork until such removal can be completed without damage to the concrete.

Table 3.2 – Formwork striking time

Position of formwork	Striking Time
Beam sides, walls and columns	1 to 2 day
Slab soffits – props remain undisturbed	4 days
Beam soffits - props remain undisturbed	7 days
Removal of slab props	14 days
Removal of beam props	21 days

3.35 Surface Finishes

3.35.1 General

After removal of the formwork no treatment of any kind other than that required for curing the concrete shall be applied to the concrete faces until after inspection by the Project Manager/Engineer. All honeycombed areas, deformed surfaces or other defective surfaces shall then be repaired at the direction of the Project Manager/Engineer. Immediately following the Project Manager/Engineer's inspection of surface finish, all tie bolt cavities shall be filled with sand cement mortar and the surface left smooth, sound, even and uniform in colour.

Should the finishes surface either as-stuck or after repair exhibit a non uniform colour or texture, the Project Manager/Engineer shall have the right to order that the surface be given a skim coat and then painted.

3.35.2 Formed Surfaces

All joints between panels shall be vertical and horizontal unless otherwise directed. Suitable joints shall be provided between sheets to maintain accurate alignment in the plane of the sheets.

For warped surfaces, facings shall be built up of laminated splines cut to make a tight surface which shall then be dressed and sanded to the required curvature.

Type 1: This finish is for surfaces against which backfill or further concrete will be placed. Formwork shall consist of sawn boards, sheet metal or any other suitable material which will prevent the loss of grout when the concrete is being placed.

Type 2: This finish is for surfaces which are permanently exposed to view but where the highest standard of finish is not required. Forms to provide a Type F2 finish shall be faced with wrought thicknesses tongued and grooved boards with square edges arranged in a uniform pattern and close jointed or with suitable sheet material. The thickness of boards or sheets shall be such that there shall be no visible deflection under the pressure exerted by the concrete placed against them. Joints between boards or panels shall be horizontal and vertical unless otherwise directed. This finish shall be such as to require no general filling of surface pitting, but fins, surface discoloration and other minor defects shall be remedied by methods agreed by the Project Manager/Engineer.

Type 3: This finish is for surfaces which will be in contact with water flowing at high velocity and for surfaces permanently exposed to view where good appearance and alignment are of importance. To achieve this finish, which shall be free of board marks, the formwork shall be faced with plywood complying with BS 1088 or equivalent material in large sheets. The sheets shall be arranged in an approved, uniform pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features or changes in direction of the surface. Suitable joints shall be provided between sheets to maintain accurate alignment in the place of the sheets. Unfaced wrought boarding or standard steel panels will not be permitted for Type F3 finish. The Contractor shall ensure that the surface is protected from rust marks, spillages and stains of all kinds.

Type 4: This finish is similar to that required for type 3 but is used in places where a first-class alignment and a dense surface free from airholes and other defects is required, suitable for the application of decorative finishes, in very high velocity water channels and in other similar circumstances.

3.35.3 Unformed Surfaces

Type U1: This is screed finish for surfaces of roads of foundations, beds, slabs, and structural members to be covered by backfill, subsequent stages of construction, bonded concrete topping or cement mortar beds to receive paving, and on exposed surfaces of paving where a superior finish is not required. It is also the first stage of Type U2 and U3 finishes. The finishing operations shall consist of levelling and screeding the concrete to produce a uniform, plane or ridged surface, surplus concrete being struck off by a straight edge immediately after compaction.

Type U2: This is a floated finish for exposed surfaces where a hard smooth steel trowelled surface is not required. Floating shall be done only after the concrete has hardened sufficiently, and may be by hand or machine. Care should be taken that the concrete is worked no more than is necessary to produce a uniform surface free from float marks.

Type U3: This is a hard smooth steel trowelled finish for surfaces exposed to water flowing at high velocity. Trowelling shall not commence until the moisture film has disappeared and the concrete has hardened sufficiently to prevent excess laitance from being

worked to the surface. The surface shall be trowelled under firm pressure and left free from trowel marks.

Type U4: This finish is similar to Type U3 finish but the permissible tolerances are smaller.

3.35.4 Surface Tolerances

All parts of concrete surfaces shall be in the positions shown on the Drawings within the tolerances set out in Table 3.3 or Table 3.4.

In cases where the Drawings call for tolerances other than those given in Table 3.3 or Table 3.4, the Drawings shall rule.

Where precast units have been set to a specified tolerance, further adjustments shall be made as necessary to provide a satisfactory straight or curved line. When the Project Manager/Engineer has approved the alignment, the Contractor shall fix the units so that there is no possibility of further movement.

Table 3.3 - Surface Tolerances for Formed Surfaces

Type of Finish	Tolerance in Millimetres (See Note 1)		
	A	B	C
I	10	10	+25 to -10
2	5	10	+15 to -15
3	2	5	+10 to -10
4	See Note 2	2	+5 to -5

Note 1:

The tolerances, A, B and C given in the table are defined as follows:

A is an abrupt irregularity in the surface due to misaligned formwork or defects in the face of the formwork.

B is a gradual deviation from a plane surface as indicated by a straight edge 3 metres long. In the case of curved surfaces, the straight edge shall be replaced by a correctly shaped template.

C is the amount by which the whole or part of a concrete face is displaced from the correct position shown on the Drawings.

Note 2:

Abrupt irregularities are not permitted in a Type F4 finish. Any residual irregularities which remain after removal of formwork shall be removed by grinding to achieve a transition of 1 in 50 between the surfaces adjacent to the irregularity.

Table 3.4 - Surface Tolerances for Unformed Surfaces

Type of Finish	Tolerance in Millimetres (See Note 1)		
	D	E	F
U1	-	10	+20 to -10
U2	Nil	10	+20 to -10
U3	Nil	5	+12.5 to -7.5
U4	Nil	2	+6 to -4

Notes:

D is the maximum allowable value of any sudden change of level in the surface.

E is the maximum allowable value of any gradual irregularity of the surface, as indicated by the gap between the surface and a 3 metres long straight edge or correctly shaped template placed on the surface.

F is the maximum allowable value of the difference in level or position between a straight edge or correctly shaped template placed on the surface and the specified level or position of that surface.

3.36 Conduits, Box-outs and Apertures

The layout of conduits, box-outs, grooves, apertures and the like shall be as shown on the Drawings or as directed by the Infrastructure Development Engineer /Project Manager, and shall be subject to inspection and approval by the Project Manager/Engineer before commencing concreting.

Conduits shall be placed as near the centres of members as possible and sufficient space shall be provided between adjacent conduits to prevent difficulties in the placing of concrete.

Box-outs, holes grooves, apertures and the like shall be accurately set out in the formwork prior to placing the concrete. Fixing blocks, ends of brackets, bolts and, where possible, built in parts shall be cast into the concrete at the time of placing. No part of the concrete works shall be cut out for any such item, or for any other reason, without the Project Manager/Engineer's permission.

The Contractor shall ensure that all sub-contractors are informed of his programme for the structural works at the commencement of the Contract and that such sub-contractor's requirements relating to concrete members are approved well in advance. The Contractor shall obtain from all such sub-contractors' complete information of their requirements regarding conduits, pipes, fixing blocks, ducts, holes and any other items to be cast into or formed in the concrete members. Failure of a sub-contractor to sub-contractor to supply such information shall not be allowed to delay the progress of the Works.

3.37 Construction joints

Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be as indicated on the Drawings or as previously approved by the Project Manager/Engineer. The Contractor is to allow for working beyond the ordinary working hours where necessary in order that each section of concrete may be completed without any lapse while the work is in hand. All construction joints are to be formed square to the work.

Where vertical construction joints are required, the joint face of the first stage concrete shall be finished against a stopping-off board, or vertical end shutter, suitably notched to pass the reinforcement. When the concrete is hard and the shutter is removed, the whole joint surface shall be thoroughly hacked and roughened or scabbled with suitable tools so that no smooth skin of concrete is visible and that all aggregates and solid matrix around them is exposed.

For horizontal or slightly inclined construction joints, the surfaces shall preferably be prepared when the concrete has set but not hardened by jetting with a fine spray of water and brushing with a stiff brush to remove the smooth skin and expose the aggregate without disturbing it. Where this treatment is impractical and work is resumed after the concrete surface has hardened, a similar procedure shall be adopted as on vertical joints.

If, in the opinion of the Project Manager/Engineer, any deleterious material has come into contact with the concrete of the construction joint or if the concrete is honeycombed or unsound for any reason, the concrete shall be cut back to such a depth as the Project Manager/Engineer shall order and the roughened surfaces shall be thoroughly cleaned by compressed air and water jets or other approved means.

Immediately before concreting is resumed, the roughened joint surface shall be thoroughly cleaned with compressed air and water jets and slightly wetted and cement grout placed The Contractor shall take precaution to avoid segregation of the concrete along the joint plane and to obtain thorough compaction.

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3.38 Cement Grout

Cement grout for general purposes shall consist of Portland cement and water mixed in the proportion of one (1) part by volume of cement and one and a half (1.5) parts by volume of water. The grout shall be used within one hour (1hr) of mixing.

3.39 Cement Mortar

Cement mortar shall be machine mixed and unless otherwise specified, consist of three (3) parts of sand to one (1) part of Ordinary Portland cement mixed and thoroughly incorporated together. Just enough water will be added to give a workability appropriate to its use. The above proportions are by volume. Mortar shall be used whilst freshly mixed and no softening or retempering will be allowed.

3.40 Concrete Block and Bricks Masonry

Concrete blocks and bricks shall comply with BS 6073: Part 1 and shall have a minimum 28 days compressive strength of 3.5 N/mm^2 and 7 N/mm^2 respectively. The concrete blocks and bricks shall be laid in a staggered pattern such that the vertical joints between two consecutive layers are offset by half a block length. Joints on the inside faces shall be rendered in which case the joints shall be raked out at a depth of 5 mm. Rendering shall consist of 1:2 mortar applied to a thickness so as to ensure professional finish

The mix used to manufacture concrete blocks shall not be leaner than 1:9 by volume and the maximum size of aggregate shall be 10mm. The standard size of the concrete block shall be 400 mm x 200 x 200 mm and 300 x 100 x 100 for bricks. However blocks and bricks of other sizes may be used if approved by the Project Manager/Engineer for proper bonding at corners and openings

The concrete blocks and bricks shall be wetted before laying and shall be set in mortar, which complies with the specifications given in Clause 3.42. Unless otherwise stated, the maximum joint thickness shall be 12 mm and the horizontal and vertical joints shall be filled with mortar. Joints shall be finished flush with the face of the blocks and bricks. The Concrete block and brick masonry shall be cured for a period of seven days by covering the work with two layers of hessian, which is kept permanently saturated. Provision shall be made to clean all exposed faces both as the work proceeds and on completion so that they are left in a neat, tidy and clean condition.

Building masonry will not be permitted in heavy rain without the approval of the Project Manager/Engineer. In such instances the Contractor shall make provision to protect materials and the newly placed mortar from the rain.

Concrete blocks shall either be obtained from an approved manufacture or made on site in approved block making machines. When casting of the concrete blocks is done at site, these shall be removed from the casting machine and deposited on edge on covered racks and left for 3 days, during which time they shall be kept constantly wet. Afterwards they may be placed on racks in the open provided they are protected by hessian cloth or similar and kept wet for a further 5 days. Thereafter they shall not be moved or used in the works until they are 28 days old.

Chambers shall be constructed after pipes have been laid, except the bases may be constructed earlier to avoid deterioration of the formation.

Backfilling around completed chambers shall be with suitable material deposited equally all round and compacted in accordance with the Specifications.

Where any pipes are built into concrete or blockwork the pipe shall be surrounded in two layers of polythene sheeting unless a puddle flange has been shown on the Drawings.

3.41 Rendering Work

3.41.1 Material

Cement, water and fine aggregate shall conform to the requirements specified in the concrete works. Mesh reinforcement shall be plain diamond expanded steel lathing to BS 1369 where specified. Lime shall be to BS 980 and shall be mixed with water and allowed to stand prior to use according to the manufacturer's recommendations.

The mix proportion of the cement mortar by volume shall be as follows:

- For rendering coat, Cement: Sand = 1:5
- For finishing coat, Cement: Sand = 1:3

Lime putty may be mixed in mortar for finishing coat at 10% of sand by volume.

3.41.2 Waterproof cement mortar

Waterproof mortar shall be made by mixing a waterproof agent into ordinary cement mortar. The Contractor shall be responsible for selection and quality of the waterproof agent and this shall be approved by the Project Manager/Engineer before use. The mixing and application shall be in accordance with the manufacturer's instructions.

3.41.3 Application

The surface which are to receive a rendering coat shall be free from all laitance, scum, loose carbonate scale, loose aggregate dirt and other foreign matters. Concrete block, brick or stone surfaces shall be sufficiently and uniformly damped immediately before application of mortar. Concrete surfaces shall be kept thoroughly wet for 24 hours prior to the application of mortar.

Where shown on the drawings or directed by the Engineer, steel wire lath shall be fixed to the brick, concrete block or concrete walls before applying cement mortar plaster.

Cement mortar shall be used within 30 minutes from the time of mixing. Retempering shall not be permitted.

The total thickness of rendering plus finishing coat shall be 30 mm for the floors and 20 mm for wall. Cement mortar finish shall be trowel finished unless otherwise specified. When the finishing coat is applied, the entire surface of floor or wall shall be finished in one operation in order to minimise joint marks.

When expansion and control joints exist in the base structure, provision shall be made to prevent cracking of the mortar by inserting metal expansion beads within the coating thickness in a manner approved by the Engineer.

The finished surface shall be perfectly plumb or level as the case may be except where otherwise specified without any bulging, runs, bruises or stains.

After application of the finishing coat, the surfaces shall be kept continuously damp for not less than 48 hours and then allowed to become thoroughly dry. Moistening shall be started as soon as the surface has hardened sufficiently not to cause displacement or damage.

3.42 In Situ Concrete Chambers

In situ concrete chambers shall be constructed generally in accordance with Section 3 of this Specification.

3.43 Chamber Covers and Slabs

Covers and slabs shall be the type, size and weight shown in the drawings. Care shall be taken to see that slabs are even so that the cover can seat without rocking.

Covers and frames shall be provided as shown on the drawings. The tops of the covers shall be flush at all points with the surrounding surface of paved areas or as directed in unpaved areas. Any slight adjustment of the slab level which may be necessary to accomplish this shall be effected by topping the side walls with concrete.

4 STONEWORK

4.1 Stones

Stone for all purposes shall be the best of its kind, sound and durable, free from flaws and from soft, weathered or decomposed parts. The stone and the quarry from which it is obtained shall be subject to the approval of the Project Manager/Engineer, samples shall be submitted by the Contractor of the stone he proposes to use in the Works and the Project Manager/Engineer's approval shall be obtained before such stone is used or any order is placed. The stone used shall be clean and must be washed if deemed necessary in the opinion of the Project Manager/Engineer.

Stones for face work shall be as far as possible quarry split and not bullnosed or hammer dressed. A moderate amount of dressing to trim off large projections will however be permitted. Exposed faces of stones for masonry shall be free from tool marks except such as are inherent in the nature of any dressing that may be specified. In rock-faced work the roughness on the surface shall not project more than 40 mm for stone less than 0.3 m^2 face area and not more than 60 mm for large stones.

4.2 Wet Masonry

Masonry shall be built to the lines and levels shown on the Drawings.

For face work the stones shall show a face of not less than 0.025 m^2 and not more than 0.1 m^2 in area and none shall be less than 100 mm in depth; they shall be laid to give a uniformly random appearance and shall be selected in laying so as to present an even distribution of large and small stones on the face.

For the arises, stones shall be roughly squared, quarry split and of a size to give outbands varying from 300 mm to 500 mm in length and inbands from 150 mm to 250 mm. The alignment of arises shall be set true to the required lines.

The stones shall be set in mortar with their natural bedding plane (if any) as near normal as possible to the face or normal to the line of thrust in the case of load bearing structures. Particular care must be given to obtaining a sound bond both longitudinally and transversely and there shall be at least one bonder, or length not less than two-thirds of the wall thickness, in each square yard of wall face.

The mortar, unless otherwise specified, shall be machine mixed cement and sand in the proportion of one part to three (1:3) parts generally as described in the specification. Mortar shall completely fill all interstices between the stones.

The face joints in rubble masonry may vary in thickness from 10 mm to 20 mm. They shall be finished as a neat weathered joint with mortar while the work proceeds where the masonry is specified to be "unpointed". Where pointing is specified, the joints in each day's work shall be raked out to a depth of not less than 25 mm before the mortar has set. Subsequently the joint shall be filled with mortar and finished in accordance with Clause 4.6. The face of the masonry is to be kept wet while the pointing is proceeding. Provision shall be made to clean all exposed faces both as work proceeds and on completion so that they are left in a neat, tidy and clean condition.

Building of masonry will not be allowed in heavy rain without the written consent of the Project Manager/Engineer. Building shall only proceed when suitable precautions to the satisfaction of the Project Manager/Engineer shall be taken against the action of rain on newly placed mortar. If for any reason of urgency the consent of the Project Manager/Engineer should be desired to a departure from these provisions, the Contractor shall submit to the Project Manager/Engineer for approval their proposals for protecting the materials and work from the weather.

4.3 Bedding of Stone Masonry

Unless otherwise directed by the Project Manager/Engineer, all masonry stones, when incorporated in the Works shall be laid on its natural bed, except in the case of arches where the natural bed shall be radial.

4.4 Special Stonework

Special stonework shall consist of approved stones dressed to the shapes and dimensions and with the faces tooled, all as shown on the Drawings. All stones shall be laid true to line and centre with mortar joints as shown on the Drawings.

4.5 Pointing of Joints in Masonry

Unless otherwise shown on the Drawings, pointing to masonry joints shall be flush and shall be formed by raking the joint clean and then filling it with pointing consistency mortar which shall be given a flush face with a steel trowel.

4.6 Hand Placed Rubble Filling

Hand placed rubble filling shall consist of stones individually selected and placed by hand firmly in place in bearing contact with each other or with the sides of the space to be filled; the voids shall be carefully filled with small rocks and spalls wedged together to form a compact mass. The sides of stones shall be roughly trimmed, if necessary, with a spalling hammer to obtain a reasonably close fit. On the exposed face the stones shall be placed with their flattened sides uppermost and in the plane of the face.

4.7 Rock Pitching

Where applicable, Rock protection on embankment slopes and around structures shall be to the lines and levels shown on the contract Drawings. The terms "tipped rock" and "pitching" refer to the manner in which the rock is placed.

The different classes of rock are specified on the Drawings according to nominal size and the maximum and minimum size of the individual particles. Within the size limits of each class, the rock fragments shall be well graded with not more than forty per cent (40%) of the rocks being smaller than the stated nominal size. The shape of the rock shall be roughly uniform with no dimension less than sixty percent (60%) of the largest dimension. The individual rock pieces shall be dense, durable and abrasion resistant.

The Contractor shall submit bulk samples of not less than 2 m^3 of each class of rock for approval by the Project Manager/Engineer prior to placing. These samples shall be retained for comparison with material being placed in order to ensure a reasonable degree of uniformity within each class.

The base on which rock protection is to be placed shall be compacted and trimmed to the lines and levels shown on the drawings. Where two or more classes of rock are specified, the lower layers shall be completed to the Project Manager/Engineer's approval before the placing of subsequent layers.

Pitching will be used where a finished horizontal or inclined surface is required. It shall consist of hand placed stones, with spalls wedged into the interstices to produce an even surface, without projection above the neat lines shown on the Drawings. Care shall be taken to ensure that the stones are well bedded and the percentage of spalls shall not exceed forty percent (40%) of the total rock volume. Pitching on slopes shall be built upwards from the toe, unless otherwise directed by the Project Manager/Engineer. A coping consisting of large flat stones shall be laid along the top of stone pitching on slopes to produce a firm edge.

Stone Pitching shall consist of selected hard durable rock free from weathered or decomposed parts to the approval of the Project Manager/Engineer, containing no flaky stone and being well graded within the limits shown below. The class and the thickness of the layer shall be as shown on the drawings.

Class	Size of stone	Percentage by weight

	d (mm)	smaller than stone sized
A	300	100
	125	40-55
	45	0
B	150	100
	63	40-55
	31.5	0
C	63	100
	22	60-85
	8	20-40
	4	0

Class	Size of stone d (mm)	Percentage by weight smaller than stone sized
D	31.5	100
	16	50-80
	8	20-50
	4	0
E	350	100
	200	0
F	225	100
	90	35-55
	45	0
G	850	100
	500	30-60
	300	0

Tipped rock / stone pitching shall be placed in an approved manner in order to produce a uniform well-knit unsegregated layer in which all sized are held in position.

4.8 Geotextile Filter Cloth and Polythene Sheeting

Geotextile filter cloth shall be made of non-woven polyester material with a minimum weight of 270 g/m^2 and minimum thickness of 2.3mm. The Polythene sheeting shall be gauge 500.

The material shall be placed carefully on suitably cleared surfaces, such that tearing or piercing is avoided at all times.

Continuity at horizontal and vertical joins shall be achieved with a minimum overlap of 0.6m. Overlaps may be physically sealed using spot welds with an open flame and subject to approval of the Project Manager/Engineer. On a horizontal join, the new layer shall be placed on the outside and backfilling or plum concrete shall proceed carefully to ensure that full contact of the join overlap is maintained. On a vertical join, the new layer shall be placed on the inside, and backfilling or plum concrete shall proceed such that contact is first on the outside layer, thereby sealing the inside layer to prevent soil/concrete migration between the overlap.

4.9 Hardcore

Hardcore shall consist of broken rock, concrete or other approved hard material, clean and free from extraneous matter, having a maximum particle size of 200 mm. It shall be spread and levelled, watered and compacted, and then blinded with a layer of fine material of grading 3 mm to dust, watered and compacted all to the Project Manager/Engineer's approval.

5 PIPEWORK

5.1 General

The Contractor shall construct pipelines to the lines and levels using grades, classes, or designs of pipe, bedding, haunching and surrounding as shown on the Drawings or directed by the Project Manager/Engineer.

Unless otherwise described in the Contract or agreed by the Project Manager/Engineer only one type of pipe shall be used within any individual length.

All materials shall be subject to the approval of the Project Manager/Engineer prior to procurement and delivery. Upon delivery, the Project Manager/Engineer shall inspect the delivered material for compliance with the specifications. In case of non-conformity, the Contractor shall replace the material at his own cost.

The pipes and fittings shall comply in all respects with British Standards and jointing of pipes and fittings shall be carried out in accordance with the manufacturer's instructions and to the approval of the Infrastructure Development Engineer /Project Manager

5.2 Storage and Protection of Materials (Pipes)

Pipes shall be stacked on a firm base using two timber packers only under the barrel of rigid pipes such as concrete or steel.

Flexible pipes such as uPVC shall be stacked closely side by side on a firm plane base so that the whole length of the barrel is uniformly supported and sockets are clear of the ground. Each succeeding layer shall be placed at right angles to the previous layers. The height of any stack shall be not more than six layers of pipes and in the case of steel, not more than two layers.

Fittings and specials of any type shall be stored in a single layer only.

Pipes and fittings shall at all times be adequately protected from damage during transport, storage and handling. Cracked or chipped pipes shall not be used in the permanent works. Steel and large diameter plastic pipes shall be fitted in the factory with end caps or reinforcement adequate to prevent distortion during transport, storage and handling.

Plastic pipes and fittings shall be protected from direct sunshine and excessive heat. Deformed pipes and fittings shall not be used in the permanent works.

Rubber rings and other pipe jointing material shall be stored under cover from direct sunshine.

Granular bedding shall be stored on a firm impermeable base so that it does not become contaminated with deleterious matter.

5.3 Handling Pipes and Fittings

Before any pipes are delivered to site the Contractor shall submit details to the Infrastructure Development Engineer /Project Manager of his proposals for handling pipes during transport, in store and during laying.

During transport and in store, pipes shall not rest on narrow traverse supports likely to cause damage to the pie or its coating. Pipes shall not be unloaded from a vehicle by tipping or dropping.

Pipes shall be lifted by flat braided wire slings or band slings except in the case of externally coated pipes and plastic pipes for which band slings having a width of at least 300 mm shall be used. Wire rope sling shall not be used for any pipes. No pipes shall be lifted by means of hooks applied to the ends of the pipe or by means of appliances such as grabs and togs.

In making arrangements for handling pipes, the Contractor shall take into account any recommendations made by the pipe manufacturer.

Where appropriate the requirements of this Clause shall apply to fittings and other components.

5.4 Cutting Pipes

The cutting of pipes for making up lengths shall be carried out by a method which leaves a clean square end.

Steel pipes to be cut shall have the line to be cut clearly marked round the pipe. Cutting shall be carried out by cutting disc or by oxy-acetylene and the cut end shall subsequently be ground to the correct profile for the method of jointing in use.

5.5 Pipes and Fittings

5.5.1 Steel pipes

Steel pipes and specials for water and sewerage shall comply with BS 534.

Galvanised mild steel pipes and fittings shall comply with BS 1387 Class B or ”Medium Grade" and complying with ISO 65. Threading for screwed and socketed joints shall be in accordance with the requirements of BS 21.

Joints shall be made with an approved pipe-jointing compound in accordance with the manufacturer's instructions. Red lead compounds shall not be used. Joints in underground piping shall be coated with bitumen or other approved composition.

All underground sections of pipework to be protected against corrosion by treating with "COLAS primer, and wrapped with fibreglass and coated with two coats of 'COLAS' bituminous tap coats all to manufacturers specification.

The bituminous paint is to be manufactured to ASTM D1187-82.

All fittings for galvanised steel water pipework shall be galvanised heavy weight fittings in accordance with BS 1740, BS 5153 and BS 5154. All fittings shall be subject to the approval of the Project Manager/Engineer.

Brass or gunmetal fittings shall be subject to the approval of the Project Manager/Engineer.

5.5.2 uPVC pipes

Unplasticized Polyvinyl Chloride (uPVC) pressure pipe shall have outside diameters complying with ISO 161, laying lengths complying with ISO 264 and wall thicknesses complying with 1SO

4065. The uPVC pipes shall comply with BS 3505 Class C (0.9 bar working pressure). Joints shall be of the spigot and integral socket type. Solvent weld joints are not permitted in buried uPVC pipelines.

Fittings for use with uPVC pressure pipe shall be manufactured from either uPVC or cast iron with socketed joints and shall comply with ISO 727. Cast iron fittings shall be bitumen coated. Aluminium alloy fittings are not permitted.

The metal adaptor fittings shall comply with ISO 4132.

5.6 Laying Pipes in Trenches and Headings

Where applicable, Immediately before pipes are placed in any trench, the bottom shall be cleared of all stones and other debris and shall be in a condition acceptable to the Project Manager/Engineer. Prior to placing in the trench, all pipes shall be inspected for damage. Damaged pipes which in the opinion of the Project Manager/Engineer cannot satisfactorily be made good shall not be used in the permanent works. End caps or discs placed on the pipes for protection during transit shall not be removed until immediately before the pipes are jointed.

Pipes shall be laid in straight lines unless otherwise shown on the drawings. No pipe shall deviate from the true line and level by more than 5 mm. Pipes shall be firmly bedded throughout their length to the required alignment and level so that they are concentric at each joint. All pipes shall be suitably wedged, shored or otherwise restrained to prevent movement during testing and backfilling but such restraints shall not be left in place permanently unless instructed or agreed by the Project Manager/Engineer.

Pipes which are to receive a concrete bed and Hauch or surround shall be sent on suitable concrete blocks or bricks with a pad of hessian-based damp proof course two millimetres thick interposed between the pipe and the block. Setting blocks shall not be used with other forms of bedding.

Unless otherwise agreed by the Project Manager/Engineer a close-fitting brush or swap shall be placed in pipelines having nominal diameters of 650 mm or less and shall be drawn forward progressively as pipelaying proceeds by means of a suitable rope which shall be threaded through each pipe as it is laid. Pipelines having nominal diameters greater than 650 mm shall be kept clean by suitable means as pipelaying proceeds. No debris of any kind shall be allowed to remain in the pipeline. Where the pipeline has internal lining, persons entering shall wear rubber boots and equipment trolleys shall have rubber tyred wheels. Pipes and joints shall be kept free of dirt, mud and other deleterious matter at all times. If pipelaying is stopped at any time, a cap shall immediately be placed on the end of the last pipe laid to exclude dirt.

Suitable precautions shall be taken to prevent the floating of pipes due to flooding of trenches. If floating should occur, the whole of the pipe run affected shall be removed and trench prepared again. No pipes shall be re-laid in trenches which have flooded until the trenches and the pipes have been inspected by the Infrastructure Development Engineer/Project Manager. The Contractor shall be entirely responsible for the sufficiency of all temporary supports and side slopes to the excavations. The excavation shall be carried out in such a way as to maintain the stability of all roads and other adjacent structures or works.

Pipes having integral sockets shall be laid with sockets facing upstream unless otherwise agreed or instructed by the Project Manager/Engineer.

Pipes in headings shall be laid in accordance with the requirements of this clause but pipe lengths shall not exceed 1.5 m unless otherwise agreed by the Project Manager/Engineer.

5.7 Pipes Laid on Natural Ground

Filling shall commence with selected fill consisting of easily compacted material from which all stones larger than 25 mm and all lumps of clay larger than 75 mm have been removed. The selected fill shall be deposited equally on each side of the pipe carefully compacted in layers not more than 150 mm thick. Care shall be taken to ensure that no voids are left under the pipe. The filling shall be continued to a level of 300 mm above the crown of the pipe

In the case of steel, ductile iron and plastic pipes, the Contractor shall ensure that no distortion of the pipe takes place during the backfilling operation.

The remainder of the trench shall be filled with excavated material and compacted in 150 mm thick layers by means of a vibrating plate compactor or a mechanical rammer. The trench shall be filled flush with the surrounding ground surface.

5.8 Pipes laid on Granular Bedding

Granular bedding material shall be placed and compacted generally on both sides of the pipe up to the horizontal diameter of the pipe. Care shall be taken to ensure that no voids are left under the pipe. Thereafter the selected fill shall be as described in Clause 5.8 above.

5.9 Pipes with Concrete Bedding and Surround

The configuration of the concrete bedding, surround or arch shall be as shown on the drawings including the location of reinforcement if any is required. Pipes to be set in concrete shall be supported as set out in Clause 5.7. Small diameter pipes in short lengths shall be supported behind pipe socket. Large diameter pipes and long lengths shall be supported on two packers.

After jointing and testing as set out in the appropriate parts of this section, concrete of the class shown on the drawings shall be carefully placed and compacted under the pipes making sure that no voids are left, and brought up to the configuration shown on the drawings. The Contractor shall ensure that the pipes do not float or are in any way disturbed during concrete placing. The remainder of the backfill shall be placed as set out in Section 2 of this Specification.

Where pipes, which are laid on a bed of granular material, are to be protected by a concrete arch, the laying and jointing shall proceed as set out in the appropriate parts of the Specification and granular material shall be brought up to the horizontal diameters of the pipes.

After testing, concrete shall be placed over the pipes to the configuration shown on the drawings and the remainder of the backfill shall hereafter be placed as set out in Section 2 of this Specification.

Flexible joints shall be formed in concrete beddings, arches or surrounds in the location shown on the drawings. Such joints shall coincide with the pipe joint in such a way that the end of the socket is flush with one face of the joint and the socket faces into the joint space.

Joints in concrete beddings, arches and surrounds shall be 18 mm wide unless otherwise instructed by the Project Manager/Engineer and shall be filled with a compressible material such as a sheet of cane fibre board or cork board. The material used shall be subject to the approval of the Infrastructure Development Engineer /Project Engineer.

5.10 Joints in Pipelines

5.10.1 Concrete pipes

(a) Rigid Joints

When laying rigidly jointed pipelines with pipes having integral sockets, before entering a pipe spigot into its socket, both spigot and socket shall be clean and free from mud, oil, grease or other deleterious matter. A gasket of tarred hemp yarn, cut to length so that it forms a butt joint at the crown of the pipe shall be wrapped round the spigot which shall then be fully entered into the socket and the gasket caulked up hard into the joint. The joint shall then be filled completely with a plastic mortar composed of one part of cement to two parts of sand.

The pipes shall not be pressure tested or disturbed in any way for at least 48 hours after jointing.

Rigidly jointed sleeves used to join two spigots shall be jointed in the same manner as integral sockets.

If the drawings require ogee jointed pipes to be laid with a mortar joint, the joint shall be made at the time of laying. Mortar as described above shall be applied to the lower semi-circumference of the socket and to the upper semi circumference of the spigot and the pipe shall be drawn hard into the socket. Excess mortar squeezed out of the joint shall be removed from both the inside and outside of the joint.

(b) Flexible Joints

Flexible joints between pipes having integral socket may be formed by a shaped rubber gasket fitted within the socket or by a rubber ring of circular cross section (O-ring) placed on the pipe spigot. The type of flexible joint to be used shall be subject to the approval of the Project Manager/Engineer and shall be made strictly in accordance with the manufacturer's recommendations.

5.10.2 uPVC pipes

Flexible jointed uPVC pipes shall be jointed in accordance with the manufacturer's instructions.

Solvent welded joints shall be made strictly in accordance with the manufacturer's instructions using solvent supplied by him for exposed pipes.

5.10.3 Steel pipes

These shall be caulked in thread seal for rigid joints. Flexible joints incorporating rubber O-rings shall be made in accordance with the manufacturer's instructions. Joints incorporating bolted or screwed glands or couplings shall be made in accordance with the manufacturer's instructions.

Components of flexible joints from different manufacturers shall not be used together.

5.11 Painting of Exposed Pipes and Fittings

All metal surfaces within chambers shall be mechanically wire brushed to remove all loose scale, grease etc. Within two hours of cleaning a primer shall be applied, followed after two hours by a first coat of heavy consistency bitumen paint all to the approval of the Project Manager/Engineer. A second coat of the heavy consistency paint shall be applied after 24 hours. The final coating thickness shall not be less than 250 microns.

Preparation and application of the coating system shall be strictly in accordance with the Manufacturer's instructions.

This clause shall not be applied to chemically or thermally bonded coatings on steel pipes.

6 STEELWORK

6.1 General

Except where otherwise specified, structural steel shall be grade 43, complying with BS 7668, "Specification for weldable structural steels".

All structural rolled steel members shall comply in dimension, weight and tolerance with that shown on the drawings and with BS 4, "Structural steel sections" and BS EN 10056, 10067 and 10210.

6.2 Bolts, nuts and fastenings

Bolts, studs, nuts and washers etc, shall be of mild steel unless otherwise specified. The dimensions and tolerances of nuts and bolts shall comply with BS 4190, "Specification for ISO metric black hexagon bolts, screws and nuts" or where specified to BS 3692, "Specification for ISO metric precision hexagon bolts, screws and nuts" and the threads shall be to BS 3643, "ISO metric screw threads". The heads of the bolts shall be forged out of the solid bar and the ends shall be cleanly cut with standard threads and the nuts must fit the bolts accurately and tightly. Washers of the shape and type indicated on the drawings shall comply with BS 4320, "Specification for metal washers for Project Manager/Engineering purposes".

Where nuts, bolts and washers are required to be galvanized, the galvanizing shall be to BS 3382, "Specification for electroplated coatings on threaded components".

6.3 Electrodes

Electrodes used in welding mild steel shall comply with the requirements of BS 639, "Specification for covered carbon and carbon manganese steel electrodes for manual metal-arc welding".

6.4 Contractor's Shop Drawings

Where the Contractor is required to undertake the detailed design of the steelwork components, he shall provide the Infrastructure Development Engineer/Project Manager with copies of detailed shop drawings for approval at least fourteen (14) days before commencing fabrication. The Contractor shall be responsible for the detailed design of all connections and these shall be fully detailed on the shop drawings together with all dimensions, clearances, welding details and procedures, machining, marking, etc. The Contractor shall not commence fabrication until he has received the Infrastructure Development Engineer's written approval of the shop drawings. Approval of such drawings shall in no way relieve the Contractor of his responsibility for accuracy or the correct operation of the component.

6.5 Fabrication and Erection of Steelwork

The standard of workmanship and Project Manager/Engineering practices to be adopted for fabrication and erection shall conform to BS 449, "Specification for the use of structural steel in building" and BS 5531, "Code of practice for safety in erecting structural frames".

The Contractor shall supply samples of materials and standards of workmanship as required by the Project Manager/Engineer. All samples approved by the Project Manager/Engineer shall be retained and shall be considered as setting the standard for all subsequent work.

Inspection of work will be carried out by the Infrastructure Development Engineer/Project Manager and the Contractor shall give sufficient notice of the date when fabricated steelwork is ready for inspection. The Contractor shall provide particulars of places and dates of manufacture of all materials for the Permanent Works and the names of the manufactures. Copies in duplicate of all orders for materials shall be sent to the Project Manager/Engineer at the time of placing such orders.

The Contractor shall ensure that all foundation bolts and supports including built-in bolts, etc upon which the steelwork is to be erected are in the correct position and that the steelwork fits correctly in required positions without forcing or straining in any way. Any check by the Project Manager/Engineer of the Contractor's measurements shall not relieve him of his responsibility for obtaining this fit unless any errors in position are clearly not attributable to him.

No permanent bolting or site welding shall be done until proper alignment has been obtained. The Contractor may use temporary jigs, anchors or supports during erection, but must allow for thermal movement to take place freely at all times.

If the Contractor wishes to drill holes in or fix attachments to the steelwork to carry temporary work such as shuttering, he shall obtain the Project Manager/Engineer's approval of the positions and details of all such holes or attachments and shall close such holes and remove the attachments to the satisfaction of the Project Manager/Engineer.

On completion of erection of any part of the steelwork on which the Contractor wishes to add further works, such as roofing, he shall first obtain the Project Manager/Engineer's approval of the steelwork and remedy any defects required by the Project Manager/Engineer. Any approval given shall in no way relieve the contractor of his responsibility for ensuring the subsequent correct positioning and behaviour of the steel work of other parts of the structure.

6.6 Welding

All shop welds shall be carried out by qualified welders who shall be under competent supervision. All welding is to be carried out in accordance with BS 5135, "Specification for arc welding of carbon and carbon manganese steels". The Contractor's proposals for welding shall be submitted to the Project Manager/Engineer for approval before any work is undertaken.

The Infrastructure Development Engineer/Project Manager may call for a test of a welder's capabilities in accordance with BS 4872, "Specification for approval testing of welders when welding procedure is not required".

In the case of site welds, the welding procedure for making each type of joint shall be approved by the Project Manager/Engineer before the work is commenced and the Contractor shall make such trial welds as the Project Manager/Engineer may need to demonstrate the soundness of the proposed method and the competence of his workmen.

Where site welding is used all welded joints shall be subject to inspection by the Project Manager/Engineer. Any welds that are in the opinion of the Project Manager/Engineer defective, shall be cut out and the welds remade to the satisfaction of the Project Manager/Engineer. The cost of such corrective measures including any resultant delays, shall be borne by the Contractor.

6.7 Painting General

The Contractor shall submit to the Infrastructure Development Engineer/ Project Manager for his approval details of the types and manufacturers of paints he is proposing to use, together with the manufacturer's recommendations concerning preparation of surfaces, primers and undercoats, application methods, safety precautions and drying times for each type of paint. All paints used in the Works must be supplied ready-mixed in unbroken, sealed containers, which clearly show the type, colour and manufacturer of the paint and carry detailed "instructions for use".

All metal surfaces on which paint is to be applied shall be blast cleaned as laid down in BS 7079, "Preparation of steel substrates before application of paints and related products", or other mechanical means and fully prepared in accordance with the manufacturer's recommendations. Applications of paint coatings on external work shall not be carried out or continued in mist, rain or excessively damp conditions. The Contractor shall take all necessary precautions to prevent dust and dirt coming into contact with freshly applied paint before it has dried.

Paints shall be applied either by brushing or spraying in accordance with the manufacturer's instructions. The thinning of paints shall not be permitted without the approval of the Infrastructure Development Engineer/Project Manager/Engineer. Unless otherwise recommended by the manufacturer, the minimum interval between the application of a first coat of paint and the second shall be twenty-four hours (24hrs). Special care shall be taken to ensure complete coverage of all corners, arises and openings without causing an excessive build-up of paint and avoiding runs.

Steelwork to be painted shall be clean and free from all rust, grease, oil and mill scale.

6.8 Painting Steelwork Immersed in Water

Steelwork subject to immersion in water shall be blast cleaned or thoroughly mechanically cleaned by an approved alternative process and immediately coated before leaving the factory with zinc phosphate or similar compatible metallic inhibitive primer with a minimum dry film thickness of 50 microns. Following drying of the primer, the steelwork shall be coated with one coat of non-toxic, non-tainting, high build bituminous paint to BS 3416, "Specification for bitumen-based coating for cold application, suitable for use in contact with potable water", having a minimum dry film thickness of 100 microns.

After erection, damaged areas of steelwork shall be mechanically cleaned and touched up with primer and bituminous paint to fully restore the factory applied coating system and thickness.

Finally, two overall finish coats of bituminous paint with a minimum dry film thickness per coat of 100 microns giving an overall minimum dry film thickness of the complete coating system of 350 microns.

6.9 Painting other steelworks

Where steelwork, which is not galvanized and not subject to immersion in water is required to be coated amd painted, it shall be thoroughly cleaned and painted prior to leaving the factory with:

(a) one coat of zinc phosphate or similar compatible metallic inhibitive primer with a minimum dry film thickness of 50 microns.

(b) one coat of grey lead primer with a minimum dry film thickness of 50 microns.

(c) two coats of micaceous iron oxide undercoat paint with a minimum dry film thickness per coat of 50 microns.

After erection, damaged areas of steelwork shall be mechanically cleaned and touched up with primer and under coat to fully restore the factory applied coating system and thickness.

Finally, one overall finish coat of enamel gloss micaceous iron oxide paint with a minimum dry film thickness of 50 microns giving an overall minimum dry film thickness for the complete coating system of 250 microns.

6.10 Galvanizing

All steel and ironwork of whatever kind required to be galvanized is to be pickled in dilute hydrochloric acid and then washed, fluxed and stoved and coated with zinc by dipping in a bath of molten zinc. All components are to be immersed in the bath only for the time sufficient for them to attain the temperature of the bath, they are then to be withdrawn at such a speed that a coating of 80 microns thickness is achieved, or such other practical maximum thickness for the component as defined in BN EN ISO 1461:1999, "Specification for hot dip galvanized coatings on iron and steel articles".

The galvanizing is to be carried out after all drilling, chipping, trimming, filing, fitting and bending operations are complete and shall cover all faces evenly.

After erection of galvanised steel components, damaged or welded areas shall be painted immediately after cleaning with two coats of metallic zinc primer with each coat having a thickness of 50 microns. The paint shall be applied strictly on accordance with the manufacturer's instructions and shall be compatible with any subsequent paint systems to be applied.

6.11 Galvanized handrails

Handrail tubes where applicable shall be 38 mm nominal diameter steel tube to BS 1387, "Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads". The top and bottom rails shall be 900 mm and 450 mm respectively above floor level. The rails and vertical standards shall be connected using screwed steel pipe fittings to BS 1740, "Specification for wrought steel pipe fittings (screwed BS 21 R-series threads)", where practical with the final connections being welded in accordance with Clause 6.6.

The handrail assembly shall be securely mounted on base plates fabricated of mild steel and attached to the base or foundation slab in a manner to be approved by the Project Manager/Engineer.

All sharp edges and rough areas shall be carefully ground off and the entire handrail assembly cleaned and galvanized in accordance with Clause 6.10.

7 CONSTRUCTION TOLERANCES

The following are the tolerances within which the works are to be executed or as directed by the Project Manager/Engineer:

EARTHWORKS

Top level of Embankments after compaction		+100/ -0 mm
Sides of Embankments over a 10 m length		+100/ -0 mm
Channel or Excavation cutting		+20/ -20 mm
Channel Water Way Area		- 0
Horizontal Alignment of Channels:	Maximum Over 20 m length	300 mm 100 mm
Formation Level for Structures		+0/ -ve filled with concrete
Formation Level for Gabions		+0/ -100 mm

CONCRETE STRUCTURES

The following tolerances shall apply to all wrought formed and fair or fine unformed finishes.

Tolerance from Specified Position

Maximum departure of plan position of structure	150 mm

Tolerance from Specified Dimension

Maximum departure in thickness, cross-sectional dimension or position of columns, beams, walls, footings and the like	+25/ -10 mm

Surface Tolerance on Straightness or Departure from Specified Curve

General Surfaces

Maximum deviation in horizontal or vertical direction

• gradual over a 10m length	25 mm
• abrupt	10 mm

Reinforcement

Maximum departure in required spacing	15 mm
Minimum lap length shall be:	
- In the case of mild steel reinforcing	40 times bar diameter
- in the case of high yield steel reinforcing	50 times bar diameter

Stonework

Pitching and Masonry over a 2 m length	+100/ -25 mm
Face of gabion basket	+ 75/ -25 mm
Thickness of tipped rock or filter layer	+100/ - 0 mm

SECTION II: BILLS OF QUANTITIES AND METHOD OF MEASUREMENT

8 PREAMBLE TO BILL OF QUANTITIES

8.1 General Directions

In this Bill of Quantities, the sub-headings and item descriptions identify the work covered by the respective items. The exact nature and extent of the work to be performed shall be ascertained by reference to the Drawings, Specification and Conditions of Contract, as the case may be read in conjunction with the matters listed against the relevant headings in the Preamble.

The quantities of work and material set forth in the Bill of Quantities are an estimate only and are not to be considered as limiting nor as extending the amount of work to be done and material to be supplied by the Contractor. The Works as completed in accordance with the Contract shall be measured and paid for as described in this Bill of Quantities and in accordance with the Conditions of Contract and Specification.

In the item descriptions, all dimensions shall be in millimetres unless otherwise stated.

The rates and prices entered in the Bill of Quantities shall be deemed to be the full inclusive value of the work described by the several items including the following unless expressly stated otherwise.

i. Labour and plant and all costs in connection therewith.

ii. The supply of materials and goods to site, including costs for purchase, transportation, storage, wastage and any other charges.

iii. Constructional Equipment and all costs in connection therewith.

iv. Fixing, erecting, installing or placing.

v. All Temporary Works.

vi. Compliance with all conditions, liabilities and risks involved in the execution of the works set forth or reasonably implied in the documents on which the Contract is based.

vii. Establishment charges, overheads and profit.

viii. Locating existing services.

ix. Contractor's accommodation, buildings and services (i.e. water, security, transport, welfare, etc).

8.2 Measurement

The measurement of work shall be computed net from the Drawings unless stated otherwise

8.3 Use of Alternative Materials or Designs

Where in the Contract a choice of alternative materials or designs is indicated for a given purpose, the description billed and rates inserted shall be deemed to cover any of the permitted alternative materials or designs which the Contractor may elect to use.

8.4 Unpriced Items

The cost of items which do not have a price or rate entered against them in the Bill of Quantities shall be deemed to be covered by the rates and prices entered against the remaining items in the Bill of Quantities.

8.5 General Attendance

General Attendance in connection with Nominated Sub-contractors shall include for affording the use of existing work space, access, temporary roads, erected scaffolding, working shelters, staging, ladders, hoists, storage, latrines, messing, welfare and other facilities existing on Site and the provision of protection, water, telephone, electricity for lighting, and clearing away rubbish and debris arising from the work.

8.6 Definitions

(a) "Conditions of Contract" means the Conditions of Contract contained in these Documents.

(b) Words and expressions defined in the Conditions of Contract shall have the same meaning herein.

(c) "Provisional Item" means an item describing work. the requirement for which is uncertain at the time the tender documents are issued and which can only be carried out on instruction of the Project Manager.

(d) The word "work" includes work to be carried out, goods, materials and services to be supplied, and liabilities, obligations and risks to be undertaken by the Contractor under this Contract.

(e) The expression "expressly required" means shown on the Drawings, described in the Specification or ordered by the Project Manager pursuant to the Contract.

(f) "Bill of Quantities" means lists of items giving brief identifying descriptions and estimated quantities of the work comprised in the Contract.

(g) "Daywork" means the method of valuing work on the basis of time spent by the workmen, the materials used and the Equipment employed.

(h) A hyphen between two dimensions means a range of dimensions which includes all dimensions exceeding that preceding the hyphen but not exceeding that following the hyphen.

(i) "Existing Ground Surface" means the surface of the sludge or ground before any work has been carried out.

8.7 Progress Payments

Progress payments in the Interim Certificates referred to in the Conditions of Contract in respect of sum items in the Bill of Quantities shall be by means of interim progress instalments or milestones, such instalments not exceeding in aggregate, the total of each sum item. Such interim progress instalments shall be assessed by the Engineer/Project Manager based on the

extent that the work to be done or liabilities or charges to be incurred by the Contractor under the description of each item bears to the extent of such work, liabilities or charges actually carried out under each sum item from time to time.

Such progress payments in respect of sum items shall be subject to the terms of retention referred to in the Conditions of Contract.

9 PARTICULAR INSTRUCTIONS FOR MEASUREMENT AND PAYMENT

9.1 Preliminaries

Items whose units of measurement are time based shall not be measured:

i. between the end of the time for completion or extended time for completion of the Works and the date of completion of the Works as described in the Contract;

ii. after the expiration of the Maintenance Period where services are required as a consequence of the default of the Contractor.

Payment to the Contractor for Items shall be the actual sum expended by the contractor as substantiated by receipts/invoices. However in each case such a sum shall not exceed the sum inserted against the corresponding item in the Bill of Quantities.

9.2 Services for the Project Manager

9.2.1 Site Offices

The sum item provided in the Bill of Quantities for site offices for the Project Manager shall be deemed to include the provision, maintenance and removal on completion of fully equipped site offices. The sum shall include all costs of furnishing, equipping, cleaning, maintaining, heating and lighting all as specified.

9.2.2 Survey Equipment and Chainmen

The sum provided in the Bill of Quantities for survey equipment shall cover the full cost of provision and maintenance of all labour, materials and equipment necessary for the proper setting out and checking of the Works. It shall include survey instruments, tapes, ranging rods, poles, staves, stagings, moulds, templates, profiles and the like. Equipment to revert to the Contractor after completion of the contract.

Payment of the sum item shall be made in the following manner except otherwise revised by the employer:

(a) Sixty per cent of the sum when all items of the equipment have been handed over to the Project Manager.

(b) Forty per cent of the sum in equal monthly instalments spread over the period from the time of taking over by the Project Manager until the date for completion of the contract. In the event of an interim payment certificate not being issued in any month, then the instalment shall be added to the first subsequent certificate.

(c) Retention monies shall be deducted from the above sums, in accordance with the Conditions of Contract.

9.3 Contractor's Camps, Offices etc.

The sum item provided in the Bill of Quantities for provision, maintaining and removal of Contractor's camps, offices, workshops, etc., if any, shall be paid to the Contractor in equal monthly instalments spread evenly throughout the contract period.

9.4 Earthworks

9.4.1 The units of measurement

Site clearance	m^2
Cutting of trees with girth greater than 500 mm	nr
Stripping of 150 mm top soil	m^2
Bulk excavation and filling	m^3
Excavation for chambers and manholes	m^3
Excavation of rock	m^3
Excavation, filling and compaction of pipelines	m
Preparation of surface, trimming of slopes, pitching, soiling, grassing and wet masonry	m^2
Overhaul of material	m^3.km

9.4.2 Method of Measurement

I. Earthworks measured by m^2

These shall be measured as plan area instructed by the Project Manager.

II. Earthworks measured by m3

The measured volume shall be the net-in-situ volume obtained from the difference between the lines, levels and profiles of the ground or rock surface agreed with the Project Manager before excavation is commenced and the lines, levels and profiles as shown on the Drawings, or as may be ordered by the Project Manager as necessary for the Works. Where the Drawings do not indicate the profiles of the excavation, the measured volume shall be the volume of the voids that would be formed if the completed structure, for which the excavation is performed, were to be lifted vertically out of the ground.

III. Pipelines measured by length

Depths used for classification in the Bill of Quantities shall be measured from the commencing surface to the inverts of the pipes.

IV. Over-excavation

No measurement will be taken for material excavated beyond the limits and levels specified above, unless directed by the Project Manager/Infrastructure Engineer.

V. Filling

Normal material shall be measured by volume as the net compacted volume of filling comprised within the sections shown on the Drawings. No extra payment will be made for additional material placed to allow for the effect of settlement.

VI. Haulage

Measurement shall be the product of the volume compacted material insitu and the haulage distance in excess of 10 km, one way, along the shortest route as determined by the Project Manager.

VII. Trial Pits

Trial pits ordered by the Project Manager shall be measured by the cubic metre of excavated material. The depth of excavation shall be measured from the commencing surface to the final surface. Trial pits required by the Contractor for his own information and use shall not be measured for payment.

VIII. Pitching, Wet Masonry, Grassing, Soiling, Trimming, Preparation of Surface

The area for measurement shall be calculated from the finished dimensions of the surface as shown on the drawings or instructed by the Project Manager/Engineer

IX. Cutting of trees

The girth shall be measured 1.5 m from the ground level. Only girth greater than 1.5 m shall be paid.

9.4.3 Item Coverage

No separate payment will be made beyond the rates for excavation for:

(a) All necessary Temporary Works including dealing with water in the excavation.

(b) Any over breakage and any additional working space required and refilling of same.

(c) Making good all slips or falls of materials.

(d) Trimming of excavation to correct lines levels and profiles.

(e) Preparation of foundations as specified except where specifically provided for in separate Bill items.

(f) Location, uplifting, transportation, handling and sorting of approved selected material from the excavations for use in the backfilling of trench and other excavations.

(g) Backfilling and disposal of materials and removal of surplus to spoil dump, including trimming and grading as required by the Project Manager.

(h) Providing, storing, transporting and using explosives for rock excavation.

(i) Temporary reinstatement.

(j) Permanent reinstatement except where provided for separately in the Bill of Quantities.

9.5 Geotextile Filter Cloth and Polythene Sheeting

9.5.1 The units of measurement

Geotextile filter cloth : m^2

9.5.2 Method of Measurement

Measurement shall be to net surface area as measured on the drawings or as instructed by the Engineer/Project Manager. Overlaps shall not be measured.

9.5.3 Item coverage

The rate shall include for all overlaps required to ensure continuity.

9.6 Concrete and Reinforced Concrete

9.6.1 The units of measurement

(a) In-situ concrete other than blinding : m^3

(b) Blinding concrete with the thickness stated : m^2 (Or as indicated in BoQ)

9.6.2 Method of Measurement

All cast-in-situ concrete will be the quantity calculated from the dimensions shown on the Drawings or as approved by the Infrastructure Development Engineer/Project Manager. No deductions in the measurement will be made for:

(a) Mortar beds.

(b) Chamfers, ducts, chases, fillets, splays, drips, rebates, recesses, grooves and the like, not exceeding 0.01 m^2 in cross sectional area.

(c) Bolt holes, pockets, sockets, mortices and the like formed in the concrete not exceeding 0.1 cu m in volume.

(d) Cast in components each less than 0.1 cu m in volume.

(e) Reinforcement and other metal sections.

9.6.3 Item coverage:

No separate payment will be made beyond the rates for concrete for:

(a) Trial mixes (for Specification Classes of concrete only).

(b) Supply of cement, water and processed aggregates.

(c) Supply and placing of mortar beds or rendering as specified.

(d) Mixing, transporting, placing, compacting, surface tamping to provide U1 finish, protecting and curing the concrete.

(e) Hacking, cleaning and roughening by wet sand blasting, scabbling or other means concrete surfaces on or against which further concrete is to be placed.

(f) Rubbing down faces of finished concrete work, or repair of surface defects.

(g) Shuttering and water stops to construction joints not expressly required by the Project Manager, keys and the like.

(h) Providing samples and testing of materials and concrete.

(i) Provision and use of admixtures.

(j) Placing and compacting concrete around steel reinforcement and other cast in components.

(k) Placing and compacting concrete at varying heights.

(l) Creating falls, cambers and shaped profiles.

(m) Formwork to edge of concrete in blinding layers.

(n) All additional concrete to fill overbreak and/or working space.

(o) Where concretes of different cement contents are required to be placed simultaneously in the same lift of concrete.

(p) Placing and compacting concrete to inclined or battered faces including any necessary upper surfaces formwork inclined at an angle of less than 20° to the horizontal.

9.7 Movement Joints

9.7.1 Units of Measurement

These shall be:

(a) Expansion and contraction joints, both horizontal and vertical : m^2
(measurement on one phase of the joint only)

(b) Water stops of stated type and width : m

9.7.2 Item coverage

No separate payment will be made beyond the rates for joints and water stops for:

(a) Supplying, cutting, joining and fixing water stops.

(b) Formwork to face of joint.

(c) Bituminous painting of face of joint.

(d) Joint filler to expansion joints.

(e) Forming rebate for sealant, and supply and placing of sealant.

(f) Work and materials involved in debonding dowel bars.

9.8 Precast Concrete

9.8.1 Units of Measurement

(a) Beams, slabs, segmental units of stated dimensions : nr

(b) Copings, cills and the like of uniform cross-section : m

The term "precast concrete" applies to any concrete unit or member cast on Site but not in its final position and to concrete units or members manufactured off Site.

9.8.2 Item Coverage

No separate payment will be made beyond the rates for precast concrete for:

(a) Trial mixes and testing as specified.

(b) Reinforcement, cement and processed aggregates.

(c) Formwork, surface finishing, lifting devices and bearing plates.

(d) Forming sockets, holes, grooves, rebates, recesses and ducts, except where specifically provided in the Bill of Quantities.

(e) Handling, laying and fixing the units in position.

(f) Aligning members and units, adjustable levels and soffit profiles, and temporary fixing to prevent displacement.

(g) Cutting and trimming copings, cills and the like to size.

9.9 Steel of Reinforcement

9.9.1 The units of measurement

(a) Steel rod reinforcement	:	t
(b) Steel fabric reinforcement	:	m^2
(c) Steel dowels of stated diameter and length	:	nr

9.9.2 Method of Measurement

The weight of steel rod reinforcement shall be calculated on the basis that steel weighs 0.00785 kg per square millimetre of cross-sectional area per linear metre. The steel rod reinforcement shall be measured as the net theoretical calculated weight of the steel actually used in the work (including laps as specified) in accordance with the bending schedules prepared by the Project Manager with no allowance being made in the measurement thereof for rolling margin or otherwise. Tying wire shall not be measured.

Fabric reinforcement shall be measured as the area of work covered excluding laps.

9.9.3 Item Coverage

No separate payment will be made be made beyond the rates for steel reinforcement for:

(a) Supplying, cutting to length, cleaning, bending, hooking, waste incurred by cutting, handling.

(b) Placing and fixing in the required position, including binding wire or other approved material.

(c) Placing supports and spacers.

(d) Extra fabric reinforcement in laps.

(e) in the case of dowels - drilling holes or forming pockets in the structure and casting dowels into their final position including application of bituminous paint.

9.10 Formwork

9.10.1 The units of measurement

(a) General formwork : m^2

(b) Formwork less than 300 mm wide : m

(c) Boxouts, pockets, etc of stated size : nr

(d) Rebates, chases, etc of stated size : m

(e) Columns of constant cross section, dimensions stated : m

9.10.2 Method of measurement:

Subject to the limitations stated below general formwork will be measured as the superficial area of formwork actually in contact with the finished face of the concrete.

Formwork shall not be measured:

(a) For forming construction joints (whether shown or not on the Drawings), skewbacks, stunt ends, stepping, bonding chases, keys and the like.

(b) For forming boxouts, pockets, etc., of stated sizes that are measured by number.

(c) For forming rebates, chases, etc., of stated size that are measures by length.

(d) To edge of concrete in blinding layers.

(e) To upper surfaces of concrete inclined at angle of less than 20^o to the horizontal.

9.10.3 Classification of formwork:

Plane formwork shall be classified according to its angle of inclination as follows:

Class	Angle of inclination to the vertical
Horizontal	85^0 - 90^0
Sloping	10^0 - 85^0
Battered	0^0 - 10^0
Vertical	0^0

9.10.4 Item coverage

No separate payment will be made beyond the rates for formwork for:

(a) Falsework, centering, fabricating, assembling, cutting, fitting and fixing in position and taking all measurement necessary to produce the required profiles;

(b) Forming camber or falls;

(c) Linings and taking all measures necessary to produce the required finish to the surfaces of the concrete;

(d) Cutting and fitting around projecting members, pipes reinforcement and the like;

(e) Forming fillets, chamfers, splays, drips, rebates, recesses, grooves and the like not exceeding 0.01 square metre in cross-sectional area, unless itemised in the Bill of Quantities;

(f) Maintaining in place until it is struck and allowing for any variation from the minimum period for striking arising from prevailing weather conditions;

(g) Striking, taking down and removing;

(h) Any additional concrete provided in lieu of formwork to fill overbreak or working space.

9.11 Built in Plant, Equipment and Pipework

Items appear in the Bill of Quantities for building-in plant, equipment and pipework. The rates in Bill of Quantities shall include for all materials, formwork, etc. required for building-in. No additional payment will be made should the Contractor choose to form boxouts, pockets, etc., and grout in at a later date.

9.12 Unshattered surfaces

The unit measurement shall be:

Type U2, type U3 and type U4 finish : m^2

Unshattered surfaces are described in the Specification. Items are provided where appropriate for the surface finish type U2, U3 and U4 and the rates entered under these items shall include for all material, Equipment and labour required to finish the unshuttered concrete as specified.

No measurement shall be made for normal screed finish type U1.

9.13 Breaking out Reinforced Concrete and Blockwork

9.13.1 The Units of Measurement

(a) Breaking out, section thickness stated or shown on the Drawings : m^3

(b) Making good perimeter of permanent openings, section thickness statement or shown on the Drawings : m^2

(c) Building in pipework, etc. of stated size : nr

9.13.2 Method of Measurement

(a) Breaking out: The section thicknesses stated or shown on the Drawings are nominal thicknesses only. For measurement and payment purposes the thicknesses of the sections shall be measured on Site.

(b) Making good: For measurement purposes the perimeter shall be that existing after any making good of permanent openings. The perimeters and section of thicknesses shall be as measured on Site. The rates in the Bill of Quantities shall include for all materials, formwork, etc. and for filling of overbreak.

9.13.3 Item Coverage

No separate payment will be made beyond the rates for breaking out for:

(a) All equipment necessary.

(b) Any temporary supports, staging and the like.

(c) Any overbreak.

(d) Material for building in pipes and supporting the pipe.

(e) Formwork.

(f) Removal of "broken out" materials off Site.

(g) Cutting through reinforcement.

9.14 Pipes and Pipework

9.14.1 The Units of Measurement

(a) Pipelines : m

(b) Pipework, fittings and valves : nr

9.14.2 Method of Measurement

(a) Lengths of pipelines shall be measured net as laid along their centre lines, including fittings.

(b) Short lengths of pipes, the dimensions of which are detailed in the Bill of Quantities, shall be measured by number extra over the pipeline rate if laid in trenches or chambers.

(c) Lengths of drainage pipes built into manholes and other chambers shall be measured from the inside faces of chambers.

(d) Pipeline depth classifications quoted in the Bill of Quantities shall be measured from the commencing surface to the invert of the pipe.

9.14.3 Item Coverage

No separate payment will be made beyond the rates for pipes and pipework for:

(a) Cost of supplying all pipes, jointing materials and short lengths to suit fittings.

(b) All necessary cutting and waste.

(c) All Equipment, labour and materials required for handling, distributing, laying and jointing in position.

(d) Testing of the pipe system.

(e) All items listed in Section 2.8.3 of this Particular Instructions.

9.15 Pipework Ancillaries

9.15.1 The Units of Measurement

(a) Beds, haunches and surrounds : m^3

(b) Concrete stools and thrust and anchor blocks of stated volume : nr

9.15.2 Method of Measurement

(a) Separate measurement shall not be made for beds to haunched or surrounded pipes where the same material is used for beds and haunches or beds and surrounds respectively.

(b) The width of concrete pipe protection shall be taken as 300 mm plus the outside diameter of pipe unless detailed otherwise.

9.15.3 Item Coverage

No separate payment will be made beyond the rates for thrust blocks, surrounds and the like for:

(a) Excavation and backfilling including working space in the case of thrust blocks.

(b) Formwork type F1 finish.

(c) Providing unshattered surfaces to type U1.

(d) Providing pipe wrapping and jointing as specified.

9.16 Structural and Miscellaneous Metalwork

9.16.1 The Units of Measurement

(a) Structural and miscellaneous metal work including gates, stairways, landings, walkways, pipes and platforms	:	t
(b) Gates of stated dimensions	:	nr
(c) Ladders, handrails and the like	:	m
(d) Flooring, duct covers and the like	:	m^2

9.16.2 Method of Measurement

Measurement by weight shall be the total weight of the finished member comprising plates, rolled sections, shear connectors, stiffeners, cleats, packs, splice plates and all fittings computed in accordance with the relevant British Standard, with no allowance for tolerances for rolling margins and other permissible deviations from standard weights, and excluding the weights of weld fillets, bolts, nuts and washers, rivet heads, and protective coatings. No deduction shall be made for splays, notches, holes and the like each not exceeding 0.10 square metres.

The weight of steel involved shall comply with the relevant British Standards.

Measurement by number shall comprise all the accessories required to install the item and to bring it to the operational condition.

9.16.3 Item Coverage

No separate payment will be made beyond the rates for:

(a) Cost of supplying materials.

(b) Moulding, fabricating, welding, drilling, machining, screwing, galvanising or painting as may be specified;

(c) Handling, transporting, hoisting, fitting and fixing and in position to complete;

(d) Supply of all fixings;

(e) Painting after erection as specified;

9.17 Perimeter Fence and Gates

9.17.1 The Units of Measurement

(a) Fence : m

(b) Gates : nr

9.17.2 Item Coverage

No separate payment will be made beyond the rates for:

(a) Excavation and backfilling

(b) Cost of supplying materials.

(c) Moulding, fabricating, welding, drilling, machining, screwing, galvanising or painting as may be specified;

(d) Handling, transporting, hoisting, fitting and fixing and in position to complete;

(e) Supply of all fixings;

(f) Painting after erection as specified

9.18 Blockwork, Brickwork and Masonry

9.18.1 The Unit of Measurement

(a) Blockwork, brickwork, and masonry not exceeding 1 metre in thickness : m^2

(b) Blockwork, brickwork, and masonry exceeding 1 metre in thickness : m^3

(c) Damp proof courses, wall thickness stated : m

9.18.2 Method of Measurement

(a) Volume and areas measured for blockwork, brickwork and masonry shall include the volumes and areas of joints.

(b) No deduction or addition to the volumes and areas measured shall be made for rebates, projecting courses or other surface features each less than 0.05 square metre in cross sectional area.

(c) No deduction from the volumes and areas measured shall be made for holes and openings in walls or surfaces each less than 0.25 square metre in cross sectional area.

(d) Areas shall be measured at the centre lines of blockwork, brickwork and masonry.

9.18.3 Item Coverage

No separate payment will be made beyond the rates for the rates for blockwork, brickwork, and masonry for:

(a) Jointing, pointing and fair-faced work, in any type of bond including all rough and fair cutting.

(b) Plinths, corbels, bull noses, chases, rebates, quoins, brick copings, string course and the like.

(c) Centering and all temporary supports.

(d) Bonding into existing work.

(e) Protection into existing work.

(f) Building in pipes, holdfast, bolts and the like and forming openings less than 0.25 square metre in cross section.

(g) Ties and reinforcement.

9.19 Chambers and Manholes

In-situ reinforced concrete chambers and manholes shall be measured under the relevant items for excavation, concrete, formwork, reinforcement, manhole covers, step irons and the like. This section of the Particular Instructions relates to precast concrete chambers and manholes.

9.19.1 The units of measurement

(a) Precast chambers and manholes of stated size and depth : nr

9.19.2 Method of measurement

The depth for measurement purposes shall be measured from the top of the cover to the top of the base slab.

9.19.3 Item coverage

The rates entered in the Bill of Quantities shall be deemed to cover excavation, provision and placing of precast unit, slabs and covers concrete surrounds, building in pipes and other fittings and all other work necessary to complete the chamber and manhole in accordance with the Drawings and Specification.

9.20 Rendering

9.20.1 The units of measurement

(a) Rendering : m^2

9.20.2 Method of measurement

The rate shall include all necessary admixtures and any other relevant works.

9.21 Site roads and Footpaths

9.21.1 The units of measurement

(a) Spoil of material : m^3

(b) Preparation of existing ground : m^3

(c) Gravel course of stated depth : m^3

(d) Excavation of materials : m^3

(e) Concrete pipe culverts : m

(f) 200 mm thick blockwork : m^2

(g) Overhaul : m^3 km

9.21.2 Method of measurement

The measurement for preparation of the existing ground, gravel course, excavation of materials and overhaul shall include for meeting all the requirements of the Ministry of transport and communication Standard Specification for Road and Bridge Construction.

The haulage of material in excess of 20 km shall be measured per cubic metre kilometre and shall be computed by multiplying the measured quantities of material in cubic metres by the length of approved shortest practicable route measured in kilometres in one direction only.

Measurement for the blockwork shall comply with section 2.21 of the particular instructions for measurement and payment. The rates shall include for reinforcement, rip-rap and rendering as indicated on the drawing.

10 DAYWORK SCHEDULE

Works shall not be executed on a daywork basis except by written order of the Project Manager. Bidders shall enter rates for daywork items in the Schedules, which rates shall apply to any quantity of daywork ordered by the Project Manager. Nominal quantities have been indicated against each item of daywork and the extended total for daywork shall be carried forward as a Provisional Sum to the Summary Total Tender Amount. Unless otherwise stated, payments for daywork shall be subject to price adjustment and retention in accordance with the Conditions of Contract.

10.1 Daywork Labour

In calculating payments due to the Contractor for the execution of dayworks, the hours for labour will be calculated from the time of arrival of the labour at the job site to execute the particular item of daywork to the time of return to the original place of departure, but excluding meal breaks and rest periods. Only the time of classes for labour directly doing work ordered by the Project Manager and for which they are competent to perform will be measured. The time of gangers (charge hands) actually doing work with the gangs will be measured but not the time of foremen or other supervisory personnel.

The Contractor shall be entitled to payment in respect of the total time that labour is employed on daywork, calculated at the rates entered by him in the "Schedule of Daywork Rates - Labour", which shall include the following:

(a) The rates for labour shall cover all direct costs to the Contractor, including (but not limited to) the amount of wages paid to such labour, transportation time, overtime, subsistence allowances, and any sums paid to or on behalf of such labour for social benefits in accordance with the Nigerian law, and;

(b) The rates shall be deemed to cover the Contractor's profit, overheads, superintendence, liabilities and insurances and allowances to labour, timekeeping and clerical and office work, the use of consumable stores, water, lighting and power: the use and repair of stagings, scaffolding, workshops and stores, portable power tools, manual equipment and tools:

supervision by the Contractor's staff, foremen and other supervisory personnel; and charges incidental to the foregoing.

10.2 Daywork Material

The Contractor shall be entitled to payment in respect of materials used for daywork (except for materials for which the cost is included in 3.1 (b) above, at the rates entered by him in the " Schedule of Daywork Rates - Materials" which shall include the following:

(a) the rates for materials shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, losses, etc., and shall provide for delivery to store for stockpiling at the Site.

(b) the rates shall be deemed to cover the Contractor's profit, overheads, superintendence, liabilities and insurances and allowances for any clerical and office work and charges incidental to the foregoing.

The cost of hauling materials for use on work ordered to be carried out as daywork from the store or stockpile on the Site to the place where it is to be used will be paid in accordance with the terms for Labour and Construction Equipment in this Schedule.

10.3 Daywork Construction Equipment

The Contractor shall be entitled to payments in respect of Constructional Equipment already on site and employed on daywork at the basic rental rates entered by him in the "Schedule of Daywork Rates - Constructional Equipment". The said rates shall be deemed to include due and complete allowance for depreciation, interest, indemnity and insurance, repairs, maintenance, supplies, fuel, lubricants, and other consumables, and all overhead, profit and administrative costs related to the use of such equipment. The cost of drivers, operators and assistants will be paid for separately as described under the section on Daywork Labour.

In calculating the payment due to the Contractor for Constructional Equipment employed on daywork, only the actual number of working hours will be eligible for payment, except that where applicable and agreed with the Project Manager, the travelling time from the part of the Site where the Constructional Equipment was located when ordered by the Project Manager to be employed on daywork and the time for return journey thereto shall be included for payment.

SECTION III: DRAWINGS

CONTENTS

Chapter	Description	Page
1	LIST OF DRAWINGS	

(See separate A3 drawings and plans for the Drawings)

Refer to the drawing Code **CDEL/KT/APP/**

2 DRAWING UNIT

Drawing unit is metric; as shown on drawing

3 SCALE

Drawing scale is as shown on drawing