THE UNITED ARAB EMIRATES

THE MINISTRY OF AGRICULTURE AND FISHERIES

WATER AND SOIL DIRECTORATE

SHIMAL DAM PROJECT

SPECIFICATIONS

TENDER AND CONTRACT DOCUMENTS

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GENERAL SPECIFICATIONS

SECTION 1

GENERAL

1.1 PREAMBLE

The General Specifications shall be read in conjunction with the Agreement, Conditions of Contract, Drawings and Bill of Quantities, and the Contractor shall comply with all the provisions contained within these Documents and the Engineer's instructions.

Any clause in the Specifications which relate to the Works or materials not required by the Contract shall be deemed not to apply.

In order to avoid needless repetition of such phrases as "to the Engineer" and "by the Engineer" or "The Engineer's Representative" throughout the Specifications it shall be understood that when an order, instruction, decision, exercise of judgement or other similar act is indicated, such order, instruction, decision, exercise of judgement or other similar action will be issued, given, made or reserved to the Engineer or the Engineer's Representative.

1.2 GENERAL

The Contractor shall fulfill all the requirements and obligations of all clauses and items of the Conditions of Contract and the Specifications. Where there is not specific item in the Bill of Quantities and where no statement is made in the Specifications to the contrary, the cost for requirement or obligation such as mobilization of construction equipment, overhead, profit, etc. shall be included in the item of the General in the Bill of Quantities.

1.3 ABBREVIATIONS

In this Contract the following abbreviations have the meaning hereby assinged to them:

"AASHO" means the specifications issued by the American Association of State Highway Officials.

"ACI" means the specifications issued by the American Concrete Institute.

"ASA" means the specifications issued by the American Standard Association.

"ASTM" means the specifications issued by the American Society for Testing and Materials.

"BS" means the specifications issued by the British Standards Institution.

"JIS" means the specifications issued by the Japanese Industrial Standard Association.

"U.A.E." means the United Arab Emirates.

"mm" means millemetre.

"cm" means centimetre.

"cm^2" or "sq.cm" means square centimetre.

"cm^3" or "cu.cm" means cubic centimetre.

"m" or "lin.m" means Linear metre.

"m^2" or "sq.m" means square metre.

"m^3" or "cu.m" means cubic metre.

"km" means kilometre.

"g" means gram.

"kg" means kilogram.

"ton" means 1,000 kilograms.

"gal" means U.S. gallon.

"ml" means millitre.

"l" means litre.

"USG" means U.S. gauge.

"ϕ" means diamter.

"%" means percentage.

"No." means number.

1.4 DRAWINGS

1.4.1 DESCRIPTIONS

(a) The Drawings consist of the Contract Drawings, Instruction Drawings, Construction Drawings and As-built Drawings.

(b) The Contract Drawings mean the drawings attached to the Contract Documents and are the basic drawings to execute the works under the Contract. The Contract Drawings are deemed to show guidance nature to execute the relative works.

(c) The Instruction Drawings are the drawings issued by the Engineer during the execution of works in order to indicate the detail and the revision of the Contract Drawings, in case if the Engineer will so decide.

The Contractor shall cooperate the Engineer for the preparation of the drawings by means of submitting the information and data resulting from the survey works, the conditions of the working site, etc.

The Contractor shall check the Instruction Drawings after receiving by the Engineer and advise him of any errors or omissions that are discovered on the Drawings.

(d) The Construction Drawings shall be prepared by the Contractor based on the Contract and Instruction Drawings for the purpose of the execution of works taking into consideration the Contractor's execution methods of works.

The Construction Drawings shall contain all detail and information required in accordance with standard engineering practice. All calculation sheets for structural design, quantitative analysis and any other factors instructed by the Engineer shall be attached to the Construction Drawings.

The size of the Construction Drawings, title of the Drawings, etc. shall be instructed by the Engineer.

(e) The As-built Drawings shall be prepared and submitted to the Engineer by the Contractor by the Provisional Handover. The As-built Drawings to be submitted shall be one original and four complete sets of blue print as executed. Prior to the submittion of the As-built Drawings, the Contractor shall take the Engineer's approval for each drawings.

1.4.2 PAYMENT

The expenses for the Construction Drawings shall be borne by the Contractor.

Payment for the preparation of the As-built Drawings will be made by the contracted price in Lump Sum in the Bill of Quantities after approval of said Drawings by the Engineer.

1.5 DATA, AND SAMPLING AND TESTING

1.5.1 DESCIPTION

As soon as practicable after being awarded the Commencement of the Works, the Contractor shall submit to Engineer for his approval the drawings, catalogues, samples, diagrams and other described data for all mechanical, electrical, architectual and such other materials and equipment, which he propose for use under the Con-

tract.

Samples of materials and equipment to be used shall be submitted for the approval of the Engineer in sufficient time, but not later than 45 days prior to purchase.

All materials to be used in the works shall be tested either at the place of manufacture or on the site whether they comply with the requirements of the Specifications. If such testing is undertaken at the place of manufacture, the Contractor shall submit the supplier's test certificates to the Engineer for his approval before dispatching the relevant consignment.

1.5.2 PAYMENT

No payment for the preparation of the data, and sampling and testing shall be made.

1.6 HANDOVER OF THE SITE

Within 45 days after signing the Contract, the Contractor shall dispatch his authorized representative to the Site and be handed over the Site by the Engineer.

The Contractor shall keep the Site without any damage after the Handover of the Site by his own responsibility.

The following sites will be handed over to the Contractor for the execution of the Works;

- The area of works nominated in the Contract with marginal and frontage space.
- Quarries, borrow areas, spoil bank, etc.

When the Contractor intends to use other additional lands which are not handed over by the Engineer, the Contractor shall prepare the lands by his own effort and expenses but take the approval by the Engineer.

The Contractor shall, when required, supply in writing full information regard-

ing the localities in which the materials are being obtained and in which the work is being prepared.

1.7 TEMPORARY WORKS

(a) The Contractor shall, at his own expense, provide, maintain and remove on completion of the Works, all Temporary Works and he shall make them safe and suitable in every respect to carry all plants or equipment required for the Works, or for providing access for himself or others, or for any other purpose. The Temporary Works shall be constructed to the satisfaction of the Engineer, but the Contractor shall nevertheless be responsible for damage done to or caused by these Temporary Works.

(b) The Contractor shall make all necessary arrangements, including payment if necessary, with the Authorities or land owners concerned for use of land, before constructing Temporary Works, and he shall obtain the approval of such Works from the Engineer. Such approval will not, however relieve the Contractor of his responsibility. He shall clean up and restore the land on completion to the satisfaction of the Authorities or land owners.

1.8 TRIAL PIT INFORMATION

The soils and materials test results and information provided for the Contractor with the Contract Documents at Tender stage are for his information only. The Contractor shall be deemed to have studied his information during the preparation of his tender and to have carried out any such further tests as he may consider necessary. No claims for additional payment will be considered from the Contractor on the grounds that the information is insufficient, incorrect, or misleading.

1.9 SETTING OUT

1.9.1 DESCRIPTION

Before commencing the works, the Contractor shall check the original Control Points and Bench Marks shown on the Drawings. Should the Contractor find any discrepancy between the original survey and the new survey, he shall inform the Engineer and receive

the instruction from the Engineer.

The Contractor shall establish an additional number of the Control Points and Bench Marks for the execution of Works and shall set out the position of various structures on the ground. The result of survey and setting out shall be checked and approved by the Engineer.

In the event of any such Bench Mark having become obliterated, the Contractor shall make his own arrangements to ensure that the Works are constructed to the levels shown on the Drawings or as amended by the Engineer, and if found necessary to cover or destroy any of such indicated Bench Marks, the Contractor shall transfer the level of such Bench Mark to another approved fixed points, which shall then be surveyed and marked on the Drawings.

The Contractor shall survey and establish the levels of the whole site of the Works by means of levelled cross-sections taken every 50 metres or less as agreed with the Engineer along the centre line and shall agree to the levels so taken, and these shall form the basis of measurement for earthworks and all other Works where required.

The Contractor shall, without any extra charge, supply necessary manpower, material and equipment to the checking operation of the Engineer. The check carried out by the Engineer shall not in any way absolve the Contractor from sole responsibility for the consequence of any inaccuracy in setting out.

1.9.2 PAYMENT

Payment for the setting out will be made on the basis of contract in Lump Sum prices in the Bill of Quantities. 40% of the contracted price for setting out will be paid when the setting out is commenced and remaining 60% of price for setting out will be paid after approval of the setting out by the Engineer.

1.10 WORKS ORDER

After approval of the Construction Drawings by the Engineer, the Engineer will

issue the Work Order to the Contractor for the commencement of the relevant works taking into account the progress of works.

No work shall be commenced before receiving the Work Order written by the Engineer.

The Engineer/Engineer's Representative shall then have full power and authority to order the Contractor to suspend or to stop such works that are not in accordance with the approved Construction Drawings and/or commenced without the issuance of the relevant work order by the Engineer.

1.11 ORDERS TO FOREMEN

Whenever the Contractor or his site engineer is not present on any part of the work when the Engineer may desire to give orders or directions they shall be received by the foreman or person who may be in charge of the work. Such orders shall be fully complied with and shall be deemed to be orders given to the Contractor.

1.12 COMPENSATION OF TRAFFIC AND WATER FLOOR

In accordance with the Conditions of Contract, the Contractor shall be responsible for safely maintaining traffic through or round any part of the Works habitually used by traffic with the maximum convenience.

The standard of construction for temporary diversion ways shall be suitable in all respects for the class or classes of traffic using the existing way and all such diversions shall also be subject to the approval of the Engineer as to the location, width and maintenance standard.

The Contractor shall provide and maintain all necessary diversions, diversion signs, barricades, fencing and lighting and shall if directed provide flagmen and "stop-go" signs at restriction points. The size, lettering and wording of all such signs shall be as approved.

The Contractor shall ensure that the river, stream, irrigation canal and water supply system in the working site shall be kept ordinary conditions.

In case diverting water and replacing water course, the Contractor shall nego-

tiate with the relative authority, organization and peoples to use water and shall construct the sufficient facilities to divert and supply water with to the approval of the Engineer. The Contractor shall not put alter the rate of flow of such water except with the approval of the Engineer.

No direct payment shall be made to the Contractor for any work required by the provisions of this Clause, the cost of which shall be deemed to be included in the rates and prices.

1.13 EXISTING SERVICES

Drains, pipes, cables and similar services encountered in the course of the Works shall be guarded from injury or damage by the Contractor at his own cost so that they may continue to function uniterruptedly to the satisfaction of the owners thereof, and the Contractor shall not store materials or otherwise occupy any pary of the Site in any manner likely to hinder the operations of such owners.

1.14 KEEPING WORKS FREE FROM WATER

Except where otherwise specified, the Contractor shall keep the site of works free from water so that the works will be carried out in dry. The Contractor shall construct any coffer dam, temporary bulkhead and drainage facilities including canal and pump, if necessary.

The Contractor shall carefully study rainfall and flood of the river to construct the facilities to keep the site of works free from water. The Contractor shall have full responsibility for diversion and drainage of water during rainy and flood seasons. Any loss and damage that may result from flood shall be recovered by the Contractor's expenses.

1.15 USE OF EXPLOSIVES

When the use of explosives is necessary for the execution of the Works, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall be responsible for all damage resulting from the use of explosives.

The Contractor shall provide and erect special signs to warn the public of his

blasting operations. Such signs shall be placed at appropriate points within the project and these signs shall be maintained as to be clearly evident to the public during all critical periods of blasting operations.

All explosives shall be stored in a safe and secure manner as approved by the anthority concerned and all such storage places shall be marked clearly and in large letters: DANGEROUS EXPLOSIVES.

Storage shall be provided to the satisfaction of the Engineer and in general not closer than 300 m from the road or from any building or camping area or place of human occupancy.

1.16 SIGNPOST AND NOTICE BOARD

The Contractor shall provide signposts and notice boards at the places indicated by the Engineer. The signpost shall show the direction to the work site and the name of Project, Employer, Engineer, Contractor, etc. The notice board shall describe the outline and illustrate the general plan of the Project.

1.17 ENGINEER'S OFFICE

1.17.1 DESCRIPTION

This item shall consist of the rent, maintenance and cleaning of the building in the Khorfakkan as well as the furnishing and maintenance of the office furnitures including the air-conditions for the sole use of the Engineer/Engineer's Representative and his staff together with the provision, installation, maintenance and services. The furniture and equipment shall remain the property of the Employer. The building shall be approved in advance by the Engineer.

The building and services shall be available in full working order before any construction operations are commenced, and shall continue to be so available during progress of the Works until the Certificate of Completion for the whole of the Works has been issued.

The Contractor shall be responsible for making all arrangements

and payments in respect of the building or access to it.

The Contractor shall be responsible for the security of the building and its contents at all times and shall employ watchmen for this purpose.

1.17.2 STAFFING

The Contractor will be required to employ and be responsible for the welfare and housing of the following staff to be available during the hours agreed by the Engineer's Representative from time to time at the Site office of the Engineer's Representative:

– One Cleaner

– Two Office Boys

– Three Drivers

1.17.3 SERVICES

Flollowing services shall be provided, installed and maintained in the Engineer's Office;

(a) An adequate piped supply of clean, fresh water connected to the toilet and suitable sewage disposal facilities.

(b) A 222-250 volts, 50 cycle A.C. electricity supply, with sufficient and suitable light fittings and socket outlets.

(c) Ten 1 H.P. (12500 B.T.U.) air conditioning units.

(d) Three public telecommunication lines.

(e) Office supplies.

1.17.4 FURNITURE AND EQUIPMENT

The Engineer's Office shall be furnished with new furniture and

equipment provided in the clause 1.17 of the Particular Specifications.

1.17.5 PAYMENT

Payment for the Engineer's Office will be made on the basis of the contracted Lump Sum price in the Bill of Quantities.

50% of the contracted price will be paid at the starting the usage of the Engineer's Office by the Engineer/Engineer's Representative. Remainder 50% will be paid by the monthly payment from the month when the Engineer's Representative starts the usage to the month when the Certificate of Completion for the whole of the Works has been issued.

1.18 ENGINEER'S RESIDENCE

1.18.1 DESCRIPTION

This item shall consist of the rent, maintenance and cleaning of two buildings in the Khorfakkan as well as the furnishing and maintenance of the furniture including the air-conditions for the sole use of the Engineer/Engineer's Representative and his staff together with the provision, installation and maintenance of services. The renting buildings shall be two storied house and more than 150 sq.m in each. The furniture and equipment shall remain the property of the Employer. The building shall be approved in advance by the Engineer.

The building, furniture, equipment and services shall be available in full working order before any construction operations are commenced, and shall continue to be so available during progress of the Works until the Certificate of Maintenance for the whole of the Works has been issued.

The Contractor shall be responsible for making all arrangements and payments in respect of the building or access to it.

The Contractor shall be responsible for the security of the building

and its contents at all times and shall employ watchmen for this purpose.

1.18.2 STAFFING

The Contractor will be required to employ and be responsible for the welfare and housing of the following staff to be available during the hours agreed by the Engineer's Representative.

– One Cook

– One Assistant Cook

– Three Cleaners

1.18.3 SERVICES

Following services shall be provided, installed and maintained in the Engineer's Residences;

(a) Adequate piped supply of clean potable water connected to toilets and bathrooms in the Buildings and suitable sewage disposal facilities.

(b) Electric immersion water heaters in the bathrooms connected to the piped water supply.

(c) 220-250 Volts, 50 cycle A.C. electricity supply with sufficient and suitable light fittings and socket outlets.

(d) One public telecommunication line for each building.

(e) One electric, vacuum cleaner for each building.

1.18.4 FURNITURE AND EQUIPMENT

The Engineer's Residences shall be furnished with new furniture and equipment provided in the clause 1.18 of the Particular Specifications.

1.18.5 PAYMENT

Payment for the Engineer's Residence will be made on the basis of the contracted Lump Sum price in the Bill of Quantities.

50% of the contracted price will be paid at the starting the usage of the Engineer's Residence by the Engineer/Engineer's Representative. Remainder 50% will be paid by the monthly payment from the month when the Engineer's Representative starts the usage to the month when the Certificate of Completion for the whole of the Works has been issued.

1.19 ENGINEER'S TRANSPORTATION

1.19.1 DESCRIPTION

The Contractor shall provide new petrol or diesel engined vehicles complete with spare wheels and standard tools for the exclusive use at all times of the Engineer's Representative and his staff. The vehicles shall be as follows:-

Type A : Air-conditioned long wheel base GMC Station Wagon or approved equivalent. ..... 2 units

Type B : Air-conditioned long wheel base sedan, engine capacity --2000 cc approved by the Engineer. ..... 1 unit

The order for the vehicles shall be placed immediately on receipt of the Handover of the Site.

The Contractor shall be fully responsible for all insurance, licences, repairs, fuel and lubricants, for the duration of the Contract up to the time of the issue of the Certificate of Maintenance, unless prior notice is given by the Engineer that the vehicles are no longer required for the purpose of the Contract.
The vehicles shall be taxed and comprehensively insured for any driver and passenger throughout the duration of the Contract. The policies of insurance shall be fully comprehensive, and for any driver. The policies shall be to the approval of the Engineer and the

Contractor shall produce them for inspection on request.

All the vehicles shall be provided with competent and experienced drivers by the Contractor, who speak the English well, and shall be under Engineer's control during day and night.

1.19.2 PAYMENT

Payment for the Engineer's transportation will be done by the same manner provided at the clause 1.18 of the General Specifications.

1.20 PROGRESS REPORT AND PHOTOGRAPHS

1.20.1 PROGRESS REPORT

During the progress of works, the Contractor shall submit 5 copies of the monthly progress report not later than 10th of each following month.

The report shall show the works completed during the month and also to have as attachments the following information and documents.

- Physical records such as climate conditions and river discharge.
- Engaged staffs and labours.
- Construction equipment and materials furnished on the Site by the Contractor and their operation conditions.
- Accidents, dispensary frequency and antilliteracy campaign.
- Status of the works performed with comparison to the Contract Quantities by figures, bar charts and graphics.
- Photographic records.
- Special events.

Daily or weekly reports may be required for the nominated special works in a form approved by the Engineer. These reports shall be submitted to the Engineer up to 9 a.m. on the following day or the first day of the following week.

1.20.2 PHOTOGRAPHS

The Contractor shall employ a competent photographer who shall take first quality colour photographs for retention by the Engineer, of all significant aspects of construction work during the period of the Contract.

Three prints (glossy finish) plus the negative of thirty different colour photographs size 20 cm by 25 cm shall be submitted by the Contractor each month as directed by the Engineer. Each photograph shall bear the Project name, the date, and a serial number which shall be carreid consecutively from month to month. The Contractor shall ensure that all important and/or unusual aspects of the construction and of the site are carefully photographed at appropriate stages of completion, and shall comply with all instructions by the Engineer in this respect.

1.20.3 PAYMENT

Payment for the preparation of the progress report and progress photographs shall be made by the unit set out in the Bill of Quantities.

1.21 LATEST VERSIONS OF TECHNICAL MEMORANDA, SPECIFICATIONS ETC.

Where a technical publication or specification produced by a National or International Body (e.g. ASTM, JIS, BS, etc.) is referred to anywhere in the Contract Documents it shall be understood that the latest version, together with any addenda, corrigenda etc. shall be used.

SECTION 2

SITE INSTALATION

2.1 INTRODUCTION

This Section covers temporary access and haul roads, electric power, water supply, sewage disposal and telecommunications for construction purposes and for living accommodations, construction camp and associated installations, safety requirements and other temporary work items.

Site installation shall include supply, transport, erection, removal and maintenance of all machinery, vehicles, scaffolding, equipment, lighting etc.

2.2 APPROVAL OF STANDARD AND LAYOUT

The standard of the housing, canteen and medical care facilities, etc. and the location of the construction camp including living accommodation and layout of the buildings provided for shall be submitted to the approval of the Engineer.

No house, office, store, workshop or other habitable building will be permitted underneath or within 10 meters of the nearest point in plan of any conductor of an overhead powerline.

2.3 CONSTRUCTION AND RUNNING OF NECESSARY FACILITIES

The Contractor shall construct, maintain and operate at the construction camp all necessary facilities to be used for every purpose for the realisation of the works, construction and maintenance of all the necessary equipment and for the living quarters for his personnel as well as offices, working shops, warehouses, storage and assembly areas and other facilities. These facilities shall correspond to the standard of such construction sites.

2.4 CUSTODY AND PROTECTION

The Contractor shall in connection with the works provide and maintain all lights, guards, fencing and watching when and where necessary or required by the Engineer and/or by any competent statutory or authority for the protection of the works and for safety and convenience of the public.

2.5 ILLUMINATION

All transit areas and open-air night working sites are to be illuminated by the Contractor with sufficient intensity during the whole night. Adequate illumination is also to be provided by the Contractor in all his workshops and offices for 24 hours a day. All cables for lighting and power are to be adequately protected.

2.6 TELECOMMUNICATION

The Contractor shall make all arrangements for efficient telephone, radio and telegraph facilities required within the project area to inter-communicate between various sites and for an efficient link with the public telecommunication system.

The Contractor shall maintain his above described inter-communication system during the life of the Contract and pay all charges levied on the operation thereof by the telephone and postal authorities and follow their rules and operation instructions of the respective facilities in all respect.

The installation and operation of the switchboards and telephone utilities required by the Contractor shall be taken care of by him at his own cost.

2.7 ACCESS

The improvements, maintenance and diversion of existing roads in the vicinity of the construction site used for construction purposes shall be carried out by Contractor. Road improvements elsewhere which are necessary for transport of vehicles, equipment, materials, etc. shall be included.

The Contractor shall repair any damage to the public and private roads and bridges, resulting from the transportation of vehicles, equipment or materials

to the site by him.

The roads, existing or temporary, shall be built and kept in such a condition, that all equipment and trucks may use them without difficulties at any time, throughout the year.

Within the scope of the site installation the Contractor shall build, maintain and remove with the approval of the Engineer all necessary temporary roads, bridges, parking areas and similar facilities at, to or near the sites, quarries, borrow areas for cars, trucks and mobile equipment in connection with the construction of the works.

The location shall be selected in such a way that minimal damage will be done to lands. Special care shall be given that the construction or removal of the temporary roads and parking areas will not endanger the stability of natural slopes. Not removed roads remain in the property of the authority at no extra cost to him.

The temporary roads and parking areas will be open to the use of everybody involved in the realisation of the Project.

2.8 STORING AREAS

This item comprises the execution, maintenance and removal of the temporary storing areas required for site installation and in connection with the construction.

All storing areas shall be well graded and drained if necessary, workman likely designed for trafficability by heavy equipment and provided with good access.

2.9 POWER SUPPLY

The power supply of the construction sites in the entire Project area has to be made for a continuous 24-hour-a-day operation power supply with sufficient capacity to satisfy peak and emergency demands like fire, fighting, pumps, cooling, etc.

The Contractor shall submit a technical report with a detailed demand analy-

sis. The current system for the housing and offices has to be in 220 V/50 cycles and clearly stated.

All electrical devices and cables must be installed safely and workman likely.

The Contractor shall make provision for an adequate number of plants as the Contractor may require to ensure the safety of all personnel occupied in all works of this Contract. Provision shall also be made for the necessary breaker, automatic stating equipment, electrical switchgear and protection devices, etc. to ensure readiness and safety of the operation.

A copy of the mentioned drawings and data of the foreseen equipment shall be given to the Engineer.

2.10 WATER SUPPLY

The Contractor shall make provision for wells for the supply of water for the works, including potable water in sufficient quantities. The Contractor can use the well which was digged by the Employer and will be directed to the Contractor on site. This chapter includes the necessary reservoirs to cover all demand peaks at any time and the appropriate piping to ensure sufficient pressure.

The Contractor is responsible for the water supply to the works, living camp, offices, etc.

For the needs of the Contractor's field laboratory the Contractor shall provide water of adequate pressure and capacity.

For watering of dam embankment the Contractor shall provide the water by the pipe line with adequate pressure and capacity, or by the tank lorry or other transportation equipment.

A detailed description of the planned water supply plant shall be given to the Engineer for his approval.

2.11 ACCIDENT AND FIRE PREVENTION

The Contractor shall be responsible for all accident and fire preventions of

the site. Precaution shall be exercised at all times by the Contractor for the protection and safety of all persons and property.

The Contractor shall comply with all applicable statutory requirements and such directions as the Engineer may consider necessary or desirable for accident and fire protection. The general conduct of the works shall be accomplished in accordance with the safe practices in construction work laid down in the respective laws and regulations of the U.A.E.

All magazines or storage areas for explosives and detonators shall be located in such a way as to conform to the requirements of rules and regulations of the U.A.E. and according to the Engineer's directions.

The magazines and storage areas shall be guarded by the Contractor at all times.

2.12 SAFETY PRECAUTIONS

2.12.1 GENERAL

In general, the safety standards for the transmission and fencing of electric power, handling of explosives, use of electro-mechanical and pneumatic equipment and personnel transport are conform to the laws and regulations in force in the U.A.E. and enforced by a safety engineer appointed by the Contractor who will be responsible for the safety on the Project area.

2.12.2 PERSONAL SAFETY EQUIPMENT

All personnel employed on the working sites are to be provided with safety equipment appropriate to the tasks upon which they are engaged, such as helmets, safety footwear, gloves, lamps, waterproof clothing and dust masks.

2.12.3 ELECTRICAL EARTHING

In every case, all electric motors, equipment, rails and pipes are to be earthed electrically, and the earth connections are to be inspected at regular intervals by qualified personnel.

2.12.4 WEATHER PROTECTION

The Contractor is to undertake at his expense all necessary precautions for the protection against the inclement weather.

2.12.5 FIRE PRECAUTIONS

An adequate number of fire extinguishers shall at all times be available at various working sites or camps; their number, type and location will be subject to approval.

2.13 SANITATION AND MEDICAL CARE

The Contractor shall comply with the rules and regulations of the sanitary authorities as regards sanitary requirements in connection with the works. In the event of illness of an epidemic nature breaking out, the Contractor shall carry out and comply with all orders, arrangements or regulations as may be issued by the government.

The Contractor shall take all necessary precautions for organizing and maintaining efficiently and adequate numbers of sick-rooms and first-aid posts, both at the working sites and in the accommodation areas, all at his own cost. Arrangements for an immediate communication and a rapid transport of injured persons to the medical dispensary shall be made.

The Contractor shall provide and maintain a medical dispensary at the project area, controlled by a medical attendant. A qualified medical practitioner will be in attendance at the dispensary at least two times a week.

The Contractor's medical and first-aid facilities shall at all times be available for use by the personnel of the Enployer and the Engineer/Engineer's Representative and every labourer free of charge and shall include a portable respirator and a vehicle, suitable for use as an ambulance.

A detailed description of the planned measures concerning medical care shall be given to the Engineer for his approval.

2.14 FACILITIES FOR SITE OPERATION

The Contractor shall make available housing accommodations and victualling for his personnel employed on the construction works. A detailed description of the intended installations shall be given to the Engineer. No buildings, yards etc. shall be erected without the approval of the Engineer. The housing and office facilities shall be subject to approval by the Engineer. Work helpers shall be obtained from the neighbouring area.

2.14.1 LOCATION

Location is intended in the areas next to the site installations or in the camp areas.

2.14.2 MAIN OFFICE OF CONTRACTOR

The main office of the Contractor shall be situated in the Project area.

2.14.3 CANTEEN

The Contractor shall make available adequate canteen facilities for his and other persons employed on the construction works. These facilities shall be open to anybody involved in the dam Project.

2.15 CLEANING-UP, RESTORATION

The Contractor shall, at all times, keep the working and storage areas used free from accumulations of waste materials or rubbish. Restoration of the area after completion of the works go on the expenses of the Contractor.

2.16 WASTE DISPOSAL AND SEWAGE TREATMENT

For the disposal of all arising waste, the Contractor shall designate a suitable located place to be approved by the Engineer. The transport of all waste to this site where it shall be destroyed by fire as far as possible, is at the Contractor's expense. After completion of the works, the waste disposal shall be entirely covered with earth or rock.

Sanitary installations are to be provided by the Contractor at suitable places on the working sites, for use by all personnel involved in the Project. The Contractor shall be responsible for the cleanliness and hygienic conditions of these installations. For the treatment of the sewage, filters and septic tanks of approved design shall be provided. Any pollution of rivers, aquifers and terrain has to be avoided. A detailed description of the planned measures shall be given to the Engineer.

2.17 CONSTRUCTION PROCESSION PLANTS

2.17.1 AGGREGATE PREPARATION PLANT FOR DAM MATERIALS

A plant with appropriate capacity is required for the:

- Separation of the alluvial material
- Mixing of the fine portion of the alluvium with the colluvium (in case the Contractor proposes another than the intermediate stock-piling method proposed by the Engineer)
- Mixing of sand and bitumen (if bituminous sand is applied in the structure)

2.17.2 CONCRETE PLANT

The equipment used for preparing concrete shall meet the requirements for conveying, storing, measuring and mixing. The equipment provided shall be of sufficient capacity and in such a working state that the time specified for the execution will not be exceeded.

2.18 FIELD LABORATORY

The Contractor shall provide and maintain a complete field laboratory to organize, perform and evaluate the relevant tests directly on the site and immediately after sampling.

The buildings for the laboratory shall consist of one room for the Engineer, one storage and one large room for testing, and this building shall have more than 60 sq.m in the total area with air-conditioner approved by the Engineer. Arrangements for sufficient power and water supply shall be made.

The Contractor shall provide and maintain all laboratory instruments stated

in the Clause 2.18 of the Particular Specifications, and shall submit a detailed list of the laboratory instruments showing their types, manufacturer's name, model number or name, series number and manufactured year for the Engineer's approval at least 45 days before purchasing them.

The Contractor shall provide all necessary manpower for the laboratory operation such as experienced personnel, skilled and unskilled labours and so on.

The laboratory will be run by the Contractor's experienced personnel and supervised by the Engineer. In general, the field laboratory is concerned with:

(a) Organization and evaluation of the compaction tests,
(b) Control of construction materials, and
(c) Control of placing operations.

The construction of an embankment shall be controlled in a manner to assure that the each zone are relatively homogeneous and that the average properties are at least equal in quality to the valules assumed in the design.

The control testing will involve work in the borrow areas and placing zones. The Contractor should make every effort in his construction operations not to interfere with test activities and may even be required to halt operations for brief periods if interference cannot be avoided. Consideration of such difficulties has to be reflected in the unit prices.

Main laboratory test will be stated below, and these test will be carried out in conformity to the ASTM specifications, other standards or specifications approved by the Engineer. The Contractor shall provide the specifications and/or standards to be used for the laboratory test on himself.

(a) Tests for sand and gravel
  - Sieve analysis
  - Water content test
  - Compaction test
  - Field density test
  - Field permeability test.

(b) Tests for rock materials

– Sieve or screen analysis
– Specific gravity and absorption test

(c) Tests for concrete
– Sieve analysis of aggregate
– Compressive test
– Slump test

A detailed description of the installations and the test performances shall be given to the Engineer for his approval.

The Contractor shall accept the test results of the field laboratory as well as instructions and restrictions stipulated by the Engineer on the basis of these test results or defined elsewhere in the Specifications. Further specialized testing as may be required and which cannot be run in the field laboratory due to lack of time or equipment, will be assigned to an independent organization, and the Contractor shall pay and accept also any such results or instructions and restrictions resulting therefrom.

2.19 CONTROL OF THE INSTALLATIONS

The Engineer will examine the site installations and will have the right to ask for any reasonable additional improvements, complementary installations, communication extensions, devices or safety measures, etc. and the Contractor will deliver them without any supplementary compensation.

2.20 LOCATION OF SITE INSTALLATIONS

For all site installations, the Contractor has to take into consideration flood conditions due to natural rainfall, river diversion, and temporary and permanent impounding.

2.21 MEASUREMENT AND PAYMENT

Payment for the various items of the site installation will be made on the basis of contracted lump sum prices including furnishing, transport, erection, maintenance, depreciation, dismantling, removal, dislocation of the installation and restoration of the site to its original or better state.

The amount up to sixty (60) percent of the total contracted amount can be paid at the adequate rate that the Engineer decided according to the progress of each work of site installation, whereas the balance forty (40) percent shall be paid in corresponding to the progress of the whole contracted works.

SECTION 3

STRIPPING

3.1 DESCRIPTION

Stripping shall be excavation of top soil including removal of trees, vegitables, stumps, brush, roots, rubbish, debris and other objectionable matters from the area indicated on the Drawings or directed by the Engineer.

3.2 CONSTRUCTION

Unless otherwise specified the areas designated for stripping shall be carried out all kinds of excavation as well as clearing of all trees, stumps, brush, roots, rubbish, debris and other objectionable matters as shown on the Drawings.

The thickness of stripping is 50 cm in depth, unless otherwise as shown on the Drawings or directed by the Engineer.

Excavated materials under the STRIPPING including tress, vegitables, stumps, brush, roots, rubbish, debris and other objectionable matters shall be removed to the location/s at any distance directed by the Engineer. These excavated materials shall not be used for any embankment or backfill.

3.3 MEASUREMENT

The measurement for stripping shall be made by the Drawings approved by the Engineer and the volume will be computed in cubic metres by the average end area method.

3.4 PAYMENT

The accepted quantities of stripping, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

– excavation as shown on the Drawings or directed by the Engineer.

– removal of trees, vegitables, stumps, brush, roots, rubbish, debris and other objectionable matters within the area to be excavated.

– hauling of excavated materials including loading, unloading to spoil bank area at any distance.

– arrangement and final treatment of spoil bank area as approved or directed by the Engineer.

SECTION 4

TRENCH EXCATATION

4.1 DESCRIPTION

Trench excavation shall consist of the excavation of earth materials including soil, sand and gravel to lines, grades and dimensions as shown on the Drawings, and the hauling and the placing of the excavated materials in embankment approved by the Engineer.

4.2 CONSTRUCTION DETAILS

The excavation shall be carried out in conformity to the lines, grades, slopes and dimensions as shown on the Drawings or directed by the Engineer, and all suitable materials shall be hauled to and placed in the embankment area at any distance.

The excavated surface shall be regulated within a tolerance of ± 10 cm. In case of the over excavation which is not approved or directed by the Engineer, the Contractor shall carry out, at the Contractor's own cost, the filling works by the same materials and same method as for embankment of dam body provided in the Section 10 of the Specifications.

4.3 MEASUREMENT

The measurement for trench excavation shall be made by the construction Drawings approved by the Engineer and the volume will be computed in the cubic metres by the average end area method.

4.4 PAYMENT

The accepted quantities of trench excavation, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

– excavation of trench as shown on the Drawings

– hauling at any distance to the places approved by the Engineer including loading and unloading.

SECTION 5

COMMON EXCAVATION

5.1 DESCRIPTION

Common excavation shall consist of the excavation of earth material incluing soil, sand and gravel to lines and grades as shown on the Drawings, and the hauling and the placing of the excavated materials in embankment approved by the Engineer.

5.2 CONSTRUCTION DETAILS

The excavation shall be carried out in conformity with the lines, grades, slope and dimensions as shown on the Drawings or directed by the Engineer, and all suitable materials shall be hauled to and placed in the embankment area at any distance.

The line for common excavation shown on the Drawings is the pay-line, so that after completion of the excavation, any earth materials must not remain within the pay-line shown on the Drawings approved by the Engineer.

In case of over excavation from the pay-line, the Contractor shall fill up by the Contractor's own expenses by the concrete provided in the Item No.13 of the Specifications and by the method instructed by the Engineer.

5.3 MEASUREMENT

The measurement for common excavation shall be made by the construction Drawings approved by the Engineer and the volume will be computed in the cubic metres by the average end area method.

5.4 PAYMENT

The accepted quantities of common excavation, measured as provided above, will be paid for at the Contract unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

– excavation as shown on the Drawings.

– hauling to the place approved by the Engineer includng loading and unloading.

– filling work by concrete for the over excavation.

SECTION 6

ROCK EXCAVATION OF DAM ABUTMENTS

6.1 DESCRIPTION

Rock excavation of dam abutments shall consist of the excavation of rock materials of dam abutments as shown on the Drawings and the hauling the excavated rock materials to the embankment area including loading, unloading, etc.

6.2 CONSTRUCTION DETAILS

The excavation shall be carried out by using the excavating tools approved by the Engineer in conformity with the lines, grades and dimensions as shown on the Drawings or directed by the Engineer, and the excavated rock materials can be used as the embankment materials with the approval of the Engineer.

The hauling shall include the loading, unloading, hauling of excavated rock material to the embankment area by any kind of transportation and spreading.

6.3 MEASUREMENT

The measurement for rock excavation of dam abutments shall be made by the construction Drawings approved by the Engineer and the volume will be computed in the cubic metres.

6.4 PAYMENT

The accepted quantities of rock excavation of dam abutments, measured as provided above, will be paid for the contracted unit price (rate) in the Bill Quantities.

The rate shall include the following works;

– excavation of rock materials of dam abutments by the excavating equip-

ments

– hauling to the embankment area including loading, unloading and spreading.

SECTION 7

ROCK EXCAVATION

7.1 DESCRIPTION

Rock excavation shall consist of the excavation of rock materials, such as serpentinite and so on, by blasting or other excavating methods approved by the Engineer and hauling the excavated material to the rock embankment area of dam body or to the spoil bank area approved by the Engineer including the loading, unloading and treatment of spoil bank area.

7.2 CONSTRUCTION DETAIL

Prior to the rock excavation of spill way, the Contractor shall submit his proposal of schedule and plan for the Engineer's approval.

The rock excavation can be done by the blasting and/or the other excavating methods approved by the Engineer.

In any case, the rock excavation shall be carried out in conformity with lines, grades and dimensions as shown on the approved Drawings by the Engineer.

A tolerance of rock excavation shall be within ± 10 cm.

The rock excavation of 50 cm above the planning bottom or bed shall be carried out by using the pick-hammer or suitable equipment, or approved blasting methods by the Engineer.

All objectionable materials, such as oil, mud, rock fragments, chips, mortar, organic materials, stagnant water, etc. shall be removed from the rock surface and such cost shall be borne by the Contractor.

The excavated materials will be separated to two classes; suitable material for dam embankment and material for waste as directed by the Engineer. The suitable material for dam embankment shall be hauled to the embankment area

approved by the Engineer at any distance and wasting material shall be hauled to the spoil bank area directed by the Engineer. The rock of diametre less than the 5 mm may be wasted.

7.3 BLASTING

The Contractor shall perform blasting in such manner as to preserve the bed-rock below and beyond the lines at all excavation in the soundest possible conditions. The method of blasting shall therefore be altered in accordance with the condition of the rock, and quantities of explosive charges and depth of drill holes shall be reduced in stages as the final lines of excavation are approached.

The Contractor shall performed test blasting in order to determine excavation methods by which the required results may be obtained in the most economical manner or suitable method for using excavated material to fill materials and shall obtain the approval of the Engineer for depths, sizes and spacing of drill holes and types and method of charging of explosives. The Contractor shall not perform blasting operations before the scale and pattern of the blasting operation have been submitted to the Engineer for his approval.

The Contractor shall be entirely liable for any accident which may occur and shall protect and indemnify the Employer from all claims that arise therefrom. Where loss, inconvenience, injury or accident is likely to be caused to persons, animals, the works, property etc., the Engineer shall have power to regulate or prohibit blasting.

The Contractor shall give warning each time of his intention to blast and place station men on the roads and elsewhere with flags, horns and whistles to prevent persons, animals and traffic going into or remaining within the danger zone.

Blasting shall not be permitted within 20 m of the existing structure or parts of structures already placed the concrete.

7.4 MEASUREMENT

The measurement of rock excavation shall be made by the Construction Drawings approved by the Engineer and the volume will be computed in the cubic metres by the approved method by the Engineer.

7.5 PAYMENT

The accepted quantities of rock excavation, measured as provided above, will be paid for the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

- excavation of rock materials by the blasting or other methods approved by the Engineer.

- hauling the excavated materials which are suitable for embankment to the embankment area of dam body or the excavated materials which are not suitable for embankment to the spoil bank area including loading, unloading and treatment of spoil bank area.

SECTION 8

SPOIL BANK

8.1 DESCRIPTION

Spoil bank is the place where the non-suitable materials for embankment from excavation or otherwise directed by the Engineer will be wasted.

The spoil bank area will be directed by the Engineer, then the Contractor shall submit his plan and schedule for spoil bank treatment to the Engineer for his approval.

The slope of spoil bank shall be less than one to one. The spoil bank shall be arranged the terrace each five metres height.

8.2 PAYMENT

No separate payment for spoil bank shall be made, therefore, these construction cost shall be included in the contracted unit price (rate) of the stripping, common excavation, rock excavation and son on.

SECTION 9

BACKFILL

9.1 DESCRIPTION

The backfill is the works of filling up the excavated place such as inlet and outlet of the conduit by sand and gravel.

9.2 CONSTRUCTION

The materials for the backfill shall be the same as sand and gravel provided in the Section 10 in the Specifications.

The compaction of the backfill shall be carried out by the approved compacting equipment by the Engineer but not by heavy equipment after watering.

9.3 MEASUREMENT

Measurement of backfill by sand and gravel shall be made by the Construction Drawings approved by the Engineer and the volume will be computed in the cubic metres by the average end area method.

9.4 PAYMENT

The accepted quantities of backfill by sand and gravel, measured as provided above, will be paid for the contracted unit price (rate) in the Bill of Quantities.

No separate payment shall be made for the material from borrow pit or any excavation. The contracted unit price (rate) in the Bill of Quantities shall be deemed to consider the prices of excavation at borrow pit, hauling of the excavated materials from borrow pit, compaction of materials coming from the borrow pit and excavated area and so on.

The rate shall include the following works;

– spreading, watering, compaction etc. of all embankment materials by the equipment approved by the Engineer.

– Excavation of sand and gravel at borrow pit, and hauling the excavated materials from borrow pit to embankment area including loading and unloading.

SECTION 10

EMBANKMENT OF SAND AND GRAVEL

10.1 DESCRIPTION

The embankment of sand and gravel is the embankment of the part as shown on the Drawings by the sand and gravel which are obtained from trench excavation, common excavation and borrow pit.

The embankment of sand and gravel shall consist of spreading, watering and compaction of the material from the trench excavation, and common excavation, and shall consist of excavation, hauling, spreading, watering and compaction of the material from the borrow pit.

10.2 CONSTRUCTION DETAIL

The embankment shall be constructed in reasonably close conformity to the lines, grades and climensions established or shown on the Drawings.

Prior to the commencement of embankment, the Contractor shall submit to the Engineer for his approval the equipment to be used for the embankment. The Contractor shall not start the embankment without the approval of the Engineer for embankment equipment.

In case if the Engineer orders to the Contractor to submit the catalogue and/ or other data for evaluation of the Contractor's proposal, the Contractor shall submit the Engineer's requirements immediately to the Engineer without any extra cost.

The excavated surface of stripping, trench excavation and so on shall be well compacted by the approved compacting equipment prior to the spreading of embankment materials.

The embankment material obtained from the trench excavation, common excavation and so on shall be within 30 cm diametre, and embankment of

sand and gravel shall be placed in horizontal banking layers not exceeding 40 cms in loose measurement and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous levelling and manipulating will be required to insure uniform density.

Embankment constructed in layers of the depths specified shall be compacted by means of rollers, hauling equipment, mechanical tamping and vibrating euqipment or by other suitable means. Equipment shall be routed to distribute travel over the entire area of each layer of material insofar as is practicable, and separate pieces of equipment shall not follow in the immediate tracks of preceding equipment.

After layer for embankment will be placed, the Contractor shall carry out the watering whose amount will be directed by the Engineer.

The compaction shall be carried out eight (8) passes of a 10 ton vibrating roller.

10.3 MEASUREMENT

Measurement of embankment of sand and gravel shall be made by the Construction Drawings approved by the Engineer and the volume will be computed in the cubic metres by the average end area method.

10.4 PAYMENT

The accepted quantities of embankment of sand and gravel, measured as provided above, will be paid for the contracted unit price (rate) in the Bill of Quantities.

No separate payment shall be done for the embankment material from borrow pit or any excavation. The contracted unit price (rate) in the Bill of Quantities shall be deemed to consider the prices of excavation at borrow pit, hauling of the excavated materials from borrow pit, compaction of materials coming from the borrow pit and excavated area, and so on.

The rate shall include the following works;

– spreading, watering, compaction etc. of all embankment materials by the equipment approved by the Engineer.

– excavation of sand and gravel at borrow pit, and hauling the excavated materials from borrow pit to embankment area including loading and unloading.

SECTION 11

EMBANKMENT OF ROCK

11.1 DESCRIPTION

The embankment of rock is the embankment of the part as shown on the Drawings by the rock which are obtained from the rock excavation of dam abutment and spillway or otherwise directed by the Engineer.

The embankment of rock shall consist of spreading and compaction by the suitable capacity of Bulldozer.

11.2 CONSTRUCTION DETAIL

The embankment shall be carried out in reasonably close conformity to the lines, grades and dimensions established or as shown on the Drawings. Although the outer line of embankment is a payline, no embankment shall be finished within these paylines.

Embankment of rock may be carried out by the following methods:

- embankment materials will be unloaded on the initial embankment or compacted place already, and these materials will be pushed out by bulldozer, whose minimum required weight is 21 tons.

- The construction method of initial embankment shall be subject to the Engineer's approval, however, the space of initial embankment shall be enough to move the hauling equipment and bulldozer.

- In any case the depth of one layer of embankment shall not be exceeded 80 cm.

- The materials passing 5 mm sieve shall not be used for the embankment of rock.

11.3 MEASUREMENT

Measurement of embankment of rock shall be made by the construction Drawings approved by the Engineer and the volume will be computed in the cubic metres by the average end area method.

11.4 PAYMENT

The accepted quantities of embankment of rock, measured as provided above, will be paid for the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

- Spreading, compaction, etc. of all embankments materials by the approved equipments.

SECTION 12

BORROW PIT

12.1 DESCRIPTION

This section covers the preparation and stripping of borrow pit and excavation of sand and gravel materials for dam embankment from borrow pit (so-called the Borrow Pit Excavation in this Section).

12.2 CONSTRUCTION

The borrow pit area will be at upstream of dam body and will be directed by the Engineer at site as well as dimensions; width, length and depth, however, the depth of borrow pit from natural ground surface will not exceed by two (2) metres.

The stripping of the borrow pit shall be carried out in accordance with the provisions of the Section 3 in this Specifications. The depth of stripping shall be 50 cm in minimum.

The borrow pit excavation shall be carried out by the construction equipment approved by the Engineer. These excavated materials will be used for the dam embankment provided at the Section 9, accordingly the followings shall not be included;

- excavated material exceeding by the 30 cm in diameter.

- trees, vegitables, stumps, brush, roots, rubbish, debris and other objectionable matters which will not be approved for the embankment by the Engineer.

12.3 MEASUREMENT & PAYMENT

The works of borrow pit will be separated into stripping and the borrow pit excavation.

The measurement and payment of stripping shall be made in accordance with the provisions of the Section 3 of this Specifications.

The cost of the borrow pit excavation shall be included in the rate of embankment and payment shall not be made only for the borrow pit excavation.

SECTION 13

CONCRETE

13.1 DESCRIPTION

Structural Concrete shall consist of furnishing all materials and constructing structures of shapes and dimensions shown on the Drawings or as directed by the Engineer, using Portland Cement concrete, in accordance with the details shown on the Drawings and the Specifications.

Portland Cement concrete shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, water and additives when required. The mixture shall be proportioned, mixed, placed and cured in accordance with these Specifications for the class of concrete specified.

13.2 MATERIALS

13.2.1 GENERAL REQUIREMENTS

The classes of concrete and their respective minimum cement contents, consistencies and the minimum required compressive strengths shall be as shown:

Class	Min. Required Comp. strength @ 28 day. kg/cm^2 cylinder	Min. cement 50 kg bags/m^3	Max. size of aggregates mm
A1	210	7	40
A2	210	7	150
B1	160	5	40
B2	160	5	150
C	120	4	40

The cement content shown is the minimum required, and for any mix shall not exceed 500 kg/m^3.

AGGREGATES—GENERAL REQUIREMENTS

Potential aggregate sources shall be examined and particular attention shall be paid to the following aspects of the deposits and the actual or proposed extraction and production arrangements.

(i) Name, location, local national grid reference, type of deposit, potential variability, methods of extraction.

(ii) Methods and degree of control exercised over extraction.

(iii) Processing methods, types of plant, number of processing stages, standards of maintenance and process control, producer's laboratory facilities and technical staffing.

(iv) Stockpiling arrangements, loading and supply arrangements.

(v) Potential variations in end-products due to variations inherent in the deposit and in the existing methods of extraction, processing and stockpiling.

(vi) Possible modifications to existing extraction, processing, storage and handling arrangements, and to supervision arrangements to reduce end-product variations.

(vii) Possible requirements for supplementary processing on site.

(viii) Photographs shall be provided of each of the proposed new sources and relating production arrangements. The source photographs should preferably and close-ups of working faces.

SAMPLING

Aggregate deposits shall be sampled and tested in an appropriate and systematic manner to assess their potential variability and to assist in determining appropriate methods of extraction and processing.

The deposit investigation and sampling programs shall be relevant to each type of deposit and shall be devised and supervised by an experienced approved (Engineering) Geologist, after he has made a field reconnaissance of the potential deposit areas, or the existing workings.

Each size of aggregate shall be sampled at the discharge points on the production plant (i.e. conveyors or hoppers, not stockpiles) at three well spaced intervals during the course of each of three consecutive production days; these samples shall be designated "production samples".

In addition, selected samples shall be taken from producer's stockpiles to represent any readily visible variations in physical characteristics, or apperance, of materials ready for loading, these samples shall be designated "stockpile samples".

All samples shall be taken by arrangement with and in the presence of the Engineer, or his representative, and shall be tested as required below.

Representative portions of the above samples shall be taken for reference purposes and shall be split and retained on site by the Contractor and by the Engineer.

WASHING AND PROCESSING

The Contractor may be required to carry out on site supplementary and/or effective washing of coarse and fine aggregates where the aggregate producer's methods, in the opinion of the Engineer, may not result in end-products which consistently comply with all requirements of the specification, or where aggregates suffer un-acceptable changes during loading at source or during subsequent transportation to the site, or otherwise.

Aggregates which have been rejected may be re-processed by the Contractor on site, or by the producer, and then resubmitted for approval.

STORAGE

Adequate stocks of tested and approved aggregates shall be maintained on site and the capacity of the storage piles for each type and grading of aggregate shall be sufficient to hold the respective quantities required for the maximum amount of concrete which the Contractor is obliged or intends to pour in any continuous operation. Stockpiles shall be built in layers of 1.50 meters maximum height and segregation of the aggregates prevented. Concrete Block walls shall separate different grades of aggregates.

Dense concrete or bituminous slabs shall be laid with sufficient falls to cover all aggregate stockpile areas and shall extend to cover all surrounding areas where aggregates are likely to be discharged or handled. These areas shall be swept and kept clean at all times to ensure that the aggregates are not contaminated by the adjacent ground through trafficking or otherwise, and are to be constructed with adequate drainage for surplus water.

Windbreaks shall be provided where aggregates might suffer excessive contamination by windblown materials. During periods of heavy rain the bins or compounds shall be covered by tarpaulins or other approved means.

Where aggregates are stockpiled the bases must slope away from the point from which aggregates are to be taken for mixing. Hosing of the stockpiles to prevent any accumulation of salt at their bases will be required to the Engineer's satisfaction.

REJECTION

The general or localized build up of fines in aggregate sotckpiles shall not be allowed and any material which, in the opinion of the Engineer, is so affected will be rejected.

Aggregates which have suffered segregation or contamination during processing, handling at source, transportation to the site, stockpiling and handling on site, or which otherwise do not comply with the requirements of the specification, either locally or generally,

will be rejected and shall be removed promptly from the site.

The Engineer shall have the right to order that any aggregates which do not meet with this approval shall not be used in the Work. The Contractor shall have the right, at his own expense, to sample, test and give an opinion on such aggregate. If, after this, the aggregates are again rejected by the Engineer, they shall be immediately removed from the site by the Contractor at his own expense, notwithstanding any prior approval of the source which may have been given by the Engineer.

13.2.2 FINE AGGREGATE FOR CONCRETE AND MORTAR

Fine aggregate for concrete shall consist of natural sand having hard and durable particles, or of other inert materials with similar characteristics.

It shall not contain harmful materials such as clay lumps, tree roots, shale, iron pyrites, coal mica, organic matter or any deleterious matter which may attack the reinforcement, in such a form or in sufficient quantity to affect adversely the strength of and durability of the concrete. If necessary the aggregate shall be washed and sieved to remove the deleterious substances.

Fine aggregate shall meet the following gradation requirements:

Standard Sieve Size	Percent Passing by Weight
3/8 inch	100
No.4	95–100
No.16	45–80
No.50	10–30
No.100	2–10
No.200	0–4

If the fineness modulus varies by more than two-tenths (0.2) from the value assumed in the concrete mix design, the use of such fine aggregate shall be discontinued until suitable adjustments can be made in the mix proportions to compensate for the difference in gradation.

13.2.3 COARSE AGGREGATE FOR CONCRETE

Coarse aggregate for concrete shall consist of natural gravel, crushed gravel, or crushed stone, free from coating of clay or other deleterious substances. It shall not contain harmful materials such as iron pyrites, coal, mica, laminated materials, tree roots, shale, or any materials which may attack the reinforcement, in such a form or in sufficient quantity to affect adversely the strength and durability of the concrete. If necessary coarse aggregate shall be washed to remove deleterious substances.

Coarse aggregate shall meet the following gradation requirements and shall be uniformly graded within the limits stated:

Sieve Size	Percent Passing Maximum Aggregate Size (mm)				
	150	40	25	20	15
6 inch	100	–	–	–	–
5 inch	80–100	–	–	–	–
3 inch	65–80	–	–	–	–
2½ inch	–	–	–	–	–
2 inch	40–60	–	–	–	–
1½ inch	–	100	–	–	–
1 inch	25–40	95–100	100	–	–
¾ inch	–	35–70	95–100	100	–
½ inch	10–20	–	–	90–100	100
3/8 inch	–	10–30	20–55	40–70	85–100
No.4	0–5	0–5	0–10	0–15	60–85
No.8	–	–	0–5	0–5	40–60
No.50	0–3	0–3	0–3	0–3	9–20
No.100	0–2	0–2	0–2	0–2	3–10
No.200	0–1	0–1	0–1	0–1	0–3

13.2.4 WATER

Water for washing aggregates, reinforcement, formwork, and for mixing of concrete, shall be fresh, clean and substantially free form oil, acids, alkali, sewage, deleterious mineral or organic matter. It shall not contain chlorides such as sodium chloride in excess of

3000 ppm nor sulphates such as sodium sulphate in excess of 2000 ppm. It shall not contain any impurities in amount sufficient to cause a change in the time of setting of Portland Cement of more than 25 percent, nor a reduction in the compressive strength of mortar of more than 5 percent compared to results obtained with distilled water.

Water for curing concrete shall not have a PH lower than 5 nor contain impurities in sufficient amount to cause discoloration of the concrete. Sources of water shall be maintained at such depth and the water shall be withdrawn in such a manner as to exclude silt, mud, grass and other foreign matter.

All sources of water to be used in construction, including that used for compaction of backfill around the concrete structures, shall be approved by the Engineer. If at any time during construction, water from an approved source becomes unsatisfactory, the Contractor shall provide satisfactory water from other mains sources.

The water shall be reasonably clear and shall contain not more than one quarter (0.25) percent solids of weight.

13.2.5 CEMENT

(1) GENERAL

The cement shall be of approved manufacture and shall be delivered in bags with seals unbroken, or if delivered in bulk, it shall be delivered in approved containers. Test certificates from the manufacturers or suppliers shall be submitted for each consignment and shall indicate the results of the tests for compressive strength, setting time, soundness and fineness carried out in accordance with the requirements of the relevant ASTM or British Standards. Cement should be stored on the Site in such a way to keep it away from water at all times.

(2) TESTS AND ACCEPTANCE

The total acid soluble alkali content ($Na_2O + 0.658\ K_2O$) of cements determined in accordance with BS 4550: Part 2, shall not exceed 0.60 percent by weight, except where otherwise approved or required.

The Contractor shall obtain from each proposed manufacturer a typical sample of cement which shall be fully and independently tested in accordance with the appropriate Standard and the results shall be included with the relevant proposal. All costs associated with the testing shall be allowed for by the Contractor. Primary and secondary sources of the required cements shall be given. The following information shall be supplied:

MANUFACTURER

Company name and address of producing works.

CEMENT TYPE

Manufacturer's description of cement type and brand name and standards to which compliance is guaranteed.

COMPOSITION AND PROPERTIES

Average values and corresponding maximum and minimum values in respect of the following items, for a continuous production period of at least six months (state period covered) ending not earlier than three months before submission of the data:

Composition	Properties
Insoluble Residue	Lime Saturation Factor (LSF)
Silica (SiO_2)	Alumina-Iron Ratio (A/F)
Alumina (Al_2O_3)	Tri-calcium Aluminate (C_3A)
Total Iron (Fe_2O_3)	Free lime in Clinker (as CaO)
Calcium (CaO)	Total Acid soluble alkalis

Composition	Properties (Cont'd)
Magnesium (MgO)	Heat of Hydration—at 7 days
Potassium (K_2O)	at 28 days
Sodium (Na_2O)	Fineness (M^2/Kg)
Sulphate (SO_3)	Setting Times—Initial (min)
Sulphur (S)	—Final (min)
Chloride (Cl)	Soundness (mm)
Loss of Ignition	Compressive Strength —3 days
	—7 days
	—28 days
	—3 months

PRODUCTION CHANGES

State if any material or production process changes have been made since the end of the above period; if any are proposed, give brief details.

CONSIGNMENTS

The manufacturer's bulk average test certificate for each consignment of cement. The certificate shall show the results for chemical composition and physical properties determined in accordance with the relevant Standard.

Samples shall be taken from each consignment of cement and tested as directed by the Engineer in an approved independent laboratory, at the cost of the Contractor.

Where bulk cement deliveries are proposed, the Contractor shall provide all information required by the Engineer concerning off-site storage and loading arrangements and shall provide reasonable facilities for the Engineer to inspect these arrangements for approval purposes. Consignments shall be used in the order in which they are delivered.

(3) PORTLAND CEMENT

Normal and rapid hardening cement shall comply with B.S. 12, or equivalent ASTM-C 150 type II.

(4) SULPHATE RESISTING CEMENT

Whenever sulphate resisting cement is specified it shall comply with the B.S. 4248 or the equivalent ASTM-C 150 type II or type V.

13.2.6 ADMIXTURES

Air entraining agents, plasticisers, waterproofing agents, retarders, and other similar admixtures shall be of approved proprietary brands and shall be used in accordance with the manufacturer's recommendations. Samples of proposed admixture shall, if required, be submitted to an approved testing authority by the Contractor in order to ascertain its suitability for use in the Works.

The cost of such admixtures shall be included in the cost of concrete and no extra payment shall be made if they are used. The proportions of cement, fine aggregate and coarse aggregates and water shall be determined by the Contractor before concreting commences and submitted together with such test results as may be required to the Engineer for approval and the Contractor shall not commence concreting before such approval is given nor shall he alter or vary in any way the proportions of mix unless he submits fresh test results and mix proportions to te Engineer for approval.

The approval by the Engineer of such mix designs does not in any way absolve the Contractor of any of the requirements of the Specification.

If naturally occuring sand gravel mixtures are to be used with or without the addition of single sized aggregates, the Contractor shall satisfy himself that the natural variations in the source of such material do not prejudice the strength of the concrete or the requirements of maximum aggregate size and for this purpose the Engineer may require tests of concrete made from material selected from various parts of the source and may require screening or pre-treatment of the mixture as is in his opinion necessary to ensure compliance with the Specifications.

13.3 MIXING AND TESTING

13.3.1 SAMPLES OF AGGREGATES

Samples of both fine and coarse aggregates are to be submitted to the Engineer for testing at least one week before commencing deliveries. No deliveries inbulk are to be commenced until such samples are approved by the Engineer as complying with this Specification.

13.3.2 TRIAL MIXES

Following the Engineer's approval of the materials for each class of concrete the Contractor shall prepare a trial mix of each grade of concrete in the presence of the Engineer. Each trial mix shall comprise not less than 1/3 of a cubic metre of concrete and shall be mixed in an approved type of concrete mixer similar to that which the Contractor proposes to employ on the Works. The quantities of all ingredients of each trial mix including water shall be carefully determined by weight according to the approved mix design. Each trial mix shall show no tendency to segregate when handled and compacted by the methods by which the Contractor proposes to handle and compact the grade of concrete in the Works and it shall be capable of adequate compaction by such methods.

13.3.3 WATER/CEMENT RATIO

The quantity of water to be added to the cement and aggregates during mixing shall be just sufficient to produce a workable mix to enable it to be well compacted and worked into corners of form-work and around reinforcement. All mixes shall be designed in respect of the proportioning of water so that the Slump Test shall not be greater than 7 cm for concrete which is to be vibrated and 14 cm for concrete which will not be vibrated. Measurement of water on the Site shall take into account the moisture present in the aggregates, and Slump Tests shall be taken sufficiently frequent-ly to ensure that variations in the moisture content of the aggregate are fully taken into account in determining the amount of water

to be added.

13.3.4 MEASUREMENT OF INGREDIENTS

The aggregate for the concrete shall be measured by weight but measurement by volume may be allowed in special circumstances with the prior approval of the Engineer.

When the aggregates are to be measured by weight the weight-batching machines shall be of a type approved by the Engineer. They shall be kept clean and in good condition and adjustment. At intervals as the Engineer may require, the Contractor shall check the accuracy of each weight-batching machine.

When the aggregates are to be measured by volume, the proportions of fine and coarse aggregate shall be measured in well constructed gauge boxes, of dimensions approved by the Engineer to guarantee that whole multiples of such gauge boxes will ensure the use of one or more whole bags or containers of cement and the capacity of the concrete mixer shall be such as to ensure that no splitting of cement bags or containers is required. Gauge boxes shall be properly filled and struck off level, addition of fine aggregates to allow for bulking due to moisture content being made as required.

An efficient water measuring device shall be fitted to each concrete mixer.

Any cement container shall be such as to contain an accurately weighed amount of cement.

13.3.5 MIXING CONCRETE

The concrete shall be mixed in a power driven machine of the batch type, no hand mixing being allowed. The mixer shall be large enough to admit the use of 1 cement bag or container or whole multiples of bags or containers at a time. The mixing shall continue until there is a thorough distribution of the materials and the mass is uniform in consistency and colour. The period of mixing, judged from the time that all the ingredients including water are in the

mixing drum shall be as ordered by the Engineer but shall not be less than 2 minutes or 20 revolutions of the drum whichever is the longer. Should there be for any reason a stoppage of greater than 30 minutes, the drum or other containers of the mixer shall be thoroughly washed and cleaned before mixing is resumed. On completion of the mixing the concrete shall be discharged into clean boards or into clean barrows, etc. The method of discharge from the mixer shall be such as to cause no segregatation whether partial or otherwise of the concrete materials.

13.3.6 RE-MIXING

Concrete which has commenced to set shall not be remixed either with or without additional water and in no case shall such concrete be used in the Works.

13.3.7 CONCRETE TESTING—PRELIMINARY

The following method of testing shall apply to standard concrete cubes or cylinders.

After the materials have been approved and at least 10 days before any concrete is poured, the Contractor shall make preliminary sets of test cubes. Each set of test cubes shall comprise eight 6 inch cubes made from a single sample of concrete taken from the point of final discharge of the wet concrete. Each cube shall be made under the Engineer's supervision. Cubes shall be tested as follows: three cubes shall be tested seven days after the date of manufacture and three cube 28 days after the date of manufacture. The remainded cubes will only be tested if the Engineer wishes to check the results of the tests on either of the other cubes and shall otherwise be preserved by the Contractor until the end of the Period of Maintenance. Preliminary test cubes shall be made and tested for the grades of concrete as directed by the Engineer and for all purposed variations of quality, quantity or origin of the aggregates and cement.

Should either the test cube crushed at 7 days or that crushed at 28 days fall below the specified requirements and the failure is

confirmed by the testing of the remainder cubes, the Contractor shall, on the Engineer's instructions alter the mix design and/or the source of aggregate cement or water and/or the method of mixing including alteration of the type mixer. The compressive strength of the concrete cube or cylinder at 7 days shall be equal to two thirds the required compressive strength at 28 days.

For each class of concrete, the preliminary test strength requirements shall be that specified in Clause 13.2.1 increased either by one third or 75 kg/cm^2 , whichever gives the least value.

Cubes shall be made and tested in accordance with ASTM. The ultimate cylinder compressive strengths of concrete shall be determined in accordance with AASHTO T22 on test specimens obtained and prepared in accordance with AASHTO T23 and AASHTO T126, except that six inches (152 mm) by 12 inches (30 cm) cylinders shall be used for all compression tests. The Contractor shall furnish single-use cylinder molds conforming to AASHTO M205, or when approved by the Engineer, re-usable vertical molds made from heavy gage metal.

13.3.8 CONCRETE TESTING—WORKS

During the course of the construction of the Works, the Contractor shall make test cubes or cylinders, as required by the Engineer. Two sets of cubes will normally be taken from each structure directed by the Engineer, but additional cubes shall be taken as directed by the Engineer's Representative. Three cubes will be tested at 7 days and Three cube at 28 days.

Should either of the cubes fall below the specified requirements, the Contractor shall, on the Engineer's instructions, either alter the mix design and/or the method of making the concrete and controlling its quality to reduce the variability of the concrete and/or cut out and replace at his own expense concrete placed in the Works on any day on which a defective cube was made if in the opinion of the Engineer such concrete is likely not to be capable of fulfilling its purpose.

The Engineer may require the Contractor to cut out defective concrete from the Works even though test cubes made from that concrete have not failed.

13.3.9 CONCRETE TESTING—CONSISTENCY

The Contractor shall carry out slump tests at such frequency as the Engineer considers necessary to ensure that the workability and consistency of the concrete is maintained in accordance with the specified mix or accepted mix design and the trial mix. But in any case consistency tests shall be carried out at least once every two hours during which concrete is being mixed.

13.3.10 TRANSPORTING CONCRETE

Concrete shall be taken from the place of mixing to the place of deposition by methods which will prevent the segregation or loss of the ingredients and which are sufficiently rapid to ensure that the concrete does not commence to set before it is compacted in position. The concrete shall be deposited as near as possible to its final position in the Works and shall not be allowed to flow into position. Deposition of the concrete through chutes shall not be permitted and neither shall the concrete be dropped freely from a height exceeding 2 m. Pumping concrete through delivery pipes may be permitted but only with the prior approval of the Engineer.

13.3.11 FREQUENCY OF TESTING

During the mixing and casting of concrete the frequency of testing for control purposes shall be as indicated below or as directed by the Engineer. No direct payment is made for testing. The price of this work is to be included in the bid prices of concrete.

Type of Test	Frequency
Grading, fine and coarse aggregate.	Once for each source Prior to approval and once Prior to casting of each lift for any major concrete structure

Type of Test	Frequency (Cont'd)
Concrete Cube or Cylinder Test	1 set (Minimum 3 Cubes or Cylinders) from each mixer for each individual pour.
Compressive Test	As directed
Slump Test	Once every two hours from each mixer
Mix Design	Once for each source of aggregate or every combination of sources

13.4 PLACING CONCRETE

13.4.1 GENERAL REQUIREMENTS

No concrete shall be placed in a foundation until the extent of excavation and the character of bearing material have been approved and no concrete shall be placed in any structure until the placement of reinforcing steel and the adequacy of the forms and falsework have been approved.

Reinforcing Steel and Formwork Surfaces to be in contact with concrete shall be thoroughly cleaned of any contaminating salty dust, by washing with water which complies with the requirements of Clause 13.2.4., and/or other methods to the Engineer's approval.

The concrete shall be placed in its final position as soon as possible after it has been mixed and in any case before the initial set has taken place. The Contractor shall ensure that concrete which has already been placed in position and commenced to set is not disturbed by the placing or compaction of further concrete nearby. All concrete shall be carefully worked around and between reinforcement and all other embedded fittings without such reinforcement or fittings being disturbed. Concrete is to be worked well up against whatever surface it joins.

13.4.2 PLACING CONCRETE IN WATER (TREMIE CONCRETE)

Tremie concrete shall be deposited in water only if specified on the plans and/or directed by the Engineer and under the Engineer's

supervision. Concrete to be deposited in water shall have the cement content increased by 25% at the Contractor's expense. Concrete shall be carefully placed in a compact mass in the space in which it is to remain by means of a tremie bottom dump bucket or other approved method that does not permit the concrete to fall through the water without adequate protection. The concrete shall not be disturbed after being deposited. No concrete shall be placed in running water and forms which are not reasonably water tight shall not be used for holding concrete deposited under water.

13.4.3 HOT WEATHER CONCRETING

When the air temperature in the shade is expected to reach 33 degrees C or higher, the Contractor shall schedule his operations to place and finish the concrete during the hours that the air shade temperature will be below 33 degrees C. This should preferably be in the latter part of the day after the maximum temperature has been reached, and subject to the approval of the Engineer.

The temperature of the concrete at the time of placing shall not be permitted to exceed 33 degrees C. Concrete materials shall be stored in a cool shaded position away from the direct rays of the sun. Both water and aggregate shall be cooled if necessary prior to mixing and ice water shall be used if ordered by the Engineer. The prices in the Bill of Quantities shall be deemed to cover all such special work.

The time available for handling and placing of concrete during periods of high temperature may be considerably reduced and the Contractor must take appropriate precautions. Concrete should be protected during transportation by use of damp hessian or similar means. No additional water may be added at the time of mixing without the approval of the Engineer, as this may lead to additional shrinkage of the concrete. On no account shall water be added during transportation or placing of the concrete. Retarding admixtures to facilitate placing and finishing of the concrete shall conform to AASHTO M194, Type D and used only if approved by the Engineer.

Hot weather concreting should conform to the requirements of "Hot Weather Concreting"; Report by American Concrete Institute Committee 305, ACI Journal August 1977, Title No.74–33.

13.5 VIBRATING CONCRETE

All concrete shall be compacted by vibrating with an approved vibrator. The vibrators shall not be attached to any reinforcement or embedded fitting and where vibrators of the immersion type are used, care shall be taken to ensure that they do not come into contact with the reinforcement or embedded fittings. Freshly placed concrete shall not be vibrated in a manner likely to cause damage to concrete in other parts of the Works which has already taken its initial set. Concrete shall not be vibrated in such a manner and to such an extent as to cause segregation of the constituent materials. If shutter type vibrators are used they shall be augumented by immersion type vibrators if the thickness of the concrete member is more than 15 centimetres.

13.6 CURING OF CONCRETE

All concrete shall be protected from the harmful effects of sunshine, drying winds, rain, flowing water, or other adverse effect. For at least 7 days after placing, the concrete shall be prevented from drying out by being sprayed with fresh clean water and covered with hessian, clean sand or other approved material which shall be kept wet and in contact with the concrete.

Concrete when deposited shall have a temperature of not less than 5°C and not more than 33°C. The temperature of the concrete shall not exceed 40°C within two hours of being placed.

Membrane curing of concrete with an approved liquid may be used as an alternative to curing with water except that membrane curing liquid shall not be applied to surface of concrete from which the shuttering has been struck, until the concrete has been inspected and approved by the Engineer.

Concrete curing compound shall be of an approved type which shall be readily distinguishable upon the concrete surface for at least four hours after application. The colour, if any, shall become inconspicuous within seven days after application.

Curing shall commence immediately after the concrete has been compacted to finished level.

When concrete is placed in hot weather, when the air shade temperature exceeds 21 degrees C. and when significant temperature changes occur between day and night, the Contractor shall take special precautions during the curing period, in addition to those described in the Specification. The concrete shall be properly and adequately protected and cured during the first few hours after placing. A temperature as constant as possible should be achieved during this period. An effective curing system shall be provided over the concrete surface to prevent moisture loss, and provide thermal insulation at night. In addition the concrete surface shall be protected from the direct rays of the sun by means of opaque light coloured covers, which should be ventilated during the day and have side covers at night.

The Contractor shall ensure that all concrete is adequately protected against inclement weather until properly set and shall if necessary provide additional protection to that specified above.

All aspects relating to the curing of concrete shall be subject to approval by the Engineer.

13.7 JOINTS IN CONCRETE

13.7.1 INTERVALS DURING CONCRETING

The timetable for the depositing of concrete between construction joints should be so arranged that no face of concrete shall be left for more than 20 minutes before fresh concrete is deposited against it. Pauses for meals, servicing of machines, changes of shift etc..., and the distribution of the concrete among the positions where work may be proceeding simultaneously must be carefully organized to ensure that the above menthioned interval shall not be exceeded.

13.7.2 CONSTRUCTION JOINTS

Construction joints shall be as shown on the Drawings or as directed by the Engineer. If the Contractor wishes to make additional con-

struction joints he shall obtain the prior approval of the Engineer of additional reinforcement at the Contractor's expense.

Construction joints shall be formed by inserting temporary vertical stopping-off boards to form a tongue and groove joint with the concrete placed subsequently except if separately detailed on the Drawings. Unless otherwise shown on the Drawings construction joints shall be located as near as possible to the position of minimum shear and tensible stress in the concrete.

13.7.3 JOINTING FRESH TO SET CONCRETE

As a construction joint, the face of the previsouly placed concrete shall be cleaned of any skin or laitance or loose material by brushing with a wire brush or other approved method and washing with clean water. Insecurely held aggregate shall be removed. Excess water shall be covered with 1 : 2 cement mortar which must be vigorously stippled into the surface by means of a suitable stiff brush, the depositing of the fresh concrete following closely.

13.8 INSPECTION OF CONCRETE

The Contractor shall not proceed with the surface finish or making good of concrete surfaces until he has received the Engineer's permission to do so and he shall not apply cement slurry or mortar or any other coating to the concrete surfaces from which the shuttering has been struck until the concrete has been inspected and approved by the Engineer.

13.9 FAULTY CONCRETE WORK

The Contractor shall on the written instruction of the Engineer remove and reconstruct any such portion of the work which in the opinion of the Engineer is unsatisfactory as regards quality of concrete, incorrect dimension of the cast portion, badly placed or insufficient reinforcement, honeycombing or other such cause as shall render the construction not up to the standard required and which in the opinion of the Engineer may prejudicially affect the strength or durability of the construction.

13.10 REPAIRS TO CONCRETE

The method of repairing and replacing defective concrete which the Contractor proposes to adopt shall be submitted to the Engineer for prior approval and the repair shall be carried out in such a manner as he may direct or approve.

13.11 SUPERVISION OF CONCRETE WORK

Throughout the progress of the concrete work the Contractor shall employ and provide such supervision as is necessary to ensure:-

(1) the day to day control of the quality of the concrete, and

(2) the mixing, transporting, placing, compacting, curing and protection of the concrete, and

(3) the carrying out of all testing as specified herein and any further testing which the Engineer may require, and

(4) the conducting of investigations as the Engineer may require, and

(5) the preparation of reports and the keeping of records as the Engineer may require.

13.12 FINISHING OF CONCRETE

All concrete surfaces (except culvert decks and foundation slabs) not requiring shuttering shall be trowelled to a smooth dense surface and shall be free from irregularities. Top faces culvert decks shall be carefully screeded and tamped to the required shape and to a dense surface and fine particles being brought to the surface and should be free from irregularities greater than 0.32 cm in height or depth.

Shuttered surfaces of concrete which will always be in contact with the ground may be cast against sawn timber. All other exposed shuttered surfaces including precast concrete shall be cast against steel, plywood or planed timber formwork and shall be carefully rubbed down with carborundum to remove all imperfections and irregularities. Surfaces which are honeycombed, porous or irregular and which in the opinion of the Engineer do not comply with the

specification shall be cut out and replaced with sound concrete as directed by the Engineer. The cost of all normal surface finishes and made good shall be deemed to be included in the tendered rate for the concrete.

13.13 SPACING BLOCKS AND TEMPORARY CONSTRUCTION TIES

Internal spacing blocks and construction ties shall be avoided as far as is in the Engineer's opinion possible and practicable. Where it is intended that the spacing blocks or construction ties shall be removed whether before or after the concrete has set, the making good of the concrete shall be subject to the Engineer's approval. The removal of the blocks or ties must not jeopardise the stability of the construction. If, with the approval of the Engineer, the spacing blocks and construction ties are allowed to remain in the concrete then they shall be of such material and of such quality that they do not prejudice the strength of the work. Concrete spacing blocks shall be made of concrete at least equal in quality to the main concrete. Metal ties shall be positioned such that they do not come into contact with any of the reinforcement or fittings and no part of the tie shall be permanently embedded in the concrete nearer than 5 cm to the exterior surface of the concrete. All holes shall be filled with 1 : 2 cement mortar.

13.14 CODES OF CONCRETE

If a conflict is found between Codes of Practice, the Engineer shall decide on the Practice (s) to be followed.

13.15 CEMENT MORTAR AND GROUT

Unless otherwise specified, mortars and grouts shall be composed of Portland Cement and sand in the following proportions:-

NOMINAL PROPORTIONS

Quality	Portland Cement	Sand
G1	1	1
G2	1	2
G3	1	3

The amount of water added shall just be sufficient to make the mortar or

grout workable consistent with its purpose.

13.16 CLASSIFICATION OF CONCRETE

The classification of concrete to be used for each works shall be as follows:

B/Q Item No.	Description	Close of concrete
	PART III MAIN DAM	
3.06	Plain Concrete	B1
	PART IV SPILL WAY	
4.02	Reinforced Concrete	A2
4.03	Cobble Concrete	Mixture of 0.82 cu,m of B2 and Cobble whose sieves shall be within 300 mm and 200 mm and whose space shall be 100 mm in minimum.
	PART V CONDUIT	
5.03	Level Concrete	C
5.04	Reinforced Concrete	A1
5.05	Cobble Concrete	Same as B/Q item No.4.03.

13.17 MEASUREMENT

The measurement for concretes shall be made by the Drawings approved by the Engineer and volume will be computed in cubic metres by the average end area method or equivalent method approved by the Engineer.

13.18 PAYMENT

The accepted quantities of each classified concrete, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the cost of all testing mix design, trial mixes, mixing, transporting, placing, compacting, curing, surfaces finishing, protection, construction joints repairs to concrete, supervision, and all labour and materials.

In addition price (s) shall also include for the provision, temporary support, and placement of precast beams.

SECTION 14

FORMWORKS

14.1 DESCRIPTION

Formworks shall consist of furnishing all materials and construction of form for the concretes as shown on the Drawings or directed by the Engineer.

The formworks, also, shall include the any kind of support for the formworks.

14.2 DESIGN AND CONSTRUCTION OF FORMWORK & FALSEWORK

Formwork shall in every respect be adapted to the structure and the required surface finish of the concrete. It shall include all temporary moulds for forming the concrete to the required shape and finish and for the support of such moulds. It shall be fixed in perfect alignment and securely ledged and braced so as to be able to withstand, without displacement deflection or movement of any kind, the weight of the construction and the movement of persons materials and plant. Joints shall be close enough to prevent the leakage of liquid and fine materials from in concrete.

The inside surfaces of all forms shall, except for permanent formwork, or unless otherwise agreed by the Engineer, be coated with a release agent approved by the Engineer. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not come into contact with the reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in formwork to concrete which will be visible in the finished Work.

The Contractor shall submit to the Engineer for approval at least one month before commencing work, details of his proposed system of form work and falsework, including detailed drawings and calculations. Form work and falsework shall be capable of absorbing temperature changes and be constructed so as to permit removal, without causing damage to the concrete.

Notwithstanding any approval of falsework design by the Engineer, the Contractor will be held fully responsible for the adequacy and correctness of the design.

Formwork shall be lined with a material approved by the Engineer to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and shall be so joined and fixed to its backing that it imparts on blemishes. It shall be of the same type and obtained from only one source for any one structure. The Contractor shall make good any imperfections in the finish as directed by the Engineer.

Permanently exposed concrete surfaces shall be protected from rust marks and stains of all kinds.

Unless otherwise specified, all formwork joints for exposed surfaces finish shall form a regular pattern with horizontal and vertical lines continuous throughout each structure and all construction joints shall coincide with these horizontal or verticall lines. Details of the proposed patterns of formwork joints shall be submitted to the Engineer for approval before proceeding with the Work.

14.3 PREPARATION FOR CONCRETING

Immediately before the concrete is deposited, the formwork shall be thoroughly cleaned out and freed from sawdust, shavings, wire cuttings, dust, sand, clay and all other deleterious and extraceous materials. Temporary openings shall be provided in the formwork to facilitate this work. The inside surfaces of the formwork shall, immediately prior to final erection, be coated with mould oil. The mould oil shall be of approved type and shall be applied uniformly and the quantities used shall be the minimum consistent with its purposes. The Contractor shall ensure that all steel reinforcing and adjoining concrete surfaces are kept free of mould oil.

14.4 APPROVAL BEFORE CONCRETING

The Contractor shall in all cases request the approval of the formwork by the Engineer in sufficient time to allow an inspection to be made and shall not commence concreting until such approval is obtained. The period between the Contractor's request for approval and his intention to commence concreting shall not be less than one clear normal working day and the Engineer may

require a longer period, if, in his opinion, the formwork is of such complexity as to require it.

Such approval shall not absolve the Contractor of his responsibilities under the Contract.

14.5 REMOVAL OF FORMWORK

All formwork shall be struck without jarring the concrete of subjecting the same to sudden shock.

Before striking any formwork, the Contractor shall satisfy himself that the concrete is sufficiently hardened to bear its own load and other loads that may be placed on it. No formwork is to be removed, if, in the opinion of the Engineer, the concrete has not set sufficiently. Approval of the Engineer shall not relieve that Contractor of his liability to make good any concrete which may be damaged by premature removal or collapse of forms.

Subject to the above and the concrete strength test results, the minimum periods for removal of formwork generally are as follows:-

Slabs	Soffits (props left under)	3 days
	Props	7 days
Columns & Walls (Unloaded)		3 days
Conduit and Crest		2 days

The periods stated above are based on a constant surface temperature of the concrete of 16°C and the use of ordinary Portland Cement. They shall be increased during cold weather as directed by the Engineer, and may be changed if other types of cement are used, subject to the Engineer's agreement.

In case of the special types of formwork, striking times are to be approved by the Engineer.

Formwork shall be constructed so that the side forms of members can be

removed without disturbing the soffit forms and, if props are to be left in place when the soffit forms are removed, these props shall not be disturbed during the striking.

All formwork shall be removed without damage to the concrete.

Where it is intended to re-use formwork it shall be thoroughly cleaned and made good to the satisfaction of the Engineer.

No supports for the shuttering may be left in the finished concrete without the written permission of the Engineer.

14.6 CLASSIFICATION OF FORMWORK

The classification of formworks shall be as follows:

Formworks : all kinds of formworks except "curved formworks" provided below.

Curved Formworks : for using the curve part of spillway crest.

14.7 MEASUREMENT

The measurement for formworks shall be made by the Drawings approved by the Engineer and area will be computed in the square metres by the approved method by the Engineer.

14.8 PAYMENT

The accepted quantities of formworks, measured as provided above, will be payed for at the contracted unit price (rate) stiputaled in the Bill of Quantities.

The rate shall include the cost of all materials, transporting, placing, removing, protection, all labourer etc.

SECTION 15

REINFORCING BAR

15.1 DESCRIPTION

This work shall consist of furnishing, fabricating and placing steel reinforcing bars of the grade, type, quality, size, shape and quantity designated, all in accordance with these Specifications and the details shown on the Drawings.

The Contractor shall be responsible for furnishing reinforcing bar in sufficient quantity and of the proper sizes, lengths, and shapes shown on the Drawings for any given structure.

15.2 MATERIALS

All reinforcing bars shall be deformed bars and shall conform with ASTM-A 15, ASTM-A 305 and ASTM-A 408, the results of bond tests shall be furnished to the Engineer as required by him.

Tying wire shall be either:

i) 1.6 mm diameter (No.16 gauge) soft annealed iron wire, or

ii) 1.2 mm diameter (No.18 gauge) stainless steel wire.

15.3 CONSTRUCTION

Steel reinforcing shall be stored on timber packing clear of the ground. When fixed in the Work and immediately prior to concreting, it shall be entirely free from loose mill scale, loose rust, oil, grease, paint, mould oil, and all other deleterious and extraneous material. All hooks, bends etc., unless otherwise shown on the Drawings shall be as directed by the Engineer.

For the bar bending lists incorporated in the Drawings the Contractor shall be responsible for their accuracy and shall satisfy himself as to errors and omis-

sions and all other things regarding their suitability for the work before such work is put in hand. When new bar bending lists are required or existing ones required to be amended, the Contractor shall prepare such lists and submit them to the Engineer for approval.

All reinforcement shall be bend at temperatures in the range 5°c and 100°c.

Cold worked and hot rolled high yield bars shall not be straightened or bend again once having been bent. Where it is necessary to bend mild steel reinforcement already cast in the concrete, the internal radius of bend shall not be less than twice the diameter of the bar.

Steel reinforcement shall be bent accurately to the shapes and dimensions shown on the approved bar bending lists or Drawings. Bars shall be bent round mandrels of the requisite diameter.

15.3.1 PLACING REINFORCEMENT

The number, size, form and position of all reinforcement shall, unless otherwise directed or authorized by the Engineer, be strictly in accordance with the Drawings. Nothing shall be allowed to interfere with the disposition of the reinforcing bars. Bars generally must be of the required lengths. Welding of the bars will not be permitted. Lapping of the bars other than the lap splices shown on the Drawings should be avoided. The Engineer may approve certain lappings under special conditions.

All bars shall be so placed that the cover of the bars as shown on the Drawings is accurately maintained. The steel reinforcement shall be so connected as to form a rigid cage. All intersecting bars shall be bound together with 16 gauge soft iron wire with the ends of the wire turned into the main body of the concrete.

15.3.2 MAINTAINING REINFORCEMENT IN POSITION

Concrete distance blocks shall, unless otherwise directed, be used between the reinforcement and the bottom and sides of the forms to ensure correct placing and cover of the bars. The strength of such concrete distance blocks shall be not less than that of the main

concrete. The greatest care shall be taken to prevent any displacement or bending of the members of the reinforcement adjusted and temporarily fixed in position before commencement of the concreting. Reinforcement temporarily left projecting from the concrete at construction of other joints shall be adequately protected against displacement both during concreting and afterwards and shall not be bent out of position unless agreed by the Engineer. During the concreting a competent steel fixer shall be in attendance to re-set any reinforcement inadvertantly displaced.

15.3.3 APPROVAL BEFORE CONCRETING

The Contractor shall in all cases request the approval of the steelwork by the Engineer in sufficient time to allow an inspection to be made and shall not commence concreting until such approval is obtained. The period between the Contractor's request for approval and his intention to commence concreting shall not be less than one clear normal working day and the Engineer may require a longer period if, in his opinion, the reinforcement is of such complexity as to require it.

Such approval shall not absolve the Contractor of his responsibilities under the Contract.

15.4 MEASUREMENT

The prices inserted in the Bill of Quantities for Reinforcement and payments thereof shall be based on the net calculated weight of Reinforcement used in the work in accordance with the Drawings or bending lists or as may be directed by the Engineer and shall include, inter alia, the cost of all supply, transporting, cutting, bending, placing, tying (including cost of tying wire), provision of testing, all work and materials to debond dowel bars as shown, etc. No allowance will be made for rolling or cutting margins. No allowance shall be made for lapping or splicing bars unless such lapping or splicing is allowed for in the Drawings or bar bending lists, except for welded wire fabric, for which the weight for payment shall be based on the area covered and the rate allow for laps as shown on the Drawings.

15.5 PAYMENT

The accepted quantities of reinforcing bar, measured as provided above, will be payed for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the cost of all materials, transporting, cutting, bending, placing, protection and labour as well as tying wire and so on.

SECTION 16

DOWEL BAR

16.1 DESCRIPTION

This section covers preparation and placing of dowel bars which are constructed at the parts as shown on the Drawings approved by the Engineer.

The dowel bar shall be round bar whose dimensions are 19 millimetres in diameter, 1.0 metre in length and whose material is subject to the Engineer's approval.

The bars shall be spaced as shown on the drawing and placed across the joints so that the dowels are positioned parallel to each other and to the surfaces of the structures. Special care shall be taken to keep the dowels accurately in position during placing of the concrete. Immediately before the concrete is placed half the length of each dowel to be initially embedded shall be coated with a film of oil. Before final set of the concrete in the initial placement, the dowel shall be twisted to break any bond that may occur.

16.2 MEASUREMENT AND PAYMENT

Measurement of dowel bar shall be made by the construction Drawings approved by the Engineer and the quantity will be computed in the number.

The accepted quantities for dowel bar, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

- materials such as round bar, coating materials, etc.
- transportation
- treatment such as cutting, painting, etc.
- placing
- all required labourers and tools.

SECTION 17

WATER STOP

17.1 DESCRIPTION

This section covers preparation and placing of water stop.

Water stop shall be rubber material conforming to the following specifications.

Item	Rubber
Specific weight	1.15 or more
Tensile strength (kg/sq.cm)	200 or more
Elongation (%)	400 or more
Hardness	60-70

All water stop shall be stored in the coolest place that is possible and in no case rubber shall be stored in the open or exposed to the direct rays of the sun. All rubber shall be stored where there is a free circulation of air. All field splice and intersections of water stops shall be made so as to provide water tight connection with such means as specified by manufacturer. The Contractor shall provide suitable support and protection during the progress of the Works to protect the water stop from damage, deterioration or warping. The rubber water stop shall be installed so that equal widths of the material are embedded in the concrete on each side of the joint. The concrete shall be carefully placed and vibrated to provide a complete bond between the concrete and all embedded areas of the water stop.

17.2 MEASUREMENT AND PAYMENT

Measurement of water stop shall be made by the construction Drawings approved by the Engineer and the quantity will be computed in the linear metre.

The accepted quantities for water stop, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

- all kinds of materials
- transportation
- treatment such as cutting, placing
- all required labourers and tools.

SECTION 18

ELASTIC FILLER

18.1 DESCRIPTION

This section covers preparation and placing of elastic filler.

Suitable elastic joint filler shall be furnished and placed by the Contractor in the expansion joints in the place as shown on the Drawings.

Elastic joint filler shall conform to U.S.A. Federal Specification HH-F-341 A or specification approved by the Engineer. The thickness of plate shall be 20 mm.

The Contractor shall cut the filler as shown on the Drawings. The exposed edge of filler material shall be placed at the required distance below the finished surface of the concrete. All cut edges of the joint filler shall be held securely in place against the completed side of a joint by nails that were cast into the concrete that was placed first. Joint in the filler shall be tight so that mortar from the concrete will not seep through to the opposite concrete surface.

18.2 MEASUREMENT AND PAYMENT

Measurement of elastic filler shall be made by the construction Drawings approved by the Engineer and the quantity will be computed in the square metres.

The accepted quantities for elastic filler, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

- all kinds of materials
- transportation
- treatment such as cutting, placing
- all required labourers and tools.

SECTION 19

REINFORCED CONCRETE PIPE (R.C. PIPE)

19.1 DESCRIPTION

This section covers preparation and placing of R.C. pipe which is placed at the places as shown on the Drawings approved by the Engineer.

The R.C. pipe will be as precast reinforced concrete pipe by the pipe manufacturer, so that inside diametre will be ranged between 1.40 m and 1.50 m. R.C. pipe dimensions such as inside diameter, thickness, length and reinforcing bar arrangement shall be subject to the Engineer's approval.

In case if precast reinforced concrete pipe will not be available in the market, the Contractor shall prepare the precast reinforced concrete pipe on himself. In this case, the Contractor shall submit the construction Drawings for the pipe and formwork for the Engineer's approval at least 45 day of commacement of precasting works.

In any case, the pipe shall be plain ent.

19.2 MEASUREMENT AND PAYMENT

Measurement of R.C. pipe shall be made by the construction Drawings approved by the Engineer and the quantity will be computed in the linear metres.

The accepted quantities for R.C. pipe, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities. This unit price shall not be change according to the pureharcing or the precasting on himself.

The rate shall include the following works;

- all kinds of materials
- transportation
- placing
- all required labourers, equipment and tools.

SECTION 20

DRY MASONRY

20.1 DESCRIPTION

This section covers preparation and construction of dry masonry which is placed at the places as shown on the Drawings approved by the Engineer.

Stone for masonry shall be the best of its kind, sound and durable, free from flaws and form soft, weathered or decomposed parts. The stone and the quarry from which it is obtained shall be subject to the approval of the Engineer. When required by the Engineer, samples shall be submitted by the Contractor of the stone he proposes to supply and the Engineer's approval shall be obtained before any order is placed or stone quarried.

Squared rubble or ashlar shall consist of approved stones from quarries that are not less than 20 cm long, 15 cm wide and 10 cm thick. All stones shall be roughly equared and dressed smoothly on beds and joints for a distance of at least 10 cm from the exposed face. Bond stones shall be provided at the rate of at least one for each cubic meter of the works. They shall measure at least 15 cm X 15 cm on the face and extend for threequarters of thickness of the wall. Vertical joints shall not extend past more than three stones and the horizontal lapping of stones shall be not less than 10 cm. The stone-work shall be made level at intervals of about 60 cm. The interior spaces in the wall shall be filled with small pieces of stones or cobbles grouted in position.

20.2 MEASUREMENT AND PAYMENT

Measurement of dry masonry shall be made by the construction Drawings approved by the Engineer and quantity will be computed in the cubic metre.

The accepted quantities for dry masonry, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

– materials
– transportations
– treatment of stone
– placing
– labourers and tools.

SECTION 21

GABION

21.1 DESCRIPTION

This section covers preparation and placing of gabion which is constructed at the places as shown on the Drawings approved by the Engineer.

Gabions consist of wire cages filled uniformly and compacted with approved stone which shall not be smaller than the size of the cage mesh. All wire used shall be in accordance with ASTM-A 475 or equivalent specifications approved by the Engineer. The empty cages shall be placed to lines and levels as shown on the Drawings. The kind of stones used for the Gabions shall be approved by The Engineer.

Cages of gabions shall consist of triple twisted wire netting with squarish mesh 7.5 cm by 8 cm securely tied to wire frames. The mesh shall be formed from 5 mm wire and the frame from 10 mm wire.

The size of gabion will be 1 m X 1 m X 4 m, however, the size shall be subject to the Engineer's approval.

Stone for masonry shall be the best of its kind, sound and durable, free from floaws 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 Engineer.

21.2 MEASUREMENT AND PAYMENT

Measurement of gabion shall be made by the construction Drawings approved by the Engineer and quantity will be computed in the cubic metre.

The accepted quantities for gabion, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

- materials
- treatment and erecting
- transportation
- placing
- labourers and tools.

SECTION 22

WIRE STABLER OF PIPE

22.1 DESCRIPTION

This section covers preparation and placing of wire stablers of pipe which are constructed at the places as shown on the Drawings approved by the Engineer.

Wire stabler of pipe will be used for the purpose of fixing the R.C. pipe. Therefore the wire stabler of pipe shall consist of anchor bar of 13 mm in diamnetres, wire of 10 mm in diametres and wire clips.

Half of anchor bar shall be embedded in the base concrete which is constructed prior to the placing the R.C. pipe. After placing the R.C. pipe, the R.C. pipe shall be fixed on the base concrete by wire and wire clips.

22.2 MEASUREMENT AND PAYMENT

Measurement of wire stabler of pipe shall be made by the construction Drawings approved by the Engineer and the quantity will be computed by the number.

The accepted quantities for wire stabler of pipe, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

- materials
- transportation
- treatment
- placing
- labourers and tools.

SECTION 23

PAVING OF DAM CREST BY GRAVEL

23.1 DESCRIPTION

This section covers preparation and placing of paving of dam crest by gravel which is constructed at the place as shown on the Drawings approved by the Engineer.

Paving of dam crest by gravel shall consist of obtaining the materials, hauling, spreading and compaction, maximum size of materials shall be 40 mm, and paving thickness shall be of after well compaction so that the Contractor is required to obtain and haul the materials more than as shown on the Drawings.

23.2 MEASUREMENT AND PAYMENT

Measurement of paving of dam crest by gravel shall be made by the construction Drawings approved by the Engineer and quantity will be computed in the cubic meter after well compacted.

The accepted quantities for the paving of dam rest by gravel, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the following works;

- obtaining the material
- hauling the material including loading and unloading
- spreading
- compaction
- treatment
- labourers, tools and construction equipment

SECTION 24

SERVICE ROAD

24.1 DESCRIPTION

This section covers preparation and construction of service road as shown on the Drawings.

The route of service road will be directed by the Engineer, so that the Contractor shall carry out the top-survey of route, longitudinal section, level and cross section, and shall submit the results. In accordance with the results of survey carried out by the Contractor, the Engineer will instruct the level and formation of the service road. Then, the Contractor is required to construct the service road in accordance with the approved construction Drawings by the Engineer.

24.2 DIMENSIONS

Dimensions of the service road to be constructed will be as follows;

- effective width ..... 7.0 m
- total width of road surface ..... 9.0 m (typical)
- thickness of seal coat ..... 5 cm
- typical embankment height ..... 50 cm

24.3 EXCAVATION AND FILL

Excavation and fill for the road shall be made to the lines, grades, and cross-sections shown on the Drawings or as directed by the Engineer. Where material occurs below formation level in cuttings or on the sites of embankments which is unsuitable to remain in these positions it shall, as required by the Engineer, be removed, replaced or treated in such a manner as will render it suitable.

Where ordered by the Engineer, The Contractor shall construct open drains along the road as are necessary at the sides of the formation and at the top of cuttings. Excavated material from such drains shall be disposed of as directed by the Engineer and all works shall be completed before any foundation work to the carriage-way or verges is commenced.

24.4 PREPARATION OF SUBGRADE

(a) The subgrade is defined as that part of the work on which the Sub-base is placed or in case of no Sub-base, the support level for the base. Its width shall be that of the full width of Base plus the width of the shoulders as shown on the Drawings or specified herein.

(b) When the Drawings so indicate or when directed by the Engineer, the existing road surface will be the subgrade. When the existing road surface is to be used as subgrade, the adjustment of the elevation on which the base or Sub-base is to be placed shall be made by a levelling course constructed in accordance with "Base Cource" section 24.5 after the old surface has been scraped well to the approval of the Engineer.

(c) Culverts, drain pipes and any other items of construction below the elevation of the subgrade, shall be completed inclusive of the fully compacted back fill over them, and ditches, drains, outlets for drainage and head walls for culverts, shall be in such operative condition as to assure prompt and proper run-off of water to prevent wetting of the subgrade. Before preparation of the subgrade the Contractor shall secure in writing approval of the completion of these features from the Engineer.

(d) All materials within 30 cm. below subgrade elevation shall be well compacted.

(e) Any irregularities or depressions which develop in the surface of the subgrade during compaction shall be corrected by loosening the surface of the affected area and, after adding or removing fill, recompacted as specified. Any part of the subgrade which has been completed shall be protected against drying out and cracking and damage resulting from any cause shall be repaired at the Contractor's expense, as directed by the Engineer. At all times the surface of the subgrade shall be kept in such a condition that it will drain quickly and effectively; and to this end small temporary

drainage grips shall be cut through the verges where necessary.

(f) The finished surface of the sub-grade after compacting shall be as smooth as possible and maling allowace for prescribed camber and curvature, shall not diverge at any point by more than 2.0 cm from a 300 cm straight-edge placed in any position on the finished surface shall not be any more than 2.0 cm below the prescibed level.

24.5 BASE COURCE

(a) The base is the portion of the road cross-section which lies between the top of the subgrade and the underside of the pavement.

(b) All aggregates for use in the construction of the base courses shall be obtained only from sources approved by the Engineer. They shall be free from dirt, organic matter, shale, clay or other deleterious matter and shall consist of clean tough durable sharp angled fragments without any excess of thin or elongated pieces and shall be of such quality that it will bind readily to form the firm and stable courses.

(c) The thickness of the base shall be 20 cm after construction.

(d) The grading of the materials to be used for base courses shall be subject to the following limits:

Sieve Number	% Passing (by weight) base
1½"	100
1 "	70-100
3/8"	40-80
No.4	30-70
No.10	20-50
No.50	10-25
No.200	0-10

(e) The base aggregate shall be spread upon the subgrade prepared according to requirement of section 24.4 not exceeding 20 cm after compaction. Spreading of the aggregate shall be performed only by means of approved mechanical spreading devices. In no case shall the base be dumped in a pile on the subgrade. Base aggregates shall be placed on the subgrade

without segregation of the coarse and fine particles. The gravel shall be compacted by means of vibro-rollers, vibrotampers or other suitable compaction equipment.

24.6 SEAL COAT PAVEMENT

(a) The seal coat shall comprise the hot application of bituminous material with cover aggregate, as herein specified, upon the finished and accepted bituminous gravel base.

(b) The bituminous material shall be of subject to approval of the Engineer. The Contractor shall submit his proposal to the Engineer for his approval prior to purcharsing the material.

(c) The cover aggregates to be used shall be composed of clean stone chips or gravel free from clay lump or other materials which prevent the binding action of bituminous material with the aggregates. The cover aggregates shall be hard and durable with a soundness value.

The grading of cover aggregate for the seal coat shall be 6/12 mm and it shall be so graduated that not more than 5% shall be retained on 12 mm square mesh sieve and not more than 5% shall pass the 6 mm square mesh sieve. The particles of cover aggregate shall be clean, tough and durable free from flaky pieces the stone chips shall be hard and rough with a cubical shape having sharp edges the gravel shall be of a spherical shape.

The amount of cover aggregate per squaremeter of seal coat shall be 15 ~ 18 kg. The exact quantity to be applied will be determined by the Engineer.

(d) The seal coat shall be applied when the surface to be treated is dry or slightly damp, when the temperature of the road surface is 20°C or more and when the weather is not foggy or rainy.

Prior to placing the seal coat, loose dirt and other objectionable material shall be removed from the existing surface. If so directed by the Engineer, the surface shall be cleaned with a power broom and/or power blower. The Bituminous material shall be so applied that a uniform distribution is obtained at all points. During all applications the surface of adjacent

structures and trees shall be protected in such manner as to prevent them being spattered or marred. No bituminous material shall be discharged into a borrow pit or gutter. The spreading of cover aggregate for seal coat shall immediately follow application of the bituminous material. Before the bituminous material is applied, sufficient seal aggregate to cover the distributor load of bitumen shall be in trucks on the road-way at the site of work. No bitumen shall be down for more than 15 minutes before the cover aggregate is applied. Initial spreading shall be done with the aggregate spreading equipment. Trucks spreading aggregate shall be operated in reverse gear so that the bituminous material will be covered before truck wheels pass over it. Supplemental spreading and smoothing shall be done with a broom drage and by hand methods where necessary. The Contractor shall control the traffic speed moving on the seal coat so that it is not more than 40 km./hr. during the first 24 hours after placing.

24.7 WARNING SIGNS AND ROAD SIGNS

Warning signs and road signs shall be constructed and installed to the dimensions and locations as shown on the Drawings or as directed by the Engineer. These signs shall be capable of reflecting light.

24.8 MAINTENANCE OF ROAD

During the construction period the roads shall be kept in good condition and at the end of Contract period before final takeover of the Contract, the road shall be grade and rolled or re-paved to be in a first class condition.

24.9 MEASUREMENT AND PAYMENT

Measurement of service road shall be made by the construction Drawings approved by the Engineer and the quantity will be computed in the linear metre of centre line of road.

The accepted quantities for the service road, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include all works concerning the road works except cross culvert and cross siphon.

For the cross culvent and cross siphon, separate payment will be made by as follows;

Concrete ..... by concrete class A1 provided in the Section 13.

Formworks ..... by formworks provided in the Section 14.

Reinforcing bar ..... by reinforcing bar provided in the Section 15.

R.C pipe ..... by R.C pipe provided in the Section 19.

SECTION 25

REPLACEMENT OF POWER DISTRIBUTION LINE

25.1 DESCRIPTION

This section covers preparation and placing of replacement of existing power distribution line which will be directed by the Engineer.

25.2 REQUIREMENT

The material for the replacement of existing power distribution line shall be the same as existing ones or equivalent approved by the Engineer.

New route of replacement of power distribution line will be as directed by the Engineer.

The tension of the electric wire shall be subject to the approval of the Engineer.

25.3 FOUNDATION OF ELECTRIC POLE

In case of sand and gravel base;
The foundation of the pole shall be embedded 2.0 m in minimum in the earth and upper 1.0 m of the foundation shall be backfilled by the plain concrete, class B1, provided in the Section 13, and lower 1.0 m shall be backfilled by the sand and gravel with well compaction.

In case of rock base;
The foundation of the pole shall be embedded 1.0 m in minimum in the rock and all backfill shall be carried out by the concrete B1 provided in the Section 13, and 1.0 m above the natural ground surface shall be protected by the concrete B1. The dimension of this protection concrete shall be as directed by the Engineer.

The pole shall be protected by the wire, if the Engineer directs.

25.4 MEASUREMENT AND PAYMENT

Measurement of replacement of power distribution line shall be made by the construction Drawings approved by the Engineer and quantity will be computed in the linear matres of electric wire. However, the length which occure by the slack shall not be considered as payment length.

The accepted quantities for replacement of power distribution line, measured as provided above, will be paid for at the contracted unit price (rate) in the Bill of Quantities.

The rate shall include the all works concerning construction of power distribution line.

PARTICULAR SPECIFICATIONS

SECTION 1

GENERAL

1.1 PREAMBLE

Add the following:

Except if and to the extent otherwise provided by the Contract the provisions of these Particular Specifications shall prevail over those of the General Specifications.

1.16 ENGINEER'S OFFICE

The Building for the Engineer's office shall have following rooms and total area of this Building shall be more than 150 sq.m.

– Engineer's Representative's Room

– Local Manager's Room

– Secretary's Room

– Drafting & Conference Room

– Storage

– Kitchen

The building shall be furnished with new furniture and equipment. The followings are a listing of the minimum basic furniture and equipment to be provided by the Contractor for the Engineer's Office:

(a) Engineer's Representative's Room

	Quantities
– Metal Desk, 1.90 m X 0.90 m top, 6 side drawers and 1 center drawer, ARTMETAL, or approved equal.	1
– Revolving Executive Chair, on rollers, with armrests.	1
– Bookcase, 0.30 m X 0.90 m X 0.80 m high, wood or metal.	2
– Overstuffed Office Lounge Suite, Coffee Table, wooden, Formica top, 0.50 m X 1.20 m X 0.40 m high.	1
– Wastebasket, large, metal, solid sides, no wire.	2
– Automatic Voltage Regulator, 500 w min., suitable for 100 or 220 constant voltage output, depending on voltage supplied by Contractor.	2
– Wall Board 250 cm X 150 cm.	2
– Pocket Electronic Calculator, SHARP Model PC-1211 or approved equal.	1
– 1 H.P. (12500 BTU) air conditioner	1

(b) Local Manager's Room

– Metal Desk, 1.50 m X 0.75 m top, 6 side drawers and 1 center drawer, ARTMETAL, or approved equal.	1
– Revolving Executive Chair, on rollers, with armrests.	1
– Bookcase, 0.30 m X 0.90 m X 0.80 m high, wood or metal.	1
– Straight Chair	1
– Wastebasket, large, solid sides, no wire.	1

	Quantities
– Wall Board, 250 cm X 150 cm.	1
– Pocket Electronic Calculator, SHARP model EL-5100 or approved equal.	1
– Coffee table.	1
– 1 H.P. (12500 BTU) air conditioner	1
(c) Engineers' Room	
– Metal Desk, 1.50 m X 0.75 m top, 6 side drawers and 1 center drawer, ARTMETAL, or approved equal.	5
– Revolving Executive Chair, on rollers, with armrests.	5
– File Cabinet, four drawers, lock type, legal side with metal clip hanging files (30 per drawer), ARTMETAL or approved equal.	2
– Coffee Table.	4
– Bookcase, 0.30 m X 0.80 m high, wood or metal.	3
– Straight Chairs.	5
– Wastebasket, large, metal, solid sides, no wire.	4
– Wall Board 250 cm X 150 cm.	2
– Pocket Electronic Calculator, SHARP model EL-5100 or approved.	4
– 1 H.P. (12500 BTU) air conditioner	3
(d) Secretary's Room	
– Metal Desk, 1.50 m X 0.75 m top, 6 side drawers and 1	1

	Quantities
center drawer, ARTMETAL, or approved equal.	
– Revolving Executive Chair, on rollers, with armrests.	1
– File Cabinet, four drawers, lock type, legal side with metal clip hanging files (30 per drawer), ARTMETAL or approved equal.	2
– Coffee Table.	1
– Bookcase, 0.30 m X 0.80 m high, wood or metal.	1
– Straight Chairs.	3
– Wastebasket, large, metal, solid sides, no wire.	2
– Cupboard with shelves and locks.	1
– Wall Board 250 cm X 150 cm.	1
– Typewriter Tables, metal no rollers.	1
– English typewriter, I.B.M., 19 inch carriage, elite type or approved equal.	1
– Metal Desk, 1.10 m X 0.85 m top, 3 side drawers and 1 center drawer, or approved equal.	2
– Dry Photo-Copier, Electric, to handle up to 30 cm X 42 cm paper, CANON Model "NP200-J", or approved equal.	1
– Blue Printing Machine, Electric, to handle up to 60 cm X 85 cm paper, to be approved by the Engineer's Representative.	1
– 1 H.P. (12500 BTU) air conditioner	1

(c) Drafting & Conferences Room

	Quantities
– Table 200 cm X 120 cm.	1
– Drafting Tables.	1
– T-squares.	1
– Stools.	1
– Straight Chairs.	12
– Wastebaskets, large, metal, solid sides, no wire.	2
– Drawing instruments.	2
– Protractors.	2
– Cupboard with shelves & locks.	1
– Wall boards 250 cm X 150 cm.	2
– Dyeline Machire, to be approved by the Engineer's Representative.	1

1.17 ENGINEER'S RESIDENCE

The building for the Engineer's residence shall be more than 150 sq.m, and shall be furnished with new furniture and equipment. The followings are a listing of the minimum basic requirement to be provided by the Contractor.

Description	Quantities
Entrance Hall	
– Metal dress hanger	1 X 2 = 2
– Wooden shoe case	1 X 2 = 2
– Wooden telephone table	1 X 2 = 2

Deseription	Quantities
Sitting Room	
– Wooden bookcase	1 X 2 = 2
– Wooden armchair	6 X 2 = 12
– Wooden teatable	1 X 2 = 2
– Carpet	1 X 2 = 2
– Curtain for window with curtain hanger	n X 2 = 2 X n
– 1 H.P. (12500 BTU) air conditioner	1 X 2 = 2
Dining Room	
– Wooden dining table for 6 persons	1 X 2 = 2
– Wooden chairs for above table	6 X 2 = 12
– Wooden cup-board	1 X 2 = 2
– Carpet	1 X 2 = 2
– Curtain for window with curtain hanger	1 X 2 = 2
– I H.P. (12500 BTU) air conditioner	1 X 2 = 2
Bedroom	
– Single bed with Dunlo pilow matress	2 X 2 = 4
– Wooden bed table	2 X 2 = 4
– Bed lamp	2 X 2 = 4
– Dressing table with mirror and stool	2 X 2 = 4

Deseription	Quantities
– Feather pilow with two pilow covers	2 X 2 = 4
– Sheet for single bed	4 X 2 = 8
– One person blanket	4 X 2 = 8
– Carpet	2 X 2 = 4
– Curtain for window with curtain hanger	2 X 2 = 4
– 1 H.P. (12500 BTU) air conditioner	2 X 2 = 4
Kitchen	
– Four flames gas cooker with oven and two lipuid gas containers	1 X 2 = 2
– Refrigerator (230 liter)	1 X 2 = 2
– Washing machine	1 X 2 = 2
– Metal table 0.8 X 0.8 m	1 X 2 = 2
– Metal chair	3 X 2 = 6
– Curtain for window with curtain hanger	2 X 2 = 4
Kitchen necessaries	
– Aluminium large pan	1 X 2 = 2
– Aluminium medium pan	1 X 2 = 2
– Aluminium small pan	3 X 2 = 6
– Large cast iron sauce pan	1 X 2 = 2
– Medium aluminium sauce pan	1 X 2 = 2

Deseription	Quantities
– Small aluminium sauce pan	1 X 2 = 2
– Kitchen skimmer	1 X 2 = 2
– Kitchen ladle	1 X 2 = 2
– Large knife	1 X 2 = 2
– Small knife	1 X 2 = 2
– Knife sharpener	1 X 2 = 2
– Dining, tea and dessert sets consisting of: Soup plate, large plate, sit plate, and dessert plate, large spoon, knife and fork, fruit knife and fork, table skimmer and ladle, cup and saucer, tea spoon, large drinking glass, small melamin drinking up (6 pieces of each item)	1 X 2 = 2
– Ashtray (glass)	4 X 2 = 8
– Large dish	2 X 2 = 4
– Medium dish	2 X 2 = 4
– Large bowl (Tureen & salad)	4 X 2 = 8
– Medium bowl	4 X 2 = 8
– Small bowl	6 X 2 = 12
– Large aluminium kettle	1 X 2 = 2
– Medium teapot	1 X 2 = 2
– Medium garbage pail	4 X 2 = 8
– Water jug	1 X 2 = 2

Deseription	Quantities
– Salt-sprinkler	2 X 2 = 4
– Pepper-sprinkler	2 X 2 = 4
– Kerosene container	1 X 2 = 2
– Litter container	1 X 2 = 2
– Shoe-cleaning door mat (made of herbacous fibre)	1 X 2 = 2
– Melamin tray	4 X 2 = 8
– Melamin sugar bowl	2 X 2 = 4

SECTION 2

SITE INSTALLATION

2.18 FIELD LABORATORY

The Contractor shall provide and maintain for the duration of Contract to the satisfaction of the Engineer the laboratory building with services, equipment, apparatus, fittings, furniture and the relevent ASTM literature for testing referred to in the Specifications and Drawings. This laboratory is for the use of the Engineer's Representative and the laboratory technicians and labourers shall be supplied by the Contractor and supervised by the Engineer's Representative.

The laboratory equipment and apparatus shall be of an approved type and shall be adequate in the opinion of the Engineer to carry out all the tests as listed in the Specifications. Air-conditioning, electric light, gas, power and water shall be supplied to the Field Laboratory by the Contractor.

The laboratory office shall be furnished with new furniture and equipment. The following is a listing of the minimum basic furniture and equipment to be provided by the Contractor for the laboratory office:

2 Metal Desks 1.50 m X 0.75 m top, 6 side drawers and 1 center drawer Artmetal or approved equal.

4 Straight Chairs

2 Coffee tables

2 Wastebaskets large, solid sides, no wire.

2 Wall Boards, 250 cm X 150 cm.

2 Electronic Calculators, SHARP model EL-5100 or approved equal.

2 Cupboards with shelves and locks.

1 File cabinet four drawers, lock type, legal size with metal clip hanging files (20 per drawer), ARTMETAL, or approved equal.

3 1 H.P. (12500 BTU) air conditioners.

1 Set of shelves for the concrete wet room.

At the end of the Contract all equipment, apparatus and furniture shall become the property of the Contractor, and shall be removed from the Site.

The Contractor shall furnish the following equipment and apparatus for the purpose of carrying out the following tests:

Grain Size Analysis

a) U.S. Standard 12 inch diameter brass sieves.

Sieve Size ASTM Designation	Sieve Openings mm	inches	Quantity
3 inches	76.2	3.00	1
2 1/2 inches	63.5	2.50	1
2 inches	50.8	2.00	1
1 1/2 inches	38.1	1.50	1
1 inch	25.4	1.00	1
No.12	1.68	0.0661	1
Brass pan			1
Brass cover			1

b) U.S. Standard 8 inch diameter brass sieves, and wodden flame square sieves (40 cm X 60 cm X 7 cm)

Sieve Size	Sieve Openings		Quantity	
Designation	mm	inches	8 in	square
1 1/4 inches	31.7	1.250	1	2
1 inch	25.4	1.000	1	2

Sieve Size	Sieve Openings		Quantity	
Designation	mm	inches	8 in	square
3/4 inches	19.1	0.750	1	2
5/8 inches	15.9	0.625	1	2
1/2 inch	12.7	0.500	1	2
3/8 inch	9.52	0.375	1	2
No.4	4.76	0.187	1	2
No.8	2.38	0.0832	1	2
No.10	2.00	0.0787	1	2
No.16	1.19	0.0469	1	2
No.20	0.84	0.0331	1	2
No.30	0.59	0.0232	1	2
No.40	0.42	0.0165	1	2
No.50	0.297	0.0117	1	2
No.80	0.177	0.0070	1	2
No.100	0.149	0.0059	1	2
No.140	0.105	0.0041	1	2
No.200	0.074	0.0029	1	2
Brass pan			1	–
Brass cover, less ring			1	–

c) Sitrring Apparatus

	Quantity
– Hydrometer graduated in grams per litre	5
– Hydrometer jars 1000 ml	5
– Thermometer accurate to 1°C.	5
– Beaker 500 ml.	3

d) Miscellaneous

– Motorized dynamic sieve shaker (8", 12" sieves)	1
– Wire sieve brush	2
– Fine sieve brush	2

	Quantity
– Sample bags (10" X 18" size)	50
– Sample bags (17" X 32" size)	50
– Sample bags, plastic lined (10" X 18")	50
– Unit weight measure.	2
– Sieving Timer	1
Sand Equivalent Test	
– Brass irrigation tube.	1
– Rubber tubing with pinch clamp.	1
– Weighted foot for sand level.	1
– Rubber stopper for cylinder.	4
– Wide mouth funnel	1
– Measuring can.	1
– Supply of standard stock solution.	10 pints
– Plastic measuring cylinders.	4
– Plywood carrying case.	1
– Stainless steel round sample bowl, 9" diameter 4" deep.	1
– Square drying pan, 10 1/2" X 10 1/2" X 1"	1
Compaction Test	
– Modified compaction hammer (2" dia. 10 lb., 18" drop).	2

	Quantity
– Modified compaction mould 1/13.33 cu.ft. volume; 6″ int. dia. 4.584″ high)	3
– Straight edge.	3
– Mixing trowel.	2
– Mixing pans, rectangular (20″ X 20″ X 6″ deep).	10
– Spring scale (capacity 10 kg, sensitivity 50 grams).	1
– Balance (capacity 1,000 grams, sensitivity 0.01 gram).	1
– Balance (capacity 25 kg sensitivity 1 gram). (to measure the weight in the water)	2
– Table balance (capacity 100 kg. sensitivity 50 gram).	2
– Field scale.	1
– Sample ejector with 2″, 3″, 4″ & 6″ disc & reaction plate.	1
– Wire basket	1
Moisture Test	
– Drying over 24″ X 20″ external size thermostatically controlled capable of maintaining a temperature of 110°± 5°C.	1
Thermometers	
– From – 10°C to 110°C, 1°C divisions.	2
– From 0°C to 220°C, 1°C divisions.	2
– Soil and concrete testing thermometer from 20°F to	

	Quantity
200°F, 2°F divisions.	2
– Metal thermometer from 0°C to 150°C, 2°C divisions.	2
– Armoured thermometer from 50°F to 750°F.	2
Concrete Test	
– Cylindrical moulds.	8
– Slump cone test – complete.	1
– Compression tests 250,000 pounds capacity or equivalent metric units.	1
– Guard for testing Machine.	1
– Cylinder capping set.	2
– Capping Compound (100 kg)	2
– Concrete curing cans.	12
– Concrete test hammer.	1
Miscellaneous Items of Equipment	
– Gradiated cylinder 500 cc.	5
– Gradiated cylinder 1000 cc.	5
– Hot Plate 1000 Watts	2
– Stopwatch 30 min. 1/5 sec.	1
– Asbestos gloves	2
– Glass marking pencil	1 dozen

	Quantity
– Laboratory tongs.	2
– Pencil sharpener.	2
– Assorted French curves set.	1
– Small hand scoop	4
– Large hand scoop	4
– Vernier calipers	1
– Steel seale, 3.0 m	2
– Field permeability apparatus	1
– Steel Flame, ϕ50 cm inner dia.	1
– Vinyle sheet, 3.0 m × 3.0 m	50
– Backet, 10 litre capacity	5