Lot # (2)

Installation, Erection and Civil Works.

Annex VII

TECHNICAL SPECIFIATIONS

Special Specification

The project is financed by Islamic development Bank (IDB) for upgrading the existing Gaza Power Plant & Gaza West Substation under direction and supervision of United Nation Development Project/PAPP (UNDP/PAPP).

Project Period: 16 Calendar months: 12 months for lot1 & 2 and 4 months for lot 3.

1) SCOPE OF WORKS:
   a) The project consists of two lots as follows:
      - LOT # 1: Supply of Power Transformers and all requested and suggested spare parts as well as Supply of Electrical materials and Equipments.
      - LOT # 2: Design, Erections, Connections and Commissioning works of the procured items in addition to all necessary civil works as outlined under the BOQ.

   b) The contractor will supply all workmanship, materials, equipments, machineries, and whatever needed to complete the tasks through the tender documents.
   c) Works have to be executed within the official working hours. In case the contractor wishes to work beyond that, he has to obtain a written approval from the Engineer.
   d) The contractor's project team:
      The contractor has to employ technical staff throughout the contract period of the project implementation and until preliminary handing over of the project. CV's and work experience in construction projects should be submitted in the process of approving the site staff. A certified agreement between the contractor and staff member should be submitted accordingly.
      The minimum technical staff during the implementation phase is as follows:

1- Local staff:
   - Electrical Engineer 8 years experience
   - Mechanical Engineer 8 years experience
   - Civil Engineers 8 years experience
   - Surveyor 8 years experience
   - Foreman 8 years experience

2- International staff:
   - Electrical Engineer 15 years experience (Expert)
   - Mechanical Engineer 15 years experience (Expert)

   The technical staff should be engaged on site on full time basis and have the sufficient experience and capabilities of carrying out their duties. Otherwise, the supervision will have the full right to replace any unsuitable staff with more competent one. However, any extra staff that will be needed due to the nature of work remains the contractor's responsibility.

   e) Time Schedule:
      The contractor has to submit a time schedule enclosed within his offer showing different activities of the project and the sequence of work activities using MS-Project.
      This time schedule will be revised and approved by the engineer before the initiation of work activities. The contractor has to update it and do all modifications deemed necessary to work activities as per the instructions of the supervision such that the contract duration is maintained.
      The contractor shall carry out quantity verification to be executed before the start up of work activities. Accordingly, the written approval on the scope of works shall be obtained prior to execution process.

   f) Schedule of material supply
      The contractor is required to submit a schedule of materials supply and assure continuous operations on work activities as per the approved time schedule.
      All raw materials relevant to the civil works are to be supplied and stored on site.
      The schedule of works should include the dates and quantities of material supply as well as the equipment supply to assure proper planning of work activities.
   g) Work plan
      The contractor has to submit a written work plan that illustrates the methodology to be followed in implementation of each work activity.
   h) Samples and catalogues:
      The contractor has to submit all samples and /or catalogues for all materials to be used on the project to verify their compliance with the technical specifications as follows:

*The samples and catalogues will be handed along with the request of material approval as per the schedule of material supply such that two weeks is allowed to obtain approval before order of material supply is placed.

*The samples and catalogues should show the data of technical specification and other data necessary for erecting, commissioning and maintenance.

i) Cash – Flow

The contractor has to submit a cumulative cash flow chart (S-curve) expected during implementation. Updates should be carried out on regular basis to adapt the actual expenditure on the project.

j) Monthly reports and photographs.

The contractor has to submit monthly reports in three copies reflecting the actual progress of works, executed work activities, difficulties faced and photos showing such progress.

k) Closures of borders.

The closure of borders is expected risk and the contractor has to assure proper storage of materials such that to keep work activities going on smoothly. No financial claims will be accounted in case of any closure is taking place.

l) Contract documents:

All tender documents stipulated in the ITB should be submitted, signed and stamped.

All requirements set in the technical specification (General and Specific), drawings, bill of quantity, pre-bid meeting notes and/or any addendum thereof are deemed to be included in the unit prices of the items and no extra charges will be paid in that respect.

2) WORKMANSHIP:

The contractor has to engage competent workers to achieve the workmanship stated in the tender documents. It is expected that best local practices be utilized in case no specific workmanship is identified.

3) DRAWINGS:

a) The contractor has to abide to any additional detail or general drawings issued by the engineer and will be considered as part of the contract.

b) The contractor will develop shop drawings for all work activities and submit for approval. No activity can be started unless engineer approves relevant shop drawing.

c) The contractor should submit three copies of the shop drawings according to the approved time schedule and obtain the approval of supervisor before commencing relevant work activities. In case of changes required, the contractor will resubmit the drawings with changes and obtain approval before execution of works.

d) As Built Drawings:

The contractor is responsible to submit as built drawings before the preliminary handing over in four hard copies A3 size and two CD's. They should show all details (architectural, structural, mechanical, and electrical along with services routes, trenches, manholes, and levels ...etc) for the review and approval of the engineer.

4) DISCREPANCY AND MISTAKES IN TENDER DOCUMENTS:

a) The contractor is deemed to thoroughly study the tender documents and highlight any discrepancy or mistake in the tender documents during the tendering stage for the engineer to verify it and give the corrected information to base upon his price in the tendering phase.

b) In case there is missing information in the contract documents or discrepancy or improper description of details of the items, it doesn't relieve the contractor from carrying out the item in the most correct manner as if identified and properly described in the original documents.

c) The contractor has to acknowledge the engineer in case of omission, discrepancy or mistakes in the tender documents in the tendering stage and price according to the engineer's answer.

5) INSPECTION OF SITE:

The contractor is deemed to have visited and investigated the site and identified all site conditions in terms of ground nature, accessibility to site, availability of services like water & electricity and all factors affecting execution of work activities before submitting his offer. All such factors are deemed to be taken into consideration while pricing.

6) SUB-CONTRACTORS:
Sub- contractors are dealt with according to General Conditions of Contract. The main contractor should submit to the Engineer; the certified agreement between him and the subcontractor prior to commencement of the work.

7) EQUIVALENCE AND ENGINEER'S INSTRUCTION:
Wherever equivalence and Engineers' instruction are mentioned within the contract documents, they are interpreted to be dealt with and /or executed according to the consent of the engineer.

8) SITE MEETINGS:
Periodical site meetings will be carried out and the contractor or duly authorized delegate should attend the meetings.

9) TESTING:
The contractor at his own expenses shall provide any test as requested by the Engineer's Representative for any materials supplied, installed, or stored in the site according to the stipulated tests in the general specifications. The contractor has to secure devices and equipments that are necessary to test sanitary and electrical works as requested by the Engineer.

10) SPECIFICATIONS:
Specifications that will be adopted within this contract are to meet the international standards.

In case there is no clear or missing specification of items, it is deemed that the contractor has based his prices on high quality materials and best practice in implementation.

11) TAKE OFF QUANTITIES AND PRICING:
    a) Description of items
    The tender documents are complementary and self explanatory and what is deemed necessary in one is deemed necessary in all. Accordingly, the item specification is not limited to item description in the bill of quantity but rather to the tender documents as a whole.

    b) Quantities
        i) Net measurements of quantities as executed or erected in place will be used in the project ignoring losses and overlapping parts.
        ii) Quantities are based on actual measurements on site.
        iii) The contractor shall attach all supporting documents for all finished quantities with each payment to the Engineer for review.
        iv) The contractor should inform the owner or his representative about any increase in quantities prior to execution in a written form. In case of extra quantities are executed without informing the owner or the Engineer and obtaining approval on the implementation will not be accounted in the quantities.
    c) Pricing:
        i) Description of items: The contractor is deemed that he understood all items within the bill of quantities and that he included all required expenses for permanent or temporary activities and components inclusive but not limited to overhead, profit, fees for services, materials, samples, losses in materials, equipments,…etc, to achieve and maintain the works in first grade quality and in the correct form. No claims will be accepted for comprehensiveness in pricing.
        ii) The contract individual price of items shall not include frontloading or backloading. All prices of items should be adequate to execute the relevant task individually.
        iii) The cost of any item in the B.O.Q. shall include all prices of raw material, workmanship cost, profits, and all direct and indirect relevant costs.
        iv) Any un-priced item in the B.O.Q. will be executed at zero cost.
        v) The contractor is deemed to base his price according to proper breakdown of cost. Hence, he is expected to submit such price analysis within his offer.
        vi) The unit rates shouldn't include VAT. All payments will be processed according to Zero VAT invoices all according to PA rules and regulations in that respect. The contractor has to include all expenses that might occur in his overhead expenses and no claims will be accepted regarding this issue.
        vii) Price shall include fees of testing according to specification and engineer's instruction. UNDP has the right to change the testing laboratory from time to time.
        viii) The contractor has to submit valid income and VAT tax clearance issued by the Ministry of finance along with the tender.

12) PROJECT SIGN BOARDS:
    a) The contractor has to supply and install two project sign boards. They will be made up of painted steel sheet 200cmX350cm including all necessary materials and workmanship for installation. All information and logos that have to be included on the board will be handed by the engineer during the mobilization period.
    b) The contractor will supply and fix Italian Carara marble sign 120cm x 100cm x 3cm. All information and logos that have to be included on the board will be handed by the engineer before the partially handing over of the project.

13) TEMPORARY INSTALLATIONS DURING IMPLEMENTATION
    All temporary facilities implemented before the start of project works and be at the expenses of the contractor and by the fall of the construction cost and the total after the expiration of the term of the project. In case of any delaying by the contractor in establishing of such buildings or any part thereof and removal of thereof, the Engineer's Representative and Employer have a right to establish the remainder and removal thereof at the end of the project and reduce the amounts disbursed from the account of the contractor without any objection to the action or cost.

14) OFFICES FOR THE ENGINEER'S REPRESENTATIVE
    a) The Contractor shall provide conditioned suitable site offices for the use of the supervision team throughout the period of construction. The site offices shall be constructed in a location approved by the Engineer during the mobilization period. The offices shall be of fixed or mobile type and shall have walls, ceiling and partitions lined with "Masonite" boards or similar material. All rooms shall have glazed windows complete with fly screens. Adequate fitted hardware, electrical switches, sockets, lighting, air conditioning, and plumbing fittings, sanitary ware etc., shall be provided as necessary for the different areas of the office.
    b) Any delay in furnishing the offices during mobilization period; will result in deducting 200 $ per each delayed day from the contractor's dues.
    c) The contractor shall prepare all needed access roads to and through the site on his own expenses and according to instruction of Engineer.
    d) The site offices shall be equipped, serviced and maintained in a clean, weatherproof and sanitary condition.
    e) The electrical installation shall provide for simultaneous use of all electrical appliances. The contractor shall secure electrical supply even during the electricity cuts to his site operation and site offices
    f) The Contractor shall arrange for a temporary power supply to the offices and provide and maintain adequate standby diesel generator. All electricity bills shall be paid by the Contractor.
    g) The Contractor will arrange for a temporary main water supply and maintain two tanks of 1000 m3 capacity on site throughout the mobilization period and before commencement of project activities.
    h) Throughout the duration of the Contract, the Contractor shall ensure an uninterrupted supply of water and electricity to the offices.
    i) The contractor shall be responsible for the security of the office building and its contents during the project period covering all the operation and maintenance costs for the equipment provided.
    j) All offices furniture shall remain the property of the contractor and will be returned to him after the completion of the project.

SCHEDULE OF THE ENGINEER'S OFFICES

The requirements of the site offices on this contract are as follows:

Room No	Description	Size Requirement
1	Engineer office	4.0 m x 6 m
2	Meeting office	4.0 m x 6 m
3	Toilet	1.5 m x 2 m
4	Kitchen	2 m x 1.5 m

SCHEDULE OF OFFICE FURNITURE

The table below shows the required furniture for the site offices

Item	Description	Quantity
A	Desk with two locking drawers and steel chair	1
B	Chair	6
C	Meeting Table1.0x2.0m	1
D	Samples cupboard	1
E	Computer (Pentium 4) With (DeskJet 1300 printer + UPS + LCD monitor + table)	1
F	All the office stationary as per engineer's instruction during all the project period	1
G	Office boy under the instructions of supervisor engineer at all times.	1

The costs for these items shall be included in the contractor's unit prices.

1 Civil Works

GENERAL AND PARTICULAR SPECIFICATIONS OF WORKS AND MATERIAL QUALITIES

I N D E X

SPECIFICATIONS PAGE

GENERAL AND PARTICULAR SPECIFICATIONS OF WORKS AND MATERIAL QUALITIES

I N D E X

I N D E X

SECTION A - GENERAL

SECTION A

GENERAL

A 1 SCOPE OF WORK

These Specifications cover all the works necessary **for the upgrading works of the existing Gaza Power Plant & Gaza West Substation.** includes testing and commissioning of all equipment and maintaining the whole works.

A 2 DRAWINGS

A list of Contract Drawing available at the date of tender is included on the front page of the Drawing Book and at the end of these Specifications

A 3 CONTRACTOR'S PRICE

The Contractor's price shall include for all materials labour and plant requirements necessary for the completion of the Contract in accordance with the Contract Drawing and specifications with exception only of items supplied by e Employer.

A 4 USE AND PROTECTION OF SITE

The Contractor shall take such measures and exercise such are to protect the Site as shown on the Site Plan during the course of the Works as directed by and to the entire satisfaction of the Engineer.

All temporary buildings and work areas such as Site Offices, Workshops Store Buildings and Yards, Living Accommodation, Messrooms, etc. shall be constructed in position approved by the Engineer.

The contractor shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the Engineer. The Contractor shall erect suitable temporary fences as required by the Engineer.

The Contractor shall not load or permit any part of the structures to be loaded with a weight that will endanger its safety.

On commencement of the Contract, the Contractor shall clear the Site and adjacent area of all rubbish and debris to the satisfaction of the Engineer.

USE AND PROTECTION OF SITE (Cont'd)

Upon completion of the Contract, the Site and any adjacent areas affected by the building operation shall be properly cleared of all temporary works, debris and other rubbish and all disturbed works and ground made good to the entire satisfaction of the Engineer.

A 5 MATERIALS FOUND ON SITE

Any sand, gravel or other building material found on the Site shall not be used in the execution of the Works without the prior written consent of the Engineer, which shall not be unreasonably withheld.

A 6 TEMPORARY STORMWATER DRAINAGE

The Contractor shall ensure that the whole of the Site, is kept free from the risk of stormwater flooding and shall provide such temporary ditches, gullies and the like as may be necessary and shall at completion of the Works backfill such excavation and make good all works disturbed.

A 7 SHOP DRAWINGS

If at any time before the commencement or during the progress of the work it appears to the Contractor that for the proper execution of specific part of the works, shop drawings are necessary, these drawings shall be prepared by the Contractor and submitted to the Engineer for approval. On the otherhand,the Engineer shall have authority to order at any time and the Contractor agrees to provide any number of shop drawings which in the opinion of the Engineer are necessary for the proper execution of a specified work, the Contractor shall not proceed with the above mentioned work unless these shop drawings are approved by the Engineer.

Shop drawings shall be fully detailed and drawn to proper scale.

Unless otherwise specifically required in the drawings or Specifications, shop drawings shall be supplied in four copies with dark lines on a white background.

Shop drawings shall be approved or returned to the Contractor for alternation or amendment within four (4) weeks of their receipt by the Engineer. Shop Drawings returned for alternation or amendment shall be resubmitted for approval. Altered or amended shop drawings shall show the nature of the alternation or amendment in a revision block on the drawings with a revision number or letter and the date of the revision.

A 8 " AS BUILT " DRAWINGS

All prints of the Drawings, where required, shall be corrected by the Contractor and submitted to the Engineer for approval as the works proceed. Upon the completion of the Works, the Contractor shall prepare a completely new set of drawings for the project as executed and submit same in duplicate to the Engineer for approval.

When approved by the Engineer, the Contractor shall submit one transparency and six copies of all drawings duly marked "As-Built". The final payment shall not be made except for the actual works that have been completed in accordance with the Specifications and have been duly presented on the "As-Built Drawings".

The Contractor shall not be entitled to any extra payment or extension of time for the correction, preparation and supplying of the above mentioned drawings and transparencies.

A 9 SCAFFOLDING

The Contractor shall provide, erect, maintain, and dismantle any clear away at completion proper and adequate scaffolding including that required for Sub-Contractors and Specialists. Putlong holes shall be made good to match the adjacent surface as the scaffolding is dismantle. The Contractor shall be entirely responsible for all safety precautions in connection with the scaffolding and for its entire sufficiency for the work.

A 10 PROTECTION

In the pursuance of his obligations under the Conditions of Contract, the Contractor shall wherever required or directed by the Engineer cover up and protect the Works form the weather and from damage by him or other workmen performing subsequent operations. He shall provide all necessary dustsheets, barriers and guard rails and clear away same at completion.

The Contractor shall take all reasonable and proper steps for the protection of all places on or about the Works, which may be dangerous to his workmen or any other persons or to traffic. The Contractor shall provide and maintain warning signs, red warning lamps and barricades as necessary in all such places.

A 11 SEPARATE CONTRACTS

The Employer reserves the right to let other separate contracts in connection with the work under similar conditions. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and co-ordinate his work with theirs.

If any part of the Contractor's work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report to the Engineer and defects in such work shall render it unsuitable for such proper execution and results.

His failure so to inspect and report shall constitute an acceptance of the other Contractor's Works as fit and proper for the reception of this work, except as to defects which may develop in the other Contractor's work after the execution of his work.

To ensure the proper execution of his subsequent work, the Contractor shall measure work already in place and shall at once report to the Engineer any discrepancy between executed work and the Drawings.

A 12 DEFINITIONS

"Approved "directed "selected" means the approval, direction or selection by the Engineer.

"Instructions means the instructions in writing of the Engineer or Engineer's Representative unless specified otherwise.

"Manufacturer's Recommendation" means the Manufacturer's recommendations or instructions, printed or in writing and current at the date of tender.

" Or approved equal" means that materials of different manufacturer may be substituted if proper approval has been obtained. The rates or prices will be held to be based on the materials specified.

Where an item is denoted as N.I.C. on the Drawings it shall mean that item indicated is not included in the Contract.

Where the terms Architect or Engineer is used in this Contract they shall have the same meaning.

Where the terms Architect's Representative or Engineer's Representative are used they shall have the same meaning.

A 13 STANDARDS

In the Contract reference is made to the Standards, Codes of practice and Specifications issued by the following organizations, hereinafter referred to by the following abbreviations:

AASHO Means the American Association of State Highway Officials.

ACI Means the American Concrete Institute.

AFNOR Means the Association Francaise de Normalisation.

AISC Means the American Institute of Steel Structure.

ASA Means the American Standards Association.

ASHRAE Means the American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASTM Means the American Society for Testing and materials.

AWWA Means the American Water Works Association.

B S Means the British Standards Institution.

CMA Means the Cable Manufacturers Association.

DIN Means the Deutscher Normanusschuss.

NEMA Means the National Electrical Manufactures Association.

NFPA Means the National Fire Protection Association.

VDE Means the Verban Deutscher Electrotechniker

These references shall in every case be deemed to include the latest edition or issue of such standards.

The Contractor upon receiving instructions shall supply the Engineer's Representative with single copies of all standards referred to on the Drawings or Specification and shall arrange for further copies for his own use.

A 14 MATERIALS GENERALLY

All materials and manufactured goods are to be the best of their respective kinds and as described in the Specifications and the Contractor shall submit for the approval of the Engineer a list of names and addresses of the manufacturers, the trade marks and types of all materials and articles he proposes to employ together with all specifications and descriptions that may be required in this connection before any orders are placed. Samples are to be provided if requested by the Engineer. Where a particular proprietary product, supplier's catalogue is referred to in the Specifications or shown on the drawings the material specified may be obtained from another source provided it is similar, equal and approved by the Engineer.

If during the course of the Contract certain materials required for use in the Works should be unobtainable despite the best efforts of the Contractor, then the Contractor may offer for the approval of the Engineer substitute materials.

The use of these substitute materials shall be at the sole discretion of the Engineer.

In the event of the acceptance of the substitute materials a suitable price reduction shall be made in the respect of decrease in quality or value but no price addition shall be made in respect of increase in quality or value.

In the event of refusal of the substitute materials the Contractor shall not be relieved of any of his obligations under the Contract and shall be solely liable for any delay or loss occasioned by his failure to provide materials as specified.

Where manufacturers recommendations have been entered into the contract documents, it is for the purpose of giving an indications to the contractor of the Engineer’s intentions on the application and use of the material.

It is deemed that the successful Contractor will make direct contact with the manufacturer m to ensure that he is carrying out the works in accordance with their recommendations.

A 15 CONTRACTOR TO VERIFY SITE MEASUREMENTS

The Contractor shall check and verify all site measurements wherever requested by other specialist contractors or by nominated or other sub-contractors to enable the to prepare their own shop drawings, and pass on the information with sufficient promptness as will not in any way delay the Works. A copy of all such information passed or shall be given to the Engineer.

A 16 SAMPLES

The Contractor shall furnish for approval, with reasonable promptness all samples of materials and workmanship required by the Engineer. The Engineer shall check and approve such samples with reasonable promptness for conformance with the design concept of the works and for compliance with the information given in the Contract Documents. The Work shall be in accordance with approved samples.

a) All material samples shall be delivered to the Engineer's office with all charges in connection with therewith paid by the Contractor.

b) Duplicate final approval samples, in addition to any required for the Contractor's use, shall be furnished to the Engineer.

c) Samples shall be furnished so as to delay fabrication allowing the Engineer reasonable time for consideration of the sample submitted.

d) Each sample shall be properly labelled with the name and quality of the material, manufacturer's name, name of project, the Contractor's name and the date of submission and the Specification number to which the sample refers.

A 17 CUTTING AND PATCHING

The Contractor shall be responsible for all cutting, patching and making good in all trades for all work and his prices will be deemed to include for all such cutting and patching and making good.

A 18 SITE OFFICES, LATRINES, ETC.

The Contractor shall provide and maintain on the Site for the duration of the Contract the following: -

a) A temporary office for the accommodation of his Agent/Engineer and Staff, including all necessary sanitary facilities, such offices shall be open at all reasonable hours to receive instructions, notices or other communications. Telephone and Electric installations shall also be provided.

b) A suitable and adequate temporary office shall be provided and furnished by the Contractor for the sole use of the Engineer and his staff. Such office shall be to the approval of the Engineer.

c) Adequate fire fighting equipment to the approval of the Local Fire Authority and the Engineer.

d) An approved sign board, written in Arabic and English. The size of signboard and lettering including to wordings shall be as directed by the Engineer.

A 19 ATTENDANCE ON THE ENGINEER

The Contractor shall for the duration of the Contract supply sufficient attendance for the Engineer's supervisory staff and shall maintain and pay all water, electricity, and telephone charges shall keep the Site Office and supervision cabins in a clean and sound condition at all times.

The Contractor shall be responsible for the security of the Site Office and its contents at all times and shall employ watchman for this purpose

A 20 TESTING

The Contractor shall allow in his rates and prices for the cost of carrying our tests necessary for compliance with the Specification in independent laboratories outside the Site.

A 21 TEMPORARY BUILDINGS

The Contractor shall provide and maintain on the Site sheds, offices, messrooms, sanitary accommodation and other temporary works of any kind whatsoever for the Contractor's supervisory staff and work people and for Sub-Contractor's staff employed upon the works.

The Contractor's site office shall be open during working hours to receive instructions notices or other communications.

Sheds shall be suitable to store all materials equipment and furniture which in the opinion of the Engineer needs protecting from the weather.

The Contractor shall provide and maintain in approved positions on the Site Adequate sanitary accommodation for his staff workmen and sub-Contractors. This sanitary accommodation shall be kept in a clean and orderly condition to the approval of the Public Health Authority and the Engineer to ensure that no nuisance is caused.

A 22 TEMPORARY WORKS AND REINSTATEMENT

The Contractor shall provide and maintain all temporary roads and tracks necessary for movement of plant and materials, and clear same away at completion and make good all works damaged or disturbed.

The Contractor shall submit drawings and full particulars of all Temporary Works to the Engineer before commencing same. The Engineer may required modifications to be made if he considers them to be insufficient and the Contractor shall give effect to such modifications but shall not be relieved of his responsibilities for the sufficiency thereof.

The Contractor shall divert as required, at his coast and to the approval of the Engineer, all public utilities encountered during the progress of the Works, except those specially indicated on the drawings as being included in the Contract.

Where diversions of services are not required in connection with the permanent Works, the Contractor shall uphold, maintain and keep the same in working order in existing locations.

The Contractor shall make good, at his own expense, all damage to telephone, telegraph and electric cable or wires, sewers, water, or other pipes except where the Public Authority or Private Party Owing or responsible for the same elects to make good the damage. The cost incurred in so doing shall be paid by the Contractor to the Public Authority or Private Party in demand.

All injury to the surface of the land, to the beds if water courses, projecting banks, etc. where disturbed by the Works (other than where specifically ordered by the Engineer) shall be repaired by the Contractor or the authorities concerned, at the Contractor's expense. All such making good shall be to the approval of the Engineer.

All requirements detailed above shall be provided and maintained at the expense of the Contractor.

The Employer shall not be liable for loss or injury to and Temporary Works.

A 23 WATER FOR THE WORKS

The Contractor shall make all necessary arrangements and provide all water for the proper execution of the Works, together with all transport temporary plumbing, storage and distribution, pay all charges and alter adapt and maintain temporary work as necessary remove and make good at completion.

A 24 ELECTRICITY FOR THE WORKS

The Contractor shall make all necessary arrangements and provide all artificial lighting and power for the proper execution and security if the Works and its protection.

With all meters temporary wiring and fittings, pay all charges and alter, adapt and maintain the temporary works as necessary and remove and make good at completion

A 25 PROVISION OF PLANT AND TOOLS

The Contractor shall provide and install all necessary hoists, ladders, scaffolding. Staging, tackles, tarpaulins, tools, vehicles, and other plant (mechanical and otherwise) and allow for altering adapting and maintaining them in good condition as necessary and eventually removing from site and making good.

A 26 TEMPORARY BARRIERS, FENCING ETC...

The Contractor is to provide all temporary barriers, fencing, hoarding, guard rails, gates, and the like as may be necessary to protect the public and others, for proper execution of the Works and shall remove and clear away at completion of the Works and make good all work disturbed.

A 27 INCONSISTENCY IN CONTRACT DOCUMENTS

The Contractor shall execute the Works according to the provisions of the Contract Documents. Any work indicated in one of the documents but omitted and/or stated in one or more of the other documents shall be treated as though it were included in all of them.

If any two documents of the Contract conflict as to the quality of the work to be carried out, the discrepancy shall be brought to the notice of the Engineer, who shall instruct the Contractor which of the two conflicting documents to regard as correct.

If the Contractor should discover that any work has been omitted and/or not indicated entirely or partially from all the documents, but that such work is essential to the safety or proper functioning of the works, he shall report the facts immediately to the Engineer. If the work is something which in the opinion of the Engineer could not have been foreseen by an experienced Contractor, the Engineer should issue to the Contractor a variation order stipulating the details of the work to be done.

Save as aforesaid in the above paragraph, no additional payment shall be made in respect of work carried out in connection with discrepancies between the various Contract Documents.

A 28 ERRORS IN COMPUTING CONTRACT DOCUMENTS

The Contractor shall be responsible for any error which he makes in computing any quantities of material and labour required or costs involved or through any lack of knowledge of the Site or misunderstanding of anything shown or implied on the Drawings or in the Specifications and/or the Bills of Quantities.
The Contractor must refer any discrepancy in the Drawings or the Specifications to the Engineer before proceeding in any of the Works otherwise the decision of the Engineer as to the interpretation of the discrepancy will be final. Any item or items of work not specifically shown on the Drawings or referred to in the Specifications but which would be necessary for the proper construction of the works in accordance with the best practice is implied and must be included for as incidential to the Contract Sum. Any item for which the Contractor has not inserted a price in the Bills of Quantities shall be deemed to be covered by other prices or rates therein.

A 29 SITE MEETINGS

During the course of the Works, site progress meetings shall be held at regular intervals at least once every two weeks in the presence of the Engineer for the purpose of co-ordinating the Contractor's work and to insure that full compliance with the various sequences of the contract are maintained. Minutes of such Site meetings will be recorded, copies will be distributed to all persons concerned and full effect shall be given to all instructions contained therein

Prior to such meetings the Contractor shall give to the Engineer's representative details in writing of that portion of the Works he proposes to construct during the coming two weeks with details of the plant and methods he proposes to employ. These proposals shall be discussed at the meeting and no work based on such proposals shall proceed without the approval of the Engineer's Representative

The Contractor shall have no claim against the Employer for costs incurred by him in changing the method of working or in the provision and use of other additional plant.

A 30 DAILY REPORTS

The Contractor shall deliver daily to the Engineer's Representative a report as to the number of workpeople employed on the Works in each Trade and copies of delivery notes of all materials and goods to the Site during the day.

A 31 ACCESS FOR THE ENGINEER

The Contractor shall provide at all times during the execution of the Works and the Maintenance Period proper means of access with ladders, gangways etc., and the necessary attendance to move and adapt same as directed for the inspection or measurement of the Works by the Engineer or the Engineer's Representative.

A 32 SETTING OUT AND LEVELLING

Prior to commencement of any site work the Contractor shall arrange to record on an approved grid existing site ground levels and agree with the Engineer's Representative the accuracy thereof by preparing a record drawing signed by the Contractor's Agent and the Engineer's Representative. The Contractor shall set out and level the Works and obtain the approval of the Engineer's Representative before commencing construction.

A 33 PROGRAMME TO BE FURNISHED

The Contractor shall prepare a programme for the Works, including the work of subcontractors and other work concurrent with the Contract, using the critical path network method. The Contractor shall submit three (3) copies of programme to the Engineer with his tender. Submission of programme will not relieve the Contractor of his obligations to apply in writing for instructions as required by the Conditions of Contract. Receipt of programmes by the Engineer shall neither affect the Contract completion date no relieve the Contractor of his responsibility to complete the Works by this date. The Contractor shall review the programme once each month to take account of any circumstances which arise affecting the progress of the Works, and shall produce a revised programme and submit copies to the Engineer.

A 34 CANCELLATION DUE TO SLOW PROGRESS

If the Engineer shall be of the opinion that having regard to the state of the Works at any time, the Contractor will be unable to complete any section of the Works by the time specified or by such extension thereof as he may be entitled to under the Contract and the Contractor has failed to carry out steps and to expedite the work in accordance with the Conditions of Contract or, if the Engineer is of the opinion that such steps are inadequate, the Engineer may, by written order omit the whole or any part of the uncompleted work included in that section and the Employer shall be at liberty to execute such omitted work by his own workman or by other Contractors. If the cost of such omitted or uncompleted work shall exceed the sum which would have been payable to the Contractor on the completion of the said work, then the Contractor shall, upon demand, pay to the Employer the amount of such excess and it shall be deemed a debt due by the Contractor to the Employer and shall be recoverable accordingly.

A 35 DELAYS

The Contractor will be deemed to have allowed for all delay caused by difficulty in obtaining labour and materials or by suspension of part or the whole of the Works due to adverse and inclement weather conditions.

A 36 NON-PRODUCTIVE TIME

The Contractor shall allow for all costs incurred by non-productive time and all other expenses in connection with overtime.

A 37 SAFETY, HEALTH AND WELFARE

The Contractor shall comply with enactments regulations and working rules relating to safety health and welfare of workpeople.

A 38 CONTRACTOR'S SITE REPRESENTATIVE

The Contractor's Representative in charge of the Works shall be a duly graduated Engineer having at least Three (3) years experience in the superintendence of similar works and shall be required to have a proper command of the Arabic and English languages.

A 39 ATTENDANCE

The Contractor shall allow for and be responsible for the general attendance of one trade upon another.

A 40 OFFICIAL VISITORS

The Contractor shall at all times when authorized by the Engineer give free undisputed access and all facilities to any authorized employee of the Employer, any representative of the U.N.D.P. or any person authorized by the U.N.D.P. wishing to view or inspect any part of the Works or the materials to be incorporated therein.

A 41 CARE OF THE WORKS, ETC.

The Contractor shall keep all persons (including those employed by Sub-Contractors) under control and within the boundaries of the Site. He will be held responsible for the care of the existing premises and of the works generally until their completion, including all work executed and materials, good and plant (including those Sub-Contractors and Suppliers)deposited on the Site; together with all risks arising from the weather, carelessness of work people, damage or loss by theft or any other cause; and he shall make good at his own expense or such damage and lose.

A 42 WORK AT COMPLETION

The Contractor shall clean the Works thoroughly inside and out removing all splashes, deposits, rubbish and surplus material. The Contractor shall remove all temporary markings, coverings and protective rappings unless otherwise instructed.

The Contractor shall touch up minor faults in painted surfaces carefully matching colour and brushing out edges. He shall repaint badly marked areas back to suitable breaks and junctions.

The Contractor shall adjust, ease and lubricate all doors, windows, drawers hardware, equipment, appliances controls and other moving parts as necessary to ensure easy and efficient operations.

The Contractor shall leave the Works secure with all access locked. He shall account for all keys and shall hand over to the Employer with itemized schedule signed by the Employer as receipt.

I N D E X

SECTION B - EXCAVATION, EARTH WORKS AND ROAD WORKS

S E C T I O N B

EXCAVATION - EARTH WORKS AND ROAD WORKS

B 1 GENERAL

The Contractor shall carry out all excavations, filling, backfilling and all other earthworks required in whatever material may be encountered.

The Works shall be executed accurately to the dimensions, levels, lines and profiles as indicated on the drawings or directed by the Engineer.

The Contractor shall reconstruct to the proper level and profile any filled areas which settle or spread during the execution of the work or during the maintenance period.

The Contractor shall drain and dewater the underground water to a level below the excavation by lowering the water table with a proper drainage and dewatering system approved by the Engineer.

B 2 SOIL INFORMATION

The Contractor shall be deemed to have visited the Site of Works and satisfied himself as to the nature of the ground and made himself conversant with the local conditions to be encountered during the execution of the Contract. The con-tractor is requested to perform a soil test to determine the nature and bearing capacity of the soil surface as directed by the Engineer.

B 3 MATERIALS

B 3.01 Backfill and Fill

Backfill and fill shall be a structurally sound material such as: less than 1 gravel or native soil free of rocks, lumps, vegetables and other organic materials obtained from suitable excavated material and/or from approved borrow pits.

B 3.02 Water

Water shall be clean potable water as specified under “Concrete Work”

B 3.03 Concrete

Concrete used as fill for making up the correct level areas of over-excavation shall be, where required by the Engineer of Class "B" as specified under "Concrete Work".

B 3.04 Hardcore

Hard-core under floor paving, etc...)(Where shown on the drawings or as directed by the Engineer) shall consist of tough, sound and durable rubble stones (maximum 150mm), free from coatings, drys, seems or flows of any character. Fine aggregate for blinding the interstices of hard-core bed shall be as described in "Concrete Work".

B 3.05 Agricultural Soil, Gravel and Sand Fill

Agricultural soil shall be first choice top soil rich in organic materials and free from roots, stones and rubbish suitable for plantation and shall be obtained from an approved source. Gravel fill shall consist of graded gravel 50mm. Down to 20mm. And blinded with clean coarse sand.

B 4 SITE PREPARATION

B 4.01 Existing Public Utilities

The Contractor shall ascertain the whereabouts of all existing public utilities on the site, both above and below ground. Such utilities shall be removed, sealed or rerouted in a manner prescribed by the Public Authorities concerned at the Contractor's own expense. The Contractor shall also be held responsible for all damages entailed on any of the public utilities adjacent to the Site resulting from the Works.

B 4.02 Removal of Existing Structures and Other Obstructions

This work shall include, but not be limited to, the removal of existing structures and other obstructions interfering with the Works. The Salvaging of any of these materials for the use of the Employer shall be as directed by the Engineer and unwanted materials shall be disposed off the Site in a satisfactory Manner at the Contractor's expense.

B 4.03 Cleaning and Grubbing

The Contractor shall perform the clearing and grubbing (if any) of top soil consisting mainly of loose soil, vegetable and organic matters, drift sand, unsuitable soil and rubbish by scarifying the areas to be excavated and side-walks to a minimum depth of 300mm from the natural ground level. All materials resulting from the above operations shall be removed from the Site, loaded and transported and off loaded spread and levelled to approved dumps as directed by the Engineer.

B 5 SETTING-OUT

The Contractor shall stakeout the work as shown on the Drawings and secure the Engineer's approval of his stakeout before proceeding with construction. If, in the opinion of the Engineer, modification of the line or grade is advisable before or after stake-out the Engineer will issue detailed instructions in writing to the Contractor for such modification and the Contractor shall revise the stake-up for further approval in accordance with the relevant Clause of the Conditions of Contract.

B 6 EXCAVATION

B 6.01 General

Excavation in any material whatsoever found including rock to reduce levels and to form foundations, bases, trenches, septic tanks, cesspools, pits and the like to depths shown on the drawings or as directed by the Engineer.

Completely remove all existing obstructions in the line of excavations such as wall, slabs, curbs, steps and the like.

Trim excavations to required profiles and levels. Remove all loose material.

Level and well ram and consolidate surface of ground and bottom of all excavations to receive concrete foundations, beds, etc.

Bottoms of excavations shall be approved by the Engineer's
Representative before any concrete is laid.

Should the Contractor excavate deeper than is shown on the drawings or required by the Engineer's Representative to obtain a solid bottom he must fill up excavation to the proper level with concrete Class B at his own expense.

B 6.02 Excavation in Rock

Rock shall be defined as boulders, exceeding 0.25m3 in volume or any kind of stone or rock formation which in the opinion of the Engineer's Representative requires for its removal drilling and blasting wedging, sledging or barring or breaking up with power-operated hard tool..

The definition shall exclude any soft or disintegrated rock which can be removed with a hard pick or mechanical excavator or shovel or loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere.

Blasting by explosives shall not be permitted without obtaining the written approval of the Engineer. If such approval is given the Contractor shall be solely responsible for:-

1 - Obtaining permits, keeping record.
2 - Storing permits, keeping record.
3 - Taking all necessary precautions in compliance with the regulations pertinent to the use of Explosives.
4 - Any damage that may occur due to the blasting operations where rock is encountered it shall be carefully excavated and the Contractor shall not be entitled to additional compensation unless otherwise specified in the Bills of Quantities.

B 7 **PLANKING AND STRUTTING**

The terms "planking and strutting" will be deemed to cover whatever methods the Contractor elects to adopt for shoring the sides of excavation and also for planking and strutting the excavations against the sides of adjoining buildings, public roadways, etc… The Contractor will be held responsible for shoring the sides of all excavations, adjoining building and the like and no claim for additional excavation, concrete or other material or workmanship will be considered in this respect.

In the event of any collapse occurring the excavations, the Contractor shall re-excavate and re-instate such excavations at his own expense. No additional excavations will be paid or should the Contractor batter the sides of the excavations.

B 8 **KEEPING EXCAVATIONS FREE FROM WATER**

All excavations shall be kept clear of water by pumping or bailing or by well-point dewatering, but the latter system shall not be employed if any danger exists of withdrawing water from the foundations of the adjoining buildings and such water shall be discharged clear of the works and the method adopted shall in no way contravene the regulations of the Local Authorities.

The system or systems to be employed shall be approved by the Engineer. Such approval if given shall not waive the Contractor's responsibilities and liabilities under the Contract.

Particular attention shall be paid to the installation of sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel and public.

B 9 **STORING OF SUITABLE EXCAVATED MATERIAL**

During excavation, materials suitable for backfill and fill shall be stockpiled on the Site at sufficient distance from the sides of the excavation to avoid over-loading and prevent caveins or mixing with the concrete during the construction of foundations.

B 10 **DISPOSAL OF UNSUITABLE AND SURPLUS EXCAVATED MATERIAL**

Upon the order of the Engineer, all unsuitable and surplus excavated materials shall be immediately removed. Loaded and transported off the site area by the Contractor to approved dumps and he shall abide by the relevant local regulations.

B 11 **EXCAVATION FOR FOUNDATIONS AND SUB-STRUCTURE**

The Contractor shall excavate to reach a suitable strata accepted by the Engineer or as shown by the Drawings during excavation for foundations, the bottom layer of excavation of minimum 200mm in thickness, shall be left undisturbed and subsequently removed manually only when the concrete in blinding is about to be placed in order to avoid softening or deterioration of the surfaces of the excavation.

Bottom of all excavations shall be formed to correct levels as shown on the Drawings or as directed in writing by the Engineer and shall be trimmed, levelled and well cleaned before pouring and concrete.

In the event of the contractor excavating deeper than the levels required, he shall make the difference between levels with concrete class "B" at his own expense.

After each excavation is complete, the Contractor shall notify the Engineer to that effect, and no concrete shall be placed until the Engineer has approved the excavation and the character of the foundation material.

B 12 **EXCAVATION FOR TRENCHES**

B 12.01 General

The Contractor shall provide all forms and bracings, and excavate trenches necessary to install all drainage, sewer water supply, electrical and telephone cables to the lines and grades complete in strict conformity with these specifications, applicable drawings and/or as directed by the Engineer.

B 12.02 Grading

The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its length, except for the portions of the pipe where it is necessary to excavate for bell-holes and for proper sealing of joints. Bell-holes and depressions for joints shall be dug after the trench has been graded.

Share shall be taken not to excavate below the depths indicated. Where rock shall be excavated to the required depth. Uneven surface of the bottom trench shall be excavated 15mm deeper. Such depth, if in rock, shall be back-filled with concrete Class "B" as specified under "Concrete Work" and when in earth, shall be back-filled with approved sand at the Contractor's own expense.

Whenever unstable soil, which in the opinion of the Engineer, is incapable of properly supporting the pipe or duct is encountered in the bottom of the trench, such soil shall be removed to the depth required and the trenchy back-filled to the proper grade with sand, fine gravel or other suitable material approved by the Engineer.

The width of the trench for Drainage at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall be 20mm on each side of the pipe. The width of the trench above that level may be as wide as necessary for sheeting and bracing and the proper performance of the work.

Trench for Water Supply System shall be of a depth to provide minimum cover over the top of 300mm and avoid interference of water lines with other utilities. Width of trench shall be a maximum of 200mm on each side of the pipe.

The width of trenches for electrical and telephone cables shall be as specified in their relative section. Banks may be sloped or widened to facilitate placement of cables, but not to an extend that will cause interference with other utilities.

Excavation for appurtenant structures for manholes, septic tank, percolating pit and similar structures shall be sufficient to allow a minimum of 300mm of clear space between their outer surfaces shoring timbers which may be used to protect the banks.

B 13 **BACKFILL AND FILL**

Approved suitable excavated material as specified under "MATERIALS" shall be used in the backfilling and filling next to footings, foundations underground structures, under sub-floors, etc... and shall be laid in layers not exceeding 200mm and compacted with compaction equipment, as approved by the Engineer. Moisture content shall be adjusted as directed by the Engineer and 95% of dry weight compaction accordance to ASTM: D1557-70 shall be achieved.

Should the quantity of the excavated material be not sufficient for the process of backfill and fill, the Contractor shall obtain the quantity required of such backfill and fill from approved borrow pits and transport same to the Site of work at his own expense.

No backfill shall be executed until the footings, foundations, etc., have been inspected, measured and approved by the Engineer.

Trenches should be backfilled until all required tests are performed and until the Engineer has verified that the Utility systems have been installed in accordance with the
Specifications and the Drawings. The backfill in the pipe zone must be placed and completed so as to provide and maintain adequate and even support around the pipe wall. If mechanical compaction equipment is need, care must be taken to prevent direct contact with the pipe.

B 14 **BED OF HARDCORE**

The bed of hard-core, where shown on the Drawings or as directed by the Engineer shall be of an approved rubble stone as specified under "MATERIALS" and shall be laid under floor pavings. The rubble stone for hard-core shall be hand-packed with sharp edge upward and wider (natural face) laid on the ground. The interstices of hard-core bed shall be filled with approved fines, wetted sufficiently and well consolidated. The thickness of the hard-core bed shall be as shown on the Drawings.

B 15 **PLACING OF AGRICULTURAL SOIL, GRAVEL AND SAND**

The agricultural sifted soil as specified under "MATERIALS" shall be spread in the flower boxes and beds to the thickness shown on the Drawings after thorough watering and on a bed of 100mm thick graded gravel blinded with clean coarse sand to the satisfaction of the Engineer.

B 16 **EXCAVATIONS OF CUTTINGS IN CARRIAGE WAYS**

1- Hauling of material from cuttings or borrow pits to the embankments or other areas of fill shall proceed only when sufficient compaction plant is operating at the place of disposition to ensure compliance with the requirements of specifications.

2- Any excess depth excavated below formation level tolerance shall be made good by back filling with suitable material of similar characteristics to that removed, compacted in accordance with specification.

3- The slopes of cuttings shall be cleared of rock fragments which move when prized by a crow bar.

4- Construction traffic shall not use the surface of the bottom of a cutting unless the cutting is in rock or the Contractor maintains the level of the bottom surface at least 30cm above formation level. Any damage to the sub-grade arising from such use of the surface shall be made of good by the Contractor at his own expense, with material having the same characteristics as the material which has been damaged.

B 17 **FILLING AND FORMING OF EMBANKMENTS AND OTHER AREAS OF FILL**

1- Embankments and other areas of fill shall be formed of material defined as " suitable material".

2- All earthworks material placed in or below embankments, below formation level in cuttings or else wherein the works shall be deposited and compacted as soon as practicable after excavation in layers of thickness appropriate to the compaction plant used or as a permitted departure therefrom. Embankments shall be built up evenly over the full width and shall be maintained at all times with a sufficient camber and a surface sufficiently even to enable surface water to drain readily from them. During the construction of embankments, the Contractor shall control and direct constructional traffic uniformly over their full width. Damage to compacted layers by constructional traffic shall be made good by the Contractor.

3- In areas of shallow filling where after removal of topsoil the ground level is within 30cccm of formation level constructional traffic shall not use the surface unless the Contractor brings up and maintains the surface level at least 30cm above formation level. Any damage to the sub-grade arising from such use shall be made good by the Contractor at his own expense with material having the same characteristics as the damaged materials.

B 18 **COMPACTION OF EMBANKMENTS AND OTHER AREAS OF FILL**

1- All materials used in embankments and as filling elsewhere shall be compacted as soon as practicable after deposition.

2- Variation from the method of compaction stated below or the use of plant not included therein will be permitted only if the Contractor demonstrates at site trials that a state of compaction is achieved by the alternative method equivalent to that obtained using the approved methods. This procedure shall be agree and approved by the Engineer.

3- The Engineer may at any time carry out comparative field density tests determined in accordance with S. S. 1377 test No. 14 on material, which he considers has been, inadequately compacted. If the test results when compared with the results of similar tests made on adjacent approved work in similar materials carried out in accordance with specification, show the state of compaction to be inadequate and this held to be due to failure of the Contractor to comply with the requirements of the Contract, the Contractor shall carry out such further work as the Engineer may decide is required to comply with the terms of the Contract.

5- The Contractor shall not less than 24 hours before he proposes to carry out compaction processes during periods of overtime, apply in writing to the Engineer for permission to do so.

B 19 **ROAD WORKS**

B 19.01 OVERALL REQUIREMENTS

A) Horizontal alignments, surface levels and surface regularity of pavement courses:

1- Horizontal alignments shall be determined from one edge of the carriage way pavement surface as shown on the Drawings. The edge of the carriageway as constructed and all other parallel alignments shall be correct within a tolerance of 15mm there from.

2- The levels of pavement courses shall be determined from the true pavement surface, which shall be the surface of the wearing course from flexible pavements calculated from the carriage way vertical profile and cross falls as sown on the Drawings. The vertical depth below the true pavement surface at any point on the constructed surface of the formation or pavement courses shall be within the appropriate tolerances stated below:

Base course tolerance	= __	10 mm
Road base tolerance	= __	15 mm
Sub-base tolerance	= __	20 mm
Formation tolerance	= __	25 mm

3- The surface level of the laid wearing course shall not deviate vertically at any point from the true pavement surface by more than 10mm.

4- For checking compliance with the above tolerances, measurements of surface levels will be taken at a grid of points 20 meter centers longitudinally and at 2 meter centers trans-versely starting one meter from the edge of the carriage way.

5- Compliance with tolerance shall be tested by rolling straight edge, operated parallel to the center line of the carriage way and one meter from the near side edge of each lane of carriage way.

6- For lengths less than 100 meter the laid pavement surface and the surface of the base course shall be tested with a 4 meter straightedge placed parallel to the centerline of the road. The laid pavement surface and the surface of the base course shall have no greater depression under the straightedge than 10mm and 10mm respectively.

7- Where any tolerance is exceeded the Contractor shall determine the full extent of the area which is out of tolerance and shall make good by rectifying the surface of the pavement course or formation in the manner described below:

a- Formation level:
If the surface is too high it shall be re-trimmed and re-compacted. If the surface is too low the deficiency shall be corrected by the addition of fresh suit-able material of the same classification laid and compacted to specification.

b- Roadbases and Sub-bases:
Where this consist of unbound material the top shall be scarified, reshaped, with added material as necessary, and recompacted all to specification. The area treated shall normally be not less than 30 meter long and 2.5 meter wide or such less length to be determined by the Engineer as necessary to obtain compliance with specification.

B) Use of surfaces by constructional traffic:

1- Constructional traffic used on pavement under construction shall be suitable in relation to the thickness of the courses it traverses so that damage is not caused to sub-grade or the material already constructed.

2- The wheels or tracks of plant moving over the various pavement courses shall be kept from deleterious materials.

C) Transporting, laying and compacting of road pavement materials containing Tar or Bitumen Binder.

1- Bituminous materials shall be transported in clean vehicles and shall be covered over when in transit or a waiting tripping. The use of dust,
Oil or water in the interior of the vehicles to facilitate discharge of the mixed materials is permissible but the amount shall be kept to a minimum and excess shall be removed by tipping or brushing.

2- The mixed material shall as soon as possible after arrival at the site be supplied continuously to the paver and laid without delay. The rate of delivery of material to the paver shall be so regulated as to enable the paver to be operated continuously and it shall be so operated whenever practicable

3- The rate of travel of the paver and its method of operation shall be adjusted to ensure an oven and uniform flow of material across the full laying width, freedom from dragging or tearing of the material and minimum segregation.

4- The material shall be laid generally in conformity with the recommendations for laying in the British Standard to which it has been made.

5- Hand laying of any bituminous material will be permitted only in the following circumstances:
   a. For laying regulating courses of irregular shape and varying thickness.
   b. In confined spaces where it is impracticable for a paver to operate.
   c. For footways.

6- Material shall be compacted as soon as rolling can be effected without causing undue displacement of the mixed material and while this has at least the minimum rolling temperature stated in the appropriate British Standard. The material shall be uniformly compacted by an 8-10 tons smooth wheel roller having a width of roll not less than 45cm, or by a mult-wheeled pneumatic tyred roller of equivalent weight except that wearing course and base course material shall be surface finished with a smooth wheel roller.

7- The material shall be rolled in a longitudinal carriageway over lapping on successive passes by at a pneumatic tyred roller, at least the nominal width of the tyre.

8- Hand-raking of wearing course material which has been laid by a paver and the addition of such material by handspreading to the paved area for adjustment of level will be permitted only in the following circumstances:
   a- At the edges of the layers of material and at gullies and manholes.
   b- Where other wise directed by the Engineer.

9- Rollers shall not stand on newly laid material while there is a risk that it will be deformed thereby.

10- a. By heating the joint with an approved joint heater at the time when the additional width is being laid but without cutting back or coating with binder. The heater shall raise the temperature of the full depth or the wearing course to figure within the rolling temperature range specified for the material and for a width not less than 75mm on each side of the joint. In this case, however the Contractor shall have available for use in the event of breakdown, equipment necessary for operating method (c).

b. By using two or more pavers operating in echelon where there is practicable and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling or by using a multiple-lane-width payer.

c. By cutting back the exposed joints to a vertical face of not less than the specified thickness, discarding all loosened material and cooling the vertical face completely with a grade of hot tar or hot bitumen suitable for the purpose before the next width is laid.

11- Base course material shall not remain uncovered by either the wearing course or surface treatment whichever is specified in the Contract for more than 3 consecutive days after being laid.

B 19.02 SUB-BASE AND ROAD BASE

A. Constructions requirements for materials of base and sub-grade.

1- Transport vehicles carrying plant mixed mater-ial shall have a capacity suited to the output of the mixing point and the site conditions and be capable of discharging cleanly. Material when mixed shall be removed at once from the mixer, transported directly to the point where it is to be laid and protected from the weather both during transit from the mixer to the laying size and whilst tripping.

2. All material shall be placed and spread evenly. Spreading shall be undertaken either concurrently with placing or without delay. Roadbase material shall be spread using a paving machine or spreader box operated with a mechanism which levels off the material to an even depth. Except where otherwise specified in individual clauses, the material shall be spread in one layer so that after compaction the total thickness is as specified.

3- Compaction shall be completed as soon as possible after the material has been spread.

4- Special care shall be taken to obtain full compaction in the vicinity of both longitudinal and transverse.

5- The surface of any layer of material shall be on completion of compaction be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

6- Compaction shall be carried out by the method specified in the table page ().

B) Granular sub-base and Road Material:

1- It shall comprise natural sands, gravels, crushed rock. The material shall be well graded and lie within the following grading limits:

B.S. Sieve Size	Percentage by weight passing
3 in	100
1 1/2 in	85 - 100
3/8 in	45 - 100
3/16 in	25 - 85
No. 25	8 - 45
No. 200	0 - 10

The particle size shall be determined in accordance with B.C. 1377.

2- The material passing no. 36B.S. sieve, when tested in accordance with B.S. 1377 shall have a plasticity index of less than 6.

3- The material shall be laid and compacted to the requirements of specifications at a moisture content within the range one percent above to 2 percent below the optimum percentage determined in accordance with vibrating hammer method test in B.S. 1377

4- On completion of roadbase and until any surfacing is laid on it, the finished surface shall be maintained free from potholes, ruts and undulations, irregularities depressions, loose material or other defects.

5- Paved hard shoulders shall be constructed of the materials and to the dimensions described in the contract. Alternatively if agreed by the Engineer the Contractor may construct hard shoulders to the same specification as the carriage way pavement.

B 19.03 FLEXIBLE SURFACING

A) Rolled Asphalt for Base:

1- This material shall be made in accordance with the requirements of B,S, 594for base course mixtures subject to the under mentioned proviso relating to blastfurnace slag. It shall be laid and compacted to relevant clauses.

2- Coarse aggregate content 65 percent. When the bulk density of the slag coarse aggregate is less than 80lb per cubic foot, the coarse aggregate content shall be reduced to 55 per cent.

3- Petroleum bitumen in accordance with B.S. 594 of penetration as described in the contract.

B) Rolled Asphalt Wearing Coarse:

1- Rolled asphalt wearing coarse shall be in accordance with the general requirements of B.S.594.

2- Asphaltic Cement:

a. Equal proportions by weight of petroleum bitumen of appropriate penetration and refind asphalt or/

b. Pitch/Bitumen to the following specifications: A mixture of 75-80 percent of petroleum bitumen with 20-25 percent of a coal tar pitch produced by straight running predominately from a vertical retort crude source.

The softening point of the pitch shall lie between 55 C and 80 C and the petroleum bitumen shall have a penetration conforming to the requirements of B.S.594 tables 1, 2 or 3 as described in the Contract. The Engineer may require, from time to time, certificates confirming that the mixture has a salability index not higher than 1.2 when tested according to the method described in the Road Research Laboratory Research Note No. RN/4112. The use of density-gradient column in a storage stability test for pitch/bitumen mixtures; or

c. Petroleum Bitumen.

3- Content of coarse aggregate for new works 3 percent by weight.

4- Binder Content/ Bulk of Blastfurnace Slag Relationship.

When the coarse aggregate is blastfurnace slag the binder content shall be related to the bulk density of the aggregate. When the bulk density is less than 87lb per cubic foot (1400Kg/M3) rounded to the nearest 1lb per cubic foot (16Kg/M3) the soluble bitumen content shown in the following table:

Percentage by weight of total mixture

Coarse Aggregate retained on No. 7 B.S. Sieve	Soluble binder	Aggregate passing No.200 B.S. Sieve	Aggregate passing No. 7 and retained on No. 200 B.S. Sieve	
Aggregate				
	Min. Max.	Min. Max.	Min.	Max.
Crushed rock 30	7.9 8.9	8.9 10.9	50.9	53.2
Blast-furnace slag 30	8.0 9.0	8.9 10.9	50.1	53.1

Shall be increased as shown below in the table and the percentage of aggregate passing the No.7 B.C. Sieve and retained on the No. 200 B.S. Sieve correspondingly reduced. Slag having a bulk density of less than 68lb per cubic foot shall not be used.

Bulk density of slag Lb/ft3	Addition to specified percentage of soluble bitumen content	
	New Works	Resurfacing
87 and above	Nil	Depending on the
81-86	0.1	coarse aggregate
74-80	0.2	content specified
68-73	0.3	

C) Bituminous Sprays:

1- When it is necessary to prepare a surface for the application of a bituminous spray and to undertake the spraying and any specified binding, this shall be done in accordance with the recommendation of the Ministry of Transport Road notes relating to surface dressing in so far as they apply to work to be undertaken. The work shall also be undertaken in accordance with the under-mentioned general requirements and any specific requirements as described in the Contract.

2- The Engineer may require the contractor to provide a certificate stating that a particular binder distributor has been tested since the previous surface dressing season and that the test indicates conformity of the requirements for B.S.1707 for hot binder distributors or with the requirements of B.S. 3236 for emulsion distributors.

3- Before spraying is commenced, the surface shall be freed of all loose material. The surface as a whole shall be dry and any damp areas shall be completely free from standing water.

4- Binding material, where required by the contract, shall consist of a commercial grade of hard clean crushed rock or slag fine aggregate or sand; it shall contain not more than 15 percent retained on a ¼ inch B. S. Sieve.

5- Unless the Engineer permits otherwise, all loose material on the sprayed surface, including any building material, shall be removed before any further layer of the pavement is laid.

B 19.04 SIGNS AND ROAD MARKINGS

A) Permanent Traffic signs and information signs:

1- Permanent traffic signs shall be either externally or internally illuminated, reflecting or non-reflecting as described in the Contract and the local standards.

2- Where illumination is to be provided, this shall be by lamps of tungsten filament or fluorescent type complying with B.S. 873 Where reflectorisation is required the means shall be of approved type all as described in the Contract.

3- Signs shall be erected with approved fittings on posts made from rectangular or tubular steel. The construction and supports of large signs shall be as described in the Contract.

I N D E X

SECTION C - CONCRETE WORK

S E C T I O N C

CONCRETE WORK

C 1 SCOPE

This section describes and specifies work required for plain and reinforced concrete, including formwork intended to be used for the Project under the Contract in accordance with the Drawings, Bills of Quantities and as directed by the Engineer.

At the beginning of each month, the Contractor shall submit to the Engineer his concreting programme for that month, stating the pouring dates, so that adequate checking and supervision can be provided before and during the pouring operation. No pouring shall be allowed unless the Engineer has been given a week-advanced notice of the intention to pour.

C 2 APPLICABLE TESTS AND CODES

Prior to commencement of concrete work, the Contractor shall submit samples to the Engineer before sending them to the laboratories for testing, to establish the probability of the materials passing tests for specified requirements.

After the Engineer is convinced that the samples with their sources are truly representative samples and sufficient materials are available on the Site for the completion of all concrete works under the Contract, the samples shall be approved and sent to the laboratories for testing. Upon the Engineer’s request, the Contractor shall have the tests made, at his own expense in the laboratories approved by the Engineer.

All concrete aggregates, cement and water shall be sampled and tested as frequently as deemed necessary by the Engineer. All tests samples shall be obtained in accordance with the latest editions of the American Society for Testing and Material (ACI) Code or any equally approved standard.

C 3 **MATERIALS**

C 3.01 Cement

(A) General

Cement shall be Portland Type originating from approved manufacturers in sealed and labelled bags, each 50 kgs. Not capacity, name and brand of the manufacturer shall plainly be identified thereon and Delivered to the Site in good condition Cement delivered in bulk shall be accepted only if a central mixing plant is used. The Quality of cement shall conform to the Standard Specification for PORTLAND CEMENT of ASIM Designation: C150-74 Type I- for use in general concrete construction and Type V- for use when high sulphate resistance is desired.

(B) Storage of Cement

All cement shall be stored in suitable weatherproof and approved storage sheds which will protect the cement from dampness. Storage sheds shall be erected in locations approved by the Engineer. Provision for storage shall be ample, and the consignment of cement as received shall be separately stored in such a manner as to provide easy access for the identification and inspection of each consignment Cement shall be used in the order of its delivery to site, new deliveries shall not be used unless the cement from earlier deliveries has be completely used. Stored cement shall meet the test requirements at any time after storage when a re-test is ordered by the Engineer all the expense of the Contractor.

The Contractor shall keep accurate records of the deliveries of cement and of its use in the work. Copies of these records shall be supplied to the Engineer in such form as may be required.

(C) Rejection

The Contractor shall notify the Engineer of dates of delivery so that there will be sufficient time for sampling the cement either at the mill or upon delivery.

The provisional acceptance of the cement at the mill shall not deprive the Engineer of the right to reject on a reset of soundness at the time of delivery of the cement to the Site.

Package of cement varying by 5 percent or more from the specified weight shall be rejected and if the average weight of packages in any consignment, as shown by weighing 50 packages taken at random, is less than that specified, the entire consignment shall be rejected and the Contractor shall remove it forthwith from the Site at his own expense and replace it with cement of satisfactory quality.
Stale cement or cement reclaimed from cleaning bags shall not be used and cement which for any reason has become partially set, or contains lump or caked cement, shall be rejected.

C 3.02 Aggregates

(A) General Requirements
All aggregates shall consist of tough, hard, durable uncoated particles. The Contractor shall be responsible for the processing of this material to meet the requirements of the Specifications. Approval of aggregate quality and/or gradation shall not waive the responsibility of the Contractor to provide concrete of having the minimum strength specified.

(B) Storage
Coarse and fine aggregates shall be delivered and stored separately on site in such a manner as to prevent segregation and contamination or the admixture of foreign materials. Aggregate which has become seg-regated or contaminated with foreign matter during storage or handling will be rejected and shall be removed and replaced with material of acceptable quality at the Contractor's expense. Aggregates of the quality and colour selected shall be stored in sufficient quantity to avoid interruption of concreting work at any time.

C 3.03 Fine Aggregate

(A) General Requirements
All fine aggregate shall conform to Standard Specification for Concrete Aggregates of ASIM Designation: C-33 and also to the detailed requirements give in Table 300 A (appended herebelow). It shall not contain harmful materials such as iron pyrites, coal, mica, and shale. Alkali, coated grains, or similar laminated materials such as soft and flaky particles, or any material which may attack the reinforcement, in such a form and in sufficient quantity to affect adversely the strength and durability of the concrete. Fine Aggregate passing sieve No. 4 shall not contain any voided shells.
Fine aggregates shall be washed thoroughly with deminaralized water to ensure compliance with the appropriate requirements and limitations of the specifications.

The Contractor shall provide and maintain for this proposes sand-washing plant and equipment.

Fine Aggregate from different sources of supply shall not be mixed or stored in one pile nor used alternately in the same class of construction or mix.

Table 300 A

Grading : Sieve		Percent Passing
3/8		100
No. 4		95 - 100
8		80 - 100
16		50 - 85
30		25 - 60
50		10 - 30
100		2 - 10
200		0 - 3
Fineness modulus		2.50-2.15
Organic Impurities	The color shall have an intensity not darker than two-thirds the intensity of the standard color solution. (Not darker than Plate 2 as determined by the Standard Method of Test for Organic Impurities in Sands for Concrete of ASTM Designation C - 40	
Chlorides soluble in dilute Nitric Acid	Not more than 0.10 percent by weight when expressed as sodium chloride (NACL).	
Total Acid soluble sulphates	Not more than 0.50 percent by weight when expressed as sulpher trioxide (S03)	
Silt	Not more than 2 percent	
Mortar strength	Compression ratio not less than 95 percent.	
Soundless	Weighted average loss when subjected to 5 cycles of the soundless test using magnesium sulfate, not more than 10 percent.	

C 3.04 Coarse Aggregate

(A) General Requirements

All coarse aggregate for concrete shall conform to Standard Specifications for Concrete Aggregates of ASTM Destination: C-33 Coarse aggregate shall consist of gravel, crushes gravel, or crushed stone, having hard, strong durable pieces, free from adherents. It shall not contain harmful materials such as iron pyrites, coal, mica, alkali, laminated materials, or any material which may attack the reinforcement, in such a for or in sufficient quantity to affect adversely the strength and durability of the Concrete. Coarse aggregates shall be washed thoroughly with deminaralized water to ensure compliance with the appropriate requirements and limitations of the specifications. The Contractor shall provide and maintain for this purpose approved washing plant and equipment.

(B) Deleterious Substances

The amount of deleterious substances shall not exceed the following limits:

	Max. Permissible Limit Percent by Wt.
- Soft fragments	2.0
- Coal and lignite	0.5
- Clay lumps	0.25
- Materials passing the No.200 sieve	1.0
- Thin or clognated pieces(length greater than 5 times average thickness)	4.0
- Other local deleterious substances	0
- Chlorides soluble in dilute Nitric acid when expressed as Sodium Chloride (NaCL)	0.05
- Total acid soluble sulphates when expressed as sulpher trioxide (S03)	0.5

(C) Percentage of Wear

Coarse aggregate shall conform to the following requirements:
Percentage of wear, Los Angeles test, not more than 30

(D) Grading

Coarse aggregate, when tested according to the requirements of ASTM, shall meet the following gradation and shall be uniformly graded within the limits stated in Table 1 herebelow:

Table 1

ASTM Passing		Percentage by Weight		
		Grading (3/4" to No.4)	Grading (1" to No.4)	Grading (2" to No.4)
2 1/2	inch	-	-	100
2	inch	-	-	95 - 100
1 1/2	inch	-	100	-
1	inch	100	95 - 100	35 - 70
3/4	inch	95 - 100	-	-
1/2	inch	-	25 - 60	10 - 30
/3/8	inch	20 - 55	-	-
No. 4		0 - 10	0 - 10	0 - 5
No. 8		0 - 5	0 - 5	-
No. 200		0 - 1	0 - 1	0 - 1

(E) Combined Aggregate

Approved fine and coarse aggregate on each batch of concrete shall be combined in proportions as approved by the Engineer, according to test results giving the required compressive concrete stress as specified per type of Concrete.

The combined aggregate gradation using the ¾ in. to No. 4 gradation shall be used for concrete members with reinforcement to close or permit proper placement and consolidation of the concrete. Change from one gradation to another shall not be made during the progress of the work unless approved by the Engineer. Such changes are admitted only after being proved by test results.

C 3.05 Aggregate for Mortar

(A) General Requirements

Aggregate for motor shall conform to the Standard Specification for Aggregate for Masonry Mortar of ASTM Designation : C-144 and shall consist of hard, strong, durable uncoated mineral or rock particles, free from injurious amounts of organic or other deleterious substances.

(B) Organic Impurities

Fine aggregate for mortar when subjected to the Calorimetric test for organic impurities and producing a color darker than the standard color shall be rejected.

C 3.06 Water

(A) Quality of Water

Water for mixing of concrete shall be fresh, clean and free from injurious amounts of oil, acid, or any other deleterious mineral and/or organic matter. It shall not contain chlorides such as sodium chloride in excess of 700 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 10 percent, nor a reduction in compressive strength of mortar of more than 5 percent compared to results obtained with distilled water.

The PH of the water for mixing and curing of concrete shall not be less than PH 4.5 or more than PH 8.5.

(B) Tests for Water

When required by the Engineer the quality of the mixing water shall be determined by the Standard Method of Test for quality of water to be used in concrete, as specified in B.S. 3148: 1959 Tests for Water for Making Concrete.

In sampling water for testing, care shall be taken to ensure the containers are clean and that samples are representative.

C 3.07 Admixtures

Admixtures in concrete shall be used only when approved by the Engineer and shall conform to the requirements of the ASTM Standard Specifications Designation c-494-68 for Water Reducing and
Retarding Admixtures, and C-260-69 for Air entraining Admixtures for Concrete, and waterproofing and watertighting.

The Contractor shall ensure that the admixture supplied for use in the work is equivalent in composition to the admixture subjected to test under this Specification. Tests shall be made whenever practicable using the cement, aggregates, admixtures proposed for specific work, because The specific effects produced by chemical admixtures may vary with the properties of the other ingredients of the concrete.

The specific effects produced by chemical admixtures may vary with the properties of the other ingredients of the concrete.

Admixture that contain relatively large amounts of chloride shall accelerate corrosion of reinforcing steel and shall be the cause of rejection.

Water reducing and retarding admixtures shall comply with the physical requirements of ASTM tests and shall be approved in writing by the Engineer.

When the admixture is delivered in packages or containers, the proprietary name of the admixture, the type and the weight or volume shall be plainly marked thereon. Similar information shall be provided in the shipping advises accompanying packaged or bulk shipments of admixtures.

The admixture shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, and in a suitable weather-tight stores that will protect the admixture from dampness.

Costs of such admixtures, sampling and testing shall be at the Contractor's expense.

C 4 **COMPOSITION OF CONCRETE**

The cement content, coarse aggregate size, water content, consistency and the approximate weights of fine and coarse aggregate (saturated surface-dry basis) for the class of concrete shall be within the requirements of Table I and II Below.

The weight of fine and coarse aggregate given in Table II below are based on the use of aggregates having bulk specific gravities, in a saturated surface-dry condition, 2.65-5%. For reasonably well graded materials of normal physical characteristics, the use of the below indicated proportions, together with specified water content to obtain the required consistency, will result in concrete of the specified cement content, plus or minus two (2) percent.
For aggregate having specified gravities outside the ranges indicated in the Table II below, the weights shall be corrected by multiplying the weights shown in Table II below by the ration of the specific gravity of the aggregate and 2.65.

The relative weights of fine and coarse aggregate per sack of cement given in Table II below are based on the use of natural sand having a fineness modulus within the range of 2.70 and 2.90 and methods of placing which do not involve high frequency vibration. When sharp, angular manufactured sands, or extremely coarsely graded sands are used, the relative amount of fine aggregate should be increased. For finer sands the relative amount of fine aggregate should be decreased. In general, the least amount of sand which will insure concrete of the required workability for the placing conditions involved should always be compensated for by changing the weight of coarse aggregate in the opposite direction by a corresponding amount.

Table I

Class of Concrete	Compressive Strength At 28 Days (in Kg/cm2) Cube	Minimum Cement Content Kgs	Coarse Aggregate Size	Max. Water Content Liters Per Bag	Consistency Range in Slump Vibrated - Non Vibrated
					m m m m
A	250	375	3/4in.or 1in.-No.4 as required by the Engineer	27	50-100 75-125
B	200	350	Ditto	27	50-100 33-125
C	150	250	2in.-No 4	30	25-50 50-75

Table II

Class of Concrete	Cylinder Compressive Strength At 28 Days Kg/cm2	Approximate Weight (Saturated Surface-Dry) of Fine and Coarse Aggregate Per Sack (50Kgs) of Cement			
		Rounded Coarse Aggregate		Angular Coarse	
		Fine	Coarse	Fine	Coarse
		Kgs	Kgs	Kgs	Kgs
A	250	40	170	95	150
B	210	95	180	100	160
C	140	140	370	160	340

Table II is given for indicative purposes and is not binding.

The total sodium chloride content of any materials used for making concrete shall be less than :

- For mass concrete ..... 1.5 percent
- For reinforced concrete ..... 0.7 percent

Expressed as a percentage, by weight of the cement. In calculations made under the provisions of this clause, any chloride, other than sodium chloride in the materials shall be converted to the equivalent of sodium chloride and be added to the amount of sodium chloride. The sulphate content shall not exceed 0.03 percent by weight of the cement.

C 5 **PROPORTIONS**

C 5.01 General

After the materials provided by the Contractor have been accepted for the works, the proportions and equivalent batch weights shall be determined which will produce concrete having not less than the strength required.

C 5.02 Trial Mixes

The actual proportions shall be determined on the basis trial mixes made by the Contractor and conducted with the content being determined by means of yield test in accordance with American Society for Testing Material (ASTM) Designation (C-138). The proportions will be such as to required (within a tolerance of plus or minus one (1) percent, the cement content shown in Table I as the minimum cement content, provided, however, that if the materials supplied by the Contractor are of such a nature or are so graded that proportions based on the minimum cement content cannot be used without exceeding the maximum allowable water content specified in Table I, the proportions will be adjusted so as to require the least amount of cement which will produce concrete of the required plasticity and work- ability without exceeding such maximum allowable water content. No additional compensation will be made for the increase in quantity of cement required.

C 5.03 Contents

The mixes required will be designated in kilograms of fine and coarse aggregate exclusive of free water, per sack (50 Kilograms) of cement and in liters of total mixing water per sack of cement on the basis of the required amount of cement per cubic meter of concrete.

C 5.04 Batch Weights

Since the proportions are designated in terms of aggregate in surface-dry condition, the equivalent batch weights to be used in the work shall be corrected periodically to take into account the actual moisture content of the aggregates at the time of use.

C 6 **CONCRETE COMPRESSION AND SLUMP TESTS**

C 6.01 Cubical Test

The Compression Strength of Concrete shall be obtained according to cubical tests locally done. Test cubes made in the field shall have a dimension of 10cm, At least 3 separate batches of concrete shall be made for trial and these shall be tested for compliance with the requirements of the table below, at least 3 test cubes being made from each batch of concrete. Once a mix is approved no substantial change in the materials or proportions of materials being used shall be made without the approval of the director of works who may then require further trial mixes to be produced. The compressive strength of the concrete will be taken as the arithmetic mean of the strength of all the cubes tested. The following table will be used to compare test results: -

3-4 samples taken	5 samples or more

Kind of Concrete	Mean value At 28 days Kg / cm2	Minimum Individual Value at 28 days Kg / cm2	Mean value At 28 days Kg / cm2	Minimum Individual Value at 28 days Kg / cm2
B - 150	190	130	180	120
B - 200	240	180	230	170
B - 300	340	280	330	270

Table of Compressive Strength results of samples of concrete at 28 days.

(Mixed by Weight)

C 6.02 Slump Tests

Slump tests shall be carried out periodically to ensure the appropriate water cement ratio in accordance with the Standard Method of Test of Slump of Portland Cement Concrete of the ASTM Designation: C-143.

C 6.03 Test of Hardened Concrete in the Structure

Where the results of specimens indicate that the concrete does not meet specification requirements, coreboring tests conforming to the current issue of ASTM Designation: C-42 shall be performed, as directed by the Engineer, all at the Contractor's expense.

C 7 MEASUREMENT OF MATERIALS

Materials shall be measured by weight, except as otherwise specified or where other methods are specifically authorized by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Each size of an aggregate and the cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities can be measured to within 1% of the desired amount. Cement in standard packages (sack) need not be weighed. The mixing water shall be measured by a measuring device susceptible of control accurate to plus or minus half percent of the capacity of the tank but not exceeding 2 liters. All measuring devices shall be subject to the Engineer's approval.

Where volumetric measurements are exceptionally authorized by the Engineer for projects where the amount of concrete is small, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate.

C 8 MIXING OF CONCRETE

C 8.01 General

Unless otherwise authorized by the Engineer, concrete shall be machine mixed.

The mixing of concrete or mortar shall not be permitted when the temperature is above 40 C or when the temperature is below 5 C.

C 8.02 Mixing on Site

Concrete shall be thoroughly mixed in a batch mixer conforming to the requirements of B.S. 1305 Batch type concrete mixers which will ensure a uniform distribution of the materials throughout the mass.

The mixer shall be equipped with adequate storage and a device for accurately measuring and automatically controlling the amount of water used on each batch. Pre – ferably mechanical means shall be provided for recording the number of revolutions for each batch and automatically preventing the discharge of the mixer until the materials have been mixed within the specified minimum time.

The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein.

All concrete shall be mixed for a period of not less than 1 ½ minutes after all materials, including water, are in the mixer. During the period of the mixing the mixer shall operate at the speed for which it has been designed, but this speed shall be not less than 14 nor more than 20 revolutions per minute.

The first batch of concrete material placed in the mixer shall contain sufficient excess of cement, sand and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon the cessation of mixing for a considerable period, the mixer shall be thoroughly cleaned.

C 8.03 Truck Mixing

Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, watertight, and so constructed that the concrete can be mixed to ensure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured in accordance with Section C.7 and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a tank for carrying mixing water. Only the prescribed amount of water shall be placed in the tank unless the tank id equipped with a device by which the quantity of water added can be readily verified. Truck mixers may be required to be provided with means by which the mixing time can be readily verified by the Engineer.

The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing shall be continued for not less than 50 revolutions after all ingredients including the water, are in the drum. The speed shall not be less than 4 r.p.m., nor more than a speed resulting in a peripheral velocity of the drum of 70 meters per minute.

Nor more than 100 revolutions of mixing shall be at speed in excess of 6 r.p.m. Mixing shall begin within 30 minutes after the cement has been added either to the water or aggregate. When cement is charged into a mixer drum containing water or surface-wet aggregate and when the temperature is above (33 C) is used this limit shall be reduced to 1245 minutes; the limitation on time between the introduction of the cement to the aggregates and the beginning of the mixing may be waived when, in the judgement of the Engineer, the aggregates are sufficiently free from moisture, so that there will be no harmful effects on the cement.

C 8.04 Partial mixing at the Central Plant

When a truck mixer provided with adequate mixing blades is used for transpiration, the mixing time at the mixing plant may be reduced to 30 seconds and the mixing completed in the truck mixer. The mixing time in the truck mixer shall be as specified under the Section C.8.3 for truck mixing.

C 8.05 Plant Mix

Mixing at a central plant shall conform to the requirements for mixing at the Site and shall conform to the applicable requirements of the Standard Specification for Ready-Mixed Concrete of ASTM Designation: C-94.

C 8.06 Time of Hauling and Placing Concrete

If the distance from the mixing plant to the construction Site is so great that between the time of mixing and pouring the concrete, the temperature is below 40 C and the travelling time is more than 30 minutes, truck mixers must be employed.

When truck mixers are used, concrete shall be discharged and placed in its final position in the forms within thirty (30) minutes after water is first added to the mix.

C 8.07 Delivery

The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The methods of delivering and handling the concrete shall be such as will facilitate placing with the minimum of rehandling and without damage to the structure of the concrete.

C 8.08 Retempering

The concrete shall be mixed only in such quantities as are required for immediate use and any concrete which has developed initial setting shall not be used. Concrete which has partially hardened shall not be retempered or remixed.

C 9 HANDLING AND PLACING CONCRETE

C 9.01 General

Prior to pouring concrete in any structure, the Contractor shall secure a written order to commence from the Engineer. In preparation for the placing of concrete all sawdust, chips, and other construction debris and extraneous matters shall be removed from the interior of forms, structs, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the firms and not buried in the concrete. Con-
Crete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall not be permitted unless the authorization in writing of the Engineer is obtained. In case an interior quality of concrete is produced by the use of such conveyers, the Engineer may order discontinuance of their use and the substitution of a satisfactory method of placing. Open troughs and chutes shall be of metal lined and shall be of rounded cross section to avoid the accumulation of concrete in corners. The chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. The slope shall be steep enough (1 vertical to 2 or 2 ½ horizontal) to permit flow requiring a slump greater than specified or required for placement.

All chutes, troughs and pipes shall be kept clean and free from coating of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure. When placing operations would involve dropping the concrete more than 1.50 meter, It shall be deposited through sheet metal or other approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. After initial setting of concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcement bars which project.

C 9.02 Hot Weather Concreting

The temperature of concrete when placed shall not exceed 27°c. When the relative humidity is 50 percent or less and shall not exceed 32 °C. For values of relative humidity between 50 percent and 70 percent, the max temperature of concrete shall be found by interpolation.

In lieu of above, the temperature of concrete when placed shall not exceed 32 °C, regardless of the relative humidity.

The Contractor shall comply with the above requirements by the following procedures:-

- Cooling the mixing water and/or replacing 50% of the mixing water by crushed ice. When crushed ice is used it shall be stored at a temperature that will prevent formation of lumps. The ice shall be completely melted by the time mixing is completed.

- Shading aggregate stockpiles and/or keeping moist by sprinkling then with water.

- Cement shall not be used if its temperature exceeds 77 °C.

- Painting the mixer drum white and spraying it with cool water or shading the mixer from direct sunrays.

- Maintaining the mixing time and delivery time to the minimum acceptable.

- Sprinkling of forms sub-grade and reinforcement with cool water prior to placement of concrete.

Water reducing and retarding admixture shall be used in all concrete work when the temperature of concrete exceeds 27 °C The water cement ratio inclusive of free surface moisture on aggregates and any admixtures shall be kept to a minimum.

C 9.03 Vibrating Concrete

Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject to the following provisions:

- Vibration shall be internal unless special authorization of other methods is given by the Engineer or as provided herein.

- Vibration shall be of a type and design approved by the Engineer. They shall be capable of transmitting vibration to the concrete at frequencies of not less than 4500 impulses per minute.

- The intensity of vibration shall be such as to visibly affect mass concrete of 25mm slump.

- Contractor shall provide a sufficient number of the vibrators to properly compact each batch immediately after it is placed in the forms.

- Vibration shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures, and into the corners and angles of the forms.

- Vibration shall be applied only by experienced operators under close supervision, at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any point to the extent that localized areas of grout are formed.

- Application of vibration shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.

- Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibrations. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.

- Vibrator shall be supplement by such spading as it necessary to ensure smooth surface and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

- The use of implements such as compressors which are likely to disturb or disarrange reinforcement or formwork shall not be permitted.

Concrete shall be placed in horizontal layers not more than 300mm thick as hereinafter provided. When less than q complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the batches. Each layer shall be compacted so as to avoid the formation of a construction joint with preceding layer which has taken initial set.

When the placing of concrete is temporarily discontinued, the concrete after be coming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid visible points as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smoothed with a trowel.

Immediately following an approved discontinuance of placing concrete all accumulations of mortar splashed upon the reinforcement bars and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete steel bond at and near the surface of the concrete while cleaning the reinforcement bars.

C 10 **PRECAST HOLLOW CONCRETE BLOCKS [HOURDIS]FOR RIBBED SLABS:**

C 10.01 Material and Manufacture

Aggregate shall be so sized, graded, proportioned and thoroughly mixed in a batch with such proportions of cement and clean water as to produce a homogeneous concrete mixture. However, in no case shall the proportion of cement in the mixture be less than five (5) standard [each weighing 50 Kgs] per cubic meter of concrete.

Precast hollow concrete blocks (hourdis) for a ribbed slab shall be manufactured in approved vibrated, machine. If for any reason the strength requirements is not achieved,

Cement shall be increased at the Contractor's own expense. The blocks shall be cured for twelve (12) consecutive days and shall be at least twenty-one (21) days old before incorporation in the Works. The blocks shall be of an approved pattern of withstanding a compressive force applied at the ends of 30 kgs/cm2 based on the gross sectional area of the block obtained without deducting voids.

The blocks shall be hard, sound, durable, sharp, clean with well defined arises, free from cracks and flaws or other defects and of the dimensions shown on the Structural Drawings. The blocks shall be obtained from an approved local factory.

C 10.02 Workmanship

Precast hollow concrete blocks (hourdis) shall be laid exactly in a line with the cells on the long dimensions. Close edge blocks shall be used at the end; the dimensions of the ribs and size of reinforcing bards shall be exactly according to the Structural Drawings, In narrow width specially made half blocks shall be used and full block shall not be used along their length (with the calls along the long dimensions of the rib.)

The blocks are to be laid on adequate forms. All blocks shall be cleaned and thoroughly wetted with clean water before the concrete is poured and labourers shall not be allowed to walk on them, Any block found to be defective or damaged during concreting operations shall be removed and replaced before pouring the concrete, all at the Contractor's expense.

C 11 **FORMWORK**

General

The Contractor shall be responsible for the design and stability of the formwork. The Contractor shall submit a full program of work indicating the various phases for the erection and removal of forms and the manner in which he intends to execute all concrete works.

C 11.02 Material

All forms shall be of wrought lumber and shall be built mortar tight and of sufficient, rigidity to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The Contractor shall take into consideration the effect of vibration on the formwork, and shall be responsible for any damage or default resulting thereof.

C 11.03 Workmanship

Forms shall be inspected by the Engineer prior to installation of reinforcement

The number of spacing of the form struts and braces shall be such that the forms will be braced rigidly and uniformly lock joints between form sections shall be free from play or movement.

The shape, strength rigidity, watertightness and surface smoothness of re-used forms shall be maintained at all times. Any warped or bulged lumber must be resized before being re-used. Forms which are unsatisfactory in any respect shall not be re-used.

Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 40mm from the face within injury to the concrete. In case ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least 10mm. From the face of the concrete with chisels or nippers for green concrete, nippers are necessary. All fittings for metal ties shall be of such design that the cavities produced upon their removal are the smallest possible. The cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in colour.

All forms shall be treated with oil and saturated with water immediately before placing the concrete. For members with exposed faces, the forms shall be treated with approval oil to prevent the adherence of concrete.

Any material which will adhere to or discolour the concrete shall not be used.

The Contractor shall provide means for accurately measuring the settlement of the forms during placement of the concrete and shall make all necessary corrections as directed by the Engineer

C 11.04 Removal of Form-work

In the determining of the time for removal of forms, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete and the materials used in the mix. In general, the forms of any positions of the structure shall not be removed until the concrete is strong enough to prevent injury to the concrete.

When the forms are removed. Unless otherwise directed by the Engineer forms shall remain in place for the following specified period of time:

- Centering under beams : 21 days
- Floor slabs : 21 days
- Walls , sides of beams and other vertically formed surfaces : 3 days

Method of form removal likely to cause overstressing of the concrete shall not be used. In general, the forms shall be removed from the bottom upwards. Forms and their supports shall not be removed without the written approval of the Engineer. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight. Centers shall be gradually and uniformly lowered in such a manner as to avoid injurious stresses in any part of the structure.

The Contractor shall include in his prices for any formwork which may have to be left in position due to the impossibility of removal of same.

C 12 **REINFORCEMENT**

C 12.01 General

The Contractor shall prepare for his own use bar bending Schedules from the information given on the Drawings and in these Specifications. These Schedules shall be submitted to the Engineer for approval which shall in no way release the Contractor of his responsibility for the correctness of these Schedules.

All reinforcement shall be placed strictly in accordance with the Drawings and as instructed in writing by the Engineer. Nothing shall be allowed to interfere with the required disposition of the reinforcement, and the Contractor shall ensure that all parts of reinforcement are placed correctly in position and are temporarily fixed where necessary to prevent displacement before or during the process of tamping and ramming the concrete in place. The ties, links or stirrups connecting the bars shall be taut so that the bars are properly braced the inside of their curved part small be in actual contact with the bars, around which they are intended to fit.

Placed correctly in position and are temporarily fixed where necessary to prevent displacement before or during the process of tamping and ramming the concrete in place. The ties, links or stirrups connecting the bars shall be taut so that the bars are properly braced the inside of their curved part small be in actual contact with the bars, around which they are intended to fit.

C 12.02 Type and Quality of Steel Reinforcement

A - Hot-Rolled Steel Plain Rods and Bars

Hot rolled steel plain rods and bars shall conform to the strength requirements and minimum elongation of the Standard Specification for Deformed Billet-Steel Bars of Grade 40 with minimum yield strength 2400Kg/cms (35000 psi) for concrete Reinforcement of ASTM Designation (A-615) or equivalent.

B - Deformed Steel Rod and Bars

Deformed steel and bars shall conform to the requirements of the Standard Specification for Deformed Billet-Steel Bars of grade 60 with minimum yield strength 4200 kg/cm2 (60000 psi) for concrete reinforcement of ASTM Designation (A-615) or equivalent.

C 12.03 W i r e

Wire for bending reinforcement bars shall be of soft black annealed mild steel wire. The diameter of the Wire shall not be less that 16 S.W.G. (1.6mm) and the binding shall be twisted tight with proper pliers. The free ends of the binding wire shall be bent inwards.

C 12.04 Order Lists

Before ordering material, all order lists and bending diagrams detailed in accordance with the latest revision of AGI Building Code shall be furnished by the Contractor for the approval of the Engineer, and no material shall be ordered until such lists and steel bending diagrams have been approved. The approval of order lists and bending diagrams by the Engineer shall in no way relieve the Contractor of his responsibility for the correctness of such lists and diagrams. Any expenses incurred to the revision of material furnished in accordance with such lists and diagrams to make and comply with the design drawings including cut and waste shall be borne by the Contractor.

C 12.05 Protection of Material

Steel reinforcement shall be protected at all times from injury. When placed in the work, it shall be free from dirt, detrimental scale, paint, oil, loose, rust, grease or other foreign substances.

C 12.06 Fabrication

Bar reinforcement shall be bent to the shapes shown on the Drawings and Steel Bending (Diagrams), Bending dimensions and scheduling of bars for the reinforcement of concrete. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be bent except as shown on the plans or specifically permitted by the Engineer.

C 12.07 Placing and Fastening

All steel reinforcement shall be accurately placed in the position shown on the Drawings and firmly held during the placing and setting of concrete. Bars shall be tied at all intersections except where spacing 300mm in each direction, in which case alternate intersections shall be tied.

Distance from the forms shall be maintained by means of stays, blocks ties, hangers, or other approved supports. Blocks for holding reinforcement from contract with the forms shall be precast mortar blocks of approved shapes and dimensions or approved metal chairs. Metal chairs which are in contact with the exterior surface of the concrete shall be galvanized. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks shall not be permitted. Reinforcement in any member shall be placed and then inspected and approved by the Engineer before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and its removal is required.

C 12.08 Splicing

All reinforcement shall be furnished in the full lengths indicated on the Drawings. Splicing bars, except where shown on the drawing, will not be permitted without the written approval of the Engineer, Splices shall be staggered as far as possible.

Additional splices, other than those shown on the Drawings; and allowed by the Engineer, shall be at the Contractor’s own expense.

The cost of all supports for holding reinforcement bars shall be borne by the Contractor.

C 13 **CURING** AND **PROTECTION**

C 13.01 Water Curing

All concrete shall be cured for a period of time required to obtain the full-specified strength but not less than seven (7) consecutive days. Unformed surfaces shall be covered with sand burlap, or other approved fabric mats kept continually wet. If the forms are removed before the end of the curing period, curing shall be continued as on the uniformed surfaces. When burlap, sand or other approved fabric materials are used, they shall not cause any undesirable finish such as rough surface and discolouring where exposed to light. Unhardened concrete shall be protected from heavy rains or flowing mechanical injury and the Contractor shall submit for the Engineer's approval his construction procedure which is designed to avoid such an eventually. No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. Water for curing shall conform to Section C 3.6.

C 13.02 Curing with Curing Media

Curing medium shall meet all requirements of the specifications for Liquid Membrane-Forming Compounds for Curing Concrete of ASTM Designation: C-309 and test for water retention by concrete curing materials of ASTM Designation: C-156.

The compound shall be applied to the concrete surface by means of a sprayer, roller or lamb's wool applicator and shall be sprayed on. Ample time be allowed for the concrete surface to harden and to prevent any damage. The compound shall give a drying time not to exceed thirty minutes, and shall be applied undiluted directly from the manufacturer's labelled container in accordance with the manufacturer's directions and to the satisfaction of the Engineer.

The compound shall be completely compatible with adhesives, joint sealants and cement grout.

C 13.03 Payment

No separate payment shall be made for curing with water or with curing media. The cost of such curing shall be deemed to be included in the Unit Prices of "CONCRETE WORK".

C 14 CONCRETE [FAIR FACE] EXPOSED SURFACES

C 14.01 Formwork

Formwork for exposed concrete surface shall conform to the applicable requirements of Section C 14, in addition to those Specifications.

All concrete surfaces that are to be left exposed to view as a finished surface except for precast concrete units, shall be produced by vertical metal shuttering

The quantity of the surface of concrete exposed to view shall be consistent throughout the Project and the following methods shall be adopted to obtain the required finish.

- Metal forms of an approved type for precast units

The Contractor may submit alternative proposals for the Engineer's approval if he so desires.

The Contractor is to submit to the Engineer for his approval shuttering details and sequence of operation relating to fair face concrete work. Sample panels shall be constructed for all their face concrete finishes and following the Engineer's approval the panels will remain on site and constitute a standard which must be maintained throughout the duration of the Contract.

C 14.02 Coating Forms with Mineral Oil

In addition to the above forms or linings, the forms shall be coated before placing reinforcement with an approved colourless mineral oil free of kerosene.

All surplus oil on form surfaces and any oil on reinforcing steel shall be removed.

c 14.03 Samples and Workmanship

The Contractor shall submit for approval a sample panel not less than 600x1200mm to demonstrate the quantity of the exposed concrete produced by forms at his own expense.

The quantity of the finished work shall be measured against the quality of the approved sample panel and the work of inferior quality shall be repaired or replaced as directed by the Engineer without any additional cost.

c 14.03 Samples and Workmanship (Cont'd)

The quality of the finished surfaces shall be uniform in colour and consistency, whether in colour or in texture, in any of the finished surfaces, the Engineer may order the repair or the demolition of the portion of concrete work and the reconstruction of same at the expense of the Contractor and the Contractor shall have no right to claim for any expenses or time delay incurred.

Alternatively the Engineer may order the Contractor to plaster all exposed surfaces and bush-hammer the entire area of, concrete in the Project so as to render all exposed surfaces of concrete consistent throughout the Project at the Contractor's own expense

C 15 MONOLITHIC SMOOTH FINISH SURFACES

All concrete surfaces which are not in acceptance condition and which are required to be surface-finished as designated herein, shall be rubbed to a smooth and uniform texture with a carborundum brick and clear water as soon as the forms are removed and the concrete is ready to hone. The loose material formed on the surface shall be removed as soon as it dries by rubbing the surface with burlap or other approval material. A cement wash shall not be used.

Concrete surface shall be free from honeycombing, air holes, fins and projections arising from defective mixings, placing or formwork. When the formwork has been stuck off, the surface of concrete shall be left untouched until inspected by the Engineer. Any defective concrete work shall at the discretion of the Engineer be demolished completely and rebuilt or cut out and made good with concrete of the same proportions as the original. Such rectifications shall be to the satisfaction of the Engineer and at the Contractor's own expense.

I N D E X

SECTION D - BLOCKWORK

SECTION D

B L O C K W O R K

D 1 **SCOPE**

These Specifications cover the supply if materials, manufacturer and workmanship of concrete blocks intended to be used for the construction of blockwalling, partitions, facings, claustras, etc., required for the Project in accordance with the Drawings, Bills of Quantities and as directed in writing by the Engineer.

D 2 **MATERIALS**

D 2.01 Cement

Cement for solid or hollow blocks and mortar shall be ordinary Portland Cement ASTM Designation C 150-74 and white cement ASTM: c 91-71 .

D 2.02 Aggregates

Aggregate or solid and hollow concrete blocks and mortar shall conform to the requirements for the aggregates in the "CONCRETE WORK" Section.

D 2.03 Water

Water to be used in blockwork shall conform to the requirements specified for water in the "CONCRETE WORK" Section.

D 2.04 Lime

Lime shall be non-hydraulic lime complying in all respects with B.S. 8980, and shall be prepared in accordance with the appropriate requirements of British Standard Code of Practice 121: Part 1: 1973, latest revision.

The Contractor must satisfy himself by analysis or otherwise that the ground lime is not adulterated or air-slaked.

Factory produced, dry hydrated, non-hydraulic or semi-hydraulic lime, ready for use, shall be mixed with sand and made into coarse mix or be soaked to putty by mixing with water and allowing to stand not less than (16) sixteen hours before use.

The lump or ground non-hydraulic or quicklime shall be slaked, run to putty and matured for not less than two (2) weeks.

D 3 **MANUFACTURE OF CONCRETE BLOCKS**

Aggregate shall be so sized, graded, proportioned and thoroughly mixed in a batch mixer with such proportions of cement and water as to produce homogeneous concrete mixture. However, in no case shall the proportion of cement in the mixture be less than five (5) standard bags (each weighing 50 kgs) per cubic meter of concrete.

Precast concrete blocks shall be manufactured in approved vibrated machines. If for any reason the strength requirements is not achieved, the cement shall be increased at the Contractor's own expense. The water used in the mix shall be clean and of a sufficient quantity to allow complete hydration of the cement without providing an excess when moulding.

Concrete blocks shall be hard, sound, durable, sharp, rect- angular shape, clean with well define arises free from racks and flaws or other defects.

Concrete blocks shall be either obtained from an approved local factory or manufactured on the Site. If manufactured on Site, the blocks shall be pressmoulded in approved moulds and vibrating presswire machines with a minimum of 2800 cycles per minute.

Blocks manufactured on the Site shall be cured in the shade by being kept thoroughly moist with water applied by sprinklers or other approved means for a period of at least seven (7) days. The blocks shall be stocked on a clean and level platform free from earth or other impurities during the curing process, and shall be stocked in honeycomb fashion after curing. The blocks shall not be used prior to one (1) month after the date of manufacture, not shall any block be used that have not been inspected and approved by the Engineer.

Concrete blocks (solid or hollow) shall be of the following dimensions:

Height	=	200 mm	+ 1 % Tolerance
Length	=	400 mm	+ 1 % do .
Width	=	As required	+ do .

The nominal width of blocks shall be as indicated on the Drawings and as directed in writing by the Engineer.

Hollow concrete blocks shall comply with the following requirements:

Compressive strength at Twenty-Eight (28) Days over Cross- Sectional Area: -

a) Load-Bearing Walls
60 kgs/cm2 average of 12 blocks
50 kgs/cm2 minimum for any block

b) Non-Load-Bearing Walls

30 kgs/cm2 average if 12 blocks
25 kgs/cm2 minimum for any block

Water Absorption
20 % or less of dry weight

The design of the cavities and webs of the hollow concrete blocks shall be submitted to the Engineer prior to manufacture. The thickness of the face shell and of the membrane of solid portions shall be nowhere less than forty (40). The combined thickness of the solid portions shall be not less than one fourth (1/4) of the width and length of the block respectively.

D 4 **MORTAR**

Mortar shall be prepared in the following proportions with the addition of the minimum quantity of clean water for workability.

Cement and sand mortar (1:3) shall be composed of one part cement to three parts of sand by volume.

Hydrated lime up to 1/4(one quarter) by volume of the dry cement may be added for bedding blocks, upon the approval of the Engineer, to improve workability without appreciably reducing the strength.

The ingredients for cement and sand shall be measured in proper clean gauge boxes and the mixing shall be carried out by means of an approved mechanical batch mixer.

In the cast of cement-lime mortar, the sand and lime shall be mixed first and the cement added. It shall be assumed that the lime has not increased the bulk of the sand.

Cement mortars shall be used within thirty

D 5 **WORKMANSHIP**

All blockwork shall be set out built to the respective dimensions, thickness and heights shown on the Drawings and/or instructed in writing by the Engineer.

All walls and partitions, where shown on the Drawings without indicating the type of the block to be used, shall be built in hollow concrete blocks, unless otherwise directed in writing by the Engineer.

The blocks shall be well soaked before being used and the tops of walls left off shall be wetted before work is recommenced. All blocks shall be well buttered with mortar before being laid and all joints shall be in uniform manner and shall not exceed 10mm, no one portion being raised more than 1.00m above another at one time, and wall of partition necessarily left at different levels, must be racked back. All perpends, quoins, internal and external angles, etc. properly bonded together and levelled round. All blockwork shall be plumbed vertically.

The surface of the walls and partitions prepared for plastering, shall have the joints raked out 20mm from the face of the wall to form key for the plaster.

All blockwalls shall be bonded to reinforced concrete columns by means of wall ties, complying in all respects with B.S. 1243 latest edition. The ties shall be minimum 200mm long of which 100mm shall be embedded in the re-d concrete column and the remainder set into the block wall at the rate of two (2) ties per meter. Partitions shall be bonded to main wall by toothing at every fourth course into main wall to a depth of not less than 100mm.inforce

All walls and partitions shall be properly cured by sprinkling water for a period not less than three (3) days after completion of laying the course.

Walls and partitions terminating against soffits of beams or slabs shall be lightly wedged with metal wedges after mortar in bed joints has attained its initial set, and the joint packed with mortar.

Cut and fit blockwork next to reinforced concrete door, window, jambs and sills, and form chases for the ends of the door and window lintels. No hollow blocks shall abut any built-in fixtures e.g. door and window frames, apertures, louvers, etc. .

The cavity between skins of blockwork shall be 100mm (nominal) wide and kept clear of mortar dropping throughout the construction of the hollow walls. The skins of hollow walls are to be tied together with butterfly twist type galvanized steel wire to the approval of the Engineer and built into each skin one meter apart horizontally and every alternate course, staggered.

2. Electromechanical Works

2.1 Completeness of the Contract

2.1.1 The Contractor shall be responsible for executing all required works included in this Contract and any other works deem necessary to have and guarantee the Power Substation working the proper way to the highiest international standards of operation.

2.1.1 The Contractor shall pay all attention to perform the required works in this Contract and to properly integrate them to the existing facilities in the Substation in such a way that the whole Substation is functioning and operating smoothly in a an efficient, reliable, healthy mode, and safe conditions.

2.1.2 The Contractor may need to coordinate with or consult the Former Contractors who had implemented earlier similar stages of the Substation if he find this helpful to carry-out his obligations, e.g. ABB AB SUBSTATIONS / SWEDEN & EGEMAC / EGYPT. The addresses of those Contractors may be requested from the Client / Owner (UNDP-PAPP / PENRA).

2.2 Drawings and Documentation

2.2.1 The Contractor shall prepare and submit to the supervision team for approval comprehensive dimensioned general and detailed drawings and other pertinent information of all the required Works.

2.2.2 Approval of drawings shall not relieve the Contractor of his obligations to complete building the Substation in accordance with the Specifications.

2.2.3 The Contractor shall be responsible to do all Engineering and Design Works for the Additional Transformer Bay Extension (DT 1), and he shall enclose in his Bid, overall drawings showing dimensions, main working principles, internal components, fixing methods and circuit diagrams details and wiring layout to a detail level allowing the Client / Employer to evaluate the functionality and completeness of facilities and works.

2.2.4 The Contractor shall be responsible to update the Existing Substation Control System (SCS) Software, (ABB Design), to include the Transformer Bay Extension (DT 1), mentioned in item (1.2.3) above.

2.2.5 Moreover, at the end of work execution, the Contractor shall be responsible to submit to the Client / Owner, a complete set of as-built drawings and documentations for the executed works integrated to those of the existing facilities to produce a final comprehensive set of as-

built drawings and documentations for the entire Substation at its final stage , i.e. including the works of this Contract, It may be helpful to the Contractor to coordinate and consult with the Former Designer of the Substation (ABB AB Substations / Sweden) to efficiently perform this requirement.

2.3 Erection & Mounting of Electrical Apparatus, Equipment, Switchgear and Power Transformers

2.3.1 Power transformers shall be placed on concrete foundations (as detailed in Civil Works Specifications and Drawings).

2.3.2 Other Electrical Apparatus, Equipment, and Switchgear shall be fixed on their special steel structures mounted on concrete foundations.

2.4 Training

- Training should be provided to the Power Substation staff on the day to day use of the equipment and all maintenance requirements that will not be undertaken by the supplier. The training should be comprehensive enough to allow the Power Substation staff to be fully conversant with the working of all the equipment to a reasonable competence.

- The Contractor shall provide his Training Proposal (activities & time-period) to efficiently carry out the above training program for both the on-job training at site and at the Supplier home-country.

- The training shall include , at minimum the following topics:

2.4.1 Substation Operation, Protection, Control and Commissioning :

- Commissioning of H.V. & M.V. Electrical Switchgear and Equipment & Electro-mechanical Auxiliary Systems and Overall Commissioning of the Substation.
- Operational Switching Procedure for Power Transformers Breakers, Disconnectors and all other related H.V. & M.V. Switchgear.
- Optimization of Operation & Performance, Protection and Control of Parallel Connected Power Transformers and Connection Conditions & Precautions.

2.4.2 Substation Maintenance:

- Inspection, Troubleshooting and Fault Clearing, of Switchgear and Overall Substation.

2.5 Work Plan & Commissioning

2.5.1 A full work plan should be provided by the supplier in response to this ITB. The work plan should include all key milestones from the date of PO acceptance by the Contractor to installation and final acceptance certification by UNDP.

2.5.2 All equipment is to be installed and commissioned by qualified personnel provided by the supplier in Gaza. Acceptance testing of all installed equipment should be undertaken and certified as acceptable to UNDP before final payment shall be made.