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Jericho Agro-Industrial Park (JAIP)

Structural Works

Technical Specifications

March, 2015

SECTION- I

STRUCTURAL WORKS

SECTION 1 – GENERAL

To be read in conjunction with Preliminaries, General Conditions and General Specification Section.

101 Scope of Works

The items contained in the scope of works are indicative only. The Contractor is entirely responsible for ascertaining the precise extent of works described in the scope of works in arriving at his price for each item. All costs in connection with renovation and repair works must reflect all work deemed necessary by and to the complete satisfaction of the Engineer to restore building structure, fabric and finishing to their original installed condition or better.

The Work comprises the Construction, Completion, Maintenance and Handing over of the project **RFQ-202-2014, (Wastewater Pumping Station with Force Main & Deep Water well with Desalination Unit)**:

102A. Attendance and Facilities to the Nominated and Client's Sub-Contractors

The Contractor shall provide all related attendance to the nominated and Client's Sub-Contractor(s), co-ordinate the various works, and provide facilities as described under the pricing preambles of the provisional sums:-

- A. The Contractor shall provide to the nominated and Client's sub-contractors the following but not limited to:-
 - a) Reasonable site offices and facilities depending on the nature and volume of their Works. The Contractor shall provide assistance for obtaining telephone and facsimile connections. However all connection and running charges for the telephone and facsimiles shall be borne by the nominated sub-contractors.
 - b) Sufficient storage sheds for storing their equipment to be positioned or work to be performed.
 - c) Water & electricity required for the performance including for testing and commissioning of their works.
 - d) Lifting including loading and unloading of all heavy equipment.
 - e) Sharing, site crane, hoists, etc., to lift personnel and equipment that can be handled by them.
 - f) Other attendance, facilities...etc. as described in the pricing preambles of Provisional Sums.
 - g) Lifting of all heavy equipment on roof, terraces, etc.

- h) All scaffolding required by the Sub-Contractors.
 - j) Provision of pit ladder to all lift and other pits.
 - k) Protection of all completed works.
 - l) Others as specified in the preambles of Provisional sums.
- B. Builder's works to be carried out by the Main contractor for the nominated sub-contractors are described in the pricing preambles of the relevant trades and provisional sums. However this is not to be considered as exhaustive and the Contractor shall provide all builders' works that are generally provided and needed for the completion of the Works.
- C. All the above requirements shall be included by the Contractor in his prices while pricing the same in the provisional sums.

103 Abbreviations of Standards

The following abbreviations have been used for the Standards applicable to the Works under the Contract.

BS	- British Standards
CP	- Code of Practice
ASTM	- American Society for Testing and Materials.
ACI	- American Concrete Institute.
ISO	- International Organization for Standardization.
ANSI	- American National Standards Institute.
AASHTO	- American Association of State Highways & Transportation Officials.
DIN	- Deutsches Institut für Normung.
BSEN	- European Standards - Adopted as British Standards.
EN	- Euronorms Harmonized Standard.
UL	- Underwriters Laboratories Inc.
IEC	- International Electrotechnical Commission.
CENELEC	- Committee European de Normalisation Electrotechnique.

Referenced Standards shall form part of the Contract Documents and shall have the same force and effect as if bound with this specification.

104 Proprietary Named Items

Proprietary named items included within this Project Specification are a guide to the quality of such items. The Contractor shall be permitted to offer other proprietary materials which are similar and approved. However, the contractor shall be deemed to have priced for the items as named and not for any alternative that may be submitted later.

105 Standards

The works have been designed to incorporate and utilize economically, goods, materials and workmanship to various specifications which are detailed herein. Reference is commonly made to British Standards (BS) and British Standard Codes of Practice (CP) and to the American Society for Testing and Materials Standards (ASTM). Different National or International Standards ISO, DIN, etc., that correspond to the specified BS or ASTM Standard may be used provided that their requirements are not less stringent, and provided that the Contractor presents copies of such Standards translated into English. If any redesign of the Works is necessitated by the adoption of such alternatives the costs incurred shall be borne by the Contractor.

Except where specifically indicated otherwise all references shall be deemed to refer to the current standards (the latest edition or issue) as of the date of the signing of the Contract.

106 Units of Measurement and Abbreviations

All units of weight and measurement shall be based on the Metric system of Weights and Measurements except standard products which may be expressed in nominal units of the Imperial System.

The metric terms and symbols occurring in the Contract Documents are based on the "System International d'Unites (S1 System)".

<u>Abbreviation</u>	<u>Description</u>	<u>Abbreviation</u>	<u>Description</u>
m	Linear Metre	mm	Millimetre
m2	Square Metre	cm	Centimetre
m3	Cubic Metre	No	Number
Kg	Kilogram	C	Celsius
Tonne	1000 Kilogram	LS	Lump Sum

107 Definitions

Wherever in the Contract Documents, or on the Drawings, the words "as directed", "as Described", "as ordered", "as requested", "as required", "as permitted", or words of like import are used, it shall be understood that the direction, description, order, request, requirements or permission of the Engineer is intended. Similarly, the words "approved", "acceptable", "satisfactory" and words of like import shall mean approved by, acceptable to, or satisfactory to the Engineer.

108 Bill of Quantities

The Contractor shall price each individual item in Bill of Quantities. Rates shall be deemed to include plant, labour, materials, allowance for wastage, transportation and overheads and profit. Rates shall also be used in the evaluation(s) on site as appropriate.

109 Site Visit

The Contractor is to visit the site before completing his Tender in order to acquaint himself fully with the project, prevailing conditions, site access and availability. No claim for extensions of time or additional costs shall be entertained due to the Contractor's lack of c

110 No Objection Certificates" (NOCs)

Copies of "No Objection Certificates" (NOCs) received from Authorities shall be handed over to the Engineer. The contractor shall carryout necessary exploratory works and investigations to obtain sufficient information as required.

The cost of locating or verifying the location of existing services, maintaining, protecting from damage during construction and liaison with the various Service Authorities and complying with their dictates shall be borne by the Contractor unless provided for elsewhere. This is applicable to those services that are visible on site and shown on drawings and NOCs.

Any re-routing required shall be carried out by the contractor in co-ordination with the concerned authorities and as directed by the Engineer.

111 Locating, Protecting, Maintaining and Diverting Services and Public Utilities

The Contractor shall ascertain the whereabouts of all existing services and public utilities such as electrical cables, telephone lines, sewers, water supply lines, gas lines, pipes, wires, fences, etc., on the site, both above and below ground. Service and other utilities may exist in certain locations not indicated on drawings. Completeness or accuracy of information given on the drawings is not guaranteed. It is the responsibility of the Contractor to ascertain their whereabouts from the concerned authorities before commencing any works on site. The Contractor shall also obtain any re-routeing requirements from the concerned authorities and shall be responsible to carry out such works accordingly to the satisfaction of the authorities and the Engineer.

Where diversions of services are not required in connection with the permanent works, the Contractor shall project, uphold, maintain and keep the same in working order in their existing locations and shall restore them to their original condition on completion to the satisfaction of the Engineer.

The Contractor shall make good, at his own expense, all damage caused to any of the services and public utilities by him or his sub-contractors, except where the Public Authority or Private Party Owning the same, elects to make good the damage under their own arrangements. The cost incurred in making good the damages by the Public Authority or Private Party shall be paid to them by the Contractor on demand.

All costs in connection with the above works shall be borne by the Contractor without any extra cost to the Client.

The Client shall not be liable for any loss or injury in connection with any of the above works.

113 Water for the Works

The Contractor shall provide all necessary water for the works including that required for testing and commissioning of the works including those of the sub-contractors and nominated sub-contractors, irrespective of availability of main supply. The Contractor shall provide all temporary plumbing and storage, pay all charges, and alter, adapt and maintain temporary works as necessary and remove and make good on completion.

114 Temporary Power and Lighting for the Works

The Contractor shall provide all necessary artificial lighting and power for the execution, security of the works, protection and for the purposes of testing and commissioning of the works, including those of the sub-contractors and nominated sub-contractors, irrespective of availability of main supply, with all meters, temporary wiring and fittings, etc., pay all charges, and alter, adapt and maintain the temporary work as necessary and remove and make good at completion.

115 Safeguard of Life and Health

The Contractor shall take and apply all necessary measures for the safeguard of the life and health of his workers, including the provision and maintenance of adequate First Aid Facilities throughout the Contract Period.

116 Safety and Security

It will be the sole responsibility of the Contractor to provide full and continued security and safety for the site including all site facilities until the substantial completion certificate is issued and all the works are completed and the Contractor has demobilized.

The Contractor shall allow for complying with any current security regulations and requirements which may be applicable to the site. The Contractor will be deemed to have acquainted himself thoroughly with all security regulations that may be in force at the time of submission of tender and to have allowed in his tender for their effect upon his operations with regard to the supply of labour and materials, access to site and project execution generally. No claim will be entertained for the Contractor's lack of knowledge of security regulations. The Contractor shall ensure that his workforce and staff on site adhere strictly to cultural restrictions.

The cost of any delay resulting from the security requirements and regulations will be deemed to be included in the tender price.

Safety practice shall comply with the requirement the local/governing Municipality/Authorities.

- a) Safety helmets
- b) Safety shoes
- c) Protective eye glass
- d) Ear muffs

Contractor shall liaise with the Engineer and shall observe and ensure that all their personnel observe, all relevant security procedures particularly those applicable to performing works in an ongoing operating environment

Laboratories used to perform test shall be approved by the Engineer.

The Engineer reserves the right to utilize the Contractor's control testing laboratory and equipment to make spot tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Employer.

119 Scaffolding

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

Scaffolding shall be a complete system from a manufacturer approved by the Engineer. The Contractor shall provide shop drawings and design calculations to prove the sufficiency of the proposed system for the intended applications for the approval of the Engineer as and when called for to do so. However approval accorded by the Engineer shall not absolve the Contractor of any of his responsibilities or obligations.

120 Method Statement

The Contractor shall compile and submit a detailed schedule of method statements that are to be furnished by him and his sub-contractors including nominated sub-contractors in fulfillment of his responsibilities as specified and required to complete the project for the approval of the Engineer. Any modifications/comments of the Engineer shall be incorporated and resubmitted for approval. The Engineer however shall have the right to request for method statements for non listed items, if required, in the interest of this project and the Contractor shall provide the same.

121 Keeping Site Free From Rubbish

The premises and the Project site shall be maintained in a reasonably neat and orderly condition by the Contractor and his sub-contractors and kept free from accumulations of waste materials and rubbish during the entire construction period. The Contractor shall remove all crates, cartons and other flammable waste materials or trash from the work areas at the end of each working day.

Floors shall be "broom-cleaned", or its equivalent, during the course of the work. Additional cleaning of all other items which are provided as a part of the Contract, including removal of dust, dirt, stains and finger marks from all finished wood, metal, marble or glass surfaces, shall be performed by the Contractor as required to the approval of the Engineer, before handover of the works.

The Contractor shall be responsible for the general cleaning and maintenance of the premises and the Project site and for the co-ordination of the clean-up work of all trades. The Contractor shall ensure that each trade shall clean and maintain its portion of the work as required and as directed by the Engineer. If the premises and job site are not maintained properly, the Engineer, may have any accumulations of waste materials or trash removed and deduct such costs from payments due to the Contractor.

Elevator shafts, electrical pipe and duct shafts, chases, enclosed spaces and similar spaces which are generally unfinished, shall be cleaned by the Contractor and left free from rubbish, loose plaster, mortar drippings, extraneous construction materials, dirt and dust, before requesting the Engineer to make final inspection of the work.

All areas of the building in which painting and finished work is to be performed shall be cleaned by the Contractor or his sub-contractor(s) thoroughly just prior to the start of the work, and these areas shall be maintained in satisfactory condition for painting and finishing. This cleaning shall include the removal of trash and rubbish from these areas; broom cleaning of floors; the removal of any plaster, mortar, dust and other extraneous materials from all finished surfaces, including but not limited to, all exposed structural steel, miscellaneous metal, woodwork, plaster, duct work, conduit and also all surfaces visible after all permanent fixtures, grilles, registers and other such fixtures or devices are in place.

The Contractor shall institute an effective programme of rodent and pest control for the entire site within the construction limits. During the construction period, services of an experienced exterminator shall be utilized if desired and as directed by the Engineer. The Contractor shall provide suitable covered containers for all edible rubbish and shall enforce their use by all employees. Containers shall be emptied and the contents removed from the site as often as required to maintain an adequate rodent/pest control programme.

122 Progress Photographs

The Contractor shall arrange to have monthly record photographs of the Works taken. These photographs shall cover such extent of the Works as the Engineer shall direct. The days upon which the photographs are taken shall be as decided by the Engineer.

The Contractor shall provide the Engineer with two sets of the monthly progress photographs with dates imprinted on them.

One set shall comprise the following:-

- One color negative of each photograph for an anticipated average maximum of fifty exposures per month.
- Seven color prints (294 x 210mm) off each of a maximum of twenty of the negatives as selected by the Engineer.
- Electronic Media: With each submittal, include three (3) Compact Disks (CD), in protective cases, identified by date photographs were taken.

Digital photographs shall be taken with a suitable digital camera complying with the following specification:

- Minimum 5 Mega Pixels resolution
- File format Jpeg or Tiff
- Monitor LCD for viewing
- Built-in flash for illumination
- SD Card compatible
- Non-Digital zoom (minimum 5X)

The prints are to be processed by an approved professional and shall be in color on heavy weight paper with matt finish. A label giving a brief description shall be affixed in the bottom right-hand corner of each photograph. Each photograph shall be provided in an approved clear plastic cover for binding.

The copyright of all photographs shall be vested in the Employer and the negatives and prints shall be delivered to the Engineer within 4 days of exposure. The photographs shall not be used for any other purpose whatsoever without the Employer's approval.

123 Setting Out

The Contractor shall employ an experienced Land Surveyor to carry out all setting out and surveying work.

Before the commencement of the Works the Contractor will be supplied with the information necessary to establish the lines and levels of the Works. The Engineer has shown on the Drawings all the Survey markers established but can give no warranty for their existence at the start of the Contract nor will he accept responsibility for replacing any survey markers found to be missing. Where survey markers have been established by the Engineer the Contractor shall check the accuracy of their position and level and shall immediately notify the Engineer of any discrepancies.

The Contractor shall, as soon as practicable, supply the Engineer with records in approval form relating to all reference pegs and bench marks and shall keep such records up to date by formal notice to the Engineer.

All survey reference pegs shall be carefully preserved except where construction requires their removal and before such removal the approval of the Engineer shall be obtained.

In order to establish the existing ground levels over the areas of the works, the Contractor shall establish a grid over the Site and agree the levels with the Engineer. The Contractor shall prepare drawings representing the configuration of the areas which shall be signed by the Engineer and the Contractor as record.

The Contractor shall establish bench marks and grid lines at each floor showing exact floor elevations and other lines and dimensional reference points as required.

124 Shop Drawings

Provide accurately prepared, large scale and detailed shop drawings on reproducible sheets, prepared specifically for the Project for all disciplines and as instructed by the Engineer. The shop drawings shall show adjacent conditions and related work. Accurate field dimensions and conditions shall be shown. Any special coordination with other trades required shall be clearly noted.

Notwithstanding any specific requirements, 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 a specific part of the Works, shop drawings are necessary, these drawings shall be prepared by the Contractor and submitted to the Engineer for approval. The Engineer shall have authority to order at any time and the Contractor shall 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.

All shop drawings shall be properly checked and coordinated with all connected trades/ disciplines by the Contractor and shall be signed by a designated qualified coordination Engineer as proof of verification and correction and submitted to the Engineer.

125 Record Drawings

The Contractor shall maintain one complete set of drawings of all disciplines (Structural, Electrical, Mechanical, civil, landscaping, External works etc.), at site exclusively to note all deviations/changes and submission at the time of completion of the works. All changes/deviations and details such as levels of foundations, routing of services, invert levels of pipes, cables, manholes, etc., the position of tees, bends, cleanouts and other appurtenances, details of underground services encountered and any other relevant data, locating dimensions where appropriate shall be accurately and neatly recorded on these drawings as work proceeds. All changes noted/recorded on the drawings shall be submitted to the Engineer for approval as and when the changes occur and are recorded.

126 As-Built Record and Survey Drawings

The Contractor shall prepare 'as-built' record and survey drawings of the Works detailing all works installed under the contract including services and all finished level surface. The drawings shall be accompanied by maintenance manuals, service literature and lists of spare parts where applicable.

As-built record drawings, operation and maintenance manuals and any other literature required for the efficient operation of the completed works shall be supplied by the contractor to the Engineer free of charge. The drawings shall be on polyester film or other durable and easily reproducible medium, approved by the Engineer.

The Contract shall not be considered as complete until the Contractor submits to the Engineer the as-built drawings and documentation, and obtains the Engineer's approval.

Copies of as- built drawings and documentation shall be submitted to the Engineer before the expiry of the Contract Period as named in the Contract and shall include one copy of each drawing and document specifically marked for archival storage. The Certificate of Maintenance (FCC – Final Completion Certificate) will not be signed by the Engineer until all as-built drawings and accompanying documents and service literature are approved and a certificate has been issued by the Engineer to his effect.

129 Identification

No later than 10 days prior to commencement on site, the Contractor shall submit to the Engineer or his representative the names of all workers to be on the site, together with the company name (in the case of subcontractors).

Workers are to leave the site upon completion of their work.

130 Alternative Materials

Should the Contractor wish to offer alternative items or materials to those specified he shall supply details of such alternatives together with details of any reduction in the Contract Price should the alternative be allowed to be substituted for the specified items or materials. All offered alternatives shall comply fully in all respects with the Specifications of the particular items or materials. Acceptance or refusal of any alternatives will be entirely at the discretion of the Engineer.

If during the course of the Contract certain materials or items required for use in the Works should be unobtainable, despite the best effort of the Contractor, the Contractor may offer for the approval of the Engineer alternative materials or items, provided that they possess the minimum requirements of the originally specified material.

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

In the event of refusal of any alternative materials or items 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 the materials or items as specified.

131 Materials, Goods and Workmanship Generally

The whole of the goods materials and workmanship incorporated in the works shall be new and of the best quality available and shall be to the approval of the Engineer.

Should the Engineer discover on the Works any materials other than those specified or approved, he may order their removal from the site and for their replacements as specified. All costs incurred for such removal and replacement, and of associated works shall be borne by the Contractor.

132 SUBMITTAL PROCEDURES

- a) Transmit each submittal with Engineer accepted form.
- b) Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- c) Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
- d) Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
- e) Schedule submittals to expedite Project, and deliver to Engineer. Coordinate submission of related items.
- f) For each submittal for review, allow 15 calendar days excluding delivery time to and from Contractor.
- g) Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.
- h) Allow space on submittals for Contractor and Engineer review stamps.
- i) When revised for resubmission, identify changes made since previous submission.
- j) Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- k) Submittals not requested will not be recognized or processed.
- l) Whenever it's necessary or requested, it's the Contractor responsibility to get approvals on fire-rated doors, Electromechanical Shop Drawings and other related materials from the Civil Defense and other related authorities before proceeding with construction of any part of the Works. Also, it shall also be his responsibility to get approvals from the

Civil Defense and other related authorities on As-Built Drawings. Additionally, the Contractor shall be liable for the later follow-up regarding getting the occupancy permission and similar approvals.

133 Schedule of Procurement of Material

The Contractor shall produce a "Schedule of Procurement of Materials" and submit the same within 3 weeks of commencement of works for the approval of the Engineer. This schedule shall give the following information:

- (a) Item to be procured
- (b) Quantity
- (c) Date of submission for approval
- (d) Date of approval
- (e) Date of order
- (f) Expected date of arrival at site
- (g) Date required on site

The Contractor is required to produce documentary evidence that all materials or items have been ordered in sufficient time to ensure their arrival on site sufficiently in advance of their incorporation in the Works.

No claim will be considered for extension of the Contract Period due to non-availability of materials as a result of the Contractors failure to comply with this requirement.

134 Samples and Testing of Materials

A. Samples

Prior to ordering or delivering any materials or manufactured items to the Site, the name and address of the supplier(s) and, where required by the Engineer, adequate samples, schedules and manufacturer's certificates of all the materials and goods to be used in the Works shall be submitted to the Engineer for approval at no extra cost to the Project.

In case of rejections further samples, until final approval is accorded, shall be submitted. The Contractor shall have no claims to extra cost or time lost due to improper submissions, the resultant rejections and the approval process.

If considered necessary and ordered by the Engineer, the samples shall be tested for compliance at the Contractor's expense in a laboratory approved by the Engineer.

B. Testing

The Contractor shall be, at his own expense, responsible for the sampling, storage, transportation and laboratory testing of products and materials as required in the Specification.

The Contractor shall make available on site necessary equipment for the use of the Engineer for tests to be conducted at site.

Eg. - Slump cone with baseplate and tamping rod.

- Thermometer suitable for measuring concrete temperature.
- Magnetic flux principle instrument for non-destructive method of testing paint film thickness. - etc.,etc.

In addition, suitable experienced labour to carry out the operations in connection with the above shall be provided by the Contractor as required by the Engineer.

The Contractor shall allow for the costs of the above in his unit rates.

135 Construction Programme

The Contractor shall prepare a co-ordinated programme of all the works, including incorporation of the works of his sub-contractors and nominated sub-contractors and submit the same for the approval of the Engineer.

The programme shall be prepared using proprietary latest software such as:

Primavera

And compressed as CPM PERT CHART and GANTT chart, showing earliest and latest start/finish times for each activity and related periods of float.

Contractor shall prepare and submit to the Engineer, within 30 days of issue of notice to commence a fully weighted "S" curve indicating planned construction effort and related labor and plant histograms.

"S" curve shall be updated with actual progress on weekly basis and incorporated in the Contractor's Weekly Report.

136 Periodic Reports

The Contractor must present to the Engineer detailed daily/weekly reports and monthly summary report showing the following:

- (a) Labour force working during the period.
- (b) Quantity and Type of materials and equipment used during the period.
- (c) Quantity of works executed.
- (d) Climatic conditions with special reference to any direct effect they may have on the works.
- (e) Unforeseen circumstances (if any) which may hamper the progress of the Works.
- (f) Graph showing the relation between the executed portions of the works and the corresponding portions in the Work Programme.

The Contractor shall prove to the Engineer upon his request the correctness of the above mentioned reports without having the right to use such documents to support a claim for any extra payment or compensation whatsoever in regard or in relation to such reports. However this shall not vitiate the rights of the Engineer to use the report as evidence to decide on any aspects connected with delays and claims.

137 Site Progress Meetings

During the course of the Work, Site progress meetings shall be held at regular intervals, at least once every two weeks, or at other intervals as directed by the Engineer, for the purpose of coordinating the Contractor's Works and to ensure that full compliance with the various sequences of the Contract are maintained. Minutes of such Site meetings will be recorded by the Engineer and 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.

Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems impeding planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

138 Protection of Finished Works

The Contractor shall carefully protect his own finished work, the works of his subcontractors and the works of Local Authorities if any, up to the time of completion and final handover of the project. The Contractor shall be liable for the reinstatement of any work damaged during the progress of the Works, caused by any reason whatsoever.

END OF SECTION 1

SECTION 2 – EARTHWORKS

To be read in conjunction with Preliminaries, General Conditions and General Specification Section.

201 EXCAVATION AND EARTHWORKS

201A Scope

This specification covers all necessary work required for the excavations from existing excavated levels (The site has already been excavated to face of slab on grade level) to final foundation's bottom levels. Backfilling and other sundry works in accordance with the Drawings and/or Bills of Quantities and as directed by the Engineer.

201B Soil Information

The Contractor shall visit and ascertain the nature of the ground to be excavated and the work to be done and shall accept all responsibility for the cost of the work involved.

The Contractor is further shall read the Geotechnical report. The Contractor shall conduct at his own expense any further testing investigations to satisfy himself as to the soundness of the available information.

201C Standards

A) ASTM

- A 328/328M-00 : Specification for Steel Sheet Piling.
- C 33-02a : Specification for Concrete Aggregates.
- C 88-99a : Test Method for Soundness of Aggregates by use of Sodium or Magnesium Sulfate.
- C 117-95 : Test Method for Material Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
- C 131-01 : Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- D 421-85(1998) : Dry Preparation of Soil Samples for Particle Size Analysis & Determination of Soil Constants.
- D 1140-00 : Amount of material in Soils Finer than 200 Sieve.
- D 1556-00 : Density of Soil in Place by the Sand-Cone Method.
- D 1557-00 : Compaction Characteristics of soil Using Modified Effort (2,700 kN-m/m³).
- D 1883-99 : CBR of Laboratory Compacted Soils.
- D 2922-01 : Density of Soil and Soil-Aggregate in Place by Nuclear Methods. (Shallow Depth)
- D 4318-00 : Liquid & Plastic Limits & Plasticity Index of Soils.

B) BS

- BS 1377 : Method of Test for Soils for Civil Engineering Purposes.
- BS 812 : Testing Aggregate.
- BS 6031:1981 : Code of Practice for Earthworks.

202 BACKFILLING AND FILLING

202A Material

Material for backfilling and filling shall be compactable reverbed and basecourse.

The Contractor shall backfill or fill for:

- a) Site leveling for buildings and landscape works. This work shall be done by filling to the required levels with allowance for any subsequent settling.
- b) Backfill below and around foundation (Engineering Fill) shall be done in layers not exceeding 25cm thickness when compacted to be watered and compacted with mechanical compactors to the required elevations, the upper 1m of the fill shall maintain 98% modified Proctor of maximum dry density while the rest shall have 95% modified Proctor test of maximum dry density.
- c) The material to be used for filling and backfilling whether excavated from within the site or imported from outside the site shall satisfy the AASHTO classification for granular material and falling within one of the following subgroups:

Subgroup	% Passing No. 200 sieve	LL	PI
A-2-4	35 max.	40 max	10 max.
A-2-5	35 max.	41 min	10 max.
A-2-6	35 max.	40 max	11 min

Classification tests shall be carried out to determine the suitability of material prior to the start of filling and backfilling work.

202B Received Backfilling and Filling

The Contractor shall be responsible for any depression resulting from defective backfilling or filling, and he shall reconstruct or repair any damages to structures, pipelines or trenches resulting from defective backfilling or filling at his own expense.

202C Requirements & Testing

The following requirements, tests and frequencies shall be followed:

Density and OMC for each fill material as defined by ASTM D1557 Method D and determined in an approved laboratory shall be referenced to the Engineer. The percentage of compaction shall be determined by the percent of maximum dry density at OMC in accordance with ASTM D1557 Method D.

If some of the materials are larger than 19 mm the maximum density shall be corrected by the following formula:

$$D = (P_f, D_f)/100 + (P_c \times 0.90 D_t)/100.$$

Where D = Corrected maximum dry density.

P_c = Percent of material retained on the 19 mm sieve.

P_f = Percent of material passing the 19 mm sieve.

D_f = Maximum density of material passing 19 mm sieve.

D_t = Bulk specific gravity of material retained on 19 mm sieve multiplied by 1000 kg/m³.

The area of excavation and the length of trench open at any one time shall be controlled according to the site conditions and subject to limits as directed by Engineer.

Excavation support system (wood or steel sheeting, soldier piles, wood lagging and secant pile walls) and bracing shall be cut off or left in place at elevations/locations determined and as directed by the Engineer.

Well points and pumps shall be installed under the supervision of competent representatives of specialist sub-contractors in accordance with the requirements specified under the relevant clauses/sections.

During progress of work, earth-moving operations shall be conducted in such a manner so as to minimize the creation and dispersion of dust.

Suitable and safe ramps or other covered crossings where required shall be provided access to construction personnel and other users during construction, and shall be removed on completion.

A. Excavated material/selected Borrow (non structural fill)

Non- Compacted.

- Gradation Analysis - one test per 1000 m³ of excavated on-site soil stockpiled for use as compacted on-site fill material and whenever classification of material is in doubt and/or as directed by Engineer.
- Liquid Limit and Plastic Limit and Plasticity Index - One test per 1000 m³ of excavated on-site soil stockpiled for use as compacted on-site fill material and whenever classification of material is in doubt.

Liquid Limit - 40%, Plastic Limit - 11%

- Moisture Density - One per 1000 m³ of soil placed and/or whenever visual inspection indicates a significant change in material gradation.

Compacted

- In-Place Density - Areas greater than 100 m²; one per 800 m³ placed, or one per alternate lift, whichever results in a greater frequency. Minimum percentage compaction.

Areas 100 m² or less; one per every half (½) meter of compacted fill.

B. Screened Gravel: (Structural Backfill)

- Contractor's soils testing laboratory to provide sufficient inspection to ensure compaction of fill material and compaction equipment in use.
- Gradation Analysis - One for each source and whenever visual inspection indicates a significant change in material gradation.

202D Tolerances

Finished surfaces shall be constructed to plus or minus 25 mm of the elevations indicated. Cut

and fill areas shall be graded to within plus or minus 60 mm of the grades indicated.

Edges of embankments shall be completed to plus or minus 60 mm of the slope lines indicated.

The Engineer shall be provided with adequate survey information to verify compliance with above tolerances.

Moisture content of fill material shall be maintained within ± 2 % of optimum moisture content (OMC) as specified in the case of structural backfill.

202E Submittals

The Contractor shall submit the following for the approval of Engineer.

- Detailed sequence of work, description of construction methods, including dewatering and erosion control measures. Formulated schedule and procedures to eliminate possibility of undermining or disturbing foundations of partially and completed structures, pipelines and embankments or existing structures and pipelines.
- No excavation shall be permitted until schedule and procedures have been reviewed and approved by Engineer.
- Information on proposed compaction equipment at least two weeks prior to use. Compaction operations shall not be commenced until the equipment has been reviewed and approved by the Engineer.
- Details of dust control measures.
- Details of effective control measure against erosion and sedimentation, prior to start of earth moving activities.
- Locations of proposed borrow sources for screened gravel and selected borrow, at least two weeks prior to use of material.
- Laboratory test results every week or as required by the Engineer.
- Written verification of fill lift thickness and compaction weekly or as required by the Engineer.
- Tamping tools adapted for the backfilling of retention system voids after its removal.

202F Workmanship

Materials for backfilling shall comply with and be laid in accordance with BS 6031:1981 Code of practice for earthworks.

Approved suitable excavated material shall be used on the backfilling and filling next to footings, foundations, underground structures etc. & shall be laid in layers not exceeding thickness shown on drawings & compacted with compaction equipment or mechanical tampers when not possible to use such compaction equipment, as approved by the Engineer.

A relative compaction of at least 95% of the Laboratory maximum dry density shall be achieved at optimum moisture content determined in accordance with Test 13 of BS 1377.

Each layer of backfill shall be inspected, tested and approved by the Engineers, prior to commencement of the next layer.

Should the quantity of 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 it 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 shall not be backfilled until all required tests are performed and until the Engineer has verified that the pipes and cables have been installed in accordance with the Specifications and the Drawings. Unless otherwise stated in the Specification, selected fine dry material free from stones, organic matter, lumps and deleterious materials shall be carefully hand packed and tamped around the lower half of the pipes and against the sides of the trench, and for the full width of the trench in order to avoid displacement of the pipes. Filling shall then be continued to a height of 150 mm above the pipes

and leveled across the trench from side to side with selected fine material which shall be hand packed and consolidated with wooden or other approved rammers.

Each layer shall then be well rammed and consolidated before the next layer is placed, until the trench is completely filled to the required levels. Power ramming shall be permitted on layers, which are 300 mm above the crown of the pipes provided that all the lower layers have been hand rammed to a satisfactory level of compaction and tested in accordance with the requirements of this specification.

202G Water

Water shall be clean potable water as specified under SECTION 03 - Concrete.

203H Concrete

Concrete used as fill for making up to correct levels, areas of over- excavation, shall be, where required by the Engineer, Grade "14" as specified under SECTION 03 - Concrete.

203 SITE PREPARATION

203A Excavation Permits

The Contractor shall be responsible for obtaining all permits relating to excavation works and shall bear all costs involved. The Contractor shall abide by all conditions, etc. laid down in such permits.

203B Existing Services

The Contractor shall ascertain the whereabouts of all existing services on the Site, both above and below ground. Such services shall be protected, maintained, removed, sealed or rerouted in a manner prescribed by the Public Authorities concerned at the Contractor's own expense as specified under "Locating, Protecting Maintaining and Diverting Services and Public Utilities". Excavations to locate services shall be carried out by hand.

204 EXCAVATION

204A General

The Contractor shall perform all excavations true to lines, widths and depths shown on the Drawings or to such further lines, depths or dimensions as may be directed by the Engineer to reach a suitable bearing strata.

204B Excavation in Rock

Rock shall be defined as boulders, exceeding 0.25 m^3 in volume or any kind of stone or rock formation which in the opinion of the Engineer requires for its removal drilling and blasting, wedging, sledging or barring, or breaking up with a power- operated hand tool. The definition shall exclude any soft or disintegrated rock which can be removed with a hand pick or mechanical excavator or shovel, or loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere. Blasting by explosive shall not be permitted.

206. SETTING-OUT

The Contractor shall stake-out the work as shown on the Drawings and secure the Engineer's approval of his stake-out 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- out for further approval in accordance with the relevant Clause of the Conditions of Contract.

207. 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 any cave-in or mixing with the concrete during the construction of foundations.

208. 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 Site area by the Contractor to dumps located by and approved by the local authorities concerned.

209. EXCAVATION FOR FOUNDATIONS

The levels to which the Contractor shall excavate are shown on the Drawings. Should it be found necessary to reach a more suitable stratum, the Contractor shall perform all additional excavation as directed by the Engineer.

During excavation for foundations, the bottom layer of excavation of minimum 150 mm in thickness, shall be left undisturbed and subsequently removed manually only when the concrete 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, leveled and well cleaned before pouring any concrete.

In the event of the Contractor excavating deeper than the levels shown on the Drawings he shall make up the difference between levels with concrete Grade 15 at his own expense.

Should loose soil, bad ground or cavities be encountered within any part of the excavations the Contractor shall remove such matter and fill to the appropriate levels with hard-core or other approved fill material leveled and compacted to the Engineer's satisfaction.

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.

210. EXCAVATION FOR TRENCHES

The Contractor shall excavate trenches and provide all planking and strutting 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.

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 depression for joints shall be dug after the trench bottom has been graded.

Care shall be taken not to excavate below the depths indicated. Where rock is encountered, the rock shall be excavated to the required depth. Uneven surfaces of the bottom of trench shall be excavated 150 mm deeper. Such depth, if in rock, shall be backfilled with concrete grade 15 as specified under "Section 03 – Concrete" and when in earth, shall be backfilled 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 trench backfilled 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 200 mm 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.

Trenches for Water Supply System shall be of a depth to provide minimum cover to the top of the pipe of 900 mm and avoid interference of water lines with other utilities. Width of trench shall be a maximum of 200 mm on each side of the pipe.

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

Excavation for manholes, septic tank, percolating pits and similar structures shall be sufficient to allow a minimum of 800mm of clear space between their outer surfaces and shoring timbers which may be used to protect the banks.

211. SETTLEMENT

The Contractor shall be responsible for making good all settlement in the works that may occur up to the end of the maintenance period of the Contract, unless stated otherwise in the Specification.

212. TESTING

The Engineer may at any time carry out dry density tests in accordance with BS 1377, Test No. 13, and such other tests as required. The Engineer shall check the results of the tests for the adequacy of degree of compaction by comparison with the degree of compaction achieved. Should the compaction be inadequate then the Contractor shall carry out such further work as is necessary to improve the compaction to comply with the terms of the Contract. All such additional work and testing involved shall be at the expense of the Contractor.

201 BASE COURSE LAYER

The base course layer under slabs on-grade shall conform to the specifications given in the following table (Class-B). The base course layer under external paved area shall conform to the following table (Class-A). The base course layer shall be overlaid with a clean well graded sand bed providing 20mm cover to the upper most granular of the base course layer. Material shall be Crushed Limestone, Crushed Basalt or Crushed Granite with layer thickness as specified in the cross sections and a max tolerance in level of +10mm.

	GRANULAR BASE COURSE		
	TESTS	LIMITS	TEST METHOD REFERENCE STANDARDS
B A S E C O U R S E	<ul style="list-style-type: none"> -Abrasion - Ratio of Wear Loss Rev100/Rev500 - Fractured Faces (For Aggregate Retained On #4) - C.B.R. - L.L. - P.I. -M.D Density 	<ul style="list-style-type: none"> 40% max. 0.25 max. 80% min. (one face or two faces) 80% min. 25% max. 2-6% max. 2.1 (gm/cm³)min. 	<ul style="list-style-type: none"> AASHTO T96 AASHTO T96 ASTM D1883 (modified) AASHTO T89 AASHTO T89, T90 AASHTO T180-D-With Replacement

		GRADATION (%)		
		CLASS A	CLASS B	
B A S E	2"	---	100	AASHTO T-27 and AASHTO T-11
	1 1/2"	100	70-100	
	1"	75-100	55-85	
	3/4"	60-90	50-80	
	1/2"	45-80	---	
	3/8"	40-70	40-70	
	# 4	30-65	30-60	
	# 10	20-40	20-50	
	# 40	8 -20	10-30	
	# 200 (before comp.)	5 -10	5-12	
	# 200 (after comp.)	+ 3% max.	+ 3% max.	
C O U R S E	- Compaction	95% min.	90% min.	AASHTO T180-D with replacement and AASHTO T191
	- Clay lumps and friable particles	3% max.		AASHTO T112
	- S.E (%)	30 min.		AASHTO T176
	- Flakiness Index	25% max.		B.S 812
	- Elongation Index	25% max.		B.S 812
	- Soundness: Na Mg	12% max. 18% max.		AASHTO T104
	- Gypsum Content (Expressed as SO3)	2%		B.S 1369

SECTION 3 – CONCRETE

To be read in conjunction with Preliminaries, General Conditions and General Specification Section.

301 INSITU CONCRETE CONSTRUCTION GENERALLY

301A Codes and Standards

The following Standards, codes, and other documents referenced in this Section. Keep one copy of each in the project field office, and supply the same to the Engineer for reference along with the submittals or as called for by the Engineer. However, the standard Codes shall remain the property of the Contractor. In all cases, the reference is to be the latest edition, including all amendments published at the date of invitation to tender.

The initials BS followed by a number refers to the British Standard of that number.

The initials AASHTO followed by a number refers to the American Association of State Highways and Transportation Officials publication of that number.

The initials ACI followed by a number refers to the American Concrete Institute publication of that number.

The initials ASTM followed by a number refers to the American Society for Testing and Materials publication of that number.

The British Standards referred to in this section are:

BS 12 : 1996	:	Ordinary and rapid-hardening Portland cement
ENV 197-1 1992:		Fly Ash or Pulverized Fuel Ash
BS 146: 1973	:	Portland blast furnace cement
BS 812	:	Methods for sampling and testing mineral aggregates, sands and fillers
BS 882, 1201	:	Aggregates from natural sources for concrete
BS 1370:1979	:	Low heat Portland cement
BS 1881	:	Method of testing concrete
BS 3148 : 1980 :		Tests for water for making concrete
BS 4027:1980	:	Sulphate resisting Portland cement
BS 5075:1982	:	Accelerating admixtures, retarding admixtures and water reducing admixtures
BS 5328 : 1981 :		Methods for specifying concrete including ready-mixed concrete

The American Standards referred to in this section are:

AASHTO T-26	:	Method of Test for Quality of Water TO be used in Concrete
ACI 301	:	Structural Concrete Specifications
ACI 305	:	Hot -Weather Concreting
ACI 308	:	Standard Practice for Curing of Concrete
ACI 304.2	:	Placing Concrete by Pumping Methods
ACI 318-99	:	Building Code Requirements for Structural Concrete
ASTM A36	:	Structural Steel
ASTM A82	:	Steel Wire, Plan, for Concrete Reinforcement.
ASTM A615/	:	Deformed and Plain Billet-Steel Ears for concrete Reinforcement
A615M-96a		
ASTM A722	:	Uncoated high-Strength Steel Bar for Pre stressing Concrete.
ASTM C33	:	Concrete Aggregates.
ASTM C40	:	Test for Organic Impurities in fine Aggregate for Concrete
ASTM C88	:	Test method for Soundness of Aggregate by use of Sodium Sulphate or Magnesium Sulphate
ASTM C94	:	Ready Mix Concrete

ASTM C131	:	Test Method for Resistance Degradation of Small-Size Coarse Aggregates by Abrasion and Impact in the Los Angeles machine.
ASTM C138	:	Test method for Unit Weight, Yield and Air Content (Cravi metric) of Concrete.
ASTM C142	:	Clay Lumps & Friable Particles in Aggregates.
ASTM C150	:	Portland Cement.
ASTM C231	:	Air Entrainment Test.
ASTM C232	:	Bleeding Water Test.
ASTM C289	:	Test Method for Potential Reactivity of Aggregates (Chemical method)
ASTM C295	:	Petrographic Examination of Aggregate for Concrete.
ASTM C309	:	Liquid-membrane forming Compounds for Curing Concrete.
ASTM C494	:	Chemical Admixtures for Concrete.
ASTM C535	:	Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM C1202	:	Electrical Indication of Concrete's Ability to Resist Chloride Ion
ASTM C1260	:	Potential Alkali Reactivity of Cement Aggregate Combinations.
CSA 23.1	:	Concrete Materials and Methods of concrete Construction

301B Qualifications

The Contractor shall follow the guidelines contained in the latest editions of the codes, specifications and standards listed above, except where more stringent requirements are shown or specified.

Plant and field inspection and testing of concrete and all ingredients there in, and reinforcement shall performed by an independent laboratory approved by the Engineer at the Contractors expense. Materials and installed work may require testing and re-testing as directed by the Engineer, at any time during the progress of the work, which shall carried out by the Contractor at his own expense.

The Contractor shall provide free access to visit and inspect the materials, stockpiles and facilities, proposed works, plants and sources of materials by the Engineer.

All tests including re-testing of rejected materials and installed work shall be done at the Contractors expense.

301C Method Statement

During the mobilization period, the Contractor shall submit a method statement detailing his proposal for the organization of all concreting activities at the site as well as off site for the approval of the Engineer.

The Contractor shall submit method statements for any particular activity when called for by the Engineer and demonstrate its feasibility through mockup /placement samples of appropriate sizes as approved and directed by the Engineer.

MATERIALS AND WORKMANSHIP

301D CEMENT

Ordinary Portland cement complying with BS 12 or ASTM 150 for Type I shall be used for all Concrete as indicated on Structural Drawings.

DO NOT USE High Alumina or Rapid Hardening cement.

OBTAIN details of source and manufacture of cement for approval.

Ground Granulated Blast Furnance Slag (GGBFS) cement replacement to ASTM C989 or Fly ash to ASTM C618 Class F cement replacement to be used for Raft foundations. For mixing with type II cement prior approval shall be obtained from the Engineer, concrete mix for raft foundations shall contain GGBFS 60% maximum cement replacement or Fly ash 30% maximum cement replacement, Contractor shall insure that thermal difference between any

points within the raft does not exceed 20 °C, and the maximum concrete temperature does not exceed 70 °C.

Cement Storage

Cement storage shall be subject to approval and shall afford easy access for inspection and identification of each shipment in accordance with test reports. It shall be used in the order in which it was delivered.

Bagged cement shall be delivered to site in the manufacturer's original sealed bags or containers and shall be stored in a dry, weather tight, properly ventilated structure, with adequate provisions for preventing the absorption of moisture and raised at least 150 mm off the ground to prevent deterioration. The storage shall be large enough to allow sufficient cement to be kept to allow continuity of work. Not more than 10 bags shall be piled one on top of the other while shoring in bags. Suitable shading shall be provided to limit the temperature to maximum 40 deg. C.

If cement in bulk is used it will be stored in approved purpose made silos large enough to allow continuity of work. No cement shall be stored on site for more than 3 months.

301E AGGREGATES

All aggregates fine and course shall comply in every respect with BS 882: 1992 and ASTM C33. They shall be well graded, clean, hard, free from undesirable material, and obtained from a source approved by the Engineer or as indicated on Structural Drawings.

It is preferred that the fine and course aggregates are obtained from the same source (approved at the commencement of the works), throughout the Contract. If it is necessary to change to a further approved source, all the tests on aggregates mentioned herein and elsewhere shall be repeated.

During excavation at a particular source of aggregate, care shall be taken to ensure that the excavation does not get too close to the high water mark where there may be a high concentration of salts due to the evaporation of water. The Engineer may inspect the source of aggregate during the progress of the Contract, and may order further tests if he considers them necessary.

PROVIDE: before ordering or using in the mix design, details of proposed nature and source of aggregates for approval.

301F Grading of aggregate

Course aggregate shall be prepared as single sized and blended to produce a normal size grading. The combined grading shall be within the appropriate grading limits laid down in BS 882 and as described below.

The gradation of fine aggregate shall be in accordance with BS 882 and shall be crushed aggregate from a source approved by the Engineer or as indicated on Structural drawings.

All-in aggregate shall be permitted for low-grade concrete only.

For normal use, aggregates shall consist of fine aggregates (those passing a 5 mm (3/16") sieve, and coarse aggregates (those retained on a 5 mm (3/16") sieve batched separately which, when combined together, give a grading curve which lies within the following limits:

<u>Sieve Size</u>	<u>% Passing by wt.</u>
20.0 mm (3/4")	100
10.0 mm (3/8")	45 - 75
5.0 mm (3/16")	30 - 48
2.36 mm (No. 7)	23 - 42

1.18 mm (No. 14)	16 - 34
600 µm (No. 25)	9 - 2
300 µm (No. 52)	2 - 1
150 µm (No. 100)	0 - 15

The amount of material passing BS 75 micron sieve in the combined aggregates when tested in accordance with BS 812 (wet sieving method) shall not exceed the following limits: -

- Fine aggregate - 3% by weight
- Coarse aggregate - 1% by weight

301G Sampling of Aggregates

Sampling and testing of aggregates when required by the Engineer shall be carried out in accordance with BS 812. If adequate laboratory facilities do not exist on site, samples must be taken and sent to a testing laboratory approved by the Engineer. Samples of about 0.015m³ (1/2 cu.ft.) and 0.03 m³ (1 cu.ft.) of fine and coarse aggregate shall be sent in suitable airtight containers.

301H Testing of Aggregates

All fine and coarse aggregates shall be imported from sources approved by the Engineer and shall be within the limits laid down in the table below in respect of contamination and reactivity:

CONTAMINATION AND REACTIVITY OF AGGREGATES

Property	Method of test & Standards	Maximum Limit (% by weight)
Clay, Silt and Dust	Wet Sieving through 0.075 mm sieve, BS 812: Part 103.	<i>Coarse Aggregates</i> Natural or Crushed Gravel 1 % Crushed Rock 1 % Crushed Rock 1 % <i>Fine Aggregates</i> Natural Sand or Crushed Gravel 3 % Crushed Rock 5 %
Clay Lumps	ASTM C 142	Coarse Aggregate 1 % Fine Aggregate 1 %
Organic Impurities	ASTM C 40	Colour standard not darker than Plate No. 3
Chlorides AS Cl	Acid soluble * BS 812: Part 117	Coarse Aggregate 0.02 % Fine Aggregate 0.05 %
Sulphates as SO ₃	Acid Soluble * BS 812: Part 118	Coarse Aggregate 0.3 % Fine Aggregate 0.3 %
Potential alkali Reactivity	ASTM C 289 **	If the total amount of potentially reactive material exceeds 0.5 % by weight of the total aggregate the alkali in the cement shall be restricted to 3 3 Kg/m ³ of concrete Innocuous Innocuous
Chemical method of Cement	ASTM C 289	
Aggregate Combination	ASTM C 227	6 month expansion 0.1 % max

Strict control shall be exercised to ensure that the maximum chloride content indicated is not exceeding at any time. Any violations shall be cause enough for rejection at any stage of the construction.

Aggregate may initially be assessed for its reactivity in accordance with ASTM C 289 and if potential reactivity is indicated than mortar bar tests in accordance with ASTM C 227 shall be carried out.

The tests and the maximum acceptable limits sampled and tested in accordance with the specified BS, shall be as indicated in the table below: -

RELEVANT TESTS AND STANDARDS FOR AGGREGATES

Property	Method of test & Standards	Maximum Limit (% by weight)
Contamination and Reactivity	As detailed in the table above	
Grading	BS 812: Part 103 (Dry)	As detailed under Aggregates
Surface texture	Descriptive, BS 812	Limit not applicable
Water absorption	Weighing dry & saturated ASTM C 128 / C127	Coarse Aggregate 2 % Fine Aggregate 2.3 %
Soundness 5 Cycles	ASTM C 88	MgSO ₄ 12 % Na ₂ SO ₄ 12 %
Drying shrinkage	BS 812: Part 120	Shrinkage 0.05%
Shell content Coarser than 10 mm Size 2.36 & 5 mm Finer than 2.36 mm	BS 812 Part 106	maximum 5 % maximum 10 %
Particle shape Flakiness index Elongation index	BS 812 Part 105.1 Part 102.2	maximum 25 % maximum 25 %
Specific Gravity	ASTM C 128/C 127	Course & Fine aggregate 2.6
Mechanical Properties	10% fines, BS 812: Part 111 Impact Value Part 112 Los Angeles abrasion test (ASTM C-131 or C-535)	Minimum 100 kN 30 % 30 %

301J Frequency of Routine Tests on Aggregate

The Contractor shall carry out the various tests at the frequencies indicated below:

However, the Engineer shall reserve the right to call for additional tests wherever it is warranted.

FREQUENCY OF ROUTINE TESTS ON AGGREGATES

Property	Method of Test	Maximum Limit (% by weight)
Grading	BS 812 Part 103	Each 3 weeks or per 150 m3 whichever is more frequent.
Material finer than 0.075 mm	BS 812 Part 103	Each 3 weeks or per 150 m3 whichever is more frequent
Clay lumps & friable Particles	ASTM C 142	Each 3 weeks or per 150 m3 whichever is more frequent.
Organic impurities	ASTM C 40	Each 45 days or per 300 m3 whichever is more frequent.
Water absorption	ASTM C128/C127	Each 45 days or per 300 m3 whichever is more frequent.
Specific Gravity	ASTM C128/C127	Each 45 days or per 300 m3 whichever is more frequent.
Shell content	BS 812 Part 106	Each 3 months or per 600 m3 whichever is more frequent.
Particle shape	BS 812 Part 105.1 & 105.2	Each 3 months or per 600 m3 whichever is more frequent
Acid soluble chlorides, CL Qualitative, Quantitative	BS 812 Part 117 A & B - Ditto - Appx C	At source and on each delivery to site 1 representative test per 2 weeks of aggregate to be used
Acid soluble Sulphates S03	BS 812 Part 118 Appendices A/B	On each delivery to site 1 representative test per 2 weeks of aggregate to be used
Soundness, Mg S04	ASTM C88 (5 cycles)	Each 48 concrete days
Mechanical strength 10% fines or impact Los Angeles abrasion	BS 812 parts 111,112 ASTM C 131/C 535	Each 72 concrete days Each 72 concrete days
Moisture variation	by Moisture Meters	Every two days for sands
Drying shrinkage	BS 812 Part 120	At start of project and whenever there is a change in the source of supply.
Potential Reactivity -of Carbonate -of cement aggregate combination	(ASTM C295, C289) (ASTM C586) (ASTM P214 & C227)	At start of project and whenever there is a change in the source of supply

301K Storage of Aggregates

The ready mix concrete supplier shall at all times maintain sufficient quantities of each type of aggregate considered by the Engineer to be sufficient to ensure continuity of work.

Each type and grade of aggregate shall be stored separately in bins; in such a manner that segregation of the various size particles shall not occur. The floors of the bins shall be of concrete or other approved material having sufficient slope to ensure adequate drainage of aggregates before being used for concreting.

Suitable precautions shall be taken to avoid contamination of aggregates by wind blown dust, etc. Suitable approved shading shall be provided to control the temperature and any contaminations especially chlorides.

Storage bins shall be emptied and cleaned at regular intervals as approved by the Engineer.

301L WATER

Water for mixing and curing shall be obtained from an approved source and shall be clean and free of acids, oils, vegetable, and deleterious matter which may have an effect on the strength and appearance of the hardened concrete by discoloration or efflorescence.

The Contractor, when required by the Engineer, shall arrange for analysis of samples of the water to be made by an approved testing laboratory and the water shall comply in all respects with the requirements of BS 3148:1980.

The PH value of water shall be within the range of 7-9 and the concentration of inorganic contamination shall not exceed the values indicated below:

- Dissolved solids excluding those listed below - 2200 ppm 0.20%
- Sulphates, alkali carbonates or bicarbonates - 1000 ppm 0.10%
- Chlorides - 500 ppm 0.05%
- Suspended solids - 2000 ppm 0.20%

301M Admixtures and Additives

Admixtures and additives (water reducing additives, retarders, etc.) shall be used only with the prior approval of the Engineer. Additives shall be subjected to tests before approval and during progress of work on site at the discretion of the Engineer. All costs incurred towards all tests shall be borne by the Contractor.

Admixtures shall conform to one of the following standards:

- ASTM C494 Chemical admixtures for concrete.
- ASTM C1017 Chemical admixtures for use in flooring Concrete.

Admixtures/Additive shall:

- Have no adverse effect on the shrinkage and water tightness properties of finished concrete.
- Not have any added chloride (0%, Calculated as calcium chloride by weight of cement in the concrete).
-

301N Water Proofing Admixture to Water Tanks.

Water proofing admixture to water tanks and others as indicated in the table on structural drawing shall be one of the following:

- An inorganic copolymer liquid admixture "Ipanex" of IPA Inc. USA.
- A multi component, single pack, waterproofing admixture "Pudlo" of David Ball Group.
- A combination of Conplast SP432MS and Conplast WP400 of Al Gurg Fosroc.

Or approved equivalent.

The dosage and the method of administration into concrete during mixing shall be as per the written instructions of the manufacturer. It shall be the Contractor's responsibility to ensure that the supplier is available at the plant during mixing to ensure that the manufacturer's instructions are carried out correctly.

The supplier shall study the cement type & quantity, other cementations materials (if any), in the concrete mix and ensure that the admixture dosage does not in any way adversely effect the strength or any of the other properties of the concrete. Trial mixes shall be provided with the admixture and tests shall be performed to prove that the desired strength and other characteristics of the concrete are obtained as specified in addition to the requirements addition to the requirements of concrete characteristics specified under trial mixes and other relevant clauses of this specification and indicated on structural drawing.

The concrete produced with the waterproofing admixture shall achieve the durability characteristics and other requirements as indicated in the table on structural drawing.

Any approval accorded by the Engineer shall not relieve the Contractor of any of his contractual responsibilities and obligations.

It shall be the responsibility of the Contractor to ascertain and implement any special precautions that need to be taken during production, pouring and curing of the concrete and inform the Engineer in advance of the same.

The Contractor shall provide a compatibility and performance guarantee for a period of 25 years.

301P ARRANGEMENT OF INFORMATION: The different parts of in-situ concrete construction specified in separate sections as follows:

- 302 In situ concrete mixes, casting and curing
- 303 Formwork
- 304 Reinforcement
- 305 Designed joints
- 306 Worked finishes to concrete.

Clauses dealing with particular aspects of certain types of construction may thus be dispersed over several sections.

302 INSITU CONCRETE MIXES, CASTING AND CURING

CONCRETE MIXES

302A CONCRETE MIXES: Make concrete mixes having the appropriate strength grade to produce finished work as scheduled in this Clause and in the General structural Notes drawing or as otherwise directed.

302B COMPLIANCE WITH BS 5328: Constituent materials, composition of mixes, production of concrete, information to be provided, sampling, testing and compliance to be in accordance with BS 5328 unless otherwise specified.

302C READY-MIXED CONCRETE used provided that it is obtained from a plant which holds a current Certificate of Accreditation under the Quality Scheme for Ready-mixed Concrete. each mix must be obtained from only one source unless otherwise approved. Confirm name and address of depot(s) to the Engineer before any concrete is delivered. Retain all delivery notes for inspection. (Delivery ticket to give : (See separate sheet).

- Name and number of ready-mixed concrete dept.
- Serial number of ticket
- Date
- Truck number
- Name of purchaser
- Name and location of job
- Grade or mix of concrete including minimum cement content if specified.
- Workability
- Type of cement
- Nominal maximum size of aggregate
- Type name and quantity of admixtures, if included
- Quantity of concrete in cubic meters
- Time of loading
- Time of introduction of the mixing water or of cement if later than the loading time.
- Type of aggregate

302D SUPPLIER TO PROVIDE: 1 cubic meter of each mix before it is required for use on site to allow contractor to carry out workability tests.

INSITU CONCRETE MIXES, CASTING AND CURING SCHEDULE

Concrete Grade	Concrete Element	Minimum cement contents (Kg/cu.m)	Cylinder Strength (N/mm ²)	Aggregate	Maximum free-water / cement ratio	Cement Type	Additive Materials
Grade 15	Blinding concrete	250	15	20mm	0.6	Type I (ASTM C150)	--
Grade 20	Walls behind stone	350	20	20mm	0.5	Type I (ASTM C150)	--
Grade 40	1- Columns and shear walls from 8th floor to roof, 2- Basement walls, parapet walls, beams, slabs, beams, staircase, foundations and tie Beams.	350	40	20mm	0.5	Type I (ASTM C150)	Replacement cement with Fly ash or GGBFS cement where required
Grade 50	Columns and shear walls up to 7 th floor	350	50	20mm	0.5	Type I (ASTM C150)	

- Admixture to the approval of the Engineer.

302 INSITU CONCRETE MIXES, CASTING AND CURING (contd.)

DESIGN AND MIXING

302E EVIDENCE OF SUITABILITY:

For each designed mix, before making concrete for use in the works and whenever a change in the materials or mix proportions is proposed, submit and obtain approval of:

- Details of proposed quantities of each ingredient per cubic metre of compacted concrete and proposed workability.
- Either existing data or details of appropriate tests on trial mixes to show that the proposed constituent materials and method of manufacture will produce concrete of the required quality, which will not segregate or bleed and will be capable of being fully compacted.

302F WATER CONTENT of concrete must be carefully controlled and adjusted to allow for moisture content of aggregates to give consistent quality and workability. Water shall be potable and shall not contain chemical impurities exceeding 2000 ppm.

302G ADMIXTURES: Use only if specified or approved. Admixtures to satisfy requirements of BS 5077. Make trial mixes and in consultation with the Engineer adjust the dosage and/or mix proportions in order to give suitable properties in the fresh and hardened concrete.

Do not use admixtures containing calcium chloride or proprietary admixtures containing more than 0.02% of equivalent or hydrous calcium chloride by weight of cement in the final mix.

TESTING/CERTIFICATION OF CONCRETE

302H COMPLETE CORRELATED RECORDS must be maintained for each mix type, including:

- Composition of the mixes tested, including any admixtures.
- All sampling and site tests.
- Identification marks or numbers of all specimens tested in the laboratory.
- The location of the part(s) of the structure represented by each sample.
- The location in the structure of the batch from which each sample has taken.

302J Test Reports

1.9.1 Sieve analysis, mechanical properties and deleterious substance content for coarse and fine aggregate.

1.9.2 Chemical analysis and physical tests of each type of cement.

1.9.3 Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, ratio of water to cementitious materials, type and manufacturer of cement.

Standard deviation data for each proposed concrete mix based on statistical records.

Curve showing the ratio of water to cementitious materials for concrete mixes based on laboratory tests. Give average Cylinder strength test results at 28 days for laboratory concrete mix designs. Provide results of 7 and 14 day tests.

302K FIELD TESTS

Sets of field control Cylinder specimens will be taken by an independent testing laboratory, during the progress of the Work. All field control Cylinder specimens taken shall be in compliance with BS 1881. The number of sets of concrete test Cylinders taken for each class of concrete placed each day shall not be less than one per day, nor less than one for each 115 cu.m. of concrete nor less than one for each 500 sq.m of surface area for slabs or walls.

1. A "set" of test consists of six Cylinders: three to be broken at seven days and two to be broken and their strengths averaged at 28 days. The remaining Cylinder may be used for a special break at 3 days or to verify strength after 28 days if 28 day breaks are low.
 2. When the average 28 day compressive strength of the Cylinders in any set falls below the required compressive strength or below proportional minimum seven-day strengths (where proper relation between seven and 28 day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve required strengths.
- A. The Contractor shall cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through his operations, and furnishing material and labor required for the purpose of taking concrete Cylinder samples. All shipping of specimens will be paid for by the Contractor. Curing boxes shall be acceptable to the Engineer.
 - B. Slump tests will be made in the field immediately prior to placing the concrete. Such tests shall be made in accordance with ASTM C143. If the slump is greater than that specified, the concrete shall be rejected.
 - C. Air Content: Test for air content shall be made on a fresh concrete sample. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If lightweight aggregates or aggregates with high absorptions are used, the latter test method shall be used.

302L FAILURES:

Should any of the 7 day Cylinder test results fall below the specified requirements, the Contractor shall take serious note of the same that the required 28 days strength may not be achieved. He may be permitted by the Engineers to proceed with the works at the sole risk of the Contractor for all consequent effects there to. The Contractor shall carry out investigation to ascertain the cause for the failure at 7 days, if the 28 days strength is achieved and shall submit his report and recommendation if any for the review of the Engineer.

The Engineer shall review the same and may order and the Contractor shall carryout any remedial measures to avoid further occurrences.

Should any Cylinder test results of 28 days fall below the specified requirements, the Engineer will decide whether the concrete in the work represented by those Cylinders can be accepted or not. Failing acceptance, the Contractor shall carry out one or more of the following actions at his own expense to prove the concrete used in the Works is within acceptable limits.

- (a) The drilling and testing of cored Cylinders in accordance with the procedures laid down in BS 1881: Part 120: 1983 and Part 124: 1988.
- (b) The carrying out of load tests, or other non-destructive tests in accordance with the procedures laid down in BS 1881: Parts 202 to 206.

The course of action to be taken, the size and location of cores for testing and interpretation will be decided by the Engineer who will also approve the testing authority and laboratory. If the Engineer after these secondary testing procedures has been completed, still considers that the concrete used is not acceptable, the Contractor shall remove all sections of the works containing the defective concrete and replace it with approved concrete at his own expense.

The Contractor shall be solely responsible for all delays and losses cause as a result of the above and shall not be entitled for any extension of time or claims.

302 INSITU CONCRETE MIXES, CASTING AND CURING (Cont'd....)

PLACING AND COMPACTING

302P OBTAIN written permission from the Engineer for pouring any concrete.

302Q UNDERLAY: Before placing structural concrete (not blinding concrete) on hard-core or other absorbent substrates, lay polythene sheet (minimum 1000 gauge) or other protection membrane as specified. Lap edges 150 mm.

302R CONSTRUCTION JOINTS:

- Carefully brush and spray surface while concrete is still green to remove surface laitance and expose aggregate finish. Obtain approval for any alternative method.
- Surface to be clean and damp when fresh concrete is placed against it.

302S CLEANING: At time of placing ensure that all surfaces on which concrete is to be placed are clean, with no debris, tying wire clippings, fastenings or free water.

302T PLACING:

- Record time, date and location of all pours.
- OBTAIN Engineer's approval before any pour.
- Place while sufficiently plastic for full compaction. Do not add water or retemper mixes.
- Place in final position in one continuous operation up to construction joints. Avoid formation of cold joints.
- Do not discharge from an excessive height or through reinforcement or other obstructions in a way, which may cause uneven dispersal, segregation or loss of ingredients. Use suitable chutes or trunking to place concrete where necessary.
- Place in layers no thicker than can be effectively compacted with the equipment being used.
- Take appropriate measures specified hereinafter for casting thick concrete slabs more than 1000mm thick.
- Do not use vibrators to make concrete flow horizontally into position, except where necessary to achieve full compaction under void formers and cast in accessories and at vertical joints.
- Use appropriate admixture (e.g. super-plasticizer) to place self-flowing and self-compacting concrete in heavily reinforced sections.

302U COMPACTING: Fully compact concrete to full depth (until air bubbles cease to appear on the top surface), especially around reinforcement, cast-in accessories, into corners of formwork and at joints. Ensure amalgamation with previous batches, but do not damage adjacent partly hardened concrete. Use mechanical vibrators of not less than 10,000 oscillations per minute.

302V PLACING CONCRETE FOR GROUND SLAB: To be cast in long strips between expansion joints in alternate strips.

302 INSITU CONCRETE MIXES, CASTING AND CURING (Cont'd....)

CURING AND PROTECTION

302W CURING:

- Prevent surface evaporation from concrete throughout the period(s) specified below by:
 - Retaining formwork in position and, if necessary, covering exposed surfaces immediately after striking and
 - Covering top surfaces of fresh concrete immediately after completion of placing and compacting each bay, removing covering only to permit any finishing operations and replacing immediately thereafter.
- Maintain detailed records of location and timing of casting of individual batches, removal of formwork and removal of coverings. Keep on site, available for inspection.
- Coverings for curing may be suitable impervious sheet materials or a suitable curing compound with an efficiency of at least 75%, and:
 - Must be effective in preventing evaporation of water from the concrete, particular attention being paid to sealing at edges and junctions.
 - Must not disfigure permanently exposed surfaces.
 - Must not affect the satisfactory bond of subsequent construction and finishes.
- Until the exposed top faces of fresh concrete are in a state suitable to receive sheets in direct contact or a sprayed curing compound as applicable, cover with waterproof sheeting held clear of the surface and well sealed against draughts at edges and junctions.

302X CURING PERIODS: Concrete surfaces shall be protected and kept moist by wet hessian cover for a minimum period of 5 days or as directed by the Engineer.

302Y PROTECTION: Prevent damage to concrete, including:

- Surfaces generally: From site, indentation and physical damage.
- Surfaces to be exposed in the finished work: From dirt, rust marks and other disfiguration.
- Immature concrete: From thermal shock, physical shock, overloading, movement and vibration.

302Z CONCRETING IN EXTREME CONDITIONS

Do not carry out concreting operation in the open during storms or heavy rains.

- Erect cover for protection of materials, plant and formwork.
- Take additional precautions to protect against strong wind, driving rains and dust.
- IN HOT WEATHER follow recommendations of ACI 305 R-99 "Hot Weather Concreting".
- Shield surfaces and reinforcement against which concrete is to be placed from direct rays of the sun.
- Take adequate measure against the detrimental effects of wind and low humidity in hot concreting conditions.
- Take necessary measures, as described below, when prevailing conditions are such that the concrete placing temperature might exceed 30°C.

(a) Insulate or paint white all concrete handling equipment.

(b) Shade forms, moulds and mixed concrete from sun light.

302 INSITU CONCRETE MIXES, CASTING AND CURING (Cont'd....)

302Z CONCRETING IN EXTREME CONDITIONS (contd.)

- (c) Restrict transit time of concrete supply to a minimum, taking account of the use of admixture, etc.
- (d) Shade aggregate stockpiles, water tanks and pipes. Cool mix constituents and plant. Spray coarse aggregates with cold water.
- (e) Carry out concreting operation at night when the ambient temperature is lower. Arrange adequate lighting at all points of mixing, transportation and placing of concrete to the satisfaction of the Engineer.
- (f) Limit temperature of placed concrete by measures as described herein.
- (g) Add crushed ice to mixing water to reduce concrete placing temperature.
- (h) No concrete shall be mixed at an air temperature of less than 5°C unless proposals to counteract the effect of cold weather have been submitted by the Contractor and agreed in writing by the Engineer. Exposed surfaces of concrete shall be efficiently protected to maintain its temperature above five degrees C until it has hardened.
Comply with ACI 306.1 (American Concrete Institute) - Standard Specification for Cold Weather Concreting.
- (i) The Contractor shall provide a thermometer suitable for measuring the temperature of aggregates, thermometer shall be hung in a position indicated by the Engineer's Representative

303 FORMWORK FOR INSITU CONCRETE

GENERALLY/PREPARATION

303A LOADINGS: Design and construct formwork to withstand the worst combination of:

- Total weight of formwork, reinforcement and concrete.
- Construction loads including dynamic effects of placing, compacting and construction traffic.
- Wind loads.
- Assign responsibility of scaffolding, access or shoring to specialist supplier/erector to the approval of the Engineer.

303B WORK BELOW GROUND:

- Vertical faces of strip footing, bases and slabs may be cast against faces of excavation, provided:
- Prior approval is obtained
- The faces are sufficiently accurate and stable
- Adequate measures are taken to prevent contamination of concrete
- Faces of walls must be cast against formwork

All faces that will be exposed to view or to liquids, formwork shall be constructed and faced with plywood or other approved material so that the inside surfaces are smooth, true and free from all irregularities.

All other faces of concrete except against existing structures rough formwork may be used, which may be plain sawn timbers, or any other approved materials.

CONSTRUCTION

303C ACCURACY:

Construct formwork accurately and robustly with adequate supports to produce finished concrete to the required dimensions. Formed surfaces must be free from twist and bow blow-holes and honeycombing (other than any required cambers). All intersections, lines and angles shall be square, plumb and true.

303D JOINTS IN FORMS:

Construct formwork, including joints in form linings and between forms and completed work, to prevent loss of grout, using seals when necessary. Secure formwork tight against adjacent concrete to prevent formation of steps.

303E INSERTS, HOLES, CHASES:

- Confirm positions and details to ensure that alterations to and decisions about their size and location are not made without knowledge and approval of Engineer.
- Fix inserts or box out as required in correct positions before placing concrete. Form all holes and chases. Do not cut hardened concrete without approval.

303F FAIRFACE (SMOOTH) FINISH:

Allow the mortar to partially harden for one or two hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)

Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has' been cut off with the trowel so it can be wiped off clean with the burlap.

On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.

A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. Walls shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least three days after the application of the repair grout.

STRIKING

303G RESPONSIBILITY: Strike formwork without disturbing, damaging or overloading structure, and without disturbing props. Notwithstanding other clauses in this specification and any checking or approvals by the Engineer, the responsibility for safe removal of any part of the formwork and any supports without damaging the structure rests with the Contractor.

303H MINIMUM PERIODS: Refer to the Specifications for Construction of Buildings for the Kingdom of Jordan issued by the Ministry of Public Works and Housing 1996, Section 3. Obtain the Engineer's instructions if certain parts of the formwork to be left in place for a longer period.

304 REINFORCEMENT FOR INSITU CONCRETE

REINFORCEMENT

304A DEFORMED BAR REINFORCEMENT to ASTM A-615, Grade 420.

304B CLEANLINESS: Store reinforcement clear of the ground and prevent contamination by other materials. At time of placing concrete, reinforcement to be clean and free of corrosive pitting, loose millscale, loose rust, oil and other substances which may adversely affect the reinforcement, concrete, or bond between the two.

FIXING

304C LAPS OR SPLICES: Obtain instructions if details are not shown on drawings.

304D LAPS in nominal bar reinforcement to be according to BS 8110: Part 1: 1997, if not shown on drawings.

304E FIX REINFORCEMENT adequately, using tying wire, approved steel clips or tack welding if permitted. Wire or clips must not encroach into the concrete cover.

304F SPACERS: In addition to supports shown on drawings or schedules, provide spacers and chairs at not more than 1 m centers or closer spacing as necessary to support reinforcement in position and maintain the specified cover. Reinforcement must be fixed in position before the concrete is placed. Cover spacers to be not closer than 300mm centers and staggered on adjacent parallel bars.

304G COVER SPACERS: Type(s) which will adequately support the reinforcement, adequately resist displacement, not cause indentation of the formwork and made from:
Plastics (perforated to at least 25% of their area),
or Fiber cement, or
Concrete (strength and durability to match surrounding concrete).

304H REQUEST Engineer's inspection of the fixed reinforcement in advance of concrete pouring.

TESTS

304J Tests shall be carried out on reinforcement bars delivered to the job site in an independent laboratory approved by the Engineer for compliance with the requirements of the above mentioned Standards. At least 2 samples of each size and type shall be taken as directed by the Engineer and tested.

The Contractor shall provide, in addition, copies of the manufacturer's certificates of test results relating to the steel reinforcement for each consignment brought to site.

FIREPROOFING

304K Contractor shall provide all horizontal and vertical openings with Fire proofing materials.

305 DESIGNED JOINTS IN INSITU CONCRETE

- 305A. ACCURACY: All joints to be accurately located, straight and well-aligned, and truly vertical or horizontal or parallel with the setting out lines of the building.
- 305B. CONSTRUCTION JOINTS IN CONCRETE EXPOSED TO VIEW, additional to joints required by the designer, will not be permitted.
- 305C. CONSTRUCTION JOINTS IN CONCRETE WEARING SURFACE FLOORS, additional to joints required by the designer, will not be permitted.
- 305D. FORMED JOINTS: Construct using rigid, grout-tight side forms or stop ends designed to accommodate projecting bars or fabric without temporary bending or displacement.
- 305E. FORMED JOINTS in concrete wearing surface floors:
- Forms to be square edged with a steel top surface and in good condition.
 - Compact thoroughly at edges to give level, closely abutted joints with no lapping.
- 305F. ROUGHENING OF CONTRACTION JOINT FACES: Brush and spray surface of formed contraction joints while concrete is still green to leave a thoroughly roughened exposed aggregate finish. For concrete section more than 300mm thick, appropriate keys to be formed along all construction joints.
- 305G. CRACK INDUCING GROOVES:
- Depth 50mm, width 20mm
 - Either, form by inserting temporary strip into the fully compacted concrete, re-compact and re-level the slab, and remove strip.
Or, if the type of aggregate used so permits, cut with a saw sufficiently early to prevent random cracking (within 24 hours of casting the slab).
- 305H. EXPANSION JOINTS AND KICKER JOINTS: Where shown on drawings, construct rigid stop-ends and formwork. Manufacturer's instruction/procedures to be followed when using any water bars or joint fillers.
- 305J. DAY WORK JOINTS : Construction joint as 305F above
- 305K. STOPPAGE DUE TO PLANT BREAKDOWN: Scabble the face to at least 100mm before new concrete to be placed next to it. Apply bonding agent before placing fresh concrete.

306 WORKED FINISHES TO IN SITU CONCRETE

306A. **TIMING:** Carry out all finishing operations at optimum times in relation to the setting and hardening of the concrete. Do not wet surfaces of concrete to assist surface working. Do not sprinkle cement on to surface.

306B. **SMOOTH FLOATED FINISH**

Use a hand float; skip float or power float to give an even surface with no ridges or steps.

306C. **TROWELLED FINISH**

- Float concrete to an even surface with no ridges or steps, then immediately commence curing as specified in section 302.
- When the concrete is suitably stiff, hand or power trowel to give a uniform smooth but not polished surface, free from trowel marks and other blemishes, and suitable to receive the specified flooring material.
- Resume specified curing without delay.
- Adequately protect the surface from construction traffic until flooring material is laid.
- If, because of inadequate finishing or protection, the surface of the concrete is not suitable to receive the specified flooring material, it must be made good by application of a smoothing compound by and to the satisfaction of the flooring subcontractor. Allow for the cost of any such making good.

306D. **TROWELLED FINISH for wearing surfaces:**

- Float concrete to an even surface with no ridges or steps, then immediately commence curing as specified in section 302.
- Successively hand or power trowel at intervals, applying sufficient pressure to close the surface, to give a uniform smooth finish free from trowel marks and other blemishes.
- Resume specified curing without delay.
- Complete a sample area of the finished work, size 10 sq. m, in advance of the remainder, in an approved location, and obtain approval of appearance before proceeding.

306E. **SURFACE SEALER:** Apply an approved resin sealer to concrete wearing surface floors in accordance with manufacturer's recommendations.

307 Liquid Applied Waterproofing

A. Material

Liquid applied waterproofing shall be a cold applied, rubberized, flexible bitumen, material in liquid form which when applied dried within 3 hours @ 20 °C. The membrane shall form a tough durable resilient, impermeable barrier to water and most aqueous reagents, adhering to the structural surface. The membrane shall be suitable for hot climates.

A primer or bonding agent if recommended by the manufacturer of the membrane shall be provided, before the application of the liquid membrane.

The minimum thickness of the membrane shall be 1mm unless otherwise indicated on Drawings.

B. Workmanship

The membrane shall be handled and applied strictly in accordance with the manufacturer's written instructions. Surfaces to be covered shall be clean, flat, dry and free from any matter likely to adversely affect the performance of the waterproofing. The liquid membrane shall be mixed and applied in two coats by spray or squeegee to obtain the required minimum thickness, strictly in accordance with the manufacturer's instructions.

308 TORCH APPLIED SBS WATERPROOFING MEMBRANE

The waterproofing membrane for protection of concrete substructure shall be one layer SBS heavy laminate bituminous felt of a type suitable for hot climates, reinforced with 200gm/m² of non woven spun-bonded polyester and modified bituminous compound presenting high thermal stability, plasticity and flexibility characteristics as detailed on drawings and as specified in this Section. The thickness of the membrane shall be 4mm as specified and indicated on drawings.

The typical characteristics of a 4mm thick membrane shall be as follows:

Tests	Unit	Required Val.	Tolerance
Thickness	mm	4	± 5%
Aeric Mass	Kg/m	4.4	±10%
Tensile strength; Long	N/5 cm	900	±20%
Tranv	N/5 cm	750	±20%
Lap joint strength; Long	N/5 cm	950	±20%
Tranv	N/5 cm	750	±20%
Elongation at break; Long	%	50	±15%
Tranv	%	55	±15%
Cold Bending	°C	-20 ⁰	≤ -5
Form Stability	°C	100	≥100
Water pressure resistance (DIN 16935)	KPa	No leakage at 1000 mm water head/24 hrs.	≤ 1000
Softening point (ASTM D36)	°C	130	<130
Down penetration 25 ⁰ C (ASTM D5)	dmm	25	±5

A. **WORKMANSHIP GENERALLY:**

- Waterproofing membrane shall be laid strictly in accordance with the manufacturer's instructions.
- Apply materials carefully to provide a completely waterproof, continuous membrane.
- Ensure that surfaces to be covered are clean, dry, smooth and free from voids, sharp protrusions.
- Protect finished sheeting adequately to prevent puncturing during following work.
- Cover sheeting with permanent overlying construction as soon as possible. Immediately prior to covering check for damage and repair as necessary.
- Fix the sheets to substrate by melt off the polyethylene film and a thin layer of bitumen while unrolling and laying the membrane.

B. **INSPECTION:** Inform the Engineer a reasonable length of time before covering any part of membrane with overlying construction, to allow inspection.

C. **PRIMER(S):** Type(s) recommended for the purpose by the sheet manufacturer. Apply by mopping, brushing or spraying to achieve an even and full cover of the surface. Allow to dry thoroughly before covering

309 POLYETHYLENE SHEET

Polyethylene sheets 250 microns thick shall be provided to areas as indicated on the drawings either in transparent or black color to gauges shown therein. Polyethylene sheets shall be manufactured from 100% prime first grade quality resins to BS 6515:1984. Materials manufactured from recycled, off spec. or waste materials shall not be accepted. The polyethylene sheet shall exhibit all the characteristics of BS 6515:1984 and the Contractor shall produce necessary test certificates to the Engineer to prove the same. Overlaps shall not be less than 100mm and shall be sealed together using an approved adhesive or tape. The material shall be supplied, stored and installed in accordance with the manufacturers written instructions.

310 ARCHITECTURAL JOINT SYSTEMS "ELASTOMERIC JOINT SEALANT"

310A GENERAL

This Section includes floors, walls, and ceilings joints.

Description:

- High grade, polysulphide based sealant possessing outstanding resistance to deterioration due to weathering.

Submittals:

- **Product Data:** Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.
- **Shop Drawings:** Provide placement drawings that include line diagrams showing entire route of each joint system and details.

Work Included in This Section

- a. Supply and installation of weather-resistant expansion joint seal which accommodates structural movements in all directions.

Quality Assurance

- a. Execute work of this section by skilled, trained applications conforming to installation procedures as per manufacturer's recommendations.

- b. Field Conditions: Where applicable, prior to the installation work; determine the acceptability of the formed recesses in the deck. The Engineer shall decide whether such recesses are approved or additional work should be done.

Warranty

Manufacturer shall warrant that the manufactured goods provided will be free from any defect in materials and workmanship, and, when properly installed by trained applicators, will meet the performance criteria noted in the Manufacturer's manuals and catalogs. This warranty shall extend for a period of five (5) years following the date of installation. For the exact terms of the warranty, refer to the Manufacturer's Warranty Statement.

Storage, Delivery, Handling, and Protection

- a. Coordinate deliveries to comply with the construction schedule and arrange ahead for off-the-ground undercover storage.
- b. Make sure to follow all written directions and warnings on all packaged materials.

310B Technical Data:

- Solid content % : >99%
- Viscosity : thixotropic paste.
- Tack free at 20°C : 24 hours
- Staining : none.
- Slump gun grade : all
- Resistance to ozone : non-crack
- Hardness shore A : 25
- Operating temperature : -30°C to 90°C
- Recommended Movement : transverse $\pm 25\%$ M.A.F (Movement Accommodation Factor)

310C Joint Size:

- Joints should have a minimum width: depth ratio 2:1

310D Application procedure:

- Joint preparation surface treatment
- Surfaces must be clean and dry. Wire brush thoroughly and remove dust and all contaminants.
 - A bond breaking tape should be applied before priming.

310E Priming:

The correct primer to be used according to manufacturer's recommendations.

310F Surface Application

- a. Application of primer should be not being carried out below 4°C.
- b. A single coat of primer should be applied by brush in accordance with the instructions on the primer tins. The primer must be allowed to dry to a tack free state before applying Joint Sealant.
- c. Joint Sealant should be applied within 3 hours of primer, otherwise re-priming will be necessary.

310G Application temperatures:

Joint Sealant should be applied when the ambient temperature is between 4°C and 50°C.

SECTION 4 – Masonry Works

4.A CONCRETE HOLLOW BLOCKS:

The blocks shall be locally available concrete hollow blocks of generally regular and uniform size, shape & color, uniformly well finished. The bricks shall be free from cracks, chips, flaws, stones or lumps of any kind.

SPECIFICATION.

In this specification, the letters I.S., when followed by two sets of numbers, refer to the Irish Standard of which the first is the serial number and the second the year of its promulgation by the Minister for Industry and Commerce.

SCOPE

This specification applies to pre-cast, hollow concrete building blocks made with natural aggregates.

CEMENT

The cement used in the manufacture of the blocks shall be normal Portland cement or rapid hardening Portland cement conforming to the provisions of I.S. 1: 1949.

AGGREGATE

The aggregate used in the manufacture of blocks shall consist of naturally occurring sand, gravel or stone, crushed or uncrushed or a combination thereof. It shall be hard, strong, durable, clean and free from adherent coatings and shall not contain excessive quantities of flat or elongated particles. It shall not be of a type that is liable to suffer from the action of frost.

The aggregate shall not contain harmful material in sufficient quantity to affect adversely the strength or durability of the concrete. Mica, shale or similar laminated materials or soft particles shall not be present in such a form or in such quantity as to affect adversely the concrete.

Aggregate shall all pass through a $\frac{3}{4}$ in. test sieve or through a test sieve of nominal width of aperture not exceeding 75 per cent. Of the thinnest leaf of the block, whichever has the lesser aperture. When the aggregate contains fine aggregate, the fine aggregate shall not contain more than 10 per cent. Of material passing a No. 100 test sieve.

When tested as described in Appendix A the quantity of material passing a No. 200 test sieve shall not exceed, in the case of fine aggregate, 3 per cent. For natural sand and 5 per cent. For crushed stone and, in the case of coarse aggregate, 1 per cent.

When tested for organic impurities as described in Appendix B the aggregate shall not show a depth of color exceeding that of the reference solution.

For the purposes of this clause, fine aggregate shall be material passing a 3/16 in. test sieve and coarse aggregate shall be material retained on a 3/16 in. test sieve.

Test sieves shall conform to the requirements of I.S. 24: 1950.

VISUAL INSPECTION

All blocks shall be sound and free from cracks or other objectionable defects, which would interfere with the proper placing of the blocks.

SURFACE TEXTURE

The surfaces of the blocks, except where they are specially prepared as an external facing, shall be of such a texture as will provide a good key for jointing, rendering or plastering.

CURING

The blocks shall be cured for such a period as may be necessary to ensure that they shall conform to the requirements of Clauses 10 and 11.

DIMENSIONS

The size of block shall normally (200mmx200mm x400mm) or (200mm x100mmx400mm). Bricks of one standard size shall be used on one work unless specially permitted by the Owner/Architects.

COMPRESSIVE STRENGTH

Compressive strength of bricks shall not be less than 35 Kg/Sq.cm.

APPROVAL OF OWNER

Prior approval of Owner/Architects shall be obtained for the brands of bricks to be used in the work after compliance with the above specifications/tests.

4.2 MORTAR

Unless otherwise specified, mortar for brick work shall be composed of 1 part of cement to 6 parts of approved sand for walls of one brick thick (20 cm) and over and one part of cement to 4 parts of approved sand for half brick thick and brick on edge walls.

4.3 CONSTRUCTION DETAILS

a) Soaking

All brick shall be immersed in water for 24 hours before being put into work so that they will be saturated and will not absorb water from the mortar.

b) Bats

No bats or cut bricks shall be used in the work unless absolutely necessary around irregular openings or for adjusting the dimensions of different course and for closers, in which case, full bricks shall be laid at corners, the bats being placed on the middle of the courses.

C) Laying

The bricks shall be laid in mortar to line, level and shapes shown on the plan, slightly pressed and thoroughly bedded in mortar and all joints shall be properly flushed and packed with mortar so that they will be completely filled with mortar and no hollows left anywhere. Bricks shall be handled carefully so as not to damage their edges. They should not also be thrown from any height to the ground but should be put down gently. All course shall be laid truly horizontal and all vertical joints made truly vertical. Vertical joints on one course and the next below should not come over one another and shall not normally be nearer than quarter of a brick length. For battered faces beading shall be at right angles to the face. Fixtures, plugs, frames etc. if any, shall be built in at place shown in the plans while laying the courses only and not later by removal of bricks already laid. The top layer of bricks of one or more thick wall coming in contact with R.C.C beam, slab and at window sill level etc shall be laid on edge as per direction.

Care shall be taken during construction to see that edges of bricks at quoins, sills, heads etc. are not damaged.

The verticality of the walls and horizontality of the courses shall be checked very often with plumb bob and spirit level respectively. All external wall should have fair face on exterior surface.

4.4 SCAFFOLDING

The scaffolding must be of approved type strong and rigid stiffened with necessary cross bearers and safe to prevent injury to persons or materials. The contractor shall have to allow other trades to make reasonable use of his scaffolding as directed by the Owner/ Architects. If for the interest of work the contractor have to erect scaffolding in the other properties including local bodies or Corporation, the arrangement for the same including the cost of licensing fees etc. shall have to be borne by the contractor and the Owner should be kept free from any liability on this account.

Put log holes shall be made good by bricks to match the face work when put logs are removed after ensuring that the holes behind are solidly filled in with 1:4:8 cement concrete.

4.5 CURING

All brick works shall be kept well watered for 14 days after laying. While pozzalana cement is used for mortar the curing shall be extended by one week at contractors expense.

4.9 MEASUREMENTS :

- a) Half brick thick and brick on edge walls shall be measured in sq.m unless otherwise mentioned.
- b) One brick wall and thicker walls shall be measured in cum. Brick walls up to and including 3 brick in thickness should be measured in multiples of half bricks which shall be deemed to be inclusive of mortar joints. Widths of more than three bricks in walls will be measured actually and limited to the width specified.
- c) No deduction or addition shall be made on any account for:-
 - Ends of dissimilar materials (i.e. joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels steps etc.) up to 0.1 sqm in section.
- d) For details of measurements not mentioned elsewhere in the contract, the method of measurement should be as per relevant I.S. Code.

4.B CEMENT PLASTER (INTERNAL & EXTERNAL)

- a) Preparation of Surface the walls to be plastered to have all joints raked out to a depth of 10 mm, if not already done. R.C.C surface shall be properly hacked to get good key to the plaster. All dust and oily matter, if any, shall be brushed and cleaned and surface to be plastered shall be kept wet for 6 hours before plastering is commenced.
- b) Proportion of Mortar : The plaster in walls, lintels, columns, ceiling, ceiling beams, projected slabs, rails, chajja, marquise, domes etc. shall be done with sand cement mortar in the proportion as described in the Schedule of Quantities). No more cement mortar shall be prepared than that can be used within half an hours.
- c) Application of Plaster : The mortar shall be applied evenly with force on the surface to be plastered. The mortar surface shall be finished at once by being rubbed over with a trowel till the cement appears on the surface. All corners, angles and junctions shall be truly vertical and horizontal as the case may be, carefully and neatly finished. Rounding of corners and junctions where required shall be done without extra charge. The mortar shall adhere to the surface intimately when set and there should be no hollow sound when struck.
- d) When neat cement finish is specified over the plaster surface, a coat of pure Portland cement slurry, 1.5 mm thick shall be applied and well rubbed to the plaster surface while the plaster surface is still fresh.
- e) When no finish is specified, the plastered surface shall be rubbed well to an even plane with a wooden float for external surface and finished smooth with a steel trowel for internal surface.
- f) Rates to include Apart from other factors mentioned elsewhere in the contract rates for the item of plaster shall include for the following :-
 - i) Erecting, dismantling and removing the scaffolding.
 - ii) Preparing the surface to receive the plaster.
 - iii) Providing cement plaster of the specified average thickness.
 - iv) All labour, materials, use of tools and equipment to complete the plastering as per specification.

- v) Curing for 7 days
- vi) Any moulding work if shown on the drawings or as specified unless separately provided in the tender.
- vii) Labour for plastering the surface in two operations when thickness of plaster is more than 12 mm thick. T.S. Civil-37
- viii) Plaster work in bends, arises, rounded angles, fair edges, narrow returns, quirks 'V' joints, splays, drip mouldings, making good to metal frame junctions with skirting of dados narrow width and small quantities, making good round pipes, conduits, timbers, sills, brackets, railings, etc and making good after all the sub-contractors or nominated sub-contractors have done their work.
- ix) Neat cement finish when specified in the item.

a) Mode of Measurement

Plaster shall be measured in square metre.

Walls : The measurement of wall plastering shall be taken between the walls or partitions (the dimensions before plastering shall be taken) for the length and from the top of floor or skirting depending upon the situation to the ceiling for the height.

Deductions : For jambs soffits, sills, etc. for openings not exceeding 0.5 sq.m each in area, ends of joists, beams, posts, girders, steps etc. not exceeding 0.5 sqm each in area, and opening not exceeding 3 sqm each, deductions and additions shall be made in the following manners :-

- a) No deductions shall be made for ends of joists, beams, posts, etc. and openings not exceeding 0.5 sqm and no additions shall be made for reveals, jambs, soffits sills etc. of these openings nor for finishing the plaster around ends of joists, beams, posts, etc.
- b) Deductions for openings exceeding 0.5 sqm but not exceeding three sqm each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills etc. of these openings :-
 - i) When both faces of wall are plastered with the same type of plaster, deduction shall be made for one face only.
 - ii) When two faces of wall are plastered with different type of plasters or if one face is plastered and other pointed, deductions shall be made in the plaster or pointing on the side on which the width of reveals is less than that on the other side but no deduction shall be made from plaster or pointing on the other side. Where widths of reveals on both faces of wall are equal, deduction of 50 per cent of area of opening on each face shall be made from areas of plastering and/or pointing as the case may be.
 - iii) When width of door frame is equal to thickness of wall or is projecting beyond thickness of wall, full deduction for opening shall be made from each plastered/pointed face of the wall.
 - iv) In case of openings of area above 3 sqm each deductions shall be made for the openings but jambs, soffits and sills shall be measured. T.S. Civil-38 Ceiling
 - a) Ceiling shall be measured between the walls or partitions and the dimensions before plastering shall be taken.
 - i) Ceiling with projected beams shall be measured over beam and the plastered sides of beams shall be measured and added to plastering on ceilings.

