Package #1: Skeleton Works

Technical Specifications

September, 2010
Section 2A - Architectural and Civil Works

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SECTION-B: GENERAL

B1 SCOPE OF WORK
These Specifications cover the construction, completion, and maintenance, of the following buildings and related works including internal and external works at The Ministry of Foreign Affairs, together with all the services and any other works as directed by the Engineer:

B2 DRAWINGS
A list of Contract Drawings (for tendering) available at the date of tender is included on the front page of the Drawing Books and at the end of these Specifications.

B3 CONTRACTORS PRICE
The Contractor's price shall include for all material delivered to the site, labour and plant requirements necessary for the completion of the Contract in accordance with the Contract Drawings and Specifications and B.O.Q.

B4 USE AND PROTECTION OF SITE
The Contractor shall take such measures and exercise such care to protect the site as shown on the Site Plan during the course of the Works as directed by and to the entire satisfaction of the Engineer.

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

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

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

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

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

B5 MATERIALS FOUND ON SITE
Any sand, gravel or other building materials on the Site shall not be used in the execution of the Works without the prior written consent of the Engineer which shall not be unreasonably withheld.

B6 TEMPORARY STORMWATER DRAINAGE
The Contractor shall ensure that the whole of the Site, is kept free from the risk of storm water flooding and shall provide such temporary ditches, gullies and the like as may be necessary and shall at completion of the Works backfill such excavations and make good all works disturbed.

B7 SHOP DRAWINGS
If at any time before the commencement or during the progress of the work it appears to the Contractor that for the proper execution of 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 at no additional cost to the client. On the other hand, the Engineer shall have authority to order at any time and the Contractor agrees to provide any number of shop drawings, which, in the opinion of the Engineer are necessary for the proper execution of a specified work. The Contractor shall not proceed with the above-mentioned work unless the
Engineer approves these shop drawings.

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

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

Shop drawings shall be approved or returned to the Contractor for alteration or amendment within two (2) weeks of their receipt by the Engineer. Shop drawings returned for alteration or amendment shall be resubmitted for approval.

Altered or amended shop drawings shall show the nature of the alteration or amendment in a revision block on the drawings with a revision number or letter and the date of the revision.

**B8 AS-BUILT DRAWINGS**

All prints of the Drawings, where required, shall be corrected by the Contractor and submitted to the Engineer for approval as the Works proceed. Upon the completion of the Works, the contractor shall prepare a completely new set of drawings for the project as executed and submit same in duplicate to the Engineer for approval. When approved by the Engineer, the Contractor shall submit one transparency and six copies of all drawings dully marked "As-Built". The final payment shall not be made except for the actual works that have been completed in accordance, with the specifications and have been duly presented on the "As-Built Drawings".

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

**B9 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. Put 10gm holes shall be made good to match the adjacent surface as the scaffolding is dismantle. The Contractor shall be entirely responsible for all safety precautions in connection with the scaffolding and for its entire sufficiency for the work.

**B10 PROTECTION**

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

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

**B11 SEPARATE CONTRACTS**

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

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

His failure so to inspect and report shall constitute an acceptance of the other Contractor's works as fit and proper for the reception of this work, except as to defects which may develop in the other Contractor's work after the execution of his work.
To ensure the proper execution of his subsequent work, the Contractor shall measure work already in place and shall at once report to the Engineer any discrepancy between executed work and the Drawings.

B12 DEFINITIONS
"Approved" "directed" or "selected" means the approval, direction or selection by the Engineer.

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

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

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

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

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

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

B13 STANDARDS
In this Contract reference is made to the Standards, Codes of Practice and Specifications issued by the following organizations, hereinafter referred to by the following abbreviations.

AASHO Means the American Association of State Highway officials.
ACI Means the American Concrete Institute.
AFNOR Means the Association Francaise de Normalisation.
AISC Means the American Institute of Standards and Codes.
ASA Means the American Standards Association.
ASHRAE Means the American Society of Heating, Refrigerating and Air-Conditioning Engineers.
ASTM Means the American Society for Testing and Materials.
AWWA Means the American Water Works Association.
BS Means the British Standards Institution.
CMA Means the Cable Manufacturers Association.
DIN Means the Deutscher Normausschuss.
NEMA Means the National Electrical Manufacturers Association.
NEPA Means the National Fire Protection Association.
VDE Means the Verban Deutscher Elektrotechniker.

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

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

B14 MATERIALS GENERALLY
All materials and manufactured goods are to be the best of their respective kinds and as described in the Specifications, and the Contractor shall submit for the approval of the Engineer a list of names and addresses of the manufacturers, the trade marks and types of all materials and articles he proposes to employ together with all specifications and descriptions that may be required in this connection before any orders are placed. Samples are to be provided if requested by the Engineer. Where a particular proprietary product, supplier's catalogue is referred to in the specifications or shown on the drawings the material specified may be obtained from another source provided it is similar, equal and approved by the Engineer.

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

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

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

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

Where manufacturers’ recommendations have been entered into the Contract Documents, it is for the purpose of giving an indication to the Contractor of the Engineer's intentions on the application and use of the material.

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

B 15 MATERIALS TO BE IMPORTED
The Contractor is required to take the necessary measures to obtain materials or items which are not obtainable on the local market and which have to be ordered from abroad. (refer to the ASHA mandatory clause in Condition of Contract, Enclosure 12)

No claim will be considered for extension of the Contract Period due to non-availability of materials.

B 16 CONTRACTOR TO VERIFY SITE MEASUREMENTS
The Contractor shall check and verify all site measurements wherever requested by other specialist contractors or by nominated or other sub-contractors to enable them to prepare their own shop drawings, and pass on the information with sufficient promptness as will not in any way delay the works. A copy of all such information passed on shall be given to the Engineer.

B 17 SAMPLES
The Contractor shall furnish for approval, with reasonable promptness all samples of materials and workmanship required by the Engineer. The Engineer shall check and approve such samples with reasonable promptness for conformance with the design concept of the Works and for compliance with the information given in the Contract Documents. The work shall be in accordance with approved samples.

a) All material samples shall be delivered to the Engineer's Office with all charges in connection therewith paid by the Contractor.
b) Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Engineer.
c) Samples shall be furnished so as not to delay fabrication allowing the Engineer reasonable time for consideration of the sample submitted.
d) Each sample shall be properly labeled with the name and quality of the material, manufacturer's name, name of project, the Contractor's name and the date of submission and the specification number to which the sample refers.

B 18 CUTTING AND PATCHING
The Contractor shall be responsible for all cutting, patching and making good in all trades for all work and his prices will be deemed to include for all such cutting and patching and making good.

B 19 SITE OFFICES, LATRINES, ETC.
The Contractor shall provide and maintain on the Site for the duration of the Contract the following Consultant office and is to submit layout to consultant for approval:
a) A temporary office of 70m² area for the accommodation of 6-7 members of the Consultants Supervision Team. The office shall include AC system hot and cold, lighting fixtures and installations, toilet, kitchenette with tea boy, telephone –2lines. Also included are the following office equipment: Copier, 4 Pcs, fax with line. Such office shall be open at all reasonable hours to relieve instructions, notices or other communications.

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

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

All offices, latrines, Sign-Boards and other temporary works shall be dismantled and removed from the site on completion of the whole Contract and the Site shall be made good and left clean and tidy to the satisfaction of Engineer.

B 20 ATTENDANCE ON THE ENGINEER
The Contractor shall for the duration of the Contract supply sufficient attendance for the Engineer's supervisory staff and shall maintain and pay all water, electricity, telephone charges and the remuneration of the tea boy and shall keep the Site Office and supervision cabins in a clean and sound condition at all times.

The Contractor shall be responsible for the security of the Site Office and its contents at all times and shall employ watchmen for these purposes.

B 21 TESTING
The Contractor shall allow in his rates and prices for the cost of carrying out tests necessary for compliance with the Specification in independent laboratories outside the Site.

B 22 TEMPORARY BUILDINGS
The Contractor shall provide and maintain on the Site sheds, offices, messrooms, sanitary accommodation and other temporary works of any kind whatsoever for the Contractor's supervisory staff and work people and for Sub-Contractor's staff employed upon the works.

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

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

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

B 23 TEMPORARY WORKS AND REINSTATEMENT
The Contractor shall provide and maintain all temporary roads and tracks necessary for movement of plant and materials, and clear same away at completion and make good all works damaged or disturbed.

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

The Contractor shall divert as required, at his own cost and to the approval of the Engineer, all public utilities encountered during the progress of the works, except those specially indicated on the drawings as being included in the Contract.
Where diversions of services are not required in connection with the permanent works, the Contractor shall uphold, maintain and keep the same in working order in existing locations.

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

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

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

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

B 24 WATER FOR THE WORKS
The Contractor shall make all necessary arrangements and provide all water for the proper execution of the works, together with all transport temporary plumbing, storage and distribution, pay all charges and later adapt and maintain temporary work as necessary remove and make good at completion.

B 25 ELECTRICITY FOR THE WORKS
The Contractor shall make all necessary arrangements and provide all artificial lighting and power for the proper execution and security of the works and its protection. With all meters temporary wiring and fittings, pay all charges and alter, adapt and maintain the temporary works as necessary and remove and make good at completion.

B 26 PROVISION OF PLANT AND TOOLS
The contractor shall provide and install all necessary hoists, ladders, scaffolding, staging, tackles, tarpaulins, tools, vehicles, and other plant (mechanical and other wise) and allow for altering, adapting and maintaining them in good condition as necessary and eventually removing from site and making good.

B 27 TEMPORARY BARRIERS, FENCING ETC...
The contractor is to provide all temporary barriers, fencing, hoardings, guard rails, gates and the like as may be necessary, to protect the public and others, for proper execution of the works and shall remove and clear away at completion of the Works and make good all work disturbed.

B 28 NAME BOARD
If instructed by the Engineer, the Contractor shall provide, erect and maintain a name board at the entrance of the Site bearing the Employer's and Consultant's name, the name of the Project and his name, his Sub-Contractor's names and such other names and information as the Engineer may direct to be inserted upon it. The name board shall be not less than 3000 x 2000mm lettered in Arabic and English and in an approved form. The Contractor shall remove such name board from the Site on completion of the Works.

B 29 PROTECTIVE CLOTHING
The Contractor shall provide and maintain all necessary protective and safety clothing and equipment for the operatives and Site Staff.

B 30 INCONSISTENCY IN CONTRACT DOCUMENTS
The Contractor shall execute the Works according to provisions of the Contract Documents. Any work indicated in one of the documents but omitted and/or stated in one or more of the other documents shall be treated as though it were included in all of them.
If any two documents of the Contract conflict as to the quality of the work to be carried out, the discrepancy shall be brought to the notice of the Engineer, who shall instruct the Contractor which of the two conflicting documents to regard as correct.

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

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

**B 31 ERRORS IN COMPUTING CONTRACT DOCUMENTS**

The Contractor shall be responsible for any error which he makes in computing any quantities of material and labour required or costs involved or through any lack of knowledge of the Site or misunderstanding of anything shown or implied on the Drawings or in the Specifications and/or the Bills of Quantities.

The Contractor must refer any discrepancy in the Drawings or the Specifications to the Engineer before proceeding in any of the Works otherwise the decision of the Engineer as to the interpretation of the discrepancy will be final.

Any item or items of work not specifically shown on the Drawings or referred to in the Specifications but which would be necessary for the proper construction of the works in accordance with the best practice is implied and must be included for as incidental to the Contract Sum.

Any item for which the Contractor has not inserted a price in the Bills of Quantities shall be deemed to be covered by other prices or rates therein.

**B 32 SITE MEETINGS**

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

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

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

**B 33 DAILY REPORTS**

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

**B 34 PHOTOGRAPHS AND ADVERTISING**

The Contractor shall supply once a week as directed by the Engineer unmounted three copies of an average of 20 photographs of a size not less than 250 x 200mm of such portions of the Works completed and in progress as may be directed by the Engineer. The negatives of the photographs shall be the property of the Engineer and no prints from these negatives may be supplied to any person unless under the authority of the Engineer.
The Contractor shall not display or permit advertisements to be displayed on the Site without consent of the Resident Engineer.

The Contractor shall treat all details related to the Contract as confidential. No photographs or other documents may be used for advertising or other purposes without the written authority of the Employer, which authority shall not be unreasonably withheld.

**B 35 ACCESS FOR THE ENGINEER**

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

**B 36 SETTING OUT AND LEVELLING**

Prior to commencement of any site work the Contractor shall arrange to record on an approved grid existing site ground levels and agree with the Engineer's Representative the accuracy thereof by preparing a record drawing signed by the Contractor's Agent and the Resident Engineer.

The Contractor shall set out and level the Works and obtain the approval of the Engineer's Representative before commencing construction.

**B 37 PROGRAM TO BE FURNISHED**

The Contractor shall prepare a program for the Works, including the work of sub-contractors and other work concurrent with the Contract, using the critical path network method (CPM).

The Contractor shall submit three (3) copies of program to the Engineer within seven (7) days of the date of the Engineer's Order to Commence the Works and shall keep one copy in the site office.

Submission of program will not relieve the Contractor of his obligations to apply in writing for instructions as required by the Conditions of Contract.

Receipt of programs by the Engineer shall neither affect the Contract completion date nor relieve the Contractor of his responsibility to complete the Works by this date.

The contractor shall review the program once each month to take account of any circumstances that arise affecting the progress of the Works, and shall produce a revised program and submit copies to the Engineer.

**B 38 OVERTIME**

If the Contractor deems it necessary to execute work outside normal working hours in order to complete the Works by the agreed date, or for any other purpose, he shall obtain the consent of the Engineer before doing so. Such work shall be entirely at the expense of the contractor who shall comply in all respects with the requirements of any local labour code. The Contractor shall meet at his own expense all wages and expenses due to the Engineer or his supervisory staff as a result of working overtime.
B 39  **CANCELLATION DUE TO SLOW PROGRESS**  
If the Engineer shall be of the opinion that having regard to the state of the Works at any time, the Contractor will be unable to complete any section of the works by the time specified or by such extension thereof as he may be entitled to under the Contract and the Contractor has failed to carry out steps and to expedite the work in accordance with the Conditions of Contract or, if the Engineer is of the opinion that such steps are inadequate, the Engineer may, by written order omit the whole or any part of the uncompleted work included in that section and the Employer shall be at liberty to execute such omitted work by his own workmen or by other contractors. If the cost of such omitted or uncompleted work shall exceed the sum which would have been payable to the Contractor on due completion of the said work, then the Contractor shall, upon demand, pay to the Employer the amount of such excess and it shall be deemed a debt due by the Contractor to the Employer and shall be recoverable accordingly.

B 40  **DELAYS**  
The Contractor will be deemed to have allowed for all delays caused by difficulty in obtaining labour and materials or by suspension of part or the whole of the Works due to adverse and inclement weather conditions.

B 41  **NON-PRODUCTIVE TIME**  
The Contractor shall allow for all costs incurred by non-productive time and all other expenses in connection with overtime.

B 42  **SAFETY, HEALTH AND WELFARE**  
The Contractor shall comply with enactments, regulations and working rules relating to safety, health and welfare of workpeople.

B 43  **CONTRACTOR'S SITE REPRESENTATIVE**  
The Contractor's Site Representative in charge of the Works shall be a duly graduated Civil Engineer having at least twelve (12) years experience in the superintendence of similar works and shall be required to have a proper command of the Arabic and English Languages. Also a Civil Engineer of 5-7 years experience and site civil foreman with ten (10) years experience. Also, an electrical engineer of not less than 8 years experience. Also, a mechanical engineer of not less than 8 years experience.

B 44  **ATTENDANCE**  
The Contractor shall allow for and be responsible for the general attendance of one trade upon another.

B 45  **OFFICIAL VISITORS**  
The Contractor shall at all times when authorized by the Engineer give free undisputed access and all facilities to any authorized employee of the Employer, any representative of the Government or any person authorized by the Government wishing to view or inspect any part of the works or the materials to be incorporated therein.

B 46  **CARE OF THE WORKS, ETC.**  
The Contractor shall keep all persons (including those employed by sub-contractors) under control and within the boundaries of the Site. He will be held responsible for the care of the existing premises and of the Works generally until their completion, including all work executed and materials, goods and plant (including those of sub-contractors and suppliers) deposited on the Site; together with all risks arising from the weather, carelessness of work people, damage or loss by theft or any other cause; and he shall make good at his own expense of such damage and loss.
B 47  WORK AT COMPLETION
The Contractor shall clean the Works thoroughly inside and out removing all splashes, deposits, rubbish and surplus materials.

The Contractor shall remove all temporary markings, coverings and protective wrappings unless otherwise instructed.

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

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

The Contractor shall leave the Works secure with all access locked. He shall account for all keys and shall hand over to the Employer with itemized schedule retaining duplicate schedule signed by the Employer as receipt.
SECTION-C: EXCAVATIONS AND EARTHWORKS

C 1 GENERAL
The Contractor shall carry out all excavations, filling, backfilling and all other earthworks required in whatever material may be encountered. The contractor shall verify by use of test boreholes at various locations the soil report conclusions, and shall report back to the engineer.

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

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

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

C 2 SOIL INFORMATION
The Contractor shall be deemed to have visited the Site of Works and satisfied himself as to the nature of the ground and made himself conversant with the local conditions to be encountered during the execution of the Contract.

C 3 MATERIALS
C 3.01 BACKFILL AND FILL
All fill material should be as specified in section “C13”.

C 3.02 Water
Water shall be clean potable water as specified under "Concrete Work"

C 3.03 Concrete
Concrete used as fill for making up to correct level areas of over-excavation shall be, where required by the Engineer, of Class "B" as specified under "Concrete Work".

C 3.04 Hardcore
Hardcore under floor paving, etc., (where shown on the Drawings) shall consist of tough, sound and durable rubble stones (maximum 150mm), free from coatings, dries, seams or flows of any character. Fine aggregate for blinding the interstices of hardcore bed shall be as described in "Concrete Work".

C 3.05 Gravel and Sand Fill
Gravel fill shall consist of graded gravel 50mm. down to 20mm. and blinded with clean coarse sand.

C 4 SITE PREPARATION
C 4.01 Existing Public Utilities
The Contractor shall ascertain the whereabouts of all existing public utilities on the site, both above and below ground. Such utilities shall be removed, sealed or rerouted in a manner prescribed by the Public Authorities concerned at the Contractor's own expense. The Contractor shall also be held responsible for all damages entailed on any of the public utilities adjacent to the Site resulting from the Works.

C 4.02 Removal of Existing Structures and Other Obstructions
This work shall include, but not be limited to, the removal of existing structures and other obstructions interfering with the Works. The salvaging of any of these materials for the use of the Employer shall be as directed by the Engineer and unwanted or surplus materials shall be disposed off the Site in a satisfactory manner at the Contractor's expense.
C 4.05 Cleaning and Grubbing
The Contractor shall perform the clearing and grubbing (if any) of top soil consisting mainly of loose soil, vegetable and organic matters, drift sand, unsuitable soil and rubbish by scarifying the areas to be excavated and side-walks to a minimum depth of 300mm from the natural ground level.

All materials resulting from the above operations shall be removed from the Site, loaded and transported and off loaded, spread and leveled to approved dumps as directed by the Engineer.

C 5 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.

C 6 Excavation
C 6.01 General
Excavate in any material whatsoever found including rock to reduce levels and to form foundations, bases, trenches, septic tanks, cesspools, pits and the like to depths shown on the drawings.

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

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

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

The Engineer's Representative shall approve bottoms of excavations before any concrete is laid.

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

C 6.02 Excavation in Rock
Rock shall be defined as boulders, exceeding 0.25m3 in volume or any kind of stone or rock formation which in the opinion of the Engineer's Representative requires for its removal drilling and blasting, wedging, sledging or barring or breaking up with power-operated hand tool.

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

Blasting by explosives shall not be permitted without obtaining the written approval of the Engineer. If such approval is given the Contractor shall be solely responsible for :-
1. Obtaining permits, keeping record.
2. Storing explosives in a place far from any person's reach.
3. Taking all necessary precautions in compliance with the regulations pertinent to the use of Explosives.
4. Any damage that may occur due to blasting operations where rock is encountered it shall be carefully excavated and the Contractor shall not be entitled to additional compensation unless otherwise specified in the Bills of Quantities.
C 7  **PLANKING AND STRUTTING**
The terms "planking and strutting" will be deemed to cover whatever methods the Contractor elects to adopt for shoring the sides of excavation and also for planking and strutting the excavations against the sides of adjoining buildings, public roadways, etc. The Contractor will be held responsible for shoring the sides of all excavations, adjoining building and the like and no claim for additional excavation, concrete or other material and workmanship will be considered in this respect.

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

C 8  **KEEPING EXCAVATIONS FREE FROM WATER**
All excavations shall be kept clear of water by pumping or bailing or by well-point dewatering, but the latter system shall not be employed if any danger exists of withdrawing water from the foundations of the adjoining buildings and such water shall be discharged clear of the Works and the method adopted shall in no way contravene the regulations of the local Authorities.

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

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

C 9  **STORING OF SUITABLE EXCAVATED MATERIAL**
During excavation, materials suitable for backfill and fill shall be stockpiled on the Site at sufficient distance from the sides of the excavation to avoid over-loading and prevent cave-ins or mixing with the concrete during the construction of foundations.

C 10  **DISPOSAL OF UNSUITABLE SURPLUS EXCAVATED MATERIAL**
Upon the order of the Engineer, all unsuitable and surplus excavated materials shall be immediately removed, loaded and transported off the Site area by the Contractor to approved dumps and he shall abide by the relevant local regulations.

C 11  **EXCAVATION FOR FOUNDATIONS AND SUB-STRUCTURE**
The levels to which the Contractor shall excavate are shown on the Drawings. Should it be found necessary to reach more suitable strata, the Contractor shall perform all additional excavations. The difference in approved quantities or excavations, concrete and reinforcement shall be adjusted and paid for at the Contract Unit Rate.

During excavation for foundations, the bottom layer of excavation of minimum 200mm in thickness, shall be left undisturbed and subsequently removed manually only when the concrete in blinding is about to be placed in order to avoid softening or deterioration of the surfaces of the excavation.

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

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 nature of the foundation material.

C 12  **EXCAVATION FOR TRENCHES**
C 12.01  **General**
The Contractor shall provide all forms and bracings, and excavate trenches necessary to install all drainage, sewer, water supply, electrical and telephone cables to the lines and grades complete in strict conformity with these specifications, applicable drawings and/or as directed by the Engineer.
C 12.02 Grading
The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its length, except for the portions of the pipe where it is necessary to excavate for bore-holes and for proper sealing of joints. Bell-holes and depressions 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 surface of the bottom trench shall be excavated 15mm deeper. Such depth, if in rock, shall be backfilled with concrete class "B" as specified under "Concrete Work" 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 200mm 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 over the top of 300mm and avoid interference of water lines with other utilities. Width of trench shall be a maximum of 200mm on each side of the pipe.

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

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

C 13 BACKFILL AND FILL
Approved suitable excavated material as specified under "MATERIALS" shall be used in the backfilling and filling next to footings, foundations underground structures, under sub-floors, etc. and shall be laid in layers not exceeding 250mm thick and compacted with compaction equipment or mechanical tampers when not possible to use such compaction equipment, to the satisfaction of the Engineer. Moisture content shall be adjusted as directed by the Engineer and of dry weight percentage compaction as stated in BOQ in accordance with standard Proctor Compaction Test ASTM 698 shall be achieved.

Materials to be used for filling behind basement walls, shall be:
One- Soil or soil-rock mixture which is free from organic matter or other deleterious substances.
Two- Shall not contain rock or lumps over 15cm in greater dimension, and not more than 15% larger than 7cm.

The Contractor shall obtain all required fill from approved sources and transport same to the Site of work at his own expense.

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

Trenches shall not be backfilled until all required tests are performed and until the Engineer has verified that the utility systems have been installed in accordance with the Specifications and the Drawings. The backfill in the pipe zone must be placed and completed so as to provide and maintain adequate and even support around the pipe wall. If mechanical compaction equipment is used, care must be taken to prevent direct contact with the pipe.
C 14  **BED OF HARDCORE**
The bed of hardcore, where shown on the Drawings, shall be of an approved rubble stone as specified under "MATERIALS" and shall be laid under floor pavings or as stated on the drawings and directed by the engineer. The rubble stone for hardcore shall be band-packed with sharp edge upward and wider (natural face) laid on the ground. The interstices of hardcore shall be filled with approved fines, wetted sufficiently and well consolidated. The thickness of the hardcore bed shall be as shown on the Drawings.
SECTION-D: CONCRETE WORK

D 1 SCOPE
This section describes and specifies work required for plain and reinforced concrete, including formwork intended to be used for the Project under the Contract in accordance with the Drawings, Bills of Quantities and as directed by the Engineer.

At the beginning of each month, the Contractor shall submit to the Engineer his concreting program for that month, stating the pouring dates, so that adequate checking and supervision can be provided before and during the pouring operation. No pouring shall be allowed unless the Engineer has been given a 24 hour advanced written notice of the intention to pour.

D 2 APPLICABLE TESTS AND CODES
Prior to commencement of Concrete Work, the Contractor shall submit samples to the Engineer before sending them to the laboratories for testing, to establish the probability of the materials passing tests for specified requirements.

After the Engineer is convinced that the samples with their sources are truly representative samples and sufficient materials are available on the Site for the uninterrupted progress of concrete works according to the approved project schedule of works under the Contract, the samples shall be approved and sent to the laboratories for testing.

The Contractor shall have the tests made, at his own expense in the laboratories approved by the Engineer.

All concrete aggregates, cement and water shall be sampled and tested as frequently as deemed necessary by the Engineer. The Contractor shall, at his own expense, supply all test samples. Samples shall be obtained in accordance with the latest editions of the American Society for Testing and Materials (ASTM), American Concrete Institute (ACI) Code or any equally approved standard.

D 3 MATERIALS
D 3.01 Cement
(A) General
Cement shall be Portland Type, originating from approved manufacturers, obtained in sealed and labeled bags, each 50kgs. net capacity, name and brand of the manufacturer shall plainly be identified thereon and delivered to the Site in good condition. Cement delivered in bulk shall be accepted only if a central mixing plant is used. The quality of cement shall conform to the Standard Specification for PORTLAND CEMENT of ASTM Designation: C 150 - 74 Type I - for use in general concrete construction.

(B) Storage of Cement
All cement shall be stored in suitable weatherproof and approved storage sheds that will protect the cement from dampness. These storage sheds shall be erected in locations approved by the Engineer. Provisions for storage shall be ample, and the consignment of cement as received shall be separately stored in such a manner as to provide easy access for the identification and inspection of each consignment. Cement shall be used in the order of its delivery to site, new deliveries shall not be used unless the cement from earlier deliveries has been completely used. Stored cement shall meet the test requirements at any time after storage when the Engineer at the expense of the Contractor orders a retest. The Contractor shall keep accurate records of the deliveries of cement and of its use in the work, copies of these records shall be supplied to the Engineer in such form as may be required.

(C) Alkali Content
The total alkali content (NA₂O + 0.658K₂O) shall not be in excess of 0.60 percent by weight of cement
when tested in accordance with "Standard Method for Chemical Analysis of Hydraulic Cement ASTM C 114-69".

(D) Expansion due to Sulfate Exposure
The expansion in fourteen (14) days shall be less than 0.045 percent when tested in accordance with "Standard Method of Test for Potential Expansion of Portland Cement Mortars exposed to Sulfate ASTM C452-68".

(E) Heat of Hydration
The heat of hydration shall not exceed 70 calories per gram and 80 calories per gram at seven (7) days and twenty-eight (28) days respectively when tested in accordance with "Standard Method of Test for Heat of Hydration of Portland Cement ASTM C186-68".

(I) Autoclave Expansion
The autoclave expansion shall not exceed 0.80 percent when tested in accordance with "Standard Method of Test of Autoclave Expansion of Portland Cement ASTM C151-68".

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

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

Packages of cement varying by 5 percent or more from the specified weight shall be rejected. And if the average weight of packages in any consignment, as shown by weighing 50 packages taken at random, is less than that specified, the entire consignment shall be rejected. The Contractor shall remove such consignment forthwith from the Site at his own expense and replace it with cement of satisfactory quality.

Stale cement or cement reclaimed from cleaning bags shall not be used and cement that for any reason has become partially set, or contains lump or caked cement, shall be rejected.

D 3.02 AGGREGATES
(A) General Requirements
All aggregates shall consist of tough, hard, durable uncoated particles. The Contractor shall be responsible for the processing of this material to meet the requirements of the Specifications. Approval of aggregate quality and/or gradation shall not waive the responsibility of the Contractor to provide concrete of having the minimum strength specified.

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

D 3.03 Fine Aggregate
(A) General Requirements
All fine aggregate for concrete shall conform to Standard Specification for Concrete Aggregates of ASTM
Designation: C-33 and also to the detailed requirements given in Table 300 A (appended herebelow). It shall not contain harmful materials such as iron pyrites, coal, mica, shale, alkali, coated grains, or similar laminated materials such as soft and flaky particles, or any material which may attack the reinforcement, in such a form and in sufficient quantity to affect adversely the strength and durability of the concrete. Fine Aggregate passing sieve No. 4 shall not contain any voided shells.

Fine aggregates shall be washed thoroughly with demineralized water to ensure compliance with the appropriate requirements and limitations of the specifications. The Contractor shall provide and maintain for this purpose sand-washing plant and equipment.

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

<table>
<thead>
<tr>
<th>Grading Sieve:</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>95-100</td>
</tr>
<tr>
<td>8</td>
<td>80-100</td>
</tr>
<tr>
<td>16</td>
<td>50-85</td>
</tr>
<tr>
<td>30</td>
<td>25-60</td>
</tr>
<tr>
<td>50</td>
<td>10-30</td>
</tr>
<tr>
<td>100</td>
<td>2-10</td>
</tr>
<tr>
<td>200</td>
<td>0-3</td>
</tr>
<tr>
<td>Fineness modulus</td>
<td>2.5-2.15</td>
</tr>
</tbody>
</table>

Organic Impurities: The color shall have an intensity not DANKER THAN two-thirds the intensity of the standard color solution. (Not darker than Plate 2 as determined by the Standard Method of Test for Organic Impurities in Sands for Concrete of ASTM Designation:C - 40)

Chlorides soluble indilute: Nitric Acid Not more than 0.10 percent by weight when expressed as sodium chloride (NaCl).

Total acid soluble sulphates: Not more than 0.50 percent by weight when expressed as sulfur trioxide (SO₃).

Silt: Not more than 2 percent.

Soundness: Compression ratio not less than 95 percent.

Weighted average loss when subjected to 5 cycles of the soundness test using Magnesium sulfate, not more than 10 percent.

D 3.04 Coarse Aggregates

(A) General Requirements

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

<table>
<thead>
<tr>
<th>Deleterious Substances</th>
<th>Max. Permissible Limit Percent by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Soft fragments</td>
<td>........................................ 2.0</td>
</tr>
<tr>
<td>- Coal and lignite</td>
<td>........................................ 0.5</td>
</tr>
<tr>
<td>- Clay lumps</td>
<td>........................................ 1.0</td>
</tr>
<tr>
<td>- Materials passing the No. 200 sieve</td>
<td>........................................ 1.0</td>
</tr>
<tr>
<td>- Thin or elongated pieces (length greater than 5 times average thickness)</td>
<td>................................... 0.40</td>
</tr>
<tr>
<td>- Other local deleterious substances</td>
<td>........................................ 0.0</td>
</tr>
<tr>
<td>- Chlorides soluble in dilute Nitric acid when expressed as sodium Chloride (NaCl)</td>
<td>................................... 0.1</td>
</tr>
<tr>
<td>- Total acid soluble sulphates when expressed as sulfur trioxide (S03)</td>
<td>................................... 0.5</td>
</tr>
</tbody>
</table>

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

(D) Soundness
When the coarse aggregate is subjected to five alternations of the sodium sulfate soundness test, the weighed loss shall not exceed 10 (ten) percent. In the event of failing to obtain a satisfactorily result it shall be subjected to an alternate freezing thawing test.

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

<table>
<thead>
<tr>
<th>ASTM</th>
<th>PERCENTAGE BY WEIGHT PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grading (¼” to No. 4)</td>
</tr>
<tr>
<td>2 ½ inch</td>
<td>-</td>
</tr>
<tr>
<td>2 inch</td>
<td>-</td>
</tr>
<tr>
<td>1 ½ inch</td>
<td>-</td>
</tr>
<tr>
<td>1 inch</td>
<td>100</td>
</tr>
<tr>
<td>¾ inch</td>
<td>90-100</td>
</tr>
<tr>
<td>½ inch</td>
<td>-</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>20-55</td>
</tr>
<tr>
<td>No. 4</td>
<td>0-10</td>
</tr>
<tr>
<td>No. 8</td>
<td>0-5</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-1</td>
</tr>
</tbody>
</table>

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

The Combined aggregate gradation using the 3/4-in. to No. 4 gradation shall be used for concrete members with reinforcement too close to permit proper placement and consolidation of the concrete. Change from one gradation to another shall not be made during the progress of the work unless approved by the Engineer. Such changes are admitted only after being proved by test results.
D 3.05 Aggregate for Mortar

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

(B) Organic Impurities
Fine aggregate for mortar when subjected to the colorimetric test for organic impurities and producing a color darker than the standard color shall be rejected.

D 3.06 Water

(A) Quality of Water
Water for mixing of concrete shall be fresh, clean and free from injurious amounts of oil, acid, or any other deleterious mineral and/or organic matter. It shall not contain chlorides such as sodium chloride in excess of 700ppm. nor sulphates such as sodium sulphate in excess of 500ppm. It shall not contain any impurities in an amount sufficient to cause a change in the time of setting of Portland Cement of more than 10 percent, nor a reduction in compressive strength of mortar of more than 1 percent compared to results obtained with distilled water.

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

(B) Tests for Water
When required by the Engineer, the quality of the mixing water shall be determined by the Standard Method of Test for Quality of Water to be used in Concrete, as specified in B.S. 3148: 1959 Tests for Water for Making Concrete at the Contractor’s expense.

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

D 3.07 Admixtures
Admixtures in concrete shall be used only when approved by the Engineer and shall conform to the requirements of the ASTM Standard Specifications Designation C-494-92 for Water Reducing and Retarding Admixtures, and C-260-94 for Air-entraining Admixtures for Concrete.

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

Admixtures that contain relatively large amounts of chloride that accelerate corrosion of reinforcing steel shall be rejected.

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

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

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

Costs of such admixtures, sampling and testing shall be at the Contractor's expense and are deemed to be included in the Concrete unit price.
D 4 COMPOSITION OF CONCRETE

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

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

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

<table>
<thead>
<tr>
<th>Table I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class of Concrete</td>
</tr>
<tr>
<td>F’c 320</td>
</tr>
<tr>
<td>F’c 250</td>
</tr>
<tr>
<td>F’c 210</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class of Concrete</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>F’c 320</td>
</tr>
<tr>
<td>F’c 250</td>
</tr>
<tr>
<td>F’c 210</td>
</tr>
</tbody>
</table>
Table II is given for indicative purposes and is not binding.
Total chloride content (as NaCl) of any mix, including any chloride present in the other materials and in
the mix water, shall not exceed 0.35% by weight of cement in the mix.
Total sulfate content (as SO3) of any mix, excluding that present in the cement but including any present in
the other materials, shall not exceed 2.5% by weight of cement in the mix.

D 5 PROPORTIONS
D 5.01 General
After the materials provided by the Contractor have been accepted for the works, the proportions and
equivalent batch weights shall be determined which will produce concrete having not less than the strength
required.

D 5.02 Trial Mixes
The actual proportions shall be determined on the basis of trial mixes made by the Contractor and
conducted with the content being determined by means of yield test in accordance with American Society
for Testing Material (ASTM) Designation (C-138) at the Contractor’s expense. For the proportions which
will made for the required strengths, the cement content shown in Table 1 is considered to be the minimum
cement content required, provided, however, that if the materials supplied by the Contractor are of such a
nature or are so graded that proportions based on the minimum cement content cannot be used without
exceeding the maximum allowable water content specified in Table 1, the proportions will be adjusted so as
to require the least amount of cement which will produce concrete of the required plasticity and workability
without exceeding such maximum allowable water content. No additional compensation will be made for
the increase in quantity of cement required.

D 5.03 Contents
The mixes required will be designated in kilograms of fine and coarse aggregate exclusive of free water,
per sack (50 kilograms) of cement and in liters of total mixing water per sack of cement on the basis of the
required amount of cement per cubic meter of concrete.

D 5.04 Batch Weights
Since the proportions are designated in terms of aggregates in surface-dry condition, the equivalent batch
weights to be used in the work shall be corrected periodically to take into account the actual moisture
content of the aggregates at the time of use.

D 6 CONCRETE COMPRESSION AND SLUMP TESTS
D 6.01 Test Cylinders
The compression tests shall be performed as based on standard specification for compressive strength
cylindrical concrete specimens of ASTM Designation: C-39. Test cylinders made in the field shall have
a diameter of 6” and a length of 12” in accordance with ASTM Designation: C-31

In order to determine the crushing strength and density measurements of the concrete during construction
operation, at frequency intervals during the conduct of the work, the Contractor shall make and cure test
cylinders from the concrete as mixed for the work which shall be tested in accordance with ASTM
Designation C-39, after seven and twenty eight days or as directed by the Engineer. Concrete test
specimens shall be made and cured in accordance with the current issue of ASTM Designation C-31 for
field cured cylinders, and ASTM Designation C192 for laboratory cured cylinders. The specimens cured
under the laboratory conditions are for acceptance of the concrete in the structure so represented. The field-
cured cylinders shall be used for the control of curing and to determine when the structure may be put in
service.

If the average strength tests of the specimens cured under laboratory conditions falls below the minimum
allowable compressive strength at twenty-eight days, the concrete mix shall be redesigned. If the average
strength of the specimens cured under field conditions for the concrete placed in the structure falls below
the minimum allowable compressive strength required, the concrete shall be removed and replaced to secure the required strength. In the determination of the average compressive strength of the specimens, no single cylinder specimen shall have strength less than eighty five (85%) of the specified strength.

The Contractor shall provide, at his own expense, three (3) sets of four (4) cylinders for each one hundred (100) cubic meters of concrete or fraction thereof, placed during a single day run of any one pour forming a unit or work, or as deemed necessary by the Engineer or Engineer's Representative.

All tests shall be carried out on dry specimens after seven and twenty eight days of curing and such sampling and testing shall be carried out in a laboratory approved by the Engineer at the Contractor's own expense.

The Engineer may request extra cylinders to be made for testing at three days whenever he deems necessary. All such tests are at the Contractor’s own expense.

In case test cubes will be used for the daily testing of concrete, then the contractor shall submit test results for the trial mixes using both cylinders and cubes to develop the correlation factor between test results between test cylinders and test cubes for each type of concrete at least 10 days prior to commencement of work. This does not relieve the Contractor from conducting cylindrical tests at the request of the Engineer, the cost of which falls at the Contractor and is deemed to be included in the concrete unit price.

D 6.02 Slump Tests
Slump Tests shall be carried out periodically to ensure the appropriate water cement ratio in accordance with the Standard Method of Test of Slump of Portland Cement Concrete of the ASTM Designation: C-143

D 6.03 Test of Hardened Concrete in the Structure
Where the results of specimens indicate that the concrete does not meet specification requirements, core boring tests, conforming to the current issue of ASTM Designation: C-42 shall be performed, as directed by the Engineer, all at the Contractor's expense.

D 7 MEASUREMENT OF MATERIALS
Materials shall be measured by weight, except as otherwise specified or where the Engineer specifically authorizes other methods. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Each size of an aggregate and the cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities can be measured to within 1 percent of the desired amount. Cement in standard packages (sack) need not be weighed. The mixing water shall be measured by a measuring device susceptible of control accurate to plus or minus half percent of the capacity of the tank but not exceeding 2 liters. All measuring devices shall be subject to the Engineer's approval.

D 8 MIXING OF CONCRETE
D 8.01 General
Unless otherwise authorized by the Engineer, concrete shall be machine mixed.
The mixing of concrete or mortar shall not be permitted when the temperature is above 40°C or when the temperature is below 5°C.

D 8.02 Mixing at Site
Concrete shall be thoroughly mixed in a batch mixer conforming to the requirements of B.S. 1305 Batch type concrete mixers which will insure a uniform distribution of the materials throughout the mass.

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

The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein. No mixer having a rated capacity of less than a 1-bag batch shall be used nor shall a mixer be charged in excess of its rated capacity.

All concrete shall be mixed for a period of not less than 1 ½ minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed, but this speed shall not be less than 12 nor more than 20 revolutions per minute.

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

D 8.03 Truck Mixing

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

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

Not more than 100 revolutions of mixing shall be at speed in excess of 6 r.p.m. Mixing shall begin within 30 minutes after the cement has been added either to the water or aggregate. When cement is charged into a mixer drum containing water or surface-wet aggregate and when the temperature is above (33°C) is used this limit shall be reduced to 15 minutes; the limitation on time between the introduction of the cement to the aggregates and the beginning of the mixing may be waived when, in the judgement of the Engineer, the aggregates are sufficiently free from moisture, so that there will be no harmful effects on the cement.

D 8.04 Partial mixing at the Central Plant

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

D 8.05 Plant Mix

Mixing at a central plant shall conform to the requirements for mixing at the Site and shall conform to the applicable requirements of the Standard Specification for Ready-Mixed Concrete of ASTM Designation C: 94. Ready-mix concrete suppliers shall be approved by the Engineer prior to commencement of works, and in compliance with the concrete specifications.

D 8.06 Time of Holding and placing concrete

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

When truck mixers are used, concrete shall be discharged and placed in its final position in the forms within thirty (30) minutes after water is first added to the mix.
D 8.07 Delivery
The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The methods of delivering and handling the concrete shall be such that will facilitate placing with the minimum of re-handling and without damage to the structure of the concrete.

D 8.08 Retempering
The concrete shall be mixed only in such quantities as are required for immediate use and any concrete that has developed initial setting shall not be used. Concrete that has partially hardened shall not be re-tempered or re-mixed.

D 9 HANDLING AND PLACING CONCRETE
D 9.01 General
Prior to pouring concrete in any structure, the contractor shall secure a written order to commence from the Engineer.

In preparation for the placing of concrete, all sawdust, chips and other construction debris and extraneous matters shall be removed form the interior of forms. Struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying concrete form the mixer to the forms shall not be permitted unless the authorization in writing of the Engineer is obtained. In case an inferior quality of concrete is produced by the use of such conveyors, the Engineer may order discontinuance of their use and the substitution of a satisfactory method of placing.

Open trough and chutes shall be of metal lined and shall be of rounded cross section to avoid the accumulation of concrete in corners. The chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. The slope shall be steep enough (1 vertical to 2 or 2 1/2 horizontal) to permit flow requiring a slump greater than that specified or required for placement.

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

D 9.02 Vibrating Concrete
Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject to the following provisions:

- The vibration shall be internal unless special authorization of other methods is given by the Engineer or as provided herein.
- Vibration shall be of a type and design approved by the Engineer. They shall be capable of transmitting vibration to the concrete at frequencies of not less than 4500 impulses per minute.
- The intensity of vibration shall be such as to visibly affect a mass concrete of 25mm slump over a radius of at least 500mm.
- The Contractor shall provide a sufficient number of vibrators to properly compact each
batch immediately after it is placed in the forms.

- Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and imbedded fixtures, and into the corners and angles of the forms.
- Vibration shall be applied only by experienced operators under close supervision, at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation that localized areas of grout are formed.
- Application of vibration shall be at points uniformly spaced and not farther apart than twice the radius over which the vibrations is visibly effective.
- Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibrations. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.
- Vibrators shall be supplemented by such spading as is necessary to insure smooth surface and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.
- The use of implement such as compressors that are likely to disturb or disarrange reinforcement or formwork shall not be permitted.

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

The top surface of the concrete slabs shall all be smoothed with a mechanical trowelling machine, manual trowelling will not be accepted.

When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete.

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

**D 9.03 Cold or Hot Weather**

Concrete is not to be mixed or placed at a shade air temperature below 2 deg .C on a rising thermometer or at a shade air temperature below 3 deg .C on a falling thermometer.

When the shade air temperature is 37 deg .C and rising, special precautions shall be taken during concerting operations, such as shading of the aggregates and plant, cooling of the mixing water or other methods approved by the Engineer, so that the temperatures of the concrete when placed shall not be in excess of 39 deg .C.

**D 10 CONSTRUCTION JOINTS**

Construction joints shall be made only where located on the Drawings. If not detailed on the drawings, or in the case of emergency, construction joints shall be placed as directed by the Engineer. Shear keys or inclined reinforcement shall be used where necessary to transmit shear or bond the two sections together.
D 10.02 Bonding
Before depositing new concrete on or against concrete that has hardened, the forms shall be retightened. The surface of the hardened concrete shall be roughened as required by the Engineer, in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance, and saturated with water. To insure an access of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces including vertical and inclined surfaces, shall first be thoroughly covered with a coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints that are exposed to view shall be carefully finished true to line and elevation.

D 11 FORMWORK
D 11.01 General
The Contractor shall be responsible for the design and stability of the formwork. The contractor shall submit a full program of work indicating the various phases for the erection and removal of forms and the manner in which he intends to execute all concrete works. The Contractor shall be responsible for the haulage, installation, removal, and maintaining of the waffle moulds that are provided by the owner, the cost of such work is deemed to be included in the unit price of the concrete works. The concrete quantity shall be measured net. Plastic chamfers of standard size shall be used for all corners.

All exposed concrete should be fair face finish as specified in Section C14.

D 11.02 Material
All forms shall be tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

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

Where formwork happens to fall above existing structures and/or buildings, the Contractor shall, at his own expense and responsibility, design and install a formwork system to be approved by the Engineer that does not transfer any loads to the existing structures and/or buildings. The cost of such formwork shall be deemed to be included in the Unit Prices of "CONCRETE WORK".

D 11.03 Workmanship
Forms should be inspected by the Engineer prior to installation of reinforcement.

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

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

Metal ties or anchorages within the form shall be so constructed as to permit their removal to a depth of at least 40mm from the face without injury to the concrete. In case ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least 10mm. from the face of the concrete with chisels or nippers; for green concrete, nippers are necessary. All fittings for metal ties shall be of such design that the cavities produced upon their removal are the smallest possible. The cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in colour.

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

Any material that will adhere to or discolor the concrete shall not be used.

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

D 11.04 Removal of Formwork
In the determining of the time for removal of forms, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete and the materials used in the mix. In general, the forms of any positions of the structure shall not be removed until the concrete is strong enough to prevent injury to the concrete when the forms are removed. Unless otherwise directed by the Engineer, forms shall remain in place for the following specified period of time:

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

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

The Contractor shall include in his prices for any formwork that may have to be left in position due to the impossibility of removal of same. The cost of such formwork shall be deemed to be included in the Unit Prices of "CONCRETE WORK".

D 12 REINFORCEMENT
D 12.01 General
The Contractor shall prepare for his own use Bar Bending Schedules from the information given on the Drawings and in these Specifications. These Schedules shall be submitted to the Engineer for approval that shall in no way relieve the Contractor of his responsibility for the correctness of these Schedules.

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

D 12.02 Type and Quality of steel Reinforcement
A - Hot-Rolled Steel Plain Rods and Bars
Hot rolled steel plain rods and bars shall conform to the strength requirements and minimum elongation of the standard Specification for Deformed Billet - Steel Bars of Grade 40 with minimum yield strength 2800 Kg/cm² (40,000 psi) for Concrete Reinforcement of ASTM Designation (A-615) or equivalent.

B - Deformed Steel rods and Bars
Deformed Steel rods and bars shall conform to the requirements of the Standard Specification for Deformed Billet - Steel Bars of Grade 60 with minimum yield strength 4200 kg/cm² (60000 psi) for concrete reinforcement of ASTM Designation (A-615) or equivalent. All steel subject to be tested for the required strength whenever deemed by the Engineer to be necessary. All such tests to be are on the Contractors own expense.
D 12.03 **Wire**

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

D 12.04 **Order Lists**

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

D 12.05 **Protection of Material**

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

D 12.06 **Fabrication**

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

D 12.07 **Placing and Fastening**

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

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

D 12.08 **Splicing**

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

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

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

D 13 **CURING AND PROTECTION**

The method, procedure materials, and equipment for curing shall be approved by the Engineer. Curing may be accomplished by any of the following methods or combination thereof, as approved.

D 13.01 **Water Curing**

All concrete shall be cured for a period of time required to obtain the full specified strength but not less
than seven (7) consecutive days. Unformed surfaces shall be covered with sand burlap, or other approved fabric mats kept continually wet. If the forms are removed before the end of the curing period, curing shall be contained as on the unformed surfaces. When burlap, sand or other approved fabric materials are used, they shall not cause any undesirable finish such as rough surface and discoloring where exposed to light. Unhardened concrete shall be protected from heavy rains or flowing mechanical injury and the Contractor shall submit for the Engineer's approval his construction procedure that is designed to avoid such an eventuality. No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. Water for curing shall conform to section C3.6.

D 13.02 Curing with Curing Media
Curing medium shall meet all requirements of the specifications for liquid Membrane-Forming Compounds for Curing Concrete of ASTM Designation: C-309 and test for water retention by concrete curing materials of ASTM Designation: C-156

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

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

D 13.03 Payment
No separate payment shall be made for curing with water or with curing media. The cost of such curing shall be deemed to be included in the Unit Prices of "CONCRETE WORK".

D 14 EXPOSED CONCRETE (FAIR FACE) SURFACES
D 14.01 Formwork
All exposed concrete surfaces shall be fair face. Formwork for exposed concrete surfaces shall conform to the applicable requirements in section C11, in addition to these specifications

All concrete surfaces that are to be left exposed to view as a finished surface shall be produced by vertical wooden shuttering.

The quality of the surface of concrete exposed to view shall be consistent throughout the works and the following methods shall be adopted to obtain the required finish:

Metal forms of an approved type for precast units and circular columns.
Wooden boards, each 100mm wide for cast-in-situ concrete members, treated and lined to produce fair face finish.

The contractor may submit alternative proposals for the Engineer’s approval if he so desires.

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

D 14.02 Coating Forms with Mineral Oil
In addition to the above forms or linings, the forms shall be coated before placing reinforcement with an approved colourless mineral oil free of kerosene.

All surplus oil on form surfaces and any oil on reinforcing steel shall be removed.
D 14.03 Construction Joints
Construction joints, if they are not clearly indicated on the Drawings shall not be allowed. Construction joints, in cases where weather conditions so require shall be studied in detail ahead of time and the joint shall be grooved in a predetermined pattern approved by the Engineer at no additional cost to the owner.

D 14.04 Samples and Workmanship
The contractor shall submit for approval a sample panel not less than 600x1200mm to demonstrate the quality of the exposed concrete produced by forms at his own expense.

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

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

Alternatively the Engineer may order the Contractor to plaster all exposed surfaces and bush-hummer the entire area of concrete in the project so as to render all exposed surfaces of concrete consistent throughout the project at the Contractor’s own expense.

D 15 MONOLITHIC SMOOTH FINISH SURFACES
All concrete surfaces which are not in acceptable condition and which are required to be surface-finished as designated herein, shall be rubbed to a smooth and uniform texture with a carborundum brick and clear water as soon as the forms are removed and the concrete is ready to hone. The loose material formed on the surface shall be removed as soon as it dries by rubbing the surface with burlap or other approved material. A cement wash shall be used.

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

E 1 SCOPE
These specifications cover stonework facing intended to be used for external walls, required for the works in accordance with the Drawings; Bills of Quantities and as directed in writing by the Engineer.

E 2 MATERIALS
Stone building and/or facing to walls shall be of durable, local stone, dimensions as shown on drawings, approved by the Engineer and of quality suitable to ensure permanence in the structure. It shall be even grained, free from cracks, seams, holes, shakes, objectionable irregularities of colour, impurities, structural weaknesses and other defects that would tend to increase unduly the deteriorations from natural causes. All stones for facing shall be selected well in advance of time required. Samples of stone materials and dressing shall be submitted for the Engineer's approval 30 days before delivery of such material to site.

Joints shall not exceed 10 mm and shall be grooved recessed and pointed with non-staining mortar tinted to match colour of stone. Grooves shall be filled with same tinted mortar. Mortar for all masonry shall consist of slaked lime putty or dry hydrated lime and cement and sand mixed in the following proportions.

1 White cement
2 Parts of fine crushed stone sand

Stone shall be "Mofajjer" and "Mattabeh". Beds and joints shall be sufficiently bush-hammer dressed for an approximate depth of 10mm from the face of the stone at the edge to provide regular course of different heights and to ensure stones fit reasonably close together when built.

The width of horizontal beds shall be as shown on Drawings whereas the vertical joints shall be as inconspicuous as possible and shall not exceed 10 mm in width.

The stone facing shall be fixed to the structure as detailed on the Drawings and as per approved method of installation. Insulation between internal wall and stone facing shall be polystyrene or equal approved by the engineer.

E 3 STONE FLOOR TILE
Stone tiles for flooring, coping, stair treads, risers and skirting shall be local of stone, "Mizzi" obtained from an approved source.

The stone tiles shall be of the dimensions and thicknesses shown on the Drawings and in the Bills of Quantities and shall be uniform in color and texture, smooth and free from voids and shall be of an approved colour and to the pattern and sizes shown on the Drawings. Sample of stone tiles shall be submitted to the Engineer for approval prior to order.

Mortices shall be carefully cut without causing any damage to the tiles, and rebates shall be carefully formed by special machines to the width and depth required to the satisfaction of the Engineer.

E 4 WORKMANSHIP
Walls shall be carried up in a uniform manner, no one portion being allowed to rise more than four courses above another at one time and any such rising shall be regularly stepped for bonding. The total thickness of stone facing and mortar backing shall be as shown on Drawings.

All stone shall be hand placed. Courses shall be bedded solidly with full mortar beds and joints fully squeezed out. All stones shall be cleaned and thoroughly wetted before setting.

To ensure even and regular width of beds and joints when setting stones the contractor shall use non-staining hardwood wedges to ensure close and regular fitting between beds and joints. All stones
shall be solidly bedded and jointed in mortar.

The mortar backing shall be worked into crevices at the back and around every stone in such a manner to eliminate all voids and bond perfectly with the facing stone to form a homogeneous solid mass. Particular care shall be taken during tamping to ensure that facing stones are not displaced from their correct positions. Concrete backing in all masonry walls, shall be poured behind not more than one-course height of stone per day.

At completion of masonry walls the horizontal joints of all stone faced walls shall be racked out to a depth of 10 mm cleaned wetted and pointed with mortar composed 1 part white cement and 2 parts very fine sand tinted to the color selected by the Supervising Engineer.

The Contractor when executing pointing shall ensure that the mortar is pressed tight into the joints by means of approved tools for pointing. Care shall be exercised to avoid spreading mortar in the faces of the stones. The Contractor shall set up samples for the Engineer's approval before executing any pointing.
SECTION - F: ROOFING, WATERPROOFING & EXPANSION JOINTS

F 1 SCOPE
These specifications cover waterproofing and roofing systems intended to be used for underground structures, floors and roof decks required for the Works in accordance with the Drawings, Bills of Quantities and as directed in writing by the Engineer.

F 2 MATERIALS

F 2.01 Vapor Barriers
The vapor barrier for use in damp-proofing and waterproofing under R.C. sub-floors shall comprise of Polyvinyl Chloride membrane such as manufactured by the British "Cellophane Ltd." or manufactured by Serviced Division of "W.R. Grace Ltd." and/or other approved equivalent.

The waterproofing under floor tiling of the kitchens and toilets shall be similar to "Tretolastic Damp Surfaces Primer with two coats of Tretol 202 T Bitumen Solution as manufactured by Tretol Buildings Products, Ltd., England" or "No. 5 Pluvex Bitumen Sheeting as manufactured by Ruberoid Building Products Ltd." and/or other approved equivalent.

F 2.02 Primer
The material used as a primer shall conform to ASTM Specifications D 41, for Primer for use with Asphalt in Damp-proofing and Waterproofing below or above ground level for application to concrete and masonry surfaces.

F 2.03 Bitumen
The bitumen for damp-proofing and waterproofing shall be a soft, adhesive "Self-healing" asphalt which flows easily under the mob and which is suitable for use below ground level on horizontal and vertical surface under uniformly moderate temperature conditions both during the process of installation and during service.

The bitumen shall be homogeneous and free from water and shall conform to the requirements of ASTM Specifications D449-73 "Type A".


F 2.04 Mastic Asphalt
Mastic asphalt for damp-proofing and waterproofing shall comply with B.S. 1097, B.S. 1418 and with B.S. Code of Practice C.P. 102- Protection of buildings against water from the ground.

Mastic asphalt for roofing purposes shall comply with B.S. 988. B.S. 1162, 2nd with B.S. Code of Practice C.P. 144, Part 4-Mastic Asphalt.

F 2.05 Roofing Felt

F 2.06 Brush Paint Waterproofing Membrane
Waterproofing membrane shall be brush painted type where specified, and shall be of the rubberized bitumen emulsion type. Application shall be in accordance with the manufacturer’s instructions. A minimum application of two coats is required, with the coats applied at right angles to each other, to provide the minimum required thickness, which shall not in any case be less than 500 microns for underground retaining walls, and 250 microns for above ground surfaces.

Prior to application, surfaces must be clean, dry, and free from dirt, dust, oil or grease. All loosely
adhering particles such as rust, scale, cement laitance shall be removed prior to application of waterproofing coats as well. All organic growth shall be removed using a fungicidal wash, followed by a thorough washing with clean water.

F 3  WORKMANSHIP
F 3.01 Damp-proofing and waterproofing

(A)  Vapor Barriers
The vapor barrier, where shown on the Drawings or stated in the Bills of Quantities, for use in damp-proofing and waterproofing shall be laid in strict conformity with the manufacturer's instructions.

(B)  Primer and Asphalt
The primer and asphalt, as specified under "Materials" shall be used as a damp-proof and waterproof course to accessible underground surfaces of reinforced concrete structures and internal surfaces of flower boxes to the extent shown on the Drawings, and shall consist of one coat of primer and two coats of asphalt.

All surfaces to be damp-proofed and waterproofed shall be properly prepared by brushing, cleaning and leaving the surfaces free from dirt, dust, grease, loose or projecting particles of mortar or concrete, all traces of salt shall be thoroughly sprayed with water and allowed to dry and disappear from the surfaces before the application of the priming coat.

Asphalt shall be applied hot in two coats for both horizontal and vertical work. Each coat of asphalt shall be allowed to dry for a period of at least 24 hours before the second coat is applied. Warm, clean and properly make good injunctions between horizontal and vertical asphalt, with two coats angle fillets at all internal angles.

(C)  Storage and Handling for Materials
Rolls of felt and containers of bitumens shall be stored on end. Rolls of felt shall be properly covered and all materials shall be kept clean and dry. In cold weather, plied felts shall not be thrown or dropped since the shock of impact can fracture adhesive between plies causing them to separate. Such a condition, often considered a factory defect, more frequently is caused by rough handling.

(D)  Preparation of Materials
Bitumen shall be placed in kettles, melted and frequently stirred to prevent burning. Cutting back, adulterating or fluxing of bitumen with any other material shall not be allowed.

Felts shall be unrolled, turned over, piled up and permitted to flatten. Then they shall be re-rolled in the opposite direction before application.

(E)  Application of Materials
Before work is started all rubbish shall be removed and, during the work, the deck shall be maintained clean and free of loose or foreign materials and obstructions other than tools and appliances of the roofer.

Decks that are scaling or that are covered with dust shall not be primed until thoroughly cleaned. Leaky containers for bitumen shall not be used since splashes seldom can be removed entirely.

A sufficient quantity of bitumen shall be used so that it will flood ahead of the roll in an unbroken line so that the felt will be completely embedded.

The felts shall be rolled closely behind the mop so that at no time shall the mopping be more than one meter broomed in while the bitumen is still hot. The stable type of broom or suitable squeegee shall be used for this purpose.

In applying felts on built-up roofs it is important that they be laid so that the flow of water is over or parallel to (never against) the laps of the finishing felts. Care shall be taken to ensure that all surfaces upon which felt is to be laid are dry, smooth and clean.
Felts shall be applied in three layers of felt, lapping each felt 600mm over the preceding one. Mop the full width under each felt with the asphalt.

The felt shall be dressed and bonded into mouths of rainwater outlets and well fitted and sealed around openings.

When roofing abuts against vertical surfaces such as walls as parapets, it shall be carried up for a minimum height of 150mm and 150mm back off the walls or parapets forming triangular fillets as a skirting or base continuous with the roof membrane.

Pipes and other structures piercing the roof shall be primed with a bitumen solution and shall have a collar of hot bitumen formed up to them at 45\(^\circ\). The roofing felt shall be dressed up and capping layer of flashing felt shall be dressed over the collar, bonded to the pipe and secured with four turns of stout copper wire.

At angles or other obstacles wherever felt needs cutting, mastic joint or seal shall be used to ensure the continuation of the waterproofing membrane.

All roof finishes shall be carefully worked or fitted around pipes or openings. On completion all roofs are to be left sound and water tight and in a neat and clean condition.

(F) Minimum materials required per 9 square meters of waterproofing area:

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
<th>Approx.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime Coat</td>
<td>As recommended by the asphalt manufacturer.</td>
<td></td>
</tr>
<tr>
<td>Felts</td>
<td>3 layers of saturated asphalt felt</td>
<td>20 Kgs</td>
</tr>
<tr>
<td>Bitumen</td>
<td>Mastic asphalt for mopping each layer of felt</td>
<td>10 kgs</td>
</tr>
<tr>
<td></td>
<td>For flood coat to receive chippings</td>
<td>136 Kgs</td>
</tr>
</tbody>
</table>

They shall include all enclosure fittings. Wooden strips shall be as specified under JOINERY AND IRONMONGERY.

Care shall be taken during installation not to cause any damage to the waterproofing material laid on roof deck.

F4 EXPANSION JOINTING MATERIAL

Expansion joint filler shall be of a preformed type in fibrous materials with a cellular structure, impregnated with tar distillate or cutback bitumen compressible without extrusion or elastic so that after repeated compression to 50% thickness it is capable of recovering at least 7.5% of its original thickness. The filler shall be obtained from Expadite Ltd., W.R. Grace Ltd., Fosroc, of England, Sica, of Italy, or equal and approved by the Engineer.

Exposed edges of joints are to be pointed with a polysulfied synthetic rubber joint sealing compound of proven suitability in the prevailing climatic conditions, and shall be used strictly in accordance with the manufacturer’s instructions.
CONSTRUCTION STANDARD SPECIFICATION

Section G: STRUCTURAL STEEL

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CONSTRUCTION STANDARD SPECIFICATION

STRUCTURAL STEEL

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.

   Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges" and as otherwise shown on drawings.

B. Related Sections: Refer to the following sections for related work:

1. "Cast-In-Place Concrete" for anchor bolt and reinforcing steel installation in concrete.

2. "Concrete Masonry Unit" for anchor bolt installation in masonry.

1.03 SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract "Submittal Procedures".

B. Product Data: Submit product data or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

2. Anchor bolts.

3. Unfinished threaded fasteners.

4. High-strength bolts (each type), including nuts and washers; include direct tension indicators if used.

5. Structural steel primer paint.


C. Material Safety Data Sheets (MSDS): Submit MSDS for structural steel (each type), anchor bolts, unfinished threaded fasteners, high-strength...
bolts (each type) including nuts and washers, structural steel primer paint and nonmetallic shrinkage-resistant grout.

D. Shop drawings: Submit shop drawings, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.

1. Include details of cuts, connections, cambers, holes and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.

2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

E. Welder Certifications: Provide certification that welders to be employed in work have satisfactorily passed qualification tests in accordance with AWS D1.1.

If recertification of welders is required, retesting will be Contractor's responsibility.

F. Test reports: Submit test reports conducted on shop- and field-bolted and welded connections. Include data on type(s) of tests conducted and test results.

G. Welding Procedures: Provide written welding procedure specification (WPS) document per AWS Code requirements.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges" with paragraph 4.2.1 modified by deletion of the following sentence:

   "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of his preparation of these shop drawings."

2. AISC "Specifications for Structural Steel Buildings" including the "Commentary", later referred to as "AISC Specifications".


4. AWS D1.1

5. ASTM A6

B. Qualifications for Welding Work: Qualify welding procedures and welding operators in accordance with the requirements of AWS D1.1.

C. All materials used shall not contain asbestos fibers.
1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time so that work will not be delayed.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. If bolts and nuts become dry or rusty, clean and lubricate before use.

Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.06 PROJECT CONDITIONS

Field Measurements: Check actual locations of walls and other construction to which steel framing must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Metal Surfaces, General: For fabrication of work that will be exposed to view, use only materials that are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes.

B. Structural Steel Shapes, Plates, and Bars: ASTM A36

C. Cold-Formed Steel Tubing: ASTM A500, Grade B.

D. Hot-Formed Steel Tubing: ASTM A501.

E. Steel Pipe: ASTM A53, Type E or S, Grade B: or ASTM A501. Finish: Black, except where indicated to be galvanized.


G. Headed Stud-Type Shear Connectors: ASTM A108, Grade 1015 or 1020, cold-finished carbon steel with dimensions complying with AISC Specifications.

H. Anchor Bolts: ASTM A307, nonheaded type unless otherwise indicated.
I. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low-carbon steel bolts and nuts; provide hexagonal heads and nuts for all connections.

J. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

   1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325.

   2. Where indicated as galvanized, provide units that are zinc-coated, either mechanically deposited complying with ASTM B695, Class 50, or hot-dip galvanized complying with ASTM A153.

K. Direct Tension Indicators: ASTM F959, type as required; use at Contractor's option.

L. Electrodes for Welding: Comply with AWS Code.

M. Structural Steel Primer Paint: Red oxide, lead- and cadmium-free, corrosion-inhibiting primer complying with performance requirements of FS TT-P-664.

N. Nonmetallic Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107 (formerly referenced as CE CRD C621).

Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

100 Non-Shrink Grout (Non-Metallic) - Conspec, Inc.
Crystex - L & M Construction Chemicals, Inc.
Euco N-S Grout - Euclid Chemical Co.
Kemset - Chem-Masters Corp.
Sonogrount - Sonneborn Building Products Div., Rexnord Chemical Products, Inc.
Supreme Grout - Cormix, Inc.
Sure-Grip High Performance Grout - Dayton Superior
Vibropruf #11 - Lambert Corp.
2.02 FABRICATION

A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. Connections: Weld or bolt shop connections, as indicated.

1. Bolt field connections, except where welded connections or other connections are indicated.

2. Provide high-strength threaded fasteners, unless otherwise indicated.

C. High-Strength Bolted Connections: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts".

D. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors in field, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions.

F. Steel Wall Framing: Select members that are true and straight for fabrication of steel wall framing. Straighten as required to provide uniform, square, and true members in complete wall framing.

   Build up welded door frames attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug-weld steel bar stops to frames, except where shown removable. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches (25 cm) o.c., unless otherwise indicated.

G. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings.

1. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work.

2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
2.03 SHOP PAINTING

A. General: Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches (51 mm) of embedded areas only.

1. Do not paint surfaces to be welded or high-strength bolted with friction-type connections.

2. Do not paint surfaces scheduled to receive sprayed-on fireproofing.

3. Apply 2 coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with SSPC as follows:

   SP-1 "Solvent Cleaning"
   SP-2 "Hand-Tool Cleaning"
   SP-3 "Power-Tool Cleaning"

C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 3.0 mils. Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.04 SOURCE QUALITY CONTROL

Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements. Promptly remove and replace materials or fabricated components that do not comply.

PART 3 - EXECUTION

3.01 ERECTION

A. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

B. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.

   Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.
C. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and bases or plates to insure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

4. For proprietary grout materials, comply with manufacturer's instructions.

D. Field Assembly: Set structural frames accurately to lines and elevations indicated and in accordance with AISC Specifications. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structures within specified AISC tolerances.

2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

3. Splice members only where indicated and accepted on shop drawings.

4. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

5. Do not enlarge unfair holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

E. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress, as acceptable to the SDR. Finish gas-cut sections equal to a sheared appearance when permitted. Comply with NFPA 51B for cutting processes.

F. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

Apply by brush or spray to provide minimum dry film thickness of 3.0 m
3.02 QUALITY CONTROL

A. Saffarini & Associates may engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

1. Testing Laboratory shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.

2. Provide access for Testing Laboratory to places where structural steel work is being fabricated or produced so required inspection and testing can be accomplished.

3. Testing Laboratory may inspect structural steel at plant before shipment. SNL reserves the right, at any time before construction complete, to reject materials not complying with specified requirements.

B. Correct Deficiencies in structural steel work that inspections and laboratory test reports have indicated are not in compliance with requirements. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

C. Shop-Bolted and Field-Bolted Connections: Inspect or test in accordance with AISC Specifications.

   Verify that gaps of installed direct tension indicators are less than gaps specified in ASTM F959, Table 2.

D. Shop Welding and Field Welding: Inspect and test during fabrication for shop welding and during erection for field welding, of structural steel assemblies, as follows:

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.

2. Perform visual inspection of all welds.

3. Perform tests up to and including 100% of welds at SNL’s option. Inspection procedures may include the following:

   a. Liquid Penetrant Inspection: ASTM E165.

   b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not acceptable.

   c. Radiographic Inspection: ASTM E94 and ASTM E142; minimum quality level "2-2T".

   d. Ultrasonic Inspection: ASTM E164.

4. Acceptance criteria shall be as specified in AWS D1.1.