# GOVERNMENT OF KHYBER PAKHTUNKHA
# PROJECT MANAGEMENT UNIT

## MUNCIPAL SERVICES PROGRAM

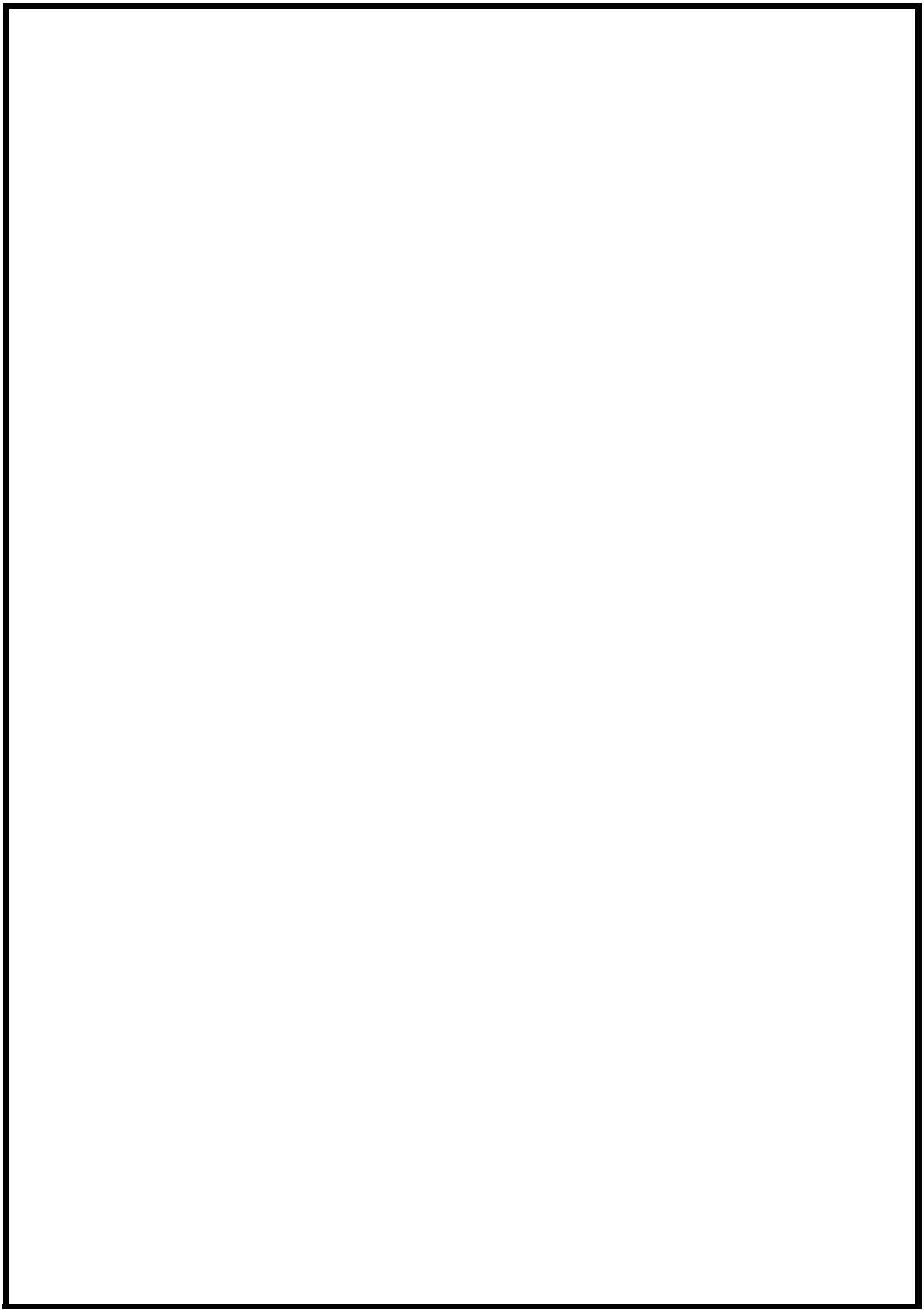
## Upgradation/Rehabilitation of Tehkal Payan Drainage System (Balance works)

## BID REFERENCE NO------

## Tender Documents
## Volume-II
## Specifications

Special Provisions
Technical Provisions

**September 2019**



**Municipal Services Program**

**Water and Sanitation Improvement Project Peshawar Town-1**

**Tender Documents**

**Volume II**

# SPECIFICATIONS

**TABLE OF CONTENTS**

# SECTION - 1

# SPECIAL PROVISIONS

## SECTION - 100

## SPECIAL PROVISIONS

### 01 GENERAL

The General Conditions of Contract Part I & II shall form an integral part of these General Requirements.

The Contractor shall notify all sub-contractors of the provisions of the Conditions of Contract and the General Requirement of this Specification.

The arrangement and divisions of these Specifications is not to be construed as establishing the limits of responsibility of sub-trades.

The Contractor is responsible for delineating the scope of Sub-Contracts and for coordinating all the Works.

All works shall be carried out in accordance with the following specifications, supplemented by detailed specifications contained in the following sections. Any inconsistencies or ambiguities shall be brought to the notice of the Engineer for his clarification/decision. Decision and direction of the Engineer, in all such cases, shall be final and binding.

The Contractor shall make himself thoroughly familiar with the site conditions, foresee any and all problems likely to the encountered during execution of the works, and shall be able and ready to solve them effectively. Proposals for solutions to the problems shall be submitted to the Engineer for approval before proceeding with the work.

The Contractor shall make all necessary arrangements for community satisfaction regarding his operations related to the construction works.

### 02 APPLICABLE CODES AND STANDARDS

In the absence of other Standards being required by the Contract Documents, all work and materials shall meet the requirement of the Uniform Building Code of the United States, and/or applicable American Society for Testing Materials (ASTM) American Association of State Highway and Transportation Officials (AASHTO) Specifications and the latest American Concrete Institute Manual of Concrete Practice and American Institute of Steel Construction (AISC) Manual relevant to the Works except in cases where the Pakistan Building Code requires a higher standard. In such cases the Pakistani Code shall govern. Where the abbreviations listed below are used, it refers to the latest code, standards, or publication of the following organizations:

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI | American Concrete Institute |

| | |
|---|---|
| AISC | American Institute of Steel Construction |
| ANSI | American National Standards Institute |
| ASA | American Standard Association |
| ASCE | American Society of Civil Engineers |
| ASTM | American Society for Testing and Material |
| AWS | American Welding Society |
| BSI | British Standards Institute |
| ICAO | International Civil Aviation Organization |
| BSICP | British Standard Institute Code of Practice |
| PCA | Portland Cement Association |
| PSI | Pakistan Standard Institute |
| UBC | Uniform Building Code |

Should the Contractor, at any time and for any specific reasons, wish to deviate from the above standards or desires to use materials or equipment other than those provided for by the above standards, then he shall state the exact nature of the change giving the reasons for making the change and shall submit complete specifications of the materials and descriptions of the equipment for the Engineer's approval, whose decisions shall be conclusive and binding upon the Contractor.

## 03 CODES, STANDARDS, CERTIFICATES

The Contractor shall have at his site office:

Copies of all latest editions of codes and standards referred to in these specifications by number, or equivalent codes and standards approved by the Engineer.

Catalogues and published recommendations from manufacturers supplying products and materials for the project.

The Contractor shall provide manufacturer's or supplier's certificates to the Engineer for all products and materials which must meet the requirements of a specific code or standard as stated in these Specifications.

## 04 UNITS OF MEASUREMENTS

The SI System shall be used throughout this Project.

## 05 MANUFACTURER'S RECOMMENDATIONS

All material and products for any temporary and/or permanent work should be preferably locally manufactured /available in the local market and to be of best quality complying with the standards as specified herein. The Engineer may also supplement such specifications during the progress of work.

All materials and products used for such and other items shall be subject to standard testing and if found below the specified standard or their equivalent shall be removed from the site immediately at Contractor's own expense. All testing of materials finished and unfinished, shall be carried out by the Contractor at his cost, in the presence of the Engineer for which the Contractor shall maintain a reasonably well equipped laboratory of his own, close to the site of

work or make any other additional arrangement to the satisfaction of the Engineer. The Contractor shall include testing charges in the rates and shall not be entitled to any reimbursement on this account for routine testing.

The Contractor must give early attention to the submission of samples of materials for approval of the Engineer, indicating the names of the manufacturing firms, where applicable, specially of cement, sand, aggregates, steel, water, tiles, hard-core and all finishes and fittings. Whenever practicable, samples shall be submitted at least three weeks before its proposed usage. Unless specified otherwise and whenever materials are ordered to be forwarded to a testing laboratory other than site laboratory for checking/ testing, the Contractor will bear the cost of fees for such tests.

Installation of manufactured items shall be in accordance with procedures recommended by the manufacturer or as approved by the Engineer.

## 06 EXISTING CONDITION AT SITE

Drawings and information pertaining to existing project conditions are furnished for reference.

Neither the Employer nor the Engineer warrants the adequacy or correctness of these.

## 07 PROTECTION AND PRECAUTIONS

The Contractor and his sub-contractors shall afford all necessary protection to existing structures and will be required to make good at his own expense any damage done to such structures through his own or his representatives or subcontractors' fault and negligence.

The Contractor and his sub-contractors shall afford all necessary protection to existing roads in the area. He will clear and make good at his own expense any damage to or debris on these roads through his own fault and negligence. He must at all time ensure the free and normal flow of traffic and shall not cause obstruction to the traffic system. The Contractor and his sub-contractors shall provide and maintain necessary protection and precautionary measures such as warning signs, warning lamps and barricades etc. to prevent accidents.

The Contractor shall promptly correct all such damage to original condition at no additional expense to the Employer.
The Contractor shall cooperate with trades performing work under other Contracts as necessary for completion.

## 08 SETTING OUT OF WORK

Establish all boundaries, markers, levelling stakes and bench marks on the site to adequately set out all work. Verify all data and their relationship to establish Engineer's survey control points and public bench-marks and report discrepancies to the Engineer.

Permanently mark the necessary controls for distance and elevation sufficient to serve throughout the Contract and protect these control points adequately against damage and displacement.

Project setting out is for the use of all trades; each trade is responsible for the layout of its own work.

## 09 SEQUENCE OF CONSTRUCTION

The Contractor shall submit his proposal for approval of the Engineer the sequence of Construction, prior to starting the works. The works shall be executed as per approved sequence of construction.

The Contractor shall submit a complete plan of the proposed sequence and methods of operations for the execution of the works. Detailed drawings showing the location and construction of dumping and working platforms, gantries, building and all other structures in connection with the Contractor's plant and material storage sheds shall also be submitted to the Engineer for his approval.

The contract drawings are the working drawings to guide the Contractor generally about the shape and size of all the structures and fittings. Before proceeding to make preparations, fabrication, execution, erection of any such fittings and other details of any temporary works, scaffolds, railings, formworks; the Contractor shall be under obligation to prepare and submit detailed shop drawings to the satisfaction and the approval of the Engineer, before doing any or all of that described above or as directed. Approval of the contractor’s drawings shall not relieve the Contractor for any part of his obligation provided in the Contract Documents.

## 10 LINES AND LEVELS

Survey control points will be established by the Contractor and shall be checked by the Engineer. The Contractor shall be responsible for accuracy of these and shall be responsible for all requirements necessary for the execution of any work to the locations, lines, and levels specified or shown on the drawings, subject to such modifications as the Engineer may require as work progresses.

## 11 PARTIAL POSSESSION

Whenever, as determined by the Employer any portion of work performed by the Contractor is in a condition suitable for use, the Employer may take possession of or use such portion.

Such use by the Employer shall in no instance be construed as constituting final acceptance, and shall neither relieve the Contractor of any of his responsibilities under the Contract, nor acts a waiver by the Employer of any of the conditions thereof, provided that the Contractor shall not be liable for the cost of repairs, re-work, or renewals which may be required due to ordinary wear and tear resulting from such use. However, if such use increases the cost or delays to the completion of remaining portions of work, the Contractor will be entitled to an equitable adjustment.

If, as a result of the Contractor's failure to comply with the provision of the Contract, such use proves to be unsatisfactory, the Employer will have the right to continue such use until such portion of the work can, without injury to the Employer, be taken out of service for correction of defects, errors, omissions, or replacement of unsatisfactory materials or equipment, as necessary for such work to comply with the Contract; provided that the period of such operation or use pending completion of appropriate remedial action shall not exceed twelve months unless otherwise mutually agreed upon in writing between the parties.

## 12 EXISTING SERVICES

The Contractor shall search for, find, locate and protect any wiring, cable, duct, pipe work, etc., within or immediately adjoining the site area. The Contractor shall promptly inform the Engineer and Employer about the location and other details once any utility line is found.

The Contractor shall take full responsibly for safety of existing service lines, utilities and utility structures uncovered or encountered during excavation and construction operations.

The Contractor shall take full responsibility for damaging any such service lines, utility/utility structure and any cost and/or expense that arises or issues from any such damage shall be borne directly by him. Should any damage to any such service occur, the Contractor shall forthwith take remedial action, initiate safety precautions, install temporary services and carryout repair all at his own cost and expense and inform the Engineer and notify all relevant authorities.

Existing utilities which are to remain in service for or after the works are to be determined by the Contractor. If any existing service lines, utilities and utility structures which are to remain in service are uncovered or encountered during these operations, they shall be safeguarded, protected from damage, and supported.

The contractor shall get approval from concerned authorities before working upon it and get approval or rerouting etc. The contractor shall demonstrate all safety requirements before carrying out work upon the electrical lines.

## 13 PLANT AND EQUIPMENT

The Contractor shall submit a detailed list of plant and equipment which he shall undertake to bring to the site to carry out the work. The list shall satisfy the Engineer as to type, size and quantity. The list shall include for each piece of equipment the type, manufacturer, model, identification number and year of manufacture. The Contractor shall provide on the site of the work at his cost all of the equipment listed and all subsequent equipment required for approval of the detailed programme of work and such equipment which may be directed by the Engineer. The Contractor shall supply all plant and equipment necessary for the construction of each phase of the work and it must be on site, inspected and approved by the Engineer.

## 14 CONSTRUCTION AREA AND ACCESS

The Contractor shall confine his operations to the areas that are actually required for the Works and shall fence the area accordingly. Arrangements for access roads, storage areas and routes for haulage of materials are to be made by the Contractor at his own cost, subject to the approval of the Engineer.

The contractor shall cordon off construction site and his storage area / site camp by providing and installation of GI sheet or any suitable material as approved by the Engineer. The contractor shall submit his plan in this regard and get approval of the Engineer before start of site cordon off.

## 15 STORAGE & HANDLING FACILITIES

The Employer will provide the Contractor possible space within or nearby the area of site of works for the storage of plant, equipment and materials and for Contractor's temporary office, during the currency of the Contract, Bidders are invited to visit the site, available area and access points to site. In case the adjacent area as required by the Contractor is not available within the Project boundary for storage of plant, equipment and machines then the Contractor shall arrange at his own expense possible space for storage of plant, equipment and machines at his own cost and expense. On no account shall such temporary installations conflict/interfere with any of the permanent installations, services and any operational function of Employer. The handling and storage of all plants, equipment and materials at site shall be the sole responsibility of the Contractor and at no risk and cost to the Employer.

The Contractor shall protect all material against corrosion, mechanical damage or deterioration during storage and erection on site. The protection methods shall be to the approval of the Engineer.

## 16 TEST LABORATORY AND TESTING

16.1 Testing, except as otherwise specified herein, shall be performed by an approved testing agency as proposed by the Contractor and approved by the Engineer and at no extra cost to the Employer. The Engineer may require all testing to be carried out under his supervision.

16.2 If suitable and adequate independent material testing laboratory is not available in the vicinity, then the Contractor shall establish and maintain a materials testing laboratory at site within contractor’s camp and the laboratory shall have sufficient working area and shall be equipped with all necessary facilities including a suitable store/curing room. Contractor will provide seating arrangement for the Engineer’s Technician in the Lab. All acceptance testing shall be carried out under the Engineer’s Supervision. After completion of the Works, the contractor may demobilize material testing laboratory along with all equipment.

16.3 The Contractor shall supply and maintain to the satisfaction of the Engineer or his representative complete testing equipment, apparatus, tools, gauges, instruments, etc. in sufficient number and adequate for all tests to be carried out as specified in these specifications. Valid calibration certificates of gauges / instruments / equipment shall be provided by the Contractor.

16.4 The Contractor, after the approval by the Engineer for the source of cement and steel shall make available at the site sufficient stock of the materials in advance in order to allow sample testing for quality control prior to use.

16.5 The quality control testing shall be performed by the Contractor's competent personnel in accordance with a site testing and quality control programme to be established by the Contractor and approved by the Engineer or his Representative. The Contractor shall keep a complete record of all quality tests performed on site and submit the same to the Engineer. All quality control and related tests shall be carried out in accordance with applicable standards and codes.

16.6 All costs associated with sampling, testing and inspection shall be borne by the contractor which includes establishment of lab at site, staff hiring, test equipment, furnishing, office equipment, consumables, photo copies of relevant test standards, arrangement for calibration

of equipment and transport for collection of samples from site/borrow areas/factory visits/witness of testing in independent approved labs.

## 17 CONSTRUCTION & CHECKING AT SITE

The Contractor shall submit to the Engineer in due time for approval and discussion, his proposals and plans as to the method and procedure to be adopted for the temporary and permanent works involved.

The submitting to these suggestions and arrangements, and the approval thereof by the Engineer shall not relieve the Contractor of his responsibilities and duties under the Contract.

The carrying out of all work included in the Contract is to be supervised by a sufficient number of qualified representatives of the Contractor and full facilities and assistance are to be afforded by the Contractor for the Engineer or his Representative to check & examine the execution of the work.

The Engineer reserves the right to inspect all parts of the works but may at his discretion waive inspection on certain items. This shall in no way absolve the Contractor from his responsibilities. This particularly applies to the checking of materials, the accurate setting out of foundations, and to the levelling, setting and aligning of the various parts, and to the proper fitting and adjustment of manufactured and finished materials and fixtures in position.

If the Engineer or his Representative find that the work progress is slow in such a way that the works or parts thereof will not be completed in the time specified, then he shall order the Contractor to work overtime or in shifts and the Contractor shall comply. These arrangements will be free of all financial encumbrances and at no additional costs to the Employer.

In the event of night work, the Contractor shall provide sufficient and adequate lighting to the satisfaction of the Engineer or his Representative and shall supply the necessary manpower for satisfactory continuation of the work after normal hours. Also, the contractor shall arrange security and safety measures for his staff and Engineer's staff upto the Engineer's satisfaction before proposing night works.

## 18 BAR BENDING SCHEDULE

Bar bending (reinforcement bars) schedule of all drawings shall be prepared by the Contractor and submitted in triplicate to the Engineer for approval.

## 19 DRAWINGS

19.1 Tender Drawings: The drawings listed in the Tender documents, and these show the scope of work to be performed by the Contractor. Tender Drawings shall not be used as a basis for fabrication or construction but may be used as a basis for placing preliminary order for materials, subject to corrections based on the future issue of Drawings as provided under sub-clause 19.2 Drawings Issued for Construction. Tender Drawings are subject to be modified and supplemented by additional detail by the Engineer.

19.2 Drawings Issued for Construction: After Award of Contract, Tender Drawings shall be placed by Drawings Issued for Construction including supplementary Specifications as may be necessary. Such drawings and specifications shall be constured to be included in the expression Custody of Drawings under Sub-Clause 6.1 of General Conditions of Contract. Drawings Issued for Construction may include some of the Tender Drawings with or without modification and additional drawings as required to express design intent in greater detail. Such drawings may also be modified from time to time. Drawings Issued for Construction will be the drawings from which shop, fabrication, erection, installation, concrete placing, formwork, or other construction detail drawings shall be prepared by the Contractor. The work shall be executed in conformity with Drawings Issued for Construction. The Contractor shall prepare a schedule of Drawings Issued for Construction of various parts of the Works based on Construction programme approved by the Engineer for issuance to the Contractor from time to time.

19.3 Study of Drawings: The Contractor shall study all Drawings Issued for Construction carefully as soon as practicable after receipt thereof, and any errors discovered shall promptly be brought to the knowledge of the Engineer for his instructions.

19.4 Copies of Drawing: Drawings will be issued to the Contractor free of charge as follows:

Drawings Issued for Construction - One copy in A-3 size (hard form) and soft form (PDF Only) as specified in sub-clause 6.1 Custody of Drawings, of General Conditions of Contract.

19.5 Drawings to be furnished by the Contractor:

(a) Shop Drawings.

All shop drawings required for the work including all kinds of fabrication, field erection, installation, placement and layout drawings shall be furnished by the Contractor for approval of the Engineer. If additional detail drawings are necessary to complete any part of the work, such including reinforcing steel, drawings shall be prepared by the Contractor and submitted to the Engineer for approval. All drawings shall be complete and shall be submitted in due time and in logical order to facilitate proper coordination.

(b) Lift and placement Drawings.

At least thirty calendar days prior to starting construction of any concrete lift or other placement, the Contractor shall submit lift or other placement drawings to the Engineer for approval. Lift or other placement drawings shall be submitted for each lift or other placement of concrete to be placed. These drawings shall be to such scale as to clearly show all recesses, openings, and embedded parts, including embedded structural steel, mechanical and electrical items, reinforcement placement in each lift in sufficient detail for proper execution of the work.

(c) Construction Plant Layout Drawings.

Three prints of drawings, showing the layout of construction plant and equipment the Contractor proposes to use on the work, shall be submitted by the Contractor for review to the Engineer. The drawings shall show the locations of the principal components of the construction plant, offices; storage areas and yards which the Contractor proposes to construct or use at the site of the work and elsewhere. The drawings shall also show the unloading facilities for materials and equipment at the work site.

19.6 Submissions and Approvals:

(a) Except as otherwise specified, three copies of each drawing for approval or review shall be furnished to the Engineer. Within thirty calendar days after receipt, the Engineer will send one copy to the Contractor marked Approved, Approved/Except as Noted, or Returned for Correction. The notations Approved and Approved/Except as Noted will authorize the Contractor to proceed with the fabrication of the materials and equipment covered by such drawings subject to the corrections, if any, indicated thereon. Drawings returned for correction will be resubmitted for approval in the same manner as for new drawings. Every revision made during the life of the Contract shall be shown by number, date and subject in a revision block.

(b) Upon receipt of prints which have been Approved or Approved Except as Noted, the Contractor shall furnish three prints plus one electronic copy in CAD of each drawing to the Engineer. If revisions are made after a drawing has been approved, the Contractor shall furnish 3 additional prints and electronic copy in CAD subsequent to each approved revision.

(c) Shop drawings to be prepared by a Sub-contractor shall be submitted in the same manner as (a) & (b) above but they will be submitted through the Contractor.

(d) All of the applicable requirements of this Clause with reference to drawings to be prepared by the Contractor, including Sub-contractors, shall apply equally to catalogue cuts, illustrations, printed specifications, or other data submitted for approval.

(e) Any work done on Contractor's drawings shall be at the Contractor's risk. The Engineer will have the right to request any additional details and to require the Contractor to make any changes in the drawings which are necessary to conform to the provisions and intent of design and specifications without additional cost to the Employer. The approval of the drawings by the Engineer shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory. Approval by the Engineer of the Contractor’s drawings shall not be held to relieve the Contractor of his obligation to meet all the requirements of the Specifications or of his responsibility for the correctness of the Contractor's drawings or of his responsibility for correct fit of assembled parts in final position or of his responsibility for the adequacy of method of construction.

## 20 AS-BUILT DRAWINGS

The Contractor shall, at all times, keep on the site one copy of all drawings and approved samples together with copies of all building, mechanical, electrical and public safety codes and relevant standards applicable to the works. All such material shall be made available to the Engineer.

In addition, the Contractor shall, at all times, keep on site a separate set of prints on which shall be noted neatly, accurately and promptly as the work progresses all significant changes between the work shown on the drawings and that which is actually constructed. The subContractors shall each keep on site, at all times, a separate set of prints of the drawings showing their parts of the work on which shall be noted, neatly accurately and promptly as work progresses the exact physical location and configuration of the works as actually installed, including any revisions or deviation from the Contract Documents.

At the completion of the works, the Contractor shall at his expense, supply to the Engineer six copies and CD containing electronic copy in approved version of CAD of all as built drawings amended to comply with the work "As Built". The Contractor shall provide in the same format as the original drawings, any additional drawing required to record the work.

## 21 RESTORATION AND CLEANING

The Contractor shall do regular cleaning and clean away all rubbish and excess materials that may accumulate from time to time on completion and before handing over. Upon completion of the works he shall obliterate all signs of temporary construction facilities such as work areas, structures, foundations of temporary structures, stock piles of excess or waste materials, or any other vestiges of construction, unless otherwise directed by the Engineer. The works and site shall be left in a clean and satisfactory state for immediate use and occupation. Care shall be taken not to use any cleaning materials which may cause damage to the surface to be cleaned.

## 22 PROTECTION OF THE WORKS

In addition to the safety and security of equipment, materials and manpower on site, the Contractor shall whenever necessary cover up and protect the works from weather and damage by his own or other workmen performing subsequent operation. He shall provide all necessary dust sheets, barriers and guard rails and clear away the same at completion.

The Contractor shall take all proper steps for protection at all places on or about the works which may be dangerous to his workmen or any other person or to traffic. The Contractor shall provide and maintain warning signs, warning lamps and barricades as necessary.

## 23 PRODUCT DATA

Manufacture’s standard schematic drawings shall be modified or deleted to indicate only information which is applicable to the project. Such standard information shall be supplemented to provide all additional applicable information.

Manufacturer's catalogue sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive literature shall be clearly marked to identify pertinent materials products or models. Dimensions and required clearances shall be indicated. Shop performance characteristics and capacities shall be noted.

## 24 SAMPLES

24.1 The Contractor shall furnish for approval of the Engineer/Consultant/Architect with reasonable promptness all samples as directed by the Engineer or specifically called for in these Specifications. The Engineer shall check and such samples shall be approved by Architect/Consultant with reasonable promptness for compliance with the requirements of Contract Documents. All work shall be in accordance with approved samples. The approved sample shall be kept at site to verify each consignment.

24.2 Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Engineer, one for office use and the other for the Site.

24.3 Samples shall be furnished so as not to delay fabrication, allowing the Engineer reasonable time for consideration of the sample submitted.

24.4 Each sample shall be properly labeled with the name and quality of the material, manufacturer's name, name of the project, the Contractor's name and the date of submission, and the Specifications Article number to which the sample refers.

24.5 The manufacturer's installation directions shall be provided with each sample. The Contractor shall pay all transportation costs and deliver samples to the Engineer's office, Site or testing laboratory as directed by the Engineer.

Samples will not be returned unless return is requested at the time of submission; all packing and transportation costs for the return of samples shall be paid by the Contractor.

24.6 Samples shall be of adequate size and number to permit proper evaluation of the material by the Engineer. Where variations in colour, texture, dimensions or other characteristics are to be expected, the Contractor shall submit samples showing the maximum range of variation. Materials exceeding the range of variation of the approved samples shall not be used on the Work.

24.7 If both Shop Drawings and samples are required for the same item, the Engineer may require both to be submitted before approving either.

24.8 No acceptance or approval of any Shop Drawings or sample, or any indication or directions by the Engineer on any Shop Drawings shall constitute an authorization for any increase in the Contract Sum.

## 25 PRODUCT QUALITY AND HANDLING

Suppliers of local and foreign products and installations specified shall have been regularly engaged in the business of manufacturing, fabricating, installing and / or servicing work required for a period not less than 5 years. In addition, the Engineer may request as appropriate a:

- List of similar installations that describe project, scope and date of completion.
- Complete literature, performance data, and technical data.
- List of services record within Pakistan.
- Location of service office from which this installation could be maintained.

For the actual fabrication, installation and testing of the specified work, use only thoroughly trained and experienced workmen completely familiar with the items required and with the manufacturers recommended methods of installation. In acceptance or rejection, no allowance will be made for the lack of skill on the part of workmen.

Use all means necessary to protect materials before, during and after installation and to protect the installed work and materials of all other trades. In the event of damage, immediately make all repairs and replacement necessary for approval and at no additional cost to the Employer.

## 26 INSPECTION & TESTS REPORTS

The Contractor shall submit Quality Assurance Plan (QCP) in accordance with the Quality Assurance Plan (QAP) issued by the Engineer and carryout all testing and inspections works accordingly. All equipment and materials furnished under these specifications and all work performed in connection therewith will be subject to rigid inspection by the Engineer or the Engineer's Representative. Acceptance of equipment and material or the waiving off inspection thereof shall in no way relieve the Contractor of his responsibility for meeting the requirements of the Contract.

The Contractor shall furnish the Engineer with certified true copies of test reports of all materials used in the manufacture and fabrication of all equipment and material including metal work, steel pipes, fire bricks etc. The result of these tests shall be in such form as to show compliance with the applicable Specifications, standards and codes for the material used.

## 27 ACCIDENT PREVENTION, PROTECTIVE EQUIPMENT

The Contractor shall comply and enforce compliance by all his sub-Contractors with the highest standards of safety and accident prevention in accordance with international standards and in compliance with all applicable laws, ordinances and statutory provisions in Pakistan.

All requisite barriers, fences, warning signs, lights and other safety precautions as required for the protection of persons and property on or adjacent to the site shall be provided at the Contractor's cost.

All warning signs shall be in two languages, English and Urdu, and shall at all times be maintained in a clean and legible condition, to the satisfaction of the Engineer.

Trash shall be removed at frequent intervals to the satisfaction of the Engineer.

## 28 TEMPORARY FACILITIES

The Contractor shall provide, erect or install, maintain, alter as necessary and remove on completion except as otherwise directed by the Engineer all temporary facilities and services including access roads as described hereinafter and/or in the Contract Document.

Installation of temporary services at the site shall be given priority over all other construction at the site.

### 28.1 Temporary Road

The Contractor shall prepare and maintain such temporary roads as may be necessary, from the site to the nearest road and also within the site. Such roads shall be positioned strictly in accordance with the Engineer's instructions and the Contractor shall reduce or control any dust nuisance by spraying with water as directed. The Contractor shall satisfy himself as to the locations and nature of the proposed access routes to the site and shall be responsible for preventing any damage whatsoever to adjacent property and vegetation and keeping the access road free from debris at all times.

### 28.2 Temporary Services

The Contractor shall provide all services at his own i.e water, power, sanitation, drainage whether required for his camp or construction works, the Employer may provide water and sewerage connections to the Contractor at agreed rates between Employer and Contractor.

28.3 Temporary Water Supply

The Contractor shall supply in sufficient quantity all necessary potable and other water for construction purposes for all trades at point within a reasonable distance of the work. He shall make arrangements and pay charges for water service installation, maintenance and removal thereof, and pay the costs of water for all trades.

When the permanent water supply and distribution system has been installed, it may be used as the source of water for construction purposes provided that the Contractor obtains the written approval of the Engineer and the Employer and assumes full responsibility for the entire water distribution system and pays all charges/costs for operation and maintenance of the system mutually agreed between the Employer and the Contractor.

Temporary pipe lines and connections from the permanent service line, whether outside or within the area of site of works but necessary for the use of Contractor and his sub-contractor shall be installed, protected and maintained at the expense of the Contractor.

At completion of the work or at such time as the Contractor makes use of the permanent water supply installation, the temporary water services equipment and piping shall be removed by the Contractor at his own expense.

28.4 Temporary Electricity

The Contractor shall make all the necessary arrangements for a temporary electricity service, pay all expense in connection with the installation, operation and removal thereof and pay the costs of electricity consumed by all trades.

In the event that the site can not be connected to a local electricity network or where the available power is insufficient the Contractor has to make his own provision and maintain such installation.

A temporary lighting system shall be furnished, installed and maintained by the Contractor as required to satisfy the minimum requirements for safety and security. The temporary lighting system shall afford adequate general illumination to all building areas. Adequate outdoor lighting shall be provided to illuminate staging trenches and the like to the satisfaction of the Engineer and general illumination throughout adequate for watchmen and emergency personnel.

Temporary equipment and wiring for power and lighting shall be in accordance with the applicable provisions of governing codes. Temporary wiring shall be maintained in a safe manner and utilised so as not to constitute a hazard to persons or property.

When the permanent electrical power and lighting systems are in an operating condition, they may be used for temporary power and lighting for construction purposes provided that the Contractor obtains the written approval of the Engineer and the Employer and assumes full responsibility for the entire power and lighting system and pays all charges/costs for operation and maintenance of the system mutually agreed between the Employer and the Contractor.

Approval, license etc. if required under local laws will be obtained by the Contractor on his own responsibility and cost.

At completion of construction work, or at such time as the Contractor makes use of permanent electrical equipment and devices, temporary electricity services shall be removed by the Contractor as his own expense.

28.5 Waste Disposal

The Contractor shall make such temporary provisions as may be required in order to dispose of any chemicals, fuels, grease, bituminous materials, waste and soil waste and the like without causing pollution to either the site or the environment. Disposal of any materials, wastes, effluents, garbage, oil, grease, chemicals and the like shall be in areas specified by the concerned local authority proposed by the Contractor and subject to the approval of the Engineer. If any waste material is dumped in unauthorized areas the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed area. If necessary, contaminated ground shall be excavated, disposed off as directed by the Engineer and replaced with suitable fill material compacted and finished with topsoil all at the expense of the Contractor.

28.6 Fire Protection

The Contractor shall provide and maintain adequate fire protection in the form of barrels of water with buckets, fire bucket tanks, fire extinguishers, or other effective means ready for instant use, distributed around the project and in and about temporary inflammable structures during construction of the works.

Gasoline and other flammable liquids shall be stored in and dispensed from safety containers approved by the Engineer and storage shall not be within building.

Torch-cutting and welding operations performed by the Contractor shall have the approval of the Engineer before such work is started and a chemical extinguisher is to be available at the location where such work is in progress.

The Contractor shall follow the instructions and specifications of the Civil Defence Department and or other local authority.

28.7 Telephone

The Contractor shall immediately after receiving the Letter of Acceptance take the necessary steps to obtain a mobile and landline telephone on site. He shall be responsible for all installation and connection charges and periodic mobile and landline telephone accounts.

## 29 PROGRESS MEETINGS

The Contractor shall make all arrangements for progress weekly/monthly meetings including place, seating, presentation etc as approved by the Engineer. The meeting room must be air conditioned and sufficient for at least seating of twelve persons.

## 30 CONSTRUCTION SCHEDULE

A Construction schedule shall be maintained in accordance with the provisions of the General Conditions of Contract.

The schedule shall be accompanied with sufficient data and information including all necessary particulars of constructional plant, equipment machinery, temporary Works, arrival of plant, equipment at site and their installation, method of operation, work forces employed, etc., for activities of the Works.

Should the Engineer consider any alteration or addition in the programme and time schedule, the Contractor shall conform thereto without any cost to the Employer.

Whenever necessary and wherever the progress of the actual work shows departure, the programme and time schedule shall be undated and submitted to the Engineer for his approval.

## 31 NOTIFICATION TO THE ENGINEER

The Engineer's Representative shall be notified daily in writing of the nature and location of the Works the Contractor intends to perform the next day so as to enable necessary inspection and measurement to be carried out. The Engineer may, if necessary, direct that longer notice be given of certain operations.

## 32 NIGHT WORK

For night work activities, the Contractor shall inform and submit his detail program/methodology and get prior approval from the Engineer. When work is done at night the Contractor shall maintain from sunset to sunrise such lights on or about his work and plant as the Engineer may deem necessary for the proper observations of the work and the efficient prosecution hereof.

## 33 WEATHER

No work is to be undertaken when, in the opinion of the Engineer, the weather is so unsuitable that proper protection of the work cannot be ensured.

## 34 CO-ORDINATION WITH OTHER CONTRACTORS

The Contractor shall make all necessary coordination with other Contractor (if any) and shall make sure that all embedding components such as pipes, steel bases etc. are properly, accurately and timely installed.

The Contractor shall inform the other contractor the schedule of any construction activity well in advance giving him sufficient time to finish his part of job, before any compaction/concreting etc. The Contractor shall get the signature of the authorized representation of the other contractor before carrying out any construction activity.

If any part of electrical work is damaged or has to be dismantled or redone due to negligence/omissions/incorrect position of the embedding etc. on part of the Contractor, all such losses/expensed shall be borne by the Contractor.

All expenses incurred for the above works including coordination are deemed to be covered in his tendered cost and no separate/extra payment shall be paid against such item.

## 35 SUBMISSION REQUIREMENTS

35.1 Schedule submission at least thirty days before the dates when reviewed submittals will be needed.

35.2 Submit Shop Drawings as per provision given in Sub-Clause 19.5 (a) and number of copies of Product Data which the Contractor requires for distribution plus four copies which will be retained by the Engineer alongwith electronic copy in approved version of CAD.

35.3 Submit three samples unless otherwise specified.

35.4 Accompany submittals with transmittal letter, in duplicate, containing:

- Date
- Project title and number
- Contractor's name and address
- The number of each Shop Drawing, Product Data and the Sample submitted.
- Notification of deviations from Contract Documents.
- Other pertinent data.

## 36 RESUBMISSION REQUIREMENTS

Shop Drawings:

- Revise initial drawings as required and resubmit as specified for initial submittal.
-
- Indicate on drawings any changes which have been made by the Engineer.
-
- Product Data and Samples: Submit new data and samples as required for initial submittal.

## 37 SURVEY INSTRUMENTS

All the instruments, equipment, stakes and other material necessary to perform all work should be possessed by the Contractor. The survey work shall be carried out by competent staff consistent with the current practices. The Contractor shall maintain on site surveying instruments in perfect working conditions to enable the Engineer to check lines and level at all times.

Survey instruments and equipment shall include but not limit to the following:

- Electronic Total Station
- Electronic Data Recorder

- Disto Laser Meter
- Precision Level Invert Staff
- Automatic Levels
- Power level
- Compass, steel tape, ranging poles etc

## 38 WEEKLY PROGRESS REPORT AND PHTOGRAPHS

38.1 During the continuance of the Contract, the Contractor shall submit weekly progress reports on forms as approved by the Engineer. Such weekly reports shall show the actual progress completed as of date of the report plotted against the schedule as given by the Contractor at the start of work and shall be broken down so as to indicate status of all activities associated with mobilization design, material procurement, manufacture, surveys works, tests with regard to the agreed contract programme.

38.2 The Employer and the Engineer reserve the right to coordinate the schedules of this Contractor and other Contractors working at the Site, and to adjust and/or change any and all such schedules as required during the course of construction in order to achieve a coordinated project in harmony with the Employer's completion date.

38.3 Commencing after the first week of construction, and continuing every week until completion, the Contractor shall take and submit photographs to the Engineer's Representative, to show progress of his work and completion of each structure or major feature.

## 39 CONTRACTOR TO NOTIFY DELAYS ETC.

Any delay which will affect the completion of Works shall be detailed by the Contractor who shall state the action he is taking for effective completion of the Contract programme.

The Contractor shall submit a report in respect of the various sections of the Works, the equipment in use or held in readiness, a return of labour and supervisory staff, and details of any matters arising which may generally affect the progress of the work.

The Contractor shall give a summary of the detailed progress report giving the position with regard to the agreed Contract programme.

The progress reports shall be set out in a format to the approval of the Engineer, and forwarded promptly so that on receipt the information contained therein is not more than 21 days out of date.
If during execution of the Contract, the Employer considers the progress position of any section of the work to be unsatisfactory, or for any other reason relating to the Contract, he will be at liberty to convene a meeting and the Contractor’s Representatives are to attend such meeting.

The Contractor's Site Office shall prepare and submit 6 copies of a weekly progress report to the Employer and Engineer's Site Office. This report shall summarize site activities, records and details where difficulties in maintaining the agreed program are being experienced or are likely to cause subsequent delay.

The Contractor's Site Office shall also prepare and submit to the Engineer's Site Office 2 copies of Daily Activity Report summarizing the main activities to be undertaken each day, noting special activities such a tests, alignment checks, etc. The Contractor shall be responsible for

expediting the delivery of all material and equipment to be provided by him and his subcontractors.

## 40 PHOTOGRAPHS

As soon as work commences on Site, the Contractor shall provide photographs (at least 10 to 12) of the works from positions to be selected by the Engineer. Each photographic print shall not be less than 297mm x 210mm and shall bear a printed description, a serial number and the date when taken.

The negatives/soft copies of all photographs shall be held at the Contractor's Site Office, numbered and handed over to the Employer at the completion of the Contract. Soft copy of digital photos having description and serial number shall be submitted to the Engineer along with progress reports.

## 41 INAUGURATION PLAQUE

The Contractor at completion of the works shall construct an inauguration board as per size and details given by Employer/Engineer showing project details and inauguration date and the name of the inaugurating personality.

## 42 SIGN BOARD

The Contractor shall construct/erect a Sign board as per size and details given by Employer/Engineer showing project details and names of the Employer, Granting Agency, Consultant and Contractor. The sign board shall be maintained by the Contractor for the entire construction duration.

## 43 FACILITIES FOR THE ENGINEER

### 43.1 Site Office

NOT REQUIRED

### 43.2 Transport

NOT REQUIRED

## 44 FACILITIES FOR THE EMPLOYER

NOT REQUIRED

## 45 PAYMENT OF WORK

No payment shall be made for the works involved within the scope of this section of specification.

The BOQ items against which rates are not quoted in the bid, the cost of such items if executed at site shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

In case of failure of the contractor to comply with all or any provision(s) of this clause the damage(s) caused shall be attributable towards the Contractor, and the Engineer shall assess the amount of such damage(s) which shall be deducted from the monies due or to become due to the Contractor. However, the said amount may be reimbursed to the Contractor on rectification of all damage caused and subsequent certification by the Engineer that the said damage has been rectified by the Contractor at his own cost as per the requirements specified herein above.

# SECTION - G 01

# CONTRACTOR'S CAMP

## SECTION G 01

## CONTRACTOR'S CAMP

### 1. SCOPE

The work to be done under this item consists of construction, erection, installation and maintenance of the Contractor's Project Site Offices or main camp and the Contractor's sub-camps or temporary camps, if any, and shall include all offices, shops, warehouses, and other operational buildings; all housing and related facilities including accommodations for the Contractor's personnel.

### 2. GENERAL

The location of the Contractor's camps, including all buildings, utilities and facilities therefor, and of the camps or establishments of all persons/parties in the vicinity operating or associated with the Contractor shall be subject to approval of the Engineer.

The work to be done under this item will terminate upon the actual Completion Date. However, if directed by the Engineer or the Employer, the Contractor shall continue such work to the extent required by the Contractor's personnel during the period of maintenance. No compensation shall be paid for the continued operation and maintenance of the Contractor's Camps during the period of maintenance.

Upon completion of the Works, or at such time within the period of maintenance as directed by the Engineer, the Contractor shall remove all buildings utilities and other facilities from the Site and restore all camp areas to a neat and clean condition.

Contractor shall protect the environmental interests and HSE regulations at camp and works sites during execution of the contractual work.

### 3. CODES AND STANDARD

The construction, operation and maintenance of all camps of the Contractor shall comply with all applicable provisions of current Pakistan Labour Camp Rules.

### 4. MAINTENANCE

The Contractor shall furnish, make arrangements for, and carry out proper and adequate maintenance of the Contractor’s Camp areas at such camp to provide a neat, well-kept camp in all respects with pleasant and healthy surroundings and conditions for all occupants of their camp.

Adequately equipped and properly staffed portable first aid stations or dispensaries shall be provided by the Contractor at camps and other strategic locations to administer first aid treatment at any time required and free of charge to all persons on the Site, including employees of the Engineer and the Employer.

### 5. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

# SECTION – G 02

# SURVEY AND LAYOUT

## SECTION G 02

## SURVEY AND LAYOUT

### 1. SCOPE

Under this item the Contractor shall make the stakeout survey for construction purposes with competently qualified men, consistent with the current practices. The work shall proceed immediately upon the award of the contract and shall be expeditiously progressed to completion in a manner and at a rate satisfactory to the Engineer. The Contractor shall keep the Engineer fully informed as to the progress of the stakeout survey. The scope of this section of specifications is covered by detailed specifications as laid down herein.

### 2. MATERIAL AND EQUIPMENT

All instruments, equipment, stakes and other material necessary to perform all work shall be provided by the Contractor. These instruments and equipment shall be available to Engineer at all times for the purpose of checking the work of the Contract.

All stakes used shall be of a type approved by the Engineer, clearly and permanently marked so as to be legible at all times. It shall be the Contractor's responsibility to maintain these stakes in their proper position and location at all times. Any existing stakes or markers defining property lines and survey monuments which may be disturbed during construction shall be properly tied into fixed reference point before being disturbed and accurately reset in their proper position upon completion of the work.

### 3. CONSTRUCTION

The Contractor shall trim trees, bushes and other interfering objects, not consistent with the plan, from survey lines in advance of all survey work to permit accurate and unimpeded work by his stake-out survey crews and the Engineer's survey crews. The exact position of all work shall be established from control points, which are shown on the plans or modified by the Engineer. Any error, apparent discrepancy in or absence of data shown or required for accurately accomplishing the stakeout survey shall be referred to the Engineer for interpretation or furnishing when such is observed or required.

The Contractor shall be responsible for the accuracy of his work and shall maintain all reference points, stakes, etc. throughout the life of the contract. Damaged, destroyed or inaccessible reference points, bench marks or stakes shall be replaced by the Contractor. Existing or new control points that will be or are destroyed during construction shall be re-established and all reference ties recorded thereon shall be furnished to the Engineer. All stakeout survey work shall be referenced to the centerlines shown on the Plans. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the Contractor. All computations, survey notes and other records necessary to accomplish the work shall be kept neatly and made available to the Engineer upon request and furnished to the Employer upon Contract completion.

The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor and any necessary correction to the work shall be immediately made. Such checking by the Engineer shall not relieve the Contractor of any of his responsibilities for the accuracy or completeness of his work.

Reference points, base lines, stakes and benchmarks for borrow pits shall be established by the Contractor.

All required right-of-way and easement limits shall be established, staked and referenced by the Contractor concurrent with the construction stakeout survey.

The Contractor shall place at least two offset stakes or references at each centre lines station and at such intermediate stations as the Engineer may direct. From computations and measurements made by the Contractor, these stakes shall be clearly marked with the correct centre line, station number, offset and cut or fill so as to permit the establishment of the true centre line location during construction. He shall locate and place all cut, fill, slope, line grade or other stakes and points as the Engineer may direct to be necessary for the proper progress of the work.

## 4. MEASUREMENT AND PAYMENT

No payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bill of Quantities.

# CIVIL WORKS

# SECTION – C 01

# CLEARING, GRUBBING & SETTING OUT OF WORKS

## CLEARING, GRUBBING & SETTING OUT OF WORKS

### 1.00 Clearing, Grubbing and Setting Out of Works

### 1.01 Scope of Work

The Work covered by this section of Specifications consists of furnishing all labour, materials, necessary equipment, services, miscellaneous and necessary items, required to satisfactorily complete the clearing, grubbing and setting out of the Works, as indicated on Drawings, specified herein and subject to the terms and conditions of the Contract.

### 1.02 Clearing

Clearing shall consist of cutting up or trimming of trees, if any, and the satisfactory disposal of trees and other vegetation designated for removal, together with the down timber, snags, bushes, and rubbish occurring within the areas to be cleared. Trees, other vegetation, stumps, roots, and bushes in areas to be clear shall be cut-off below the original ground to extract the roots except such individual trees, groups of trees and vegetation as may be indicated on the Drawings or designated by the Engineer to be left standing. Individual trees, groups of trees, and other vegetation, to be standing, shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by such other means as the circumstances required, and as approved by the Engineer. Clearing operations shall be conducted so as not to cause any damage or harm to existing structures and installations and to those under construction, and so as to provide for the safety of employees and others.

### 1.03 Grubbing

Grubbing shall consist of the removal and disposal of all occurring stumps, roots larger than 38 mm in diameter, matted roots in the designated grubbing areas, stumps, roots, logs or other timber more than 38 mm in diameter, matted roots and other debris shall be excavated and removed to a depth not less than 450 mm below any subgrade, shoulder or slope. In areas where the cut is over 1.0m, grubbing shall not be necessary. In areas to be paved, or in areas indicated on the Drawings or designated by the Engineer as future paved areas where excess excavation from grading operations is placed, grubbing will be necessary.

### 1.04 Disposal

Unless directed otherwise, timber and other refuse shall be disposed off at locations approved by the Engineer in a manner that will avoid all hazards such as damage to existing structures, construction in progress, trees and vegetations. The Contractor shall be responsible for compliance with all pertinent laws and regulations pertaining to the burning of fires and observance of any security regulations applicable thereto.

Disposal by burning shall be kept under constant attendance until the fires have burned out or have been extinguished. No materials will be permitted to be pushed or placed on adjacent property without prior written approval of the owner of such property.

### 1.05 Setting Out of Works

The Contractor shall set out the Works and shall be responsible for true and perfect levels and setting out of the same and for correctness of the direction, positions, levels, dimensions and alignments of all parts thereof. If any error in this respect shall appear during the progress of the Work, the Contractor shall at his own expense rectify such error to the satisfaction of the

Engineer. Any checking by the Engineer shall not relieve the Contractor from his complete unshared responsibility for correct setting out of Works. The Contractor shall construct and maintain accurate bench marks so that the lines and levels can be easily checked by the Engineer.

## 1.06 Drainage Ditches/Dewatering

The Contractor shall construct and maintain such ditches/drains in addition to those shown on Drawings or as may be ordered by the Engineer to adequately drain the areas under construction of the water from any source including subsoil water in foundations. If due to any negligence the area is flooded the same shall be drained with adequate measures by the Contractor at his own cost.

## 1.07 Method of Measurement and Payment

1.07.1 The quantities for clearing, grubbing & setting out of works including cutting, removal and disposal of all materials shall be taken into account on the basis of Square meter and payment shall be made accordingly at the rate entered in the Bill of Quantities.

1.07.2 No separate payment shall be made for grubbing, clearing, disposal and protection works and setting out of Works. The Contractor shall be deemed to cover the costs for this item of work in the unit price of other Contract items.

END OF SECTION

# SECTION – C 02

# EXCAVATION AND BACKFILLING

## SECTION C 02 EXCAVATION AND BACKFILLING

### 2.00 Excavation and Backfilling

### 2.01 Scope of Work

The Work covered by this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with excavation, de-watering, filling, back-filling and disposal of all surplus and unsuitable material for construction works and foundations, complete in strict accordance with this section of the Specifications and the applicable Drawings and subject to the terms and conditions of the Contract and as per existing laws imposed by the local authorities.

The Contractor is to visit the site and ascertain for himself the condition of the surface of the ground and the type of soil likely to be encountered.

### 2.02 Original Levels

The quantity of excavation, earthwork, etc., shall be calculated from the level grid drawings to be produced by the Contractor and approved by the Engineer before commencement of any earthwork operation.

### 2.03 Setting Out

All setting out is to be checked and approved by the Engineer.

The Contractor shall take all necessary precautions during the progress of the Works to ensure that coordinated points are not disturbed and/or damaged.

If required, setting out is also to be checked and agreed with the local statutory body/authority.

### 2.04 Quality Control

#### 2.04.1 Tests

Testing will be undertaken by an independent testing laboratory proposed by the Contractor or site lab established by the contractor and approved by the Engineer. All costs associated with sampling, transportation and testing shall be borne by the Contractor.

#### 2.04.2 Standards

Relevant AASHTO Standards mentioned in Appendix-A of QC Plan will be used in sampling and testing of materials.

The Contractor shall have in effect at all times, a QA/QC program, which clearly establishes the authority and responsibility of those responsible for the quality system. Personnel

performing quality functions shall have sufficient and well defined authority to enforce quality requirements that includes but not limited to initiate, identify, recommend and provide solutions to quality problems and verify the effectiveness of the corrective action.

Implementation of the system shall be in accordance with the Contractor's quality manual and project specific quality plan, which shall both, together with all related/ referenced procedures, be submitted to the Engineer for review, comment and approval.

The Engineer reserves the right to inspect materials and workmanship at all stages of construction and to witness any or all tests. The Contractor/Sub-Contractor, within 30 days after award, but prior to the pre inspection meeting, shall provide to the Engineer with a copy of his Construction and Inspection Plan for review, including any mandatory witness requirements of the Engineer.

## 2.05 Sub-Soil Conditions

2.05.1 The Contractor shall be deemed to have acquainted himself with the sub-soil conditions on the Site and his bid shall be fully covering the works involved.

2.05.2 The Contractor shall make his own deductions for sub-surface conditions which may affect methods or cost of constructions of the work hereunder and he shall make no claim whatsoever for damages or compensation, should he find conditions during the progress of the Work, different from those as calculated and/or anticipated by him.

2.05.3 The Contractor shall be deemed to have made local and independent inquiries as to the site conditions and shall take the whole risk of the nature of the ground, subsoil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground, subsoil or material.

2.05.5 It is envisaged that contractor may encounter foundations of dismantled structures. Contractor should make his investigation and include efforts and cost required to dismantle, clear and disposal such subsurface foundations in the rate of excavation.

## 2.06 Excavation

2.06.1 Excavation shall include the removal of all material of every name and nature. If rock or concrete is encountered, it should be removed carefully and without excessive noise and vibration. Use of explosives shall not be permitted and no extra rates or any payment in such a case shall be made to the Contractor.

2.06.2 The Contractor shall give reasonable notice to commence any excavation and he shall submit to the Engineer full details of his proposals. If the Engineer may require modifications to be made in the Contractor's proposals, the Contractor shall give effect to such modifications but shall not be relieved of his responsibility with respect to such work.

2.06.3 For major excavations, the Contractor shall submit for the prior approval of the Engineer full details and Drawings showing the proposed method and procedure for supporting and strutting, dewatering and maintenance of adjacent structures. The design, provision, installation, erection, maintenance and removal of such temporary works shall be the responsibility of the Contractor and all costs in these respects shall be deemed to be included in the rates quoted by the Contractor.

2.06.4 The Contractor's attention is drawn particularly to his obligations under relevant Clause of the Conditions of Contract in respect of those works which are in close proximity to existing buildings/structures.

2.06.5 The excavation shall conform to the dimensions and elevations as indicated on the Drawings or as directed by the Engineer. Foundations on made up ground shall have to be taken down to natural bottom soil as per Drawings, direction and approval of the Engineer.

2.06.6 Excavation shall extend to a sufficient distance from wall and footings to allow for placing and removal of forms, installation of services and for inspection but the same shall not be paid separately and is deemed to be included in the unit rates of the Contractor.

2.06.7 In the event of any excavations being carried out deeper than required/specified levels, the same shall be filled in by the Contractor at his own cost to the required levels with lean concrete 1:3:6 under the footings and foundation slabs as per the instructions of the Engineer.

2.06.8 In the event of any excavations being carried out wider than the required/ specified dimensions, the same shall be filled in by the Contractor at his own cost to the required levels with properly compacted well graded sand free from any deleterious substance as per directions of the Engineer.

2.06.9 No excavation shall be back-filled nor any Permanent Work commenced until the foundation has been inspected by the Engineer and his permission to proceed given.

2.06.10 In case, any excavation is carried out and the pits and trenches, are filled with accumulated sand or debris from blowing windstorm, dust-storms, moving sand dunes or by any other reasons thereof after the levels were checked by Engineer, then the excavation or leveling shall have to be carried out again in the same manner as before unless and until concreting is done in the foundation/trenches. No separate payment shall be made on any such accounts.

## 2.07 **Shoring and Bracing**

2.07.1 The Contractor shall provide at his own cost, where required, all shoring, bracing, walls, supports etc. to the sides of the excavation to prevent sliding or any movement. Where found necessary, excavated sides shall be sloped as directed by the Engineer with no extra cost to the Employer.

2.07.2 Shoring including sheet piling, where required during excavation, shall be installed to protect workmen and the banks, adjacent, structures, paving and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor selects to adopt with prior approval of the Engineer, for upholding the sides of excavation against the side of public roadways and adjoining properties in existing hardcore or any other material. The Contractor will be held responsible for upholding the sides of all excavations and no claim for additional excavation, concrete or other material will be considered in this respect and shall be deemed to be included in his rates.

## 2.08 Dewatering and Drainage

2.08.1 The Contractor shall control at his own cost all the grading in the vicinity of the Site of Work in order to prevent any water from running into the excavated areas.

2.08.2 The Contractor shall, at his own cost, keep dry all pits and trenches during construction and all dewatering and pumping out whether due to ground water seepage or otherwise shall be included in the rates as quoted by the Contractor except otherwise provided in the Contract. The method employed in all cases shall be approved and agreed by the Engineer.

## 2.09 Protection of Utility Lines

When any existing utility lines whether to be retained or to be removed are encountered within the area of operations, the Contractor shall notify the Employer/Engineer, and shall not proceed until necessary measures are taken for protection or removal of the lines and instructions are obtained from the Engineer/Employer. This will be done at no extra cost to the Employer.

## 2.10 Fill and Backfill

2.10.1 After completion of foundations, footings, walls, slabs and other construction below the elevation of the final grades and prior to backfilling, forms shall be removed and excavation shall be cleaned of trash and debris. No backfilling shall be done until the entire foundations and footings etc. have been cured, inspected, approved and measured by the Engineer. Backfill shall be placed in horizontal layers not more than 6” thick and shall have proper moisture content for the required degree of compaction. Each layer shall be compacted by mechanical tampers or by other suitable equipment approved by the Engineer. Backfill shall be brought to a suitable elevation above grade to provide for anticipated settlement and shrinkage thereof.

2.10.2 Where concrete slabs, floors and pavements are to be placed on the ground, any loam, organic and other unsuitable materials shall be removed.

2.10.3 Filling shall consist of suitable approved material from site excavation or approved granular material from outside source, free from lumps, debris, rubbish, wood, organic or other unsuitable matter and capable of compaction by approved means to achieve desired density. Contractor will make separate stocks of suitable and

unsuitable excavated materials determined by tests at site for use of suitable material in backfill.

2.10.4 Fill, where required to raise the sub-grade for concrete slabs, shall be clean unadulterated earth, free from deleterious and organic substances and shall also be free from wood, stones and other debris. In case, sand shall be provided for filling, the same shall be clean and free from harmful substances.

2.10.5 All materials, when used in fill shall be compacted to required modified AASHTO density by power roller, mechanical rammer, or other approved equipment, in layers not more than 6" thick. In sand filling, each layer shall be uniformly spread, saturated with water or dried and then compacted. The Contractor shall arrange at his own cost the testing of the filling.

2.10.6 Backfill shall not be placed against foundation walls etc. before 14 days and not prior to the damp proofing /water proofing treatment as specified elsewhere in these documents. Backfills shall be brought up evenly on each side of structures as far as practicable. Heavy equipment for spreading and compacting backfill shall not be operated closer to the structures less than the distance equal to the height of the backfill above the top of footing.

2.10.7 The filling material shall be subject to the approval of the Engineer and shall conform to AASHTO Soil Classification System.

2.10.8 Filling around pipes and cables shall be carried out carefully by placing fine material to cover the pipe or cable completely before the normal filling is placed.

## 2.11 Compaction

Fill and/or backfill within the building or wherever required within the premises shall be compacted by approved means to a required compaction i.e. percent of maximum dry density as mentioned below;

| | **Fine Granular Material** | | **Granular material or sand** |
|---|---|---|---|
| | **Plastic** | **Non-Plastic** | |
| **Top of fill up to 30 cm (2-layers)** | **95%** | **97%** | **100%** |
| **30 to 75 cm below (3-layers)** | **93%** | **95%** | **98%** |
| **Below 75 cm each layer** | **90%** | **92%** | **95%** |

## 2.12 Rough Grading

2.12.1 Necessary rough grading shall be carried out by the Contractor to establish the finish grade or construction requirements of the Site, grades not otherwise indicated shall be uniform levels or slopes between points on existing and finished grades. Abrupt changes in slopes shall be rounded. Additional fill required to complete rough grading shall be provided as directed by the Engineer.

2.12.2 Where paving's or slabs are specified, all rough grading shall be done to the subgrade of the base course, removing all large stones and debris and shall be compacted uniformly to the correct lines and levels ready to receive the paving or slab. Refilling, where required shall be executed with suitable selected materials in layers not exceeding 6" in thickness and thoroughly compacted to the required density.

## 2.13 Bottom Elevations of Footings/Foundations

The elevations as noted in the Drawings are only approximate and must be adjusted in the field with the approval of the Engineer depending on the soil conditions encountered. No concreting shall begin until the design soil bearing capacity is substantiated by visual inspection by the Engineer. Where suitable foundation material is found lower than the underside of footings as detailed, the space between the founding material and footing soffit shall be backfilled with well compacted gravel/soling. Where soling is provided below the foundations, it shall be well compacted and the interspaces shall be properly filled with lean concrete.

The Contractor in planning his work shall make arrangements and provision to construct the lowest level footing first.

## 2.14 Disposal of Surplus Earth and Rubbish

All surplus earth, unsuitable material and rubbish shall be disposed off the Site as directed by the Engineer. The term disposal shall include all operations of loading, unloading, stacking, spreading, re-handling, filling depressions, leveling and grading as per instructions of the Engineer to the locations permitted by the concerned authorities.

## 2.15 Measurement & Payment

Excavation and backfilling shall be measured per cubic meter on the assumption of vertically excavated walls required for the nominal concrete dimensions of the structural members of the foundation shown on the Drawings and paid for at the unit rates entered in the Bill of Quantities, including compaction, disposal of surplus earth, dewatering, bracing, shoring etc.

END OF SECTION

# SECTION – C 03

# PLAIN AND REINFORCED CONCRETE

## SECTION C 03

## PLAIN AND REINFORCED CONCRETE

### 3.00 Plain and Reinforced Concrete

### 3.01 Scope of Work

The Work covered by this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with plain and/or reinforced concrete work complete in strict accordance with this section of Specifications, applicable Drawings and subject to the terms and conditions of this Contract.

### 3.02 Referenced Documents

Concrete Works shall be performed in strict accordance with the Specifications, drawings and the stipulations of the latest editions of the standards. British Standard Institute (BSI), the American Concrete Institute (ACI), the specifications of the American Society for Testing and Materials (ASTM) as referenced to throughout the Section shall be applicable subject to the Engineer's approval.

Latest editions of the following Pakistan, British, ACI and ASTM Standards are relevant to these specifications wherever applicable.

**Pakistan Standards**

| | | |
|---|---|---|
| P S | 232 | Portland Cement (ordinary & rapid hardening) |
| P S | 243 | Natural aggregates for concrete |
| P S | 279 | Abrasion of coarse aggregates by the use of Los Angeles machine. |
| P S | 280 | Determination of aggregates crushing value. |
| P S | 281 | Organic impurities in sand for concrete aggregates |
| P S | 282 | Material finer than No. 200 B.S. test sieve in aggregates. |
| P S | 283 | Soundness test for aggregates by the use of sodium sulphate or magnesium sulphate. |
| P S | 284 | Sampling aggregates for concrete. |
| P S | 285 | Sieve or screen analysis of fine and coarse aggregates. |
| P S | 286 | Description and classification of mineral aggregates. |
| P S | 421 | Sampling fresh concrete. |
| P S | 422 | Slump test for concrete. |
| P S | 560 | Making and curing concrete compression test specimen in the field. |
| P S | 612 | Sulphate Resistant Portland cement type `A' and sampling fresh concrete in the laboratory. |
| P S | 716 | Mixing and sampling fresh concrete in the laboratory. |
| P S | 717 | Compacting factor test for concrete. |
| P S | 746 | Definitions and terminology of cements. |
| P S | 849 | Making and curing concrete compression test cubes. |

**ASTM (American Society for Testing and Materials)**

| | | |
|---|---|---|
| C | 33 | Concrete Aggregates. |

| | | |
|---|---|---|
| C | 40 | Organic impurities in sand for concrete. |
| C | 87 | Effect of organic impurities in fine aggregates on strength of mortar. |
| C | 88 | Soundness of aggregates. |
| C | 94 | Ready mixed Concrete. |
| C | 117 | Material finer than No.200 (0.075mm) sieve. |
| C | 123 | Light weight pieces in aggregates. |
| C | 125 | Concrete and concrete aggregates. |
| C | 127 | Specific gravity and absorption of coarse aggregate. |
| C | 128 | Specific gravity and absorption of fine aggregate. |
| C | 131 | Resistance to abrasion of small size coarse aggregate. |
| C | 136 | Sieve or screen analysis of fine and coarse aggregate. |
| C | 142 | Clay lumps and friable particles in aggregates. |
| C | 143 | Slump of Portland Cement Concrete. |
| C | 150 | Portland Cement. |
| C | 156 | Water retention by concrete curing material. |
| C | 171 | Sheet material for curing concrete. |
| C | 172 | Fresh concrete sampling. |
| C | 289 | Potential reactivity of aggregate. |
| C | 309 | Liquid membrane forming compounds for curing concrete. |
| C | 332 | Light weight aggregates for insulating concrete. |
| C | 494 | Chemical admixtures for concrete. |
| C | 535 | Resistance to abrasion of large size coarse aggregates. |
| C | 685 | Concrete made by volumetric batching and continuous mixing. |
| D | 75 | Aggregate sampling. |
| D | 1751 | Preformed expansion joint filler for concrete paving and structural concrete. |
| D | 1752 | Preformed sponge rubber and cork expansion joint fillers for concrete paving structural concrete. |
| D | 1850 | Concrete joint sealer (cold application type). |
| E | 11 | Wire cloth sleeves for testing purposes. |
| E | 96 | Water vapor transmission of materials in sheet form. |
| E | 154 | Materials for use as vapor barrier under concrete slabs. |
| E | 337 | Relative humidity by wet and dry bulk psycho-meter. |
| C | 400 | Requirements for water for use in mixing and curing concrete. |
| C | 995 | Standard Test Method for Time of Flow of Fiber Reinforced Concrete Through Inverted Slump Cone, |
| C | 1018 | Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam With ThirdPoint Loading) |
| C | 1116 | Standard Specification for Fiber-Reinforced Concrete and Shotcrete |
| C | 1399 | Test Method for Obtaining Average Residual-Strength of Fiber- Reinforced Concrete |

**British Standards**

| | | |
|---|---|---|
| B.S | 12 | Portland cement, ordinary and rapid hardening. |
| B.S | 410 | Test Sieves |
| B.S | 812 | Methods for the sampling and testing of mineral aggregates, sand fillers |
| B.S | 882 | Concrete aggregates from natural sources |
| B.S | 1881 | Methods of testing concrete. |
| B.S | 3148 | Tests for water for making concrete. |
| B.S | 4027 | Sulphate-resisting Portland cement. |
| C.P | 8110 | Structural use of concrete. |

**ACI (American Concrete Institute)**

117 Standard Specifications for tolerances for concrete construction and materials.
201.2 Guide to durable concrete.

211 Recommended practice for selecting proportions for normal and heavy weight concrete.
214 Recommended practice for evaluation of strength test results of concrete.
301 Specifications for structural concrete for building.
304 Recommended practice for measuring, mixing, transporting and placing concrete.
305 Hot weather concreting.
308 Standard practice for curing concrete.
309 Recommended practice for consolidation of concrete.
318 Building code requirement for reinforced concrete.
347R Guide to Formwork for concrete.

## 3.03 General

**3.03.1** Until and unless specified or directed otherwise by the Engineer, all materials and workmanship shall be based on the latest versions of applicable ASTM Standards in force at the time of inviting tenders.

**3.03.2** Any defective work in the opinion of the Engineer shall be removed and reconstructed without undue delay to the approval of the Engineer and the Contractor shall bear all additional costs incurred.

**3.03.3** Any previous checks by the Engineer shall not in any way relieve the Contractor of his responsibility in respect of quality and accuracy of Work.

**3.03.4** Full care shall be taken to install embedded items. Embedded items shall be inspected and checks for reinforcements and other materials and items shall be completed and approved before concrete is placed.

**3.03.5** The Contractor shall get the bar bending schedules of reinforcement checked and approved by the Engineer prior to the cutting of reinforcement.

**3.03.6** The Contractor shall maintain an accurate record of ambient temperature of Site. Ambient temperature shall be measured using mercury thermometers or other thermometers acceptable to the Engineer.

**3.03.7** Throughout the concrete work, the Contractor shall employ full time on the Works suitable number of qualified and experienced Engineers whose sole duties shall be as follows;

- Design of concrete mixes
- Quality control of concrete
- Supervision of mixing, transporting, placing, compacting, finishing, curing and protecting concrete.
- Supervision of sampling and testing.
- Preparation and submission of test certificates and reports.
- Completion and keeping of record.
- Such other duties as the Engineer may direct.

**3.03.8** All concrete work including reinforcement etc. shall be carried out in accordance with the applicable requirements of ACI/ASTM/BSS Standards and to the instructions of the Engineer.

## 3.04 Materials

**3.04.1 Cement:** Cement shall be fresh and of approved make & source. It shall be one of the following as specified by the Engineer;

a) Ordinary Portland Cement (OPC) conforming to ASTM C-150, Type-1 or British Standard Specifications BS-12.

b) Sulfate Resistant Cement (SRC) conforming to ASTM C-150, Type-V or BS4027.

c) Low Alkali (OPC) or (SRC) can be specified, if aggregates (Fine or Coarse) intended to be used in concrete found reactive with alkalis in cement by petrography and mortar bar tests as per ASTM C-295, C-227 or C-1260.

d) Slag cement, where specified, will be a blended cement containing 50 - 60% ground granulated blast furnace slag (conforming to ASTM C989 or BS 6699) and 40 - 50% Ordinary Portland Cement (BS 12) fully conforming to Code requirements for fineness, chemical composition, strength, setting time, soundness, etc.

e) The supply of cement must be so programmed by the Contractor that at no time the quantity of cement stock shall be less than that required for an average consumption of four weeks. Lorry or truck or other means of transportation for the conveyance of cement to the Site of Work shall be clean, dry, metal-lined and covered from top with water proof sheets, so that cement is sufficiently protected from any deterioration during transit.

f) Cement shall be delivered in sealed bags and be stored in moisture-protected and well-ventilated sheds and each cement supply shall be stored separately.

g) The Contractor shall provide at his own cost on the Site all necessary sheds which shall be perfectly dry, waterproof and adequately protected against ingress of water for the storing of cement to be delivered to the Work, to ensure adequate supplies being available for the Work.

h) Cement, which is damp or contains lumps which cannot be broken to original fineness by finger pressure will be condemned irrespective of age and must be removed from the Site.

i) If any time the Engineer considers that any batch of cement may have deteriorated on Site during storage for any reason, he will direct that tests shall be made and the batch of cement on the Site which may be in question shall not be used until it has been shown by test to be of satisfactory quality at a laboratory approved or appointed by the Engineer. The Contractor shall bear all costs of such testing. The Contractor without delay shall remove any rejected cement from the Site. Cement reclaimed from cleaning bags or leaking

containers shall not be used in the Works and immediately be removed from the Site.

j) Cement shall be consumed in the sequence of its arrival at Site unless otherwise directed by the Engineer.

**3.04.2 Aggregates**

a) All fine and coarse aggregates to be used shall be supplied from approved sources, which shall not be changed without permission in writing from the Engineer. Aggregates shall conform to the requirements of ASTM C33.

b) Fine aggregates, shall consist of natural sand, manufactured sand or a combination thereof. It shall be clean, free from dust / clay, organic matters, other deleterious substances and impurities.

c) Fine aggregates shall conform to the following grading requirements as mentioned in ASTM C-33;

| Sieve Number/Size | Percentage passing |
|---|---|
| 9.5 mm (3/8") | 100 |
| 4.75 mm (No. 4) | 95 - 100 |
| 2.36 mm (No. 8) | 80 – 100 |
| 1.18 mm (No. 16) | 50 – 85 |
| 0.6 mm (No. 30) | 25 – 60 |
| 0.3 mm (No. 50) | 10 – 30 |
| 0.15 mm (No. 100) | 2 – 10 |

Fineness modulus of fine aggregate shall be maintained between 2.4 to 3.0. It shall not vary more than +/- 0.2 in at least four out of five consecutive tests from the moving average of last five tests.

d) Coarse aggregates shall be approved river gravel or hard crushed stone from a source approved by the Engineer and shall be clean, inert, hard, non-porous and free from laminated particles, sand, dust, salt, lime, chalk, clay, organic impurities or other deleterious matter.

e) Coarse aggregate shall conform to the following grading requirement for Reinforced Concrete. (Nominal Size 20.0 mm to 2.36 mm);

| Sieve Number/Size | Percentage passing |
|---|---|
| 25.0 mm | 100 |
| 20.0 mm | 90 – 100 |
| 9.5 mm | 20 – 55 |
| 4.75 mm (No. 4) | 0 – 10 |
| 2.36 mm (No .8) | 0 – 5 |

For other sizes of aggregates if required, grading mentioned in Table-2 of ASTM C-33 will be followed.

f) All aggregates shall be stored on properly constructed paving and in bins and there shall be a physical partition between the stockpiles of coarse and fine aggregates. No mixed up aggregates shall be used in any concrete. Under no circumstances aggregates shall be allowed to be in contact with ground.

g) If required, aggregates shall be washed and screened to the sequence of receipt of supplies unless otherwise directed by the Engineer.

h) All aggregates shall be subjected to the approval of the Engineer. Any aggregates not found to be of the required standard shall be rejected by the Engineer and shall have to be removed from Site without delay. Concrete structures executed with rejected aggregates shall be dismantled and rebuilt at the Contractor's expense.

i) Other required physical / chemical properties for coarse and fine aggregates are as under;

| | | |
|---|---|---|
| L.A. Abrasion of C. Agg. | ASTM C-131 | Max 40% |
| Soundness by sodium sulfate | ASTM C-88 | Max 12% |
| Sand Equivalent of sand | ASTM D-2419 | Min 70% |
| Sulfates | --- | Max.0.40% |
| Chlorides | --- | Max 0.05% |
| Flat & Elongated pieces (C.Agg) | ASTM D-4791 | Max 8% |
| | BS – 812 | Max 25% |

j) Aggregates both fine and coarse shall be non-alkali/silica reactive, if found so low alkali cement having total alkalis < 0.6 % (Na2O+0.658K2O) will be used without any extra cost.

k) The following tests shall be performed initially for approval and as per given interval thereafter:

l)

| | Test | Standard | Interval |
|---|---|---|---|
| - | Soundness | ASTM C 88 | quarterly |
| - | Specific Gravity | ASTM C 127 | bi-weekly |
| - | Absorption | ASTM C 128 | bi-weekly |
| - | Abrasion | ASTM C 131 | quarterly |
| - | Gradation | ASTM C 136 | daily |
| - | Sand Equivalent | ASTM D 2419 | weekly |
| - | Cleanliness | ASTM C 227 | weekly |
| - | Flaky/Elongated | ASTMD-4791 | monthly |
| - | Chloride | --- | quarterly |
| - | Sulfates | --- | quarterly |

Guidelines for adjustment in combined grading are given below.

**Gradation of Combined Coarse and Fine Aggregates for Concrete**

| Particle Size Square Openings (Equivalent U.S. Sieve Designation) | Percentage by Weight Passing Sieves Maximum Aggregate Size | | | | |
|---|---|---|---|---|---|
| | 50mm | 37.5mm | 25mm | 19mm | 9.5mm |

| | | | | | |
|---|---|---|---|---|---|
| mm (2 1/2 in.) | 100 | - | - | - | - |
| 50.00 mm (2 in.) | 90 - 100 | 100 | - | - | - |
| 37.05 mm (1 1/2 in.) | 70 – 90 | 90-100 | 100 | - | - |
| 25.00 mm (1 in.) | 50 - 75 | 50 - 86 | 90 - 100 | 100 | - |
| 19.00 mm (3/4 in.) | 45 - 70 | 45 - 75 | 55 - 100 | 90 -100 | - |
| 12.05 mm (1/2 in.) | - | - | - | - | |
| 09.05 mm (3/8 in.) | 38 - 55 | 38 - 55 | 45 - 75 | 60 - 80 | 90-100 |
| 05.00 mm (No. 4) | 30 - 45 | 30 - 45 | 35 - 60 | 40 - 60 | 50 - 85 |
| 02.36 mm (No. 8) | 22 - 35 | 23 - 38 | 27 - 45 | 30 - 45 | 37 - 52 |
| 01.18 mm (No. 16) | 15 - 27 | 17 - 33 | 20 – 35 | 20 - 35 | 25 - 40 |
| 00.60 mm (No. 30) | 10 - 18 | 10 - 22 | 12 - 25 | 13 - 23 | 15 - 25 |
| 00.30 mm (No. 50) | 4 - 10 | 4 - 10 | 5 - 15 | 5 – 15 | 5 - 15 |
| 00.15 mm (No. 100) | 1 - 3 | 1 - 3 | 1 - 5 | 1 - 5 | 1 - 5 |
| 0.075 mm (No. 200) | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 | 0 - 2 |

63.00

100

### 3.04.3 Water

Water to be used in the Work shall be potable water and shall be free from all impurities whether suspended or dissolved. Further, the water shall not contain any chemical impurities, salts etc. of any kind. Water shall be tested for its fitness in Works in accordance with AASHTO Method T26-51.

### 3.04.4 Admixtures

a) All concrete with specified strength of 4000 psi or greater shall use an approved super plasticizer conforming to BS 5075: part 3, BS: EN 934-2, 1998 or ASTM C494.

b) For use of an admixture, the information required by the Engineer shall be submitted to him for each admixture for his approval.

c) The cost of the admixtures shall be deemed to be included in the rates.

## 3.05 Concrete Mixes

Concrete mixes to be used in various parts of the Works shall be as indicated on the Drawings and mentioned in the Bill of Quantities. As soon as possible after award of the Contract, the Contractor shall prepare trial mixes as required to satisfy that the specified

concrete strengths will be obtained using the materials and mix proportions in accordance with Table-1 appended hereto. The proportion of cement shall be increased if necessary to obtain the strengths required. Unless noted otherwise, all blinding concrete shall be of Class E.

**TABLE – 1**

| Class of Concrete | Minimum Qty. of Cement Kg/$m^3$ | Work Cylinder Strength (fc') | | Max. Water-Cement Ratio | Max. Water-Cement Ratio |
|---|---|---|---|---|---|
| | | @ 7 days ($N/mm^2$) | @ 28 days ($N/mm^2$) | | |
| C40 | 400 | 32 | 40 | 0.40* 0.42* | 0.40* |
| C35 | 370 | 28 | 35 | | 0.45* |
| C28 | 345 | 22 | 28 | 0.45* | 0.50* |
| C21 | 275 | 17 | 21 | 0.55 | 0.60 |
| C9 | 200 | 7 | 9 | 0.8 | 0.70 |

*Note: The w/c ratios shall be appropriate to the mix design with use of super plasticizer and is subject to adjustment based on mix designs submitted and results of trial mixes.

Submit proposed Lab Mix-designs with three different W/C ratios for each grade of concrete at least 30 calendar days before placement of concrete in accordance with ACI-211. Cast 12cylinders of 6x12 inches for each mix and test set of 3 after 3,7,14 & 28 days for pre-cast concrete. Cast 9-cylinders and test set of 3 after 3, 7 & 28-days for normal concrete mixes. Design strength should be kept higher than specified works strength as mentioned in Table-1. Sample of all materials used in mix-design should also be provided along with material submittals to Engineer.

Repeat selected Lab Mix-design in field at batching plant, make 3 trial batches with selected W/C ratio and submit proposed final mix designs for each grade of concrete at least 7 calendar days before start of concrete placement,

Average required strength (**f**cr') of works cylinders initially will be kept higher than specified strength (fc') as mentioned in ACI-318.

| | |
|---|---|
| For < 21 Mpa | fc' + 7.0 |
| For 21 – 35 Mpa | fc' + 8.3 |
| For > 35 Mpa | 1.1fc' + 5.0 |

These values will be changed to following equation after 30 strength tests of each grade of concrete: **f**cr' = fc' + (1.34 x standard deviation)

The Contractor shall obtain approval from the Engineer in writing for each mix design before producing the actual concrete for the works.

## 3.06 Batching and Mixing

Concrete shall be mixed by a mechanical batch type mixing plant with adequate facilities for accurate measurements and control of each material entering the mixer and for changing the proportions to conform to varying conditions of the Work. The mixing plant assembly shall permit ready inspection of operations at all times. The plant and its location shall be subject to approval of the Engineer.

Water shall be measured for every batch with due allowance for water already present in aggregates.

### 3.06.1 Batching Units

Batching units shall be supplied with the following items:-

a) Weighing unit shall be provided for each type of material to indicate the scale load at convenient stages of the weighing operations. Weighing units shall be checked at times directed by and in the presence of the Engineer and required adjustments shall be made before further use.

b) Water mechanism shall be tight, with the valves interlocked so that the discharge valve cannot be opened before the filling valve is fully closed and shall be fitted with a graduated gauge.

c) Discharge gate shall control delivery of materials from weighing bins to the mixer. Accuracy of weighing for different materials shall be within the following limits:-

| **Materials** | **Percentage by Weight** |
|---|---|
| Cement | +/- 1% |
| Water | +/- 1% |
| Fine Aggregate (Sand) | +/- 2% |
| Coarse Aggregate | +/- 2% |
| Admixture | +/- 3% |

### 3.06.2 Mixing Units

a) Mixers shall not be charged in excess of rated capacity nor be operated in excess of rated speed. Excessive mixing requiring addition of water to preserve required consistency shall not be permitted. The entire batch shall be discharged and discarded before re-charging.

b) Mixing time shall be measured from the instant water is introduced into the mixer drum containing all solids. All mixing water shall be introduced before one-fourth of the mixing time has elapsed. Mixing time for mixers of one cubic meter or less shall be not less than 2 minutes; for larger than one cubic meter capacity mixers, time shall be increased by 15 seconds for each additional half cubic meter or fraction thereof, which may be varied if the charging and mixing operations fail to result in the required uniformity in composition and consistence within a batch and from batch to batch. If an air-entraining agent is allowed to be used, additional mixing time shall be allowed so as to provide the specified air-content.

c) Unless waived by the Engineer, device such as discharge-lock to lock the discharge mechanism, until the required mixing time has elapsed, shall be provided on each mixer. Mixing shall continue for at least 40 revolutions of mixer drum.

d) No hand mixing under any circumstances even with extra cement shall be permitted. If during concreting, the mixing plant fails, the concrete already poured shall be removed, unless directed otherwise by the Engineer. Mixers, which have been out of use for more than 30 minutes shall be thoroughly cleaned before any further concrete is mixed.

e) The mixing water shall be regularly sampled and tested for salt content and contamination.

**3.07 Ready Mixed Concrete**

Ready mixed concrete shall comply with the requirements of ASTM C94 and as agreed with the Engineer.

Each mixer truck shall arrive at the job Site with its water container full. In the event that a container is not full or concrete tests give a greater slump than acceptable, the load shall be rejected.

Shade temperature and concrete temperature shall be recorded at the point of discharge of the mixer and at placement for each load of concrete delivered to Site. Maximum and minimum temperature and wet bulb temperature shall be recorded daily.

Slump tests shall be performed in accordance with ASTM C143 or BS 1881 at the point of placement for each load delivered to the Site.

No water shall be added at the Site.

Transit mixers equipped with automated devices for recording the number of revolution of the drum shall be used.

The concrete shall be mixed and the water added to the mixer at the depot. No additional water shall be added at any stage from batching to placing.

Truck mixer's mixing performance when tested in accordance with BS 3963 shall be within the limits of table 5 of BS 1305.

The drum of the truck agitator or truck mixer shall be completely clean and empty before it is filled with concrete. Trucks shall not be loaded in excess of the manufacturer's rated capacity, which shall be displayed on the vehicle in terms of the volume of mixed concrete.

Concrete shall be delivered, placed and consolidated within 45 minutes after the introduction of the water to the cement at batch plant when no admixtures are used, if admixtures are added at plant this time can be increased after check of setting time of concrete in field conditions and approval of engineer.

The concrete supplier may not introduce admixtures at either during transportation to the Site or at Site.

The actual batched weight of cement, water, admixture, additives and coarse and fine aggregates, the time of introduction of the water and the mixing temperature after water has

been added shall be recorded on each delivery ticket by the supplier. When concrete is wet batched no water shall be added after batching.

In addition, where required by the Engineer, the Contractor shall provide details of the aggregate moisture contents determined at the plant. These shall be provided on a daily basis both as test results and in the form of a print out of the data programmed into the batching plant. The delivery ticket shall show details of any automatic adjustments to the quantity of water added to the mix, i.e. Compensating for the actual moisture contents measured during batching.

The supplier's test certificate giving the results of tests on aggregates for workability and strength shall be submitted by the Contractor to the Engineer at weekly intervals.
Calibration of the Ready Mix Plant shall be carried out at regular intervals and calibration certificates of the plant shall be submitted to the Engineer.

## 3.08 Volume Batching

Volumetric batching may be allowed at contractor's request in unavoidable circumstances with the Engineer's approval after meeting following condition;  Trial mixes shall be prepared by volume also.

- Contractor shall arrange standby concrete mixer in working condition.
- Proper system of water and admixture dispensing will be adopted.
- Batching and mixing will be supervised by Contractor's QC Inspector.
- Source & Grading of sand and aggregate shall be maintained as used in trial mixes.
- Materials shall be procured from approved sources only to avoid variation.
- Cement shall be used from one source in one time. However, approval shall be obtained for more than one source in case of emergencies.
- The Contractor shall follow inspection and testing plan as mentioned in QC plan.
- Qualification tests shall be required for Engineer's approval for all basic materials going to be used in permanent works i.e. cement, sand, coarse aggregate and steel etc.

## 3.09 Samples and Testing

### 3.09.1 General

Test cylinders of concrete shall be prepared and stored by the Contractor in accordance with the ASTM C-172, as and when directed by the Engineer. Test cylinders and the concrete materials shall be tested in an approved laboratory and the Contractor shall bear all charges for the same, including such other tests as may be determined by and acceptable to the Engineer.

### 3.09.2 Water

Water shall be tested in accordance with AASHTO Method of Test T26-51.
Water for mixing in reinforced concrete shall be free from oil and shall not contain more than 1000 PPM chlorides and 1300 PPM sulphates (SO4).

In Non-reinforced concrete water for mixing shall also be free from oil and shall not contain more than 2000 PPM chlorides and 1500 PPM sulphates (SO4)
In no case shall the water contain an amount of impurities that will cause a change in the setting time of Portland cement by more than 25%, nor a reduction in compressive strength of mortar by more than 5% at the age of 14-days when compared with the results of same mix made with distilled water.
Water for washing concrete aggregates shall be of the same quality as mixing.
Water for curing concrete shall not contain impurities to cause discoloration or etching of surface. Quality of water shall be determined as per AASHTO T-26.

**3.09.3 Cement**

Cement shall be tested as prescribed in BS-12.

**3.09.4 Aggregate**

Aggregates shall be tested as prescribed in ASTM C-33. In addition, fine aggregates shall be tested for organic impurities in conformity with ASTM C-40.

**3.09.5 Reinforcement**

Reinforcement bars shall be tested as prescribed in BS 4449, BS-4461 and ASTM A615 for deformed steel bars and mild steel plain bars. Refer clause 4.12 of this section for specification requirements of reinforcement works.

**3.09.6 Testing of Concrete**

**3.09.6.1** Concrete Compressive Strength Test

a) Works Test Cylinders shall be made of all structural concrete incorporated into the works. Unless otherwise directed by the Engineer, one set of cylinder of any particular mix shall be taken from either :-
   - each pile concreted.
   - each 350 cu.ft. or part thereof in columns
   - each 1000 cu.ft. in walls and small foundations
   - each 1750 cu.ft. in slabs, beams and large foundations, or each day's production whichever is the more frequent.

b) Each set of the Works Test Cylinders shall comprise six 6”x12” Cylinders made from a single sample of concrete taken from the point of final deposition of the set concrete under the Engineer's supervision.

c) The sampling, making, curing and testing of Works Test Cylinders shall be carried out in accordance with ASTM C3 & C39. Test results shall be recorded on approved forms and submitted in duplicate to the Engineer immediately following the test.

d) A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using that mix. The number of samples per day and the times which they are taken shall

be varied at random (thereafter at least one sample shall be taken each day the concrete of that particular mix is made).

e) From each sample six Cylinders shall be made, three for test at seven days, and three for test at twenty-eight days.

f) Specimens shall be cured under laboratory conditions except that the Engineer may require curing under field conditions in which case strength of field cured specimens shall not be less than 85% of that of companion laboratory condition cured specimens.

g) All cylinder moulds shall be steel moulds perfectly true, having all internal and meeting faces machined to a smooth surface.

h) If the strength tests of the laboratory cured specimens for any portion of the Work falls below the minimum allowable compressive strength at 28 days required for the class of concrete used in that portion, the Engineer shall have the right to order replacement of the affected work.

i) All test specimens shall bear distinguishing mark showing number, date of casting, quality of concrete and place from where sample was taken. A proper daily record of test specimens made and test results obtained shall be maintained by the Contractor and weekly test results shall be submitted to the Engineer.

j) Statistical analysis for each grade of concrete shall be made for 30 test results as per ACI-214 and reported to the Engineer.

**3.09.7 Concrete Members not complying with Specifications**

(i) Where concrete in the Works does not comply with the Specifications, the Engineer may order any or all of the following or any other appropriate action to be taken:

(a) Drilling of cores from structure and testing its compressive strength.

(b) To carry out load tests or other non-destructive tests on concrete structure.

(c) To cut out and replacement of such volume as is considered defective by the Engineer.

(d) Strengthening of the structure in accordance with the requirements and as proposed by the Engineer.

(e) Any other action which in the opinion of the Engineer is necessary.

(ii) The Contractor shall carry out all such tests, investigations, rehabilitation or replacement in coordination with and as acceptable to the Engineer at no additional cost to the Employer.

## 3.10 Transporting and Placing Concrete

### 3.10.1 General

a) Concreting shall be conveyed and deposited as quickly as possible after mixing and shall proceed so that, as far as possible, a complete section of the Work is done in one operation. The concrete may be distributed in barrows, skips, and chutes and by any other method such as pumps, conveyor belts etc.
all to the approval of the Engineer.

b) Transportation of concrete shall be in a manner approved by the Engineer and shall be so as to avoid segregation or loss of ingredients of concrete.

c) All foundations and portions of Work to be concreted shall be approved by the Engineer in writing before concrete is poured.

d) All forms and reinforcement shall be completed, cleaned, inspected and approved before pouring of concrete. No concrete is to be deposited till the Engineer has inspected and approved in writing all reinforcement, foundations, forms, details, positioning of all fixtures and materials to be embedded in concrete, control levels and screeds, etc. and is satisfied with the arrangements the Contractor has made to efficiently proceed with the work such as sufficient labour, materials, plants etc. Such an approval will not relieve the Contractor from any of his obligations under this Contract. No concrete shall be deposited without the written permission from the Engineer who shall have no authority to waive off this condition. Any concrete without such written authorization shall be liable to be rejected.

e) Placing of concrete shall not be permitted when, in the opinion of the Engineer the sun, heat, wind, cold, snow, or limitations or facilities furnished by the Contractor prevent proper placing, finishing and curing of concrete.

f) All concrete shall be thoroughly compacted and consolidated by means of pneumatic or mechanical immersion type vibrators of suitable size having minimum frequency of 8000 RPM. Care shall be taken to avoid segregation due to excessive vibration. The Contractor shall maintain on Site at all times one or more standby vibrators. Tapping or other external vibration of forms shall not be allowed unless so directed by the Engineer. In that case formwork shall be adequate to withstand vibrations. Compaction shall be done until the whole mass assumes a jelly like appearance and consistency with water just appearing on the surface. Concrete shall be sufficiently tamped and consolidated around the steel bars, care shall be taken that the vibrator does not touch steel or formwork, and is worked into all parts of the moulds in order that no voids or cavities are left. Steel shall not be disturbed during operations of concreting. Concrete shall be brought up in even layers of suitable thickness as per rate of placement for proper consolidation, to avoid cold joint and worked against side of forms to give a smooth and uniform surface. No surplus water shall be allowed to come out and lie on the surface of concrete. The concrete must be of such a consistency that when ramming, consolidating and tamping is completed, a thin film of water is just appearing on the surface. In vibrating, care shall be taken to avoid displacing the reinforcement.

g) Hardened concrete, debris and foreign materials shall be removed from interior of forms and from inner surface of mixing and conveying equipment.

h) Runways and gangways shall be provided for wheeled concrete handling equipment and workmen, and such equipment shall not be wheeled over reinforcement, nor shall runways be supported on reinforcement.

i) Concrete shall not be dropped freely from a height of more than 3.0 meters in columns and 1.2 meters elsewhere. In cases where an excessive drop is inevitable, the Contractor shall provide spouts, down pipes, chutes, or side ports to forms with pockets, which will let concrete stop and flow easily into the form without any risk of segregation. The discharge of the spouts, down pipes or chutes shall be controlled so that the concrete may be effectively compacted into horizontal layers.

j) Concrete is to be deposited as quickly as possible after mixing and to proceed continuously. Concrete which has attained its initial set or has contained its mixing water for more than 45 minutes shall not be allowed to be placed in the work.

k) When concrete is laid on hard core, such as sub-grade for floor slabs, or other absorbent material, the surface is to be watered, consolidated and, where specified, blinded before the concrete is deposited.

l) Fresh concrete shall not be placed on previously laid concrete or on old concrete surfaces until the latter has been cleaned of all dirt, scum and laitance by wire brushes. The clean surface shall then be thoroughly wetted and grouted with cement slurry as approved by the Engineer.

m) Care shall be taken not to disturb newly placed concrete by vibrator, indirect loading or otherwise. No traffic or loading shall be allowed on the concrete until it has thoroughly set and hardened.

n) Construction joints in concrete shall only be given at locations indicated on the drawings or as approved by the Engineer. If approved by the Engineer, the concrete at the end of the day's work shall be finished off against a temporary shutter stop, which shall be vertical and securely fixed. Such stops shall be removed within 24 hours of placing of concrete. Construction joints not shown on the Drawings shall be reinforced with steel bars or dowels, if deemed necessary by the Engineer, and shall be furnished by the Contractor without any additional cost.

o) No concrete shall be placed during rains or inclement weather and all fresh concrete shall be suitably protected from rain fall and excessive heat or cold.

p) Should any part of the exposed surface present a rough, uneven or imperfect appearance, when the shuttering is removed, it shall be picked out to such depth and refilled and properly re-surfaced and entirely redone as per directions and approval of the Engineer at the cost of the Contractor.

q) On removal of the forms and before the concrete skin has had time to harden, all faces of the concrete inside and outside to be kept exposed (i.e. unplastered) shall be rubbed over with carborundum stone, and washed with cement to remove all marks, projections, hollows, or any other defect. No extra payment shall be made for this work.

r) All exposed surfaces and lines of the concrete work are to be true and fair without cracks, bends, windings and distortions of all kinds, without any extra charges by the Contractor. All concrete work to remain exposed and unplastered is to be fair-faced, smooth, pleasing and to the entire satisfaction of the Engineer.

s) A float or screed is to be worked over the exposed surfaces of all concrete work on the flat or curve, so as to render the surfaces perfectly smooth, clear and to the necessary slopes or falls or as required to receive the floor or roof finishes according to the Drawings and as directed by the Engineer without any extra charge by the Contractor.

### 3.10.2 Temperature

No concrete shall be mixed or placed while the ambient temperature is above 35 degrees centigrade (°C) on a rising thermometer or above 40 degrees centigrade (°C) on a falling thermometer. The Contractor shall supply an accurate maximum and minimum thermometer and hang it in an approved position in the Works.

The Contractor shall plan the day's concrete in such a manner as to ensure that each bay or panel is completed at a proper construction joint before the temperature rises above the permissible limit.

The Contractor shall allow in his rates for any additional expenses incurred by complying with this Clause in order to complete the works within the "Time for Completion".

Fresh Concrete temperature shall not exceed 32 degree centigrade in summer and shall not be less than 10 degree centigrade in winter.

### 3.10.3 Hot Weather Concreting

The following precautions should be adopted to maintain fresh concrete temperature $\leq 32$ °C.

a) Shading of aggregate stock piles.

b) Insulation of water tanks and pipelines.

c) Use of chilled water.

d) Addition of ice flakes into mix to further lower temperature.

e) Shading of formwork and reinforcement from the sun and drying winds.

f) Cooling of formwork and reinforcement by mist spraying prior to and ahead of casting of the concrete.

g) Covering and spraying with water of hardening concrete surfaces.

h) Concreting during the cooler part of the day.

Refer to ACI Standard 305R-99: Recommended Practice for Hot Weather Concreting.

## 3.11 Protection and Curing

### 3.11.1 General

All exposed concrete shall be cured. Curing shall be accomplished by preventing loss of moisture, rapid temperature change and mechanical injury or injury from rain or flowing water for a period of at least seven (7) days. Curing shall be started as soon as the concrete has hardened sufficiently for the surface not to be marked.

Curing shall be done either by covering with sand, hessian, canvas or other approved fabric mats, which shall be kept continuously wet. If required and so directed by the Engineer, formed surface with forms in position shall also be cured by keeping all forms continuously wet. As an alternative, curing of concrete on all exposed surfaces which could not be kept covered, such as sides of the beams, under side of the slabs, may also be done by sealing concrete surface with liquid membrane-forming curing compounds white pigment type conforming to ASTM C-309 or equal so as to arrest loss of moisture from concrete, with the approval of the Engineer. Care shall be taken so as to spray the compound/chemical on all the exposed faces of concrete so that no loss of moisture takes place. The Contractor shall take special care that curing of concrete is satisfactorily carried out and in accordance with methods specified herein and/or as instructed by the Engineer. Any negligence in this regard may result in total rejection of such concrete works, which in the opinion of the Engineer have not been adequately cured.

### 3.11.2 Curing Methods

a) Pounding

- Build dike, then fill with water to cover the entire concrete slab.
- Avoid water or dike material that can stain the concrete.
- Use curing water at temperature within 20°F of the concrete temperature.
- Avoid premature or sudden release of pounded water, which can damage the surrounding environment.

b) Sprinkling or Fog Spraying

- Keep surface continuously wet. Alternate wetting and drying may cause craze cracking.
- Use low water pressure and flow to avoid washing away the fresh concrete surface.
- Use a water temperature within 20°F of the concrete temperature. ▪ Avoid if water runoff can damage the surrounding environment.

c) Using Wet Materials

- Cover the concrete with wet hessian, straw, sawdust or sand.

- Wet continuously or cover plastic sheets and wet frequently.
- Avoid materials that discolor concrete. ▪ Prevent materials from blowing away.

d) Using Plastic Sheets or Waterproof Paper

- Use flat type. Lap edges 6 inches and cover exposed concrete edges.
- Use minimum 4 mil thick plastic sheet; white in hot weather and black in cold weather.
- Don't use on architectural concrete.
- Secure covering to prevent concrete exposure.

e) Using Curing Compounds

Apply white pigmented acrylic based curing compound conforming to ASTM C309, Type-2 and approved by the engineer to the concrete surface as soon as the bleed water has dried and the fresh concrete has hardened sufficiently.

### 3.11.3 Thick Sections

a) For sections of 5 feet thick or more, proper arrangements shall be made to control the temperature of the concrete during mixing and placing and to control the heat of hydration. The Contractor shall ensure that the maximum concrete temperature shall be limited to 70°C. For methods to pre-cool concrete, refer to Subsections 4.09.2 & 4.09.3.

b) To minimize the potential for thermal cracking, the maximum temperature differential between the inner core and outer surfaces must not exceed 20°C. This temperature differential is the difference between the temperature at the hottest portion of the concrete and that at the surface. The Contractor shall submit to the Engineer his proposals to control and monitor this.

c) To minimize temperature differential, the top surface of the poured raft shall be properly insulated to keep it warm and to decrease the rate of cooling. Use tenting, quilts, or sand on polyethylene sheeting for this purpose. Insulation should be kept in place until the hottest portion of the concrete cools to within the temperature difference limit of the average air temperature. For example, if a 20°C temperature difference is specified and the average air temperature is 30°C, insulation should not be removed until the hottest portion of the concrete cools down to 50°C.

### 3.11.4 Period of Curing

Period of curing for any concrete shall be 7 days or more as directed by the Engineer. All concrete pours and concrete structures shall be clearly marked with non-washable paints to indicate the date of placing concrete. During hot weather, curing shall be done even at night. It shall be obligatory on the part of the Contractor to obtain a certificate from the Engineer that the curing has been properly done. A suitable format shall be printed and kept on Site to be signed by the Engineer for every part of the Work.

## 3.12 Reinforcement Steel

### 3.12.1 General

a) The work covered by this sub-section of the Specifications consists of furnishing all materials, tools, labour and in performing all operations in connection with the providing, straightening, cutting, bending, fixing, binding including binding wire,

chairs, pins, spacer blocks complete in strict accordance with this subsection of the Specifications, the applicable Drawings, approved bar bending schedule, and the terms and conditions of the Contract.

b) The Contractor shall procure reinforcing steel only from reputable manufacturers/ suppliers duly approved by the Engineer.

c) Verification of the source of supply shall be prepared by the Contractor and submitted to the Engineer along with necessary certificates and test reports.

d) The Contractor shall prepare detailed bar cutting and bending schedules on the basis of the working Drawings and in consideration of BS-4466 and of any requirement resulting from the applied bar bending process.

e) The Contractor shall inform the Engineer of the completion of any reinforcement in time, in order to facilitate its inspection and check of conformity with the working Drawings well before the concreting. Relevant formalities shall be agreed upon between the Contractor and the Engineer at the appropriate time.

f) Reinforcement bar sizes have generally been shown on the Drawings in the form of designated bar numbers.

g) Reinforcement shall be deformed, except that plain reinforcement bars are permitted for spirals. Reinforcing steel bars (Plain and deformed) shall conform to the Standards mentioned below and as indicated on the Drawings and Bill of Quantities.

   i) Hot rolled deformed and plain billet steel bars (Grade-40 & 60) conforming to ASTM A-615 or BS 4449.
   ii) Deformed steel wire conforming to ASTM A-496. iii) Welded steel wire fabric conforming to ASTM A-185.
   iv) Steel bar mats conforming to ASTM A-184
   v) Cold drawn steel wire conforming to ASTM A-82.
   vi) Welded deformed steel wire fabric conforming to ASTM A-497. vii) Structural steel shapes, plates and bars conforming to ASTM A-36.

h) For each consignment, the Contractor shall furnish to the Engineer the manufacturer's mill test certificates which will include physical tests of bars and chemical tests of billet heat to guarantee that the steel supplied meets all the requirements of the relevant specifications.

i) 18 gauge galvanized wire to BS 4482 shall be used for binding the steel reinforcement.

j) Joint samples will be taken from site and tested in approved laboratory in the presence of Engineer's representative before starting the cutting of bars or when so required by the Engineer. All cost of such sampling, transportation and testing shall be borne by the Contractor.

k) All reinforcing steel bars shall be free from loose mill scale, loose rust, oil, grease, dirt or other harmful substances at the time of delivery.

### 3.12.3 Storage

Reinforcement bars shall be stored on platform sufficiently above ground surface and covered with polythene sheet. Bars shall be free from scales, oil, and structural defects prior to placement in Works. Rusted or dirty steel bars shall not be used in the Works unless brushed and cleaned by proper steel wire brushes and after being approved for use by the Engineer.

### 3.12.4 Reinforcement Cutting and Placing

All reinforcement steel shall be cut and bent cold in strict accordance with bar bending schedules prepared by the Contractor and approved by the Engineer. The Contractor shall prepare bar bending schedule from approved structural working Drawings and as per instructions of the Engineer. The bending schedules shall be drawn on approved forms and submitted to the Engineer for checking and approval. The steel reinforcement shall be cut and bent to sizes as per Drawings and approved bending schedules. In case, any bars cut, bent or even fixed in position are found incorrect in dimensions, size and shape and are not according to the requirements of the Drawings or instructions of the Engineer, notwithstanding any previous approval of the Engineer, the Contractor shall replace such steel bars, cut, bent or fixed in position, by correct sizes bars at his own cost and no extra payment shall be made to the Contractor on such account. Suitable spacers, chairs as approved by the Engineer shall be used for the purpose of supporting and spacing of bars. In case, any bars are bent or displaced they shall be straightened or replaced prior to pouring. All reinforcement bars within the limit of a day's pour shall be in place and firmly tied with 18 gauge wires. Bars with kinks or bends not shown on the Drawings shall not be used. Reinforcement bars shall not be used for supporting the workmen and concreting work. Separate supporting system shall be used for this purpose.

Concrete cover to all reinforcement bars shall be provided as shown in the Drawings using steel chairs and concrete spacer blocks.

Concrete cover over reinforcement is provided as per requirement of specifications for protection of steel from possible corrosion due to ingress of moisture from sides of structure. This cover ranges from 1 to 3 inches for different structures and exposure conditions. Material used in spacers is normally cement mortar or concrete of compressive strength equal or greater than the specified strength of concrete used in structure. Surface area of spacer shall not be less than 4- Sq. Inch and thickness as per cover requirement. Binding wire is embedded during casting of spacer to fix it firmly with re-bar. Hard plastic and non-reactive metal spacers are also being used by the construction contractors which need approval of Engineer.
Like other embedded items, spacers shall be clean and free from coating, dust, oil or any other foreign matter and shall be firmly and securely fastened in position to avoid displacement during concrete placing and vibration. The spacers shall be well cured and dry before use in the Works. The spacers shall meet the specified requirements of water absorption. All spacers shall be properly fixed in their required positions and as directed by the Engineer.

For any structural member which shall receive fair-forced concrete surfaces, special spacers shall be used while do not impair the specified appearance of concrete surfaces.

### 3.12.5 Laps and Splices

No splicing of bars shall be allowed at positions other than shown on the Drawings. All lap lengths shall be of the minimum sizes as indicated on the Drawings and in accordance with ACI 318-05. Splices of adjacent bars shall be staggered, unless approved otherwise by the Engineer. All reinforcing steel fixed in position shall be inspected by the Engineer and no concrete shall be poured until steel placement has been approved in writing by the Engineer. For inspection purposes, the Contractor shall give to the Engineer reasonable notice before the scheduled pouring time. Clear concrete cover to reinforcement steel shall be as specified or indicated on the Drawings.

### 3.12.6 Mesh Reinforcement

a) Where indicated mesh shall be of the sizes as shown on the Drawings and conform to BS 4482 or 4449 with mesh sizes to BS 4483 or ASTM A-185 (Welded Steel Wire Fabric for Concrete Reinforcement). Mesh reinforcement when used in slabs shall be supported at proper elevations by standard accessories. In slabs on ground (porous fill), precast concrete spacer blocks may be substituted for chairs.

b) Overlaps in fabric reinforcement shall be a minimum of two meshes, except where otherwise shown on the Drawings, correctly aligned and at least 50% of the wire intersections shall be tied with 18 gauge tying wire. Laps shall be staggered in adjacent rows of sheets.

### 3.12.7 Welding

Reinforcement shall not be welded except where required by the Contract or agreed by the Engineer. If welding is employed, the procedures shall be as set out in BS 2640 for gas welding or BS 7123 for metal arc welding. Full strength but welds shall only be used for steel complying with BS 4449. If high yield deformed bars are to be welded they shall have a carbon equivalent of the steel less than 0.51%.

### 3.12.8 Testing

Tests shall be carried out when directed by the Engineer in accordance with ASTM A-615 or BS 4449.

Tests providing information on following will be required from each delivery of reinforcement:

(a) Elongation
(b) Yield and ultimate tensile strength
(c) Cross sectional area
(d) Bend
(e) Unit-weight
(f) Stress/strain curve (Optional)
(g) Deformation (Optional)
(h) Chemical composition (Optional)

The Contractor is to allow for tensile, bond, re-bond and chemical tests at his own cost, for each size of bar to be used in the concrete construction.

Test results for each bar size shall be submitted to the Engineer two weeks before concrete work commences on Site.

Full testing shall be required if the source of supply of reinforcement changes, in which case the cost of such extra testing will be borne by the Contractor.

When any test results do not conform to the relevant standard, the reinforcement steel shall be removed from the Site and all costs resulting there from shall be borne by the Contractor.

## 3.13 Formwork

### 3.13.1 General

The formwork shall be inclusive of all labour, material, workmanship and alike. All formwork and supports thereto shall be designed by the Contractor and relevant drawings shall be submitted to the Engineer for approval before the Work is put in hand. Such an approval shall not relieve the Contractor from all or any of the obligations of the Contractor or give rise to any claims.

Forms shall be of suitable material (for fair face surface smooth steel plates, marine ply or plastic sheets and for plastered finish wooden planks can be used), size, shape, quality and strength to build the structure as per design. The forms shall be true to line/grade and shall be mortar tight and sufficiently rigid to prevent displacement and sagging between supports. The contractor shall bear responsibility for their adequacy. The surfaces of forms shall be smooth and free from irregularities, dents, sags and holes. The internal ties shall be arranged so that, when the forms are removed, no metal will show in the concrete surface or discolor the surface when exposed. All forms shall be wetted with suitable mineral oil which shall be applied shortly before concrete pouring. Forms shall be constructed so that they can be removed without injuring the concrete or its surface.

The forms shall not be removed before the expiration of at least 30-Hrs from vertical faces of walls, slender columns and similar structures. Forms supported by false work.

Under slabs, beams, girders, arches etc shall not be removed until tests indicate that at least 80% of design strength has developed.

All formwork and supports shall be designed by the contractor and relevant drawings shall be submitted to the Engineer for approval before the work is put in hand. Such an approval shall not relieve the contractor from all or any of the obligations of the contractor or give rise to any claim.

### 3.13.2 Making Forms

The formwork for columns, beams, slabs, foundations, pits, lintels, fins, panels, purdis, parapets and all other works whether to be precast or cast-in-situ shall be of steel plates, scaffolding pipes and joints or other approved material and shall be rigidly formed and designed by the Contractor to the shapes and forms as per Drawings in accordance with the best of the existing practices, so as to be able to withstand without displacement, deflection or deformation or movements of any kind, the pressure of the moist concrete and all other loads. No plank timber formwork will be accepted at any location.

Formwork shall be designed, erected, supported, braced and shall be maintained so that it will safely support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure.

Formwork shall be constructed such that concrete members and structures are of correct size, shape, alignment, elevation and position.

Design of forms and false work shall be such as to include values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability and other factors pertinent to safety of structure during construction.

Shores and struts shall be provided with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination.

Trussed supports shall be provided when adequate foundations for shores and struts cannot be secured.

Form facing materials shall be supported by structural members spaced sufficiently close to prevent objectionable deflection.

Forms placed in successive units shall be fitted for continuous surfaces to accurate alignment, free from irregularities, and within allowable tolerances.

Camber shall be provided in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.

Formwork shall be sufficiently tight to prevent leakage of cement paste during concrete placement.

**3.13.3 Fair faced Finish**

a) Facing Material

The form facing material shall produce a smooth, hard, uniform texture on the concrete. It shall be M.S. steel sheets, plywood, tempered concrete grade hardboard, metal or plastic, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surface, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface, shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.

b) Shop Drawings

Shop Drawings shall be submitted by the Contractor for Engineer's approval, showing grooves, joints etc. if indicated on the Drawings or instructed by the Engineer before taking up the job of formwork in hand.

c) Repair

No repair of surfaces designated `fair-faced' shall be allowed. Any concrete failing to achieve the desired finish or with defective surfaces shall be removed and replaced at Contractor's expense. The Engineer may reject any defective concrete surface and order it to be cut out in part or in whole and replaced at the Contractor's expenses.

**3.13.4 Rigid with Allowance for Camber & Bulges**

The formwork shall be fabricated and erected in position, perfect in alignment, levels and true to plumb and shape and securely braced so as to enable it to withstand all weights, dead and live, to be endured during placing of concrete and its subsequent hardening till the formwork is struck. It shall be sufficiently rigid as not to loose its shape and shall be made to compensate for bulging, and deflection to give the finished concrete the required lines, plumb, size and shape.

**3.13.5 Exposed Surfaces Left Un-plastered**

In addition to the provision made elsewhere, for all the concrete work covered in this Contract which are to remain exposed in the finished work and left un-plastered, the formwork shall be smoothly faced by using M.S. steel sheets or lining the shuttering with smooth G.I. sheets or non-absorbent material like Formica sheets or in any manner as approved by the Engineer so as to make a perfectly smooth surface of the finished concrete. Where any surface defects on the exposed concrete surfaces occur and which do not impair the structural performance, being in excess of the designed surfaces and the architectural appearance of the Work in the opinion of the Engineer such defects may be removed by guniting and grinding with carborundum stone or in any other approved manner, at the cost of the Contractor, otherwise the whole or part of the Work shall be removed and made good by the Contractor, at his own cost. For precast concrete members, the forms shall be rigid, exact and smooth.

**3.13.6 Materials and Labours**

The Contractor shall supply all materials runners, and labour, necessary for a good and speedy erection of formwork such as steel plates, shuttering planks, struts, bolts, stays, gangways, boards, fillets etc. and shall do all that is essential in executing the job in a workman-like manner to the satisfaction of the Engineer.

**3.13.7 Formwork Not to Interfere or Injure Work**

The formwork shall be so designed and arranged as to not unduly interfere with concrete during its placing and easy to be removed without injuring the finished concrete. Wedges, clamps, bolts and rods shall be used, when permitted and where practicable, in making the formwork rigid and in holding it to true position.

**3.13.8 Openings in Formwork**

Wherever concreting is required to be carried out within forms of depth exceeding 2.0 meters, temporary openings in the side of the form shall be provided to facilitate the pouring and consolidation of the concrete. Small temporary openings shall be provided

at bottom of the forms to permit the removal of rubbish etc. but the same shall be suitably closed before pouring.

### 3.13.9 Opening and Other Details

Provision shall be kept in the formwork such as openings, recesses, holes, pockets, fillets, etc. for housing services and other architectural details in the finished concrete or on its surface and edges as shown on the Drawings or as directed by the Engineer and to fix all necessary inserts, dowels, pipes, holdfasts etc. in concrete as shown on the Drawings or as directed by the Engineer.

### 3.13.10 Joints in Formwork

All joints in the formwork shall be sufficiently closed to prevent leakage of mortar from concrete for concrete surfaces not to be exposed in the finished work. The joints in the finished work shall be close jointed and perfectly smooth so as not to allow any leakage of the mortar from the concrete and show any appearance of leaking mortar on concrete surfaces.

### 3.13.11 Treatment and Inspection of Forms

All rubbish particularly chippings, shavings and saw dust shall be removed from the interior of the forms, before placing concrete. Forms shall be coated with approved shuttering oil before reinforcement is placed. Surplus oil on forms and any oil thus applied on reinforcing steel shall be removed. If the forms are not used within 24 hours, a fresh coat of oil shall be given before placing of concrete.

### 3.13.12 Striking Shuttering

No struts or timbering which serve the purpose of supporting the shuttering or centering shall be struck and removed without permission from the Engineer in writing and the work of striking and removal after the receipt of such permission shall be conducted under the personal supervision of the competent foremen in the employment of the Contractor and the Contractor even after the permission from the Engineer shall hold himself fully responsible for any consequences whatsoever. In all cases the Engineer will direct and control the minimum period of time for which the forms, shuttering or centering shall remain in place before being struck; but, for the general guidance of the Contractor, the following are to be considered as the minimum periods for the main classes of Work.

| **Type of Formwork** | **Normal Weather** | **Cold Weather** |
|---|---|---|
| Footing sides | 12 hours | 18 hours |
| Vertical sides of beams, and columns | 12 hours walls | 18 hours |
| Slab soffits | 10 days | 14 days |
| Beam soffits | 14 days | 20 days |

The Engineer may require, however, that any wailings, soldiers, struts or other timbers or supports, the removal of which may cause the transference of load to the finished work, to be kept in place for three weeks after the placing of the concrete.

Form removal time can be reduced considerably if high early strength concrete is used in structures. In such case contractor will have to submit proposal along with test results of high early strength concrete for the approval of Engineer.

**3.13.13 Injury or Damage**

The Contractor shall be responsible for any injury to the Work and any consequential damages caused by or arising from the removal and striking of forms, centering and supports, due to striking too soon. Any advice, permission or approval given by the Engineer relative to the removal and striking of forms, centering and supports shall not relieve the Contractor from the responsibilities herein defined.

**3.13.14 Treatment after Removal of Forms**

Any minor surface honey-combing or other irregularities are to be properly made good immediately upon the removal of the formwork and the surface made good to the satisfaction of the Engineer at the Contractor's own expense. Any small voids shall be neatly repaired with cement mortar consisting of one part of cement to two parts of sand and the whole surface rubbed over with carborundum stone and cement wash to bring the whole to a smooth and pleasing finish and uniform color.

**3.13.15 Types of Finish**

Where details of the required finishes are not specified separately the following shall apply:

Type A - Rough Finish for Buried or Rendered Work

This finish is obtained by the use of properly designed formwork or moulds of closely jointed saw or wrought boards or other suitable material. The surfaces will be imprinted with the grain of the boards and their joints. In addition, small blemishes caused by entrapped air or water may be expected, but the surface should be free from voids, honeycombing or other large blemishes. The holes left for formwork bolts shall be filled. Fins and irregularities projecting more than 3mm shall be cleaned off.

Type B - Normal Finish Exposed Work

This finish is obtained by the use of properly designed forms of closely jointed wrought boards, plastic, steel or other suitable materials, provided that the surfaces shall be free from the imprint of the forms. Small blemishes caused by entrapped air or water may be expected, but the surface should be free from voids, honeycombing or other large blemishes. The holes left for formwork bolts shall be filled. Fins and other projections shall be removed and all blemishes filled with cement and fine aggregate paste. Care shall be taken in the choice of any release agent used, to ensure that the finished concrete surface is not permanently stained or discoloured.

Type C - Superior Finish Exposed Work

This finish can only be achieved by the use of high quality concrete any by using properly designed forms having a hard, smooth surface. The concrete surfaces should

be smooth with true, clean arises. Only very minor surfaces blemishes should occur and there should be no staining or discoloration from the mould oil or curing agent.

The surface shall be free from the imprint of wood grain. Un-faced wrought boarding or standard panels shall not be used. The material for the form shall be provided in large sheets and arranged in an approved uniform pattern: joints between sheets shall be arranged to coincide with architectural features, sills or heads of windows or changes in direction of the surface; all joints between sheets shall be accurately aligned in the plane of the sheets. Bolt holes are not allowed.

Other types of Finish

These shall include any finish different from A, B and C that requires the use of special forms or linings, the use of a different concrete mix near the surface, grinding, bush hammering or other treatment. If any of these special finishes is required it shall be fully specified on the drawings.

Whichever method the Contractor uses for obtaining each finish, the same method shall be used for the remainder of the work.

Remedial treatment to the finish of the concrete, additional to that specified above, requires the approval of the Engineer. Finish of Unformed Surfaces

The finish of unformed surfaces shall be tampered floated, toweled or brushed as defined below and shown on the Drawings or as directed by the Consultant:

TF Tamped: Surfaces shall be formed by leveling and tamping the concrete to produce a uniform plain or ridged surface, surplus concrete being struck off by a straight edge immediately after compaction. It is also the first stage of the following finishes.

FF Floated: Shall be a uniform surface which has been worked no more than is necessary to remove screed marks by hand with a wood or steel float of a type approved by the Engineer. The surface shall not be floated until the concrete has hardened sufficiently.

ST Steel Toweled: Shall be hard, smooth finish free from trowel marks formed with a steel trowel under firm pressure. Toweling shall not commence until the moisture film has disappeared and the concrete has hardened sufficiently to prevent excess laitance from being worked to the surface. If laitance is brought to the surface it shall be removed.

BR Brushed: Shall be formed by first producing a floated finish and then, before the concrete has hardened, by drawing a wire broom over the concrete surface at right angles to the traffic flow to give an average texture depth of 1mm.

PF Power Float: Shall be a uniform surface which has been worked no more than is necessary to remove screed marks with a power float of a type approved by the Engineer. The surface shall not be floated until the concrete has hardened sufficiently.

Direct Finishing: Where specified, direct finishing consisting of dry-shake or granolithic application shall be carried out in accordance with the specialist manufacturer's details.

Plastic Cracking: If plastic shrinkage cracking occurs, the construction affected shall be rectified and the Contractor shall take all necessary steps to prevent a recurrence. Rectification method and results shall be subject to the approval of the Engineer.

Random Drying Shrinkage Cracking and Plastic Settlement Cracking: If any cracking of the concrete occurs in an uncontrolled manner, the construction affected shall be rectified

and the Contractor shall take all necessary steps to prevent a recurrence. Rectification method and results shall be subject to the approval of the Engineer.

Curing compound shall not be used on concrete surfaces which are to be bonded with concrete later (e.g. at construction joints) unless all such surfaces are broken away to completely remove the membrane prior to further concreting at the joint. Furthermore, curing compounds shall not be allowed to contaminate reinforcement.

As membrane curing compounds may affect the subsequent treatment or finish of the surface of the concrete, their use requires to be approved by the Engineer before they are adopted. The Contractor is to supply sufficient technical data regarding his suggested compound to enable the Engineer to assess its suitability.

Un-formed Surfaces: Within ten minutes of placing and compaction, the un-formed surfaces of the concrete shall be completely covered with reflective polythene sheeting with substantial close fitting taped laps. The polythene sheeting may be raised a short distance above the concrete so that it does not mark the surface. At the edges of the pour, the polythene shall drape over the forms and it shall be securely fixed to prevent billowing due to the wind.

Within three hours of placing and compaction the polythene shall be quickly removed and replaced with wet hessian laid onto the concrete surface. The polythene shall then be replaced and secured as above.

The polythene sheeting and hessian may be temporarily removed for surface finishing of the concrete.

The hessian shall be kept continuously damp during the curing period. Inspections shall be carried out at intervals not exceeding 6 hours.

Protective measures shall be maintained throughout the curing period to shade the concrete from direct sunlight and protect it from the wind by the use of windbreaks.

Formed Surfaces:

Formwork shall be shaded and continuously wetted to prevent high temperatures accelerating the curing. As soon as possible, forms shall be loosened to enable curing water to run down inside them. Within half an hour of stripping, formed surfaces shall be covered by wet hessian and reflective polythene and then treated in accordance with the requirements stated above for un-formed surfaces.

### 3.14 Construction Joints

Construction joints shall be located as indicated on the Drawings and/or as approved or directed by the Engineer. Prior to construction of any structure, the Contractor shall submit a proposal showing location of construction joints and sequence of construction to suit his concreting programmed for the approval of the Engineer. Joint in columns shall be made at the underside of the deepest beam framing thereto. Beam stems and slabs shall be poured monolithically unless allowed otherwise by the Engineer in writing. Joints not specified or shown on the Drawings if so required and approved by the Engineer, shall be so located as to least impair the strength and appearance of the Work. Except and where indicated on the Drawings, no jointing shall be made in footings or foundations without written approval of the Engineer. Construction joints shall be at right angles to the member and shall be formed against firm stop boards. The stop board shall be removed as soon as possible after placing the concrete but without the risk of movement of the concrete and the concrete surface shall be well brushed with a hard brush

and washed off with a spray of water, two to four hours after casting, to expose the aggregate and provide key for the next pour.

In all water retaining structures and other substructure pits and trenches, P.V.C. or any other approved water stops shall be provided at the construction joints in the manner shown on the Drawings and/or approved by the Engineer.

Whenever a section of concrete is left unfinished, for any reasons with the approval of the Engineer, leaving surface which will be hard-set before additional concrete can be joined to it, such dovetails, grooves or other bonds shall be provided as may be necessary to ensure a good bond with the new work, at the cost of the Contractor. Before deposition fresh concrete upon or against any concrete which is already set, the surface of the set concrete shall be roughened with a cutting tool, any laitance removed, thoroughly cleaned from all foreign matter, well watered and covered with approved bonding agent and cement grout, and special care shall be taken to ram the fresh concrete thoroughly up and against the set concrete; and, if deemed necessary by the Engineer, the joints shall be reinforced with steel bars or dowels to be all furnished and done by the Contractor without any additional cost.

### 3.15 Concrete Floor Slab Finishing

Concrete slabs shall be finished as described herein. In preparation for finishing, floor slabs shall be struck off to the required level at or below the elevation or grade of the finished floors as shown on the Drawings. Floors shall be leveled with a tolerance of 1 mm in 1m. Where drains occur, the floor surface shall be pitched to the drains as indicated on the Drawings or as directed by the Engineer.

#### 3.15.1 Monolithic Finish

All concrete surfaces in floors, except where other finish is specified, shall be finished by steel floats or straight edges to bring the surface to the required finish level as shown on the Drawings. While the concrete is still green, but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood floated to a true even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. The concrete shall then be hand toweled to produce smooth impervious surface free from trowel marks. If necessary, the process shall be repeated so that the final finish shall produce ringing sound from the trowel. No separate payment shall be made for finishing floor slabs in the aforementioned manner.

#### 3.15.2 Concrete Topping

Where indicated on the Drawings, base slab under concrete topping shall receive a screed finish. After the base slab is thoroughly cured and when directed, concrete topping shall be laid to the thickness as indicated on the Drawings in alternate panels of suitable sizes as directed by the Engineer.

### 3.16 Anchor bolts, Inserts, Sleeves, Chases, Recesses, Steel Frames

The Contractor shall provide chases and openings required for other sections of the Works and will cooperate and coordinate with other trades in placing their pipes, ducts, and other built-in items as the Work proceeds, entirely at his own cost and risk.

The Contractor shall furnish and place in position accurately, as shown on the Drawings, all inserts, sleeves, chases, recesses, etc., supplied by the Contractor, subcontractors or other contractors, as directed. Full cooperation and coordination shall be maintained with other contractors, subcontractors in this regard.

### 3.17 Waterproof Concrete

Waterproof concrete shall consist of structural concrete as specified herein and with the addition of an approved waterproofing additive. This shall be mixed in accordance with the manufacturer's instructions and as detailed in the Bill of Quantities.
Contractor's attention is drawn to the special care required for casting roof framing, ponds, swimming pools and all underground structures including basement floor, retaining walls, sumps, pits, etc. These are all designed to ACI 350-06, Code Requirements for Environmental Engineering Concrete Structures for water retaining structures. The Contractor shall ensure that workmanship and curing is up to the required standard.
The Contractor shall take full responsibility for ensuring that the resulting construction is completely watertight and free from penetration of moisture.

When in the opinion of the Engineer, damp patches and/or leakage of water in the finished work are due to failure of the Contractor to comply with this specification, the affected work shall be made good at the Contractor's expense.

Water stop shall be provided in all construction joints and the type of water stop will be as specified or to the approval of the Engineer. All water stops will be joined by welding strictly in accordance with the manufacturer's recommendations and all multiple joints and special intersections shall be manufactured by the supplier.

Before commencement of work, the Contractor shall obtain the Engineer's approval of the methods to be used to support and maintain the water stop in the correct location while the concrete is placed and also the layout and form of all additional construction joints other than those shown on the drawings. Unless indicated otherwise on the drawings, all construction joints in waterproof concrete shall be formed incorporating water stops to Engineer's approval.

All service holes cast in shall incorporate sleeves with puddle flanges and temporary openings for services should incorporate water stops.

Care shall be taken at all times to ensure that water stops are not perforated or damaged in any way and the concrete shall be carefully placed and compacted around the water stop to ensure void free impervious concrete.

All kickers or starter plinths to walls (if used) on the periphery of the watertight construction shall be cast monolithically with the base.

The formwork shall comply with this Specification and in addition any bolt or fastening embedded in or passing through the concrete shall be to the approval of the Engineer and not impair the water-tightness of the structure. The use of through bolts and sleeves is strictly prohibited.

Special attention shall be given to the elimination of shrinkage or thermal cracking. The size of any bay or slab or wall and sequence of pouring shall be such as to minimize cracking.

Slotted inserts or sockets cast into the structural concrete shall be provided for all fixings including services. The cutting of holes in watertight concrete is strictly prohibited.

The Contractor is completely responsible for making all basements and swimming pools absolutely watertight. If any leakages or moist patches occur, the cost of any repairs, etc. to make the basement and swimming pool fully watertight will be borne by him. The Contractor is to give a ten year guarantee for water-tightness, reckoned from the date of completion of roof framing, basement and swimming pool. The form of guarantee is to be to the satisfaction of the Client. Should any leaks or dampness occur during the Guarantee period of ten years, the Contractor shall, at no cost to the Client, immediately re-waterproof the defective area or areas and make good all damages to surface finishes such as plaster, painting, paneling, tiling, etc. electrical or other installations or other property, caused by leaks or dampness or reimburse the Client for making good such damages.
Water-tightness of swimming pools shall be inspected and tested in accordance with BS 8007: 1987.

### 3.18 Cleaning and Removal of Rubbish

On completion of Works herein, the Contractor shall remove all concrete debris, rubbish, shuttering materials, scraps etc., from the vicinity of the structures completed. All areas shall be cleaned to the satisfaction and approval of the Engineer. The rubbish shall be disposed off within or outside the Site premises free of cost as directed by the Engineer.

### 3.19 Tolerances

The structure shall be built to dimensions and levels shown on the Architect's drawings. Deviation from true positions and/or levels will be accepted only if they do not effect the finished dimensions, positions and levels as shown on the Architect's drawings.

Permitted tolerances shall be in accordance with the current issue of ACI 117-90, Standard Specifications for Tolerances for Concrete Construction and Materials.

Construction Tolerances of Structural Elements Supporting curtain walls or surfaces affecting curtain wall set out:-

- Maximum deviation vertically from defined position immediately after stripping of formwork $\pm$12mm.

- Maximum deviation laterally from defined position immediately after stripping formwork and prior to any pre-stressing (if used) $\pm$12mm or building height/4000 whichever is greater. This laterally out of position tolerance includes all local deviations in edge of slab or edge beams as well as overall building tolerance.

NOTE: All structural tolerances given above are for curtain walls (if used) and for all external structural faces of building affecting set out of masonry, windows and other cladding/finishes.

Tolerances mentioned in the BS 5606 Tables 2 & 3 shall be applicable as under;

| | |
|---|---|
| **All setting out dimensions, horizontal or vertical** | ± 6mm |
| Sections of concrete members | ± 5mm |
| **Foundations:** | |
| Surface of foundation against ground (underside) | ± 10mm |
| Top surfaces of foundations, bases and piers | ± 20mm |
| **Floor Slabs:** | |
| Surface level of floor slabs (3m straight edge) | ± 5mm |
| Surface level of floor slabs to datum | ± 10mm |
| **Columns, Beams and Walls:** | |
| Plumb of columns, Beams and walls in storey height | ± 5mm |
| Plumb of columns, Beams and walls in full building height | ± 10mm |
| Plumb to any pointing building height | ± 5mm |
| **Lift Shafts:** | |
| Inside faces of lift shafts in storey height | ± 5mm |
| Inside faces of lift shafts in full basement | ±10mm |
| Dimensions and position of openings | ± 5mm |
| Holding down bolt assemblies | ± 3mm |
| Position of embedded items. | ± 5mm |

## 3.20 External Exposed Concrete Surface

All external exposed concrete surfaces of cast-in-situ or precast units shall be given smooth or pattern finish as shown in the drawings or as directed by the Engineer. All concrete surfaces exposed to weather shall be treated with an approved architectural paint finish.

## 3.21 Water Retaining Structures

### 3.21.1 Scope of Work

The Work covered under this subsection of Specifications consists of furnishing all labour, tools, scaffolding, hoisting equipment, appliances and materials of every kind and character; and in performing all operations in connection with procurement, transportation and delivery, supply and installation of special provisions for water retaining structures to ensure water tightness in all possible respects in strict accordance with requirements of Drawings and Bill of Quantities as specified herein, and to the entire satisfaction of the Engineer and subject to the terms and conditions of the Contract.

### 3.21.2 General

a) Special consideration shall be given to the control of cracking and the provision of dense impervious concrete. Special consideration will also be given to the design of the concrete mix and to the supervision of the placing and compacting in order to provide a dense impermeable concrete. The mix shall be of the stiffest consistency having a workability which will ensure that it can be

satisfactorily placed in the formwork and compacted without risk of segregation, honey-combing, sweating or bleeding. Special care shall be given to the method and order of placing the concrete and to the construction of joints in order to achieve full continuity and complete water tightness.

b) The Contractor shall maintain an accurate record of ambient temperature at Site.

c) Ambient temperature shall be measured using mercury thermometers or other thermometers acceptable to the Engineer.

d) Throughout the concrete work, the Contractor shall employ full time on the Works suitable number of qualified and experienced Engineers whose sole duties shall be as follows;
- Design of concrete mixes
- Control of quality of concrete
- Supervision of mixing, transporting, placing, compacting, finishing, curing and protecting concrete including thermal control of concrete pours.
- Supervision of sampling and testing.
- Preparation and submission of test certificates and reports.
- Compilation and keeping of record.
- Such other duties as the Engineer may direct.

**3.21.3 Cement Content**

The minimum cement content for all water retaining structures shall be 385 kg/$m^3$ and the maximum cement content of 500 kg/$m^3$. The maximum water-cement ratio shall not exceed 0.40.

**3.21.4 Admixtures**

a) Suitable admixtures from Sika, Fosroc, BASF, Schomburg or other equivalent approved manufacturer may be used in concrete mixes with the prior approval of the Engineer. The amount of admixtures added to each batch of concrete requires careful control and shall be added in the doses as recommended by the manufacturers and approved by the Engineer. The cost of the admixtures shall be deemed to be included in the unit rates.

b) For use of an admixture, the information required by the Engineer shall be submitted to him for each admixture for approval.

**3.21.5 Junction of Floor and Wall**

Where the walls are designed to be monolithic with the bottom slab and beam system, a continuous up stand section of the wall shall be cast at the same time integrally with slab. A suitable arrangement of the reinforcement and formwork shall be made to facilitate this. The height of this up stand, which shall not be less than specified shall be sufficient to enable the next lift of formwork to fit tightly and avoid leakage of the cement paste from the newly deposited concrete. Such leakage, where it occurs is liable to cause porosity in the finished concrete and is not acceptable.

### 3.21.6 Pipes through Walls and Floor

When it is necessary for pipes to pass through a wall or bottom floor, it is preferable to cast the pipes into the panel when it is concreted. If this is not practicable, it will be necessary to box out. In either case, it is desirable that the position of the pipe shall not coincide with a joint. When an opening has been boxed out the sides of the opening shall be treated as construction joint.

All piping and fittings shall be tested as a unit for leaks immediately prior to concreting. The testing pressure above atmospheric pressure shall be fifty (50) percent in excess of the pressure to which the piping and fittings may be subjected but the minimum testing pressure shall be not less than 1.0 $N/mm^2$ (150 psi) above atmospheric pressure. The pressure test shall be held for four hours with no drop in pressure except that which may be caused by air pressure.
No liquid, gas or vapor, except water not exceeding 32°C nor 0.135 $N/mm^2$ pressure, is to be placed in the pipes until the concrete has thoroughly set.

The concrete cover of the pipes and fittings shall be not less than 1½ inch. The piping and fittings shall be assembled by welding, brazing, solder seating, or other equally satisfactory method. Screw connections shall be prohibited. The piping shall be so fabricated and installed that it will not require any cutting, bending, or displacement of the reinforcement from its proper locations.

Drain pipes and other piping designed for pressure of not more than 1 psi above atmospheric pressure need not be tested.

### 3.21.7 Arrangement of Reinforcement

Particular attention shall be given to the spacing of reinforcement at points so that access to the concrete surface can be provided to enable it to be prepared to receive the following batch of concrete.

The length of lap and anchorage provided shall be in accordance with the requirements of ACI 318.

### 3.21.8 Formwork

Ties used to secure and align the formwork shall not pass completely through any part of the water retaining structure unless effective precaution can be taken to ensure water tightness after their removal. The ends of any embedded ties shall have cover equal to that required for the reinforcement. The gap left from the end of the tie to the face of the concrete shall effectively be sealed. Any steel left in the structure shall be adequately protected against corrosion.

### 3.21.9 Construction

The degree of success in achieving a watertight structure depends on the quality of workmanship in making and placing concrete, good on site organization, proper ground water control, clean and dry excavation, careful storage of materials, closefitting formwork, correctly fixed reinforcement and clean joints.

It is essential that the concrete, when placed, is thoroughly compacted to form a dense uniform mass. The mix shall be of adequate workability and compaction by vibration. Immediately after the removal of formwork, the concrete surface shall be carefully inspected and any defects made good as soon as possible.

### 3.21.10 Curing

Even after minimum curing period specified in the clause pertaining to curing in the Specifications for Plain and Reinforced Concrete, it may be desirable to prevent drying of the concrete and to restrict the range of temperature changes which it is subjected to.

### 3.21.11 Inspection and Repair

As soon as possible after completion of the water retaining structures, the structure shall be examined for defects which may lead to water penetration or leakage. All openings exposed to the weather shall be covered and all water on the floors shall be removed and the surfaces allowed to dry before the inspection. Water retaining structures shall be tested in accordance with BS:5337 or other approved standard.

Defects that are revealed through which water may penetrate or leak shall be repaired by the Contractor to the entire satisfaction of the Engineer. Where internal repairs are to be made, the areas of weakness shall be isolated by suitable means and any cracks sealed by an approved process by a specialist contractor experienced in this type of work.

## 3.22 Inspection and Making Good

### 3.22.1 Inspection of Defects

(i) Surfaces exposed after stripping shall be inspected by the Concrete Engineer of the Contractor, together with the Engineer. The following standards shall be valid for the assessment of the concrete quality:

- The appearance of the concrete surface must conform to the specified requirement of finish.
- The concrete surface must be uniformly smooth, even and free of ridges and other irregularities,
- The concrete must have a pore-free, dense surface on all sides with no evidence of segregation or inadequate compaction,
- No reinforcing bars may be exposed or signs be present, which indicate an inadequate concrete cover of the reinforcing bars,
- No hair cracks shall be visible.

(ii) During the inspection, the Engineer will determine the type and extent of defects to be eliminated and ascertain if cracks are still moving.

The Contractor is obligated; if necessary and applicable, undertake the following in accordance with para (iii) below:

- To expose reinforcing bars, which apparently have an inadequate concrete cover, in the area determined by the Engineer and to bend them inward through suitable measures.

- To caulk out honeycombs and similar defective spots, which are traceable to segregation of the concrete.

- To pressure-grout damaged areas, cracks, etc.,

- To seal all hair cracks of a measured width of more than 0.05 mm, with suitable and recognized epoxy resin material.

- To seal all holes resulting from the removal of formwork bolts and the like.

- To demolish and reconstruct such structural concrete members which cannot satisfactorily be repaired or which are otherwise unfit for the Works in the Engineer's opinion.

- To propose and apply a proven system or measures according to the type and extent of the defect, as set out in para (iii) below in order to achieve a result and appearance acceptable to the Engineer.

**3.22.2 Patching & Repair**

(i) Apply a cementitious repair material approved by the Engineer. The proprietary cementitious repair material, bonding agent and application method shall meet the following criteria:

- The repair material shall be cementitious and shall possess a similar thermal co-efficient to the base concrete.

- The repair material shall have shrinkage compensating characteristics.

- The bonding agent shall be compatible with both the existing concrete and the repair material.

- The system shall exhibit long term durability.

The proprietary cementitious repair material and bonding agent shall be stored, applied and cured in accordance with the manufacturer’s requirements and recommendations.

Finish the cementitious repair material to a straight line with the existing surface, to the profile of the original undamaged concrete section.

The Engineer may direct that where the cover to the existing reinforcing is insufficient, the repair may protrude beyond the existing concrete face. The protruding edges of the repair shall then have a 45° chamfer, and shall be horizontal or vertical to provide a pleasing finish.

The Engineer's evaluation of the Contractor's proposed materials and application method shall be based on the above criteria.

The Contractor shall submit full details and specifications of his proposed materials and installation methods to the Engineer for approval prior to commencement of work.

This shall include certificates of approval from competent authorities to prove their suitability.

(ii) Patching work shall begin at the latest 24 hours after stripping, however it shall in no case be undertaken prior to carrying out the joint inspection of the concrete by the Contractor and the Engineer.

(iii) Patching and repair work shall be executed only through qualified personnel using high quality and recognized materials, e.g., concrete and cement or special mortar. A special bonding agent such as suitable epoxy resin and the like, of first class quality shall be used where appropriate, to also ensure good bonding and adequate denseness in the joints.

(iv) All costs for repair and patching work are to be borne by the Contractor.

### 3.22.3 Sealing of Cracks

(i) Cracks detected in concrete members cast by the Contractor, are to be sealed according to the directives of the Engineer, provided cracked structural concrete members are not rejected by the Engineer.

(ii) All cracks identified by the Engineer as requiring remedial work shall be sealed by injection epoxy to full depth of crack from the exposed surface. The surface of the cracks must be cleaned. Injection nipples are to be provided at 150mm to 300mm intervals and the remaining surfaces of the cracks are to be sealed with suitable epoxy compound. Prior to the injection, the crack shall be cleaned of dust by blowing oil free and clean compressed air through all the injection nipples. In case of cracks in vertical or sloped walls, the injection must start at the lowest nipple.

(iii) The epoxy resin shall be a suitable product from Sika, Fosroc , BASF or other approved manufacturer, complying with ASTM C-881, and as approved by the Engineer. Epoxy injection shall be in accordance with the manufacturers written instructions. Note that on completion of injection and curing of the epoxy, the nipples are to be removed and the exposed surfaces ground or scraped smooth to provide a smooth, even and tidy finish restoring the original profile).

## 3.23 Measurement and Payment

### 3.23.1 Formwork

All costs for formwork must be included in the concrete prices and will not be measured and paid separately. The prices shall include all related costs for the different materials and performances, erection, strengthening and removal of shuttering relative to the formwork.

### 3.23.2 Reinforcement

a) Reinforcing bars will be measured as per Drawings of structure in consideration of nominal weight (as per ASTM A615) of each size of bar and paid per ton at the unit rate entered in the Bill of Quantities.

b) The prices shall include all costs involved with the supply, transportation, storage and protection, the cutting, bending, wastage and placing, inclusive of concrete spacers, chairs, stands, binding wire, tying into position, etc

c) Assembly stands, spacers etc., whether designated in the Drawings or not or otherwise demanded by the Engineer will not be measured and paid separately.

d) If installed reinforcement must be dismantled under certain circumstances or where additional reinforcing bars are to be provided on Engineer's instruction (due to less unit weight of steel bars,) the Contractor is not entitled to any compensation, if such additional supplies and/or performances are required and demanded by the Engineer due to the Contractor's faulty execution of the respective work.

### 3.23.3 Concrete

a) Concrete works shall be measured and paid for as per theoretical volumes calculated on the basis of the Drawings, or as otherwise approved by the Engineer and paid at per cubic meter at the rates entered in the Bill of Quantities.

Only those concrete members will be measured for payment whose test results are satisfactory as per applicable standard’s requirements and accepted by the Engineer

Recesses (e.g. openings in slabs, break-through and the like) with an individual volume of more than 0.10 sq. m. or 0.05 cu. m. shall be deducted.

b) The prices for concrete works shall include all cost for the complete work and are not limited to the cost of formwork, its support, anchoring, chamfers, construction joints etc., the required scaffolding, false-work, temporary works, post-treatment and, if necessary, repair of concrete, all preliminary and routine tests, as well as the required technical checks and drawings for Temporary Works in connection with the concrete works.

c) The cost for special finishing of exposed concrete surfaces such as fair-faced finish etc. shall be included in the unit price applicable to the respective structural member and will not be compensated for separately.

d) The cost of all concrete admixtures and additives shall not be paid for separately and is deemed to be included in the unit rates of respective items of the BOQ.

### 3.23.4 Joints

a) Expansion Joints

Expansion joints shall be measured and paid for separately per running meter of accepted lengths, according to the Drawings / bill of quantities. The prices shall include all costs for the different materials and performances relative to the laying and sealing of the joints.

b) Dummy Joints

Dummy joints required by the Contractor with the Engineer's consent for the sound execution of the Works will not be paid for separately, but the costs involved are deemed to be covered by the concrete prices applicable to the respective structural member.

c) Construction Joints

Construction joints will not be measured and paid for.

The Contractor is deemed to have covered the costs for all related supplies and performances by surcharges included in the respective concrete prices.

However, the cost of PVC water stop shall be measured and paid for separately per running meter of accepted lengths.

### 3.23.5 Tamping of Equipment and Grouting of Recesses

The costs resulting from materials and performances in connection with the tamping of installed items or the grouting of recesses are deemed to be included in the prices for the supply and/or installation of the respective items, and will therefore not be separately compensated for.

END OF SECTION

# SECTION – C 04

# PLASTERING AND RENDERING

## SECTION C 04

## PLASTERING AND RENDERING

### 4. Plastering and Rendering

### 4.1. Scope of Work

The Work covered by this section of the Specifications consists of furnishing all plant, tools, labour, appliances, materials and performing all operations in connection with lathing, plastering and rendering, complete in strict accordance with this section of the Specifications and the applicable drawings, as per instructions of the Engineer and subject to the terms and conditions of the Contract.

### 4.2. General

4.2.1. Except as may be otherwise shown or specified, all plaster and rendering shall be cement sand plaster. Plastered ceilings and walls shall include partitions, piers, columns, beams, ceilings, plastered jambs and other returns, reveals, and backs of recesses and alcoves, and joints and heads of windows and doors, unless otherwise specified or shown on the Drawings. Plaster on walls shall be carried down to dado, skirting and projected bases. Plasterwork shall also include all plasterwork on and under concrete surfaces to be left exposed and concrete not specified to be left fairfaced, as indicated on Drawings.

4.2.2. A 13mm thick render coat shall be applied to walls with a slightly roughened surface where wall finishes of applied nature, such as ceramic tiles, marble tiles, terrazzo tiles etc., are to be installed over wall surfaces.

### 4.3. Materials

4.3.1. Portland cement shall be as mentioned in Section-04, Plain & Reinforced concrete.

4.3.2. Sand shall be clean and free from dirt to comply with the requirements of ASTM C-144.

4.3.3. Water shall be clean and free from oils, acids, alkalis, salts and organic or other injurious matter and as described in Section-04 Plain & Reinforced concrete.

4.3.4. Mortar plasticizer shall comply with BS 4887 and shall be used in accordance with the manufacturer's instructions.

### 4.4. Mixing of Plaster

Except where hand mixing of small batches is approved by the Engineer, mechanical mixers of an approved type shall be used for the mixing of plaster. Frozen, caked, or lumped materials shall not be used. Mechanical mixers, mixing boxes and tools shall be cleaned after mixing each batch and kept free of plaster from previous mixes. Plaster shall be thoroughly mixed with the proper amount of water until uniform in colour and consistency.

Re-tempering will not be permitted, and all plaster which has begun to stiffen shall be discarded. When no plasticizer is used, plaster shall be used within 30-minutes after mixing of water, however with the use of plasticizer initial setting time will be determined and time extension shall be allowed accordingly with the approval of engineer.

## 4.5. Proportioning of Plaster on Internal Walls and Base Plaster

4.5.1. All plaster shall be Portland cement sand plaster, all coats of which shall be mixed in the following proportions by volume:

One part cement: 4 parts sand.

4.5.2. All coats of plaster in water retaining structures shall be waterproofed by the addition of an approved waterproofing additive/admixture from Sika, Fosroc, Master Builders, Schaumberg or equivalent.

## 4.6. Preparation of Surfaces of Plaster

4.6.1. Surfaces to receive plaster shall be brushed to remove all loose particles, dust, laitence, efflorescence, etc. and any projecting fins on concrete surfaces shall be hacked off.

Glossy or greasy surfaces shall also be suitably cleaned and chipped off to remove all traces of mould oil.

4.6.2. Where unduly smooth in-situ concrete surfaces are encountered, such surfaces must be hacked properly before applying plaster.

4.6.3. Surfaces shall thoroughly be sprayed with water and allow free water to evaporate before plaster is applied.

4.6.4. Irregularities in the surfaces to be plastered shall be filled with cement mortar 24 hours before plastering is commenced.

4.6.5. Before plastering is commenced, all junctions between differing materials shall be reinforced. This shall apply where walls join columns and beams particularly where cracks are likely to develop and places directed by the Engineer. The reinforcement of such joints shall consist of a strip of galvanized expanded metal lathe/mesh, atleast 6" wide, which shall be plugged, nailed or stapled to the surfaces to be plastered at the intervals not exceeding 12". The joints in mesh shall be lapped minimum 6".

4.6.6. It shall be responsibility of the Contractor to ensure that all electrical conduits, pipes, concealed or embedded items, ducts, brackets, doors, window and ventilator frames, and all other fixtures on walls, ceilings, columns or required elsewhere have been fixed in position before the plastering is commenced.

4.6.7. Cuttings and chasings in the brickwork shall be repaired as per the instructions of the Engineer atleast twenty four hours before the plastering is commenced.

## 4.7. Application of Plaster

4.7.1. The Contractor shall not start any work till the surfaces are inspected by the Engineer. In case, any plaster work is done without obtaining the consent of the Engineer, the Engineer shall have the right to order removal of all such work and cleaning and preparation of the surfaces to his full satisfaction and the Contractor shall comply with such orders without any delay and redo the work at his own cost. No extra/additional payment shall be made to such work.

4.7.2. All surfaces to be plastered shall be treated with cement slurry as a base coat for proper bond. Any approved bonding agent may also be used as an alternative to cement slurry with approval of the Engineer.

4.7.3. Plaster to internal and external surfaces shall be applied in the thickness shown on the Drawings or specified elsewhere. In any case, the plaster thickness shall not be less than the specified thickness.

4.7.4. Plaster shall be applied in two (2) coats on masonry and concrete surfaces where thickness is more than 19mm. The thickness of each coat shall not exceed 19mm.

a. In case of 2 coats, the first coat or the render coat shall be full and thick and shall be applied with sufficient force to form good keys. The under coat shall be roughened and cross-scratched upon attaining its initial set to provide a proper bond to the next coat and shall be kept damp with a fog spray.

b. Finish coat shall not be applied until the under coat has seasoned for 2 days. Just before application of the finish coat, the under coat shall again be wetted evenly with a fog spray.

Finish coat shall be of smooth finish or as directed by the Engineer.

The finish coat shall be kept moist with a fog spray for atleast 2 days and thereafter shall be protected against rapid drying until properly and thoroughly cured.

4.7.5. Plastering shall be executed in a neat workmanlike manner and shall be finished off with a wood or steel float, straight and plumb and shall not have wavy surface. The surface shall be of even texture and entirely free from all marks. The edges and corners shall represent a straight line. All the arrises shall be rounded to 6 mm (¼") radius unless otherwise specified. Plastering shall neatly be made good around pipes or fittings, corners etc.

4.7.6. As far as practical, plastering shall not be commenced until all mechanical, electrical and plumbing items, conduits, pipes, fittings and fixtures have been installed in their sequence of operations.

4.7.7. Plaster is to be maintained in moist condition for atleast four days after it has developed enough strength not to be damage by water.

4.7.8. Plaster stops angles- beads and corner of expanded metal shall be used for protection of arrises, edges and plaster ends as shown on the Drawings and as directed by the Engineer.

4.7.9. Plaster containing cracks, blisters, pits, uneven surfaces discoloration or any defects shall not be acceptable. Any such defective plaster rejected by the Engineer shall be removed and replaced in conformity with these Specifications by the Contractor at his own cost to the satisfaction and approval of the Engineer. No extra payment shall be made for any defective or rejected work.

4.8. **Sampling of Plaster**

Samples may be taken by the Engineer at any time from plaster work in place. Areas represented by samples which show oversanding or not as per specified ration will be rejected.

4.9. **Patching**

Plaster containing cracks, blisters, pits, checks, or discoloration will not be acceptable. Such plaster shall be removed and replaced with plaster conforming to this Specification and approved by the Engineer. Patching shall match with existing work in texture and colour to the satisfaction of the Engineer.

4.10. **Concrete / Masonry Joints**

All joints of concrete and block/brick walls shall be specially treated as described here or as shown on Drawings. A 6" wide approved expanded metal shall be fixed at the joints and then plaster shall be applied. The expanded metal shall be with a weight of 3.58 lbs./sq. meter.

**4.11. Measurement and Payment**

4.11.1. Plaster shall be measured and paid per square meter, complete and approved, at the unit rates entered in the Bill of Quantities, including preparations, junction reinforcements, metal lathe, chamfered edges, rounding off corners etc. and in the thickness as specified in Bill of Quantities.

4.11.2. Render coat or backing plaster shall not be paid for separately but shall be deemed to be included in the rates of the finished item.

4.11.3. No extra payment shall be made, against cost of samples, cartage, testing etc, to the Contractor, his sub-contractor supplier or vendor.

4.11.4. No extra payment shall be made for plastering to surfaces required to give fair finish

END OF SECTION

# SECTION – C 05

# BRICK WORKS

## 5.01 SCOPE

The work under this section of the specification consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in connection with supplying and constructing brick masonry, complete in strict accordance with this section of the specifications and applicable drawings and subject to the terms and conditions of the Contract. The scope of this section of specification is covered with detailed specification as laid down herein.

## 5.02 APPLICABLE CODES AND STANDARDS

Latest editions of the following ACI codes and ASTM Standards referred to herein, are applicable to these Specifications.

**ACI Codes**

| | |
|---|---|
| ACI 530 | Building Code Requirements for Masonry Structures |
| ACI 530.1 | Specifications for Masonry Structures |

**ASTM Standards**

| | |
|---|---|
| ASTM C 62 | Building Bricks (Solid Masonry units made from clay or shale) |
| ASTM C 216 | `Facing Bricks (Solid Masonry units made from clay or shale) |
| ASTM C 67 | Sampling and Testing Bricks |
| ASTM C 270 | `Mortar for Unit Masonry |
| ASTM A 615 | ``Deformed and plain billet bars for concrete reinforcement |

## 5.03 SUBMITTALS

### 5.03.1 **Manufacturer's Data**

Submit two copies of the manufacturer's specifications and other data for each type of brick and accessory required. Instructions shall be included for handling, storage, installation, and protection of units and accessories.

### 5.03.2 **Samples**

Submit three samples of each type of brick and accessories for the full range of exposed texture to be used in the completed work.

### 5.03.3 **Test Reports**

Test reports of bricks, sand, cement and reinforcing steel.

5.03.4 **Certificate of Compliance**

For Cement.
Reinforcing Steel.

## 5.04 MATERIALS

5.04.1 **Cement & Aggregates**

O.P. Cement shall conform to the requirements of ASTM C 150 Type-I or BS-12.

White cement conforming to BS-12 for use in pigmented mortar.

Fine aggregate (Sand) for mortar shall conform to the requirements of ASTM C 144.

Water used in the manufacture of bricks and in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, alkali, salts and other impurities. The water shall be tested in accordance with BS 3148, where directed by the Engineer.

5.04.2 **Mortar**

Mortar shall conform to the requirements of ASTM C 270,

Proportioning of mortar shall be 1 part of O.P Cement to 4 parts of sand by volume for laying bricks and 1 part of White Cement to 3 parts of sand with addition of pigment for struck pointing of facing brick joints.

Methods and equipment used for mixing mortar will be such so as to accurately determine and control the amount of each separate ingredient entering into the mortar. Mortar shall be mixed only in sufficient quantities for immediate use and shall be used within 30 minutes after mixing of water in cement. The mixers shall be thoroughly cleaned and washed at the end of each day's work.

5.04.3 **Bricks**

Bricks shall conform to the requirements of ASTM C 62, Grade MW for compressive strength which requires average of 5 bricks sample 2500 psi and not less than 2200 psi of individual brick. Building bricks in an oven dry condition shall not absorb more than $1/5^{th}$ of its weight of water when immersed one hour in water.

All bricks shall be of first class quality, made from good brick earth, free from saline deposits. They shall be thoroughly burnt, uniform in shape/size, having sharp/square edges, parallel faces and of red or copper color. Bricks shall be homogenous in texture and shall emit a clear ringing sound when struck and shall be free from flaws, cracks, chips, stones or modules of lime

Size of bricks shall be 9 x 4.5 x 3 inch (228 x 114 x 75 mm), weight between 7 to 9.25 lbs.
All bricks shall have a “frog” ¼ inch deep on one face. Facing bricks shall have fair face all round, free from efflorescence and any other objectionable deposits which is likely to damage the facing.

The Contractor shall submit samples of bricks for approval prior to commencement of work. Defective bricks shall not be used.

5.04.4 **Reinforcing & Anchors**

Two # 3 bars shall be provided at every sixth course for anchoring of brick masonry. Two # 3 bars at every fifth brick length shall be provided for anchoring masonry walls, as shown on the drawing.

## 5.05 PLACING

The methods and equipment used for transporting the bricks and mortar shall be such as will not damage the brick nor delay the use of mixed mortar. Bricks shall not be placed during heavy rains as it will wash-away the mortar from the brick. Mortar already spread which becomes diluted by rain shall be discarded and replaced before commencement of work. All bricks to be used in brick masonry shall be soaked in water for three to four hours before they are used to ensure that each brick is thoroughly and uniformly wetted. All bricks shall be free from water adhering to their surface when they are placed in the brick masonry.

Bricks shall be laid "frog" upward with mortar joints and in stretcher bond or as approved by the Engineer. Both bed and vertical joints shall be 10 mm in thickness completely filled with mortar as specified herein, and each brick shall be bedded by firmly tapping with the handle of trowel. All horizontal joints shall be parallel and all vertical joints in alternate courses shall be directly over one another. Excess mortar at the outer edges shall be removed and joints drawn straight. Work required to be embedded in the brick masonry shall be installed as the work progresses. At the completion of the work all holes or defective mortar joints shall be cut out and re-pointed.

## 5.06 CURING AND REPAIR

All brick masonry shall be water cured and shall be kept wet for at least seven days by an approved method which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements of the specifications for curing & mixing of concrete.

If, after the completion of any brick masonry work, the brick is not in alignment or level, or does not conform to the lines and levels, shown on the drawings, or shows a defective surface, it shall be removed and replaced by the Contractor, without additional cost to Engineer. Repair or patching of the defective area will not be acceptable unless allowed, in writing, by the Engineer.

## 5.07 DAMP PROOF COURSES

All damp proof courses unless otherwise specified shall be 50 mm thick, consisting of cement concrete having a 28 day minimum cylinder strength of 3000 psi, mixed with approved quality water proofing compound as per manufacturer's specifications and shall be laid at required levels as per drawings and instructions of the Engineer. The damp proof course shall be tamped, consolidated, leveled and edges and corners made to the requirements of the relevant drawings including finishing and curing complete.

## 5.08 CLEANING AND PROTECTION

At the completion of the work, all holes, and defective mortar joints shall be cut and repointed. Exposed masonry shall be protected against staining or other damage and excess mortar shall be cleared off the surfaces as the work progresses. All exposed masonry shall be clean, smooth, fine and shall be of acceptable finish approved by the Engineer.

## 5.09 TOLERANCES

All tolerances shall be as per requirements of ACI-530.1

## 5.10 MEASUREMENT AND PAYMENT

5.10.1 Brick work covered under this section of Specifications, complete and approved at any height, will be measured and paid for per cubic meter including preparations, mortar, adhesive, grouting, pointing, scaffolding, anchor bar reinforcement, surface sealant etc. as per rates entered in the Bill of Quantities and generally in accordance with the applicable terms and Conditions of the Contract.

5.10.2 No extra payment shall be made against cost of samples, cartage. Testing, etc., to the Contractor, Sub-contractor supplier or vendor.

5.10.3 Render coat or backing plaster shall not be paid for separately but shall be deemed to be included in the rates of the finished item.

5.10.4 In case of different thickness of slab in different areas or for any other reason whatsoever, if chiseling of masonry is required the Contractor shall do so at his own cost. Where, for any reason whatsoever, the height of the wall is short of ceiling height of the actual height shall be made good with 3,000psi concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under item of masonry. Similarly where the lintel heights are such that the Contractor has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiseling, but where such cast-in-place concrete is provided, payment for the same will be made at the unit rate for masonry.

5.10.5 Payment will be made for acceptable measured quantity of brick masonry on the basis of unit rate quoted in the Bills of Quantities & shall constitute full compensation for all the works related to the item.

END OF SECTION

# SECTION – C 06

# MISCELLANEOUS METAL WORK

## SECTION C 06

## MISCELLANEOUS METAL WORK

### 6. Miscellaneous Metal Work

#### 6.1 Scope of Work

The Work covered in this section of the Specifications consists of furnishing all plant, tools, labour, equipment, appliances and materials and in performing all operations in connection with the fabrication and installation of miscellaneous metal works, complete in strict accordance with this section of the Specifications and the applicable Drawings and subject to the terms and conditions of the Contract.

#### 6.2 General

##### 6.2.1 STANDARDS

The following standards are referred to in this Section:
BS 476 Fire tests on building materials and structures
BS 729 Hot dip galvanized coatings on iron and steel articles
BS 124 Metal door frames (steel)
BS 1282 Guide to the choice, use & application of wood preservatives.
BS 1449 Steel plate, sheet and strip.
BS 1474 Wrought aluminium & aluminium alloys for general engineering purposes, bars, extruded round tube and section
BS 1615 Method for specifying anodic oxidation coatings on aluminium and alloy
BS 1706 Electroplated coatings of nickel and chromium
BS1722 Fences
BS1723 Brazing
BS 1724 Bronze welding by gas
BS 2901 Filler rods and wires for gas shielded and welding
BS2994 Cold rolled steel Sections
BS 2997 Aluminium rainwater goods
BS 3049 Pedestrian guard rails (metal)
BS 3083 Hot-dip zinc coated &hot-dip aluminium/zinc coated corrugated steel sheets for general purposes
BS 3987 Anodic coatings on wrought aluminium for oxidation external architectural applications.
BS4147 Bitumen based hot applied coating material for protecting iron and steel, including suitable primers where required.
BS 4254 Two-part polysulphide based sealants
BS 4255 Rubber used in pre-formed gaskets for weather exclusion from buildings
BS 4300 Specification (supplementary series) for wrought aluminium and aluminium alloys for general engineering purposes.
BS 4315 Methods of test for resistance to air and water penetration
BS 4873 Aluminium alloy windows
BS 5368 Method of testing windows.

BS 5707 Solutions of wood preservatives in organic solvents.
BS 6213 Guide to selection of constructional sealants
BS 6375 Performance of windows
BS 6496 Powder organic coatings for application & storing to aluminium alloy extrusion, sheet and pre-formed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and pre–formed sections coated with organic coatings
BS 6497 Powder organic coatings for application and storing to hot-dip
BS 6510 galvanized hot-rolled steel Section and steel sheet for windows
BS 7036 and associated external architectural purposes, and for the finish
BS 7773 on galvanized steel Section and sheet coated with organic coatings. Steel windows, bills, window boards and doors.
Code of practice for provision and installation of safety devices for automatic power operated pedestrian door systems Code for practice for cleaning and preparation of metal surfaces.
BS EN 288Approval of welding procedures for metallic materials
BS EN 485Aluminium and aluminium alloys -sheet, strip and plate
BS EN 10142 Continuously hot-dip zinc coated low carbon steel sheet and strip for cold forming: technical delivery conditions.
BS EN 10143 Continuously hot-dip metal coated steel sheet and strip-Tolerances on dimensions and shape
BS EN 10152 Electrolytically zinc coated cold rolled steel flat products-Technical delivery conditions

**6.2.2** All metal shall be well formed to shape and size, with sharp lines or angles. Shearing and punching shall be left clean to true lines and surfaces. Shop connections shall be welded or riveted and site connections bolted unless otherwise noted..

**6.2.3** All metals shall be free from corrosion, scale, distortion and other damage, and only new material shall be used for fabrication purposes.

**6.2.4 Coordination with other Trades**

a. All work under this section shall be coordinated with the work to be done as specified under other sections of the Specifications and as well as with other trades.

b. The Contractor shall furnish all information and instructions required for work by other trades.

c. The Contractor shall drill, tap, cut and fit the work included herein as required to accommodate work of other trades in conjunction with it.

d. The Contractor shall be responsible for obtaining demarcation exact site dimensions and accurate execution of all parts of the work specified.

e. All the works shall be carried out exactly in accordance with the approved shop drawings.

f. The Contractor shall provide easement to all other trade in performing their constructional activities.

### 6.2.5 Samples

The Contractor shall submit samples and mock-ups in accordance with the following or as directed by the Engineer:

a. submit samples of all materials and finishes including the following:

i) samples matching the appearance, colour, texture & other characteristics of each finish required.

ii) finished samples of panels and major extrusions, iii) Samples showing finishes over welds and over materials welded.

b. the size of all samples to be agreed with the engineer or as noted in the contract documents

c. the Contractor shall submit any pre -printed or prepared manufacturer's performance data.

## 6.3 Materials

### 6.3.1 Steel

a. All steel sections shall comply with BS 4, parts 1 and 2, and BS 4848. Steel shall be mildsteel complying with BS 4360, Grades 43A, 43B and 43C as appropriate.

b. Steel tubes for structural and general engineering purposes shall comply with BS 1775.

c. Steel tubes and tubulars for balustrades shall comply with BS 1387 designation of either light, medium or heavy and the steel pipe fittings shall comply with BS 1740.

d. Galvanized MS tube shall comply with BS4 and BS 1387 medium grade.

e. Stainless steel sections shall be to BS 970, quality En. 58A. stainless steel pipes shall be to BS 3605.

f. All steel shall be supplied from a specifically approved source, from approved manufacturers, and certificates of origin and mill test certificates shall be supplied in all cases, proof of compliance with the relevant standards shall be a condition of approval.

### 6.3.2 Nuts, Bolts and Screws

a. Nuts, bolts & screws etc. shall comply with BS 4190 and BS 1494 and shall have SI metric threads complying with BS 3643.

b. Stainless steel bolts are to be set bolts and shall comply with BS 4190. The stainless steel for bolts, nuts and washers shall comply with BS 970, quality En 58 A.M.

c. Self-tapping screws shall comply with BS 4194.

## 6.4 Fabrication

### 6.4.1 General Fabrication

a. All steel and other metals are to be cut, drilled, formed, bent, worked and otherwise fabricated to the details, forms and dimensions indicated on the approved shop drawings; setting out joints and fixings are to be such as to produce finished components that are perfectly square, sound and rigid. All members are to be of the sizes specified, and no alterations, additions or omissions in the size or arrangements of members may be made without Engineer's approval. The inclusion of gussets, bracing plates, fixing lugs, spacers, packings, etc. in the interests of rigidity or ease of fixing may be considered, but on a specific approval from the Engineer.

b. All open-ended members, including hollow sections, shall be capped off with welded plates or caps; no hollow surfaces which cannot be galvanized or maintained are to be left exposed to atmosphere, whether shown so on Drawings or not.

c. The provision of BS 449 shall apply generally to fabrication workmanship.

### 6.4.2 Joints

a. All steel joints specified as welded shall be cleanly and solidly welded, in general accordance with the provisions of BS 5135, using electrodes as specified in BS 639. All welds shall be continuous, solid, with no spot welding, and shall be ground off smooth flush and perfect on completion.

b. All joints specified as bolted, screwed or otherwise mechanically connected shall be properly set out to provide sufficient but not excessive tolerance, holes drilled accurately, and then soundly and solidly connected. All bolts, screws and connectors shall be either hot-dipped galvanized steel, stainless steel or non-ferrous metal, no untreated steel fixing device is to be used in any circumstances. Fixings shall be selected suitable for the particular purposes, and Engineer's approval obtained.

### 6.4.3 Tolerances

a. All metalwork shall be fabricated to overall dimensions so as to provide sufficient but not excessive tolerances between the components and adjoining work, and between adjoining metal components, bearing in mind building materials tolerances, thermal expansion, erection distortions and all other factors.

### 6.4.4 Drawings and Calculations

Detailed fabrication and shop drawings and, where appropriate, structural calculations shall be prepared by the Contractor for the approval of the Engineer for all the fabricated components. These shall be approved before commencement of work and should indicate all connections, fixing, methods of fabrication, and all other relevant details.

### 6.4.5 Finishes and Protection

All metalwork shall be protected during transportation delivery, storage on Site, and after erection, by such measures as shall be agreed with the Engineer, to prevent damage of any type, in particular scratching, denting, distortion, and other mistreatment. Materials so damaged will not be acceptable, and shall have to be replaced.

### 6.4.6 Riveting

Riveting where exposed shall be flush unless otherwise indicated on Drawings or directed by the Engineer.

### 6.4.7 Bolting

Bolting, where permitted, shall be done with proper size bolts. Nuts shall be drawn tight and thread nicked.

### 6.4.8 Steel

The use of Structural Steel in Buildings shall comply with BS 449 Part 2.

### 6.4.9 Welding

a. Welding of all steel shall comply with BS 5135. All welded joints which will be exposed shall be ground to a smooth finish. All welding shall be executed by experienced certified welders.

b. Welding shall be continuous except where tack-welding is specifically permitted. Tack welding will not be permitted on exposed surfaces.
c. Where galvanized items are to be welded, the weld and joint shall be ground smooth and immediately coated with an approved cold galvanizing zinc solution.

### 6.4.10 Shop Finishing

a. Shop paint all ferrous metalwork except galvanized work and those portions of items which are to be embedded in concrete or masonry and surfaces and edges which are to be site welded.

b. Remove scale, rust and other deleterious materials before the shop coat of paint is applied.

c. Immediately after surface preparation, metal primer paint be applied in accordance with the manufacturer's instructions. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

### 6.4.11 Installation

a. Provide anchorage devices and fasteners where necessary for securing to finished work including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, rag-bolts, wood screws and other connectors as necessary.

b. Cut, drill and fit as necessary for installation. Set the work accurately in location, alignment and elevation, plumb, level and true. Provide temporary bracing or anchors in formwork for items which are to be cast or built into concrete, masonry or similar construction. Form right joints with exposed connections accurately fitted together. Do not cut or abrade members with finishes which cannot be completely restored on Site. Where cutting, welding and grinding are required for fitting and jointing of the work, restore finishes to eliminate any evidence of such corrective work.

c. Carry out all welds and carefully make good on completion.

d. Immediately after erection, clean all site welds, bolted connections and rough areas of the shop paint and coat all exposed areas with the same material as used for shop painting.

e. Paint areas around welds of galvanized metals with galvanizing repair paint and coat rough areas with the same paint.

### 6.4.12 Storage and Handling

a. All items described under this Section shall be handled, delivered and stored in a manner that will avoid damage, rust or deformation. Items shall be stored offground and shall be entirely covered with weatherproof coverings in storage area.
b. Items which become rusted or damaged because of non-compliance with these conditions will be subject to rejection, and such items shall be replaced without additional cost to the Employer.

### 6.4.13 Protection

a. Before arriving on Site, all surfaces of hot-dip galvanized method which are damaged, have rough spots or joints (which must be welded after hot-dip galvanizing), shall be touched up, using an approved zinc primer coat. Primer shall be compatible for finish paint. Hot dip galvanized items shall not receive a shop coat of primer so that there may be a visual inspection on Site of such items by the Engineer.

b. Thoroughly insulate all non-ferrous items in contact with dissimilar metals, concrete, masonry and mortar with approved zinc-chromate coating or plastic membrane on contact surfaces before installation.

## 6.5 Miscellaneous Items

### 6.5.1 Hollow Metal Frames

Hollow metal frame shall comprise of M.S. sheet of SWG 16. All shapes and sizes of complete unit as well as components shall be strictly in accordance with details shown on the Drawings, fabricated, painted and fixed to brick masonry or concrete surfaces.

a. **Frames**

i. All hollow metal frames shall be fabricated using 16 gauge M.S. sheets of best quality, free from all defects, and in accordance with the details indicated on the Drawings.

ii. Frames shall be constructed as full welded units from approved manufacturers as per approved shop drawings.

iii. All corners mitred and back-welded and any exposed welds at all joints ground and dressed smooth.

iv. Anchors shall be provided as per approved details, 8” long, MS flat 3 to 4 Nos. to each jambs and welded to frame at shop for embedding in blockwork/brickwork.

v. All frames shall have channel spreaders. Frames cut, reinforced, mortised, drilled and tapped as required for application of all hardware. All frames shall be fabricated as per final approved hardware schedule.

vi. Rubber/Neoprene bumper or sound absorbers shall be installed 3 per strike jamb.

vii. All contact edges shall be closed tight.

viii. Finished work shall be strong and rigid, neat in appearance and free from defects, warps, bulges or buckles. Moulded members shall be clean-cut straight with true edges.

ix. All cut-outs shall be protected against mortar or plaster with mortar guards of approved gauge

x. After the frame is fabricated, all tool marks shall be ground smooth, all exposed surfaces degreased and thoroughly cleaned of rust, oil and other impurities and coated with approved primer to enable the surface of the metal to resist corrosion and promote paint adhesion. The remaining irregularities specially welding shall be dressed smooth.

b. **Installation**

i. Frames that are fabricated and brought on the Site shall be approved by the Engineer before installation. Any defective or substandard work shall not be acceptable.

ii. Frames shall be installed in accordance with the manufacturer's drawings and recommendations, all to the satisfaction of the Engineer.

d. **Painting**

i. One coat of anti-corrosion primer paint shall be applied to all exposed surfaces before the frame is installed. After this another base coat of enamel paint should be given.

ii. After the frame has been installed properly, three coats of enamel paint of an approved quality and shade shall be finally applied to all exposed surfaces.

e. **Storage and Handling**

The Contractor shall be responsible for storage, handling and protection of the material on the job. Scratches, holes, dents and nicks and other marring of the paint film will have to be made good and touched up without any extra cost.

### 6.5.2 Steel Grating / Screens

Steel Grating / Screens shall be fabricated and installed, as per details indicated on Drawings as approved by the Engineer, manufactured in accordance with approved shop drawings. The Steel Grating / Screens sections/frames shall be of the sizes as details given drawings, including Angle Irons, bars, MS plates, base plate, welding, bolts and screws etc., embedded and installed in position complete.

## 6.6 Measurement and Payment

**6.6.1** Steel Grating / Screens shall be measured and paid per weight in K.g and paid for at the unit rate entered in the Bill of Quantities, inclusive of frame and all accessories, fixing brackets / plates, screws, bolts etc., painting/galvanizing and installation, complete in all respect.

**6.6.2** No extra payment shall be, paid to the Contractor, Sub-contractor, supplier or vender against cost & cartage of sample submitted for approval, for damaged & rejected work.

END OF SECTION

# SECTION – C 07

# WATER PROOFING

## SECTION C 07

## WATER PROOFING

### 7.0 Water Proofing

### 7.01 Scope of Work

The work covered by this section of the specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with the execution of the work of water proofing complete, in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the contract.

Also, the Damp Proof Course (DPC) shall be horizontal and vertical as shown on the drawings and specified in the Bill of Quantities.

**HORIZONTAL**

**In Walls**

The horizontal D.P.C. shall consist of 50 mm (2 inch) thick, cement concrete with two (2) sand blinded coats of Hycrab-A-20

**Under Floors**

Same as in walls except bitumen layers to be laid on 12/20 mm blinding screed (1:6) to even out surface of lean concrete hard core.

**VERTICAL**

The vertical D.P.C. shall consist of 20 mm thick 1:3 cement sand mortar with 5% pudlo and two (2) sand blinded coats of hot Hycrab-A-20

### 7.02 Materials Requirements

All material i.e. cement, sand aggregate, water polythene sheet and bitumen shall conform to the relevant British Standards, specifications given in respective sections or as directed by the Engineer.

The Contractor shall submit to the Engineer samples of all material for testing and approval. If instructed by the Engineer, the Contractor shall construct Mock-up for inspection and testing.

### 7.03 Construction Requirements

#### 7.03.1 Damp Proof Course

The Contractor shall lay the D.P.C. only when the level, quality of masonry work, etc. is approved.

The concrete work of D.P.C. shall conform to the relevant specifications given in these specifications for the execution of these items.
Horizontal D.P.C. shall extend to the full width of the wall i.e. upto the external faces.. The period of curing of concrete shall be not less than 72 hours. Every care should be taken that concrete is not left dry during this period. The work of laying Damp Proof Course shall be carried out as follows unless otherwise described in BOQ:-

a. Placing 2" layer of Class-B cement concrete.
b. Bitumen coating as mentioned below

The application of bitumen coating in case of vertical D.P.C. shall be same as mentioned above.

7.03.2 **Bitumen Coating**

Laying 2 Coats of hot bitumen Hycrab-A-20 or 10/20 grade as approved @ 1 Kg. per sq. m. (each coat) over entire width and lengths of concrete after the concrete has been properly cured for at least 72 hours, and sand blinding where specified.

7.04 **Measurement and Payment**

15.04.01 Bitumen coating shall be measured per in square meter unit rates entered in the Bill of Quantities, inclusive of all materials, labour, plant, machinery, admixture, rework etc complete in all respect.

15.04.02 Vertical / Horizontal Damp Proof Courses shall be measured per in square meter unit rates entered in the Bill of Quantities, inclusive of all materials, labour, plant, machinery, admixture, rework etc complete in all respect.

15.04.03 No extra payment shall be, paid to the Contractor, Sub-contractor, supplier or vender against cost & cartage of sample submitted for approval, for damaged & rejected work.

END OF SECTION

# SECTION – C-08

# Dismantling Work

# SECTION-C 08

# DISMANTLING WORKS

## 1. SCOPE

The work covered by this Section of the Specifications consists of furnishing all plant, labor, equipment, appliances and performing all operations in connection with demolition/ dismantling and removal of existing drains, structure, asphalt road, pavement, kerbs, medians, foundations, approaches/plate forms, trees, plants, removal of services with accessories and Plain concrete / masonry structures including disposal of demolished / dismantled and removed material to designated places. Whole work shall be done in accordance with these specifications and as directed by the Engineer.

## 2. PROCEDURES

2.1 The method of dismantling and demolition including the sequence of operations and any special procedural requirements shall be submitted to the Engineer for consideration not less than seven days before the work is due to begin. Demolition work shall be carried out in accordance with BS 6187, and the submittal shall include information demonstrating the Contractor's proposed methods to attain compliance.

2.2 The Engineer will define the limits where demolition/ dismantling and removal activity is to be done and shall approve the procedures/methods to be adopted by the Contractor. The Contractor shall layout the boundaries/limits for Engineer’s checking and approval before commencing dismantling work.

2.3 Before start of dismantling/demolition works, sufficient photographs will be taken and submitted to the Engineer and inventories shall be prepared and signed jointly and the materials obtained from the result of dismantling/demolition shall be distributed as per specifications given herein or in the contract.

2.4 Whole work shall be performed in an orderly manner and the Contractor shall take all necessary precautions and expedients to prevent damages to the adjacent structures, installed equipment/machinery, pipes, conduits, any other installation etc. Any damage caused to the structures and installations due to negligence of the Contractor during demolition/ dismantled and removal operations shall be repaired/replaced by the Contractor at his cost and to the satisfaction of the Engineer.

## 3. DISMANTLING OF EXISTING BUILDINGS

3.1 The existing structure / drains shall be dismantled/demolished in such a way that the useable materials, i.e. steel rebars etc can be used by the Owner. All safety precautions shall be exercised while execution and unusable debris shall be disposed off as per Engineer’s instructions.

3.2 Foundations buried or visible shall be cleared and ditches/trenches shall be refilled with compaction to use the surface for new structure. Utilities lines shall be provided bypass or alternate routine before dismantling to ensure supply / drainage uninterrupted. The

surface shall be cleaned out after dismantling and dismantled material shall be disposed off at the places as designated by the Engineer.

## 4. REMOVAL & SHIFTING OF TREES

The trees which are to be removed shall be excavated up to roots end and removed completely their all branches etc. No structure works shall be allowed to rest on the soil containing roots or any part of it.

The trees of girths ranging from 2.5ft to 6ft shall be removed / replanted as directed by the Engineer, at the designated places, these large trees shall be excavated around the tree, but not less than 200mm, in such a manner that the roots of trees should not be cut or exposed to atmosphere, sufficient native soil should remain adhesive to the roots of tree.

Immediately prior to shipping all plants shall be inspected, dug, prepared and packed with care and skill in accordance with the recognized standard practice for the kinds of plants concerned.

During transportation, all plants shall be packed adequately to ensure protection from sun, wind, climatic or seasonal injuries. Tarpaulins and other covers shall be placed over plants when they are transported by trucks for more than 10 km.

Roots system of all plants shall not be permitted to dry out at any time and shall not be exposed to excessive heat or to freezing temperature.

Immediately after digging and prior to packing in moss or other suitable materials, roots shall be dipped in a solution of humectants. All earth-balls shall be firmed and intact and contained in hessian or palm bark. Do not drop balled or bur lapped stock at any time. All balled and hessian covered plants and container growth plants shall at all times be handled by the ball or by the container and not by the plant stem. The head of each tree shall be carefully tied to prevent fracture of branches.

If soil or the habit of root growth is such that the final roots are not adequately protected, wrap exposed root systems in hessian and prevent from drying.

The moisture of retained soil shall be protected by wrapping up the hessian cloth immediately after it has been uprooted, before transporting to the designated places or at temporary stack yard. The maximum time of stacking of any tree shall not exceed more than 2 days.

The new location of tree shall be excavated up to the depth / height of root mass, so that the no any portion shall remain above the ground level, which was initially rested below ground level.

The Contractor shall arrange all required watering, pesticides, fertilizers etc. for the shifted tree, without any additional cost to employer.

## 5. DEMOLITION OF ROAD, PAVEMENT AND CONCRETE/ MASONRY WORKS

The Contractor shall demolish road pavement and concrete / masonry / flooring works to the line and depth as shown on the Drawings or as directed by the Engineer. Explosives shall not be used to remove the plain and reinforced cement concrete or any other material whatsoever.

Mechanically operated breakers, concrete saws, chipping hammers or other approved methods shall be employed for cutting. Care shall be taken that existing services and structures are not damaged. It shall be the responsibility of the Contractor to replace at his cost any services, Structures damaged by the Contractor due to his negligence during cutting operations or thereafter until the whole of cut parts/areas are restored to original condition to the satisfaction of the Engineer. The Contractor shall exercise all safety precautions and methods while any dismantling activities and shall ensure that site is cordoned off and workers have used PPEs.

## 6. CLEARANCE OF GREEN AREA

The bushes/plants in existing green area shall be cleared off up to the roots and the surface shall smoothen and cleared from all debris and any organic material before receiving new layer.

## 7. REMOVAL OF EXISTING SERVICES/ UTILITIES

7.1 The Contractor shall mark all the services/ utilities falling within the ROW. After getting approval from the Engineer, the contractor shall remove all such services/ utilities as per the requirement/ specifications of the relative department whose utilities/ services are being removed/ shifted.

## 8. DISPOSAL

8.1 All debris materials resulting from demolition / dismantling works shall be disposed off to places designated by the Engineer in the manner of disposition required and directed by the Engineer.

8.2 All useable materials resulting from demolition and removal shall remain the property of the Employer and shall be stacked at designated places.

8.3 The Contractor shall segregate the useable materials as directed by the Engineer and stack at designated places.

## 9. MEASUREMENT AND PAYMENT

9.1 General

Except otherwise specified herein or elsewhere in the Contract Documents no measurement and payment will be made for the under mentioned items related to this section. The cost thereof shall be deemed to have been included in the quoted unit rate of the items of the Bill of Quantities under this section.

9.1.1 Temporary diversion and safety measures, Demarcation/layouts etc.

9.1.2 Loading, unloading, transportation and disposal of demolished/ dismantled/ removed/ useable material to the place designated by the Engineer.

9.1.3 Permissions/approvals, if required, from the relative department and information to the stack holders.

9.1.4 Stacking of all useable material to the place designated by the Engineer.

9.1.5 Earth work

9.1.6 Hessian cloth, plaster of Paris etc

9.1.7 Repair / finishing of adjacent component of dismantled structure.

9.2 **Drains / structure**

9.2.1 Measurement

Measurement of acceptably completed works of demolition of existing drains / structures will be made on the basis the running meter length of drains sections actually demolished and cleared, shown on the Drawings or as directed by the Engineer.

9.2.2 Payment

Payment will be made for acceptable measured quantity of demolition of existing drains / structure on the basis of unit rate per running meter quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

9.3 **Removal & Shifting of Trees**

9.3.1 Measurement

Measurement for acceptably completed works of removal and shifting of existing trees will be made on the basis of number of the trees removed and shifted as directed by the Engineer.

9.3.2 Payment

Payment will be made for acceptable measured quantity of removal and shifting of trees on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

9.4 **PCC/RCC Work**

9.4.1 Measurement

Measurement of acceptably completed works of RCC & PCC where provided in the contract specifically will be made on the basis of number of Cubic meter of the RCC & PCC actually demolished, shown on the Drawings or as directed by the Engineer.

9.4.2 Payment

Payment will be made for acceptable measured quantity of demolition dismantling and removal of RCC & PCC work on the basis of unit rate per

cubic meter quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

9.5 **Road Works**

9.5.1 Measurement

Measurement of acceptably completed works of road works where provided in the contract specifically will be made on the basis of number of square meter of the surface actually demolished, shown on the Drawings or as directed by the Engineer.

9.5.2 Payment

Payment will be made for acceptable measured quantity of demolition dismantling and removal of road works on the basis of unit rate per square meter quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

END OF SECTION