

TENDER AND CONTRACT
DOCUMENTS

VOLUME -II (PART-A)

TECHNICAL SPECIFICATIONS

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SECTION - 1 GENERAL REQUIREMENTS

1. General

The General Conditions of Contract & Special Conditions of Contract 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 Consultant/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 be 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 Consultant for approval before proceeding with the work.

The Tender Drawings, Design Criteria and Specifications are to be read in conjunction and shall be mutually explanatory. In case of any conflict the order of preference shall be as under duly followed by the Special and General Conditions of Contract in Volume I of Tender & Contract documents.

- i) Specifications
- ii) Tender Drawings
- iii) Bill of Quantities

2. Scope of Work

The scope of work comprises **Construction work for Strengthening of Research program at International Centre For Chemical & Biological Sciences, HEJ Research Institute of Chemistry, University of Karachi** as per drawings and specification as defined hereunder and as specified in subsequent sections of tender documents. The Contractor shall perform all relevant engineering, procurement, installation, construction and execution, coordination with other services, testing and commissioning including all documentation, drawings, calculations and supply of manuals as required completing the work. The Contractor shall also be responsible to supply and install all other items not specifically mentioned in these documents but which are necessary for proper completion of the works included in the scope of this Contract.

3. 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 publications 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
PCA	Practice 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.

4. Codes, Standards, Certificates

The Contractor shall supply and 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.

5. Units of Measurements

The British System of Units (FPS) and shall be used or otherwise mentioned throughout this Project.

6. Manufacturer's Recommendations

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

7. Existing Condition at Site

Drawings and information pertaining to existing project conditions are furnished for reference. Neither the Employer nor the Consultant/Engineer warrants the adequacy or correctness of these.

8. 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.

9. Setting Out of Work

Establish all boundaries, markers, leveling stakes and benchmarks on the site to adequately set out all work. Verify all data and their relationship to establish and Engineer's survey control points and public benchmarks and report discrepancies to the Consultant/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.

10. Sequence of Construction

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

11. Lines and Levels

Survey control points will be established by' the Engineer. The Contractor shall be responsible for verifying 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.

12. 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 Consultant will have the right to continue such use until such portion of the work can, without injury to the Consultant, 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 pending completion of appropriate remedial action shall not exceed twelve months unless otherwise mutually agreed upon in writing between the parties.

13. Existing Services

The Contractor shall search for, find locate and protect any visible/un visible wiring, cable, duct, pipe work, etc., within or immediately adjoining the site area.

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

14. 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 Consultant/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.

15. 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 Consultant / Engineer.

16. 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. 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 Consultant/Engineer and or employer.

17. Test Laboratory and Testing

- 17.1 Testing, except as otherwise specified herein, shall be performed by an approved testing agency as proposed by the Contractor and at no extra cost to the Employer. The Engineer may require all testing to be carried out under his supervision only.
- 17.2 If suitable and adequate material testing laboratory is not available in the vicinity, then the Contractor shall provide and maintain a materials testing laboratory in the vicinity of the Contractor's Camp and the laboratory shall have sufficient working area and shall be equipped with all necessary facilities including a suitable store room.
- 17.3 The Contractor shall supply and maintain to the satisfaction of the Consultant/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 requirement shall be provided by the Contractor.
- 17.4 The Contractor, after the approval by the Consultant/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.
- 17.5 The quality contract 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.

18. 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 Consultant/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 leveling, 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 Consultant/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.

19. Bar Bending Schedule

Bar bending (reinforcement bars) schedule of all drawings shall be prepared by the Contractor and submitted to Consultants' Head Office for approval starting well in advance before steel cutting. The approved bar bending scheduled shall be followed for cutting of steel and preparation of bills.

20. Drawings

20.1 Tender Drawings: The drawings listed in the General Conditions of contract, Volume I and provided in Volume IV are referred to as Tender Drawings 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 Consultant / Engineer.

20.2 Drawings Issued for Construction: After Award of Contract, Tender Drawings shall be replaced by Drawings Issued for Construction including supplementary Specifications as may be necessary. Such drawings and specifications shall be construed to be included in the expression Custody of Drawings under Sub-Clause 6.1 of General Conditions of Contract Part I. 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 Consultant/Engineer for issuance to the Contractor from time to time.

20.3 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.

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

Drawings Issued for Construction - Two copies as specified in sub-clause 6.1 Custody of Drawings, of General Conditions of Contract - Part I Volume I.

20.5 Drawings to be furnished by the Contractor:

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 Consultant/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 Consultant/Engineer for approval. All drawings shall be complete and shall be submitted in due time and in logical order to facilitate proper coordination.

a. 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 Consultant/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.

b. 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.

c. Submissions and Approvals:

Except as otherwise specified, three copies of each drawing for approval or review shall be furnished to the Consultant. Within thirty calendar days after receipt the Consultant 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.

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

- d. 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.
- e. All of the applicable requirements of this Clause with reference to drawings to be prepared by the Contractor, including Subcontractors, shall apply equally to catalogue cuts, illustrations, printed specifications, or other data submitted for approval.
- f. Any work done on Contractor's drawings shall be at the Contractor's risk. The Consultant/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 Consultant 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 Consultant/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.

21. 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 sub-Contractors shall 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 Consultant/Engineer six copies and one reproducible copy of all drawings along with CD containing 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.

22. 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 In-charge. 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.

23. Protection of the Works

The Contractor shall whenever necessary cover up and protect the works from Weather 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.

24. Product Data

Manufacturer'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.

25. Samples

25.1 The Contractor shall furnish for approval of the Engineer with reasonable Promptness all samples as directed by the Consultant or specifically called for in these Specifications. The Consultant shall check and approve such samples with reasonable promptness for compliance with the requirements of Contract Documents. All work shall be in accordance with approved samples.

25.2 Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Consultant, one for office

use and the other for the Site office.

- 25.3** Samples shall be furnished so as not to delay fabrication, allowing the Consultant/Engineer Incharge reasonable time for consideration of the sample' submitted.
- 25.4** Each sample shall be properly labeled with the name and quality of the material, manufacturers name, name of the project, the contractor's name and the date of submission, and the Specifications Article number to which the sample refers.
- 25.5** 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 & Consultants' Head 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.
- 25.6** Samples shall be of adequate size and number to permit proper evaluation of the material by the Consultant/Engineer Incharge. 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.
- 25.7** If both Shop Drawings and samples are required for the same item, the Consultant/Engineer Incharge may require both to be submitted before approving either, 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.

In the event that the site cannot 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 Incharge 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 utilized 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 Client 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.

25.7.1 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 Consultant/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 In charge and replaced with suitable fill material compacted and finished with topsoil all at the expense of the Contractor.

25.7.2 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 In charge and storage shall not be within building.

Torch-cutting and welding operations performed by the Contractor shall have the approval of the Engineer In charge 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 relevant department and or other local authority.

25.7.3 Telephone

The Contractor shall immediately after receiving the Letter of Acceptance take the necessary steps to obtain mobile and land line telephone on site. He shall be responsible for all installation and connection charges and periodic mobile and landline telephone accounts. The telephone shall be made available to the Engineer for the due performance of his duties at all times and free of charge during construction and defects liability period.

26. 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 an activities of the Works.

Should the Consultant / 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 Consultant/Engineer In charge for his approval.

27. Notification to the Engineer

The Consultant/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.

28. Night Work

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.

29. 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.

30. Co-Ordination With Other Contractors

The Contractor shall make all necessary coordination with other Contractor and shall make sure that all embedding components such as pipes, steel bases etc. (as required for completion of electrical works) 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.

31. Submission Requirements

31.1 Schedule submission at least sixty days before the dates when reviewed submittals will be needed.

- 31.2** Submit Shop Drawings as per provision given in Sub-Clause 20.5 (a) and number of copies of Product Data which the Contractor requires for distribution plus four copies which will be retained by the Engineer.
- 31.3** Submit three samples unless otherwise specified.
- 31.4** 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.

32. 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 Consultant/Engineer. Product Data and Samples: Submit new data and samples as required for initial submittal.

33. Survey Instruments

All the instruments, equipment, stakes and other material necessary to perform all work shall be provided 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

Laser Meter

Precision Level invert Staff

Automatic Levels

Power level

Compass, steel tape, ranging poles

34. Weekly Progress Report and Phtographs

34.1 During the continuance of the Contract, the Contractor shall submit weekly progress reports on forms as approved by the Consultant. 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.

34.2 The Employer and the Consultant/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.

34.3 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.

35. 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 Consultant, 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 and record and details where difficulties in maintaining the agreed programme 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 as 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.

36. 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 297 mm x 210 mm and shall bear a printed description, a serial number and the date when taken.

The Soft Copy & Hard Copy of the Photographs in CDs & Report Files should be kept at site office and copy of the same should be sent to consultants' head office.

37. Facilities for the Engineer

37.1 Site Office

The Contractor shall construct, provide and maintain Consultant's Site Office of about 150-160 square meter covered area as per the specifications throughout the project (completion). A preliminary layout of the site office shall be provided by the Consultant. After receiving letter of award the Contractor will submit to the Engineer detailed shop drawings for review and approval. Specifications for construction of site office shall be the same as provided in Volume-II of the tender documents.

The Consultant's site office shall be furnished and equipped with new and unused furniture, equipment, air-conditioners, electrical fittings etc., as per the list given below:

1	Wooden office table with drawers and side racks with locks and keys	3 (Three) No.
2	Office Chairs	3 (Three) No.
3	Wooden sitting visitors chairs with arms (standard size)	6 (Six) No.
4	Steel filing cabinet (standard size)	2 (Two) No.
5	Split type (1-1/2 Ton – 2Ton)	2 (Two) No.
6	Electric Kettle	1 (One) No.
7	Microwave Oven	1 (One) No.
8	Laptop Core i 5, Original Intel processor 4GB DDR3 Ram, 500 GB hard disk, 15.4" LED Display along with Laser Printer (A-3 Size), Scanner, DVD Writer, Speakers, Licensed software for microsoft, MS office and autocad.	1 (One) No.
9	USB Internet Device	1 (One) No.
10	Computer Table & chair	2 (Two) No..

If any equipment, furniture and installations become unserviceable for any reason whatsoever the Contractor shall promptly replace the same as and when directed by the Consultant. The Consultant's Site office with fittings, fixtures and all other equipment/accessories shall be maintained and operated for the entire duration of construction period as well as for the duration of subsequent defects liability period.

The Site Office including fittings, fixtures, furniture, furnishing and all other equipment/accessories shall be the property of the Contractor on completion of the Contract.

37.2 Contractors Employees.

The Contractor shall provide and employ on the Site for the purpose of or in connection with the Contract:

S. No	Staff to be Employed with Qualification	No.	Experience
1	Project Manager - B.E. in Civil	1	Minimum 15 years experience
2	Site Supervisor - D.A.E. (3 years) in Civil Technology	2	Minimum 15 years experience.
3	Site Supervisor - D.A.E. (3 years) in Electrical Technology	1	Minimum 15 years experience.
4	Surveyor - D.A.E. (3 years) in Civil Technology	1	Minimum 5 years experience.
5	Quantity Surveyor - D.A.E. (3 years) in Civil Technology	1	Minimum 10 years experience.

S. No.	Staff to be Employed with Qualification	No.	Experience
1	Work Superintendents	3	Metric / non-metric with 10 to 15 years experience in the construction of RCC work and can understand drawings well
2	Remaining staff be employed by the Contractor as required at site as per schedule of Work		

All contractors employee CV before induction for proposed project will be approved by Consultant & Client Engineer.

38. Payment of Work

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

The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

SECTION – 2 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.

The location of the Contractor's camps, including all buildings, utilities and facilities there for, 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 Consultant/Engineer.

The work to be done under this item will terminate upon the actual Completion Date. However, if directed by the Consultant 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 Consultant, the Contractor shall remove all buildings utilities and other facilities from the Site and restore all camp areas to a neat and clean condition.

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

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 Consultant and the Employer.

2. Payment of Work

No payment shall be made for the works involved within the scope of this section of Specifications unless otherwise specifically stated in the Bills of Quantities or herein.

The cost thereof shall be deemed to have been include in the quoted unit rate of other items of the Bills of Quantities.

SECTION – 3 STAKE-OUT SURVEY

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 Consultant/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 Consultant/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. Payment of Work

No payment shall be made for the Works involved within the scope of this section of Specifications unless otherwise specifically stated in the Bills of Quantities or herein.

The cost thereof shall be deemed to have been included in the quoted unit rate of other items of the Bills of Quantities.

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SECTION – 4 CLEARING AND GRUBBING

1. Scope

The clearing and grubbing shall consist of clearing the designated area of all trees, down timber, snags, bush, other vegetation, rubbish and all other objectionable material, and shall include grubbing stumps, roots, and matted roots, and disposal of all spoil material resulting from the clearing and grubbing. It shall also include the removal and disposal of structures that protrude, encroach upon, or otherwise obstruct the work, except when otherwise provided for on the plans or directed by the Engineer to be saved. The scope of this section of specifications is covered with detailed specifications laid down herein.

2. Limit of Area

2.1 Location of Works

The Engineer will define the limit of areas where clearing and grubbing is to be done. Normally it will include all land within the right of way and all other construction area including ditches, detours, minor road crossings and other areas shown on the plans or as specified or as directed by the Engineer. The Engineer will designate the fences, structures and debris and trees and bushes to be cleared where grubbing is not required. It shall not include clearing and grubbing of borrow or other pit areas from which material is secured. It shall include the leveling or removal of all bunds or mounds within the right of way unless otherwise directed by the Engineer.

2.2 Grubbing and Cutting

All roots and stumps within the limits of the site shall be grubbed and excavated unless otherwise specified or approved by the Engineer.

2.3 Disposal

All wood and bush shall be burned or otherwise disposed off within fifteen (15) days after cutting or felling unless otherwise approved. No tree trunks, stumps or other debris shall be left within Site unless approved in writing by the Engineer. The location of disposal areas shall be within or outside the limits of the project or as approved in writing by the Engineer and shall be acquired by the Contractor at his own expense. Any useable material shall remain the property of the Employer.

2.4 Protection and Restoration

The Contractor shall prevent all damage to pipes, conduits, wires, cables or structures above or below ground. No land monuments, property markers, or official datum points shall be damaged or removed until the Engineer has witnessed or otherwise referred their location and approved their removal. The Contractor shall so control his operations as to prevent damage to trees and shrubs, which are to be preserved. Protection may include fences and boards lashed to trees to prevent damage from machine operations. The existing covered or open benchmarks should be relocated as directed by the Engineer. In the event that anything specified herein to be saved and protected is damaged.

SECTION – 5 DISMANTLING WORKS

1. Scope

The work covered by this Section of the Specifications consists of furnishing all plant, labour, equipment, appliances and performing all operations in connection with demolition! dismantling and removal of existing building components, walls, floors, skirting, plaster and removing of doors, windows and ventilators, removal / re-routing of utility services of the building with accessories, removal of existing roof finishes and disposal/stacking of material to designated places. Whole work shall be done in accordance with these and other relevant specifications and as directed by the Engineer.

2. Procedures

2.1 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.

2.2 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 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. Demolition of Building Components

3.1 The Contractor shall demolish walls, floors skirting, cutting of plaster, removing of doors, windows, ventilators, concrete/ masonry works and other associated parts 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. Manually or where required 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.

4. Removal of Existing Services/ Utilities/Finishes

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

5. Disposal

5.1 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.

5.2 All useable materials resulting from demolition and removal shall remain the property of the Employer and shall be stacked at

designated places.

6. Measurement and Payment

6.1 General

Except otherwise specified herein or elsewhere in the Bill of Quantities/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 other items of the Bill of Quantities under this section.

6.1.1 Temporary diversion and safety measures.

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

6.1.3 Permissions/approvals, if required, from the relative department.

6.1.4 Stacking of all useable material to the place designated by the Engineer/Employer.

6.1.5 Earth work

6.1.6 Shifting of Existing lines, Sewer line, and water supply lines or rerouting the same as per new design and drawing.

6.1.7 Shifting of Existing Generators, Transformers, Panels, Switch boards and all electrical / plumbing accessories including motors / pumps as per new design and drawing.

6.2 Dismantling of Tile Floors/Dado/Skirting / Wall fly proof jali

6.2.1 Measurement

Measurement for acceptably completed works of dismantling and removal of existing tile floors/dado/skirting/wall/fly proof jali and staking of useable material at designated places will be made on the basis of actual area in square foot of dismantled floor/dado/skirting/wall/fly proof jali as directed by the Engineer.

6.2.2 Payment

Payment will be made for acceptably measured quantity of dismantled tile floor/dado/skirting/wall/fly proof jali on the basis of unit rate per square foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item. If this item is not covered in the BOQ the cost thereof shall be deemed to have been included in the quoted unit rate of other items of bill of quantities.

6.3 Removal of Doors and Windows with Chowkhats

6.3.1 Measurement

Measurement for acceptably completed works of removal of existing doors/windows with chowkhats and staking of useable material at designated places will be made on the basis of actual number of removed doors/windows with chowkhats as directed by the Engineer.

6.3.2 Payment

Payment will be made for acceptably measured quantity of removal of existing doors/windows with chowkhats 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. If this item is not covered in the BOQ the cost thereof shall be deemed to have been included in the quoted unit rate of other items of bill of quantities.

6.4 RCC Slab

6.4.1 Measurement

Measurement for acceptably completed works of removal of existing RCC slab will be made on the basis of actual volume in cubic feet of dismantled concrete as directed by the Engineer.

6.4.2 Payment

Payment will be made for acceptably measured quantity of dismantling of existing RCC slab on the basis of unit rate per cubic feet quoted in the Bill of Quantities full compensation for all the works related to the item.

6.5 Removing / Chipping of Plaster (Int. / Ext.) at any level at any height.

6.5.1 Measurement

Measurement for acceptably completed works of removing and chipping of existing Plaster and debris to be shifted outside the premises / at designated places will be made on the basis of actual area in square foot of removed plaster as directed by the Engineer.

6.5.2 Payment

Payment will be made for acceptably measured quantity of removing / chipping of existing plaster on the basis of unit rate per square foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item. If this item is not covered in the BOQ the cost thereof shall be deemed to have been included in the quoted unit rate of other items of bill of quantities.

6.6 Removing / Electrical / Plumbing fitting and fixtures at any level at any height.

6.6.1 Measurement

Measurement for acceptably completed works of removing of Electrical / Plumbing fitting and fixtures and stacked at designated places will be made on the basis of actual in Nos. of removed items as directed by the Engineer.

6.6.2 Payment

Payment will be made for acceptably measured quantity of removed fittings and fixtures on the basis of unit rate per Nos. quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item. If this item is not covered in the BOQ the cost thereof shall be deemed to have been included in the quoted unit rate of other items of bill of quantities.

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SECTION – 6 EARTH WORK

1. Scope of Work

The work under this section of the specification consist of furnishing all plant, labour equipment, appliances and materials and in performing all operations in connection with earthworks of all underground services and structural units, stock piling of suitable excavated material, disposal of unsuitable and surplus excavated material in accordance with this section of specifications, the applicable drawings and subject to terms and conditions of the Contract.

2. General

2.1 The Contractor shall be deemed to have made local and independent inquires as to, 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 an extra or additional payment nor to be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.

2.2 All excavations, cut and fills shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the Period of Maintenance the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the Period of Maintenance any damage or defects in cuts and fills, in structures and other works, caused by slips, falls of wash-ins or any other ground movement due to the Contractor's negligence shall be made good by the contractor at his own cost.

3. Site Preparation

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

3.2 The Contractor shall construct and maintain accurate bench marks so that the Lines and Levels can be easily checked by the Engineer.

3.3 The Contractor shall perform a joint survey with the Engineer's Representative, of the area where earth work is required, plot the ground levels on the drawings and obtain approval from the Engineer before starting the earth work and shall supply a copy to the Employer duly checked, signed and authenticated by the Engineer before start of work.

4. Excavations

4.1 Excavation shall include the removal of all material of every name and nature. It is expected that rock and other hard material will be encountered during excavation, The rate of excavation shall include the removal of all sub-surface material of every name and nature and no classification of sub-surface material shall be made nor any additional payment shall be made.

4.2 The major portion of excavations shall be carried out by mechanical

excavators and excavated materials disposed off to stock on spoil as directed by the Engineer. The excavation may be done by normal means, unless otherwise specified by the Engineer, leveling, trimming and finishing to the required levels and dimensions shall be done manually. The material suitable for fill and backfill if approved by the Engineer shall be stockpiled within the limits of whole of the Site as directed by the Engineer. Excavated material unsuitable for use as fill and backfill shall be disposed off by the Contractor at locations approved by the Engineer within specified free haulage limit.

4.3 The Contractor shall give reasonable notice that he intends to commence any excavation and he shall submit to the Engineer full details of his proposals. The Engineer's approval shall not relieve the Contractor of his responsibility with respect to such work.

4.4 The Contractor shall preserve the completed excavation from damage due to slips' and earth movements, ingress of water from any source whatsoever and deterioration by exposure to the sun and the effects of the weather.

All excavations shall be kept free of water and shall be maintained dry to the satisfaction of the Engineer. Prevent surface water and sub-surface water and sub surface ground water from flowing into the excavation and flooding the project site and surroundings.

Do not allow water to accumulate in excavations, remove water from excavations to prevent softening of foundation bottoms, under cutting footings and soil changes determined to the stability of sub-grades and foundations. Provide and discharge lives necessary to convey the water away from the excavations convey water removed from excavation and rain water to outside the limits in manner that no damages is caused to the surrounding services properties.

4.5 Excavation for pits, cable trenches, equipment-foundations and other structures shall be taken out to the levels and dimensions shown on Drawings or such other levels and dimensions as the Engineer may direct.

4.6 Excavation shall extend to adequate distance from walls and footings to allow for placing and removal of forms, installations of services and for inspection, except where the concrete for walls and footings is authorized to be deposited directly against excavated surfaces. Undercutting will not be permitted. The additional excavation for placing and removal of forms, installation of services, for inspection and generally for working area on slopes for stability shall not be measured for payment and shall be deemed to be included in the rates for excavation as measured net.

4.7 All' excavations in foundations shall be taken to 6 inch above the final excavation elevations shown on the drawings and the 6-inch shall be trimmed carefully to a smooth and level surface. Immediately after trimming to the final elevation, a layer of blinding concrete shall be placed to the thickness shown on the drawings. All excavations for foundations which have been trimmed and disturbed shall be compacted and covered by lean concrete by the end of the day.

4.8 No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the Engineer and his

permission to proceed is given.

- 4.9 If excavation for sub-structures are carried below the required level, as shown on the Drawings or as directed by the Engineer, the surplus depth shall be filled in with concrete of same grade as of blinding concrete at the sole cost of the Contractor.
- 4.10 All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry.
- 4.11 Shoring, where required during excavation, shall be installed to protect workmen and the bank, adjacent paving, structures and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor select to adopt, with prior approval of the Engineer, for upholding the sides of excavation and also for planking and strutting to excavation against the side of roadways and adjoining properties in existing hardcore of 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.
- 4.12 Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation and that are to be retained, as well as utility lines constructed during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his own expense. Any existing utility lines which are not known to the Contractor in sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired by the Contractor and adjustment in payment will be made as approved by the Engineer. When utility lines which are to be removed, are encountered within the area of operations the Contractor shall notify the Engineer in ample time for the necessary measures to be taken to prevent interruption of the service.
- 4.13 Where applicable the excavation work shall include the excavation in above water table and excavation below water table. The Contractor shall provide all plant, equipment, pumps, sheeting, well points as required to keep the water table 3.0 feet below the deepest foundation as shown on the drawings till the completion of foundation works.
- 4.14 4.14 Before starting the excavation for pipelines, the Contractor shall ensure the correct alignment of the pipeline on the ground the depth and width of excavation of the trench, all in accordance with the Drawings and instructions of the Engineer. The Contractor shall make profile with cement concrete pillars.
- 4.15 Excavation shall be carried out true to lines, levels, grades and widths as shown on the drawings or as directed by the Engineer ensuring proper laying of the pipe line, the bedding fill, construction of chambers for appurtenances and any other structures. The trench bottom shall be graded to provide even and substantial bearing over the specified bedding and of the structure.

Without the written permission of the Engineer, not more than 600 feet of the trench shall be opened in advance of the completed pipeline.

- 4.16 The Engineer may require the Contractor to excavate below the

.elevations shown on the drawings or he may order him to stop above the elevations shown depending upon the suitable foundation material encountered,.

- 4.17 If for any reason, the levels, grades or profiles of the excavations are changed adversely by the Contractor, the Contractor shall at his own cost, be liable to bring the excavations to the required levels and profiles as shown on the drawings or as directed by the Engineer.

5. Excavation Tolerances

Excavation shall be performed within the tolerances for excavation limits indicated on the drawings, where no tolerance limits are indicated excavation shall be performed to tolerances established by the Engineer as acceptable for the design and type of work involved.

6. Fill and Backfill

- 6.1 The backfilling shall include filling under the floors, around the foundation trenches, pipes, conduits, ducts and channels.

The backfilling shall include loading, unloading, transporting, placing, stacking, spreading of earth, watering, rolling, ramming and compacting, etc., complete as specified herein.

- 6.2 The excavated material if found suitable shall be stockpiled within the free haulage limit of the Project Boundary. This material shall be used for filling/back-filling if approved by the Engineer and shall be transported by the Contractor anywhere required for the purpose of filling/back-filling work in this Contract.

The Contractor shall provide the approved quality of backfill and fill material required to complete the fill and back-filling work from the places /borrow areas as designated by the Engineer. All necessary permissions from any authority for excavation within Borrow areas/ designated places shall be of contractor's responsibility. Deep filling shall be predominantly granular material and free from slurry mud, organic or other unsuitable matter and capable of compaction by mechanical means.

- 6.3 Material for backfilling shall be as approved by the Engineer and shall be placed in layers not exceeding 6 inches measured as compacted material with sufficient water and compacted to produce in-situ density not less than 95% of the maximum dry density at optimum moisture content.

- 6.4 Depending on the depth of fill the Engineer may instruct increased thickness of successive layers to be placed. The filling shall be compacted by mechanical means as approved by the Engineer.

- 6.5 Filling around pipes and cables shall be carefully placed with fine material to cover the pipe or cable completely before the normal fill is placed.

- 6.6 Backfilling of trenches/foundations shall be carried out only after the pipe line/structural works within the excavations have been inspected, tested and approved by the Engineer.

Fill shall not be placed against foundation walls prior to approval by the Engineer. Fill shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting

the fill shall not be operated closer to the wall than a distance equal to the height of the fill above the wall.

7. Tolerances

The stabilization of compacted backfill / fill surface shall be smooth and even and shall not vary more than 3/8 inch in 10 feet from true profile and shall not be more than 1/2 inch from true elevation.

8. Disposal of Surplus Excavated Material

- 8.1 The rejected unsuitable material and surplus excavated material shall be disposed off at designated place or as directed by the Engineer. No compensation of any lead/lift is . admissible and rates quoted shall be deemed to include the same.
- 8.2 The disposal of surplus/unsuitable excavated material shall include loading, unloading, transporting, stacking, spreading and leveling as directed by the Engineer.

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 works related to the relevant BOQ items. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

- 9.1.1 Timber shoring, planking, strutting and providing slope for upholding the sides of excavations.
- 9.1.2 Any fill with approved material necessitated by over excavation due to fault or convenience of the Contractor except under structural members.
- 9.1.3 Stockpiling the excavated material at approved location within free haulage limit of the Project Boundary and transporting back suitable material to places requiring fill or backfill.
- 9.1.4 Specified foundation bed preparation.
- 9.1.5 Excavation involved in providing adequate working space around sides of foundation and service line trenches.
- 9.1.6 Providing approved quality fill/backfill material obtained from excavated material as designated by the Engineer.
- 9.1.7 Rolling, leveling, watering & compacting the fill and backfill to required density.
- 9.1.8 All laboratory and field tests stipulated in these specifications.
- 9.1.9 Disposal of rejected surplus and unsuitable excavated material at designated place or as directed by the Engineer. No compensation of any lead/lift is admissible and rates quoted shall be deemed to include the same.
- 9.1.10 De-watering to keep the foundations dry during construction.
- 9.1.11 All cost inclusive of borrow area's royalty charges

9.1.12 Testing of Sub-grade material equal to or greater than CBR value 10%

9.1.13 Providing and testing of sweet earth.

9.2 Excavation

9.2.1 Measurement

Quantities of excavation shall be, circulated / measured from the pre-work levels of leveled and graded ground taken jointly by the Contractor and the Engineer before commencement of the work.

The quantities set out for excavation and its subsequent disposal shall be deemed to be the bulk quantity before excavating and no allowance shall be made for any subsequent variations in bulk or for any extra excavation.

Unless otherwise shown on the Drawings quantities of excavation shall be measured of acceptably completed works on the basis of vertical excavations required in accordance with lines of concrete.

Quantities of excavation for laying service line trenches shall be measured for payment on the basis of vertical excavation faces for the specified width for the trench as shown on the drawings.

Measurement for acceptably completed excavation works shall be made on the basis of number of cubic feet of material excavated for foundation and service trenches as shown on the Drawings or as directed by the Engineer.

9.2.2 Payment

Payment will be made for acceptably measured quantity of excavation on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item, including but not limiting to back filling.

9.3 Backfill/Fills

9.3.1 Measurement

Measurement for acceptably completed backfill/fill works will be made on the basis of number of cubic feet of compacted back fill / fill in position in accordance with the lines, levels and grade as shown on Drawings or as directed by the Engineer.

9.3.2 Payment

Payment will be made for acceptably measured quantity of backfill/fill on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 7 FORM WORK

1. Scope

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in any floor and roof and floor and at any height in connection with the supply and installation of formwork for the purpose of shuttering in concreting work, complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract. The works include all formwork required at any floor and at any height required for the completion of the work as per drawings/specifications.

2. General

It shall be the responsibility of the Contractor to perform the work by engaging well-trained & experienced staff or by the sub-contractor who shall have enough number of well-trained and experienced staff to coordinate his activities with the other operations. However the Contractor shall be responsible for the quality of work performed by the sub-contractor -as per the requirements of these specifications.

3. Materials

The Contractor shall use the following formwork materials for different purposes as stated below:

3.1 Timber

Form framing, sheathing and shoring.

3.2 Plywood

Form sheathing and panels.

3.3 Steel

Heavy forms and false Work Column and joint forms Permanent forms Welding of permanent forms

3.4 Form Ties Anchors and Hangers

For securing formwork against. placing loads and pressures.

3.5 Coatings

To facilitate form removal.

3.6 Steel Joists

For formwork support.

3.7 Steel frame shoring

For formwork support.

4. Delivery And Storage

4.1 Delivery

The delivery of formwork materials shall be done in such a manner that damage can be prevented.

4.2 Storage

Formwork should be stored, after cleaning and preparing for re-use if used before, in such a manner that access to all different materials is available.

Material which can be affected by weathering shall be stored in appropriate building or under covers and shade.

5. Workmanship

- 5.1 Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.

Where required details and locations of special forms to be used are set out on the drawings. The Engineer shall refuse any formwork in any part of the building, which has been constructed with a non-approved formwork. The Engineer shall refuse any concreting which will not be perfect or may not conform to the approved model.

- 5.2 Earth cuts shall not be used as forms for vertical surfaces of reinforced concrete work unless required as such or permitted by the Engineer.

- 5.3 Mud centering shall not be permitted without the prior approval of the Engineer.

- 5.4 Formwork shall be of wrought timber steel, plywood, proprietary building boards and such special materials, as may be shown on the drawings or approved by the Engineer, which give the required finish to the surface of concrete. Wooden formwork shall be free from loose knots and shall be well seasoned.

The responsibility of the safe design of the formwork shall be entirely that of the Contractor.

- a) No wooden props, bamboo, ballies etc., shall be used as supports to beams or roofs and floors. Only steel pipe scaffoldings (tubular) to be used for all works.
- b) No wooden formwork shall be allowed to be used in columns, roofs and floors and beams etc. All the form work shall be of steel as approved.
- c) Only wooden planks of approved quality and thickness of 2 inches minimum on the sides of beams shall be allowed.
- d) All the erected formwork shall be inspected and approved in all respects by the Engineer or his representative prior to concreting.
- e) Where concrete will be exposed to view, special care shall be taken in the selection of the form material and the construction of the forms, to the end that the concrete will be smooth, uniform in texture, true in line and face and free from honey-combing and other projections. All sides and joints on the forms shall be flush (without lipping) and inconspicuous, wood used for such work shall be thoroughly cleaned before each reuse and shall be free from cracks, splinters, nails, or other defects effecting the appearance of the concrete.

- 5.5 The formwork shall conform to the shape, lines and dimensions as shown on the plans and be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete, and shall be sufficiently tight to prevent loss of liquid from the concrete. The design and Engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. Where necessary, to maintain the specified tolerances, the formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. The Contractor shall establish and maintain in an undisturbed conditioned until final completion and acceptance of the project, sufficient control points and benchmarks to be used as references for checking upon tolerances.
- 5.6 Forms for architectural concrete shall be designed to produce the required finish or finishes. Deflection of facing materials between studs as well as deflection of studs and wailers shall be limited to 0.0025 times the span or as otherwise specified. Forms shall be designed to permit easy removal. Prying against the face of the concrete shall not be allowed. Only wooden wedges shall be used.
- 5.7 Where natural plywood-form-finish, grout-cleaned-finish, smooth-rubbed- finish, scrubbed-finish or sand-floated-finish is required, forms shall be smooth (faced with plywood, liner sheets, or pre-fabricated panels) and true to line, in order that the surfaces produced will require little dressing to arrive at true surfaces. -Where any as-cast finish is required, no dressing shall be permitted in the finishing operation.
- 5.8 Where as-cast surfaces, including natural plywood-form-finish are specified, the panels of material against which concrete is cast shall be orderly in arrangement, with joints between panels planned in approved relation to openings, building corners, and other architectural features.
- 5.9 Where panels for as-cast surfaces are separated by recessed or otherwise emphasized joints, the structural design of the forms shall provide for locating form ties, where possible, within the joints so that patches of tie holes will not fall within the panel areas.
- 5.10 Forms shall not be re-used if there is any evidence of surface wear and tear or defect, which would impair the quality of the surface finish. Forms shall be thoroughly cleaned and properly coated with form oil before re-use.
- 5.11 The formwork shall be designed so that the soffits of slabs and sides of beams, columns and walls may be removed first, leaving the forms to the soffits of beams and their supports in position.
- 5.12 Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Unless otherwise specified in the Contract Documents chamfer strips shall be placed in the corners of forms to produce beveled edges on permanently exposed surfaces. Interior corners on such surfaces and the edges of formed joints will not require beveling unless required by the Contract Documents.

- 5.13 Positive means such as wedges or jacks for accurate adjustment and for proper removal of shores and struts shall be provided and all settlement shall be monitored during concrete placing operation. Forms shall be securely braced against lateral deflections.
- 5.14 Where concreting of thin members is required to be carried out within formwork of considerable depth, temporary openings in the sides of the formwork shall be provided where necessary to facilitate the placing and consolidation of concrete. Small temporary openings shall also be provided at the bottom of the formwork for columns, walls and deep beams to permit the cleaning out of debris and observation immediately before concrete is deposited.
- 5.15 Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 diameter or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than 3/4 inch. When the formed face of the concrete is not to be permanently exposed to view, form ties may be cut flush with the formed surfaces. Precaution shall be taken not to rotate form ties. Through bolts may be permitted provided that they are greased to allow for easy withdrawal and the holes subsequently made good. Through bolts are not to be used on water-retaining structures and basement walls.
- 5.16 At construction joints contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by no less than 1. Inch. The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint so as to maintain a true surface.
- 5.17 Wood forms for wall opening shall be constructed to facilitate loosening, if necessary to counteract swelling of the forms.
- 5.18 Wedges used for final adjustment of the forms prior to concrete placement shall be fastened in position after the final check.
- 5.19 Formwork shall be so anchored to shores or to other supporting surfaces or members that upward or lateral movement of any part of the formwork system during concrete placement will not occur.
- 5.20 Runways or planks for moving labour and equipment shall be provided with struts or legs and shall be supported directly on the formwork or upon the structural member without resting on the reinforcing steel.
- 5.21 All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before placing fresh concrete.

Forms shall be sufficiently tight to prevent leakage of grout or cement paste. Board forms having joints opened by shrinkage of the wood shall be removed and replaced. Plywood and other wood surfaces not subject to shrinkage shall be sealed against absorption of moisture from the concrete by either:

1. A field applied, approved form oil or sealer, or
2. A factory applied non-absorptive liner .

When forms are coated to prevent bond with concrete, it shall be done prior to placing of the reinforcing steel. Excess coating material shall not be allowed to stand in puddles in the forms nor allowed to come in contact with the concrete against which fresh concrete will be placed. Care shall be taken that such approved composition is kept out of contact with the reinforcement. Whereas-cast finishes are required, materials, which will impart a stain to the concrete shall not be applied to the form surfaces. Where the finished surface is required to be painted, the material applied to form surfaces shall be compatible with the type of paint to be used.

- 5.22 For reinforced concrete, in no circumstances shall forms be struck until the concrete attains 75% of ultimate strength.

The strength referred to shall be that of concrete using the same cement and aggregates, with the same proportions, and cured under conditions of temperature and moisture similar to those obtaining in the work. Where possible, the formwork should be left for longer time as it would assist the curing.

In normal circumstances (generally where temperatures are above 20° C and where ordinary cement is used, forms may be struck after expiry of the following periods. Walls, columns and vertical sides of beams. 48 hours or as may be decided by the Engineer.

Side of slab (shores or props left under)	6 days.
Beams soffits (shores or props left under)	12 days.

Removal of shores or props to slabs.

Spanning up to 12 feet.	10 days.
Spanning over 12 feet.	16 days.

Removal of shores or props to beams.

Spanning up to 18 feet.	18 days
Spanning over 18 feet.	25 days

For rapid hardening cement 3/7 of the above period will be sufficient in all cases except vertical sides of slabs, beams and columns which should be retained for a minimum of 24 hours.

The number of shores or props, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slab and beams, as the case may be.

Proper allowance shall be made for the decrease in rate of hardening of concrete in cold weather and the above minimum duration must be increased when the mean daily temperature is below 20° C.

- 5.23 When repair of surface defects or finishing is required at an early age, forms shall be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.
- 5.24 Top forms on sloping surfaces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping surfaces shall be performed at once and be followed by the specified curing.
- 5.25 Wood forms for wall openings shall be removed as soon as this can be accomplished without damage to the concrete.

- 5.26 All formwork shall be removed without such shock or vibration as would damage the reinforced concrete. Before the top plank and struts are removed, the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened. Proper precautions shall be taken to allow for the decrease in the rate of hardening that occurs with all cement in the cold weather.
- 5.27 When re-shoring or re-propping is permitted or required, the operations shall be planned in advance and shall be subject to approval. While re-shoring is underway no live load shall be permitted on the new construction. In no case during re-shoring shall concrete in beam, slab, columns or any other structural member be subjected to combined dead and construction loads in excess of the load permitted by the Engineer for the developed concrete strength at the time of re-shoring.
- Re-shores shall be placed as soon as practicable after stripping operations are complete but in no case later than the end of working day on which stripping occurs.
- Re-shores shall be tightened to carry their required loads without overstressing the construction. Re-shores shall remain in place at least until tests representative of the concrete being supported have reached the strength specified in sub-clause 5.23 hereof.
- 5.28 Floors supporting props or shores under newly placed concrete shall have their original supporting props or shores left in place or shall be re-shored. The re-shoring system shall have a capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one half the capacity of the shoring system above. The re-shores shall be located directly under a shore position above unless other locations are permitted.
- The re-shoring or re-propping shall extend over a sufficient number of storey's to distribute the weight of newly placed concrete, forms, and construction live loads in such a manner that the design superimposed loads of the floors supporting shores or props are not exceeded.
- 5.29 It is generally desirable to give forms for reinforced concrete an upward camber to ensure that the beams or slabs (specially cantilever slabs) do not have a sag when they have taken up their deflection, but this should not be done unless permitted by the Engineer.
- 5.30 No loads, other than man and light plant required in connection with the actual work in hand, shall be allowed on suspended floors until 28 days after concreting where ordinary Portland Cement is used and 14 days when rapid hardening Portland Cement is used.
- 5.31 Prior to placing concrete, all forms shall be inspected and all debris and extraneous matter removed. The form oil or release agent shall not react with concrete to affect the strength nor shall it give any colour.

6. Measurement and Payment

No payment will be made for the works involved within the scope of this section of the specifications unless otherwise specifically stated in the Bills of Quantities or herein.

The cost thereof shall be deemed to have been included in the quoted unit rate of relevant items of the Bills of Quantities.

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SECTION – 8 REINFORCEMENT

1. Scope

The work under this section of specifications consists of furnishing, cutting, fabricating, bending and placing steel reinforcement in concrete structures or elsewhere as shown on the drawings or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

2. Applicable Standards

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

British Standard

B.S 4449 Carbon steel bars for the reinforcement of concrete.

B.S 4466 Specifications for bending dimensions and scheduling of bars for the reinforcement of concrete.

ACI Standard

ACI315 Details and detailing of concrete reinforcement.

ACI318 Building Code Requirements for Reinforced Concrete and commentary.

ASTM Standard

A 82 Cold - Drawn steel wire for concrete reinforcement.

A 305 Minimum requirement for the deformations of deformed steel bars for concrete reinforcement.

A 615 Deformed Billet Steel Bars concrete Reinforcement.

In addition to the above, the latest editions of other Pakistan Standards, British standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other standard as may be specified by the Engineer for Special Material and construction are also relevant.

3. Material

3.1 Unless otherwise specified, all steel bars for reinforcement of concrete shall be conforming to ASTM A615, Grade 60 deformed hot rolled billet steel bars with minimum yield strength of 60,000 Psi (414Mpa).

3.2 Reinforcement shall be free from all loose or flaky rust and mill scale, or coating, Including ice, and any other substance that would reduce or destroy the bond.

4. Compliance With Specifications

The Contractor shall submit certificates of compliance from the manufacturer stating that the supplied reinforcement conforms to the specifications. In addition, wherever and as directed by the Engineer, conformance of the supplied reinforcing bars with the specifications shall be demonstrated by the Contractor through laboratory tests, in accordance with the relevant standards.

5. Delivery & Storage

5.1 Delivery

Steel reinforcement bars shall be kept in bundles firmly secured and tagged. Each bar or bundle of bars shall be identified by marks as per relevant BS standards.

5.2 Storage

The method of storage shall be approved by the Engineer. Reinforcing bars shall, be stored in racks or platforms above the surface of ground and shall be protected against scaling, rusting, oiling, coatings, damage, contamination and structural defects prior to placement in works. Bars of different diameters and grades shall be so labeled and kept separately.

6. Bar Bending Schedules

The Contractor shall prepare bar bending schedules of all the reinforcing steel bars and these bar bending schedules shall be submitted to the Engineer for his approval. The Contractor shall obtain approval of the bar bending schedules before starting actual bar bending works.

The Engineer's approval, however, will not relieve the Contractor of his responsibility in this regard.

7. Fabricating, Bending & Placing

7.1 Reinforcement is to be accurately placed as shown in the drawings, and secured against displacement by using 16 gauge G.I wire ties or suitable slips at intersections and supported from the formwork by using concrete, metal or plastic chairs and spacers or hangers of an approved pattern.

Where concrete blocks are used for ensuring the cover, they shall be made of mortar not leaner than 1 part of cement to 2 parts of sand.

Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories in contact with the form work shall be galvanized or shall be made of plastic.

7.2 Bars used for concrete reinforcement shall be fabricated in accordance with the dimensions shown in the bar bending schedule approved by the Engineer.

7.3 The cutting tolerance for all bars shall be + 25 mm

7.4 Fabrication tolerances shall be as per ACI-315

7.5 Placing tolerances shall be as per ACI-318 & 317.

7.6 Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval of Engineer.

7.7 Vertical bars in columns shall be offset at least one bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all columns dowels.

7.8 Reinforcement shall not be bent or straightened in a manner that will

injure the material. No bars shall be bent twice in the same place, nor shall they be straightened after bending. Unless permitted by Engineer, reinforcement shall not be bent after being partially embedded in hardened concrete.

- 7.9 No splice of reinforcement shall be made, except as shown on the working drawings.
- 7.10 Welding of reinforcement shall not be done unless permitted and approved by the Engineer.
- 7.11 Exposed reinforcement intended for bonding with future extensions is to be effectively protected from corrosion. Protection is also to be provided to reinforcement partly built into concrete where the exposed part is to be built into later concrete.
- 7.12 No concreting is to be carried out until the reinforcement has been checked and approved by the Engineer.
- 7.13 All detailing shall be done as per ACI-315, ACI-318 and ACI-350R, as and where required.
- 7.14 Standard or actual weight whichever is lesser shall be used for calculation of weight.

8. Measurement & Payment

8.1 General

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

8.1.1 Providing and installing chairs, supports, hooks, hangars, spacers, binding wires, corrosion protection and laps not shown on Drawings including wastage and rolling margin.

8.1.2 Testing of mild and deformed steel bars.

8.2 Reinforcing Bars

8.2.1 Measurement

Measurement for acceptably completed works of reinforcement bars shall be made by weight according to bar bending schedules approved by the Consultant / Engineer.

8.2.2 Payment

Payment will be made for access table measured quantity of reinforcement on the basis of unit rate per metric ton quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 9 PLAIN AND REINFORCED CONCRETE

1. 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 the supply. and installation of plain and reinforced concrete work complete in any floor and at any height as per drawings except where specifically stated in the relevant item of Bill of Quantities, in strict accordance with this section of the specifications and the applicable drawings, and subject to the terms and conditions of the Contract. The scope of this section of specification is covered with detailed specifications as laid down herein.

2. General

- 2.1 Full co-operation shall be given to trades like electrical, mechanical and other services.
- 2.2 Suitable templates or instructions or both shall be provided for setting out items not placed in the forms. Embedded items and other materials for mechanical and electrical operations shall have been completed, inspected, tested and approved before concrete is placed.
- 2.3 For special concrete finish and for special methods of construction (e.g. slip forms), formwork shop drawings shall be designed and prepared by the Contractor, at his own cost. Approval of shop drawings as well as that of actual samples of concrete finish shall be obtained before work is commenced.

3. Applicable Standards

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

3.1 Pakistan Standards

PS 177	Compaction proctor test.
PS 232	Portland Cement (ordinary & rapid hardening). Natural aggregates for concrete.
PS 243	Abrasion of coarse aggregates by the use of Los Angeles machine
PS 279	Determination of aggregate/crushing value.
PS 280	Organic impurities in sand for concrete aggregates.
PS 281	Material finer than No. 200 B.S. test sieve in aggregates, method of test for.
PS 282	Soundness test for aggregates by the use of sodium sulphate or magnesium sulphate. Sampling aggregates for concrete.
PS 283	

PS 284	Sampling aggregates for concrete.
PS 285	Sieve or screen analysis of fine and coarse aggregates. Description and classification of mineral aggregates.
	Sampling fresh concrete.
PS 286	Sampling fresh concrete.
PS 421	Slump test for concrete.
PS 422 PS 560	Making and curing concrete compression test specimen in the field. Sulphate-resistant Portland cement type "A" and sampling fresh concrete in the laboratory.
PS 612	Mixing and sampling fresh concrete in the laboratory.
PS 716	Compacting factor test for concrete.
PS 717	Definitions and terminology of cements.
PS 746 PS 849	Making and curing concrete compression test cubes.

3.2 ASTM (American Society for Testing and Materials)

B 370 C 33 Copper sheet and strip for building construction. Concrete Aggregates.

C40	Organic impurities in sand for concrete.
C87	Effect of organic impurities in fine aggregates on of mortar. Soundness of aggregates. Ready mixed Concrete.
C88	Compressive strength of hydraulic cement mortars.
C94	Material finer than NO.200 (0.075mm) sieve. Light-weight pieces in aggregates.
C109	Concrete and concrete aggregates.
C117	Specific gravity and absorption of coarse aggregate.
C123	Specific gravity and absorption of fine aggregate.
C125	Resistance to abrasion of small size coarse aggregates.
C127	Sieve or screen analysis of fine and coarse aggregate. Clay lumps and friable particles in aggregates.
C131	Slump of Portland Cement Concrete.
C136	Aggregate for masonry mortar.
C142	Portland Cement.
C143	Water retention by concrete cunning material
C144	Sheet material for curing concrete.
C150	Air content or hydraulic cement mortar.
C156	Density of hydraulic cement.
C171	Time of setting of hydraulic cement by vicat needle.
C185	Air entraining admixtures for concrete.
C188	Potential reactivity of aggregate.
C191	Liquid membrane-forming compounds for curing concrete.
C260	Lightweight aggregates for structural concrete.
C289	Lightweight aggregates for concrete masonry.
C309	Lightweight aggregates for insulating concrete.
C330	Chemical admixtures for concrete.
C331	Resistance to abrasion of large size coarse aggregates.
C494	Unit weight of structural lightweight concrete.
C535	Aggregate sampling.
C567	Preformed expansion joint filler for concrete.

D75	Concrete joint sealer (hot poured elastic type).
D994	Preformed expansion joint filler for concrete paving and structural construction.
D1190	
D1751	Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction.
D1752	
D1850	Concrete joint sealer (cold application type).
E11	Wire cloth sleeves for testing purposes.
E96	Water vapor transmission of materials in sheet form.
E154	Materials for use as vapor barrier under concrete slabs.
E337	Relative humidity by wet and dry bulk psychomotor.

3.3 ACI (American Concrete Institute)

- 3.3.1 Recommended practice for selecting proportions for normal and heavy weight concrete.
- 214 Recommended practice for evaluation of strength test result of concrete
- 301 Specifications for structural concrete for buildings.
- 304 Recommended practice for measuring, mixing, transporting and placing concrete.
- 305 Hot weather concreting.
- 308 Recommended practice for curing concrete.
- 309 Recommended practice for consolidation of concrete.
- 318 Building code requirements for reinforced concrete.
- 347 Recommended practice for concrete for work.
- 512 Precast structural concrete in building.
- 517 Low pressure steam curing.
- 533 Fabrication, handling and erection of Precast concrete wall panels.

3.4 British Standards

BS 12	BS	Portland cement, ordinary and rapid hardening.
410		Test Sieves.
BS 812	BS 882	Methods for the sampling and testing of mineral aggregates, sands and fillers.
BS 1305		Coarse and fine aggregates from natural sources.
BS 1881		Batch Mixer.
BS 3148		Methods of testing and sampling concrete.
BS 3837		Tests for water for making concrete.
BS 5328		Expanded polystyrene boards.
BS 3869		Structural Concrete.
BS 3927		Rigid expanded polyvinyl chloride for thermal insulation.
BS 4027		Phenolic foam materials for thermal insulation and building applications. Sulphate-resisting Portland cement.
BS 8110		Structural use of concrete.
CP 114		Structural use of reinforced concrete in buildings.

CP 116	Structural use of Precast concrete.
CP 5337	The structural use of concrete for retaining aqueous liquids

In addition, the latest editions of other Pakistan and British Standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other Standards as may be specified by the Engineer for special Materials and Construction are also relevant.

4. Materials

4.1 Aggregates

- 4.1.1 The sources of supply of all fine and coarse aggregates shall be subject to the approval of the Engineer.
- 4.1.2 All fine and coarse aggregates shall be clean and free from clay, loam, silt and other deleterious matter. If required, the Engineer reserves the right to have them washed by the Contractor at no additional expense. Coarse and fine aggregates shall be delivered and stored separately at site. Aggregates shall not be stored on muddy ground or where they are likely to become dirty or contaminated.
- 4.1.3 Fine aggregate shall be hard coarse sand, crushed stone or gravel screenings shall conform to requirements of PS 243 and/or BS 882 and/or ASTM C 33. Only fine aggregate of grading zones 1 to 3 (BS 882) shall be used.
- 4.1.4 Coarse aggregate shall be gravel or crush stone of hard, durable material free laminated structure and conforming PS 243 and/or BS 882 and/or ASTM C 33 graded as follows for use in mass concrete as in foundations:

Total Pressure B.S.Sieve	Percent by weight
3 inc. (76.2mm)	100
1.5 inc. (38.10mm)	95-100
0.75 inc. (19.05mm)	30-70
0.38 inc. (9.52mm)	10-35
0.19 inc. (4.76mm)	0-5

Coarse aggregate for all cast-in-place concrete other than mass concrete as for foundations shall be graded with the following limits:

Total Passing B.S. Sieve	Percent by weight
1.5 in. (38.10 mm)	100
0.75 in. (19.05 mm)	95-100

- 4.1.5 Wherever feasible, the nominal maximum size of aggregate for cast- in- place reinforced concrete slabs and other members shall be 3/4 inch. If there are difficulties in placing such a concrete the maximum size may be restricted to 1/2 inch provided the requirements for strength are satisfied. The grading requirements of 1/2 inch or 3/8 inch down aggregate shall be agreed to with the Engineer as per relevant ASTM/BS standards.

4.1.6 The nominal maximum size of the aggregate for Precast concrete shall not be larger than one fifth of the narrowest dimension between sides of forms, or one-third of the depth of slabs or three-fourths of the minimum clear distance between reinforcing bars or between bars and forms, whichever is least. In Precast columns the nominal maximum size of the aggregate shall be limited as above but shall not be larger than two-thirds of the minimum clear distance between bars.

4.1.7 Coarse aggregates in Precast concrete of normal weight may be of one maximum size for all concrete placed in 1 day when quantities to be placed are too small to permit economical use of more than one mix design.

When a single mix design is so used. the maximum nominal size shall be as required for the most" critical condition of concreting, in accordance with the requirements of clause (4.1.6) above.

4.1.8 Except where it can be shown to the satisfaction of the Engineer that a supply of properly graded aggregate of uniform quality can be maintained over the period of the work, the grading of the aggregates shall be controlled by obtaining the 3/4" maximum nominal size, the different sizes being stocked in separate stock piles and recombined in the correct proportion for each batch at the batching plant. The materials shall be stock-piled for a period before use so as to drain nearly to constant moisture content (as long as site and other conditions permit, preferably for at least a day). The grading of the coarse and fine aggregates shall be tested at least once for every 100 tons supplied, to ensure that the grading is uniform and same as that of the samples used in the preliminary tests.

4.1.9 For use in fire proof concrete, the aggregates shall be fire clay and semi-acidic fine ground. The use of broken fire clay bricks as coarse aggregate and waste of semi-acidic refractory particles as fine aggregate can be allowed.

4.2 Cement

4.2.1 The cement shall be fresh and of approved origin and manufacture. It shall be one of the following as may be specified by the Engineer.

Ordinary or Rapid Hardening Portland cement complying with the requirements of PS 232 or BS 12 or ASTM C 150.

Sulphate Resisting Portland/Cement complying with the requirements of PS 612 or BS 4027 or ASTM C 150.

4.2.2 Unless otherwise specified, ordinary Portland Cement complying with the requirements of BS 12 shall be used.

4.2.3 For all fair faced concrete it will be necessary to use approved cement with a view to obtain light shade concrete as approved by the Engineer.

4.2.4 The Contractor shall supply to the Engineer at fortnightly intervals, test certificates with the appropriate standard in respect of the samples of cement from the work-site. These

tests shall be carried out in a laboratory approved by the Engineer.

- 4.2.5 Only one brand of each type of cement shall be used for concrete in any individual member of the structure. Cement shall be used in the sequence of receipt of shipment, unless otherwise directed.
- 4.2.6 There shall be sufficient cement at site to ensure that each section of work is completed without interruption.
- 4.2.7 Cement reclaimed from cleaning of bags or from leaky containers shall not be used.
- 4.2.8 The Contractor shall provide and erect (at his cost) a suitable plain, dry, well ventilated, weatherproof and water proof shed of sufficient capacity to store the cement.
- 4.2.9 Cement shall be used as soon as possible after delivery and cement which the
- 4.2.10 Engineer considers has become stale or unsuitable through absorption of moisture' from the atmosphere or otherwise shall be rejected and removed immediately from the site at the Contractor's expense. Any cement in containers damaged so as to allow the contents to spill or permitting access of the atmosphere prior to opening of the container at the time of concrete mixing shall be rejected and removed immediately from the site at the Contractor's expense.
- 4.2.11 The mixing together of different types of cement will not be permitted.

4.3 Water

Only clean water from the city supply, tube well installed at the site or from other sources approved by the Engineer shall be used. The Contractor shall supply sufficient water for all purposes, including mixing the concrete, curing, and cleaning plant and tools. Where doubt exists as to the suitability of the water, it shall be tested in accordance with BS 3148. Where water can be shown to contain any sugar or an excess of acid, alkali or salt, the Engineer may refuse to permit its use.

In case of doubt, the Engineer may require that concrete mixed with water proposed to be used should not have a compressive strength lower than 90 percent of the strength of concrete mixed with distilled water.

4.4 Additive

All additives such as foaming and water proofing agents shall be from a manufacturer approved by the Engineer.

Air Entraining Admixtures shall conform to APM C 260. Other Admixtures shall conform to ASTM C494.

5. Nominal Concrete Mixes

5.1 Proportions of Mix

5.1.1 Cement and aggregates:

Cement, fine aggregate and the coarse aggregate shall be weighed separately. The proportions of cement to fine aggregate and coarse aggregate shall be adjusted so as to provide the concrete of the required crushing strength when tested as set out in Table 1.

- 5.1.2 The Contractor shall regulate and arrange mixing of the ingredients for the designed mix of the concrete by weight batching. The cost of designing the mix shall be borne by the Contractor.

5.1.3 Water / Cement ratio:

The quantity of water used shall be just sufficient to produce dense concrete of adequate strength and workability for its purpose. For all external work and foundations the water/cement ratio should not exceed 0.55 for concrete Class A, B and C.

5.1.4 Workability:

The workability shall be controlled by direct measurement of the water content, allowance being made for any water in the fine and coarse aggregates. The concrete shall be just sufficiently workable to be placed and compacted, without difficulty, by the available means.

'Workability' shall be determined by either the slump or compaction factor tests as directed by the Engineer and these shall be performed in accordance with the methods given in PS 422 to PS 177 or ASTM C 143.

The slump or compaction factor for each class of concrete shall be determined during the preliminary Test mixes and the value obtained shall not be modified without the written consent of the Engineer. Unless otherwise permitted or specified, the concrete shall be proportioned and produced to have a slump of 3 inch or less for consolidation by vibration. A tolerance of up to 1 inch above- the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, which ever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

5.2 Strength requirements for concrete :-

- 5.2.1 Portland cement concrete when aggregates comply with BS 882.
- 5.2.2 Concrete made with Portland cement shall comply with the strength Table 1 columns 4&6 (Works Test).

Table 1: Strength requirements for Portland concrete with aggregates complying with BS. 882.

Class	Min Cement per of concrete	Min Cube Crushing of Strength at 28 days (psi) (lb)	Min. water per 110 lb. bag of (gallon)	Class Min Cement per of concrete
1		2	3	4
A		30.00	4350	4.40
B		22.00	3750	5.06
C		18.00	3000	5.28
D		13.00	1550	7.05
E		9.50	1000	7.27

Note: Conversion Factors. 1 psi = 0.06897 MPa 1 gal = 4.54 liter

1 lb. = 0.4537 Kg. 1 cu.ft. = 0.028 cum.

5.2.3 The strengths given in Table 1 are based on the assumption that average temperature is 20 degree C. Where accurate records of temperature are kept, allowance may be made for change of temperature or the cubes may be tested at the equivalent maturity.

5.2.4 Unless otherwise stated, the types of concrete shall be classified on the basis of compressive strength requirements. The Contractor shall provide Mix design by weight for each class of concrete.

Manufacture 12 test cubes for each 3 mix design batches (6 x 6 x 6) inches in accordance with the Mix design batching by weight and test 3 cubes each at 3,7,14 & 28 days intervals in the presence of Engineer's Representative and submit all relevant data and results of tests for approval of the Engineer.

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

No payments for producing the Mix design, manufacture of test cubes and testing shall be paid. The Contractor shall include this cost in the relevant item of concrete.

5.3 Batching

5.3.1 All cement, including cement supplied in bulk, shall be batched by weight. A bag of cement may be taken as weighing 110 lb. with the prior approval of the Engineer.

5.3.2 Aggregates shall be batched by weight, due allowance being made for water content. Aggregates may be batched by volume through conversion of weigh batching, only with the prior permission of the Engineer. The apparatus for weight batching may be an integral part of the mixer or a separate unit of a type approved by the Engineer. It shall be accurate within 2% and shall be checked for accuracy at least once a

week.

- 5.3.3 The quantity of additives i.e. foaming and water proofing agents etc. shall be as prescribed by the manufacturer or as directed by the Engineer.
- 5.3.4 Where the batching plant is of the type in which cement and aggregates are weighed in the same compartment. the cement shall be introduced into the compartment between two sizes of aggregates.
- 5.3.5 Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period, which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

5.4 Mixing

The concrete shall be mixed in an approved batch mixer conforming to the requirements of BS 1305. It shall be fitted with the manufacturer's plate stating the rates, capacity and the recommended number of revolutions per minute and shall be operated in accordance therewith. It shall be equipped with a suitable charging mechanism and an accurate water-measuring device. The mixer shall be capable of thoroughly combining the aggregates, cement and water into a uniform mass within the specified mixing time and of discharging the concrete without harmful segregation.

- 5.4.1 Mixing shall continue for the period recommended by the mixer manufacturer or until there is apparently a uniform distribution of the materials and the mass is uniform in colour, whichever period is longer. If it is desired to use a mixing period of less than 1-1/2 minutes, the Engineer's approval shall be obtained in writing.
- 5.4.2 Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three quarters of the required mixing time shall take place after the last of the mixing water has been added.
- 5.4.3 The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixing blades shall be replaced when they have lost 10 percent of their original height.
- 5.4.4 Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be re tempered, but shall be discarded.

5.5 Transporting:

- 5.5.1 The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by means, which will prevent segregation or loss of ingredients. All skip vehicles, or containers used for transporting the concrete shall be thoroughly cleaned.
- 5.5.2 During hot or cold weather, concrete shall be transported in

deep containers, on account of their lower ratios of surface area to mass, which reduces the rate of loss' of water, by evaporation during hot weather and loss of heat during cold weather.

5.6 Placing

- 5.6.1 Before placing of concrete, formwork shall have been completed; water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors and other embedded items shall have been kept in position; and the entire preparation shall have been approved by the Engineer.

No concrete is to be placed into the foundation trenches until the ground to receive the same has been examined and approved by the Engineer for this purpose.

- 5.6.2 Concrete shall be deposited continuously, or in layers of such thickness that no concrete will be deposited on concrete, which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located as shown in the Contract Documents or as approved by the Engineer. Placing shall be carried out at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained.

- 5.6.3 The actual sequence of construction proposed by the Contractor shall be subject to the Engineer's approval before construction starts on any part of the structure, and this sequence shall not be varied without the Engineer's approval.

- 5.6.4 The concrete after it has been mixed shall be placed as soon as it is practicable. Once the concrete has left the mixer, no more water shall be added, although the concrete may be mixed or agitated to help maintain workability. The concrete shall not be used if, through any cause, the workability of the mix at the time of placing is too low for it to be compacted fully and to an acceptable finish by whatever means available.

The time between mixing and placing should be reduced, if the mix is richer or the initial workability of the mix is lower than normal, or if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere.

The Contractor shall ensure that the delay between mixing and placing including consolidation does not exceed 45 minutes under any circumstances. Any concrete which does not satisfy this requirement shall be rejected.

- 5.6.5 Concrete shall be deposited as nearly as possible in its final position to avoid segregation due to re handling or flowing. In no circumstances may concrete be railed or made to flow

along the forms by the use of vibrators, Concreting shall be carried on as a continuous operation using methods, which shall prevent segregation or loss of ingredients.

- 5.6.6 The free fall of concrete shall not be allowed to exceed 6 feet. Where it is necessary for the concrete to be lowered more than this depth, it is not to be dropped into its final position, but shall be placed through pipes fed by a hopper. When a pipe is used for placing concrete the lower end shall be kept inside or close to the freshly deposited concrete. The size of the pipe shall be not less than 9 inch in diameter.
- 5.6.7 'Mass-concrete' shall be placed in layers approximately 18 inch thick. Vibrator heads shall extend into the previously placed layer.
- 5.6.8 The workmen carrying concrete to the site, and all other workmen moving about on the reinforcement before the concrete is placed, shall move only along runways or planks placed for the purpose and no person shall be allowed to walk on the reinforcement itself.
- 5.6.9 Prior to the laying of concrete on load bearing masonry walls, bearing plates and at other points, as may be directed by the Engineer, the surface will be brought to a true, hard and smooth level surface using cement sand mortar in the ratio of 1 volume of cement to 3 volumes of sand. Two layers of building paper weighing .082 lb./will then be laid flat to separate the concrete from the surface on which it is to be laid.

5.7 Construction Joints

- 5.7.1 Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be predetermined by the Engineer.
- 5.7.2 Joints not shown on the drawings shall be so made and located as to least impair the strength of the structure and shall need prior approval of the Engineer. In general, they shall be located near the middle of the spans of slabs and beams unless a secondary beam intersects a main beam at this point, in which case the joint in the main beam shall be offset a distance equal to twice the width of the secondary beam. Joints in walls and columns shall be at the underside of floors, slabs or beams and at the top of footings or floor slabs. Beams, brackets, columns capitals, haunches and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.
- 5.7.3 All reinforcing steel shall be continued across joints. Keys and inclined dowels shall be provided as directed by the Engineer. Longitudinal keys at least 1-1/2 inches deep shall be provided in all joints in walls and between walls and slabs or footings.
- 5.7.4 When the work has to be resumed; on a surface which has hardened, such surface shall be roughened in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

- 5.7.5 The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned herein shall be dampened (but not saturated) immediately prior to placing of fresh concrete.
- 5.7.6 The hardened concrete of joints in exposed work, joints in the middle of beams, and slabs; and joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout similar in proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2 inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained initial set.
- 5.7.7 Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle, and brushed, care being taken to avoid dislodgment of particles of aggregate. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 6 inch in thickness, and shall be well rammed against old work, particular attention being paid to corners and closed spots.
- 5.7.8 Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement passing through them, so that each portion can be positioned and removed separately without disturbance or shock to the reinforcement or the concrete. Stop ends made of expanded metal or similar material may only be left permanently in the concrete with prior written approval of the Engineer. Where such stop ends are used, no metal may be left permanently in the concrete closer to the surface of the concrete than the specified cover to the reinforcement.

5.8 Expansion Joints

Expansion joints shall be provided wherever indicated on the Drawings or as directed by the Engineer. In no case shall the reinforcement, corner protection angles, or other embedded items be permitted to extend continuously through any expansion joint.

All expansion joints shall be carefully placed so as not to be displaced during concreting. The method of placing the expansion joints shall be strictly in accordance with the Drawings and/or as directed by the Engineer. All materials for use in the expansion joints shall have prior approval of the Engineer before placing order for supply.

5.9 Embedded Items

- 5.9.1 The material, design and location of water stops in joints shall be as indicated in the Contract Documents. Each piece of pre molded water stop shall be of maximum practicable length in order that the number of end joints will be held to a minimum. Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective water-tightness fully equal to that of the continuous water stop material, shall permanently develop not less than 50 percent of the mechanical strength of

the parent section and shall permanently retain their flexibility.

- 5.9.2 Electric conduits and other pipes which are planned to be embedded shall not, with their fittings, displace more than four percent of the area of the cross section of a column on which Stress is calculated or which is required for fire protection. Sleeves, conduits, or other pipes passing through floors, walls, or beams shall be of such size or in such location as not to impair unduly the strength of the construction; such sleeves, conduits, or pipes might be considered as replacing structurally in compression the displaced concrete/ provided that they are not exposed to rusting or other deterioration, are of uncoated or galvanized iron or steel not thinner than standard steel pipe, have a nominal inside diameter not over 2 inch and are spaced not less than three diameters on centers. Except when plans of conduits and pipes are approved by the Engineer, embedded pipes and conduits other than those merely passing through shall not be larger in outside diameter than one third the thickness of the slab, wall, or beams in which they are embedded not so located as to impair unduly the strength of the construction. Sleeve pipes, or conduits of any material not harmful to concrete and within the limitations of this section may be embedded in concrete with the approval of the Engineer provided they are not considered to replace the displaced concrete.
- 5.9.3 All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting. All Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
- 5.9.4 Expansion joint material, water stops and other embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

2.2 Pre-Cast Concrete

Pre-cast concrete units shall be fair faced, cast to the sizes and dimensions as indicated on the Drawings. The concrete used for pre-cast units shall conform to the specifications laid down for cast in situ reinforced cement concrete unless otherwise required and directed by the Consultant.

The Contractor shall be required to submit a sample of pre-cast unit for the approval of the Engineer; all pre-cast units shall strictly conform to the approved sample.

Pre-casting platform of the size and at the location approved by the Engineer shall be constructed. The concrete in one pre-cast unit shall be placed in one operation, in accordance with the details shown on the Drawings.

The material and design of formwork and the method of pre-casting the units shall be approved by the Engineer. The erection/installation

and removal of the pre-cast units from the pre-casting platform shall not be permitted until and unless they are properly cured to the satisfaction of the Engineer.

All pre-cast units shall be smoothly finished to the required lines, grades, angles, etc. Holes, grooves, pockets and hooks shall be provided as shown and/or as directed by the Engineer. The units shall be properly stacked on a platform without causing any cracks and damages. Curing of all the pre-cast units shall be done in accordance with the relevant BS code/approval of the Engineer.

2.2.1 Erecting Pre-cast Units

All the pre-cast units shall be transported and erected into position in a manner as approved by the Engineer.

The Contractor shall submit his proposal in this regard and obtain approval from the Engineer in advance.

2.2.2 Lifting Beams

The Contractor shall use lifting beams at his own cost for erecting pre-cast members where the Engineer so directs. Lifting beams shall be supplied and erected by the Contractor, at his own cost, at all points where lifting is necessary for maintaining the plant but is inaccessible to mobile/cranes or, alternatively, covered by overhead traveling cranes. The Contractor, however, is to supply the trolleys and erect them on the lifting beams, and to test operation of installed equipment.

3. Cement Concrete Pavements

For all concrete work relevant specifications of this section shall apply.

3.1 Side Forms and Construction

Side forms shall be of steel or any other suitable material and of a design as approved by the Engineer.

In general, only materials and methods that have proved their acceptability by past performance will be considered. All form shall be constructed so that they can be removed without hammering or prying against the concrete.

Horizontal joints in the forms will not be permitted. Forms shall be thoroughly cleaned and oiled with linseed/mineral oil shall be given two coats of niter-cellulose lacquer each time they are used.

The forms shall be set on a thoroughly compacted base true to line and level and firmly secured in position by appropriate methods. Conformity with the alignment and levels shown on the Drawings shall be checked as and when required by the Engineer. Where necessary corrections shall be made immediately before placing the concrete; where any form has been disturbed it shall be reset and rechecked.

Pavements shall be constructed in panels of sizes as shown on the Drawings. The panels shall be laid alternately, the adjoining panels being concreted when the side forms are struck and the jointing materials placed, inspected and approved by the Engineer. Each panel is to be concreted in one operation and no interruptions shall be permitted during the operation. The concrete shall be tipped from the

trolley slightly in advance of the working place and then shoveled into position. The spreading shall be carried out very carefully. Compaction shall be done by means of vibrators compactors of approved surface vibrators. If a vibrators compactor is used, it shall be operated on the concrete and will not be allowed to strike or displace the forms. The spreading and compacting of the successive layers shall proceed without interruptions and as quickly as practicable so as to ensure that the slab is ' monolithic throughout its depth.

The wearing surface shall be laid while the base concrete is still wet and screeded to line and level. When the initial set takes place the surface shall be troweled smooth with a steel trowel to provide a dense closed surface.

All the joints shall be carefully formed as shown on the Drawings or as directed by the Engineer. The joint filler together with performed groove shall provide complete separation of adjacent slabs. The joints shall all be sealed with bitumen as shown on the Drawings and as directed by the Engineer.

3.2 Protection and Curing

General Requirements:

Concrete shall be protected adequately from injurious action by sun, rain, flowing water and mechanical injury, and shall not be allowed to dry form the time it is placed until the expiry of the minimum curing periods specified hereinafter. Water curing shall be accomplished by keeping the surface of the concrete continuously wet by covering with water or with approved water saturated covering. Where wood forms are left in place for curing, they shall be kept sufficiently damp at all times to prevent openings at the joints and drying out of the concrete. All portions of the structure shall be kept moist for the full curing periods, specified hereinafter.

When liquid membrane curing compound is used the surface of the concrete shall be protected from traffic or other abrasive action, that may break the membrane, for the full period of curing. The membrane curing compound shall be colorless or light colored and shall be approved by the Engineer and shall comply with ASTM Designation C 309.

Curing Periods:

The curing period shall be at least 10 days, or as directed by the Engineer.

Removal of Forms:

The Contractor shall exercise great care in avoiding damage to joints, arises, dowel bars etc., while removing the forms. Under no circumstances will the use of pry bars between the forms and pavement be permitted. Side forms shall not be removed until at least 40 hours have elapsed from the time of completing the concreting of the slab, which they contain. In no case shall forms be removed until the concrete has hardened sufficiently to permit removal without damage to the concrete. Concrete work shall be protected from injury resulting from the storage or movement of material during construction.

3.3 Finishing

All unformed surfaces shall be finished with a wood float except as otherwise specified. Visible vertical surfaces shall have all projections and irregularities removed. The entire surface shall be rubbed if required by the Engineer, with a No. 16 carborundum brick, or other abrasive until even, smooth and of uniform appearance, and shall be shed clean. Plastering of surface, application of cement or other coating will not be permitted.

All exposed corners shall be chamfered, 1"x 1" (2.5 cms x 2.5 cms) unless otherwise mentioned or shown on the plans or directed by the Engineer. Concrete surfaces which will be covered with other materials shall be screeded without floating.

3.4 Spreading, finishing and floating of concrete in pavements General Requirements

The striking of, compacting and floating of concrete shall be done by mechanical methods, if approved by the Engineer. Where the Engineer determines that it is impracticable to use mechanical methods, manual methods of spreading, finishing and floating may be used on pavement lines as indicated on the Drawings.

Mechanical Methods

The concrete shall be spread uniformly between the forms, immediately after it is placed, by means of an approved spreading machine. The spreader shall be followed by an approved finishing machine equipped with two oscillating or reciprocating screeds. The spreading machine or the finishing machine shall be equipped with vibrating equipment that will vibrate the concrete for the full paving width. internal vibrators shall be used adjacent to the longitudinal edge of the pavement. These vibrators shall be attached to the rear of the spreading machine or to the finishing machine. Vibrators shall not rest on new pavements or side forms or in contact with any dowel bars and the arrangement of power supply to the vibrators shall be such that when the motion of machine is stopped, vibration shall cease. The rate of Vibration shall be not less than 8000 vibrations per minute. The concrete shall be spread to full width before being struck off and compacted so that the surface will conform to the finished grade and cross-section as shown on the plans and at the same time leave sufficient material for the floating operation. The spreading & finishing machine shall move over the pavement as many times and at such intervals as may be required by the Engineer to ensure thorough compaction.

Except as otherwise specified, after the pavement has been struck off and compacted, it shall be finished with an approved longitudinal float. The Contractor may use a longitudinal float composed of one or more cutting and smoothing floats suspended from and guided by rigid frame. The frame shall be carried by four or more visible wheels riding on and constantly in contact with the forms.

The contractor may use a longitudinal float which works with a sawing motion, while held in a floating position parallel to the road centre line and passing gradually from one side of the pavement to the other.

Movements ahead, along the centre line of the road, shall be in successive advances of not more than half the length of the float.

Instead of using other type of longitudinal float a single machine, which will affect satisfactory compaction, finishing and floating may be used. This machine may be towed by a spreading machine. This combination, finishing floating machine shall be equipped with screeds and vibrators as hereinafter specified for spreading and finishing machine. Floating shall be accomplished by means of a non-oscillating float held in a suspended position from the frame.

If any spreading, finishing and floating equipment is not maintained in full working order or if the equipment as used by the Contractor proves inadequate to obtain the results prescribed, such equipment shall be improved or satisfactory equipment substituted or added at the direction of the Engineer.

Manual Methods

When striking-off and compacting by manual methods is permitted, the concrete shall be leveled and then struck-off to such an elevation that, when properly compacted, the surface will conform to the required grade and cross-section. The strike board shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither ends is raised from the side forms during the process. While striking off, a slight excess of concrete shall be kept in front of the cutting edge at all times. Prior to tamping, the concrete along the forms shall be thoroughly spaded or vibrated. The entire area of pavement shall be tamped or vibrated a manner that will ensure maximum compaction. The concrete shall be brought to the required grade and shape by the use of a tamper consisting of a heavy plank whose length exceeds the width of the pavement by 1 foot or by the use of a mechanical vibrating unit spanning the full width of the spread. The tamper shall be constructed with properly trussed roads to stiffen it and prevent sag and shall be shod with a heavy strip or metal for a tamping surface. The tamper shall be moved with a combined tamping and longitudinal motion, raising it from side form and dropping it so that the concrete will be thoroughly compacted and rammed into place. A small surplus material is compacted and rammed into front of the tamper or vibrating unit and tamping or vibrating shall continue until the true cross-section is obtained and the mortar flushes slightly to the surface.

On grades in excess of 5 percent where hand methods are permitted, a little strike board shall follow at a speed of 25 ft to 50 ft per hour back of the heavy strike board, and shall be used in the same way, so as to remove waves caused by flow of concrete.

Where hand tamping is permitted, not less than two strike boards or tampers shall be used for production in excess of 350 CU.ft. After the concrete has been compacted, it shall be smoothed with a wooden float where necessary, as directed by the Engineer.

Longitudinal Floating

Manual floats shall be at least 12 ft. in length not less than 6 inches in width and shall be properly stiffened to prevent bending or warping. In

using the float, it shall be held parallel to centre line of the pavement at all time and shall be moved laterally across the pavement from one side or edge to the other until all high areas are cut down and floated into depressions, leaving a surface that is smooth and true to grade. Batch transverse passage of the longitudinal manual float shall lap the proceeding passage by half.

First Straight Edge Testing

Immediately following final floating the entire area of the pavement shall be tested with a 10-ft. (approx. 3. meters) straight edge. Any depressions found shall be immediately fillet." with fresh concrete which shall be struck off compacted and finished. High areas shall be worked down and refinished. The straight edge testing and refloating shall continue until the pavement has the required surface contour.

After the first straight edge testing and when most of the water sheet has disappeared from the surface. and just before the concrete becomes non-plastic, the surface shall t.': dragged with a strip of burlap (coarse canvas) 3 ft. to 10 ft. wide and having a length 4 ft. more than the width of the slab. The burlap shall be dragged along the surface of the pavement in a longitudinal direction. Burlap shall be clean and kept free from coatings of hardened concrete. It shall be moist at the time of use.

Second Straight Edge Testing:

After the concrete has hardened sufficiently to permit walking on it, the surface of the pavement shall again be tested with a 1 a-ft. straight edge. 'Any portion of the pavement which shows a variation from the testing edge of more than 1/8 inch shall be corrected by cutting, or shall be removed and replaced at the expense of the Contractor.

3.5 Expansion and Construction Joints

- i) All the expansion and contraction joints shall be carefully formed as shown on the Drawings or as directed by the Engineer. As regards dowel bars and joint assemblies, such stakes, brackets or other devices shall be used, as necessary to keep the entire joint assembly in true vertical and horizontal position. The joint filler together with the preformed groove shall provide complete separation of adjacent slabs. The joints shall all be sealed with the specified non-extruding sealing compound set in a 3/4 inch wide preformed chase as shown on the Drawings. The preformed chase shall be thoroughly cleaned of all dust, debris, stones or other hard material prior to its sealing. The riser of all joints shall be rounded to a radius as shown on the Drawings before the concrete hardens.
- ii) The joints sealing compound shall be hot poured bitumen or approved sealing compound for concrete pavements complying with BS-2499 for hot tropical climates and heavy duty industrial site subject to severe exposure. All joints)o be filled with flex cell expansion joint filler, or an approved elastic, compressible, durable and rot-proof equivalent of sufficient rigidity to enable it to be satisfactorily installed in the joint and resist deformation during the passage of the concreting equipment. The filler is to be of the same thickness as the joint Width. Holes to

accommodate the dowel bars shall accurately be drilled or punched out. Where shown on the Drawings, dowel bars of required diameter shall be placed at the specified spacing. The bars shall be lubricated with an approved lubricant. One end of the dowel bar at expansion joints shall be provided with a closely fitting sleeve 3 inch long, consisting of bitumen coated plastic or other approved material to permit expansion. A loose plug 1 inch deep of approved compressible filling material shall be inserted into the sleeve as shown on the Drawings at the end of the bar. All the dowel bars shall be mild steel bars of the size shown on the Drawings and shall conform to the requirements as specified in the section 'Concrete.

- iii) Contraction joints shall be provided as shown on the Drawings. The assembly and method of constructing the expansion joints/contraction joints shall be subject to the approval of the Engineer.

3.6 Consolidation

3.6.1 All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Internal vibrators shall have a minimum frequency of 8000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. They shall be operated by competent workmen. Use of vibrators to transport within forms shall not be allowed. vibrators shall be inserted and withdrawn at points approximately 18 inch apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not excessive so as to cause segregation, generally from 5 to 15 sec. A spare Vibrator shall be kept on the job site during all concrete placing operations.

Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented, if necessary, by spading to work the coarse aggregate back from the formed surface.

3.6.2 If there is any tendency for the mix to segregate during consolidation, particularly if this produces excessive laitance, the mix proportions shall be modified to effect an improvement in the quality of the concrete to the satisfaction of the Engineer and in conformity with the provisions of Clause 5.

3.6.3 Vibrator shall not be allowed to contact the formwork for exposed concrete surfaces.

3.6.4 Mechanical vibrators shall be of a type suited in the opinion of the Engineer to the particular conditions.

3.6.5 Over-vibration or vibration of very wet mixes is harmful and should be avoided.

3.7 Curing and Protection

3.7.1 Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold

temperatures and mechanical injury and shall be maintained with minimum moisture loss at a relative constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval of the Engineer.

- 3.7.2 For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing: Ponding or continuous sprinkling. Application of absorptive mats fabric kept continuously wet. Application of waterproof sheet materials approved by the Engineer. Application of other moisture-retaining covering as approved. Application of a curing compound conforming to ASTM C 309. The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any water sheen, which may develop after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other material is to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications.
- 3.7.3 Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal the concrete shall be cured until the end of the time prescribed for curing.
- 3.7.4 Curing in accordance with sub-clause 5.13.1 & 5.13.2 above shall be continued for at least 10 days in the case of all concrete except concrete with rapid-hardening Portland Cement for which the period shall be at least 3 days. Alternatively, if tests are made of cubes kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the minimum specified works cube strength. If one of the first four curing procedures of sub-clause 5.13.2 is used initially, it may be replaced by one of the other procedures of that sub-clause any time after the concrete is one day old provided the concrete is not permitted to become surface dry during the transition.
- 3.7.5 When the mean daily outdoor temperature is less than 5 degree C (41 deg. F) temperature of the concrete shall be maintained between 10 and 20 degrees C (50 to 68 deg. F) for the required curing period of sub-clause 5.13.4.

When necessary, arrangements for heating, covering insulation or housing t/ie. Concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury due to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless precautions' are taken to prevent exposure of the concrete to exhaust gasses, which contain carbon dioxide.

- 3.7.6 During hot weather when necessary, provision for wind-brakes, shading for spraying, sprinkling, ponding or wet covering with a light coloured material shall be made in advance of placement. Such protective measures shall be taken as quickly as concrete hardening and finishing operation will allow.
- 3.7.7 Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 3 deg. C (37 deg. F) in anyone hour or 10 degree C (50 deg. F) in any 24 hour period.
- 3.7.8 During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock and excessive vibrations. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to over stress the concrete.

3.8 Works in Extreme Weather

- 3.8.1 Unless adequate protection is provided and approval is obtained from the Engineer, concrete shall not be placed during rain. Rainwater shall not be allowed to increase / ease the mixing water nor to damage the surface finish.
- 3.8.2 When the temperature of the surrounding air is expected to be below 5 deg. C during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed, shall be no lower than 13 deg. C for sections less than 12 inch in any dimension nor 10 deg. C for any other sections.

When necessary, concrete material should be heated before mixing and carefully protected after placing, in general, heating or mixing water alone to about 60 deg. C may be sufficient for this purpose. Dependence should not be placed on salt or other chemicals for the prevention of freezing. No frozen material or materials, containing ice shall be used. All concrete damaged by frost shall be removed. It is recommended that concrete exposed to the action of freezing weather should have entrained air and the water content of the mix should not exceed 5.5 gallon/bag of cement.

If water or aggregate is heated above 38 deg. C the water shall be combined with the aggregate in the mixer before cement is added.

Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 38 deg. C.

- 3.8.3 During hot weather, the temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 32 deg. C. For massive concrete, this temp. should not exceed 21

degree C. When the temp. of the concrete exceeds 32 degree C, precautionary measures approved by the Engineer shall be put into effect. When the temperature of the steel is greater than 50 deg. C, steel forms and reinforcement shall be sprayed with water just prior to placing the concrete. The ingredients shall be cooled before mixing, or flaked ice or well crushed ice of a size that will melt completely during mixing may be substituted for all part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered. Other precautions recommended by ACI Standard 305-72 shall also be adopted.

4. EST of Concrete Quality

- 4.1 The Contractor shall provide samples of concrete for testing at the Engineer's direction. Proper facilities shall be provided for making and curing the test specimens in accordance with PS 560 and PS 849. A competent person shall be employed by the Contractor whose first duty shall be to supervise all stages in the preparation and placing of the concrete. All Test specimens shall be made and site tests carried out under his direct supervision.
- 4.2 Preliminary cube tests and works cube test shall be performed in accordance with PS 560 and PS 849 at the discretion of the Engineer. Works transverse tests shall be performed in accordance with sub-clauses 208 c and 610 d of CP 114. The standard of acceptance for preliminary and works tests shall be as given below.
- 4.3 The usual test for concrete with maximum size of aggregate up to 1-1/2 inch is the 6 inch cube tested in compression. Details of making and curing compression test cubes are given in PS 560, PS 849 and BS 1881 and details of the testing are given in Part 8 of BS 1881.

For all grades of concrete, preliminary cube strength test with the mixes and materials to be used shall be performed in accordance with PS 560, PS 849 and BS 1881 before the work is begun and subsequently whenever any change is to be made in the materials or in the proportions of materials to be used, or as required by the Engineer. The strengths shall comply with the standard of quality specified in accordance with Table 1 for preliminary tests. The cost of such testing shall be borne by the Contractor.

- 4.4 Test sample shall be taken at the mixer or as directed by the Engineer. The test specimens shall be cured in accordance with PS 560, PS 849 and BS 1881. Records shall be kept of all test cubes identifying the mix used the section of work for which the concrete was used and the date poured. !
- 4.5 Five test cubes are to be tested for compressive strength as specified in BS 1881. These tests shall be carried out at site or in a laboratory approved by the Engineer. Two cubes shall be tested at the age of seven days and three at 28 days and the strengths determined are to comply with the standard of quality specified. The laboratory tests shall be carried out by an independent organization, such as Government Testing Laboratory or such other undertakings approved by the Engineer. The original test reports

received from the above authorities should be submitted to the Engineer.

- 4.6 For all grades of concrete, the appropriate strength requirement shall be considered to be satisfied if none of the strengths of the cubes is below the specified cube strength or if the average strength of the three cubes is not less than the specified cube strength and the difference between the greatest and the least strength is not more than 20% of the average.
- 4.7 When the results of works cube tests show that the strength of any concrete is below the minimum specified, the Engineer may give instructions for the whole or part of the work concerned to be removed and replaced at the expense of the Contractor. The Contractor shall bear the cost of any other part of his, or any other contractor's work, which has to be removed and replaced as a result of the defective concrete. If any concrete is held to have failed, the Engineer may order the proportions of that class of concrete to be changed in order to provide the specified strength.

5. Finishing of Formed Surfaces

5.1 General

- 5.1.1 After removal of forms, the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the Contract Documents.
- 5.1.2 When finishing is required to match a small sample furnished to the Contractor, the sample finish shall be reproduced on an area at least 100 Sq. ft. in an inconspicuous location designated by the Engineer before proceeding with the finish in the specified location.
- 5.1.3 Allowable deviations from plumb or level and from the alignment profile grades, and dimensions are specified in clause 9. Tolerances for concrete construction and defined as tolerances that are to be distinguished from irregularities in finish as described herein. The finish requirements for concrete surfaces shall be as generally specified in this clause and as indicated on the Drawings. Finishing of concrete surfaces shall be performed or, by workmen who are skilled in concrete finishes. The Contractor shall keep the Engineer advised as to when finishing of concrete will be performed. Unless inspection is waived in each -specific case, finishing of concrete shall be performed only in the presence of the Engineer. Concrete surfaces will be tested by the Engineer where necessary to determine whether surface irregularities are within the limits herein after specified. Surface irregularities are classified as abrupt or gradual.

Offsets caused by displaced or misplaced form sheeting or lining or sections, or otherwise defective form lumber will be considered as abrupt irregularities, and will be tested by direct measurements. All other irregularities will be considered as gradual irregularities, and will be tested by use of a template, consisting of a straight edge or the equivalent thereof for curved surfaces. The length of the template will be 6.5 ft. for testing of formed surfaces and 10ft. for testing of unformed

surfaces.

5.2 As-cast Finishes

Unless otherwise specified or indicated on the Drawings the classes of finish shall apply as follows:

5.2.1 Rough form finish:

No selected form facing materials shall be specified for rough form finish surfaces. Tie holes and defects shall be patched. Fins exceeding 1/4" in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

5.2.2 Fair face finish:

Fair face finish applies to concrete formed surfaces, the appearance of which is considered by the Engineer to be of special importance, such as surfaces of structures prominently exposed to public inspection. Surfaces of concrete structures requiring fair face finish is shown in the Drawings. Surface irregularities, measured as described in sub-clause 7.2.1, 'Rough form finish', shall not exceed 1/4 inch for gradual irregularities and 1/8 inch for abrupt irregularities, except that abrupt irregularities will not be permitted at construction joints. Abrupt irregularities at construction joints and elsewhere in excess of 1/8 inch and gradual irregularities in excess of 1/4 inch shall be reduced by grinding so as to conform to the specified limits. Abrupt irregularities at construction joints shall be ground on level of 1 to 20 ratio of height to length.

Unless otherwise approved, repair of imperfections in formed concrete shall be completed within 24 hours after removal of forms. The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, tempered concrete-form-grade hardboard, metal, plastic paper, or other approved material capable of producing the desired fair face 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 surfaces, worn edge, 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.

5.2.3 Architectural Finish Concrete:

Architectural finish concreting formed surfaces as shown on the Drawings is required by the Engineer where the architectural appearance of surfaces of structures exposed to public view is of special consideration and importance. The Contractor shall use approved special material for formwork and design the forms in conformity with the specified architectural patterns, textures and finishes in order to obtain first class architectural finish on formed concrete surface without any defect, irregularities, blemishes, imperfections and encrustations.

Samples:

Submit to the Engineer a minimum of two units or portions of units of each precast item required. Each pair of samples when accepted will describe the allowable limits between which variations can be acceptable.

Similar samples of in-situ concrete for approval by the Engineer submit two samples, 2 Sq. ft. of each type of exposed in-situ concrete. All in-situ samples will remain at the construction site.

Sample approvals of precast & in-situ concrete:

These samples will be reviewed and approved on the basis of colour, dimensional accuracy, and finish of surfaces and general appearance. The same requirements for sample approval will be required for both precast and in-situ concrete exposed surfaces.

Forms:

The contractor must maintain the forms unusually tight and braces to prevent movement, mal-alignment and bleeding that will result in sand streaks, honeycomb, fins, stain or unsightly appearance. / .

If wood forms are chosen to be used by the Contractor they shall be constructed of 3/4 inch minimum thickness plywood constructed in a fashion to allow many re-uses with all surfaces sealed with a polyurethane varnish.

Edges, surfaces and corners of forms shall be sealed to prevent loss of any matrix or unequal absorption of water. Corners of wood forms shall be filled with suitable compound and all contact surfaces sealed with a polyurethane varnish.

Re-use of forms shall be subject to approval by the Engineer.

Curing:

Curing shall be done in shade (out of direct sunlight) and shall be for a minimum period of 4 days.

Finishing Procedures:

"Finishing procedures for filling air void smooth finished concrete developed by a formed surface":

While the concrete surface is still damp (not more than three days after removal of forms), apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within any pits or blemishes in the parent concrete; avoid coating large areas of the finished surface. Before slurry has dried or changed colour, apply a dry (almost crumbly) grout comprised of one part cement, of the type and brand of cement used in the original concrete, to one and one-half parts clean masonry sand with f3 fineness modulus of approximately 2.25 and complying with the graduation requirements of the ASTM Specifications C 144. Mix proper amounts of white cement and colouring with the parent mortar to produce a satisfactory colour match with the

parent concrete after hardening. Use samples previously prepared.

Apply the finishing grout uniformly with damp (neither dripping wet nor dry) pads of coarse burlap approximately 6 inch square used as a float. Scrub the grout well into the pits to provide a dense mortar in all the imperfections to be filled. Allow the mortar to partially harden, from one to two hours, depending upon the weather. Avoid direct hot sunlight. If the air is hot and dry, keep the concrete surface damp during this period using a fine fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout from the small pits or holes, cut off all that can be removed with a trowel without delay; next allow the surface to dry thoroughly and rub it vigorously with clean, dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. Complete the entire cleaning and grouting operation for the grout to dry after it has been cut with the trowel, so it can be wiped off clean with the burlap.

On the day after the repair work, the concrete surfaces should again be wiped off clean with dry burlap to remove any inadvertent dust; leave no built-up surfaces on the parent surfaces. Employ, if possible, a used piece of burlap containing old hardened mortar to act as a mild abrasive. Use of fine abrasive stone if needed to remove any remaining built-up film without breaking through the surface film of the original concrete. Such scrubbing should be light and sufficient only to remove excess material without working up a lather of mortar or changing the texture of concrete.

Following the final finishing or stoning operation, provide a thorough wash down with stiff bristle brushes to remove all extraneous materials and spray the concrete surface with a fine fog spray periodically to maintain a continually damp condition for at least three days after application of the repair grout.

Rust Stains:

All rust stains are to be removed employing the following procedure:

The rust stain shall be soaked for 10 minutes with a solution of 0.055 lb. of sodium citrate in 0.33 lb. water (brushing the solution at short intervals is satisfactory). Then the surface is sprinkled with crystals of sodium hydrosulfite and covered with a paste of Fuller's Earth and water. On a vertical surface, the paste is applied with a trowel, with the crystals first sprinkled on the paste so they will be in direct contact with the stain. The paste is allowed to dry for 10 minutes then scraped off and the treatment repeated if necessary.

Repairing of Formed Surfaces:

It is the intention of Specification to require form mixture of concrete and workmanship so that concrete surfaces, when exposed, will require no patching. Any concrete which is not

formed as required and conforming to approved samples or for any reason is out of alignment or level or shows a defective surface, shall be removed from the job by the Contractor at his expense unless the Engineer grants permission to repair the defective area. Permission to patch any such area shall not be considered a waiver of the Engineer's right to require a complete removal of defective work if the repair does not, in his opinion, satisfactorily restore the quality and appearance of the surface. The Engineer shall be the sole judge of acceptability of appearance.

5.3 Finishes of Unformed Surfaces:

5.3.1 Monolithic Concrete Floor Finish

Where monolithic concrete floor finish is shown on the Drawings, placing shall proceed continuously for the full thickness of the course or RCC slab without change in concrete mix. Mixing water shall be the minimum required for proper placing, and will be as specified by the Engineer. After placing, floors, and other surfaces shall be floated with a wood float to a true surface and to elevation as shown on the Drawings. Where indicated on the Drawings, floor surfaces shall be steel trowel finished. Troweling shall be the minimum amount consistent with maintaining a smooth dense surface, and shall not be done until the mortar has hardened sufficiently, to prevent excess fine material from being worked to the surface, and shall produce a dense uniform surface, free from blemishes and trowel marks.

Gradual surface irregularities shall not exceed 1/16 inch. The addition of water, dry cement, or dry cement mortar, to the surface of the concrete to facilitate finishing will not be permitted.

5.3.2 Equipment Foundations'

Unless otherwise specified, exposed, surfaces of equipment foundations shall be given steel trowel finish to produce a surface similar to the specified concrete floor finish.

6 Repair of Surface Defects

6.1 General

6.1.1 Any concrete failing to meet the specified strength or not formed as shown on drawings, concrete out of alignment, concrete with surfaces beyond required tolerances or with defective surfaces which cannot be properly repaired or patched in the opinion of the Engineer shall be removed at Contractor's cost. The Engineer may reject any defective concrete and order it to be cut out in part or in whole and replaced at the Contractor's expense. All ties and both less and all repairable defective areas shall be patched immediately after form removal.

6.2 Repair of Defective Areas

6.2.1 All honeycombed and other defective concrete shall be removed down to sound concrete. The area to be patched and an area at least 6 inch wide surrounding it shall be dampened

to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand passing NO.25 BS Sieve and shall then be well brushed into the surface.

- 6.2.2 The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2-1/2 parts sand by damp loose volume. White Portland cement shall be substituted for a part of the gray Portland cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by a trial patch.
- 6.2.3 The quantity handling of mixing water shall be no more than necessary for allowed and placing. The patching mortar shall be mixed in advance and of to stand with frequent manipulation with a trowel, without addition placing water, until it has reached the stiffest consistency that will permit
- 6.2.4 After surface water has evaporated from the area to be patched, the bon coat shall be well brushed into the surface. When the bond coat begins to loose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least 1 hour before being finally finished. The patched area shall be kept damp for 7 days. Metal tools shall not be used in finishing a patch in a formed wall, which will be exposed.
- 6.2.5 Where as-cast finishes are specified, the quantity of patched area shall be strictly limited. The combined total of patched areas in as cast surfaces shall not exceed 2 sq.ft. in each 1000 sq.ft. of as-cast suri'3ce. This is in addition to form tie patches, if the project design permits ties to fall within as-cast areas.
- 6.2.6 Any patches in as-cast architectural concrete shall be indistinguishable from surrounding surfaces. The mix formula for patching mortar shall be determined by trial to obtain a good colour match with the concrete when both patch and concrete are cured and dry. After initial set, surfaces of patches shall be dressed manually to obtain the same texture as surrounding surfaces.
- 6.2.7 Patches in architectural concrete surfaces shall be cured for 7 days. Patches shall be protected from premature drying to the same extent as the body of the concrete.

6.3 Tie and Bolt Holes

After being cleaned and thoroughly dampened, the tie and bolt holes shall be filled solid with patching mortar. If architectural appearance requires, these holes may be filled partially creating the desired round clear holes pattern on surfaces exposed to view.

6.4 Proprietary Materials

If permitted or required by the Engineer, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations with prior approval of the Engineer.

Where tolerances are not stated in the specifications or drawings for any individual structure or feature thereof, maximum permissible deviations from established lines, grades and dimensions shall conform to the following. The Contractor is expected to set and maintain concrete forms so as to ensure complete work within tolerance limits. These allowable tolerances shall not relieve the Contractor of this responsibility for correct fitting of indicated materials. These tolerances are not cumulative.

6.5 Variation from the plumb (or the specified batter for inclined walls.)

6.5.1 In the lines and surfaces of columns, piers, walls and in arises: In any 10 feet of length or height In any storey or 20 feet length Maximum for the entire length or height. In any bay or 20 feet maximum 1/4 inch Maximum for the entire length or height 1/2 inch

6.5.2 Variation from the level or from the grades indicated on the drawings.

6.5.3 In floors, ceilings, beams soffits and in arises measured before removal of supporting shores.

In any 10 feet of length 1/4 inch

In any bay or in any 20 feet length 3/8 inch

Maximum for the entire length 3/4 inch

6.5.4 For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.

In any bay or 20 feet length 1/4 inch

Maximum for the entire length 1/2 inch

6.6 Variation of the linear building lines from established position in plan and related position of columns, walls and partitions.

In any bay or 20 feet of length Maximum for the entire length 1/2 inch
1 inch

6.7 Variation in the sizes and locations of sleeves, floor openings and wall openings. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs And walls.

Minus 1/4 inch

Plus 1/2 inch 9.6 Footing

6.7.1 Variation in dimensions in plan Minus 1/2 inch

Plus (plus variation applied to concrete only, not to reinforcing bars or dowels). 2 inch

6.7.2 Misplacement or eccentricity

2 percent of the footing width in the direction of misplacement but not more than (applies to concrete only, not to reinforcing bars or dowels). ½ inch 2 inch

- 6.7.3 Thickness Decrease in thickness 5%
- 6.7.4 Increase in Specified thickness No limit

6.8 Variation in Steps

- 6.8.1 In a flight of stairs
 - Rise +1 / 8 inch-
 - Tread +1 / 4 inch-
- 6.8.2 In consecutive steps
 - Rise +1 / 16 inch-
 - Tread +1 / 8.inch-

6.9 'Tolerances for Precast concrete construction'

Forms must be true to size and dimensions of concrete members shown on the plans and be so constructed that the dimensions of the finished products will be within the following limits at the time of placement of these units in the structure, unless otherwise noted' on structural-architectural drawings:

- 6.9.1 Overall dimensions of members 1/16 inch per 10 feet
- 6.9.2 Cross-sectional dimensions
 - Sections less than 3 inch. 1/16 inch
 - Sections over 3 inch and less than 18 inch. 1/8 inch 1/4 inch
 - Sections over 18 inch. 1/8 inch
- 6.9.3 Deviations from straight line in long sections. 1/16 inch
 - per 10 feet
 - Not more than +1/16 inch
 - per 10 feet span
 - Maximum differential between adjacent units in erected position 1/4 inch

7 Acceptance of Structure

7.1 General

- 7.1.1 Completed concrete work which meets all applicable requirements will be accepted subject to the other terms of the Contract Documents.
- 7.1.2 Completed concrete work which fails to meet one or more of the requirements and which has been repaired to bring it into compliance will be accepted subject to the other terms of the Contract Documents.
- 7.1.3 Completed concrete work which fails to meet one or more of the requirements and which cannot be brought into

compliance may be accepted or rejected as provided in these Specifications or in the Contract Documents. In this event, modifications may be required to assure that remaining work complies with the requirements.

7.2 Dimensional Tolerances

- 7.2.1 Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of clause 9 shall be considered potentially deficient in strength and subject to the provisions of sub clause
- 7.2.2 Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of clause 9 may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance. Permission is required if excess material is to be removed in accordance with this clause. 10.2.3 Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected or if misplaced items interfere with other construction.
- 7.2.3 Inaccurately formed concrete surfaces exceeding the limits of Clause 9 or of Clause 5.6 of Section 'Formwork' and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.

7.3 Appearance

- 7.3.1 Architectural concrete with surface defects exceeding the limitations of Sub-clause 5.6 of Clause 5 of the Section, 'Formwork' shall be removed and replaced.
- 7.3.2 Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods.
- 7.3.3 Concrete not exposed to view is not subject to rejection for defective appearance.
- 7.3.4

7.4 Strength of Structure

- 7.4.1 The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions. Concrete strength requirements not considered to be satisfied in accordance with Clause 6 hereof.
- 7.4.2 Reinforcing steel size, quality, strength, position or arrangement at variance with the requirements as listed under specification of 'Reinforcement' or in the Contract Documents. Concrete which differs from the required dimensions or location in such a manner as to reduce the strength. Curing less than that specified. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development. Mechanical injury,

construction fires, accidents of premature removal of formwork likely to result in deficient strength. Poor workmanship likely to result in deficient strength.

Structural analysis and/or additional testing may be required when the strength of the structure IS considered potentially deficient.

Core tests may be required when the strength of the concrete in place is considered potentially deficient.

- 7.4.3 If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their result evaluated in accordance with British Standard BS 8110 or ACI Standard 318.
- 7.4.4 Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction if so directed by the Engineer or shall be replaced, at the Contractor's expense.
- 7.4.5 The Contractor shall pay all costs incurred in providing the additional testing and/or analysis required by this section.
- 7.4.6 The Employer will pay all costs of additional testing and/or analysis which is made at his request and which is not required by these Specifications, or by the Contract Documents.

8 Testing of Material

- a) A site laboratory shall be established by the Contractor for all the required testing of concrete, aggregates and other materials etc. All tests shall preferably be done at site. Only the test which are not possible to be carried out in the site laboratory shall be referred to the laboratory approved by the Engineer. All testing charges thereof shall be borne by the Contractor.
For testing of reinforcement steel bars, the samples shall be referred to the laboratory approved by the Engineer at the cost of the Contractor.
- b) Cement shall be tested as prescribed in -STM C -150.
- c) Aggregates shall be tested as prescribed in British Standard BS 812 - 882. addition fine aggregate shall be tested for organic impurity in conformance with ASTM Standard CAO.

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 specified works related to the relevant items of the Bills of Quantities. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

- 9.1.1 Providing, fixing, striking, etc. of formwork.
- 9.1.2 Providing, placing and fixing of anchor bolts or any other embedded parts.
- 9.1.3 Providing and installing all type of joints in concrete structure, including expansion joints.

9.2 Plain and Reinforced Concrete

9.2.1 Measurement

Concrete shall be measured as executed but no deduction shall be made for the following: Volume of any steel embedded in the concrete.

Volume occupied by water pipes, conduits etc. not exceeding 10 square inches each in cross-sectional area.

Voids not exceeding 4 square inch in work given in square feet. If any void exceeds 4 square inch, total void shall be deducted.

Voids, which are not to be deducted as specified above, refer only to openings or vents which are wholly within the boundaries of measured areas. Openings or vents which are at the boundaries of measured areas shall always be subject to deductions irrespective of size.

Concrete work shall be classified and measured separately as listed under items of Bills of Quantities. Junction between straight and curved works shall in all cases be deemed to be included with the work in which they occur.

Measurement of walls shall be taken between attached columns piers or pilaster. The thickness of attached columns, piers or pilaster shall be taken as the combined thickness of the wall and the columns, piers or pilaster.

Attached or isolated columns, piers, pilaster, and the like (except where caused by openings) having a length on plan not exceeding four times the thickness shall be classified as columns. Those having a length over four times the thickness and are caused by openings in wall shall be classified as walls.

Columns shall be measured from the top of footing/footing beams or floor surfaces to the underside of beams or slabs as the case maybe. Where the width of beams is less than the width of columns, the extra width at the junction shall be included in the beams.

The depth of the beams shall be measured from bottom of the slab to the bottom of the beams except in case of inverted beams where it shall be measured from top of slab to the top of beam. The cross-section of the beam shall be the actual cross-section below or above the slab. .

Measurement of acceptably completed works of plain and reinforced cement concrete will be made on the basis of number of cubic feet concrete placed and compacted in

position within the neat lines of the structure as shown on the Drawings or as directed by the Engineer.

9.2.2 Payment

Payment will be made for the acceptable measured quantity of plain and reinforced cement concrete on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

9.3 M16 Hilti System Dowels

9.3.1 Measurement

Measurement of acceptably completed works of drilling and fixing of anchoring dowels as per M16 Hilti's System HIT-HY150 injection adhesive with HAS rod will be made on the basis of number of dowels drilled and fixed in position as shown on the Drawings or as directed by the Engineer.

9.3.2 Payment

Payment will be made for the acceptable measured quantity of drilling and fixing of anchoring dowels as per M16 Hilti's System HIT-HY150 injection adhesive with HAS rod, on the basis of unit rate per number quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

9.4 For Mortar

9.4.1 Sand

Sand for mortar shall comply with the requirements for BS-1200. It shall be graded in accordance with the following table and the various sizes of particles shall be uniformly distributed. Sand that has been in contact with seawater shall not be used unless it has been thoroughly washed to the satisfaction of the Engineer.

Sieve Size (No.)	Percent Passing by weight	
	Min.	Max.
#4	100	
#8	95	
#16	70	100
#30	40	75
#50	10	35
#100	2	15
#200		

Sand up to .0025 inch shall not be more than 8% by weight of the total.

9.4.2 Cement:

Cement shall be Sulphate Resistant conforming to BS-12.

9.4.3 Water:

Water shall be clean and free from any harmful impurity. Where the quality of the water is doubtful, it shall be tested in accordance with BS- 3148.

9.4.4 Additives:

Additives where used, shall be proprietary products used in the proportions and manner recommended by the manufacturer. The additives shall in no way adversely affect the mortar strength or contain chemicals, which may be harmful to other building materials. To add gypsum to cement is strictly forbidden.

9.4.5 Mortars and Grout:

Materials for mortar, sand binding agent and water, shall be mixed by volume or by weight for at least 3 minutes with the minimum amount of water to produce a correctly mixed mortar or grout of workable consistency in a mechanical batch mixer. For small jobs, hand mixing may be permitted, the ingredients being mixed with sufficient water to produce a correctly mixed workable mortar.

Mortar shall be as strong, but no stronger than the materials it bonds together:

Mortars shall be mixed in batches, which can be used within a period before the setting process commences. Once a mix begins drying off, it shall be rejected. No ingredients shall be added to it once the setting process has begun.

9.4.6 Reinforcement:

For reinforcement refer specification section no. 2200.

10 Concrete Block Making

- 10.1 The Solid and Hollow blocks shall be machine moulded. The block making machines shall be of the standard approved by the Engineer. They shall be operated according to the instructions laid down by the manufacturers.
- 10.2 The blocks shall be continuously water cured by sprinkling water for a minimum of 10 days and covered between sprinkling operations with 4 mils thick polyethylene sheeting. After 10 days water curing period the blocks shall be air-dried. Under no circumstances will blocks be used in the work until they are completely dry. During curing period no surfaces of the block will be allowed to dry.
- 10.3 Cured concrete blocks shall be stored off the ground, stacked on level platforms which allow air circulation under stacked units. Units shall be covered and protected against wetting. Care shall be exercised in the handling of all concrete blocks. No damaged blocks shall be used in the work.
- 10.4 The hollow blocks shall be manufactured as per pattern shown on the drawing. These block units shall be provided by the Contractor for use where required in building structures from approved type of materials. Units shall have uniformly fine smooth surfaces of uniform

colour. These shall be free of any honey combing or other imperfections or deformations, all edges true and straight, and at right angles with each other and without any chipped or otherwise broken edges.

- 10.5 The blocks cast on different dates shall be stacked separately and must be labeled showing the date on which they were cast.
- 10.6 Reinforced cement concrete hollow block masonry shall be provided where shown on the drawings. Hollow block manufactured by moulding machine shall have well formed cavities, sharp and well defined edges and corners, smooth surfaces without any imperfections or deformations.

11 Properties of Blocks

- 11.1 All blocks shall be of the size and shape required to complete the work shown in the Drawings or as instructed by the Engineer.
- 11.2 The cement, sand and coarse aggregate shall be volume batched and their proportion may be adjusted so as to provide the concrete of the required strength when tested and shall be mixed in a concrete mixer in accordance with clause 5.4 of the section 'Plain and Reinforced Concrete'.
- 11.3 All blocks shall comply with ASTM C145 198,8 edition. The compressive strength of various solid and hollow block shall be as follows:

S. No	Type of Concrete Masonry ASTM 1988 Edition	Compressive Average of 3 Units	Strength Psi Individual Unit (MPa)	Location
1	Solid load bearing	1800 (12.4)	1500 (10.4)	Exposed to frost action
2	Masonry Unit	1200 (8.30)	1000 (6.90)	
3	(ASTM-C-145) Solid/Hollow non	600(4.14)	500 (3.45)	Not exposed to moisture & weather
4	load bearing Masonry units (ASTM-C-90) Hollow load bearing masonry	1000 (6.90)	800 (5.50)	Exposed to moisture & weather
5	(ASTM-C-90)	700 (4.80)	600 4.10	Not exposed to moisture &

- 11.4 The Contractor shall provide test certificates providing the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test certificates shall be provided as required by the Engineer, to ensure that all batches of blocks have the minimum specified crushing strength.
- 11.5 A laboratory approved by the Engineer shall carry out the test. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The Engineer will require to test samples of blocks periodically and the Contractor shall make necessary arrangements accordingly. The method of sampling for all tests shall be in accordance with.

- 11.6 All properties or specifications of blocks, not explained in these Specifications shall comply with the requirements of ASTM C145 1988 edition as directed by the Engineer.

12 Suction Rate

The Contractor shall, at his own cost, satisfy the Engineer that the suction rate of the block when determined in accordance with Appendix "A" of BS 3921 does not exceed 20 g/dm²/ min. or that the Contractor is able to adjust it so that it does not exceed this value on site.

13 Soluble Salt Content

For exposed block work, the contents by weight percent of soluble sulphate, calcium, magnesium, potassium and sodium radicals, shall not exceed 0.30, 0.10, 0.30, 0.03 and 0.03, percent respectively when ascertained in accordance with BS 3921, at the cost of the Contractor.

14 Reinforcing and Anchors of Block Masonry

Unless otherwise stated reinforcing and anchors shall conform to under mentioned sizes:

- 14.1 Joint reinforcing shall be 1.32mm (0.05-inch) diameter mild steel wire. Mesh design, galvanized after fabrication. Steel wire woven into 12mm mesh 75rym wide. Reinforcing bar anchors shall be 250mm dia. deformed bar minimum 10 inch long.
- 14.2 Two 6mm dia bar shall be provided at every fourth course for anchoring of block masonry to columns. Two # 10 bars at every fourth horizontal course shall be provided for anchoring masonry walls to plinth beam/floor beam, as shown on the drawings.
- 14.3 Dovetail anchors and slots (if used as an alternate anchorage) shall be not less than 18 gauge galvanized steel.

15 Erection

- 15.1 Blocks shall be laid true to line, level and laid in accurately spaced courses in stretcher bond with vertical joints of each course located at centre of units in alternate courses below. Vertical joints shall be buttered in the entire height of blocks. Each course shall be bonded at corners and at intersections of walls and shall be properly bonded. Courses of block shall be kept plumb throughout and corner reveals shall be true and in plumb.
- 15.2 Standard width of mortar joints for both horizontal and vertical joints shall be 10mm (maximum). Mortar joints in walls shall have full mortar coverage on vertical and horizontal faces between the blocks. Mortar joints on wall including struck joints, shall be thoroughly compacted and pressed tight against the edges of the blocks with proper tools. Blocks terminating against soffits of beam or slab construction shall be wedged tight with wedges and the joints shall be packed solidly with mortar between the top of the block and the bottom of slab or beam. Control expansion joints shall be kept free from mortar or other debris.
- 15.3 Unless otherwise shown on the drawings or specified by the Engineer, the spaces around doorframes and other material or built in

items shall be solidly filled with mortar. Spaces around the door and window holdfasts shall be filled in with Class 'C' concrete.

- 15.4 Work required to be built in with masonry including doorframe anchors, wall plugs, and dovetail anchors and accessories shall be built in as the erection progresses.
- 15.5 The block work shall be carried up in a uniform manner and no portion shall be carried more than one meter above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and leveled round each floor.
- 15.6 Sleeves, Chases, holes, sinking and mortices for other trades shall be correctly located and formed to the sizes as required by the relevant trades. Chiseling of completed walls or the formation of holes shall only be carried out.
- 15.7 Walls of blocks indicated, as being non-load bearing shall be constructed on the concrete floor slab unit after the floor formwork is struck and the concrete has obtained sufficient strength to support their weight. Toothing into load-bearing walls shall not be permitted.
- 15.8 All bolts, anchors, ties, pipe sleeves, flushing metal attachments, lintels and the like required to be built into the work shall be correctly inserted and executed as the work proceeds.
- 15.9 Walls or partitions abutting concrete columns or walls shall be securely anchored and tied with metal anchors or ties at not more than 450mm vertical centres. Wall ties cast in with concrete shall be bent down after the removal of formwork and shall be securely jointed into the mortar beds of walling.
- 15.10 Care shall be taken during construction of cavity walls so as to avoid the filling up of cavity with mortar. G.I. flashing and weep holes shall be provided where ever specified on the drawings or as per the instructions of the Engineer. Weep holes will be formed by oiled rods, removed after the mortar is set, at specified locations.

16 Scaffolding

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the Engineer shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate for masonry items.

Damage to masonry from scaffolding or from any other object shall be repaired by the Contractor at his own cost.

17 Jointing

Jointing is the forming of joints as work proceeds. Joints shall be as follows:

- 17.1 Exterior exposed joints shall be tightly formed to a weather joint with the point of the trowel.
- 17.2 Interior exposed joints shall be tightly formed to a concave joint
- 17.3 Joints which are subsequently covered with plaster or other finish materials shall be struck flush.

18 Tolerances

All block work shall be erected plumb and true to line and level with the maximum variation in any storey height or any length of wall being one mm in one meter. The maximum tolerance in the length, height or width of any single masonry unit shall be! 3mm.

19 Damp Proof Course

Damp-proof course shall be laid on an even mortar bed, free from projections, which may puncture the material. Where the damp-proof course is to be stepped only flexible membrane shall be used.

All damp proof course, unless otherwise specified, shall consist of class 'C' cement concrete 50mm thick, mixed with 2.5 kg. of pudlo per bag of cement or other approved quality water proofing compound as per manufacturers specifications and shall be laid at required levels as per drawings and instructions of the Engineer. The D.P.C shall be tamped consolidated, leveled, edges and corners made to the requirements of concerned drawings including finishing and curing complete.

20 Solid Block Work Around Opening of Hollow Masonry

Around all openings in hollow block masonry, the Contractor shall provide solid block work c:f same thickness as that of hollow block masonry wall and of width as indicated on the Drawings .. Solid block shall be laid around openings in such a manner that these are bonded integrally with hollow block masonry.

21 Reinforced Hollow Block Masonry

Where specified on the Drawings, reinforced hollow block masonry shall be provided. Horizontal and vertical reinforcement shall be cold worked deformed bar. Two bars of No. 8 (8mm) diameter shall be provided at every third horizontal course at 600mm centers, while the vertical reinforcement shall be two bars of No. 12 (12mm) diameter at 800mm centers. Bars shall be anchored and held firmly vertical in respective beams and columns in the manner shown in shop Drawings. The reinforced hollow part of 'he block wall shall be solidly filled with Class 'D' concrete at intervals of one meter maximum height as the laying of block masonry work proceeds. The filled concrete shall be consolidated thoroughly by rodding to avoid formation of voids. Contractor shall submit shop drawings of anchoring and placing of reinforcement in hollow block masonry for approval of the Engineer.

22 Curing and Repairs

22.1 All block 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 water used in the manufacture of blocks.

22.2 If, after the completion of any block masonry, the work is not in alignment or level, or does not, conform to the lines and grades shown on the Drawings •or shows a defective surface, it shall be removed and replaced by the Contractor at his expense unless the Engineer grants permission in writing, to patch or replace the defective area.

23 Masonry Short of Height

In case of different thickness of slab in different areas or rooms or for any other reasons, 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 the actual height shall be made good with Class 'C' nominal mix concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under the item of wall 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 of masonry.

24 Measurement and Payment

24.1 General

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

24.1.1 Chiseling of masonry, wherever required

Providing and fixing all joints reinforcing bars dovetail anchors, Cement sand mortar used in laying blocks, curing of masonry works and making of weep holes, Wastage of material etc.

Providing and filling Class 'D' Concrete in the cavity of hollow block masonry.

Providing and laying damp proof courses including damp proof materials and GI sheet flashing within cavity wall.

24.2 Solid Block Masonry

24.2.1 Measurement:

Measurement for acceptably completed works of respective type of solid block masonry will be made' on the basis of number of cubic feet provided and installed in position as shown on the drawings or as directed by the Engineer. Each measurement shall be taken to the nearest W'. All opening\$ left in the masonry wall shall be deducted.

24.2.2 Payment:

Payment will be made for acceptable measured quantity of respective type of solid block masonry work on the basis of unit rate per cubic feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 10(a) BRICK MASONRY

1. Scope

The work covered by this section of the specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all the operations in connection with masonry work, complete in strict accordance with the specifications herein and the applicable drawings subject to the terms and conditions of the contract. The work under this section includes the brickwork in foundations, walls and partitions both load bearing and non-load bearing.

2. Materials

2.2.1 Bricks

All bricks shall be sound, of well burnt clay, uniform in shape and size, when struck, the brick should produce ringing sound. The brick shall be free from flows, cracks, and shipped corners, nodules of lime, kankar, other blemishes and salt. When the brick is soaked in water for one hour, it should not absorb more than one sixth of its own weight. Bricks of only one size shall be used in the works. Bricks from different kilns not having the same size and colour shall not be accepted. The minimum compressive strength of the bricks tested in accordance with B.S. 1257 shall be 1300 psi subject to the condition that average compressive strength of five bricks tested shall not be less than 1500 psi.

2.2.2 Cement

Cement shall be Ordinary Portland Cement as specified in respective section.

2.2.3 Aggregates

Aggregates used shall meet the requirements specified under respective concrete section. All the aggregates dry and properly screened from approved source, shall also be acceptable for block making.

2.2.4 Brick Masonry Units

- i) The brick shall be solid as required and shall be carefully made so that they are true in line and face with square corners and free from all defects. The ends of the bricks, masonry, shall be double grooved or as directed by the Consultants.
- ii) The bricks shall be cured by keeping moist continuously for a period of at least fifteen (15) days and then shall be allowed to dry in shade for least thirty (30) days before used in masonry.
- iii) All bricks shall have clean cut straight and true edges, smooth dense faces of uniform appearance without voids, honeycombs, projections and shall be free from cracks spalls, chips, rugged edges or other defects detrimental to their use.
- iv) Where bricks are to be plastered or rendered, the bricks surface shall have a coarse texture suitable for bonding the plaster as approved by the Engineer.
- v) All bricks shall be stacked at site in a quantity not exceeding 5,000 bricks in each stack. The stacking shall be done in such

a manner as to avoid smearing of the bricks in the lowest part of the stack with clay. Bricks smeared with clay show very poor bond with mortar sand, therefore, any bricks thus affected be rejected out of hand without recourse. When transported to the site the bricks shall not be dumped from the vehicle, the bricks shall be manually unloaded and stacked as aforesaid.

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SECTION – 10(b) BLOCK MASONRY

6.1 SCOPE

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

The work under this section includes the block masonry in foundations, walls and partitions both load bearing and non-load bearing.

6.2 MATERIALS

6.2.1 BLOCKS.

All blocks shall be sound, of well burnt clay, uniform in shape and size, when struck, the block should produce ringing sound. The block shall be free from flaws, cracks, chipped corners, nodules of lime, kankar, other blemishes and salt. When the block is soaked in water for one hour, it should not absorb more than one sixth of its own weight. Blocks of only one size shall be used in the works. Blocks from different kilns not having the same size and colour shall not be accepted. The minimum compressive strength of the blocks tested in accordance with B.S. 1257 shall be 1300 psi subject to the condition that average compressive strength of five blocks tested shall not be less than 1500 psi.

6.2.2 Cement

Cement shall be Ordinary Portland Cement as specified in respective section.

6.2.3 Aggregates

Aggregates used shall meet the requirements specified under respective concrete section. All the aggregates dry and properly screened from approved source, shall also be acceptable for block making.

6.2.4 Block Masonry Units

- i) Concrete masonry blocks shall be made on the project site and shall be of the sizes required as per drawings and/or as directed by the Consultants and shall generally conform to the requirements of British Standard 2028, 1364:1968 until and unless specified or otherwise in the specifications.
- ii) The block shall be solid as required and shall be carefully made so that they are true in line and face with square corners and free from all defects. The ends of the blocks, masonry, shall be double grooved or as directed by the Consultants.
- iii) The blocks shall be cured by keeping moist continuously for a period of at least ten (10) days and then shall be allowed to dry in shade for at least twenty (20) days before used in masonry.
- iv) All blocks shall have clean cut straight and true edges, smooth dense faces of uniform appearance without voids, honeycombs, projections and shall be free from cracks spalls, chips, rugged edges or other defects detrimental to their use.
- v) Where blocks are to be plastered or rendered, the blocks surface shall have a coarse texture suitable for bonding the plaster as approved by the Engineer.
- vi) All blocks shall be stacked at site in a quantity not exceeding 5,000 blocks in each stack. The stacking shall be done in such a manner as to avoid smearing of the blocks in the lowest part of the stack with clay. Blocks smeared with clay show very poor bond with mortar sand, therefore, any blocks thus affected be rejected out of hand without recourse. When transported to the site the blocks shall not be dumped from the vehicle, the blocks shall be manually unloaded and stacked as aforesaid.

6.2.5 CEMENT MORTAR FOR MASONRY

Proportion

Cement Mortar shall be composed of one part of Ordinary Portland Cement to 6 (six) parts of all block masonry walls. Hand mixing, when permitted by the Engineer shall be done on clean hard platform as much as required for immediate use with only just sufficient water, to produce mortar of a proper consistency. If directed by the Engineer, the mixing shall be done by mechanical mixers. Sand shall be of an approved quality and shall pass 100% through 3/16 inch sieve.

SECTION – 11 CARPENTRY AND JOINERY

1. Scope

The work covered under this section of Specifications consists of providing all material, labour, plant, equipment, appliances and performing all operations in any floor and at any height. connected with the fabrication and erection of all woodwork, mill work, construction assembly, surface finish treatment and building in of all cabinet type items, supports etc. of wood or metal and incidentals, associated woodwork appurtenances, procuring and applying preservatives, installation of "Finish Hard Ware" in connection with finish woodwork as per details shown on the Drawings or as directed by the Engineer.

2. Materials

2.1 Timber

2.1.1 Hard Wood:

Hard wood shall comprise of Oak, beech, Walnut Mahogany, Teak, Iroko and Sheesham.

2.1.2 Soft Wood:

All soft wood shall consist of pines, spruce, hemlock and douglas fir or cedrous deodar (referred in the document as deodar), wood locally known as 'Partal' to be used in shutter core where specified.

2.1.3 General Characteristics:

All the timber shall be in accordance with the requirements of BSI No: 1186, 'Quality of Timber and Workmanship in Joinery.

The whole of the timber shall be from the heart of sound and fully grown tree, uniform in substance, straight first class quality properly seasoned, free from large or loose dead-knots, open shakes and excessive sapwood. The scantlings of all timbers shall be brig t: sound and square edged. The moisture content of timber shall not be more. than 10 (ten) percent in case of soft wood and 7 (seven) percent in case of hard wood.

2.1.4 Preservation of Wood:

Prior to installation of all finish wood works in their respective positions, preservatives shall be applied to safeguard the wood work against fungus, termite and bores.

The Preservatives shall be of the best available quality as approved by the Engineer. The method of application shall be strictly in accordance with the manufacturer's instructions. The treatment and application of all the preservatives shall comply with the requirements of BS-CP 98:1964.

2.1.5 Adhesive:

The adhesives shall conform to the requirements of BSI No. 745 "Animal Glues for Wood" manufactured by M/s Host shall be considered approved for this Project or as directed and approved by (he Engineer.

2.1.6 Nails and Screws:

All nails and screws shall comply with requirements of BSI NO. 1202 and BSI NO. 1210 respectively.

2.1.7 Ply Wood

The ply wood shall comply in all respects with BSI No. 1455:1963. All the ply wood shall only be obtained from KDC Board (Pvt.) Limited, Jhelum as approved by the Engineer.. All plywood shall be manufactured with phenol pharamaldihide or any other approved water proof adhesive but not with urea pharamaldihide.

Ply wood used for doors, and other similar works shall be to the thickness and size as shown on the Drawings or as directed by the Engineer. The grade shall be first quality and the face and back shall be free from end joints, dead knots, overlaps, patches and other similar defects. The surfaces shall be free, smooth for painting or polishing.

2.1.8 High Density Fibre (MDF) Board

Medium density fibre board to be used on the project shall be LASANI of thicknesses as specified in the drawings. Board shall be manufactured with water proof resinous glues and shall be guaranteed by the manufacturer. All boards required for the exterior surfaces of cabinets shall be laminated with farmica in approved colour and texture in factory as specified elsewhere.

3. Samples

All samples of the material used for the work under this Section of Specification shall be approved by the Engineer and same type of material shall be used throughout the work. If the Engineer desires to get the material tested, this will be got done by the Contractor at his own cost from a laboratory approved by the Engineer.

4. Fabrication

Unwrought' timber shall be used. Sawing shall be done with sufficient oversize margin to finally meet the requirements of specified sizes and dimensions of the finished work.

All framing shall be joined and glued properly as shown n on the Drawings or as directed by the Engineer. All joints shall be secured with sufficient number of nails. The Contractor shall perform all necessary mortising, tenoning, grooving, matching, tangoing, housing, rebating and all operations required for the correct jointing. The Contractor shall also provide all metal plates, screws, nails and other fixing material that may be ordered by the Engineer for the proper execution of the joinery work. Fabrication that develop defects due to bad workmanship or unsound materials not conforming to these specifications and the directions of the Engineer, shall be cut out and

replaced at Contractor's own expense before the expiry of the maintenance period.

5. Protection Of Materials

All materials and assembled units shall be protected from weather and stored in such a way as to prevent decay, warping and attack by fungus and termites.

6. Wooden Doors

6.1 Materials

6.1.1 First class Deodar wood as approved by the Engineer shall be used for door frames and door shutters except the core of shutters which shall be partial wood as specified and shown on drawings.

6.1.2 Architraves, beads, lippings shall be of Deodar wood of specified sizes and fixed as per details shown on Drawings.

6.2 Ground, Blocking & Nailing Strips

6.2.1 Ground, blocking and nailing strips shall be provided as necessary to receive the work included herein and as required for the work of other trades.

Except as otherwise shown or specified, ground blocking and nailing strips shall be secured in place as follows:

6.2.2 To steel--- by means of 3/8" diameter bolts spaced not over 3 feet.

6.2.3 To brick wall ---- by the use of cut nails spaced not more than 1.5 feet apart and driven directly into the block. .

6.2.4 To poured concrete --- by means of 1/4" diameter galvanized expansion bolts spaced not more than 1.5 feet part or by any approved method.

6.3 Exterior and Interior Door Frames

All exterior and interior door frames shall be fabricated of wooden sections of first class deodar wood frame as shown on drawings.

All exposed surfaces of frames and architraves/beads shall be painted with synthetic matt finished enamel paint of approved shade as per the instructions of the Engineer.

The door frames shall be secured in place by means of 4 inches screws and matching Rawal plugs and built into the plastered masonry after the same has dried 4 number screws in each jamb and 2 number for upto 3.5 feet width and 3 number for upto 5 feet width of doors in the head shall be used.

6.4 Door Shutters

The shutters will be fixed to the frames with approved quality fittings as per hardware schedule.

6.5 Squareness Maximum diagonal difference 1/8" (between length of diagonal measured on face of door from upper right corner to lower left corner and length of diagonal measured from upper left corner to lower right corner).

Doors, shutters shall be fabricate in a workman like manner strictly to the correct sizes and shapes as shown on the Drawings or as directed by the Engineer.

Manufacturer's Qualifications:

The manufacturer of doors herein specified shall have been in business of manufacturing doors of type specified for minimum period of five years. The door shutters shall be built in sections, properly jointed and glued together.

The surfaces shall be prepared for painting or polishing. All door shutters shall be paneled, fabricated from first class deodar wood as shown on drawing . Fitting, Hanging and trimming All the doors shall be fitted, hung and trimmed as Here in after specified and as indicated on the Drawings.

Doors shall have a clearance of 1/8" at sides and top unless otherwise directed by the Engineer and shall have 3/16" clearance at bottom. Doors shall be hung and trimmed with hardware as specified. All the locks shall be installed at the same height and shall be located at height as directed by the Engineer. Where directed by the Engineer margin for carpet shall be incorporated in the door shutter.

6.6 Hardware

Hardware shall be of best quality local make extra heavy duty and first class finished material except door locks and door closures which shall be imported of Japanese origin as per attached hardware schedule. The Contractor shall obtain prior approval from the Engineer for quality, shape, pattern, and brand of all the hardware materials by providing samples and catalogues, etc., and shall provide and fix only the approved hardware materials.

Completed doors shall be sound, rigid and free from defects and warp. All edges shall be aligned and smooth, joints shall be close fitting, hard wood doweled or mortised framed and of a strength to maintain frame and of strength to maintain the structural properties of the member connected. All adjoining faces and edges shall be flush and smooth. Edges shall be rectangular and solid.

6.7 Quality Assurance

6.7.1 Tolerances: Doors shall be fabricated to following tolerances
Size: Plus or minus 1/16 in overall dimensions Maximum
Warp: 1/8"

6.8 Submittal

6.8.1 Provide manufacturer's literature completely describing products.

6.8.2 Provide shop drawings showing door types, details and locations, referred to the door type and hardware group shown on door and hardware schedules.

6.8.3 Provide certificates stating that doors were constructed with timber of the Species specified having moisture content and meeting equilibrium and relative humidity requirements.

6.8.4 Submit samples of plywood for selection of colour and grain.

6.8.5 Procurement of materials shall be made only after the shop drawings and samples have been approved by the Engineer.

6.9 Product Delivery, Storage and Handling

6.9.1 Deliver and store products in waterproof, protective containers with seals unbroken and labels intact until time to use.

6.9.2 Keep products dry, stack products off ground on level platforms, fully protected from weather, including direct sunlight.

6.9.3 Identify type, size and location of each door before delivery in order to permit installation at correct location.

6.10 Installation

6.10.1 Install doors at correct openings and assure smooth swing and proper closer with frames.

6.10.2 Install finish hardware in accordance with manufacturer directions.

6.10.3 Hardware shall be carefully and securely fitted. Upon handing over the work, hardware shall be demonstrated to operate freely. Keys shall be placed into a respective locks and upon acceptance of the work keys shall be tagged and delivered to the Engineering work at site.

7. Wooden Railing

Material for wooden hand railing in stairs shall be superior quality teak wood/ deodar wood & 1/2 inch dia mild steel pipes. It shall be fabricated and installed in accordance with the design shown on the drawings/details and as per the instructions of the Engineer. Sample of railing shall be fabricated & mock up samples installed at locations designated by the Engineer for approval, prior to s

Shop/detail drawing indicating the basic details at various locations including details at turnings shall be submitted by the Contractor for Engineer's approval. Hand railing shall be installed to line level and plumb. The surface of railing in stairs shall be prepared for polishing. The railing shall be polished/painted with clear lacquer and the steel surfaces shall be painted with matt finished enamel paint.

8. SS & Glass Railing

Material for hand railing in stairs shall be 3" dia stainless steel pipe handrail, 1" dia stainless steel balustrades, 18mm thick or as per drawing unbreakable Security glass and clamps including all fixing accessories complete in all respect as shown on the drawings, It shall be fabricated and installed in accordance with the design shown on the drawings/details and as per the instructions of the Engineer. Sample of railing shall be fabricated & mock up samples installed at locations designated by the Engineer for approval, prior to starting work at site. Shop/detail drawing indicating the basic details at various locations including details at turnings shall be submitted by the Contractor for Engineer's approval. Hand railing shall be installed to line level and plumb.

9. Defective Work

In the event of non-conformance to specification and drawings, the wood works shall be rejected by the Engineer and the Contractor shall remove and replace the rejected work by new work of same specifications.

10. Surface Preparation

The surfaces of all wood works shall be prepared in the (manner as directed by the Engineer) for polishing or painting.

11. Mock-Up Sample

After approval of shop drawings and tests etc., the contract shall submit at his own cost one mock-up sample of each type of wood works complete with all fixing, fixtures accessories prior to the actual fabrication of the bulk.

The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

12. Measurement & Payment

12.1 General

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

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

12.1.1 Glazing where required and all finished hardware fittings in carpentry and joinery works, including locks, kick and push plate, architrave, beading, handles, locking arrangements etc.

12.1.2 Prime coat, painting with synthetic enamel paint/lacquer polish in carpentry and joinery works/hand railing.

12.1.3 Anti termite treatment to wood works and adhesives

12.1.4 SS / Steel balusters, steel base and steel strip for wooden railing.

12.1.5 Deodar wood blocking, shipping & base frame work in cabinets/hand railing.

12.1.6 SS Plate in the door bottom.

12.2 Wooden Door

12.1.1 Measurement

Measurement of acceptably completed works of all types of wooden doors will be made on the basis of net actual area in

square feet fabricated and installed in position as shown on the Drawings or as directed by the Engineer. Net area will be measured in accordance with plastered masonry opening in between jambs and plastered head and bottom of shutter.

12.1.2 Payment

Payment will be made for acceptable measured quantity of all types of wooden doors on the basis of unit rate per square feet quoted in the Bill of Quantities against respective item and shall constitute full compensation for all the works including all hardware & fittings like locks, tower bolts, push plates etc. as per details mentioned in Volume III & IV of Tender & Contract Document related to the item.

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SECTION – 12 ALUMINIUM WORKS

1. Scope

The work covered under this section of the specifications consists of providing all material, labour, equipment, performing all operations required for providing and installation of aluminium. doors, windows, ventilators & louvers including all related items such as sealants, gasket, netting, rollers, hinges, latches, fastenings, anchor bolts, door locks, locking devices and glass complete in strict accordance with this section of specifications, the applicable drawings and as scheduled. Any additional information required in this connection and not stated in these specifications, shall be obtained from the Engineer's Representative.

2. Applicable Standards

Latest editions of following ISO and British Standards are relevant to these Specifications wherever applicable.

2.1 ISO (International Organization for Standardization)

1804	Doors Door	Terminology
6442	Leaves	Measurement of defects of general flatness
6443	Door	Measurement of dimensions and defects of squareness.
	Leaves	
6444	Door	
	Leaves	
6613	Windows & Doors	Test of behaviour under humidity variations (successive uniform climates) wind resistance tests. Air permeability test.

2.2 BSI (British Standard Institution)

1227 Hinges

4873 Aluminum alloy windows.

3. General

3.1 Door, Windows, ventilators, louvers and other items to be provided shall be aluminium, of profile pattern and design shown on drawings and shop drawings manufactured by reputable manufacturer approved by the Engineer. The contractor shall provide manufacture literature completely describing the product instructions for installation and maintenance.

3.2 All the sections used for doors, windows, ventilators & louvers fly screens shall be of best quality aluminium products such as equal and unequal angles, channels, tubes, corrugated strips, mouldings etc., in accordance with International standards conforming to ASTM B 308 & B 221.

3.3 All doors, windows. Ventilators and louvers shall be of type and size indicated on drawings and shall conform to the requirements shown and specified herein.

3.4 Contractor shall arrange tests and analysis if directed by the Engineer of scaled models of each door, window, ventilator and louvers type at the maker's works or any laboratory specified by the Engineer for the material supplied by him to be tested in the presence of the Engineer's Inspector, to whom test certificates, proof sheets, etc. shall be furnished. The models shall be submitted to the Engineer for approval prior to testing. Nevertheless, neither the fact that the materials have been tested in the presence of the inspector nor that the Engineer may have been furnished with test certificates in lieu of sending an inspector to the works shall affect the liberty of the Engineer to reject, after delivery of materials found not in accordance with these specifications.

3.5 The contractor shall submit shop drawings conforming to design concept which shall show full construction details, quantities and locations, fastenings, stiffening members and attachments to adjacent construction and materials. Shop drawings and calculations shall be submitted at the proper time to allow for checking, revisions, and agreement and to permit manufacturer's product delivery and start of site work to suit the building programme. The Contractor shall submit representative samples of finished doors, windows, anchoring mechanism, embedded parts, fastenings, glass panes, accessories and other materials for the Engineer's approval.

After approval of shop drawings and tests etc., the Contractor shall submit at his own cost one mock-up sample of each type of aluminium works complete with glazing, all components assembly method and required fittings and accessories prior to the actual fabrication of the bulk. The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

Fabricate and assemble all work in the shop of the approved manufacturer to reduce field fabrication to a minimum unless otherwise directed by the Engineer.

The glass shall conform to specification laid down under chapter 'Glazing' and shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to size as shown on drawings, so as to fit the grooves in window members.

3.6 The structural shape of the Aluminium members shall be of uniform quality, colour temper, clean, round, commercially straight and free from injurious defects.

3.7 All doors, windows, ventilators and louvers shall be fabricated as a complete unit, fully airtight and watertight, including rubber gasket for glazing, hinges, stays, rollers, latch, locking arrangement, handles, etc anodized in specified colour, inclusive of glass sheet, necessary holes for fixing, door locks, door closures and window locking requirements, all as approved by the engineer.

Contractor shall, provide certificate signed by the manufacturer stating that each lot has been sampled, tested and respected and has met the requirements in accordance with these specifications and the same shall be furnished to the Engineer.

- 3.8 The shop drawings shall clearly show that there shall be no penetration of rainwater from the exterior to the interior in case of severe wind and rainstorm. This has to be specially ensured in bill section.

4. Material

4.1 Frames/shutters

The frames of aluminium door, windows and ventilator shall be formed from rolled, strip or extruded aluminium. The thickness of sectional members shall be at least 1.6 mm. All outer / frame sections of open able / fixed windows. Ventilators and louvers curtain wall shall be 95 mm minimum in width. The Frames for doors and door/windows curtain wall shall be at least 97 mm in width.

- 4.2 As shown on the drawings, aluminium frames shall be provided as per international standard approved by the Consultant.
- 4.3 Fasteners shall be stainless steel of a type selected to prevent galvanic action with the components fastened.
- 4.4 Gaskets shall be vinyl glazing channel gasket to commercial standard CS-230-60.
- 4.5 Hardware shall be manufacturer's standard hardware. Flush to match doors, windows, ventilators and louvers finish. Floor mounted concealed type double action/swing imported door closures shall be provided to all doors. Heavy duty in-matching finish stays shall be provided to all open able windows, ventilators and louvers. Stays shall be attached to the window frame so as could be replaced easily.
- 4.6 Joint sealant shall be approved elastomer.
- 4.7 All Aluminium sections shall be powder coated in accordance with the standards of Aluminium Association of USA. The anodisation shall be of not less than 70-90 microns. The anodic oxide surface shall be properly sealed.
- 4.8 For powder coated finish aluminium sections to be coated shall be mill finish. The sections shall be firstly degreased with a degreasing chemical to remove all/any stains. The sections will then be given a chromating coating and electro static powder coating in the desired colour with a powder-coating machine. After colour coating the sections will be baked at baking temperature of 220 degree Centigrade for 25 minutes.
- 4.9 All sliding/open able windows shall be sliding/open able wire/fly screen shutters in window matching finish with wire/fly screen of size so as not to permit the entry of flies and mosquitoes. The wire mesh shall be 30 SWG. 14 mesh (14 x 14 openings per square inch).

5. Design Requirement

The Contractor shall design the installation to meet or excel the following requirements,

5.1 Tolerances

The Contractor shall be responsible for agreeing to all dimensions with the Engineer before proceeding with the manufacture and for making provision to allow for building tolerances required by the Engineer. Contractor shall also take site measurements of the structure completed before manufacturing.

5.2 Thermal & Seismic Movements

The window and glazing assemblies are to be constructed and installed in the openings with sufficient tolerance and, where necessary, to provide for Joints incorporated in couplings, to provide for expansion and contraction as will be caused by the local seismic and climatic conditions and temperature changes, winter to summer - day to night without buckling, distortion of joints, or other harmful effects.

6. Workmanship

The Contractor shall be responsible for the protection and installation of all items furnished. All items shall be installed plumb and square and shall be solidly anchored in a good workman like manner in accordance with the manufacturer's instruction and as specified herein. The Contractor shall be responsible for the protection of installed items from damage by other trades. All items shall be left in operating, neat and clean condition, free from dirt, finger marks, etc. The Contractor shall be responsible for final cleaning before the final acceptance.

The glass panes shall firmly be secured in the rebates with the rubber gasket. Ensure that the beads and grooves are clean, dry and unobstructed at the time of glazing. The complete unit shall be airtight and watertight on completion. No doors, windows and ventilator shall be considered complete until and unless the fingerprints and other stains and marks have been removed from the surface of glass and aluminium.

7. Product Delivery and Storage

7.1 Deliver doors, windows, ventilator and louvers in a manner preventing damage to units,

7.2 Applicable Standards

Latest editions of following British Standards are relevant to these Specifications wherever applicable.

Store materials off the ground under cover in a manner preventing deterioration or All embedded parts and anchor bolts shall be delivered to the site carefully and keeping the fabricated shape and configuration. All these parts shall be suitably marked for identification.

SECTION – 13 GLAZING

1. Scope

The work under this section of the Specifications consists of furnishing all labour, equipment, tools, appliances, scaffolding and providing in any floor and at any height glass, gaskets, sealants, compound and other materials required for performing all operations in connection with the installation and setting of all types of glass and glazing complete in every respect in accordance with the Drawings or as directed by the Engineer. The scope of this section of Specifications is covered with detailed Specifications as laid down herein.

2. Applicable Standards

Latest addition of following British Standards are relevant to these specifications where ever applicable:

2.1 BSI (British Standards Institution)

952	Glass for glazing
5051	Security glazing part I & II
CP.152	Glazing

3. General

- 3.1 Each type of glass shall have the manufacturer's label on each pane, and the labels shall remain on the glass until final cleaning.
- 3.2 Glazing sealant shall be as recommended by the manufacturer for the particular application.
- 3.3 Spacer shims distance (pieces) shall be plasticized polyvinyl chloride (PVC). Thickness shall be equal to space shown on drawings between glass and rebates bead or cleat. Depth shall give not less than 1/4" cover of glazing sealant.
- 3.4 Contractor shall submit samples for each type of glass, minimum 4' x 4' in size with protective edges. Samples of glazing sealant minimum 0.1 liter of specified types shall be submitted.
- 3.5 Contractor shall submit 1 feet long sample c; each type of glazing gasket.
- 3.6 Contractor shall also submit printed materials manufacturer's installation instructions for specified glazing gaskets, compounds sealants and accessories including description of required equipment and procedures and precautions to be observed.

4. Delivery Storage and Handling

- 4.1 Contractor shall deliver materials in manufacturer's original, unopened containers clearly labeled with manufacturer's name and address, material, brand, type, class and rating as applicable.

Contractor shall store the materials in original unopened containers with labels intact/protected from ground contact and from elements which may damage glass.

Contractor shall handle the materials in a manner to prevent breakage of glass and damage to surfaces.

Examine each piece of glass and discard and replace glass with edge damage or face imperfection. All glazing shall be wind tight and fully water tight on completion.

Clean glazing channels and other framing members indicated to receive glass. Remove coatings which are not firmly bonded to the substrate, Remove lacquer from metal surfaces wherever elastomeric sealants are to be used. Apply primer and sealer to joint surfaces wherever recommended by the sealant manufacturer and as shown on the drawings.

Trim and clean excess glazing materials from surrounding surfaces immediately after installation and eliminate stains and discolorations.

Cure glazing sealants and compounds in compliance with manufacturer's instructions to obtain high early bond strength internal cohesive strength and surface durability.

While glazing operation is in progress great care shall be taken to avoid breakage or damage to the glass and adjoining glazing. The Contractor shall make good at his own cost, all glass broken by his workmen while cleaning or carrying out other operations. On the completion of the glazing work, all glass that has been set by the Contractor shall, if it becomes loose, within the maintenance period, be refixed at Contractor's expense.

No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass and checked by the Engineer for water tightness.

5. Protection and Cleaning of Glazing

- 5.1 Remove all smears labels and excess glazing sealant, leave clean inside and outside free from scratches. The Contractor shall be responsible for the protection of installed glass. Before final acceptance, damaged or broken glass shall be removed and replaced with the new glass at no additional expense to the Employer and replaced with new glass at no additional aged or broken glass shall be removed.
- 5.2 All glass surfaces shall be washed clean both inside and outside within two weeks prior to final acceptance by the Consultant.

6. Measurement and Payment

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

SECTION – 14 BITUMEN COATING

1. Scope

The work under this section of the Specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations related to water proof treatment to foundations and basement structures complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. Submittal

2.1 Samples of all materials proposed for use under this section, shall be submitted to the Engineer for approval.

3. Materials

3.1 Bitumen 10/20 grade.

4. Delivery Storage and Handling

Materials shall be protected from damage during loading shipment delivery and storage Non staining materials shall be used for blocking and packing

5. Preparatory Work

5.1 All surfaces to be treated shall be dust free and dry. Application of finishes shall not start unless the preparatory work has been inspected and approved by' the Engineer.

6. Bitumen Coating/Painting In Foundation Sub-Structures, Under Floors

a) Bitumen Painting:

All surfaces to be bitumen painted shall be thoroughly cleaned of any accretion, dust, dirt etc. by scraping, wire brushing or as directed by the Engineer. The surface shall be primed with a coat or asphalt oil used at the rate of not less than 1.08 gallon /10 square meter. Two coats of hot bitumen paint shall be applied at the rate of 1.0 kg/ Sq.m. each coat. The first coat shall be allowed to dry for about 6 hours before applying the second coat. During operation of painting great care shall be taken to avoid air bubbles. The manufacturers shall be taken to avoid air bubbles. The manufacturer's instructions and Engineer's directions shall be followed.

7. Measurement and Payment

7.1 General

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

7.1.1 All preparatory work, scrapping, scratching, cleaning, cant strips, gravel strips, etc.

7.1.2 Coats of bitumen.

7.2 Bitumen Painting/Coating

7.2.1 Measurement

Measurement of acceptably completed works of bitumen painting/coating will be made on the basis of net actual area in square foot as shown on the Drawings or as directed by the Engineer.

7.2.2 Payment

Payment will be made for acceptable measured quantity of bitumen painting/coating on the basis of unit rate per square foot quoted in the Bills of Quantities. The unit rate shall include all cost of surface preparation and shall constitute full compensation for all the works related to the item.

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SECTION – 15 CEMENT PLASTER

1. Scope

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in any floor and at any height connection with providing and installation of cement plaster, and specified external rendering complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the contract.

2. General

- 2.1 Except as may be otherwise shown on surfaces specified, all plaster work, both internal and external shall be ordinary Portland Cement plaster of the required thickness as shown on the drawings.
- 2.2 Plastering shall not commence until all electric conduits, drainage and sanitary pipes, inlets to tanks, brackets, clamps, doors and window frames and all sort\$ of inserts and embedded items are fixed in position. It shall be the responsibility of the Contractor to make sure that all such work is carried out by other contractors before starting of plaster work. Chiseling and repairing of cement plaster shall not be permitted without the approval of the Engineer.
- 2.3 Sample of materials shall be submitted to the Engineer for his approval prior to use in the works.

3. Material

- 3.1 Cement for plaster shall be Ordinary Portland Cement (B.S 12 or P.S 232) or Sulphate resisting cement (B.S 4027 or P.S. 612) as specified 'and shall conform to requirements specified in the section "Plain and Reinforced Concrete".
- 3.2 Sand for plaster shall coy with the requirements of BS 1199, BS 1200 or the draft Pakistan Standard "Sand for Plaster" as directed by the Engineer.
- 3.3 Water for plaster shall conform to requirements specified in the section for "plain and reinforced concrete".
- 3.4 All materials and workmanship for plaster, not explained in these Specifications, Shall comply with the requirements of relevant BS CP 211 and CP 221 as directed by the Engineer.

4. Proportioning and Mixing

- 4.1 Measurement of materials by volume shall be by containers of known capacity to maintain consistent proportions. No lumpy or caked material shall be used. Mixing equipment boxes and tools shall be clean. Materials shall be proportioned as specified on the Drawings, in the Bill of Quantities or as directed by the Engineer. Mixing shall be continuous until all ingredients are evenly distributed and thoroughly mixed.
- 4.2 Only limited water shall be added for proper workability and such quantity of mortar shall be prepared which can be consumed in thirty minutes after preparation. Preparation of mortar in bulk quantity for use

during the entire day or for any other time more than that stipulated above is expressly prohibited. Retempering shall not be permitted and all mortar which has begun to stiffen shall be discarded.

- 4.3 Plaster ingredients shall be thoroughly mixed either by hand on a clean cement concrete platform or by a mechanical mixer, as directed by the Engineer.

5. Preparation of Surface to be Plastered

- 5.1 Concrete surface to be plastered shall be cleaned to remove all grease, form oil and other surface impurities, which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface of all-concrete ceilings, beams and columns shall be lightly hacked by approved means to give the required key for plastering.
- 5.2 All masonry surfaces to be plastered shall be cleaned to remove all matter, which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface shall be washed with clean water and kept damp for 24 hours before further treatment. The surface thus prepared shall be treated uniformly with cement and sand slurry. The slurry to be used shall be one part cement to one part sand by volume with water added to make a stiff creamy mix. The slurry shall be applied with a stiff brush on surface, which has previously been well wetted. The surface so treated shall be left to cure for 3 days.

6. Application of Plaster

- 6.1 The plaster of thickness less than the specified thickness shall be rejected. If the plaster is to be more than 1/2" thick, it shall be done in two coats. The surface of first coat shall be made rough before the second coat is applied. The plaster shall not have wavy surface and shall be perfectly in plumb. The edges and corners shall represent a straight line. The plaster shall be kept wet continuously for at least ten (10) days. No extra payment shall be allowed for jambs, junctions, corners, edges, round surfaces or for more than one layer of plaster required due to any unevenness in the work done by the Contractor. The plasterwork is to cover all conduits, pipes etc fixed in the walls and ceiling. Wherever specified, metal lath shall be nailed firmly before plastering is commenced. The plaster surface shall be tested frequently with a 10 feet straight edge and plumb bob.
- 6.2 Plaster containing cracks, blisters, pits, dis coloration or any, defects shall not be acceptable. Any such plaster or loose plaster shall be removed & replaced with plaster in conformity with these specifications and as additionally directed by the Engineer. Contractor shall cut out and patch all defective work at his own cost. All damaged plaster shall be patched as directed by the Engineer. Patching plaster shall match appearance of and shall be finished level with adjoining plaster.

7. Metal Lath

Metal lathing shall be fabricated from sheet steel and shall be of uniform quality and free from flaws broken strands, cracks and corrosive pitting, shall be rectangular and true to shape and shall comply with BS-1369.

All lathing shall be galvanized. Where plastering material depends entirely on the lathing for its key, these shall be not less than two complete mesh openings per 1-1/8" in one direction and the width of the aperture shall not be less than 3/16".

Sheets shall not be less than 1.6 kg/sq.m when fabricated, using 0.7 mm thick steel sheet. Where used on smooth surfaces to form a key it shall be not less than 1.2 kg/sq.m when fabricated, using 0.5 mm thick steel sheet. Tying wire shall be 1.2 mm diameter galvanized annealed iron wire.

Sheets shall be welded to angle iron frame as shown on drawings. 8.

8. Angle and Beads

Angle beads, stop beads, depth gauge beads, edging profiles, plaster dividing profiles, interior angle profiles, plaster borders and the like shall all be manufactured from sheet steel and galvanized after fabrication, all beads shall be perforated at edges to ensure good adhesion of the plaster work. Thickness and dimensions shall suit particular locations and plaster thickness.

All angle beads, stop beads, depth gauge beads and the like are to be fixed in accordance with the manufacturer's instructions, at all corners, stops, joints, etc. as per directions of Engineer In charge.

9. Internal / External Plaster

9.1 Where specified in the Drawings external surface shall have an average 20mm thick plaster finish, consisting of a base coat of 1:4 cement sand mortar in Grey cement and the finish coat of smooth plaster as shown on the Drawings and as directed by the Engineer.

9.2 Where specified in the Drawings all internal plaster shall have an average 12mm thick consisting of base coat of 1 :3:1:4 cement sand mortar in grey cement and finish coat of smooth plaster as shown on the Drawings and as directed by the Engineer.

9.3 Stucco Plaster

Wherever specified in the drawings external stucco plaster shall consist of 1 :2, one part white cement & 2 parts approved shade of marble chips zero size mixed with approved pigment to achieve desired shade. Wherever shown on drawings, grooves shall be provided with aluminum U/Y channels. The contractor shall prepare mockup samples of stucco plaster for the approval of Engineer. The plaster shall be applied with machines and the final rough surface/texture/shade shall be as per the approved sample, direction and approval of the Engineer-In charge.

10. Cleaning and Protection

10.1 Rubbish and debris shall be removed as necessary to make way for work of other trades and as directed by the Engineer. As each room or space is completed all rubbish, debris, scaffolding and tools should be removed to leave the room clean.

10.2 Prior to plastering all aluminum windows, finished metals should be covered by sheet of plastic or tarpaulin to protect it from damage.

10.3 Protect finished plaster from injury by any source. Contractor shall also protect walls, floors and work of other trades from Plastic materials.

11. Tolerances

Surfaces of plaster work shall be finished with a true plane to correct line and level with all angle and corners to a right angle unless otherwise specified and with walls and reveals plumb and square.

Maximum permitted tolerances shall not exceed 1/8" in 6 feet variation from plumb or level in any exposed line or surface and 1/16" variation between planes of abutting edges or ends.

12. Measurement and Payment

12.1 General

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

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height. otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

12.1.1 Metal lath over reinforced concrete and masonry joint.

12.1.2 Joints, junctions, corners, beads, drip course edge, roundings, and aluminum UN channels in groves. Etc.

12.1.3 More than one layer due to any unevenness in the finished works and base coat plaster in stucco plaster including marble chips/colour pigments.

12.1.4 Cutting & patching of all defective works.

12.1.5 Surface preparation, cleaning and protection as specified.

12.1.6 Marble chips & pigments in stucco plaster.

12.1.7 Roughning of first coat of plaster before application of 2nd coat incase where overall required plaster thickness exceeds 1/2 inch.

12.2 Plain Plaster/Stucco plaster Measurement

Deductions shall not be made for ends of joints, beam posts, etc., and openings not exceeding 5 square feet each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings non for finishing the plaster around ends of joints, beams posts, etc.

In case of opening of area exceeding 5 square, feet each, deduction shall be made for the openings and also no addition shall be made for reveals jambs, soffits, sills, etc., of these openings.

Measurement of acceptably completed works of plaster will be made on the basis of number of square feet of the surface area plaster as shown on the Drawings, or as directed by the Engineer.

12.3 **Payment**

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

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SECTION – 16 MARBLE

1. Scope

The work under this section of specifications, consists of providing all material, labour, plant, equipment, appliances in any floor and at any height and performing all operations required for providing and installing marble natural stone slab for toilet counters, where shown on the drawings, complete in strict accordance with this section of the specification and the applicable Drawings.

2. Submittals

The Contractor shall submit manufacturer's specifications and other product data for each type of marble stone and fixtures required, including instructions for handling, storage, installation and protection.

Shop Drawings shall be submitted showing sizes, dimensions, sections and profiles of slab, arrangement and provisions for jointing, anchoring, fastening and supports and other necessary fixing details. Indicate locations, layouts and pattern arrangements for each stone type and colour.

Submit three ranges samples 300mm x 300mm in size or size approved of each type of stone showing colour, grade, finishing and texture for approval of the Engineer.

3. Delivery, Storage and Handling

Materials shall be protected from damage during loading, shipment, delivery and storage. Non staining materials for blocking and packing shall be used. Stack marble at site in accordance with manufacturer's recommendations and as required to prevent staining, scratching, etching or breakage.

4. Materials

4.1 General

Marble shall be compact, dense, metamorphic rock of lime stone origin obtained from quarries within Pakistan. It shall have a specific gravity of 2.7 and hardness number on Moh's scale shall range from 3 to 4.

Obtain each marble stone type from a single quarry and ensure consistent colour range and texture throughout the work. All pieces shall be of uniform thickness and truly square in shape.

Provide marble slabs/sills and tiles of specified sizes in floors, stair tread & risers and counter tops as shown on drawings.

Provide marble slabs/ sills and tiles of type, colour and finish for each area as directed by the Consultant/Engineer.

Provide stone of specified thickness. Saw cut the back surfaces that are meant to be concealed in finished work.

Provide irregular shaped units, staircase units and skirting base units to the profiles of required shapes & sizes and polished exposed surfaces wherever specified.

4.2 Marble Stone Type

All marble stone types are to be selected and approved by the Engineer for quality, colour and texture.

Marble: Marble of approved type and colour of local origin, first class quality and high class finish acceptable to the Engineer.

4.3 Beds and Backings

Where applicable, standard cementitious screed and mortar beds and backings, mixed and proportioned by volume shall be as follows: -

Grey ordinary Portland	: 1 part
Cement Sand Water	: 3 parts
	: Clean, fresh and free from deleterious substances

4.4 Adhesives, Grouts and Sealants

Proprietary adhesives, joint grouts and sealants of approved type as required and recommended by the manufacturer for specific application shall be used. The colour of the joint grout and the sealants shall match with the colour of stone.

5. Execution

5.1 Flooring, Skirting/dado and Stair

Apply cement slurry coat over surfaces of concrete substrate immediately prior to placing setting bed. Limit area of application to avoid premature drying out. Install setting bed of required thickness and set stone units before initial set occurs. Apply a thin layer of cement paste to bottom of each unit. Set tamps and level units immediately. Set units in required pattern with uniform joint widths.

Point joints as soon as possible after initial set. Force grout into joints, strike flush and tool slightly concave.

Remove mortar and grout from surfaces well still moist and as the work progresses.

Do not permit traffic on finished surface during setting and for a minimum of 24 hours after final pointing of joints.

5.2 Marble Toilet Counters

Marble toilet counter tops of the specified size shall be installed in areas shown on Drawings with M.s. angle framing and fixing accessories in accordance with approved shop drawing. Joints shall be cement grouted with matching colour or with matching colour sealant.

5.3 Repair and Cleaning

Remove and replace stone units which are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units which do not match adjoining stonework or are not in line and level as shown on Drawings. Provide new matching units, install and point joints to

eliminate evidence of replacement. Repoint defective and unsatisfactory joints to provide neat, uniform appearance.

a. Marble

i. Measurement

Measurement of acceptably completed works of respective types of Marble will be made on the basis of net actual area in square feet of Marble Flooring provided and installed in position as shown on the Drawings or as directed by the Consultant/Engineer.

ii. Payment

Payment will be made for acceptable measured quantity of respective type of Marble Flooring on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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SECTION – 18 FLOOR AND WALL FINISHES

1. Scope

The work under this section of the Specification consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in any floor and at any height in connection with the installation of cement concrete floors and floor finishes including bases, skirting and external surface treatments, complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. Material

2.1 Cement

Cement shall be ordinary Portland cement conforming to B.S. 12 or PS 232.

2.2 Sand

All fine sand shall be obtained from sources approved by the Engineer. The grading shall conform to B.S 882 Grading Zone 1 and 2 of which the gradation limits are as follows:

Percentage (by weight) passing

B.S. Sieve	Grading Zone 1	Grading Zone 2
3/8" (9.53 mm)	100	100
3/16" (4.765 mm)	90-100	90-100
No. 7	60-95	75-100
No. 14	30-70	55-90
No. 25	15-34	35-59
No. 52	5-20	0-10
No. 100	0-10	

2.3 Coarse Aggregate

Coarse aggregate shall be crushed or uncrushed gravel or crushed stone, angular or rounded in shape and shall have granular, crystalline or smooth surface free from friable, flaky and laminated pieces, mica and shale. It shall not contain matters injurious to concrete. All coarse aggregate shall conform to BSS NO.882 and shall be graded as follows:

B.S. Sieve	% Passing by weight
1" (25.40 mm)	100
3/4" (19.05 mm)	90-100
3/8" (9.53 mm)	20-55
3/16"(4.765 mm)	0-10

The aggregate shall be stored on properly constructed paving or as directed by the Engineer.

There shall be a physical partition between the stockpiles of coarse and fine aggregate. If required aggregates shall be washed and screened to the satisfaction of the Engineer. Sieve analysis of all the aggregates to be used in the works shall be carried out as and when required by the Engineer. All aggregate shall be subject to the approval of the Engineer.

Any aggregates not found to be of the specified/approved standard shall be rejected by the Engineer and all such rejected material shall be removed from site with-out delay.

Floors, sub-base or base constructed with rejected aggregates shall be dismantled and rebuilt at the expense of the Contractor.

2.4 Stone Ballast

Stone ballast to be used as soling shall comprise of strong, hard, durable stone of approved size. The stone shall be obtained from approved quarry and shall be sound, free from laminations and weak cleavages and shall conform to specifications of "Stone Soling".

2.5 Water

Water used for mixing concrete, curing or any other operation of the works specified herein shall be fresh, clean and free from organic or inorganic matters in solutions or in suspension. Only water of the approved quality shall be used for all constructional purposes:

2.6 Ceramic/Porcelain tiles

Ceramic tiles shall be imported, premium quality, plain white/ coloured or printed. Porcelain tiles shall be imported Italian or Spanish or Granitto. The tiles shall be of sizes as specified on the drawings and shall conform. to BS 1281 as per samples.

2.7 Cleaning Compound

The compound used for all cleaning of terrazzo shall be an approved neutral chemical cleaner free from acid and alkali or any other material that will affect the colour or otherwise damage the terrazzo and shall not affect the conductivity of terrazzo floors.

2.8 PVC Vinyl Tiles

PVC vinyl tiles shall be imported best quality of size 300mm X 300mm Colour and shade shall be as per sample to be submitted by the Contractor and approved by the Engineer.

2.9 Division Strips

Division strips shall be of marble as approved by the Engineer. Standard division strips for floor finishes shall be not less than 5mm (3/16") in thickness and shall not be less than 1-3/4" in depth.

2.10 Marble Chips

Marble chips shall have an abrasive hardness of not less than 16, as determined by the test of wear resistance in National Bureau of Standards Reports MBS 98. Size shall vary from No. zero to 8.

2.11 Preservative Material

Preservative treatment for terrazzo floor shall produce a water-proof finish which will not be impaired by immersion in water at room temperature for a period of 2-1/2 hours, approximately 18 hours after the floor is finished by buffing, as specified. The preservative material shall not discolour the terrazzo nor leave a tacky or sticky finished film on the surface after buffing.

3. Cement Concrete Flooring

The materials for C.C flooring shall be same as already specified under clause 3, "Materials".

3.1 Composition of Concrete

Concrete shall be composed of Portland Cement, sand, coarse, aggregate and water, all well mixed and brought to the proper consistency. The Contractor shall mix the ingredients as indicated on the Drawings. The proportions of the various ingredients shall be determined from time to time during the progress of the work and tests shall be made of samples of the aggregates and the resulting concrete. The mix proportions and appropriate water-cement ratio will be determined on the basis of the production of concrete having required workability, density, impermeability, durability and required strength.

3.2 Mixing Concrete

The concrete ingredients shall be mixed in a batch mixer for not less than 1-1/2 minutes after all ingredients, except the full amount of water, are in the mixer. The Engineer reserves the right to increase the mixing time when the charging and mixing operations fail to produce a concrete batch in which the ingredients are uniformly distributed and the consistency is not uniform. The concrete shall be uniform in composition and consistency from batch to batch except when changes in composition or consistency are required. Water shall be added prior to, during and following the mixer charge. Excessive over-mixing requiring addition of water to preserve the required concrete consistency will not be permitted. The concrete ingredients shall be mixed by volumetric measurement in purpose made boxes approved by the Engineer.

3.3 Construction

The base course of the floor shall comprise of stone ballast of 2 inches (approx: 50 mm) mesh size. The base course shall be thoroughly compacted by suitable power rammers to the total consolidated

thickness as shown on the Drawings and as approved by the Engineer. The interstices shall be filled with smaller size stones. The base course shall be blinded with sand and the whole surface watered. Over the well compacted base course, a layer of concrete of the required grade and thickness shall be laid, in panels of the sizes as indicated on the Drawing and as approved by the Engineer.

After the C.C bed has been cured, as directed by the Consultant/Engineer, it shall be roughened and well watered before floor finishing is laid. The floor finish shall comprise of cement concrete of required grade and shall be laid in panels to the required thickness as shown on the Drawings or as directed by the Engineer. The concrete after laying will be thoroughly rammed and mortar worked up to the top and smoothed with a steel trowel. The edge of each section into which the floor is divided should be defined by wooden screeds of the approved width and of a depth equal to the depth of the floor concrete.

Freshly placed concrete floor and completed floor portions as finished shall be protected to prevent loss of water by covering with damp hessian, water proof paper, damp sand or other approved material, and shall be kept constantly damp for a period of four days or longer after concreting as directed by the Consultant/Engineer. The concrete shall be allowed to dry out slowly over a period of three days after wet curing is completed.

The expansion joints in floors shall be filled in with hot bitumen, of the approved grade, as directed by the engineer.

4. Terrazzo Flooring

4.1 Mix

The terrazzo mixes shall be composed by weight as follows:

Plain terrazzo for all floors and bases indicated as terrazzo and not otherwise specified, shall be composed of one part cement, white or grey, and 2 parts of marble chips of the sizes and colours hereinafter specified.

4.2 Preparation for Terrazzo

The grade and thickness of concrete as shown on the Drawings shall be laid as under bed to receive terrazzo. The surface of the bed shall be roughened for bonding with the terrazzo finish. If the surface is too smooth it shall be roughened with a toothed chisel and, prior to laying the terrazzo the bed shall be cleaned of all dirt, oil grease and extra loose material.

4.3 Division Strips

Terrazzo floors and bases shall be divided up by marble strips of specified thickness and depth. The division strips between field work and borders shall have exposed tops in full width of the strips. The division strips shall be set immediately after the spreading of the under bed, the strips being partially embedded therein, securely anchored to the subfloor and grouted solid.

All division strips shall be set, straight to lines and to the proper level to ensure that the tops of the strips will show uniformly after grinding and smoothing operations are completed and joints and intersections shall be fitted tight. Strips shall be braced to prevent bulging during the placing of terrazzo.

Unless otherwise shown on the drawings, the divisions in field work of large areas shall not exceed 4 feet x 4 feet and in small areas shall not exceed 2 feet x 2 feet.

Edging strips shall be placed at doorways between terrazzo and other types of flooring and along the edges of all terrazzo bases or borders and adjoining other types of floor finishes or floor covering. The edging strips at doorways shall be placed in line with the step face of doors. All edging strips shall be anchored and grouted solid in the under bed or to the concrete sub-floor and braced to prevent bulging as specified for division strip.

4.4 Laying Terrazzo

4.4.1 The sub-surface shall be swept clean, thoroughly moistened, but not saturated, and slushed with a coating of neat cement grout approximately 1/8" in thickness. The under bed consisting of class 'C' cement concrete screed shall be spread and brought to a level not less than 3/4" below the finished floor level. The dividing strips shall be installed in the green under bed. The terrazzo mix shall be spread, tamped and rolled into a compact mass not less than 3/4" thick. After rolling additional aggregate mix shall be sprinkled over the surface to fill up all depressions, to take up excess moisture and to permit the terrazzo to be trowelled to a level, dense and even surface, slightly above the finish line of floor. This level, shall allow for the surface grinding necessary to expose the specified area of aggregate, and to produce smooth, level floors free of waves and depressions.

4.4.2 Seasoning

The completed terrazzo shall be allowed to season for 6 days during which time it shall be kept moist by (1) covering with approximately 1" thickness of sand; or (2) covering with building paper or mats; or (3) sprinkling with water at every 10 hour interval.

4.4.3 Surface

Following the curing period, the terrazzo shall be machine ground to a true, even surface using a No. 24 grit followed by a No. 80 grit or finer abrasive stone. After the first grinding, the floors shall be thoroughly grouted with the same cement and colour composition as specified for the matrix of the terrazzo mix. The grout shall be of the consistency of thick cream, and shall be brushed over the floor to eliminate all pits and thoroughly fill the surface for final grinding.

4.4.4 Finishing

Not less than 72 hours after application, the grouting coat shall be removed by grinding. In the later stages of grinding, the grit stones or other abrasive used in the grinding machine shall be of a grain or fineness that will give the surface smooth finish. Small areas, inaccessible portions and corners which cannot be reached by the grinding machine shall be ground and rubbed by hand.

4.4.5 Protection

The walls and all surfaces of the finished work of other trades shall be properly protected from damage and spoiling during the process of grinding and washing of the terrazzo. After the finish grinding has been completed and the surface treatment applied, the terrazzo work shall be covered and protected with material approved by the Engineer until completion of the work of all other trades.

4.4.6 Cleaning and Coating

Prior to placing the protective covering, the terrazzo floor shall be approved by the Engineer. After the work of all other trades has been completed and the protective covering removed, all terrazzo work shall be washed with cleaning compound, mixed with warm water and using a fine abrasive where necessary to remove any stains or cement' smears. The terrazzo' shall be allowed to dry thoroughly and shall be given a sealing application of preservative material. The sealing material shall be applied in accordance with the manufacturer's directions, leaving all terrazzo work in clean condition as approved by the Engineer.

4.4.7 Dado/Skirting

The ingredients of dado/skirting shall be one part of cement and two parts of marble chips varying from Nos. zero to 2. Striking shall be laid over a base of plaster of specified thickness. The thickness of dado/skirting layer shall be as specified. The surface shall be grinded and polished to the satisfaction of the Engineer.

5. Installation of Tile Flooring

When setting out the tiles, care shall be taken to establish the correct elevation for the floor. A gauge rod shall be used, indicating the overall measurement of a given number of tiles with specified joint width to reduce cutting.

After the floor has been machine finished, it should be covered with white, non-staining sand or rags to protect it while other work is being done. After removal, the floor shall be thoroughly scrubbed.

5.1 General

The base shall be prepared by laying cement concrete of specified grade and of thickness as shown on the drawings, or specified in the Bill of Quantities.

The curing period of the setting bed shall be as directed by the Engineer. As large an area of setting bed shall be spread at one time as can be covered with tiles before the mortar has set. Surplus mortar shall be removed. The thickness of setting bed in any space shall not be less than 1/2".

Floor and wall surfaces to receive the tiles shall be thoroughly cleaned of all dirt, dust, oil and other objectionable matters. Tiles shall be laid out from the centre line of each space in an outward direction and the pattern should be made symmetrical with a minimum number of cut tiles as directed by the engineer.

Joints between the tiles shall be of uniform width. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Tiles shall be laid to the straight edges.

5.2 Ceramic/Porcelain Tiles

The ceramic/porcelain tiles shall be laid to the required lines, levels and grades over a setting bed of cement sand mortar comprising of one part of cement and 4 parts of sand by volume and the joints filled with neat white or grey cement including vertical and horizontal covers. The tile floor shall be kept wet for at least 72 hours and no traffic should be allowed on the tiles during curing period.

6. Measurement and Payment

6.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no measurement and payment will be made for the under mentioned specified works related to the relevant items of the Bill of Quantities.

The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

6.1.1 Loss and wastage of material due to consolidation, erosion and settlement.

6.1.2 All type of joints (expansion, contraction and construction joint etc.).

6.1.3 Class 'C' cement concrete screed base and 1:4 cement sand mortar under floor.

6.1.4 Rough plaster base under skirting / dado.

6.1.5 Finishing/grinding, washing & polishing works of ceramic, concrete, terrazzo tile, terrazzo floors and marble tiles.

6.1.6 Marble strips in terrazzo floors

6.1.7 1 :2 and 1:4 cement sand rough cast plaster.

- 6.1.8 Sand cushion under concrete pavers
- 6.1.9 Adhesives used in the laying of PVC flooring.
- 6.1.10 Bedding / Jointing Material of Envicrete jali
- 6.1.11 Pigmented grouting
- 6.1.12 Cleaning of tiles after installation.
- 6.1.13 Bull-nozing, chamfering of edges of marble tops including base mortar and making holes for wash basin including all necessary fixing accessories.

6.2 Cement Concrete Floor

6.2.1 Measurement

Measurement of acceptably completed works of cement concrete floor steel trowelled finish will be made on the basis of net actual area in square feet laid in position as shown on the Drawings or as directed by the Engineer.

6.2.2 Payment

Payment will be made for acceptable measured quantity of cement concrete floor steel trowelled finish on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

6.3 Ceramic/Porcelain Tile Floor

6.3.1 Measurement

Measurement of acceptably completed works of ceramic/porcelain tile in floor will be made on the basis of net actual area in square feet-of floor laid in position as shown on the drawing or as directed by the Engineer.

6.3.2 Payment

Payment will be made for acceptable measured quantity of ceramic/porcelain tile floor on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

6.4 Ceramic/Porcelain Tile Dado/Skirting

6.4.1 Measurement

Measurement to acceptably completed works of ceramic/Porcelain tile in dado/skirting will be made on the basis of net actual area in square feet of dado/ skirting laid in position as shown on the Drawing or as directed by the Consultant/Engineer.

6.4.2 Payment

Payment will be made for acceptable measured quantity of ceramic/porcelain tile in dado/ skirting on the basis of unit rate per square feet quoted in the Bills of Quantities. The unit rate

shall include all cost of cement, sand, mortar and shall constitute full compensation for all the works related to the items.

6.5 Terrazzo Flooring/Skirting

6.5.1 Measurement

Measurement of acceptably completed works of terrazzo flooring/skirting will be made on the basis of net actual area in square feet laid in position as shown on the Drawings or as directed by the Engineer.

6.5.2 Payment

Payment will be made for acceptable measured quantity of terrazzo flooring/skirting on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

6.6 PVC Vinyl Tile

6.6.1 Measurement

Measurement of acceptably completed works of PVC vinyl tile flooring will be made on the basis of net actual area in square feet laid in position as shown on the Drawings or as directed by the Engineer.

6.6.2 Payment

Payment will be made for acceptable measured quantity of PVC vinyl tile flooring on the basis of unit rate per square feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 19 PAINTING

1. Scope

The work under this section of the Specifications consists of furnishing all materials, plant, labour, equipment, appliances and performing all operations in any floor and at any height in connection with surface preparation, mixing, painting concrete works, gates, frames, walls, ceilings and all such surfaces as shown on the Drawings and/or as directed by the Engineer. The scope of this section of specification is covered with detailed specifications as laid down herein.

2. Applicable Standards

Latest editions of following British Standards are relevant to these specifications wherever applicable.

2.1 BSI (British Standards Institution)

245 Specification for mineral solvents (white spirits and related hydrocarbon solvents) for paints and other purposes.

2521 Lead - based-priming paint for wood work .

2523 Lead based priming paint for iron and steel.

2569 Sprayed metal coatings.

4800 Paint colours for building purposes. Painting of building.CP2

3. Cleaning and preparation of metal surfaces

3.1 Except as otherwise specified, all painting shall be applied in conformity with BS CP 231 "Painting of Building" as applicable to the work.

3.2 The Contractor shall repair at his own 'expense all damaged" or defective areas of shop-painted metal and structural steel work. Metal surfaces against, which concrete is to be placed will be furnished shop-painted and shall be leaned prior to being embedded in concrete.

3.3 Except as otherwise specified all concrete and plastered surfaces are to be painted.

3.4 The Engineer will furnish a schedule of colours for each area and surface. All colours shall be mixed in accordance with the manufacturer's instructions.

3.5 Colours of priming coat (and body coat) where specified, shall be lighter than those of finish coat. The Engineer shall have unlimited choice of colours.

Samples of all colours, and finishes shall be prepared in advance of requirement so as not to delay work and shall be submitted to the Engineer for approval before any work is commenced. Any work done without such approval shall be redone to the Engineer's satisfaction, without additional expense to the

Employer. Samples of each type of paint shall be on separate 12" x 12" x 1/8" tempered hard board panels. Manufacturer's colour chart shall be submitted for colour specifications and selection.

4. Materials

- 4.1 All materials shall be acceptable proven first grade products and shall meet or exceed the minimum standards of reputable manufacturers as approved by the Engineer.
- 4.2 Colours shall be pure, non-fading pigments, mildew-proof sun-proof, finely ground in approved medium. Colours used on-plaster and concrete surfaces shall be lime proof. All materials shall be subject to the Engineer's approval.
- 4.3 All synthetic enamel paints and primers for structural steel works, metal work and wood works will be the best available of its type and shall be approved by the Engineer prior to its procurement.
- 4.4 Approved quality Weather Shield Weather Coat paint shall be used for painting the exteriors of the structures or other surfaces where specified on the drawings as directed by the Engineer.
- 4.5 The plastic emulsion paint, vinyl emulsion paint or similar as approved by the Engineer shall be used for interior surfaces.
- 4.6 All material for Bitumen painting shall consist of Bitumen grade 10/20. It shall be used for foundations or wherever recommended by the Engineer.
- 4.7 Only paints manufactured by ICI, Berger or approved equivalent shall be used in this Project. All material shall be delivered to site in their original unbroken containers or packages & bear the manufacturer's name, label, brand & formula & will be mixed and applied in accordance with his directions.

5. Delivery Storage And Container Sizes

Paints shall be delivered to the site in sealed containers, which plainly show the type of paint, colour (formula or specifications number) batch number, quantity, date of manufacture, name of manufacturer and instructions for use. Pigmented paints shall be supplied in containers not larger than 20 liters. All materials shall be stored under cover in a clean storage space, which should be accessible at all times to the Engineer. If storage is allowed inside the building, floors shall be kept clean and free from paint spillage.

6. Surface Preparation

- 6.1 All oil, grease, dirt, dust, loose mill scale and any other foreign substance shall be removed from the surface to be painted, polished and white washed by the use of a solvent and clean wiping material. Following the solvent cleaning, the surfaces shall be cleaned by scrapping, chipping, blasting, wire brushing or other effective means as approved by the Engineer.

- 6.2 In the event the surfaces become otherwise contaminated in the interval between cleaning and painting, recleaning will be done by the Contractor at no additional cost.
- 6.3 Surfaces of stainless steel, aluminum, bronze, and machined surfaces adjacent to metal work being cleaned or painted shall be protected by effective masking or other suitable means, during the cleaning and painting operations.
- 6.4 All the surfaces to be painted with approved quality paint shall be free from dust, dirt, fungus, lichen, algae etc. Oil paint, varnish and lime wash should always be removed by scraping and washing.
- 6.5 All surfaces to be bitumen painted shall be thoroughly cleaned of any accretion, dust, dirt etc. by scraping, wire-brushing or as directed by the Engineer. The surface shall be primed with a coat of asphalt oil used at the rate of not less than 0.50 pound per square foot. No work in this section shall be allowed until all surfaces or conditions have been inspected and approved by the Engineer.

7. Application

- 7.1 All paint and coating materials shall be in a thoroughly mixed condition at the time of application. All work shall be done in a workman like manner, leaving the finished surface free from drips, ridges, waves, laps, and brush marks. All paints shall be applied under dry and dust free conditions. Unless approved by the Engineer paint shall not be applied when the temperature of the metal or of the surrounding air is below 7 degrees centigrade. Surfaces shall be free from moisture at the time of painting.

All primary paint shall be applied by brushing. The first coat of paint shall be applied immediately after cleaning. When paint is applied by spraying, suitable measures shall be taken to prevent segregation of the paint in the container during painting operation.

Effective means shall be adopted for removing all free oil and moisture from the air supply lines of the spraying equipment. Each coat of paint shall be allowed to dry or harden thoroughly before the succeeding coat is applied. Surfaces to be painted that will be inaccessible after installation shall be completely painted prior to installation.

Coats of Weather Shield Weather Coat paint shall be applied in accordance with the manufacturer's instructions or as directed by the Engineer.

Only as much material should be mixed as can be used up in one hour. Over thinning will not be permitted. After the first coat the surfaces will be soaked evenly four or five times and the second coat shall be applied after leaving for at least overnight.

- 7.2 Where shown on Drawings all exterior finishes shall be painted with Weather Shield/weather coat paint in approved colours as

per manufacturer's specifications. The number of coats shall be as shown on the drawings or as directed by the Engineer.

7.3 All wooden doors shall be painted with approved synthetic enamel paint as per manufacturer's recommendation and instructions or after approval of the Engineer.

7.4 Plastic emulsion paint vinyl emulsion paint or matt enamel paint of the approved make and shade shall be applied to surfaces as shown on Drawings as per manufacturer's instructions. The number of coat shall be as indicated on the Drawings or as directed by the Engineer.

7.5 Two coats of hot bitumen paint shall be applied to exposed concrete surfaces in contact with earth. The first coat shall be allowed to dry for about six hours before applying the second coat. During the operation of painting great care should be taken to avoid air bubbles. The manufacturers instructions and Engineer's directions shall be complied with.

8. Job Conditions

8.1 Observe manufacturer's recommended minimum and maximum temperature but do not apply paint or finish to any surface unless ambient temperature is 10 degree C or above and less than 43 degree C. No painting shall be done above 90% relative humidity.

8.2 Place drop cloths to adequately protect all finished work.

8.3 Remove and replace all items of finish hardware, device plates, accessories, lighting fixtures or other removable items.

8.4 In no case shall any finish hardware or other finished item that is already fitted into place be painted, unless otherwise specified.

9. Quality Assurance

All paint for anyone surface shall be top quality, of one manufacturer and approved by the Engineer. Deep tone accent colours shall be used and the unavailability of final coat colours may be the basis for rejecting materials for anyone surface.

10. Schedule of Measurement Of Paint Area

10.1 Irrespective of prime coats and number of paint coats applied to exposed painting surface area of column, walls, projections, ceilings, false ceilings and other surfaces (Except gates, doors windows and ventilators) shall be measured as per actual paint-surface area for single time only and paid in accordance with quoted rate of Bill of Quantities.

11. Measurement And Payment

11.1 General

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

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

11.1.1 Preparatory works, including preparatory materials, scraping, scratching, sand blasting, clearing, prime coating, priming, protection of finished works etc.

11.1.2 Polishing works, including preparatory materials, scraping, cleaning, sanding etc/

11.1.3 Painting work on steel & wooden surfaces.

11.1.4 Before application of paint on existing surface the old paint surface shall be removed existing paint filling of cracks, surface preparation and application of primer coat, if any.

11.2 Measurement

11.2.1 Measurement of acceptably completed respective type of painting works will be made on the basis of net actual areas in square feet of the surface painted as shown on the Drawings or as directed by the Engineer.

11.2.2 Payment will be made for acceptable measured quantity of respective type of painting on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 20 TEXTURED I GRAFFITO WALL COATING

1. Scope

The work under this section of the Specifications consists of furnishing all materials, plant, labour, equipment, appliances and performing all operations in connection with surface preparation, mixing, and application of graffito wall coating as shown on the Drawings and/or as directed by the Engineer. The scope of this section of specifications is covered with detailed specifications as laid down herein.

2. General

- 2.1 Except as otherwise specified, all painting shall be applied in conformity with BS CP 231 "Painting of Building" as applicable to the work.
- 2.2 The Engineer will furnish a schedule of colours for each area and surface. All colours shall be mixed in accordance with the manufacturer's instructions.
- 2.3 Samples of all colours/coating, stains and finishes shall be prepared in advance of requirement so as not to delay work and shall be submitted to the Engineer for approval before any work is commenced. Any work done without such approval shall be redone to the Engineer's satisfaction, without additional expense to the Employer. Samples of each type of . coating shall be on separate 300 x 300 x 3 mm tempered hard based panels. Manufacturer's colour chart shall be submitted for colour specifications.

3. Material

- 3.1 Material shall be acceptable, proven, top-grade products and shall meet or exceed the minimum standards of reputable manufacturers as approved by the Engineer.
- 3.2 The material for textured graffito coating shall be variable granular material and shall composed of Acrylic Copolymer Emulsions spherodial quartz various additives, metallic oxides, inerts of different granulemetries colouring agent, antibacterial and antibacterial agents.
- 3.3 All materials shall be delivered to site in their original unbroken containers or packages and bear the manufacturer's name, label, brand and formula and will be mixed and applied in accordance with his directions.

4. Surface Preparation

- 4.1 All oil, grease, dirt, dust, loose mill scale and any other foreign substance shall be removed from the surface to be coated. Following the solvent cleaning, the surfaces shall be cleaned by scraping, chipping, blasting, wire brushing or other effective means as approved by the Engineer.

In the event the surfaces become otherwise contaminated in the interval between cleaning and costing, recleaning will be done by the Contractor at no additional cost.

No work in this section shall be allowed until all surfaces or conditions have been inspected and approved by the Engineer.

The grafito coating material should be applied with stainless steel trowel and finished with plastic trowel in thickness as per manufacturer's specification. To get straight texture plastic trowel should be moved vertically and the trowel is to be rotated to obtain swirl texture.

5. Measurement And Payment

5.1 General

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

5.1.1 Preparatory works, including preparatory materials, scraping, scratching, sand paper rubbing, cleaning, protection of finished works etc.

5.1.2 Providing and applying rough plaster base Corner, pattas, rounding&, arches, borders, grooves etc.

5.2 Measurement

Measurement of acceptably completed works of graffito coating to specified surfaces will be made on the basis of actual area in square foot of the surface coated as shown on the Drawing or as directed by the Engineer.

Payment

Payment will be made for acceptable measured quantity of coating to specified surfaces on the basis of unit rate per square foot quoted in the Bill of Quantities & shall constitute full compensation for. all the works related to the item

SECTION – 21 FALSE CEILING

1. Scope

The work under this section of the Specifications consists of furnishing all materials, plant, labour, equipment, appliances and performing all operations in connection with providing and fixing of False Ceiling as shown on the Drawings and/or as directed by the Engineer. The scope of this section of specifications is covered with detailed specifications as laid down herein.

2. Product Delivery, Storage and Handling

- 2.1 Material shall be delivered in original; unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating.
- 2.2 Material shall be stored in original protective packaging to prevent soiling, physical damage or wetting.
- 2.3 Cartons shall be stored in the installation area, opened at each end to stabilize moisture content and temperature, for 48 hours prior to installation.

3. Job Site Conditions

- 3.1 Work which will be concealed by false ceilings shall be completed, tested, inspected and accepted before ceiling work is started.
- 3.2 False ceiling installation shall not begin until the area has been closed in, and temperature and humidity approximate occupancy conditions. Wet work shall be cured and dry before ceiling work is started.
- 3.3 Surface which will support the ceilings, and those to which the ceiling abut, shall be inspected and accepted for completeness and adequacy to receive the ceilings before the work begins.

4. Installation and Workmanship

False ceiling suspension system and panels shall be installed in accordance with the requirements of BSI-CP.290 and with the manufacturer's recommendations as approved by the Engineer.

4.1 Suspension System

The hangers as specified shall be evenly disposed as per drawings, details and place and position as indicated. The suspension system should be installed by making holes in the roof and shall be made good as directed by the Engineer. Their lengths clear of roofing slab shall be as per shop drawing details.

The framing of the specified section and run at spacing as per shop drawings. The jointing of runners to hangers shall be as per approved shop drawing details. The extra framing if required shall be provided for light receptacles as per approved shop drawing details.

Wall hangers shall be positively and rigidly connected to the structure and to cross runners.

4.2 False Ceiling tiles.

Tiles shall be installed in the grid system after completion of installation of the suspension of lighting and air conditioning fixtures.

Forming ceiling panels shall be laid out in pattern including border of uniform width around all sides of each ceiling area. The pattern shall be as per shop drawings approved by the Engineer.

All panels shall be furnished and installed in an approved manner and as per approved types, sizes and surface design.

6 Fixtures

Light fixtures shall be installed as per approved pattern and supported in accordance with manufacturer's recommendations.

7 Finishing

After installation, dirty, soiled or discoloured surfaces shall be cleaned and left free from defects and ready to receive any painted finish if required.

The panels which are damaged or improperly installed shall be removed and replaced' by the Contractor at his cost.

8 Measurement and Payment

a. General

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

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

Aluminum approved suspension system including main channels, main tee/cross tee bars, wall moulding and edge trims, hanger strips and accessories hold down clips, Aluminum tiles / strips etc. complete for aluminum tile / strips ceiling.

b. False Ceiling

i. Measurement

Measurement of acceptably completed works of respective types of false ceiling will be made on the basis of net actual area in square feet of false ceiling provided and installed in position as shown on the Drawings or as directed by the Consultant/Engineer.

ii. Payment

Payment will be made for acceptable measured quantity of respective type of false ceiling on the basis of unit rate per square feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION – 22 STEEL DOORS

1.1 DESCRIPTION

Providing making and fixing steel doors, windows and ventilators single or double leaf, single shutter or double shutter, fully paneled and include providing and fixing of wire gauze, glazing, deodar wood beading, steel putty filling, all mongery fittings or fixtures if required and shown on drawings or as directed by the Engineer and conforming to the relevant B.S./ASTM Specifications.

1.2 MATERIAL REQUIREMENTS

All materials steel sections, etc. shall comply with the specifications given in respective section. The steel sections shall be according to ones shown in the drawings and shall be free from injurious matter air holes blows wounds spitted grains un-cleaned and blunt rises and crevices.

1.3 CONSTRUCTION REQUIREMENTS

The steel sections shall be thoroughly straightened in the shape by methods that will not injure it before being laid off or worked in any way.

i. Cutting & Forming:

All members shall be so cut and formed that they can be accurately assembled without being unduly cracked strained or forced into position.

ii. Jointing:

The jointing of different parts of the members of members of mild steel shall be carried out by welding process with the help of electric/hydroxy flame. Welding points should be made quite smooth by filling them and should confirm to the width stipulated in the relevant drawings.

iii. Wire Gauze:

Unless otherwise specified or directed by the Engineer the 24 gauge, 12x12 mesh wire gauze shall be fixed as shown on the drawings.

iv. Glazing:

Glazing shall be strictly according to the specifications given in respective section and shall be fixed as shown on the drawings.

v. Fittings Fixtures etc.

All mongery fittings fixtures shall be of approved quality and shall be fixed as per standard practice or as per drawings. All the welding points shall be smoothened by filling and the heads of bolts sunken in the frame.

vi. Fixing:

All the frames of windows shall be fixed at site with the hold fasts of specified size and number and as shown on drawings.

All finished members must be free be free from twists bends or open joints and shall strictly be in accordance with drawings.

vii. PRECAUTION/PROTECTION

Unless otherwise permitted in writing by the Engineer or if shown otherwise on drawings the steel windows shall be placed in position before the work reaches the sill level so that they can be built in as brick work or masonry proceeds. The Contractor shall take care to protect the work from any damage of whatsoever nature during the construction period. In case of any such damage done to the work the Contractor shall remove replace or rectify such work at his own cost without compensation.

The windows, doors, steel grills, gates etc. shall be painted with primary coats of red oxide and good quality of Zinc Chromate Primer or any approved anticorrosive paint after proper grinding and two coats of synthetic enamel paint of approved make. No extra payment shall be made for such work.

SECTION – 22 LIST OF APPROVED MANUFACTURES AND MAKE CIVIL WORKS

- ORDINARY PORTLAND CEMENT Falcon Cement, Lucky Cement, Pakland Cement.
- SULPHATE RESISTANT CEMENT Falcon Cement, Lucky Cement, Pakland Cement.
- STEEL Amreli Steel, Abbas Steel & Razzak Steel.
- SAND Bolari Sand, Jhangara.
- CRUSH AGGREGATES Good Quality Crush from Hub Origin or as approved by Consultant.
- TERMITE PROOFING WORK Bi-Flex FMC / Mairaj Ali Akbar Group or as Approved By Consultant.
- ALUMINIUM DOORS/WINDOWS Lucky, Krudsons or Equivalent as approved by Consultant.
- DOUBLE TEE RCC ROOF PANEL M/s. Izhar Concrete Pvt Ltd, Izhar Group of Companies.
- GLAZED TILES Master Tiles, Shabbir Tiles, Karam Ceramics or Imported as approved by consultant
- PORCELAIN TILES Local /Imported of approved manufacturer (Nano Polish) or as approved by Consultant.
- INDUSTRIAL TILES National Tiles, EMCO Tiles or as approved by Consultant.
- MARBLE TILES Popular Marble Industries, Marina Marbles or as approved by Consultant.
- BOND FOR TILES STILE BOND or equivalent

- PAINT WEATHER SHIELD, SPD DISTEMPER, SYNTHETIC ENAMEL PAINT, MATT FINISH PAINT. ICI /Berger/ Jotun/ Nippon.
- PAINTS / PRIMER & PUTTY ICI Pakistan Ltd/ Berger Paints Pakistan Ltd. / Jotun/ Nippon
- WOOD SHILED, WOOD PRESERVATIVES Jotun Paints
- ALUMUNIUM EXPANSION, JOINT COVER.STRIP FOR FLOORS/WALLS ETC Balco, M/s. Chemi Tech., Sika or As Approved By Consultant.
- HARDWARE & HANDLES JB Saeed, & Co., Mona Hardware, Building Hardware Store.
- WOODEN CABINETS Best quality MDF / Lasani or approved by Consultant
- WOOD WORK & DOORS Sterling or equivalent approved by Consultant.
- FLUSH DOORS Sterling or equivalent approved by Consultant
- GLASS Tinted Glass imported as approved or Ghani Glass if directed by Consultant.
- TEMPERED GLASS Pakistan Safety Glass.
- LOOKING MIRROR Imported Belgium Glass or As Approved By Consultant.
- VENITIAN BLINDS Protector, MI Décor.
- FIBER GLASS SHEET (Hollow / Solid) Toughlite Brand, Polyron Brand.
- GALVANISED IRON (GI) PIPE, VALVES & FITTINGS M/s. I.I.L., M/s. Sattar & Sons or As Approved By Consultant.
- RCC PIPE M/s. RAZIA Brand or As Approved By Consultant.

