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**SECTION - 1**  
**CONTRACTOR'S CAMP**

## **1.1 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 thereof, and of the camps or establishments of all persons/parties in the vicinity operating or associated with the Contractor shall be subject to approval of the Engineer.

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

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

The Employer shall not be responsible to provide any space to the Contractor for building his construction and labour camps and any other facilities in this respect. The Contractor shall make his own arrangements for space for his construction and labour camp at his own risk and cost.

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

The Contractor shall furnish, make arrangements for, and carry out adequate maintenance for the Contractor's camp areas at each camp to provide a neat, well kept camp in all respects with pleasant and healthful surroundings and conditions for all occupants of their camp. The Contractor's camps shall be kept clean, well graded, and free from undergrowth and brush and adequately drained. Roads and streets shall be kept in good condition. All utilities shall be adequately and properly, operated and maintained to provide services and conditions meeting the requirements of these specifications in all respects.

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

The Contractor shall facilitate the Engineer in use of his site office if and when required by the Engineer in performance of his duties regarding the supervision of project.

## **1.2 PAYMENT OF WORK**

No payment shall be made for the work 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 rates of other items of the Bills of Quantities.

**SECTION - 2**  
**STAKE-OUT SURVEY**

**2.1. SCOPE**

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

**2.2. MATERIAL AND EQUIPMENT**

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

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

**2.3. SUBMITTALS**

Submit all survey data, computations, field notes, drawings and all other survey records necessary to accomplish the work.

**2.4. EXECUTION**

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.

**2.5. PAYMENT OF WORK**

No payment shall be made for the work 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 rates of other items of the Bills of Quantities.

**SECTION - 3**  
**DISMANTLING AND DEMOLITION WORKS**



### **3.1. SCOPE**

This Section specifies the requirements for dismantling and demolition and removal of buildings, structures and related service utilities, disposal of materials arising from dismantling and demolition work, and procedure or methods or process to be followed for dismantling and demolition.

All available plans of the structure where dismantling and demolition works are to be carried out are to be examined and where the nature of the construction is uncertain a special investigation is to be carried out as agreed with the Engineer.

### **3.2. GENERAL**

3.2.1 The Contractor is to inspect determine for himself the work involved and the equipment and the materials required for the specified dismantling and demolition work.

3.2.2 All materials arising from the dismantling and demolitions are to be disposed off as directed by the Engineer.

3.2.3 Materials arising shall be cleared from the site as the work proceeds in an approved manner. Removal operations for materials arising should be conducted with the least interference to the public and not be started until approved by the Engineer. The Engineer has the right to reject off-site disposal plans if disposal would leave an unsightly condition anywhere.

3.2.4 The Contractor is to provide safeguards, including warning signs, barricades, temporary fences as required for the protection of the public and Site personnel during dismantling and demolition and removal operations. The safeguards are to be maintained until dismantling and demolition and removal operations are complete.

3.2.5 The Contractor shall conduct his operations in a manner that minimizes the spread of flying particles and dust. Rubbish and debris shall to be sprinkled with water to keep dust to a minimum.

3.2.6 In addition, the following safety rules shall be observed in the performance of the work:

- a) no wall or part of wall shall be permitted to fall outwardly from structures.
- b) ways are to be kept free of obstructions and debris.
- c) wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use.
- d) Isolated walls should not be left un-shored unless they are structurally stable against wind and other forces likely to affect them.

### **3.3. SPECIAL-INVESTIGATIONS**

The Contractor is to ascertain from the responsible authority whether any mains or services need to be redirected or cut-off. The Contractor shall conform to any procedures prescribed by the relevant authority and the Engineer.

### **3.4. METHOD OF STATEMENT**

The Contractor is to prepare a method statement which shall detail all aspects proposed dismantling and demolition work and associated procedures before commencing any

dismantling and demolition work. The method statement shall be approved by the Engineer before any dismantling and demolition work commences.

The design of any shoring and supports necessary to maintain the stability of any structure retained after the dismantling and demolition of adjoining property are to be submitted to the Engineer for approval. The responsibility for the sufficiency of the design is to rest with the Contractor, notwithstanding the approval of the Engineer.

### **3.5 EXECUTION**

3.5.1 The Contractor shall completely or partially demolish and remove structures as approved by the Engineer, including all foundation, sub structure materials, services related or connected thereto.

3.5.2 Debris, including brick, concrete, stone, metals and similar materials are to be disposed off by the Contractor off the Site, at suitable locations as approved by the Engineer.

3.5.3 Once dismantling and demolition work has started, the same is to be continued till the completion, promptly and expeditiously.

3.5.4 The Contractor is responsible for removing any additional small "out" or miscellaneous structures that have not been indicated in the documents unless otherwise instructed by the Engineer.

3.5.5 Operations necessary for the removal of an existing or part of an existing structure or obstruction, which may damage new construction, are to be completed prior to placing the new work unless otherwise specified in the documents.

### **3.6. UTILITY-SERVICES**

3.6.1 The Contractor is to arrange for the disconnection of all utilities that serve buildings and/or provide as per the requirements alternate arrangements for the services in accordance with the respective requirements and regulations of the relevant authority.

3.6.2 The Contractor shall liase directly with the service utility authorities to assertion correct procedures and safe working practices related to disconnection of each particular utility service.

3.6.3 The Contractor shall demolish and remove external utility service lines as follows:

- (a) abandoned portions of utility lines located outside areas of new buildings, that are less than 650 mm below proposed finished ground levels.
- (b) abandoned portions of utility lines which occur within areas of new buildings
- (c) abandoned utility lines that would interfere with installation of new utility lines
- (d) other abandoned lines not specified that interface with performance of the work of this contract.

Unless otherwise stated elsewhere in the Documents, the point of disconnection of utility services shall be at a point agreed with by the utility owner.

### **3.7. TEMPORARY WORK**

3.7.1 The Contractor is to provide temporary works for protection of existing pavements, utilities, and structures where and when necessary.

- 3.7.2 Support is to be provided for members of framed structures before cutting them.
- 3.7.3 Where a structure's stability may be affected by the dismantling and demolition of a member, temporary bracing, and guys, are to be provided to restrain the remaining members.

**3.8. MEASUREMENT AND PAYMENT**

Except otherwise specified herein or elsewhere in the Contract Documents, the payment for dismantling and demolition works shall be made on lump sum basis unless specifically specified other-wise in the Bills of Quantities. The payment shall include, but not limited to, all costs incurred in connection with provision of all works to be executed under these specifications and the Contractor shall not be entitled to any claim or claim any compensation on this account.

**SECTION - 4**  
**EARTHWORK**

#### **4.1. SCOPE OF WORK**

The work under this section of the specifications consists of furnishing all plant, labor, equipment, appliances and materials and in performing all operations in connection with earthwork of all underground services and structural units, roads and temporary drainage, 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. The Contractor shall make his own arrangement (including obtaining permissions from the concerned agencies/authorities for the use of land/areas in the immediate vicinity of the Project Site and the payments in this regard if any) for the acquisition of areas to be used for stockpiling of suitable excavated material.

#### **4.2. SUBMITTALS**

The Contractor shall perform a joint survey with the Engineer's Representative, of the area where earthwork is required, plot the ground levels on the drawings and obtain approval from the Engineer before starting the earthwork.

#### **4.3. EXECUTION**

The Contractor shall be deemed to have made local and independent inquiries 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.

All excavations, cuts and fills shall be constructed to the lines, levels, slopes and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the Defects Liability Period the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the Defects Liability Period any damage or defects in cuts and fills, in structures and other works or rolling of stones/boulders caused by blasting or otherwise, 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.

#### **4.4. SITE PREPARATION**

4.4.1 The Contractor shall set out the work 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 work, the Contractor shall at his own expense rectify such error, to the satisfaction of the Engineer/Engineer's Representative.

4.4.2 The Contractor shall construct and maintain accurate bench marks so that the Lines and Levels can be easily checked by the Engineer/Engineer's representative.

#### **4.5. EXCAVATIONS**

4.5.1 The Contractor shall set out the work 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 work, the Contractor shall at his own expense rectify such error, to the satisfaction of the Engineer/Engineer's Representative.

4.5.2 The excavation may be done by mechanical excavators and/or by normal means and the excavated materials be disposed off to stock on spoil as directed by the Engineer. 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 in and around the Project Site at locations designated and approved by the Engineer.

Excavated material unsuitable for use as fill and backfill shall be disposed off by the Contractor at safe and suitable locations, as approved by the Engineer.

4.5.3 The Contractor shall give reasonable notice that he intends to commence any excavation and 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.

4.5.4 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 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 detrimental to the stability of sub-grades and foundations. Provide discharge lines 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 are caused to the surrounding services properties.

4.5.5 NOT USED

4.5.6 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.

4.5.7 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.

4.5.8 All excavations in foundations shall be taken to 6 inch above the final excavation elevations shown on the drawings and the last 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.

4.5.9 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.

4.5.10 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.

- 4.5.11 The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry condition.
- 4.5.12 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 elects 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.
- 4.5.13 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.
- 4.5.14 Where applicable the excavation work shall include the excavation 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.
- 4.5.15 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.
- 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.
- 4.5.16 The Engineer may require the Contractor to excavate below the elevations shown on the drawings or may order him to stop above the elevations shown depending upon the suitable foundation material encountered.
- 4.5.17 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.

#### **4.6 EXCAVATION TOLERANCES**

All slopes, lines and grades shall be true, correct and accurate to those shown in the plans or otherwise directed and approved by the Engineer. The sub-grade in cuts shall be accurate to the authorized profile grade for the sub-grade to  $\pm$  one inch (1").

Where discrepancies are found in the work the Contractor shall make the necessary corrections.

**4.7 FILL AND BACKFILL**

4.7.1 The backfilling shall include filling under the floors, around the foundation trenches/walls, 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.

4.7.2 Backfill shall be either using granular backfill material or common backfill as directed and approved by the Engineer. Granular backfill materials shall meet the following requirements.

a) Grading Requirements

mm	Inch	A	B
25	1"	100	100
19	3/4"	60 – 100	75 – 100
4.75	No. 4	50 – 85	55 – 100
2.0	No. 10	40 – 70	40 – 100
0.425	No. 40	25 – 45	20 – 50
0.075	No. 200	0 – 15	5 – 15

b) Material satisfying the requirements of coarse sand falling under soil classification A-3 (AASHTO). In case coarse sand is utilized for granular fill it shall be ensured that the same is confined properly with approved material.

c) The material shall have a plasticity index of not more than six (6) as determined by AASHTO T – 89 and T – 90.

4.7.3 The excavated material if found suitable shall be stockpiled. 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 surplus stockpiled material left over after the completion of fill and back-filling works shall be disposed off by the Contractor and the area to be cleaned up and left in a condition as was prior to its use for stockpiling.

4.7.4 The Contractor shall provide the approved quality of backfill and fill material required to complete the fill and back-filling work from the places as designated by the Engineer.

Deep filling shall be predominantly granular material and free from slurry mud, organic or other unsuitable matter and capable of compaction by ordinary means.

4.7.5 Material for backfilling shall be as approved by the Engineer and shall be placed in layers not exceeding six (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.

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 or as approved by the Engineer.

- 4.7.6 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.
- 4.7.7 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.
- 4.7.8 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 top of footing.
- 4.7.9 Before the start of fill and backfill, the Contractor shall satisfy himself as to the levels and slopes of the fills and backfill shown on the Drawings, the requirements of compaction, the possibility of settlement & all other particulars whatsoever in connection with the filling works.
- 4.7.10 All filled areas shall be left neat, smooth and well compacted, the top surface consisting of the normal site surface soil, unless otherwise directed.

#### **4.8 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.

#### **4.9 DISPOSAL OF SURPLUS EXCAVATED MATERIAL**

- 4.9.1 The rejected unsuitable material and surplus excavated material shall be disposed off at locations approved by the Engineer. No compensation of any lead/lift is admissible and rates quoted shall be deemed to include the same. The surplus excavated material shall be so placed that it will present a neat appearance and not offer any danger to abutting properties.
- 4.9.2 The material shall be declared unsuitable if the soaked CBR (96 hours) is less than five (5) percent or if falls under A-6 or A-7 of AASHTO soil classification.
- 4.9.3 The disposal of surplus/unsuitable excavated material shall include loading, unloading, transporting, stacking, spreading and leveling and as directed by the Engineer.

#### **5.0 MEASUREMENT AND PAYMENT**

##### **5.1 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.

- 5.1.1 Timber shoring, planking, strutting and providing slope for upholding the sides of excavations.

- 5.1.2 Any fill with approved material necessitated by over excavation due to fault or convenience of the Contractor except under structural members.
- 5.1.3 Stockpiling the excavated material and transporting back suitable material to places requiring fill or backfill.
- 5.1.4 Specified foundation bed preparation.
- 5.1.5 Excavation involved in providing adequate working space around sides of foundation and service line trenches.
- 5.1.6 Providing approved quality fill/backfill material obtained from excavated material as designated by the Engineer.
- 5.1.7 Excavation in rock, control of and removal of water during or after earthwork operations.
- 5.1.8 Rolling, leveling, watering & compacting the fill and backfill to required density.
- 5.1.9 All laboratory and field tests stipulated in these specifications.
- 5.1.10 Disposal of rejected surplus and unsuitable excavated material and left-over stockpiled suitable material at locations approved by the Engineer. No compensation of any lead/lift is admissible and rates quoted shall be deemed to include the same.
- 5.1.11 De-watering to keep the foundations dry during construction.
- 5.1.12 Obtaining permissions from the concerned agencies/authorities for the use of land/areas in the immediate vicinity of the Project Site and the payments in this regard if any for stockpiling of suitable excavated material.

## **5.2 Excavation**

### **5.2.1 Measurement**

Quantities of excavation shall be calculated/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.

### **5.2.2 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.

**5.3 Backfill/Fills**

5.3.1 Measurement

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

5.3.2 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 - 5**  
**TERMITE CONTROL TREATMENT**

**5.1. SCOPE**

The scope of work for anti -termite treatment includes injection of insecticide in sides and bottom of foundation trenches, spraying on stockpiled backfill material and injections of the insecticide in floor sub-grade of the building. The scope also covers treatment of all wood works with insecticides before installation in position.

**5.2. APPLICABLE STANDARDS**

All methods of termite protection used herein shall be in accordance with the standard practices of National Pest Control Association, U.S.A and the British Wood Preserving Association.

**5.3. SUBMITTALS**

The Contractor shall supply samples of all the materials to be used for insecticide control for approval of the Engineer and testing in accordance with the specified standards. Rejected materials shall be removed from the site immediately.

**5.4. MATERIAL**

4.1 An emulsible concentrate insecticide shall be used for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a diluent. Provide a working solution of the following chemical element and concentrations.

**BIFLEX** with Bifenthrin  
**Or**  
**Approved Equivalent**

4.2 All mixing shall be done at site and mixing proportion of insecticide with water shall be in accordance with the approved manufacturer's recommendations and shall be verified by the Engineer.

4.3 Pure turpentine shall be used for dilution of insecticide, in approved proportion for application to woodwork.

**5.5 EXECUTION**

**5.5.1 EXTENT OF APPLICATION**

5.5.1.1 Insecticide solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150 psi to all applications to, on or in earth.

5.5.1.2 Soil treatment shall begin after all work of preparation of earth prior to installation of concrete has been done. After application, no additional earth moving or work upon sub grade should be done. No covering of earth or concrete should be applied over soil treatment until at least 24 hours after treatment has been made.

5.5.1.3 Insecticide solution should not be applied during wet weather, or when the earth surface is excessively wet. Application should be made to all areas beneath concrete slabs-on-grade, including sidewalks and paving abutting buildings for distance of at least 6 feet beyond building line. Solution shall be applied in amounts of not less than 5 lit./ Sq.M or 5 lit./10.76 Sq.ft. of area. If applied over gravel or sand fill, application shall not be less than 7 lit./ Sq.M or 7 lit./10.76 Sq.ft. of area. Insecticide shall penetrate to a depth of 1-inch minimum in porous earth at bottom and 2 inch to 3 inch at sides of excavations, or as specified by the manufacturer of the approved chemical, which ever is more.

5.5.1.4 Sides of foundation/retaining wall excavations, grade beam, and similar areas shall be treated with solution at a rate of 0.5 lit per square feet upon inner sides of such excavations or as specified by the manufacturer of the approved chemical, which ever is more, and at all locations where concrete slabs for platforms and similar work about the building. Similar treatment shall be made at all locations where expansion joints, control joints, column bases and similar work occur at or below grade slabs.

5.5.1.5 In the areas of application signs shall be fixed to show that soil treatment has been applied. Such signs shall be removed when areas are covered by other construction.

5.5.1.6 Care shall be exercised to insure that no marks or damage occurs to the finished structure as a result of the work under this section.

5.5.1.7 All woodwork for the entire project is to be insecticide treated (before application of solignum). Insecticide shall be sprayed on all surfaces of all the wooden work viz., door frames, blocking, furring, planks, boards etc. before installation. Spraying is to be done at the site, after delivery and before installation. No spraying shall be necessary after field sawing, jointing or installation of such material.

## **5.6. QUALITY ASSURANCE**

5.6.1 In addition to the requirements of these specifications, comply with manufacturer's instructions and recommendations for the work, including preparation of substrata and application.

5.6.2 A professional operator shall be engaged who shall have license in accordance with regulations of governing authorities for application of soil treatment solution.

## **5.7. GUARANTEE**

The Contractor is to guarantee that the building shall be free from termites (white ants), wood bores and other pests, which cause damage to wood or other organic material for 10 years from the date of acceptance of the building.

In the event of any damage caused within the guaranteed period, the Contractor shall replace at his own cost such damaged material and finishes affected and suitably preserve and treat the entire premises with the best method known to the trade to prevent the spreading of termites.

## **5.8. MEASUREMENT & PAYMENT**

### **5.8.1 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 Bills of Quantities. The cost there of shall be deemed to have been included in the quoted unit rate of the respective items of the Bills of Quantities.

5.8.1.1 Termite control treatment on wood works.

5.8.1.2 Turpentine/water/any other liquid or solution required as per the recommendations of the approved manufacturer for mixing insecticide solution.

5.8.1.3 Transportation of material and storage at site.

5.8.1.4 Anti-termite treatment on stock piled backfill material.

5.8.2 Termite Control Treatment

5.8.2.1 Measurement

Measurement of acceptably completed works of termite control treatment will be made on the basis of number of square feet of plinth area treated of ground floor by measuring the two dimensions (length & breadth) of treated area. No separate measurement will be made for the vertical or horizontal surfaces of the foundation.

5.8.2.2 Payment

5.8.2.2.1 Payment will be made for acceptable measured quantity of termite control treatment on the basis of unit rate per square feet of plinth area treated for of ground floor/lower floor quoted in the Bills of Quantities & shall constitute full compensation for all the works related to the item.

5.8.2.2.2 For "Termite Proofing", the rate is for the unit plinth area (measured along the outside of the external walls at DPC or peripheral plinth beam level irrespective of the number of storeys in the building) and covers the following operations:

- i. Treatment of bed and sides of excavated foundation trenches
- ii. Treatment of backfill.
- iii. Treatment of filled up earth.
- iv. Treatment of timber to be used in the Project.
- v. Treatment of surrounding areas within 10 feet of the building.
- vi. Any other operation which the specialized firm may deem necessary in context to their guaranteed obligations.

**SECTION - 6**  
**FORMWORK**



**6.1. 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 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.

It shall be the responsibility of the Contractor to perform the work by well trained and experienced staff or by the sub-contractor who shall have enough number of well trained and experienced staff and coordinate 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.

**6.2. APPLICABLE STANDARDS**

As per the requirements of Section 2300.

**6.3. SUBMITTALS**

As per the requirements of Section 2300.

**6.4. MATERIALS**

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

**6.4.1 TIMBER**

Form framing, sheathing and shoring.

**6.4.2 WATER PROOF PLYWOOD**

Water Proof Plywood shall be used for form sheathing and panels for all form work (columns, beams, slabs etc).

**6.4.3 STEEL**

- Heavy forms and false work
- Column and joint forms
- Permanent forms
- Welding of permanent forms

**6.4.4 FORM TIES ANCHORS AND HANGERS**

For securing formwork against placing loads and pressures.

**6.4.5 COATINGS**

To facilitate form removal.

**6.4.6 STEEL JOISTS**

For formwork support.

**6.4.7 STEEL FRAME SHORING**

For formwork support.

## 6.5. DELIVERY AND STORAGE

### 5.1 DELIVERY

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

### 5.2 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.

## 6.6. EXECUTION

### 6.6.1 WORKMANSHIP

6.6.1.1 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 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.

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

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

6.6.1.4 a) Formwork shall be of 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.

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

c) 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.

d) 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 with  $\frac{3}{4}$ " plywood lining as approved.

e) All the erected formwork shall be inspected and approved in all respects by the Engineer or his representative prior to concreting.

f) 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 honeycombing 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.

- 6.6.1.5 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.

- 6.6.1.6 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 walers 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.

- 6.6.1.7 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.

- 6.6.1.8 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.

- 6.6.1.9 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.

- 6.6.1.10 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.

- 6.6.1.11 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.

- 6.6.1.12 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.

- 6.6.1.13 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.

6.6.1.14 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.

6.6.1.15 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 off 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.

6.6.1.16 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.

6.6.1.17 Wood forms for wall opening shall be constructed to facilitate loosening, if necessary to counteract swelling of the forms.

6.6.1.18 Wedges used for final adjustment of the forms prior to concrete placement shall be fastened in position after the final check.

6.6.1.19 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.

6.6.1.20 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.

6.6.1.21 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.

6.6.1.22 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. Where as-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.

- 6.6.1.23 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 of props left under).	6 days.
Beams soffits (shores or props left under).	12 days.
Removal of shores or props to slabs.	
1. Spanning upto 12 feet.	10 days.
2. Spanning over 12 feet.	16 days.
Removal of shores or props to beams.	
1. Spanning upto 18 feet.	18 days.
2. 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.

- 6.6.1.24 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.

- 6.6.1.25 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.

- 6.6.1.26 Wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to the concrete.
- 6.6.1.27 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.
- 6.6.1.28 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 6.1.23 hereof.
- 6.6.1.29 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 storeys 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.
- 6.6.1.30 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.
- 6.6.1.31 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.
- 6.6.1.32 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.

## 6.2 Design of Formwork

Design of formwork will be the responsibility of the Contractor.

Design of formwork shall include consideration of the following factors:

- 6.2.1 Rate and method of placing concrete.
- 6.2.2 Construction loads, including vertical, horizontal and impact loads.
- 6.2.3 Special form requirements for fast track construction of reinforced concrete work.
- 6.3 The structural analysis and concrete strength data used in planning and implementation form removal and shoring shall be furnished by the contractor to the Engineer when so requested.
- 6.4 No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to support safely its weight and loads placed thereon.
- 6.5 Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Concrete strength data shall be based on tests of field-cured cylinders or, when approved by the Engineer, on other procedures to evaluate concrete strength.
- 6.6 No construction loads exceeding the combination of superimposed dead load plus specified live load shall be supported on any un-shored portion of the structure under construction, unless analysis indicates adequate strength to support such additional loads.
- 6.7 Forms supports for concrete members shall not be removed until concrete member carry their dead load and anticipated construction loads.
- 6.8 The removal of formwork for multistory construction should be a part of a planned procedure considering the temporary support of the whole structure as well as that of each individual member. Such a procedure should be worked out prior to construction and should be based on a structural analysis taking into account the following items, as a minimum:
  - a. The structural system that exists at the various stages of construction and the construction loads corresponding to those stages;
  - b. The strength of the concrete at the various stages during construction;
  - c. The influence of deformations of the structure and shoring system on the distribution of dead loads and construction loads during the various stages of construction;
  - d. The strength and spacing of shores or shoring systems used, as well as the method of shoring, bracing, shore removal and re-shoring including the minimum time intervals between the various operations.
  - e. Any other loading or conditions that affect the safety or serviceability of the structure during construction.For multi storey construction, the strength of concrete during the various stages of construction should be substantiated by filed-cured test specimens or other approved methods.

## **6.7. 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 rates of other items of the Bills of Quantities.

**SECTION - 7**  
**REINFORCEMENT**



### 7.1. SCOPE

The work under this section of specifications consists of furnishing, cutting, fabricating, bending and placing steel reinforcement and Welded wire fabric in any floor and at any height in concrete structures or elsewhere as shown on the drawings or as directed by the Engineer.

### 7.2. APPLICABLE STANDARDS

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

#### ASTM Standard

- A 305 Minimum requirement for the deformations of deformed steel bars for concrete reinforcement.  
A 615 & A 706 Deformed billet steel bars for concrete reinforcement.  
A 185 Welded steel wire fabric for 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 standards as may be specified by the Engineer for Special Material and construction are also relevant.

### 7.3. SUBMITTALS

3.1 Reinforcement shall be obtained only from manufacturers approved by the Engineer. Each consignment of reinforcement steel shall be subject to acceptance test. Samples shall be taken for acceptance test from each consignment as the Engineer may direct and shall be tested at the contractor's cost. Should the result of such tests show that the sample does not meet with the specifications the whole consignment shall be rejected and removed from the site at the Contractor's cost.

#### 3.2 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.

All detailing shall be done as per ACI standards AC1-315 & 318. The Contractor shall obtain approval of the bar bending schedules before starting actual bar bending works.

### 7.4. MATERIAL AND SIZE OF BARS

- 7.4.1 Reinforcement for concrete shall conform to the respective ASTM Standards as specified in the Drawings and in the Contract Documents.
- 7.4.2 Unless otherwise specified, all deformed reinforcing bars shall comply with the requirements of ASTM A615 or A706 for deformed hot rolled new stock billet steel bars and shall have a minimum yield strength of 40 ksi and a maximum yield strength of 58 ksi; also ratio of ultimate strength to yield strength shall not be less than 1.25 as per requirements of ACI 318-02 for Seismic Zone 3 & 4.
- 7.4.3 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. Reduced section steel reinforcement shall not be used.
- 7.4.4 The phosphorus content determined by chemical composition test shall not exceed the limits as specified in ASTM A615.

**7.5. DELIVERY AND STORAGE**

**7.5.1 DELIVERY**

Steel reinforcement bars shall be kept in bundles firmly secured and tagged. Each bar or bundle of bars shall be identified by marks stamped on hot or cold or painted on or by any other means. The identifying marks shall contain the following information:

- Name of the producer or his trade.
- Standard to which the bars have been manufactured.
- The class type and strength.
- The diameter.
- The number of the test certificate.

**7.5.2 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 free from scaling, rusting, oiling, coatings, damage, contamination and structural defects prior to placement in works. Bars of different diameters and grades of steel reinforcement shall be kept separately.

**7.6. FABRICATING, BENDING & PLACING**

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

7.6.2 The cutting tolerance for all bars shall be  $\pm 1$  inch.

7.6.3 Where an overall or an internal dimension of a bent bar is specified in the schedule, the bending tolerance, unless otherwise stated, shall be as in Table 1.

**Table 1: Bending Tolerances**

Dimensions of bent bars		Tolerance	
		plus inch	minus inch
Over Feet	Upto & including feet		
--	3	1/5	1/5
3	6	1/5	1/5
6		1/5	1

6.4 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 the Engineer, reinforcement shall not be bent after being partially embedded in hardened concrete.

Bars which depend for their strength on cold working shall not be heated for any reason.

7.6.5 Welding shall be permitted for bars only under suitable conditions and with suitable safeguards in accordance with BS 693, BS 1856, or AWS D12.1, provided the type of reinforcing bar has the required welding properties. Tack welding may be used to fix in position bars that cross each other, only with prior approval of the Engineer. Welding shall be done as in lectum structural steel & metal works.

7.6.6 No splice of reinforcement shall be made except as shown on the working drawings.

7.6.7 Reinforcement is to be accurately placed as shown in the drawings, and secured against displacement by using 18-20 gauge black annealed 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 formwork shall be galvanized or shall be made of plastic.

7.6.8 Concrete clear cover for reinforcing steel shall be as follows:

<b>Structural Members</b>	<b>Minimum Cover (inches)</b>
a) Concrete cast against and Permanently exposed to earth	3
b) Concrete exposed to earth or weather:	
For reinforcing bars # 6 or larger	2
For reinforcing bars less than # 6	1-1/2
c) Concrete not exposed to weather or in contact with ground:	
Slabs, Walls	3/4
Beams, Columns: (Primary Reinforcement)	1-1/2

7.6.9 Bars shall be placed to the following tolerances:

1. Concrete cover to formed surfaces	$\pm$ 1/4 inch
2. Minimum spacing between bars	- 1/4 inch
3. Top bars in slabs and beams	
a. Members 8 inch deep or less	$\pm$ 1/4 inch
b. Members more than 8 inch but not over 2 feet deep	$\pm$ 1/2 inch
c. Members more than 2 feet deep	$\pm$ 1 inch
4. Crosswise of members: spaced evenly within	2 inch

5. Lengthwise of members ± 2 inch

- 7.6.10 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.
- 7.6.11 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 column dowels.
- 7.6.12 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.
- 7.6.13 All reinforcement, at the time concrete is placed, shall be free of loose mill scale, loose rust mud, oil, grease, or other materials that may adversely affect or reduce the bond.
- 7.6.14 No concreting is to be carried out until the reinforcement has been checked and approved by the Engineer.

**7.7. MEASUREMENT & PAYMENT**

**7.7.1 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.

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.

Providing and installing cover blocks, chairs, supports, hooks, spacers, binding wires, and laps not shown on drawings including wastage and rolling margin. Laps shown on drawings shall be payable.

**7.7.2 Mild Steel and Deformed Steel**

7.7.2.1 Measurement:

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

The Contractor shall not claim for the difference in the actual weights of bars and their standard weights given in the Table below:

Nominal Bar Diameter (Inches)*	Bar No.	Weight Lbs/ft.
1/4"	-	0.167
3/8"	#3	0.376
1/2"	#4	0.668
5/8"	#5	1.043
3/4"	#6	1.502
7/8"	#7	2.044

1"	#8	2.670
1-1/8"	#9	3.400
1-1/4"	#10	4.303
1-3/8	#11	5.313

2204.60 Lbs = 1.00 tonne

\* to the nearest 1/8"

#### **7.8. PAYMENT**

Payment will be made for acceptable 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.

The rate quoted include all lead/lift required for steel fabrication & placement at/in any floor and at any height as per drawings.

**SECTION -8**  
**PLAIN AND REINFORCED CONCRETE**

## 8.1. 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.

## 8.2. APPLICABLE STANDARDS

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

### 2.1 ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

B	370	Copper sheet and strip for building construction.
C	33	Concrete Aggregates.
C	40	Organic impurities in sand for concrete.
C	87	Effect of organic impurities in fine aggregates on of mortar.
C	88	Soundness of aggregates.
C	94	Ready mixed Concrete.
C	109	Compressive strength of hydraulic cement mortars.
C	117	Material finer than No.200 (0.075mm) sieve.
C	123	Light-weight pieces in aggregates.
C	125	Concrete and concrete aggregates.
C	127	Specific gravity and absorption of coarse aggregate.
C	128	Specific gravity and absorption of fine aggregate.
C	131	Resistance to abrasion of small size coarse aggregates.
C	136	Sieve or screen analysis of fine and coarse aggregate.
C	142	Clay lumps and friable particles in aggregates.
C	143	Slump of Portland Cement Concrete.
C	144	Aggregate for masonry mortar.
C	150	Portland Cement.
C	156	Water retention by concrete curing material
C	171	Sheet material for curing concrete.
C	185	Air content or hydraulic cement mortar.
C	188	Density of hydraulic cement.
C	191	Time of setting of hydraulic cement by vicat needle.
C	260	Air entraining admixtures for concrete.
C	289	Potential reactivity of aggregate.
C	309	Liquid membrane-forming compounds for curing concrete.
C	330	Lightweight aggregates for structural concrete.
C	331	Lightweight aggregates for concrete masonry.
C	332	Lightweight aggregates for insulating concrete.
C	494	Chemical admixtures for concrete.
C	535	Resistance to abrasion of large size coarse aggregates.
C	567	Unit weight of structural lightweight concrete.
D	75	Aggregate sampling.
D	994	Preformed expansion joint filler for concrete.
D	1190	Concrete joint sealer (hot poured elastic type).
D	1751	Preformed expansion joint filler for concrete paving and structural construction.
D	1752	Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction.
D	1850	Concrete joint sealer (cold application type).
E	11	Wire cloth sleeves for testing purposes.
E	96	Water vapor transmission of materials in sheet form.
E	154	Materials for use as vapor barrier under concrete slabs.

E 337 Relative humidity by wet and dry bulb psychrometer.

2.2 ACI (AMERICAN CONCRETE INSTITUTE)

- 211.1 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.
- 306.1-90 Standard Specifications for Cold Weather Concreting
- 306R-88 Cold 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 formwork.
- 512 Pre-cast structural concrete in building.
- 517 Low pressure steam curing.
- 533 Fabrication, handling and erection of pre-cast concrete wall panels.

2.3 BRITISH STANDARDS

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

**8.3. SUBMITTALS**

- 8.3.1 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.
- 8.3.2 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.
- 8.3.3 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.

- 8.3.4 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.
- 8.3.5 Where doubt exists as to the suitability of the water, it shall be tested in accordance with BS 3148.
- 8.3.6 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.

- 8.3.7 'Workability' of Concrete 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 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.

- 8.3.8 Manufacturer's recommendations and instructions along with the sample of material shall be submitted to the Engineer for his approval.
- 8.3.9 The Contractor shall, at his own cost, make optimum mix design and testing for approval of the composition of Non Shrinking grout and Non Shrink second stage Concrete Grout, prior to Commencement of the work.
- 8.3.10 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. The proposal for transporting and erecting pre-cast units in position shall also be submitted by the Contractor for the approval of the Engineer.

#### **8.4. MATERIALS**

##### **8.4.1 Aggregates**

8.4.1.1 The sources of supply of all fine and coarse aggregates shall be subject to the approval of the Engineer.

8.4.1.2 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.

8.4.1.3 Fine aggregate shall be hard coarse sand, crushed stone or gravel screenings and 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.

8.4.1.4 Coarse aggregate shall be gravel or crush stone of hard, durable material free from laminated structure and conforming to PS 243 and/or BS 882 and/or ASTM C 33 graded as follows for use in mass concrete as in foundations:

<b>Total Passing B.S. Sieve</b>		:	<b>Percent by weight</b>
3 in.	(76.20 mm)	:	100
1.5 in.	(38.10 mm)	:	95-100
0.75 in.	(19.05 mm)	:	30-70
0.38 in.	(9.52 mm)	:	10-35
0.19 in.	(4.76 mm)	:	0-5

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

<b>Total Passing B.S. Sieve</b>		:	<b>Percent by weight</b>
1.5 in.	(38.10 mm)	:	100
0.75 in.	(19.05 mm)	:	95-100
0.38 in.	(9.52 mm)	:	25-55
0.19 in.	(4.76 mm)	:	0-10

8.4.1.5 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 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.

8.4.1.6 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.

8.4.1.7 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.

8.4.1.8 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 19.05 mm maximum nominal size, the different size 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 course and fine aggregates shall be tested at least once for every 100 tons supplied to ensure that the grading is uniform and the same as that of the samples used in the preliminary tests.

- 8.4.1.9 For use in fireproof 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.

#### **8.4.2 CEMENT**

- 8.4.2.1 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 cements 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.
- 8.4.2.2 Unless otherwise specified, ordinary Portland cement complying with the requirements of BS 12 shall be used.
- 8.4.2.3 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.
- 8.4.2.4 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.
- 8.4.2.5 There shall be sufficient cement at site to ensure that each section of work is completed without interruption.
- 8.4.2.6 Cement reclaimed from cleaning of bags or from leaky containers shall not be used.
- 8.4.2.7 The Contractor shall provide and erect (at his own cost) in a suitable plane, dry, well ventilated, weather-proof and water proof shed of sufficient capacity to store the cement.
- 8.4.2.8 Cement shall be used as soon as possible after delivery and cement which the 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.
- 8.4.2.9 The mixing together of different types of cement will not be permitted.

#### **8.4.3 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 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.

#### **8.4.4 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 ASTM C 260. Other Admixtures shall conform to ASTM C 494.

#### **8.4.5 NOMINAL CONCRETE MIXES**

##### 8.4.5.1 Proportions of Mix

a) 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.

b) 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.

c) 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 concrete, water/cement ratio shall not exceed 0.45, except that for water retaining structures water/cement ratio shall not exceed 0.40.

d) 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.

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 upto 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.

##### 8.4.5.2 Strength requirements for concrete

a) Concrete made with Portland cement shall comply with the cube strength requirements of Table 1, columns 5 & 7 (Works Test). Cylindrical Compressive Strength shall comply with ACI 214.



## 8.6. EXECUTION

### 8.6.1 CAST-IN-SITU CONCRETE WORK

#### 8.6.1.1 Batching

- a) 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.
- b) 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.
- c) 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.
- d) 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.
- e) 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.

#### 8.6.1.2 Mixing

- a) The concrete shall be mixed in an approved batch mixer conforming to the requirements of BS 1305 or ACI 304R (ASTM C685). 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.
- b) 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.
- c) 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.
- d) 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.
- e) Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be re-tempered, but shall be discarded.

#### 8.6.1.3 Transporting

- a) 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.
- b) 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.

#### 8.6.1.4 Placing

The Contractor shall note that placing of concrete will be done with concrete pump as mentioned in Appendix-G to Tender, Volume-I of Tender Documents. No other method of placing of concrete will be allowed.

- a) 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.

- b) 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.
- c) 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.

- d) Concrete shall be deposited as nearly as possible in its final position to avoid segregation due to rehandling or flowing. In no circumstances may concrete be railed or made to flow along the forms by the use of vibrators.
- e) 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.
- f) 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.
- g) 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./ft<sup>2</sup> will then be laid flat to separate the concrete from the surface on which it is to be laid.

- h) 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.
- i) Every Contractor whose work is related to the concrete or services 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.

#### 8.6.1.5 Construction Joints

- a) Construction 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.
- b) 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.
- c) 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.
- d) 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 un-exposed walls and all others not mentioned herein shall be dampened (but not saturated) immediately prior to placing of fresh concrete.
- e) 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.
- f) 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.



- g) 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.

#### 8.6.1.6 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.

#### 8.6.1.7 Placing and Connection of Water-Stops

The water-stops and expansion joint material shall be positioned accurately and supported against displacement as shown on the drawings.

#### 8.6.1.8 Embedded Items

- a) 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 may 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 centres. 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 nor 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.
- b) All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

#### 8.6.1.10 Consolidation

- a) 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.

- b) 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.
- c) Vibrator shall not be allowed to contact the formwork for exposed concrete surfaces.
- d) Mechanical vibrators shall be of a type suited in the opinion of the Engineer to the particular conditions.
- e) Over-vibration or vibration of very wet mixes is harmful and should be avoided.

8.6.1.11 Curing and Protection

- a) 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.
- b) 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 or 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.

- c) 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.
- d) Curing in accordance with sub-clause 'a' & 'b' 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 'b' 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.
- e) 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'd'.

When necessary, arrangements for heating, covering insulation or housing the 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.
- f) 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.
- g) 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 any one hour or 10 degree C (50 deg. F) in any 24 hour period.
- h) 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.

#### 8.6.2 WORKS IN EXTREME WEATHER

- 8.6.2.1 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 the mixing water nor to damage the surface finish.

- 8.6.2.2 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 & aggregate having a temperature greater than 38 deg. C.

- 8.6.2..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 temperature should not exceed 21 degree C. When the temperature 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.

## **8.7. TEST OF CONCRETE QUALITY**

- 8.7.1 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. 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.
- 8.7.2 Preliminary cube tests and works cube test shall be performed in accordance with the discretion of the Engineer. The standard of acceptance for preliminary and works tests shall be as given below.
- 8.7.3 The usual test for concrete with maximum size of aggregate upto 1-1/2 inch is the 6 inch cube tested in compression. Details of the testing are given in Part 8 of BS 1881.
- 8.7.4 For all grades of concrete, preliminary cube strength test with the mixes and materials to be used shall be performed in accordance with 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.
- 8.7.5 Test sample shall be taken at the mixer or as directed by the Engineer. The test specimens shall be cured in accordance with 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.

- 8.7.6 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.
- 8.7.7 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.
- 8.7.8 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.

## **8.8. FINISHING OF FORMED SURFACES**

### **8.8.1 GENERAL**

- 8.8.1.1 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.
- 8.8.1.2 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.
- 8.8.1.3 Allowable deviations from plumb or level and from the alignment profile grades and dimensions are specified in clause 10. 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 only 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 10 ft. for testing of unformed surfaces.

#### 8.8.2 AS-CAST FINISHES

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

##### 8.8.2.1 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.

##### 8.8.2.2 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 8.2.1, '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.

#### 8.8.3 FINISHES OF UNFORMED SURFACES

##### 8.8.3.1 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. Trowelling 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.

## **8.9. REPAIR OF SURFACE DEFECTS**

### **8.9.1 GENERAL**

8.9.1.1 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.

8.9.1.2 All ties and bolt holes and all repairable defective areas shall be patched immediately after form removal.

### **8.9.2 REPAIR OF DEFECTIVE AREAS**

8.9.2.1 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.

8.9.2.2 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.

8.9.2.3 The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

8.9.2.4 After surface water has evaporated from the area to be patched, the bond 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.

8.9.2.5 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 surface. This is in addition to form tie patches, if the project design permits ties to fall within as-cast areas.

8.9.2.6 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.

8.9.2.7 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.

8.9.3 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.

8.9.4 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.

**8.10. CONCRETE CONSTRUCTION TOLERANCES**

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.

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

8.10.1.1 In the lines and surfaces of columns, piers, walls and in arrises:

In any 10 feet of length or height	1/4 inch
In any storey or 20 feet length	3/8 inch
Maximum for the entire length or height.	1 inch

8.10.1.2 For exposed corner columns, control joint grooves and other conspicuous lines.

In any bay or 20 feet maximum	1/4 inch
Maximum for the entire length or height	1/2 inch

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

8.10.2.1 In floors, ceilings, beams soffits and in arrises 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



COSTRUCTION OF BOUNDARY WALL OF MARBLE CITY. MOHMAND AGENCY (PHASE-II)

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	Maximum for the entire length	3/4 inch
8.10.2.2	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
8.10.3	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	1/2 inch
	Maximum for the entire length	1 inch
8.10.4	Variation in the sizes and locations of sleeves, floor openings and wall openings.	$\pm 1/4$ inch
8.10.5	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
8.10.6	Footings	
8.10.6.1	Variation in dimensions in plan	
	Minus	1/2 inch
	Plus (plus variation applied to concrete only, not to reinforcing bars or dowels).	2 inch
8.10.6.2	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).	2 inch
8.10.6.3	Thickness	
	Decrease in specified thickness	5%
	Increase in specified thickness	No limit
8.10.7	Variation in Steps	
8.10.7.1	In a flight of stairs	
	Rise	$\pm 1/8$ inch
	Tread	$\pm 1/4$ inch
8.10.7.2	In consecutive steps	
	Rise	$\pm 1/16$ inch
	Tread	$\pm 1/8$ inch

8.10.8 Tolerances for Pre-cast 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:

8.10.8.1	Overall dimensions of members	1/16 inch per 10 feet
8.10.8.2	Cross-sectional dimensions	
	Sections less than 3 inch.	1/16 inch
	Sections over 3 inch and less than 18 inch.	1/8 inch
	Sections over 18 inch.	1/4 inch
8.10.8.3	Deviations from straight line in long sections.	
	Not more than	1/8 inch per 10 feet.
8.10.8.4	Deviation from specified camber	$\pm$ 1/16 inch per 10 feet span.
	Maximum differential between adjacent units in erected position	1/4 inch

**8.11. ACCEPTANCE OF STRUCTURE**

8.11.1 GENERAL

- 8.11.1.1 Completed concrete work which meets all applicable requirements will be accepted subject to the other terms of the Contract Documents.
- 8.11.1.2 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.
- 8.11.1.3 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.

8.11.2 DIMENSIONAL TOLERANCES

- 8.11.2.1 Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of clause 10 shall be considered potentially deficient in strength and subject to the provisions of sub clause 11.4.
- 8.11.2.2 Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of clause 10 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.

8.11.2.3 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.

8.11.2.4 Inaccurately formed concrete surfaces exceeding the limits of Clause 10 or of Clause 6.1.6 of Section 'Formwork' and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.

### 8.11.3 APPEARANCE

8.11.3.1 Architectural concrete with surface defects exceeding the limitations of Sub-clause 6.1.6 of the Section, 'Formwork' shall be removed and replaced.

8.11.3.2 Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods.

8.11.3.3 Concrete not exposed to view is not subject to rejection for defective appearance.

### 8.11.4 STRENGTH OF STRUCTURE

8.11.4.1 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.
- Reinforcing steel size, quantity, 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.

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

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

8.11.4.4 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.

- 8.11.4.5 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.
- 8.11.4.6 The Contractor shall pay all costs incurred in providing the additional testing and/or analysis required by this section.
- 8.11.4.7 The Employer will pay all costs of additional testing and/or analysis which are made at his request and which is not required by these Specifications, or by the Contract Documents.

#### **8.11.5 Testing of Material**

- a) 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 ASTM C -150.
- c) Aggregates shall be tested as prescribed in British Standard BS 812 & 882. In addition fine aggregate shall be tested for organic impurity in conformance with ASTM Standard C.40.

### **8.12. MEASUREMENT AND PAYMENT**

#### **8.12.1 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 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.

- 8.12.1.1 Providing, fixing, striking, etc. of formwork.
- 8.12.1.2 Providing, placing and fixing of anchor bolts or any other embedded parts.
- 8.12.1.3 Providing and installing all type of joints in concrete structure, including expansion joints.
- 8.12.1.4 Providing and fixing water stoppers.

#### **8.12.2 Plain and Reinforced Concrete**

##### **8.12.2.1 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 of concrete placed and compacted in position within the neat lines of the structure as shown on the Drawings or as directed by the Engineer.

#### 8.12.2.2

##### 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.



**SECTION - 9**  
**STRUCTURAL STEEL WORKS**

### **9.1. SCOPE**

The work covered by this section, consists of supply of all material, labour, plant, equipment and appliances including welding, bolts, nuts, washers, anchor bolts, embedded parts etc, fabrication, erection and painting in accordance with the specifications and as per drawings and as directed by the Engineer.

### **9.2. APPLICABLE STANDARDS**

Latest edition of the following standards are relevant to these specifications wherever applicable:

AISC Code of standard practice

AISC Specifications for Design, Fabrication and Erection of Structural Steel for Buildings.

AISC Specifications for structural joints using ASTM A325 or A490 Bolts.

ASTM Specifications for materials

AISC/  
SSPC Guide to shop painting of structural steel

AWS Specifications for welding of steel structures

BS 449 Use of structural steel in Buildings

### **9.3. SUBMITTALS**

Design drawings shall be prepared by the Engineer and supplied to the Contractor. These shall contain main dimensions, sizes of members, typical details of joints.

Workshop drawings shall then be prepared by the Contractor from the design drawings supplied and submitted to the Engineer for approval.

### **9.4. MATERIAL**

All the components shall be sound and free from injurious matter, cracks, air-holes, blows, wounds, scales, spitted grains and blunt rises. Except otherwise stated in the drawings, the material specifications shall conform to the following. Wherever necessary the Contractor may use equivalent alternative material subject to approval of the Engineer.

#### **9.4.1 STRUCTURAL STEEL**

Structural steel for structures shall conform to the requirements of ASTM A-36 or equivalent

#### **9.4.2 STEEL SHEETS & PLATES**

Steel sheets and plates, where required, shall conform to the requirements of BS 1449 "Steel Plates, Sheet and Strips".

#### **9.4.3 STEEL FORGING**

Steel forging shall conform to the requirements of ASTM A235.

#### **9.4.4 STEEL CASTING**

Steel casting shall conform to the requirements of ASTM A27.



9.4.5 WELDING

Welding Electrodes for manual shielded metal arc welding shall conform to AWS A 5.1 latest edition or the A 5.5 latest edition. Equivalent locally manufactured electrodes may be used subject to the approval of the Engineer.

9.4.6 STEEL BOLTS

Except where otherwise shown in the Drawings, the steel bolts shall conform to the applicable requirements of ASTM A307 "Specification for Low Carbon Steel Externally and Internally Threaded Standard Fasteners."

9.4.7 COMMON BOLTS, ANCHOR BOLTS, NUTS AND WASHERS

Common Bolts, Anchor Bolts, Nuts and Washers Bolts and Nuts shall conform to the requirements of ASTM A 307.

9.4.8 HIGH STRENGTH BOLTS

High strength carbon steel bolts including nuts and washers shall conform to the requirements of ASTM A325 latest editions and of AISI B18.2

9.4.9 WASHERS

Cut Washers: Shall be of structural grade steel and shall conform to the dimension of the manufacturer's regular standard for plain washers for the size of bolts used.

9.4.10 CAST IRON

Shall conform to the requirements of latest edition of ASTM A 48.

**9.5. CONNECTIONS**

9.5.1 DESIGN OF CONNECTION

All connections shall be designed and detailed for forces shown on the drawings, if any or 50% of the effective capacity of the member, whichever is greater.

Shop connections may be welded or bolted. Field connections shall be bolted unless noted otherwise on design drawings.

9.5.2 INSTALLATION OF BOLTS

High strength bolts shall be installed in accordance with AISC "Specifications for Structural Joints using ASTM A 325 or A 490 bolts".

9.5.3 MINIMUM SPACING OF BOLTS

The distance between centers of bolt holes shall not be less than  $3d$ , where  $d$  is the diameter of the bolt in inches.

9.5.4 MINIMUM EDGE DISTANCE

The minimum edge distance i.e. center of standard hole to edge of connected part shall be as given in the table below:

<b>NOMONAL BOLT DIAMETER (INCHES)</b>	<b>AT SHEARED EDGES (INCHES)</b>	<b>AT ROLLED EDGES OR PLATES, SHAPES OR GAS CUT EDGES (INCHES)</b>
<b>1 / 2</b>	<b>1.5 TIMES THE DIAMETER OF BOLTS</b>	<b>3 / 4</b>
<b>5 / 8</b>		<b>7 / 8</b>
<b>3 / 4</b>		<b>1</b>
<b>7 / 8</b>		<b>1 – 1 / 8</b>
<b>1</b>		<b>1 – 1 / 4</b>

9.5.6 ALLOWABLE STRESSES

Allowable design stresses for structural steel members and their connections, including temporary bracings and shorings shall be in accordance with AISC Specifications.

**9.6. EXECUTION**

9.6.1 FABRICATION

The Contractor shall notify the Engineer about any problems or doubts/errors discovered in the drawings for clarification/rectification well in time to prevent any fabrication errors. Fabrication shall not be commenced until approval has been obtained from the Engineer.

9.6.1.1 Straightening of Material

Rolled material, before being worked upon must be straightened within tolerances by ASTM specifications A6 Straightening, necessarily shall be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 1100°F for A 514 steel or 1200°F for other steels.

9.6.1.2 Cutting

As far as possible cutting must be done by shearing, Oxygen cutting shall be done where shear cutting is not possible and shall preferably be done by Machine. All edges shall be free from gauges, notches or burs. If necessary the same shall be removed by grinding.

Metal sections shall be well formed, to shape and size, with sharp line or angles. Shearing and punching shall leave clean, true lines and surfaces. The metal sections shall be thoroughly straightened by methods that will not injure it, before being laid off or worked in any way. The members shall be so straightened that they are not, more than 1/16", away from a straight plane in either direction, for the full length of members. All members shall be so cut and formed that they can be accurately assembled without being unduly cracked, strained or forced into position.

9.6.1.3 Holes Punching Drilling

Holes shall be punched where thickness of the material is not greater than the diameter of bolt + 1/8". Where the thickness of the material is greater the holes shall either be drilled or sub-punched and reamed to size. The die for all sub-punched holes and the drill to all sub-drilled holes shall be at least 1/16" smaller than the nominal diameter of the rivet or bolt. Holes for A514 steel plates over 1/2" thick shall be drilled.

#### 9.6.1.4 Welding

##### a) General:

The execution and inspection of welding will be done in accordance with the provisions of the American welding society code for welding in Building construction, D1.0. No welding for piping/electrical supports shall be made transversely to any tension flanges of trusses, beams or columns.

##### b) Automatic sub-merged Arc Welding:

For all built-up members, i.e. sections fabricated from plates and flat bars or compound rolled sections, plate and box girders, where long continuous, welding is to be done, should be executed by Automatic submerged Arc Welding process in accordance with relevant AWS specifications.

##### c) Maximum and minimum size and lengths of fillet welds shall be in accordance with AISC specifications.

Surface to be welded shall be free from loose scale, slag, rust, grease, paint or any other foreign matter except mill scale, which withstands vigorous wire brushing.

##### d) Tolerances

- A variation of 1 mm is permissible in the over all length of members with both ends finished for Contact bearing. The bearing surfaces prepared to a common plane by milling.
- Members without end finished for contact bearing which are to be framed to other steel parts of the structure shall have a variation from detailed length not greater than 1/8" for length over 30 feet and not greater than 1/16" for length.
- Members with ends finished for contact bearing shall have a variation 1/32" in the over all length.

#### 9.6.2 TEST ASSEMBLY

9.6.2.1.1 After fabrication and before galvanization or painting, test assembly of complete Structural Components shall be done on the shop floor as directed by the Engineer.

9.6.2.1.2 Each test assembly will be inspected by the Engineer and will be dismantled only after his approval in writing

#### 9.6.3 SURFACE PREPARATION/PAINTING

##### 9.6.3.1 Surface Preparation

- a) All structural steel material i.e. rolled steel sections, plates, pipes, flat bars, chequered plates shall be cleaned free from loose scale, rust, burrs slag, etc. by means of sand blasting.

#### 9.6.3.2 Painting

- a) Immediately after surface preparation all material shall be given one prime coat of rust preventive paint.
- b) After fabrication one shop coat of prime paint and then one coat of enamel paint shall be applied.
- c) One final coat of enamel paint shall be applied after erection of all components.
- d) The type of primer and enamel paints to be applied shall be as specified on the drawings and the thickness of each coat of the paint shall be in accordance with the specifications of the paint manufacturer.
- e) All other requirements for the specified paint system shall be in accordance with the paint manufacturer's specification / recommendations.
- f) The Contractor shall use the best quality of the type of paint specified and shall get the same approved by the Engineer.
- g) Steel work/Surfaces not to be painted
  - i) Steel work to be encased / embedded in concrete or surface in contact with concrete or grout shall not be painted, but shall be given a cement wash after sand blasting.
  - ii) Machined finished surfaces shall not be painted but shall be coated with rust preventive compound, (approved by the Engineer) immediately after finishing. Such surfaces shall also be protected with wooden pads or other suitable means for transportation. Unassembled pins, keys, and bolt thread shall be greased and wrapped with moisture resistant paper.
  - iii) Contact surfaces of connections using high strength bolts in friction type connections shall not be painted. Such surfaces of all components after fabrication shall be cleaned free of all paints, grease, burrs slag by means of sand blasting. No coating whatsoever shall be applied to these surfaces. The surface roughness for high strength friction grip bolts is a very important factor and the components therefore will not be erected unless approved by the Engineer.

#### 9.6.3.3 Zinc Coating

Components should be galvanized after complete fabrication i.e. welding, drilling etc. The process should consist of removal of rust and mill scale by pickling in hydrochloric acid or sulphuric acid followed by water wash and pre-fluxing in tanks containing zinc ammonium chloride and then fluxing with ammonium chloride. The fluxed components should then be passed through a drying oven prior to immersion in a bath of virtually pure molten zinc.

Wherever specified by the Engineer, zinc coating shall be applied in a manner and of a thickness and quality conforming to the requirements of ASTM A123 Standard Specifications for zinc (hot galvanized) coating on products fabricated from rolled, pressed and forged steel shapes, plate bars and strips.

### 9.6.3 ERECTION

#### 9.6.3.1 Bracing

The structure shall be carried up true and plumb within the limits defined in the AISC code of standard practice. Temporary bracing shall be introduced wherever necessary to take care of all loads of which the structure may be subjected including the equipment and the operation of the same. Such bracings shall be left in place as long as required for safety.

#### 9.6.3.2 Alignment

Bolts tightening as specified by ASTM A 325 shall not be done at site during erection until the structure has been fully aligned and leveled.

#### 9.6.4.3 Joints using High Strength Bolts

All structural joints using high strength bolts shall be executed and inspected in accordance with "AISC Specification for structural joints using ASTM A 325 or A 490 bolts".

#### 9.6.4.4 Stubs

Stubs of trusses before being embedded in concrete shall be erected in position timely aligned using stub setting templates.

## 9.7. INSPECTION AND TESTS

9.7.1 Manufacturer's Work Test Certificate for all material used shall be furnished by the contractor for Engineer's scrutiny and approval.

9.7.2 Rolling tolerance of all shapes and profile according to AISC shall be in accordance with the provisions of the American Society for Testing and Materials Designation A.6. The Contractor shall check these before being worked upon and these shall be rejected if found not within limits.

9.7.3 The Contractor shall arrange for analysis and test of all material rolled locally at a testing laboratory selected by the Engineer.

9.7.4 Inspection of Welding.

The inspection of welding shall be performed in accordance with the American Welding Society specifications, as directed by the Engineer.

9.7.5 Rejection

Materials or workmanship not in reasonable conformance with the provisions of these specifications shall be rejected at any time during the progress of the work or the completion and erection at site.

## 9.8. MISCELLANEOUS STEEL WORKS

### 9.8.1 General

The work covered shall include furnishing, fabricating, installing and painting miscellaneous steel work including the following:

- Steel doors and windows
- G.I. Flashings
- Steel pipe handrail
- Steel embedded plates anchor bolts and other miscellaneous items
- Steel protection angles and channels
- Structural Steel Trusses

The Contractor shall submit shop drawings for each item showing in sufficient detail the material, its fabrication, surface preparation and other relevant information so as to conform to the applicable requirements of relevant clauses of these specifications for Engineers Approval. After the approval of drawing the Contractor shall erect a mock-up sample showing exactly the finished item as it will be fabricated/erected. Only after the approval of the mock-up sample the Contractor shall start the fabrication of items to be installed in place. Any proposed deviation due to field conditions and availability of local material shall be submitted to the Engineer for approval.

## 9.9. MEASUREMENT & PAYMENT

### 9.9.1 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 Bill of Quantities. The cost there of 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 works to be executed under these specifications in any floor and at any height.

- 9.9.1.1 Nuts, bolts, screw, rivets, heads, fillets, welds welding rods, locks, rollers, rolling tracks, pivot hinges, etc.
- 9.9.1.2 Anti-corrosive prime coat.
- 9.9.1.3 Cleaning with sand blasting.
- 9.9.1.4 Painting.
- 9.9.1.5 Embedding/fixing of steel pipe hand rail in concrete work and wooden covering.
- 9.9.1.6 All hardware in steel doors, locks, hold fasts, etc.
- 9.9.1.7 All metal embedded parts, metal fittings and fixtures required for the operational process.
  - i. Providing 2 hour fire resistant doors, UL listed fabricated from 16SWG MS sheet and the core filled with heavy density foam injected polyurethane of low U factor ( $< .069$ ) and full width door frame fabricated from 14 SWG M.S sheet including painting etc. complete in all respects as per design, approved shop drawings/mock-up samples of the type FRD1.

- ii. Glazing in steel door/windows including seals and gaskets and providing/fabricating louvers.
- iii. Epoxy primer to internal surfaces of door frame and shutter including frame.

9.9.2 Steel Doors & Windows

9.9.2.1 Measurement

Measurement of acceptably completed works of respective types of Steel Doors & Windows 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.

9.2.2 Payment

Payment will be made for acceptable measured quantity of respective types of Steel Doors & Windows 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 shown on drawings.

9.9.3 Steel Handrail

9.9.3.1 Measurement

Measurement of acceptably completed works of respective types of Steel Hand railing will be made on the basis of actual length in feet fabricated & installed in position as shown the drawings or as directed by the Engineer.

9.9.3.2 Payment

Payment will be made for acceptable measured quantity of respective types of Steel Hand railing on the basis of unit rate per feet quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

9.9.4 Structural Steel Trusses

9.9.4.1 Measurement

Measurement of acceptably completed works of structural steel trusses will be made on the basis of number of metric tons of structural steel provided & erected in position as shown the drawings or as directed by the Engineer.

9.9.4.2 Payment

Payment will be made for acceptable measured quantity of structural steel trusses on the basis of unit rate per metric ton quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

**SECTION - 10**  
**CEMENT PLASTER**



### 10.1. 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 using Polypropylene Fibers, 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.

### 10.2. MATERIAL

- 10.2.1 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".
- 10.2.2 Sand for plaster shall comply with the requirements of BS 1199, BS 1200 or the draft Pakistan Standard "Sand for Plaster" as directed by the Engineer.
- 10.2.3 Water for plaster shall conform to requirements specified in the section for "plain and reinforced concrete".
- 10.2.4 Polypropylene Fibers (Duracrete or approved equivalent) should be added to the plaster mix during the mixing operation. The mixing time (typically 3 to 5 minutes) ensures uniform distribution throughout the plaster material. The dosage of fibers per bag of cement for plastering should be 100 gms by weight for ½ inch fibrillated DCF-13 fibre in case of duracrete or as per recommendations of the approved manufacturer.
- 10.2.5 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.

### 10.3. EXECUTION

#### 10.3.1 GENERAL

- 10.3.1.1 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.
- 10.3.1.2 Plastering shall not commence until all electric conduits, drainage and sanitary pipes, inlets to tanks, brackets, clamps, doors and window frames and all sorts of inserts and embedded items are fixed in position. It shall be the responsibility of the Contractor to make sure that other contractors carry out all such work before starting of plasterwork. Chiseling and repairing of cement plaster shall not be permitted without the approval of the Engineer.
- 10.3.1.3 Sample of materials shall be submitted to the Engineer for his approval prior to use in the works.

#### 10.3.2 PROPORTIONING AND MIXING

- 10.3.2.1 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.

10.3.2.2 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 times more than that stipulated above is expressly prohibited. Re-tempering shall not be permitted and all mortar, which has begun to stiffen, shall be discarded.

10.3.2.3 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.

### 10.3.3 PREPARATION OF SURFACE TO BE PLASTERED

10.3.3.1 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 hacked by approved means to give the required key for plastering.

3.3.2 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 two (2) hours before further treatment. Surface thus prepared shall be treated uniformly with a cement and sand slurry of one part cement and one part sand mix before application of plaster.

### 10.3.4 APPLICATION OF PLASTER

10.3.4.1 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.

10.3.4.2 Plaster containing cracks, blisters, pits, dis-colouration 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.

10.3.5 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.

10.3.6 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.

10.3.7 INTERNAL/EXTERNAL PLASTER

10.3.7.1 Where specified in the Drawings external surface shall have an average 1/2" 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.

10.3.7.2 Where specified in the Drawings all internal plaster shall have an average 1/2" 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.

10.3.8 NOT USED.

10.3.9 CLEANING AND PROTECTION

10.3.9.1 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.

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

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

10.3.10 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.

**10.4. MEASUREMENT AND PAYMENT**

**10.4.1 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 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.

- 10.4.1.1 Metal lath over reinforced concrete and masonry joint.
- 10.4.1.2 Joints, junctions, corners, beads, drip course edge, roundings, and aluminum U/Y channels in groves wherever required/specified. etc.
- 10.4.1.3 More than one layer due to any unevenness in the finished works and base coat plaster in stucco plaster including marble chips/colour pigments.
- 10.4.1.4 Cutting & patching of all defective works.
- 10.4.1.5 Surface preparation, cleaning and protection as specified.
- 10.4.1.6 Approved waterproofing agent.
- 10.4.1.7 Polypropylene Fibers in plaster work.

**10.4.2 Plain Plaster/Plaster with waterproofing agent**

10.4.2.1 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 respective type 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.

10.4.2.2 Payment

Payment will be made for acceptable measured quantity of respective type 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.

**SECTION - 11**  
**LIGHT FIXTURES**

### 11.1. SCOPE OF WORK

The work under this section consists of supplying, installing, testing and commissioning of all material and accessories of the complete Light fixtures as specified herein and/or shown on the drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and co-ordinate at Site with other services for exact locations and positions of the light fixtures.

The lighting fixtures with accessories shall also comply with the General Specifications for Electrical Works, Section-8001 and with other relevant provisions of the Tender Document.

### 11.2. GENERAL

The description of light fixtures is given in the bill of quantities, and stated on the drawings, and all relevant material is described in this Section. The determination of quality is based on certified photo-metric data covering the coefficient of utilization, light distribution curves, construction material, shape, finish, operation, etc.

The Contractor shall submit at least two samples of each and every light fixture specified and obtain approval of the Engineer before purchasing. The quality and finishes of the local make light fixtures (if mentioned in BOQ) shall be same as that of standard manufacturer. The accessories such as ballast, lamp/starter holders, starters, lamps, ignitors, etc. for all type of light fixtures shall be of Philips make or approved equivalent. Approved equivalent against those specified will be accepted if the specified one is/will not be available. For any substitution the Engineer's approval is necessary.

All fixtures shall be finished in standard color schemes as mentioned in the manufacturer's catalogue for respective fixtures, unless specifically stated in the Specifications, Drawings or Bill of Quantities or directed by the Engineer.

### 11.3. APPLICABLE STANDARDS/CODES

The latest editions of the following standards/codes shall be applicable to the material specified within the scope of this section:

- |                   |   |
|-------------------|---|
| IEC 81 & BS 1853  | - Tubular fluorescent lamps                                 |
| IEC 82 & BS 2818  | - Ballast for tubular fluorescent lamps                     |
| IEC 155 & BS 3772 | - Starters for fluorescent lamps                            |
| IEC 400           | - Lamp holders and starter holders for fluorescent lamps    |
| IEC 566           | - Capacitors for use in TL, HP mercury and LP sodium vapour |
| BS 3677/3767/4017 | - discharge lamp circuits                                   |
| IEC 598           | - Luminaires  |

### 11.4. MATERIAL

#### 11.4.1 Fluorescent Light Fixtures

The fluorescent light fixtures shall have lamps and ballasts of proper rating as shown on the drawings. Each lamp shall be provided with an independent ballast.

The fluorescent lamps shall be tubular, 1214/604mm long, 28 mm. dia. for 36/18 watts respectively as specified. The fluorescent shall be cool white, with colour rendering and light colour of 840 characteristics with an average output of 3350 lumens (+ 5%) for 36 watts and 1350 lumens (5%) for 18 watts after 100 burning hours. The ballast shall be 'Low Loss' polyester filled type, totally enclosed and suitable to operate upto 250 VAC. The power loss shall not be more than 6 watts for 36/18 watts ballast. A wiring diagram, wattage, voltage and current figures shall be printed on the body of the ballast.

The lamp holders shall be rotary lock-in type. The starters shall be glow type with radio interference suppressor/by-pass capacitor. The internal wiring of the fluorescent light fixtures shall be done with heat resistant wires at the manufacturer's factory. Heat resistant sleeves shall be provided on cables passing near ballasts. All light fixtures shall be provided with power factor improvement capacitor to give a minimum power factor of 0.90. Connectors suitable for connecting 2.5 sq.mm cable conductors shall be provided for supply connections. An earth terminal for connection to 2.5 sq.mm cable conductor shall be provided.

The light fixtures shall be shock resistant, shock tested and damp proof conforming to IP65.

The design of light fixture for recess mounting shall be co-ordinated with the design of false ceiling prior to commencement of manufacture. Shop drawings shall be submitted for approval of Engineer.

## **11.5. LIGHT FIXTURE INSTALLATION**

### **11.5.1 General**

The mounting heights of light fixtures are indicated on the drawings, and position of fixtures are according to the mentioned scale.

The Contractor must ensure that the light fixtures are installed uniformly with respect to the dimensions of the area. Any modifications due to site conditions may be made with the approval of Engineer. All fixtures shall be carefully aligned before fixing in position.

The wiring between ceiling rose or terminal box and the fixture shall be carried out with 3-core 0.75 sq.mm and 1 sq.mm flexible copper conductor PVC/PVC cable respectively for circuits protected by 10 amps and 15/20 amps mcbs. The wiring inside light fixture body shall be done with heat resistant cables or PVC insulated cable in heat resistant sleeves as approved by the Engineer.

Glasses, shades, reflectors, diffusers, etc., must be in a clear condition after installation. All light fixtures shall be earthed by an earth wire connected to the earth terminal in the fitting.



### **11.5.2 Fluorescent Light Fixtures**

The fluorescent light fixtures on the surface of ceiling shall be installed with the back of the body flush with the ceiling surface, and in a manner so as to facilitate wiring. Nylon plugs and galvanized steel bolts or screws shall be used for fixing the light fixture to the ceiling. For light fixtures installation on false ceiling the installation method/detail shall be co-ordinated with ceiling design and submitted for approval of Engineer. Care shall be taken to prevent the weight of the fixture from being transferred to the false ceiling.

Pendant light fixtures shall have two holes in the top of each casing for supporting to the ceiling by a 3/4" dia. galvanized pipe or any other standard method as approved by the Engineer. Wiring from ceiling rose to the fixture shall be installed through the pipe. Proper arrangements such as long threads with check nuts, etc. for minor adjustment in the mounting heights of the fixtures shall also be provided.

## **11.6. MEASUREMENT AND PAYMENT**

### **11.6.1 General**

The Contractor's bid amount against each Bill of Quantities item as given below shall include supply, installation, testing, commissioning and completion for all work specified herein and/or shown on the Tender Drawings related to the item.

### **11.6.2 Fluorescent/Incandescent /Compact Fluorescent Light Fixtures**

**11.6.2.1 Measurement:** Measurement shall be made for each light fixture including all accessories acceptably supplied and installed by the Contractor as complete unit.

**11.6.2.2 Payment:** Payment shall be made for the number of units measured as provided above at the contract unit price and constitute full compensation for supplying, installing, connecting, testing and completion of fluorescent/ incandescent light fixture including all accessories such as ballasts, capacitors, ignitors, lamps, lamp starter, holders, starters, suspension rods, GI pipe bracket, ceiling supports, internal wiring, nuts, bolts, screws, etc., as required and complete in all respects.