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STRUCTURAL SPECIFICATIONS
FOR TENDER

PROPOSED 15-STOREY HOSPITAL BUILDING FOR
PHILIPPINE GENERAL HOSPITAL – FELICIDAD SY
MULTI-SPECAILTY BULDING
ERMITA, MANILA

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PHILIPPINE GENERAL HOSPITAL
Infrastructure Project
FELICIDAD SY MULTI-SPECAILTY BULDING
ERMITA, MANILA CITY

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DIVISION 1 - SITEWORK

SECTION 1

EARTHWORK

1.0 SCOPE OF WORK

Within this section of this specification includes the supply of labor, materials and equipment required to complete the necessary excavation, backfilling and grading on the site as indicated and inferred by the drawings, specified herein, or both.

2.0 SITE ACCESS

Provide and maintain any temporary means of site access with the approval of the authority having jurisdiction.

3.0 CHARACTER OF EXCAVATION

It shall be assumed that the Contractor has visited the site prior to tendering and has satisfied himself as to the nature of the materials in which excavations are to be carried out and no extra expense shall be allowed resulting from lack of this precaution.

4.0 DETAILED REQUIREMENTS ON STRUCTURAL EXCAVATION

a. General. Excavate by any methods as long as it conforms which the requirements indicated. All excavations shall be accomplished in the dry and shall be to the depths indicated in the plan. Scabble and trim sides of excavation to perpendicular or battered clean faces and finish bottoms of excavation accurately level and grade as shown on the drawings or established on site .

Keep all excavations free from water. Remove any satisfactory material resulting from softening or other disturbances by the entry of waters. Water which accumulated in excavated areas shall be removed by pumping or any other approved methods before filling or pouring concrete.

Carry out all remedial work required as a result of failure of banks and sides of excavations.

b. Footings and Foundations. Cut and form excavation for all footings to the detail and to the extent indicated.

c. Tolerance. Maintain limits of excavations within the following tolerances;

a. Bottoms of excavations + 50mm
-

b. Vertical face of excavation - 0 mm + 50 mm

Whenever unsuitable soil that is incapable of supporting the structure is encountered in the bottom of the excavation, such soil should be removed to the depth necessary to obtain proper bearing.

d. Drainage System at Site. The Contractor shall provide, constructed and maintain for the duration of the work, drainage system of the site approved by the engineer.

e. Backfilling. Backfill and ram around footings and other structures with the best of excavated materials placed in 150 mm layers, well watered and consolidated.

Materials for backfill shall be approved as specified and shall be carefully placed and compacted to a density equal to adjacent areas.

After the form are removed, all trash, wood chips and other debris shall be removed from areas to be backfilled. Backfill materials shall be free from brush roots and other undesirable materials which would be detrimental to compaction requirements.

No backfilling shall be placed until they have been inspected and backfilling is authorized.

f. Surplus Excavated Materials. Surplus materials not suitable nor required for backfill shall be removed from the site unless otherwise stated.

5.0 PLACING AND COMPACTING FILL

a. Materials. Common fill shall be approved materials, free from roots and stumps. Earthfill shall be used if site excavated materials are rejected or insufficient. Select fill shall be placed where specified and indicated in the plan and shall consists of gravel., crushed rocked or a combination thereof. The materials shall be free from undesirable matters and should be thoroughly tamped after placing/

b. Placing Fill. Before placing fill materials, the surface upon which it will be placed shall be cleared of all bushed, roots, vegetable matters and debris, scarified and thoroughly wetted to insure good bonding, between the ground and fill materials. Fill in contact with new concrete work shall not be placed until at least forty-eight (48) hours after removal or forms.

c. Compacting Fill. The fill shall be evenly spread in horizontal layers approximately 150 mm thick and each layer watered and compacted by approved power rollers, machine or hand tampers to a new density of at east 90% relative compaction.

END OF SECTION

DIVISION 2

CONCRETE

PART 1 - GENERAL

1.1 SCOPE OF WORK: The work includes cast-in-place concrete construction, complete.

1.2 General Requirements: Unless otherwise specified herein, concrete works shall conform to the requirements of the ACI Building Code (ACI 318, latest edition). Full cooperation shall be given to other trades to install embedded items. Before concrete is placed, embedded items shall have been inspected, reinforcing bars and materials for concrete accepted.

PART 2 - MATERIALS

2.1 CEMENT Cement for concrete work shall conform to requirements of ASTM C150,"Specification for Portland Cement".

2.1.1 STORAGE Cement in bags shall be stored in a suitable weatherproof structure which shall be as airtight as practicable. Floors shall be elevated above the ground at a distance sufficient to prevent absorption of moisture. Bags shall be stocked closed together to reduce circulation of air, but shall not be stocked against outside walls. The manner of storage shall permit easy access for inspection and identification of each shipment. Cement that has been in storage so long, that there is doubt to its quality will be tested by standard mortar tests to determine its suitability for use and such cement shall not be used without approval.

2.2 WATER: Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts organic materials and other substances that may be deleterious to concrete reinforcements.

2.3 AGGREGATES:

2.3.1 Fine Aggregates: Fine aggregates shall consist of natural sand. They shall be hard, tough, durable, uncoated particles. The stipulated percentage of fines in the sand shall be obtained by the processing of the natural sand or by the smallest size of crushed aggregates shall be generally rounded or cubical and the coarse aggregates shall be reasonably free from flat and elongated particles. The coarse aggregate shall be well graded from fine to coarse. It shall be separated into the following specified size groups. The grading of the aggregate within the separated size groups as delivered to the mixer shall be as follows:

Sieve Sizes US Standard Sq. Mesh	**Percent by Weight** 19.0 mm size	**Passing Individual** Sieves 38.0 mm Size
50 mm		100
38.0 mm		90-100
25.4 mm	100	20-55

	Percent by Weight	**Passing Individual**
US Standard Sq. Mesh	19.0 mm size	Sieves 38.0 mm Size
19.0 mm	90-100	0-15
9.0 mm	20-55	0-5
No. 4.0	0-10	-

2.3.2 Storage. Aggregates shall be stored in such a manner as to avoid the intrusion of foreign materials. Aggregates of different sizes shall be stored in separate piles. Stock piles of coarse aggregates shall be built in horizontal layers not exceeding 1.20 meters in depth to avoid segregation. Should the coarse aggregate become segregated, it shall be remixed to conform to the grading requirements given herein. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete as required by work schedule.

PART 3 - EXECUTION

3.1 PROPORTIONING AND MIXING:

3.1.1 Proportions: The proportions of all materials entering into the concrete shall in general follow the ACI Standard Recommendation for Selection of Proportions for Concrete (ACI 613). The Contractor shall provide all necessary equipment and plant to determine and control the actual amounts of each materials entering each batch to produce the concrete strength required.

3.1.2 Class of Concrete: Refer to the Design Criteria for the strength of concrete required for the project.

3.1.3 Changes in Proportions: The design mix shall be verified during the progress of the work at intervals as specified in 3.7, by testing standard 150 mm diameter by 300mm high cylinders. For the first 24-hours after molding, the cylinders shall be kept moist.

The Contractor shall furnish the necessary labor and facilities for taking the samples and handling and storage of cylinders at the project site. The Contractor will ship cylinders under the supervision of the Engineer to an acceptable private testing agency. The proportions will be changed whenever necessary in order to maintain the standard of quality required by the specifications.

3.1.4 Mixing: All concrete shall be machine mixed. Mixing shall begin 30 minutes after the cement has been added to the aggregates. The time of mixing after all the cement and aggregates are in the mixer drum shall not less than one (1) minute for mixers having a capacity of 3/4 cubic meter or less; for mixers having larger capacities, the minimum time shall be increased by 15 seconds for each additional 3/4 cubic meter or fraction thereof of additional capacity. All mixing water shall be introduced in the drum before 1/4 of the mixing time has elapsed. The mixer drum shall rotate at a peripheral speed of about 60 meter per minute throughout the mixing period. The entire contents of the mixer drum shall be discharged before re-charging. The time elapsing between the introduction of the mixing water to the cement and placing of the concrete in final position in the forms shall not exceed 45 minutes. The re-tampering of concrete, i.e., mixing with or without additional cement, aggregates or water will not be permitted.

3.2 FORMS:

3.2.1 General: Forms shall be used wherever necessary to confine the concrete and shape it to required lines or to insure the concrete from contamination with the materials caving or sloughing from adjacent excavated surface. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall be maintained rigidly in correct position. Forms shall be sufficiently tight to prevent the loss of mortar from the concrete. Forms for exposed surfaces shall be lined with form grade plywood. Bolts and rods used for internal ties shall be so arranged that when the forms are removed, all metals will not be less than 19mm from the formed surfaces.

3.2.2 Removal of Forms: Forms shall be removed in a manner which will prevent damage to the concrete. Forms shall not be removed without approval. Any repair of surface imperfections shall be performed immediately and curing shall be started as soon as the surface is sufficiently hard.

3.2.3 Cleaning and Oiling of Forms: Before placing the concrete the contact surface of the form shall be cleaned of encrustations of

mortar, grout or other foreign materials and shall be coated with commercial form oil that will effectively prevent sticking and will not stain the concrete surface.

3.3. CONVEYING AND PLACING CONCRETE:

3.3.1 Conveying: Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods which will prevent segregation. Use of belt conveyors, chutes or other similar equipment in which the concrete is delivered to the structure in a thin continuously exposed flow will not be permitted. There shall be no vertical drop greater than 1.5 meter except where suitable equipment is provided to prevent segregations.

3.3.2 Placing: approval of the engineer shall be obtained before starting any concrete pour. Concrete shall be worked readily into the corners or angles of the forms and around all reinforcements and embedded items without permitting the materials to segregate. Concrete shall be deposited as close as possible to its final position in the forms so that flow within the mass does not exceed 3 meters and consequent segregation is reduced to a minimum. Near forms, embedded items or where directed, the discharge shall be controlled so that the concrete may be effectively compacted into horizontal layers not exceeding 300 mm in depth within the maximum lateral movement specified. Free water shall be collected in depressions away from the forms and removed by bailing prior to placement of additional concrete. All concrete placing equipment and methods shall be subject to approval.

3.3.3 Consolidation of Concrete: Concrete shall be consolidated with the aid of mechanical vibrating equipment and supplemented by hand spading and tamping. In no case shall vibrators be used to transport concrete inside the forms. The vibrating equipment shall be of the internal type and shall at all times be adequate in quantity and power to properly consolidate all concrete. Forms or surface vibrators shall not be used. The duration of vibration shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. Vibrators shall not be inserted into lower courses that have commenced initial set. Consolidation around major embedded parts shall be by hand spading and tamping only.

3.4 CURING

3.4.1 General: All concrete shall be moist cured for a period of not less

than seven (7) consecutive days by an approved method applicable to local conditions. The Contractor shall have on hand all equipment needed for adequate curing and protection of the concrete.

3.4.2 Moist Curing: The surface of the concrete shall be kept moist by intermittently spraying with water or by covering with burlap or other approved materials saturated with water and keeping the covering wet by spraying or intermittent hosing. Water for curing shall be clean and free from elements which might cause staining or discoloration of the concrete.

3.5 CONSTRUCTION JOINTS: Construction joints shall not be made without the approval of the Engineer. Joint shall be located so as not to impair the strength of the structure. When a construction joint is made, the surface of the hardened concrete shall be thoroughly cleaned and all laittance removed. The joint shall then be thoroughly wetted and slushed with a coat of neat grout before placing of new concrete.

3.6 INSPECTION: Concrete shall be proportioned, mixed and placed only in the presence of the Engineer or his representative.

3.7 SAMPLING OF TESTS: A set of concrete cylinder samples shall be taken by the contractor not less than once a day or for each 50 cubic meter of concrete. A set comprise of 4 samples taken at random. Such samples shall be properly labelled indicating date and place where concrete was poured. These samples shall be tested in 7, 14 and 28 days. The fourth sample shall be tested only if there is doubt as to the result of the three samples tested.

***END OF SECTION ***

DIVISION 3

REINFORCING STEEL

PART 1 - GENERAL

1.1 SCOPE OF WORK. The work includes fabrication and placement of reinforcing steel bars for reinforced concrete members.

1.2 SHOP DRAWINGS. Shop drawings, showing all fabrication dimensions and locations for placing of the reinforcing steel and accessories shall be submitted for approval. Approval shall be obtained before fabrication.

1.3 Details of concrete reinforcements and accessories not covered herein shall be in accordance with the Manual of Standard Practice for Detailing Reinforced Concrete Structures (ACI 315) and the ASEP Guide to Earthquake Resistant Design of Structures, 1991 Edition.

PART 2 - MATERIALS

2.1 Reinforcing steels shall conform to the requirements of ASTM A615, "Specifications for Deformed Billet Steel Bars for Concrete Reinforcement."

2.2 Class of Steel: Refer to the Design Criteria for the grade of steel required for the project.

2.3 The Contractor shall provide the Engineer with manufacturers certificate for each batch of reinforcement to be used in the works for approval at least 28 days before the reinforcement is fixed. The test certificates shall show conformance with the requirements of ASTM A615.

2.4 Reinforcements shall be stored in manner that will avoid rusting, coating with grease, oil, dirt and other objectionable material.

2.5 Reinforcements shall be weldable.

PART 3 - EXECUTION

3.1 FABRICATING AND PLACING TOLERANCES:

- 3.1.1 Sheared Length = 25mm
- 3.1.2 Overall dimension of stirrup, ties = 6mm
- 3.1.3 Clear distance to formed surface = +6mm
- 3.1.4 Minimum spacing between bars = 25mm
- 3.1.5 Top bars in slab and beams
  - 3.1.5.1 Top bars in slab = +6mm
  - 3.1.5.2 Top bars in beams = +12mm
  - 3.1.5.3 Members more than 600mm deep = +25mm

3.2 PLACING

3.2.1 The following minimum protective covering shall be followed.

3.2.1.1 Concrete deposited against ground	= 75mm
3.2.1.2 Formed surface exposed to weather or in contact with the ground	= 50mm
3.2.1.3 Interior surfaces	=38mm for beams, columns = 19mm for slabs, walls

3.2.2 All reinforcements shall be supported and fastened together by accessories to prevent displacement by construction loads or the placing of concrete. Where the concrete surface will be exposed to weather in the finished structure, the portions of all accessories within 12mm of the concrete surface shall be non-corrosive or protected corrosion.

3.2.3 All splices not shown on the drawings shall be subject to approval. Splice length shall follow the requirement of the ACI Building Code Requirements for Reinforced Concrete (ACI-318) and the ASEP Guide to Earthquake Resistant Design of Structures, 1991 Edition.

3.2.4 Reinforcements shall not be bent after being embedded on hardened concrete unless permitted by the Engineer.

3.2.5 Testing: Standard testing shall be made on each size of reinforcing steel bars for every 10 tons or every lot delivered whichever is less. Testing shall be by an approved private materials testing agency.

END OF SECTION

DIVISION 4

UNIT MASONRY, MORTAR

PART 1 - GENERAL

1.0 SCOPE OF WORK:
The work includes the supply, construction and finishing of all concrete block works including reinforcing bars and filling where required, and including building-in of necessary items supplied by other trades.

1.1.1 General Requirements: Supply and lay concrete masonry complete with other necessary accessories as indicated and inferred by the drawings.

PART 2 - MATERIALS:

2.1 MASONRY BLOCKS: Masonry blocks shall develop a minimum compressive strength of fm' = 4.83MPa at 28 days. Three samples of each type of block shall be submitted for approval and all blocks used in the work shall come within the approved sample range. Blocks shall be sound, dry, clean and crack-free and shall be cured for at lest 28 days before delivery.

The concrete blocks shall be hollow type according to the drawings. For hollow blocks the total area of holes shall be less than half the cross-section of the block.

2.2 MORTAR:

2.2.1 Portland cement shall be a standard brand conforming to ASTM C150.
2.2.2 Mortar shall conform to ASTM C270-86.
2.2.3 Water shall be clean, drinkable and free from acids and alkalis.
2.2.4 Mortar shall consist of homogenous mixture of one part cement by volume, one-tenth part of hydrated lime and three parts of well graded sand. Mortar shall have a minimum slump of 100 millimeters and a maximum slump of 150 millimeters.
2.2.5 Grout shall be mixed using 3 parts sand, 1/10 parts lime and an approved plasticizer used in accordance with manufacturer's instructions.

PART 3 - EXECUTION

3.1 BUILT-IN MATERIALS: All materials to be built-in such as flashing, dowels, frames, conduit, outlet boxes, etc. shall be installed as the masonry work progresses.

3.1.1. Where openings occur, lintel beams shall be provided as shown in the drawings.

3.1.2 Bolts and anchors and other steel fittings shall be accurately set into walls as work progresses and positioned in such a way that they will be embedded in mortar or core-filling concrete.

3.2 LAYING BLOCKS:

3.2.1 Bond: Blocks shall be laid in stretcher bonds unless indicated otherwise and walls shall be laid true and plumb.

3.2.2 Joints: Mortar shall be straight, clean and uniform in thickness. Horizontal and vertical mortar joints shall be 10 mm in thickness.

3.2.2.1 In bed joints, mortar shall be spread in length only to the extent that it will still be plastic when the last unit is laid thus assuring adequate bond between the mortar and the upper masonry unit.

3.2.2.2 Where walls are to receive mortar bed for tile finish the joints shall be grooved to provide key.

3.2.3 Filling Concrete: Fill all cavities of blocks with concrete. Blocks to be filled shall not be laid to a height greater than 1200 mm before filling. Place concrete fill thoroughly until no further settlement occurs.

3.3. BLOCKWORK REINFORCEMENT:

Reinforcing bars shall be clean and free from loose mill scale, rust, mud, oil, grease, paint and other coating which would reduce the bond between the concrete and reinforcement. Reinforcing bars shall conform to the requirements of ASTM A615-86.

3.3.1 Placing Reinforcements: All horizontal reinforcement shall be laid in the wall as the block laying progresses. Horizontal reinforcement 12mm diameter or greater shall be mortared into the corners of channel blocks and all lapping shall be done with one bar positioned vertically over the other. Splice lengths of both horizontal and vertical reinforcement shall not be less than 30 diameter or 400 mm whichever is greater. Core filling concrete shall consist of homogenous mixture of cement, aggregate and water as follows:

a. For cores where the least dimension is greater than 75 mm

Cement		one part by volume
Sand	-	two parts by volume
Aggregate (9.5 mm)		four parts by volume

Water	The water/cement ratio shall be such as to give sufficient workability for adequate compaction.

The minimum compressive strength of core filling concrete at 28 days shall be 10 Mpa. Mixing, transporting and placement of core filling concrete shall be as specified below.

3.3.2 Core filling of masonry wall shall be cured for at least three (3) days after core filling is placed. Vertical reinforcement shall be firmly kept in place by wiring at the top and bottom of the wall. Core filling concrete shall be placed for the full height in lifts of not more than 1200 mm height. A minimum delay period of one hour and a maximum delay period of three hours shall be observed between lifts. It is important that wall and columns be filled to full height in 1200 mm maximum lifts as described above and wall should not be constructed higher than 1200 mm if the maximum and minimum delays between lifts. It is important that walls and columns be filled to full height in 1200 mm maximum lifts as described above and wall should not be constructed higher than 1200 mm if the maximum and minimum delays between lifts cannot be achieved. Concrete shall be thoroughly compacted into place. The core concrete shall be kept down a distance of 25 mm from the top of block work and this surface shall be thoroughly scabbled before any further concrete is placed.

3.4 TESTING: Three random samples of mortar shall be obtained from every 100 square meter section of the work. These specimens shall be standard 150 mm diameter by 300 high cylinders in the case of core concrete and standard 100 mm in case of the mortar. The following acceptance criteria shall apply (28 days compressive strength.):

a. The average of all results shall be not less than 1.2fm'.
b. No result shall be less than 0.8 fm'.

3.5 CLEANING DOWN:

3.5.1 Progressive Cleaning: Block work shall be cleaned down with clean water as work progresses before mortar has set.

3.5.2 On Completion: Clean down with dry brushing and in accordance with the manufacturer's instruction and leave all work clean and free from mortar splashes. Efflorescent deposits shall be brushed off and hosed down.

3.5.3 Timber stains shall be removed with a solution of 10 parts water to 1 part dilute hydrochloric acid followed by hosing down.

END OF SECTION

DIVISION 5

STRUCTURAL STEEL

PART 1 – GENERAL

1.1 SCOPE OR WORK: The work includes the supply of plant, labor, equipment, materials and performing all operations in connection with the fabrication and erection of all structural steel members and their accessories as shown in the drawings.

1.1.1 GENERAL REQUIREMENTS: Unless otherwise specified herein, structural steel works shall conform with the AISC Specifications for the Design, Fabrication and Erection of Structural Steel for the Buildings.

PART 2 - MATERIAL

2.1 Structural steel shall conform with the requirements of ASTM A36 "Standard Specifications for Structural Steel". Minimum yield strength shall be 245 Mpa (36,000 psi).

2.2 Structural shapes such as W sections, tubular, and other sections not available locally shall be fabricated from steel plates.

2.3 Welding electrodes for manual or submerged shielded metal-arc welding shall conform to E70 series of the Specifications for Mild Steel Arch-Welding Electrodes (ASTM A233).

2.4 Structural steel components shall be stored in an enclosed area free from contact with soil

2.5 Stainless components shall conform with the requirements of ASTM A242 and ASTM A588 of American Institute of Steel Construction, (latest edition). Minimum yield strength shall be 345 Mpa.

2.6 PAINTS: The original and characteristics of the paints shall be submitted to the Engineer's approval.

The Engineer reserves the right to have preliminary approval test carried out on samples of the paints, in a laboratory of his choice, sampling, transport and testing shall be at the Contractor's expenses.

All paints for protection against corrosion and fire, should be supplied by the same manufacturer, unless otherwise authorized by the Engineer.

2.6.1 Primer Paints: Epoxy primer shall be applied on all structural steel components before delivery to jobsite. Damage to the paint due to handling shall be repaired properly.

2.6.1.1 Maximum thickness of primer 1.0mm.

2.6.2 Intermediate Coat: This coat be applied on site.

2.6.2.1 Minimum thickness of intermediate coat = 1.0mil.

2.6.3 Finishing Coat: Apply enamel paint after erection of all structural steel components.

2.6.3.1 Minimum thickness of finishing coat = 1.5mils.

PART 3 - EXECUTION

3.1 General Requirements:

3.1.1 The workmanship shall be of first class quality and shall follow normally accepted methods defined by the relevant Philippine or American Standards.

3.1.2 The work shall be carried out in such a manner as to ensure a satisfactory coordination with the works of the other trades.

3.2 Fabrication and Erection – Detail Drawings:

3.2.1 The contractor shall prepare all the necessary fabrication and erection detail drawings for the structural steelwork and shall submit two copies of the same to the Engineer before commencing the fabrication. After carrying out any modifications required by the Engineer the Contractor shall supply five copies of the approved drawings to the Engineer.

3.2.2 The detail drawings shall give complete information of the fabrication and erection of the component parts of the structural steel work including the locations, size and type

of welds and the locations, size, type, grade and quality of bolts.

3.2.3 Approval of the shop drawings by the Engineer shall in no way relieve the Contractor of full responsibility for the adequacy and accuracy of the shop drawings and the correct fabrication and erection of the structural steelwork.

3.3 Cutting and Bending:

3.3.1 All members, plates, brackets, etc. shall be nearly and adequately sheared, sawn, or profiled to the required shape. Grind all rough edges after cutting. The bearing surface of base plates, end of columns shall be accurately machined.

3.3.2 Where steel is oxy-cut, care shall be taken to preserve the full shape. Bends shall be made to the radius or angle required without leaving a hammer marks.

3.4 Punching and Drilling:

3.4.1 Holes for bolts shall be drilled or sub-punched and reamed to 2mm larger in diameter than the specified bolt size.

3.4.2 All drilled holes shall have parallel sides and shall be drilled with the axis of the holes perpendicular to the surface. All rough edges shall be smoothed by grinding. When holes are drilled in one operation through two or more materials the parts shall be separated before assembly.

3.4.3 Holes for bolts shall not be formed by gas cutting.

3.5 Welded Construction:

3.5.1 All welds shall be made only by highly skilled welders or welding operators qualified by test to perform the type of work. All welding works shall be done in accordance with the Code for Welding in Building Construction of the American Welding Society.

3.5.2 Surfaces to be welded shall be free from loose scale slag, rust, grease, paint and other foreign materials. Joint surfaces shall be free from fins and tears. Preparation or

edges by gas cutting shall be done by mechanically guided torch.

3.5.3 In assembling built up members, the procedures and sequence of welding shall be such as will avoid distortion and minimize shrinkage stresses. Fabrication and assembly shall done in the shop unless otherwise approved by the Engineer.

3.5.4 When required, multiple layer welds maybe peened with light blows from a power hammer using a round nose tool. Peening shall be done after the welds has cooled to a temperature warm to the hand. Care shall be taken to prevent scaling or flaking of weld and base metal from overpeening.

3.6 High Strength Bolted Construction:

3.6.1 Bolts shall conform to ASTM A325 (Specifications for High Strength Carbon Steel Bolts for Structural Steel Joints).

3.6.2 Surfaces of high strength bolted parts in contact with the bolt head and nut shall not heave a slope of more than 1:20 with respect to the plane normal to the bolt axis. Where the surface of high strength bolted part has a slope more than 1:20, a beveled washer shall be used to compensate for the lack or parallelism. High strength bolted parts fit solidly together when assembled and shall not be separated by gaskets or any other compressible material. When assembled, all joint surfaces including those adjacent to the washer shall be free of scale, dirt, burns, and other defects that would prevent solid seating of the parts.

3.6.3 Each fastener shall be tightened to provide, when all fastener in the joint are tight, at least the minimum tension indicated below for the size of fastener:

Bolt Diameter	Minimum Tension (KN)
12 mm	55
16 mm	85
20 mm	125
22 mm	175
25 mm	225
28 mm	250

Bolts shall be tightened with properly calibrated wrenches or by turn-of-nut method.

When calibrated wrenches are used to provide the above bolt tension, their setting shall be such as to induce a bolt tension 5-10% in excess of the above. These wrenches shall be calibrated daily by tightening, in a device capable of indicating actual bolt tension, not less than three typical bolts of each diameters from the bolt in a single joint, the wrench shall be returned to touch up bolts previously tightened which may have been loosened by the tightening of subsequent bolt, until all are tightened to the prescribed amount.

When the turn-of-nut method is used to provide the bolt tension specified above, there shall first be enough bolts brought to a snug tight condition to ensure that the parts of the joint are brought into good contact with each other. (Snug tight is defined as the tightness attained by the full effort of a man using an ordinary spud wrench). Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation of ½ turn with the tightening progressing from the most rigid of the joint to its free edges.

3.7 Tolerances:

3.7.1 Built-up structural members fabricated by welding, unless otherwise specified. Shall be straight within the tolerances allowed for wide flange shapes by ASTM Specification A36.

3.7.1.1 Compression members shall not deviate from straightness by more than 1/1000 of the axial length between point which are to be laterally supported.

3.7.1.2 Completed members shall be free from twist, bends and open joint. Sharp kinks or bends shall be cause for rejection of material.

3.7.2 A variation of 0.8 mm is permissible in the overall length of members with both ends finished for contact bearing. Members without ends finished for contact bearing, which are to be framed to other steel parts of the structure, may have a members 9.0 meters or less in length, and not greater than 3.0 mm for members over 9.0 meter in length.

3.8 Erection:

3.8.1 Bracing: The frame of steel skeleton building shall be carried true and plumb as per plan and temporary bracings shall be introduced whenever necessary to take care of all loads to which the structure may be subjected including equipment.
Proper precaution shall be taken during erection that no excessive stress is induced in any part of the work. No part of the column shall be more than 3 mm from its true theoretical position.

3.8.2 Temporary Connection: As erection progress the work shall be securely bolted to take care of all dead, wind and erection load.
Permanent bolting shall not be carried out until correct alignment has been ascertained.

3.9 Painting:

3.9.1 General: Iron and steel surfaces shall be cleaned and painted.

3.9.2 Shop painting: Subject to the following exceptions all structural steel work on completion of fabrication shall be cleaned and painted in workshops as specified hereinafter.
Contact surfaces to be welded shall not be painted within eight centimeters of the weld, prior to welding. Bolted shop contact surfaces shall not be painted. Bolted field contact surfaces shall given a rust inhibitive treatment which shall be removed prior to assembly. Surfaces against which concrete will be poured shall not be painted.

3.9.2.1 Priming: Priming shall proceed only when the relative humidity in less than 80% and the temperature is above 12 degrees centigrade.
The coating shall be applied by high pressure airless spray as soon as possible after sand or grit blasting and dust freeing. If the time elapsed since the start of blasting exceeds 8 hours, brushing and dust-freeing shall be repeated.

After application, a careful touching up shall be carried out according to the method proposed by the Contractor and submitted to the Engineer.

The application of a coat or primer reacting coat on the epoxy/zinc priming coat is advised. It is however left to the sole responsibility of the Contractor to decide whether or not to apply this coat and his decision should be conformed by the Manufacturer of the paint used.

The primer reacting coat shall be applied, if used with a spray gun.
All paint shall be thoroughly dry and hardened before leaving the workshop.

3.9.3 On site painting: Coats applied at the workshop shall be completely re-examined and renewed when the framework units are delivered to the site.

The paints used shall be capable or providing protective coats at least as efficient as those used at the workshop. The supplier of the paint shall specify the method of use and the products to be used for this repainting work.

In all cases, any repainting shall be provided by a thorough cleaning of the steel including a sufficiently vigorous brushing to remove all traces of dirt or rust and all parts of the protective coating which are no longer adhering to the support.

3.9.4 Checking paint work: Control of paint-work shall include a check of the quality of the sanding (or grit-blasting), checks of the quality of the paint, and checks of the thickness of the protective coats.

3.9.5 Protection and Cleaning: The Contractor shall take all necessary precautions to ensure a perfect protection of works which could become corroded or stained in the course of erection and during repainting operations. Protective measures shall include construction of platform, positioning of layers of sand, tarpaulins, etc.

4.0 Testing

4.0.1 Testing of materials will be required on samples randomly selected by the owner's representative.

***END OF SECTION ***