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PROPOSED TRAUMA CENTER

BGHMC COMPOUND, BAGUIO CITY
CORDILLERA ADMINISTRATIVE REGION

TECHNICAL SPECIFICATION FOR STRUCTURAL WORKS

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PROPOSED BAGUIO GENERAL HOSPITAL MEDICAL CENTER
GENERAL NOTES AND SPECIFICATIONS FOR STRUCTURAL WORKS
(Issued as a Supplement to the Structural Plans)

1.0 WORKING DRAWINGS

1.1 This "General Notes & Specifications for Structural Works" shall form a part of the Structural Plans.

1.2 In the interpretation of these structural plans, indicated dimensions shall govern and distances or sizes shall not be scaled for construction purposes.

1.3 In cases of conflict in details or dimensions between the Architectural and Structural Plans, refer to the Structural Engineer or his authorized representative of final decision.

1.4 In cases of conflict between the Structural Plans and the General Notes and Specifications, the Plans shall govern.

2.0 DESIGN LOADS

2.1 Dead Loads

The design loads unless otherwise specified in the structural plans are as follows:

Concrete	150 pcf
Partitions (As reflected on plan)	10 psf (minimum)
Concrete Toppings	10 psf
Ceiling Utilities / Mechanical / Electrical/ Plumbing	10 psf

The Architect and building contractor shall get the approval of the Structural Engineer for any loading different from or exceeding these loads.

Concrete hollow block partition and R.C. walls are as indicated in the structural plans. Additional CHB and R.C. walls shall be subject to the approval of the Structural Engineer.

2.2 Live Loads

The design live loads unless otherwise specified in the plans are as follows :

Stairs	100 psf
Office/ Hospital	50 psf
Roof Deck	50 psf

These design live loads shall never be exceeded at any time during the life of the structure without the written consent of the Structural engineer.

It shall be the responsibility of the Owner of the building to get the approval of the Structural Engineer of any live load that will be imposed on any area of the building different from and or exceeding the design live loads specified herein.

No portion of the building shall be used as temporary storage of construction materials in excess of the design live loads with the consent of the Structural Engineer.

2.3 Earthquake Loads

The design earthquake loads are as per the provisions of the "Uniform Building Code (USA) 1997 Edition " for Earthquake Zone 4. These loads are assumed to be statically applied to the structure.

2.4 Winds Loads

The design wind loads are as per the provision of the "National Structural Code of the Philippines

2.5 Equipment Loading

Equipment not indicated in the plans shall be not installed without the approval of the Structural Engineer.

The manufacturer shall submit equipment data specifying the weight, and its reaction at the base, and its vibration characteristics.

3.0 REINFORCED CONCRETE CONSTRUCTION

3.1 Cement shall conform to Portland Cement ASTM C150

3.2 Concrete aggregates shall conform to ASTM C33 except the aggregates failing to meet these specifications but which have produced concrete of adequate strength and durability may be used to the approval of the Structural Engineer.

3.3 Water used in mixing concrete shall be clean and free from injurious amounts of oil, acids, alkalis, salts, organic material or other substances deleterious to concrete or steel

3.4 Reinforcing bars shall conform to ASTM A615

3.5 Admixtures to be used in concrete shall be subject to prior approval by the Structural Engineer.

3.6 Cement and aggregates shall be stored in such a manner as to prevent their deterioration or the intrusion of foreign matter.

3.7 Concrete cylinder samples for strength tests of each class of concrete shall be taken neither less than twice a day nor less than once for each 110 cu. m. of concrete or for

each 490 sq. m. of surface area place. The cylinder samples for strength tests shall be taken cured and tested in accordance with ASTM C172, ASTM C31, and ASTM C39.

3.8 Acceptance of Concrete

Concrete poured will be considered satisfactory if the average of all sets of these consecutive strength tests results equal or exceeds the required concrete strength (f_c') and not individual strength test falls below the required f_c' by more than 500 psi.

3.9 Core tests and load tests

If individual tests of laboratory cured cylinder samples produced strength more than 500 psi below f_c' core test and or load tests may be resorted subject to the approval by the Structural Engineer.

3.10 Mixing of concrete

All concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged.

3.11 Conveying of concrete

Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent the separation or loss of materials.

3.12 Depositing of Concrete

Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to re-handling or flowing.

3.13 Curing

Concrete shall be maintained in a moist condition for at least 7 days after placing. Wet burlap may be laid over the slab constantly applied with water.

4.0 CONCRETE MIXES

Unless otherwise indicated in the drawings, the minimum 28 day cylinder compressive strength shall be as follows:

- | | |
|-------------------------------|-------------------|
| a. Foundation ----- | $f_c' = 4000$ psi |
| b. Columns ----- | $f_c' = 4000$ psi |
| c. Slab on fill ----- | $f_c' = 3000$ psi |
| d. Beam & suspended slab----- | $f_c' = 4000$ psi |
| e. All others ----- | $f_c' = 3000$ psi |

5.0 FOOTINGS

5.1 Allowable Soil Bearing Capacity, based on soil investigation report, is 2350 psf. The contractor shall verify actual soil condition at site.

5.2 Existing underground pipes, tunnels, etc., shall be brought to the attention of the Structural Engineer for evaluation.

5.3 An excavation adjacent to an existing structure shall be provided with adequate sheet piling by the Contractor. The sheet piles shall be properly designed to resist earth and water pressure as well as surcharge loading on the footings of the adjacent existing structures.

5.4 Unless otherwise detailed in the plans CHB wall footing shall be as per figures on Sheet SS-1.

5.5 RC slab on fill other than pressure slab @ basement shall be .125m thick with 10mm bars at 0.30 m.o.c. each way unless otherwise indicated in the plans.

5.6 All earth fill supporting ground slabs for flooring, parking sidewalk, etc., shall be compacted to 90% proctor in layers of 0.30m. unless otherwise specified by the structural engineer.

6.0 REINFORCED CONCRETE BEAMS

6.1 Unless otherwise noted in the plans or specifications camber all RC beams at least 6mm (1/4") for every 4500mm (15') of clear span except cantilevers, which shall be 18mm (3/4") for every 3000mm (10') of clear span.

6.2 If there are two or more layers of reinforcing bars, use 25mm separators spaced at 0.90 m.o.c. In no case shall there be less than two separators between layers of bars.

6.3 If beam reinforcing bars end in a wall, the clear distance from the bar to the farther face of the wall shall be not less than 5 bar diameters. The reinforcing bar shall terminate on a standard 90 degrees hook.

6.4 Beam reinforcing bars supporting slab reinforcement shall be 25 mm from the bottom of the finish.

6.5 When a beam crosses a girder, rest beam bars on top of the girder bars. At column intersection girder bars shall be on top of beam bars.

6.6 Length of bar cur off and bar clearances shall be as specified in Sheet SS-1.

6.7 Top bars splices shall be located at mid span and bottom bar splices at column supports. Unless otherwise indicated in the plans splice lengths shall follow those given for developments length as per figure on Sheet SS-1.

7.0 REINFORCED CONCRETE SLABS

7.1 Unless otherwise noted in plans or specifications, camber all R.C. slabs 3mm (1/8") per 3000mm (10') of shorter span.

7.2 If slab are reinforced both ways, bar along the shorter span shall be placed below those along the long span at the center and over the longer span bars near the supports.

7.3 Lengths of bar cut off shall be as specified in Sheet SS-1.

7.4 Concrete covering shall be 18mm.

7.5 Unless otherwise specified by the Engineer, bar chairs shall provide at least 600mm each way to support top and bottom bars separately.

8.0 C.H.B. WALLS

8.1 Unless otherwise specified, the vertical and horizontal reinforcements for CHB shall be 10 mm bar diameter, spaced at 400 mm o.c. for all wall thickness. Lap splices shall be 300 mm long (minimum)

8.2 Lintel beams to be used shall be (t x 0.20m) reinforced by 4-12 mm bars with 10mm at 300mm o.c. ties where "t" is the CHB wall thickness.

8.3 Lintel beam shall be provided at top of CHB wall openings. It shall extend at least 200 mm beyond the openings.

8.4 For high walls, lintel beams shall be provided at 3000 mm o.c.

8.5 For long walls, vertical lintel beams acting as columns shall be provided at 6000 mm o.c.

8.6 Where CHB walls adjoin R. C. Columns and beams, provide dowels on R.C. column and beams prior to pouring to match CHB wall reinforcement. The dowels shall be 12 mm bars at 400mm o.c. (L-600 mm).

8.7 Where the top of CHB wall adjoins a beam, provide 50 mm gap to be filled with a soft material like styropor. Rebars as required in 109.6 shall be retained for stability.

8.8 Where the sides of a CHB wall adjoin a column provide 50 mm gap to be filled with a soft material like styropor. Rebars as required in 109.6 shall be retained for stability.

8.9 Where columns and beams have been poured without the CHB wall dowels, provided 12 mm dia expansion bolts at 400 mm o.c. These anchors shall be drilled and hammered in place. No chipping off of concrete columns and beams is allowed unless permitted by the Engineer.

9.0 STRUCTURAL TOLERANCES

Unless otherwise specified by the Engineer, the following are the acceptable structural tolerances for cast-in place concrete construction. All dimensions, which are not within the required tolerances, shall be corrected prior to pouring of concrete. Tolerances for pre-cast concrete construction shall be ½ of the values given below:

- a.) Cross sectional dimensions and location of reinforcement, protrating steel.

Dimensional less than 200mm	-	+6mm
200mm to 600mm	-	+9mm
Over 600mm	-	=12mm

- b.) Member lengths or height
(Maximum limitation=12mm) - 6mm per 3.0 meters

- c.) Deviation from straight line
(Sweep and or plumbness) - 6mm per 3.0 meters

- d.) Locations of bar cut-off or bonds - +50mm

10.0 CONCRETE PROTECTIONS FOR REINFORCEMENT

The following minimum concrete cover shall be provided for reinforcing bars, prestressing tendons or ducts. For bar bundles, the minimum cover shall equal the equivalent diameter of the bundled bars needed but not be more than 2 inches on the tabulated minimum whichever is greater.

10.1 Cast-in-place concrete (non-prestressed concrete construction)

- a) Cast against and permanently exposed to earth 75 mm
- b) Exposed to earth or weather
20 mm diam. and larger 50 mm
- c) Not exposed to weather or in contact with ground, slabs, walls and joints.
- | | |
|--------------------------------|------|
| 36 mm diam. and smaller | 19mm |
| No 14 and No 18 | 38mm |
| Beams, girders and columns | |
| Principal reinforcements, ties | |
| stirrups or spirals | 38mm |

11.0 REINFORCING BARS

11.1 All reinforcing bars shall be deformed conforming to ASTM A615-68

11.2 Unless otherwise noted in the plans the minimum yield strength of the reinforcing bars to be used corresponding to the structural member shall be grade 60 ($f_y = 60,000$ psi for all sizes.

11.3 Development length requirements (l_d) shall be as per Table on Sheet SS-1

11.4 Splice and anchorage lengths shall follow those set for development length (l_d) unless otherwise indicated in the plans or approved by the Structural Engineer.

11.5 Equivalent metric size bars when used shall be as per tabulations below :

No 3	10 mm \emptyset
No 4	12 mm \emptyset
No 5	16 mm \emptyset
No 6	20 mm \emptyset
No 8	25 mm \emptyset
No 9	28 mm \emptyset
No 10	32 mm \emptyset
No 11	36 mm \emptyset

12.0 "STANDARD" HOOK

12.1 A standard hook for rebars if required shall be either of the following:

- a) A semicircular turn plus an extension of at least 4 bar diameter but not less than 62 mm at the free end of the bar
- b) A 90-degree turn plus an extension of at least 12 bars diameter at the free end of the bar.

12.2 Minimum diameter of bend measured on the inside of the bar shall be as follows:

10 mm \emptyset to 25 mm \emptyset	- 6 bar diameter
28 mm \emptyset to 36 mm \emptyset	- 8 bar diameter
No 14 to No 18	- 10 bar diameter

13.0 CONSTRUCTION JOINTS

13.1 Construction joints shall be located near the middle of the span of slabs, beams or girders.

13.2 Where a joint is to be made, the surface for the concrete shall be thoroughly cleaned and all Latinate and standing water removed. Vertical joint also shall be thoroughly wetted and coated with near cement grout immediately before placing of new concrete.

13.3 Construction joints in walls, slabs and other structures that are subjected to water pressure shall be provided with water stops. Kind, type, and size of water stops shall be as approved by the Engineer.

13.4 At beam –girder intersection, the construction joint on the girder shall be offset a distance equal to twice the width of the beam. Diagonal bars shall be provided to resist 100% shear of the construction joint.

13.5 Construction joints in columns shall be located a distance above the floor equal to at least the maximum dimensions or 1/6 of story height.

14.0 PIPES EMBEDDED IN CONCRETE

14.1 Pipes with their fitting shall not displace more than 4% percent of the cross-sectional area of the column.

14.2 Pipes of aluminum shall not be embedded in concrete.

14.3 Concrete cover for pipes shall be at least 38mm for concrete surfaces exposed to the weather or in contact with the ground or 18mm for concrete surfaces not exposed to the ground or weather.

14.4 No vertical pipes are allowed to punch through a beam girder.

14.5 Horizontal pipes may punch through a beam or girder subject to the approval of the structural engineer. The contractor shall submit to the engineer the actual location where pipes cross a beam or girder. Where permitted by the engineer, provide at least 2-16mm (600mm long) U bars to enclose the pipe at the point of intersection of each face of the beam.

15.0 REMOVAL OF FORMS AND SHORES

15.1 Forms shall be removed in such a manner as to ensure complete safety of the structure.

15.2 Unless otherwise specified by the Structural Engineer, the following shall be the basis of removal of forms and shoring for reinforced concrete (R.C) construction.

	Age of Concrete
Beam side forms	2 days
Column side forms	2days
Slab bottom forms	7days

16.0 REINFORCED CONCRETE COLUMNS

16.1 Unless otherwise indicated, the column pedestal embedded in the ground shall be 50mm larger than the column as per plan at the basement floor level, or ground floor level if there is no basement.

16.2 Construction joints in columns shall be located at the top of the pedestal (basement floor line, or ground floor line if there is no basement) or at least a distance above the floor equal to the maximum dimension of the column or 1/6 story height.

16.3 All ties shall be fastened to column vertical reinforcement by means of wires at all intersection portions of ties and columns rebars.

- 16.4 Not more than one-half (1/2) of the total number of bars shall be spliced at the same level. The lap splice be 1.3 l_d of the bar development length. Splices shall be staggered at a distance of at least 40 bar diameters.
- 16.5 Column bar splice lengths shall follow those tabulated for development on Sht.SS-1.
- 16.6 Lap welded splice maybe used in lieu of the above. The capacity of the weld provided shall be 125% larger than the tensile capacity of the bigger bar being spliced. No butt welded splices are allowed unless otherwise permitted by the structural engineer.
- 16.7 Confinement ties shall be provided on all columns at beam column intersections as shown in SS-1.

17.0 REINFORCED CONCRETE WALLS

- 17.1 Unless otherwise indicated in the plans, the R.C. wall horizontal bars shall be inside the vertical bars (retaining wall).
- 17.2 Reinforcing bars shall have at least 30mm concrete clearance except in 100mm wall or less where they shall be at the center.
- 17.3 Carry vertical bars 600mm above floor level to provide for splices when necessary. Elsewhere stop at 50mm below the top of the slab the bar shall terminate on a standard 90 degree hook.
- 17.4 Horizontal and vertical bars conforming to ASTM A615 shall have a minimum splice lapping and wired with NO. 16 GI wire provided that splices in adjacent bars are staggered at least 1.50 m.o.c. not more than one-half(1/2) of the total numbe of bars shall be spliced at the same line. Splices shall be staggered a distance of at least 40 bar diameters.
- 17.5 All opening on walls or slabs less than 300mm thick shall be reinforced as per figure on Sheet SS-1.
- 17.6 At wall intersection and corners, the anchorage length provided shall be as shown on figures on sheet SS-1.

18.0 WELDED SPLICES

- 18.1 Lap welded splices when used shall develop a resistance equal to at least 125 percent of the tensile capacity of the bar being spliced.
- 18.2 Butt-welded splice when used shall be considered 75% efficient. The remaining 50% capacity to develop 125 percent of the tensile capacity of the bar shall be provided for by an additional welded lap splice connection on the same joint.
- 18.3 Details of all welded splices shall be submitted by the Contractor for approval of the structural engineer.

18.4 Only certified welders shall be allowed to perform welding operations. These welders shall be subject to the approval of the work engineers.

18.5 Testing of welds shall be by X-ray method (non-destructive test) unless otherwise directed by the structural engineers.

18.6 Connection of crossing bars by tack welding is not permitted.

19.0 ELECTRICAL CONDUITS

19.1 All electrical conduits shall be placed between the top and bottom reinforcement of slabs and R.C. walls.

19.2 The spacing of these conduits shall be at least three times the diameter on cantilever.

SS 103 SITE PREPARATION

This work includes performing site preparation, excavation, borrow, filling, backfilling, compacting and finished grading necessary to construct the finished grades indicated for structures and on - grade slabs or site work. Contractor shall be responsible for evaluating soil borings and data shown on the drawings and shall include in his tender rock excavation as required.

103.1 CLEARING AND GRUBBING

Unless indicated otherwise, remove trees, stumps, shrubs, and brush within the limits of construction. Protect from damage trees and shrubs, which are to be saved, or which are outside the limits of construction. Except where area is indicated "Clearing Only", grub out matted roots over 2 inches in diameter to at least 18 inches below the existing surface.

103.2 UNSATISFACTORY MATERIAL

Remove organic matter, muck, rubbish, and unsuitable clays under structures, which are less than one meter in thickness and under pavements or slabs on grade. The Engineer shall direct the depth of removal of such unsuitable material.

103.3 EXCAVATION

Excavate to the contours and dimensions indicated. Keep excavations free from water while construction is in project notify the Engineer immediately in writing in the event that it is necessary to remove rock, hard material, or other material defined as unsatisfactory to a depth greater than indicated. Refill excavations cut below the depths

indicated with approved fill material and compact as specified herein. Excavate soils permitted to soften from exposure to weather.

103.4 EXCAVATION FOR STRUCTURES

Excavate to depth indicated. If excavation is deeper than indicated, then fill with concrete when the foundation or footings are placed.

103.5 SHORING AND SHEETING

Shore and sheet excavations, as necessary to prevent injury to persons and damage to structures shall be provided. Also arrange shoring and sheeting to preclude injurious caving during removal.

103.6 BORROW MATERIALS

Select borrow materials to meet requirements and conditions of the particular fill to be used. Perform necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits as indicated operations to the borrow excavation.

103.7 FILLING AND BACKFILLING

103.8 FILLING AND BACKFILLING ADJACENT TO STRUCTURES

Place backfill adjacent to structures and compact to prevent wedging action or eccentric loading upon or against the structures. Step or serrate the slopes bounding or within areas to be backfilled to prevent sliding of the fill. Do not use equipment for backfilling operations for the formation of embankments against structures retaining walls that will be done after approval has been obtained from the Engineer.

103.9 COMPACTION

Compact each layer or lift of material specified so that the in-place density tested is not less than the 96 percentage of maximum density.

103.10 SITE GRADING Ground (Street) LEVEL

Grade to finished grades indicated within 3 centimeters Grade areas to drain water away from structures and provide suitable surface herein.

103.11 PROTECTION OF SURFACES

Protect newly graded areas from traffic, erosion, and settlements. Repair damage grades, elevations, or slopes prior to acceptance of works.

NOTES FOR STRUCTURAL STEEL

122 DESIGN SPECIFICATIONS :

- 122.1 DL + LL : Refer to IBC latest edition & NSCP 2015 vol. 1
- 122.2 WL : Refer to IBC latest edition & NSCP 2015 vol. 1
- 122.3 EL : Refer to IBC latest edition & NSCP 2015 vol. 1

123 DESIGN CODES :B

- 123.1 American Institute of Steel Construction (AISC)
- 123.2 American Welding Society (AWS)
- 123.3 American Iron and Steel Institute (AISI)
- 123.4 National Structural Code of the Philippines (NSCP '15 vol. 1)

123.5 Latest International Building Code (IBC latest edition)

124 MATERIAL SPECIFICATIONS:

124.1 Unless otherwise indicated in the plans, structural steel shapes and plates shall conform to ASTM –A50 (Fy=50ksi). Certified Mill Test shall be submitted by the fabricator to the Structural Engineer.

124.2 Welding shall conform to AWS standard, E60 or E70 electrodes shall be used unless otherwise specified by the Structural Engineer.

124.3 The fabricator shall have the welds tested by X-ray method by an independent company engaged in non-destructive testing as directed by the Structural Engineer. The welds are considered satisfactory if 9 out of 10 samples passed the requirement otherwise the welds shall be corrected.

124.4 Unless otherwise noted, bolts shall conform to ASTM A325.

125 FABRICATION :

125.1 Steel fabricator shall submit shop drawing showing complete detailed connections for approval by the Structural engineer. No material shall be ordered nor fabrication started until the Structural Engineer approves such drawings.

125.2 All dimensions in the plans shall be verified by the steel fabricator in the field in coordination with the general contractor.

125.3 Unless otherwise specified in the plans, gusset plates and stiffeners shall be 6 mm thk. (minimum)

125.4 All splices shall be staggered. No splices shall be permitted at point where critical stressed occur. Splice plate shall have a minimum length of 300 mm.

125.6 All bearing plates shall have a minimum thickness of 12 mm

125.7 All erection bolt holes shall be 3 mm plus nominal bolt diameter

125.8 All cuttings shall be neat cut

125.9 Shop paint (red lead primer or any equivalent brand; 2 coats) shall be provided. Any work that is not in conformance with these specifications will be rejected at any time during the progress of the works. .

STRUCTURAL STEEL

PART I - GENERAL

1.01 SCOPE OF WORK

- A. The work to be undertaken in this section shall comprise the furnishing, fabrication, re-assembly in site, painting, delivery, erection, and installation of all materials including anchor bolts, base plates, erection bolts, bracing and all other structural steel work indicated in the plans or specified herein.

1.02 CODES AND SPECIFICATIONS

- A. The work under these sections shall comply with the applicable requirements of the following Codes and Specifications:
1. National Structural Code of the Philippines, Vol. I, Buildings, Towers and other Vertical Structures (NSCP 2001).
 2. ASEP – Steel Handbook, Vol. I, Dimensions and Properties 3rd Edition
 3. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, American Institute of Steel Construction, (AISC), latest edition.
 4. Code of Standard Practice for Steel Buildings, American Institute of Steel Construction (AISC), latest edition.
 5. Structural Welding Code, American Welding Society (AWS), latest edition.
 6. American Society for Testing and Material (ASTM).

1.03 MATERIALS

- A. All structural steel required for this structure shall conform to the “Specifications for Structural Steel” (ASTM A-36 latest revision) for rolled and built-up sections.
- B. All arc-welding electrodes shall conform to the requirements of American Welding Society “Specification for Iron and Steel Arc-Welding Electrodes”, latest revision.
- C. All connection bolts and anchor bolts shall conform to ASTM designation A325 high strength bolts. For erection or for connection not requiring high strength bolts as shown in the plans, use A307.

1.04 WORKMANSHIP AND FABRICATION

- A. Workmanship and fabrication shall be in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, latest revision.

1.05 CONNECTIONS

- A. All shop connections shall be welded while field connection shall be bolted unless otherwise indicated in the plans or on the approved fabrication drawings.
- B. All areas of contact surfaces shall be free of oil, paint, burrs and loose scale.
- C. One sided connection shall not be used unless explicitly indicated on the drawings.
- D. End distance unless shown otherwise shall conform to AISC Specifications, Table 1.16.5.
- E. The Contractor shall furnish and install erection angles for fit-up of welded connections.
- F. Ample clearance shall be provided for field erection.

1.06 SPLICES

- A. Field splices shall not be made on trusses unless extreme length, depth, or weight would make shipment in one place impossible or undesirable.
- B. Shop splices of main members or parts thereof, including individual truss members shall be made with complete penetration butt welds.

1.07 WELDING

- A. The technique of welding, the workmanship, appearance and quality of welds used, and the method used in correcting non-conforming work shall be in accordance with the structural welding code, AWS D11-77, of the American Welding Society.
- B. The electrode shall be of classification number ASTM E70XX and shall be suitable for welding position, recommended power supply, type of coating, and other conditions of intended use in accordance with the instruction in each container.
- C. The welding equipment shall be of the type that will produce proper current so that the operator may produce satisfactory welds. The welding machine shall be NEMA rated at 400 AMPS, 25-40 arc-volt capacity.
- D. All field welding shall be done by direct current.
- E. Surface to be welded shall be free from loose scale, rust, grease, paint, and other foreign material except that mill scale which withstands vigorous wire brushing may remain. A light film of licensed oil may likewise be disregarded. Joint surfaces shall be free from fins and tears.
- F. Finished members shall be true to line and free from twists, bends and open joints.
- G. Connection may be tested by ultrasound, radio-graphic or any non-destructive test as directed by the Engineer. All expenses for the testing shall be for the account of the Contractor.
- H. Welds that do not pass the non-destructive test may be redone at most twice. Should the same weld fail for the third time, the structural members affected should be replaced.
- I. The Owner reserves the right to remove test specimens from any portion of the work to verify the quality of welding. The Contractor, at his expense, shall repair or replace any base metal or filler metal found to be defective. When a defective area is found, the Owner reserves the right to remove test specimens from both sides of the defective area at the Contractor's expense.
- J. Structural welds shall be either as defined by AISC or regarded as any weld necessary for the development of strength between adjoining pieces of steel. Structural welds shall be made as shown on the Drawings.
- K. When required by AWS D1.1, Section 5, Paragraph 5.2, the Contractor shall develop and submit for authorization to proceed by the Engineer, welding procedures designed to produce welds in accordance with the intent of this Specification. In developing these procedures, the Contractor shall show that consideration has been given to selection of type and size of electrode, heat input, interpass temperature, preheat, bead deposition, technique, and welder qualification.
- L. Welding procedures specifications for pre-qualified joints, AWS D1.1 Appendix "F" Form, shall be submitted by the Contractor, when requested by the Engineer, for authorization to proceed prior to start of fabrication.

- M. Welder's qualification record (AWS D1.1 Appendix E) shall be made available for the Owner's authorization to proceed, upon request. All welders and welding operators shall be qualified per AWS D1.1 Section 5, and shall have certificates on file for the Owner's review at any time during fabrication. The Owner reserved the right to require the testing or retesting of welders for qualification in accordance with the AWS Code, Section 6.4. All costs and material required for the qualification of welders shall be at the Contractor's expenses.
- N. Welds made by welders that are not pre-qualified or that have not been properly qualified and had no authorization to proceed shall be rejected and completely removed.

1.08 WELDER'S QUALIFICATIONS

- A. All welders, welding operator and trackers to be employed shall have been qualified by test as prescribed in Section 5 of AWS D1.1-77 of the American Welding Society.
- B. All welders who shall be employed in this project shall at least the 4G position test and shall be only certified by any of the following independent testing companies:
 - 1. Industrial Inspection (International), Inc.
 - 2. Corrosion Technologist, Inc.
 - 3. Asiatic Corrosion Control
 - 4. Metal Industries Research and Development Center

1.09 PRE-ASSEMBLY PAINTING

- A. The truss structures should be pre-assembled at shop by the Contractor prior to the transport of structural elements to site for erection.
- B. All surfaces shall be dried free from rust, scale and grease prior to painting.
- C. The truss structure shall be painted. Use of Zinc chromate primer is required. Paint coating shall not be less than 175 grams per sq.m. (25 microns per coat).
- D. Paint shall be delivered to the shop and jobsite in original sealed containers, which shall be clearly marked with the manufacturer's name and the identifying brand number or name. The paint shall be used as prepared by the Manufacturer without thinning or other admixture.

1.10 DIMENSIONAL TOLERANCES

- A. Mill tolerances shall conform to ASTM A6.
- B. Length

A variation of 0.8 mm. (1/32 in.) 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 variation from the detailed length not greater than 1.6 mm (1/16 in.) for members 9.1 m. (30 ft.) or less in length, and not greater than 3.2 mm. (1/8 in.) for members over 9.1 m. (30 ft.) in length.

- C. The tolerances of welded structural members shall conform to AWS Standards.

1.11 MARKING AND SHIPPING

- A. All structural steel shall be prominently paint marked for identification in erection. These marks should incorporate the requisition sheet number, the area designation, as specified on the Owner's drawings and piece mark number, which shall follow logical sequences. The steel members shall be marked in such a way as to indicate the correct orientation for the erection, a note covering this must appear on the diagrams. The erection diagrams should also indicate the column grid marks shown on the Owner's drawings.
- B. All bolting, nuts, and washers shall be shipped prior to or with the first lot of structural steel. Base plates shall be shipped with the steel supported by the base plate.
- C. All material shall be properly protected and so loaded as to prevent damage in transit. Bolts, nuts, washers, etc., shall be packaged in boxes or keys.

Beveled plate edges prepared for field welding shall be protected. Loose clips and other small structural parts shall be either boxed or wired together and fixed on to larger parts. Floor plains shall be bundled for shipment. Machine surfaces (bolt threads, beveled plate edges, etc.), shall be coated with a corrosion inhibitor.
- D. Each crate, box, etc., as shipped shall, in addition to the address, be marked to show the contents thereof, the complete requisition number and the identification of the structure on which such material will be used.

1.12 REJECTION

- A. Structures or parts thereof and material entering therein, indicating irremediable or injurious defects, improper fabrication, excessive repairs, or that they are not in accordance with this Specification, shall be subject to rejection. They shall also be subject to rejection if such conditions are discovered after acceptance of the items at the Contractor's works.

1.13 ERECTION

A. General

The erection of all structural steel shall conform to the applicable requirements of the AISC Specification and AISC Code of Standard Practice. All structural steel work shall be erected accurately to the lines and levels shown on the Drawings. All columns and other vertical members shall be plumb and horizontal members level before permanent connections are made. All temporary bracing, guys and bolts as may be necessary to insure the safety of the structure until the permanent connections have been made shall be provided by the Contractor. Members shall be connected, as erection progresses, to resist all dead load, wind and erection stresses.

B. Bolted Connections

Mating faces of bolted connections shall be cleaned to bare steel, free from paint, grease and other foreign matter. Field connections shall be accurately fitted up before the bolts are taken up. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the hole or to distort the metal. All unfair holes shall be drilled or reamed. After joints are fitted up properly, bolts shall be tightened by the turn-of-nut method.

C. Cutting and Burning

The use gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Its use may be permitted on minor members if the member is not under stress and then only after the written approval of the Engineer has been obtained.

D. Tolerances

The tolerances of erection and fabrication of structural steel, unless otherwise specified, shall comply with the AISC Specification. The maximum deviation from true vertical shall be one part in 500.

1.14 FIELD MEASUREMENT

- A. The Contractor shall make measurements in the field to verify or supplement dimensions shown on structural drawings, and he shall take the responsibility for the fit of the steel to the existing work.

1.15 INSPECTION

- A. The Owner will provide inspectors for shop and field inspection of the structural steel.
- B. Inspection at mill, shop or field in no way relieves the Contractor from his responsibility to furnish satisfactory materials and workmanship, and the right is reserved to reject any material on workmanship at any time before the final acceptance if, in the opinion of the Owner's Inspector, the material and/or workmanship does not conform to the requirements of the Contract.
- C. The Inspector shall have full access at all times and at all points where work is being done or where materials are stored and shall full authority to reject or have corrected any work or material that fails to conform to the terms of the Contract.
- D. The Inspector, in addition to the visual inspection, may order at the CONTRACTOR'S expense weld testing by radiographic or any other standard non-destructive testing method at the places and location not included in the Contractor's scope of work as selected by the Inspector. The necessary shop assistance for satisfactory execution of testing shall be supplied by the Contractor. If any individual connection at any tested 5% length of total welding length in continuous built-up member ready from shipping to field is found to contain cracks or 4% or more of defective welding length to such an extent that welds are not acceptable in accordance with the specified standards, the Inspector can call at his selected locations for additional testing until the extent of defects is determined of the total defective weld length in any individual connection or in one continuous built-up member ready for shipping to field falls below 4% of total length in the member. In such a case all the non-destructive testing and retesting cost for the particular built-up member performed by the Inspector's selected testers shall be borne by the Contractor. All welding rejected by the Inspector because of defects discovered by testing or visual inspection shall be corrected at the expense of the Contractor.
- E. The Inspector may order at the CONTRACTOR'S expense tension tests on the steel plates as rolled sections to verify conformance with ASTM A-36 specifications. Contractor shall cut and shape the test samples and shall deliver them to the Materials Testing Laboratory at no expense to the Owner.

1.16 SUBMITTAL OF DOCUMENTS

- A. The following documents shall be submitted to the Owner by the Contractor for approval. In case of the Owner's request to submit documents other than the following, this request shall be satisfied:

1. Shop Drawing

The Contractor, immediately on the award of the Contract, shall prepare shop (fabrication) drawings of all structural steel, based on the designs for the approval of the Engineer. The preparation of these drawings shall not be subject without the Engineer's permission. These drawings shall show all the detailed requirements necessary for the fabrication and erection of the structures, and shall be based on the AISC Specifications, latest edition. Approval of these drawings shall be primarily with reference of sections and connections and checking is only for conformance with the design concept and compliance with the information given in the Contract Documents. The Contractor shall be responsible for the dimensions to be confirmed and correlated at the jobsite; for the correct fittings of the component parts; for the information that pertains solely to the fabrication processes as to techniques of construction and for the coordination of the work of all trades.

2. Fabrication and Erection Manual
 - a. Management System of this Construction
 - b. Work System
 - c. Careers of Engineers and Instructors in charge
 - d. Welder's name, age, experience, certificate of qualification
 - e. Welding Standards
 - f. Paint and Painting Method
 - g. Inspection method
3. Steel Mill Test Reports and/or Materials Testing Laboratory Reports
4. Fabrication, Shipping and Erection Schedule
5. Match Marking Drawing
6. Report of Welding Inspection
7. Report of Mechanical Tests for High Strength Threaded Fasteners
8. Net Weight List of Product
9. Accuracy Report for Erection

PART II PRODUCTS

2.01 MATERIALS

- A. Where materials, products, or equipments are specified by reference to a specific standard or by reference to a specific manufacturer, materials, products, or equipment which ensure an equal or higher quality than the standards or manufacturers mentioned will also be acceptable. It will be incumbent on the Contractor to verify the equal or higher quality and submit comparative data (both specified and proposed data) for review.

2.02 STRUCTURAL STEEL

- A. Structural steel shall comply with the provisions of ASTM Specifications appropriate for the grade designated on drawings (ASTM A36).
- B. Dimensional standards: ASTM A6; welded shapes per dimensional standards of mill rolled sections.
- C. Quality: Sound, free from loose mill scale, cracks, laminations and slag inclusions.

- D. Steel Tubing and Pipe shall comply with ASTM A501.

2.03 WELDED ELECTRODES

- A. Welded electrodes shall comply with the provisions of AWS "Structural Welding Code" and specifications A5.1, A5.5, A5.17, A5.18 and A5.20.

2.04 BOLTS

- A. High strength bolts and high strength bearing bolts, nuts and washers shall comply with the provisions of:
1. ASTM A325 or A490
 2. AISC Specifications for "Assembly of Structural Joints Using High Strength Bolts"
- B. Anchor Bolts: Use A354 Grade BC

2.05 PAINT

- A. Prime Paint: Red Primer or PS TT-P-86, Type II red lead paint
- B. Zinc Rich Paint: DOD-P-21035A; weight not less than 2.5 kilograms per liter.

2.06 MISCELLANEOUS MATERIALS

- A. Provide miscellaneous materials or accessories as indicated on Drawings or required for good construction practice.
- B. Provide supplemental structural steel support framing around minor floor openings where indicated in the Drawings.

2.07 FABRICATION

- A. General: Fabricate per AISC Specifications. Materials shall be properly marked where field assembly requires. Sequence of shipments shall be such as to expedite erection and minimize the field handling of materials.
- B. Planning and Milling:
1. Mill bearing surfaces to true planes. Mill ends of column perpendicular to centerline axis connected mid depth points at ends of member. Milled surfaces shall be completely assembled or welded before milling. Cut and fit column and bearing stiffeners to give full bearing over cross section.
 2. Column Base Plates:
 - a. From 50 millimeters to 100 millimeters thickness: Straighten by pressing.
 - b. Over 100 millimeters thickness: Plane top for column bearing; plane bottom when bearing on steel.
- C. Holes, Cutouts and Fitting: Provide where indicated for other trades. No additional holes, cutouts or fittings permitted without written permission. Provide only openings shown on structural drawings. Submit any additional openings proposed for shop drawing for review.
- D. Camber: Fabricate beams, girders and assemblies with natural camber upward, unless otherwise indicated.

- E. Connections shall be as indicated on drawings. Alternate connections maybe required due to erections to erections or other conditions. All connections for shop or field connections of splicing shall be shown on the shop fabrication drawings for review prior to fabrication.
- F. All connections shall be detailed by the fabricator based on information indicated on drawings and all considerations of shipment and erection. Detailing shall be performed using rational engineering design and standard practice in accordance with AISC. Details indicated in Drawings maybe subject to minor changes during detailing.
- G. Individual steel shapes indicated on Drawings consist of members which are identified by the designations indicated. Where alternative shapes are indicated, an initial set of erection drawings shall be submitted which indicate all members which are proposed to be used. Where indicated on Drawings or where material availability is difficult, individual members maybe fabricated from individual plates and all such proposed substitutions shall be indicated on initial erection drawings.
- H. No combination of bolts or welds shall be used for stress transmission in the same faying face of any connection.
- I. Automatic or semi-automatic welding maybe used per AWS Procedure.
- J. Welding, filler metal, welding technique, qualified welders and procedures shall be in accordance with AISC Specification for the "Design, Fabrication and Erection of Structural Steel for Buildings," and AWS "Structural Welding Code" and "Filler Metal Specifications".
- K. All steel shall be clean particularly in areas where painting, welding, bolting and stud welding will be performed.
- L. Welding processes other than shielded metal arc or submerged arc maybe used provided procedure qualification test in accordance with the American Welding Society are made for the intended application of any such process.
- M. Built-up sections assembled by welding shall be free of warpage and all axes shall have alignment within specified tolerances.
- N. Welds not specifies shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS.
- O. All welding sequences shall be such as to reduce the residual stresses due to welding to a minimum value.
- P. The toughness and notch sensitivity of the steel shall be considered in the formation of all welding procedures to prevent brittle and premature fracture.
- Q. Welded connections shall be detailed and designed to minimize accumulation and concentration of through-thickness strains due to weld shrinkage.
- R. Repairs: Remove defects, reweld and grind welds flush; method of repair shall be acceptable, In lieu of repairs, materials with defects maybe replaced with new at Contractor's option and expense.

2.08 PREPARATION OF SURFACES AND PAINTING

- A. General: Do not paint when ambient temperature is below 7 degree Celsius. Paint in dray weather or under cover. Apply paint by brush or spray over dry dust free surface per manufacturer's direction. Do not thin paint in excess of manufacturer's recommendations. Allow paint to dry before handling or shipment of structural steel; keep paint at least 50 millimeters away from welds. Do not paint surfaces to receive fireproofing.
- B. Prime Paint:
 - 1. Surface Preparation: Clean surfaces of loose mill scale, dirt, dust and other foreign matter by use of suitable tools; hand tool cleaner per SSPC-3. Remove oil and grease with volatile solvents per SSPC-1.
 - 2. Application: Apply one coat to surface where indicated; dry film thickness not less than 0.05 millimeters.
- C. Machine Finished Surfaces: Carefully protect against corrosion with a coat of white lead and tallow or similar protection; apply per AISC requirement prior to shipment.
- D. Concealed Surfaces: Parts inaccessible after assembly or erection shall be given 2 coats of primer paint, preferably of different colors.
- E. Field Painting:
 - 1. Field paint all bolt heads and nuts, welds, abrasions remaining due to any source, and any portion of the steel work which is unpainted for any reason.
 - 2. Field paint with primer paint.
 - 3. The completed steel work shall be cleaned of all foreign materials.
- F. Unpainted Surfaces: Remove oil and grease with solvent cleaners; remove dirt and other foreign materials by sweeping with wire brushes.

PART III EXECUTION

3.01 BENCH MARKS

- A. Employ the services of a licensed Professional Engineer who shall establish permanent bench marks, field check all elevations of concrete on which structural steel is to be placed and locations of anchor bolts, reporting any discrepancy to the Engineer before the work proceeds.

3.02 ERECTION

- A. Be responsible for the accurate setting and leveling of all bearing plates. Furnish templates for accurate setting of all anchor bolts. Bearing plates shall be leveled on steel wedges or shims or as otherwise detailed. Bearing plates shall be grouted as specified in Section 03300 – CONCRETE, GENERAL.
- B. Erect building frame true and level. Erect columns in manner to allow for shrinkage of girders after welding. Check plumbness after erection of each tier. Maintain structural stability of frame during erection; provide temporary bracing where necessary to maintain frame stability and to support required loads, including equipment and its operation.

3.03 ERECTION TOLERANCE

- A. Be responsible for correct fitting of all structural members and for the elevation and alignment of the finished structure per AISC Code of Standard Practice (minimum). Be responsible for any adjustment necessary in the steel work because of discrepancies in elevation and alignment. Furnish shim plates or developed fill where required to obtain fit and alignment.
- B. Unless otherwise noted, the structure shall be leveled and plumbed to an accuracy of 1 to 1000, but not to exceed 12 millimeters. The actual centerlines of members shall not vary from theoretical centerlines by more than 12 millimeters at any point. All leveling and plumbing shall be based on the mean operating temperature of the structure. Allowance shall be made for the difference in temperature at time of erection and the mean temperature at which the structure will be when completed and in service.
- C. All measurements relating to the above shall be on theoretical centerline of members.

3.04 CONNECTIONS

- A. No welding or bolting shall be done until as much of the structure as will be stiffened by welding or bolting has been properly aligned.
- B. Drift pins shall not be used to enlarge unfair holes in main material. Holes that must be enlarged to admit bolts shall be reamed. Use of burned holes for bolted connections will not be permitted and main structural members with burned holes will be rejected. Burning and drifting may be used to align unfair holes in secondary bracing members only. In all cases, minimum edge distances shall remain at enlarged holes.
- C. When high strength bolts or high strength bearing bolts are used, the AISC Specifications shall apply including values as noted therein, and installation by eight "turn of the nut tightening" or with the torque wrenches. In using manual torque wrenches, the required torque can be read from the wrench dial. Care should be taken that the wrench is properly calibrated. Nuts shall be in motion when torque is measured. In using power wrenches, the recommendations of the wrench manufacturer shall be followed. Manual and power torque wrenches shall be calibrated at least once daily and for each lot of bolts.
- D. Alternative bolting may be accomplished by utilizing Coronet Load-Indicator washers as "direct tension indicators" in accordance with current specifications as indicated in AISC, 8th Edition, UBC-ICBO Report No. 2885, and the manufacturer's recommendations whichever are more stringent. Proposers shall indicate their cost with and without the use of indicators for all bolting and for use on friction bolted connections only.

3.05 SURVEY

- A. Make an accurate survey of actual locations of steel members immediately upon completion of erection of steel of the entire structure and promptly submit. Should locations vary beyond allowable tolerances, take necessary corrective measures and modify details and/or procedures as required.

- END OF SECTION -