



نگهداشت و افزایش تولید میدان نفتی بینک  
سطح الارض و ابنیه تحت الارض

عمومی و مشترک



شماره پیمان:

053 - 073 - 9184

#### SPECIFICATION FOR FABRICATION OF STEEL STRUCTURES

نسخه	سریال	نوع مدرک	رشته	تسهیلات	صادرکننده	بسته کاری	پروژه
D02	0003	SP	ST	000	PEDCO	GNRAL	BK

شماره صفحه: 1 از 21

طرح نگهداشت و افزایش تولید 27 مخزن

## SPECIFICATION FOR FABRICATION OF STEEL STRUCTURES

نگهداشت و افزایش تولید میدان نفتی بینک

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IDC: Inter-Discipline Check  
IFC: Issued For Comment  
IFA: Issued For Approval  
AFD: Approved For Design  
AFC: Approved For Construction  
AFP: Approved For Purchase  
AFQ: Approved For Quotation  
IFI: Issued For Information  
AB-R: As-Built for CLIENT Review  
AB-A: As-Built -Approved



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## 1.0 INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.



### GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – General Facilities
EPD/EPC CONTRACTOR (GC):	Petro Iran Development Company (PEDCO)
EPC CONTRACTOR:	Joint Venture of : Hirgan Energy – Design & Inspection(D&I) Companies
VENDOR:	The firm or person who will fabricate the equipment or material.
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
THIRD PARTY INSPECTOR (TPI):	The firm appointed by EPD/EPC CONTRACTOR (GC) and approved by CLIENT (in writing) for the inspection of goods.
SHALL:	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL:	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

## 2.0 SCOPE

. This specification covers the minimum requirements for fabrication of steel structural Such as building, equipment, shelters and supporting which shall be considered in the Project.

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### 3.0 NORMATIVE REFERENCES

#### 3.1 LOCAL CODES AND STANDARDS

- IPS-C-CE-210 Construction Standard for Steel Structure
- IPS-E-CE-500 Engineering Standard for Loads
- INBC-PART10 Steel Structure Design & Construction
- INBC-PART11 Industrial Building Construction
- ISDCOI-038 Iranian Seismic Design Code for Petroleum Facilities & Structures (3<sup>rd</sup> Edition)
- STD-2800 Iranian Code of Practice for Seismic Resistant Design of Building (4<sup>rd</sup> Edition)
- General Technic Specification for Construction Works, Iranian Ministry of Planning and Budget Publication , Publication No.55
- ISIRI14262-2 / S235JR Iranian Seismic Design Code for Petroleum Facilities & Structures (3<sup>rd</sup>)
- ISIRI3132 Iranian National Standard Organization – Hot Rolled Steel Rods for Reinforcing Concrete
- ISIRI5654 Iranian National Standard Organization - Mechanical properties of large gear nuts - Properties and test methods



#### 3.2 INTERNATIONAL CODES AND STANDARDS

- AISC 303-16 Standard Practice for Steel Buildings and Bridges
- AISC 325 Steel Construction Manual
- AISC 326 Detailing for Steel Construction
- AISC 360-10 Specification for Structural Steel Buildings
- ASTM A36/A36M Standard Specification for Carbon Structural Steel
- ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A153 Standard Specification for Zinc Coating (Hot-Dipped) on Iron and Steel Hardware
- ASTM A193 Standard Specification for Alloy-Steel for High-Temperature Service
- ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for

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#### High Pressure or High Temperature Service

- ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 6000psi Tensile Strength
- ASTM-A325 Specification for High-Strength Bolts for Structural Steel Joints
- ASTM F436M American Society for Testing and Materials-Specification for Hardened Steel Washers
- ASTM-A446 Specification for Steel Sheet Zinc Coated (Galvanized)
- ASTM-A490 Specification for High-Strength Bolts. Clauses 10.9 and 10.9.3 for Structural Steel Joints
- ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- ASTM A501 Standard Specification for Hot Formed Welded and Seamless Carbon Steel Structural Tubing
- ASTM A525 Standard Specification for General Requirement for Steel Sheet, Zinc Coated(Galvanized) by Hot-Dip Process
- ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts
- ASTM A615 Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
- ASTM B695 Standard Specification for Coating of Zinc Mechanically Deposited on Iron and Steel
- ASTM E190 Method for Guided Bend Test for Ductility of Welds
- ASTM E376 Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods
- ASTM F959 Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series
- ASTM F1136 Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
- AWS-A2.4 American Welding Society, Symbols for Welding, Brazing and Non-destructive Testing
- AWS-A3 American Welding Society, Welding Terms and Definitions
- AWS-D1.1 Structural Welding Code-Steel
- AWS-S1 Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
- AWS-S5.17 Specification for Steel Electrodes and Fluxes for Submerged Arc Welding

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### 3.3 THE PROJECT DOCUMENTS

- BK-GNRAL-PEDCO-000-ST-SP-0005 Specification for Erection of Steel Structures
- BK-GNRAL-PEDCO-000-ST-DC-0001 Design Criteria of Structural Works

### 3.4 ENVIRONMENTAL DATA

Refer to "Process Basis of Design; Doc. No.BK-GNRAL-PEDCO-000-PR-DB-0001".

### 3.5 ORDER OF PRECEDENCE

In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT.

## 4.0 REQUIREMENTS

### 4.1 QUALITY CONTROL

**4.1.1** Fabricator shall be solely responsible for quality control of all materials and workmanship.

**4.1.6** A written Material Handling Procedure, Quality Control Program, and Inspection Procedures document shall be provided. This document shall provide details of how compliance with requirements in this Practice and contract documents shall be achieved.



**4.1.7** Purchaser has the right to inspect all materials and workmanship and shall have unrestricted entry to fabricator's shop at all times while work is being performed.

**4.1.8** The purchaser may reject improper, inferior, defective, or unsuitable materials and workmanship.

**4.1.9** All materials and workmanship rejected shall be repaired or replaced as directed by purchaser.

**4.1.10** Bolted connections shall be inspected in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts.

**4.1.11** Welding procedures and individual welders shall be qualified in accordance with requirements of AWS D1.1

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**4.1.12** Welding procedures previously qualified for purchaser may be used without requalification. However, purchaser reserves the right to require requalification of any questionable procedure before the start of fabrication.

**4.1.13** All welding shall be inspected in accordance with AWS D1.1. Inspectors shall be qualified and certified as AWS Certified Welding Inspectors in accordance with the provisions of AWS D1.1 or AWS QC1 or shall be trained by and working under the supervision of an AWS Certified Welding Inspector.

**4.1.14** Nondestructive testing of welded joints shall be performed in accordance with ANSI/AISC 360-10 Chapter N. ANSI/AISC 360-10 requirements for buildings shall also apply to Non-building structures.

**4.1.15** Certified mill test reports for each heat of structural steel and each lot of high strength bolts shall be available for review by purchaser.

**4.1.17** Purchaser reserves the right to inspect and reject all galvanized steel in accordance with ASTM A123/A123M and ASTM E376.

## 4.2 SUBMITTALS

**4.2.1** The following items shall be submitted for approval. Work shall not proceed without approval:

- Checked erection and shop drawings
- Checked engineering calculations for each fabricator-designed connection
- Quality Control Program and Inspection Procedures
- Welding Procedure Specification (WPS)
- Procedure Qualification Records (PQR)
- Welder(s) qualification records



**4.2.2** Final erection drawings, shop drawings, and field bolt lists shall be sent to the persons responsible for managing construction at their field office before shipment of steel

**4.2.3** A shipping list (including total weight of release and weight of shipment), a bolt list, and final erection drawings shall accompany the first shipment of each release.

**4.2.4** As a minimum, the following documents shall be submitted to purchaser for record purposes:

- Final erection and shop drawings
- Records of Quality Control inspection test reports requested by purchaser
- Final engineering calculations for each fabricator-designed connection sealed and signed by the responsible Professional Engineer
- Records of calibration or recalibration performed on the tools or equipment used during the work, if requested by purchaser



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#### 4.3 SHOP DRAWING



- 4.3.1 Shop drawings and erection drawings shall be prepared in accordance with the AISC documents listed in Section 3.
- 4.3.2 Erection drawings shall reference the corresponding design documents; shop drawings shall reference the corresponding erection drawings.
- 4.3.3 Shop drawings shall clearly show the specification and grade of steel to be used.
- 4.3.4 Erection drawings shall clearly show the mark number and position for each member. Mark number system shall be agreed upon in advance with purchaser.
- 4.3.6 Purchase order number shall be shown on all erection and shop drawings.
- 4.3.7 Shop drawings shall state the welding electrode to be used.
- 4.3.8 Surface preparation and shop applied coatings, including areas to be masked, shall be noted on the shop drawings.
- 4.3.9 A bolt list and list of other fasteners showing the number, grade, size, and length of field bolts and other fasteners for each connection shall be provided. These lists may be shown on either the shop drawings or separate sheets.
- 4.3.10 In the event that drawing revisions are necessary, the shop drawings shall clearly be clouded showing all changes of the latest revisions.
- 4.3.11 Shop drawings and erection drawings shall be prepared using a three-dimensional steel modeling and detailing software system. All miscellaneous steel such as handrail, guards, stairs, and ladders shall be included in the same three-dimensional model as main structural steel and detailed using the same system

#### 4.4 PERFORMANCE

- 4.4.1 All work shall be in accordance with the ANSI/AISC 303-16, ANSI/AISC 360-10
- 4.4.2 If local specifications, codes, or standards exist for the materials, section properties, design, and test methods covered by this Practice which yield equivalent quality and performance, they may be substituted only with prior written approval by purchaser.

#### 4.5 PRODUCTS AND MATERIALS

- 4.5.1 Structural channels, angles, and other hot-rolled shapes shall be ISIRI/S235JR, ASTM A36/A36M, A529/A529M, A572/A572M, A588/A588M, A709/A709M, A1043/A1043M as specified in contract documents.

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#### 4.5.2 Plates and bars shall be

ISIRI, ASTM A36/A36M, A242/A242M, A283/A283M, A514/A514M, A529/A529M, A572/A572M, A588/A588M, A709/A709M, A1043/A1043M, A1066/A1066M, as specified in contract documents.

#### 4.5.3 Using of other equivalent materials must be with client approval. As a general guide following could be considered:

Class 4.6 mechanical properties are approximately equivalent to those of Specification A307, Grade A.

Class 8.8 mechanical properties are approximately equivalent to those of Specification ASTM F3125/A325M, Type 1.

Usage of ASTM A563M Gr. 10S Heavy Hex nuts are accepted.

Usage of ASTM F436M Type 1 washers are accepted.

#### 4.5.4 Welding filler metal shall be AWS D1.1/D1.1M

E70 electrodes shall be used for steel parts and E60 electrodes shall be used for tack welding.

#### 4.5.5 Welded steel bar grating and grating stair treads shall be ASTM A1011/A1011M, Commercial Steel (Type B), galvanized in accordance with ASTM A123/A123M. Top surface of bearing bars shall be plain, unless serrated is specified. Grating stair treads shall have abrasive or checkered plate nosing.

## 5.0 MATERIALS

### 5.1 MATERIAL REQUIREMENTS

A minimum thickness of 6mm shall be considered for any part of structural shapes constituting main structural frames of steel pipe racks, steel structures, heavy pipe supports and shelters.

The minimum thickness of plate material used for structural connections shall be 10 mm.

Where contact of dissimilar metals will cause galvanic action or corrosion, a suitable insulating material shall be provided between the metals.



No rimmed or capped steel shall be used.

Structural steel pipe shall be limited to seamless or electric-welded, straight-seam pipe.

Where steel pipes or tubing are used, all open ends shall be sealed to prevent internal corrosion.

### 5.2 STRUCTURAL SHAPES , PLATES AND BARS

Shapes, Plates and Bars shall be per ISIRI 14262-2 , S235JR unless otherwise stated on the design drawing.

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### 5.3 PIPE COLUMNS AND HANDRAIL

Pipe for columns or handrail shall be as per ASTM A53 Type E or S, Grade B or API Standard 5L, Grade B.

### 5.4 HIGH STRENGTH BOLT ASSEMBLIES

High strength bolt assemblies, except twist-off type bolt assemblies, shall be as follows:

Bolt Class 8.8 Grade B acc. to ISIRI 2874-1 Galvanized

Nut Class 8 Style 2 Grade B acc. to ISIRI 5654 and ISIRI 9737 Galvanized

Washer 200 HV acc. to ISIRI 9742 Galvanized



### 5.5 STANDARD BOLT ASSEMBLIES

Common bolts for secondary connections should conform class 4.6 as per ISIRI 2874-1(or ISO 898-1).Nuts for common bolts shall conform to class 5 as per ISIRI 5654(or ISO 898-2) and washers for common bolts shall conform to 200HV according to ISIRI 9742.

### 5.6 BOLTS FOR LOW SERVICE TEMPERATURES

- For service temperatures under -20°, bolts and nuts shall conform to ASTM A 320 L 7 and ASTM A 194 / 194 M (connection of steelworks on cold equipment).

### 5.7 WELDING FILLER METAL



Welding electrodes shall be per AWS D1.1 and AWS A.5.1, section 4.1 with electrode strength of 58 ksi minimum yield strength at 70 ksi minimum tensile strength. However, E70XX electrodes may be used for tack welding.

### 5.8 CRANE RAILS

ASTM A759.

### 5.9 FLOOR PLATE

ASTM A36 /A36M.

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## 5.10 OPEN GRID FLOORING

Open grid flooring and stair treads shall be as per ASTM A36 / A36M, galvanised as per ASTM A153 Grade 100. The top surface of bearing bars shall be serrated type. Grating stair treads shall have abrasive nosing.

## 6.0 DESIGN

### 6.1 DESIGN LOADS

Minimum loads shall be as specified in the Civil and Structural Design Criteria. All structural framing shall be designed for the load combinations shown in the Civil and Structural Design Criteria and shall be within the limits of loads and resistance factor design given in AISC.

Unless otherwise stated, minimum design requirements for vertical loads on the framing of open type structures supporting pipes shall be in accordance with the Civil and Structural Design Criteria. This loading shall be reviewed after piping design is completed to ensure that the original design is adequate to carry the piping as designed.

Mechanical properties of structural members continuously subjected to temperatures above 260°C shall be reduced in accordance with Appendix 4 of AISC Steel Construction Manual.

### 6.2 CONNECTIONS

The minimum design capacity of all bolted or welded, framed beam connections shall be the member end reaction shown on the design drawings.

The top of columns for pipe racks shall be "cut square" minimum 75 mm above the top of the highest beam connecting to the column to facilitate future extension unless noted on CONSTRUCTION CONTRACTOR arrangement drawings.



Column splices shall be developed for the full strength of the column, the abutting surfaces of the upper and lower lift of the column shall be "milled".

If the member end reaction is not shown on the design drawings, the minimum design capacity shall be one-half of the total uniform load capacity shown in the Allowable Uniform Load Tables in Part 2 of the AISC Manual of Steel Construction: Allowable Stress Design, for the given beam size, span and grade of steel.

#### 6.2.1 BOLTED CONNECTIONS

All connections, joints and fasteners that are part of the seismic load resisting system shall meet the requirements of AISC 360-05, Specification for Structural Steel Buildings, and AISC 341, Seismic Provisions for Structural Steel Buildings.

If direct tension indicator washers are used they shall conform to ASTM F959 or F959M, and shall be installed according to the VENDOR's published specifications.

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All ASTM A325 or A325M high-strength bolts shall be Type 1, plain, for structures that are painted or Type 3, galvanised, for structures with galvanised steel. Galvanised washers and nuts shall be furnished when galvanised bolts are required.

All bolts, nuts and washers shall be properly identified and marked with the material grade and the VENDOR's logo.

## 6.2.2 WELDED CONNECTIONS

Design, detailing, and fabrication of all welded connections shall conform to the AWS D1.1-2000, Structural Welding Code; AISC Manual of Steel Construction and AISC Detailing for Steel Construction.

The minimum fillet weld size is 6 mm for strength welds. Seal welds may be 4 mm minimum fillet weld.

Major field connections shall be bolted type, while all shop connections shall be either bolted or welded. In case of major field welded connection, the design shall be submitted to COMPANY for prior approval.

Connections of minor and miscellaneous steelwork may be welded subject to CONTRACTOR approval.

## 6.3 PLATFORMS , LADDERS AND STAIRS



If the access and storage areas listed below are located more than 4.5 m above grade, fixed platforms shall be provided in accordance with the Piping Design Job Specification.

- Access to service openings such as manholes.
- Access to all equipment and instruments requiring inspection, adjustment, servicing during operation, or frequent maintenance.
- Local storage of material required for maintenance and operation.

Primary access to platforms attached to vessels and secondary access to any platforms may be by ladder. Primary access to main operating levels, or service levels located in structures, furnaces and the roof of buildings with equipment requiring frequent maintenance shall be by stairs.

A second means of escape shall be provided with ladders. Such exits shall be located so that walking distance to the nearest primary or auxiliary exit does not exceed 15 m and the length of dead-end platforms is not greater than 8 m.

Maximum rise for a single unbroken flight of stairs shall be in accordance with Construction Standard drawing for stairways. A single run shall have the same slope. Maximum stairway slope shall not exceed 41 degrees. Maximum riser height shall not exceed 200 mm. Minimum width between stair stringers shall be 800 mm. Stair treads shall be serrated galvanised grating with non-skid nosing.

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All ladders shall be caged except when 2.3 m clearance under cage cannot be maintained. The maximum rise of any ladder between landings shall be 9.0 m. Ladder details shall be in accordance with Construction Standard Drawings for ladders. As a general rule all ladders shall be side-step ladders. Self-closing safety gates shall be provided across the ladder openings at all landings. Ladders shall be supported intermediately by attachments and near the top of the ladder.

Hand railing shall be constructed of steel pipe and shall be in accordance with Construction Standard drawing for tubular hand railing. Placing posts on both sides of the joint and interrupting the rail shall provide expansion and contraction of railing at expansion joints. Railings shall enclose all platforms and stairways. Railings shall be easily removable where required for periodic maintenance of equipment or facilities, such as at vessel manholes and at the channel end of elevated exchangers.

Toe plates shall be provided on walkways and platforms along all edges protected by handrails, under the bottom treads of all stairway which rise from landings, and around floor openings for permanent equipment, when the clearance between the edges of the flooring is greater than 50 mm. Toe plates shall be provided around all pipe penetrations larger than 300 mm, through platforms. Toe plates shall be omitted across ladder openings.

Flooring of platforms and walkways shall be serrated rectangular open grid type, galvanised after fabrication in accordance with ASTM A 123 Grade 100. Load bearing bars shall be 25 mm minimum depth x 6 mm thick at 30 mm cross centres with twisted cross bars at 50 mm interbar space. Grating shall be attached to supporting steelwork with galvanised clips. Holes or cut-outs in floor panels shall have perimeter stiffening strips or toe plates welded in prior to galvanising.



Galvanised solid floor plate with a raised pattern affording a non-slip surface (checkered plate) shall be used only for flooring in valve pits or similar. Minimum thickness of floor plate shall be 6 mm exclusive of pattern. 13-mm diameter drainage holes staggered at 600-mm centres shall be provided in floor plates with a minimum of one hole per panel. Removable floor plates shall be attached to supporting steelwork with galvanised countersunk bolts.

#### 6.4 PIPE AND EQUIPMENT SUPPORTS

Structural design of pipe racks and pipe supports shall be in accordance with the requirements of the Civil and Structural Design Criteria. Equipment supports shall be designed to resist the effects of vibration where necessary and to avoid resonance with equipment.

#### 6.5 CLEARANCES AND WIDTHS

The minimum clearances and widths for structures, platforms and access shall be in accordance with the Piping Design Job Specification.

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Unless otherwise specified, minimum clear headroom over platforms, walkways, and stairways shall be 2.1 m.

Minimum platform width shall be 0.8 m.

Minimum walkway width for main passageways shall be 1.0 m.

## 6.6 EQUIPMENT HANDLING FACILITIES AND LIFTING LUGS

Davits shall be provided for handling equipment on vertical vessels. For example, safety valves which are subject to removal for periodic maintenance and for which use of mobile handling equipment is not practical. Davits shall be positioned so that the equipment can be lowered through clear, unobstructed openings to grade. Runway beams shall be provided for handling equipment during maintenance, if such equipment is inaccessible to mobile handling equipment.

For skid mounted equipment with a total lift weight of less than 3000 kg it is acceptable to use fillet welded lifting lugs. For weights over 3000 kg, lifting lugs must be butt welded.

## 6.7 DESIGN DETAILS

Steelwork design shall incorporate details which avoid recesses and pockets that will entrap rainwater and/or the accumulation of dirt and sand. Coefficients of static friction for various material combinations are given in the Civil and Structural Design Criteria. Shear resistance of columns base plates shall be developed by shear in the anchor bolts or by other mechanical means such as shear keys. Base plates shall be proportioned so that the maximum bearing stress on grout and foundation concrete shall not exceed the requirement given in the Civil and Structural Design Criteria.



## 7.0 SPECIFIC REQUIREMENTS FOR STEEL SHELTERS

If a shelter is closed sided (partially or fully), all the cladding and roofing shall be in sandwich panel with insulation material interposed (unless otherwise masonry wall considered as per design requirements)

### 7.1 DESIGN

Wind pressure shall be applied to wall and roof surfaces in accordance with the requirements of ASCE7-10.



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## 7.2 FRAME

The shelter shall be rigid frame type with hinged or fixed column bases. The structural framework shall be rolled structural shapes or welded built-up sections. Cold-formed shapes are not allowed.

Rigid frames shall be designed according to elastic design methods. Provisions shall be made to prevent lateral movement of the compression flange at the knee joint..

Minimum roof slope shall be 15%.

Frame tolerances: refer to AISC Code and Standard Practice for Steel Building and Bridges.

## 7.3 ROOFING AND CLADDING

Where no thermal insulation and/or no sound absorption are required, cladding shall be single skin. In the other case, it shall be double skin.

Where required, roof and wall sound absorbing cladding to machinery shelters shall be acoustic insulated. (double skin, sandwich type panel)

Fasteners and fastener spacing shall be selected according to the design loading calculation, including a perpendicular load of 2.5 kN/m<sup>2</sup>.

## 8.0 FABRICATION

8.1 All fabrication shall be in accordance with ANSI/AISC 303-16 and ANSI/AISC 360-10, unless otherwise specified in contract documents, state or local laws, or building codes.



5.2 All welding shall be in accordance with AWS D1.1/D1.1M and contract documents.

5.3 Shop splices, substitutions of member sizes, or changes in details or dimensions shall not be permitted without written authorization from engineer of record.

5.4 All beams, except cantilevers, shall be fabricated with natural mill camber in the up position.

5.5 All re-entrant corners shall be shaped, notched-free, to a radius.





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- 5.6 If performing shop assembly work, the tolerances shall not exceed those specified in ANSI/AISC 303-16.
- 5.7 All pieces shall be clearly marked with a permanent identifying erection mark number. Method and location of marking shall be proven by past performance to survive galvanizing, shipping, handling, and outdoor storage and be approved by purchaser.
- 5.8 Before surface preparation, all sharp corners, burrs (including bolt hole burrs), weld spatter, slag, weld flux, loose mill scale and other foreign matter shall be removed.
- 5.9 Platforms, stairways, guards, and handrails shall be shop assembled in the largest units suitable for handling and shipping. Ladder cages shall be shop assembled on ladders.
- 5.10 The method for fastening grating shall be as specified in the contract documents. A minimum of two fasteners per panel shall be used at each support, with a minimum of four per panel. The fasteners shall be supplied with 5% extra to cover losses.
- 5.11 Grating/checkered plate openings shown in design documents shall be cut and banded in the shop unless otherwise noted in design documents.
- 5.12 Joints perpendicular to the span of grating and checkered plate flooring shall be permitted only over support members.

## 9.0 GALVANIZING / CORROSION PROTECTIVE COATING

### 9.1 GENERAL

- 6.1.1 Galvanizing of steel shapes, plates, and hardware shall be hot dip galvanized in accordance with ISIRI 16353/ISO 1461.
- 6.1.2 Anchor bolts, nuts, washers and other threaded fasteners shall be hot dip galvanized in accordance with ISIRI 19289/ISO 10684.



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## 9.2 FABRICATION

- 6.2.1 It shall be fabricator's responsibility to safeguard against embrittlement and warpage in accordance with ASTM A143/A143M and ASTM A384/A384M.
- 6.2.2 Fabrication details shall be in accordance with ASTM A385/A385M to allow for the creation of high quality zinc coatings.
- 6.2.3 If practical, cutting, drilling and welding shall be performed before galvanizing.
- 6.2.4 Weld slag shall be removed before galvanizing.
- 6.2.5 The edges of tightly contacting surfaces shall be completely seal welded.
- 6.2.6 Vent holes shall be provided for piping or tubular assemblies as required by ASTM A385/A385M.
- 6.2.7 Potential problems that require a modification in design shall be brought to the attention of purchaser before proceeding

## 9.3 REPAIR

- 6.4.1 Any damage to galvanizing shall be repaired in accordance with ASTM A780/A780M and as described below unless otherwise specified in contract documents.
- 6.4.2 Before repair of damaged galvanized coating, exposed substrate metal shall be cleaned to bright metal and free of all visual rust, oil, or grease. Any non- adhering galvanizing shall be removed to the extent that the surrounding galvanizing is integral and adherent.
- 6.4.3 If surface defects exceed 2% of a member's area, the defects shall be repaired by re dipping the member in the zinc bath.
- 6.4.4 For coating applied for a cold repair, the dry film thickness shall be 2 to 3 mils (0.05 mm to 0.08 mm) and contain a minimum of 65% zinc dust by weight.
- 6.4.5 Hot repair shall be made using zinc alloy rod or powder manufactured for the repair of galvanized steel.
- 6.4.6 Galvanized steel which has been rejected shall be stripped, regalvanized, and submitted again for inspection.
- 6.4.7 Correction of excessive warpage that exceeds ASTM A6/A6M criteria shall be

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performed by press straightening if possible.



6.4.8 The application of localized heating to straighten shall be approved by engineer of record.

## 10.0 SHIPPING & DELIVERY

Delivery of steel shall be in the order needed for erection. The delivery sequence for the fabricated steel, unless otherwise noted in contract documents or arranged by purchaser, shall be as follows:

- a. Loose base plates
- b. Steel embedded in concrete
- c. Erection bolts
- d. First tier columns and framing for all its levels (including stairs, grating, and handrail)
- e. Second tier columns and its framing, etc.

- 10.1 All bolts, washers, and nuts shall be packaged and delivered in rigid (not cardboard), weatherproof container.
- 10.2 Railcars and/or trucks shall be loaded in such a manner that continuous drainage is ensured.
- 10.3 All steel and its coatings shall be protected from any damage caused by handling, storage, or shipping before receipt by purchaser.
- 10.4 Adequate protection shall be provided for threads on sag rods and any other threaded components to prevent damage during shipping and handling.
- 10.5 All materials and documentation shall be delivered to the job site in good condition.
- 10.6 All materials and documentation will be inspected by purchaser upon receipt to determine that all items included in the bill of materials have been supplied, to ensure that all documentation has been received, and to check for any damage.

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## 11.0 INSPECTION

- 11.1 The resident Engineer reserves the right of inspection for its representative during fabrication.
- 11.2 Materials shall be tested in accordance with the supplied specifications and the Resident Engineer may request standards supplementary tests.
- 11.3 The inspector may take samples of the material used in order to ascertain chemical and mechanical characteristics and check that materials used in fabrication comply with the fabricator's declaration.
- 11.4 The inspector shall verify the compliance between fabricated drawings, inspect structural shapes and carry out a visual examination of welds.
- 11.5 The inspector shall inspect identification stamps and ascertain the exact reference of application.
- 11.6 The fabricator shall provide free access for the inspector to all sites where the materials are stored of fabricated, at any time during fabrication.
- 11.7 The inspection and testing of subcontracts shall be in the care and responsibility of the fabricator. The Resident Engineer reserves the right to carry out inspections at subcontractors and operate tests in accordance with the stipulated order. A representative of the fabricator shall always be present during such inspection and tests.

