

**CONSTRUCTION STANDARD**  
**FOR**  
**STEEL STRUCTURES**

**CONTENTS :****PAGE No.**

<b>1. SCOPE .....</b>	<b>2</b>
<b>2. REFERENCES .....</b>	<b>2</b>
<b>3. UNITS .....</b>	<b>2</b>
<b>4. REGULATIONS .....</b>	<b>2</b>
<b>5. DISCREPANCIES .....</b>	<b>3</b>
<b>6. SHOP PAINTING.....</b>	<b>3</b>
<b>7. SCHEDULING .....</b>	<b>3</b>
<b>8. MATERIALS .....</b>	<b>3</b>
<b>9. FABRICATION .....</b>	<b>5</b>
<b>10. ERECTION .....</b>	<b>9</b>

## 1. SCOPE

This Standard specifies the minimum requirements for the supply, fabrication, erection and inspection of steel framed structures in Iranian Oil Industries.

## 2. REFERENCES

In this Standard the following standards and codes have been referred to, and to the extent specified, form a part of this Standard.

### **AISC (AMERICAN INSTITUTE OF STEEL CONSTRUCTION INC.)**

Manual of Steel                    "Specification and Codes"  
 Construction, 9th Edition,  
 1989, Part 5

### **AWS (AMERICAN WELDING SOCIETY)**

AWS D1.1-88                    "Structural Welding Code-Steel"

### **RCSC (RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS)**

"Specification for Structural Joints Using ASTM A325 or A490 Bolts", 1985

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

A325 M-88                    "Specification for High-Strength Bolts for Structural Steel Joints (Metric)"  
 A490 M-85                    "Specification for High-Strength Steel Bolts. Clauses 10.9 and 10.9.3, for  
 Structural Steel Joints (Metric)"

### **IPS (IRANIAN PETROLEUM STANDARDS)**

IPS-C-CE-260                    "Fireproofing"  
 IPS-C-TP-102                    "Construction Standard for Painting"  
 IPS-E-TP-100                    "Engineering Standard for Paint"

### **SSPC (STEEL STRUCTURES PAINTING COUNCIL)**

SSPC-Volume 1                    "Good Painting Practice"

## 3. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

## 4. REGULATIONS

The work shall be done in accordance with the national and local Laws and Regulations. For subjects not covered by Regulations or this Standard, the fabrication and erection shall be based on good engineering and working practice, and shall be subject to approval of the AR\*.

\* AR = Authorized Representative of the Owner.

## **5. DISCREPANCIES**

Generally in case of discrepancies between plans and specifications for buildings, the specifications govern. In case of discrepancies between plans and specifications for bridges, the plans govern. In case of discrepancies between scale dimensions on the plans and figures written on them, the figures govern. In case of discrepancies between the structural steel plans and plans for other trades, the structural steel plans govern.

## **6. SHOP PAINTING**

### **6.1 General Requirements**

Shop painting and surface preparation shall be in accordance with the provisions of the "Code of Standard Practice" of the American Institute of Steel Construction, Inc.

Unless otherwise specified, only steelwork in contact with concrete need not be painted; all other steelwork shall be given at least one coat of shop paint.

### **6.2 Inaccessible Surfaces**

Except for contact surfaces, surfaces inaccessible after shop assembly shall be cleaned and painted prior to assembly, if required by design documents.

### **6.3 Contact Surfaces**

Paint is permitted unconditionally in bearing-type connections. For slip-critical connections, the faying surface requirements shall be in accordance with the RCSC "Specification for Structural Joints Using ASTM 325 or A490 Bolts", Paragraph 3.(b).

### **6.4 Finished Surfaces**

Machine-finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be removed prior to erection, or which has characteristics that make removal prior to erection unnecessary.

## **7. SCHEDULING**

**7.1** The contract documents specify the schedule for the performance of the work. This schedule states when the "released for construction" plans will be issued and when the job site, foundations, piers and abutments will be ready, free from obstructions and accessible to the erector, so that erection can start at the designated time and continue without interference or delay caused by the Owner or other trades.

**7.2** The fabricator and erector have the responsibility to advise the Owner, in a timely manner, of the effect any revision has on the contract schedule.

## **8. MATERIALS**

### **8.1 Marking and Shipping of Materials**

Erection marks are applied to the structural steel members by painting or other suitable means, unless otherwise specified in the contract documents.

**8.1.1** Bolts, all metal plates and inserts material are to be install in concrete are commonly shipped in separate containers according to length and diameter; loose nuts and washers are shipped in separate containers according to sizes. Pins and other small parts, and packages of bolts, nuts and washers are usually shipped in boxes, crates, kegs or barrels. A list and description of the material usually appears on the outside of each closed container.

## **8.2 Delivery of Materials**

Special care shall be taken to avoid bending, twisting or otherwise distorting individual members. Fabricated structural steel is delivered in such sequence as will permit the most efficient and economical performance of both shop fabrication and erection. If the Owner wishes to prescribe or control the sequence of delivery of materials, he reserves such right and defines the requirements in the contract documents. If the Owner contracts separately for delivery and erection, he must coordinate planning between contractors.

**8.2.1** Anchor bolts, washers and other anchorage or grillage materials to be built into masonry should be shipped so that they will be on hand when needed. The Owner must give the fabricator sufficient time to fabricate and ship such materials before they are needed.

**8.2.2** The quantities of material shown by the shipping statement are customarily accepted by the Owner, fabricator and erector as correct. If any shortage is claimed, the Owner or Erector should immediately notify the carrier and the fabricator in order that the claim may be investigated.

**8.2.3** The size and weight of structural steel assemblies may be limited by shop capabilities, the permissible weight and clearance dimensions of available transportation and the job site conditions. The fabricator limits the number of field splices to those consistent with minimum project cost.

**8.2.4** If material arrives at its destination in damaged condition, it is the responsibility of the receiving party to promptly notify the fabricator and carrier prior to unloading the material, or immediately upon discovery.

## **8.3 Non-Destructive Testing**

When non-destructive testing is required, the process, extent, technique and standards of acceptance are clearly defined in the contract documents. For specific work the relevant test shall be defined by AR.

## **8.4 Surface Preparation and Shop Painting Inspection**

Surface preparation and shop painting inspection must be planned for acceptance of each operation as completed by the fabricator. Inspection of the paint system, including material and thickness, is made promptly upon completion of the paint application. When wet film thickness is inspected, it must be measured immediately after application.

### **8.4.1 Independent Inspection**

When contract documents specify inspection by other than the fabricator's and erector's own personnel, both parties to the contract incur obligations relative to the performance of the inspection.

**8.4.2** The fabricator and erector provide the inspector with access to all places where work is being done. A minimum of 24 hours notification is given prior to commencement of work.

**8.4.3** Inspection of shop work by the Owner or his representative is performed in the fabricator's shop to the fullest extent possible. Such inspections should be in sequence, timely, and performed in such manner as to minimize disruptions in operations and to permit the repair of all non-conforming work while the material is in process in the fabricating shop.

**8.4.4** Inspection of field work is completed promptly, so that corrections can be made without delaying the progress of the work.

**8.4.5** Rejection of material or workmanship not in conformance with the contract documents may be made at any time during the progress of the work. However, this provision does not relieve the Owner of his obligation for timely, in-sequence inspections.

**8.4.6** The fabricator and erector receive copies of all reports, prepared by the Owner's inspection representative.

## **8.5 Electrodes**

Electrodes shall be stored in their original packets or cartons in a dry place adequately protected from weather effects.

If electrodes became affected by dampness but are not otherwise damaged, they may be used after being dried, cut in a manner approved by the electrode Manufacturer.

## **8.6 Fireproofing**

Fireproofing of structural steel members, marked "FP" on construction drawings, shall be accomplished in accordance with IPS-E-CE-260.

# **9. FABRICATION**

## **9.1 General**

All material, before and after fabrication shall be straight unless required to be of curvilinear form, and shall be free from twists.

End of beams, channels and other parts abutting against or upon other parts shall be cut to exact lengths and true and square so as to provide a good bed or joints as the case may be .

Edges of web plates shall be flush with the face of the flange angles, and stiffeners shall fit closely against the flanges.

Bolt heads and ends of eye rods shall not be welded on butt formed out of the solid metal.

Structures partly or wholly supported by or supporting pressure vessels shall be bolted to cleats or brackets fabricated and assembled by the vessel Manufacturer, except where otherwise specified on the drawings. Prior approval of the AR must be obtained for any welding done to pressure vessels.

## **9.2 Preparation of Material**

**9.2.1** Thermal cutting of structural steel may be by hand or mechanically guided means.

**9.2.2** Surfaces noted as "finished" on the drawings are defined as having a maximum ANSI roughness height value of 500. Any fabricating technique, such as friction sawing, cold sawing, milling, etc., that produces such a finish may be used.

**9.2.3** Refer to Clause 10.7 for erection of site connection material.

## **9.3 Fitting and Fastening**

**9.3.1** Projecting elements of connection attachments need not be straightened in the connecting plane if it can be demonstrated that installation of the connectors or fitting aids will provide reasonable contact between faying surfaces.

**9.3.2** Run-off tabs are often required to produce sound welds. The fabricator or erector does not remove them unless specified in the contract documents. When their removal is required, they may be hand flame-cut close to the edge of the finished member with no further finishing required, unless other finishing is specifically called for in the contract documents.

**9.3.3** All high-strength bolts for shop attached connection material are to be installed in the shop in accordance with RCSC's "Specification for Structural Joints Using A325 or A490 Bolts", unless otherwise noted on the shop drawings.

#### **9.4 Dimensional Tolerances**

**9.4.1** A variation of 0.8 mm is permissible in the overall length of members with both ends finished for contact bearing as defined in Clause 9.2.2.

**9.4.2** 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 1.59 mm for members 9 m or less in length, and not greater than 3.18 mm for members over 9 m in length.

**9.4.3** Unless otherwise specified, structural members, whether of a single-rolled shape or built-up may vary from straightness within the tolerances allowed for wide-flange shapes by ASTM specification A6, except that the tolerances on deviation from straightness of compression members is 1/1000 of the axial length between points which are to be laterally supported.

Completed members should be free from twists, bends and open joints. Sharp kinks or bends are cause for rejection of material.

**9.4.4** Beams and trusses detailed without specified camber are fabricated so that after erection any camber due to rolling or shop fabrication is upward.

**9.4.5** Any permissible deviation in depths of girders may result in abrupt changes in depth at splices. Any such differences in depth at bolted joints, within the prescribed tolerances, is taken up by fill plates. At welded joints the weld profile may be adjusted to conform to the variation in depth, provided that the minimum cross section of required weld is furnished and that the slope of the weld surface meets AWS Code requirements.

#### **9.5 Cambering, Curving and Straightening**

Local application of heat or mechanical means are permitted to introduce or correct camber, curvature and straightness. The temperature of heated areas, as measured by approved methods, shall not exceed 566°C for A852 steel, 593°C for A514 steel nor 649°C for other steel. The same limits apply for equivalent grades of A709 steels.

#### **9.6 Clearances**

Care shall be taken to ensure that the clearances specified are worked to. The erection clearance for cleated ends of members connecting steel to steel shall not be greater than 2 mm at each end. The erection clearances at end of beams without web cleats shall be not more than 3 mm at each end, but where, for practical reasons, this clearance has to be increased, the seatings shall be suitably designed.

Where black bolts are used the holes may be made not more than 2 mm greater than the diameter of the bolts, for bolts up to 24 mm diameter and not more than 3 mm greater than the diameter of the bolts, for bolts over 24 mm diameter, unless otherwise specified by the AR.

#### **9.7 Cutting**

Cutting may be by shearing, cropping, sawing or machine flame cutting. Hand flame cutting may be permitted, subject to the approval of the AR. Sheared or cropped edges shall, if necessary, be dressed to a neat workmanlike finish and shall be free from distortion where parts are to be in metal-to-metal contact.

#### **9.8 Holing**

All holes shall be accurately marked off from template of corresponding plate, and drilled, except in plates 10 mm thick or under when they may be punched. Holes shall be cleaned from burrs or rough edges and countersunk where required.

## 9.9 Assembly

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers, if any, are provided. All tubular members shall be sealed so as to prevent the access of moisture to the inside of the members.

## 9.10 Bolting

Where necessary, washers shall be tapered or otherwise suitably shaped to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least one thread.

A close tolerance or turned bolt shall be of sufficient length to avoid any threaded portion being within the thickness of the connected parts that is required to develop the bearing load on the bolt, and shall be provided with a washer or washers, under the nut, of sufficient thickness to ensure that at least one full thread (in addition to the thread runout) remains clear between the nut and the unthreaded shank.

Where a tubular member is drilled to take bolts or studs, provision shall be made to prevent the access of moisture to the interior of the tube. For example, a transverse sleeve can be inserted where a bolt passes through a tube, or grommets can be used under heads and nuts.

The tightening of the high strength bolts shall be done by the turn-of-nut method. Either the nut or the bolt head may be turned while the other is prevented from rotating. First enough bolts shall be brought to a "snug tight" condition to insure that the parts of the joint are properly compacted, that is, brought into full contact with each other. Snug tight shall be defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following the initial step, bolts shall be placed in all remaining holes in the connection and brought to snug tightness. All bolts or nuts in the joint shall be tightened additionally by  $\frac{1}{2}$  turn if both outer faces of bolted parts are normal to bolt axis;  $\frac{3}{4}$  turn if one outer face is normal to bolt axis and the other sloped 1:20 with no beveled washers; 1 turn if both outer faces are sloped 1:20 from normal to bolt axis with no beveled washers. The tolerance on rotation shall be limited to  $\frac{1}{6}$  turn ( $60^\circ$ ) over and nothing under the above specified values.

## 9.11 Welding

### 9.11.1 Qualification and testing of welders

No welding of structural steel may be done without qualified welders, as per AWS D1.1 and approved welding procedure.

Test samples of a welder's work shall be furnished to Owner for approval, when requested. Welding and flame cutting procedure qualifications shall be carried out, using representative samples of materials to be used in the work.

The tests shall include specimen weld details representative of the actual construction, which shall be welded in a manner simulating the most unfavorable condition liable to occur in the particular fabrication.

X-Ray testing shall be carried out according to IPS-C-PI-290 when requested by AR.

### 9.11.2 Welds

Reasonably smooth and uniform as welded surfaces are acceptable on all welds exposed to view. Butt and plug welds do not project more than 1.6 mm above the exposed surface. No finishing or grinding is required except where clearances or fit of other components may necessitate, or when specially required by the contract documents.

The technique of welding, the workmanship, appearance and quality of welds and methods used in correcting non-conforming work shall be in accordance with Sections 3 and 4 of the AWS D1.1 "Structural Welding Code-Steel".

**9.11.3 Limitation**

The minimum size of fillet welds shall be as shown in Table 1. Minimum weld size is dependent upon the thicker of the two parts joined, except that the weld size need not exceed the thickness of the part. For this exception, particular care shall be taken to provide sufficient preheat for soundness of the weld. Weld sizes larger than the thinner part joined are permitted if required by calculated strength. In the as-welded condition, the distance between the edge of the base metal and toe of the weld may be less than 1.6 mm provided the weld size is exactly verifiable.

The maximum size of fillet welds that is permitted along the edges of connected parts shall be:

- 1) The thickness of base metal, for metal less than 6.4 mm thick,
- 2) 1.6 mm less than the thickness of base metal, for metal 6.4 mm or more in thickness, unless the weld is especially designated on the drawing to be built out to obtain full-throat thickness.

**TABLE 1 - MINIMUM SIZE OF FILLET WELD**

MATERIAL THICKNESS OF THICKER PART JOINED (mm)	MINIMUM SIZE OF FILLET WELDS (mm)
6.4	3
6.4 to 12.7	5
12.7 to 19.0	6
19	8
Leg dimension of fillet weld. Single-pass weld must be used.	

The minimum effective length of fillet welds designed on the basis of strength shall be not less than 4 times the nominal size, or else the size of the weld shall be considered not to exceed ¼ of its effective length. If longitudinal fillet welds are used alone in end connections of flat bar tension members, the length of each fillet weld shall be no less than the perpendicular distance between them. The transverse spacing of longitudinal fillet welds used in end connections of tension members shall not exceed 200 mm. Intermittent fillet welds are permitted to transfer calculated stress across joint or faying surfaces when the strength required is less than that developed by a continuous fillet weld of the smallest permitted size, and to join components of built-up members. The effective length of any segment of intermittent fillet welding shall be not less than 4 times the weld size, with a minimum of 38 mm.

In lap joints, the minimum lap shall be 5 times the thickness of the thinner part joined, but not less than 25 mm. Lap joints joining plates or bars subjected to axial stress shall be fillet welded along the end of both lapped parts, except where the deflection of the lapped parts is sufficiently restrained to prevent opening of the joint under maximum loading.

Fillet welds in holes or slots are permitted to transfer shear in lap joints or to prevent buckling or separation of lapped parts and to join components of built-up members. Such fillet welds may overlap. Fillet welds in holes or slots are not to be considered plug or slot welds.

Side or end fillet welds terminating at ends or sides, respectively of parts or members shall, whenever practicable, be returned continuously around the corner for a distance not less than 2 times the nominal size of the weld.

This provision shall apply to side and top fillet welds connecting brackets, beam seats and similar connection, on the plane about which bending moments are computed. For framing angle and simple end-plate connections which depend upon flexibility of the outstanding legs for connection flexibility, end returns shall not exceed four times the nominal size of the weld. Fillet welds deposited on the opposite sides of a common plane of contact between two parts shall be interrupted at a corner common to both welds.

#### 9.11.4 Plug and slot welds

##### a) Effective area

The effective shearing area of plug and slot welds shall be considered as the nominal cross-sectional area of the hole or slot in the plane of the faying surface.

##### b) Limitation

The minimum diameter of the hole for a plug weld shall be no less than the thickness of the part containing it plus 8 mm, preferably rounded to the next larger odd 1.6 mm. The maximum diameter shall equal the minimum diameter plus 3 mm or  $2\frac{1}{4}$  times the thickness of the member, whichever is greater.

The minimum center to center spacing of plug welds shall be four times the diameter of the hole. The minimum spacing of lines of slot welds in a direction transverse to their length shall be 4 times the width of the slot. The minimum center-to-center spacing in a longitudinal direction on any line shall be 2 times the length of the slot.

The length of the slot for a slot weld shall not exceed 10 times the thickness of the part containing it. The width of the slot shall be not less than the thickness of the part containing it plus 8 mm, rounded to the next larger odd 1.6 mm, nor shall it be larger than  $2\frac{1}{4}$  times the thickness of the member. The ends of the slot shall be semicircular or shall have the corners rounded to a radius not less than the thickness of the part containing it, except those ends which extend to the edge of the part.

The depth of filling of plug or slot welds in metal 15.9 mm or less in thickness shall be equal to the thickness of the material. In metal over 15.9 mm thick, the thickness of the weld shall be at least one half the thickness of the material, but not less than 15.9 mm.

#### 9.11.5 Combination of welds

If two or more of the general types of welds (groove, fillet, plug, slot) are combined in a single joint, the effective capacity of each shall be separately computed with reference to the axis of the group in order to determine the allowable capacity of the combination.

#### 9.11.6 Mixed weld metal

When notch-toughness is specified, the process consumables for all weld metal, tack welds, root pass and subsequent passes, deposited in a joint shall be compatible to assure notch-tough composite weld metal.

#### 9.11.7 Preheat for heavy shapes

For ASTM A6 Group 4 and 5 shapes and welded built-up members made of plates more than 50.8 mm thick, a preheat equal to or greater than 176.7°C shall be used when making groove weld splices.

## 10. ERECTION

### 10.1 General

The contractor shall furnish all tools, equipment, facilities, scaffolding, temporary guys and bracings etc. and shall perform all labor and services necessary for the proper execution and completion of all structural steel erection as shown on the drawings, as specified herein and/or reasonably implied thereby to carry out the apparent intent of the work.

## **10.2 Method of Erection**

When the Owner wishes to control the method and sequence of erection, or when certain members cannot be erected in their normal sequence, the Owner so specifies in the contract documents. In the absence of such restrictions, the erector will proceed using the most efficient and economical method and sequence available to him consistent with the contract documents. When the Owner contracts separately for fabrication and erection services, the Owner is responsible for coordinating planning between contractors.

## **10.3 Existing Services and Installations**

The contractor shall make himself familiar with the location of all services above and below ground and shall take all reasonable precautions to prevent damage thereto. No props or supports shall be attached or affixed to such services.

The contractor shall be responsible for the safety and for any damage occasioned to installations and services through or in consequence of his operations.

## **10.4 Assembly**

**10.4.1** The contractor shall align, plumb and level all steelwork accurately and in accordance with the contract drawings. Permanent bolting or welding shall not commence until correct alignment, plumbing and leveling have been completed and approved by the AR.

**10.4.2** During erection, temporary bracing and guys shall be used to maintain structural integrity.

**10.4.3** The sequence of erection shall be such that members furthest from the crane are installed first.

**10.4.4** Normal procedure is to plumb main columns and beams between splices, before starting to dress the elevations of the structure with secondary members.

**10.4.5** Sufficient temporary wind bracing should be used over night and during week ends and holidays to prevent collapse by wind.

**10.4.6** Damaged or corroded members shall not be incorporated in the structure, and if damaged during erection, the relevant member shall be replaced.

**10.4.7** Holes should be provided in the slab or stanchion bases, etc. to facilitate grounding and to permit the escape of air or excess water.

## **10.5 Erection on Concrete Foundation**

Erection of steelwork shall not normally commence until concrete foundations and slabs have cured for a minimum of 7 days, except at the discretion of the AR.

## **10.6 Handling**

Steelwork at site shall be stored, handled and erected in such manner as to not subject it to excessive stresses. All work during erection shall be securely bolted and, if the AR so directs, it shall be temporarily braced to resist erection stresses and conditions including those arising from erection equipment. No bolting or welding shall be executed until correct position and alignment has been obtained.

## **10.7 Site Connection Material**

**10.7.1** The fabricator provides site connection details consistent with the requirements of the contract documents which will, in his opinion, result in the most economical fabrication and erection cost.

**10.7.2** When the fabricator erects the structural steel, the fabricator supplies all materials required for temporary and permanent connection of the component parts of the structural steel.

**10.7.3** When the erection of the structural steel is performed by someone other than the fabricator, the fabricator furnishes the following site connection material:

- a) Bolts of required size and in sufficient quantity for all site connections of steel to steel which are to be permanently bolted. Unless high-strength bolts or other special types of bolts and washers are specified, common bolts are furnished. An extra 2 percent of each bolt size (diameter and length) are furnished.
- b) Shims shown as necessary for make-up of permanent connections of steel to steel.
- c) Back-up bars or run-off tabs that may be required for site welding.

**10.7.4** When the erection of the structural steel is performed by someone other than the fabricator, the erector furnishes all welding electrodes, fit-up bolts and drift pins used for erection of the structural steel.

### **10.7.5 Field welding criteria**

Fusion faces shall be free from irregularities which would interfere with the deposition of weld metal, or which might cause other defect in the welded joint.

Shop paint on surfaces adjacent to welds shall be wire-brushed to reduce paint film to a minimum.

Welding shall not be undertaken when surfaces to be welded are wet. Unless the necessary precaution are taken, welding shall not be carried out when rain or snow is falling, in dusty conditions, or during period of high wind. Welding shall not be carried out on any surface, the temperature in the immediate vicinity of which before welding is lower than  $-18^{\circ}\text{C}$ . The welded joint shall be free from defects. Defective portions shall be removed, rewelded and then re-inspected. Serious undercutting shall be made good by the deposition of additional weld metal. All welding equipment and methods including protection, shall be to the satisfaction of the AR. The AR shall have the right to approve the equipment and its capability to perform the work required.

## **10.8 Dimensions**

All completed work shall be exact to the dimensions required except as officially directed by the AR and confirmed in writing.

Every piece of material shall be free from contamination, twist and distortion. Rectification of distortion in welded structure shall be executed in a manner as directed by the AR.

### **10.8.1 Corrections**

Correction of fabrication errors, which involve flame cutting, heating, additional holes, relocation of clips, etc. shall not be undertaken without approval of AR.

## **10.9 Tolerances**

Structural elements shall be considered plumb, level and aligned in accordance with the AISC Manual. The tolerances on position and alignment of member working points and working lines are as follows:

### **10.9.1 Columns**

Individual column shipping pieces are considered plumb, if the deviation of the working line from a plumb line does not exceed 1:500, subject to the following limitations:

- a) The member working points of column shipping pieces adjacent to elevator shafts may be displaced no more than 25 mm from the established column line in the first 20 stories; above this level, the displacement may be increased 1 mm for each additional story up to a maximum of 50 mm.
- b) The members working points of exterior column shipping pieces may be displaced from the established column line no more than 25 mm toward nor 50 mm away from the building line in the first 20 stories; above the 20th story, the displacement may be increased 1.6 mm for each additional story, but may not exceed a total displacement of 50 mm toward not 75 mm away from the building line.
- c) The member working points of exterior column shipping pieces at any splice level for multi-tier buildings and at the tops of columns for single tier buildings may not fall outside a horizontal envelope, parallel to the building line, 38 mm wide for buildings up to 90 m in length. The width of the envelope may be increased by 12 mm for each additional 30 m in length, but may not exceed 75 mm.
- d) The member working points of exterior column shipping pieces may be displaced from the established column line, in a direction parallel to the building line, no more than 50 mm in the first 20 stories; above the 20th story, the displacement may be increased 1.6 mm for each additional story, but may not exceed a total displacement of 75 mm parallel to the building line.

### 10.9.2 Members connecting to columns

- a) The horizontal alignment of members connecting to columns is considered acceptable if any error in alignment is caused solely by the variation in column alignment within permissible limits.
- b) The elevation of members connecting to columns is considered acceptable if the distance from the member working point to the upper milled splice line of the column does not deviate more than plus 5 mm or minus 8 mm from the distance specified on the drawings.

### 10.9.3 Other members

Members not covered above are considered plumb, level and aligned if the displacement of the individual member does not exceed 1:500 from a straight line struck between the support points of the member.

### 10.10 Field Painting

The erector does not paint field bolt heads and nuts, field rivet heads and field welds, nor touch up abrasions of the shop coat. Except where special preparation is called for, all steelwork shall be delivered primed in accordance with the IPS-C-TP-102 "Construction Standard for Painting". Part to be encased in concrete shall not be painted or oiled.

Contact surfaces for connection using high strength fabrication grip bolts shall have all paint, dirt and other deleterious matter removed together with any other defects which would prevent the solid heating of the parts or interfere with friction development.

All enclosed surfaces of box members shall be completely sealed by oiling or coating with an approved bituminous paint and the ends of all such members and tubes shall be closed by suitable metal plates, welded in position.

Contact and inaccessible surfaces not utilizing high strength friction grip bolts shall be rubbed down after the removal of all dirt and other deleterious material and given two coats primer paint according to IPS-C-TP-102. If so required, surfaces shall be brought into contact while the paint is still wet.

All dirt, grease and other matter shall be removed and the clean surface of all steelwork exposed where priming is damaged during erection operations. Two coats of primer shall be applied at suitable intervals to completely cover the base metal.

**10.11 Damaged Area**

Immediately after erection, all surfaces on which the shop coating has been damaged, shall be thoroughly cleaned and touched up with the same coating and in accordance with painting Standard.

**10.12 Field Inspection**

AR shall have all right to inspect the structural steel at any time during erection to assure that the materials and workmanship are in accordance with this Standard and contract documents.

**10.13 Final Clean-Up**

Upon completion of erection and before final acceptance, the erector removes all of his falsework, rubbish and temporary buildings from the site.