Are You Properly Specifying Materials?

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Keeping tabs on available ASTM Specifications for each structural shape will help you make the right choices when designing your projects.

THE MATERIALS AND PRODUCTS USED IN BUILDING DESIGN and construction are almost universally designated by reference to an appropriate ASTM specification. This simplifies the design and construction process because you can define all the characteristics of a specified product. However, with dozens of ASTM specifications applicable in steel building construction alone, it can be a challenge to keep the standard designations used in contract documents current.

This article provides a summary of the common ASTM specifications used in steel building design and construction, including structural shapes, plate products, fastening products, and other products. This information is based upon similar and more extensive information in the 13th Edition AISC *Steel Construction Manual*. The reader may also find it convenient to use the recently revised AISC publication *Selected ASTM Standards for Structural Steel Fabrication 2008*, which is a compilation of more than 60 steel-related ASTM standards. Both of these publications are available for purchase online at **www.aisc.org/bookstore**.

STRUCTURAL SHAPES

See the summary in Table 2-1.

W-Shapes

The preferred material specification for W-shapes is ASTM A992 (F_y = 50 ksi, F_u = 65 ksi). The availability of W-shapes in grades other than ASTM A992 should be confirmed prior to their specification. W-shapes with higher yield and tensile strength can be obtained by specifying ASTM A572 Grade 60 or 65, or ASTM A913 Grades 60, 65, or 70. W-shapes with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A588 or ASTM A242 Grade 42, 46, or 50. Other material specifications applicable to W-shapes include ASTM A36, ASTM A529 Grade 50 and 55, ASTM A572 Grade 42 and 50, and ASTM A913 Grade 50.

M-Shapes and S-Shapes

The preferred material specification for M- and S-shapes is in transition. ASTM A36 (F_y = 36 ksi, F_u = 58 ksi) has been traditional, but at least one steel producer now sells these shapes in ASTM A572 Grade 50 (F_y = 50 ksi, F_u = 65 ksi) for a lower price than ASTM A36. During this transition, we suggest you ask a fabricator what grade is most common when you use these shapes. The availability of M-shapes in other grades should be confirmed prior to their specification. M-shapes with atmospheric corrosion resistance (weathering) can be obtained by specifying ASTM A588 or ASTM A242 Grade 50. Other material specifications applicable to M- and S-shapes include ASTM A572 Grades 42, 55, 60, and 65, ASTM A529 Grades 50 and 55, ASTM A913 Grades 50, 60, 65, or 70, and ASTM A992.

Channels

The preceding comments for M- and S-shapes apply equally to channels.

HP-Shapes

The preferred material specification for HP shapes is ASTM A572 Grade 50 (F_y = 50 ksi, F_u = 65 ksi); the availability of other grades should be confirmed prior to specification. HP-shapes with atmospheric corrosion resistance (weathering) can be obtained by specifying ASTM A588 or ASTM A242 Grades 46 or 50. Other material specifications applicable to HP-shapes include ASTM A36, ASTM A529 Grades 50 or 55, ASTM A572 Grades 42, 55, 60, and 65, ASTM A913 Grades 50, 60, 65, and 70, and ASTM A992.

Angles

The preferred material specification for angles is ASTM A36 (F_y = 36 ksi, F_u = 58 ksi). The availability of angles in grades other than ASTM A36 should be confirmed prior to their specification. Angles with higher yield and tensile strength can be obtained by specifying ASTM A572 Grade 42, 50, 55, 60, or 65, ASTM A529 Grades 50 or 55, ASTM A913 Grades 50, 60, 65, or 70, and ASTM A992. Angles with atmospheric corrosion resistance (weathering)

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Table 2-1

Applicable ASTM Specifications for Various Structural Shapes

Steel Type	ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Min. Yield Stress[a] (ksi)	Applicable Shape Series									
					W	M	S	HP	C	MC	L	HSS Rect.	HSS Round	Pipe
Carbon	A36		36	58-80[b]	■	■	■	■	■	■	■			
	A53 Gr. B		35	60										■
	A500	Gr. B	42	58									■	
			46	58								■		
		Gr. C	46	62									▒	
			50	62								▒		
	A501		36	58								▒	▒	
	A529[c]	Gr. 50	50	65-100	▒	▒	▒	▒	▒	▒	▒			
		Gr. 55	55	70-100	▒	▒	▒	▒	▒	▒	▒			
High-Strength Low-Alloy	A572	Gr. 42	42	60	▒	▒	▒	▒	▒	▒	▒			
		Gr. 50	50	65[d]	▒	▒	▒	■	▒	▒	▒			
		Gr. 55	55	70	▒	▒	▒	▒	▒	▒	▒			
		Gr. 60[e]	60	75	▒	▒	▒	▒	▒	▒	▒			
		Gr. 65[e]	65	80	▒	▒	▒	▒	▒	▒	▒			
	A618[f]	Gr. I & II	50[g]	70[g]								▒	▒	
		Gr. III	50	65								▒	▒	
	A913	50	50[h]	60[h]	▒	▒	▒	▒	▒	▒	▒			
		60	60	75	▒	▒	▒	▒	▒	▒	▒			
		65	65	80	▒	▒	▒	▒	▒	▒	▒			
		70	70	90	▒	▒	▒	▒	▒	▒	▒			
	A992		50-65[i]	65[i]	■	▒	▒	▒	▒	▒	▒			
Corrosion Resistant High-Strength Low-Alloy	A242		42[j]	63[j]	▒									
			46[k]	67[k]	▒			▒			▒			
			50[l]	70[l]	▒	▒	▒	▒	▒	▒	▒			
	A588		50	70	▒	▒	▒	▒	▒	▒	▒			
	A847		50	70								▒	▒	

■ Preferred material specification.

▒ Other applicable material specification, the availability of which should be confirmed prior to specification.

□ Material specification does not apply.

[a] Minimum unless a range is shown.
[b] For W-shapes with flange thickness over 3 in., only the minimum of 58 ksi applies.
[c] For shapes with a flange thickness less than or equal to 1.5 in. only. To improve weldability a maximum carbon equivalent can be specified (per ASTM Supplementary Requirement S78). If desired, maximum tensile stress of 90 ksi can be specified (per ASTM Supplementary Requirement S79).
[d] If desired, maximum tensile stress of 70 ksi can be specified (per ASTM Supplementary Requirement S81).
[e] For shapes with a flange thickness less than or equal to 2 in. only.
[f] ASTM A618 can also be specified as corrosion-resistant; see ASTM A618.
[g] Minimum applies for walls nominally 3/4-in. thick and under. For wall thicknesses over 3/4 in., F_y = 46 ksi and F_u = 67 ksi.
[h] If desired, maximum yield stress of 65 ksi and maximum yield-to-tensile strength ratio of 0.85 can be specified (per ASTM Supplementary Requirement S75).
[i] A maximum yield-to-tensile strength ratio of 0.85 and carbon equivalent formula are included as mandatory in ASTM A992.
[j] For shapes with a flange thickness greater than 2 in. only.
[k] For shapes with a flange thickness greater than 1.5 in. and less than or equal to 2 in. only.
[l] For shapes with a flange thickness less than or equal to 1.5 in. only.

characteristics can be obtained by specifying ASTM A588 or ASTM A242 Grades 46 or 50.

Structural Tees

Structural tees are split from W-, M-, and S-shapes to make WT-, MT- and ST-shapes respectively. For the preferred material specifications, as well as other suitable material specifications for structural tees, refer to the preceding sections on W-, M- or S-shapes as appropriate.

Rectangular (and Square) HSS

The preferred material specification for rectangular HSS is ASTM A500 Grade B (F_y = 46 ksi, F_u = 58 ksi), although ASTM A500 Grade C (F_y = 50 ksi, F_u = 62 ksi) continues to be common. The availability of rectangular HSS in grades other than ASTM A500 Grade B should be confirmed prior to their specification. Rectangular HSS with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A847. Other material specifications applicable to rectangular HSS include ASTM A501 and ASTM A618.

Round HSS

The preferred material specification for round HSS is ASTM A500 Grade B (F_y = 42 ksi, F_u = 58 ksi), although ASTM A500 Grade C (F_y = 46 ksi, F_u = 62 ksi) continues to be common. The availability of round HSS in grades other than ASTM A500 Grade B should be confirmed prior to specification. Round HSS with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A847. Other material specifications applicable to round HSS include ASTM A501 and ASTM A618. See also items 4 and 5 in the sidebar "10 Important Tidbits."

Steel Pipe

The preferred (and only) material specification for steel pipe used in structural applications is ASTM A53 Grade B (F_y = 35 ksi, F_u = 60 ksi). See also items 4 and 5 in the sidebar "10 Important Tidbits."

PLATE PRODUCTS

See the summary in Table 2-2.

Structural Plates

The preferred material specification for structural plates is ASTM A36 (F_y = 36 ksi for plate thickness equal to or less than 8 in., F_y = 32 ksi otherwise; F_u = 58 ksi). The

availability and cost-effectiveness of structural plates in grades other than ASTM A36 should be confirmed prior to their specification. Note also that the availability of grades other than ASTM A36 varies through the range of thicknesses as shown in Table 2-2. Structural plates with higher yield and tensile strength can be obtained by specifying ASTM A572 Grade 42, 50, 55, 60, or 65, ASTM A529 Grade 50 or 55, ASTM A514 Grade 90 or 100, or ASTM A852. Structural plates with atmospheric corrosion resistance (weathering) characteristics can be obtained by specifying ASTM A588 or ASTM A242 Grade 42, 46, or 50.

Structural Bars

The preceding comments for structural plates apply equally to structural bars, except that neither ASTM A514 nor A852 are applicable.

Table 2-2

Applicable ASTM Specifications for Plates and Bars

Steel Type	ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Min. Yield Stress[a] (ksi)	Thickness: to 0.75 incl.	0.75 to 1.25 incl.	1.25 to 1.5 incl.	over 1.5 to 2 incl.	over 2 to 2.5 incl.	over 2.5 to 4 incl.	over 4 to 5 incl.	over 5 to 6 incl.	over 6 to 8 incl.	over 8
Carbon	A36		32	58-80										■
			36	58-80	■	■	■	■	■	■	■	■	■	
	A529	Gr. 50	50	70-100	▒	▒[b]	▒[b]	▒[b]	▒[b]					
		Gr. 55	55	70-100	▒	▒[b]	▒[b]							
High-Strength Low-Alloy	A572	Gr. 42	42	60	▒	▒	▒	▒	▒	▒	▒	▒		
		Gr. 50	50	65	▒	▒	▒	▒	▒	▒				
		Gr. 55	55	70	▒	▒	▒	▒						
		Gr. 60	60	75	▒	▒								
		Gr. 65	65	80	▒	▒								
Corrosion Resistant High-Strength Low-Alloy	A242		42	63				▒	▒	▒				
			46	67		▒	▒							
			50	70	▒									
	A588		42	63								▒	▒	
			46	67							▒			
			50	70	▒	▒	▒	▒	▒	▒				
Quenched and Tempered Alloy	A514[c]		90	100-130						▒	▒	▒		
			100	110-130	▒	▒	▒	▒	▒					
Quenched and Tempered Low-Alloy	A852[c]		70	90-110	▒	▒	▒	▒	▒	▒				

■ Preferred material specification.

▒ Other applicable material specification, the availability of which should be confirmed prior to specification.

□ Material specification does not apply.

[a]Minimum unless a range is shown.
[b]Applicable to bars only above 1-in. thickness.
[c]Available as plates only.

Changes to A490: Introducing F1136 Grade 3

Hydrogen embrittlement concerns have always meant that ASTM A490 bolts are not permitted to be galvanized. This has always left the question of what to do when the A490 strength level is desired and the structure is galvanized.

Research was undertaken to qualify a metallic coating suitable for use on A490 bolts, following the procedures provided by IFI-144 ("Test Evaluation Procedures for Coating Qualification Intended for Use on High-Strength Structural Bolts") and using a coating system meeting the requirements of ASTM F1136 Grade 3 ("Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners"). Accordingly, the ASTM A490-08a revision allows ASTM F1136 Grade 3 coatings to be applied to A490 bolts (see Section 4.3.1 & 4.3.2).

The application of an F1136 Grade 3 coating is a multi-step process of cleaning via alkaline bath and mechanical blast, followed by two coating layers that are applied and cured each in turn before a final seal coat is applied and cured. Acid is not involved at any stage in the process. The resulting silvery finish has a thickness of around 0.4 mils (9.25 microns), whereas equivalent hot-dip galvanizing would be on the order of 4 mils (90 microns), or 3 mils (65 microns) for mechanical galvanizing. If desired, paint may be applied on top of the F1136 Grade 3 coating.

The Research Council on Structural Connections provides the research report on their website at **http://boltcouncil.org/files/IBECAResearchReport6-02.pdf**. However, note that at present neither the RCSC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" nor the AISC Specification recognize the use of F1136 Grade 3 coatings, as they were written prior to completion of the relevant research and subsequent acceptance in A490-08a.

Table 2-3

Applicable ASTM Specifications for Various Types of Structural Fasteners

ASTM Designation		F_y Min. Yield Stress (ksi)	F_u Min. Yield Stress[a] (ksi)	Diameter Range (in.)	Applicable Product: High-Strength Bolts: Conventional	High-Strength Bolts: Twist-Off-Type Tension Control[d]	Common Bolts	Nuts	Washers	Direct-Tension-Indicator Washers	Threaded Rods	Shear Stud Connectors	Anchor Rods: Hooked	Anchor Rods: Headed	Anchor Rods: Threaded & Nutted
A108		–	65	0.375 to 0.75, incl.								■			
A325[d]		–	105	over 1 to 1.5 incl.	■										
		–	120	0.5 to 1, incl.	■										
A490		–	150	0.5 to 1.5	■										
F1852		–	105	1.125		■									
		–	120	0.5 to 1, incl.		■									
F2280		–	150	0.5 to 1.125		■									
A194 Gr. 2H		–	–	0.25 to 4				▒							
A563		–	–	0.25 to 4				■							
F436[b]		–	–	0.25 to 4					■						
F959		–	–	0.5 to 1.5						■					
A36		36	58-80	to 10							■		▒		▒
A193 Gr. B7[e]		–	100	over 4 to 7							▒		▒		▒
		–	115	over 2.5 to 4							▒		▒		▒
		–	125	2.5 and under							▒		▒		▒
A307 Gr. A		–	60	0.25 to 4			■							▒	
A354	Gr. BC	–	115	2.5 to 4 incl.	[c]						▒		▒	▒	▒
		–	125	0.25 to 2.5, incl.	[c]						▒		▒	▒	▒
	Gr. BD	–	140	2.5 to 4 incl.	[c]						▒		▒	▒	▒
		–	150	0.25 to 2.5, incl.	[c]						▒		▒	▒	▒
A449		–	90	1.75 to 3 incl.	[c]						▒		▒	▒	▒
		–	105	1.125 to 1.5, incl.	[c]						▒		▒	▒	▒
		–	120	0.25 to 1, incl.	[c]						▒		▒	▒	▒
A572	Gr. 42	42	60	to 6							▒		▒		▒
	Gr. 50	50	65	to 4							▒		▒		▒
	Gr. 55	55	70	to 2							▒		▒		▒
	Gr. 60	60	75	to 1.25							▒		▒		▒
	Gr. 65	65	80	to 1.25							▒		▒		▒
A588		42	63	over 5 to 8, incl.							▒		▒		▒
		46	67	over 4 to 5, incl.							▒		▒		▒
		50	70	4 and under							▒		▒		▒
A687		105	150 max.	0.625 to 3							▒		▒		▒
F1554	Gr. 36	36	58-80	0.25 to 4									■	■	■
	Gr. 55	55	75-95	0.25 to 4									▒	▒	▒
	Gr. 105	105	125-150	0.25 to 3									▒	▒	▒

■ Preferred material specification.

▒ Other applicable material specification, the availability of which should be confirmed prior to specification.

□ Material specification does not apply.

–Indicates that a value is not specified in the material specification.
[a]Minimum unless a range is shown or maximum (max.) is indicated.
[b]Special washer requirements may apply per RCSC Specification Table 6.1 for some steel-to-steel bolting applications and per Part 14 for anchor-rod applications.
[c]See AISC Specification Section J3.1 for limitations on use of these products as bolts.
[d]When atmospheric corrosion resistance is desired, Type 3 can be specified.
[e]For anchor rods with temperature and corrosion resistance characteristics.

Raised-Pattern Floor Plates

ASTM A786 is the standard specification for rolled steel floor plates. As floor-plate design is seldom controlled by strength considerations, ASTM A786 "commercial grade" is commonly specified. If so, per ASTM A786 Section 5.1.3, "the product will be supplied with 0.33 percent maximum carbon, by heat analysis, and without specified mechanical properties." Alternatively, if a defined strength level is desired, ASTM A786 raised-pattern floor plate can be ordered to a defined plate specification such as ASTM A36, A572, or A588; see ASTM A786 Sections 5.1.3 and 8.

Sheet and Strip

Sheet and strip products, which generally are thinner than structural plate and bar products, are produced to such ASTM specifications as A606, A1008, or A1011. Previously A570 and A607 were listed. These standards have been withdrawn and the materials covered by them are now in A1008, A1011, and (for thicker materials) A1018. These are "umbrella" standards with many types and grades; the structural steel type is designated "SS" and the standards provide for grades from 25 or 30 to 80. Availability should be checked before specifying the grade.

FASTENING PRODUCTS

See the summary in Table 2-3.

Conventional Bolts

The preferred material specification for conventional (heavy hex) high-strength bolts in steel-to-steel connections is ASTM A325, although ASTM A490 can be specified when higher strength is desired. In either case, Type 1 is the most commonly specified (medium-carbon steel). When atmospheric corrosion resistance is desired, Type 3 can be specified. While still formally permitted in the AISC Specification, the use of other bolt material specifications like ASTM A307 in steel-to-steel bolting applications has become quite uncommon.

In the rare cases when diameters larger than 1½ in. are required, the upper limit of ASTM A325 and A490 is exceeded. To cover these cases, ASTM A354 Grade BC and A449 are permitted to be used as bolts for A325 strength level, and ASTM A354 Grade BD is permitted for A490 strength level. Note that these standards are material standards, not bolt standards, so the desired head and threading dimensions

must be specified as per ANSI ASME B18.2.6 heavy hex class 2A.

Twist-Off Type Tension-Control Bolt Assemblies

The preferred material specification for twist-off type tension-control bolt assemblies is ASTM F1852 (which offers the strength level of ASTM A325 bolts), although ASTM F2280 (which offers the strength level of ASTM A490 bolts) can be specified when higher strength is desired. In either case, Type 1 is the most commonly specified (medium-carbon steel). When atmospheric corrosion resistance is desired, Type 3 can be specified. The use of these devices must conform to the requirements in the RCSC Specification, which provides detailed requirements for pre-installation verification (Section 7), installation (Section 8) and inspection (Section 9).

Nuts

The preferred material specification for heavy-hex nuts is ASTM A563. The appropriate grade and finish is specified per ASTM A563 Table X1.1 according to the bolt or threaded part with which the nut will be used. For steel-to-steel structural bolting applications, the appropriate grade and finish is summarized in the RCSC Specification Section 2.4. If its availability can be confirmed prior to specification, ASTM A194 Grade 2H nuts are permitted as an alternative, as indicated in the RCSC Specification Table 2.1.

Washers

The preferred material specification for hardened steel washers is ASTM F436. This specification provides for both flat and beveled washers. While standard ASTM F436 washers are sufficient in most applications, there are several specific applications when special washers are required. The special washer requirements in RCSC Specification Section 6 apply when oversized or slotted holes are used in the outer ply of a steel-to-steel structural joint.

In anchor rod and other embedment applications, hole sizes generally are larger than those for steel-to-steel structural bolting applications. Accordingly, washers used in such applications generally are larger and might require design consideration for proper force transfer, particularly when the anchorage is subject to tension. Table 14-2 in the 13th Edition AISC *Steel Construction Manual* discussed the use of ASTM F844 washers in some of these applications.

Compressible-Washer-Type Direct-Tension Indicators

When bolted joints are specified as pretensioned or slip-critical and the direct-tension-indicator pretensioning method is used, ASTM F959 compressible-washer-type direct-tension indicators are specified. Type 325 is used with ASTM A325 high-strength bolts and type 490 is used with ASTM A490 high-strength bolts. The use of these devices must conform to the requirements in the RCSC Specification, which provides detailed requirements for pre-installation verification (Section 7), installation (Section 8), and inspection (Section 9). The RCSC Specification also permits alternative washer-type indicating devices subject to the provision in Section 2.6.2.

Anchor Rods

The preferred material specification for anchor rods is ASTM F1554, which covers hooked, headed, and threaded and nutted anchor rods in three strength grades: 36, 55, and 105. ASTM F1554 Grade 36 is most commonly specified, although grades 55 and 105 also are normally available. ASTM F1554 Grade 36 may be welded, while Grade 55 may be welded if it is ordered with Supplement S1 and the carbon equivalent formula in Section S1.5.2.1. Grade 105 is not suitable for welding, as the heat may detrimentally affect the product. Other material specifications applicable to headed anchor rods include ASTM A307, A354, and A449. For applications involving rods that are not headed, ASTM A36, A193, A307, A354, A449, A572, A588, and A687 can be specified. For applications involving headed rods, note that Grade C has been deleted from ASTM A307 and replaced by ASTM F1554 Grade 36.

Threaded Rods

The preferred material specification for threaded rods, whether provided with plain or upset ends, is ASTM A36. Other material specifications applicable to threaded rods include ASTM A193, A307, A354, A449, A572, A588, and A687.

Shear Stud Connectors

The preferred material specification for shear stud connectors used for the interconnection of steel and concrete elements in composite construction is ASTM A29 provided as defined in ASTM A108. The mechanical requirements are stated in AWS D1.1 Table 7.1 for Type B shear stud connectors (F_y = 50 ksi, F_u = 65 ksi).

Forged Steel Structural Hardware

Forged steel structural hardware products, such as clevises, turnbuckles, eye nuts, and sleeve nuts occasionally are used in building design and construction. These products are generally provided to AISI material specifications. AISI C-1035 is commonly used in the manufacture of clevises and turnbuckles. AISI C-1030 is commonly used in the manufacture of steel eye nuts and steel eye bolts. AISI C-1018 Grade 2 is commonly used in the manufacture of sleeve nuts. Other products, such as steel rod ends, steel yoke ends and pins, cotter pins, and coupling nuts are provided generically as "carbon steel." The dimensional and strength characteristics of these devices are described in the literature provided by their manufacturer. Note that such information often is provided as a safe working load and based upon a factor of safety as high as 5, assuming that the product will be used in rigging or similar applications subject to dynamic loading. If so, the tabular value might be overly conservative for permanent installations and similar applications subject to static loading only. In these applications, a factor of safety of 3 is more common.

Filler Metal

The appropriate filler metal for structural steel is summarized in ANSI/AWS D1.1 Table 3.1 for the various combinations of base metal specification and grade, and electrode specification. A tensile strength level of 70 ksi is indicated for the majority of the commonly used steels in building construction.

OTHER PRODUCTS

Steel Castings and Forgings

Steel castings are specified as ASTM A216/A216M Grade WCB with Supplementary requirement S11. Steel forgings are specified as ASTM A668.

Crane Rails

Crane rails are furnished to ASTM A759, ASTM A1 and/or manufacturer's specifications and tolerances. Rail is designated by unit weight in units of pounds per yard. Dimensions of common rail are shown in Table 1-21 in the 13th Edition AISC *Steel Construction Manual*. Most manufacturers chamfer the top and sides of the crane rail head at the ends (unless specified otherwise) to reduce chipping of the running surfaces. Often crane rails are ordered as end-hardened, which improves the resistance of the crane rail ends to impact from contact with the moving wheel during crane operation. Alternatively, the entire rail can be ordered as heat-treated. When maximum wheel loading or controlled cooling is needed, refer to manufacturer catalogs. Purchase orders for crane rails should be noted "for crane service." Light 40-lb rails are available in 30-ft lengths, standard rails in 33-ft or 39-ft lengths, and crane rails up to 80 ft. Consult manufacturer for availability of other lengths. Rails should be arranged so that joints on opposite sides of the crane runway will be staggered with respect to each other and with due consideration to the wheelbase of the crane. Rail joints should not occur at crane girder splices. Odd lengths that must be included to complete a run or obtain the necessary stagger should be not less than 10 ft long. Rails are furnished with standard drilling in both standard and odd lengths unless stipulated otherwise on the order. MSC

10 Important Tidbits

1. When in doubt, check it out. Have questions about availability? Call a fabricator or the AISC Steel Solutions Center (**solutions@aisc.org**). Either one can keep you swimming in available steel.

2. Remember that quantity means economy! Repetitive use of similar shape sizes brings the total cost of steel construction down. Best advice: Strive to use enough of any individual shape specified so that the quantity on the job is a mill order quantity–generally about 20 tons. The small cost of additional weight will be offset easily by the economies of mill ordering cost savings and detailing, fabrication, and erection similarity.

3. Times change. ASTM A992 originally was introduced covering only W-shapes. A recent revision to this ASTM standard expanded its scope to include other hot-rolled structural cross-sections (channels, angles, M-shapes, etc.), allowing them to be made to ASTM A992. Nevertheless, A992 is still not very common in shapes other than W-shapes.

4. Round HSS ≠ Steel Pipe. Know the difference between ASTM A500 and ASTM A53. ASTM A500 is for HSS (F_y = 42 ksi for grade B; 46 ksi for grade C). ASTM A53 is for steel pipe (F_y = 35 ksi).

5. But round HSS are similar to steel pipe. Know the similarity between available round HSS (ASTM A500) and steel pipe (ASTM A53). Generally speaking, only round HSS with the same cross-sectional dimensions as steel pipe are stocked and available. So avoid specifying a round HSS with a cross section that does not match up to one of the steel pipe cross-sections. This is a lot easier than it sounds; just use round HSS with non-zero numbers after the decimal point in the diameter. For example, HSS 5.563x0.258 has the same cross section as a Pipe 5 Std. And it generally will be available, while HSS 5.000x0.250 is an HSS-only product and will require a mill order quantity to obtain.

6. Properly designate your HSS. A round HSS is designated by nominal diameter and wall thickness, each expressed to three decimal places—for example, HSS 5.563x0.258. A square or rectangular HSS is designated by nominal outside dimensions and wall thickness, each in rational numbers—for example, HSS 5x3x⅜.

7. Properly designate your steel pipes. Use nominal pipe size (NPS) designation through NPS 12—for example, Pipe 5 Std., Pipe 5 x-strong or Pipe 5 xx-strong. Note that this notation has commonly been abbreviated as follows for the examples given: P5, PX5 and PXX5, respectively. Above NPS 12, use the format "Pipe" followed by diameter x nominal wall thickness, each expressed to three decimal places—for example, NPS 14 Standard is designated Pipe 14.000x0.375. The latter format also applies to any steel pipe size smaller than NPS 12 that does not have an NPS size.

8. Don't confuse anchor rods with bolts. Do not specify your anchor rods as ASTM A325 or A490. ASTM A325 and A490 are for headed bolts, with limited thread length, generally available only up to 8 in. in length, and governed by provisions for steel-to-steel structural joints only. You say you've always specified your anchorage devices this way and it's never been a problem? Well, the reality is that your fabricator has been awfully nice to not embarrass you by pointing out that you've specified a product that does not come in the length you likely specified—or as a hooked or longer-threaded rod. Use ASTM F1554, which covers hooked, headed, and threaded/nutted rods in three strength grades.

9. Have all the information at your fingertips. More extensive information can be found in the 13th Edition *Steel Construction Manual* and the AISC publication *Selected ASTM Standards for Steel Construction*, both of which are available at **www.aisc.org/bookstore**.

10. When in doubt, check it out. Oh wait, this is number 1. Well, it is important and therefore bears repeating.