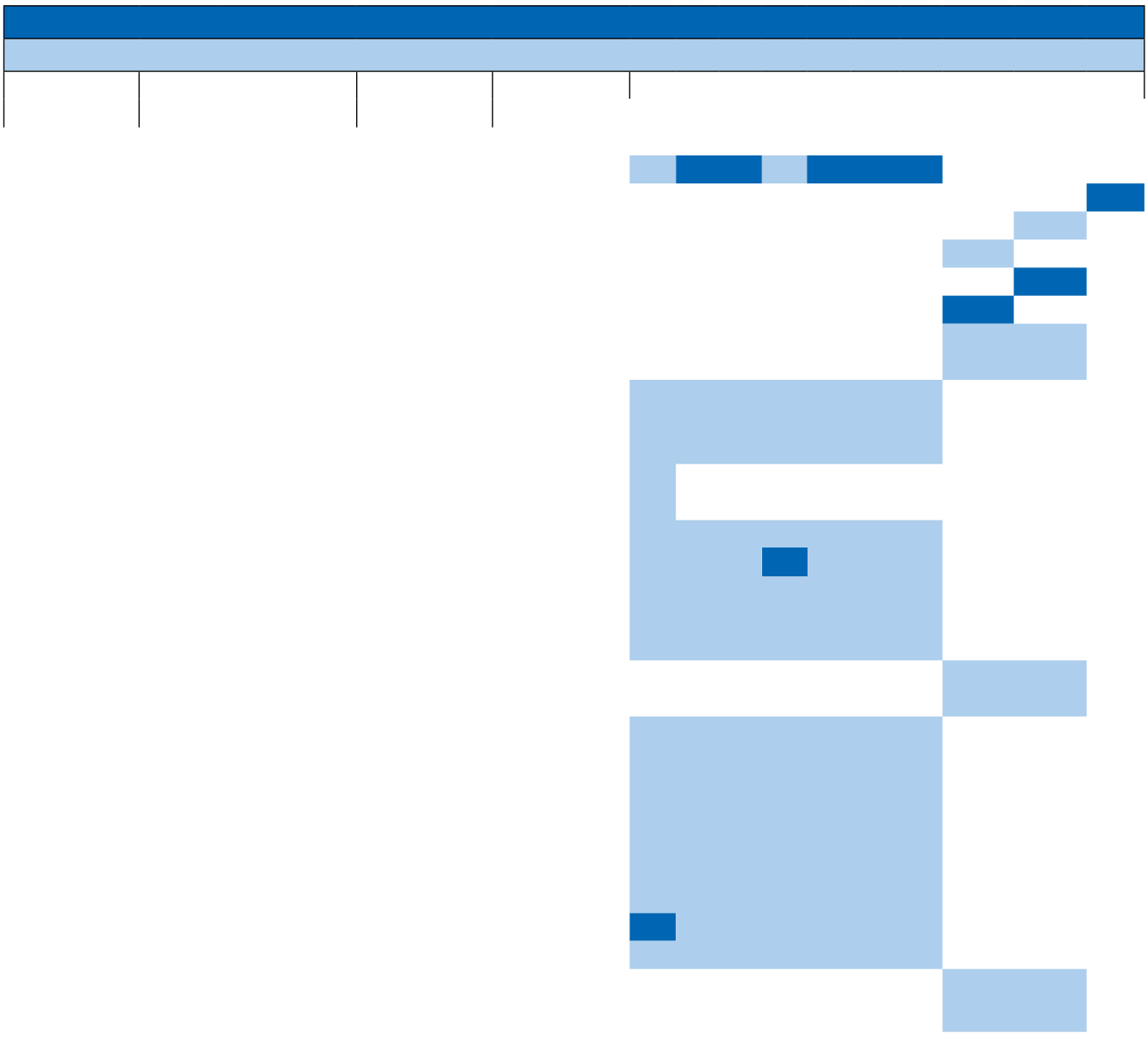
THE MATERIALS AND PRODUCTS used in building design and construction are almost universally designated by reference to an appropriate ASTM specification. This simplifies the design and construction process because you can define all the characteristics of a specified product. However, with dozens of ASTM specifications applicable in steel building construction alone, it can be a challenge to keep the standard designations used in contracts 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 14th Edition AISC *Steel Construction Manual*. You may also find it convenient to use the AISC publication *Selected ASTM Standards for Steel Construction*, a compilation of more than 60 steel-related ASTM standards. (Both the AISC *Manual* and *Selected ASTM Standards* are available for purchase online at **www.aisc.org/bookstore**.)

Note that ASTM standards routinely include a section on ordering requirements that lists the variables in each standard that should be specified in a complete order or specification for the material. This is routine for the purchasing department at the local fabrication company and may be of great interest to others as well.

STRUCTURAL SHAPES



M-Shapes and S-Shapes

The preferred material speci cation for these shapes is in transition. Use of ASTM A36 (F_y = 36 ksi, F_u = 58 ksi) is now only slightly more common than use of a 50-ksi grade like ASTM A572 Grade 50, ASTM A529 Grade 50, or ASTM A992; each of these 50-ksi grades has F_y = 50 ksi and F_u = 65 ksi for these shapes. The availability and cost effectiveness of M-shapes and S-shapes in grades other than these should be con rmed prior to their speci cation.

M-shapes and S-shapes with a higher yield and tensile strength can be obtained by specifying ASTM A572 Grades 55, 60 and 65, ASTM A529 Grade 55 or ASTM A913 Grades 60, 65 or 70. Atmospheric corrosion resistance (weathering characteristics) can be obtained by specifying ASTM A588 Grade 50. These and other material specications applicable to M-shapes and S-shapes are shown in Table 1.

Channels

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

HP-Shapes

The preferred material speci cation for HP shapes is ASTM A572 Grade 50 (F_y = 50 ksi, F_u = 65 ksi); the availability and cost effectiveness of other grades should be con rmed prior to speci cation.

HP-shapes with atmospheric corrosion resistance (weathering characteristics) can be obtained by specifying ASTM A588 Grade 50. These and other material speci cations applicable to HP-shapes are shown in Table 1.

Angles

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

Structural Tees

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

Rectangular (and Square) HSS

The preferred material speci cation for rectangular hollow structural sections (HSS) is ASTM A500 Grade C (F_y = 50 ksi, F_u = 62 ksi). Note that a new standard, ASTM A1085 (see sidebar "New (and Recently New) Things"), seeks to replace it. The availability and cost effectiveness of rectangular HSS in grades other than ASTM A500 Grade C should be con rmed prior to their speci cation.

Rectangular HSS with atmospheric resistance (weathering characteristics) can be obtained by specifying ASTM A847. These and other material speci cations applicable to rectangular HSS are shown in Table 1.

Round HSS

The preferred material speci cation for round HSS is ASTM A500 Grade C (F_y = 46 ksi, F_u = 62 ksi). Note that a new standard, ASTM A1085 (see sidebar "New

Th9 obtained by1<u>1</u> 1 Tf-c corrosion resistance (weathering characteristics)

New (and Recently New) Things

- *A CMa e E ec a f Sa S ge* : The MC12×14.3 that recently was added to ASTM A6 was conceived as a stair stringer. It has a 2⅛-in. flange width, which is wide enough to accept the common handrail pipe size and fillet weld around it. No more crimping the pipe or goobering the weld!
- *B gge HP- Ma e* : The HP18- and HP16-series shapes that recently were added to ASTM A6 provide for even higher pile strengths. They, like all HP shapes, also have thicker webs (=) and may help eliminate the need for stiffeners and doublers when used as columns.
- *La ge HSS*: Until recently ASTM A500 HSS was limited to ⅝-in. thickness and 64-in. perimeter. It now permits HSS to ⅞-in. thickness and 88-in. perimeter. While the standards permit these larger sizes, they are not currently made in the U.S.; availability should be checked. HSS with sizes that exceed ASTM A500's 88-in. periphery limit can also be obtained and are discussed in an article titled "Larger Hollow Structural Sections" in the November 2011 issue of *M de S ee* . This includes a discussion of ASTM A1065, which covers these shapes produced by forming two channels and welding the channels together.
- *ASTM A1085 f HSS*: Formalized in April 2013, this new standard offers tighter tolerances on wall thickness and corner radii, shape perimeters of up to 88 inches, minimum yield strength of 50 ksi, minimum tensile strength of 70 ksi *a d* a maximum yield of 70ksi, standard CVN of 25 ft-lb at 40 °F with the option to request a custom CVN through a supplementary requirement. For additional information on ASTM A1085, see **www.aisc.org/A1085** and "Hollow Product, Solid Benefit" in the September 2013 issue of *M de S ee* .
- *S e B g*: ASTM recently approved ASTM F3125, an umbrella specification that covers what is now in ASTM A325, A490, F1852 and F2280. The beauty of this standard is that these previously separate standards have been unified, coordinated and made consistent with each other (kudos to Chad Larson, president of LeJeune Bolt Company, for leading the effort to create this significant improvement). In future editions of RCSC and AISC standards, we expect you will see ASTM F3125 referenced instead of the currently separate list of standards. The names of the current standards are used as the names of the grades in the new standard, so you will still be able to order A325, A490, F1852 and F2280 bolts, and you will still be able to identify them by the marks on the head. Stay tuned!
- *T Me a e a e* : ASTM A283 covers low-yield carbon steel plate material in four grades. ASTM A1043 covers plates and shapes and is most commonly used as core material in the manufacture of buckling-restrained braces. These two newer products are shown in Tables 1 and 2.
- *Ve H g S e g B g*: ASTM also just approved ASTM F3111 and F3043, which are 200-ksi structural bolts available in heavy hex and TC versions, respectively. These bolts have strict environmental requirements that are discussed in the standards, but essentially they must always remain dry and free from contact with corrosive chemicals. These bolts are proprietary and not produced domestically ask the steel fabricator to make sure you can obtain these bolts; if so, they may be helpful, especially in large connections.

Steel Pipe

The material speci cation for steel pipe used in structural frames is ASTM A53 Grade B (F_y = 35 ksi, F_u = 60 ksi). In some regions, ASTM A53 material is more readily available than ASTM A500 for round cross sections. See the sidebar "12 Tidbits" for further information.

PLATE PRODUCTS

See Summary in Table 2.

Structural Plates

The preferred material speci cation for structural plates is in transition. Use of 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) is as common as use of ASTM A572 Grade 50 (F_y = 50 ksi, F_u = 65 ksi for plate thickness equal to or less than 4 in.). The availability and cost effectiveness of structural plates in grades other than these should be con rmed prior to their speci cation. Note also the thickness ranges are different for other grades as shown in Table 2-2.

Structural plates with higher yield and tensile strength can be obtained by specifying ASTM A572 Grade 55, 60 or 65, ASTM A529 Grade 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 Grade 42, 46 or 50. These and other material speci cations applicable to structural plates are shown in Table 2.

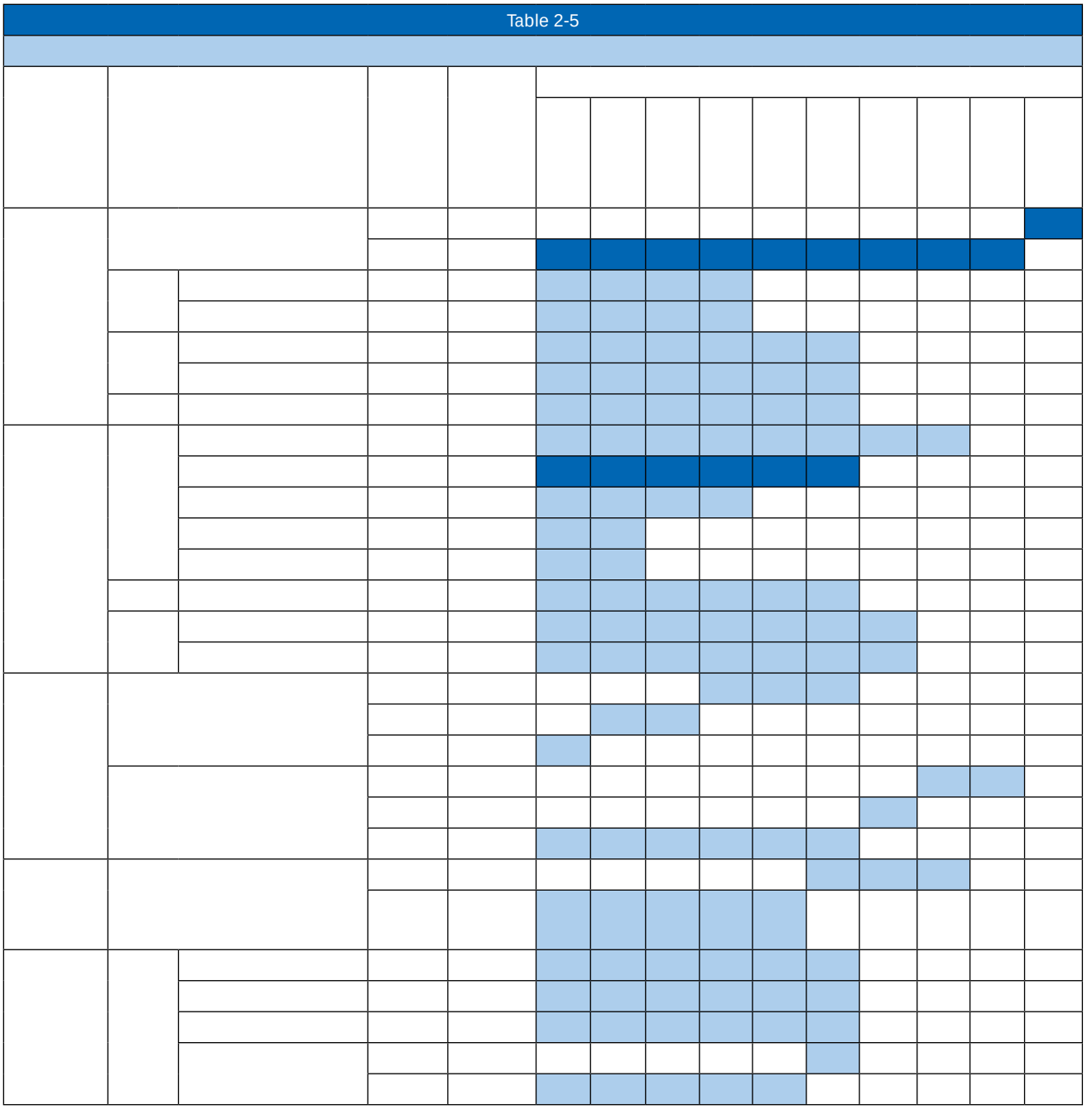
Structural Bars

The preceding comments for structural plates apply equally to structural bars, except ASTM A514 is not applicable.

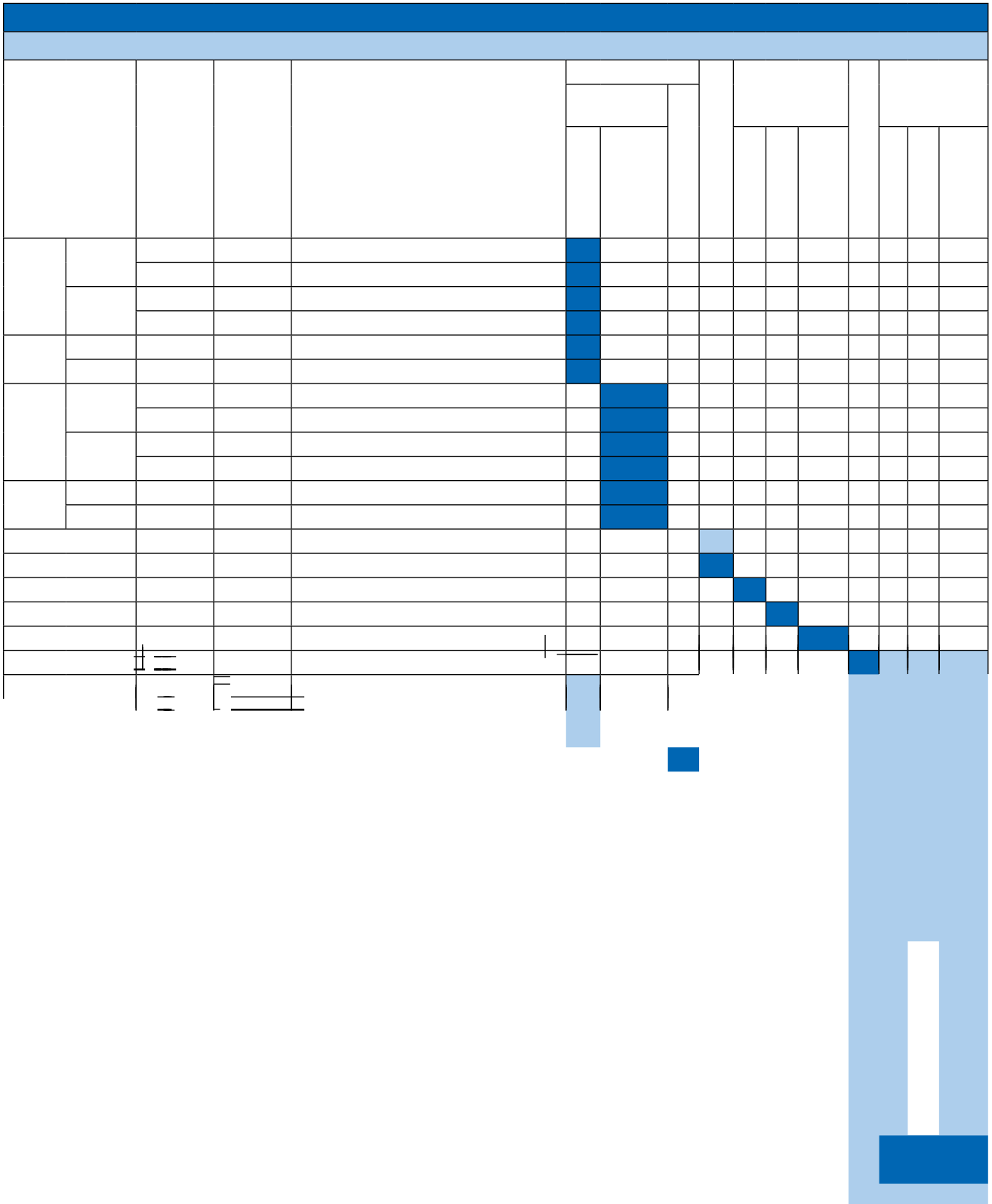
Raised-Pattern Floor Plates

ASTM A786 is the standard specification for rolled steel oor plates. As oor-plate design is seldom controlled by strength considerations, ASTM A786 "commercial grade" is commonly speci ed. If so, per ASTM A786 Section 5.1.3, "the product will be supplied with 0.33 percent maximum carbon…and without speci ed

Table 2-5



mechanical properties." Alternatively, if a de ned strength



12 Important Tidbits for 2015

1. When in doubt, check it out. Have questions about availability? Call a fabricator or contact the AISC Steel Solutions Center (**solutions@aisc.org**; 866.ASK.AISC). Either one can keep you swimming in available steel. Also visit **www.aisc.org/availability**.
2. Times change. ASTM A992 originally was introduced covering only W-shapes. A later 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 still is not common in shapes other than W-shapes.
3. Round HSS ≠ steel pipe. Know the difference between ASTM A500 and ASTM A53. ASTM A500 is for HSS (F = 46 ksi for Grade C, 42 ksi for Grade B). ASTM A53 is for steel pipe (F = 35 ksi).

ASTM A354 Grade BD is permitted when the size required is outside the range of ASTM A490. These standards are material standards, not bolt standards, so the desired dimensions have to be speci ed as per ANSI ASME B18.2.6 heavy hex class 2A.

Shear Stud Connectors

Shear studs are speci ed as given in AWS D1.1 Clause 7, with material as required in Clause 7.2.6. Type B is usual and the corresponding mechanical requirements are stated in AWS D1.1 Table 7.1 (F_y = 51 ksi, F_u = 65 ksi).

Forged Steel Structural Hardware

Forged steel structural hardware products, such as clevises, turnbuckles, eye nuts and sleeve nuts are occasionally used in building design and construction. These products are generally provided to AISI material speci cations. 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 may be 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

Filler metals permitted for use with prequali ed welding procedure speci cations are shown associated with the base metals for which they are considered "matching" in AWS D1.1 Table 3.1. A tensile strength of 70 is considered matching for base metals up to 70 ksi minimum tensile strength.

OTHER PRODUCTS

Steel Castings and Forgings

Steel castings can be produced in a wide variety of chemical compositions and mechanical properties; most are heat treated. Two standards useful in steel structures are ASTM A216 Grade WCB with Supplementary Requirement S11 and A958A958M Grade SC8620 class 80/50. Steel forgings are speci ed as ASTM A668.

Crane Rails

Crane rails are furnished to ASTM A759, ASTM A1 and/or manufacturer's speci cations and tolerances. Rail is designated by unit weight in units of pounds per yard. Dimensions of common rail are shown in the AISC 14th Edition *Manual* Table 1-21; other rail pro les also exist and may be available.

Most manufacturers chamfer the top and sides of the crane rail head at the ends unless speci ed otherwise to reduce chipping of the running surfaces. Often crane rails are ordered as end-hardened, which improves the crane rail ends' resistance 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 for splice bars in both standard and odd lengths unless stipulated otherwise on the order. ■