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Are You Properly Specifying Materials?
January 14, 2020



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AISC Live Webinars

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AISC Live Webinars

Course Description

Are You Properly Specifying Materials?
January 14, 2020

When you specify materials by referencing ASTM specifications, are you sure that you're making the right choices? With the many ASTM specifications available in steel building construction, it can be a challenge to stay current with standard material production practices. This webinar will review which ASTM specifications are standard in steel building design and construction for structural shapes, plate products, fastening products, and other products. Specify steel materials with confidence on your next job, and reduce RFIs!



AISC Live Webinars

Learning Objectives

- Describe the importance of not over-specifying or under-specifying steel material as related to cost and project success.
- List the preferred material specifications for structural shapes and plate products.
- Describe recent changes in how fasteners are standardized.
- Identify new materials used for HSS and how they differ from past preferred materials.



Are You Properly Specifying Materials?

January 14, 2020



Lawrence F. Kruth, PE
 Vice President of Engineering & Research
 American Institute of Steel Construction
 Chicago, IL



steelwise

ARE YOU PROPERLY SPECIFYING MATERIALS?


BY JONATHAN TAVARES

WE WOULD HOPE THAT your answer to the important question (repeating it in the title of this month's *SteelWise* is a reassuring "Yes!"

We recognize that your answer might be a less confident "Yes," an "I think so," an "I'm not sure," a "Maybe" or even a "Please help!" Wherever you are on the spectrum, rest assured we're here to help clarify any confusion.

As we know, ASTM specifications undergo periodic revisions and new ones come into existence. The design and construction process is simplified greatly through the reference of appropriate ASTM specifications because they allow you to define all the relevant characteristics of a specified product. However, with dozens of ASTM specifications applicable to steel construction alone, it can be a challenge to keep the standard designations used in contracts current.

Here, we'll provide a summary of the most common ASTM specifications used in steel building design and construction, including standards for structural shapes, plate products, fastening products and more. This information is based on similar information in AISC's 15th Edition *Steel Construction Manual*. Another useful AISC publication is *Selected ASTM Standards for Steel Contractors*, which provides a compilation of more than 60 steel-related ASTM standards. Both publications are available at www.aisc.org/publications. ASTM standards typically include a section on ordering requirements listing the variables in each standard that should be specified in a complete order or specification for the material. This is useful for fabricator purchasing departments at local fabrication companies.



Jonathan Tavares
jtavares@aisc.org is a staff engineer in AISC's Steel Solutions Center.

As material specifications change and improve, so too can your steel-framed buildings.

Structural Shapes
Let's start with structural shapes, which are summarized in Table 2-4.

W-Shapes. The preferred material specification for W-shapes is ASTM A992 ($F_y = 50$ ksi, $F_u = 65$ ksi). The availability and cost-effectiveness of W-shapes in grades other than ASTM A992 should be confirmed prior to their specification. W-shapes of limited sizes with higher yield and tensile strength can be obtained by specifying ASTM A529 Grade 55, ASTM A572 Grades 55, 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. These and other material specifications applicable to W-shapes are shown in Table 2-4.

M-Shapes and S-Shapes. The preferred material specification for these shapes is in transition. ASTM A36 ($F_y = 36$ ksi, $F_u = 58$ ksi) is now only slightly more common than 50-ksi grades like ASTM A529 Grade 50, ASTM A572 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 those listed should be confirmed prior to their specification. M-shapes and S-shapes with a higher yield and tensile strength can be obtained by specifying ASTM A529 Grade 55, ASTM A572 Grades 55, 60 and 65 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 specifications applicable to M-shapes and S-shapes are shown in Table 2-4.

Channels. The preceding comments for M-shapes and S-shapes apply equally to channels. However, note that channels are more commonly available as ASTM A992 ($F_y = 50$ ksi, $F_u = 65$ ksi). Be sure to confirm material availability with your fabricator.

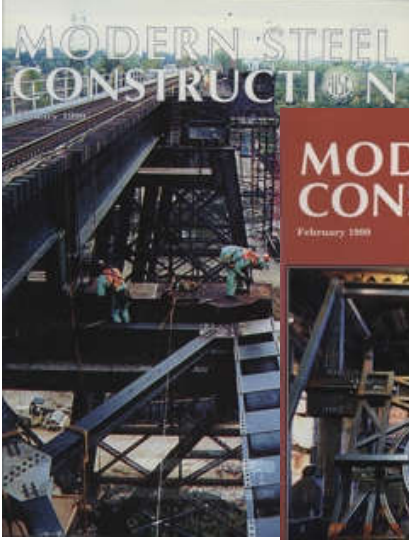
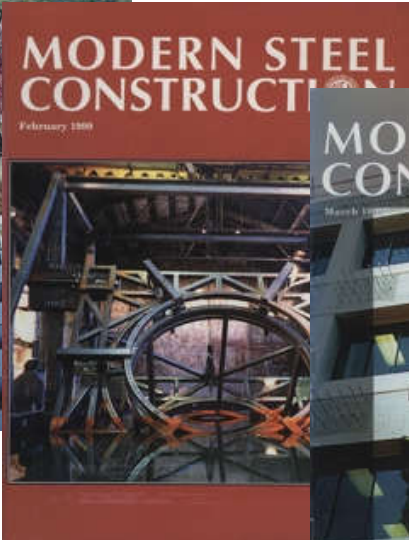
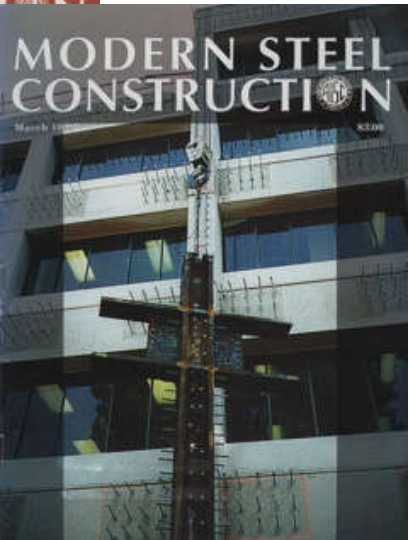
HIP-Shapes. The preferred material specification for HIP shapes is ASTM A572 Grade 50 ($F_y = 50$ ksi, $F_u = 65$ ksi); the availability and cost effectiveness of other grades should be confirmed prior to specification. HIP-shapes with atmospheric corrosion resistance (weathering characteristics) can be obtained by specifying ASTM A588 Grade 50. These and other material specifications applicable to HIP-shapes are shown in Table 2-4.


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

Modern Steel Construction

April 2018

9

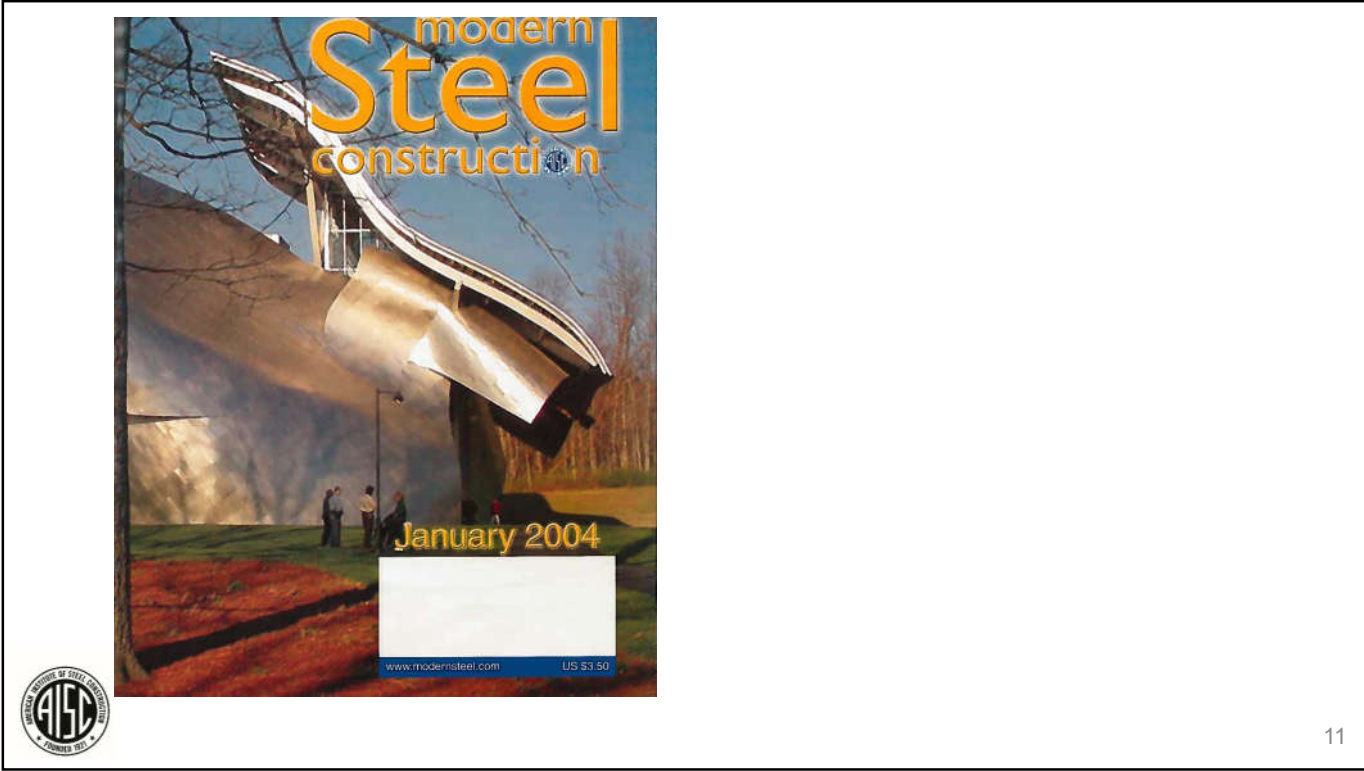






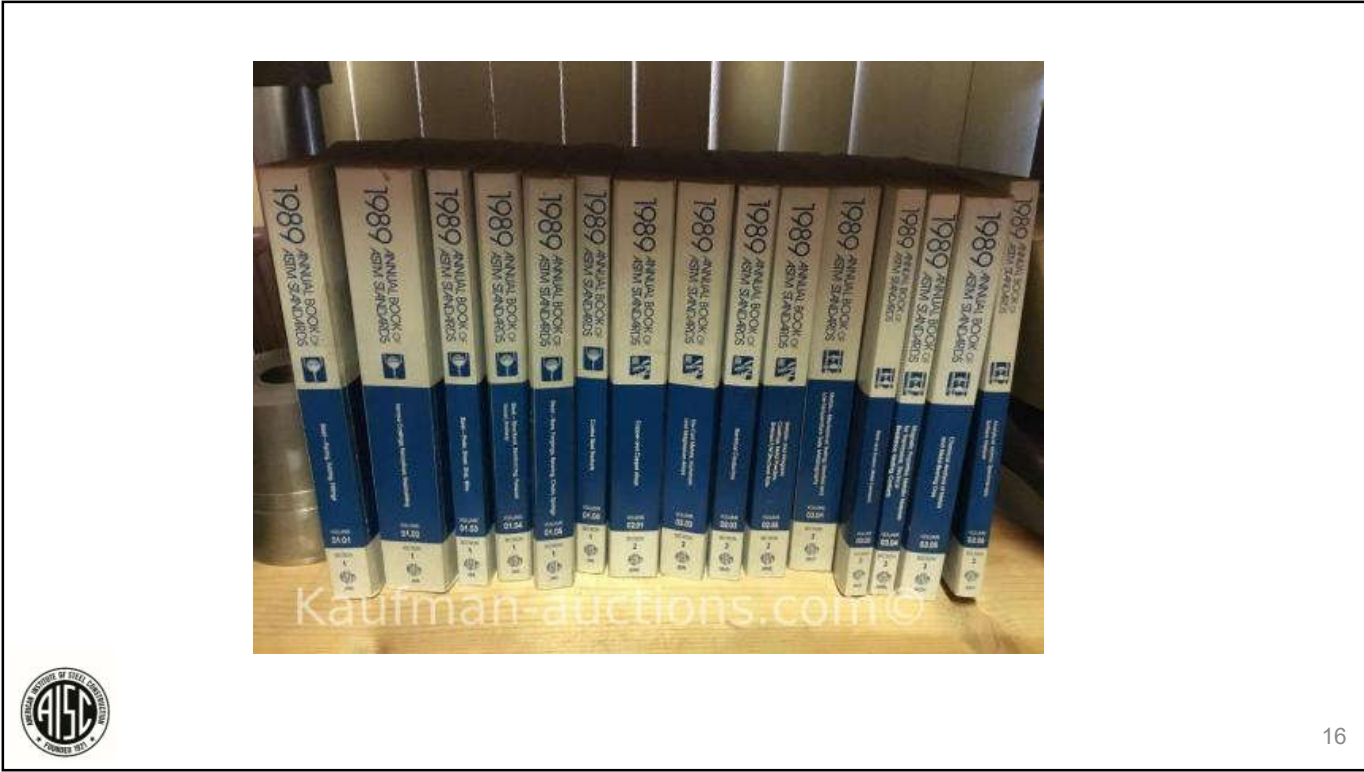
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10











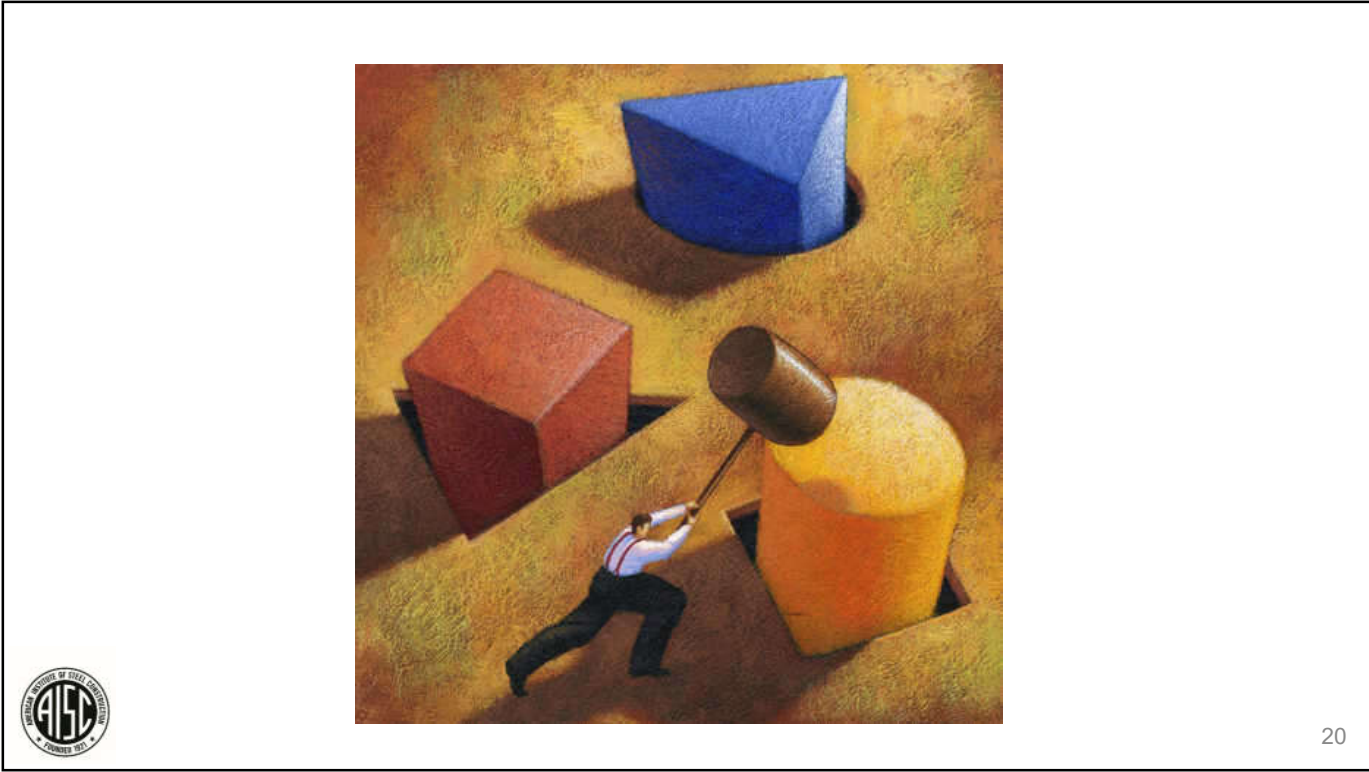
ASTM Standards Get You:

- Ordering requirements
- Mechanical requirements (F_y , F_u , and elongation)
- Chemical composition requirements
- Process requirements
- Testing requirements
- Tolerances for cross-section, curvature, etc.
- Provisions for repair of defects
- Reporting requirements



18





ANSI/AISC 360-16
An American National Standard

**Specification
for Structural Steel Buildings**

July 7, 2016

Supersedes the *Specification for Structural Steel Buildings*
dated June 22, 2010 and all previous versions of this specification

Approved by the AISC Committee on Specifications

AMERICAN INSTITUTE OF STEEL CONSTRUCTION
130 East Randolph Street, Suite 2000
Chicago, Illinois 60601-6204

ANSI/AISC 341-16
An American National Standard


**Seismic Provisions
for Structural Steel Buildings**

July 12, 2016

Supersedes the *Seismic Provisions for Structural Steel Buildings*
dated June 22, 2010, and all previous versions

Approved by the AISC Committee on Specifications

AMERICAN INSTITUTE OF STEEL CONSTRUCTION
130 East Randolph Street, Suite 2000
Chicago, Illinois 60601-6204



21


A3. MATERIAL

1. Structural Steel Materials

Material test reports or reports of tests made by the fabricator or a testing laboratory shall constitute sufficient evidence of conformity with one of the ASTM standards listed in Section A3.1a. For hot-rolled structural shapes, plates, and bars, such tests shall be made in accordance with ASTM A6/A6M; for sheets, such tests shall be made in accordance with ASTM A568/A568M; for tubing and pipe, such tests shall be made in accordance with the requirements of the applicable ASTM standards listed above for those product forms.

1a. ASTM Designations

Structural steel material conforming to one of the following ASTM specifications is approved for use under this Specification:



22



- (a) Hot-rolled structural shapes
 - ASTM A36/A36M
 - ASTM A529/A529M
 - ASTM A572/A572M
 - ASTM A588/A588M
 - (b) Hollow structural sections (HSS)
 - ASTM A53/A53M Grade B
 - ASTM A500/A500M
 - ASTM A501/A501M
 - ASTM A618/A618M
 - (c) Plates
 - ASTM A36/A36M
 - ASTM A242/A242M
 - ASTM A283/A283M
 - ASTM A514/A514M
 - ASTM A529/A529M
 - (d) Bars
 - ASTM A36/A36M
 - ASTM A529/A529M
 - (e) Sheets
 - ASTM A606/A606M
 - ASTM A1011/A1011M SS, HSLAS, AND HSLAS-F
- | |
|-------------------|
| ASTM A709/A709M |
| ASTM A913/A913M |
| ASTM A992/ A992M |
| ASTM A1043/A1043M |
| ASTM A847/A847M |
| ASTM A1065/A1065M |
| ASTM A1085/A1085M |
| ASTM A572/A572M |
| ASTM A588/A588M |
| ASTM A709/A709M |
| ASTM A1043/A1043M |
| ASTM A1066/A1066M |
| ASTM A572/A572M |
| ASTM A709/A709M |




ANSI/AISC 303-16
An American National Standard

**Code of Standard Practice
for Steel Buildings
and Bridges**

June 15, 2016

Supersedes the *Code of Standard Practice for Steel Buildings and Bridges*
dated April 14, 2010 and all previous versions

Approved by the Committee on the Code of Standard Practice


AMERICAN INSTITUTE OF STEEL CONSTRUCTION
130 East Randolph Street, Suite 2000, Chicago, Illinois 60601
www.aisc.org



Code of Standard Practice Section 6.1.1 Excerpt:
Unless an alternative system is established in the *fabricator's*
written procedures, shop-standard material shall be as
follows:

| Material | Shop-standard material grade |
|-----------------|-------------------------------------|
| W and WT | ASTM A992 |
| M, S, MT and ST | ASTM A36 |
| HP | ASTM A572 grade 50 |
| L | ASTM A36 |
| C and MC | ASTM A36 |
| HSS | ASTM A500 grade C |
| Steel Pipe | ASTM A53 grade B |
| Plates and Bars | ASTM A36 |



25

| Material | Shop-standard material grade |
|-----------------|-------------------------------------|
| W and WT | ASTM A992 |
| M, S, MT and ST | ASTM A36 |
| HP | ASTM A572 grade 50 |
| L | ASTM A36 |
| C and MC | ASTM A36 |
| HSS | ASTM A500 grade C |
| Steel Pipe | ASTM A53 grade B |
| Plates and Bars | ASTM A36 |



26



Material

W and WT

M, S, MT and ST

HP

L

C and MC

HSS

Steel Pipe

Plates and Bars

Shop-standard material grade

ASTM A992

ASTM A36

ASTM A572 grade 50

ASTM A36

ASTM A36

ASTM A500 grade C


ASTM A53 grade B

ASTM A36



**Table 2-4
Applicable ASTM Specifications
for Various Structural Shapes**


| Steel Type | ASTM Designation | F _y Yield Stress ^a (ksi) | F _u Tensile Stress ^a (ksi) | Applicable Shape Series | | | | | | | | | | | |
|---------------------|-------------------------|--|--|-------------------------|----|---|----|---|----|---|-------|-------|------|---|--|
| | | | | W | M | S | HP | C | MC | L | HSS | | | | |
| | | | | | | | | | | | Rect. | 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 | Gr. A | 36 | 58 | | | | | | | | | ■ | | |
| | | Gr. B | 50 | 70 | | | | | | | | | ■ | | |
| | A529 ^c | Gr. 50 | 50 | 65-100 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| | | Gr. 55 | 55 | 70-100 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| | A709 | 36 | 58-80 ^b | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| | A1043 ^{d1} | 36 | 36-52 | 58 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| | | 50 | 50-65 | 65 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| | A1065 | Gr. A | 50 | 65 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| | High-Strength Low-Alloy | A572 | Gr. 42 | 42 | 60 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Gr. 50 | | | 50 | 65 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| Gr. 55 | | | 55 | 70 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| Gr. 60 ^e | | | 60 | 75 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| A618 ^f | | Gr. 65 ^e | 65 | 80 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| | | Gr. 80 ^e , 85 & 100 | 80 ^g | 100 ^g | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| A709 | | Gr. III | 50 | 65 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| | | 50 | 50 | 65 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| | | 50S | 50-65 | 65 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| | | 50W | 50 | 70 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| | 50 | 50 ^h | 65 ^h | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | |



29

**Table 2-4
Applicable ASTM Specifications
for Various Structural Shapes**

| Steel Type | ASTM Designation | F _y Yield Stress ^a (ksi) | F _u Tensile Stress ^a (ksi) | Applicable Shape Series | | | | | | | | | | | |
|------------|-------------------|--|--|-------------------------|---|---|----|---|----|---|-------|-------|------|---|--|
| | | | | W | M | S | HP | C | MC | L | HSS | | | | |
| | | | | | | | | | | | Rect. | 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 | Gr. A | 36 | 58 | | | | | | | | | ■ | | |
| | | Gr. B | 50 | 70 | | | | | | | | | ■ | | |
| | A529 ^c | Gr. 50 | 50 | 65-100 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |



30



**Table 2-5
Applicable ASTM Specifications
for Plates and Bars**

| Steel Type | ASTM Designation | F _y Yield Stress ^a (ksi) | F _u Tensile Stress ^a (ksi) | Plates and Bars, in. | | | | | | | | | | | |
|-------------------------|-------------------|--|--|----------------------|-------------------------|------------------------|---------------------|---------------------|---------------------|-------------------|-------------------|-------------------|--------|--|--|
| | | | | to 0.75 incl. | over 0.75 to 1.25 incl. | over 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 | | | | | | | | | | | | |
| | A283 ^b | Gr. C | 30 | 55-75 | | | | | d | | | | | | |
| | | Gr. D | 33 | 60-80 | | | | | d | | | | | | |
| | A529 | Gr. 50 | 50 | 65-100 | | b | b | b | b | b | | | | | |
| | | Gr. 55 | 55 | 70-100 | | c | c | c | c | c | | | | | |
| A709 | Gr. 36 | 36 | 58-80 | | | | | | | | | | | | |
| 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 | | | | | | | | | | | |
| | A709 | Gr. 50 | 50 | 65 | | | | | | | | | | | |
| | A709 | Gr. 36 | 36-52 | 58 | | | | | | | | | | | |



**Table 2-6
Applicable ASTM Specifications for
Various Types of Structural Fasteners**

| ASTM Designation | F _y Min. Yield Stress (ksi) | F _u Tensile Stress ^a (ksi) | Diameter Range (in.) | Bolts | | | Nuts | Washers | | | Anchor Rods | | | | |
|------------------|--|--|------------------------|--------------|---------------|--------------------------------|------|--------------|----------|-------|--------------------------|---------------|--------|--------|-------------------|
| | | | | Conventional | High-Strength | Twist-Off-Type Tension-Control | | Common Bolts | Hardened | Plain | Direct-Tension Indicator | Threaded Rods | Hooked | Headed | Threaded & Nutted |
| | | | | | | | | | | | | | | | |
| F3125 | Gr. A325 ^d | — | 120 | 0.5 to 1.5 | | | | | | | | | | | |
| | Gr. F1852 ^d | — | 120 | 0.5 to 1.25 | | | | | | | | | | | |
| | Gr. A490 ^d | — | 150 | 0.5 to 1.5 | | | | | | | | | | | |
| | Gr. F2280 ^d | — | 150 | 0.5 to 1.25 | | | | | | | | | | | |
| F3111 | — | 200 | 1 to 1.25 incl. | | | | | | | | | | | | |
| F3043 | — | 200 | 1 to 1.25 incl. | | | | | | | | | | | | |
| A194 Gr. 2H | — | — | 0.25 to 4 | | | | | | | | | | | | |
| A563 | — | — | 0.25 to 4 | | | | | | | | | | | | |
| F436 | — | — | 0.25 to 4 ^b | | | | | | | | | | | | |
| F844 | — | — | any | | | | | | | | | | | | |
| F959 | — | — | 0.5 to 1.5 | | | | | | | | | | | | |
| A36 | 36 | 58-80 | to 10 | | | | | | | | | | | | |
| | 105 | 125 | 2.5 and under | | | | | | | | | | | | |
| | 95 | 115 | over 2.5 to 4 | | | | | | | | | | | | |
| A193 Gr. B7 | 75 | 100 | over 4 to 7 | | | | | | | | | | | | |
| | A307 Gr. A | — | 60 | 0.25 to 4 | | | | | | | | | | | |
| Gr. BC | 109 | 125 | 0.25 to 2.5 incl. | | | | | | | | | | | | |
| | 99 | 115 | over 2.5 to 4 incl. | | | | | | | | | | | | |





ARE YOU PROPERLY SPECIFYING MATERIALS?

BY JONATHAN TAVAREZ

As material specifications change and improve, so too can your steel-framed buildings.



WE WOULD HOPE THAT your answer to the important question (rewording as the title of this month's SteelWise is a rousing "Yes!"

We recognize that your answer might be a less confident "Yes" or "I think so," an "I'm not sure," a "Maybe" or even a "Please help!" Whenever you are on the spec, not around we're here to help clarify any confusion.

As we know, ASTM specifications undergo periodic revisions and new ones come into existence. The design and construction process is simplified greatly through the reference of appropriate ASTM specifications because they allow you to define all the relevant characteristics of a specified product. However, with dozens of ASTM specifications applicable to steel construction alone, it can be a challenge to keep the standard designations used in contracts current.

Here, we'll provide a summary of the most common ASTM specifications used in steel building design and construction, including standards for structural shapes, plate products, fastening products and more. This information is based on similar information in AISC's 15th Edition *Steel Construction Manual*. Another useful AISC publication is *Selected ASTM Standards for Steel Construction*, which provides a compilation of more than 60 steel-related ASTM standards. Both publications are available at www.aisc.org/publications. ASTM standards typically include a section on ordering requirements listing the variables in each standard that should be specified in a complete order or specification for the material. This is routine for fabricator purchasing departments at local fabrication companies.



Jonathan Tavarez
Executive Director
Steel Solutions Center

Structural Shapes

Let's start with structural shapes, which are summarized in Table 2-4.

W-Shapes. The preferred material specification for W-shapes is ASTM A992 ($F_y = 50 \text{ ksi}$, $F_u = 65 \text{ ksi}$). The availability and cost-effectiveness of W-shapes in grades other than ASTM A992 should be confirmed prior to their specification. W-shapes of limited sizes with higher yield and tensile strength can be obtained by specifying ASTM A242 Grade 50, ASTM A572 Grades 50, 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. These and other material specifications applicable to W-shapes are shown in Table 2-4.

M-Shapes and S-Shapes. The preferred material specification for these shapes is in transition. ASTM A36 ($F_y = 36 \text{ ksi}$, $F_u = 58 \text{ ksi}$) is now only slightly more common than 50-ksi grades like ASTM A242 Grade 50, ASTM A572 Grade 50, or ASTM A992; each of these 50-ksi grades has $F_y = 50 \text{ ksi}$ and $F_u = 65 \text{ ksi}$ for these shapes. The availability and cost-effectiveness of M-shapes and S-shapes in grades other than those listed should be confirmed prior to their specification. M-shapes and S-shapes with a higher yield and tensile strength can be obtained by specifying ASTM A242 Grade 50, ASTM A572 Grades 50, 60 and 65 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 specifications applicable to M-shapes and S-shapes are shown in Table 2-4.

Channels. The preceding comments for M-shapes and S-shapes apply equally to channels. However, note that channels are now most commonly available as ASTM A992 ($F_y = 50 \text{ ksi}$, $F_u = 65 \text{ ksi}$). Be sure to confirm material availability with your fabricator.

HIP-Shapes. The preferred material specification for HIP-shapes is ASTM A572 Grade 50 ($F_y = 50 \text{ ksi}$, $F_u = 65 \text{ ksi}$); the availability and cost effectiveness of other grades should be confirmed prior to specification. HIP-shapes with atmospheric corrosion resistance (weathering characteristics) can be obtained by specifying ASTM A588 Grade 50. These and other material specifications applicable to HIP-shapes are shown in Table 2-4. Angles. The preceding comments for M-shapes and S-shapes apply equally to angles.

33



34





W-Shapes

ASTM A992

$$F_y = 50 \text{ ksi}$$

$$F_u = 65 \text{ ksi}$$



35



W-Shapes

Atmospheric

Corrosion

Resistance

ASTM A588

$$F_y = 50 \text{ ksi}$$

$$F_u = 70 \text{ ksi}$$



36



W-Shapes ASTM A913

37



W-Shapes ASTM A913 Grade 50 Grade 65 Grade 70

38



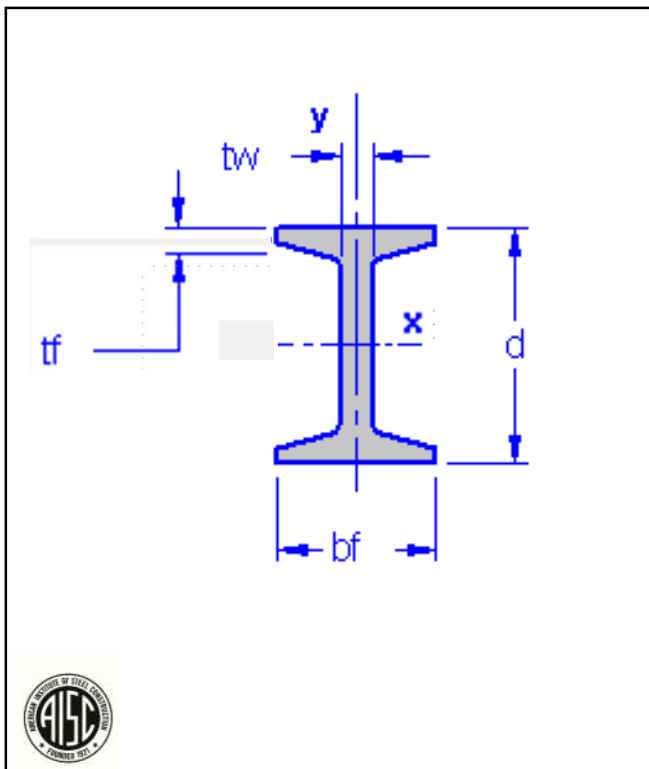


W-Shapes

ASTM A913

| | |
|---------------|--------------|
| W44 x 230-335 | W18 x 35-311 |
| W40 x 149-655 | W16 x 26-100 |
| W36 x 135-925 | W14 x 22-873 |
| W30 x 90-391 | W12 x 14-336 |
| W27 x 84-539 | W10 x 12-112 |
| W21 x 44-275 | W8 x 10-67 |

39



S-Shapes

ASTM A36

$F_y = 36$ ksi

$F_u = 58$ ksi

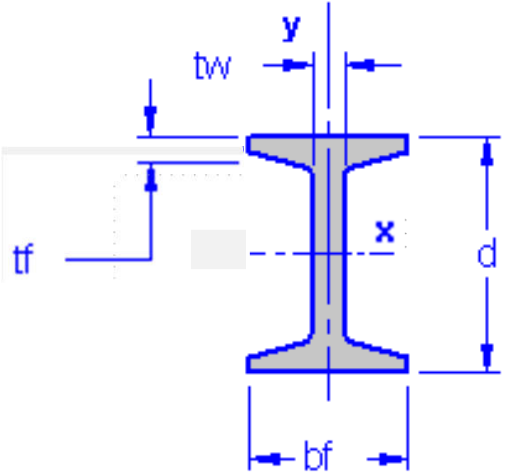
-or-

ASTM A***


$F_y = 50$ ksi

$F_u = 65$ ksi

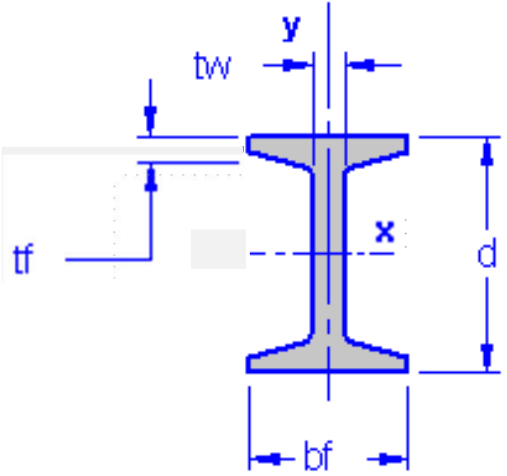
40



S-Shapes
ASTM A36
 $F_y = 36$ ksi
 $F_u = 58$ ksi
-or-
ASTM A***
A572 Grade 50
A529 Grade 50
or A992




41



S-Shapes
Atmospheric
Corrosion
Resistance

ASTM A588
 $F_y = 50$ ksi
 $F_u = 70$ ksi



42



Channels

C-Shapes and
MC-Shapes



Channels

Same as
S-Shapes



MC 12 x 14.3 Stringer Channel



45



Angles Same as S-Shapes



46



Photo courtesy of ArcelorMittal



Angles

Large Leg Angles

- L12×12×1³/₈
- L12×12×1¹/₄
- L12×12×1¹/₈
- L12×12×1

- L10×10×1³/₈
- L10×10×1¹/₄
- L10×10×1¹/₈
- L10×10×1
- L10×10×7⁸/₁₆
- L10×10×3⁴/₁₆



Tees

WT → W-Shapes



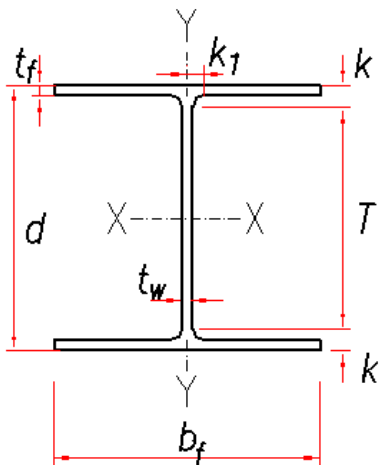


Tees

WT → W-Shapes
ST → S-Shapes



49



HP-Shapes

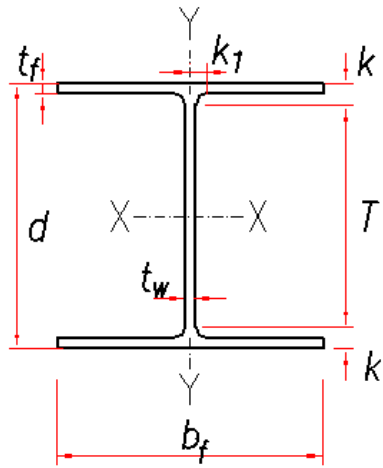
Bearing Piles



50



HP-Shapes



ASTM A572 Grade 50

$F_y = 50$ ksi

$F_u = 65$ ksi



51

HP-Shapes



ASTM A572 Grade 50

$F_y = 50$ ksi

$F_u = 65$ ksi



52





HSS



53



HSS (Rect.)

~~ASTM A500~~

~~Grade B~~

~~$F_y = 46$ ksi~~

~~$F_u = 58$ ksi~~



54



HSS (Rect.)

ASTM A500

Grade C

$F_y = 50$ ksi

$F_u = 62$ ksi



55



HSS (Round)

ASTM A500

Grade C

$F_y = 46$ ksi

$F_u = 62$ ksi



56



HSS

Atmospheric
Corrosion
Resistance
ASTM A847



57



HSS

ASTM A1085
 $F_y = 50$ ksi
 $F_u = 65$ ksi



58





HSS

ASTM A1085

No more $0.93t$

59



HSS

ASTM A1085

No more $0.93t$

$F_{y\ max} = 70\ \text{ksi}$

60



HSS

ASTM A1085

No more 0.93t

$F_{y\ max} = 70\ \text{ksi}$

CVN 25 ft-lb @ 40°F

61

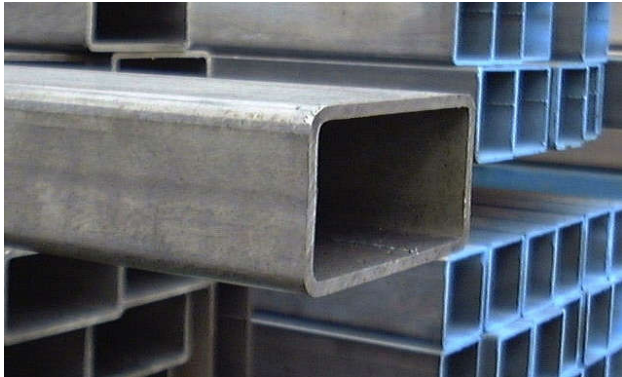


HSS

ASTM A1085

Ask your local
Fabricator

62



HSS

ASTM A500 and
ASTM A1085
Now available in
larger sizes up to 88
inch periphery and
7/8 inch wall
thickness.



63



Steel Pipe

ASTM A53 Grade B

$$F_y = 35 \text{ ksi}$$

$$F_u = 60 \text{ ksi}$$



64

Round HSS ≠ Steel Pipe



Round HSS ≠ Steel Pipe
A500 Grade C A53 Grade B



Round HSS ≠ Steel Pipe
A500 Grade C A53 Grade B
 $F_y = 46$ ksi $F_y = 35$ ksi



67

Round HSS ≠ Steel Pipe
A500 Grade C A53 Grade B
 $F_y = 46$ ksi $F_y = 35$ ksi
HSS6.625x0.280 Pipe 6 Std.



68



Round HSS ≠ Steel Pipe

| | |
|----------------|----------------|
| A500 Grade C | A53 Grade B |
| $F_y = 46$ ksi | $F_y = 35$ ksi |
| HSS6.625x0.280 | Pipe 6 Std. |

But there are similarities ...

The two designations shown have the same physical cross section.



69

Round HSS ≠ Steel Pipe

| | |
|----------------|----------------|
| A500 Grade C | A53 Grade B |
| $F_y = 46$ ksi | $F_y = 35$ ksi |
| HSS6.625x0.280 | Pipe 6 Std. |



But there are similarities ...

The two designations shown have the same physical cross section.



70



| | | |
|-------------------------|----------|--------------------------|
| <u>Round HSS</u> | ≠ | <u>Steel Pipe</u> |
| A500 Grade C | | A53 Grade B |
| $F_y = 46$ ksi | | $F_y = 35$ ksi |
| HSS6.625x0.280 | | Pipe 6 Std. |



Because A53 is Pipe,
Hydrostatic Testing is required
This is an added cost to A53



71

Plates




Bars




72






Plates & Bars

ASTM A36
 $F_y = 36$ ksi
 $F_u = 58$ ksi
-or-
ASTM A572 Grade 50
 $F_y = 50$ ksi
 $F_u = 65$ ksi




73



Plates & Bars

ASTM A36
 $F_y = 36$ ksi *
 $F_u = 58$ ksi
-or-
ASTM A572 Grade 50
 $F_y = 50$ ksi **
 $F_u = 65$ ksi



74

Plates & Bars

Atmospheric
Corrosion
Resistance

ASTM A588

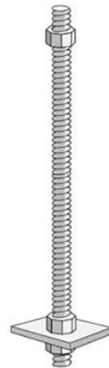
$F_y = 50$ ksi

$F_u = 70$ ksi



75

Fasteners



76

Fasteners

**Table 2-6
Applicable ASTM Specifications for
Various Types of Structural Fasteners**

| ASTM Designation | F_y Min. Yield Stress (ksi) | F_u Tensile Stress* (ksi) | Diameter Range (in.) | Bolts | | | Nuts | Washers | | | Anchor Rods | | | | | |
|------------------|----------------------------------|--------------------------------|------------------------|---------------|--------------|--------------------------------|------|--------------|----------|-------|--------------------------|---------------|--------|--------|-------------------|--|
| | | | | High-Strength | Conventional | Twist-Off-Type Tension-Control | | Common Bolts | Hardened | Plain | Direct-Tension Indicator | Threaded Rods | Hooked | Headed | Threaded & NUTTED | |
| F3122 | Gr. A325 ^d | — | 120 | 0.5 to 1.5 | ■ | | | | | | | | | | | |
| | Gr. F1852 ^d | — | 120 | 0.5 to 1.25 | | ■ | | | | | | | | | | |
| | Gr. A490 ^d | — | 150 | 0.5 to 1.5 | ■ | | | | | | | | | | | |
| | Gr. F2280 ^d | — | 150 | 0.5 to 1.25 | | ■ | | | | | | | | | | |
| F3111 | — | 200 | 1 to 1.25 incl. | ■ | | | | | | | | | | | | |
| F3043 | — | 200 | 1 to 1.25 incl. | ■ | | | | | | | | | | | | |
| A194 Gr. 2H | — | — | 0.25 to 4 | | | | ■ | | | | | | | | | |
| A563 | — | — | 0.25 to 4 | | | | ■ | | | | | | | | | |
| F436 | — | — | 0.25 to 4 ^b | | | | ■ | | | | | | | | | |
| F844 | — | — | any | | | | ■ | | | | | | | | | |
| F959 | — | — | 0.5 to 1.5 | | | | ■ | | | | | | | | | |
| A36 | 36 | 58-80 | to 10 | | | | | | | | | | | | | |
| A193 Gr. B7 | 105 | 125 | 2.5 and under | | | | | | | | | | | | | |
| | 95 | 115 | over 2.5 to 4 | | | | | | | | | | | | | |
| | 75 | 100 | over 4 to 7 | | | | | | | | | | | | | |
| A307 Gr. A | — | 60 | 0.25 to 4 | | | | ■ | | | | | | | | | |



77

High Strength Bolts Old



ASTM A325
ASTM A490



ASTM F1852
ASTM F2280



78



High Strength Bolts

New

ASTM F3125



Grade A325
Grade A490

Grade F1852
Grade F2280



79

High Strength Bolts

ASTM F3111

ASTM F3043



200 ksi Bolts

Not available in the US at this time



80



High Strength Bolts

ASTM F3148



TNA Bolt
Torque + Angle



High Strength Bolts

Grade A325 – 120ksi

Grade A490 – 150 ksi



TNA Bolt
Torque + Angle

ASTM F3148 – 144KSI



83

High Strength Bolts

ASTM F3148



Installation Method

1. Snug Tighten
2. Set Degree of Rotation (90° or 120°)



84

Other Fastener Products



ASTM A563 NUTS



ASTM F436 WASHERS



ASTM A959 DTI WASHERS



85

Other Fastener Products

Anchor Rods



F1554 Grade 36

F1554 Grade 55

F1554 Grade 105



86

Other Fastener Products

Anchor Rod Washers



**Table 14-2
Recommended Sizes for Washers and
Anchor Rod Holes in Base Plates**

| Anchor Rod Diameter | Hole Diameter | Washer Size | Min. Washer Thickness | Anchor Rod Diameter | Hole Diameter | Washer Size | Min. Washer Thickness |
|---------------------|---------------|-------------|-----------------------|---------------------|---------------|-------------|-----------------------|
| in. | in. | in. | in. | in. | in. | in. | in. |
| 3/4 | 1 5/16 | 2 | 1/4 | 1 1/2 | 2 3/8 | 4 | 1/2 |
| 7/8 | 1 9/16 | 2 1/2 | 5/16 | 1 3/4 | 2 7/8 | 4 1/2 | 5/8 |
| 1 | 1 7/8 | 3 | 3/8 | 2 | 3 1/4 | 5 | 3/4 |
| 1 1/4 | 2 1/8 | 3 1/2 | 1/2 | 2 1/2 | 3 3/4 | 5 1/2 | 7/8 |

Notes: 1. Hole sizes provided are based on anchor rod size and correlate with ACI 117 (ACI, 2010).
2. Circular or square washers meeting the washer size are acceptable.
3. Clearance must be considered when choosing an appropriate anchor rod hole location, noting effects such as the position of the rod in the hole with respect to the column, weld size, and other interferences.
4. ASTM F844 washers are permitted instead of plate washers when hole clearances are limited to 5/16 in. for rod diameters up to 1 in., 1/2 in. for rod diameters over 1 in. up to 2 in., and 1 in. for rod diameters over 2 in. This exception should not be used unless the general contractor has agreed to meet smaller tolerances for anchor rod placement than those permitted in ACI 117.



87

Welds

Filler Metals - $F_{EXX} = 70$ ksi

AWS A5.36

Supersedes A5.20 & A5.29



88



Other Things in the Article

- Raised Pattern Floor Plates – ASTM A786
- Crane Rails – ASTM A759
- Shear Studs – AWS D1.1 Clause 7.2.6 Type B
- Threaded Rods – A36, A193, A354, A449, A572
- Castings and Forgings – ASTM A27, A958, A668



89

Bridges

- ASTM A709
 - ASTM A36, A572, A992, A588 and three high-performance steel (HPS) grades
 - The HPS grades are available in plate form only.
 - Grades 50S and 50W are available in shapes. 50CR available in plates.
 - The other grades are available in plates form and as shapes.
- Toughness levels for three exposures and two uses.
- Acceptable for use where the corresponding parent standard is specified.



90





Steel Construction Manual Fifteenth Edition

Connection Material 36 ksi



Steel Construction Manual ➔ Sixteenth Edition

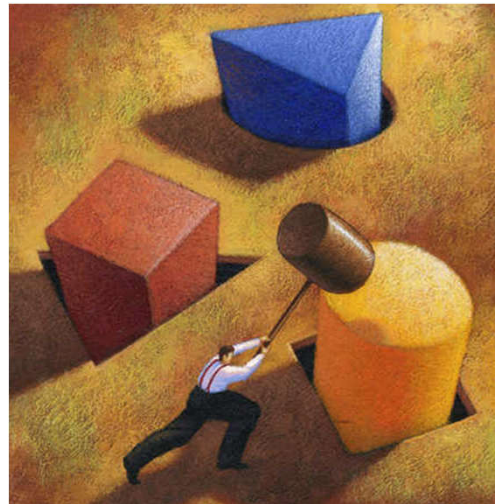
Connection Material

~~36 ksi~~

50 ksi




93




94





Right = Happy



97



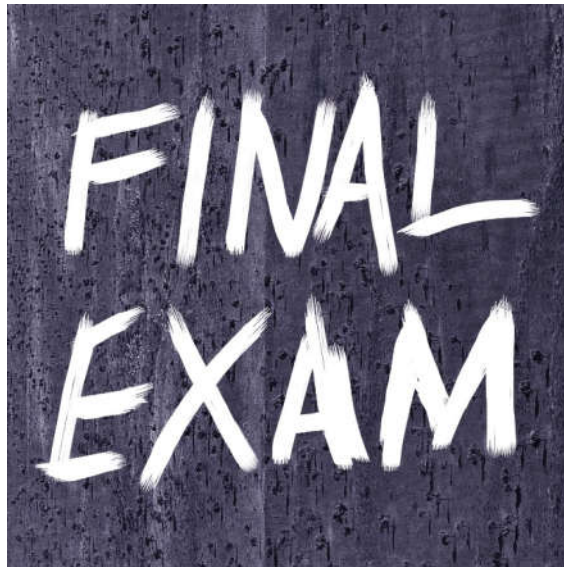
Right = Happy

NO RFI's!!



98





FINAL
EXAM

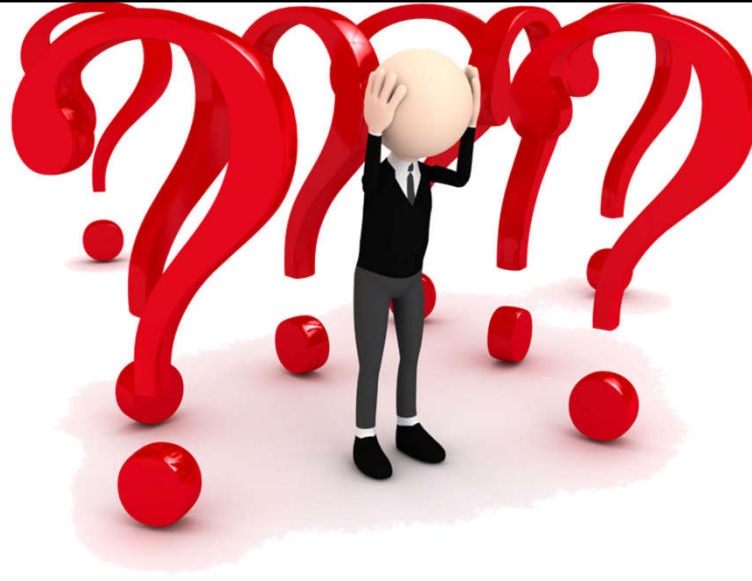


Final Exam

Where can you find the preferred material for all structural steel material?

- a. AISC Steel Construction Manual
- b. ASTM Book of Standards
- c. AISC Selected ASTM Standards for Steel Fabrication
- d. Modern Steel Construction





AISC | Questions?



CEU / PDH Certificates

- You will receive an email on how to report attendance from: registration@aisc.org.
- Be on the lookout: Check your spam filter! Check your junk folder!
- Completely fill out online form. Don't forget to check the boxes next to each attendee's name!



CEU / PDH Certificates

- Reporting site (URL will be provided in the forthcoming email).
- Username: Same as AISC website username.
- Password: Same as AISC website password.



AISC | Thank you

