IF YOU'VE EVER ASKED YOURSELF "WHY?" about something related to structural steel design or construction, *Modern Steel Construction*'s monthly Steel Interchange column is for you!

1945 Steel

We have a large manufacturing building that was designed in 1945 and built in 1946. Is it true that A7 steel with a yield stress of 33 ksi was used at this time and until 1964? Is it acceptable to use current design methods for allowable bending, tension, and compression using 33 ksi for the steel yield strength? The "Historical Record, Dimensions and Properties—Rolled Shapes" published by AISC and edited by Herbert Ferris references the 1936 AISC specification and states the allowable basic working stress to be 20 ksi. This appears to come from 0.6 F_y (assuming 33 ksi steel). Does this mean F_b = 0.66 F_y could not be used if applicable? We have a copy of the AISC fifth edition specification published in 1947. Were the unit stresses shown in Part III of the specification the same in the fourth edition, which we are assuming was used until 1947?

Question sent to AISC's Steel Solution Center

ASTM A7 was the primary steel used in building construction and referenced by the AISC specification from the time it was consolidated with the bridge standard in 1939 as ASTM A7. In 1960, *Supplementary Provisions Governing Use of ASTM A36 Steel* was recognized by the AISC specification in addition to ASTM A7. Soon after that, A36 became the prime structural steel used in buildings, until recently when ASTM A992 was introduced. ASTM A7 was listed as one-half the tensile strength with a minimum yield stress of 33 ksi during the 1940s. Yes, the basic working stress was listed at 20 ksi based on $0.6F_y$. The F_b of $0.66F_y$ was added in the later ASD specifications for laterally supported compact shapes having an axis of symmetry in the plane of bending.

The steel does not know which specification it was designed under. The available strength of members and connections are permitted to be determined based on present specifications.

It is preferable to use more current design methods when assessing existing structures. In addition to the basic design provision, Appendix 5 of the current AISC *Specification for Structural Steel Buildings* (a free download at **www.aisc.org/2005spec**) provides guidance on evaluation of existing structures. You may also want to reference *Design Guide 15: AISC Rehabilitation and Retrofit Guide—A Reference for Historic Shapes and Specifications*. It is an update of the Ferris book you referenced in your question. This guide is available for AISC members to download free at **www.aisc.org/epubs** or can be purchased from **www.aisc.org/bookstore**.

Kurt Gustafson, S.E., P.E.
American Institute of Steel Construction

No More Group Numbers?

In the ninth edition ASD manual there is a table on page 1-8, Table 2. In the LRFD third edition, the table is found on page 2-27, Table 2-4. Can you please tell me where this table is found in the new 13th edition AISC manual?

Question sent to AISC's Steel Solution Center

This table no longer exists because group numbers were removed from ASTM A6. Accordingly, we have followed their lead and removed them from the *Manual* and the *Specification*. ASTM now uses flange thickness to categorize shapes as heavy, and a flange thickness in excess of 2" is considered heavy.

The reason for the ASTM A6 elimination of group numbers has to do with the representative accuracy of the tensile specimens. It was found that taking tensile specimens from the flanges of a shape is a much better indicator of material strength than using the web.

Sergio Zoruba, Ph.D., P.E.
American Institute of Steel Construction

Thermal Cutting

Is it now permissible to use plasma or flame cutting methods to make bolt holes?

Question sent to AISC's Steel Solution Center

Although previous specifications limited the methods that can be used, the 2005 AISC specification, Section M2.5, allows the use of any hole-making method that results in a surface roughness not exceeding 1,000 microinches. Most methods can be used to achieve this, including punching, drilling, and thermal cutting with flame and plasma equipment.

Charlie Carter, S.E., P.E.
American Institute of Steel Construction

Fireproofing HSS Beams

While there may be some structural advantages with HSS, there seems to be growing concern in the industry with fireproofing HSS when they are used as structural beams. Is spray-applied fireproofing a suitable method for protecting HSS beams? There do not appear to be any UL designs for fire protecting HSS beams. Can you address this common issue?

Question sent to AISC's Steel Solution Center

The Solutions Center contacted Farid Alfawakhiri of the American Iron and Steel Institute for his expert opinion on the subject. His response is as follows:

HSS beams are rare in construction; therefore, there is no incentive for producers of fire resistive materials to maintain UL designs for HSS beams. Historically, there was no testing of HSS beams for fire resistance because of the limited commercial application. The common practice for HSS beam protection is to use column designs. This approach is overly conservative and not very cost-effective, but that is generally accepted for the limited use of HSS beams.

The conservatism of column designs for beam use follows from the ASTM E119 test procedures and acceptance criteria that are more severe for columns than for beams. In ASTM E119 tests, column specimens are exposed to fire from four sides, and the limiting average temperature for steel is 1,000 °F. Steel beam specimens are exposed to fire from three sides only (having a floor on the fourth side), and the limiting average temperature (for the conservative unrestrained ratings) is 1,100 °F. Comparison of required protection for similar steel sections in UL column versus beam designs also proves this point.

Farid Alfawakhiri
American Iron and Steel Institute

Weight of Paper

The AISC manual lists paper as weighing 58 lb/ft³. I have spoken with people in the file storage industry (condensed filing) and they use 40 to 43 lb/ft³. Do you know where AISC got the value they use and what it represents?

Question sent to AISC's Steel Solution Center

The origin of this data goes back to ANSI A58.1, which was the precursor to ASCE 7.

Older steel manuals listed a range of specific gravity for many materials, but listed one unit weight, which was based on an average of the extreme specific gravities listed. You will note that for paper the specific gravity was listed in the ninth edition manual with a range of 0.70–1.15. Using the average specific gravity of 0.925 and multiplying by 62.4 results in a unit weight of approximately 58 lb/ft³, which was also listed in the manual for the density of paper.

The current 13th edition *Steel Construction Manual* does not list specific gravity in Table 17-12, but does give a range for the unit weight instead. The range listed for paper in the new manual is 43.6–71.6 lb/ft³.

Kurt Gustafson, S.E., P.E.
American Institute of Steel Construction

Minimum Fillet Weld Size

Table J2.4 in the ninth edition ASD manual and the third edition LRFD manual shows the minimum sizes of fillet welds based on "thicker part joined." The new 13th edition manual is now based on "thinner part joined." Why has this changed?

Question sent to AISC's Steel Solution Center

The use of filler metal considered to be "low-hydrogen" reduces the likelihood of cracking when using small welds to make attachments to thick parts. The use of the thinner part joined in making the determination of fillet weld size is based on the prevalence of the use of "low-hydrogen" electrodes for welding of structural steel.

Sergio Zoruba, Ph.D., P.E.
American Institute of Steel Construction

Using OCBF in SDC C

We are designing a structure in accordance with IBC 2003, which references the AISC 341-02 *Seismic Provisions for Structural Steel Buildings*. We have an ordinary steel concentrically braced frame and are in Seismic Design Category C. Per IBC 2003 Table 1617.6.2, for an ordinary steel concentrically braced frame, special detailing should be provided per Chapter 14 of AISC 341-02. This chapter requires connections of bracing members to be connected for an expected tensile strength of $R_yF_yA_g$. However, in Chapter 1 of AISC 341-02 under "Scope," it states that "These provisions shall apply to buildings that are classified in the applicable building code as Seismic Design Category D (or equivalent) and higher or when required by the engineer of record." Do we need to detail according to the *Seismic Provisions* requirements in Chapter 14 per IBC, or does the statement in Chapter 1 of AISC 341-02 allow us to not follow these provisions because we are in Seismic Design Category C?

Question sent to AISC's Steel Solution Center

The *Seismic Provisions* are developed to address requirements for high ductility systems where $R > 3$. The applicable building code (or ASCE 7 in the absence of an applicable building code) stipulates R factors associated with each system and permitted usage of these systems in each seismic design category (SDC). You need to look at the last categorization (8) in Table 1617.6.2 of IBC 2003, "Structural Steel Systems Not Specifically Detailed for Seismic Resistance with an $R = 3$." Such a system is permitted in SDCs A, B, or C, but not in D or higher. One can choose to use an ordinary concentrically braced frame in SDC C with the associated higher R factor, but then the system must be detailed in accordance with the *Seismic Provisions*, such that the system is capable of meeting the higher ductility requirements. Alternatively, the $R = 3$ system can be used without the detailing requirements in AISC 341.

Kurt Gustafson, S.E., P.E.
American Institute of Steel Construction

Steel Interchange is a forum for *Modern Steel Construction* readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine.

If you have a question or problem that your fellow readers might help you solve, please forward it to us. At the same time, feel free to respond to any of the questions that you have read here. Contact Steel Interchange via AISC's Steel Solutions Center:

Steel SolutionsCenter
One East Wacker Dr., Suite 700
Chicago, IL 60601
tel: 866.ASK.AISC • fax: 312.670.9032
solutions@aisc.org