100-Year-Old Steel

I am trying to determine the load-bearing capacity of a roof on a building that is about 100 years old. The steel has been identified as S9×19.75 (purlins) and S15×33 (girders). Is there any way, for purposes of calculations, to determine the yield strength of the members? I’m guessing it’s unlikely that the members are ASTM A36 steel. What was standard for the time?

Question sent to AISC’s Steel Solutions Center

If the building is about 100 years old, it is definitely not ASTM A36 steel. The ASTM A36 Standard was not issued until 1962.

The year 1900 represented the issuance of the first ASTM Standard for Structural Steel, which was intended to bring uniformity to the various steel materials being produced at the time. It is only a guess as to what the actual characteristics of a specific material may represent for that time period; that is, if it was produced to an ASTM Standard. The 1900 ASTM A9 Standard for Buildings listed tensile strength of 60,000 to 70,000 psi with a minimum yield point of 35,000 psi. The 1909 ASTM A9 Standard listed slightly lower tensile strength (T.S.) at 55,000 to 65,000 psi and minimum yield point at half of the T.S.. AISC Design Guide 15: AISC Rehabilitation and Retrofit Guide is a reference for historic shapes and specifications. Therein you will find a historical summary of ASTM specifications for structural steel.

Unless there is good documentation as to what was specifically specified for the project, it would be prudent to undertake a testing program to determine reasonable material parameters for the structure. For further guidance refer to Appendix 5 of the 2005 AISC Specification for Structural Steel Buildings (a free download at www.aisc.org/2005spec), which covers evaluation of existing structures. Section 5.2 of this appendix covers material properties.

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

Seismically Braced Frame

I have a building in which I used X-braces to transfer the lateral loads to the foundations. In a few bays, I have to move the bottom of the braces up three feet from the finish floor elevation to allow access for doors. This building is in a high seismic area (Seismic Design Category E), and is a one-story building (approx. 18 ft to bottom of steel). Can this still be considered an Ordinary Concentrically Braced Frame?

Question sent to AISC’s Steel Solutions Center

If the bracing members are designed as tension-only, neglecting the strength in compression, the K-configuration is not appropriate for an OCBF system. In other cases, see Section 14.3 of the 2005 AISC Seismic Provisions for OCBF special bracing configuration requirements.

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

Grade 50 Angle Availability

Are angle shapes produced in Grade 50 material?

Question sent to AISC’s Steel Solutions Center

The base grade for angle shapes is ASTM A36. The steel availability search function on the AISC web site (www.aisc.org/availability) will list producers of various shapes based on the base grade for that shape. Some mills may produce ASTM A992 or A572 Grade 50 angles, but you would need to inquire as to specific availability. If you are looking for a specific shape, you may try contacting one or more of the steel service centers or
Seismic Requirements for Composite SLRS

I would like some clarification on the seismic design provisions of AISC 341-02, AISC LRFD-99 and the provisions of IBC 2003. Table 1617.6.2 of IBC permits designing steel structures as “Structural Steel Systems not Specifically Designed for Seismic Resistance.” IBC 2205.3, “Seismic requirements for composite construction,” states that in Seismic Design Category B or above, the design of composite systems shall conform to AISC 341, Part II. If I’m in a SDC C, and want to avoid “detailing for seismic”, if I use $R = 3$, $\Omega_0 = 3$ and $C_d = 3$, can I design a composite system per AISC LRFD-99, without following AISC 341 Part II?

Question sent to AISC’s Steel Solutions Center

No, Section 2205.3 of IBC 2003 requires the use of AISC 341 Part II for SDC B or higher if you plan to use a composite lateral system like those provided in AISC 341 Part II. Composite lateral framing systems are not categorized as “Structural Steel Systems not Specifically Designed for Seismic Resistance.”

Structural Steel Systems not Specifically Designed for Seismic Resistance are permitted in SDC C or lower if you use $R = 3$, $\Omega_0 = 3$ and $C_d = 3$.

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

Bent Anchor Rods

I recently received an RFI stating that one of the four 1¼ in. diameter ASTM A307 anchor rods at one braced column was bent out-of-plumb by 22° and asking for a fix solution.

In the past I have seen steel workers swinging big sledgehammers to straighten crooked anchor rods. However, I am hesitant to recommend this practice. I would like to recommend that they heat the offending rod and bend it gently back into place using a large piece of pipe as a lever. Is this an acceptable way to straighten slightly bent anchor rods or is there a preferred or published methodology? Some related questions are “If heat is used, how much should they heat the rod?” and “Could this procedure be utilized for various grades of anchor rods?”

Question sent to AISC’s Steel Solutions Center

I would like to know the industry standard conversion for 1” ASTM A325 Imperial bolt to a Metric bolt. Please indicate the standard metric size bolt.

Question sent to AISC’s Steel Solutions Center

There are two separate ASTM Standards for these bolts, namely ASTM A325 and ASTM A325M. Similarly, ASTM A490 and A490M also exist. ASTM A325 addresses Imperial A325 bolts while ASTM A325M covers Metric A325s. Please note that there is no conversion between these standards. Each contains a different set of bolts with different physical size characteristics.

For example, the ASTM A325 Standard allows a 1 in. nominal diameter bolt. However, the ASTM A325 Standard does not contain a 25.4 mm (1 in.) nominal diameter bolt; rather, it contains an M24 bolt (i.e. 24 mm).

Using an M24 bolt in a standard hole sized for a 1-in.-nominal diameter bolt would make the hole oversized for the 24 mm bolt diameter. Therefore, a slip-critical joint will now be required by the specification. The next larger metric bolt is M27. Using an M27 in a standard 1¼ in. hole would create erection problems during bolting, as the typical ⅛ in. play in a standard hole is gone.

It would be a very tight fit, not practical under normal construction tolerances.

As such, there is no conversion between the systems. Any attempts to convert must consider the aforementioned issues. Either the entire design should be in Imperial units, or Metric units, to avoid these pitfalls.

Please refer to ASTM standards at www.astm.org for additional information on these bolt specifications.

Sergio Zoruba, Ph.D., 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. The opinions expressed in Steel Interchange do not necessarily represent an official position of the American Institute of Steel Construction, Inc. and have not been reviewed. It is recognized that the design of structures is within the scope and expertise of a competent licensed structural engineer, architect or other licensed professional for the application of principles to a particular structure.