

*Modern Steel Construction's* monthly *Steel Quiz* allows you to test your knowledge of steel design and construction. All references to LRFD specifications pertain to the 1999 *LRFD Specification for Structural Steel Buildings*, available as a free download from AISC's web site:

[www.aisc.org/lrfdspec](http://www.aisc.org/lrfdspec)

ASD references pertain to the 1989 *ASD Specification for Structural Steel Buildings*. Where appropriate, other industry standards are also referenced.

Anyone is welcome to submit questions for *Steel Quiz*—one question or 10! If you or your firm are interested in submitting a *Steel Quiz* question or column, contact ►

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This month's quiz was developed by AISC's Engineering and Research department. Sharpen your pencils and go!

1. What does the quantity  $1.1R_y F_y A_g$  represent in the design of a Special Concentrically Braced Frame (SCBF) per the AISC *Seismic Provisions for Structural Steel Buildings*?

2. How much of a bolt must project beyond the nut when properly installed?

3. What flange thickness is required for welding shear stud connectors in a composite beam?

4. What is the purpose of doing CVN (Charpy V-notch) tests on members and plates?

5. Why is CVN testing only required when thickness exceeds 2 in. (1.5 in. in some case in the AISC *Seismic Provisions*)?

6. What notch toughness requirements are appropriate for exterior exposed steel?

7. AWS D1.1 specifies dimensions for weld access holes. What is the origin of these dimensions?

8. When TC bolts are used, does this automatically require that the joint be made slip-critical?

9. When can a conventional shear tab be used in lieu of a through-plate connection to the face of an HSS column?

10. Which is the proper specification of the material: "ASTM A992 grade 50" or "ASTM A992"?

**Turn page for answers**

## Answers

**1.** This is the design force corresponding to tension yielding of the brace, including the effects of material overstrength ( $R_y$ ) and strain hardening (1.1). In a special concentrically braced frame (SCBF), the goal is to have a system that can undergo significant controlled inelastic deformations through tension yielding and compression buckling of the bracing elements. The quantity  $1.1R_yF_yA_g$  provides the means of determining the axial force in the brace that the rest of the system will have to withstand.

**2.** *RCSC Specification* Section 2.3.2 states that "The bolt length used shall be such that the end of the bolt extends beyond or is at least flush with the outer face of the nut when properly installed." So as long as the point of the bolt is flush with or projects beyond the face of the nut, the bolt length is acceptable.

**3.** From *LRFD Specification* Section I5.6, the shear stud diameter cannot exceed 2.5 times the flange thickness, unless the stud is over the web. However, the best way to apply this limit is to establish a minimum flange thickness for selection of beam sizes, which means

that flange thickness must be greater than 0.4 times the stud diameter when studs are not centered over the beam web.

**4.** When thick plates and heavy shapes are used in applications loaded in tension, the core area has to be notch tough to ensure brittle fracture will not occur.

**5.** Essentially, plates thinner or shapes lighter than the threshold value will have toughness without a special requirement. Above the threshold, it may not be a guarantee, hence the requirement. Some additional conservatism is taken in the *AISC Seismic Provisions* due to the more extensive demands predicted in those applications.

**6.** In cold-weather applications, notch toughness is the primary means of ensuring that the steel will perform properly. If the steel is exposed, this may be necessary and the specifier should consult ASTM A709 (Tables S1.1, S1.2 and S1.3).

**7.** Weld access holes serve multiple functions. As one function, they permit the access needed to continue

welds past the web. As another, they provide a transition that accommodates shrinkage strains from weld cooling. The weld access hole extends to a location where the end of the hole is in compression and therefore cannot crack. The dimensions indicated in AWS D1.1 satisfy this distance requirement.

**8.** No. TC bolts can be used in snug-tightened, pretensioned and slip-critical joints. In a snug-tightened joint, we don't care how high the level of pretension is. The use of this product here is merely for the convenience or preference of the installer. In pretensioned or slip-critical joints, TC bolts can be used as the installation method to achieve the proper pretension in the bolt.

**9.** There are two criteria. The first is a wall slenderness check —  $b/t \leq 1.40(E/F_y)^{0.5}$  — that is required for the second check to be valid. The second check is a punching shear calculation to ensure that the plate will not slice through the wall. This is covered in detail in the *AISC Hollow Structural Sections Connections Manual*.

**10.** Because ASTM A992 is a 50 ksi material only, it is properly specified as "ASTM A992". ★