steel quiz

LOOKING FOR A CHALLENGE? *Modern Steel Construction*'s monthly Steel Quiz tests your knowledge of steel design and construction. Most answers can be found in the 2005 *Specification for Structural Steel Buildings*, available as a free download from AISC's web site, **www.aisc.org/2005spec**. Where appropriate, other industry standards are also referenced.

This month's Steel Quiz was developed by AISC's Steel Solutions Center. Sharpen your pencils and go!

1 **True/False:** In the AISC *Seismic Provisions*, all bolted joints found in seismic load resisting systems must be slip-critical.

2 In which plies of bearing-type connections are short-slotted holes permitted?

3 Which ASTM standard addresses the hot-dip galvanizing of fasteners and small parts?
- **a.** A780
- **b.** A123
- **c.** A767
- **d.** A153

4 **True or False:** Truss camber should be inspected immediately prior to erection.

5 Connection-element rupture strength at welds...
- **a.** is proportional to the minimum tensile strength of the element.
- **b.** is proportional to the minimum yield strength of the element.
- **c.** should be checked only when the connection element is designed for fatigue.
- **d.** is a serviceability issue.

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

7 What is the primary purpose of doing CVN (Charpy V-notch) tests on thick members and plates?

8 How does one approximate the torsional constant, *J*, for open cross-sections such as those found in wide-flanges, channels, and angles?

9 Does the 2% rule for beam lateral bracing account for bracing stiffness?

10 What does the term shear lag represent in the design of a tension member?

TURN PAGE FOR ANSWERS

steel quiz

ANSWERS

1 **False.** The 2005 *Seismic Provisions* (free download from www.aisc.org/2005seismic) do require that bolted joints in seismic load resisting systems must have faying surfaces prepared to at least a Class A slip resistance. High-strength bolts are mandatory and must be pretensioned during installation. However, when used in standard holes, the design shear strength of such bolted joints is permitted to be calculated as for bearing-type joints.

2 Short-slotted holes are permitted in any or all plies of a bearing-type connection, but the length of the slot must be normal to the direction of load. Refer to Section J3.2 of the 2005 AISC specification (www.aisc.org/2005spec).

3 **d.** ASTM A153 includes a special provision that allows the galvanizer to use a spinner or centrifuge to remove excess zinc from critical sections of small parts such as threads. This specification is similar to ASTM A123 (the more common specification covering hot-dip galvanizing of structural steel), as it requires minimum coating thicknesses based on the thickness and type (bolt, casting, forged part) of steel.

4 **False.** As stated in the 2005 AISC *Code of Standard Practice for Steel Buildings and Bridges*, Section 6.4.4: "For the purpose of inspection, camber shall be measured in the Fabricator's shop in the unstressed condition." This document is a free download from www.aisc.org/code.

5 **a.** That is, the connection-element rupture strength at welds is proportional to the minimum tensile strength of the element. Refer to Chapter J of the AISC specification for connection element and weld strength requirements. This subject is also addressed in Part 9 of the 13th edition *Steel Construction Manual*.

6 The 2004 RCSC specification, Section 2.3.2 states: "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." Download a free copy of this specification from www.boltcouncil.org.

7 When thick plates and heavy shapes are used in applications loaded in tension, the core area has to be sufficiently notch tough to ensure that brittle fracture will not occur. It should be noted that minimum notch toughness values exist for these applications in both the AISC specification and the AISC seismic provisions.

8 One can define several rectangular elements within an open cross-section (i.e., an angle contains two, whereas a W-shape contains three rectangular elements.) The torsional constant for each element can be approximated simply as $bt^3/3$, where b is the longer and t the shorter length of each element. Summing these quantities for each element comprising an open cross-section will result in a close approximation of the torsional constant for the entire cross-section. Please note that fillet radii have a small contribution and are ignored in this approximate approach. This procedure is not applicable to closed cross-sections.

9 No, it does not, as it only considers strength. This long-standing rule of thumb provides bracing for 2% of the compressive force in the flange or member being braced. Although it lacks an explicit consideration of the required bracing stiffness, this approximation is typically conservative when used with proper brace and connection details (i.e., details that have appropriate stiffness characteristics.) Note that the 2% rule applies only to compression members that are considered straight within ASTM tolerances. One can develop the judgment necessary to know when the details provide adequate stiffness, by using the more detailed and exact strength and stiffness criteria for beam bracing, which are included in Appendix 6 of the 2005 AISC specification.

10 Shear lag describes the behavior at an end connection of a tension member where some, but not all, of the cross-sectional elements are connected. The area that is effective in resisting tension may be less than the full calculated net area for the cross-section. An example is a single-angle tension member connected by only one leg. The adjacent leg at the connection does very little in the way of resisting tension at the connection, but becomes fully effective beyond the connection out in the length of the tension member.