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 What is the preferred material specification for HP shapes?

- **a.** ASTM A36 Grade 36
- **b.** ASTM A572 Grade 50
- **c.** ASTM A709 Grade 50
- **d.** ASTM A992

2 For very low service temperatures of structural steel frames, which of the following must be considered?

- **a.** notch toughness
- **b.** hardness
- **c.** elongation
- **d.** corrosion

3 Which of the following is not a serviceability criterion?

- **a.** deflection
- **b.** vibration
- **c.** drift
- **d.** strength

4 **True/False:** A plate perpendicular to a supporting member and fillet welded on both sides will not fail by way of weld rupture as long as the weld size is at least $^5/_8$ times the thickness of the plate.

5 In which configuration can a flare-bevel groove weld be used?

- **a.** between two perpendicular plates
- **b.** between two lapped plates
- **c.** between lapped plate and HSS
- **d.** between butt-spliced HSS

6 In the expression given for bolt bearing on connected material $R_n = 1.2L_ctF_u \le 2.4dtF_u$, which term is the tear-out calculation and which term is the bearing deformation calculation, respectively?

- **a.** both are bearing terms
- **b.** $1.2L_ctF_u$, $2.4dtF_u$
- **c.** $2.4dtF_u$, $1.2L_ctF_u$
- **d.** Both are tear-out terms

7 A slotted hole with length shorter than the value given in AISC Specification Table J3.3 for a short-slotted hole must be treated as:

- **a.** standard hole
- **b.** oversized hole
- **c.** short-slotted hole
- **d.** long-slotted hole

8 **True/False:** Structural shape size groupings are used for tensile property classification in the current ASTM A6 Standard.

9 Which axis must be used when determining the effective length factor for torsional or flexural-torsional buckling?

- **a.** x-axis to determine K_x
- **b.** y-axis to determine K_y
- **c.** w-axis to determine K_w
- **d.** z-axis to determine K_z

10 How is the torsional constant, J, determined for an open section or shape?

- **a.** AISC *Manual* tables
- **b.** $\sum b_i t_i^3/3$ of each rectangular element comprising the cross-section
- **c.** $I_x + I_y$
- **d.** $I_x^2 + I_y^2$

TURN PAGE FOR ANSWERS

steel quiz

ANSWERS

1 The answer is **b**, ASTM A572 Grade 50, listed in Table 2-3 of the 13th edition *Manual* (www.aisc.org/bookstore). HP shapes may be ordered to other ASTM designations, but availability in grades other than the preferred grade should be confirmed prior to specification. For shape availability and a listing of mill contact information, visit www.aisc.org/availability.

2 The answer is **a**, notch toughness, which is usually evaluated using a Charpy V-notch (CVN) test. Hardness is a function of yield strength; and yield strength tends to increase slightly at temperatures below ambient temperature. Elongation is a measure of ductility, and along with corrosion, neither one is a consideration specific to low service temperatures. Refer to AISC FAQ 4.4.6 at www.aisc.org/faq for additional information on this topic.

3 The answer is **d**, strength. While strength is essential, serviceability criteria relate to the ability of a structure to preserve its appearance, maintainability, durability or the comfort of its occupants or function of machinery, under normal usage.

4 **True**. This rule-of-thumb is based on the current single-plate shear connection weld sizing criteria found in Section 10 of the 13th edition *Manual*.

5 The answer is **c**, between a lapped plate and HSS. Flare-bevel groove welds may also be specified for other configurations involving a joint comprised of one straight side and the other with a radius. Keep in mind that flare-bevel groove welds are actually PJP groove welds. For an illustration of the joint configuration for this type of weld, refer to Figure 3-9 in AISC *Design Guide 21: Welded Connections – A Primer for Engineers* available from www.aisc.org/epubs.

6 The answer is **b**. An easy way to remember these terms: the tear-out limit state, $1.2L_c tF_u$, is based upon L_c, which is the clear distance from the edge of the hole to the edge of the material. The bearing deformation limit state, $2.4dtF_u$, is a stress of $2.4F_u$ times the projected bearing area.

7 The answer is **c**. Table J3.3 provides maximum dimensions for each hole type. When the value(s) given is (are) exceeded, the hole must be treated as the next larger type of hole. In this case, the slotted hole has a length that is shorter than the length listed in Table J3.3 of the 2005 AISC specification, it still must be treated as a short-slotted hole.

8 **False**. In older versions of ASTM A6, shapes were classified into groups 1 through 5, with Group 5 based on the thickness of the web of the shape. More current versions of ASTM A6 have eliminated this classification system in favor of one based upon flange thickness; heavy shapes are now simply those with a flange thickness exceeding 2 in.

9 The answer is **d**. One can think of compression members (except for single-angles) as having three axes. Flexural buckling may occur about the x- and y- geometric axes. A third axis runs along the length of the compression member and is known as the z-axis. Torsional and flexural-torsional buckling may only occur about the z-axis (i.e. twisting of the cross-section), hence the effective length factor for such buckling would be K_z. Refer to Section E4 of the 2005 AISC specification for additional information.

10 The answers are **a** and **b**. *J* should not be confused with the polar moment of inertia. The torsional constant, *J*, can be looked up using the Tables found in Section 1 of the 13th edition AISC manual. However, for open-sections, one can also sum the individual $b_i t_i^3/3$ contributions of each rectangular element comprising an open-section to estimate *J*.