

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 assumed force spread angle (to each side) when using the Whitmore section?
 - a. 30 degrees
 - b. 37.7 degrees
 - c. 41.7 degrees
 - d. 45 degrees
- 2 **True/False:** ASTM A992 addresses hot-rolled shapes and plates.
- 3 Which of the following is not a constructability concern?
 - a. W8 and smaller shapes
 - b. Bolt available strength
 - c. Beam length overrun
 - d. Entering and tightening clearances
- 4 Prying action involves the deformation of a connecting element under a tensile force that:
 - a. decreases the bolt tensile force below that from direct tension alone.
 - b. increases the bolt tensile force above that from direct tension alone.
 - c. both a and b.
 - d. none of these.
- 5 **True/False:** Conventional single-plate shear connections may be used without modification for HSS columns as long as the wall is not classified as a slender element.
- 6 ASTM A325 and A490 high-strength bolts are available in the following nominal diameters:
 - a. $\frac{3}{8}$ in. through $1\frac{1}{4}$ in.
 - b. $\frac{3}{8}$ in. through $1\frac{1}{2}$ in.
 - c. $\frac{1}{2}$ in. through $1\frac{1}{4}$ in.
 - d. $\frac{1}{2}$ in. through $1\frac{1}{2}$ in.
- 7 What do pretensioned and slip-critical bolted connections have in common?
 - a. both are bearing joints
 - b. both have the same available strength
 - c. both require a minimum installed tension
 - d. both cost the same
- 8 **True/False:** Structural steel has the same yield strength at room temperature as it does at 750 °F.
- 9 A roof system must be designed to assure adequate strength and stability under ponding conditions, unless the roof slopes towards points of free drainage by:
 - a. at least $\frac{1}{8}$ in. per ft.
 - b. at least $\frac{1}{4}$ in. per ft.
 - c. at least $\frac{1}{2}$ in. per ft.
 - d. at least $\frac{3}{4}$ in. per ft.
- 10 **True/False:** If longitudinal fillet welds are used alone in end connections of flat-bar tension members, the length of each fillet weld may be less than the perpendicular distance between them.

TURN PAGE FOR ANSWERS

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ANSWERS

1 The answer is **a**. The Whitmore section assumes a 30-degree spread of force to each side of a connecting element along the line of force. For additional information on the Whitmore section, refer to page 9-3 of the 13th edition AISC manual (www.aisc.org/bookstore).

2 **False**. ASTM A992-04a addresses structural steel shapes, such as those found in the ASTM A6. However, it does not address plates. One may consider specifying plate material 4 in. or less in thickness as ASTM A572 Grade 50. One additional important note: only W-shapes are commonly available in ASTM A992, even though the standard allows for other hot-rolled shapes.

3 The answer is **b**. That is, bolt available strength does not affect the ability of a building frame to be erected. However, small shapes, beams that are longer than specified, and improper (or unchecked) tooling clearances may result in installation and fit-up issues.

4 The answer is **b**. Prying action involves the deformation of the connecting element under a tensile force. This deformation results in an increase in the bolt tensile force above that

induced by direct tension alone. For additional information, refer to page 9-10 of the 13th edition AISC manual.

5 **True**. If a slender HSS column wall were used, a local distortion in the wall caused by the slight rotation of the single-plate shear connection could result in a reduction in strength in the HSS column. Refer to page 10-158 in the 13th edition AISC manual for additional information.

6 The answer is **d**. According to ASTM A325 and A490s, such high-strength bolts are allowed to have a nominal diameter ranging from ½ in. to 1½ in. Bolt diameters outside of this range are not classified as ASTM A325 or A490 high-strength bolts.

7 The answer is **c**. Both pretensioned and slip-critical bolted joints must be tightened during installation to a tensile force equivalent to at least $0.70F_u$. This is obvious for pretensioned bearing joints, as the name implies. However, the same holds true for slip-critical joints, as the calculated slip resistance between the faying surfaces can only occur when a clamping force exists to create the friction between the surfaces.

8 **True**. In fact, the tensile strengths of structural steel at room temperature and at 750 °F are also the same. The thermal values for yield strength, tensile strength, and the modulus of elasticity are listed in Table A-4.2.1 in the 2005 AISC specification (www.aisc.org/2005spec).

9 The answer is **b**. Or, if an adequate system of drainage is provided to prevent accumulation of water, such investigation though structural analysis would not be required. Please refer to Section B3.8 of the 2005 AISC specification for additional information.

10 **False**. The condition described would result in significant shear lag in the connection and is expressly prohibited by Section J2.2b of the 2005 AISC specification. The *Specification* requires that the longitudinal welds be the same length as, or longer than, the perpendicular distance between them. If that is the case, one may use Section D3.3 to determine the shear lag factor, U . This factor reduces the effective net area—and lowers the available strength—of the tension member to compensate for the shear lag.