

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 definition of "bolt grip"?
 - a. total length of bolt
 - b. total length of bolt, including head
 - c. thickness of material through which a bolt passes
 - d. thickness of plies, including any washers
- 2 Which of the following are stiffened elements?
 - a. web of a W-shape
 - b. flange of an W-shape
 - c. wall of a rectangular HSS
 - d. leg of an angle
- 3 Which limit state is directly applicable to a member with slender elements?
 - a. local buckling
 - b. lateral-torsional buckling
 - c. flexural-torsional buckling
 - d. yielding
- 4 If $\phi = 0.90$ in LRFD, what is the factor of safety Ω ?
- 5 **True/False:** Warping stresses in round HSS and pipes can be ignored.
- 6 How are the plastic neutral axis (PNA) and elastic neutral axis (ENA) determined?
- 7 If a fillet weld group is comprised of both longitudinal (R_{wl}) and transverse (R_{wt}) fillet welds, then the combined nominal strength of the weld group is the greater of which two nominal strengths?
 - a. $R_n = R_{wl} + 1.5R_{wt}$
 - b. $R_n = 1.5R_{wl} + R_{wt}$
 - c. $R_n = 0.85R_{wl} + 1.5R_{wt}$
 - d. $R_n = R_{wl} + R_{wt}$
- 8 Round ASTM A500 HSS have a yield strength of:
 - a. 35 ksi
 - b. 42 ksi
 - c. 46 ksi
 - d. 50 ksi
- 9 **True/False:** Fatigue is an issue for high-strength bolts in shear.
- 10 What is the unit weight of steel?
 - a. 110 lb/ft³
 - b. 145 lb/ft³
 - c. 490 lb/ft³
 - d. 525 lb/ft³

TURN PAGE FOR ANSWERS

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ANSWERS

1 The answer is **c**. According to the Glossary of the 2005 AISC *Specification* (www.aisc.org/2005spec), grip is defined as the thickness of material through which a bolt passes. The 2004 RCSC Bolt Specification (www.boltcouncil.org) has a slightly more detailed definition as the thickness of the plies of a joint through which the bolt passes, exclusive of washers or direct-tension indicators.

2 Only **a** and **c** are considered stiffened elements. That is, the stiffened element must always have its ends attached to other elements. For example, the ends of a web are stiffened by flanges in a W-shape. It is important to know the difference between stiffened and unstiffened elements in order to properly check for compactness, non-compactness and slenderness of elements.

3 The answer is **a**, local buckling.

4 It must be 1.67. One must remember the rule-of-thumb, namely $\phi \times \Omega = 1.5$. Hence $\Omega = 1.5/\phi = 1.5/0.9 = 1.67$. This is a handy rule of thumb when translating from ASD to LRFD, or vice versa. Recall that ϕ is the

LRFD resistance factor and Ω is the ASD factor of safety for use in the 2005 AISC *Specification* when working with nominal strength expressions.

5 True. Round cross-sections do not warp when subjected to torsion. It follows that round HSS and pipe under torsion will not develop stresses due to warping, only pure torsional stresses. Although this is untrue in a strict sense for square and rectangular HSS, warping effects are usually insignificant compared to those stresses developed from pure torsion; warping stresses therefore typically are also ignored in square and rectangular HSS. Warping effects are significant, however, in shapes of open cross-section. For additional information, refer to AISC *Design Guide 9: Torsional Analysis of Structural Steel Members* at www.aisc.org/epubs.

6 For symmetric sections, the plastic and elastic neutral axes are both located at the centroid. However, for asymmetric sections, such as a composite flexural member, each will be positioned at a different location within the cross-section. It is important to realize the plastic neutral axis is the location such that the tension on one side equals

the compression on the other. In contrast, the elastic neutral axis is determined based upon equilibrating the moments of area of the tension and compression elements of the cross-section.

7 The answers are **c** and **d**. That is, $R_n = \max[0.85R_{wl} + 1.5R_{wtr}, R_{wl} + R_{wtr}]$ to account for the load-deformation relationship for the weld group. Refer to Section J2.4(c) of the 2005 AISC *Specification* for additional information.

8 The answer is **b**, 42 ksi. Refer to the Chapter 2 of the 13th edition AISC *Manual* (www.aisc.org/bookstore) or the ASTM A500 Standard.

9 False. As mentioned in Chapter 7 of AISC *Design Guide 17: High-Strength Bolts – A Primer for Structural Engineers* (www.aisc.org/epubs), there are no reported instances of fatigue failure of the fasteners themselves when high-strength bolts are used in shear-type connections.

10 The answer is **c**. Section 9.2.1 of the 2005 AISC *Code of Standard Practice* (www.aisc.org/code) states that the unit weight of steel shall be taken as 490 lb/ft³.