

# STEEL QUIZ

**STEEL QUIZ, A MONTHLY FEATURE IN MODERN STEEL CONSTRUCTION**, allows you to test your knowledge of steel design and construction. Unless otherwise noted, all answers can be found in the *LRFD Manual of Steel Construction*. **To receive a copy of the 1997 AISC Publications List, please call 800/644-2400 or fax 312/670-5403.**

## QUESTIONS:

1. A column was designed assuming 36 ksi steel and the hypothetical wide-flange cross-section chosen just met the width-thickness ratio limit  $\frac{95}{\sqrt{F_y}}$ . Subsequently, it was discovered that the actual yield stress of the column supplied was 55 ksi, at which the section exceeds that width-thickness ratio limit. Must the designer re-evaluate this column as a slender-element cross section?
2. A  $\frac{1}{16}$ -in. gap is permissible in compression bearing joints such as column splices and bearing stiffeners, True or False?
3. When some but not all of the elements of the cross-section of a tension member are connected, the effective net area may be less than the total net area due to a phenomenon known as what?
4. Which of the following number of cycles is the threshold after which fatigue must be considered in design?
  - a) 5,000
  - b) 20,000
  - c) 100,000
  - d) 2,000,000
5. Which of the following conditions is not acceptable:
  - a) an installed bolt with the point flush with the face of the nut
  - b) a shear stud connector with the top of the head exactly flush with the top of the slab
  - c) a 10-in.-long fillet weld along a connection plate that is  $\frac{1}{16}$ -in. smaller than the nominal size specified for a 1-in. segment
  - d) none of the above
6. Which of the following statements is false:
  - a) the strength of a tension member is controlled by the smaller of the limit states of yielding and rupture
  - b) as the unbraced length of a compact-section beam is increased, the limit state that controls the design will change from yielding to inelastic lateral-torsional buckling to elastic lateral-torsional buckling
  - c) unless the cross-section is slender, column buckling occurs in the elastic range
  - d) in the LRFD Specification, block shear rupture strength is controlled by the combination possessing the larger rupture term of shear rupture/tension yielding and shear yielding/tension rupture
7. For an interior column, what is the plumbness tolerance specified in the AISC Code of Standard Practice?
8. Torsional loading of a restrained shape of open cross-section produces what three stresses?
9. Which of the following is not the most current version of an AISC Specification or Code?
  - a) Code of Standard Practice for Steel Buildings and Bridges, September 1, 1986
  - b) LRFD Specification for Structural Steel Buildings, December 1, 1993
  - c) LRFD Specification for Single-Angle Members, December 1, 1993
10. For a  $\frac{3}{4}$ -in. diameter ASTM A325 high-strength bolt, what ply-thickness adjacent to the nut will ensure that the threads will be excluded from the shear plane in all cases?

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## ANSWERS:

1. No. Although the value decreases as yield strength increases, the critical stress for local buckling is a function of element slenderness, not the actual yield stress. Because this critical stress remains unchanged, local buckling still will not limit the strength of the column.
2. True. *LRFD Specification* Section M4.4 states that "Lack of contact bearing not exceeding a gap of  $\frac{1}{16}$ " ... is permitted."
3. Shear lag.
4. b. Fatigue must be considered above 20,000 cycles of loading.
5. d. From *RCSC Specification* Section 2(b) "...The length of the bolts shall be such that the end of the bolt will be flush with or outside the face of the nut when properly installed."; the strength of a shear stud connector depends on either the cone of concrete under the head or the strength of the connector itself; from AWS D1.1 Sections 8.15.1.7 and 9.25.1.7 "A fillet weld ... shall be permitted to underrun the nominal fillet weld size specified by  $\frac{1}{16}$ " without correction, provided that the undersized portion of the weld does not exceed 10 percent of the length of the weld.
6. c. When the column cross-section meets the non-compact limits of LRFD Specification Table B5.1, column buckling may occur either in the inelastic or the elastic range, depending upon the unbraced length.
7. The plumbness of the theoretical working line from column end to column end must be within a slope of 1:500. Additional limitations apply if this interior column is adjacent to an elevator shaft; see *AISC Code of Standard Practice* Section 7.11.3.1.
8. Shear stress due to pure (St. Venant) torsion, shear stress due to warping, and normal stress due to warping.
9. a. The most current *AISC Code of Standard Practice for Steel Buildings and Bridges* is dated June 10, 1992.
10. From *RCSC Specification* Commentary Section C2, an outer ply thickness of  $\frac{3}{8}$  in. (or  $\frac{1}{4}$ -in. with one  $\frac{5}{32}$ -in.-thick washer) is sufficient to ensure that the threads will always be excluded from the shear plane for a  $\frac{3}{4}$ " diameter ASTM A325 high-strength bolt. A lesser ply thickness may also be suitable, depending upon the total grip and bolt length used; see "Specifying Bolt Length for High-Strength Bolts" by C.J. Carter in the 2nd Qtr. 1996 *Engineering Journal*.