

**S**TEEL 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 free catalog of AISC publications, circle #10 on the reader service card in the back of this magazine.**

## Questions:

1. Why is  $M_p$  limited to  $1.5M_y$  in LRFD Specification Section F1.1?
  - a) a column base with four headed anchor rods embedded into concrete
  - b) a girt connection made with ASTM A307 bolts
  - c) none of the above
2. It is necessary to reduce the shear strength for the tension present in a fully tensioned bolt that carries shear load only, True or False?
  - a) its length must be at least  $1\frac{1}{2}$  times the thickness of the material through which it is cut
  - b) its height must provide proper clearance and be at least greater than the thickness of the material through which it is cut
  - c) it must be filled with weld metal after the CJP weld is completed
  - d) all of the above
3. Which of the following is not correct when a weld access hole is provided to make a complete-joint-penetration groove welded joint:
  - a) W-shapes
  - b) channels
  - c) structural tees
  - d) Z-shapes
4. Can a connection fitting such as a double angle or single plate be placed against the web of a W-shape in a such a position that it encroaches on the k-distance (fillet region)?
 

*(Editor's Note: If you would like to submit a question to Steel Quiz, please send it to Charlie Carter at AISC, One East Wacker Dr., Suite 3100, Chicago, IL 60601.)*
5. What tolerance is specified in the AISC *Code of Standard Practice* for the elevation of a girder connected to a column?
 

9. LRFD Manual page 11-93 contains a discussion recommending that shop-assembled truss connections be designed for some minimum force, such as 50 percent of the member strength. Why?
6. What is "killed" steel?
 

10. For which of the following shapes does the shear center coincide with the centroid?
7. The maximum effective length of a fillet weld is limited to 70 times the fillet weld leg size when loaded by forces parallel to the weld, True or False?
  - a) a bolted expansion joint detail with a slip pad between the steel plies
8. Which of the following applications are covered in the RCSC *LRFD Specification for Structural Joints Using ASTM A325 or A490 Bolts*?
  - a) a bolted expansion joint detail with a slip pad between the steel plies

## Answers:

1. From LRFD Specification Commentary Section F1.1, "If the shape has a large shape factor ... significant inelastic deformation may occur at service load if the section is permitted to reach  $M_p$  [=  $F_y Z$ ] at factored load. The limit of  $1.5M_y$  [=  $1.5F_y S$ ] at factored load will control the amount of inelastic deformation for sections with shape factors greater than 1.5 [such as tees]."
2. False. The approach used by AISC and RCSC in bolt design is configured to provide consistent reliability at ultimate load. Because at ultimate load (i.e., failure) any initial pretension is lost due to shear deformations in the bolt prior to failure, there is no need to check shear-tension interaction unless an externally applied tension exists concurrently with the shear.
3. c is false; from LRFD Manual page 8-125, "weld access holes should not be filled with weld metal since it is difficult to provide sound weld metal to fill such a void and doing so may introduce a triaxial stress under loading. Both a and b are true per LRFD Specification Section J1.6.
4. Yes. The shape of circular and parabolic fillets is such that a comparatively large encroachment is possible with a very small departure from a theoretically flat surface. As illustrated in LRFD Manual Table 9-1 (page 9-12), fillet encroachments ranging from  $1/8$ -in. for a  $5/16$ -in. fillet radius to  $5/16$ -in. for a 1-in. fillet radius can be accommodated with a departure from flatness not exceeding  $1/32$ -in.
5. From AISC Code of Standard Practice Section 7.11.3.2.(b), "The elevation of members connecting to columns is considered acceptable if the distance from the member working point to the upper milled splice line of the column does not deviate more than plus  $3/16$  in. or minus  $5/16$  in. from the distance specified on the drawings."
6. As defined in ASTM A6/A6M, Section 3.1.9, killed steel is deoxidized to an oxygen content such that no reaction occurs between carbon and oxygen during solidification; this eliminates the formation of carbon monoxide gas bubbles in the molten steel, which tend to get trapped as the steel cools.
7. True. Refer to LRFD Specification Section J2.2b.
8. d. As stated in the Preface to the RCSC Specification, "The intention ... is to cover the design criteria and normal usage and practices involved ... in steel-to-steel structural connections. It is not intended to cover the full range of structural connections using threaded fasteners nor the use of high-strength bolts other than those included in ASTM A325 or A490 nor the use of ... material other than steel within the grip."
9. To account for loads induced during handling, shipping, and erection, it is recommended that truss connections be designed for "a minimum of 50 percent of the member strength or a lesser amount as determined by the engineer." It is further noted that similar consideration may be required for truss connections that are field assembled on the ground for subsequent erection.
10. a and d. The shear center will coincide with the centroid for any doubly-symmetric member, such as a W-shape, hollow structural section, or steel pipe. For singly-symmetric shapes, such as channels, angles, tees, the shear center and centroid lie at different locations on the axis of symmetry. One special-case unsymmetric shape for which the shear center and centroid coincide is the Z-shape.