

steel quiz

Most of the answers to this month's steel quiz can be found in the AISC *Specification* and AISC *Steel Construction Manual* as well as on the AISC and *Modern Steel Construction* websites (www.aisc.org and www.modernsteel.com).

- 1 True/False: AISC 341 requires that the unbalanced brace force be considered in the two-story X-braced configuration.
- 2 True/False: When checking steel-to-steel bearing strength using AISC *Specification* Section J7, the available strength can be higher than F_y for some materials.
- 3 True/False: The recommended nut grades can be found in ASTM standards for the fasteners with which they are used.
- 4 What is the minimum flange thickness for composite action when welding shear studs through metal deck?
 - a) Stud diameter divided by 4
 - b) Stud diameter divided by 3
 - c) Stud diameter divided by 2.5
 - d) None of the above
- 5 What is the specified minimum yield strength of an ASTM A307 bolt?
 - a) 30
 - b) 36
 - c) 50
 - d) None of the above
- 6 True/False: For stability design as outlined in Chapter C of the AISC *Specification*, there are four methods: the Direct Analysis Method, the Effective Length Method, the First-Order Analysis Method and the B_1 - B_2 Method.
- 7 True/False: AISC requires that mislocated holes be filled in Chapter M of the *Specification*.
- 8 True/False: The installation procedures in the RCSC *Specification* only apply to steel-to-steel connections.
- 9 Which of the following is an acceptable method for transferring shear in a foundation?
 - a) Shear lug
 - b) Encased strut
 - c) Embed plate
 - d) All of the above
- 10 True/False: Consideration of tension field action is not permitted in end panels of plate girders.

TURN PAGE FOR ANSWERS

- 1 True. The potential unbalanced force will depend upon brace sizes and angles. In general, AISC 341 Section F2.3 requires that two analyses are performed: one where all braces reach maximum force (with two braces in tension and two braces in compression) and one in which the tension braces are at maximum strength and the compression braces have lost a significant percentage of strength after buckling. The 2010 AISC *Seismic Provisions* have clarified this in the provisions and commentary and can be downloaded for free at www.aisc.org/2010sp.
- 2 True. The Commentary to Section J7 in the AISC *Specification* gives some insight into this result when the available strength exceeds that predicted by the yield of the material. It states: "In general, the bearing strength design of finished surfaces is governed by the limit state of bearing (local compressive yielding) at nominal loads. The nominal bearing strength of milled contact surfaces exceeds the yield strength because adequate safety is provided by post-yield strength as deformation increases. Tests on pin connections (Johnston 1939) and rockers (Wilson 1934) have confirmed this behavior."
- 3 True. ASTM standards for bolts, such as A325 and A490, provide the recommended nut grades (these also are summarized in the RCSC *Specification*). For anchor rods, ASTM F1554 Section 6.6 covers the recommended nut grades.
- 4 (c) This requirement can be found in AISC *Specification* Section I8.1 (a free download from www.aisc.org/2010spec), which states: "The diameter of a steel headed stud anchor shall not be greater than 2.5 times the thickness of the base metal to which it is welded, unless it is welded to a flange directly over a web." The Commentary to Section I8.1 explains, "Studs not located directly over the web of a beam tend to tear out of a thin flange before attaining full shear-resisting strength. To guard against this contingency, the size of a stud not located over the beam web is limited to 2½ times the flange thickness (Goble, 1968). The practical application of this limitation is to select only beams with flanges thicker than the stud diameter divided by 2.5."
- 5 (d) There is not a specified minimum yield strength in ASTM A307, but there are tensile strength requirements.
- 6 False. The first three are the methods provided; the B_1 - B_2 approach given in Appendix 8 is a method of calculating second order effects, not a stability design method. For more information, see "A Comparison of Frame Stability Analysis Methods in ANSI AISC 360-05" by Carter and Geschwindner in the 3rd Quarter 2008 issue of the AISC *Engineering Journal*. This is a free download to AISC members at www.aisc.org/ej.
- 7 False. AISC does not have any requirements for mislocated holes, and often they can simply be left open. Alternatively, an open hole can be filled with a bolt, or welded restoration can be pursued. AWS D1.1 Clause 5.26.5 "Welded Restoration of Base Metal with Mislocated Holes" and the commentary in clause C-5.26.2 should be consulted if a hole is to be filled by welding. Note that there are restrictions for base metal subject to cyclic tensile stress and for quenched and tempered base metals.
- 8 True. RCSC provisions apply to steel-to-steel bolted connections. They do not apply to steel-to-concrete connections involving anchor rods. Installation procedures for steel-to-concrete connections must be developed independently by the project team. Such factors as concrete creep and bond between the anchor and concrete are typical considerations for these types of connections when the joint is to be installed with a desired level of pretension.
- 9 (d) The three methods above—shear lug, encased strut and embed plate—are all acceptable methods of shear transfer. Shear lugs are one of the more common methods and this approach is illustrated in AISC's *Design Guide 1* (available for download at www.aisc.org/dg).
- 10 True. As stated at the bottom of Page 16.1-327 of the Commentary to the 2010 AISC *Specification* (www.aisc.org/2010spec), "In the case of end panels there is a panel only on one side. The anchorage of the tension field is limited in many situations at these locations and is thus neglected." The SSRC *Guide to Stability Design Criteria for Metal Structures*, 6th Ed. (Ziemian 2010), Section 6.10, page 290 provides more information. The author makes the following statement: "If the end panel is designed for tension-field action, an end post must be provided. A possible end post consists of the bearing stiffener and an end plate (Fig. 6.4a)."



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Anyone is welcome to submit questions and answers for Steel Quiz. If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866.ASK.AISC or at solutions@aisc.org.