

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 **True/False:** Oversized or slotted bolt holes in outer plies do not need to be completely covered by a washer.
- 2 Which of the following conditions apply to snug-tightened joints?
 - a. tightness attained with a few impacts of an impact wrench
 - b. tightness obtained by the full effort of an ironworker using an ordinary spud wrench
 - c. all plies must be in firm contact
 - d. actual pretension may vary significantly
- 3 When camber is called out in the structural design drawings, which of the following must be specified?
 - a. direction
 - b. magnitude
 - c. tolerance
 - d. location
- 4 What is the specified upper bound for C_b in the 2005 AISC specification?
 - a. 2.0
 - b. 2.3
 - c. 2.7
 - d. 3.0
- 5 **True/False:** A single-plate shear connection welded at both ends is acceptable.
- 6 The resistance factor, ϕ , for shear strength of rolled I-shapes with $h/t_w \leq 2.24\sqrt{E/F_y}$ is:
 - a. 0.60
 - b. 0.80
 - c. 0.90
 - d. 1.00
- 7 Which of the following cross-sections do not undergo warping under torsion?
 - a. I-shape
 - b. C-shape
 - c. Square HSS
 - d. Pipe
- 8 In new construction, slip-critical bolted joints and fillet welds may be considered as sharing load in shear connections when which two of the following are met:
 - a. standard or short-slotted holes loaded transversely
 - b. standard or short-slotted holes loaded longitudinally
 - c. fillet welds must be loaded transversely
 - d. fillet welds must be loaded longitudinally
- 9 Which material has a yield strength of 46 ksi?
 - a. ASTM A53 Grade B Pipe
 - b. ASTM A500 Grade B round HSS
 - c. ASTM A500 Grade B square/rectangular HSS
 - d. ASTM A992
- 10 **True/False:** A fully composite flexural member loaded in negative moment is assumed to have full interaction if the shear connection strength exceeds that of either the tensile yield strength of the steel section or the compressive strength of the concrete slab.

TURN PAGE FOR ANSWERS

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ANSWERS

1 False. Section J3.1 of the 2005 AISC specification references the 2004 RCSC specification (www.boltcouncil.org) requirements. Therein, Section 6.2.5 mandates that a washer shall be of sufficient size to completely cover the hole. It should be noted that bolts approved for use in Section A3 of the AISC specification contain head areas that will completely cover a standard hole. Hence washers may or may not be required when standard holes are specified. Refer to Section 6 of the RCSC specification to make an exact determination for a particular application. The reason that bolt holes must be covered by the head of a bolt, or by washers for oversized and slotted holes, is to properly distribute the clamping force of the installed bolt. In exterior exposures, it also serves to minimize the water infiltration and corrosion concerns during erection and/or exposed service.

2 All of the above. If an impact wrench is used, the snug-tightened condition may be obtained by a few impacts of an impact wrench. Alternatively, a snug-tightened bolted joint may require the full effort of an ironworker using a spud wrench. In all cases, the connection plies of a snug-tightened joint must always be in firm contact. Due to the variability in the tightness obtained by these methods, the pretension in the bolt will vary significantly and therefore cannot (and need not) be quantified for a snug-tightened condition. For additional information, refer to the definition of snug-tightened joint in the 2004 RCSC specification.

3 a, b, and d, according to Section 3.1.5 of the 2005 AISC Code of Standard

Practice (www.aisc.org/code). Camber tolerance is given in Section 6.4.

4 d. Over the years, this upper bound has increased. The 2005 AISC specification includes an increase in maximum C_b to a value of 3.0.

5 False. A basic requirement of any shear connection is that it must accommodate beam end rotation. Otherwise, negative bending moments will develop in the shear connection, which can lead to behavior inconsistent with the design, and possibly failure. Most shear connections will accommodate beam end rotation by flexing (such as single- or double-angle shear connections.) However, such flexing is not physically possible with single-plate shear tabs. Single-plate shear connections accommodate beam end rotation through a combination of rotation at the bolt line, plate yielding, and bolt plowing against the holes in the plate.

6 d. Chapter G of the 2005 AISC specification contains an increase in available shear strength for most structural steel shapes by way of a resistance factor $\phi = 1.0$ and a safety of factor of $\Omega = 1.5$. Other shapes and sections are designed using a resistance factor $\phi = 0.9$ and a safety of factor of $\Omega = 1.67$.

7 d. That is, round cross-sections do not undergo warping when subjected to torsion. Note that, as a design simplification, one may assume that square and most rectangular HSS cross-sections do not warp because the warping effects in these closed sections are small. Refer to AISC Design Guide 9 on torsion (www.aisc.org/epubs).

8 a and d. Applied only to new construction (i.e., no pre-existing loads), load sharing in a shear connection is allowed when standard and/or short-slotted transversely loaded holes are used in conjunction with longitudinally loaded fillet welds. The idea here is that standard and/or short-slotted transversely loaded holes only have $1/16$ " or less play in the load direction, while longitudinally loaded fillet welds contain greater ductility than transverse loaded welds, and are able to accommodate $1/16$ " of deformation. Refer to Section J1.8 of the 2005 AISC specification, as the bolts are limited to 50% of the available strength of bearing bolts when such sharing occurs.

9 c. ASTM A500 Grade B round HSS has a yield strength of 42 ksi. Due to the tighter radii and additional cold working in A500 Grade B square/rectangular HSS, the yield strength is increased to 46 ksi.

10 False. A fully composite flexural member loaded in positive moment is assumed to have full interaction if the shear connection strength exceeds that of either the tensile yield strength of the steel section or the compressive strength of the concrete slab. A fully composite flexural member loaded in negative moment is assumed to have full interaction if the shear connection strength exceeds that of either the tensile yield strength of the longitudinal reinforcing bars in the slab or the compressive strength of the steel section. See the Commentary to Section I1 of the 2005 AISC specification for further discussion.

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.



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