steel quiz

LOOKING FOR A CHALLENGE? *Modern Steel Construction*'s monthly Steel Quiz tests your knowledge of steel design and construction. The answers for many of this month's questions can be found in the 2005 AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341-05), which is available as a free download at **www.aisc.org/freepubs**.

1 True/False: When designing Ordinary Concentrically Braced Frames (OCBF) with seismic isolation systems using the AISC *Seismic Provisions for Structural Steel Buildings* (ANSI/AISC 341-05), the bracing connection requirements of Part 1, Section 14.4 apply.

2 What are the limiting width-thickness ratios for a tee section to be considered seismically compact?
a) None
b) 0.38 $\sqrt{E/F_y}$
c) 0.45 $\sqrt{E/F_y}$
d) 0.30 $\sqrt{E/F_y}$

3 True/False: The compactness limits in Table I-8-1 of ANSI/AISC 341-05 apply only to the axis about which bending or buckling occurs.

4 True/False: Braces in Special Concentrically Braced Frames (SCBF) and OCBF must be designed for $\Omega_0 Q_E$.

5 In the design of building structures, which seismic design categories ~~(SD~~C) permit the use of steel ~~sys~~tems not specifically detailed ~~for s~~eismic resistance?
a) SDC A and B only
b) SDC B and C only
c) SDC A only
d) SDC A, B, and C only

6 True/False: The AISC *Seismic Provisions* (ANSI/AISC 341-05) is used for the design of the lateral force resisting system (LFRS) when required by governing building code.

7 True/False: Hollow Structural Sections (HSS) are permitted for use in Ordinary Moment Frames (OMF).

8 True/False: When designing using ANSI/AISC 341-05, the overstrength factor (Ω_0) is applied to the seismic loading prescribed in the applicable building code only when specifically required by the AISC *Seismic Provisions*.

9 How many prequalified special moment frame (SMF) and intermediate moment frame (IMF) moment connection types currently are covered in the AISC 358-05 including Supplement No. 1?
a) 3 b) 4
c) 5 d) 6

10 Which of the following are ductile limit states used to create system fuses in the seismic structural systems prescribed in the AISC *Seismic Provisions*?
a) Member and connection yielding
b) Bearing deformation at bolt holes
c) Buckling of compression elements
d) All of the above

steel quiz ANSWERS

1 True. The last sentence of ANSI/AISC 341-05 Part 1, Section 14.1 (Scope) states that OCBF above seismic isolation systems need not comply with 14.2 and 14.3, but shall comply with 14.4 and 14.5. Therefore, the required strength for bracing connections for OCBF bracing connections above base isolation systems must meet the requirements in Section 14.4.

2 (d) According to Part 1, Section 8.2b and Table I-8-1 of ANSI/AISC 341-05, both the stem and flanges must meet a limit of $0.30\sqrt{E/F_y}$ for a tee section to be considered seismically compact.

3 False. The compactness limits in Table I-8-1 of ANSI/AISC 341-05 are intended to prevent local buckling in the inelastic range. They are independent of the axis about which bending or buckling occurs.

4 False. In ASCE 7, $E_h = \rho Q_E$, unless specifically noted otherwise. (To clarify, Q_E is not in the load combinations; E is.) Neither ASCE 7-05 nor ANSI/AISC 341-05 require the use of the amplified seismic load (Ω_0) in the design of bracing members in OCBF (or SCBF). The brace size is typically governed by compression or slenderness (ANSI/AISC 341-05 Part 1, Section 14.2).

5 Both answers B and D are acceptable. Per ASCE 7-05, Table 12.2-1, the option to design the structure as "Steel Systems Not Specifically Detailed for Seismic Resistance, Excluding Cantilever Column Systems" (often referred to as an R=3 system) is permitted in SDC B or C. SDC A does not require use of an R factor in the design of the system and the typical system used in SDC A is essentially the same as an R=3 system in terms of its details. An R=3 system cannot be used in SDC D, E, or F.

6 True. When the governing building code requires compliance with ANSI/AISC 341-05 (as in when an R=3 system is not permitted or not used), all members of the lateral force resisting system have to comply with the provisions of AISC 341. There are also non-building structural systems in Chapter 15 of SEI/ASCE 7 that do not require compliance with the AISC *Seismic Provisions*.

7 True. HSS can be used in OMF as long as the requirements of ANSI/AISC 341-05 are met. The connections required and preferred depend upon the configuration and members being framed, economics, and fabricator preferences. Design guidance for HSS moment connections can be found in the 13th Edition AISC *Steel Construction Manual* (available for purchase at **www.aisc.org/bookstore**) and AISC *Steel Design Guide 24, Hollow Structural Section Connections*. (*Steel Design Guide 24* is available at **www.aisc.org/epubs** as a free download for AISC members and for purchase by others.).

8 True. In the AISC *Seismic Provisions*, the use of the overstrength factor is only necessary where the use of *amplified seismic loads* is specifically required (see ANSI/AISC 341-05 Part 1, Section 4.1). In addition to the requirements in ANSI/AISC 341-05, the applicable building code may also require the use of load combinations including the overstrength factor (Ω_0) for the design of specific members and connections.

9 (c) There are currently five prequalified connection types included in AISC 358-05 with Supplement No. 1: the reduced beam section (RBS) connection, bolted unstiffened and stiffended extended end-plate (BUEEP and BSEEP) moment connections, bolted flange plate (BFP) moment connection, welded unreinforced flange-welded web (WUF-W) moment connection, and Kaiser bolted bracket (KBB) moment connection (a proprietary connection).

10 (d) Ductile limit states include member and connection yielding and bearing deformation at bolt holes, as well as buckling of members that conform to the width-thickness limitations of ANSI/AISC 341-05 Part 1, Table I-8-1. Rupture of a member or a connection and buckling of a connection element are not considered to be ductile limit states.

Steel SolutionsCenter

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**.