

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.

- 1 True/False: In the seismic design requirements in ASCE 7, a response spectrum is developed based upon assumed dynamic properties of a representative building.
- 2 Into which of the following ranges of period do most earthquake accelerations fall?
 - (a) 0.2 – 1.0 seconds
 - (b) 0.5 – 1.2 seconds
 - (c) 1 – 2.2 seconds
 - (d) None of the above
- 3 Which buildings are more likely to have a fundamental period that is resonant with most earthquakes?
- 4 True/False: A seismic load resisting system designated as ordinary always has less strength than one designated as special.
- 5 What is the response modification coefficient, R , in ASCE 7-05, for a steel special moment frame?
 - (a) 3.5
 - (b) 4.5
 - (c) 8
 - (d) 10
- 6 Is it correct to say that the over-strength factor, Ω_o , is used when designing elements that are intended to remain nominally elastic in the design earthquake?
- 7 When designing a moment connection for a special moment frame, which of the following approaches can be used?
 - (a) A prequalified connection can be selected from AISC 358
 - (b) A connection can be qualified based upon existing tests available in the literature per AISC 341 Appendix S
 - (c) A connection can be qualified based upon project-specific tests per AISC 341 Appendix S
 - (d) All of the above
- 8 How many moment connections are prequalified in AISC 358?
 - (a) 1
 - (b) 3
 - (c) 6
 - (d) 9
- 9 Does AISC 358 permit the use of a concrete slab in special moment frames with prequalified bolted extended end-plate moment connections?
- 10 True/False: According to ASCE 7-05, $R = 3$ systems are permitted in low-seismic applications (Seismic Design Categories A, B, and C), and the requirements of the AISC *Seismic Provisions* need not be applied.

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ANSWERS

- 1 False. The seismic design requirements in ASCE 7 are based upon the use of a response spectrum, which represents the characteristics of the design earthquake. This response spectrum is used for the design of buildings with varying dynamic properties.
- 2 (a) Most earthquake accelerations fall in a natural period range of 0.2 to 1.0 second. See Part 1 of the AISC *Seismic Design Manual* for more information on this.
- 3 (b) A typical two-story building has a fundamental period of vibration of about 0.2 seconds, while a typical 10-story building has a period of about 1.0 second. Therefore, buildings in this range are more likely to be resonant.
- 4 False. A seismic load resisting system designated as ordinary is detailed to meet ductility and redundancy requirements that are not as stringent as those of a similar system classified as special. Strength-wise, the comparison depends upon the member sizes and connections that are used, and it is not an absolute as to which system will have a higher strength.
- 5 (c) The response modification coefficient, R , in Table 12.2-1 of ASCE 7-05, for steel special moment frames is 8. Sections 14.1 and 12.2.5.5 of ASCE 7-05 provide more information on this.
- 6 Yes. Seismic load resisting systems rely on dissipation of earthquake energy through some varying level of inelastic behavior in specifically chosen elements in the structure. That is, specific components in each system are designated for such ductile behavior in order to protect the others that are not. The overstrength factor, Ω_o , is used to amplify the seismic force for elements that must be designed to remain nominally elastic.
- 7 (d) Subject to the approval of the authority having jurisdiction, an engineer may use any moment connection in an SMF that satisfies the testing requirements of AISC 341 Appendix S. This can be done with existing testing or new testing. Often, however, one of the connections that has been prequalified in AISC 358 by a panel (CPRP) according to Appendix P can be used. This prequalification means that the available testing is already known to meet the requirements in Appendix S.
- 8 (c), though you can claim partial credit if you said (b). Until recently there were three prequalified moment connections in AISC 358: two bolted extended end-plate moment connections and one reduced beam section moment connection. Three additional moment connections recently have been added by supplement: a welded unreinforced flange moment connection with a welded web, a bolted flange plate moment connection, and a proprietary connection called the Kaiser bolted bracket connection. This supplement will be available at www.aisc.org shortly.
- 9 Yes, though don't feel bad if you said no. Until recently, Section 6.2 of AISC 358 prohibited the use of SMF systems with concrete slabs when using prequalified extended end-plate moment connections. However, the same supplement that added additional connection options also relaxed this limitation, where a 1-in. gap is provided between the concrete and column faces. This is commonly accomplished with rigid insulation to maintain the required compressible gap.
- 10 True. $R = 3$ systems allow an approach for low-seismic applications in which seismic loads are treated in a manner similar to wind and gravity loads, without the capacity design or structural fuse requirements found in the AISC *Seismic Provisions*. This approach depends upon the normal ductility, redundancy, and robustness present in steel framing.

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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