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.

It's all about the AISC *Seismic Provisions* in this month's Steel Quiz, developed by AISC's Steel Solutions Center. Sharpen your pencils and go! You can download a copy of the AISC Seismic Provisions at no charge at www.aisc.org/2005seismic.

1 Does the AISC specification apply to steel structures other than buildings?

2 When must the AISC *Seismic Provisions* be used?

3 **True/False:** All structural steel buildings are required to meet the requirements of the AISC *Seismic Provisions*.

4 When is a non-building steel structure required to meet the requirements of the AISC *Seismic Provisions*?

5 What is the purpose of the Response Modification Coefficient (*R* factor) in relation to the lateral force resisting system?

6 **True/False:** The required *R* factor is associated with the ductility requirements of the SLRS?

7 How is the Response Modification Coefficient (*R* factor) used in the design process?

8 What are the seismic response characteristics of a moment frame system versus that of a braced frame system?

9 What is the difference between a Special Moment Frame, an Intermediate Moment Frame, and an Ordinary Moment Frame?

10 **True/False:** When determining the design forces for connections to comply with the AISC *Seismic Provisions*, the minimum specified yield strength F_y for the connected member is used.

TURN PAGE FOR ANSWERS

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ANSWERS

1 **Yes.** Section A1 of the Specification includes the following statement of scope:

The Specification sets forth criteria for the design, fabrication, and erection of structural steel buildings and other structures, where other structures are defined as those structures designed, fabricated and erected in a manner similar to buildings, with building-like vertical and lateral load resisting elements.

2 The AISC *Seismic Provisions* are required to be used when a Seismic Load-Resisting System (SLRS) of higher ductility ($R > 3$) is used as a means to dissipate high seismic energy. The detailing requirements of the *Seismic Provisions* are correlated to the required ductility to accommodate large deformations and drift while maintaining the structural integrity of the SLRS.

3 **False.** The applicable building code or ASCE 7 standard defines which steel building frame types must be detailed in accordance with the AISC *Seismic Provisions*. See Table 12.2-1 of ASCE 7-05 for Seismic Force-Resisting System classifications, permitted applications, and design coefficients for building systems. While most steel systems in this table do require the use of the AISC *Seismic Provisions*, there is one common type permitted in Seismic Design Categories A, B, and C that does not. The so-called steel system not detailed for seismic resistance is permitted by Section H of ASCE 7-05 Table 12.2.1.

4 Many non-building steel structures are similar to buildings and are required to be detailed in accordance with the AISC *Seismic Provisions*. Chapter 15 of ASCE 7-05 provides an approach for other non-building structures. See Table 15.4-1 of ASCE 7-05 for further details.

5 The response modification coefficient R represents the ratio of elastic response to inelastic response. That is, there are elastic forces that would develop in the seismic load-resisting system (SLRS) under the specified ground motion if the structure exhibited elastic response. But the structure will behave inelastically before these forces are reached, and the R factor is used as a divisor to determine the design forces from the elastic forces.

6 **True.** A higher R factor is indicative of a system that can accommodate more deformation and ductility during a seismic event.

7 Primarily, the R factor is used in the calculation of the design base shear. The lower the R factor, the higher the bases shear.

8 In general, a moment frame system will have more lateral flexibility than that of a comparably detailed concentrically braced frame system. The ductility required in a moment frame is provided by the beam through bending. In a concentrically braced frame, the ductility is provided by tensile yielding or compressive buckling of the brace.

9 The difference between the Special, Intermediate, and Ordinary classifications of moment frames is in the level of ductility associated with each system. The connections of Special Moment Frames are expected to be capable of sustaining an interstory drift angle of at least 0.04 radians. Intermediate Moment Frames are expected to withstand limited inelastic deformations in their members and connections. Ordinary Moment Frames are expected to withstand minimal inelastic deformations in their members and connections.

Lateral systems designed for high ductility have a higher R factor associated with them, which means they are designed for less seismic load. As the members yield and the SLRS softens, the period of the structure becomes longer and lower seismic loads are attracted.

10 **False.** Because the connection designs are often based upon developing a plastic hinge or yielding in a connected member, an estimate of the actual yield strength must be used. Called the expected strength, R_yF_y is used in these cases, where R_y Factors for various steels are stipulated in Table I-6-1 of the *Seismic Provisions*.

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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