Modern Steel Construction's monthly *Steel Quiz* allows you to test your knowledge of steel design and construction. All references to LRFD specifications pertain to the 2005 *Specification for Structural Steel Buildings*, available as a free download from AISC's web site:

www.aisc.org/2005spec

ASD references pertain to the 1989 *ASD Specification for Structural Steel Buildings*. Where appropriate, other industry standards are also referenced.

Anyone is welcome to submit questions for *Steel Quiz*—one question or 10! If you or your firm are interested in submitting a *Steel Quiz* question or column, contact ▶

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This month's *Steel Quiz* is related to Chapter E, "Design of Members for Compression," of the 2005 AISC *Specification for Structural Steel Buildings*, available as a free download at:

www.aisc.org/2005spec

1. **True or false:** The nominal compressive strength of a uniformly compressed, non-slender W-shape is always determined based on the limit state of flexural buckling.

2. Is there a distinction between compact and noncompact sections in relation to the nominal compressive strength of a compression member?

3. What effect does a slender, unstiffened element have on the strength of a compression member as opposed to that of a non-slender element?

4. Which of the following limit states may control the determination of the nominal compression strength of a compression member with slender elements?
   a. flexural buckling
   b. torsional buckling
   c. flexural-torsional buckling

5. **True or false:** The nominal compressive strength of a uniformly compressed, singly symmetric, non-slender element section is determined based on the limit states of flexural-torsional and torsional buckling.

6. **True or false:** The 2005 specification does not use KL/r as a determining factor in assessing the flexural buckling stress of compression members.

7. How is the effective length factor (K) determined for a compression member?

8. Is it permitted to neglect the effects of eccentricity on single-angle compression members?

9. What is the assumed plane of buckling for an unequal leg, single-angle web member of a planar truss where the long leg is attached to a gusset plate and the adjacent web members are attached on the same side of the gusset plate?

10. For a built-up member composed of two or more shapes, is the nominal compressive strength determined based on the built-up section acting as a unit, or the components acting individually?

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Answers

1. **False:** In most cases, the nominal compressive strength of uniformly compressed members, with compact and non-compact sections, will be determined based on the limit state of flexural buckling. However, when the torsional unbraced length is larger than the lateral unbraced length, the nominal compressive strength may be determined based on the limit states of flexural-torsional and torsional buckling. See Section E3 of the 2005 specification.

2. **No.** Compact and noncompact sections are treated in the same category for determining the nominal compressive strength of compression members. The main distinction for this determination is between that of slender and non-slender element sections.

3. Slender unstiffened elements will reduce the design strength (allowable strength) of the compression member. Such elements are designed according to Section E7 of the 2005 specification, whereby the reduction factor $Q = Q_s$ is used to account for the effects of local buckling of the element on the design strength (allowable strength) of the cross section. $Q = 1.0$ for non-slender element sections.

4. The answer is **a**, **b**, and **c**. Note that local buckling effects (slenderness) are addressed in each of these limit states with Q as described in Section E7 of the 2005 specification.

5. **True:** Section E4 of the 2005 specification stipulates that the nominal compressive strength of singly symmetric and unsymmetric members and certain doubly symmetric members, such as cruciform or built-up columns with compact and non-compact sections, be determined based on the limit states of flexural-torsional and torsional buckling. However, the stipulations of Section E4 do not apply to single angle members, which are covered in Section E5.

6. False: KL/r is a determining factor in assessing the flexural buckling stress (F_{cr}) of a compression member.

7. The engineer has many choices under the 2005 specification for assessing the effective length of compression members in a building structure. In many cases K can simply be taken as unity when the analysis methods provided in Chapter C and Appendix 7 are used, even for moment frames. When the limitations for the use of $K = 1$ are not satisfied, the traditional approaches of using the alignment chart or idealized approximate values provided in the commentary remain useful.

8. Yes, if the following three conditions are all met:
   1. Members are loaded at the ends in compression through the same leg.
   2. Members are attached by welding or by minimum two-bolt connections.
   3. There are no intermediate transverse loads.

   Design requirements for single-angle compression members are covered in Section E5 of the 2005 specification.

9. The web angle is assumed to buckle about the axis parallel to the connected leg of the angle. Said another way, buckling is assumed out-of-plane of the truss of which the web member is a part.

10. The answer is, "It depends upon the interconnection of the elements." If the built-up section is designed to act as a unit, the individual components of the built-up section must be so interconnected. This includes satisfying the requirement that the effective slenderness ratio of each of the component shapes between the fasteners does not exceed three-fourths times the governing slenderness ratio of the built-up member. See Section E6 of the 2005 specification and commentary for further guidance. ★