

steel quiz

Steel Quiz made its first appearance in the November 1995 issue of *Modern Steel Construction*. This month's Steel Quiz takes a look at some of the best questions from 1998.

- 1 **True or False:** The permissible range of strain rate for use in tension testing of a steel coupon is specified in ASTM A370 Section 8.4.1. If the test is run at the maximum speed permitted therein, the resulting yield strength F_y will be greater than that which would be obtained had the test been run at the minimum speed permitted therein.
- 2 Why is pin bearing strength (AISC *Specification* Section J7) lower than bolt bearing strength (AISC *Specification* Section J3.10) for the identical standard hole size and material thickness (assume that edge distance is not a consideration)?
- 3 The increase in bolt tension due to deformation of the connected part is known as _____.
- 4 Torsional loading of a restrained shape of an open cross section produces three stresses. What are they?
- 5 Which limit states may govern the design of a steel beam?
- 6 **True or False:** All beams need to be checked for the limit state of lateral-torsional buckling.
- 7 **True or False:** A stick-out of two threads beyond the face of the nut is required for a properly installed bolt.
- 8 A column was designed assuming 50-ksi steel and the hypothetical wide-flange cross section chosen just met the width-to-thickness ratio limit, $0.56(E/F_y)^{1/2}$. Subsequently, it was discovered that the actual yield stress of the column supplied was 65 ksi, at which the section exceeds that width-to-thickness ratio limit. Must the designer reevaluate this column as a slender-element cross section?
- 9 Which of the following number of cycles is the threshold after which fatigue must be considered in design?
 - a. 5,000
 - b. 20,000
 - c. 100,000
 - d. 2,000,000
- 10 **True or False:** As the unbraced length of a compact-section beam is increased, the limit state that controls the design will change from yielding to inelastic lateral-torsional buckling to elastic lateral-torsional buckling.

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ANSWERS

- 1 **True.** Unlike the tensile strength F_u , the yield strength F_y varies slightly with the range of strain rate that is permitted in ASTM A370.
- 2 In the latter case, the bolt head and nut provide confinement to the material that will undergo bearing deformations, which stiffens the material and increases the strength. However, a pin connected assembly usually does not benefit from the same level of confinement and the design strength is lower.
- 3 Prying action.
- 4 Shear stress due to pure (St. Venant) torsion, shear stress due to warping, and normal stress due to warping.
- 5 Beam limit states relate to strength, stability and serviceability, in flexure or shear. Those related to flexural strength and stability are: flexural yielding, lateral-torsional buckling, flange local buckling and web local buckling. Also related to strength and stability is the limit state of shear yielding and/or buckling. Serviceability limit states for beams are deflection and vibration. Kudos to you if you also recognize that beam connection limit states also matter! Extra kudos if you think about these as you design and select your beams!!
- 6 **False.** Lateral-torsional buckling is only applicable to beams bending about their major axis. Consequently, lateral bracing is not required for members loaded through their shear center and bending about their weak axis.
- 7 **False.** The RCSC *Specification* defines sufficient thread engagement as "having the end of the bolt extend beyond or at least flush with the outer face of the nut, a condition that develops the strength of the bolt."
- 8 No. Although the value decreases as yield strength increases, the critical stress for local buckling is a function of element slenderness, not the actual yield stress. Because this critical stress remains unchanged, local buckling still will not occur in the element at required strength.
- 9 **b.** Fatigue must be considered above 20,000 cycles of loading. This is stated in Appendix Section 3.1 of the *AISC Specification*.
- 10 **True.**



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Everyone 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.