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.

This month's Steel Quiz was developed by AISC's Steel Solutions Center. Sharpen your pencils and go!

1. Where in the 2005 AISC *Specification* (**www.aisc.org/2005spec**) can a design engineer find the requirements for filler metal strength level?
2. Can the strength of a weld group that is composed of segments that are parallel and transverse to the direction of loading be determined by summing the individual strengths of the weld segments?
3. Where cyclic loading requires design for fatigue resistance, does the grade of steel affect the likelihood of fatigue cracking?
4. True/False: According to the 2005 AISC *Specification*, evaluation of fatigue resistance is not required if the stress range results in compressive loads only.
5. What type of cracking is addressed by stress category F in the fatigue provisions in Appendix 3 of the 2005 AISC *Specification*?
6. True/False: Longitudinal backing bars are permitted to remain in place in assemblages that will be subject to significant cyclic loading.
7. What is the primary cause of weld cracking?
8. How can the design engineer reduce shrinkage stresses in welded connections?
9. True/False: When structural steel is cooled rapidly, a microstructure that is susceptible to cracking can be formed.
10. True/False: The American Welding Society publishes a document that specifically addresses welding in Seismic Lateral Resisting Systems.

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ANSWERS

1 Requirements for welding consumable are given in 2005 AISC *Specification* sections A3.5, J2.6, and J2.7. Permissible filler metal strengths are shown in Table J2.5, based on matching filler metals shown in AWS D1.1 Table 3.1 (**www.aws.org**).

2 Yes, if the directional increase factor for the transversely loaded segments is ignored. Alternatively, Equation J2-9b can be used with the directional increase.

3 No. Fatigue resistance is dependent on the sensitivity of the details to fatigue, the stress range, and the number of loading cycles.

4 False. According to Appendix 3 of the 2005 AISC *Specification*, evaluation of fatigue resistance is required even when the entire stress range results in compressive stress only.

5 Stress category F addresses fatigue cracks that form within the weld rather than in the base metal.

6 True. According to Section 3.5 of Appendix 3 in the 2005 AISC *Specification*, backing bars that run longitudinal (parallel) to the direction of the load are permitted to remain in place. These backing bars must be continuous or joined with complete-joint-penetration butt joints, if spliced.

7 Shrinkage stresses associated with the hot expanded weld and base metal creates residual stresses that remain after the material cools. This can result in cracking when there is insufficient ductility to accomodate these deformations.

8 Section 5.5 of AISC Design Guide 21 (available at **www.aisc.org/epubs**) lists measures that can help reduce shrinkage stresses in welded connections. Among them is reducing the volume of weld metal used, and the design engineer plays a key role in making sure that this can be done by specifying appropriate weld types, sizes, and loads.

9 True. Rapid cooling around welds can increase the possibility of the development of a sensitive heat-affected zone (HAZ), particularly with a chemistry that is high in carbon and some other alloying elements. HAZ cracking is one of three weld crack types addressed in Chapter 5 of AISC Design Guide 21. Methods for reducing cooling rates, when necessary, also are presented in the same chapter.

10 True. AWS D1.1 addresses general welding requirements, and AWS D1.8 specifically addresses the special requirements when specifying welding in seismic frames that are designed for ductility. The requirements in AWS D1.8 are referenced in the AISC *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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