steel quiz

This month's Steel Quiz focuses on fillet weld requirements per the *Specification for Structural Steel Buildings* (ANSI/AISC 360) and AISC Design Guide 21: *Welded Connections—A Primer for Engineers*. (Both are available at **www.aisc.org/publications**.) Many thanks to Laura K. Dolak, SE, who contributed this month's questions and answers.

1 The intent of *Specification* Table J2.4 (minimum fillet weld size) is to ensure sufficient:
a. material quantity **b.** heat input
c. weld visibility **d.** time spent

2 For which of the following joint types does the maximum fillet weld size apply, per AISC *Specification* section J2.2b?
a. Lap **b.** Butt
c. Inside corner **d.** Tee

3 Concerning fillet welds, the more transverse the load direction:
a. the smaller the rupture surface and the lower the strength
b. the smaller the rupture surface and the higher the strength
c. the larger the rupture surface and the lower the strength
d. the larger the rupture surface and the higher the strength

4 Which fillet weld geometry results in a higher strength-to-volume ratio?
a. ½-in. size × 12-in. length
b. ¼-in. size × 24-in. length

5 Which end-loaded fillet weld geometry results in a higher strength-to-volume ratio?
a. ¼-in. size × 24-in. length
b. ¼-in. size × 48-in. length

6 What is the minimum length for a fillet weld without reduction of design strength?
a. The weld size
b. Twice the weld size
c. Four times the weld size
d. Eight times the weld size

7 In addition to the above limitation, what is the minimum length for intermittent fillet welds?
a. ¾ in. **b.** 1 in. **c.** 1¼ in. **d.** 1½ in.

8 For a fillet welded T-joint, what is the maximum gap allowed between pieces before the weld size must be increased by the gap size?
a. 1/32 in. **b.** 1/16 in. **c.** ⅛ in. **d.** ¼ in.

TURN PAGE FOR THE ANSWERS

steel quiz ANSWERS

1 **b.** Assuming minimum weld sizes are made in a single pass (as the footnote in Table J2.4 indicates) there is a direct relationship between weld size and heat input. Sufficient heat input is required in order to achieve fusion and to slow cooling, preventing cracks that may otherwise occur. See Design Guide 21 Section 3.5.1 for more information.

2 **a.** The limits, based on material thickness, are intended to prevent melting away of exposed edges. Tee joints and inside corner joints do not have exposed edges. Butt joints cannot be joined with fillet welds. See Design Guide 21 Section 3.5.2 for images and further discussion.

3 **d.** The transverse load orientation affords strength increase because the failure "plane" is a curved surface whose area is greater than the area defined by the effective throat extruded the length of the weld (the failure plane for longitudinally loaded fillet welds). See Design Guide 21 Section 3.5.7 for discussion.

4 **b.** Strength, which is proportional to the product of length and size, is the same for each choice. Volume, which is proportional to the product of length and size squared, is half as much for choice b. **BONUS:** It should be noted that relative volume is an indirect indication of relative cost. Since labor, not material, dominates fabrication costs, the number of passes required to produce the weld can be a better indication of cost. Table 8-12 of the AISC *Steel Construction Manual* (**www.aisc.org/manual**) indicates that the ½-in. fillet weld will require four passes, whereas a ¼-in. fillet weld only requires one pass. The relative cost can be estimated as the product of the number of passes and their lengths.

5 **a.** Strength-to-volume ratios would be equal, were it not for the penalty on end-loaded fillet welds longer than 100 times their size per AISC *Specification* J2.2d. Increases in length result in less uniformity in stress distribution, owing to complex effects of relative stiffnesses in addition to shear lag. The condition does not frequently occur in practice.

6 **c.** The strength of fillet welds not meeting this criterion may be calculated with size taken as one-quarter of the length, per AISC *Specification* J2.2c.

7 **d.** See AISC *Specification* J2.2b. (e)

8 **b.** 1⁄16 in., the same as the increment between weld sizes. See Clause 5.21.1 in AWS D1.1 and Design Guide 21 Section 3.5.11 for more information.

Anyone is welcome to submit questions and answers for the 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**.