

steel quiz

This month's Steel Quiz is based on fatigue requirements in Appendix 3 of the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360, www.aisc.org/specifications). The questions and answers were contributed by Hamza Sekkak, a PhD student at the Illinois Institute of Technology. Thank you, Hamza!

- 1 Per the AISC *Specification*, fatigue resistance of members consisting of shapes or plate shall be determined when the number of live load application cycles exceeds:
a. 5,000 b. 20,000
c. 100,000 d. 500,000
- 2 **True or False:** When the applied cyclic stress range is less than the threshold allowable stress range, F_{TH} , no further evaluation of fatigue resistance is required.
- 3 Does fatigue typically need to be considered for seismic or wind loading?
- 4 **True or False:** Stress ranges that are completely in compression need to be investigated for fatigue.
- 5 From Appendix 3 in the *Specification*, stresses are calculated on the basis of The maximum permitted stress is due to peak cyclic loads.
a. live loads / F_y
b. amplified loads / $0.66F_y$
c. live loads / $0.66F_y$
d. amplified loads / F_y
- 6 Which of the two below details (with weld reinforcement removed) would be assigned fatigue Category B, and which would be assigned fatigue Category E?

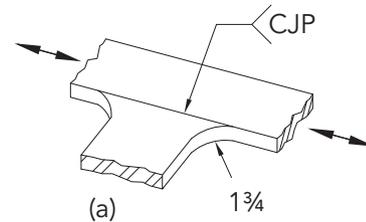


Figure 1a

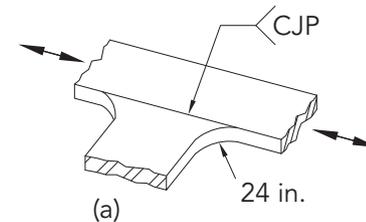


Figure 1b

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steel quiz ANSWERS

- b.** The appendix on fatigue in the *Specification* (Appendix 3) deals with high cycle fatigue (i.e., >20,000 cycles).
- True.** At low levels of cyclic tensile stress, a point is reached where the stress range is so low that fatigue cracking will not initiate regardless of the number of loading cycles. This level of stress is defined as the fatigue threshold, F_{TH} .
- No.** Section B3.11 in the *Specification* states: "Fatigue need not be considered for seismic effects or for the effects of wind loading on typical building lateral force-resisting systems and building enclosure components."
- False.** Fluctuations in stress that do not involve tensile stresses do not cause crack propagation and are not considered to be a fatigue condition. For a member subjected to compression only, cracks may initiate only in regions of high tensile residual stress and do not propagate because residual stresses are relieved by the crack. Thus, stress ranges that are completely in compression do not need to be investigated for fatigue.
- c.** The provisions of this Appendix apply to stresses calculated on the basis of live loads. Calculated stresses shall be based upon elastic analysis. Stresses shall not be amplified by stress concentration factors for geometrical

discontinuities. The maximum permitted stress due to live loads is $0.66F_y$.

- The detail shown in Figure 1a would be assigned to Category E.

The detail shown in Figure 1b would be assigned to Category B.

From Table A-3.1 in Appendix 3, the ranges of radiuses and their corresponding categories are as follows:

Description	Stress Category
$R \geq 24$ in. (600 mm)	B
6 in. $\leq R < 24$ in. (150 mm $\leq R < 600$ mm)	C
2 in. $\leq R < 6$ in. (50 mm $\leq R < 500$ mm)	D
$R < 2$ in. (50 mm)	E



If you are interested in submitting one question or an entire quiz, contact AISC's Steel Solutions Center at 866.ASK.AISC or solutions@aisc.org.