

steel quiz

This month's Steel Quiz takes a look at end-plate moment connection design as covered in AISC Design Guide 16: *Flush and Extended Multiple-Row Moment End-Plate Connections*, by Thomas M. Murray and W. Lee Shoemaker (www.aisc.org/designguides).

- 1 A flush end-plate moment connection is typically used:
- a. In frames subject to light lateral loads
 - b. Near inflection points of gable frames
 - c. At beam-to-column moment connections
 - d. a and b
 - e. a, b and c

- 2 True or False: End-plate moment connections discussed in Design Guide 16 have adequate moment-rotation stiffness to be classified as a fully restrained (FR) moment connections.

- 3 True or False: ASTM A325 bolts in end-plate moment connections not subjected to fatigue or high-seismic loading can be installed in the snug-tightened condition.

- 4 True or False: Weld access holes are required for the flange-to-end-plate welds for extended end-plate moment connections subject to high-seismic loading.

- 5 In Equation 2-7, taken from Design Guide 16, the 1.11 factor:

- a. Accounts for the variability in the yield strength of the end plate
- b. Accounts for residual stresses in the end-plate due to welding
- c. Is an additional safety factor created to help simplify the end-plate design procedure
- d. Ensures thick-plate behavior and not prying action

- 6 In Equation 2-7, taken from Design Guide 16, the γ_r factor:

- a. Ensures that a flush end plate qualifies as a fully restrained (FR) connection
- b. Is a yield line adjustment factor to account for extended end-plate configuration

- c. Accounts for minimum pretension in a snug-tight bolt
- d. Accounts for end-plate connections with axial loads

$$t_{p,reqd} = \sqrt{\frac{(1.11)\gamma_r\phi M_{np}}{\phi_b F_{py} Y}} \quad (2-7)$$

- 7 True or False: When pre-tensioned or snug-tightened bearing type end-plate moment connections are used, it is common practice to assume that the compression bolts resist all of the shear force.

- 8 When the applied moment is less than the design flexural strength of the beam, the beam flange to end-plate weld can be designed for the required flexural strength but not less than _____ of the specified minimum yield strength of the connected beam flange.

- a. 30%
- b. 40%
- c. 60%
- d. 80%

- 9 True or False: For beam shear resistance, the authors of Design Guide 16 recommend using the full depth of the beam web.

- 10 Stitch bolts between the tension and compression flange are sometimes used in deep end-plate connections to:

- a. Meet OSHA safety requirements
- b. Reduce plate separation caused by welding distortions
- c. Increase the overall connection stiffness to meet the requirements in Section B3.6 in the AISC *Specification*
- d. Provide additional bolts just in case some bolts can't be installed due to fit-up issues

TURN PAGE FOR ANSWERS

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ANSWERS

- 1 **c.** Extended end plates are typically used for beam-to-column moment connections. However, flush end plates are sometimes used for beam-to-column moment connections when a plate extension would interfere with other members or the roof deck.
- 2 True. Section B3.6b in the *AISC Specification* addresses the requirements for fully restrained (FR) moment connections.
- 3 True. Note, though, that it is very likely that snug-tightened bolts will have some percentage of pretension. The recommended design procedures in Design Guide 16 provides percentages that should be used based on the bolt diameter for ASTM A325 snug-tightened bolts.
- 4 False. Weld access holes should not be used for end-plate moment connections. Testing has shown that they significantly increases flange strain adjacent to the access hole and can cause fracture of the beam flange after the first few inelastic cycles.
- 5 **d.** When the applied load is less than $0.90 M_{pl}$ (where M_{pl} is the connection strength for the limit state of end-plate yielding), the end plate behaves as a thick plate and prying action can be neglected in the bolts.
- 6 **a.** For a flush end plate, M_u must be increased 25% to limit the connection rotation at ultimate moment to 10% of the simple-span beam rotation.
- 7 True. This is done to avoid combined tension and shear loading on the bolts at the other flange.
- 8 **c.** The 60% recommendation exists because during testing, it was observed that connections designed for low demands tended to fail at levels less than what were predicted.
- 9 False. Only the distance between the mid-depth of the beam and the inside face of the beam compression flange or the distance between the inner row of tension bolts plus two bolt diameters and the inside face of the beam compression flange, whichever is smaller, is recommended to be used. This assumption is based on engineering judgment.
- 10 **b.** Because stitch bolts are located near the member's center of gravity, the contribution to the connection flexural strength is small and therefore neglected.