steel quiz

This month's Steel Quiz focuses on AISC Design Guide 2 *Design of Steel and Composite Beams with Web Openings* (available at **www.aisc.org/designguides**).

1 True or False: A single design approach can be used for both unreinforced and reinforced openings.

2 In designing web openings, the opening depth is limited for practical reasons to which percentage of member depth?
a) 50% b) 60%
c) 70% d) 80%

3 True or False: The design procedure in Design Guide 2 excludes the use of non-compact shapes.

4 Using the design procedure in Design Guide 2, can the opening be placed above or below the center line of the beam?

5 Can reinforcement of the beam web opening be placed on one side of the web only?

6 Can a reinforcement plate be welded to the web along one side only?

7 Can a concentrated load be placed above a beam web opening?

8 True or False: Castellated beams are designed using AISC Design Guide 2.

9 Which of the following is permitted in AISC Design Guide 2?
a) Steel beams with unreinforced openings
b) Steels beams with reinforced openings
c) Composite beams with unreinforced openings
d) Composite beams with reinforced openings
e) All of the above

10 For a uniformly loaded, simply supported beam, would it be better to locate a web opening near the center of the beam or near the beam support?

11 Which of the following options could be used to avoid costly reinforcement of a beam web opening?
a) Selecting a beam with a thicker web
b) Changing the proportion of the opening
c) Moving the opening to a less critical location
d) All of the above

12 True or False: Web opening reinforcement design is typically delegated to a fabricator using option 3 in Section 3.1.2 of the AISC *Code of Standard Practice*.

13 True or False: Design Guide 2 can only be used to design one web opening per beam.

TURN TO PAGE 14 FOR ANSWERS

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ANSWERS

1. True.
2. c) 70%
3. True. This exclusion ensures that local buckling does not affect the performance; fortunately, there are few W-shapes that this exclusion affects. W44×230, W40×149, W36×135, W33×118, W30×90, W24×55, W16×26 and W12×14 are the only wide-flange shapes that have non-compact webs relative to shear.
4. Yes. The eccentricity, *e*, is measured from the center line of the steel section. For steel members, *e* is positive whether the opening is above or below the center line. For composite members, *e* is positive in the upward direction.
5. Yes, and this is preferable for the usual beam since it minimizes cost when reinforcement cannot be eliminated. However, members reinforced on one side of the web should not be used for long laterally unsupported spans. For shorter spans the lateral bracing closest to the opening should be designed for an additional load equal to 2% of the force in the compression flange. Equations 3-33 thru 3-36 provide additional requirements when reinforcement is provided on only one side of the web.
6. Yes. A fillet weld may be used on one or both sides of the bar within the length of the opening. However, fillet welds should be used on both sides of the reinforcement on extensions past the opening.
7. No, unless an alternative design approach is used.
8. False. Castellated beams have holes that are spaced with a frequency that generally exceeds the limits given for the method in AISC Design Guide 2, and are designed by manufacturer-specific methods.
9. e) All of the above.
10. In the given case, it would be better to locate a web opening near the center of the beam as it is better to locate web penetrations at areas of low shear.
11. d) All of the above.
12. False. Don't delegate the design of reinforcing around a web opening. Either eliminate the need for it or specify the reinforcement and welding requirements on the design drawings.
13. False. The design expressions in Design Guide 2 are applicable to members with individual openings or multiple openings spaced far enough apart so that the openings do not interact. Spacing requirements are provided in the design guide.