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. What does $C_b$ represent?

2. What value of $C_b$ is permitted to be used for a simple span beam, braced at each end, supporting a uniform load for the entire span length?

3. What is the difference between $Z_x$ and $S_x$?

4. Neglecting the fillets, how is $Z_x$ of a W-shape calculated?

5. Where can one find a summary of the appropriate limit states required to be checked for a flexural member of a specific shape configuration?

6. When is it permitted to use the plastic section modulus $Z_x$ for a flexural member design?

7. What is $L_p$ and how is it determined?

8. How is the weak-axis nominal flexural strength of a compact W-shape determined?

9. How is the nominal flexural strength of a compact round HSS determined?

10. How is the nominal shear strength of a round HSS determined?
steel quiz

ANSWERS

1. $C_b$ designates the lateral-torsional buckling modification factor for non-uniform moment diagrams when both ends of the unsupported segment are braced. Equation (F1-1) of the AISC specification defines the permitted $C_b$.

2. $C_b = 1.14$ is permitted for this case. See Table 3-1 in the 13th edition Steel Construction Manual for values of $C_b$ for other support conditions for simply supported beams.

3. $Z_x$ represents the plastic section modulus about the X-axis of a shape, where the full cross-section of the shape has yielded. $S_x$ represents the elastic section modulus about the x-axis of a shape where the extreme fibers of the cross-section have reached the yield point.

4. Neglecting the fillets:

   $$Z_x = \left( b_t \cdot t_b \cdot d - t_l \right) + \left[ t_w \cdot \left( d - 2t_f \right)^2 / 4 \right]$$

   for a W-shape.

5. These limit states are provided in Chapter F of the 2005 AISC specification. Table User Note F1.1 in the 2005 specification provides a guide for the application of Chapter F Sections.

6. The plastic section modulus $Z_x$ is permitted to be used in the design of a flexural member if: (1) the slenderness of all elements in the cross-section is $\leq \lambda_p$; and (2) the unbraced length of the member is $\leq L_p$.

7. $L_p$ is the limiting laterally unbraced length of a flexural member for the limit state of yielding:

   $$L_p = 1.76 \cdot t_b \cdot \sqrt{E / F_y}$$

   Equation (F2-5)

8. The weak-axis nominal flexural strength of a compact W-shape is based on the limit state of yielding (plastic moment):

   $$M_n = M_p = F_y \cdot Z \leq 1.6 \cdot F_y \cdot S_y$$

   Equation (F6-1)

9. The nominal flexural strength of a compact round HSS is based on the limit state of yielding (plastic moment):

   $$M_n = M_p = F_y \cdot Z$$

   Equation (F8-1)

10. The nominal shear strength of a round HSS is calculated based on the critical shear stress times one-half of the gross area of the cross-section:

    $$V_n = F_{cr} \cdot A_g / 2$$

    Equation (G6-1)

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.

Steel Solutions Center