steel quiz

This month's Steel Quiz takes a look at approximate second-order analysis as covered in Appendix 8 of the AISC *Specification* (**www.aisc.org/2010spec**).

1 The displacement indicated by dimension #_____ in Figure 1 results in a *P*-Δ effect and the displacement indicated by dimension #_____ results in a *P*-δ effect.
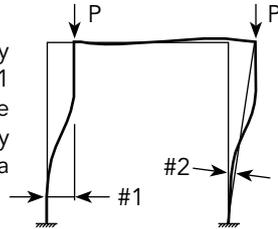
Figure 1

2 Equation (A-8-1) from the AISC *Specification* is shown below (Question 4). M_{nt} corresponds to the moments shown in Figure ___ and M_{lt} corresponds to the moments in Figure ____. (Choose between Figures 2 and 3.)
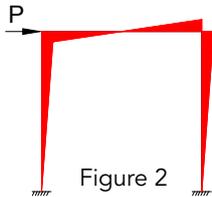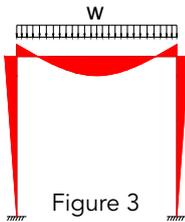
Figure 2

Figure 3

3 True or False: Gravity loads do not generate sidesway reaction forces.

4 In Equations (A-8-1) and (A-8-2) shown below, the B_1 multiplier account for _____ effects and the B_2 multiplier account for _____ effects (choose between *P*-Δ and *P*-δ).

$$M_r = B_1 M_{nt} + B_2 M_{lt} \qquad \text{(A-8-1)}$$
$$P_r = P_{nt} + B_2 P_{lt} \qquad \text{(A-8-2)}$$

5 True or False: The B_1 multiplier should be taken as 1.0 for members that are not subject to compression.

6 True or False: When using the direct analysis method and calculating B_2, the first-order inter-story drift, Δ_H, in Equation (A-8-7) should be determined based on an analysis using reduced stiffness as covered in Section C2.3.

$$P_{e\,story} = R_M \frac{HL}{\Delta H} \qquad \text{(A-8-7)}$$

TURN PAGE FOR ANSWERS

steel quiz | ANSWERS

1   Dimension #1 results in a *P-Δ* effect and Dimension #2 results in a *P-δ* effect. *P-Δ* effects are the effects of loads acting on the displaced location of joints or nodes in a structure. *P-δ* effects are the effects of loads acting on the deflected shape of a member between joints or nodes.

2   Figure 3, Figure 2. The moments in Figure 3 correspond with M_{nt}, the first-order moment with the structure restrained against lateral translation. The moments in Figure 2 correspond with M_{lt}, the first-order moment due to lateral translation of the structure only. For structures where gravity load causes negligible lateral translation, P_{nt} and M_{nt} are the effects of gravity load and P_{lt} and M_{lt} are the effects of lateral load.

3   False. Sidesway can occur under gravity loads, and ignoring this in sensitive structures can lead to significant errors in the second-order moments. This is especially true for frames with unsymmetrical framing and/or loading.

4   *P-δ* , *P-Δ*. The B_1 multiplier is used to account for *P-δ* effects. The B_2 multiplier is used to account for *P-Δ* effects.

5   True. This is stated in Section 8.2 of the AISC *Specification*.

6   True. Section 8.2.2 in the AISC *Specification* states that the first-order inter-story drift, Δ_H, is "computed using the stiffness required to be used in the analysis (stiffness reduced as provided in Section C2.3 when the direct analysis method is used)."