Modern Methods for Learning Basics of Structural Stability: From Behavior to Practice
Final Exam – December 15, 2020
Due: January 5, 2021, 8:00 a.m. EST – Submit through online form

AISC Night School

1. Steel structures and their components are often slender with limit states that include instability because of steel's:
    a. Excellent strength to weight and stiffness to weight ratios.
    b. Ductility in buckling conditions.
    c. Consistent strength to weight and stiffness to weight ratios.
    d. Inadequate strength to weight and stiffness to weight ratios.
    e. None of the above.

2. Given strengths for a full range of slenderness (L/r) of a pinned-roller supported columns, which of the following is true?
    a. The axial yield load (squash load) always exceeds the Euler buckling load.
    b. The axial yield load (squash load) always exceeds the inelastic buckling load.
    c. The axial yield load (squash load) may never exceed the Euler buckling load.
    d. The axial yield load (squash load) is reduced by the presence of residual stresses.
    e. The inelastic buckling load exceeds the Euler buckling load.

3. True or False: The AISC *Specification*'s column curve provides an exact prediction for all I-shaped sections appearing in the AISC *Manual*.
    a. True
    b. False

4. The AISC column curve accounts for:
    a. Flexural buckling impacted by partial yielding accentuated by the presence of residual stresses.
    b. Elastic flexural buckling.
    c. Full yielding of the cross section.
    d. (a) and (c) only
    e. (a), (b), and (c)

5. True or False: One should expect a higher compressive strength when running a geometric and material nonlinear analysis (GMNIA) than a linear buckling analysis (LBA).
    a. True
    b. False

6. For which of the following slenderness ratios does the column strength have the greatest discrepancy from Euler buckling strength?
    a. $L/r = 15$
    b. $L/r = 105$
    c. $L/r = 190$
    d. The strength for all of the above columns differs from Euler about the same amount.


7. The resistance to twisting a wide flange shape is related to St. Venant torsion and warping torsion. Which of the following is not true?
    a. St. Venant resistance is significantly larger for an HSS section than for a wide flange section.
    b. Torsional warping resistance for a wide flange shape increases as its depth increases.
    c. Warping resistance is produced by cross flange bending.
    d. St. Venant resistance for a wide flange section is always significantly larger than its warping resistance.

8. True or False: As the minor axis moment of inertia of a beam increases, the elastic lateral-torsional buckling moment increases.
    a. True
    b. False

9. What allowable flexural stress corresponds to the length $L_r$ in the AISC *Specification* flexural strength curve? ($C_b = 1.0$)
    a. $0.3F_y$
    b. $0.5F_y$
    c. $0.7F_y$
    d. $0.9F_y$

10. Which of the following statements best describes $L_p$?
    a. It is the unbraced length at transition from plastic to elastic LTB
    b. It is the unbraced length at transition from inelastic to elastic LTB
    c. It is the unbraced length at transition from full yield to inelastic LTB
    d. It is determined by setting the first-yield moment equal to the elastic critical moment.

11. As demonstrated in Learning Module 4, a beam with which of the following unbraced lengths ($L_b$) experienced the most twist at its own maximum applied ratio?
    a. $L_b = L_p$
    b. $L_b = L_r$
    c. $L_b > L_r$

12. Which of the following types of stiffeners, primarily used in bridge applications, were studied to restrain warping at the ends of beams?
    a. Channels
    b. Partial-depth plate stiffeners
    c. Round tubes
    d. Square tubes


13. At what level of axial force is the transition between the two linear parts of the AISC bilinear interaction curve? (Note: $P_c$ is the available axial strength.)
    a. $0.1P_c$
    b. $0.2P_c$
    c. $0.3P_c$
    d. $0.7P_c$

14. Which of the following is not a beam-column limit state?
    a. Full Yielding
    b. Flexural buckling
    c. Lateral-torsional buckling
    d. Torsional-flexural buckling
    e. None of the above – they are all beam-column limit states

15. True or False: When deriving the $B_1$ factor, the real (i.e., second-order) moment diagram for the beam-column gives a constant (non-varying) moment demand for the entire length of the beam.
    a. True
    b. False

16. How is the moment gradient effect accounted for when computing the multiplier, $B_1$?
    a. $B_1$ is a function of the lateral-torsional buckling modification factor, $C_b$.
    b. $B_1$ is a function of the equivalent uniform moment factor, $C_m$.
    c. $B_1$ does not account for moment gradient.
    d. Both (a) and (b)

17. Which of the following load effects is accounted for by AISC 360-16 Equation H1-1?
    a. Axial force
    b. Major axis moment
    c. Minor axis moment
    d. All of the above
    e. (a) and (b), but not (c)

18. True or False: As demonstrated in Learning Module 8, providing warping end restraint causes an increase in beam-column strength for major axis bending but does not for minor axis bending.
    a. True
    b. False

19. True or False: The AISC *Specification* includes provisions for both elastic and inelastic design methods.
    a. True
    b. False


20. Which of the following statements is true?
    a. Designs by the direct analysis method and the effective length method are usually quite similar.
    b. The effective length method requires a factor of 0.8 be applied to all stiffnesses contributing to the stability of the structural system.
    c. The direct analysis method with $L = L_c$ ($K = 1$) requires member out-of-straightness be explicitly modeled when computing required strengths.
    d. All of the above

21. Which of the following is correct about the stiffness reduction parameter, $\tau_b$?
    a. It is used for both the direct analysis method and the effective length method.
    b. It is permitted to be taken as 1.0 if an additional notional load is applied.
    c. It is permitted to be used in lieu of the 0.8 factor when using the direct analysis method.
    d. All of the above

22. Which of the following ways can be used to account for the effect of system imperfections on the structure response, when using the direct analysis method?
    a. Directly modeling the imperfections
    b. Applying notional loads
    c. Using an effective length factor, K, greater than 1.0
    d. (a) and (b), but not (c)
    e. (a) and (c), but not (b)

23. Which of the following parameters can be used to approximate the ratio of maximum second-order drift to maximum first-order drift, to assess the sensitivity of a structural system to second-order effects?
    a. $B_1$ multiplier
    b. $B_2$ multiplier
    c. $C_m$ factor
    d. $K$ factor

24. According to the speakers, a good use of computer power in the future would be which of the following?
    a. Use the existing analysis capabilities, but significantly increase the number of load cases being investigated.
    b. Continue to investigate the same number of load cases, but perform much more sophisticated analyses of many of them.
    c. Use computer programs to replace the engineer's judgment.