Continuing Education Course #160
Post-Tensioned Concrete Design for Buildings
Part Two

1. Throughout this course, we have used the following sign convention:
- a. Moments causing tension in the top fiber are negative
- b. Moments causing tension in the bottom fiber are positive
- c. Eccentricities below the neutral axis are negative and above the neutral axis are positive
- d. All of the above

NOTE: The following question was revised on 18 September 2018

2. To determine the moments and shears in a continuous structure, such as a one-way slab, which one of the following analysis methods could be used?
- a. A 2D computer model
- b. Standard beam diagrams
- c. ACI Moment coefficients
- d. Any one of the above

3. In the analysis of a continuous one-way post-tensioned slab system, it is acceptable to use centerline dimensions and pinned supports.
- a. True
- b. False

4. Which one of the following is true about balanced load moments?
- a. All of the below
- b. They are caused by the effective pre-stress force
- c. Balanced load moments act in the opposite direction as dead load moments
- d. They are usually chosen to be a fraction of the deal load moments, typically from 60% to 80%

NOTE: The following question was revised on 18 September 2018

5. In a continuous post-tensioned slab or beam, in which span is it most practical to add additional pre-stress?
- a. An end span
- b. An interior span
- c. The shortest interior span
- d. The center span

6. The minimum average amount of effective pre-stress in a one-way post-tensioned slab is:
- a. 100 psi
- b. 125 psi
- c. 250 psi
- d. 300 psi

7. When determining concrete stresses immediately after the transfer of pre-stress, what loads are typically present on the structure at that time?

- a. Dead and live loads
- b. Dead load and balancing load
- c. Live load
- d. Balancing load

8. The allowable concrete stresses at transfer for tension and compression, respectively, for a continuous member (i.e. not simply supported) without adding additional bonded reinforcement are:

- a. Tension stress is not allowed
- b. $f_t \leq 0.75\sqrt{f'_c}$ and $f_c \leq 0.45\ f'_c$
- c. $f_t \leq 6\sqrt{f'_c}$ and $f_c \leq 0.6f'_c$
- d. $f_t \leq 3\sqrt{f'_{ci}}$ and $f_c \leq 0.6f'_{ci}$

NOTE: The following question was revised on 18 September 2018

9. If the allowable concrete stresses at pre-stress transfer or at service load states are exceeded:

- a. The drape could be adjusted such that the stresses are within allowable limits
- b. Mild bonded reinforcing steel could be added
- c. The balanced load could be revised
- d. Any combination of the above

10. When checking concrete stresses at the service load level, the loads on the structure at that time are:

- a. All sustained loads (all permanent loads)
- b. Dead and live loads only
- c. Live loads only
- d. Self-weight of the member and pre-stress force

11. The allowable concrete stresses at service loads are:

- a. M/S using gross section properties
- b. $f_t \leq 7.5\sqrt{f'_c}$ and $f_c \leq 0.45\ f'_c$
- c. $f_t \leq 6\sqrt{f'_c}$ and $f_c \leq 0.6f'_c$
- d. $f_t \leq 3\sqrt{f'_{ci}}$ and $f_c \leq 0.6f'_{ci}$

12. Which of the following may be said about hyperstatic actions?

- a. Forces are generated by the support restraints due to post-tensioning
- b. They must be in equilibrium
- c. They include shears and moments
- d. All of the above

NOTE: The following question was revised on 18 September 2018

13. Which one of the following is true regarding mild bonded reinforcing steel for a post-tensioned member:

- a. Mild bonded reinforcing steel is only required when allowable services load stresses are exceeded
- b. The minimum amount of mild bonded reinforcing steel depends on the flexural demand
- c. Oftentimes, the minimum amount of mild bonded reinforcing steel results in sufficient nominal moment capacity
- d. Mild bonded reinforcing steel is required on both the tension and compression faces of a member

NOTE: The following question was revised on 18 September 2018

14. f_{PS} is defined as:

○ a. The stress loss in the pre-stressing steel due to pre-stress losses
○ b. The stress in the pre-stressing steel at the moment of stressing
○ c. The breaking stress in the pre-stressing steel
○ d. The stress in the pre-stressing steel at nominal flexural capacity

15. ACI requires a minimum amount of average compressive pre-stress for temperature and shrinkage.
○ a. True
○ b. False

NOTE: The following question was revised on 18 September 2018

16. The most efficient use of pre-stressing force is when:
○ a. The drapes in all spans of a continuous structure are all set to the same amount
○ b. The number of tendons is an equal number
○ c. The maximum available drape in each span is used
○ d. Tendons are grouped into bundles

17. In the two-span beam example, if the stiffness of columns was ignored, and the beam assumed to be simply supported, which one of the following would be true?
○ a. Dead load moments would be greater, but live load moments would be smaller
○ b. The negative moment at the exterior supports would be zero, the negative moment at the center support and the positive moment at mid-span would be greater
○ c. There would be no difference in the balanced load moments
○ d. Hyperstatic moments would not exist

18. When checking the concrete stresses at service loads and the allowable concrete stresses are exceeded, which of the following are possible actions to take?
○ a. Revise the balanced load
○ b. Adjust the drape
○ c. Add mild reinforcing steel
○ d. Any of the above

19. Why does ACI place limits on the allowable service load concrete tensile stresses?
○ a. To prevent collapse
○ b. To minimize pre-stress losses due to shortening
○ c. To guard against premature deterioration due to cracked concrete
○ d. To minimize the use of mild reinforcing steel

20. Satisfying service load stresses ensures adequate structural strength.
○ a. True
○ b. False

21. The hyperstatic moments computed in the two-span beam design example:
○ a. Are significant and are the same rough order as the dead load service moments
○ b. Do not need to be included in the factored load combinations
○ c. Do not affect the columns
○ d. Are insignificant and may be ignored

22. Why would there be a load factor of 1.0 for hyperstatic actions when determining the factored demand in the equation $M_u = 1.2M_D + 1.6M_L + 1.0M_{HYP}$?
○ a. Because the actual pre-stress force is accurately predicted and a load factor greater than 1.0 is not warranted.
○ b. Since hyperstatic actions reduce the dead load actions, to use a load factor greater than 1.0 would be

unconservative

- ○ c. Both of the above
- ○ d. None of the above

NOTE: The following question was revised on 18 September 2018

23. Even if shear reinforcing is not required by analysis in the middle portion of a post-tensioned beam span, it is practical to place beam stirrups at some maximum spacing such as 48" on center to help have something to anchor tendon support bars to at the correct height. True or false?

- ○ a. True
- ○ b. False

24. In the two-span beam example, referring to the Final Design Sketch on page 24, the negative moment capacity at the exterior support would be computed using which of the following equations? Assume $\mathbf{d_p}$, the depth to the centroid of the post-tensioning steel, is different than **d**, the depth to the centroid of the mild steel.

- ○ a. $\phi M_n = \phi(A_{ps} f_{ps} + A_s f_y)(d_p - \frac{a}{2})$
- ○ b. $\phi M_n = \phi A_{ps} f_{ps}(d_p - \frac{a}{2}) + \phi A_s f_y(d - \frac{a}{2})$
- ○ c. $\phi M_n = \phi(A_{ps} f_{ps})(d_p - \frac{a}{2})$
- ○ d. $M_u = 1.2M_D + 1.6M_L + 1.0M_{HYP}$

25. The minimum area of mild bonded reinforcing in a post-tensioned beam or one-way slab is:

- ○ a. Always enough to ensure adequate structural strength
- ○ b. Equal to $0.004A_g$
- ○ c. Required to prevent concrete cracks in the tensile zone
- ○ d. Equal to $0.004A_{ct}$