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Continuing Education Course #103
Post-Tensioned Concrete Design for Buildings
Part One

1. A Post-tensioned concrete structure is best defined as (choose one):
- ○ a. A type of concrete structure that mainly resists compressive forces
- ○ b. A type of pre-stressed concrete structure that is usually manufactured at a precast facility
- ○ c. A type of pre-stressed concrete in which forces are applied through the use of pre-stressing steel that is tensioned after the concrete has hardened
- ○ d. A type of concrete structure that has steel reinforcing

2. Load balancing is best described as:
- ○ a. The amount of pre-stress that results in a pre-compression of the member
- ○ b. A beam or slab that has enough tendons to balance the live load
- ○ c. A portion of the design load, usually 80% of the dead load, is selected to be balanced by the action of the tendons
- ○ d. A post-tensioned beam that has an equal amount of dead load and live load

NOTE: The following question was revised on 2 August 2018

3. Harped tendons may be used in both in cast-in-place, post-tensioned structures and in pre-tensioned, precast concrete members.
- ○ a. True
- ○ b. False

4. Tendon drape is defined as:
- ○ a. The distance from the neutral axis to the lowest point of the tendon sag
- ○ b. The maximum distance between a line connecting the applied force at each end of a member and the lowest point of the tendon sag
- ○ c. The distance between the neutral axis and the applied force at either end of the member
- ○ d. The distance between the bottom of the member and the lowest point of the tendon sag

5. In continuous post-tensioned structures with uniformly distributed loads, tendons are typically smoothly draped in parabolic and reverse parabolic profiles.
- ○ a. True
- ○ b. False

6. In simplified analysis of post-tensioned structures, as in this course, it is acceptable to use a simple upward parabolic drape in each span.
- ○ a. True
- ○ b. False

7. A continuous slab has five spans that are not equal. The same load is being balanced in each span and the effective post-tensioning force is the same for all spans. Which one of the following statements is true?

- a. All five spans will utilize the maximum available drape
- b. All five spans will have a different amount of drape, depending on their span
- c. The drape will be the same in all spans
- d. The drape in the end spans will be zero

8. Hyperstatic moments are best defined as:
- a. The moments generated in a structure due to support settlement
- b. The moments generated by post-tensioning forces due to support restraint and continuous spans
- c. The moments generated by post-tensioning forces in simple span structures
- d. The sum of the balanced load moment and the live load moment

9. A pre-stress force is applied above the neutral axis of a member. Which one of the following statements is false?
- a. The eccentricity is considered positive
- b. The moment caused by this pre-stress force is positive
- c. The pre-stress force causes tension in the bottom of the member
- d. The pre-stress force causes tension in the top of the member

10. In a statically indeterminate structure, hyperstatic moments vary linearly between supports.
- a. True
- b. False

NOTE: The following question was revised on 2 August 2018

11. Since post-tensioned members are normally built integrally with their supports, hyperstatic moments are induced in the supports, and are usually accounted for in computer software.
- a. True
- b. False

12. Which of the following sources of pre-stress loss is not usually considered?
- a. Tendon seating at force transfer
- b. Elastic shortening of concrete
- c. Thermal shortening
- d. Unintentional curvature in post-tensioning tendons

13. With regard to pre-stress seating losses, the shorter the tendon:
- a. The greater the effect of the pre-stress seating loss on the overall effective pre-stress force
- b. The lesser the effect of the pre-stress loss on the effective pre-stress force
- c. The less tension on the tendon is required to develop the required effective pre-stress force
- d. The more wobble and curvature have an effect on the effective pre-stress force

14. Pre-stress loss is best defined as:
- a. The loss in tendon tension as the jacking force is released
- b. An estimate of the amount of loss in pre-stress due to concrete creep
- c. The loss of a portion of a tendon's tension, both immediately and over time, due to a combination of factors, such as seating loss, friction, concrete strain, concrete shrinkage, concrete creep, and tendon relaxation
- d. The amount of tension lost due to poor operator technique

15. If a post-tensioned concrete member has an extreme fiber tension stress greater than $12\sqrt{(f'_c)}$, then the member is classified as:
- a. Class A
- b. Class C (cracked)

○ c. Class T (transition between cracked and uncracked)
○ d. Class U (uncracked)

16. A post-tensioned concrete beam is classified as Class C (cracked). Which one of the following is true?
○ a. The extreme fiber tension stress less than $12\sqrt{(f'_c)}$
○ b. Gross section properties may be used for deflection calculations
○ c. The section may be assumed to be uncracked for service stress calculations
○ d. Cracked section properties must be used for service stress calculations, and a bilinear moment-deflection relationship must be used for deflection calculations

17. Limiting the stresses in the concrete and tendons to below the maximum allowed by ACI at all stages of loading ensures the structure has adequate structural strength.
○ a. True
○ b. False

18. What is the allowable compression stress at force transfer at mid-span of a post-tensioned concrete beam?
○ a. 0.45 f'_c
○ b. 0.70 f'_{ci}
○ c. 0.60 f'_{ci}
○ d. 0.75 f'_c

19. What is the allowable extreme fiber compression stress at service load at mid-span of a post-tensioned concrete beam?
○ a. 0.45 f'_c
○ b. 0.70 f'_{ci}
○ c. 0.60 f'_{ci}
○ d. 0.75 f'_c

20. Pre-stressed two-way slabs must be designed with the extreme fiber tension stress no greater than:
○ a. $6\sqrt{(f'_{ci})}$
○ b. $6\sqrt{(f'_c)}$
○ c. 0.60f'_c
○ d. $3\sqrt{(f'_{ci})}$

21. Which one of the following statements is false?
○ a. Minimum area of bonded reinforcing in a one-way post-tensioned slab is a function of the yield strength f_y of the bonded steel.
○ b. Minimum area of bonded reinforcing in a post-tensioned beam is related to the area of the concrete on the tensile side of the center of gravity of the cross section.
○ c. Minimum bonded reinforcing is not required in two-way slabs in positive moment areas if the extreme fiber tension at service loads is less than $2\sqrt{(f'_c)}$.
○ d. The length of minimum bonded reinforcing, where it is required, shall be at least one-third the clear span in positive moment regions.

22. In the nominal flexural strength example, if the span were 120 feet (span to depth ratio increases from 20 to 40 > 35), the stress in the pre-stressed reinforcement at nominal moment strength f_{ps} would be different than the value computed for the 60-foot span in the example?
○ a. True
○ b. False

23. In post-tensioned flexural members, strain compatibility computations should be used to determine the nominal stress in pre-stressing steel except which one of the following cases?

- a. When there is a high percentage of bonded reinforcement
- b. When bonded reinforcing is located in the compression zone
- c. When pre-stressing steel is located in the compression zone
- d. When a more accurate determination is desired

NOTE: The following question was revised on 2 August 2018

24. In the one-way beam shear design example, at what point is shear reinforcing no longer required?

- a. When ultimate applied shear demand, V_u, is less than $\emptyset V_c$
- b. When the ultimate applied shear demand V_u is less than $0.5 \emptyset V_c$
- c. When the ultimate applied shear demand, V_u, is less than V_s
- d. One third the clear span distance from the support

25. In the one-way beam shear design example, with h = 36 inches, what would the maximum spacing of shear reinforcing be?

- a. 14" o.c.
- b. 21" o.c.
- c. 24 " o.c.
- d. 27 " o.c.