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Continuing Education Course #161  
Post-Tensioned Concrete Design for Buildings  
Part Three

1. Two-way flat slabs differ from two-way flat plates in what way:
  - a. Two-way flat plates require less reinforcing.
  - b. Two-way flat slabs require less reinforcing.
  - c. Two-way flat plates do not have drop panels.
  - d. Two-way flat slabs do not have drop panels.
2. It is acceptable to use the Direct Design Method to analyze two-way post-tensioned slab systems.
  - a. True.
  - b. False.
3. Banded tendons are used in two-way post-tensioned floor systems for which one of the following reasons:
  - a. It simplifies construction.
  - b. It reduces the amount of post-tensioning tendons required.
  - c. It behaves more like a one-way system.
  - d. It reduces the amount of mild bonded reinforcing required.
4. ACI dictates which direction the banded tendons must run in a two-way post-tensioned slab.
  - a. True.
  - b. False.
5. Structural integrity tendons in two-way slabs are best defined as:
  - a. Continuous tendons in post-tensioned beams anchored at the outside face of the exterior support.
  - b. At least two  $\frac{1}{2}$  diameter or larger tendons in each direction passing through the column core in case of a punching shear failure.
  - c. Tendons passing through the column core that are included in flexural strength calculations.
  - d. Tendons passing through the column core that are neglected in shear strength calculations.
6. Which of the following factors does not contribute to punching shear strength of two-way slabs?
  - a. Concrete compressive strength.
  - b. Column size.
  - c. Unbraced column length.
  - d. Drop panels.
7. The critical section for punching shear in two-way slabs is defined as:
  - a. The section through the slab at the face of the support.
  - b. The minimum length of perimeter around a slab support no closer than  $d/2$  to the face of support.
  - c. The minimum length of perimeter around a slab support no closer than  $d/2$  to the face of support times the slab thickness  $h$ .

d. The minimum length of perimeter around a slab support no closer than  $d/2$  to the face of support times the slab depth  $d$ .

8. Punching shear capacity for two-way post-tensioned slabs is a function of a factor times  $b_0 d \sqrt{f_c}$ . The factor is influenced by:

- a. Whether the location is a corner, edge, or interior column.
- b. The column aspect ratio.
- c. The vertical component of the pre-stress force.
- d. All of the above.

9. When calculating the shear strength for an eight-inch thick post-tensioned two-way flat plate floor at an edge column, in order for the pre-stress force to be fully effective, the slab must extend past the face of the column at least:

- a. 8"
- b. 32"
- c.  $d/2$
- d.  $h/2$

10. Eccentricity of shear is a concept that:

- a. Applies a portion of the transfer moment to the critical section as a shear stress.
- b. Is additive to the direct shear stress.
- c. Results in a shear stress of  $(\gamma_v M_{Uc})/J$
- d. All of the above.

11. For a square column, what percentage of the moment is required to be transferred by eccentricity of shear?

- a. 60%
- b. 40%
- c. 52%
- d. 48%

12. For a 12" x 60" column, where the 12" dimension is parallel to the direction of analysis (that is  $b_1 = 12"$  and  $b_2 = 60"$ ), approximately what percentage of the moment is required to be transferred by eccentricity of shear?

- a. 40%
- b. 77%
- c. 23%
- d. 60%

13. Consider a two-way slab 9 inches thick with 24" by 24" columns. What is the slab width specified by ACI over which a moment must be considered transferred at a column in a two-way slab?

- a. 24"
- b. 37.5"
- c. 42"
- d. 51"

14. Consider a two-way post-tension roof slab with typical column bays of 28 feet by 24 feet. What would the recommended minimum thickness of the slab be?

- a. 6"
- b. 7"
- c. 8"
- d. 9"

15. What is the minimum average pre-stress for a two-way post-tensioned slab?

- a. 100 psi
- b. 125 psi
- c. 200 psi
- d. 250 psi

16. In a continuous structure, if the uniformly distributed service live load exceeds 75% of the uniform service dead load:

- a. Then all spans may be loaded with the full live load to determine the maximum negative and positive moments.
- b. Then alternate span live loading arrangements must be considered to determine the maximum negative and positive moments.
- c. Then a single floor cannot be isolated for analysis.
- d. The far ends of the columns must be considered fixed.

17. What features does an equivalent frame that ACI defines have that the simplified version we have used in this course does not?

- a. Variable stiffness in the columns at the slab-column joint.
- b. Torsional members framing into sides of the column perpendicular to the direction of the span being analyzed.
- c. Variable slab stiffness at the drop panels and columns.
- d. All of the above.

18. The width of an equivalent frame is:

- a. Equal to the width to the centerline of the panels on both sides of the centerline of the equivalent frame.
- b. The average width of all the bays in the direction of analysis.
- c. The width of the column strip in the direction of analysis.
- d. The average of the tributary widths of the frames in the direction of analysis and perpendicular to the analysis.

19. It is acceptable to carry a different balanced load in different spans.

- a. True.
- b. False.

20. When is it required to have bonded reinforcing steel in positive moment areas of two-way slabs?

- a. When  $\sqrt{f_c} > 70$  psi
- b. When  $2\sqrt{f_c} > 140$  psi
- c. When tensile stress in positive moment areas exceeds  $2\sqrt{f_c}$
- d. Minimum bonded reinforcing is always required

21. What is the maximum compressive concrete strength allowed in two-way pre-stressed slabs?

- a. 4,000 psi
- b. 5,000 psi
- c. 6,000 psi
- d. There is no upper limit

22. What is the minimum area of bonded steel required in negative moment regions of two-way slabs?

- a.  $A_s = 0.00075A_{cf}$
- b.  $A_s = 0.004A_{ct}$
- c.  $A_s = 0.004A_g$
- d.  $A_s = 0.00075A_g$

23. ACI defines that the width of the band of tendons in a banded system is:

- a. The band width is not defined by ACI.
- b. Equal to  $1.5h$  on both sides of the column.
- c.  $8h$ .
- d. Five feet.

24. The center-to-center spacing of tendons, or bundles of tendons, in a slab shall be:

- a. No more than  $8h$ .
- b. No less than  $4d_b$ .
- c. No more than five feet.
- d. All of the above.

25. When the service tensile stress exceeds the allowable value, what action must be taken?

- a. The drapes or the balanced load must be adjusted such that tensile stresses are within allowable limits.
- b. The minimum area of bonded reinforcing  $A_s = 0.00075A_{cf}$  must be added.
- c. No action is required if the flexural capacity of the slab using the effective pre-stress force exceeds the factored demand.
- d. Bonded reinforcing must be added to take the total tensile force.

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