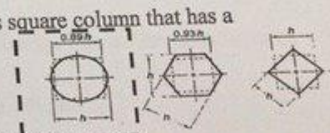
2000 ملاحظات خرسانة

٢٤/٦/٢٠١٩

Slab thickness and DDM

1. Which one of following relation is correct :
   (A) Design shear strength is greater than required shear strength.
   (B) Design shear strength is greater or equal than required shear strength.
   (C) Design shear strength is lesser than required shear strength.
   (D) Design shear strength is lesser or equal than required shear strength.
   Answer (B)
2. Concrete slab carried directly by columns , without the use of beams or girders , such slab is described by:
   (A) Flat plate
   (B) Flat slab
   (C) Solid slab
   (D) Waffle slab
   Answer (A)
3. Concrete slab carried directly by drop panels , without the use of beams or girders , such slab is described by:
   (A) Flat plate
   (B) Flat slab
   (C) Solid slab
   (D) Waffle slab
   Answer (B)
4. If the ratio of length to width of one slab panel is larger than 2, then most of the load is carried by :
   (A) Long direction.
   (B) Short direction
   (C) Long and short directions.
   (D) None of them
   Answer (B)
5. circular column that has diameter equals to 500 mm, shall be treated as square column that has a length equals to :
   (A) 400 mm (B) 440 mm (C) 445 mm (D) 450 mm



   Answer (C) ($0.89 \times 500 = 445$)
6. Enlarged head of a supporting column of a flat slab is technically known as :
   (A) Supporting end of column (B) Top of column (C) Capital (D) Drop Panel
   Answer (C)
7. Projection below the slab used to reduce the amount of negative reinforcement over a column or the minimum required slab thickness, and to increase the slab shear strength in technically known as :
   (A) Supporting end of column (B) Top of column (C) Capital (D) Drop Panel
   Answer (D)
8. Panel is a slab portion bounded by :
   (A) Column.
   (B) Beam
   (C) Wall
   (D) Column, beam and wall.
   Answer (D)

9. Column strip is a design strip with a width on each side of a column centerline equal to the :

(A) Lesser of $0.25\ell_1$ or $0.25\ \ell_2$.

(B) Lesser of $0.4\ell_1$ or $0.4\ \ell_2$.

(C)Larger of $0.25\ell_1$ or $0.25\ \ell_2$.

(D) Larger of $0.3\ell_1$ or $0.3\ \ell_2$.

Answer (A)

10. Middle strip is a design strip bounded by:

(A) Two beams

(B) Two column

(C)Two column strip

(D) None of above.

Answer (C)

11. In computing required slab thickness of drop panel below the slab shall not be assumed:

(A) Greater than one-quarter (1/4) the distance from edge of drop panel to edge of column.

(B) Greater than one-quarter (1/6) the distance from edge of drop panel to edge of column.

(C)Greater than one-quarter (1/8) the distance from edge of drop panel to edge of column.

(D) Greater than one-quarter (1/10) the distance from edge of drop panel to edge of column.

Answer (A)

12. The minimum thickness for flat slab shall not be less than:

(A) 90 mm (B) 100 mm (C) 125 mm (D) 150 mm

Answer (B)

13. The minimum thickness for interior panel for flat slab with drop panel due to deflection control is:

(A) $\frac{\ell_n}{33}$ (B) $\frac{\ell_n}{30}$ (C) $\frac{\ell_n}{40}$ (D) $\frac{\ell_n}{36}$

Answer (D)

14. The minimum thickness for exterior panel (4.5×4) m for flat plat with edge beams due to deflection control is:

(A) 90 mm (B) 100 mm (C) 250 mm (D) 140 mm

Answer (D)

15. The minimum thickness for exterior panel for flat slab with drop panel and with edge beams due to deflection control ($f_y = 420$ MPa) is:

(A) $\frac{\ell_n}{31}$ (B) $\frac{\ell_n}{30}$ (C) $\frac{\ell_n}{36}$ (D) $\frac{\ell_n}{28}$

Answer (C)

16. The minimum thickness for interior panel (6×7.2) m for flat slab with drop panels due to deflection control is($f_y = 420$ MPa):

(A) 200 mm (B) 150 mm (C) 120 mm (D) 100 mm

Answer (A)

23. For end span (exterior panel) the positive moment for slab without beams between all supports and with edge beam is:

(A) 0.35

(B) 0.65

(C) 0.16

(D) 0.5

Answer (D)

Table 8.10.4.2—Distribution coefficients for end spans

	Exterior edge unrestrained	Slab with beams between all supports	Slab without beams between interior supports		Exterior edge fully restrained
			Without edge beam	With edge beam	
Interior negative	0.75	0.70	0.70	0.70	0.65
Positive	0.63	0.57	0.52	0.50	0.35
Exterior negative	0	0.16	0.26	0.30	0.65

24. Lateral distribution of moments between middle and column strips and beams are depends upon:

(A) The ratio ℓ_2/ℓ_1

(B) The relative stiffness of the beam and the slab.

(C)The degree if torsional restraint provided by the edge beam

(D) All of above.

Answer (D)

25. For parallel nonprestressed reinforcement in a horizontal layer, clear spacing shall be at least the :

(A) Greatest of 25mm.

(B) Greatest of db.

(C) Greatest of $(4/3)d_{agg.}$

(D) All of above

Answer (D)

26. For nonprestressed solid slabs, maximum spacing (s) of deformed longitudinal reinforcement at critical section shall be the lesser of :

(A) 2h

(B) 450

(C) 2h ad 450

(D) None of above

Answer (C)

27. if width of the column or wall is at least $(3/4)\ell_2$ then:

(A) Negative Mu shall be uniformly distributed across ℓ_2

(B) Positive Mu shall be uniformly distributed across ℓ_2

(C)Positive and negative Mu shall be uniformly distributed across ℓ_2

(D) All of above

Answer (A)

28. Slab with beams between columns along exterior edges, exterior panels shall be considered to be without edge beams if α_f is :

(A) Lesser than 0.5

(B) Lesser than 0.8

(C) Larger than 1

(D) None of above

Answer (B)

29. At discontinuous edge with edge beam if α_f if lesser (<) than 0.8 than slab thickness shall be increased by at least :

(A) 5%

(B) 8%

(C) 9%

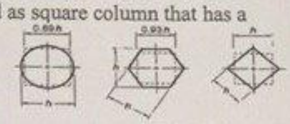
(D) 10%

Answer (D)

30. Polygon column that has dimensions equals to 500 mm, shall be treated as square column that has a length equals to :

(A) 400 mm (B) 440 mm (C) 445 mm (D) 500 mm

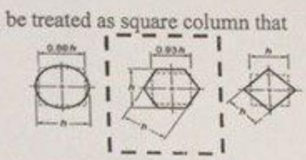
Answer (D)



31. Hexagonal column that has diagonal length equal to 500 mm , shall be treated as square column that has a length equal to :

(A) 465 mm (B) 440 mm (C) 445 mm (D) 500 mm

Answer (A) (0.93 × 500 = 465 mm)



32. The minimum thickness for an exterior panel in flat plate without edge beams (f_y = 280 MPa) is taken as :

(A) $\ell_n/28$ (B) $\ell_n/30$ (C) $\ell_n/33$ (D) $\ell_n/36$

Table 8.3.1.1—Minimum thickness of nonprestressed two-way slabs without interior beams (mm)[1]

	Without drop panels[3]			With drop panels[3]		
	Exterior panels		Interior panels	Exterior panels		Interior panels
f_y, MPa[2]	Without edge beams	With edge beams[4]		Without edge beams	With edge beams[4]	
280	$\ell_n/33$	$\ell_n/36$	$\ell_n/36$	$\ell_n/36$	$\ell_n/40$	$\ell_n/40$
420	$\ell_n/30$	$\ell_n/33$	$\ell_n/33$	$\ell_n/33$	$\ell_n/36$	$\ell_n/36$
520	$\ell_n/28$	$\ell_n/31$	$\ell_n/31$	$\ell_n/31$	$\ell_n/34$	$\ell_n/34$

Answer (c)

33. The minimum thickness for an interior panel in flat slab with drop panel (f_y = 420 MPa) is taken as :

(A) $\ell_n/33$ (B) $\ell_n/34$ (C) $\ell_n/36$ (D) $\ell_n/40$

Answer (c)

Table 8.3.1.1—Minimum thickness of nonprestressed two-way slabs without interior beams (mm)[1]

	Without drop panels[3]			With drop panels[3]		
	Exterior panels		Interior panels	Exterior panels		Interior panels
f_y, MPa[2]	Without edge beams	With edge beams[4]		Without edge beams	With edge beams[4]	
280	$\ell_n/33$	$\ell_n/36$	$\ell_n/36$	$\ell_n/36$	$\ell_n/40$	$\ell_n/40$
420	$\ell_n/30$	$\ell_n/33$	$\ell_n/33$	$\ell_n/33$	$\ell_n/36$	$\ell_n/36$
520	$\ell_n/28$	$\ell_n/31$	$\ell_n/31$	$\ell_n/31$	$\ell_n/34$	$\ell_n/34$

34. The minimum thickness for an exterior panel in flat slab with drop panel and without edge beams (f_y = 420 MPa) is taken as :

(A) $\ell_n/31$ (B) $\ell_n/33$ (C) $\ell_n/36$ (D) $\ell_n/40$

Answer (B)

Table 8.3.1.1—Minimum thickness of nonprestressed two-way slabs without interior beams (mm)[1]

f_y, MPa[2]	Without drop panels[3]			With drop panels[3]		
	Exterior panels		Interior panels	Exterior panels		Interior panels
	Without edge beams	With edge beams[4]		Without edge beams	With edge beams[4]	
280	$\ell_n/33$	$\ell_n/36$	$\ell_n/36$	$\ell_n/36$	$\ell_n/40$	$\ell_n/40$
420	$\ell_n/30$	$\ell_n/33$	$\ell_n/33$	$\ell_n/33$	$\ell_n/36$	$\ell_n/36$
520	$\ell_n/28$	$\ell_n/31$	$\ell_n/31$	$\ell_n/31$	$\ell_n/34$	$\ell_n/34$

35. Direct Design method for analysis of two way slab can be used if :

(A) There shall be at least three continuous spans in each direction.

(B) Successive span length measured center to center of supports in each direction shall not be differing by more than one – third the longer span.

(C) Panel shall be rectangular, with ratio of longer to shorter panel dimensions, measured center to center of supports, not to exceed 2.

(D) All of above

Answer (D)

36. Lateral distribution of moments are depends upon :

(A) The ration ℓ_2/ℓ_1

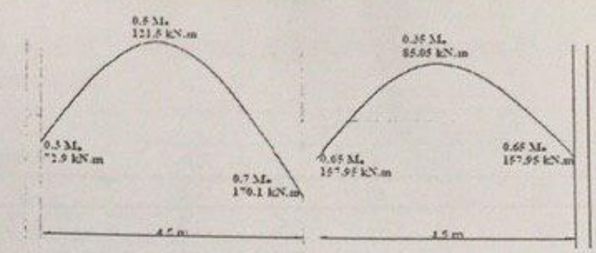
(B) The relative stiffness of the beam and the slab.

(C) The degree of torsional restraint provided by the edge beam.

(D) All of above.

Answer (D)

37. For longitudinal distribution of moments for flat plate without edge beams shown in figure below :



Choose the correct answer:

The negative moment at column strip at exterior support is :

(A) 36.3 kN.m (B) 72.9 kN.m (C) 100 kN.m (D) 46.4 kN.m

Answer (B)

C.S moment = 1 × 72.9 = 72.9

Table 8.10.5.2—Portion of exterior negative M_u in column strip

$\alpha_{f1}\ell_2/\ell_1$	β_t	ℓ_2/ℓ_1		
		0.5	1.0	2.0
0	0	1.0	1.0	1.0
	≥2.5	0.75	0.75	0.75
≥1.0	0	1.0	1.0	1.0
	≥2.5	0.90	0.75	0.45

The positive moment at middle strip at interior panel is:

(A) 34.02 kN.m (B) 90.125 kN.m (C) 21.648 kN.m (D) 74.674 kN.m

Table 8.10.5.5—Portion of positive M_u in column strip

$\alpha_{f1}\ell_2/\ell_1$	ℓ_2/ℓ_1		
	0.5	1.0	2.0
0	0.60	0.60	0.60
≥1.0	0.90	0.75	0.45

Note: Linear interpolations shall be made between values shown.

C.S moment = 0.6 × 85.05 = 51.03

M.S moment = 85.05 - 51.03 = 34.02 kN.m

Answer (A)

The negative moment at middle strip at interior panel is:
(A) 34.02 kN.m (B) 43.534 kN.m (C) 39.27 kN.m (D) 25.125 kN.m

Table 8.10.5.1—Portion of interior negative M_u in column strip

$\alpha_{f1}\ell_2/\ell_1$	ℓ_2/ℓ_1		
	0.5	1.0	2.0
0	0.75	0.75	0.75
≥1.0	0.90	0.75	0.45

Note: Linear interpolations shall be made between values shown.

C.S moment = 0.75 × 157.05 = 117.78
M.S moment = 157.05 - 117.78= 39.27 kN.m

Answer (C)

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	Exterior Span			Interior span	
	Exterior Negative	Positive	Interior Negative	Negative	Positive
Total Moment	72.9	121.5	170.1	157.95	85.05

ويطلب نفس السؤال رقم 37

Or

	Exterior Span			Interior span		Exterior Span		
	Exterior Negative	Positive	Interior Negative	Negative	Positive	Exterior Negative	Positive	Interior Negative
Total Moment	72.9	121.5	170.1	157.95	85.05	72.9	121.5	170.1

38. In direct design method, I_b (the moment of inertia of the effective beam) is based on the:
(A) Effective concrete section
(B) Gross concrete section
(C) Cracked concrete.
(D) Transformed concrete section
Answer (B)

39. In direct design method, Is (the moment of inertia of the effective slab) is based on the:
(A) Effective concrete section
(B) Gross concrete section
(C) Cracked concrete
(D) Transformed concrete section
Answer (B)

40. Beams between supports shall resist the portion of column strips Mu is :

(A) 0.5 (B) 0.75 (C) 0.85 (D) 0.9

Answer (C)

Table 8.10.5.7.1—Portion of column strip M_u in beams

$\alpha_{f1}\ell_2/\ell_1$	Distribution coefficient
0	0
≥1.0	0.85

Note: Linear interpolation shall be made between values shown

41. A Middle strip adjacent and parallel to wall is designed for :

(A) Twice the moment assigned to the half middle strip corresponding to the first row of interior support.

(B) Third the moment assigned to the half middle strip corresponding to the first row of interior support.

(C) Half the moment assigned to the half middle strip corresponding to the first row of interior support.

(D) One third the moment assigned to the half middle strip corresponding to the first row of interior support.

Answer (A)

Shear

42. Reduction factor Ø in shear is equal to:

(A) 0.9 (B) 0.8 (C) 0.75 (D) 0.65

Answer (C)

43. V_{ug} is :

(A) Is the shear strength provided by shear reinforcement

(B) Is the nominal shear strength provided by concede

(C) Is the factored shear stress on the slab critical section for two way action due to gravity loads without moment transfer.

(D) None of them

Answer (C)

44. Which of the following relation is correct:

(A) Vs = Vc – Vu (B) Vs = Vu (C) Vs = Vu/Vc (D) none of them

Answer (D)

في حال كان هناك اختيار صحيح فهو

Vu = Vc + Vs

45. The shear perimeter (b_o)for (300 × 400) mm corner column in a flat plate with 150 effective depth is

(A) 2000 mm (B) 1000 mm (C) 850 mm (D) 700 mm

Answer (C)

46. Which one of following relation is correct :

(A) Design shear strength is greater than required shear strength.

(B) Design shear strength is greater or equal than required shear strength.

(C) Design shear strength is lesser than required shear strength.

(D) Design shear strength is lesser or equal than required shear strength.

Answer (B)

47. The shear perimeter (b_o)for (500 × 500) mm interior column in a flat plate with 200 effective depth is

(A) 2000 mm (B) 1000 mm (C) 850 mm (D) 2800 mm

Answer (D)

48. The shear perimeter (b_o)for (500 × 500) mm edge column in a flat plate with 200 effective depth is

(A) 2000 mm (B) 1900 mm (C) 850 mm (D) 2800 mm

Answer (C)

49. Modified factor (γ_v) when there is a moment transfer for an interior square column is:

(A) 0.4 (B) 1 (C) 0.7 (D) 1.1

Answer (A)

$\gamma_f = \frac{1}{1+\frac{2}{3}\sqrt{\frac{b_1}{b_2}}}$ for square column b1 = b2 then γ_f = 0.6 then γ_v = 1- 0.6 = 0.4

50. Modified factor (γ_f) when there is a moment transfer for an interior square column is:

(A) 0.4 (B) 1 (C) 0.7 (D) 0.6

Answer (D)

51. An interior column with dimensions (500 × 500) mm and d = 200 mm the C_{AB} for this column is:

(A) 400 mm (B) 350 mm (C) 600 mm (D) 800 mm

Answer (B)

Remember C_{AB} = B1/2 = 7000/2 = 350 mm

ممكن يطلب

C_{AB} للكولوم Edge or corner

52. (J_c) for an interior column with dimensions (500 × 500) mm and d =170 mm is:

(A) 3.4535×10^{10} mm^4 (B) 3.07861×10^{10} mm^4 (C) 2.649×10^{10} mm^4 (D) 9.1×10^9 mm^4

Answer (A)

ممكن يطلب Jc للكولوم edge or corner

53. B_c for square column equal to :

(A) 1 (B) 0.5 (C) 1.5 (D) 4

Answer (A)

Remember $\beta c = \frac{\textit{larger length of column}}{\textit{smaller length of column}}$

54. α_s for interior column is :

(A) 20 (B) 30 (C) 40 (D) 50

Answer (C)

Remember α_s = 40 for interior column, 30 for edge column and 20 for corner column .

55. For two way members with shear reinforcement , vc shall not exceed the limits of :

(A) $0.5\sqrt{f_c'}$ (B) $0.17\sqrt{f_c'}$ (C) $0.55\sqrt{f_c'}$ (D) $0.33\sqrt{f_c'}$

Answer (B)

56. For two way members with shear reinforcement , effective depth shall be selected such that v_u calculated at critical sections does not exceed the value

(A) $0.5\sqrt{f_c}$ (B) $0.17\sqrt{f_c}$ (C) $0.55\sqrt{f_c}$ (D) $0.33\sqrt{f_c}$

Answer (A)

57. In punching shear , the first critical section will be :

(A) At d/2 from the face of the column.

(B) At d/2 from the face of the column capital

(C) At d/2 from the face of the drop panel

(D) All the above

Answer (A)

58. A reinforced concrete slab is 200 mm thick. The diameter of the stirrups that cannot be used is of

(A) 8 mm (B) 10 mm (C) 12 mm (D) 16 mm

Answer (D)

بخصوص موضوع shear ممكن يطلب فقط check بدون حساب حديد القص

Check the two-way shear action (punching shear) only around an interior column (400 × 400) mm in a flat plate floor **(just check do not calculate shear reinforcement)**, the floor will carry a total factored load of (Vu) 600 kN ,Use effective depth (d) = 180 mm, and $f_c' = 25$ MPa

Or

او ممكن يطلب حساب حديد القص (spacing)

Check the two-way shear action (punching shear) only around an interior column (400 × 400) mm in a flat plate floor ,**find the area of vertical shear reinforcement if required** the floor will carry a total factored load of (Vu) 600 kN ,Use effective depth (d) = 180 mm, and $f_c' = 25$ MPa

59. If fc` =32 MPa then vc for interior column (450 × 450) mm with effective depth (d) equal to150 is

(A) 1.7 MPa

(B) 1.867MPA

(C) 1.4 MPa

(D) 0.4 MPa

$$v_c = \min. \begin{cases} 0.33\sqrt{f_c'} = 0.33 \times \sqrt{32} = 1.867 \text{ MPa} \\ 0.17\left(1+\frac{2}{\beta}\right)\sqrt{f_c'} = 0.17 \times \left(1+\frac{2}{1}\right) \times \sqrt{32} = 2.885 \text{ MPa} \\ 0.083\left(2+\frac{\alpha_s d}{b_o}\right)\sqrt{f_c'} = 0.083 \times \left(2+\frac{40 \times 150}{2400}\right) \times \sqrt{32} = 2.113 \text{ MPa} \end{cases}$$

Answer (B)

60. What is the name of Code in our study ?

(A) ACI 318-14

(B) ACI 416 – 14

(C) ACI 222

(D) ACI 5656

Anwer (A)

Yield Line

61. In orthotropic slab
    (A) The resisting moments are equal in all directions
    (B) The resisting moment are different in two perpendicular directions
    (C) The resisting moment are different in all perpendicular directions
    (D) The resisting moment are equal in all perpendicular directions
    Answer (B)
62. In isotropic slab
    (A) The resisting moments are equal in all directions
    (B) The resisting moment are different in two perpendicular directions
    (C) The resisting moment are different in all perpendicular directions
    (D) The resisting moment are equal in all perpendicular directions
    Answer (A)
63. The internal work (IW or Wi) is :
    (A) $\sum m\ell\theta$ (B) $\sum m\ell\delta$ (C) $\sum w\ell\delta$ (D) $\sum w\ell$
    Answer (A)
64. The external work (EW or We) for slab subjected to uniform load is :
    (A) $\sum m\ell\theta$ (B) $\sum m\ell\delta$ (C) $\sum wA\delta$ (D) $\sum w\ell$
    Answer (C)
65. The internal work (IW or Wi) for square or rectangular or circular slab subjected to concentrated load at it 'is center is :
    (A) $\sum m\ell\theta$ (B) $\sum m\ell\delta$ (C) $\sum wA\delta$ (D) $P\delta$
    Answer (D)

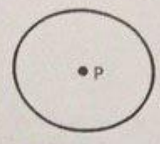
Location of axis of rotation

1. Axes of rotation generally lie **along lines of support** (the support line may be **a real hinge** as in **simple supported**, or it may establish the location of a yield line, which acts as a plastic hinge and in continuous or **fixed support**).
2. Axes of rotation **pass over any columns.**
3. The slab segments can be considered to rotate as right bodies in space about these axes of rotation.
4. Yield lines are generally **straight**.
5. A yield line passes through **the intersection of the axes of rotation** of adjacent slab.
6. A yield line passes under **the point load (concentrated force).**

ممكن يجي سؤال على واحد من النقاط اعلاه مثل سؤال 64

66. Which of the following is not a characteristic feature of yield lines?
    (A) Yield line are always parallel
    (B) Yield line sometimes be parallel with support
    (C) Yield line sometimes be nonparallel with supports
    (D) Yield line maybe intersects.
    Answer (A)

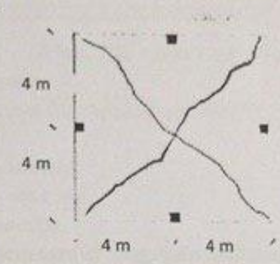
67. The exterior work (W_e) for slab subjected to concentrated load (P) shown below is:



(A) 0.5P (B) P (C) 0.3P (D) 8P

Answer (B)

68. The interior work (W_i) for square slab subjected to a concentrated load at center shown below is:



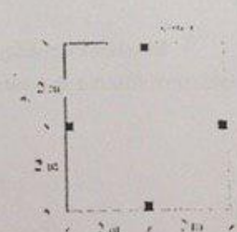
(A) 2m (B) 4m (C) 6m (D) 8m

Answer (D)

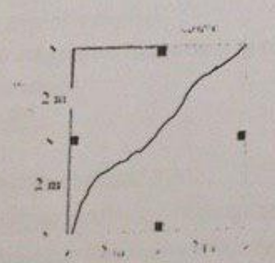
How?

$W_i = m\ell\emptyset = m \times 8 \times \frac{1}{4} \times 4_{\text{No. of segmaent}}$

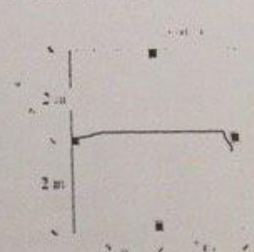
69. What is the correct yield line pattern for slab below ?



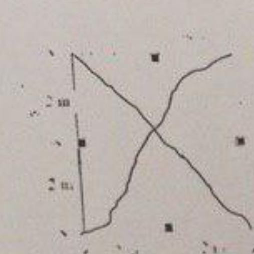
(A)



(B)



(C)



Answer (C)

70. In Class U prestress concrete is:

(A) $f_t \geq 0.62\sqrt{f_c'}$ (B) $f_t \leq 0.62\sqrt{f_c'}$ (C) $f_t > 0.62\sqrt{f_c'}$ (D) $f_t < 0.62\sqrt{f_c'}$

Answer (B)

Table 24.5.2.1—Classification of prestressed flexural members based on f_t

Assumed behavior	Class	Limits of f_t
Uncracked	U[1]	$f_t \leq 0.62\sqrt{f_c'}$
Transition between uncracked and cracked	T	$0.62\sqrt{f_c'} < f_t \leq 1.0\sqrt{f_c'}$
Cracked	C	$f_t > 1.0\sqrt{f_c'}$

[1]Prestressed two-way slabs shall be designed as Class U with $f_t \leq 0.50\sqrt{f_c'}$

وممكن يسئل عن Class T or Class C

71. Losses of prestress concrete are:

(A) Elastic expansion of concrete (B) shrinkage of steel (C) Cracks in concrete (D) Friction

Answer (D)

Advantages of prestressed concrete

1. **High strength steel and concrete**
2. **Eliminated cracks in concrete**
3. **P.C more suitable for structure of long span and those carrying heavy loads**
4. **Under D.L the deflection is reduced , owing to the cambering effected of prestress (useful for bridges and long cantilevers)**

72. Advantage of prestress concrete are :

(A) High strength steel and concrete
(B) Eliminated cracks in concrete
(C) P.C more suitable for structure of long span and those carrying heavy loads
(D) All of above

Answer (D)

Disadvantages of prestressed concrete

1. **Higher cost of materials**
2. **More complicated formwork maybe necessitated**
3. **End anchorages and bearing plates are usually required**
4. **Labor costs are greater.**

73. Disadvantage of prestress concrete are :

(A) High labor costs
(B) High cost of materials
(C) More complicated form may be required
(D) All the above.

Answer (D)

74. Pretension concrete is:

(A) Tendons tensioned before the concrete is placed
(B) Tendons is tensioned after the concrete has hardened
(C) All of above
(D) None of above

Answer (A)

75. Post tension concrete is:

(A) Tendons tensioned before the concrete is placed
(B) Tendons is tensioned after the concrete has hardened
(C) All of above
(D) None of above

Answer (B)

76. In initial stage the member:

(A) Is under prestress force and self-weight only
(B) In under prestress force and self-weight and working load
(C) None of above

Answer (A)

77. In final (service) stage the member:

(A) Is under prestress force and self-weight only
(B) In under prestress force and self-weight and working load
(C) None of above

Answer (B)

Losses in prestressing force

1. **Elastic shortening of concrete**
2. **Concrete creep under sustained load**
3. **Concrete shrinkage**
4. **Relaxation of stress in steel**
5. **Friction loss between the tendons and the concrete during stressing operation**
6. **Loss due to slip of steel strands**

ممكن يسئل سؤال عن النقاط اعلاه مثل سؤال

78. Losses in prestress could be due to :

(A) Elastic expansion of concrete
(B) Shrinkage of steel
(C) Cracks in concrete
(D) Friction

Answer (D)

79. Sustained loads mean

(A) Dead Load (B) Live load (C) Total load (D) all of above

Answer (B)

80. Concrete compressive stress limits immediately after transfer of prestress at end of simply supported is:

(A) 0.7fci` (B) $0.5\sqrt{fci}$ (C) 0.5fci` (D) 0.45 fci`

Answer (A)

Table 24.5.3.1—Concrete compressive stress limits immediately after transfer of prestress

Location	Concrete compressive stress limits
End of simply-supported members	$0.70f_{ci}'$
All other locations	$0.60f_{ci}'$

ممكن يسئل عن All other location

او عن mid span فيكون الحل لكلا الحالتين هو:

0.6 fci

81. Concrete compressive stress limits at service load for prestress plus sustained load is

(A) 0.7fci` (B) $0.5\sqrt{fci}$ (C) 0.5fci` (D) 0.45 fc

Answer (D)

Table 24.5.4.1—Concrete compressive stress limits at service loads

Load condition	Concrete compressive stress limits
Prestress plus sustained load	$0.45f_c'$
Prestress plus total load	$0.60f_c'$

ممكن يسئل عن

Concrete compressive stress limits at service load prestress plus total load

فيكون الحل

0.6fc`

82. Concrete tensile stress limits immediately after transfer of prestress in tension zone at all other location (or maybe mid span) is

(A) 0.7fci` (B) $0.25\sqrt{fci}$ (C) 0.5fci` (D) 0.45 fc

Answer (B)

Table 24.5.3.2—Concrete tensile stress limits immediately after transfer of prestress, without additional bonded reinforcement in tension zone

Location	Concrete tensile stress limits
Ends of simply-supported members	$0.50\sqrt{f_{ci}'}$
All other locations	$0.25\sqrt{f_{ci}'}$

Equivalent Frame Method

83. In equivalent frame method , the fixed end moments for a uniform load(w) will be:
(A) $< w\ell^2/12$ (B) $w\ell^2/12$ (C) $> w\ell^2/12$ (D) none of these
Answer (C)

84. Stiffness of equivalent column (modified column stiffness) is:
(A) Greater that stiffness of column
(B) Equal to stiffness of column
(C) Lesser than stiffness of column
(D) None of these
Answer (C)

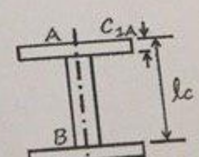
85. In Equivalent frame method , k will be
(A) <4 (B) ≤ 4 (C) =4 (D) >4
Answer (D)

86. In Equivalent frame method , COF will be
(A) < 0.5 (B) ≤ 0.5 (C) =0.5 (D) >0.5
Answer (D)

87. The flexibility of the equivalent (K_{ec}) column is equal to ____________:
(A) $\frac{1}{K_{ec}} = \frac{1}{\Sigma K_c}$
(B) $\frac{1}{K_{ec}} = \frac{1}{\Sigma K_c} - \frac{1}{\Sigma K_t}$
(C) $\frac{1}{K_{ec}} = \frac{1}{\Sigma K_c} + \frac{1}{\Sigma K_t}$
(D) None of above.
Answer (C)

88. I_{sb} is :
(A) Moment of inertia for slab.
(B) Moment of inertia for beam.
(C) Moment of inertia for slab and beam.
(D) None of above.
Answer (C)

89. If a slab thickness equal to 500 mm and ℓ_c equal to 5000 mm then K_{AB} for column equal to:
(A) 6.09 N.mm (B) 12.44 N.mm (C) 4.91 N.mm (D) 9.69 N.mm
Answer (C)



$C_{1A}/\ell_C = 500 / 5000 = 0.1$

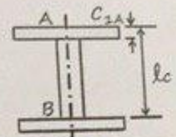
Coefficients for column stiffness.

Slab* depth	Uniform load FEM=Coeff.$(wl_2l_1^2)$		Stiffness factor		Carry over factor	
			Bottom	Top		
C_{1A}/ℓ_c	M_{AB}	M_{BA}	k_{AB}	k_{BA}	COF_{AB}	COF_{BA}
0.00	0.083	0.083	4.00	4.00	0.500	0.500
0.05	0.100	0.075	4.91	4.21	0.496	0.579
0.10	0.118	0.068	6.09	4.44	0.486	0.667
0.15	0.135	0.060	7.64	4.71	0.471	0.765
0.20	0.153	0.053	9.69	5.00	0.452	0.875
0.25	0.172	0.047	12.44	5.33	0.429	1.000

90. If a slab thickness equal to 500 mm and ℓ_c equal to 5000 mm then C_{AB} for column equal to:

(A) 6.09 (B) 0.486 (C) 4.91 (D) 9.69

Answer (B)



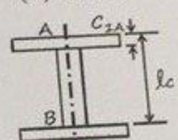
Coefficients for column stiffness.

Slab* depth	Uniform load FEM=Coeff.($wl_2l_1^2$)		Stiffness factor		Carry over factor	
			Bottom	Top		
C_{1A}/ℓ_c	M_{AB}	M_{BA}	k_{AB}	k_{BA}	COF_{AB}	COF_{BA}
0.00	0.083	0.083	4.00	4.00	0.500	0.500
0.05	0.100	0.075	4.91	4.21	0.496	0.579
0.10	0.118	0.068	6.09	4.44	0.486	0.667
0.15	0.135	0.060	7.64	4.71	0.471	0.765
0.20	0.153	0.053	9.69	5.00	0.452	0.875
0.25	0.172	0.047	12.44	5.33	0.429	1.000

91. If a slab thickness equal to 500 mm and ℓ_c equal to 5000 mm then M_{AB} for column equal to:

(A) 6.09 (B) 0.486 (C) 4.91 (D) 0.118

Answer



Coefficients for column stiffness.

Slab* depth	Uniform load FEM=Coeff.($wl_2l_1^2$)		Stiffness factor		Carry over factor	
			Bottom	Top		
C_{1A}/ℓ_c	M_{AB}	M_{BA}	k_{AB}	k_{BA}	COF_{AB}	COF_{BA}
0.00	0.083	0.083	4.00	4.00	0.500	0.500
0.05	0.100	0.075	4.91	4.21	0.496	0.579
0.10	0.118	0.068	6.09	4.44	0.486	0.667
0.15	0.135	0.060	7.64	4.71	0.471	0.765
0.20	0.153	0.053	9.69	5.00	0.452	0.875
0.25	0.172	0.047	12.44	5.33	0.429	1.000

92. At exterior supports without brackets or capitals, the critical section for negative Mu in the span perpendicular to an edge shall be at__________ of the supporting element :

(A) The center.

(B) The face.

(C) A distance not farther away than $0.175\ell_1$.

(D) None of above.

Answer (B)

93. When use equivalent frame method to analysis a slab, panel shall be:

(A) Rectangular with a ratio of longer to shorter panel dimensions measured center to center of supports, not to exceed 2.

(B) Rectangular with a ratio of longer to shorter panel dimensions measured center to center of supports, not to exceed 5.

(C) Rectangular with a ratio of longer to shorter panel dimensions measured center to center of supports, not to exceed 8.

(D) Rectangular with a ratio of longer to shorter panel dimensions measured center to center of supports, not to exceed 10.

Answer (A)

94. If L (live load) > 0.75D (dead load) then

(A) Maximum factored moment when full factored L on all spans

(B) Pattern live loading using 0.75 factored L to determine maximum factored moment

(C) Both of above

(D) None of above

Answer (B)

95. If L (live load) ≤0.75D (dead load) then

(A) Maximum factored moment when full factored L on all spans

(B) Pattern live loading using 0.75 factored L to determine maximum factored moment

(C) Both of above

(D) None of above

Answer (A)

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Monthly Exam
Reinforced Concrete Design II
Subjects: Prestress Concrete and Slab Thickness

Stage: 4th Group A
Time: 1 and 30 min
Date: 4 / 5/ 2019

Answer all questions

Q1

A. Choose the correct answer ,use $f_y = 420$ MPa: **(20 Marks)**

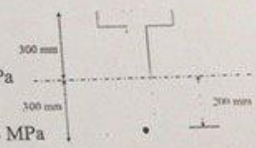
1. The minimum thickness for flat slab shall not be less than:
   (A) 90 mm (B) 100 mm (C) 125 mm (D) 150 mm
2. The minimum thickness for interior panel for flat slab with drop panel due to deflection control is:
   (A) $\frac{\ell_n}{33}$ (B) $\frac{\ell_n}{30}$ (C) $\frac{\ell_n}{40}$ (D) $\frac{\ell_n}{36}$
3. The minimum thickness for exterior panel (4.5 × 4) m for flat plat with edge beams due to deflection control is:
   (A) 90 mm (B) 100 mm (C) 250 mm (D) 140 mm
4. The minimum thickness for exterior panel for flat slab with drop panel and with edge beams due to deflection control is :
   (A) $\frac{\ell_n}{31}$ (B) $\frac{\ell_n}{30}$ (C) $\frac{\ell_n}{36}$ (D) $\frac{\ell_n}{28}$
5. The minimum thickness for interior panel (6 × 7.2) m for flat slab with drop panels due to deflection control is:
   (A) 200 mm (B) 150 mm (C) 120 mm (D) 100 mm

B. Find the minimum thickness for slab with beams ,use $f_y = 420$ MPa **(20 Marks)**

1. Slab with beams (7.8 × 7.8) m clear span with $\alpha_m = 3.4$
2. Slab with beams (6.1 × 5.2) m clear span with $\alpha_m = 1.4$

Q2:

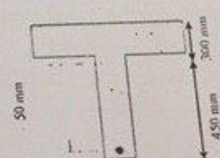
A. A simply supported symmetrical I prestressed beam, of span 12 m and its cross section is carrying a live load equal to 10 kN/m. in addition to its weight compute following allowable stress and compare it with ACI allowable stress: Use $\gamma = 25$ kN/m³, $I = 4 \times 10^9$ mm⁴, $A_c = 100 \times 10^3$ mm², $C_t = C_b = 300$ mm, Pi = 800 kN, Pe = 600 kN,
(20 Marks)



1. Top fiber stress at ends in initial stage is :
   (A) −5 MPa (B) 1.5 MPa (C) −3 MPa (D) 4 MPa
2. Bottom fiber stress at mid span in final stage is :
   (A) 1.875 MPa (B) − 3.25 MPa (C) −1.24 MPa (D) 1.13 MPa
3. Losses in pretension concrete are________ posttension concrete.
   (A) Smaller than. (B) Larger than. (C) Same as. (D) None of them.

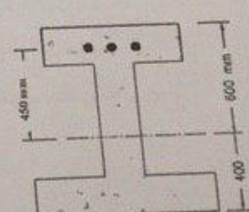
B. A simply supported prestressed beam, of span 12 m and its cross section is shown in Figure, is carrying a service load equals to 10 kN/m. Compute the required prestressing forces for: **(20 Marks)**

a. Top fiber stress equals to zero under beam weight plus prestressing force only.
b. Bottom fiber stress equals to zero under full loads.
Use $\gamma_c = 24$ kN/m³, $I = 11 \times 10^9$ mm⁴, $A_g = 130000$ mm².



Q3: A cantilever prestressed beam, of span 10 m and its cross section is shown in Figure, is carrying a service load equals to 10 kN/m. Compute the required prestressing forces for: **(20 Marks)**

a. Bottom fiber stress equals to zero under beam weight plus prestressing force only.
Use $\gamma_c = 24$ kN/m³, $I = 18 \times 10^9$ mm⁴, $A_g = 120000$ mm².



Good Luck :)

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Monthly Exam
Reinforced Concrete Design II
Subjects: Prestress Concrete and Slab Thickness

Stage: 4th Group A
Time: 1 and 30 min
Date: 4 / 5/ 2019

(a) Slabs without drop panels as given in 8.2.4... 125 mm.
(b) Slabs with drop panels as given in 8.2.4........ 100 mm.

Table 8.3.1.1—Minimum thickness of nonprestressed two-way slabs without interior beams (mm)[1]

f_y, MPa[2]	Without drop panels[3]			With drop panels[3]		
	Exterior panels		Interior panels	Exterior panels		Interior panels
	Without edge beams	With edge beams[4]		Without edge beams	With edge beams[4]	
280	$\ell_n/33$	$\ell_n/36$	$\ell_n/36$	$\ell_n/36$	$\ell_n/40$	$\ell_n/40$
420	$\ell_n/30$	$\ell_n/33$	$\ell_n/33$	$\ell_n/33$	$\ell_n/36$	$\ell_n/36$
520	$\ell_n/28$	$\ell_n/31$	$\ell_n/31$	$\ell_n/31$	$\ell_n/34$	$\ell_n/34$

Table 8.3.1.2—Minimum thickness of nonprestressed two-way slabs with beams spanning between supports on all sides

α_{fm}[1]	Minimum h, mm		
$\alpha_{fm} \le 0.2$	8.3.1.1 applies		(a)
$0.2 < \alpha_{fm} \le 2.0$	Greater of:	$\dfrac{\ell_n\left(0.8+\dfrac{f_y}{1400}\right)}{36+5\beta(\alpha_{fm}-0.2)}$	(b)[2],[3]
		125	(c)
$\alpha_{fm} > 2.0$	Greater of:	$\dfrac{\ell_n\left(0.8+\dfrac{f_y}{1400}\right)}{36+9\beta}$	(d)[2],[3]
		90	(e)

$$f_{ti} = \frac{-P_i}{A} + \frac{P_i \times e \times C_t}{I} - \frac{M_g \times C_t}{I}$$

$$f_{bi} = \frac{-P_i}{A} - \frac{P_i \times e \times C_b}{I} + \frac{M_g \times C_b}{I}$$

$$f_{ts} = \frac{-P_e}{A} + \frac{P_e \times e \times C_t}{I} - \frac{M_g \times C_t}{I} - \frac{M_s \times C_t}{I}$$

$$f_{bs} = \frac{-P_e}{A} - \frac{P_e \times e \times C_b}{I} + \frac{M_g \times C_b}{I} + \frac{M_s \times C_b}{I}$$

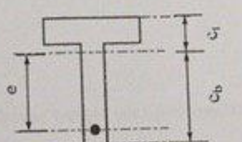

Table 24.5.3.1—Concrete compressive stress limits immediately after transfer of prestress

Location	Concrete compressive stress limits
End of simply-supported members	$0.70f_{ci}'$
All other locations	$0.60f_{ci}'$

Table 24.5.3.2—Concrete tensile stress limits immediately after transfer of prestress, without additional bonded reinforcement in tension zone

Location	Concrete tensile stress limits
Ends of simply-supported members	$0.50\sqrt{f_{ci}'}$
All other locations	$0.25\sqrt{f_{ci}'}$

Table 24.5.4.1—Concrete compressive stress limits at service loads

Load condition	Concrete compressive stress limits
Prestress plus sustained load	$0.45f_c'$
Prestress plus total load	$0.60f_c'$

Table 24.5.2.1—Classification of prestressed flexural members based on f_t

Assumed behavior	Class	Limits of f_t
Uncracked	U[1]	$f_t \le 0.62\sqrt{f_c'}$
Transition between uncracked and cracked	T	$0.62\sqrt{f_c'} < f_t \le 1.0\sqrt{f_c'}$
Cracked	C	$f_t > 1.0\sqrt{f_c'}$

[1]Prestressed two-way slabs shall be designed as Class U with $f_t \le 0.50\sqrt{f_c'}$.

Q1

Typical Solution

A (20%)

1. B 2. D 3. D 4. C 5. A

B (20%)

1. Slab with beams (7.8 × 7.8) m clear span with α_m= 3.4

α_m= 3.4 > 2

$$h = \frac{\ell n(0.8+\frac{fy}{1400})}{36+9\beta} \quad \beta = \frac{\ell n}{Sn} = \frac{7.8}{7.8} = 1$$

$$h = \frac{7800 \times (0.8 + \frac{420}{1400})}{36+9 \times 1} = 190.667 \text{ mm} > 90 \text{ mm O.K}$$

Use h = 200 mm

2. Slab with beams (6.1 × 5.2) m clear span with α_m= 1.4

$0.2 < \alpha_m = 1.4 < 2.0$

$$h = \frac{\ell n\left(0.8 + \frac{fy}{1400}\right)}{36+5\beta(\alpha_{fm}-0.2)} \quad \beta = \frac{\ell n}{Sn} = \frac{6.1}{5.2} = 1.17$$

$$h = \frac{6100\times\left(0.8 + \frac{420}{1400}\right)}{36 + 5 \times 1.17 \times (1.4-0.2)} = 155.97 \text{ mm} > 125 \text{ mm O.k}$$

Use h = 160 mm ■

Q2:

A (20%)

1. D Not O.K 2.A O.K 3.B

B (20%)

C_t = 300 mm, C_b = 450 mm, e = 450 − 50 = 400 mm

$W_g = A \times \gamma$

$W_g = 130000 \times 10^{-6} \times 24 = 3.12$ kN/m

$$M_g = \frac{W_g \times \ell^2}{8} = \frac{3.12 \times 12^2}{8} = 56.16 \text{ kN.m}$$

$$M_s = \frac{W_s \times \ell^2}{8} = \frac{10 \times 12^2}{8} = 180 \text{ kN.m}$$

a. Top fiber stress equals to zero under beam weight plus prestressing force only

$$f_{ti} = \frac{-P}{A} + \frac{P \times e \times C_t}{I} - \frac{M_g \times C_t}{I}$$

$$0 = \frac{-P \times 10^3}{130000} + \frac{P \times 10^3 \times 400 \times 300}{11 \times 10^9} - \frac{56.16 \times 10^6 \times 300}{11 \times 10^9}$$

$$0 = \frac{-P}{130} + \frac{P \times 3}{275} - 1.5316$$

$P \times 3.2.167 \times 10^{-3} = 1.5316$

$$P = \frac{1.5316}{3.2167 \times 10^{-3}}$$

$\therefore P = 476.14$ kN ■

b. Bottom fiber stress equals to zero under full load

$$f_{bs} = \frac{-P}{A} - \frac{P \times e \times C_b}{I} + \frac{M_g \times C_b}{I} + \frac{M_s \times C_b}{I}$$

$$0 = \frac{-P \times 10^3}{130000} - \frac{P \times 10^3 \times 400 \times 450}{11 \times 10^9} + \frac{56.16 \times 10^6 \times 450}{11 \times 10^9} + \frac{180 \times 10^6 \times 450}{11 \times 10^9}$$

$$0 = \frac{-P}{130} - \frac{P \times 9}{550} + 2.297 + 7.363$$

$P \times 0.0241 = 9.66$

$$\therefore P = \frac{9.66}{0.0241} = 400.8 \text{ kN} ■$$

Q3: (20%)

$C_t = 600$ mm, $C_b = 400$ mm, e = 450 mm

$W_g = A \times \gamma$

$W_g = 120000 \times 10^{-6} \times 24 = 2.88$ kN/m

$M_g = \frac{W_g \times \ell^2}{2} = \frac{2.88 \times 10^2}{2} = 144$ kN.m

Bottom fiber stress equals to zero under beam weight plus prestressing force only

$f_{bi} = \frac{-P_i}{A} + \frac{P_i \times e \times C_b}{I} - \frac{M_g \times C_b}{I}$

$0 = \frac{-P \times 10^3}{120000} + \frac{P \times 10^3 \times 450 \times 400}{18 \times 10^9} - \frac{144 \times 10^6 \times 400}{18 \times 10^9}$

$0 = \frac{-P}{120} + \frac{P}{100} - 3.2$

$P \times 1.667 \times 10^{-3} = 3.2$

$P = \frac{3.2}{1.667 \times 10^{-3}}$

$\therefore P = 1920$ kN ■

Student Al-Elem University College
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Monthly Exam
Reinforced Concrete Design II
Subjects: Moment Transfer in Two-Way Slabs

Stage: 4th Group A
Time: 1 Hour.
Date: 27 / 02/ 2019

Typical Solutions

Q.1 (40 %): A flat plate floor has a thickness equals to 190 mm, and supported by 350 mm square columns spaced 5.0 m on center each way. Check the adequacy of the slab in resisting punching shear at a typical interior column, and provide shear reinforcement, if needed. The floor will carry a total factored load of 450 kN and the factored slab moment resisted by the column is 20 kN.m. Use effective depth = 150 mm, f_y = 420 MPa, and $f_c^{'}$ = 35 MPa

Solution:

$b_1 = C_1 + d = 350 + 150 = 500$ mm

$b_2 = C_2 + d = 350 + 150 = 500$ mm

$b_o = 2b_1 + 2b_2 = 2 \times 500 + 2 \times 500 = 2000$ mm

$C_{AB} = \frac{b_1}{2} = \frac{500}{2} = 250$ mm

$$J_c = 2\left(\frac{b_1 d^3}{12} + \frac{d b_1^{\,3}}{12}\right) + 2(b_2 d)\left(\frac{b_1}{2}\right)^2$$

$$J_c = 2\left(\frac{500 \times 150^3}{12} + \frac{150 \times 500^3}{12}\right) + 2 \times (500 \times 150) \times \left(\frac{500}{2}\right)^2$$

$J_c = 1.278 \times 10^{10}$ mm^4

$$v_{ug} = \frac{V_u}{b_o \cdot d} = \frac{450 \times 10^3}{2000 \times 150} = 1.5 \text{ MPa}$$

$$v_c = \min.\begin{cases} 0.33\sqrt{f_c'} = \mathbf{1.952} \text{ MPa} \\ 0.17\left(1 + \frac{2}{\beta}\right)\sqrt{f_c'} = 3.017 \text{ MPa} \\ 0.083\left(2 + \frac{\alpha_s d}{b_o}\right)\sqrt{f_c'} = 2.455 \text{ MPa} \end{cases}$$

$\therefore \; v_c = 1.952$ MPa

$\phi v_c = 0.75 \times 1.952 = 1.464$ MPa

$$\gamma_f = \frac{1}{1 + \left(\frac{2}{3}\right)\sqrt{\frac{b_1}{b_2}}} = \frac{1}{1 + \left(\frac{2}{3}\right)\sqrt{\frac{500}{500}}} = 0.6$$

$\gamma_v = 1 - \gamma_f = 1 - 0.6 = 0.4$

$$v_{u,AB} = v_{ug} + \frac{\gamma_v M_{sc} c_{AB}}{J_c} = 1.5 + \frac{0.4 \times 20 \times 10^6 \times 250}{1.278 \times 10^{10}} = 1.656 \text{ MPa}$$

$v_u = 1.656 > \phi v_c = 1.464$ MPa Not O.K

$\therefore$ Shear reinforcement is required.

$v_u \le \phi\, 0.5\sqrt{f_c'}$

$v_u = 1.656 \text{ MPa} < 0.75 \times 0.5 \times \sqrt{35} = 2.2185$ MPa O.K.

$v_c = 0.17\sqrt{f_c'} = 0.17 \times \sqrt{35} = 1.005$ MPa

$$v_s = \frac{v_u}{\phi} - v_c = \frac{1.656}{0.75} - 1.005 = 1.203 \text{ MPa}$$

$$v_s = \frac{A_v f_y}{b_o s}$$

$$\Rightarrow \; A_v = \frac{v_s b_o s}{f_y} = \frac{1.203 \times 2000 \times 75}{420} = 429.64 \text{ mm}^2 \;\blacksquare$$

Q.2 (60 %): The flat plate slab of 200 mm total thickness and 160 mm effective depth is carried by 500 mm square column 6.0 m on centers in each direction. A factored load of 21.97 kN/m^2 and a factored slab moment resisted by the column is 25 kN.m must be transmitted from the slab to a typical edge column about an axis parallel to the edge of slab. Determine spacing of closed stirrups of vertical shear reinforcement if required. Use Ø = 12 mm for closed stirrups, f_y = 420 MPa and fc` = 30 MPa.

Solution:

$b_1 = C_1 + \frac{d}{2} = 500 + 80 = 580$ mm

$b_2 = C_2 + d = 500 + 160 = 660$ mm

$b_o = 2b_1 + b_2 = 2 \times 580 + 660 = 1820$ mm

$$c_{AB} = \frac{2(b_1 d)\left(\frac{b_1}{2}\right)}{2(b_1 d) + b_2 d} = 184.84 \text{ mm}$$

$$J_c = 2\left[\frac{b_1 d^3}{12} + \frac{d b_1^{\,3}}{12} + (b_1 d)\left(\frac{b_1}{2} - c_{AB}\right)^2\right] + (b_2 d)c_{AB}^2$$

$J_c = 1.1259 \times 10^{10}$ mm^4

$V_u = 21.97 \times (6 \times 3.25 - 0.58 \times 0.66) = 420$ kN

$$v_{ug} = \frac{V_u}{b_o \cdot d} = \frac{420 \times 10^3}{1820 \times 160} = 1.442 \text{ MPa}$$

$$v_c = \min.\begin{cases} 0.33\sqrt{f_c'} = \mathbf{1.807} \text{ MPa} \\ 0.17\left(1 + \frac{2}{\beta}\right)\sqrt{f_c'} = 2.793 \text{ MPa} \\ 0.083\left(2 + \frac{\alpha_s d}{b_o}\right)\sqrt{f_c'} = 2.108 \text{ MPa} \end{cases}$$

$\therefore \phi v_c = 0.75 \times 1.8067 = 1.355$ MPa

$$\gamma_f = \frac{1}{1 + \left(\frac{2}{3}\right)\sqrt{\frac{b_1}{b_2}}} = \frac{1}{1 + \left(\frac{2}{3}\right)\sqrt{\frac{580}{660}}} = 0.615$$

$\gamma_v = 1 - \gamma_f = 1 - 0.615 = 0.385$

$$v_{u,AB} = v_{ug} + \frac{\gamma_v M_{sc} c_{AB}}{J_c} = 1.442 + \frac{0.385 \times 25 \times 10^6 \times 184.84}{1.1259 \times 10^{10}}$$

$v_{u,AB} = 1.6$ MPa

$v_u = 1.6 > \phi v_c = 1.355$ MPa Not O.K

$\therefore$ Shear reinforcement is required.

$v_u \le \phi\, 0.5\sqrt{f_c'}$

$v_u = 1.6 \text{ MPa} < 0.75 \times 0.5\sqrt{30} = 2.05$ MPa O.K.

$v_c = 0.17\sqrt{f_c'} = 0.17 \times \sqrt{30} = 0.931$ MPa

$$v_s = \frac{v_u}{\phi} - v_c = \frac{1.6}{0.75} - 0.931 = 1.202 \text{ MPa}$$

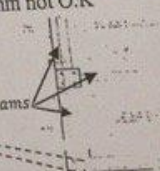
$$S = \frac{A_v f_y}{b_o v_s} = \frac{678.6 \times 420}{1820 \times 1.202} = 130 > \frac{d}{2} = 80 \text{ mm not O.K}$$

Use S = 80 mm ■

Note about Calculating A_v

$A_v = \frac{\pi}{4} \times 12^2 \times 2_{No.of\ Legs} \times 3_{No.\ of\ Beams}$

$A_v = 678.6$ mm^2



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Monthly Exam
Reinforced Concrete Design II
Subjects: DDM and Shear

Stage: 4th Group B
Time: 2 Hours.
Date: 5 / 1 / 2018

Typical Solutions

Q.1 (40 %): for the transverse interior frame (B) of the flat plate with edge beam shown in figure below by using direct design method find:

1. Longitudinal distribution of the static moment at factored loads.

2. Lateral distribution of the moment at exterior support.

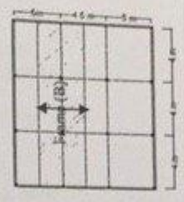
Slab thickness = 210 mm, d = 170 mm

q_u = 18 kN/m^2

All columns = 500 × 500 mm

All edge beams = 300 × 600 mm

fc`= 28 MPa, f_y = 420 MPa



Solution

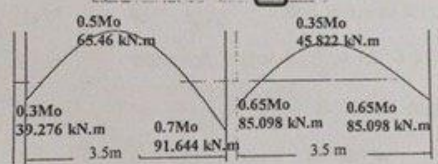
1-Longitudinal distribution

$q_u = 18\ kN/m^2,\ \ell_2 = \left(\frac{5}{2}+\frac{4.5}{2}\right) = 4.75\ m$

$\ell_n = 4 - 0.5 = \mathbf{3.5}\ m > 0.65 \times 4 = 2.6\ m$

$M_o = \frac{q_u \ell_n^2 \ell_2}{8} = \frac{18 \times 3.5^2 \times 4.75}{8} = 130.92\ kN.m$

Table 8.10.4.2—Distribution coefficients for end spans



2-Lateral distribution

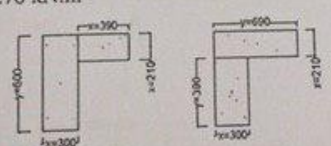
For exterior support

Negative moment = 39.276 kN.m

$\alpha_f = 0$

Find βt:

$\beta_t = \frac{C}{2 I_s}$



Calculate C:

$C = \sum\left(1 - 0.63\frac{x}{y}\right)\left(\frac{x^3 y}{3}\right)$

$C1 = \left(1 - 0.63 \times \frac{300}{600}\right)\left(\frac{300^3 \times 600}{3}\right) + \left(1 - 0.63 \times \frac{210}{390}\right)\left(\frac{210^3 \times 390}{3}\right)$

$C1 = 4.495 \times 10^9\ mm^4$

$C2 = \left(1 - 0.63 \times \frac{300}{390}\right)\left(\frac{300^3 \times 390}{3}\right) + \left(1 - 0.63 \times \frac{210}{690}\right)\left(\frac{210^3 \times 690}{3}\right)$

$C2 = 3.5306 \times 10^9\ mm^4$ Use larger $\therefore$ $\mathbf{C = 4.495 \times 10^9}$ mm^4

$Is = \frac{\ell_2 \times h_{slab}^3}{12} = \frac{4750 \times 210^3}{12} = 3.6658 \times 10^9\ mm^4$

$\beta_t = \frac{C}{2 I_S} = \frac{4.495 \times 10^9}{2 \times 3.6658 \times 10^9} = 0.613$

-Exterior C.S $_{coefficient}$% = 100−10βt + ~~12 βt~~ $(\alpha_{f1}\frac{\ell_2}{\ell_1})$ × $(1 - \frac{\ell_2}{\ell_1})$ → 0

-Exterior C.S $_{coefficient}$% = 100−10 × 0.613 = 93.87 % = 0.9387

-Exterior Mc.s = 0.9387 × 39.276 = 36.868 kN.m

-Exterior Mm.s = 39.276 −36.868 = 2.408 kN.m ■

Q.2(40 %): Check the two way shear action (punching shear) only around an interior column (300×300) mm in a flat plate floor of a span (6.0×6.0) m. Find the area of vertical shear reinforcement if required. Assume d = 190 mm. Total q_u = 19 kPa (including slab weight). f_c' = 25 MPa, f_y = 414 MPa.

Solution:

$(b_o) = (300 + 190) \times 4 = 1960\ mm$

$Vu = 19 \times (6 \times 6 - 0.49 \times 0.49) = 679.438\ kN$

$v_{ug} = \frac{Vu}{b_o \cdot d} = \frac{679.438 \times 10^3}{1960 \times 190} = 1.824\ MPa$

$v_c = \min.\begin{cases} 0.33\sqrt{25} = \mathbf{1.65\ MPa} \\ 0.17\left(1+\frac{2}{1}\right) \times \sqrt{25} = 2.55\ MPa \\ 0.083\left(2 + \frac{40 \times 190}{1960}\right) \times \sqrt{25} = 2.439\ MPa \end{cases}$

$\therefore\ \mathbf{v_c = 1.65\ MPa}$

$\Phi v_c = 0.75 \times 1.65 = 1.2375\ MPa < v_u = 1.824\ MPa$

Not O.K.

∴ Shear reinforcement is required

$v_u = 1.824\ MPa < 0.75 \times 0.5 \times \sqrt{25} = 1.875\ MPa$ O.K.

$v_c = 0.17\sqrt{f_c'} = 0.17 \times \sqrt{25} = 0.85\ MPa$

$v_s = \frac{v_u}{\phi} - v_c = \frac{1.824}{0.75} - 0.85 = 1.582\ MPa$

$v_s = \frac{A_v f_y}{b_o\, s}$ Where $s = \frac{d}{2} = \frac{190}{2} = 95\ mm$

$A_v = \frac{v_s\, b_o\, s}{f_y} = \frac{1.582 \times 1960 \times 95}{414} = 711.5\ mm^2$

The required area of vertical shear reinforcement = 711.5 mm^2 ■

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Monthly Exam
Reinforced Concrete Design II
Subjects: DDM and Shear

Stage: 4th Group B
Time: 2 Hours.
Date: 5 / 1 / 2018

Q.3 (40 %): Check the two way shear action (punching shear) only around a corner column (400 × 200) mm in flat plate floor of span (7.0×7.0) m. Also find the **spacing** of closed stirrups of vertical shear reinforcement if required.

Loading condition: $V_u = 18\ kN/m^2$, slab thickness $h = 215\ mm$, $d = 160\ mm$, use Ø10 mm for closed stirrups, $f_y = 414\ MPa$, $f_c' = 35\ MPa$

<u>Solution:</u>

$(b_o) = (400 + 80) + (200 + 80) = 760$ mm

$Vu = 18 \times (3.7 \times 3.6 - 0.48 \times 0.28) = 237.34$ kN

$$v_{ug} = \frac{Vu}{b_o \cdot d} = \frac{237.34 \times 10^3}{760 \times 160} = 1.951\ \text{MPa}$$

$$v_c = \min. \begin{cases} 0.33\sqrt{35} = \mathbf{1.952\ MPa} \\ 0.17\left(1 + \frac{2}{2}\right) \times \sqrt{35} = 2.011\ \text{MPa} \\ 0.083\left(2 + \frac{20 \times 160}{760}\right) \times \sqrt{35} = 3.049\ \text{MPa} \end{cases}$$

$\therefore\ \mathbf{v_c = 1.952\ MPa}$

$Øv_c = 0.75 \times 1.952 = 1.464\ \text{MPa} < v_u = 1.951\ \text{MPa}$

Not O.K.

$\therefore$ Shear reinforcement is required

$v_u = 1.951\ \text{MPa} < 0.75 \times 0.5 \times \sqrt{35} = 2.218\ \text{MPa O.K.}$

$v_c = 0.17\sqrt{f_c'} = 0.17 \times \sqrt{35} = 1.005\text{MPa}$

$$v_s = \frac{v_u}{\phi} - v_c = \frac{1.951}{0.75} - 1.005 = 1.596\ \text{MPa}$$

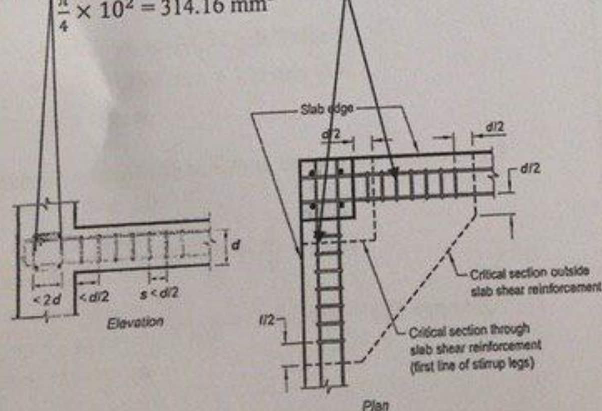
$v_s = \frac{A_v f_y}{b_o s}$ Where $A_v = 2 \times 2 \times \frac{\pi}{4} \times 10^2 = 314.16\ mm^2$

$$S = \frac{A_v f_y}{v_s b_o} = \frac{314.16 \times 414}{1.596 \times 760} = 107.23\ \text{mm}$$

$S_{max} = \frac{d}{2} = \frac{160}{2} = 80$ mm use S = 80 mm ■

Note about calculating A_v

$A_v = 2_{No.of\ Legs\ to\ resist\ punching} \times 2_{No.of\ integral\ beams} \times \frac{\pi}{4} \times 10^2 = 314.16\ mm^2$



Al-Elem University College
College of Engineering
Civil Engineering Department

Monthly Exam
Reinforced Concrete Design II
Subjects: Slab thickness & DDM

Stage: 4th Group B
Time: 2 Hours.
Date: 22 /12/ 2018

Typical Solutions

Q.1(20%): Find the minimum thickness of a slab for an interior panel due to deflection control for the following: Use f_y = 420 MPa. (60000 psi).

a- Flat slab with drop panels (6 × 5.5) m clear span.

b- Flat plate (4.5 × 3.2) m clear span.

c- Slab with beams (8 × 7.8) m clear span with α_m= 3.5

d- Slab without drop panels (6.5 × 5.3) m clear span with α_m= 0.11

e- Slab with beams (6 × 5.2) m clear span with α_m= 1.3

Solution:

Note: All slab thicknesses have been ***rounded up to nearest 10mm.***

a- Flat slab with drop panels (6 × 5.5) m clear span.

$h = \frac{\ell_n}{36} = \frac{6000}{36} = 166.67$ mm > 100 mm O.K

Use h ≈ 170 mm ■

b- Flat plate (4.5 × 3.2) m clear span.

$h = \frac{\ell_n}{33} = \frac{4500}{33} = 136.4$ mm > 125 mm O.K

Use h ≈ 140 mm ■

c- Slab with beams (8 × 7.8) m clear span with α_m= 3.5

α_m= 3.5 > 2.0

$h = \frac{\ell_n\left(0.8 + \frac{f_y}{1400}\right)}{36+9\beta}$ $\beta = \frac{\ell_n}{S_n} = \frac{8}{7.8} = 1.025$

$h = \frac{8000 \times \left(0.8 + \frac{420}{1400}\right)}{36 + 9 \times 1.025} = 194.6$ mm > 90 mm O.K

Use h ≈ 200 mm ■

d- Slab without drop panels (6.5 × 5.3) m clear span with α_m= 0.11

α_m= 0.11 < 0.2 go to ACI Code Table 8.3.1.1

$h = \frac{\ell_n}{33} = \frac{6500}{33} = 196.9$ mm > 125 mm O.K

Use h ≈ 200 mm ■

e- Slab with beams (6 × 5.2) m clear span with α_m= 1.3

$0.2 < \alpha_m = 1.3 < 2.0$

$h = \frac{\ell_n\left(0.8 + \frac{f_y}{1400}\right)}{36+5\beta(\alpha_{fm}-0.2)}$ $\beta = \frac{\ell_n}{S_n} = \frac{6}{5.2} = 1.154$

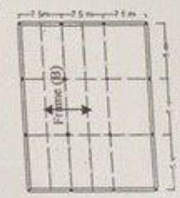
$h = \frac{6000 \times \left(0.8 + \frac{420}{1400}\right)}{36 + 5 \times 1.154 \times (1.3 - 0.2)} = 155.8$ mm > 125 mm O.K

Use h ≈ 160 mm ■

Q.2 (30 %): for the transverse interior frame (B) of the flat plate with edge beams shown in figure below by using direct design method find:

1. Longitudinal distribution of the static moment at factored loads.
2. Lateral distribution of the moment at exterior Support.

Slab thickness = 150 mm, d = 115 mm
q_u = 16 kN/m²
All columns = 500 × 500 mm
All edge beams = 300 × 500 mm
fc' = 28 MPa, f_y = 420 MPa



Solution

1-Longitudinal distribution

q_u=16 kN/m², $\ell_2 = \left(\frac{7.5}{2} + \frac{7.5}{2}\right) = 7.5$ m

$\ell_n = 5 - 0.5 = 4.5$ m > 0.65 × 5 = 3.25 m

$M_o = \frac{q_u \ell_n^2 \ell_2}{8} = \frac{16 \times 4.5^2 \times 7.5}{8} = 303.75$ kN.m

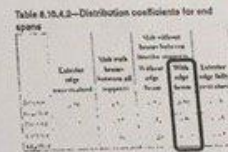
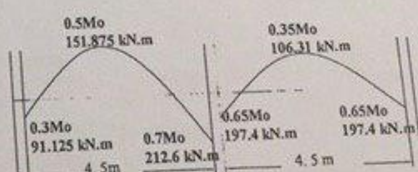


Table 8.10.4.2—Distribution coefficients for end spans



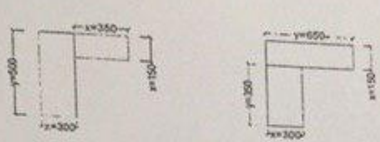
2-Lateral distribution

Exterior Negative Moment = 91.125 kN.m

$\alpha_f = 0$

Find βt:

$\beta_t = \frac{C}{2I_S}$



Calculate C:

$C = \sum\left(1 - 0.63\frac{x}{y}\right)\left(\frac{x^3 y}{3}\right)$

$C1 = \left(1 - 0.63 \times \frac{300}{500}\right)\left(\frac{300^3 \times 500}{3}\right) + \left(1 - 0.63 \times \frac{150}{350}\right)\left(\frac{150^3 \times 350}{3}\right)$

$C1 = 3.086 \times 10^9\ mm^4$

$C2 = \left(1 - 0.63 \times \frac{300}{350}\right)\left(\frac{300^3 \times 350}{3}\right) + \left(1 - 0.63 \times \frac{150}{650}\right)\left(\frac{150^3 \times 650}{3}\right)$

$C2 = 2.07 \times 10^9\ mm^4$ Use larger ∴ $\mathbf{C = 3.086 \times 10^9}\ mm^4$

$I_s = \frac{\ell_2 \times h^3_{slab}}{12} = \frac{7500 \times 150^3}{12} = 2.109 \times 10^9\ mm^4$

$\beta_t = \frac{C}{2I_S} = \frac{3.086 \times 10^9}{2 \times 2.109 \times 10^9} = 0.7316$

-Exterior C.S $_{coefficient}\% = 100 - 10\beta t + 12\,\beta t\left(\alpha_{f1}\frac{\ell_2}{\ell_1}\right) \times \left(1 - \frac{\ell_2}{\ell_1}\right)$

-Exterior C.S $_{coefficient}\% = 100 - 10 \times 0.7316 = 92.684\ \%$

Negative moment at C.S = 0.92684 × 91.125 = 84.45 kN.m

Negative moment at M.S = 91.125 – 84.45 = 6.675 kN.m ■

Table 8.10.5.1—Portion of interior negative M_u in column strip

$\alpha_{f1}\ell_2/\ell_1$	ℓ_2/ℓ_1 0.5	1.0	2.0
0	0.75	0.75	0.75
≥1.0	0.90	0.75	0.45

Note: Linear interpolations shall be made between values shown.

Table 8.10.5.5—Portion of positive M_u in column strip

$\alpha_{f1}\ell_2/\ell_1$	ℓ_2/ℓ_1 0.5	1.0	2.0
0	0.60	0.60	0.60
≥1.0	0.90	0.75	0.45

Note: Linear interpolations shall be made between values shown.

Q.3 (40 %): for the longitudinal exterior frame (A) of the flat plate without edge beam shown in figure below by using direct design method find:

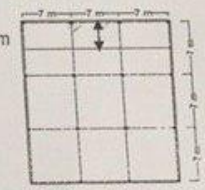
1. Longitudinal distribution of the static moment at factored loads.
2. Lateral distribution of the moment interior panel (column and middle strip moments at negative and positive moments).

Slab thickness = 250 mm, d = 215 mm

$q_u = 17\ kN/m^2$

All columns = 450 × 450 mm

fc' = 28 MPa, f_y = 420 MPa



Solution

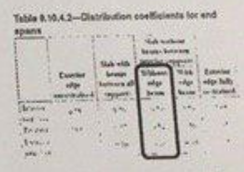
1-Longitudinal distribution

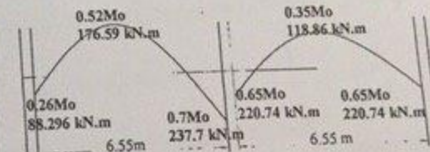
$q_u = 17\ kN/m^2$, $\ell_2 = \left(\frac{7}{2} + \frac{0.45}{2}\right) = 3.725$ m

$\ell_n = 7 - 0.45 = \mathbf{6.55}$ m > 0.65 × 7 = 4.55 m

$M_o = \frac{q_u \ell_n^2 \ell_2}{8} = \frac{17 \times 6.55^2 \times 3.725}{8} = 339.6$ kN.m

Table 8.10.4.2—Distribution coefficients for end spans





2. Lateral Distribution

<u>For interior panel</u>

Interior Negative moment = 220.74 kN.m

$\alpha_f = 0$

~~Negative moment at CS = 0.~~75 × 220.74 = 165.55 kN.m

Negative moment at MS = 220.74 - 165.55= 55.2 kN.m

Positive moment = 118.86 kN.m

~~Positive moment at CS = 0~~.6 × 118.86 = 71.316 kN.m

Positive moment at MS = 118.86 –71.316 = 47.54 kN

The minimum thickness of an exterior panel in a flat plate without edge beams (f_y equals 280 MPa) is taken as:
a) $\ell_n/28$ b) $\ell_n/30$ c) $\ell_n/33$ d) $\ell_n/36$

The minimum thickness of an interior panel in a flat slab with drop panels (f_y equals 420 MPa) is taken as:
a) $\ell_n/33$ b) $\ell_n/34$ c) $\ell_n/36$ d) $\ell_n/40$

The minimum thickness of an exterior panel in a flat slab with drop panels and without edge beams (f_y equals 420 MPa) is taken as:
a) $\ell_n/31$ b) $\ell_n/33$ c) $\ell_n/36$ d) $\ell_n/40$

In Direct Design Method, I_b (the moment of inertia of the effective beam) is based on the:
a) Effective concrete section b) Gross concrete section c) Cracked concrete section d) Transformed concrete section

A circular column, that has a diameter equals to 500 mm, shall be treated as square column that has a length equals to:
a) 400 mm b) 440 mm c) 445 mm d) 450 mm

Enlarged head of a supporting column of a flat slab is technically known as
a) Supporting end of the column b) Top of the column c) Capital d) Drop panel

In equivalent frame method, *k* will be
a) < 4 b) ≤ 4 c) $= 4$ d) > 4

Stiffness of equivalent column (modified column stiffness) is
a) Greater than stiffness of column b) Equal to stiffness of column c) Lesser than stiffness of column d) None of these

In equivalent frame method, the fixed-end moments for a uniform load (w) will be
a) $< w\ell^2/12$ b) $= w\ell^2/12$ c) $> w\ell^2/12$ d) None of these

Which of the following relations is correct ?
a) $v_s = v_c - v_u$ b) $v_s = v_u$ c) $v_s = v_u / v_c$ d) None of these

Which of the following relation is correct?
a) Design shear strength is greater than required shear strength b) Design shear strength is greater than or equal to shear required strength
c) Design shear strength is lesser than required shear strength d) Design shear strength is lesser than or equal to shear required strength

A reinforced concrete slab is 200 mm thick. The diameter of the stirrups that cannot be used is of
a) 8 mm b) 10 mm c) 12 mm d) 16 mm

The shear perimeter (b_o) for (300×400) mm corner column in a flat plate, with 150 mm effective depth, is
a) 2000 mm b) 1000 mm c) 850 mm d) 700 mm

In punching shear, the first critical section will be
a) At d/2 from the face of the column b) At d/2 from the face of the column capital
c) At d/2 from the face of the drop panel d) All the above

Which of the following is not a characteristic feature of yield lines?
a) Yield lines are always parallel b) Yield lines sometimes be parallel with supports
c) Yield lines sometimes be nonparallel with supports d) Yield lines may be intersect

In orthotropic slab
a) The resisting moments are equal in all directions b) The resisting moments are different in two perpendicular directions
c) The resisting moments are different in all directions d) The resisting moments are equal in two perpendicular directions

Loss of prestress could be due to
a) Elastic expansion of concrete b) Shrinkage of steel c) Cracks in concrete d) Friction

Disadvantage of prestressed concrete are
a) High labor costs b) Higher cost of materials c) More complicated formwork may be required d) All the above

In Class U prestressed concrete
a) $f_t \geq 0.62\sqrt{f'_c}$ b) $f_t \leq 0.62\sqrt{f'_c}$ c) $0.62\sqrt{f'_c} < f_t \leq 1.0\sqrt{f'_c}$ d) $f_t < 0.62\sqrt{f'_c}$

Sustained loads mean
a) Dead load b) Live load c) Total load d) All the above

الأسم: محمد زياد محمود A الشعبة:

The minimum thickness of an exterior panel in a flat plate without edge beams (f_y equals 280 MPa) is taken as:
a) $\ell_n/28$ b) $\ell_n/30$ c) $\ell_n/33$ d) $\ell_n/36$

The minimum thickness of an interior panel in a flat slab with drop panels (f_y equals 420 MPa) is taken as:
a) $\ell_n/33$ b) $\ell_n/34$ c) $\ell_n/36$ d) $\ell_n/40$

The minimum thickness of an exterior panel in a flat slab with drop panels and without edge beams (f_y equals 420 MPa) is taken as:
a) $\ell_n/31$ b) $\ell_n/33$ c) $\ell_n/36$ d) $\ell_n/40$

In Direct Design Method, I_b (the moment of inertia of the effective beam) is based on the:
a) Effective concrete section b) Gross concrete section c) Cracked concrete section d) Transformed concrete section

A circular column, that has a diameter equals to 500 mm, shall be treated as square column that has a length equals to:
a) 400 mm b) 440 mm c) 445 mm d) 450 mm

Enlarged head of a supporting column of a flat slab is technically known as
a) Supporting end of the column b) Top of the column c) Capital d) Drop panel

In equivalent frame method, *k* will be
a) < 4 b) ≤ 4 c) $= 4$ d) > 4

Stiffness of equivalent column (modified column stiffness) is
a) Greater than stiffness of column b) Equal to stiffness of column c) Lesser than stiffness of column d) None of these

In equivalent frame method, the fixed-end moments for a uniform load (w) will be
a) $< w\ell^2/12$ b) $= w\ell^2/12$ c) $> w\ell^2/12$ d) None of these

Which of the following relations is correct ?
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