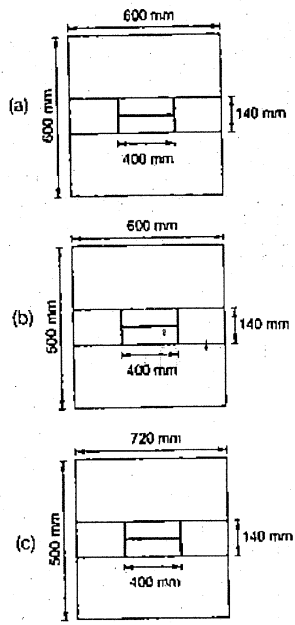
7 CHAPTER

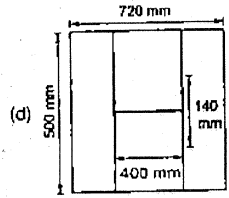
Column Bases and Foundations

Q.1 A square steel slab base of area 1 m^2 is provided for a column made of two rolled channel sections. The 300 mm × 300 mm column carries an axial compressive load of 2000 kN. The line of action of the load passes through the centroid of the column section as well as the slab. The yielding stress of slab base is 250 MPa. The required minimum thickness of the slab base is

(a) 54.5 mm (b) 47.6 mm
(c) 43.4 mm (d) 37.6 mm

Q.2 Which one of the following plan views of a gussted base plate will result in minimum base plate thickness?





Q.3 The type of stress induced in the foundation bolt fixing a column to its fitting is

(a) pure compression (b) pure tension
(c) bearing (d) bending

Q.4 In a gusseted base, when the end of column is machined smooth for complete bearing, the axial load is transferred to base slab

(a) fully through fastening
(b) fully by direct bearing
(c) 50% by direct bearing and 50% through fastening
(d) None of these

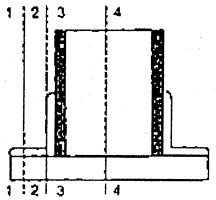
Q.5 A column base is subjected to moment. If the intensity of bearing pressure due to axial load is equal to stress due to moment, the bearing pressure between the base and the concrete is

(a) uniform compression throughout
(b) zero at one end and compression at other end.
(c) tension at one end and compression at other end.
(d) uniform tension throughout.

Q.6 Thickness of base plate is determined from the

(a) flexural strength of the plate
(b) shear strength of the plate
(c) bearing strength of the concrete pedestral
(d) punching criteria

Q.7 In the gussel base as shown in figure, the critical section for calculating thickness is



(a) 1 - 1 (b) 2 - 2
(c) 3 - 3 (d) 4 - 4

Q.8 Which of the following statement is correct?
(a) Column bases transmit the column load to the concrete foundation.
(b) Column load is spread over a large area on concrete.
(c) In column bases, intensity of pressure on concrete block is assumed to be uniform
(d) All of the above

Q.9 As per IS : 800, the thickness of slab base is given by

(a) $\frac{3W}{F_b}\left(A^2-\frac{B^2}{4}\right)$ (b) $\sqrt{\frac{3W}{F_b}\left(A^2-\frac{B^2}{4}\right)}$

(c) $\sqrt{\frac{3W}{F_b}\left(A^2-\frac{B^2}{2}\right)}$ (d) $\sqrt{\frac{3W}{3F_b}\left(A^2-\frac{B^2}{4}\right)}$

Where A and B are larger and smaller projections respectively of plate beyond column, W is the pressure on the underside of base and F_b is permissible bending stress in slab base.

Q.10 The permissible bending stress in slab base is (f_y = 250 N/(mm^2))
(a) 150 N/mm^2 (b) 185 N/mm^2
(c) 165 N/mm^2 (d) 181.5 N/mm^2

Q.11 Consider the following statements:
A grillage base is checked for
1. bending 2. shear
3. compression 4. web crippling
Which of these statements are correct?
(a) 1 and 4 (b) 1 and 3
(c) 2, 3 and 4 (d) 1, 2 and 4

Q.12 A column carries a load P and rests on two tier grillage foundation. Then maximum shear force is

(a) $\frac{P}{2}\left(\frac{L-a}{L}\right)$ (b) $\frac{P}{L-a}\left(\frac{L}{2}\right)$

(c) $2P\times\left(\frac{L}{L-a}\right)$ (d) $\frac{2}{P}\left(\frac{L-a}{L}\right)$

where, a and L are length of base plate and upper tier beam respectively.

Q.13 What is the permissible tensile stress in bolts used for column bases?
(a) 120 N/mm^2 (b) 150 N/mm^2
(c) 185 N/mm^2 (d) 165 N/mm^2

Q.14 In plastic method of base plate design, the pressure from the concrete below is assumed to be constant from the neutral axis to the edge of the base plate being equal to
(a) 0.25 f_{ck} (b) 0.45 f_{ck}
(c) 0.5 f_{ck} (d) 0.67 f_{ck}

Q.15 What is the minimum number of anchor bolts provided even if column is subjected to only axial loads?
(a) 2 (b) 3
(c) 1 (d) 4

Q.16 In case of grouted anchors, failure may occur by bond failure at the grout-concrete interface. The bond strength is given by, N_b =
(a) $1.2\tau_o d_o l$ (b) $1.2\pi\tau_o d_o l$
(c) $\tau_o d_o l$ (d) $\pi\tau_o d_o l$
where, τ_o = Bond strength of grout concrete
d_o = Diameter of bolt hole.
l = length of embedment.

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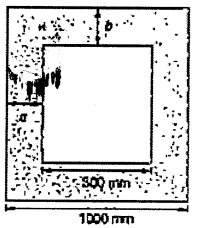
Answers Column Bases and Foundations

1. (c) 2. (b) 3. (b) 4. (c) 5. (b) 6. (a) 7. (b) 8. (d) 9. (b) 10. (b)
11. (d) 12. (a) 13. (a) 14. (b) 15. (a) 16. (d)

Explanations Column Bases and Foundations

1. (c)



Bearing pressure on slab base

$$w=\frac{P}{A}=\frac{2000\times10^3}{1000\times1000}=2\ \text{N/mm}^2$$

$$M_1=\frac{w}{2}\left(a^2-0.3b^2\right)$$

$$=\frac{2}{2}\left[(350)^2-0.3\times(350)^2\right]$$

$$=85750\ \text{N-mm}$$

$$M_p=\frac{1.2f_yZ_e}{\gamma_{m_0}}=\frac{1.2f_y\left(\frac{t^2}{6}\right)}{\gamma_{m_0}}=85750$$

or t = 43.4 mm

2. (b)
Thickness of base plate,

$$t=c_1\sqrt{\frac{2.75w}{f_y}}$$

where, c_1 is portion of base plate acting as a cantilever.

Figure	cantilever portion(c_1)
(a)	$\frac{600-140}{2}=230$mm
(b)	$\frac{600-400}{2}=100$mm
(c)	$\frac{500-140}{2}=180$mm
(d)	$\frac{720-400}{2}=160$mm

For t to minimum, c_1 should be minimum.

5. (b)
Intensity of bearing pressure due to axial load P

$$f_1=\frac{P}{BL}$$

Stress due to moment

$$f_2=\frac{M}{I}.y=\frac{M}{\frac{BL^3}{12}}.\frac{L}{2}=\frac{6M}{BL^2}$$

$$\text{Resultant stress}=\frac{P}{BL}\pm\frac{6M}{BL^2}$$

Maximum stress at one end

$$=\frac{P}{BL}+\frac{6M}{BL^2}=\frac{2P}{BL}$$

$$\left(\because\frac{P}{BL}=\frac{6M}{BL^2}\right)$$

Minimum stress at other end

$$=\frac{P}{BL}-\frac{6M}{BL^2}=0$$

11. (d)
The grillage base essentially consists of steel beams encased in concrete. They are provided when
(i) The load on the column is very heavy
(ii) The bearing capacity of the soil on which the concrete block is to be is poor.
They are designed for bending, shear and web crippling.

12. (a)
Maximum shear force

$$=\frac{P}{L}\left(\frac{L-a}{2}\right)$$

Maximum bending moment

$$=\frac{P}{8}(B-b)$$

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