

Exterior Panel, Rectangular, No drop

Example → Design an interior and exterior panel of a flat slab of panel size 4.5m x 6m without providing drop and column head.

Size of column = 300mm x 400mm

live load = 4 kN/m²

Floor finish = 1 kN/m²

height of column is 4m above and below the slab.

Use M20 concrete and Fe 415 steel.

Solution → Design of interior panel is already has done in Ex (Rectangular panel, no drop, no column head)

Some data is required from there -

→ Effective depth of flat slab = 160mm

→ Total depth of flat slab = 210mm

→ Along Longer direction

$$\alpha_c = 0.824$$

$$M_o = 271215000 \text{ Nmm}$$

→ Along shorter direction

$$\alpha_c = 2.6042$$

$$M_o = 203411250 \text{ Nmm}$$

After designing interior panel,

Along longer direction → Page no 55, Clause no - 31.4.3.3

$$\text{Interior negative design moment} = 0.75 - \frac{0.10}{1 + \frac{1}{\alpha_c}} = 0.75 - \frac{0.10}{1 + \frac{1}{0.824}} = 0.7048$$

$$\text{Positive design moment} = 0.63 - \frac{0.28}{1 + \frac{1}{\alpha_c}} = 0.63 - \frac{0.28}{1 + \frac{1}{0.824}} = 0.504$$

$$\text{Exterior negative design moment} = \frac{0.65}{1 + \frac{1}{\alpha_c}} = \frac{0.65}{1 + \frac{1}{0.824}} = 0.294$$

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	Total Moment (Nmm)	Column Strip (Nmm)	Middle Strip (Nmm)
Interior -ve	$0.7048 \times 271215000 = 191152332$	$0.75 \times 191152332 = 143364249$	$\Rightarrow 191152332 - 143364249 = 47788083$
Exterior -ve	$0.994 \times 271215000 = 79737210$	$1.00 \times 79737210 = 79737210$	$\Rightarrow 79737210 - 79737210 = 0$
+ve Moment	$0.504 \times 271215000 = 136692360$	$0.60 \times 136692360 = 82015416$	$\Rightarrow 136692360 - 82015416 = 54676944$

Shorter Span direction \rightarrow Page no 55, clause no - 31.4.3.3

$$\text{Interior -ve design Moment} = 0.75 - \frac{0.10}{1 + \frac{1}{\alpha_c}} = 0.75 - \frac{0.10}{1 + \frac{1}{2.6042}} = 0.678$$

$$\text{Positive design Moment} = 0.63 - \frac{0.28}{1 + \frac{1}{\alpha_c}} = 0.63 - \frac{0.28}{1 + \frac{1}{2.6042}} = 0.428$$

$$\text{Exterior negative design moment} = \frac{0.65}{1 + \frac{1}{\alpha_c}} = \frac{0.65}{1 + \frac{1}{2.6042}} = 0.4697$$

	Total Moment (Nmm)	Column Strip (Nmm)	Middle Strip (Nmm)
Interior -ve	$0.678 \times 20341250 = 137912827.5$	$0.75 \times 137912827.5 = 103434620.6$	$137912827.5 - 103434620.6 = 34478206.88$
Exterior -ve	$\Rightarrow 0.4697 \times 20341250 = 95542264.13$	$1.00 \times 95542264.13 = 95542264.13$	$= 95542264.13 - 95542264.13 = 0$
+ve Moment	$0.428 \times 20341250 = 87060015$	$0.60 \times 87060015 = 52236009$	$= 87060015 - 52236009 = 34824006$

Positive design moment:

31.4.3.3 In an end span, the total design moment M_o shall be distributed in the following proportions:

Interior negative design moment:

$$0.75 - \frac{0.10}{1 + \frac{1}{\alpha_c}}$$

Positive design moment:

$$0.63 - \frac{0.28}{1 + \frac{1}{\alpha_c}}$$

Exterior negative design moment:

$$\frac{0.65}{1 + \frac{1}{\alpha_c}}$$

31.5.5.2 Column strip : Negative moment at an exterior support

- a) At an exterior support, the column strip shall be designed to resist the total negative moment in the panel at that support.
- b) Where the exterior support consists of a column or a wall extending for a distance equal to or

greater than three-quarters of the value of l_2 , the length of span transverse to the direction moments are being determined, the exterior negative moment shall be considered to be uniformly distributed across the length l_2 .

31.5.5.3 Column strip : Positive moment for each span

For each span, the column strip shall be designed to resist 60 percent of the total positive moment in the panel.

31.5.5.4 Moments in the middle strip

The middle strip shall be designed on the following bases:

- a) That portion of the design moment not resisted by the column strip shall be assigned to the adjacent middle strips.
- b) Each middle strip shall be proportioned to resist the sum of the moments assigned to its two half middle strips.
- c) The middle strip adjacent and parallel to an edge supported by a wall shall be proportioned to resist twice the moment assigned to half the middle strip corresponding to the first row of interior columns.