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Multi Storied Garment Showroom Building Manual Calculation Design – Slabs

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Abstract: ***To avoid long distance of travel, cities are growing vertically rather than horizontally. Construction of such tall buildings are possible only by going to a set of rigidly inter-connected beams and columns. These rigidly interconnected beams and columns of multi bay and multi-storeyed are called building frames. Analysis of multi-storey building frames involves lot of difficulties and cumbersome calculations by conventional methods. To carry out such analysis is a time consuming task. According to IS 456 (2000) clause 22.4 and BS 8110 clause 3.2.1, the use of substitute frames (sub-frames) are allowed. Analysis of substitute frame is made by conventional elastic methods e.g. slope deflection, moment distribution etc. Substitute frame method for analysis can be handy in approximate and quick analysis. This G + 4 showroom building designed with only manual calculations based on values here taken from the standard code book (IS 456:2000) .***

Keywords: high rise building, multi storied building, slab design, analysis of multi storied building

1. Introduction

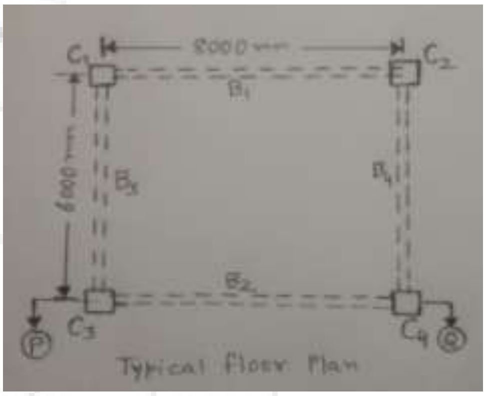
Multistory buildings, a building with multiple floors, are preferred in cities Multi – storey buildings help in increasing the usable area of the building without increasing the area of the land and thus saves a lot of money. A building frame is a three dimensional structure consisting of a number of bays in two directions at right angles to each other.

2. Structure Analysis

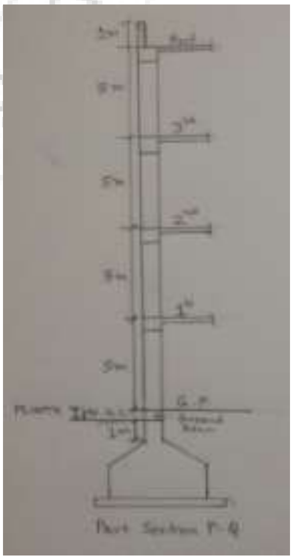
Most of the structures designed today are **statically indeterminate**. Two Fundamental methods to analyze the statically indeterminate structures are **Force Methods** and **Displacement Methods**. Some classical techniques used to apply the displacement methods are **Slope Deflection Methods**, **Moment Distribution Methods** etc . Moment distribution method was introduced by Professor Hardy Cross in 1932. This method has remained the most popular method of tackling indeterminate beams and rigid frames. Moment distribution method uses an iterative technique and one goes on carrying on the cycle to reach to a desired degree of accuracy.

3. Plan and Section of G+4 Structure

Building consisting of two blocks , Show room (functional block) and Lift / Stairs etc (service block) . The service block is structurally independent of functional block .



The typical floor plan of G + 4 showroom building is shown above of area 48 Sq.m.



Part section of P-Q show some details of multi storied showroom building.

4. Roof Slab Design

Here ratio of longer span to shorter span is small (less than 2) , so it is design as two –way slab . When the slab is supported on all the four edges and when the ratio of long span to short span is small ($l_y / l_x < 2$) , bending take place along both the spans . Such a slab is known as a two way slab or a slab spanning in two directions. In two way slab, reinforcement has to be provided in both the directions. When such a slab is loaded, the corners get lifted up. If the corners are held down, by fixidity at the wall support etc, the bending moment and deflection are further reduced. In that case, special torsional reinforcement at the corner has to be provided to check the cracking of corners.

Design Procedure for two way slab:
L_y/ L_x = 8300/6300=1.317

Design constant f_{ck} = 20 N/mm^2 for M20 concrete and f_y = 415 N/mm^2 for F_e 415 steel .
For F_e 415 , $\frac{x_{u,max}}{d} = 0.479$; R_u = 2.761

From deflection point of view, L/d =20 for simply supported slab . Let us assume p_t = 0.2 % for an under reinforced section. Hence, we get modification factor =1.68. Hence L/d = 33.6 and d= 6300/33.6 = 187.5mm. Providing 20mm nominal cover and 10mm dia bars, D= 187.5 +20 + 5 = 212.5mm. Hence assume an **overall depth of 220mm** for the purpose of computing dead weight.

Weight of slab = 5.5 KN/m2
Live load = 3KN/m2
Hence w_u = 1.5 x 8.5 = 12.75 KN/m2
This is the case 9 of IS code 456:2000 table 26 so , α_x =0.079 and α_y = 0.056
$M_{ux} = \alpha_x w_u l_x^2$ = 39.9 KN-m
$M_{uy} = \alpha_y w_u l_x^2$ = 28.34 KN-m
Now check for effective depth d= $\sqrt{\frac{M_{ux}}{R_u\, b}}$ = 121mm < 195mm (o.k)
A_{stx} = 558mm^2
A_{sty} = 448mm^2
Size of torsional mesh = $l_x/5$ = 1.2m from the centre of support . Area of tortional reinforcement = ¾ A_{stx} = 418.5mm^2 .

5. Conclusion

We have manually calculated the details about this structure. By designing this structure , we got clarity on structure and known knowledge about the structure . we observe that by using manual methods we gain more knowledge than by designing through software and this project is based on Indian standard . We have faced the real engineering practice in this project .

6. Acknowledgement

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