Analysis and Design of A Multistoried Building For Residential Purpose

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Abstract- *Analysis and design is a preliminary step to be considered in the construction of any structure. It deals with every minute detail of frames, distribution of loading and estimation of the structure.*

For the analysis of frames, several methods can be used. In this particular analysis, KANI'S METHOD of analysis is used. The analysis consists of calculating final end moments at the joints, shear force in beams and columns, axial loads in columns.

The load distribution complies with IS: 875-1985(part 2). The design of various structural components has been done in with Limit state method with IS: 456-2000 using SP-16

I. INTRODUCTION

- The population in cities is tremendously increasing which results in increase in density of roads and drains which in turns decrease horizontal area available for education or residential purpose.
- Thus the demand on land area for housing is fast growing send the land rates sky rocketing.
- To meet demand of technology for construction of tall multistorey structures creating wonders such as erection of sky scrapers etc., leading to availability of shelter for middle and lower income group of people.

LOADING STANDARDS

The following I.S. Codes are used in the analysis and design of the structure.

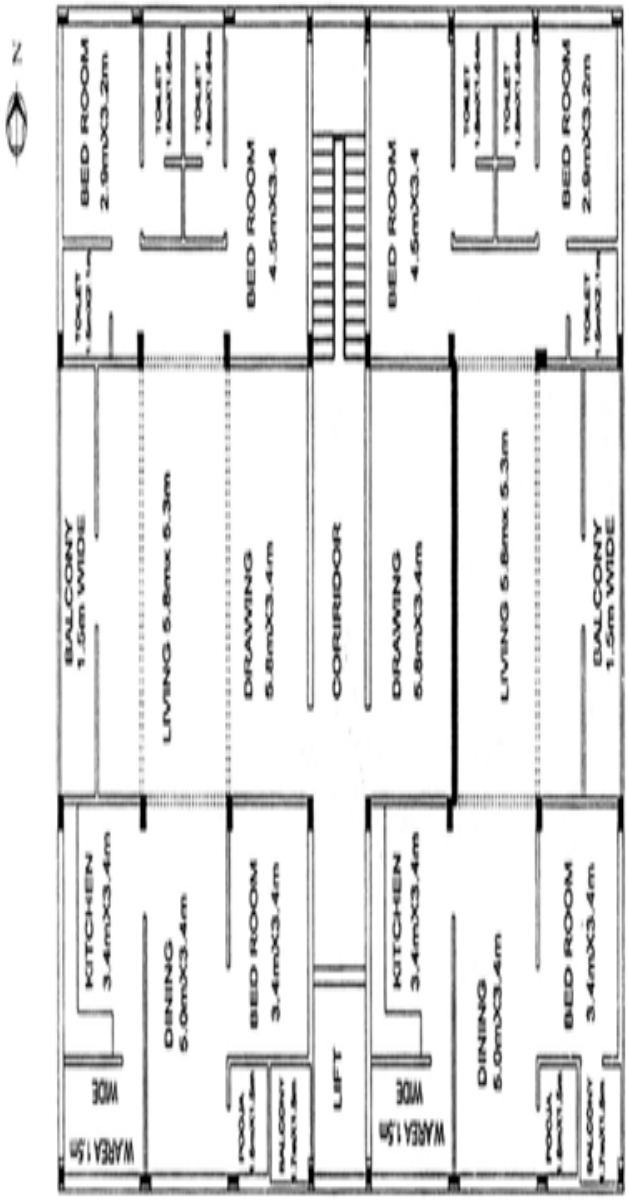
- I.S.875-1965
- I.S.456-2000

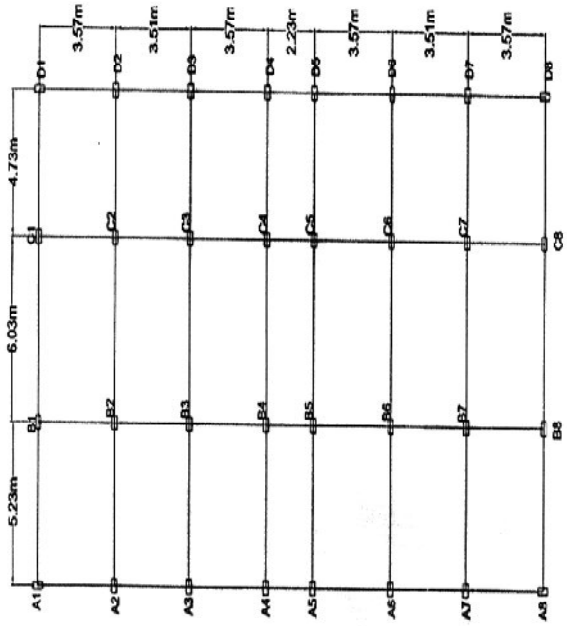
DEAD LOAD

- Unit weight of concrete : 25 KN/m^3
- Unit weight of brick masonry : 19.2 KN/m^3
- Floor finish load : 1 KN/m^3
- For the provision of partition wall : 4.41 KN/m^3

LIVE LOAD

- Living area : 2 KN/m^2
- corridor : 4KN/m^2
- Staircase : 3KN/m^2
- Top floor : 2KN/m^2





II. DESIGN OF SLABS

Slabs are plate elements which usually carry uniformly distributed from the floor or roof of the building. Like beams, slabs also may be simply supported, cantilever or continuous depending upon the conditions .They are classified according to the system of supports used as under

1. One way slabs
2. Two way slabs
3. Flat slabs supported directly on columns without beams
4. Grid slabs

ONE WAY SLAB:

Slabs which are supported on two opposite supports are a one way spanning slab . In short, a slab which transfers its load on one of the set of two opposite edge supports is called one way slab.

However its true that as long as Ly>2Lx. Keeping Lx constant, if Ly is increased the observation will be different.

TWO WAY SLAB:

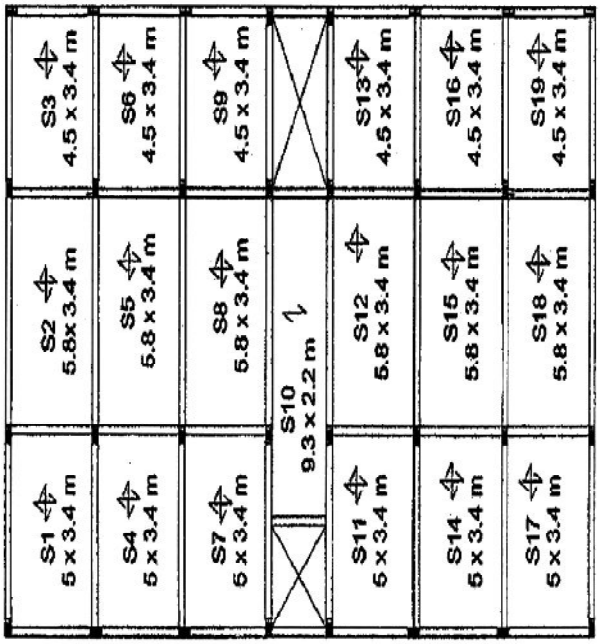
The slab is supported on all four edges and if Ly < 2Lx, the tendency if the slab is to bend in both the directions. Such slabs are call two way slabs.

FLAT SLAB:

Sometimes beam free area is required to reduce the floor height and to permit large amount of light which might be obstructed by the large depth of the beams spanning in comparatively large spans (5-6 m). Flat slabs are used in such cases. For office buildings in commercial areas, flat slabs are beneficial.

GRID SLAB :

Sometimes, in large halls , public places a large column free area is required. In these cases large depth beams may be permitted in but the columns are permitted only on periphery. In such cases grid slabs and grid beams are provided. For example, an area of 16m x 20 m is kept column free using grid slabs.



GENERAL DESIGN REQUIREMENTS FOR SLABS AS PER IS 456-2000:

1. Effective Span: The clear span plus effective depth of the slab or centre to centre distance between the supports which ever is less.
2. Limiting Stiffness: The stiffness of slab is governed by the span to depth ratio.
3. Minimum Reinforcement: The reinforcement in either direction of span shall not be less than 0.15% of gross cross sectional area if mild steel and for high strength deformed bars 0.12% is used.
4. Maximum diameter of bars: The diameter of the bars shall not exceed one eight of the total thickness of slab.
5. Spacing of main reinforcement: The spacing of main reinforcement in slabs shall not be more than three times the effective depth of solid slab or 300 mm which ever is less.

6. Distribution reinforcement: The area of distribution reinforcement shall not be less than 0.15 % of gross cross sectional area if plain bars and 0.12 % high yield strength deformed bars are used. The spacing of distribution reinforcement in slabs shall not be more than 5 times the effective depth of the slab over 450 mm which ever is less.
7. Cover to Reinforcement: At each end of reinforcement bar not less than 25 mm nor less than twice the diameter of such bar. The bottom cover for reinforcement shall not be less than 20 mm nor less than the diameter of such bars.

III. COLUMNS DESIGN

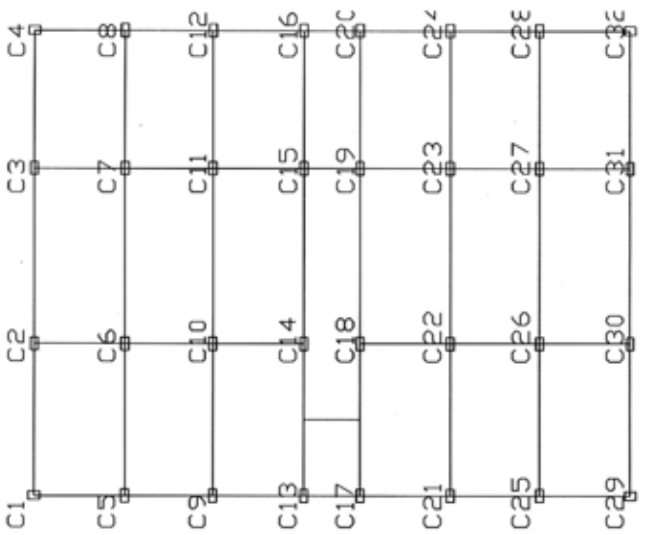
Columns are the vertical members whose effective length is greater 3 times its least lateral dimension carrying compressive loads is called as columns. Columns transfer the loads from the beams or slabs to the footings or foundations.

Types of columns:

1. Based on type of reinforcement
   a. Tied column
   b. Spiral column
   c. Composite column

2. Based on type of loading
   a. Axially loaded column
   b. Uniaxial or Biaxial

3. Bassed on slenderness ratio
   a. Short column
   b. Long column



Column layout

DESIGN PROCEDURE OF COLUMNS

- The column dimensions are assumed as 300x450 mm.
- The actual load 'P' at the elevation is noted.
  exmin = (l/500+b/30)
  eymin = (l/500+d/30)
  exmax=(0.055xb)
  eymax=(0.05xD)
- The factored load 'Pu' is determined by using the formula.
  Pu = P x 1.5
  Pu= 0.4fckAg+(0.67fy-0.4fckAsc)
  Asc= (Pu-0.4fckAg)/(0.67FyAsc)
- Assume 'P', percentage of steel greater than 0.8 and less than 4.
- Calculate the value of 'd¹ /D'
  Where, d¹= effective cover
  D = Overall depth of the column section.

STAAD PRO COLUMN DESIGN VALUES

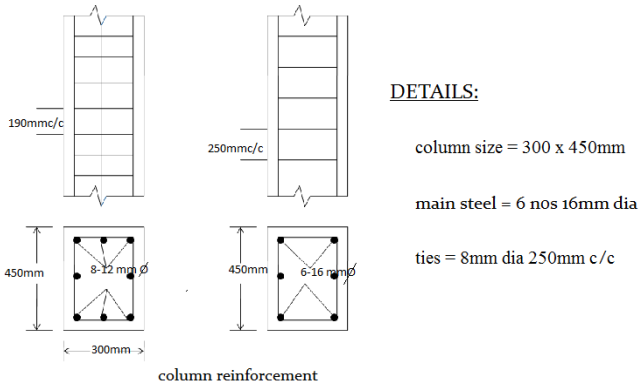
CATEGORISATION OF COLUMNS:
Ground Floor
Category I: columns subjected to axial load and uniaxial bending

C5,C6,C7,C8,C9,C10,C11,C12,C21,C22,C23,C24,C25,C26,C27,C28

Category II: columns subjected to axial and biaxial bending

C1,C2,C3,C4,C13,C14,C15,C16,C17,C18,C19,C20,C29,C30,C31,C32

Column Number	L/C	Node	Fy	Fx	Fz	Mx	My	Mz
600	3 1.5(DL+LL)	1	741.603	9.671	17.018	-0.028	-25.862	13.834
		33	-726.335	-9.671	-17.018	0.028	-28.595	17.113
601	3 1.5(DL+LL)	33	579.815	12.156	19.429	-0.027	-30.860	19.357
		65	-564.547	-12.156	-19.429	0.027	-31.312	19.541
602	3 1.5(DL+LL)	65	414.582	12.793	20.384	0.013	-32.411	20.287
		97	-399.314	-12.793	-20.384	-0.013	-32.819	20.649
603	3 1.5(DL+LL)	97	246.932	13.570	21.415	0.034	-33.937	21.388
		129	-231.664	-13.570	-21.415	-0.034	-34.592	22.035



DETAILS:

column size = 300 x 450mm

main steel = 6 nos 16mm dia

ties = 8mm dia 250mm c/c

IV. CONCLUSIONS

- The quantity of materials whose site area is 669.3 Sq.m and built up area of 370.28 Sq.m. are estimated for this G+4 multistoried building.
- The quantity of steel used this multi Storey building is 36.49 tonnes.
- The Cost of raw materials required for this multi Storey building is Rs.85,00,000

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