IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 73-77
www.iosrjournals.org

Analysis and Design of G+5 Residential Building

V.Varalakshmi[1], G. Shiva Kumar[2], R. Sunil Sarma[3]

[1]*Associate professor, Department of Civil Engineering,*
Marri Laxman Reddy Institute of Technology and Management, Dundigal, Hyderabad, India
[2,3]*Students, Department of Civil Engineering,*
Marri Laxman Reddy Institute of Technology and Management, Dundigal, Hyderabad, India

ABSTRACT: *The design process of structural planning and design requires not only imagination and conceptual thinking but also sound knowledge of science of structural engineering besides the knowledge of practical aspects, such as recent design codes, bye laws, backed up by ample experience, intuition and judgment. The purpose of standards is to ensure and enhance the safety, keeping careful balance between economy and safety. In the present study G+5 building at Kukatpally, Hyderabad, India is designed (Slabs, Beams, Columns and Footings) using Auto CAD software. In order to design them, it is important to first obtain the plan of the particular building that is, positioning of the particular rooms (Drawing room, bed room, kitchen toilet etc.) such that they serve their respective purpose and also suiting to the requirement and comfort of the inhabitants. Thereby depending on the suitability; plan layout of beams and the position of columns are fixed. Thereafter, the loads are calculated namely the dead loads, which depend on the unit weight of the materials used (concrete, brick) and the live loads, which according to the code IS:456-2000 and HYSD BARS FE415 as per IS:1786-1985. Safe bearing capacity of soil is adopted as 350KN/M^2 at a depth of 6ft and same soil should extent 1.5 times the width of footing below the base of footing. Footings are designed based on the safe bearing capacity of soil. For designing of columns and beams, it is necessary to know the moments they are subjected to. For this purpose, frame analysis is done by limit state method. Designing of slabs depends upon whether it is a one - way or a two way slab, the end conditions and the loading. From the slabs, the loads are transferred to the beam. Thereafter, the loads (mainly shear) from the beams are taken by the columns. Finally, the sections must be checked for all the four components with regard to strength and serviceability.*

Keywords: *Beams, columns, footings, slabs, Structural Designing.*

I. INTRODUCTION:

Buildings come in a wide amount of shapes and functions, and have been adapted throughout history for a wide number of factors, from building materials available, to weather conditions, to land prices, ground conditions, specific uses and aesthetic reasons. A Multi-Stored is a building that has multiple floors above ground in the building. Multi-storey buildings aim to increase the floor area of the building without increasing the area of the land the building is built on, hence saving land and, in most cases, money (depending on material used and land prices in the area). The design process of multi-stored building requires not only imagination and conceptual thinking but also sound knowledge of science of structural engineering besides the knowledge of practical aspects, such as recent design codes, bye laws, backed up by ample experience, intuition and judgment. The purpose of standards is to ensure and enhance the safety, keeping careful balance between economy and safety (Divya kamath et al., 2012). In the present study G+5 building at Kukatpally, Hyderabad, India is designed (Slabs, Beams, Columns and Footings) using Auto CAD software.

II. GEOMETRY OF BUILDING:

The building is regular in plan and in elevation having storey height of H_{st} = 3.0m where all storey's are of the same height. The building consist of five bays along the two horizontal directions of bay length L_b= 5.0m with the same bay length throughout the plan. The building consist of square columns, beams of width 0.3m and slab thickness of 150mm. the size of column is constant throughout all storey and the size of beam is constant throughout each storey. The perimeter beams and exterior columns have half the elastic rigidity of interior ones and corner columns have one quarter of elastic rigidity of interior ones.

III. DESIGNING OF SLABS:

In the present paper two types of slabs are designed namely roof slab and floor slab. Roof slab is a continuous slab on the top of the building which is also known as terrace. Generally terrace has less live load and it is empty in most of the time except at some occasions. Hence all the roof slabs are designed as one way slab for the easy arrangement of the reinforcement and ease of work. Therefore in designing the roof slab dead loads (i.e., due to water proofing=2.5KN/m^2, self weight of the slab= 1×1×required depth ×25) and live loads (roof=1.5KN/m^2) are considered. Roof S2 and S5 are the same dimensions but different in end conditions because, for roof slab main steel is provided along the short span only and the load is transferred to two opposite supports only. The steel along the long span just acts as distribution steel and is not designed for transferring the load but to distribute the load and to resist shrinkage and temperature stresses. For floor slab live load is more when compared to the roof slab. Therefore in designing of floor slab dead loads (i.e., due to floor finish = 1KN/m2, sanitary blocks including filling = 2.5KN/m2 and self weight of the slab = 1×1×required depth ×25) and Live loads (i.e., Sanitary blocks public = 3KN/m^2, corridor = 5 KN/m^2, partition wall = 1.5KN/m^2) are considered. The designing is followed IS875-PART1 and 2 codes. The details of reinforcement provided in slabs are given table.1

Table.1 Details of reinforcement provided in slabs for G+5 Building

S.No	Short Span Steel	Long Span Steel	Slab Thickness	**Remarks**
S1	8mm ØR.T.S @7"c/c alternate cranks	8mm Ø R.T.S @ 7" c/c alternate cranks	$4\frac{1}{2}$"	Two-Way
S2	8mm ØR.T.S @6"c/c alternate cranks	8mm Ø R.T.S @ 8" c/c	$4\frac{1}{2}$"	One-Way
S3	8mm ØR.T.S @7"c/c alternate cranks	8mm Ø R.T.S @ 7" c/c alternate cranks	$4\frac{1}{2}$"	Two-Way
S4	8mm ØR.T.S @6"c/c alternate cranks	8mm Ø R.T.S @ 7" c/c alternate cranks	$4\frac{1}{2}$"	Two-Way
S5	8mm ØR.T.S @5"c/c alternate cranks	8mm Ø R.T.S @ 8" c/c	$4\frac{1}{2}$"	One-Way

IV. DESIGNING OF BEAMS:

A reinforced concrete beam should be able to resist tensile compressive and shear stresses induced in it by the loads on the beam. Concrete is fairly strong in compression but very weak in the low tensile strength. Plan concrete beams are thus limited in carrying capacity by the low tensile strength. Steel is very strong in tension. Thus the weakness of concrete is overcome by the provision of reinforcing steel in the tension zone around the concrete to make a reinforced concrete beam. The beam is analyzed first in order to calculate the internal actions such as bending Moment and shear force. A simplified substitute frame analysis can be used for determine the bending moments and shearing forces at any floor of roof level due to gravity loads. In order to analyse the frame it is need to calculate the loads (i.e., Uniformly distributed load including slab on the right side, masonary wall load self weight, total working load and point loads).

The designing of the beam mainly consist of fixing the breadth and depth of the beam and arriving at the area of steel and the diameters of bars to be used. The breadth of the beam is generally kept equal to the thickness of the wall to avoid offset inside the room. It shall also not exceed the width of the column for effective transfer of the load from beam to column. The depth of the beam is taken by L/10 to L/6. Therefore in the present design all beams are in rectangular shape having the breadth and depth of the beam is 230mm and 450mm respectively. The floor beams arrangement is shown in Fig.1

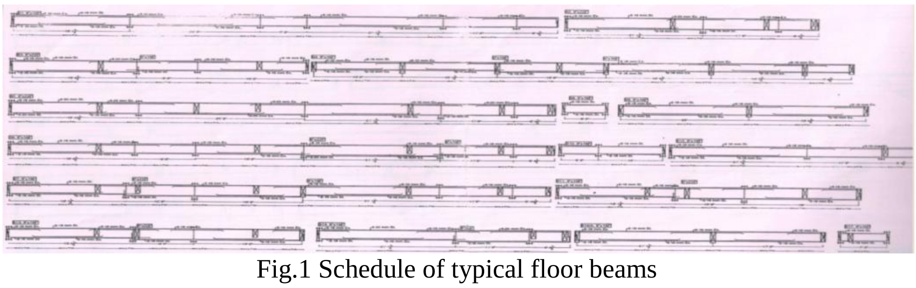

Fig.1 Schedule of typical floor beams

V. DESIGNING OF COLUMNS

A column in general may be defined as a member carrying direct axial load which causes compressive stresses of such magnitude that these stresses largely control its design. The loads and moments in the three columns in a frame are different. Each of the column is required to be designed separately. However when entire building is to be designed, there will be a number of other columns along with each of the above columns to form a group. All the columns are subjected to axial loads (P_u) and uniaxial bending moment (M_u). the column section shall be designed just above and just below the beam column joint and larger of the two reinforcements shall be adopted. This is similar to what is done for design of continuous beam reinforcement at the support. The design moment is followed IS456:2000 code. The schedule of columns are given in Table.2

Table.2 Column schedule

Coloum Type	Mix	Size	Main Steel	column number's
C1	M-20	9"×18"	8-#16	4
C2	M-20	9"×18"	10-#16	9
C3	M-20	9"×21"	10-#16	11
C4	M-20	9"×21"	4-#20+6-#16	7
C5	M-20	9"×24"	6-#20 4-#16	22
C6	M-20	12"×24"	6-#20 4-#16	11
C7	M-20	12"×24"	12-#20	17
C8	M-20	12"×24"	6-#25 6-#20	13
C9	M-20	12"×30"	6-#25 6-#20	6
C10	M-20	12"×30"	12-#25	4
C12	M-20	12"×36"	14-#25	1

VI. DESIGNING OF FOUNDATION:

Foundation design involves a soil study to establish the most appropriate type of foundation and a structural design to determine footing dimensions and required amount of reinforcement. Because compressive strength of the soil is generally much weaker than that of the concrete, the contact area between the soil and the footing is much larger than that of the columns and walls (Soil and foundation handbook, 2004). The present study indicates that the site is located in granite rock which is suitable for strong foundation. To determine the bearing capacity of soil, samples of soil are tested in the laboratory and found that the Safe bearing capacity of soil is 350KN/M^2 at a depth of 6ft and same soil should extent 1.5 times the width of footing below the base of footing. Depending on the bearing capacity of soil and designing of structure isolated square footings and combined footing of M-20 mix and reinforced with HYSD bars of Fe-415 is designed as per IS :786-1985. Therefore the footing is isolated rectangular sloped footing with pedestal. The slope is provided to decrease the concrete in the construction which results into economic construction. A pedestal is used to carry the loads from metal columns through the floor and soil to the footing when the footing is at some depth in the ground. And an isolated column footing transfers the loads from a single column to the supporting soil. The footing is designed for flexure, punching or two-way shear, and flexural or one-way shear. The allowable soil bearing pressure determines the size of the footing, and the punching shear governs the depth of the footing. The schedule of footings in the site are listed in Table.3 and general footing plan and pedestal footing plan is shown in Fig.2

Table.3. Design Considerations of Footing

Footing type	Mix	Size	Reinforcement	Footing depth	Pedestal size	Pedestal height	Pedestal reinforcement
F1	M-20	5'0"×5'0"	12mm ø R.T.S 6" c/c both directions	18"	–	–	–
F2	M-20	5'3"×5'3"	12mm ø R.T.S 6" c/c both directions	21"	–	–	–
F3	M-20	5'6"×5'6"	12mm ø R.T.S 6" c/c both directions	21"	2'0"×2'0"	24"	8 nos-#12
F4	M-20	5'9"×5'9"	12mm ø R.T.S 6"	21"	2'0"×2"0"	24"	8 nos-#12

			c/c both directions				
F5	M-20	6'3"×6'3"	12mm ø R.T.S 6" c/c both directions	24"	2'6"×2'6"	24"	8 nos-#12
F6	M-20	6'9"×6'9"	12mm ø R.T.S 5" c/c both directions	24"	2'6"×2'6"	24"	8 nos-#12
F7	M-20	7'0"×7'0"	12mm ø R.T.S 5" c/c both directions	27"	2'6"×2'6"	24"	8 nos-#12
F8	M-20	7'6"×7'6"	12mm ø R.T.S 5" c/c both directions	30"	2'6"×2'6"	24"	8 nos-#12
F9	M-20	8'0"×8'0"	12mm ø R.T.S 5" c/c both directions	30"	3'0"×3'0"	24"	12nos-#12
F10	M-20	8'3"×8'3"	12mm Ø R.T.S 4" c/c both directions	33"	3'0"×3'0"	24"	12 nos-#12
F12	M-20	9'0"×9'0"	12mm ø R.T.S 6" c/c both directions	36"	3'3"×3'3"	24"	12 nos-#12

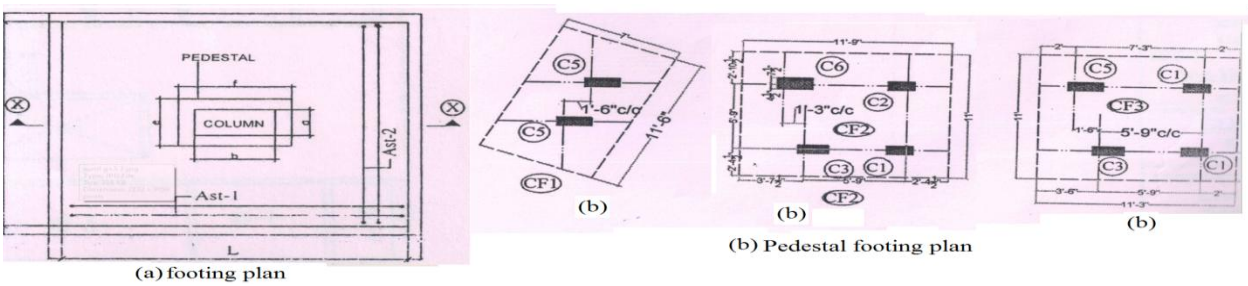

Fig.1 Typical footing plan of G+5 building

VII. DESIGN OF STAIR CASE:

Stairs consist of steps arranged in a series for purpose of giving access to different floors of a building. The location of stairs requires good and careful consideration. In the present design Dog-legged staircase is designed. The dimensions of Breadth, length and Height are 2820mm, 60000mm and 3350mm respectively.

Assume rise = 150mm Tread = 300mm and angle $(\sec\theta)=\sqrt{(150)^2+(300)^2}/300 = 1.12$

Therefore Number of risers = 3350/150 ≈ 22.

So for flight-1:11 and for flight-2:11

Going 11*treads = 3300mm

Total width of landings = 6000-3300 = 2700mm

Therefore width of landing at each end = 1350mm

For stair case provide Φ 8mm @ 200 mm c/c. the schematic layout of stair case is shown in Fig.3

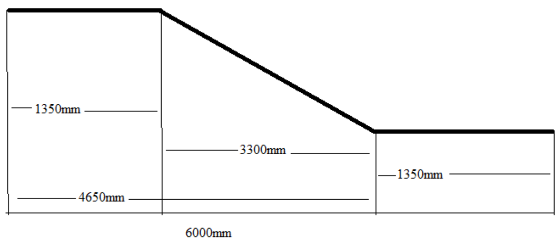

Fig.3 Schematic layout of stairs

VIII. DUCTILE DETAILING

After designing the frame column-Beam, shear walls and foundation by limitstate theory as per IS456:2000, all details of longitudinal steel, overlaps, shear capacities, confining reinforcement requirements, stirrups and ties etc. is worked out using the provisions of IS13920:1993

IX. CONCLUSION

In the present study G+5 building at Kukatpally, Hyderabad, India is designed (Slabs, Beams, Columns and Footings) using Auto CAD software. The loads are calculated namely the dead loads which depend on the unit weight of the materials used (concrete, brick) and the live loads using the code IS:456-2000 and HYSD BARS FE415 as per IS:1786-1985.The safety of G+5 reinforced concrete building will depend upon the initial architectural and structural configuration of the total building, the quality of the structural analysis, design and reinforcement detailing of the building frame to achieve stability of elements and their ductile performance. Proper quality of construction and stability of the infill walls and partitions are additional safety requirements of the structure as a whole. The detailed plan of the building is given in Fig.4.

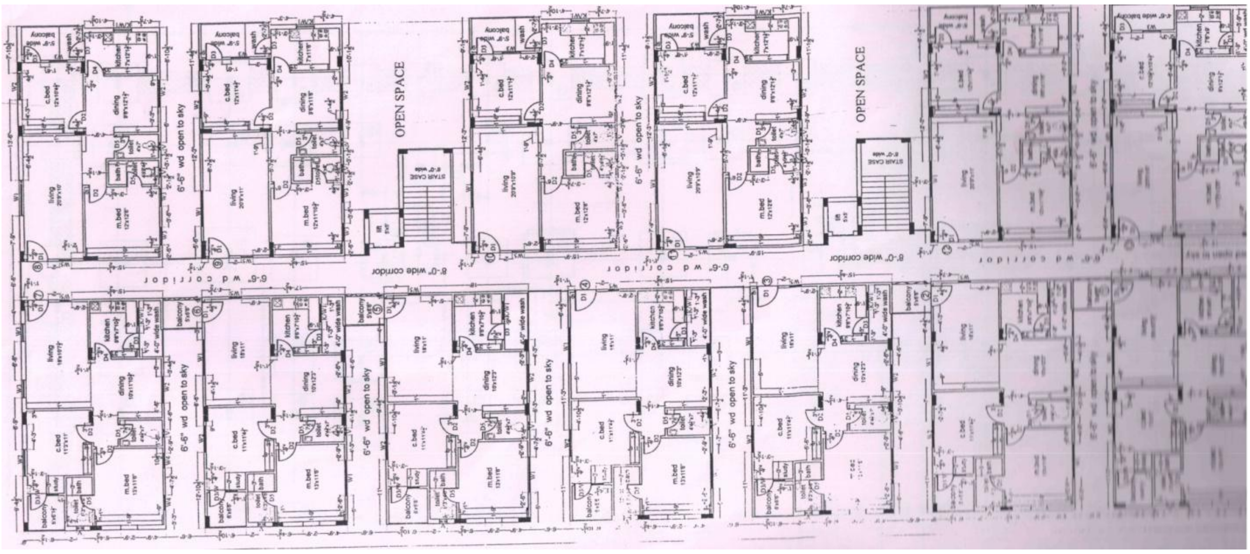

Fig.4 Typical floor working plan

REFERENCES

[1] Divya kmath, K.Vandana Reddy, *Analysis and design of reinforced concrete structures-A G+5 building model*, miniproject report, Gokaraju Rangaraju Institue of Engineering and Technology, Hyderbad, India, 2012

[2] *Soil and Foundation hand book*, State Materials Office Gainesville, Florida, 2004

[3] IS: 875 (Part 1), Part 1: Dead Loads--Unit Weights of Building Materials (Second revision), Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures, Bureau of Indian Standards, New Delhi, 2000.

[4] IS: 875 (Part 2), Part 2: imposed loads (Second revision), Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures, Bureau of Indian Standards, New Delhi, 1987.

[5] IS: 13920, *Ductile detailing of reinforced concrete structures subjected to seismic forces*, Bureau of Indian Standards, New Delhi, 1987.

[6] IS: 456 (Fourth Revision), *Plain And Reinforced Concrete - Indian Standard code of practice,* Bureau of Indian Standards, New Delhi, 2000.