DESIGN OF MULTI STOREY BUILDING RESTING ON SINGLE COLUMN

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Abstract
The aim of the project is to analyze and design of multi-storey building resting on the single column by using different code provisions. A lay out plan of the proposed building is drawn by using AUTO CAD 2010. The structure consist of ground floor plus five floors, each floor having the one house. Staircase must be provides separately. The planning is done as per Indian standard code provisions. The building frames are analyzed using the various text books. Using this so many standard books analysis of bending moment, shear force, deflection, end moments and foundation reactions are calculated. Detailed structural drawings for critical and typical R.C.C. members are also drawn. Co-ordinates for all structural members are tabulated for ready reference.

Keywords: Multi Story Building, Single Column, Staircase.

1. INTRODUCTION
The purpose for taking in this project is to design a whole building rest on single column\cite{1,2,3,5,6,7,9}. And how the different components are designed are given below in detailed.

- Design of the Foundation:
The type of foundation suitable for this multi-storey building is adopted based on the SBC\cite{20,21} value assumed. And it is designed by using standards of Indian codes and other\cite{17,18,22,21}.

- Design of the Column\cite{8}:
One of the important task in this is design of Column because only mono column is assumed. The Column is designed by taking required dimensions according to\cite{7,8,10,23,25}.

- Design of the Beam:
The desired specifications of the beams are assumed according to Code Provisions\cite{3,6,7}. And the checks are made according to that.

- Design of the Slab:
The required slab is assumed and it is designed with required specifications\cite{15,16,18,19}.

The walls are construct in English bond. The specifications are lintel for various works. The limit state of design is adopted for designing all the RCC members.

There no existing structure practically but the design is comparing between various papers as references.

2. METHODOLOGY
The method we are design the entire structure is limit state method\cite{9}.

LIMITE STATE OF DESIGN:
Limit state method of design in a factor improvement of ultimate load design. In the limit state method, a structure is designed to withstand all loads likely to act on in the duration of its life span also to satisfy the serviceability requirements like deflection, limitation and crack width.

<table>
<thead>
<tr>
<th>S. no</th>
<th>Type of the structural member</th>
<th>Specifications of member</th>
<th>Design provisions used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Foundation (Isolated square footing)</td>
<td>9mx12m</td>
<td>IS:456-2000</td>
</tr>
<tr>
<td>2.</td>
<td>Column (SHORT , COMPRESSION MEMBER)</td>
<td>2mx2m</td>
<td>IS:456-2000</td>
</tr>
<tr>
<td>3.</td>
<td>Beam(Fixed beams)</td>
<td>450mmx675mm</td>
<td>IS:456-2000</td>
</tr>
<tr>
<td>4.</td>
<td>Slab(Two way slab)</td>
<td>Thickness=150mm</td>
<td>IS:456-2000</td>
</tr>
<tr>
<td>5.</td>
<td>Stair case(straight flight stair case)</td>
<td>Tread (T)= 250mm Riser(R)= 150mm</td>
<td>IS: 456-1978</td>
</tr>
</tbody>
</table>

Hence thus using the above codes the method which is required for the design of this Multi-Storey Building is adopted.

2. GEOMETRY OF THE STRUTURE
A multi-storey building resting on the single column\cite{1,2} is planned for the analysis and design its plans is shown in figure 1(a) and 1(b).
BUILDING ORIENTATION:
The building is oriented in such a way that it is going to serve with lights and air circulation\cite{15} with easy access to all amenities. Basic facilities in residential building are given as per the NBC\cite{25} Recommendations.

Each floor consists of the individual of the house that consists of two bed rooms, kitchen, hall, separate toilets, dining hall and pooja room.

![Fig.1 (a) Plan of the Building](image)

![Fig.1 (b) Detailed view of Building Elevation](image)

### 3. PLANNING DETAILS\cite{22}
- Bed room 1 = 3mx5m, toilet 1 = 2mx1.5m
- Bed room 2 = 3mx5m, toilet 2 = 2mx1.5m
- Dining hall = 3mx3m, pooja room = 1mx1m
- Kitchen = 3mx4m, utilities = 2mx4m
- Hall = 5mx6m
- Total area = 400 m\(^2\)
- Built up area = 117 m\(^2\)

### Table-2 Design of the members in detailed

<table>
<thead>
<tr>
<th>S.NO</th>
<th>NAME OF THE MEMBER</th>
<th>DETAILS OF DESIGN</th>
<th>REMARKS</th>
</tr>
</thead>
</table>
| 1.   | Footing            | DESIGN OF MAT FOUNDATION:  
Size of the building = 9x12m  
Service load transmitted by each column = 7250 KN  
Size of the column = 2mx2m  
Safe bearing capacity of the soil = 120KN/m\(^2\)  
M20, f\(_{ck}\) = 20 KN/m\(^2\) and f\(_y\) 415 HYSD bars.  
And then continuous slab over Raft slab is designed. | According to the code provisions check is ok. |
| 2.   | Column             | COLUMN DESIGN:  
Design of Column is done as per IS:456-2000  
Section Property: 2000 x 2000, Storey height = 16.500 m  
Rectangular section:  
Width= 2000 mm, Depth= 2000 mm, Cover = 40 mm  
Member Detailed IS456 Main Reinforcement,  
Critical Combination : C4  
And all other manual design is done by used standard code. | All the checks are ok hence it is safe. |
| 3.   | Beam               | BEAM CALCULATIONS:  
Assume the thickness of the beam is 450x600  
Imposed load = 3 KN/m2  
Live load is for all rooms& Kitchens ,  
toilet and Bath rooms= 2 KN/m2 and  
self-weight is calculated as 3 KN/m2 | All the checks are ok hence it is safe |
(According to IS 456 part 2) Provide 10mm dia 240 mm centre for long span direction And the other manual required design is done by using codes and other reference books for all other rooms in the multi-storey building

4. Roof slab

<table>
<thead>
<tr>
<th>DESIGN OF ROOF SLAB</th>
<th>All the checks are ok hence it is safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>l_y = 5m, l_x = 3m, f_c = 20 N/mm^2 and f_y = 415 N/mm^2</td>
<td></td>
</tr>
<tr>
<td>Where l_y / l_x ratio is &lt;2</td>
<td></td>
</tr>
<tr>
<td>Design as a two way slab. As the span is more than 3.5m adopt Span/depth = 25 (Condition according the IS 456)</td>
<td></td>
</tr>
<tr>
<td>Depth = span/25 = 3.5/25 = 114.85 m, Say = 120mm</td>
<td></td>
</tr>
<tr>
<td>Adopt effective depth (d) = 95 mm and Overall depth (D) = 120m</td>
<td></td>
</tr>
<tr>
<td>EFFECTIVE SPAN:</td>
<td></td>
</tr>
<tr>
<td>Effective span = (clear span + effective depth) = 3.00 + 0.095 = 3.095m</td>
<td></td>
</tr>
<tr>
<td>Loads are taken from codes and Ultimate load = 8.4 KN/m^2. And the shear force and ultimate bending moments are designed. Hence the effective depth selected is sufficient to resist the design of ultimate moment.</td>
<td></td>
</tr>
<tr>
<td>Adopt 10mm dia @ 300 mm in shorter span direction.</td>
<td></td>
</tr>
</tbody>
</table>

5. Stair case

<table>
<thead>
<tr>
<th>STAIR CASE DESIGN</th>
<th>All the checks are ok hence it is safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of the stair case is straight flight stair case</td>
<td></td>
</tr>
<tr>
<td>No. of steps in straight flight is 12</td>
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</tr>
<tr>
<td>Tread (T) = 250mm, Rise (R) = 150mm</td>
<td></td>
</tr>
<tr>
<td>Width of the landing beams = 400mm and Materials M20 and f_y = 415</td>
<td></td>
</tr>
<tr>
<td>EFFECTIVE SPAN:</td>
<td></td>
</tr>
<tr>
<td>Effective span l = (12x250) + 400 = 3400mm</td>
<td></td>
</tr>
<tr>
<td>Thickness of the waist slab is (span/20) = 3400/20 = 170mm, Say = 200 mm</td>
<td></td>
</tr>
<tr>
<td>And all necessary checks are done by using code provisions. Provide 12mm of diameter and Spacing = 160mm</td>
<td></td>
</tr>
<tr>
<td>Distribution of the reinforcement = 0.12% bD = 0.0012x1000x200 = 300 mm^2</td>
<td></td>
</tr>
<tr>
<td>Provide 8mm 0f dia of bars at c/c.</td>
<td></td>
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</tbody>
</table>

4. RESULTS

1. In this project a multi-storey building resting on single column designed by using of STAAD PRO 2007.
2. Using of this software analysis of bending moment, shear force, deflections, end moments and foundation reactions are calculated.
3. Using this calculated Bending moment, shear force, and reactions the beams, columns and footing are designed.
4. By using the AUTO CAD[1] we can design the footing.
5. Detailed drawings of all R.C.C. members such as slabs, beams, columns, and footings are also shown.

5. CONCLUSION

1. We conclude our project with full satisfaction that we are designed the Multi-storey building resting on single column by using of the AUTO CAD[1].
2. The limit state method of design is adopted. We had done the design aspects of the structure manually and software.[1]
3. In our project we also used the code provision of the SP 16 and SP 34 (the design aids for concrete and detailing)
4. Finally we learn detailing of various structural members by using SP 34 design aids.
5. The knowledge gained from this project will help us to take up similar projects with courage and confidence in future course of actions.

REFERENCES

[5] SP 34- AIDS FOR DETAILING OF R.C MEMBERS.
[9] IS 875:1987 (PART 2) code of practice for design loads (other than earth quake loads) for building and structures, new Delhi (India), Bureau of Indian standard, 1987.
[10] IS 875 :1987 (PART 3) code of practice for design loads (other than earth quake loads) for building and structures, new Delhi (India), Bureau of Indian standard, 1987.
[11] INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY Design of Multistoried R.C.C. Buildings with and without Shear Walls M. Aainawala Dr. P. S. Pajgade Size of members like column can be reduced economically in case of structure with shear wall as compared to the same structure without shear wall.