Analysis, Design and Estimation of G+4 Residential Building

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Abstract—The principal objective of this project is to analyze, design and make building estimation of a multistoried building [G + 4] using STAAD Pro and MS EXCEL. The design methods used in STAAD-Pro analysis are Limit State Design conforming to Indian Standard Code of Practice. The structure was subjected to self-weight, dead load, live load and seismic loads under the load case details of STAAD Pro. The supports at the base of the structure were also specified as fixed. Then STAAD Pro was used to analyze the structure and design the members. In the postprocessing mode, after completion of the design, we can work on the structure and study the bending moment and shear force values with the generated diagrams. The design of the building is dependent upon the minimum requirements as prescribed in the Indian Standard Codes. Strict conformity to loading standards recommended in this code, it is hoped, will ensure the structural safety of the buildings which are being designed.

Keywords—STAAD Pro, MS EXCEL, Analysis, Estimation, Design.

I. INTRODUCTION
The construction in this 21st century is becoming challenging day by day as in order to achieve more economy and efficiency. As in order to bring down these challenges and save time, computer-based software programs are used by engineers. In this project after having the theoretical knowledge about the analysis and design of building we have attempted to G+4 residential building using this software also estimation using MS Excel. Our project involves most popular software’s like Auto Cad, Staad Pro and MS Excel.

I.Auto Cad: - One of the main benefits of AutoCAD is that it allows you to draw to scale and accurately, Easy Layout and Viewing, we can make changes easily and reduce risk of error, identify design problems, calculate material quantities for production store and transfer data safely save time and money.

The ground and all floors plan were drawn using Auto Cad. Also, column, footing plan was constructed in it

II.The STAAD Pro CONNECT Edition: - It is used to generate the model, which can then be analysed using the STAAD engine. Design, including design for durability, construction and use in service should be considered as a whole. The design of the building is dependent upon the minimum requirements as prescribed in the Indian Standard Codes.

III.MS Excel: - It helps in maintaining bills, making graphs, Scheduling things for a project, calculating sizes of beams and columns, etc for a civil engineer, in times of executing, quantity estimating, planning, contracts, budgeting, designing, quality controlling, quantity estimating etc. As stated, everyone uses Excel. The required calculations are one by MS Excel. You can store, replicate, modify the data; however, one might want. In our Project we have done Building Estimation and Costing and prepared quantity measurement and abstract sheet using MS Excel.

II.AIM
The aim of the research is to study and analysis, design of g + 4 building using stand pro and cost estimation using MS excel

III.RESEARCH OBJECTIVES
1) To study analysis and design of G+4 building on STAAD PRO software.
2) To make building Estimation and costing using MS excel
3) To study the results of various parameters such as static and dynamic loads, displacement and deflection.
VI. METHODOLOGY

Preparation of Building Plan and Column Plan
- Layout Using Auto Cad
- Assigning Proper Dimensions, Use of Appropriate Values and Extracting out
- Analysis and Design of G+4 Residential Building Using Staad Pro
- Create new File and Configure Units, IS Code for Steel and Design Specification.
- Input Geometry, Property, Material and Support Condition
- Input Specifications and Load Case Details for Mass, Self-Weight, Dead Load, Live Load, Seismic Load Condition
- Analysis Command and Run Analysis
- View Output File and Verify the Results
- Postprocessing Mode: Loading Diagram, Displacement, Beam Forces, Plate Load, etc.
- Generation Of Report
- Building Estimation and Costing Using Microsoft Excel
- Preparation of Quantity Measurement and Abstract Sheet for Start to the End of the Building Process by using Excel

V. WORK PROGRESS

1. BASIC DATA
- Type of Structure: Residential building Multi RCC Storey Frame
- Seismic Zone: v

3. ANALYSIS AND DESIGN USING STAAD PRO:
3.1. LOAD CONSIDERATION

(a). DEAD LOAD: -
[IS 875( Part 1):1987 This is a Code of practice for design loads (other than earthquake) for buildings and structures Part 1]

(c). SEISMIC LOAD: -
Dead loads – Unit weights of building material and stored materials (second revision)
The dead load comprises of the weights of walls, partitions, floor finishes, false ceilings, false floors and the other permanent constructions in the buildings.

- Dead load calculation
  1) Self-weight = 1 KN (Y axis).
  2) Member load (ML) = wall thickness X (Floor Height - Beam Depth) X unit weight on masonry.
     i. on External wall = 5.875 KN/m
     ii. on Internal wall = 3.675 KN/m
     iii. Parapet wall (1m Height) = 1.25 KN/m
  3) Plate Load = 2 KN/m.

(b). LIVE LOAD:


1. Design Lateral Force
   The design lateral force shall first be computed for the building as a whole. This design lateral force shall then be distributed to the various floor levels. The overall design seismic force thus obtained at each floor level shall then be distributed to individual lateral load resisting elements depending on the floor diaphragm action.

2. Design Seismic Base Shear
   The total design lateral force or design seismic base shear (Vb) along any principal direction shall be determined by the following expression:
   \[ Vb = Ah \times W \]
   Where,
   \( Ah \) = horizontal acceleration spectrum
   \( W \) = seismic weight of all the floors

3. Fundamental Natural Period
   The approximate fundamental natural period of vibration (T,), in seconds, of a moment resisting frame building without brick in the panels may be estimated by the empirical expression:
   \[ T_a = 0.075 \times h^{0.75} \] for RC frame building
   \[ T_a = 0.085 \times h^{0.75} \] for steel frame building
   The approximate fundamental natural period of vibration (T,), in seconds, of all other buildings, including moment-resisting frame buildings with brick lintel panels, may be estimated by the empirical expression:
   \[ T_a = 0.3199 \text{ sec} \] and \( (T_a)_z = 0.3968 \)

4. Stiffness Reduction Factor for RC and Masonry Column= 75%, Beam=30%.

5. Scale Factor= \( \frac{ZI}{2R} = 0.0432 \)
   \( I = 0.36 \)
   \( Z = 1.2 \)
   \( R = 5 \)

6. Seismic Live Load= 25%LL=0.5 KN
3.2. STAAD PRO OUTPUT

3.3. RESULTS OF STAAD PRO
4. BUILDING ESTIMATION AND COSTING

4.1 GENERAL

1. One of the key factors in the construction industry is estimating and costing. Accurate estimation is very important as the success and quality of a construction or project depend on it.

2. The rate of each item was taken from Govt. Of Maharashtra Public Works Department (Schedule of Rates 2018-19) and Maharashtra Jeevan Pradhikaran Pune Region (Schedule of Rates for 2019-2020).

3. The quantity measurement and abstract sheet is prepared using MS Excel.

4. Long Wall and Short Wall method is used for estimation.

5. Various Parameters like site cleaning, excavation, PCC, RCC, beam, column, painting, plastering etc., are calculated.

4.2. STRUCTURAL DRAWING

4.3. ESTIMATION SHEET

4. BUILDING ESTIMATION AND COSTING

<table>
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<tr>
<th>No.</th>
<th>Description of Item</th>
<th>Unit</th>
<th>Quantity</th>
<th>Rate (Rs.)</th>
<th>Amount (Rs.)</th>
</tr>
</thead>
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<td>1</td>
<td>Site Cleaning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Excavation</td>
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<td>3</td>
<td>PCC</td>
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<td>4</td>
<td>RCC</td>
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<tr>
<td>5</td>
<td>Beam</td>
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<tr>
<td>6</td>
<td>Column</td>
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<td>7</td>
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<td>8</td>
<td>Plastering</td>
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</tbody>
</table>
V. CONCLUSION
1. This project includes G+4 building with parking at ground floor and rest of the floors occupied with 2BHK flats. The response of a RCC high rise building under dead load, live load and seismic load is studied as per IS 875(Part 1):1987, IS 875(Part 2):1987 and IS 1893: Part 1: 2016 respectively.
2. Reinforcement details for each member i.e., beams and columns can be obtained directly after the process of analysis is carried out.
3. Estimation and Costing is done using MS Excel to know the building appropriate cost using Long Wall and Short Wall Method.
4. Overall project helped us to understand the Building Process and use of different software for easy and timely completion of work.

VI. REFERENCES