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Analysis and Design of G+5 Floors Apartment Building

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Abstract:- Our primary goal in finishing a G+5 Floor Apartment building is to make sure the building is safe from all potential loading circumstances and that it performs the intended function. In order for the structure to fulfil its function while maintaining a reasonable maintenance cost, safety requirements must be met. The structure's precise planning typically results from a number of studies conducted by town planners, investors, users, architects, and other engineers. An architect is interested in the aesthetic elements, while a structural engineer has the most influence on the overall structural design. The dead load, live load, seismic load, and wind load are taken into account when designing the structure. STAAD software was used for the structure's analysis and design.

Keywords**:** *STAAD-Pro, Residential, Economical, Storey, Autocad*

I. INTRODUCTION

The urban population of the world is expanding extremely quickly. Approximately half of the world's population now resides in cities. Urban residents will make up around 60 to 70 percent of the global population in the upcoming decades. Despite the alarming rate of urban population growth, there is a limited amount of land that can be developed. Buildings with multiple stories must be built in order to accommodate the millions of people due to urbanisation and population growth. Only by building G+5 Apartments is it possible to house millions of people. Building behaviour becomes more complex as height rises, and because these structures are more vulnerable to wind and seismic loads, we must be extremely careful while designing them. Ideally, reinforced concrete should be used.

II. LITERATURE REVIEW

- *Analysis and Design of G+5 Residential Building" V.Varalakshmi, G. Shiva Kumar, R. Sunil Sarma (2014)*

STAAD Pro software is used to develop the G+5 residential block in their current study. Dead loads, which rely on the unit weight of the material used, and live loads are computed using code IS 456: 2000, HYSD BARS Fe415. It is essential to understand the moments that will be experienced while designing columns and beams. The limit state method is used for frame analysis for this reason. The sections are next examined for strength and serviceability throughout all of their parts (slabs, beams, columns, and footings).What you want altered should go here. After that, click the button below. It's that simple!

- *Analysis and Design of a Commercial cum Residential Building by Using STAAD Pro Volume: 03 Issue: 06 June-2016 IRJET*

Business cum STAAD Pro is used to analyse building frames in residential construction, and manual frame element design is also included. The best design programme available is STAAD Pro. This programme is often used by design firms for project design. As a result, the main focus of this project is STAAD Pro building analysis. The manual calculations of a sample beam and column from the same structure, which were created in accordance with IS 456-2000, will also be used to compare the analytical results.

- *Analysis and Design of Apartment Building Vol. 3 Issue 3, March 2016 IJISE*

A crucial and fundamental ability for every engineer is practical knowledge. An apartment block in Thrissur with G+8 storeys and a car parking facility on the ground floor and basement is examined and designed in order to acquire this competence. The lift pit is surrounded by a shear wall of the building. STAAD Pro 2007 was used for the structure's modelling and analysis, while manual labour was used for the designing. A water tank, retaining wall, stairway, beam, column, slab, shear wall, and isolated footing have all been designed. And AUTOCAD 2016 is used to complete the details. Construction sites were visited in addition to the building's analysis and design.

III. METHODOLOGY

- *Planning:*

A crucial and fundamental ability for every engineer is practical knowledge. An apartment block in Thrissur with G+8 storeys and a car parking facility on the ground floor and basement is examined and designed in order to acquire this competence.

The lift pit is surrounded by a shear wall of the building. STAAD Pro 2007 was used for the structure's modelling and analysis, while manual labour was used for the designing. A water tank, retaining wall, stairway, beam, column, slab, shear wall, and isolated footing have all been designed. And AUTOCAD 2016 is used to complete the details. Construction sites were visited in addition to the building's analysis and design.

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➢ *Work Progress*

- *Basic Data*

✓ Details of building = G+5 Apartment
✓ Location= Vijayawada
✓ Walls = 230 mm Brick Masonry Walls
✓ Typical floor-to-floor height = 3.0 m
✓ Type of soil = Sandy Soil
✓ Bearing capacity of soil= 250kN/m^2

- *Ding on the Structure*

✓ Dead load for floor finish= 3.625 KN/m^2
✓ Live load for roof =1.5 KN/m^2 (As access is provided)
✓ Live load for floor = 3 KN/m^2(depending upon location such as Balcony Kitchen, corridor etc.)
✓ Wind load = As per IS: 875 not designed for wind load, since
✓ Exceed the wind loads.
✓ Earthquake load =As per IS- 1893 (Part-I): 2002

- *Other Information*

✓ Concrete grade = M25 unless specified
✓ Reinforcement grade = Fe 415 (HYSD bars)

➢ *Plan of Residential Building*

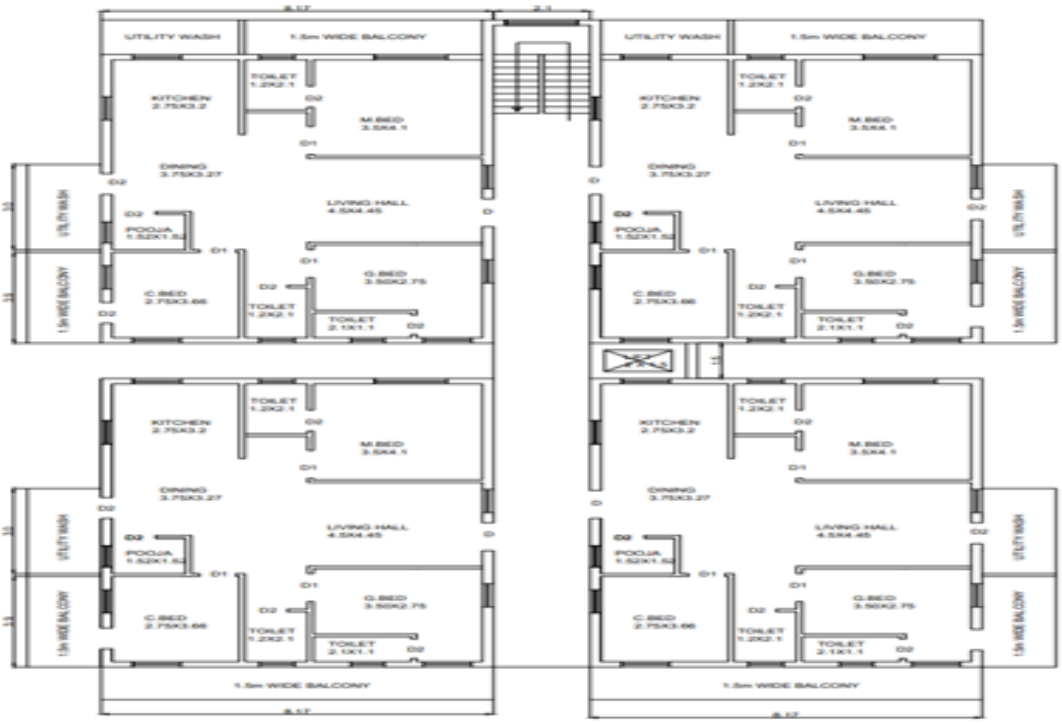

Fig 1 Plan of Residential Building

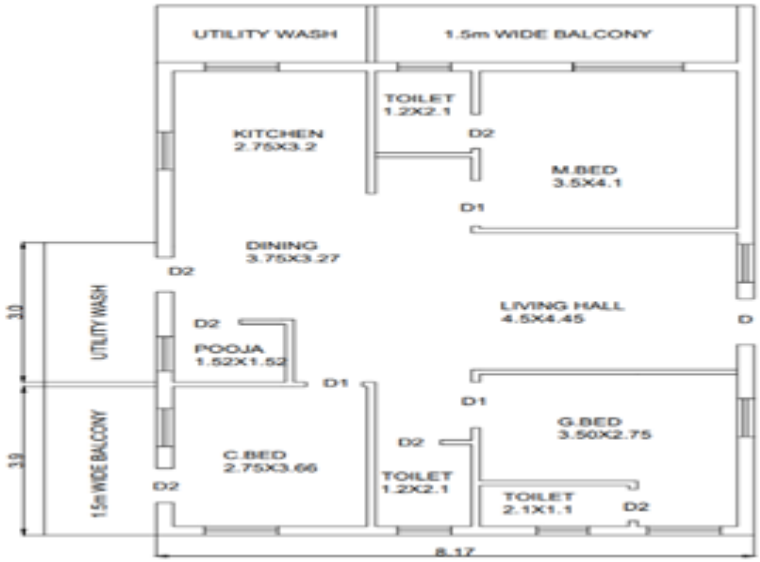

Fig 2 Plan of Single Apartment

➢ *Design of Building Components*

- *Design of Beam*

✓ *+ ve Bending Moment for*

- Mgh = Wl 2/8 = 28.2852 = (28.2852 - 2)/8 = 28.42 KN-m
- Mgh = 28.42 - (21.88 + 17.05)/2 = 8.95 "KN-m"
- Mgh = 40.52 - 8 = 125.0 KN-m
- Mgh is equal to 125 - (82.79+81.77)/2 = 42.72 KN-m.

✓ *-Ve Bending Moment for*

- Mgh's bending moment is Wl 2/8 = 28.2852, which equals (28.2852 - 2)/8 = 28.42 KN-m.
- Mgh = 40.52 - 8 = 125.0 KN-m Mgh = 28.42 - (21.88 + 17.05)/2 = 8.95 "KN-m"
- 125 - (82.79+81.77)/2 = 42.72 KN-m is the same as Mgh.
- Wl 2/8 = 28.2852, which is equivalent to (28.2852 - 2)/8 = 28.42 KN-m, is the bending moment of Mgh.
- Mgh equals 40.52 - 8 to 125.0 KN-m. Mgh is
- calculated as 28.42 - (21.88 + 17.05)/2 = 8.95 "KN-m"
- KN-m is the same as Mgh since 125 - (82.79+81.77)/2 = 42.72.

- *Design of Column*

✓ MB2-B3 is equal to Wl2/12 times 40/5/2 times 83.33 kN-m.
✓ Where (23,453,12,300) /(12,300)column = 582,18Cm3 and w = Load due to BM (I/L)column
✓ (I/L)Beam = 1.25 * 23 * 45 * (12 * 500) = 436.64 cm3
✓ Moment in column Mc equals (83.33 582.18)/(582.18 + 582.18 + 436.64) = 30.30kN-m
✓ Moment of Factoring Mu = 1.5 x 30.30 = 45.45 kN-m
✓ Total axial load Pu = 1374.84 kN bd2 Factored load Pu = 2063 kN Mu / F_{ck} bd2 = 0.039 Pu / F_{ck} bd = 0.8
✓ SP-16 Chart – 32
✓ % of steel = 3.5
✓ Area of steel required = 3.5%×230×450 = 3623mm^2

- *No of Bars*

✓ N×0.785×25^2 = 3623
✓ N = 7.39 = 8Nos
✓ Provided Ast = 6×0.785×25^2 = 2944mm^2
✓ Provide 25 dia of 6Nos
✓ Provide 2 Nos of 20 dia
✓ Ast = 2× 0.785×20^2 = 628 mm^2
✓ TOTAL Ast = 3572 mm^2

➢ *Analysis By STAAD Pro*

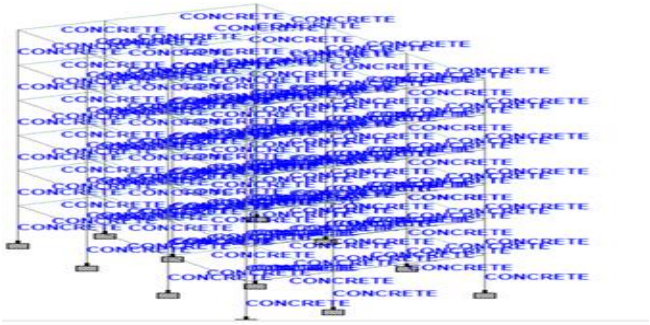

Fig 3 Property Assigning of the Structure

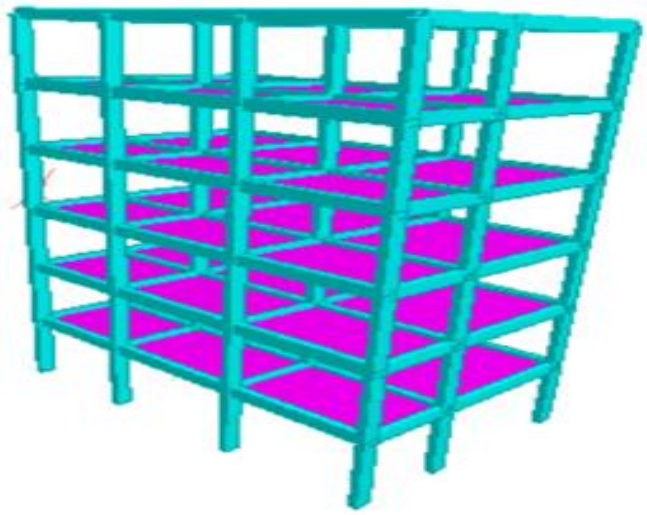

Fig 4 3-D View

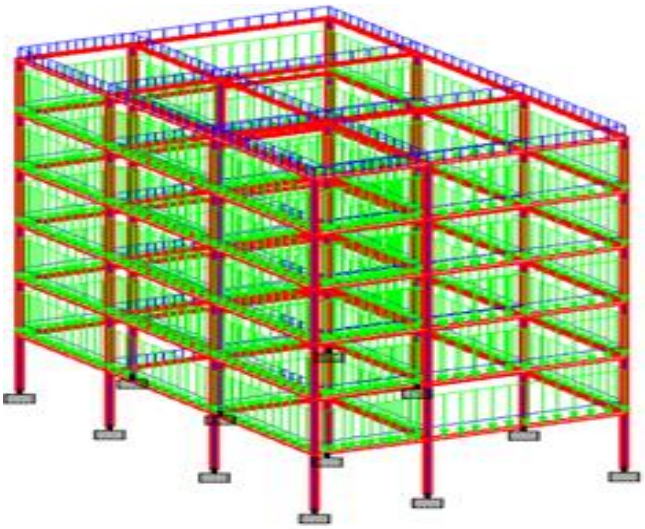

Fig 5 Application Dead Load

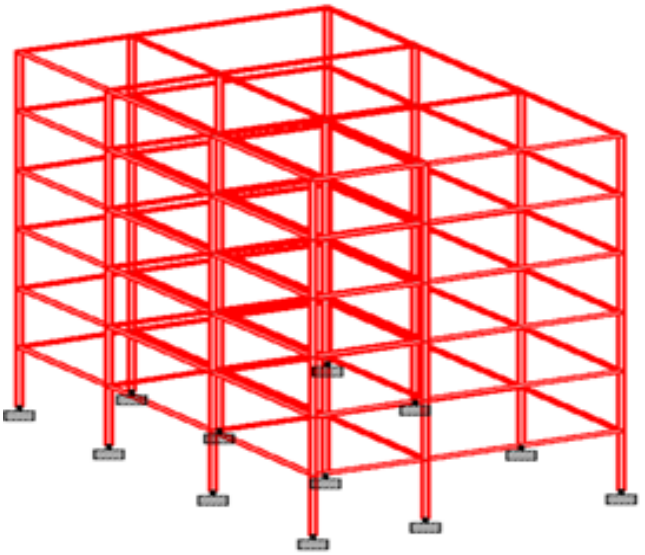

Fig 6 Application Dead Load

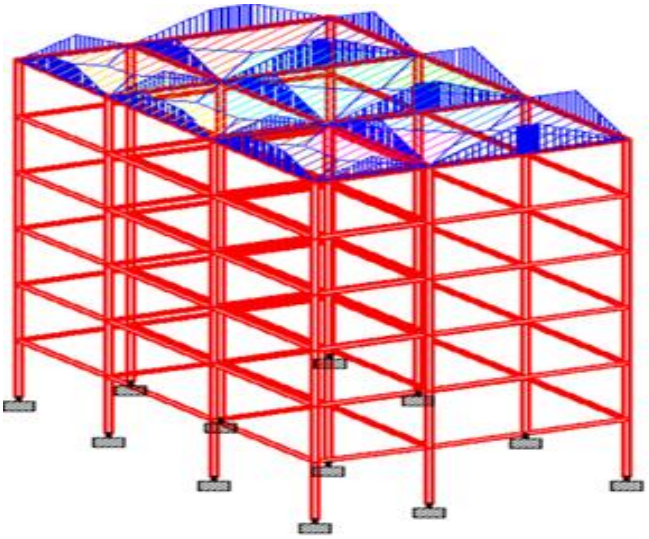

Fig 7 Roof Load

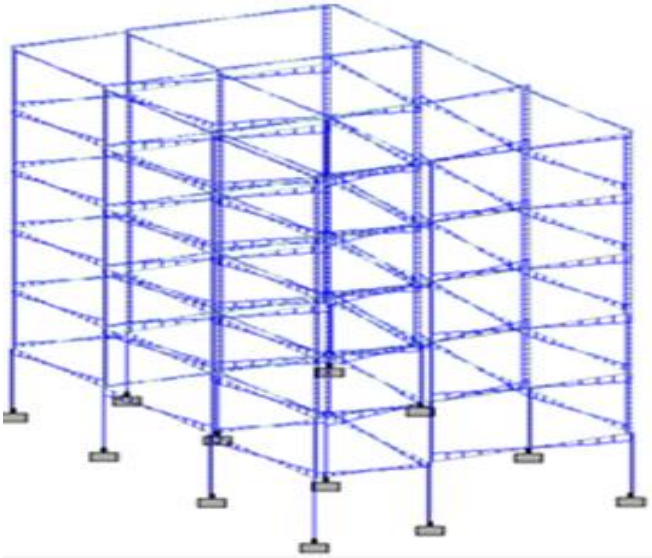

Fig 8 Shear Force Diagram of the Structure

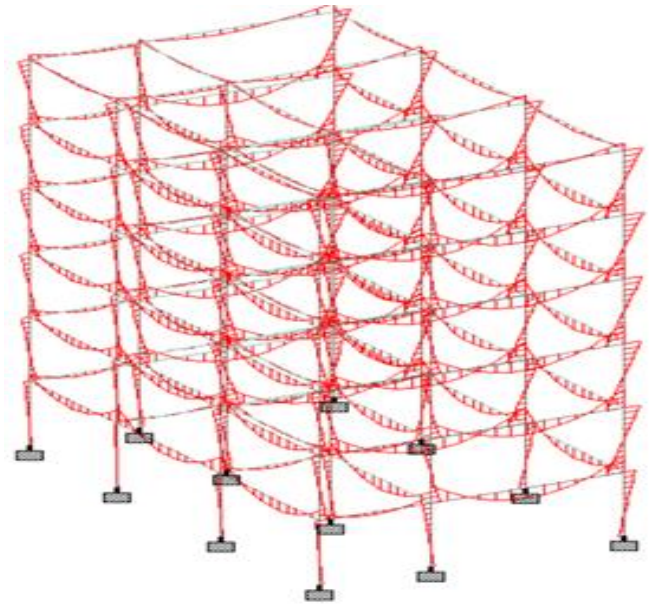

Fig 9 Bending Moment Diagram of the Structure

➢ *STADD Pro Results*

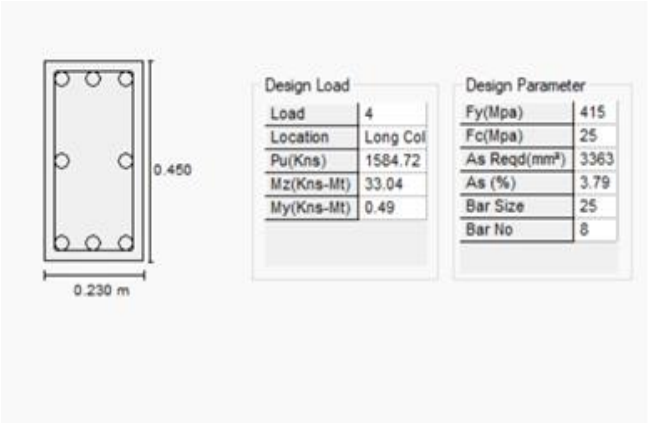

Fig 10 Column Design

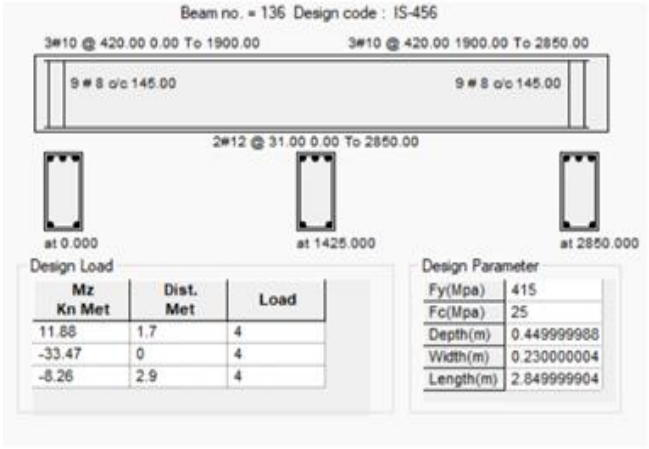

Fig 11 Column Design

Table 1 Comaparision between Manual Calculation and STAAD Pro

Parameter	Manual	Staad Pro	%Variation
Load on critical column	1375	1300	5.45
AST in Beam	697	742	6.45
AST in Column	3363	3572	6.21

IV. CONCLUSION

The residential block has been planned in accordance with the NBC specifications. For the purpose of effectively representing drawings, AUTOCAD 2008 was used. Kani's method was used for a manual analysis, and the findings were compared to those from STAAD Pro.

- It was noted that the difference between the bending moment values produced from manual calculation and those derived by STAAD Pro is no more than 10%.
- For the design of the structural members, IS-456:2000 and SP-16 were used, i.e., the LIMIT STATE technique was used.

REFERENCES

[1]. The residential neighbourhood has been designed in accordance with NBC guidelines. AUTOCAD 2008 was applied in order to adequately portray drawings. A manual analysis using Kani's approach was conducted, and the results were contrasted with those from STAAD Pro.
[2]. It was observed that there is a 10% maximum variation between the bending moment values obtained by manual computation and those obtained by STAAD Pro.
[3]. IS-456:2000 and SP-16, or the LIMIT STATE method, were employed for the design of the structural members.