Influence of Support Reactions on RCC Building Frames a Computational Method

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Abstract—High-rised structures, when planned, are ready to satisfy essential angles and workableness. While Vigor of construction relies upon burdens forced, it requires consideration. The plan includes load computations and breaking down the entire structure. The structure strategies utilized in STAAD.Pro and ETABS investigation are Cutoff state configuration adjusting to Indian Standard code of training. In this paper we have broke down and structured the G+3 multi-story building utilizing STAAD.Pro and ETABS independently and the adjustments in configuration results shear power, bowing minute and redirection of individuals from RCC building examined by utilizing STAAD.Pro and ETABS are thought about. This investigation draws out the benefits of utilizing ETABS over STAAD.Pro.

Keywords: G+3 multi-storey building, shear force, bending moment and deflection of members.

I. INTRODUCTION

The fortification is generally inserted inactively in concrete earlier than the solid set. The fortification desires the accompanying property in any event for the solid and tough development: High relation quality, High tolerates of elastic damage, Great cling to solid, independent of pH, dampness, comparative feature. Warm similarity, not making unsatisfactory worries accordingly changing temperatures.

II. REVIEW OF LITERATURE

Varikuppala Krishna, Chandrashekhar et.al (2015) “Analysis, Design of multi storied building with ETABS software. The study stated that geotechnical engineering cannot be neglected while building high rise buildings and ETABS is more user friendly and is more detailed compared to STAAD.Pro.

Sanghani (2011) contemplated to conduct of shaft and segment at different story levels. It was discovered that the greatest pivotal power created.

Poonam (2012) Consequences of the mathematical investigation demonstrated the story, particularly the primary story, must not be milder/more fragile than the story's above or beneath. Mass circulation likewise adds to the expanded reaction of the structures. The anomalies, whenever required to be given, should be given by suitable and broad investigation and configuration forms.

Prashanth.P (2012) Examined to conducted ordinary and unpredictable multi story house construction in STAAD.Pro and ETABS. Examination and configuration was found in IS: 456 and IS: 1893. Additionally physically computations analyzed outcome. It was discovered the ETABS gave the steel region in STAAD Pro. Stacking mixes were not considered in the investigation and impact of story stature on the auxiliary conduct was not depicted.

Yahyaei (2011)“Relative investigation of the static and dynamic examination of multi-story unpredictable structure”. Their study stated that by comparing the results of two structure, the frame element of regular is maximum bending moments, shear forces and axial forces for different loading conditions in both softwares.

S.K Dubey (2012), “Examination of configuration consequences of a structure planned utilizing STAAD.Pro and ETABS programming .Their investigation expressed that in the two virtual products, the design results shows 0.4%-0.5% more steel in ETABS.

III. BASIC DATA FOR BUILDINGS MODEL

1. Plan: 18x 18 m
2. Height of each storey: 3 m
3. Number of storeys: G+ 3 storeys
4. Column: (450 X 230) mm
5. Beam: (230 X450) mm
6. Walls Thickness: (230) mm thick
7. Grade of the concrete: M 25
8. Grade of the steel: Fe-415
9. Type of Soil: Type II, Medium Soil
10. Seismic Zone: II
11. Building Frame: Ordinary RC moment-resisting
12. Live Load on Typical Floor: 2000N/m²
13. Wind speed: 44 m/s
14. Support: Fixed

Live load:
Load 3.5 KN/m² is considered, zone: 5, type of soil: II, reaction decrease factor: 5.0, Importance factor: 1.0, Damping : 5.0%. Individuals are stacked with dead load, live burden.
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Earthquake burdens as indicated by IS code 875 (Part-1, Part -2) and IS: 1893 (Part-1) : 2002.

Self weights
Self-weight contains the heaviness of shafts, sections and chunk of the structure.

Dead loads
Every perpetual development of the structure dead load. The dead burden contains the loads of dividers, parcel floor completions, floors at other changeless developments in the structure. Dead burden comprises

a) Wall loads = (Density of block stone work X divider thickness x divider tallness)
   = 21000 N/m² * 0.250m * 3.1m
   = 13.8 kN/m (following up bar)
b) Wall load in because of Parapet divider at highest floor
   = (unit weight of block stone work * parapet divider thickness * Height)
   = 21000 N/m³ X 0.115mtrs X 950mm
   = 2090 N/m (following bars)
c) Floor load (because of floor thickness)
   unit weight of solid * floor thickness
   = 24000 N/m³ * 1350mm
   = 3255 N/m² (Acts on the beam)

Live load
Live loads incorporate heaviness of the portable segments, disseminated and thought load, load because of effect and vibration of residue loads. Live loads do exclude stacks because of wind, seismic movement, day off burdens because of heat changes to which the structure exposed to and so on. Live burden changes acc. to sort of structure.

Live load= 3 kN/m² every floor.
Earth quake loading.
Seismic burden can be determined taking the perspective on quickening reaction of the ground to the superstructure. As per the seriousness of seismic tremor power they are isolated into 4 zones.

As per the IS : 1893 (part-1):2002, flat Seismic Coefficient Ah for a Structure can be figured, the accompanying articulation

Ah= (ZISa)/(2Rg)

Where Z= Zone factor contingent on the zone the structure has a place with.

For Zone 2: for Z is 0.110
For Zone 3: for Z is 0.160
For Zone 4: for Z is 0.241
For Zone 5: for Z is 0.360
I= 1.50
R= Response decrease aspect
Sa/g = Average reaction Acceleration Coefficient, Here Seismic weight is taken Equivalent Length & Equivalent Width

LOAD DUE TO WIND CALCULATION
Design Wind force      \( P_Z = 0.6 \times (V_Z^2) \)
Configuration Wind rate  \( V_v = V_b \times K_1 \times K_2 \times K_3 \)
Hazard Coefficient \( K_1 = 1.08 \)
IS: 875-1987 (part3), sec 5.3.1, Table -1
Terrain & Height Factor \( K_2 = \) varies with height table 3.1
IS: 875-1987 part-3, sec 5.3.2, Table -2

According To Table -2
\( K_2 = 1.1055 \)
\( K_3 \) is Values are linearly interpolated
Topography Factor
\( K_1 = 1.00 \)
IS: 875-part-3, sec 5.3.3.1)
Basic Wind speed
\( V_B = 44 \text{m/sec} \) (Hyderabad)
Design Wind Speed
\( V_Z = V_b \times K_1 \times K_2 \times K_3 \)
\( = 44 \times 1.08 \times 1.1055 \times 1.00 \times 1 \)
\( = 48.802 \text{m/sec} \)
Design Wind Pressure \( P_Z = 0.6 \times V_Z^2 \)
\( = 0.6 \times (48.81)^2 \)
\( = 2375 \text{N/m}^2 \)

Loads and Factors Calculation
Calculating the loads and factors values which are using in the software STAAD. Pro program:

A. Live Load:
Live load for the Residential building in each storey = (2) kN/m² as per IS: 875 (part 2) – 1987.

B. Dead loads:
Dead loads which include Slabs, beams, columns, Floor finish and Wall Load are taken as prescribed by the IS: 875 -1987 Part-1 Code of Practice Design Loads (other than earthquake) for Buildings and structure.

C. Seismic Loading:
In this study, the building is located in Hyderabad which comes under
1. Zone-II,
2. Response reduction factor- 3, I
3. Importance factor- 1,
4. Soil Type is medium,
using the IS 1893 (Part-1) -2002 the following are the various values for the building considered

Fig. 1: 3-D View of the G+3 storey building in ETABS
Fig. 2: Wall and Parapet load distribution in ETABS

Fig. 3: Modeling In Staad.Pro

Fig. 4: Loading Display
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Fig. 5: Floor load (Plan View)

Fig. 6: B.M. Diagram for Self weight

Fig. 7: Shear Force diagram for Self weight

Fig. 8: Shows that controlling load combination for flexural and shear is DCON2(1.5 Self +1.5Dead)

Fig. 9: Axial Force (b) B.M. Diagram for load 1.5(Self +Dead load +EQ length)

Fig. 10: BM diagram for load 1.5(Self +Dead)
Fig. 11: Shear Force diagram for load 1.5(Self +Dead)

Table- I Support Reactions from ETABS

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**IV. RESULT AND DISCUSSION**

1. The maximum vertical responses of a G+3 building max response created is 1984.28kN in ETABS and 1428.24kN in STAAD.Pro because of burden 1.5(Self +Dead +Live).

2. Deformation of members in STAAD.Pro are 0.029mm,0mm and 0.036mm respectively where as in E-TABS are 0.0031mm,0.0039mm and 0.001mm respectively.

3. The maximum displacement is along x- direction and its value is 29 mm in STAAD.Pro and 31mm in ETABS along x-direction. So, more precise results are generated by ETABS which leads to economical design of the building.

4. Live loads to be considered on stair and lading are specified in IS875-1964 LL on stairs, landings and corridors is taken as 37KN/M2 (not liable to over crowing). When these are liable to overcrowding them the LL is adopted as 56KN/M2.

5. In a residential house the tread may be 250mm wide and rise may be 160mm height. The number of steps in a flight, at once stretch in a flight may not preferably be more than 12.
V. CONCLUSIONS

The following conclusions are made:

1. The change in design results of G+3 multi storey building which is analysed using STAAD.Pro and ETABS are summarized below:

2. Results of max vertical responses of a G+3 customary structure has been reasoned that the maximum response created is 1984.28kN in ETABS and 1428.24kN in STAAD.Pro because of burden 1.5(Self +Dead +Live)

3. Max Deformation of members of G+3 residential building in x,y,z-direction in STAAD.Pro are 0.029mm,0mm and 0.036mm respectively where as in E-TABS are 0.0031mm,0.0039mm, 0.001mm respectively, the max deformation is along x- axis, its value is 29 mm (in STAAD.Pro) and 31mm (in ETABS) along x-direction. So, more precise results are generated by ETABS which leads to economical design of the building.

4. Bending moment of beam member 481 of top storey building using STAAD.Pro is 35.932 kN.m whereas for beam B1 in E-TABS is 38.579kN.m for a load combination of1.5 (DL+LL).Here there is an increment of BM by 10% in ETABS which shows more reinforcement is required in ETABS which leads to uneconomical design.

5. Deflection of beam member 481 of top storey building using STAAD.Pro is 2.956mm whereas for beam B1 in E-TABS is 2.241mm for a load combination of 1.5(DL+LL). 6. Shear force of beam member 481 of top storey building using STAAD.Pro is52.565kN.m whereas for beam B1 in E-TABS is 38.78kN.m for a load combination of1.5 (DL+LL).

REFERENCES

5. Authority of Indian Standards: IS-875, segment 1 (1987), Dead Loads on Building and Structure, New Delhi, India.
9. Design and practical limitations in earthquake resistant structures IJCE, volume 5, issue 6, june (2014), pp. 89-93