International Journal of Engineering Applied Science and Management
ISSN (Online): 2582-6948
Vol. 3 Issue 11, November 2022

A Review on G+5 Hospital Building In Seismic Zone-Ii by Staad.Pro and Manually

Prashant Sharma[1], Mr. Shailendra Thakur[2], Dr. Ajay Swarup[3]
M. Tech Scholar, Department of Civil Engineering. SSSUTMS, Sehore (India)[1]
Assistant Professor, Department of Civil Engineering. SSSUTMS, Sehore (India)[2]
Professor, Department of Civil Engineering. SSSUTMS, Sehore (India)[3]

Abstract: *Structural design is the primary aspect of civil engineering. The foremost basic in structural engineering is the design of simple basic components and members of building viz., slabs, beams, columns and footings. The first step in any design is to decide the plan of the particular building. The location of beams and columns are decided. Then the vertical loads like dead and live loads are calculated. Once the loads are obtained, the component which takes the load first i.e. the slabs can be designed. From the slabs, the loads are transferred to the beams. The loads coming from the slabs onto the beam may be trapezoidal or triangular. Depending on this, the beam may be designed. The loads from the beams are then transferred to the columns. For designing columns, it is necessary to know the moments they are subjected to. For this purpose, frame analysis is done by Moment Distribution Method. Most of the columns designed in this project were considered to be axially loaded with uniaxial bending. Finally, the footings are designed based on the loading from the column and also the soil bearing capacity value for that particular area. All component parts are checked for strength and stability. The building was initially designed as per IS 456: 2000 without considering earthquake loads using STAAD.pro software. Then the building was analyzed for earthquake loads as per Equivalent static analysis method and after obtaining the base shear as per IS1893: 2002, again detailing has been obtained using ETABs.*

Keywords: *Seismic analysis, Multi-storey Hospital building, Staad.pro, Base shear.*

1. Introduction

Earthquake is the result of a sudden release of energy in the earth's crust that creates seismic waves. The seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time. A list of natural and man-made earthquake sources.

Seismic Sources	
Natural Source	**Man-made Source**
• Tectonic Earthquakes • Volcanic Earthquakes • Rock Falls/Collapse of Cavity • Microseism	• Controlled Sources (Explosives) • Reservoir Induced Earthquakes • Mining Induced Earthquakes • Cultural noise (Industry, Traffic, etc.)

Buildings are subjected to ground motion. PGA (Peak Ground Acceleration), PGV (Peak Ground Velocity), PGD (Peak Ground Displacement), Frequency Content, and Duration play predominant rule in studying the behaviour of buildings under seismic loads.

The new hospital block is located at the province of Prayagraj, U. P. The total built up area of the hospital building is 611.2 square meters and has six floors (Ground floor +5). The Hospital building consists of various divisions like Ortho ward, Orthopedic ward, Ophthalmology ward, ENT ward, major and minor operation theaters, outpatient ward, seminar halls for medical students, scanning and X-ray Centre and medicine store room, etc. The building is located in seismic prone zone (zone factor II). Since hospitals are very important buildings and need to remain standing after the earthquake, the design of such buildings needs to be done as per earthquake design considerations.

The present study deals with seismic analysis using Equivalent static analysis of (G+5) story RC buildings using Structural Analysis and Design (STAAD Pro.) software.

Geometry of the Hospital

The plan of the Hospital building is regular. It has a story height of H = 4.0m where all stories are of the same height. The Hospital building consist of six stories including ground floor. The Hospital building length is 31.75m and width is 19.25m so the area is 611.1875m2. The building consist of square columns with cross- section (0.5 x 0.5) m, rectangular beams with cross- section (0.6 x 0.3)m and slab thickness of 150mm. The size of column is constant for all stories. In each storey, the size of the beam is constant. The elastic rigidity of outer beams and columns are half that of interior ones and elastic rigidity of corner columns is one fourth that of interior ones.

2. Literature Review

B Ramakrishna, G Swetha, SK Amreen Shazia (2021) After analysis the G+5 building, shear force, bending moment and deflection values are observed in different seismic zones. Shear force, bending moment and deflection values for Zone III increased by 60% when compared to Zone II. Shear force, bending moment and deflection values for Zone IV increased by 24% when compared to Zone III.

Kavya H K (2020) In this project design of the residential building is done by manually, Staad pro and Etabs. In the manual process the time taken is more where as in the Staad pro and Etabs the program is predefined and accuracy is maintained. Designing using software's like Staad pro, Etabs reduces the lot of time in design work. In designing the sections manually we can't predict which load combination is critical and also loads taken are linear static whereas by using software we can design for dynamic loads and also non-linear analysis can be done**.**

Adhiraj A. Wadekar and Ajay G. Dahake (2020) Many investigational, analytical, performance and relative works have been done by many researchers related to the design of high-rise buildings. For the planning of the structure, the self-weight, imposed load, load due to wind and seismic load are considered with load combination. The analysis of building is figured by manual also simultaneously it has been checked through STAAD Pro. STAAD Pro has a function to calculate the required reinforcement for the concrete section. Shear reinforcement is intentionally designed to withstand all shear forces and torsion moments. The columns for axial and beams are designed flexure, shear and torsion are designed with the help of IS code.

T. Jayakrishna K. Murali (2018) The behaviour of the G+7 multi-storey building of regular and irregular design under earthquake is problematical, and the variations of wind loads are implicit to act consecutively with earthquake loads. In this paper, a multi-storey residential building studied for earthquake and wall loads using response spectrum method and STADD PRO. For performing dynamic analysis, a material having linear static property as assumed. These analysis are carried out by considering different seismic zones, and for each zone, the behaviour assesses by taking the Soft Soil. A different response for displacements of base shear, storey drift is plotted for different zones for different types of soils.

Megha Kalra Gaurav Kumar Lokesh Choudhary(2018) After analysis of various configurations of internal columns in the building plan through the software results obtained the following conclusions are drawn:

1. Models analyses with floating columns in the lower storey showed increase in base shear as compared to model without floating column. Thus, introduction of floating columns lead to increase in spectral acceleration which increases the horizontal seismic coefficient (Ah).
2. The storey drift for model C and model D are exceeding limits due to the different configuration of floating columns.
3. Introduction of floating columns considerably increases the fundamental time period of the structure.
4. The deflection in the corner nodes was seen to increases with the introduction of floating columns. The maximum increase in deflection was recorded in the structure with internal floating column and minimum increase was seen in model C.
5. The bending moment increases when floating columns are provided. This is due to improper formation plan of model due to which the lateral load produces the stresses into the beam and increases the bending moment.
6.The building with internal floating and external floating column are not suitable in seismic zone IV and V. In case if it is mandatory to fulfill the recommended architectural conditions, only internal floating columns should be constructed

as they are more stable as compare to external floating columns.

4. Conclusion

In the present study, G+5 Hospital building has been drawn in Auto CAD software and designed (Beams, Columns, Footings and Seismic load analysis by using Equivalent Static method) using STAAD Pro software. The dead load, live load and earthquake loads are calculated using IS: 456-2000 and IS 1893: 2002. Concrete grade M25 and HYSD bars Fe415 as per IS: 1786-1985 are used. Originally, the building was designed without earthquake loads as per IS456:2000. Then building is designed considering the earthquake loads as per IS1893: 2002. The detailing has been done as per both approaches. Indian Standard codes have been used in the analysis and design.

References

[1] B Ramakrishna, G Swetha, SK Amreen Shazia, "Analysis of Multi-Storied Building in Different Seismic Zones using STAAD Pro", IOP Conference Series: Earth and Environmental Science, Volume 982, 2021 International Conference on Innovative and Sustainable Technologies in Civil Engineering 24-25 September 2021, Bapatla, India

[2] Kavya H K, "Dynamic Analysis of Steel Structure with Bracings and Dampers under Wind and Earthquake Loads ", Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-6, October 2020, pp.691-695, URL: https://www.ijtsrd.com/papers/ijtsrd33436.pdf

[3] Adhiraj A. Wadekar and Ajay G. Dahake, "Analysis And Design Of A Multi-Storey Building By Using Staad Pro: A Review", International Journal of Advanced Research (IJAR) 8(04), 67-76 ,(2020)

[4] T. Jayakrishna K. Murali, "Seismic Analysis Of Regular And Irregular Multi-Storey Buildings By Using Staad-Pro", International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 1, January 2018, pp. 431–439.

[5] Megha Kalra, Gaurav Kumar, Lokesh Choudhary, " Seismic response of RCC framed structure with floating columns", International Journal Of Sustainable Building Technology and Urban Development, 2018, Vol. 9, No. 1, 18-30, https://doi.org/10.22712/susb.20180003

[6] George Georgoussisa, Achilleas Tsompanosa and Triantafyllos Makariosb , "Approximate seismic analysis of multi-story buildings with mass and stiffness irregularities", The 5th International Conference of Euro Asia Civil Engineering Forum (EACEF-5), Procedia Engineering 125 (2015) 959 – 966

[7] Agarwal P. and Shrikhande M., "Earthquake Resistant Design of Structures", PHI Publication, 2012.

[8] Agarwal Pankaj and Shrikhande Manish, "Earthquake resistant design of structures: New Delhi",, PHI Learning Private Limited, 2010 .

[9] Thesis of Mr. Ankur Agrawal, NIT Rourkela Student,(2012),seismic evaluation of NITR building under guidance of Prof. AV. Asha.

[10] Thesis of Mr. Aslam, ANNA UNIVERSITY: CHENNAI, 60005, April 2012. Sesimic analysis and design of multi Storey Hospital building.

[11] Thesis of Mr. M. I. Adiyanto*, University Sains Malaysia, MALAYSIA, 2008. Analysis and design of 3 storey hospital Structure subjected to seismic load.

[12] Griffith, M. C. and Pinto, A. V. "Seismic Retrofit of RC Buildings - A Review and Case Study, the University of Adelaide, Adelaide, Australia and European Commission", Joint Research Centre, Ispra Italy.