A Comparative Study of Two Different Unsymmetrical Structure

Yudhishthir Kumar[1] , Prof. Dharmendra Singh[2]
[1]Yudhishthir Kumar, M.Tech Scholar, Department Of Civil Engineering, Rabindranath Tagore University, Bhopal, MP, India.
[2]Prof. Dharmendra Singh, Assistant Professor, Department Of Civil Engineering, Rabindranath Tagore University, Bhopal, MP, India.
yudhishthirkumar11@gmail.com

* Corresponding Author: Yudhishthir Kumar

Abstract: *We used STAAD. Pro V8i to analyze two separate G+5 L-shape unsymmetrical architecture scenarios that were subjected to seismic force (Zone-V) in moderate soil conditions. In order to recognize the much more efficient and cost-effective frame, STAAD. Pro V8i software compared the designs of both and investigated differences in Frame forces, nodal deflections, as well as support responses. Torsional stiffness of the slab is frequently overlooked in assessment of structures. This research analyzes the R.C. of the mid-rise G+5 building. According to IS 1893(part I)-2002 static assessment, a frame including and excluding slab stiffness should be considered when seismic impact is present in seismic zone V having moderate soil characteristics. From the current study, it can be concluded that the reduction of moment, storey movement, and maximum dislocation is significantly aided by slab stiffness as opposed to a simple frame excluding a slab system.*

Keywords:.*G+5 L-shape unsymmetrical structure, storey displacement, peak displacement, slab system*

I. Introduction

Supporting gravity loads as well as transferring these loads to certain other architectural parts like columns and walls is the main purpose of flooring and roofing arrangements. Additionally, they are crucial in how seismic & wind forces are distributed to the vertical components of the lateral load resisting mechanism. Although architects fail to take into account the slab panels' relation to lateral load resistance, their impact is not taken into account in RC structural assessment. Due to the obvious significant intricacy of their structural performance, their relevance to the assessment of structures is disregarded. The torsional stiffness of a slab is frequently disregarded in assessment of structures. Whenever this stiffness is properly factored, the precise concept of the deformation of elastic plates demonstrates that the twisting moment relieves the bending moments by roughly 25%, which reduces the structure's need for reinforcing.

We used STAAD.Pro V8i to analyze two separate G+5 L-shape unsymmetrical architecture scenarios that were subjected to seismic force (Zone-V) in moderate soil conditions. In order to identify the much more efficient and cost-effective frame, STAAD.Pro V8i software compared the designs of both and investigated fluctuations in Frame forces, nodal dislocations, as well as supporting responses.

Soil-Structure Interactions is a challenging heterogeneous topic that touches on a few different aspects of civil engineering. Every development has a pragmatic connection to the surface, as well as the interaction of an ancient imperfection with the foundational media may have a massive effect on both the structure as well as the foundational soil. Alongside the approach of enormous advances on fragile soils, such as nuclear power plants, concrete, as well as earth dams, the Soil-Structure Collaboration challenge has turned into a vital component of Basic Engineering. Additionally, the concerns of soil connection may call for special consideration to be provided in the case of architectures, platforms, tunnels, or underground architectures.

Bentley created the architectural assessment as well as software solutions STAAD.Pro V8i. It is a software that is easy to use and contains codes for global settings. Whatever architecture exposed to stationary stacking, a dynamic reaction, wind, seismic tremors, and movement loads can be destroyed by it. STAAD.Pro V8i provides Finite element model and setup for a project involving stadiums, ducts, plants, and as well as towers. STAAD.Pro V8i provides the construction team with a flexible setup that will always satisfy the expectations of the project thanks to its assessment with a diverse selection of cutting-edge inspection capabilities, such as immediate static, reaction spectra, time historiography, connecting, drawback, sucker, as well as non-straight assessments. The amount of time needed to model and assess the structure, taking into account the effects of wind, seismic vibrations, snow, or automobiles, is reduced thanks to STAAD.Pro V8i.

II. RELATED WORK

The torsional stiffness of a slab is frequently disregarded in assessment of structures. Whenever this stiffness is properly considered, the precise concept of the deflection of elastic plates demonstrates that perhaps the twisting moment relieves the bending moment by roughly 25%, which reduces the structure's need for reinforcements. Deepak et al. al (2016) considered the strategy to dislodge opposing forces based on a building's design by familiarizing rigid stomach with the structural system as well as investigating the basic criteria of rigid stomach, semi-firm stomach, even with no region. They found that using rigid stomach is more efficacious than some other circumstances in terms of controlling columns and sections as well as detaching. Raul Chaurasia et al. (2015) used the assessment tool staad.pro to assess the efficacy of bracings at various points in the structural system to rigid diaphragm structures under lateral loads loading. They came to the conclusion that rigid diaphragm is considerably more efficient at lessening lateral forces while also being more cost-effective in aspects of reinforcing bars. Ahmad Saeed et al. Al. (2011) evaluates how adding a reinforced rigid slab to a framework that is designed to withstand lateral loads affects the forces, movement, as well as construction costs. There, he discovers that a reinforced slab progressively reduces forces as well as dislocation, making the building structure more cost-effective. Ho Jung et al. (2007) proposed a straightforward technique for more precisely estimating high point inter-storey drifts that takes into consideration greater modes impacts indicated for low-rise perimeter shear wall systems with flexibility diaphragms or perhaps even rigid diaphragm. M.W. Bari et. al. (2004) installed the new software to investigate the finite element equations and took rigid structure into consideration while using a finite element model approach for slab to evaluate with some other standard methods of analysis. He noticed that findings obtained using just a finite element mesh deviate from analysis model by roughly 20%. argues that for consistent results, a finer slab mesh is necessary. J. Andreas kappos et. al. (2002) looked at the modal assessment for lateral loads using or excluding the floor diaphragms and studied for both comparable frame as well as finite element frame when using elastic frame models for unreinforced masonry architectures in 2-dimensional and 3-dimensional construction. He discovered that the diaphragm impact is only applicable in 3-d models because action is performed in the plane perpendicular to the walls, meaning that 2-d models have little impact.

III. PROPOSED METHODOLOGY

This research analyzes the R.C. of the mid-rise G+5 building. According to IS 1893(part I)-2002 static assessment, a framework either with or without slab stiffness should be considered when seismic action is present in seismic zone V with moderate type of soil. Assessment of outcomes way to compare of node. This study is attempted in following steps:

Step-1 selection of building geometry L- shape G+5 storey of 3D frame.

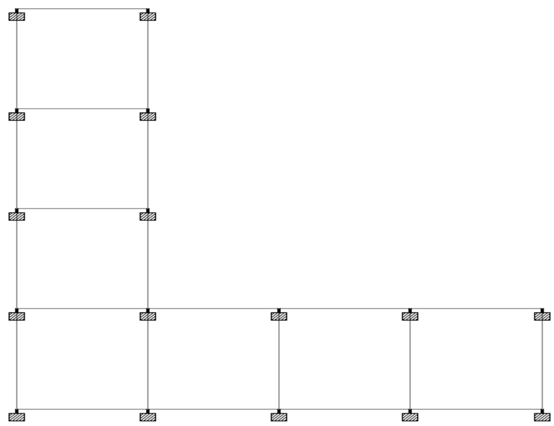

Figure 1 Plan of L-shaped building

Step-2 Assigning general property, section, material, supports and loading cases
Step-3 Selection of Seismic zones (Zone V) and medium type soil as per IS- 1893(part I) -2002.
Step-4 load combination as per 875-Part-V
Step-53-Dimensional modelling of building frames using STAAD.Pro v8i.

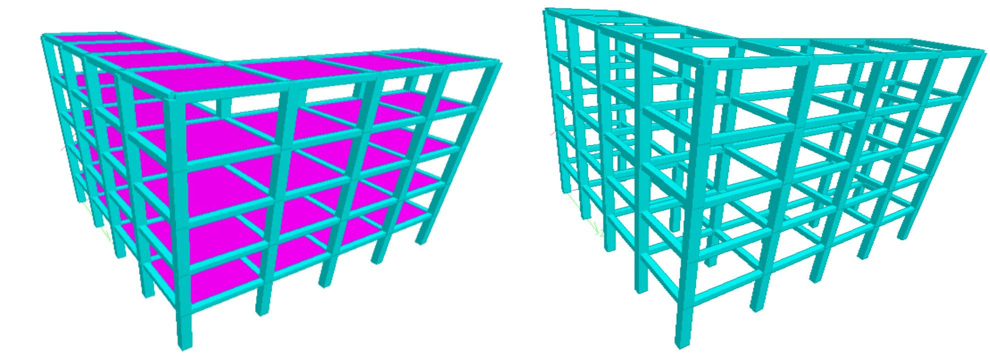

Figure 2: 3-D rendering view

Step-6 Analysis of building frames considering seismic forces in X & Z direction and gravity load as shown in figure below.

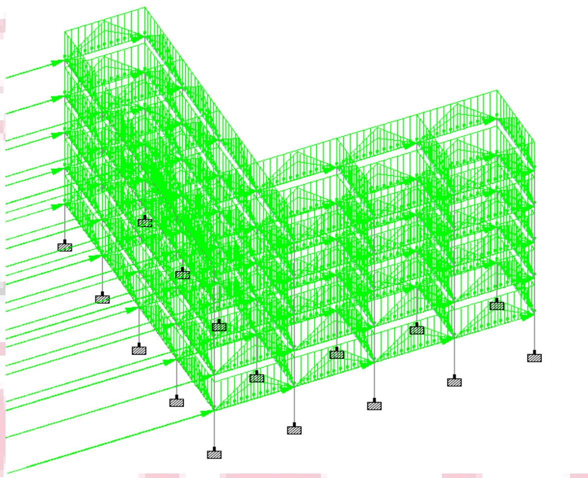

Figure 3. Loads Assigned

Step-7 Designing structures as per I.S.456:2000 to determine the amount of reinforcement required in both the cases.

IV. RESULT ANALYSIS

Underneath, we've covered how patterns loading affects frames forces as well as how different parameters influence how much patterned loading is needed.

With the aid of L-shape as well as structures, plan kinds were examined. The gross portion of the slabs was being utilized for this comparison's slab stiffness in order to demonstrate the disparities. To study the impact of slab stiffness on seismic response, linear static assessment was conducted out while taking into account moderate types soil foundations.

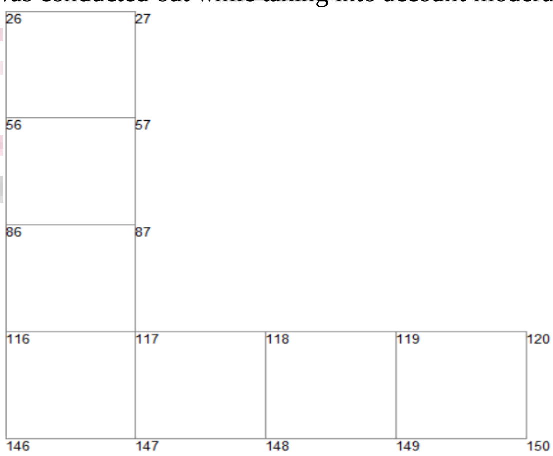

Figure 4 Roof nodes

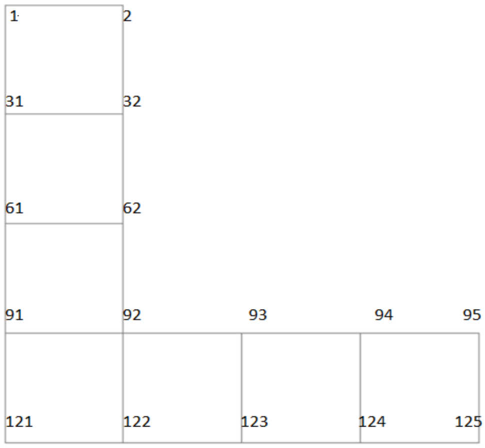

Figure 5 Node numbering at supports

Figure 6 Beams and column numbering at section X-X

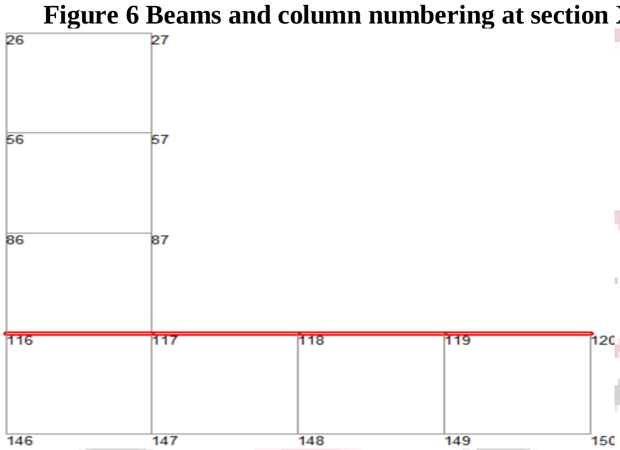

Figure 7 The section plan under consideration has four labeled nodes.

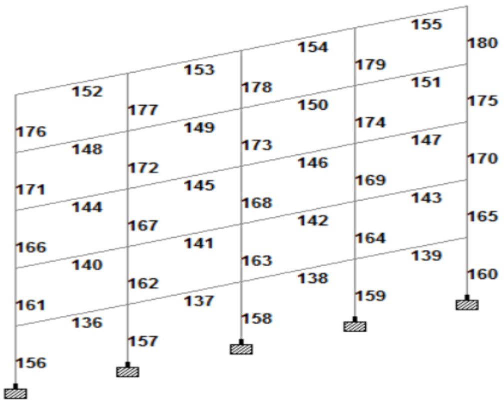

Figure 8 Section with 5 Beams And Columns Indicated

For every type of strategy in these assessments, two models were established (with slab and without slab). In comparison to a frame devoid taking slab stiffness into account, one that does offers a variation in the deflections of 0.68 to 0.84 times. While rotational of the rooftop nodes is typically either nullified or reduced as a result of the addition of slab stiffness, there is indeed a substantial decrease in the displacement of the roofing nodes. In comparison to a frame that doesn't take slab stiffness into account, a frame that does offers a variability in vertical support responses of 0.98 to 1.02 times. Nevertheless, the impacts of slab stiffness on vertical support responses is found to be statistically insignificant.For the specified load case, the modification in torsional moment and bending moment at the support caused by the implementation of the slab is found to be negatively related.

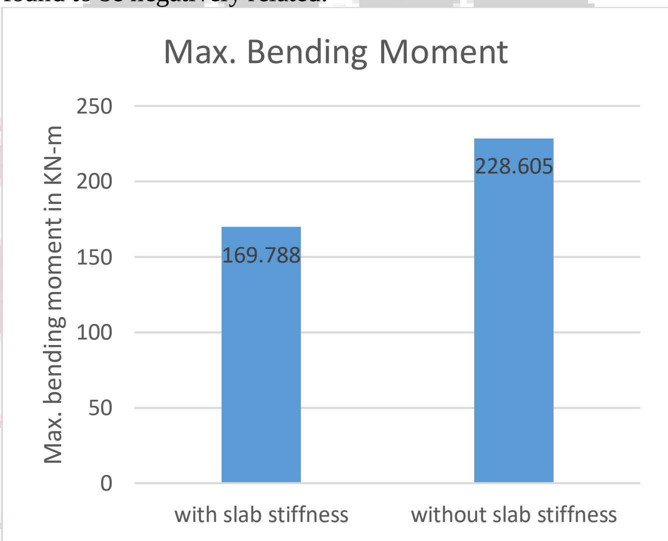

Figure 9 Max. Bending moment

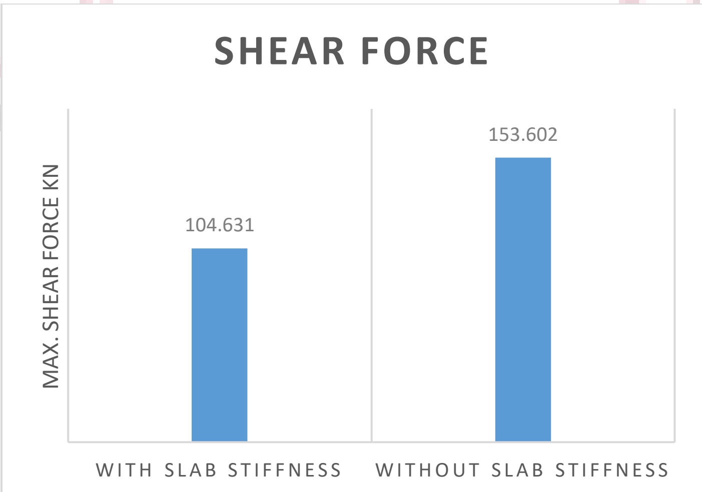

Figure 10. Max. Shear force

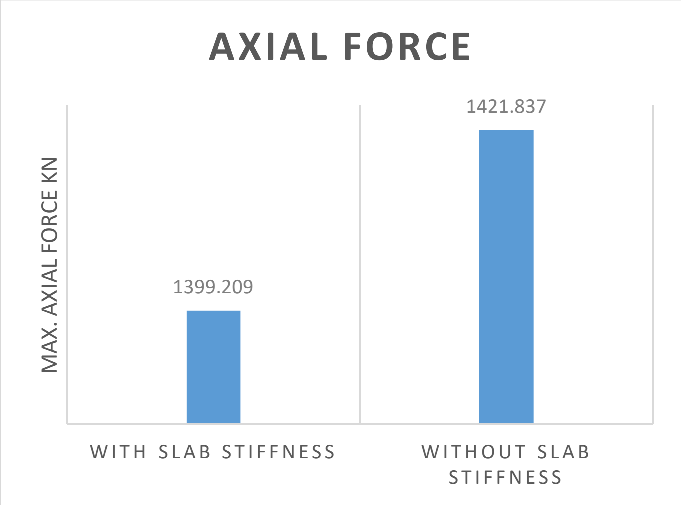

Figure 11. Axial force

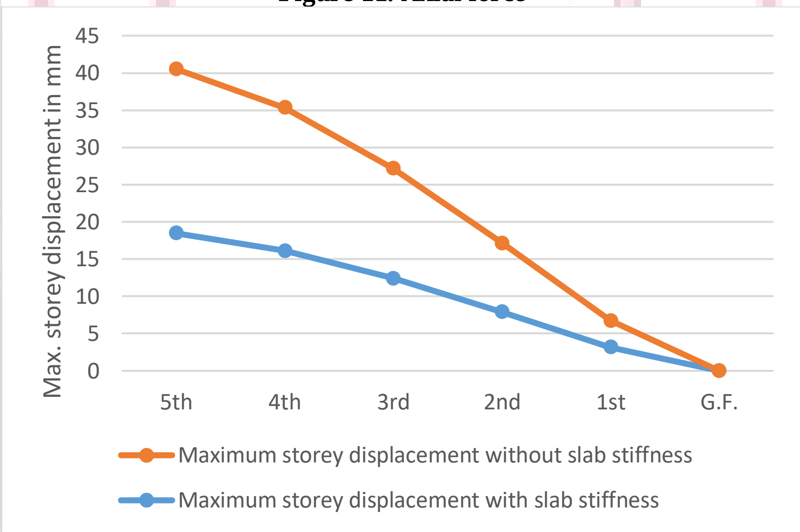

Figure 12. Max. storey displacement

V. CONCLUSION

From the present study it is seen that slab stiffness is much efficient in comparison to simple frame without slab system in reducing moment, storey displacement, peak displacement. The analysis done in the present study clearly shows that:

- When tried to compare to frames even without taking slab stiffness into account, those with slab stiffness analysis show a fluctuation in shear force of 0.71 to 0.84 times, whilst those without slab stiffness evaluation show a difference in bending moment of 0.67 to 0.86 times. It is evident that the addition of the slab reduced the shear force as well as bending moment in the beams.
- In comparison to a frame devoid taking slab stiffness into account, the axial forces on a column can vary by 0.98 to 1.01 times with a frame that does. For the specified loading, there is really no development will take in the axial force of the columns. Caused by the addition of the slab, the bending as well as torsion moments in the columns barely change.

A building frame without the need of a slab exhibits greater node dislocation, beam and column forces than a structural system with slab stiffness attributed to the effect of slab stiffness on shear force and bending moment under seismic load. The examination of numerous buildings has shown that stiff diaphragms are more efficient in developing buildings economically. The building with stiff diaphragms is predicted to be structurally advantageous, leading to significant reinforcement steel cost savings.

REFERENCES

[1] Pradeep kumar, Shashank dutt (2016), Analysis of a tall structure considering seismic force under rigid frame structure, Journal of Engineering Research and Application, ISSN : 2248 9622, Vol. 7, Issue 7, (Part 1) July 2016, pp.29 34.

[2] Rahul Chourasiya, Rashmi Sakalle (2015), Seismic analysis of multi-storey R.C. structure using bracing system and floor diaphragm, International Journal of engineering sciences & research technology, ISSN: 2277-9655.
[3] Sanjaya Kumar Patro, Sandeep jain (2013), Effect of diaphragm flexibility on seismic response of building structures, Proceedings of The Eight World Conference on Earthquake Engineering, pp. 735-742.
[4] Saeed Ahmad et. al. (2011), EFFECTS OF ECONOMIC REFORMS AND OPENNESS ON STRUCTURE CONDUCT AND PERFORMANCE OF AGRO-BASED INDUSTRIES IN PAKISTAN, American International Journal of Contemporary Research, Vol. 1 No. 2; September 2011
[5] T. Öztürk and Z. Öztürk (2008) THE EFFECTS OF THE TYPE OF SLAB ON STRUCTURAL SYSTEM IN THE MULTI-STOREY REINFORCED CONCRETE BUILDINGS, World Conference on Earthquake Engineering.
[6] D.R. Gardiner , D.K. Bull , A.J. Carr, (20018) Trends of Internal Forces in Concrete Floor Diaphragms of Multi-storey Structures During Seismic Shaking , World Conference on Earthquake Engineering.
[7] Ho Jung Lee, Mark A. Aschheim, Daniel Kuchma, (2007) Interstory drift estimates for low-rise flexible diaphragm structures, Engineering Structures, pp. 1375-1397.
[8] Joel M. Barron and Mary Beth D. Hueste (2004), Efficient seismic analysis of high-rise building structures with the effects of floor slabs, Engineering Structures, 24(5), pp. 613-623.
[9] Dr. S. N. Tande,Amol A. Sankpal, (2004), "Study of Inelastic Behavior of Eccentrically Braced Frames under Non Linear Range",International Journal of Latest Trends in Engineering and Technology.
[10] M.D. bari, P.B. Kodag, (2004), "Lateral Load Analysis of R.C.C. Building",International Journal of Modern Engineering ResearchVol.3, Issue.3, pp-1428-1434.
[11] Bull D.K.(2003), Understanding the Complexities of Designing Diaphragms in Buildings for Earthquakes, Bulletin of the New Zealand Society for the Earthquake Engineering 37(4).
[12] Andreas j. kappos , D.k. bull (2002) Seismic analysis of asyMMetric multistorey buildings including foundation interaction and P-Δ effects, Engineering Structures, 16(8), Pages 609–624.