Comparative Analytical Study Of a G+20 Storied Building Using ETABS and STAAD-PRO

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Abstract- *Reinforced With the increasing need of the urban population, concrete building structures are reaching upward. Because there is little room for expansion in plan dimensions, it is evident that high-rise structures are becoming more and more popular among designers worldwide. The development high-strength materials, enhanced workmanship, superb real-time analysis data, and a number of very effective such as SAP2000, ETABS, and Staad Pro are examples of finite element analytical and design software. among others, are also strengthening this choice. Both STAAD and ETABS are quite well-equipped and capable of handling various structure shapes, static and dynamic loadingsor various material properties.*

In the current paper, STAAD Pro and ETABS are both used to analyze a G+20 story building with a fairly simple plan dimension. The scope of the current investigation is mostly restricted to a basic comparison of their analytic outcomes under vertical loadings. The research was then expanded, a horizontal load applied. the lift wall's (the shear wall's) plan location was optimized for the horizontal base shear that would form at various support positions. the center of the plan is the most effective at handling the base shear.

Keywords- Base shear, Staad vs. Etabs, Optimal position of Shear wall, Residential building in Etabscentrallyplacedshear wall,Lateral load, Shear/Lift wall efficiency.

I. INTRODUCTION

Everything in the modern world is carefully designed and built to be used to the fullest extent possible while using the least amount of the three Ms, or Mind, Money, and Manpower. With the aid of modern technology, all processes—including production, processing, shipping, and manufacturing—are becoming more efficient and improved. The need to maximize investment while maintaining safety is growing as a result of the direct connections between the construction and engineering industries and the economy and human safety.

Due to the limited amount of available land and rising construction costs, multi-story high-rise superstructures are increasingly being built for both commercial and residential purposes. Wood etc.RCC constructions that have been properly built and developed may provide structures the ductility they need in addition to strength, they are simplercast at higher altitudes than steel buildings.benefits compared to materials like steel, wood, etc. providesufficientductilitytostructuresalongwithCompared to steel constructions, they are lighter and easier to cast at higher elevations' constructions that have been properly built and developed may provide structures the ductility they need in addition to strength,they are simpler cast at higher altitudes than steel buildings. As a result, various software, such as STAAD Pro and ETABS, are created to lower the amount of capital while still meeting the necessary minimum safety criteria for these superstructures.The main benefit and motivation for employing these design and analysis tools is that it not only makes building more affordable but also simpler and quicker. Both pieces of software are capable of handling almost any loads and geometric configurations well.Manually performing 3-dimensional frame analyses with accuracy is quite difficult; however, STAAD and ETABS make it simpler. Since both pieces of software are capable of, paper plates were modeled and then examined to produce the most precise findings. Due to the fact that both pieces of software contain all current Indian and international codes, there was essentially no need for manual computations to maintain the necessary safety requirements.results.Due to the fact that both pieces of software contain all current Indian and international codes, there was essentially no need for manual computations to maintain the necessary safety requirements.

This paper used ETABS and STAAD to examine a typical G+20 residential structure. The analysis's goal was simulating a structure apply vertical and horizontal loadings, in accordance with Indian Codes (IS-456, Is-875 part 1, 2, and 3), in order to determine the responses and forces from the programmed and compare the results The research of the response and base shear generated at base of shear walls as a result of horizontal loading was also included in the paper, and the most effective location for the shear wall in building's plan was determined.

II. PROBLEM DETAILS

A 34.5 m-high RCC-framed structure is used in the current investigation. The building's plan measures 25 m by 25 m. The city of Pune in India has been chosen as the building's location. The building's fundamental design criteria are listed in table below.

Table 1.1. Basicsdataforanalysis.

Parameter	**Values**
Densityofconcrete	50kN/m^3
Densityofsteel	15.7kg/m^3
Gradeofsteel	Fe415
Gradeofconcrete	M30
Poissonratio	0.17
Dampingfactor	0.05
Basicwindspeed	50m/s
Seismiczone	III
Location	Pune
Importancefactor	I
Responsereductionfactor	3(OMRF)
Soiltype	Medium(typeII)

Dimensional details aretabulatedbelow.

TABLE1.2.Dimensionaldetail

Parameter	**Values**
Plandimension	25 m×25 m
Elevationfromdepthof fixity	34.5m
Floor/floorheight	3.65m
Totalnumber ofstories	G+20
Sizeofcolumns	0.85m ×0.85m (upto5thfloors)
	0.53m ×0.53m (Restoffloors)
Sizeofbeams	0.51m×0.4m
Thicknessofshear wall	350mm
Depthofslab	300mm

Followingloadsareconsideredonthestructures.

Table1.3.Loaddetails.

Parameter	**Values**
Deadload (Self-weight of slab, beam andcolumn is taken care of by thesoftware itself as they are modelledwithinthestructure.)	14kN/m,8kN/m(aswall load)
	1.8 kN/m^2(Floorfinishincludingplaster)
Wind load	AsperIS875-Part3-1987forlocationPune.Onlystatic analysisiscarried out.
Liveload	AsperIS875-Part2-1987. For residential buildings
Seismicload	Static as well as dynamicanalysis(response spectrum) is carriedfollowingguidelines fromIS 1893-2002.

For this study, two models from STAAD and ETABS are compared primarily based on vertical loading. Here, the horizontal load is only represented as the result of wind load from a single direction. Under this horizontal load, the structure's behavior is investigated. The position of the lift core's shear wall is then researched for the optimum outcomes in termseffectively handling imposed horizontal load. Our long-term objective is to expand the current investigation under dynamic seismic load and evaluate the outcomes, below two images of the same building rendered in STAAD and ETABS.

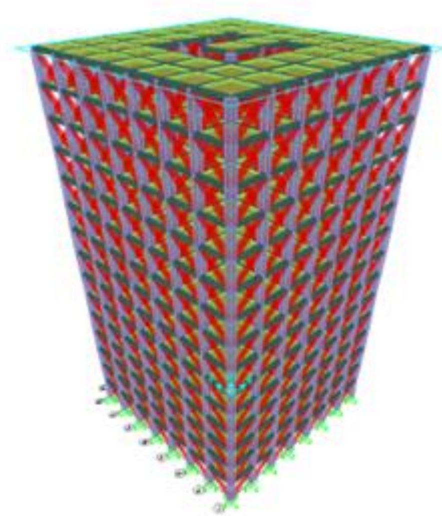

Fig1.1: Rendered image fromSTAAD

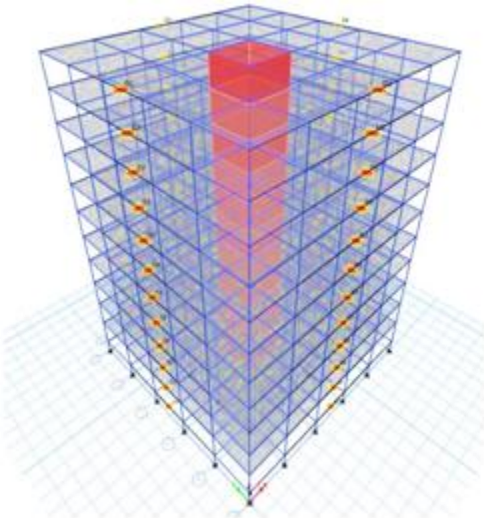

Fig1.2: Rendered image of ETABS

The shear wall supports are pinned, and all column supports are made permanent at the base. Pinched support is used to lessen the produced moment effect at the root, which needlessly increases the shear wall's thickness.

III. RESULTS

Both software STAAD and ETABS programs examine the structures, and the findings are shown below. The node numbers are on the X axis of all the graphs below, while the support responses in kN are the Y axis.

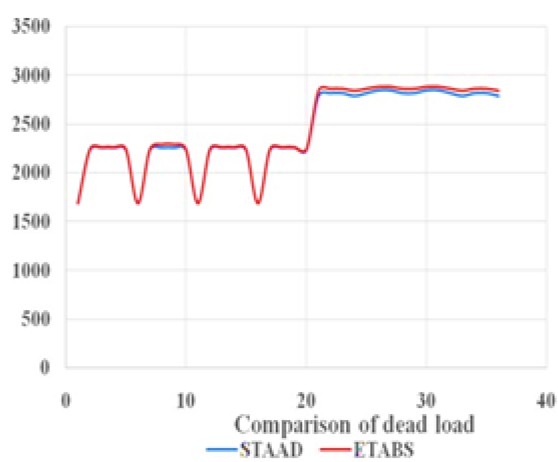

Fig 1.3: Comparison of reaction betweenSTAADandETABSunder dead load(withoutshearwall).

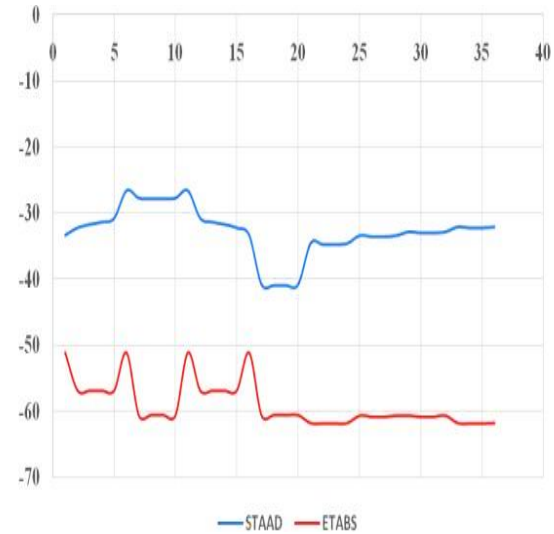

Fig 1.4: Comparison of STAAD and ETABS responses to wind load in the X direction

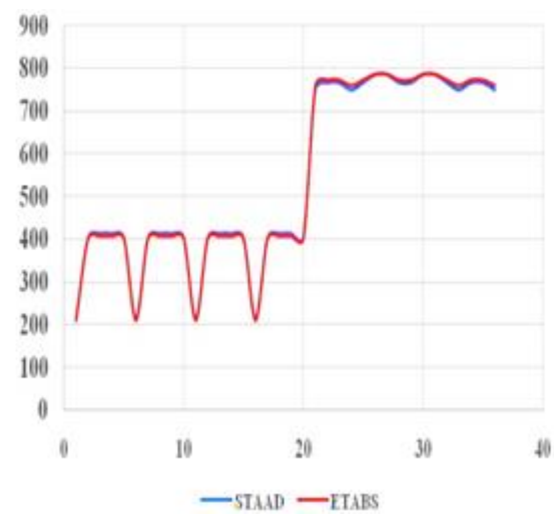

Fig 1.5: Comparison of reaction betweenSTAADandETABSunder live load(withoutshearwall).

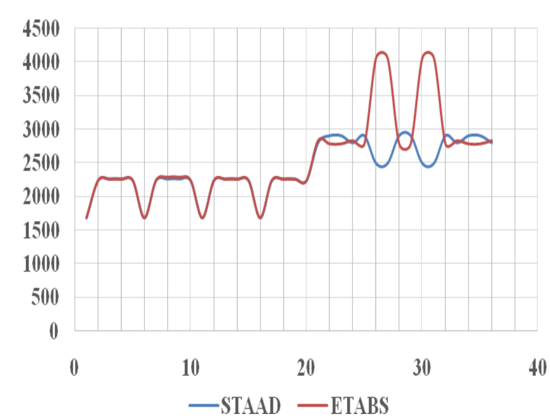

Fig1.6: ComparisonofreactionsbetweenSTAADandETABSunderdeadload(withshear wall).

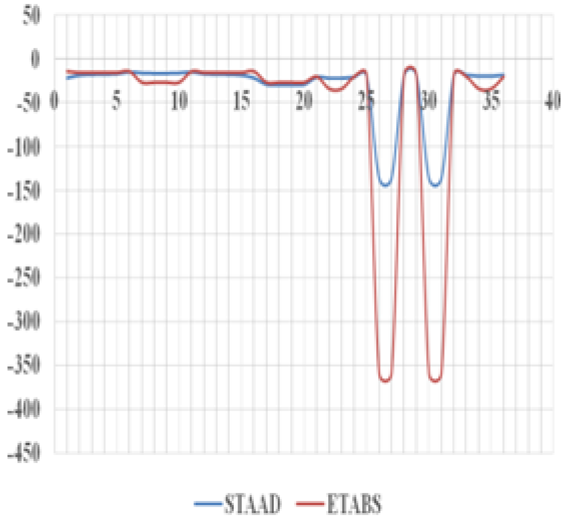

Fig 1.7: Comparison of STAAD and ETABS responses to wind load in the X direction.

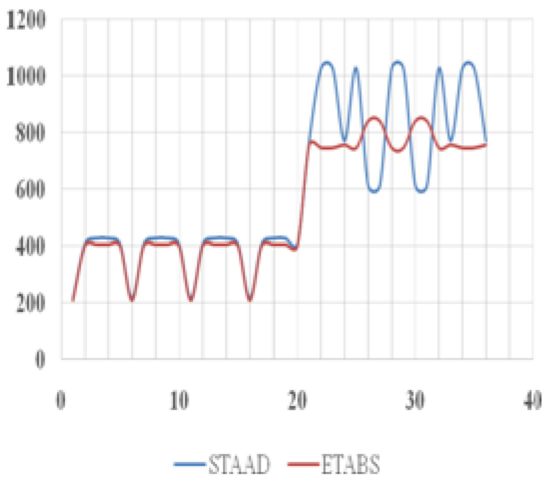

Fig 1.8: Comparison of reactions betweenSTAADandETABSunder live load(withshear wall).

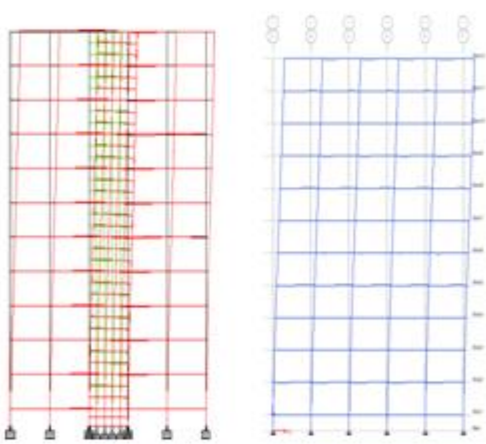

Fig 1.9: these two models' patterns of deflection under wind stress (the left model is STAAD, and the right is for ETABS).

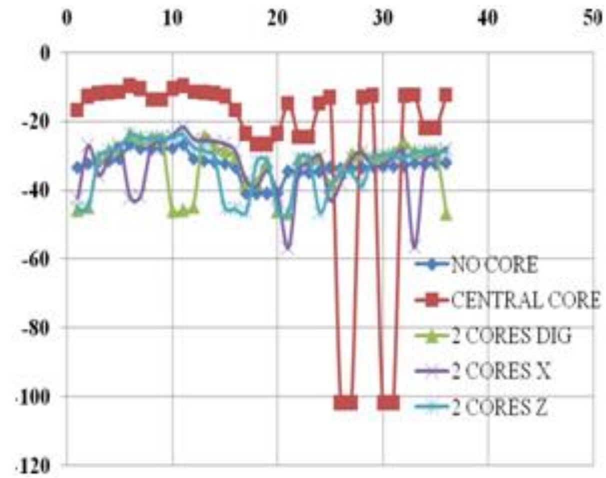

Fig 2.0 : variations in horizontal support responses under wind load for various lift or shear wall placements.

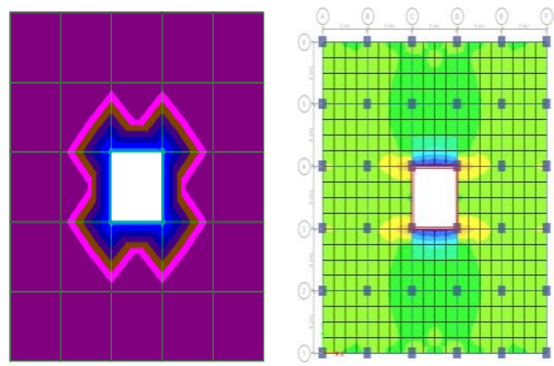

Fig 2.1: Developed stresses at the 8th floor level inslabsobtainedfromSTAAD(left) and soETABS(right).

V. INTERPRETATIONOFRESULTS

1. For easier software comparison, the findings are given in a graphical format. The observations are as follows.
2. Figures 1.3 and 1.4 show the variance in response forces at various nodes under dead and live loads, respectively. Results from both pieces of software are closely related. Additionally, it shows that model suitable geometrically for analysis.
3. Figure 1.5 shows horizontal reaction forces that have produced a wind load. Here, it discovered that there is a wide range of support reactions. ETABS is currently displaying higher values. The inclusion of a diaphragm in the ETABS model accounts for this common result. In the case of STAAD, wind load is applied directly to the model; in the case of ETABS, it is applied through a diaphragm. As a result, the load is managed better.
4. The same modifications are investigated in lift well or shear wall models. The fluctuation of dead load and live load nodes with centrally located shear wall is shown in Figures 1.6 and 1.7,alltheothervalues are similar. Only shear wall is redistributingthehorizontalload.

Figure1.9 The deflected form of the structure under wind stress is shown in Figure 9, which exhibits the same pattern in both scenarios.

5. The stress diagram for slabs at the seventh story level under a dead load is shown in Figure 2.0. During modelling, these floor slabs weren't meshing. The fig makes it obvious that ETABS automatically meshes the plate and determines the stresses more precisely. STAAD, however, did not mesh the plates; it just computed the stress at the specified plate dimension. ETABS is therefore somewhat superior to STAAD when it comes to plate analysis. Finally,
6. figure 2.1 displays the change in produced base shear caused by wind load for various lift well sites. Considered are five different number combinations. Without cores (shear walls), in the middle, along direction of horizontal load application (2 cores X), across the direction of wind load application (2 cores Z), and lastly in diagonally opposite places (2 cores Z) (2 cores dig). It is evident from the graph that all shear wall places transmit the horizontal load in a very consistent way. Only the four centrally located core points have much higher values; the other values are significantly lower. comparedtootherpositions.Thesignificanceofas a result, those four locations serve as the shear wall's support points, other column supports see less developed base shear as a result of this phenomenon. Less horizontal response will result in less developed bending moment in columns, which is quite advantageous in terms of design standards. Less time will ultimately result in less use of reinforcement, which will make the entire construction more cost-effective.Therefore, it may be inferred that if a lift is to be installed in a building, an effort should always be made to locate it as centrally as feasible for better overall structural design.

REFERENCES

[1] Authors of this paper have studied some of the literatures ([1]-[4]) available over the to get a general notion of the comparisons that may be performed for examination via the internet. The present writers considered these books to be useful.

[2] International Journal of Engineering Research & Technology (IJERT), 3, 5, May 2014, pp. 1481–1485 [3]. Galleria A.

[3] Adhikari S. K. and Rajasekhar K. "Comparative static and dynamic study on seismic analysis of uniform and non-uniform column sections in a building" International Journal of Innovative research in Science, Engineering and Technology, 4,8, August 2015, pp. 6830-3837.

[4] International Journal of Innovative Research in Advanced Engineering (IJIRAE), 2, 8, August 2015, pp. 92–97. Saber M and Peera D G., "Comparison design result of RCC building utilizing STAAD and ETABS software.

[5] Mahesh S and Rao B P., IOSR Journal of Mechanical & Civil Engineering (IOSR-JMCE)11, 6, November-2020, pp. 45-52.