A Comparative Study on High-Rise building with and without shear wall using Revit Structural and Autodesk Robot Structural Software

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Abstract - *New software is on the market every day. Many structural design software offers in civil engineering. This study uses the new Autodesk Robot structure and Revit Structures -Software to analyze G+20 buildings with or without shear walls. This research provides the use and functionality of the above software. This examines advantages and disadvantages, and uses. The growing global population and urbanization will significantly increase the need for skyscrapers. And the safety of these buildings must be considered. The structure of cultivation can be actively broken due to wind and earthquake aspects. Security against lateral forces can be achieved by implementing shear walls on the building. Modeling and comparative studies on the stiffness, stiffness and soil shift of the basic scissors of the two models will be carried out in this project using Revit structure and robotic structure software.*

Key Words: Autodesk Robot Structural, Revit Structural, Auto-CAD, Shear Wall,

1.INTRODUCTION

Shear walls or structural walls are essential lateral load resistance systems based on high increase for smooth function. They provide the building with the right stiffness and stiffness, which reduces the lightness of failure. Positioning shear walls in advantageous positions can serve as an efficient and effective way to improve the earthquake response of a building. In this paper, we present two models Seismic Zone-II of the G+20 classified framed buildings in the analysis model of the zone. Shear wall on the sides and buoyancy areas. The analysis results of basic shear, floor drift, strong shifting and stiffness of the store give you an idea and important it is to have shear walls in an RCC building, and the optimal location that can be placed.

1.1 Objective of Study

1) To Explore New Software Robot Structure and Revit Structure.
2) To understand the Behaviour of (G+20) Building With and With-Out shear wall against seismic loading
3) Comparison of Maximum Storey Axial Force, Maximum Storey Moment, storey drift, storey displacement and storey stiffness for buildings with and with-out shear wall.
4) Advantage and disadvantage in multi-Storey Building Design, Using Two software with the help of plug-in software.

2. Modeling

This study modeled a G+20-storey frame structure with a regular plan. The building is fixed to the base and the floor is thought to function as a hard diaphragm. The floor surface of the structure is 12.80 x 18.82 m.

Model 1:- With Shear Wall
Model 2:- With-Out Shear Wall

Table -1: Building Data

Sr.No	Content	Value
1	Plan	12.80X 18.820
2	No. Of Storeys	G+20
3	Storey Height	3Meter
4	Column Size	800X800 & 600X600(mm)
5	Beam Size	300x600 & 300X300(mm)
6	Grade Of Concrete	M-35
7	Grade Of Steel	Fe-500
8	Wall Thickness	0.23m
9	Slab Thickness	0.15m
10	Live Load At Typical Floor	3KN/M^2
11	Live Load At Terrase	1.5KN/M^2
12	Floor Finish Load	1KN/M^2
13	Dead Load Of Wall	11.04KN/M^2
14	Dead Load	3KN/M^2
15	Soil Type	II
16	Damping Ratio	5%
17	Impcat Factor	1.5

18	Soil Condition	Medium
19	Wind Speed	40 km/h
20	Seismic Zone	II

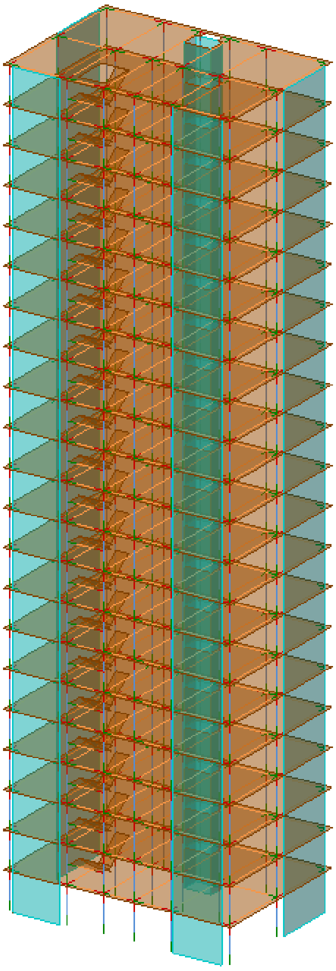

Fig -1: Elevation (3-D View) With Shear Wall At Revit Software

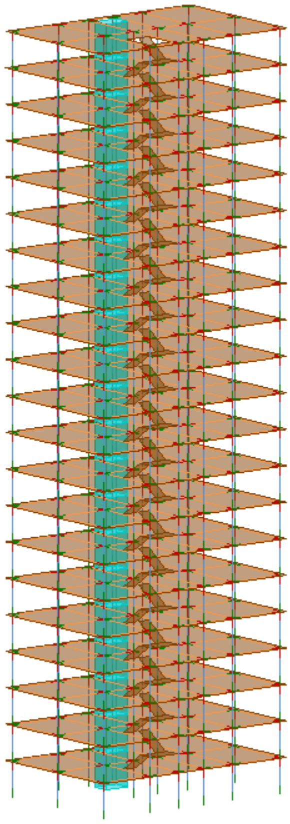

Fig -2: Elevation (3D View) With-Out Shear Wall At Revit Software

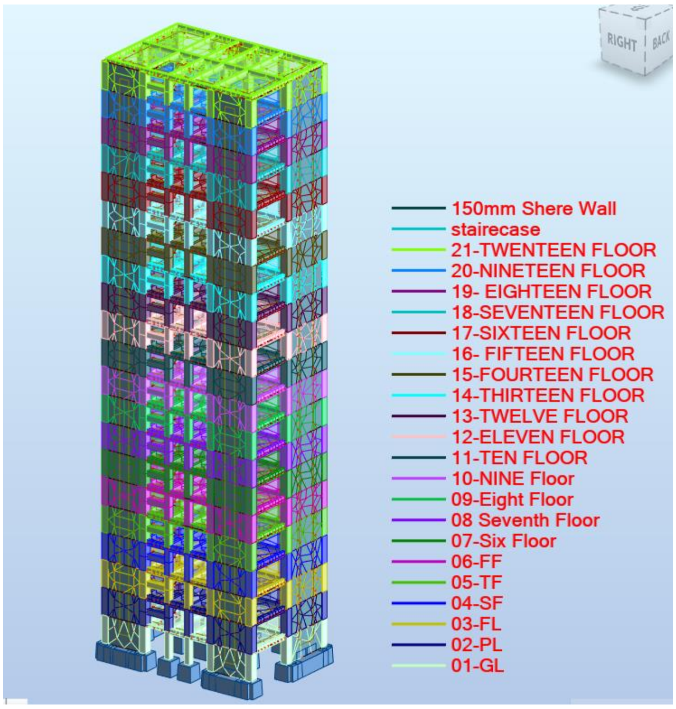

Fig -3: Elevation (3-DView) With Shear Wall At Robot Software

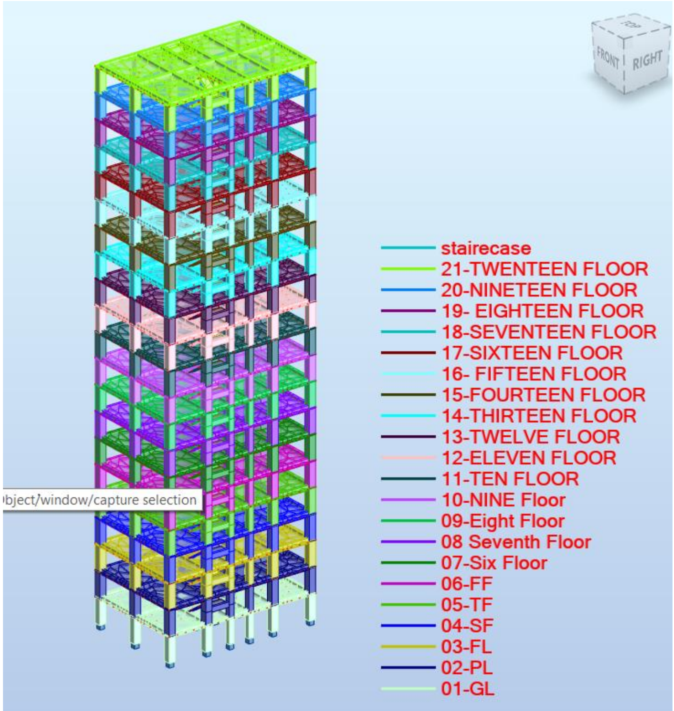

Fig -4: Elevation (3-D View) With-Out Shear Wall At Robot Software

2.1 Software Deployment

With the help of Revit software, we've made all the frame work exciting, including beams, pillars, plates, basic work. Also material properties, shapes, sizes and creation of a storey G+20 using Revit Software. Additionally, Plug-in Autodesk-Robot-Structure software to Revit Software For assign all analytical partial earthquakes, live, dead, and wind loads as per code provisioning for specific elements such as beam columns, slab, and storeys. Also the final results of this project as per robot structure software.

3. RESULTS AND DISCUSSIONS

The analysis results for all two models With Autodesk Robot structures using the Finite Element-method (FEM) method are obtained. Variations Standard For All Result for all models in tabular and graphic formats.

3.1 Storey Drift

Storey drift is defined as the relative movement of each storey with respect to other. Table-2 shows the maximum storey drift values of each model and figure-5 represents the variation of storey drift in graphical format. The results show that the maximum drift for models without shear walls is larger and less for models with shear walls.

Storey Drift(dr UY) (cm)		
Storey	With Shear Wall	With-Out Shear Wall
Storey-G	0.036	0.1
Storey-1	0.025	0.3
Storey-2	0.036	0.4
Storey-3	0.039	0.5
Storey-4	0.046	0.5
Storey-5	0.052	0.5
Storey-6	0.056	0.5
Storey-7	0.1	0.5
Storey-8	0.13	0.5
Storey-9	0.13	0.5
Storey-10	0.17	0.5
Storey-11	0.19	0.5
Storey-12	0.2	0.5
Storey-13	0.13	0.5
Storey-14	0.058	0.4
Storey-15	0.034	0.4
Storey-16	0.028	0.4
Storey-17	0.027	0.4
Storey-18	0.025	0.3
Storey-19	0.025	0.3
Storey-20	0.026	0.3

Table -2: Maximum Storey Drift (cm)

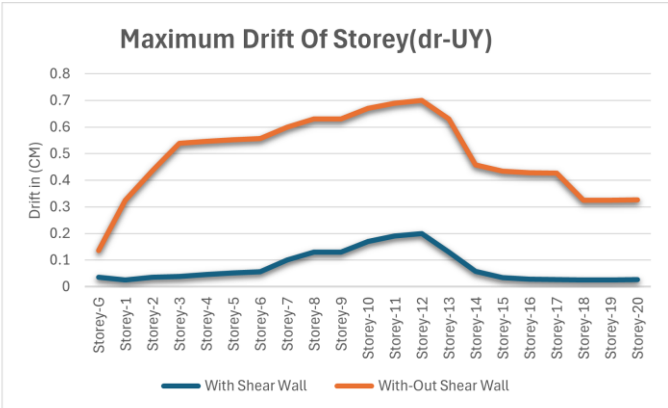

Fig -5: Maximum Storey Drift

3.2 Storey Displacement

Story displacement is the deflection of a single story relative to the base or ground level of the structure. Table -3 shows the maximum storey displacement values of each model and figure-6 represents the variation of storey displacement in graphical format. From the result the maximum storey displacement is seen higher for models without shear walls and less for models with shear walls.

Maximum Storey Displacement		
Storey	With Shear Wall (Ux)	With-Out Shear Wall
Storey-G	0	0.1
Storey-1	0	0.4
Storey-2	0	1.1
Storey-3	0	1.8
Storey-4	0	2.7
Storey-5	0	3.6
Storey-6	0	4.5
Storey-7	0.1	5.4
Storey-8	0.1	6.3
Storey-9	0.1	7.2
Storey-10	0.1	8
Storey-11	0.1	8.9
Storey-12	0.1	9.7
Storey-13	0.2	10.5
Storey-14	0.2	11.2
Storey-15	0.2	11.9
Storey-16	0.2	12.5
Storey-17	0.3	13.1
Storey-18	0.3	13.6
Storey-19	0.3	14.1
Storey-20	0.3	14.6

Table -3: Maximum Storey Displacement (cm)

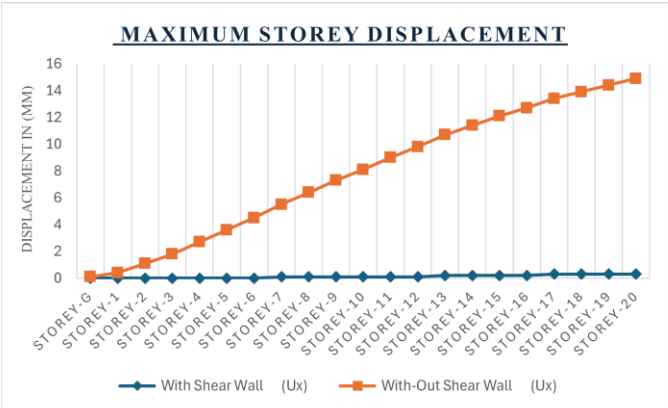

Fig -6: Maximum Storey Displacement (cm)

3.3 Storey Exact Deformation

Exact deformation is calculated as based on, node displacements, node rotations and advanced internal finite element shape functions (corresponding to applied load types) are used. Table -4 shows the maximum storey Exact Deformation values of each model and figure-7 represents the variation of storey Exact Deformation in graphical format. From the result the maximum storey Exact Deformation is seen higher for models without shear walls and less for models with shear walls.

Exact Deformation For Member		
Storey	With Shear Wall	With-Out Shear Wall
Storey-G	0.2	0.2
Storey-1	0.3	0.5
Storey-2	0.3	1.1
Storey-3	0.3	1.9
Storey-4	0.3	2.7
Storey-5	0.4	3.6
Storey-6	0.4	4.5
Storey-7	0.4	5.4
Storey-8	0.5	6.3
Storey-9	0.5	7.2
Storey-10	0.5	8
Storey-11	0.6	8.9
Storey-12	0.6	9.7
Storey-13	0.6	10.5
Storey-14	0.6	11.2
Storey-15	0.6	11.9
Storey-16	0.6	12.5
Storey-17	0.7	13.1
Storey-18	0.7	13.6
Storey-19	0.7	14.1
Storey-20	0.7	14.6

Table -4: Maximum Storey Exact Deformation (cm)

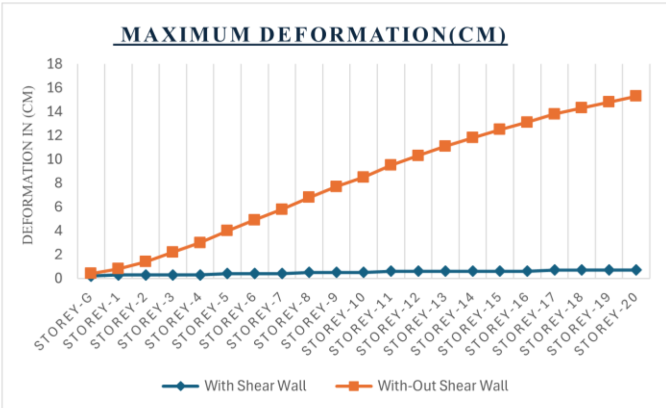

Fig -7: Maximum Storey Exact Deformation (cm)

3.4 Storey Moment

Rotational or bending effect (moment) acting on a building's structure within a single story (or floor level), caused by lateral forces like wind or earthquake loads. Table -5 shows the maximum storey moment values of each model and figure-8 represents the variation of storey moment in graphical format. From the result the maximum storey moment is seen higher for models without shear walls and less for models with shear walls.

Maximum Storey Moment (KN/M²)		
Storey	With Shear Wall	With-Out Shear Wall
Storey-G	31.93	285.4
Storey-1	58.71	126.96
Storey-2	24.87	255
Storey-3	21.04	317.65
Storey-4	22.83	349.55
Storey-5	25.02	362.48
Storey-6	27.06	368.28
Storey-7	28.93	364.18
Storey-8	30.66	357.08
Storey-9	32.07	349.03
Storey-10	33.37	338.24
Storey-11	34.37	330.11
Storey-12	35.94	313.72
Storey-13	36.68	297.71
Storey-14	37.68	279.9
Storey-15	38.28	259.9
Storey-16	39.09	238.34
Storey-17	39.55	215.54
Storey-18	40.18	193.15
Storey-19	36.99	166.66
Storey-20	73.24	179.87

Table -5: Maximum Storey Moment (KN/M²) -Mz

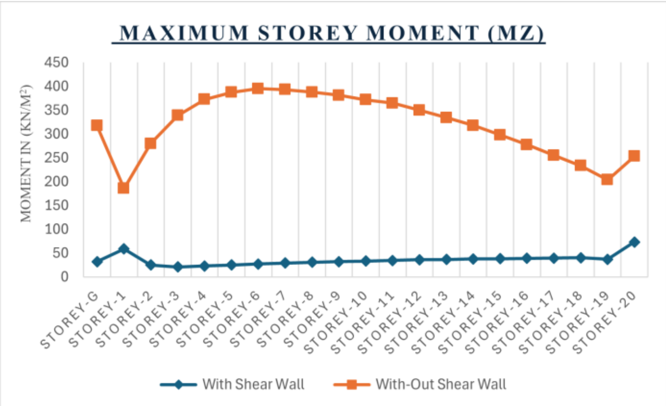

Fig -8: Maximum Storey Moment

3.4 Axial Force

An axial force is a force that acts along the longitudinal axis of a body, either pulling (tensile) or pushing (compressive) along its length. Table -6 shows the maximum Axial Force values of each model and figure-9 represents the variation of storey Axial Force in graphical format. From the result the maximum storey axial force is seen higher for models without shear walls and less for models with shear walls.

Maximum Storey Axial Force (KN/M²)		
Storey	With Shear Wall	With-Out Shear Wall
Storey-G	1988.57	3251.26
Storey-1	1880.13	3081.95
Storey-2	1774.13	2907.04
Storey-3	1670.11	2739.49
Storey-4	1567.83	2575.03
Storey-5	1467.16	2412.73
Storey-6	1368.01	2252.87
Storey-7	1270.26	2094.7
Storey-8	1173.87	1937.87
Storey-9	1078.74	1782.69
Storey-10	984.8	1628.71
Storey-11	891.96	1475.78
Storey-12	800.11	1324.57
Storey-13	709.2	1174.55
Storey-14	619.09	1025.36
Storey-15	529.69	876.96
Storey-16	440.88	729.17
Storey-17	352.57	581.86
Storey-18	264.61	435.98
Storey-19	176.9	291.26
Storey-20	92.11	147.47

Table -6: Maximum Axial Force (KN/M²) -Fx

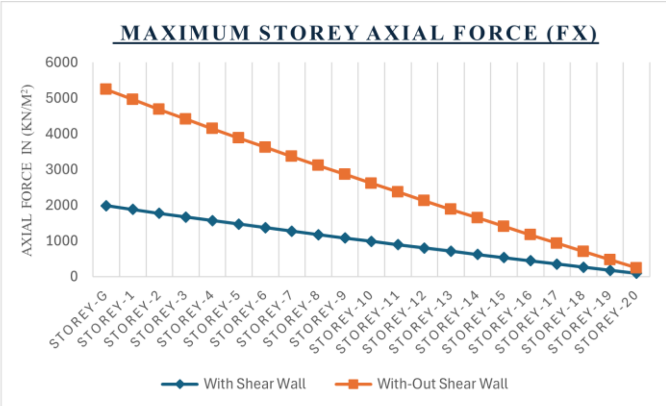

Fig -9: Maximum Axial Force

4. CONCLUSIONS

Based on the analysis of the two different building models the following conclusions are drawn:

1) Shear wall implementation reduces the chances of earthquake failure in a building by conveying more strength and stiffness.

2) Deferral, tier drift, moments, ray shear forces, colum n moments, and support responses are observed to reduce the reduction in shear walls and soft story buildings on the first floor.

3) If the shear wall is added in the appropriate location and the same stiffness in both directions, the locati on of the shear wall and the location of the shear wa ll and the stiffness of the shear wall in both directio ns is very important.

4) The maximum displacement and maximum storey drift is minimum for corner shear walled models. This shows the reduction in the deflection and movement of the G+20 building during seismic activity.

5) Revit's Integrated Professional Plugin to Robot Structure Analysis offers the advantages of optimizing structural analysis and design workflows, improving adjustments, reducing errors, and improving structural modeling and analysis accuracy. Automating data transmission and analysis results minimizes the risk of manual errors and inconsistencies.

6) load a whole structure in one program, select a part of it, and transfer that part to another Software. The integration allows for early identification of potential structural issues, enabling engineers to make necessary design changes before construction begins

REFERENCES

[1] Ali MM, Moon KS, "Diagrid Structures for Complex-Shaped Tall Buildings," Science Direct, Procedia Engineering Volume 14, 2011, Pages 1343-1350.

[2] Terri Meyer Boake, Diagrids, the New Stablity System: Combining Architecture with Engineering April 2013 DOI:10.1061/9780784412909.056Conference: Architectural Engineering Conference 2013.

[3] Mashhadiali N, Kheyroddin A, "Introducing an innovative structural system named hexagrid for tall buildings May 2012 Conference: IASS-APCS 2012.

[4] Moon KS, Connor JJ, Fernandez JE, "Moon, K. S., Connor, J. J., & Fernandez, J. E. (2007). Diagrid structural systems for tall buildings: characteristics and methodology for preliminary design. The structural design of tall and special buildings, 16(2), 205-230.

[5] Khushbu Jani, Paresh V. Patel,2013, Analysis and Design of Diagrid Structural System for High Rise Steel Buildings. Elsevier Sciverse Science Direct, Procedia Engineering 51 (2013) 92 – 100.

[6] Seung Yong Jeong,Thomas H.-K. Kang, Seismic performance evaluation of a tall building: Practical modeling of surrounding basement structures, Science Direct Journal of Building Engineering Volume 31, September 2020, 101420.

[7] James O. Malley, John Wallace,Tall Building Seismic Design and Analysis Issues - ATC-72.

[8] M. Surana, Y. Singh and D. H. Lang, Seismic Performance of Shear-Wall and Shear-Wall Core Buildings Designed for Indian Codes, Department of Earthquake Engineering, IIT Roorkee, Roorkee, India.

[9] M. Mosoarca, Failure analysis of RC shear walls with staggered openings under seismic loads, Engineering Failure Analysis journal.

[10] A. K. Marsono and S. Hatami, Evaluation of Coupling Beams Behavior Concrete Shear Wall with Rectangular and Octagonal' Applied Mechanics and Materials Dept. Faculty of Civil Engineering (FKA), University Teknologi Malaysia

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