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Seismic Behavior of Multi-Storied Hybrid Building with Different Type of Partition Walls

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Abstract: The hybrid structure or mixed structure means creative building technique in which concrete is combines with other materials with steel, timber, glass etc. for the benefit of building performance. Due to heavy weight of brick, it can be possible to use light-weight materials which can improve the seismic performance of building instead of bricks. It is possible control various seismic parameters using light weight material in hybrid building construction. The wall materials are Timber, AAC block & Brick is used for different wall combinations. The Basic 3 type of model is used in study. The total 54 number of models with different wall system combinations are studied. Calculation of seismic parameters with different wall combinations with different building configurations. The analysis of the models are done ETABS structural tool. The Indian code IS 1893(Part-1):2016 is used for the analysis. The study is concerned with comparison of various seismic parameters of the models.

Keywords: Hybrid structure, seismic parameters, displacement, hybrid frame.

I. INTRODUCTION

Nowadays, the focus of the building construction is on sustainability aspect. The building construction uses 50% of resources from nature and 25-40% of energy used(UNEP).In India, the masonry is constructed with bricks or stones conventionally. But now there are many alternatives like a autoclave aerated concrete blocks (AAC), timber partition, glass partition etc. Due to heavy weight of brick, it can be possible to use light weight materials which can improve the seismic performance of building instead of bricks. It is possible control various seismic parameters using light weight material in hybrid building construction.

II. DATA OF BUILDING & MODEL GENERATION

Live load	3 kN/m2
Floor finish	1.0 kN/m2
Terrace finish	1.0 kN/m2
Location	Zone IV
Earthquake load	As per IS-1893 (Part 1) – 2016
Depth of foundation below ground	3 m
Type of soil	Type II, Medium as per IS:1893
Storey height	As per given figure
Concrete	M30
Beam	510 x 230 mm
Slab	150 mm
Column	As per design
Steel	HYSD 415

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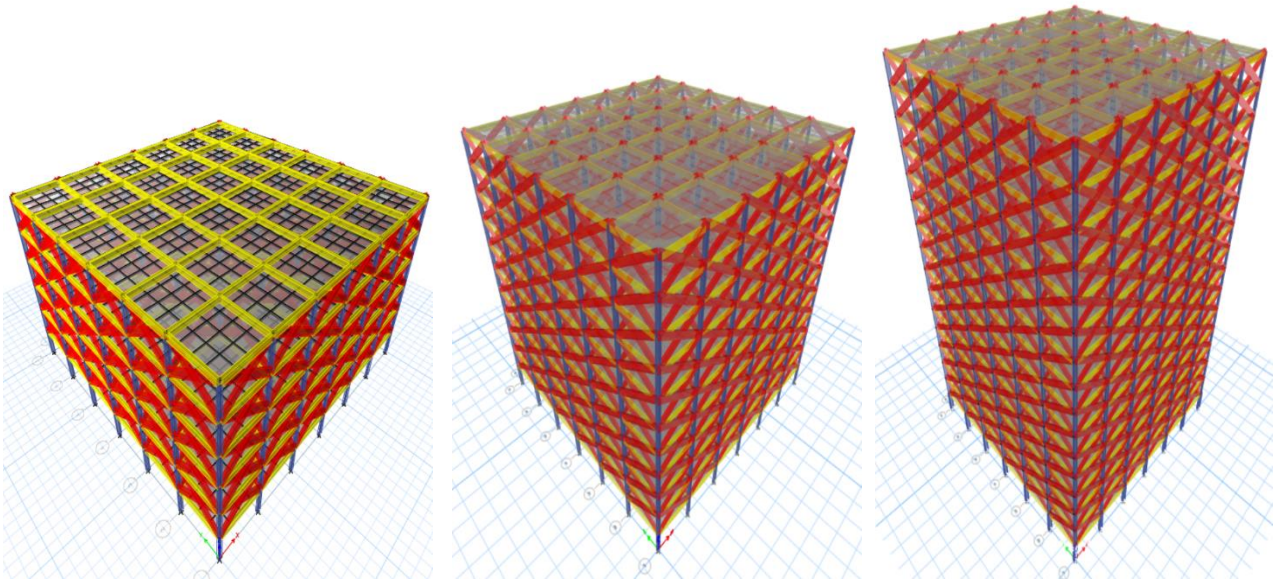
III. MODELLING & RESULT



G+5 G+10 G+15

Plan dimension = 5m x 5m (Each direction 5 Bay)

For every model 6 different alternative combinations are used, this is given below.

1) Conventional brick for interior and exterior walls
2) Exterior brick walls & interior timber partition
3) Exterior & interior AAC block walls
4) Exterior AAC block walls & interior timber partition
5) Exterior AAC block walls & interior conventional brick walls
6) Exterior conventional brick walls & interior AAC block walls

As per IS 1893: 2016 clause 7.9.2.2 the equivalent strut size is calculated from,

$$\alpha_h = \sqrt[4]{\frac{E_m\, t\, sin2\theta}{4\, E_c\, I_c\, h}} * h \qquad w_{ds} = 0.175(\alpha_h)^{-0.4} L_{ds}$$

From above equations and data it is found the size of diagonal strut as below:

G+5 Configuration:

Brick wall

periphery wall (230 mm) = 590 x 230 mm inner wall (115 mm) = 630 x 115 mm

AAC wall:

periphery wall (230 mm) = 630 x 230 mm inner wall (125 mm) = 670 x 125 mm

Timber wall:

As the timber is anisotropic material the above equations can't use. As per literature study the timber diagonal strut can be given by equivalent spring approach.

Form the numbers of experiment results they have given equations to find the wood equivalent spring stiffness.

$$k_s = \frac{k_d}{2} \times \left(\frac{L^2 + H^2}{L^2}\right)$$

k_d = in plane stiffness of timber

k_s = equivalent spring stiffness

From the test result used in literature it is required 1 KN force to displacement of 0.34 mm of plywood. In plane stiffness is 2.94 KN/mm. After all the available data used we found the spring stiffness of 1.25 KN/mm.

G+10 Configuration:

Brick wall:

periphery wall (230 mm) = 660 x 230 mm inner wall (115 mm) = 704 x 115 mm

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AAC wall:
periphery wall (230 mm) = 702 x 230 mm inner wall (125 mm) = 746 x 125 mm
Timber wall:
Equivalent spring stiffness = 1.25 kN/mm

G+15 Configuration:
Brick wall:
periphery wall (230 mm) = 672 x 230 mm inner wall (115 mm) = 719 x 115 mm
AAC wall:
periphery wall (230 mm) = 718 x 230 mm inner wall (125 mm) = 769 x 125 mm
Timber wall:
Equivalent spring stiffness = 1.25 kN/mm

Wall Combination	Eq. Zone	Seismic Weight Of Building (K N)	Time Period Of Oscillation (s)	Base Shear (KN)	Roof Displacement (mm)
All Brick Walls	IV	62067	1.176	1722	9.22
All AAC Block Walls	IV	43863	1.061	1349	9.26
Interior AAC Block + Exterior Brick	IV	52257	1.086	1570	8.96
Interior Brick + Exterior AAC Block	IV	53658	1.095	1598	9.01
Interior Timber + Exterior AAC Block	IV	40213	1.084	1211	9.89
Interior Timber + Exterior Brick Walls	IV	48606	1.048	1513	8.63

G + 5

Wall Combination	Eq. Zone	Seismic Weight Of Building (KN)	Time Period Of Oscillation (s)	Base Shear (KN)	Roof Displacement (mm)
All Brick Walls	IV	192510	1.587	3959	49.82
All AAC Block Walls	IV	139877	1.655	2759	40.30
Interior AAC Block + Exterior Brick	IV	163462	1.485	3593	42.50
Interior Brick + Exterior AAC Block	IV	168925	1.496	3686	43.83
Interior Timber + Exterior AAC Block	IV	128728	1.82	2308	41.94
Interior Timber + Exterior Brick Walls	IV	152313	1.436	3461	39.62

G + 10

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Wall Combination	Eq. Zone	Seismic Weight Of Building (KN)	Time Period Of Oscillation (s)	Base Shear (KN)	Roof Displacement (mm)
All Brick Walls	IV	286701	0.908	10300	182.34
All AAC Block Walls	IV	203981	1.584	4202	278.18
Interior AAC Block + Exterior Brick	IV	239444	0.885	8835	172.86
Interior Brick + Exterior AAC Block	IV	251238	0.889	9226	177.19
Interior Timber + Exterior AAC Block	IV	186933	1.942	3141	357.23
Interior Timber + Exterior Brick Walls	IV	222395	0.859	8446	167.47

G + 15

IV. CONCLUSION

For the Zone IV , G+5 & G+10 building found seismic weight reduction with interior timber & exterior AAC blocks wall corresponding to conventional RCC building is 35.21% & 33.31% respectively. For the Zone IV , G+5 & G+10 building found base shear reduction with interior timber & exterior AAC block walls corresponding to conventional RCC building is 29.70% & 41.72% respectively. Whereas for G+15 building the displacement is very high is 357.53 mm, so interior timber & exterior AAC block walls cannot be used. For Zone IV, the configuration of G+5 & G+10 is found to be optimum as per base shear criteria with exterior AAC block walls & interior timber walls whereas for G+15 configuration is found optimum with all the AAC block walls as per consideration of displacement.

REFERENCES

1)The seismic performance in diaphragm plane of multi-storey timber & concrete hybrid structure by Minjuan Hi, Shuo Li, Suyi Guo, Chun Ni (Journal- Elsevier)
2) Seismic performances of AAC masonry: A review of experimental and numerical approaches by Lorenzo Miccoli (Journal- Ernst & Sohn)
3) Seismic Performance Of AAC Masonry : From Experimental Testing Of The In-plane Capacity Of Walls To Building Response Simulation by Alexandre A. Costa, Andrea Penna, Guido Magenes (Journal of Earthquake Engineering)
4) Study Of Autoclaved Aerated Concrete Masonry Wall With Horizontal Reinforcement Under Compression And Shear by Radoslaw Jasinski, Lukasz Drobiec (Journal-Elsevier)
5) Seismic design of super high rise hybrid structure by Jiang Jun You Bing, Hu Ming, Hao Jiping, LI Yangcheng (World conference on earthquake engineering)
6) Criteria for Earthquake Resistant Design of Structure IS 1893 (Part-1):2016.
7)Research on seismic behaviour of wood-concrete hybrid structure by Haibei xiong, Guocheng jia (World conference of timber engineering)
8) Seismic design of super high rise hybrid structure by Jiang Jun You Bing, Hu Ming, Hao Jiping, LI Yangcheng (World conference on earthquake engineering)
9) Design Example of a Six Storey Building by Dr. H. J. Shah, Dr. Sudhir K Jain(IITK-GSDMA-EQ26-V3.0)
10) Seismic Assessment of Masonry Wall as Equivalent Diagonal Strut in RC Frame Building by Vikunj K. Tilva , Hardik N. Pansuria, Kaushal D. Patel, Smeet R. Desai (Global Research and Development Journal for Engineering)
11) CSI ETABS training manual