Seismic Assessment of Multistoried Building Using Pushover Analysis

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Abstract – A seismic analysis is performed of a G+5 RC building using Pushover method on the software STAAD.pro. Also an effort has been make to use energy efficient building materials for the construction of the building. Out of many energy efficient building materials, Flyash Bricks and Porotherm Smart Bricks are considered for the analysis. The structure considered is a non existing, geometrically symmetric building in seismic zone IV and in medium soil condition. The deflection of the structure is checked and a better energy efficient material out of the two mentioned above is suggested.

Key Words: *pushover analysis, STAAD.pro, deflection, energy efficient building materials*

1.INTRODUCTION

From past earthquakes it is proved that many of the structures are totally or partially damaged due to earthquake. So, it is necessary to determine the seismic responses of such buildings. Here we will tell about the behavior of a multistoried building using pushover analysis using the software STAAD.pro(V8i). Also green materials for the structure in the form of bricks like, Porotherm smart brick and flyash bricks are used.

A pushover analysis is a static, nonlinear procedure using a simplified, nonlinear technique to estimate seismic structural deformations. The analysis involves applying horizontal loads, in a prescribed pattern, to the structure incrementally, i.e., pushing the structure and plotting the total applied shear force and associated lateral displacement at each increment, until the structure reaches a collapse condition or a prescribed limit.

Energy efficient building design involves constructing or upgrading buildings that are able to get the most work out of the energy that is supplied to them by taking steps to reduce energy loss such as decreasing the loss of heat through the building envelope. There are endless Energy efficient materials. Energy efficient materials includes recycled steel, low-E windows, thermostat resistant barriers, vacuum insulation panels, porotherm smart bricks as shown in Fig.1, and the very commonly used flyash bricks as shown in Fig.2.

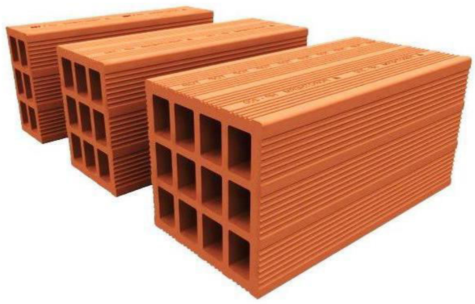

Fig -1: Porotherm Smart Brick

Fig -2: Flyash Brick

2. METHODOLOGY

The structures are G+5 Structures assumed to be situated in Delhi, India which comes under seismic zone IV according to the IS Code 1893:2016. Both the buildings are similar in terms of their geometry both have a rectangular plan. The structure contains a total of 6 bays of length 6m in the X- direction and a total of 4 bays of 4m length in the Z-direction. The storey to storey distance is 4m, hence the over -

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all dimension in X- direction is36m and in Z-direction is 16m. The overall height of the structure is 20m.

2.1 Details of the Structure

Building type	G+5 residential building
Storey height	4m
Earthquake direction	X & Z direction
Earthquake zone	Zone IV
Soil type	Medium soil
Damping ratio	5%
Importance factor	1
Grade of concrete	M24
Grade of steel	Fe 415

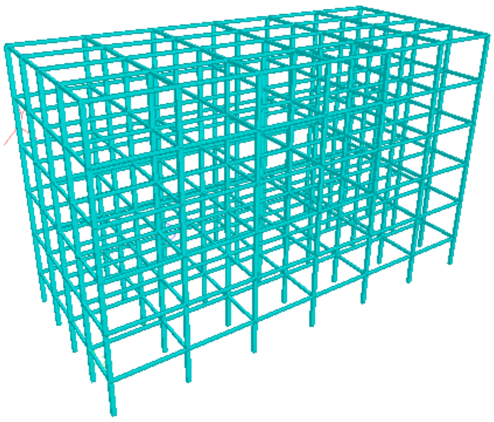

Fig -3: Geometry of the structure

Fig.3 shows the 3-D model of the structure created using the software mentioned above. The size of beams in both the structures is 230mm X 300mm whereas the size of the columns is 350mm X 350mm and the thickness of slab is 150mm.

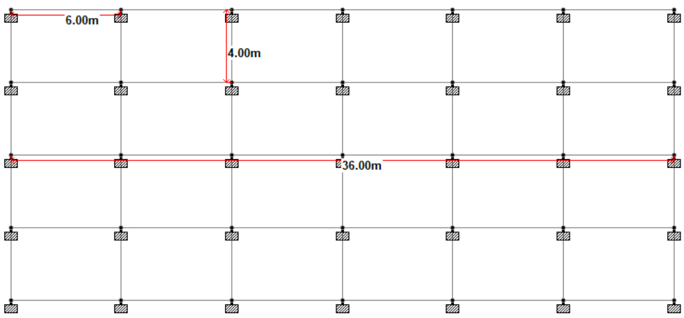

Fig -4: Plan of the structure

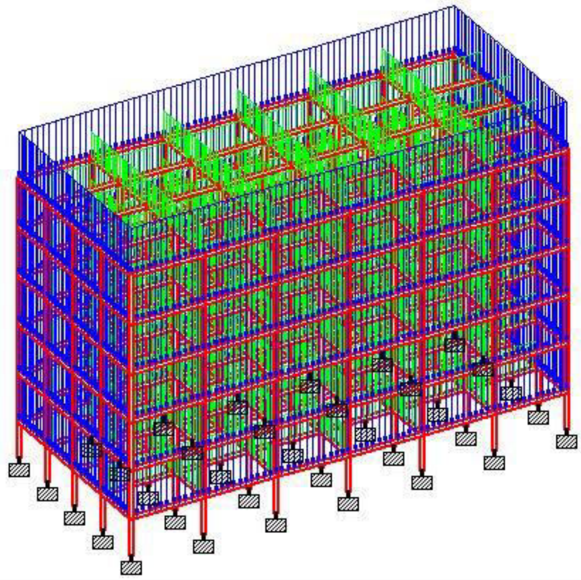

Fig -5: Wall load on the structure

Various loads such as seismic loads in both X and Z direction, selfweight of the building, flyash brick wall load was applied on model 1 whereas wall load of porotherm smart brick was applied on model 2 as shown in Fig.5. A live load of 3KN/m^2 is considered and the slab load is also considered as shown in Fig.6.

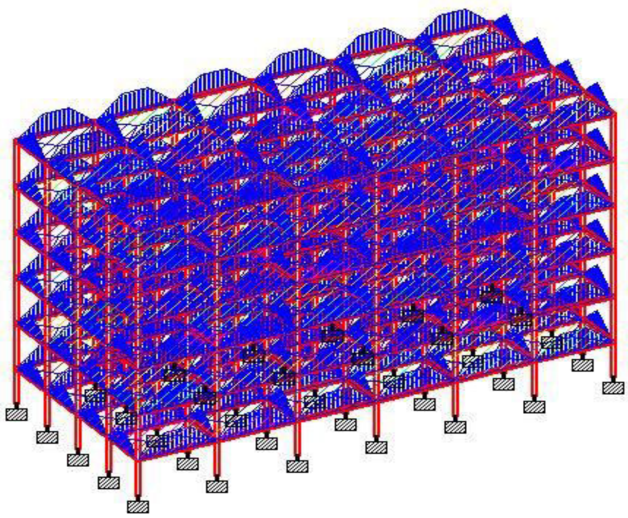

Fig -6: Slab load on the structure

3. RESULTS

The deflection of a corner column with respect to its storey is recorded along X direction and compared for both the models similarly the deflection of a column with respect to its storey is recorded along Z direction and compared for both the models Z direction and Fig.7 shows the column selected for recording the results.

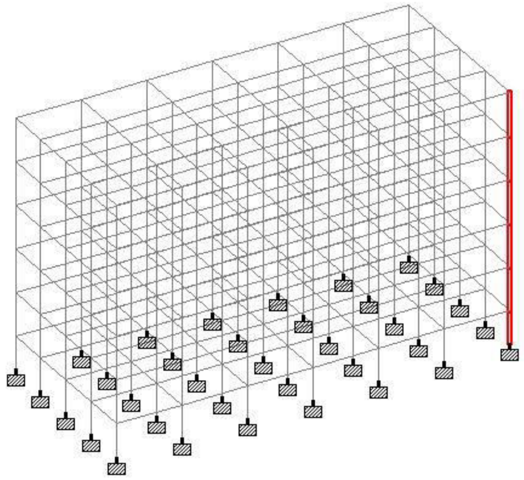

Fig -7: Column Selected for Analysis

Below are the results obtained for deflection from the analysis of both the models 1 and 2 for the corner column. Table 1 shows values of deflection for model and model 2, of the selected column along X direction.

Table -1: Deflection along X direction

Model with flyash bricks **mm**	**Model with porotherm smart bricks** **mm**
2.869	4.294
10.785	16.569
19.200	29.889
26.766	41.914
32.728	51.302
36.009	56.864

Fig.8 shows the graph obtained from plotting the deflections of both model 1 and model 2 along X direction.

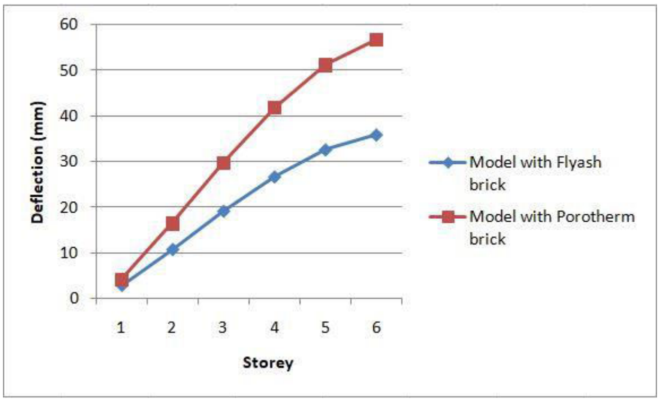

Fig -8: Deflection along X direction

Below are the results obtained for deflection from the analysis of both the models 1 and 2 for the corner column. Table 1 shows values of deflection for model and model 2, of the selected column along Z direction.

Table -2: Deflection along Z direction

Model with flyash bricks **mm**	**Model with porotherm smart bricks** **mm**
3.454	5.009
10.069	18.823
17.812	32.928
24.778	45.572
30.243	55.003
33.468	60.491

Fig.9 shows the graph obtained from plotting the deflections of both model 1 and model 2 along Z direction.

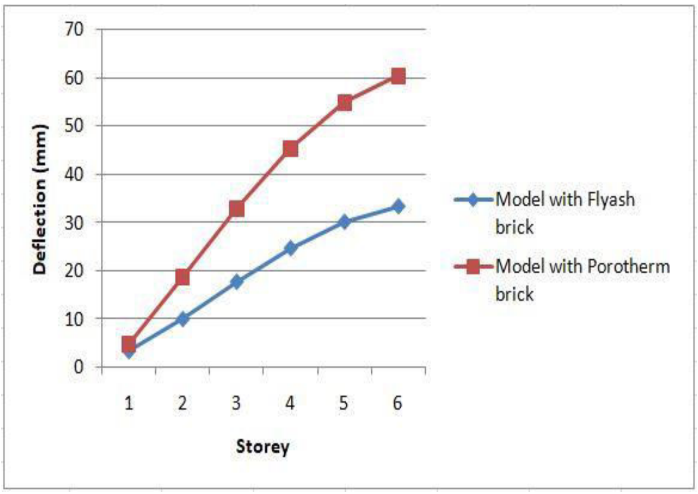

Fig -9: Deflection along Z direction

3. CONCLUSIONS

1. As the deflections for model 1 with flyash brick work and model 2 with porotherm smart bricks were plotted it is observed that model with the porotherm brickwork deflects more than the model with flyash brick work along the X direction.
2. As the deflections for model 1 with flyash brick work and model 2 with porotherm smart bricks were plotted it is observed that model with the porotherm brickwork deflects more than the model with flyash brick work along the Z direction as well.

3. It can also be seen that in both the models that the building deflects more along Z direction than in X direction.
4. We can say that using flyash bricks is a better energy efficient material in terms of stability than hollow porotherm smart brick. Results with a thermal insulating substance in the hollow porotherm brick can be looked upon for better results.

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