Behavior and Comparison of Multistory Building of Shear Wall with and without Strut

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Abstract - *The main motivation of use of these kind of system in multi-story buildings to convey the additional (gravity) load coming from structure to ground efficiently and effectively. Dead, live loads are usual loads developed from these additional (gravity loads) loads. Dislocation of multi-story buildings instanced by lateral loads, different kind of lateral load system are introduced to hold or resist those kind of effective loads. These lateral loads generate huge amount of stress or moment of sway or sudden vibrations. Therefore, structures must have suitable strength to hold out against these loads along with some kind of the stiffener to hold the laterally coming forces. Therefore this is the main criteria to learn or to study the way of acting of the structure for various lateral loading system. Lateral loading system are the main additive for the moment resisting frame for the tall structures to withstand different slight lateral loading caused by different parameters. Shear wall and infill frames are the frequently used lateral loading system.*

In this project, a trial is made to know the way of action of multi-story building when subjected to different system of lateral loading system i.e., shear wall and infill frame systems. The detail explore is conducted for various different zones of India as according to IS 1893 (part 1):2002, along with basic reflection of live, dead and seismic loads and their respective combination approximate factor of safety. One kind of method is analysed in this project i.e. for response spectrum method (dynamic analysis). The difference of these two method are evaluated as according to specification of IS 1893 (PART 1):2002 using ETABS as modelling software.

1. INTRODUCTION

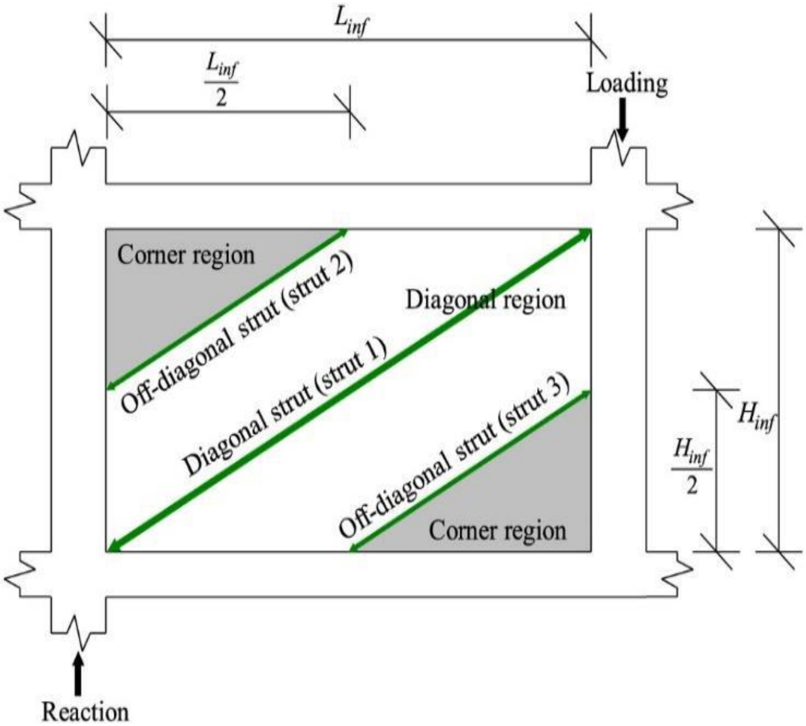
When an earthquake happens various buildings locate on the same site will show variation in the level of performance experienced by them. This variation in levels depend on different factors such as random differences in the material strength, the quantity of mass and stiffness of structural and non-structural members, levels of workmanship, condition of each structure, intensity and distribution of load at the time of earthquake and response of the soil under the buildings. Hence there is an critical need to assessment in rural areas of India for the seismic vulnerability of structures which is an necessary component of a comprehensive earthquake calamity risk management policy. Since detailed seismic vulnerability estimate is technically complex and costly procedure hence it can only be done on a limited sum of buildings. So additional complex processes can be restricted to the most critical structures and it is hence very significant to practice simple procedures to quickly evaluate the vulnerability of different kinds of buildings. An idyllic multi-story structure which is designed to prevent lateral loads due to earthquake would be symmetric in distribution of mass and stiffness in plan at every story and as well as along the height of the structure. Such structure would respond only laterally and is considered as torsionally balanced structure. Because of limitations as architectural requirement and functional essentials, it is very difficult to attain such a state in the structure. A structure can be planned to be earthquake resistant for a infrequent but tough earthquake, which will be more stable but at the same time it will be expensive. The utmost logical methodology to the seismic design problem is to admit the uncertainty of the seismic phenomenon.

The technique of analyzing the building differs from linear to non-linear. Both the linear and nonlinear analysis procedures can be executed statically as well as dynamically. The static non-linear process specifies which part of the building fails first.

The height of a structure is relative and cannot be defined in entire terms either in relation to height or the number of stories. But, from a structural engineer's point of view the tall building or multi-storied structure can be defined as one that, by virtue of its height, is affected by lateral forces due to wind or earthquake or both to an extent that they play an significant role in the structural design.

The design of tall structures essentially includes a conceptual design, approximate analysis, primary design and optimization, to safely carry gravity and lateral loads.

DIAGONAL STRUTS



Shear walls and Struts are vertical elements of the horizontal force resisting system. Shear walls and Struts are built to counter the effects of lateral load acting on a building. In residential construction, Shear walls and Struts are straight external walls that typically form a box which gives all of the lateral support for the structure. When Shear walls and Struts are designed and constructed correctly, and they will have the strength and stiffness to repel the horizontal forces. In structure construction, a firm vertical diaphragm capable of shifting lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. Examples are the reinforced-concrete wall or vertical truss. Lateral forces initiated by wind, earthquake, and uneven settlement loads, in addition to the weight of building and occupants; create powerful twisting (torsion) forces. These forces can literally tear (shear) a structure apart. Reinforcing a frame by attaching or placing a firm wall inside it sustains the shape of the frame and avoids rotation at the joints. Shear walls and Struts are particularly important in high-rise structures subjected to lateral wind and seismic forces.

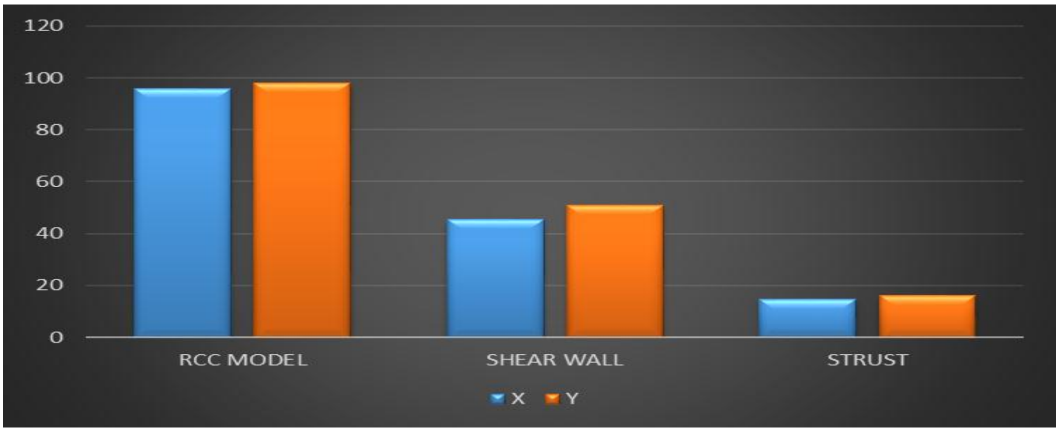
In the previous two decades, Shear walls and Struts became an significant part of mid and high-rise residential structures. As part of an earthquake resistant building design, these walls are located in building plans falling lateral displacements under earthquake loads. So shear-wall frame buildings are obtained. Shear walls and Struts structures are usually regular in plan and in elevation. However, in some structures, lower floors are used for commercial purposes and the structures are characterized with greater plan dimensions at those floors. In other cases, there are setbacks at higher floor levels. Shear walls and Struts structures are normally used for residential purposes and can house from 100 to 500 inhabitants per structure

Earthquake creates the random ground motions in all direction, radiating from the epicenter. These ground motions creates building to vibrate and induces inertia forces in them. In India majority of the existing reinforced concrete buildings in this seismic region do not meet the current seismic code requirements as these are primarily designed for gravity loads only. However, they can repel certain amount of lateral forces due to earthquakes of small magnitude, due to the effect of stiffness of the masonry shear walls. The performance of the existing structures can be improved up to certain limit by retrofitting And for the building to perform better at the earthquakes, it must be analyzed and designed as per the Indian seismic code IS 1893 (Part 1) 2002. Conventional and Pre–Engineered steel frames. Figure 1 shows the plan details of Conventional and Pre–Engineered steel frames.

RESULTS AND COMPARISON

STORY DISPLACEMENT RESULTS

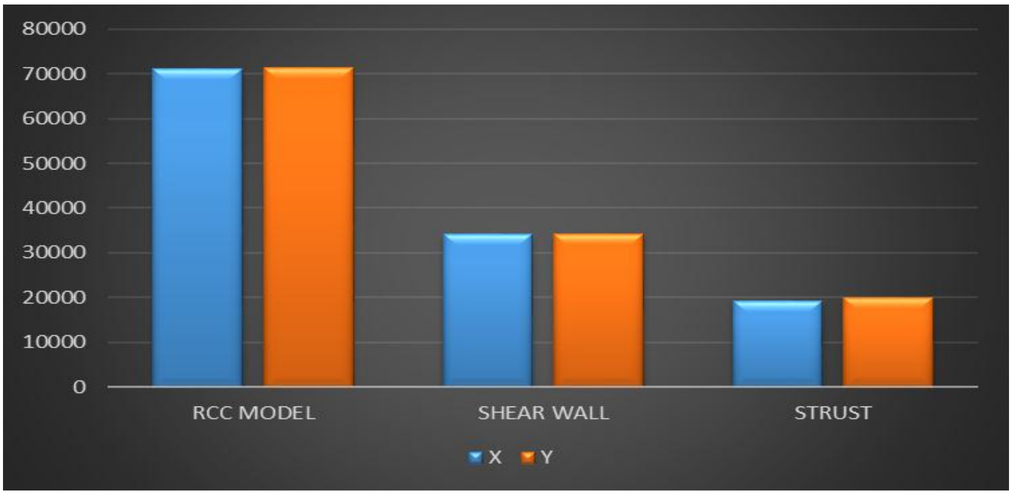
MODEL	X(KN/mm²)	Y(KN/mm²)
RCC MODEL	95.798	98.168
SHEAR WALL	45.471	50.85
STRUT	14.72	16.221



The displacement goes on increasing as the building height goes on increasing, this is also true when we provide Un-reinforced masonry(URM) shear walls in the building the displacement of the building decreases and further decrease by providing the struts in diagnol positions.

STORY DRIFT AND RESULTS

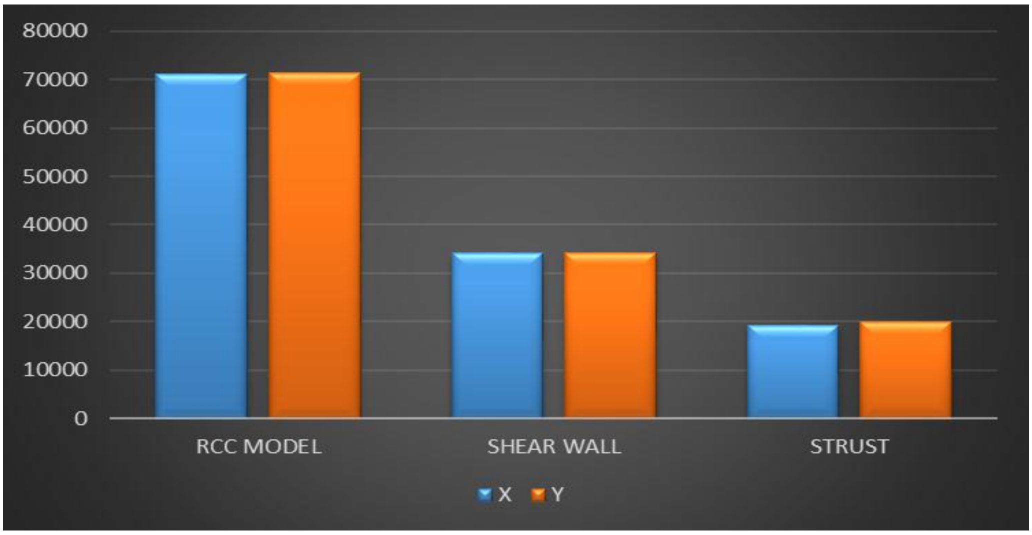
MODEL	X(KN/mm²)	Y(KN/mm²)
RCC MODEL	0.00495	0.00508
SHEAR WALL	0.003284	0.003681
STRUT	0.001024	0.001124



The drift when compared to that of the normal Rcc structure decreases when we provide shear walls and also when provided with struts. So at final by providing shear wall along with struts will be better model when compared with other

STORY SHEAR AND RESULTS

MODEL	X(KN/mm²)	Y(KN/mm²)
RCC MODEL	71165.56	71360.62
SHEAR WALL	34163.57	34233.28
STRUT	19214.94	20050.39



The stiffness when compared to that of the normal Rcc structure decreases when we provide shear walls and also when provided with struts. So at final by providing shear wall along with struts will be the better model when compared with other.

STORY STIFNESS AND ITS RESULTS

MODEL	X(KN/mm²)	Y(KN/mm²)
RCC MODEL	54504770.49	48960038.02
SHEAR WALL	38248865.33	33181192.72
STRUT	9725415.313	10225480.14

Story stiffness of the structures with URM shear wall is increased compared to bare frame (without shear wall)in X-direction. This increase in stiffness is due to increase in the seismic weight of the building

CONCLUSIONS

The present research is focused on the study of seismic behavior of RC structures using analytical technics for the structure located in the seismic zone-V of Indian medium soil. The performance of the building is studied in terms of Time period, Base shear, Lateral displacement and storey drift in Linear static and linear Dynamic analysis for with and without the effect of infill and along with struts wall structure of G+8 storey models.

the following conclusions are made from the present study are

 The Displacement goes on increasing as the structure height goes on increasing, this is also true when we provide Un-reinforced masonry (URM) shear walls in the building the Displacement of the structure decreases and further decrease by providing the struts in diagonal positions.

 Base shear of the buildings with URM shear wall is increased compared to bare frame (without shear wall) in X-direction. This increase in base shear is due to increase in the seismic weight of the structure.

 Providing shear walls in the structure results in drastic reduction of lateral displacement of the structure, there by increases the resistance and safety of the structure against seismic forces.

 The Drift and stiffness when compared to that of the normal Rcc structure decreases when we provide shear walls and also when provided with struts. So at final by Providing shear wall along with struts will be the better model when compared with other.

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