ABSTRACT

Structures on the earth are generally subjected to two types of load: static and dynamic. Static loads are constant with time while dynamic loads are time-varying. In general, the majority of civil engineering structures are designed with the assumption that all applied loads are static. The effect of dynamic load is not considered because the structure is rarely subjected to dynamic loads; more so, its consideration in analysis makes the solution more complicated and time consuming. This feature of neglecting the dynamic forces may sometimes become the cause of disaster, particularly, in case of earthquake. Reinforced concrete (RC) shear walls are used in buildings to resist lateral forces due to wind and earthquakes. They are usually provided between column lines, in stair wells, lift wells, and in shafts that house other utilities. Shear walls provide lateral load resistance by transferring the wind or earthquake loads to the foundation. Besides, they impart lateral stiffness to the system and also carry gravity loads. A well-designed system of shear walls in a building frame improves its seismic performance significantly. Safety and minimum damage level of a structure could be the prime requirement of tall buildings. To meet these requirements, the structure should have adequate lateral strength, lateral stiffness, and sufficient ductility. Among the various structural systems, shear wall-concrete frame could be a point of choice for the designer. Hence, the present study include: the effect of height of shear wall in the dynamic response of building frame.

KEY WORDS: Effect of height of shear wall, Dynamic response of building frame, Time history analysis, Height of shear wall, Dynamic response.

Introduction

The primary objective of earthquake resistant design is to prevent building collapse during earthquakes thus minimizing the risk of death or injury to people in or around those buildings. Earthquake forces are generated by the dynamic response of the building to earthquake induced ground motion. This makes earthquake actions fundamentally different from any other imposed loads. Thus the earthquake forces imposed are directly influenced by the dynamic inelastic characteristics of the structure itself. The importance of dynamic effects in structural response depends on the rate of change of external forces and the dynamic properties of structures. Dynamic responses are stresses, strains, displacement, acceleration etc. The design of buildings for seismic loads is special, when compares to the design for gravity loads (dead loads and live loads). Gravity loads are relatively constant, in terms of their magnitude and are treated as ‘static’ loads. In contrast, seismic loads are predominantly horizontal (lateral), reversible (the forces are back-and-forth), dynamic (the forces rapidly vary with time) and of very short duration. The seismic loads are more uncertain than the conventional gravity loads in terms of magnitude, variation with time and instance of occurrence. The variations of the forces with time affect the resistance of the building. The maximum magnitudes of the internal forces and their locations in the structural embers are different from those due to gravity loads. In order to make a building seismo-resistant, it should have, good building configuration, lateral strength, lateral stiffness, ductility, stability and integrity.
Objective of study

Reinforced concrete (RC) shear walls are used in buildings to resist lateral forces due to earthquakes. They are usually provided between column lines, in stair wells, lift wells, and in shafts that house other utilities. Shear walls provide lateral load resistance by transferring the wind or earthquake loads to the foundation. Besides, they impart lateral stiffness to the system and also carry gravity loads. A well-designed system of shear walls in a building frame improves its seismic performance significantly. Safety and minimum damage level of a structure could be the prime requirement of tall buildings. To meet these requirements, the structure should have adequate lateral strength, lateral stiffness, and sufficient ductility. Among the various structural systems, shear wall-concrete frame could be a point of choice for the designer. Hence, the main objective of present study is the effect of height of shear wall in the dynamic response of building frame.

STRUCTURAL MODELING AND ANALYSIS

SAP 2000 is used to compute the response of thirty (G+29), twenty (G+19) and sixteen storey (G+15) building for non linear (time history) Dynamic analysis. Results from time history analysis observed for the displacements to determine the seismic behavior. In the study of effect of height of shear wall, a comparison of displacements of each storey of different model building for the different height of shear wall was carried out by time history analysis and studied the effect of height of shear wall in building. Shear wall is modeled using the 4-noded surface elements. The shear walls have been provided with a thickness of 230 mm up to different storey heights. Related factors taken are seismic Zone factor 0.16, Response reduction factor 3, Importance factor 1, Damping 0.05, and Foundation Soil type medium. The live load as 3 kN/m² for floors.

The storey displacements for various storey levels of 30 storey building are plotted in Fig.1. For various storey displacements, we can see that the without shear wall is having the maximum storey displacement of 258.629mm and the shear wall upto 30 stories is having the maximum storey displacement of 168.855mm. The maximum storey displacements for various storey levels of 30 storey building are plotted in Fig.2.
The storey displacements for various storey levels of 20 storey building are plotted in Fig.3. For various storey displacements, we can see that the without shear wall is having the maximum storey displacement of 160.348mm, and shear wall up to 20 stories is having the maximum storey displacement of 98.171mm. The maximum storey displacements for various storey levels of 20 storey building are plotted in Fig.4.
The storey displacements for various storey levels of 20 storey building are plotted in Fig.5. For various storey displacements, we can see that the without shear wall is having the maximum storey displacement of 107.517mm and shear wall up to 16 stories is having the maximum storey displacement of 62.181mm. The maximum storey displacements for various storey levels of 20 storey building are plotted in Fig.6.
The comparison of maximum storey displacements for various storey levels of 30, 20 and 16 storey buildings (SW – 100 models) are plotted in Fig.7 For various storey displacements, we can see that the 30 storey building is having the maximum storey displacement of 168.855mm, 20 storey building is having the maximum storey displacement of 98.171mm, 16 storey building is having the maximum storey displacement of 62.181mm.
The comparison of maximum storey displacements for various storey levels of 30, 20 and 16 storey buildings (SW – 50 models) are plotted in Fig.8. For various storey displacements, we can see that the 30 storey building is having the maximum storey displacement of 179.066mm, 20 storey building is having the maximum storey displacement of 104.792mm, 16 storey building is having the maximum storey displacement of 67.86mm.

CONCLUSION

The analytical study on the dynamic response of seismo-resistant building frames was done. The storey displacements for various heights of shear wall in the dynamic response of building frames are obtained. From the study, the following conclusion can be drawn out. If the height of shear wall extended up to mid height of building frames, the displacement goes on decrease. But if the shear wall extended to full length of building there will not much reduction in the displacement. Hence, there is no need for providing shear wall throughout the height of high rise buildings. That is the response of shear wall beyond mid height of the building against lateral forces is least.

REFERENCES