ABSTRACT

Today, tall buildings are a worldwide architectural phenomenon. The behavior of the structures during seismic and wind loads definitely has a major role, not only from structural engineering point of view, but also for the safety of humans living in the structure. It is a major challenge to study the impact and performance of tall structures under wind and seismic loads.

I) In the present work, Time History analysis was carried out on a G+19 multistory Reinforced Concrete (RC) framed building taken from Panchal and Marathe (2011) with minor changes made in the building. This RC frame along with three types of lateral force resisting systems are analysed and their peak responses such as absolute accelerations, displacements and drifts under four types of Time History Earth Quakes (THEQ) are computed using the SAP2000 software. The study shows, the optimum ways to provide the lateral load resisting systems in the building based on the responses of the building. Following three types of models are considered for the analysis:

1. RC framed building with brick infill (BI) considered as the brick wall model or brick infill model.

2. RC framed building with brick infill and shear wall (provided in four corners both in x and y directions of the building and lift area) considered as the model named shear wall -I (SH_I) for analysis.

3. RC framed building with brick infill and shear wall (provided in four corners both in x and y directions of the building, two bays in y direction and lift area) are considered as the model, shear wall -II (SH_II) for the analysis.
The main considerations in the seismic resistant design of structures are, the characteristics of the structure and the location of the structure (earthquake zone - gives the characteristics of the earthquake (EQ) ground motion represented by the amplitude of ground motion i.e., Peak Ground Acceleration (PGA) and the site soil conditions). The model linear time history analysis (LTHA) of the frame subjected to four types of THEQ such as El Centro (EC), Kobe (KO), Northridge (NR) and S_Monica (SM) are carried out. The PGAs for the earthquake records are 3.417 m/s^2, 5.79 m/s^2, 8.268 m/s^2 and 2.25 m/s^2 respectively. The building assumed to be located in a region where the PGAs corresponding to Design Based Earthquake (DBE) are 0.35g.

Response spectrum analyses are carried out for the RC building, which is assumed to be located at Chennai. The corresponding zone and zone factor are taken from IS 1893 (Part 1): 2002. The peak responses of the building such as absolute accelerations, displacements and drifts are considered for 3 types of models with lateral load resisting systems and are compared with that of the bare frame (BF) and their responses are presented. The responses show that provision of both models of shear wall in buildings reduces the responses effectively and responses are found to be within the allowable limits. The effective model responses of the building for the response spectrum analysis are found to be the shear wall_1.

II) A 20-Storey benchmark steel moment resisting frame is taken from Ohtori et al (2004) benchmark control problems for seismically excited nonlinear buildings for the study of seismic response of the structure. The model time history analysis of the frame subjected to four types of earthquake loads is carried out. The four time histories considered for the analysis are of PGAs normalized to 0.35g.

In this study, the LTHA for 20-storey benchmark building is carried out using SAP2000. It is subjected to four different types of earthquakes such as
N-S component of El Centro (EC),
N-S component of Kobe (KO),
N-S component of Northridge (NR),
N-S component of S_Monica (SM).

The absolute peak acceleration for the earthquake records are 3.417 m/s$^2$, 5.79 m/s$^2$, 8.268 m/s$^2$ and 2.25 m/s$^2$ respectively. The benchmark building is assumed to be located in a region where the peak ground acceleration (PGAs) corresponding to DBE is 0.35g. The analysis is first made for the bare frame structure and then dampers are placed accordingly. The responses such as base shear, accelerations, displacements and inter-storey drifts are presented.

The 20-Storey benchmark steel moment resisting frame is taken for the study of seismic response reduction by providing dampers distributed in different configurations. Three types of viscous fluid dampers (VFDs) are used in this study such as scissor-jack (SJ), lower toggle (LT) and chevron (CH) mechanisms. The linear time history analysis of the 20-storey bare frame and the frame equipped with dampers in three types of configurations (scissor-jack, lower toggle and chevron) subjected to four types of earthquake records normalized to PGAs of 0.35g are carried out using SAP2000 software. The dampers are distributed along the height of the building to reduce the response of the building. There are six different types of placements for each type of configurations.

The effective placement of dampers in the bare frame is found out by comparing the peak average response reduction values of six different models of scissor-jack dampers.

Among the six different models of lower toggle dampers, effective placement of dampers in the bare frame is found by comparing the peak average response reduction values. Damper placements for the model LT_M_4 are found to be more efficient and cost effective compared to other types of
damper placement and distributions. The peak average response reduction values for the model LT_M_4 are 69.0 for the absolute acceleration, 59.1 for the displacements and 68.8 for the drifts.

Among six different models of chevron dampers, effective placement of dampers in the bare frame is found out by comparing the peak average response reduction values. CH_M_5 model damper placements are found to be more efficient and cost effective compared to the other types of damper placement and distributions.

III) Experimental investigation on the performance of a 2-Dimensional (2D) quarter scale RC frames with four types of masonry infilled frames such as i) RC frames without masonry infill (Bare frame), ii) RC frames with clay brick masonry infill, iii) RC frames with flyash brick masonry infill and iv) RC frames with solid concrete block masonry infill was carried out.

IV) Seismic evaluation of the moment resisting RC frame was carried out for five types of frames with and without brick infill by equivalent static analysis and response spectrum analysis using the ETABS software. Various building responses such as base shear, inter-storey drift and maximum top storey displacements are investigated for all the 5 models considered.

V) Experimental investigation was carried out on 3 types of single bay single storey steel frame such as bare frame, masonry infill frame and steel braced frame under lateral loads and also nonlinear analysis of these steel frames is carried out using ANSYS software. The yield load and ultimate load for the braced frame and brick infilled frame are found to be increased when compared to the bare frame. From the analytical investigation it is observed that the deflection of the braced frame and the masonry in filled frame are reduced 2.72 times and 1.91 times respectively when compared to the bare frame.