SYNOPSIS

SPANDHANA M.HARIDAS

Roll No. 19250012 (M. Tech)

Civil Engineering

Indian Institute of Technology Gandhinagar

Gandhinagar-382355, INDIA

Thesis Supervisor

Dr. DHIMAN BASU

Month and Year of Submission

July, 2021

PROPORTIONING ELASTOMERIC BEARINGS IN A SEISMICALLY ISOLATED BUILDING WITH HORIZONTAL AND VERTICAL SETBACKS AND TORSIONAL IRREGULARITIES

Seismic isolation is one of the proven ways of mitigating seismic demand and several base isolated facilities withstood major earthquakes in the recent past with expected performance. Seismic base isolation reduces seismic demand by shifting the building's fundamental period outside the dominant frequencies of ground motion by interposing structural elements with low horizontal stiffness between the structure and the foundation. The application of seismic isolation is regulated by the national building codes such as ASCE 7-16 in United States for the analysis and design requirements. It includes a systematic procedure for establishing upper bound and lower bound values of isolator properties with due considering the aging effect, environmental conditions, loading effects and manufacturing variations using property modification factor which improves the behaviour of isolators to any random ground motion. Base isolation in regular buildings is currently a prevalent in practice in many developed countries with isolator units designed and provided as uniform isolators throughout the isolation system to make it cost-effective even though isolators should be designed and placed in proportion to their axial loads technically. Proportionately deployed isolators are generally expected to yield better results than uniform isolators. The presence of uniform isolators is

likely to deliver a stiffer isolation system leading to a smaller period shift. Even while both strategies may not have a substantial influence for regular buildings, irregular buildings need a thorough assessment. Design of isolation system is often challenged by the structural irregularities including the asymmetry, setback, and in-plane floor flexibility, and also multi-components of seismic excitation, such as vertical, rocking, and torsional. Four different sets of buildings are examined in this thesis to better understand the impact of proportioning the isolation systems in irregular structures. Both vertical and horizontal setbacks are present in the first set of buildings. These structures are examined using three different isolation systems: two cases of uniform isolators and one case with proportionate isolators. Response spectrum and time history analysis against a set of spectrally matched suite of ground motion demonstrate that the building with proportionate isolators perform better when compared to the uniform isolators. The second set of structures is of primarily academic interest and comprising of shear walls in the first set. Once again, the observations remain the same. The third case explores the relative choice between a fixed-base building with shear walls and a base isolated building without shear wall while targeting the same seismic hazard. Both systems perform equally well if designed satisfactorily and opting for of a base isolated building is not a must for this example, which however may not be true always. Finally, a building with plan irregularity (asymmetric) is considered with three different isolation systems, namely the uniform isolators, proportionate isolators, and eccentrically placed isolators. Although the building with proportionate isolators performs better when compared with the uniform isolators as noted previously, that with eccentrically placed isolation system performs the best among the three. The eccentrically designed isolation system is aimed to minimize the torsional contribution which is reflected in the performance of associated building. The events in the selected suit of ground motions are rescaled to the fundamental mode spectral acceleration to assess the sensitivity of the proposed eccentrically isolation system on the selection of ground motion (as a simplification for the suite). The proposed isolation scheme appears to be equally effective in minimizing the torsional contribution regardless of the ground motion. Nevertheless, the observations and associated conclusions reported in this thesis are limited to the elastomeric bearings only.