Study on pounding in torsional adjacent buildings considering soil-structure interaction

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During strong earthquakes, adjacent structures with non-sufficient clear distances collide with each other. This phenomenon is called pounding. During such an event, the impact force is applied as a shock on a dynamically system. Such a shock force can alter totally the design forces, an anticipated, for the system under study. Moreover, the local damage sustained by the structure elements under direct impact force, can result in local or global failure in extreme cases. Because of complexity and many uncertainties in modeling an estimation of pounding, both as an event and as an extra force, it has been the traditional of building codes to set a rule to distance the buildings at an amount to completely eradiate the possibility of impact. The problem becomes much more complicated if effects of other existing realities, including torsional response and soil-structure interaction (SSI) are taken into account. Many attempts have been undertaken by various researchers to investigate the detrimental effects of seismic pounding in the past, especially after the 1985 Mexico City earthquake that exhibited many instances of pounding. The larger volume of the research works in the past 30 years on pounding has been on simple one-dimensional or two-dimensional models of adjacent buildings on rigid base. In the past studies on seismic impact of three-dimensional unsymmetric adjacent structures resting on a rigid base or symmetrical buildings often the effect of soil flexibility is disregarded. Only a small portion of research tasks, however, has been devoted to the ones considering simultaneous effects of pounding, torsional coupling, and SSI. The problem of seismic pounding between torsionally coupled multi story buildings is investigated in this thesis. The pair of adjacent structures rest on a flexible soil and the soil-structure interaction phenomenon is taken into account using the winkler beam on nonlinear springs. The buildings are 4 to 10 stories in height. Although a common plan being symmetric with regard to lateral stiffness is considered, a mass eccentricity variable from zero to 30% of the plan dimension is considered. Modeling of nonlinear torsional buildings with common story elevation, the seismic impact can happen anywhere along the buildings edge. Effect of impact, soil flexibility and torsional eccentricity are studied by comparison of nonlinear dynamic responses of building under 11 consistent earthquakes on D soil types at different clear distances including story drift, shear forces, and plastic hinge rotation of stories and pounding forces. The results of the study indicate that Pounding of the adjacent buildings can even happen at the clear distance required by the sample seismic design code although with a small amplitude. It has been found that the soil flexibility increases the relative lateral displacements of the lower stories and increases the pounding force in the lower half of the buildings. Moreover, Combination of the torsional response and pounding at the corners makes the peripheral lateral bearing to be the most critical regarding the nonlinear response and the ductility demand. This is true even at the clear distance required by the code.

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