

Study on pounding between adjacent buildings considering soil-structure interaction and structure-soil-structure interaction

Abstract

During severe earthquakes, adjacent buildings which are built with insufficient distance impact each other called pounding. The difference between dynamic characteristics of adjacent structures causes out-of-phase vibration which is the main reason of pounding. Population growth and livable urban space limitations led to the placement of the buildings with insufficient distance and concentrated in the most populous areas.

There are two ways for force transmission in structures located beside each other. The first is the impact between adjacent floors and the second one is the force transfer through the underlying soil called structure-soil-structure interaction or cross interaction. This study investigates the effect of pounding considering soil-structure interaction and structure-soil-structure interaction. For this purpose, the equations of the motion of structures with one degree of freedom with assuming soil-structure interaction and cross interaction are investigated. Then the effect of the cross interaction on the natural frequency of the system and the structural response are discussed. In addition, the pounding possibility based on the excitation frequencies is discussed. The equations are studied both in frequency and time domain, and the soil is simulated by concentrated spring-damper system. In the next section, adjacent steel structures having 3-12 stories are studied for 3 different distances between them and two states of fixed base and flexible base. In this section, soil-structure interaction is modeled with beam on nonlinear Winkler foundation, and cross interaction is applied with concentrated spring-damper system between two adjacent foundations. In this study, Opensees software is used for time history analysis. In addition to a high variety of behavioral models for structural modeling, this software has the potential of modeling a variety of proposed soil behavior. In this section, the effect of distance between two adjacent buildings, soil-structure interaction and structure-soil-structure interaction on reactions such as impact force, displacement, shear forces and plastic rotation of beams and columns are discussed.

Key Words : Impact between adjacent buildings, soil-structure interaction, cross interaction, natural frequencies, structural response