Nonlinear soil–structure interaction of retaining walls with pulse-like earthquakes

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Abstract

Near fault earthquakes have been distinguished for their probability of having pulse-like characteristics with higher velocity time history amplitudes. This could be significant for retaining walls found in bridges and nuclear power plant buildings. Several two-dimensional numerical models of an embedded wall-soil system were developed in Abaqus® by varying the wall rigidity and friction coefficient between the wall and soil. The friction coefficient was varied from 0 to 0.5. In one model, the wall is very rigid and in the other the wall is flexible with original modulus of elasticity. Seismic pressures in the soil-wall system are evaluated. The analyses are performed considering non-pulse and pulse-like motions that match a narrow-band modified target spectrum for a moment magnitude of 7.70. The objective is to study how the soil-wall system is affected by pulse-like seismic events and how the contact conditions affect this response.

Keywords: retaining walls; pulse-like motions; seismic pressures; friction coefficient; contact conditions

1 Introduction

Pulse-like earthquakes are believed to impose larger structural demands on structures due to the sudden release of seismic energy. The release of energy occurs in a short time window causing a distinctive pulse in the time history. Several researchers [1-3] have observed that pulse-like records tend to have lower duration than ordinary earthquake records. Consequently, most of the energy arrives in one burst at the beginning of the record leading to higher structural demands. Therefore, this must be taken in consideration during the evaluation of structures that are near geological faults due to the possibility of a pulse-like ground motion striking the area. This can cause concern in areas that are near fault due to the possibility of structures not being designed to withstand higher seismic demands and could be significant for retaining walls in nuclear power plants and bridges. Most of the nuclear power plant buildings are partially or deeply embedded in soil requiring the incorporation of soil-structure interaction (SSI) effects in the analyses. Records derived from accelerographs during the San Fernando earthquake (1971) obtained at sites close