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# NUMERICAL STUDY OF SEISMIC BEHAVIOUR OF REINFORCED SOIL BRIDGE ABUTMENTS UNDER DIFFERENT GROUND MOTIONS

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Reinforced earth walls have gained numerous applications in geotechnical engineering. Reinforced bridge abutments are similar to earth walls except that they carry a surcharge load near the top edge (from the bridge deck) in addition to the soil horizontal pressure behind the reinforced earth zone. Since bridges are among the significant infrastructures, they are expected to remain in service after earthquakes.

The reinforced soil abutments of single-span overpass railway bridges were completed near Ahvaz- Khorramshahr highway located southwest Iran, to accommodate two traffic lanes and two sidewalks. It is observed that the bridge deck/ girder load is carried by a strip footing on top of the reinforced abutment. Hence bridge loads are transferred directly to the reinforced soil zone.

Due to high seismicity of Iran, it is essential to study the behavior of reinforced soil abutments of single-span overpass railway bridges under seismic excitations. The reinforced soil abutment is one of the overpass bridges having a single-span of 19 m and 7 m abutment height constructed in Khuzestan Province in southwestern Iran. Foundation soil type was soft to medium stiff clayey deposit with high groundwater level. FLAC 2D was used to simulate the seismic excitations. Different ground motions selected from historical records of some important earthquakes around the world and also artificial harmonic wave were applied to the model to study its behavior under differnet seismic condition.

Figure 2 shows the geometry, boundary conditions, loading, reinforcement arrangement, interface elements, and finite difference grid for numerical simulation of abutment.

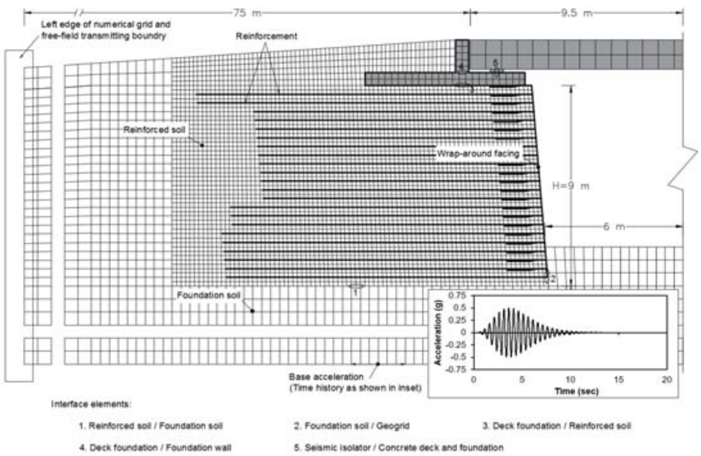


*Figure 1. Grid, interface elements, boundary conditions and seismic loading of the numerical model.*

To study the effects of acceleration wave characteristics such as frequency, number of cycles, maximum acceleration amplitude, etc. on the seismic behaviour of overpass bridge abutments, three different seismic excitations including, Kobe (1995), Loma-Prieta (1989) and Northridge (1994) and also harmonic wave were used. Horizontal displacement of the facing and the displacement of bridge deck's strip footing were studied separately under the different seismic conditions. For instance, the profile of horizontal displacement of facing is presented in Figure 2. The results show that displacement pattern is relatively similar in all models and maximum acceleration amplitude has a significant effect on the seismic behavioural indices.

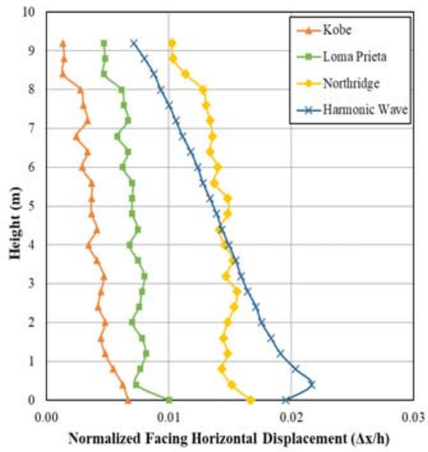


*Figure 2. Post cyclic horizontal displacement profile of facing.*

Due to complexity of real earthquake waves, artificial acceleration waves such as harmonic waves are usually used to perform seismic analysis. It is so important to choose proper parameters of the wave to achieve fairly results. Parametric study was performed to study the effects of harmonic wave properties including maximum amplitude and wave frequency. The results show that the aforementioned parameters have an important role on the system behavior. Studies on the type of input wave shows that choosing the suitable input wave plays an important role in the reliability of the results.

Detailed studies has shown that the natural frequency of the entire system is 0.5 Hz. At such a frequency, both the horizontal deformation of the facing as well as vertical deformation and rotation of the deck footing were significantly higher. For example, at such a frequency, the maximum horizontal displacement reached 0.07H at the end of seismic excitations which is too high and way beyond acceptable magnitudes. The frequency of 2 Hz selected in this paper is believed to be close to the dominant frequency of most earthquakes and on the basis of presented results, one can judge on the performance of the constructed overpass single-span bridges. In addition, results of the models stimulated by real earthquakes with wide range of frequencies also show that resonance is unlikely to occur in the overpass bridge abutments.

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