Seismic Structure-Soil-Structure Interaction (SSSI) between piled neighboring bridges: Influence of height ratio

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Abstract

This paper investigates the influence of the height ratios of three dissimilar adjacent bridges with different superstructure masses [M_{st}=350, 1050, 350 Tons] on the seismic Structure-Soil-Structure Interaction (SSSI) through 3D numerical simulations. To this end, an extensive series of numerical analyses have been performed for a range of height ratios (R) (R=1,1.1,1.15, 1.2, 1.25, 1.5, 2, and 3) focusing on its impacts on the superstructure acceleration and the internal forces induced in the foundations' piles. The considered bridges are founded on groups of piles implanted in nonlinear clay. The numerical analyses have been carried out using a Three-dimensional finite differences modeling software FLAC 3D (Fast Lagrangian analysis of continua in 3 dimensions). The results show that the mass ratios change significantly the (SSSI) effects on the superstructure acceleration and the piles internal forces. Importantly it is demonstrated that the adverse effects of mass ratios are more pronounced for the mass ratios of (R= 1.1, and 1.2) which incite increase in the bending moment, shear force and the superstructure acceleration by (up to 237.8 %, 291.4 %, and 70.33% respectively). Contrarily, the bending moment, shear force and the superstructure acceleration decrease by (up to 72 %, 82.14 %, and 81.13 % respectively) for mass ratio of (R= 3). This suggests that careful arrangement of adjacent structures with different masses could be used efficiently to control the (SSSI) effects.

Keywords

SSSI, different superstructure masses, height ratios, dissimilar adjacent bridges, nonlinear, seismic, three-dimensional.