SEISMIC BEHAVIOR OF SOIL-STEEL COMPOSITE BRIDGES

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Soil-steel composite bridge is a structure which is comprised of corrugated structural steel plates and engineered soil, designed and constructed to induce a beneficial interaction of the two materials. The corrugated plates are assembled on site in circular, elliptical or arch shapes and backfilled with granular soil. Due to their quick construction and low cost, they have become an attractive alternative to conventional bridges. Relatively large span bridges, up to 20 metres, have been constructed in recent years. Picture of a soil-steel bridge is shown in Figure 1.

Figure 1. Picture of a Soil-Steel Bridge (Source:www.armtec.com)

In spite of being inexpensive and relatively easy to construct, soil-steel bridges are quite difficult to analyse through mathematical models. Despite their being in existence for several decades, soil-steel bridges are usually designed by reliance upon empirical knowledge, supported by rudimentary analyses which are based upon oversimplifying assumption. The structural design is concerned with the design of both the soil and metallic shell and does implicitly take account of the composite nature of the soil and metallic shell.

Several experimental and analytical studies have been carried out to assess the behaviour of soil-steel bridges under normal operational loads. But there is no comprehensive study on seismic behaviour of such bridges. As for the effects of loads imposed by earthquakes, Abdel-Sayed(1993) remarked that “it seems reasonable to conclude that the response of an equivalent embankment without a conduit running through it. Accordingly, it is recommended that the same consideration be given to earthquake loading on soil-steel bridges as those that are applied to the earthquake design of embankments.”

In this paper seismic behaviour of a steel-soil arch bridge is evaluated by Finite Element Method. Using the finite element program ABAQUS, a finite element model was set up to analyse the behaviour of the bridge under earthquake loading. Assuming corrugated steel arch bridge is long enough in the longitudinal direction, a 2-D FEA model representing

a unit length of the bridge is used for the analysis. Plane strain elements are used to represent the soil and beam elements to represent the corrugated steel plate. Static push-over analysis is carried out to evaluate the seismic behaviour of the bridge. The results show that failure of the soil-steel composite bridge under lateral loading occurs at relatively low ductility indicating seismic vulnerability of such bridges.

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