CENTRIFUGE MODELLING OF ROCKING BEHAVIOUR OF BRIDGES ON SHALLOW FOUNDATIONS

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ABSTRACT

The capacity, energy dissipation, and self centering characteristics of shallow foundations have potentially important effects on the performance of a soil-foundation-bridge deck system. As the foundation width decreases, the energy dissipated by the foundation increases while permanent settlement and rotation increase and construction costs decrease. Centrifuge tests on rocking of bridge foundations show that square shallow foundations with dimensions significantly smaller than those designed according to current procedures performed well. The rocking foundations displayed excellent ductility, relatively small permanent deformations, and they provide a self-centering mechanism. Furthermore, the moment capacity of rocking foundations can in most cases be accurately predicted. Considering these benefits, rocking foundations should be considered to be a practical tool for reducing demands on structural elements of a bridge and as a potential tool for dissipating energy through plastic deformation of the soil.

Keywords: shallow foundations, bridge, soil-structure interaction, centrifuge, earthquake

INTRODUCTION

A schematic diagram of a rocking bridge bent is shown in Figure 1(a). The important parameters are the masses of the deck and footing, the stiffness of the column, length of the footing (L=B), critical contact length (Lc) which is the length of foundation in contact with the soil when the bearing capacity is mobilized, the height to center of gravity of the deck mass (Heckgdeck), and the ground motion.

Housner (1963) pointed out that structures allowed to rock survived in several earthquakes while more modern structures were severely damaged. Housner (1963) showed that the dynamic characteristics of rocking systems on an elastic half space are much different than those of elastic fixed base systems. In practice there are currently two approaches used by the California Department of Transportation (Caltrans) to characterize rocking of bridge foundations. The first approach, typically used in new construction, allows for no rocking or uplift of the footing. This ensures that the failure mechanism is plastic hinging in the column (Alameddine and Imbsen 2002). Column yielding may be preferred because soil response is considered to be unreliable and column damage may be easily inspected following an earthquake.

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