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Behavior of GRS Abutment Facing under Variable Cycles of Lateral Excitation through Physical Model Tests

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Abstract : Numerous geosynthetic reinforced soil (GRS) abutment failures over the years have been attributed to the loss of strength at the facing-reinforcement interface due to seasonal thermal expansion/contraction of the bridge deck. This causes excessive settlement below the bridge seat, causing bridge bumps along the approach road which reduces the design life of any abutment. Before designers while choosing the type of facing, a broad range of facing configurations are undoubtedly available. Generally speaking, these configurations can be divided into three groups: modular (panels/block), continuous, and full height rigid (FHR). The purpose of the current study is to use 1g physical model tests under serviceable cyclic lateral displacements to experimentally investigate the behaviour of these three facing classifications. To simulate field behaviour, a field instrumented GRS abutment prototype was modeled into a N scaled down 1g physical model (N = 5) with adjustable facing arrangements to represent these three facing classifications. For cyclic lateral displacement (d/H) of top facing at loading rate of 1mm/min, the peak earth pressure coefficient (K) on the facing and vertical settlement of the footing (s/B) at 25, 50, 75 and 100 cycles have been measured. For a constant footing offset of x/H = 0.1, three forms of cyclic displacements have been performed to simulate active condition (CA), passive condition (CP), and active-passive condition (CAP). The findings showed that when reinforcements are integrated into the wall along with presence of gravel gabions i.e. FHR design, a rather substantial earth pressure occurs over the facing. Despite this, the FHR facing's continuous nature works in conjunction with the reinforcements' membrane resilience to reduce footing settlement. On the other hand, the pressure over the wall is released upon lateral excitation by the relative displacement between the panels in modular facing reducing the connection strength at the interface and leading to greater settlements below footing. On the contrary, continuous facing do not exhibit relative displacement along the depth of facing rather fails through rotation about the base, which extends the zone of active failure in the backfill leading to large depressions in the backfill region around the bridge seat. Conservatively, FHR facing shows relatively stable responses under lateral cyclic excitations as compared to modular or continuous type of abutment facing.

Keywords : GRS abutments, 1g physical model, full height rigid, cyclic lateral displacement
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