World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:17, No:08, 2023

Influence of Footing Offset over Stability of Geosynthetic Reinforced Soil Abutments with Variable Facing under Lateral Excitation

Authors : Ashutosh Verma, Satyendra MIttal

Abstract : The loss of strength at the facing-reinforcement interface brought on by the seasonal thermal expansion/contraction of the bridge deck has been responsible for several geosynthetic reinforced soil abutment failures over the years. This results in excessive settlement below the bridge seat, which results in bridge bumps along the approach road and shortens abutment's design life. There are surely a wide variety of facing configurations available to designers when choosing the sort of facade. These layouts can generally be categorised into three groups: continuous, full height rigid (FHR) and modular (panels/block). The current work aims to experimentally explore the behavior of these three facing categories using 1g physical model testing under serviceable cyclic lateral displacements. With configurable facing arrangements to represent these three facing categories, a field instrumented GRS abutment prototype was modelled into a N scaled down 1g physical model (N = 5) to reproduce field behavior. Peak earth pressure coefficient (K) on the facing and vertical settlement of the footing (s/B) for footing offset (x/H) as 0.1, 0.2, 0.3, 0.4 and 0.5 at 100 cycles have been measured for cyclic lateral displacement of top of facing at loading rate of 1mm/min. Three types of cyclic displacements have been carried out to replicate active condition (CA), passive condition (CP), and active-passive condition (CAP) for each footing offset. The results demonstrated that a significant decrease in the earth pressure over the facing occurs when footing offset increases. It is worth noticing that the highest rate of increment in earth pressure and footing settlement were observed for each facing configuration at the nearest footing offset. Interestingly, for the farthest footing offset, similar responses of each facing type were observed, which indicates that the upon reaching a critical offset point presumably beyond the active region in the backfill, the lateral responses become independent of the stresses from the external footing load. Evidently, the footing load complements the stresses developed due to lateral excitation resulting in significant footing settlements for nearer footing offsets. The modular facing proved inefficient in resisting footing settlement due to significant buckling along the depth of facing. Instead of relative displacement along the depth of facing, continuous facing rotates around the base when it fails, especially for nearer footing offset causing significant depressions in the backfill area surrounding the footing. FHR facing, on the other hand, have been successful in confining the stresses in the soil domain itself reducing the footing settlement. It may be suitably concluded that increasing the footing offset may render stability to the GRS abutment with any facing configuration even for higher cycles of excitation.

Keywords : GRS abutments, 1g physical model, footing offset, cyclic lateral displacement
Conference Title : ICERSRW 2023 : International Conference on Earth Retention Systems and Retaining Walls
Conference Location : Moscow, Russia
Conference Dates : August 24-25, 2023