DESIGN OF BRIDGING LAYERS IN GEOSYNTHETIC-REINFORCED COLUMN-SUPPORTED EMBANKMENTS

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ABSTRACT

Column-supported geosynthetic-reinforced embankments have great potential for application in soft ground conditions when there is a need to accelerate construction and/or protect adjacent facilities from the settlement that would otherwise be induced by the new embankment load. The columns in column-supported embankments can be driven piles, vibro-concrete columns, deep-mixing-method columns, stone columns, or any other suitable type of column. A bridging layer consisting of several feet of sand or sand and gravel is also used to help transfer the embankment load to the columns. Geosynthetic reinforcement is often employed in bridging layers to enhance load transfer to the columns and increase the spacing between columns. Several methods have been developed to calculate the load on the geosynthetic reinforcement, but the calculated loads differ by over an order of magnitude in some cases, and there is not agreement on which method is correct.

In this research, a new method was developed for calculating the load on the geosynthetic reinforcement. The new method employs one of the existing mechanistically-based approaches, and combines it with consideration of the stiffnesses of the embankment, geosynthetic, column, and subgrade soil. The new method was verified against the results of a large numerical parameter study, for which the numerical procedures themselves were verified against closed-form solutions for membranes, pilot-scale experiments, and instrumented field case histories.

The results of the numerical analyses and the new calculation procedure indicate that the net vertical load on the portion of the geosynthetic reinforcement between columns increases with

increasing clear spacing between columns and increasing geosynthetic stiffness. The net vertical load on the geosynthetic decreases with increasing stiffness and strength of the foundation and embankment soils and with increasing elevation of the geosynthetic above the top of the columns or pile caps. A key finding of the research is that, if the subgrade support is good, geosynthetic reinforcement does not have a significant effect on system performance.

The new calculation procedure is implemented in an easy-to-use spreadsheet, and recommendations for designing geosynthetic-reinforced bridging layers are provided.

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