

ABSTRACT

When an embankment is to be constructed over ground that is too soft or compressible to adequately support the embankment, columns of strong material can be placed in the soft ground to provide the necessary support by transferring the embankment load to a firm stratum. This technology is known as column-supported embankments (CSEs). A geosynthetic-reinforced load transfer platform (LTP) or bridging layer may be constructed immediately above the columns to help transfer the load from the embankment to the columns. There are two principal reasons to use CSEs: 1) accelerated construction compared to more conventional construction methods such as prefabricated vertical drains (PVDs) or staged construction, and 2) protection of adjacent facilities from distress, such as settlement of existing pavements when a roadway is being widened. One of the most significant obstacles limiting the use of CSEs is the lack of a standard design procedure which has been properly validated.

This report and the testing described herein were undertaken to help resolve some of the uncertainty regarding CSE design procedures in light of the advantages of the CSE technology and potential for significant contributions to achieve the objectives of the Strategic Highway Research Program, which include accelerated construction and long-lived facilities. Twelve design/analysis procedures are described in this report, and ratings are assigned based on information available in the literature.

A test facility was constructed and the facility, instrumentation, materials, equipment, and test procedures are described. A total of 5 CSE tests were conducted with 2 ft diameter columns in a square array. The first test had a column center-to-center spacing of 10 ft and the remaining four tests had center-to-center spacings of 6 ft. The Adapted Terzaghi Method of determining the vertical stress on the geosynthetic reinforcement and the Parabolic Method of determining the tension in the geosynthetic reinforcement provide the best agreement with the test results. The tests also illustrate the importance of soft soil support in CSE performance and behavior.

A generalized formulation of the Adapted Terzaghi Method for any column/unit cell geometry and two layers of embankment fill is presented, and two new formulations of the Parabolic Method for triangular arrangements are described. A recommended design procedure is presented which includes use of the GeogridBridge Excel workbook described by Filz and Smith (2006, 2007), which was adapted for both square and triangular column arrangements. GeogridBridge uses the Adapted Terzaghi Method and the Parabolic Method in a load-displacement compatibility design approach. For completeness, recommended quality control and quality assurance procedures are also provided, and a new guide specification is presented.