MSC:

Finite Element Analysis of Three Dimensional Geogrid Mattress

Abstract

The geocell foundation mattress created from high tensile strength polymer grid reinforcement filled with granular material, provides a rigid reinforced layer permitting the maximum bearing capacity of the soft foundation soil to be mobilized, and reducing the overall settlement and also reducing differential settlement. The mattress contains and confines the soil within its pockets. It intercepts the potential failure planes because of its rigidity and forces them to pass vertically and deeper into layers of foundation soil, thereby increasing the bearing capacity of the soil.
A three-dimensional finite element model was developed to simulate the geocell mattress using the finite element package, ABAQUS. The three dimensional finite element simulation of geocell reinforcement requires the generation of membrane type element in a crisscross manner to model geocell walls which is cumbersome but it is the best way to study numerically the effect of; pattern of geocell, aspect ratio, the addition of basal planer reinforcement, and the modulus of tensile stiffness of the geogrid used to fabricate geocell mattress. Verification for the theoretical solution by the numerical results was also developed

PHD:

THE EFFECT OF WALL AND BACKFILL SOIL DETERIORATIONON CORRUGATED METAL CULVERT STABILITY

Abstract

Ministries and departments of transportation are working to undertake assessments of deteriorated
metal culverts. To assist with these assessments by developing rational methods of classifying culverts, to select those requiring replacement or repair, the current thesis studied the effects of
metal corrosion and backfill erosion on culvert stability. Finite element calculations were used to
explain how stability is jeopardized by two forms of deterioration, both material failure (yield in
the steel) and geometrical nonlinearity (bucking failure). The stability assessments are presented
for structures designed using limit states design procedures in the Canadian Highway Bridge Design Code and the LRFD Bridge Design Code of the American Association of State Highway
and Transportation Officials.
It was found that yield in culverts in intact ground is proportional to plate thickness (thrust and
moment are not affected). Buckling strength changes as corrosion occurs, but does not become
critical in structures supported by good quality backfill (without erosion). Surprisingly, thrusts decrease when erosion develops adjacent to the culvert, and this implies that factor of safety against yield is increased. However, substantial decreases in buckling strength occur, and elastic
instability can then become the critical performance limit after erosion.

Three dimensional finite element analysis indicates that local buckling can develop before global
buckling, for new structures featuring thin plates, or for thicker structures after corrosion. This
form of elastic instability may not be safely estimated using current culvert buckling equations
which consider global buckling.
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Local buckling results were not effectively estimated using the Bryn‟s equation (the conventional
method used for stiffened plate structures); therefore a preliminary design equation for assessment of local buckling is provided.
After verifying the results obtained from this thesis with physical experiments, these findings can
provide practitioners with useful evaluation tools for a quantitative assessment to the stability of
buried culverts subjected to these two different kinds of deterioration (corrosion and erosion) in
order to augment engineering experience or judgment, which is the primary tool currently being
used. Moreover, the current study helps future experimental and numerical studies by investigating various significant deterioration scenarios, and the impacts of these scenarios

3-Three Dimensional Finite Element Analyses of the Geocell Mattress Reinforcement System

ABSTRACT

The geocell foundation mattress is a self contained reinforcing system, assembled from high tensile strength geogrid reinforcement filled with granular material. It provides a rigid reinforced layer permitting the maximum bearing capacity of the soft foundation soil to be mobilized, and reducing the overall settlement and differential settlement.

A three-dimensional finite element model was developed to simulate the geocell mattress reinforcement system using the finite element package, ABAQUS. The developed model was used to quantify the improving effect of the geocell mattress and to study the effect of the different parameters affecting the behavior of the system. Comparison between the results of the 3-D finite element analyses and the available analytical solution was also carried out to investigate the accuracy and applicability of the analytical solution.

Keywords: Soil reinforcement; Geosynthetics; Geocell; Geogrid; Soft clay; Finite element.