Kansas Department of Transportation

TECHNICAL SUMMARY

Pullout Resistance of Mechanically Stabilized Earth Wall Steel Strip Reinforcement in Uniform Aggregate

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Introduction

A wide range of reinforcement-backfill combinations have been used in mechanically stabilized earth (MSE) walls. Steel strips are one type of reinforcement used to stabilize aggregate backfill through anchorage. In the current MSE wall design, pullout capacity of steel strips is evaluated to ensure internal stability of the reinforced mass. The pullout resistance of reinforcement is expressed in terms of pullout resistance factor that measures the reinforcement-backfill interaction. This pullout resistance factor is commonly determined by performing pullout tests.

AASHTO (2012) *LRFD Bridge Design Specifications* provides default values of pullout resistance factor, F*, for strip reinforcement embedded in backfill material with a uniformity coefficient of $C_u \geq 4$, where the uniformity coefficient is defined as the ratio of the particle size at 60% finer to that at 10% finer. However, for backfill with a uniformity coefficient of $C_u < 4$, AASHTO recommends project-specific pullout tests. This AASHTO requirement has disqualified a large amount of aggregates produced in Kansas quarries, or made them difficult and/or costly to be used in MSE wall construction. To address this problem, an experimental study was undertaken in the Geotechnical Engineering Laboratory at The University of Kansas to examine the effect of aggregate uniformity on pullout resistance of steel strips when the uniformity coefficient of aggregate is $C_u < 4$.

Project Description

Eighteen pullout tests were carried out on ribbed steel strip reinforcements embedded in six aggregate backfills with uniformity coefficients ranging from 1.4 to 14. The pullout resistance of each reinforcement-backfill combination was investigated under three normal stresses to simulate reinforcements placed at different depths of fill. Each test sample was prepared in a consistent way to minimize variations. One of the important influence factors was degree of compaction.

Project Results

The test results demonstrated that the overall trend for all types of aggregates was similar. The uniform aggregates generally behaved the same way as the well-graded aggregates in terms of pullout resistance. The effect of aggregate uniformity was more obvious in the tests under a lower normal stress than under a higher normal stress. When the normal stress was at 10 psi, there was no obvious effect of aggregate uniformity.

Furthermore, the pullout resistance factors obtained from this study were compared with the default F* values for ribbed strip reinforcement provided by AASHTO (2012). The comparison shows that the pullout resistance factor for ribbed steel strips decreased with depth in the same way as suggested by AASHTO. However, the F* values recommended by AASHTO are conservative as compared with the test results when aggregate backfills with uniformity coefficients ranging from 1.4 to 14 were used. In other words, the F* values recommended by AASHTO can be used to design MSE walls with ribbed steel strips in aggregate backfills with a uniformity coefficient as low as 1.4.

Project Information

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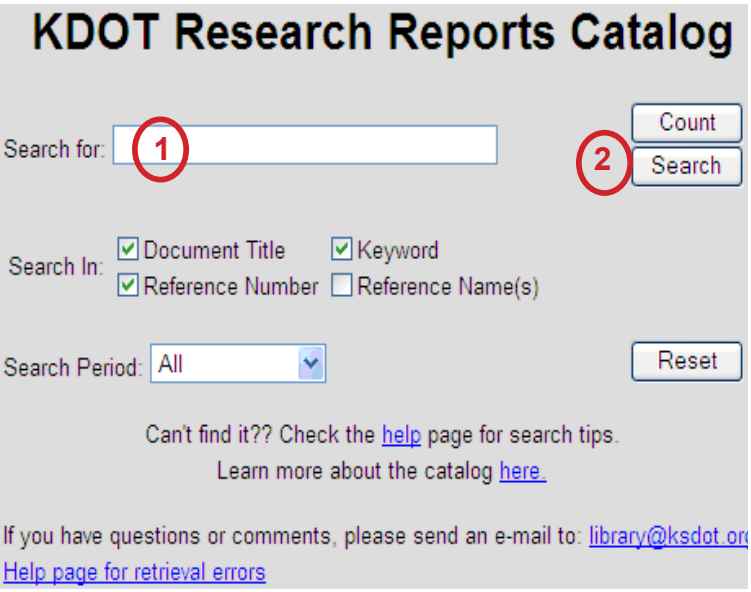

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