Kansas Department of Transportation

TECHNICAL SUMMARY

Grouting Effects on Performance of Sliplined Steel Pipes

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Sliplining Liner Installation

Introduction

Culverts and pipes installed under roadways several decades ago are reaching the end of their service life. Excavation and replacement of these buried structures will cause disruption to their service and require significant funding. Trenchless methods (e.g., sliplining) have been increasingly used to rehabilitate deteriorated buried structures (e.g., corroded steel pipes). Sliplining involves placement of a new pipe liner inside an existing deteriorated pipe and filling of grout between their space. The objective of this study was to evaluate the effect of sliplining on the behavior of corrugated steel pipes with different degrees of corrosion under loading.

Project Description

In this study, parallel-plate loading tests were carried out to evaluate the effect of sliplining on the behavior of corrugated steel pipes with different degrees of corrosion (0%, 50%, and 90%) in air. The corrosion in each steel pipe was simulated by cutting out steel segments along the invert of the pipe. A low-strength, normal density grout was used to fill the space between the steel pipe and the liner. The unlined and sliplined pipes were tested for their load-carrying capacities, stiffness, vertical and horizontal diameter changes, and average strains and curvatures.

This study investigated the effect of sliplining on the performance of a highly corroded corrugated steel pipe. An existing pipe placed under an asphalt pavement was investigated. A low-viscosity grout was used to fill the space between the steel pipe and the liner. A series of truck loading and plate loading tests were conducted before and after sliplining of the steel pipe to determine: (1) load-carrying behavior and stiffness; (2) vertical and horizontal diameter changes; (3) average strain and curvature of pipes; and (4) settlement of the pavement surface. Moreover, deformations, strains, and curvatures around the circumference of the liner were monitored during sliplining and service time.

During the experimental model study, six footing loading tests were conducted on the unlined and sliplined buried steel corrugated pipes with different degrees of corrosion in soil. The reduced-scale models were constructed in a test box under a plane-strain condition and tested under static footing loads. A low-viscosity grout was used to fill the space between the steel pipe and the liner. After the footing loading tests were conducted, the sliplined steel pipes were exhumed from the box. Then, a series of parallel plate loading tests was carried out on the exhumed rehabilitated pipes using a universal testing machine.

Project Results

The test results show that prior to sliplining, the steel pipe with 90% cutout behaved stiffer than that with 50% cutout at a higher applied load. After sliplining, however, the steel pipe with 50% cutout had higher stiffness than the pipe with 90% cutout. Sliplining increased the load-carrying capacity and stiffness of the pipe. The location of the liner relative to the existing pipe wall had a minor effect on the behavior of the sliplined steel pipes.

The sliplined corroded steel pipe had considerably higher stiffness than the corroded pipe. For the truck loading test conducted at 28 days after grouting, the sliplining reduced the vertical diameter changes of the corroded steel pipe by about 81%. For the field plate loading tests, the sliplining for 7 and 28 days reduced the settlement of the pavement by 6% and 30%, respectively, as compared with that before sliplining.

The results from the six footing loading tests show that the measured earth pressures induced by footing loading above the crown of the unlined pipe with 0% cutout were higher than those with 50% and 90% cutout. However, the degree of corrosion did not have significant effect on the earth pressures induced by footing loading above the crown of the sliplined pipes.

Project Information

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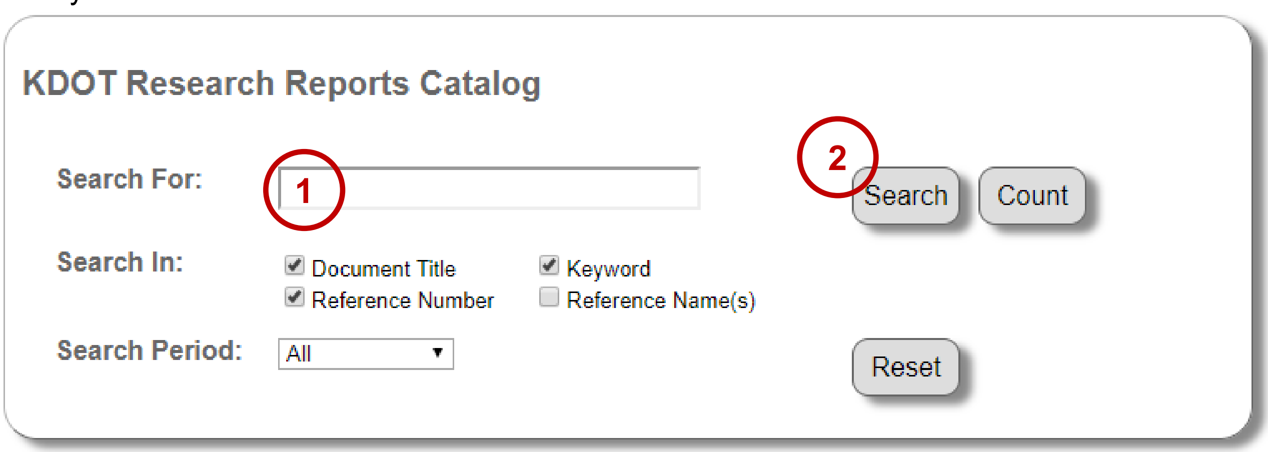

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