Kansas Department of Transportation

TECHNICAL SUMMARY

# Composite Action in Prestressed NU I-Girder Bridge Deck Systems Constructed with Bond Breakers to Facilitate Deck Removal

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## Introduction

Results are reported from tests of small-scale push-off and large-scale composite NU I-girder specimens conducted to establish an interface connection detail that (1) Facilitates in-situ removal of the bridge deck without damaging prestressed girders, and (2) Maintains composite action between the prestressed girder and reinforced concrete deck throughout the service-life of the structure.

## Project Description

Sixteen small-scale push-off tests were conducted to investigate the influence of surface preparation, bond breakers (epoxy and roofing felt), and interface reinforcement properties (yield strength, reinforcement amount, and means of anchorage) on horizontal shear transfer between precast and cast-in-place concrete surfaces. Based on the push-off test results, a connection detail was proposed that consists of roughening the top flange of the girder directly over the girder web and debonding the remainder of the interface using No. 30 ASTM D4869/D4869M-16a Type I organic roofing felt. Three full-scale composite NU35 girders, designed and fabricated using the proposed connection detail and two control connection details, were then subjected to a series of tests. First, decks were cast and then removed to quantify the extent to which the proposed connection detail reduced the effort to remove the deck and to document the types and extent of damage caused to the girders by the process. After replacing the decks, the composite girders were subjected to $2 \times 10^6$ cycles of simulated traffic load and then loaded monotonically to failure.

## Project Results

The proposed connection (partially roughened/partially debonded with a roofing felt bond breaker) is a viable option for use in practice; its use led to a 2/3 reduction in the effort required to remove the deck over the girder and protected the girder from all non-saw-related damage while also effectively sustaining composite action through $2\times10^6$ cycles of simulated traffic load after deck replacement. The proposed connection can be conservatively designed by neglecting the debonded area when calculating interface shear strength. Other test results showed that surface preparation has a large influence on the stiffness, strength at cracking, and peak strength of a horizontal shear connection; each was greatest for specimens with a fully roughened surface followed by the partially roughened surface, troweled surface, and debonded surface. Increasing the amount of interface shear reinforcement increases the initial stiffness, shear strength at cracking, and peak and post-peak strength, and does so more effectively than a similar increase in reinforcement yield strength. Casting and removal of bridge decks without bond breakers does alter the top surface of bridge girders, but the surface can be returned to a qualitatively roughened surface with reasonable effort and care. Despite the changes to the top girder surface caused by deck removal, composite action was developed across the interface and remained stable through $2\times10^6$ cycles of loading.

## Project Information

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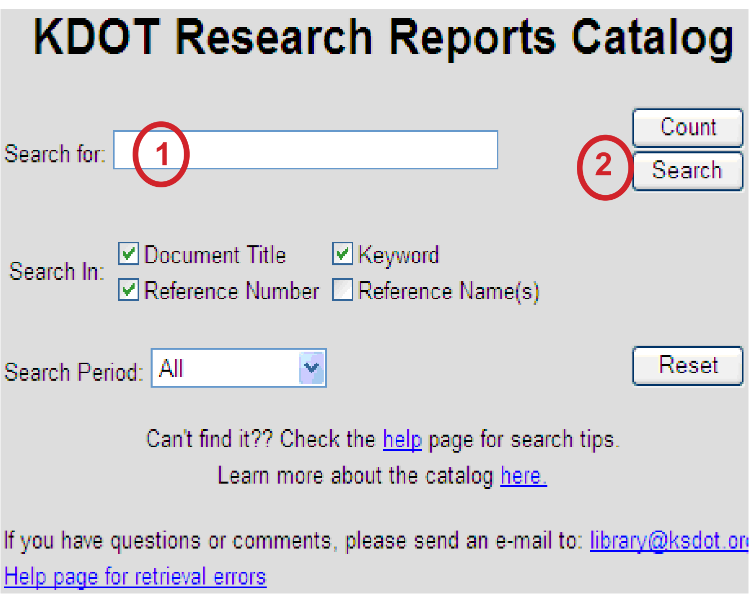


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