Kansas Department of Transportation

TECHNICAL SUMMARY

Rational Load Rating of Deck-Girder Bridges with Girder End Shear Cracks in Reverse Orientation

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Introduction

Reverse diagonal shear cracking at reinforced concrete girder supports affects many low-volume bridges built in the early 1900s in Kansas. This phenomenon, however, is not addressed in the American Association of State Highway and Transportation Officials (AASHTO, 2002) Standard Specifications for Highway Bridges or American Concrete Institute specifications. This study investigates causes of this cracking and develops Bridge Rating of Inclined Damage at Girder Ends (BRIDGE), an Excel-based software, to determine load rating of a user-specified bridge with reverse diagonal shear cracking at girder supports.

Corroded Steel Rockers Limiting the Ability of the Rockers to Rotate and Prevent the Girders from Rotating at the Supports as Designed

Project Description

A user interface creates a grillage model of an existing bridge and places various rating trucks on the bridge. Equivalent flexibility analysis distributes truck live loads within deck panels to surrounding girders and diaphragms. Stiffness matrices are utilized to find nodal displacements and reactions at the girder supports caused by truck live loads and bridge dead load. These reactions are checked against RISA software models to test the accuracy of the stiffness matrix application. ABAQUS FE models and Mohr's circle stress distribution determine driving and clamping forces on the crack due to resolution of dead and live load reactions and friction force generated between the concrete girder and rusty steel bearing pad along the shear crack orientation. In addition to the simplified modified compression field theory, these clamping and driving forces are used to determine the shear capacity of each girder at the reverse cracks. A modified version of Equation 6B.4.1 from the Manual for Bridge Evaluation (AASHTO, 2011) is used to find operating and inventory rating factors (RFs) for the bridge.

Project Results

The BRIDGE program, used to load rate Bridge No. 54-104-15.45, yielded reasonable RFs for various trucks and reduced girder widths. The operating RFs were consistently above 1 and the inventory RFs were below 1, indicating that the decision to load post this bridge is based on the engineer's judgment.

Project Information

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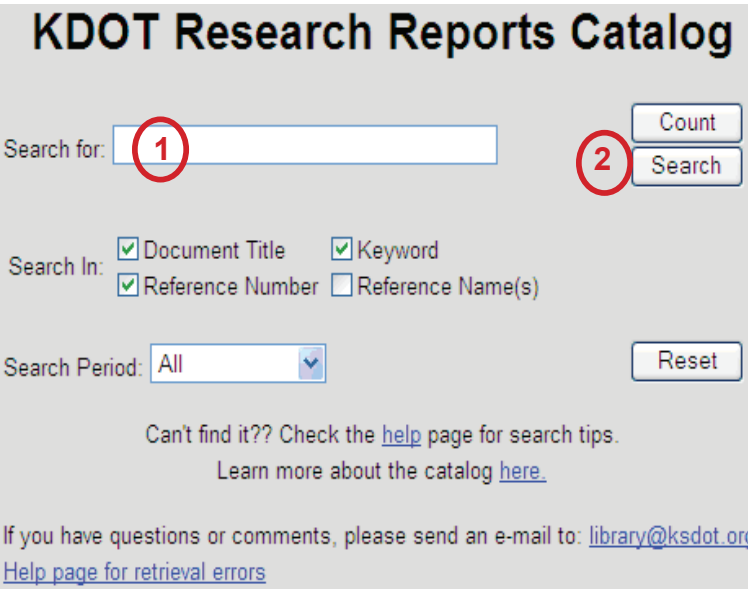

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