Kansas Department of Transportation

TECHNICAL SUMMARY

Kansas Department of Transportation Column Expert: Ultimate Shear Capacity of Circular Columns Using the Simplified Modified Compression Field Theory

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Introduction

Even though the behavior of concrete elements subjected to shear force has been studied for many years, researchers do not have a full agreement on concrete shear resistance. This is mainly because of the many different mechanisms that affect the shear transfer process of concrete, such as aggregate interlock, interface shear transfer across cracks, shear transfer in compression zone, dowel action, and residual tensile stresses normal to cracks. However, researchers agree that aggregate interlock and shear transfer in compression zone are the key components to understanding concrete behavior under full field shear, flexural, and axial stresses.

The importance of the analysis of circular columns to accurately predict their ultimate confined capacity under shear-flexure-axial force interaction domain is recognized in light of the extreme load event imposed by the current American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Construction Specifications (AASHTO, 2014).

Project Description

In this study, various procedures for computing shear strength are reviewed. Then, the current procedure adopted by AASHTO LRFD specifications, based on the Simplified Modified Compression Field Theory, is evaluated for non-prestressed circular concrete bridge piers. This evaluation is benchmarked against experimental data available in the literature, and against Response 2000 freeware program that depicts interaction diagrams based on AASHTO (1999) LRFD requirements. Differences in results are discussed and future improvements are proposed.

Project Results

A formulation conforming to AASHTO (2014) LRFD Bridge Construction Specifications is developed to predict the axial force-shear-moment interaction diagrams of circular confined concrete bridge pier sections. Comparisons with a large database of experiments indicate the accuracy of the resulting diagrams. A further step was taken to improve the accuracy of the calculations.

Transverse steel area, spacing, cross section diameter, and applied axial force are the main keys to analyze and increase the shear capacity of the cross section. Treating the cracked concrete as a new different material proved to be a beneficial approach to predict the capacities and behaviors of sections.

Project Information

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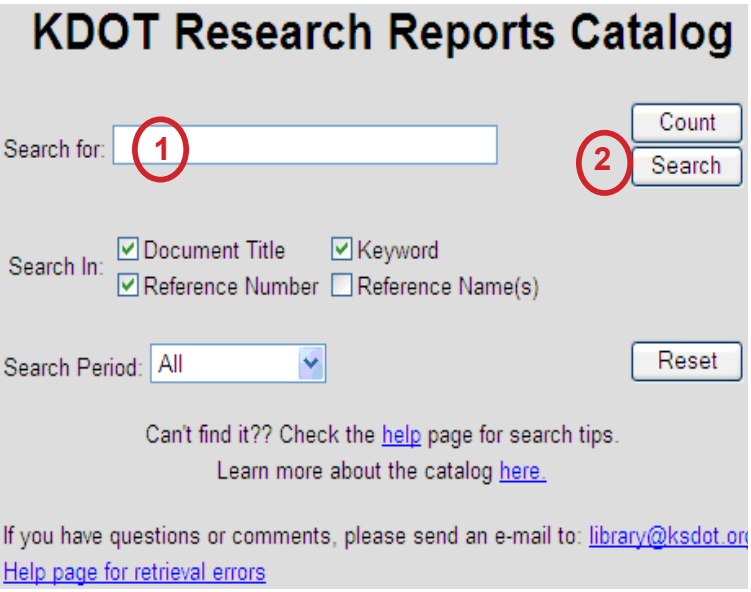

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