



Evaluating the Time-Dependent and Bond Characteristics of Lightweight Concrete Mixes for Kansas Prestressed Concrete Bridges

Report Number: K-TRAN: KSU-08-2

By: Joseph R. Holste
Robert J. Peterman, Ph.D., P.E.
Asad Esmaily, Ph.D., P.E.
Kansas State University Transportation Center

Publication Date: July 2011

Introduction

The majority of the bridges in Kansas are in rural areas. Many of these are becoming structurally deficient, and are in need of replacement. Due to the location of these bridges, cost of transporting prestressed girders to these areas often makes use of cast-in-place bridges more economical. Use of lightweight aggregate in these bridge girders would reduce the total weight and could allow multiple girders to be shipped on one semi-truck. This would reduce transportation costs and allow the more economical prestressed girders to be used in rural areas. Lightweight prestressed girders could be put in place using a lower capacity crane due to the lower self-weight of the beam. The construction process would be quicker without the need of form work associated with cast-in-place girders. The lighter self-weight would also increase allowable live loads the bridges would be able to carry.

The mass production of lightweight concrete bridge members has yet to take hold in the state of Kansas. Various tests have been done on lightweight concrete mixes in the Kansas State University structural testing laboratory. These tests included large block pullout tests, transfer length tests, and flexural beam tests to determine development lengths. Testing on beams cast at a precast/prestress plant would be needed as the next step in development and use of lightweight concrete mixes.

Self-consolidating concrete (SCC) has become a more widely used product. It is defined as a highly workable concrete that can flow through densely reinforced or complex structural elements under its own weight, and adequately fill voids without segregation or excessive bleeding, without the need for vibration. Its properties decrease the need of vibration during casting and create a better surface finish without the presence of “bugholes.”

T
E
C
H
N
I
C
A
L

S
U
M
M
A
R
Y

Project Objective

The lightweight mix developed by Perkins was used to cast creep and shrinkage prisms and beams at a precast plant. The beams cast had properties and dimensions based on research done by Larson. The beams were tested and monitored to determine if the lightweight concrete mix could be mass produced and keep the same properties as the laboratory mix.

Project Description

Twelve flexure beams were cast and tested to examine development lengths of the lightweight mixes used in this project. The beams included four T-beams, four rectangular beams with 100% development lengths (L_d), and four rectangular beams with 80% L_d . Cross sections of the beams were based on research beams that Larson had tested in determining properties of normal-weight SCC concrete mixes (Larson 2006). Results from these beams were compared to ACI code equations.

Project Results

This study found the compressive strengths of the plant-cast lightweight concrete mixes varied greatly from similar mixes in laboratory testing. Low concrete strengths caused the prestress losses to be greater than the predicted code values. Flexural beam testing revealed that several of the pretensioned beams failed suddenly due to strand slip, even though this was not the predicted failure mode.

Report Information

For technical information on this report, please contact: Robert J. Peterman, Ph.D., P.E., Kansas State University Transportation Center, at bob@ksu.edu or (785) 532-7612.

Directions for Downloading the Full Report



The screenshot shows the 'KDOT Research Reports Catalog' search page. It features a search box with a 'Count' button to its right. Below the search box are two buttons: 'Search' and 'Reset'. The 'Search In:' section has four checkboxes: 'Document Title' (checked), 'Keyword' (checked), 'Reference Number' (checked), and 'Reference Name(s)' (unchecked). The 'Search Period:' dropdown menu is set to 'All'. At the bottom, there is a link to a help page for search tips and a link to a help page for retrieval errors.

To download the full report:

<http://www.ksdot.org/burmatrres/kdotlib2.asp>

1. Enter KSU-08-2 in the search box.
2. Click the Search button to the right of the search box.
3. You may have to scroll to find the specific report.
4. To download the report, click on the title of the report to open the PDF file and save it to your hard drive.

If you have any questions, please email us at library@ksdot.org

KDOT RESEARCH