Ultra-High Performance Concrete for Connections of Precast, Prestressed Girders Made Continuous for Live Load

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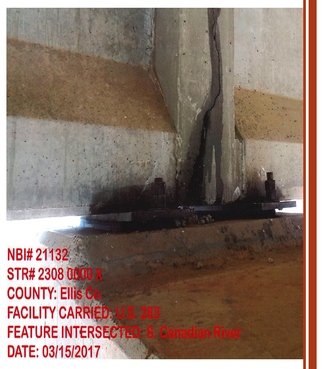
Abstract

Continuity joints were employed in bridges with precast, prestressed girders to increase the overall ability of bridges to distribute live loads through each girder by making two simple spans continuous. However, if the continuity connection cracks, continuity can be lost, resulting in simply supported conditions and the joint reinforcement is subject to potential corrosion damage. A potential solution to prevent cracking in the continuity joint is using Ultra-High Performance Concrete (UHPC). Previous research done on continuity joints has produced conflicting results; some research found that the continuity joint provides no structural benefit, and later studies show that continuity joints do have some structural impact on the bridge and increase the overall structural integrity of the bridge. UHPC has been studied to determine how effective the material is in a number of bridge applications. Six beam specimens consisting of two precast girders made continuous with a UHPC joint will be constructed and tested. Three of the six specimens will focus on newly constructed continuity joint detailing for new bridge construction and follow the AASHTO LRFD 2014 Specifications for design. The three remaining specimens will focus on retrofit continuity joint detailing for existing bridges. Both designs will consist of the same reinforcement ratio as newly constructed continuity joints. Each specimen will be tested using a static point load at mid-span of each girder in order to produce the maximum negative moment in the continuity joint. The specimens will be loaded to failure, and the experimental capacity and failure mode examined to determine whether the UHPC joint produced an adequate connection.

Background and Goals

- **UHPC is a relatively recent advancement in cementitious composite materials with mechanical and durability properties which far exceed those of conventional concrete.**
- **UHPC has been successfully used in a number of applications related to connection of precast concrete bridge components due to its superior bond development characteristics with steel reinforcement, ease of placement, and long-term durability compared to conventional concrete.**



Cracked Continuity Joint, Photo Courtesy of ODOT

- **This experiment will evaluate Ductal® in continuity joints between half-scale AASHTO Type II prestressing girders.**

Methodology

To investigate the use of UHPC in continuity joints between prestressed girders, three building phases had to be done to construct a total of six specimens.

Phase 1: Beam Construction

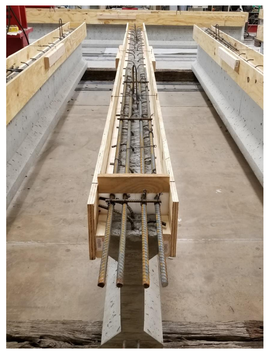
Preparing the Prestressing Bed for Formwork at Fears Lab

Prestressing Strand/Shear Reinforcement Placement

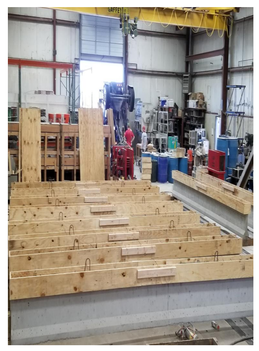
Detensioning the Strands after 24 Hours to Complete the Beam Construction

Phase 2: Slab Construction

Retrofit Negative Moment Reinforcement for Continuity Joint



New Construction Negative Moment Reinforcement for Continuity Joint



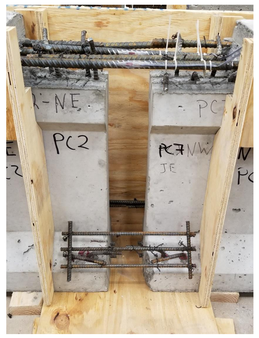
Prestressed Beams Spread Apart for Casting Concrete

Finishing the Concrete Decks

Finished Concrete Deck on Top of Prestressed Beam

Phase 3: Joint Construction

New Construction Continuity Joint with Positive and Negative Moment Reinforcement (Above) and Finished UHPC Joint (Below)



Retrofit Construction Continuity Joint with Positive and Negative Moment Reinforcement (Above) and Finished UHPC Joint (Below)

Future Work

- **Finish constructing testing apparatus**
- **Attach sensors to specimens**
- **Test each specimen using two load points at center span for each beam in one specimen to create the maximum negative moment**

Load Frames to be used for Testing

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