BRIDGE SESSIONS

Innovative Bridge Applications
AND
Physical Testing for Bridge Load Rating

ICEA Midyear Meeting
July 10, 2003
Session Speakers

- Justin Doornink, Ph.D. Student
- Travis Konda, Ph.D. Student
- Van Robbins, M.S. Student
- J. S. Ingersoll, WHKS & Co.
- Terry Wipf, ISU
- F. Wayne Klaiber, ISU
- Brent Phares, CTRE
- Scott Neubauer, Iowa DOT
Development of Abutment Design Standards for Local Bridge Designs

F. W. Klaiber, D. J. White, T. J. Wipf, B. M. Phares, V. W. Robbins

Bridge Engineering Center
Iowa State University

ICEA Midyear Meeting
July 10, 2003
Primary Objectives

- Develop standard abutment designs that complement previously developed bridge superstructures
- Creation of design tools (design aids, generic CAD drawings, etc.)
Project Tasks

- Collection of existing information
- Identify practical abutments
- Develop abutment designs
- Final Report
Progress

- Literature and information search
- Questionnaire sent to Iowa County engineers
- Formation of Project Advisory Committee
- Preliminary design calculations
- Creation of standard sheet layout
Questionnaire Results

- 35 of 99 counties responded
- 7 counties had a standard abutment of some type
- 21 counties always perform some type of subsurface investigation
- 11 counties specified they see value in the development of standard abutments
Substructure Types

- Concrete cap with H-pile abutment
- Bearing sheet pile abutment
- Timber pile and backwall
- H-pile abutment with sheet pile backwall
Innovative Substructure Designs For Consideration

- Geosynthetic-Reinforced Soil (GRS) abutment
- Rammed Aggregate Pier (Geopier™) abutment
- Mini-Pile abutment
- Gabion abutment
H-Pile Abutment with Precast Panel Backwall
Timber Abutment
H-Pile Abutment with Sheet Pile Backwall
Field and Laboratory Evaluation of Precast Concrete Bridges

J.S. Ingersoll
WHKS & Co.

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Bridge Engineering Center
Iowa State University
Panel Details

- Grouted Keyway
- Transverse Deck Reinforcement
- Longitudinal Deck Reinforcement
- Stirrup
- 1 in. Dia. Galvanized Bolts
Project Overview

Survey
- Iowa County Engineers

Field Testing
- Service Load Tested Four Deteriorated Bridges

Laboratory Testing
- Ultimate Strength Tested Individual Panels
- Tested Various Joint Configurations on Four Panel Bridge
- Ultimate Strength Tested Laboratory Bridge
- Tested a Strengthening Retrofit

Analytical Analysis
- Finite Element Bridge Model
Reinforcement Details

- 15’-6” (#8)
- 19’-6” (#7)
- 25’-0”
- 1’-3”
- 0’-5”
- 3’-1 7/8”
Deterioration
Deterioration
Deterioration

Weight Limits
- 23T
- 35T
- 42T
Field Testing
Field Testing
Field Testing
Field Testing
Results

Field Testing

- Performance Not Affected By Deterioration
- Live Load Deflections More Favorable than AASHTO Design Values
- Performance Affected by the Shear Connectors
- Transverse Load Distribution More Favorable than AASHTO Design Values (With Shear Connectors)
- Transverse Load Distribution Was Equal To or Less Favorable than AASHTO Design Values (Without Shear Connectors)
Ultimate Strength Testing
-Individual Panels
Ultimate Strength Testing

-Individual Panels
Ultimate Strength Testing
-Individual Panels

Deflection (in.)

Midspan Moment (ft-kip)

- Butler 1
- Butler 2
- Butler 3
- Butler 4
- HS20
Results

Ultimate Strength Testing of Individual Panels

- Ultimate Strength of 11 of the 12 Panels Exceeded Their Theoretical Strength (Based on design values)

- Ultimate Strength of the Other Panel Was Only Slightly Less Than Its Design Strength

- Hooked Ends on the Primary Longitudinal Reinforcing Ensured Development

- Excessive Deflections Were Observed Prior to Failure
Joint Configuration Testing
Ultimate Strength Testing
-Laboratory Bridge
Ultimate Strength Testing
-Laboratory Bridge
Strengthening Retrofit
Strengthening Retrofit