SHRP2 Project R04

INNOVATIVE BRIDGE DESIGNS FOR RAPID RENEWAL

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Introduction

Many deficient bridges in the US are in need of replacement

Minimizing traffic disruption is a priority

Most of these are routine structures

Need for standardized solutions to deploy successful ABC technologies

Systems that are easy to construct and adaptable to many sites
SHRP2  Project R04

PROJECT GOAL

To develop standardized approaches to designing, constructing, and reusing complete bridge systems that address rapid renewal needs

Phase I – Define ABC Challenges

Phase II – Identify & Refine the Best ABC Technologies

Phases III & IV – Standardize & Deploy ABC
Expected Outcome: The designer, guided by the standard plans, details and the set of ABC design examples will be able to easily complete an ABC design for a routine bridge replacement project.
ABC Standard Plans

GOALS:

• Focus on “workhorse’ bridges
• Complete bridges using prefabricated elements and modular systems
• Contractor could self-perform a lot of the work
• Simple to fabricate on site or in a plant and easy to erect using conventional cranes
• Fast assembly in the field in 1 to 2 weeks
• Durable connections / durable bridges
Span Ranges for Superstructures

• Simple / continuous spans from 40 ft to 130 ft.
• Simple for DL ; Continuous for LL ; No Open Joints
• Plans are grouped in the following span ranges:
  – 40 ft to 70 ft
  – 70 ft to 100 ft
  – 100 ft to 130 ft.
• Spans to 130 ft can usually be transported and erected in one piece at many sites.
• Weight < 200 Kips for erection using conventional cranes commonly used by contractors
• Some ABC standards can be adapted to spans < 40 ft
Modular Superstructure Systems

2 Lane bridge with shoulders shown – customize width for site

Deck Bulb Tees

Double Tees

Composite Steel System
Decked Steel Girder Module
Exterior

- Barrier can be precast
- Barrier load on exterior module
Connections for ABC

- Ultra High Performance Concrete (UHPC) longitudinal & transverse joints between superstructure modules
- Grouted splice couplers in piers replace the typical lap splice
- Self Consolidating Concrete (SCC) pile connections and abutment to wingwall connections
- Grouted cap pockets / grouted ducts for substructure connections (seismic)
- Other rapid set concrete options may be used
Grouted Splice Coupler
UHPC Joints in Bridge Deck

- Allows rapid construction. No post tensioning required
- UHPC joints are typically 6 in wide. Good durability
- Can be reinforced with hairpin bars or straight bars

(Longitudinal Joint. Longitudinal steel not shown)
Erection Concepts for Bridge Replacement Using Cranes

Factors to Consider

- Weight of Module
- Pick Radius
- Crane Set Up Locations
- Ground Access / Barge / Causeway / Work Trestle
- Truck Access for Delivery
ABC Design Examples

• Three ABC design examples for prefabricated systems in the toolkit:
  – Decked Steel Girder
  – Decked Precast Prestressed Girder
  – Precast Pier

• Design Criteria:
  • AASHTO LRFD (5th Edition)
  • Supplemental ABC criteria

The design examples provide step by step guidance on the overall structural design of bridge components for ABC
Using the ABC Toolkit

- Review the ABC Standard Plans and Design Examples
- General Information Sheets Introduce the intent and scope of the ABC standard plans and details -- includes instructions to designers so that all the key ABC issues are addressed
- Engineer of Record (EOR) should perform own ABC design calculations for the site using the examples as a guide
- EOR to customize the standard plans for the site --- span lengths / bridge width / module size / skew / foundations / etc
- Adapt ABC Special Requirements for construction
- EOR to add any aesthetic enhancements as needed or use lightweight concrete to reduce erection weights
SKEWED STRUCTURES:

These clauses are intended to provide guidance on the structural design of skewed bridges. The provisions are based on current design codes and standards and are intended to ensure the safe and economic design of skewed structures. The designer should consult the relevant design codes and standards for guidance on specific details and considerations.

DESIGN SPECIFICATIONS:

The design specifications for skewed structures should be based on the requirements of the client and the local regulations. The specifications should include details of the structural elements, loadings, and materials. The designer should consult the relevant design codes and standards for guidance on specific details and considerations.

REQUIREMENTS FOR UHPC JOINTS:

The requirements for UHPC joints should be based on the specific project requirements and the characteristics of the UHPC material. The designer should consult the relevant design codes and standards for guidance on specific details and considerations.

GEOMETRY CONTROL:

The geometry control of skewed structures should be based on the requirements of the client and the local regulations. The designer should consult the relevant design codes and standards for guidance on specific details and considerations.

CAMBER CONTROL:

The camber control of skewed structures should be based on the requirements of the client and the local regulations. The designer should consult the relevant design codes and standards for guidance on specific details and considerations.

GENERAL INSTALLATION PROCEDURE:

The general installation procedure for skewed structures should be based on the requirements of the client and the local regulations. The designer should consult the relevant design codes and standards for guidance on specific details and considerations.

SAW CUT GROOVE TEXTURE FINISH:

The saw cut groove texture finish should be based on the requirements of the client and the local regulations. The designer should consult the relevant design codes and standards for guidance on specific details and considerations.

GENERAL INFORMATION

The general information section provides an overview of the project, including the project name, location, and purpose. The designer should consult the relevant design codes and standards for guidance on specific details and considerations.
# ABC Design Example

## Organization of Deck Bulb Tee Design Example

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*** Engineer of Record should perform own ABC design ***
Closing

• New generation of ABC systems are economical to construct and designed for durability
• SHRP2 R04 ABC toolkit and training materials will be available to provide guidance to those new to ABC
• ABC costs are coming down with repeated use
• The time for ABC is now