Accelerated Bridge Construction for Local Bridge Systems

Timothy H. Cupples, PE, DBIA
Federal Highway Administration
Maryland Bridge Inventory

Bridge Ownership
- State
- County
- Town
- City
- State Park
- Local Park
- Other State
- Other Local
- Private
- Railroad
- State Toll

Structurally Deficient Bridges
- State
- County
- Town
- City
- State Park
- Local Park
- Other State
- Other Local
- Private
- Railroad
- State Toll
Progress on Reducing Structurally Deficient Bridges

SD Bridges by Year

- County
- State
FHWA Strategic Goals

• National Leadership
  – Advance Innovation

• Program Delivery
  – Streamline Project Delivery
    • Planning
    • Design
    • Construction

• System Performance
  – Improve Performance and Condition
Every Day Counts

- Identify and Deploy Innovation
- Shorten Project Delivery
- Enhance Safety
- Protect Environment
EDC Components

• Shortening Project Delivery Toolkit
• Accelerating Project Delivery Methods
• Accelerating Technology Innovation & Deployment
Accelerating Technology
Innovation & Deployment

• Prefabricated Bridge Elements and Systems

• Geosynthetic Reinforced Soil Integrated Bridge System
PBES Defined

- Structural Components
- Built Offsite or Near-Site
- Reduce Onsite Construction Time
- Reduce Mobility Impacts
Elements vs. Systems

Elements

- Single, Prefab Component
- Deck Panel
- Adjacent Prefab Beams
- Modular Deck/Beam Unit
- Prefab Footing
- Prefab Pier Cap/Column
- Prefab Abutment
Elements vs. Systems

Systems

- Entire Superstructure
- Entire Substructure Unit
- Total Bridge
2012 – PBES Deployment Goals

• 100 Cumulative PBES Bridges
• 25% of Federal Aid Bridges Utilize PBES
PBES Deployment Status
What PBES Elements are DOT’s Selecting?

- Abutment, Wingwalls
- Pier cap, Column and/or Footing
- Full-depth deck panels
- Partial-depth deck panels
- Beams: more efficient shapes

2nd Quarter 2011
GRS-IBS Defined

- **GRS - Geosynthetic Reinforced Soil**
  - An engineered fill of closely spaced (< 12” ) alternating layers of compacted granular fill material and geosynthetic reinforcement

- **IBS - Integrated Bridge System**
  - A fast, cost-effective method of bridge support that blends the roadway into the superstructure using GRS technology
Cut-away of a GRS Mass
Cross-Section of GRS-IBS

- **Beam Seat**
  (Supported Directly on Bearing Bed)

- **Facing Elements**
  (Frictionally Connected – Top Three Courses Pinned and Grouted)

- **Jointless**
  (Continuous Pavement)

- **Integrated Approach**
  (Geotextile Wrapped Layers at Beams to Form Smooth Transition)

- **Bearing Bed Reinforcement**
  (Load Shedding Layers Spaced at ≤ 6 in.)

- **Scour Protection (Rip Rap)**
  (If Crossing a Water Way)

- **GRS Abutment**
  (Reinforcement Spacing ≤ 12 in.)

- **Reinforced Soil Foundation**
  (Encapsulated with Geotextile)
Degree of Composite Behavior

Reinforcement spacing

36”  30”  24”  18”  12”  6”
4.9 ksf
(235 kPa)
6.8 ksf
(326 kPa)
10.3 ksf
(493 kPa)
2012 Deployment Goals

• **December 2012:**
  - 30 bridges have been designed and/or constructed using GRS-IBS on the NHS within 20 states
  - 75 bridges have been designed and/or constructed using GRS-IBS off the NHS
State DOT Deployment

Total of 56 projects in 28 states at some stage of development from conceptual to construction.
FROM: Robert V. Robertson, P. E., State Structures De

COPIES: Brian Blanchard, David Sadler, David O’Hagar, Charles Boyd, Tom Andres, Sam Fallaha, Denr, Jonathan Van Hook, Garry Roula, Peter Lai, Rs, Chris Richter (FHWA), Jeffrey Ger (FHWA), I

SUBJECT: Mandatory Evaluation of Suitability of Geosyn Abutments for Single Span Bridges

**DESIGN REQUIREMENTS**

   A. GRS abutments are a shallow foundation and retaining wall that significantly reduce the construction time and cost of single span bridges and can tolerate a greater degree of differential settlement than CIP walls.
   B. GRS walls and abutments, like MSE walls, are very adaptable to design changes and can be extended to incorporate a greater degree of differential settlement than CIP walls, however, are not appropriate for all sites.

2. Section 3.13.2 of the January 2011 Structures Design Guideline is expanded as follows:

**Mechanically Stabilized Earth (MSE) or Geosynthetic Reinforced Soil (GRS) abutments are acceptable alternatives for deep foundations and are required by Item 5 in subsection 19.1.3B to be considered in the structure type selection report. See Figure 7.4-1 for an illustration of a GRS abutment.** (C1)

- Both single or continuous span bridges where competent foundation is near to surface.
Why Use ABC/PBES/GRS-IBS?

- Save Time
- Save Money
- Reduce Environmental Impacts
- Enhance Safety
- Improve Constructability & Quality
Typical Crossing for Structurally Deficient County Bridge in MD

- Railroad
- Pedestrian
- Highway & RR
- Waterway
- RR & Water
Time Saving Techniques

GRS-IBS
Slide
Heavy Lift
SPMT
Launch
Save Time

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<tr>
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<tr>
<td>4</td>
<td>&lt; 3 months</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 3 months</td>
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- Reduced Apparent Construction Duration
- Reduced Mobility Impacts – Road Users
- Reduced Overall Construction Duration
Detour Length for Structurally Deficient County Bridges in MD

Number of Bridges

Detour Length (5 mile increments; 199 = no detour)
ADT on Structurally Deficient County Bridges in MD

Number of Bridges

ADT

0
1000
2000
3000
4000
5000
6500
7500
9000
11500
15000
17000
20000
21500
28500
41500
Other Time Factors

- Evacuation Route
- School Route
- Emergency Response Route
- Railroad
- Remote Site
- External Deadline
Time Saving Example

• 4 Span, 4 Lane Bridge
• BRAC Imposed External Deadline
• Replaced in 8 Weeks using PBES
• Incentive/Disincentive Clause
• Opened 18 Days ahead of schedule
Save Money

- Total Cost to Agency
  - Construction (Hard Costs)
  - Staff and Consultant (Soft Costs)
  - Utility Relocation
  - Right of Way
  - Rail Road Flagging

- Economic Impact of Construction
  - Work Zone Road User Costs
Money Saving Examples

GRS-IBS: 20% - 60% Substructure Savings

Saved $72K on RR & ROW;
$135K on Structure
Environmental Impacts

- Lower Fuel Consumption
- Reduced CO$_2$ Emissions
- Avoid Environmentally Sensitive Areas
Enhance Worker Safety

• 44% of Bridge Construction Worker Injuries Involve a Vehicle Travelling Through a Work Zone (OSHA Type 1622, 1984-2010)
• 2/3 are Fatal
• 28% of Worker Injuries Involve Construction Vehicles
• **No Work Zone = No Accident**
Lanes on Structure

Lanes on County SD Structures

- 2,000 Fatal Traffic Accidents/Yr in Work Zones (FARS 1999-2008)
- 67% Occur on 2-Lane Roads
Fatal WZ Accidents - Geometry

**Horizontal**

- Straight
- Curved

**Vertical**

- Grade
- Level
- Crest
- Sag
Approach Roadway Alignment

Number of Bridges

Approach Roadway Alignment Condition Rating

0 3 4 5 6 7 8
Safe Solutions

• Site Distance Concerns
• Sag Vertical Curve/Overpass
• 18 months/3 Phase w/ Conventional
• 8 weeks/no traffic w/ PBES

• Bridge over Railroad
• Workers on Ground/out of Traffic/Not over RR
• Safer and reduced Flagging Costs
Constructability/Quality

• Prefabrication
  – Controlled Environment
  – Quality Control

• Room to Operate
  – Work from Ground Level
  – Optimize Equipment Position

• Increased Productivity
  – No restricted work hours
  – No MOT Setup/Take Down
Length of Structurally Deficient MD County Bridges

Number of Bridges

Structure Length – 10 Ft Increments
PBES Resources

- benjamin.beerman@dot.gov
- http://www.fhwa.dot.gov/everydaycounts/
- Presentations
- Webinars
- Details
- Cost Information
- Decision Tools
- Case Studies
GRS-IBS Resources

- daniel.alzamora@dot.gov
- http://www.fhwa.dot.gov/everydaycounts/
- Presentations
- Webinars
- Standard Plans
- Design Guide
- Construction Guide
- Case Studies
THANK YOU!
QUESTIONS?
timothy.cuppies@dot.gov