GEOSYNTHETIC REINFORCED SOIL – INTEGRATED BRIDGE SYSTEM (GRS-IBS)

GRS-IBS Overview, Case Studies, & MDOT Perspective

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What is GRS-IBS?

- FHWA Every Day Counts-2 (EDC-2) Initiative
  - Technology developed as part of the Accelerated Bridge Construction

Federal Highway Administration
Every Day Counts
Innovation Initiative

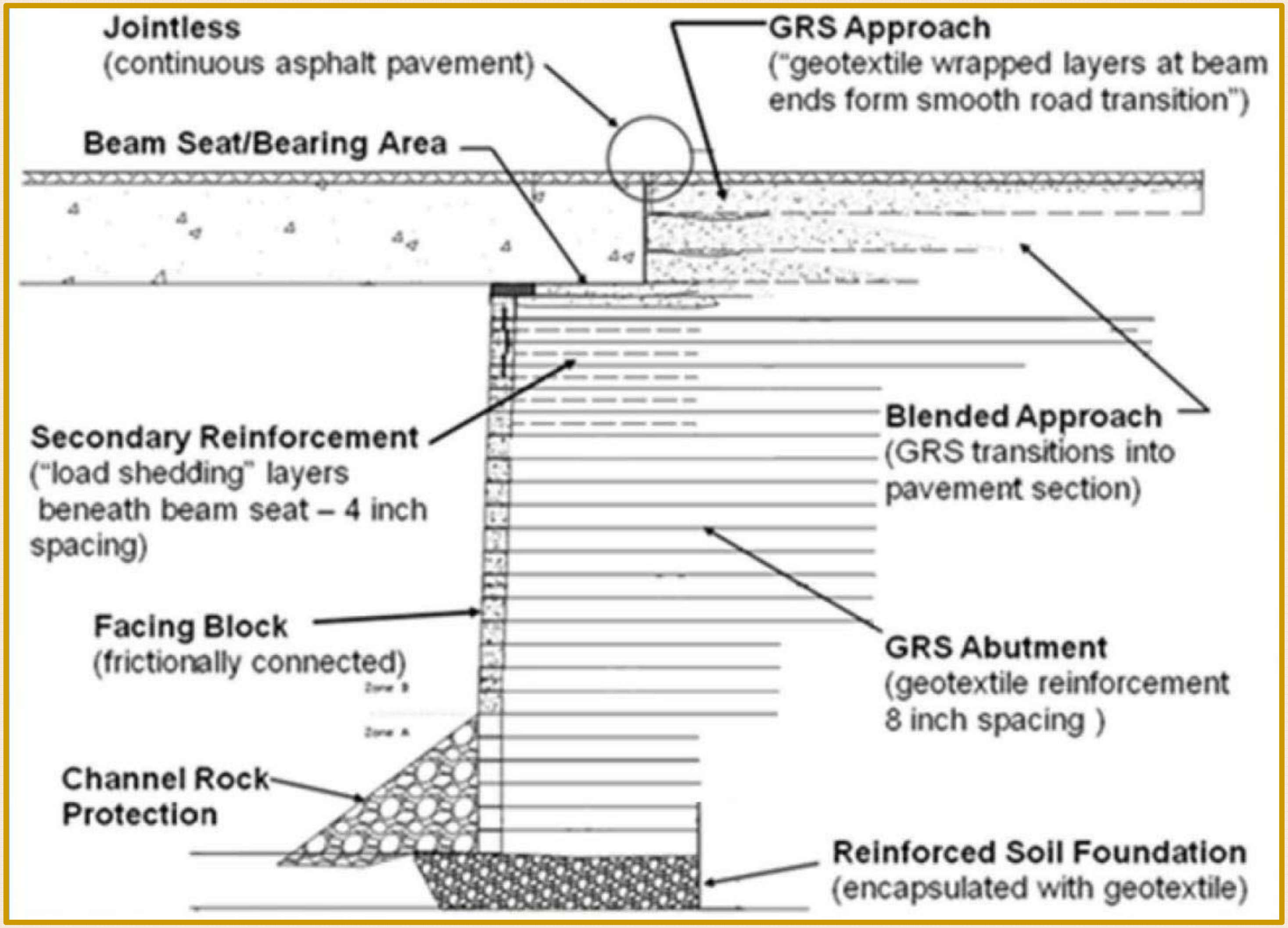
- MDOT's Goal: Develop awareness of GRS-IBS in bridge owners and designers within the state of Michigan. Develop State specific plans and specifications for a demonstration project. Let at least one bridge with this technology.

GRS DEFINED…………..

- Conventional Bridge - Design is comprised of
  - Foundation
  - Substructure
  - Superstructure.

- GRS-IBS is also comprised of three components
  - Reinforced Soil Foundation (RSF) – Aggregate wrapped in layers of geotextile.
  - GRS Abutment - Alternating layers of soil and geosynthetic reinforcements. Faced with concrete blocks.
  - IBS – Beams, guardrail, and deck (HMA or concrete).

Abutment Cross Section of GRS-IBS



RSF – Keefer Highway Project

GRS Abutment
Keefer Highway Project

IBS – Pre-Cast Concrete Box Beams
Keefer Highway

GRS IBS - Design Considerations

- Types of Facing Used for GRS IBS

Image source: Utah DOT

Image source: Scott County, IA

Image source: PA DOT

Image source: Town of North Haven, ME

Image source: Colorado DOT

GRS IBS – Implementation Progress

190 Bridges nationally in 43 states including PR and DC - September 2014

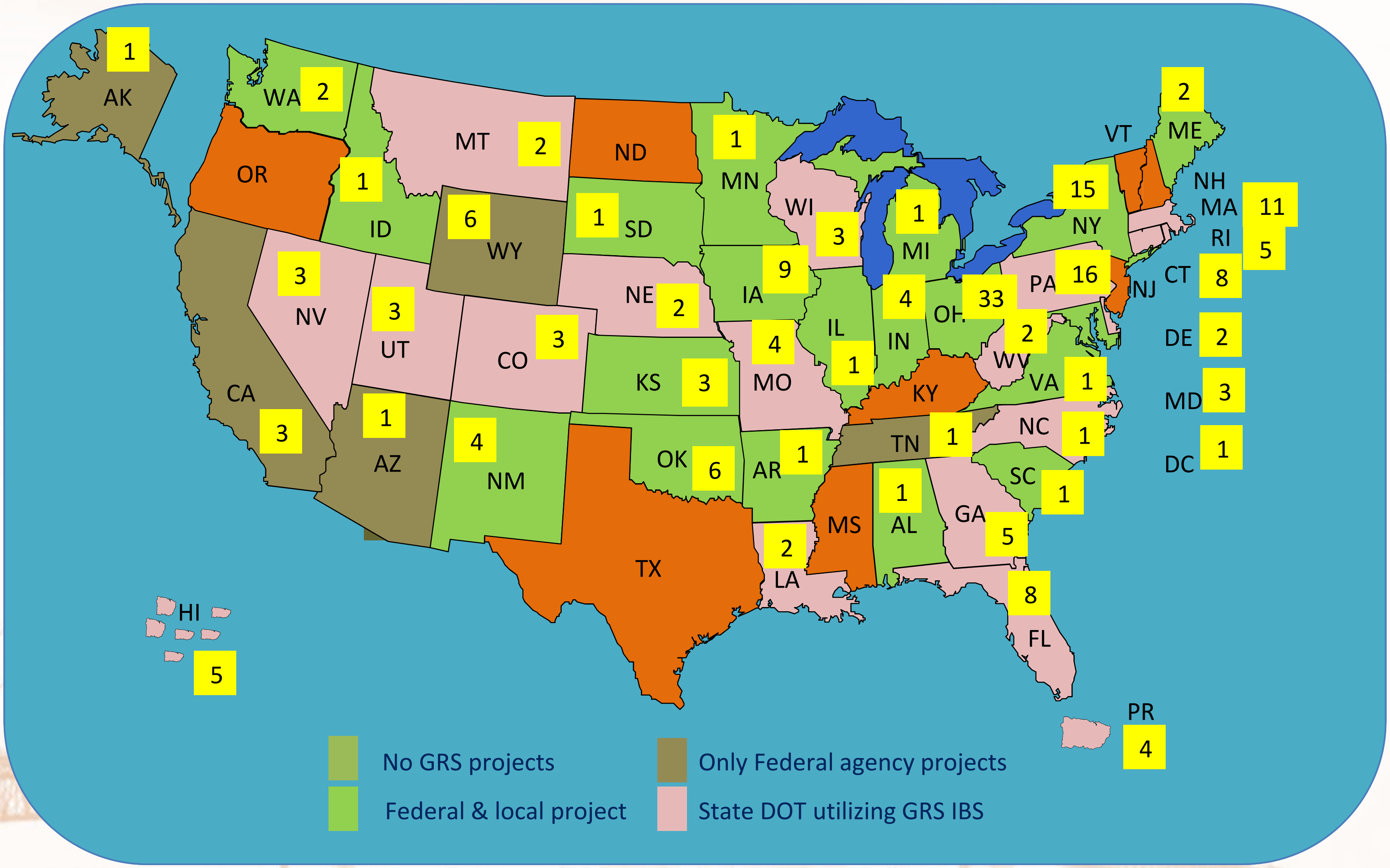
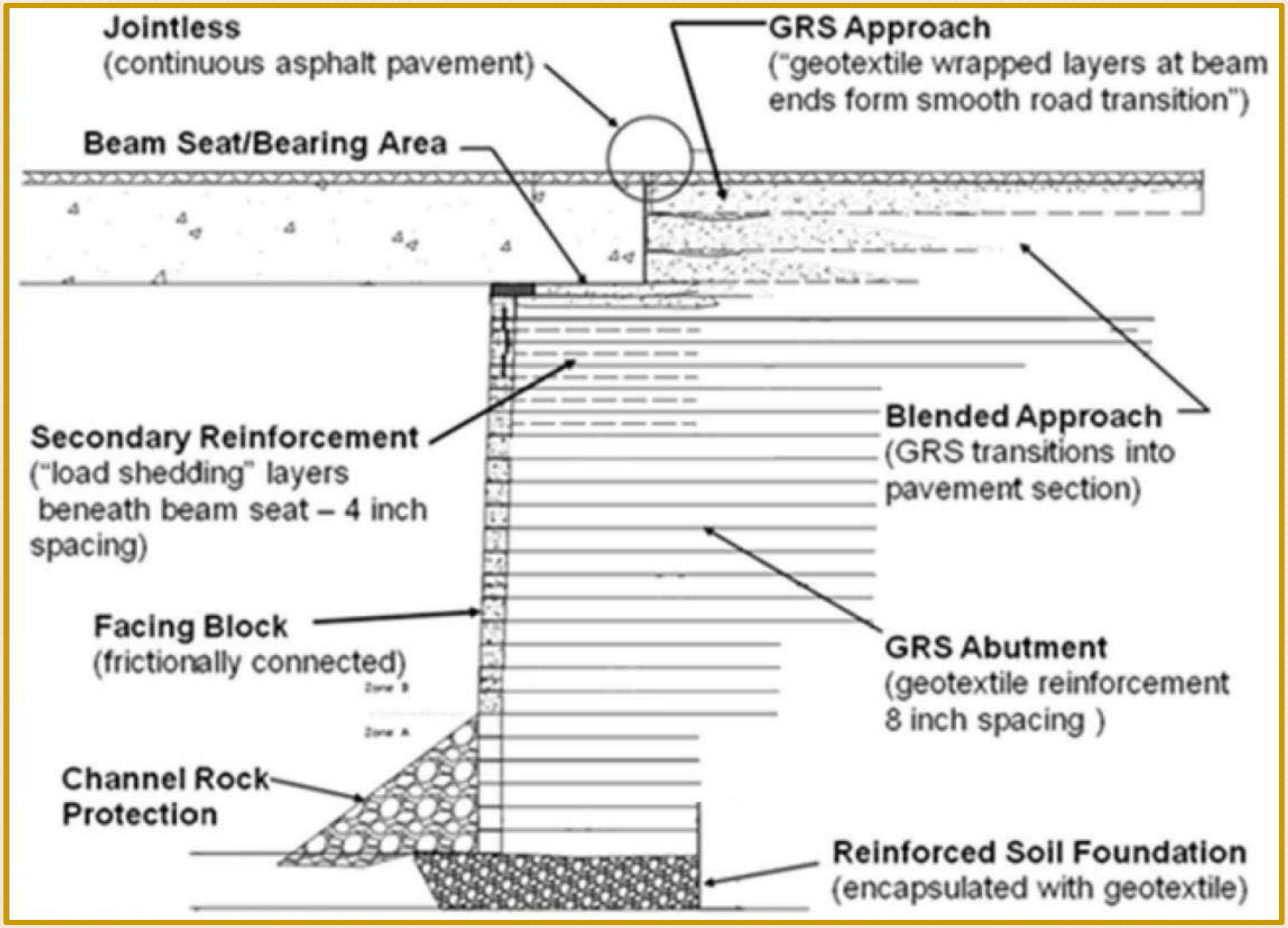


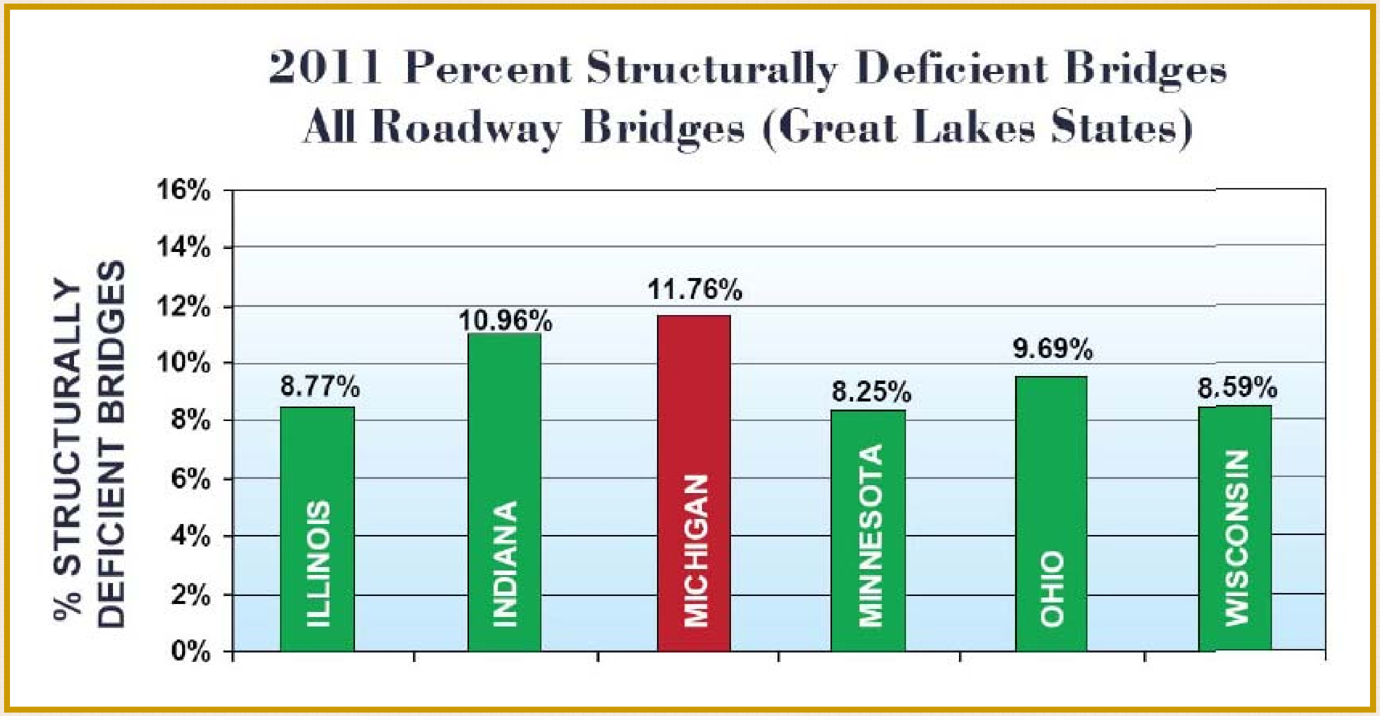
Image source: FHWA

Cross Section of GRS-IBS



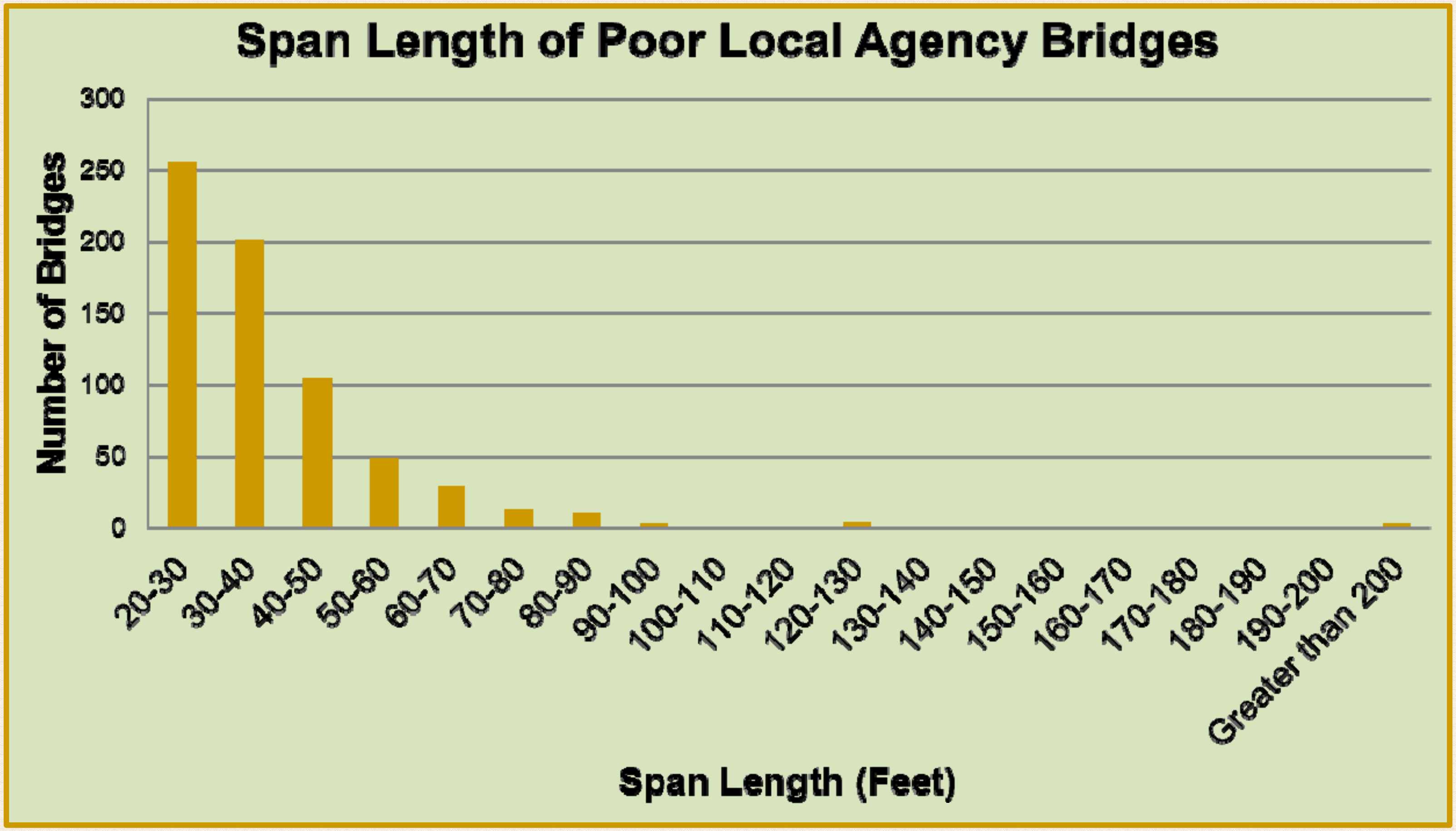
Challenge:
Improve Local Agency Bridges

- Local Agencies
  - Structurally Deficient Bridges > 1000
    - 556 Poor Bridges
    - 459 Serious and Critical



Local Agency Bridge Replacement Needs

- 675 Single-Span Poor Bridges



Guidelines on Design and Use

- At Structure Study, Consider for:
  - One-span structures only, less than 140 ft span,
  - Low traffic volume county roads and state trunklines,
  - Grade crossings or roads crossing streams, creeks, and drains that have suitable hydraulic conditions (i.e., low velocity and scour),
  - Abutment heights less than 30 feet.
  - “Good” Foundation Soils

Design Development

- Design Manual – Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide, June 2012, FHWA-HRT-11-026

- Initial Design Steps
  - Establish Project Requirements
  - Perform Site Evaluation
  - Evaluate Project Feasibility…………

Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide

Publication No. FHWA-HRT-11-026 **June 2012**

U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

Michigan Department of Transportation

Special Provision for

Geosynthetic Reinforced Soil Abutment

12DS206(G355)

Integrated Bridge System Interim Implementation Guide, dated June, 2012 (Publication No. FHWA-HRT-11-026), the standard specifications, and as directed by the Engineer.

The following definitions apply when used herein and on the plans:

Geotextile Reinforcement. Biaxial geotextile reinforcement having strength and stiffness that are approximately equal in both the machine and the cross machine directions.

Geosynthetic Reinforced Soil (GRS). Alternating layers of compacted granular fill reinforced with Geotextile Reinforcement. Facing elements are connected to the reinforcement layers to form an outer GRS Wall. Facing elements must consist of segmental block units (SBUs).

GRS Abutment. A GRS retaining wall system designed to support the weight of a bridge superstructure. Usually, GRS abutments have three sides: the abutment face wall and two wing or return walls.

GRS Abutment Face Wall. The vertical or near vertical wall parallel to the center of superstructure bearing seat and designed to support the bridge superstructure.

GRS Wing Wall. A wall attached and adjacent to the GRS abutment face wall. The GRS wing walls are built at the same time as the GRS abutment face wall and at a right or other angle to the GRS abutment face wall.

Reinforced Soil Foundation (RSF). A reinforced soil mass located below the GRS. This mass consists of alternating layers of compacted well-graded aggregate and Geotextile Reinforcement.

Retained Soil. Backfill located behind the GRS wall mass.

Clear Space. The vertical distance between the top of the GRS abutment face wall and bottom of the superstructure above the wall. This distance is 3 inches or 2 percent of the GRS wall height, whichever is greater.

Beam Seat Setback. The lateral distance from the back of the GRS SBU to the front of the superstructure bearing beam seat area. This distance is a minimum of 8 inches or as shown on the plans.

b. Materials. The basis of acceptance for all materials not addressed by the standard specifications and specified herein will be a certification in accordance with the *Materials Quality*

Design Development

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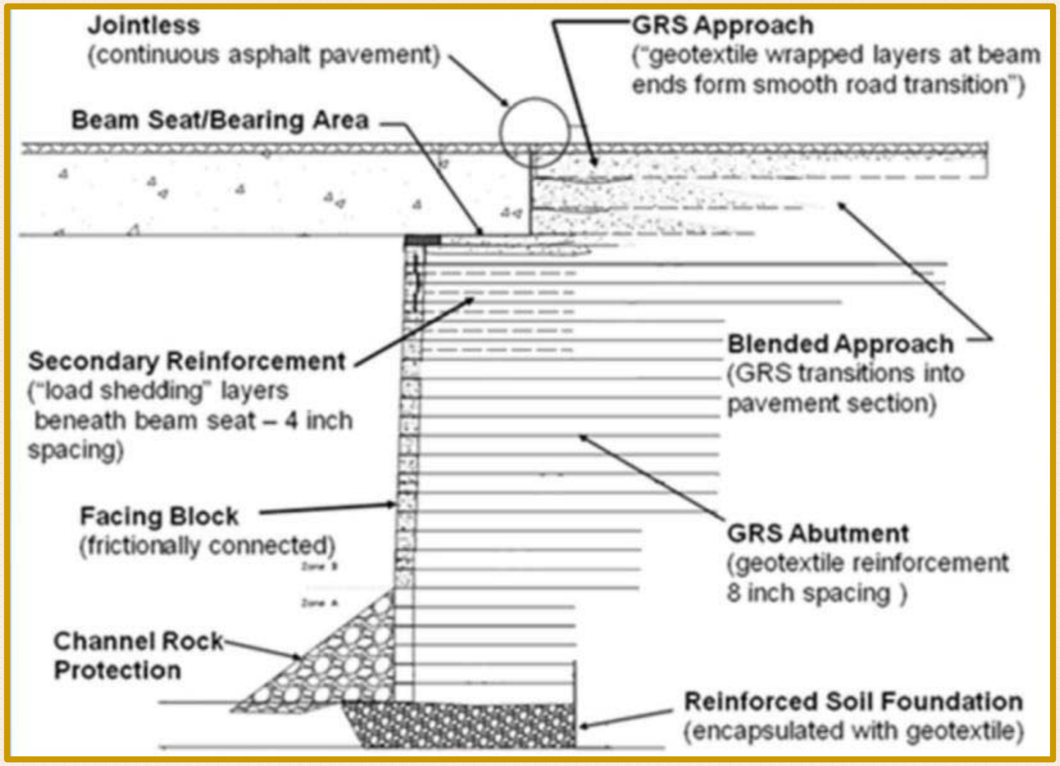
GRS-IBS Considerations

- Requires early geotechnical and hydraulic analysis to determine GRS abutment feasibility.
- Requires good communication between structural and geotechnical engineers.

Cross Section of GRS-IBS Abutment



GRS-IBS Considerations (continued)

- Perform thorough QC testing of materials during construction.
- Provide enough lead time between let date and construction start date for block testing.
  - 90 day freeze thaw testing requires 3 to 4 months depending on lab capabilities. Exception: Manufacturer has tested lot already.

Summary

- Encourage CRCs to look at GRS-IBS during Structure Study.
- Plans and special provision for a County/MDOT/FHWA funded project have been developed.
- One project let: Keefer Highway over Sebewa Creek.
- MDOT is actively searching for an appropriate trunkline to use GRS-IBS.
- If technology becomes widely used, develop specific design guidance for MDOT funded projects.

Thank you!

Questions?

GRS-IBS in Luverne, MN

Bridge Length = 77.5 ft, Wall Height ~ 22.5 ft

NY – CR 38, St. Lawrence County

PA – Sandy Creek Bridge

PA – Sandy Creek Bridge

IL – Great Western Trail over Grace Street

FL – Nassau County

SD – 8th Street, Custer

UT – I-84 Echo Project