Technical Topics on GRS-IBS Bridges

5 years of Lessons Learned

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WHAT IS GRS-IBS?
QUICK REFRESHER

**GRS-IBS SECTION**

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

- **Jointless**
  - (Continuous Pavement)

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

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

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

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

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

- **Reinforced Soil Foundation**
  - (Encapsulated with Geotextile)
SO....WHERE ARE WE AT?

- How many in audience have worked on a GRS-IBS bridge in Michigan or out of state?

- How many have even considered this technology as an option?
By end of 2019 – at least 22 built
3 more in 2020
Last report I could find from 2017 estimated over 200 bridges nationally!
It is estimated that over ¾ of bridges needing replacement could consider GRS-IBS!
IT IS ALL ABOUT MORE FOR LESS

- $$$ - Estimated $350K saved per bridge – adds up to $6,300,000 for 18 bridges in Midland County over 4 years!!

- Time – “Every day counts!” average time saved is 3 weeks per bridge – adds up to 54 weeks of construction time!!

- Flexibility – Easily modified to fit individual sites, natural bottom, avoid utility conflicts, single spans from 20 to 140 ft.

- Constructability – 8 of the 22 bridges will be built by the County’s own forces
SO... WHAT IS HOLDING US BACK?

- Fear of new technology?
- Lack of Knowledge?
- Concern about Scour?
- Soil Conditions?
- Longevity?
KEY DESIGN CONSIDERATIONS

- Part of FHWA's Everyday Counts Initiative since 2010 – first one built in 2005
- New FHWA Spreadsheet that follows LRFD methodology
- Key Failure Modes:
  - Sliding at top or bottom of RSF
  - Soil Bearing Capacity
  - Reinforcement Strength
  - Global Stability
  - Overturning is NOT
CONSIDERATIONS - Soils

- Existing “Bearing Soils”
  - Stiff Clays/Silts
  - Compact Granular
  - Loose Granular
- Backfill Materials
  - Granular Free Draining
  - Aggregate
  - Native
- RSF Materials
CONSIDERATIONS - Scour

- Locating the RSF
  - Typically place top at estimated scour
  - New FHWA TechBrief (12/18) – *Changes this*

- Counter Measures – riprap, sheet piling, depth of RSF, ???

- Monitoring
CONSIDERATIONS – Flood Events
CONSIDERATIONS - Facing Options
CONSIDERATIONS - Facing Options
CONSIDERATIONS – Superstructure
CONSIDERATIONS - Longevity

- Geosynthetics have 100 year design life
- Facing is cosmetic
- No bridge bump, reduced impact
- Oldest structure built in 2005
**KEY DESIGN ELEMENTS**

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ELEMENTS - GRS “Mass”

- Spacing between Geotextile Reinforcement
  - Typically 12” or less
  - Follows 1:1 cut slope

- Backfill Material
  - Granular or Native = 95% Max.
  - Aggregate = Uniform Effort

- Facing
  - NOT Structural
  - Tied to reinf. by friction

Facing

RSF

GRS
ELEMENTS - Beam Bearing

- Integrated Approach Reinforcement
- Beam Seat (wrapped tails)
- Bearing Bed Reinforcement
  - $\frac{1}{2}$ Reinforcement spacing
ELEMNETS - Beam Bearing

Clear Space (different than seen in manuals)
- Solid Block Facing Unit (Beam in contact)
- Polystyrene Board (to crush)
- #4 Epoxy Rebar & Concrete fill top 3-4 rows
ELEMENET RSF

Natural River Bottom

Heavy Riprap (don’t skimp)

B_{total} = 0.3H

Depth = 0.25B_{total}

Width = B_{total} + 0.25B_{total}
LESSONS LEARNED

Image Source: Allan Block
LESSONS LEARNED

Figure 10. Photo. Bridge seat and setback distances.

*Face thickness & Bearing area*

*Over-excavate*

*Geotextile strength*

Figure 13. Illustration. Reinforcement schedule for a GRS abutment.
WHAT IS THE FUTURE?

Figure 3. Construction of U.S. 301 Trail Bridge with multi-span GRS-IBS in Zephyrhills, Florida.

Figure 4. Completed two-span GRS-IBS bridge in Knox County Beach, Maine.