Geosynthetic Reinforced Soil (GRS) Abutments

• Simple design and construction
• Performance depends upon good compaction and sufficient reinforcement
• Soil bearing capacity to support the superstructure

Contd…
Geosynthetic Reinforced Soil (GRS) Abutments

- Settlement generally controls the design
- Ability to tolerate differential settlement
- Better perform under seismic loading \((NCHRP \text{ No. } 556)\)
Things to consider for this application:

- Bridge length – More cost-effective design for bridge length up to 95 feet. However, longer bridge length can be done but required more evaluation.

- Abutment height - More cost-effective design for bridge height up to 15 feet. However, higher abutments can be designed with more evaluation.

Contd...
Things to consider for this application:

- Bridge site setting – crossing roadway or water, vertical clearance or hydraulic clearance.
- Mobilization
- Hydraulic – erosion, scour

Contd…
...Things to consider for this application:

- Geotech – Soft or bad soil
- Constructability
- Right of way
GRS Abutment Design Process

• Analyze the bridge and provide preliminary estimate of DL and LL to Geotech office.

• Request settlement analysis from Geotech office.
  ➢ Intermediate and long-term settlement
  ➢ Size and height of the GRS abutment

Contd....
GRS Abutment Design Process

- Request hydraulic analysis from hydraulic office.
  - Scour depth, if required
  - Recommended elevation of footing base – Preferably at least 2 feet below existing ground line or scour elevation

Contd…
GRS Abutment Design Process

- Work closely with Geotech to determine the appropriate size and depth of the GRS foundation.
- Design and detail abutment slab and elastomeric bearing.
- Detail GRS foundation and facing as needed.
GRS Plan and Details

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Elastomeric Bearing Pad

![Diagram of Elastomeric Bearing Pad]
Abutment Slab
Abutment Slab

ELEVATION
(Left side, Abutment 2 similar)
Scales 1/4" = 1'-0"
Cut-off Bridge
Upper Ouachita National Wildlife Refuge, LA
Bridge Over Drainage Canal
Panther National Wildlife Refuge, FL
Central Canal Bridge
Mattamuskeet National Wildlife Refuge, NC
Lesson Learned

• Cellular Confinement System (CCS) use as a flexible facing system and footing base.

• Masonry unit is recommended for facing, if required.

• Highly dependent on contractor’s QA/QC; otherwise can become distorted during construction.

Contd….
Lesson Learned

• Appearance can be improved using vegetated fill on abutment sides.

• Contractor experience with CCS installation is required to avoid difficult installation.
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## Performance

<table>
<thead>
<tr>
<th>REFUGE</th>
<th>BRIDGE NAME</th>
<th>SETTLEMENT</th>
<th>STRUCTURE CONDITIONS</th>
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<td>Average</td>
<td>Differential</td>
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<td>UPPER OUACHITA</td>
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</table>
Conclusions

• Cost-effective substitute for deep foundation
• Cost between 20-40% less than pile foundations
• Built with readily available materials

Contd....
Conclusions

- Less and common construction equipment
- Highly skilled labor NOT REQUIRED
- Saving using shorter beams

Contd....
Conclusions

- QA/QC program NOT REQUIRED
- Easy to deliver site materials
- Build bridges in days or weeks, not month

Contd....
Conclusions

- Improve durability, inspection accessibility, and long-term performance
- Minimum maintenance.
- Minimum environmental impact
Questions?