GRS Abutments for Bridge Replacement National Wildlife Refuge

Quinn Nguyen – FHWA/EFLHD

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 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 to15 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

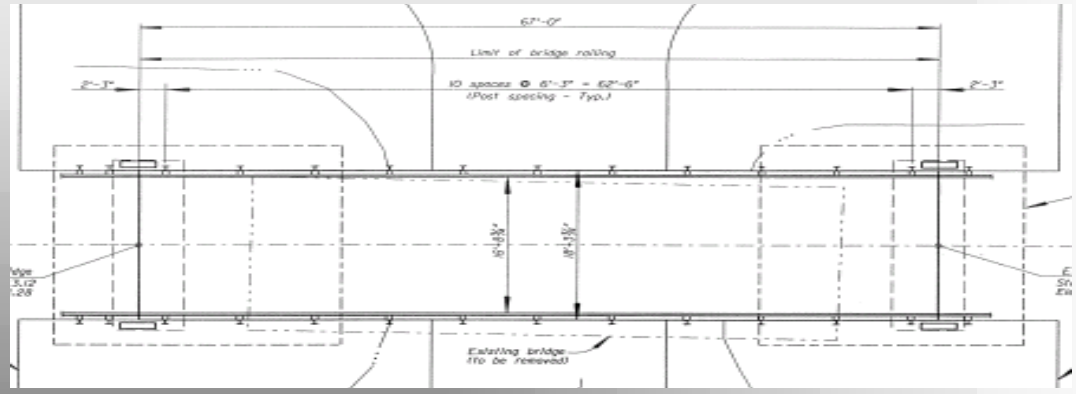
- Request hydraulic analysis from hydraulic office.
  - Scour depth, if required
  - Recommended elevation of footing base – Preferably at least 2 feet below existing ground line or scour elevation

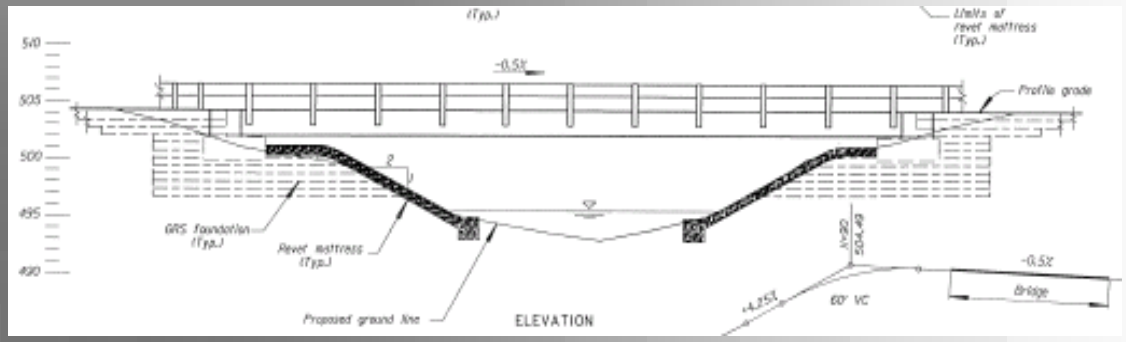
Contd…

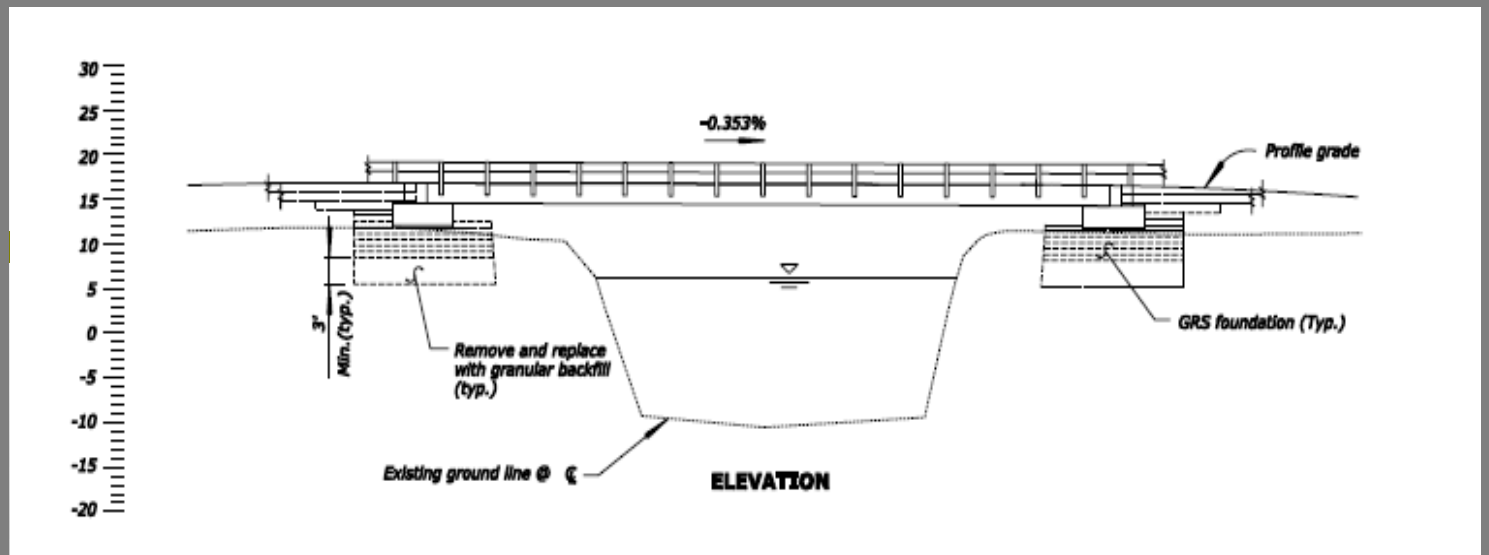
GRS Abutment Design Process

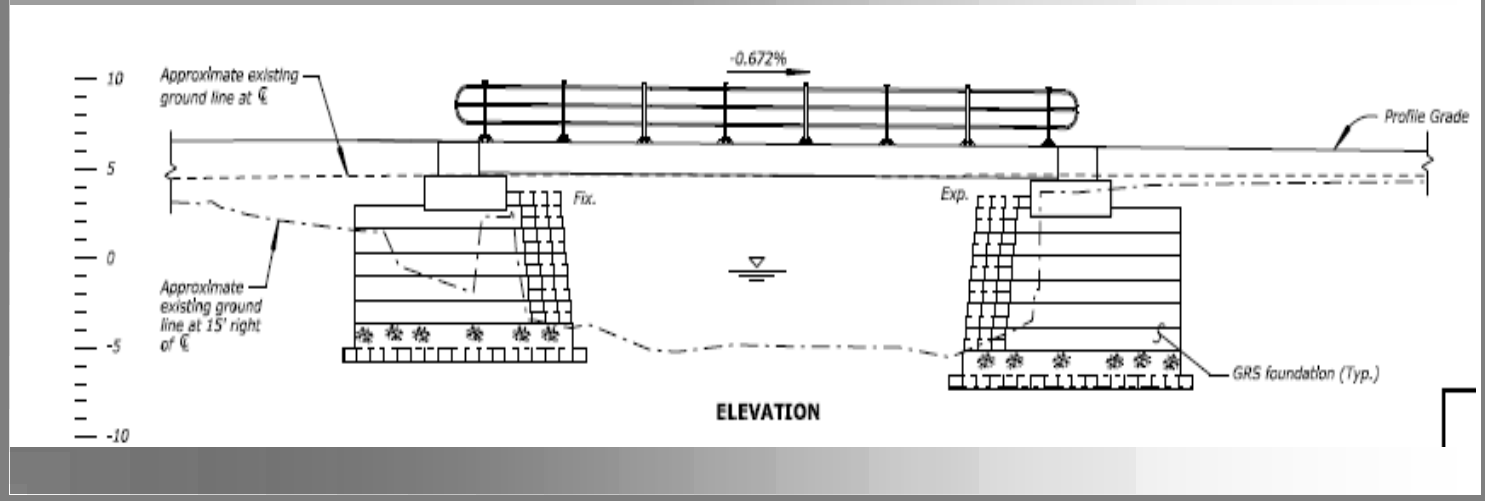
- Work closely with Geotech to determine the appropriate size and depth of the GRS foundation.
- Design and detail abutment slab and elastomeric bearing.
- Detail GRS foundation and facing as needed.

GRS Plan and Details









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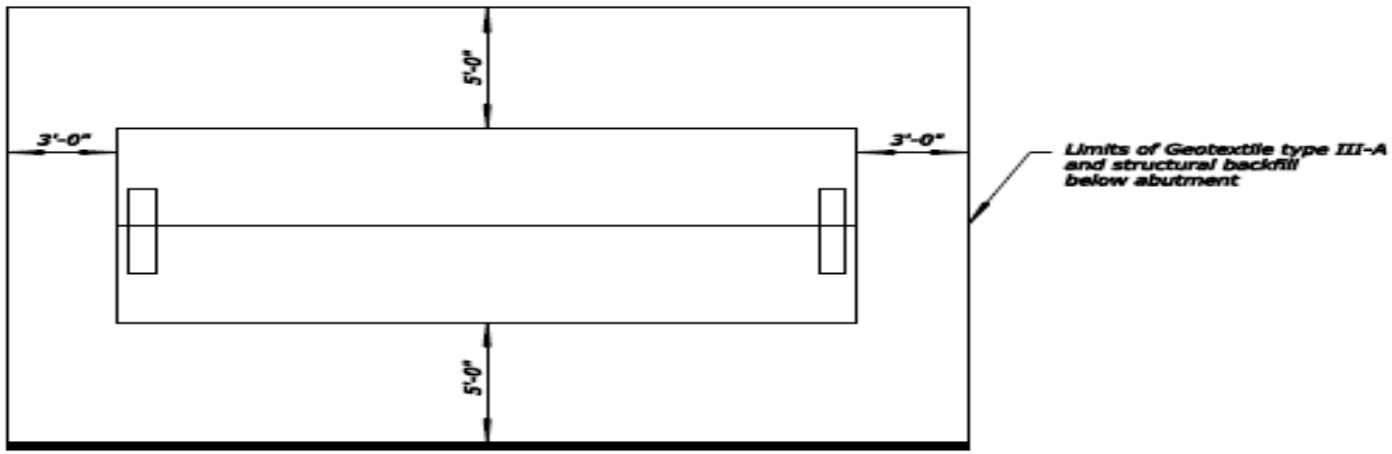
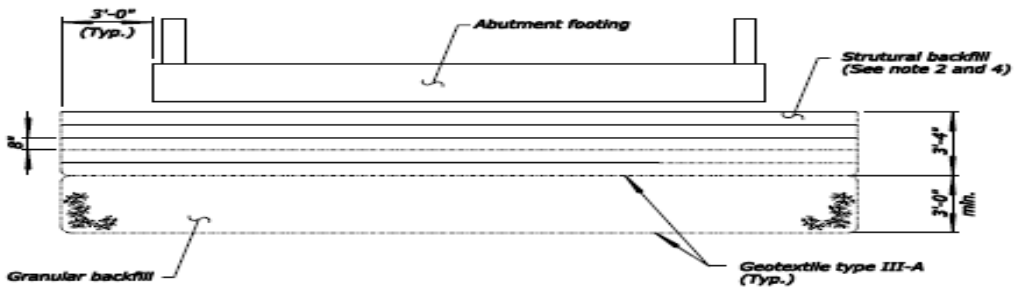


TYPICAL PLAN



TYPICAL ELEVATION

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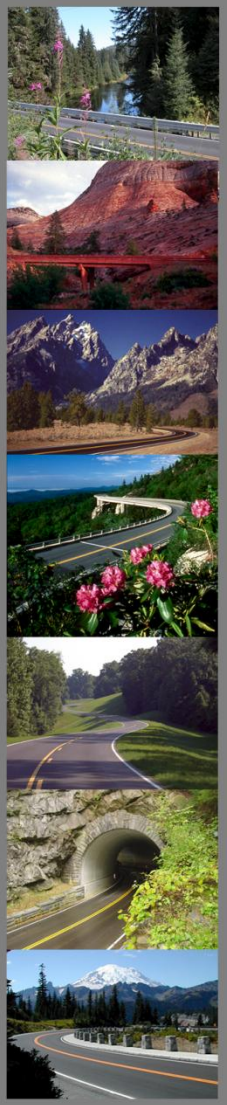

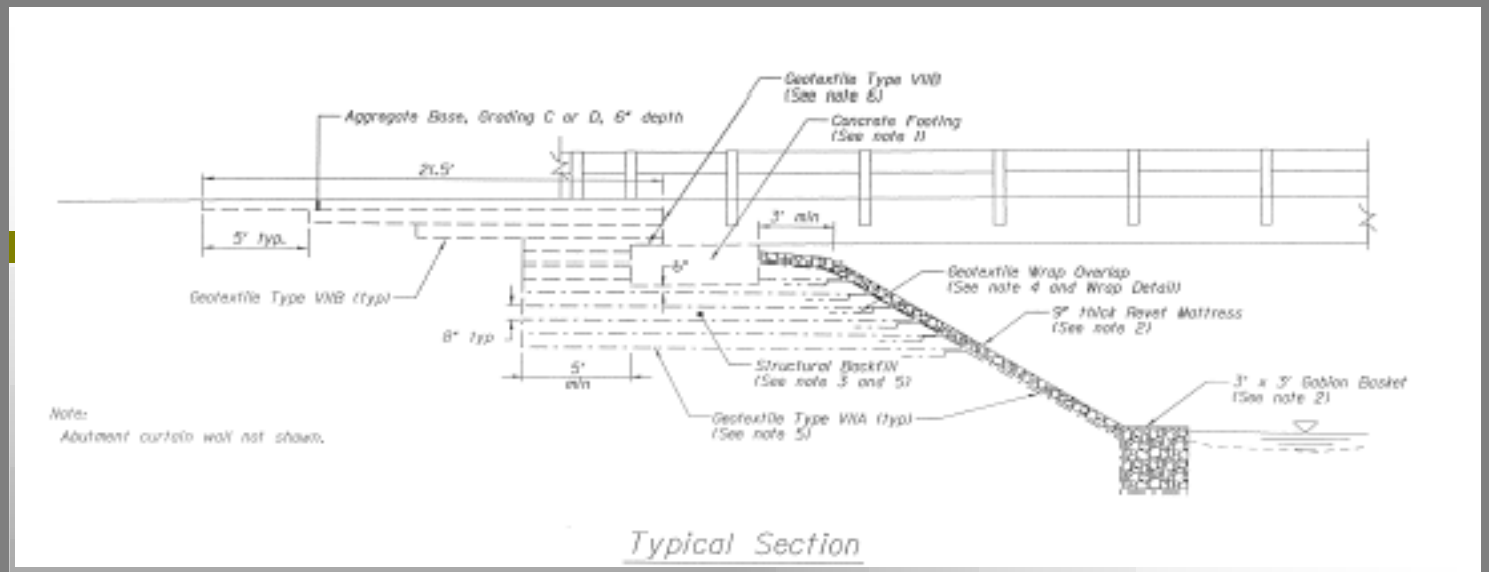

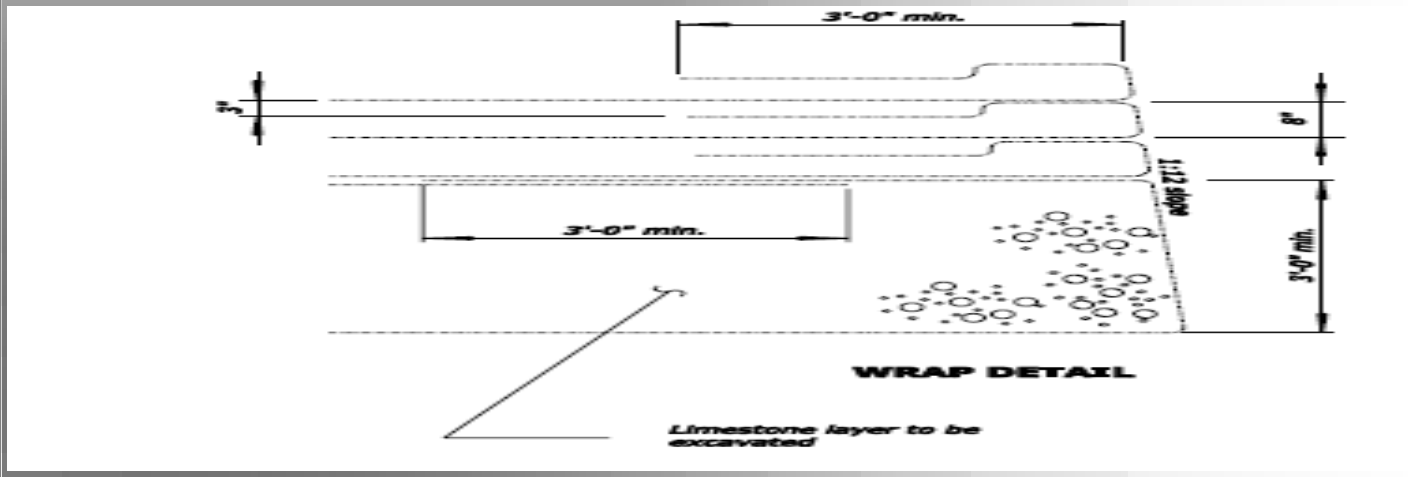

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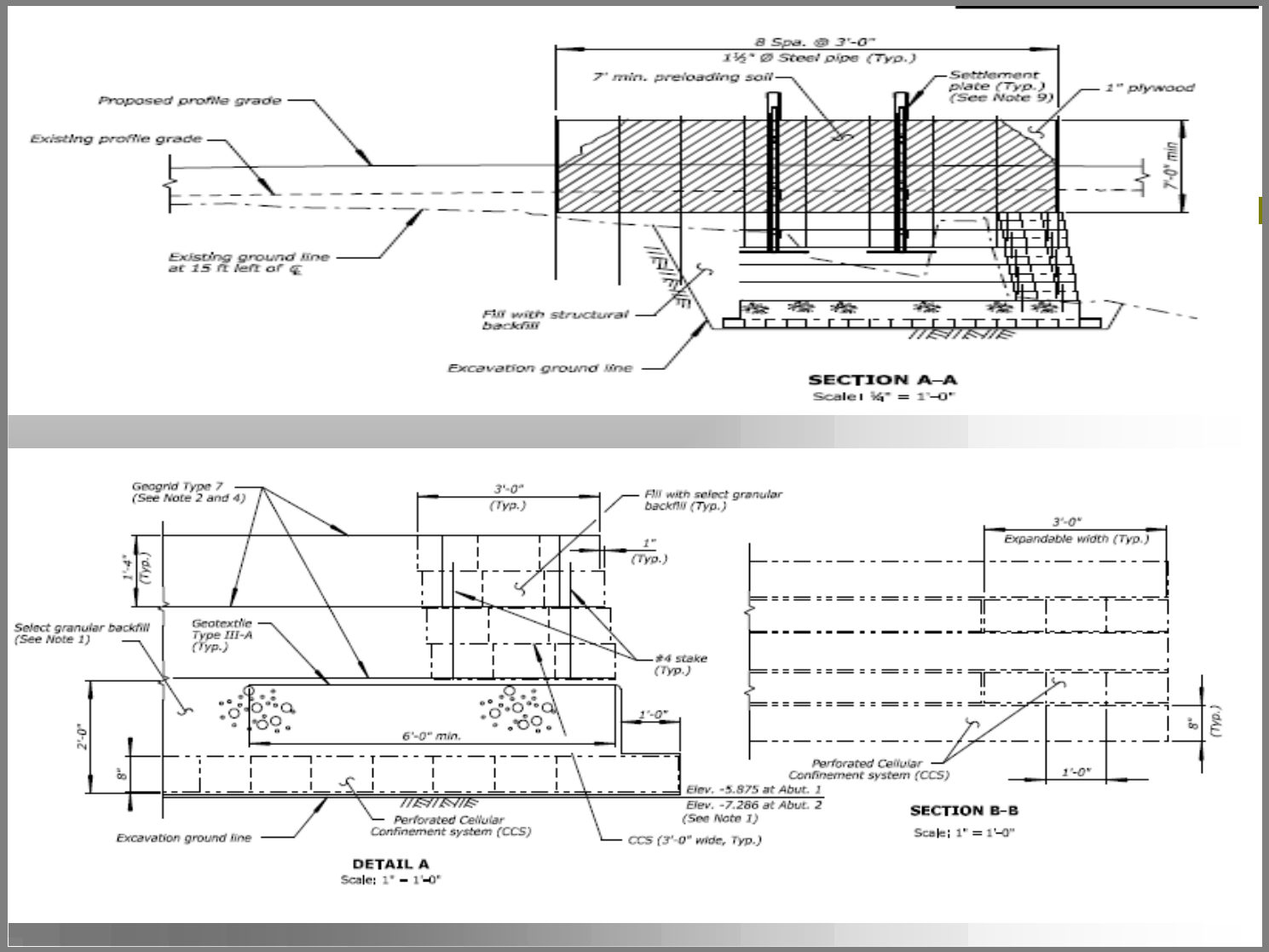

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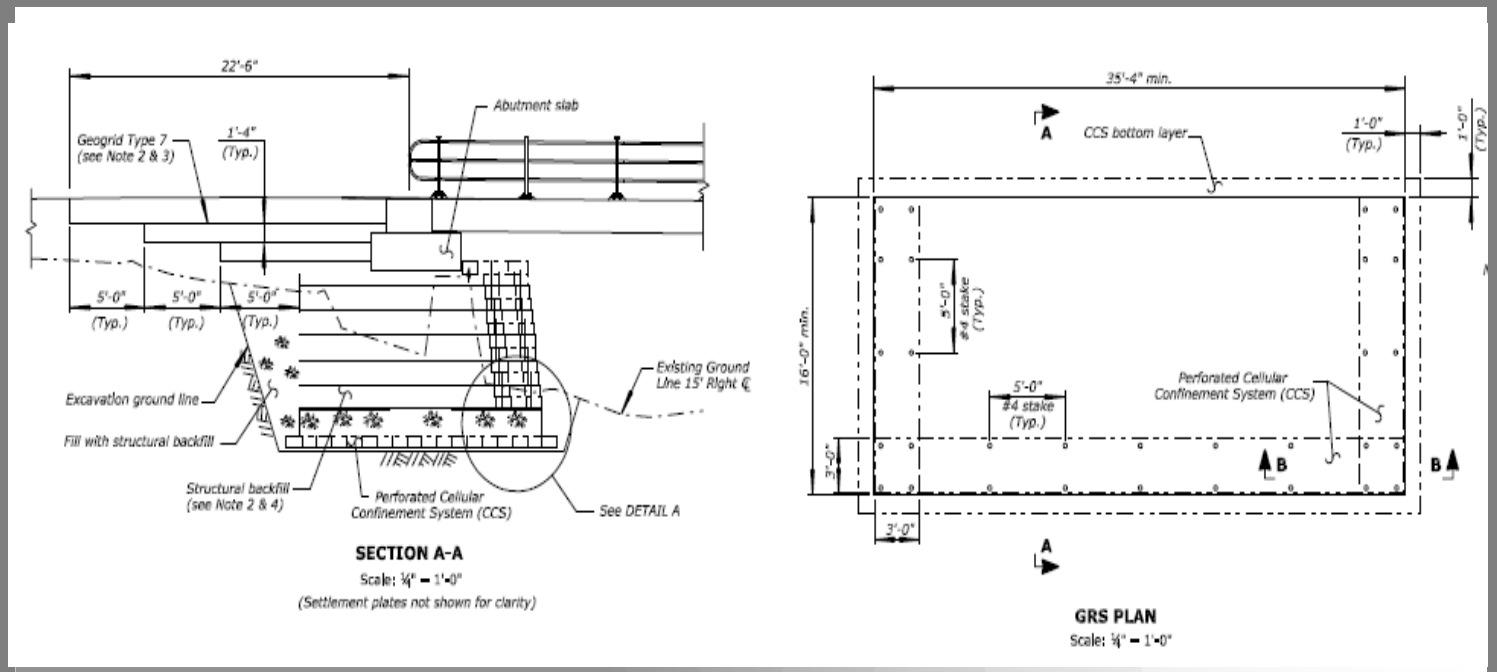

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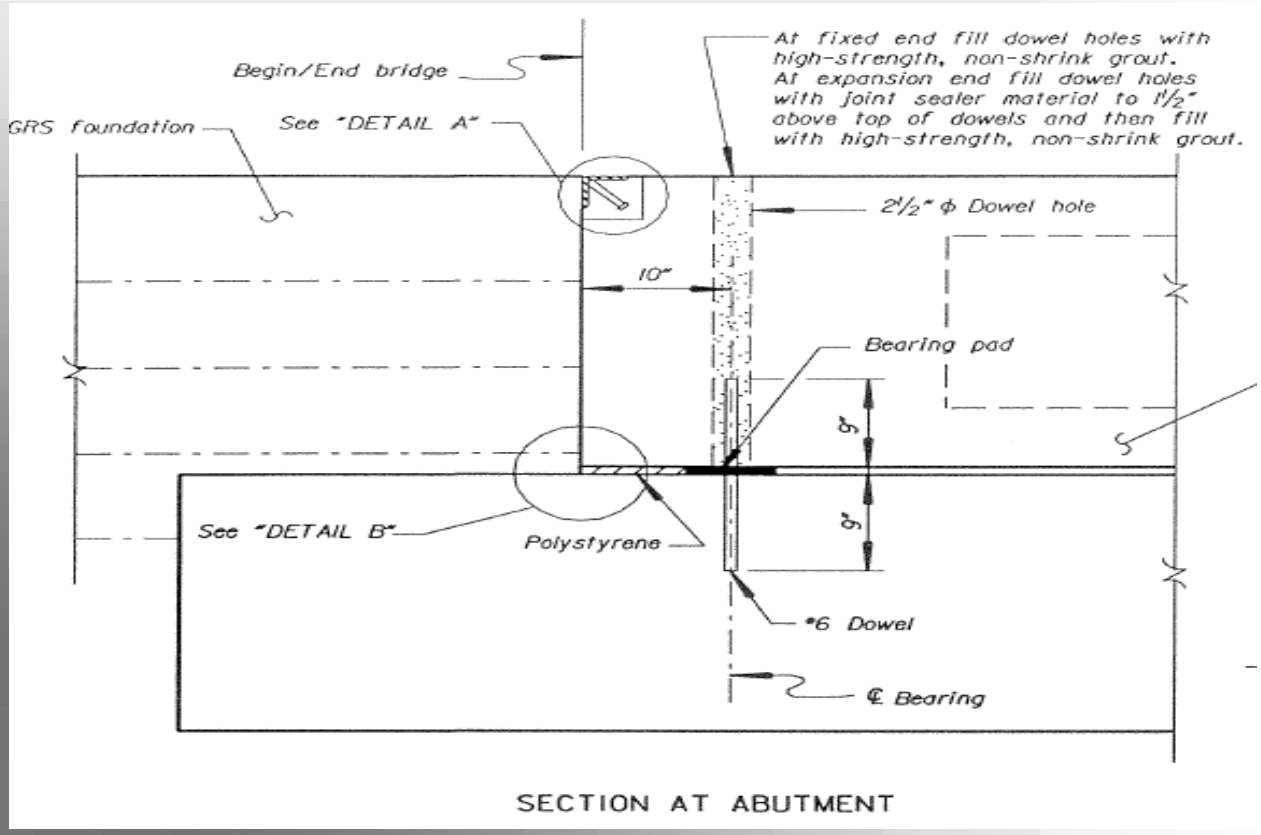
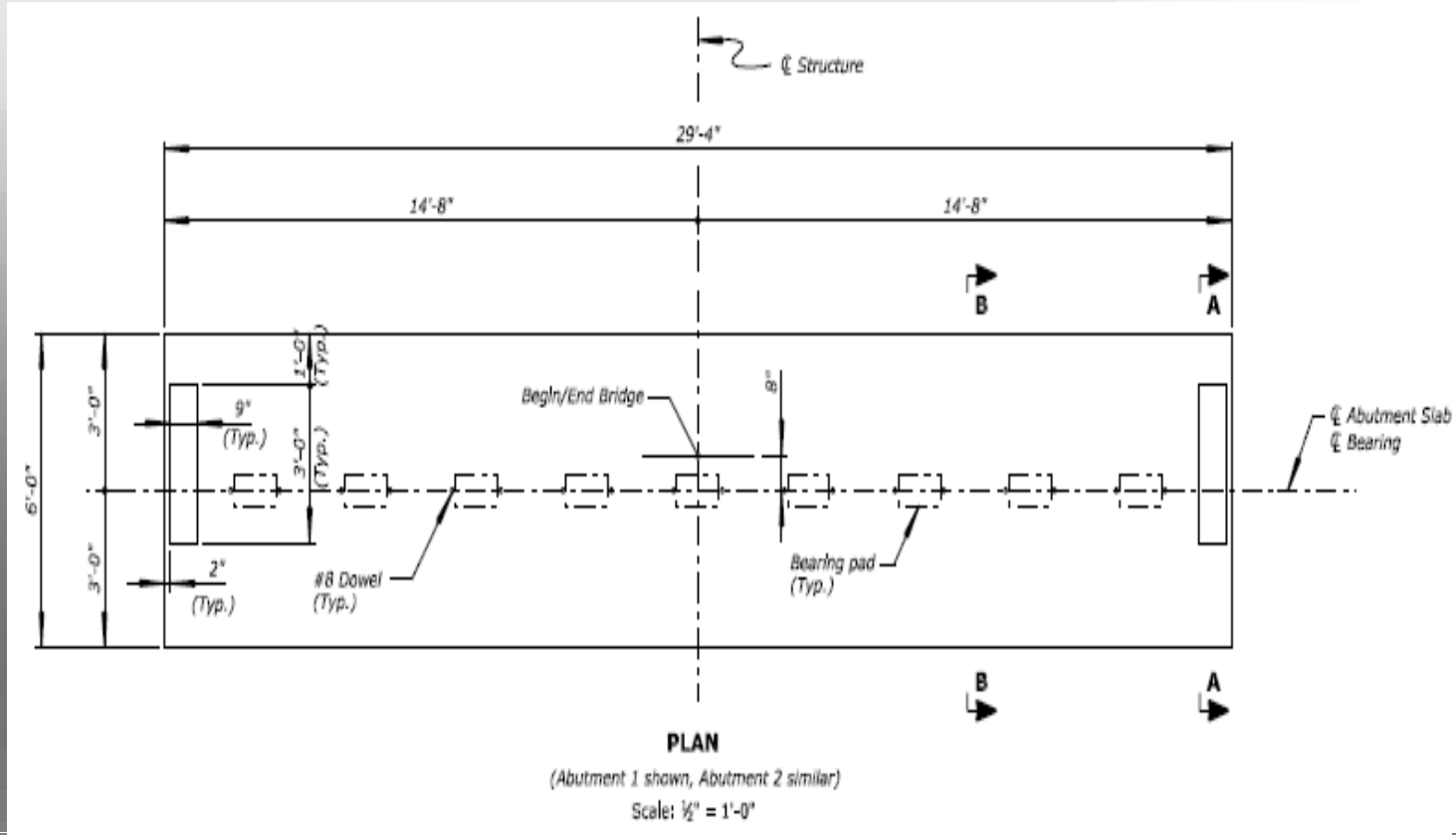
Elastomeric Bearing Pad



Abutment Slab

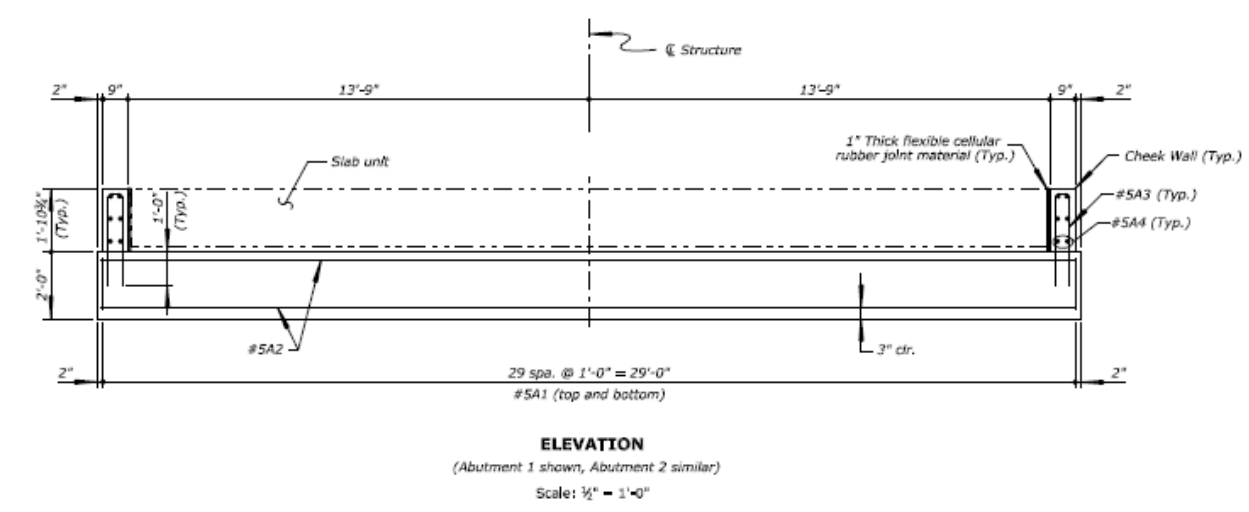


PLAN

(Abutment 1 shown, Abutment 2 similar)

Scale: ½" = 1'-0"

Abutment Slab



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Cut-off Bridge
Upper Ouachita National Wildlife Refuge, LA

Bridge Over Drainage Canal

Panther National Wildlife Refuge, FL

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Central Canal Bridge

Mattamuskeet National Wildlife Refuge, NC

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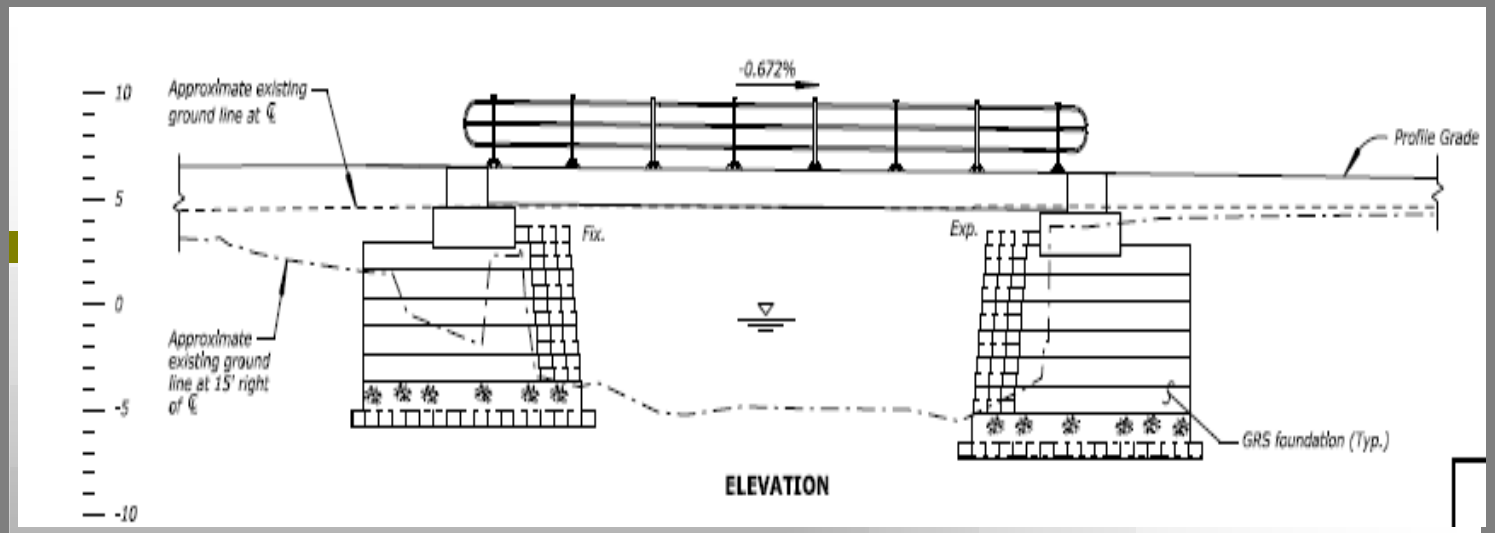

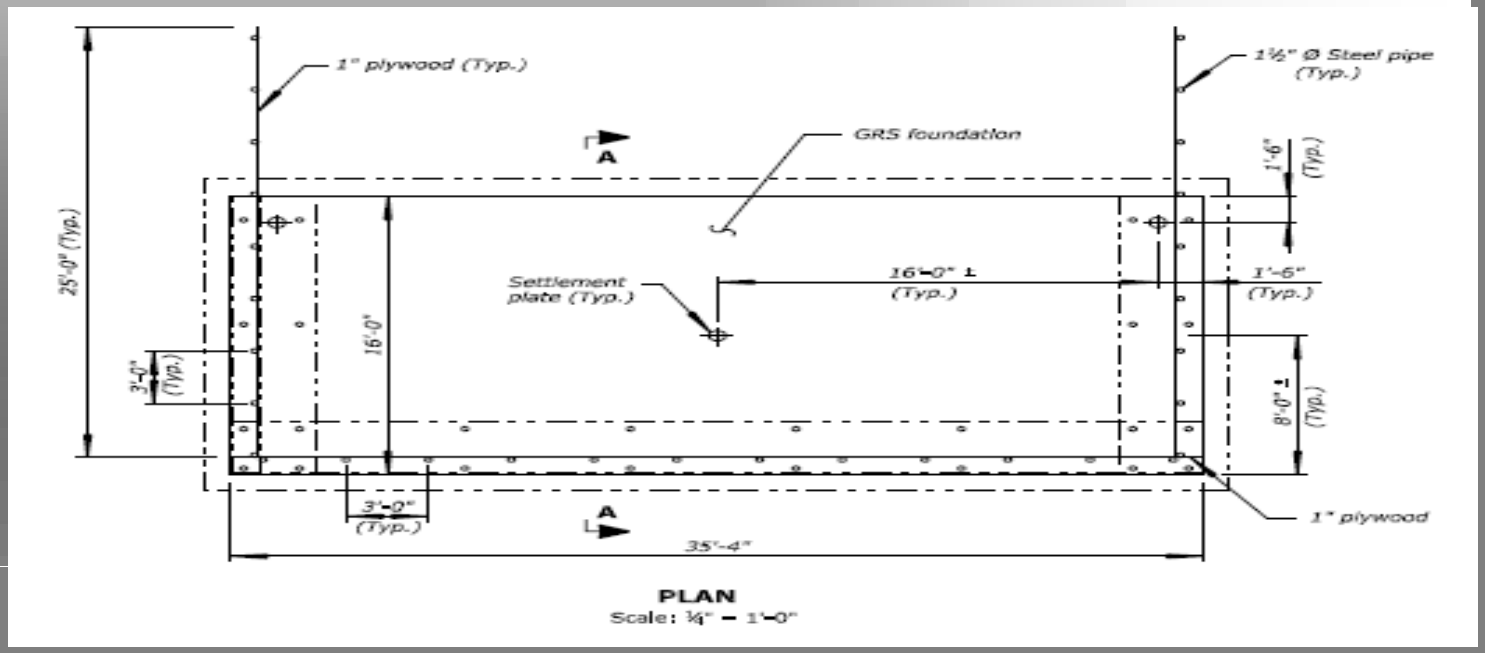

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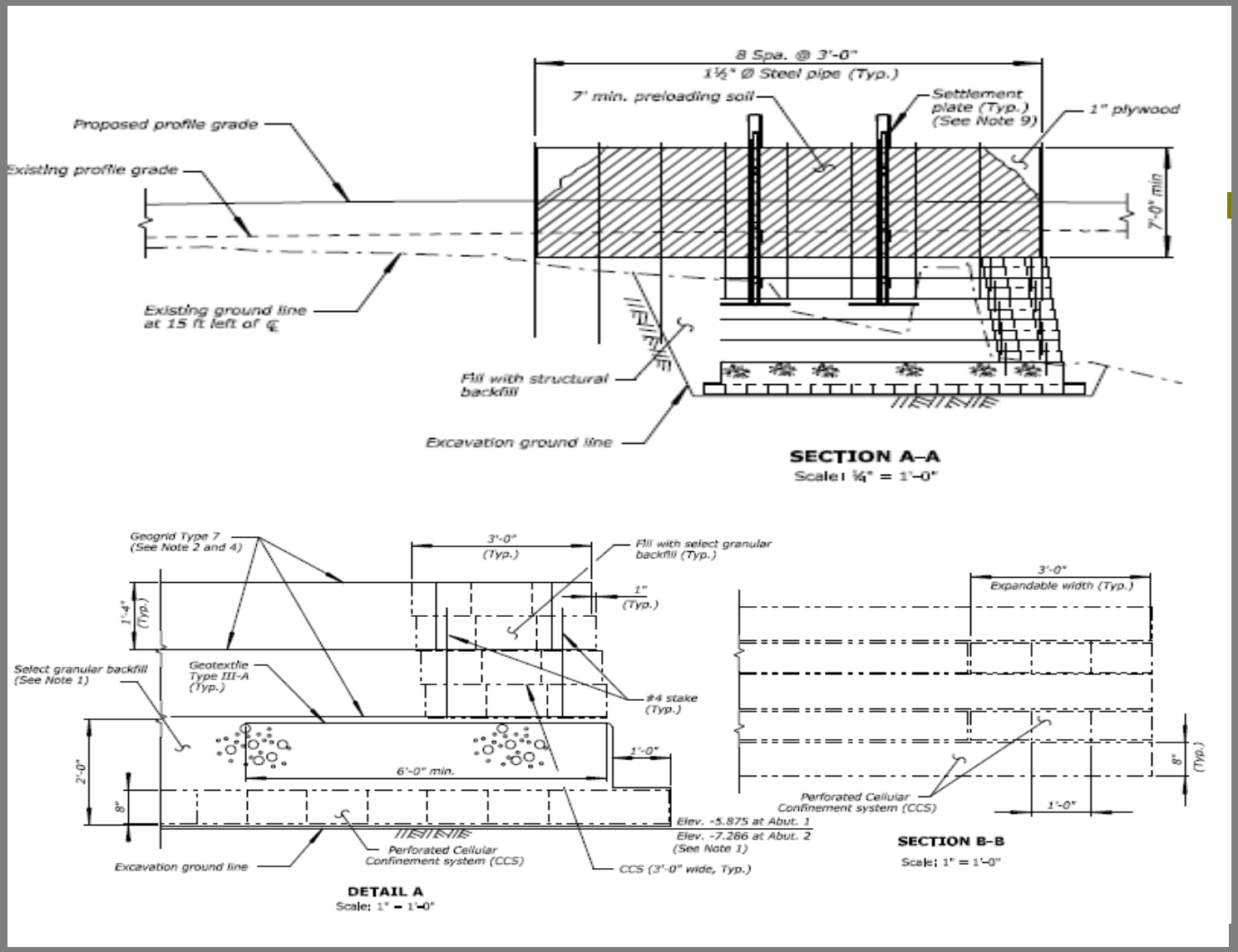

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Lesson Learned

- 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

REFUGE	BRIGE NAME	SETTLEMENT		STRUCTURE CONDITIONS
		Average	Differential	
UPPER OUACHITA	CUT-OFF CREEK	0.06 0.03	0.03	No further settlement or movement at approach has been recorded in late 2011
	BIG LAKE 2	0.69 0.36	0.033	No further settlement or movement at approach has been recorded in late 2011
	CECIL CREEK	0.78 1.05	0.27	No further settlement or movement at approach has been recorded in late 2011
MATTAMUSKEET	CENTRAL CANAL	0.36 0.48	0.12	No further settlement or movement at approach has been recorded in late 2011
	EAST CANAL	0.36 0.6	0.24	No further settlement or movement at approach has been recorded in late 2011

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?