Using a Bridge for Emergency Slide Repair

US 231 near Laceys Spring, Morgan County, AL
DBA Design and Construction Timeline

- Feb 12/13 – Slide Occurs
- Feb 14 – Get the Call
- Feb 17 – ALDOT mobilizes drills (State Holiday)
- Feb 18-20 – Visit Site, ALDOT drilling
- Mar 5 – Meet w/Director – Bridge is a GO
- Mar 9 – Excavation Underway
- Mar 11 – Bridge Limits Set by DBA/Design Begins
- Apr 15 – Foundation Design Report Delivered
- Apr 20 – Plans Issued
- May 8 – Project Letting and Award
- June 1 12:00am – Begin Construction
- **Sep 28 – Bridge Open to Traffic (7.5 months!)**
- Mid Oct – Post-Construction Instrumentation Installation Begins
- Dec – Remote Data Collection System On-Line
- Jan 2021 – Completion of Instrumentation Installations
Critical Area of slide analysis

Robust Investigation Exploration
Projected slip surface = elev 1115 at NB CL

Inclometer B-2
US-231 MP 301.7

99th Percentile
for 2010-2020

Failure

Cumulative Movement (in.)

Precipitation (in.)


Resistivity (Ohm-m)
40 109 207 808 2200

Line R1

Interbedded Sand/Clay

Interbedded Sandstone/Clay

Interbedded Limestone/Clay

Elevation (ft)

NAS = 3.6%
L2 = 0.80

RMS = 3.6%

Northeast

1140
1160
1120
1100
1080
1060
1040
1020
1000

Horizontal Distance (ft)

0 100 200 300 400 500 600 700
1 boring per abutment/bent during grading – used for design and in report
1 boring each bent shaft (not abutments) between grading and start of bridge to finalize Top of Rock, shaft tips, grade beam elevations
NB Bent 3

NB3 Center
GS EL = +1158.60 ft
Depth to Top of Rock = 49.6 ft
Top of Rock Elevation = +1109.00 ft

NB3 Downhill
GS EL = +1130.271 ft
Depth to Top of Rock = 24.0 ft
Top of Rock Elevation = +1106.271 ft

NB3 Uphill
GS EL = +1140.012 ft
Depth to Top of Rock = 10.2 ft
Top of Rock Elevation = +1129.812 ft

To R D = 49.6' EL = 1109.0'

To R D = 24.0' EL = 1106.3'

To R D = 10.2' EL = 1129.8'

D = 42.6' EL = 1116.0'

D = 49.6' EL = 1109.0'

D = 32.6' EL = 1126.0'

D = 31.2' EL = 1099.1'

D = 30.2' EL = 1109.8'

D = 25.2' EL = 1114.8'

D = 15.2' EL = 1124.8'

D = 30.2' EL = 1109.8'
NB Bent 4

NB4 Downhill
GS EL = +1125.333 ft
Depth to Top of Rock = 25.0 ft
Top of Rock Elevation = +1100.333 ft

NB4 Center
GS EL = +1142.82 ft
Depth to Top of Rock = 33.7 ft
Top of Rock Elevation = +1109.12 ft

NB4 Uphill
GS EL = +1131.760 ft
Depth to Top of Rock = 31.0 ft
Top of Rock Elevation = +1100.76 ft
SB Bent 7

SB7 Downhill
GS EL = +1090.454 ft
Depth to Top of Rock = 17.5 ft
Top of Rock Elevation = +1073.0 ft

SB7 Center
GS EL = +1105.8 ft
Depth to Top of Rock = 33.4 ft
Top of Rock Elevation = +1072.4 ft

SB7 Uphill
GS EL = +1090.777 ft
Depth to Top of Rock = 17.9 ft
Top of Rock Elevation = +1072.9 ft
Questions to Answer:
Where is Top of Rock?
Where is Bottom of Grade Beam?

- Many iterations with ALDOT Bridge Design and Roadway Design
- Varying shaft diameter, length, 2 or 3 shafts
- Varying rock strength, soil strength (slope)
Preliminary Grading Plan to begin work – March 6, 2020
- 220,000 cubic yards removed prior to bridge construction
- Additional excavation at each bent for grade beams

For later:
NB7 Inclinometer and VW Piezometer
Bent 7 NB Shaft 2 (uphill)
8ft x 1.5in pipe

9.5ft perm casing
• 2 slick lines delivered concrete between Casing and Structural Pipe
• Pump boom or free fall inside Structural Pipe
• All shafts in the dry
• Specified maximum differential of concrete in/out of Structural Pipe
Post-Construction Instrumentation

To allow load in the shafts to be characterized, should ground movement occur, so that the condition of the bridge foundations, and their suitability to resist additional movement, can be established at any given time

• DETAILS:
  • Monitor slope movement and water pressures, deflection of the drilled shafts.
  • Comparison of the measured responses with predicted values.
  • Assess risk of damage of the bridge in near real-time, at least qualitatively.

Challenges with Instrumentation Plan and Installation

• Time
• Access
  • Completion of grading NOT part of incentive – delayed access for free-field locations
  • Incentive/Disincentive contract – Additional steps out of the norm for bridge construction had potential for delays
• Details of getting components to talk to each other, for hubs to talk to cloud, etc.
**As of 01/12/21:**
All 24 Shaft ShapeArrays installed
All NB free-field instruments installed (1 SA, 3 INC, 3 VWP)
SB free-field ShapeArrays installed
Utilizing 2 existing upslope and 2 downslope inclinometers from construction
SAAV Conduit – 2 per shaft
What’s Next?...or....The Story Continues......

• All instruments are gathering data and we can download it!
• ALDOT reads Inclinometers every week to two weeks
• Analysis of data – slope movements, groundwater, shaft movements, estimating loads in the shafts
• Establish protocol for comparing measured to design
• Draft Action Levels Plan in process with M&T
• DBA monitor for first year (or so), develop training for ALDOT Geotechnical Section for future
Thanks For Listening!!!