The Sandridge Surprise

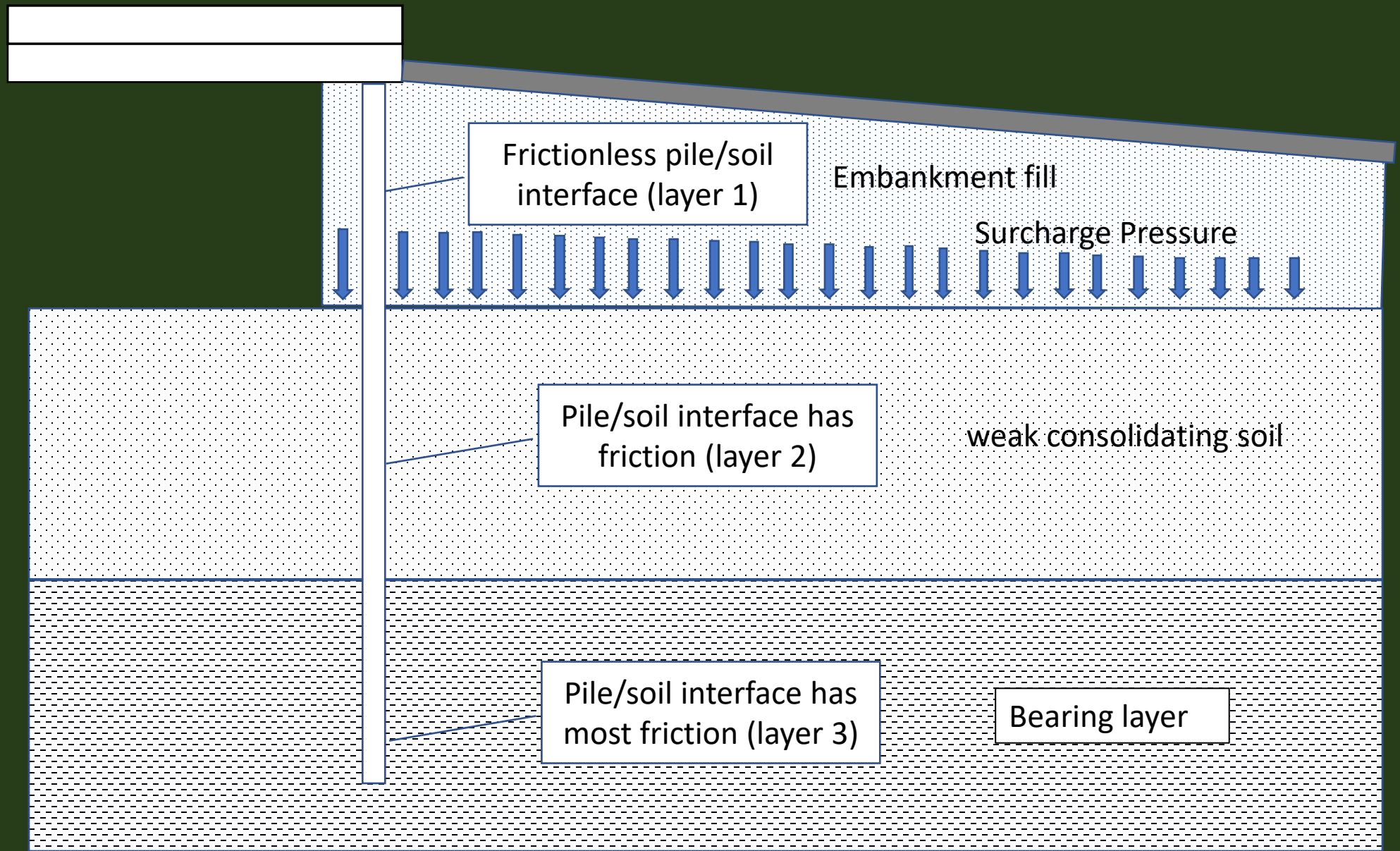
(a downdrag story)

Larry Jones, FDOT

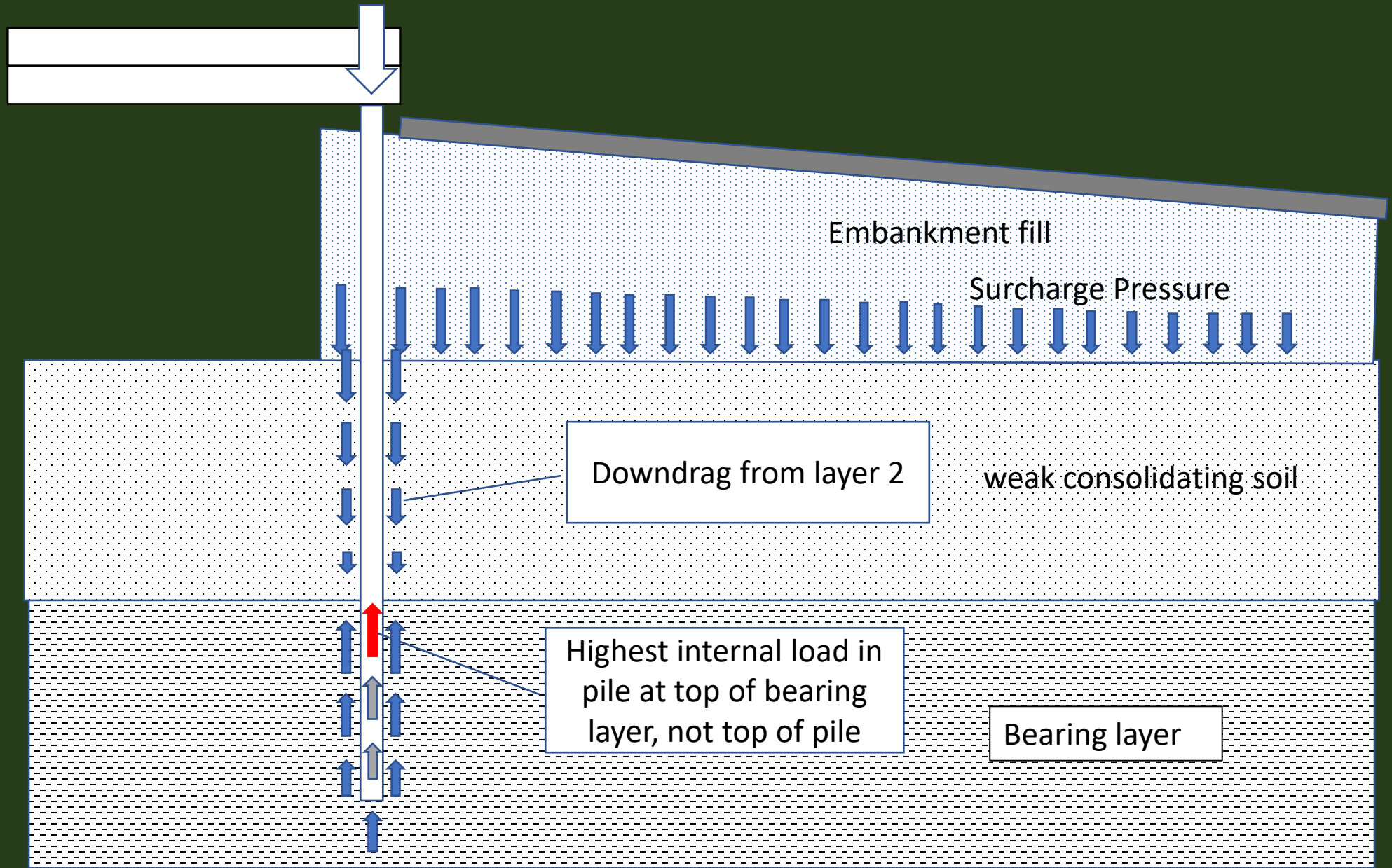
STGEC 2023

Charlotte, NC

Simple Embankment Model



Do structure loads on piles offset downdrag because they occur after the “immediate” settlements of sands supporting embankments are complete?



Sandridge Road Report -

- “Post-construction downdrag loading (negative skin friction) is not anticipated due to the primarily granular (sandy) nature of the soils encountered in the SPT borings.”

Research Project:

Field Investigation of Downdrag on Concrete Piles in Sandy Soil

GRIP 2023

Project Manager
Larry Jones

Principal Investigator
Gray Mullins

Graduate Researchers
M. Araujo, T. Mee, R. Pendyala and A. Lewis

USF UNIVERSITY OF SOUTH FLORIDA.

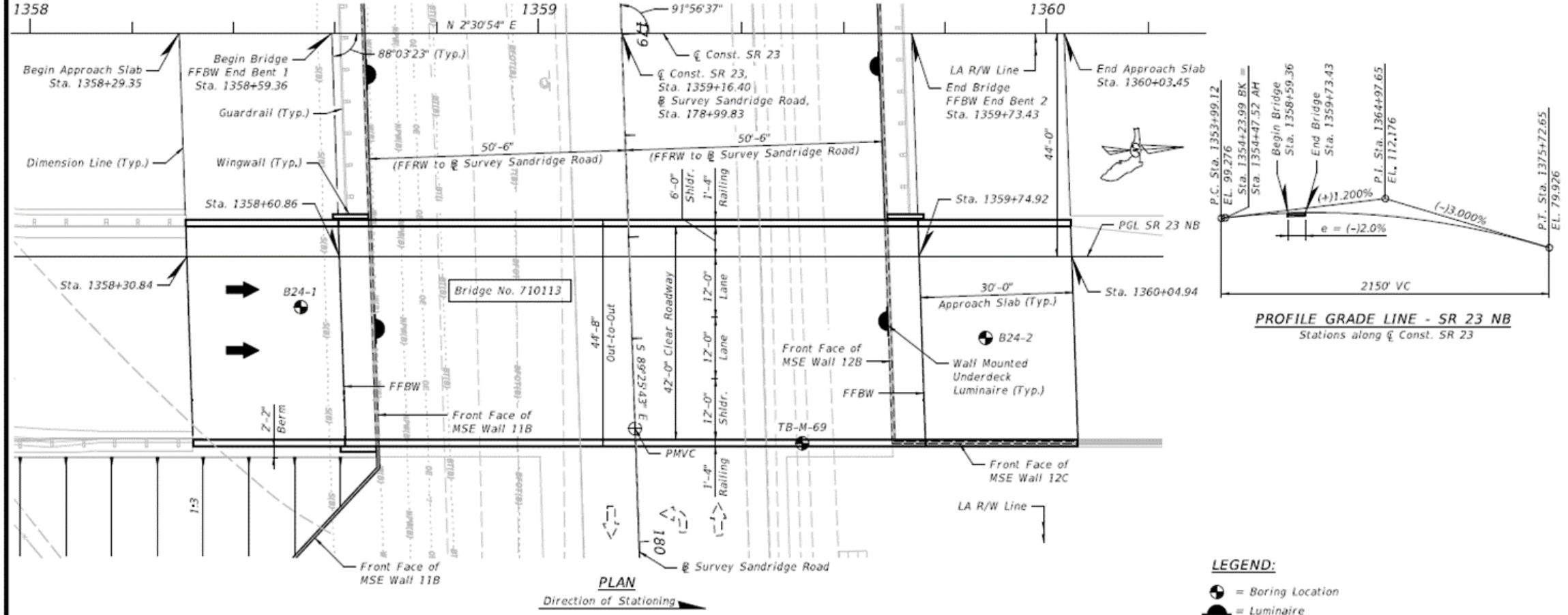
Civil & Environmental Engineering

Research Project:

- 3 Bridges on Sandy Sites
  - Sandridge Road
  - Paseo Del Mar
  - Henley Road
- Internally Instrument piles
- Instrument existing soils with settlement sensors
- Long-term monitoring

Sandridge Road Bridge

- Bridge Geometry & Approaches
  - 114-ft single span bridge over existing roadway
  - 18-in PSC pile end bents
  - Wraparound MSE Abutments, approx. 26-ft high
- Soil Profile
  - Loose light gray sands in the upper strata over dense light gray sands
- Predicted Settlement
  - Modified Hough Method = 4.6 inches
  - Schmertmann Modified Method = 3.6 inches

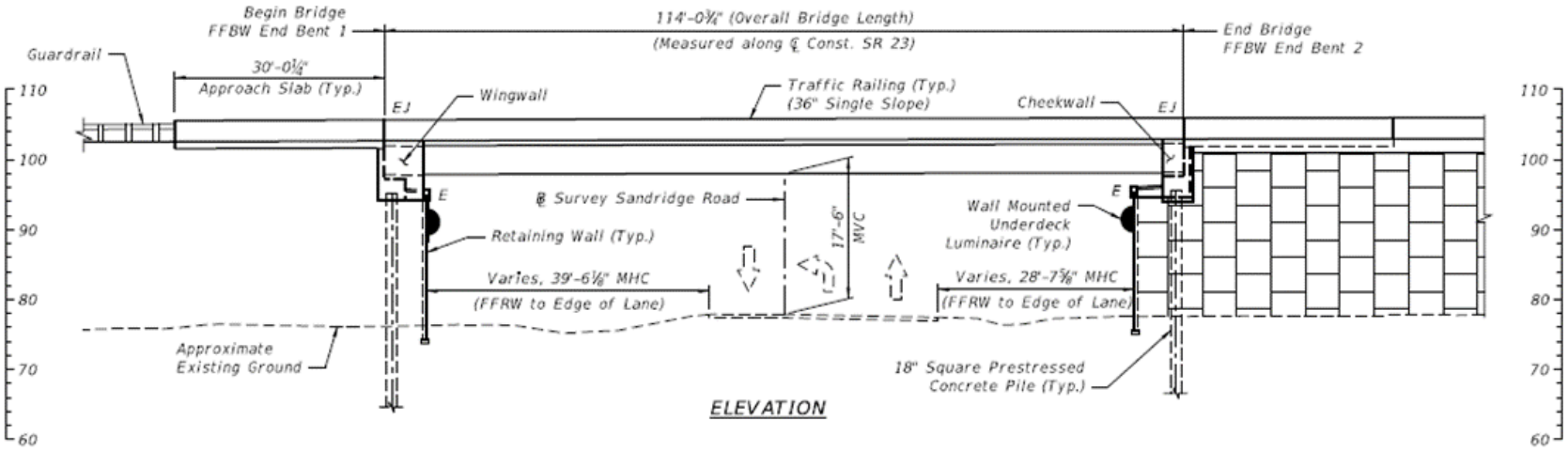


PLAN

Direction of Stationing

PROFILE GRADE LINE - SR 23 NB

Stations along ℄ Const. SR 23



ELEVATION

LEGEND:

◓ = Boring Location

◗ = Luminaire

NOTES:

1. For Traffic, Horizontal Alignment, and Vertical Profile Data not shown here, see Roadway Plans.
2. For location of utilities, see FOUNDATION LAYOUT sheet.
3. All expansion joints are a poured joint with backer rod system, unless noted otherwise.

TRAFFIC DATA

Current Year Estimate = N/A
Opening Year Estimate = 2030 AADT = 11,400
Design Year Estimate = 2050 AADT = 16,400
K = 9.4%
D = 55.0%
T = 14.0% (24 Hour)
Design Hour T = 7.0%
Design Speed = 70 MPH

Bridge No. 710113

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REVISIONS

ALEXANDER DACOSTA, P.E.

DRAWN BY:

SHEET TITLE:

REF. DWG. NO.

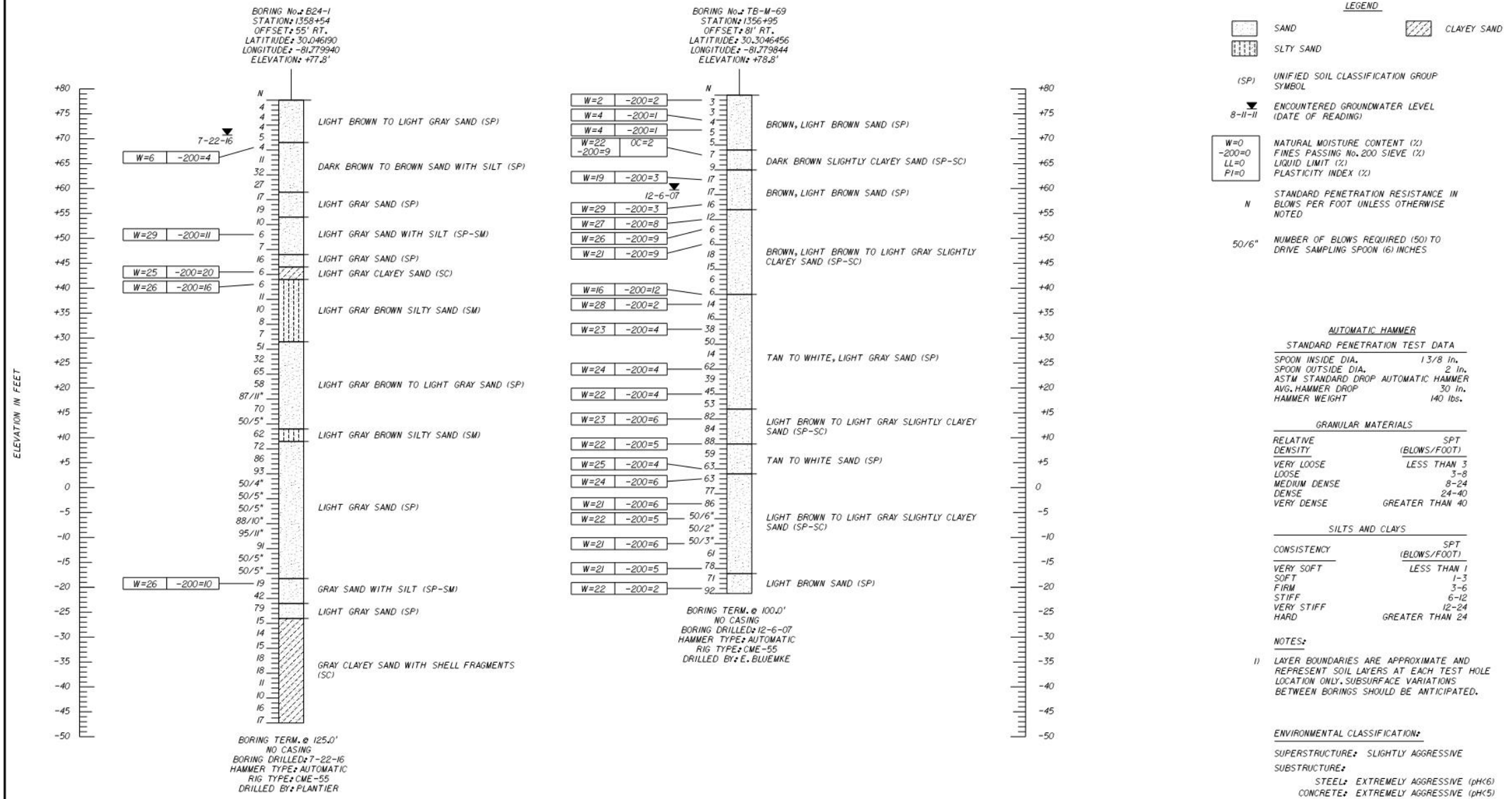


EXHIBIT A-6

BRIDGE NO. 710113

Design Loads

- Pile Loads (Service):
  - DL = 81 tons (162k)
  - LL = 41 tons (82k)
- Factored Design Loads:
  - DL = 1.25 (81) = 101.3 tons (202.6k)
  - LL = 1.75 (41) = 71.7 tons (143.4k)
  - FDL = 173 tons (346k)
- Required Nominal Bearing Resistance
  - (173)/0.65 = 266.2 => 267 tons (534k)

NBR=267 tons, FDL=173, DD=0

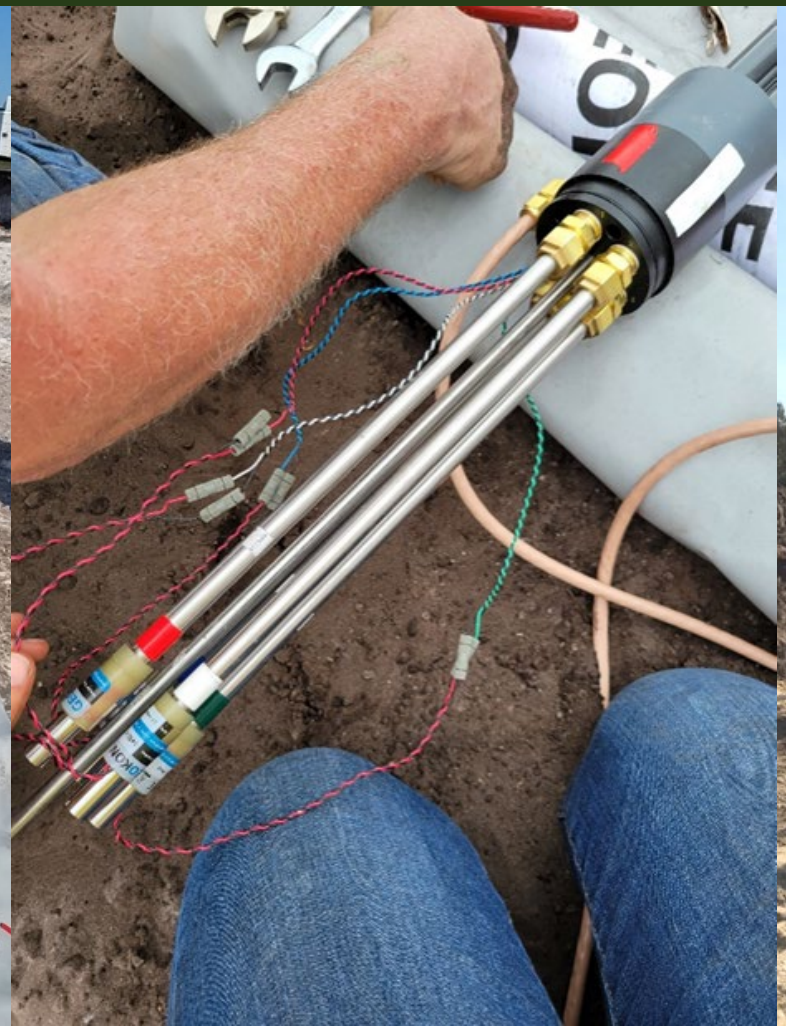
PILE DATA TABLE

INSTALLATION CRITERIA								DESIGN CRITERIA							
PIER or BENT NUMBER	PILE SIZE (in.)	NOMINAL BEARING RESISTANCE (tons)	NOMINAL UPLIFT RESISTANCE (tons)	MINIMUM TIP ELEVATION (ft.)	TEST PILE LENGTH (ft.)	REQUIRED JET ELEVATION (ft.)	REQUIRED PREFORM ELEVATION (ft.)	FACTORED DESIGN LOAD (tons)	FACTORED DESIGN UPLIFT LOAD (tons)	DOWN DRAG (tons)	TOTAL SCOUR RESISTANCE (tons)	NET SCOUR RESISTANCE (tons)	100-YEAR SCOUR ELEVATION (ft.)	@ COMPRESSION	@ UPLIFT
End Bent 1	18	267	N/A	N/A	95	N/A	N/A	173	0	0	N/A	N/A	N/A	0.65	N/A
End Bent 2	18	267	N/A	N/A	95	N/A	N/A	173	0	0	N/A	N/A	N/A	0.65	N/A

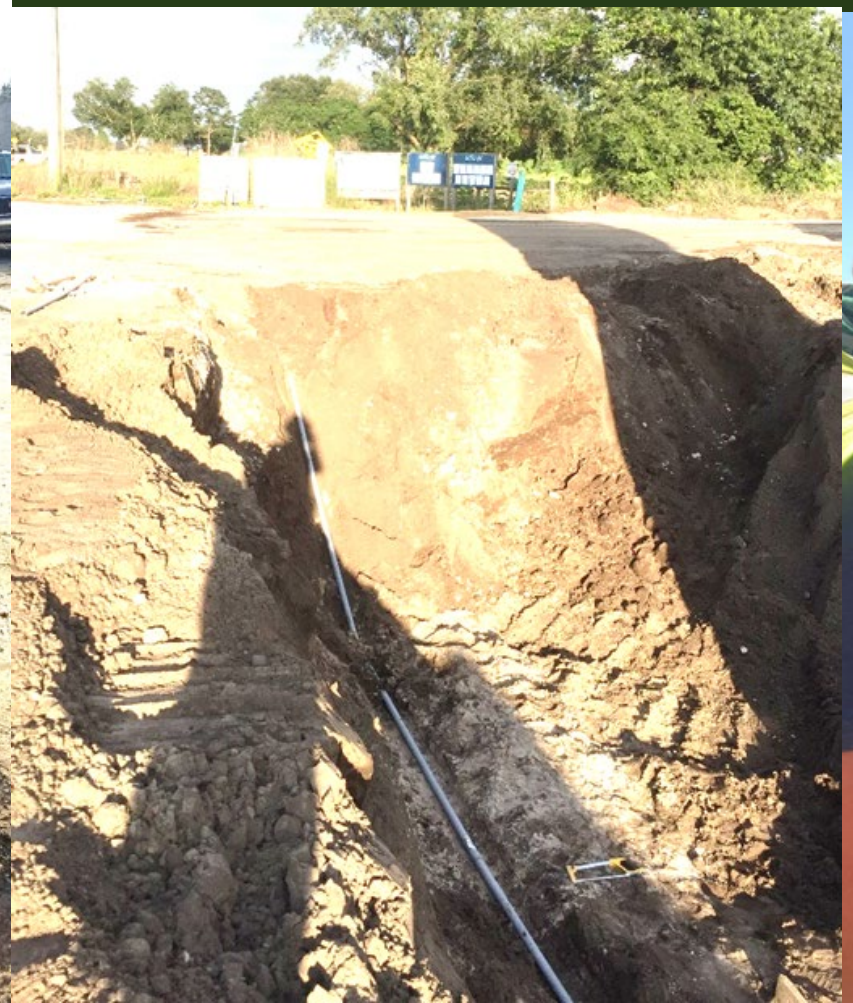
Instrumenting Piles

Pile Instrumentation

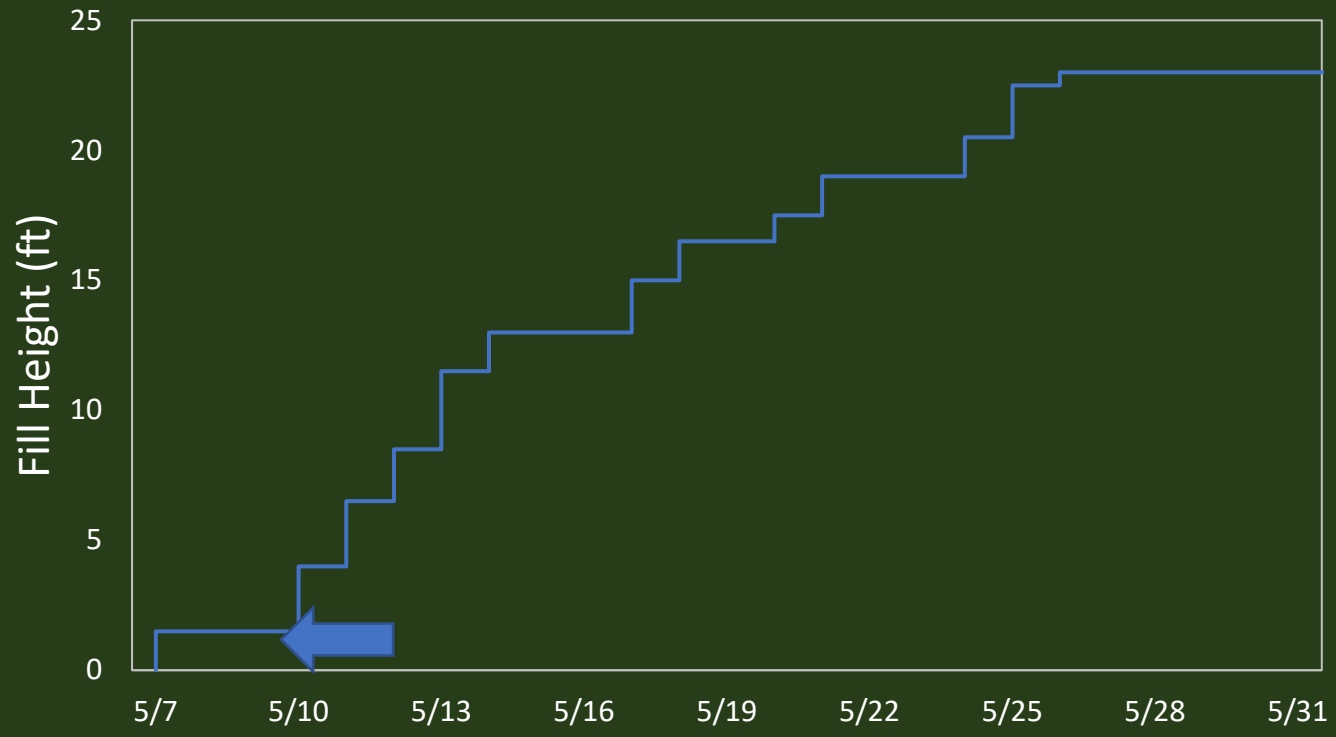
Instrument the Ground 15-ft from the Pile



Protect Instrument Leads for Monitoring



Sandridge Road Backfill



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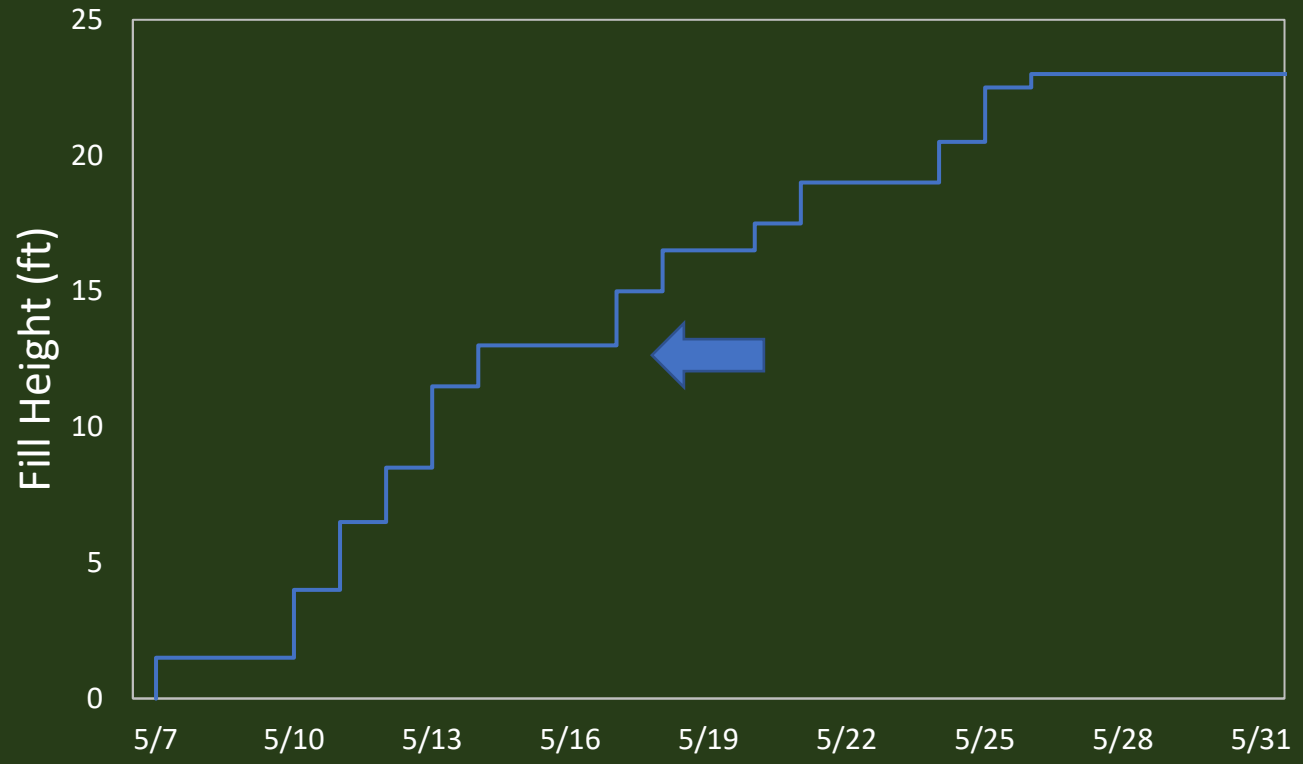

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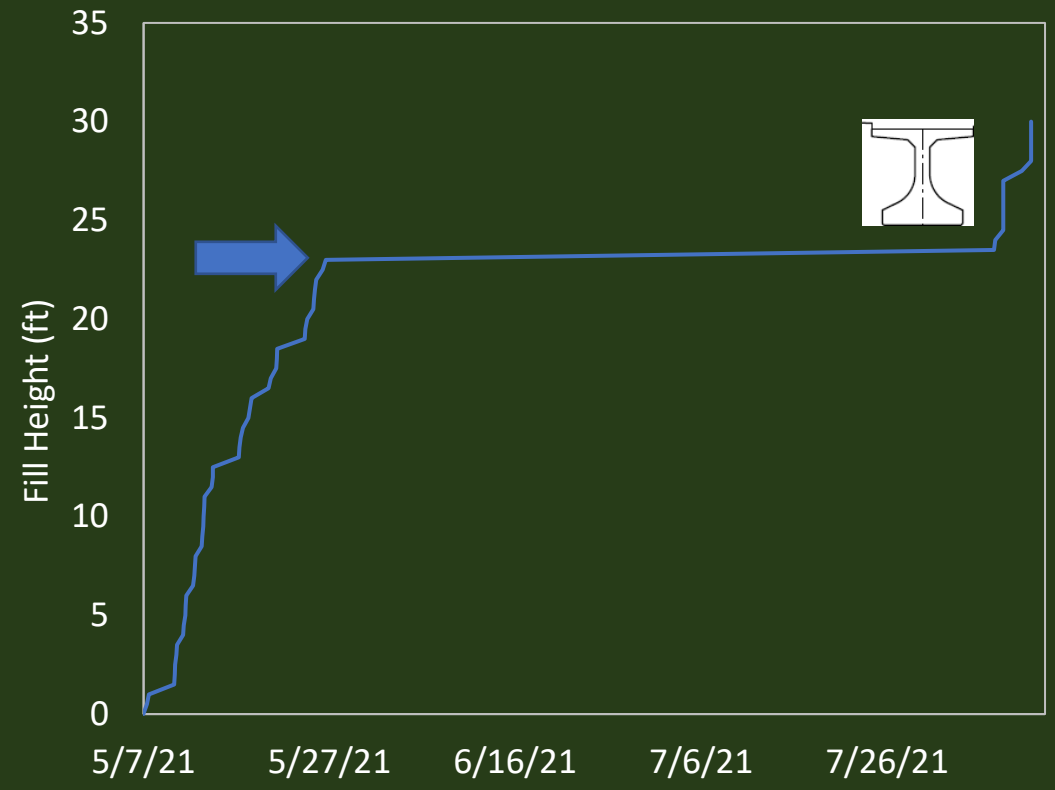
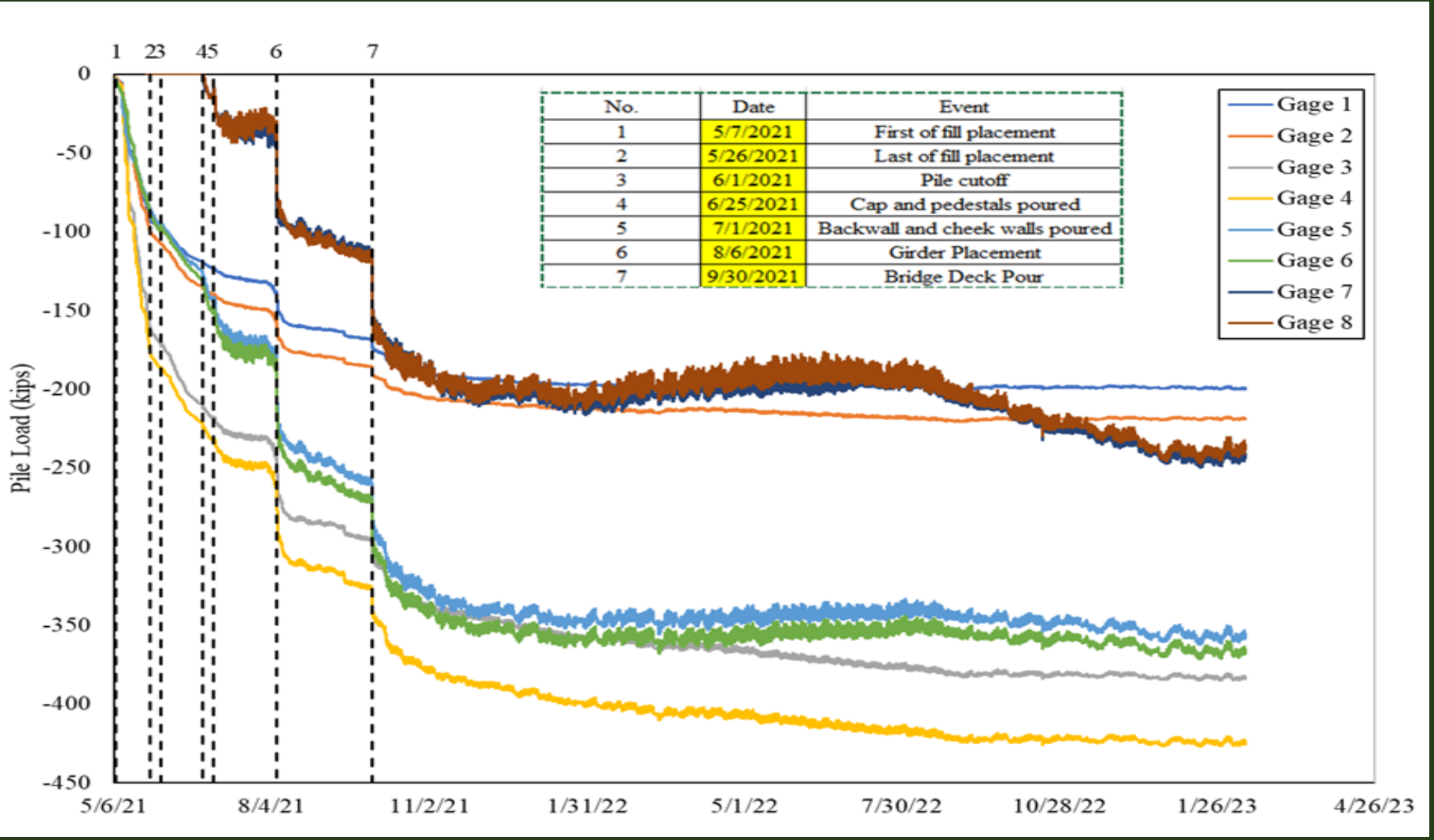
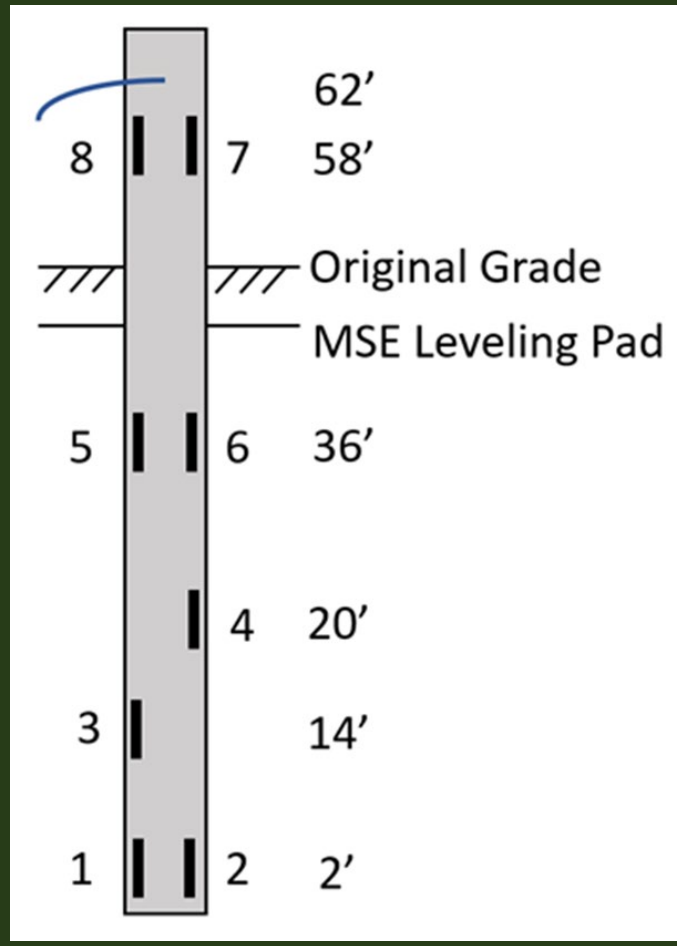


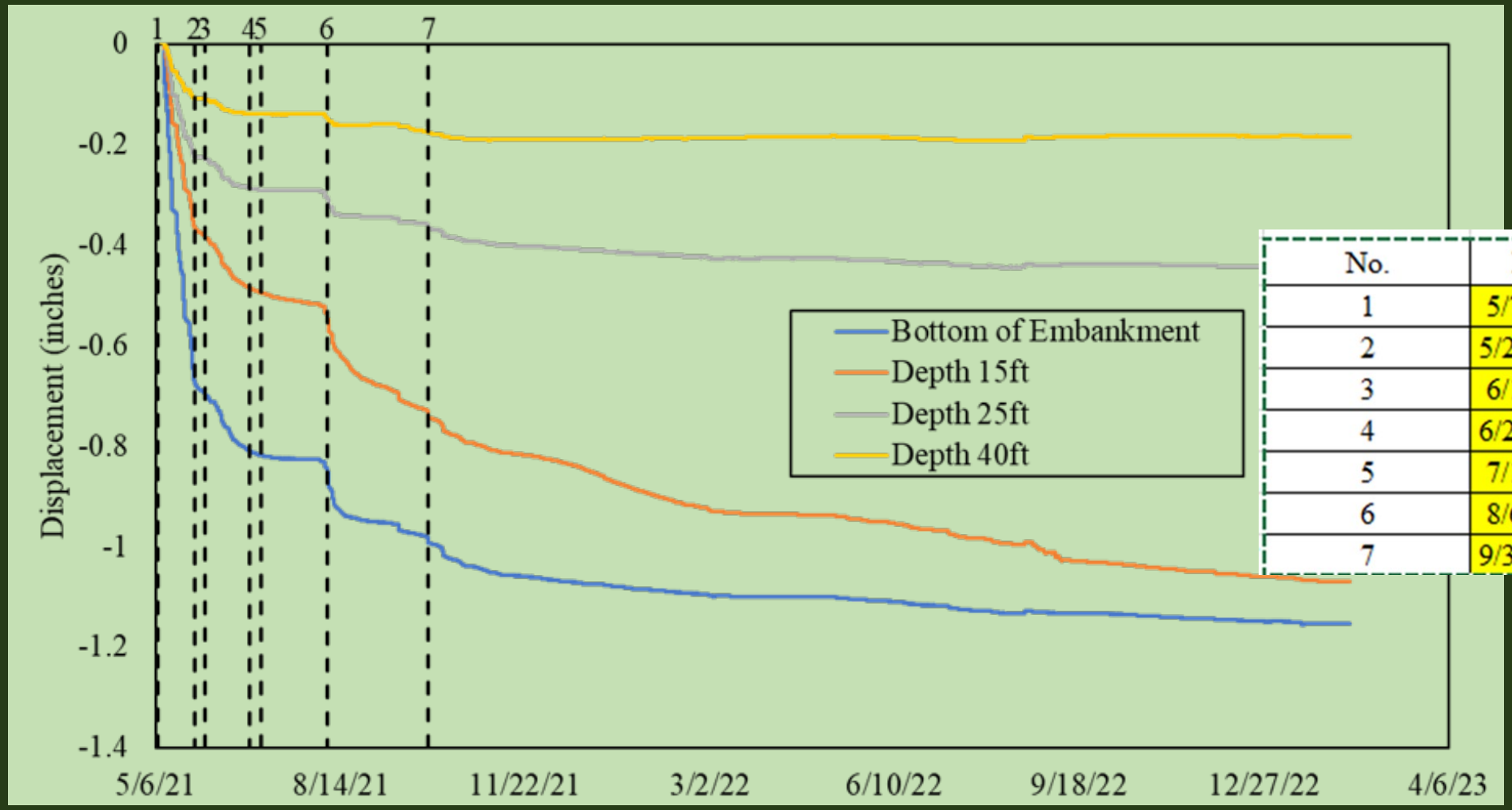
Pile Forces vs Time



No.	Date	Event
1	5/7/2021	First of fill placement
2	5/26/2021	Last of fill placement
3	6/1/2021	Pile cutoff
4	6/25/2021	Cap and pedestals poured
5	7/1/2021	Backwall and cheek walls poured
6	8/6/2021	Girder Placement
7	9/30/2021	Bridge Deck Pour



Settlements Measured by Extensometer



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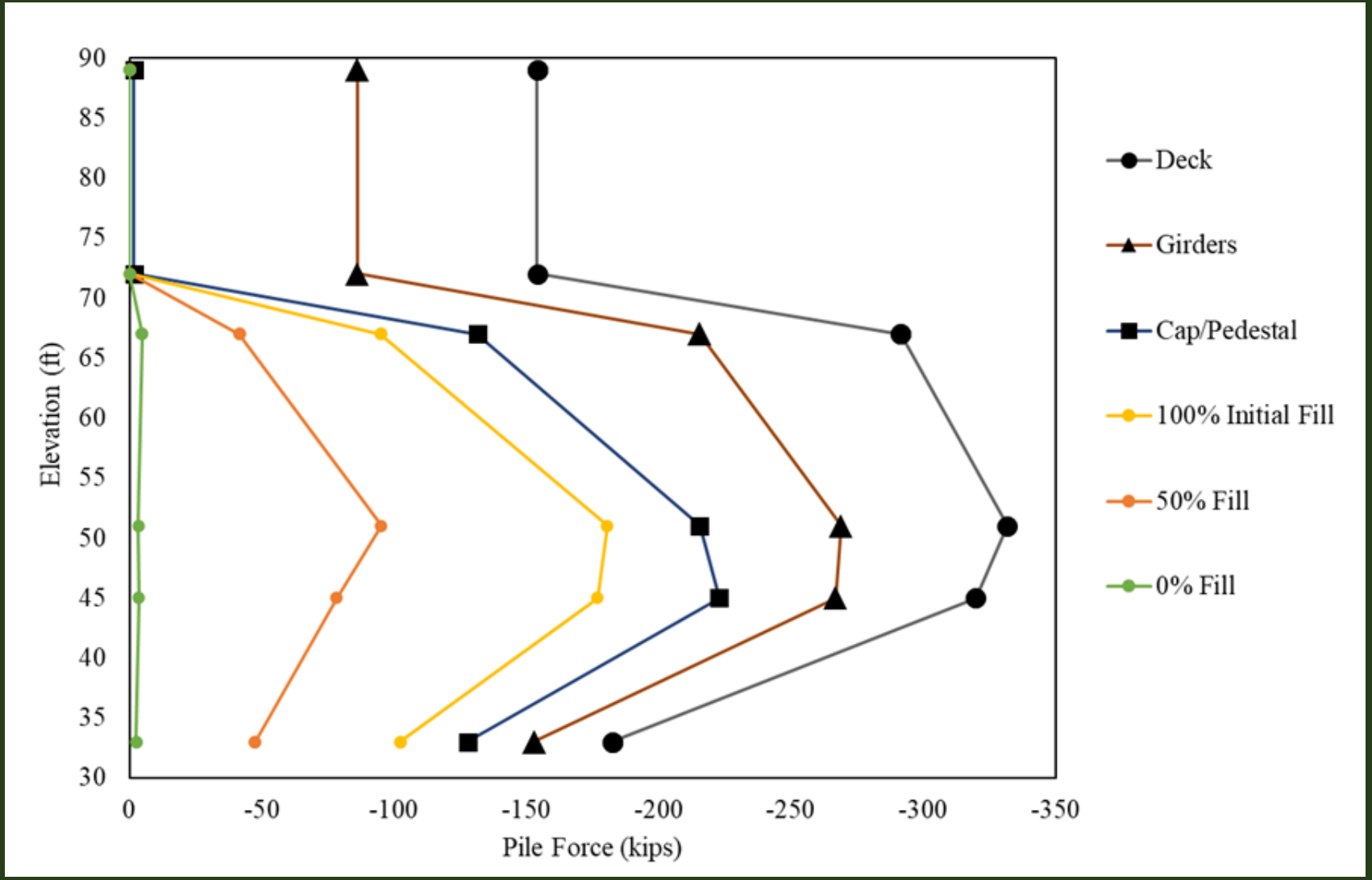
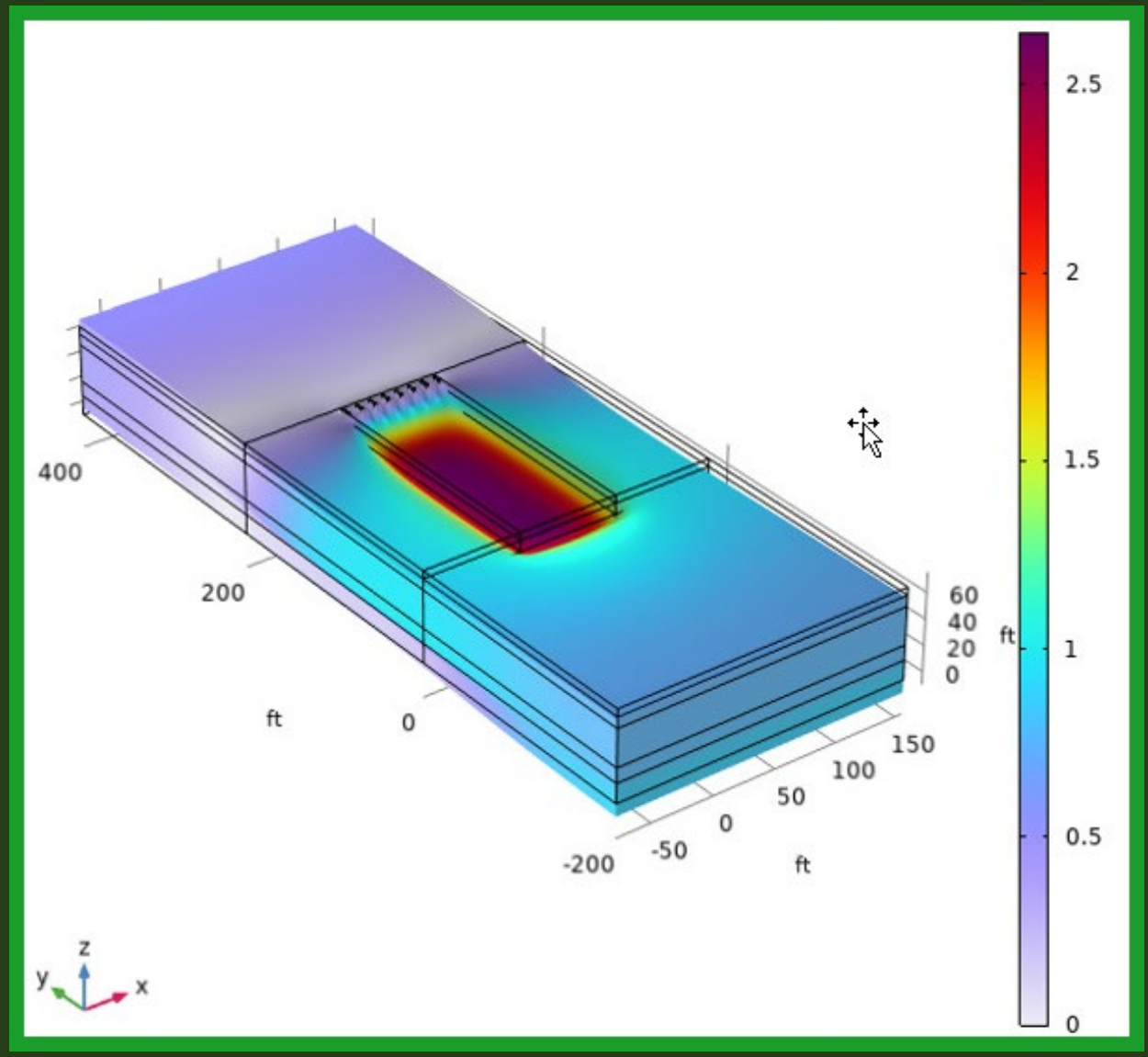
Sandridge Road Pile Forces vs Construction

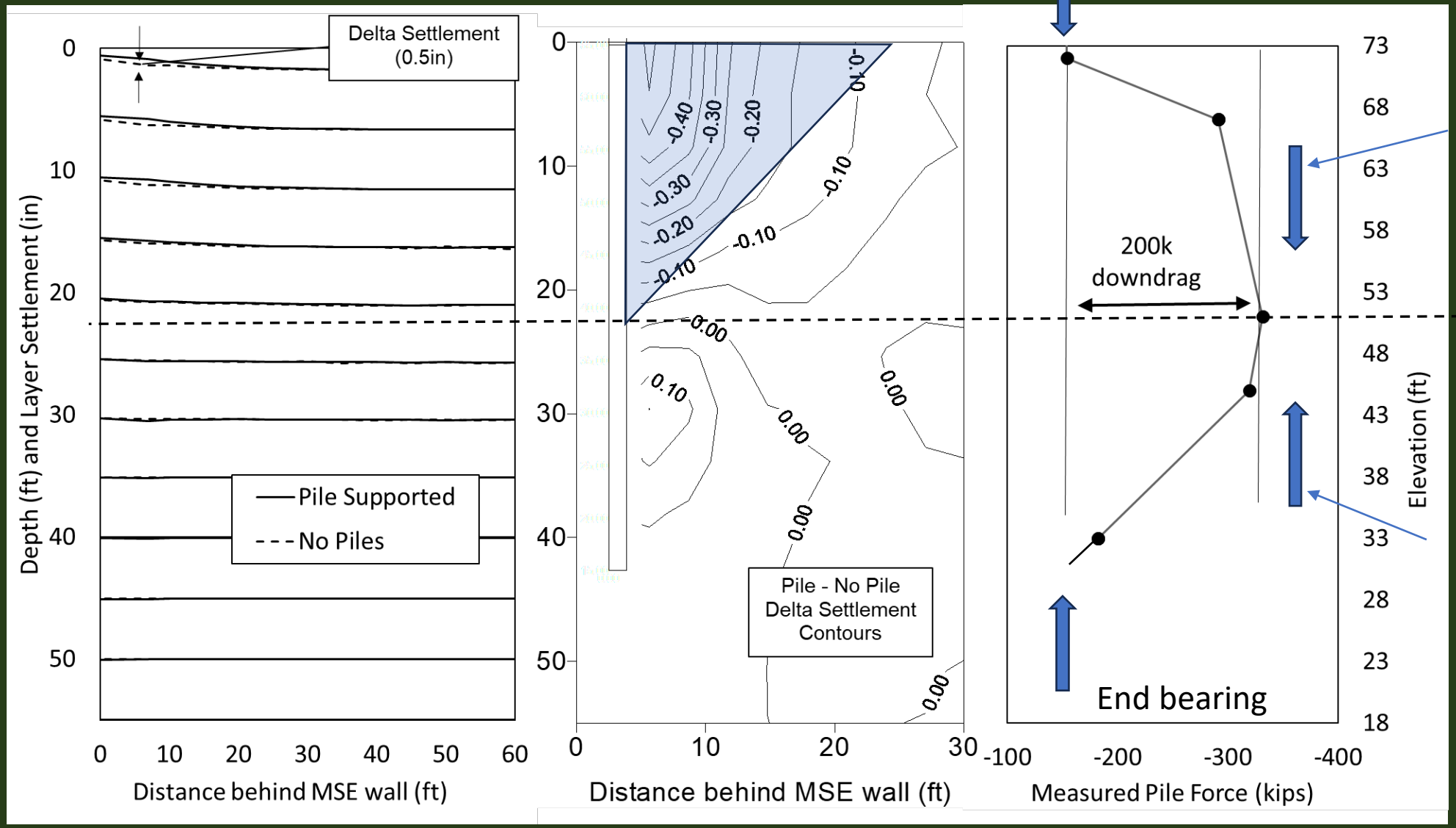



-280
-285
-290
-295
Force (kips)
Feb 17, 2023 at 9:21:49 AM
2540–2548 Sandridge Rd
Green Cove Springs FL 32043
United States
Full Truck Load (Event 4, 4.6mph)

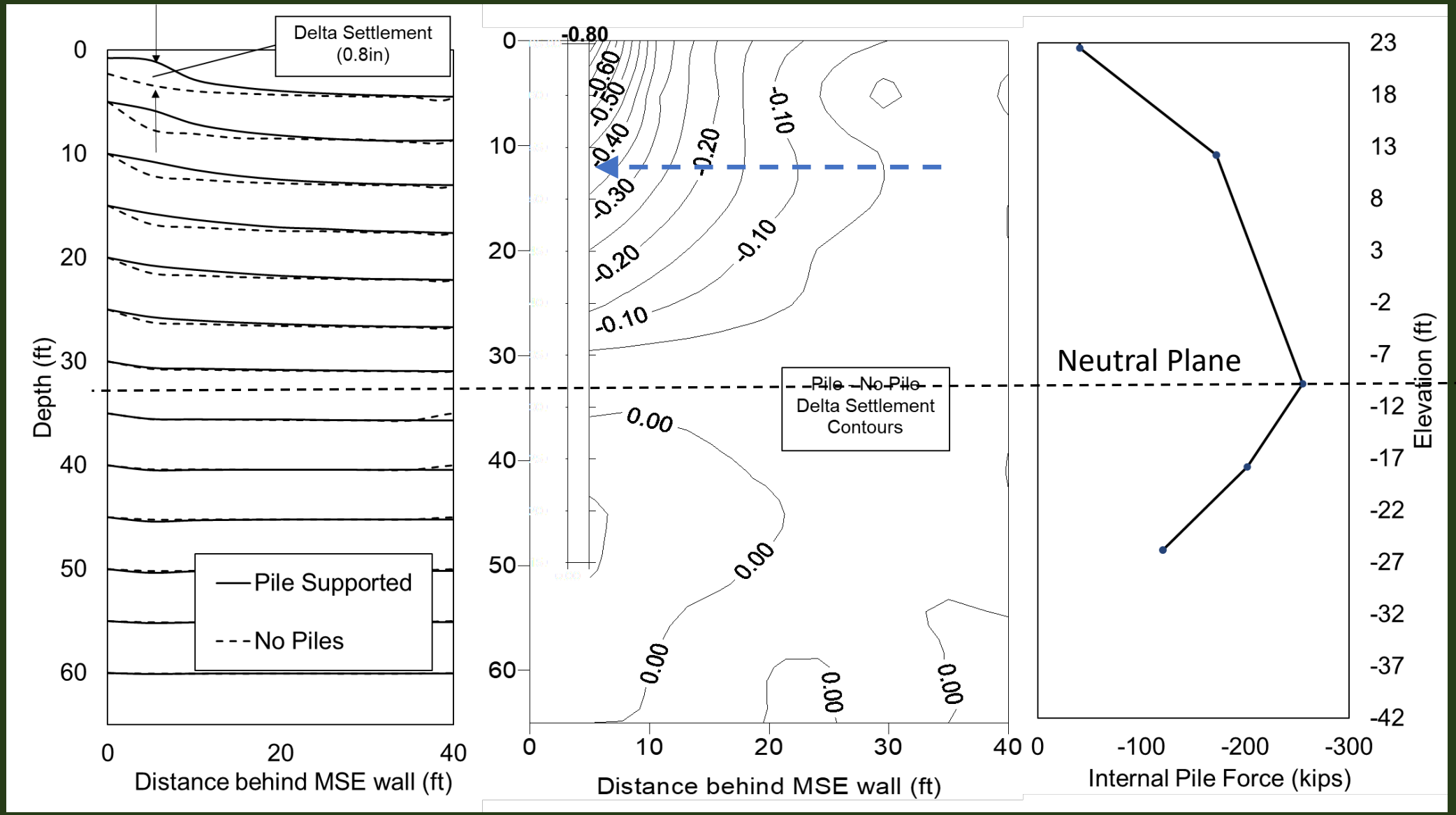
FEM of Soil Settlement



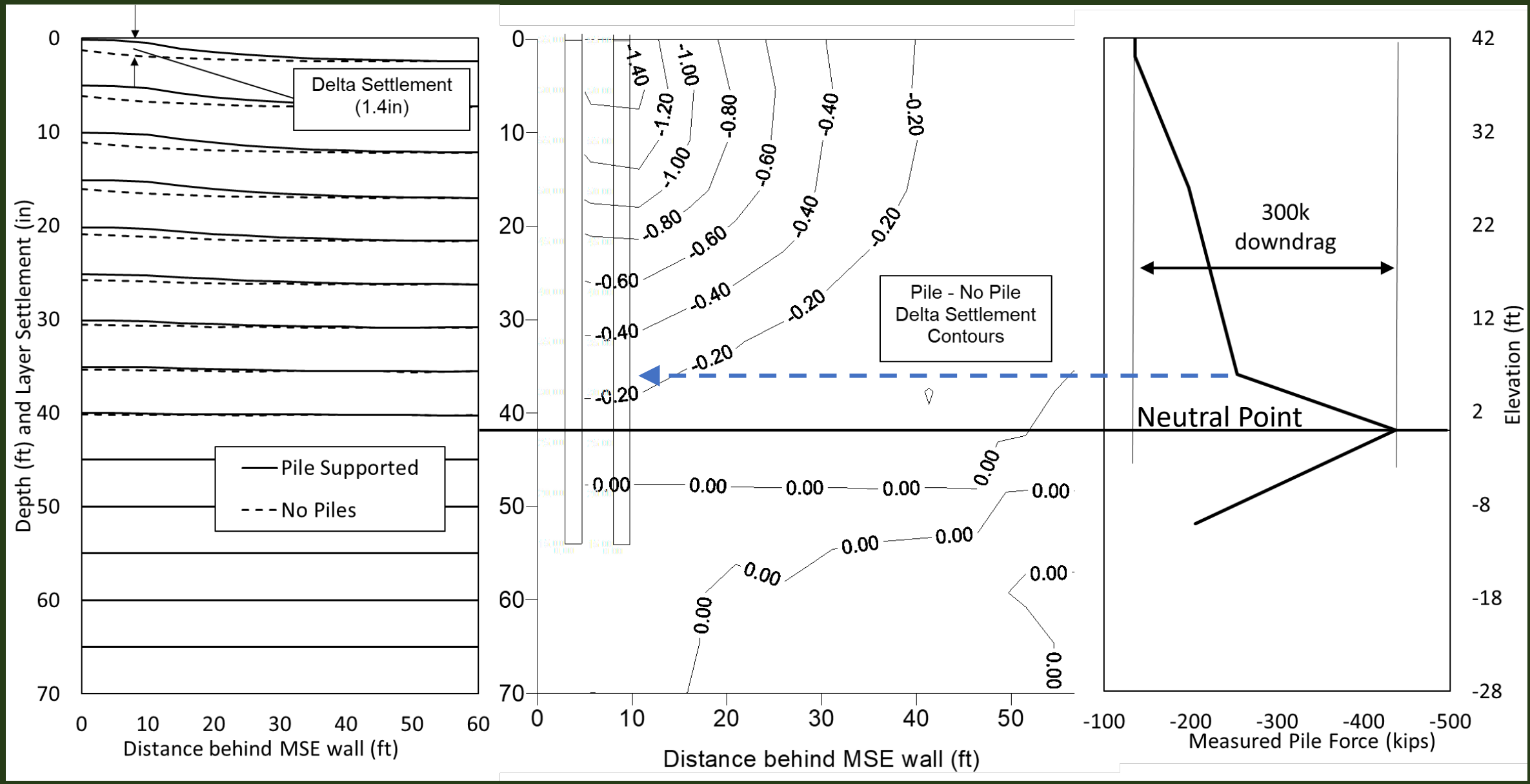
Sandridge Rd Delta Settlement



Henley Rd Delta Settlement



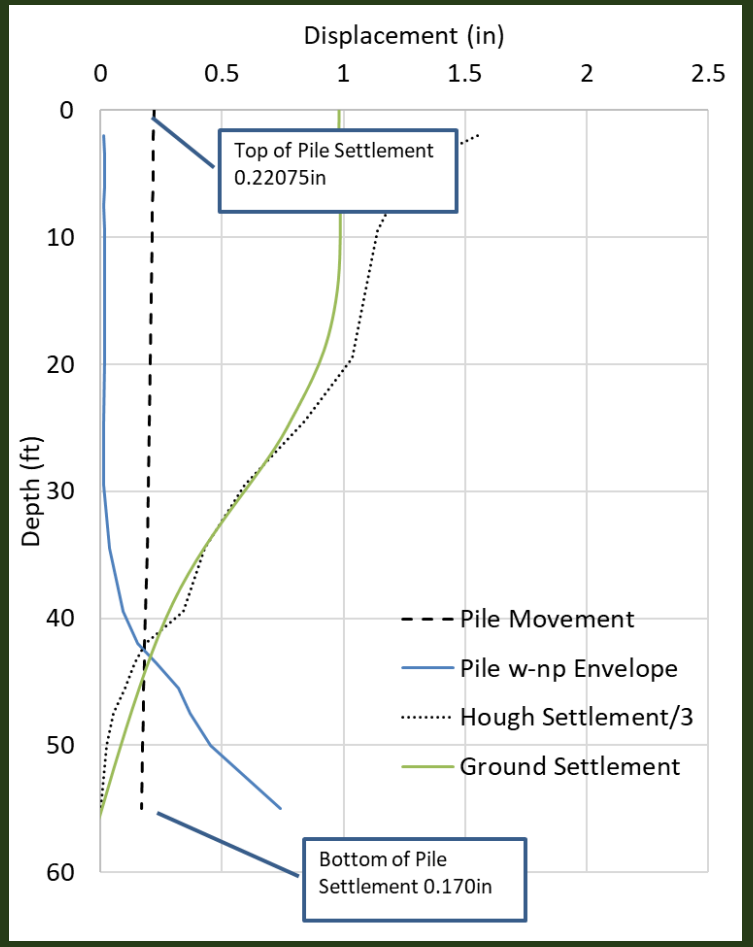
Paseo Al Mar Blvd Delta Settlement



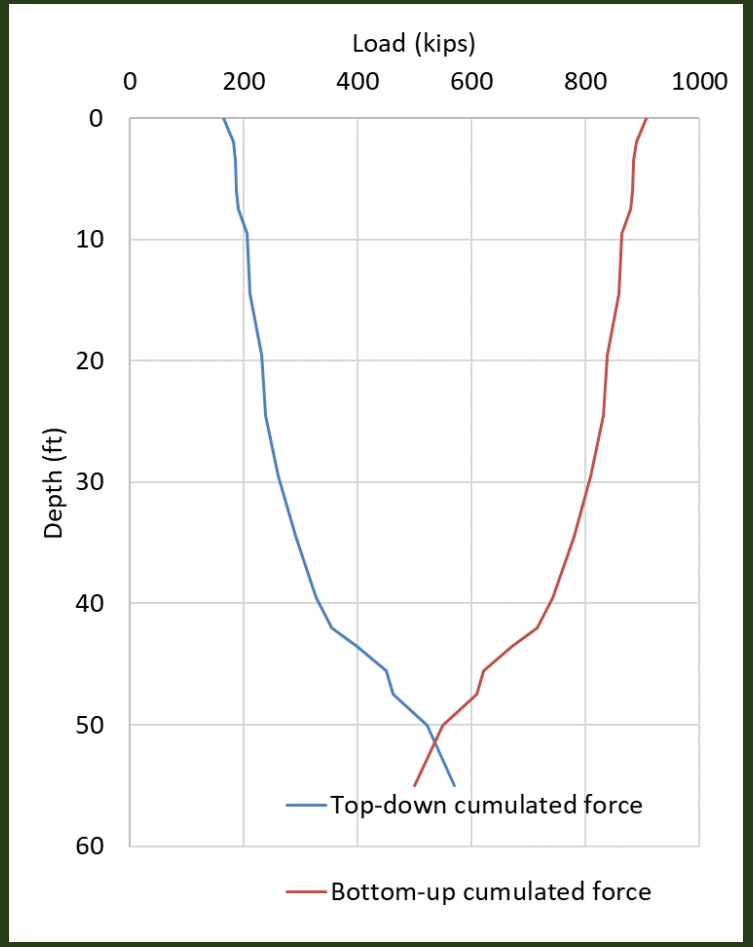
Predicting Downdrag (Paseo Al Mar shown)

Briaud & Tucker's

Neutral Point Method



Neutral Plane Method




Questions?