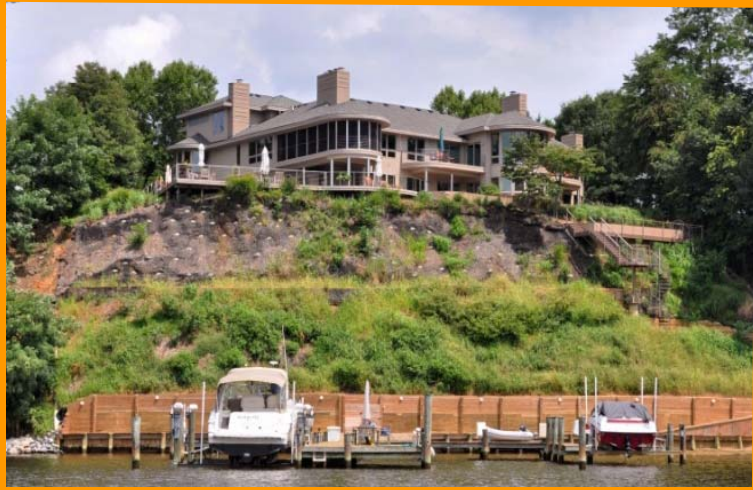
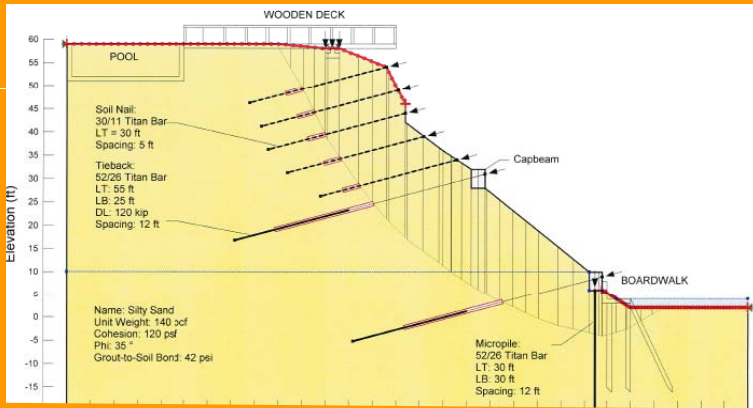


Severn River Bluff Stabilization

Dr. Jesús Gómez, P.E., D.GE



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ENGINEERING

Authors

- **Javier Rodriguez, P.E.**
M.R. Drilling, San Juan, PR
- **Helen Robinson, P.E.**
Schnabel Engineering, West Chester, PA
- **Robert Traylor**
Traylor Group LLC, Saint Michaels, MD

Outline

- Description of site
- Geotechnical issues
- Stability analyses and design concept
- Construction and monitoring
- Closure

Site Description



Site Description



Site Description



Geotechnical Issues



Geotechnical Issues

- Landslide affecting entire slope
- Overturned trees
- Damaged timber wall and pier
- Collapsed staircase and trolley
- Undermined deck
- Total loss of access to pier

Geotechnical Issues



Geotechnical Issues

- Soils are sands and silty sands
- Lightly cemented
- Very susceptible to erosion
- Old roots acted as water conduits
- Very loose near surface due to disturbance
- High groundwater table

Geotechnical Issues



Geotechnical Issues



Geotechnical Issues



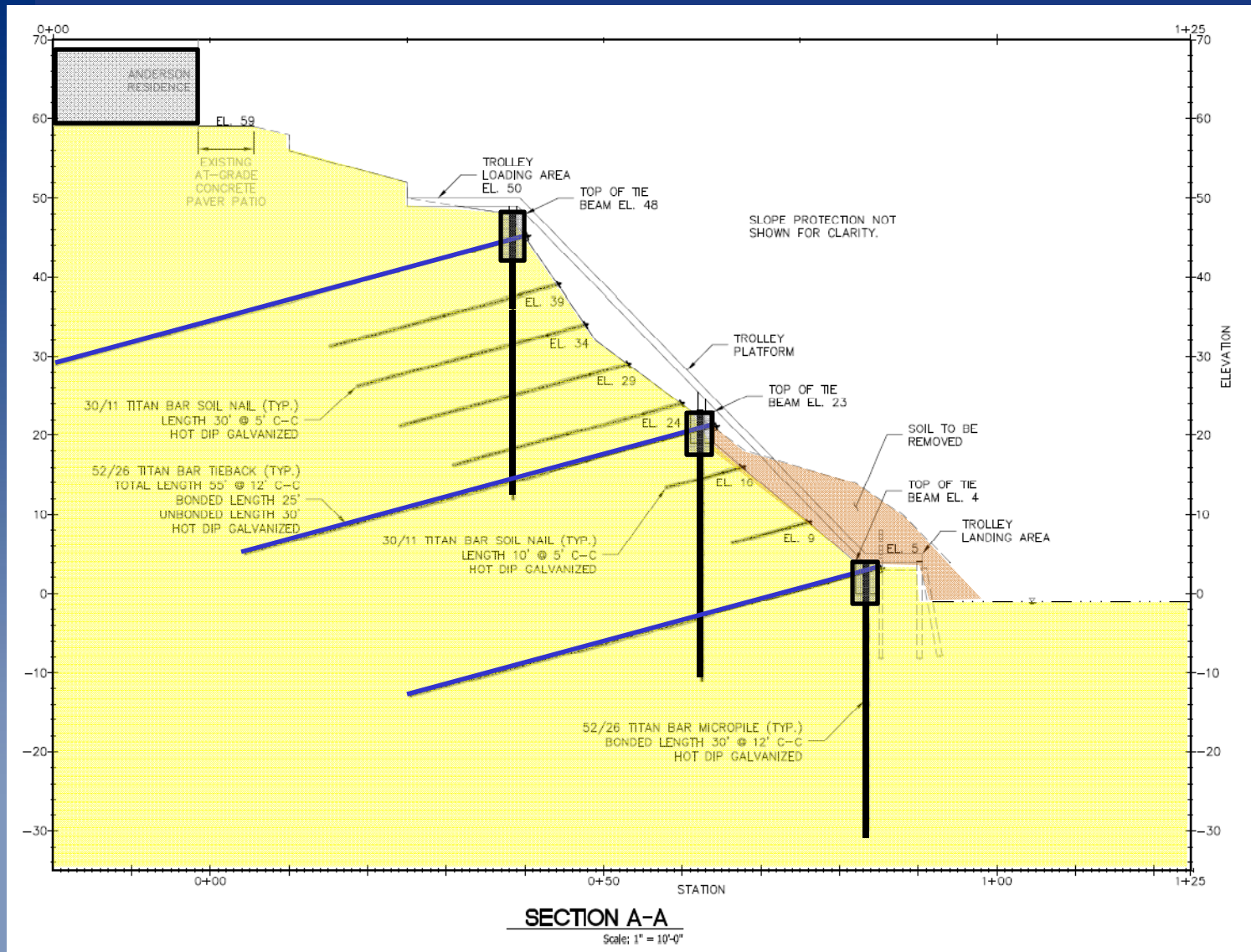
Geotechnical Issues



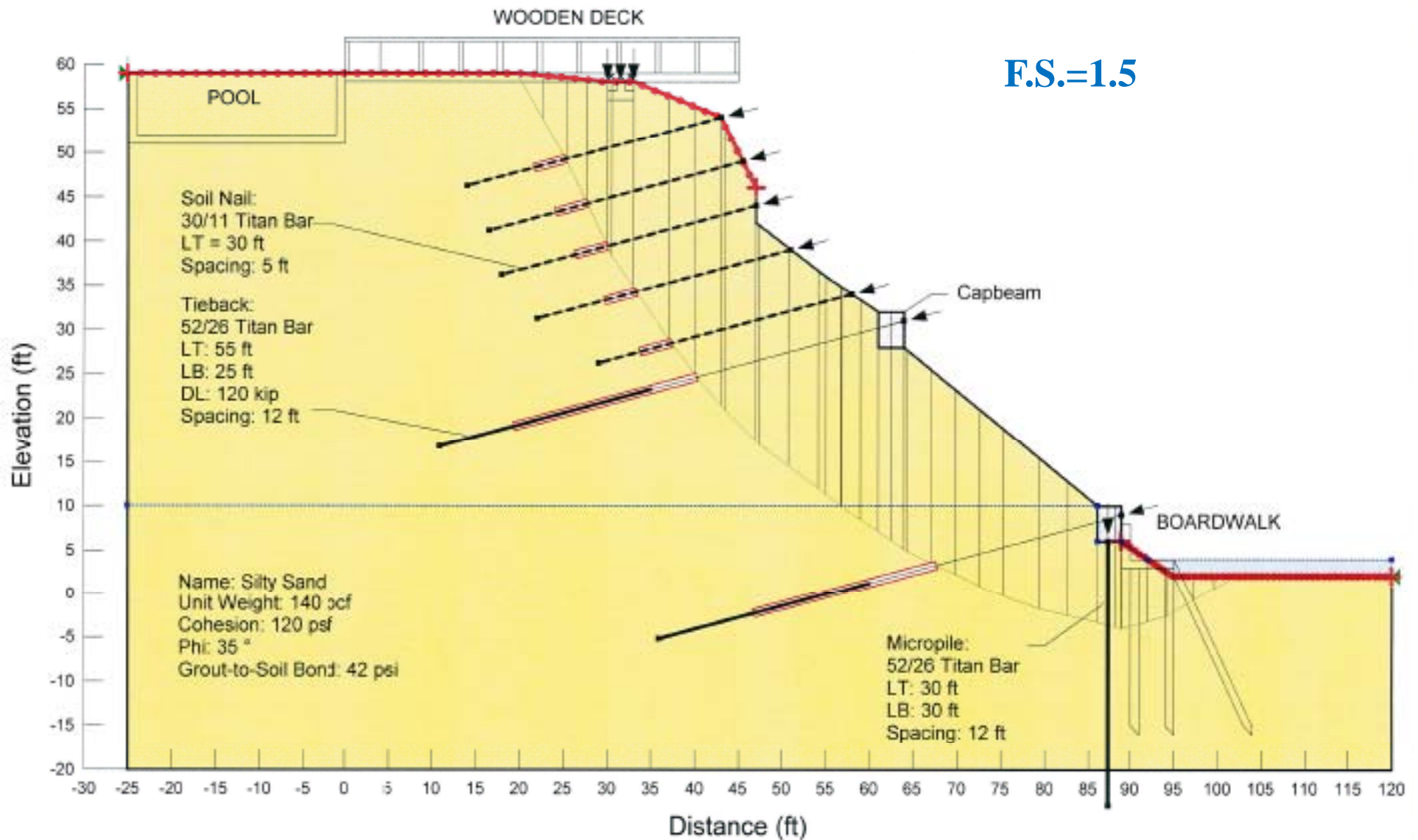
Stability Analyses

- Performed back analyses based on known slide geometry
- Developed set of soil strength parameters and compared to correlations with SPT blowcount
- Analyzed a system of micropiles and tiebacks connected through cap beams for global stability
- Included soil nails for local stability
- Designed cap beams to safely transfer tieback loads to loose surface soils

Stabilization concept



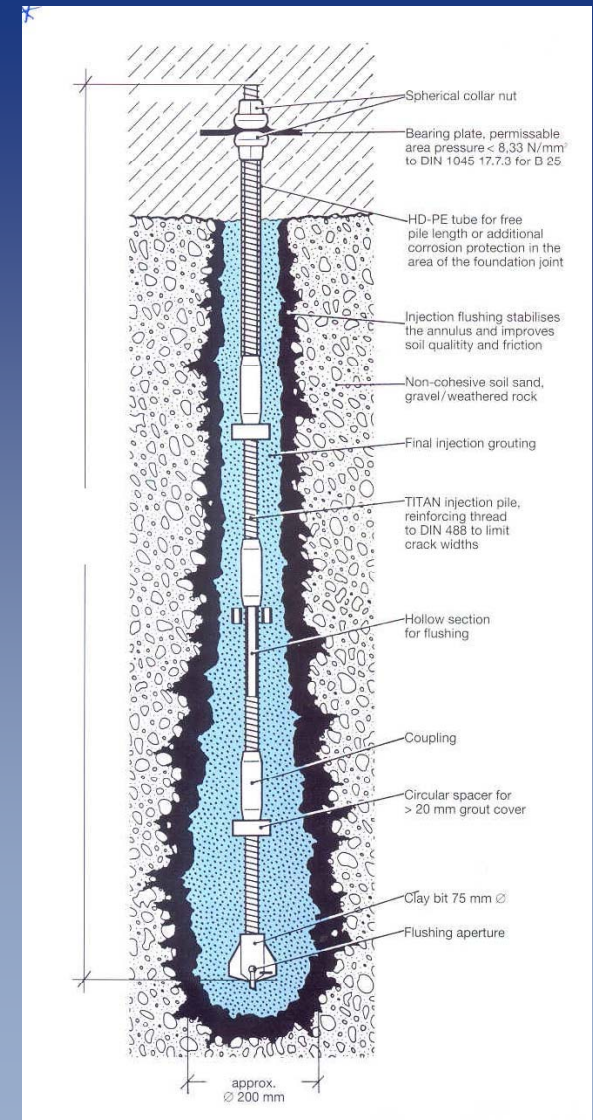
Stability Analyses



Construction

- No access from surface
- Drilling operations:
 - ◆ Most drilling using drill mast suspended from crane
 - ◆ Crane on barge or toe of slope
- Used hollow core bars for micropiles, tiebacks, and soil nails
- Faster!
- Large Capacity!
- Exerted tight control of spoils

Hollow Core Bars



Construction



Construction



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Inclinometers



Construction



Construction



Construction



Construction



Construction



Construction

- Micropiles also used to underpin undermined deck
- “Surgical” procedure carefully removing wood floor boards and replacing them
- Connected to deck using steel needle beams encased in concrete
- Increased density of soil nails immediately below deck to prevent lateral movement

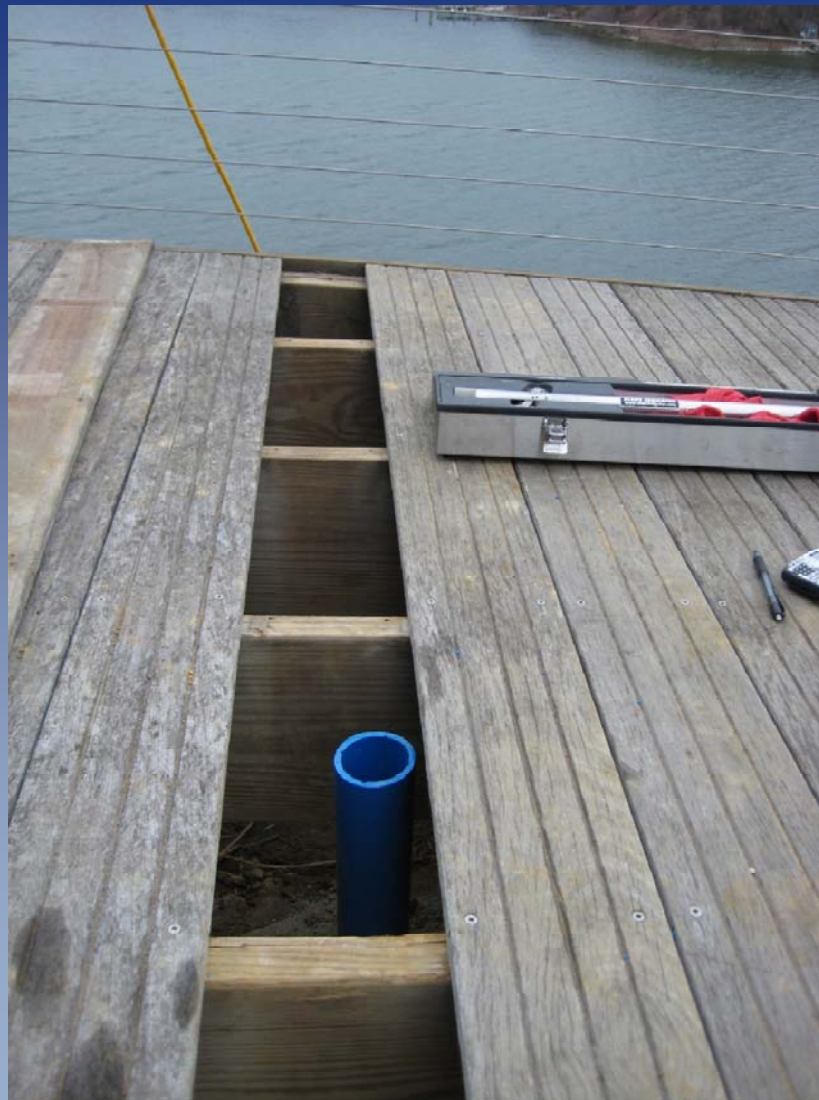
Construction



Construction



Construction



Construction

- Micropile design bond strength verified through load tests on soil nails and tiebacks
- Maximum mobilized bond stress about 42 psi in average during tests
- Most tests did not fail

Construction



Construction



Construction



Construction



Construction



Construction



Construction



Construction



Construction



Construction



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Construction



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Construction



Closure

- Inclinometers show no movement since stabilization
- Use of hollow core bars was fundamental to speed and safety
- Limited disturbance to soils

jgomez@schnabel-eng.com



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