MEASURING AND COMPARING SOIL PARAMETERS FOR A LARGE BRIDGE ON EAST COAST OF UNITED STATES

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SUBSURFACE INVESTIGATION

- Performed CPT, DMT, PMT, VST, SPT and Seismic with True Interval (0.50 m) DMT Module
- Discuss what techniques we used to more efficiently perform these tests
- Compare the undrained shear strengths and deformation moduli from the tests
- Tests were performed in clusters at the north and south ends of the channel

Subsurface Information from 1939

15-TON CAPACITY SEA FLOOR DIRECT PUSH SYSTEM

Base Area = 120 sq. ft.

Using Spreader Frame to Keep Sling Vertical
PERFORMING DILATOMETER USING SEAFLOOR SYSTEM

ADVANTAGES OF SEAFLOOR DIRECT PUSH — LIKE PUSHING ON LAND

- Testing starts at the mudline
- Measure the strength and deformation properties of very soft muds
- 3-inch casing attached to the top of the seafloor system and extended to the barge deck serves as fixed reference to measure the test depths
- Does not move with either waves or the tide and provides accurate measurements
- Attached hydraulic and air hoses to casing
- Rod pushing avoids zone between barge deck and mudline of parasitic rod buckling or lateral movement of casing
- Probes are pushed at a constant 2 cm/sec rate
- Waves do not alter this rate or cause pinching of cables

P-Y ANALYSES FROM DILATOMETER SOUNDING

VERTICAL PILE CAPACITY FROM CPT SOUNDING

PRESSUREMETER TESTS

- Used Texam Unit and performed strain-controlled tests
- About 40 data measurements/test
- Measured pressures with a digital gauge—accurate to 1 kPa
- Used 74 mm tri-wing bit for cohesive soil and 76 mm tri-cone bit for cohesionless/cemented soil
- High quality borehole critical—experienced drillers important

Corrected Pressuremeter Test Results
VANE SHEAR TESTS

- Used AP van den Berg I-VANE
- Vane Motor at bottom of hole turned vane and measured torque
  - No parasitic rod friction
- Computer at surface read values from connecting cable and displayed results while performing test
- Peak: turned vane 0.1°/sec for ¼ revolution
- Rapid turning 6°/sec for 10 revolutions
- Remolded: turned vane 0.1°/sec for ¼ revolution

STANDARD PENETRATION TESTS

- Used 125 mm diameter steel casing telescoped inside 200 mm diameter steel casing
- Added bentonite and polymers to the river water to make drilling mud—added soda ash to reduce the pH
- Used NWJ drill rods (35 mm ID) for good mud circulation
- Drill rods and Steel Casing were quite heavy for drill crew to maneuver
  - Used crane on barge to either lower or remove them from hole
  - Drilled lowered front jacks moving drill derrick out of way
  - Crane could handle 110 feet (34 m) with each of its two hoists
- Crane significantly improved efficiency of drilling/sampling operations

TRUE INTERVAL SEISMIC TESTS

- Contract required both compression and shear seismic tests to 55 meters below mudline
  - Compression waves measured the speed through incompressible water (1500 m/s—wasteful)
- Cemented layers prevented penetration from top to bottom
- Drilled 125 mm hole to 56 m
- Lowered SDMT probe to 55 m carefully aligning sensors
- Backfilled with washed fine gravel about 5 m above test
- Performed seismic tests (multiple strikes) and then raised probe 1 m for next test
- Used large hammer from seafloor to generate waves
CONCLUSIONS

- Seafloor direct push system efficiently pushed DMT and CPT—like performing them on land—the way to go!
- Do not need costly jack-up barge
- Successfully measured seismic waves with true-interval seismic DMT probe and seafloor hammer to 55 meters below mudline
- Undrained shear strength and deformation modulus values compared favorably with DMT, PMT, VST and CPT with properly chosen correlation factors
- Adjust the investigation as data are collected
  - 1939 data—-inadequate—show sandstone instead of cemented sand layers
  - Upper clays much softer than thought
  - Lower soil much stiffer and stronger than thought—needed more pressuremeter tests
- Ideally, investigations could include direct push sounding and soil boring adjacent to each other and performed simultaneously
- If direct push sounding has penetration refusal before desired depth, perform pressuremeter tests in boring to get high-quality data in that missing in-situ test zone
- Best use of costly barge time

THANK YOU QUESTIONS?