

Design and performance of a
**temporary concrete diaphragm wall
excavation support system**

South Boston, Massachusetts

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Presentation overview

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Project description and site conditions

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Finite element model used for design

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Temporary Support of Excavation (SOE) performance

4

Back modeling based on performance

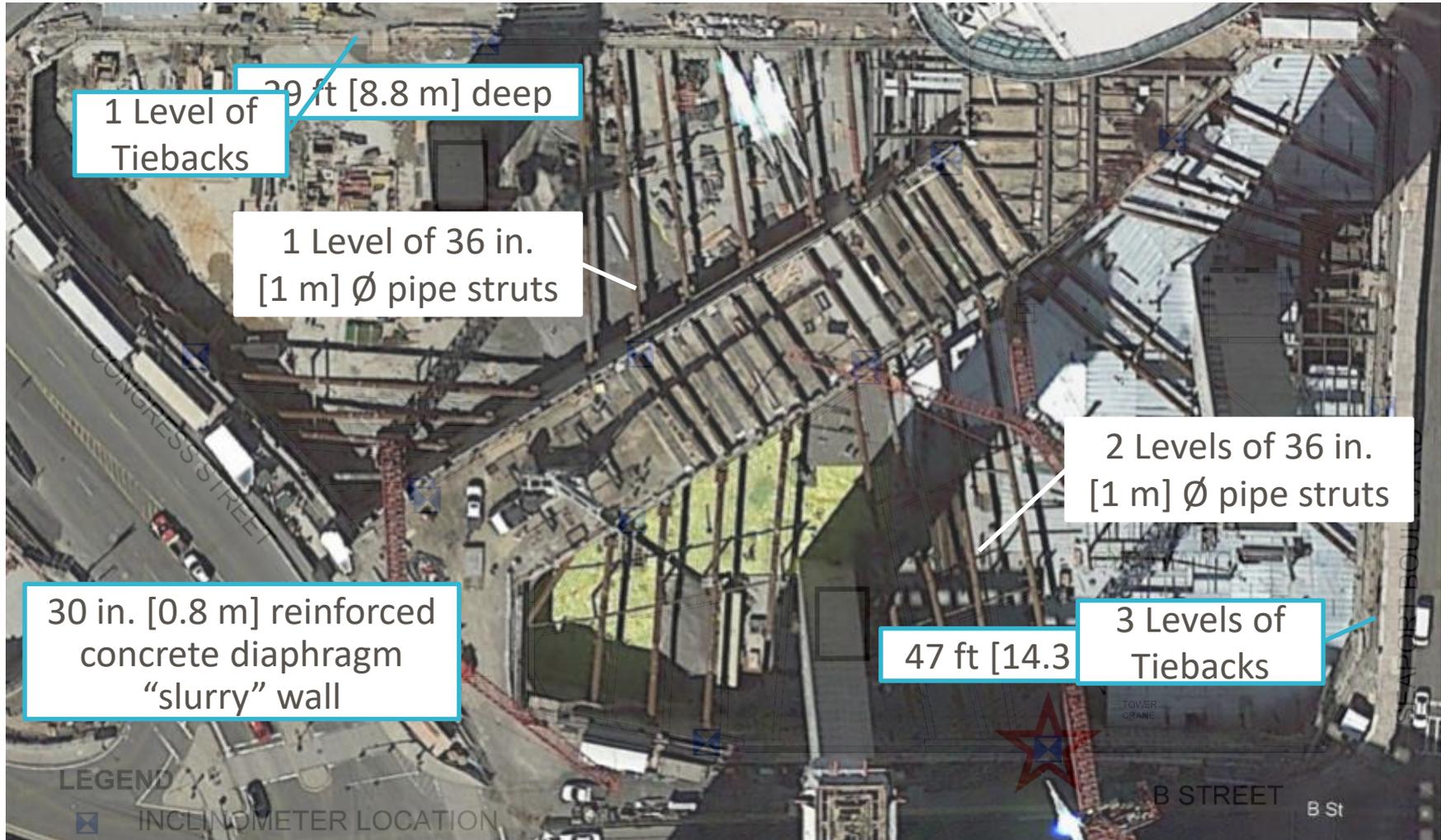
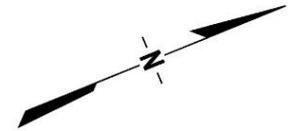
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Conclusions and takeaways

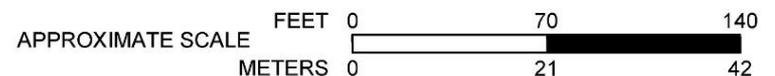


Support of Excavation plan

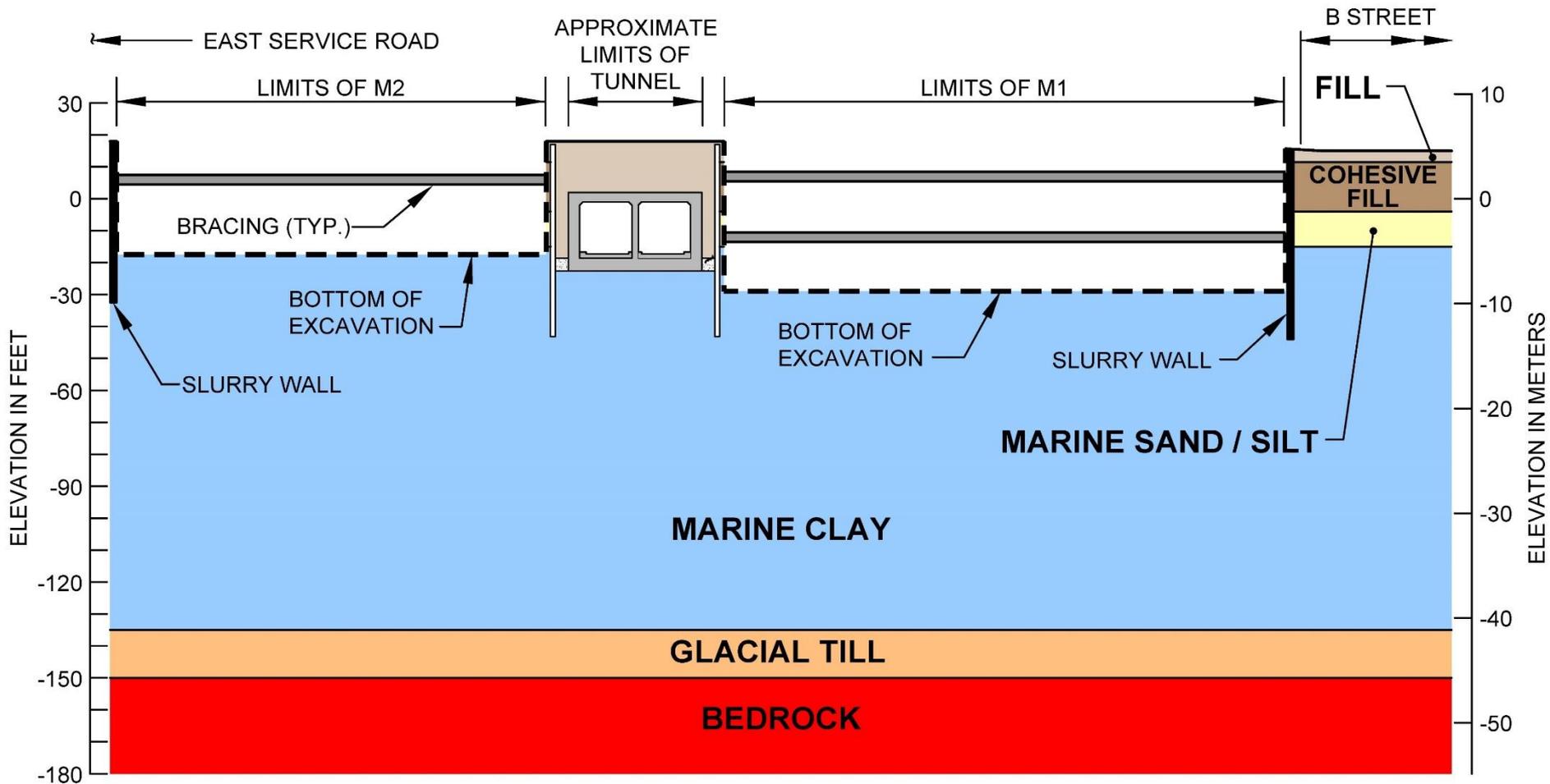
EAST SERVICE ROAD



INCLINOMETER USED FOR
MODEL CALIBRATION



Site conditions



2D finite element modeling

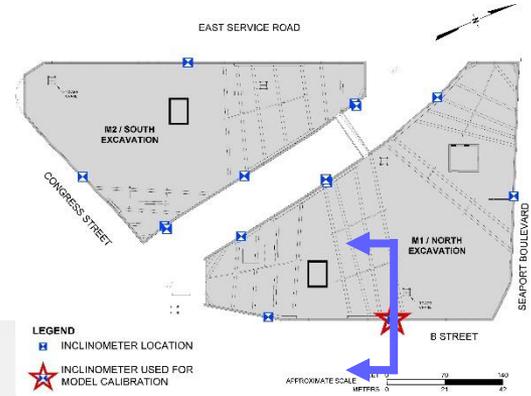
Required by project specifications

600 psf construction surcharge

Linear elastic beam element for wall (I_{cr})

Linear elastic braces, prestressed at installation

Mohr-Coulomb constitutive model

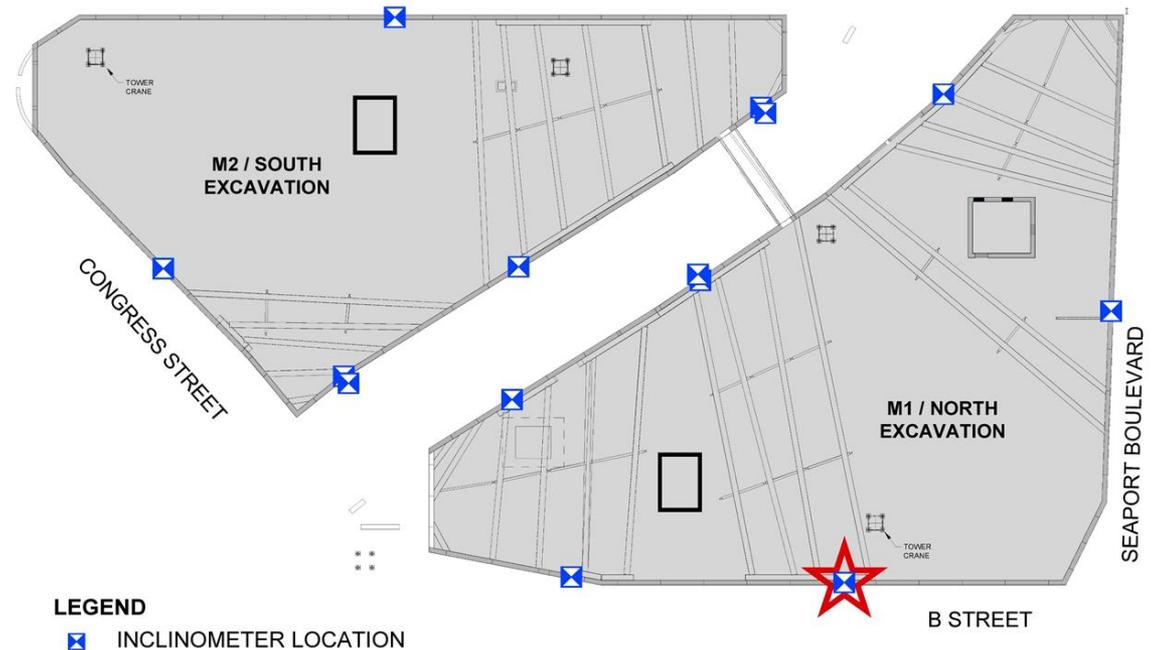


SOE performance

Maximum theoretical (Mohr-Coulomb) vs. measured deformation

Parcel/Excavation:	M1/North		M2/South	
Section	Theoretical (mm)	Measured (mm)	Theoretical (mm)	Measured (mm)
Tieback	58	69	51	43
Internally-braced*	58	23	66	23
Center cross-section of tunnel	58	94	56	33

Limiting performance criteria by specification:
89 mm [3.5 in.]



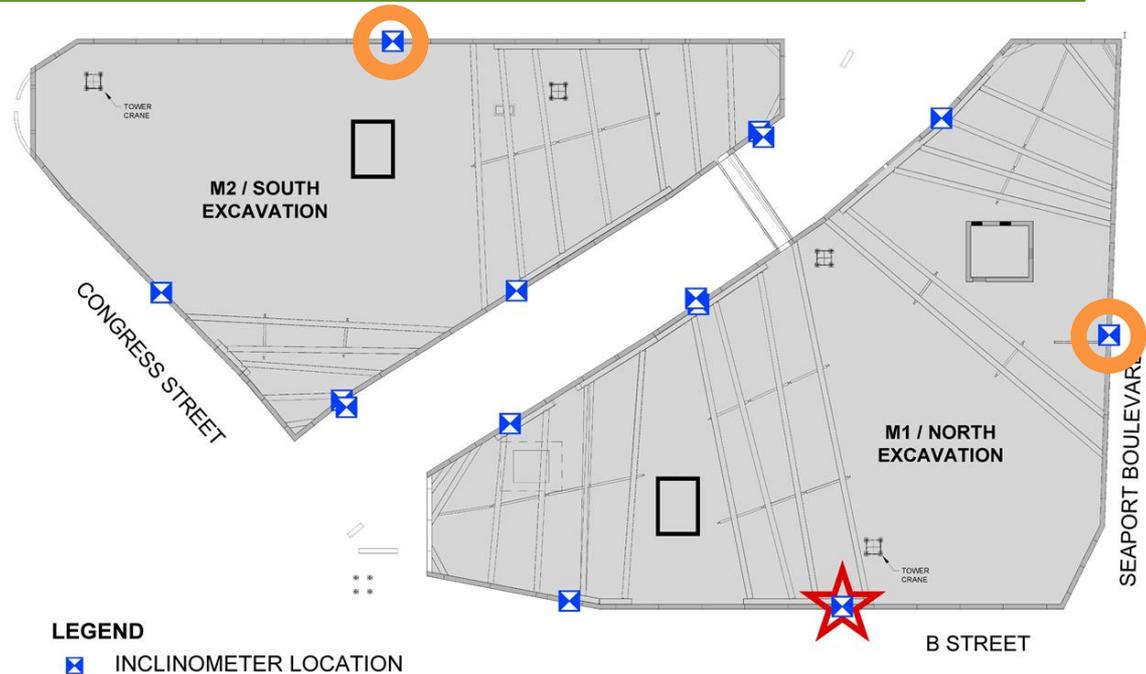
SOE performance

Maximum theoretical vs. measured deformation

Parcel/Excavation:		M1/North			
Section	Theoretical (mm)	Measured (mm)	Theoretical (mm)	Measured (mm)	
Typical tieback	58	69	51	43	
Typical internally-braced*	58	23	66	23	
Center cross-section of tunnel	58	94	56	33	

Prediction was within 10-15% of measurement

Limiting performance criteria by specification:
89 mm [3.5 in.]



SOE performance

Maximum theoretical vs. measured deformation

Parcel/Excavation:	M1/North		M2/South	
Section	Theoretical (mm)	Measured (mm)	Theoretical (mm)	Measured (mm)
Typical tieback	58	69	58	69
Typical internally-braced*	58	23	58	23
Center cross-section of tunnel	58	94	56	33

Prediction was within 60-65% of measurement

Limiting performance criteria by specification:

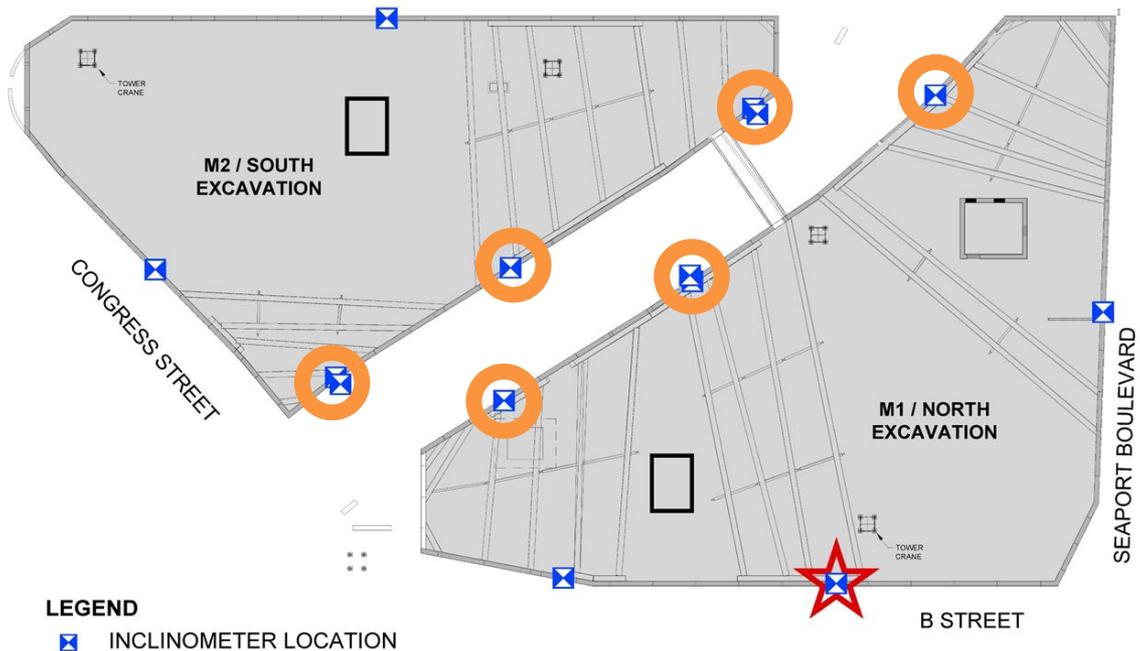
89 mm [3.5 in.]

Max. tunnel movement:

38 mm [1.5 in.]

MEASURED:

6.6 mm [0.26 in.]



LEGEND
 X INCLINOMETER LOCATION

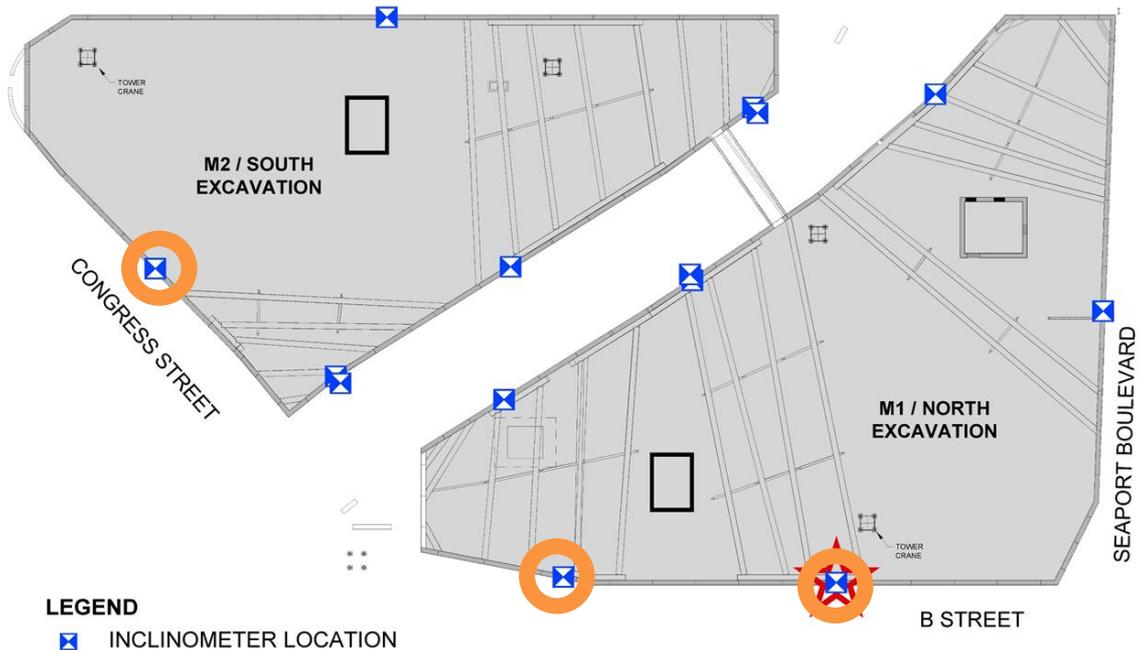
SOE performance

Maximum theoretical vs. measured deformation

Parcel/Excavation:	M1/North		M2/South	
Section	Theoretical (mm)	Measured (mm)	Theoretical (mm)	Measured (mm)
Typical tieback	58	69	58	69
Typical internally-braced*	58	23	66	23
Center cross-section of tunnel	58	94	56	33

Prediction was within 35-40% of measurement

Limiting performance
Criteria by specification:
89 mm [3.5 in.]



Performance: (3) Different stages

MOHR-COULOMB

did a poor job of capturing wall movements.

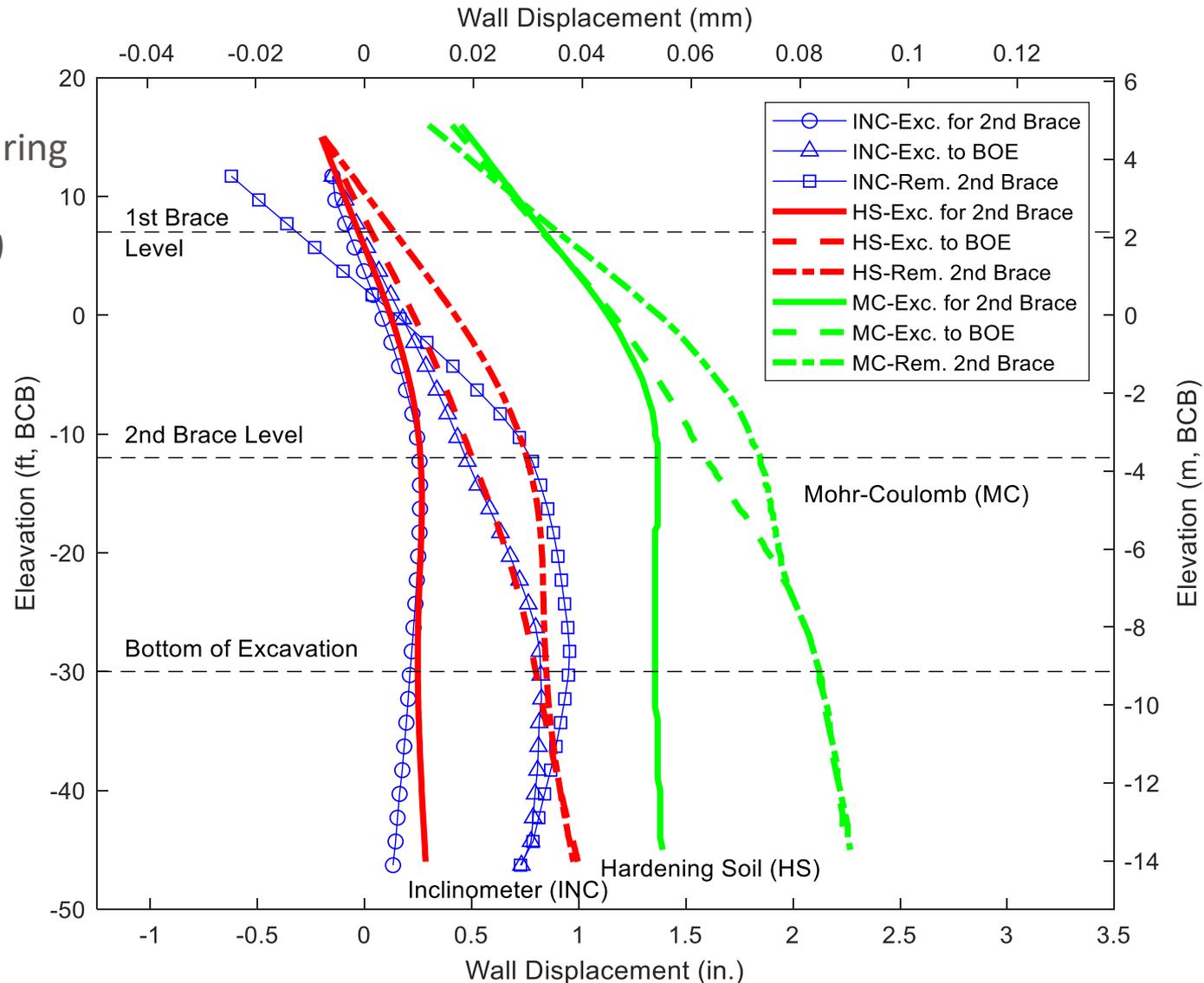
(rigid body translation)

INCLINOMETER

Showed much less movement at the toe than predicted

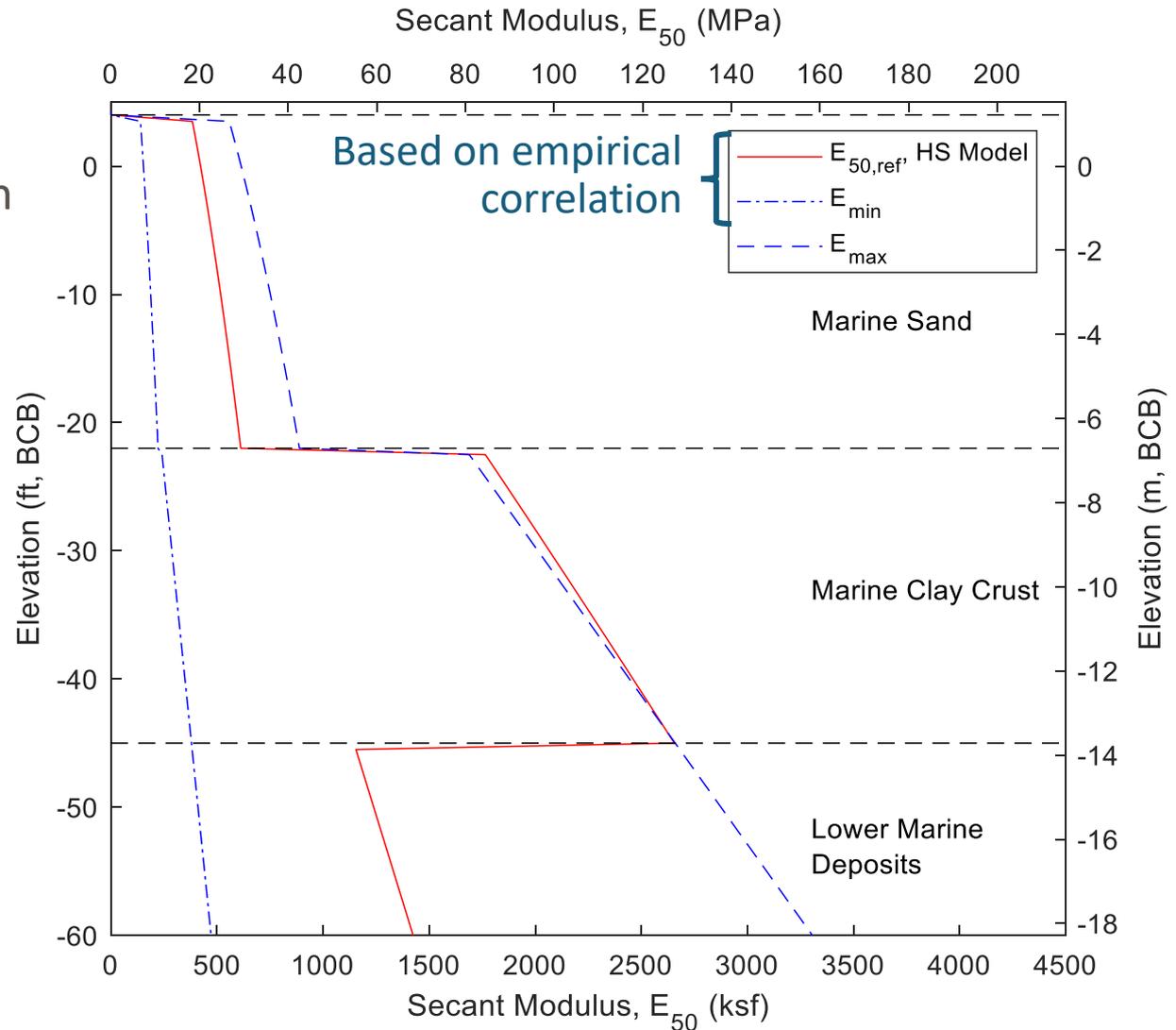
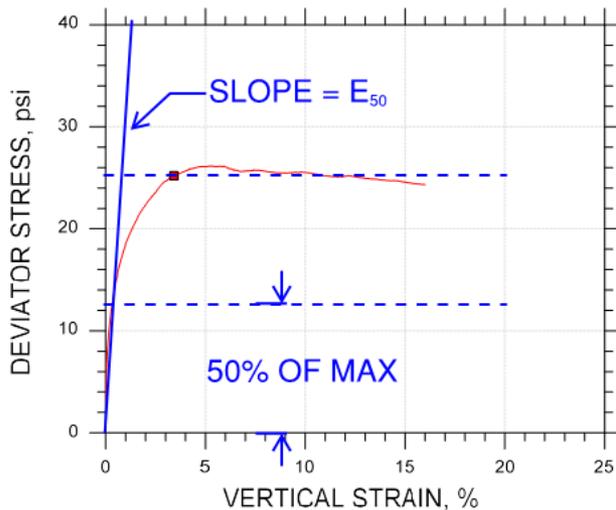
CALIBRATION

Not perfect, but Hardening Soil model got a lot closer to measured response

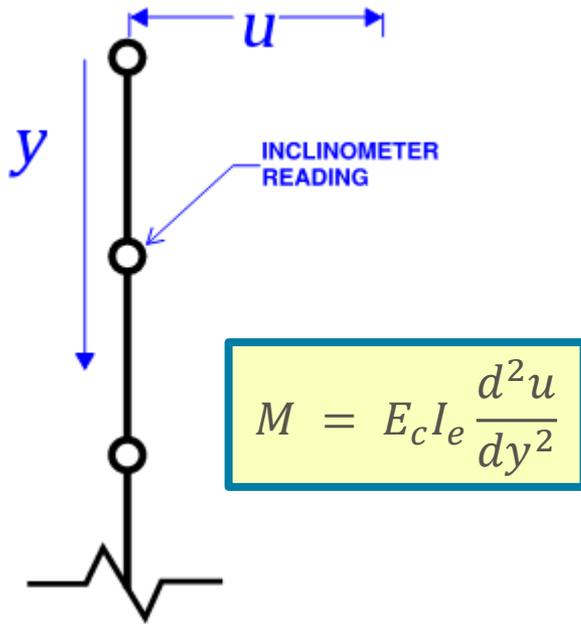


Hardening Soil model: Secant modulus, E_{50}

E_{50} for the clay deposits had a major influence on lateral wall movements in later (deeper) excavation stages

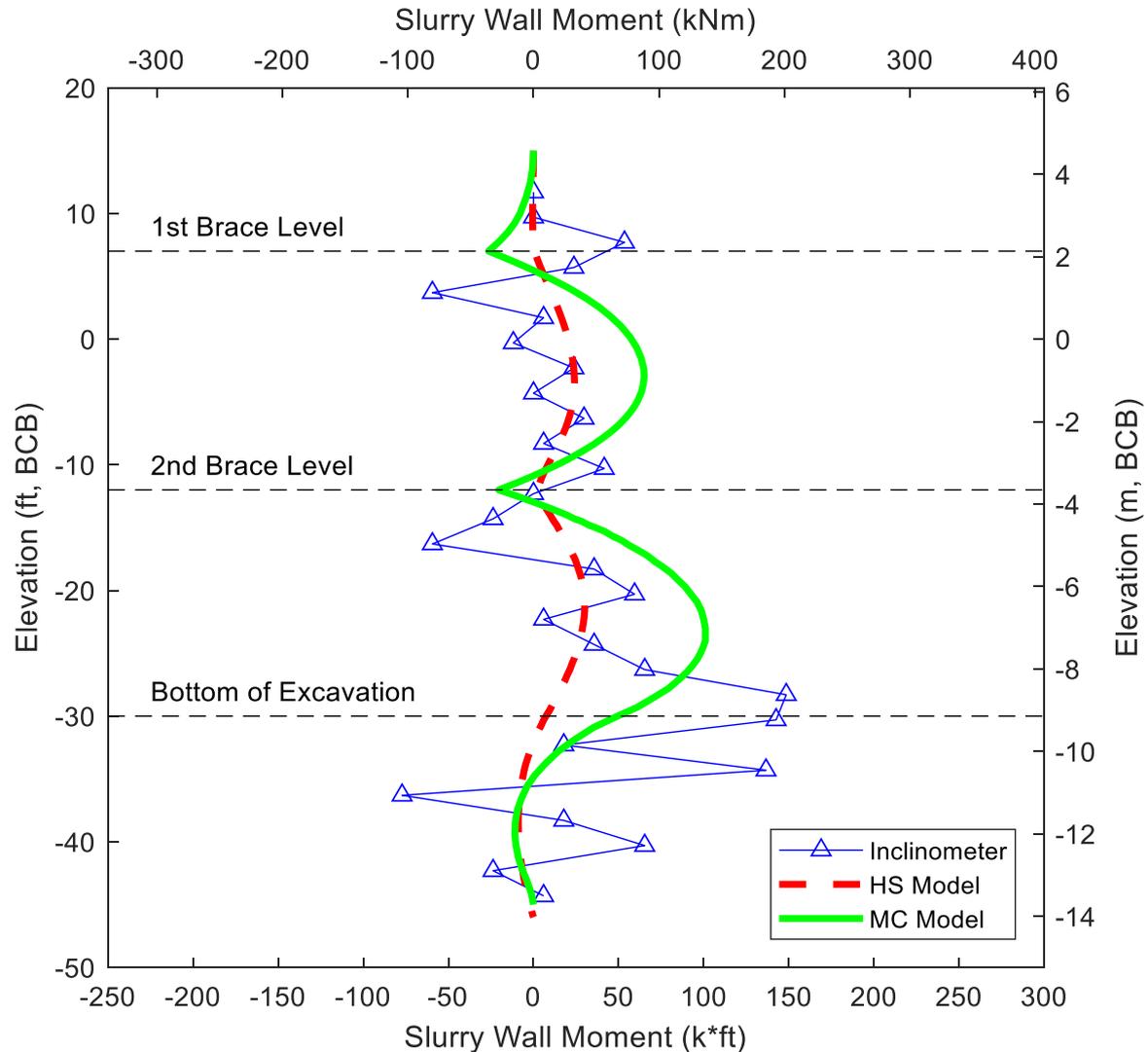


Back-calculated moment



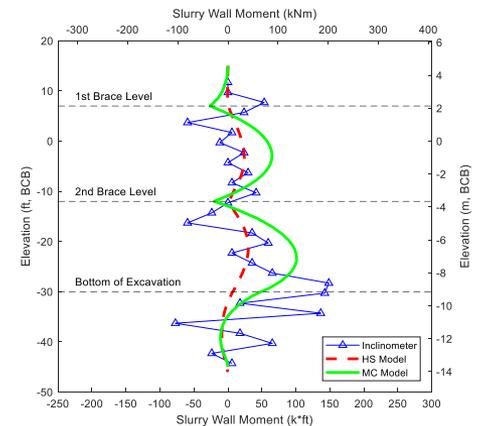
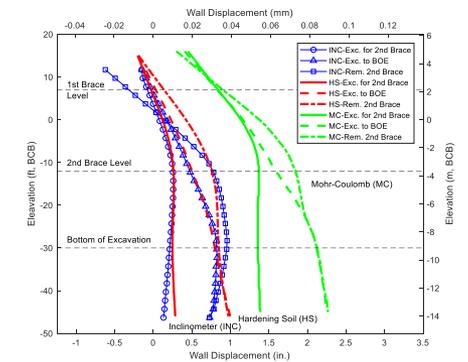
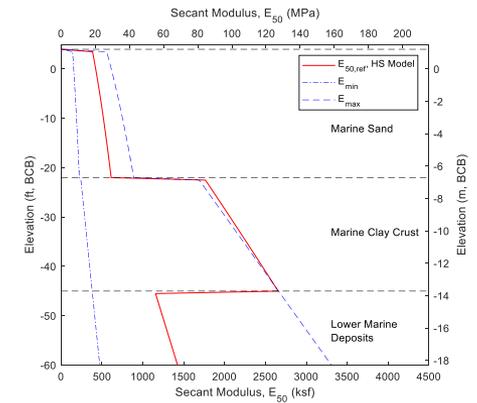
MOHR-COULOMB

Did a better job at estimating design loading HS model



Conclusions & takeaways

- **Adjusting stiffness parameters of the Marine Clay layer had the biggest influence on wall movements**
 - Secant modulus E_{50} in later stages of excavation
- **Mohr-Coulomb (MC) model was not good at estimating movements**
 - Hardening Soil (HS) takes into account stress-dependent stiffness
- **Initial MC model was OK for structural design**
 - Calibrated HS model was too rigid – could not capture the curvature of the real wall



Thank you! Questions?



HALEY
ALDRICH

Cone Penetrometer test

