Calibration of Abutment Backfill Models through Physical Testing

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Outline

- Calibration issues
- Desired boundary conditions
- Available field test data
- Comparison to models
- Extension through numerical simulation
- Gaps

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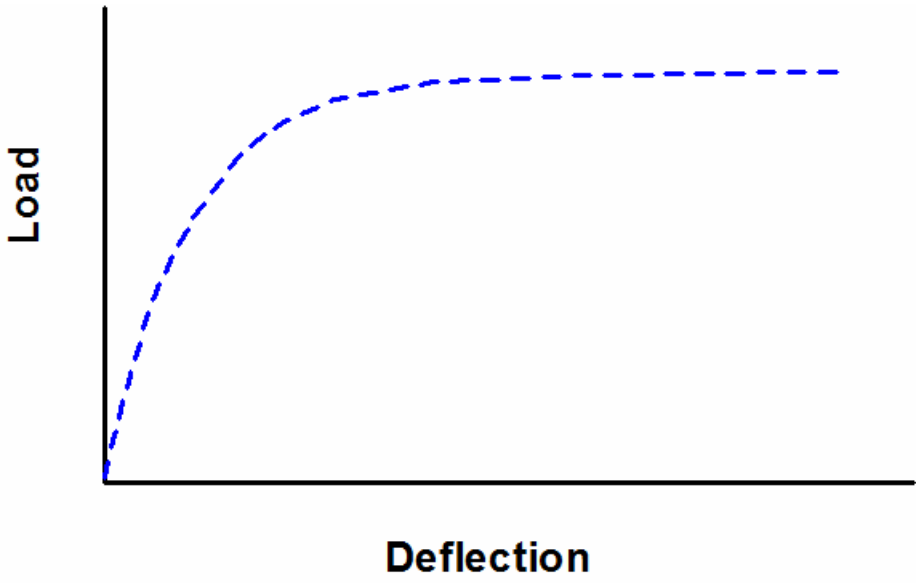
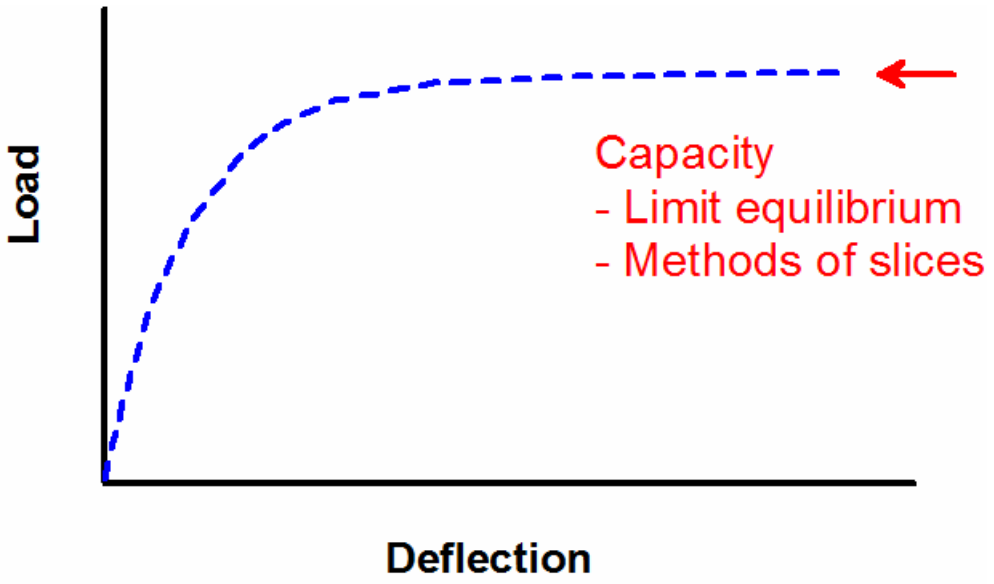
Calibration Issues

- Elements requiring calibration



Calibration Issues

- Elements requiring calibration
  - Capacity



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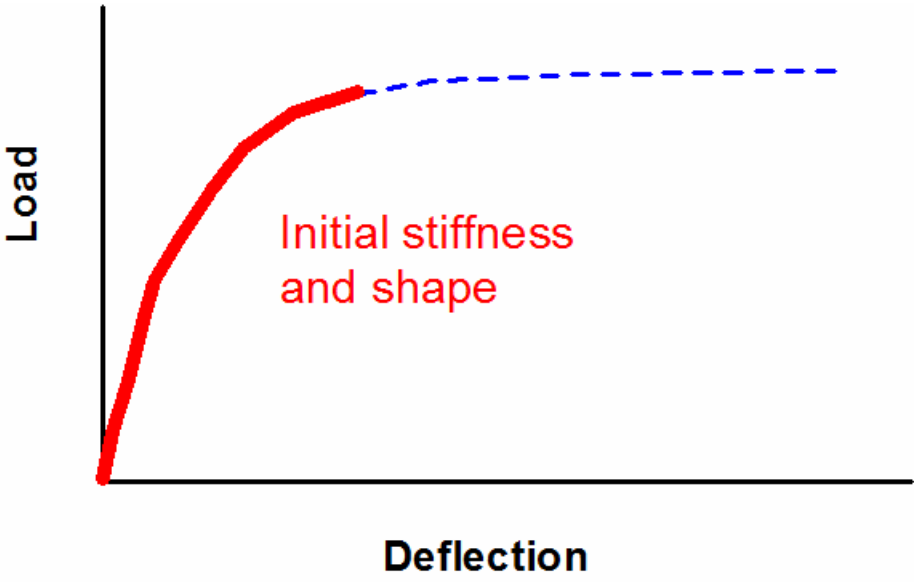
Calibration Issues

- Elements requiring calibration
  - Capacity
  - Initial stiffness, shape



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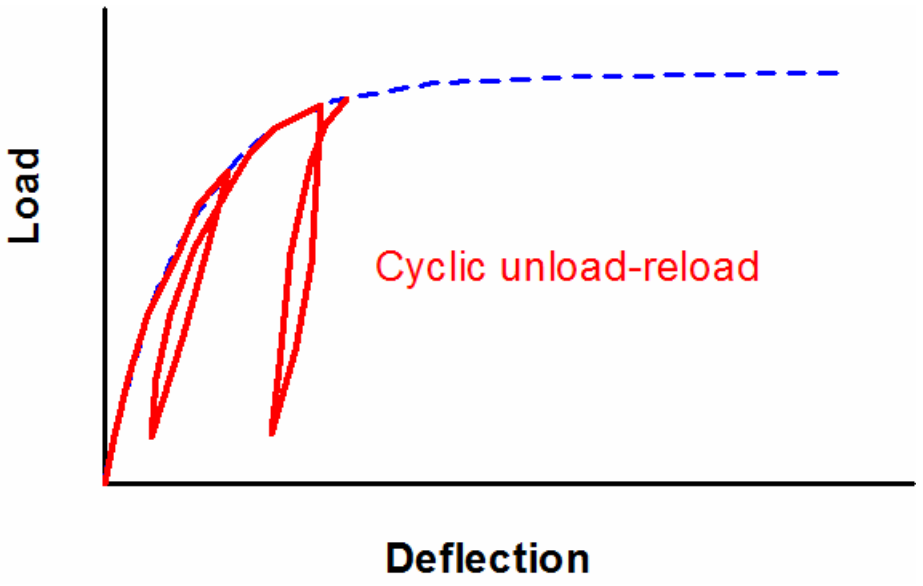
Calibration Issues

- Elements requiring calibration
  - Capacity
  - Initial stiffness, shape
  - Unload/reload



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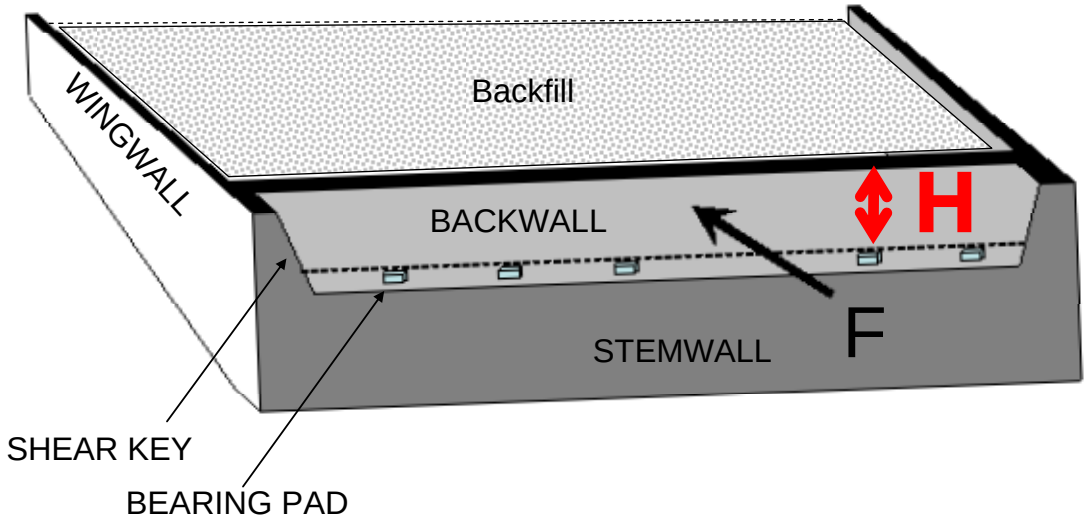
Calibration Issues

- Elements requiring calibration
- Variables
  - Wall height



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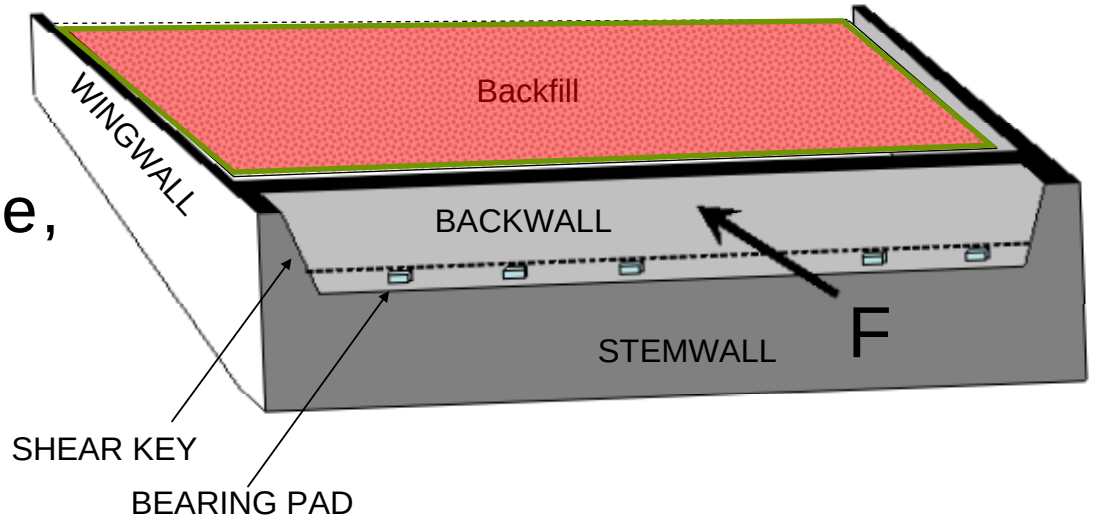
Calibration Issues

- Elements requiring calibration
- Variables
  - Wall height
  - Backfill soil (type, compaction)



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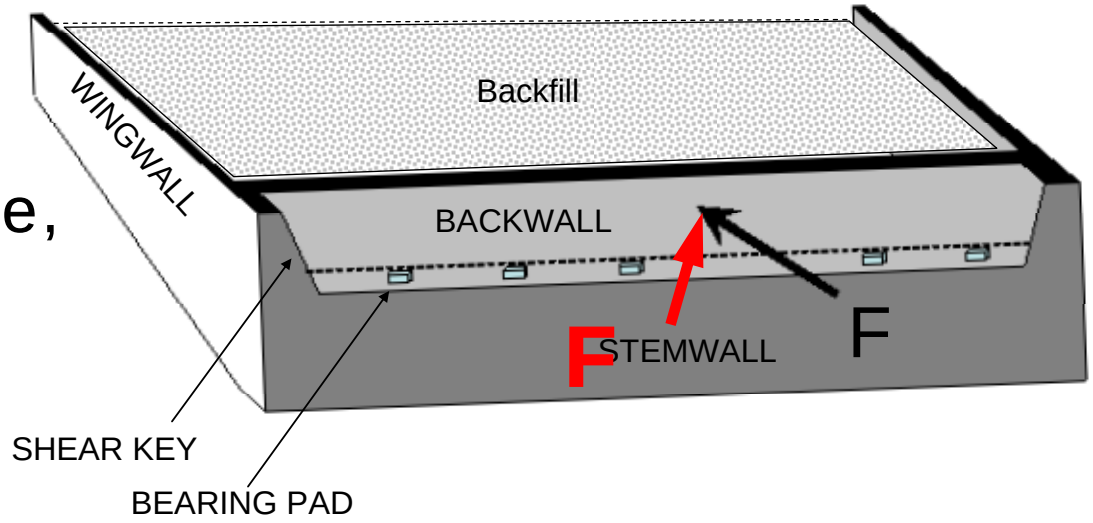
Calibration Issues

- Elements requiring calibration
- Variables
  - Wall height
  - Backfill soil (type, compaction)
  - Wall skew



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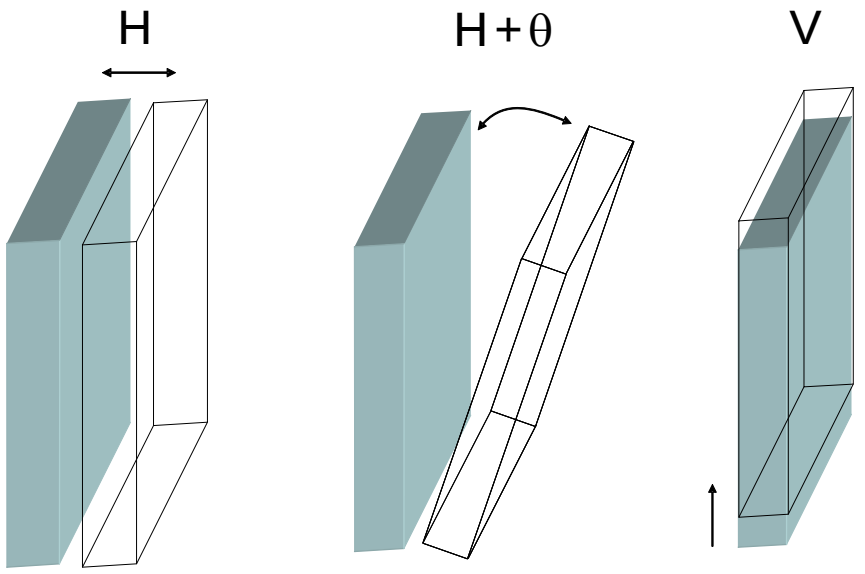
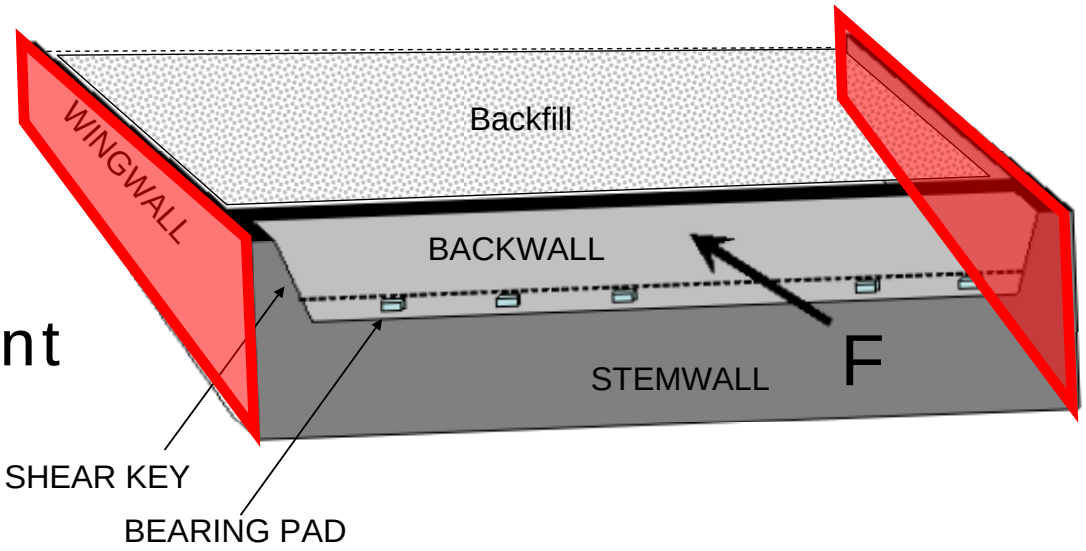
Calibration Issues

- Elements requiring calibration
- Variables
- Boundary conditions
  - Wall displacement



Calibration Issues

- Elements requiring calibration
- Variables
- Boundary conditions
  - Wall displacement
  - Wingwall configuration



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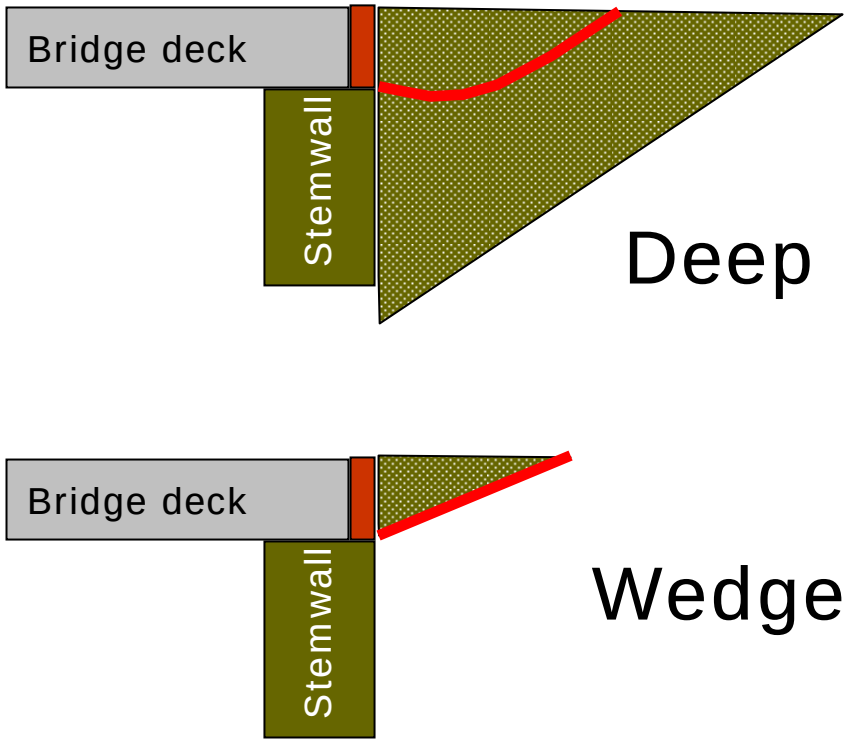
Calibration Issues

- Elements requiring calibration
- Variables
- Boundary conditions
  - Wall displacement
  - Wingwall configuration
  - Backfill configuration



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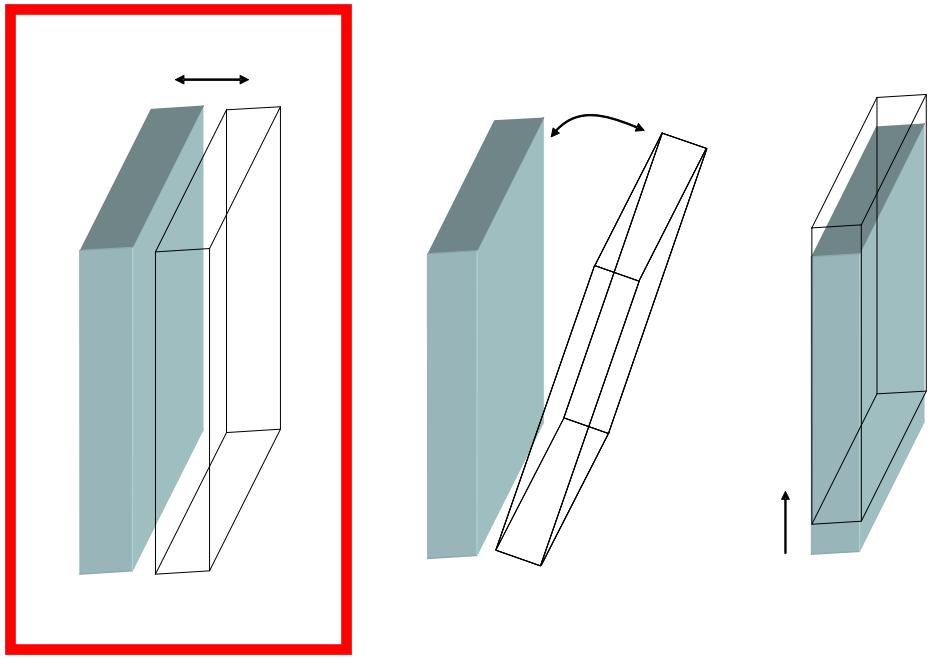
Desired Boundary Conditions

- Wall displacement



Why?

$\delta_{c\text{-}c} > \delta_{c\text{-}s}$

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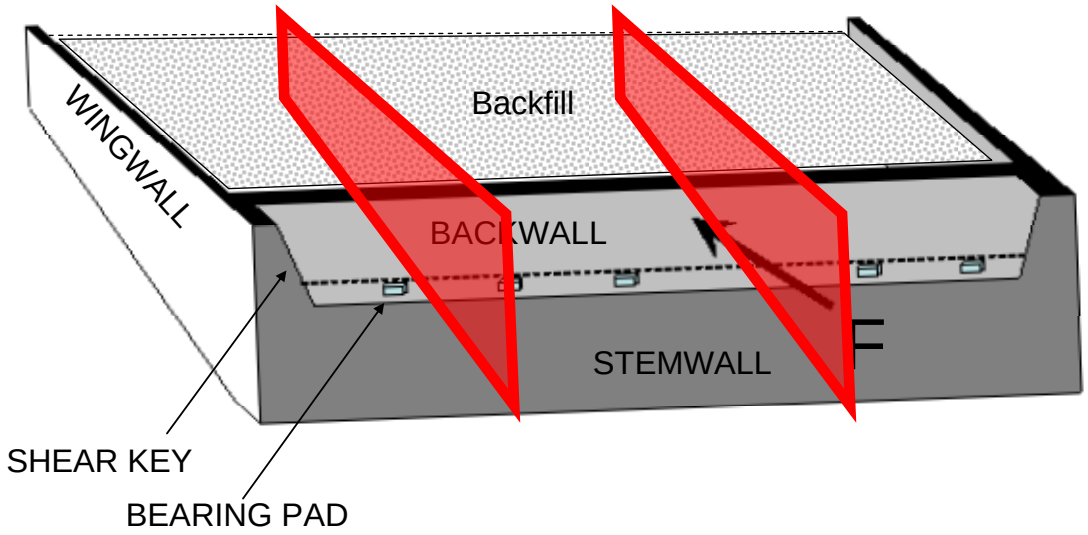
Desired Boundary Conditions

- Wall displacement
- Wingwall configuration



Why?
Width >> Height

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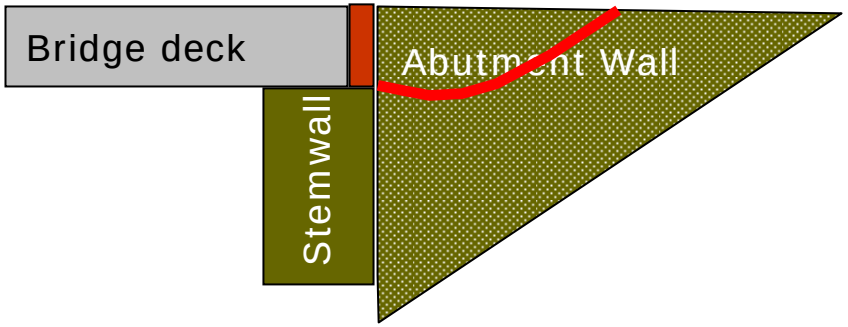
Desired Boundary Conditions

- Wall displacement
- Wingwall configuration
- Backfill configuration



Why?

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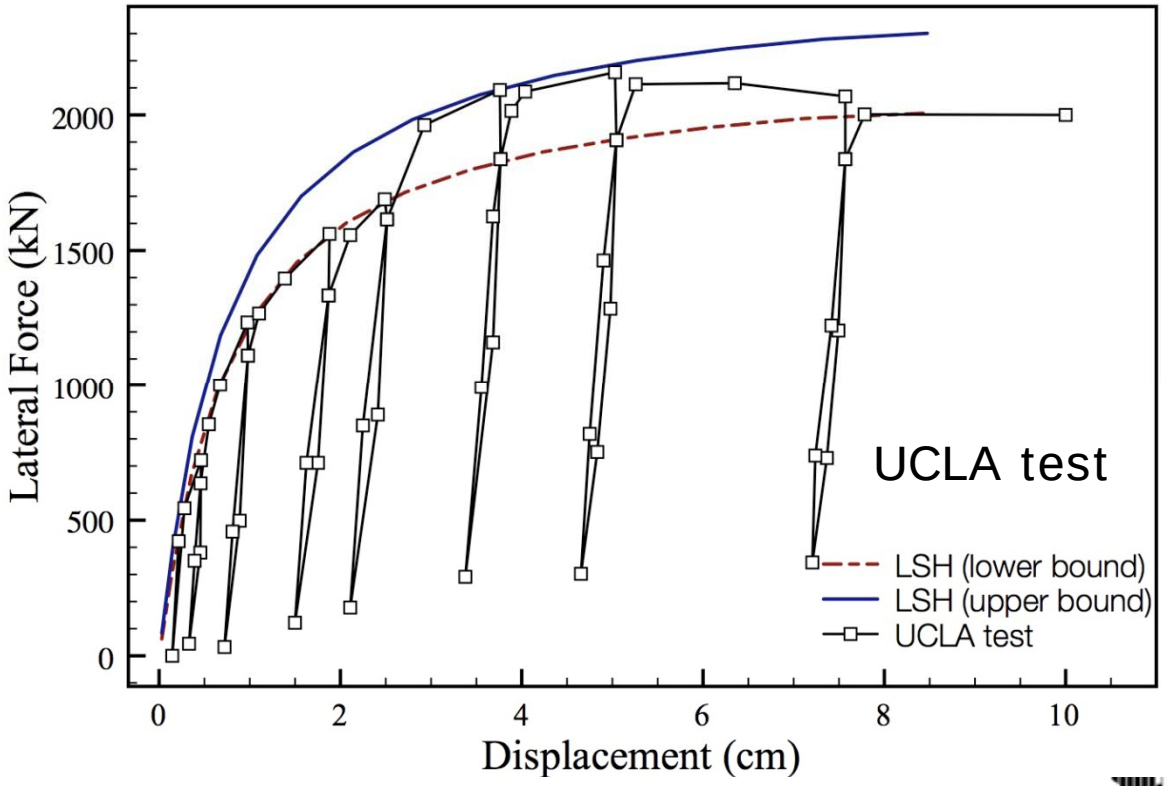
Available Field Test Data

Variables / BC	UCD (Romstadt et al. 1995)	BYU (Rollins and Sparks 2002; Rollins and Cole 2006)	UCSD (Boz. et al. 2006; Wilson and Elgamal 2008)	UCLA (Lemnitzer et al. 2009)
Height	1.7 m	1.2 m; 1.1 m	1.5-2.3 m; 1.7 m	1.7 m
Backfill soil	Clayey silt	Varies	Clayey sand, silty sand; silty sand	Silty sand (SE 30)
Skew	0	0	0	0
Wall displacement	H+θ	H+θ (small)	H, H+V; H+V	H
Wingwall configuration	W/H =2, integral	None, pile cap	W/H=2; 1.7. Integral, sep.	2D, sep.
Backfill configuration	Deep	Depth=H; Deep	Wedge	Deep

Comparison to Models

- Method of slices (LSH)



Comparison to Models

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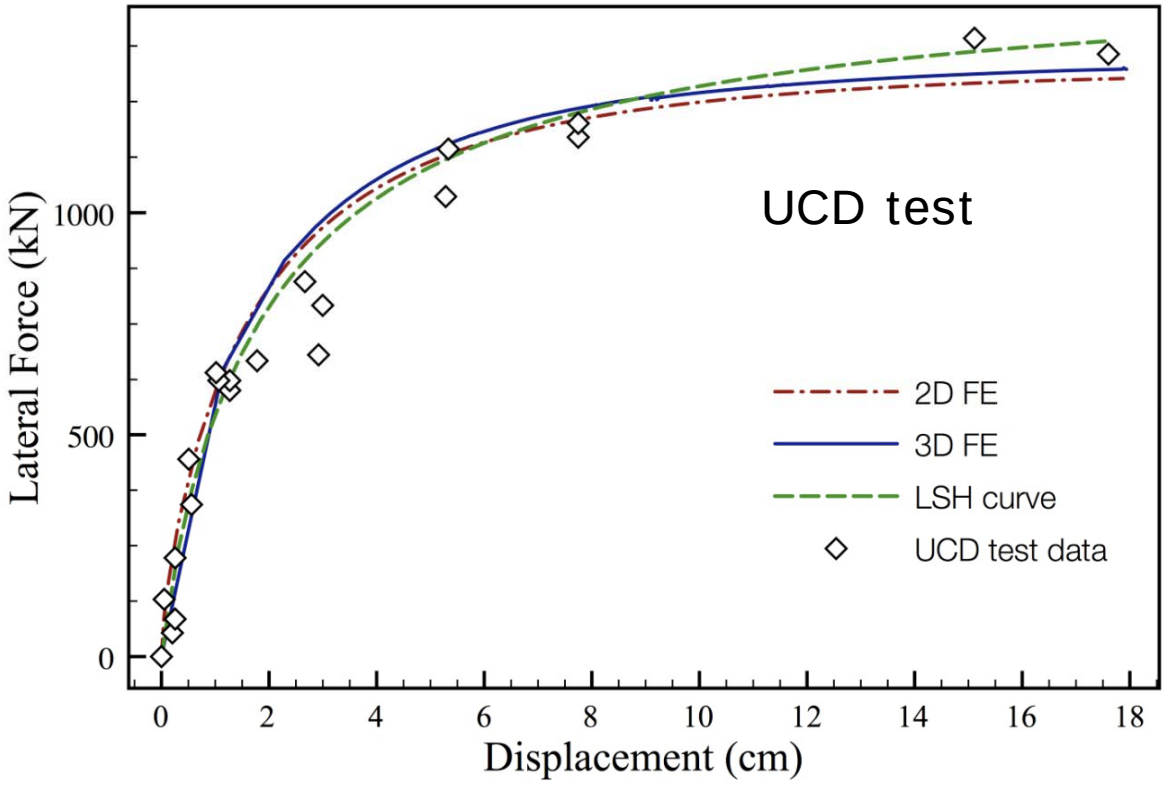
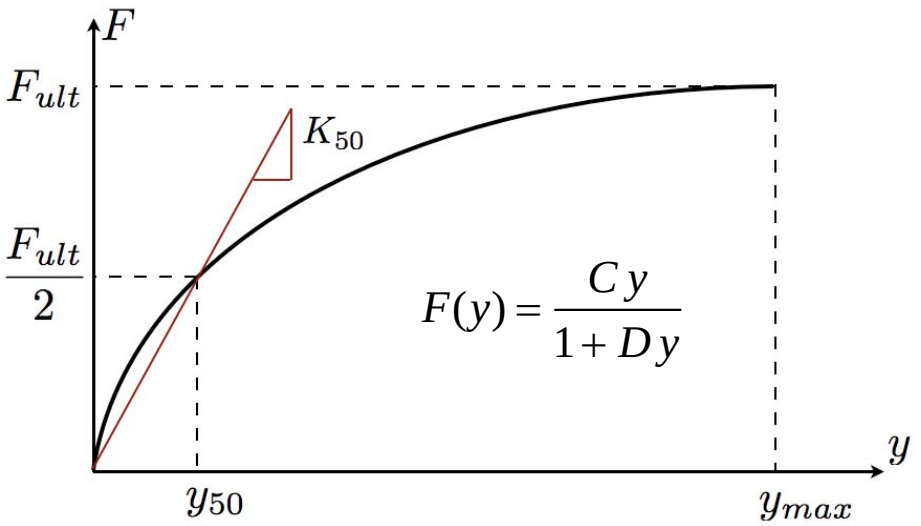


Comparison to Models

- Method of slices (LSH)
- Hyperbolic fit



$$C = \left(2K_{50} - \frac{F_{ult}}{y_{max}} \right), \qquad D = 2\left(\frac{K_{50}}{F_{ult}} - \frac{1}{y_{max}} \right)$$

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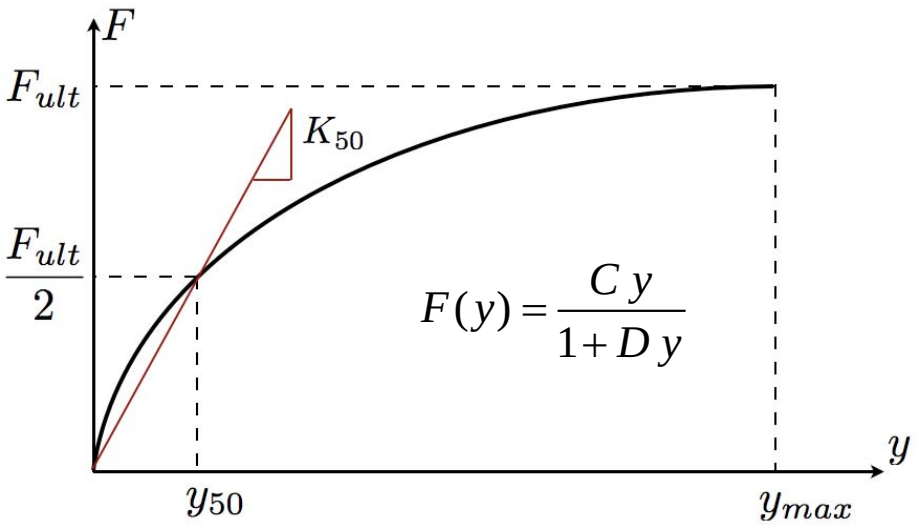
Comparison to Models

- Method of slices (LSH)
- Hyperbolic fit
- HFD coefficients apply for:
  - Skew = 0
  - 2D conditions
  - No uplift
  - H=1.67 m
  - As-tested backfills (deep)



$$C = \left(2K_{50} - \frac{F_{ult}}{y_{max}} \right), \qquad D = 2\left(\frac{K_{50}}{F_{ult}} - \frac{1}{y_{max}} \right)$$

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Extension through numerical simulation

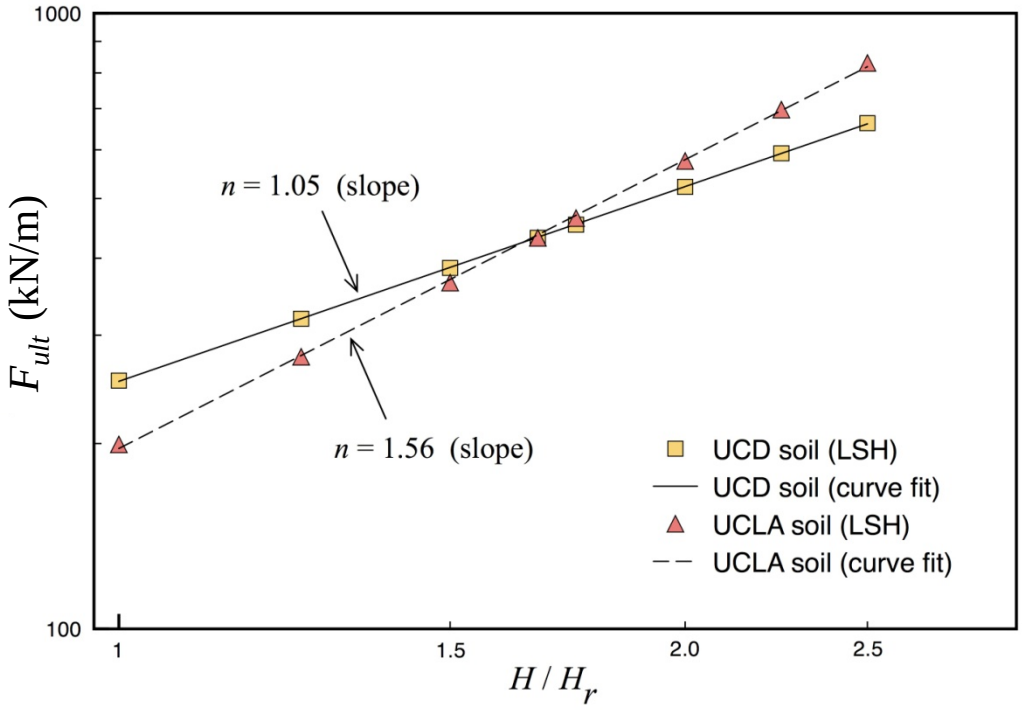
- Variable height

Extended HFD

$$F(y) = \frac{a_r y}{\hat{H} + b_r y} \hat{H}^n$$

a_r & b_r derived for two tested backfills

Shamsabadi et al. (JBE, in press)



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Extension through numerical simulation

- Variable height
- Variable backfill strengths (c & ϕ)

$$F(y) = \frac{a_r y}{\hat{H} + b_r y} \hat{H}^n$$

$$\begin{cases} a_r = \frac{1}{\beta}(\eta - 1)\alpha \\ b_r = \frac{1}{\beta}(\eta - 2) \end{cases}$$

$$\alpha = \frac{F_u}{\hat{H}^n}, \quad \beta = {y_{ult}}/{\hat{H}}, \text{ and } \eta = {y_{ult}}/{y_{50}}$$

α, β, η = fns (c, ϕ, δ, γ)

Khalili-Tehrani, 2009

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Gaps

- Skew effects
- Validation data for different heights and backfills
- Gaping behavior
- Cyclic models

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References

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