

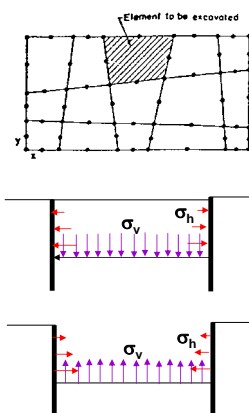
Finite Element Method in Deep Excavation

- Overview
- 1-D Analysis
- 2-D Analysis
- 3-D Analysis

1

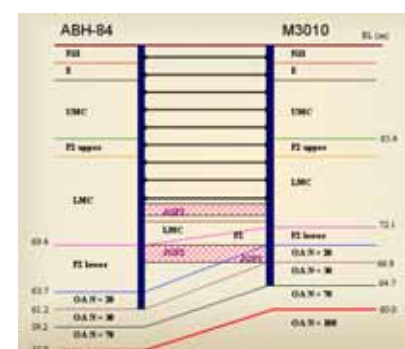
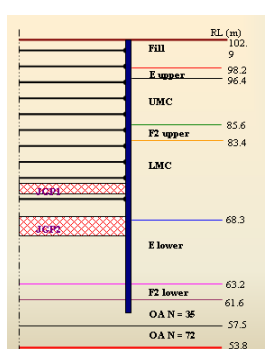
2-D Finite Element Method

- Excavation is modelled as an infinitely long trench i.e. plane strain condition.
- Soil mass is discretised into finite number of elements connected at the nodes.
- Each element can be assigned a different stiffness which may vary with loading.
- The stiffness of each element can be assembled to form a total stiffness.
- When subjected to loading, the soil and structural elements interact giving rise to deformation and an increase in soil stresses, beam forces and moments.
- The construction sequence can be simulated step by step and the element stiffness can vary at the end of each load step.



2

Half mesh or Full mesh?

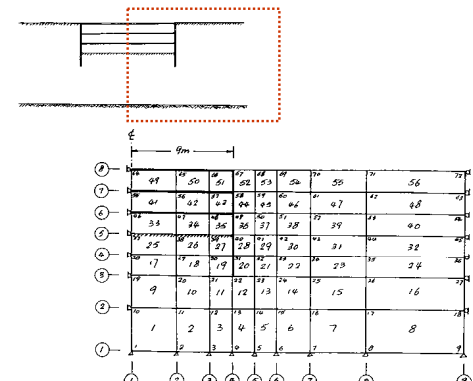


Half Mesh

Full Mesh

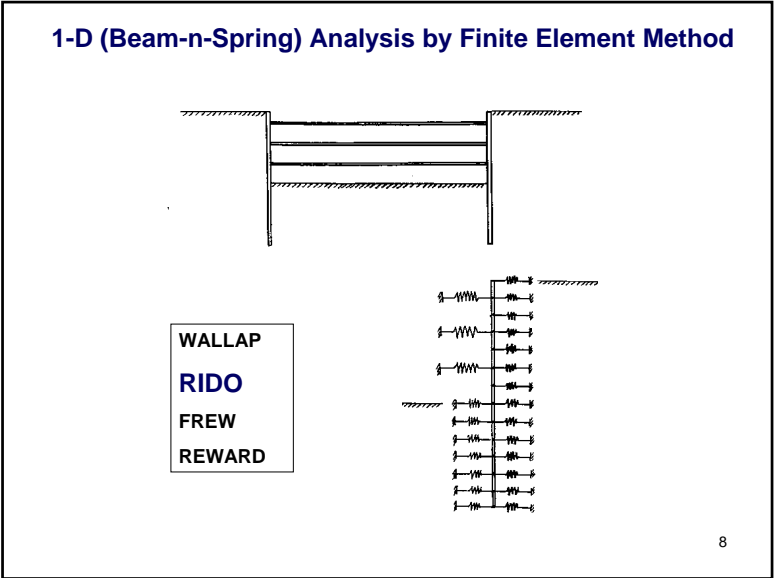
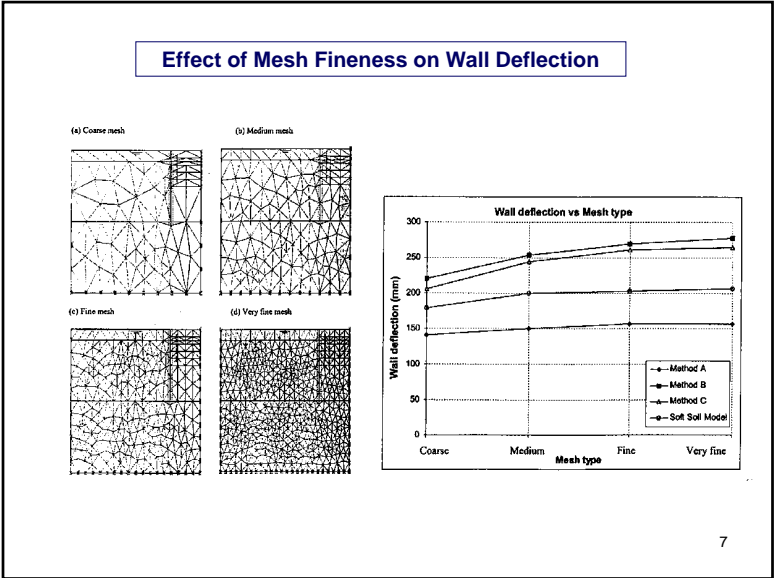
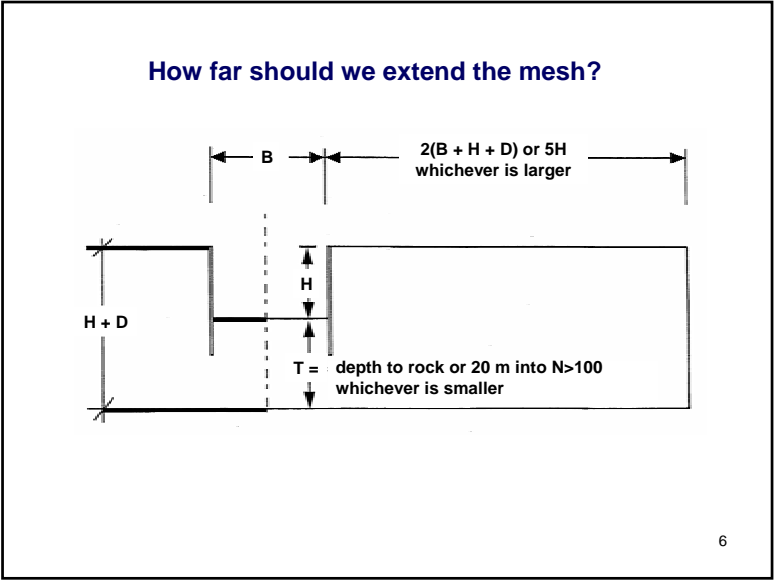
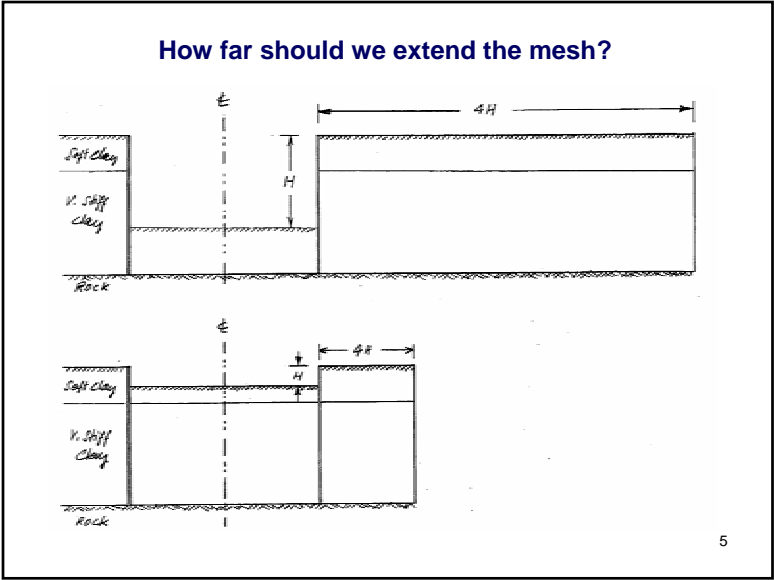
3

FE Modeling of an Excavation

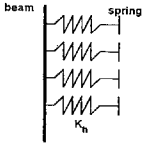


Use of half-mesh because of symmetry

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Parameters for the Beam-and-Spring Model



SOIL PARAMETERS

γ unit weight

c & ϕ cohesion and friction angle

K_o at-rest earth pressure coefficient

K_a, K_p active & passive earth pressure coefficients

K_h subgrade modulus

WALL PARAMETERS

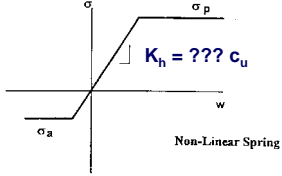
E Young's modulus

I Moment of inertia

STRUT PARAMETERS

E Young's modulus

A cross-sectional area

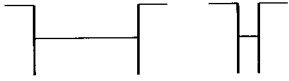


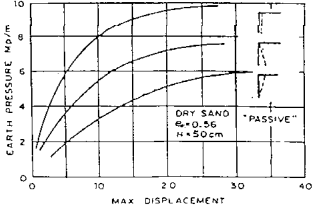
$K_h = ??? c_u$

9

K_a & K_p

- Effect of wall friction and adhesion
 - Rankine
 - Coulomb
 - Log Spiral
- Effect of mode of wall movement
 - Translation
 - Rotate about top
 - Rotate about toe
- Effect of excavation width
 - Wide
 - Narrow

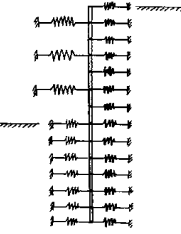




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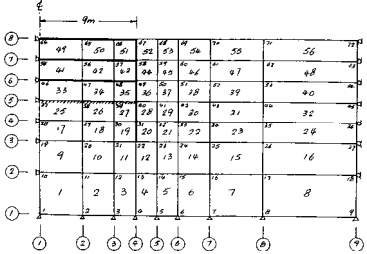
Calibration of Soil Modulus using 1-D and 2-D Programs

RIDO: 1-D
Beam-and-Spring



$K_s / c_u = ???$

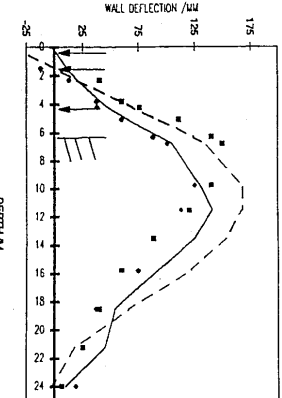
EXCAV97 - 2-D continuum
with Hyperbolic Model

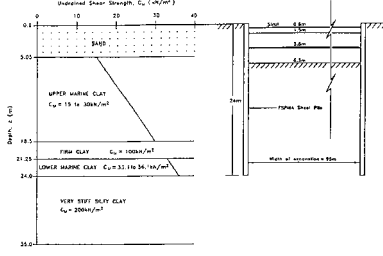


$E_i / c_u = ???$

11

Comparison of Results
Rochor Complex





Legend:

- Measured
- $E_i / c_u = 200$
- $K_s / c_u = 15$

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1D, 2D & 3D FEA

3

