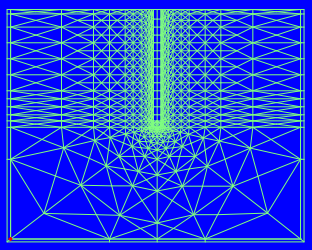
End bearing pile problem in granular material

16th CUGM at South Bank University



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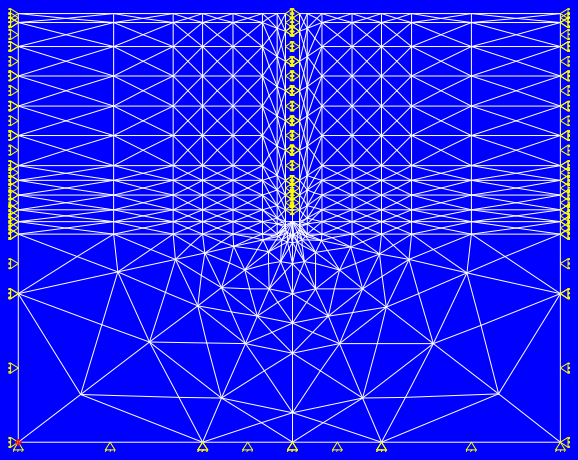
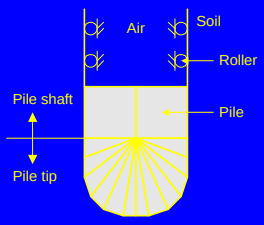
Objectives of this study:

- Comparison between **roller boundary** and **slip elements** for an end bearing pile in the granular material;
- Investigation of **degree of non-associated flow** in relation to the numerical convergence under D-MNR;
- Investigation of **boundary conditions**;
- Insight into **strain behaviour** at large pile displacement.

Mesh-A*

(roller boundary along pile shaft)



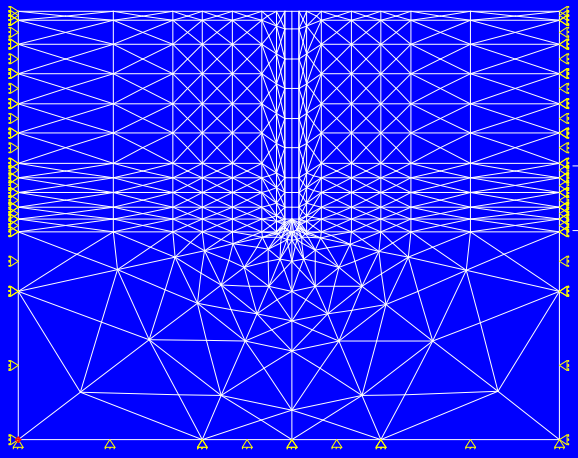


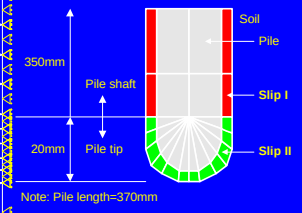
Pure end bearing pile

(464 nodes and 872 elements)

Mesh-A

(slip element types, I and II)



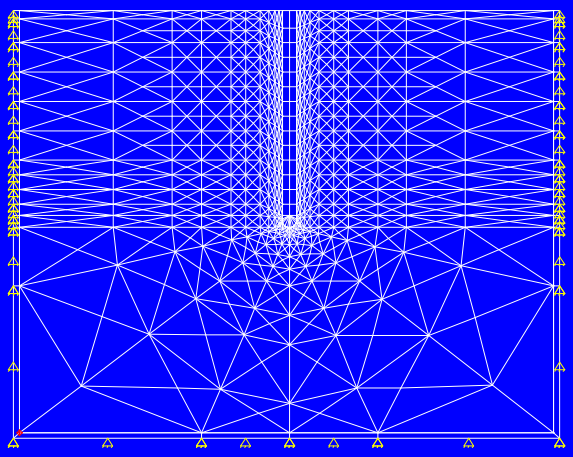


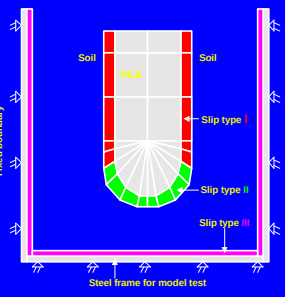
Slip element types, I and II

(510 nodes and 934 elements)

Super Mesh-A

(slip element types, I, II and III)

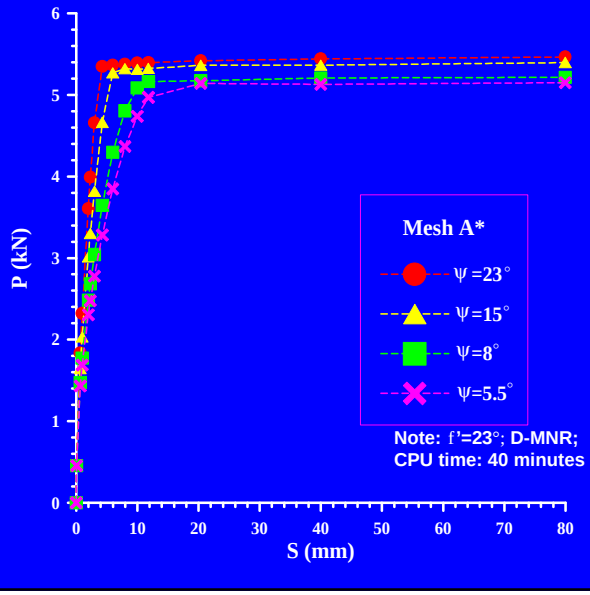




Slip element types, I, II and III

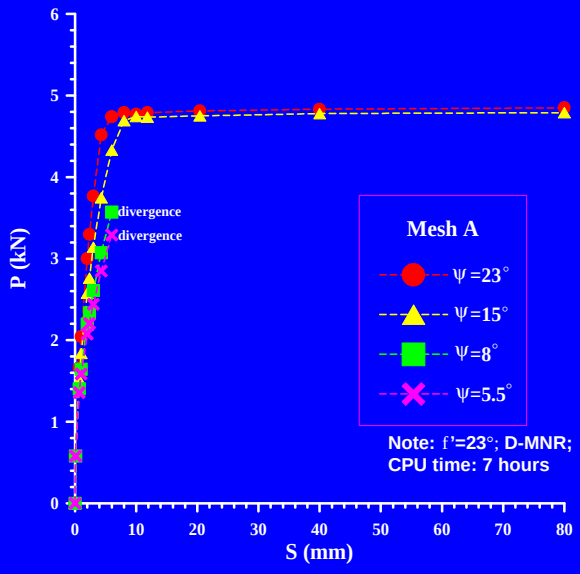
(911 nodes and 1704 elements)

P-S curve for Mesh-A*

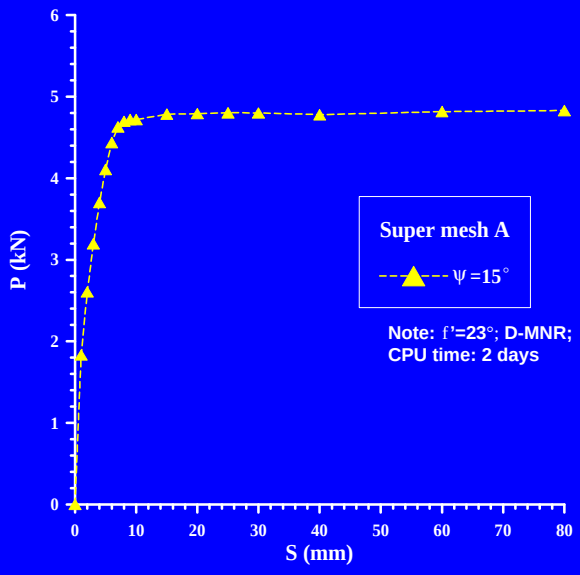


Note: f'=23°; D-MNR;
CPU time: 40 minutes

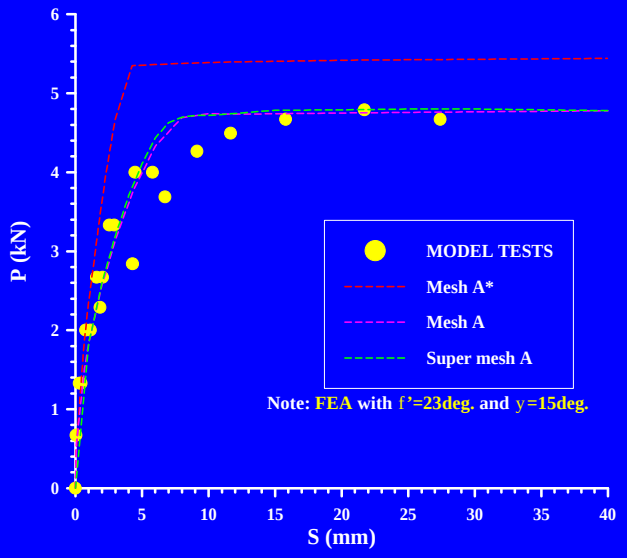
P-S curve for Mesh-A



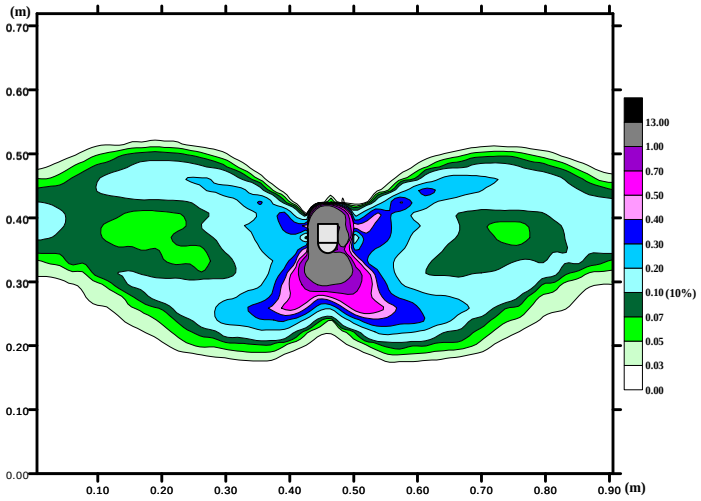
P-S curve for Super mesh-A



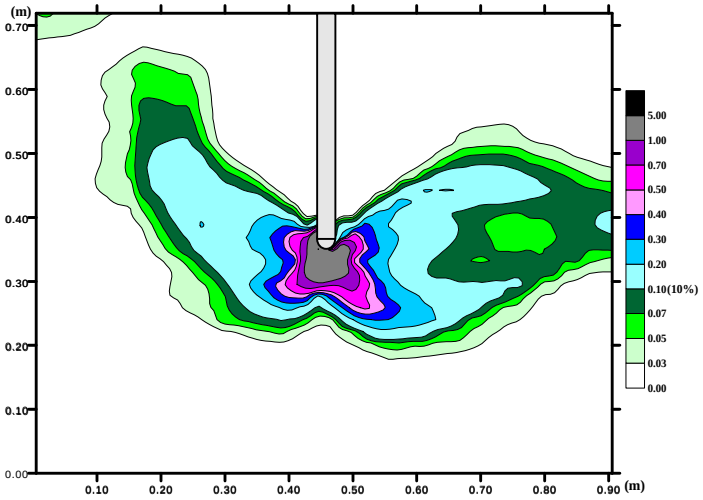
COMPARISON to MODEL TEST data



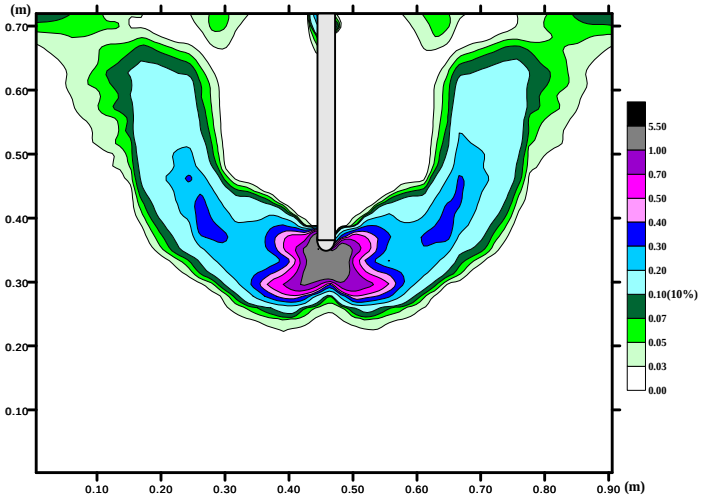
g_{max} from Mesh A* at S=40mm



g_{max} from Mesh A at S=40mm



g_{max} from Super mesh A at S=40mm



Conclusions:

- In order to satisfy the convergence criteria using **slip elements**, difference between ϕ' and ψ was found to be **10 to 13**. However, using **roller boundary** is independent of the degree of non-associate flow.

Slip elements	f'-y
No slip elements	**23**
With slip elements	**10 - 13**

- Maximum shear strain (γ_{max}) at the large pile displacement is significantly influenced by **the lateral roller boundaries** which commonly used in the conventional FE mesh. However, the author improved this situation by adopting "**slip element type III**" for his real physical model boundary conditions. It is noted that the surface (or/interface) friction angle (d_w) from Casagrande shear box test was applied in the slip element type III.

Suggestions for CRISP:

- Fully implementation of **zero extension line directions** (positive direction is only available at moment) at **one integration point** only;
- Generation of **incremental** vertical and horizontal displacement contours (e.g. plastic region between S=8mm and S=40mm).

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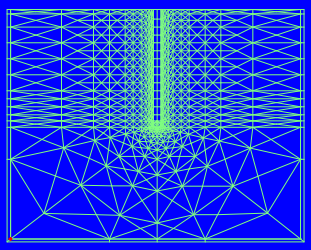

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