



# 3rd ICTG 2016

04-07 September 2016, Guimarães, Portugal



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## Large Strain and Nonlinearity in PVD-assisted Consolidation

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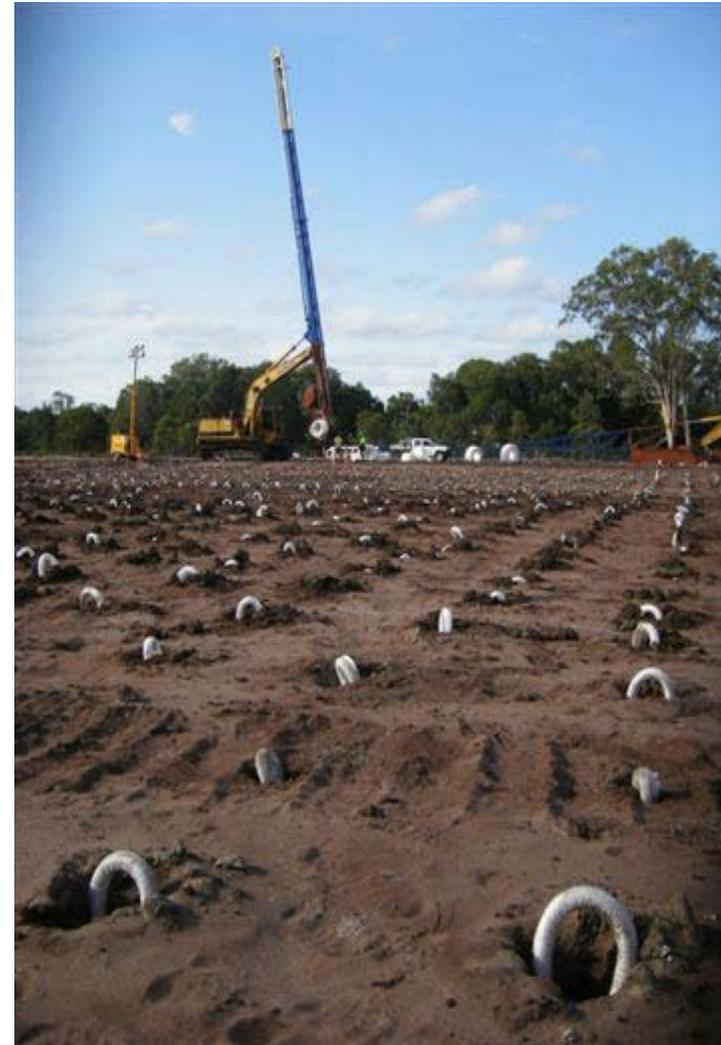
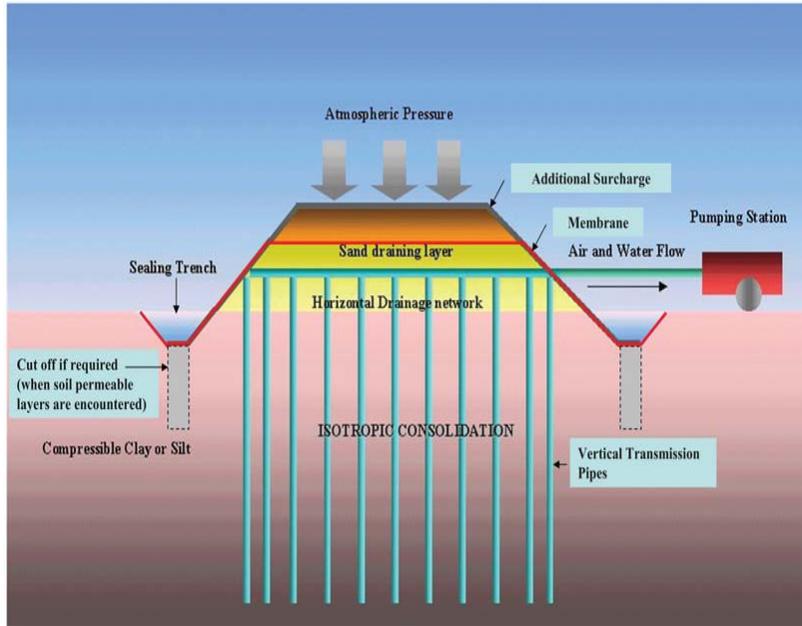


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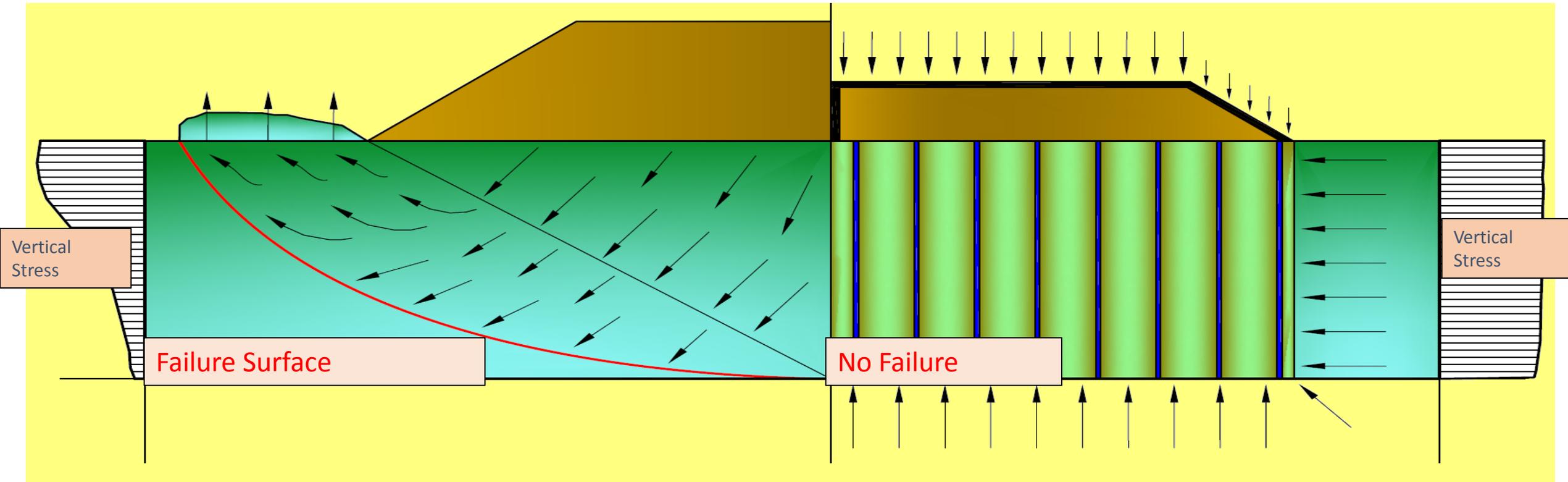


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Surcharge Loading  
Anisotropic Load

Vacuum Preloading with PVD  
Isotropic Loading



Risk of shear failure is minimized by the use of Vacuum Preloading

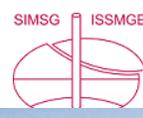


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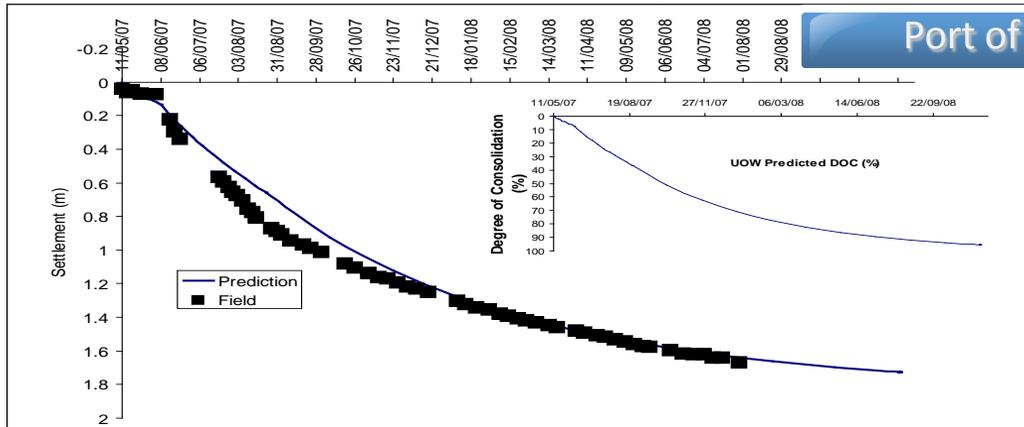
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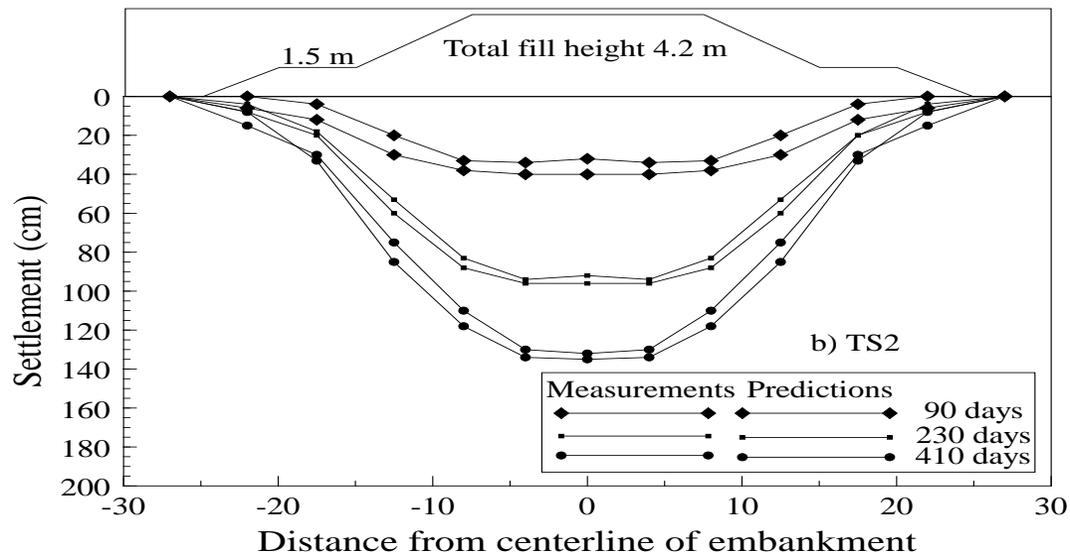


## Port of Brisbane



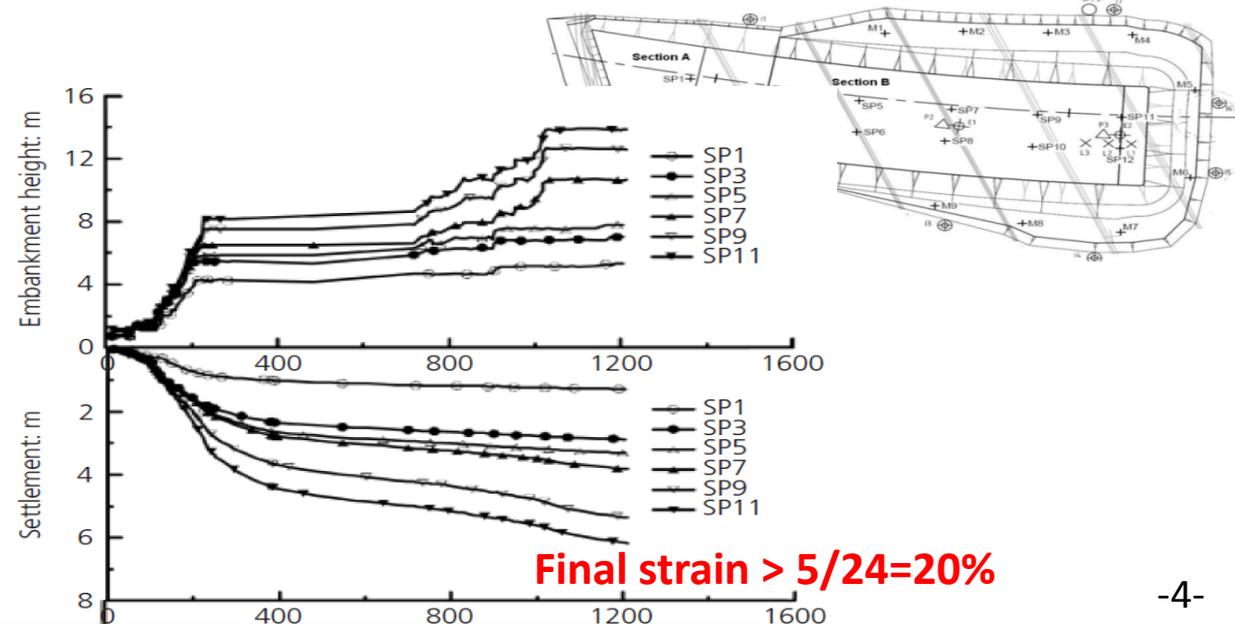
Final strain > 1.6/30=5.3%

## Tianjin Port



Final strain > 1.2/20=6%

## Ballina Bypass



Final strain > 5/24=20%



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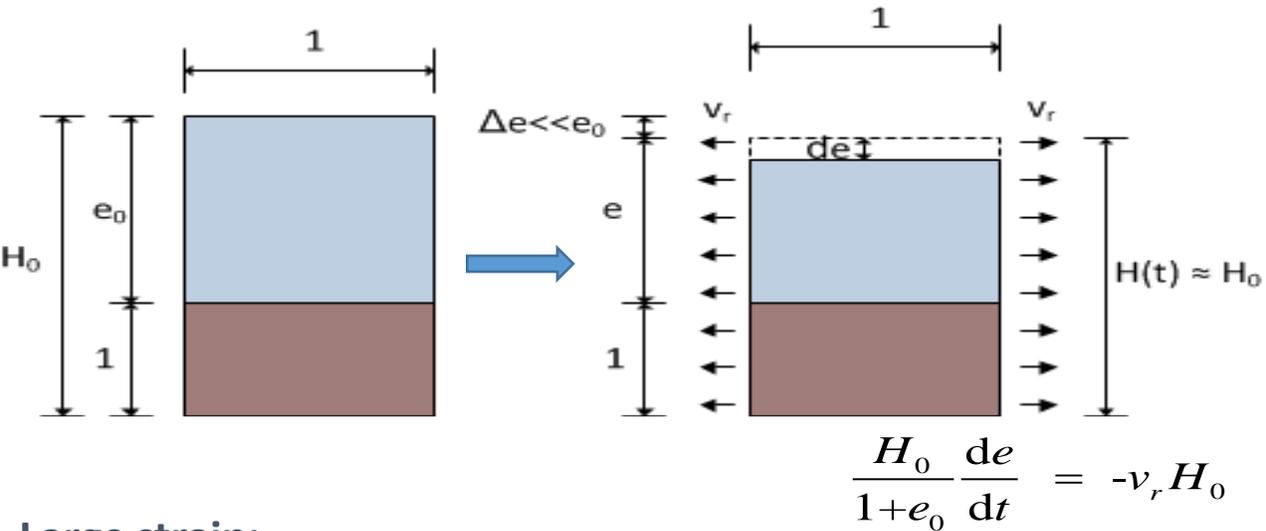
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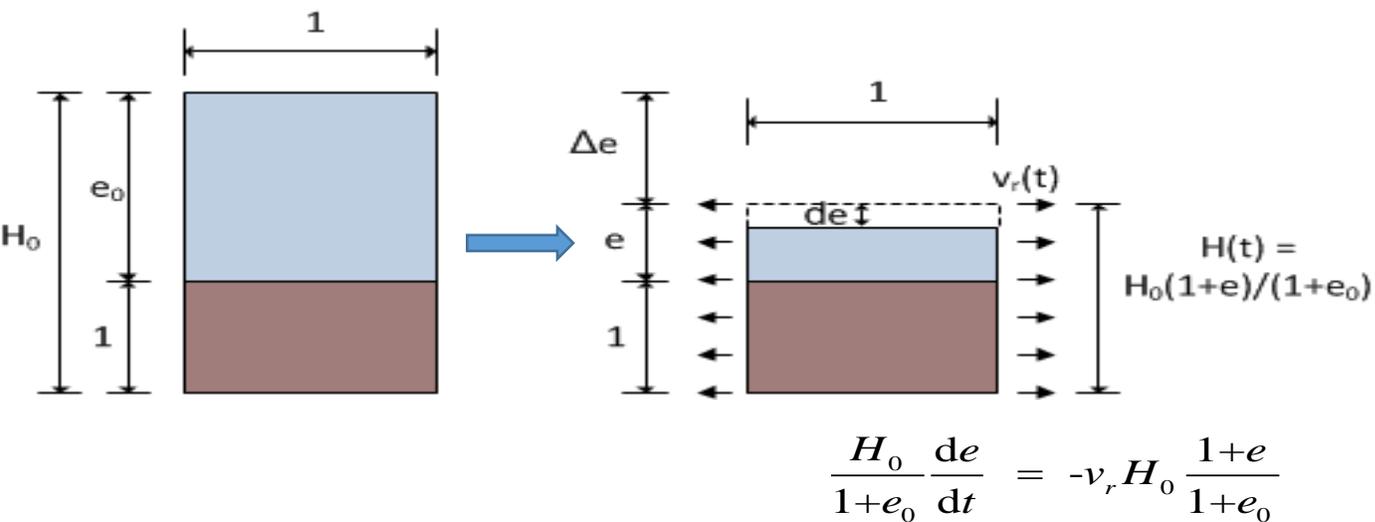
## Small strain:



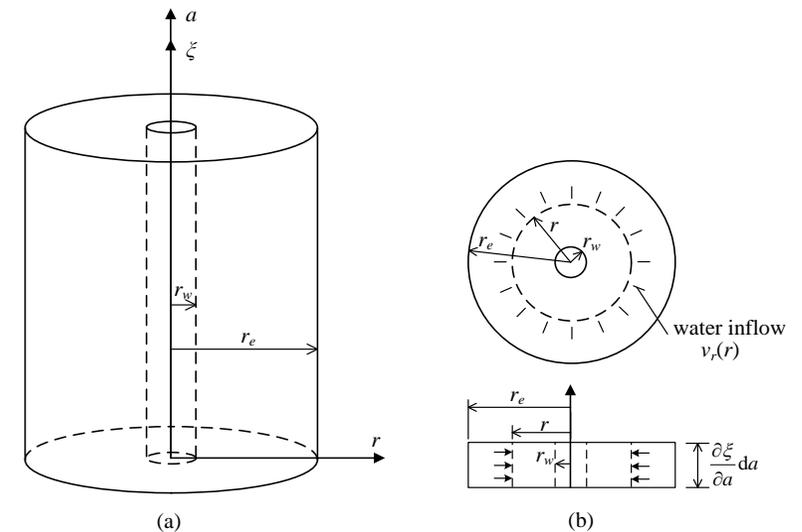
## Conventional solution: Small Strain & linear permeability and compressibility

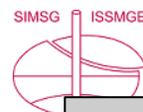
$$\frac{k_h}{m \gamma_w} \left( \frac{1}{r} \frac{\partial u}{\partial t} + \frac{\partial^2 u}{\partial r^2} \right) + \frac{k_v}{v_w} \frac{\partial^2 u}{\partial z^2} = \left( \frac{\partial u}{\partial t} - \frac{dq}{dt} \right)$$

## Large strain:



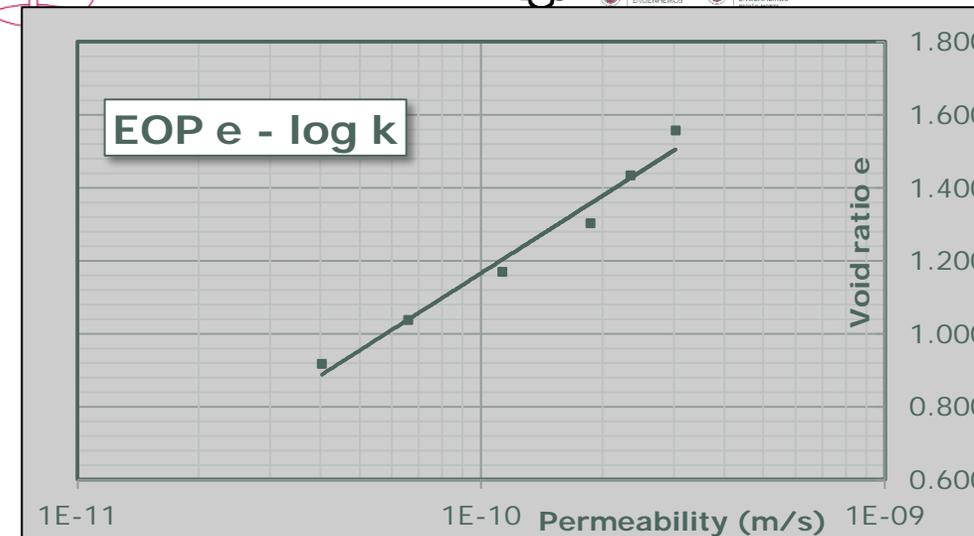
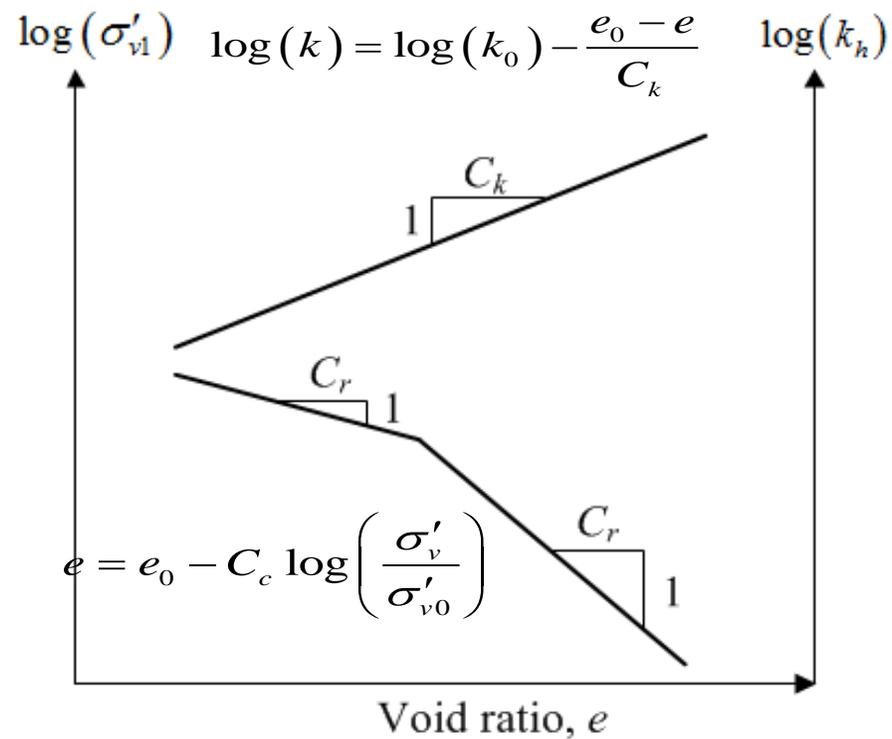
## Large strain coordinate system



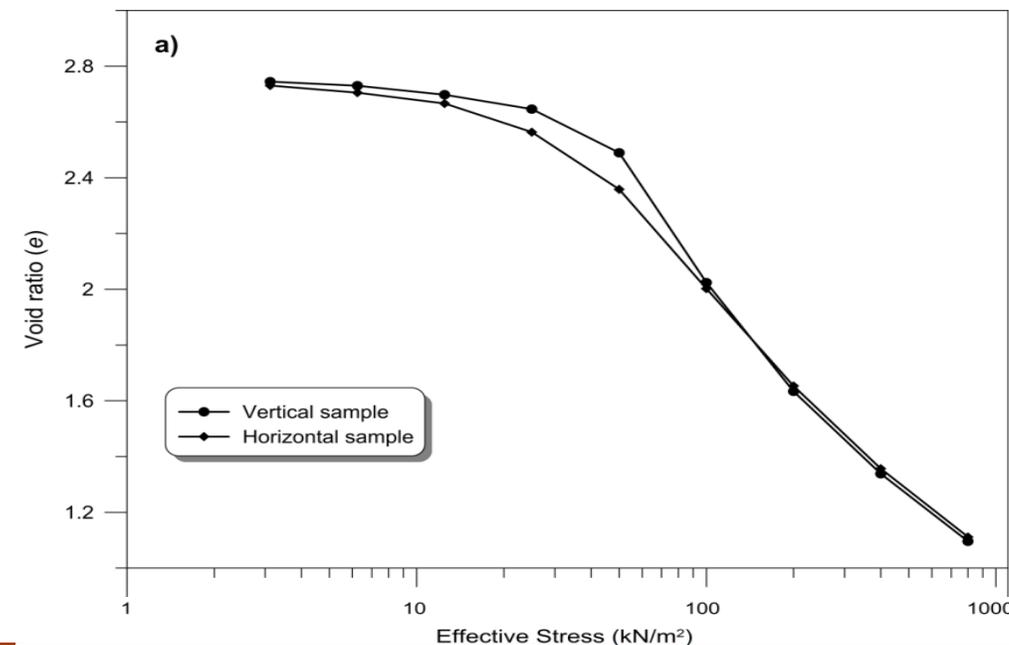


## Nonlinearities

## Void ratio-dependent permeability and compressibility



Ballina samples





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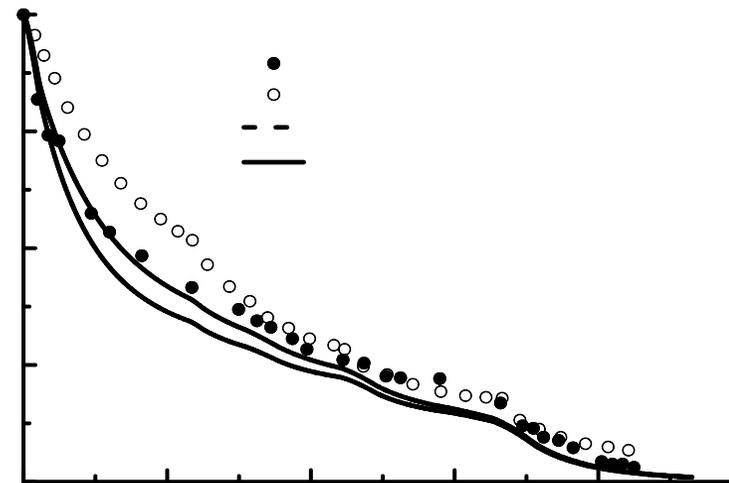
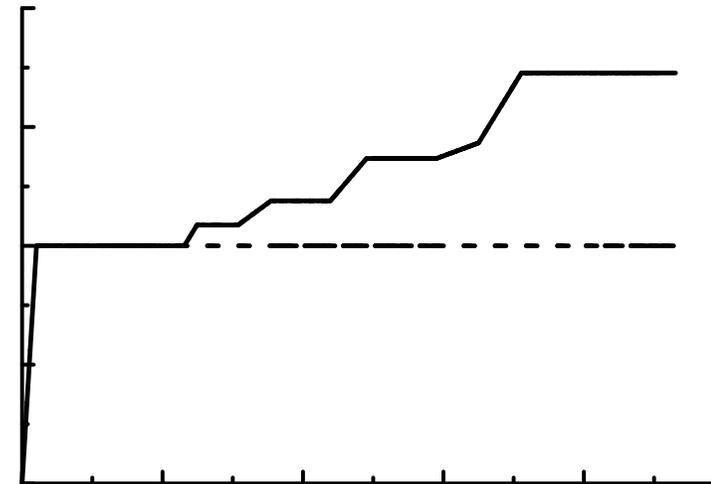
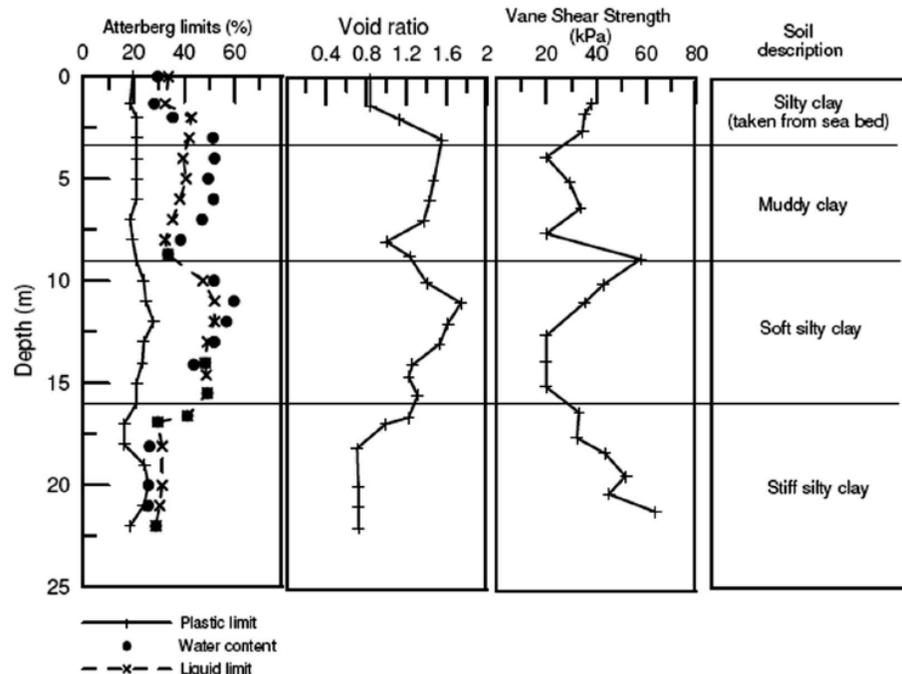
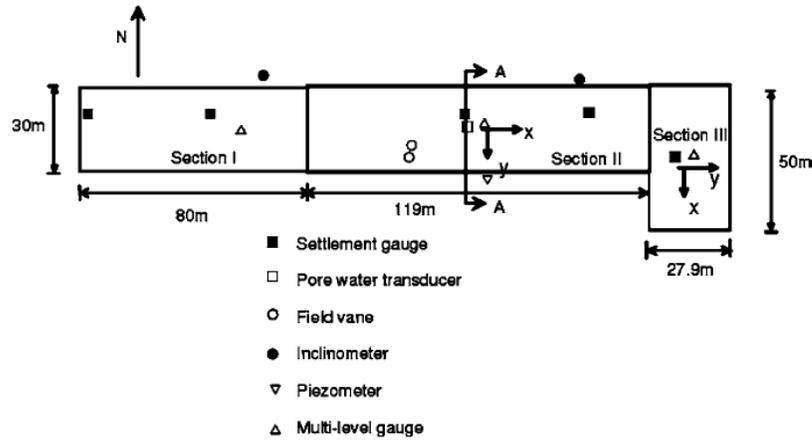


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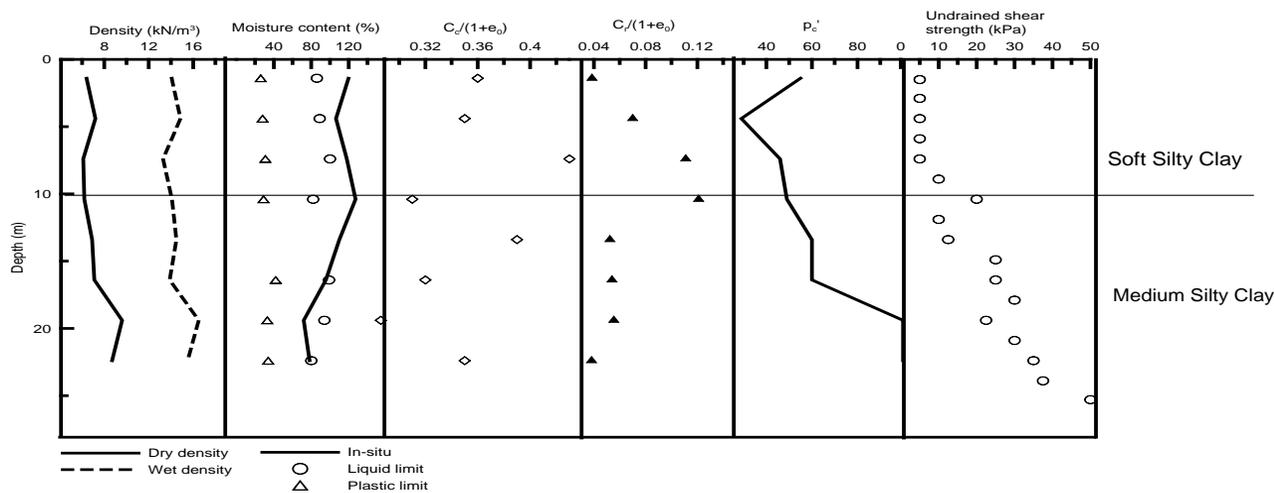
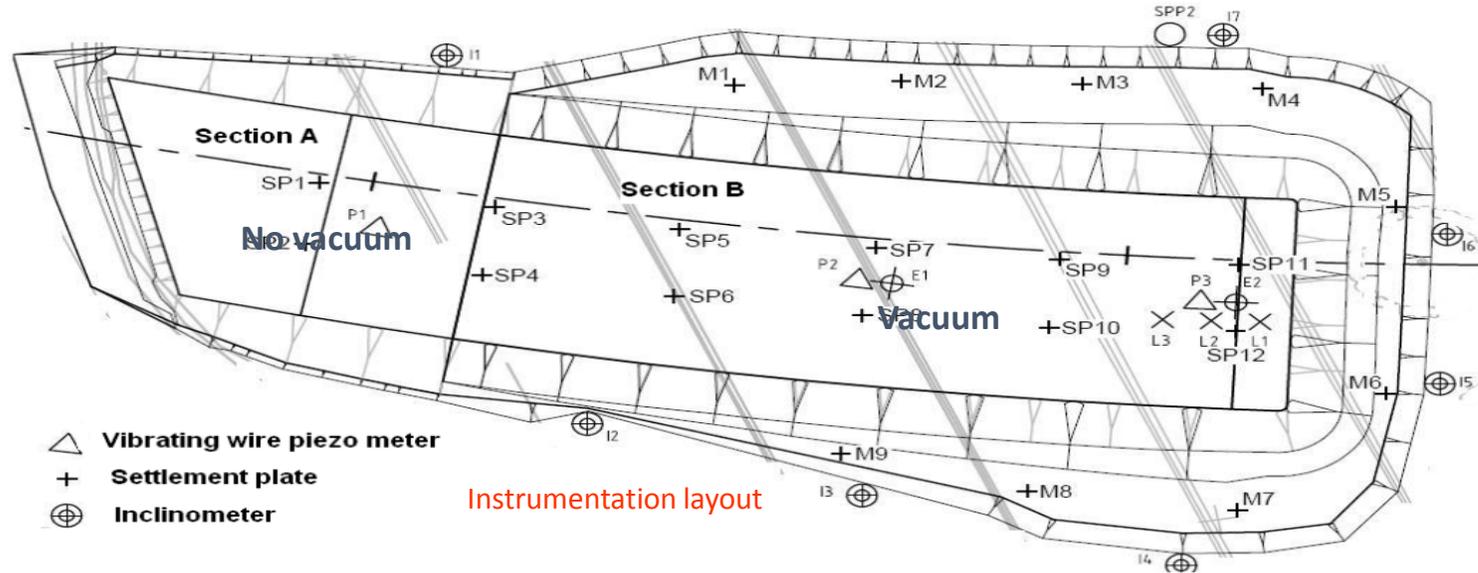
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Tianjin Port Yan and Chu (2008), Rujikiatkamjorn et al. (2008)





## Trial Embankment Stabilized with PVD and Vacuum Preloading, Ballina Bypass, Australia





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IGS



ORDEM DOS ENGENHEIROS



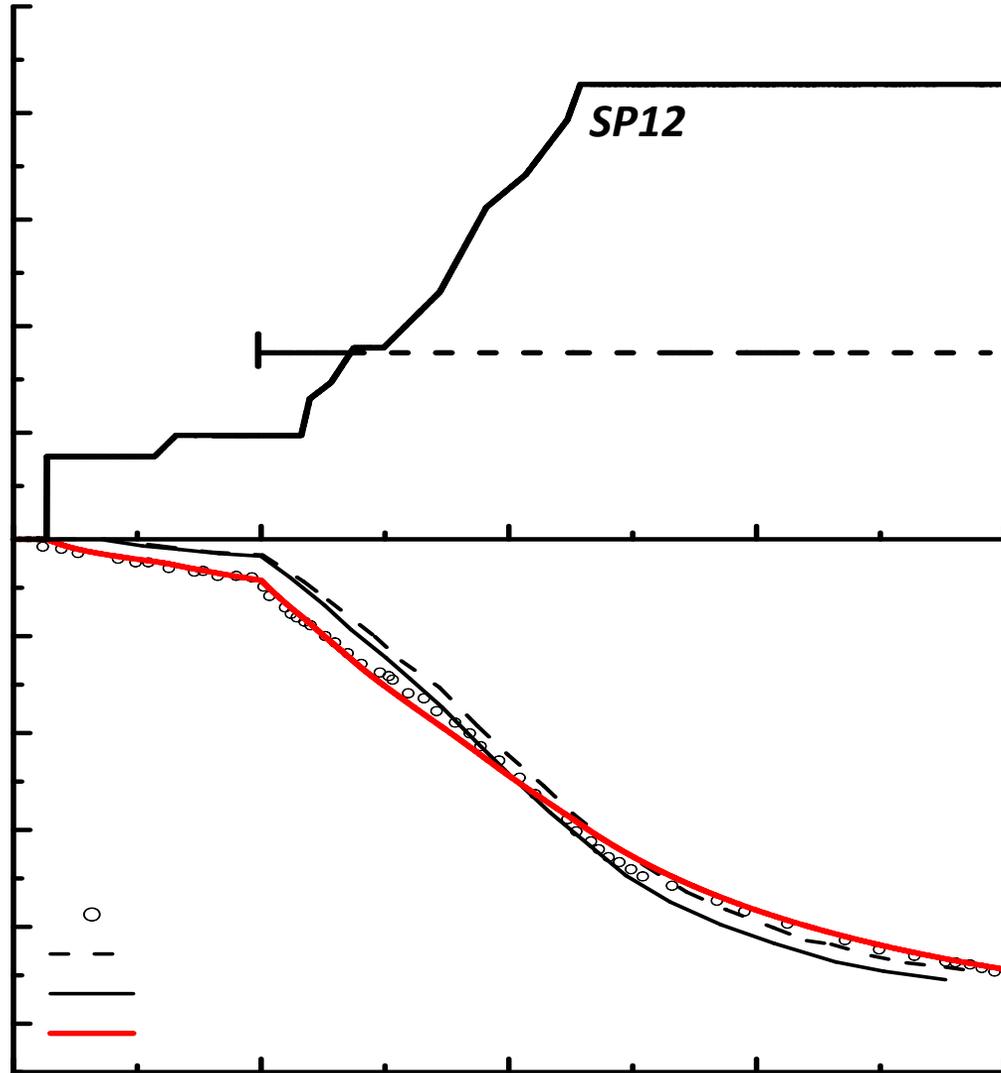
ORDEM DOS ENGENHEIROS



ORDEM DOS ENGENHEIROS



ORDEM DOS ENGENHEIROS



- (1) The conventional small-strain solution may over-predict the degree of consolidation.
- (2) Although in many cases the conventional small-strain model is still acceptable, in some cases of deep estuarine clay deposits the large-strain solution becomes significantly more accurate.



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## Acknowledgements:

Prof. Buddhima Indraratna and A/Prof. Cholachat Rujikiatkamjorn;

ARC Centre of Excellence for Geotechnical Science and Engineering;

Industry Partners and Institutions: Queensland Department of Main Roads, Port of Brisbane

Corporation, Roads and Traffic Authority, Coffey Geotechnics, Polyfabrics, Geofabrics, ARUP,

Douglas Partners, Sydney Trains, ARTC, Chemstab and Austress Menard

UoW staff and students

# Thank You for your attention!