

# **Effects of head plate size on nailed CDG steep slope behaviour subjected to rising groundwater**

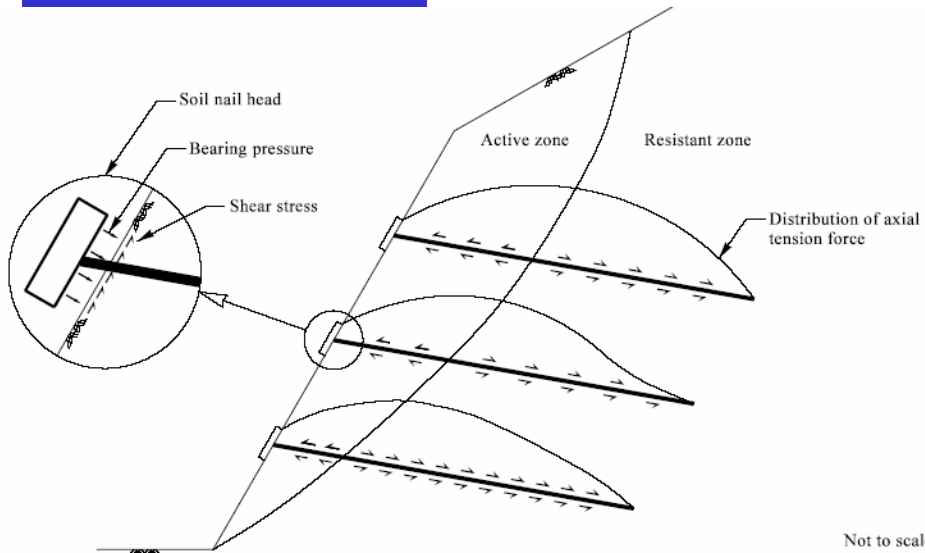
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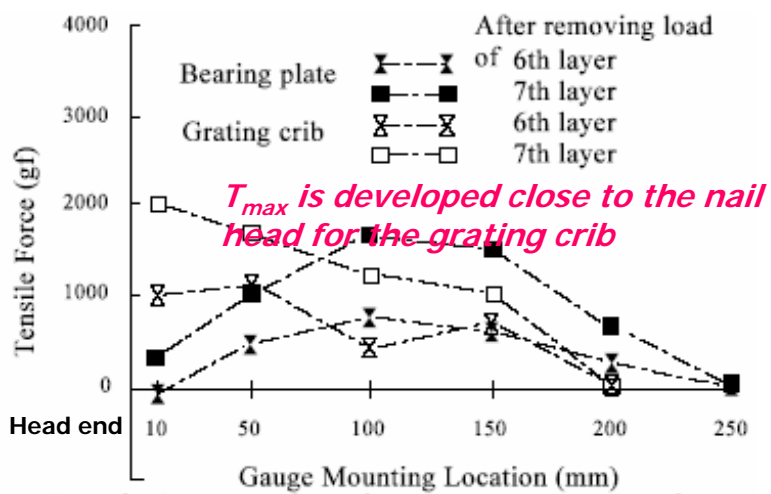
# Introduction



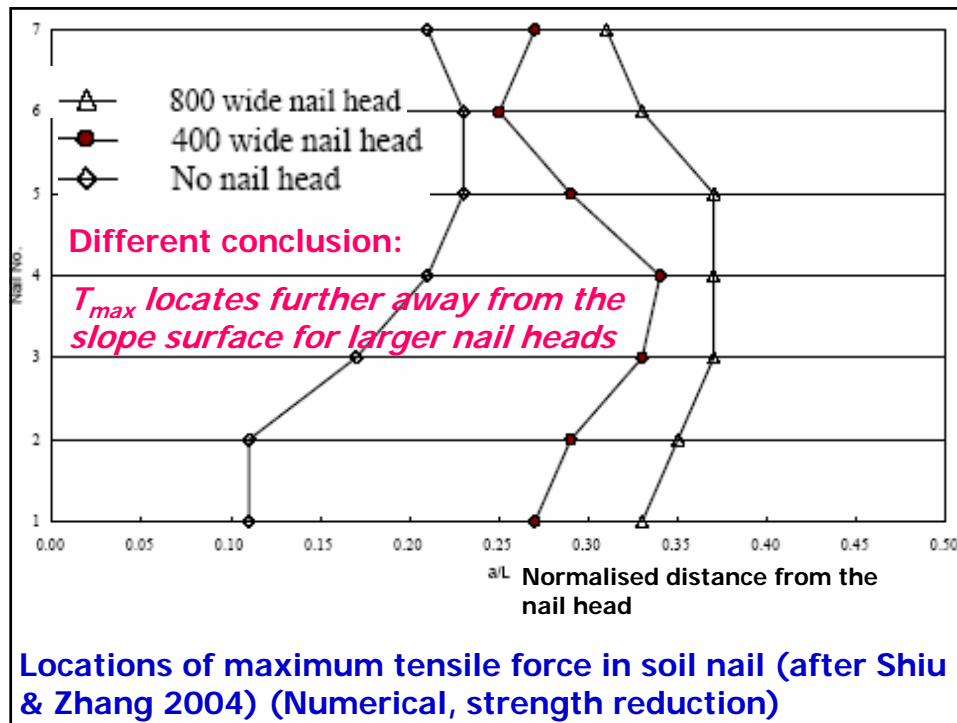
Load transfer mechanism of soil nailed structure (after Shiu & Zhang 2004)

# Literature review

## Excavation: experiment



Effect of head plate on distribution of reinforced tensile force (after Muramatsu et al 1992)



## Objectives

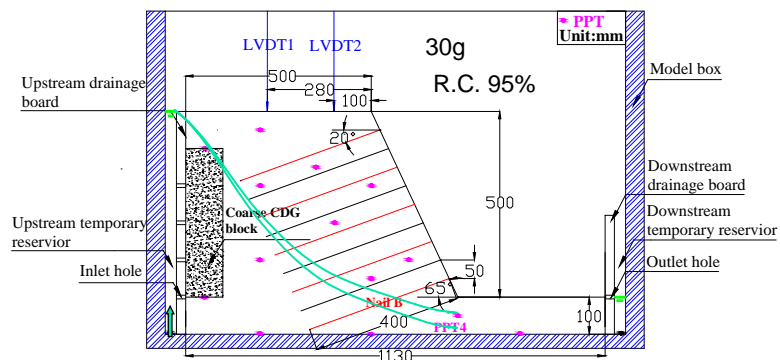
- Effects of nail head size on steep slope behaviour subjected to rising groundwater
  - Failure mechanism
  - Tensile force distribution
    - Location of maximum tensile force

# Centrifuge modelling

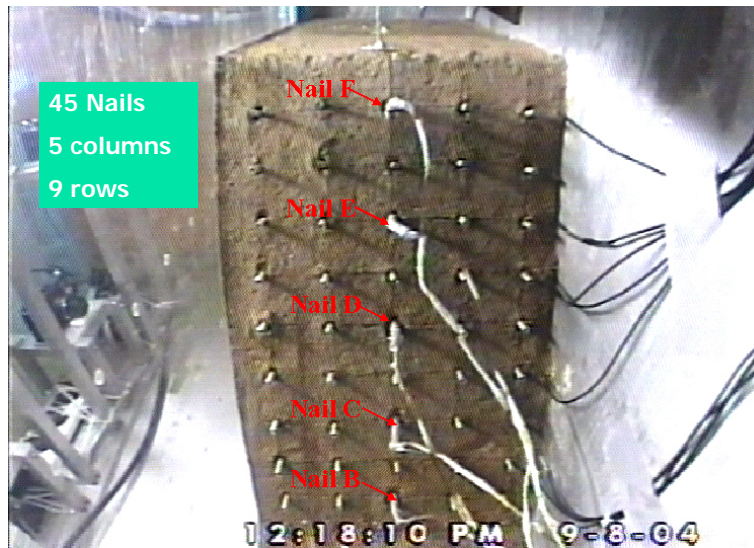
## Test programme

I.D.	Reinforced conditions
CG65_30	No nail
CGN65_30	Nailed (no head)
CGNH65_30	Nailed (400 mm wide head )
CGNH <sub>1</sub> 65_30	Nailed (600 mm wide head )
CGNGr65_30	Nailed (400 mm wide grillage)

## Nailed model package (CGN65\_30)

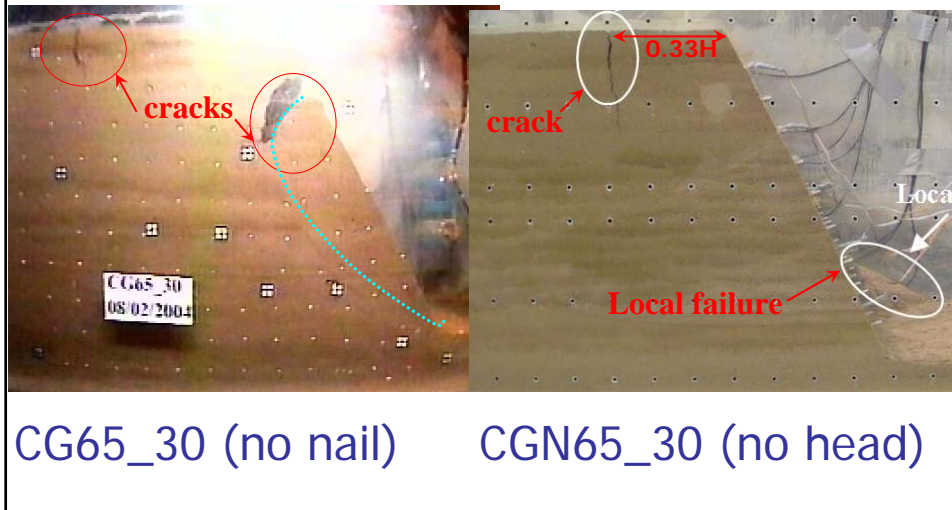


## Instrumented Soil Nails (font view)

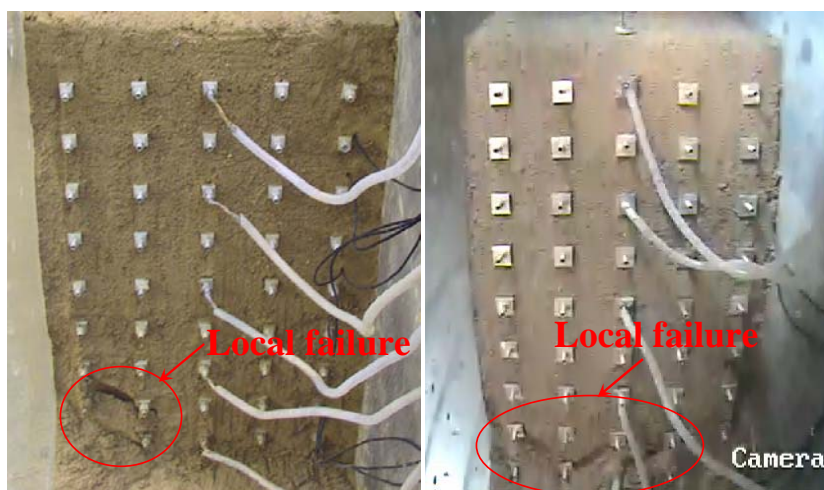


## Test Results

## Observed failure modes

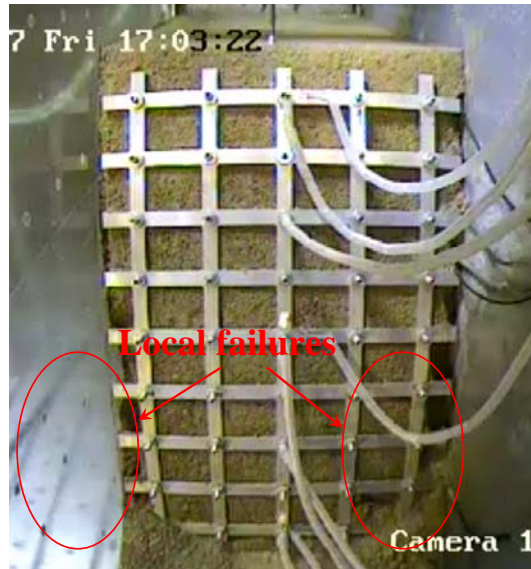


Local failures were observed in nailed slopes with different dimensions of head plate



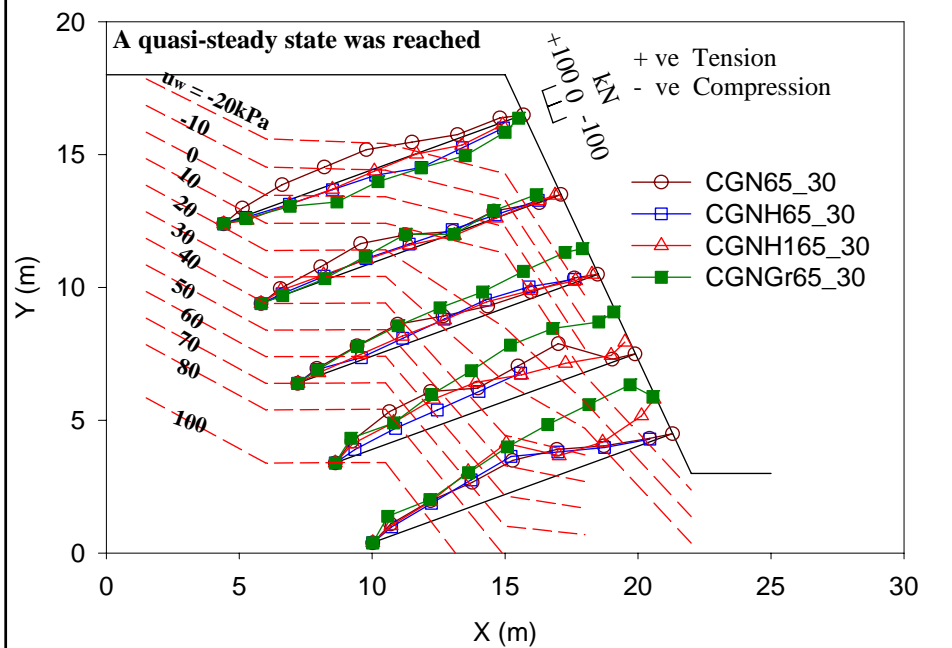
CGNH65\_30 (400 wide H)      CGNH<sub>1</sub>65\_30 (600 wide H)

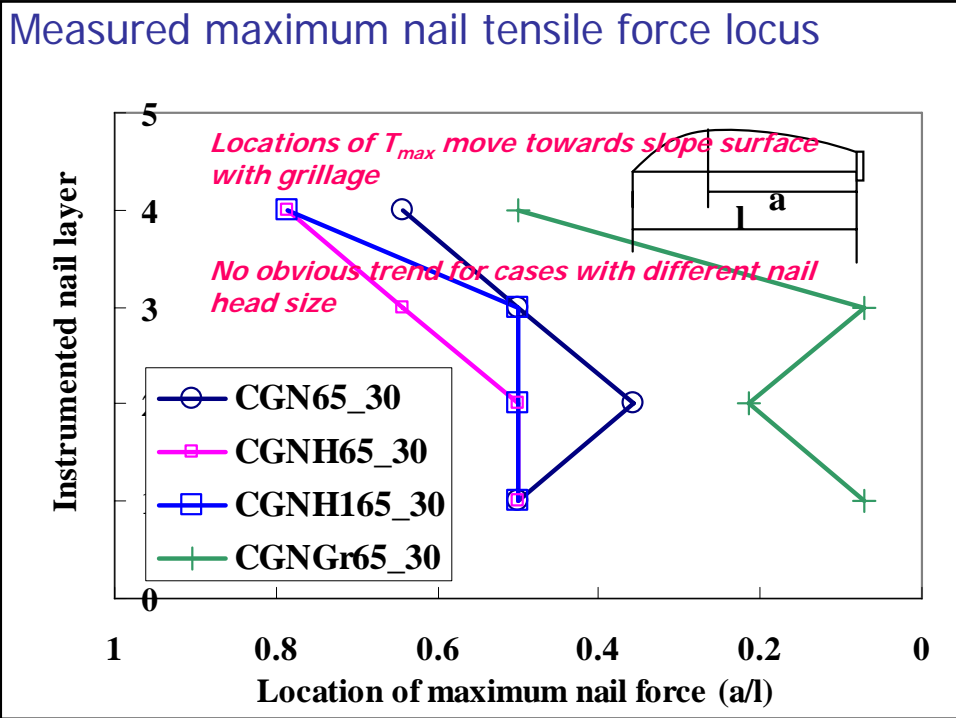
Local failures were observed in nailed slopes with grillage



CGNGr65\_30  
(400 wide G)

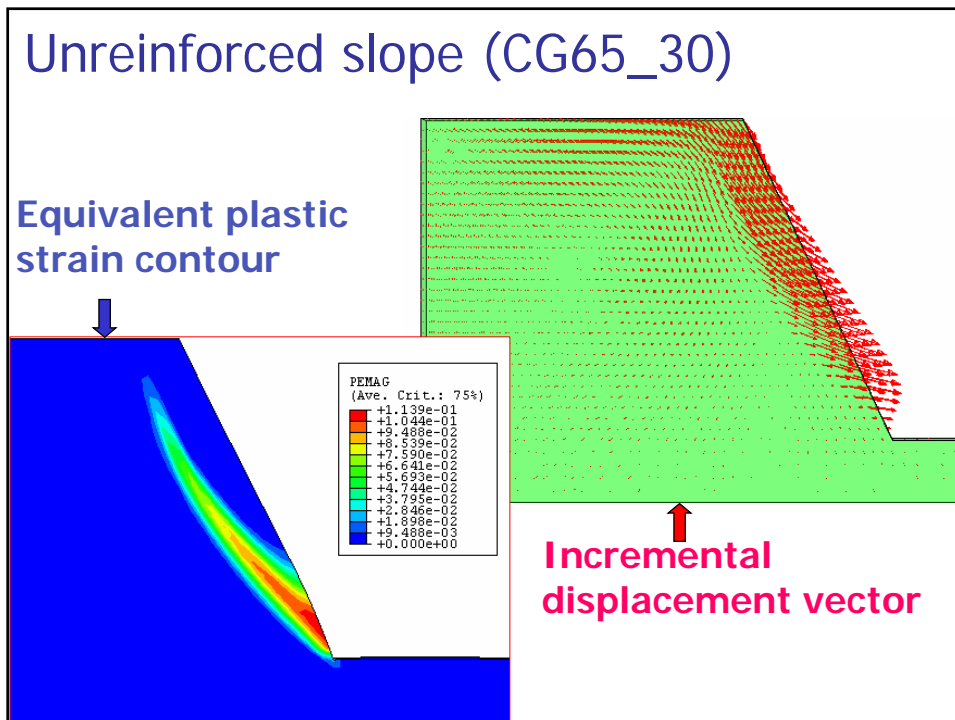
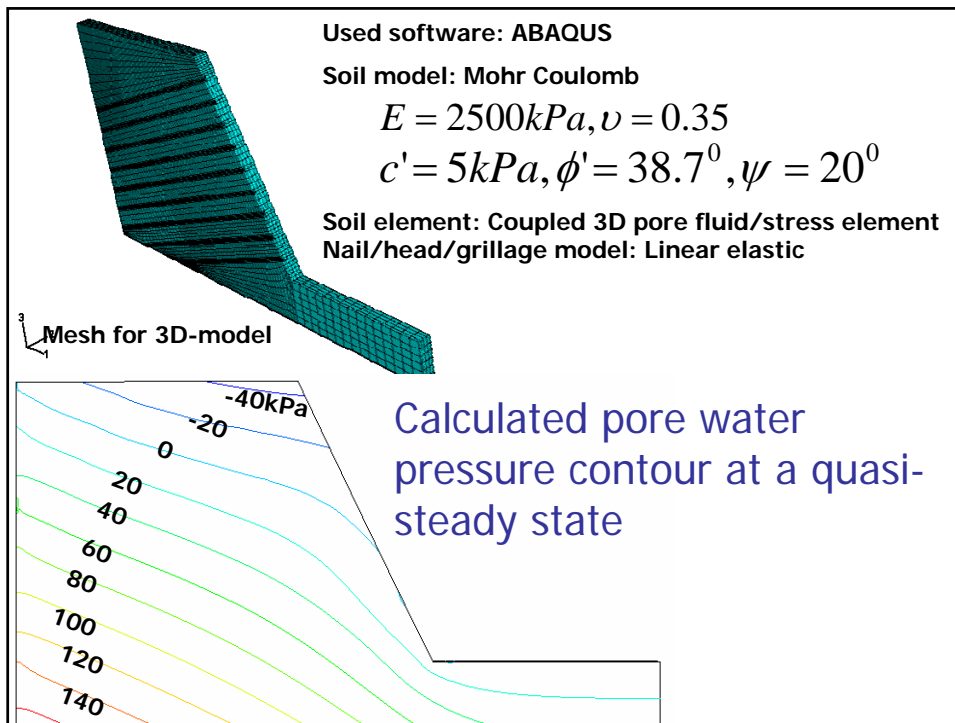
Measured Nail axial force distributions with  $u_w$  contour



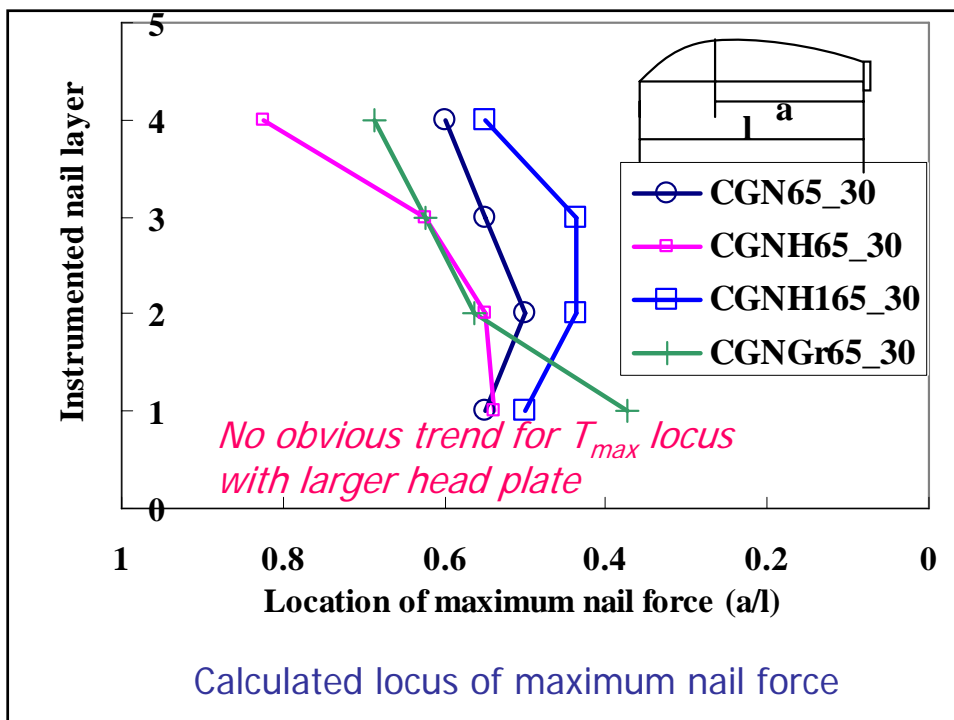
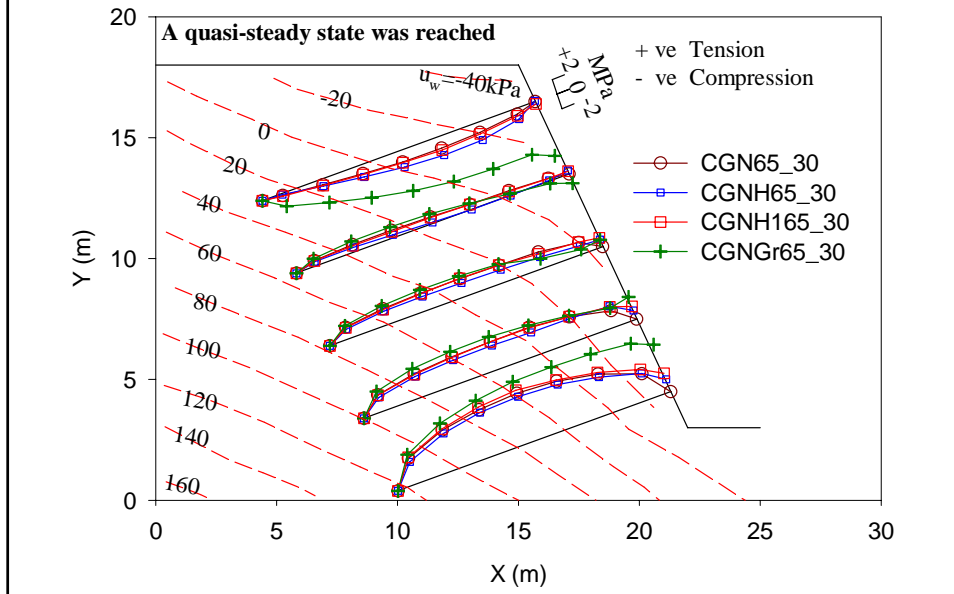


## Three Dimensional Numerical Analysis





## Calculated nail axial stress distributions with $u_w$ contour



## Summary (1)

- For the slope without soil nail, a continuous slip surface was triggered by rising groundwater
- Inclusion of soil nails (without nail head) did prevent the formation of an obvious continuous slip surface but not crack at the crest and local failure near the toe
- Further inclusion of nail heads is beneficial to prevent the failure with the active zone sliding off the upper soil

## Summary (2)

- Greater nail axial tensile forces (especially for lower nails) were mobilised close to slope surface with larger nail head plate/grillage
- Used numerical model can simulate experimental nail force distribution reasonably if there is no crack was observed in the test
- From these models (experimental, numerical),  $T_{\max}$  locus does not lie further away from or closer to the head for larger nail heads

Thank You!

Q & A