CE394M: Finite Element Analysis in Geotechnical Engineering

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Overview

1. Nicoll Highway Collapse, Singapore
   - The Collapse
   - Post collapse investigation

FE Disclaimer

IMPORTANT WARNING AND DISCLAIMER

PLAXIS is a finite element program for geotechnical applications in which soil models are used to simulate the soil behaviour. The PLAXIS code and its soil models have been developed with great care. Although a lot of testing and validation have been performed, it cannot be guaranteed that the PLAXIS code is free of errors. Moreover, the simulation of geotechnical problems by means of the finite element method implicitly involves some inevitable numerical and modelling errors. The accuracy at which reality is approximated depends highly on the expertise of the user regarding the modelling of the problem, the understanding of the soil models and their limitations, the selection of model parameters, and the ability to judge the reliability of the computational results. Hence, PLAXIS may only be used by professionals that possess the aforementioned expertise. The user must be aware of his/her responsibility when he/she uses the computational results for geotechnical design purposes. The PLAXIS organization cannot be held responsible or liable for design errors that are based on the output of PLAXIS calculations.

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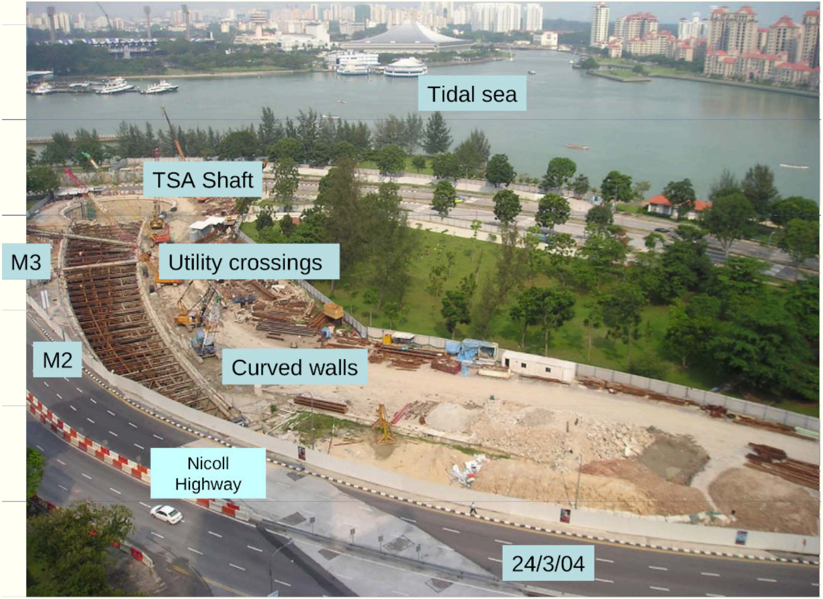
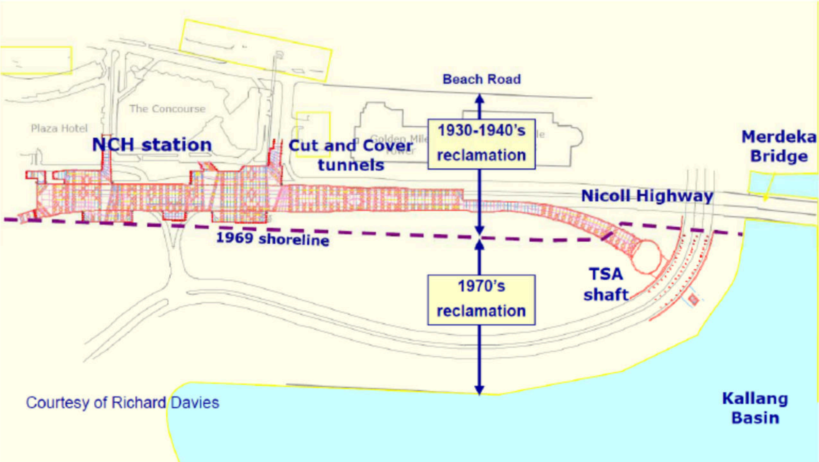
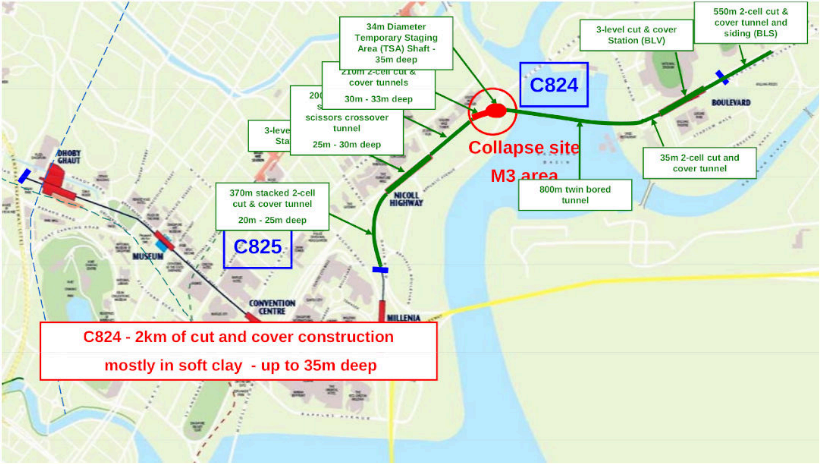
Nicoll Highway, Singapore



Nicoll Highway, Singapore

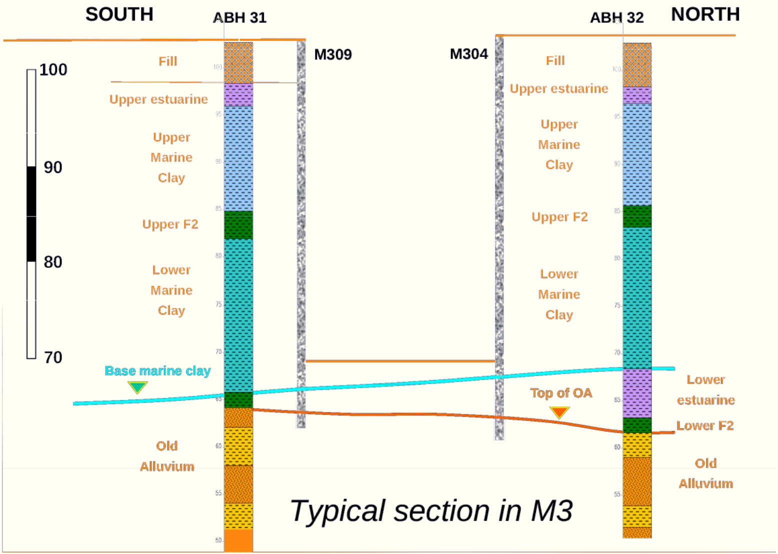


Nicoll Highway, Singapore

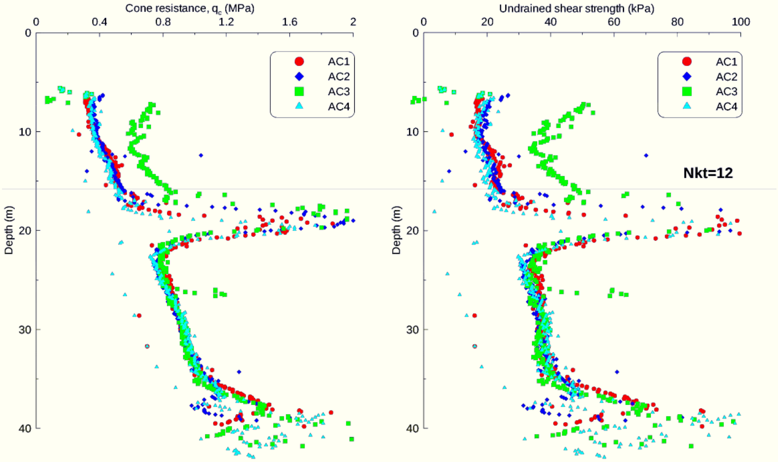


Cut and cover construction

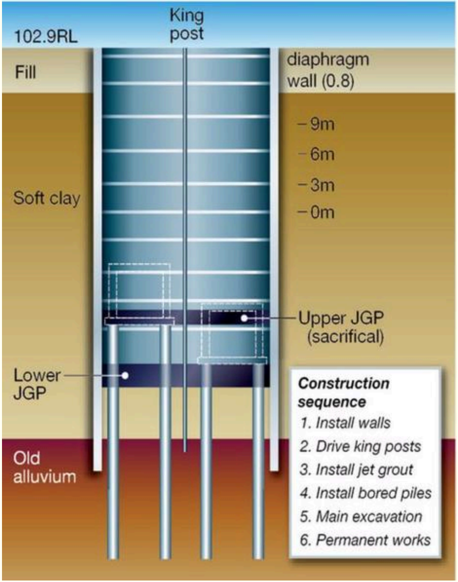
Soil profile



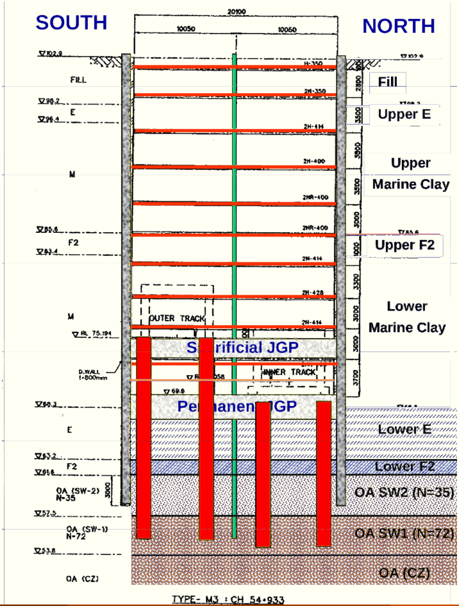
Soil profile



Construction sequence



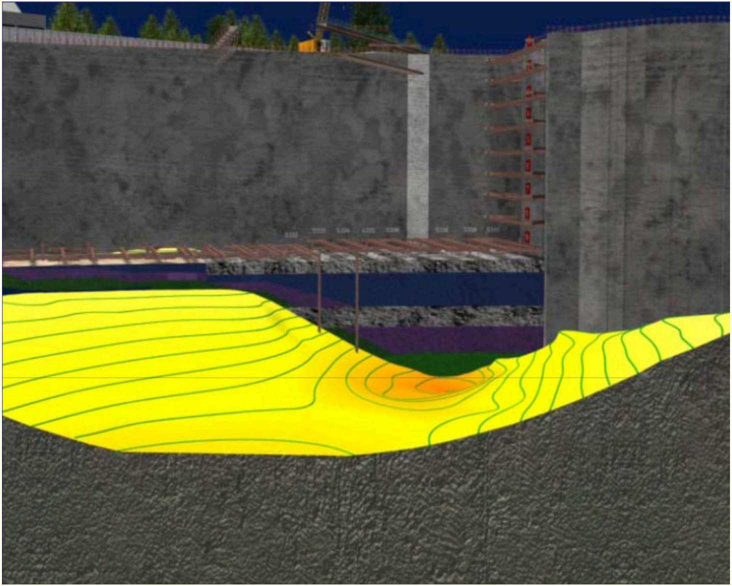
Construction sequence



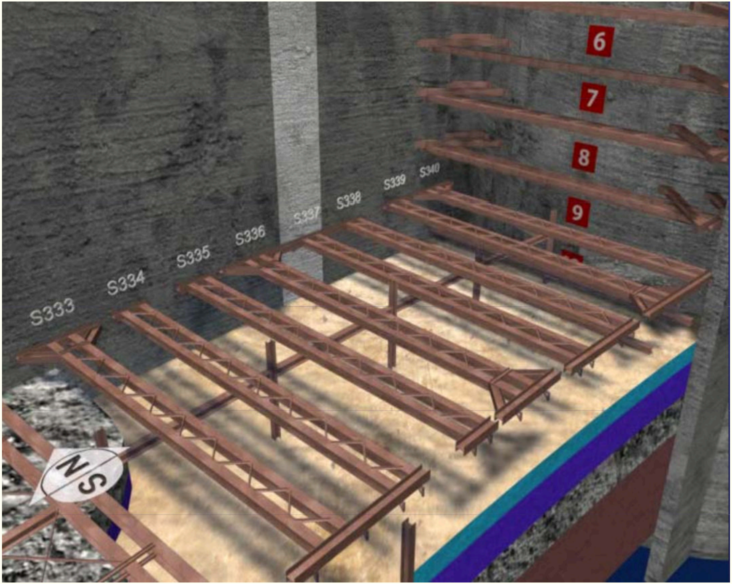
Nicoll Highway: Excavation

South side 13 March 2004

Excavating 10th level of struts



On the morning of collapse



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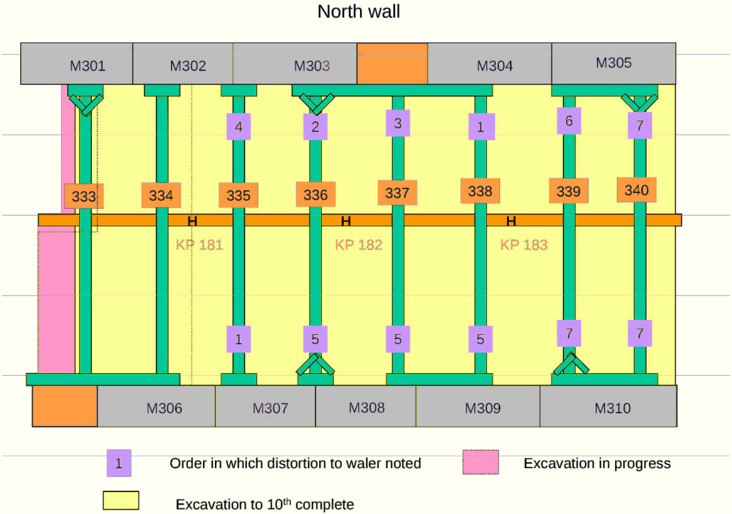


Location of walers, splays and Dwall gaps

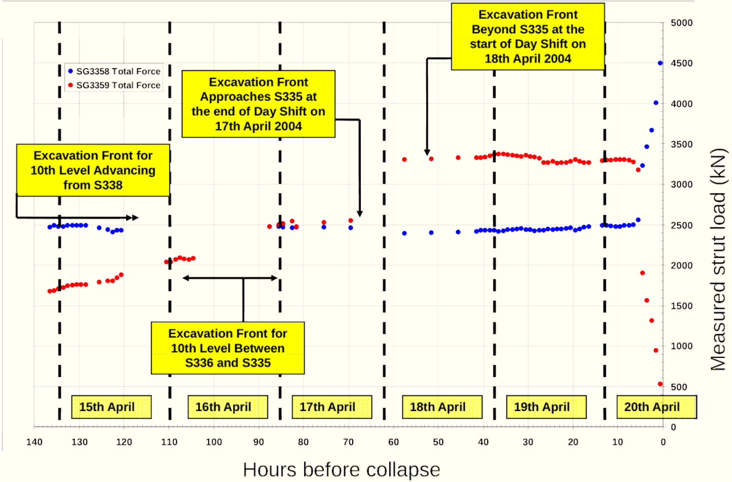
On the morning of collapse

Strut 338 North side

On the morning of collapse

Strut 335 Sorth side

Hours before collapse



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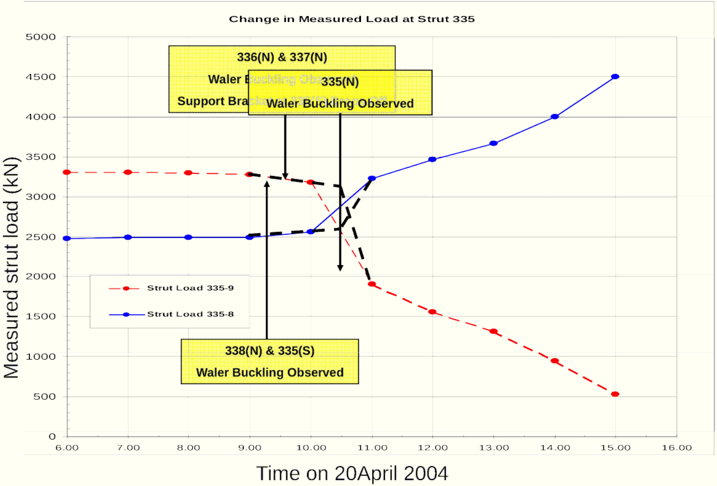
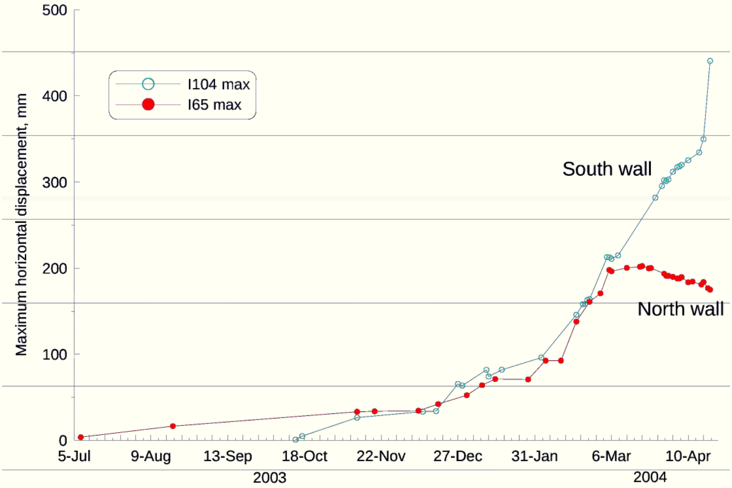
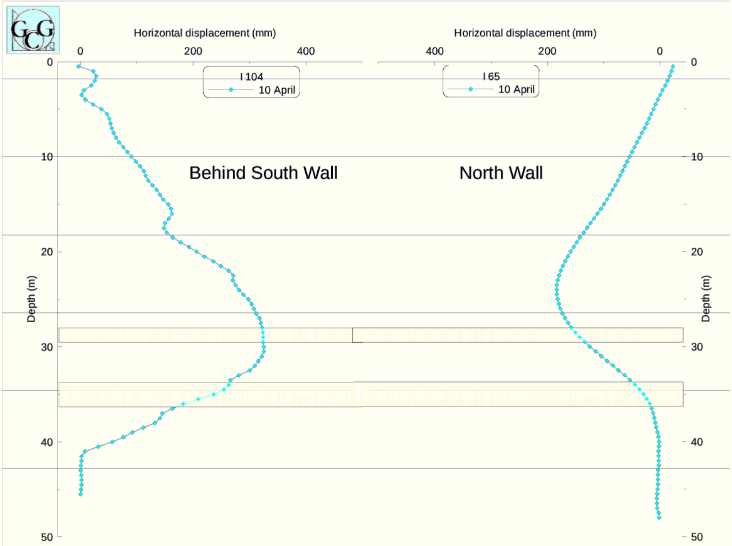


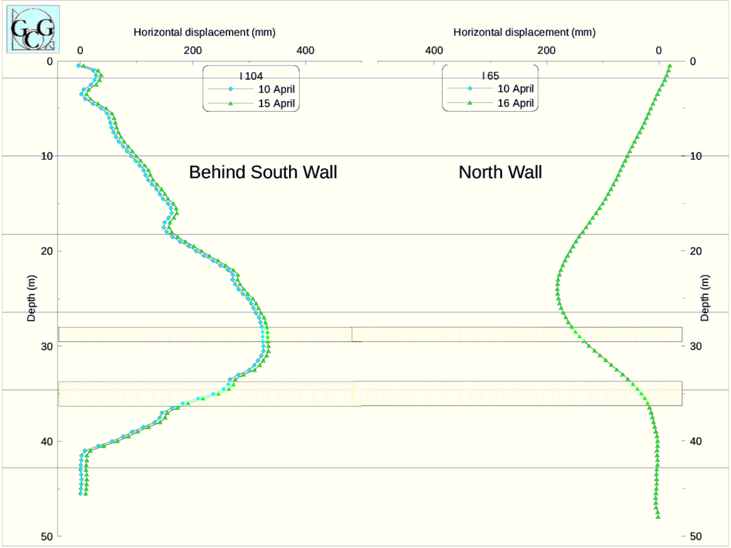
Leading up to the collapse: Inclinometer



Leading up to the collapse: Wall displacements



Leading up to the collapse: Wall displacements



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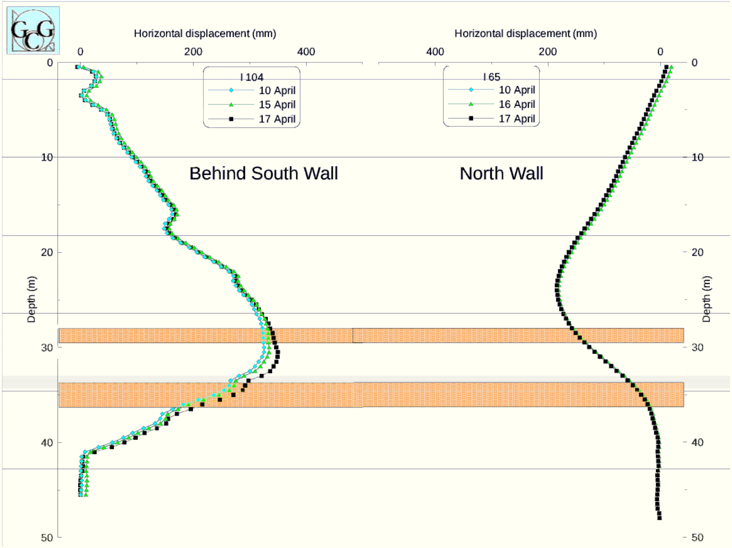

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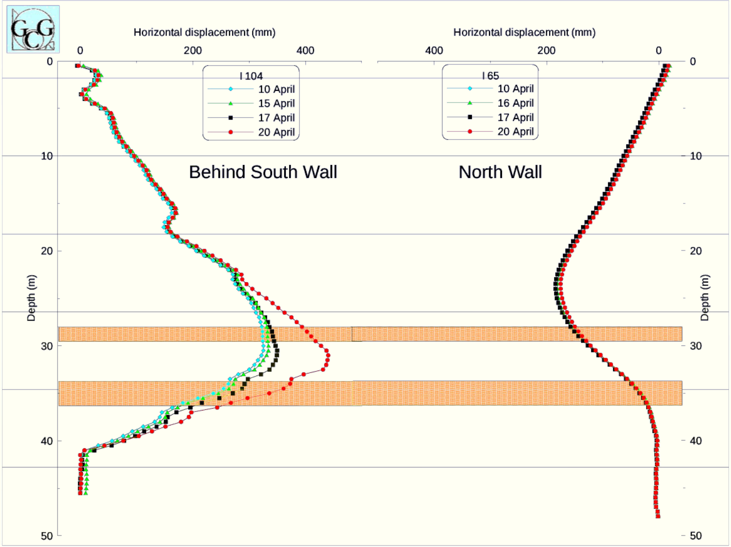


The collapse

The collapse

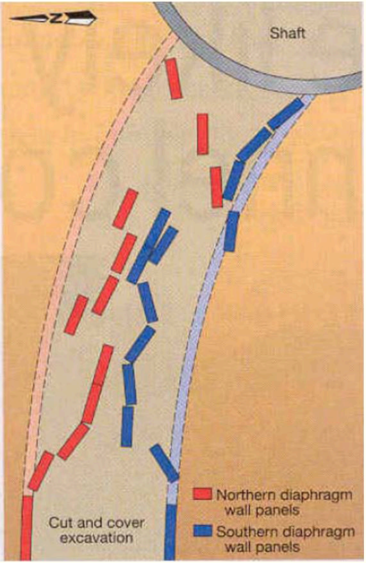
The collapse

The collapse

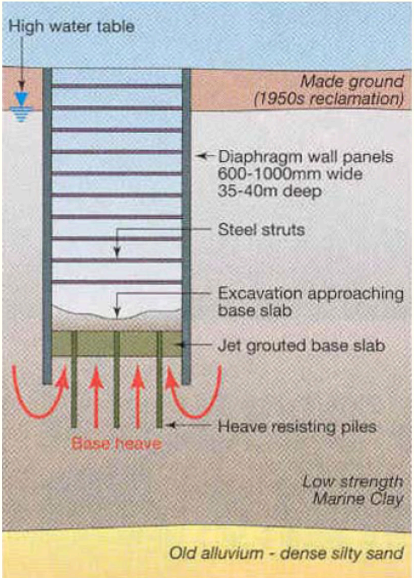
The collapse

Post collapse

Post collapse

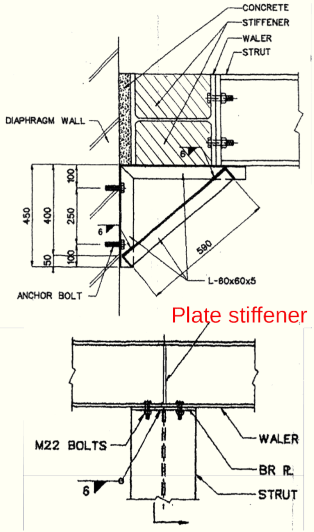


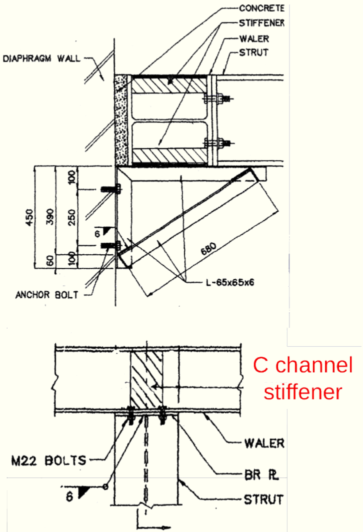
Reasons for collapse



Strut design: Replacing plate-stiffener with C-channel

Strut design: Waler connection





Strut design: Waler connection

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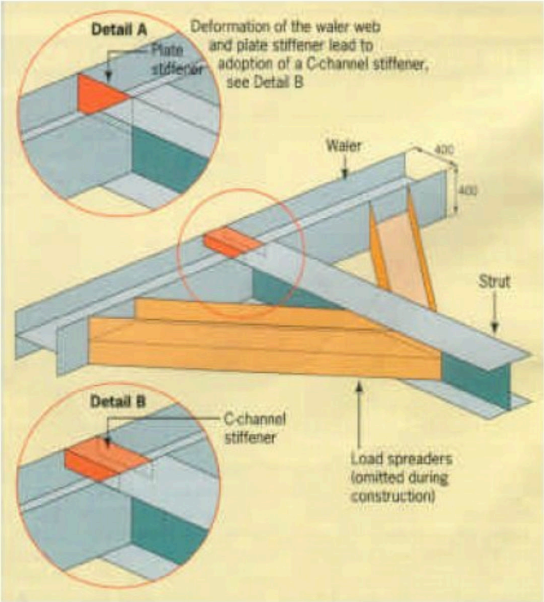
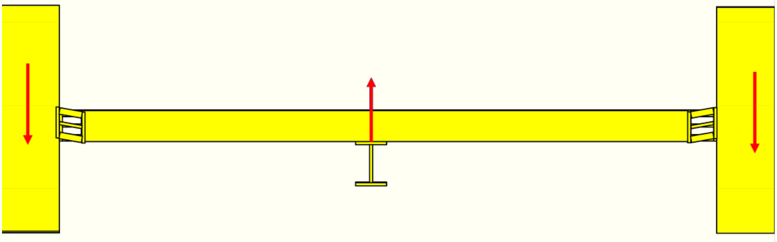
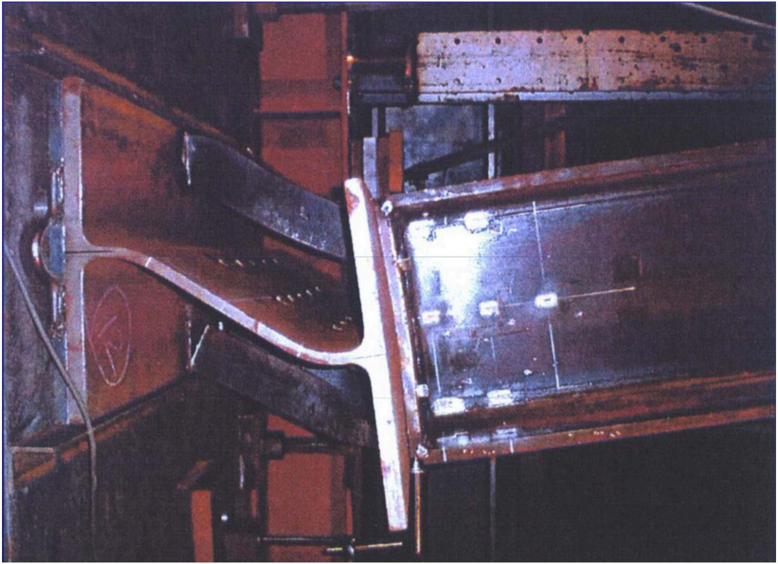


Strut design: Relative vertical displacements

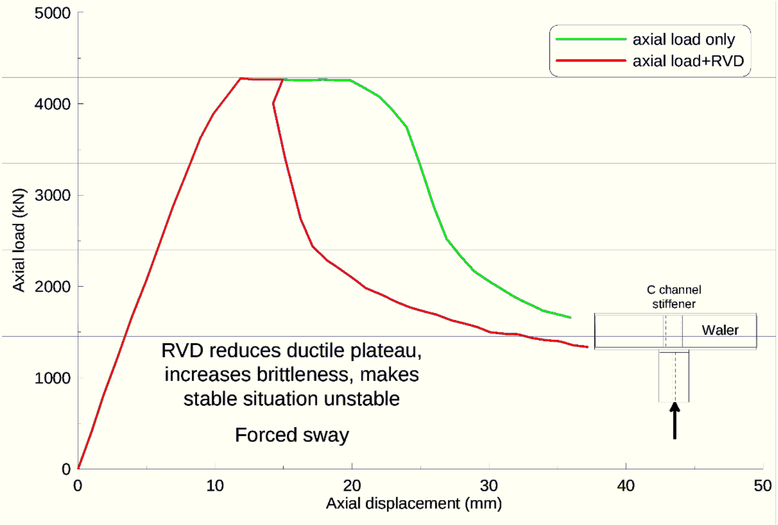


Relative vertical displacement between the King Post and the Dwall

Strut design: C-channel

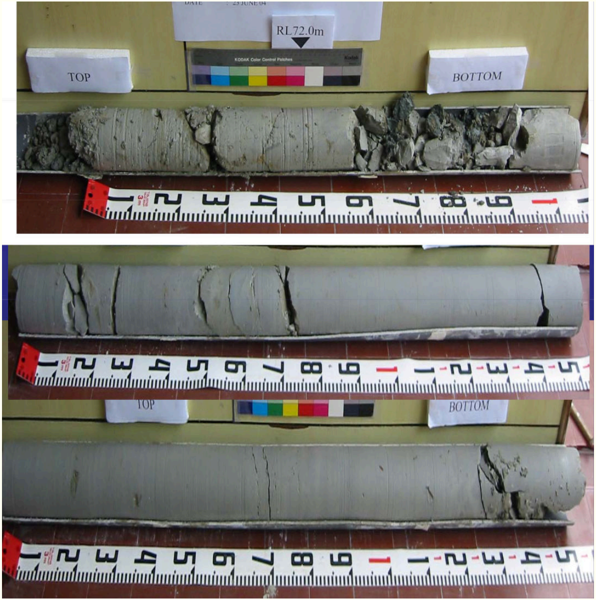


Strut design: C-channel relative vertical displacement

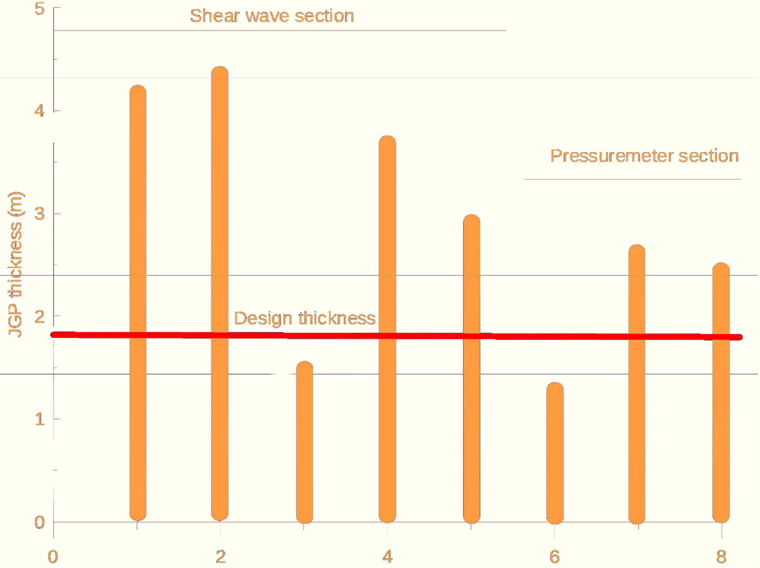


Excavation of sacrificial jet grout

Quality of jet grouting



Quality of jet grouting

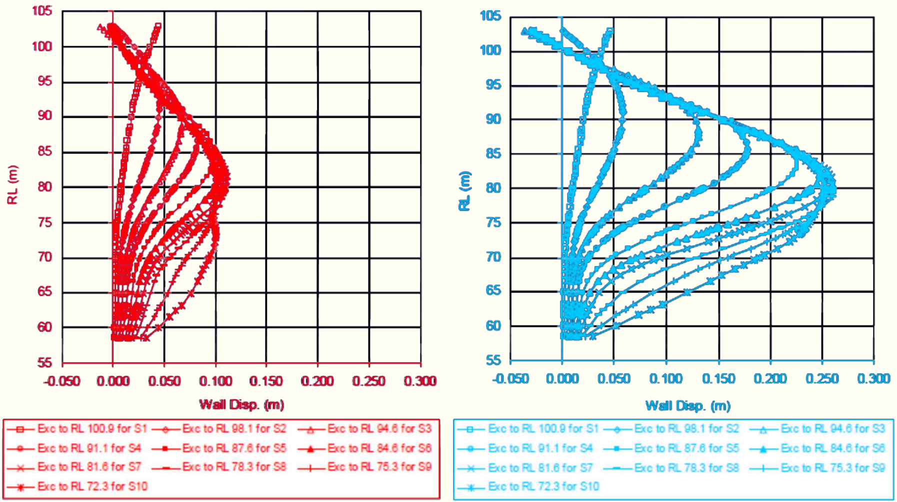


Porepressure analysis in geotechnical engineering

Undrained analysis

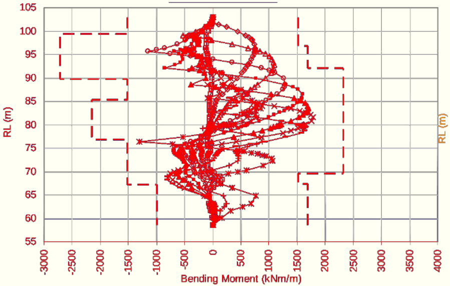
Undrained effective stress analysis

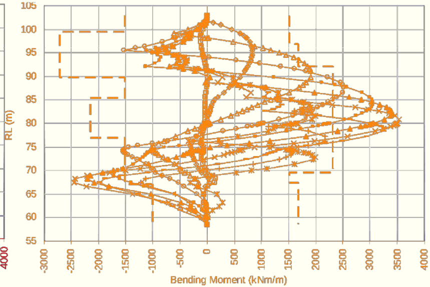
Wall displacements: Effective stress vs Undrained strength



Method A vs Method B

Bending moments: Effective stress vs Undrained strength





Method A vs Method B

Undrained effective stress analysis

- Method A over-estimates the undrained shear strength of normally and lightly overconsolidated clays
- Its use led to a 50% under-estimate of wall displacements and of bending moments and an under-estimate of the 9 th level strut force of 10%
- The larger than predicted displacements mobilised the capacity of the JGP layers at an earlier stage than predicted