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Title of presentation: Clay Cut Slope Deterioration

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Geotechnical area: Numerical Modelling and Slope Stability

The Problem

- High-plasticity clay infrastructure earthwork assets are deteriorating due to seasonal pore water pressure cycles causing seasonal ratcheting.
- The mechanism of seasonal ratcheting and long-term behaviour of slopes due to different weather patterns (i.e. climate change) is not well understood.
- Understanding slope deterioration rates and where slopes are within their life-cycle is critical for earthwork asset management strategies (see Figure 1).

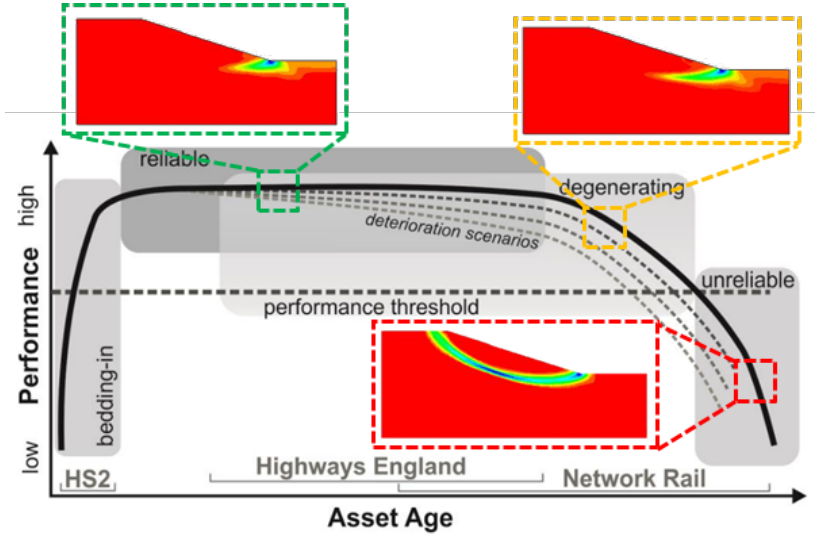

Figure 1 - Generalised deterioration model for transport earthworks (after Glendinning, *et al.*, 2015)

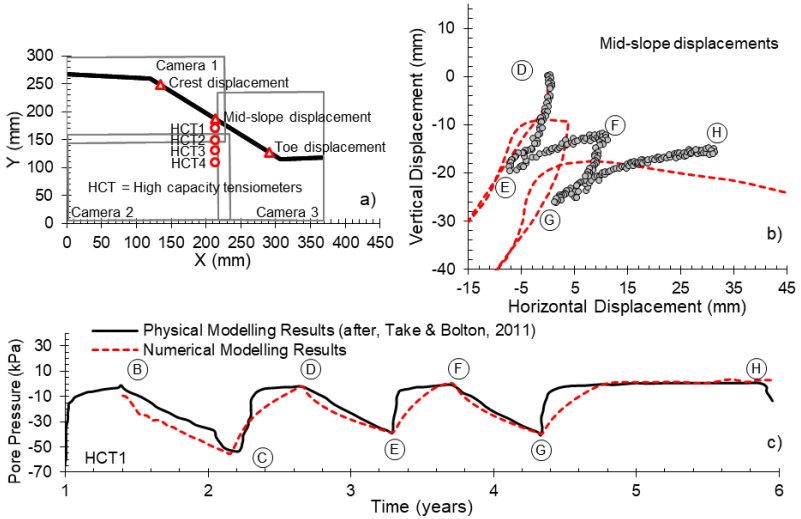

Figure 2 – Validation of numerical model behaviour against centrifuge experimentation (after Postill et al. 2019)

The Solution

- Validated numerical modelling approaches can be used to investigate long-term slope behaviour.
- The mechanism of seasonal ratcheting (i.e. hydrogeological stress cycles causing displacements and progressive failure have been captured in the modelling approach presented.

The Contribution

- Seasonal wetting and drying stress cycles can lead to mobilisation of post-peak strength and progressive failure in clay slopes.
- Seasonal stress cycles will change due to climate change. We have looked at the effect of different weather sequences on slope behaviour and shown that failure occurred earlier in a model considering climate change (i.e. wetter winters and drier summers) (see Figure 3).

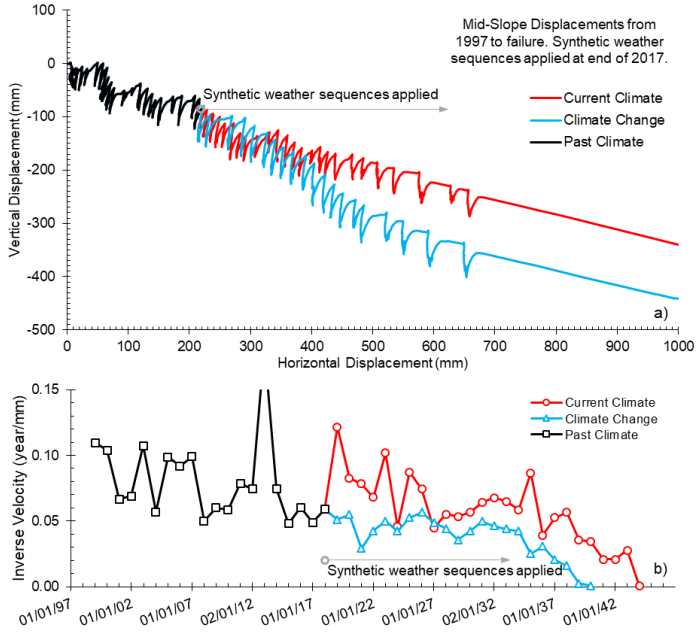

Figure 3 – Effect of climate change on slope model behaviour

References:

Glendinning, S. et al. (2015) Research-informed design, management and maintenance of infrastructure slopes: development of a multi-scalar approach. In: *IOP Conference Series: Earth and Environmental Science 26 (2015)*. IOP Publishing, 012005.

Postill, H. et al. (2019) Modelling seasonal ratcheting and progressive failure in clay slopes: a validation. *Canadian Geotechnical Journal.*

Take, W. A. & Bolton, M. D. (2011) Seasonal ratcheting and softening in clay slopes, leading to first time failure. *Géotechnique*, 61(9) 757-769.