
Unveiling the underlying mechanics: Principal Stress Rotation's impact on railway track subgrade behaviour

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2023 TRANSW SYMPOSIUM

Analysis //

Every reason Sydney trains can be delayed, according to Sydney Trains

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NSW rail customers urged to allow extra travel time tomorrow

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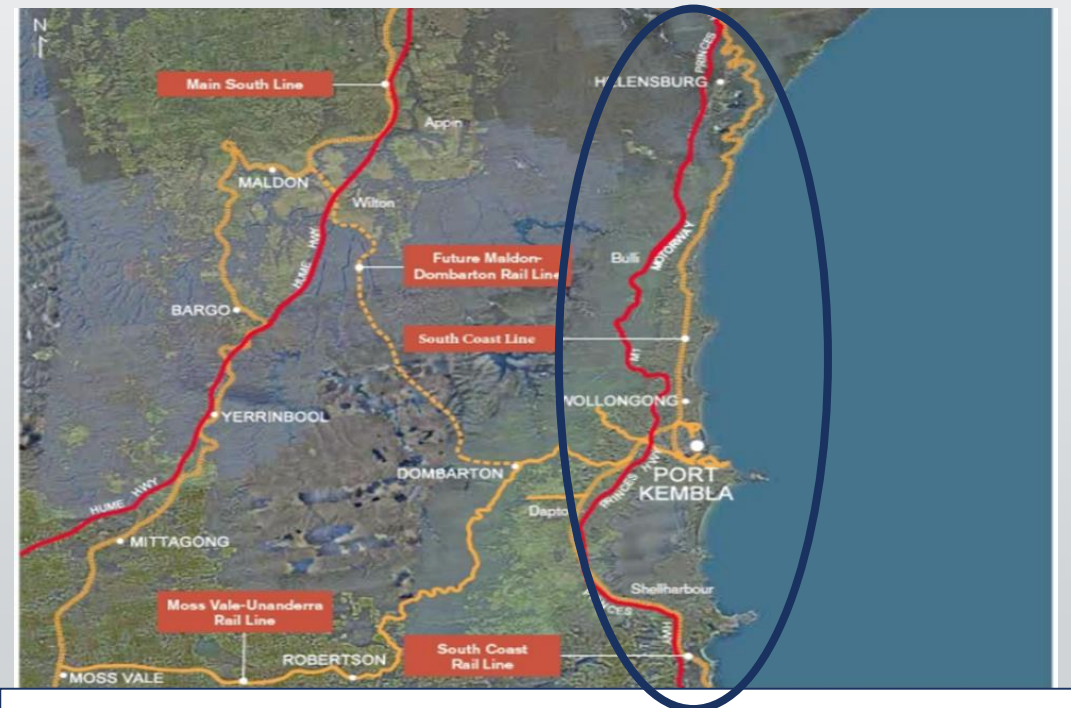
Customers can expect industrial-related impacts to continue on the NSW rail network tomorrow (Friday 8 July) with the Fair Work Tagged as

Christmas trackwork to push thousands of Sydney commuters onto buses

the Sydney Trains and NSW TrainLink Intercity network.

Rail network in NSW

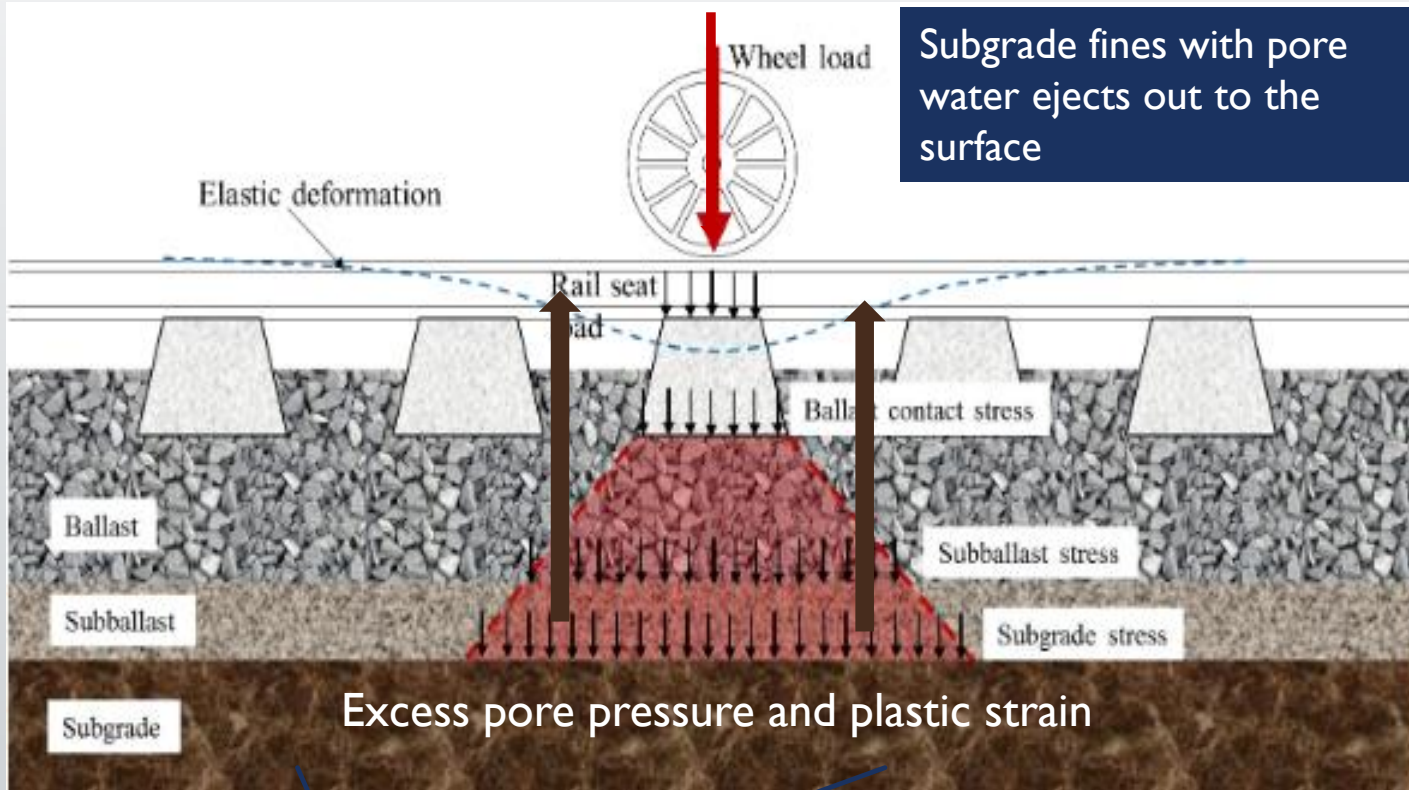
- Rail transport -contributing approximately 30 billion dollars (**Value of Rail,2020 Report**)
- Australian Government spends **200 million dollars** per year for **maintenance**
- South Coast Rail line- 300 locations of mud pumping (**Nguyen and Indraratna,2021**)



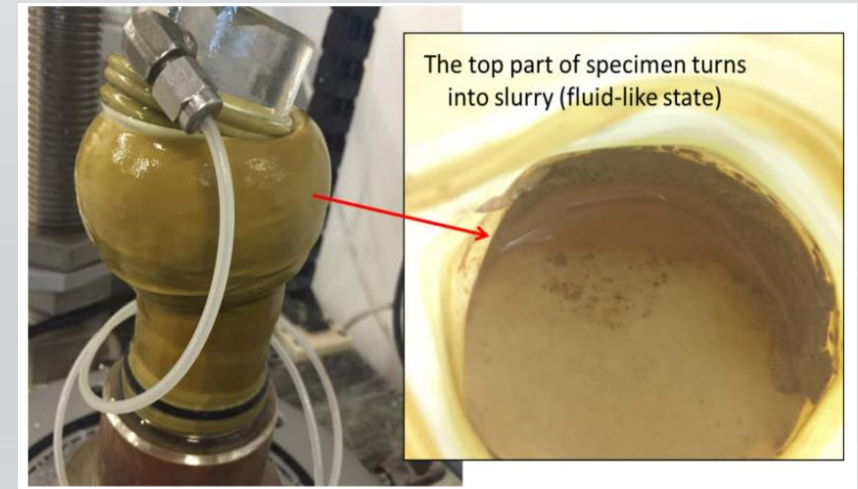
Rail Transport network, NSW, Australia (Branigan and Khansari, 2017)

What is Mud Pumping?

Cyclic load due to train movement



Mud pumping in field (Indraratna et al.,2020)

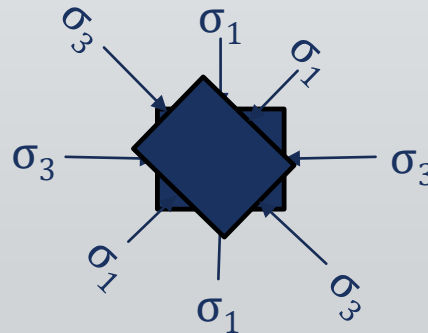
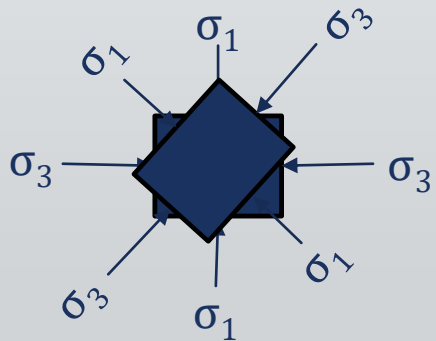
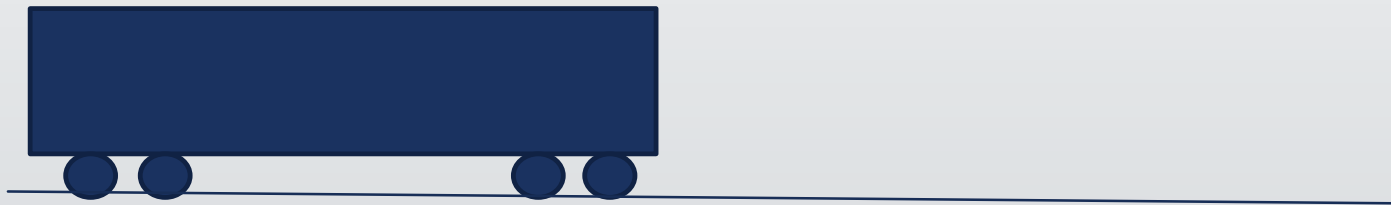


Mud pumping in laboratory (Indraratna et al.,2020)

Low lying areas with saturated subgrade and degraded drainage

What happens when a vehicle/train moves?

Vehicle movement



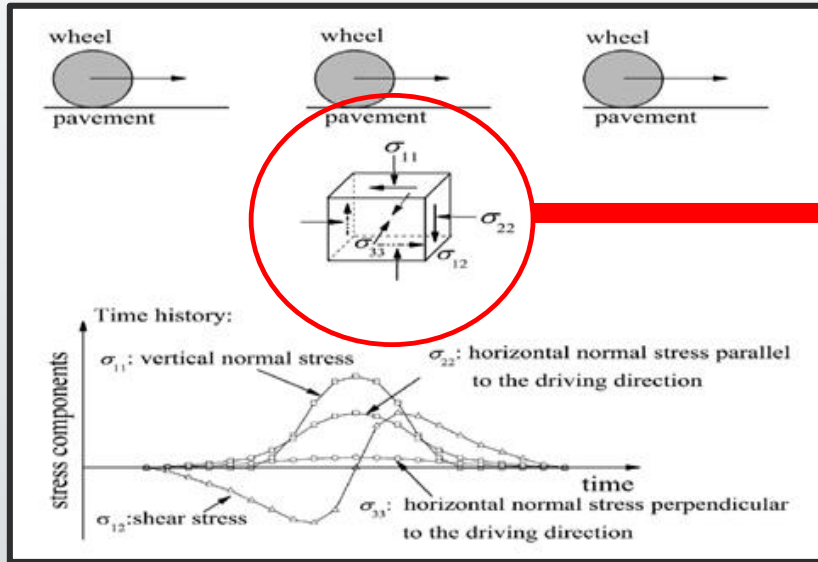
Principal Stress Rotation happens as train/vehicles move with increase in speed, on acceleration or while applying brakes



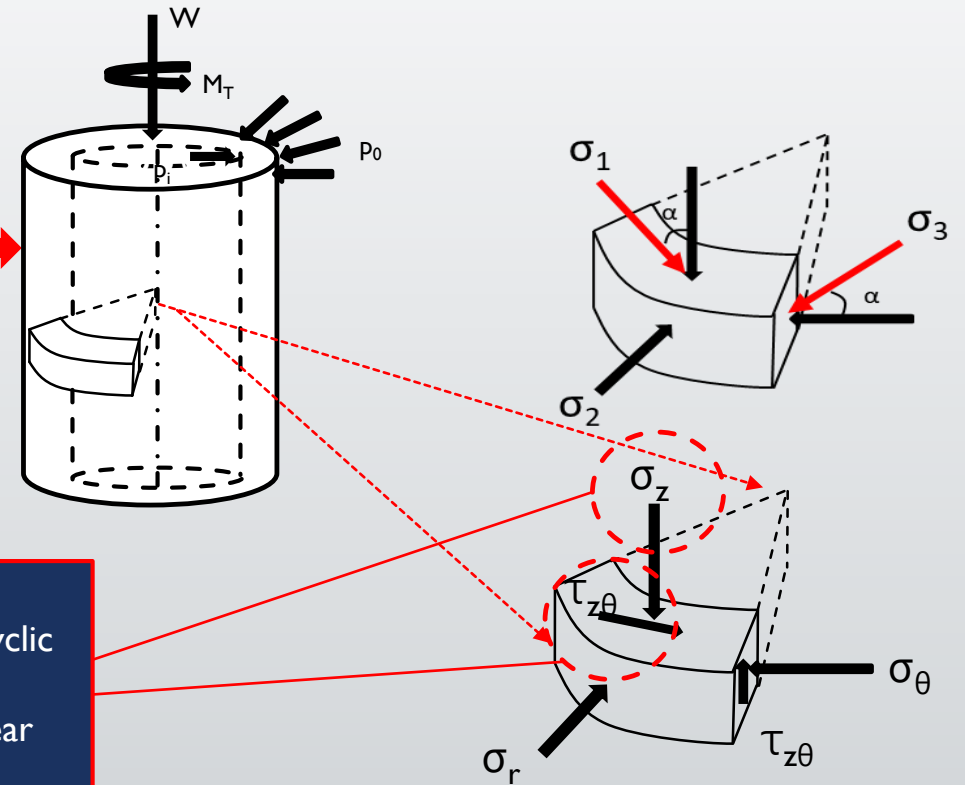
Ignored parameter

Pictorial representation of Principal Stress Rotation in the subgrade when a vehicle /train moves

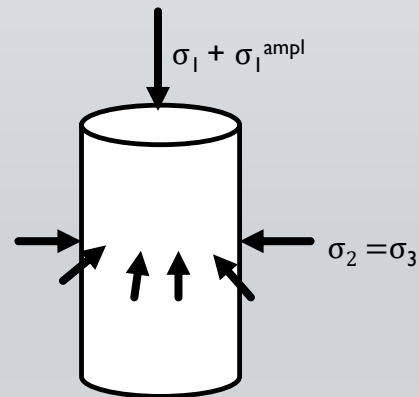
Stress condition in field- how to replicate?



Similar to stresses developed in Hollow Cylinder tests

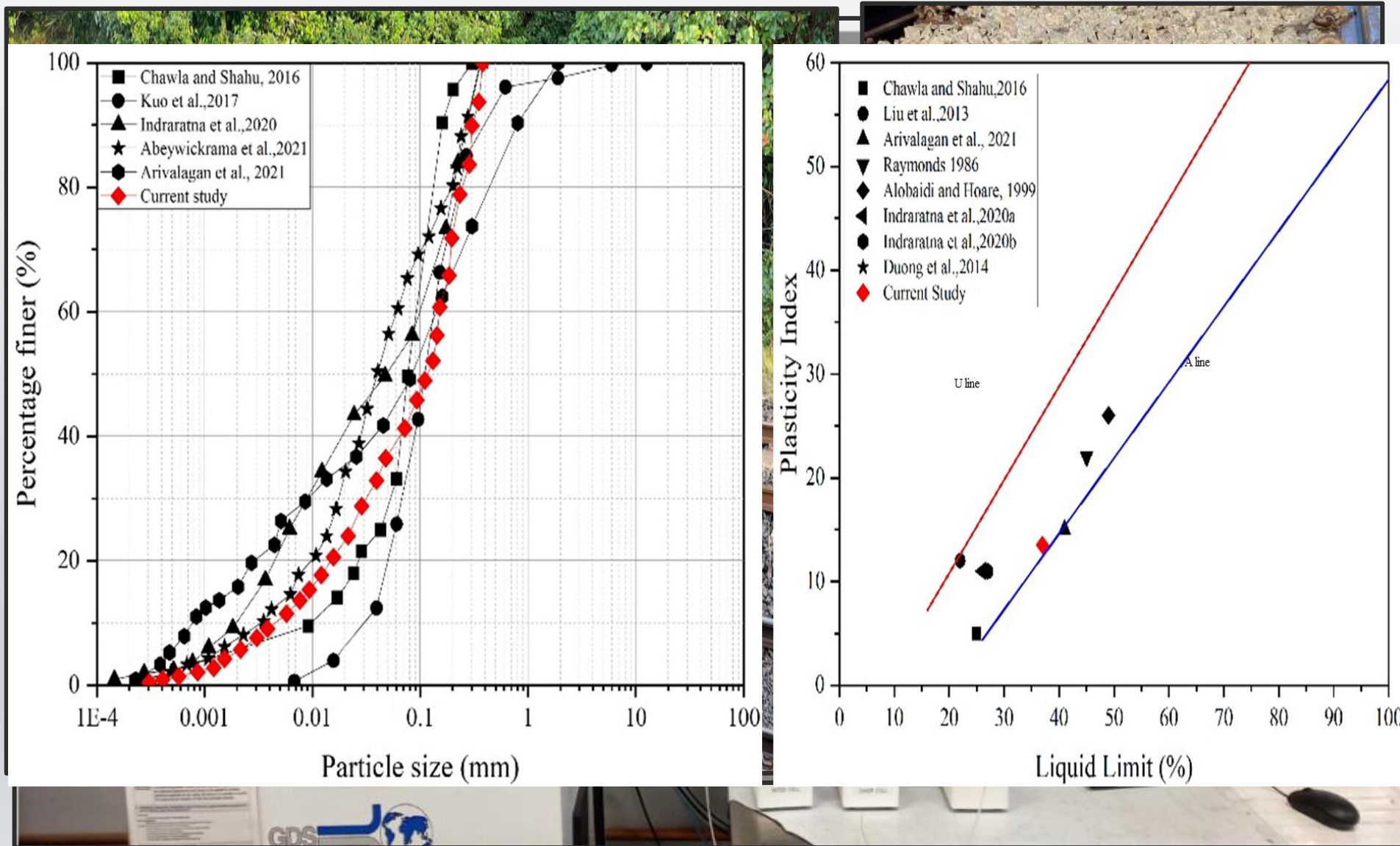
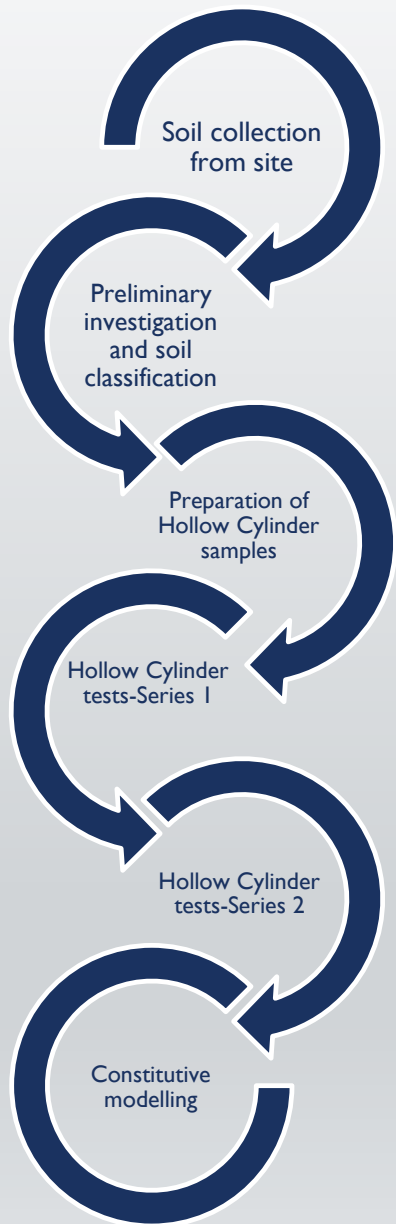


Studying the influence of cyclic vertical and horizontal shear stress

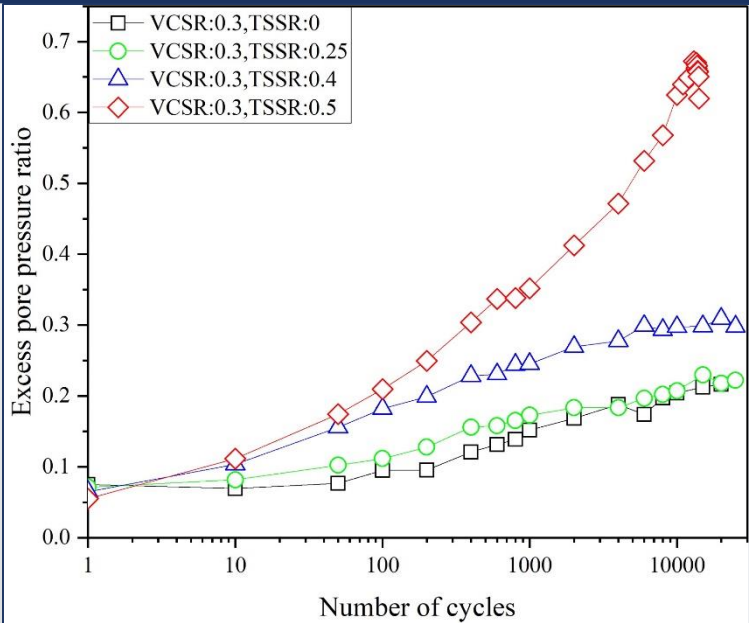
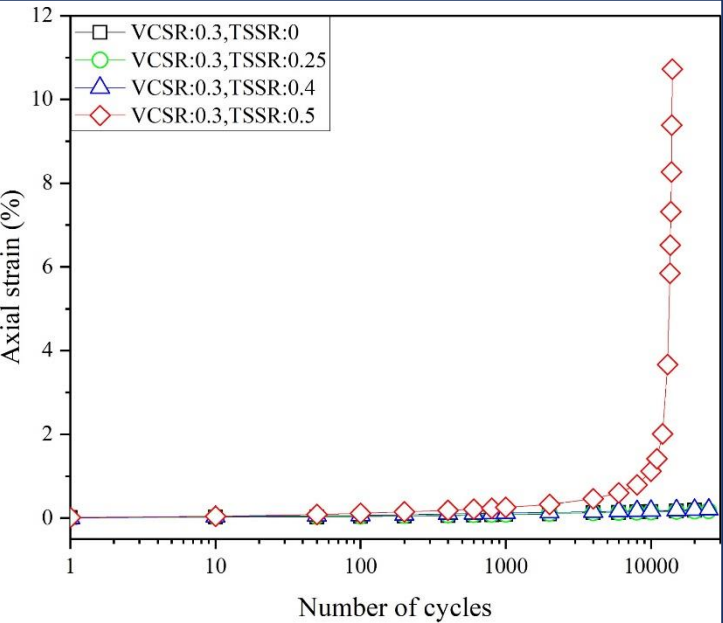


Stress application in a cyclic triaxial test

Research Methodology



Salient results



Criteria for considering soil failure:

- Axial strain (5%) and pore pressure rising exponentially

VCSR: takes into effect the axle load of train on subgrade: **vertical stress**

TSSR: takes into effect the train speed, acceleration and brake application of train on subgrade: **shear stress**

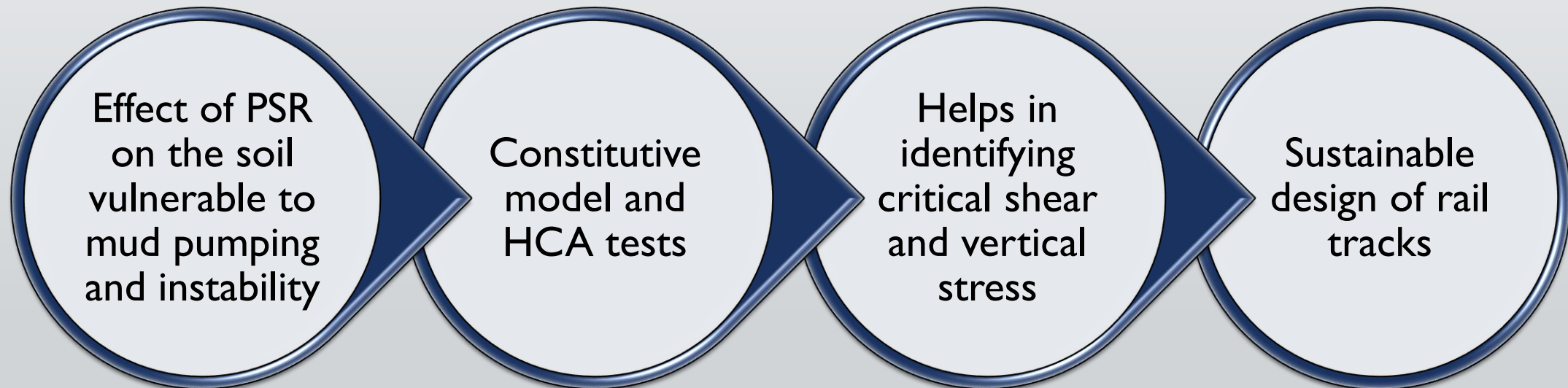


Stable sample



Failure due to increase in shear stress

Benefits of the study



Acknowledgments



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- Transport Research Centre (TRC), UTS
- Geotechnical Laboratory staff, UTS
- Sydney Trains

**Thank
You**