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Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

Scaled physical modelling of Ultra-Thin Continuously Reinforced Concrete Pavement

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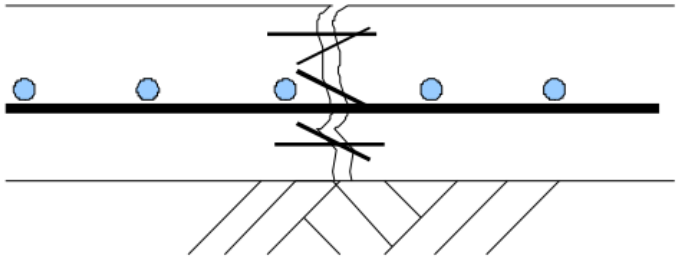
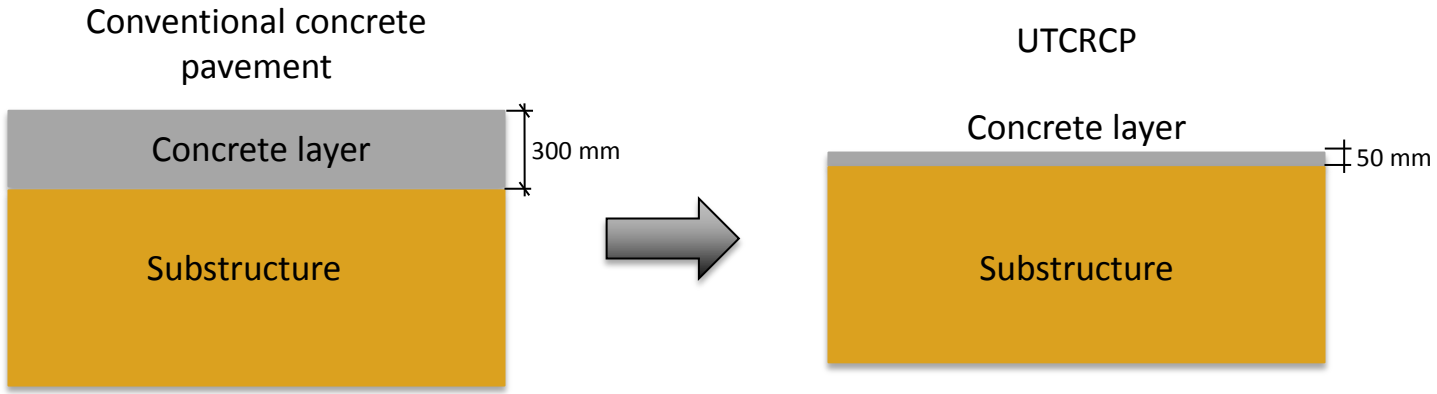
What is Ultra-Thin Continuously Reinforced Concrete Pavement?

- 50 mm concrete surfacing
- High Strength Steel Fibre Reinforced Concrete
- Steel bar mesh
  - 50 x 50 mm mesh of 5.7 mm diameter



Design of UTCRCP

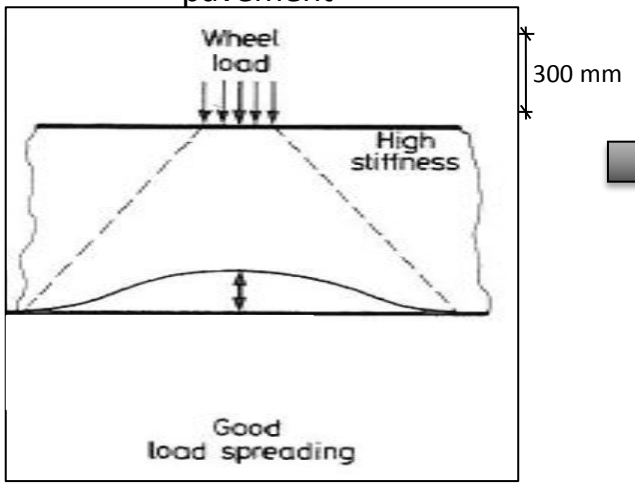
- Perspective on difference in thickness



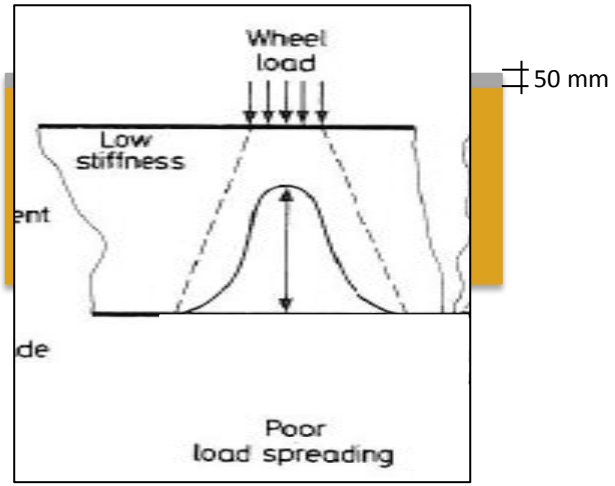
Background

- Perspective on difference in thickness

Conventional concrete pavement



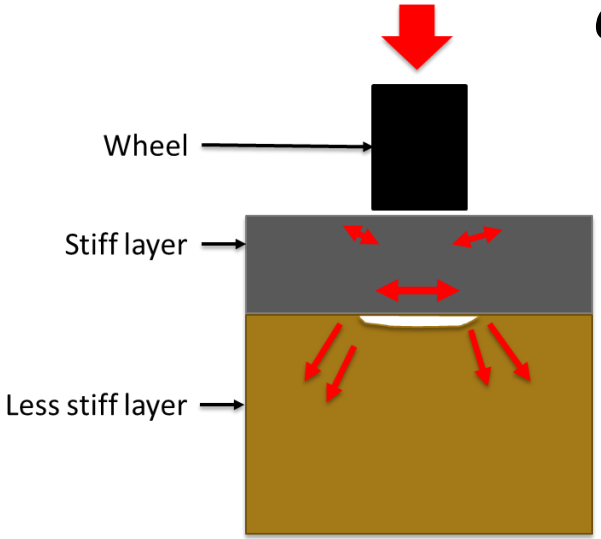
UTCRCP

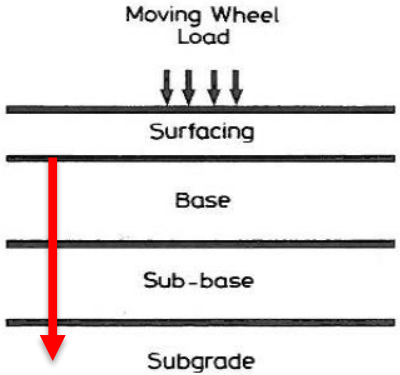


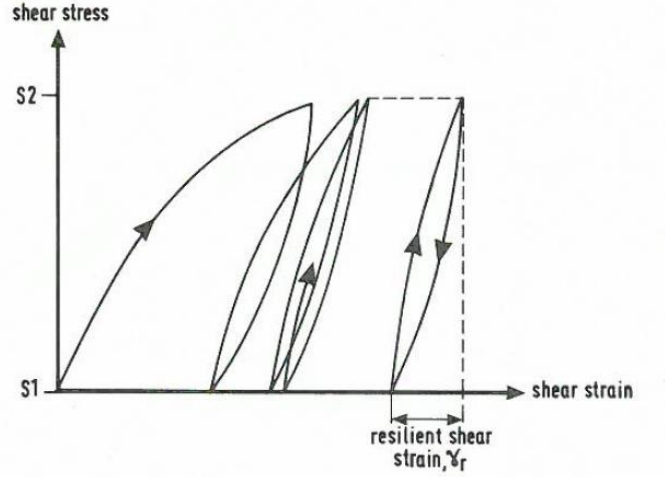
- Investigate permanent deformation
- Differential, vertical permanent deformation (rutting)?

Hypothesis

*"**Significant permanent deformation** occurs in the **substructure** of UTCRCP during the **post construction period**"*







Methodology

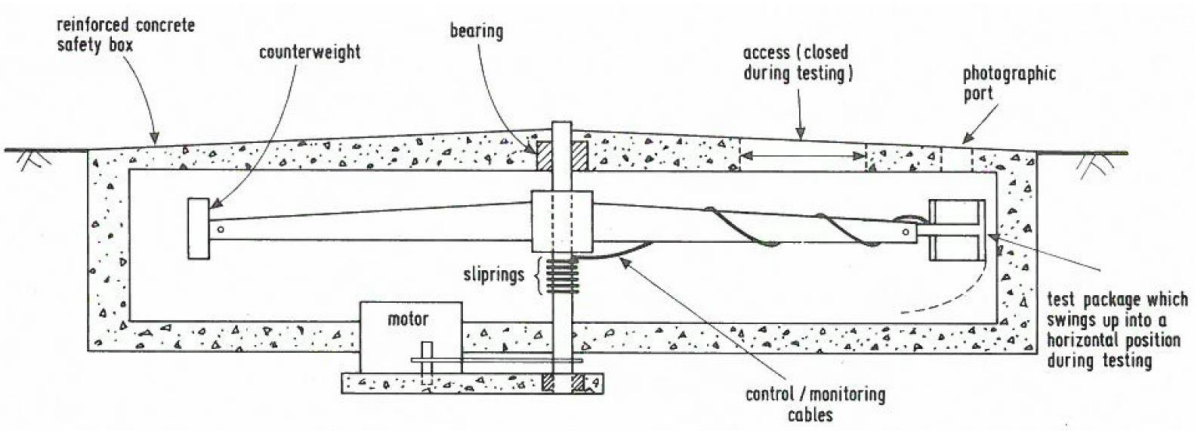
- Scaled physical modelling
- Simplify the pavement system
  - Two and three-layer systems
  - Concrete, dry sand and cement stabilized sand
- Rolling two wheel axle
- Monitor response
  - In-situ measurement system

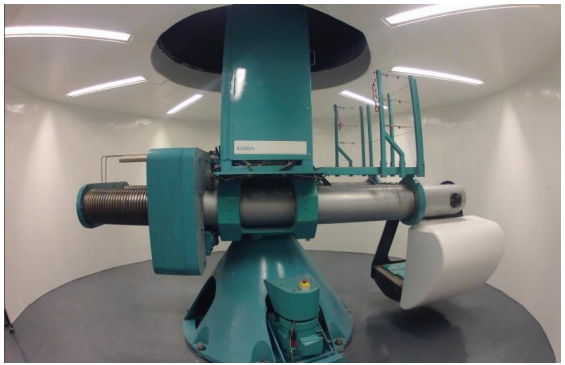
Geotechnical centrifuge

- Scaled models

Geotechnical centrifuge

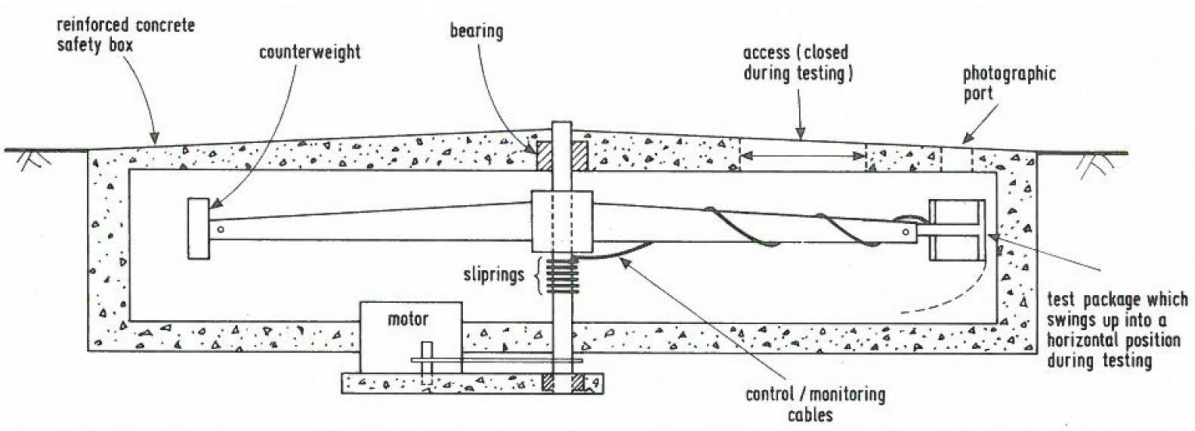
- Scaled models
  - Geotechnical centrifuge

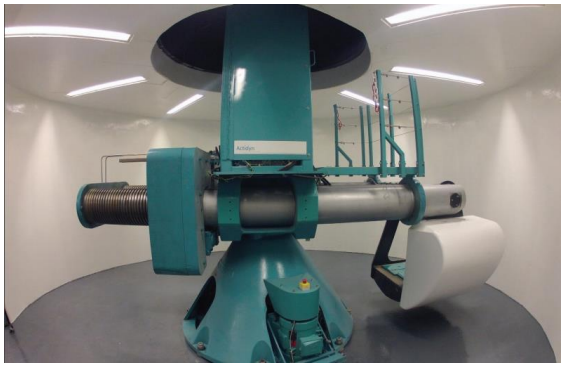




Geotechnical centrifuge

- Scaled models
  - Geotechnical centrifuge
  - Recreate stress conditions





Centrifuge pavement tester

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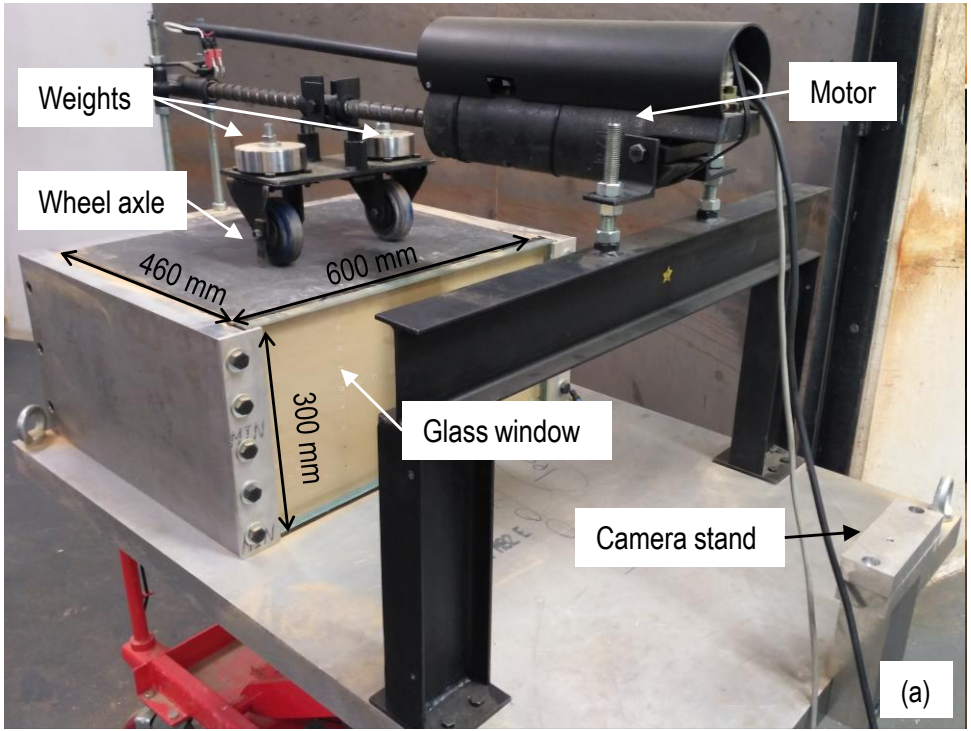
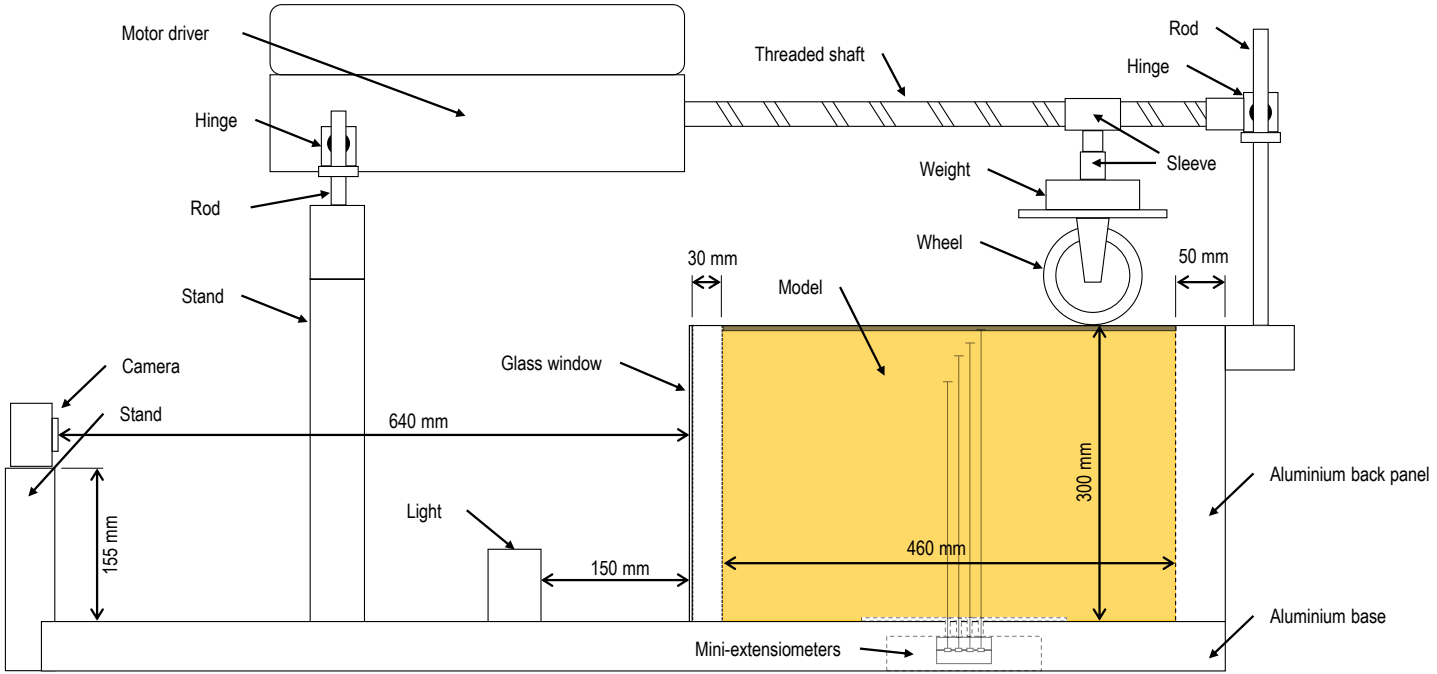
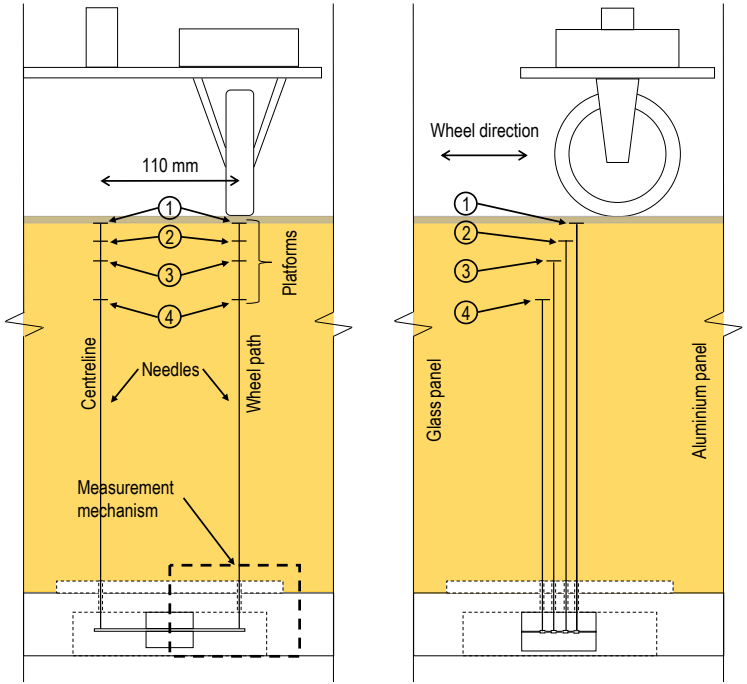


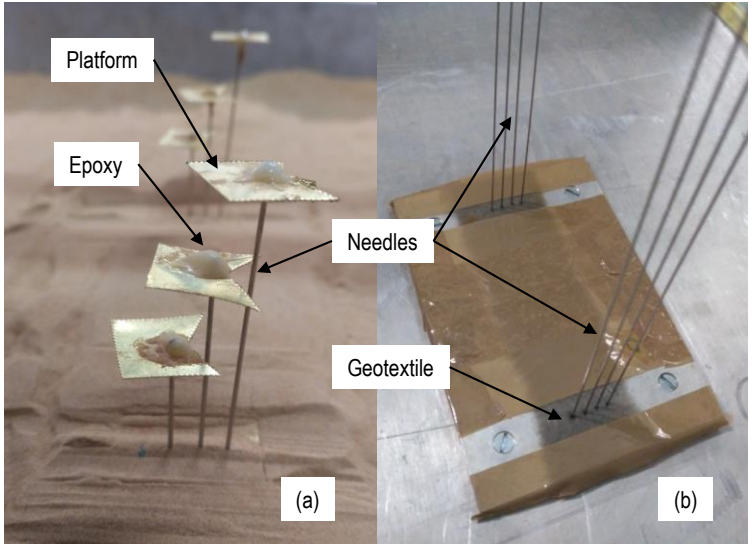
Centrifuge pavement tester



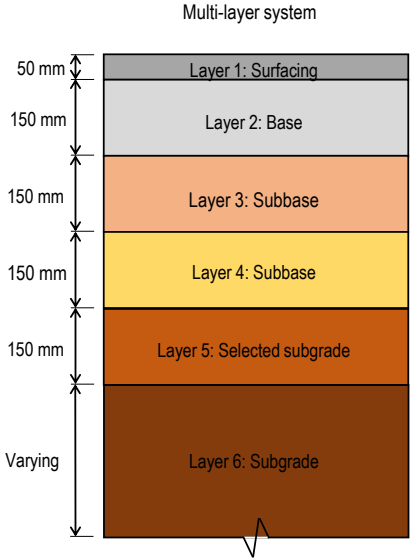
Measurement system



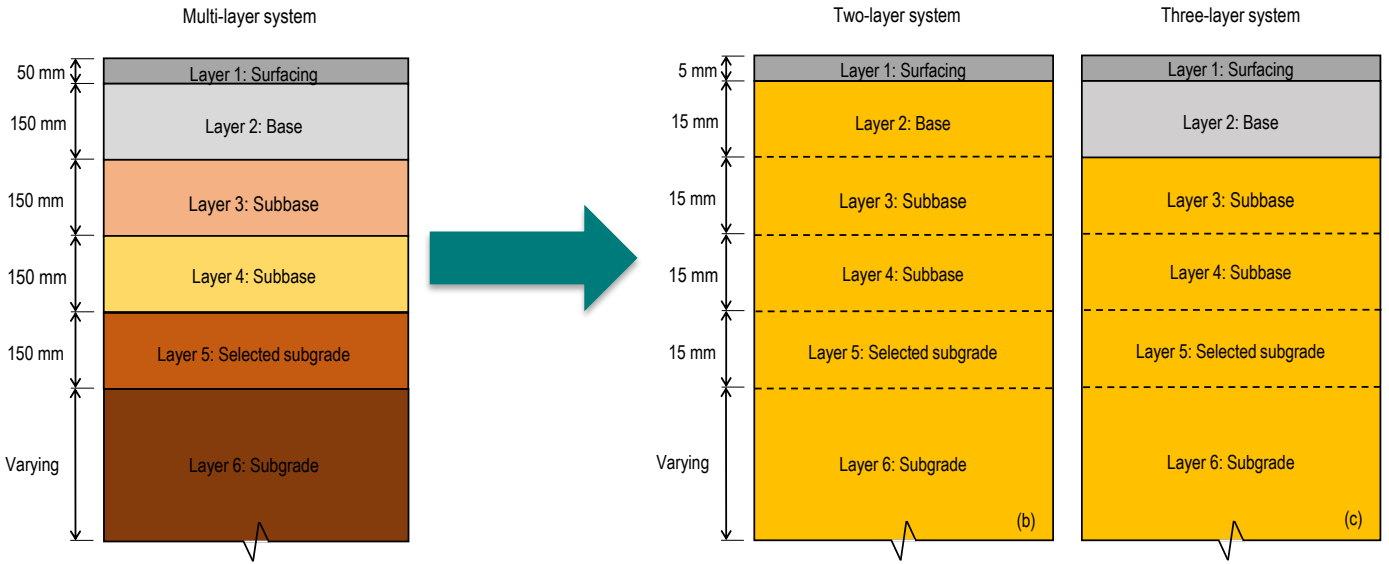
① 0 mm from bottom of concrete
② 15 mm from bottom of concrete
③ 30 mm from bottom of concrete
④ 60 mm from bottom of concrete



Models & load application



Models & load application



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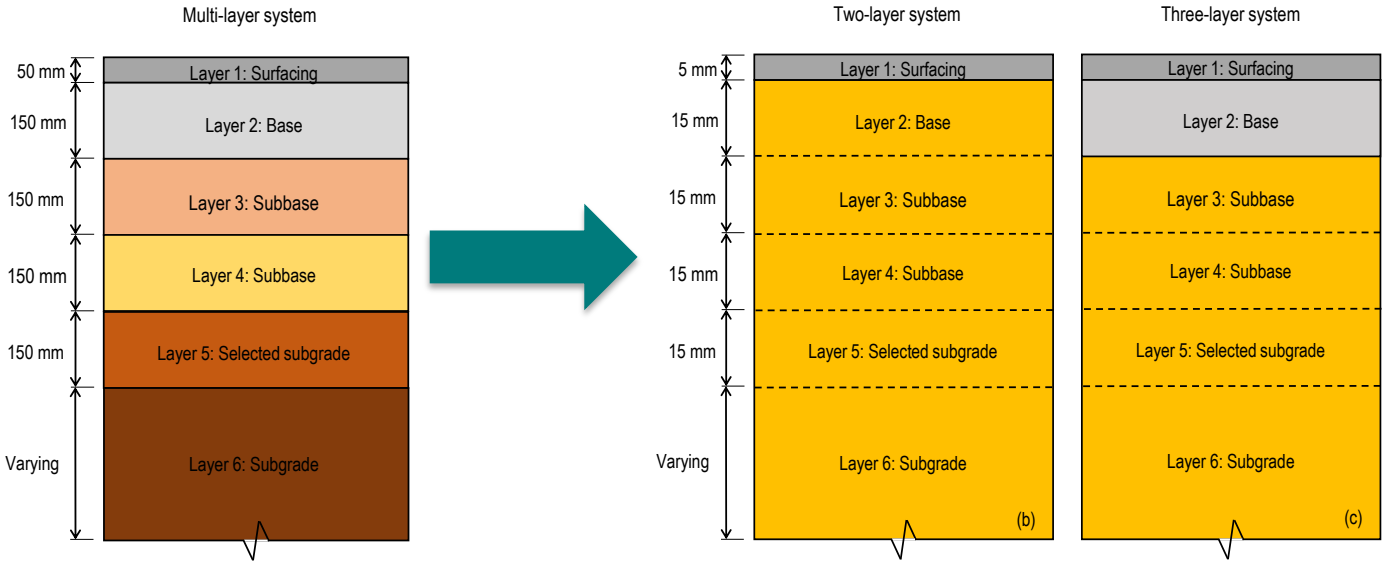
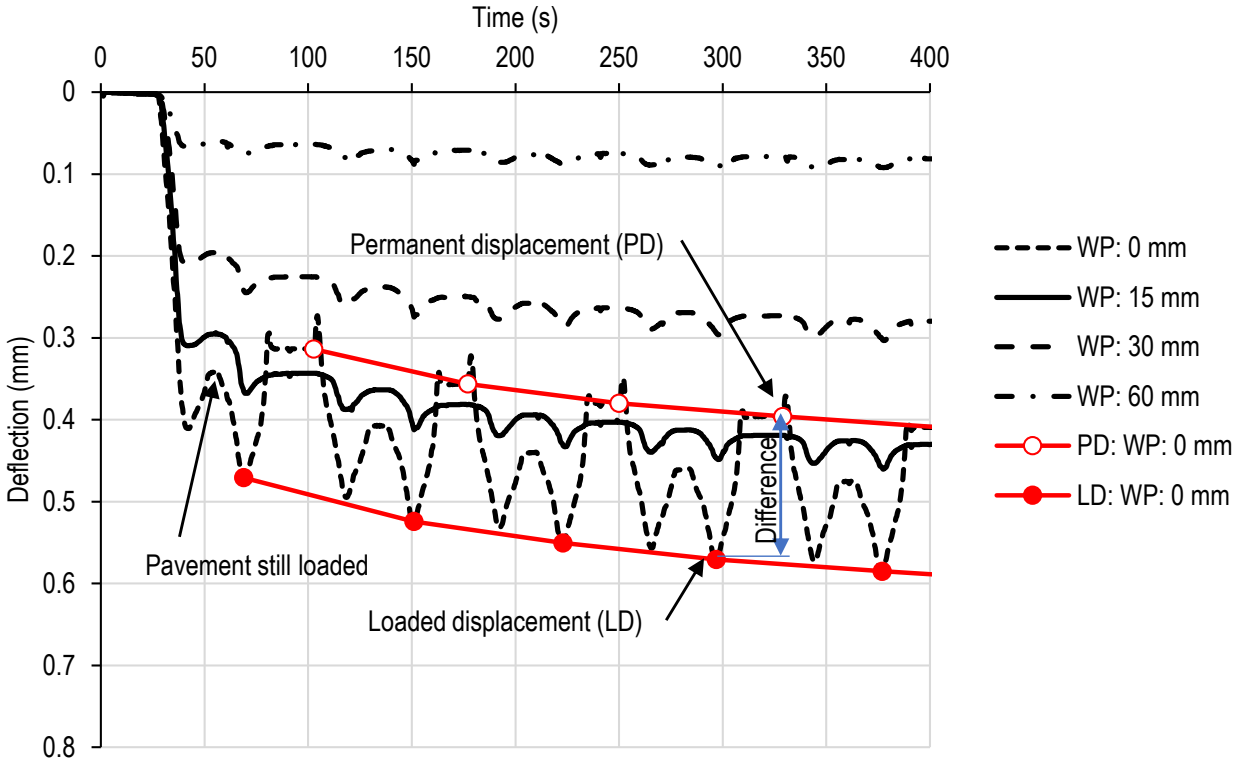
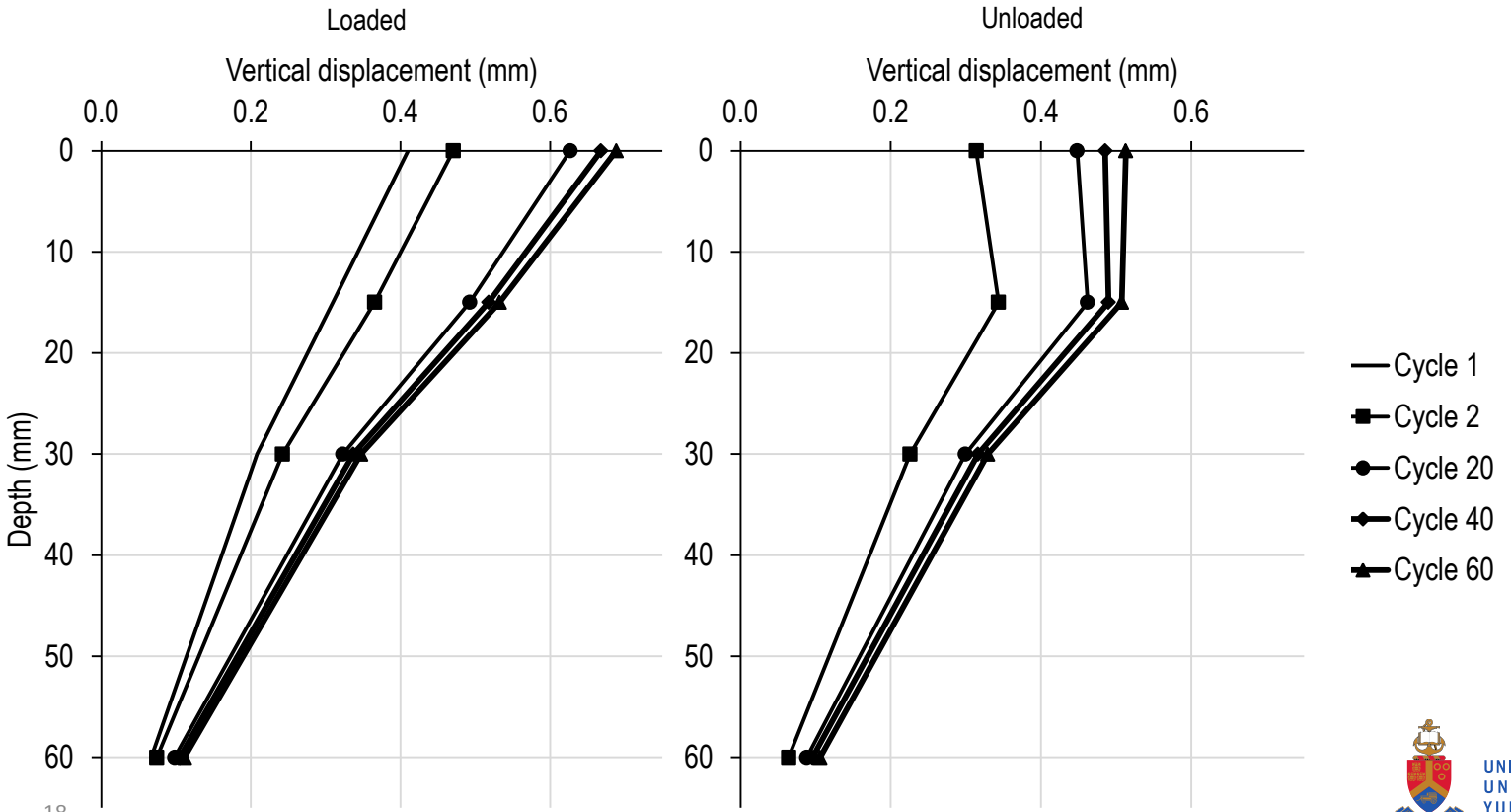


- Apply 60 wheel passes
- Wheel pressure of 560 kPa

Results – Deflection versus time



Results – Wheel path of two-layer system



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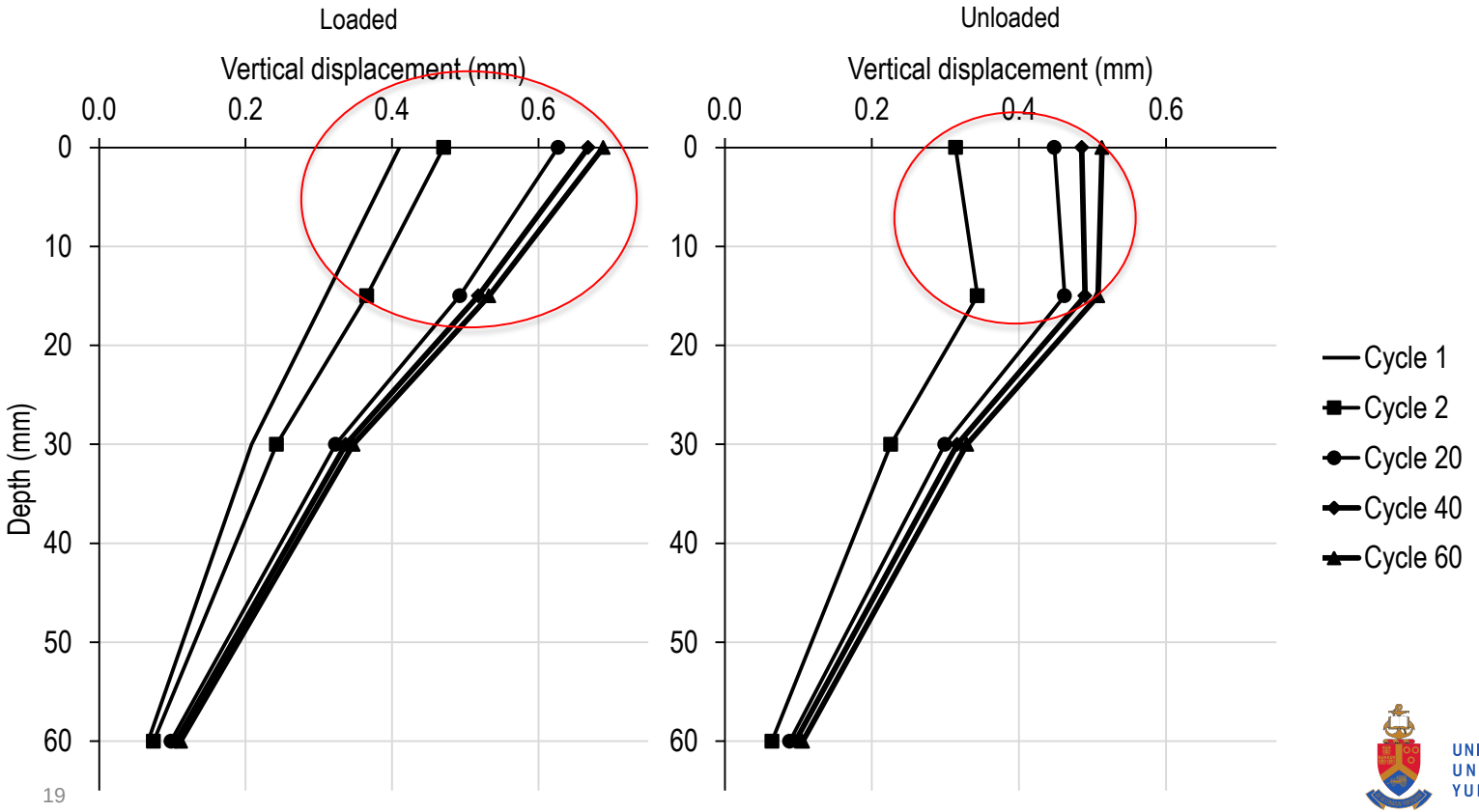

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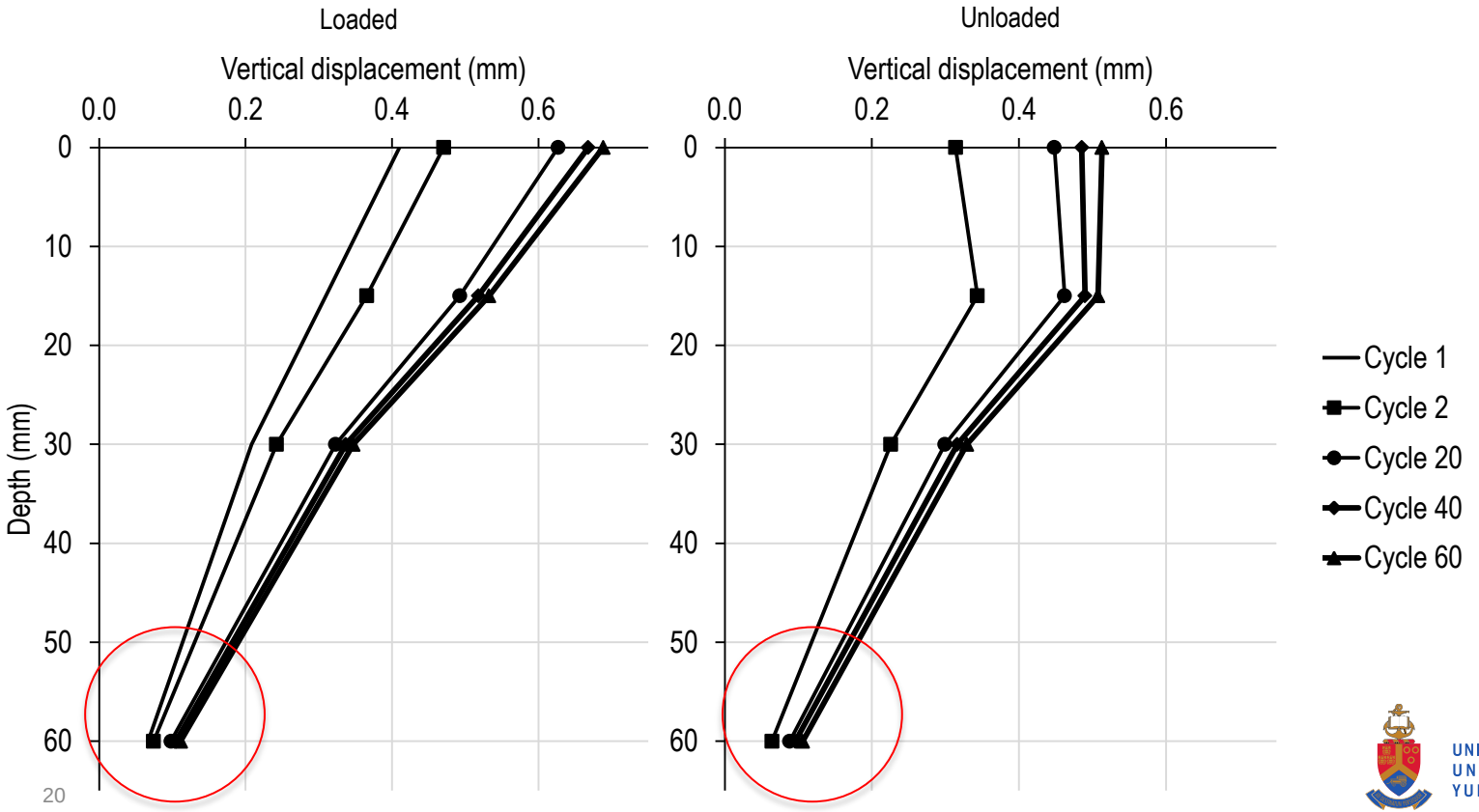
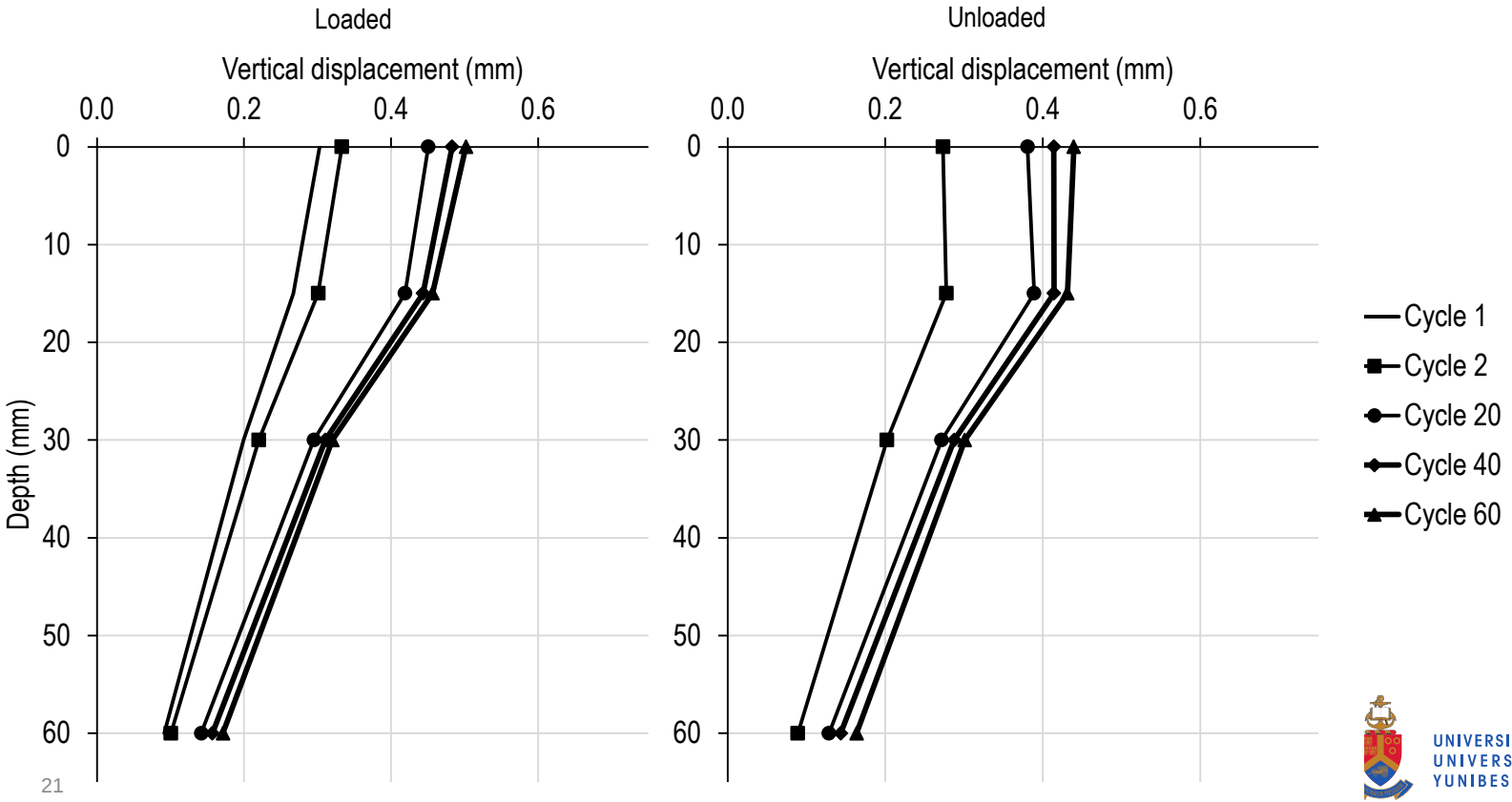


Results – Centerline of two-layer system



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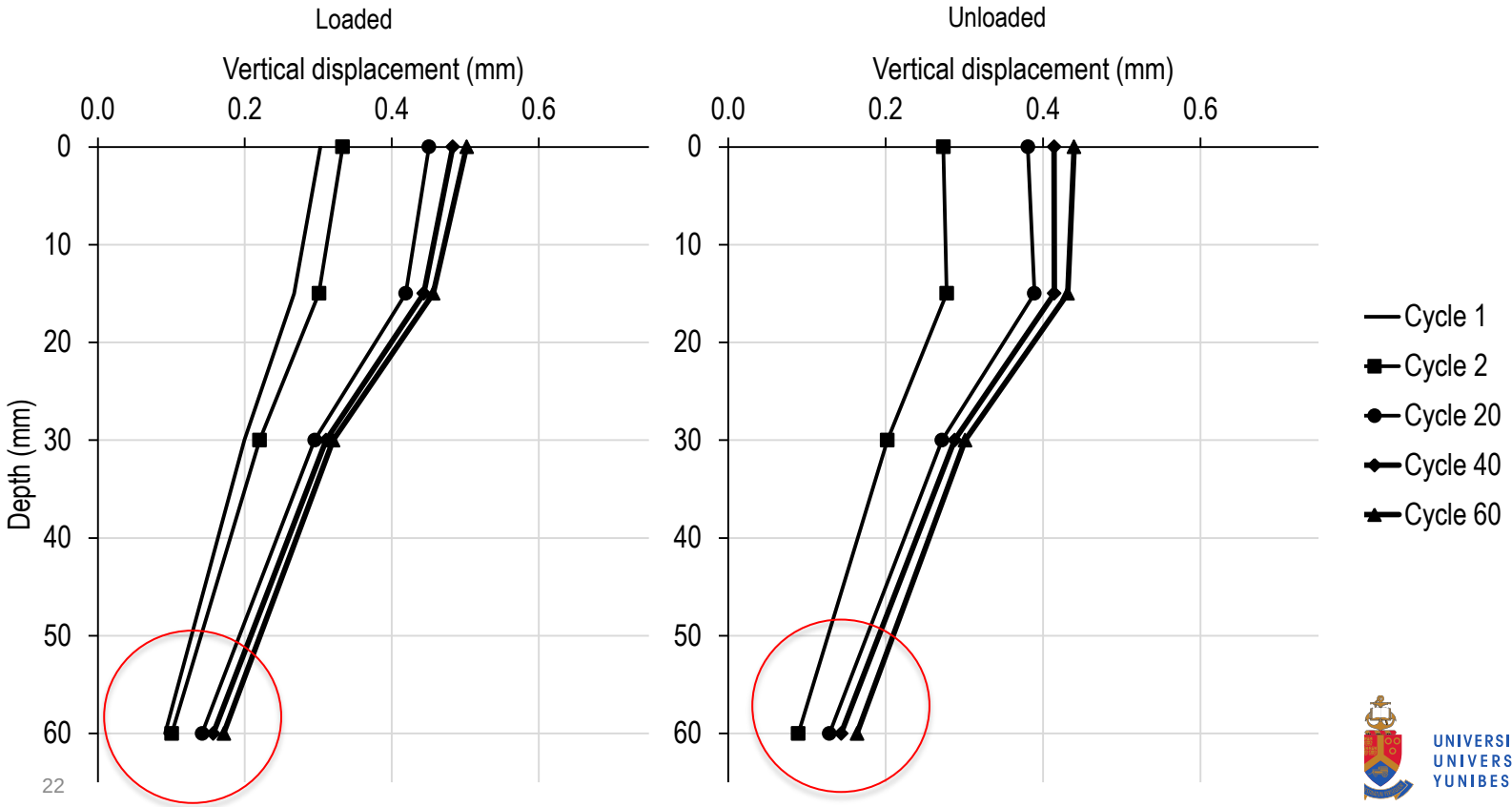
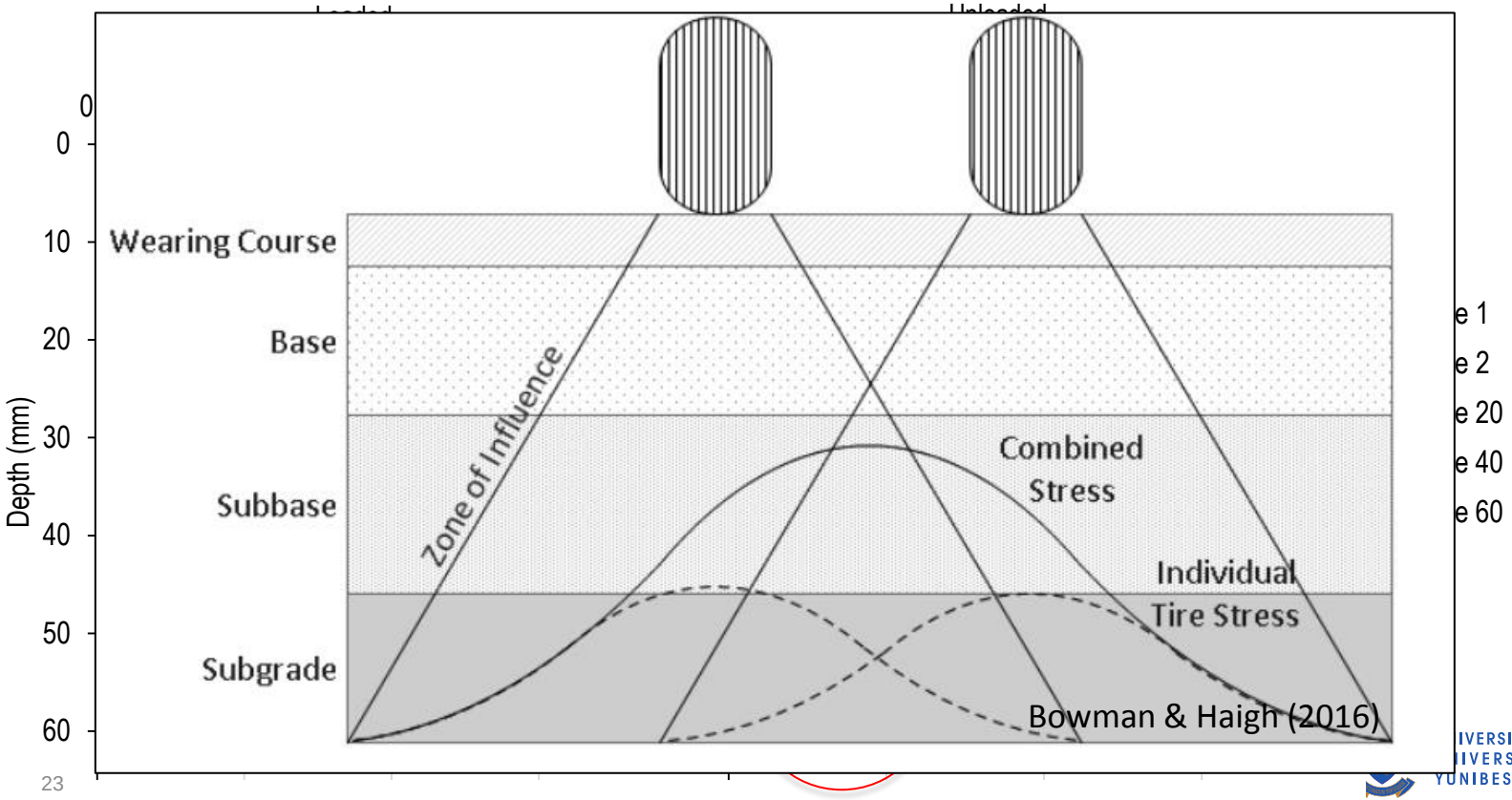
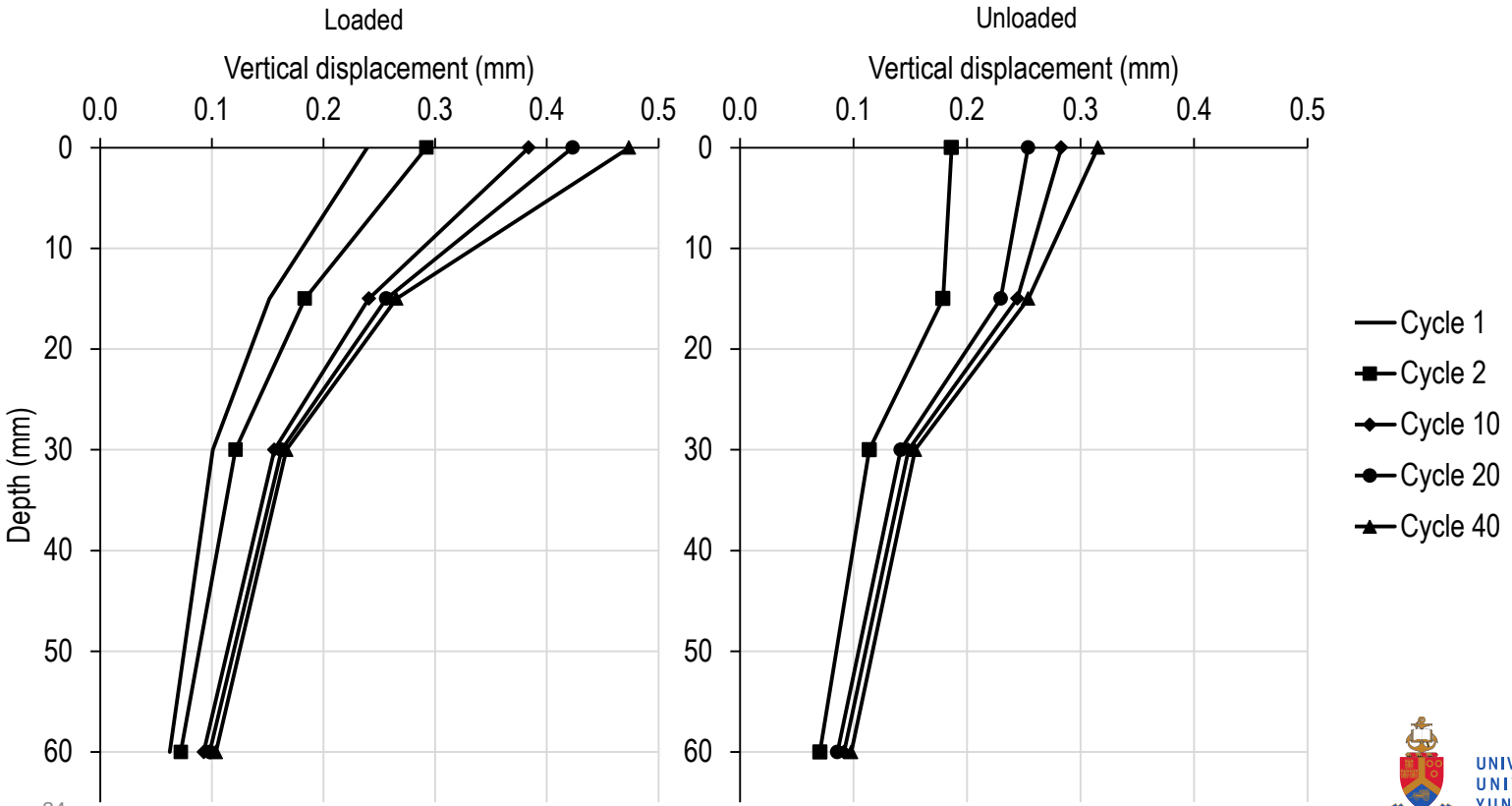


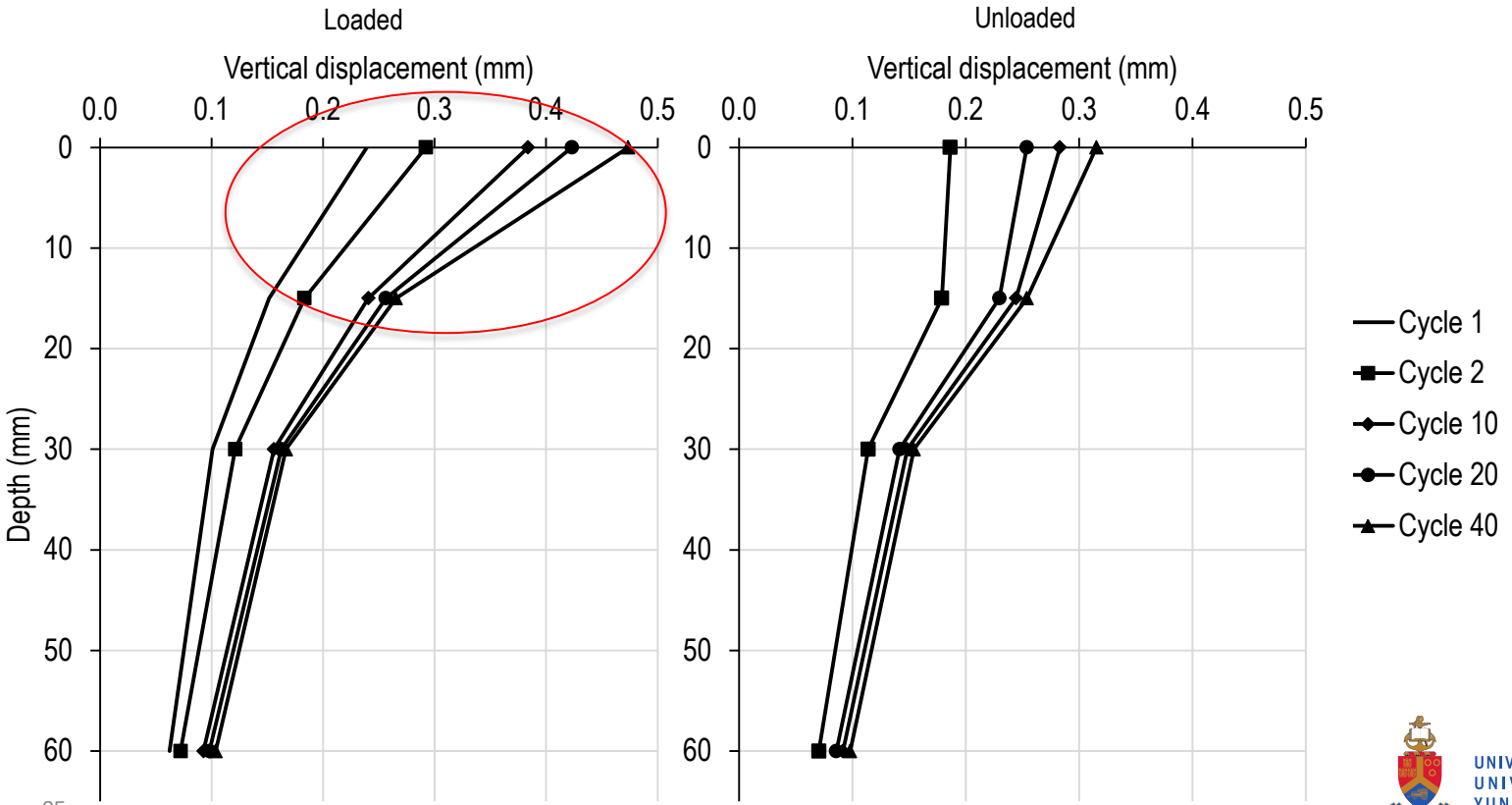
Results – Centerline of two-layer system



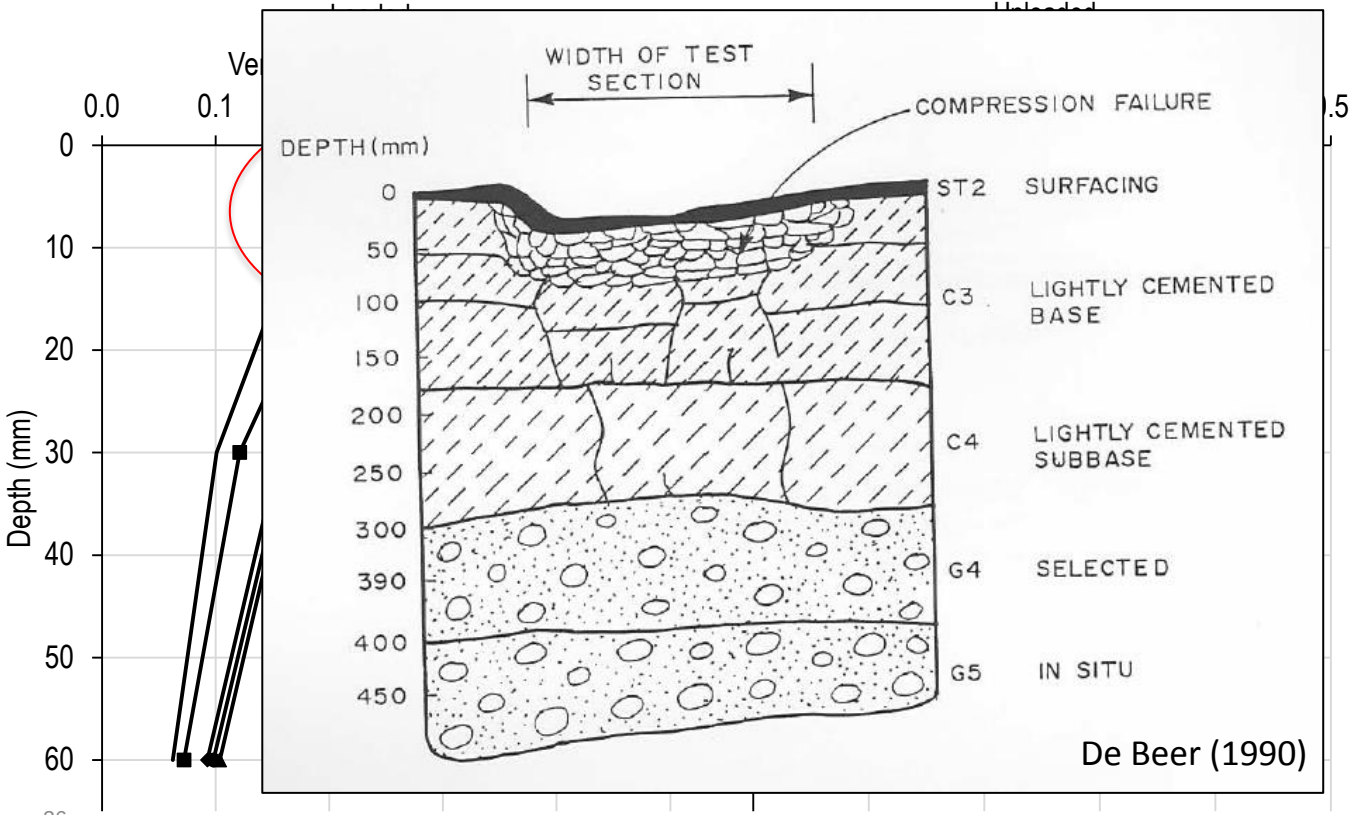
Results – Wheel path of three-layer system



Results – Wheel path of three-layer system



Results – Wheel path of three-layer system



Comments and further research

- Cavity forms between top of substructure and bottom of concrete layer
- Influence of zones of the two wheels overlap at a depth of 60 mm
- Cement stabilized sand base deteriorates

- Finite element modelling of multi-layer system
  - Include elastic-plastic behaviour sand

Thank you

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