groundbreaking research:

design of a miniature tunnelling machine for the centrifuge

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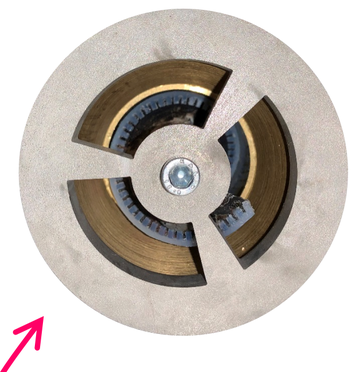
background

Tunnel construction in soft ground, namely clays and sands, causes ground movement around and above the tunnel line, which can affect the stability of nearby structures.

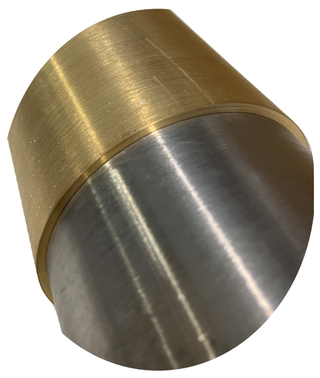
The aim of this project is to create a model tunnel boring machine to fully replicate all tunnelling processes under field stresses in a geotechnical centrifuge, a feat no other study has yet achieved.

model design

Shield: the main body of a TBM, in which the motors and jacks are housed and the lining installed is slightly conical to ease movement of the machine.



Cutterhead: different materials require different levels of support. Wider openings in the face provide less support and vice versa.

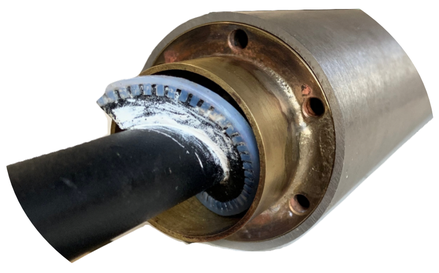


Tail void: a jump in diameter between the rear of the TBM and the tunnel lining creates a gap that either closes causing ground movement or must be filled with grout.

Tunnel lining: for real tunnels the lining is constructed in segments as the TBM advances. Here a tube with a constant diameter replicates the lining.

Overcut: TBMs often cut a path larger than the final diameter of the tunnel to allow for cornering and to avoid squeezing from ground.

Screw auger: excavated soil is removed by a screw auger rotating with the cutterhead.



Drive system: the mini-TBM will be driven forwards by an actuator, and a motor will rotate the auger and cutterhead.

next steps

The mini-TBM will be used in a series of centrifuge tests in sand and clay, comprising a parametric study. Tests will be at 50g, replicating a tunnel with a diameter of just under 4m

These will include tests in undisturbed 'greenfield' conditions, and near both single piles and pile groups.

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