Friction at microtunnelling

Summary of graduation project
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Visser & Smit Hanab

TU Delft

Introduction

- Graduation project (finished 6 December 2006)
- Friction at microtunnelling
- Prediction of jacking forces often not accurate

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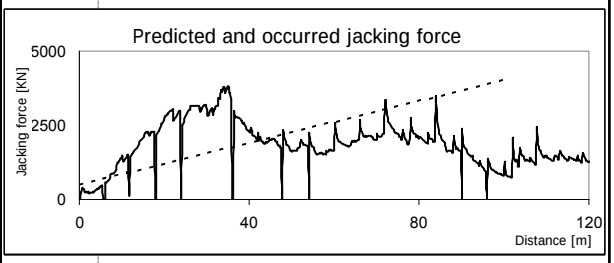
Introduction



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Introduction

<u>Objective of research:</u>

"Improve the prediction of wall friction by microtunnelling in common Dutch soil conditions."

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Wall friction

- In principle:
  Friction = Stress x friction coefficient
- Formula:
  $W = \sigma'_r \times \mu$
- Total friction force:
  $F = \int W \, dA$

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Wall friction

$W = \sigma'_r \times \mu$

Many factors have influence, e.g.:

- Overcut
- Lubrication
- Soil stability / roughness / arching mechanisms
- Tunnel roughness
- Standstills
- (Mis)alignment

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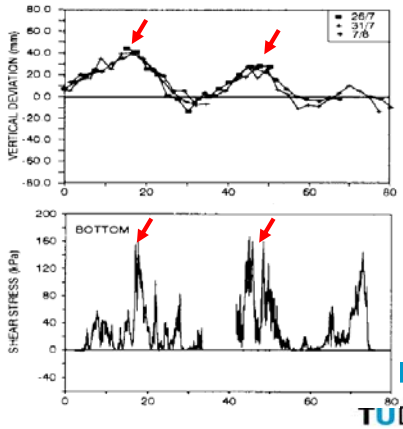
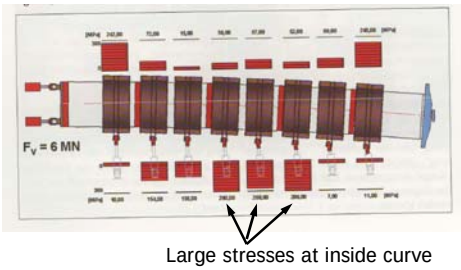
Introduction
Wall friction
(Mis) alignment
Outcomes



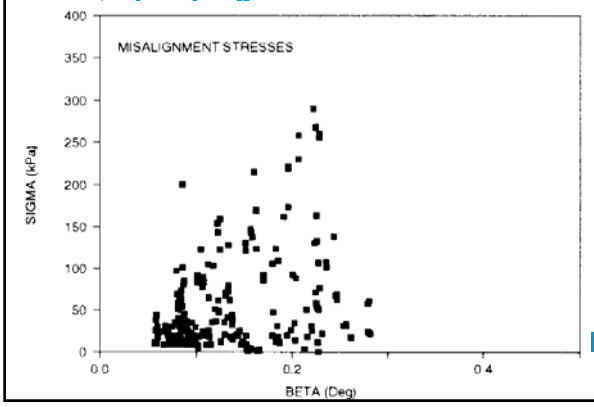
(Mis)alignment



Large stresses at inside curve

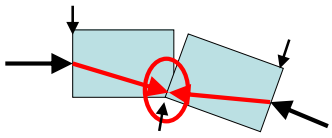
$W = \sigma'_r \times \mu$

(Mis)alignment

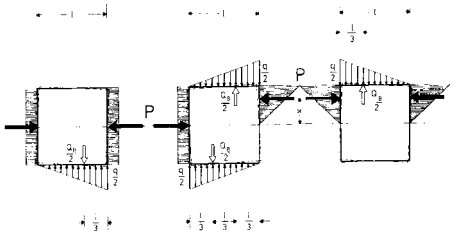


(Mis)alignment

Stresses can be explained by considering the segments as blocks



(Mis)alignment



Total resulting force : $F = (6 \cdot F_a \cdot x) / (l)$

(Mis)alignment

Conclusion (mis)alignment:

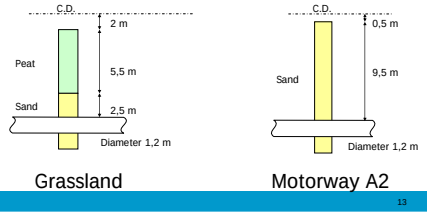
- Small direction changes give rise to high shear stress
- Explained by considering blocks
- Influence on total friction is significant (in permeable soils)

Outcomes graduation project

Introduction
Wall friction
(Mis) alignment
Outcomes

Case project (no misalignment):

- 2 parallel welded steel pipes
- 24 borings under similar conditions
- 2 borings under motorway



Grassland Motorway A2

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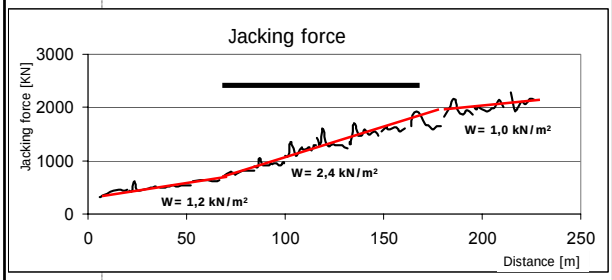
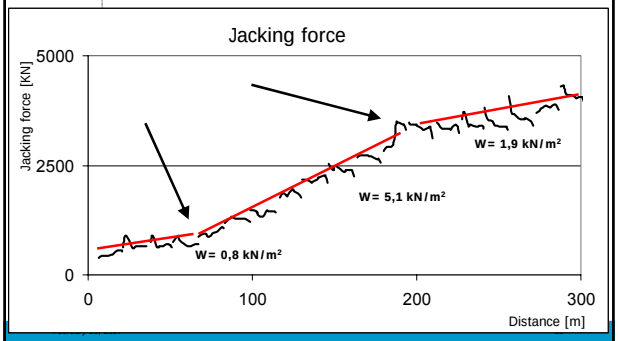


Outcomes graduation project



Outcomes graduation project

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Analysis of jacking data and theoretical analysis

- Construction related factors have a dominant influence on the friction:
  - (mis)alignment
  - poor lubricant injection
  - standstills