MEASUREMENT OF THE TIME-DEPENDENT PILE SHAFT FRICTION WITH HIGH-STRAIN DYNAMIC AND STATIC PILE LOAD TESTS

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CONTENTS

BACKGROUND

- Pile foundations for a large project
- Main motor bridge
- Piles in compression
- Piles in tension
- Verification of the bearing capacity

GEOLOGICAL CONDITIONS

- Medieval coastline
- Former harbor
- 10-20 m sand and gravel fill
- 20-40 m esker sand gravel
- 50 m to rock

NORTHERN ABUTMENT

- Large pile group
- Vertical / horisontal load
- Piles in compression
- Piles in tension
- Limited time for the construction

DESIGN (VERIFICATION/CALCULATION)

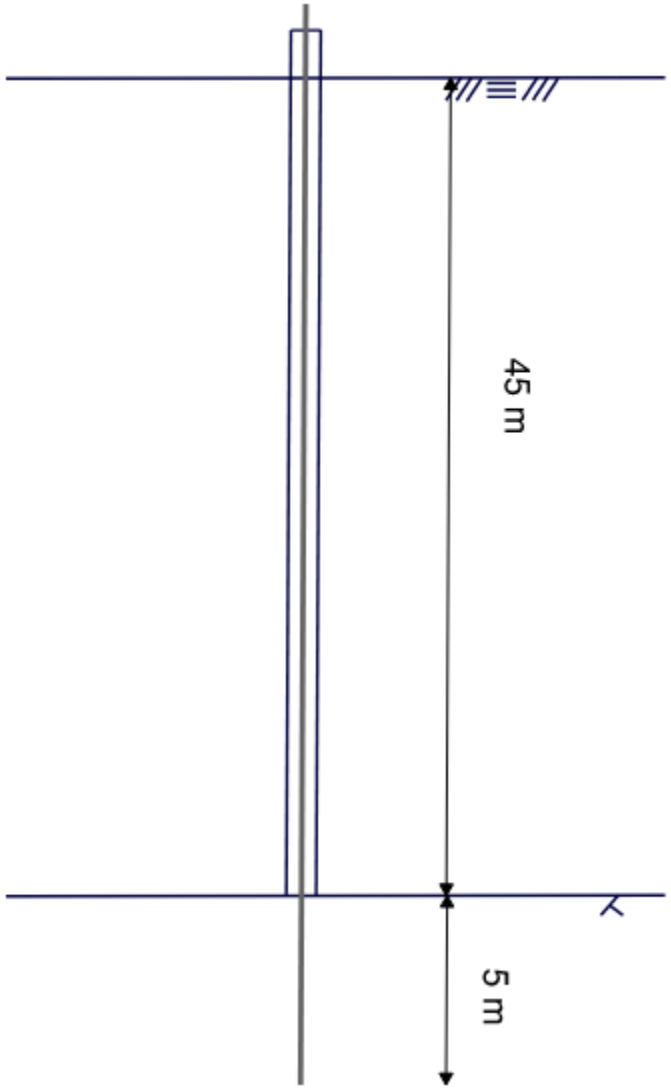
- Piles in compression
  - End-bearing piles
- Piles in tension
  - Pile shaft resistance
  - Rock anchors

DESIGN (VERIFICATION/CALCULATION)

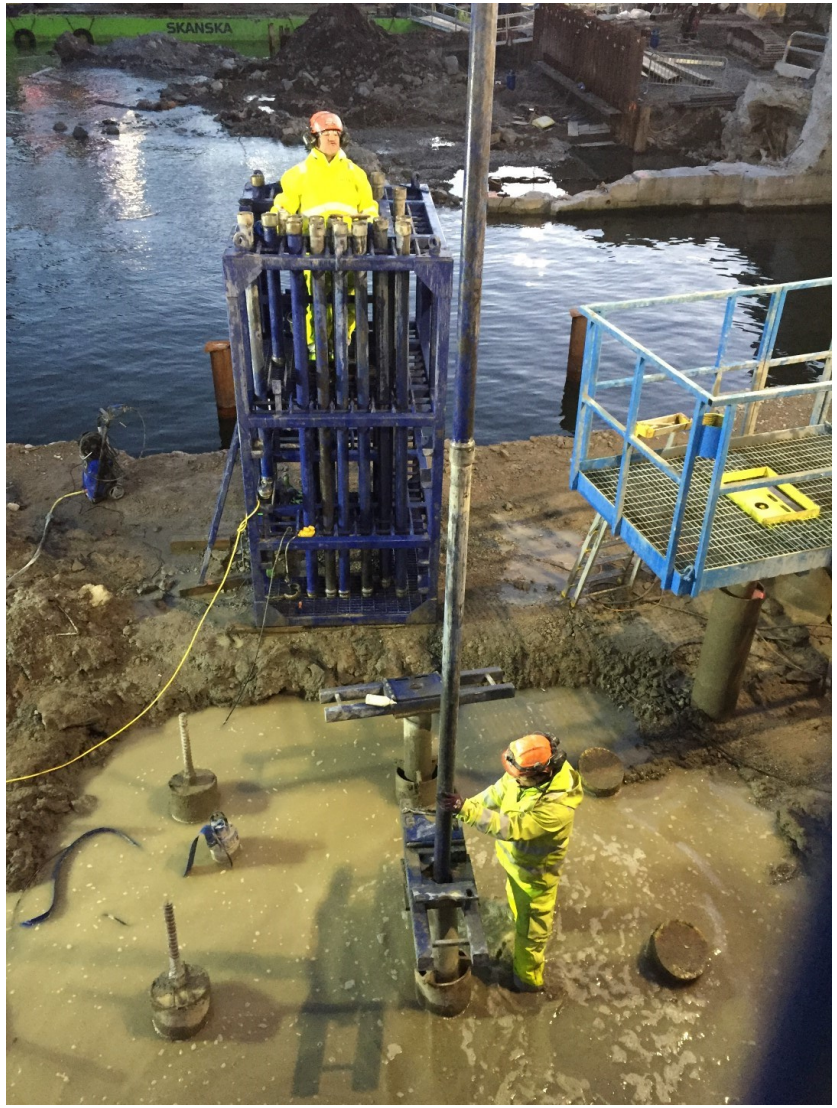
- Verification compression
  - High-strain dynamic pile load tests
  - CASE-method
- Verification tension
  - High-strain dynamic pile load tests
  - Signal matching (CAPWAP)
  - Static pile load tests (tension)
- Calculation
  - Effective stress method (β-method)
  - (CPT-based methods)

ROCK ANCHORS

- Rock anchors drilled into the ground
- Tension load tests



ROCK ANCHORS

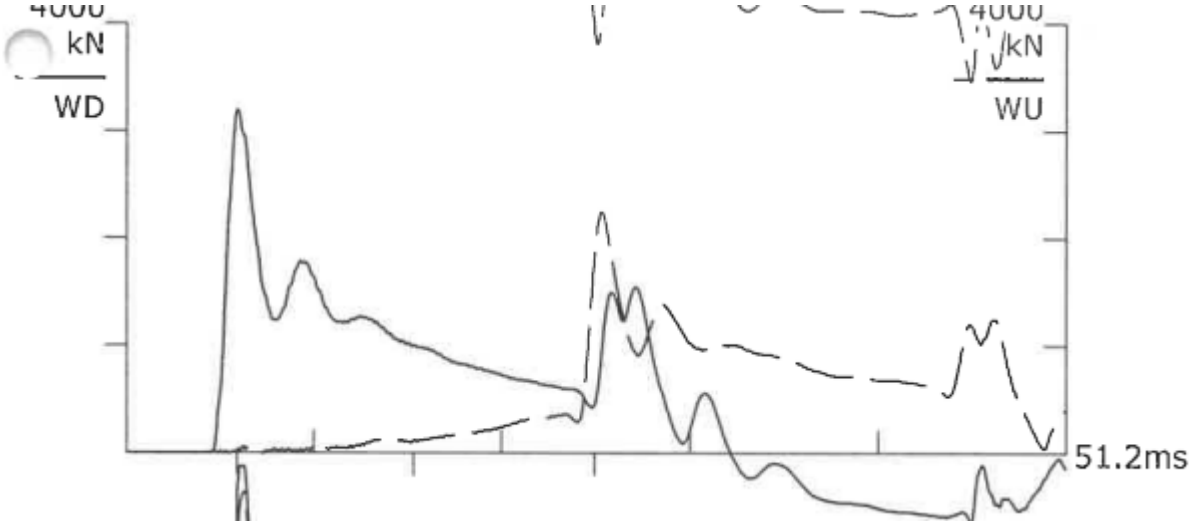


SHAFT FRICTION

- \+ Verification/calculation
- \+ High-strain dynamic pile load tests
- \+ Economically advantageous
- \+ Static pile load tests
- \+ Time to design capacity

LOAD TESTS

- Static load tests
- Dynamic load tests



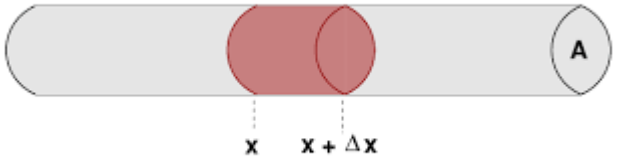
STATIC LOAD TESTING

STATIC LOAD TESTING

+ Expensive and time consuming
+ Reaction frame for the piles
+ Jack power

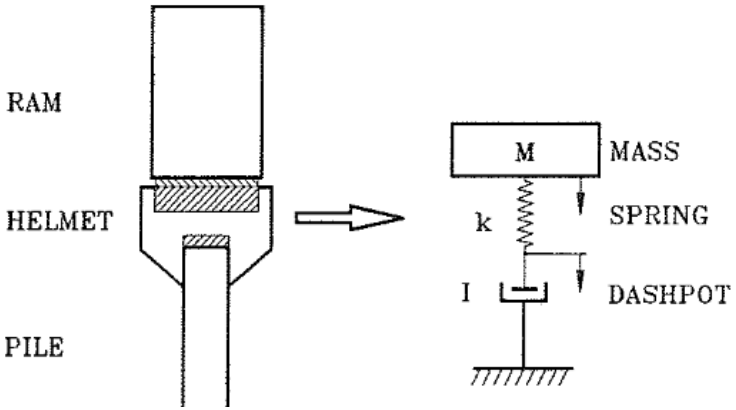
DYNAMIC PILE LOAD TESTING, METHODOLOGY

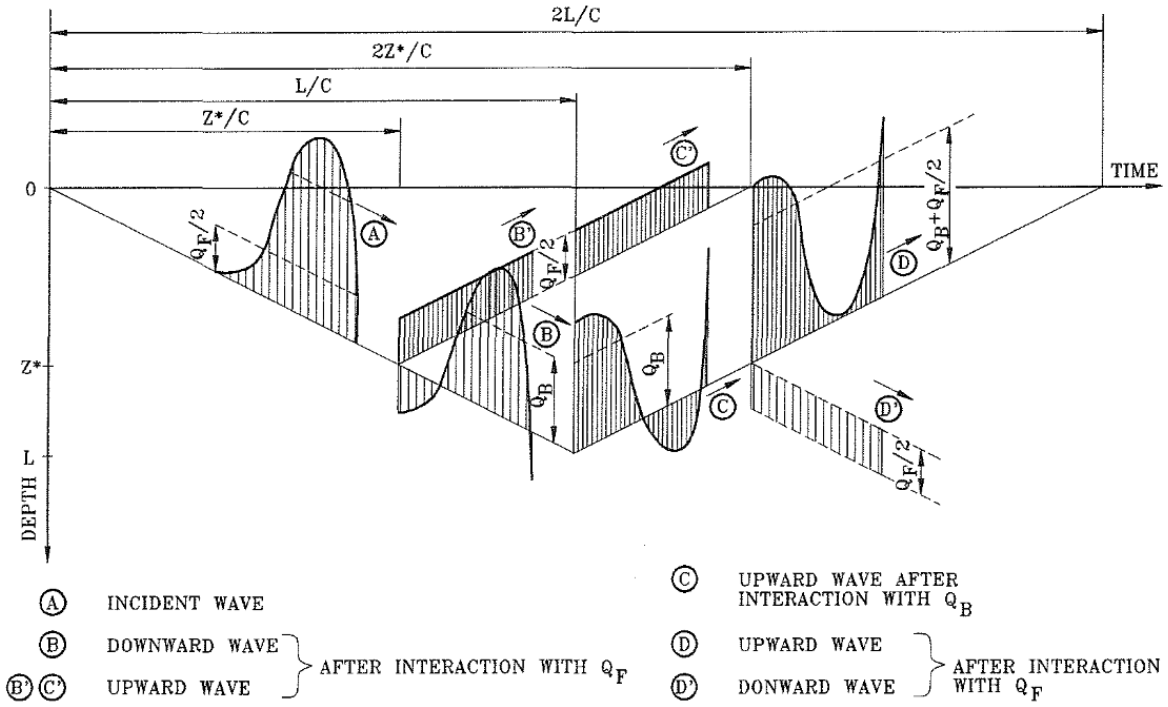
$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$



$$u(x,t) = F(x - ct) + G(x + ct)$$

DYNAMIC PILE LOAD TESTING,SHAFT





DYNAMIC PILE LOAD TESTING, PRACTICE

- Measurements
  - Acceleration
  - Strain
- Interpretation
  - Case method
  - Signal matching (CAPWAP)

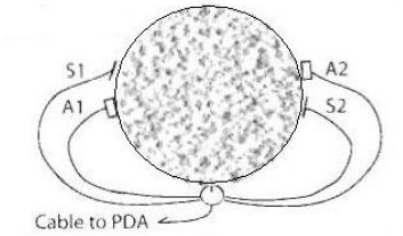


Fig-5 Schematic showing location of sensors attached to the pile.

S1, S2- Strain Transducers
A1,A2- Accelerometers

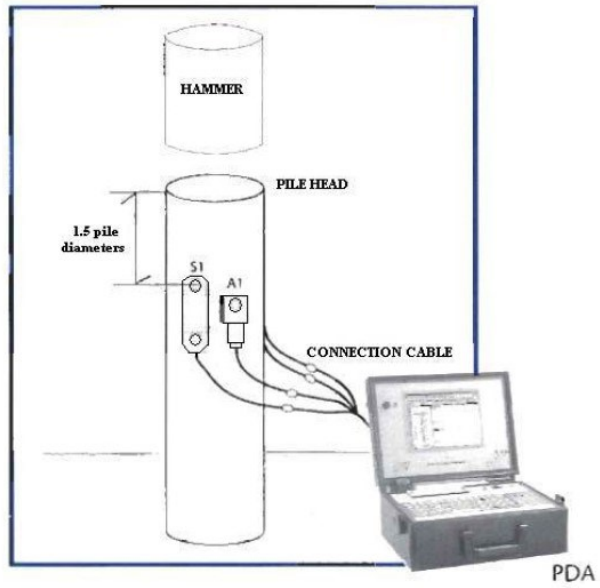
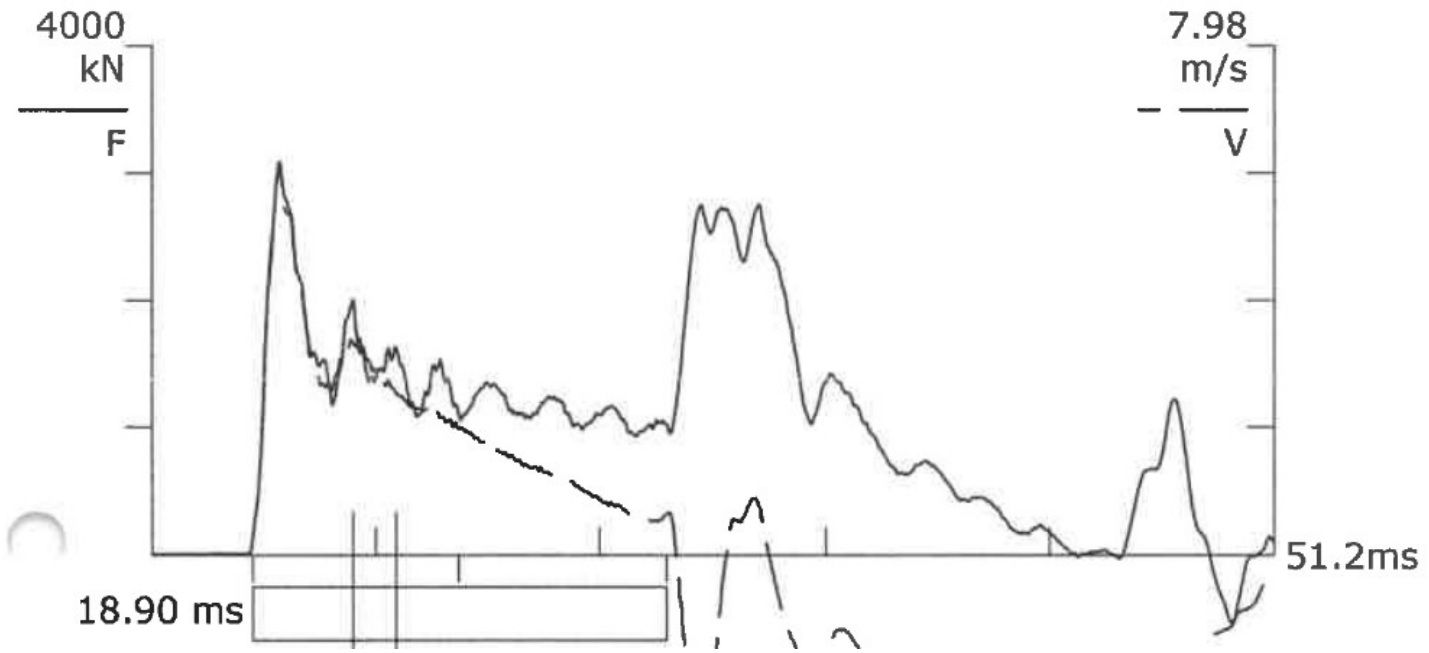


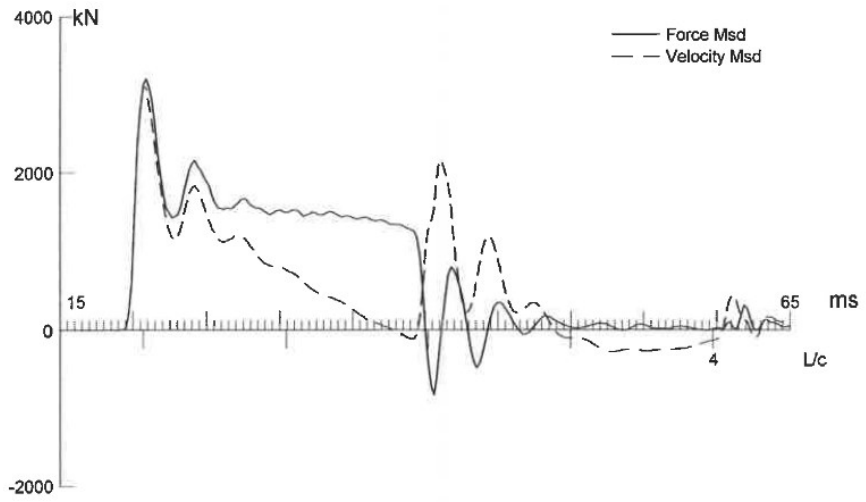
Fig-6 Typical arrangement

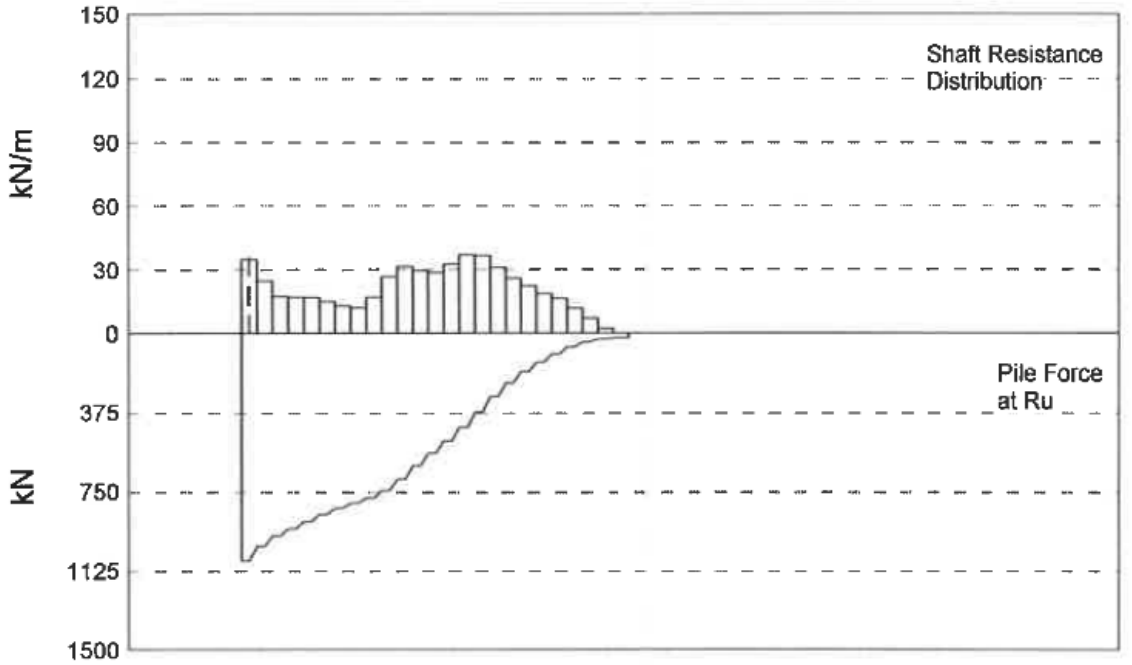
DLT AFTER COMPLETION AND DRIVING



DLT ON THE PILE SHAFT

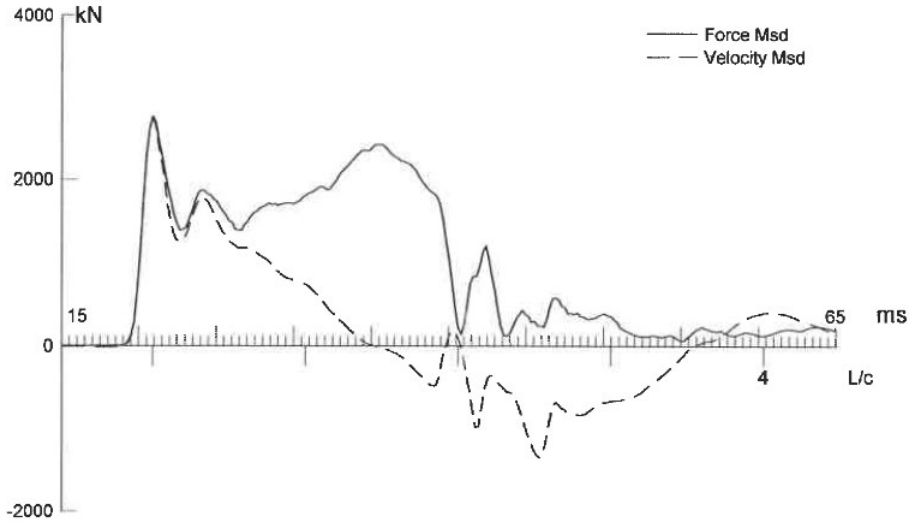
+ 20 days

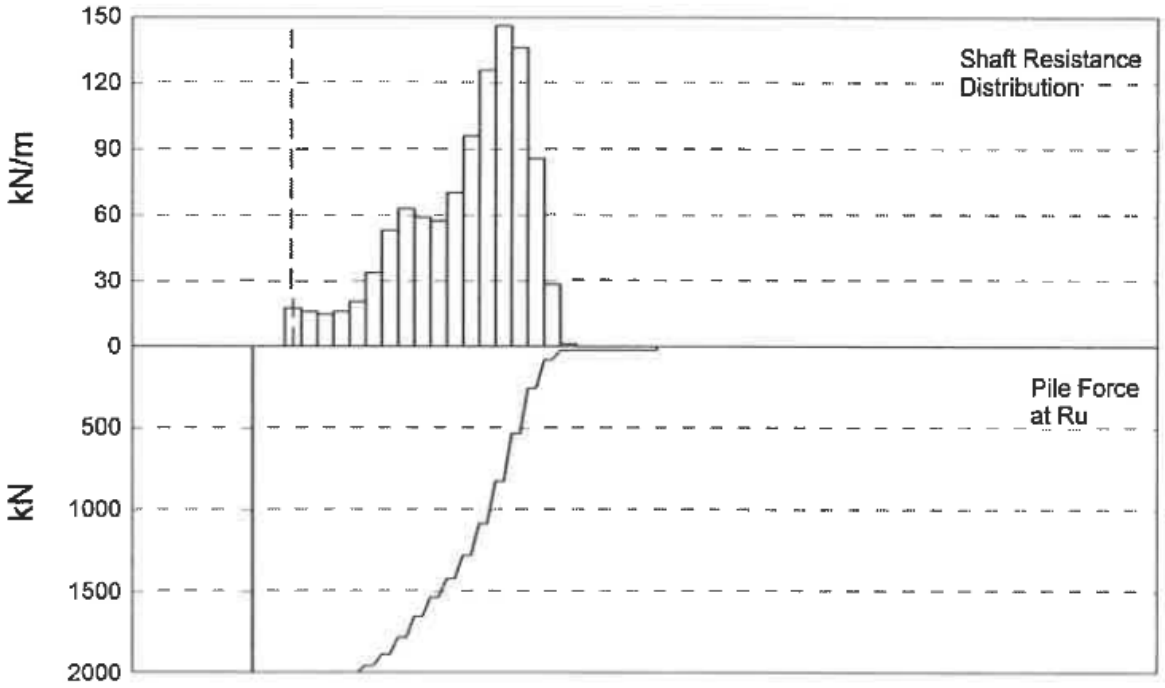




DLT ON THE PILE SHAFT

+ 91 days

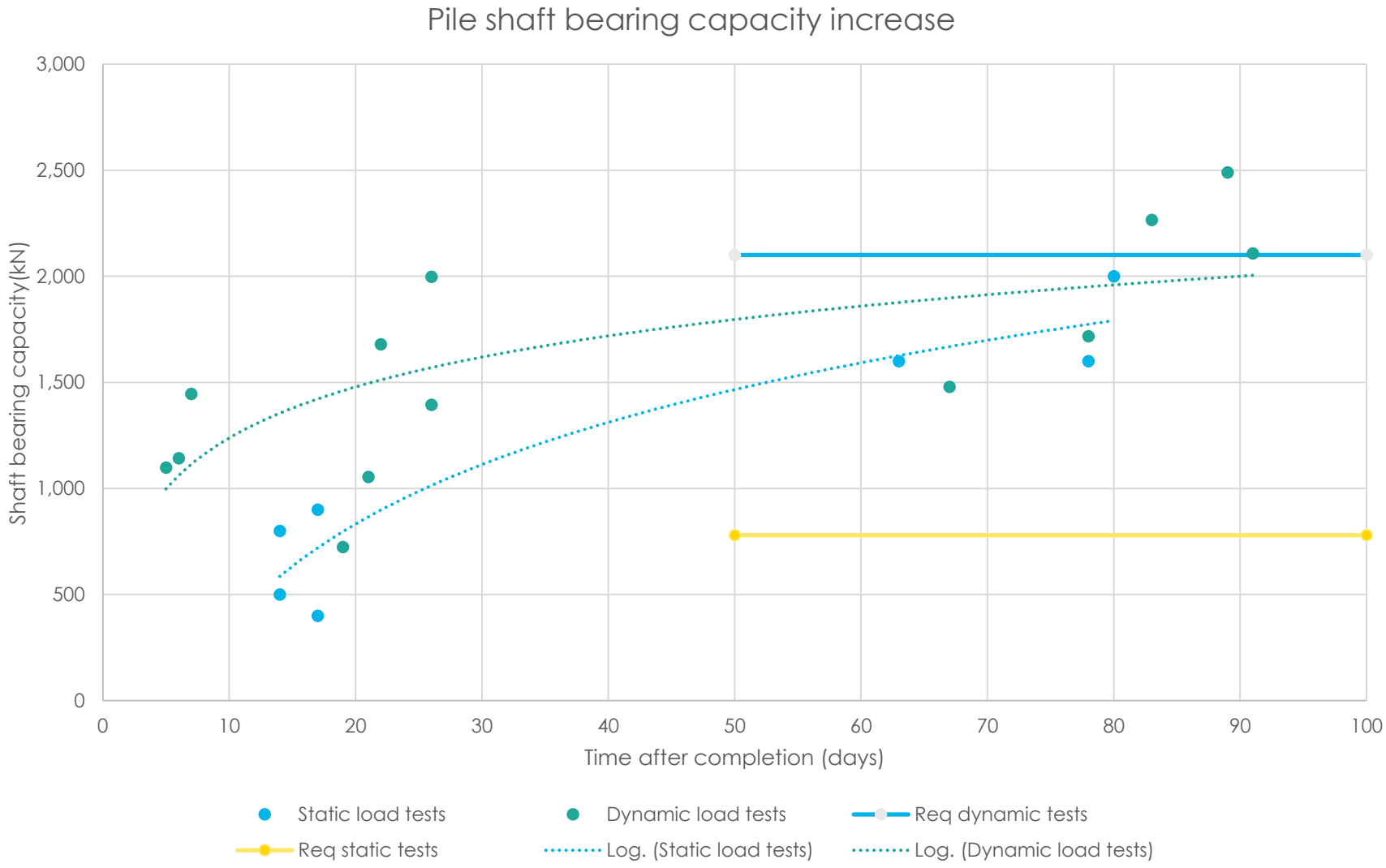




CALCULATION

- With β = 0,2
  - tan(δ) = 0,7
  - 1-sin(ϕ) = 0,43
- Bearing capacity 2500 kN

PILE SHAFT BEARING CAPACITY INCREASE



CONCLUSIONS

- The shaft friciton reaches the geostatic stress state
- This requires 2-3 months
- Early pile testing can verify the assumption
- Calculation methods are available for these drilled piles
- Time-dependent testing can be included in the design

THANK YOU!