Hvordan dokumenteres bæreevnen af skruepæle?

Professor
Lars Bo Ibsen

Build – Aalborg Universitet

lbi@Build.aau.dk

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DENMARK

INNOVATION FUND DENMARK

D2D FOUNDATION

Day to day Foundation: Innovative and cost-effective solutions for future house building using Ground Screw Foundation

BAYO-S

ANDREASEN & HVIDBERG

BUILD

INTRODUKTION – Day to Day Foundation

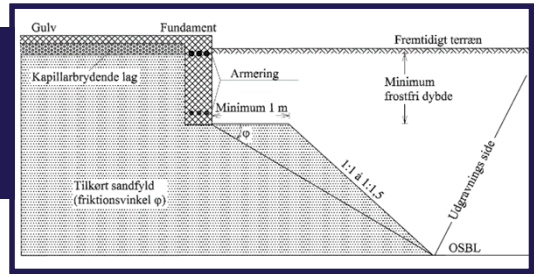
VISION

- I projektet udvikles en **ny design strategi** for skruepæle som **integrerer geoteknisk undersøgelse, installation, in-situ pæletest og pæle design**, i en operation.
- Projektet åbner et helt nyt marked for **skruepæle**, som vil **revolutionere** og være et rigtigt alternativ til de **nuværende funderingsmetoder** i alle typer huskonstruktioner - og det med en **grøn profil**.

Direkte fundering
Bæredygtige aflejringer ~ 1 – 2 m' s dybde

Pælefundering:
Bæredygtige aflejringer > 3 – 4 m's dybde

Udskiftning:
Bæredygtige aflejringer ~ 2 – 4 m's dybde



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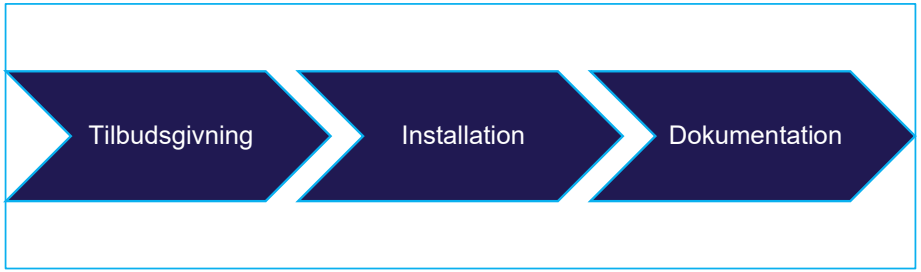
Skruepæleprojekt skal dokumenteres som et normalt pæleprojekt



Skruepæleprojekt skal dokumenteres som et normalt pæleprojekt

Tilbudsgivning → Installation → Dokumentation

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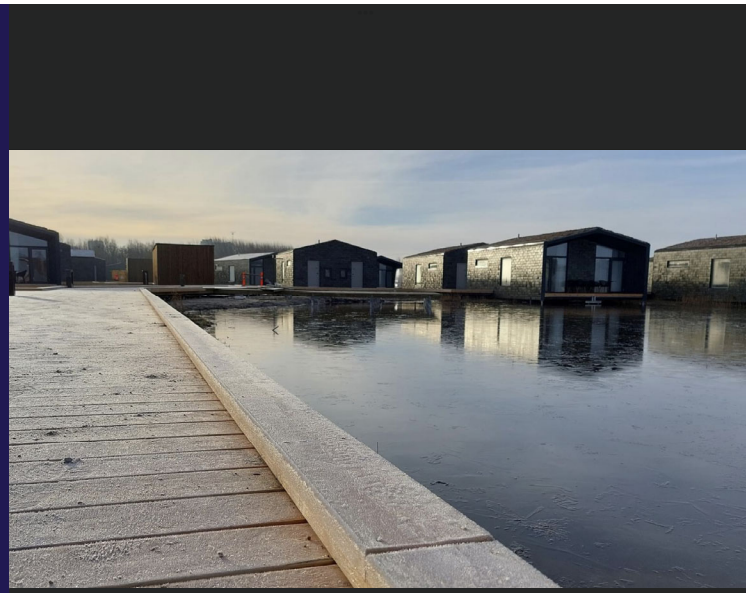

Skruepæleprojekt skal dokumenteres som et normalt pæleprojekt

Design af et skruepæleprojekt

Tilbudsgivning

Fortrængnings pæle

Design basis

- DS EN EuroCode7
- Geoteknisk boring med styrkeforsøg
- Evt. CPT forsøg
- Design laster

Pæledesign

- Geostatisk bereg.
- CPT metoder
- Nedramnings analyse
- Antal, dimension, længde
- Pæleplan

Skruepæle

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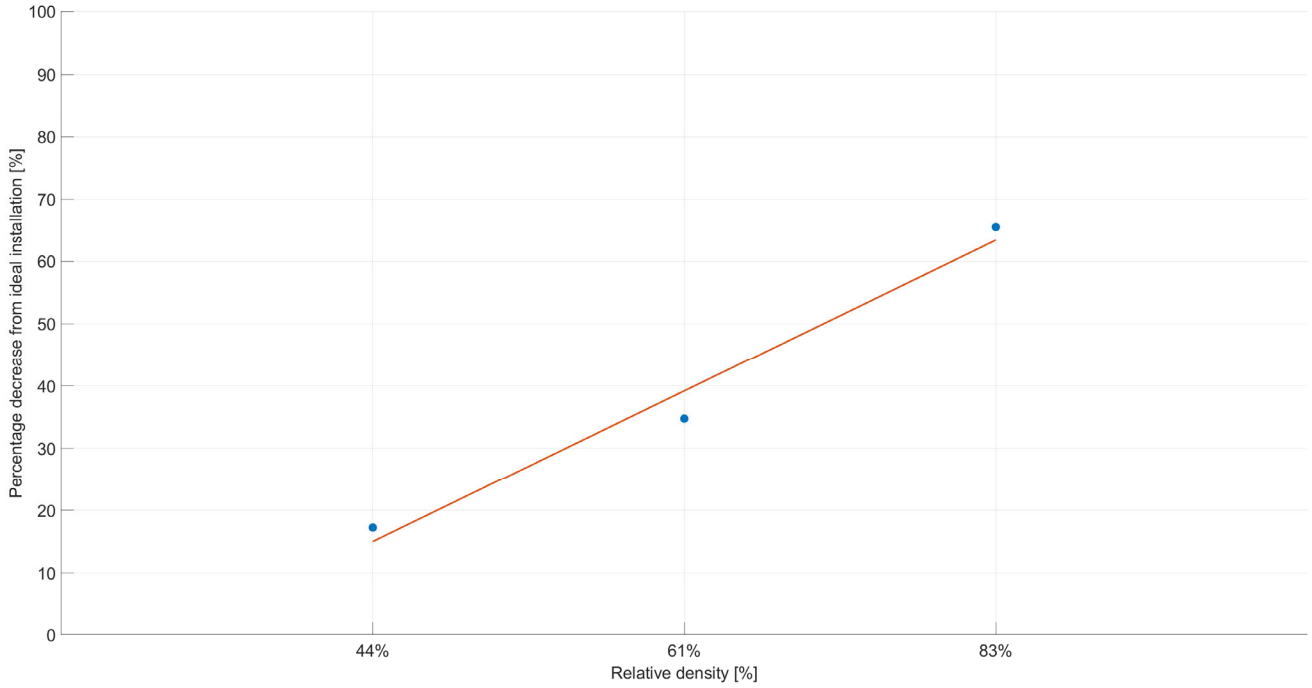
Design af et skruepæleprojekt

Tilbudsgivning



ele

Design basis

- DS EN EuroCode7
- Geoteknisk boring med styrkeforsøg
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Pæledesign

- ~~Geostatisk bereg.~~
- ~~CPT metoder~~
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- Pæleplan

Kan ikke bruges som dokumentation af bæreevnen friktionsjord

Design af et skruepæleprojekt

Der er for mange Cowboyer der agerer i markedet.

- Overholder ikke normerne krav.
- Kan ikke dokumenterer skruernes levetid eller bæreevne.
- Ingen geoteknisk viden.

Fortrængnings pæle

Design basis

- DS EN EuroCode7
- Geoteknisk boring med styrkeforsøg
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- Design laster

Pæledesign

- Geostatisk bereg.
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- Pæleplan

Skruepæle

Design

- DS EN
- Geotekn
  med sty
- Evt. CP
- Design

Pælede

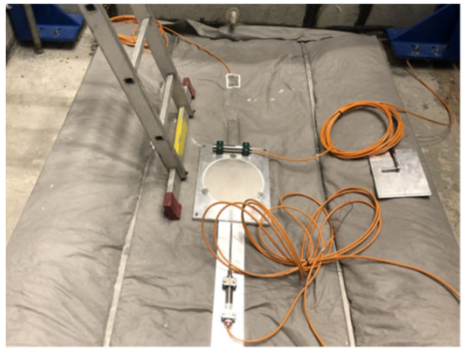
ent

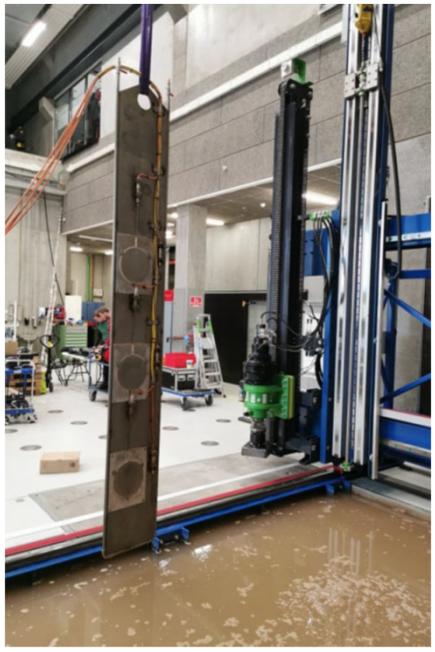
- Geostatis
- CPT metoder
- Nedskrunings analyse
- Antal, dimension, længde
- Pæleplan

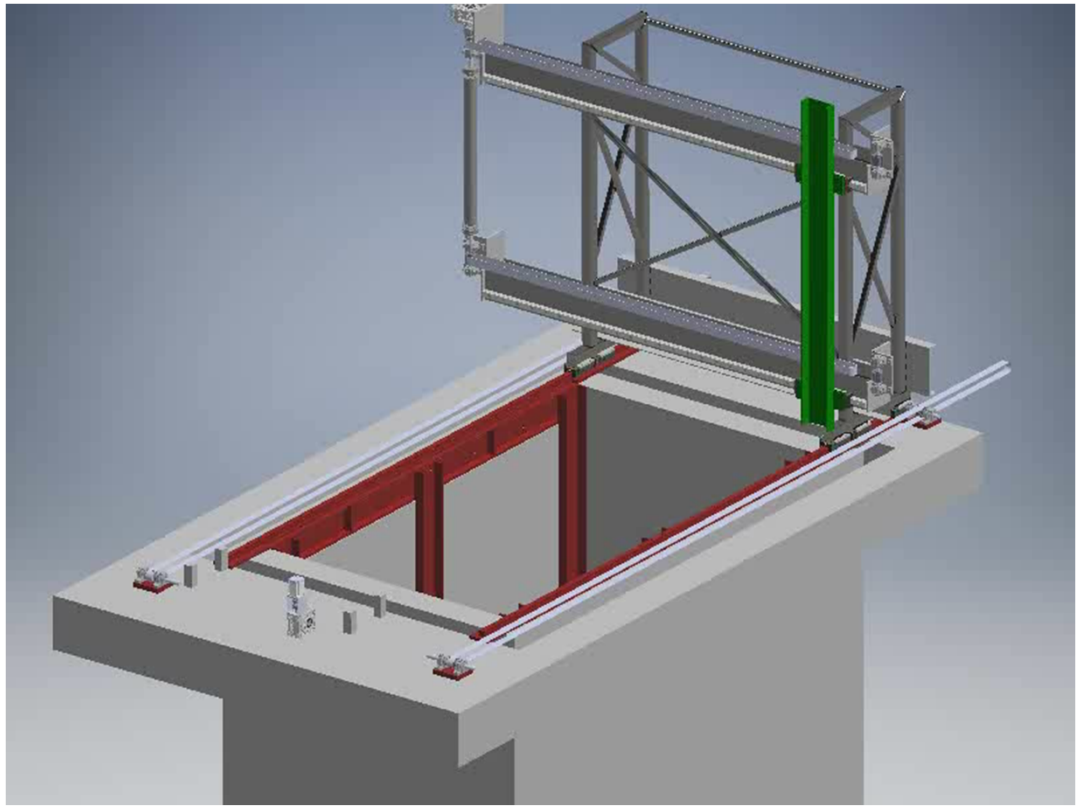
Laboratory – Test-site

Introduction of test-site

- 4,400x2,500x3,200
- 41 bags of Aalborg Sand No. 1
- Equipment
- Pressure plates and water system



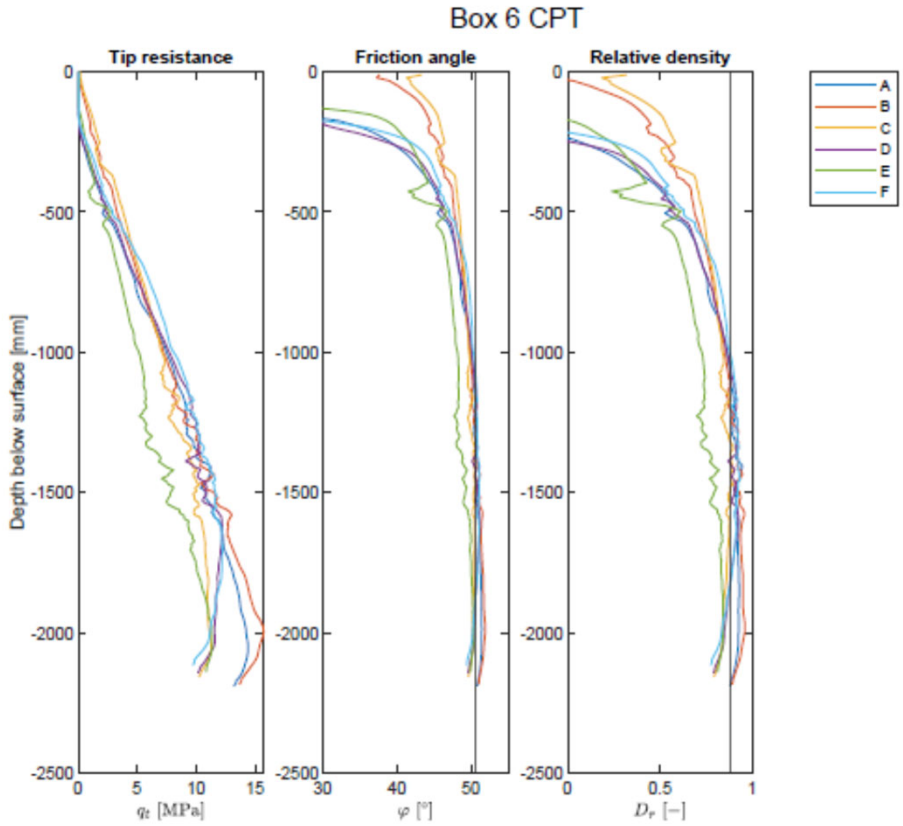




Test procedure – Soil testing

Approximately 5-6 CPT-tests at random location

- Validating uniformity of preparation
- Evaluating the relative density
- Penetration rate of 1,200mm/min



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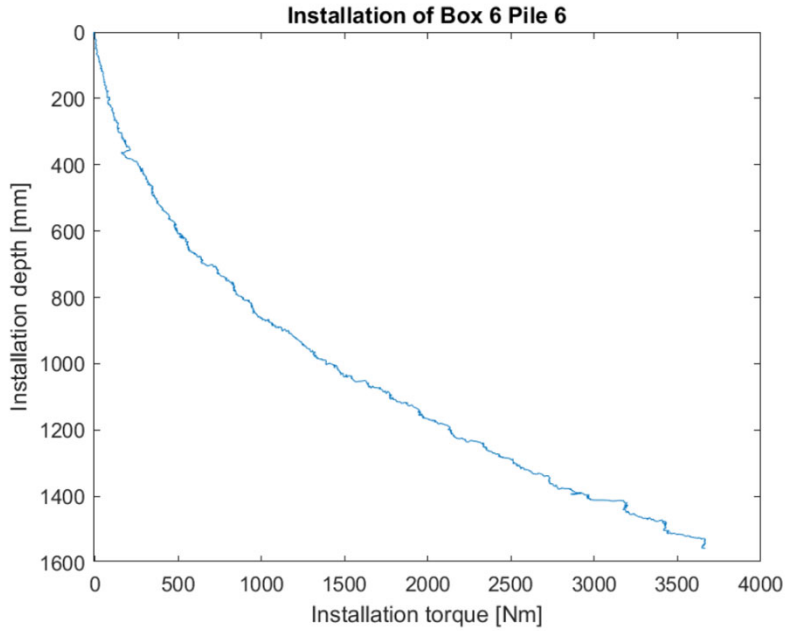
Test procedure – Soil

Soil disturbance due to large rotation speed

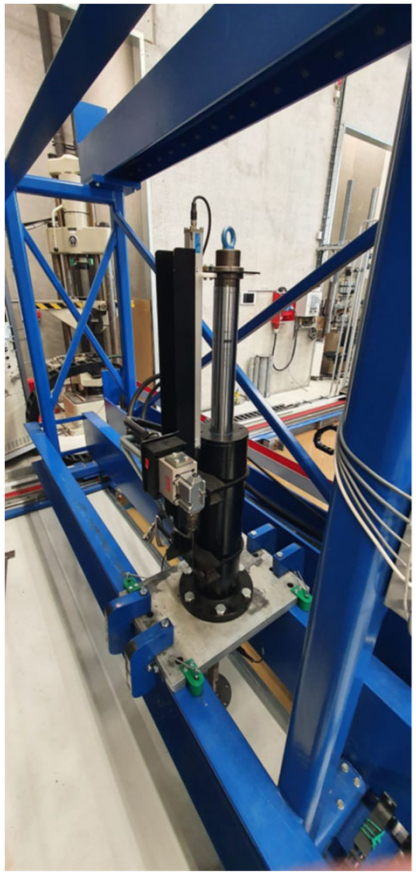
Outcome; depth and torque measurements converted to installation curve

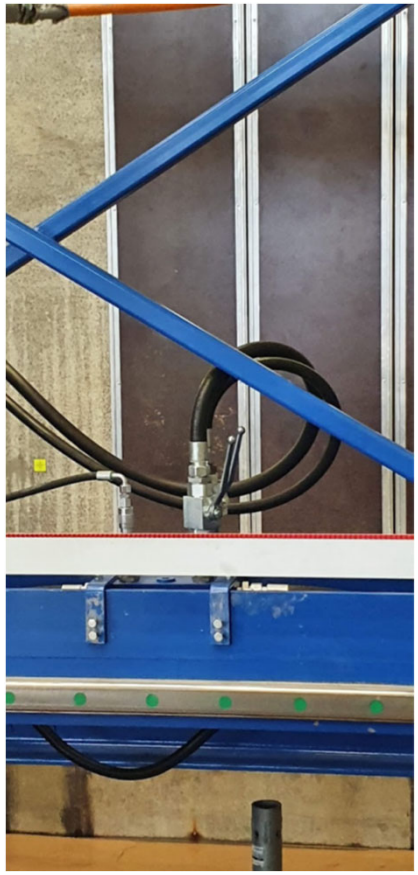


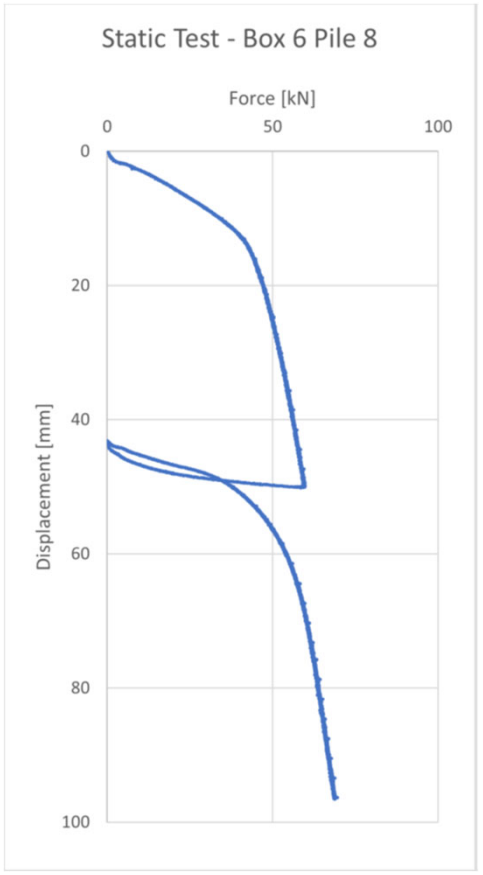
Test procedure – Static test

Static test

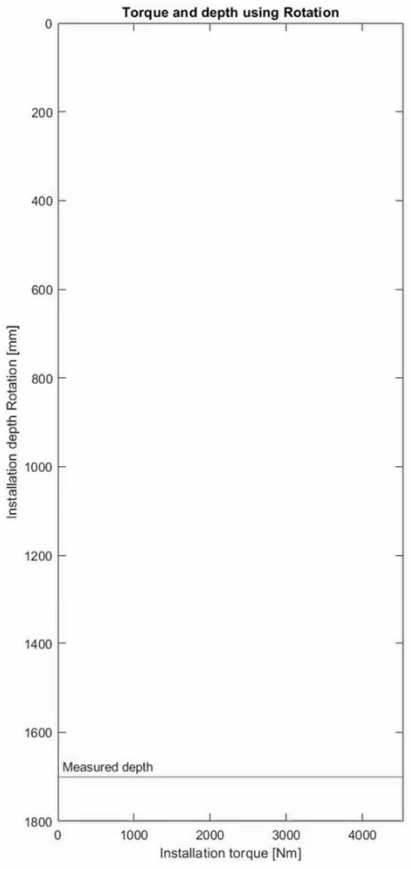
Displacement controlled test with displacement rate of 5mm/min
Loading/reloading of 50mm; in total 100mm displacement

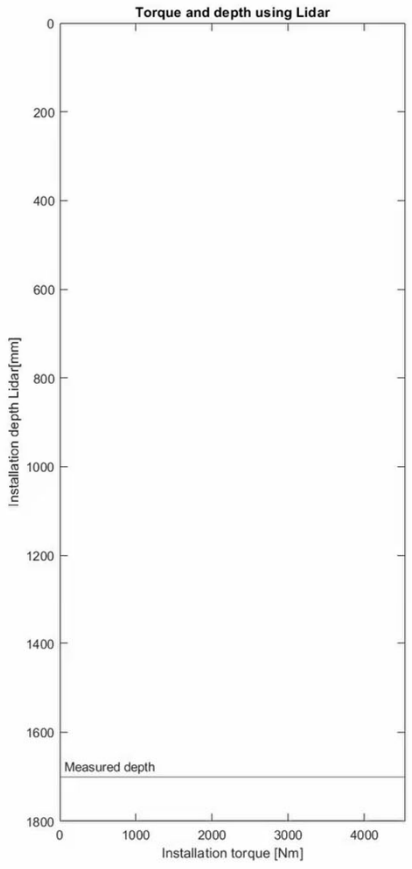






Correct Installation





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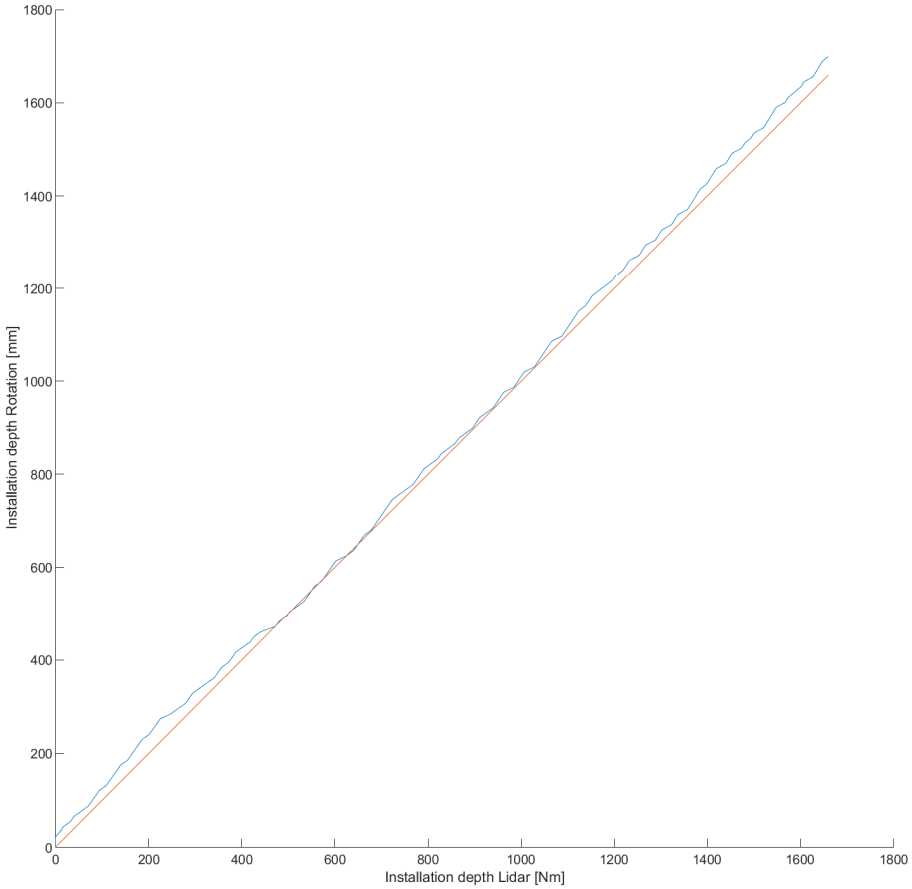


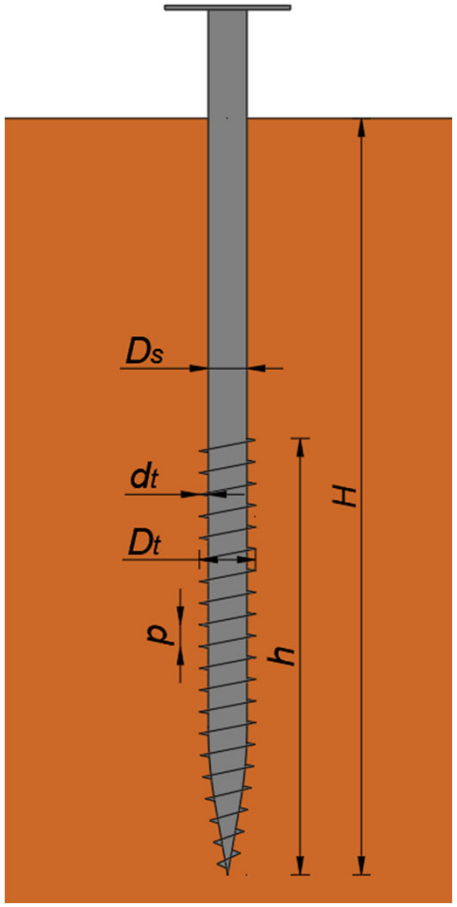
Test program – Overview of tests

6 geometrical configurations
- 4 shaft diameters and 2 thread sizes

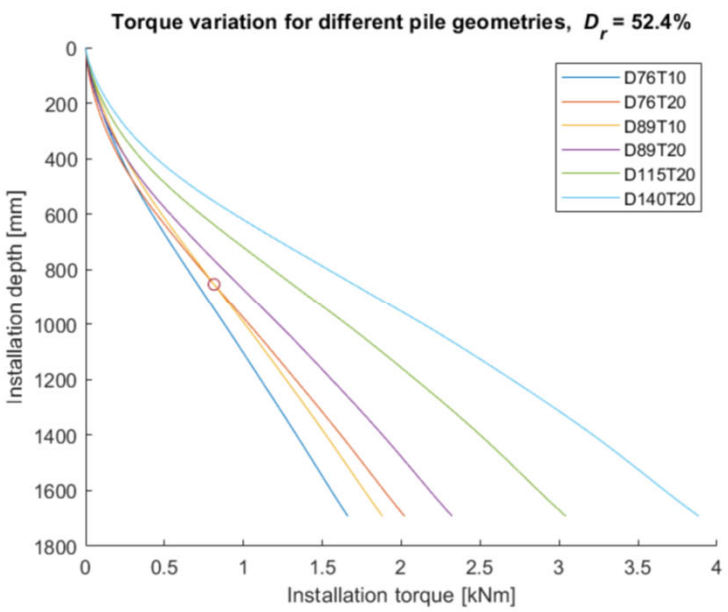
3 different soil configurations
- Loose, medium and dense

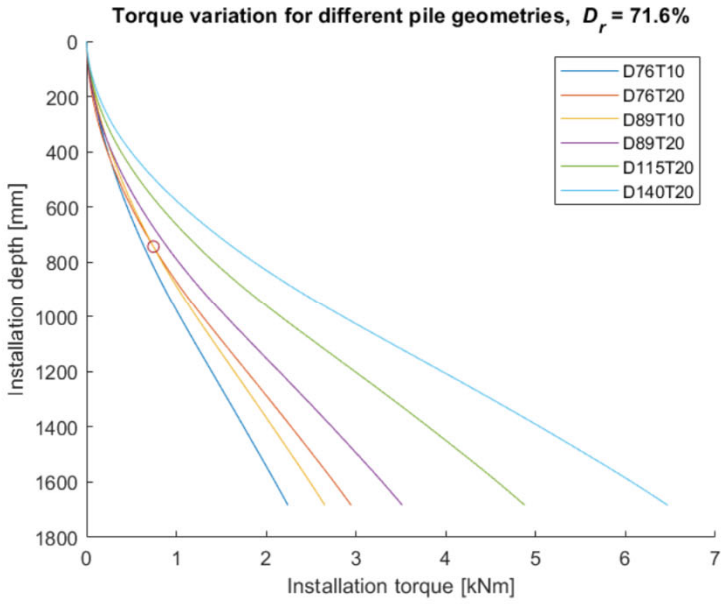
8 batches of 8 piles each tested
- 3 containing all pile geometries
- 3 containing only small diameter piles
- 2 retakes due to errors
- 64 piles in total

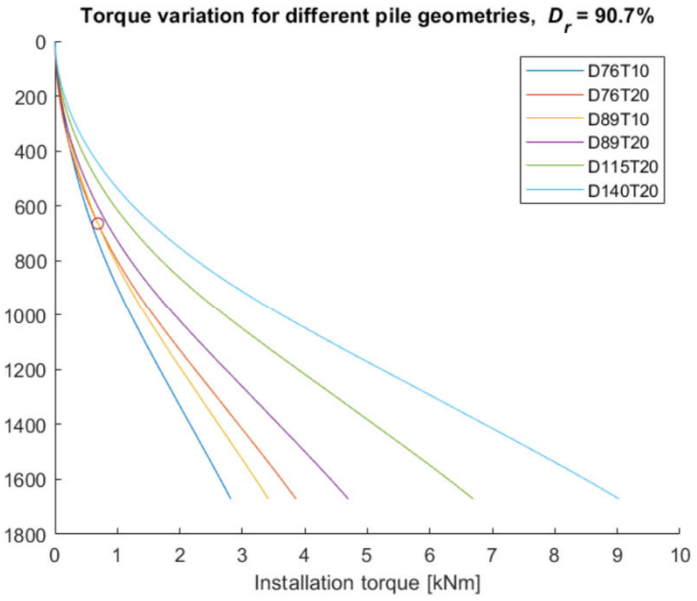
Constant geometrical sizes
- Pitch, thickness and threaded length
- Installation depth



Installation Torque







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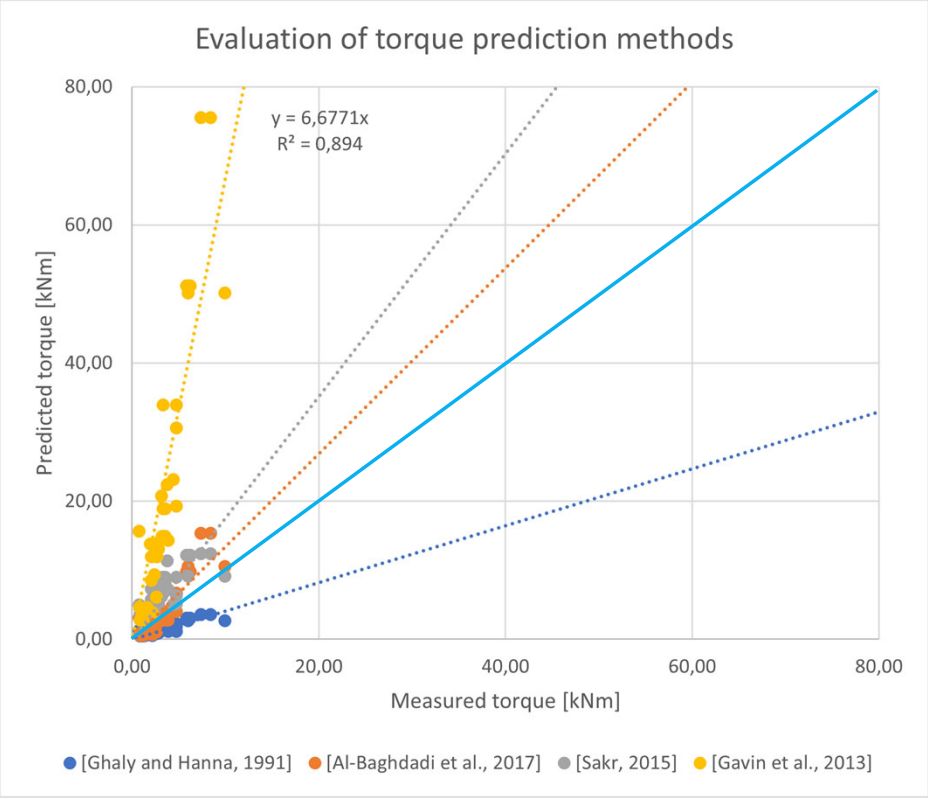
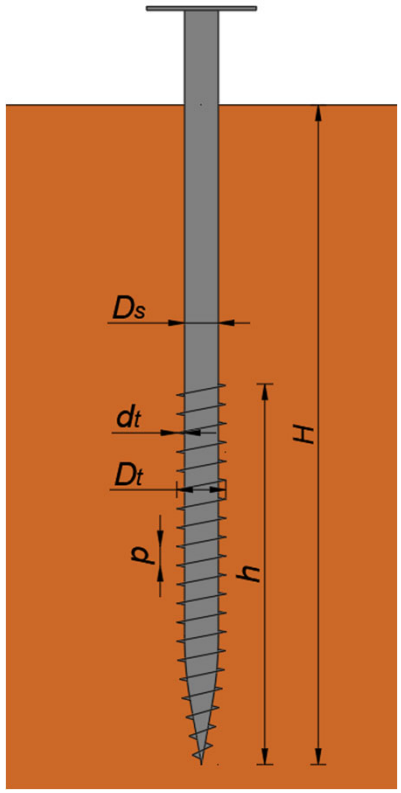
Torque prediction method

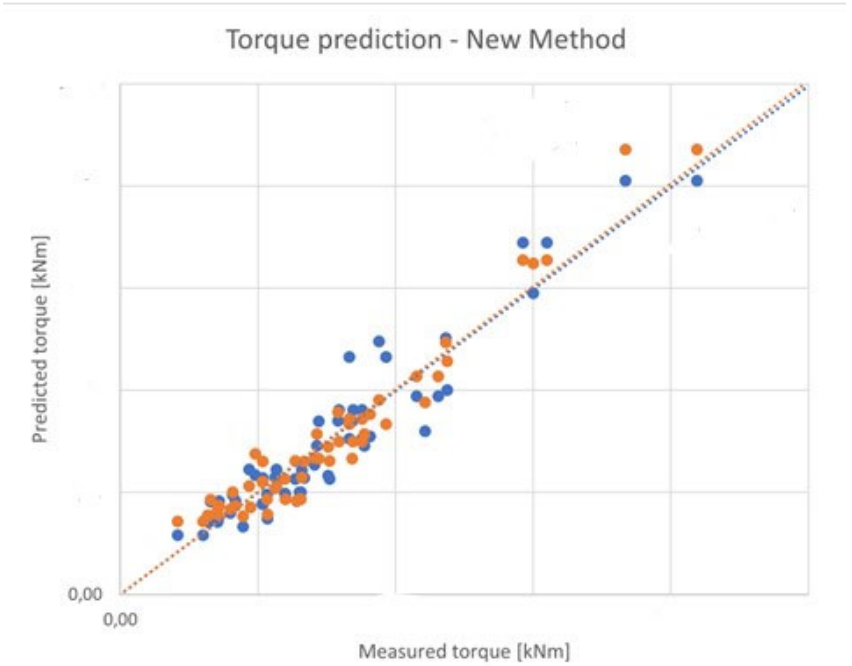
Prediction of torque based on existing methods

Two earth pressure-based methods and two CPT-based methods



Torque prediction method - AAU





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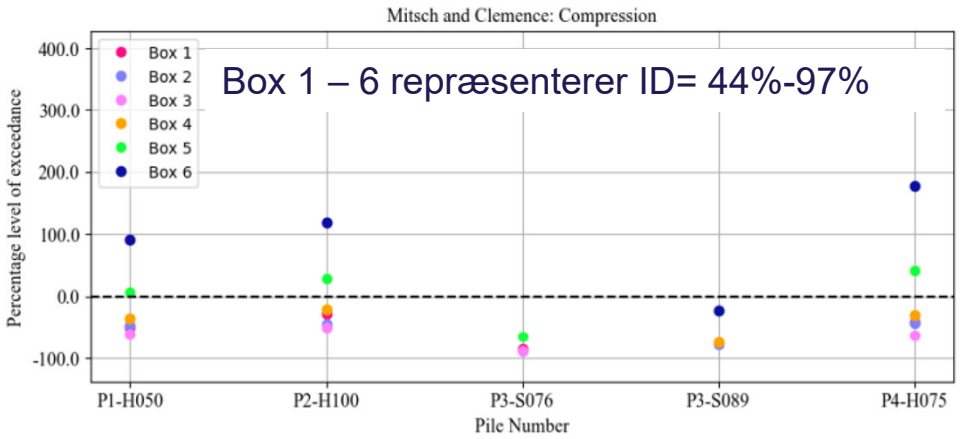
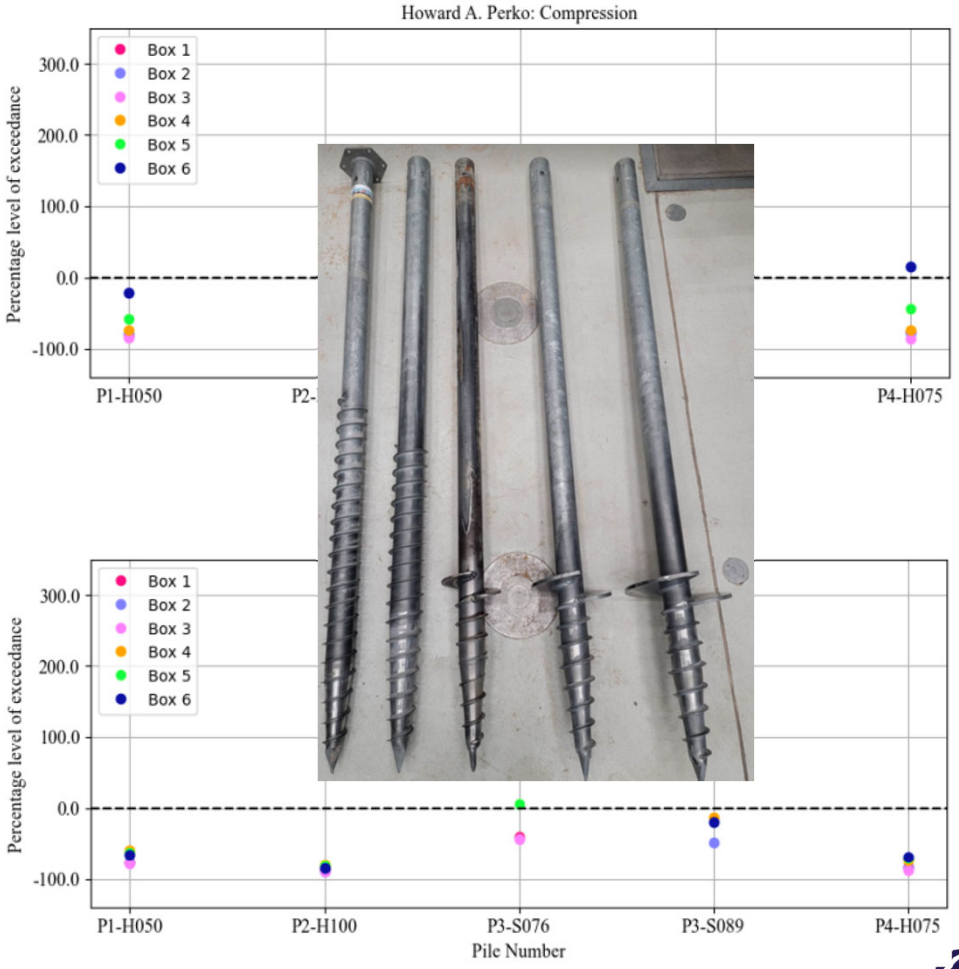
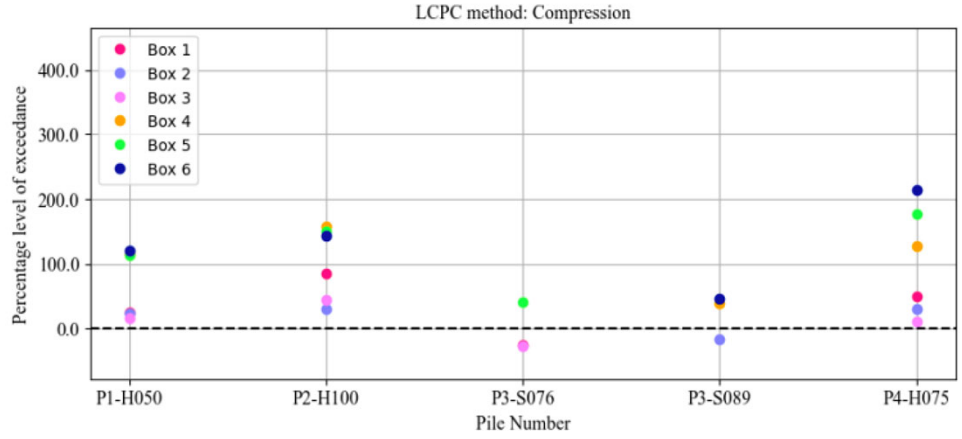
Original Methods vs static tests - COMPRESSION

Geostatisk Metoder





CPT Metoder



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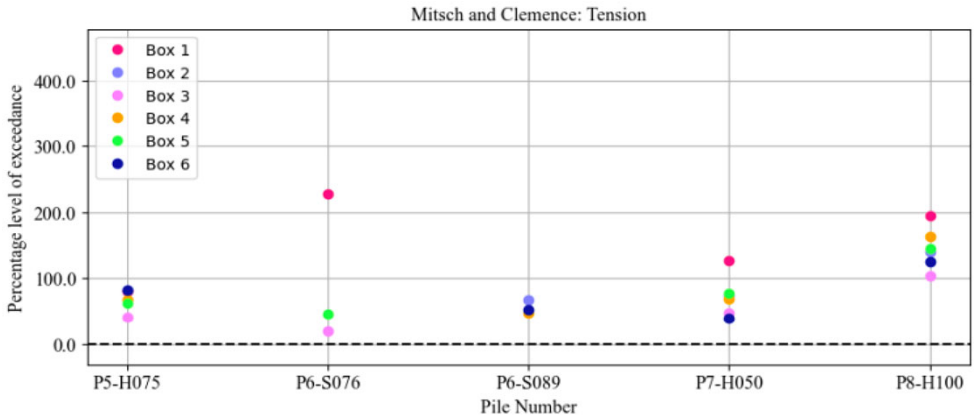
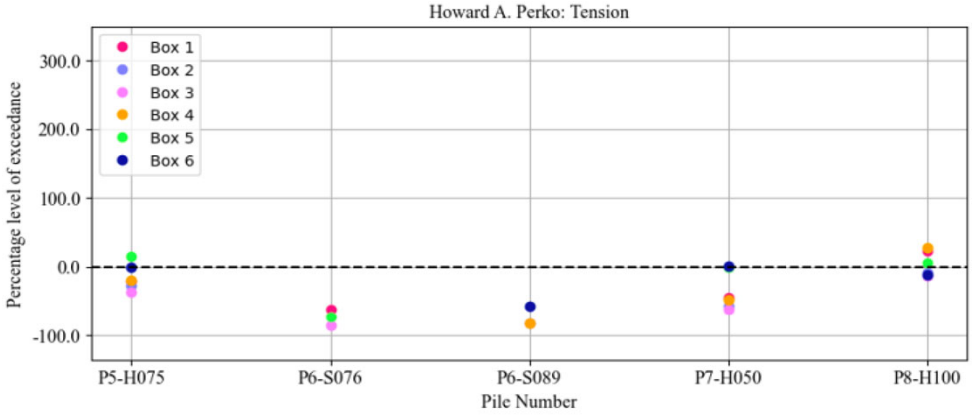
Original Methods vs static tests - Tension

Geostatisk Metoder



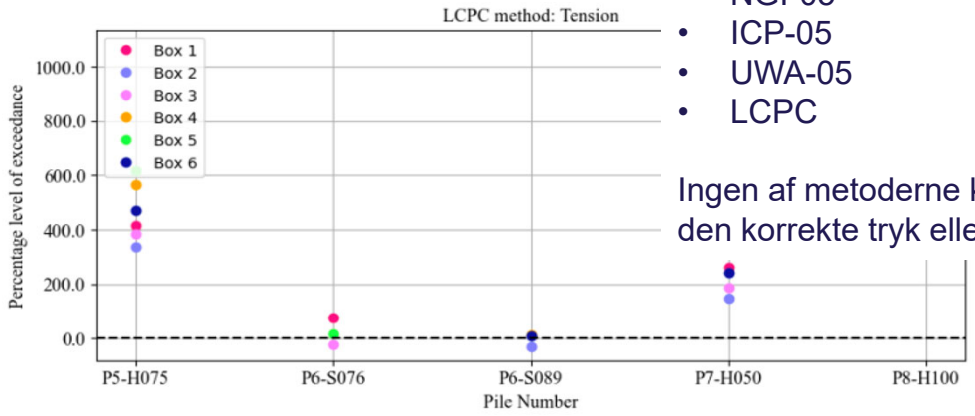


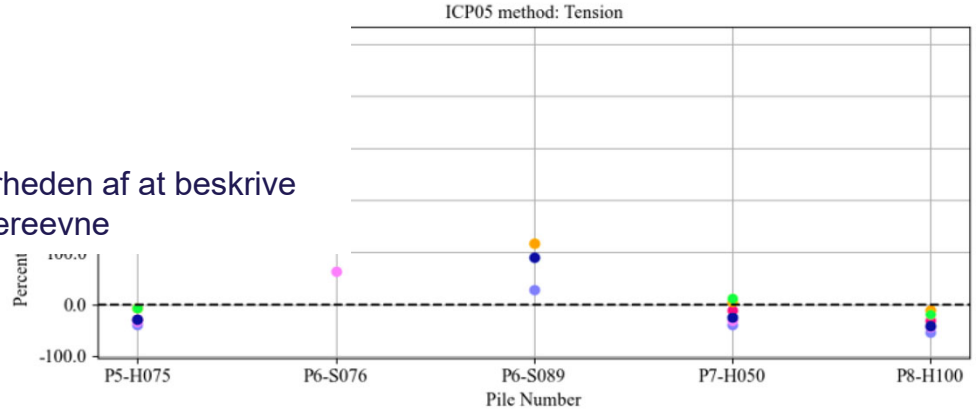
CPT Metoder

Følgende CPT Baserede Metoder er undersøgt:

- NGI-05
- ICP-05
- UWA-05
- LCPC

Ingen af metoderne kom i nærheden af at beskrive den korrekte tryk eller træk bæreevne





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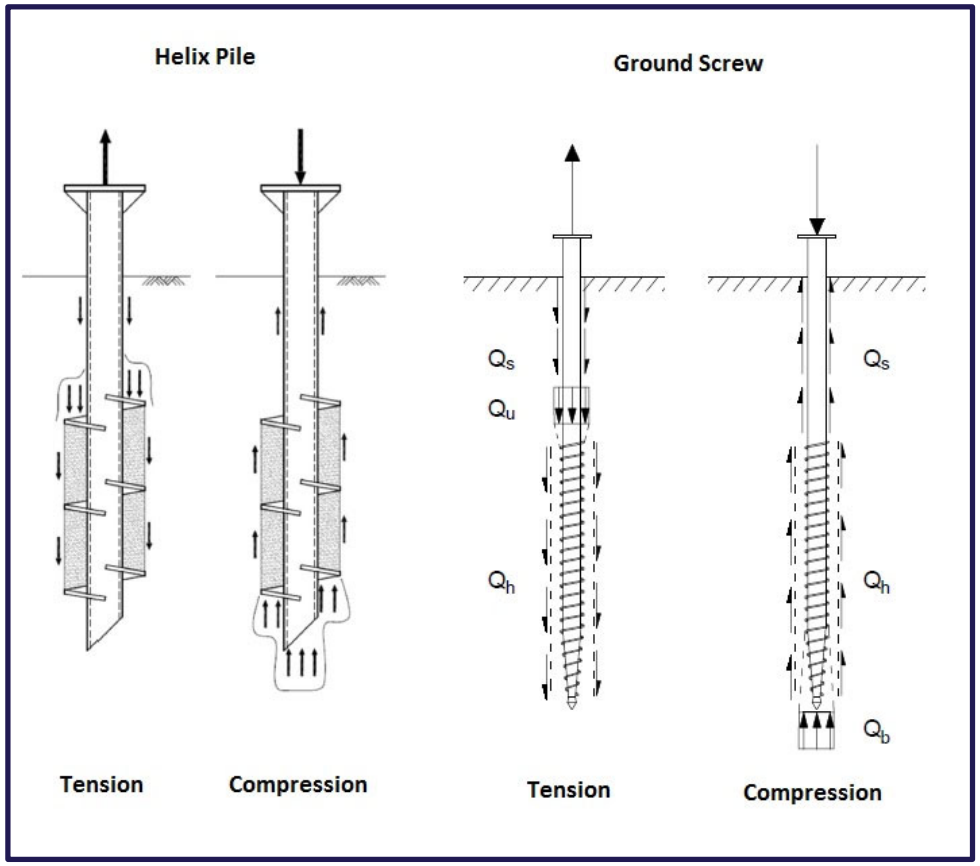
KONKURRENTER

URETEK



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Das Schraubfundament

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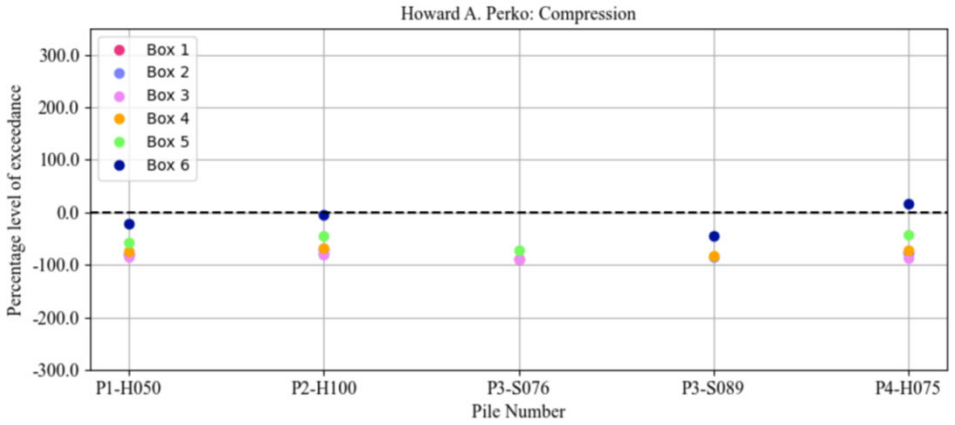
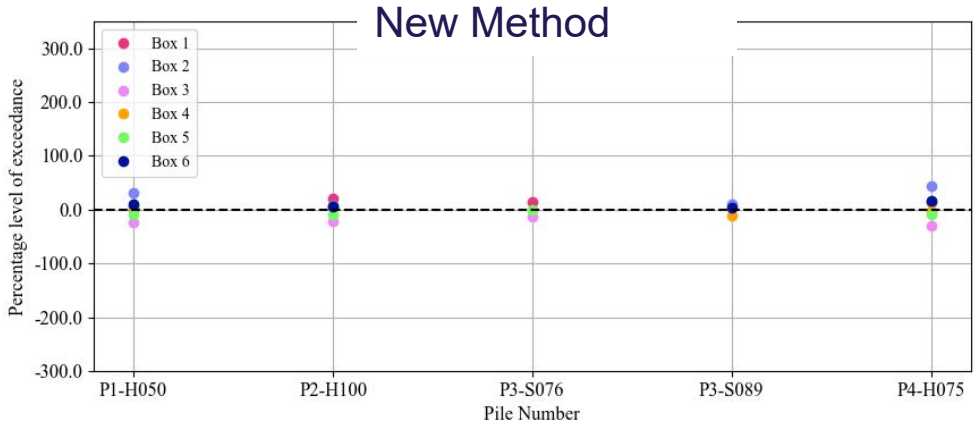
New Method vs static tests - COMPRESSION

Vigtigt at have en så korrekt beregningsmetode som muligt når der skal afgives tilbud

Bedst resultat opnås når pælegeometrien er kalibreret ind i metoden

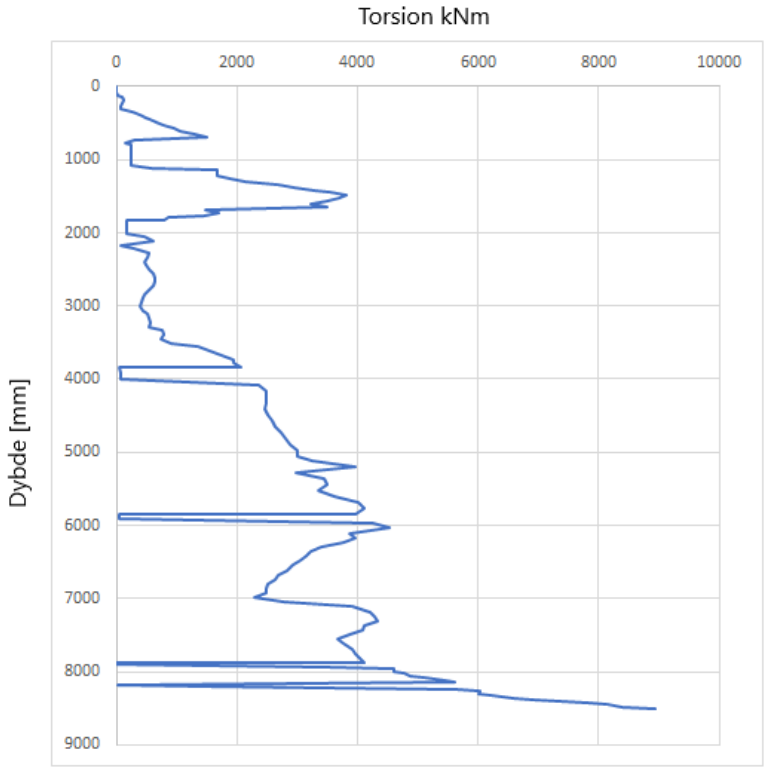




Kan ikke bruges som dokumentation af bæreevnen

Skruepæleprojekt skal dokumenteres som et normalt pæleprojekt

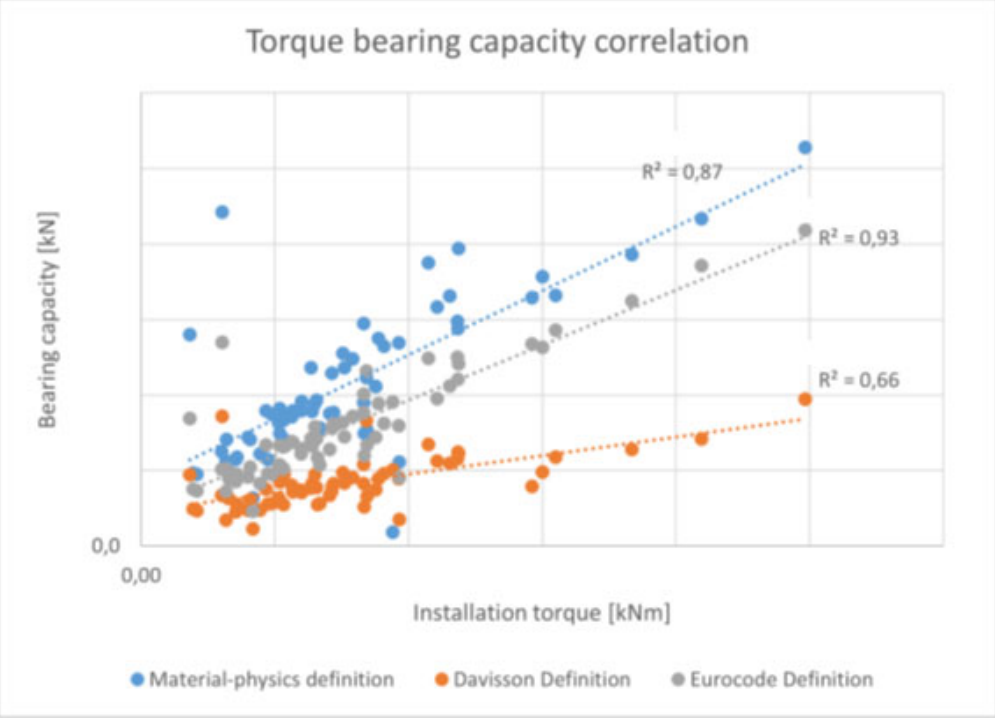
Installation



Skruepæle

Torsion journal

Torsion – Bæreevne korrelation



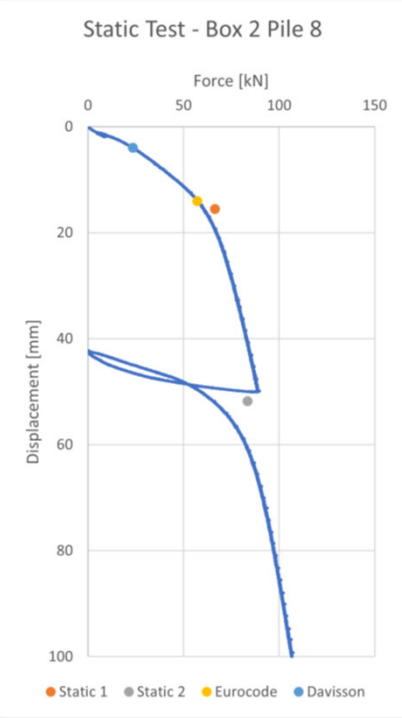
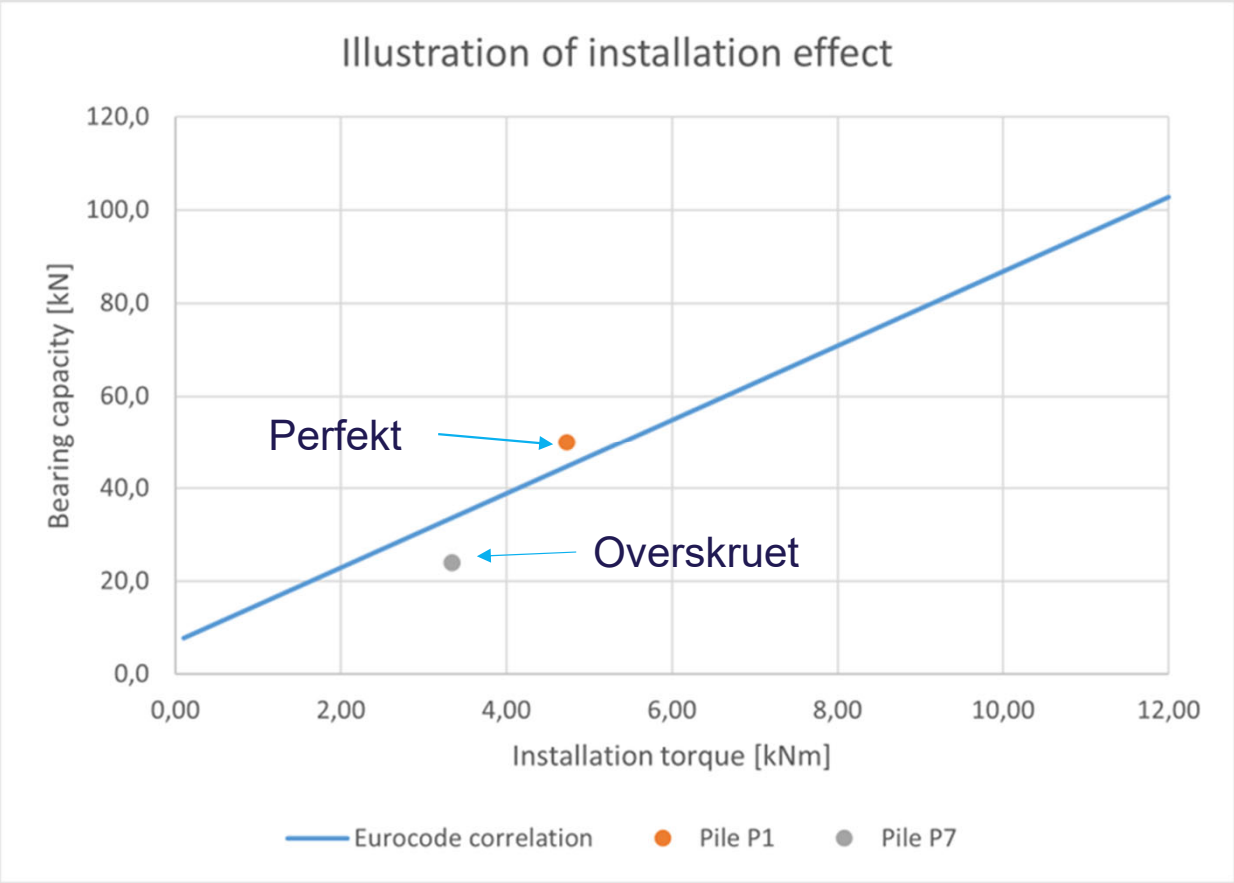


Illustration af installations effekter



Dokumentation af skruepæleprojekt

Dokumentation

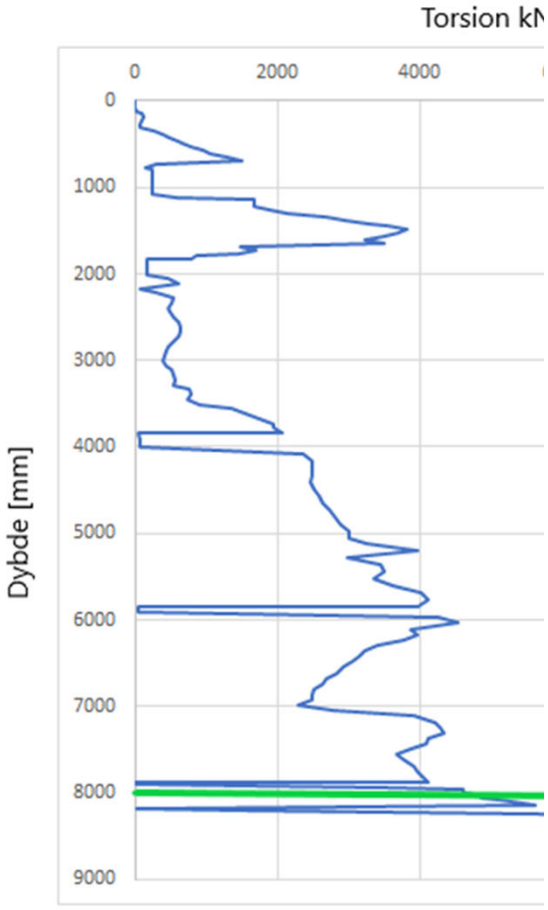
Fortrængnings pæle

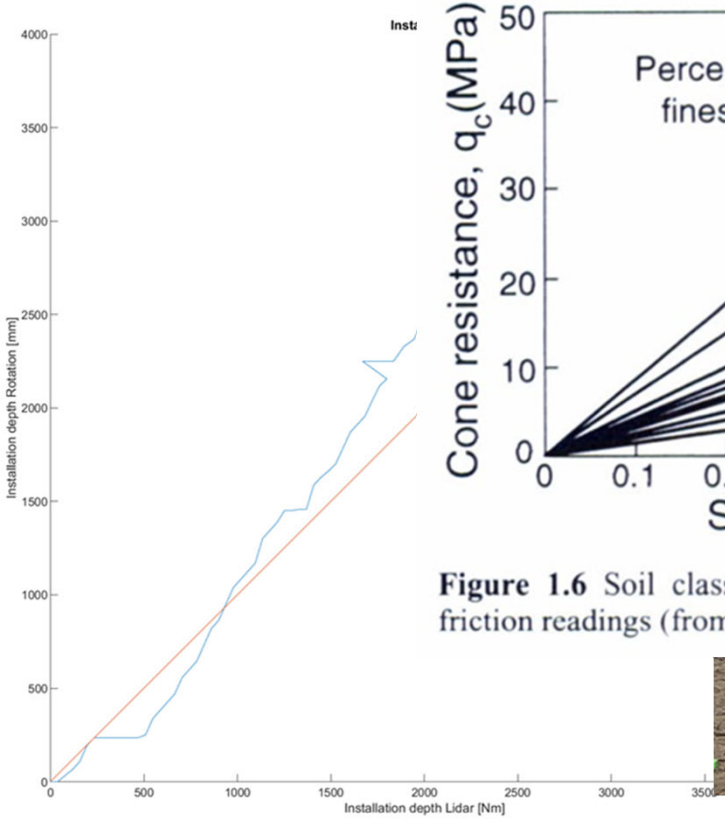
- Rammejournal for hver pæl
- Rammeformlen
- PDA
- Statiske belastningsforsøg

Skruepæle

- Torsionsjournalen for hver pæl
- Slagtest
- PDA
- Statiske belastningsforsøg

Dokumentation af skruepæleprojekt





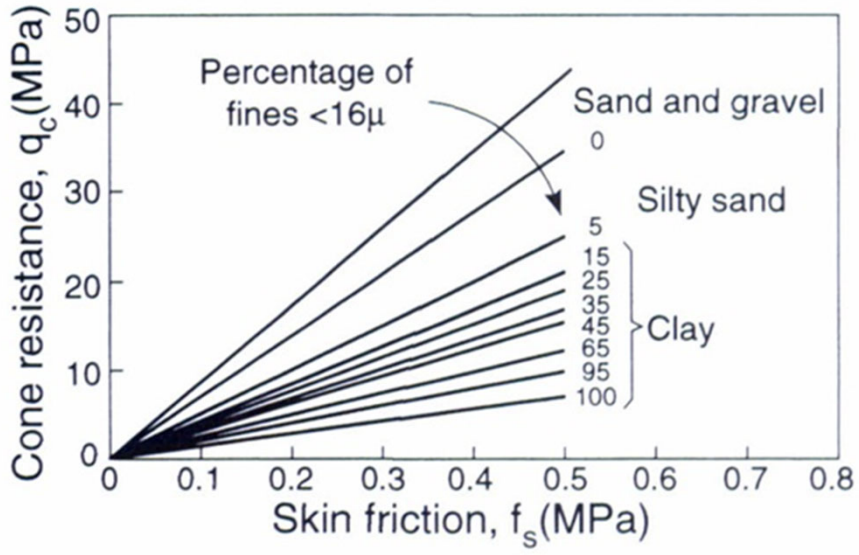
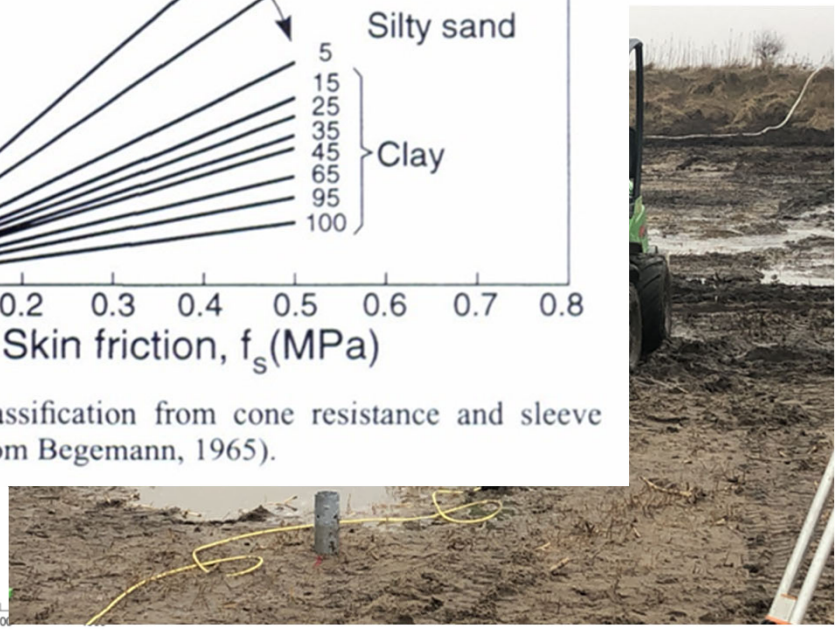


Figure 1.6 Soil classification from cone resistance and sleeve friction readings (from Begemann, 1965).



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Ny design strategi for Skruepæle

PILAR
DESIGNING THE FUTURE

Disruption

Testpæl

Intelligent installation

Intelligent installation

PILAR Cloud

DATA Algoritme AI

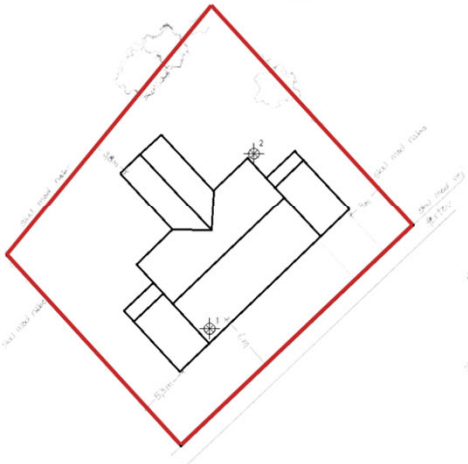
Pilar Ground Screw model

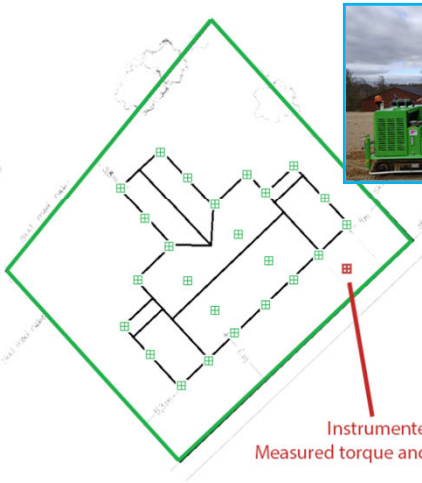
Kunstig intelligens

Algoritme Torsion → Pælens Bæreevne

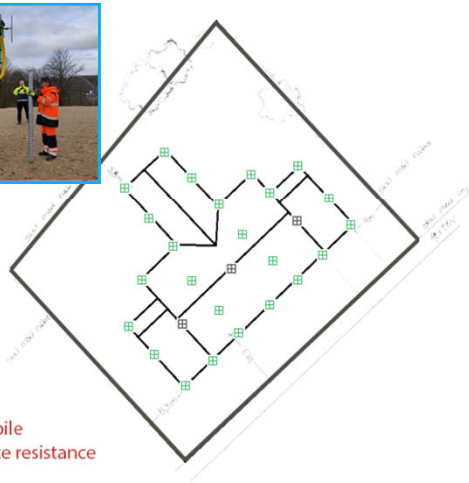
Rapport

Soil Investigation → Ground Screw Model → Initial Pile Plan → Installation torque recorded at each pile → Updated Pile Plan (If needed) → Document that recorded each piles bearing capacity





Instrumented Testpile
Measured torque and surface resistance



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PILAR
DESIGNING THE FUTURE

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PILAR Cloud

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Pilar Ground Screw model

Kunstig intelligens

Algoritme Torsion → Pælens Bæreevne

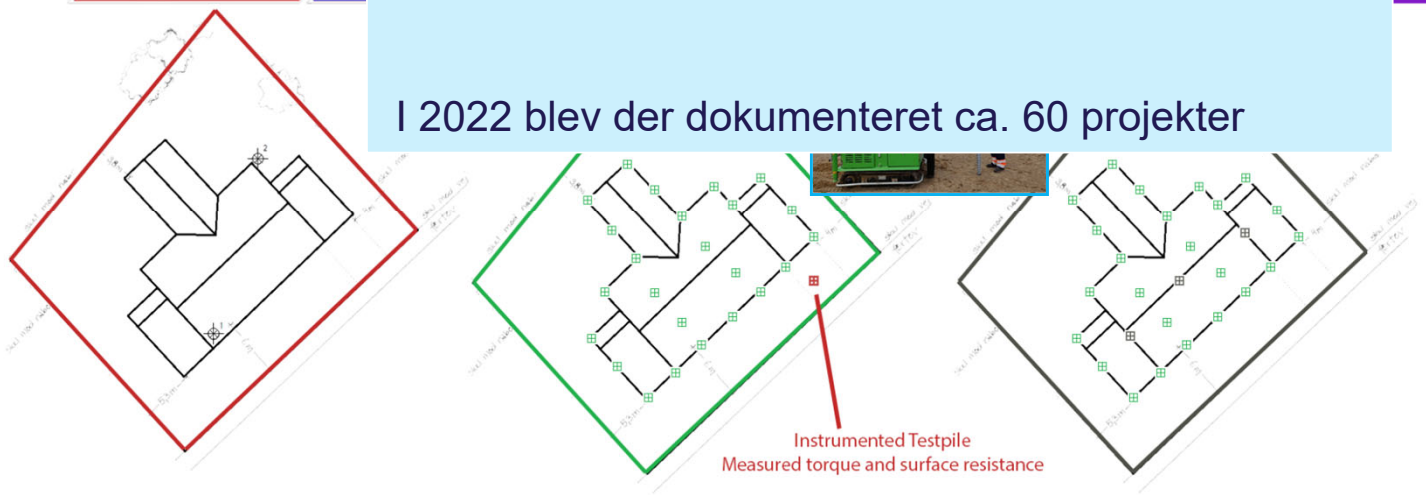
Rapport

Pilar Cloud udbydes til alle interesserede ingeniører firmaer og skruepæle installatører når testperiode er gennemført.

I 2022 blev der dokumenteret ca. 60 projekter

Soil Investigation

cument that recorded
n piles bearing capacity



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DENMARK

Manglende dokumentation af skruepæleprojekt er både besværligt og dyrt.

TAK FOR JERES OPMÆRKSOMHED