ENGINEERING CONSIDERATIONS FOUNDATION REUSE

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Overview

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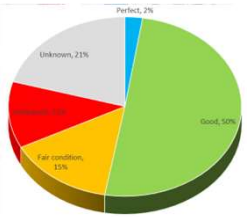
Introduction



- Allnamics > 1000 Projects involved
  - Perfect condition: 2%
  - Good condition and suitable for reuse: 50%
  - Fair condition, requiring monitoring for current use or upgrading for extended use: 15 %
  - Inadequate condition, requiring immediate corrective action and not suitable for reuse: 12 %
  - Unknown condition, requiring additional investigations to determine whether they should be ranked as fair or inadequate: 21%

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Development of Foundation Assessment

- 1970s and 1980s
  - Foundation Testing
  - Soil Investigations (CPT)
  - Visual Inspections
- 1990s and the 2000s
  - Archival Studies
  - Visual Inspections
  - Findings of the assessments in previous decades
- Previous decade
  - Archival Studies
  - Visual Inspections
  - Settlements
  - Bearing Capacity (current foundation load or derived from cone penetration data)
  - Uncertain? -> Load tests.

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Development of Foundation Assessment

- Recent
  - Formalized and Standardized
  - 2018 : Standard for the assessment of an existing structure in case of reconstruction and disapproval – Geotechnical structures" (NEN8707:2018)
  - 2020 : Update
  - 2022 : Guidelines for Building Foundations investigation and assessment of timber pile foundations and shallow foundations.

Classificatie	Omschrijving
Voldoende	Binnen 25 jaar zijn geen of geringe onderlinge zakkingsverschillen te verwachten, beperkte verhoging belasting mogelijk (wel rekentechnisch onderbouwen).
Redelijk	Binnen 25 jaar is door zakking, rotatie en/of andere factoren cascoschade aan het pand te verwachten; vervolgonderzoek zoals monitoring is wenselijk.
Matig	Binnen 15 jaar is door zakking, rotatie en/of andere factoren cascoschade aan het pand te verwachten, vervolgonderzoek zoals monitoring is wenselijk.
Onvoldoende	Binnen 5 jaar door grote zakking, grote rotatie en/of andere factoren cascoschade, funderingsherstel noodzakelijk.
Slecht	Door grote zakking, grote rotatie en/of andere factoren schade aan en/of instabiliteit van het casco; funderingsherstel noodzakelijk zo nodig direct stabiliserende maatregelen treffen aan het casco.

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Foundation assessment

- Archive
- Level floor (Vloerwaterpassing)
- Level masionary (Lintvoeg meting)
- Visual Inspection
- Ground water table
- Settlement (Meetboutjes)
- CPT's (Archive)
- Internal & External Database (Old proj
- Historical maps

- Foundation Inspection:
  - Measurements dimensions
  - Wood Sampling
  - Wood penetration (Specht)
  - Pictures
- Calculation Bearing Capacity
- Load Calculations (Gewichtsberekening)
- Load Testing (Proefbelasting)
- Cone Penetration Testing
- Other investigations: (Mandelige muren?)

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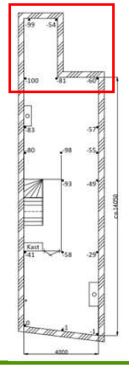
Lesson 1 : What you see = what you have?

- Foundation assessment of a townhouse in 2002
  - Visual Inspection, ok
  - Archival Study, ok
  - Superstructure, still standing
  - Differential settlement, little
  - Differential settlement of 100 mm (4 inch) between the front and back façade (Backwards !)
  - Back of the townhouse foundation was made accessible for a visual inspection
  - Revealed wood rot in the top of the timber piles



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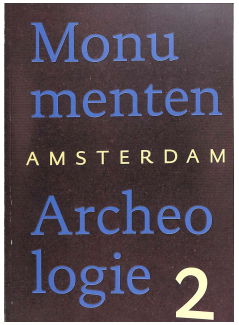
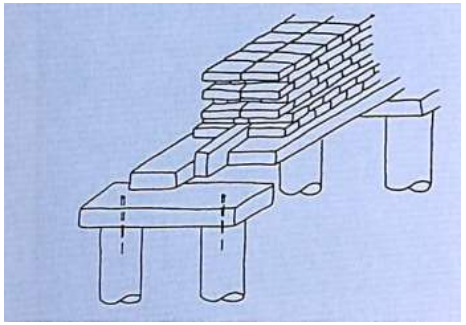
Amsterdam Wooden Pile Foundation





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Lesson 1 : What you see = what you have?

Figure 1. Case Lesson 1: the foundation piles are not aligned anymore with the rest of the structure

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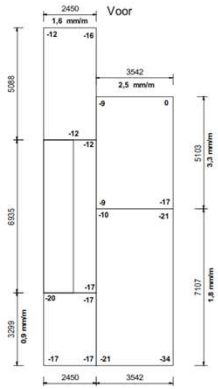
Lesson 2 : Excavation?

- Amsterdam
- No signs of foundation problems
- Superstructure, ok
- Settlements, ok

- Excavation top foundation for inspection
  - Piles no longer underneath pilecap
  - Load redistributed
  - Piles had excess capacity
  - Pile cap well below grade level (about 2 m) (Minimize diff. settlements.)



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Lesson 2 : Excavation?

Figure 2. Case Lesson 2: Some of the piles were no longer underneath the pile cap,, but the foundation still capable of supporting the superstructure

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Lesson 3 : Old, older, oldest foundation

- Building constructed in 1928
- On an existing foundation from presumably the 17th century
- New building was constructed with concrete pile caps and a concrete floor

- Recent foundation assessment
  - good shape and that there was negligible settlement
  - no relevant information on the foundation
  - So inspection was ordered
  - After partial excavation relatively slender timber piles were exposed that had been deteriorated, and some of the foundation piles did not even support any walls

- Foundation was restored by installing helical piles

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Lesson 4 : Negative skin friction

- Landfill & Embankments
- Also known as downdrag
- Recognized around 1950 (Terzaghi, Zeevaert)
- Foundation capacities based on archival reviews must be adjusted for the effects of negative skin friction, if applicable
- Subsequent soil fills may have increased the negative skin friction and in turn reduced the effective load bearing capacity

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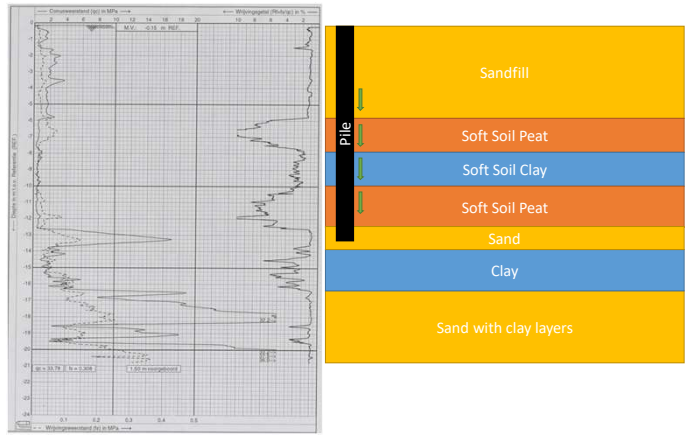

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Lesson 4 : Indische Buurt Amsterdam

- Building did not display any differential settlements
- Visual Inspection, ok
- Archival study : design calculations 80 kN, Capacity assumed 100 kN

- Soil investigation : soil fill of some 6 m of sand
- (Remaining) Bearing capacity of the piles was therefore only 60 kN

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Lesson 4 : Indische Buurt Amsterdam

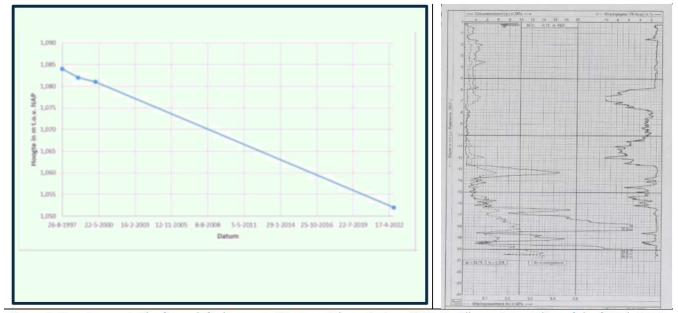

Figure 3, Case Lesson 4: The figure left shows app 30 mm settlement since 1997. A still ongoing settling of the foundation is not a problem in itself. In combination with a CPT as indicated right, one can doubt the reliability of this foundation for future use and re-use.

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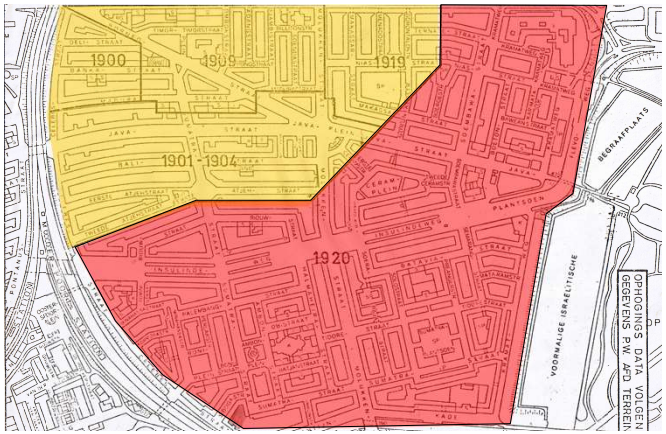

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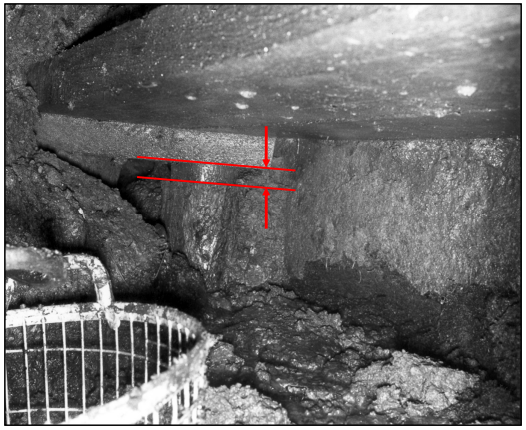

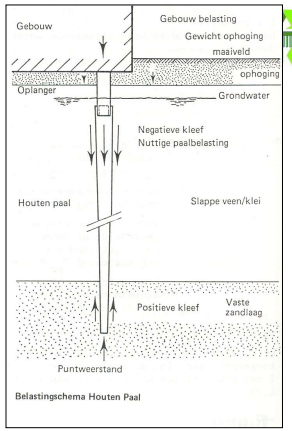

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Lesson 5 : The demonstration of capacity

- Claim : Foundation pile has demonstrated its capacity during its lifetime
- Not always true : design load, working load, service load none of them reflect the actual load on top of a pile
- Possible that a foundation has actually failed, but that due to the redistribution of the loads to the neighboring piles under a pile cap or foundation beam the foundation is still deemed to be sound.
- No basis to use that for a forward-looking determination
- City of Amsterdam requires a remaining lifetime of at least 25 years for a foundation to be reused

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Case Lesson 5 : Good condition, Failed Found.

Figure 4, Case Lesson 5; A building in good condition on a failed foundation..

Construction drawings did not contain all the usual dimensions

Foundation was partially excavated.

Showed that the foundation material had deteriorated to such an extent that the remaining effective cross-sectional area was only about 40 % of the original value

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Lesson 6 : All or nothing at all

- Guidelines = Checking the boxes?
- Uniform approach
- Weakest part of the foundation determines the outcome of the assessment

- See case 5
- 2 different experts 2 conclusions
- One argued that continued use of this foundation was not responsible and that the foundation should be repaired immediately,
- The other concluded that the foundation was obviously still functional and that no immediate repair was required

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Lesson 6 : All or nothing at all

- Suggested approach: 2 questions.
- 1 : What is the capacity of the foundation, and can the foundation resist the anticipated loads?
- 2 : What is the quality of the foundation material, and will the foundation have a remaining lifetime of at least 25 years, and preferably more than 50 years?

- If the answer to one of the two questions is negative, then existing foundation cannot be reused as is.
- First question is answered negatively, the foundation will have to be supplemented by additional foundation elements
- Negative response to the second questions requires at a minimum foundation repair
- Lack of knowledge does not justify a positive response

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Final Conclusions

- If everything is ok… Does not mean : Everything is ok
- Careful with assumptions

- Meten = Weten ☺
- Measured knowledge = Proven Knowledge

- Capacity foundation versus quality material?
- Both are important!!

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Thank you for listening!

- Questions?

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