

The first national micropile guideline in Finland

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The Ruukki logo is rendered in a bold, red, sans-serif font. The letters are thick and blocky, with a distinctive design where the 'R' and 'U' characters have a rounded, almost circular appearance at their top and bottom curves. The 'K' and 'I' characters are more standard in their blocky style. The entire logo is set against a white background.

Outline

- Short “history” of the piling codes in Finland
- Current situation with the piling codes in Finland
- 1st Finnish micropile guideline – How the drafting will be made
- Pile types to be dealt with in the guide
- Content of the guideline
- Summary

Short “history” of the piling codes in Finland 1/2

- Finland and Sweden have traditionally been driven precast concrete pile (square 235...350 mm²) countries:
 - Favourable “easy” end-bearing soil conditions
 - High technology on equipment and pile manufacturing
 - > 1st piling codes in 1970’s dealt mainly with concrete piles, which again increased their popularity
- The Finnish Guideline for Driven Piles of 1987 (LPO-87) included certain issues for driven small diameter steel piles
- At the end 1980s Rautaruukki launched a long-term project to develop steel piling with it’s partners.

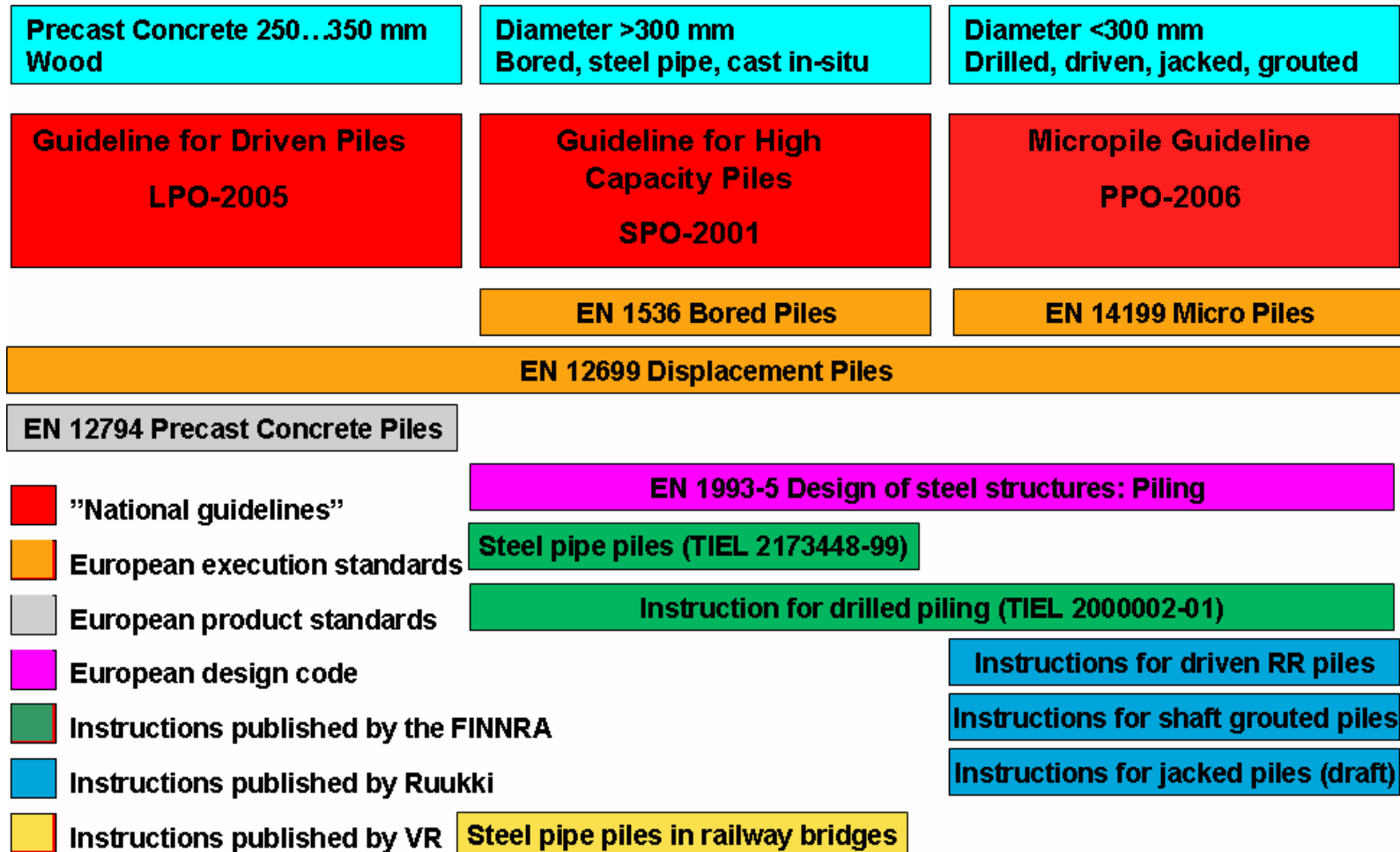
Short “history” of the piling codes in Finland 2/2

- As a result of this activity the Finnish Road Administration and the Association of Finnish Civil Engineers published their own codes for mainly large diameter piles in 1990s.
 - Design and execution small diameter steel micropiles was made according to manufacturer’s instructions and by applying concrete instruction for concrete piling
- Both before and after the change of millennium:
 - Activity on underpinning projects increased rapidly in Finland, which lead to further development of drilled, jacked and grouted piles
 - European execution standards for piles were started to prepare
 - The updated national guideline for driven piles (LPO-2005) excluded small diameter steel piles

Situation with micropiles in June 2005

- No nationally “approved or recognized” guideline for micropiles whether they are installed by:
 - impact driving
 - drilling
 - jacking
 - vibrating
- Urgent actions were needed to maintain the status of micropiles!

Finnish piling codes



- "National guidelines"
- European execution standards
- European product standards
- European design code
- Instructions published by the FINNRA
- Instructions published by Ruukki
- Instructions published by VR

1st Finnish micropile guideline – How the drafting will be made 1/2

Authors	Support group for authors	Piling Committee at FGS – Steering group	Financiers
<ul style="list-style-type: none"> •H. Jokiniemi •S. Eronen •P. Korkeakoski <p>Ruukki</p> <p>Contract was made between Finnish Constructional Steelwork Association and Financiers</p>	<ul style="list-style-type: none"> •J. Lehtonen/Turku Polytech. •M. Hakulinen/EKA Polytech. •J. Törnqvist/VTT •J. Kouhi/VTT •R. Viherma/Outokumpu •H. Wilén/PPTH (Ruukki) •U. Kalamies/FCSA •T. Harju/Ruukki <p>= Committee for infrastructure construction in Finnish Constructional Steelwork Association</p>	<ul style="list-style-type: none"> •Pentti Salo/Finnra •U. Kalamies/FCSA •O. Hakanen/Skanska Tekra •R. Heikinheimo/Ramboll •J. Heinonen/YIT •V. Holopainen/TUT •H. Jokiniemi/Ruukki •H-P. Laukkanen /R.kontkanen •J. Lehtonen/Finnish Steel Piling Ltd •A. Nylund/YM •A. Perälä/Narmaplan •P. Salmenhaara/DeNeef <p>= members: authorities, contractors, consultants, academics, suppliers</p>	<ul style="list-style-type: none"> •RIL/P. Hautala •YM/A. Nylund •FGS/I. Vähäaho <ul style="list-style-type: none"> •Association of Finnish Civil Engineers •Finnish Geotechnical Society •Finnish Ministry of the Environment <ul style="list-style-type: none"> •Ruukki by work

1st Finnish micropile guideline – How the drafting will be made 2/2

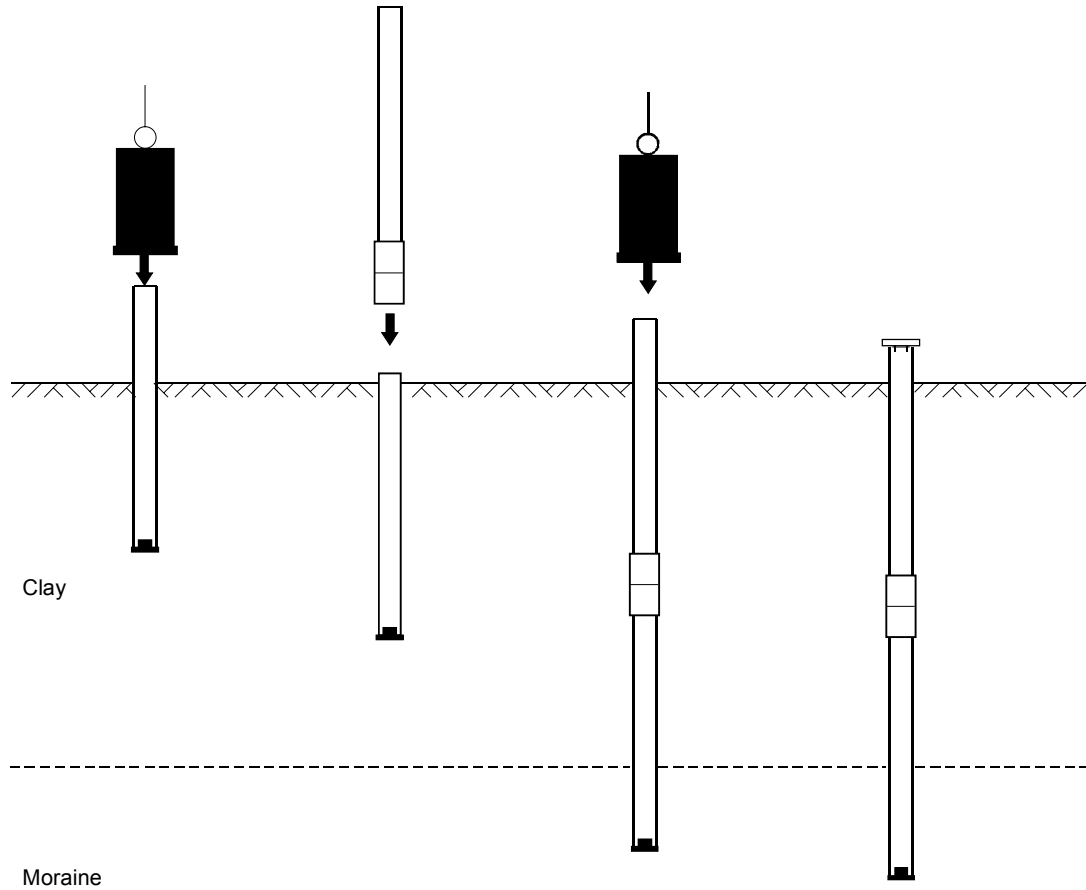
- Tight schedule
- 6 full-day meetings with FGS piling committee
- Content of the guideline about 150 “compact” A4 pages

	2005												2006											
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12			
1. Micropile types dealt with in guide					■	■																		
2. Status of guide					■	■																		
3. Terms and definitions					■	■																		
4. Site investigations					■	■	■	■																
5. Pile materials and products						■	■	■	■															
6. Design						■	■	■	■	■														
7. Execution of piling work						■	■	■	■	■	■													
8. Supervision and monitoring											■	■												
9. Documentation of piling work												■	■											
10. Job safety and environmental protection													■	■										
Circulation for comments															■	■	■							
Handling of comments																	■	■	■	■				
Publication of the guideline																					■			

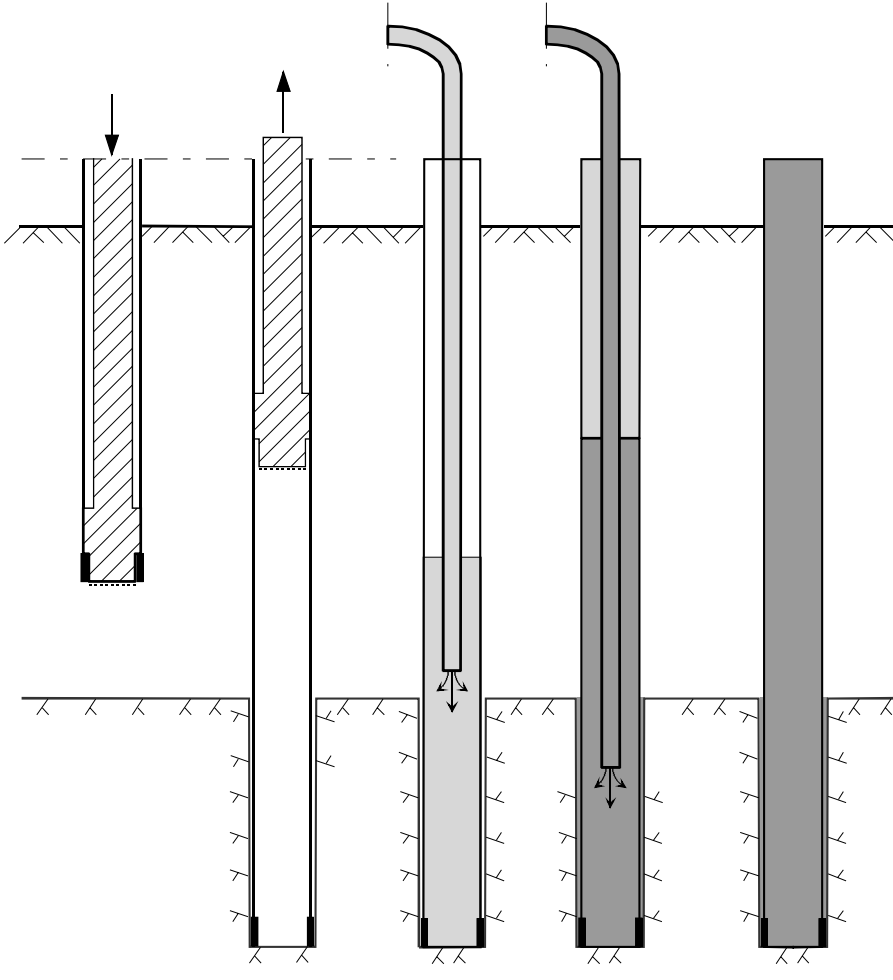
Micropile in Finland - Scope

- A pile, where steel pipe or bar is main bearing element:
 - $D < 300$ mm
 - $D > 30$ mm and 60 mm for drilled and driven piles, respectively
- Can be installed by:
 - impact driving
 - vibrating
 - drilling
 - jacking
- Geotechnical resistance can be improved by grouting during and/or after installation.

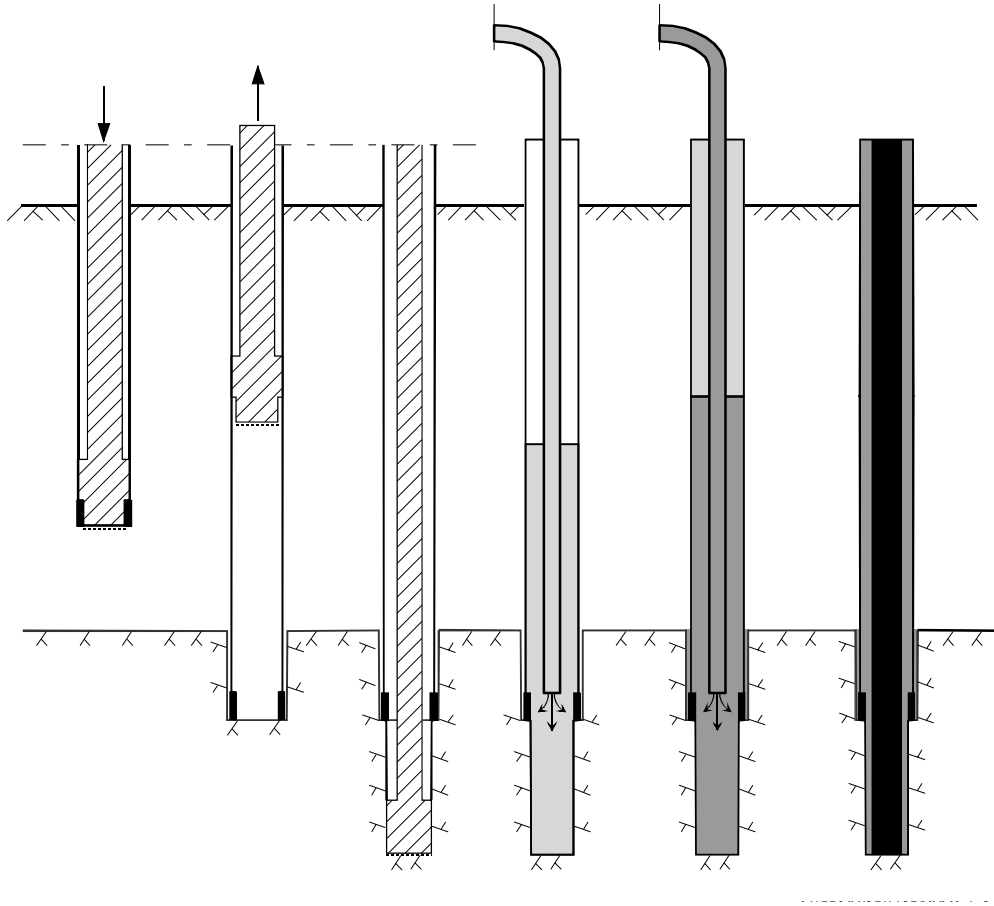
Impact driven micropile



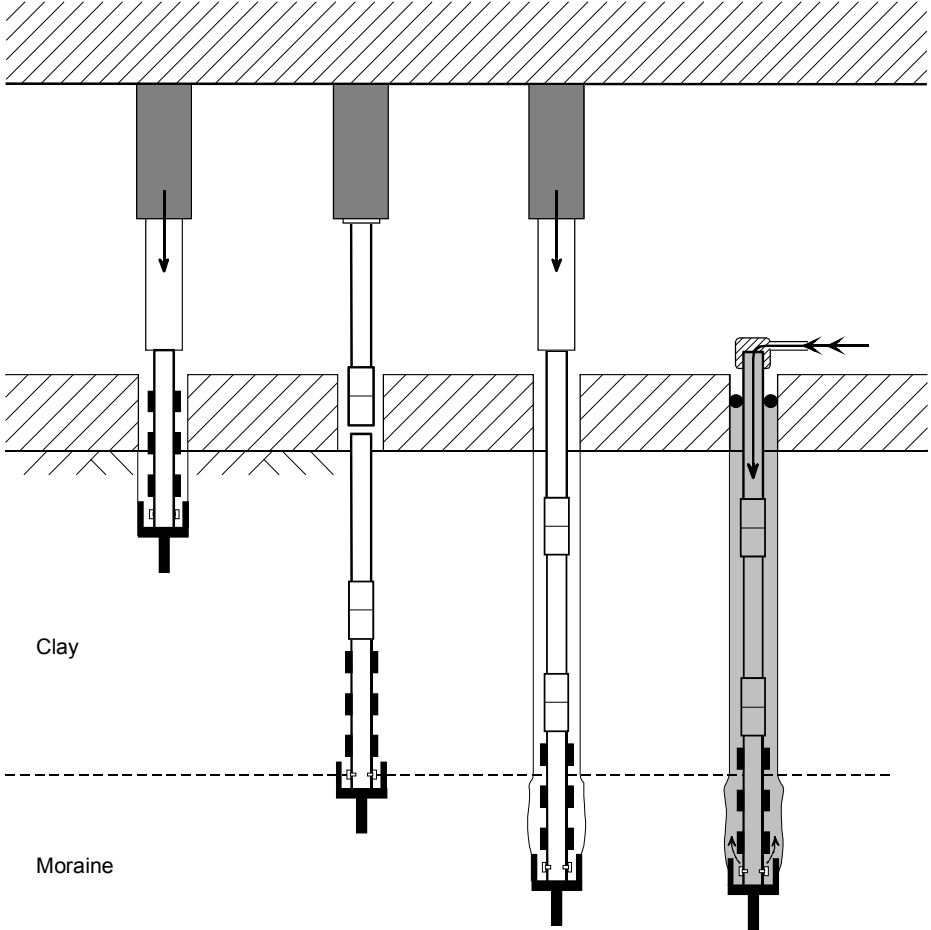
Drilled steel pipe pile



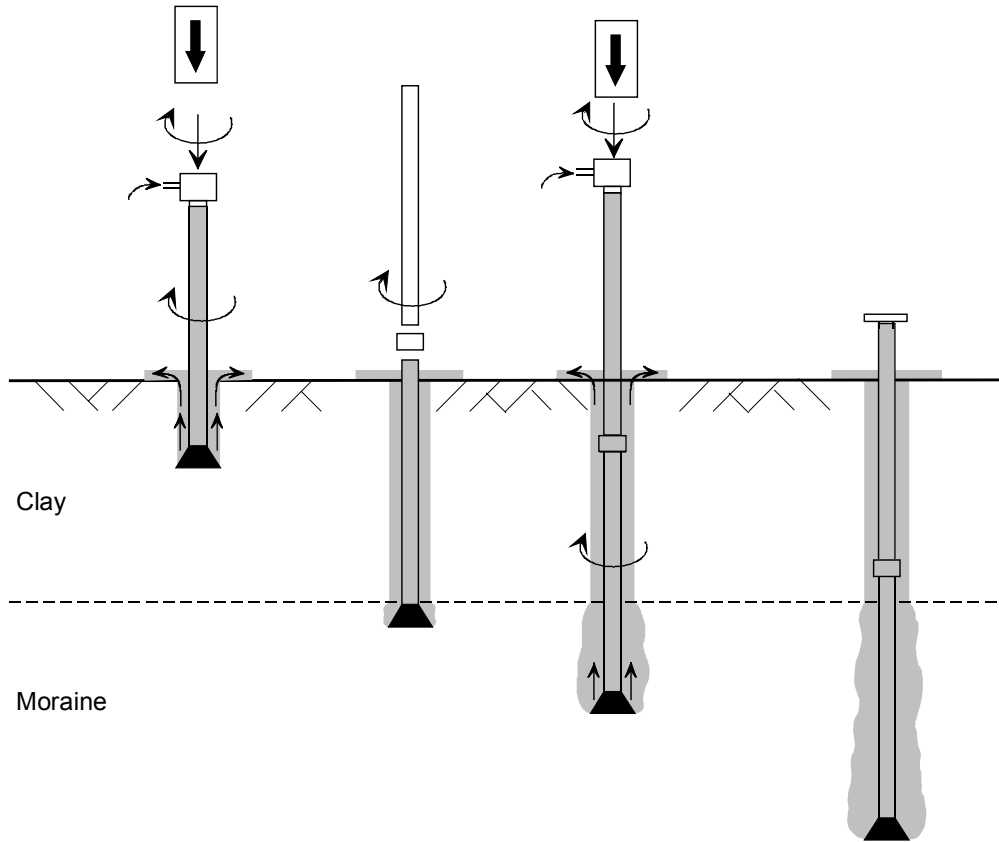
Drilled steel core pile



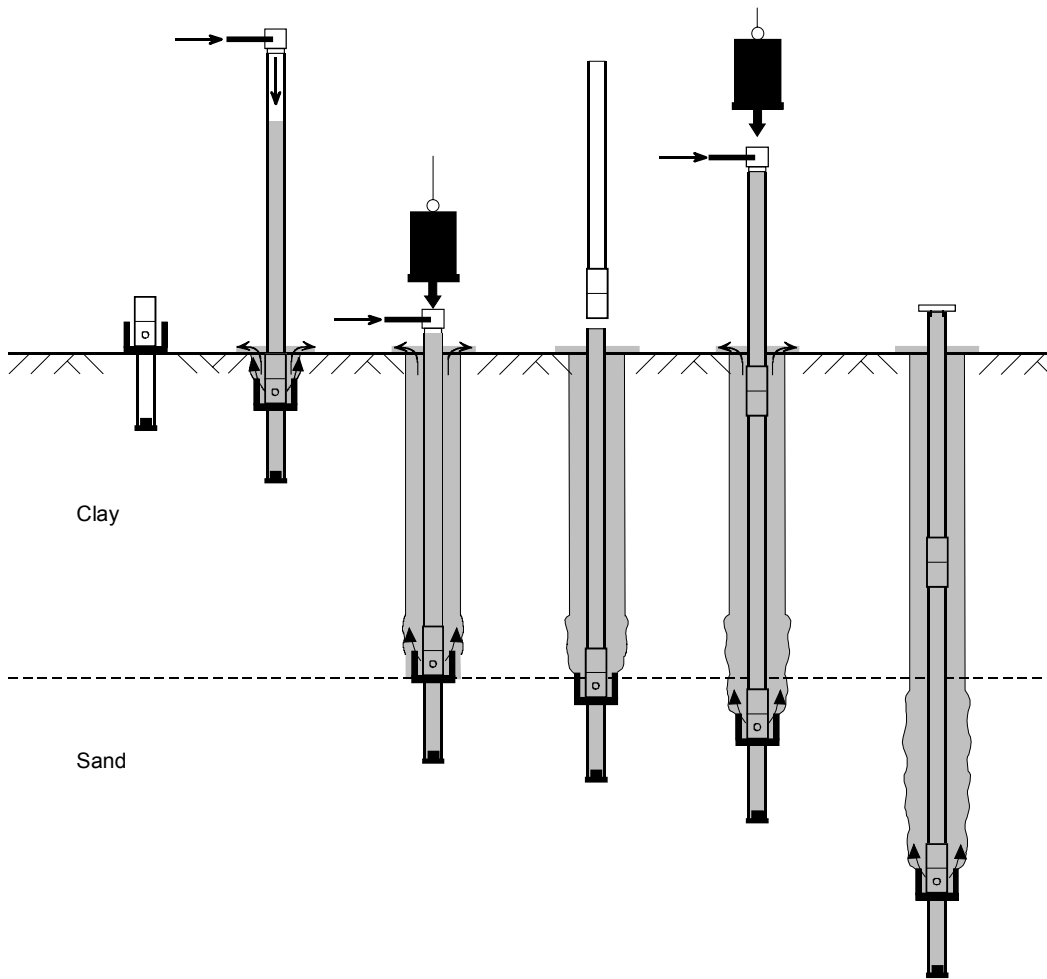
Post-grouted jacked micropile



Drilled and grouted micropile



Driven and grouted micropile



Content of the guideline

1. Micropile types dealt with in guide
2. Status of guide
3. Terms and definitions
4. Site investigations
5. Pile materials and products
6. Design
7. Execution of piling work
8. Supervision and monitoring
9. Documentation of piling work
10. Job safety and environmental protection
11. Dimensioning examples

1. Micropile types dealt with in guide

- Defines scope
- Presents micropile types dealt with
- divides piling sites according to degree of demandingness into easy (B), demanding (A) and highly demanding (AA) for later requirements

2. Status of guide

- Sets forth permitted design systems
- Lists:
 - national and European regulations and standards
 - national instructions

that should be followed in the design, manufacturing and execution of the micropiles

3. Terms and definitions

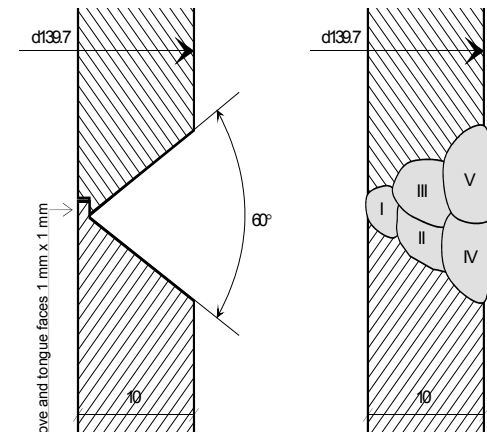
- Defines:
 - key general terms used in piling
 - special terms related to different micropile types

4. Site investigations

- Conforms national guidelines and EN 1997
- Gives recommended practices for sites of different degree of demandingness
- Gives complementary guidelines for:
 - underpinning projects
 - aggressive soil conditions

5. Pile materials and products

- Sets out the general quality requirements for:
 - structural steel, rebars, concrete, mortar, grout
- Presents requirements for:
 - mechanical splices (strength and stiffness) and welded splices
 - accessories such as pile tips, drill bits, bearing plates etc.



6. Design 1/2

- National design system:
 - geotechnical design total safety factor method
 - structural design partial safety factor method
- European design system:
 - both geotechnical and structural partial safety factor methods
- Safety factors (and safety levels) are of different magnitude
- Gives recommendations to the applicability of the micropile types to different soil conditions
- Geotechnical design:
 - compressive and tensile resistances, resistance to transverse loads, displacements, pile groups.

6. Design 2/2

- Structural design:
 - corrosion allowances in different conditions
 - buckling resistance (both steel and composite structure)
 - bond strength between mortar and steel
 - installation resistance of driven piles
 - geometrical construction tolerances
- Environmental impacts:
 - displacement, disturbance, excess pore pressure, compaction or loosening, vibration and noise

7. Execution of piling work

- Lists information needed by the contractor
- Sets qualification for the piling supervisor
- Describes piling equipments and their requirements
- Gives recommended procedures for installation of different micropile types
- Splicing
- Cutting, cleaning and reinforcing & concreting

8. Supervision and monitoring

- Supervision of materials
- Measurements
 - location and level
 - straightness
 - static and dynamic load tests

9. Documentation of piling work

- Gives recommendation of piling work documentation
- Shows model piling records for different micropile types

10. Job safety and environmental protection

- Treats:
 - job safety
 - environmental protection:
 - vibration
 - noise
 - possible discharges

11. Dimensioning examples

- Compressive resistance of the ground against pile:
 - based on sounding resistance
 - effect of number of load tests on design values
 - both national and European safety factors
- Buckling resistance

Summary

- The use of different type of micropiles has been increased strongly in Finland during the last 10 years
 - relatively strongest increase has been with drilled pile types
- A nationally recognized micropile guideline was urgently needed in Finland -> the drafting has been started and work will be carried out in quick schedule
 - Despite of implementation of European codes and standards a national guideline was considered necessary
- The guideline will conform European standards and it will utilize knowledge given in different reports of Swedish Commission on Pile Research & IWM process and U.S. publications.

Thank you for your attention!

NUUKIKI

more with metals