IWM 2000, TURKU, FINLAND

6.6.2000

CEN TC288 / WG8: MICROPILES

Chapter 9: Supervision, monitoring and testing

Chapter 10: Records

Sami Eronen

9 SUPERVISION, MONITORING AND TESTING

9.1 General

- Monitoring records and "as-built" information shall be submitted to the client's representative and/or to the designer

- Pile tests may consist of
  - Static load tests
  - Dynamic load tests
  - Integrity tests
  - Control tests

- Pile tests can be performed on preliminary and/or working piles

- Load tests on micropiles can be used for
  - Assessment of design parameters
  - Verification of pile design
  - Proof of resistance and deformation characteristics
  - Compliance with the specifications
  - Proof of the soundness and proper construction of the pile

9.2 Static load tests

- Static load tests can be:
  - Maintained load tests
  - Constant rate of penetration tests

- When static load tests are performed on preliminary micropiles at least two piles should be tested (take into account the ground conditions)

- It **shall be specified** in the documents **if static load tests have to be performed** on working micropiles

- Unless otherwise specified, for micropiles working in compression, at least one static load test should be performed for the first 100 micropiles and one for each next 100 micropiles

- Unless otherwise specified, for micropiles working in tension, at least one static load test should be performed for the first 25 micropiles and one for each next 25 micropiles

9.3 Dynamic load tests and integrity tests

- Dynamic tests can not be generalized for all kind of micropiles (for instance piles grouted into the rock)

- The most economical way of testing with driven end-bearing piles (for instance in Northern countries)

- For dynamic load tests the micropile shall be allowed to gain sufficient strength after installation

- Dynamic and integrity tests shall be carried out using **equipment built and approved for the purpose** and are required to be interpreted by **persons competent** in this area who shall also have a knowledge of the techniques of piling and experience of the specified ground conditions

10. Records

10.1 (RQ) The site records shall consist of two parts: the first making reference to the site and the general information, including:
- the pile (type, dimensions,...)
- the construction method
- the reinforcement and grout, mortar or concrete specification.

The second part shall contain particular information related to the construction procedure.

10.2 (RQ) The general information part shall be similar for the different types and methods and shall at least contain the details listed in table 10.1 and table 10.2.

Table 10.1: General information concerning the site

	Subject	necessity
1	site location	x
2	contract identification	x
3	structure	x
4	working drawing n°	x
5	reference level	x
6	main contractor	(x)
7	foundation (piling) contractor	x
8	client/employer	(x)
9	engineer/designer	(x)

x necessary information
(x) information as applicable

Table 10.2: General information concerning the procedure

	Subject	necessity
1	ground level at pile position	x
2	working platform level	(x)
3	pile diameter/length	x
4	pile base diameter/ volume	(x)
5	installation method	x
6	installation equipment	x
7	drilling fluid	(x)
8	casing	(x)
9	reinforcement details	x
10	grout, mortar or concrete specifications	x
11	grout, mortar or concrete placement details	x
12	groundwater level	x
13	groundwater/ soil pollution	(x)

x necessary information
(x) information as applicable

10.3 (RQ) The particular information part shall be specific to the type of pile and the installation method and shall contain at least the details listed in table 10.3

Table 10.3: Schedule of as-built information to be provided as applicable

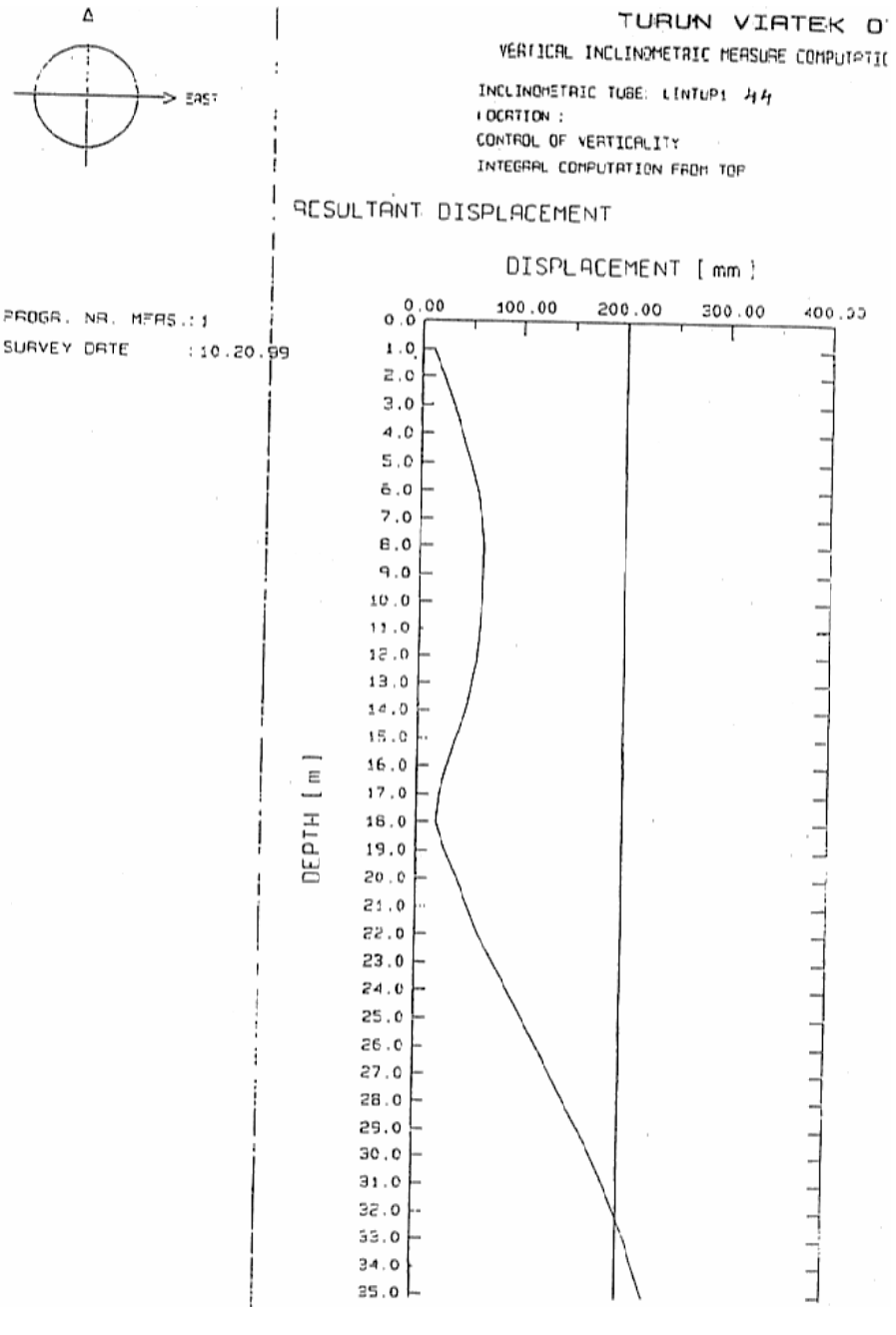
1 pile reference number
2 date
3 installation times
4 interruptions of installation
5 removal of obstructions
6 temporary/permanent casing
7 depth of casing
8 lead in tube
9 tremie pipe
10 depth of lead in tube
11 depth of pile
12 drilling log
13 pile driving record
14 ground water level
15 reinforcement length
16 number and location of joints or welds
17 data on borehole testing and pregrouting
18 grout, mortar or concrete placement duration
19 " " interruptions
20 " " volume
21 " " pressure
22 " " site tests
23 volume of pile base
24 grout, mortar or concrete composition
25 recovery of casing
26 recovery of lead in tube
27 post grouting: details of grouting pipe
28 grout properties
29 grouting procedure
30 construction deviations: position
31 " " rake
32 " " curvature

Annex F-1: (Informative) Guideline for the preparation of record for drilled micropile.

Contract : **Site :** **Location :** **Date:**		Micropile type Drilling equipment Drawing n° Micropile number
Micropile data:		
	Position x,y at foundation level, at entry position	
	Direction	
	Inclination	
	Drill method	
	Hole diameter	
	Overall drilled length	
	Cased from/to	
	Flushing medium	
	Groundwater level	
	Drill data	
	Drilling time	
	Observed ground data	
	Testing	
	Pregrouting	
Reinforcement		
	Drawing n°	
	Longitudinal bars Ø mm	
	Transverse bars Ø mm	
	Protection	
	Spacers	
Grouting/concreting		
	Composition	
	Class	
	Consistency	
	Cement quality	
	Cement quantity	
	Aggregate max.size	
	W/C ratio	
	Admixture	
	Workability time	
	Method	
	Consumption	
	Pressure	
	Pile base volume	

Annex F-2: (= Informative) Guideline for the preparation of record for driven micropile.

Contract : **Site :** **Location :** **Date:**		Micropile type : Driving equipement : Drawing n° Micropile number :
Micropile data:		
	Position x,y at foundation level,	
	at entry position	
Direction		
	Inclination	
	Shaft	
	steel	
	concrete	
	composite	
	Diameter	
	Pile toe	
	type	
	diameter	
	Joints	
	number	
	type	
	Driving method	
	Driving record	
Reinforcement		
	Drawing n°	
	Longitudinal bars	
	Transverse bars	
	Type of spacers	
Concrete		
	Class	
	Consistency	
	Prefabricated	
	Concrete mixed in-situ	
	- cement quality	
	- cement quantity	
	- aggregate max. size	
	W/C ratio	
	Admixtures	
	Workability time	
	Conditions	
	Method	
	Pile base volume	



Annex D (informative) Guidance on corrosion rates.

D.1 General

(1) This annex gives guidance on the loss of thickness of steel bearing piles and steel sheet piling due to corrosion.

D.2 Bearing piles

(1) Unless otherwise specified, for both serviceability and ultimate limit states the loss of thickness (in mm) die to corrosion of piles on the side in contact with soil, with or without groundwater, should be taken from table D.1 and for piles in water should be taken from table D.2, depending on the required design working life of the construction.

(2) The loss of thickness due to atmospheric corrosion may be taken as [0.01] mm per year in normal atmospheres and as [0.02] mm per year in locations close to the sea.

F.3 Sheet piling

(1) Unless otherwise specified, the loss of thickness for parts of sheet pile walls in contact with soil, with or without groundwater, should be taken from table D.1, depending on the required design working life of the construction. Where sheet piles are in contact with soil on both sides, the corrosion rates apply to each side.

(2) Unless otherwise specified, for both serviceability and ultimate limit states the loss of thickness for unprotected parts of sheet pile walls in contact with river or sea water should be taken from table D.2, depending on the required design working life of the construction.

(3) The loss of thickness due to atmospheric corrosion may be taken as [0.01] mm per year in normal atmospheres and as [0.02] mm per year in locations close to the sea.

NOTE: The following effects have a major influence on the corrosion rates given in tables D.1 and D.2:

- whether the structure is above or below the groundwater table
- the variation of the level of the groundwater table
- the presence of oxygen.

Table D.1: Loss of thickness [mm] due to corrosion for piles and sheet piles in Soils, with or without groundwater .

Required design working life	5 years	25 years	50 years	75 years	100 years
Undisturbed natural soils (sand, silt, clay, schist, ...)	0,00	0,30	0,60	0,90	1,20
Polluted natural soils and industrial grounds	0,15	0,75	1,50	2,25	3,00
Aggressive natural soils (swamp, marsh, peat, ...)	0,20	1,00	1,75	2,50	3,25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0,18	0,70	1,20	1,70	2,20
Non-compacted and aggressive fills (ashes, slag, ...)	0,18	0,70	1,20	1,70	2,20

Notes:

1. Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills the figures in the table should be divided by two.
2. The values given are only for guidance. Local conditions should be considered because they might affect the actual corrosion rate, which can be lower or higher than the average value given in the table.
3. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Table D.2: Loss of thickness [mm] due to corrosion for piles and sheet piles in fresh water or in sea water.

Required design working life	5 years	25 years	50 years	75 years	100 years
Common fresh water (river, ship canal, ...) in the zone of high attack (water line)	0,15	0,55	0,90	1,15	1,40
Very polluted fresh water (sewage, industrial effluent, ...) in the zone of high attack (water line)	0,30	1,30	2,30	3,30	4,30
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0,55	1,90	3,75	5,60	7,50
Sea water in temperate climate in the zone of permanent immersion or in the interidal zone	0,25	0,90	1,75	2,60	3,50

Notes:

1. The highest corrosion rate is usually found at the splash zone or at the low water level in tidal waters. However, in most cases, the highest stresses are in the permanent immersion zone.
2. The values given are only for guidance. Local conditions should be considered because they might affect the actual corrosion rate, which can be lower or higher than the average value given in the table.
3. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

Taking all known variations and risks in consideration it should have led to deep and safe cut off level of wooden piles in Turku. According todays knowledge these should be:

1,0 m	Seasonal and annual variations of ground water level
0,6 m	Safety margin for short term ground water observations
0,4 m	Oxygen free depth from ground water level
0,5 m	Rise of earth crust because of clacier in 100 years
2,5 m	**Totally**
1,0 m	Average ground water level lowering in Turku in 25 years because of poor control
3,5 m	**All together**

Altogether this is considerably more than accepted 0,2m. Noticing only some of above mentioned things in design would have saved many houses against the risks of decaying wooden piles. So bad design and poor control have caused danger of decaying wooden piles for 400 houses in central area of Turku. This means serious economical losses for many thousands of inhabitants of Turku, who have unlucky bought their flats on decaying wooden piles. Cost of that can be even 500 Euros pro squaremeter of flat in most difficult cases.

References:

/1/ Finnish Association of Civil Engineers. Code of Practice for Foundation Engineering. RIL 121-1988. Helsinki. 1988.

/2/ Lille, W.O. Perustusrakennuksista Teollisuuskouluja varten. Turun teollisuuskoulu. 1901.