



**IB BRANDNER**

DIPL.-ING. ANDREAS BRANDNER

# Durability of Micropiles

Austrian Standardization Committee

# Overview

General project description

Standards

Scope of application

Definitions

Design + execution

Control and monitoring

# Standards

- EN 1997 and B1997-1-1 Geotechnical design – general rules
- B 1997-1-3 Geotechnical design – pile foundation
- EN 445 + 446 + 447 Grout for prestressing tendons
- EN 1990-1 Basis of structural design
- EN 14199 – Execution of special geotechnical works – Micropiles
- EN ISO 1461 – Hot dip galvanized coatings on fabricated iron and steel articles – Specification and test methods
- RVS 13.03.21 – Quality Control structural maintenance – Monitoring, control and testing – anchored retaining structures

# Definitions

- Anchorage system supplier
- Special construction management
- Special construction supervision
- Standard corrosion protection
- Double corrosion protection
- Durability
- Semi permanent anchorage
- Permanent anchorage

# Design, Execution, control and monitoring

- Design
  - Exact definition of anchoring element – anchor, nail, micropile
  - Partial safety factors, design model, resistance, checking load...
  - Environmental conditions
  - Measuring system and number of devices, checks depending on damage effects classification
- General requirements of micropiles + special requirements of corrosion protection
  - Usage of complete anchorage system
  - Assessment of soil concerning corrosivity
  - Corrosion protection depending on damage effect classification

# Relation of planned period of usage and damage effect classification

Damage effect classification	Planned usage period in years			
	$\leq 2$	$\leq 20$	$\leq 50$	$\leq 100$
CC1	*	*	*	DCP
CC2	*	*	DCP	DCP
CC3	*	DCP	DCP	DCP

- Corrosion protection depending on soil properties either
  - Encapsulation with cement rout, concrete, mortar regrading crack width limitation
  - Sacrificial corrosion
  - Galvanizing of non drilled components
  - In addition tendons on non corroding material (GFK)

# Micropiles with alternating tensile-compression loading with planned usage period >20 years

- Encapsulation with, cement grout, mortar, concrete
- Sacrificial corrosion
- Galvanizing or coating
- Combination of above mentioned measures

# Redundancy of construction – additional piles

Number of necessary piles	Demanded min. additional pile (tensile)		
	CC1	CC2	CC3
1	1	1	1
$\leq 4$	$\geq 1$	$\geq 1$	$\geq 2$
$>4 - \leq 10$	$\geq 1$	$\geq 2$	$\geq 3$
$>10$	$\geq 10\% *$	$\geq 20 *$	$\geq 30 *$

\* Percentage of piles correlated to necessary number of piles per structural element  
 In design the failure of tensile pile taken into account, which causes the worst load case for the element  
 Independently micropiles in an highly corrosive environment ust have DCP when used  $>7$  years

Hollow bar systems:

- Galvanizing is not a corrosion protection
- Encapsulation has to be executed under usage of spacers
- spacers must withstand drilling forces



# Head construction of micropiles

- With alternating tensile-compression piles a tight connection to the corrosion protection has to be executed
- With alternating tensile-compression piles with SPC (sacrificial CP, galvanizing, coating) the upper part of minimum 1,50 m has to be protected by galvanizing all parts of the head
- In environment which disqualifies for galvanizing another protection method has to be chosen

# Checking and control in considerable working height > 2,50 m

- Special design testing procedure
- In these cases testing without gauge stand possible while reading the displacement at the stressing jack
- Displacement of support to be monitored

# Additional quality assuring measures

- Specification of storing conditions on site by supplier
- Instruction concerning handling by the supplier for each project
- Instruction on site concerning all steps from unloading, storage, completion of corrosion protection by the system supplier

# Tasks of supervisor

- Class CC2 and CC3 a supervisor has to be installed
- Experience with system is a must
- Participation in the instruction by system supplier is demanded
- Checking of design and testing
- Check of corrosion protection measures according to design
- Documentation of all relevant steps, tests and measures on site

# Tasks of special construction manager

- Check of design and testing measures
- Experience with system is a must
- Participation in the instruction by system supplier is demanded
- Ensuring of adequate storage
- Check of all steps of installing
- Check of testing results
- Documentation of all relevant steps, tests and measures on site

# Control of existing anchored structures

- Classification of tendons designed and installed according to previous standards or retracted standards according to EN 1997-1
- Permanent monitoring, control and testing according to RVS 13.03.21
- **Micropiles must not be tested like anchors**

# Questions?

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Thank You for your attention



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