DSI – INTERNAL WORKSHOP

Micropiles using higher steel grades – spalling of the grout cover

Dipl.- Ing. Florian Stützel

Local Presence – Global Competence

GEWI®Plus

Micropiles using higher steel grades – spalling of grout cover

1. corrosion protection systems for permanent piles

2. "higher" steel grades

3. piles under compression

4. tests and calculations

5. solutions

Micropiles using higher steel grades – spalling of grout cover

1. **corrosion protection systems for permanent piles**

2. "higher" steel grades

3. piles under compression

4. tests and calculations

5. solutions

Micropiles using higher steel grades – corrosion protection

corrosion protection acc. EN 14199

Standard Corrosion Protection

- **cover of grout**

- **increase of steel cross section (sacrificial corrosion)**

- **coatings**

Double Corrosion Protection

- **EN 1537 (sheathings + inner grout)**
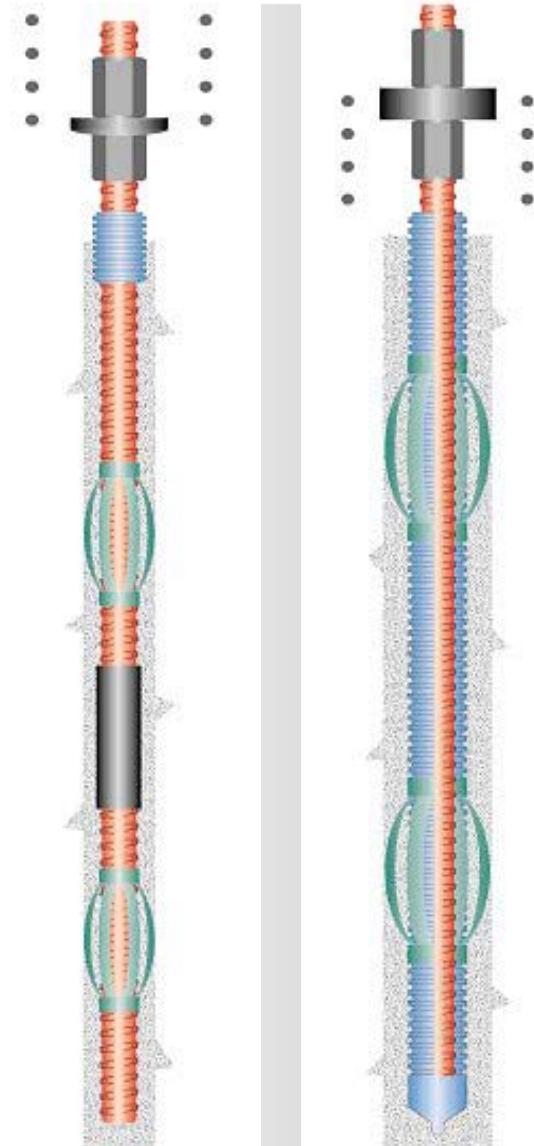
Micropiles using higher steel grades – corrosion protection

SCP: grout cover
as corrosion protection system

depending on aggressiveness and life time

acc. EN 14199

- **no agressiveness of the surrounding soil**

- **tension loads: cover ≥ 30mm**

- **compression loads: cover ≥ 20mm**

- **spalling shall not occur**

Micropiles using higher steel grades – grout cover

basis: compatibilty of steel and grout

max. concrete (grout) compression strain

$$= 2‰$$

Young's modulus of thread bars: 205 000N/mm²

permissible steel stress
= 0,002 x 205 000 = 410 N/mm²
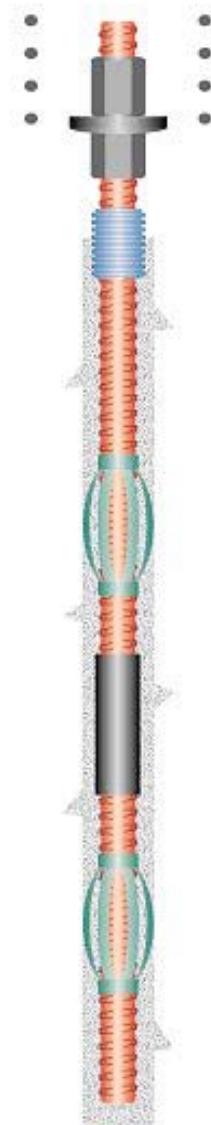
Micropiles using higher steel grades – spalling of grout cover

1. a cover of grout as permanent corrosion protection

2. **"higher" steel grades**

3. piles under compression

4. tests and calculations

5. solutions

GEWI®Plus

Micropiles using higher steel grades – higher steel grades

GEWI®Plus new!

yield stress = 670 N/mm²
ultimate stress = 800 N/mm²

load class (yield)	170	250	310	400	470	630	970	1750	2120
GEWI®	20	25	28	32		40	50	63,5	
GEWI®Plus	18	22	25	28	30	35	43	57,5	63,5

## *Micropiles using higher steel grades* – higher steel grades

GEWI®Plus exceeds the limit of 410N/mm²

stresses	design level γ_M = 1,15 γ_G = 1,35 (dead load)	max. permissible during testing 95% of yield
GEWI®Plus	670/1,15 = 583N/mm² 583/1,35 = 432N/mm² 0.6 x 800 = 480N/mm²	0,95 x 670 = 637N/mm²

Micropiles using higher steel grades – spalling of grout cover

1. a cover of grout as permanent corrosion protection

2. "higher" steel grades

3. **piles under compression**

4. tests and calculations

5. solutions

## *Micropiles using higher steel grades* – under compression
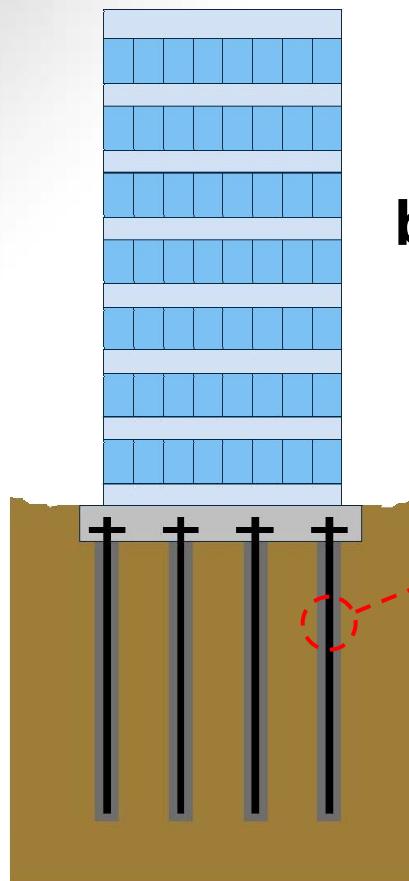
pile shaft

compatibilty problem between steel and grout
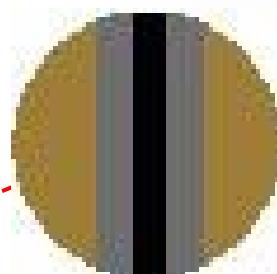
transversal deformations
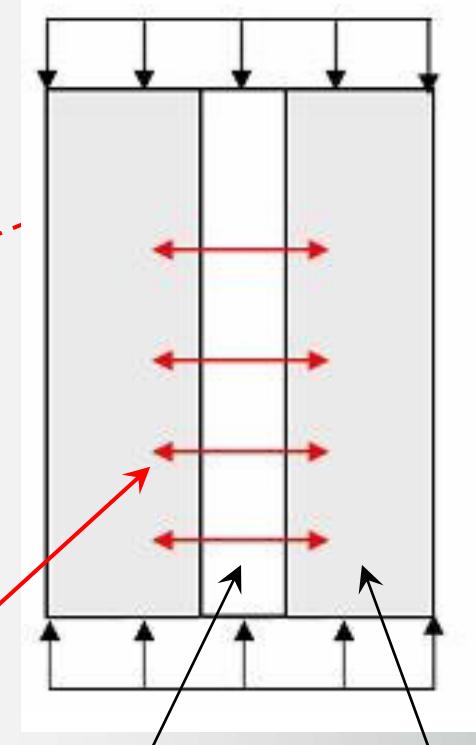
$\mu_{steel} = 0,3$ | $\mu_{grout} = 0,2$

different radical strain coefficients

Micropiles using higher steel grades – under compression
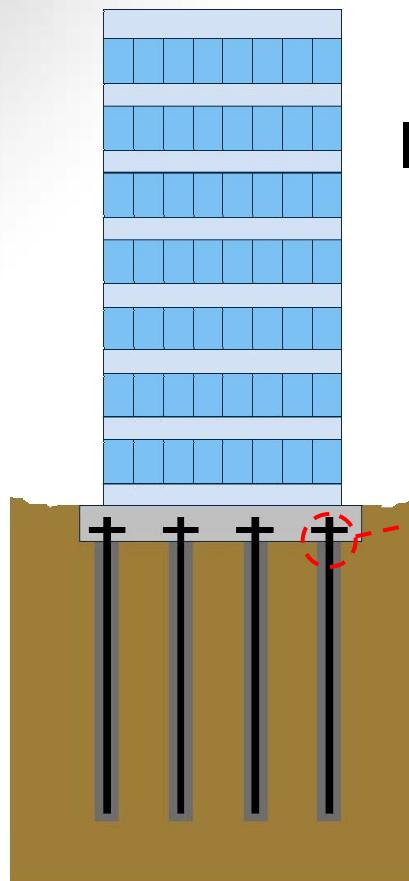
pile neck

load transfer to the grout column not guaranteed

mud
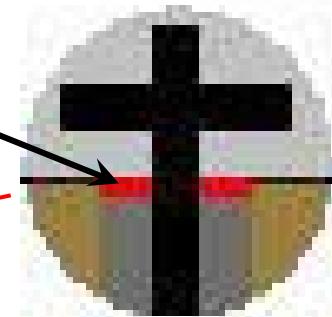
transversal deformations

load distribution
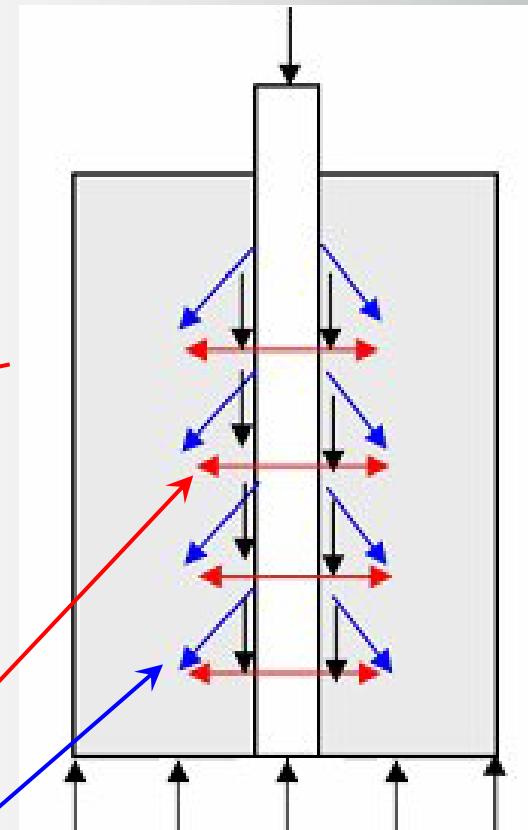
Micropiles using higher steel grades – spalling of grout cover

1. a cover of grout as permanent corrosion protection

2. "higher" steel grades

3. piles under compression

4. **tests and calculations**

5. solutions

Micropiles using higher steel grades – tests and calculations

pile shaft – compatibilty tests

GEWI®Plus
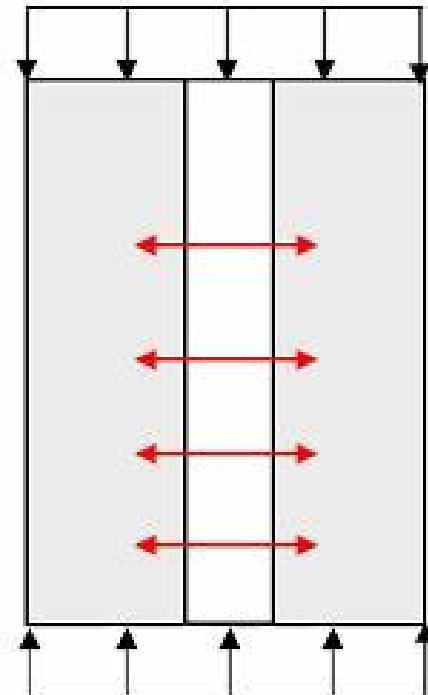
Micropiles using higher steel grades – tests and calculations

pile shaft – compatibilty calculations
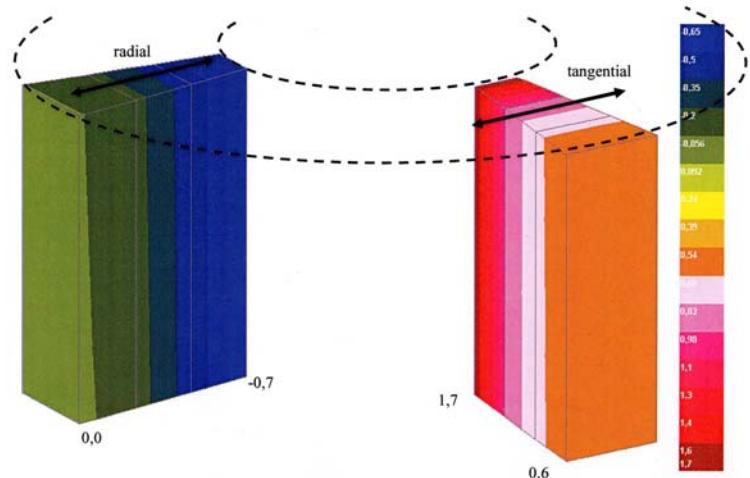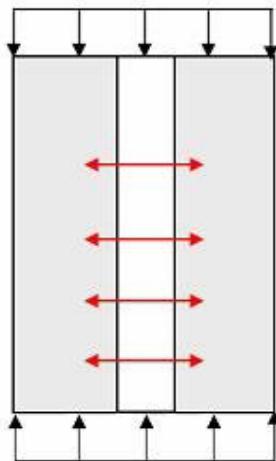
nom Ø	28	30	35	43	57,5	63,5
grout cover	25	25	30	35	45	50
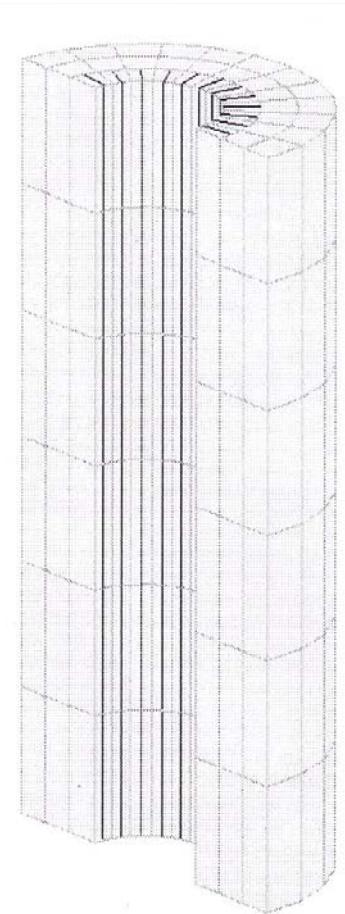
Micropiles using higher steel grades – tests and calculations

pile neck – load distribution tests
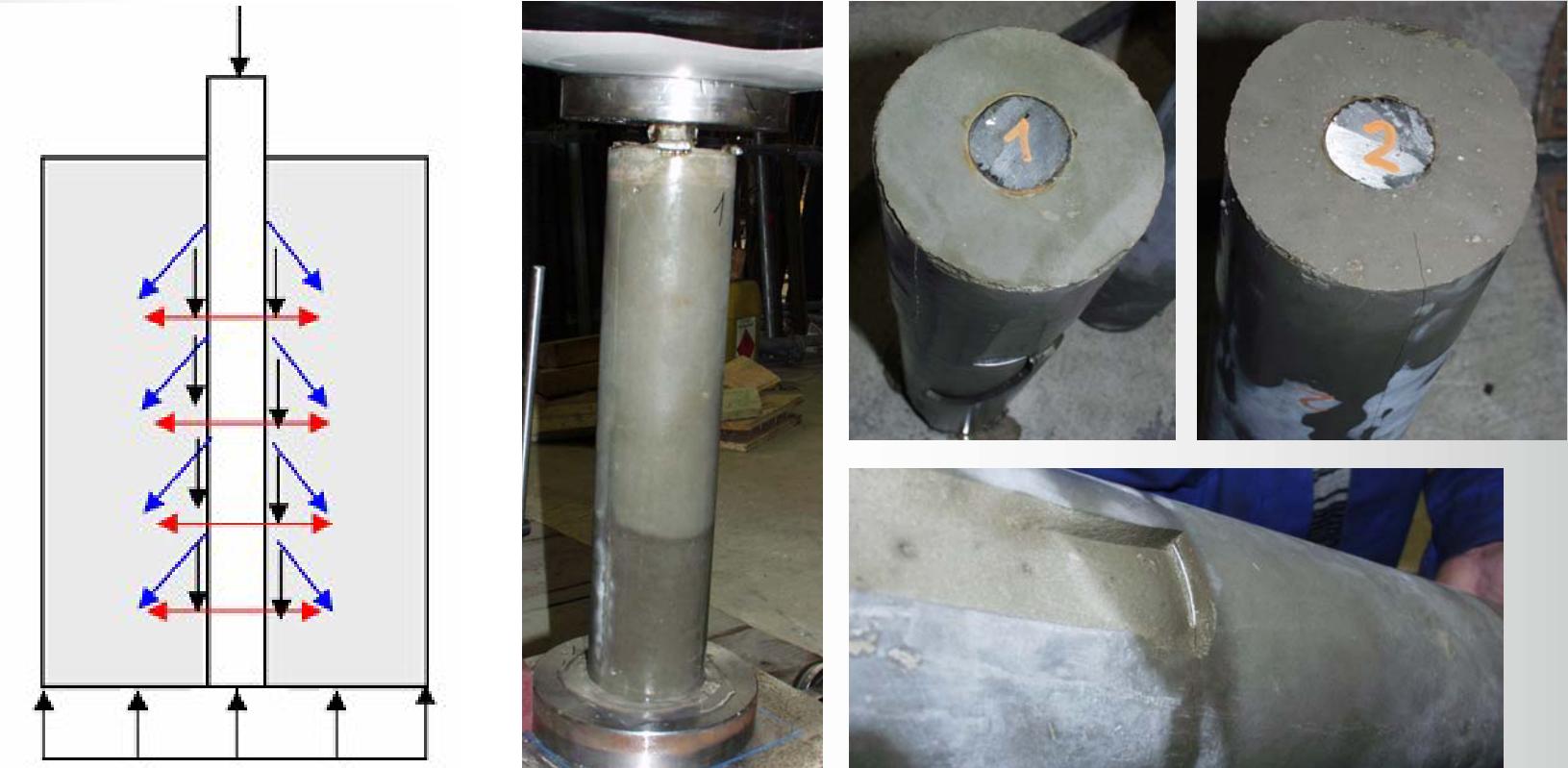
## *Micropiles using higher steel grades* – tests and calculations

pile neck – load distribution calculations
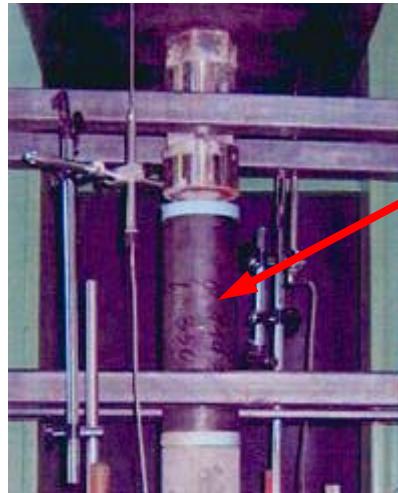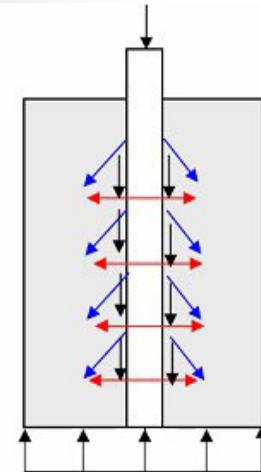
pile neck
collar
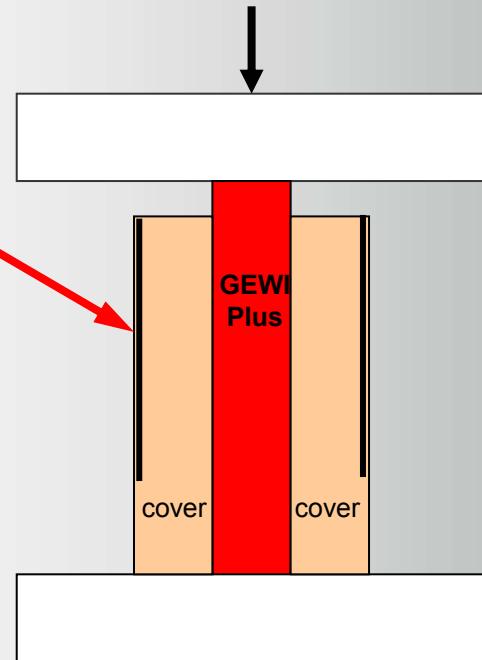
nom Ø		28	30	35	43	57,5	63,5
steel tube	length	630	680	760	950	1230	1360
	thick	3	3	3	3,2	4,3	4,8

Micropiles using higher steel grades – spalling of grout cover

1. a cover of grout as permanent corrosion protection

2. "higher" steel grades

3. piles under compression

4. tests and calculations

5. **solutions**

Micropiles using higher steel grades - solutions

cover of grout:

- **problem of spalling**

- **pile shaft:
  increased grout cover**

- **pile neck:
  pile neck collar**

- **secured environmental
  conditions**

DCP (sheathed pile):

- **spalling does not matter**

- **grout has no protection
  function**

- **load transfer to the soil
  will still work**

- **environment has no
  influence**