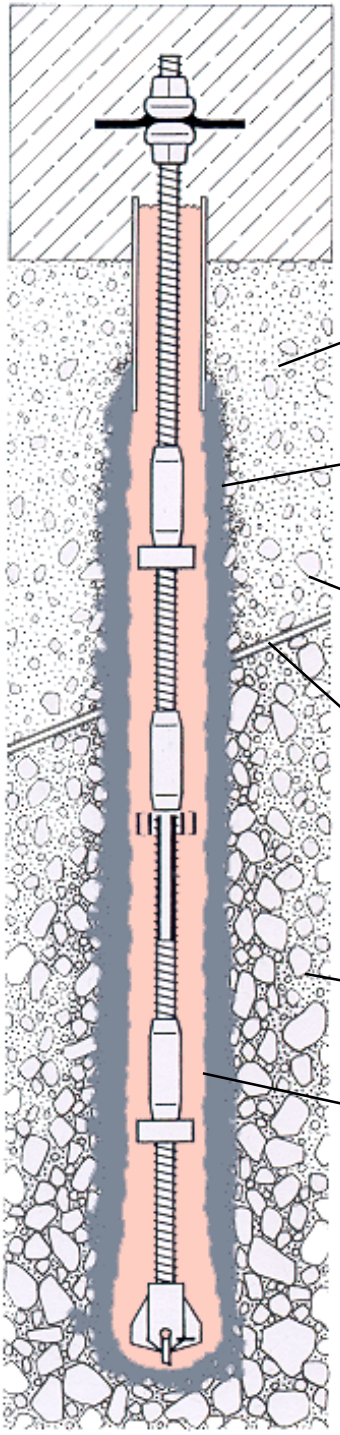
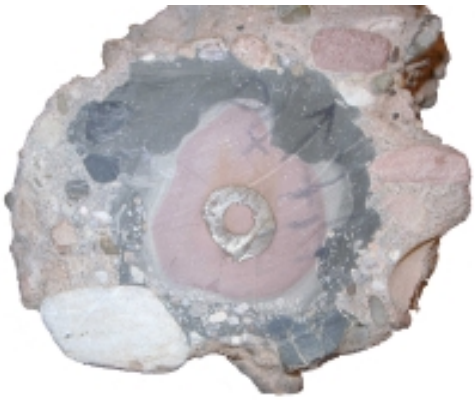
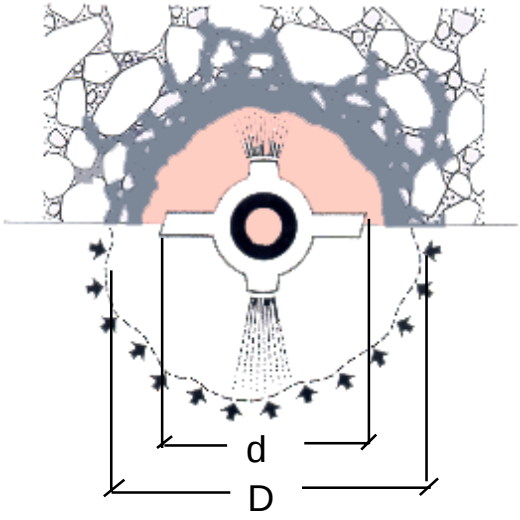
Structure of Self-Drilling Dynamic Grouted Micropiles TITAN







D > 2.0 x d for gravel
1.5 x d for sand
1.4 x d for sand-silt
1.0 x d for wheathered rock, clay

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Digged out micropile TITAN 30/11:
Drilling position 65° to vertical in very dense sand/gravel

1. **Spillway with water/cement = 0,5, (red colour), pure cement strength > 30 Mpa**
2. **Diaphragm blade filter cake by w/c ~ 0,7; arch support**
3. **Infiltration of cement improves shear bond and strength of soil**

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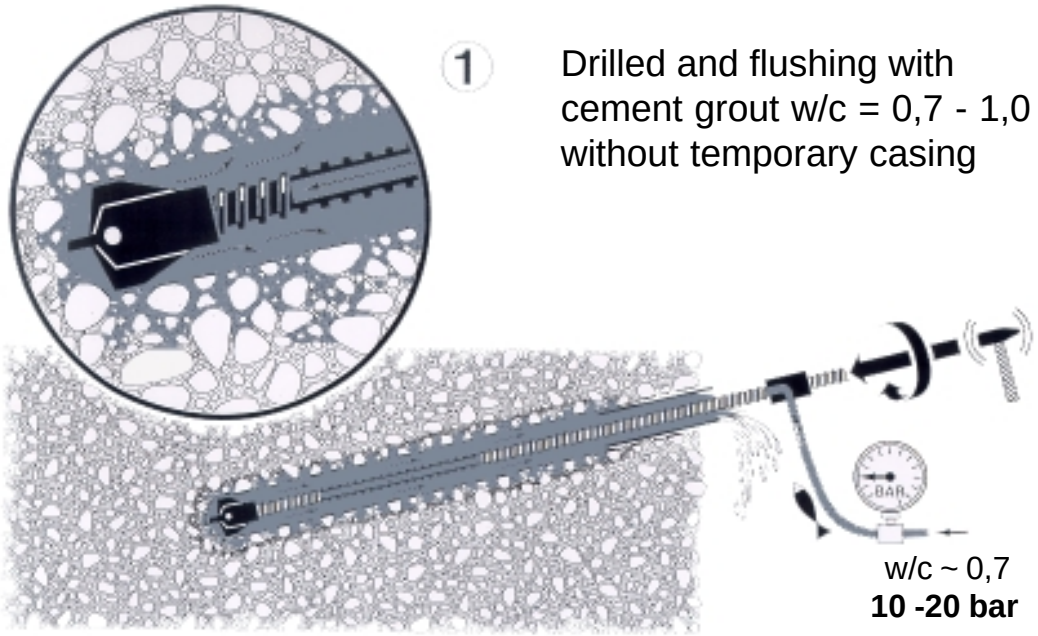
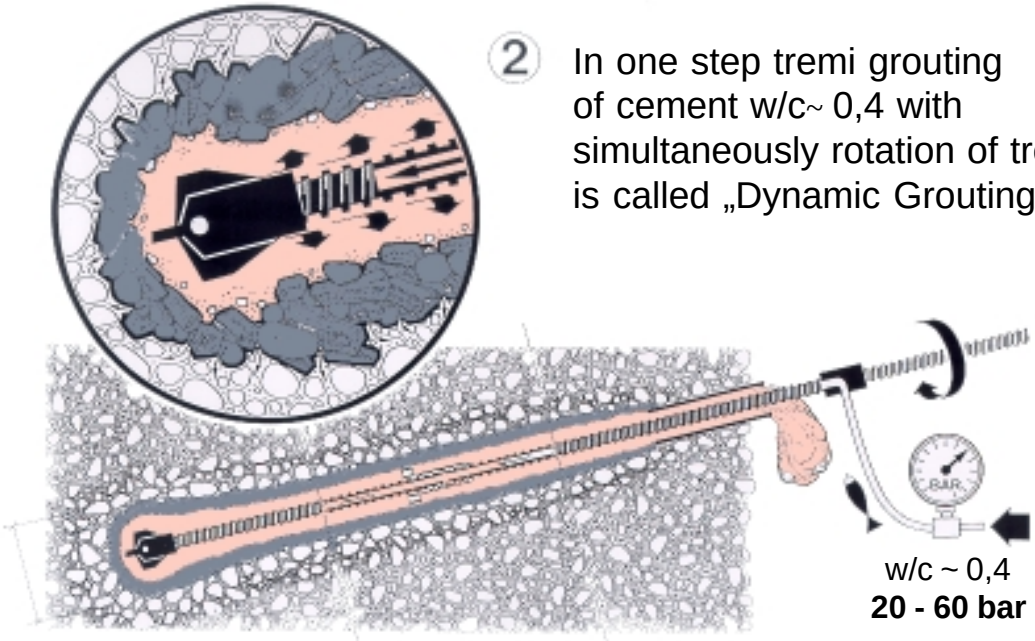
Self-Drilling and Dynamic Grouted Micropiles TITAN



1 Drilled and flushing with cement grout w/c = 0,7 - 1,0 without temporary casing

w/c ~ 0,7
10 -20 bar



2 In one step tremi grouting of cement w/c~ 0,4 with simultaneously rotation of tremi is called „Dynamic Grouting“

w/c ~ 0,4
20 - 60 bar

1,0 - 2,0 drill bit diamter depending on soil

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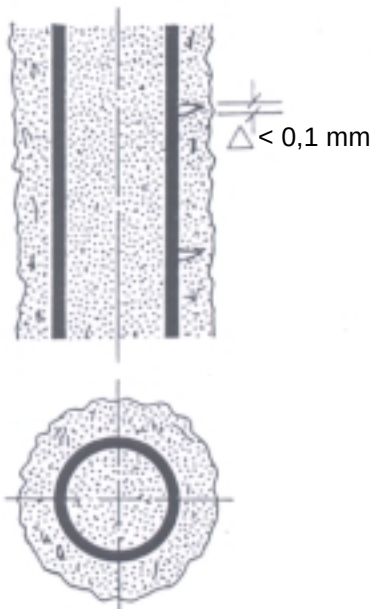
Adm. steel stress for anchorpiles according to DIN 4128
to avoid axial and radial cracks > 0,1 mm

with standard corrosion protection means, min. 20 mm cement stone cover, quality B 25

Technical development with tension piles

steel tube, smooth



Grouted steel tube pile

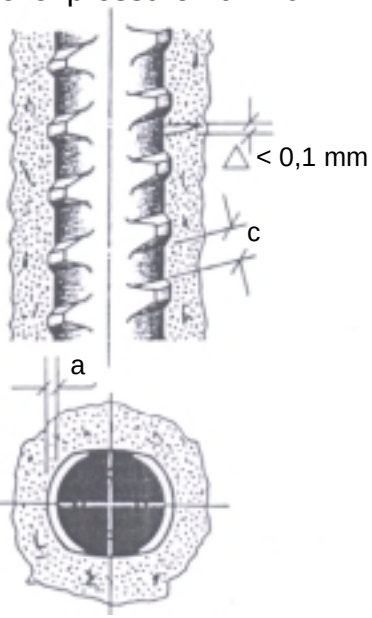
$f_R = \frac{a}{c}$

$f_R = 0$

adm. steel stress

75 N/mm²

deformed solid bars
angel of pressure 40 °-70°



GEWI pile

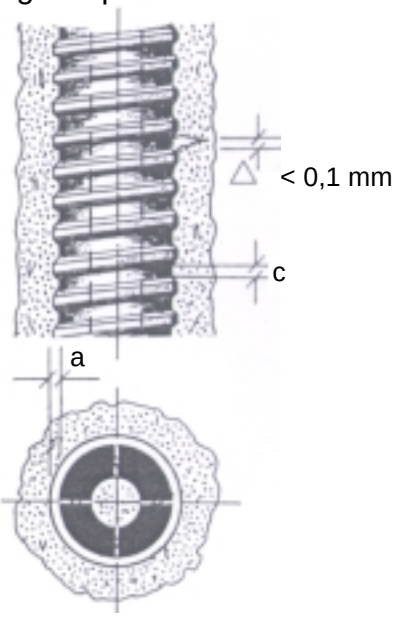
$f_R = 0{,}56 \times \frac{a}{c}$

$f_R = 0{,}074$

adm. steel stress

165 N/mm²

steel tube with continous threads
angel of pressure 40 - 70 °



TITAN pile

$f_R = \frac{a}{c}$

$f_R = 0{,}13$

adm. steel stress

275 N/mm²

Permanent anchorpiles TITAN - limited to steel stress of 275 N/mm² - need only min. 20 mm cement stone cover, quality B 25; no double corrosion protection by corrugated PE-tube, filled with cement.

(Expert opinion: Prof. Dr.-Ing. Schießl, TU Munich, B 6067, dd. 30. Nov. 1999)

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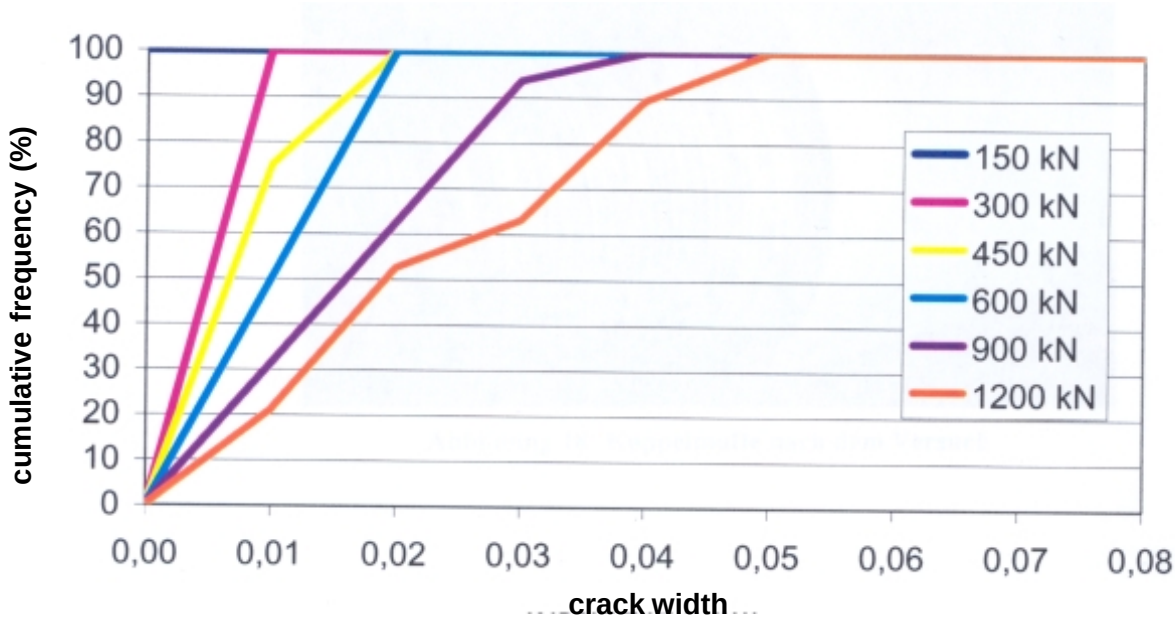
TECHNISCHE UNIVERSITÄT MÜNCHEN
INSTITUT FÜR BAUSTOFFE UND KONSTRUKTION
LEHRSTUHL FÜR MASSIVBAU

Testmachine
with grout body 180 - 220 mm ø,
1200 mm long
reinforced with TITAN 103/51



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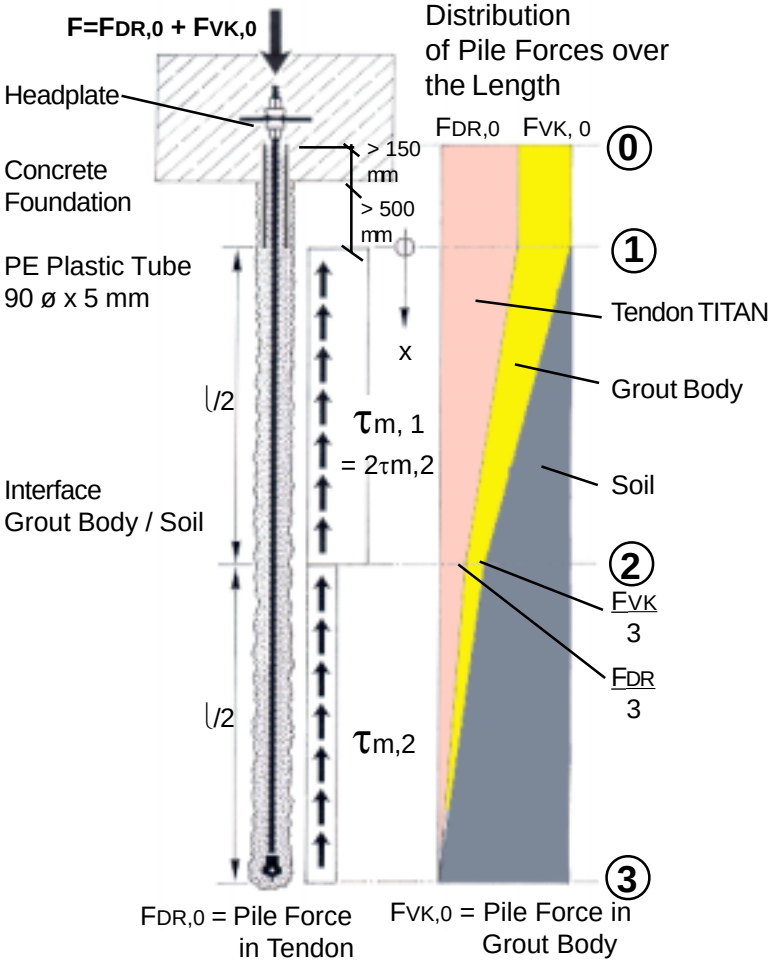
Calculation Model for Compound Micropiles TITAN 30/11



The smooth HD-PE tube has 3 functions:

1. the HD-PE tube bridges the unavoidable joint between grout body and bottom of the foundation and protects the highly loaded pile head from corrosion

2. the HD-PE tube covers the grout body and prevents internal longitudinal cracks, amongst others under test load without foundation. Consequently test piles can later be used as regular piles on the job.

3. the smooth HD-PE tube versa a corrugated tube prevents cracking the foundation concrete and forces the load transfer only via the plate (reference surface pressures)

Monitoring the distribution of the load transfer to the ground by extensometers, installed inside the hollow TITAN pile.

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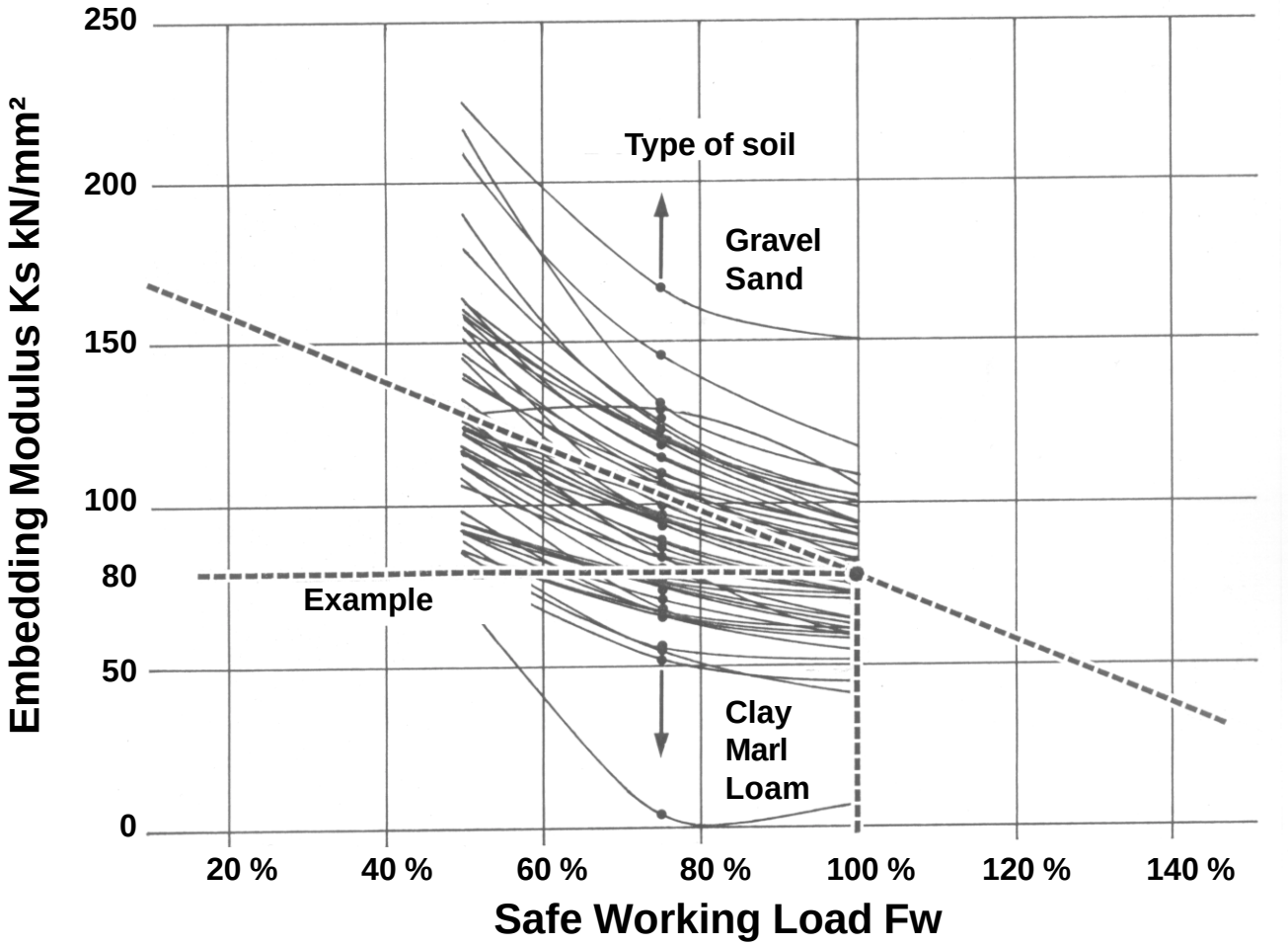
Embedding Modulus Ks for micropiles TITAN 40/16 for designing displacement of pile head



Example: **Micropile TITAN 40/16**
Safe working load Fw = 300 kN (100%)
average embedding modulus Ks = 80 kN/mm
estimated displacement

$$\Delta = \frac{300}{80} = 3{,}8 \text{ mm}$$

This diagramm is based on about 200 loading tests with micropiles TITAN 40/16 in different soils.

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Micropiles TITAN 40/16 are included in the

FRENCH NATIONAL RESEARCH PROJECT (FOREVER)

to improve design of single and reticulated micropiles.

Several tests on natural size (size 1:1) in St-REMY-LES-CHEVREUSE in 1998,
all with loose, fine and dry sand of Fontainebleau
Micropiles TITAN 40/16, length 5 m, drill bit 70 mm, flushing grout w/c=0,9,
grout pressure 8 - 20 bar

Results:

1. Skin friction qs = 74 kN/m²
   Micropiles TITAN fulfil requirements of French DTU 13.2 micropieux Typ IV (IRS or postgrouted)

2. In compression 7% loadtransfer by end bearing, 93% by friction

3. Micropile Diameter D=113 mm
   Drill bit d= 70 mm, D = (1,5 ÷ 1,8) x d

4. No visible cracks observed in the grout body

5. Steel member centred in the ground body

6. Dynamical testing of integrity and length of micropiles TITAN by French method SIMBAT works and is confirmed by CEBTP

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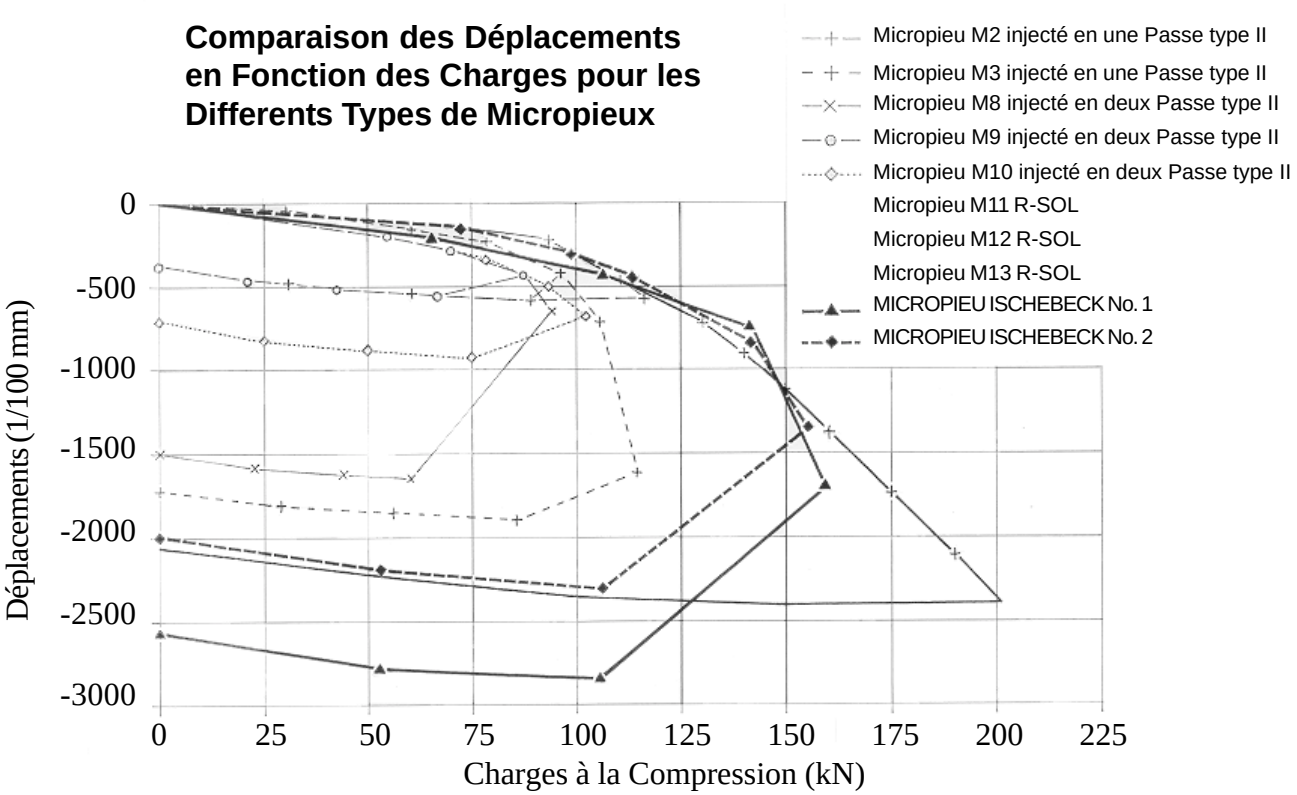
Comparaison des Déplacements en Fonction des Charges pour les Differents Types de Micropieux



	Type	Surface latérale (m^2)	Qle (totale) (kN)	qs (kPa)
M1	II[1]	1,88	140	68
M2	II[1]	1,90	> 122	> 58
M3	II[1]	1,82	106	52
M8	II[2]	1,75	95	49
M9	II[2]	1,76	> 88	> 45
M10	II[2]	1,69	102	55
M11	R-Sol	1,53	95	56
M12	R-Sol	1,58	145	83
M13	R-Sol	1,57	136	78
I1	Ischebeck	1,81	146	73
I2	Ischebeck	1,77	145	74
S	II	1,99	108	50

Capacité portante des micropieux

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