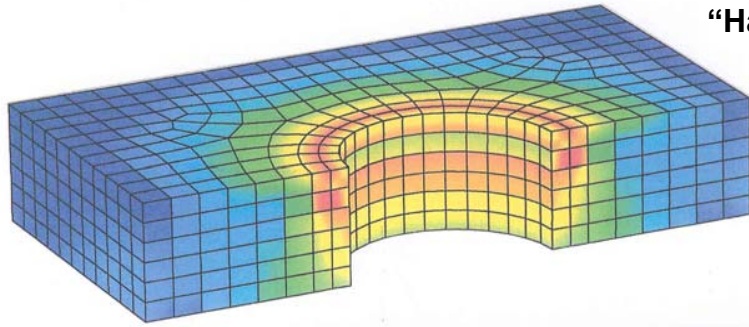


Standard – Micropile – Heads

Design Guide

FE-Modelling of Micropile Heads



“Harbour City“ Hamburg – Micropile TITAN 103/78 for Sheet Pile Wall



ISM 2006, 7th International Workshop on Micropiles
May 3-7, 2006, Schrobenhausen, Germany

Design Guide for TITAN Micropile Heads

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EU standard EN 14199 “Micropiles” for execution of nearly all types of micropiles with diameters below 300 mm and EU standard “Eurocode 7 (EC7) Geotechnical Design” are finished now.

Micropile head means the part, which transfers compression or tension loads from concrete structures, steel structures or soft facings via load bearing element to the ground. Qualified design of micropile heads requires experience, both in soil mechanics and in structural design of reinforced concrete and steel constructions.

Micropile head means to overcome an interface in our heads between geotechnical and structural engineers.

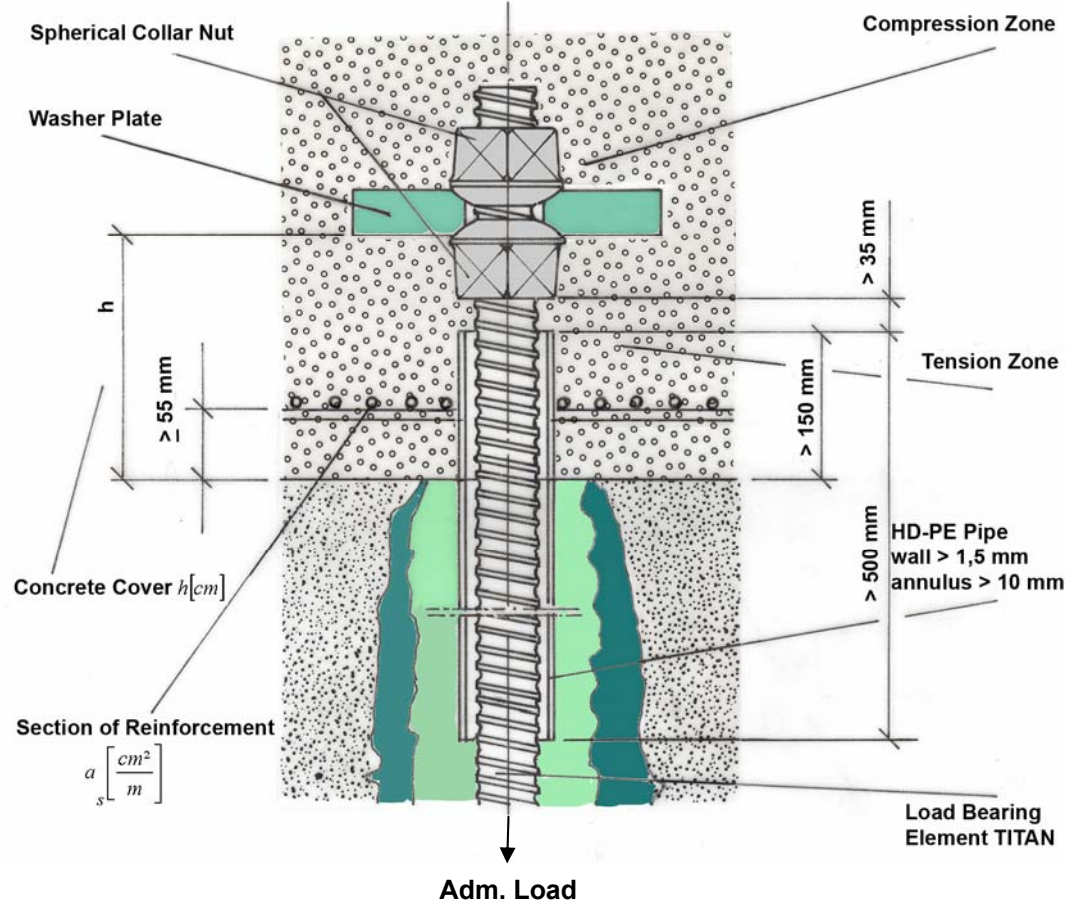
During former workshops of IWM a demand for standardized design of micropile heads was discussed already.

First design guide for TITAN micropile heads is presented now. Requirements of EN standards are fulfilled; especially referring corrosion protection.

I like to present 3 main application samples:

1. Concrete Slab
2. Sheet Pile Wall
3. Soft Facing

Micropile Head for Concrete Slab



which can be transferred to the concrete slab locally

Fröhlich
(Dr.-Ing. K.-C. Fröhlich)



Demonstrated is the transfer of uplifting loads via washer plate to the micropile.

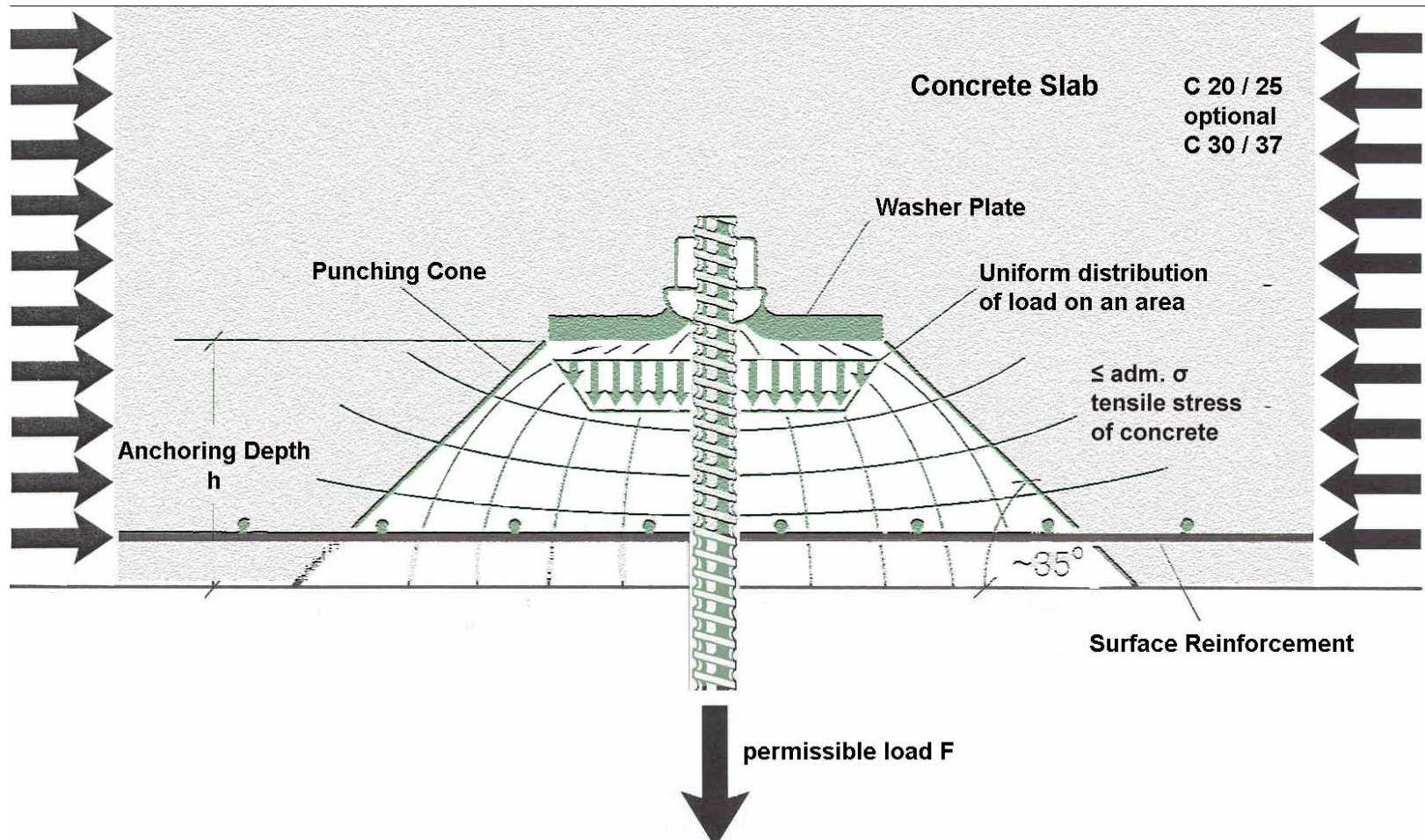
The HD-PE pipe is a general requirement of German Rail to protect the micropile in the gap between slab and ground, where cracks can't be avoided and where the micropile is most sensible, because of high load concentration.

Structural System

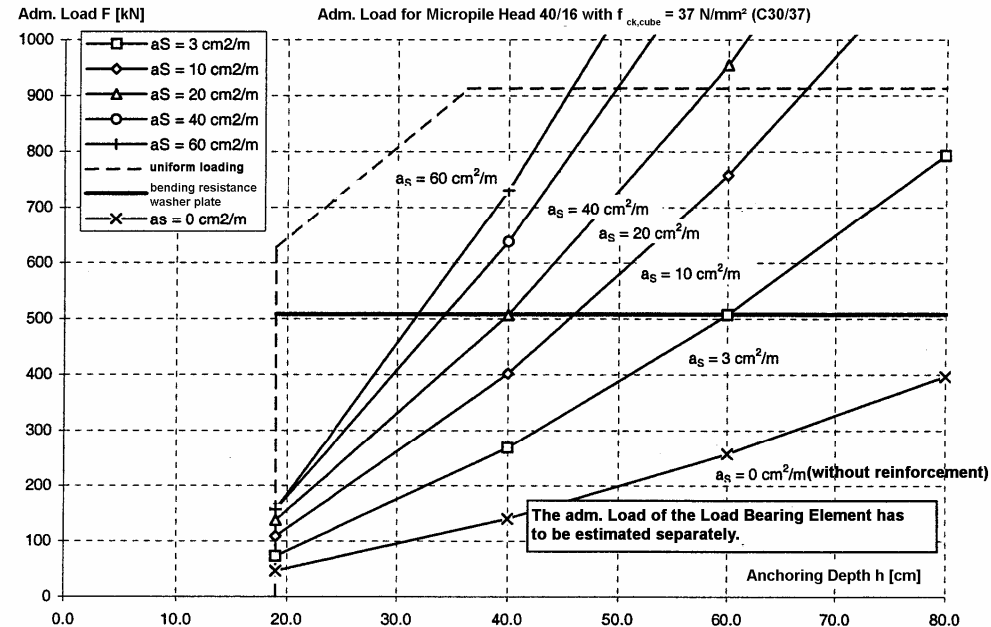
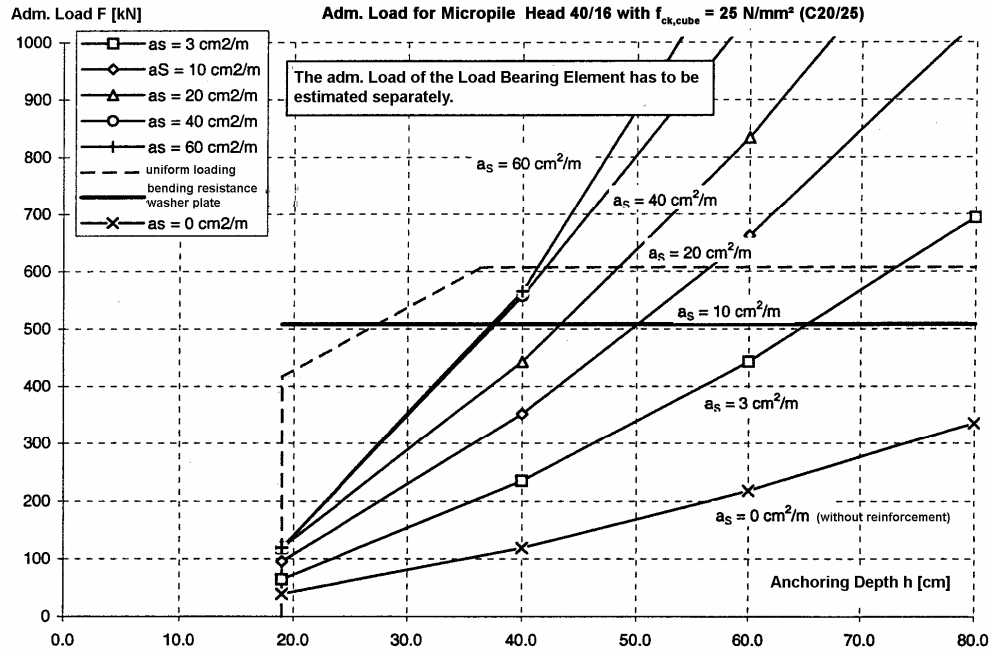
for Local Load Introduction from Micropile to Concrete Slab

Checks for

- uniform distribution of load on an area,
- punching and
- out-of-plane bending of washer plate



Design Table for Micropile Head TITAN 40/16 in Concrete



The diagrams can be used for tension and compression micropiles. Only difference is the set-up of reinforcement. (always within the tension zone)

Example:

Micropile Head for

Tension Load $F_{ad} = 300 \text{ kN}$

Micropile TITAN 40/16

Washer Plate 200/200/30 mm

Concrete Quality C.30/37

Uniform Load on Concrete

Punching

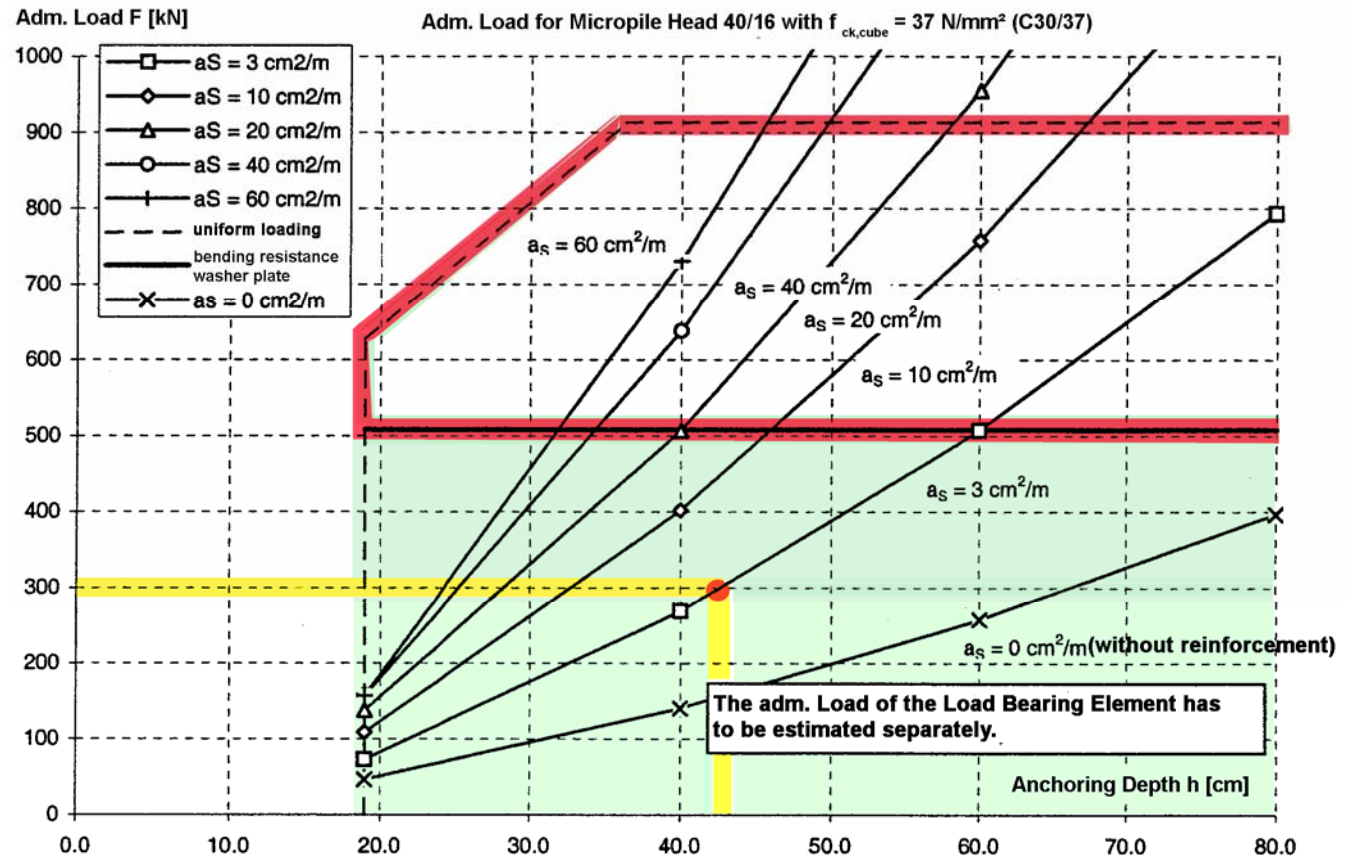
Necessary Section of

Reinforcement

$A_s = 3 \text{ cm}^2 / \text{m}$

Necessary Anchoring Depth

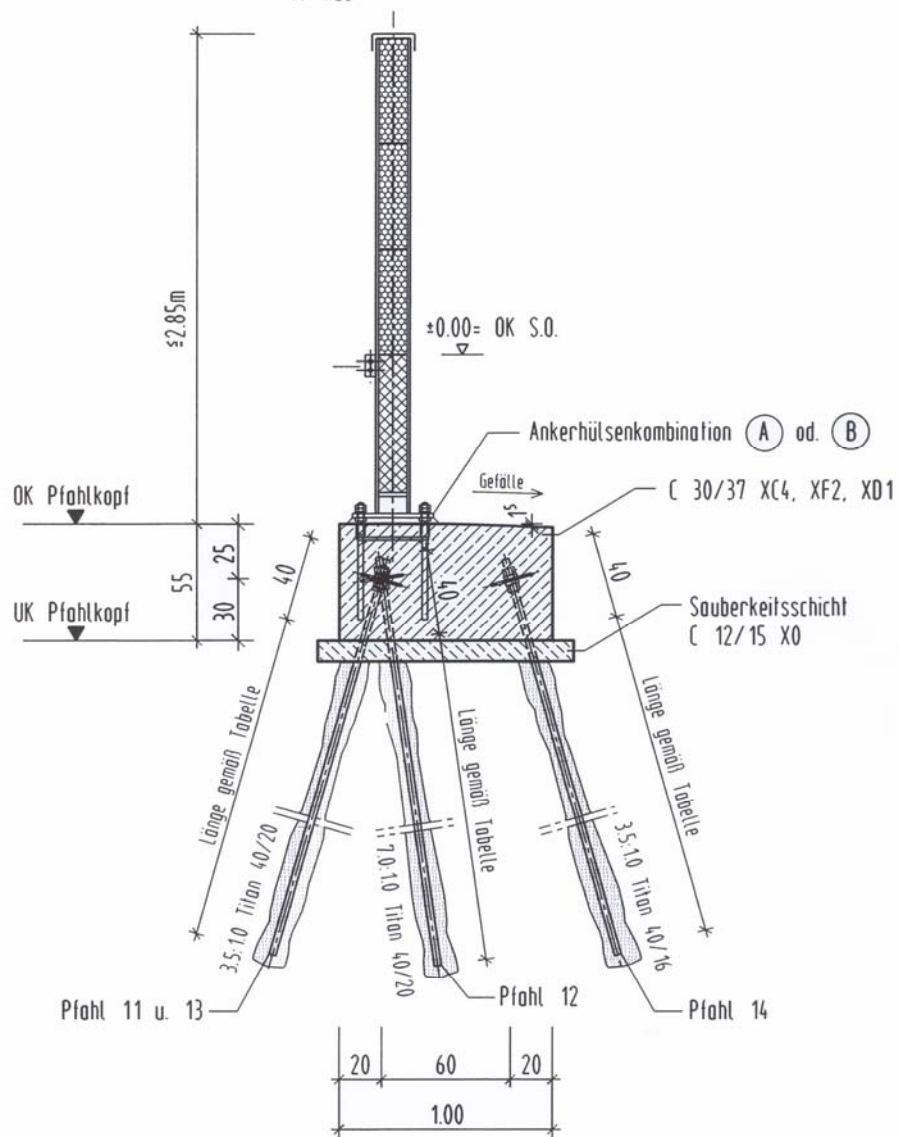
$h = 43 \text{ cm}$



**Application of Micropiles TITAN 40/20 for Foundation of Noise Wall Barriers.
installed from the Track along Main Railroad Southern Germany**

Schnitt

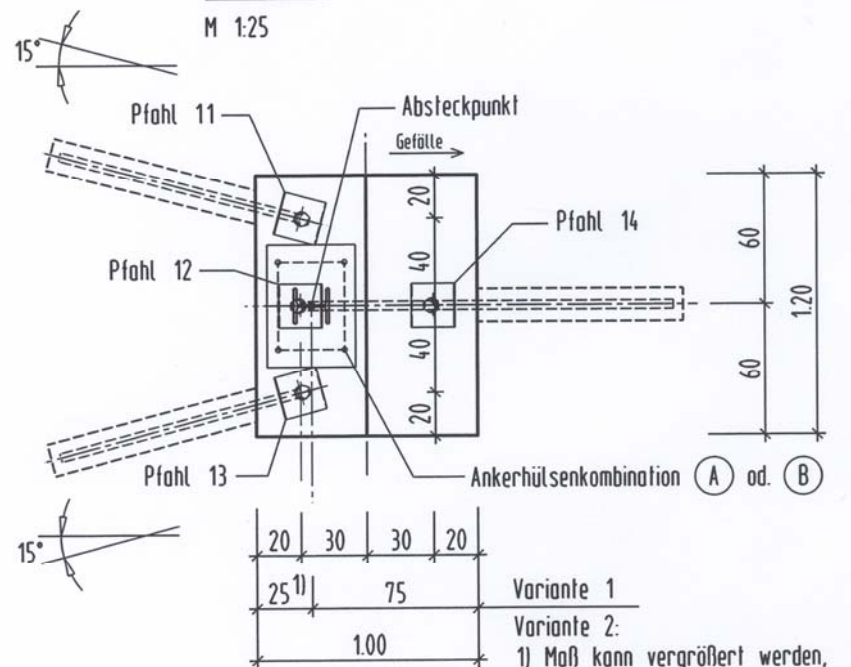
M 1:25



Pfehlbock Typ 2

Grundriss

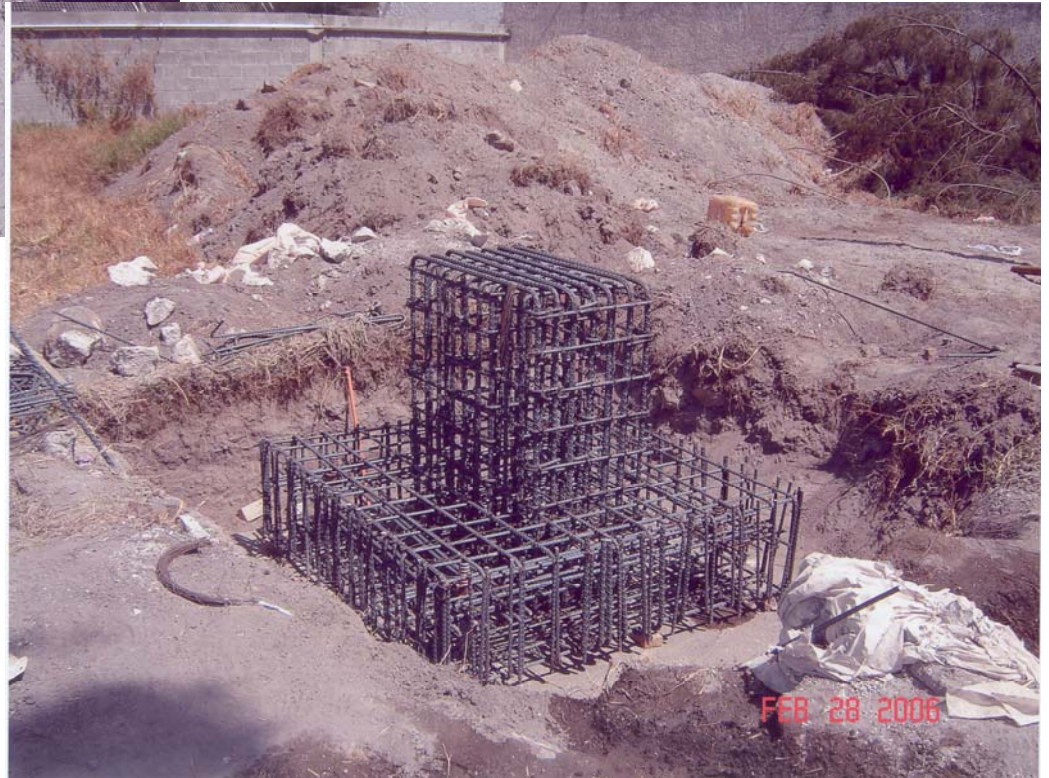
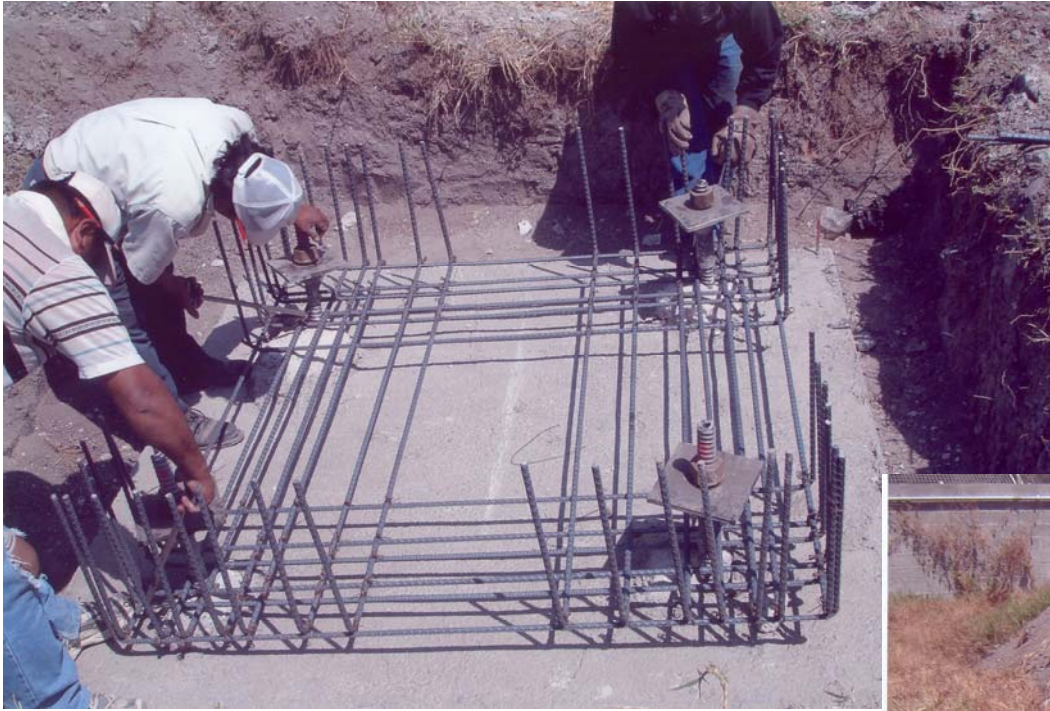
M 1:25



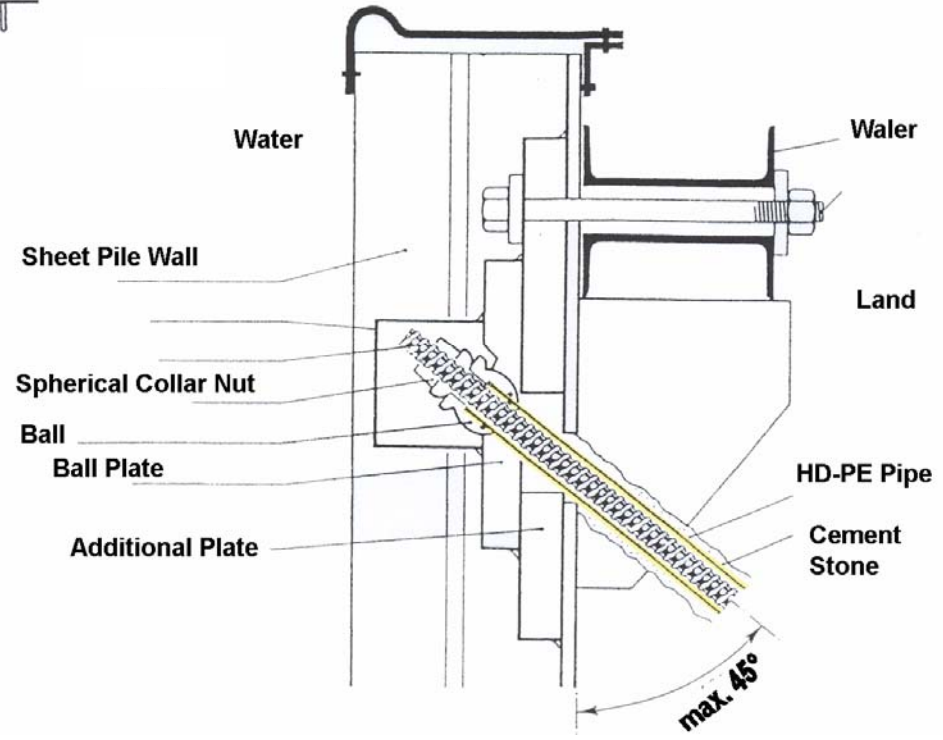
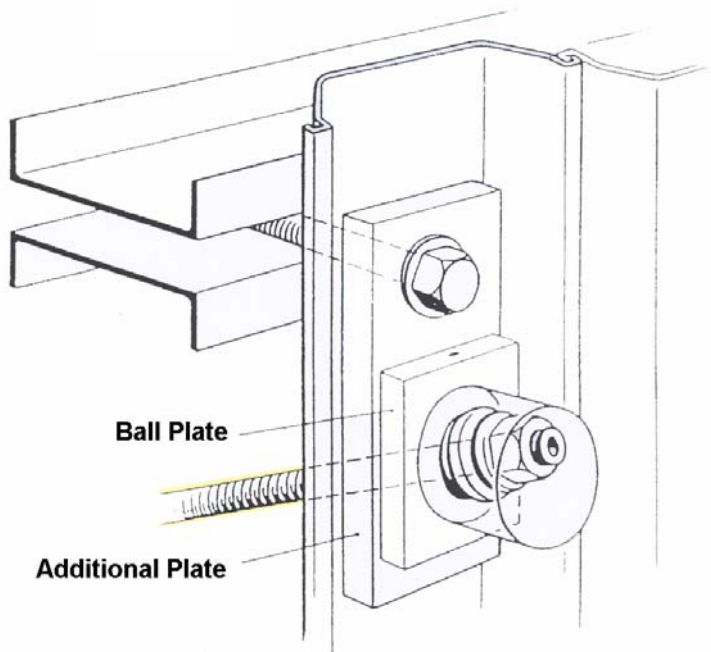
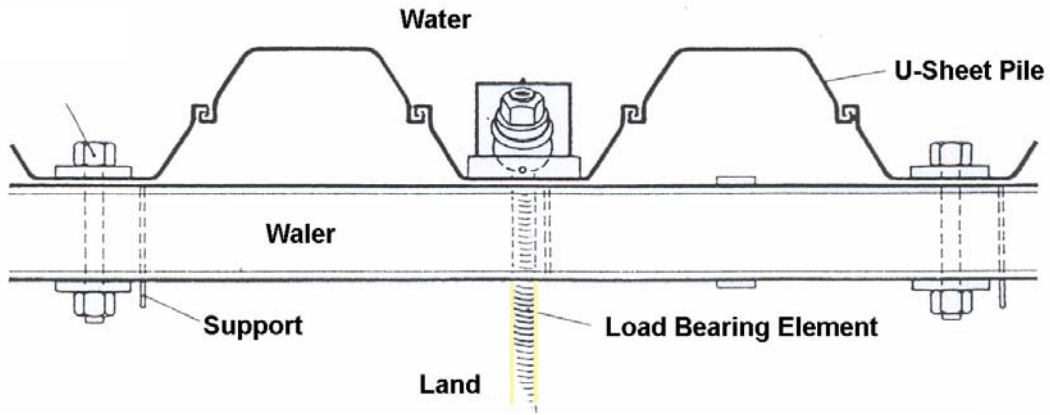
Variante 1

Variante 2:

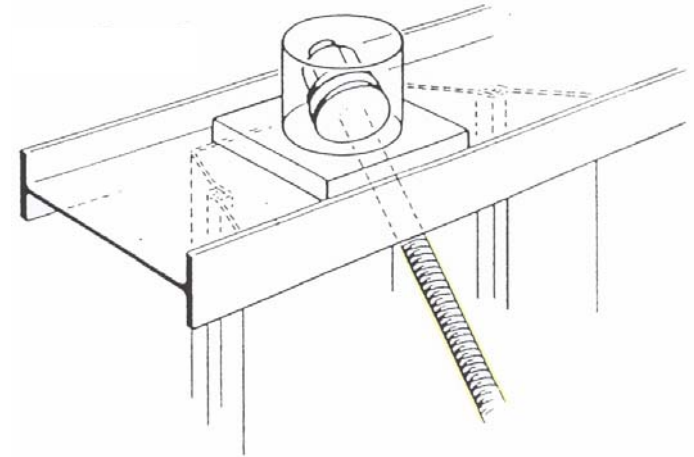
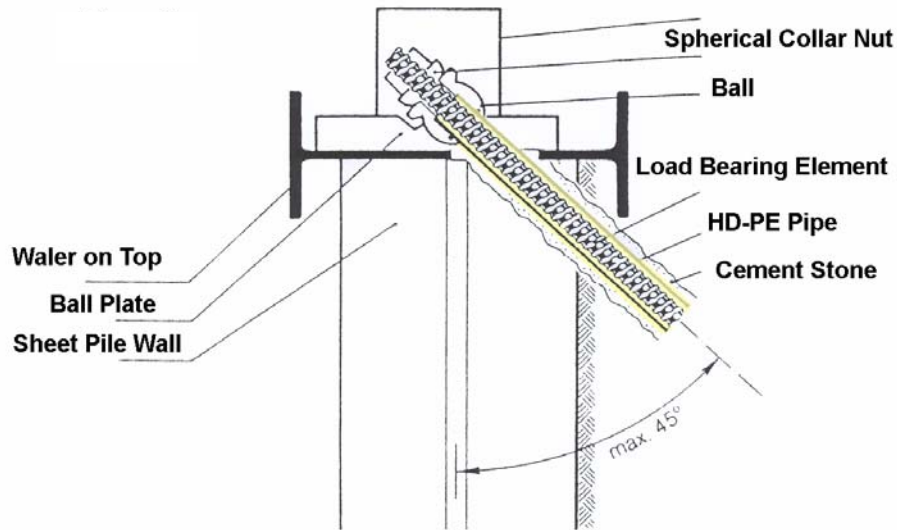
1) Maß kann vergrößert werden, wenn die Pfehle gemäß Variante 2 ausgeführt werden.



Micropile Head for Sheet Pile Walls with Waler (Type 1)



Micropile Head for Sheet Pile Walls with Water on Top of Sheet Pile Wall (Type 2)



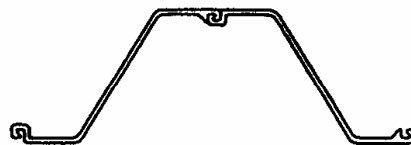
Classification of Elastic Resistance Moment of Sheet Pile Wall and Sizes of TITAN Micropiles for Type 1 and 2

W	<	900 cm ³ / m	TITAN 30 / 11 to TITAN 40 / 16
W	<	1500 cm ³ / m	TITAN 52 / 26
W	<	2000 cm ³ / m	TITAN 73/53
W	>	2000 cm ³ / m	TITAN 103 / 78 to TITAN 103 / 51

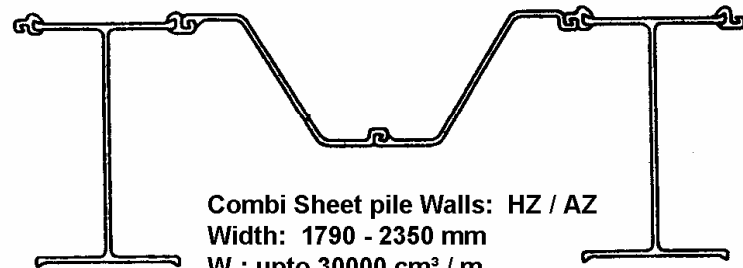
Different Types of Sheet Pile Walls



U-Profile: PU & AU
Width: 600 - 750 mm
 W_x : 600 - 3200 cm³ / m

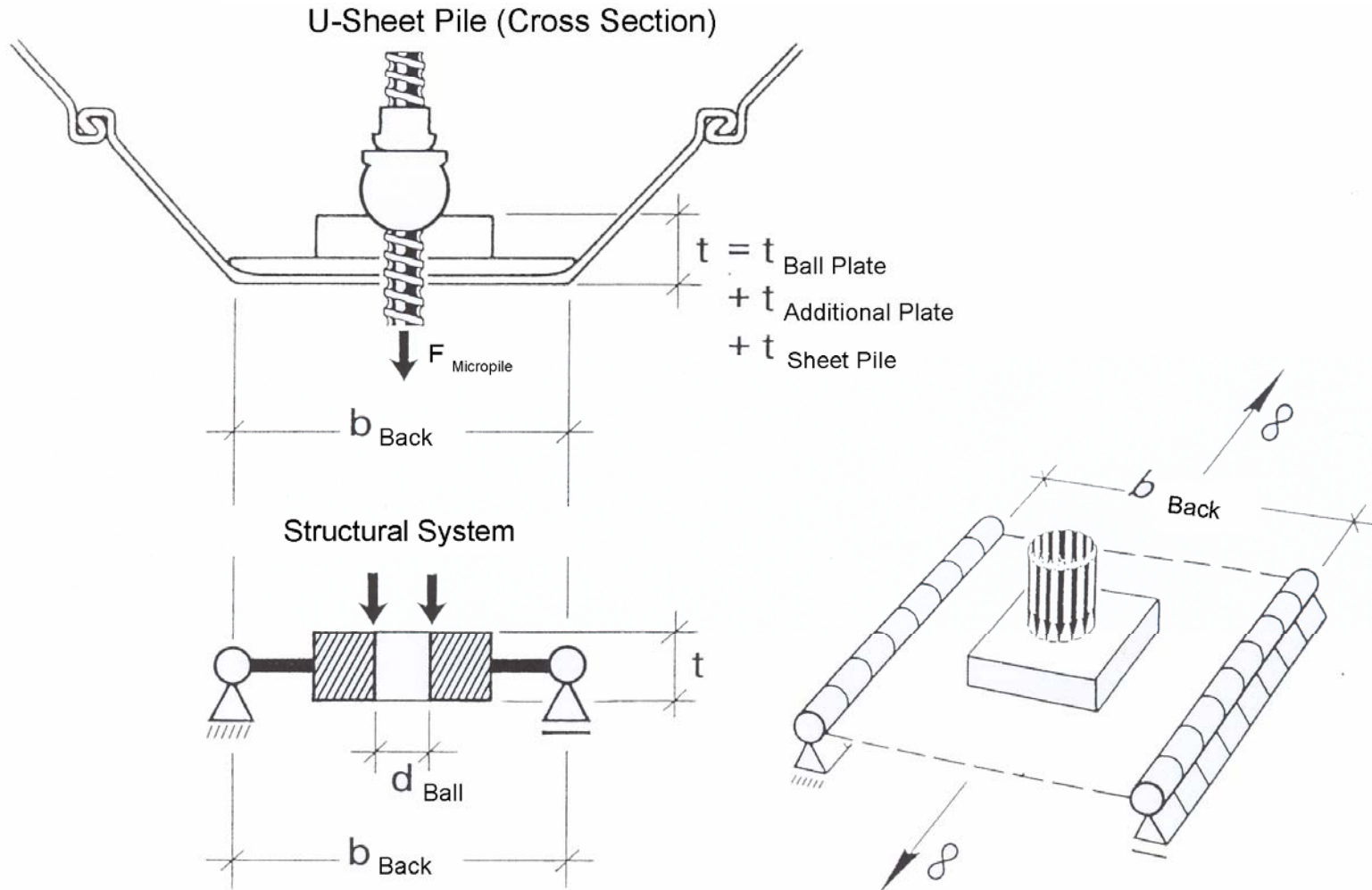


Z-Profile. AZ
Width: 580 - 700 mm
 W_x : 1200 - 5015 cm³ / m

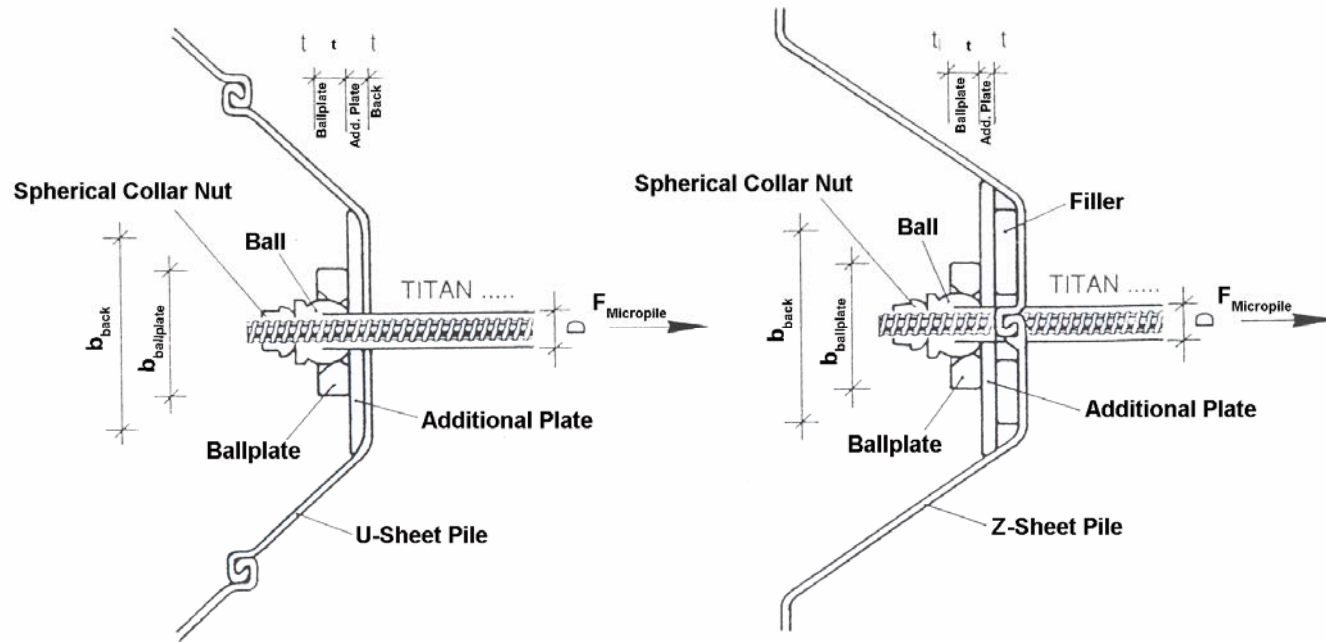


Combi Sheet pile Walls: HZ / AZ
Width: 1790 - 2350 mm
 W_x : upto 30000 cm³ / m

Structural System of Local Load Transfer to Sheet Pile (Type 1)



Design Example



b_{back} = Width of Sheet Pile Back

$b_{ballplate}$ = Width of Ball Plate [mm]

For U-Sheet Piles:

t = Wall of Ball Plate [mm]

+ Wall of Sheet Pile

+ Wall of additional Plate (if necessary)

For Z-Sheet Piles:

t = Wall of Ball Plate

+ Wall of additional Plate

F Load of Micropile [kN]

Standards

- DIN 18800
- EAU 2004
- DIN 1045-1
- DIN ENV 1993-5

Design Example

Design-Example

Known Parameters

Micropile
Micropile Load $F_{micr} = 250 \text{ kN}$
Inclination $\alpha = 30^\circ$

Sheet Pile:

Type Larssen = L 602
 $t_{Back} = 8,20 \text{ mm}$
 $b_{Back} = 246 \text{ mm}$

Steel quality: S 240

Internal forces

$F_k = F_{micr.} * \text{COS } \alpha = 216,51 \text{ kN}$

Design Load F_d

$\gamma_F = 1,50$ Parameter acc. DIN 18800
 $\psi = 1,00$ Parameter acc. DIN 18800
 $F_d = F_k * \gamma * \psi = 324,76 \text{ kN}$

Estimation based on table 40/16

for $b_{Back} = 246 \text{ mm}$

→ necessary $t = 25 \text{ mm}$

$T_{\text{additional plate}} = \text{necessary } t - t_{Back}$
 $25,0 - 8,2 = 16,8 \text{ mm}$

decided:
additional Plate $t = 18 \text{ mm}$, steel quality S 355 JD

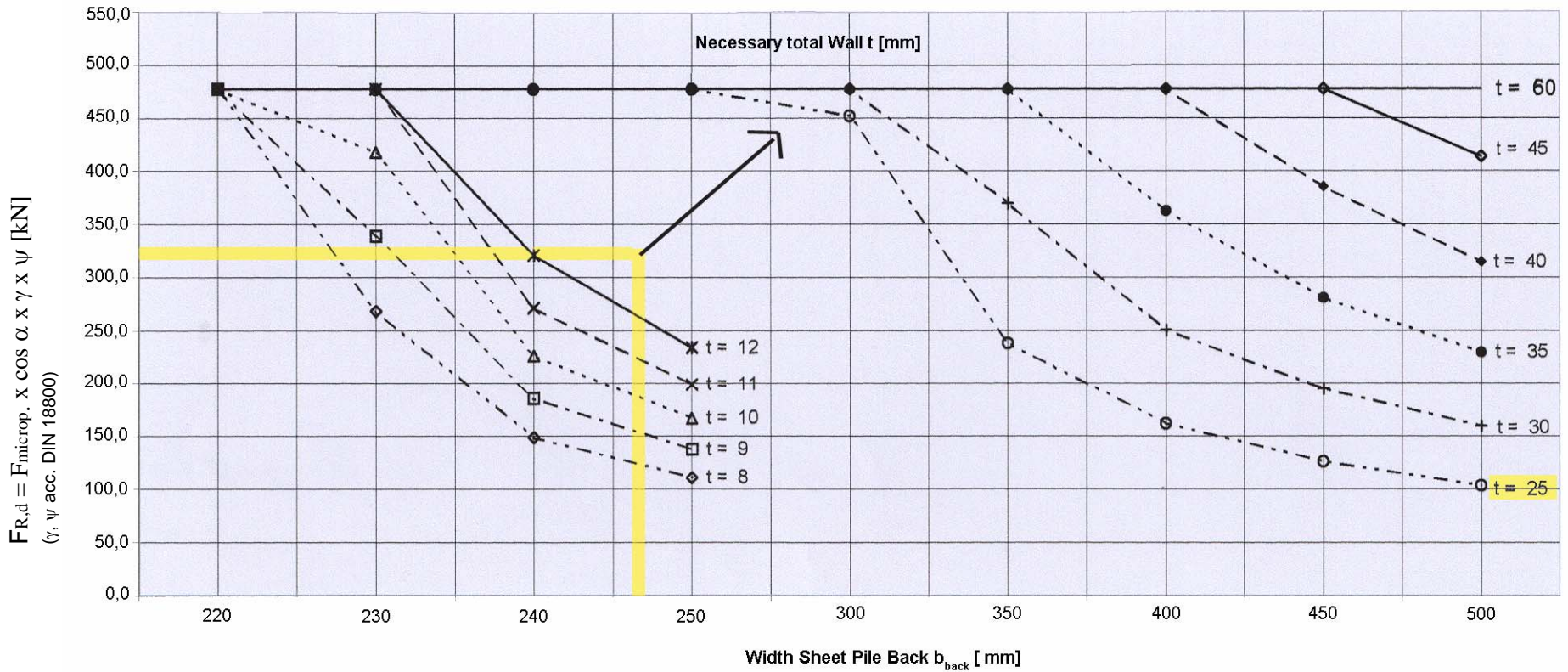
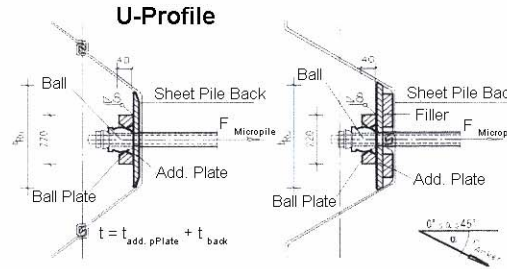
Micropile TITAN 40/16

Local load Transfer to Sheet Pile dependant on wall t and width of b_{back}

Steel Quality Sheet Pile:
S 355 GP ($\sigma_{R,d} = 322,7 \text{ N/mm}^2$)

Ball Plate: S 355 JR
220/220/40 mm
Welding 8 mm

Add. Plate: S 355



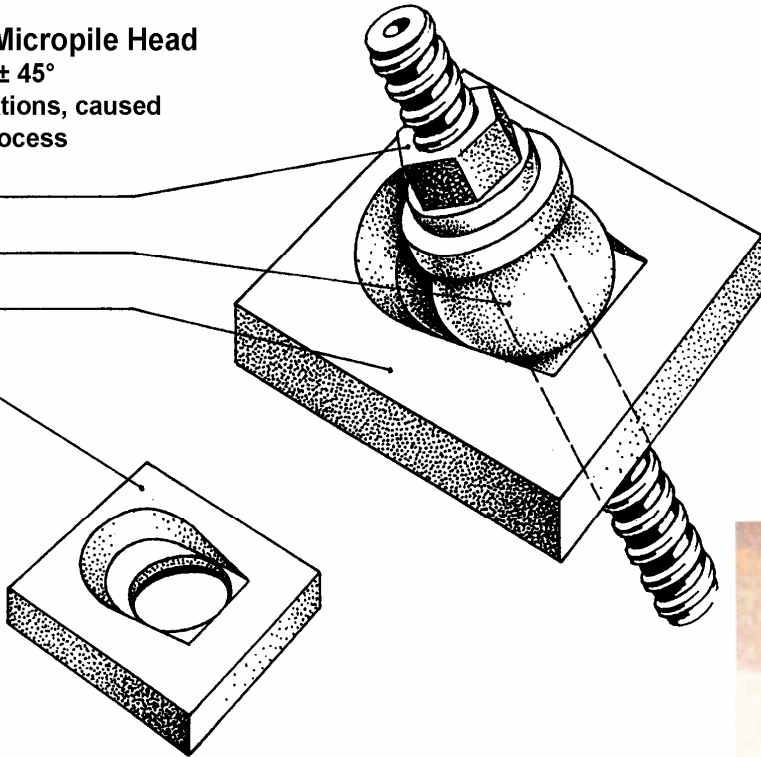
Self-Centering Micropile Head

- adjustable up to $\pm 45^\circ$
- overcomes deviations, caused by installation process

Spherical Collar Nut

Ball

Ball-Plate



Corrosion Protection of Micropile Head by
- HD-PE Pipe, sealed with O-Ring in Ball,
- and Annulus filled with Anti-Corrosion Paste



Spherical Colar Nut

Ball

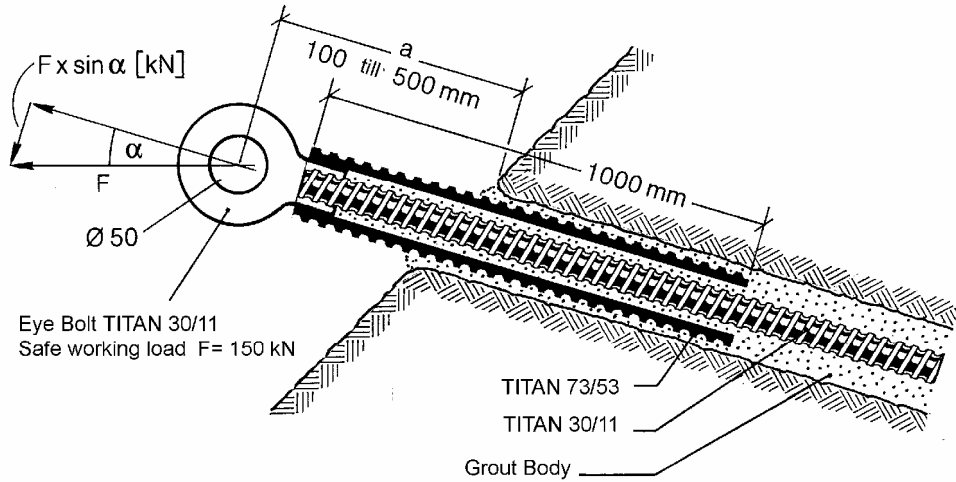
**Corrosion
Protection
Paste
(DENSOFILL)**

HD – PE Pipe

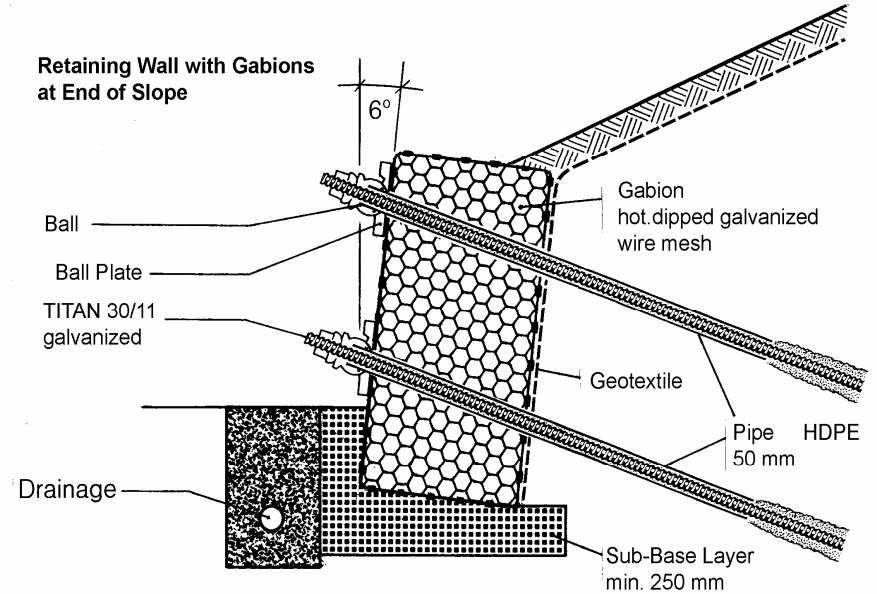


Micropile Head for Soft Facings

**Micropile Head
Tension with Bending**

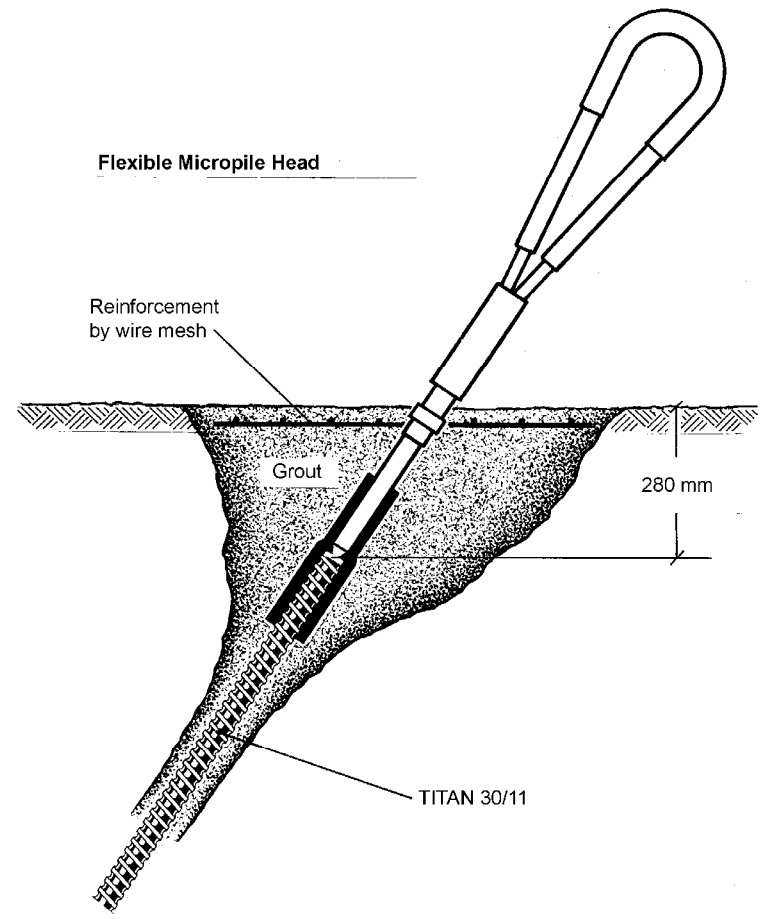


**Retaining Wall with Gabions
at End of Slope**



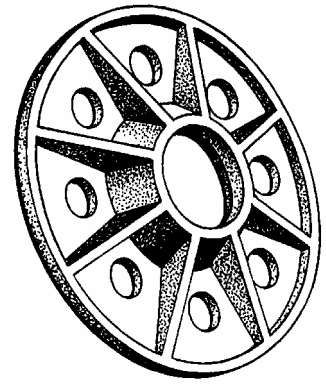
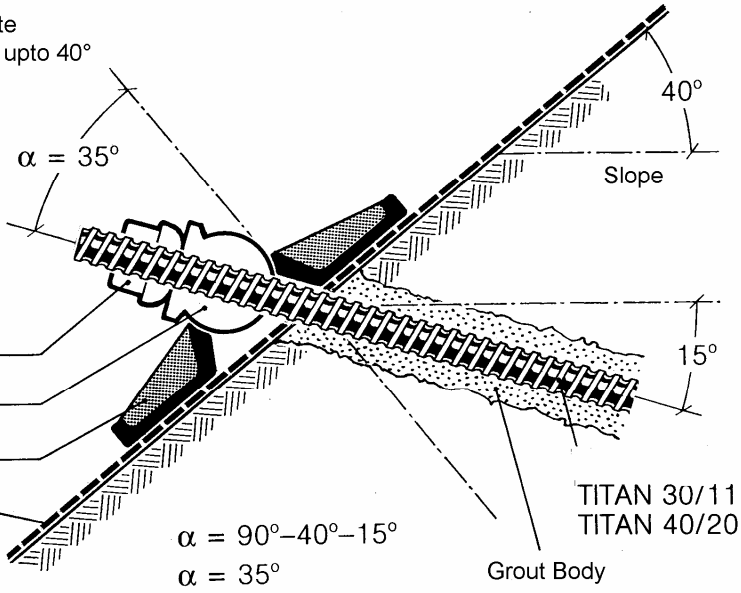
a [m]	$F_x \sin \alpha$ [kN]
0,5	21,6
0,4	27
0,3	36
0,2	54,1
0,1	108,2

Micropile Head for Soft Facings



Micropile Heads for Soft Facings

Geotextile Fixing Plate
adjustable for slopes upto 40°
soil nails inclined 15°



Project: SHENFIELD
Product: 30/16 Soil Nails
Client: Railtrack
Contractor: Jackson Rail / W T Geotechnical



Thanks for your Attention!