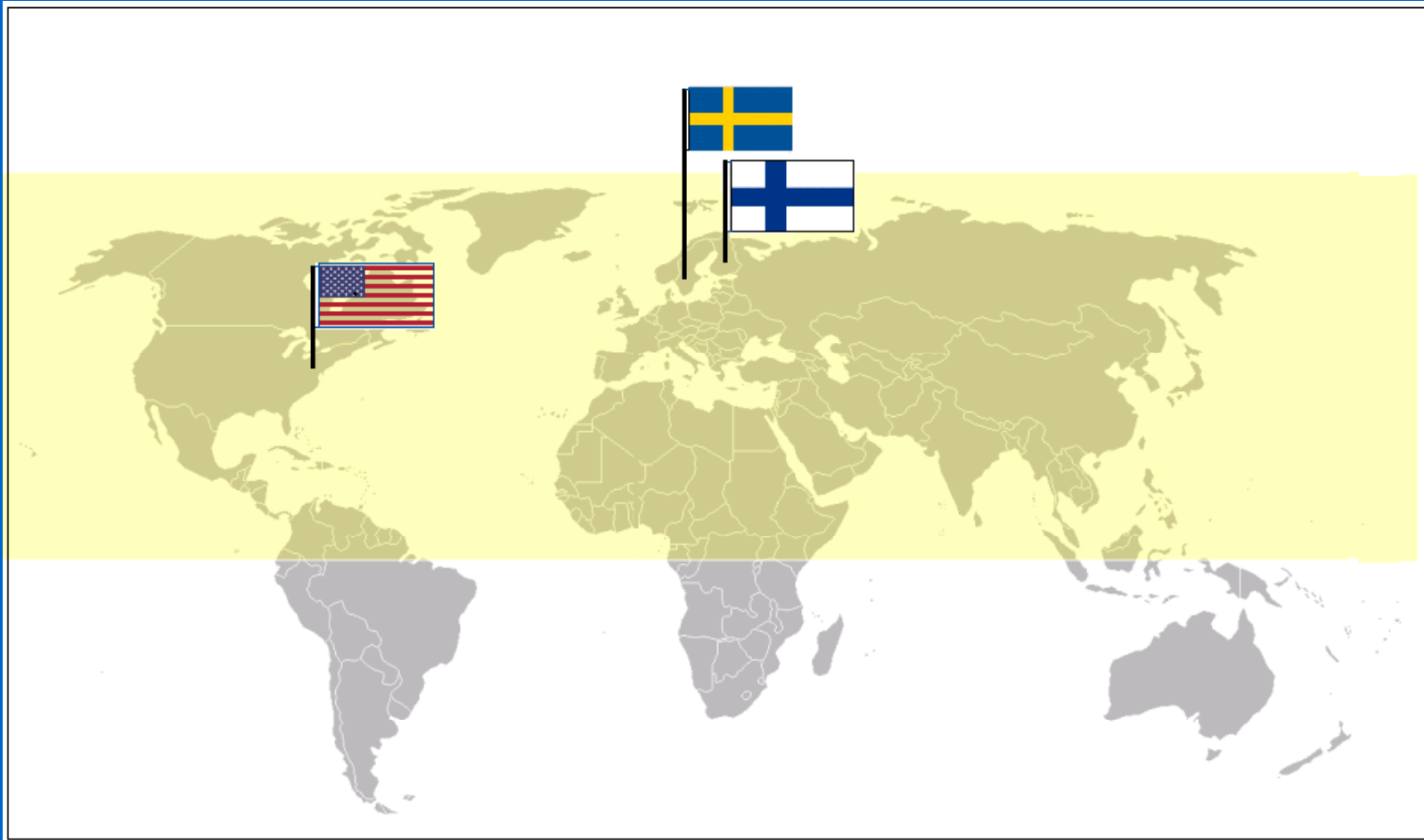


The RD-pile system

by

Håkan Bredenberg

Bredenberg Teknik, Sweden



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Colours ...



Flag of Sweden



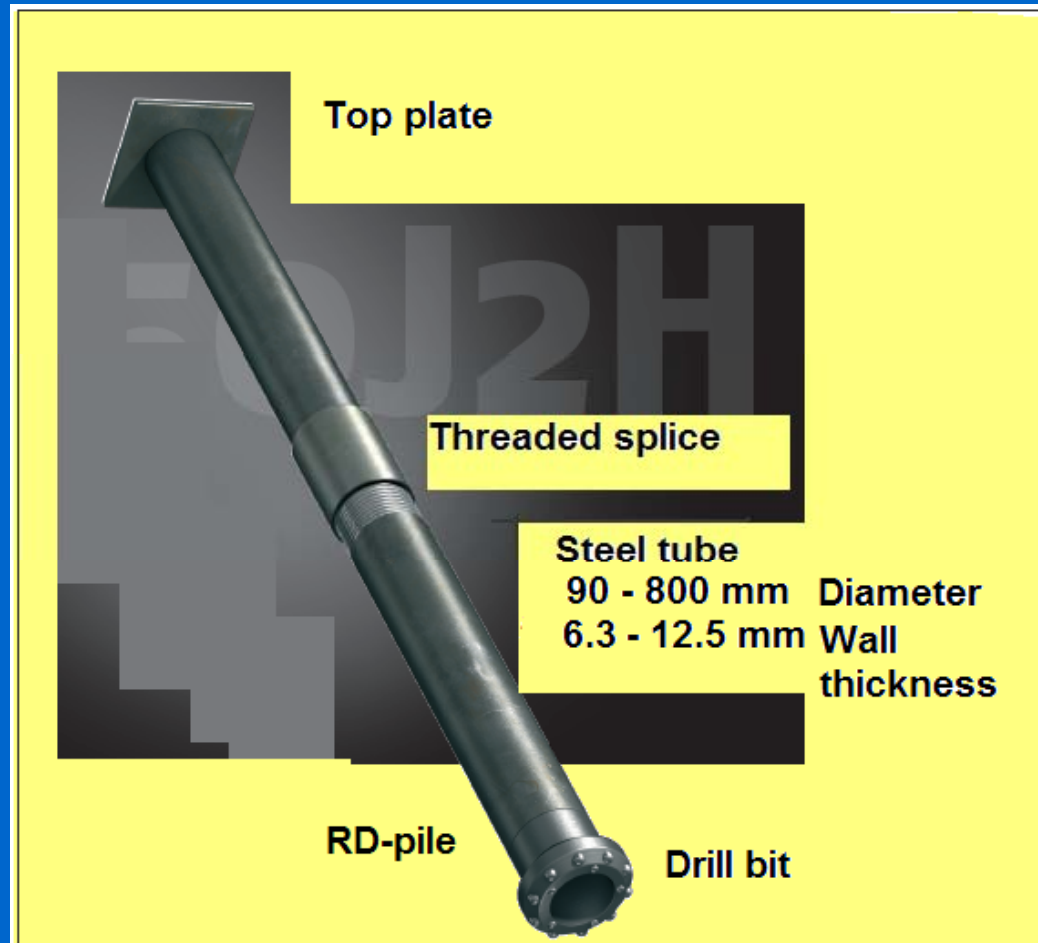
Philadelphia

New Sweden, 1638 - 1655

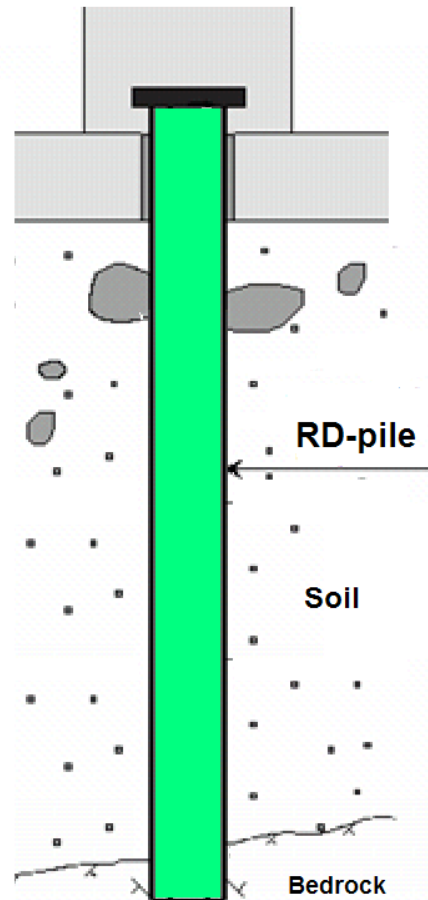


Flag of Finland

Components



It's a point bearing pile

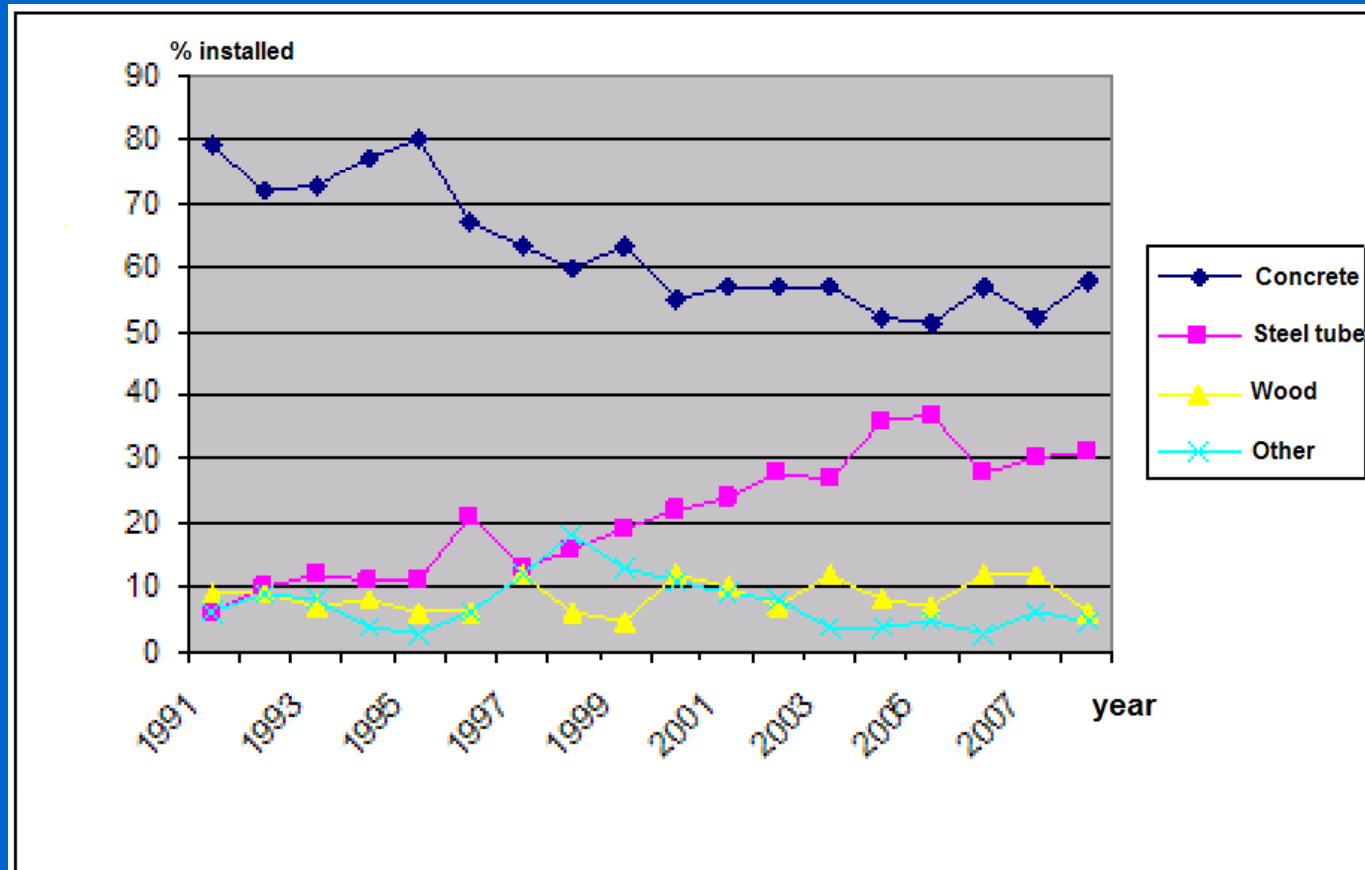


1. Drill RD-tubes down to rock
2. Verify point bearing capacity
3. Clean tube inside
4. Fill tube with concrete

Applications – where piling is required . . .



Piling market - Sweden



30% of 2 milj m = 600 000 m/year

Dimensions

Pile type	Dimensions	Steel grade
RD90/6.3	88.9 x 6.3	S440J2H
RD115/6.3	114.3 x 6.3	S440J2H
RD115/8	114.3 x 8	S440J2H
RD140/8	139.7 x 8.0	S440J2H
RD140/10	139.7 x 10.0	S440J2H
RD170/10	168.3 x 10.0	S440J2H
RD170/12.5	168.3 x 12.5	S440J2H
RD220/12.5	219.1 x 12.5	S440J2H
RD320/12.5	323.9 x 12.5	S440J2H
RD400/12.5	406.4 x 12.5	S355J2H
RD500/12.5	508 x 12.5	S355J2H
RD600/12.5	610 x 12.5	S355J2H
RD700/12.5	711 x 12.5	S355J2H
RD800/12.5	813 x 12.5	S355J2H

Steel Properties

	C [%]	Mn [%]	P [%]	S [%]	CEV [%]
S355J2H	0,22	1,60	0,030	0,030	0,39
S420MH	0,16	1,70	0,035	0,030	0,43
S440J2H	0,18	1,60	0,020	0,018	0,39
S550J2H	0,12	1,80	0,025	0,015	0,39
X60	0,15	1,60	0,030	0,030	0,43
X70	0,15	1,70	0,030	0,030	0,43

For pile dimensions up to RD 320 mm, the tubes are made by a longitudinal weld.

For larger diameters, the weld making up the tube is a spiral one.

Cold formed welded structural hollow sections, fine grain steels.

Installation method: drilling



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Drilling



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Less expensive solution ...



http://topdrill.en.ec21.com/TRB--3185086_3185146.html



Model	No. of Wings	Bit Diameter(mm)		Casing Size(mm)			Applicable Hammer
		Expanded	Retracted	I.D.	O.D.	Wall	
TRB 140	2	185	140	149.8	162	6.1	ACE50
TRB 165	2	213	162	178	194	8.0	ACE60
TRB 190	3	240	187	203.8	219	7.6	ACE60,ACE80
TRB 215	3	265	213	225.9	244.4	9.3	ACE80
TRB 240	3	295	240	254.6	273	9.2	ACE80
TRB 250	3	317	248	270	300	15.0	ACE80,TD100
TRB 280	3	345	280	304.8	323.9	9.6	ACE120
TRB 315	3	379	319	335.6	355.6	10.0	TD112
TRB 360	3	425	356	387.4	406.4	9.5	TD112
TRB 410	3	478	412	435	457.2	11.1	TD320, TD350
TRB 455	3	530	455	482.6	508	12.7	TD450
TRB 510	3	581	508	533.4	558.8	12.7	TD450
TRB 560	3	630	558	584.2	609.6	12.7	TD450, TD550
TRB 600	3	685	603	635	660.4	12.7	TD550
TRB 650	3	737	652	685.8	711.2	12.7	TD550
TRB 700	3	784	706	736.6	762	12.7	TD550
TRB 760	3	835	758	787.4	812.8	12.7	TD550
TRB 810	3	886	809	838.2	863.6	12.7	TD700
TRB 830	4	945	831	876.4	914.4	19.0	TD700
TRB 930	4	1046	931	984.2	1016	15.9	TD800



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The RD-Pile System threaded splice



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Testing of RD-piles



Figure 4.1 Test arrangement for specimen C-RD170-3.

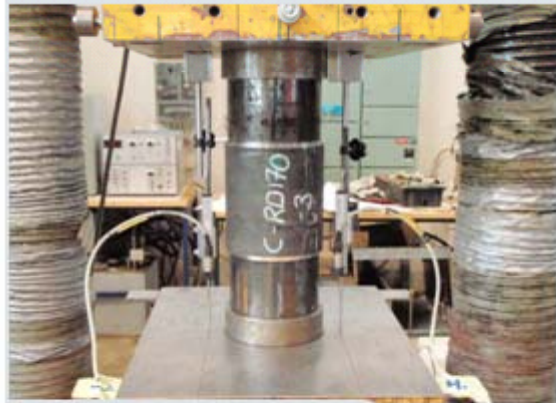
Bending tests



Figure 5.3 Test arrangement for test specimen B-RR170-1.

Some Test Results

Compression



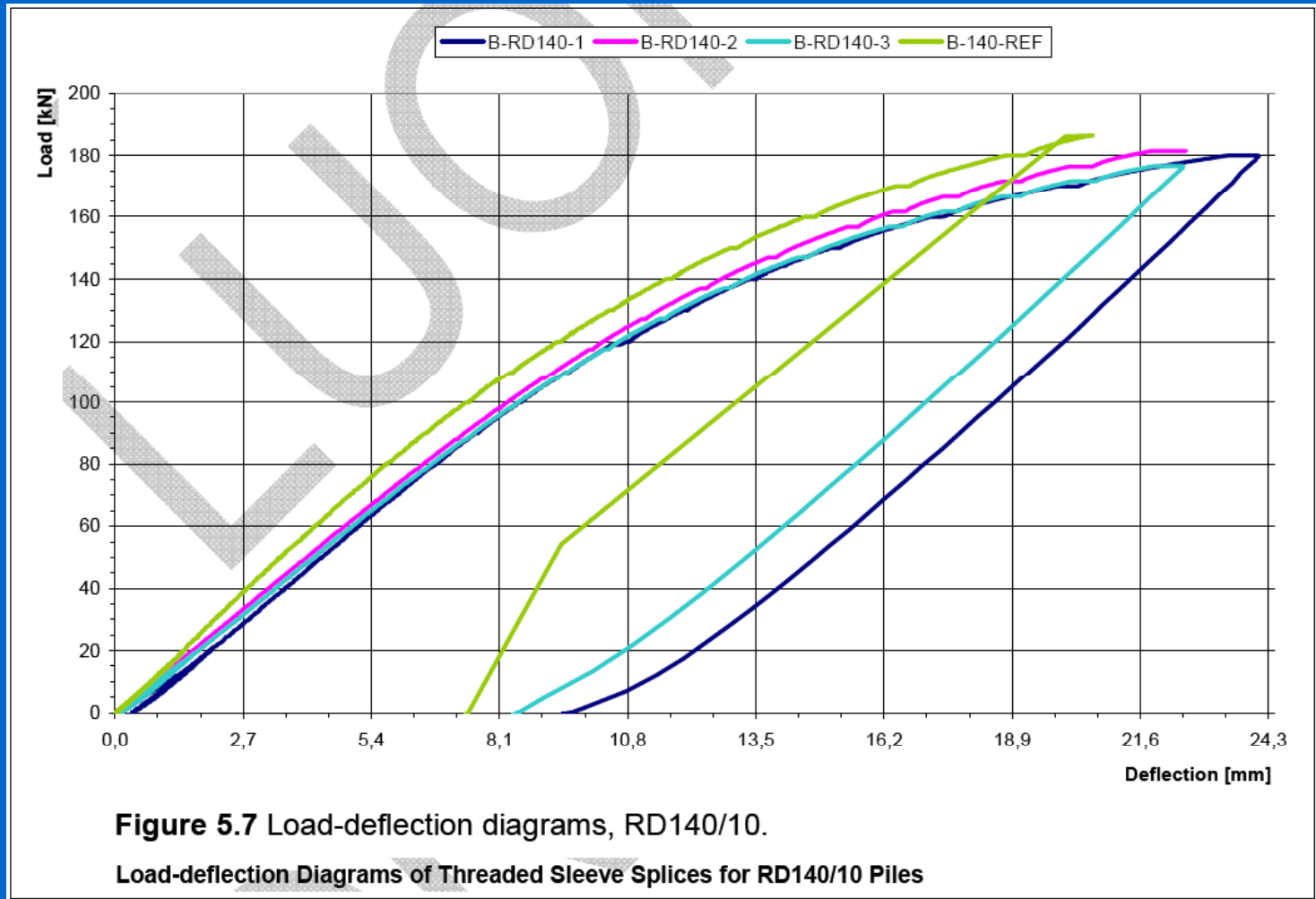
Pile	Compression strength	
	unspliced pile	tested
RDs115/8	1469 kN	1880 kN
RDs140/10	2241 kN	2790 kN
RDs170/12,5	3365 kN	4400 kN

Tension



Pile	Tensile strength	
	tested	unspliced pile
RDs115/8	1470 kN	1469 kN
RDs140/10	2230 kN	2241 kN
RDs170/12,5	3730 kN	3365 kN

Result from bending test



Compressive tests



Tensile testing

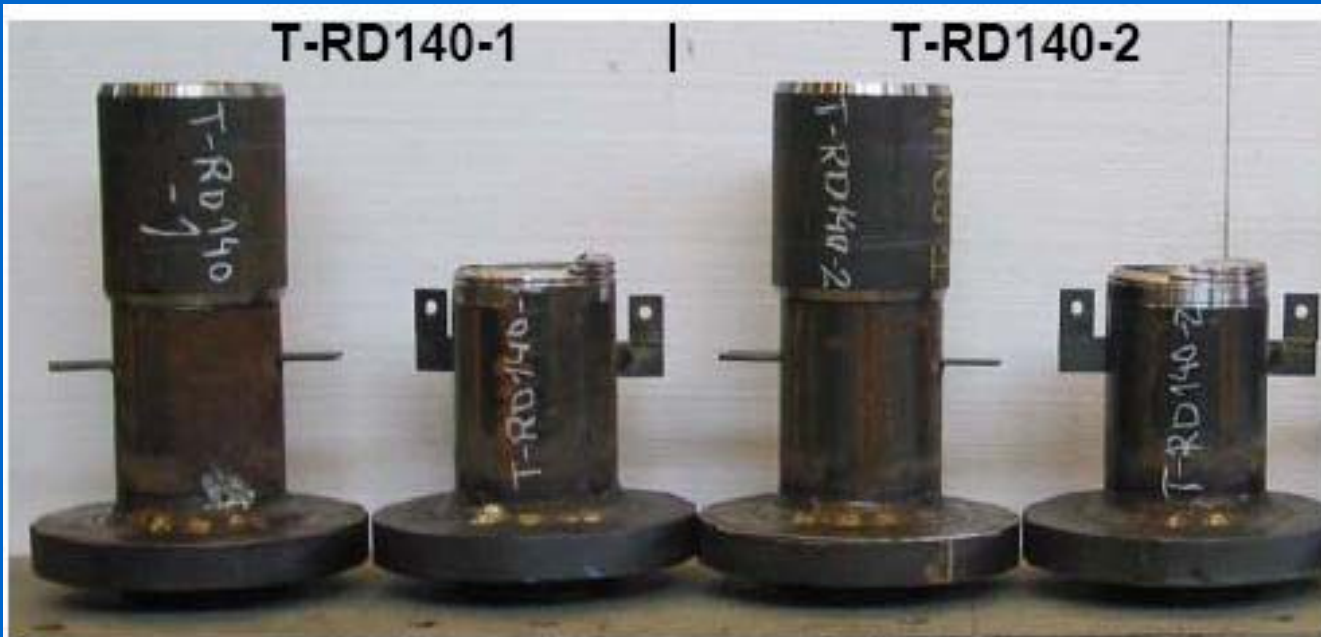


Figure 7.7 Test specimens after tensile tests, threaded sleeve splices RD140/10.

Bending tests



Figure 5.13 Failure of B-RD115-1.

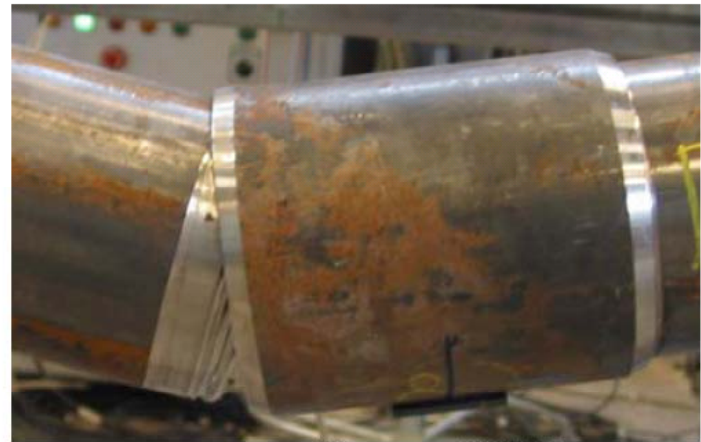


Figure 5.14 Failure of B-RD115-2.

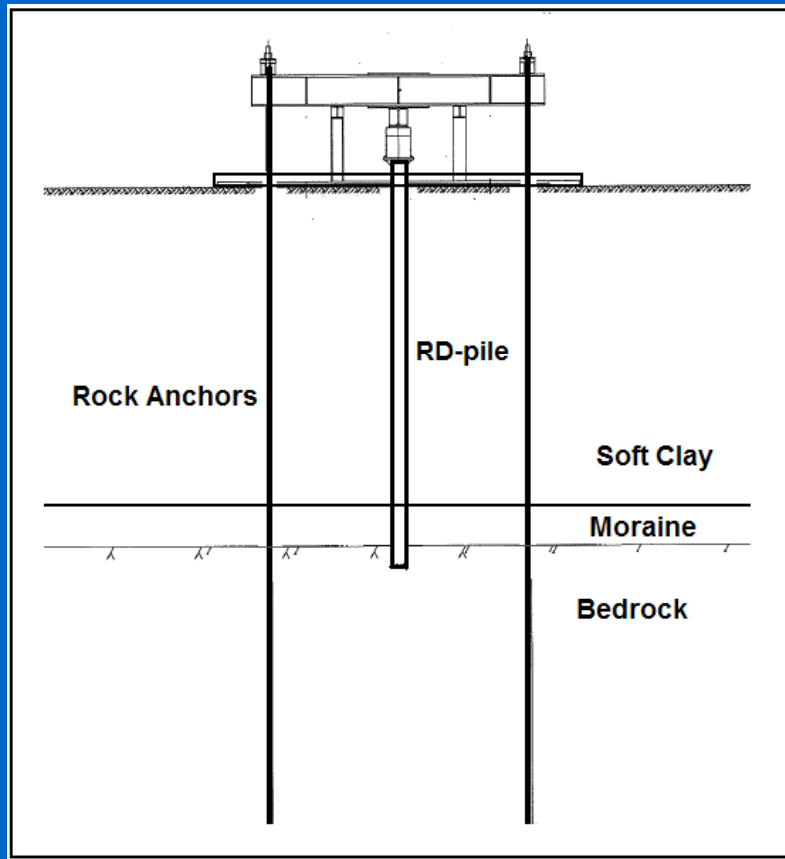


Figure 5.15 Failure of B-RD115-3.



Figure 5.16 Failure of B-RD140-2.

Full Scale Load tests

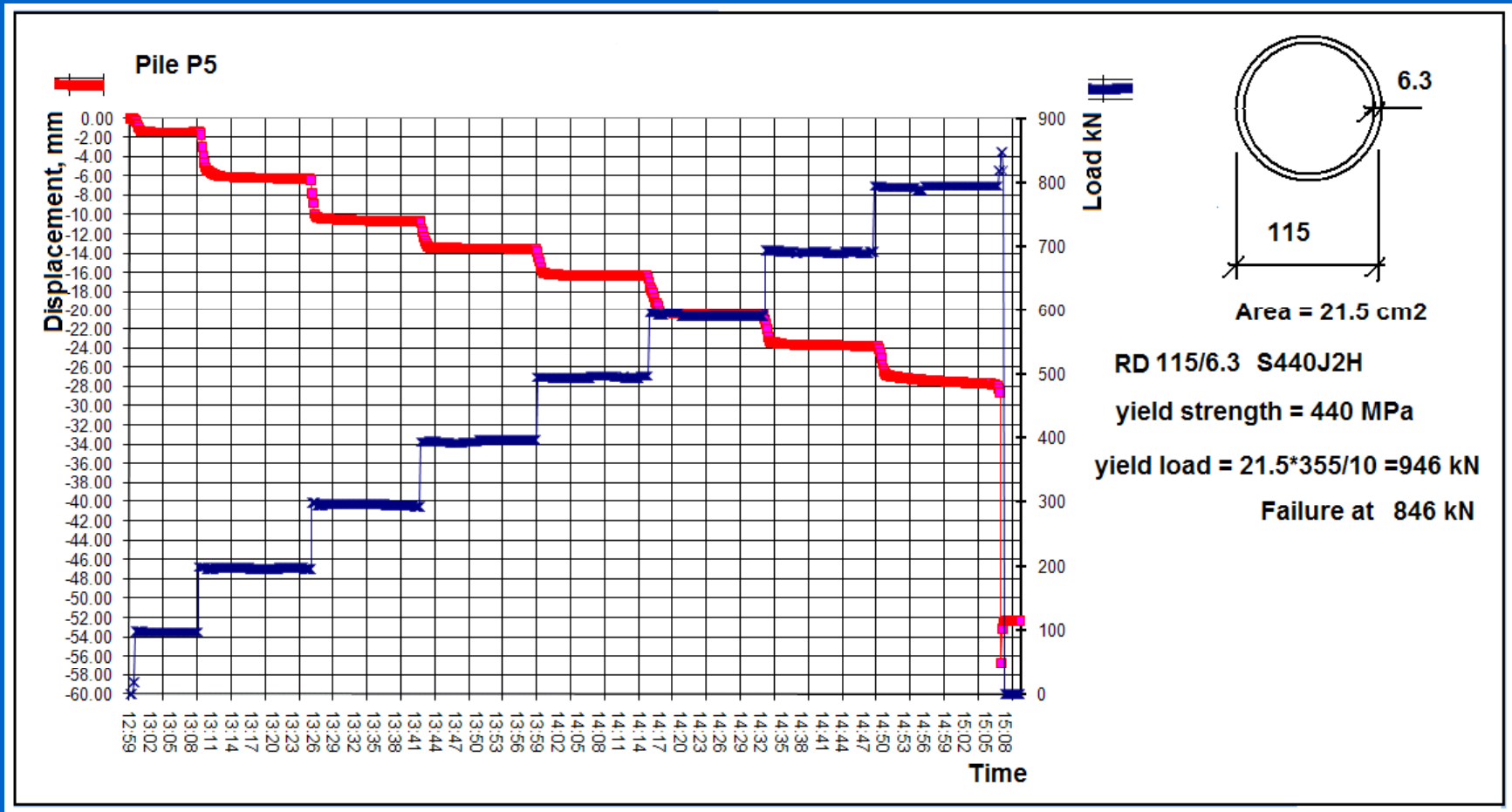


<http://www.veia.se/projekt/ruukki/index.html>

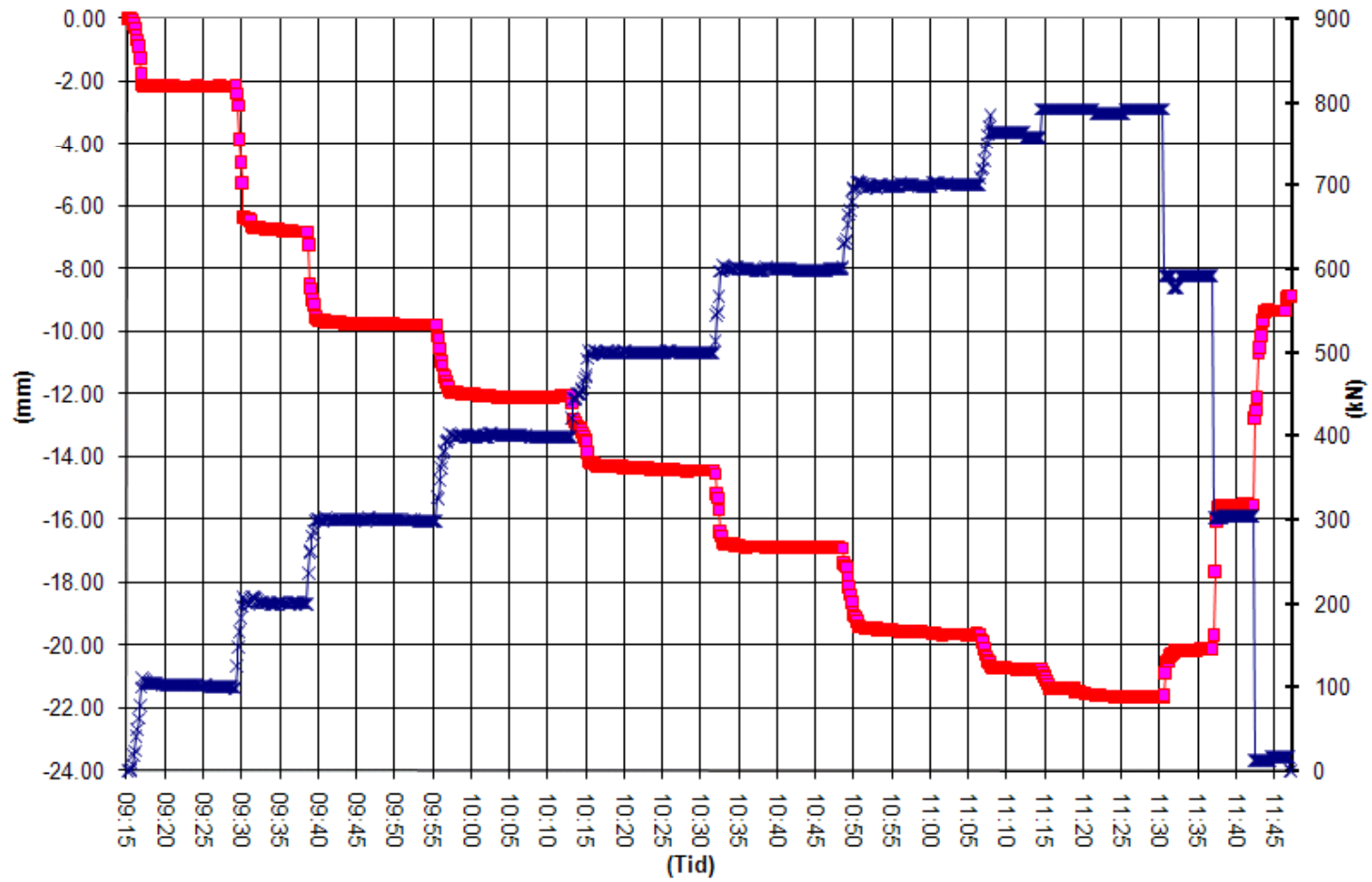
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P2



PC-program for evaluation of pile capacity

RR-RD-Pile, Ver. 1.0, Ruukki Sverige AB

File Calc Print Help

Input

Project name: Hovsta
 Identification: Provpålar P1 - P5
 Material (MPa/GPa): S440 J2H fyk/fyd = 440,0 / 396,0 MPa
 E-modulus, Ek = 210 GPa
 Driving reduction my = 0,90
 Safety Class: 1 2 3
 Shape factor ny/nz = 1,25
 Zy/Wy = 1,34
 Soil
 Ym for soil = 1,60 (both kd and cud)
 cuk = 10,00 kPa
 portion long time load = 90 %

File

File Input
 Pile = RR115/6.3
 Corrosion
 Outside corrosion = 0,0 mm
 Inside corrosion = 0,0 mm
 Option 1: Built in Stresses Group 1 2 3
 Option 2: Jointed Pile Yes No
 Option 3: Straightness check Yes No
 Option 4: Pile filled with Concrete Yes No

Deflection
 Initial deflection:
 deltaF (fictiv) = 1,1 mm (Opt 1)
 deltaG (geometrical) = 9,0 mm (Opt 2 & 3)
 Total deltaF+deltaG = 10,1 mm
 Corresponding radius of curvature = 161,3 m

Soil Data
 cud, kPa: 6,3 kPa
 Nc = 6,3
 Mc = 54,1
 qB, yield pressure = 39,4 kPa
 yB, yield deflection = 13,3 mm
 k, soil subgrade coeff = 2955,7 kPa/m
 kd = 337,8 kPa

Pile Capacity
 Buckling Length Lc = 3,61 m
 Local Buckling Index = 781 MPa
 (if > fyk no local buckling)
 Steel Yield Force FM = 575 kN at 20 mm
 Buckling force Fk = 589 kN at 27 mm
Pile Capacity = 575 kN

Results

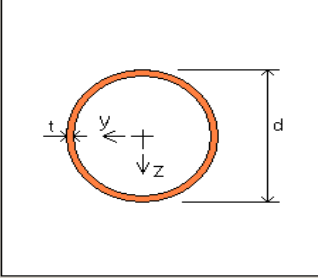
Soil Data

Pile Capacity

Deflection

F=707 kN
 589 kN
 575 kN
 0
 20,1 27,3
 mu0 = 55 mm Deflection

Steel Yield —
 Buckling —



Design of RD-piles – www.ruukki.com
 - Design tables, drawings, checklists – and more ...

Thank's for your attention !

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