

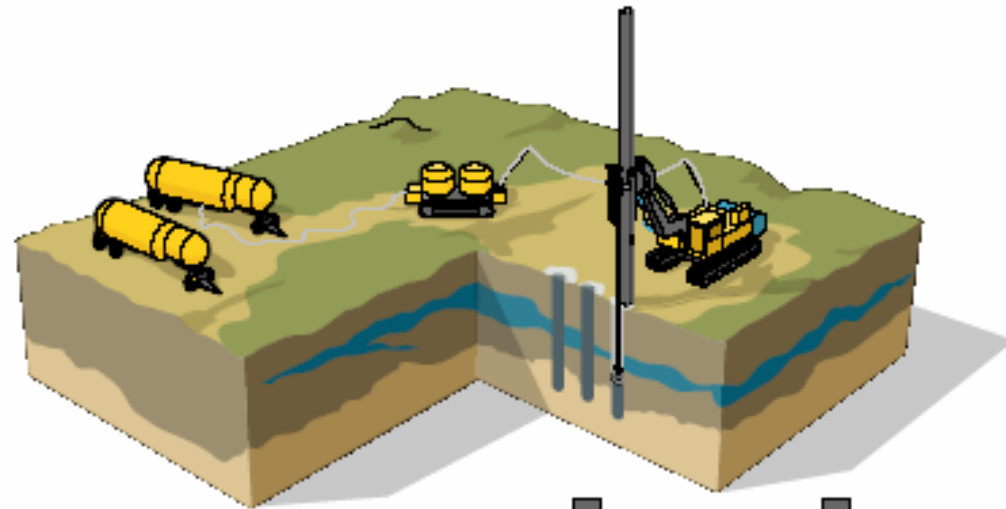
MDM™ challenges CFA Foundation of Parking House

Structure of Presentation

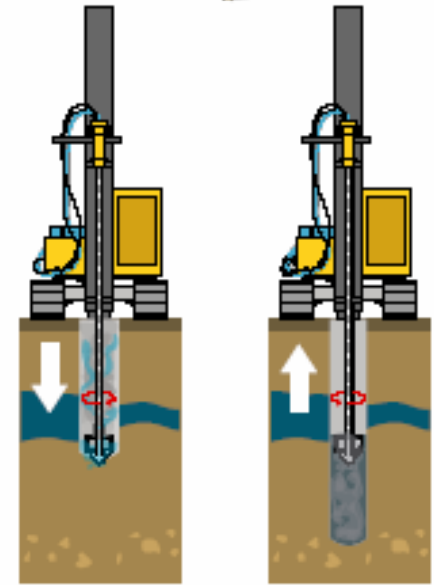
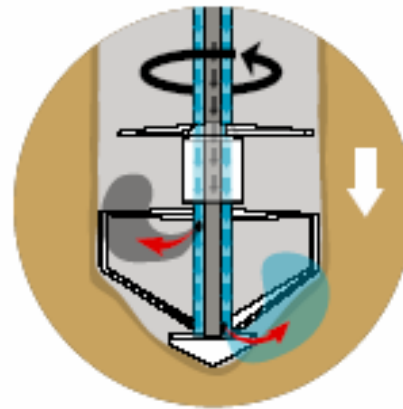
- Why MDM over CFA? – Overview MDM
- The Project
- Design
- Pre-testing
- Execution and QA/QC
- Continued monitoring
- Completion and Summary

MDM™ Modified Dry Method

Logistics and Execution Principles



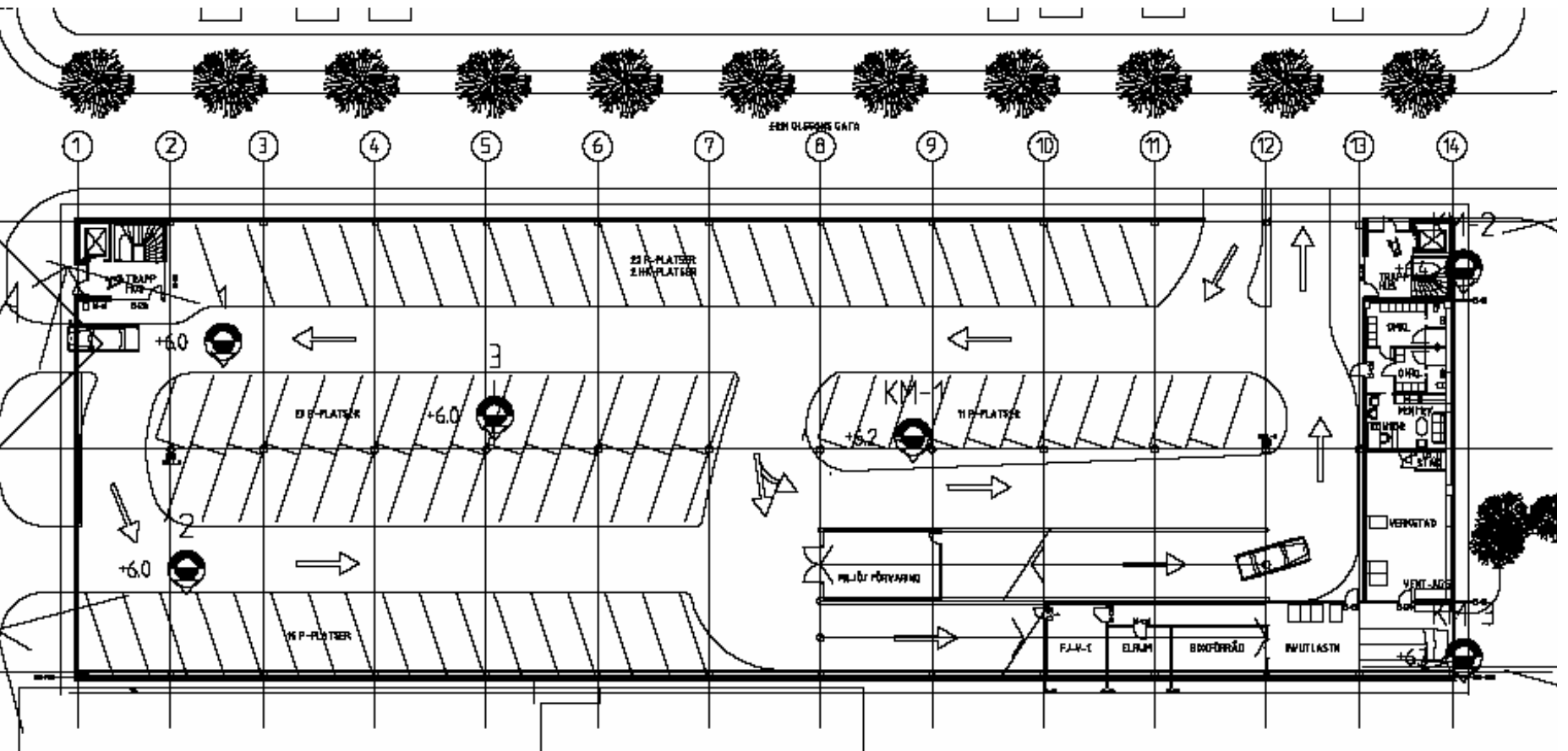
- Improves dry soils
- Penetrates stiff soils
- Optimizes mixability
- Activates the binder
- Minimizes spoil



Why MDM over CFA?

- Time savings. Substantially faster installation with MDM. Overall construction time for project reduced.
- Cost savings. 30% lower cost using MDM as foundation method

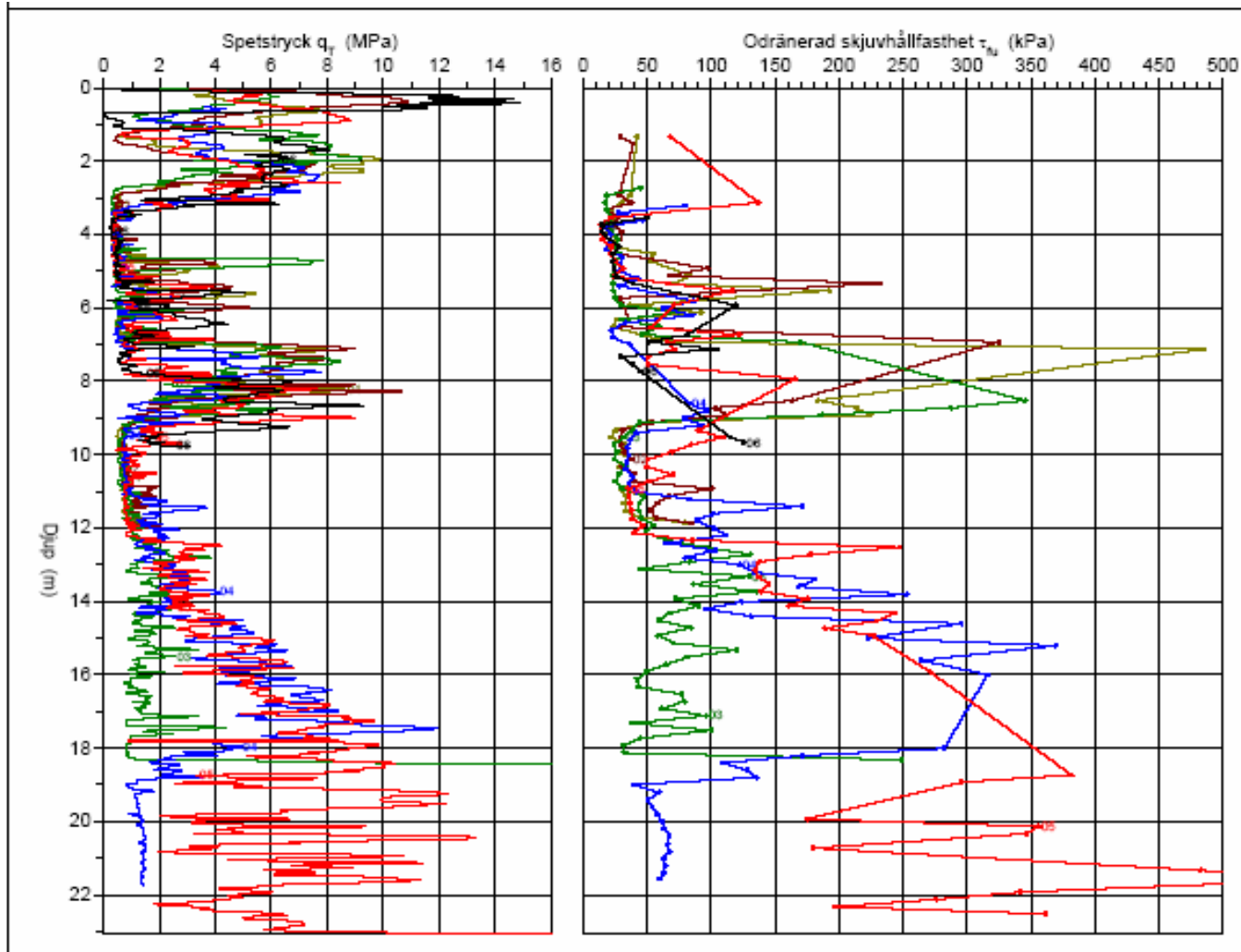
4 Story Parking Garage



CPT – test results

Cone resistance

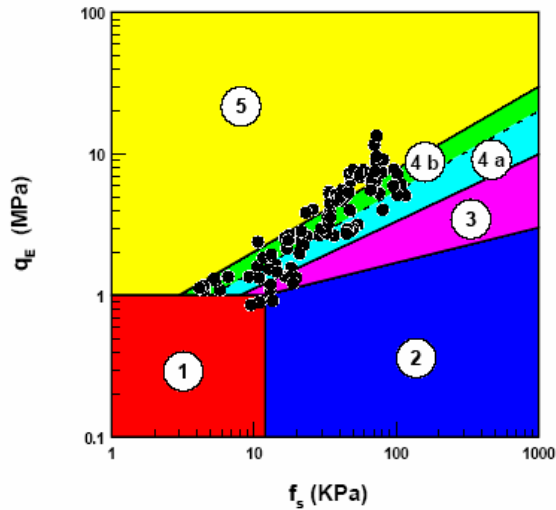
Undrained shear strength



Interpretation of soil layers

WSP 4A

Classification Chart
Eslami-Fellenius

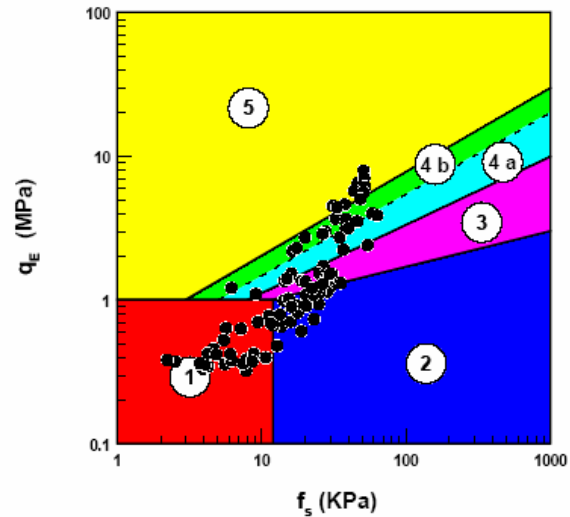


Key

- 1- Very Soft Clays – Sensitive Soils
- 2- Clays
- 3- Silty Clays – Stiff Clays
- 4- Sandy Silt and/or Silty Sand
 - a Sandy Silt and Silt
 - b Fine Sand and/or Silty Sand
- 5- Sands – Gravels

BH 3

Classification Chart
Eslami-Fellenius



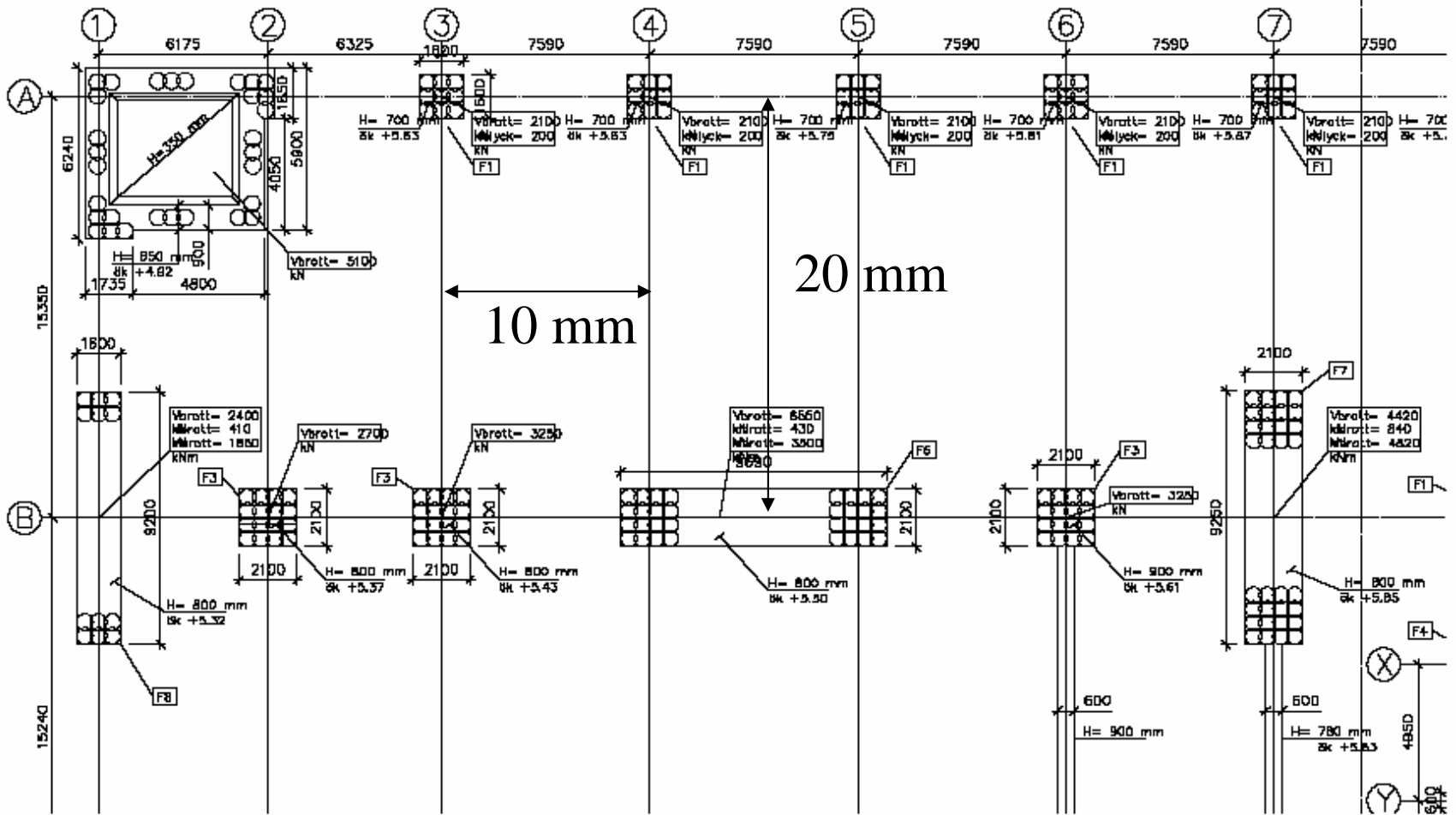
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Loads & pile design

Design parameters

- Total settlement 40 mm
- Differential settlement 1:800
- Environmental impact



Load characteristics

- Sliding

- Vertical 2100 kN (472 Kipf)
- Horizontal 200 kN (45 Kipf)
- Required friction
 - 5.4 degrees !!!!!

Result:

- Small stresses
- No reinforcement

- Shear

- Horizontal 200 kN (45 Kipf)
- Area $1.6 * 1.6 = 2.56 \text{ m}^2$
- Shear strain 78 kPa (11.3 psi)

- Contact pressure

- Horizontal 200 kN (45 Kipf)
- Contact surface $1.6 * 2 = 3.2 \text{ m}^2$
- Contact pressure 63 kPa (9.1 psi)

Load capacity MDM – piles

- Load 2100 kN (472 kipf)
- Load transfer surface, 2.56 m²
- Compressive stress 820 kPa (118 psi)
- Average compressive strength approx. 3000 kPa (435 psi)
 - Safety factor 3.7

Description of work

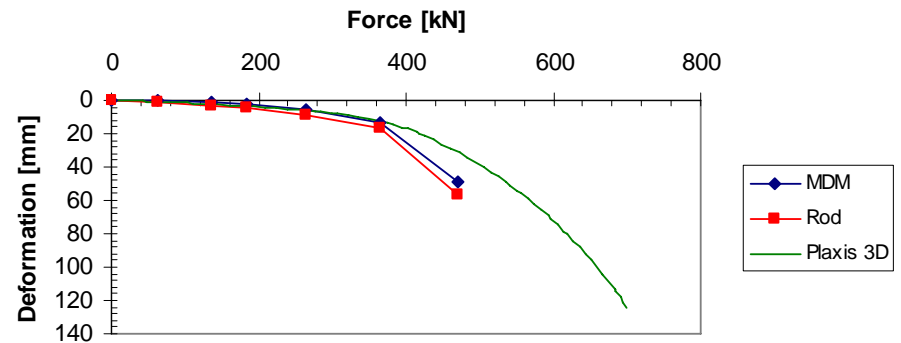
- Grading
 - Cut-off level +1.0
 - Widening of excavation
- Setting out
- Installation
 - Piles to be installed with overlap; fresh in fresh
 - Min 0.5 above cut-off
- Final grading
 - Within 0.5 – 3.0 hours
- Frost protection
- Curing 3 days
- Casting of slabs
 - Form work
 - Reinforcement
 - Pouring of concrete
- **Quality control!**

Example of block of columns & concrete slab



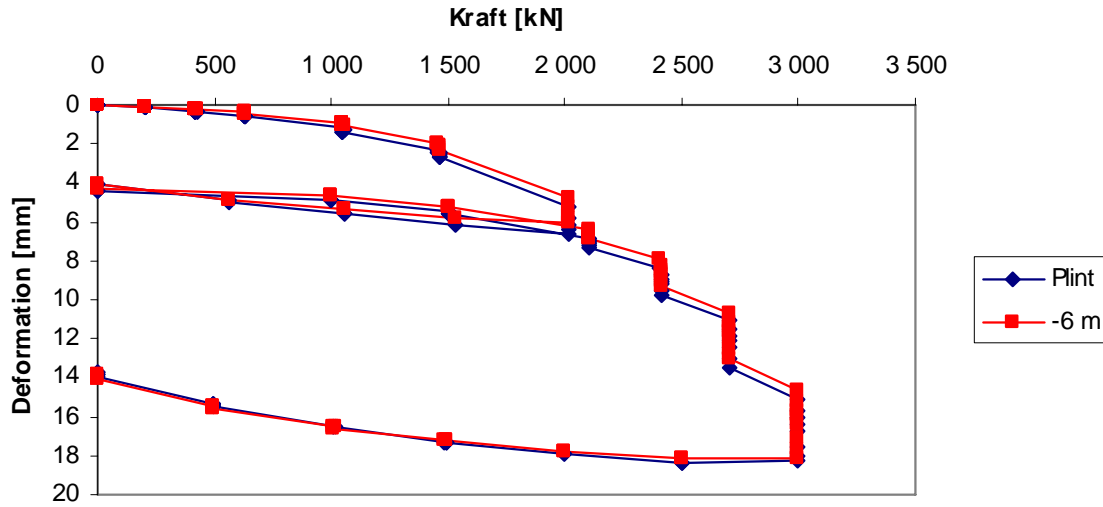
Extraction of columns – Static load test

- Pullout force 510 – 610 kN (114-137 kipf)
- Age 2 weeks
- Weight 45 kN (10kipf)
density 2.27 ton/m³
- Cohesion 39 – 46 kPa



Static load test results

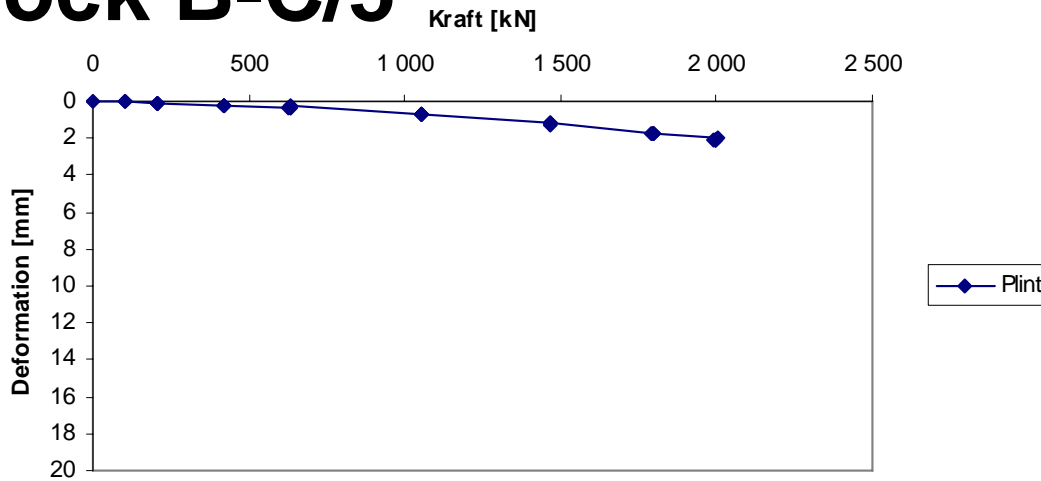
MDM block A-B/12



- 9 piles, 12 m long (net)
- 4 mm permanent deformation at 2100 kN (472 kipf)
- Secant modulus (2100 kN) – 2.5 GPa

Static load test results

MDM block B-C/5



- 9 piles, 16 m long (net)
- No permanent deformation at 2100 kN (472 kipf)
- Secant modulus (2100 kN) – 6 GPa
- Titan tension piles pulled out at 2100 kN (472 kipf), test abandoned

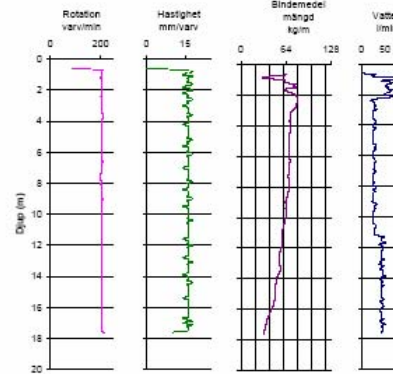
Computer Controlled Installation



Projektnamn P-hus Gamle Tull
 Delområde Halmstad
 Beställare NCC

Pelarnr 01022-A.1
 Installationsdatum 4/18/2005
 Tid 9:29:51

Borring nedåt



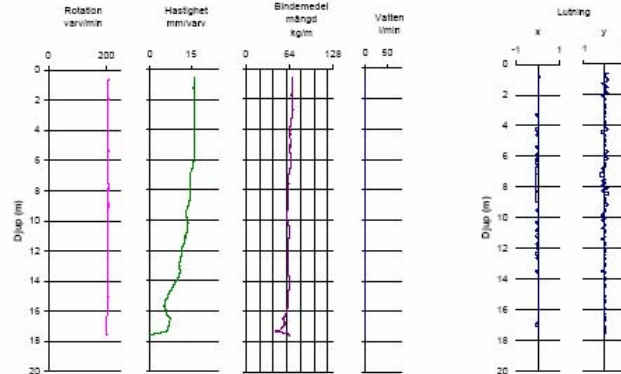
Maskin KC-4
 Operatörer Svante-Bua-Martin

Verktyg diam [mm] 600
 Tot bindemedel [kg] 2112
 Luftryck medel [Mpa] 0.71
 Tot vatten [lit] 605.9

Borrat djup [m] 17.5
 Stabiliserat djup [m] 16.98
 Tomborring [m] 0.52

Rotation enl handl 200
 Bindemedel enl handl Cem III 64+64
 Stigning enl handl 15
 Verktyg enl handl 600 mm

Borring upp



01020_A.xls

Visual control during installation



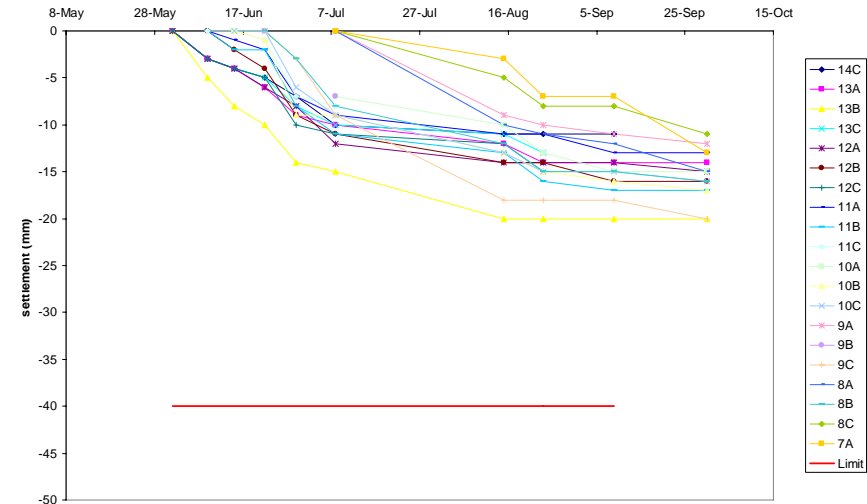
Visual Inspection of Extracted Columns Performed on continuous basis



Continued Monitoring of MDM installation

Settlement monitoring parking garage Civic Tail

HR	1-Jun	1-Jul	8-Jun	15-Jun	22-Jun	29-Jun	6-Jul	13-Aug	20-Aug	27-Aug	3-Sep	14-Sep
14C	0.000	0.000	-3	-4	-5	-7	-10	-11	-11	-11	skid	
13A	0.000	0.000	-3	-4	-8	-9	-10	-12	-14	-14	-14	-14
13B	0.000	0.000	-3	-4	-10	-14	-15	-20	-20	-20	-20	-20
15C	0.000	0.000	-3	-4	-5	-6	-8	-11	-11	-11	skid	
12A	0.000	0.000	-3	-4	-8	-9	-12	-14	-14	-14	-14	-15
12B			0	-2	-4	-6	-11	-14	-14	-14	-16	-16
13C	0.000	0.000	-3	-4	-5	-10	-11	-12	-15	-15	skid	
11A			0	-1	-2	-7	-8	-11	-11	-11	-13	-13
11B			0	-2	-2	-8	-11	-13	-16	-16	-17	-17
11C			0	0	-1	-7	-8	skid				
10A				0.000	0	-7	-10	-10	-10	-10	-10	-10
10B				0.000	-1	-6	-9	-10	-10	-10	-10	-17
10C				0.000	0	-6	-9	-10	-10	-10	-10	-16
9A					0.000	-7	skid					-12
9B		0.000			0.000	-3	-6	-10	-10	-10	-10	-20
9C		0.000			0.000	-3	-6	-10	-10	-10	-10	-15
8A		0.000				0.000	-6	-11	-11	-11	-12	-15
8B		0.000				0.000	-6	-10	-10	-10	-10	-16
8C		0.000				0.000	-5	-9	-9	-9	-9	-11
7A		0.000				0.000	-3	-7	-7	-7	-7	-13
7B		0.000					0.000	-5	-6	-6	-6	-10
7C		0.000					0.000	-6	-6	-6	skid	
6A		0.000					0.000	-6	-7	-7	-7	-10
6B		0.000					0.000	-4	-4	-4	-4	-8
6C		0.000					0.000	-7	-11	-11	-11	-16
5A		0.000					0.000	-6	-6	-6	-6	-13
5B		0.000					0.000	-1	-1	-1	-1	-9
5C		0.000					0.000	-6	-10	-10	-10	-15
4A		0.000					0.000	-5	-6	-6	-6	-13
4B		0.000					0.000	-1	-1	-1	-1	-9
4C		0.000					0.000	-2	-2	-2	-2	-13
3A								0.000	-6	-6	-6	-11
3B								0.000	0	-7	-7	-12
3C								0.000	0	-8	-8	-12
2A									0.000	-3	-3	-8
2B									0.000	-6	-6	-11



Parking House founded on MDM™ - columns



- Columns installed in blocks
 - 3 to 16 columns/block
 - 600 mm columns
 - 14 to 16 m length
- Column strength
 - Average 9 MPa
 - 3 to 17 MPa
- Column load
 - 250 to 300 kN

State of completion as of June 27, 05.



State of completion as of Nov. 13, 05.



Summary

- Project completed on time. 3 weeks for installation of 7500 lin. Meter
- Production rate of 500+ Im./10h shift
- Initial cost reduction estimate realized (30%)

Hercules

Deep Foundations

www.hercules.se

**P.O. Box 714
SE-169 27 Solna
Sweden**

Phone: +46 8 58 55 29 00

Fax: +46 8 58 55 29 29

info@hercules.se

www.hercules.se

LC Technology, Inc

www.lctechnology.us

U.S. Office

1223 Wilshire Blvd. # 1760

Santa Monica, Ca 90403

Office (310) 458-3491

Fax (310) 393-2943
