REPORT OF PDA & DLT ON 1 PILE, St. RAPHAEL PROJECT

23 August 2021

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1 Introduction

This report contains the preliminary evaluation of the PDA (Pile Driving Analysis) measurements on 1 Steel pile. The PDA-test took place of 27th of June 2013 and has been carried out by the company xxxxx

The piles have been driven by a Delmag D22 Diesel Hammer.

To determine the ultimate bearing capacity of the pile a DLT (Dynamic Load Test) is recommended after a set up period of at least 3 days. The Dynamic Bearing Capacity and the Static Bearing Capacity of the piles have been determined using the Case method.

2 Project information

The project location is situated in

Fig 2.1 General impression of test location at

3 Soil Investigation

The available soil investigation consists out of a single dilatometer test and soil samples. The location is marked in Figure 2.1. The complete test information is enclosed in appendix A.

4 Hammer Cushion and pile information

The Pile has been been partly driven by a Vibratory hammer up to a depth of 6.75m after this procedure the pile has been driven by a Delmag D22 Diesel Hammer. The pile type which has been used is circular steel pile. In the following table (4.1) an overview is given of the pile information.

Table 4.1
Pile information

Number	Dimensions Diameter and Length	Elasticity mode MPa	Mass density kg/m³
1 Test	Ø 914 mm x 14.3 m (wall thickness 11 mm)	210	7800.00



Fig 4.1 Impression of the Pile and project location



Fig 4.2 sensor mounting

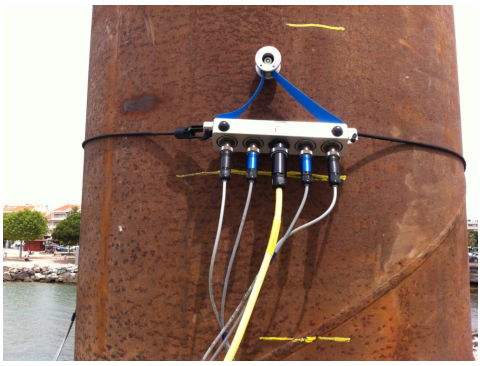


Fig 4.3 mounting of junctionbox

5 Measuring equipment

The PDA measurements have been performed with a Profound PDA system (Fig. 2) .

Two combined acceleration strain transducers (Fig.3) have been mounted at 2 m from the pile top. The applied acceleration transducers are piezo-resistive. The calibration certificates of the sensors are presented in appendix B.



Fig. 5.1 PDA USB conditioner and laptop



Fig.5.2 Combined acceleration-strain transducer

The strain and acceleration signals are transferred to a signal conditioning unit, digitised and transferred to force and velocity signals. During driving all measured hammer blows are recorded on hard disk and the measurement results presented on the lap-top screen.

6 Measuring results

In the table below the Pile driving Analysis Results are presented. The detailed results with graphical output are presented in chapter 5 and 6.

6.1 Summary of the measurements.

Table 6.1 Summary of the tests		
Pile	**Measurement log**	**Setup period**
No	**(Date and time)**	**(Days)**
1	PDA 27-06-2013	-
2	DLT 02-07-2013	4

Table 6.2 Pile Driving Analysis Results (PDA)			
Pile	**Maximum Compression At measuring level**	**Maximum Compression In the pile**	**Maximum Tension In the pile**
No	**MPa**	**MPa**	**MPa**
1	108	108	13

Table 6.3 Dynamic Load Testing Results (DLT)		
Pile	**Total Driving Resistance**	**Mobilised Static Resistance**
No	**MN**	**MN**
1	5.7	3.7

6.2 Sensor parameters

```
GENERAL TRANSDUCER DATA
Cable length                                        :40.000[m]

SIGNAL TYPES
Accelerations and strains  = 1
Velocities and strains     = 2                      :1

DATA ACCELERATION TRANSDUCERS

ACCELERATION TRANSDUCER CHANNEL 1
Serial number acceleration transducer channel 1     :AC1038
Calibration factor acc. transd. channel 1           :0.0253 [mV/g]
  (Excitation voltage 10V)
ACCELERATION TRANSDUCER CHANNEL 2
Serial number acceleration transducer channel 2     :AC1039
Calibration factor acc. transd. channel 2:          :0.0256[mV/g]
  (Excitation voltage 10V)
GENERAL DATA ACCELERATION TRANSDUCERS
Distance accel. transducers from pile top           :2.000[m]
Smoothing value acceleration signals                :30

DATA STRAIN TRANSDUCERS

STRAIN TRANSDUCER CHANNEL 3
Serial number strain transducer channel 3:          :ST1041
Calibration factor strain transducer channel 3      :3.90
Cable type  (1 = YELLOW AWY16, 2 = RED AWR4          :1
             3 = BLACK AWB4  , 4 = BLACK AWB16
             5 = YELLOW UWY16

STRAIN TRANSDUCER CHANNEL 4
Serial number strain transducer channel 4           :ST1042

Calibration factor strain transducer channel 4      :4.16
Cable type  (1 = YELLOW AWY16, 2 = RED AWR4          :1
             3 = BLACK AWB4  , 4 = BLACK AWB16
             5 = YELLOW UWY16)


GENERAL DATA STRAIN TRANSDUCERS
Distance strain transducers from pile top           :2.000 m
Smoothing value strain signals                      :30
```

SIGNAL PROCESSING DATA

Scaling of force and velocity x impedance		
No scaling	= 0	
Automatic scaling velocity to force	= 1	
Automatic scaling force to velocity	= 2	
Manual input scaling factor	= 3	:1
Sample time in microseconds		:20

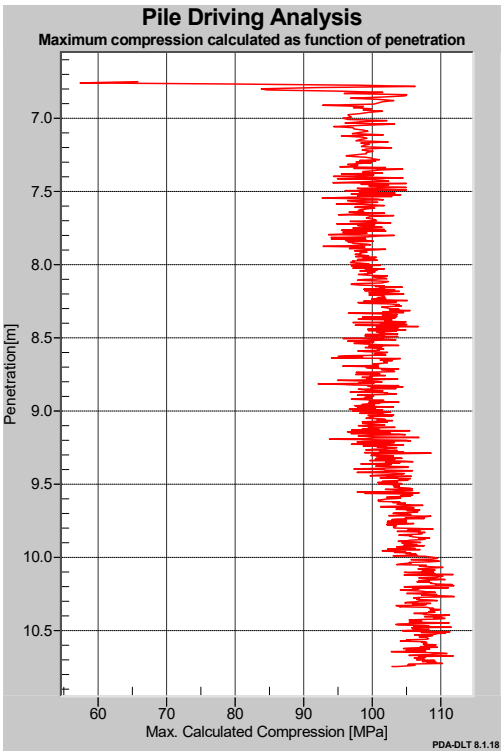
GENERAL DATA

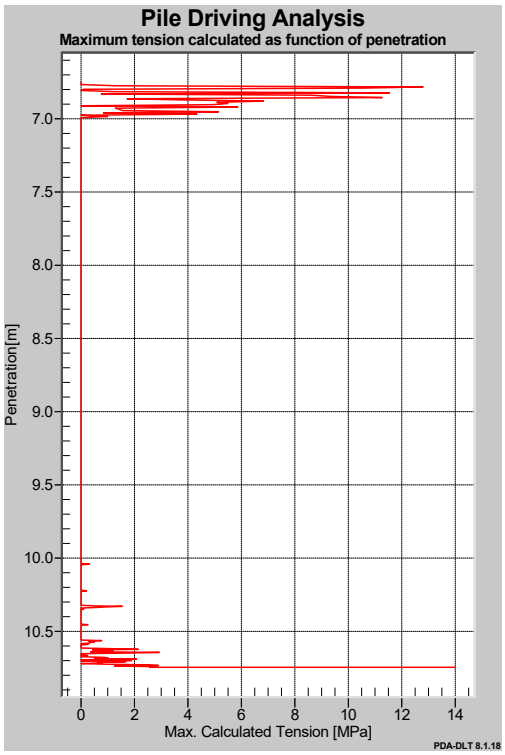
Test date	:27-06-2013
Site name	:Port de St Raphael
Site location	:St Raphael France
SPT contractor	:
Client's name	:RAZEL/BEC - CARI
Client's address	:
City	:
Country	:France
Name of operator	:G. BOULLENOIS
Type of pile driving hammer	:Delmag D22
Rated energy hammer	:38.0[kNm]

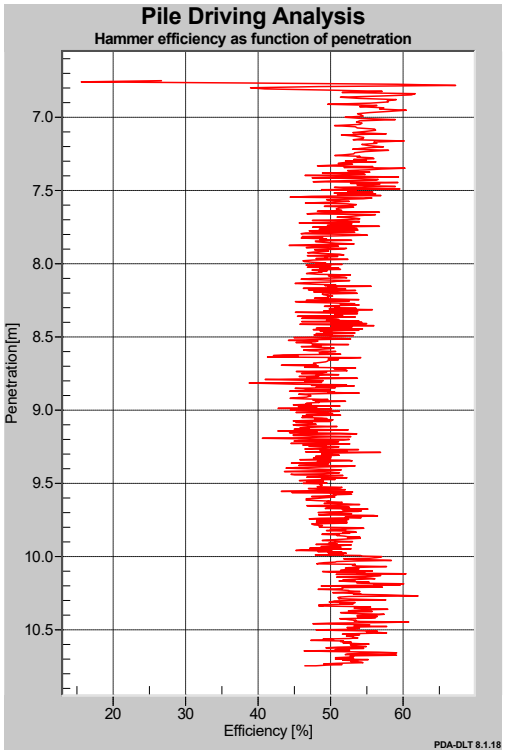
PILE DATA

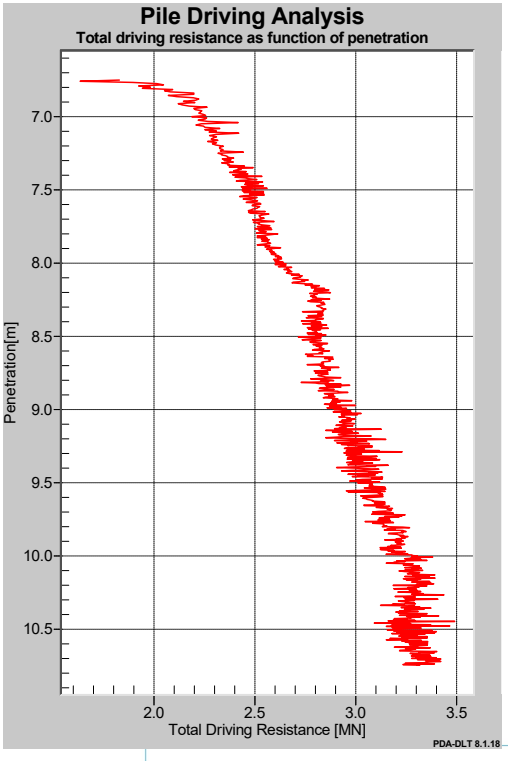
Pile type	:open end pile
Pile number	:test frejus 270613
Length below measuring level	:12.300[m]
Inclination (tan of angle with vertical)	:0.000[-]
Modulus of elasticity	:210.000[MPa]
Stress wave velocity	:5188.745 [m/s]
Cross section type	: Open Ended Pipe Pile
Outer pile diameter	:0.914[m]
Wall thickness	:11.0[mm]
Cross sectional area pile	:0.0312[m2]
Perimeter pile	:2.8714[m]
Outer pile diameter toe	:0.914[m]
Cross sectional area pile toe	:31205.4[m2]
Tension alarm level	:0[MPa]
Compression alarm level	:0[MPa]

6.3 Graphical results of PDA test









6.4 Graphical results of DLT

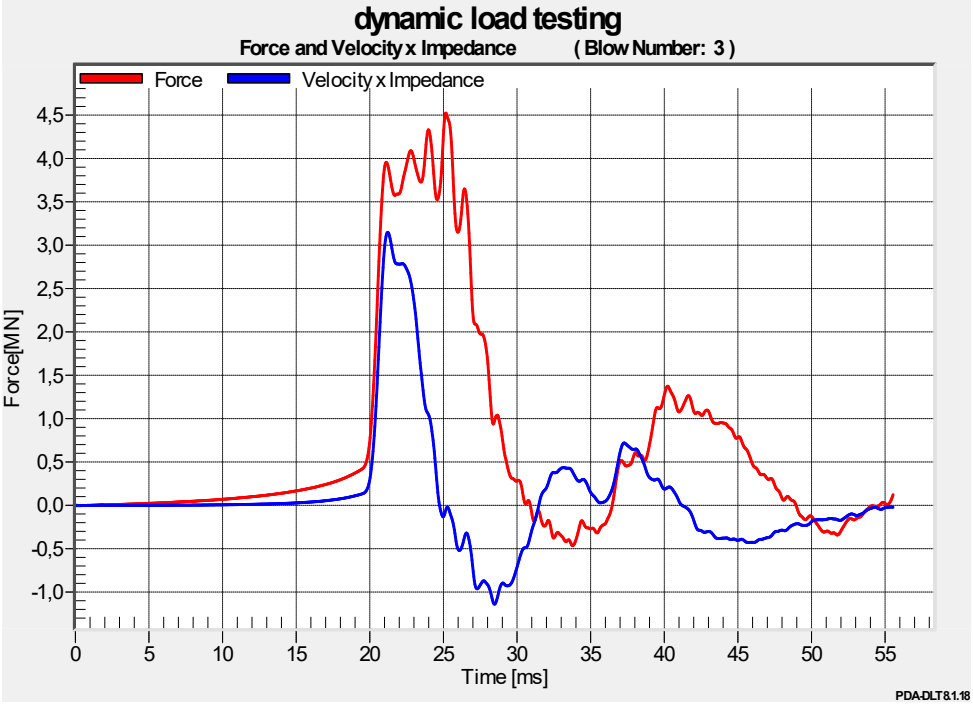


Figure 6.4.1 F Vz Graph of pile 1

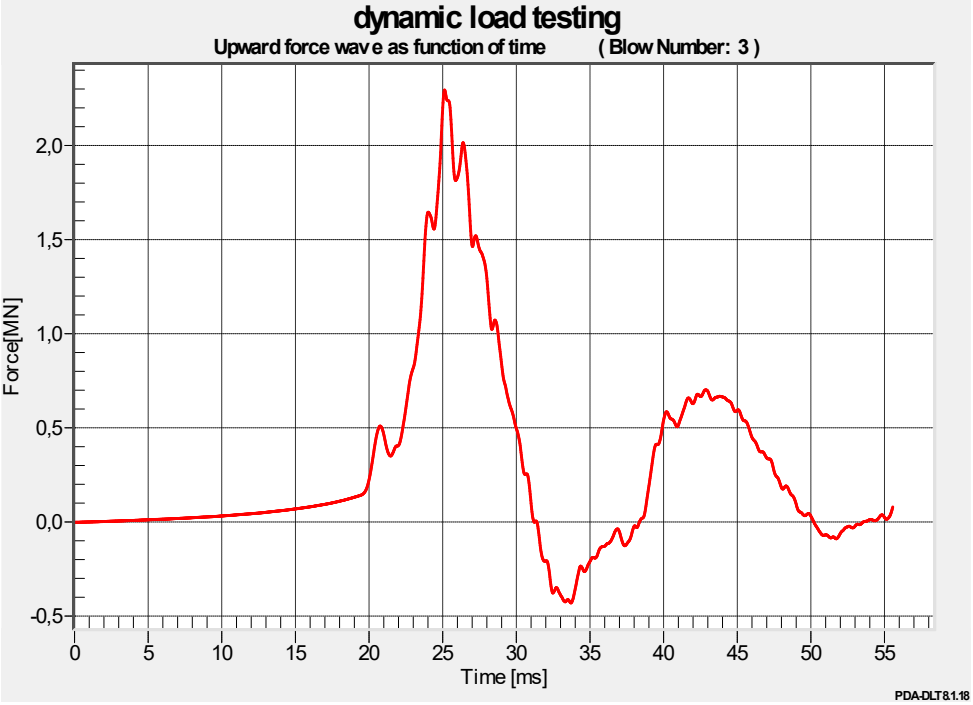


Figure 6.4.2 Upward wave

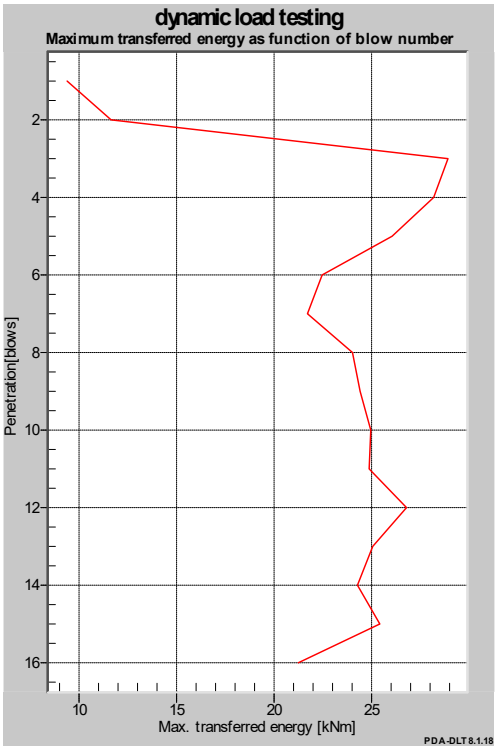


Fig 6.4.3

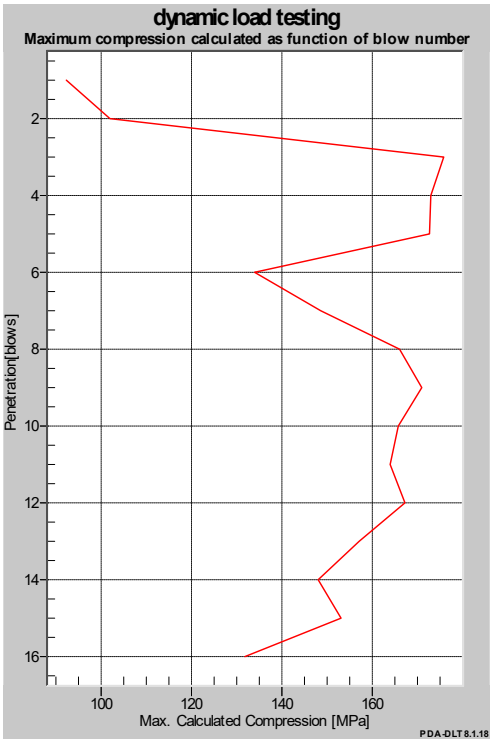


Fig 6.4.4

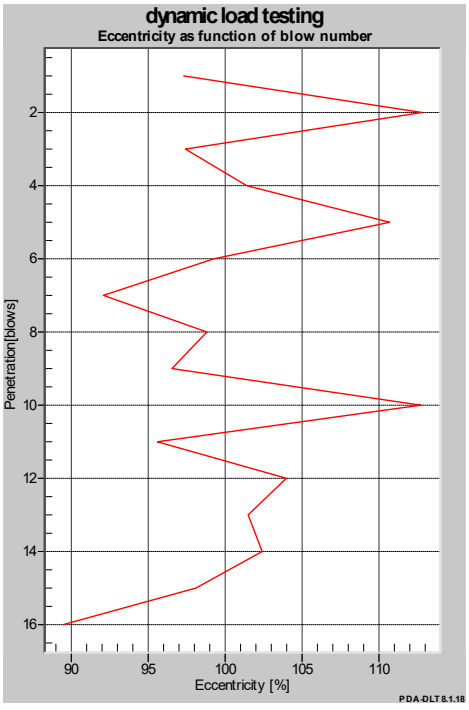


Fig 6.4.5

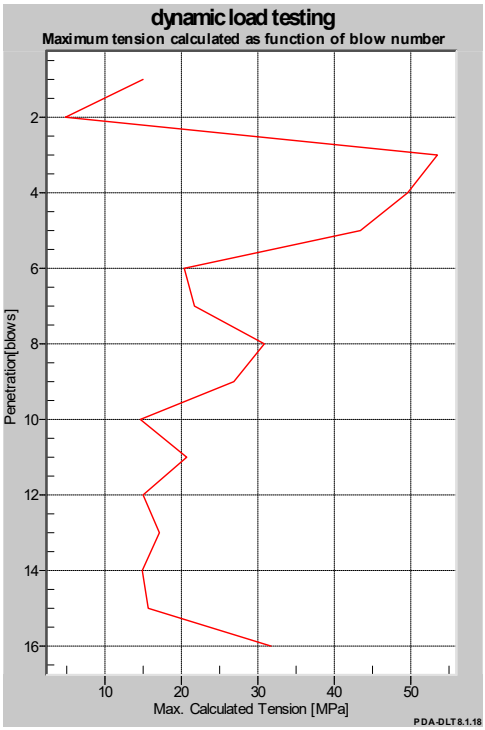


Fig 6.4.6

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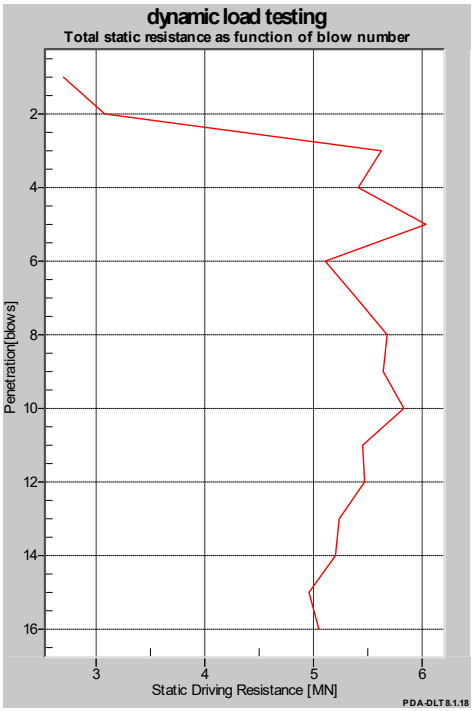


Fig 6.4.7

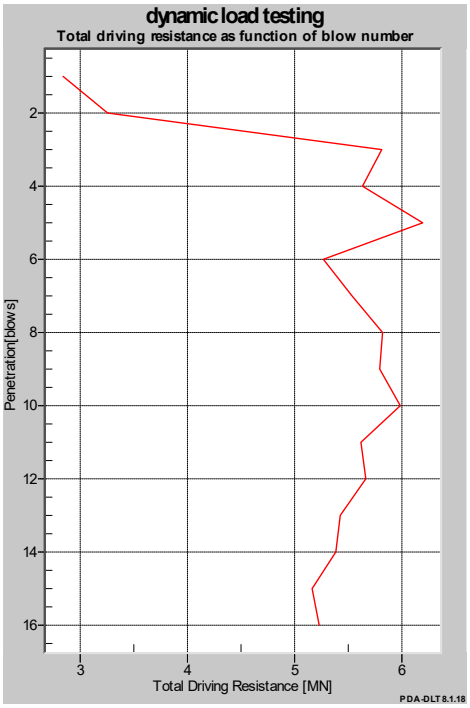
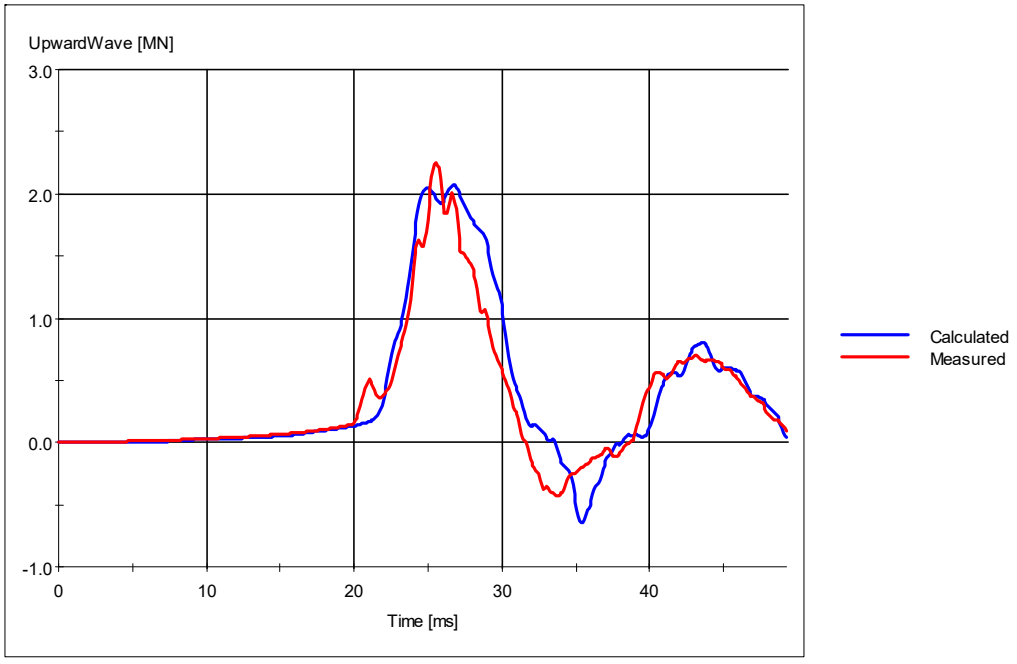


Fig 6.4.8

6.5 Graphical results of DLTwave signal match



Upw ardWave as function of Time at level = 0.000

DLTWAVE Version 8.1.73

Fig 6.5.1 Signal matching result based on blow no. 3

APPENDIX A

Calibration Sheets

(Copies)

Profound BV
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Calibration Certificate

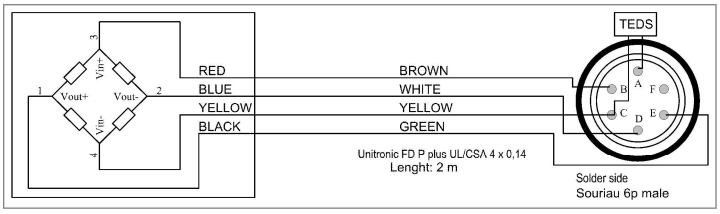
Strain sensor

Serial No. : ST1041

Technical data:

Strain range : 0...1500 µm/m
Bridge resistance : 350 Ohm
Strain gauges : 4 foil gages TML FLA-2.350-11
Insulation resistance : >10 GOhm
Cable : UNITRONIC FD P plus 4x0.14

Wiring:



Calibration data:

Static Calibration number : 3,90

Sensitivity (S) : 1,95 µV/V.µStrain
Zero load output : -26,2 µV/Volt

Date Engineer J.V.Ledderhof Signature .....

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Calibration Certificate

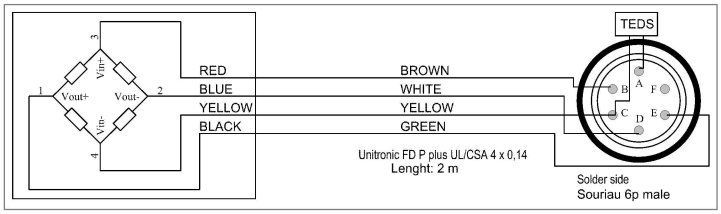
Strain sensor

Serial No. : ST1042

Technical data:

Strain range : 0...1500 µm/m
Bridge resistance : 350 Ohm
Strain gauges : 4 foil gages TML FLA-2.350-11
Insulation resistance : >10 GOhm
Cable : UNITRONIC FD P plus 4x0.14

Wiring:



Calibration data:

Static Calibration number : 3,84

Sensitivity (S) : 1,92 µV/V.µStrain
Zero load output : 48,7 µV/Volt

Date Engineer J.V.Ledderhof Signature .....

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CALIBRATION AND SPECIFICATION ACCELERATION TRANSDUCER

Transducer Identification	
Manufacture	**MEAS France**
Model	**EGCS-S055B-5000**
Serial Number	**AC1038**

Electrical Test		
Zero [typ.]	+/- 5	[mV]
Excitation	10	[V]
Input impedance	1694	[Ω]
Output impedance	915	[Ω]
Operating range	-40 to 120	[°C]

Calibration	
Sensitivity @ 1000g, 700 Hz	0.0253 [mV/g]
Calibration equipment	Traceable to a National Standard
Calibration date:	20-06-2013
Calibrated by	MEAS France

Wiring			Connector Souriau 851 06E 106 P66
	Transducer	Cable	
Input +	Red	Brown	Input + Terminal B
Input -	Black	Yellow	Input - Terminal C
Output +	Green	Green	Output + Terminal E

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Output -	White	White	Output - Terminal D

CALIBRATION AND SPECIFICATION ACCELERATION TRANSDUCER

Transducer Identification	
Manufacture	MEAS France
Model	EGCS-S055B-5000
Serial Number	AC1039

Electrical Test		
Zero [typ.]	+/- 5	[mV]
Excitation	10	[V]
Input impedance	1695	[Ω]
Output impedance	914	[Ω]
Operating range	-40 to 120	[°C]

Calibration		
Sensitivity @ 1000g, 700 Hz	0.0256	[mV/g]
Calibration equipment	Traceable to a National Standard	
Calibration date:	20-06-2013	
Calibrated by	MEAS France	

Wiring			Connector Souriau 851 06E 106 P66
	Transducer	Cable	
Input +	Red	Brown	Input + Terminal B
Input -	Black	Yellow	Input - Terminal C

Output +	**Green**	**Green**	**Output + Terminal E**
Output -	**White**	**White**	**Output - Terminal D**

APPENDIX B

Soil investigation data

Profound BV
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APPENDIX C

Numerical input and output

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Input Data

Dimensions Data

Part	Number	Type	D/B_top [m]	D/B_bottom [m]	Wall Th. [mm]	Length
Pile	1	Casing Open	0,9140	0,9140	11,0	12,800

Material Data

Part	Number	E - Modulus [MPa]	Density [kg/m3]
Pile	1	210000	7800

Soil investigation data

Layer No.	Level	Depth [m]	Thickness [m]	Cone Resist. [MPa]	Shaft Friction [KPa]	Friction Ratio [%]	Soil Type [-]
1	Top	0,000	1,000	0	0,0	0,000	Sand
	Bottom	-1,000		1	6,5	0,500	
2	Top	-1,000	1,500	1	6,5	0,500	Sand
	Bottom	-2,500		5	23,0	0,500	
3	Top	-2,500	1,500	5	23,0	0,500	Sand
	Bottom	-4,000		3	14,5	0,500	
4	Top	-4,000	1,500	3	14,5	0,500	Sand
	Bottom	-5,500		4	21,5	0,500	
5	Top	-5,500	1,500	4	21,5	0,500	Sand
	Bottom	-7,000		15	75,5	0,500	
6	Top	-7,000	1,500	15	75,5	0,500	Sand
	Bottom	-8,500		1	4,5	0,500	
7	Top	-8,500	1,500	1	4,5	0,500	Sand
	Bottom	-10,000		1	4,5	0,500	
8	Top	-10,000	1,500	1	4,5	0,500	Sand
	Bottom	-11,500		9	42,5	0,500	
9	Top	-11,500	1,500	9	42,5	0,500	Sand
	Bottom	-13,000		6	29,5	0,500	
10	Top	-13,000	1,500	6	29,5	0,500	Sand
	Bottom	-14,500		18	89,3	0,500	
11	Top	-14,500	1,500	12	238,0	2,000	Stiff clay
	Bottom	-16,000		6	112,0	2,000	
12	Top	-16,000	1,500	6	112,0	2,000	Stiff clay
	Bottom	-17,500		4	84,0	2,000	
13	Top	-17,500	1,500	4	84,0	2,000	Stiff clay
	Bottom	-19,000		5	104,0	2,000	
14	Top	-19,000	19,500	5	104,0	2,000	Stiff clay
	Bottom	-38,500		0	0,0	0,000	

Shaft soil model input

Soil Model = Smith Model

Layer No.	Level	Depth [m]	Yield stress [KPa]	Uq1 [mm]	Uq2 [mm]	Yield factor -	Beta -	Js [1/s]	Alfa -	Inner fr.fact. -	Outer fr.fact. -
	Top	0,000	0,0	2,0	2,0	1,000	1,000	1,452	1,000	1,000	1,000
	Bottom	-1,000	27,2	2,0	2,0	1,000	1,000	0,579	1,000		
	Top	-1,000	101,4	2,0	2,0	1,000	1,000	0,645	1,000	1,000	1,000
	Bottom	-2,500	132,5	2,0	2,0	1,000	1,000	0,576	1,000		
	Top	-2,500	27,8	2,0	2,0	1,000	1,000	0,107	1,000	1,000	1,000
	Bottom	-4,000	16,2	2,0	2,0	1,000	1,000	0,114	1,000		
	Top	-4,000	98,2	2,0	2,0	1,000	1,000	1,738	1,000	1,000	1,000
	Bottom	-5,500	21,2	2,0	2,0	1,000	1,000	0,848	1,000		
	Top	-5,500	22,0	2,0	2,0	1,000	1,000	0,597	1,000	1,000	1,000
	Bottom	-7,000	483,5	2,0	2,0	1,000	1,000	0,902	1,000		
	Top	-7,000	302,0	2,0	2,0	1,000	1,000	0,802	1,000	1,000	1,000
	Bottom	-8,500	30,6	2,0	2,0	1,000	1,000	0,548	1,000		
	Top	-8,500	9,5	2,0	2,0	1,000	1,000	1,152	1,000	1,000	1,000
	Bottom	-10,000	30,2	2,0	2,0	1,000	1,000	0,810	1,000		
	Top	-10,000	7,3	2,0	2,0	1,000	1,000	0,338	1,000	1,000	1,000
	Bottom	-11,500	197,1	2,0	2,0	1,000	1,000	0,623	1,000		
	Top	-11,500	170,0	2,0	2,0	1,000	1,000	0,400	1,000	1,000	1,000
	Bottom	-13,000	118,0	2,0	2,0	1,000	1,000	0,400	1,000		
	Top	-13,000	118,0	2,0	2,0	1,000	1,000	0,400	1,000	1,000	1,000
	Bottom	-14,500	357,0	2,0	2,0	1,000	1,000	0,400	1,000		
	Top	-14,500	952,0	2,0	2,0	1,000	1,000	2,000	0,200	1,000	1,000
	Bottom	-16,000	448,0	2,0	2,0	1,000	1,000	2,000	0,200		
	Top	-16,000	448,0	2,0	2,0	1,000	1,000	2,000	0,200	1,000	1,000
	Bottom	-17,500	336,0	2,0	2,0	1,000	1,000	2,000	0,200		
	Top	-17,500	336,0	2,0	2,0	1,000	1,000	2,000	0,200	1,000	1,000

Bottom	-19,000	416,0	2,0	2,0	1,000	1,000	2,000	0,200			
Top	-19,000	416,0	2,0	2,0	1,000	1,000	2,000	0,200	1,000	1,000
Bottom	-38,500	0,0	2,0	2,0	1,000	1,000	2,000	0,200		

Toe soil model input
Soil Model = Smith Model

Layer No.	Level	Depth	Yield stress	Uq1	Uq2	Yield factor	Beta	Js	Alfa
		[m]	[MPa]	[mm]	[mm]	-	-	[1/s]	-
Top	-10,000	2	2,0	2,0	0,100	1,000	0,225	1,000	
Bottom	-11,500	2	2,0	2,0	0,100	1,000	0,225	1,000	

Output Data

Total mobilised static resistance 3.742 [MN]
Static mobilised shaft resistance 2.643 [MN]
Static mobilised toe resistance 1.099 [MN]

Modelled and mobilised static resistance

Layer	Depth [m]	Modelled Res. [MN]	Mobilised Res. [MN]	
1	0.000	0.029	0.029	
2	-1.000	0.567	0.567	
3	-2.500	0.086	0.086	
4	-4.000	0.324	0.324	
5	-5.500	1.034	1.034	
6	-7.000	0.516	0.516	
7	-8.500	0.055	0.055	
8	-10.000	0.033	0.033	
9	-11.500	0.000	0.000	
10	-13.000	0.000	0.000	
11	-14.500	0.000	0.000	
12	-16.000	0.000	0.000	
13	-17.500	0.000	0.000	
14	-19.000	0.000	0.000	
		---	---	
Shaft		2.643	2.643	[MN]
Toe		1.099	1.099	[MN]
		---	---	
Total		3.742	3.742	[MN]

Mobilised static resistance

Layer	Depth [m]	Mobilised Res. [MN]	
1	0.000	0.029	
2	-1.000	0.567	
3	-2.500	0.086	
4	-4.000	0.324	
5	-5.500	1.034	
6	-7.000	0.516	
7	-8.500	0.055	
8	-10.000	0.033	
9	-11.500	0.000	
10	-13.000	0.000	
11	-14.500	0.000	
12	-16.000	0.000	
13	-17.500	0.000	
14	-19.000	0.000	

Shaft		2.643	[MN]
Toe		1.099	[MN]

Total		3.742	[MN]