

ITEG MEETING MILAN 17-18 OCTOBER 2015

# TSE method applied to difficult road works. A case study.

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# Two extra large Cedrus deodara



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# Scheda di analisi albero



PROGETTO: 00 677 11

<b>Ambito:</b>	<b>Asso</b>
AREA	(non definita)

## Dati anagrafici albero

Cartellino	1
Specie	<i>Cedrus deodara</i>

Diametro (cm)	163
Altezza(m)	23
Diam. Chioma	0

Tipo impianto	Gruppo puro
Zona	da definire
Pavimentazione	Copertura vegetale

Commento  
alle analisi

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Classe

Valori strum.

T/R

Data di analisi

Cod. rilevatori

## Giudizio complessivo

B

Normali

1

25/3/2011

n.d.

## Analisi visiva

Chioma	- sbrancamento/i L
Fusto	- ferita/e aperta L- inclinato L
Colletto	- allargato L- ferita cicatrizzata L

Verifiche strumentali

**Base**

# Scheda di analisi albero



PROGETTO: 00 677 11

<b>Ambito:</b>	<b>Asso</b>
AREA	(non definita)

Dati anagrafici albero	
Cartellino	2
Specie	<i>Cedrus deodara</i>

Diametro (cm)	135
Altezza(m)	23
Diam. Chioma	0

Tipo impianto	Gruppo puro
Zona	da definire
Pavimentazione	Copertura vegetale

Commento  
alle analisi

Classe

Valori strum.

T/R

Data di analisi

Cod. rilevatori

## Giudizio complessivo

**B**

**Normali**

1

25/3/2011

n.d.

## Analisi visiva

Chioma - ramificazioni secche S- sbilanciata S- tagli di potature L

Fusto

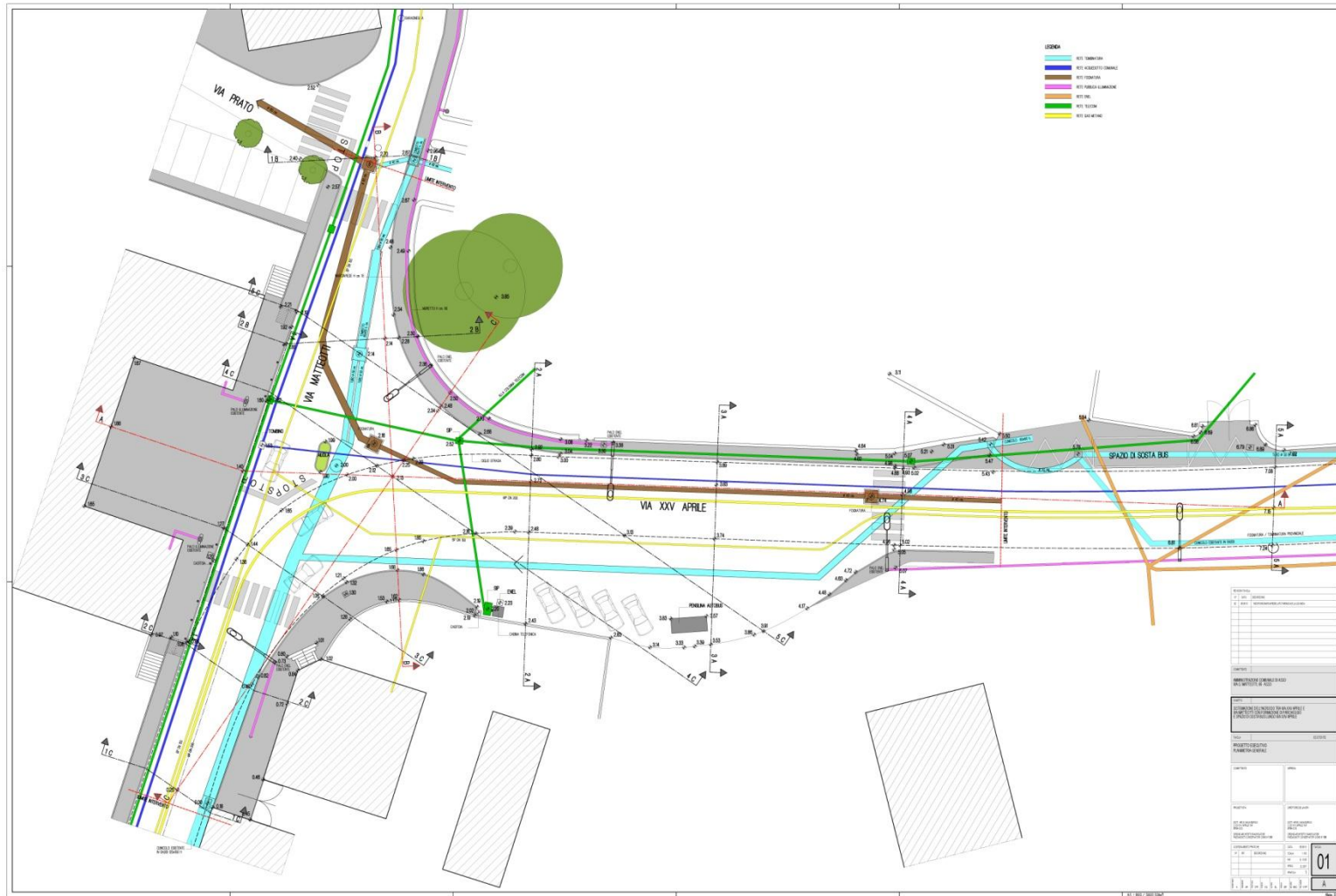
Colletto - allargato L- cordone di reazione L- ferita cicatrizzata L

Verifiche strumentali

**Base**

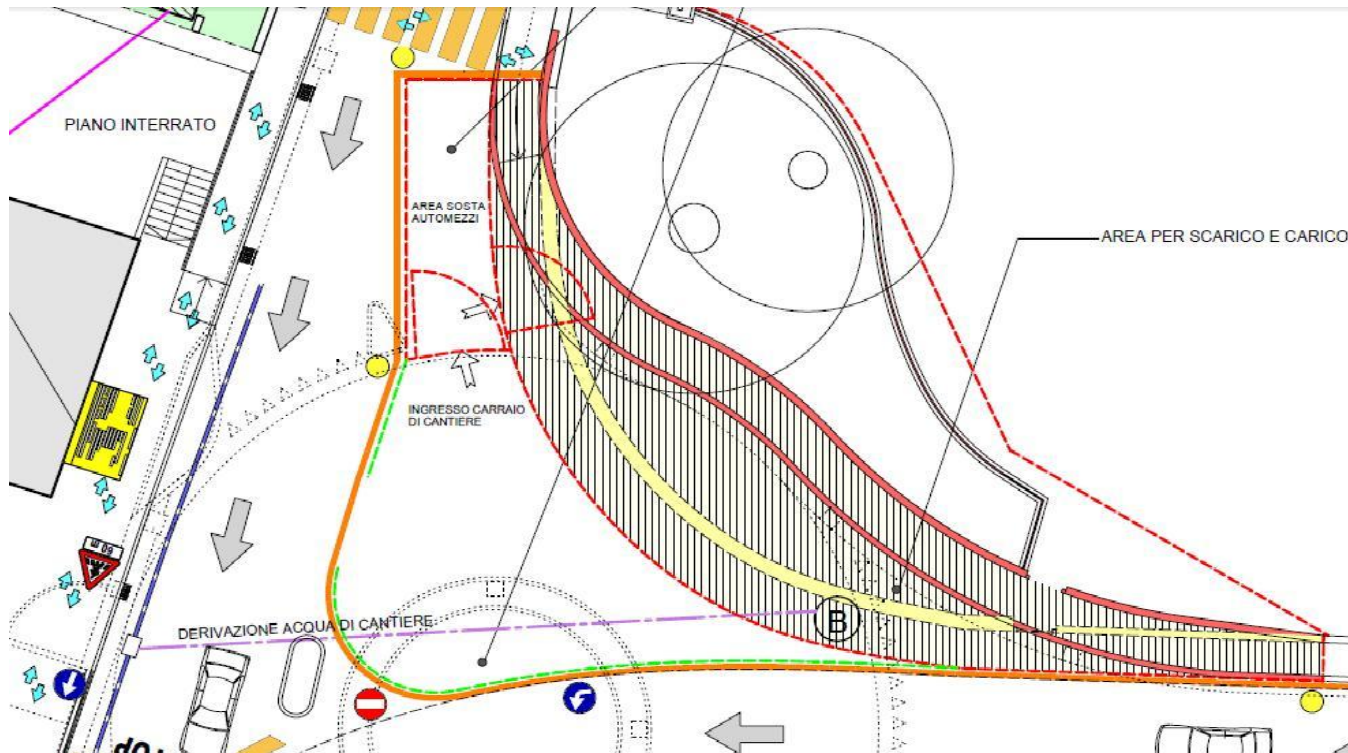


# Existing situation



# Roundabout Project





It was necessary to set a tree management plan to:

- evaluate the possibility of the excavations
- study an tree management plan to protect the roots
- The digging action of the first tree It would be reduced from 4 to 2.4 meters the root ball dimension in the road side



# Tree Management Plan

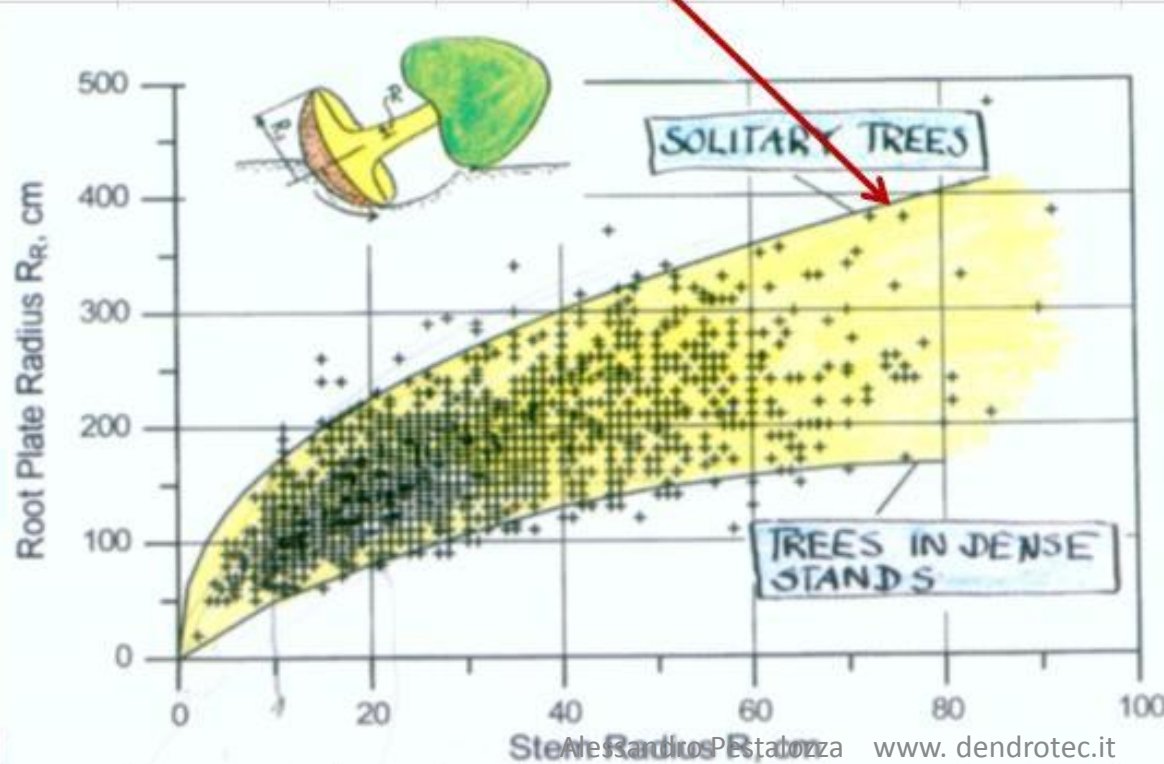
- Tree static/stability evaluation ante operam by VTA and pulling test
- Root inspection and root distribution: evaluation by Arboradix
- No dig soil removal plan
- Tree static/stability evaluation post operam by pulling test

# How large must a root ball be ?

Calcolo del raggio della zolla in funzione del raggio del tronco

*From C. Mattheck*

Stem Radius =	81,5
Rw Max =	406,32
Rw Min =	280,62



Studies carried out by Wessolly are summarized below by the following formula:

- $R_w = 1.5 * 2R$
- where:
- $R_w$  = radius of the root ball
- $R$  = radius of the trunk to 130 cm from the ground
- In our case we will have:
- $R = 81.5$  cm
- $R_w = 244.5$  cm

**The excavation at the distance of the project was considered viable and not particularly damaging to the roots**

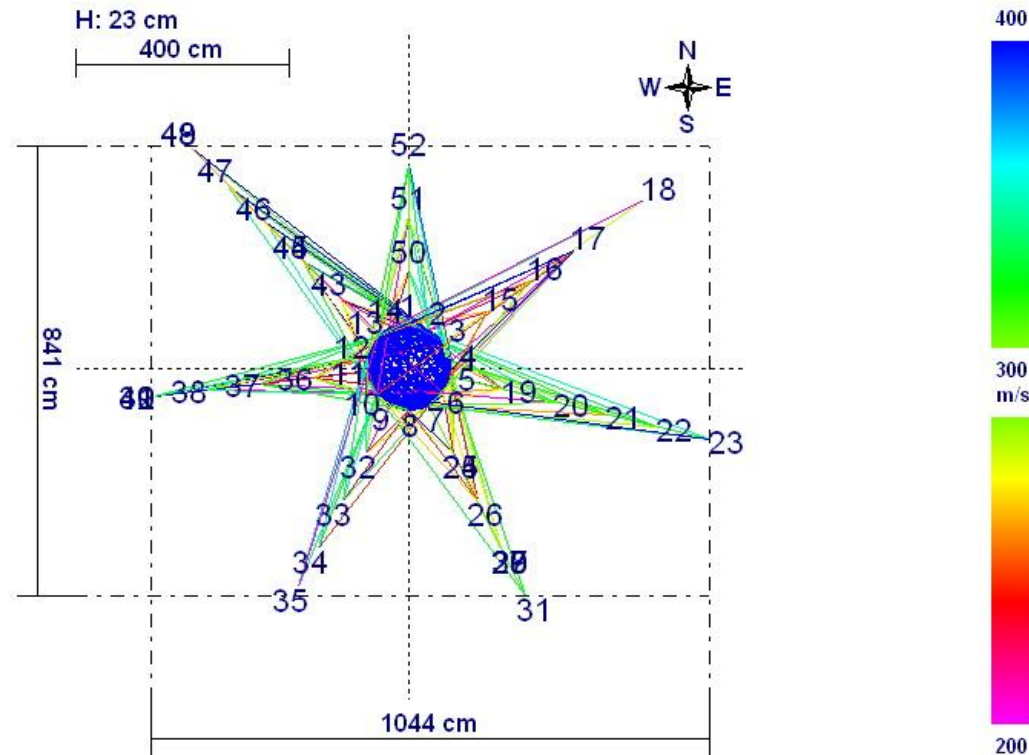
# Arboradix test

Was performed to have idea abt root distribution in the subsoil nearby the digging area



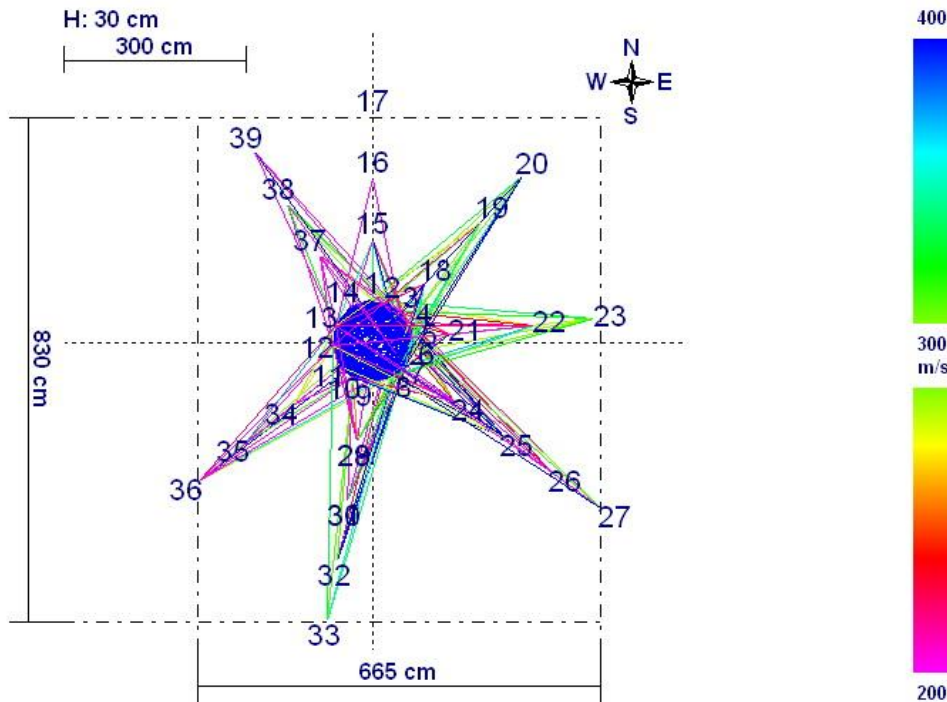


## Cedrus deodara nr 1



The Arboradix has identified the root of the cedar, which grows mainly in NW - SE. The richest portion of roots is to the North West where root development has no human limitations. The area in which instead ended up being a poor response to the stress wave is the portion of the North East and South, where there is the sidewalk at a distance of 3.9 m.

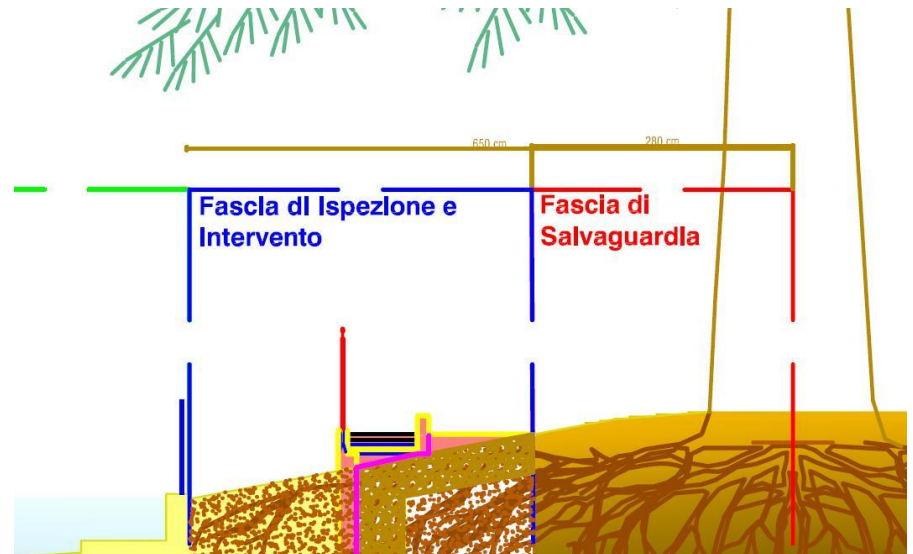
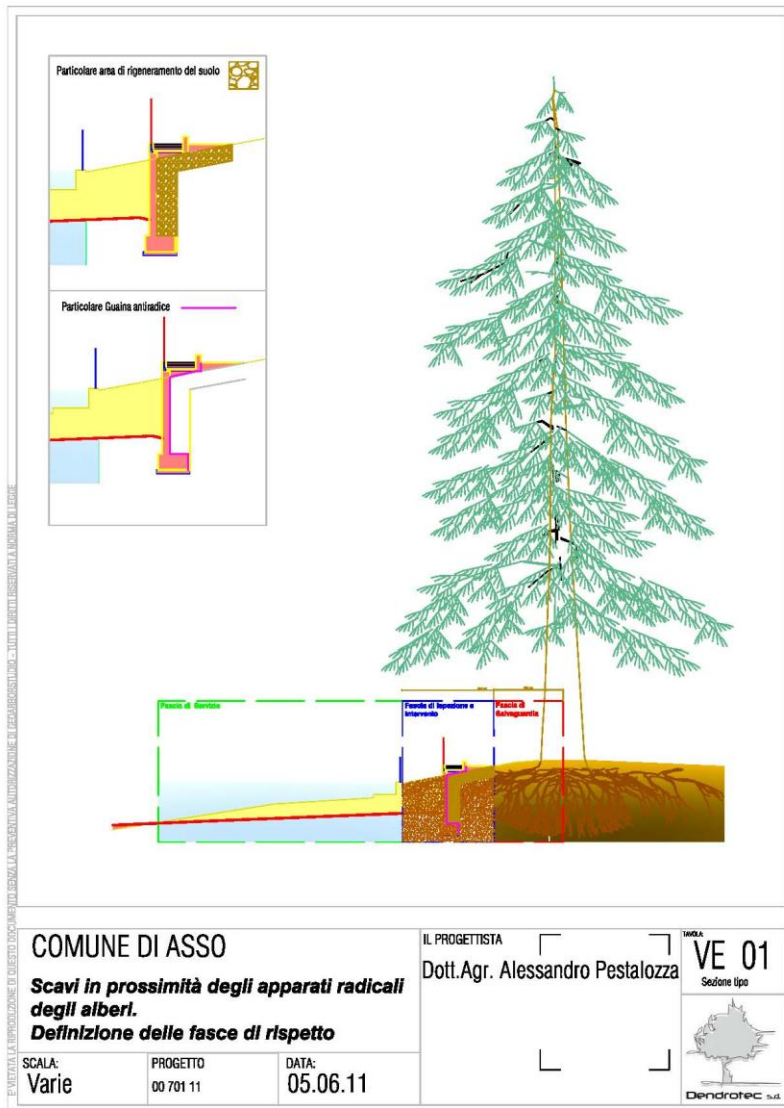
## Cedrus deodara nr 2



Arboradix revealed a root grows mainly in North - East and and the South direction, that is the area in which the subject is further away from man-made artifacts. Areas where it was found a poor response to the stimulus are quadrants of North - South and South - East, where the distance from the paving is also less than one meter

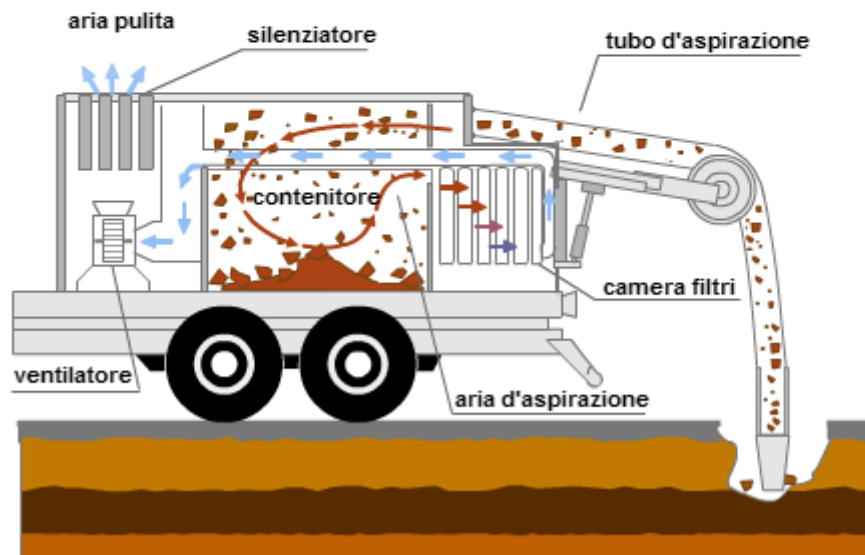
# (no) Digging Plan

- Green Area: service
- Blu Area: Mechanical and air excavation
- Red Area: Protected



# No dig excavation or better soil removal

- Ideale per aspirare qualsiasi materiale: liquido, secco, solido, melmoso, polveri
- Altissima potenza d'aspirazione costante
- Tecnica innovativa ecocompatibile
- Notevole riduzione d'impatto ambientale
- Impiego continuo senza dispendio di pulizia
- Emissione d'aria esausta nell'ambiente senza polveri
- Emissione acustica < 82 dB





## **SCHEDA TECNICA**

### DATI DI POTENZA

Profondità d'aspirazione	max. 30 m
Distanza d'aspirazione	max. 150 m

### DATI TECNICI

#### Contenitore

Volume 8 m<sup>3</sup>

### VENTILATORI

	Tecnica di ventilazione multipla
	Ventilatore doppio - DINO 2 - 4 MEGA
Portata aria	36.000 m <sup>3</sup> /h (10 m <sup>3</sup> sec)
Sotto vuoto	34.000 Pa
Potenza motrice richiesta	2x 110 kW
Potenza d'aspirazione	Regolazione graduale

### PORTA TUBO E D'ASPIRAZIONE

Porta tubo	a) Braccio di forza MTS (idraulico) fino a 8 m
Tubo d'aspirazione	Ø 250 mm

### Compressore d'aria

Potenza d'aria	4,5 m <sup>3</sup> /min a 8 bar
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### Sistema di filtrazione per la polvere

	3 fasi autopulente Basato sul principio ciclonico con separatore grosso, separatore fine e filtraggio fine a cartucce
Insonorizzazione	82 dB

### VEICOLO

Peso totale	32 t
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Marca

Iveco Trakker 4 assi  
Alessandro Pestalozza [www.dendrotec.it](http://www.dendrotec.it)

# Root inspection



# Soil removing With air flow

Key words: incompressible flow - macroporosity





Naked roots transplanting.  
All soil was removed with AirSpade

**Milano – via D'Averio**  
Cliente: **Società Umanitaria (MI)**





Parma – piazza Dalla Chiesa

Cliente: **STU spa** (PARMA)

With Airspade and Vacuum suction The Ginkgo rootball was significantly lightened in order to avoid the use of a even bigger crane

# Combined Air Spade and Suction Systems





# Combined AirSpade and Suction Systems





# Combined AirSpade and Suction Systems





# Roots : 2,5 m from stem base





# Roots : 2,5 m from stem base





# Root covering and protection





# Side walk construction





# Static evaluation WLA

Parameter

Vref 33 [m/s] Wind speed

Zref 20 [m] Reference height

Z^ 0,3 Terrain exponent

Cw 0,3 Drag coefficient

d 1,2 [kg/m³] Air density

gf 1 Gust factor

rf 1 Resonance factor

☐ Topology correction

Properties


Tree height 33 [m]

Calculate Set as compare reference

Results


Crown area	-	259 [m²]
Height of crown area center	-	17 [m]
Height of crown force center	-	19 [m]
Wind force on crown	-	45 [kN]
Stembase bending moment	-	834 [kNm]

Error variations referring ANSI/ANS-3.11/DIN 1319:  
+ F. Rinn: Sachverständige Anforderungen  
an Messgeräte und Messverfahren.  
Der Sachverständige DS 3/2007, 46-51.




Results


Tree




Windforce



Bending moment



Torsion moments



# Static evaluation Pulling Test: data

Project ?

Data Results



**TSE**  
Tree Stability Evaluation  
Software for Tree Stability Tests

Project

Asso 2

**Calculate**

## Factor description

		<b>Terrain simulation</b>		<b>Tree species</b>	
Wind gust factor	<input type="text" value="1,4"/>	<input type="text" value="Small city"/>		<input type="text" value="Cedrus atlantica"/>	
Tree swinging factor	<input type="text" value="1,4"/>	Terrain exponent	<input type="text" value="0,2"/>	Yield strength under compression	<input type="text" value="1,5"/> kN/cm <sup>2</sup>
Crown area (Arwilo)	<input type="text" value="259"/> m <sup>2</sup>	Height laminar wind layer (36,6 m/s)	<input type="text" value="305"/> m	Elasticity limit in %	<input type="text" value="0,29"/> %
Anchor point distance	<input type="text" value="23,3"/> m	Air pressure	<input type="text" value="1000"/> mb	Height dummy load/tree	<input type="text" value="14"/> m
Anchor height correction	<input type="text" value="1"/> m	Temperature	<input type="text" value="10"/> °C	Arwilo-Force center height	<input type="text" value="19"/> m
				Drag coefficient	<input type="text" value="0,2"/>

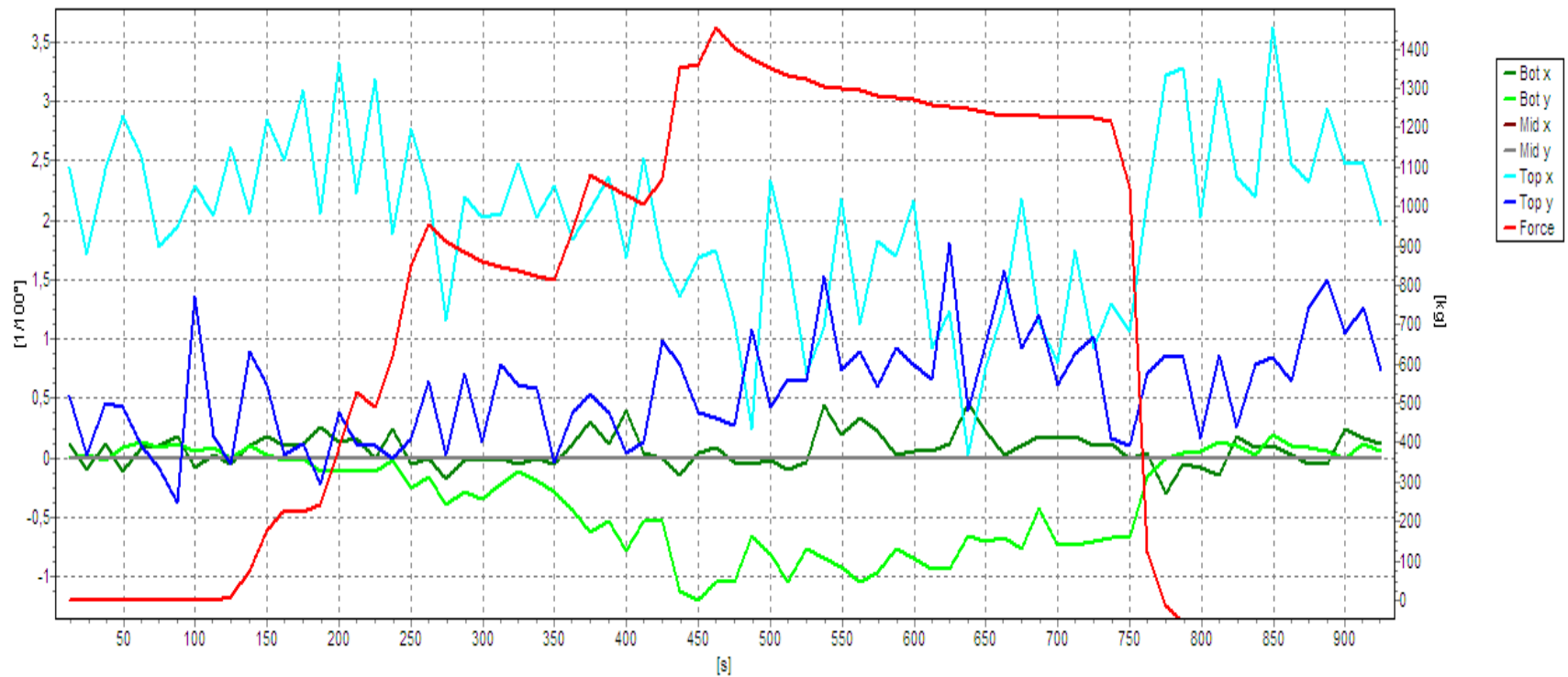
## Pulling force data

Pulling step no.	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	
Pulling force	<input type="text" value="1,450"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	t

## Inclination data

Inclination 1	<input type="text" value="0,045"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	°
Percentage of uprooting 1	<input type="checkbox"/> editable	<input type="text" value="13,4"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	%
Inclination 2		<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	°
Percentage of uprooting 2	<input type="checkbox"/> editable	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	%

# Dynatim data



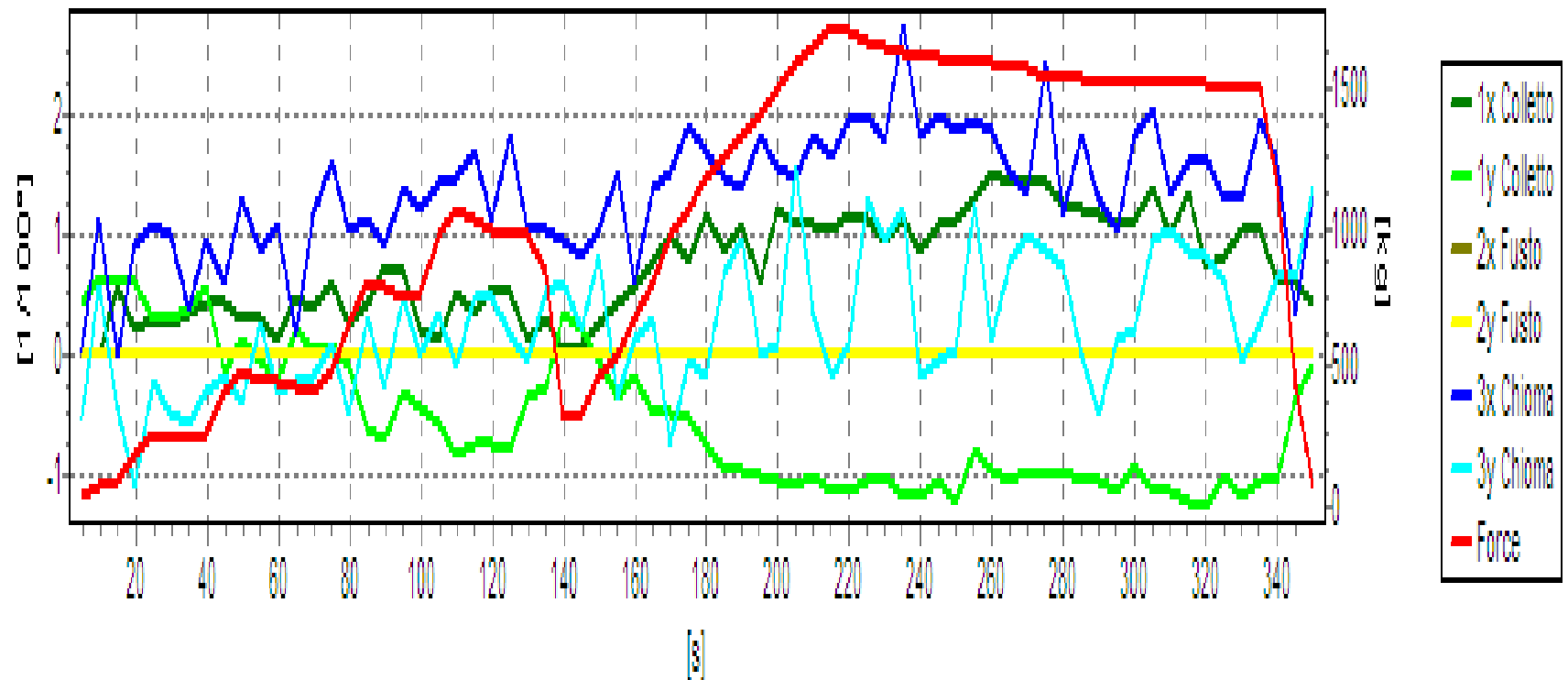
# Pulling test result Ante Operam

Data		Results									
<b>Results</b>											
<b>Optimized SIA</b>		1	2	3	4	5	6	7	8	9	10
Abstract safety factor against rupture											
<b>Inclination</b>											
Safety factor against uprooting 1		1,27									
Safety factor against uprooting 2											
<b>Tension</b>											
		Tension rupture 40% max.									
Safety factor against rupture S 1											
Safety factor against rupture S 2											
Safety factor against rupture S 3											
Safety factor against rupture S 4											
Safety factor against rupture S 5											
Safety factor against rupture S 6											
Safety factor against rupture S 7											
Safety factor against rupture S 8											
		1000/mm									
<b>Interim values</b>											
Crown load		5,49 t	53,87 kN	Air density	1,23 kg/m³						
Theoretical moment dummy load anchor point		7,45 t	73,11 kNm								
Theoretical moment trunk base		104,3 t	1023, kNm								
V real	41,51 m/s	Complies with wind strength Bft.		12							
Real pulling force	1,27										t

**SAFETY FACTOR UPROOTING = 1,27**



# Dynatim data



# Pulling test result Post Operam

Results			1	2	3	4	5	6	7	8	9	10
<b>Optimized SIA</b>												
Abstract safety factor against rupture												
<b>Inclination</b>												
Safety factor against uprooting 1			1,33									
Safety factor against uprooting 2												
<b>Tension</b>												
Tension rupture 40% max.												
Safety factor against rupture S 1												
Safety factor against rupture S 2												
Safety factor against rupture S 3												
Safety factor against rupture S 4												
Safety factor against rupture S 5												
Safety factor against rupture S 6												
Safety factor against rupture S 7												
Safety factor against rupture S 8												
1000/mm												
<b>Interim values</b>												
Crown load	5,49 t	53,87 kN	Air density 1,23 kg/m³									
Theoretical moment dummy load anchor point	10,43 t	102,3 kNm										
Theoretical moment trunk base	104,3 t	1023 kNm										
V real	41,51 m/s	Complies with wind strength Bft. 12										
Real pulling force	1,4											t

SAFETY FACTOR UPROOTING = 1,33

# Conclusion

- The combined digging system realized a good job
- The cutted roots was just a small amount and small size
- No loss of stability was observed
- No problems as far nutritional or physiological aspects is regarding