



UNIVERSITÀ  
DEGLI STUDI  
DI PADOVA



Ordine dei Geologi  
*Geologenkammer*  
TRENTINO - ALTO ADIGE  
TRENTINO - SÜDTIROL



Ordine dei Geologi  
*Friuli Venezia Giulia*

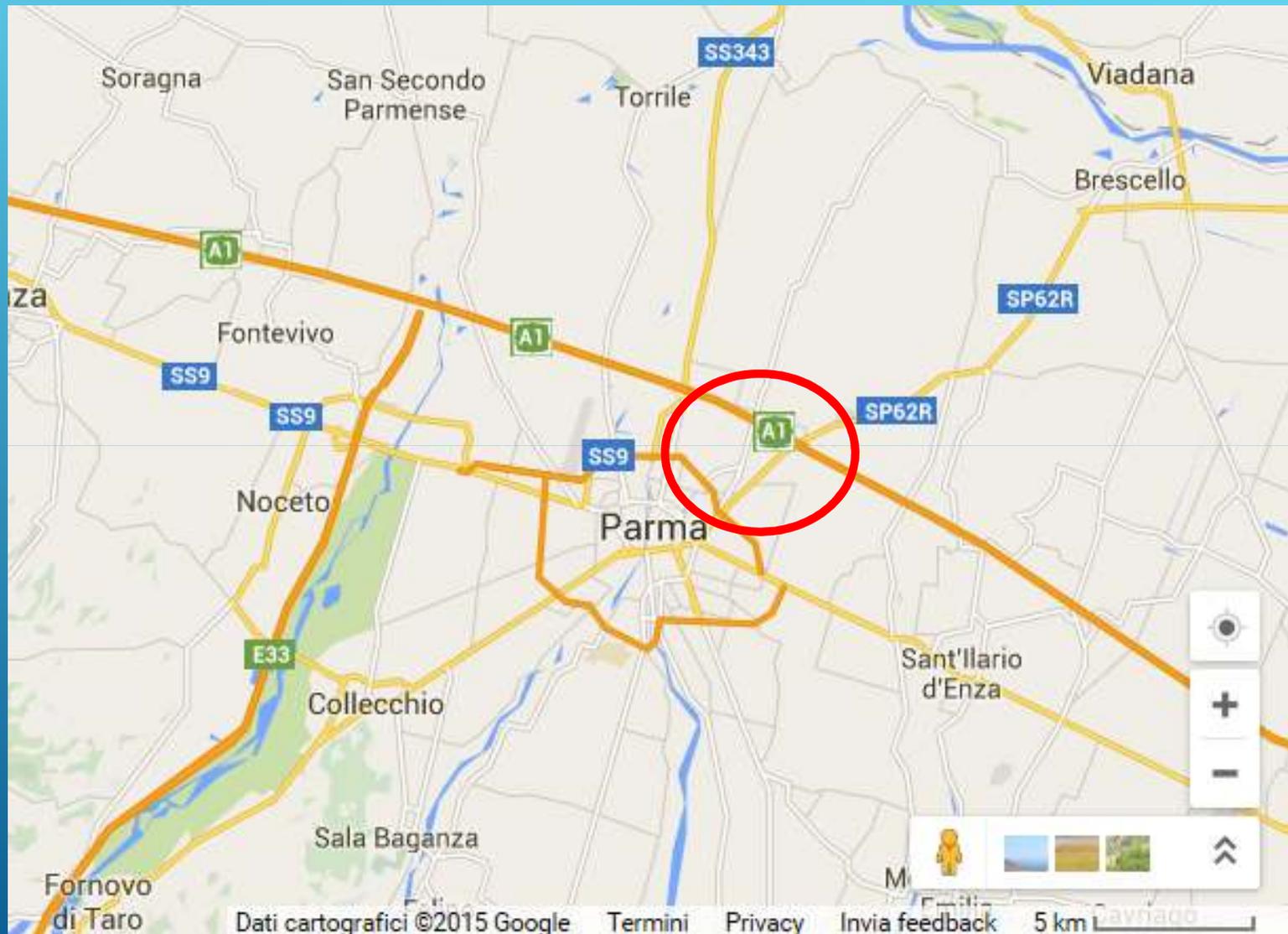


# MODELLO GEOTECNICO E SISMICO DI UN SITO NEL COMUNE DI PARMA PER LA VALUTAZIONE DELLA RISPOSTA SISMICA

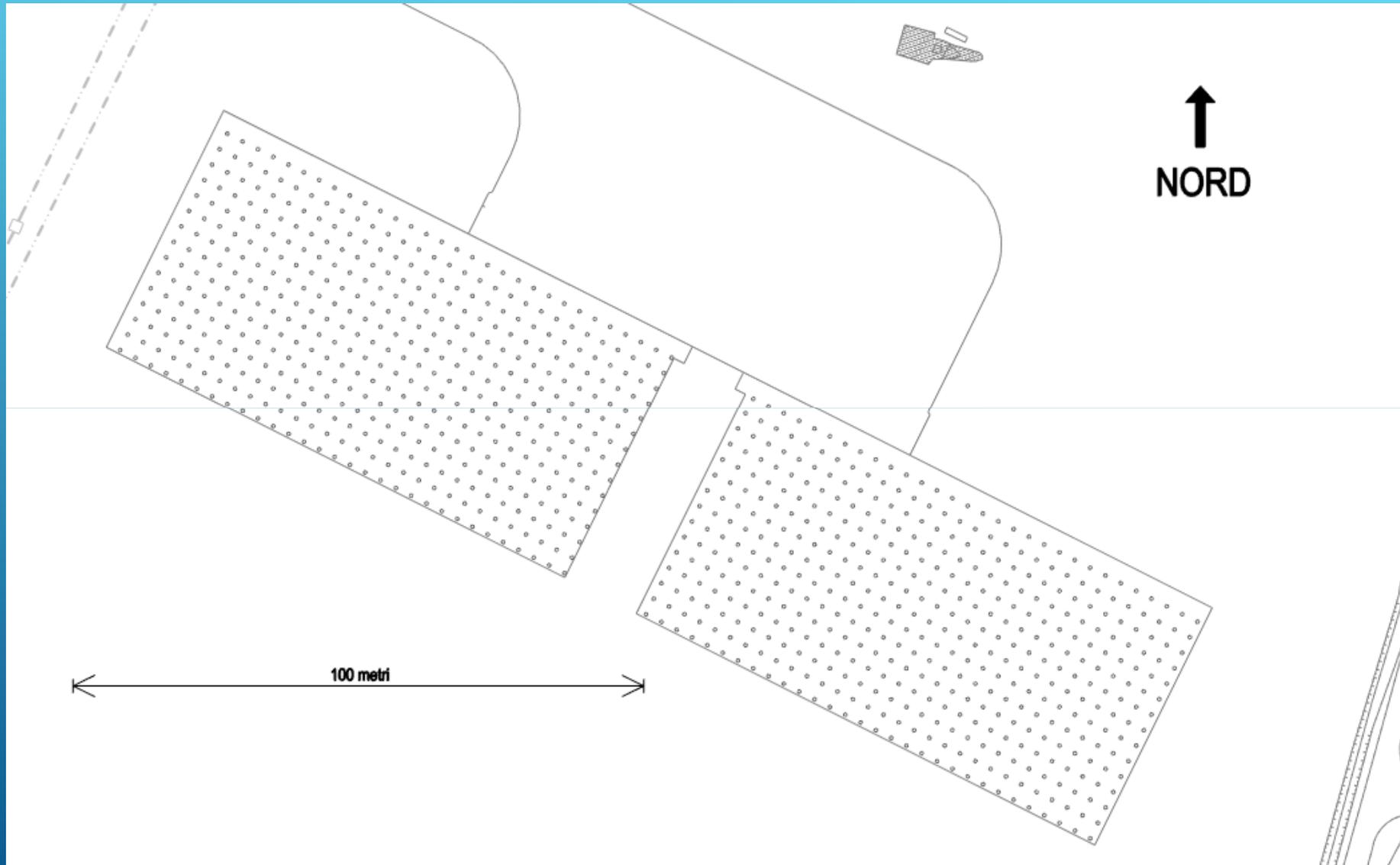
Relatore: ANDREA MASTRANGELO (Geologo, libero professionista, consulente Enser Srl – Società di Ingegneria )

venerdì 4 dicembre 2015

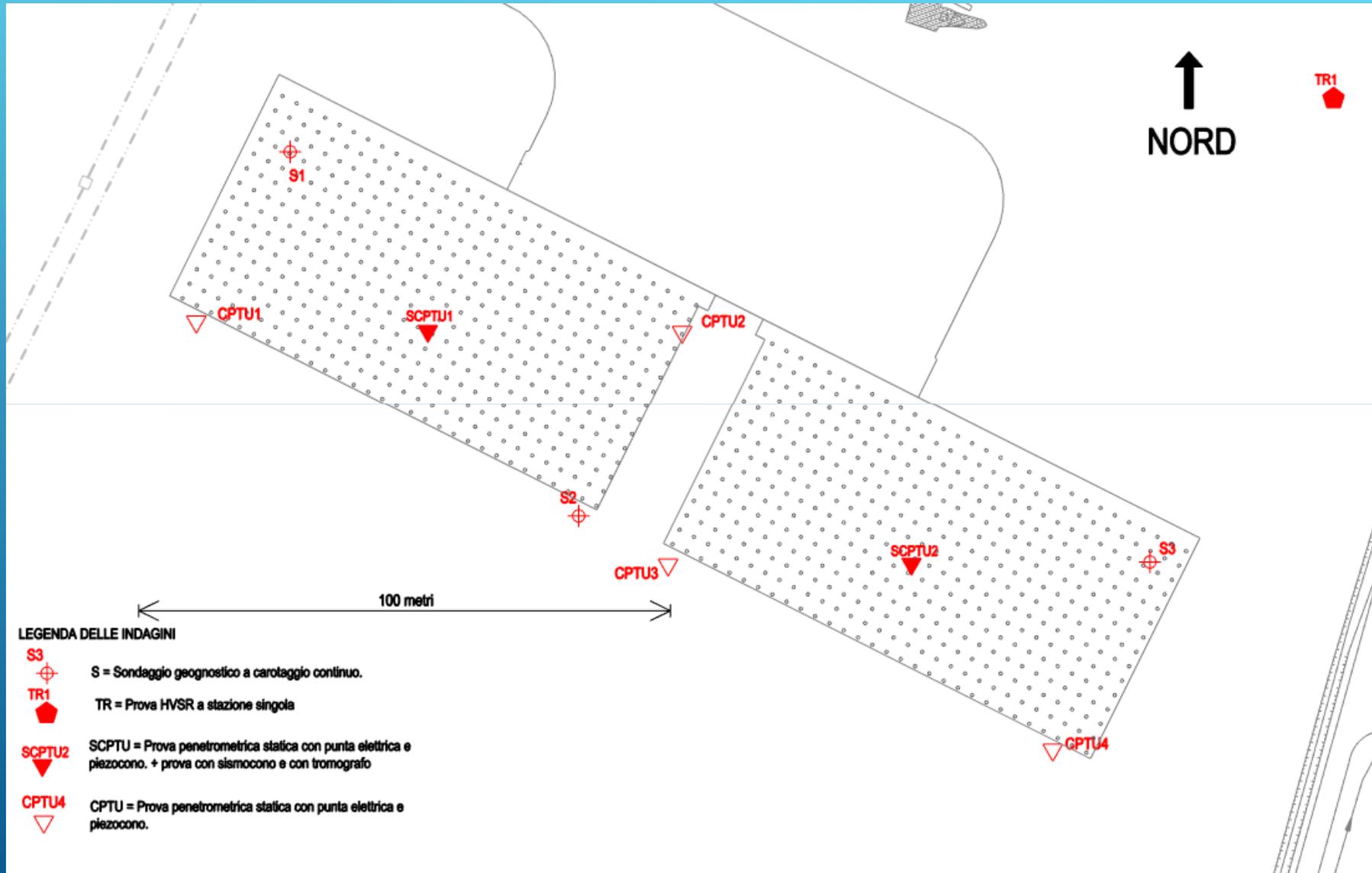
## Ubicazione area di intervento



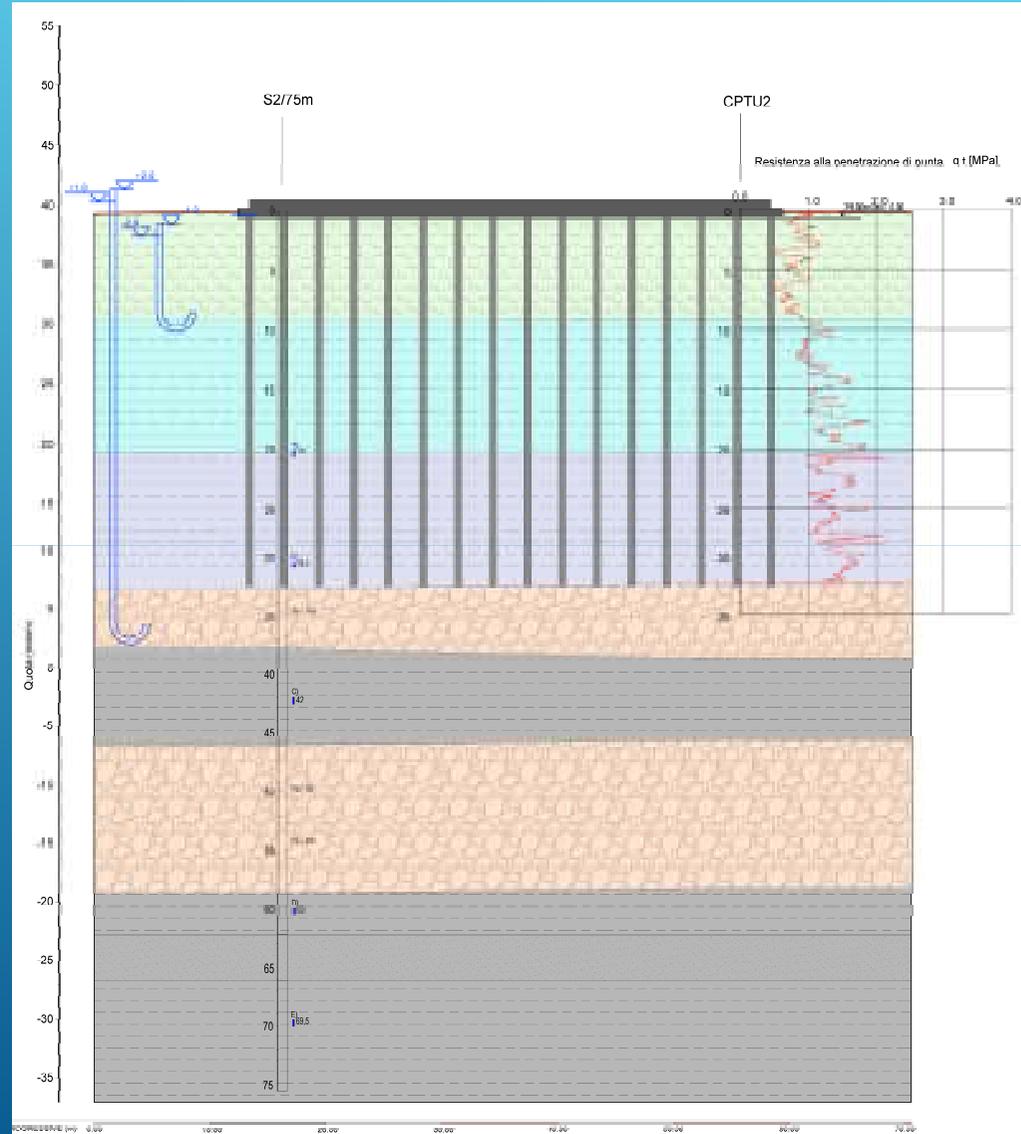
## Oggetto dell'intervento



## Indagini per il progetto



## Stratigrafia – tipo



Terreni limo-argillosi da NC  
a leggermente OC



Ghiaie e sabbie

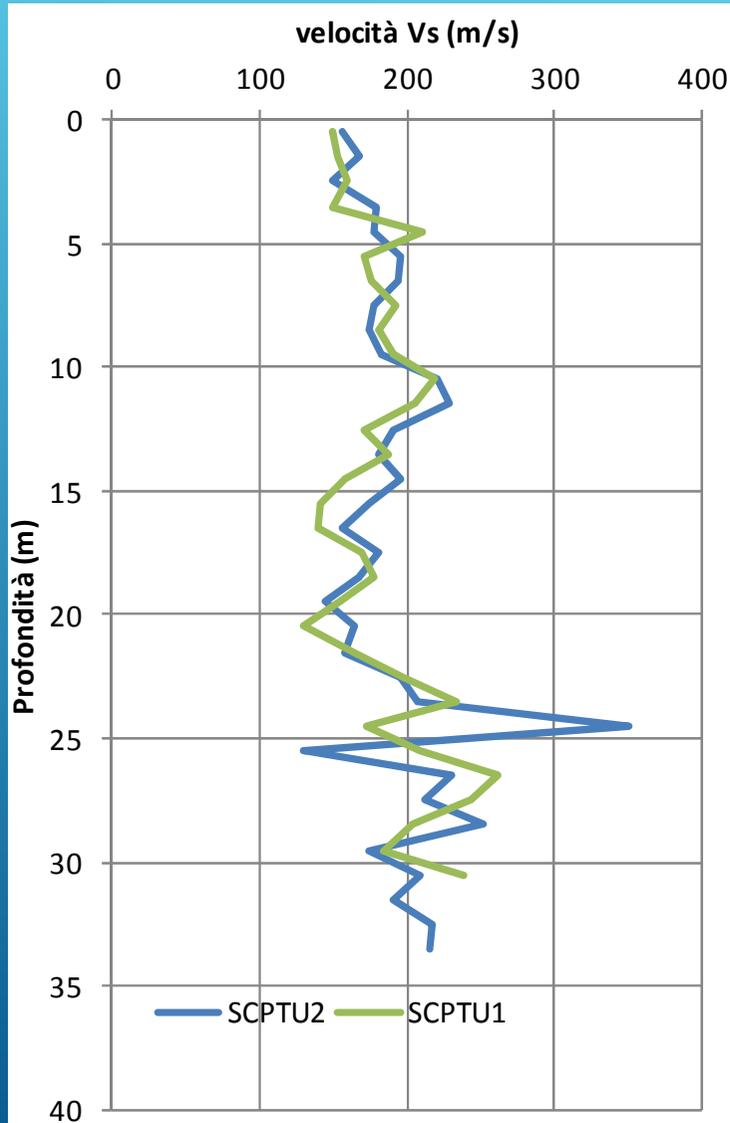


Argille e limi OC



Sabbie e limi

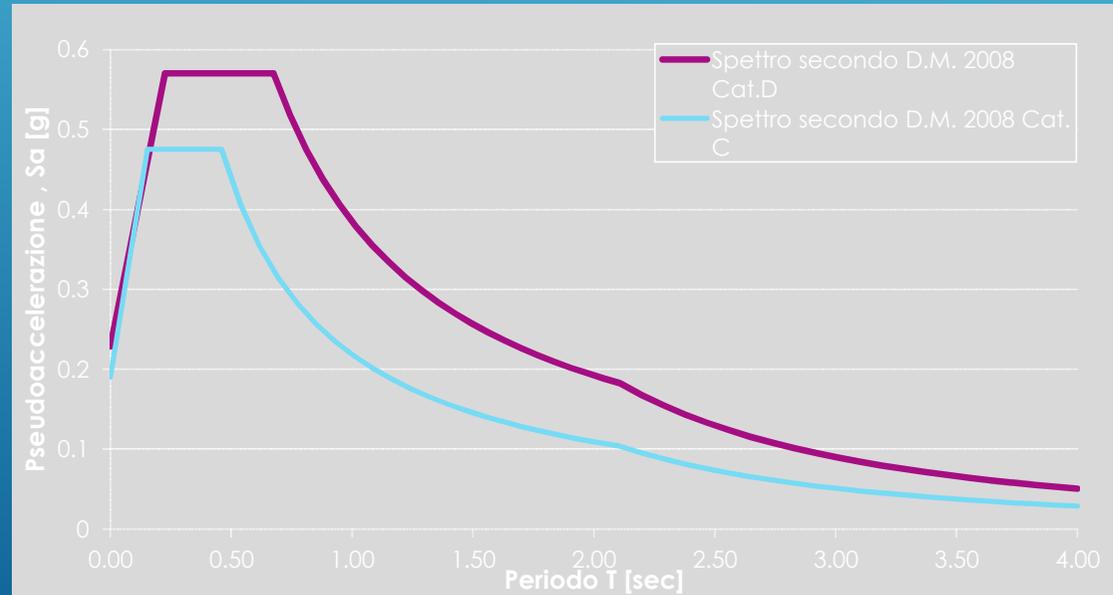
## Caratterizzazione sismica



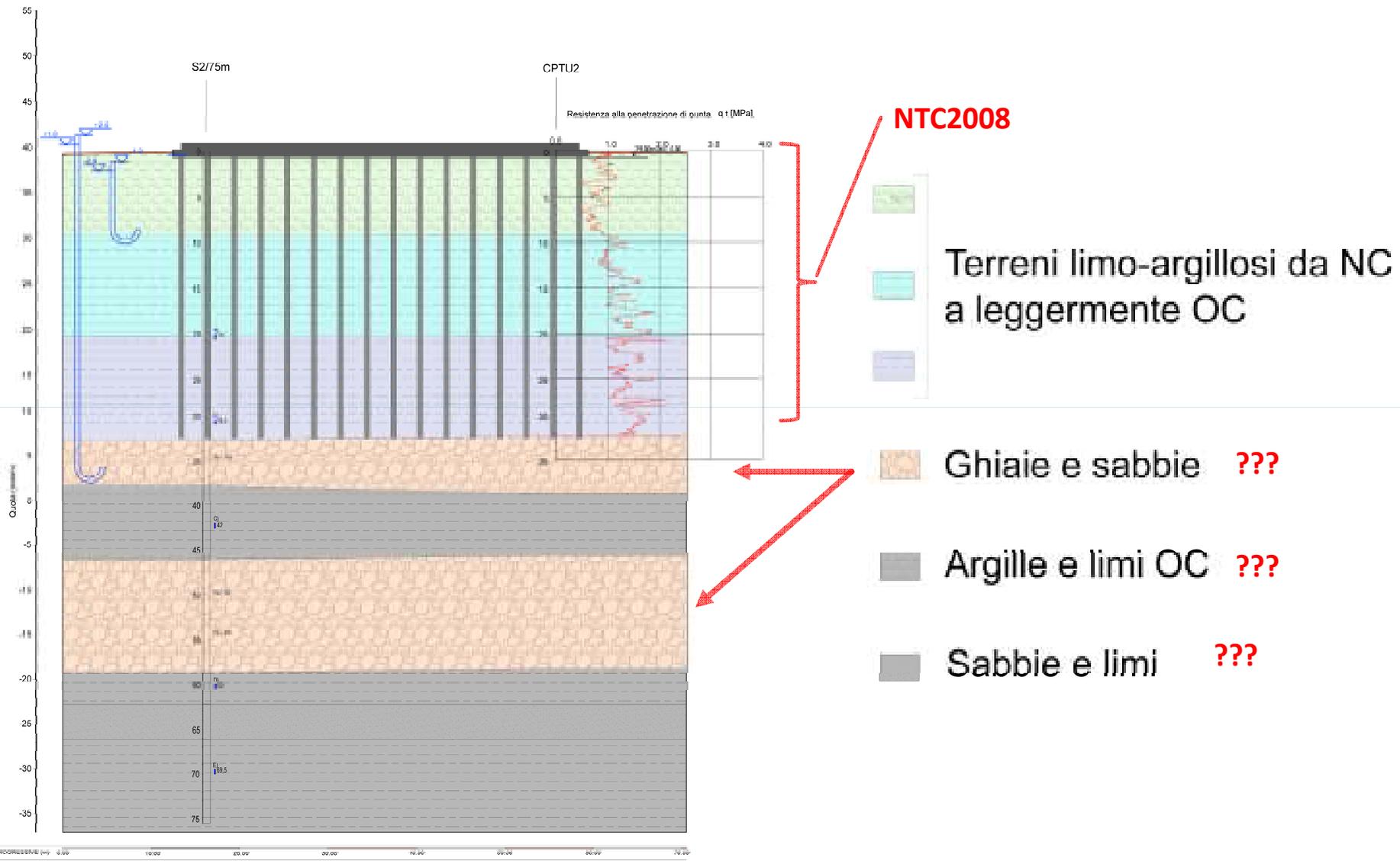
Approccio  
semplificato NTC2008

SCPTU	$V_{s30}$ - m/s
1	172
2	180

Categoria C o D!?!?



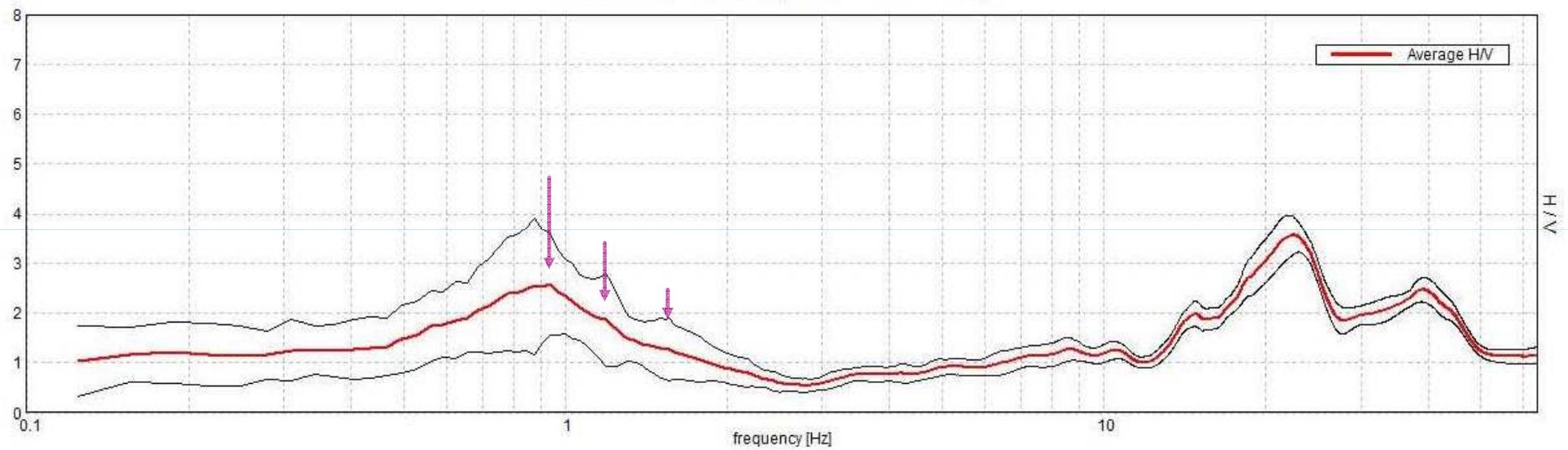
## Effetto del sisma sotto i 30m



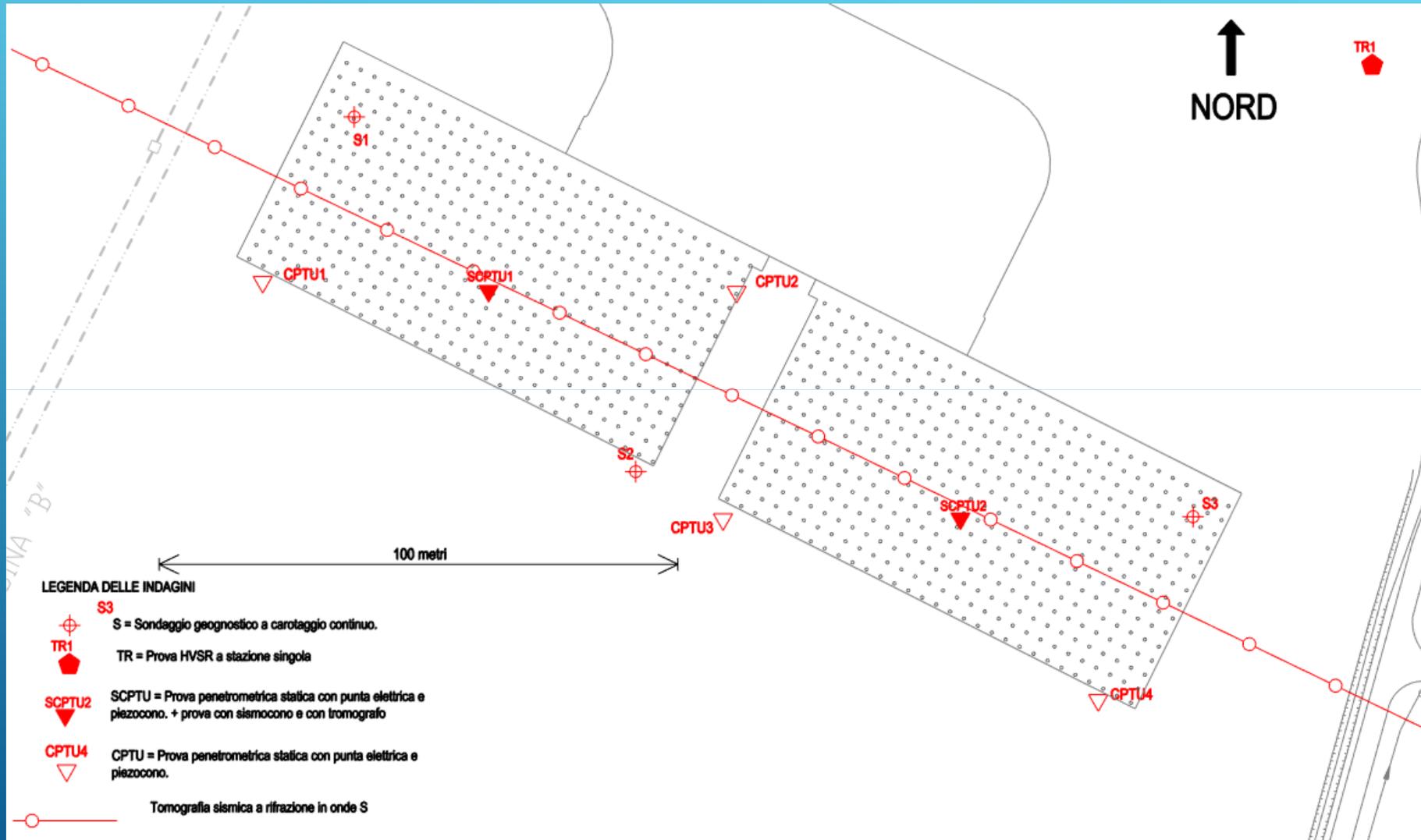
## Risultati dello spettro H/V

### RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Picco H/V a  $0.94 \pm 0.03$  Hz (nell'intervallo 0.0 - 15.0 Hz).



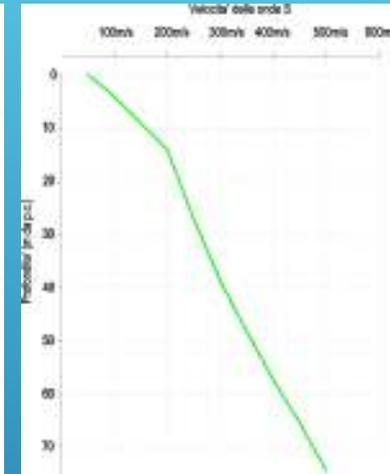
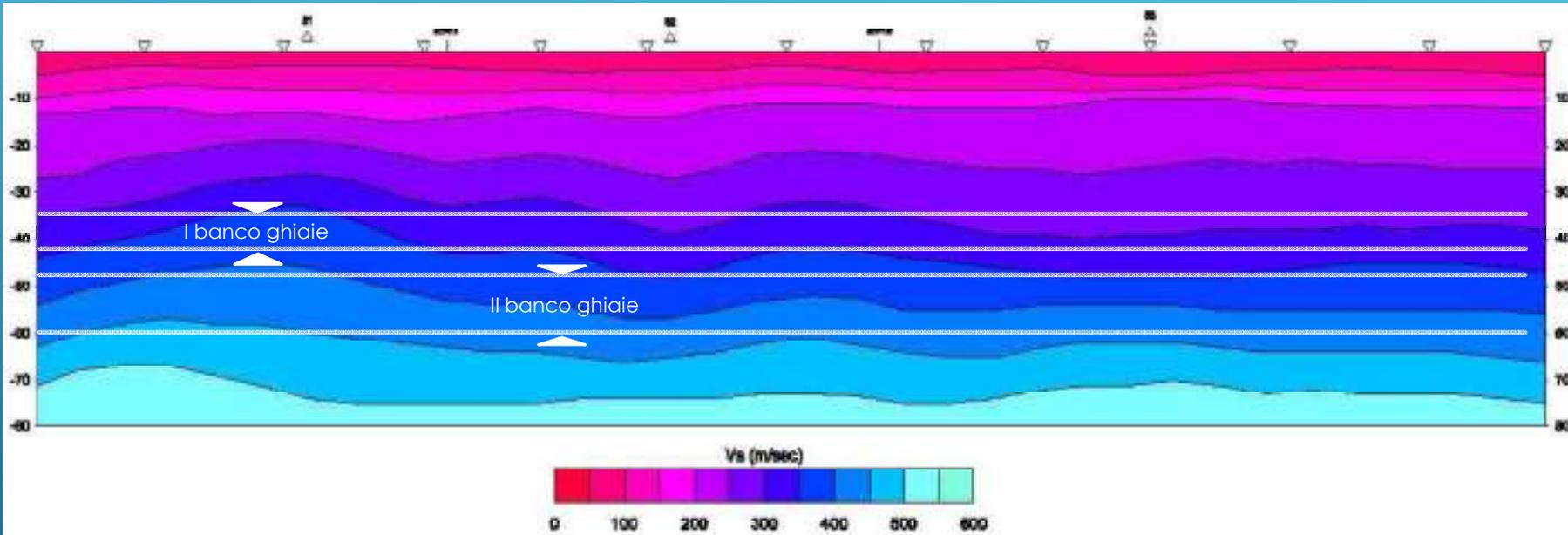
## Indagini aggiuntive: tomografia sismica a rifrazione



# Indagini aggiuntive: tomografia sismica a rifrazione

## Sezione tomografica

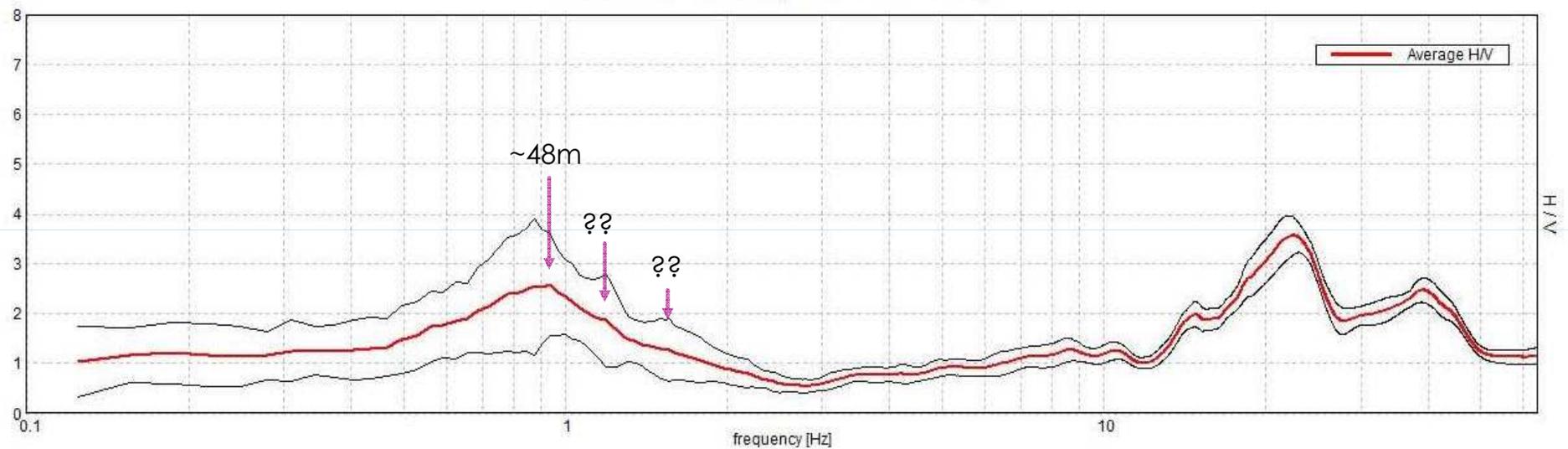
## Profilo Vs – tipo



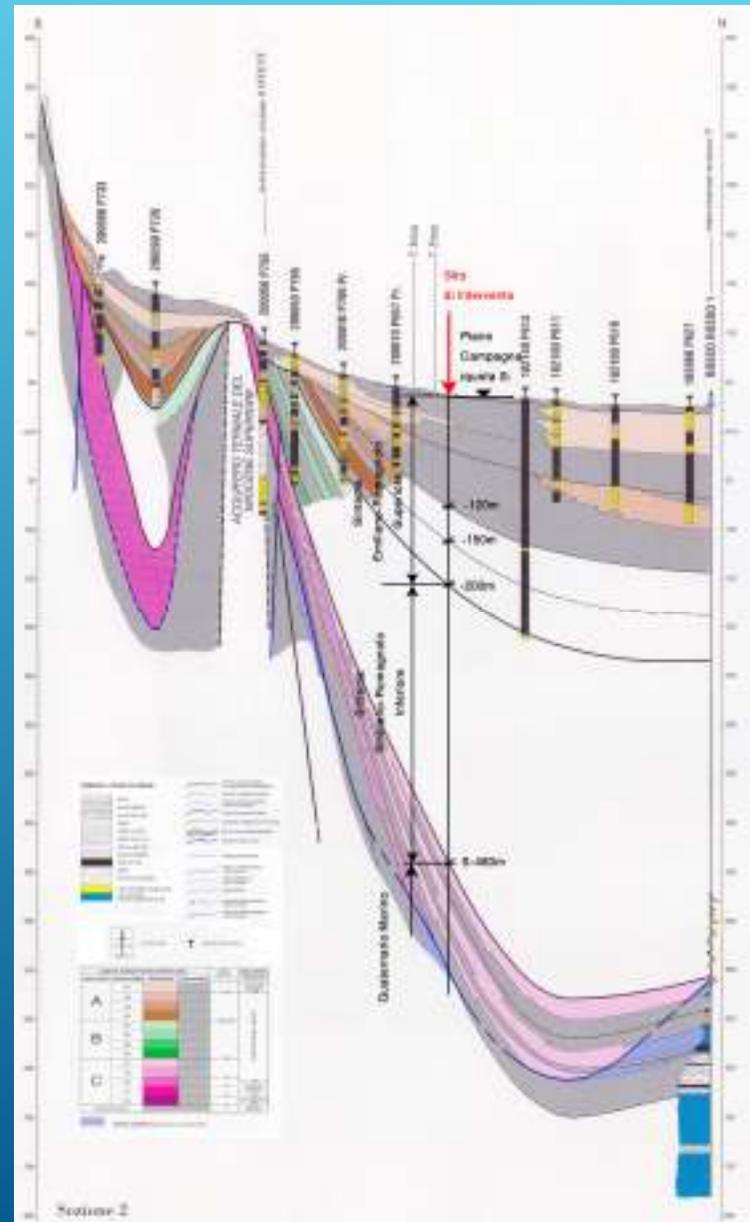
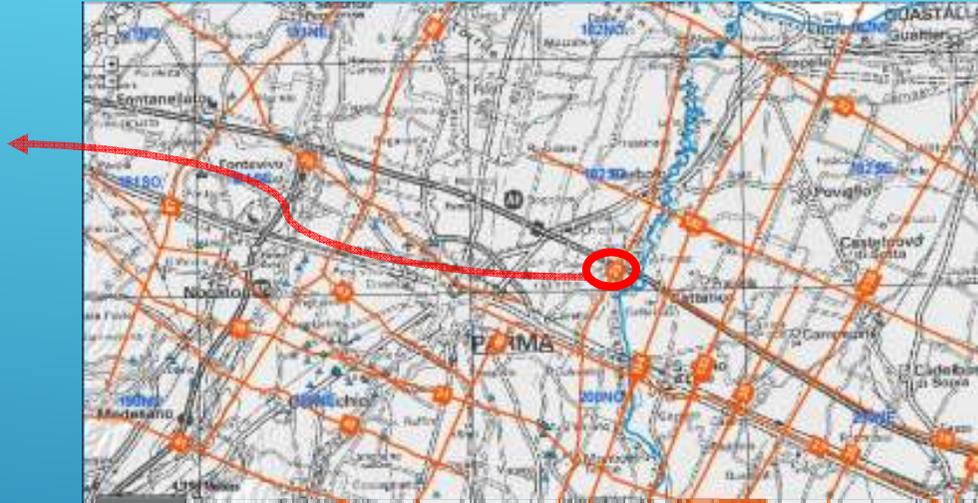
## Risultati dello spettro H/V

### RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Picco H/V a  $0.94 \pm 0.03$  Hz (nell'intervallo 0.0 - 15.0 Hz).

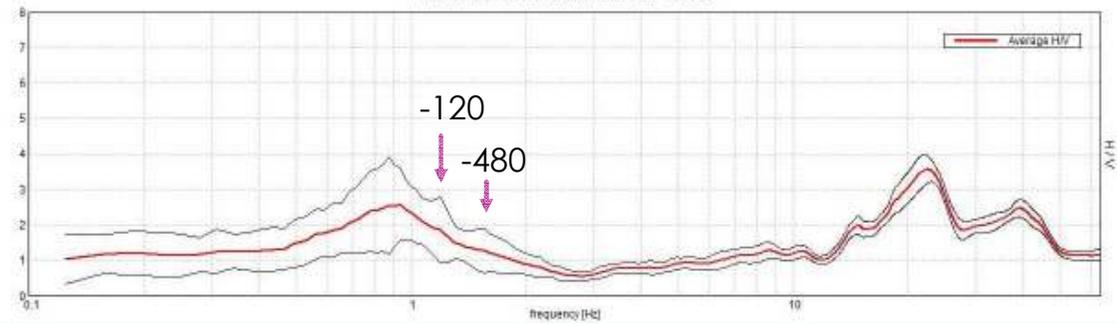


## Stratigrafia profonda e bedrock sismico



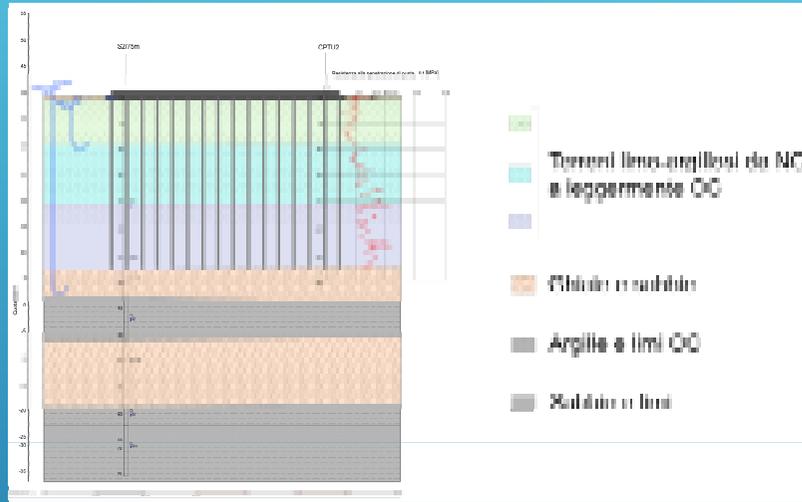
### RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Picco HV a  $0.94 \pm 0.03$  Hz (nell'intervallo 0.0 - 15.0 Hz)



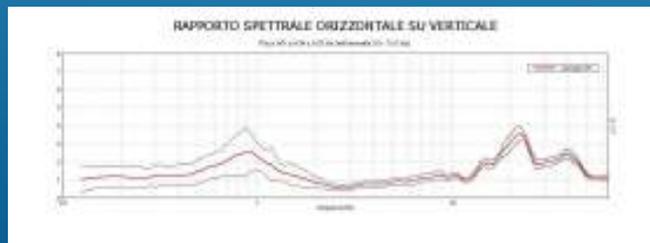
# Modello Vs del sito

## Dati superficiali

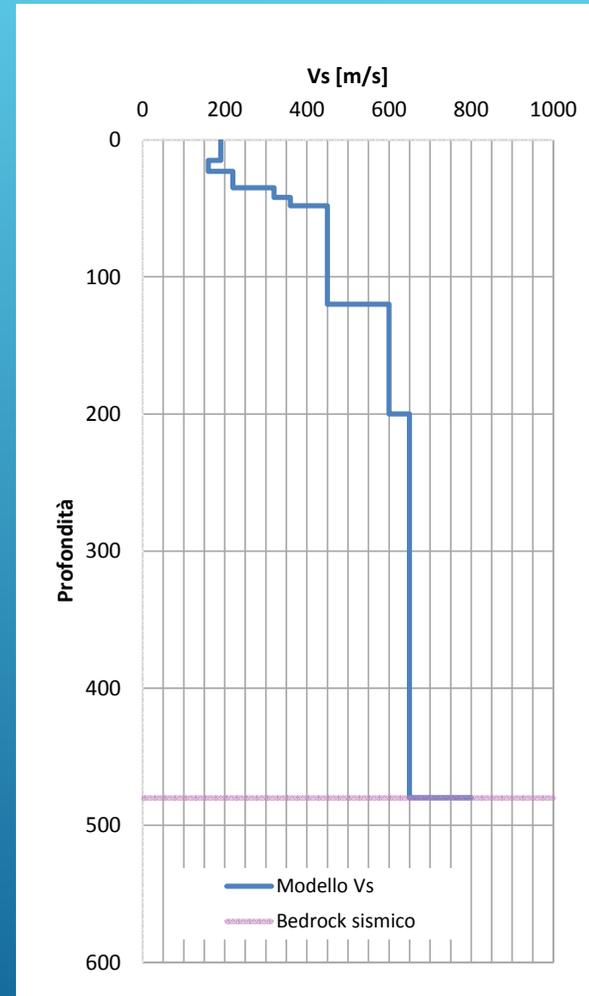


+

## Dati profondi



=



## Pesi di volume, Ridigezza e viscosità degli strati

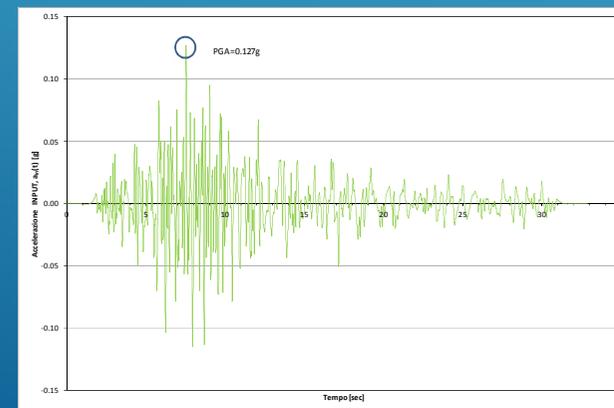
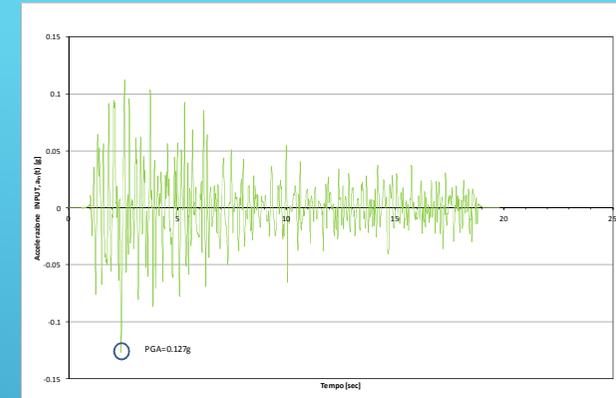
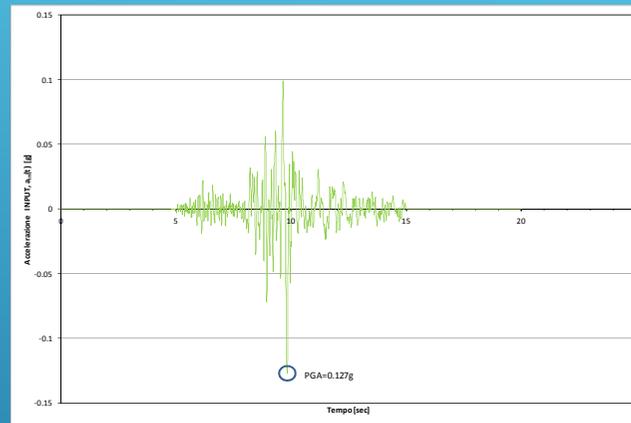
Profondità base dello strato [m da p.c.]	Spessore strato [m]	Litologia	Peso in volume del terreno [kN/m <sup>3</sup> ]
4.0	4.0	Argille superficiali	18.0
10.0	6.0	Argille superficiali	18.0
12.0	2.0	Argille superficiali	18.0
19.0	7.0	Argille superficiali	18.0
22.0	3	Argille superficiali	18.0
34.0	12.0	Argille superficiali	18.0
38.0	4.0	Ghiaie e sabbie	20.0
45.0	7.0	Argille profonde	19.0
58.0	13.0	Ghiaie e sabbie	20.0
120.0	62.0	Argille profonde	19.5
200.0	80.0	Argille profonde	19.5
480.0	280.0	Argille profonde	20.0
Bedrock sismico			21.0

Profondità base dello strato [m da p.c.]	Spessore strato [m]	Litologia	$\gamma - G/G_0$	$\gamma - D/D_0$
4.0	4.0	Argille superficiali	Vucetic & Dobry (1991)	
10.0	6.0	Argille superficiali		
12.0	2.0	Argille superficiali		
19.0	7.0	Argille superficiali		
22.0	3	Argille superficiali		
34.0	12.0	Argille superficiali		
38.0	4.0	Ghiaie e sabbie	Rollins (1986)	Rollins et al (1998)
45.0	7.0	Argille profonde	Vucetic & Dobry (1991)	
58.0	13.0	Ghiaie e sabbie	Rollins (1986)	Rollins et al (1998)
120.0	62.0	Argille profonde	Vucetic & Dobry (1991)	
200.0	80.0	Argille profonde		
480.0	280.0	Argille profonde		
Bedrock smorzamento pari al 2%				

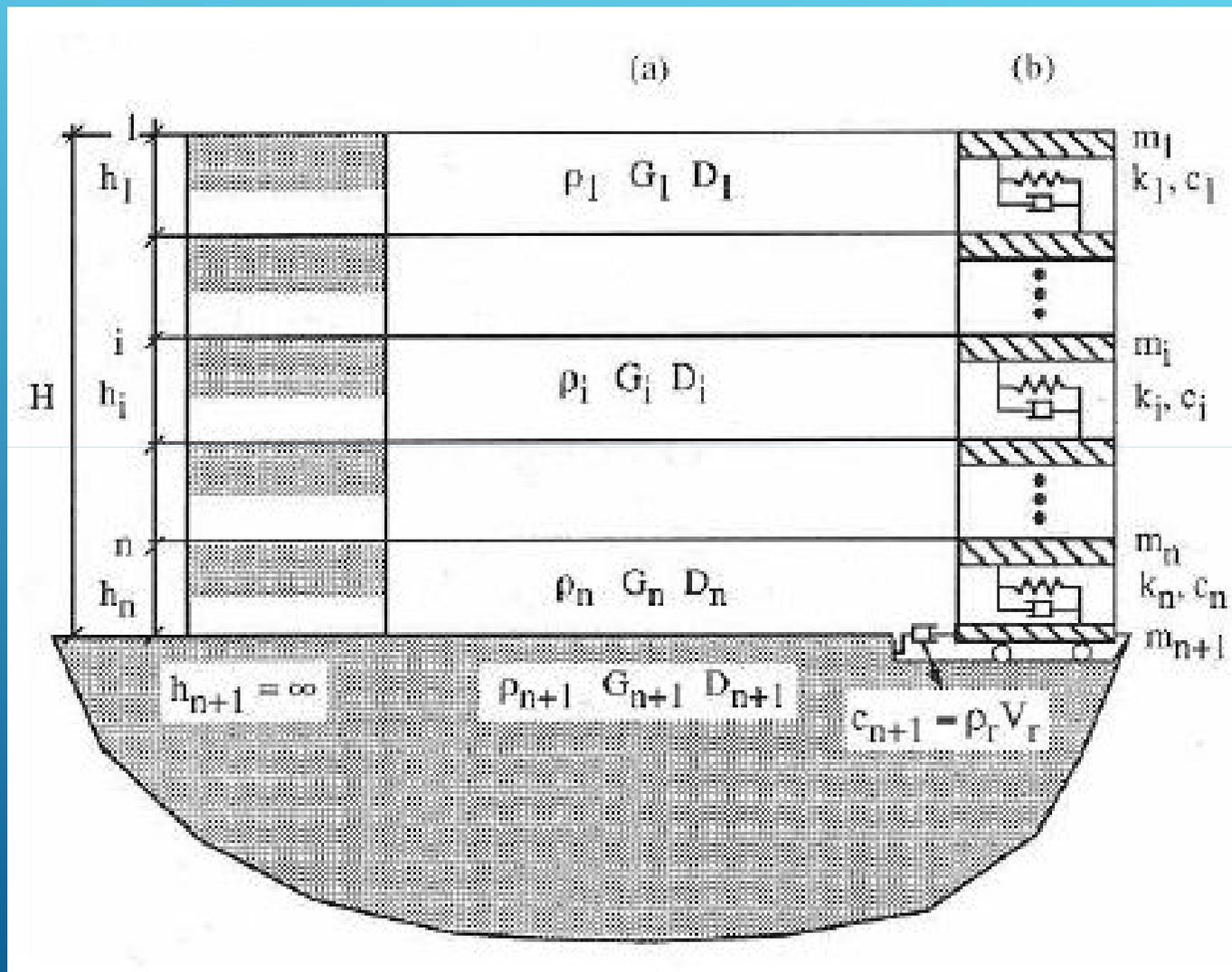
## Azione sismica di base (NTC 2008)

- $V_N = 50$  anni
- Classe II  $\rightarrow C_u = 1.0$ .

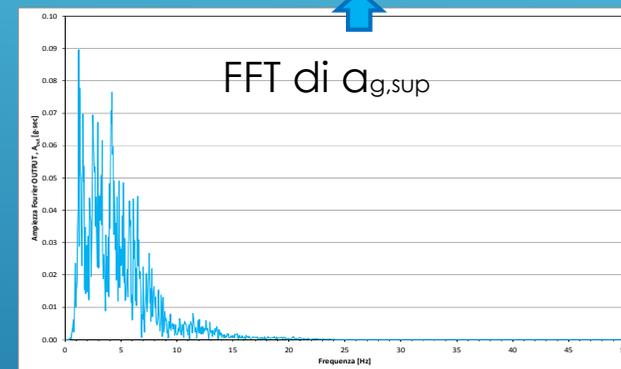
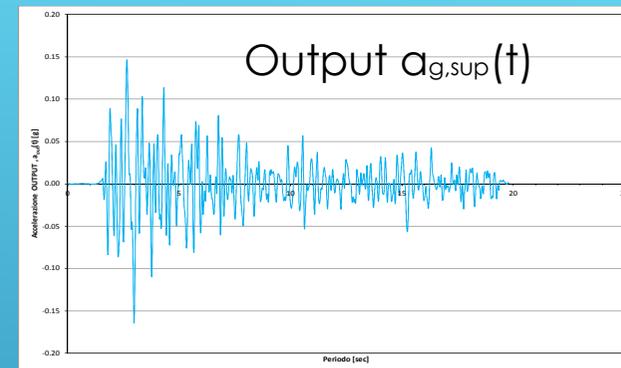
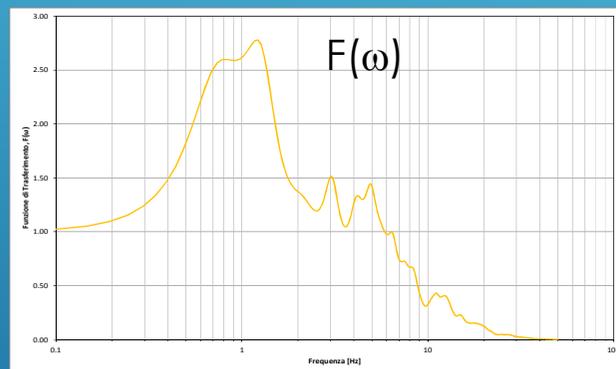
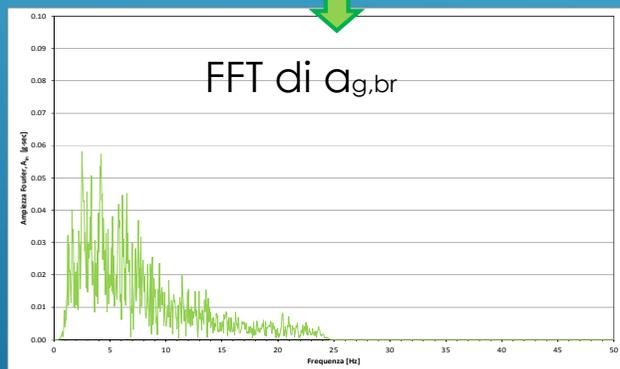
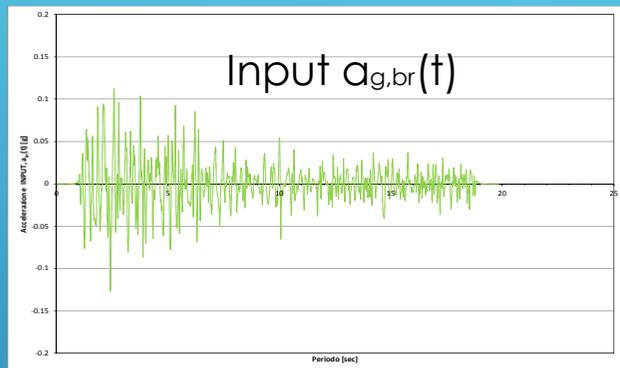
Stato Limite	$T_R$ [anni]	$a_g$ [g]
SLO	30	0.043
SLD	50	0.053
<b>SLV</b>	<b>475</b>	<b>0.127</b>
SLC	975	0.164



## Analisi RSL monodimensionale di tipo lineare equivalente



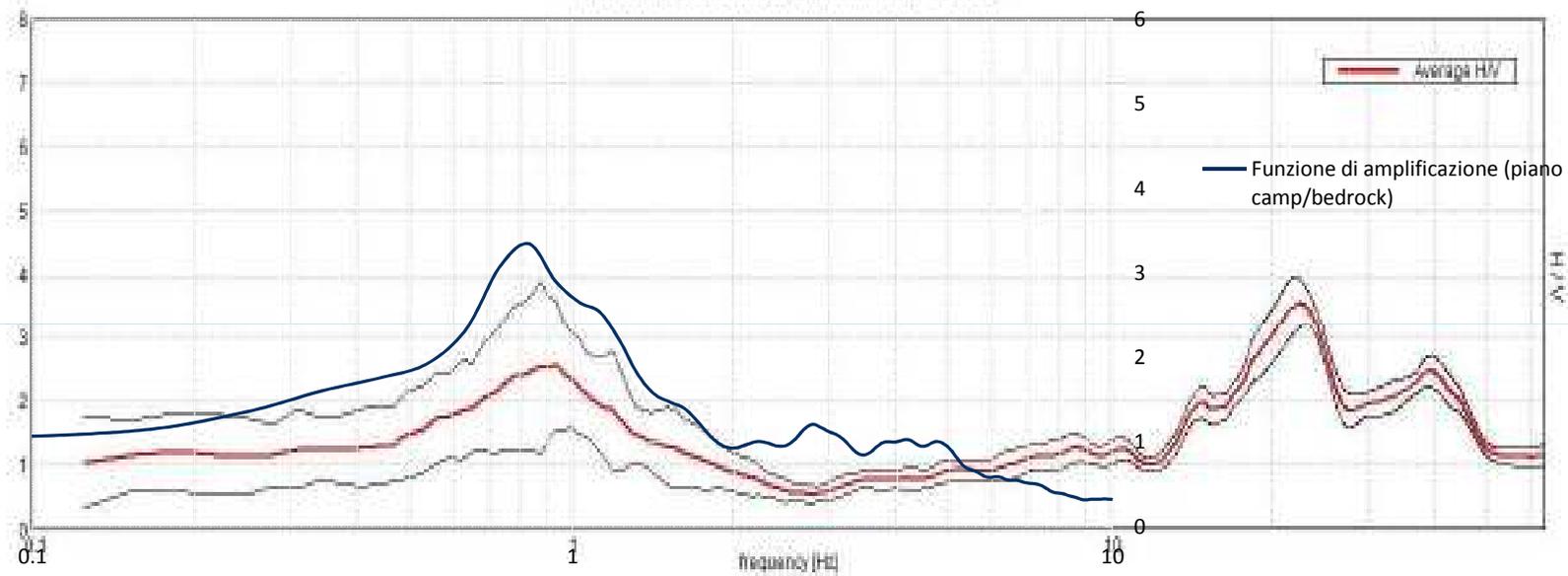
# Iterazione tipica in un'analisi di RSL lineare - equivalente



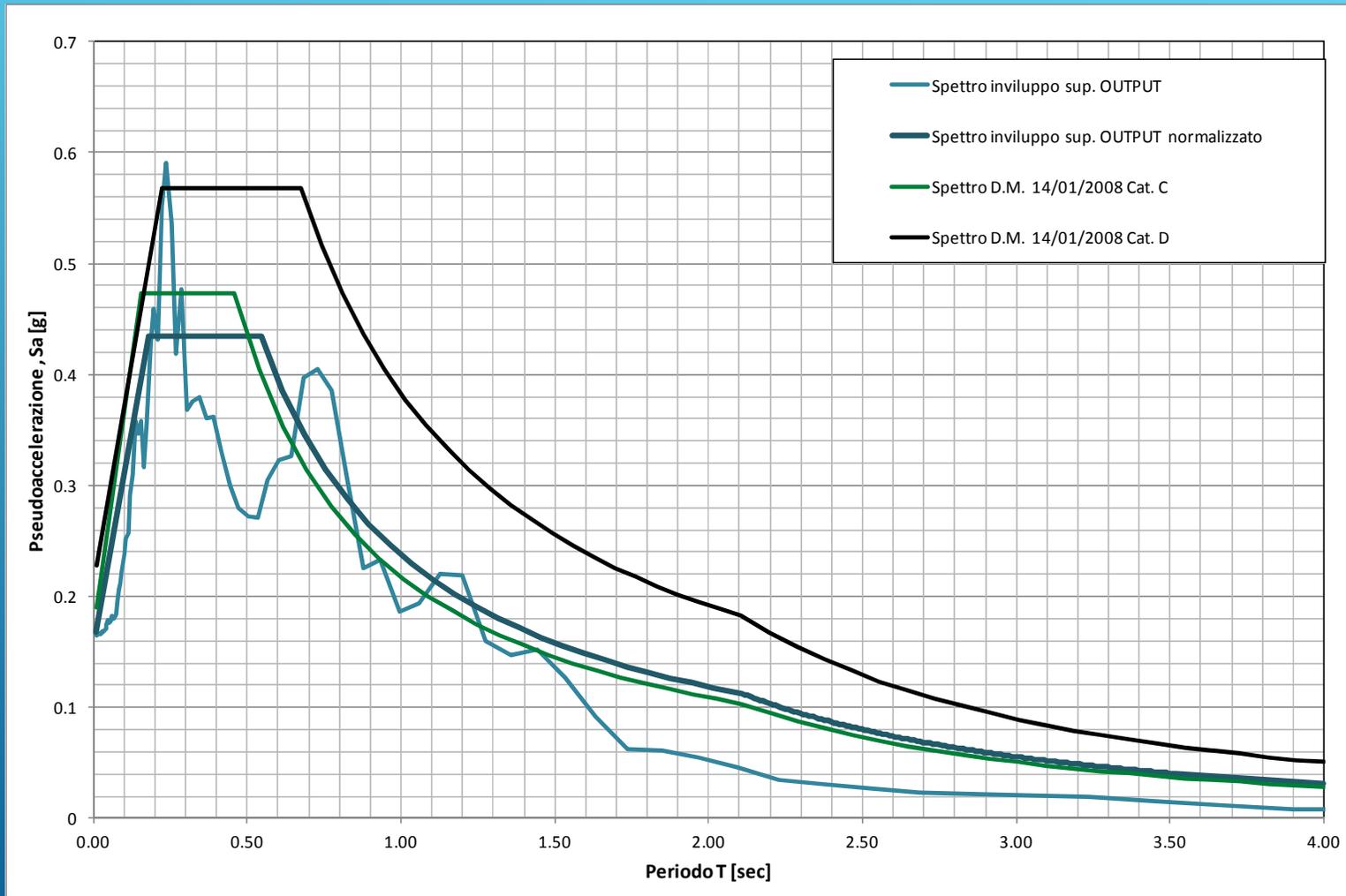
## Confronto fra Funzione di Trasferimento e Spettro H/V

### RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Picco H/V a  $0.94 \pm 0.03$  Hz (intervallo 0.0 - 15.0 Hz)



## Risultato dell'analisi di RSL

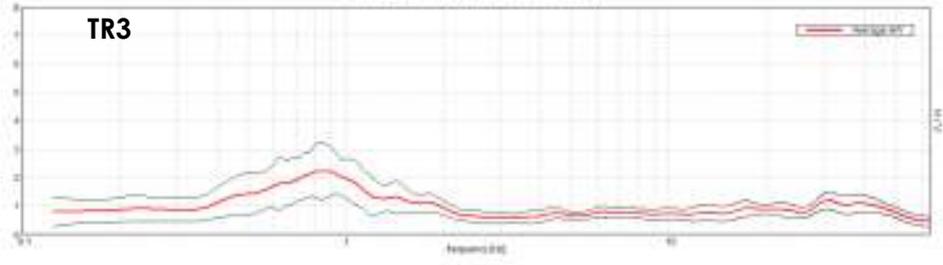


# Risposta omogenea del sito

RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Pico HV a 0.81 ± 0.04 Hz (nell'intervallo 0.3 - 64.0 Hz)

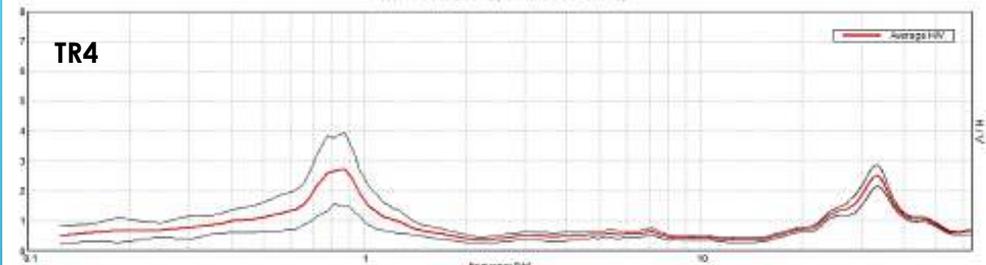
TR3



RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Pico HV a 0.88 ± 0.0 Hz (nell'intervallo 0.3 - 64.0 Hz)

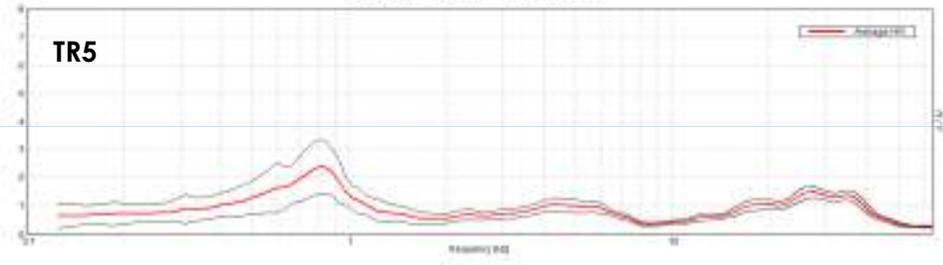
TR4



RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Pico HV a 0.81 ± 0.04 Hz (nell'intervallo 0.3 - 64.0 Hz)

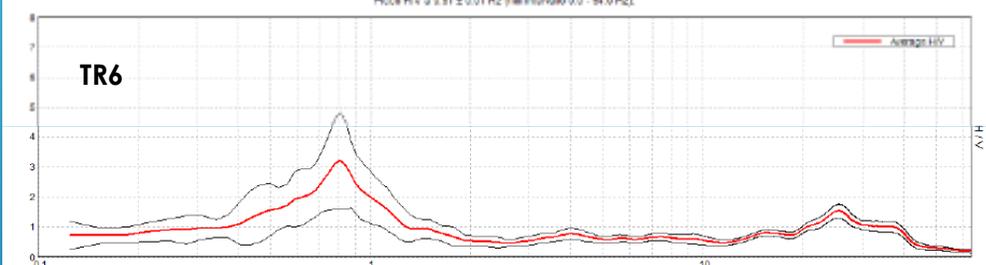
TR5



RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Pico HV a 0.81 ± 0.01 Hz (nell'intervallo 0.3 - 64.0 Hz)

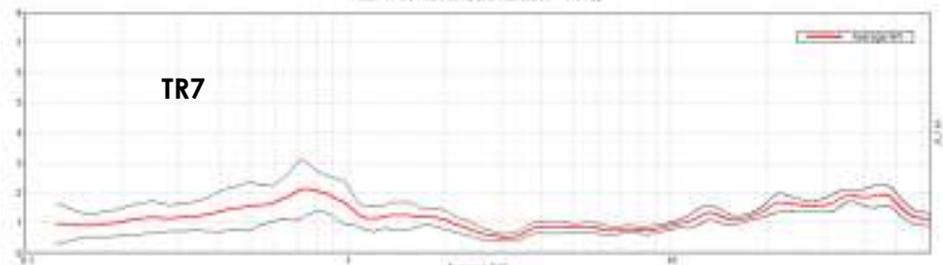
TR6



RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Pico HV a 0.78 ± 0.03 Hz (nell'intervallo 0.3 - 64.0 Hz)

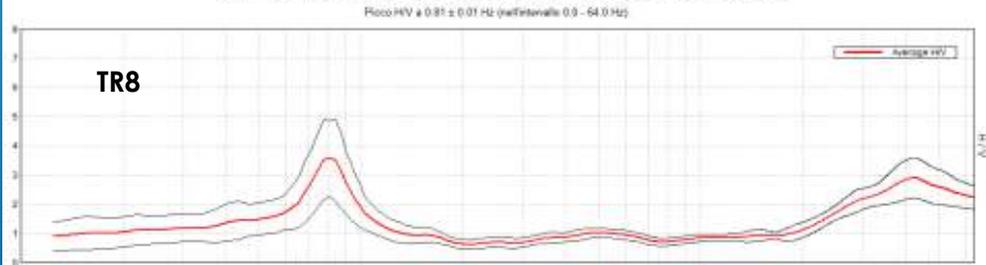
TR7



RAPPORTO SPETTRALE ORIZZONTALE SU VERTICALE

Pico HV a 0.81 ± 0.01 Hz (nell'intervallo 0.3 - 64.0 Hz)

TR8



Grazie per l'attenzione!