



ALLEGATO 3

Prove Geofisiche

Parte 1: PROVE SISMICHE ATTIVE MASW

Parte 2: PROVE SISMICHE PASSIVE HVSR





Cod. Indag.	Indirizzo	Autore	Data	MASW	HVSR	Sigla in Tav. 6
IGT0	Scuole Medie	Geoinvest s.r.l.	02/1986			
IGT1	Piano di Lottizzazione PEC1a	Geoinvest s.r.l.	02/2000			
IGT2	Via XXV 04/	Studio Geologico Tecnico Lecchese	01/2005			
IGT3	Via Martin Luther King	Geoplanet Studio Geologico	03/2005			
IGT4	Via Donizzetti	Dott. Geol. Riccardo Cortiana	12/2001			
IGT5	Via Mazzini	Studio Geoplan	01/2003			
IGT6	AT 1, tra S.P.211 e S.P.215	Fusina s.r.l.	04/2013			
IGT7	AT 3, via Dante	Studio Geoplan	09/2013			
IGT8	AT 4, via E. De Amicis - S.P.215	GeoArbor studio	01/2022	2		B1-B2
IGT9	Via Leopardi n. 16	Geotecno srl	03/2019			
IGT10	Via Luigi Galvani n.5	IPOGEO Studio Geologico		1		B3
IGT11	Via dell'Industria 3/A-3/B	GEO GROUP s.r.l.	05/2019			
IGT12	P.zza Matteotti	Dott. Ing. Cristiano Tomasi	05/2020			
IGT13	via Galileo Galilei n. 15	FAPA engineering srl	07/2020	1		B4
IGT14	via Galileo Galilei	IDROTECNA	07/2020			
IGT15	via Galvani 3	GEOPLAN s.r.l.			1	HV1
IGT16	presso stabilimento Salchi Metalcoat	GEO GROUP S.R.L.	07/2020	1	2	B5, HV2-HV3
IGT17	via Verdi	Dott. Geol. Gianbattista Fidanza	11/2020	1	1	B6, HV4
IGT18	via Leopardi	IDROTECNA	05/2020	1		B7
IGT19	Via Meucci 1	GEOCONSULT	01/2022	1		B8
IGT20	via Primo Villa 10	Geotecno srl	02/2011			
IGT21	via F. Turati	STUDIO GEOLOGICO BALLABIO	12/2021		1	HV5
IGT22	via Galileo Galilei n. 13	Geotest s.r.l.		2	6	B9-B10, HV6-HV11
IGT23	via Aldo Moro AT1	Fusina srl	02/2019	1		B11
IGT24	via Turati	ERA, Geol. Umberto Locati	12/2021		1	HV12
IGT25	via Caravaggio n. 24	Dott. Geol. Alessandro Ratazzi	03/2022			
IGT26	via E. Fermi n. 1	Dott. Geol. Alessandro Ratazzi	01/2022			
IGT27	presso stabilimento Salchi Metalcoat	GEOGROUP	07/2021	1	2	B12, HV13-HV14
IGT28	via E. Fermi n.1	Dott. Geol. Alessandro Ratazzi	09/2021			



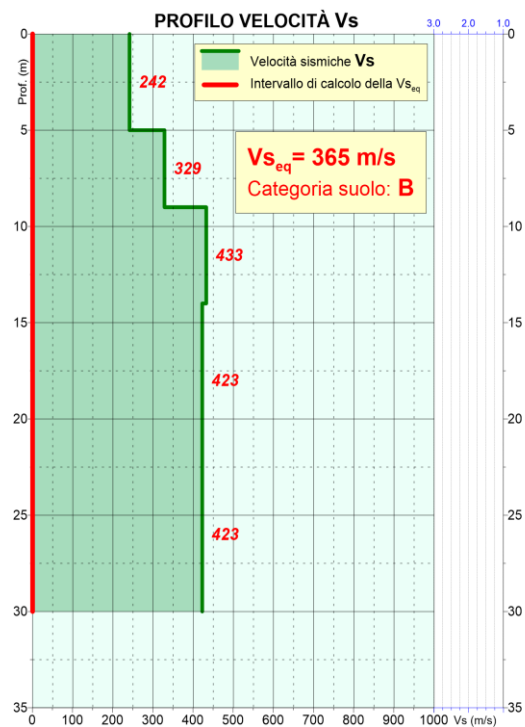


Parte 1

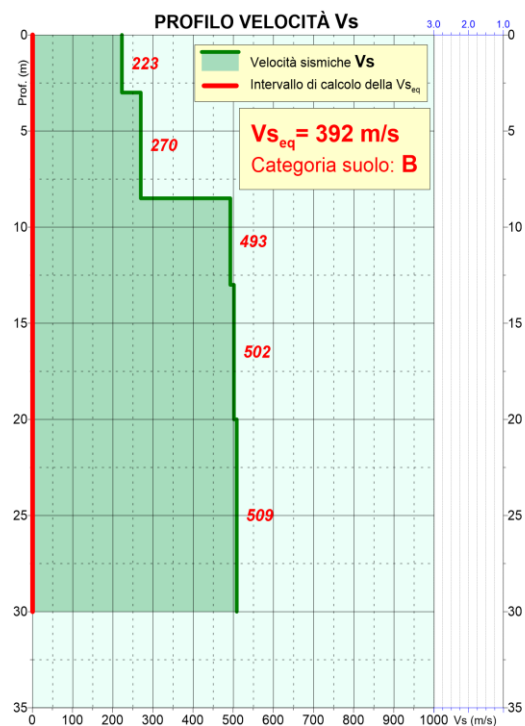
PROVE SISMICHE ATTIVE - MASW



Prova Masw – B1

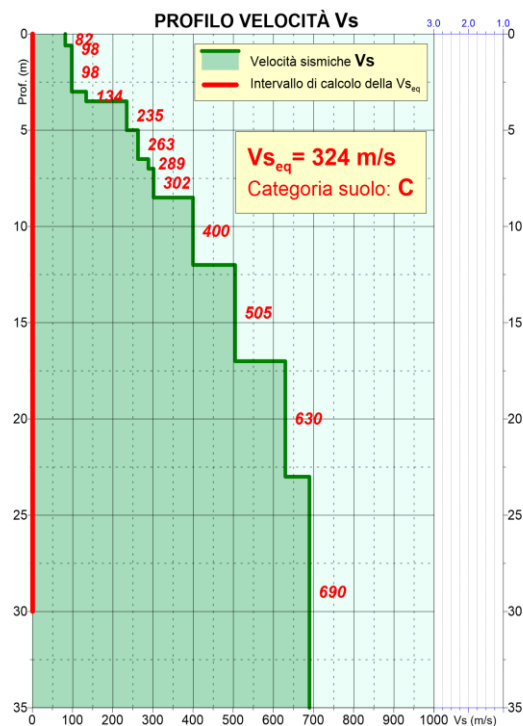
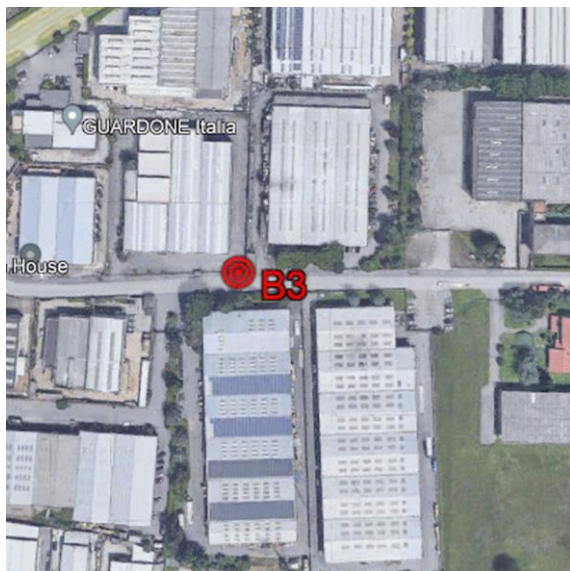


Prova Masw – B2

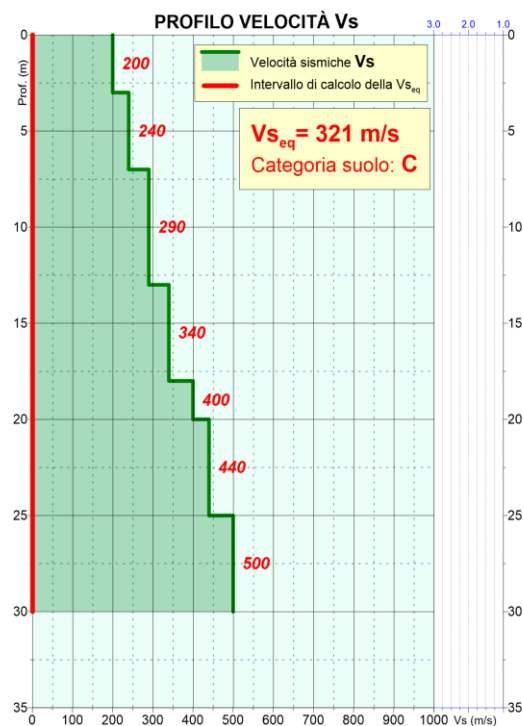
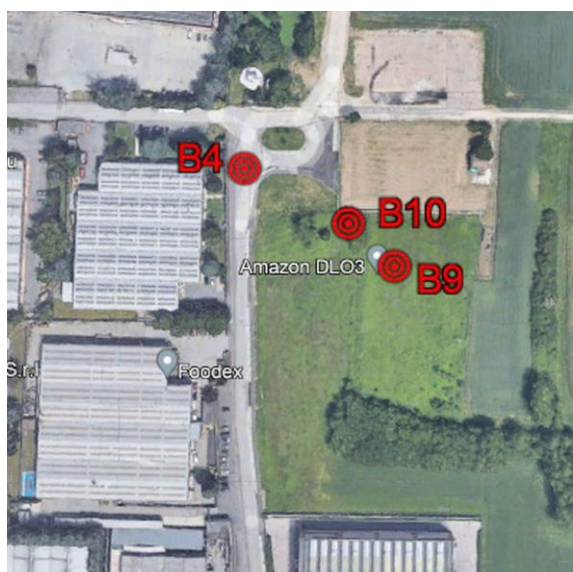




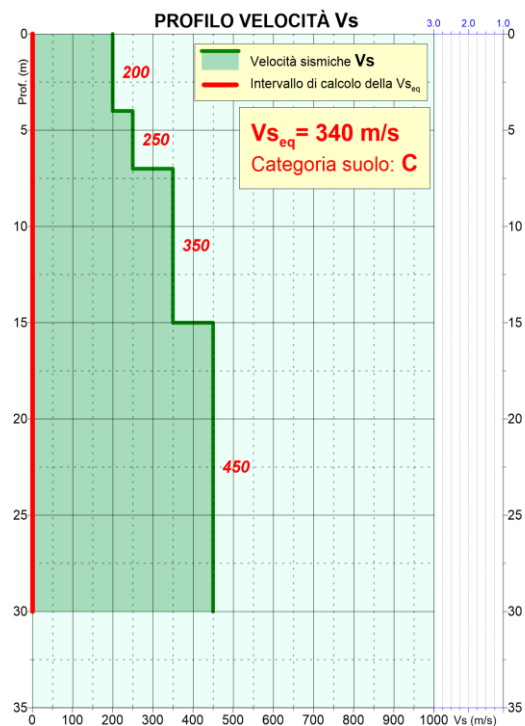
Prova Masw – B3



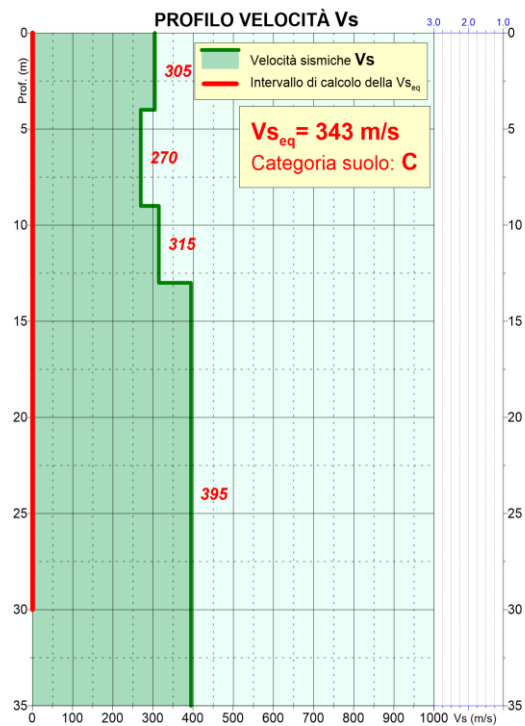
Prova Masw – B4



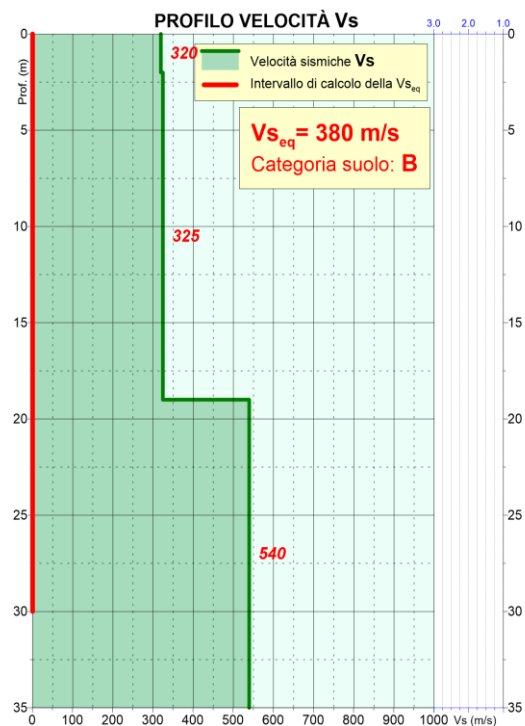
Prova Masw – B5



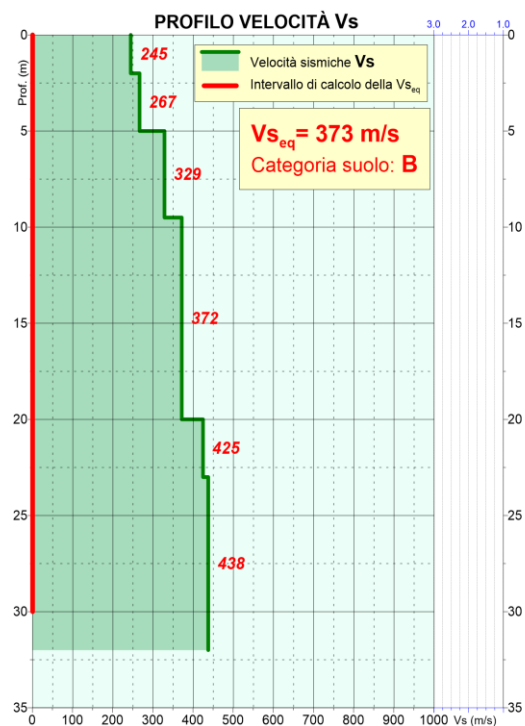
Prova Masw – B6



Prova Masw – B7

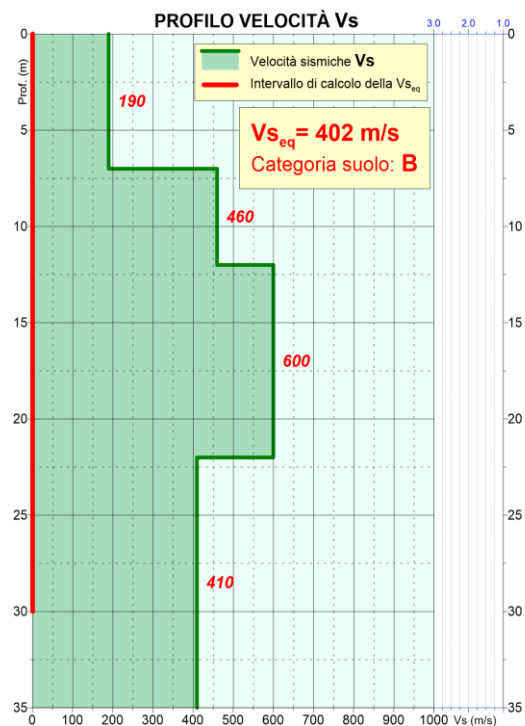
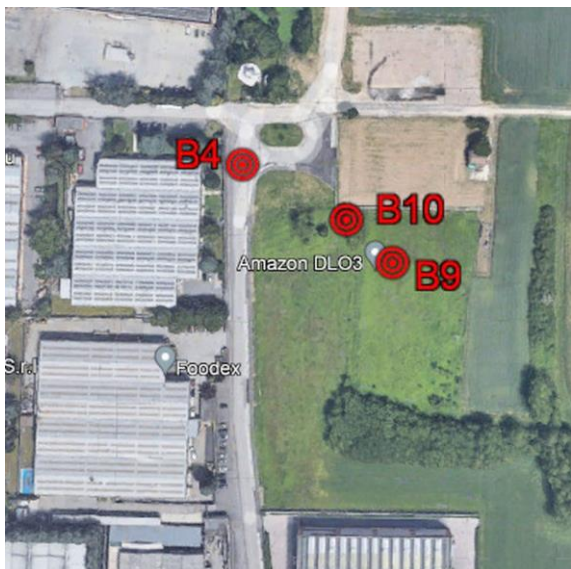


Prova Masw – B8

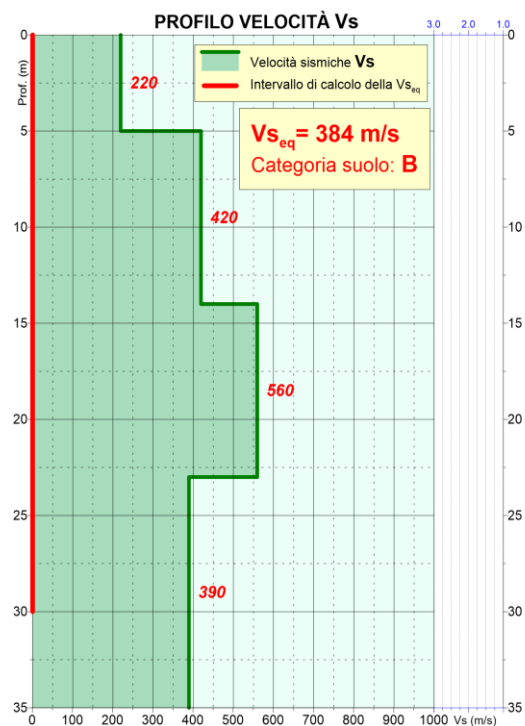
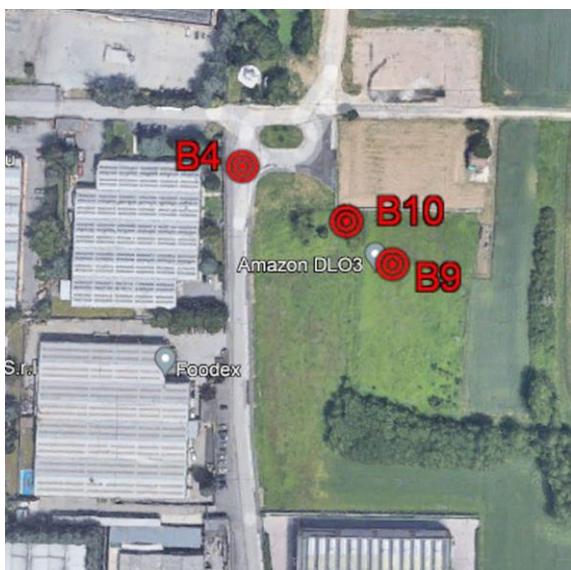




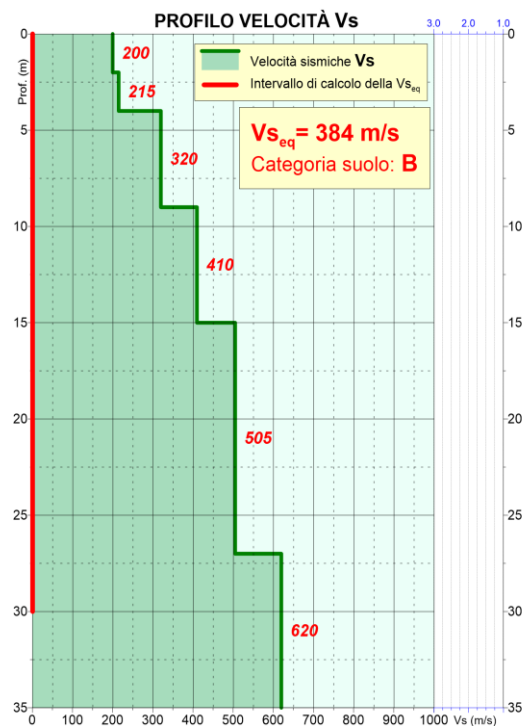
Prova Masw – B9



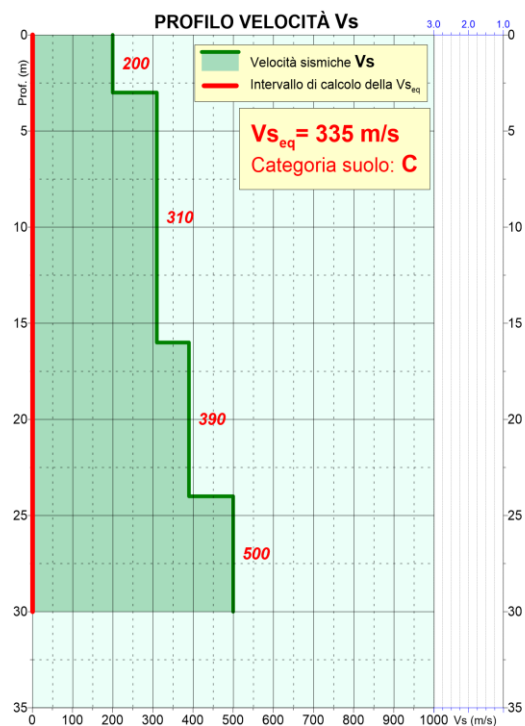
Prova Masw – B10



Prova Masw – B11



Prova Masw – B12





Parte 2

PROVE SISMICHE PASSIVE - HVSR

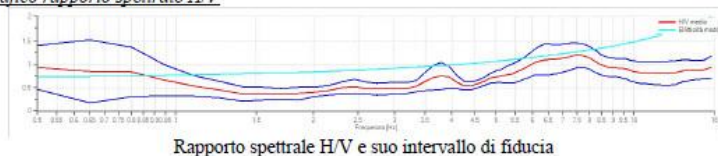


**Prova HVSR – HV1****Rapporto spettrale H/V**Dati riepilogativi:

Frequenza massima: 15.00 Hz
Frequenza minima: 0.50 Hz
Passo frequenza: 0.15 Hz
Tipo lisciamiento: Triangolare proporzionale
Percentuale di lisciamiento: 10.00 %
Tipo di somma direzionale: Media aritmetica

Risultati:

Frequenza del picco del rapporto H/V: 7.55 Hz ± 0.22 Hz

Grafico rapporto spettrale H/VVerifiche SESAME:

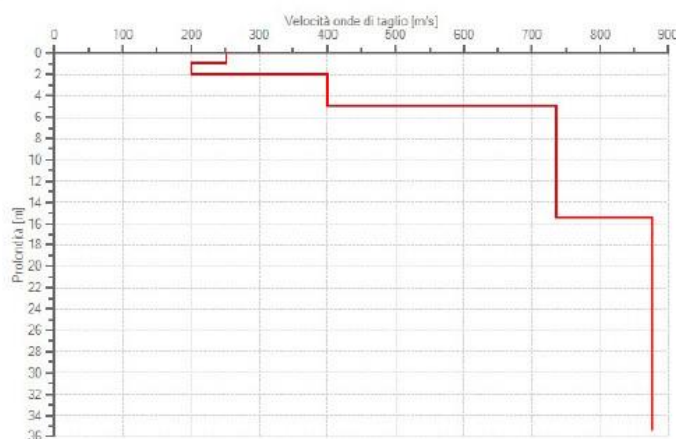
Verifica	Esito
$f_0 > 10/l_w$	Ok
$n_c(f_0) > 200$	Ok
$\sigma_A(f) < 2$ per $0.5 \cdot f_0 < f < 2 \cdot f_0$ se $f_0 > 0.5H$	Ok
$\sigma_A(f) < 3$ per $0.5 \cdot f_0 < f < 2 \cdot f_0$ se $f_0 < 0.5H$	Ok
$\exists f^- \in [f_0/4, f_0] \mid A_{H/V}(f^-) < A_0/2$	Ok
$\sigma_A(f_0) < \theta(f_0)$	Ok

Modello stratigraficoDati riepilogativi:

Numero strati: 5
Frequenza del picco dell'ellitticità: 14.75 Hz
Valore di disadattamento: 0.24
Valore Vseq: 503.48 m/s

Dati della stratigrafia:

Strato	Profondità [m]	Spessore [m]	Peso per Unità di Vol. [kN/m ³]	Coeff. di Poisson	Velocità onde di taglio [m/s]
1	0	1	19	0.28	253
2	1	1	17	0.27	200
3	2	3	19	0.29	400
4	5	10.42	20	0.25	736
5	15.42	20	20.5	0.23	876



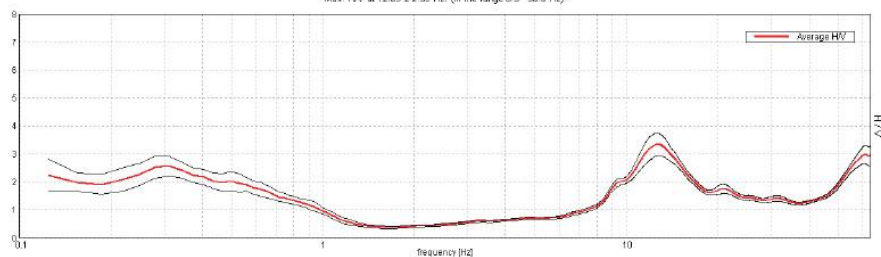
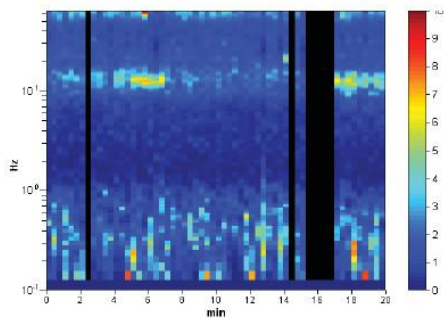
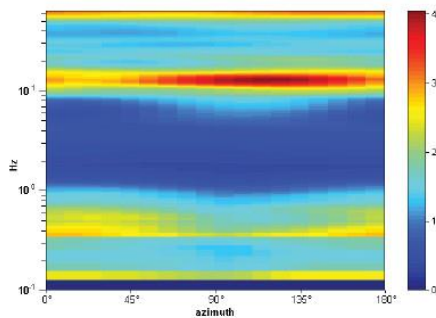
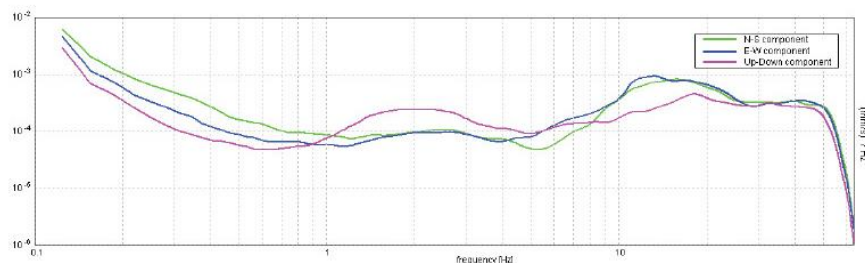
**Prova HVSR – HV2****TROMINO® Grilla**
www.tromino.eu**BURAGO DI MOLGORA, HV 1**

Instrument: TE3-0303/01-17
Data format: 32 byte
Full scale [mV]: 51
Start recording: 26/06/20 11:32:17 End recording: 26/06/20 11:52:17
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

Trace length: 0h20'00". Analyzed 88% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

Max. H/V at 12.69 ± 2.39 Hz. (in the range 0.5 - 30.0 Hz)

**H/V TIME HISTORY****DIRECTIONAL H/V****TROMINO® Grilla**
www.tromino.eu**SINGLE COMPONENT SPECTRA**

**Prova HVSR – HV3****BURAGO DI MOLGORA, HV2**

Instrument: TE3-0303/01-17

Data format: 32 byte

Full scale [mV]: 51

Start recording: 26/06/20 12:01:43 End recording: 26/06/20 12:21:43

Channel labels: NORTH SOUTH; EAST WEST; UP DOWN

GPS data not available

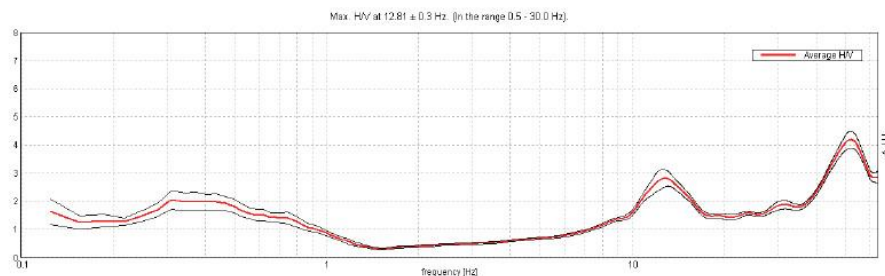
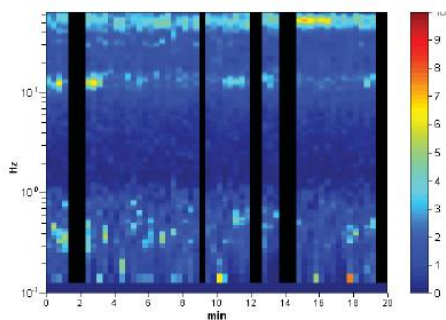
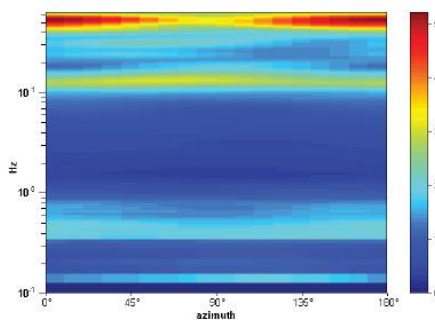
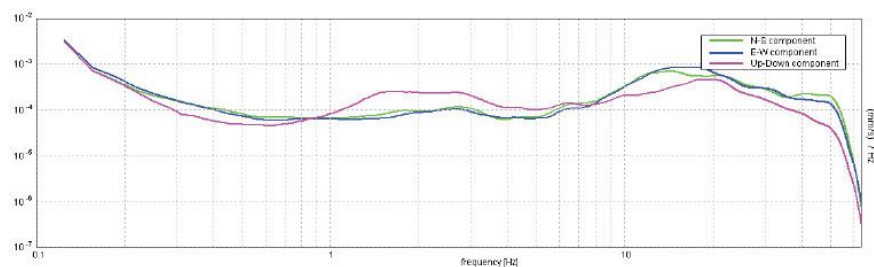
Trace length: 0h20'00". Analyzed 82% trace (manual window selection)

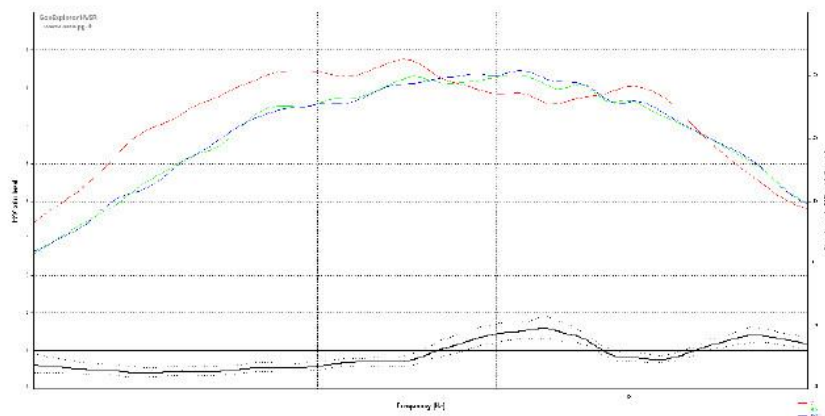
Sampling rate: 128 Hz

Window size: 20 s

Smoothing type: Triangular window

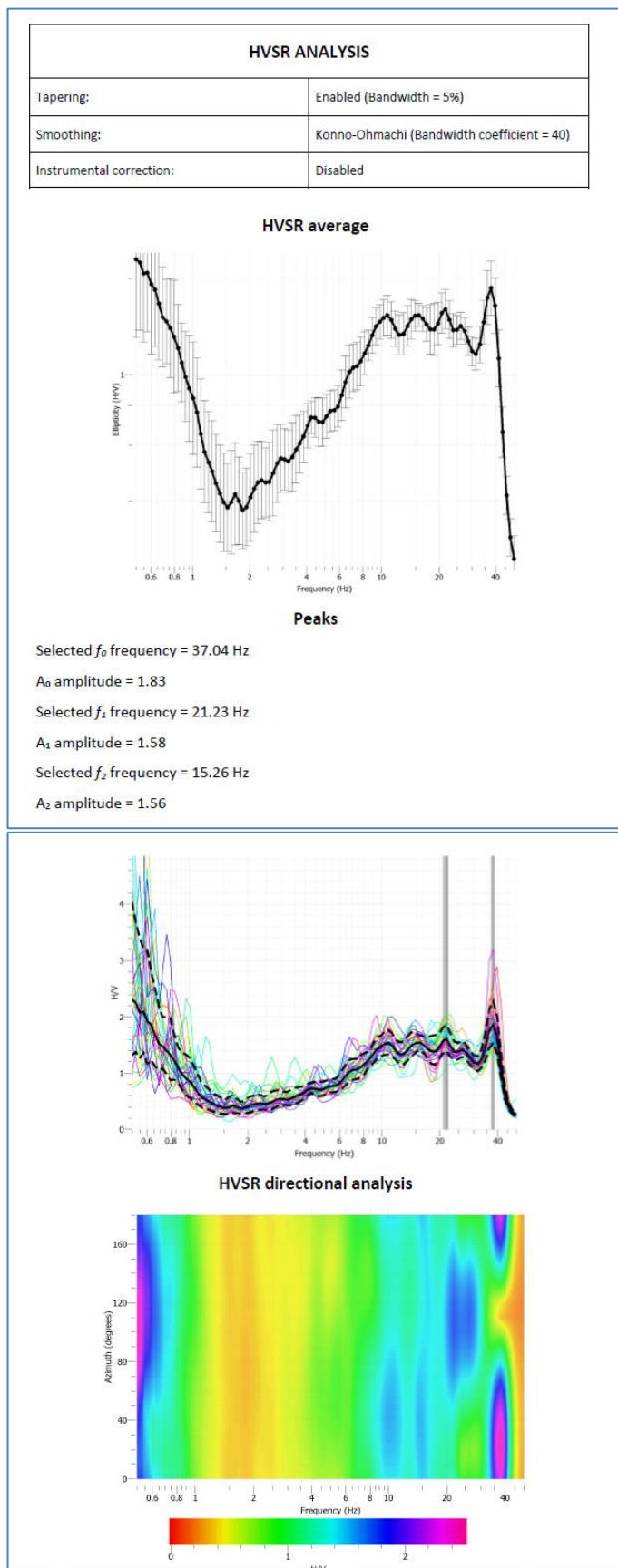
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO**H/V TIME HISTORY****DIRECTIONAL H/V****TROMINO® Grilla**
www.tromino.eu**SINGLE COMPONENT SPECTRA**

Prova HVSR – HV4**Figura 12 Spettri e curve H/V**

L'acquisizione non ha individuato picchi di amplificazione H/V.

Pertanto contrasti di impedenza sismica nelle coperture sono poco probabili anche al passaggio con i conglomerati e le arenarie del Ceppo, presenti a partire tra circa 15 e 20 m di profondità (dati stratigrafici piezometro di via Turati e vicini pozzi pubblici).

Prova HVSR – HV5



Prova HVSR – HV6

TROMINO® Grilla
www.tromino.eu

BURAGO, Via GALILEI - Prova 1

Instrument: TEP-0122/01-10

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 03/05/17 11:48:17 End recording: 03/05/17 12:08:17

Channel labels: NORTH SOUTH; EAST WEST; UP DOWN

GPS data not available

Trace length: 0h20'00". Analysis performed on the entire trace.

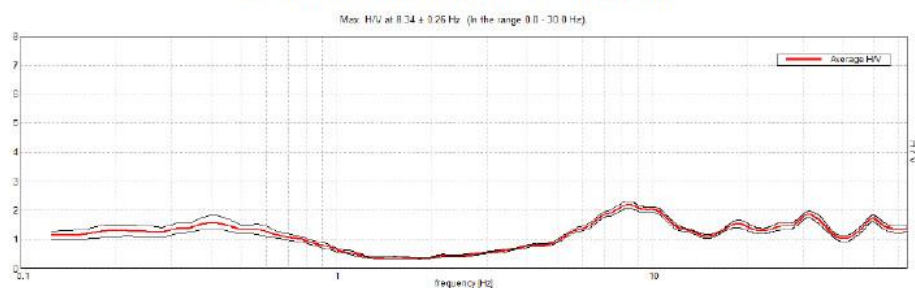
Sampling rate: 128 Hz

Window size: 20 s

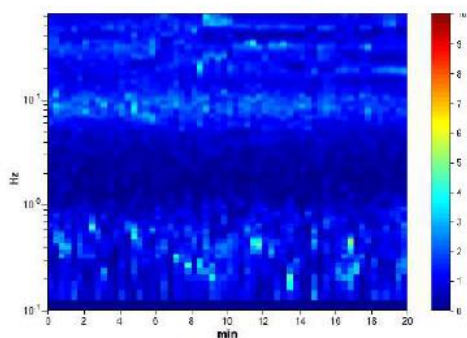
Smoothing type: Triangular window

Smoothing: 10%

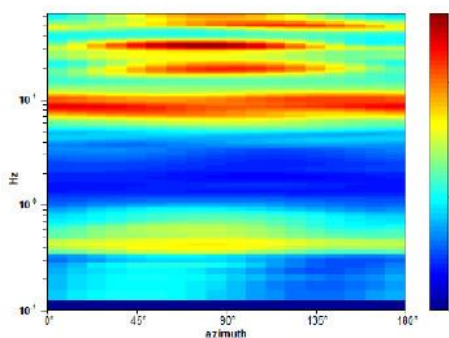
HORIZONTAL TO VERTICAL SPECTRAL RATIO



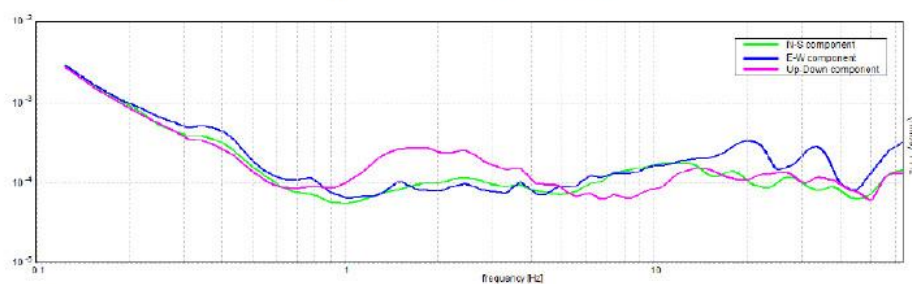
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA



**Prova HVSR – HV7****TROMINO® Grilla**
www.tromino.eu**BURAGO, Via GALILEI - Prova 2**

Instrument: TEP-0122/01-10

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 03/05/17 12:21:13 End recording: 03/05/17 12:41:13

Channel labels: NORTH SOUTH; EAST WEST; UP DOWN

GPS data not available

Trace length: 0h20'00". Analyzed 77% trace (manual window selection)

Sampling rate: 128 Hz

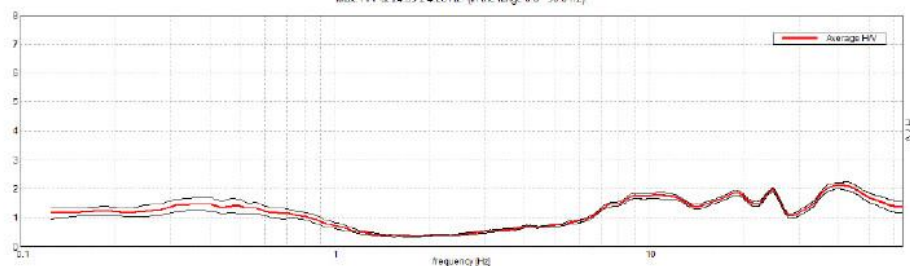
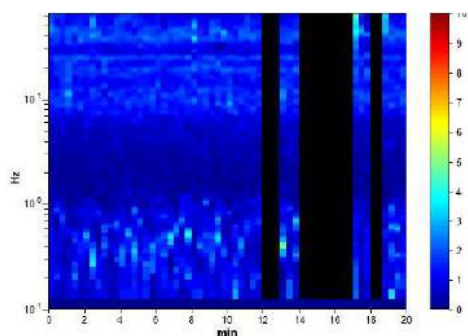
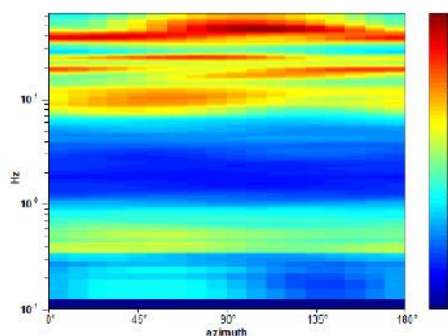
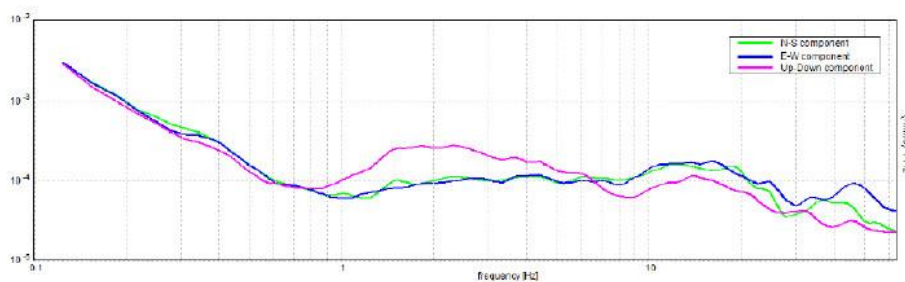
Window size: 20 s

Smoothing type: Triangular window

Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

Max. HV at 24.59 ± 4.26 Hz (in the range 0.0 - 30.6 Hz)

**H/V TIME HISTORY****DIRECTIONAL H/V****SINGLE COMPONENT SPECTRA**

**Prova HVSR – HV8****TROMINO® Grilla**
www.tromino.eu**BURAGO, Via GALILEI - Prova 3**

Instrument: TEP-0122/01-10

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 03/05/17 12:52:21 End recording: 03/05/17 13:12:21

Channel labels: NORTH SOUTH; EAST WEST; UP DOWN

GPS data not available

Trace length: 0h20'00". Analyzed 95% trace (manual window selection)

Sampling rate: 128 Hz

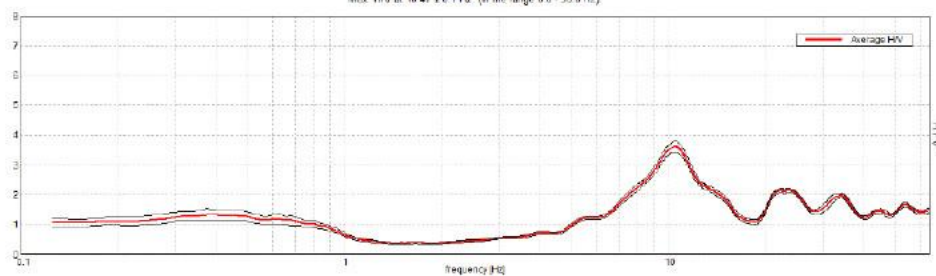
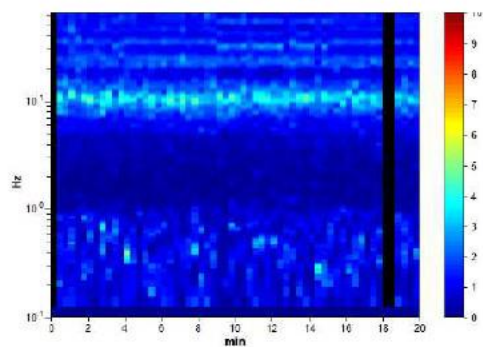
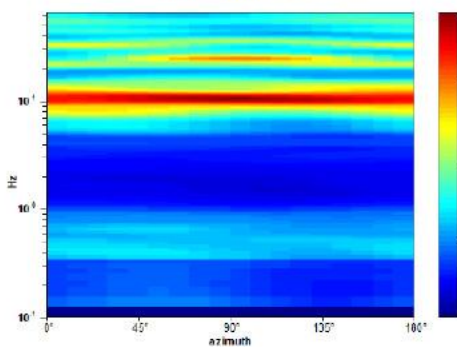
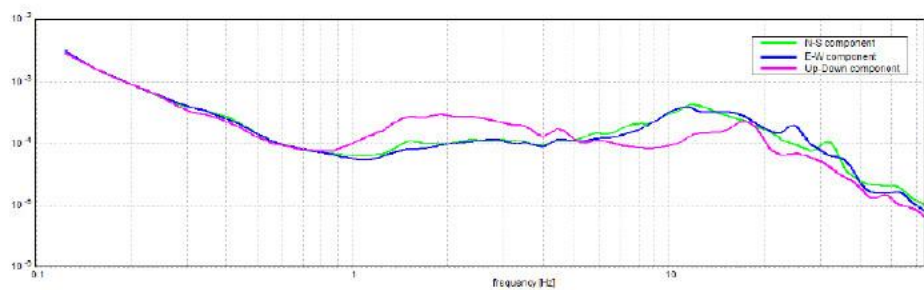
Window size: 20 s

Smoothing type: Triangular window

Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

Max H/V at 9.47 ± 0.1 Hz. (In the range 0.0 - 30.0 Hz)

**H/V TIME HISTORY****DIRECTIONAL H/V****SINGLE COMPONENT SPECTRA**



Prova HVSR – HV9

TROMINO® Grilla
www.tromino.eu**BURAGO, Via GALILEI - Prova 4**

Instrument: TEP-0122/01-10

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 03/05/17 13:22:43 End recording: 03/05/17 13:42:43

Channel labels: NORTH SOUTH; EAST WEST; UP DOWN

GPS data not available

Trace length: 0h20'00". Analyzed 93% trace (manual window selection)

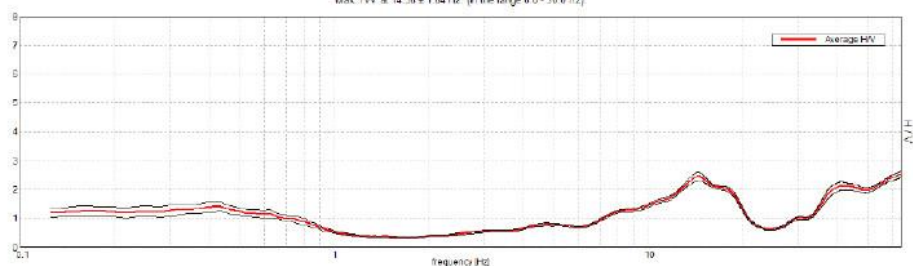
Sampling rate: 128 Hz

Window size: 20 s

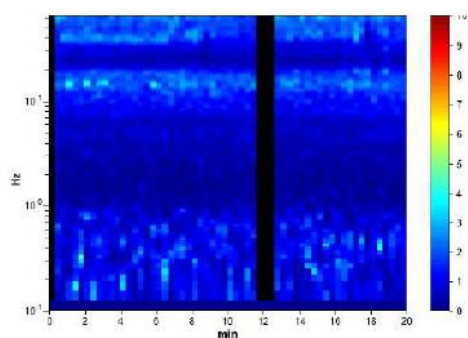
Smoothing type: Triangular window

Smoothing: 10%

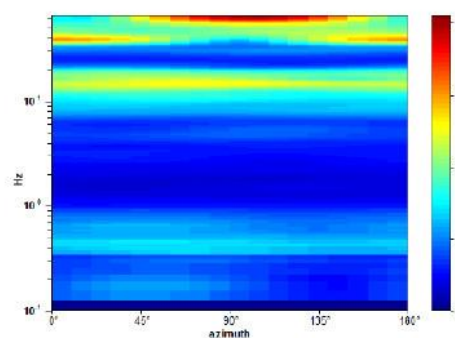
HORIZONTAL TO VERTICAL SPECTRAL RATIO

Max. HV $\pm 14.38 \pm 1.84$ Hz (in the range 0.0 - 30.0 Hz)

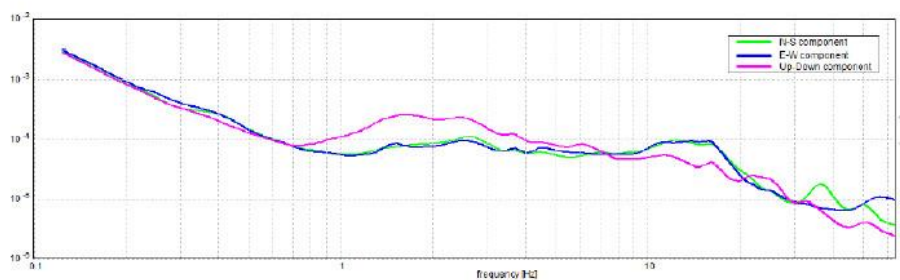
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA



**Prova HVSR – HV10****TROMINO® Grilla**
www.tromino.eu**BURAGO, Via GALILEI - Prova 5**

Instrument: TEP-0122/01-10

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 03/05/17 13:50:57 End recording: 03/05/17 14:10:57

Channel labels: NORTH SOUTH; EAST WEST; UP DOWN

GPS data not available

Trace length: 0h20'00". Analyzed 77% trace (manual window selection)

Sampling rate: 128 Hz

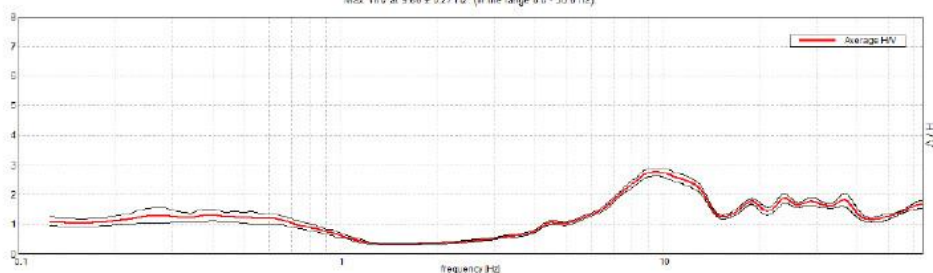
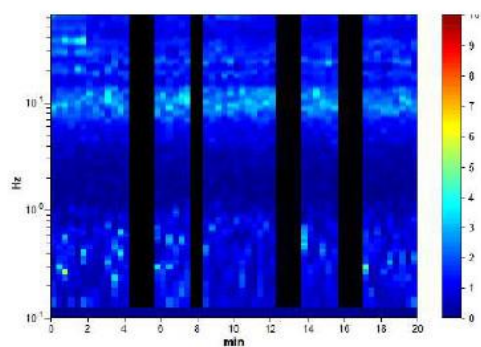
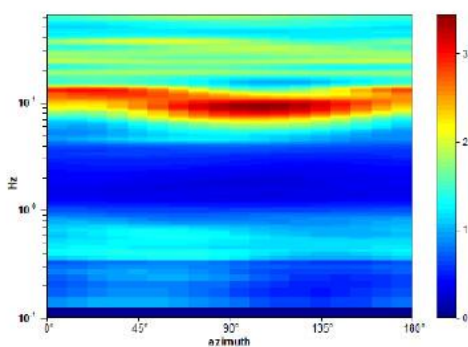
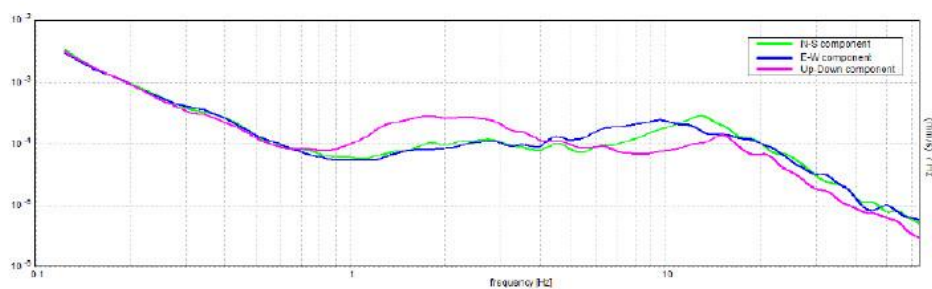
Window size: 20 s

Smoothing type: Triangular window

Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

Max H/V at 9.66 ± 0.27 Hz. (in the range 0.0 - 30.0 Hz)

**H/V TIME HISTORY****DIRECTIONAL H/V****SINGLE COMPONENT SPECTRA**

**Prova HVSR – HV11****TROMINO® Grilla**
www.tromino.eu**BURAGO, Via GALILEI - Prova 6**

Instrument: TEP-0122/01-10

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 03/05/17 14:30:33 End recording: 03/05/17 14:50:33

Channel labels: NORTH SOUTH; EAST WEST; UP DOWN

GPS data not available

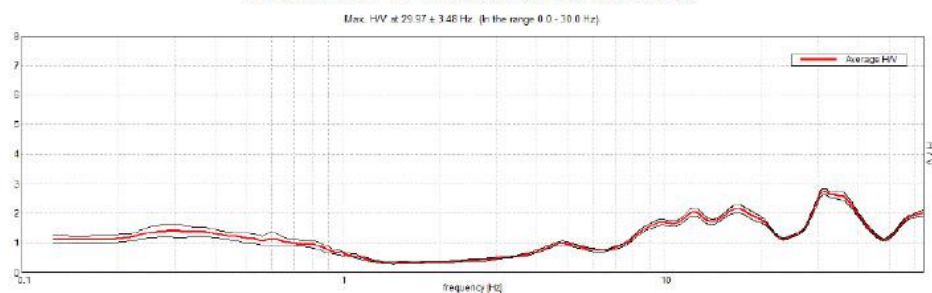
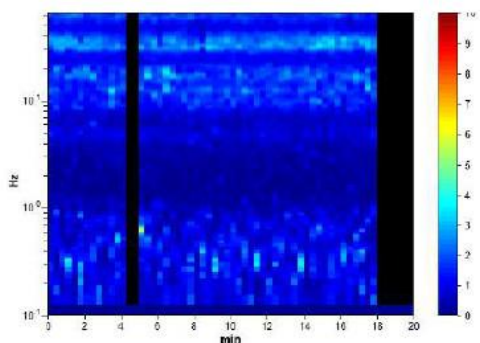
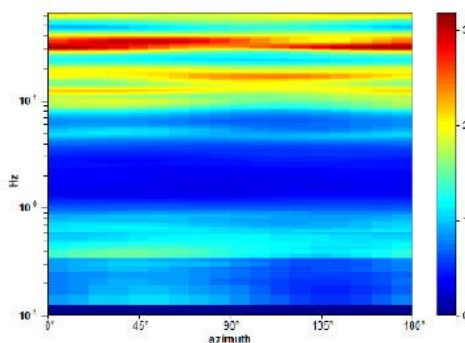
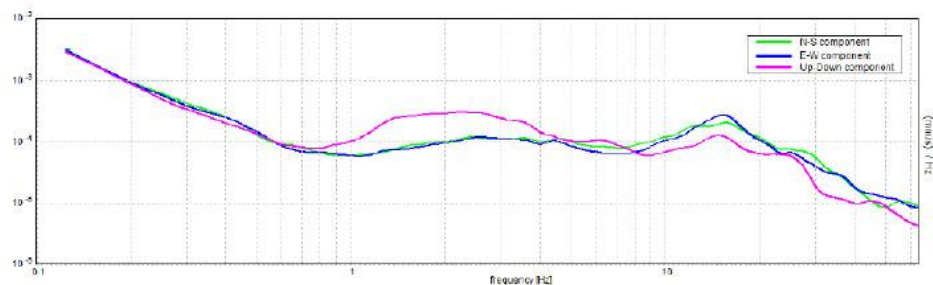
Trace length: 0h20'00". Analyzed 87% trace (manual window selection)

Sampling rate: 128 Hz

Window size: 20 s

Smoothing type: Triangular window

Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO**H/V TIME HISTORY****DIRECTIONAL H/V****SINGLE COMPONENT SPECTRA**

Prova HVSR – HV12

ERA

Tipo lisciamiento: Triangolare proporzionale

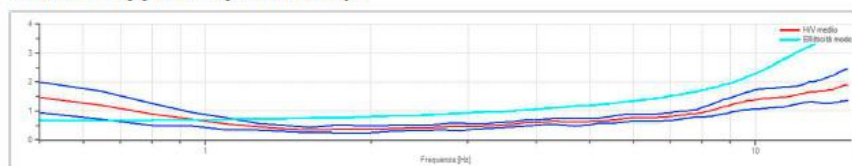
Percentuale di lisciamiento: 10,00%

Tipo di somma direzionale: Media aritmetica

Risultati

Frequenza del picco del rapporto H/V: 14,75 Hz $\pm 0,28$ Hz

Grafico rapporto spettrale H/V



Rapporto spettrale H/V e suo intervallo di fiducia

Modello stratigrafico

Dati riepilogativi

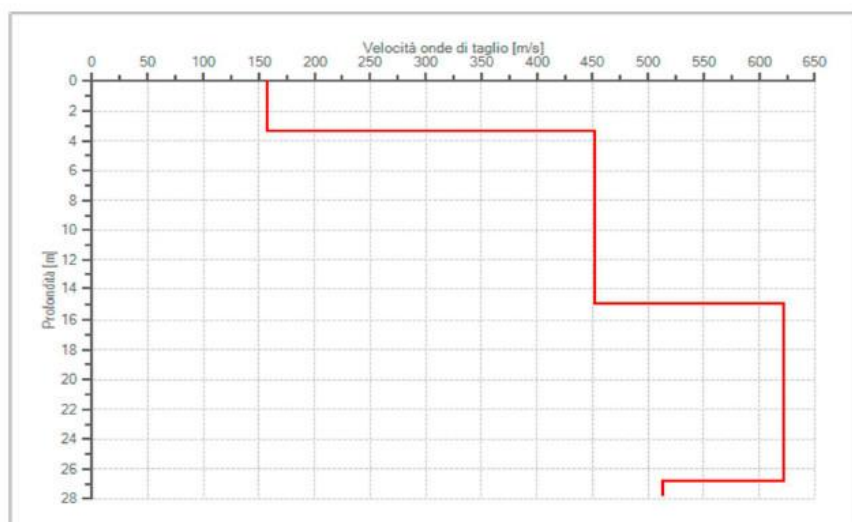
Numero strati: 4

Frequenza del picco dell'ellitticità: 14,00 Hz

Valore di disadattamento: 0,15

Dati della stratigrafia:

Strato	Profondità [m]	Spessore [m]	Peso per Unità di Vol. [kN/m³]	Coeff. di Poisson	Velocità onde di taglio [m/s]
1	0	3,36	18	0,33	158
2	3,36	11,55	19	0,32	452
3	14,91	11,95	19	0,32	622
4	26,86	1	19	0,32	513



Profilo delle velocità delle onde di taglio.

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REALIZZAZIONE CAMPO PER PADEL
CARATTERIZZAZIONE GEOLOGICA, GEOTECNICA E SISMICA AI SENSI DELLA LR 12/2005 (DGR IX/2616/2011) E DEL DM 17 GENNAIO 2018



Prova HVSR – HV13



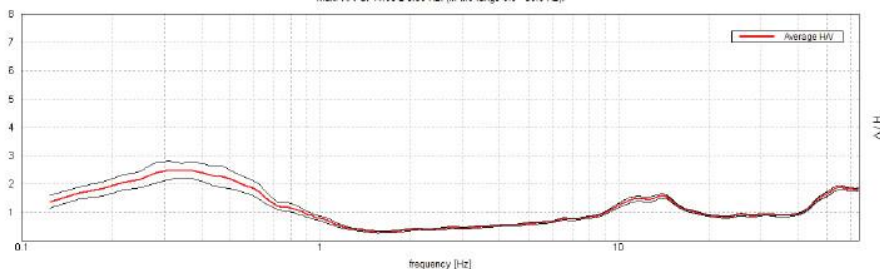
BURAGO SALCHI, HV1

Instrument: TZB-0123/01-20
Data format: 32 bit
Full scale [mV]: 179
Start recording: 29/03/2021 10:52:24 End recording: 29/03/2021 11:12:24
Channel labels: NORTH SOUTH; EAST WEST; UP DOWN
GPS data not available

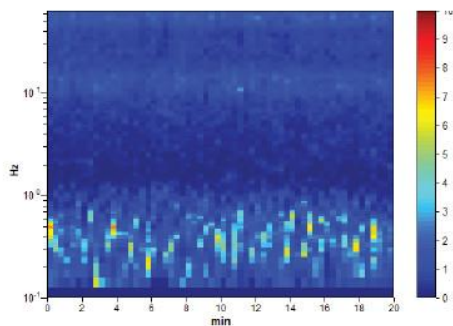
Trace length: 0h20'00". Analysis performed on the entire trace.
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

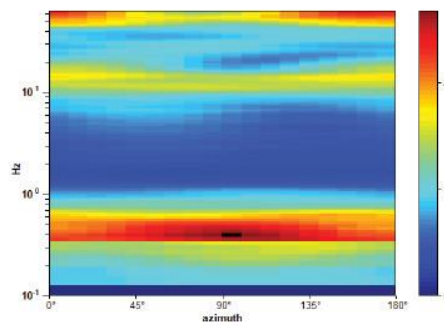
Max. HVV at 14.06 ± 0.06 Hz. (in the range 0.9 - 30.0 Hz)



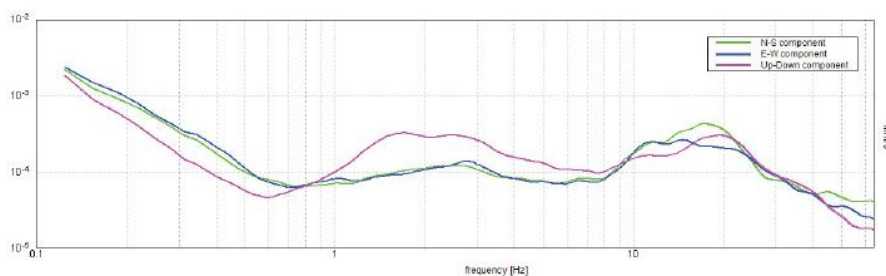
HV TIME HISTORY



DIRECTIONAL HVV



SINGLE COMPONENT SPECTRA



**Prova HVSR – HV14****BURAGO SALCHI, HV 2**

Instrument: TZB-0123/01-20

Data format: 32 bit

Full scale [mV]: 179

Start recording: 29/03/2021 10:28:54 End recording: 29/03/2021 10:48:54

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

GPS data not available

Trace length: 0h20'00". Analysis performed on the entire trace.

Sampling rate: 128 Hz

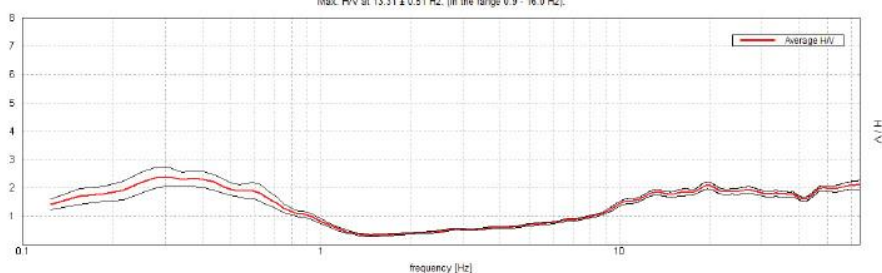
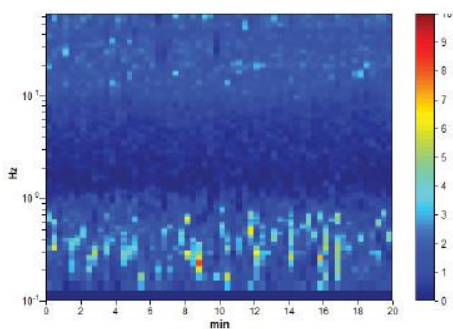
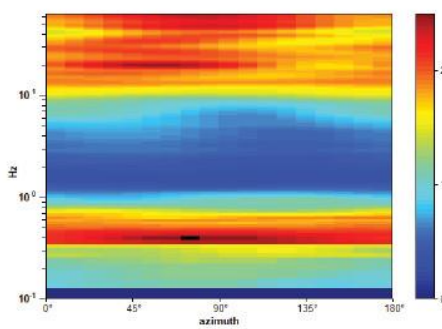
Window size: 20 s

Smoothing type: Triangular window

Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

Max. HV at 13.31 ± 0.51 Hz. (in the range 0.9 - 16.9 Hz).

**H/V TIME HISTORY****DIRECTIONAL HV****TROMINO**
www.moho.world**SINGLE COMPONENT SPECTRA**