PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

RegioneEmiliaRomagna

CONFERENZA DELLE REGIONI E DELLE PROVINCE AUTONOME

Attuazione dell'articolo 11 dalla legge 24 giugno 2009,n.77

MICROZONAZIONE SISMICA

Livello 2

Allegato 2 – Report delle indagini

Regione Emilia-Romagna

Comune di Castel Bolognese

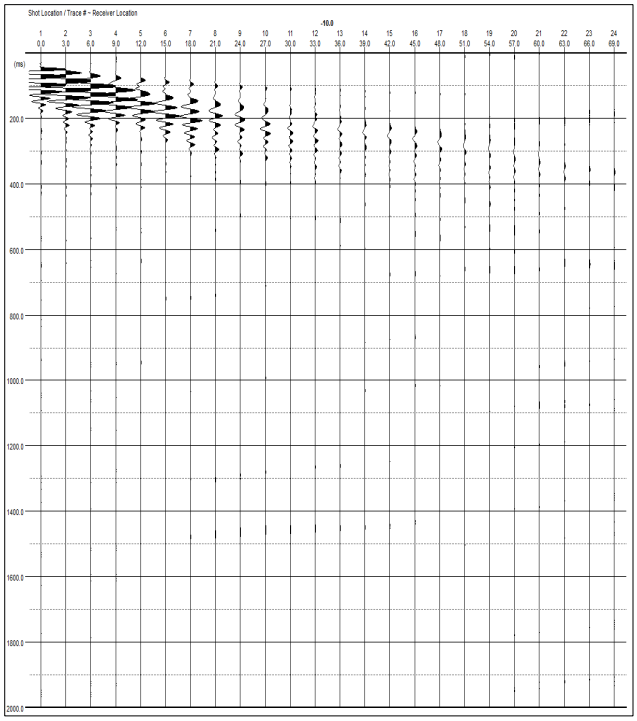
Regione	Soggetto realizzatore	Data
EMILIA-ROMAGNA	Raggruppamento temporaneo di professionisti Capogruppo: dott. geol. Samuel Sangiorgi Mandanti: dott. geol. Tiziano Righini, dott. geol. Stefano Marabini, dott. geol. Antonio Milioto	Maggio 2019

PROSPEZIONE SISMICA CON METODOLOGIA ATTIVA/PASSIVA MASW/Re.Mi.

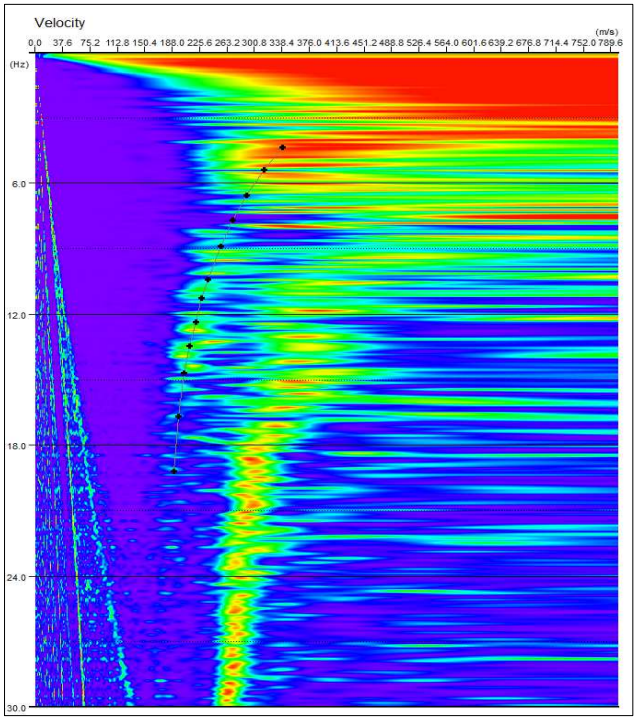
Via Rinfosco, Comune di Castel Bolognese (RA) – 039006L63005MASW63005

n° tracce	Δx (m)	L tot (m)	Δt (ms)	T (s)
15	3,0	69,0	0,5/2,0	2,0/32,0

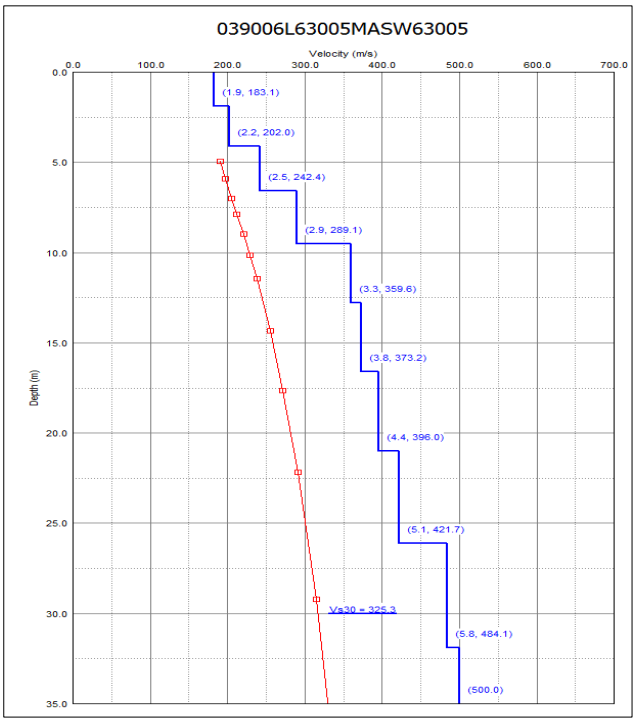
Δx: interdistanza geofonica; L tot: lunghezza profilo; Δt: passo di campionamento; T: durata registrazione.



Sismogramma registrato durante le acquisizioni di microtremore sismico. In ascissa il numero dei geofoni, in ordinata il tempo (ms).



Spettro di potenza nel dominio *f–v* e Picking della curva sperimentali delle onde R (croci nere).



Modello di sottosuolo (1D) descritti in termini di Vs e spessore dei sismostrati (spezzata blu) e curva di dispersione sperimentale delle onde R (curva rossa).

Tabella di sintesi

n. Strato	Profondità letto (m dal p.c.)	Spessore (m)	V_S (m/s)
1	1.9	1.9	183.1
2	4.1	2.2	202.0
3	6.6	2.5	242.4
4	9.5	2.9	289.1
5	12.8	3.3	359.6
6	16.6	3.8	373.2
7	21.0	4.4	396.0
8	26.9	5.1	421.7
9	31.9	5.8	484.1
10	∞	∞	500.0

V_{S30} = 325.3 ± 10% [m/s]

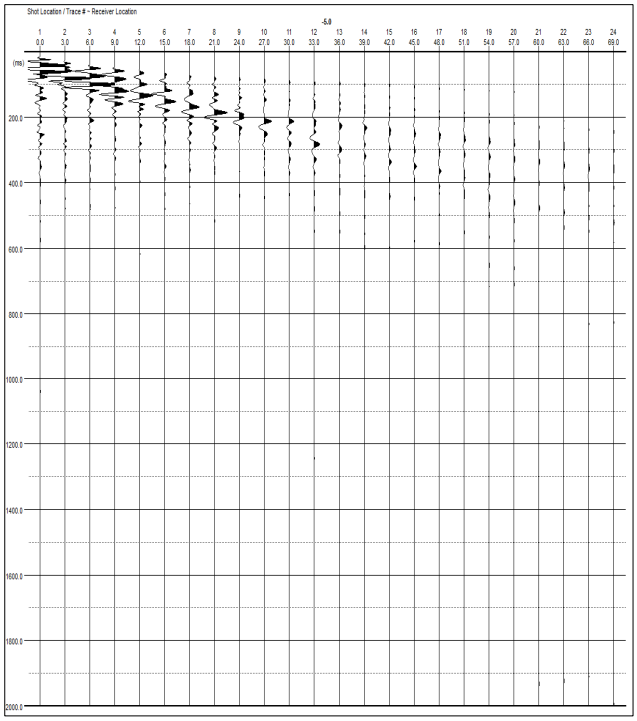
Sintesi dei parametri del modello di sottosuolo ottenuto e Valore di Vs30 calcolato.

PROSPEZIONE SISMICA CON METODOLOGIA ATTIVA/PASSIVA MASW/Re.Mi.

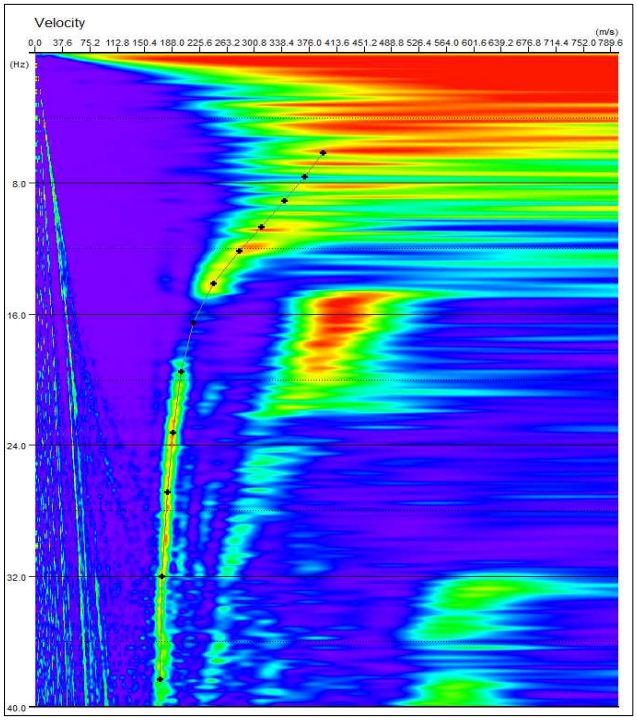
Piazzale Brunelli, Comune di Castel Bolognese (RA) – 039006L63006MASW63006

n° tracce	Δx (m)	L tot (m)	Δt (ms)	T (s)
15	3,0	69,0	0,5/2,0	2,0/32,0

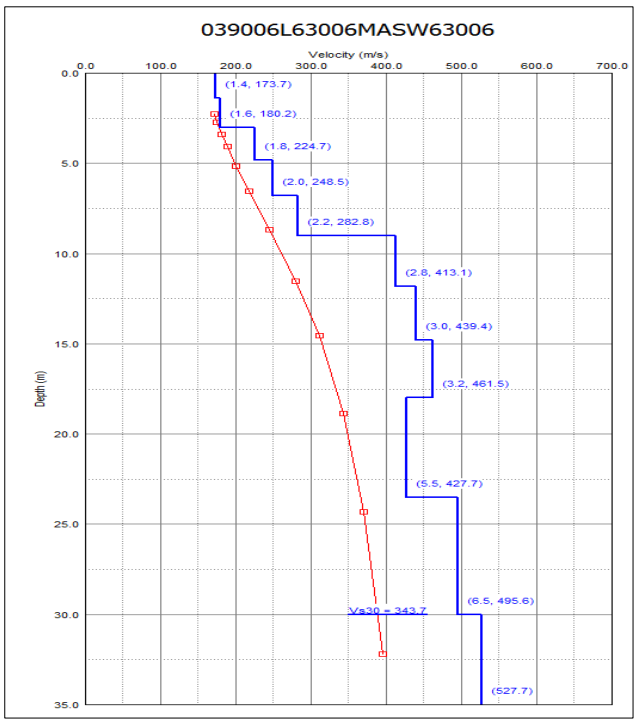
Δx: interdistanza geofonica; L tot: lunghezza profilo; Δt: passo di campionamento; T: durata registrazione.



Sismogramma registrato durante le acquisizioni di microtremore sismico. In ascissa il numero dei geofoni, in ordinata il tempo (ms).



Spettro di potenza nel dominio *f–v* e Picking della curva sperimentali delle onde R (croci nere).



Modello di sottosuolo (1D) descritti in termini di Vs e spessore dei sismostrati (spezzata blu) e curva di dispersione sperimentale delle onde R (curva rossa).

Tabella di sintesi

n. Strato	Profondità letto (m dal p.c.)	Spessore (m)	V_S (m/s)
1	1.4	1.4	173.7
2	3.0	1.6	180.2
3	4.8	1.8	224.7
4	6.8	2.0	248.5
5	9.0	2.2	282.8
6	11.8	2.8	413.1
7	14.8	3.0	439.4
8	18.0	3.2	461.5
9	23.5	5.5	427.7
10	30.0	6.5	495.6
11	∞	∞	527.7

V_{S30} = 343.7 ± 10% [m/s]

Sintesi dei parametri del modello di sottosuolo ottenuto e Valore di Vs30 calcolato.

Studio Samuel Sangiorgi
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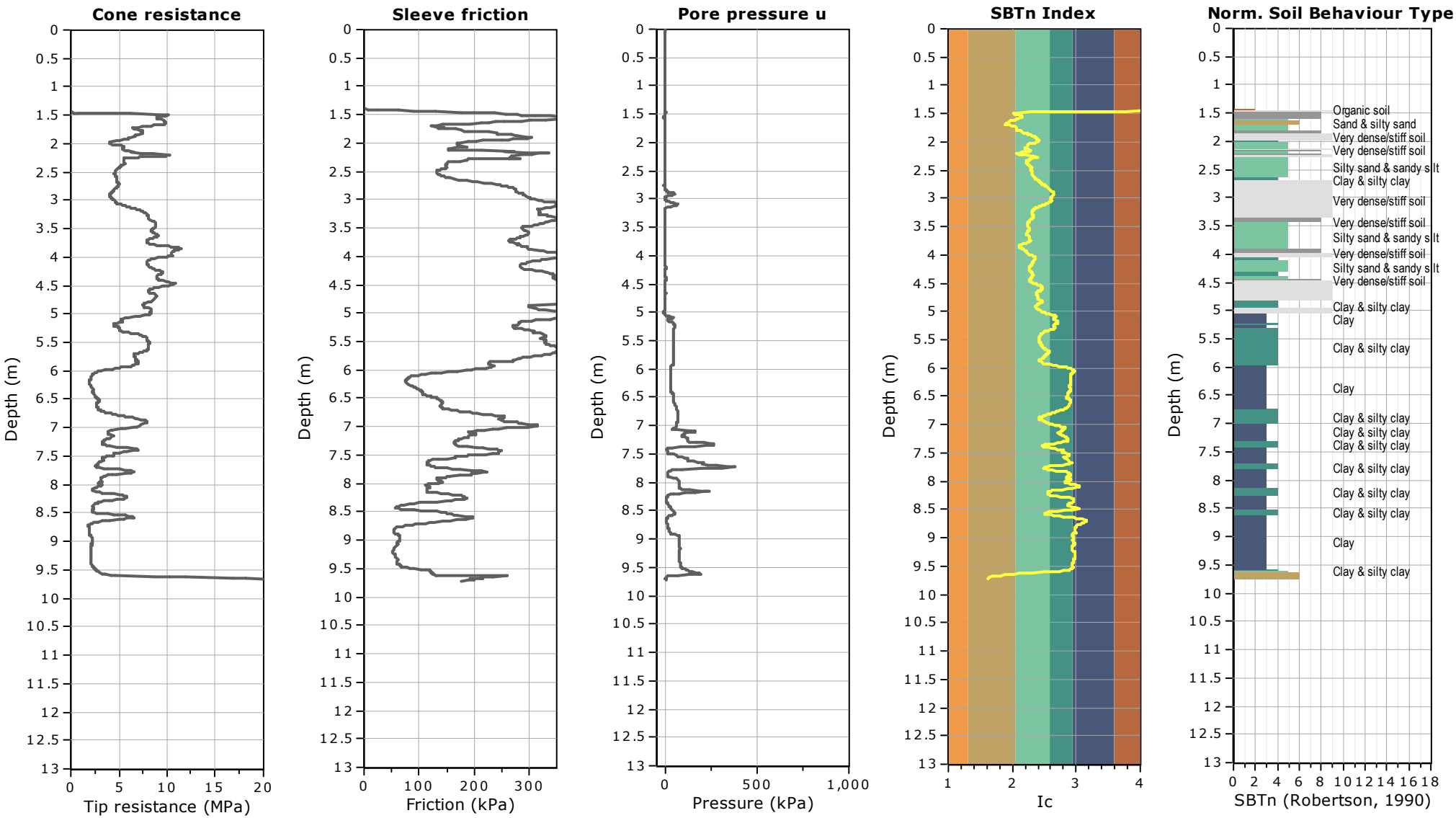
Tel. 0542-640279

Project: **Microzonazione Sismica Livello 3**
Location: **Viale Umberto I - Castel Bolognese (RA)**

CPT: CPTU2
Total depth: 9.72 m, Date: 16/11/2018



039006P59146CPTU63070

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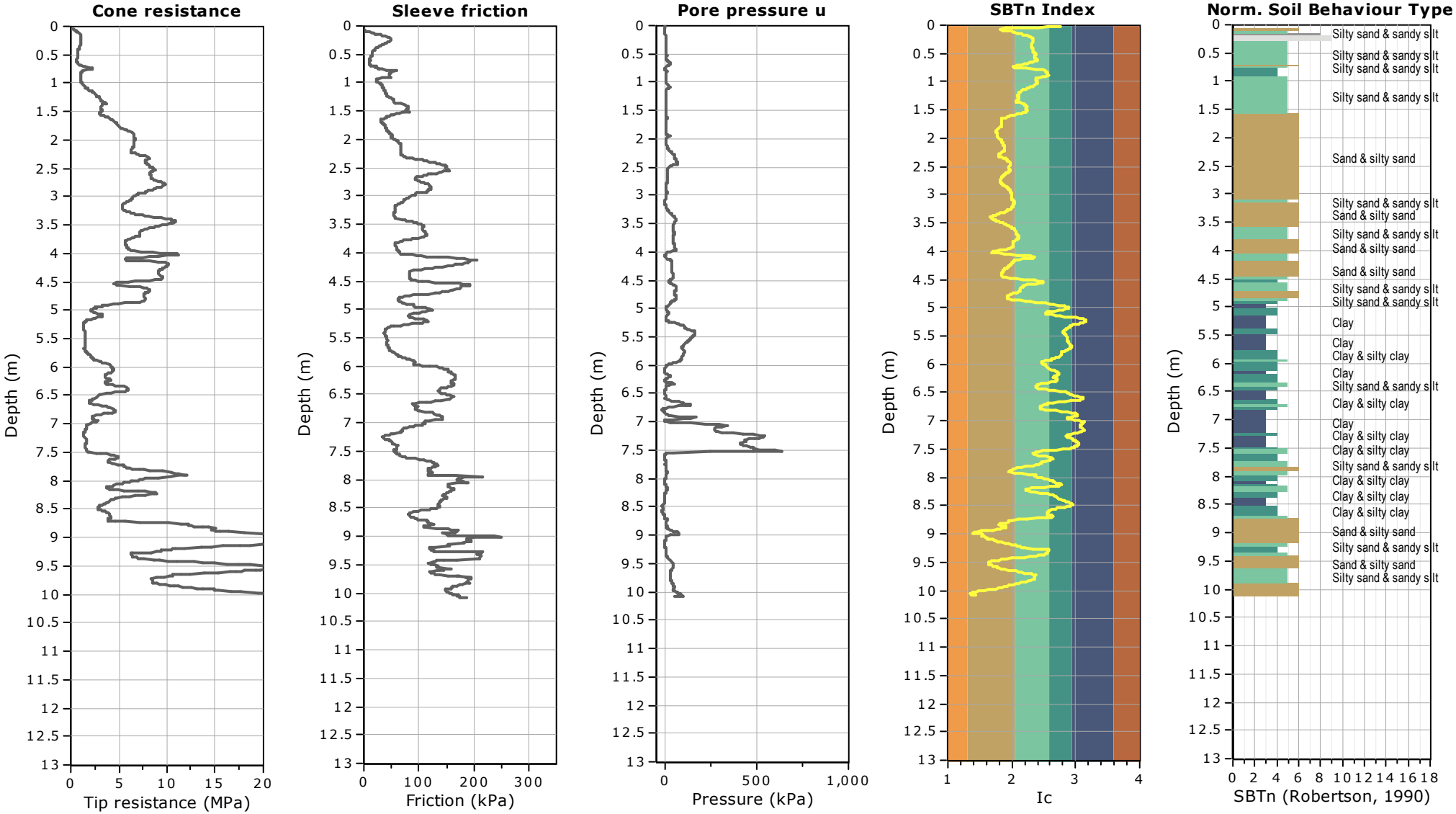
Tel. 0542-640279

Project: **Microzonazione Sismica Livello 3**
Location: **Parco Biancini - Castel Bolognese (RA)**

CPT: CPTU1
Total depth: 10.10 m, Date: 16/11/2018



039006P59147CPTU63071

Studio Samuel Sangiorgi
via Valsellustra 32, 40060 - Dozza (BO)
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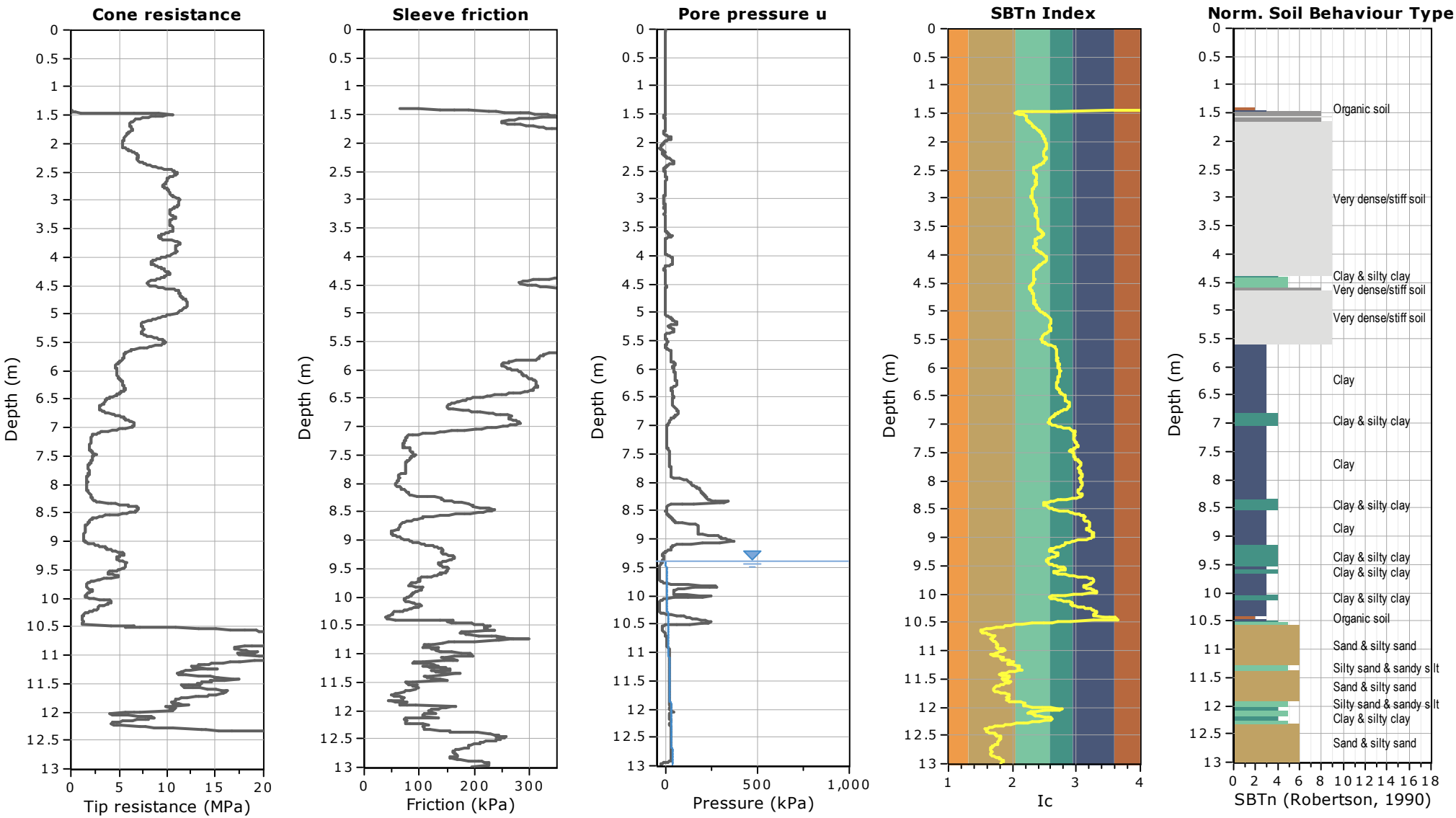
Tel. 0542-640279

Project: **Microzonazione Sismica Livello 3**
Location: **Le Cupole - Castel Bolognese (RA)**

CPT: CPTU3
Total depth: 12.99 m, Date: 16/11/2018

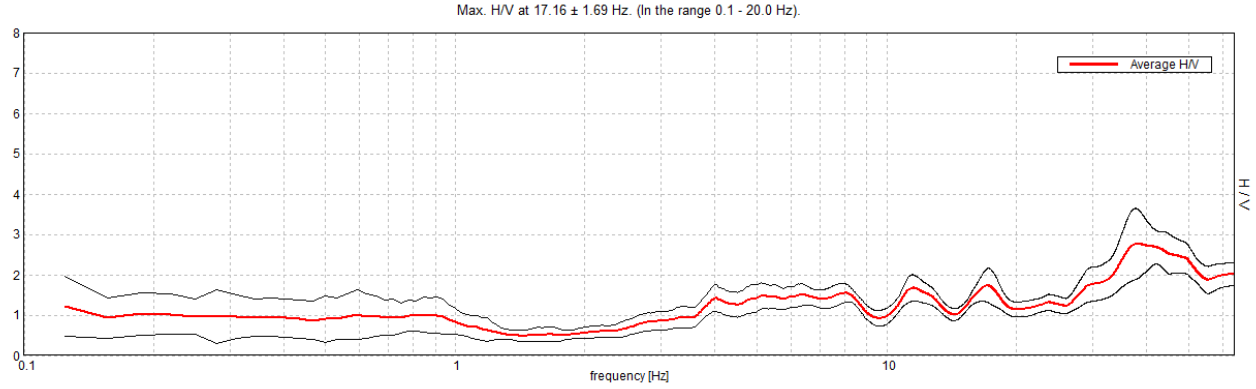


039006P59148CPTU63072

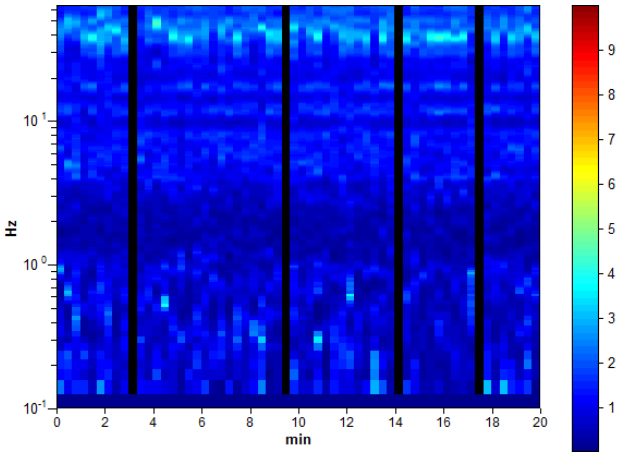
039006P59149HVSR63073
CASTEL BOLOGNESE_MS, HVSR1

Instrument: TEP-0123/01-10
Start recording: 27/09/18 12:03:16 End recording: 27/09/18 12:23:17
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 93% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

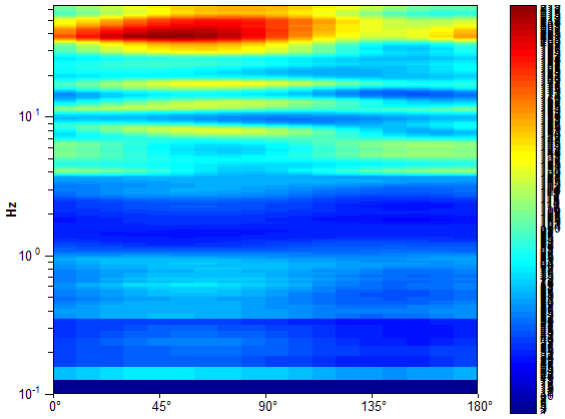
HORIZONTAL TO VERTICAL SPECTRAL RATIO



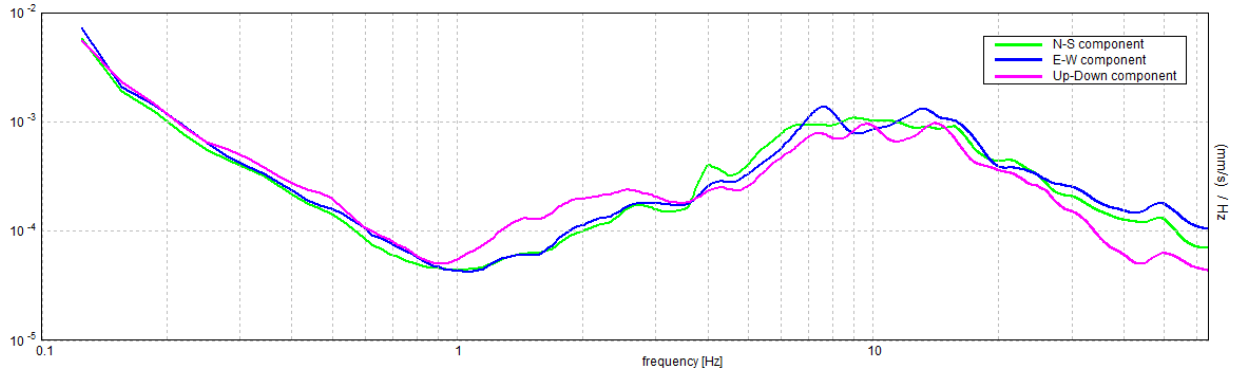
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 17.16 ± 1.69 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	17.16 > 0.50	**OK**	
$n_c(f_0) > 200$	19215.0 > 200	**OK**	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 824 times	**OK**	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			**NO**
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			**NO**
$A_0 > 2$	1.74 > 2		**NO**
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.04879| < 0.05	**OK**	
$\sigma_f < \varepsilon(f_0)$	0.83697 < 0.85781	**OK**	
$\sigma_A(f_0) < \theta(f_0)$	0.2097 < 1.58	**OK**	

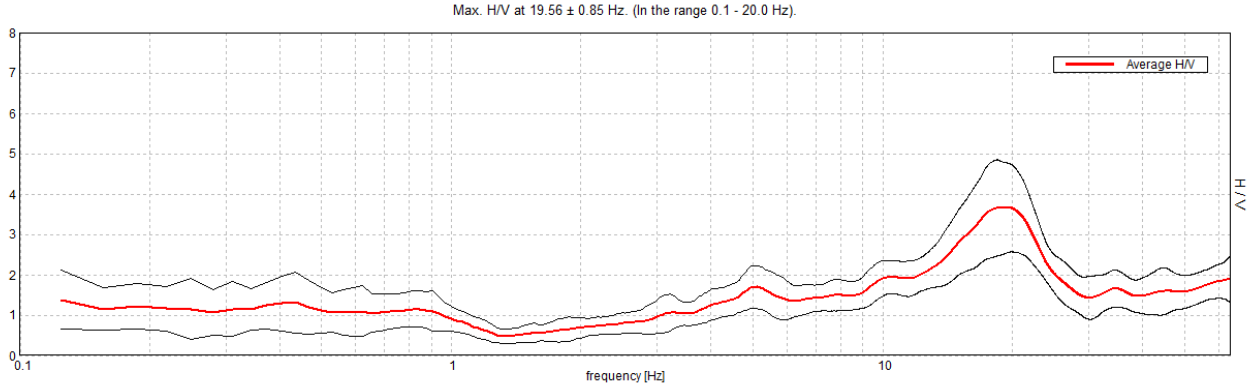
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

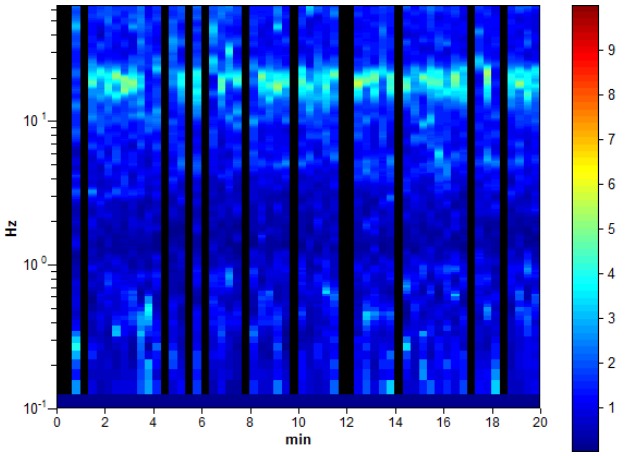
039006P59150HVSR63074
CASTEL BOLOGNESE_MS, HVSR2

Instrument: TEP-0123/01-10
Start recording: 27/09/18 12:35:18 End recording: 27/09/18 12:55:19
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 78% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

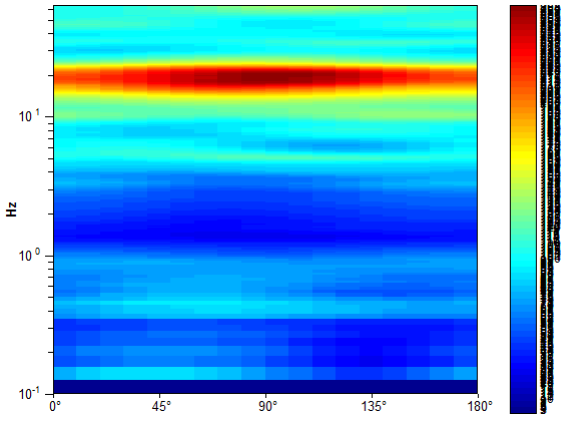
HORIZONTAL TO VERTICAL SPECTRAL RATIO



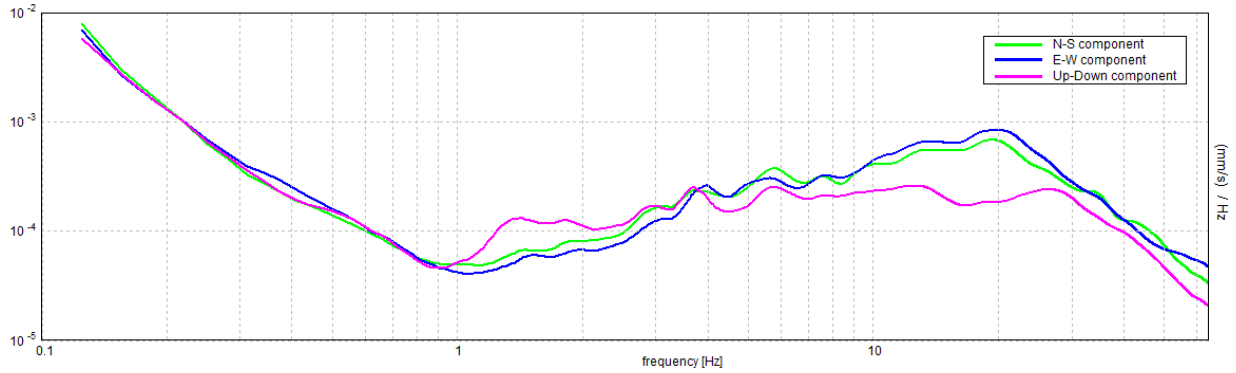
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 19.56 ± 0.85 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	19.56 > 0.50	OK	
$n_c(f_0) > 200$	18388.8 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 940 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	9.688 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$	26.125 Hz	OK	
$A_0 > 2$	3.66 > 2	OK	
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.02132| < 0.05	OK	
$\sigma_f < \varepsilon(f_0)$	0.41707 < 0.97813	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.5418 < 1.58	OK	

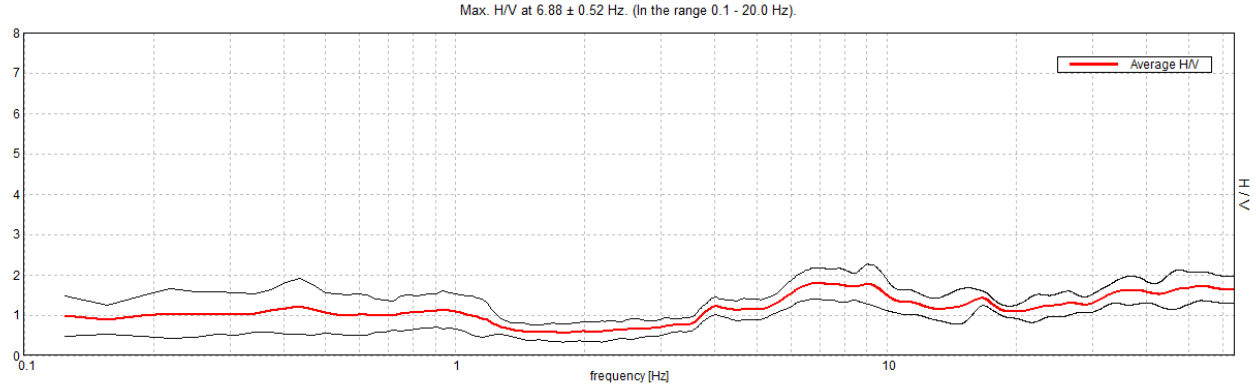
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

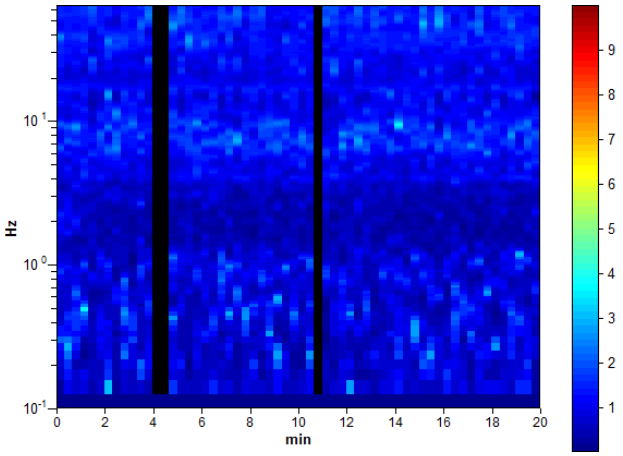
039006P59151HVSR63075
CASTEL BOLOGNESE_MS, HVSR3

Instrument: TEP-0123/01-10
Start recording: 27/09/18 13:13:41 End recording: 27/09/18 13:33:42
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 95% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

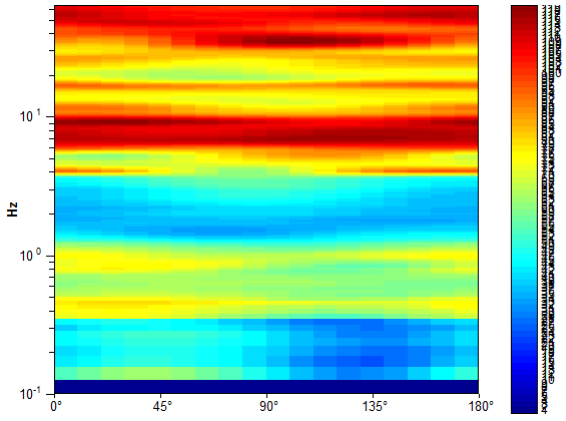
HORIZONTAL TO VERTICAL SPECTRAL RATIO



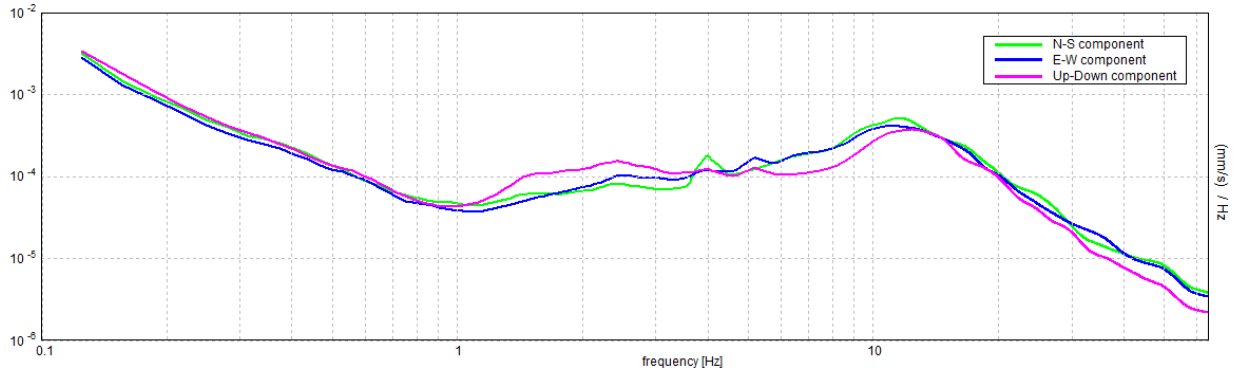
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 6.88 ± 0.52 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	6.88 > 0.50	OK	
$n_c(f_0) > 200$	7837.5 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 331 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	3.625 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.79 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.03736| < 0.05	OK	
$\sigma_f < \varepsilon(f_0)$	0.25687 < 0.34375	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.1926 < 1.58	OK	

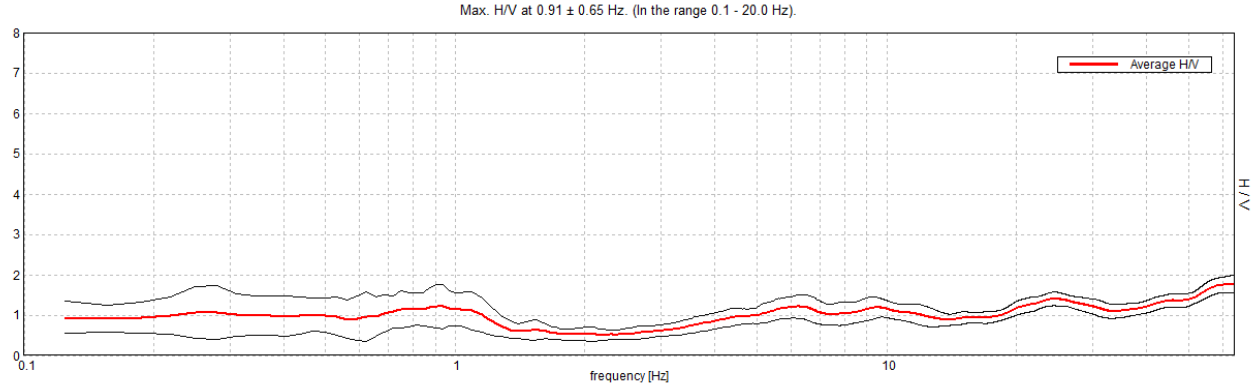
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

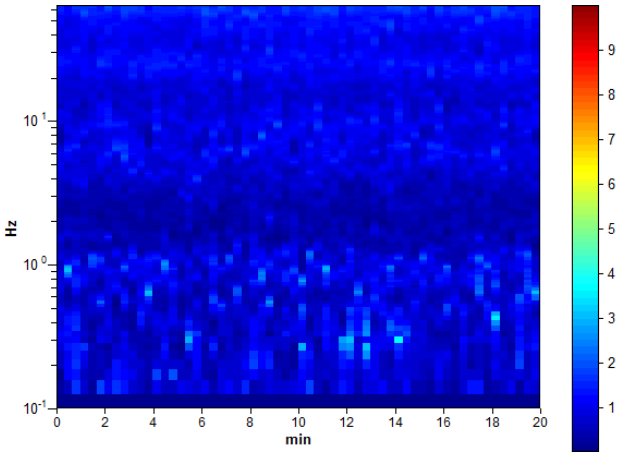
039006P59152HVSR63076
CASTEL BOLOGNESE_MS, HVSR4

Instrument: TEP-0123/01-10
Start recording: 27/09/18 13:44:05 End recording: 27/09/18 14:04:06
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analysis performed on the entire trace.
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

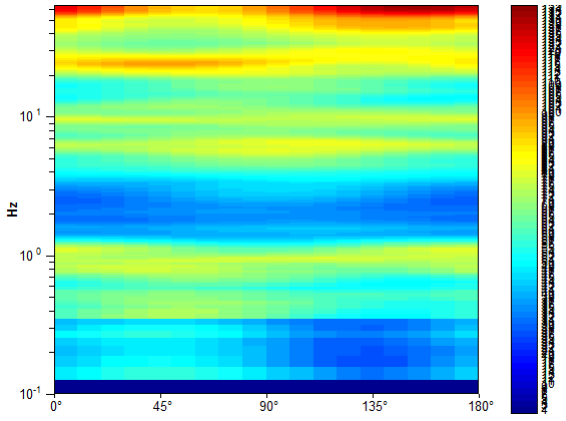
HORIZONTAL TO VERTICAL SPECTRAL RATIO



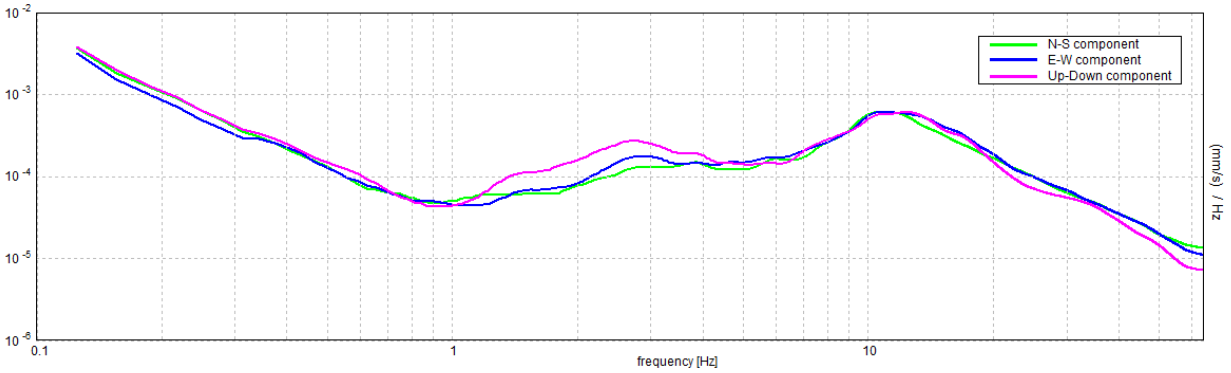
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 0.91 ± 0.65 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	0.91 > 0.50	OK	
$n_c(f_0) > 200$	1087.5 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 44 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$	1.375 Hz	OK	
$A_0 > 2$	1.22 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.3542| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	0.32099 < 0.13594		NO
$\sigma_A(f_0) < \theta(f_0)$	0.2671 < 2.0	OK	

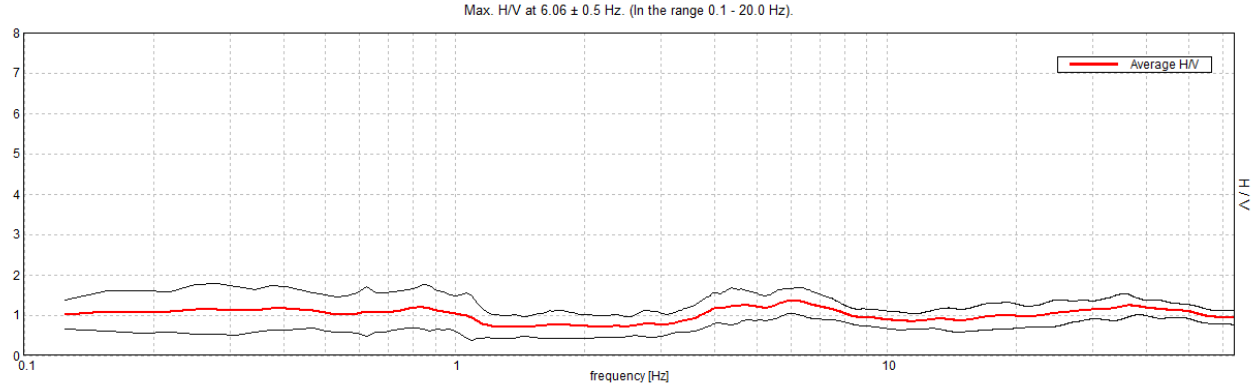
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

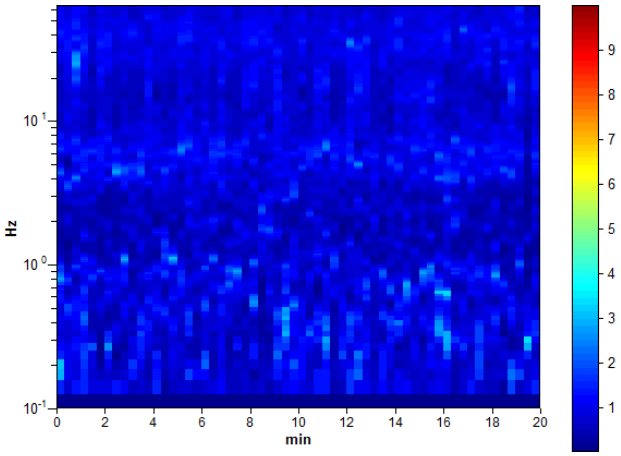
039006P59153HVSR63077
CASTEL BOLOGNESE_MS, HVSR5

Instrument: TEP-0123/01-10
Start recording: 27/09/18 14:09:59 End recording: 27/09/18 14:30:00
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analysis performed on the entire trace.
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

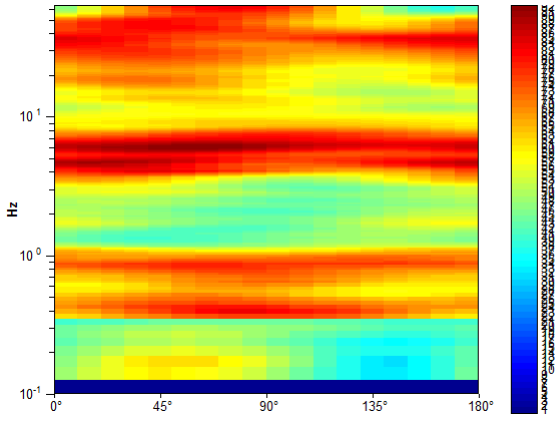
HORIZONTAL TO VERTICAL SPECTRAL RATIO



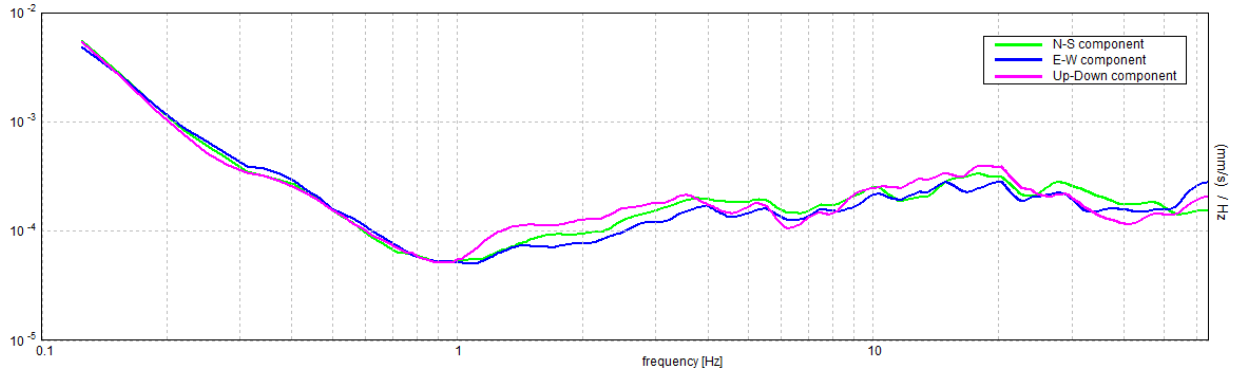
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 6.06 ± 0.5 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	6.06 > 0.50	OK	
$n_c(f_0) > 200$	7275.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 292 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.36 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.0411| < 0.05	OK	
$\sigma_f < \varepsilon(f_0)$	0.24914 < 0.30313	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.1535 < 1.58	OK	

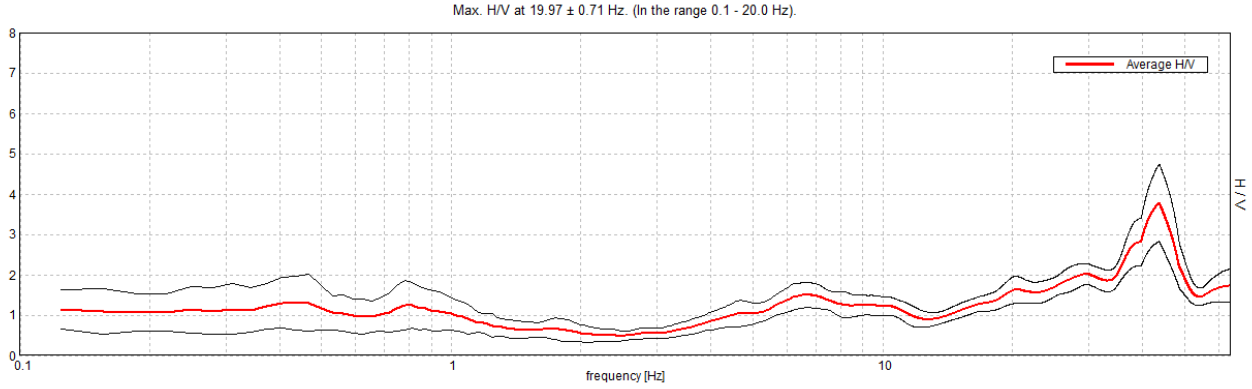
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

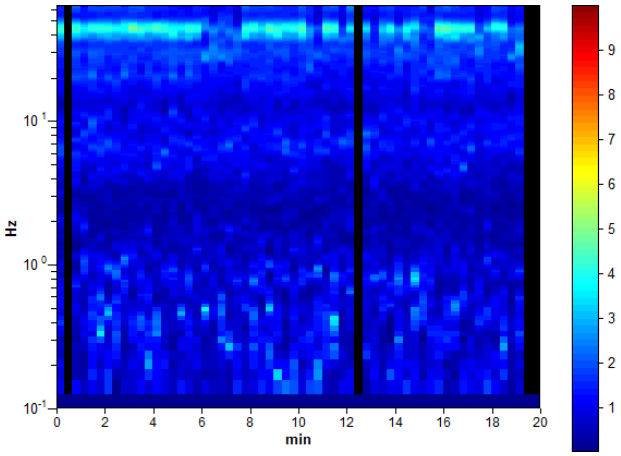
039006P59154HVSR63078
CASTEL BOLOGNESE_MS, HVSR6

Instrument: TEP-0123/01-10
Start recording: 27/09/18 14:41:30 End recording: 27/09/18 15:01:31
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 93% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

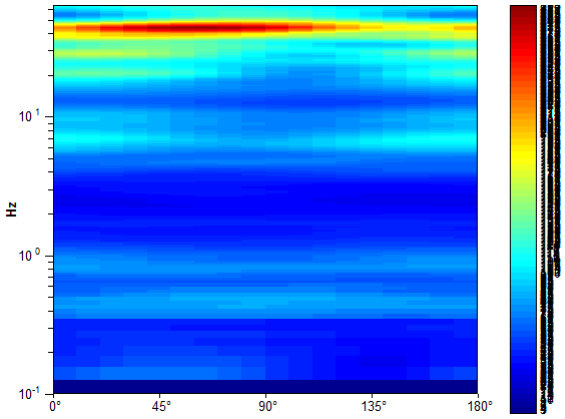
HORIZONTAL TO VERTICAL SPECTRAL RATIO



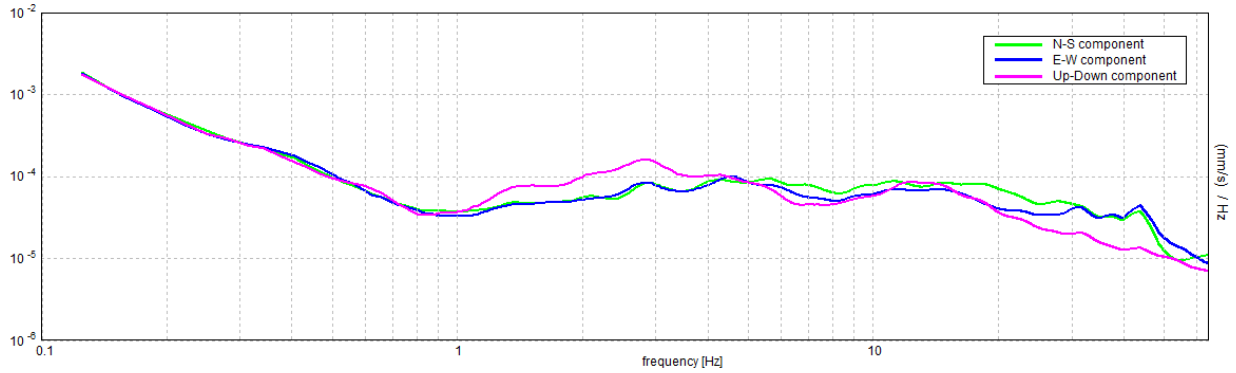
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz
0.1
1
10

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 19.97 ± 0.71 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	19.97 > 0.50	OK	
$n_c(f_0) > 200$	22365.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 960 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.61 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.01749| < 0.05	OK	
$\sigma_f < \varepsilon(f_0)$	0.34929 < 0.99844	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.163 < 1.58	OK	

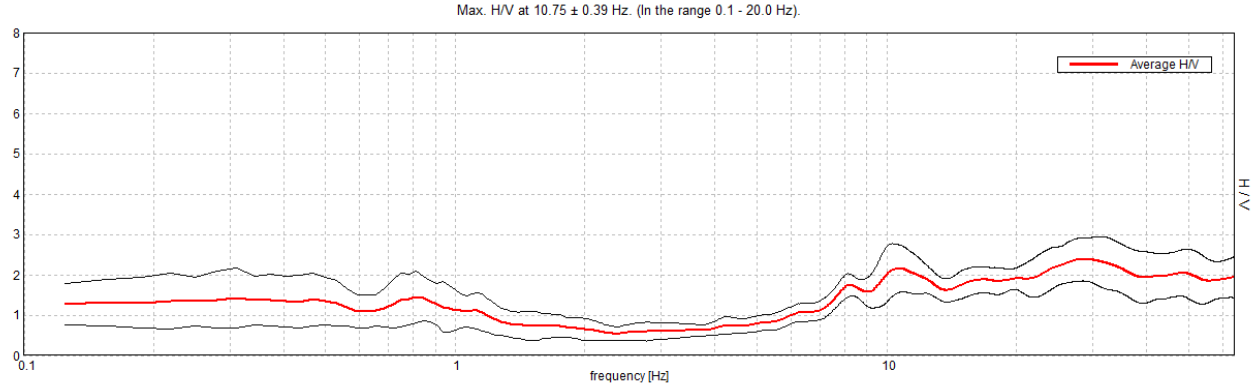
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

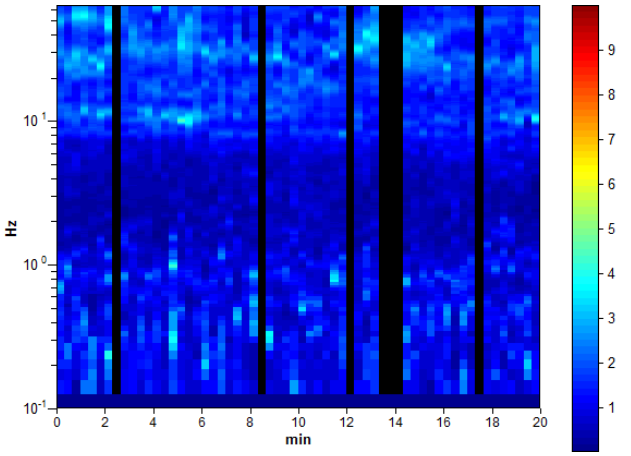
039006P59155HVSR63079
CASTEL BOLOGNESE_MS, HVSR7

Instrument: TEP-0123/01-10
Start recording: 27/09/18 15:09:47 End recording: 27/09/18 15:29:48
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 88% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

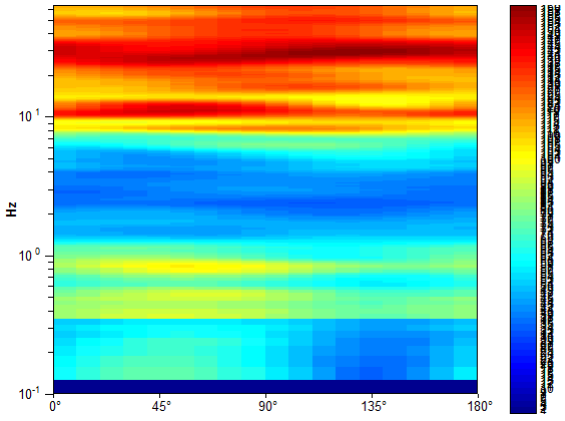
HORIZONTAL TO VERTICAL SPECTRAL RATIO



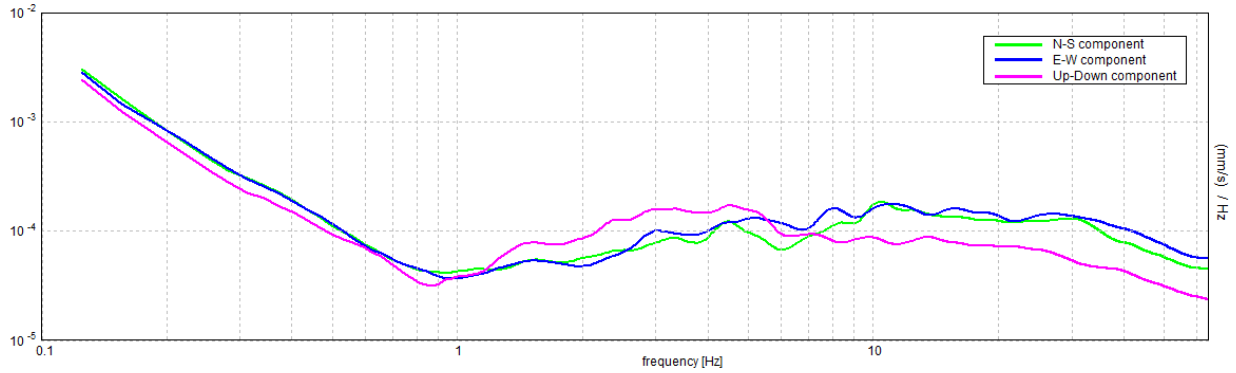
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 10.75 ± 0.39 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	10.75 > 0.50	OK	
$n_c(f_0) > 200$	11395.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 517 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	6.75 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	2.15 > 2	OK	
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.01789| < 0.05	OK	
$\sigma_f < \varepsilon(f_0)$	0.19231 < 0.5375	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.2875 < 1.58	OK	

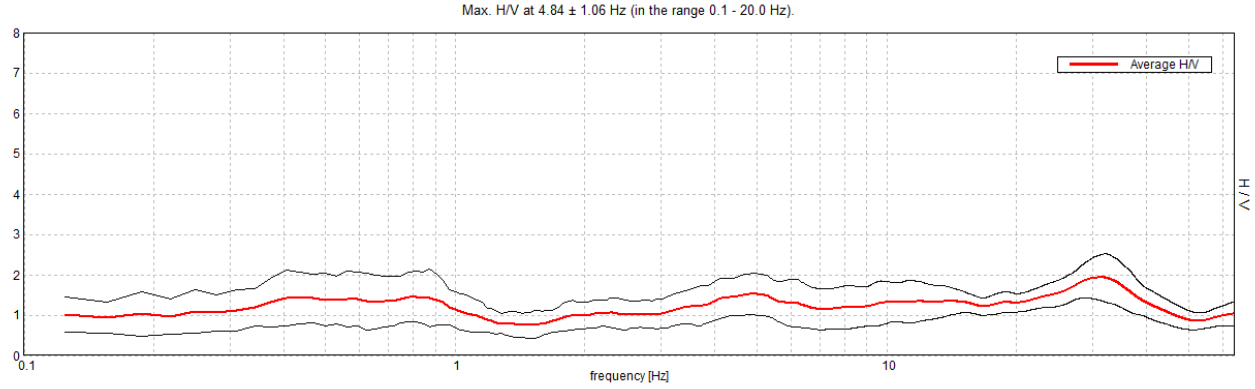
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{\log H/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

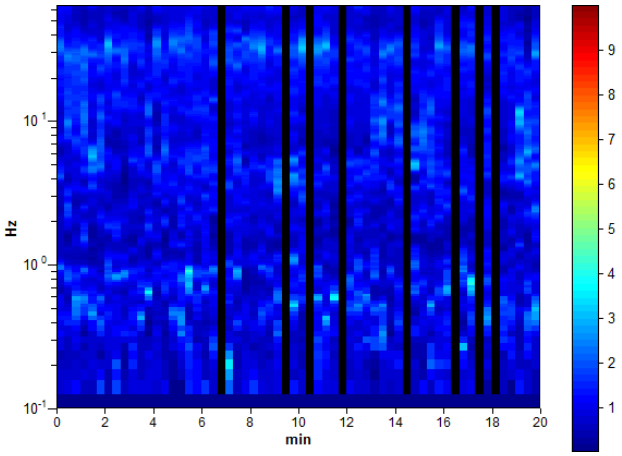
039006P59156HVSR63080
CASTEL BOLOGNESE_MS, HVSR8

Instrument: TEP-0123/01-10
Start recording: 27/09/18 15:39:30 End recording: 27/09/18 15:59:31
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 87% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

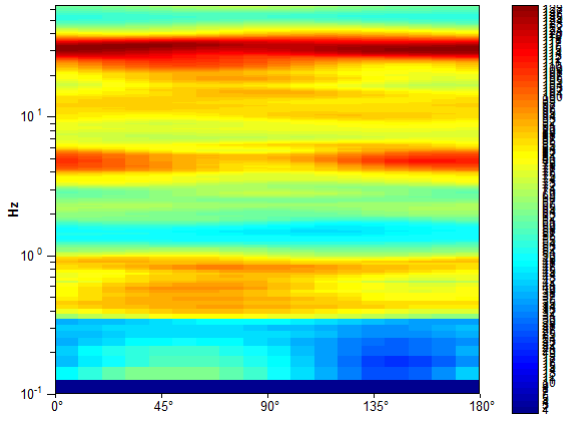
HORIZONTAL TO VERTICAL SPECTRAL RATIO



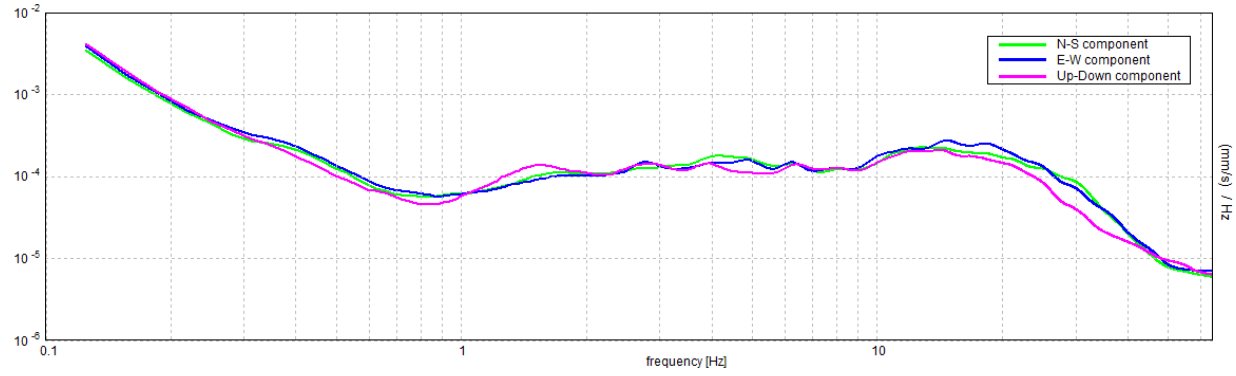
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA



[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 4.84 ± 1.06 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	4.84 > 0.50	OK	
$n_c(f_0) > 200$	5037.5 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 234 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	1.5 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.53 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.108| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	0.52312 < 0.24219		NO
$\sigma_A(f_0) < \theta(f_0)$	0.2494 < 1.58	OK	

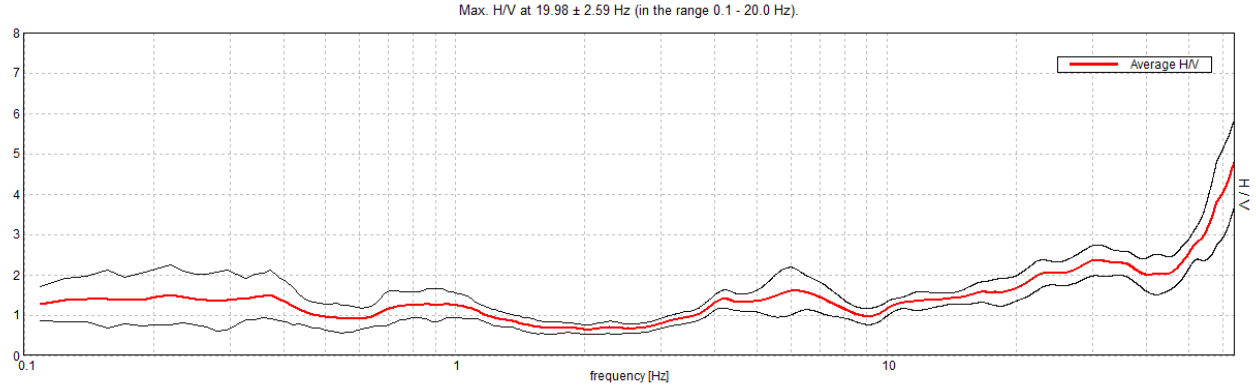
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

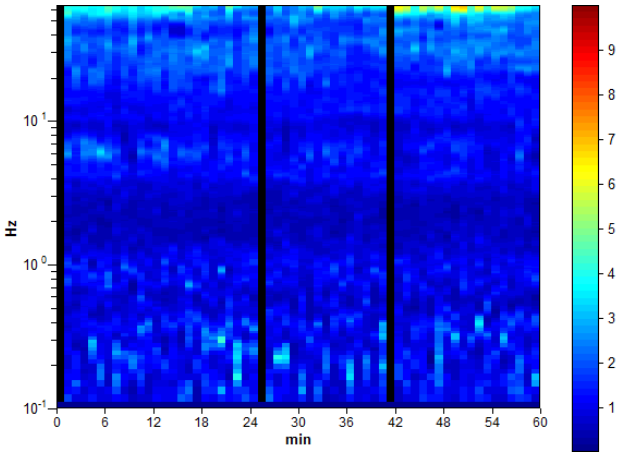
039006P59157HVSR63081
CASTEL BOLOGNESE_MS, HVSR9

Instrument: TEP-0123/01-10
Start recording: 11/12/18 09:44:10 End recording: 11/12/18 10:44:11
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 1h00'00". Analyzed 95% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 60 s
Smoothing type: Triangular window
Smoothing: 10%

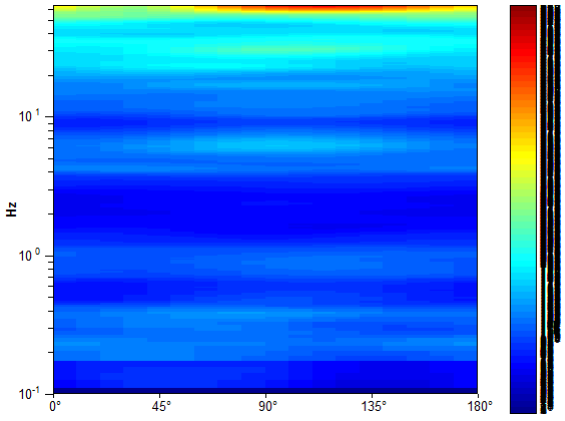
HORIZONTAL TO VERTICAL SPECTRAL RATIO



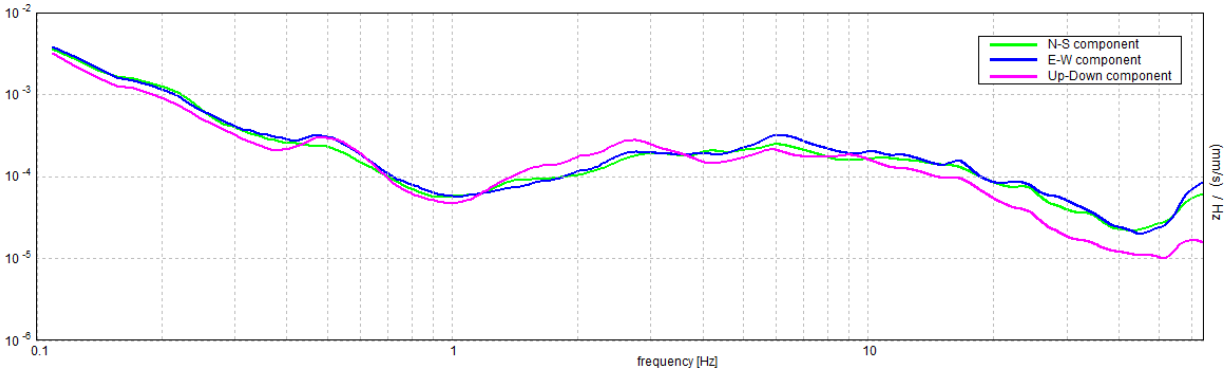
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the *Grilla* manual before interpreting the following tables**.]

Max. H/V at 19.98 ± 2.59 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	19.98 > 0.17	OK	
$n_c(f_0) > 200$	68346.6 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 1920 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.67 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.06403| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	1.27965 < 0.99922		NO
$\sigma_A(f_0) < \theta(f_0)$	0.1558 < 1.58	OK	

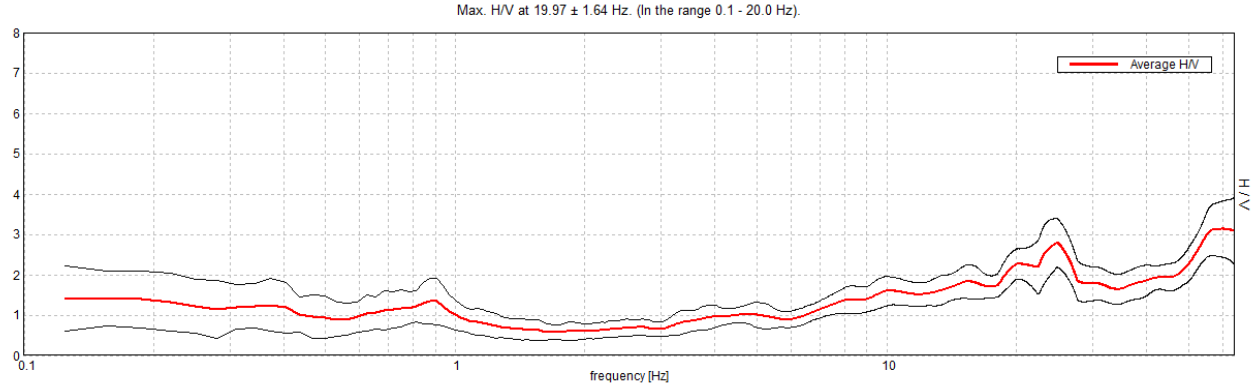
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

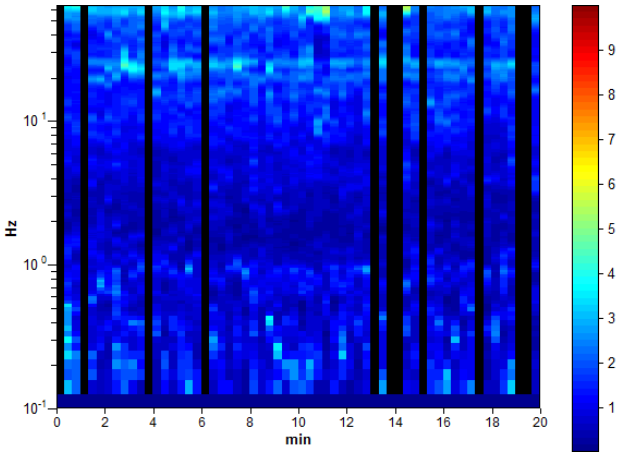
039006P59158HVSR63082
CASTEL BOLOGNESE_MS, HVSR10

Instrument: TEP-0123/01-10
Start recording: 11/12/18 10:52:45 End recording: 11/12/18 11:12:46
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 82% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

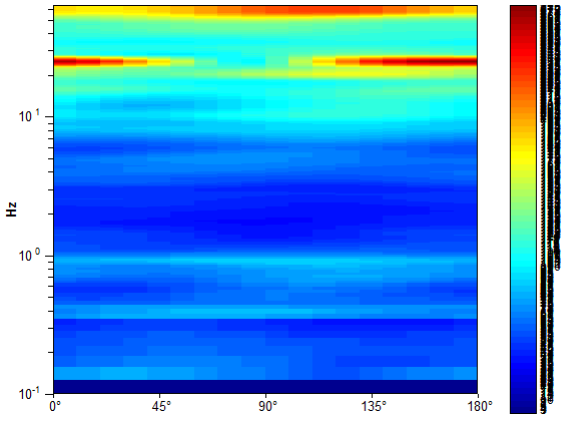
HORIZONTAL TO VERTICAL SPECTRAL RATIO



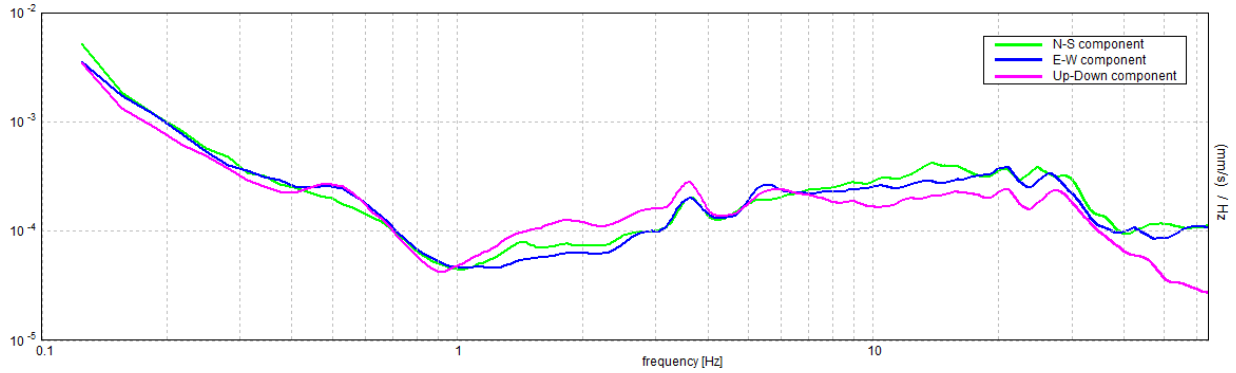
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 19.97 ± 1.64 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	19.97 > 0.50	OK	
$n_c(f_0) > 200$	19569.4 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 960 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	6.969 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	2.26 > 2	OK	
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.04035| < 0.05	OK	
$\sigma_f < \varepsilon(f_0)$	0.80582 < 0.99844	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.1846 < 1.58	OK	

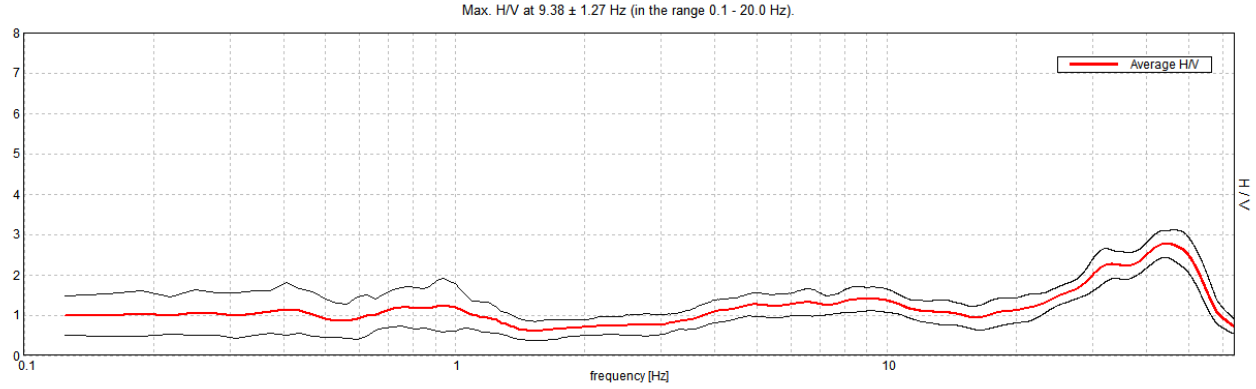
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

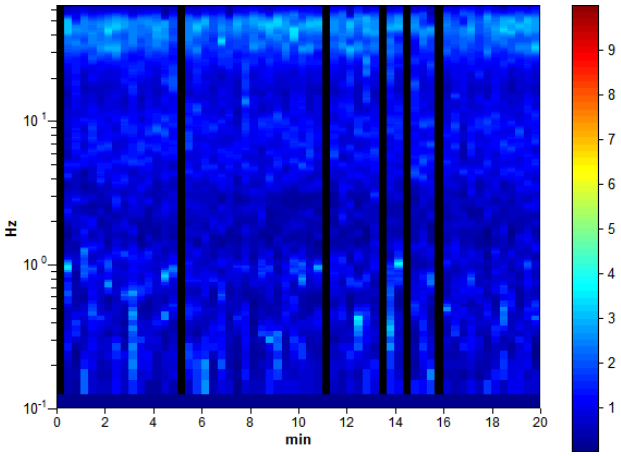
039006P59159HVSR63083
CASTEL BOLOGNESE_MS, HVSR12

Instrument: TEP-0123/01-10
Start recording: 11/12/18 13:16:19 End recording: 11/12/18 13:36:20
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 90% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

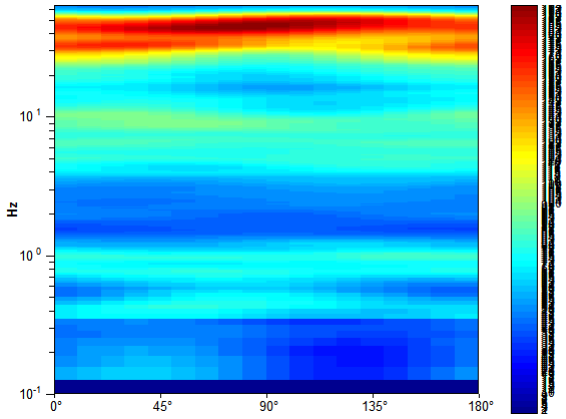
HORIZONTAL TO VERTICAL SPECTRAL RATIO



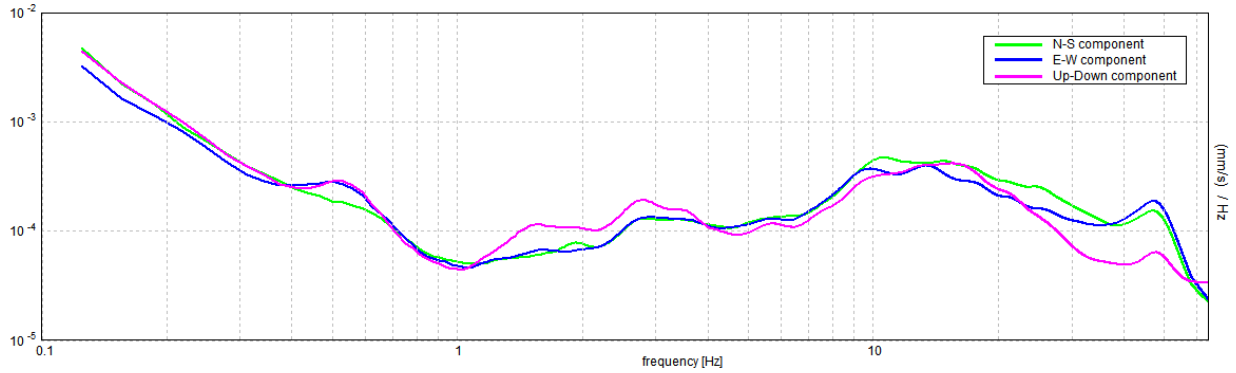
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 9.38 ± 1.27 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	9.38 > 0.50	OK	
$n_c(f_0) > 200$	10125.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 451 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.40 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.06715| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	0.62949 < 0.46875		NO
$\sigma_A(f_0) < \theta(f_0)$	0.147 < 1.58	OK	

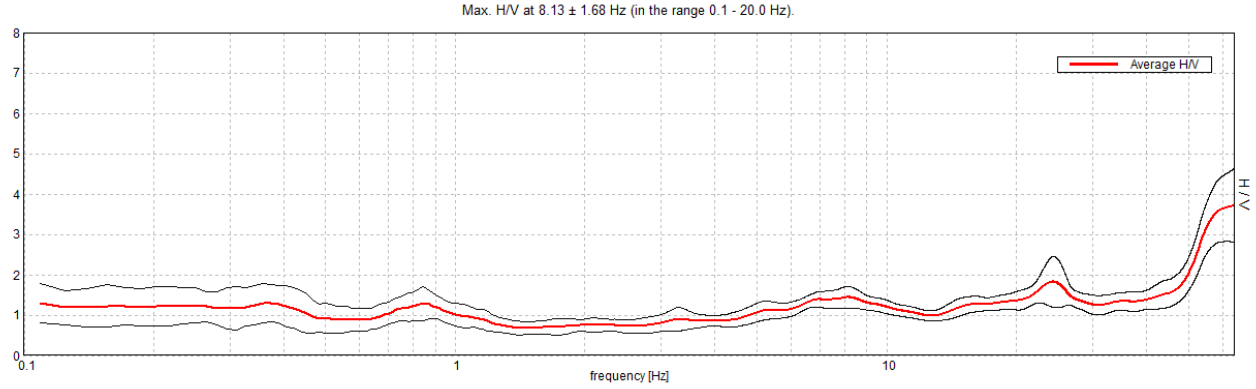
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

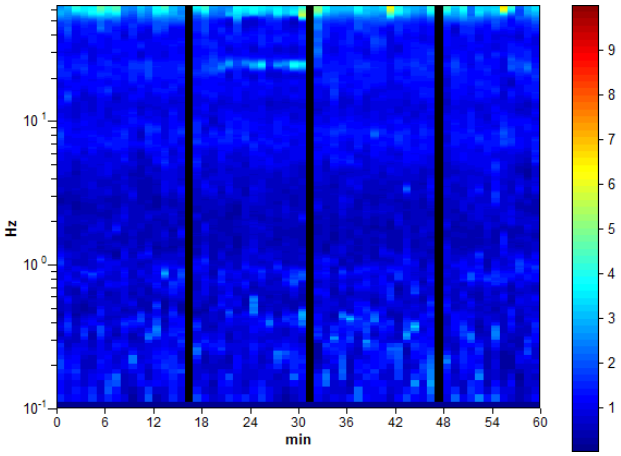
039006P59160HVSR63084
CASTEL BOLOGNESE_MS, HVSR13

Instrument: TEP-0123/01-10
Start recording: 11/12/18 13:43:32 End recording: 11/12/18 14:43:33
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 1h00'00". Analyzed 95% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 60 s
Smoothing type: Triangular window
Smoothing: 10%

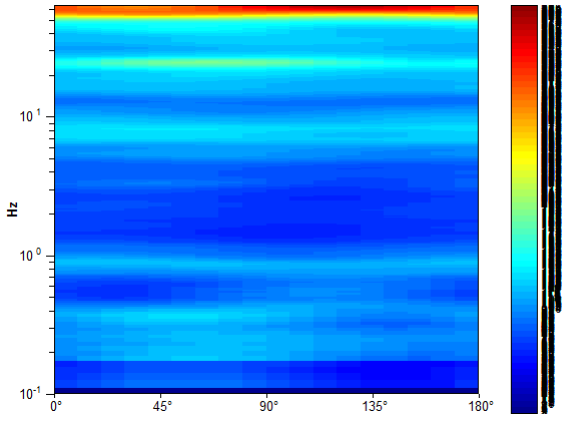
HORIZONTAL TO VERTICAL SPECTRAL RATIO



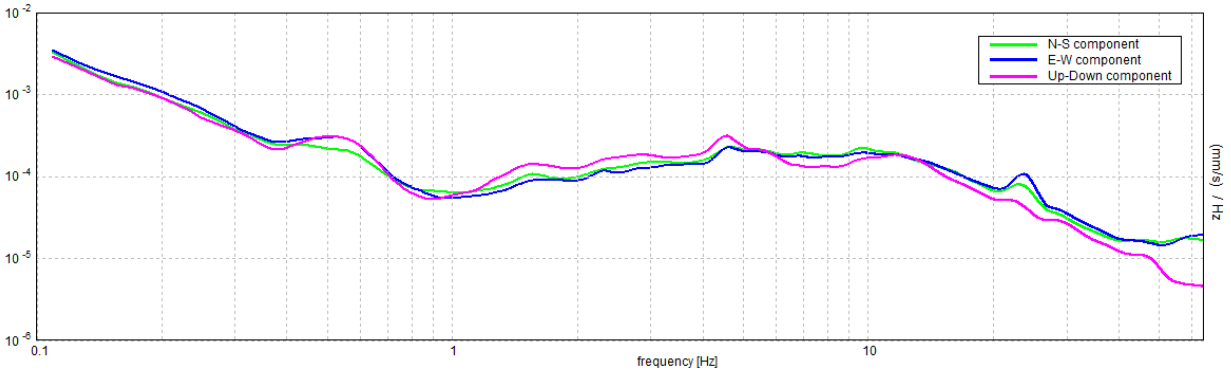
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the *Grilla* manual before interpreting the following tables**.]

Max. H/V at 8.13 ± 1.68 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	8.13 > 0.17	OK	
$n_c(f_0) > 200$	27787.5 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 781 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	2.609 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.44 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.10249| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	0.83277 < 0.40625		NO
$\sigma_A(f_0) < \theta(f_0)$	0.1351 < 1.58	OK	

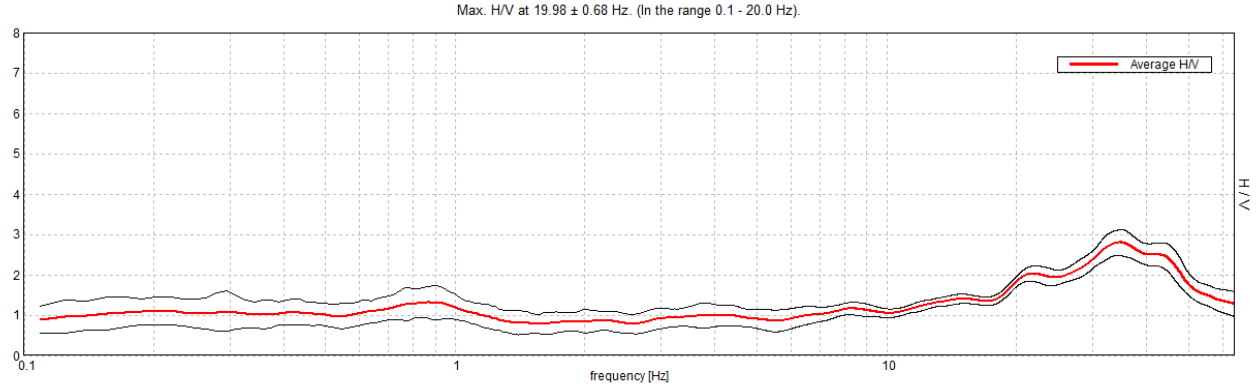
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

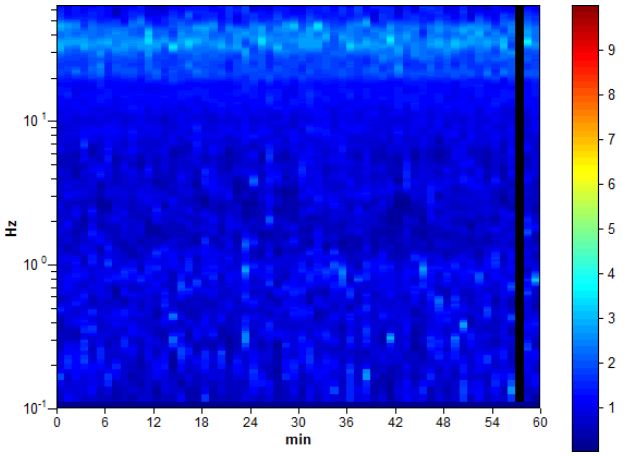
039006P59161HVSR63085
CASTEL BOLOGNESE_MS, HVSR14

Instrument: TEP-0123/01-10
Start recording: 11/12/18 14:58:54 End recording: 11/12/18 15:58:54
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 1h00'00". Analyzed 98% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 60 s
Smoothing type: Triangular window
Smoothing: 10%

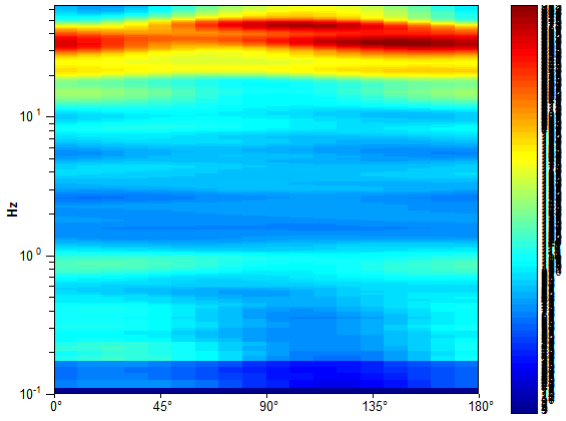
HORIZONTAL TO VERTICAL SPECTRAL RATIO



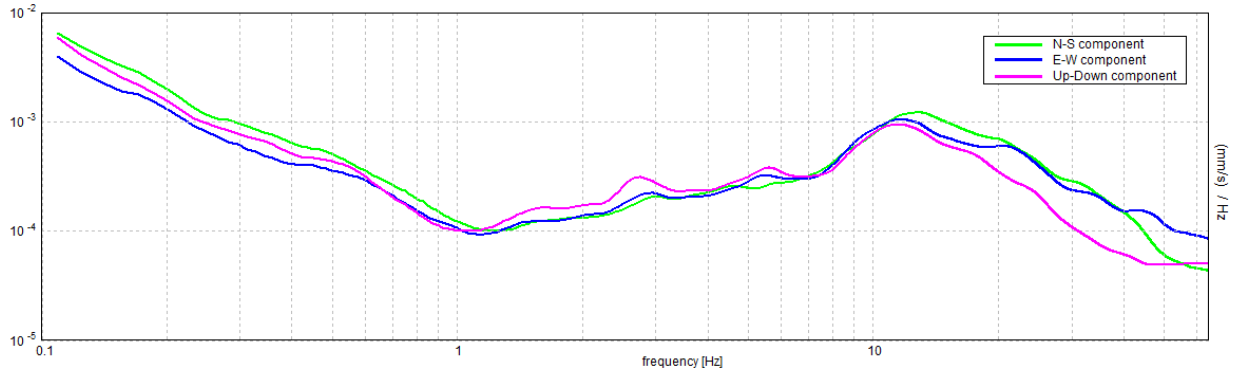
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(m/s) / Hz
0.1
1
10

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 19.98 ± 0.68 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	19.98 > 0.17	OK	
$n_c(f_0) > 200$	70744.7 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 1920 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	6.031 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.83 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.01682| < 0.05	OK	
$\sigma_f < \varepsilon(f_0)$	0.33608 < 0.99922	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.0645 < 1.58	OK	

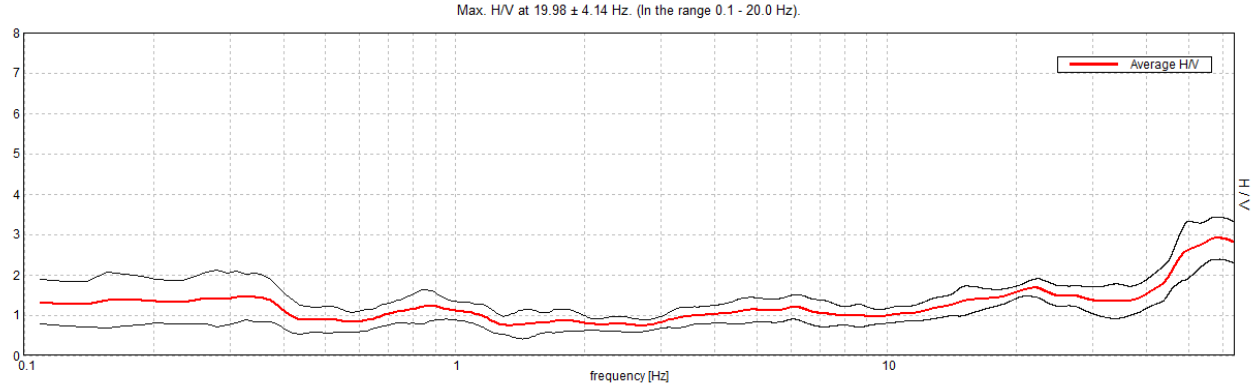
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

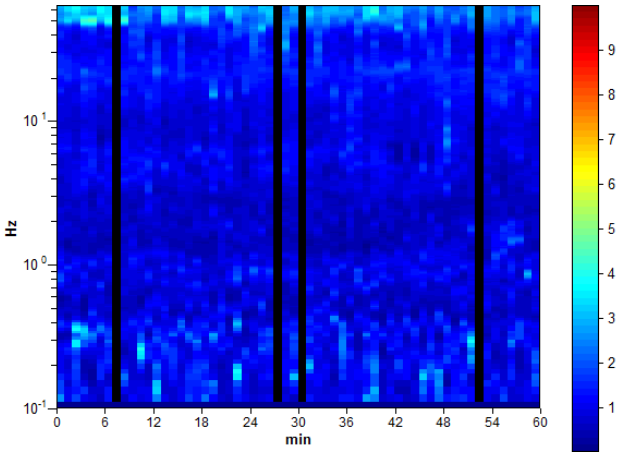
039006P59162HVSR63086
CASTEL BOLOGNESE_MS, HVSR15

Instrument: TEP-0123/01-10
Start recording: 20/12/18 09:24:50 End recording: 20/12/18 10:24:51
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 1h00'00". Analyzed 93% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 60 s
Smoothing type: Triangular window
Smoothing: 10%

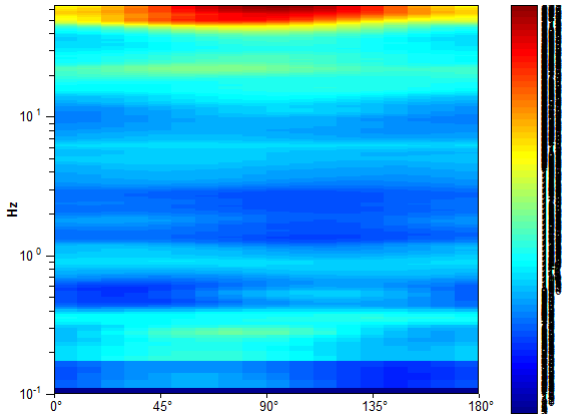
HORIZONTAL TO VERTICAL SPECTRAL RATIO



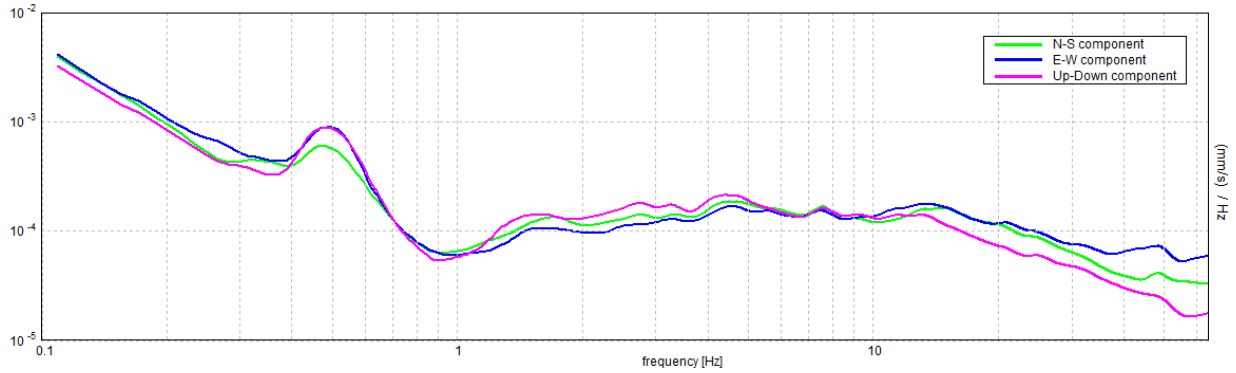
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA


N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 19.98 ± 4.14 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	19.98 > 0.17	OK	
$n_c(f_0) > 200$	67147.5 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 1920 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.57 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.10241| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	2.04651 < 0.99922		NO
$\sigma_A(f_0) < \theta(f_0)$	0.0751 < 1.58	OK	

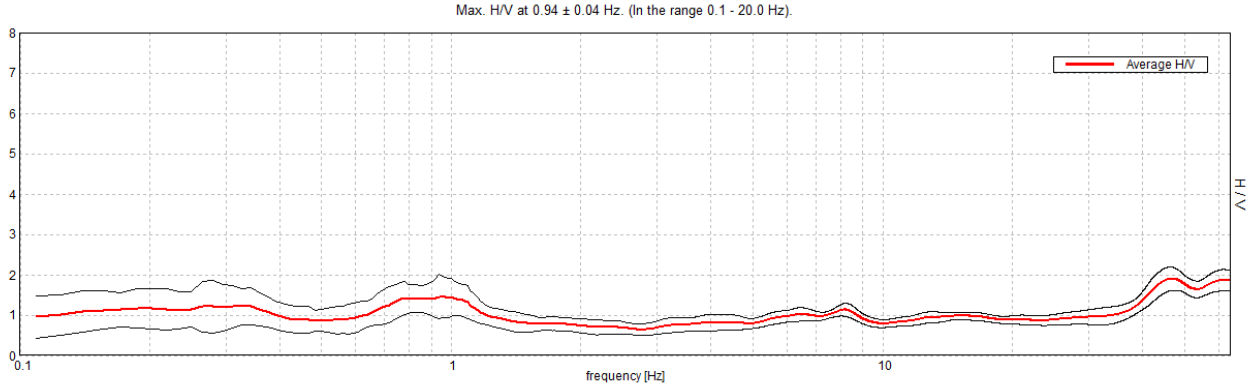
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

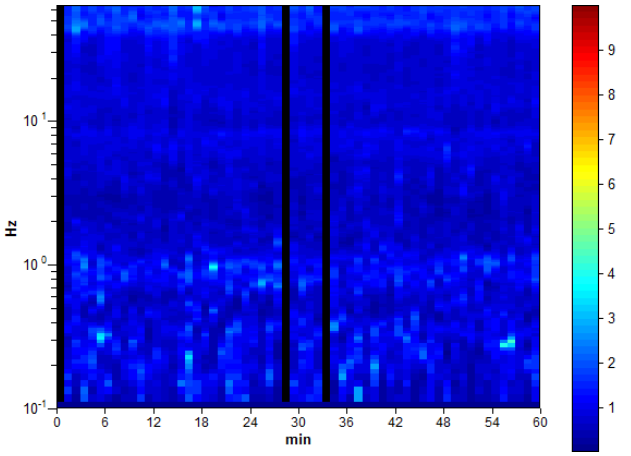
039006P59163HVSR63087
CASTEL BOLOGNESE_MS, HVSR16

Instrument: TEP-0123/01-10
Start recording: 20/12/18 10:31:24 End recording: 20/12/18 11:31:24
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 1h00'00". Analyzed 95% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 60 s
Smoothing type: Triangular window
Smoothing: 10%

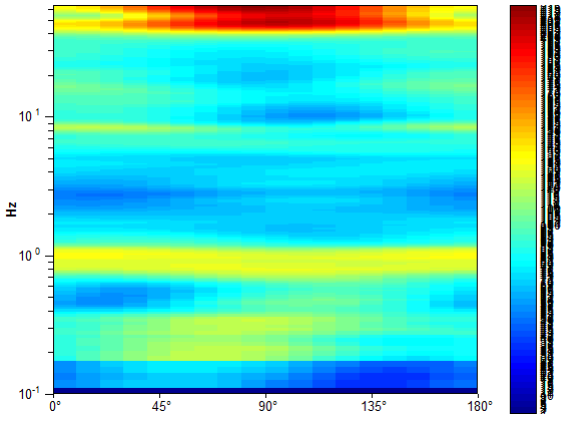
HORIZONTAL TO VERTICAL SPECTRAL RATIO



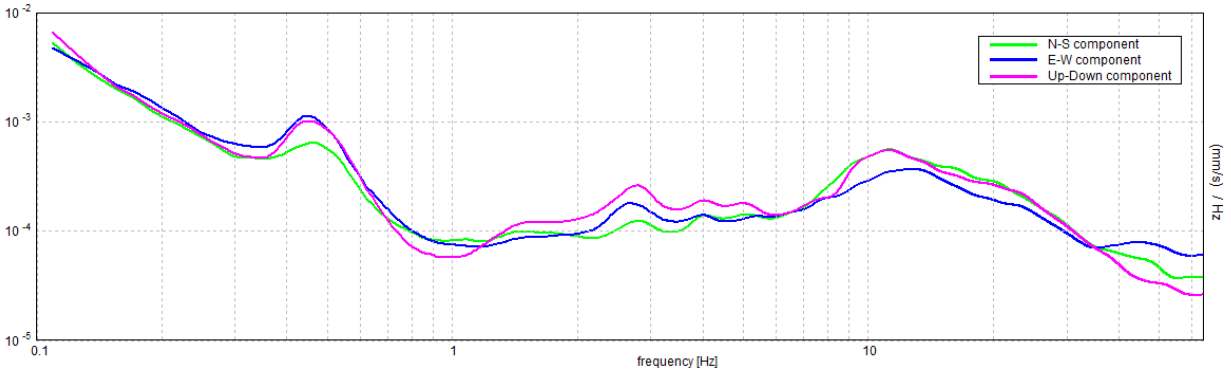
H/V TIME HISTORY



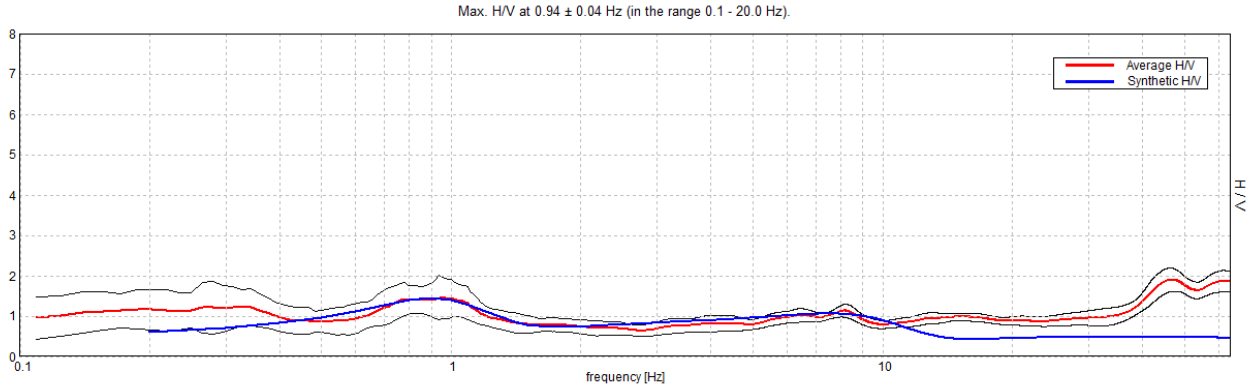
DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA

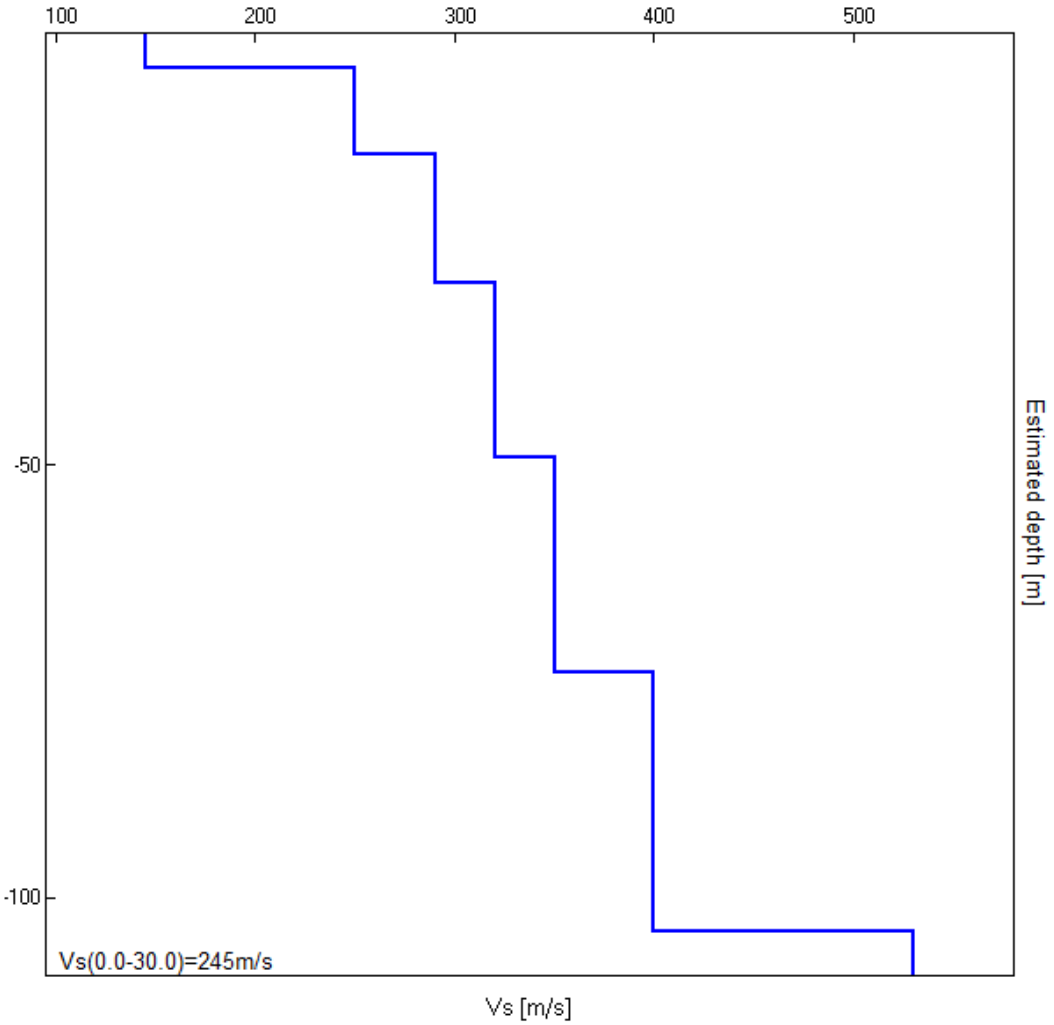

N-S component
E-W component
Up-Down component
frequency [Hz]
(mm/s) / Hz

EXPERIMENTAL vs. SYNTHETIC H/V



Depth at the bottom of the layer [m]	Thickness [m]	Vs [m/s]
4.00	4.00	145
14.00	10.00	250
29.00	15.00	290
49.00	20.00	320
74.00	25.00	350
104.00	30.00	400
inf.	inf.	530

Vs(0.0-30.0)=245m/s



[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 0.94 ± 0.04 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	0.94 > 0.17	OK	
$n_c(f_0) > 200$	3206.3 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 91 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$	2.047 Hz	OK	
$A_0 > 2$	1.45 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.0236| < 0.05	OK	
$\sigma_f < \varepsilon(f_0)$	0.02213 < 0.14063	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.2711 < 2.0	OK	

L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

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P IVA e Codice Fiscale n. 00174600387
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COMMITTENTE: RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO
CANTIERE: Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e I

PROVA N°: SCPTU 1 PROF. FALDA (m da p.c.): N.D. PUNTA: Tecnopenta G1-CPL2IN (matr. 111010)[a = 0.66]
DATA: 19/02/19 PREFORO (m da p.c.): LAT. (WGS 84): 44.330004°
COMMESSA: 18388/18 C. SITO N°: S190304 del 28.02.19 LONG. (WGS 84): 11.792090°

prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi
0.02	1.08	6.69	1.79	0.38	2.02	0.87	86.10	7.49	1.09	4.02	2.10	75.67	271.22	1.97	6.02	3.21	139.53	133.65	3.04	8.02	4.00	102.86	5.86	4.19
0.04	1.15	12.47	0.97	0.48	2.04	0.82	86.77	8.30	1.10	4.04	2.49	72.55	315.99	1.98	6.04	4.06	122.97	158.89	3.05	8.04	3.57	102.19	4.23	4.21
0.06	1.24	16.80	0.97	0.34	2.06	0.85	86.65	12.37	1.11	4.06	2.48	69.11	79.93	1.98	6.06	3.68	89.97	58.77	3.08	8.06	3.58	104.41	5.86	4.22
0.08	1.35	19.91	1.79	0.32	2.08	0.92	84.32	64.47	1.11	4.08	2.21	70.11	46.56	1.99	6.08	3.13	95.85	44.93	3.08	8.08	3.84	109.52	7.49	4.23
0.10	1.39	27.69	0.97	0.37	2.10	0.96	75.10	70.17	1.11	4.10	2.34	73.99	76.67	2.00	6.10	2.61	108.07	47.37	3.10	8.10	4.52	111.41	9.93	4.24
0.12	1.35	33.91	0.16	0.40	2.12	0.93	71.20	9.93	1.11	4.12	2.48	72.54	71.79	2.01	6.12	2.41	109.85	53.07	3.12	8.12	5.01	105.52	5.86	4.26
0.14	1.37	37.03	-0.65	0.32	2.14	0.91	64.31	-0.65	1.10	4.14	2.37	75.65	49.81	2.01	6.14	2.44	108.73	66.91	3.13	8.14	4.51	100.52	3.41	4.26
0.16	1.20	36.58	-2.28	0.38	2.16	0.92	62.20	0.16	1.11	4.16	2.15	79.10	49.81	2.03	6.16	2.26	110.62	130.40	3.14	8.16	3.58	97.74	0.97	4.28
0.18	1.14	32.52	-32.40	0.26	2.18	0.99	64.31	5.05	1.12	4.18	1.99	82.54	53.89	2.03	6.18	2.05	103.28	134.47	3.15	8.18	3.04	102.63	-0.65	4.29
0.20	1.12	33.97	-33.21	0.28	2.20	1.11	63.75	7.49	1.11	4.20	1.95	82.65	76.67	2.04	6.20	1.96	96.61	136.91	3.18	8.20	2.66	112.19	-0.65	4.31
0.22	1.12	34.97	-32.40	0.25	2.22	1.20	66.52	8.30	1.11	4.22	2.10	78.54	99.47	2.04	6.22	1.97	88.17	145.05	3.19	8.22	2.51	106.75	12.37	4.33
0.24	1.10	42.31	-34.03	0.31	2.24	1.25	68.30	7.49	1.12	4.24	2.45	74.76	147.49	2.04	6.24	2.02	80.05	160.52	3.21	8.24	2.45	97.75	29.47	4.34
0.26	1.08	43.31	-33.21	0.28	2.26	1.32	68.63	7.49	1.13	4.26	2.75	71.31	193.08	2.05	6.26	2.04	75.60	178.43	3.20	8.26	2.46	87.96	51.44	4.35
0.28	1.12	44.53	-34.03	0.29	2.28	1.38	68.07	8.30	1.13	4.28	2.62	71.98	182.49	2.05	6.28	2.04	70.38	201.22	3.22	8.28	2.58	78.19	72.61	4.35
0.30	1.17	45.43	-34.03	0.29	2.30	1.50	70.51	9.11	1.14	4.30	2.38	72.87	123.07	2.06	6.30	2.10	67.60	228.08	3.22	8.30	2.78	75.41	75.05	4.37
0.32	1.19	45.87	-34.03	0.33	2.32	1.62	76.07	79.93	1.13	4.32	2.33	76.98	109.23	2.06	6.32	2.27	65.27	251.69	3.23	8.32	2.66	77.96	70.17	4.40
0.34	1.22	47.21	-34.84	0.34	2.34	1.72	82.18	76.67	1.14	4.34	2.38	86.08	129.59	2.07	6.34	3.33	40.64	185.75	3.21	8.34	2.86	85.19	90.51	4.41
0.36	1.26	51.21	-35.65	0.36	2.36	1.96	65.05	29.47	1.14	4.36	2.36	81.99	257.39	2.06	6.36	3.50	52.98	105.17	3.21	8.36	3.68	89.63	110.87	4.44
0.38	1.29	54.11	-35.65	0.37	2.38	2.01	65.83	40.86	1.14	4.38	2.22	85.20	167.85	2.06	6.38	3.94	71.31	76.67	3.21	8.38	4.92	91.63	-25.89	4.46
0.40	1.29	57.33	-35.65	0.38	2.40	2.21	65.50	58.77	1.15	4.40	2.08	88.20	161.33	2.07	6.40	4.49	87.31	43.30	3.21	8.40	5.30	89.30	-30.77	4.47
0.42	1.27	61.11	-36.47	0.40	2.42	2.21	67.61	25.39	1.16	4.42	1.96	89.76	228.89	2.08	6.42	4.97	96.65	28.65	3.22	8.42	5.16	82.42	-29.96	4.48
0.44	1.25	63.89	-36.47	0.41	2.44	2.20	67.38	14.81	1.16	4.44	1.99	86.87	295.64	2.09	6.44	5.42	100.98	27.02	3.22	8.44	4.43	50.71	-29.96	4.50
0.46	1.25	67.45	-37.29	0.41	2.46	2.31	69.83	14.81	1.17	4.46	2.08	78.43	302.15	2.11	6.46	5.85	102.98	25.39	3.24	8.46	3.55	54.82	-31.59	4.52
0.48	1.27	78.90	-37.29	0.59	2.48	2.90	72.27	17.25	1.17	4.48	1.97	70.76	237.03	2.12	6.48	6.35	101.98	26.21	3.24	8.48	3.01	69.71	-34.84	4.53
0.50	1.33	78.35	-37.29	0.48	2.50	4.15	70.38	10.74	1.19	4.50	1.89	67.31	265.53	2.15	6.50	6.98	98.87	27.02	3.25	8.50	2.84	81.94	-34.03	4.55
0.52	1.44	79.69	-38.10	0.49	2.52	4.64	64.60	8.30	1.20	4.52	1.91	62.53	363.21	2.15	6.52	7.72	95.42	29.47	3.27	8.52	2.70	90.38	-27.51	4.56
0.54	1.56	82.58	-37.29	0.50	2.54	3.82	60.27	6.67	1.20	4.54	2.06	52.75	380.30	2.17	6.54	8.44	91.87	31.09	3.27	8.54	2.66	96.94	-12.87	4.57
0.56	1.62	86.58	-38.10	0.51	2.56	3.20	60.37	6.67	1.20	4.56	2.15	52.75	376.23	2.18	6.56	8.88	87.53	32.72	3.29	8.56	2.40	101.94	18.07	4.59
0.58	1.63	91.59	-38.10	0.51	2.58	2.78	63.59	5.05	1.22	4.58	2.15	52.08	224.01	2.20	6.58	8.92	83.20	32.72	3.30	8.58	2.19	103.27	65.28	4.59
0.60	1.63	94.26	-38.91	0.52	2.60	2.55	69.15	5.05	1.23	4.60	2.12	56.30	77.49	2.22	6.60	8.60	79.64	32.72	3.32	8.60	2.09	102.94	94.59	4.61
0.62	1.68	96.49	-38.91	0.54	2.62	2.56	76.03	8.30	1.24	4.62	2.06	61.08	63.65	2.23	6.62	8.16	76.41	28.65	3.32	8.62	1.98	100.16	118.19	4.64
0.64	1.72	97.60	-39.73	0.53	2.64	2.81	80.81	12.37	1.26	4.64	2.03	64.75	60.39	2.25	6.64	7.51	72.08	27.02	3.32	8.64	1.86	96.04	129.59	4.65
0.66	1.78	94.49	-40.54	0.55	2.66	3.05	79.25	8.30	1.26	4.66	2.13	70.19	59.58	2.27	6.66	6.05	70.07	22.95	3.33	8.66	1.81	86.82	112.49	4.68
0.68	1.82	93.16	-40.54	0.55	2.68	3.09	74.69	8.30	1.26	4.68	2.26	74.52	66.09	2.26	6.68	4.58	71.29	18.88	3.34	8.68	1.79	83.49	132.84	4.69
0.70	1.81	91.94	-40.54	0.58	2.70	3.17	69.35	9.93	1.27	4.70	2.41	77.08	75.05	2.28	6.70	3.98	79.85	18.88	3.37	8.70	1.79	75.60	154.01	4.70
0.72	1.75	91.17	-41.35	0.59	2.72	3.34	63.91	9.93	1.29	4.72	2.43	83.41	71.79	2.28	6.72	3.67	100.40	18.07	3.38	8.72	1.83	69.49	188.19	4.72
0.74	1.70	89.17	-42.17	0.61	2.74	3.60	58.68	11.55	1.29	4.74	2.35	86.29	67.72	2.30	6.74	3.45	113.84	18.88	3.41	8.74	2.01	65.04	225.64	4.74
0.76	1.67	86.95	-42.17	0.59	2.76	4.01	55.68	12.37	1.30	4.76	2.25	85.41	68.53	2.31	6.76	3.33	117.84	18.88	3.41	8.76	2.62	62.93	265.53	4.77
0.78	1.59	84.07	-42.17	0.62	2.78	4.59	52.12	15.63	1.31	4.78	2.21	84.84	71.79	2.32	6.78	3.24	122.39	21.33	3.42	8.78	3.48	59.48	70.98	4.78
0.80	1.51	80.51	-42.98	0.62	2.80	5.23	48.67	16.44	1.33	4.80	2.25	84.29	74.23	2.32	6.80	3.20	125.27	22.95	3.44	8.80	4.22	52.37	-32.40	4.78
0.82	1.40	75.52	-43.79	0.63	2.82	5.55	50.33	18.07	1.34	4.82	2.32	84.18	77.49	2.35	6.82	3.25	121.05	24.58	3.44	8.82	4.18	56.26	-32.40	4.82
0.84	1.29	68.63	-42.98	0.64	2.84	5.19	54.22	17.25	1.34	4.84	2.32	86.06	83.19	2.35	6.84	3.38	113.82	27.83	3.45	8.84	3.49	65.37	-34.03	4.83
0.86	1.18	60.30	-43.79	0.66	2.86	4.33	65.66	14.81	1.34	4.86	2.32	84.62	82.37	2.36	6.86	3.44	104.38	27.83	3.47	8.86	2.95	79.38	-27.51	4.84
0.88	1.11	53.75	-42.98	0.68	2.88	3.57	82.21	13.19	1.36	4.88	2.20	78.73	70.98	2.38	6.88	3.81	96.59	29.47	3.49	8.88	2.74	87.49	-15.31	4.86
0.90	1.03	49.86	-44.61	0.68	2.90	2.96	105.10	12.37	1.37	4.90	2.21	77.73	68.53	2.40	6.90	4.54	100.14	32.72	3.50	8.90	2.60	101.93	-2.28	4.87
0.92	0.97	46.53	-44.61	0.70	2.92	2.69	126.54	21.33	1.38	4.92	2.21	79.05	45.75	2.40	6.92	4.53	124.03	34.35	3.53	8.92	2.59	109.38	50.63	4.88
0.94	0.93	44.87	-44.61	0.70	2.94	2.58	138.65	48.19	1.39	4.94	2.13	81.72	41.67	2.42	6.94	5.10	140.25	56.33	3.55	8.94	2.42	99.38	47.37	4.89
0.96	0.88	43.31	-45.43	0.70	2.96	2.76	130.09	182.49	1.41	4.96	2.08	87.61	44.11	2.44	6.96	5.98	147.25	46.56	3.55	8.96	2.20	90.49	36.79	4.90
0.98	0.86	40.43	-46.24	0.70	2.98	2.94	114.86	170.29	1.42	4.98	2.02	92.16	54.70	2.46	6.98	6.66	150.80	37.61	3.58	8.98	1.95	86.27	22.95	4.91
1.00	0.83	35.54	-46.24	0.70	3.00	2.91	110.41	123.89	1.43	5.00	1.93	88.49	56.33	2.47	7.00	6.73	147.58	38.42	3.61	9.00	1.68	89.60	14.81	4.92
1.02	0.83	33.21	-47.05	0.69	3.02	2.75	103.85	70.98	1.44	5.02	1.77	78.16	63.65	2.49	7.02	6.46	137.46	37.61	3.61	9.02	1.46	91.60	13.19	4.92
1.04	0.82	33.10	-47.05	0.69	3.04	3.03	106.62	68.53	1.46	5.04	1.93	76.93	97.84	2.52	7.04	6.30	126.02	37.61	3.62	9.04	1.32	89.16	16.44	4.94
1.06	0.81	33.88	-47.05	0.69	3.06	3.41	110.28	72.61	1.46	5.06	2.18	69.27	105.98	2.52	7.06	6.43	120.02	38.42	3.63	9.06	1.21	84.38	31.91	4.95
1.08	0.78	33.77	-47.87	0.69	3.08	3.64	111.72	53.89	1.48	5.08	2.39	63.70	111.68	2.54	7.08	6.71	117.57	40.86	3.66	9.08	1.16	73.94	58.77	4.95
1.10	0.76	33.55	-47.87	0.69	3.10	3.52	110.16	40.86	1.50	5.10	2.35	64.70	119.82	2.55	7.10	7.02	109.45	41.67	3.67	9.10	1.14	60.82	82.37	4.97
1.12	0.73	34.22	-48.68	0.70	3.12	3.07	111.60	37.61	1.52	5.12	2.46	61.15	136.10	2.58	7.12	7.29	100.11	41.67	3.68	9.12	1.27	50.27	106.79	4.97
1.14	0.72	34.23	-48.68	0.70	3.14	2.57	113.26	36.79	1.54	5.14	2.55	64.26	140.17	2.59	7.14	7.17	101.44	40.86	3.67	9.14	1.55	40.27	123.89	4.97
1.16	0.73	32.01	-49.49	0.70	3.16	2.27	112.26	42.49	1.54	5.16	2.55	69.59	127.15	2.60	7.16	6.31	102.66	37.61	3.70	9.16	1.77	33.71	123.07	4.96
1.18	0.75	30.90	-49.49	0.71	3.18	2.26	107.81	65.28	1.55	5.18	2.54	77.14	85.63	2.60	7.18	5.59	101.66	35.16	3.71	9.18	1.87	34.04	74.23	4.97
1.20	0.77	31.24	-49.49	0.74	3.20	2.48	102.36	78.31	1.56	5.20	2.58	85.03	70.98	2.63	7.20	5.45	108.32	35.97	3.73	9.20	2.15	36.49	75.05	5.00
1.22	0.82	31.80	-50.31	0.75	3.22	2.80	98.69	92.14	1.58	5.22	2.60	96.14	72.61	2.64	7.22	5.84	116.99	39.23	3.74	9.22	7.87	33.38	150.75	5.00
1.24	0.83	33.35	-49.49	0.76	3.24	2.92	91.57	59.58	1.58	5.24	2.60	102.36	63.65	2.64	7.24	6.28	116.65	40.86	3.74	9.24	17.82	41.83	12.37	5.01
1.26	0.87	35.80	-50.31	0.78	3.26	3.00	87.79	59.58	1.60	5.26	2.54	107.14	57.95	2.66	7.26	6.68	118.76	40.86	3.77	9.26	21.04	32.53	9.11	5.01
1.28	0.93	37.58	-49.49	0.79	3.28	2.89	91.45	66.09	1.61	5.28	2.60	110.02	53.89	2.67	7.28	6.89	119.76	35.97	3.79	9.28	21.11	35.87	7.49	5.01
1.30	0.96	39.36	-50.31	0.81	3.30	2.80	89.45	88.89	1.61	5.30	2.73	114.91	52.25	2.67	7.30	6.81	116.19	34.35	3.80	9.30	20.27	40.76	6.67	4.99
1.32	1.18	73.64	-50.31	0.93	3.32	2.77	90.11	110.87	1.63	5.32	2.88	109.06	26.21	2.64	7.32	6.84	77.35	31.91	3.79	9.32	19.49	48.10	8.30	5.01
1.34	1.29	81.19	-48.68	0.93	3.34	2.73	91.44	119.01	1.64	5.34	2.78	111.17	25.39	2.66	7.34	6.95	72.79	31.09	3.81	9.34	18.87	46.66	8.30	5.03
1.36	1.35	84.97	-48.68	0.93	3.36	3.31	102.32	66.09	1.60	5.36	2.60	115.73	24.58	2.67	7.36	6.97	72.13	30.28	3.81	9.36	17.74	49.21	9.93	5.07
1.38	1.40	85.41	-48.68	0.94	3.38	3.13	102.54	34.35	1.60	5.38	2.52	119.16	24.58	2.69	7.38	7.02	72.46	29.47	3.81	9.38	17.22	51.21	11.55	5.12
1.40	1.42	86.63	-48.68	0.94	3.40	3.22	110.21	46.56	1.62	5.40	2.46	123.16	39.23	2.69	7.40	7.09	73.13	30.28	3.83	9.40	17.13	50.54	14.00	5.15
1.42	1.40	90.63	-48.68	0.95	3.42	3.58	115.64	69.35	1.62	5.42	2.49	126.05	59.58	2.70	7.42	7.21	74.02	29.47	3.84	9.42	18.03	47.31	20.51	5.17
1.44	1.36	94.52	-47.87	0.95	3.44	4.20	124.42	63.65	1.65	5.44	2.56	126.61	63.65	2.72	7.44	7.32	74.24	30.28	3.84	9.44	19.16	36.62	25.39	5.26
1.46	1.31	98.29	-33.21	0.97	3.46	4.82	131.31	39.23	1.64	5.46	2.74	120.50	68.53	2.72	7.46	7.39	73.24	30.28	3.85	9.46	20.19	43.62	27.83	5.29
1.48	1.30	102.07	26.21	0.96	3.48	5.02	135.64	35.97	1.68	5.48	2.61	116.83	65.28	2.72	7.48	7.41	72.68	30.28	3.86	9.48	21.30	41.28	30.28	5.31
1.50	1.33	106.40	73.42	0.96	3.50	4.42	133.19	31.91	1.67	5.50	2.56	108.49	65.28	2.72	7.50	7.21	73.57	28.65	3.87	9.50	22.78	68.72	35.97	5.46
1.52	1.33	110.84	94.59	0.99	3.52	3.87	134.08	32.72	1.69	5.52	2.67	103.93	65.28	2.74	7.52	6.82	74.24	26.21	3.88	9.52	21.86	81.39	29.47	5.51
1.54	1.30	113.61	114.12	0.98	3.54	3.42	138.53	31.91	1.72	5.54	3.52	96.82	70.17	2.75	7.54	6.18	75.80	23.77	3.88	9.54	23.03	102.49	35.16	5.54
1.56	1.24	111.39	110.87	0.98	3.56	3.11	142.19	32.72	1.73	5.56	4.71	97.03	76.67	2.76	7.56	5.71	79.13	23.77	3.90	9.56	24.17	108.92	37.61	5.54
1.58	1.23	108.94	113.31	0.99	3.58	2.94	143.63	47.37	1.74	5.58	5.83	89.81	77.49	2.78	7.58	5.24	82.46	23.77	3.92	9.58	24.76	105.69	18.07	5.59
1.60	1.22	107.49	114.93	1.00	3.60	2.66	135.07	33.53	1.76	5.60	5.48	78.92	72.61	2.78	7.60	5.21	99.01	22.95	3.92	9.60	26.12	139.02	27.83	5.55
1.62	1.23	107.05	122.26	1.00	3.62	2.72	130.62	31.91	1.77	5.62	4.43	81.80	66.09	2.79	7.62	5.26	114.35	22.95	3.93	9.62	25.01	146.79	26.21	5.57
1.64	1.23	106.49	123.07	1.00	3.64	3.27	126.39	35.97	1.79	5.64	3.57	97.69	61.21	2.80	7.64	5.15	122.68	22.14	3.96	9.64	24.40	152.77	28.65	5.59
1.66	1.28	104.60	128.77	1.01	3.66	3.80	117.72	34.35	1.80	5.66	3.25	101.69	58.77	2.83	7.66	4.96	132.68	22.14	3.96	9.66	24.76	153.10	32.72	5.64
1.68	1.34	103.04	130.40	1.00	3.68	3.94	110.94	31.09	1.81	5.68	3.08	102.79	58.77	2.84	7.68	4.95	145.56	20.51	3.97	9.68	27.34	149.43	44.93	5.69
1.70	1.37	100.81	127.15	1.01	3.70	4.11	101.83	28.65	1.83	5.70	2.92	100.24	57.95	2.84	7.70	5.18	144.89	18.07	3.99	9.70	31.70	128.64	60.39	5.82
1.72	1.40	98.92	85.63	1.01	3.72	4.27	91.04	29.47	1.84	5.72	2.72	90.90	57.14	2.87	7.72	5.46	139.34	17.25	4.01	9.72	34.78	149.73	63.65	5.97
1.74	1.42	97.14	67.72	1.02	3.74	4.44	80.82	29.47	1.85	5.74	2.66	79.67	57.14	2.88	7.74	4.99	135.00	15.63	4.00					
1.76	1.44	95.81	64.47	1.03	3.76	4.46	74.71	29.47	1.87	5.76	2.75	70.89	58.77	2.92	7.76	4.40	127.89	14.00	4.02					
1.78	1.45	94.14	59.58	1.03	3.78	4.20	70.92	28.65	1.88	5.78	3.04	62.89	62.03	2.94	7.78	3.96	124.22	12.37	4.05					
1.80	1.46	91.81	50.63	1.03	3.80	3.81	70.59	27.02	1.89	5.80	3.53	58.55	64.47	2.97	7.80	3.45	126.54	9.93	4.06					
1.82	1.45	89.58	47.37	1.02	3.82	3.45	75.92	26.21	1.89	5.82	4.62	61.21	73.42	2.97	7.82	3.29	132.76	11.55	4.08					
1.84	1.45	87.36	39.23	1.04	3.84	3.17	86.69	26.21	1.89	5.84	5.24	64.66	77.49	2.94	7.84	3.83	138.76	32.72	4.09					
1.86	1.44	85.58	32.72	1.03	3.86	2.79	101.47	26.21	1.91	5.86	5.82	68.43	81.56	2.94	7.86	5.01	125.20	28.65	4.12					
1.88	1.41	83.47	25.39	1.04	3.88	2.39	111.47	28.65	1.92	5.88	6.06	70.21	77.49	2.94	7.88	5.24	112.53	17.25	4.12					
1.90	1.39	82.58	22.95	1.03	3.90	2.19	104.79	75.86	1.93	5.90	5.11	76.10	69.35	2.96	7.90	4.53	100.20	14.81	4.12					
1.92	1.28	80.90	28.65	1.05	3.92	2.12	91.68	153.19	1.93	5.92	4.05	94.21	62.84	2.97	7.92	4.26	97.53	14.00	4.14					
1.94	1.21	81.67	17.25	1.06	3.94	2.09	79.12	193.08	1.95	5.94	3.28	119.32	57.95	2.99	7.94	4.29	105.08	14.81	4.15					
1.96	1.12	83.45	10.74	1.07	3.96	2.08	75.45	215.05	1.95	5.96	2.83	140.43	57.14	3.01	7.96	4.74	113.08	17.25	4.15					
1.98	1.03	85.56	6.67	1.07	3.98	1.92	77.12	223.19	1.96	5.98	2.55	149.76	60.39	3.01	7.98	5.25	112.41	11.55	4.18					
2.00	0.94	86.44	7.49	1.09	4.00	1.87	77.12	232.97	1.97	6.00	2.44	152.31	95.40	3.03	8.00	4.63	109.30	7.49	4.18					

Il Direttore Tecnico SOA:
p.i. Riccardo Mazza

Il Responsabile Prove in Sito:
dott. Massimo Romagnoli

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tel. 0532/56771; fax 0532/56119 e-mail: info@elletipi.it sito: www.elletipi.it
P IVA e Codice Fiscale n. 00174600387
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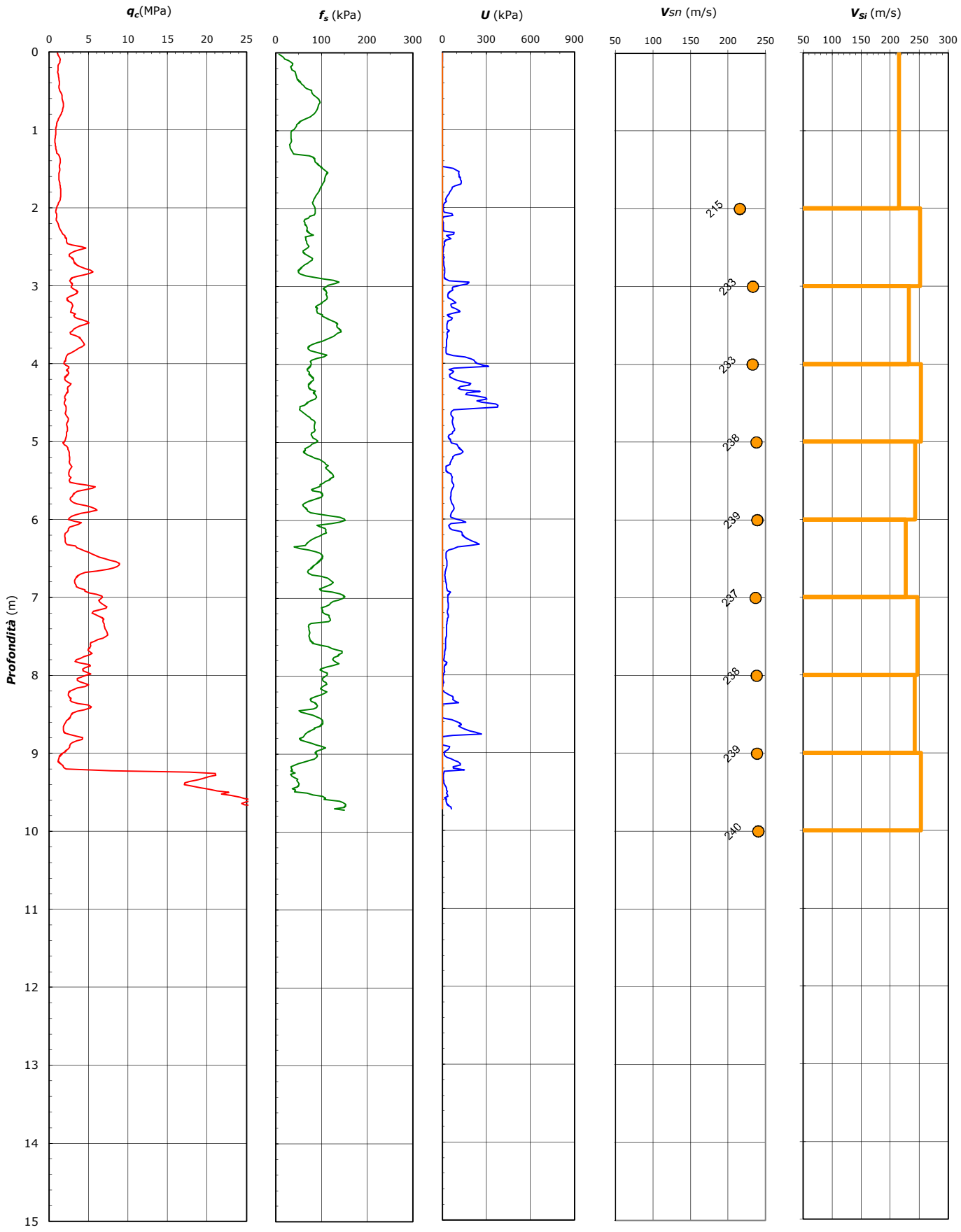
COMMITTENTE: RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO
CANTIERE: Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e I

PROVA N°: SCPTU 1 PROF. FALDA (m da p.c.): N.D. PUNTA: Tecnopenta G1-CPL2IN (matr. 111010)[a = 0.66]
DATA: 19/02/19 PREFORO (m da p.c.): LAT. (WGS 84): 44.330004°
COMMESSA: 18388/18 C. SITO N°: S190304 del 28.02.19 LONG. (WGS 84): 11.792090°



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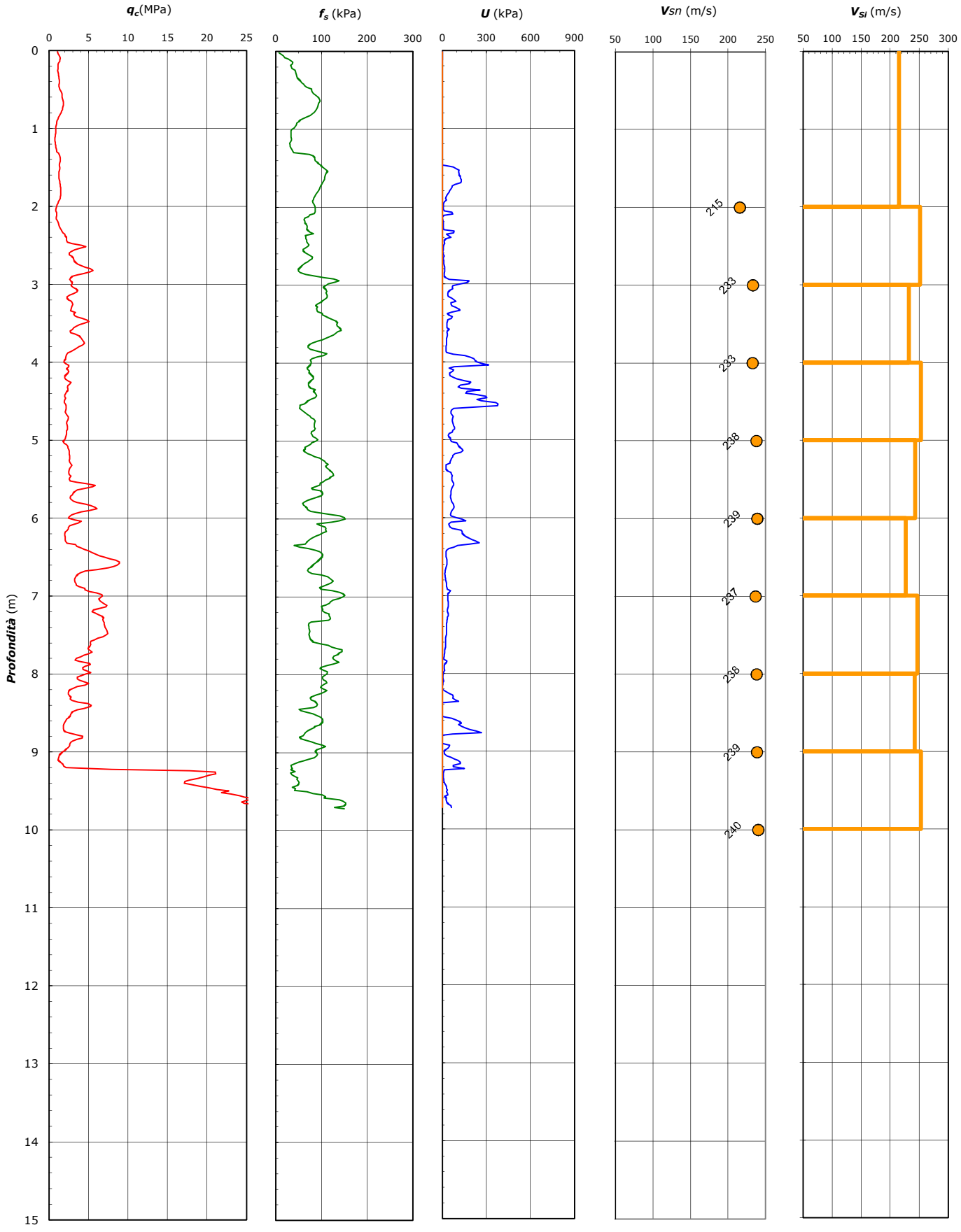

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DATA: 19/02/19 PREFORO (m da p.c.): LAT. (WGS 84): 44.330004°
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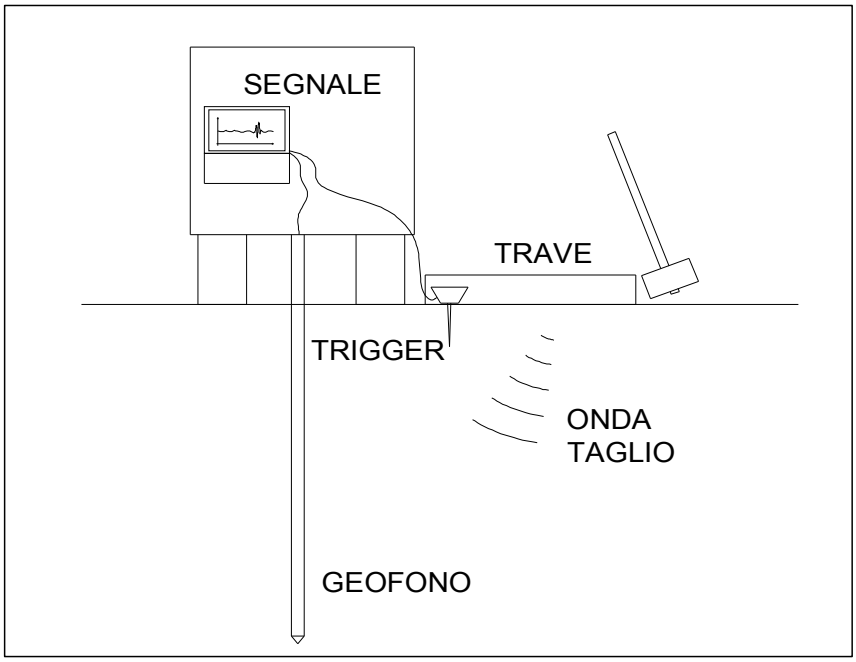
Prova Down Hole ASTM D 7400



Profondità (m)	Ts (ms)	L (m)	Vs (m/s)	Vis (m/s)
1.0	T0	1.41	-	-
2.0	3.81	2.24	215	215
3.0	7.50	3.16	233	251
4.0	11.64	4.12	233	232
5.0	15.51	5.10	238	253
6.0	19.55	6.08	239	243
7.0	23.92	7.07	237	226
8.0	27.93	8.06	238	247
9.0	32.03	9.06	239	242
10.0	35.97	10.05	240	253

D = Distanza centro trave generatrice ond
Profondità = Profondità punta da piano campagna
Ts = Tempo percorrenza onda di taglio
L = Lunghezza percorso onda di taglio
Vs = Velocità onde di taglio da piano campagna alla profondità indic = 1.00 m
Vis = Velocità onde di taglio nello strato di terreno compreso fra le due profondità indicate

Il Direttore Tecnico SOA:
p.i. Riccardo Mazza

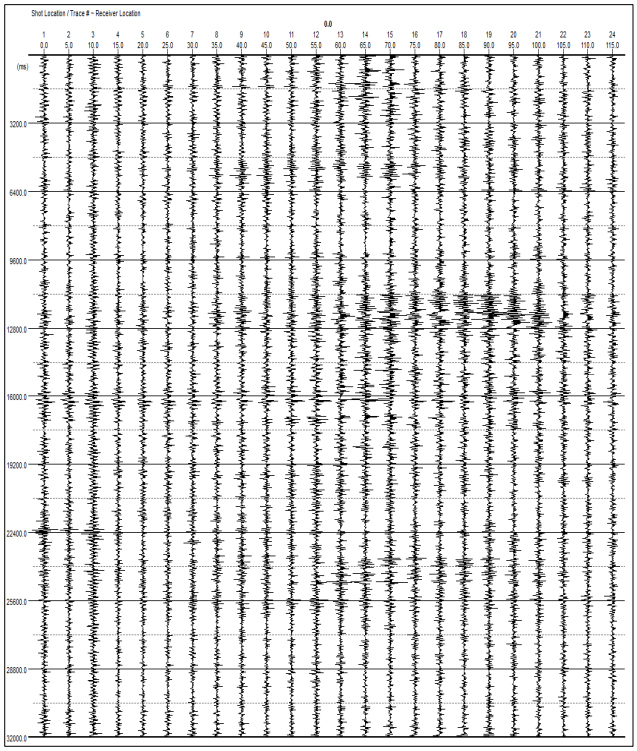
Il Responsabile Prove in Sito:
dott. Massimo Romagnoli

PROSPEZIONE SISMICA CON METODOLOGIA ESAC

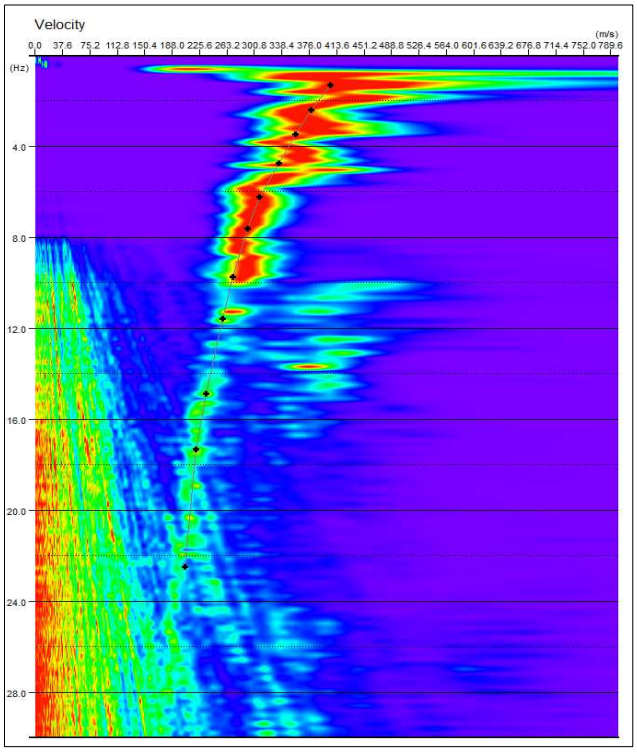
Parco Biancini, Comune di Castel Bolognese (RA) – 039006P59165ESAC_SPAC6309

n° tracce	Δt (ms)	T (s)
25	2,0	32,0

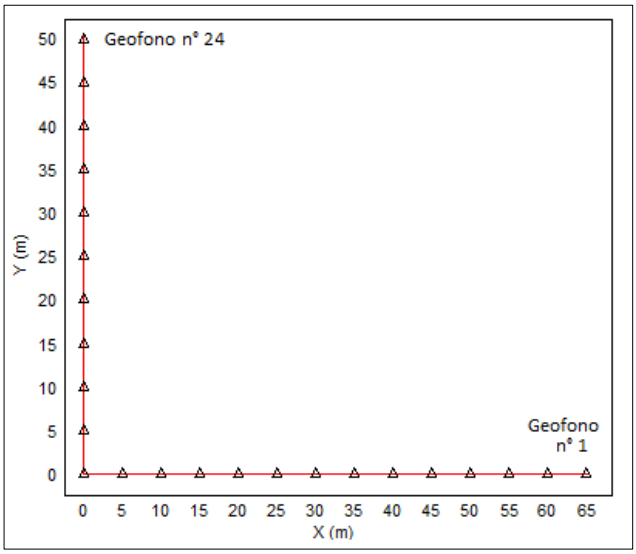
Δt: passo di campionamento; T: durata registrazione.



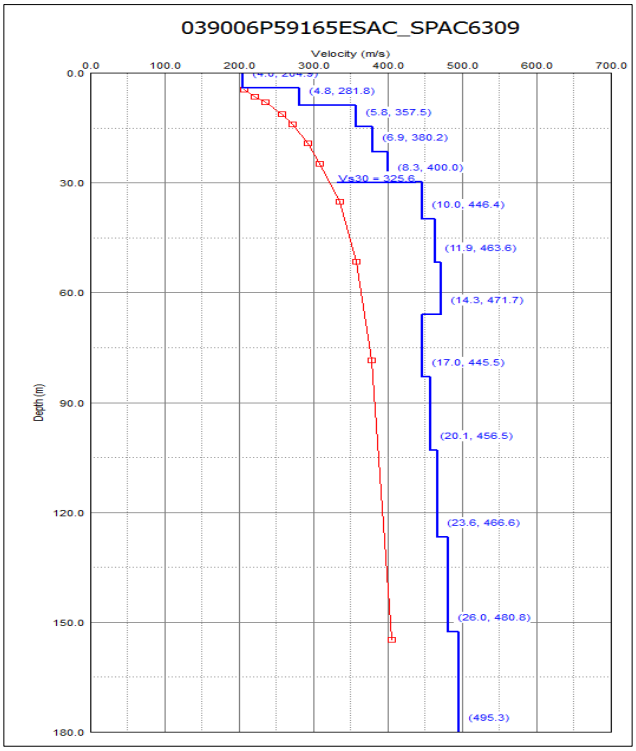
Sismogramma registrato durante le acquisizioni di microtremore sismico. In ascissa il numero dei geofoni, in ordinata il tempo (ms).



Spettro di potenza nel dominio *f–v* e Picking della curva sperimentali delle onde R (croci nere).



Geometria dello stendimento sismico bidimensionale.



Modello di sottosuolo (1D) descritti in termini di Vs e spessore dei sismostrati (spezzata blu) e curva di dispersione sperimentale delle onde R (curva rossa).

Tabella di sintesi

n. Strato	Profondità letto (m dal p.c.)	Spessore (m)	V_S (m/s)
1	4.0	4.0	204.5
2	8.8	4.8	281.8
3	14.6	5.8	357.5
4	21.5	6.9	380.2
5	29.8	8.3	400.0
6	39.8	10.0	446.4
7	51.7	11.9	463.6
8	66.0	14.3	471.7
9	83.0	17.0	445.5
10	103.1	20.1	456.5
11	126.7	23.6	466.6
12	152.7	26.0	480.8
13	∞	∞	495.3

V_{S30} = 325.6 ± 10% [m/s]

Sintesi dei parametri del modello di sottosuolo ottenuto e Valore di Vs30 calcolato.

elletipi s.r.l.
Sede operativa ed amm.va: Via Annibale Zucchini, 69 - 44100 FERRARA
tel. 0532/56771; fax 0532/56119 e-mail: info@elletipi.it sito: www.elletipi.it
P IVA e Codice Fiscale n. 00174600387
@ Laboratorio Geotecnico autorizzato con Dec. n. 6572 del 07/10/2014, art. 59 del D.P.R. 380/2001, Circolari Ministeriali 7618/STC

Azienda con Sistemi di Gestione certificati da Certiquality
Qualità Ambiente Sicurezza
UNI EN ISO 9001:2008
UNI EN ISO 14001:2004
BS OHSAS 18001:2007

COMMITTENTE: **RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO**
CANTIERE: Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e

PROVA N°: SCPTU 2 PROF. FALDA (m da p.c.): N.D. PUNTA: Tecnopenta G1-CPL2IN (matr. 111010)[a = 0.66]
DATA: 19/02/19 PREFORO (m da p.c.): LAT. (WGS 84): 44.321911°
COMMESSA: 18388/18 C. SITO N°: S190305 del 28.02.19 LONG. (WGS 84): 11.808814°

prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi
0.02	0.95	2.27	-9.61	0.45	2.02	6.00	65.26	35.16	2.36	4.02	1.32	50.15	38.42	3.88	6.02	1.36	64.15	87.26	4.97	8.02	1.70	55.91	99.47	6.32
0.04	1.06	5.49	-7.98	0.39	2.04	6.49	60.37	35.97	2.40	4.04	1.30	55.04	70.98	3.91	6.04	1.26	64.04	95.40	5.00	8.04	1.70	49.82	188.19	6.33
0.06	1.36	9.71	-7.17	0.61	2.06	6.65	55.36	36.79	2.40	4.06	1.30	59.93	84.81	3.91	6.06	1.40	43.49	191.45	5.01	8.06	1.69	49.26	182.49	6.33
0.08	1.18	15.16	-10.42	0.65	2.08	6.52	49.80	-29.96	2.41	4.08	1.27	63.04	111.68	3.92	6.08	1.34	44.27	190.63	5.01	8.08	1.66	50.37	184.13	6.34
0.10	1.47	21.49	-9.61	0.60	2.10	6.19	44.36	-30.77	2.43	4.10	1.45	47.14	72.61	3.91	6.10	1.29	46.93	198.77	5.04	8.10	1.64	51.37	181.68	6.34
0.12	1.66	24.49	-10.42	0.48	2.12	5.66	18.56	-28.33	2.44	4.12	1.38	48.47	79.12	3.94	6.12	1.21	47.71	215.87	5.05	8.12	1.60	53.04	179.24	6.35
0.14	1.82	30.16	-12.05	0.65	2.14	5.47	17.56	-28.33	2.45	4.14	1.32	48.92	84.81	3.95	6.14	1.20	45.05	254.13	5.04	8.14	1.55	54.26	176.80	6.37
0.16	2.04	34.69	-37.29	0.48	2.16	5.11	16.56	-29.15	2.46	4.16	1.27	50.58	94.59	3.95	6.16	1.25	45.27	315.99	5.07	8.16	1.53	54.26	175.99	6.37
0.18	2.05	47.92	-37.29	0.49	2.18	4.60	17.22	-29.15	2.47	4.18	1.27	50.80	105.17	3.95	6.18	1.34	42.05	331.46	5.07	8.18	1.48	54.48	174.35	6.38
0.20	2.00	66.04	-38.91	0.55	2.20	4.42	21.44	-29.15	2.49	4.20	1.31	51.91	119.82	3.96	6.20	1.40	39.49	301.34	5.08	8.20	1.44	53.70	176.80	6.39
0.22	1.91	73.83	-42.17	0.54	2.22	4.35	27.00	-29.15	2.50	4.22	1.40	52.47	146.68	3.99	6.22	1.36	38.16	215.87	5.10	8.22	1.43	52.70	189.82	6.39
0.24	1.83	85.83	-43.79	0.57	2.24	4.53	34.44	-28.33	2.50	4.24	1.43	46.47	134.47	4.00	6.24	1.32	37.82	177.61	5.11	8.24	1.44	51.03	207.73	6.42
0.26	1.78	93.06	-44.61	0.57	2.26	4.33	43.66	-29.96	2.52	4.26	1.43	44.13	146.68	4.04	6.26	1.40	39.38	186.57	5.12	8.26	1.44	48.03	219.13	6.42
0.28	1.71	99.52	-45.43	0.59	2.28	4.28	55.88	-30.77	2.54	4.28	1.46	45.02	190.63	4.04	6.28	1.48	43.27	184.13	5.14	8.28	1.46	45.81	235.41	6.43
0.30	1.60	103.86	-46.24	0.62	2.30	4.28	65.55	-30.77	2.55	4.30	1.54	43.13	169.47	4.05	6.30	1.50	46.15	145.87	5.14	8.30	1.48	43.48	242.73	6.43
0.32	1.52	105.97	-47.05	0.60	2.32	4.38	66.33	-32.40	2.56	4.32	1.59	43.35	144.24	4.06	6.32	1.47	47.49	39.23	5.15	8.32	1.49	42.26	249.25	6.44
0.34	1.49	105.87	-47.05	0.62	2.34	4.43	67.99	-34.03	2.58	4.34	1.56	45.24	126.33	4.09	6.34	1.43	49.93	32.72	5.18	8.34	1.52	41.48	254.13	6.46
0.36	1.48	106.32	-47.87	0.63	2.36	4.36	69.76	-36.47	2.60	4.36	1.46	48.46	111.68	4.10	6.36	1.40	55.38	36.79	5.18	8.36	1.53	40.92	243.55	6.48
0.38	1.46	101.66	-48.68	0.66	2.38	4.05	70.76	-39.73	2.63	4.38	1.33	50.13	113.31	4.10	6.38	1.47	59.27	53.89	5.19	8.38	1.53	41.37	242.73	6.48
0.40	1.50	100.44	-48.68	0.66	2.40	3.58	72.31	-43.79	2.63	4.40	1.32	50.79	213.43	4.13	6.40	1.77	60.38	66.09	5.20	8.40	1.54	40.70	241.92	6.49
0.42	1.51	100.90	-49.49	0.69	2.42	3.41	77.75	-42.98	2.65	4.42	1.31	50.57	243.55	4.13	6.42	2.11	60.27	70.17	5.21	8.42	1.53	41.03	239.47	6.52
0.44	1.49	94.68	-50.31	0.71	2.44	3.28	86.09	-36.47	2.68	4.44	1.34	49.90	262.27	4.14	6.44	2.11	62.26	50.63	5.24	8.44	1.54	41.81	243.55	6.53
0.46	1.52	93.24	-51.12	0.73	2.46	2.93	90.63	-46.24	2.68	4.46	1.46	46.35	347.74	4.15	6.46	1.89	63.48	42.49	5.25	8.46	1.59	41.48	246.80	6.55
0.48	1.61	91.92	-51.93	0.74	2.48	2.79	98.97	-23.45	2.72	4.48	1.61	41.35	382.74	4.15	6.48	1.71	59.26	44.93	5.25	8.48	1.62	42.15	247.61	6.57
0.50	1.64	92.92	-52.75	0.75	2.50	3.17	110.52	14.81	2.72	4.50	1.68	39.45	371.35	4.18	6.50	1.62	51.82	53.07	5.29	8.50	1.65	43.37	247.61	6.57
0.52	1.54	91.15	-53.57	0.77	2.52	3.37	110.63	-33.21	2.73	4.52	1.63	34.90	167.03	4.18	6.52	1.77	40.92	79.93	5.33	8.52	1.65	43.70	244.36	6.57
0.54	1.40	87.50	-55.19	0.79	2.54	3.21	111.84	-32.40	2.74	4.54	1.47	40.45	90.51	4.19	6.54	2.14	50.59	137.73	5.34	8.54	1.66	44.92	199.59	6.58
0.56	1.27	80.39	-55.19	0.80	2.56	2.98	113.51	-32.40	2.75	4.56	1.31	46.01	92.95	4.18	6.56	2.25	45.03	40.05	5.36	8.56	1.69	46.15	172.73	6.58
0.58	1.16	71.40	-55.19	0.83	2.58	2.69	117.84	-30.77	2.77	4.58	1.21	45.23	96.21	4.21	6.58	2.11	50.70	15.63	5.38	8.58	1.70	48.59	183.31	6.60
0.60	1.05	59.85	-56.82	0.82	2.60	2.60	123.28	-21.01	2.78	4.60	1.19	43.78	94.59	4.21	6.60	1.94	53.81	21.33	5.41	8.60	1.73	50.03	187.38	6.62
0.62	1.01	51.30	-56.82	0.83	2.62	2.58	118.83	5.86	2.82	4.62	1.20	44.78	119.82	4.22	6.62	1.71	64.25	24.58	5.42	8.62	1.78	51.92	188.19	6.62
0.64	0.95	44.75	-56.82	0.84	2.64	2.43	110.27	105.98	2.82	4.64	1.27	39.45	98.65	4.21	6.64	1.57	70.03	33.53	5.42	8.64	1.82	53.81	189.82	6.63
0.66	0.90	39.76	-57.63	0.84	2.66	2.21	105.93	114.12	2.83	4.66	1.40	37.55	76.67	4.22	6.66	1.50	66.48	41.67	5.45	8.66	1.85	56.15	191.45	6.64
0.68	0.88	34.32	-57.63	0.87	2.68	2.02	101.26	131.21	2.86	4.68	1.58	38.33	59.58	4.22	6.68	1.47	64.92	37.61	5.46	8.68	1.90	58.37	193.89	6.66
0.70	0.88	31.33	-58.45	0.88	2.70	1.92	98.03	145.05	2.86	4.70	1.79	42.33	64.47	4.23	6.70	1.42	64.59	35.16	5.47	8.70	1.95	58.81	197.15	6.67
0.72	0.85	31.56	-59.26	0.89	2.72	1.95	92.03	201.22	2.88	4.72	1.96	45.00	59.58	4.23	6.72	1.39	65.92	35.16	5.47	8.72	2.04	58.37	202.03	6.67
0.74	0.83	31.23	-59.26	0.89	2.74	2.15	90.92	310.29	2.90	4.74	1.99	50.44	48.19	4.23	6.74	1.34	64.92	53.89	5.50	8.74	2.11	59.25	203.66	6.70
0.76	0.81	31.68	-59.26	0.91	2.76	2.33	88.80	252.50	2.91	4.76	1.92	58.77	40.05	4.24	6.76	1.29	63.58	56.33	5.51	8.76	2.07	60.92	179.24	6.70
0.78	0.81	31.35	-59.26	0.93	2.78	2.24	82.80	92.14	2.92	4.78	1.81	65.44	43.30	4.26	6.78	1.28	62.14	57.95	5.55	8.78	1.96	62.14	82.37	6.72
0.80	0.83	30.14	-59.26	0.93	2.80	2.19	80.13	107.61	2.93	4.80	1.80	75.77	51.44	4.24	6.80	1.28	60.91	57.14	5.55	8.80	1.82	63.59	61.21	6.74
0.82	0.91	30.14	-60.07	0.97	2.82	2.04	76.57	119.01	2.96	4.82	1.87	79.77	74.23	4.26	6.82	1.27	58.69	58.77	5.56	8.82	1.70	65.25	62.03	6.74
0.84	1.09	30.15	-60.07	0.98	2.84	1.98	73.45	123.89	2.97	4.84	1.97	78.32	105.17	4.26	6.84	1.25	56.69	57.14	5.57	8.84	1.59	67.14	66.09	6.76
0.86	1.38	32.04	-59.26	1.00	2.86	1.92	74.67	107.61	2.99	4.86	2.01	77.54	123.07	4.26	6.86	1.25	54.80	56.33	5.59	8.86	1.50	66.59	88.89	6.76
0.88	1.62	35.38	-54.38	1.02	2.88	1.86	77.89	93.77	3.01	4.88	1.89	74.65	75.05	4.28	6.88	1.27	53.24	57.14	5.60	8.88	1.43	64.59	88.89	6.79
0.90	1.74	39.72	-54.38	1.02	2.90	1.86	81.34	92.14	3.00	4.90	1.71	71.32	37.61	4.30	6.90	1.29	52.57	57.95	5.60	8.90	1.36	62.03	89.70	6.80
0.92	1.81	47.28	-55.19	1.03	2.92	1.88	78.89	84.00	3.01	4.92	1.60	69.20	30.28	4.30	6.92	1.30	52.24	57.95	5.62	8.92	1.32	58.47	92.95	6.80
0.94	1.87	57.51	-54.38	1.05	2.94	1.85	77.44	88.07	3.04	4.94	1.66	69.53	35.16	4.31	6.94	1.37	51.57	57.14	5.64	8.94	1.28	55.58	94.59	6.81
0.96	1.93	69.84	-54.38	1.06	2.96	1.84	77.66	89.70	3.04	4.96	1.90	74.64	59.58	4.33	6.96	1.40	51.35	58.77	5.64	8.96	1.27	52.25	96.21	6.83
0.98	1.97	82.41	-54.38	1.09	2.98	1.83	80.77	103.54	3.05	4.98	1.86	77.08	110.05	4.33	6.98	1.41	51.35	58.77	5.65	8.98	1.23	49.91	95.40	6.83
1.00	1.99	94.52	-54.38	1.10	3.00	1.85	81.99	101.09	3.05	5.00	1.84	73.86	95.40	4.35	7.00	1.40	51.35	57.95	5.66	9.00	1.19	48.91	94.59	6.84
1.02	1.99	104.97	-54.38	1.11	3.02	1.87	81.99	101.09	3.06	5.02	1.83	74.97	78.31	4.36	7.02	1.39	52.24	57.95	5.66	9.02	1.13	47.91	92.95	6.85
1.04	1.95	113.53	-55.19	1.12	3.04	1.89	84.32	108.42	3.09	5.04	1.86	77.52	87.26	4.39	7.04	1.36	52.68	57.14	5.68	9.04	1.06	35.27	132.84	6.86
1.06	1.91	117.64	-56.82	1.14	3.06	1.84	83.43	108.42	3.10	5.06	1.90	78.96	100.28	4.40	7.06	1.39	45.48	104.35	5.68	9.06	1.01	35.05	134.47	6.86
1.08	1.86	117.31	-56.82	1.15	3.08	1.78	82.20	110.87	3.13	5.08	2.18	52.29	110.05	4.39	7.08	1.37	46.26	94.59	5.68	9.08	0.97	34.82	132.03	6.86
1.10	1.83	118.54	-55.19	1.18	3.10	1.73	80.20	114.12	3.14	5.10	2.19	61.29	79.12	4.39	7.10	1.35	47.59	92.14	5.70	9.10	0.94	34.27	130.40	6.88
1.12	1.71	129.37	-18.56	1.33	3.12	1.88	56.31	146.68	3.11	5.12	2.12	69.74	37.61	4.40	7.12	1.32	48.26	86.45	5.71	9.12	0.90	34.05	132.03	6.88
1.14	1.73	129.03	5.05	1.34	3.14	1.82	56.31	149.93	3.14	5.14	1.96	72.96	6.67	4.41	7.14	1.30	49.26	85.63	5.73	9.14	0.88	33.94	139.35	6.88
1.16	1.82	128.15	53.07	1.37	3.16	1.75	55.09	110.05	3.17	5.16	1.83	75.85	-5.54	4.41	7.16	1.29	50.82	85.63	5.74	9.16	0.86	31.83	151.57	6.89
1.18	1.91	126.92	55.51	1.38	3.18	1.68	54.31	100.28	3.18	5.18	1.71	83.74	-2.28	4.44	7.18	1.26	52.37	91.33	5.74	9.18	0.89	29.38	169.47	6.90
1.20	1.97	123.59	15.63	1.39	3.20	1.65	57.53	92.95	3.19	5.20	1.59	89.84	0.16	4.45	7.20	1.26	51.04	90.51	5.77	9.20	0.93	28.16	174.35	6.90
1.22	2.01	118.03	9.93	1.42	3.22	1.58	61.20	91.33	3.20	5.22	1.49	90.62	5.86	4.46	7.22	1.25	49.48	88.89	5.78	9.22	0.95	26.71	173.54	6.93
1.24	2.02	115.81	18.07	1.42	3.24	1.52	61.20	89.70	3.23	5.24	1.42	86.95	8.30	4.48	7.24	1.25	48.92	90.51	5.80	9.24	0.94	25.38	171.91	6.93
1.26	1.99	116.47	2.60	1.45	3.26	1.43	62.31	89.70	3.25	5.26	1.33	84.95	14.00	4.49	7.26	1.28	47.15	88.07	5.82	9.26	0.91	24.38	169.47	6.94
1.28	2.00	117.03	-25.89	1.46	3.28	1.41	62.86	100.28	3.28	5.28	1.29	79.51	28.65	4.49	7.28	1.26	46.48	89.70	5.83	9.28	0.89	24.27	166.21	6.96
1.30	1.97	118.69	-29.15	1.46	3.30	1.43	61.31	107.61	3.30	5.30	1.30	69.28	57.95	4.51	7.30	1.26	45.59	88.07	5.85	9.30	0.86	24.05	167.03	6.96
1.32	1.76	113.45	-37.29	1.91	3.32	1.45	58.97	124.70	3.32	5.32	1.63	55.52	43.30	4.50	7.32	1.29	45.26	89.70	5.87	9.32	0.84	24.16	167.85	6.99
1.34	1.67	119.56	1.79	1.91	3.34	1.43	55.19	132.03	3.33	5.34	1.55	55.63	47.37	4.51	7.34	1.32	45.92	92.95	5.88	9.34	0.84	23.83	167.85	7.00
1.36	1.62	122.22	10.74	1.91	3.36	1.45	53.31	144.24	3.36	5.36	1.51	53.85	65.28	4.51	7.36	1.35	45.59	90.51	5.90	9.36	0.81	23.60	167.85	7.02
1.38	1.58	124.89	28.65	1.92	3.38	1.42	50.64	148.31	3.36	5.38	1.73	53.29	129.59	4.53	7.38	1.37	45.92	91.33	5.91	9.38	0.78	23.49	166.21	7.03
1.40	1.50	127.55	32.72	1.93	3.40	1.41	45.75	158.07	3.38	5.40	1.89	53.07	110.87	4.55	7.40	1.41	46.25	92.14	5.92	9.40	0.79	22.83	166.21	7.04
1.42	1.46	131.55	30.28	1.94	3.42	1.46	44.08	159.71	3.41	5.42	2.09	52.63	40.05	4.55	7.42	1.47	46.48	93.77	5.94	9.42	0.84	21.27	171.91	7.05
1.44	1.44	126.44	24.58	1.95	3.44	1.45	45.30	171.10	3.42	5.44	2.08	52.41	35.16	4.59	7.44	1.52	47.37	95.40	5.96	9.44	0.93	18.50	178.43	7.05
1.46	1.39	120.77	14.00	1.97	3.46	1.30	42.30	137.73	3.45	5.46	1.94	55.96	31.91	4.59	7.46	1.54	48.59	94.59	5.97	9.46	1.11	17.50	193.89	7.08
1.48	1.44	110.43	19.69	1.97	3.48	1.25	41.74	143.43	3.47	5.48	1.91	58.40	33.53	4.61	7.48	1.55	50.36	96.21	5.98	9.48	1.26	17.72	178.43	7.09
1.50	1.56	99.99	31.09	1.98	3.50	1.25	44.18	151.57	3.47	5.50	2.02	59.84	40.86	4.63	7.50	1.57	51.14	97.84	5.99	9.50	1.31	19.16	109.23	7.12
1.52	1.74	93.21	41.67	2.00	3.52	1.16	47.85	158.07	3.49	5.52	2.13	63.73	34.35	4.63	7.52	1.64	52.25	97.84	6.02	9.52	1.40	21.05	112.49	7.13
1.54	1.90	91.54	43.30	2.01	3.54	1.13	47.07	139.35	3.51	5.54	2.15	66.40	19.69	4.64	7.54	1.66	54.70	98.65	6.03	9.54	1.74	22.16	145.05	7.14
1.56	2.09	82.75	41.67	2.02	3.56	1.08	45.29	115.75	3.53	5.56	1.96	67.29	7.49	4.65	7.56	1.70	56.03	101.09	6.04	9.56	2.42	23.50	168.66	7.17
1.58	2.23	81.87	40.86	2.03	3.58	1.04	43.62	113.31	3.54	5.58	1.67	68.95	4.23	4.68	7.58	1.73	56.70	101.91	6.05	9.58	3.26	32.39	42.49	7.18
1.60	2.49	82.20	40.86	2.05	3.60	1.04	43.62	127.15	3.56	5.60	1.51	64.06	9.93	4.69	7.60	1.81	57.47	103.54	6.08	9.60	3.40	37.83	7.49	7.21
1.62	2.83	81.86	41.67	2.07	3.62	1.11	41.51	147.49	3.58	5.62	1.49	62.39	53.89	4.72	7.62	1.80	59.69	105.98	6.09	9.62	3.20	39.61	-5.54	7.22
1.64	3.40	84.31	41.67	2.06	3.64	1.12	38.40	153.19	3.59	5.64	1.54	57.95	153.19	4.72	7.64	1.84	59.14	107.61	6.10	9.64	3.13	40.39	-11.23	7.22
1.66	3.95	81.64	40.05	2.08	3.66	1.13	35.18	122.26	3.60	5.66	1.43	58.50	197.15	4.74	7.66	1.83	59.14	107.61	6.11	9.66	3.01	46.28	-12.05	7.23
1.68	4.34	74.96	40.05	2.08	3.68	1.16	35.95	114.93	3.60	5.68	1.36	56.16	165.40	4.74	7.68	1.83	60.91	113.31	6.11	9.68	3.32	51.06	-11.23	7.25
1.70	4.61	68.41	40.86	2.10	3.70	1.22	39.28	118.19	3.64	5.70	1.26	52.39	163.77	4.77	7.70	1.84	62.25	115.75	6.14	9.70	4.37	54.84	-12.05	7.27
1.72	4.63	65.52	40.05	2.12	3.72	1.24	41.73	121.45	3.64	5.72	1.28	51.16	206.91	4.77	7.72	1.89	61.47	101.91	6.14	9.72	5.67	54.95	-11.23	7.30
1.74	4.50	62.41	39.23	2.13	3.74	1.25	41.50	26.21	3.67	5.74	1.25	50.50	224.01	4.78	7.74	1.83	61.58	101.91	6.16	9.74	6.85	52.50	-11.23	7.32
1.76	4.31	63.40	38.42	2.15	3.76	1.27	41.72	5.86	3.67	5.76	1.23	48.94	227.27	4.81	7.76	1.88	61.24	102.73	6.17	9.76	8.83	51.06	-7.17	7.34
1.78	4.14	68.07	35.97	2.17	3.78	1.27	45.39	12.37	3.68	5.78	1.23	46.83	230.52	4.81	7.78	1.90	62.35	102.73	6.18	9.78	10.70	52.50	-5.54	7.34
1.80	3.91	77.62	35.16	2.18	3.80	1.27	51.28	35.97	3.69	5.80	1.37	44.38	249.25	4.83	7.80	1.83	63.91	98.65	6.20	9.80	12.19	37.28	5.86	7.30
1.82	3.37	84.29	33.53	2.19	3.82	1.25	53.05	48.19	3.72	5.82	1.50	43.16	263.08	4.83	7.82	1.81	62.02	97.03	6.21	9.82	13.79	33.39	14.00	7.23
1.84	2.84	103.29	30.28	2.22	3.84	1.23	54.05	49.81	3.74	5.84	1.56	43.71	202.85	4.86	7.84	1.80	61.24	94.59	6.23	9.84	14.71	36.73	16.44	7.22
1.86	2.42	111.73	28.65	2.22	3.86	1.19	55.17	52.25	3.74	5.86	1.59	44.05	176.80	4.86	7.86	1.76	62.46	91.33	6.24	9.86	14.79	35.39	18.07	7.24
1.88	2.24	117.17	28.65	2.25	3.88	1.24	56.05	72.61	3.77	5.88	1.54	45.49	132.03	4.88	7.88	1.71	63.02	93.77	6.25	9.88	15.35	41.28	22.95	7.22
1.90	2.41	116.61	29.47	2.27	3.90	1.27	53.05	74.23	3.78	5.90	1.56	47.04	100.28	4.88	7.90	1.69	63.57	98.65	6.26	9.90	14.85	30.28	29.47	7.14
1.92	3.02	111.61	40.05	2.27	3.92	1.30	50.16	79.12	3.79	5.92	1.60	50.71	90.51	4.91	7.92	1.70	62.69	100.28	6.28	9.92	15.08	36.50	37.61	7.06
1.94	3.65	104.38	33.53	2.31	3.94	1.39	47.60	85.63	3.81	5.94	1.60	56.15	93.77	4.91	7.94	1.70	61.79	102.73	6.28	9.94	13.94	32.61	29.47	6.96
1.96	4.03	87.71	32.72	2.32	3.96	1.44	45.60	84.00	3.83	5.96	1.58	59.15	94.59	4.93	7.96	1.70	61.02	102.73	6.30	9.96	12.02	43.94	19.69	6.94
1.98	4.44	76.71	33.53	2.33	3.98	1.42	44.82	36.79	3.86	5.98	1.49	61.15	90.51	4.95	7.98	1.68	59.57	104.35	6.32	9.98	9.48	81.82	13.19	6.93
2.00	5.25	72.26	33.53	2.34	4.00	1.40	45.93	31.91	3.87	6.00	1.44	62.48	84.81	4.96	8.00	1.68	57.35	104.35	6.32	10.00	8.66	92.93	13.19	6.93

Il Direttore Tecnico SOA:
p.i. Riccardo Mazza

Il Responsabile Prove in Sito:
dott. Massimo Romagnoli

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P IVA e Codice Fiscale n. 00174600387
@ Laboratorio Geotecnico autorizzato con Dec. n. 6572 del 07/10/2014, art. 59 del D.P.R. 380/2001, Circolari Ministeriali 7618/STC

COMMITTENTE: **RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO**
CANTIERE: Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e I

PROVA N°: SCPTU 2 PROF. FALDA (m da p.c.): N.D. PUNTA: Tecnopenta G1-CPL2IN (matr. 111010)[a = 0.66]
DATA: 19/02/19 PREFORO (m da p.c.): LAT. (WGS 84): 44.321911°
COMMESSA: 18388/18 C. SITO N°: S190305 del 28.02.19 LONG. (WGS 84): 11.808814°

prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi	prof. m	qc Mpa	fs kPa	U kPa	incl. gradi
10.02	8.36	87.48	14.81	6.93	12.02	3.03	53.05	55.51	7.61															
10.04	8.35	71.02	22.14	6.95	12.04	4.14	65.97	-16.93	7.67															
10.06	9.02	64.58	23.77	6.94	12.06	4.54	81.41	-23.45	7.69															
10.08	10.53	59.12	20.51	6.97	12.08	5.59	94.75	-25.07	7.71															
10.10	12.09	66.11	-15.31	7.04	12.10	7.18	103.30	-32.40	7.72															
10.12	12.05	76.33	-24.26	7.05	12.12	8.39	100.30	-34.84	7.73															
10.14	12.00	69.55	-24.26	7.06	12.14	8.74	98.52	-34.03	7.74															
10.16	11.49	66.43	-25.89	7.07	12.16	7.94	51.30	-6.35	7.75															
10.18	11.26	67.76	-26.70	7.08	12.18	7.43	47.96	-26.70	7.78															
10.20	11.06	71.21	-26.70	7.09	12.20	6.79	44.73	-37.29	7.79															
10.22	11.24	70.09	-23.45	7.12	12.22	6.17	42.18	-36.47	7.80															
10.24	11.91	57.87	-20.19	7.15	12.24	5.48	40.40	-35.65	7.81															
10.26	11.99	36.64	-17.75	7.16	12.26	4.67	39.73	-35.65	7.83															
10.28	13.61	40.53	-7.17	7.13	12.28	3.95	41.39	-34.84	7.83															
10.30	13.21	56.20	-8.79	7.20	12.30	3.35	44.61	-27.51	7.85															
10.32	14.47	38.23	10.74	7.34	12.32	2.94	48.28	-8.79	7.89															
10.34	12.81	54.78	2.60	7.23	12.34	2.73	57.83	23.77	7.89															
10.36	12.93	53.89	4.23	7.24	12.36	2.66	67.05	140.98	7.93															
10.38	12.74	43.01	3.41	7.24	12.38	2.66	70.38	378.67	7.93															
10.40	12.79	32.56	6.67	7.30	12.40	2.76	66.83	86.45	7.94															
10.42	11.68	28.11	0.16	7.27	12.42	2.60	68.05	74.23	7.94															
10.44	12.09	40.34	3.41	7.30	12.44	2.48	65.49	111.68	7.96															
10.46	12.57	39.56	5.86	7.32	12.46	2.95	62.48	252.50	7.98															
10.48	13.34	42.11	10.74	7.37	12.48	4.14	67.37	101.91	7.99															
10.50	12.80	34.67	8.30	7.45	12.50	4.48	61.70	-19.37	8.01															
10.52	12.71	39.45	9.11	7.44	12.52	4.25	52.03	-23.45	8.01															
10.54	11.69	30.34	5.86	7.41	12.54	3.90	50.03	-21.82	8.03															
10.56	10.65	35.00	4.23	7.35	12.56	3.88	57.92	-20.19	8.06															
10.58	8.66	28.44	-1.47	7.40	12.58	4.06	70.47	-19.37	8.06															
10.60	7.66	29.11	1.79	7.40	12.60	4.39	78.81	-21.01	8.06															
10.62	5.94	28.88	-3.91	7.37	12.62	4.65	87.92	-22.63	8.08															
10.64	4.01	41.21	-7.98	7.38	12.64	4.92	84.80	-22.63	8.08															
10.66	2.84	77.66	-10.42	7.40	12.66	5.70	79.02	-18.56	8.11															
10.68	2.33	106.32	44.93	7.41	12.68	7.74	74.14	-8.79	8.12															
10.70	1.83	126.10	119.01	7.42	12.70	9.49	64.69	-7.98	8.14															
10.72	1.69	125.99	210.99	7.45	12.72	9.54	64.02	-13.68	8.13															
10.74	1.64	113.54	218.31	7.47	12.74	9.02	62.47	-17.75	8.14															
10.76	1.59	108.21	231.33	7.47	12.76	8.39	59.25	-21.01	8.16															
10.78	1.51	95.20	206.91	7.49	12.78	7.51	52.58	-22.63	8.17															
10.80	1.50	78.75	189.01	7.52	12.80	6.53	48.69	-23.45	8.18															
10.82	1.53	54.85	158.07	7.53	12.82	5.92	51.24	-23.45	8.20															
10.84	1.50	40.52	154.82	7.56	12.84	6.35	53.13	-16.93	8.23															
10.86	1.45	37.41	209.36	7.56	12.86	7.45	66.69	-14.49	8.24															
10.88	1.45	38.07	215.87	7.57	12.88	8.40	76.13	-14.49	8.25															
10.90	1.46	36.85	224.01	7.56	12.90	8.97	81.24	-16.12	8.26															
10.92	1.51	36.30	207.73	7.58	12.92	8.93	87.91	-17.75	8.27															
10.94	1.50	36.41	226.45	7.59	12.94	8.41	92.46	-21.82	8.28															
10.96	1.50	37.08	191.45	7.59	12.96	7.51	77.68	-24.26	8.29															
10.98	1.47	37.63	177.61	7.59	12.98	6.29	65.90	-26.70	8.31															
11.00	1.47	38.63	197.15	7.59	13.00	5.24	67.12	-27.51	8.32															
11.02	1.50	39.30	178.43	7.59	13.02	5.62	70.68	-2.28	8.33															
11.04	1.59	31.80	178.43	7.58	13.04	6.99	98.02	8.30	8.33															
11.06	1.57	33.47	187.38	7.58	13.06	8.62	115.91	-17.75	8.34															
11.08	1.58	34.14	158.07	7.56	13.08	9.46	118.13	-29.96	8.35															
11.10	1.58	36.03	136.10	7.56	13.10	9.60	110.91	-31.59	8.37															
11.12	1.52	37.25	147.49	7.54	13.12	9.37	103.46	-32.40	8.37															
11.14	1.47	37.92	132.84	7.53	13.14	9.28	91.57	-32.40	8.38															
11.16	1.46	38.14	134.47	7.52	13.16	10.71	89.67	-28.33	8.40															
11.18	1.42	39.14	135.29	7.52	13.18	12.21	93.12	-26.70	8.42															
11.20	1.40	37.92	135.29	7.50	13.20	12.83	91.00	-26.70	8.43															
11.22	1.37	37.70	124.70	7.50	13.22	12.73	92.44	-29.15	8.45															
11.24	1.34	37.59	120.63	7.49	13.24	12.48	91.33	-29.96	8.46															
11.26	1.30	37.03	123.07	7.49	13.26	12.39	88.21	-29.15	8.49															
11.28	1.27	36.25	125.51	7.48	13.28	13.17	82.55	-24.26	8.49															
11.30	1.24	35.92	128.77	7.48	13.30	15.46	69.21	-18.56	8.50															
11.32	1.24	35.92	135.29	7.48	13.32	19.08	73.32	-9.61	8.47															
11.34	1.24	37.14	140.98	7.48	13.34	22.95	58.47	-11.23	8.53															
11.36	1.24	37.59	145.05	7.50	13.36	27.74	63.03	-11.23	8.62															
11.38	1.24	37.25	148.31	7.49	13.38	31.02	65.14	13.19	8.64															
11.40	1.25	37.70	154.01	7.51																				
11.42	1.27	36.47	157.26	7.51																				
11.44	1.27	35.14	159.71	7.50																				
11.46	1.25	33.92	156.45	7.49																				
11.48	1.24	33.48	156.45	7.49																				
11.50	1.23	33.37	162.96	7.49																				
11.52	1.22	32.81	169.47	7.49																				
11.54	1.20	32.03	177.61	7.50																				
11.56	1.20	31.48	180.05	7.49																				
11.58	1.19	31.48	182.49	7.49																				
11.60	1.18	31.03	195.52	7.48																				
11.62	1.17	29.92	206.10	7.50																				
11.64	1.18	29.15	215.87	7.50																				
11.66	1.19	28.70	224.01	7.49																				
11.68	1.22	28.48	233.78	7.51																				
11.70	1.25	28.04	241.11	7.51																				
11.72	1.26	27.48	249.25	7.51																				
11.74	1.29	27.26	247.61	7.52																				
11.76	1.30	26.82	241.92	7.52																				
11.78	1.31	27.15	237.03	7.51																				
11.80	1.34	26.71	237.03	7.53																				
11.82	1.36	26.27	237.03	7.51																				
11.84	1.41	26.16	241.92	7.52																				
11.86	1.47	25.93	239.47	7.53																				
11.88	1.59	25.49	232.15	7.52																				
11.90	1.71	25.60	225.64	7.53																				
11.92	1.82	29.16	219.13	7.54																				
11.94	2.02	35.49	241.92	7.55																				
11.96	2.38	39.05	269.59	7.55																				
11.98	2.64	40.38	181.68	7.59																				
12.00	2.78	46.72	65.28	7.59																				

Il Direttore Tecnico SOA:
p.i. Riccardo Mazza

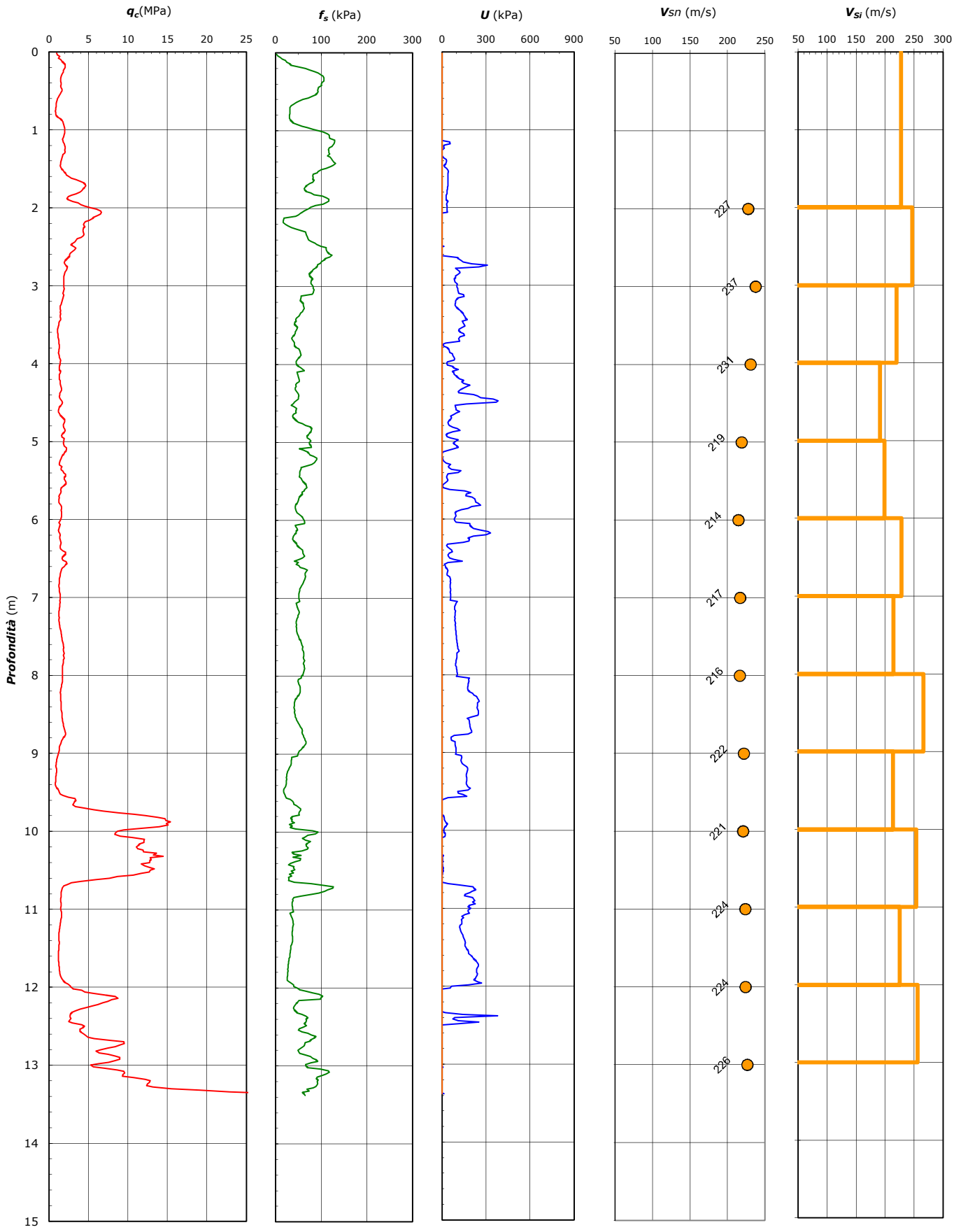
Il Responsabile Prove in Sito:
dott. Massimo Romagnoli

elletipi s.r.l.
Sede operativa ed amm.va: Via Annibale Zucchini, 69 - 44100 FERRARA
tel. 0532/56771; fax 0532/56119 e-mail: info@elletipi.it sito: www.elletipi.it
P IVA e Codice Fiscale n. 00174600387

@ Laboratorio Geotecnico autorizzato con Dec. n. 6572 del 07/10/2014, art. 59 del D.P.R. 380/2001, Circolari Ministeriali 7618/STC

COMMITTENTE: **RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO**
CANTIERE: Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e I

PROVA N°: SCPTU 2 PROF. FALDA (m da p.c.): N.D. PUNTA: Tecnopenta G1-CPL2IN (matr. 111010)[a = 0.66]
DATA: 19/02/19 PREFORO (m da p.c.): LAT. (WGS 84): 44.321911°
COMMESSA: 18388/18 C. SITO N°: S190305 del 28.02.19 LONG. (WGS 84): 11.808814°



Il Direttore Tecnico SOA:
p.i. Riccardo Mazza

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COMMITTENTE: **RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO**
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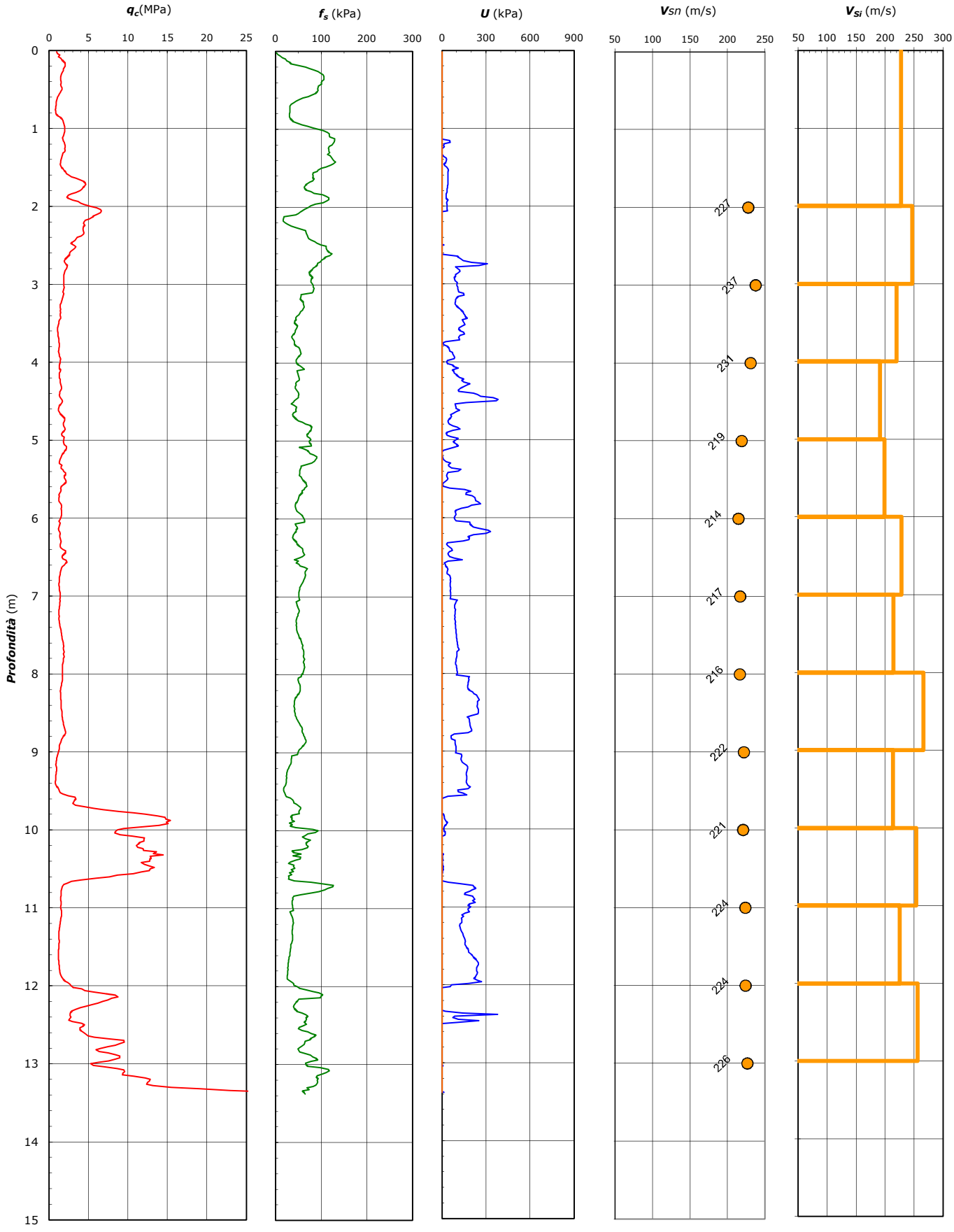
COMMESSA: 18388/18 C. SITO N°: S190305 del 28.02.19 LONG. (WGS 84): 11.808814°



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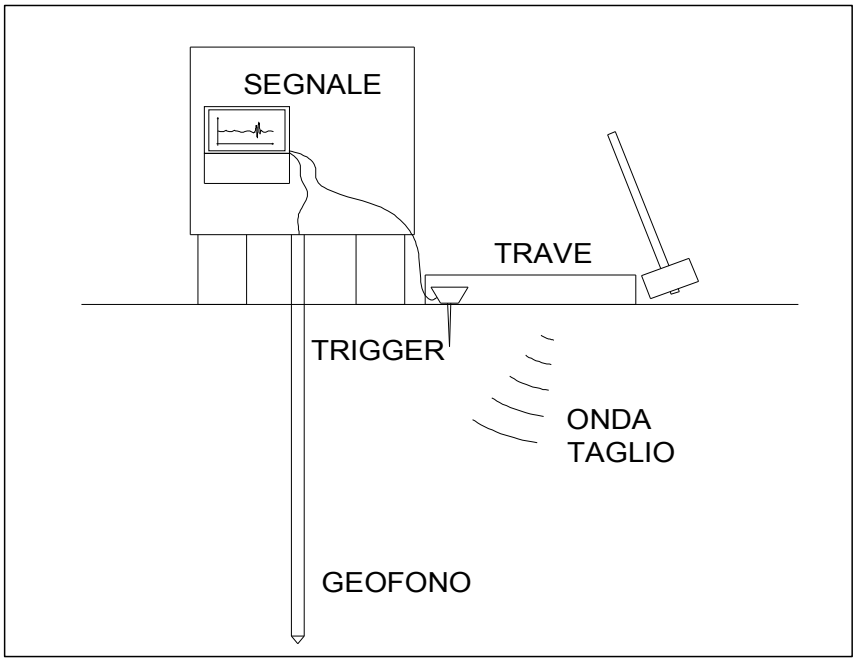
COMMITTENTE: **RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO**
CANTIERE: Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e I

PROVA N°: SCPTU 2 PROF. FALDA (m da p.c.): N.D. PUNTA: Tecnopenta G1-CPL2IN (matr. 111010)[a = 0.66]
DATA: 19/02/19 PREFORO (m da p.c.): LAT. (WGS 84): 44.321911°
COMMESSA: 18388/18 C. SITO N°: S190305 del 28.02.19 LONG. (WGS 84): 11.808814°

Prova Down Hole ASTM D 7400



Profondità (m)	Ts (ms)	L (m)	Vs (m/s)	Vis (m/s)
1.0	T0	1.41	-	-
2.0	3.61	2.24	227	227
3.0	7.36	3.16	237	247
4.0	11.74	4.12	231	220
5.0	16.84	5.10	219	191
6.0	21.78	6.08	214	199
7.0	26.11	7.07	217	228
8.0	30.74	8.06	216	214
9.0	34.47	9.06	222	266
10.0	39.13	10.05	221	213
11.0	43.05	11.05	224	254
12.0	47.48	12.04	224	225
13.0	51.38	13.04	226	256

D = Distanza centro trave generatrice ond
Profondità = Profondità punta da piano campagna
Ts = Tempo percorrenza onda di taglio
L = Lunghezza percorso onda di taglio
Vs = Velocità onde di taglio da piano campagna alla profondità indic = 1.00 m
Vis = Velocità onde di taglio nello strato di terreno compreso fra le due profondità indicate

Il Direttore Tecnico SOA:
p.i. Riccardo Mazza

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tel. 035 303120 - fax 035 290388 -
Email: ismgeo@ismgeo.it

PROVA DI COLONNA RISONANTE
Foglio 1

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Angeloni	Saccenti

Normativa di riferimento: ASTM D4015/95

N° certificato di prova:

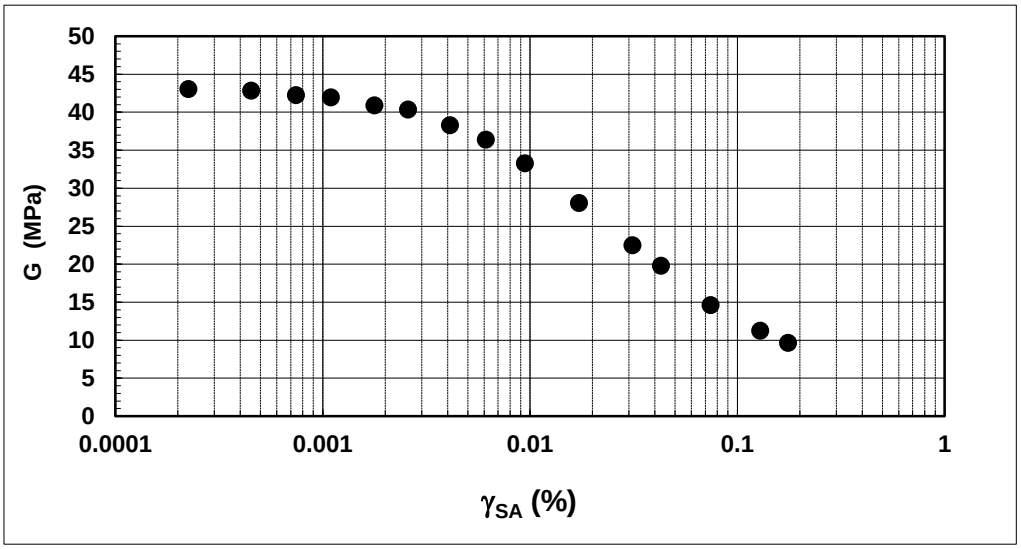
N° verbale di accettazione: 005/2019

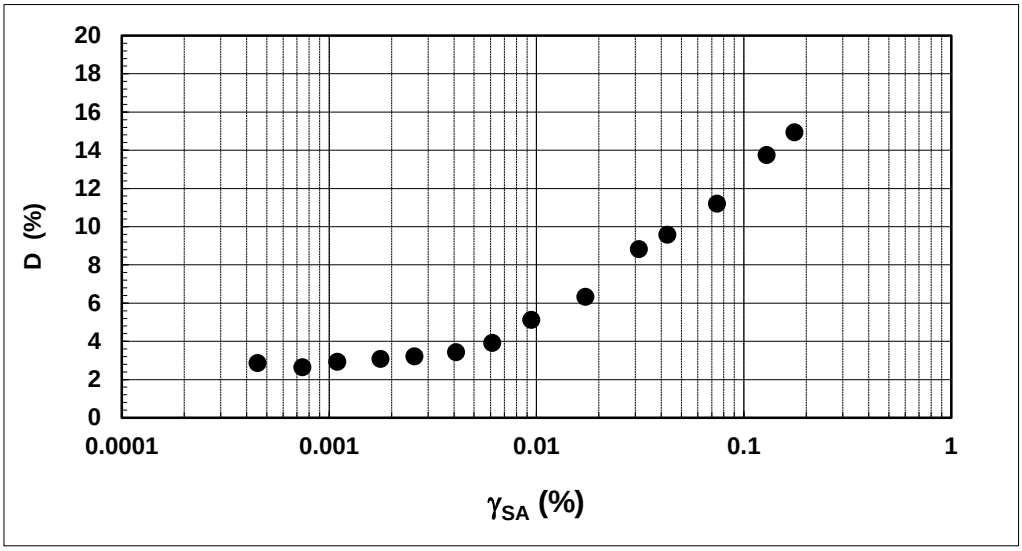
Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**C ASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI1**
Profondità prova [m]:	**3.35 - 3.45**
Prova:	**RC**
Provino:	**1**
Data prova:	**24/01/2019**

Dati generali dei provini

Dati iniziali					Dati a fine consolidazione										
Φ	H	γ_w	w	e	σ'_a	σ'_r	K	B.P.	B	D	H	γ_w	w	e	S
mm	mm	kN/m^3	%	-	kPa	kPa	-	kPa	-	mm	mm	kN/m^3	%	-	%
50.00	102.00	16.90	21.8	0.910	**45**	**45**	1.0	300.0	0.95	50.0	101.9	18.13	30.4	0.905	91

Informazioni generali	
tipo di provino	**INDISTURBATO**
metodo di preparazione	**FUSTELLAZIONE**
superfice di appoggio	**PIETRA POROSA**
eccitazione	**TORSIONALE**
peso specifico (-)	**2.700**





Legenda:

Φ = diametro del provino
H = altezza del provino
γ_w = peso di volume umido
w = contenuto d'acqua
e = indice dei vuoti
σ' =tensioni efficaci
K = σ_r / σ_a
B.P. = back pressure
B = coefficiente di Skempton
G = Modulo di taglio
γ_{SA} = def.di taglio in singola ampiezza
D = Rapporto di smorzamento di taglio
Subscritto 'a' = assiale
Subscritto 'r' = radiale
S = grado di saturazione

Note:

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PROVA DI COLONNA RISONANTE
Foglio 2

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Angeloni	Saccenti

Normativa di riferimento: ASTM D4015/95

N° certificato di prova:

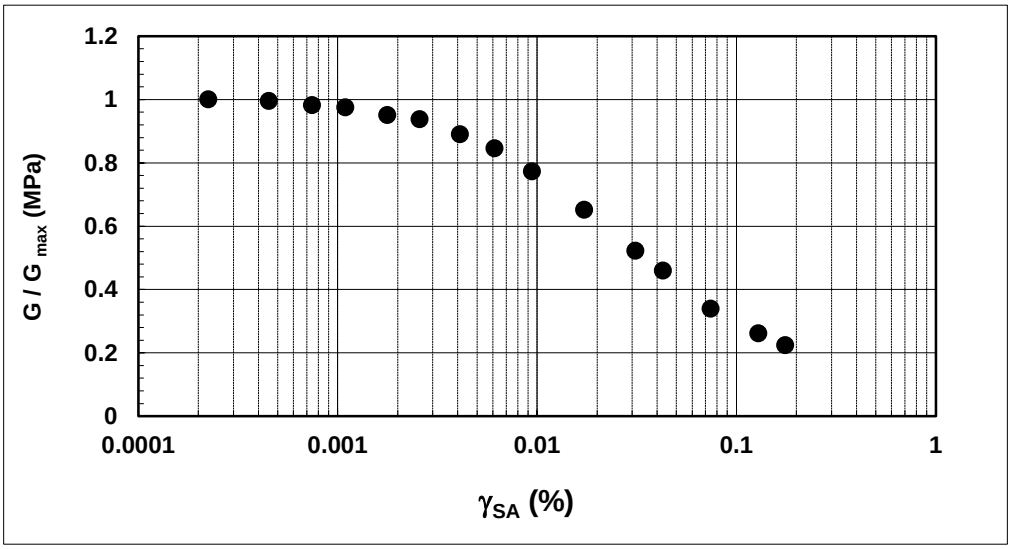
N° verbale di accettazione: 005/2019

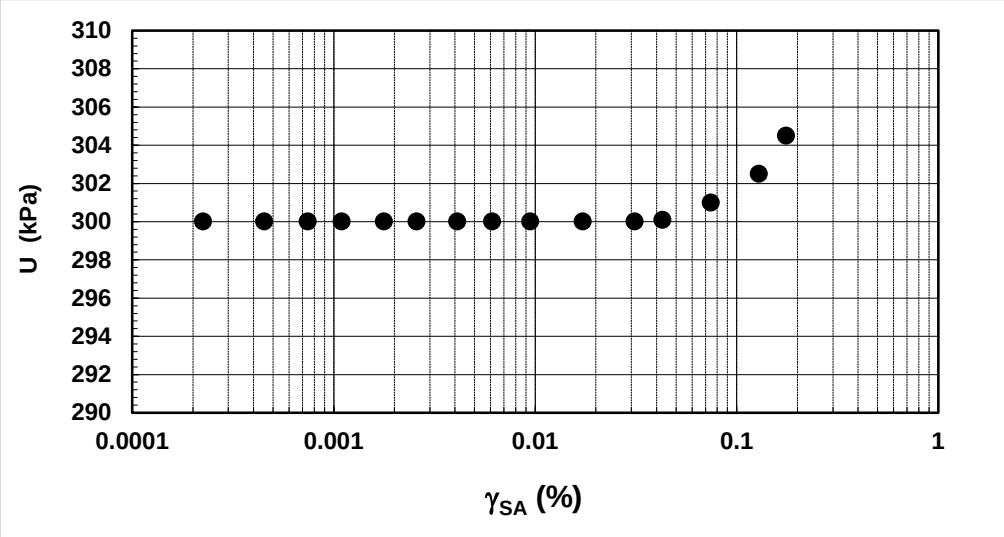
Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**C ASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI1**
Profondità prova [m]:	**3.35 - 3.45**
Prova:	**RC**
Provino:	**1**
Data prova:	**24/01/2019**

Dati generali dei provini

Dati iniziali					Dati a fine consolidazione										
Φ	H	γ_w	w	e	σ'_a	σ'_r	K	B.P.	B	D	H	γ_w	w	e	S
mm	mm	kN/m^3	%	-	kPa	kPa	-	kPa	-	mm	mm	kN/m^3	%	-	%
50.00	102.00	16.90	21.8	0.910	**45**	**45**	1.0	300.0	0.95	50.0	101.9	18.13	30.4	0.9	91

Informazioni generali	
tipo di provino	**INDISTURBATO**
metodo di preparazione	**FUSTELLAZIONE**
superfice di appoggio	**PIETRA POROSA**
eccitazione	**TORSIONALE**
peso specifico	**2.700**





Legenda:

Φ = diametro del provino
H = altezza del provino
γ_w = peso di volume umido
w = contenuto d'acqua
e = indice dei vuoti
σ' =tensioni efficaci
K = σ_r / σ_a
B.P. = back pressure
B = coefficiente di Skempton
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γ_{SA} = def.di taglio in singola ampiezza
D = Rapporto di smorzamento di taglio
Subscritto 'a' = assiale
Subscritto 'r' = radiale
S = grado di saturazione

Note:

Via Pastrengo, 9 - 24068 Seriate (Bg) -
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PROVA DI COLONNA RISONANTE
Foglio 3

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Angeloni	Saccenti

Normativa di riferimento: ASTM D4015/95

N° certificato di prova:

N° verbale di accettazione: 005/2019

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**C ASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI1**
Profondità prova [m]:	**3.35 - 3.45**
Prova:	**RC**
Provino:	**1**
Data prova:	**24/01/2019**

Dati generali dei provini

Dati iniziali					Dati di prova									
Φ	H	γ_w	w	e	σ'_a	σ'_r	K	B.P.	B	D	H	γ_w	w	e
mm	mm	kN/m^3	%	-	kPa	kPa	-	kPa	-	mm	mm	kN/m^3	%	-
50.00	102.00	16.90	21.8	0.910	**45**	**45**	1.0	300.0	0.95	50.0	101.9	18.13	30.4	0.905

Informazioni generali	
tipo di provino	**INDISTURBATO**
metodo di preparazione	**FUSTELLAZIONE**
superfice di appoggio	**PIETRA POROSA**
eccitazione	**TORSIONALE**

Valori numerici

G	G/G_{MAX}	γ	D	U
(MPa)	(-)	(%)	(%)	(kPa)
43.01	1.000	0.00022		300.0
42.82	0.996	0.00045	2.85	300.0
42.24	0.982	0.00074	2.64	300.0
41.94	0.975	0.00109	2.92	300.0
40.87	0.950	0.00177	3.08	300.0
40.32	0.937	0.00258	3.21	300.0
38.27	0.890	0.00410	3.43	300.0
36.36	0.845	0.00612	3.91	300.0
33.26	0.773	0.00944	5.11	300.0
28.02	0.652	0.01725	6.32	300.0
22.47	0.522	0.03119	8.81	300.0
19.77	0.460	0.04278	9.58	300.1
14.61	0.340	0.07444	11.20	301.0
11.24	0.261	0.12898	13.75	302.5
9.62	0.224	0.17592	14.94	304.5

Legenda:

Φ = diametro del provino

H = altezza del provino
γ_w = peso di volume umido
w = contenuto d'acqua
e = indice dei vuoti
σ' =tensioni efficaci
K = σ_r / σ_a
B.P. = back pressure
B = coefficiente di Skempton
G = Modulo di taglio
γ_{SA} = def.di taglio in singola ampiezza
D = Rapporto di smorzamento di taglio
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Subscritto 'r' = radiale

Note:

Via Pastrengo, 9 - 24068 Seriate (Bg) -
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Email: ismgeo@ismgeo.it

PROVA DI COLONNA RISONANTE
Foglio 1

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Angeloni	Saccenti

Normativa di riferimento: ASTM D4015/95

N° certificato di prova:

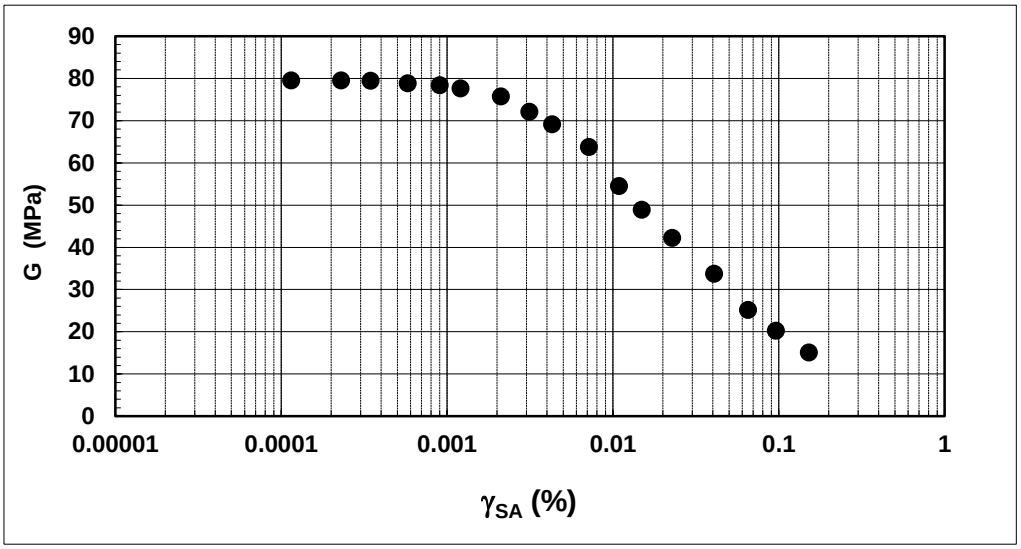
N° verbale di accettazione: 005/2019

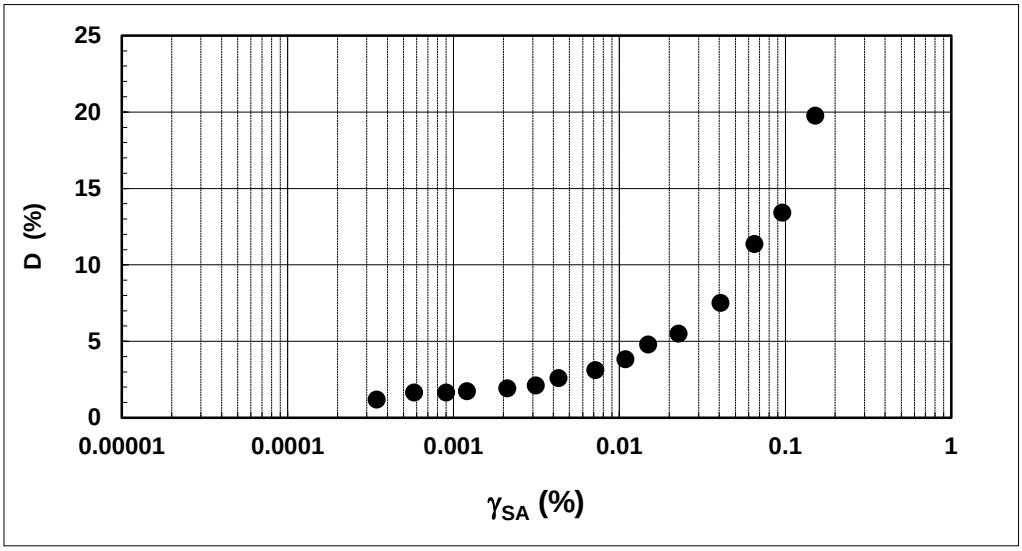
Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**C ASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI2**
Profondità prova [m]:	**6.60 - 6.70**
Prova:	**RC**
Provino:	**1**
Data prova:	**24/01/2019**

Dati generali dei provini

Dati iniziali					Dati a fine consolidazione										
Φ	H	γ_w	w	e	σ'_a	σ'_r	K	B.P.	B	D	H	γ_w	w	e	S
mm	mm	kN/m^3	%	-	kPa	kPa	-	kPa	-	mm	mm	kN/m^3	%	-	%
50.00	99.00	19.89	19.3	0.589	**70**	**70**	1.0	300.0	0.95	50.1	98.4	20.15	20.7	0.586	95

Informazioni generali	
tipo di provino	**INDISTURBATO**
metodo di preparazione	**FUSTELLAZIONE**
superfice di appoggio	**PIETRA POROSA**
eccitazione	**TORSIONALE**
peso specifico (-)	**2.700**





Legenda:

Φ = diametro del provino
H = altezza del provino
γ_w = peso di volume umido
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Subscritto 'a' = assiale
Subscritto 'r' = radiale
S = grado di saturazione

Note:

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Email: ismgeo@ismgeo.it

PROVA DI COLONNA RISONANTE
Foglio 2

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Angeloni	Saccenti

Normativa di riferimento: ASTM D4015/95

N° certificato di prova:

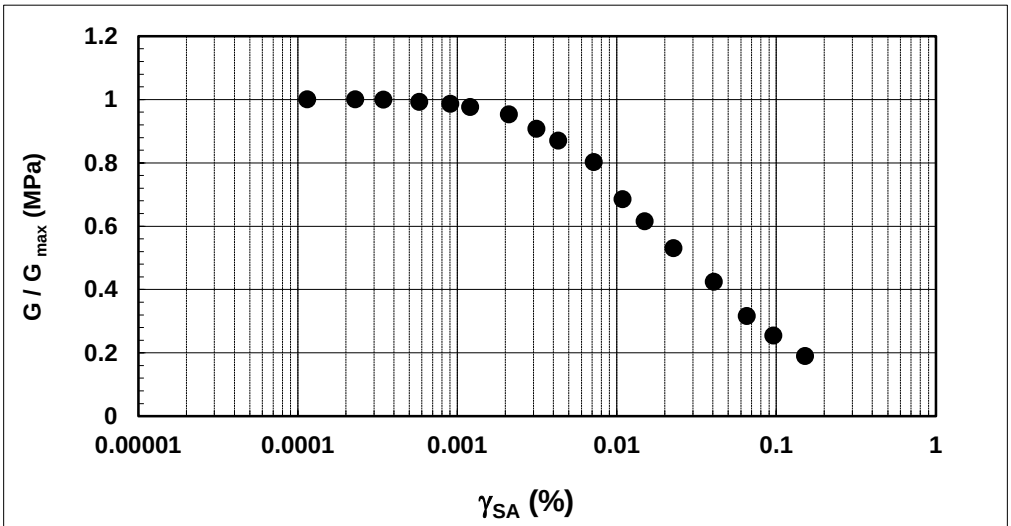
N° verbale di accettazione: *005/2019*

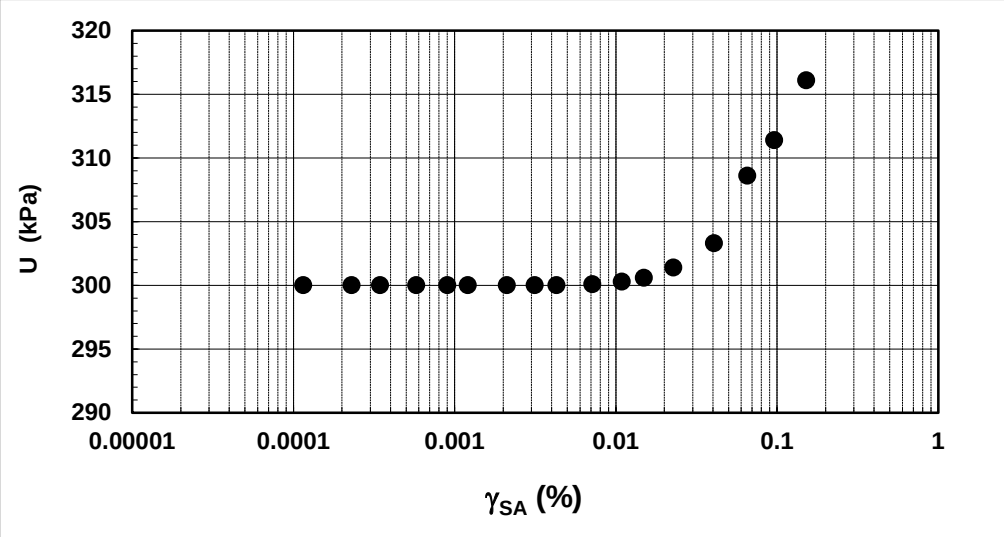
Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**C ASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI2**
Profondità prova [m]:	**6.60 - 6.70**
Prova:	**RC**
Provino:	**1**
Data prova:	**24/01/2019**

Dati generali dei provini

Dati iniziali					Dati a fine consolidazione										
Φ	H	γ_w	w	e	σ'_a	σ'_r	K	B.P.	B	D	H	γ_w	w	e	S
mm	mm	kN/m^3	%	-	kPa	kPa	-	kPa	-	mm	mm	kN/m^3	%	-	%
50.00	99.00	19.89	19.3	0.589	**70**	**70**	1.0	300.0	0.95	50.1	98.4	20.15	20.7	0.6	95

Informazioni generali	
tipo di provino	**INDISTURBATO**
metodo di preparazione	**FUSTELLAZIONE**
superfice di appoggio	**PIETRA POROSA**
eccitazione	**TORSIONALE**
peso specifico	**2.700**





Legenda:

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H = altezza del provino
γ_w = peso di volume umido
w = contenuto d'acqua
e = indice dei vuoti
σ' =tensioni efficaci
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B = coefficiente di Skempton
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Subscritto 'a' = assiale
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S = grado di saturazione

Note:

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PROVA DI COLONNA RISONANTE
Foglio 3

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Angeloni	Saccenti

Normativa di riferimento: ASTM D4015/95

N° certificato di prova:

N° verbale di accettazione: 005/2019

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**C ASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI2**
Profondità prova [m]:	**6.60 - 6.70**
Prova:	**RC**
Provino:	**1**
Data prova:	**24/01/2019**

Dati generali dei provini

Dati iniziali					Dati di prova									
Φ	H	γ_w	w	e	σ'_a	σ'_r	K	B.P.	B	D	H	γ_w	w	e
mm	mm	kN/m^3	%	-	kPa	kPa	-	kPa	-	mm	mm	kN/m^3	%	-
50.00	99.00	19.89	19.3	0.589	**70**	**70**	1.0	300.0	0.95	50.1	98.4	20.15	20.7	0.586

Informazioni generali	
tipo di provino	**INDISTURBATO**
metodo di preparazione	**FUSTELLAZIONE**
superfice di appoggio	**PIETRA POROSA**
eccitazione	**TORSIONALE**

Valori numerici

G	G/G_{MAX}	γ	D	U
(MPa)	(-)	(%)	(%)	(kPa)
79.47	1.000	0.00011		300.0
79.47	1.000	0.00023	0.00	300.0
79.42	0.999	0.00035	1.18	300.0
78.83	0.992	0.00058	1.64	300.0
78.34	0.986	0.00090	1.64	300.0
77.58	0.976	0.00121	1.73	300.0
75.70	0.953	0.00211	1.91	300.0
72.07	0.907	0.00314	2.10	300.0
69.10	0.869	0.00430	2.59	300.0
63.72	0.802	0.00717	3.11	300.1
54.47	0.685	0.01090	3.83	300.3
48.89	0.615	0.01495	4.78	300.6
42.17	0.531	0.02275	5.50	301.4
33.68	0.424	0.04069	7.50	303.3
25.15	0.316	0.06539	11.36	308.6
20.18	0.254	0.09618	13.40	311.4
15.04	0.189	0.15186	19.75	316.1

Legenda:

Φ = diametro del provino

H = altezza del provino
γ_w = peso di volume umido
w = contenuto d'acqua
e = indice dei vuoti
σ' =tensioni efficaci
K = σ_r / σ_a
B.P. = back pressure
B = coefficiente di Skempton
G = Modulo di taglio
γ_{SA} = def.di taglio in singola ampiezza
D = Rapporto di smorzamento di taglio
Subscritto 'a' = assiale
Subscritto 'r' = radiale

Note:

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TEST REPORT

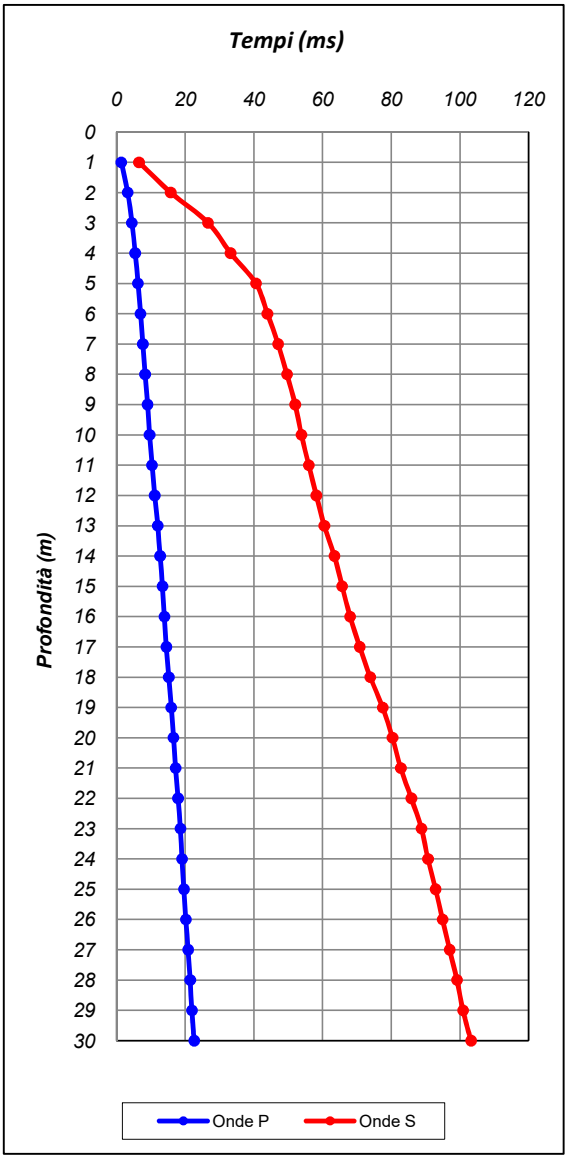
DOWN HOLE

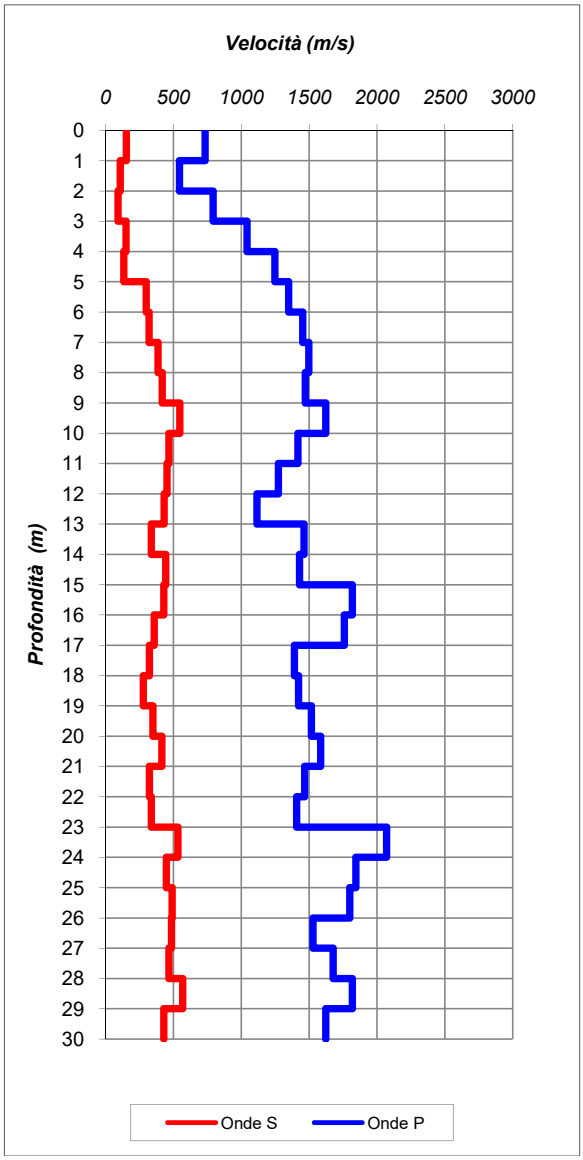
CLIENTE:	RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO		
LAVORO:	Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e Brisighella, Ravenna		
UBICAZIONE:	Castel Bolognese (RA)		
NOME TEST:	DH - S1		
DATA DI ESECUZIONE	06/02/2019		
COORDINATE (EPSG:3004)	**Y**	44°19'26.87"N	
	X	11°47'56.47"E	

Profondità (m)	***Onde P***		***Onde S***		*Poisson*	*Young (MPa)*	*Taglio (MPa)*	*Bulk (MPa)*	*γ (kN/m^3)*
	(ms)	*(m/sec)*	*(ms)*	*(m/sec)*					
1.00	1.36	734.06	6.52	153.35	0.48	121.4	41.1	886.5	17.5
2.00	3.20	545.52	15.77	108.12	0.48	59.1	20.0	482.0	17.1
3.00	4.46	792.29	26.65	91.94	0.49	44.4	14.9	1084.0	17.6
4.00	5.42	1041.79	33.20	152.57	0.49	125.4	42.1	1906.5	18.1
5.00	6.22	1248.78	40.59	135.28	0.49	101.1	33.9	2839.5	18.5
6.00	6.96	1349.18	43.93	299.89	0.47	495.7	168.2	3179.4	18.7
7.00	7.65	1452.78	47.04	320.82	0.47	573.8	194.6	3730.7	18.9
8.00	8.32	1497.89	49.63	387.33	0.46	834.5	285.0	3882.1	19.0
9.00	8.99	1472.00	52.02	417.52	0.46	961.8	330.2	3664.5	18.9
10.00	9.61	1623.06	53.85	547.05	0.44	1654.1	576.0	4302.1	19.2
11.00	10.32	1417.19	55.99	467.50	0.44	1184.7	411.6	3233.9	18.8
12.00	11.10	1274.42	58.19	454.38	0.43	1093.1	383.0	2502.0	18.5
13.00	12.00	1115.71	60.50	432.67	0.41	963.5	341.3	1814.4	18.2
14.00	12.68	1461.76	63.46	337.45	0.47	634.3	215.5	3756.1	18.9
15.00	13.38	1430.39	65.72	443.59	0.45	1073.9	371.1	3364.1	18.9
16.00	13.93	1817.80	68.04	430.73	0.47	1071.2	364.3	6002.7	19.6
17.00	14.50	1758.86	70.82	359.08	0.48	744.0	251.7	5702.5	19.5
18.00	15.22	1391.09	73.92	323.00	0.47	576.7	196.0	3373.3	18.8
19.00	15.92	1421.38	77.51	278.94	0.48	434.0	146.6	3611.4	18.8
20.00	16.58	1516.38	80.37	348.93	0.47	682.2	231.7	4067.5	19.0
21.00	17.21	1585.48	82.78	414.65	0.46	964.6	329.6	4379.6	19.2
22.00	17.89	1467.24	85.87	323.95	0.47	585.9	198.7	3811.2	18.9
23.00	18.60	1407.25	88.84	336.84	0.47	627.4	213.5	3441.3	18.8
24.00	19.09	2070.80	90.71	533.98	0.46	1682.0	574.3	7871.4	20.1
25.00	19.63	1844.19	92.94	448.72	0.47	1164.3	396.4	6167.5	19.7
26.00	20.19	1798.66	94.97	492.00	0.46	1384.8	474.4	5707.5	19.6
27.00	20.84	1528.43	97.03	486.01	0.44	1299.8	450.1	3851.7	19.1
28.00	21.44	1676.64	99.17	468.23	0.46	1237.0	424.3	4874.8	19.4
29.00	21.99	1818.41	100.93	567.86	0.45	1831.2	633.2	5648.9	19.6
30.00	22.60	1621.73	103.25	430.48	0.46	1042.8	356.6	4585.6	19.2

elletipi A COMPANY OF SOCOTEC	**TEST REPORT**	2/3
	DOWN HOLE	

CLIENTE:	RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO			
LAVORO:	Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e Brisighella, Ravenna			
UBICAZIONE:	Castel Bolognese (RA)			
NOME TEST:	DH - S1			
DATA DI ESECUZIONE	06/02/2019			
COORDINATE	**Y**	44°19'26.87"N		
	X	11°47'56.47"E		

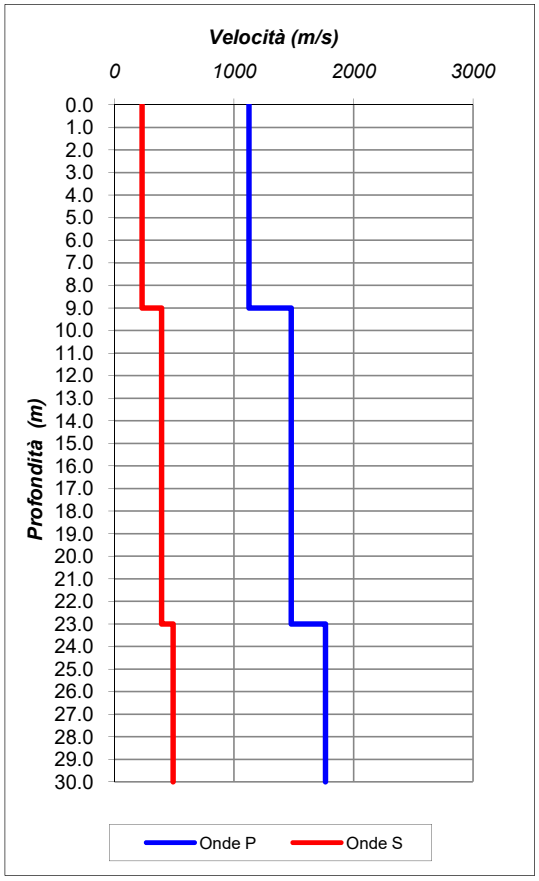


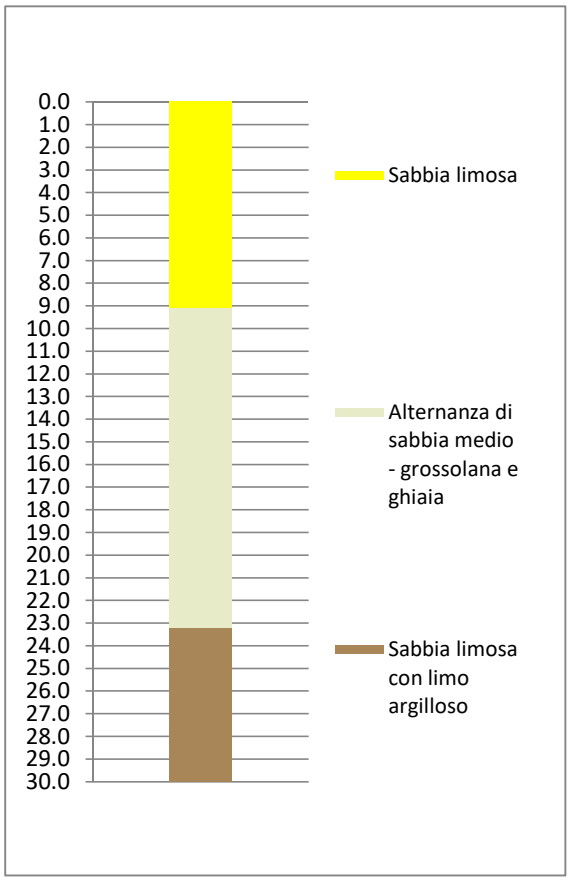


elletipi A COMPANY OF SOCOTEC	**TEST REPORT**	3/3
	DOWN HOLE	

CLIENTE:	RTP SANGIORGI - MARABINI - RIGHINI - MILIOTTO			
LAVORO:	Indagini geognostiche per la microzonazione sismica dei comuni di Castel Bolognese, Riolo Terme, Casola Valsenio e Brisighella, Ravenna			
UBICAZIONE:	Castel Bolognese (RA)			
NOME TEST:	DH - S1			
DATA DI ESECUZIONE	06/02/2019			
COORDINATE	**Y**	44°19'26.87"N		
	X	11°47'56.47"E		

Profondità base(m)	***Onde P*** *Velocità (m/sec)*	***Onde S*** *Velocità (m/sec)*	*Poisson*	*Young (MPa)*	*Share (MPa)*	*Bulk (MPa)*	γ *(kN/m^3)*
9.00	1126.03	229.65	0.48	284.59	96.26	2185.93	18.3
23.00	1477.71	392.77	0.46	855.03	292.42	3749.29	19.0
30.00	1765.55	489.61	0.46	1365.59	468.20	5463.92	19.5





$V_{S\ eq\ (0-30)}$	Suolo
337	C

SOGEO S.R.L.
INDAGINI GEOGNOSTICHE ED AMBIENTALI
Via S. Potito n. 43 - 48022 S. Potito di LUGO (RA)
Tel. 054522042 - Fax 054534443 - E-mail: sogeo@sogeo-srl.com
Concessione Ministero Infrastrutture e Trasporti - Settore C
Decr. n. 005754 del 05/07/2010

	COMMITTENTE: R.T.P. Sangiorgi-Marabini-Righini-Milioto	SOND.N°: S.1 PROF.(m): 30.00
	CANTIERE: MZS Unione Comuni Romagna Faentina - Castel Bolognese (RA)	QUOTA (m): p.d.c.
	PERFORATRICE: CMV MK900 D1	LATITUDINE (°):
	METODO PERFORAZ.: Carotaggio continuo	LONGITUDINE (°):
RIVESTIMENTO: Ø 127 mm	ATTREZZO PERFORAZ.: Carotiere semplice Ø 101 mm	DATA INIZ-FINE: 14/01/2019-15/01/2019
NOTE: Descrizione stratigrafica eseguita dalla D.L. Dott. Geol. Marabini Stefano		SCALA: 1:100
RIF.PREV.N°: 220-18	CERTIFICATO N°: BOZZA / RAPPORTO N°: ---------- / DATA DI EMISSIONE: Gennaio 2019	PAGINA N°: 1 di 1

Scala 1:100	P.P. I [daN/cm²]	Vane Test [daN/cm²]	Profondita'	Stratigrafia	Descrizione	Falda	Campioni	Campioni Rim.	S.P.T. [n. colpi] P.A.	Pz.Norton	Tubo Down Hole
1			0.55		Suolo sabbioso-limoso di colore bruno-marrone, "decarbonatato"						
			1.30		Sabbia fine limosa di colore bruno-giallastro, discretamente addensarta, "decarbonatata"						
2	1.8		1.60		Sabbia medio-fine limosa di colore bruno-rossiccio, "decarbonatata"						
	3.5		2.00		Sabbia fine limosa e limo sabbioso di colore bruno-giallastro, "decarbonatati"						
3	3.0		2.50		Argilla limosa di colore giallastro, compatta, "decarbonatata"						
	2.5		3.10		Sabbia limosa di colore bruno-ocraceo, addensata, "decarbonatata"		3.10 C.I.1				
4	3.0		3.60		Campione indisturbato		3.60				
	1.0		3.85		Sabbia limosa di colore bruno-ocraceo, addensata, "decarbonatata"						
	0.8				Limo sabbioso di colore giallastro chiaro, con sottili livelli sabbiosi						
5	1.0		4.80		Alternanze di limi sabbiosi e limi argillosi di colore giallastro, con sottili lamine sabbiose						
	1.5		5.70		Limo argilloso di colore grigio scuro, compatto (= paleosuolo)						
6	2.7		6.00		Sabbia fine di colore giallastro chiaro		6.30 C.I.2				
	2.0		6.20		Limi sabbiosi e sabbie argillose di colore giallastro chiaro, laminate, con sottili lamine sabbiose		6.80				
	2.2		6.30		Campione indisturbato						
7	2.5		6.80		Limi sabbiosi e sabbie argillose di colore giallastro chiaro, laminate, con sottili lamine sabbiose						
	3.7				Sabbia medio-grossolana, addensata, con sparsi ciottolotti arenacei (Ø 1-3 cm)						
8	1.7		8.40		Limo argilloso di colore grigio						
			9.50		Ghiaia minuta (Ø = 1-7 cm) in abbondante matrice sabbiosa di colore grigio-biancastro. Frustoli carboniosi a -11.70 m						
9			9.70		Sabbia media-grossolana di colore grigio						
			13.00		Ghiaia minuta (Ø = 1-5 cm) in abbondante matrice sabbiosa di colore grigio						
10			13.50		Sabbia media-grossolana di colore grigio						
			14.30		Ghiaia minuta (Ø = 1-5 cm) in abbondante matrice sabbiosa di colore grigio						
11			15.50		Sabbia medio-grossolana di colore grigio						
			17.00		Ghiaia minuta (Ø = 1-5 cm) in abbondante matrice sabbiosa di colore grigio						
12			17.80		Sabbia medio-grossolana con abbondanti ciottoli (Ø = 1-4 cm)						
			18.70		Ghiaia minuta (Ø = 1-6 cm) in abbondante matrice di colore giallastro e grigio, azzurro alla base						
13			20.50		Limo argilloso di colore grigio-azzurro, con frequenti concrezioni calcaree biancastre (Ømax = 1 cm)						
			22.10		Limo argilloso di colore grigio-verdastro						
14			22.80		Limo argilloso e argilla limosa di colore giallastro-verdastro, compatti, con sparse concrezioni calcaree biancastre						
			23.80		Sabbia più o meno limosa, di colore giallastro, con intercalazioni limose centimetriche						
15			24.50		Limo argilloso e argilla limosa di colore giallastro con vene ocracee, laminati, compatti						
			26.30		Limo argilloso e limo sabbioso di colore giallastro con vene ocracee						
16			27.60		Alternanze di sabbie medie-fini, più o meno limose, e limi, di colore giallastro-ocraceo-nerastro						
			28.30		Argilla limosa di colore giallo-verdastro, con sparse concrezioni calcaree biancastre (Ømax = 1 cm)						
17			28.90								
			30.00								
18											
19											
20											
21											
22	1.7										
	1.5										
23											
24	1.4										
	2.5										
25	1.3										
	1.6										
26											
	2.8										
27	3.0										
	1.4										
	2.5										
28	3.0										
	1.2										
	1.2										
29	4.0										
	4.5										
	3.5										
30	4.0										

30.00

Lo Sperimentatore

Il Direttore del Laboratorio

Istituto
Sperimentale
Modelli
GEOtecnici

Via Pastrengo, 9 – 24068 Seriate (Bg)
Tel: 035 303120
Fax: 035 303120
E-mail: ismgeo@ismgeo.it

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

CASTEL BOLOGNESE

PROVE GEOTECNICHE DI LABORATORIO

Prog. L001; Doc. RAT 050/2019

Redatto da:	Andrea Saccenti	14/03/2019
Rivisto e Approvato da:	Andrea Saccenti	

Via Pastrengo, 9 - 24068 Seriate (Bg) -
tel. 035 303120 - fax 035 303120 -
Email: ismgeo@ismgeo.it

DESCRIZIONE CAMPIONE

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Ranzini	Saccenti

N° verbale di accettazione: *005/2019*

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI1**
Profondità prelievo [m]:	**3.10 - 3.60**
Prova:	**Dc**
Data fine descrizione:	**11/03/2019**

N° certificato di prova:

Dati Generali di Campionamento

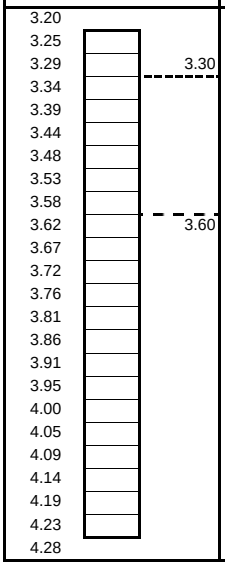
Data prelievo:	14/01/2019
Attrezzatura sondaggio	-
Attrezzatura prelievo:	-
Modalità prelievo:	-

Dati Generali del Campione

Data arrivo in laboratorio:	21/01/2019	Tipo contenitore:	FUSTELLA ACCIAIO
Data estrusione campione:	22/01/2019	Forma campione	CILINDRICO
Condizioni contenitore:	BUONE	Dimensioni Campione:	Φ= 8.9 cm L= 30 cm
		Classe del terreno:	CLASSE 4

Descrizione

3.30 m - 3.60 m: Sabbia con limo argillosa di colore marrone oliva chiaro (2.5Y 5/4) con macchie più scure, priva di reazione all'HCl.

Schizzo	Penetrometro + [MPa]	Penetrometro // [MPa]	Scissometro + [MPa]	Scissometro // [MPa]	Prove eseguite
					LLP1 Gr1 RC1 γ1 w1

Richiami

LLP = Limiti di liquidità e plasticità
Gr = Analisi Granulometrica
RC = Colonna risonante
γ = Peso di volume
w = Umidità

Rev	data emiss.	eseguito da	elaborato da
0	11/03/2019	Sirtoli	Sirtoli

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI1**
Profondità prelievo [m]:	**3.10 – 3.60**
Data prova:	**22/01/2019**

Istituto Sperimentale Modelli GEOtecnici

Via Pastrengo, 9 - 24068 Seriate (Bg) - ☏ tel. 035 303120 - 🖷 fax 035 303120 ✉ Email: ismgeo@ismgeo.it

Via Pastrengo, 9 - 24068 Seriate (Bg) -
tel. 035 303120 - fax 035 303120 -
Email: ismgeo@ismgeo.it

CARATTERISTICHE GENERALI DEL CAMPIONE

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Ranzini	Saccenti

N° verbale di accettazione: 005/2019

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI1**
Profondità prelievo [m]:	**3.10 - 3.60**
Prova:	**Cg**
Data fine descrizione:	**11/03/2019**

Prove	Profondità	Risultati prove	*Riferimento procedure*	*N° certificato di prova*
γ1	3.35m - 3.45m	Peso di volume = 16.90 [kN/m3]	*PT-LMT-00021 REV. 1*	
w1	3.35m - 3.45m	Umidità = 22 [%]	*PT-LMT-00016 REV. 0*	
LLP1	3.30m - 3.50m	Limite Liquido = 34 [%] Limite Plastico = 24 [%]	*PT-LMT-00020 REV. 1*	

Via Pastrengo, 9 - 24068 Seriate (Bg) Tel.
035 303120 - fax 035 290388 Email:
ismgeo@ismgeo.it

ANALISI GRANULOMETRICA

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Angeloni	Saccenti

Normativa di riferimento: ASTM D422/07
Classificazione di riferimento: AGI 1977
N° certificato di prova:
N° verbale di accettazione: *005/2019*

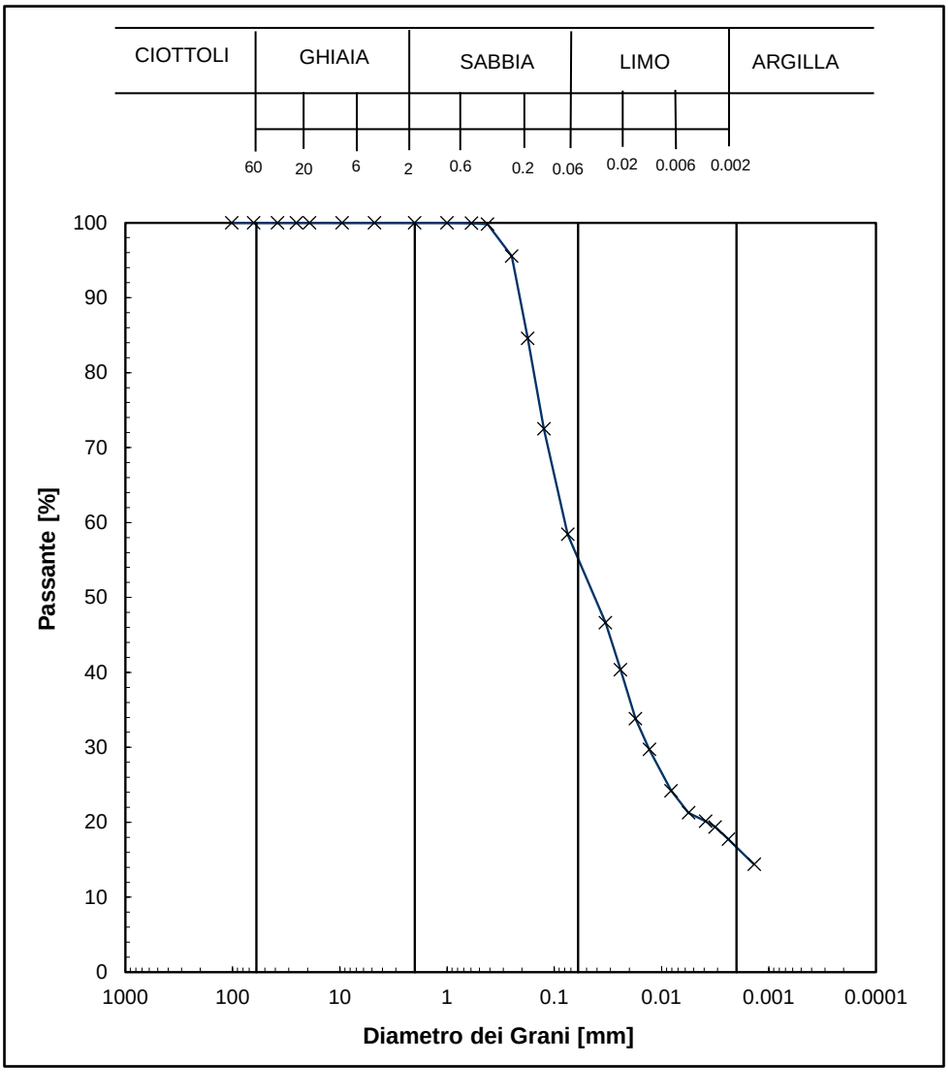
Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI1**
Profondità prelievo [m]:	**3.3 - 3.5**
Prova:	**Gr 1**
Data prova:	**25/01/2019**

Vagliatura

Diametro vaglio	Massa tratt.	Massa tratt.
[mm]	[g]	[%]
101.6	0	0
63.5	0	0
38.1	0	0
25.4	0	0
19.1	0	0
9.53	0	0
4.75	0	0
2	0	0
1	0.1	0.0
0.59	0.3	0.1
0.42	0.7	0.1
0.25	21.8	4.3
0.177	55.9	11.0
0.125	61.5	12.1
0.075	72.0	14.1

Aerometria

Tempo	Temp.	Lettura
[min]	[°C]	[-]
2	18.5	1.0223
4	18.5	1.0200
8	18.5	1.0176
15	18.5	1.0161
40	18.0	1.0142
85	18.9	1.0129
172	20.5	1.0121
257	21.0	1.0117
456	21.0	1.0111
1415	20.9	1.0099



Curva granulom.

Diametro	Passante
[mm]	[%]
1.02.E+02	100.0
6.35.E+01	100.0
3.81.E+01	100.0
2.54.E+01	100.0
1.91.E+01	100.0
9.53.E+00	100.0
4.75.E+00	100.0
2.00.E+00	100.0
1.00.E+00	100.0
5.90.E-01	99.9
4.20.E-01	99.8
2.50.E-01	95.5
1.77.E-01	84.6
1.25.E-01	72.5
7.50.E-02	58.4
3.33.E-02	46.6
2.42.E-02	40.4
1.75.E-02	33.8
1.30.E-02	29.7
8.16.E-03	24.2
5.59.E-03	21.3
3.87.E-03	20.1
3.15.E-03	19.4
2.38.E-03	17.7
1.37.E-03	14.4
-	-
-	-

Prova	Simbolo	Profondità		Massa secca materiale	Metodo preparazione materiale	% < 0.075mm	% CIOTTOLI	% GHIAIA	% SABBIA	% LIMO	% ARGILLA	Massa materiale aerometria	L max	D_{60}	D_{50}
		da m	a m	[g]								[g]	[mm]	[mm]	[mm]
Gr 1	x	3.30	3.50	510.4	VIA UMIDA	**58**	**-**	**-**	**45**	**38**	**17**	34	-	7.9.E-02	4.2.E-02

NOTE:

Via Pastrengo, 9 - 24068 Seriate (Bg) - tel. 035 303120 - fax 035 290388 - Email: ismgeo@ismgeo.it

DETERMINAZIONE LIMITI DI ATTERBERG

Concessione Ministeriale Decreto n°55126 del 12 luglio 2006 - Settori A, B e C

Sperimentatore: Diaby
Direttore: Saccenti
Data emissione: 11/03/2019
Rev.

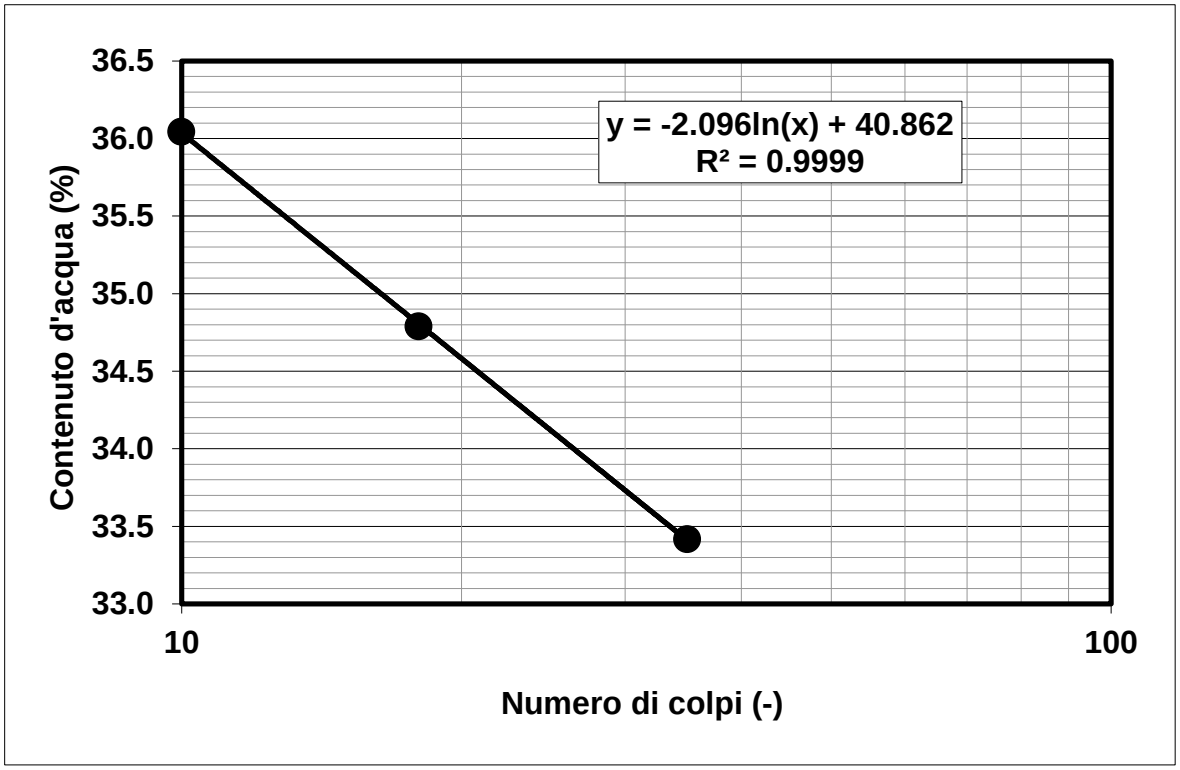
Normativa di riferimento: ASTM D4318
N° certificato di prova:
N° verbale di accettazione: 005/2019

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI1**
Profondità prova [m]:	**3.30 - 3.50**
Prova:	**LLP1**
Data prova:	**22/01/2019**

Limite Liquido	prova 1	prova 2	prova 3
numero colpi	35	18	10
massa tara (g)	22.23	22.65	22.16
massa umido + tara (g)	59.72	68.33	70.02
massa secco + tara (g)	50.33	56.54	57.34
umidità (%)	33.42	34.79	36.04

Limite Plastico		
massa tara (g)	22.25	22.44
massa umido + tara (g)	34.41	34.24
massa secco + tara (g)	32.09	31.94
umidità (%)	23.58	24.21

LL (%)	**34.1**
LP (%)	**23.9**
IP (%)	**10.2**



Note:

Via Pastrengo, 9 - 24068 Seriate (Bg) -
tel. 035 303120 - fax 035 303120 -
Email: ismgeo@ismgeo.it

DESCRIZIONE CAMPIONE

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Ranzini	Saccenti

N° verbale di accettazione: *005/2019*

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI2**
Profondità prelievo [m]:	**6.30 - 6.80**
Prova:	**Dc**
Data fine descrizione:	**11/03/2019**

N° certificato di prova:

Dati Generali di Campionamento

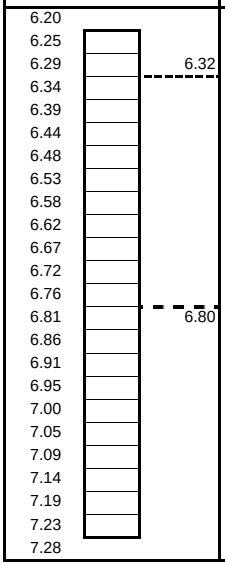
Data prelievo:	14/01/2019
Attrezzatura sondaggio	-
Attrezzatura prelievo:	-
Modalità prelievo:	-

Dati Generali del Campione

Data arrivo in laboratorio:	21/01/2019	Tipo contenitore:	FUSTELLA ACCIAIO
Data estrusione campione:	22/01/2019	Forma campione	CILINDRICO
Condizioni contenitore:	BUONE	Dimensioni Campione:	Φ= 8.9 cm L= 48 cm
		Classe del terreno:	CLASSE 4

Descrizione

6.32 m - 6.80 m: Limo con sabbia argilloso di colore marrone oliva chiaro (2.5Y 5/6) con macchie grigio chiaro e marrone scuro e con discreta reazione all'HCl.

Schizzo	Penetrometro + [MPa]	Penetrometro // [MPa]	Scissometro + [MPa]	Scissometro // [MPa]	Prove eseguite
					LLP1 Gr1 RC1 γ1 w1

Richiami

LLP = Limiti di liquidità e plasticità
Gr = Analisi Granulometrica
RC = Colonna risonante
γ = Peso di volume
w = Umidità

Rev	data emiss.	eseguito da	elaborato da
0	11/03/2019	Sirtoli	Sirtoli

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI2**
Profondità prelievo [m]:	**6.30 – 6.80**
Data prova:	**22/01/2019**

Istituto Sperimentale Modelli GEOtecnici

Via Pastrengo, 9 - 24068 Seriate (Bg) - ☎ tel. 035 303120 - 🖷 fax 035 303120 ✉ Email: ismgeo@ismgeo.it

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CARATTERISTICHE GENERALI DEL CAMPIONE

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Ranzini	Saccenti

N° verbale di accettazione: 005/2019

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI2**
Profondità prelievo [m]:	**6.30 - 6.80**
Prova:	**Cg**
Data fine descrizione:	**11/03/2019**

Prove	Profondità	Risultati prove	*Riferimento procedure*	*N° certificato di prova*
γ1	6.60m - 6.70m	Peso di volume = 19.89 [kN/m3]	*PT-LMT-00021 REV. 1*	
w1	6.60m - 6.70m	Umidità = 19 [%]	*PT-LMT-00016 REV. 0*	
LLP1	6.58m - 6.70m	Limite Liquido = 28 [%] Limite Plastico = 21 [%]	*PT-LMT-00020 REV. 1*	

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035 303120 - fax 035 290388 Email:
ismgeo@ismgeo.it

ANALISI GRANULOMETRICA

Concessione Ministeriale Decreto n° 55126 del 12 luglio 2006 - Settori A, B e C

rev.	data emiss.	sperimentatore	direttore
0	11/03/2019	Angeloni	Saccenti

Normativa di riferimento: ASTM D422/07
Classificazione di riferimento: AGI 1977
N° certificato di prova:
N° verbale di accettazione: *005/2019*

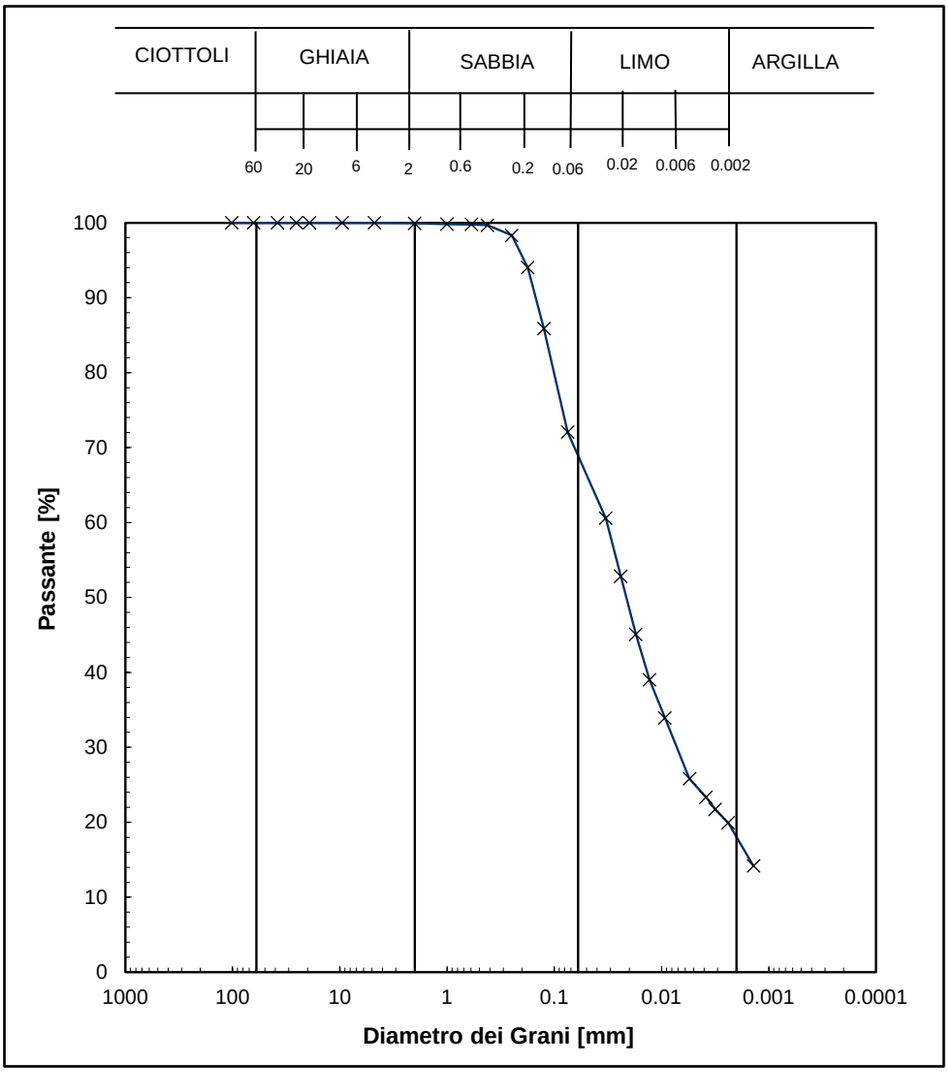
Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI2**
Profondità prelievo [m]:	**6.58 - 6.7**
Prova:	**Gr 1**
Data prova:	**25/01/2019**

Vagliatura

Diametro vaglio	Massa tratt.	Massa tratt.
[mm]	[g]	[%]
101.6	0	0
63.5	0	0
38.1	0	0
25.4	0	0
19.1	0	0
9.53	0	0
4.75	0	0
2	0.4	0.1
1	0.4	0.1
0.59	0.3	0.1
0.42	0.5	0.1
0.25	6.2	1.3
0.177	19.8	4.3
0.125	37.4	8.1
0.075	63.7	13.8

Aerometria

Tempo	Temp.	Lettura
[min]	[°C]	[-]
2	18.5	1.0227
4	18.5	1.0204
8	18.5	1.0181
15	18.5	1.0163
30	18.0	1.0149
90	18.4	1.0124
176	20.6	1.0112
261	20.7	1.0107
460	21.0	1.0101
1420	20.5	1.0085



Curva granulom.

Diametro	Passante
[mm]	[%]
1.02.E+02	100.0
6.35.E+01	100.0
3.81.E+01	100.0
2.54.E+01	100.0
1.91.E+01	100.0
9.53.E+00	100.0
4.75.E+00	100.0
2.00.E+00	99.9
1.00.E+00	99.8
5.90.E-01	99.8
4.20.E-01	99.7
2.50.E-01	98.3
1.77.E-01	94.0
1.25.E-01	85.9
7.50.E-02	72.1
3.30.E-02	60.6
2.40.E-02	52.8
1.74.E-02	45.1
1.29.E-02	39.0
9.32.E-03	33.9
5.48.E-03	25.8
3.84.E-03	23.3
3.16.E-03	21.7
2.38.E-03	19.9
1.39.E-03	14.2
-	-
-	-

Prova	Simbolo	Profondità		Massa secca materiale	Metodo preparazione materiale	% < 0.075mm	% CIOTTOLI	% GHIAIA	% SABBIA	% LIMO	% ARGILLA	Massa materiale aerometria	L max	D_{60}	D_{50}
		da m	a m	[g]								[g]	[mm]	[mm]	[mm]
Gr 1	x	6.58	6.70	460.7	VIA UMIDA	**72**	**-**	**0**	**31**	**51**	**18**	34	-	3.2.E-02	2.1.E-02

NOTE:

Via Pastrengo, 9 - 24068 Seriate (Bg) - tel. 035 303120 - fax 035 290388 - Email: ismgeo@ismgeo.it

DETERMINAZIONE LIMITI DI ATTERBERG

Concessione Ministeriale Decreto n°55126 del 12 luglio 2006 - Settori A, B e C

Sperimentatore: Diaby
Direttore: Saccenti
Data emissione: 11/03/2019
Rev.

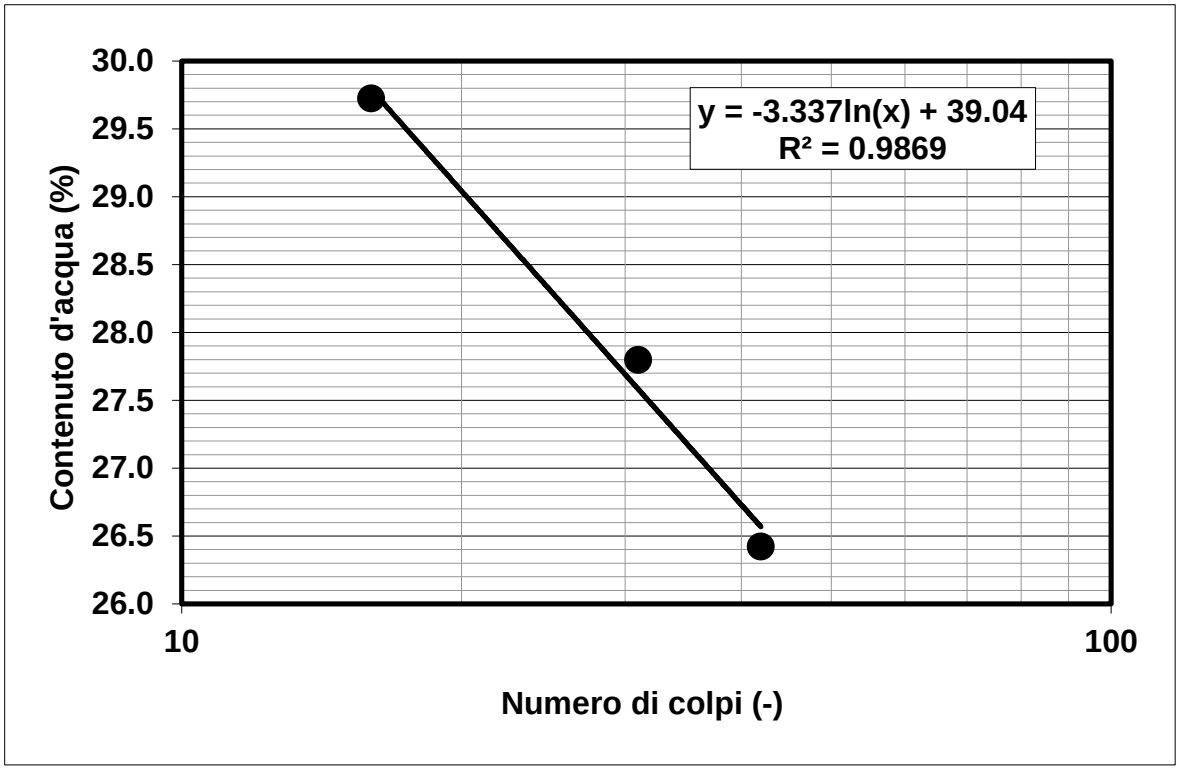
Normativa di riferimento: ASTM D4318
N° certificato di prova:
N° verbale di accettazione: 005/2019

Committente:	**DOTT. GEOL. SANGIORGI**
Cantiere:	**CASTEL BOLOGNESE**
Sondaggio:	**S1**
Campione:	**CI2**
Profondità prova [m]:	**6.58 - 6.70**
Prova:	**LLP1**
Data prova:	**22/01/2019**

Limite Liquido	prova 1	prova 2	prova 3
numero colpi	42	31	16
massa tara (g)	22.36	20.96	22.31
massa umido + tara (g)	64.61	72.73	83.24
massa secco + tara (g)	55.78	61.47	69.28
umidità (%)	26.42	27.80	29.72

Limite Plastico		
massa tara (g)	22.11	22.40
massa umido + tara (g)	34.27	34.89
massa secco + tara (g)	32.12	32.68
umidità (%)	21.48	21.50

LL (%)	**28.3**
LP (%)	**21.5**
IP (%)	**6.8**

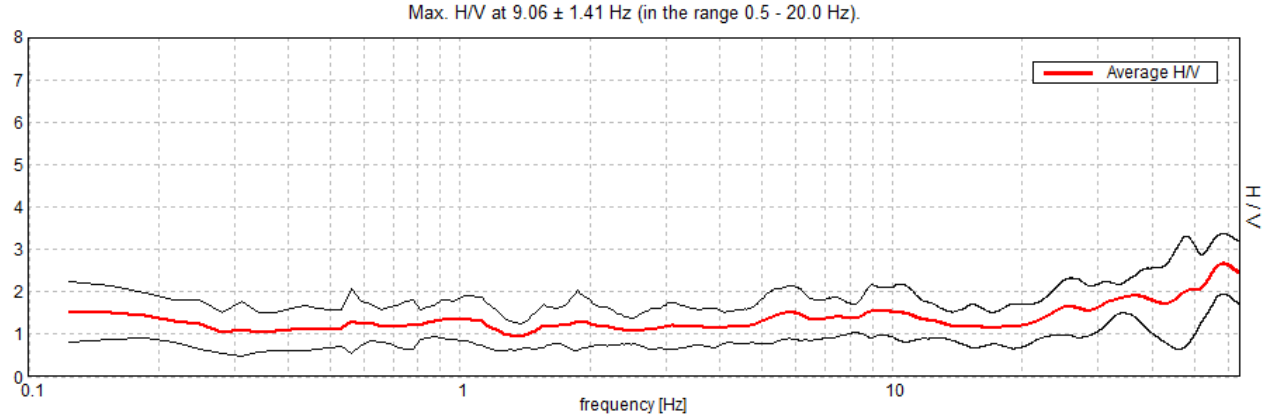


Note:

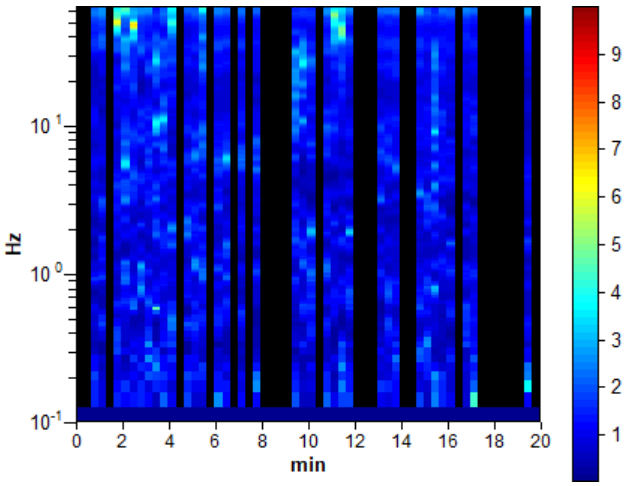
039006P59168HVSR63099
CASTEL BOLOGNESE_MS, HVSR17

Instrument: TRZ-0108/01-10
Start recording: 20/01/20 14:36:15 End recording: 20/01/20 14:56:16
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 58% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

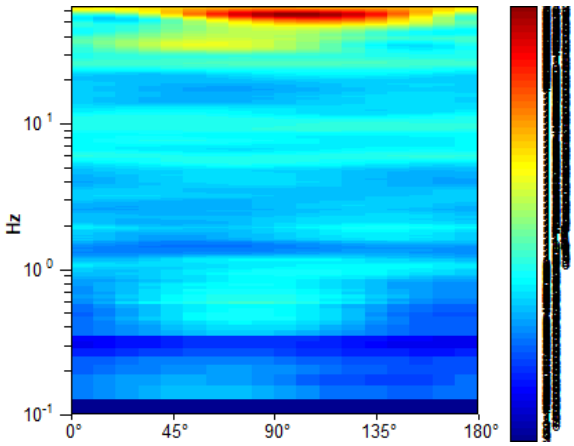
HORIZONTAL TO VERTICAL SPECTRAL RATIO



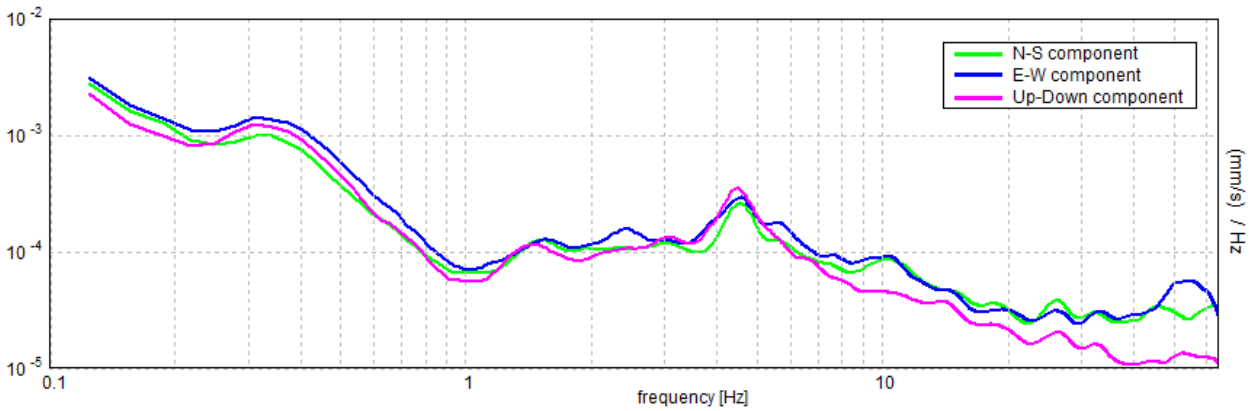
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA



[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 9.06 ± 1.41 Hz (in the range 0.5 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	9.06 > 0.50	OK	
$n_c(f_0) > 200$	6343.8 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz	Exceeded 0 out of 436 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.55 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.07533| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	0.68267 < 0.45313		NO
$\sigma_A(f_0) < \theta(f_0)$	0.3027 < 1.58	OK	

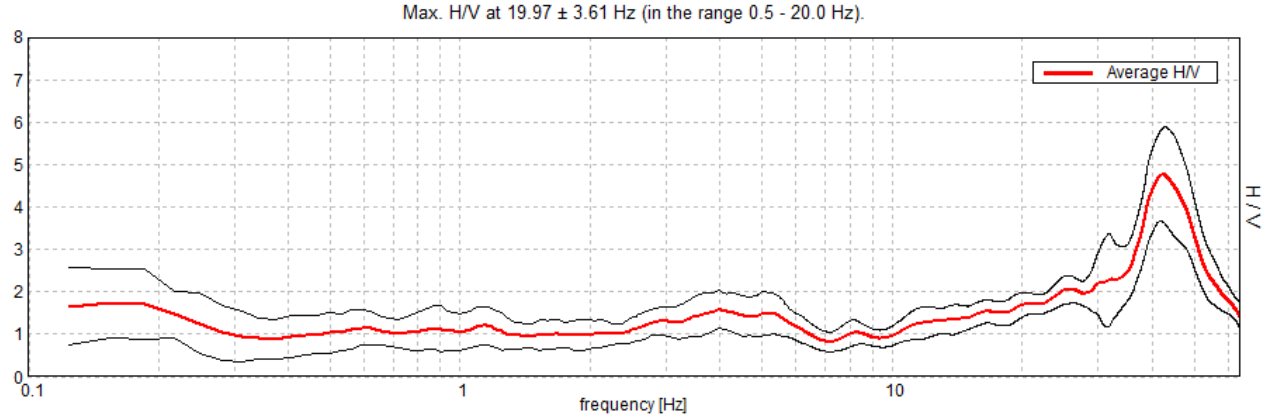
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

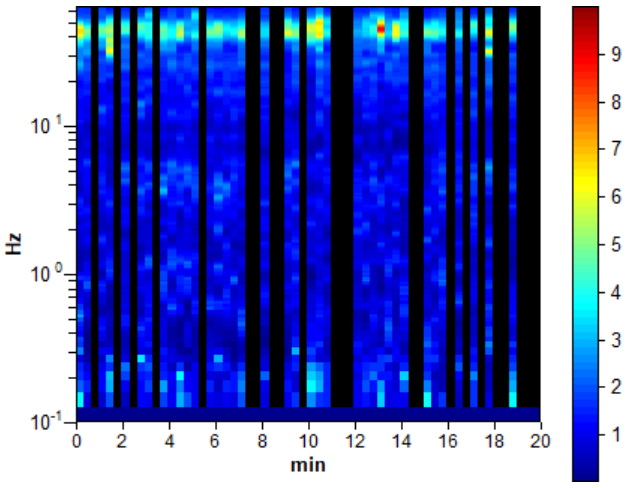
039006P59169HVSR63100
CASTEL BOLOGNESE_MS, HVSR18

Instrument: TRZ-0108/01-10
Start recording: 20/01/20 15:13:11 End recording: 20/01/20 15:33:12
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
Trace length: 0h20'00". Analyzed 62% trace (manual window selection)
Sampling rate: 128 Hz
Window size: 20 s
Smoothing type: Triangular window
Smoothing: 10%

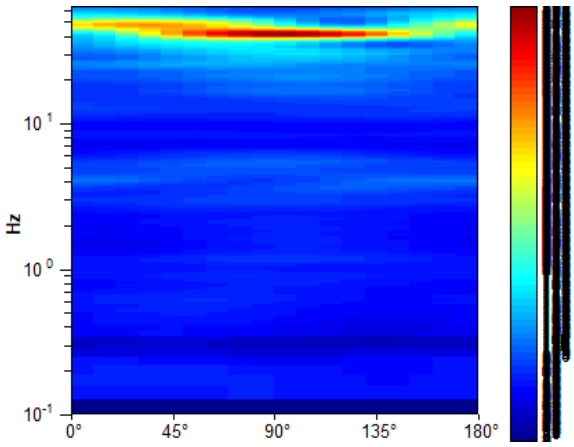
HORIZONTAL TO VERTICAL SPECTRAL RATIO



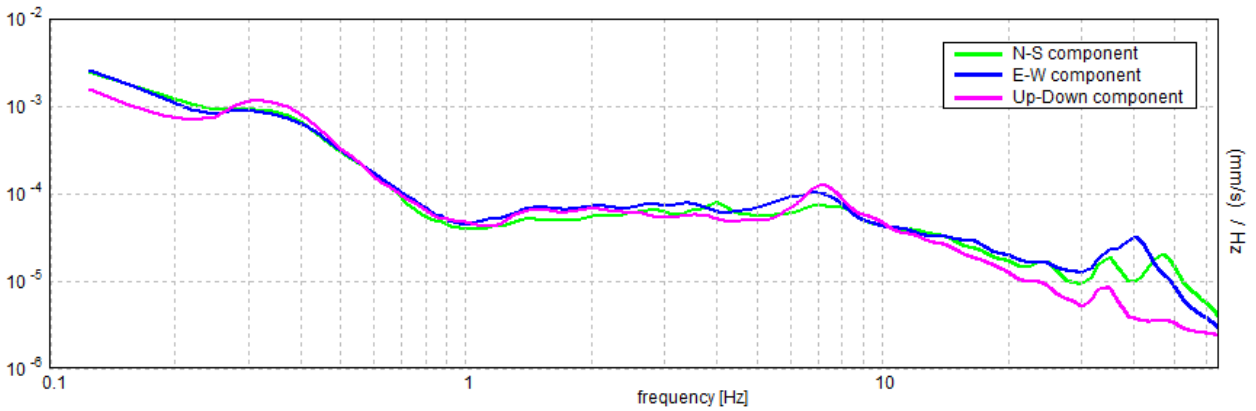
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA



[According to the SESAME, 2005 guidelines. **Please read carefully the** *Grilla* **manual before interpreting the following tables**.]

Max. H/V at 19.97 ± 3.61 Hz (in the range 0.5 - 20.0 Hz).

Criteria for a reliable H/V curve [All 3 should be fulfilled]			
$f_0 > 10 / L_w$	19.97 > 0.50	OK	
$n_c(f_0) > 200$	14776.9 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5$Hz **$\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5$Hz**	Exceeded 0 out of 960 times	OK	
Criteria for a clear H/V peak [At least 5 out of 6 should be fulfilled]			
Exists f^- in $[f_0/4, f_0]$ | $A_{H/V}(f^-) < A_0 / 2$	7.406 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ | $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	1.69 > 2		NO
$f_{peak}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	|0.08777| < 0.05		NO
$\sigma_f < \varepsilon(f_0)$	1.75264 < 0.99844		NO
$\sigma_A(f_0) < \theta(f_0)$	0.1428 < 1.58	OK	

L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{logH/V}(f)$	standard deviation of log $A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$					
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	0.25 f_0	0.2 f_0	0.15 f_0	0.10 f_0	0.05 f_0
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
log $\theta(f_0)$ for $\sigma_{logH/V}(f_0)$	0.48	0.40	0.30	0.25	0.20