



PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile



Regione Emilia-Romagna



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 d'Aiano



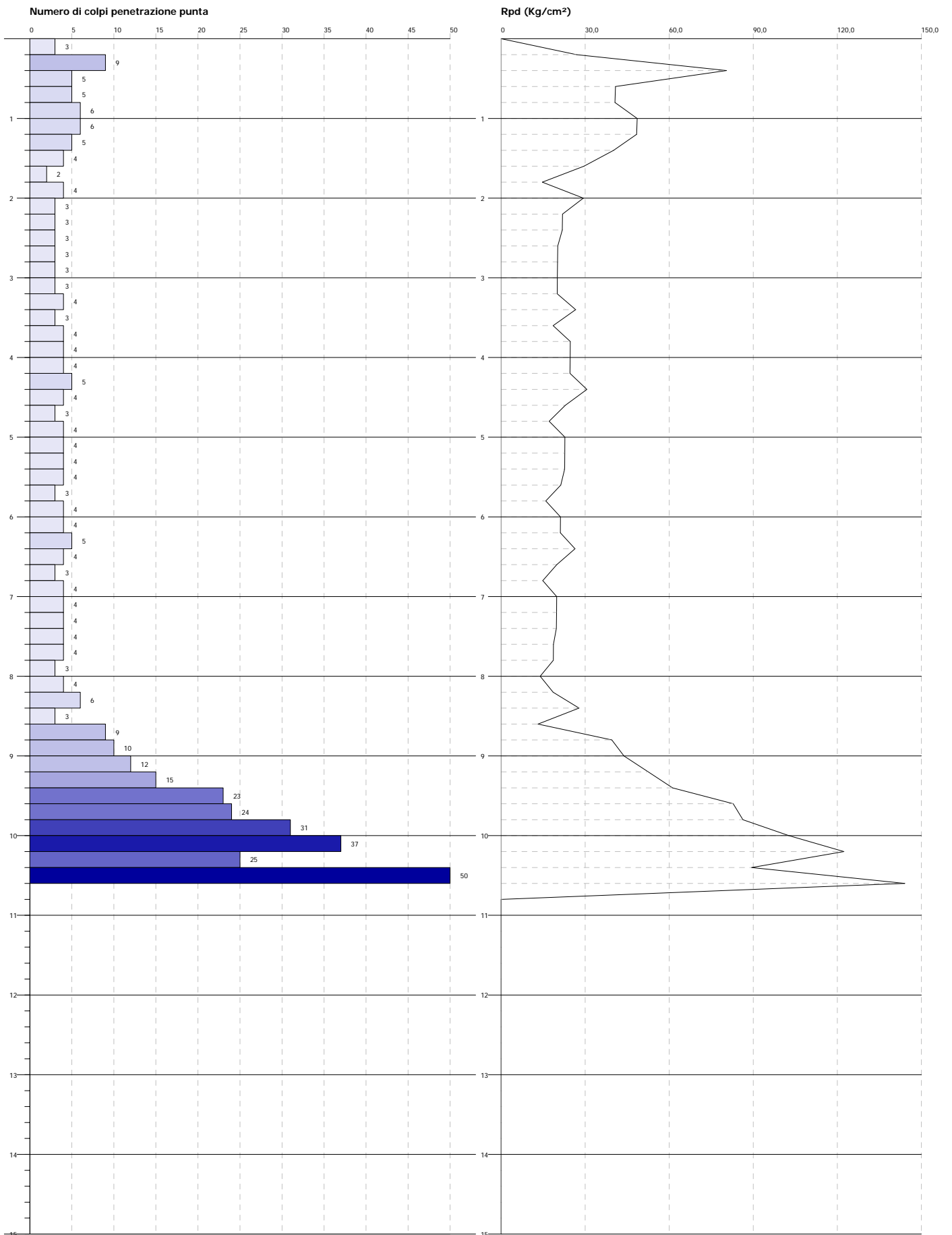
Regione	Soggetto realizzatore	Data
EMILIA–ROMAGNA	Dott. geol. Samuel Sangiorgi	Maggio 2019

Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data : 19/10/2018

FALDA: foro occluso e asciutto alla prof. di m. 8,20. NOTA: estratte n.2 aste bagnate.

Scala 1:64

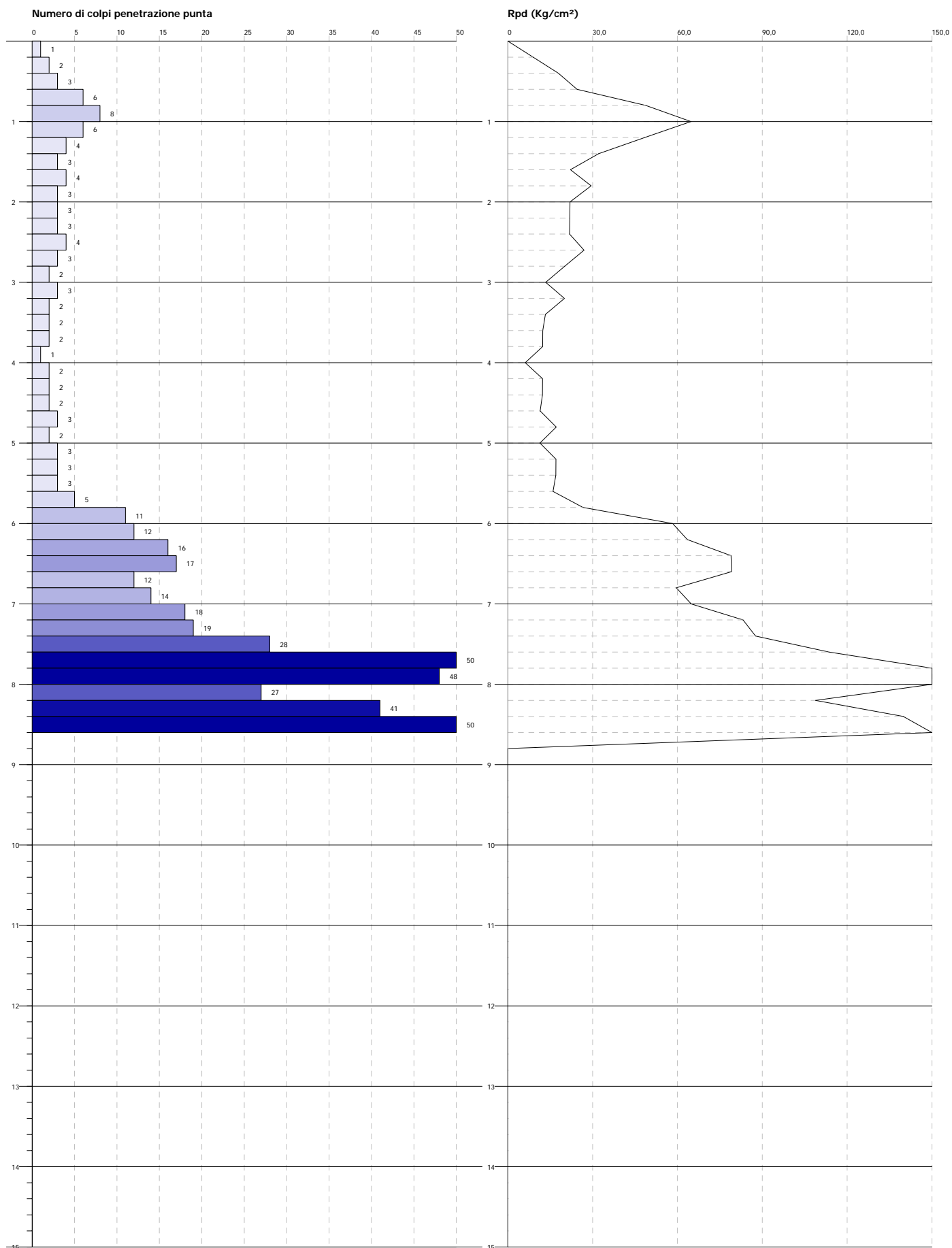


Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data : 19/10/2018

FALDA: foro occluso e asciutto alla prof. di m. 3,90. NOTA: 4 m. circa di terreno riportato.

Scala 1:64



CASTEL D'AIANO_MS, MS 2018 TR1

037013P112HVSR137

Instrument: TRZ-0108/01-10

Start recording: 07/02/19 10:49:03 End recording: 07/02/19 11:05:04

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 93% trace (manual window selection)

Sampling rate: 128 Hz

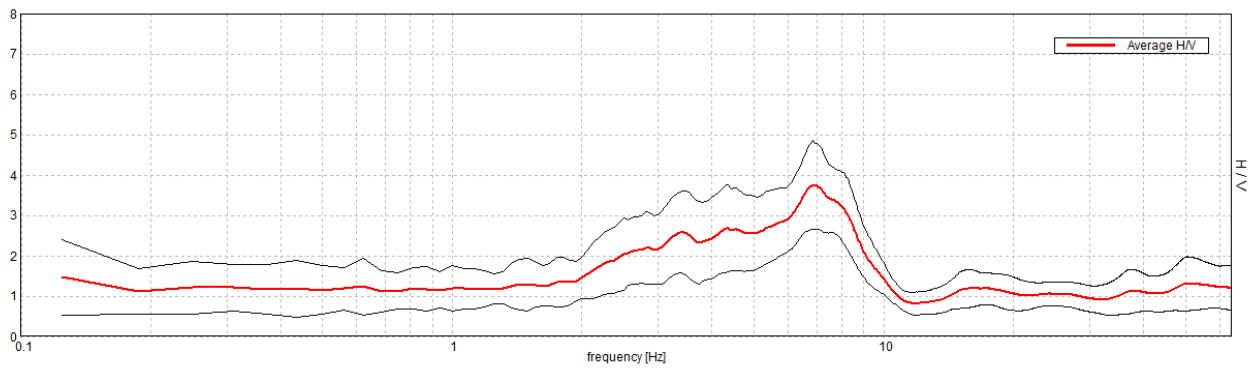
Window size: 16 s

Smoothing type: Triangular window

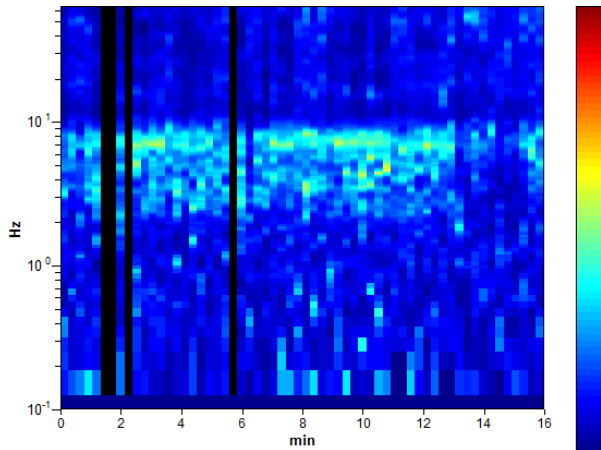
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

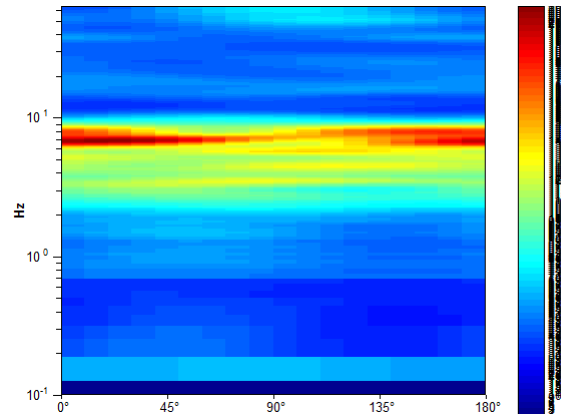
Max. H/V at 6.88 ± 0.14 Hz. (In the range 0.1 - 20.0 Hz).



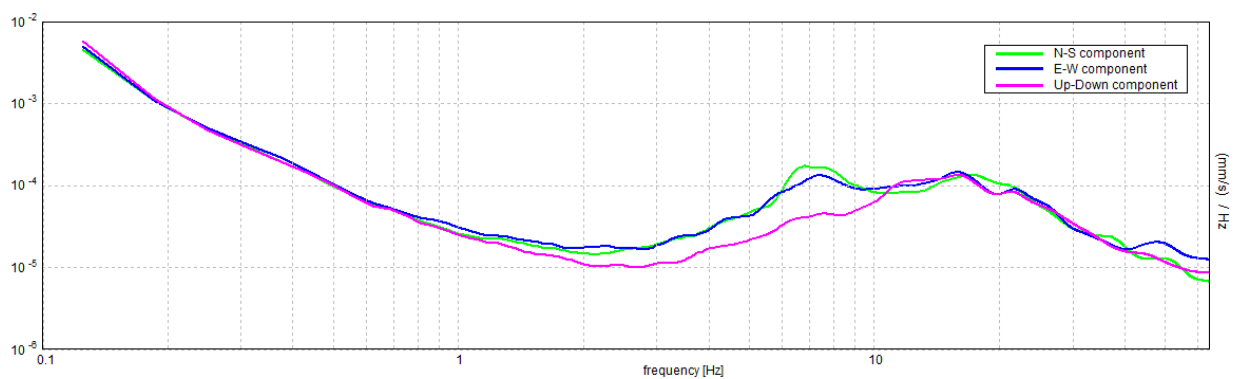
H/V TIME HISTORY



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 6.88 ± 0.14 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$6.88 > 0.63$	OK	
$n_c(f_0) > 200$	$6160.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 166 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	2.313 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	9.313 Hz	OK	
$A_0 > 2$	$3.75 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01007 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.06923 < 0.34375$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.5404 < 1.58$	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 $\sigma_A(f_0)$

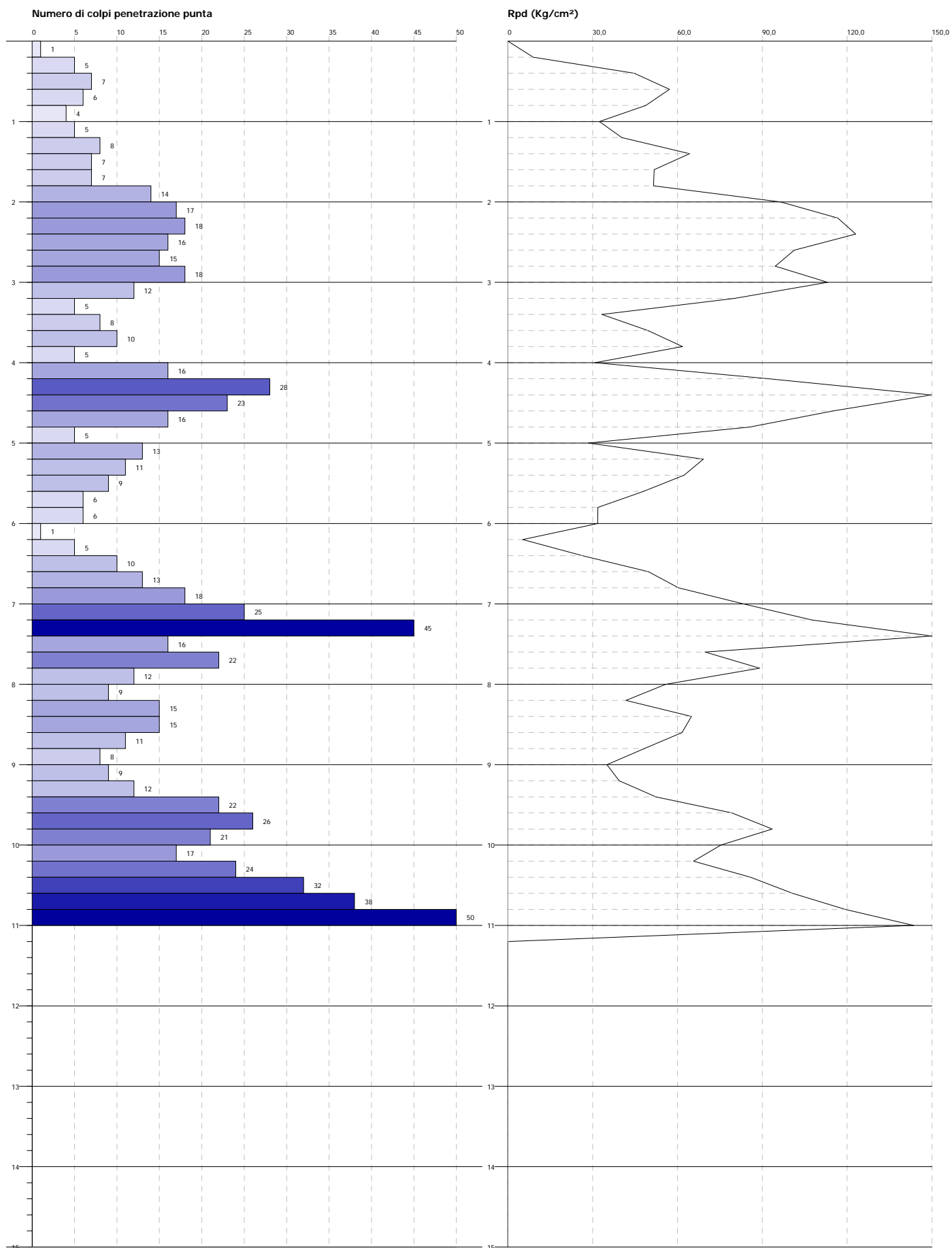
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :31/10/2018

FALDA: foro occluso alla prof. di m. 3,50; acqua m. 3,40. Estratte circa n.7 aste bagnate

Scala 1:64



CASTEL D'AIANO_MS, MS 2018 TR2

037013P113HVSR124

Instrument: TRZ-0108/01-10

Start recording: 07/02/19 10:21:10 End recording: 07/02/19 10:37:11

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 73% trace (manual window selection)

Sampling rate: 128 Hz

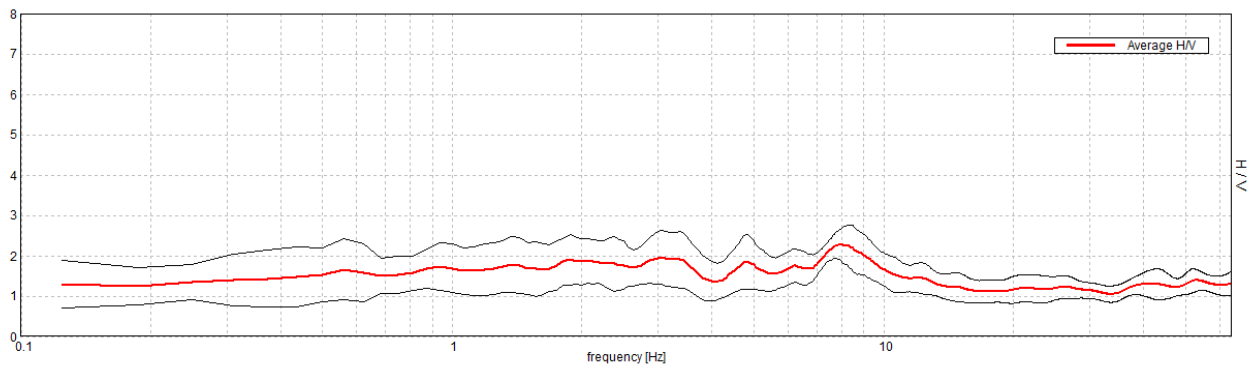
Window size: 16 s

Smoothing type: Triangular window

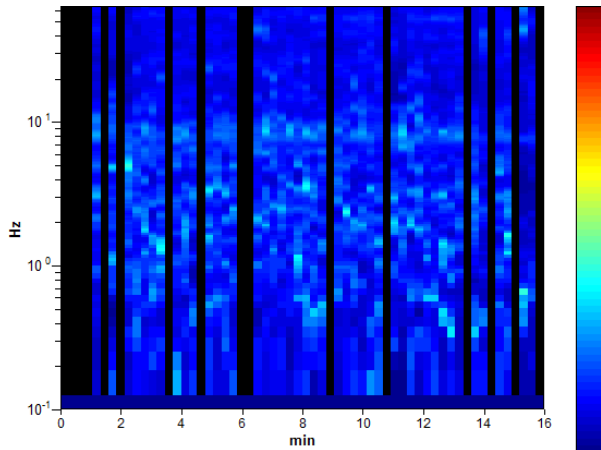
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

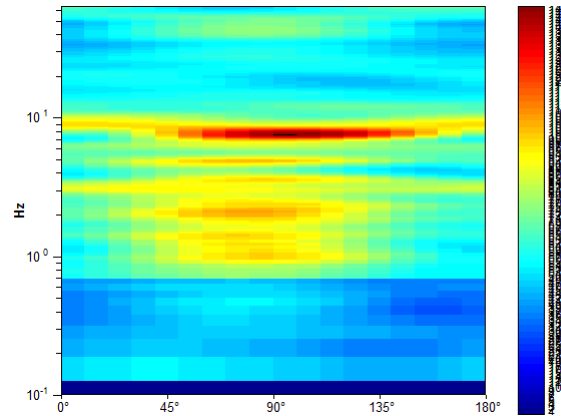
Max. H/V at 7.94 ± 0.45 Hz. (In the range 0.1 - 20.0 Hz).



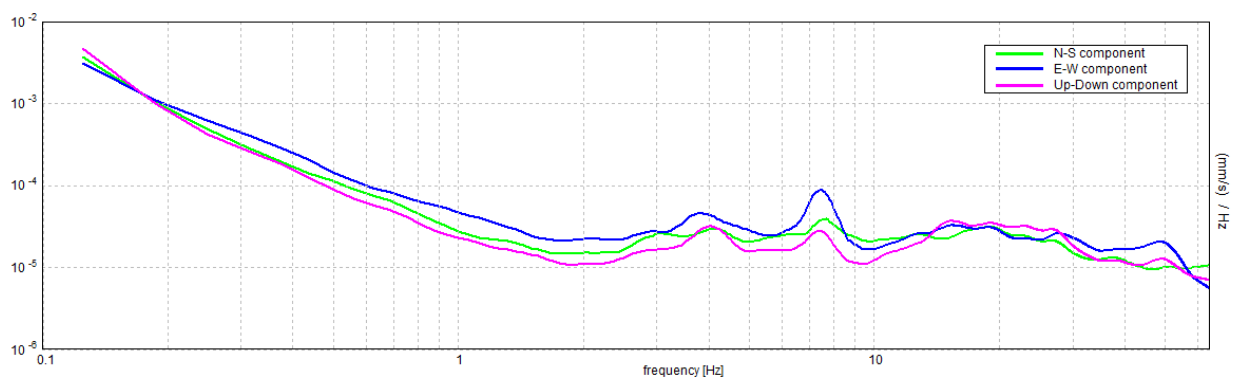
H/V TIME HISTORY



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 7.94 ± 0.45 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$7.94 > 0.63$	OK	
$n_c(f_0) > 200$	$5588.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 192 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	16.0 Hz	OK	
$A_0 > 2$	$2.27 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.02782 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.22084 < 0.39688$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1907 < 1.58$	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 $\sigma_A(f_0)$

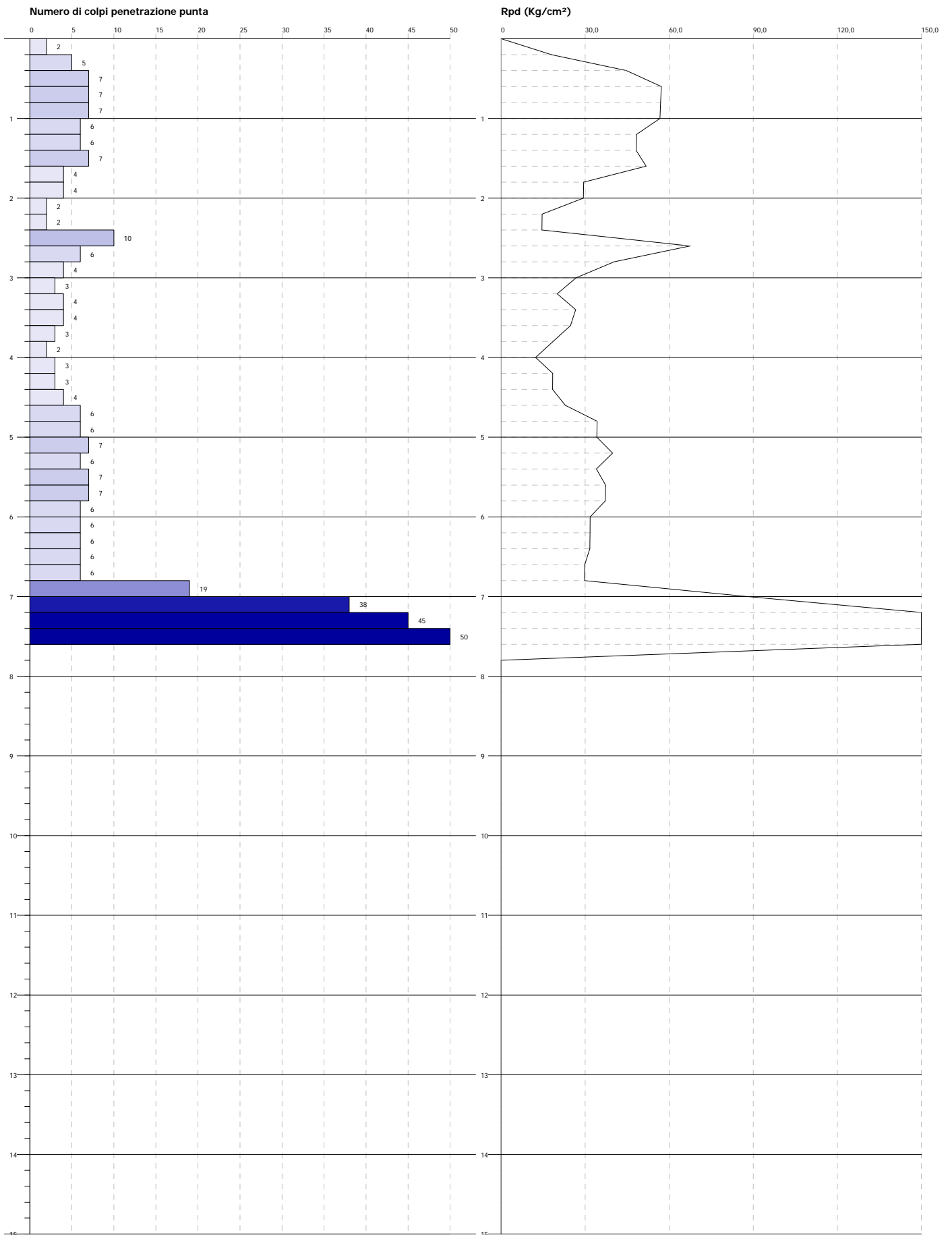
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data : 11/10/2018

FALDA: m.2,30 circa da p.c.

Scala 1:64

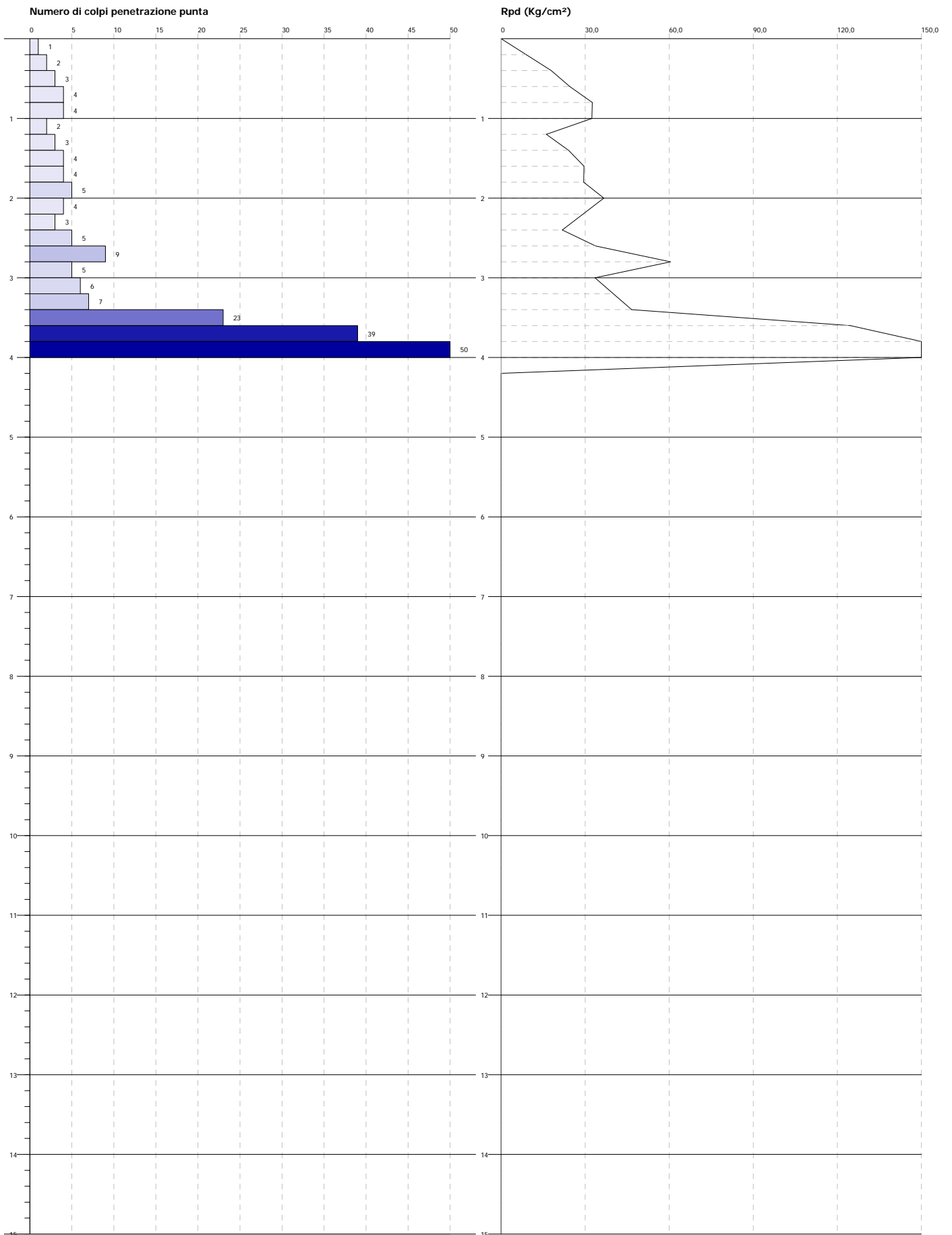


Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :31/10/2018

FALDA: foro occluso e asciutto alla prof. di m. 4,00

Scala 1:64

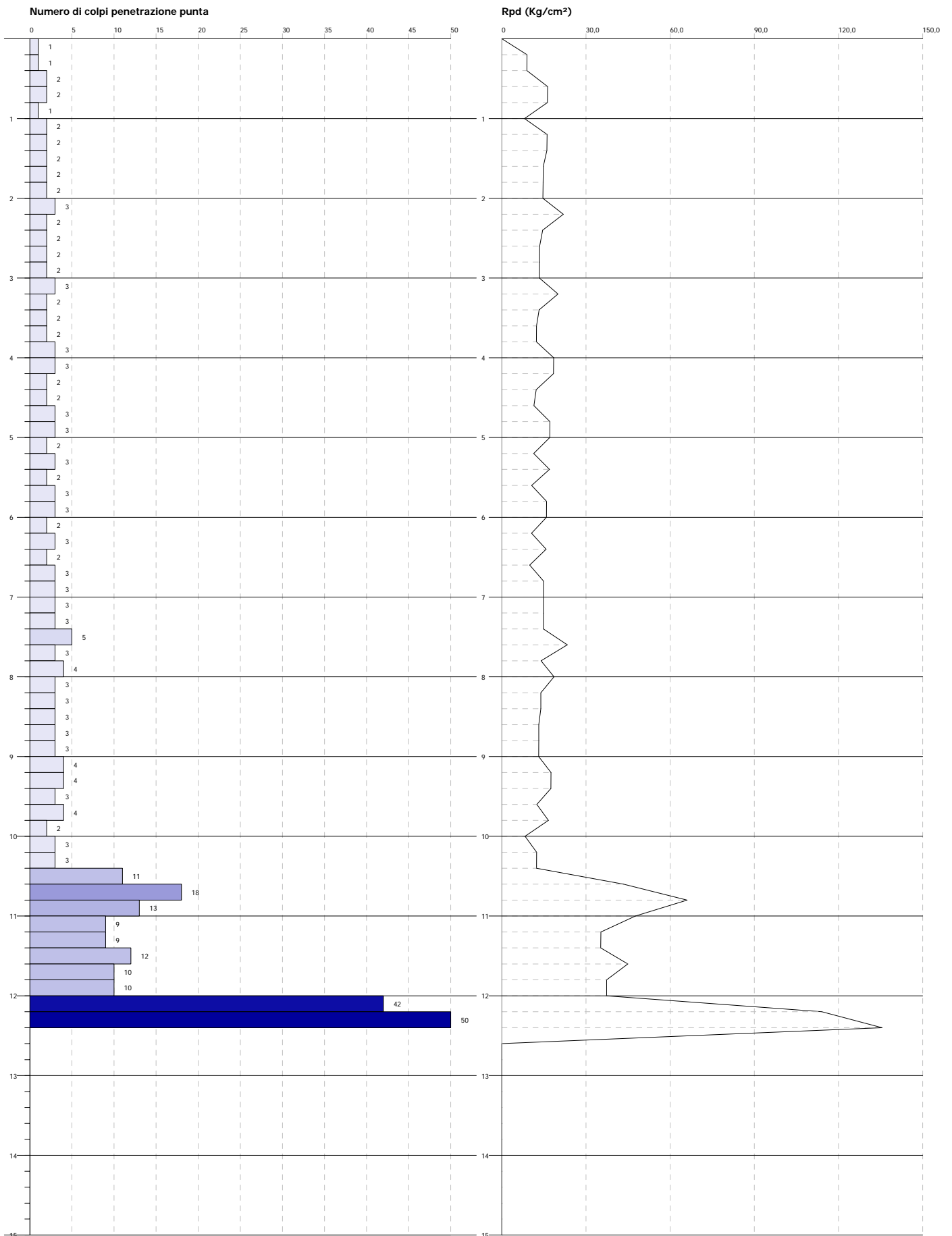


Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data : 19/10/2018

FALDA: foro occluso e asciutto alla prof. di m. 10,50.

Scala 1:64

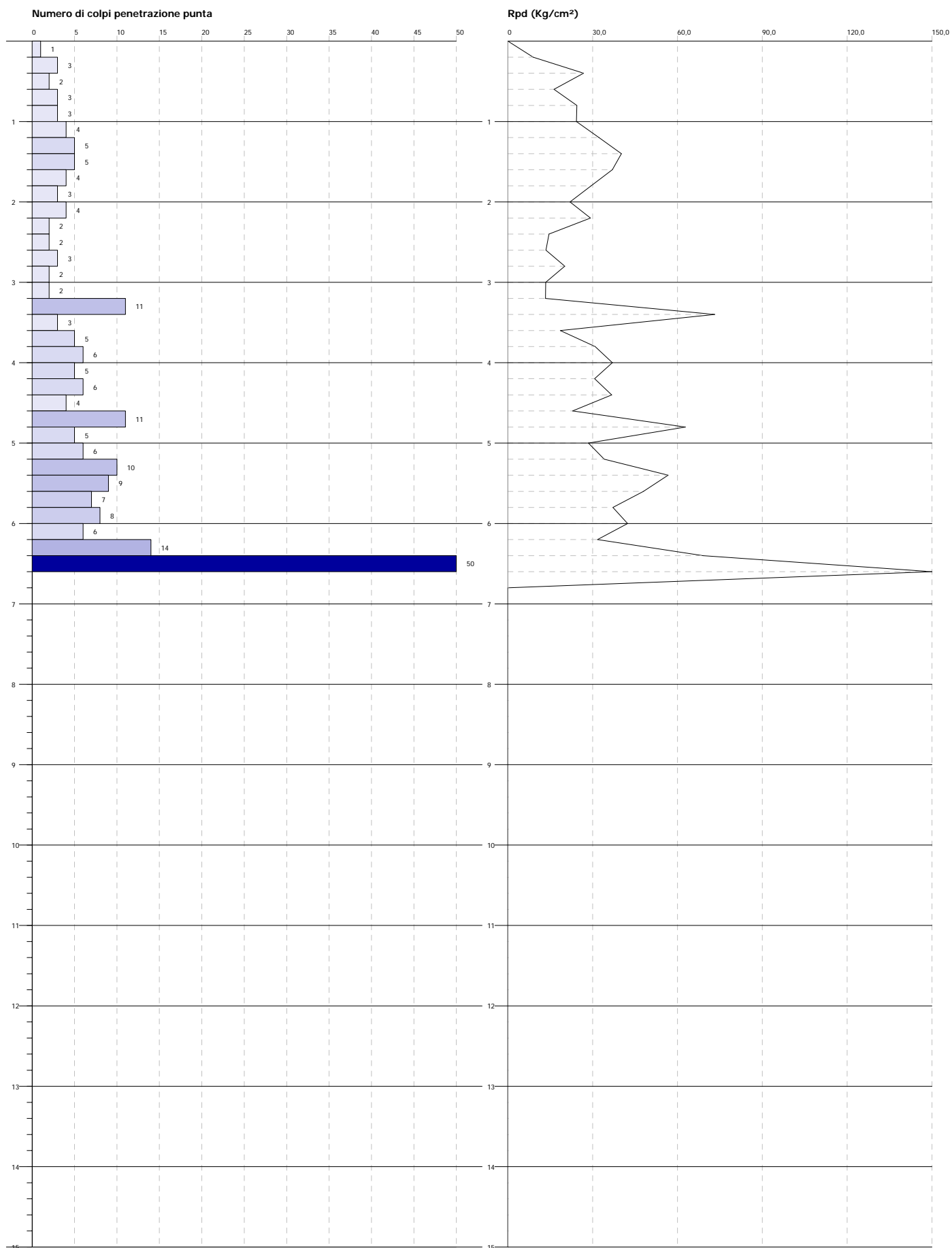


Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :08/11/2018

FALDA: m.3,20 da p.c.

Scala 1:64



CASTEL D'AIANO_MS, MS 2018 TR7

037013P117HVSR129

Instrument: TRZ-0108/01-10

Start recording: 09/11/18 15:42:53 End recording: 09/11/18 15:58:54

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 88% trace (manual window selection)

Sampling rate: 128 Hz

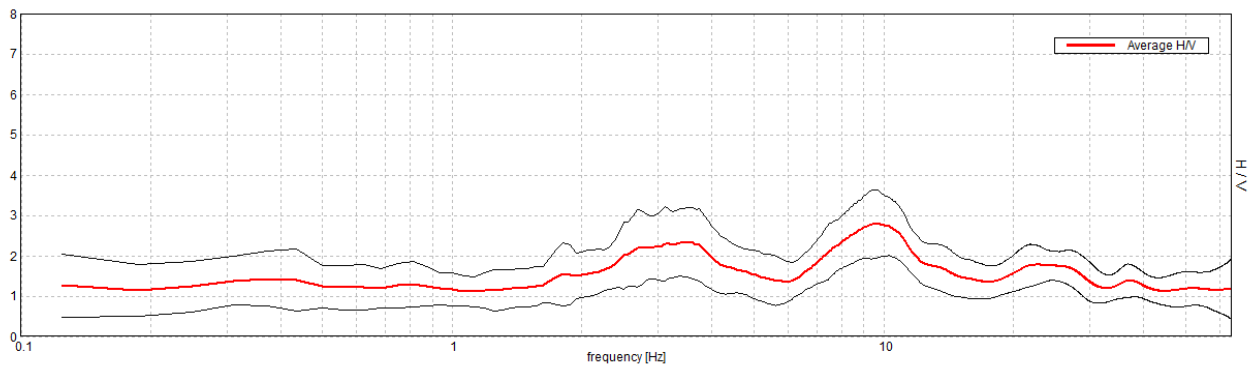
Window size: 16 s

Smoothing type: Triangular window

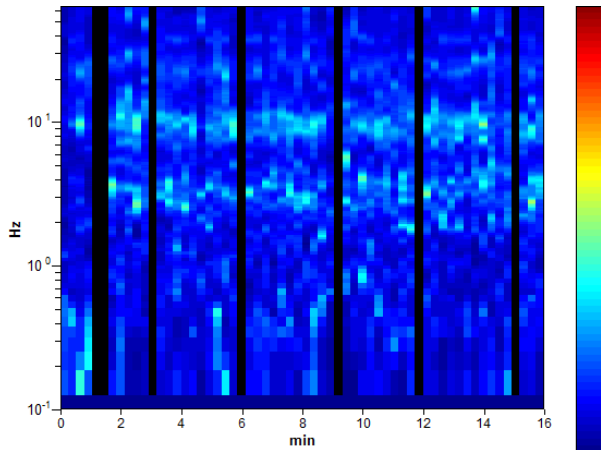
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

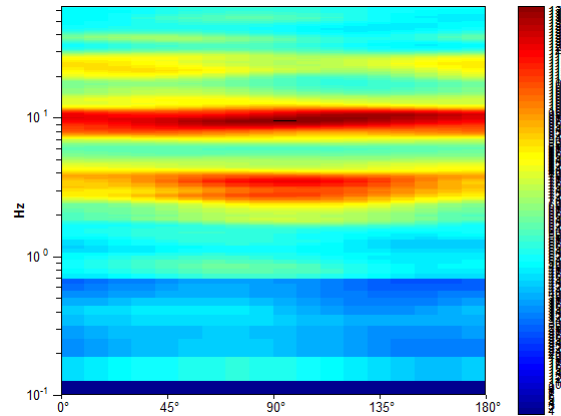
Max. H/V at 9.69 ± 0.62 Hz. (In the range 0.1 - 20.0 Hz).



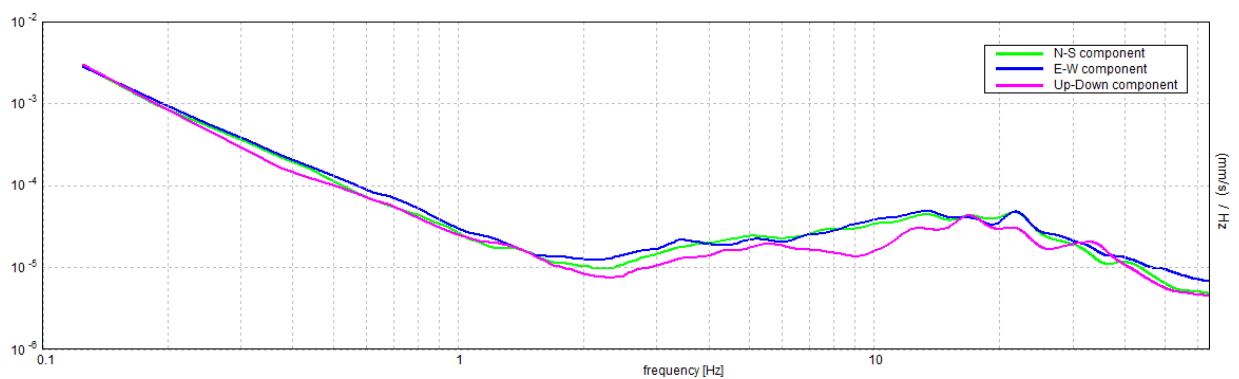
H/V TIME HISTORY



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 9.69 ± 0.62 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$9.69 > 0.63$	OK	
$n_c(f_0) > 200$	$8215.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	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 $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	6.125 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	16.313 Hz	OK	
$A_0 > 2$	$2.79 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.03155 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.30562 < 0.48438$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.4121 < 1.58$	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 $\sigma_A(f_0)$

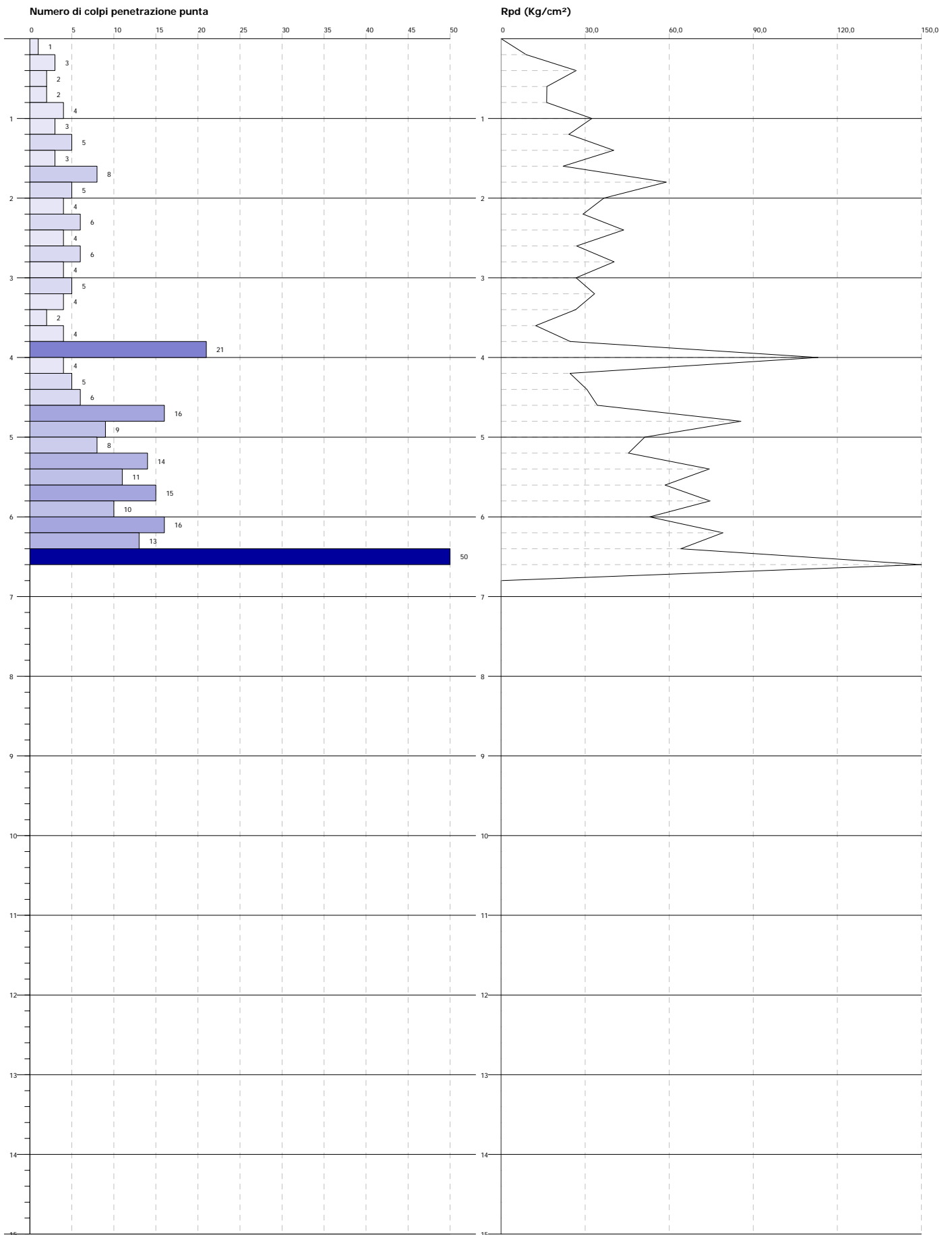
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :08/11/2018

FALDA: m.2,80 da p.c.

Scala 1:64



CASTEL D'AIANO_MS, MS 2018 TR8

037013P118HVSR131

Instrument: TRZ-0108/01-10

Start recording: 07/02/19 12:23:42 End recording: 07/02/19 12:39:43

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 58% trace (manual window selection)

Sampling rate: 128 Hz

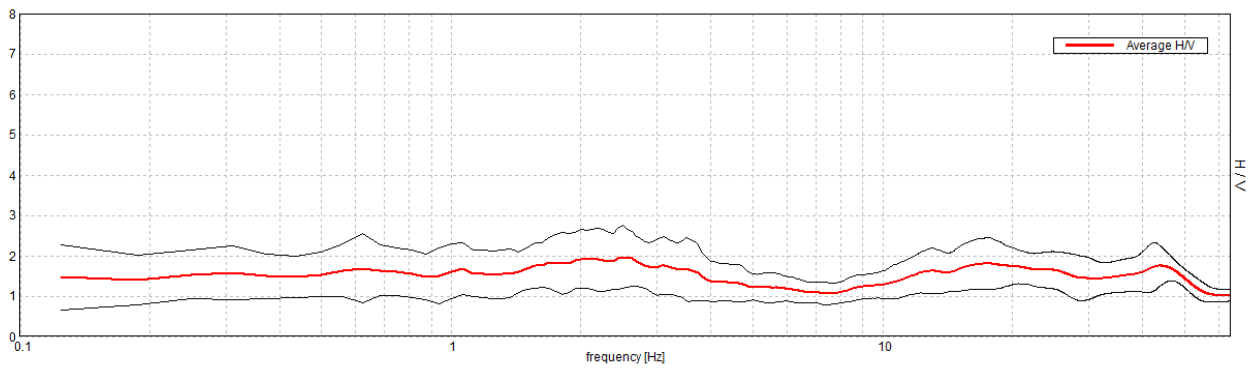
Window size: 16 s

Smoothing type: Triangular window

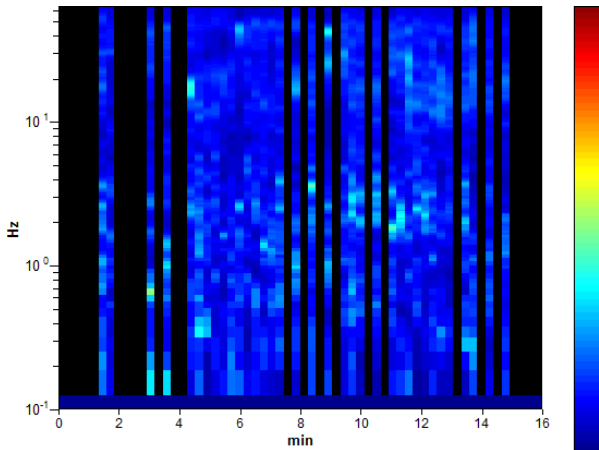
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

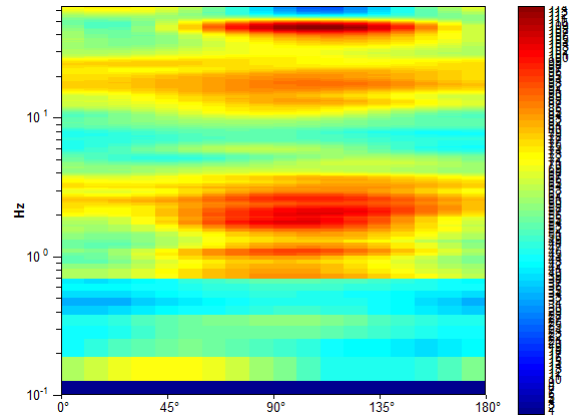
Max. H/V at 2.5 ± 0.3 Hz. (In the range 0.1 - 20.0 Hz).



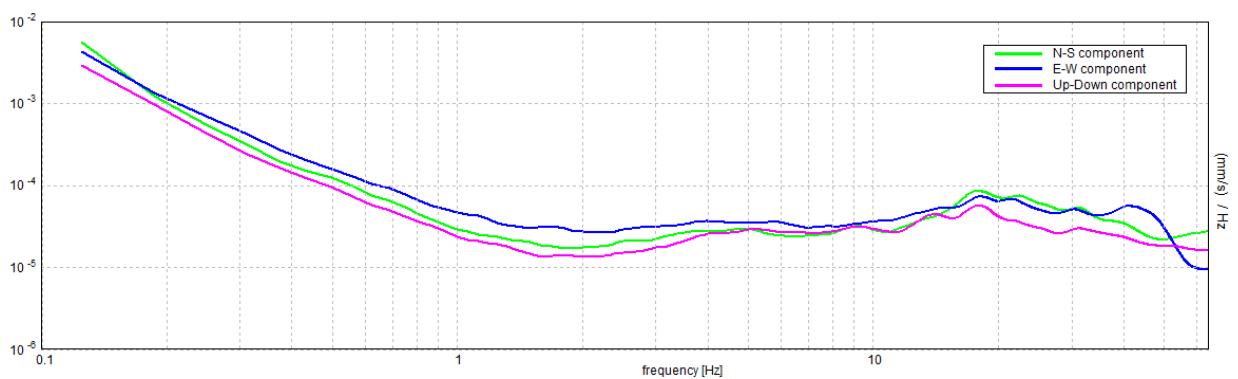
H/V TIME HISTORY



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 2.5 ± 0.3 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$2.50 > 0.63$	OK	
$n_c(f_0) > 200$	$1400.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 61 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
$A_0 > 2$	$1.97 > 2$		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.05881 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$0.14704 < 0.125$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.3803 < 1.58$	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 $\sigma_A(f_0)$

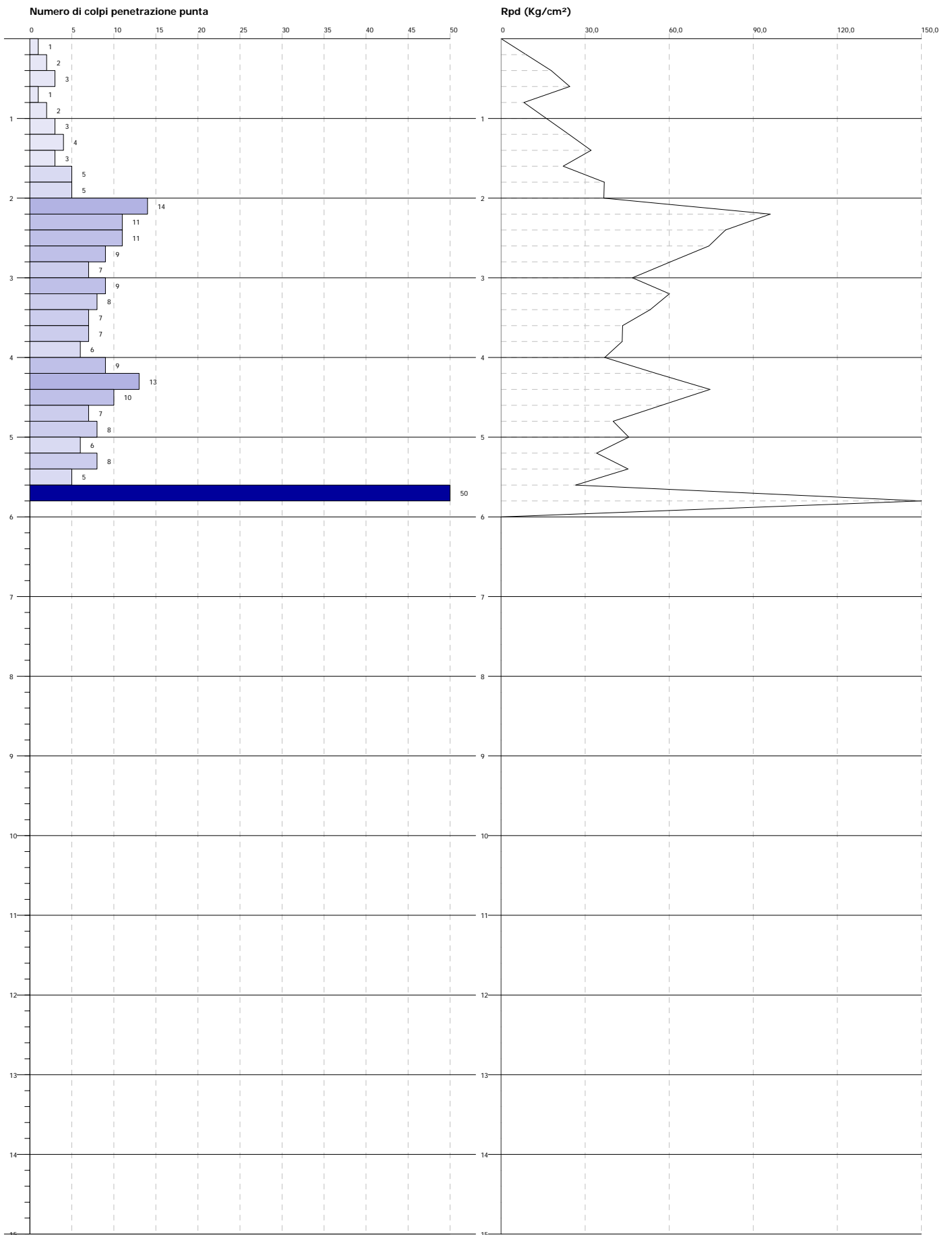
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :08/11/2018

FALDA: m.4,10 da p.c.

Scala 1:64



CASTEL D'AIANO_MS, MS 2018 TR13

037013P119HVSR133

Instrument: TRZ-0108/01-10

Start recording: 07/02/19 12:44:04 End recording: 07/02/19 13:00:05

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 67% trace (manual window selection)

Sampling rate: 128 Hz

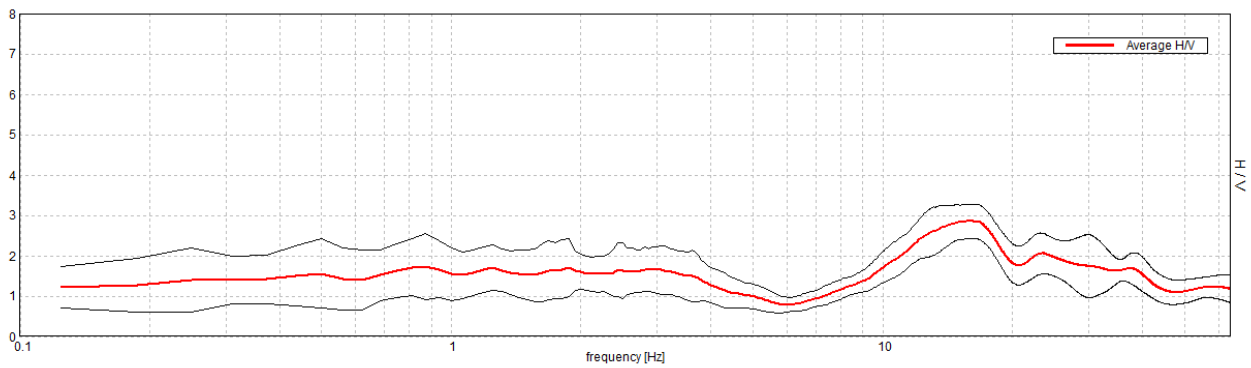
Window size: 16 s

Smoothing type: Triangular window

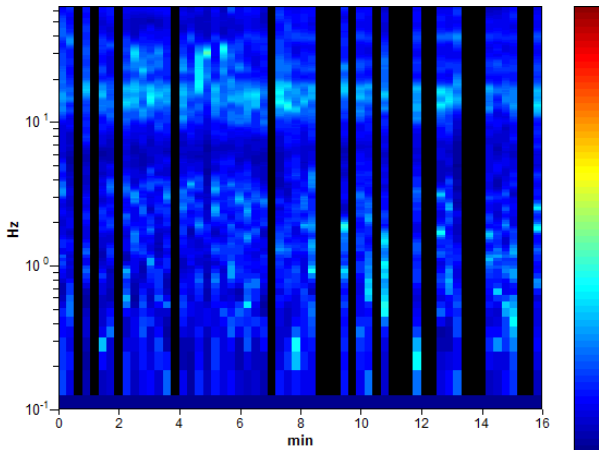
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

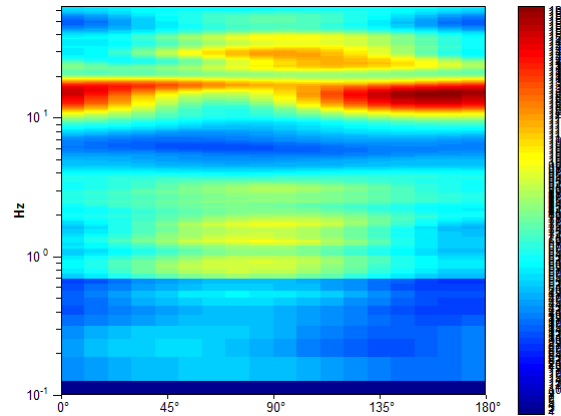
Max. H/V at 15.63 ± 0.18 Hz. (In the range 0.1 - 20.0 Hz).



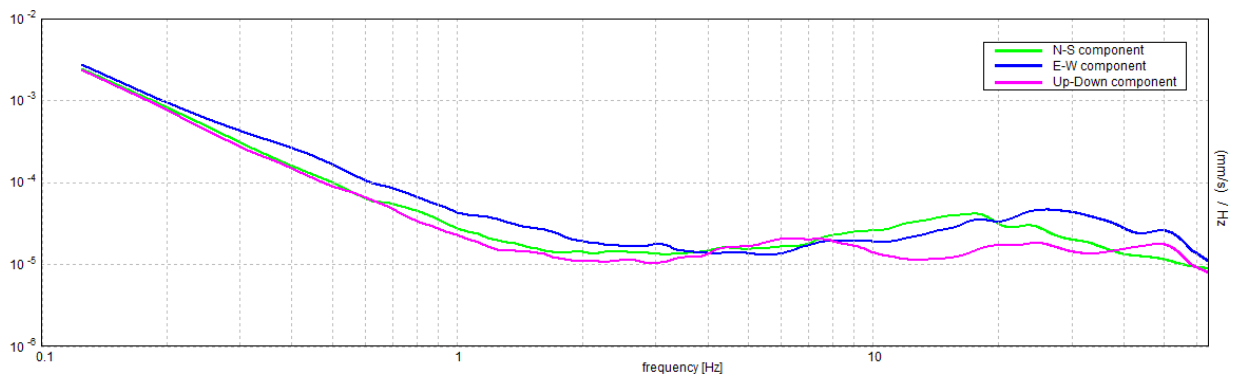
H/V TIME HISTORY



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 15.63 ± 0.18 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	15.63 > 0.63	OK	
$n_c(f_0) > 200$	10000.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 376 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	9.188 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	41.063 Hz	OK	
$A_0 > 2$	2.85 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00554 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.08652 < 0.78125$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.2086 < 1.58$	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 $\sigma_A(f_0)$

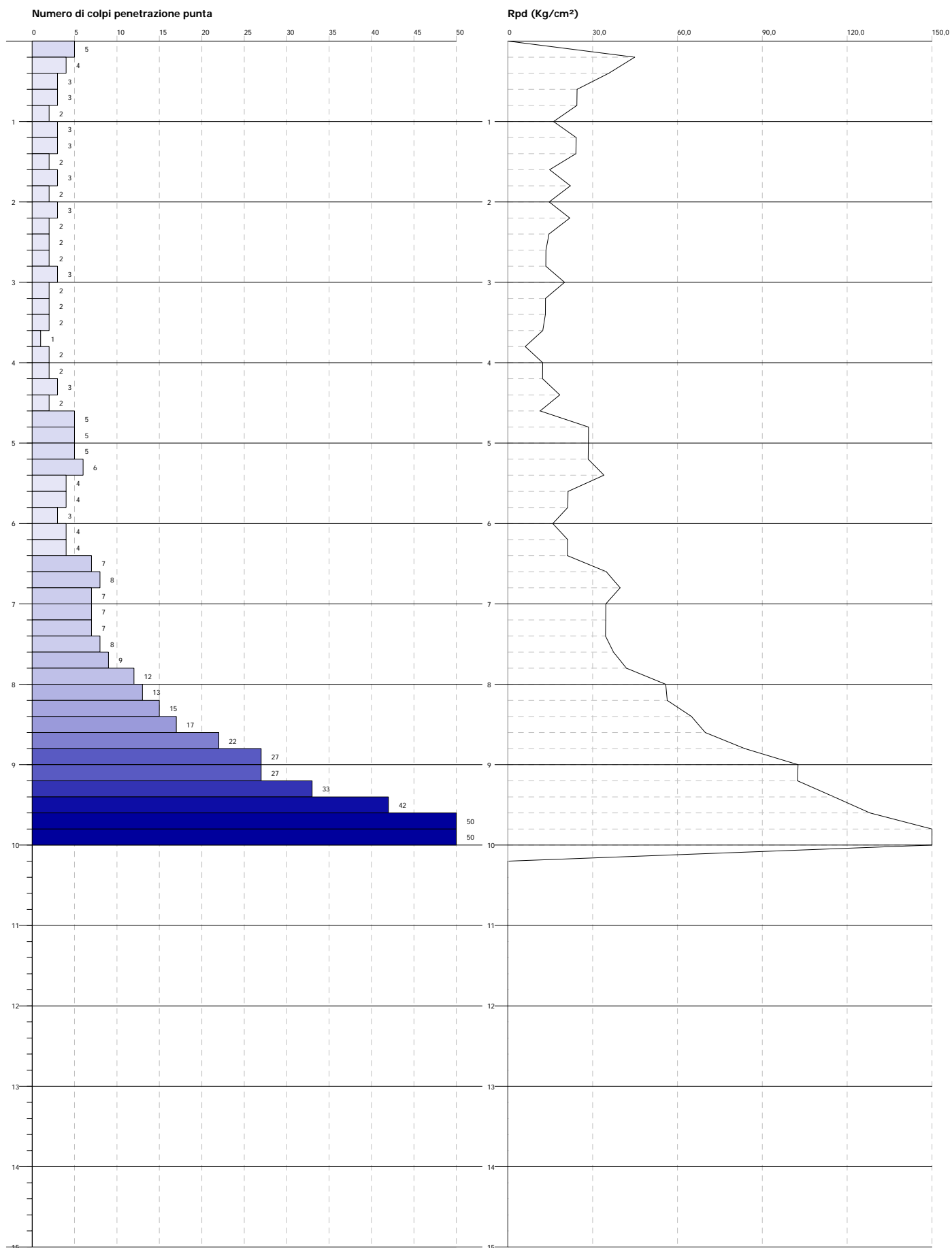
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data : 11/10/2018

FALDA: foro occluso a p.c.; estratte n.6 aste bagnate

Scala 1:64

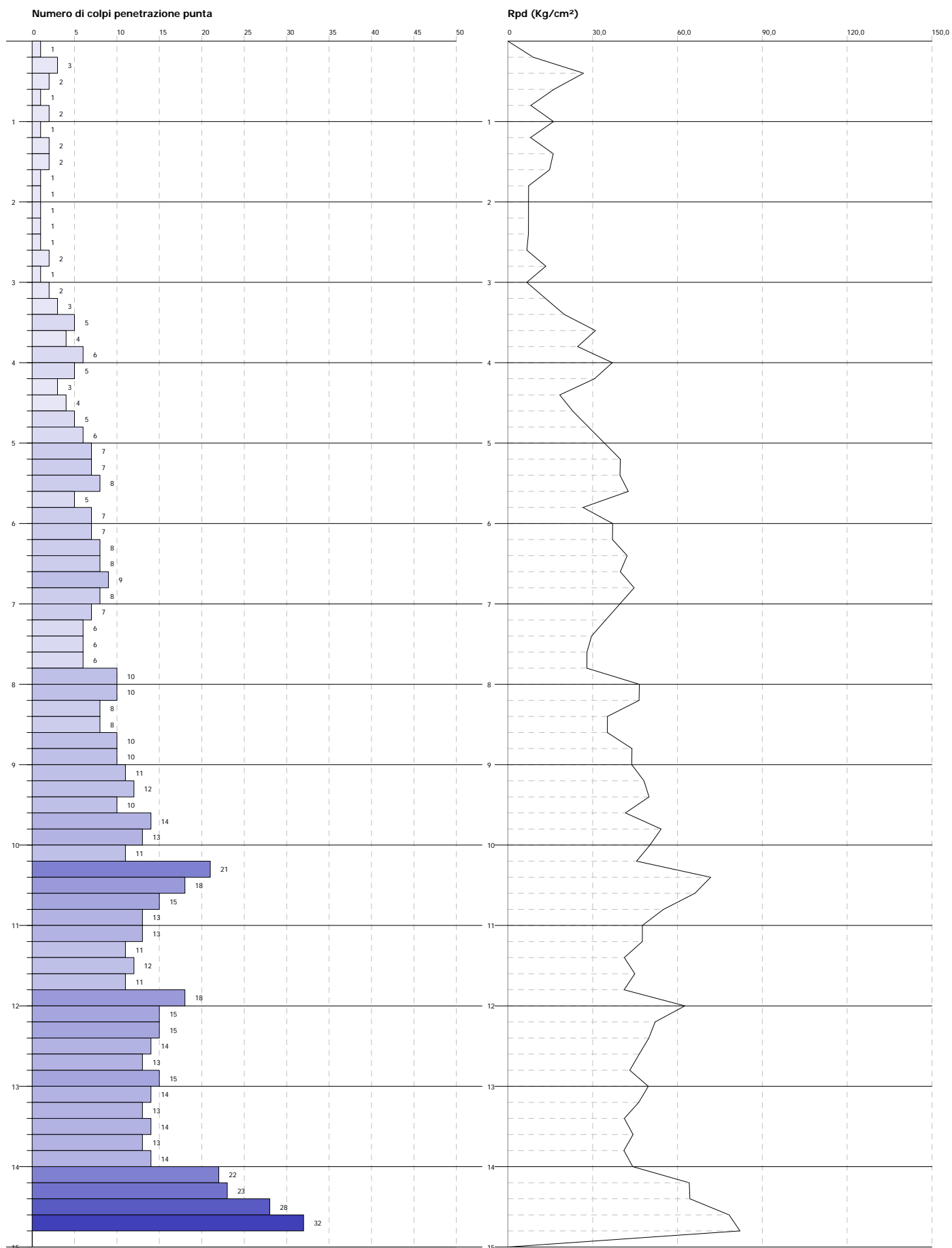


Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data : 11/10/2018

FALDA: m.2,40 circa da p.c.

Scala 1:64



CASTEL D'AIANO_MS, MS 2018 TR15

037013P121HVS151

Instrument: TRZ-0108/01-10

Start recording: 07/02/19 11:38:03 End recording: 07/02/19 11:54:04

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 73% trace (manual window selection)

Sampling rate: 128 Hz

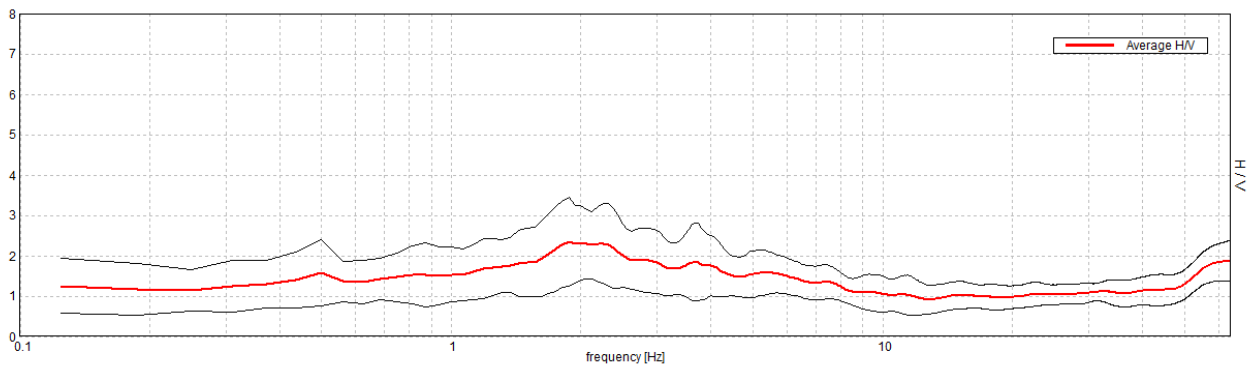
Window size: 16 s

Smoothing type: Triangular window

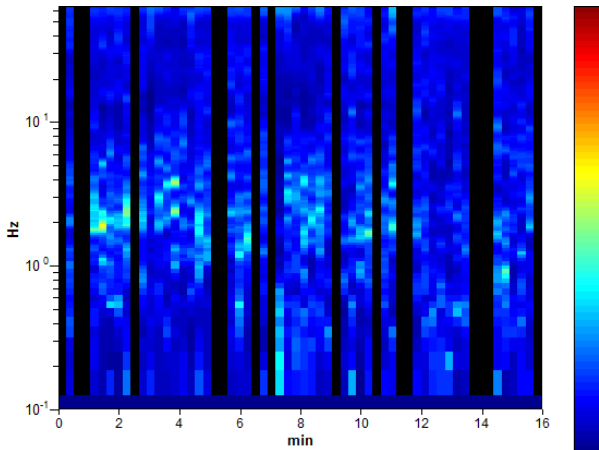
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

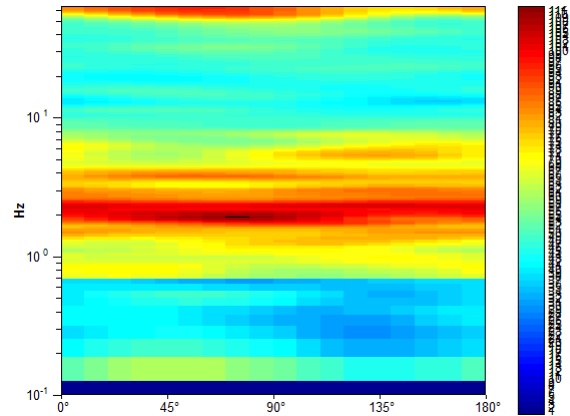
Max. H/V at 1.88 ± 0.07 Hz. (In the range 0.1 - 20.0 Hz).



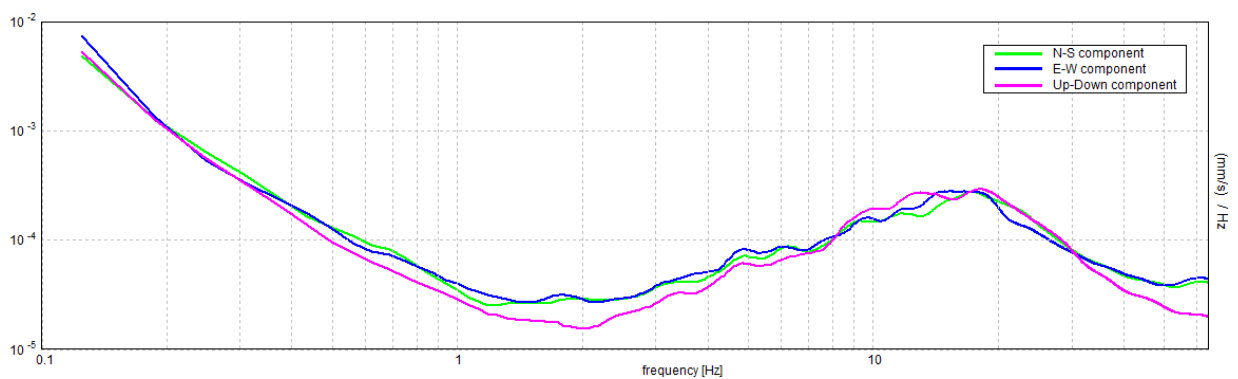
H/V TIME HISTORY



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 1.88 ± 0.07 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$1.88 > 0.63$	OK	
$n_c(f_0) > 200$	$1320.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 46 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
$A_0 > 2$	$2.34 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01831 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.03433 < 0.1875$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.5448 < 1.78$	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 $\sigma_A(f_0)$

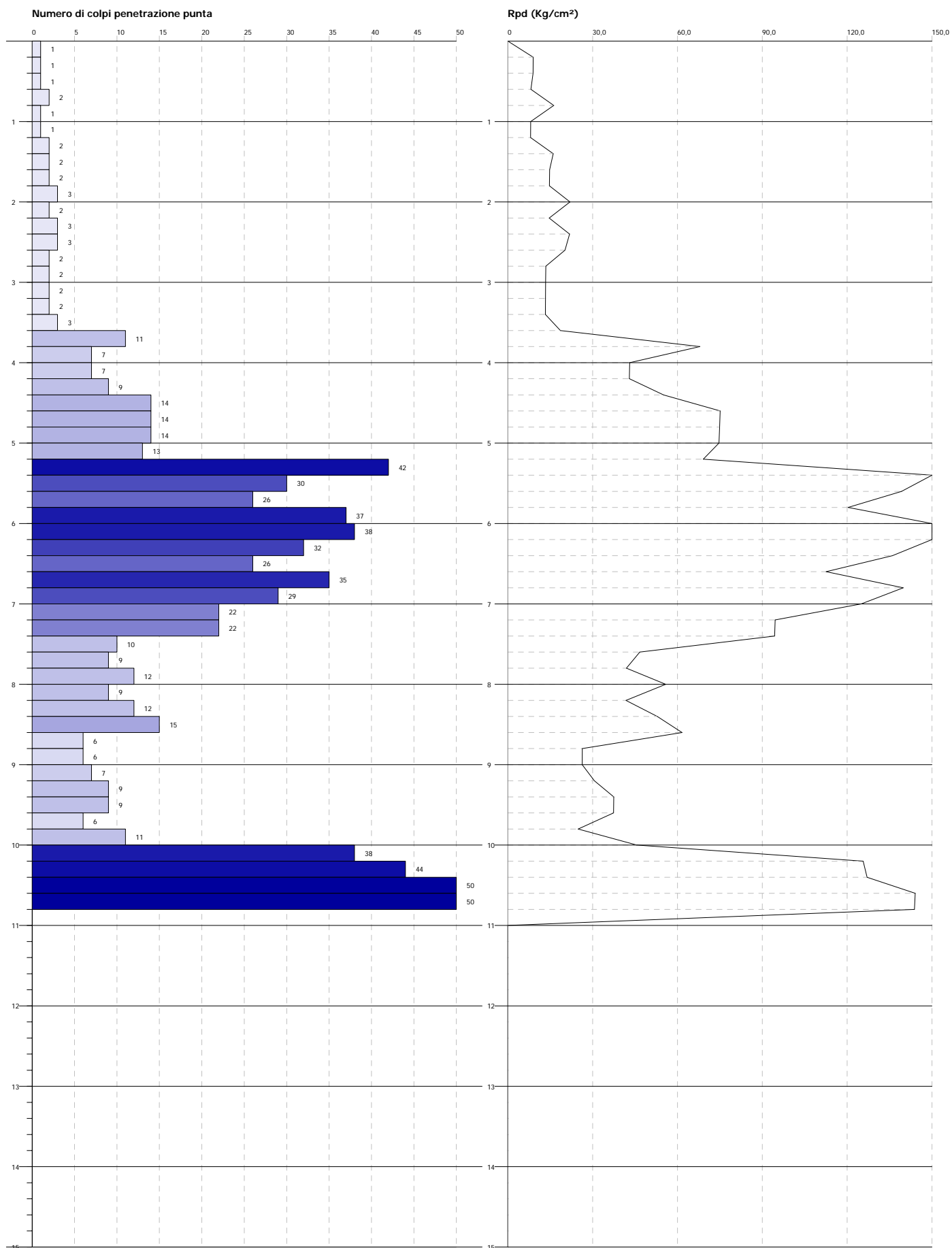
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :07/11/2018

FALDA: foro occluso e asciutto alla prof. di m. 1,50 da p.c. Estratte n.7 aste bagnate.

Scala 1:64

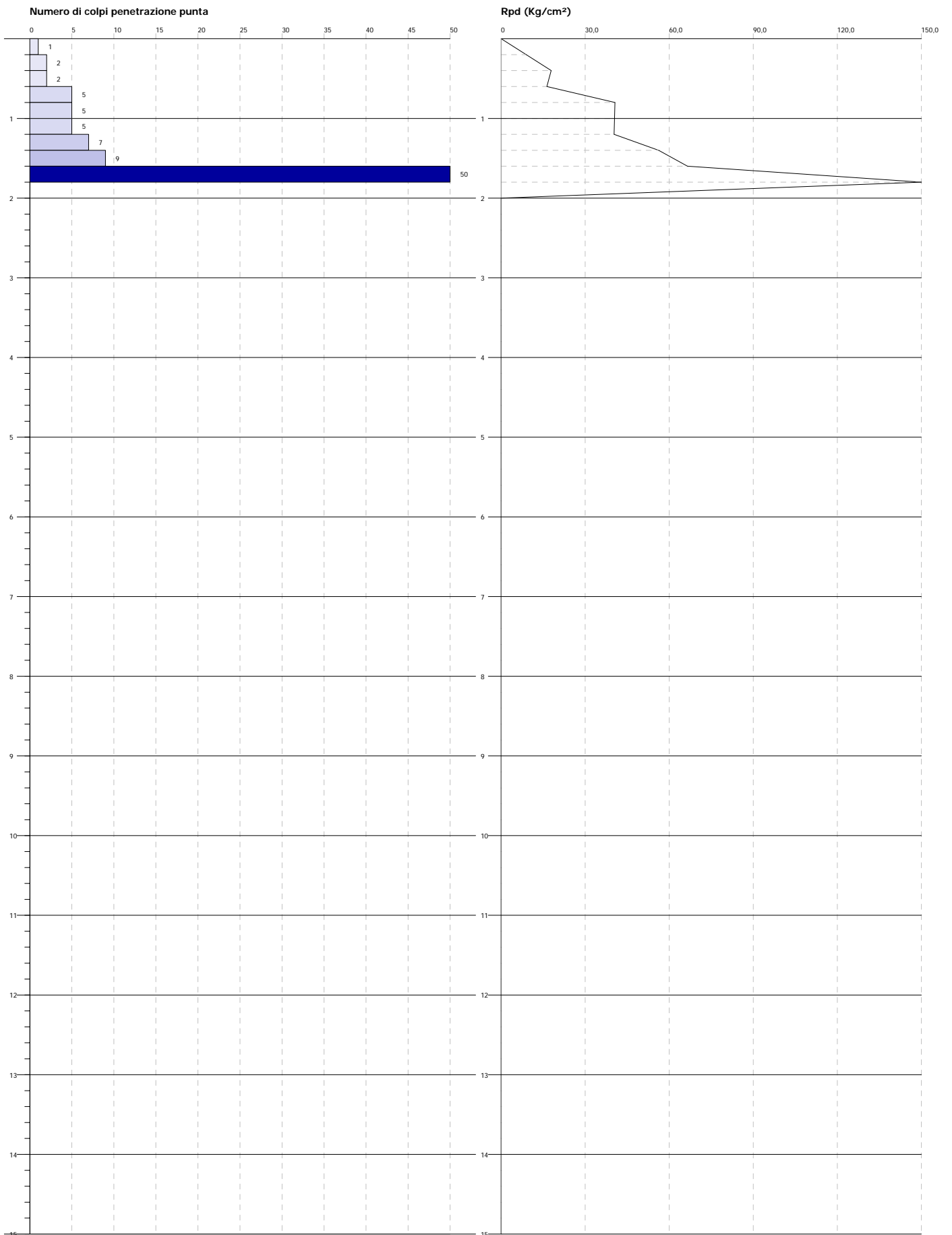


Committente : geol. Samuel Sangiorgi
Cantiere : Microzonazione Sismica
Località : Comune di Castel D'Aiano

Data :07/11/2018

FALDA: foro asciutto

Scala 1:64



CASTEL D'AIANO_MS, MS 2018 TR10

037013P123HVSR139

Instrument: TRZ-0108/01-10

Start recording: 31/10/18 12:01:29 End recording: 31/10/18 12:17:30

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 73% trace (manual window selection)

Sampling rate: 128 Hz

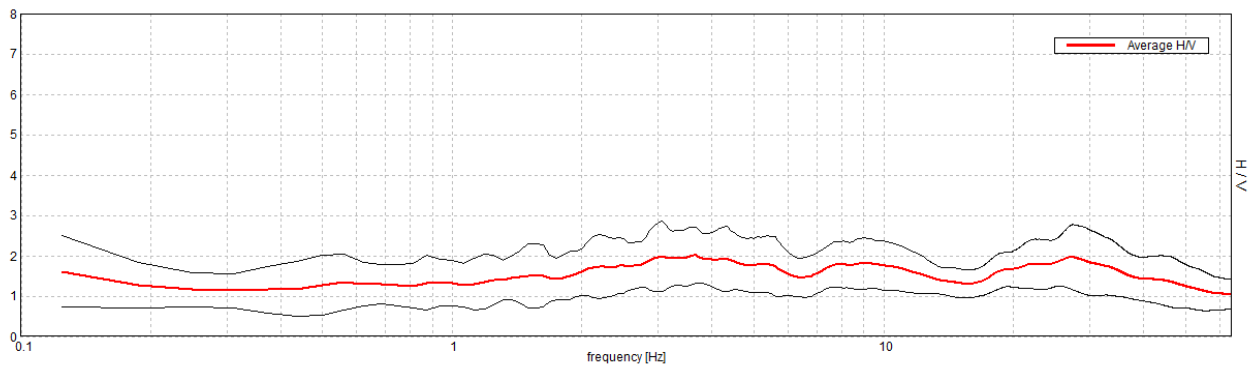
Window size: 16 s

Smoothing type: Triangular window

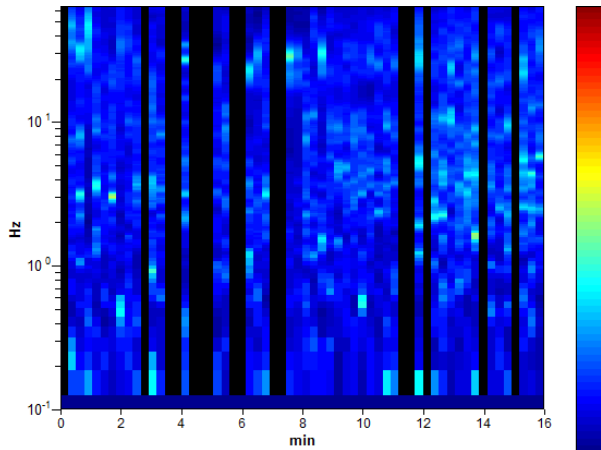
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

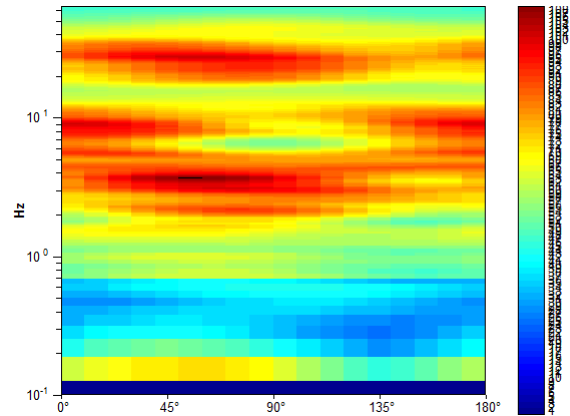
Max. H/V at 3.69 ± 0.29 Hz. (In the range 0.1 - 20.0 Hz).



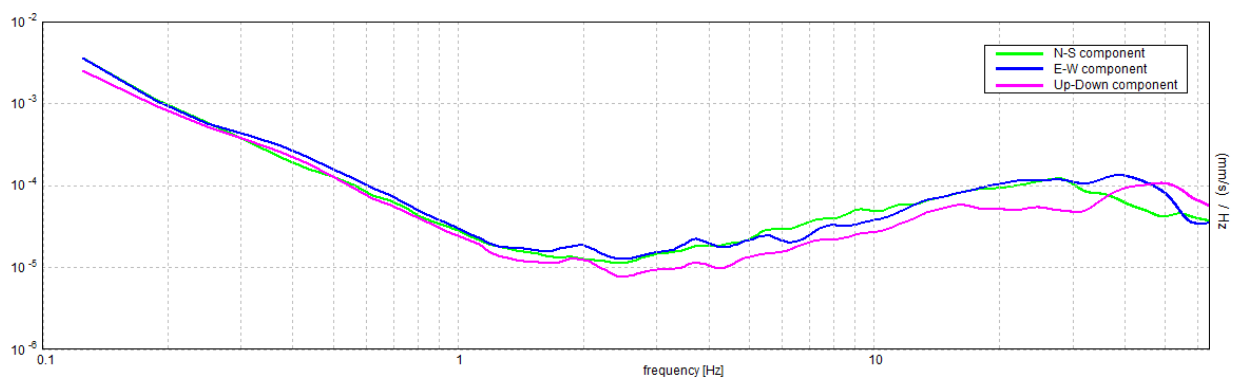
H/V TIME HISTORY



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 3.69 ± 0.29 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$3.69 > 0.63$	OK	
$n_c(f_0) > 200$	$2596.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 90 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
$A_0 > 2$	$2.01 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.03846 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.1418 < 0.18438$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.3415 < 1.58$	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 $\sigma_A(f_0)$

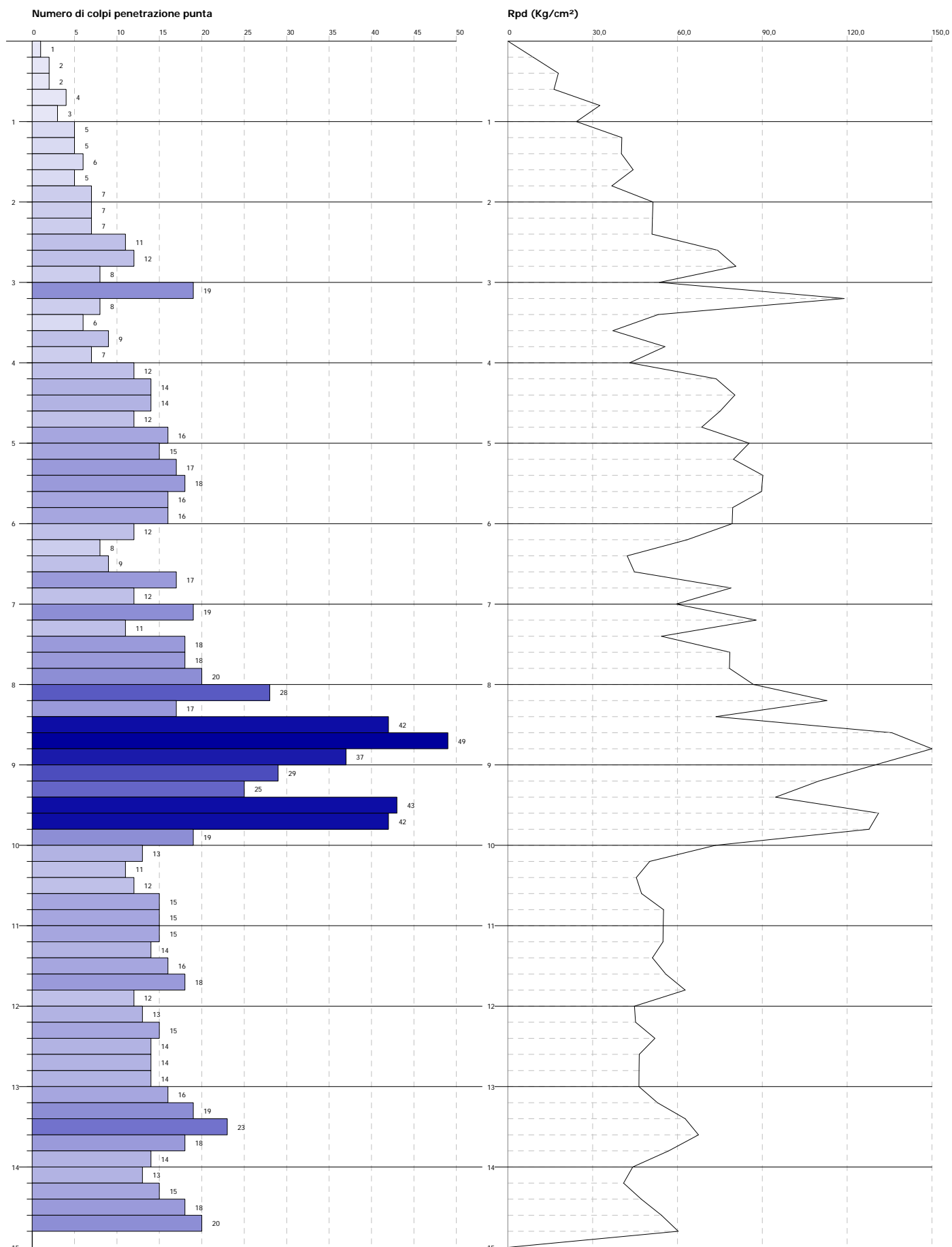
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :07/11/2018

FALDA: foro occluso e asciutto alla prof. di m. 4,40. Estratte n.8 aste bagnate.

Scala 1:64

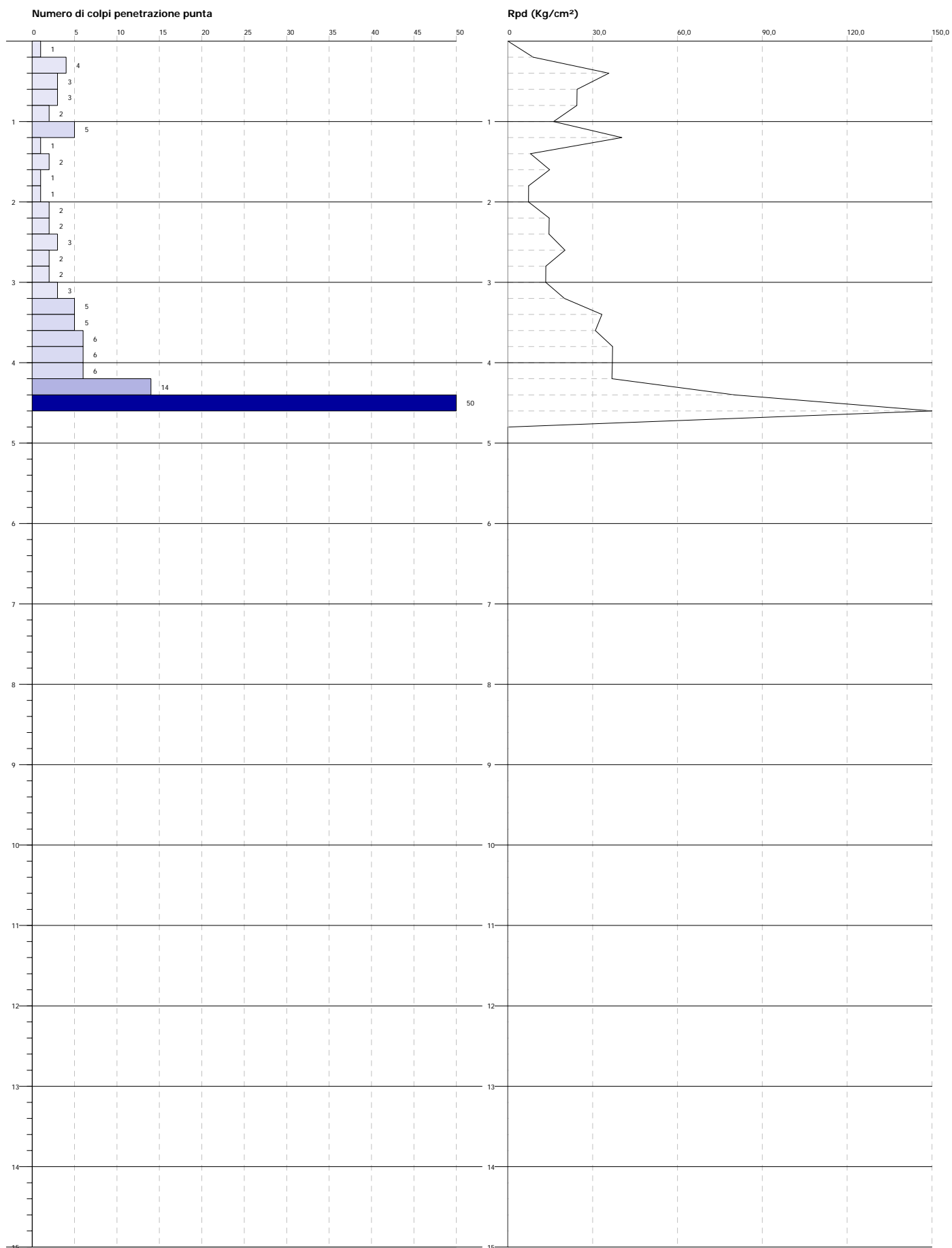


Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :31/10/2018

FALDA: foro occluso e asciutto alla prof. di m. 4,40

Scala 1:64

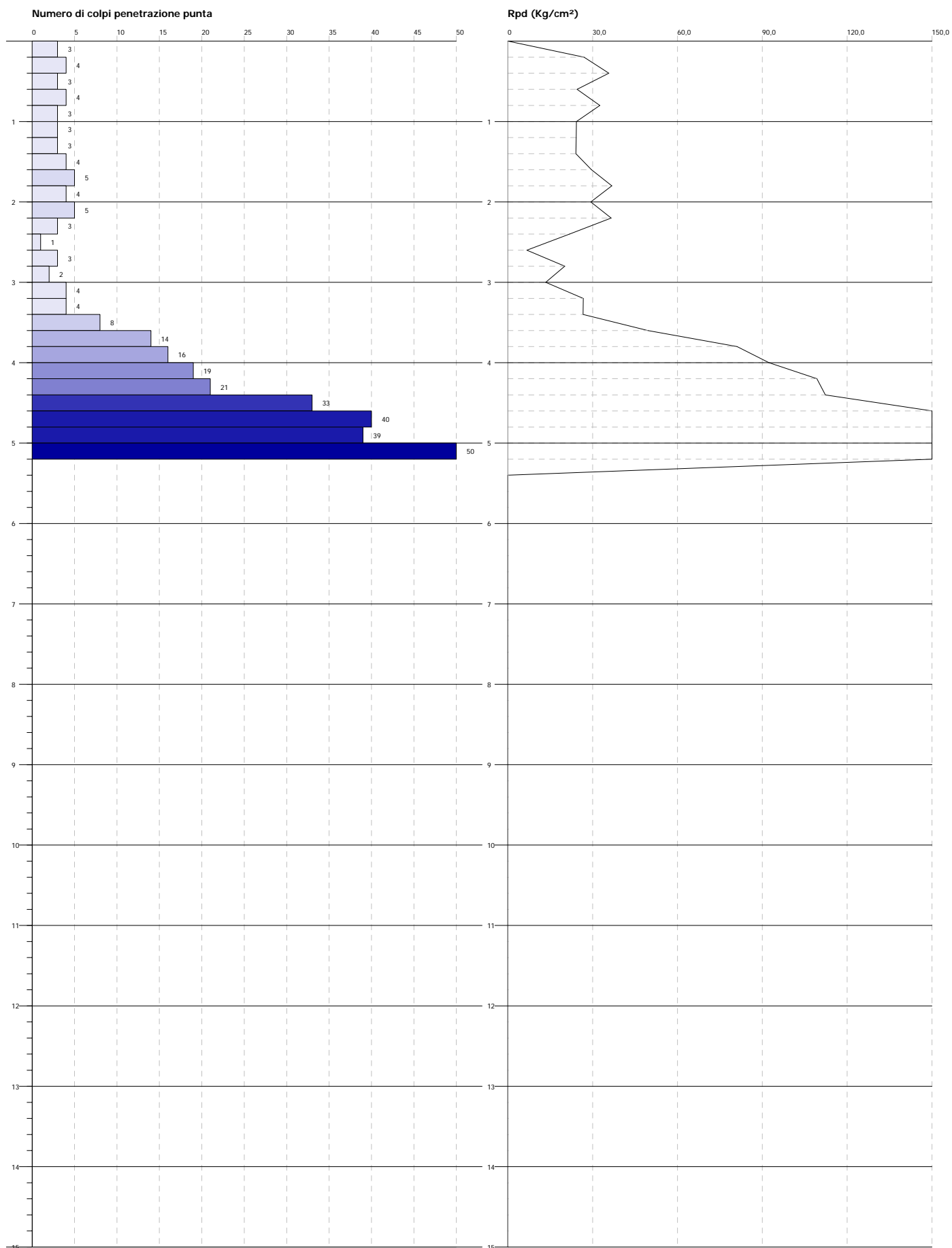


Committente : geol. Samuel Sangiorgi
 Cantiere : Microzonazione Sismica
 Località : Comune di Castel D'Aiano

Data :31/10/2018

FALDA: foro occluso e asciutto alla prof. di m. 5,00

Scala 1:64



CASTEL D'AIANO_MS, MS 2018 TR3

037013P127HVSR143

Instrument: TRZ-0108/01-10

Start recording: 31/10/18 13:23:22 End recording: 31/10/18 13:39:23

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 87% trace (manual window selection)

Sampling rate: 128 Hz

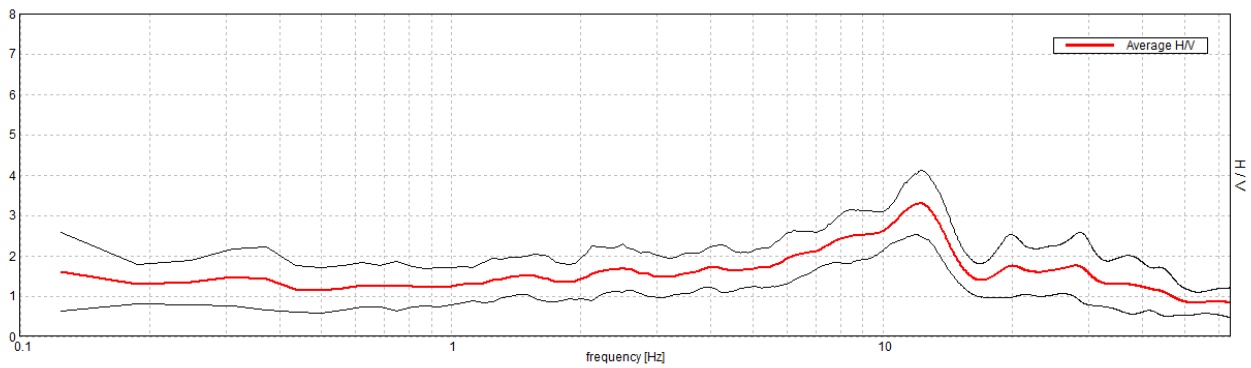
Window size: 16 s

Smoothing type: Triangular window

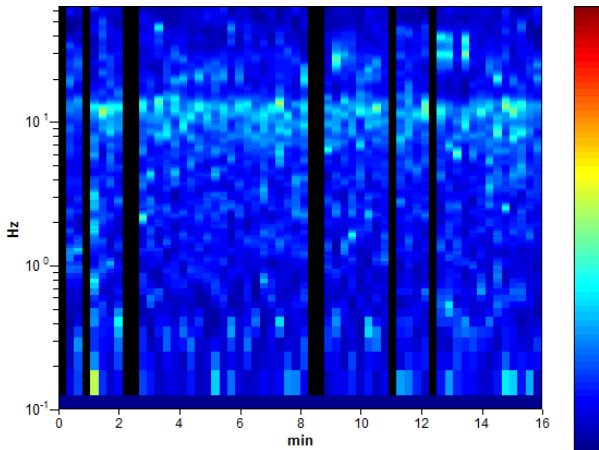
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

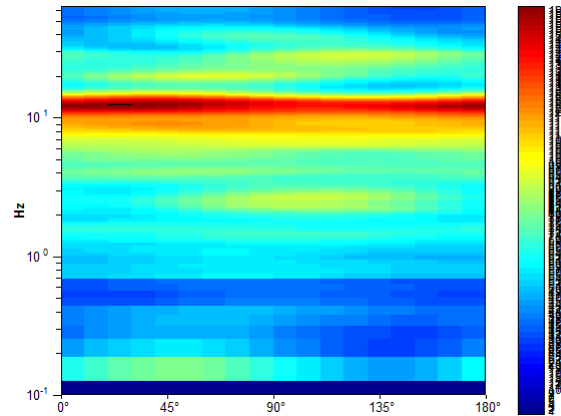
Max. H/V at 12.25 ± 0.5 Hz. (In the range 0.1 - 20.0 Hz).



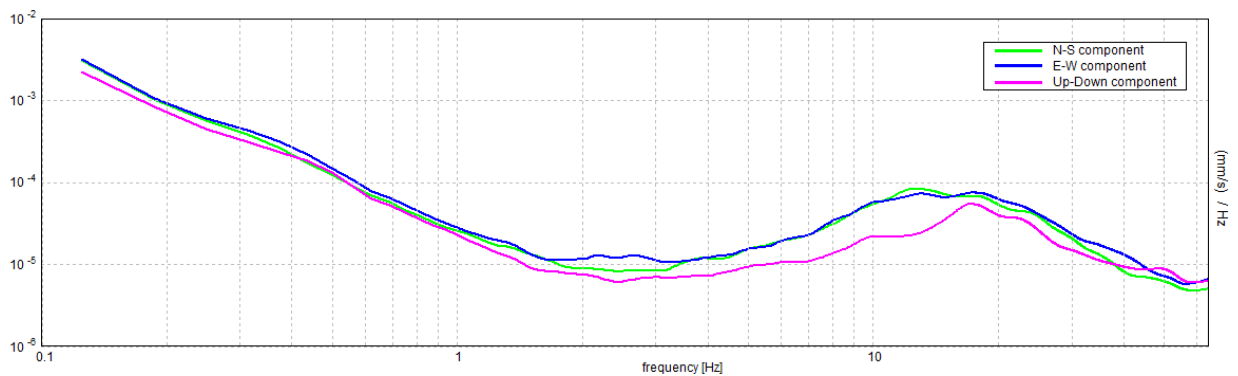
H/V TIME HISTORY



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 12.25 ± 0.5 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	12.25 > 0.63	OK	
$n_c(f_0) > 200$	10192.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 295 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	4.813 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	15.5 Hz	OK	
$A_0 > 2$	3.29 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.02029 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	0.24856 < 0.6125	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.4003 < 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

CASTEL D'AIANO_MS, MS 2018 TR4

037013P128HVSR144

Instrument: TRZ-0108/01-10

Start recording: 07/02/19 11:13:08 End recording: 07/02/19 11:29:09

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 73% trace (manual window selection)

Sampling rate: 128 Hz

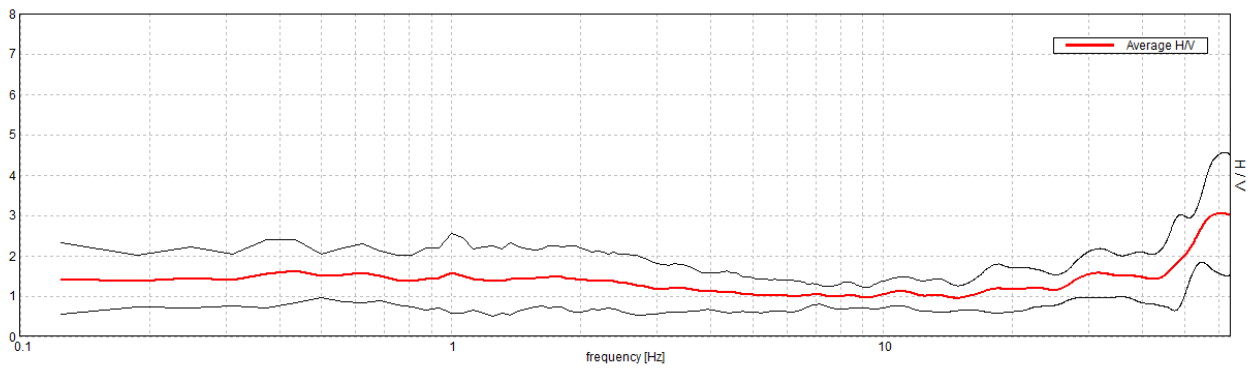
Window size: 16 s

Smoothing type: Triangular window

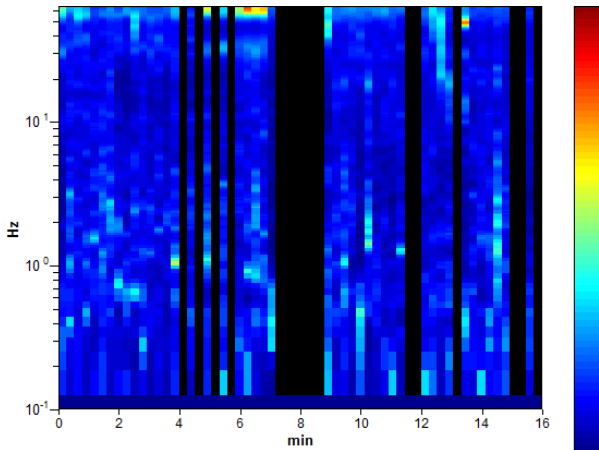
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

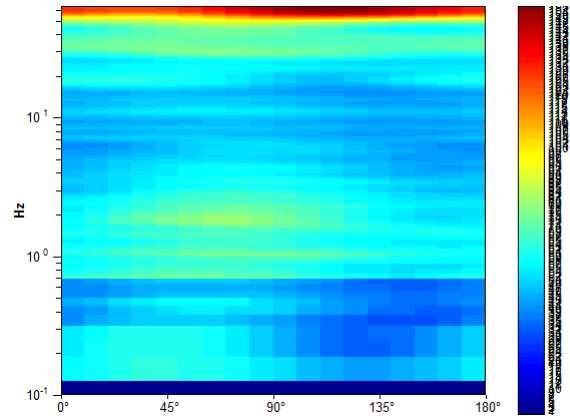
Max. H/V at 0.44 ± 0.16 Hz. (In the range 0.1 - 20.0 Hz).



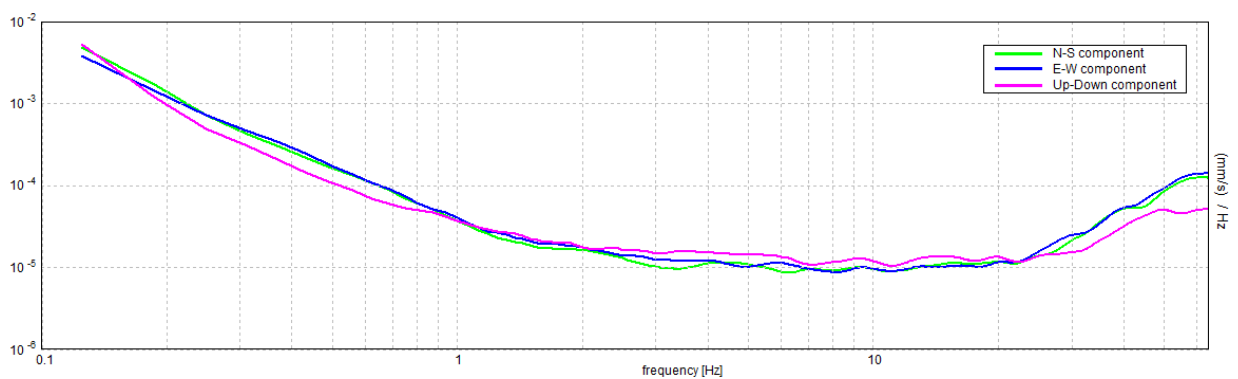
H/V TIME HISTORY



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 0.44 ± 0.16 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$0.44 > 0.63$		NO
$n_c(f_0) > 200$	$308.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 12 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
$A_0 > 2$	$1.62 > 2$		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.17472 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$0.07644 < 0.0875$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.3797 < 2.5$	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

CASTEL D'AIANO_MS, MS 2018 TR5

037013P129HVSR145

Instrument: TRZ-0108/01-10

Start recording: 09/11/18 16:43:37 End recording: 09/11/18 16:59:38

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 88% trace (manual window selection)

Sampling rate: 128 Hz

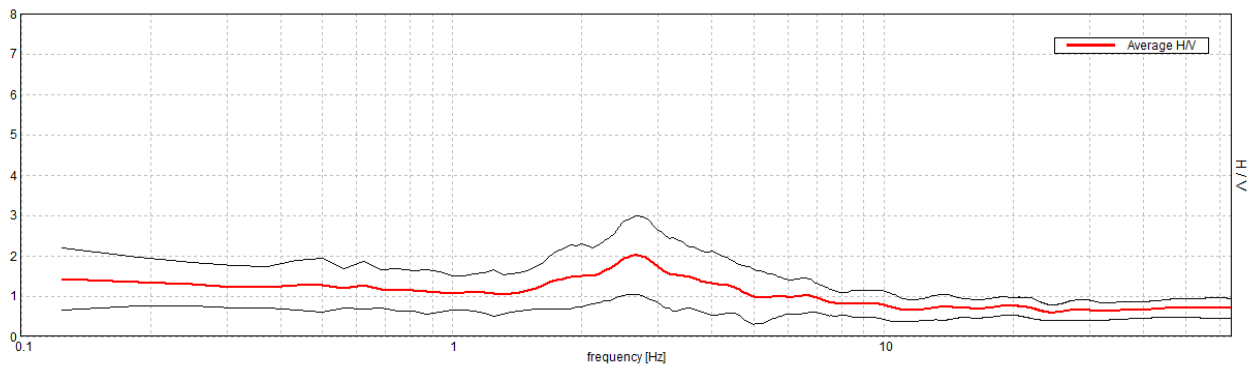
Window size: 16 s

Smoothing type: Triangular window

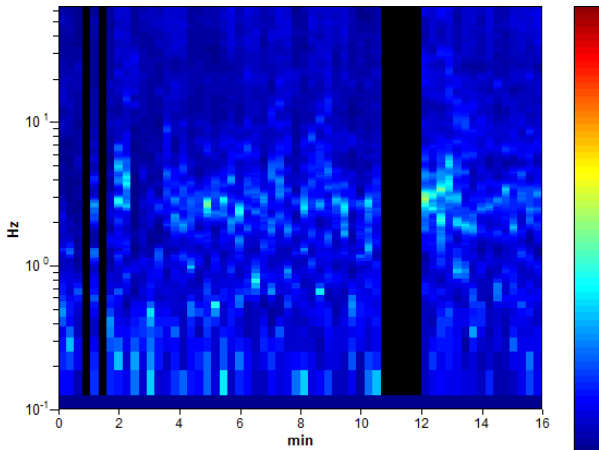
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

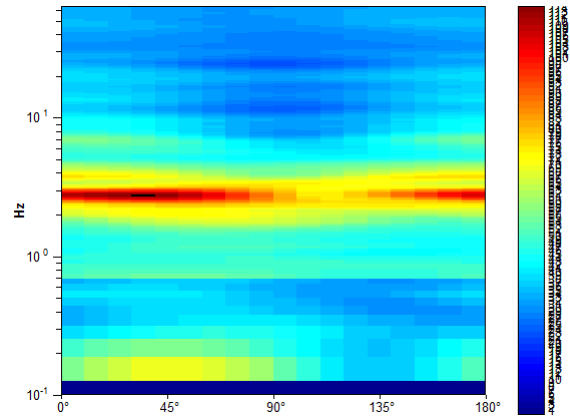
Max. H/V at 2.69 ± 0.37 Hz. (In the range 0.1 - 20.0 Hz).



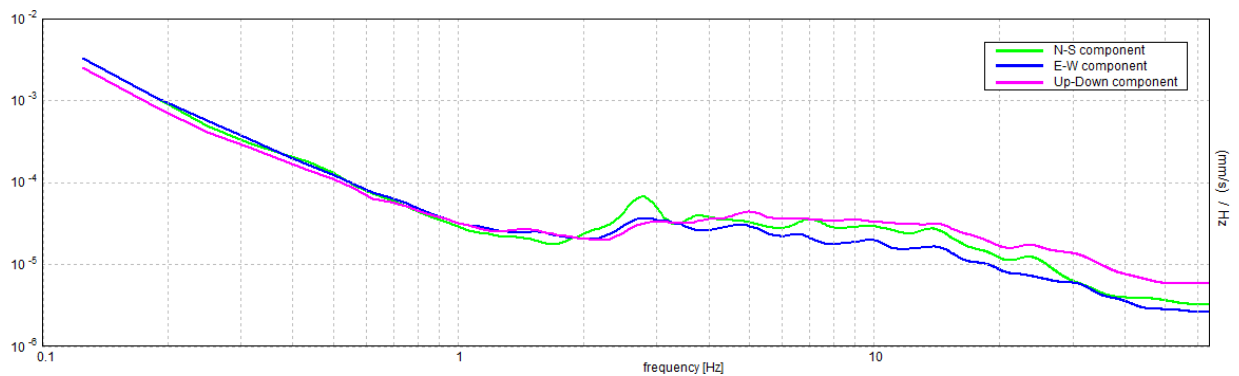
H/V TIME HISTORY



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 2.69 ± 0.37 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$2.69 > 0.63$	OK	
$n_c(f_0) > 200$	$2279.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 66 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 $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	5.0 Hz	OK	
$A_0 > 2$	$2.00 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.06828 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$0.18349 < 0.13438$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.4802 < 1.58$	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

CASTEL D'AIANO_MS, MS 2018 TR6

037013P130HVSR146

Instrument: TRZ-0108/01-10

Start recording: 09/11/18 17:25:44 End recording: 09/11/18 17:41:45

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 87% trace (manual window selection)

Sampling rate: 128 Hz

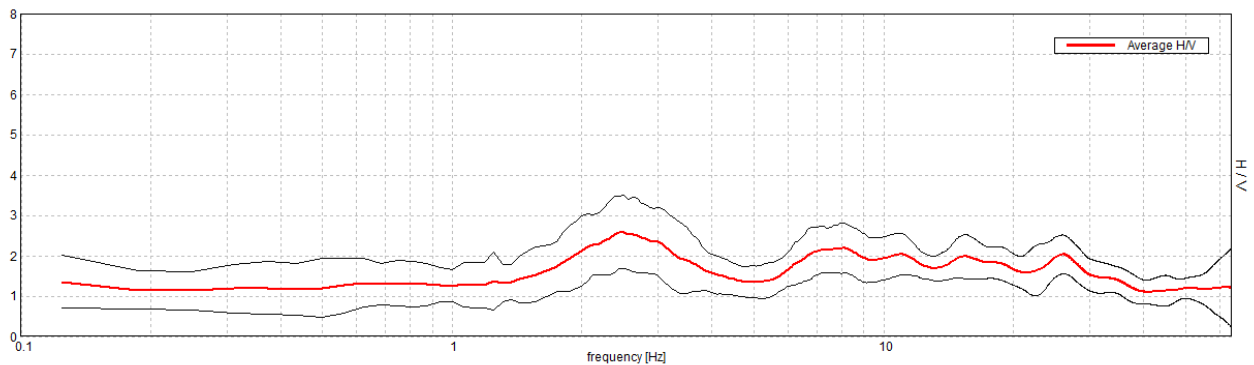
Window size: 16 s

Smoothing type: Triangular window

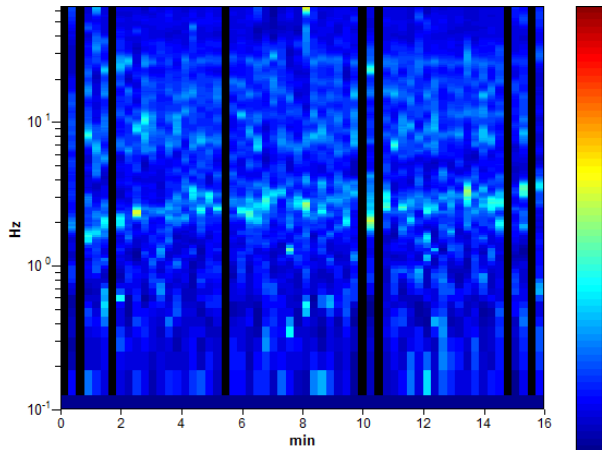
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

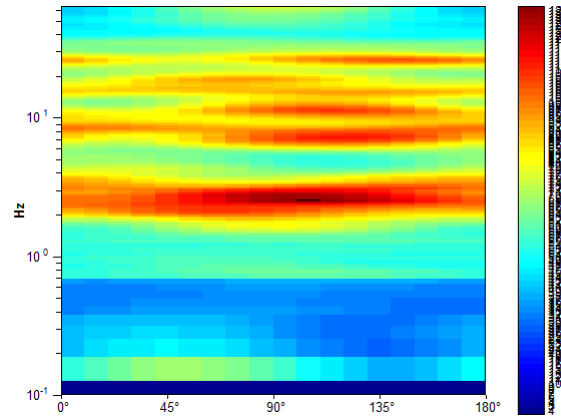
Max. H/V at 2.5 ± 0.23 Hz. (In the range 0.1 - 20.0 Hz).



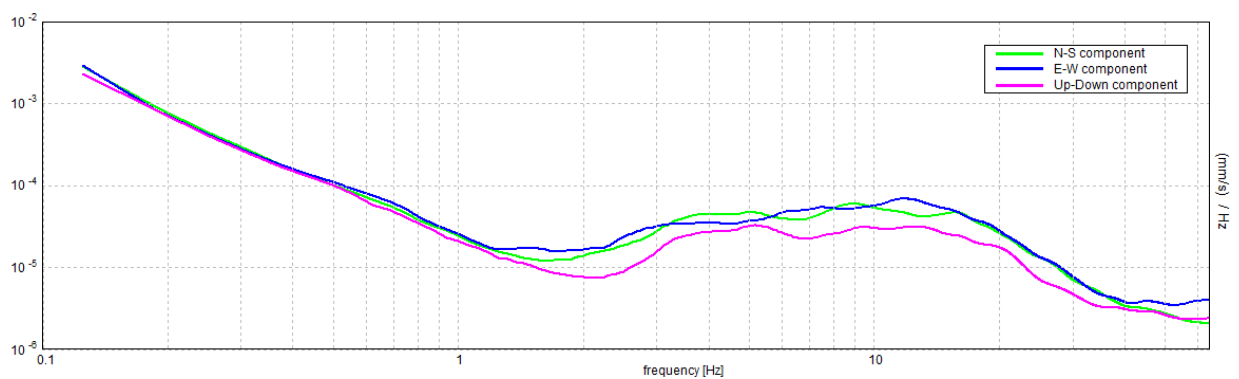
H/V TIME HISTORY



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 2.5 ± 0.23 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$2.50 > 0.63$	OK	
$n_c(f_0) > 200$	$2080.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 61 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	1.188 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	$2.59 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.04459 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.11148 < 0.125$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.4475 < 1.58$	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

CASTEL D'AIANO_MS, MS 2018 TR9

037013P131HVSR147

Instrument: TRZ-0108/01-10

Start recording: 07/02/19 11:59:54 End recording: 07/02/19 12:15:54

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 87% trace (manual window selection)

Sampling rate: 128 Hz

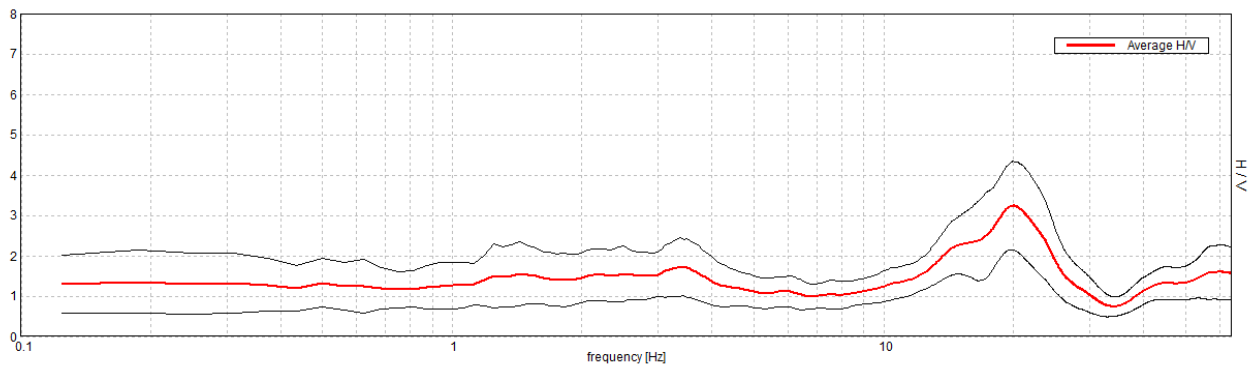
Window size: 16 s

Smoothing type: Triangular window

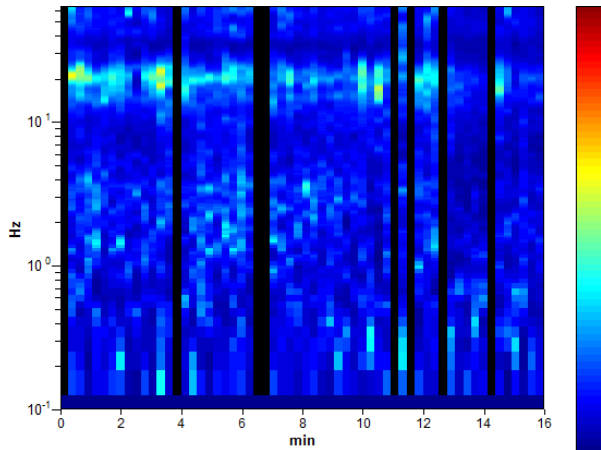
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

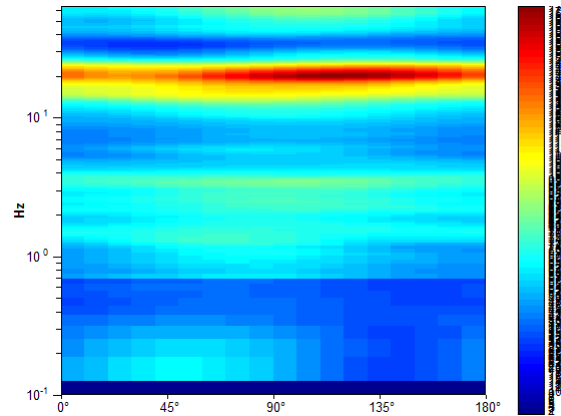
Max. H/V at 19.94 ± 0.02 Hz. (In the range 0.1 - 20.0 Hz).



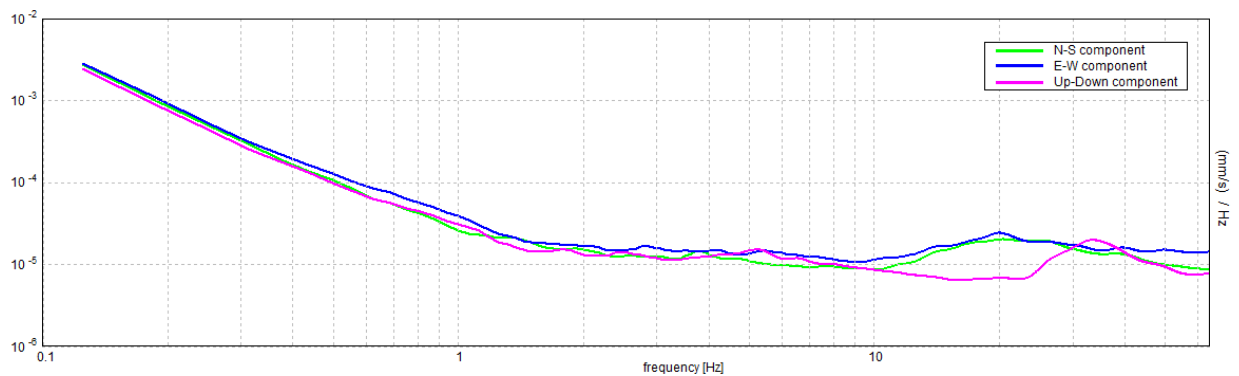
H/V TIME HISTORY



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 19.94 ± 0.02 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	19.94 > 0.63	OK	
$n_c(f_0) > 200$	16588.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 480 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	12.563 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	25.813 Hz	OK	
$A_0 > 2$	3.24 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00043 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.00867 < 0.99688$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.5411 < 1.58$	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

CASTEL D'AIANO_MS, MS 2018 TR11

037013P132HVSR148

Instrument: TRZ-0108/01-10

Start recording: 31/10/18 10:43:24 End recording: 31/10/18 10:59:25

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 97% trace (manual window selection)

Sampling rate: 128 Hz

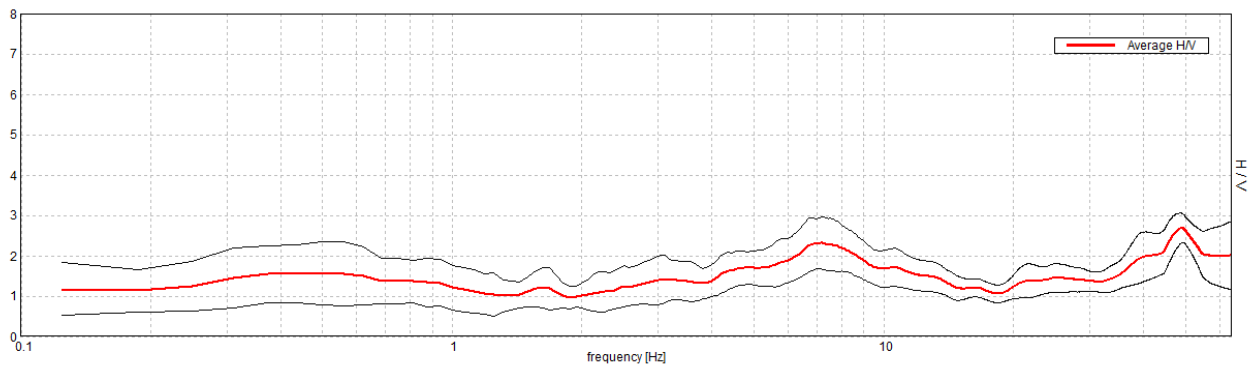
Window size: 16 s

Smoothing type: Triangular window

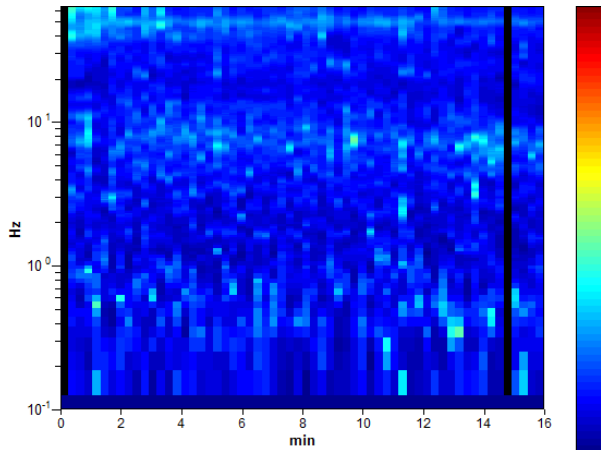
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

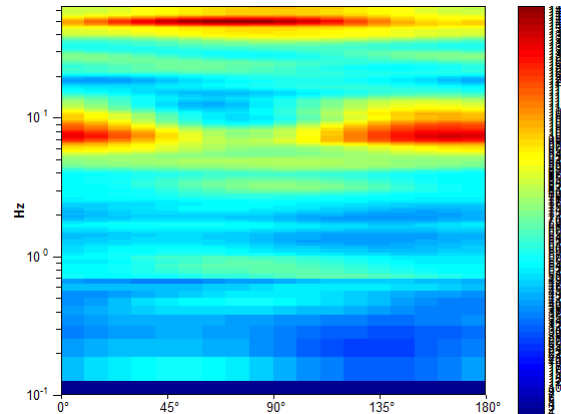
Max. H/V at 7.13 ± 0.18 Hz. (In the range 0.1 - 20.0 Hz).



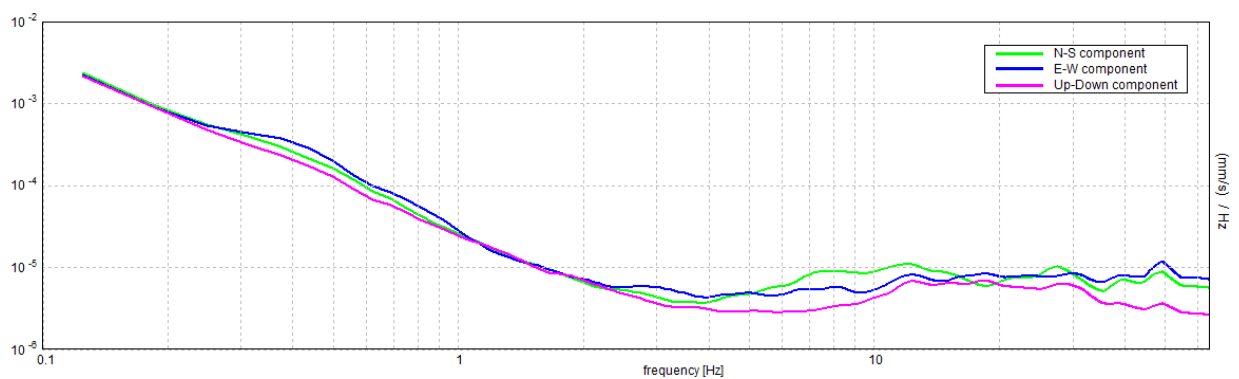
H/V TIME HISTORY



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 7.13 ± 0.18 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	7.13 > 0.63	OK	
$n_c(f_0) > 200$	6612.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 172 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	2.375 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	17.063 Hz	OK	
$A_0 > 2$	2.31 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.0125 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	0.08904 < 0.35625	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.3137 < 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

CASTEL D'AIANO_MS, MS 2018 TR12

037013P133HVSR149

Instrument: TRZ-0108/01-10

Start recording: 09/11/18 17:47:30 End recording: 09/11/18 18:03:31

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 87% trace (manual window selection)

Sampling rate: 128 Hz

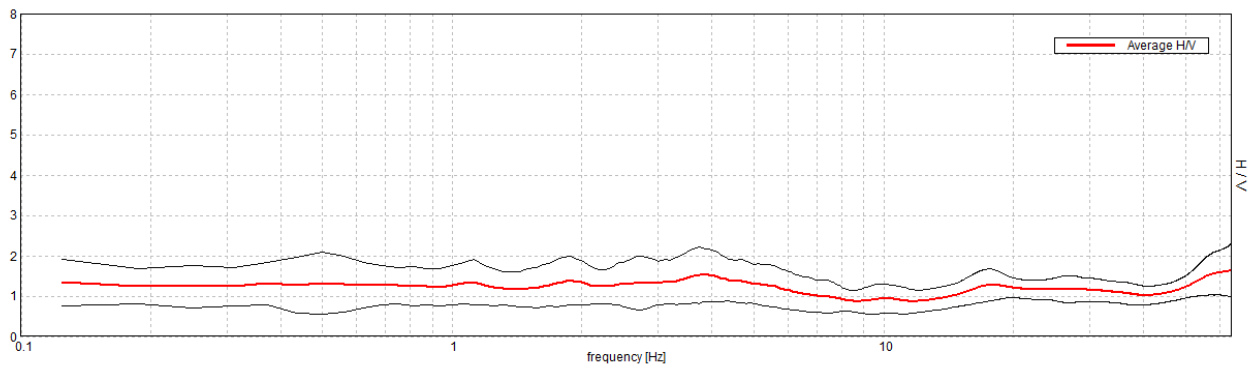
Window size: 16 s

Smoothing type: Triangular window

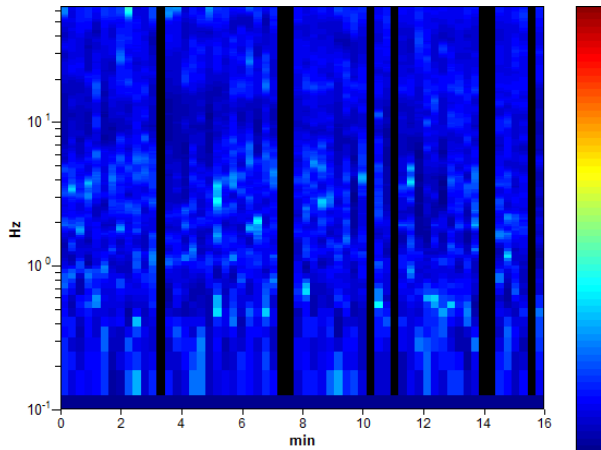
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

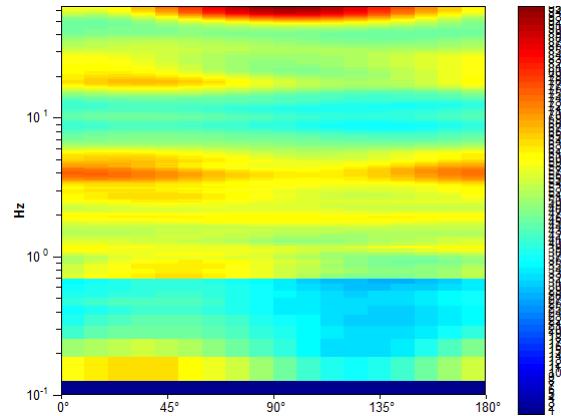
Max. H/V at 3.94 ± 0.16 Hz. (In the range 0.1 - 20.0 Hz).



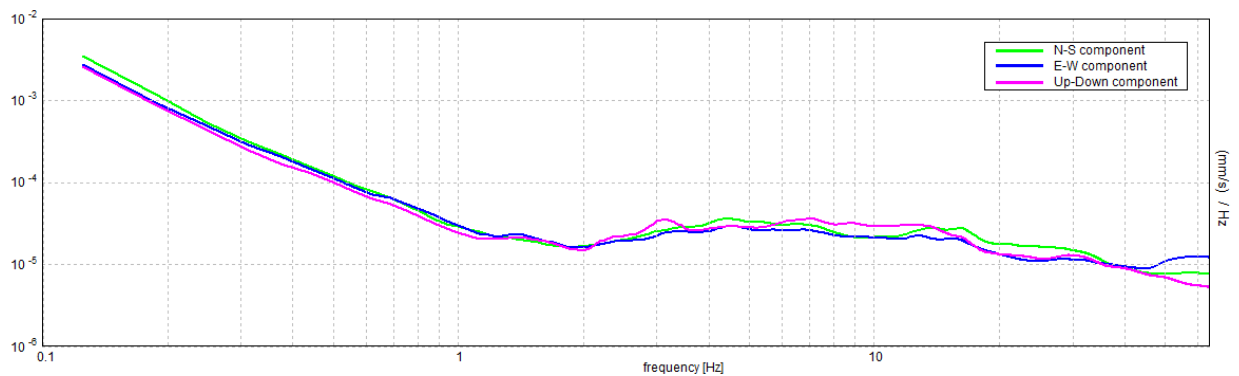
H/V TIME HISTORY



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 3.94 ± 0.16 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$3.94 > 0.63$	OK	
$n_c(f_0) > 200$	$3276.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 96 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
$A_0 > 2$	$1.52 > 2$		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01975 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.07778 < 0.19688$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.3244 < 1.58$	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

CASTEL D'AIANO_MS, MS 2018 TR14

037013P134HVSR150

Instrument: TRZ-0108/01-10

Start recording: 09/11/18 17:05:08 End recording: 09/11/18 17:21:09

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 85% trace (manual window selection)

Sampling rate: 128 Hz

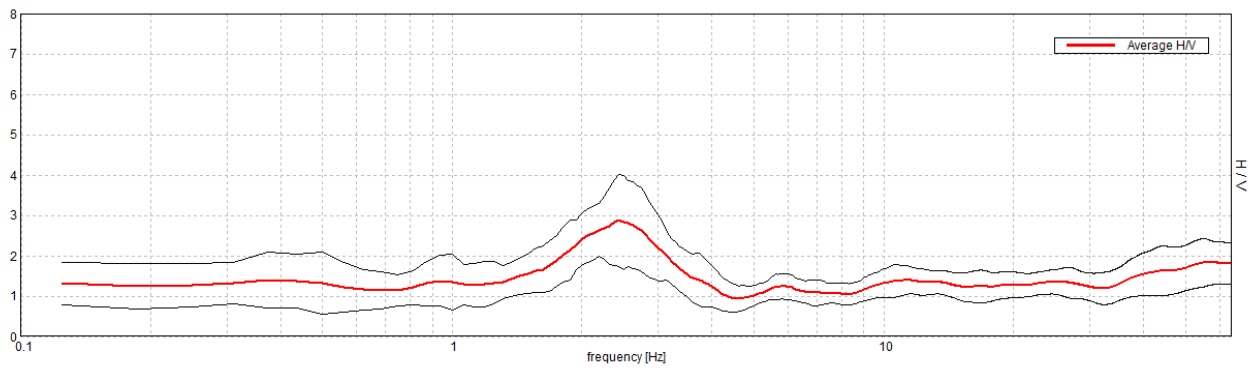
Window size: 16 s

Smoothing type: Triangular window

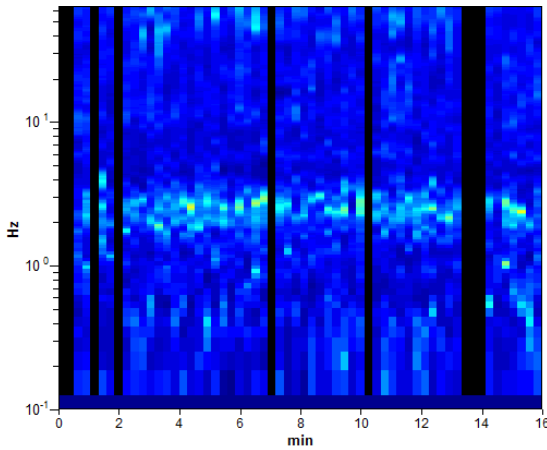
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

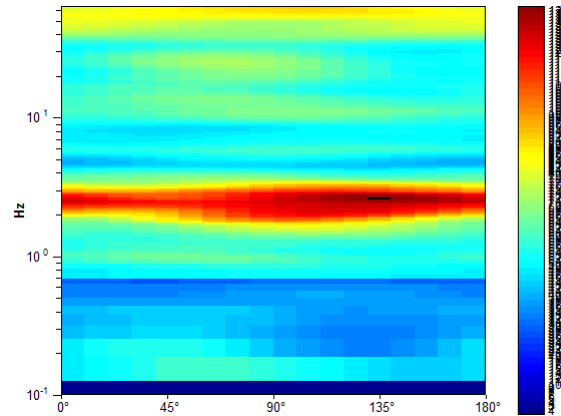
Max. H/V at 2.44 ± 0.06 Hz. (In the range 0.1 - 20.0 Hz).



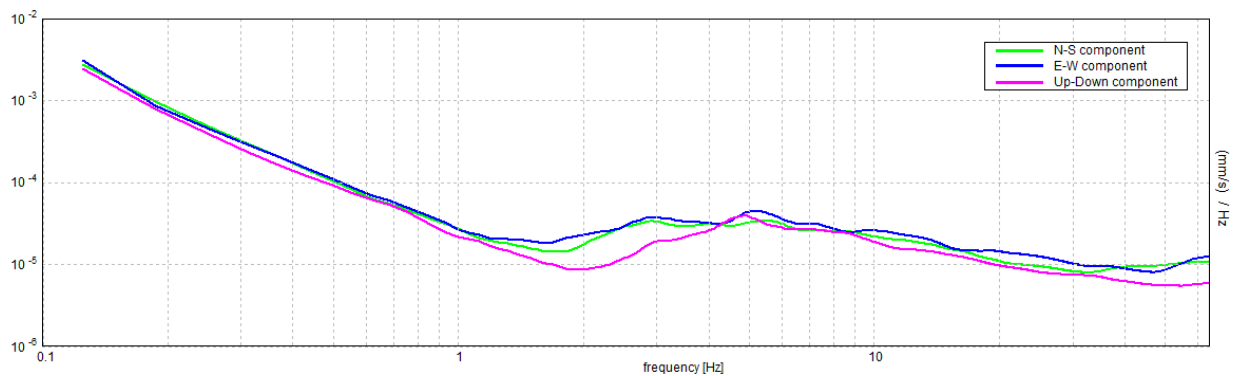
H/V TIME HISTORY



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 2.44 ± 0.06 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$2.44 > 0.63$	OK	
$n_c(f_0) > 200$	$1989.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 60 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	1.375 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	3.688 Hz	OK	
$A_0 > 2$	$2.87 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01219 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.02972 < 0.12188$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.5602 < 1.58$	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

CASTEL D'AIANO_MS, MS 2018 TR16

037013P135HVSR152

Instrument: TRZ-0108/01-10

Start recording: 28/08/18 11:40:24 End recording: 28/08/18 11:56:25

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 60% trace (manual window selection)

Sampling rate: 128 Hz

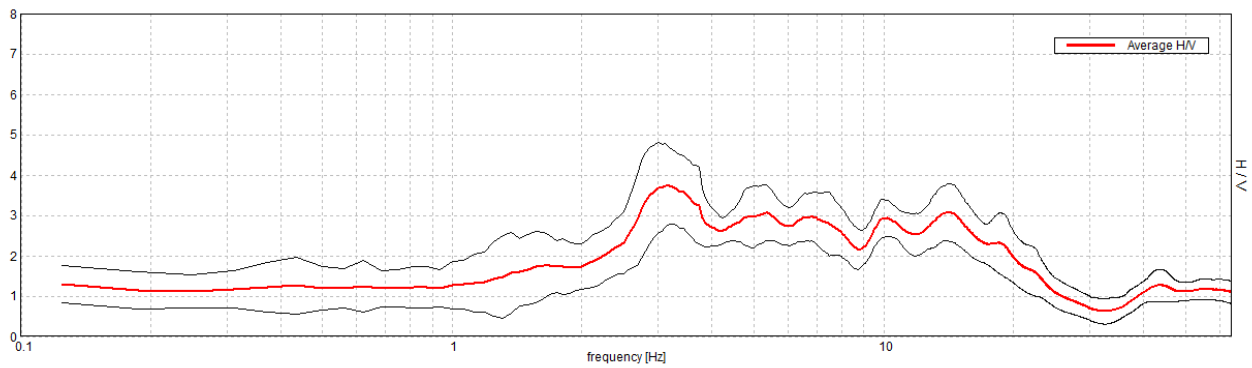
Window size: 16 s

Smoothing type: Triangular window

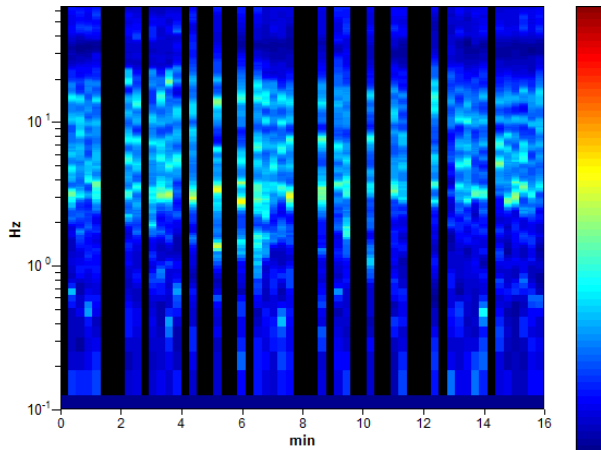
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

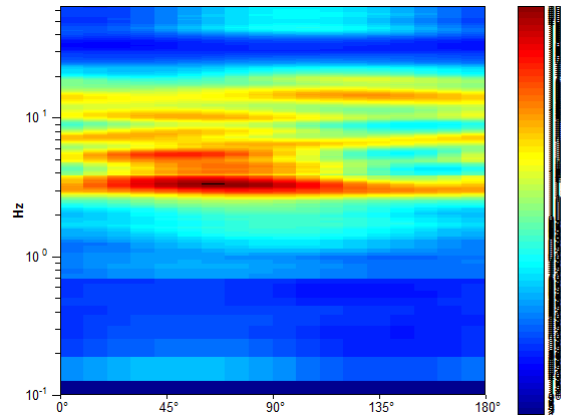
Max. H/V at 3.13 ± 0.03 Hz. (In the range 0.1 - 20.0 Hz).



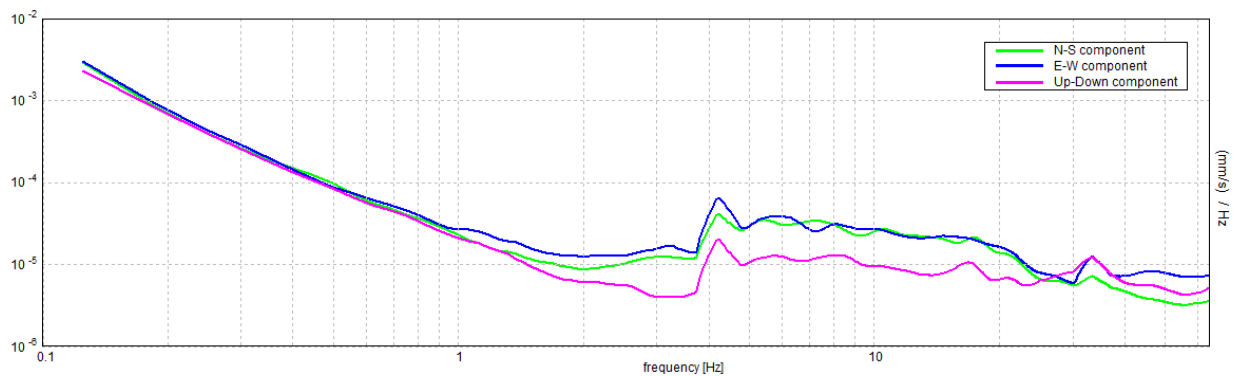
H/V TIME HISTORY



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 3.13 ± 0.03 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$3.13 > 0.63$	OK	
$n_c(f_0) > 200$	$1800.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 76 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	2.125 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	$3.73 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00427 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.01334 < 0.15625$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.5048 < 1.58$	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

CASTEL D'AIANO_MS, MS 2018 TR17

037013P136HVSR153

Instrument: TRZ-0108/01-10

Start recording: 28/08/18 14:11:16 End recording: 28/08/18 14:27:17

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 73% trace (manual window selection)

Sampling rate: 128 Hz

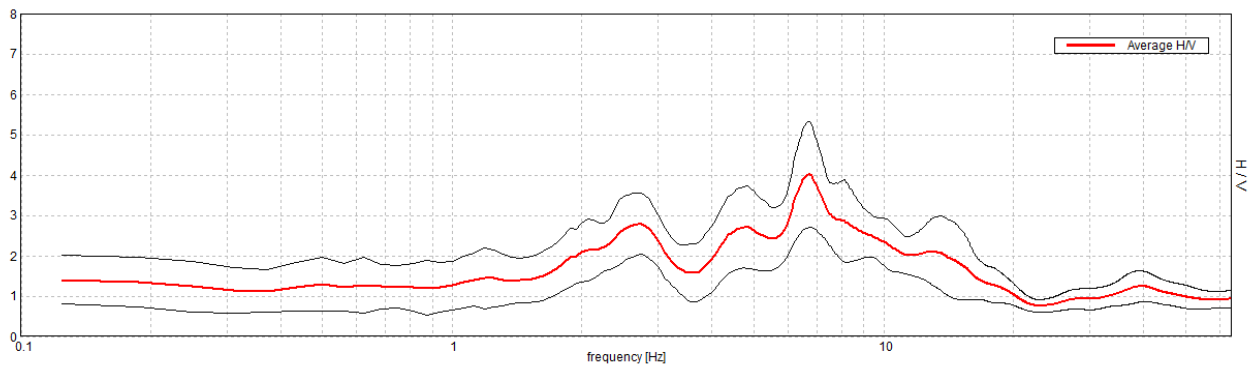
Window size: 16 s

Smoothing type: Triangular window

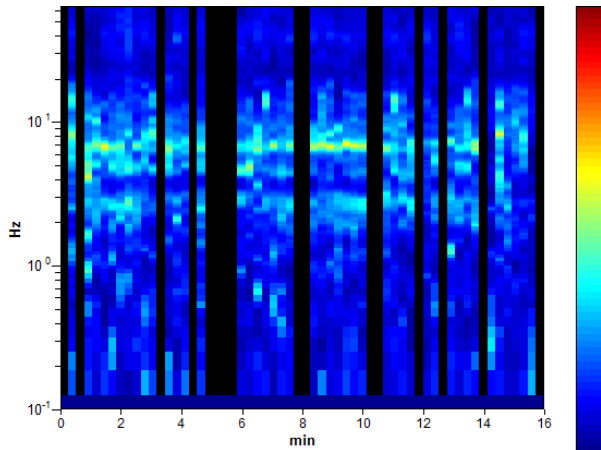
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

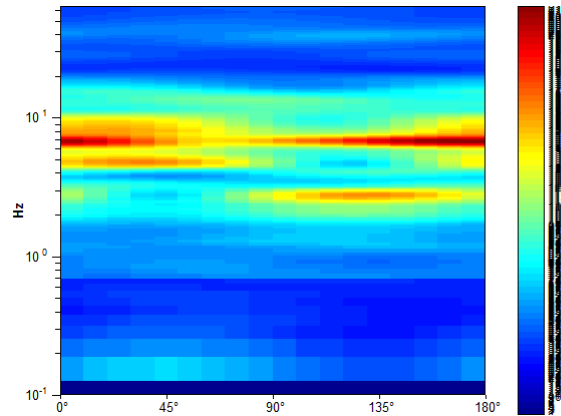
Max. H/V at 6.75 ± 0.07 Hz. (In the range 0.1 - 20.0 Hz).



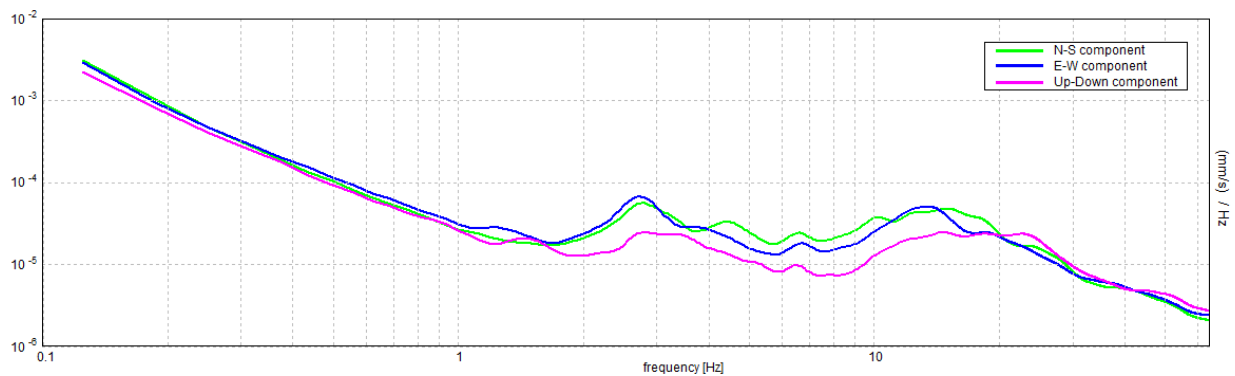
H/V TIME HISTORY



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 6.75 ± 0.07 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$6.75 > 0.63$	OK	
$n_c(f_0) > 200$	$4752.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 163 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	4.0 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	13.938 Hz	OK	
$A_0 > 2$	$4.00 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00508 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.03427 < 0.3375$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.6423 < 1.58$	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

CASTEL D'AIANO_MS, MS 2018 TR18

037013P137HVSR154

Instrument: TRZ-0108/01-10

Start recording: 28/08/18 15:00:48 End recording: 28/08/18 15:16:49

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 80% trace (manual window selection)

Sampling rate: 128 Hz

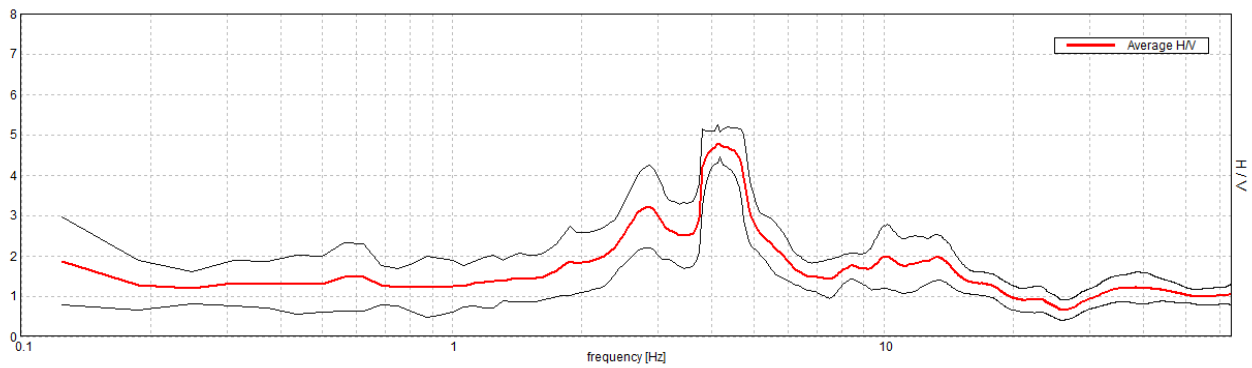
Window size: 16 s

Smoothing type: Triangular window

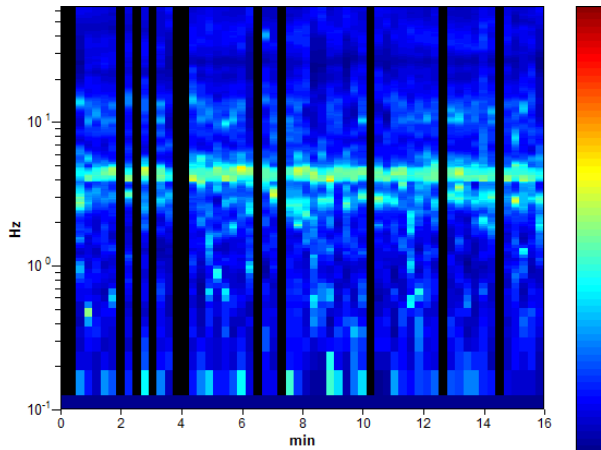
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

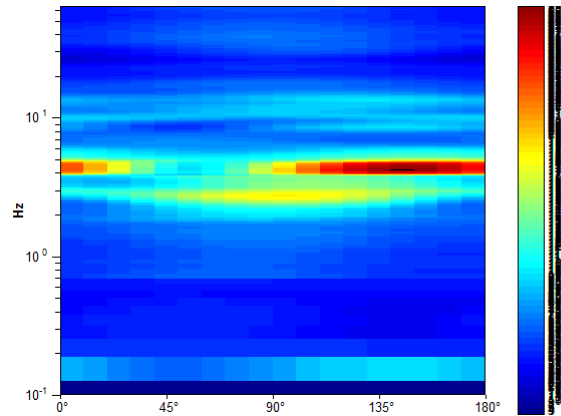
Max. H/V at 4.13 ± 0.07 Hz. (In the range 0.1 - 20.0 Hz).



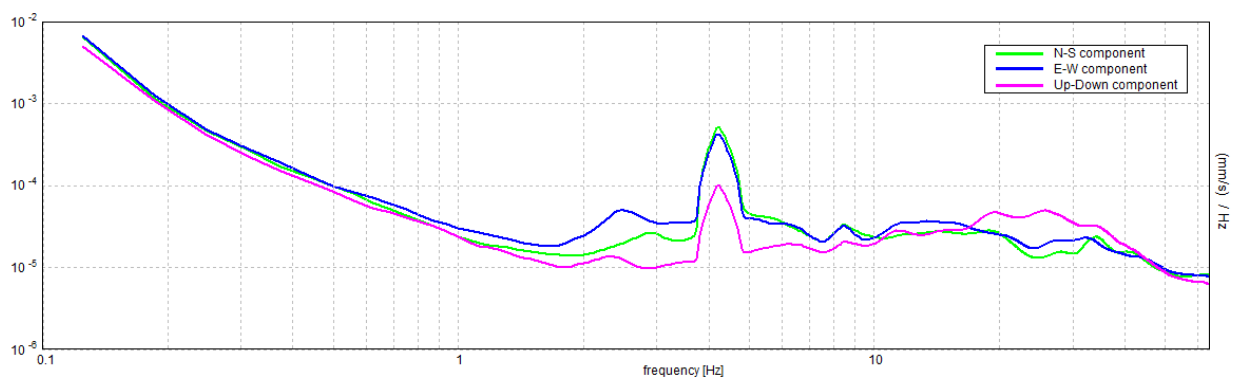
H/V TIME HISTORY



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 4.13 ± 0.07 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	4.13 > 0.63	OK	
$n_c(f_0) > 200$	3168.0 > 200	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 100 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	2.438 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	5.375 Hz	OK	
$A_0 > 2$	4.77 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00785 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	0.0324 < 0.20625	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.2328 < 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

CASTEL D'AIANO_MS, MS 2018 TR19

037013P138HVSR155

Instrument: TRZ-0108/01-10

Start recording: 28/08/18 15:40:43 End recording: 28/08/18 15:56:44

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 88% trace (manual window selection)

Sampling rate: 128 Hz

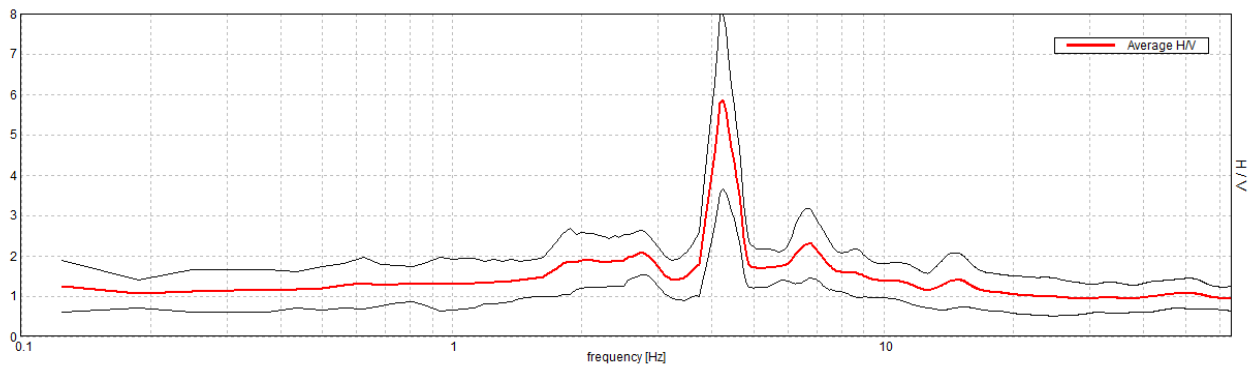
Window size: 16 s

Smoothing type: Triangular window

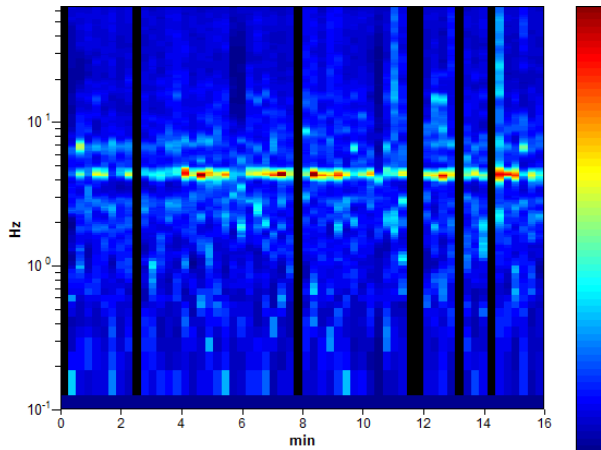
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

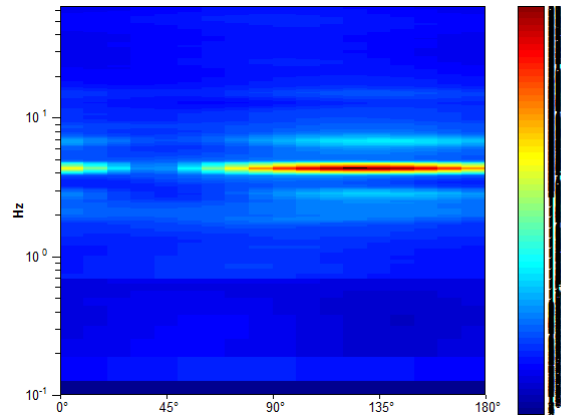
Max. H/V at 4.25 ± 0.2 Hz. (In the range 0.1 - 20.0 Hz).



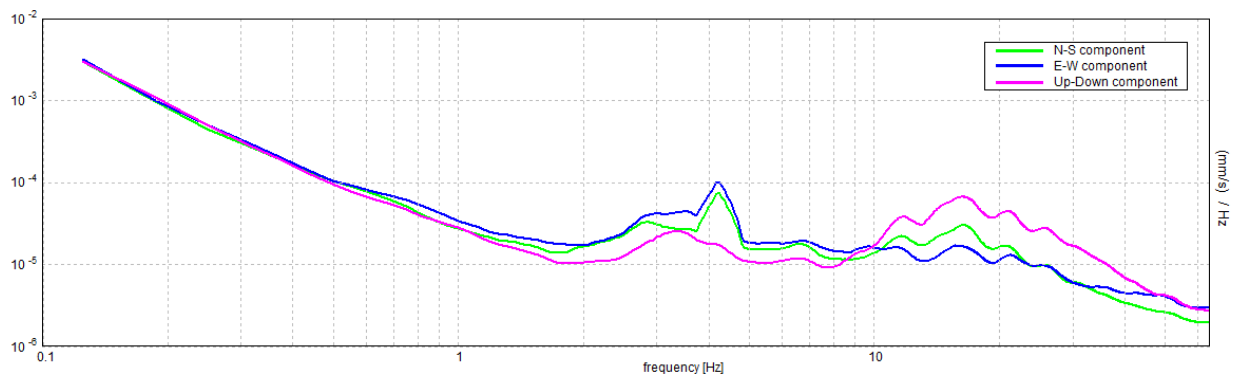
H/V TIME HISTORY



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 4.25 ± 0.2 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$4.25 > 0.63$	OK	
$n_c(f_0) > 200$	$3604.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 4 out of 103 times		NO

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	3.875 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	4.75 Hz	OK	
$A_0 > 2$	$5.87 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.02313 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.0983 < 0.2125$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$1.0937 < 1.58$	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

CASTEL D'AIANO_MS, MS 2018 TR20

037013P139HVSR156

Instrument: TRZ-0108/01-10

Start recording: 28/08/18 16:51:14 End recording: 28/08/18 17:07:15

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

Trace length: 0h16'00". Analyzed 88% trace (manual window selection)

Sampling rate: 128 Hz

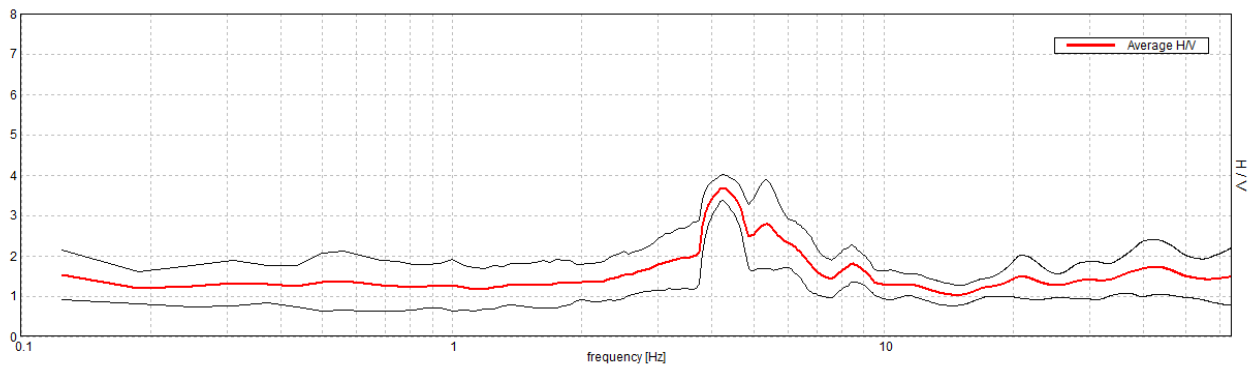
Window size: 16 s

Smoothing type: Triangular window

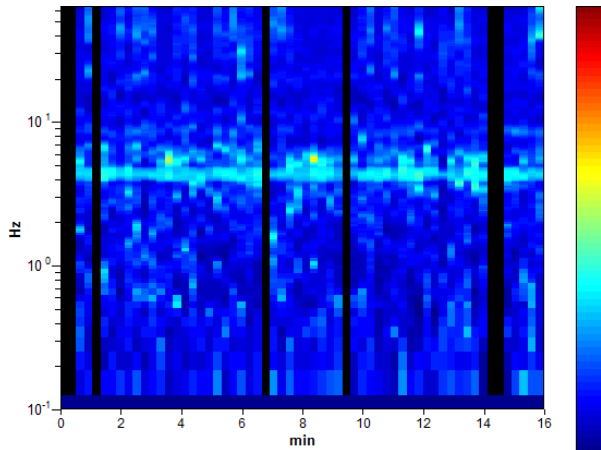
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

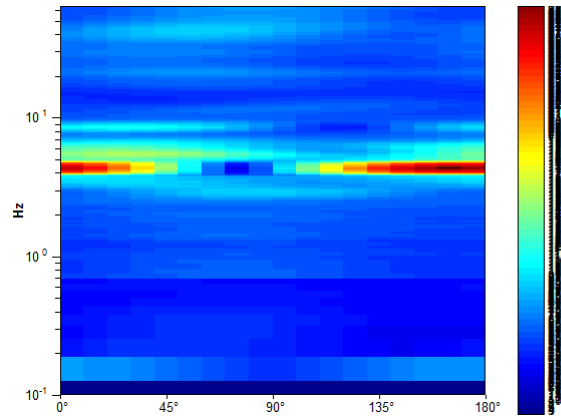
Max. H/V at 4.25 ± 0.04 Hz. (In the range 0.1 - 20.0 Hz).



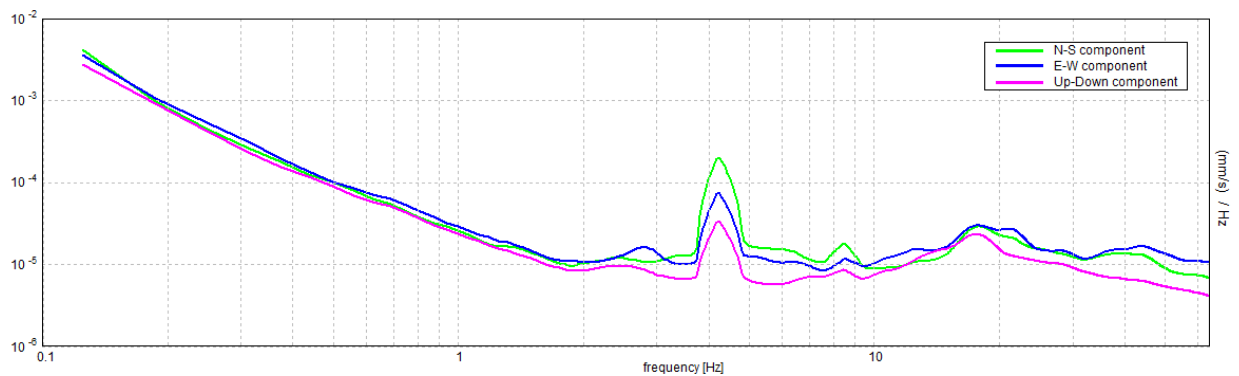
H/V TIME HISTORY



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 4.25 ± 0.04 Hz (in the range 0.1 - 20.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$4.25 > 0.63$	OK	
$n_c(f_0) > 200$	$3604.0 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 103 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	3.063 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	6.75 Hz	OK	
$A_0 > 2$	$3.69 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00422 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.01792 < 0.2125$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1555 < 1.58$	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 $\sigma_A(f_0)$

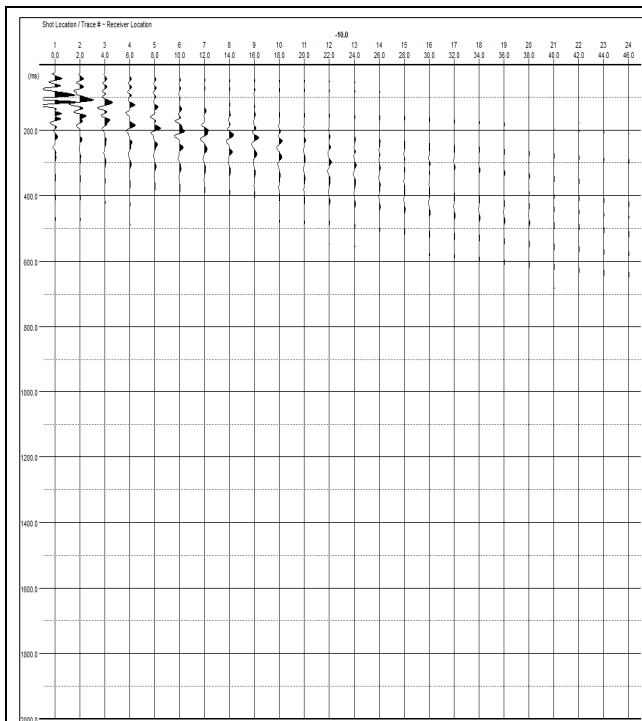
Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

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

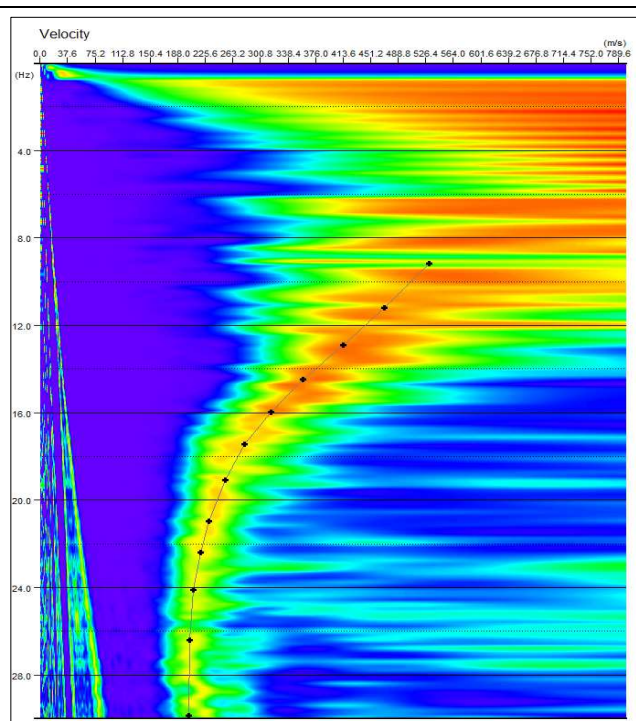
Via Farfareda, Comune di Castel d'Aiano (BO) – 037013L9MASW9

n° tracce	Δx (m)	L tot (m)	Δt (ms)	T (s)
15	2,0	46,0	0,5/2,0	2,0/32,0

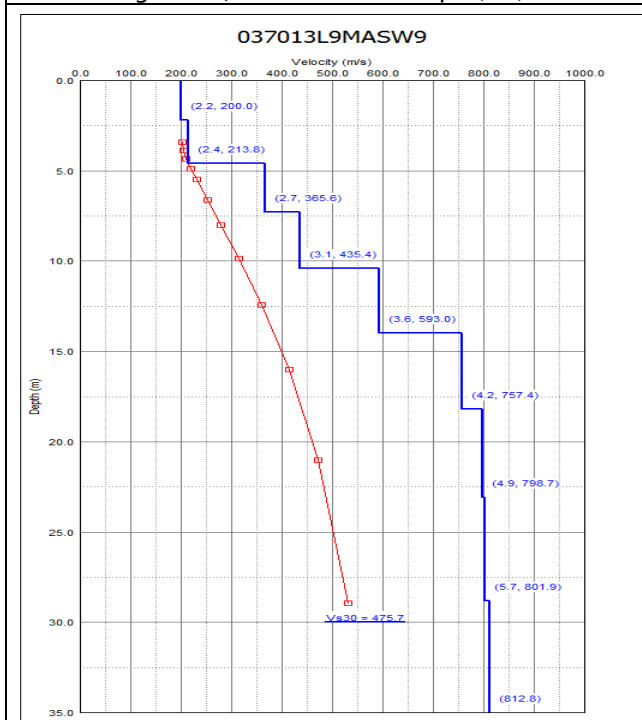
Δx : interdistanza geofonica; L tot: lunghezza profilo; Δt : passo di campionamento; T: durata registrazione.



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 sperimentale delle onde R (croci nere).



Modello di sottosuolo (1D) descritti in termini di V_s 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	2.2	2.2	200.0
2	4.6	2.4	213.8
3	7.3	2.7	365.6
4	10.4	3.1	435.4
5	14.0	3.6	593.0
6	18.2	4.2	757.4
7	23.1	4.9	798.7
8	28.8	5.7	801.9
9	∞	∞	812.8

$$V_{s30} = 475.7 \pm 10\% \text{ [m/s]}$$

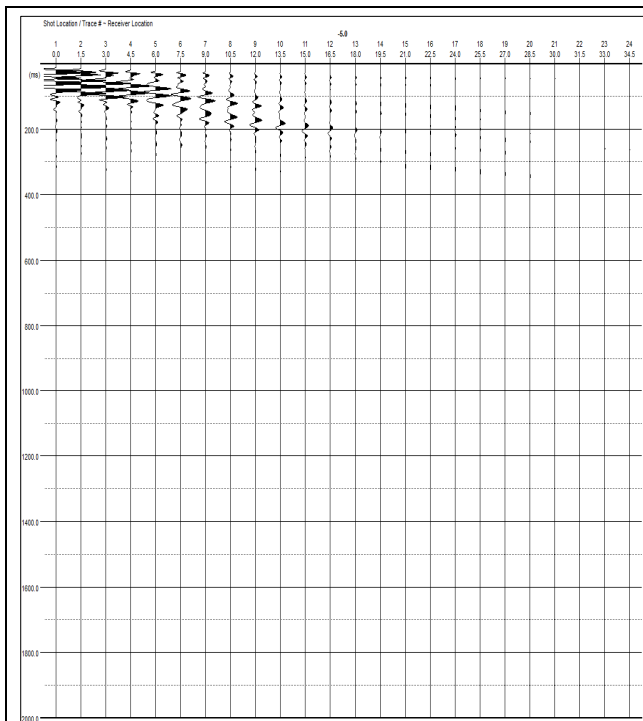
Sintesi dei parametri del modello di sottosuolo ottenuto e Valore di V_{s30} calcolato.

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

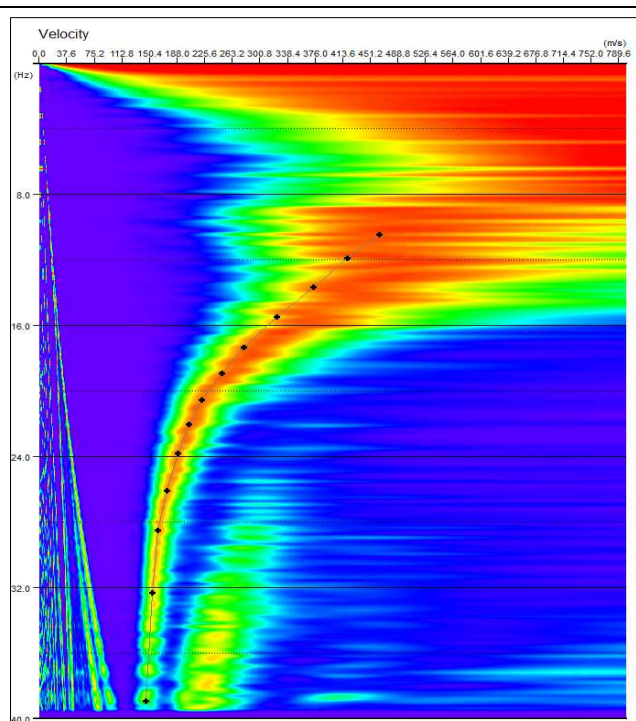
Villa d'Aiano, Comune di Castel d'Aiano (BO) – 037013L10MASW10

n° tracce	Δx (m)	L tot (m)	Δt (ms)	T (s)
15	1,5	34,5	0,5/2,0	2,0/32,0

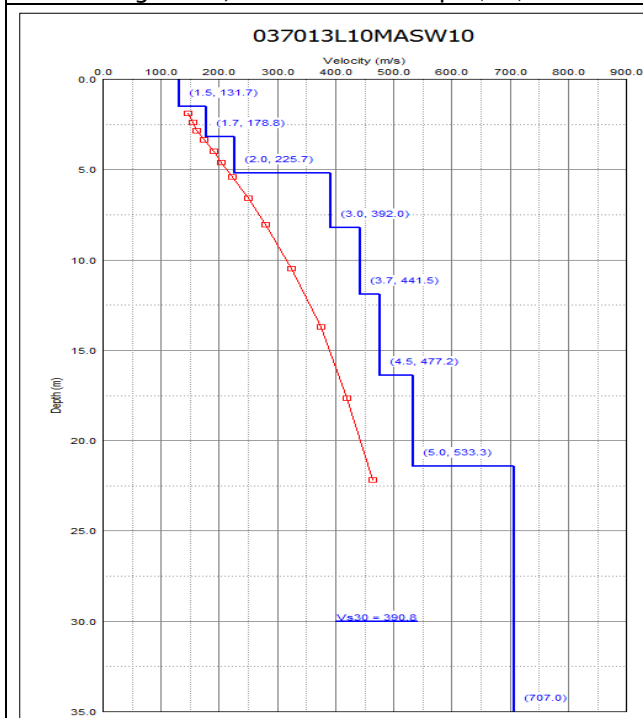
Δx : interdistanza geofonica; L tot: lunghezza profilo; Δt : passo di campionamento; T: durata registrazione.



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 sperimentale delle onde R (croci nere).



Modello di sottosuolo (1D) descritti in termini di V_s 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	1.5	1.5	131.7
2	3.2	1.7	178.8
3	5.2	2.0	225.7
4	8.2	3.0	392.0
5	11.9	3.7	441.5
6	16.4	4.5	477.2
7	21.4	5.0	533.3
8	∞	∞	707.0

$$V_{s30} = 390.8 \pm 10\% \text{ [m/s]}$$

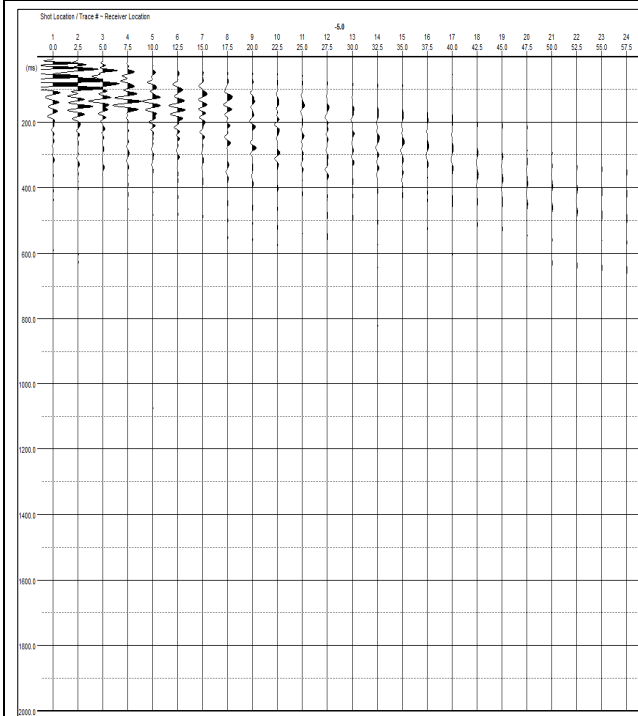
Sintesi dei parametri del modello di sottosuolo ottenuto e Valore di V_{s30} calcolato.

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

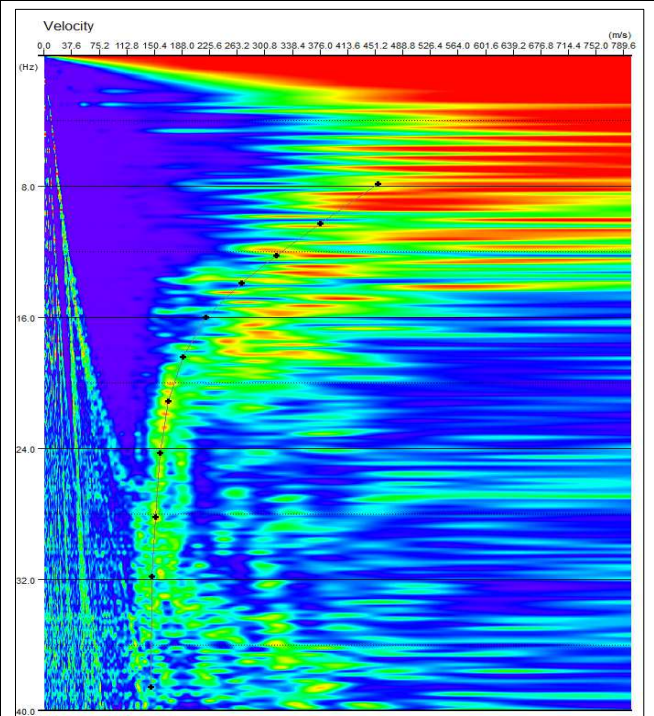
Via dell'Artigiano, Comune di Castel d'Aiano (BO) – 037013L11MASW11

n° tracce	Δx (m)	L tot (m)	Δt (ms)	T (s)
15	2,5	57,5	0,5/2,0	2,0/32,0

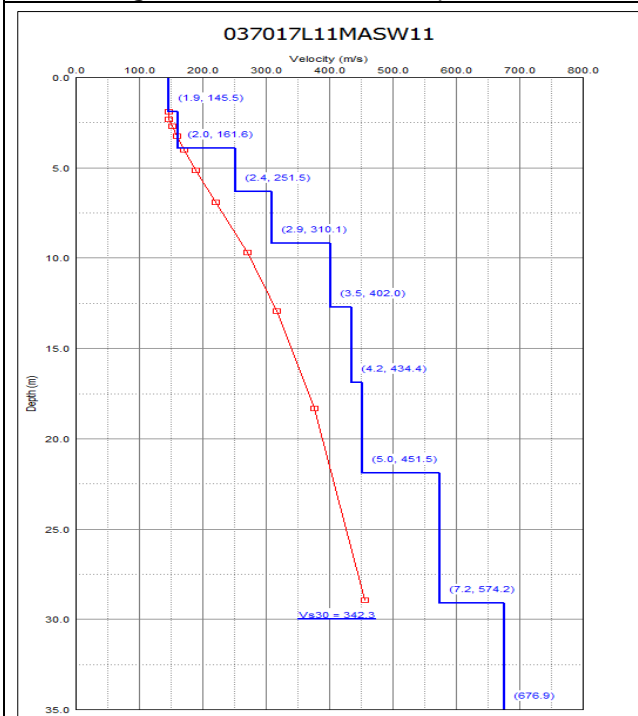
Δx : interdistanza geofonica; L tot: lunghezza profilo; Δt : passo di campionamento; T: durata registrazione.



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 V_s 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	145.5
2	3.9	2.0	161.6
3	6.3	2.4	251.5
4	9.2	2.9	310.1
5	12.7	3.5	402.0
6	16.9	4.2	434.4
7	21.9	5.0	451.5
8	29.1	7.2	574.2
9	∞	∞	676.9

$$V_{S30} = 342.3 \pm 10\% \text{ [m/s]}$$

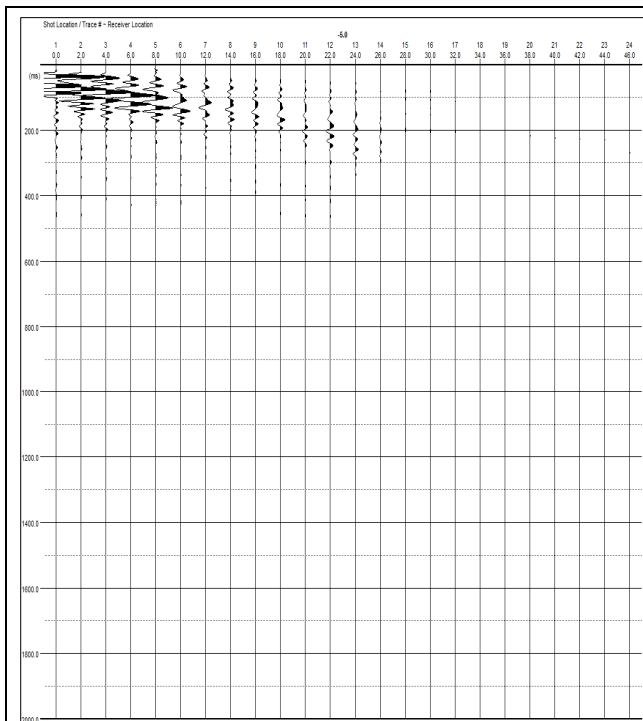
Sintesi dei parametri del modello di sottosuolo ottenuto e Valore di V_{S30} calcolato.

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

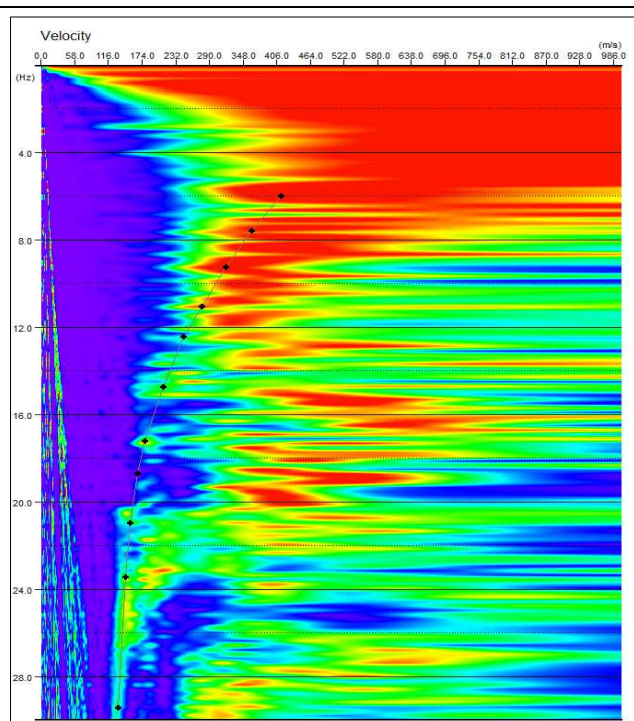
Rocca di Roffreno, Comune di Castel d'Aiano (BO) – 037013L13MASW13

n° tracce	Δx (m)	L tot (m)	Δt (ms)	T (s)
15	2,0	46,0	0,5/2,0	2,0/32,0

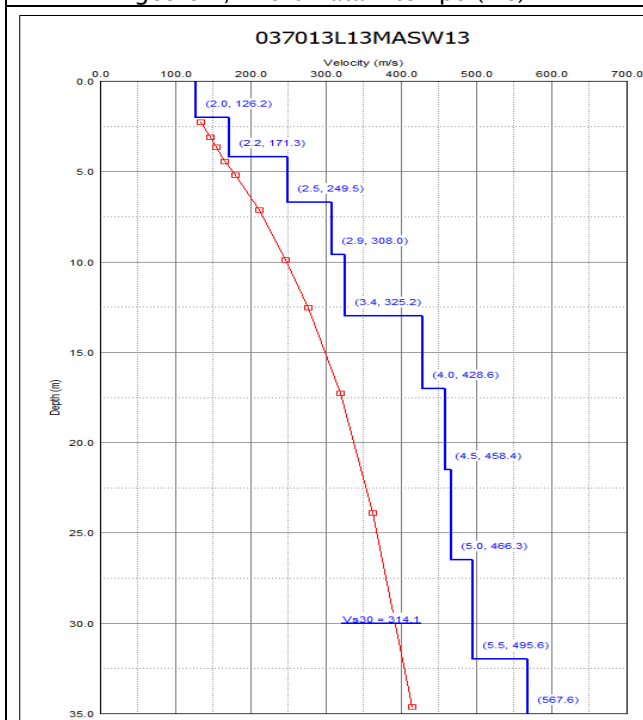
Δx : interdistanza geofonica; L tot: lunghezza profilo; Δt : passo di campionamento; T: durata registrazione.



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 V_s 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	2.0	2.0	126.2
2	4.2	2.2	171.3
3	6.7	2.5	249.5
4	9.6	2.9	308.0
5	13.0	3.4	325.2
6	17.0	4.0	428.6
7	21.5	4.5	458.4
8	26.5	5.0	466.3
9	32.0	5.5	495.6
10	∞	∞	567.6

$$V_{s30} = 314.1 \pm 10\% \text{ [m/s]}$$

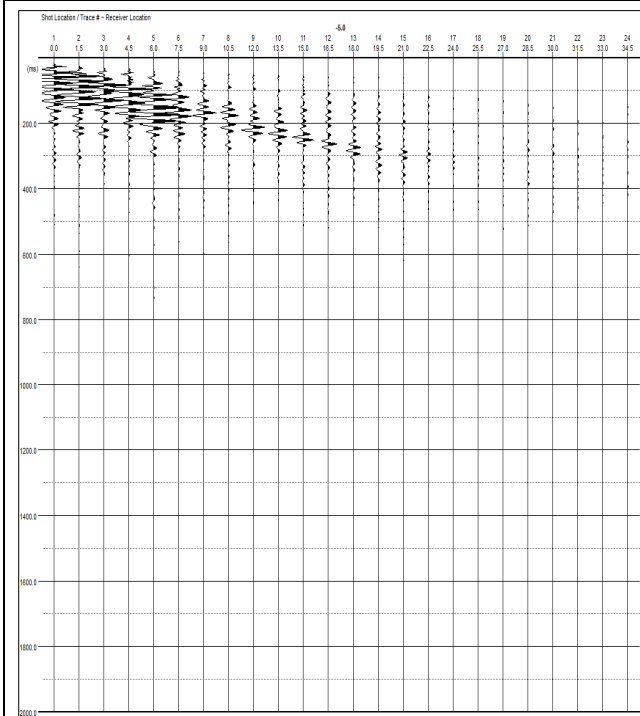
Sintesi dei parametri del modello di sottosuolo ottenuto e Valore di V_{s30} calcolato.

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

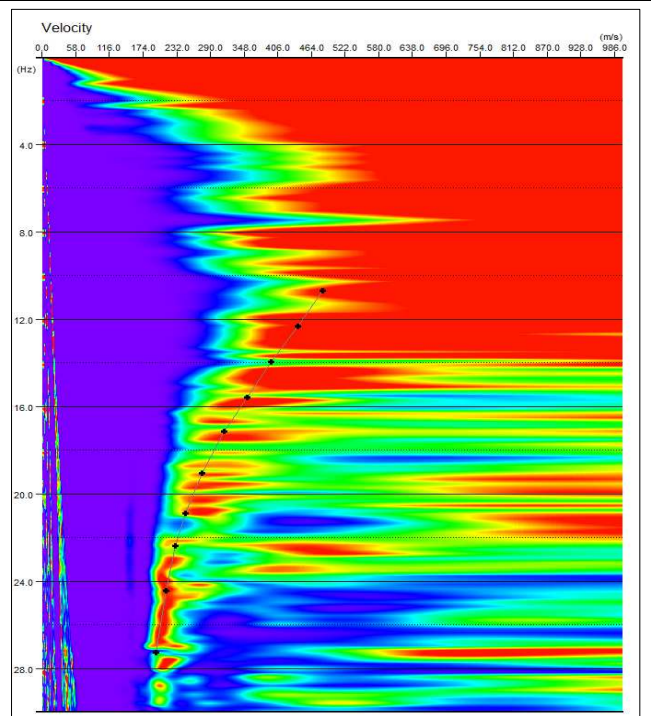
Labante, Comune di Castel d'Aiano (BO) - 037013L14MASW14

n° tracce	Δx (m)	L tot (m)	Δt (ms)	T (s)
15	1,5	34,5	0,5/2,0	2,0/32,0

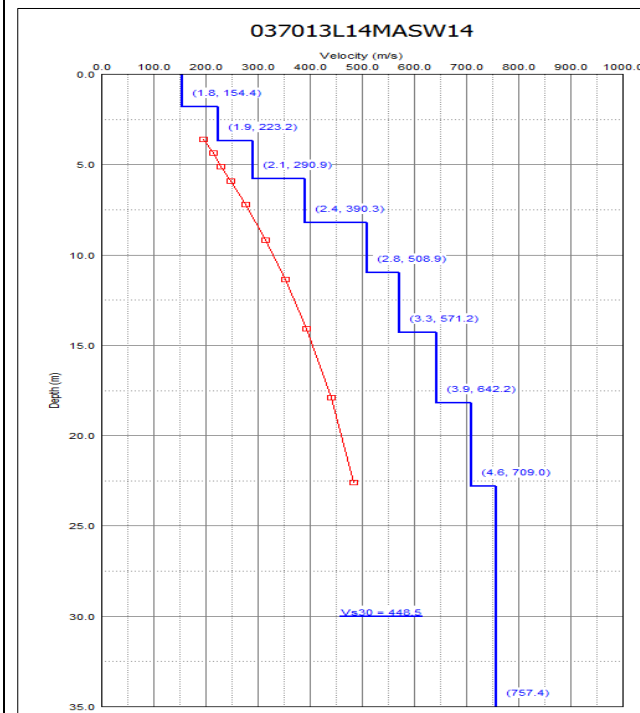
Δx : interdistanza geofonica; L tot: lunghezza profilo; Δt : passo di campionamento; T: durata registrazione.



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)	Vs (m/s)
1	1.8	1.8	154.4
2	3.7	1.9	223.2
3	5.8	2.1	290.9
4	8.2	2.4	390.3
5	11.0	2.8	508.9
6	14.3	3.3	571.2
7	18.2	3.9	642.2
8	22.8	4.6	709.0
9	∞	∞	757.4

$V_{s30} = 448.5 \pm 10\% [m/s]$

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