Progetto S4 INGV

Task 3

Indagini SASW USGS
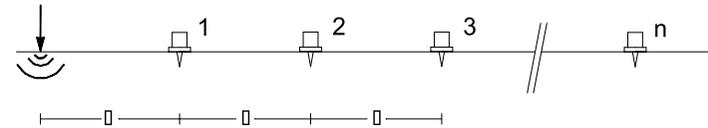
POLITECNICO DI TORINO

Dipartimento di Ingegneria
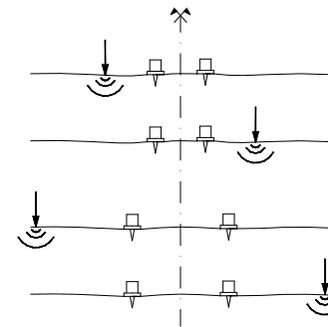Strutturale e Geotecnica

SWM techniques

Active methods

Multistation
(f-k, τ-p, ...)

Two-station (SASW)

Passive methods

Spatial Array
SPAC, FK (FBDF, Capon, ...), ...
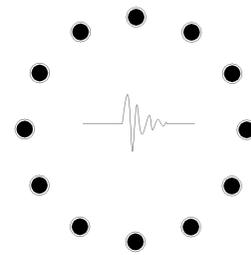
Linear array (ReMi)

?
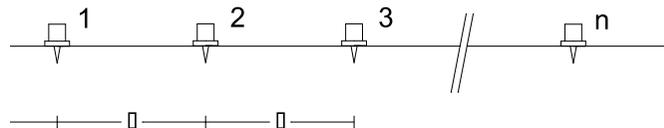
Multistation (fk) vs 2-station SASW

Synthetic datasets

(Foti, 2002)
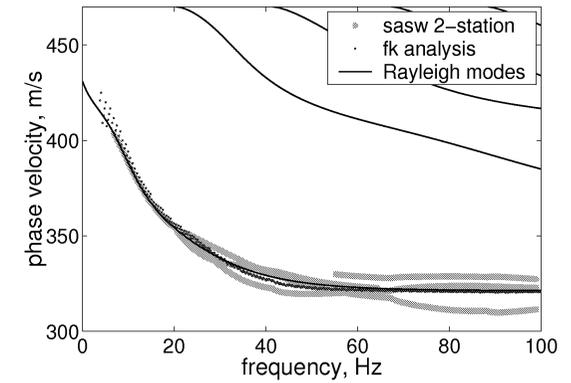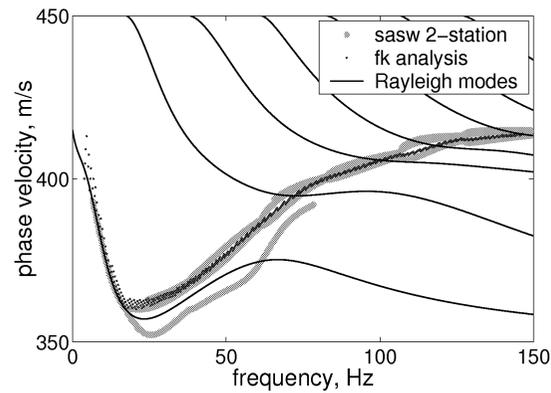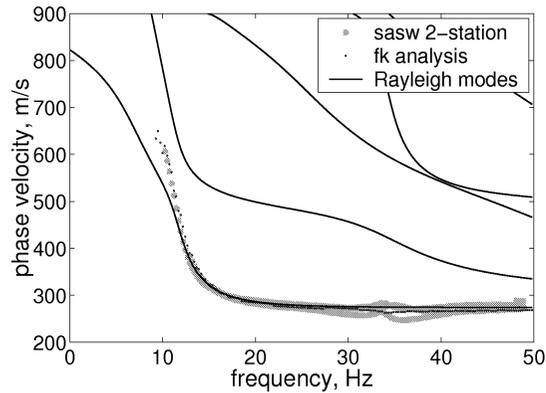
Real experimental data
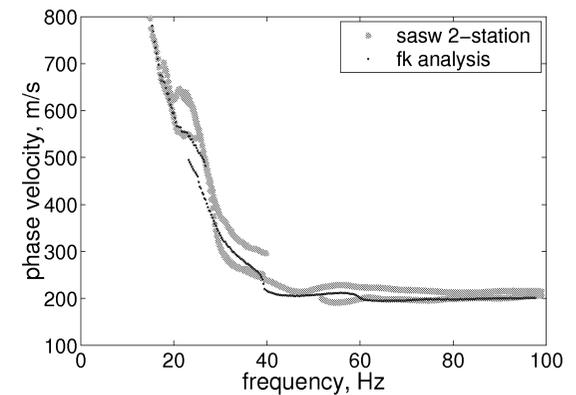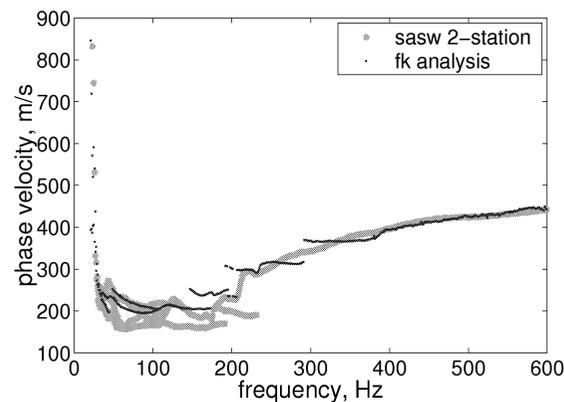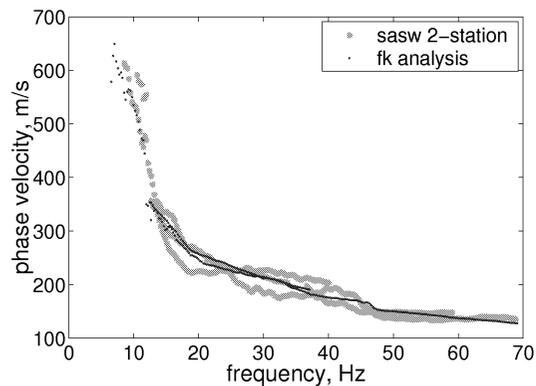
SASW: rules for testing geometry
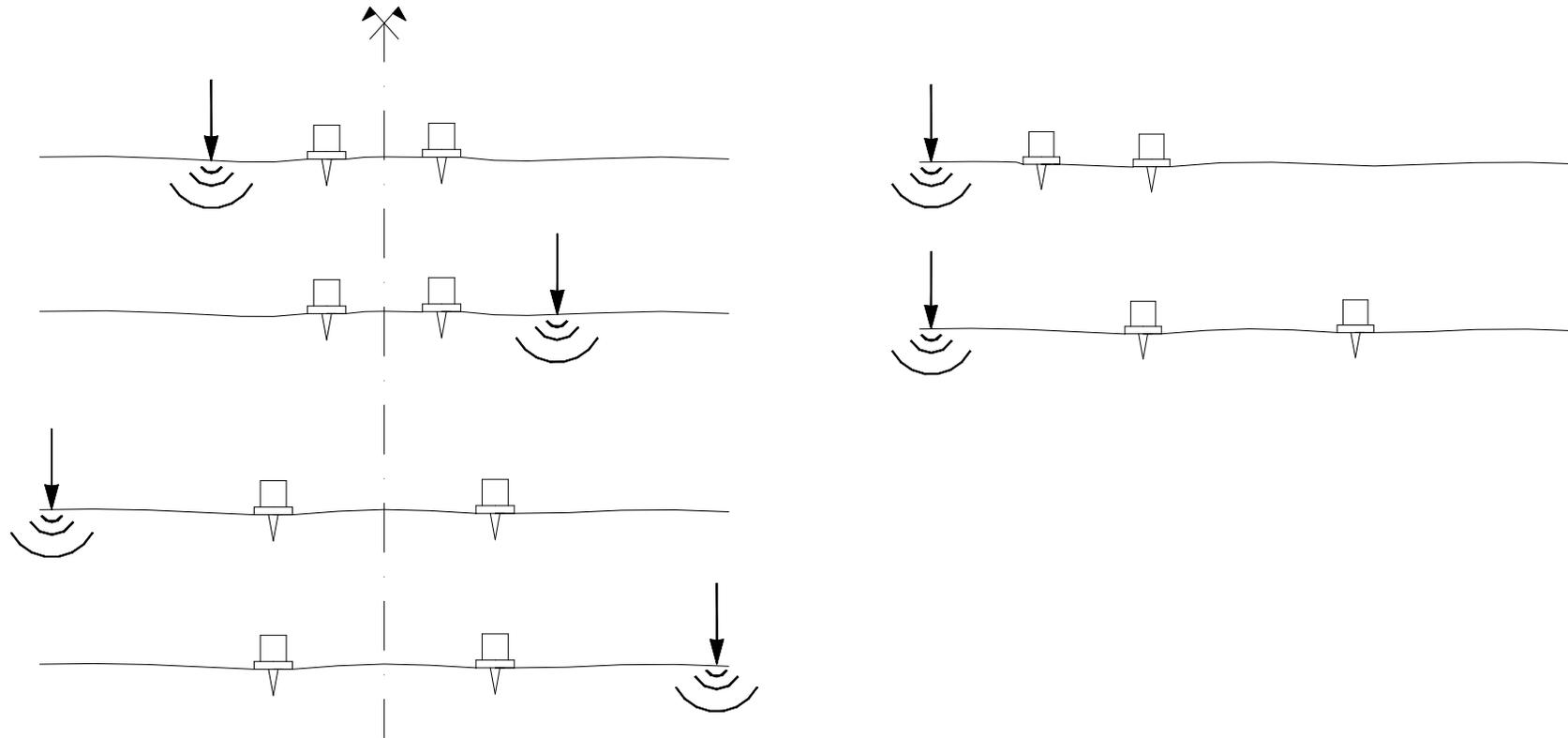
Common receiver midpoint array

Heavy sources are used with larger spacing to obtain
low frequency (long wavelength) information

SASW: Assembling experimental data
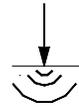
$\Delta = 30\mu$

Averaging over frequency segments

Dispersion curve
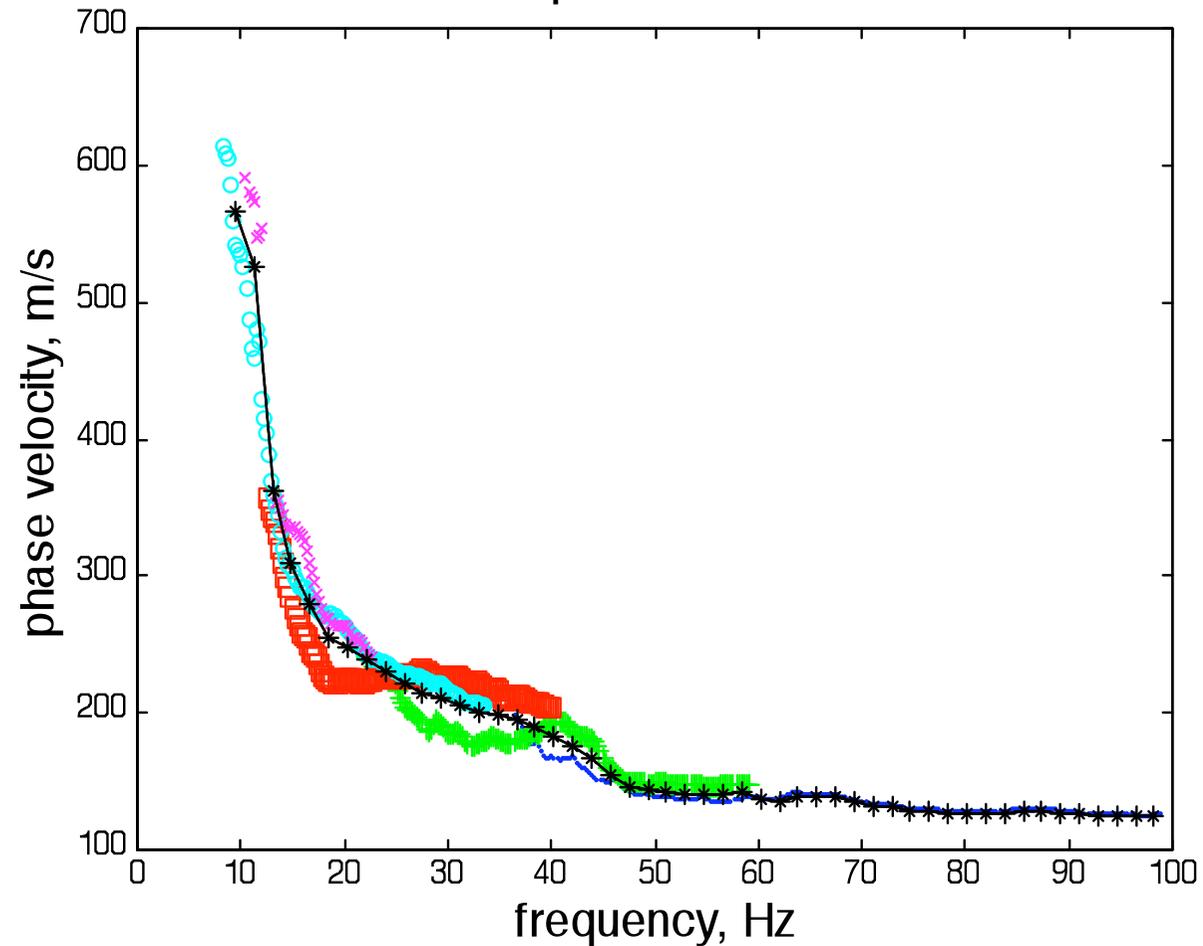
SASW (Spectral Analysis of Surface Waves)

Σιγναλ Α□□□□□□

Ιμ π□□□□□, Σι□□□□ι□□□ □□
Ρανδομ Νοι□□ Σ□□□□□

Νεαρ Ρ□□□ι□□□   Φαρ Ρ□□□ι□□□

Δ   Ξ
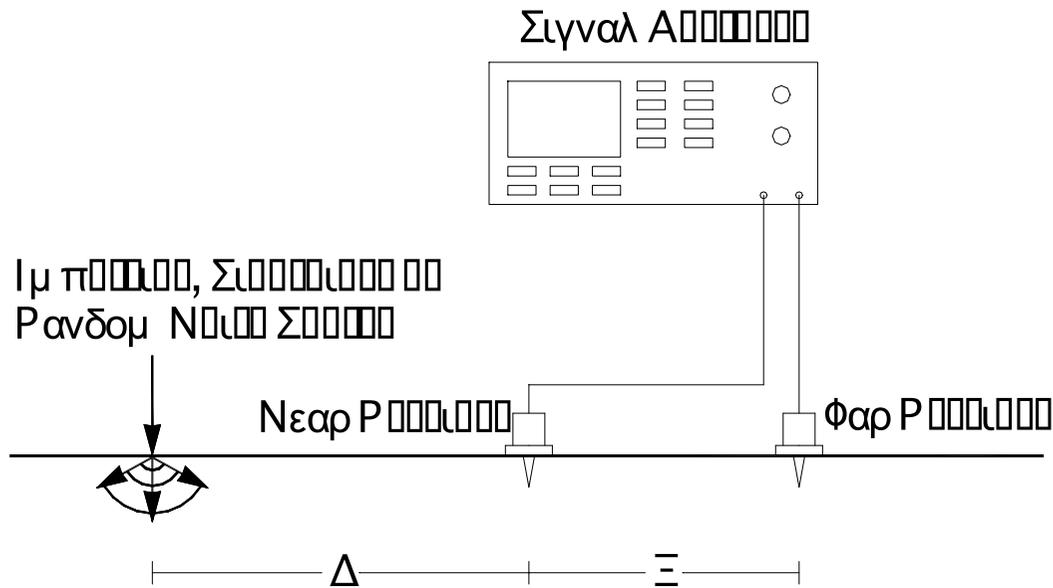
Usually D=X
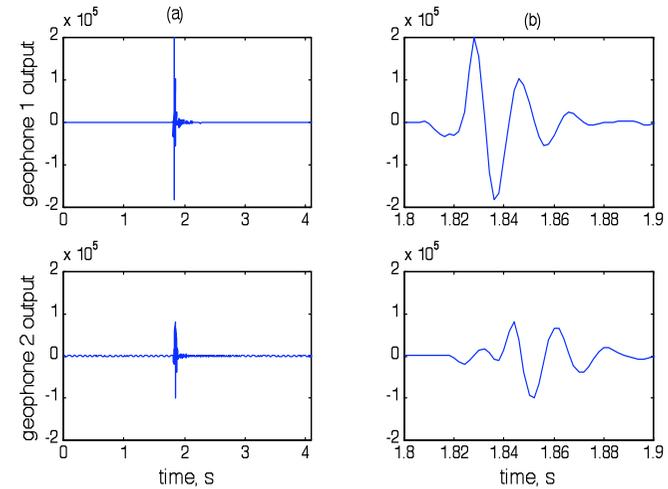
Fast Fourier Transform

$Y_1(\omega) = FFT(y_1(t))$

$Y_2(\omega) = FFT(y_2(t))$

| Phase Velocity | Time Delay | Cross Power Spectrum |

$V_R(\omega) = X / t(\omega)$ $t(\omega) = fase(G_{y1y2}(f)) / \omega$ $G_{y1y2} = Y_1(\omega)^* \cdot Y_2(\omega)$

Frequency range of acceptable data function of D (near field effects)

Phase unwrapping
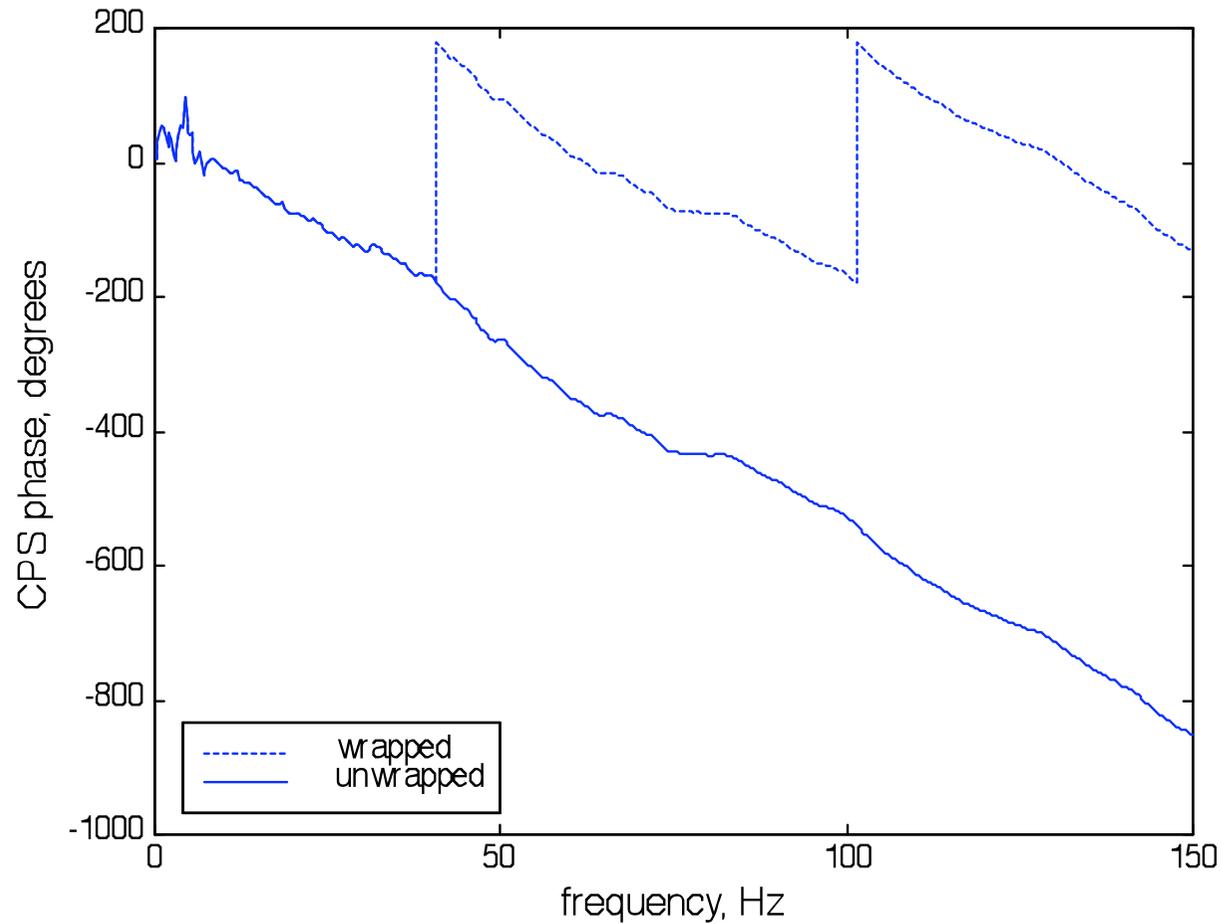
USGS - SASW tests Umbria-Marche

SITE	SITE NAME	TOWN	REGION	LAT	LON	NEHRP	Vs_30 (m/s)	NEHRP(SUB)	VS_100 (m/s)
254BEV	BEVAGNA CHURCH ST	BEVAGNA	UMBRIA	42.932	12.611	D	182	D-	278
255 SMI	MARIA CASTEL	FOLIGNO	UMBRIA	42.954	12.699	C	395	C-	527
256CSA	NUOVO ASSISI	ASSISI	UMBRIA	43.008	12.591	D	293	D+	440
257CLF	COLFIORITO	COLFIORITO	UMBRIA	43.037	12.921	D	317	D+	719
258CLC	COLFIORITO- CASERMETTE	COLFIORITO	UMBRIA	43.029	12.890	C	405	C-	720
259NCR	NOCERA STATION-B	NOCERA	UMBRIA	43.111	12.785	C	428	C-	938
260NCB	NOCERA BISCONTIN STATION-C	UMBRA - B	UMBRIA	43.104	12.805	C	442	C-	823
261NCS	GRAVEL ROAD	UMBRA - C	UMBRIA	43.148	12.791	C	694	C+	1170
262GBP	GUBBIO SOIL SITE PIANA	GUBBIO	UMBRIA	43.314	12.590	C	492	C+	864
263GBB	GUBBIO - PARK COLLO	GUBBIO	UMBRIA	43.358	12.595	B	922	B-	1759
264NCI	NORCIA INDUSTRIAL PARK	NORCIA	UMBRIA	42.780	13.097	C	551	C+	546
265NRC	NORCIA SITE C	NORCIA SITE C	UMBRIA	42.792	13.097	C	677	C+	1148
266NRA	NORCIA TEMP. STA. A	NORCIA	UMBRIA	42.796	13.081	D	218	D-	264
267CSC	CASCIA	CASCIA	UMBRIA	42.719	13.012	C	540	C+	993
268CSP	CASCIA PETRUCCI APTMTS	CASCIA	UMBRIA	42.718	13.018	D	339	D+	488
269SLW	SELLANO WEST	SELLANO	UMBRIA	42.886	12.922	C	509	C-	713
270MTL	MATELICA	MATELICA	MARCHE	43.248	13.008	C	437	C-	767

Revised results (sept- 2008)

Test ID	Experimental data	Inversion	Comments
255 SMI	There is evidence of two separate branches: a fundamental mode (frequency range 5-13Hz) and an higher mode (above 15Hz)	It is not clear if the numerical curve is a fundamental mode or includes the effects of mode superposition	
257 CLF	The experimental data seems not reliable below 25 Hz		The only reasonable conclusion is that Vs is about 200m/s up to 5m depth
258 CLC	There is no agreement between different branches of the dispersion curves. The experimental data seems not reliable below 20 Hz		The only reasonable conclusion is that Vs is about 200-250m/s up to 5m depth
259 NCR	Maybe higher mode at low frequency	ok	
261 NCS	Average quality	ok	
262 GBP	Average quality	ok	
265 NRC	No field data are shown	Poor agreement of experimental vs numerical	Need reinterpretation
267 CSC	ok	Poor agreement of experimental vs numerical	I would use only experimental data for wavelength less than 160m, trying to obtain VS up to about 80m depth
268 CSP	Average quality	ok	
269 SLW	No field data are shown	ok	The VS profile should be plotted only up to a depth of 20m (half of maximum wavelength)
270 MTL	There is evidence of two separate branches: one below 35Hz the other above 50Hz	ok	

Test ID	Experimental data	Inversion	Comments
255 SMI	There is evidence of two separate branches: a fundamental mode (frequency range 5-13Hz) and an higher mode (above 15Hz)	It is not clear if the numerical curve is a fundamental mode or includes the effects of mode superposition	

UMBRIA-MARCHE, ITALY SMR Stations

Site ID	**255 SMI**
NEHRP CLASS:	C
Vs30	380 (m/s)
SUB-CLASS	C-

Location

SMR Station	SMI
State	UMBRIA
Description	CHURCH ST MARIA
POSITION	FOLIGNO
LAT (N)	42.95417
LON (E)	12.69892

Data Type	SWEPT-SINE SASW
Investigators	KAYEN, SCASSERRA
Date collected	12-Nov-2006

TEST METHODS	PARALLEL-ARRAY SOURCES; CONTINUOUS HARMONIC WAVE-SASW; 3D AMBIENT MICROTREMOR ANALYSIS

PROJECT NAME	UMBRIA-MARCHE SMR CHARACTERIZATION
SPONSOR	PEER, UNIV OF ROME

SITE SUB CLASS: **Vs30 (m/s)**

A	>1500 m/s
B+	1080 < Vs30 ≤ 1500 m/s
B-	720 < Vs30 ≤ 1080 m/s
C+	540 < Vs30 ≤ 720 m/s
C-	360 < Vs30 ≤ 540 m/s
D+	270 < Vs30 ≤ 360 m/s
D-	180 < Vs30 ≤ 270 m/s
E	<180 m/s
F	Special Soil Conditions: Liquefiable soils; quick and high sensitivity clays; collapsible cemented soils; peats>3m; high (>75) PI soils thicker than 8m; soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

257 CLF	The experimental data seems not reliable below 25 Hz		The only reasonable conclusion is that Vs is about 200m/s up to 5m depth

UMBRIA-MARCHE, ITALY SMR Stations
Site ID   **257CLF**
NEHRP CLASS: **E**
Vs30   **168 (m/s)**
SUB-CLASS   **E**
Reanalysis 8_2008
Location

SMR Station   CLF
State   UMBRIA
Description   COLFIORITO-NR.MARCHE BRDR
POSITION   COLFIORITO
LAT (N)   43.03737
LON (E)   12.92118

Data Type   SWEPT-SINE SASW
Investigators KAYEN, SCASSERRA
Date collected 11/13/200

TEST METHODS   PARALLEL-ARRAY SOURCES;
                   CONTINUOUS HARMONIC
                   WAVE-SASW; 3D AMBIENT
                   MICROTREMOR ANALYSIS

PROJECT NAME   UMBRIA-MARCHE
                   SMR CHARACTERIZATION
SPONSOR   PEER, UNIV OF ROME

SITE SUB CLASS: **Vs30 (m/s)**
A   >1500 m/s
B+   1080 < Vs30 ≤ 1500 m/s
B-   720 < Vs30 ≤ 1080 m/s
C+   540 < Vs30 ≤ 720 m/s
C-   360 < Vs30 ≤ 540 m/s
D+   270 < Vs30 ≤ 360 m/s
D-   180 < Vs30 ≤ 270 m/s
E   <180 m/s
F   Special Soil Conditions: Liquefiable soils; quick
         and high sensitivity clays; collapsible cemented soils;
         peats>3m; high (>75) PI soils thicker than 8m;
         soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

New Field Ave
Orig Field Ave
Inverted Phase Velocity (m/s)
Modified Field Ave. Velocity (m/s)

(D) Shear Wave Velocity SASW

NEW 257CLF
DH profile
257CLF

258 CLC	There is no agreement between different branches of the dispersion curves. The experimental data seems not reliable below 20 Hz	The only reasonable conclusion is that Vs is about 200-250m/s up to 5m depth

UMBRIA-MARCHE, ITALY SMR Stations

Site ID   258CLC
                 D
Vs30   296 (m/s)
SUB-CLASS   D+
Reanalysis 8_2008
Location

SMR Station   CLF
State   UMBRIA
Description   COLFIORITO-CASERMETTE
POSITION   COLFIORITO
LAT (N)   43.02865
LON (E)   12.89037

Data Type   SWEPT-SINE SASW
Investigators   KAYEN, SCASSERRA
Date collected   11/13/200

TEST METHODS   PARALLEL-ARRAY SOURCES;
                 CONTINUOUS HARMONIC
                 WAVE-SASW; 3D AMBIENT
                 MICROTREMOR ANALYSIS

PROJECT NAME   UMBRIA-MARCHE
                 SMR CHARACTERIZATION
SPONSOR   PEER, UNIV OF ROME

SITE SUB CLASS: Vs30 (m/s)
A   >1500 m/s
B+   1080 < Vs30 ≤ 1500 m/s
B-   720 < Vs30 ≤ 1080 m/s
C+   540 < Vs30 ≤ 720 m/s
C-   360 < Vs30 ≤ 540 m/s
D+   270 < Vs30 ≤ 360 m/s
D-   180 < Vs30 ≤ 270 m/s
E   <180 m/s
F   Special Soil Conditions: Liquefiable soils; quick
                 and high sensitivity clays; collapsible cemented soils;
                 peats>3m; high (>75) PI soils thicker than 8m;
                 soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

258CLC
Vs (m/s)

258CLC

259 NCR	Maybe higher mode at low frequency	ok	

261 NCS	Average quality	ok	

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

262 GBP	Average quality	ok	

UMBRIA-MARCHE, ITALY SMR Stations
Site ID   262GBP
NEHRP CLASS: D
Vs30   281 (m/s)
SUB-CLASS   D+
Reanalysis 8_2008
Location

SMR Station   GBP
State   UMBRIA
Description   GUBBIO SOIL SITE PIANA
POSITION   GUBBIO
LAT (N)   43.314
LON (E)   12.59

Data Type   SWEPT-SINE SASW
Investigators   KAYEN, SCASSERRA
Date collected   17-Nov-2005

TEST METHODS   PARALLEL-ARRAY SOURCES;
          CONTINUOUS HARMONIC
          WAVE-SASW; 3D AMBIENT
          MICROTREMOR ANALYSIS

PROJECT NAME   UMBRIA-MARCHE
          SMR CHARACTERIZATION
SPONSOR   PEER, UNIV OF ROME

SITE SUB CLASS: Vs30 (m/s)
A   >1500 m/s
B+   1080 < Vs30 ≤ 1500 m/s
B-   720 < Vs30 ≤ 1080 m/s
C+   540 < Vs30 ≤ 720 m/s
C-   360 < Vs30 ≤ 540 m/s
D+   270 < Vs30 ≤ 360 m/s
D-   180 < Vs30 ≤ 270 m/s
E   <180 m/s
F   Special Soil Conditions: Liquefiable soils; quick
          and high sensitivity clays; collapsible cemented soils;
          peats>3m; high (>75) PI soils thicker than 8m;
          soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field ... Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

265 NRC	No field data are shown	Poor agreement of experimental vs numerical	Need reinterpretation

UMBRIA-MARCHE, ITALY SMR Stations
Site ID   **265NRC**
NEHRP CLASS: **C**
Vs30   **568 (m/s)**
SUB-CLASS   **C+**
REANALYSIS
Location

SMR Station   NRC
State   UMBRIA
Description   NORCIA SITE C-CENTRAL DIST.
POSITION   NORCIA SITE C-CENTRAL DIST.
LAT (N)   42.79223
LON (E)   13.097

Data Type   SWEPT-SINE SASW
Investigators   KAYEN, SCASSERRA
Date collected   18-Nov-2006

TEST METHODS   PARALLEL-ARRAY SOURCES;
               CONTINUOUS HARMONIC
               WAVE-SASW; 3D AMBIENT
               MICROTREMOR ANALYSIS

PROJECT NAME   UMBRIA-MARCHE
               SMR CHARACTERIZATION
SPONSOR   PEER, UNIV OF ROME

SITE SUB CLASS: **Vs30 (m/s)**
A   >1500 m/s
B+   1080 < Vs30 ≤ 1500 m/s
B-   720 < Vs30 ≤ 1080 m/s
C+   540 < Vs30 ≤ 720 m/s
C-   360 < Vs30 ≤ 540 m/s
D+   270 < Vs30 ≤ 360 m/s
D-   180 < Vs30 ≤ 270 m/s
E   <180 m/s
F   Special Soil Conditions: Liquefiable soils; quick and high sensitivity clays; collapsible cemented soils; peats>3m; high (>75) PI soils thicker than 8m; soft/medium stiff clays thicker than 36m.

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(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

NEW Field Ave. Velocity (m/s)
ORIG Field Ave. Velocity (m/s)
Inverted Phase Velocity (m/s)

(D) Shear Wave Velocity SASW

DH Vs
NEW 265NRC-C
NEW 265NRC-D
ORIG 265NRC

POLITECNICO DI TORINO

267 CSC	ok		Poor agreement of experimental vs numerical	I would use only experimental data for wavelength less than 160m, trying to obtain VS up to about 80m depth

UMBRIA-MARCHE, ITALY SMR Stations
Site ID   **267CSC**
NEHRP CLASS: **B**
Vs30   **760 (m/s)**
SUB-CLASS   **B-**

Location

SMR Station   CSC
State   UMBRIA
Description   CASCIA
POSITION   CASCIA
LAT (N)   42.71875
LON (E)   13.012

Data Type   SWEPT-SINE SASW
Investigators   KAYEN, SCASSERRA
Date collected   20-Nov-2006

TEST METHODS   PARALLEL-ARRAY SOURCES; CONTINUOUS HARMONIC WAVE-SASW; 3D AMBIENT MICROTREMOR ANALYSIS

PROJECT NAME   UMBRIA-MARCHE SMR CHARACTERIZATION
SPONSOR   PEER, UNIV OF ROME

SITE SUB CLASS: Vs30 (m/s)
A   >1500 m/s
B+   1080 < Vs30 ≤ 1500 m/s
B-   720 < Vs30 ≤ 1080 m/s
C+   540 < Vs30 ≤ 720 m/s
C-   360 < Vs30 ≤ 540 m/s
D+   270 < Vs30 ≤ 360 m/s
D-   180 < Vs30 ≤ 270 m/s
E   <180 m/s
F   Special Soil Conditions: Liquefiable soils; quick and high sensitivity clays; collapsible cemented soils; peats>3m; high (>75) PI soils thicker than 8m; soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW
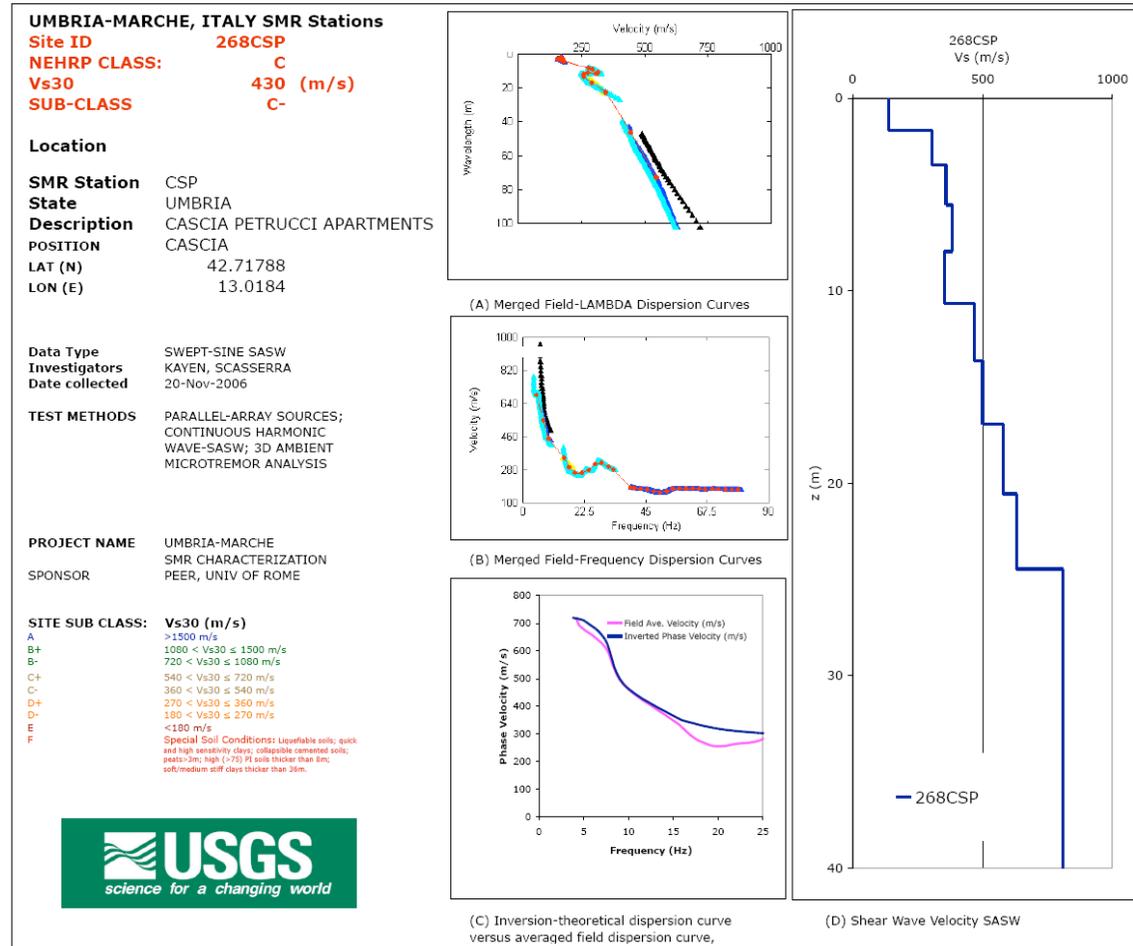
scaglia cinerea

268 CSP	Average quality	ok	

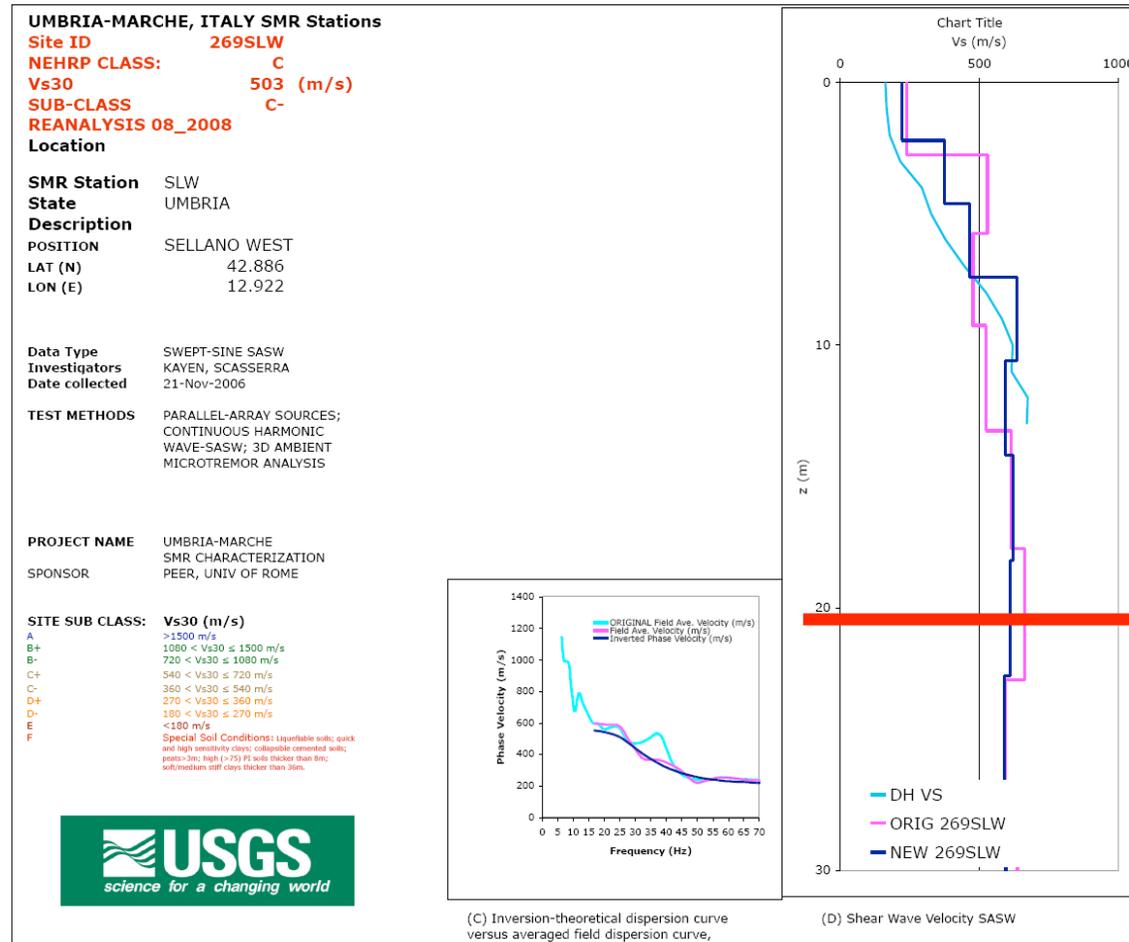## NB: non revisionata (elaborazione uguale al precedente rapporto)

UMBRIA-MARCHE, ITALY SMR Stations

Site ID	**267CSC**
NEHRP CLASS:	**C**
Vs30	**540 (m/s)**
SUB-CLASS	**C+**
Vs 80	**993 (m/s)**
Location	

SMR Station	CSC
State	UMBRIA
Description	CASCIA
POSITION	CASCIA
LAT (N)	42.71875
LON (E)	13.012

Data Type	SWEPT-SINE SASW
Investigators	KAYEN, SCASSERRA
Date collected	20-Nov-2006
TEST METHODS	PARALLEL-ARRAY SOURCES; CONTINUOUS HARMONIC WAVE-SASW; 3D AMBIENT MICROTREMOR ANALYSIS

PROJECT NAME	UMBRIA-MARCHE SMR CHARACTERIZATION
SPONSOR	PEER, UNIV OF ROME

SITE SUB CLASS: Vs30 (m/s)

A	>1500 m/s
B+	1080 < Vs30 ≤ 1500 m/s
B-	720 < Vs30 ≤ 1080 m/s
C+	540 < Vs30 ≤ 720 m/s
C-	360 < Vs30 ≤ 540 m/s
D+	270 < Vs30 ≤ 360 m/s
D-	180 < Vs30 ≤ 270 m/s
E	<180 m/s
F	Special Soil Conditions: Liquefiable soils; quick and high sensitivity clays; collapsible cemented soils; peats>3m; high (>75) PI soils thicker than 8m; soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

268 CSP	Average quality	ok	

UMBRIA-MARCHE, ITALY SMR Stations

Site ID	268CSP
NEHRP CLASS:	C
Vs30	430 (m/s)
SUB-CLASS	C-

Location

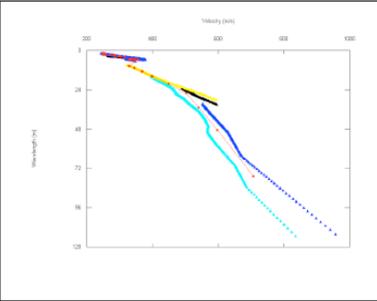|	
SMR Station	CSP
State	UMBRIA
Description	CASCIA PETRUCCI APARTMENTS
POSITION	CASCIA
LAT (N)	42.71788
LON (E)	13.0184

Data Type	SWEPT-SINE SASW
Investigators	KAYEN, SCASSERRA
Date collected	20-Nov-2006
TEST METHODS	PARALLEL-ARRAY SOURCES; CONTINUOUS HARMONIC WAVE-SASW; 3D AMBIENT MICROTREMOR ANALYSIS

PROJECT NAME	UMBRIA-MARCHE SMR CHARACTERIZATION
SPONSOR	PEER, UNIV OF ROME

SITE SUB CLASS: Vs30 (m/s)

A	>1500 m/s
B+	1080 < Vs30 ≤ 1500 m/s
B-	720 < Vs30 ≤ 1080 m/s
C+	540 < Vs30 ≤ 720 m/s
C-	360 < Vs30 ≤ 540 m/s
D+	270 < Vs30 ≤ 360 m/s
D-	180 < Vs30 ≤ 270 m/s
E	<180 m/s
F	Special Soil Conditions: Liquefiable soils; quick and high sensitivity clays; collapsible cemented soils; peats>3m; high (>75) PI soils thicker than 8m; soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

269 SLW	No field data are shown	ok	The VS profile should be plotted only up to a depth of 20m (half of maximum wavelength)

270 MTL	There is evidence of two separate branches: one below 35Hz the other above 50Hz	ok	

UMBRIA-MARCHE, ITALY SMR Stations
Site ID   **270MTL**
NEHRP CLASS: **C**
Vs30   **491 (m/s)**
SUB-CLASS   **C-**
Re-Analysis 2008
Location

SMR Station   MTL
State   MARCHE'
Description   MATELICA
POSITION
LAT (N)   43.24841
LON (E)   13.0079

Data Type   SWEPT-SINE SASW
Investigators   KAYEN, SCASSERRA
Date collected   21-Nov-2006

TEST METHODS   PARALLEL-ARRAY SOURCES;
                 CONTINUOUS HARMONIC
                 WAVE-SASW; 3D AMBIENT
                 MICROTREMOR ANALYSIS

PROJECT NAME   UMBRIA-MARCHE
                 SMR CHARACTERIZATION
SPONSOR   PEER, UNIV OF ROME

SITE SUB CLASS: **Vs30 (m/s)**
A   >1500 m/s
B+   1080 < Vs30 ≤ 1500 m/s
B-   720 < Vs30 ≤ 1080 m/s
C+   540 < Vs30 ≤ 720 m/s
C-   360 < Vs30 ≤ 540 m/s
D+   270 < Vs30 ≤ 360 m/s
D-   180 < Vs30 ≤ 270 m/s
E   <180 m/s
F   Special Soil Conditions: Liquefiable soils; quick
             and high sensitivity clays; collapsible cemented soils;
             peats>3m; high (>75) PI soils thicker than 8m;
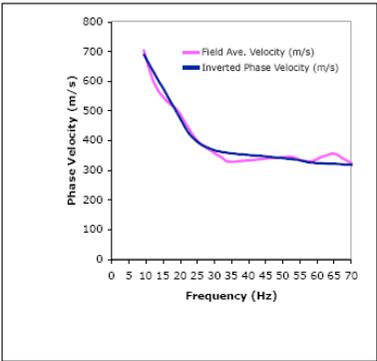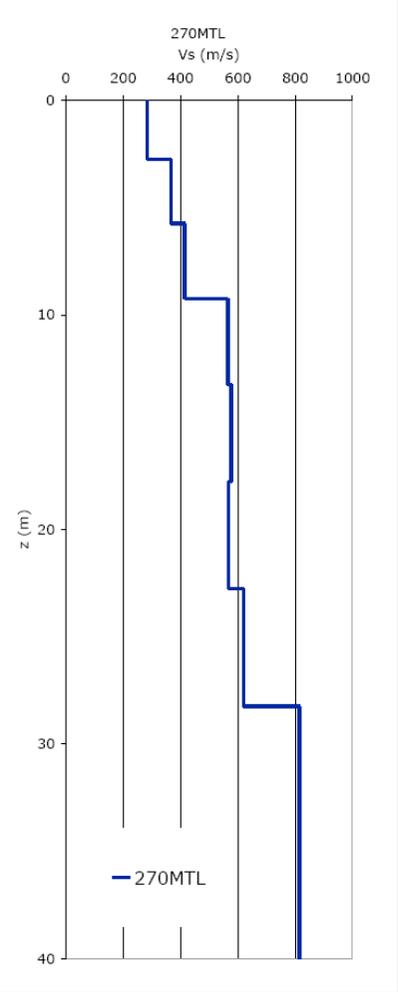   soft/medium stiff clays thicker than 36m.
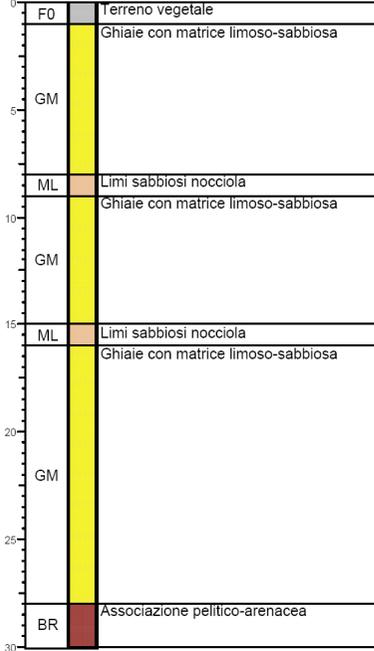

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

270MTL
Vs (m/s)

(D) Shear Wave Velocity SASW

F0		Terreno vegetale
GM		Ghiaie con matrice limoso-sabbiosa
ML		Limi sabbiosi nocciola
GM		Ghiaie con matrice limoso-sabbiosa
ML		Limi sabbiosi nocciola
GM		Ghiaie con matrice limoso-sabbiosa
BR		Associazione pelitico-arenacea

Not revised

Test ID	Experimental data	Inversion	Comments
254 BEV	Ok	Too many layers?	
256 CSA	Single acquisition? Irregular trend (higher modes?)	Investigation depth not compatible with available information	Need reinterpretation
260 NCB	Not reliable (phase jump?)		
263 GBB	Not reliable (mode jump?)	Poor agreement of experimental vs numerical	
264 NCI	Not reliable	Poor agreement of experimental vs numerical	
266 NRA	Strong variation for different acquisition setups		Need reinterpretation

254 BEV	Ok	Too many layers?	

UMBRIA-MARCHE, ITALY SMR Stations

Site ID	**254BEV**
NEHRP CLASS:	**D**
Vs30	**182 (m/s)**
SUB-CLASS	**D-**
Vs100	**278 (m/s)**
Location	

SMR Station	SMI
State	UMBRIA
Description	
POSITION	BEVAGNA
LAT (N)	42.9324
LON (E)	12.6111

Data Type	SWEPT-SINE SASW
Investigators	KAYEN, SCASSERRA
Date collected	11-Nov-2006
TEST METHODS	PARALLEL-ARRAY SOURCES; CONTINUOUS HARMONIC WAVE-SASW; 3D AMBIENT MICROTREMOR ANALYSIS

PROJECT NAME	UMBRIA-MARCHE SMR CHARACTERIZATION
SPONSOR	PEER, UNIV OF ROME

SITE SUB CLASS:	Vs30 (m/s)
A	>1500 m/s
B+	1080 < Vs30 ≤ 1500 m/s
B-	720 < Vs30 ≤ 1080 m/s
C+	540 < Vs30 ≤ 720 m/s
C-	360 < Vs30 ≤ 540 m/s
D+	270 < Vs30 ≤ 360 m/s
D-	180 < Vs30 ≤ 270 m/s
E	<180 m/s
F	Special Soil Conditions: Liquefiable soils; quick and high sensitivity clays; collapsible cemented soils; peats>3m; high (>75) PI soils thicker than 8m; soft/medium stiff clays thicker than 36m.

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(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

Bevagna active vs passive

256 CSA	Single acquisition? Irregular trend (higher modes?)	Investigation depth not compatible with available information	Need reinterpretation

UMBRIA-MARCHE, ITALY SMR Stations
Site ID 256CSA
NEHRP CLASS: D
Vs30 293 (m/s)
SUB-CLASS D+
Vs100 440 (m/s)
Location

SMR Station CSAD
State UMBRIA
Description CASTEL NUOVO ASSISI
POSITION ASSISI
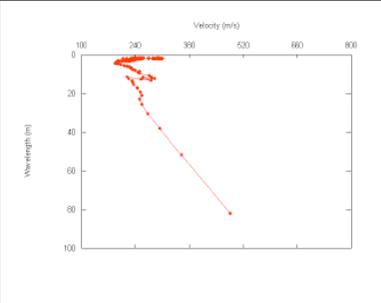**LAT (N)** 43.0081
LON (E) 12.5905

Data Type SWEPT-SINE SASW
Investigators KAYEN, SCASSERRA
Date collected 12-Nov-2006

TEST METHODS PARALLEL-ARRAY SOURCES; CONTINUOUS HARMONIC WAVE-SASW; 3D AMBIENT MICROTREMOR ANALYSIS
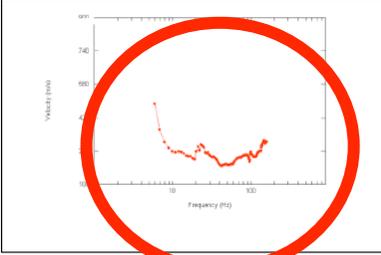
PROJECT NAME UMBRIA-MARCHE SMR CHARACTERIZATION
SPONSOR PEER, UNIV OF ROME

SITE SUB CLASS: **Vs30 (m/s)**
A >1500 m/s
B+ 1080 < Vs30 ≤ 1500 m/s
B- 720 < Vs30 ≤ 1080 m/s
C+ 540 < Vs30 ≤ 720 m/s
C- 360 < Vs30 ≤ 540 m/s
D+ 270 < Vs30 ≤ 360 m/s
D- 180 < Vs30 ≤ 270 m/s
E <180 m/s
F **Special Soil Conditions:** Liquefiable soils; quick and high sensitivity clays; collapsible cemented soils; peats>3m; high (>75) PI soils thicker than 8m; soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

Prof. Metri	Litologia	Descrizione della litologia	Vs
10		Limi argillosi	200 m/s
		Ghiaie e sabbie sciolte	600 m/s
50			
		Ghiaie e sabbie mediamente addensate	800 m/s

260 NCB	Not reliable (phase jump?)		

263 GBB	Not reliable (mode jump?)	Poor agreement of experimental vs numerical	

264 NCI	Not reliable	Poor agreement of experimental vs numerical	

UMBRIA-MARCHE, ITALY SMR Stations

Site ID: **264NCI**
NEHRP CLASS: **C**
Vs30: **551 (m/s)**
SUB-CLASS: **C+**
Vs100: **546 (m/s)**
Location:

SMR Station: NCI
State: UMBRIA
Description: NORCIA INDUSTRIAL PARK
POSITION: NORCIA
LAT (N): 42.77974
LON (E): 13.09729

Data Type: SWEPT-SINE SASW
Investigators: KAYEN, SCASSERRA
Date collected: 18-Nov-2006

TEST METHODS: PARALLEL-ARRAY SOURCES; CONTINUOUS HARMONIC WAVE-SASW; 3D AMBIENT MICROTREMOR ANALYSIS

PROJECT NAME: UMBRIA-MARCHE SMR CHARACTERIZATION
SPONSOR: PEER, UNIV OF ROME

SITE SUB CLASS: Vs30 (m/s)
A: >1500 m/s
B+: 1080 < Vs30 ≤ 1500 m/s
B-: 720 < Vs30 ≤ 1080 m/s
C+: 540 < Vs30 ≤ 720 m/s
C-: 360 < Vs30 ≤ 540 m/s
D+: 270 < Vs30 ≤ 360 m/s
D-: 180 < Vs30 ≤ 270 m/s
E: <180 m/s
F: Special Soil Conditions: Liquefiable soils; quick and high sensitivity clays; collapsible cemented soils; peats>3m; high (>75) PI soils thicker than 8m; soft/medium stiff clays thicker than 36m.
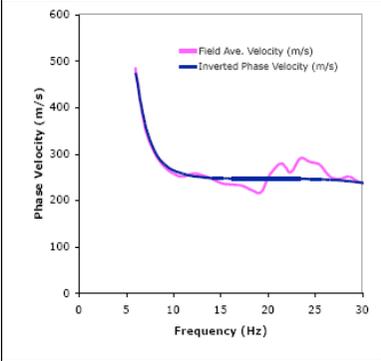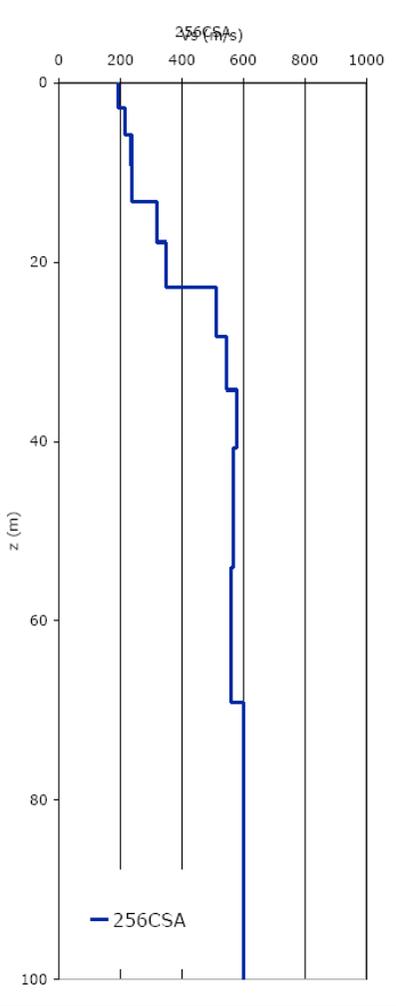
(A) Merged Field-LAMBDA Dispersion Curve

(B) Merged Field-Frequency Dispersion Curves

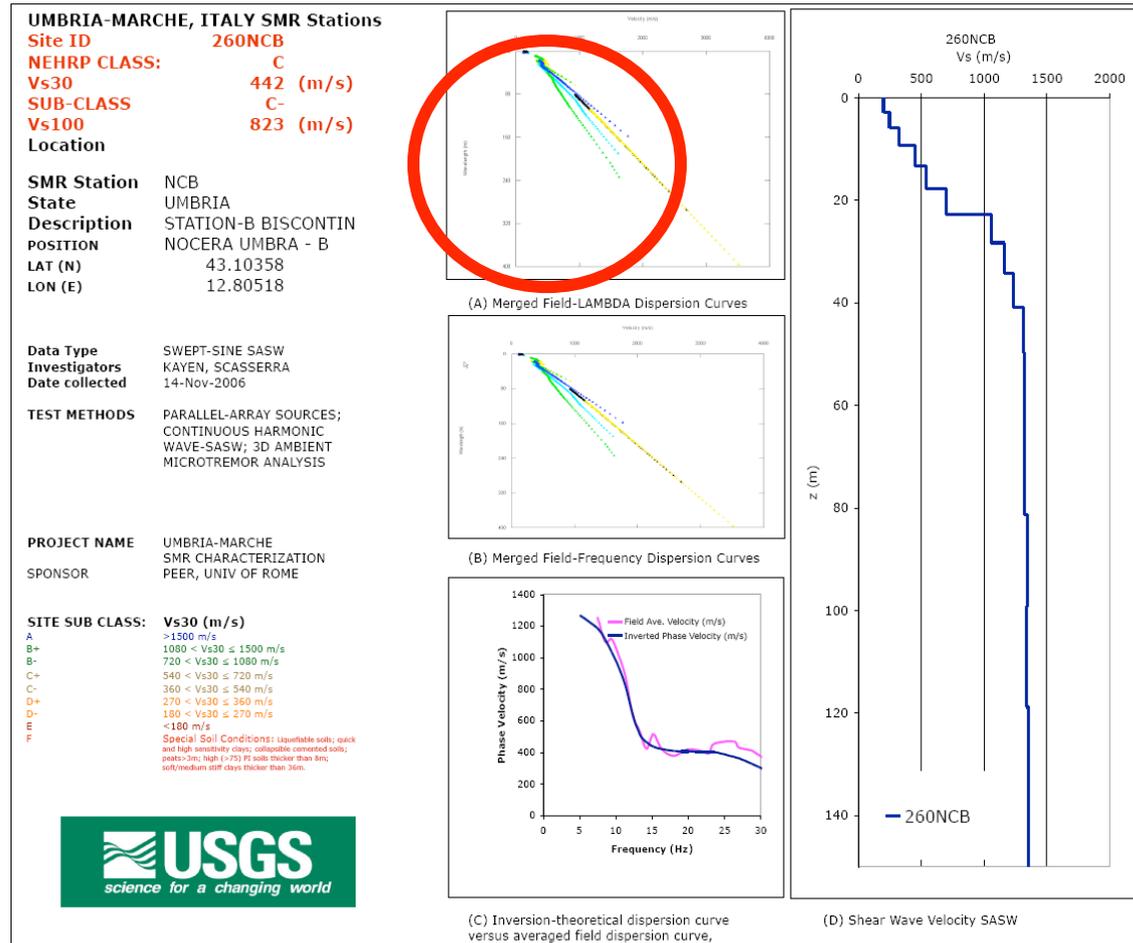(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW

266 NRA	Strong variation for different acquisition setups		Need reinterpretation

UMBRIA-MARCHE, ITALY SMR Stations
Site ID   266NRA
NEHRP CLASS: D
Vs30   218 (m/s)
SUB-CLASS   D-
Vs 80   264 (m/s)
Location

SMR Station   NRA
State   UMBRIA
Description   NORCIA TEMPORARY STATION A
POSITION   NORCIA
LAT (N)   42.79556
LON (E)   13.08096

Data Type   SWEPT-SINE SASW
Investigators KAYEN, SCASSERRA
Date collected 19-Nov-2006

TEST METHODS   PARALLEL-ARRAY SOURCES;
               CONTINUOUS HARMONIC
               WAVE-SASW; 3D AMBIENT
               MICROTREMOR ANALYSIS

PROJECT NAME   UMBRIA-MARCHE
               SMR CHARACTERIZATION
SPONSOR   PEER, UNIV OF ROME

SITE SUB CLASS: Vs30 (m/s)
A   >1500 m/s
B+   1080 < Vs30 ≤ 1500 m/s
B-   720 < Vs30 ≤ 1080 m/s
C+   540 < Vs30 ≤ 720 m/s
C-   360 < Vs30 ≤ 540 m/s
D+   270 < Vs30 ≤ 360 m/s
D-   180 < Vs30 ≤ 270 m/s
E   <180 m/s
F   Special Soil Conditions: Liquefiable soils; quick
                  and high sensitivity clays; collapsible cemented soils;
                  peats>3m; high (>75) PI soils thicker than 8m;
                  soft/medium stiff clays thicker than 36m.

(A) Merged Field-LAMBDA Dispersion Curves

(B) Merged Field-Frequency Dispersion Curves

(C) Inversion-theoretical dispersion curve versus averaged field dispersion curve,

(D) Shear Wave Velocity SASW