



petra

Studio Tecnico  
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**ELABORAZIONE PROVA SISMICA CON METODOLOGIA MASW  
MONTACCHIELLO (PI) - SCUOLA MATERNA  
RELAZIONE DI CALCOLO - APRILE 2013**

==o== SECTION#1

dataset: 6.sgy

minimum offset (m): 6

geophone spacing (m): 1.5

sampling (ms): 0.131

Dispersion curve: 6pick.cdp

Number of individuals: 30

Number of generations: 31

Rayleigh-wave dispersion analysis

|  |     |       |     |       |     |       |     |
|--|-----|-------|-----|-------|-----|-------|-----|
| Adopted search space (minimum Vs & thickness): | 100 | 1.902 | 100 | 3.804 | 200 | 3.804 | 300 |
|--|-----|-------|-----|-------|-----|-------|-----|

|  |     |       |     |       |     |       |     |
|--|-----|-------|-----|-------|-----|-------|-----|
| Adopted search space (maximum Vs & thickness): | 150 | 13.69 | 250 | 15.21 | 400 | 15.21 | 500 |
|--|-----|-------|-----|-------|-----|-------|-----|

|                         |      |      |     |     |
|-------------------------|------|------|-----|-----|
| Adopted Poisson values: | 0.35 | 0.35 | 0.3 | 0.3 |
|-------------------------|------|------|-----|-----|

Output folder: C:\Users\Utente\Desktop\Petra recenti\238\_asiloforti-montac\_giorgio\6

==o== SECTION#2

Rayleigh wave analysis

Optimizing Vs & Thickness - generation: 1; average & best misfits: -41.2195 -28.2891

Optimizing Vs & Thickness - generation: 2; average & best misfits: -35.6447 -15.6204

Optimizing Vs & Thickness - generation: 3; average & best misfits: -35.2178 -15.6204

Optimizing Vs & Thickness - generation: 4; average & best misfits: -29.7039 -12.0823

Optimizing Vs & Thickness - generation: 5; average & best misfits: -28.377 -12.0823

Optimizing Vs & Thickness - generation: 6; average & best misfits: -23.7456 -9.02134

Optimizing Vs & Thickness - generation: 7; average & best misfits: -21.8572 -8.93598

Optimizing Vs & Thickness - generation: 8; average & best misfits: -25.9763 -8.93598

Optimizing Vs & Thickness - generation: 9; average & best misfits: -22.3288 -8.93598

Optimizing Vs & Thickness - generation: 10; average & best misfits: -18.6482 -8.93598

Optimizing Vs & Thickness - generation: 11; average & best misfits: -24.4539 -8.93598

Optimizing Vs & Thickness - generation: 12; average & best misfits: -22.7208 -8.93598

Optimizing Vs & Thickness - generation: 13; average & best misfits: -22.1444 -8.93598

Optimizing Vs & Thickness - generation: 14; average & best misfits: -21.889 -8.93598

Optimizing Vs & Thickness - generation: 15; average & best misfits: -21.8857 -8.93598

Optimizing Vs & Thickness - generation: 16; average & best misfits: -21.4458 -8.93598

Optimizing Vs & Thickness - generation: 17; average & best misfits: -20.7539 -8.93598

Optimizing Vs & Thickness - generation: 18; average & best misfits: -22.4043 -8.93598

Optimizing Vs & Thickness - generation: 19; average & best misfits: -18.8461 -8.93598

Optimizing Vs & Thickness - generation: 20; average & best misfits: -18.3283 -8.93598

Optimizing Vs & Thickness - generation: 21; average & best misfits: -20.4547 -8.93598

Optimizing Vs & Thickness - generation: 22; average & best misfits: -21.3694 -8.93598

Optimizing Vs & Thickness - generation: 23; average & best misfits: -24.0901 -8.93598

Optimizing Vs & Thickness - generation: 24; average & best misfits: -23.2399 -8.93598

Optimizing Vs & Thickness - generation: 25; average & best misfits: -25.3076 -8.93598

Optimizing Vs & Thickness - generation: 26; average & best misfits: -22.3837 -8.93598

Optimizing Vs & Thickness - generation: 27; average & best misfits: -21.2105 -8.93598

Optimizing Vs & Thickness - generation: 28; average & best misfits: -19.6094 -8.93598

Optimizing Vs & Thickness - generation: 29; average & best misfits: -20.2351 -8.93598

Optimizing Vs & Thickness - generation: 30; average & best misfits: -18.8442 -8.93598

Optimizing Vs & Thickness - generation: 31; average & best misfits: -19.673 -8.93021

Checking the new search space (for the finer search)

Now a finer search around the most promising search space area

Rayleigh wave analysis

Optimizing Vs & Thickness - generation: 1; average & best misfits: -25.5649 -8.83527

Optimizing Vs & Thickness - generation: 2; average & best misfits: -21.7837 -8.66103



Optimizing Vs & Thickness - generation: 3; average & best misfits: -25.4452 -8.66103  
Optimizing Vs & Thickness - generation: 4; average & best misfits: -23.6586 -8.64994  
Optimizing Vs & Thickness - generation: 5; average & best misfits: -22.0871 -8.64994  
Optimizing Vs & Thickness - generation: 6; average & best misfits: -25.5346 -8.64994  
Optimizing Vs & Thickness - generation: 7; average & best misfits: -24.3799 -8.64994  
Optimizing Vs & Thickness - generation: 8; average & best misfits: -21.7082 -8.64994  
Optimizing Vs & Thickness - generation: 9; average & best misfits: -22.105 -8.64994

Model after the Vs & Thickness optimization (fixed Poisson values):

|                |      |      |     |     |
|----------------|------|------|-----|-----|
| Vs (m/s):      | 125  | 189  | 293 | 500 |
| Poisson:       | 0.35 | 0.35 | 0.3 | 0.3 |
| Thickness (m): | 3.3  | 10   | 4.4 |     |

Number of models considered to calculate the average model: 16

#####

RESULTS winMASW Pro

#####

Dataset: 6.sgy

Analyzed curve: 6pick.cdp

==o== SECTION#3

MEAN MODEL

|                            |     |      |     |     |
|----------------------------|-----|------|-----|-----|
| VS (m/s):                  | 122 | 189  | 325 | 499 |
| Standard deviations (m/s): | 4   | 5    | 32  | 4   |
| Thickness (m):             | 3.2 | 10.4 | 5.6 |     |
| Standard deviations (m):   | 0.2 | 0.5  | 1.8 |     |

Approximate values for Vp, density & elastic moduli

|                      |      |      |      |      |
|----------------------|------|------|------|------|
| Vp (m/s):            | 254  | 393  | 608  | 934  |
| Density (gr/cm3):    | 1.72 | 1.83 | 1.93 | 2.04 |
| Vp/Vs ratio:         | 2.08 | 2.08 | 1.87 | 1.87 |
| Poisson:             | 0.35 | 0.35 | 0.30 | 0.30 |
| Young modulus (MPa): | 69   | 176  | 531  | 1319 |
| Shear modulus (MPa): | 26   | 65   | 204  | 507  |
| Lamé (MPa):          | 60   | 152  | 306  | 763  |
| Bulk modulus (MPa):  | 77   | 195  | 442  | 1101 |

Fundamental mode

Mean model

| f(Hz)   | VR(m/s)  |
|---------|----------|
| 4.45213 | 345.2881 |
| 4.70319 | 337.3161 |
| 5.45638 | 280.5891 |
| 5.95851 | 232.3374 |
| 7.0883  | 189.615  |
| 8.59468 | 171.6924 |
| 10.6032 | 161.3019 |
| 13.2394 | 150.8497 |
| 16.0011 | 138.73   |
| 20.2691 | 125.3549 |
| 24.2862 | 119.6697 |
| 27.9266 | 117.1975 |
| 32.6968 | 115.609  |
| 36.8394 | 114.9297 |

==o== SECTION#4

BEST MODEL

|                |          |          |          |     |
|----------------|----------|----------|----------|-----|
| Vs (m/s):      | 125.4777 | 188.9925 | 292.6225 | 500 |
| thickness (m): | 3.29044  | 10.2195  | 4.39529  |     |

Approximate values for Vp, density & elastic moduli

|                   |      |      |      |      |
|-------------------|------|------|------|------|
| Vp (m/s):         | 261  | 393  | 547  | 935  |
| Density (gr/cm3): | 1.73 | 1.83 | 1.91 | 2.04 |
| Vp/Vs ratio:      | 2.09 | 2.08 | 1.87 | 1.87 |
| Poisson:          | 0.35 | 0.35 | 0.30 | 0.30 |



|                      |    |     |     |      |
|----------------------|----|-----|-----|------|
| Young modulus (MPa): | 73 | 176 | 426 | 1324 |
| Shear modulus (MPa): | 27 | 65  | 164 | 509  |
| Lamé (MPa):          | 64 | 152 | 243 | 763  |
| Bulk modulus (MPa):  | 82 | 195 | 353 | 1102 |

dispersion curve (frequency - Rayleigh phase velocity)

Fundamental mode)

best model

| F(Hz)   | VR(m/s)  |
|---------|----------|
| 4.45213 | 346.7805 |
| 4.70319 | 339.0453 |
| 5.45638 | 279.835  |
| 5.95851 | 230.8107 |
| 7.0883  | 189.2903 |
| 8.59468 | 172.0139 |
| 10.6032 | 161.9639 |
| 13.2394 | 152.0575 |
| 16.0011 | 140.9756 |
| 20.2691 | 128.4921 |
| 24.2862 | 122.9519 |
| 27.9266 | 120.4916 |
| 32.6968 | 118.8922 |
| 36.8394 | 118.2029 |

==o== SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 38 m

Inversion quality: very good

VS5 (mean model): 140 m/s

VS5 (best model): 141 m/s

VS20 (mean model): 200 m/s

VS20 (best model): 201 m/s

VS30 (mean model): 249 m/s

VS30 (best model): 251 m/s

==o== SECTION#6

Possible Soil Type: C

(based on the mean model)

For Italian Users:

Dalla normativa (modifiche del D.M. 14/09/2005 Norme Tecniche per le Costruzioni, emanate con D.M.

Infrastrutture del 14/01/2008, pubblicato su Gazzetta Ufficiale Supplemento ordinario n° 29 del 04/02/2008):

A - Ammassi rocciosi affioranti o terreni molto rigidi, caratterizzati da valori di VS30 superiori a 800 m/s, eventualmente comprendenti in superficie uno strato di alterazione, con spessore massimo di 3 m.

B - Rocce tenere e depositi di terreni a grana grossa molto addensati o terreni a grana fine molto consistenti, con spessori superiori a 30 m, caratterizzati da graduale miglioramento delle proprietà meccaniche con la profondità e valori del VS30 compresi tra 360 m/s e 800 m/s (ovvero NSPT30 > 50 nei terreni a grana grossa e cu30 > 250 kPa nei terreni a grana fina).

C - Depositati di terreni a grana grossa mediamente addensati o terreni a grana fine mediamente consistenti, con spessori superiori a 30 m caratterizzati da graduale miglioramento delle proprietà meccaniche con la profondità e valori del VS30 compresi tra 180 m/s e 360 m/s (ovvero 15 < NSPT30 < 50 nei terreni a grana grossa e 70 < cu30 < 250 kPa nei terreni a grana fina).

D - Depositati di terreni a grana grossa scarsamente addensati o terreni a grana fine scarsamente consistenti, con spessori superiori a 30 m caratterizzati da graduale miglioramento delle proprietà meccaniche con la profondità e valori del VS30 inferiori a 180 m/s (ovvero NSPT30 < 15 nei terreni a grana grossa e cu30 < 70 kPa nei terreni a grana fina).

E - Terreni dei sottosuoli dei tipi C o D per spessori non superiori a 20 m, posti sul substrato di riferimento (con VS > 800 m/s).

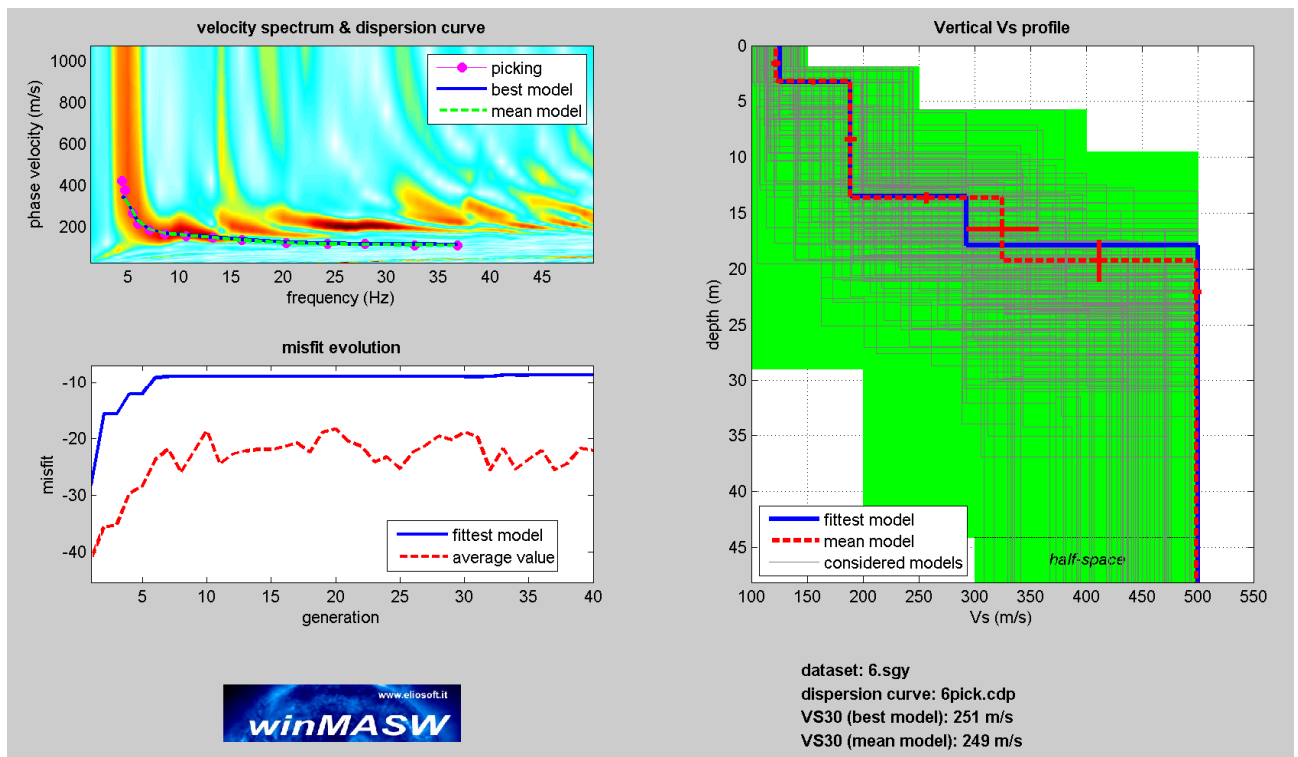
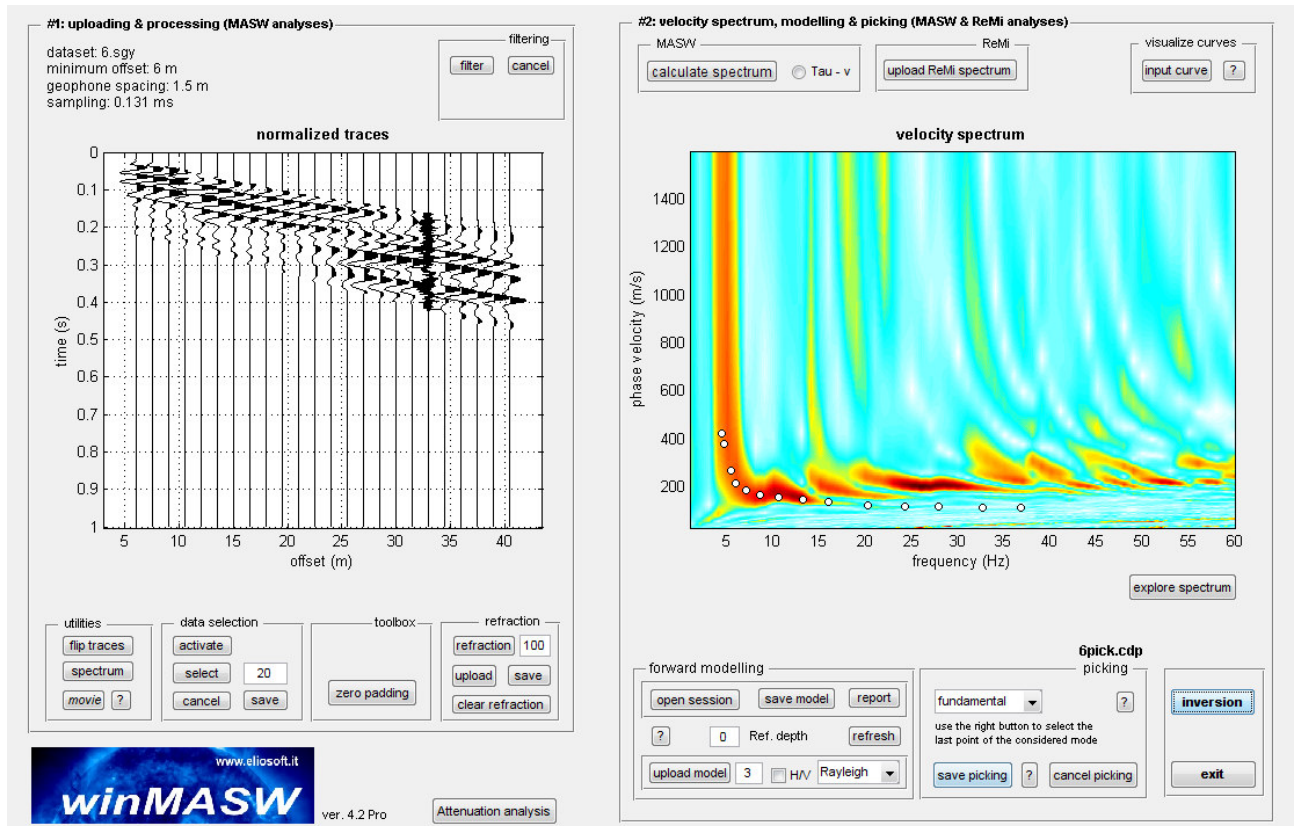
S1 - Depositati di terreni caratterizzati da valori di VS30 inferiori 100 m/s (ovvero 10 < cu30 < 20 kPa) che includono uno strato di almeno 8 m di terreni a grana fina di bassa consistenza, oppure che includano almeno 3 m di torba o argille altamente organiche.

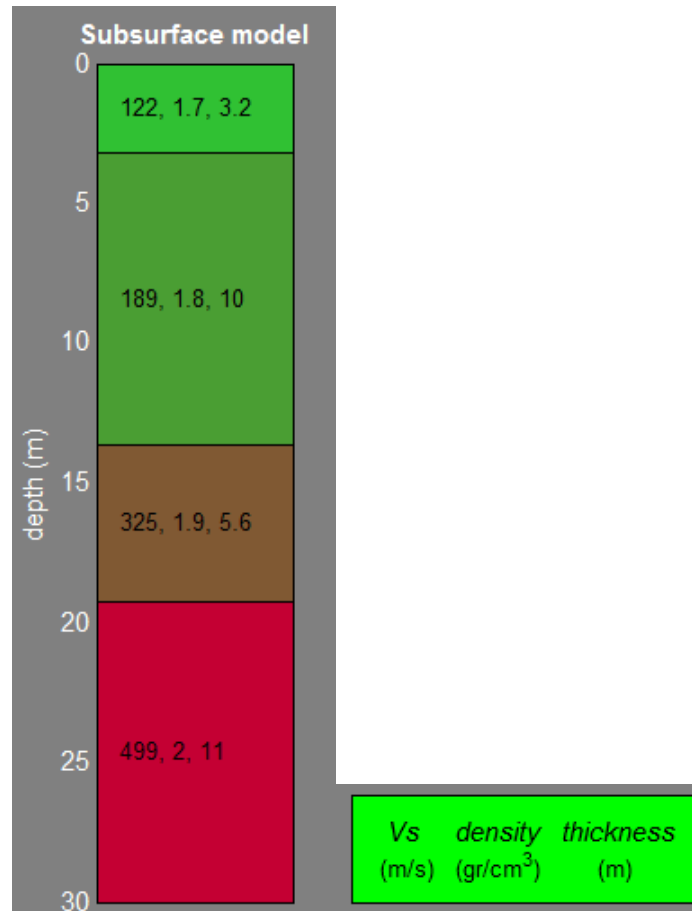
S2 - Depositati di terreni suscettibili di liquefazione, di argille sensitive, o qualsiasi altra categoria di sottosuolo non classificabile nei tipi precedenti.



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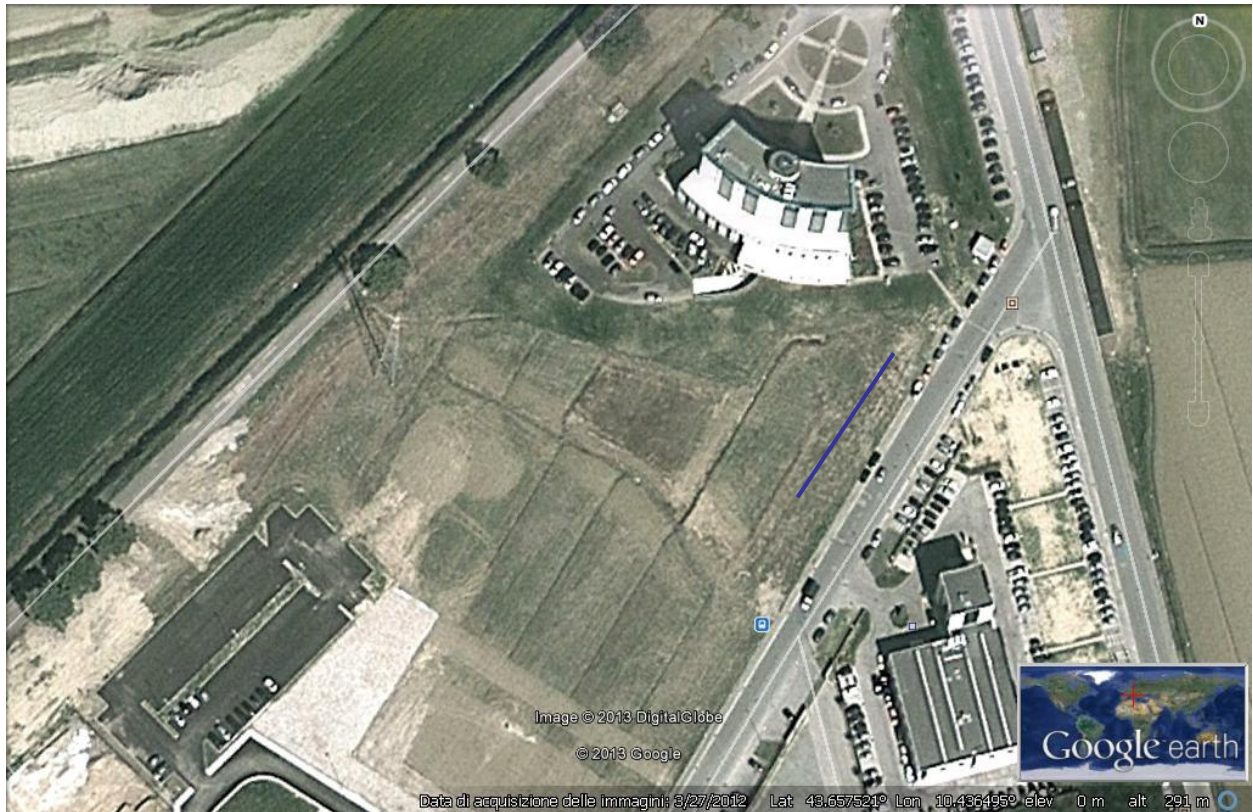
winMASW 4.2 Pro - Surface Wave Analysis - [www.eliosoft.it](http://www.eliosoft.it)





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*Ubicazione prova sismica "masw" (linea blu) presso Scuola Materna Montacchiello (PI)*