COMUNE DI PISA

RISTRUTTURAZIONE E SOSTITUZIONE EDILIZIA IN VIA DI GELLO

INDAGINE SISMICA MASW

SECTION#1
dataset: 04.sgy
minimum offset (m): 4
geophone spacing (m): 2
sampling (ms): 0.131
Dispersion curve: 4.cdp
Number of individuals: 30
Number of generations: 31

Rayleigh-wave dispersion analysis

Adopted search space (minimum Vs & thickness): 140 2 150 3.958896 250 3.958896 400
Adopted search space (maximum Vs & thickness): 220 5 350 15.83558 500 15.83558 650
Adopted Poisson values: 0.35 0.35 0.35 0.4

SECTION#2
Rayleigh wave analysis
Optimizing Vs & Thickness - generation: 1; average & best misfits: -41.8014 -15.7832
Optimizing Vs & Thickness - generation: 2; average & best misfits: -30.3265 -9.77342
Optimizing Vs & Thickness - generation: 3; average & best misfits: -25.4064 -6.57384
Optimizing Vs & Thickness - generation: 4; average & best misfits: -22.9501 -6.57384
Optimizing Vs & Thickness - generation: 5; average & best misfits: -20.4115 -5.70358
Optimizing Vs & Thickness - generation: 6; average & best misfits: -20.4379 -5.70358
Optimizing Vs & Thickness - generation: 7; average & best misfits: -18.599 -5.70358
Optimizing Vs & Thickness - generation: 8; average & best misfits: -22.22 -5.70358
Optimizing Vs & Thickness - generation: 9; average & best misfits: -23.2634 -5.70358
Optimizing Vs & Thickness - generation: 10; average & best misfits: -23.7902 -5.70358
Optimizing Vs & Thickness - generation: 11; average & best misfits: -24.2949 -5.70358
Optimizing Vs & Thickness - generation: 12; average & best misfits: -23.2269 -5.70358
Optimizing Vs & Thickness - generation: 13; average & best misfits: -21.3367 -5.70358
Optimizing Vs & Thickness - generation: 14; average & best misfits: -21.5499 -5.70358
Optimizing Vs & Thickness - generation: 15; average & best misfits: -18.8335 -5.70358
Optimizing Vs & Thickness - generation: 16; average & best misfits: -19.8177 -5.69212
Optimizing Vs & Thickness - generation: 17; average & best misfits: -16.7724 -5.69212
Optimizing Vs & Thickness - generation: 18; average & best misfits: -20.0512 -5.69212
Optimizing Vs & Thickness - generation: 19; average & best misfits: -18.36 -5.69212
Optimizing Vs & Thickness - generation: 20; average & best misfits: -19.323 -5.69212
Optimizing Vs & Thickness - generation: 21; average & best misfits: -21.1657 -5.69212
Optimizing Vs & Thickness - generation: 22; average & best misfits: -23.3782 -5.69212
Optimizing Vs & Thickness - generation: 23; average & best misfits: -23.9192 -5.69212
Optimizing Vs & Thickness - generation: 24; average & best misfits: -23.3529 -5.69212
Optimizing Vs & Thickness - generation: 25; average & best misfits: -23.1854 -5.69212
Optimizing Vs & Thickness - generation: 26; average & best misfits: -20.5934 -5.69212
Optimizing Vs & Thickness - generation: 27; average & best misfits: -21.999 -5.69212
Optimizing Vs & Thickness - generation: 28; average & best misfits: -23.1401 -5.69212
Optimizing Vs & Thickness - generation: 29; average & best misfits: -22.7693 -5.69212
Optimizing Vs & Thickness - generation: 30; average & best misfits: -22.1534 -5.69212
Optimizing Vs & Thickness - generation: 31; average & best misfits: -20.2013 -5.69212

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: -24.0451 -5.69212

Optimizing Vs & Thickness - generation: 2; average & best misfits: -20.4203 -5.69212
Optimizing Vs & Thickness - generation: 3; average & best misfits: -25.8186 -5.69212
Optimizing Vs & Thickness - generation: 4; average & best misfits: -21.7449 -5.69212
Optimizing Vs & Thickness - generation: 5; average & best misfits: -22.3934 -5.69212
Optimizing Vs & Thickness - generation: 6; average & best misfits: -20.7166 -5.69212
Optimizing Vs & Thickness - generation: 7; average & best misfits: -22.0246 -5.69212
Optimizing Vs & Thickness - generation: 8; average & best misfits: -22.1922 -5.69212
Optimizing Vs & Thickness - generation: 9; average & best misfits: -23.3974 -5.69212

Model after the Vs & Thickness optimization (fixed Poisson values):
Vs (m/s): 188 258 386 650
Poisson: 0.35 0.35 0.35 0.4
Thickness (m): 4.5 8 12

Number of models considered to calculate the average model: 7

RESULTS winMASW Pro

Dataset: 04.sgy
Analyzed curve: 4.cdp

SECTION#3

MEAN MODEL

VS (m/s): 188 257 388 646
Standard deviations (m/s): 0 5 8 11

Thickness (m): 4.5 8.2 11.2
Standard deviations (m): 0.1 0.5 1.0

Approximate values for Vp, density & elastic moduli
Vp (m/s): 391 535 808 1582
Density (gr/cm3): 1.83 1.90 2.00 2.17
Vp/Vs ratio: 2.08 2.08 2.08 2.45
Poisson: 0.35 0.35 0.35 0.40
Young modulus (MPa): 174 339 814 2530
Shear modulus (MPa): 65 126 301 904
Lamé (MPa): 150 293 704 3612
Bulk modulus (MPa): 193 377 905 4215

Fundamental mode
Mean model

f(Hz)	VR(m/s)
5.20532	474.7129
5.83298	442.648
6.96277	352.5452
8.46915	281.9216
10.4777	244.2345
13.1138	221.7864
16.3777	205.6795
20.5202	192.3277
24.2862	185.2896
28.1777	181.2519
32.1947	178.9562
35.9606	177.7275

SECTION#4

BEST MODEL

Vs (m/s): 188.2525 258.2612 385.9715 650
thickness (m): 4.48717 8.04405 11.685

Approximate values for Vp, density & elastic moduli

Vp (m/s):	392	538	803	1592
Density (gr/cm3):	1.83	1.90	2.00	2.17
Vp/Vs ratio:	2.09	2.09	2.08	2.45
Poisson:	0.35	0.35	0.35	0.40
Young modulus (MPa):	174	342	805	2563
Shear modulus (MPa):	65	127	298	916
Lamé (MPa):	152	298	694	3661
Bulk modulus (MPa):	195	382	893	4271

dispersion curve (frequency - Rayleigh phase velocity)

Fundamental mode)
best model

F(Hz)	VR(m/s)
5.20532	476.0106
5.83298	441.8906
6.96277	352.6068
8.46915	284.5135
10.4777	246.6653
13.1138	223.5407
16.3777	206.9541
20.5202	193.198
24.2862	185.91
28.1777	181.7191
32.1947	179.3332
35.9606	178.0543

SECTION#5

Maximum penetration depth according to the "Steady State Rayleigh Method": 40 m

Inversion quality: very good

VS5 (mean model): 193 m/s
VS5 (best model): 193 m/s

VS20 (mean model): 268 m/s
VS20 (best model): 269 m/s

VS30 (mean model): 319 m/s
VS30 (best model): 318 m/s

SECTION#6

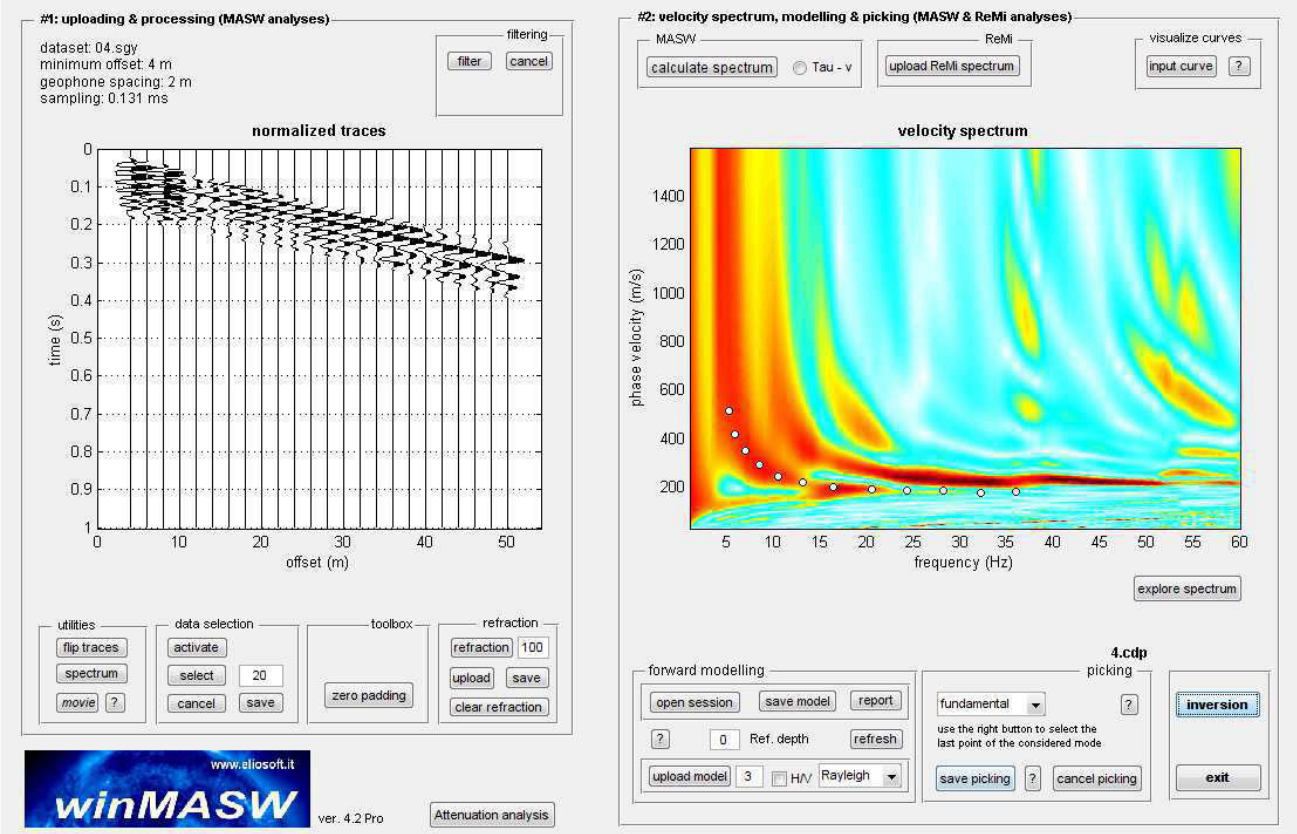
Possible Soil Type: C
(based on the mean model)

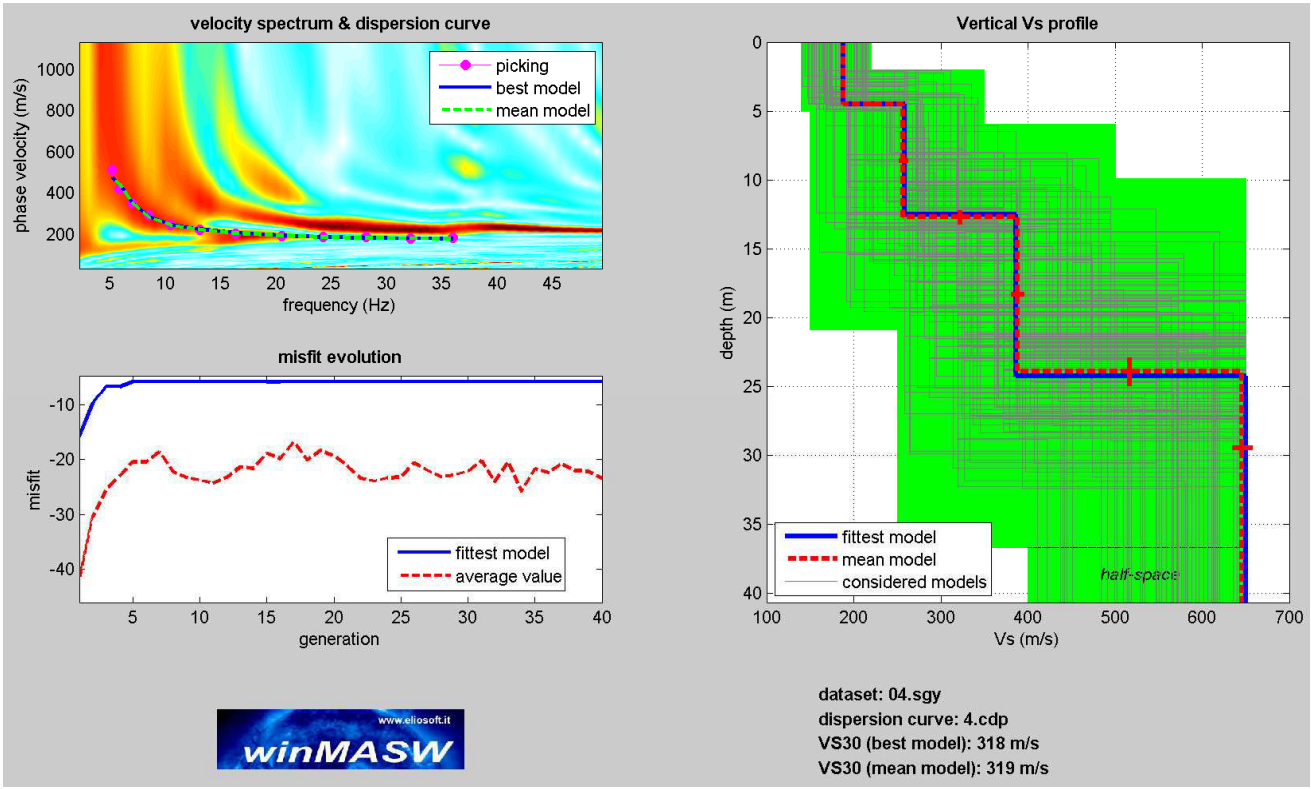
For Italian Users:
Dalla normativa (modifiche del D.M. 14/09/2005 Norme Tecniche per le Costruzioni, emanate con D.M. Infrastrutture del 14/01/2008, pubblicato su Gazzetta Ufficiale Supplemento ordinario n° 29 del 04/02/2008):

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 - Depositi 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 - Depositi 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 - Depositi di terreni caratterizzati da valori di VS30 inferiori 100 m/s (ovvero 10 < cuS30 < 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 - Depositi di terreni suscettibili di liquefazione, di argille sensitive, o qualsiasi altra categoria di sottosuolo non classificabile nei tipi precedenti.

winMASW 4.2 Pro
Surface Wave Analysis

www.eliosoft.it




velocity spectrum & dispersion curve
phase velocity (m/s)
frequency (Hz)
picking
best model
mean model
misfit evolution
misfit
generation
fittest model
average value
Vertical Vs profile
depth (m)
Vs (m/s)
fittest model
mean model
considered models
half-space
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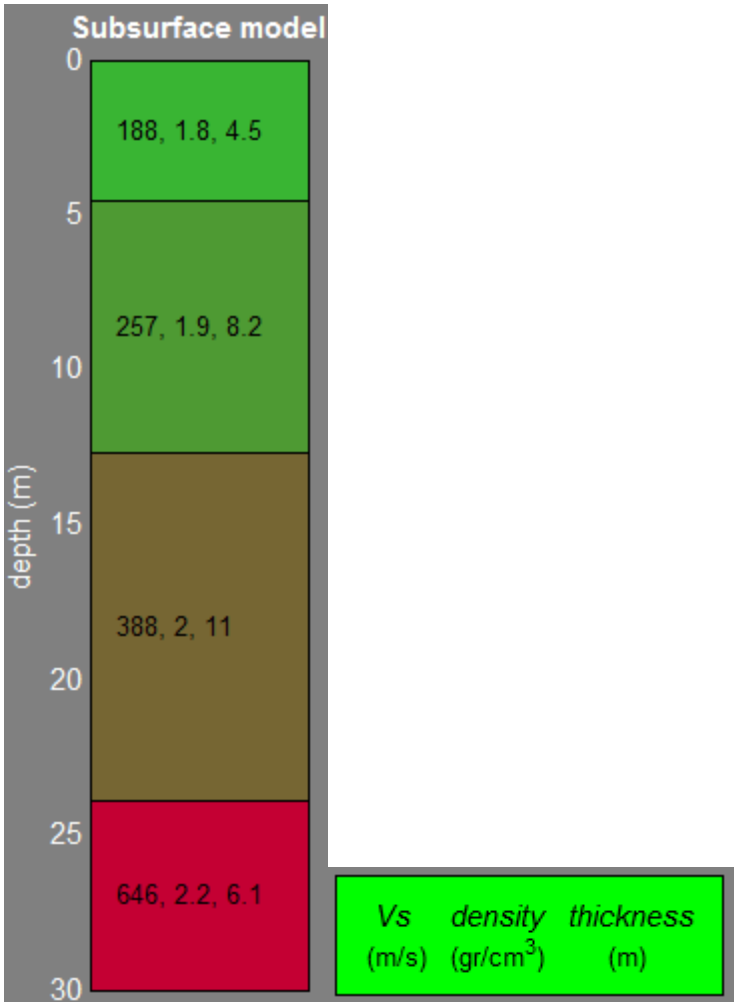
winMASW
dataset: 04.sgy
dispersion curve: 4.cdp
VS30 (best model): 318 m/s
VS30 (mean model): 319 m/s


Subsurface model
depth (m)
188, 1.8, 4.5
257, 1.9, 8.2
388, 2, 11
646, 2.2, 6.1
Vs (m/s)
density (gr/cm3)
thickness (m)