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Site effects in a narrow and faulted valley

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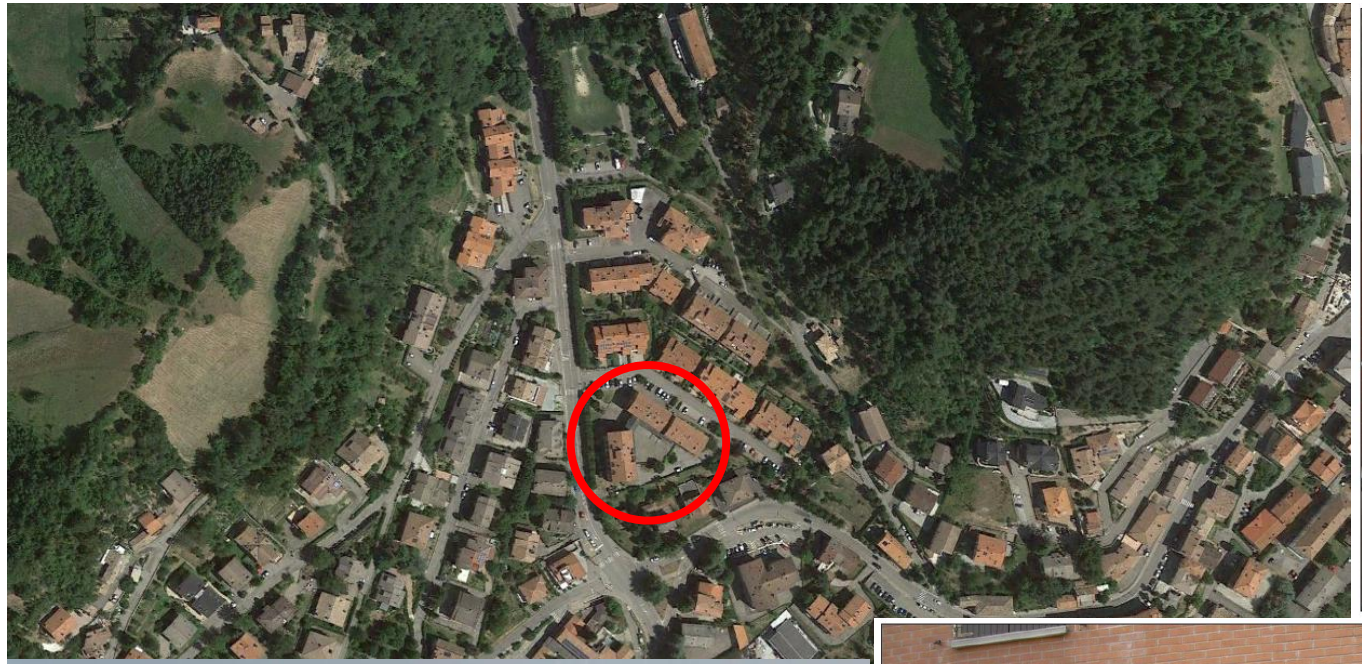
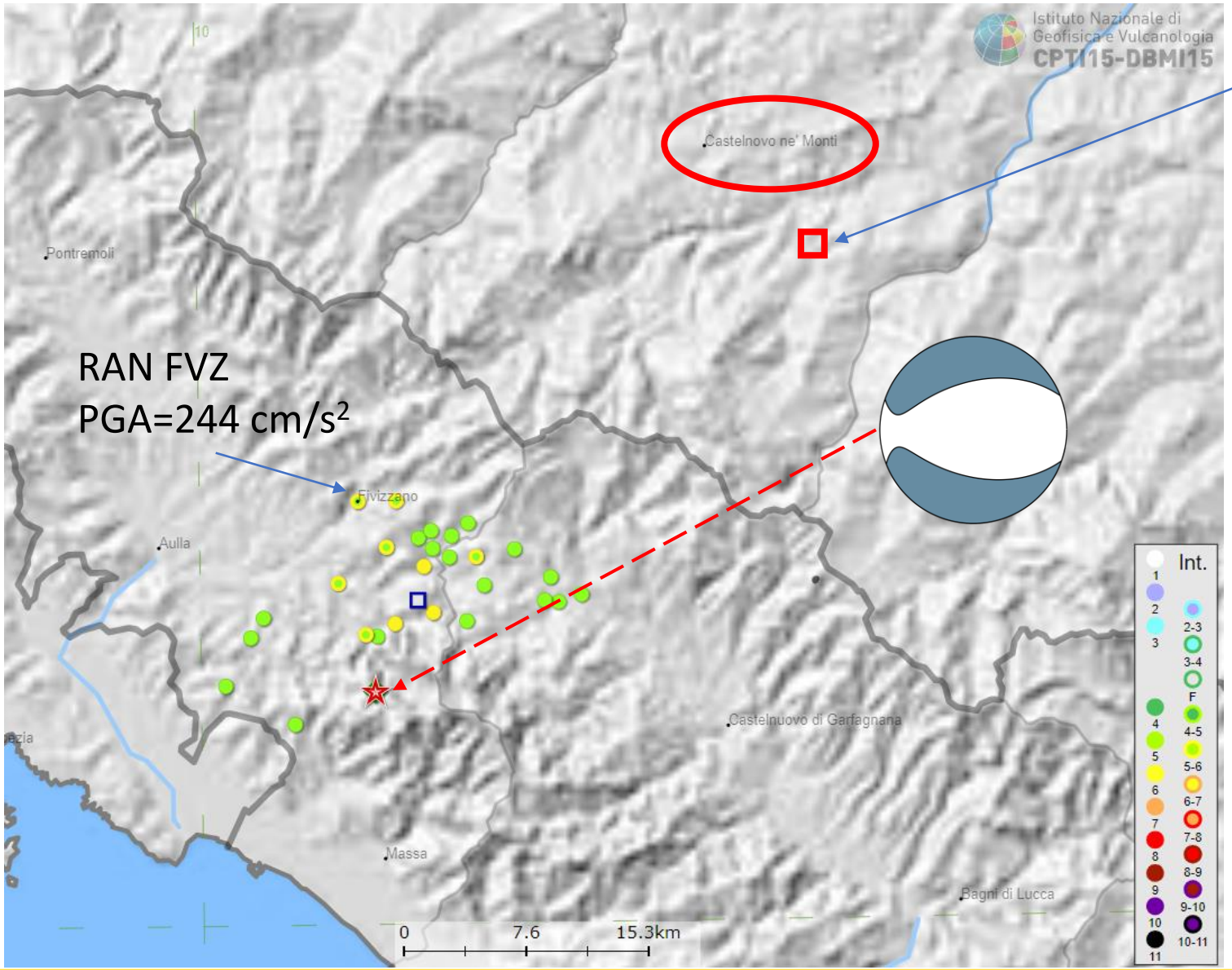


damage in Castelnovo ne' Monti (Reggio Emilia Apennines) following the Lunigiana earthquake of 21/6/2013



RAN VLM: PGA=55 cm/s^2

http://ran.protezionecivile.it/IT/index.php

RAN FVZ

PGA=244 cm/s^2

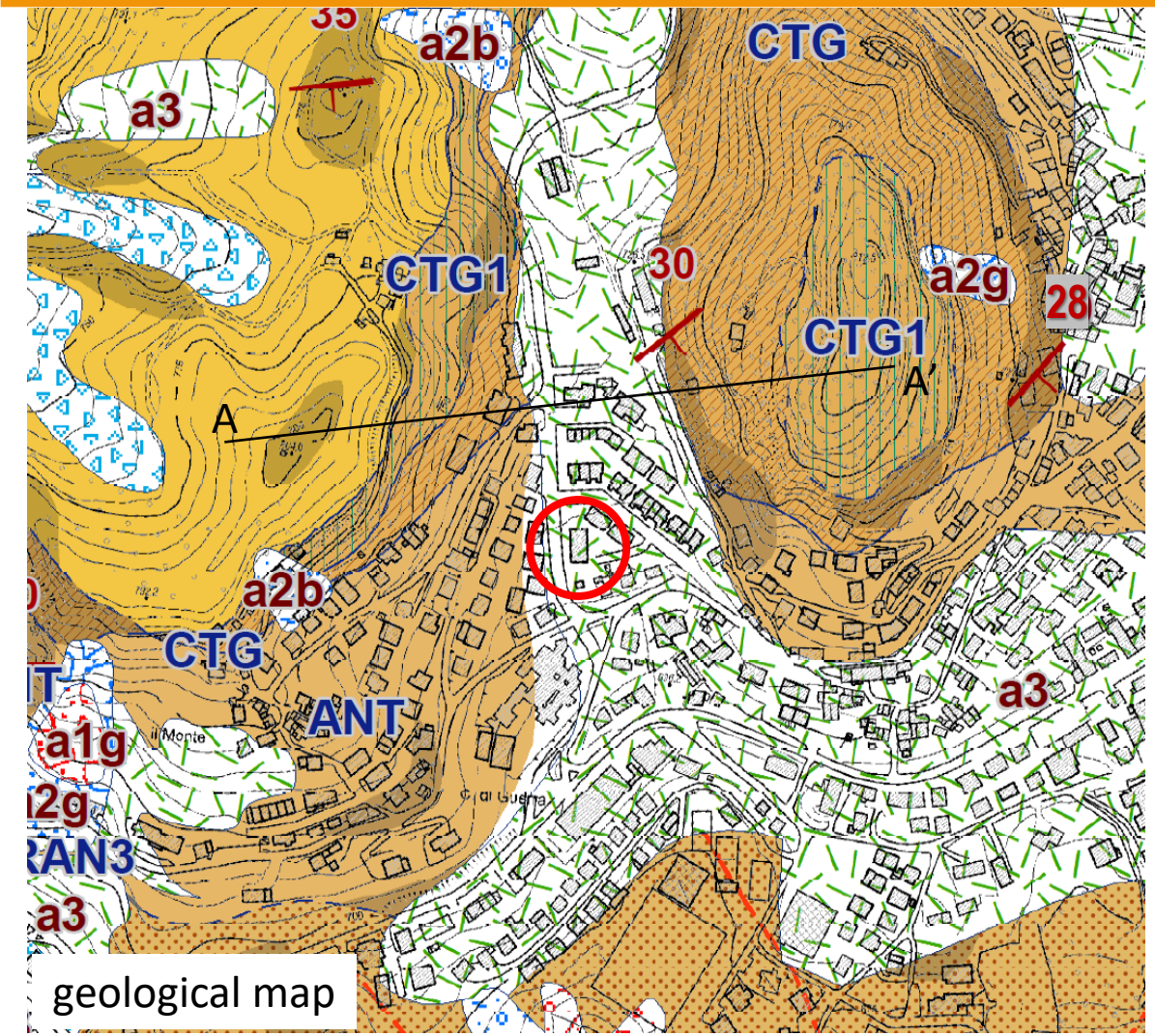
macroseismic intensities (CPTI 15)

2013 June 21 10:33:56.07
Lunigiana

EqID 20130621_1033_000

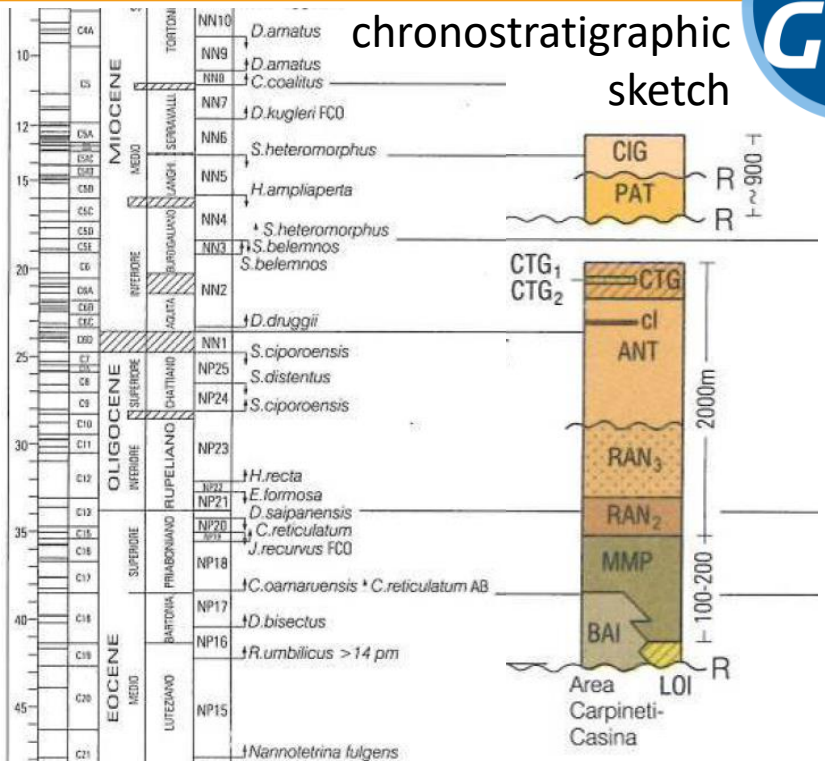
	Lat	Lon	Ep. origin	Io	Mw ErMw	Mag. origin	Depth
☆ CPTI15	44.131	10.136		6	5.36 ± 0.07	InsO	7.0
□ Macro	44.182	10.170	bx0	6	4.69 ± 0.23	bxn	
◇ Instr	44.131	10.136	BSINGV		5.36 ± 0.07	MwMT	7.0

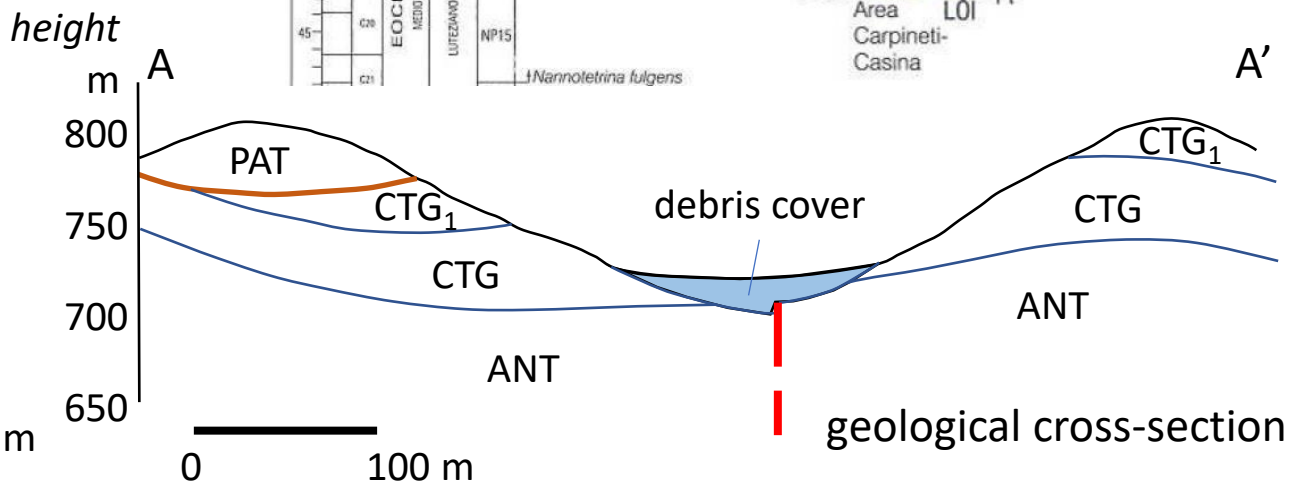
To understand the causes of the anomalous damage observed, the Municipality, already equipped with second-level seismic microzonation, also planned a third-level study in this site and other areas of particular interest, where second-level seismic microzonation has shown high amplifications



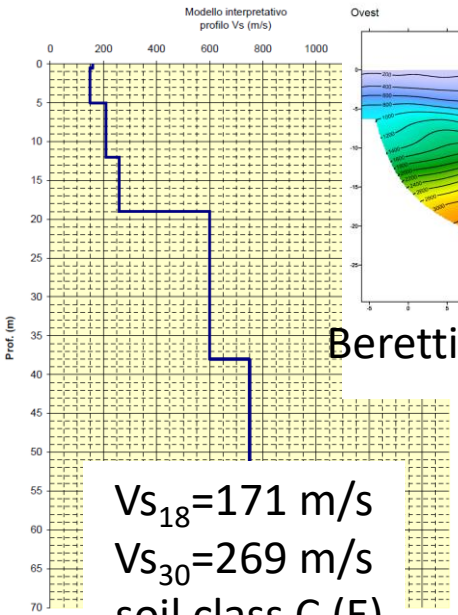
geological map

chronostratigraphic sketch



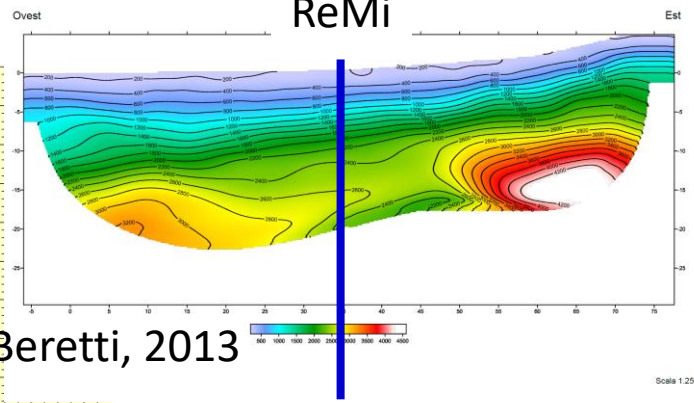


geological cross-section



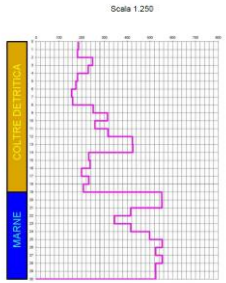
Vs_{18}=171 m/s
Vs_{30}=269 m/s
soil class C (E)

ReMi



Beretti, 2013

northern seismic line



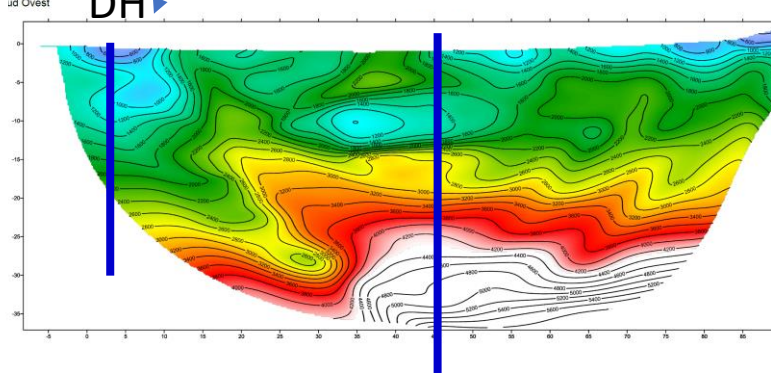
Vs_{19}= 224 m/s
Vs_{30}=279 m/s
Soil class C

Beretti, 2013

damaged building

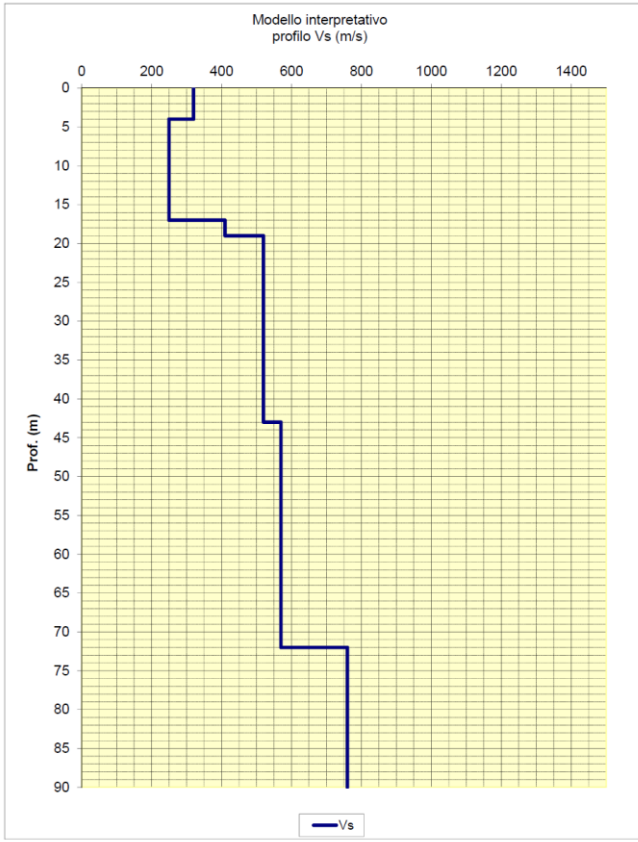
DH

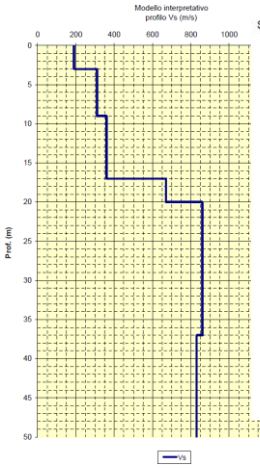
ReMi



central seismic line

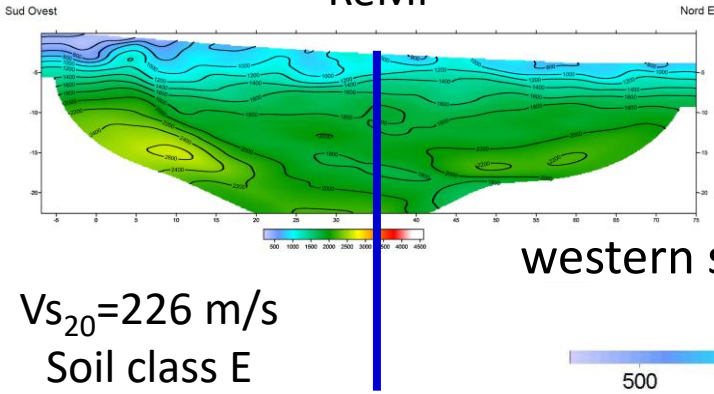
Vs_{17}=264 m/s
Vs_{30}=314 m/s
Soil class C



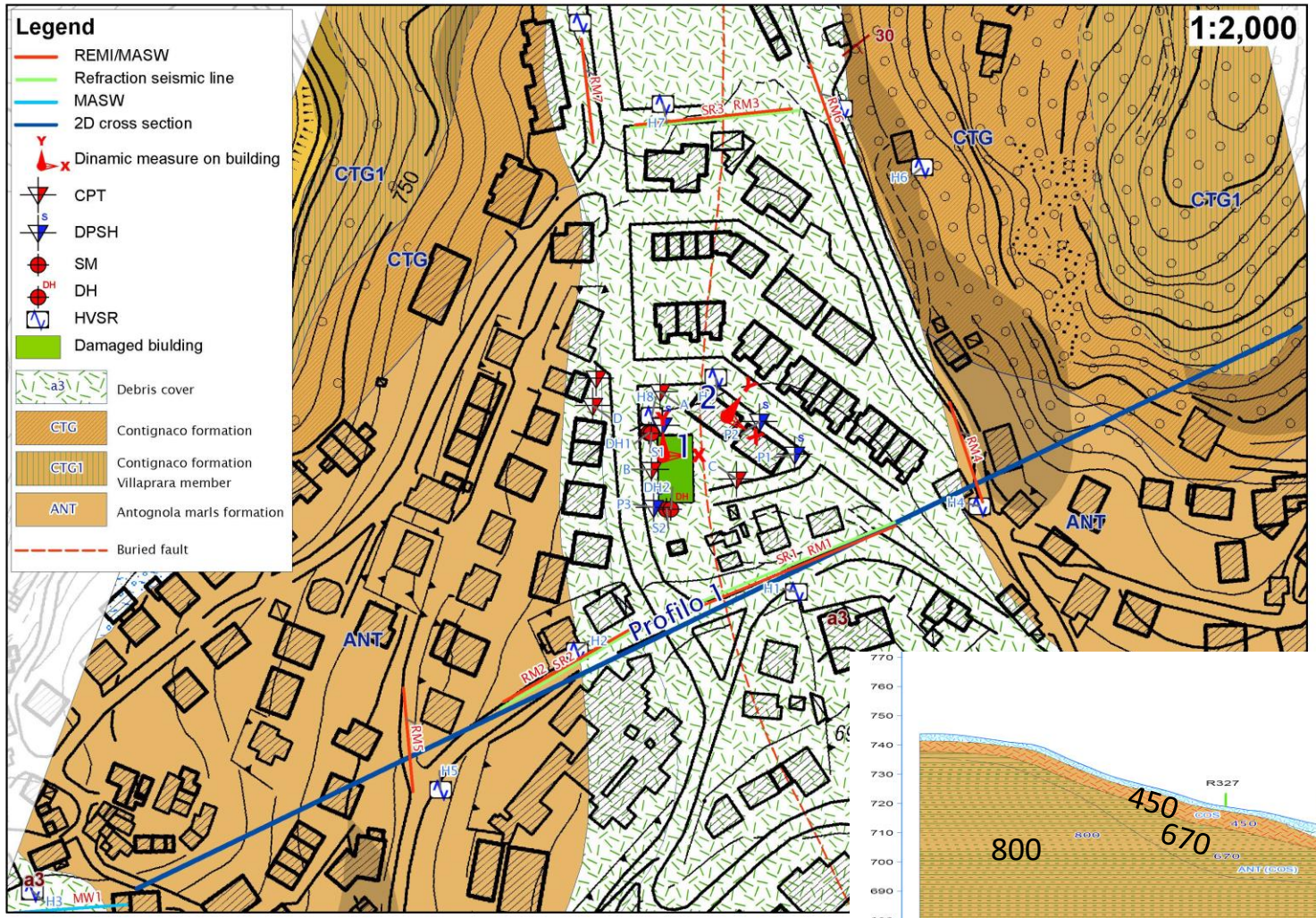


Vs_{20}=226 m/s
Soil class E

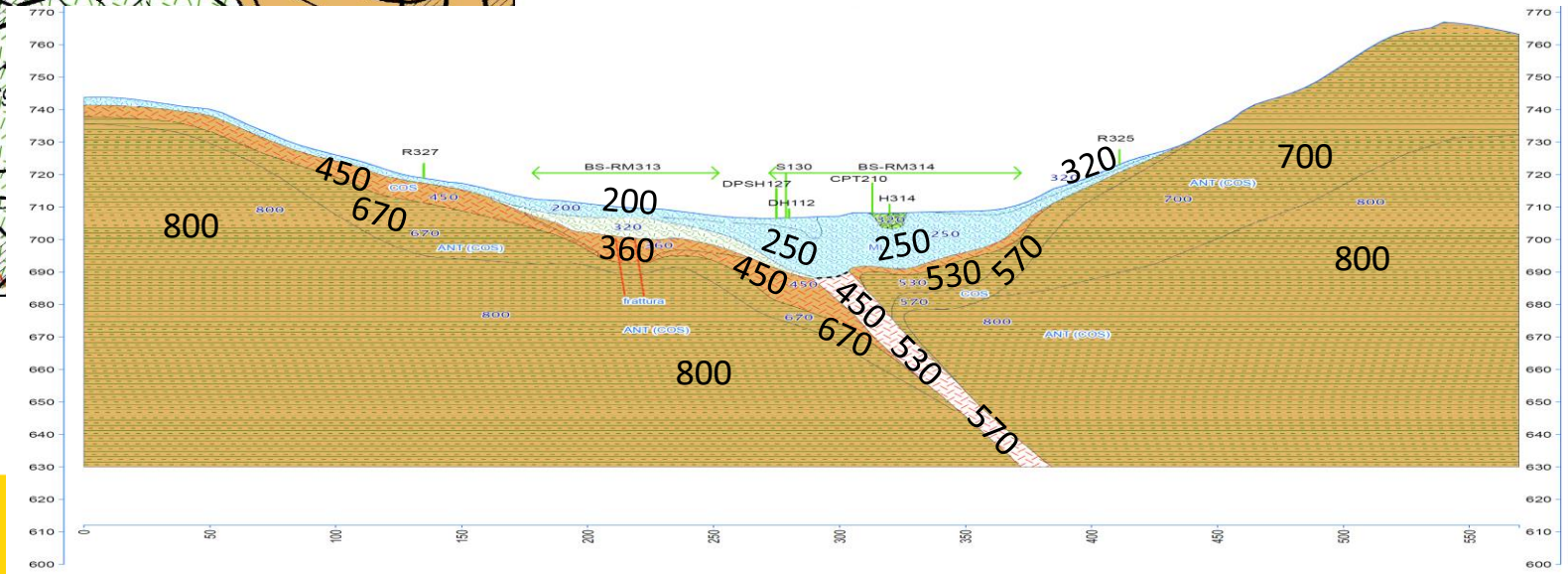
ReMi

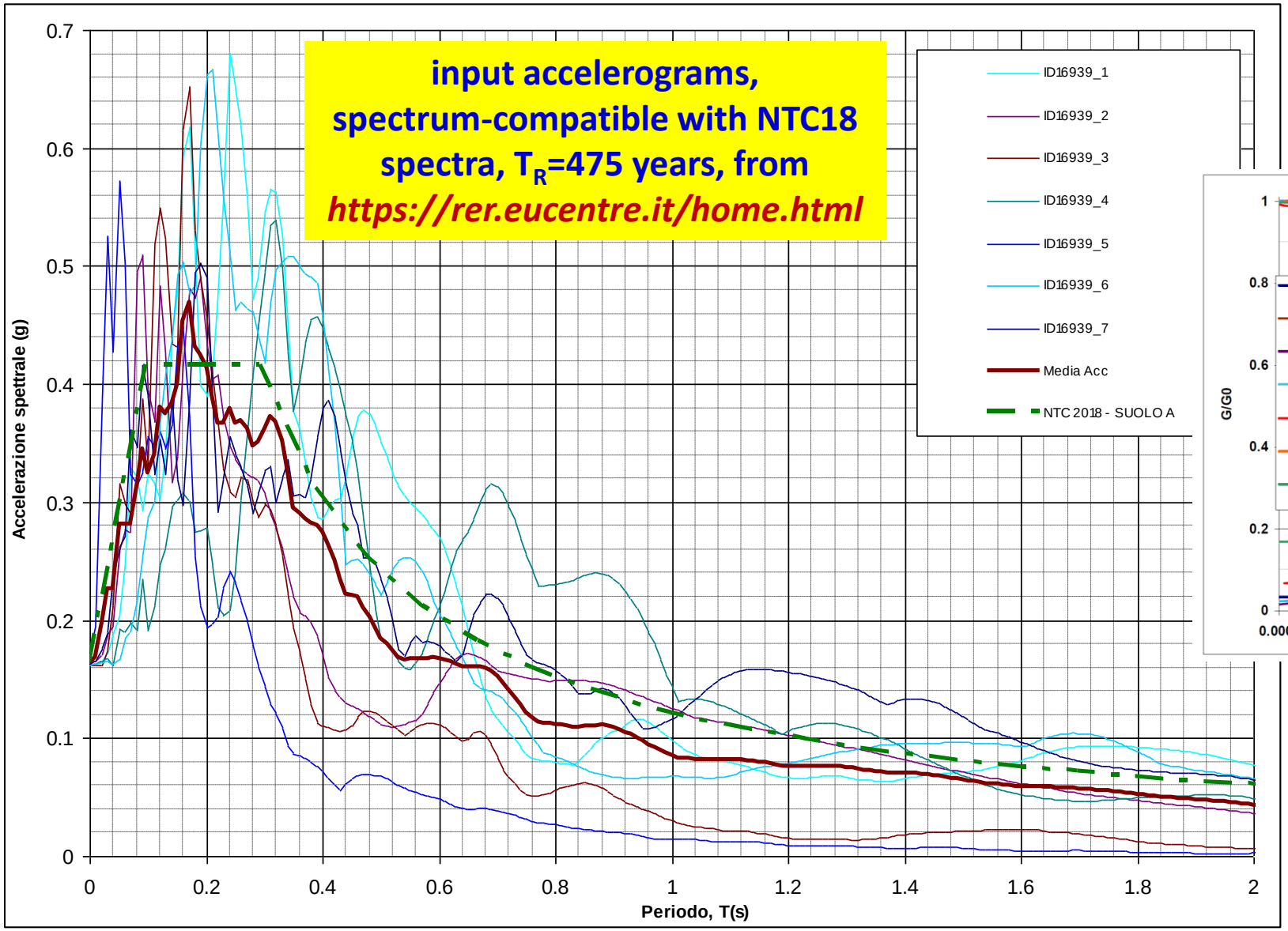


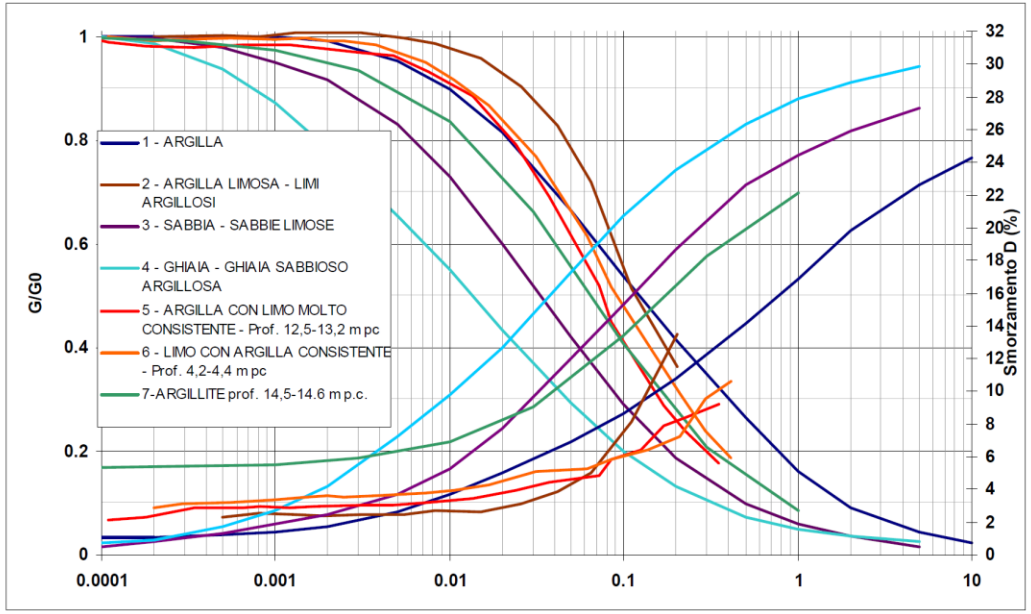
western seismic line



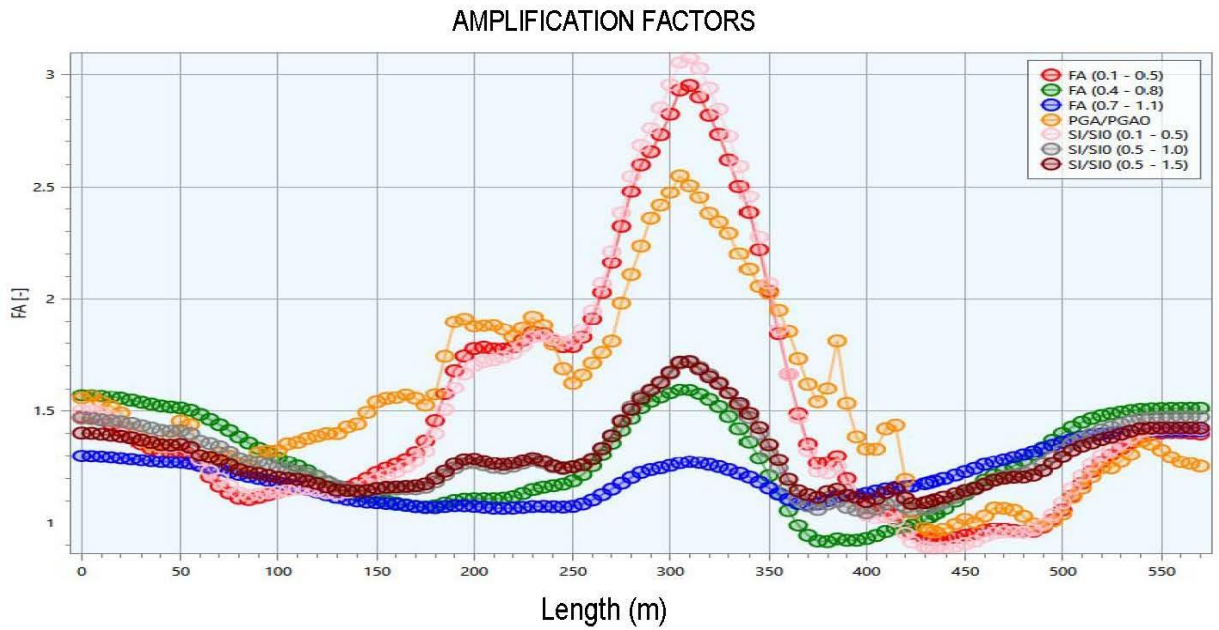
geological cross-section for 2D LSR

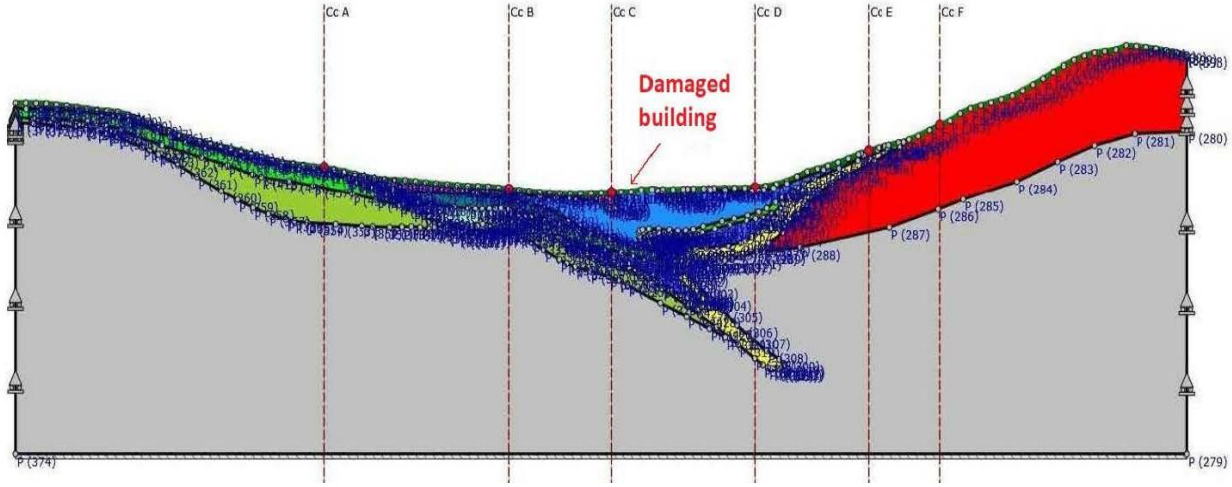




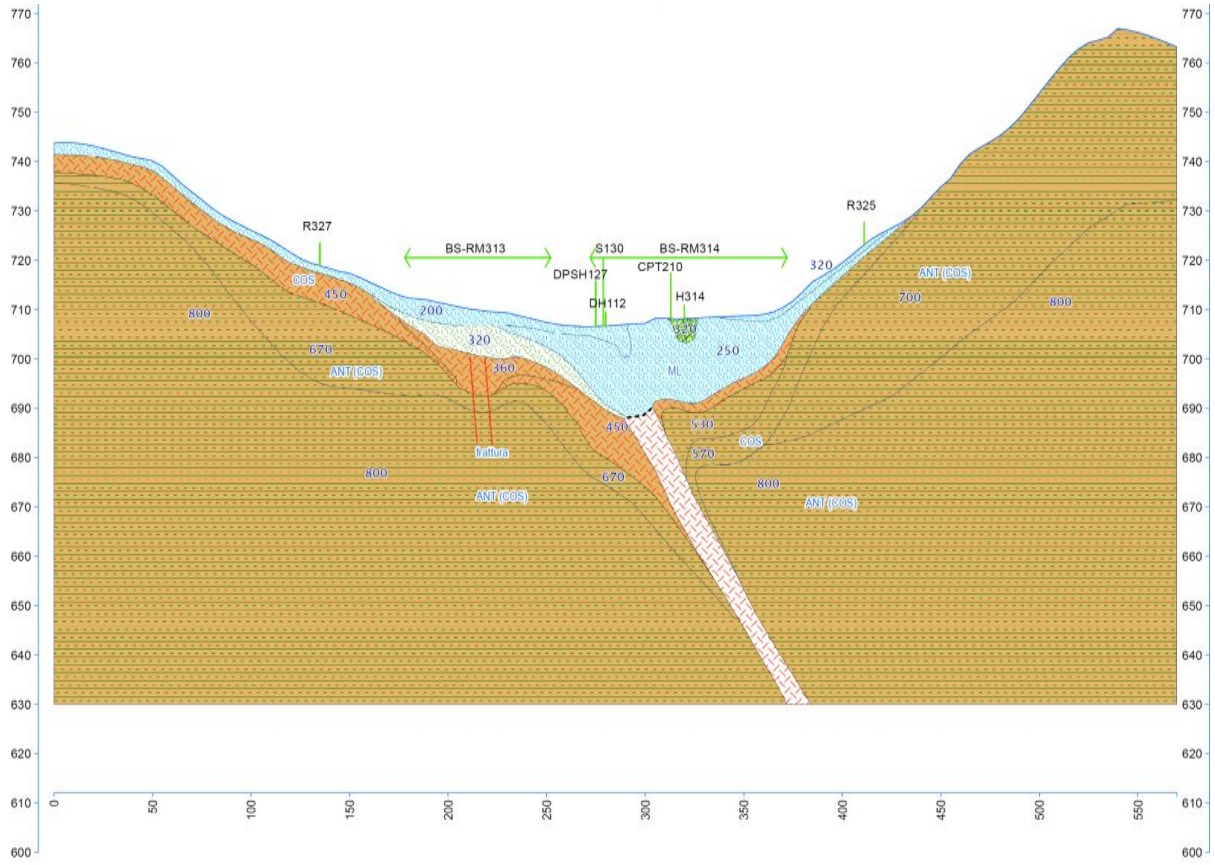


damping and shear modulus curves (from literature and laboratory tests on local samples, Beretti 2013)





Code: LSR-2D, Stacec Srl



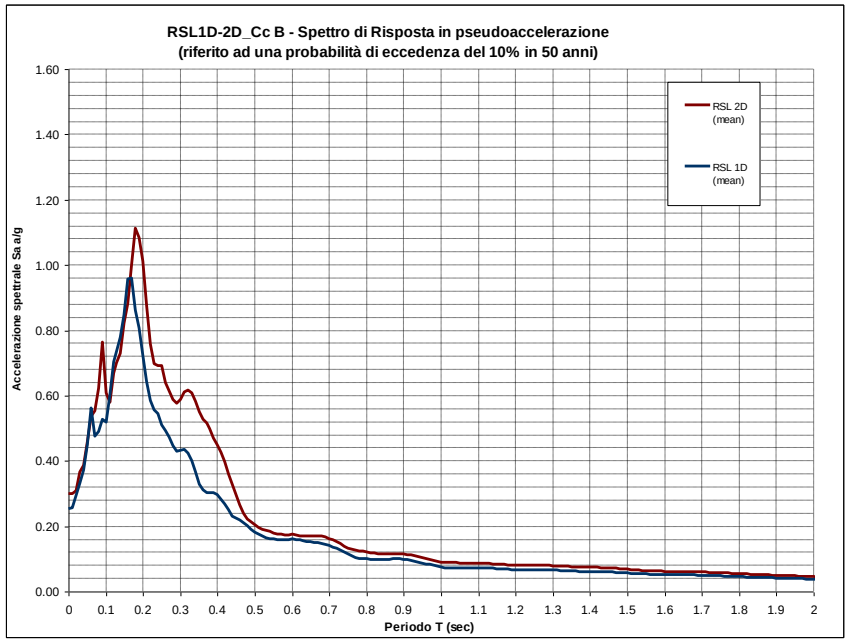
2D LSR, output data

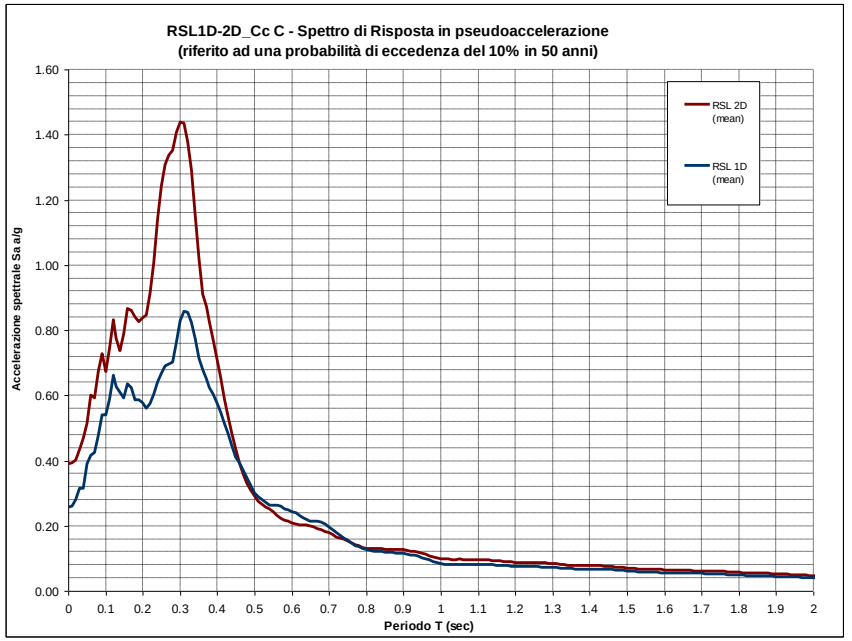
1D vs 2D

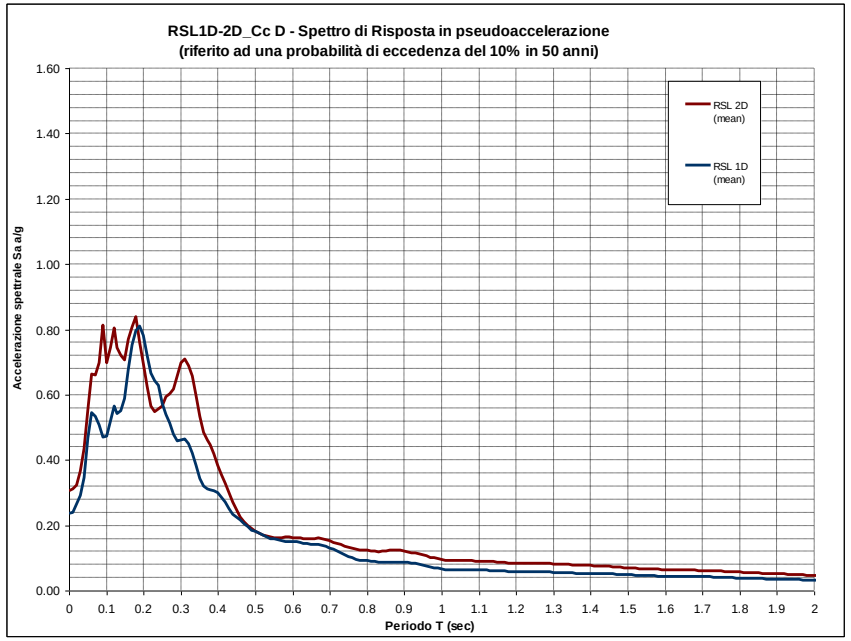
W

Central area (damaged building)

E





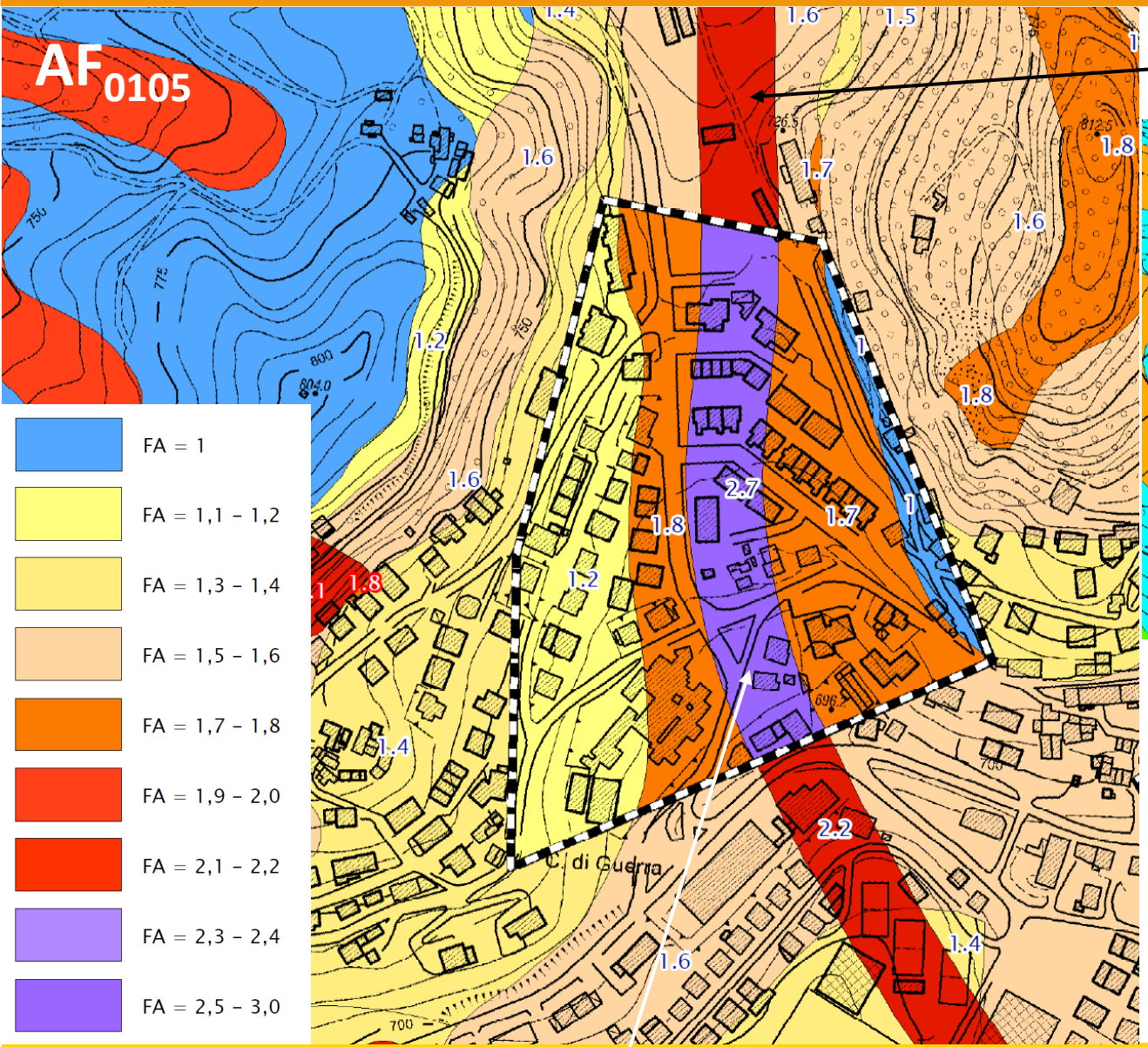


Amax (ag/g)	FPGA	FH0105	FH0510	FA0105	FA0408	FA0711
0.299	1.84	1.72	1.06	1.81	1.16	1.06
0.253	1.54	1.31	1	1.44	1	1

Amax (ag/g)	FPGA	FH0105	FH0510	FA0105	FA0408	FA0711
0.39	2.41	2.7	1.23	2.65	1.53	1.17
0.257	1.57	1.92	1.26	1.84	1.56	1.1

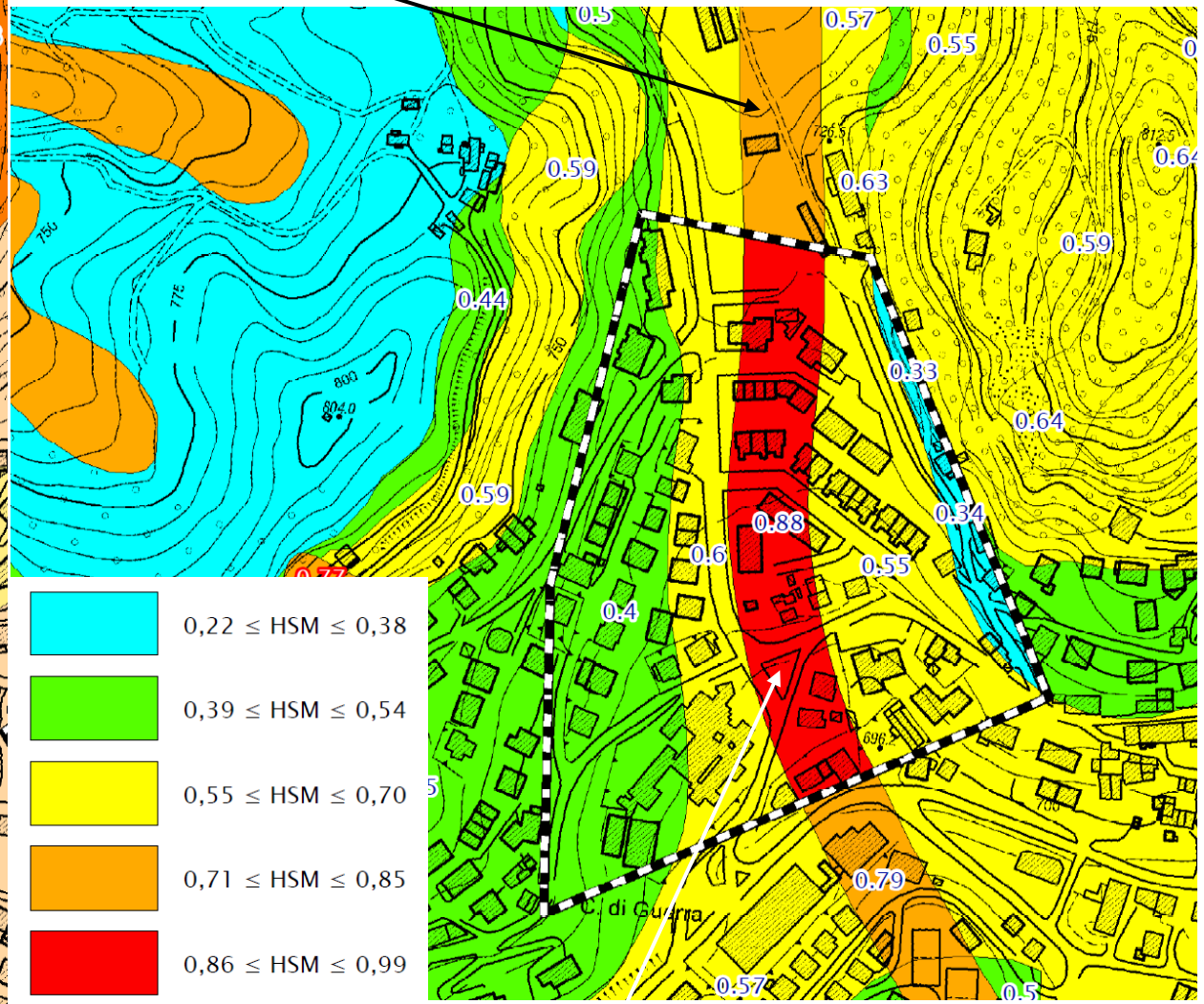
Amax (ag/g)	FPGA	FH0105	FH0510	FA0105	FA0408	FA0711
0.307	1.89	1.56	1.04	1.65	1.05	1.09
0.237	1.45	1.3	1	1.39	1	1

LSR: 1D vs 2D, comparison across the valley



SM2

H_{SM}



Seismic Microzonation maps

Conclusions

- The study area is susceptible to 2D site effects, due to the strong variation in the thickness of the debris cover/depth of the substratum, made irregular by a buried fault.
- The comparison between 2D and 1D analyses showed a considerable underestimation of the amplification and shaking values calculated with the 1D analyses.
- The advisability of 2D analyses for a more correct estimation of local seismic hazard, in this as in other similar cases, can already be inferred from an examination of topographic and basic geological maps, which faithfully map landforms, detrital covers and tectonic structures that dislocate the substratum

Thank you for your attention

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