An example of on-line system for probabilistic seismic hazard assessment at the surface of non linear soil deposits

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➢ The system, which is intended for demonstration purposes only, covers the whole Italian territory.

➢ The seismic hazard at the bedrock is contained in a database and cannot be changed by the User.

➢ Site amplification is computed based on advanced amplification functions and on key site characteristics as defined by the User.

➢ The system includes also a simplified procedure to assess structural vulnerability based on fragility curves.

➢ The on-line system is a simplified version of an off-line software which accounts also for epistemic uncertainty and accepts site specific amplification functions.
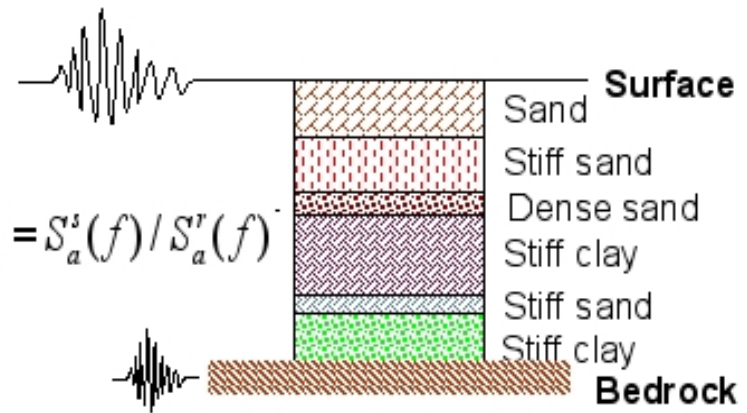
Analysis sequence

$$AF(f)?$$

Soil Amplification

Seismic Source

Attenuation

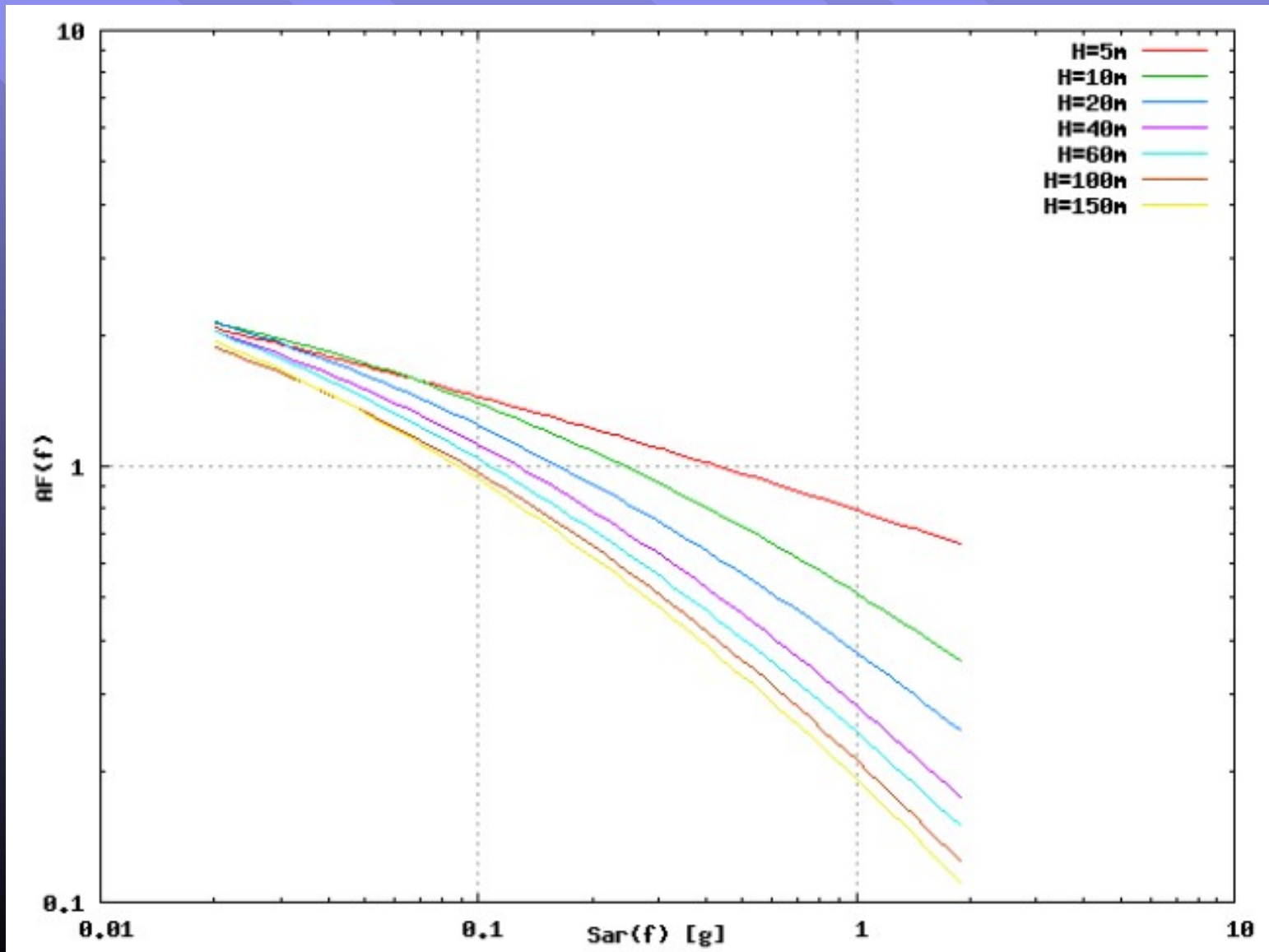**Bedrock Motion**
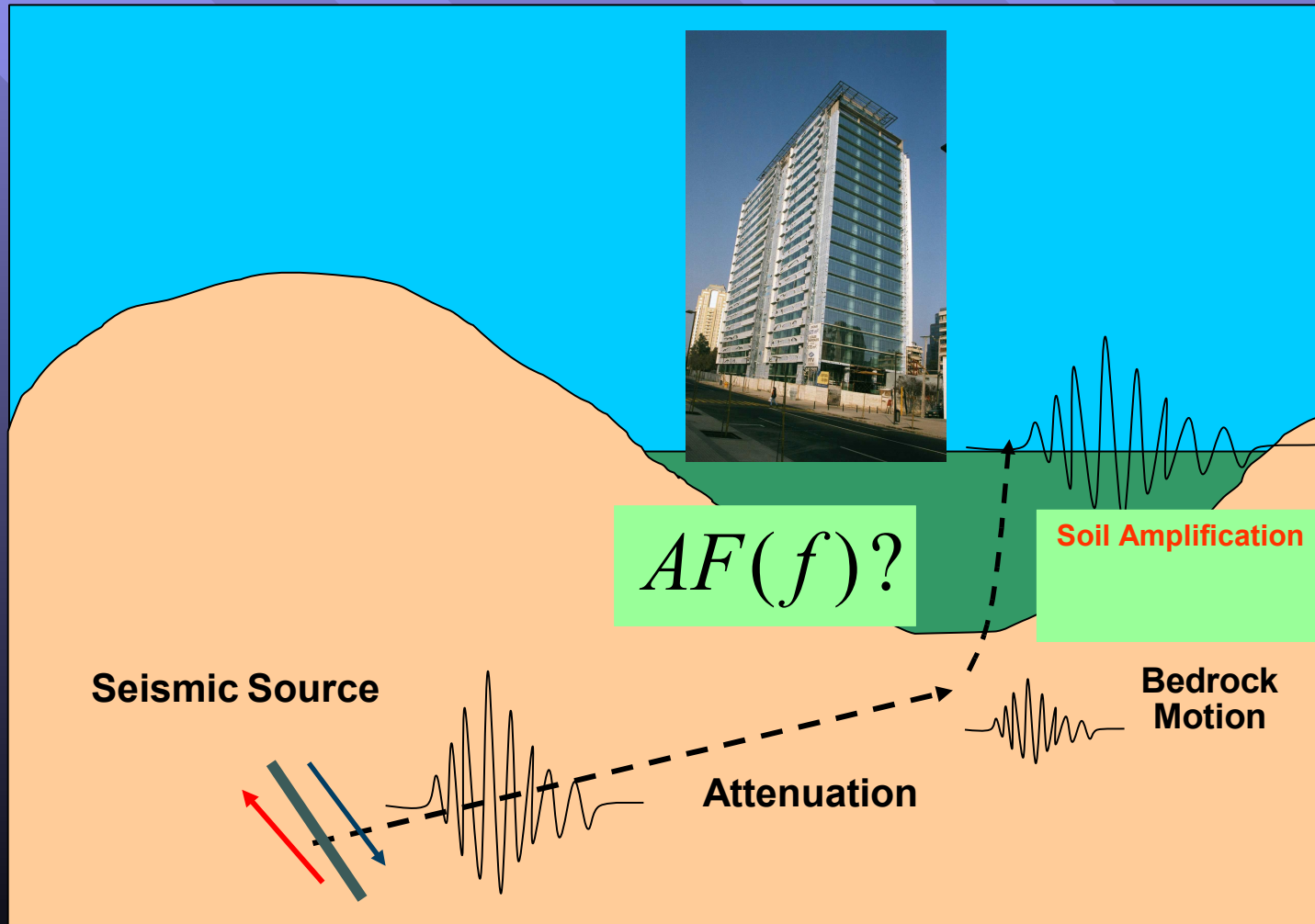
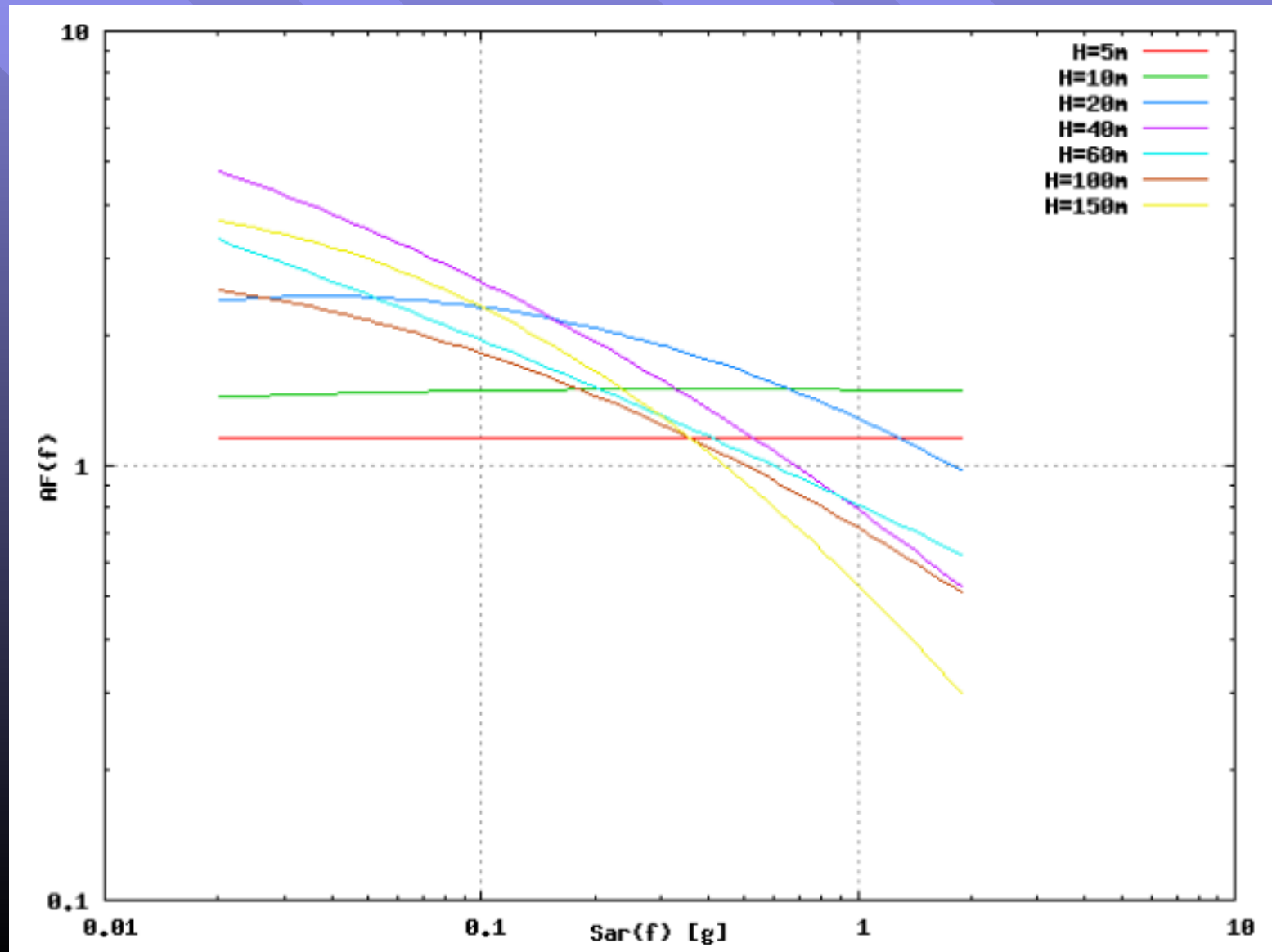# Amplification function
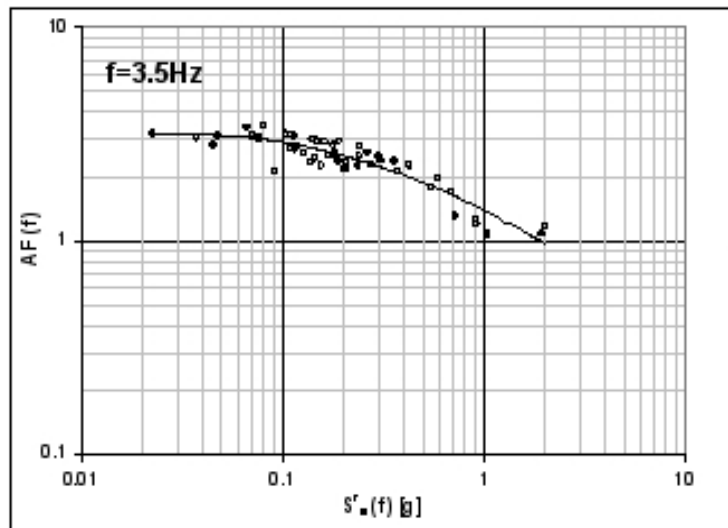
$$AF(f) = S_a^s(f) / S_a^r(f)$$

$$AF(f) = S_a^s(f) / S_a^r(f) = \exp\{a + b[\ln S_a^r(f)] + c[\ln S_a^r(f)]^2 + \varepsilon_{\ln AF(f)} \sigma_{\ln AF(f)}\}$$
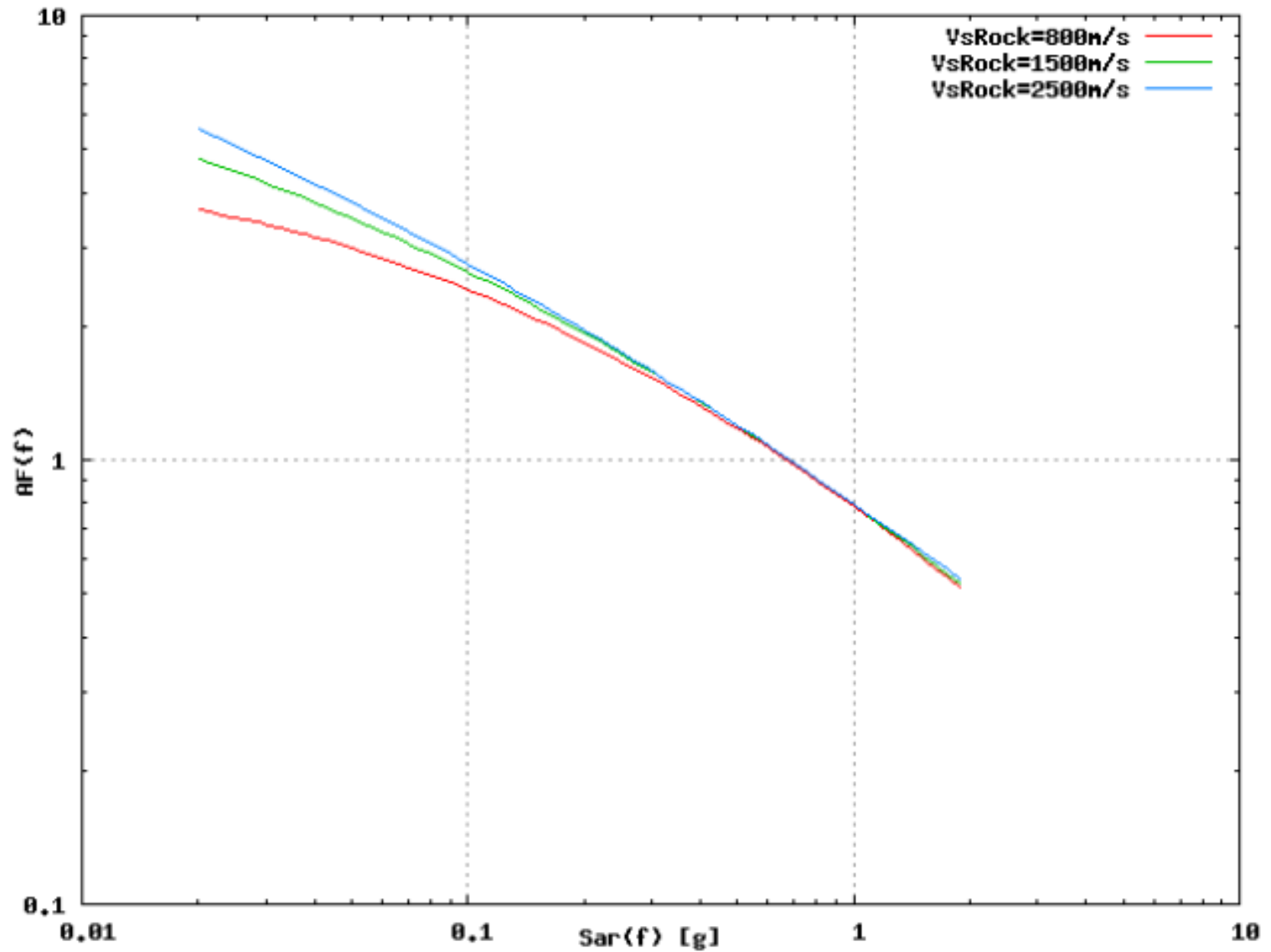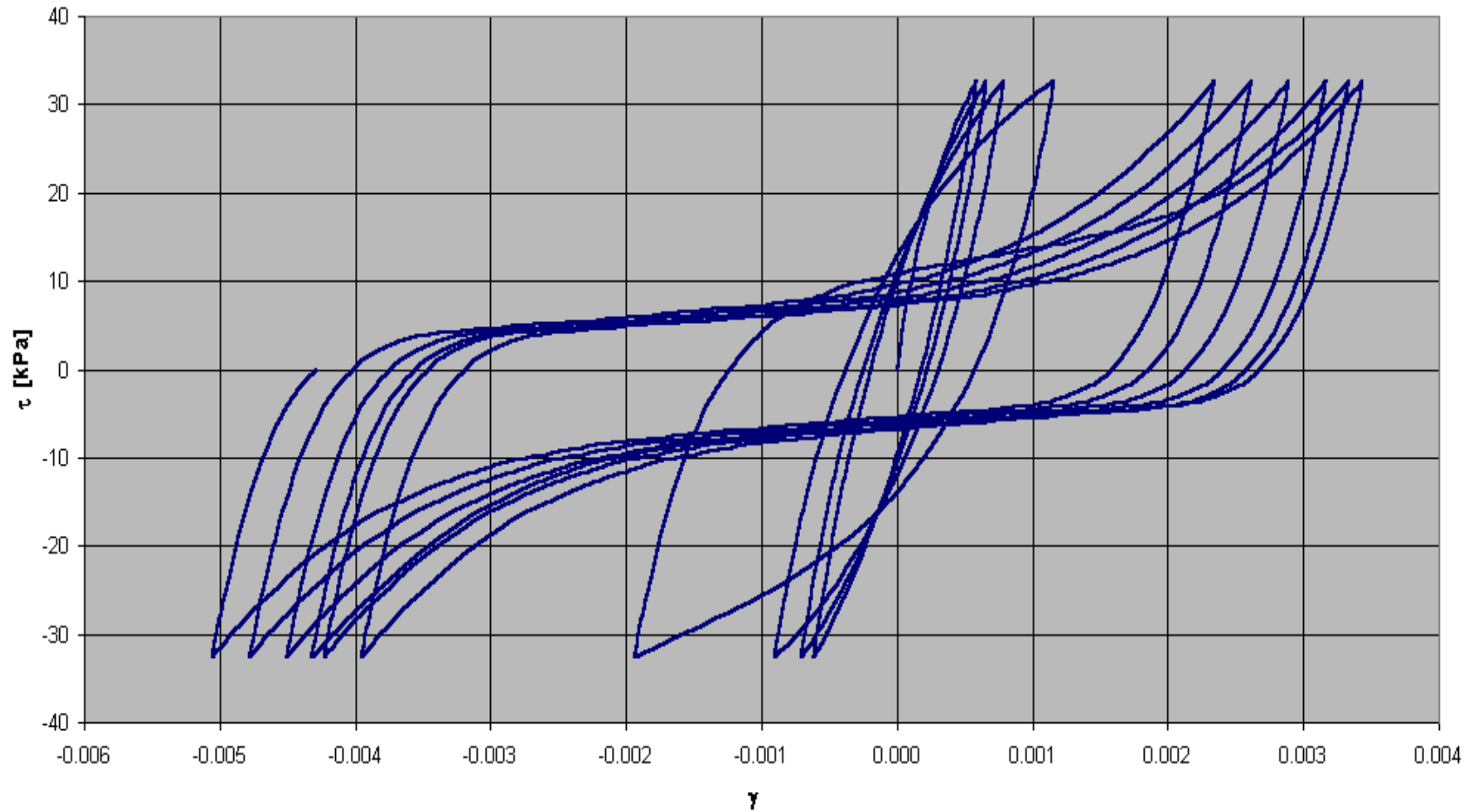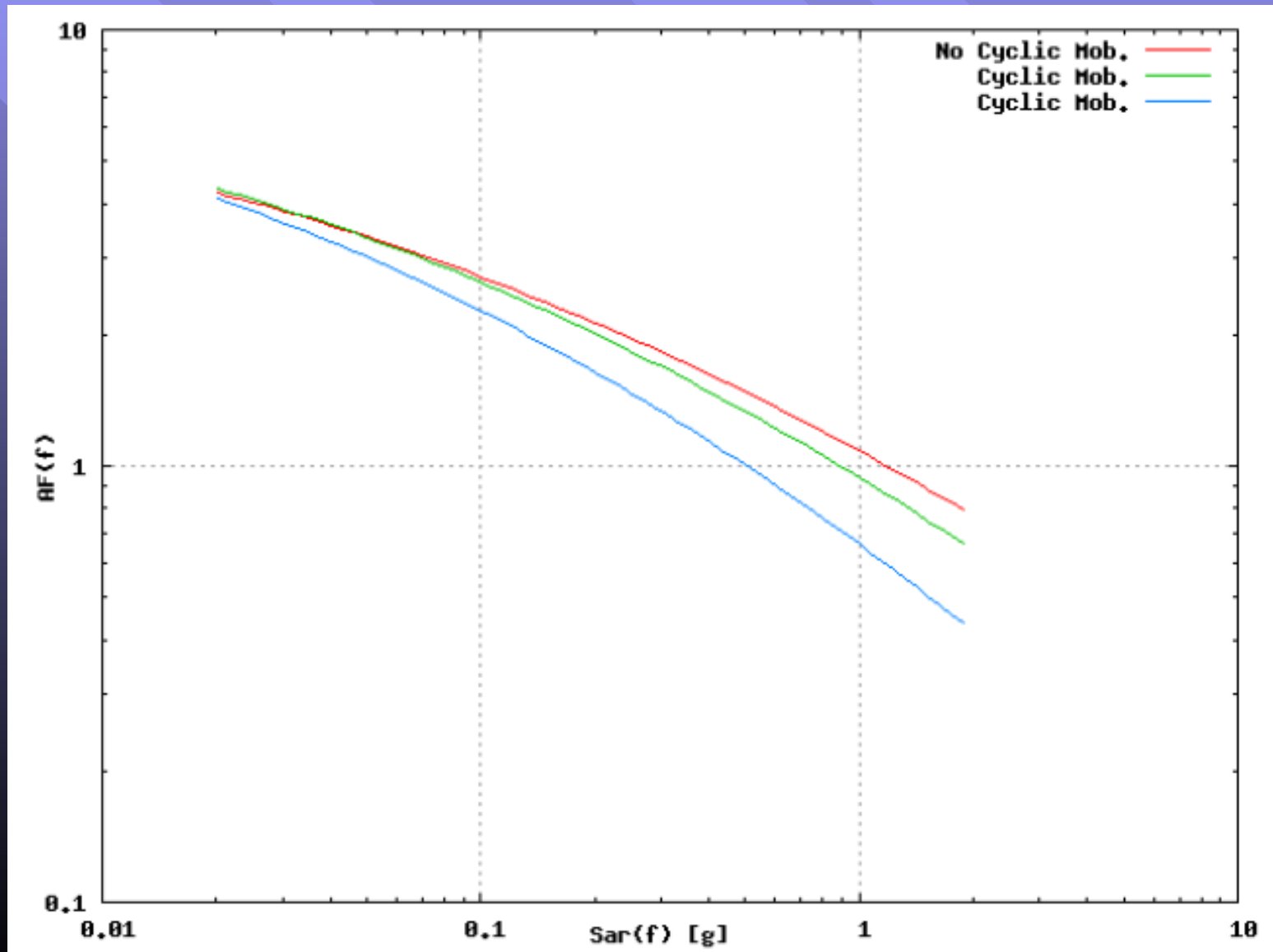
H - f=100Hz
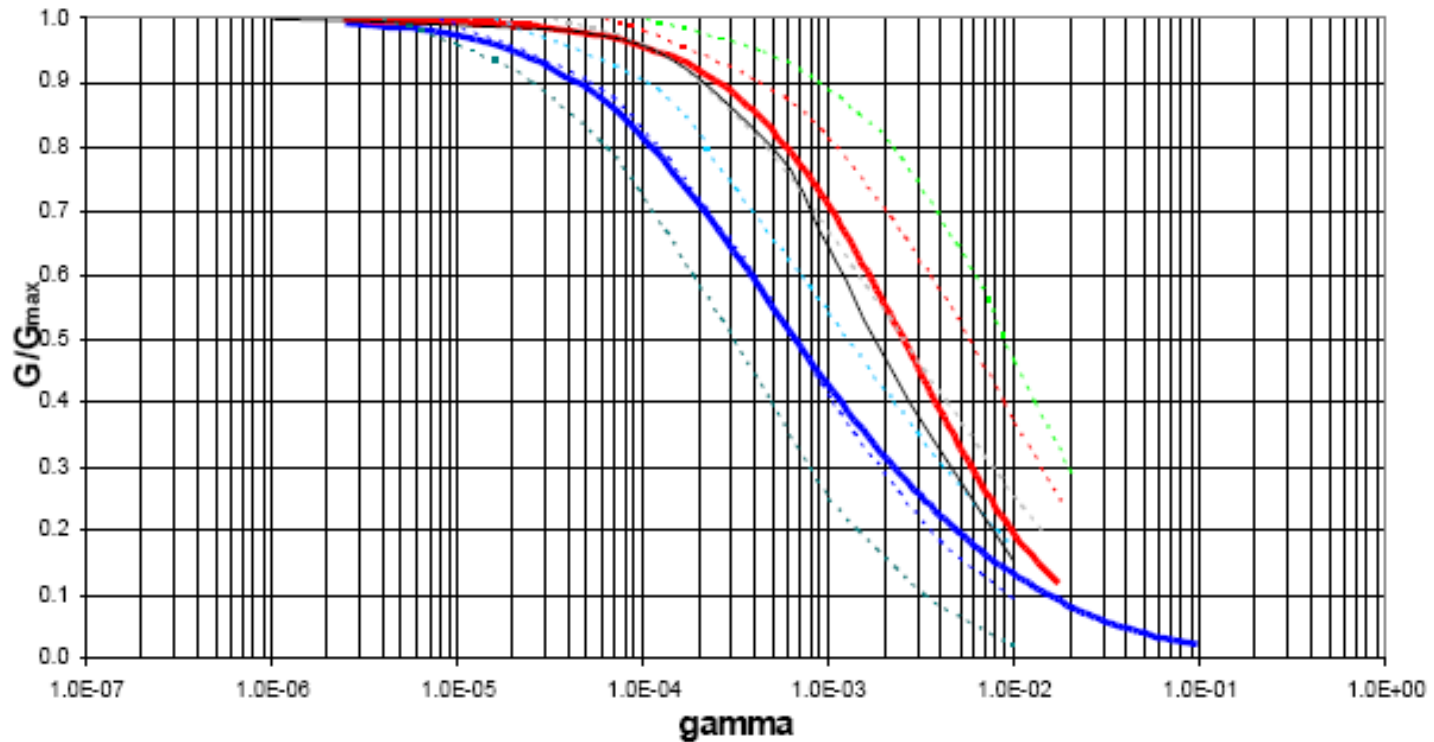
H – f=1.33 Hz

V~S-Rock~

Cyclic mobility
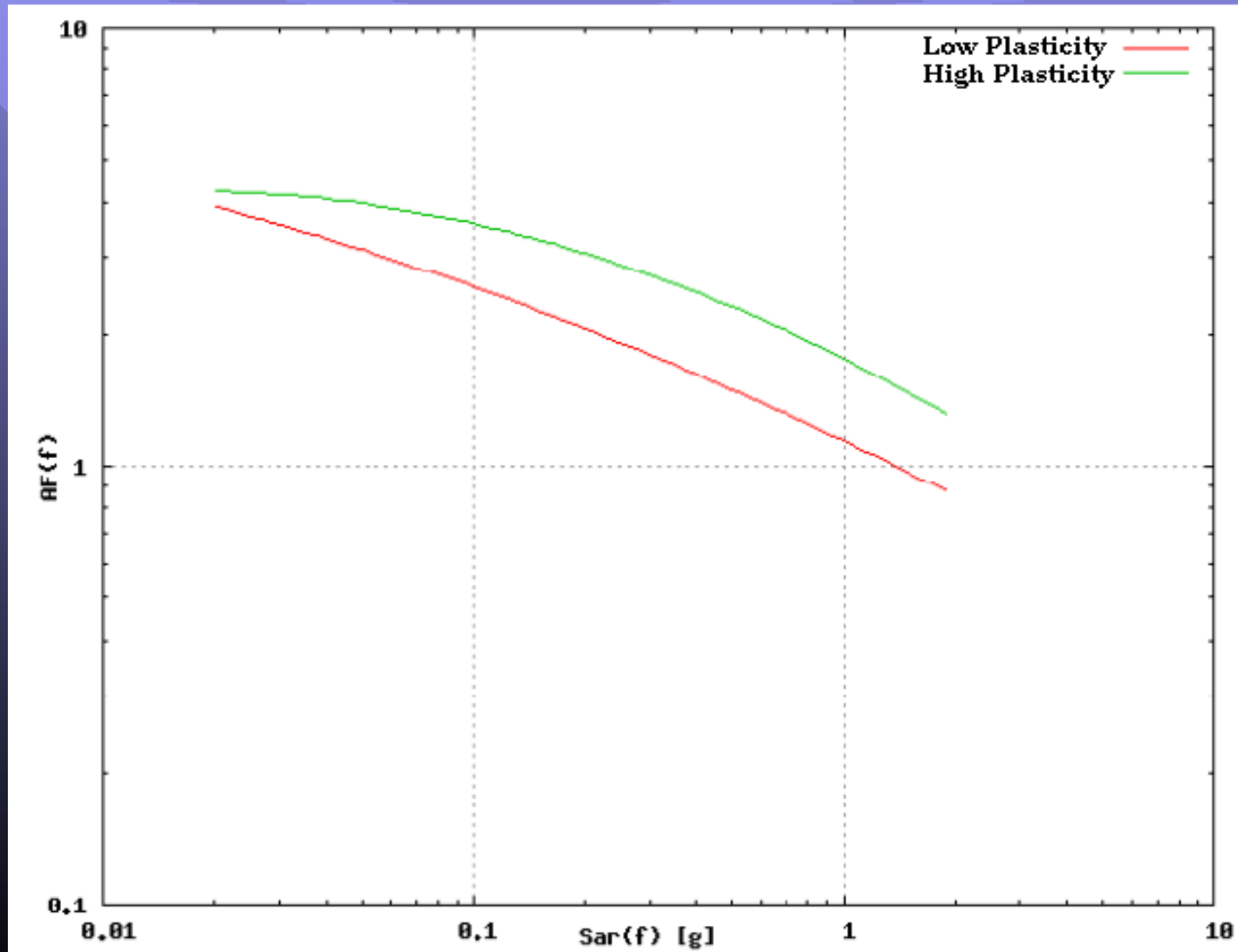

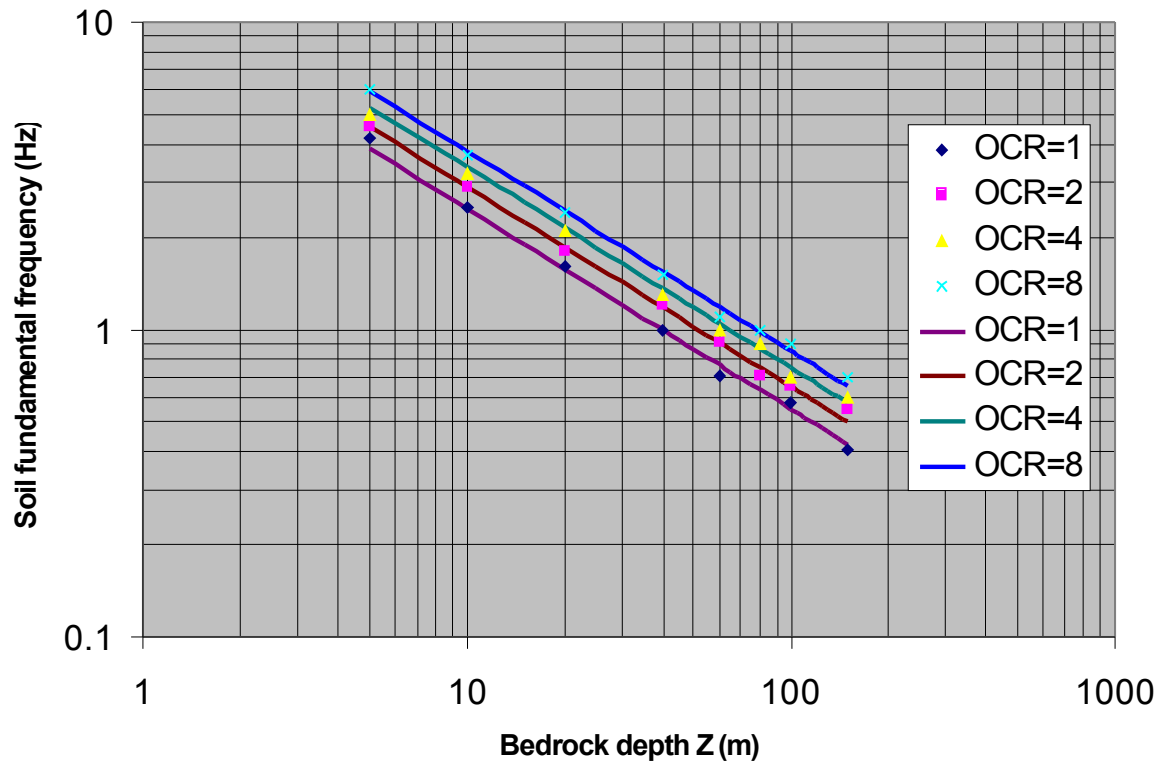Shear stress versus shear strain

Cyclic Mobility

Soil plasticity and age

Soil plasticity and age

Regression parameters
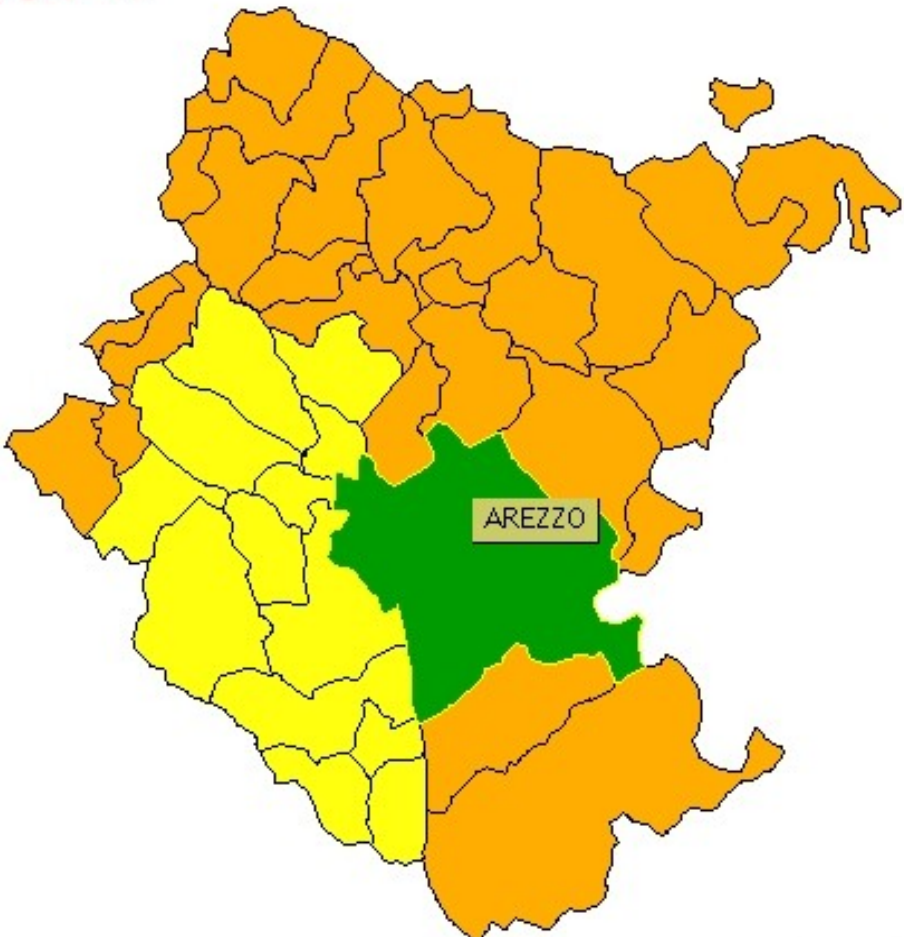
- **site f. frequency**

  or

- **site V$_{S30}$**
- **GW surface**
- **soil type**
- **soil plasticity**
- **cyclic mobility**
- **bedrock depth**
- **bedrock V$_S$**

Select Location

Basic site information

AESP | Location | Structure | **Site (1 of 2)** | Site (2 of 2) | Analysis | Results | Offer

Info

Methodology:
In this field the user can choose between the **base method** and the **advanced method** to compute site amplification. If case the **base method** is chosen, the system computes the amplification factors by comparing the Sabetta and Pugliese (1996) attenuation relationship for generic alluvial deposits with the attenuation relationship for rock. On the other hand, if the **advanced method** is selected, the system applies advanced amplification functions and computes the seismic hazard at the ground surface by means of a convolution procedure.

Geology:
This field contains information required by AESP for the on-line-simplified estimate of the amplification factors for each relevant oscillation frequency.

Topographic Amplification:
This field contains information required

Ground Characteristics

Selected Method

ADVANCED METHOD ▼

Geology

Alluvium ▼

Topographic Amplificati...

Ridge-crest width less than base width-sl... ▼

Soil Type

Plastic silt or clay with constant OCR ▼

Groundwater Depth

Select ▼

Consistency/Relative De...

Medium to high consistency ▼

Fines Content

Select ▼

Advanced site information

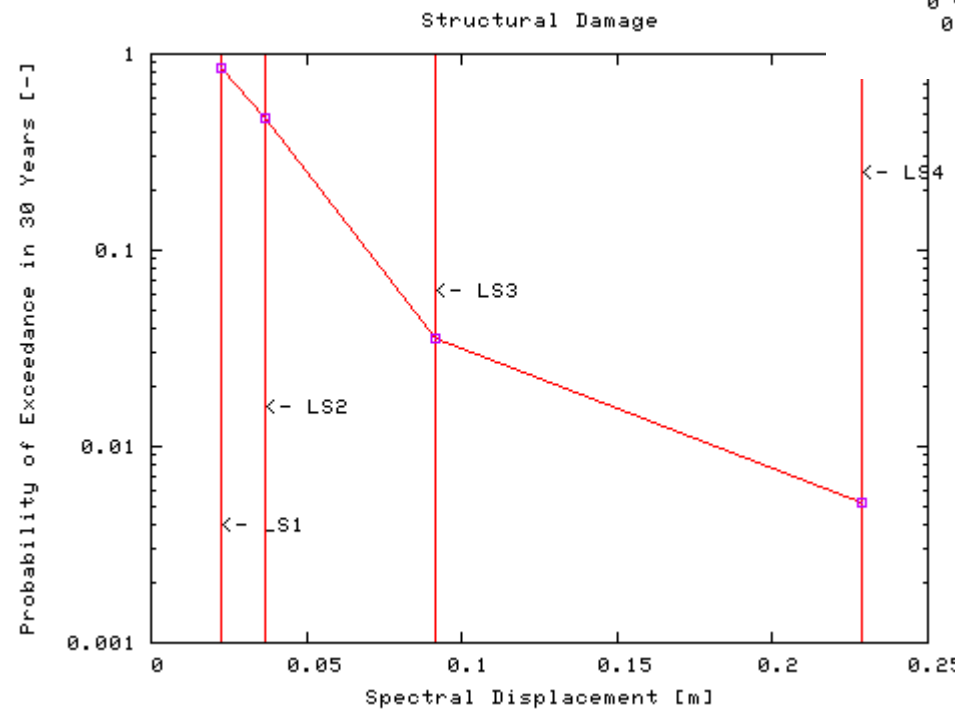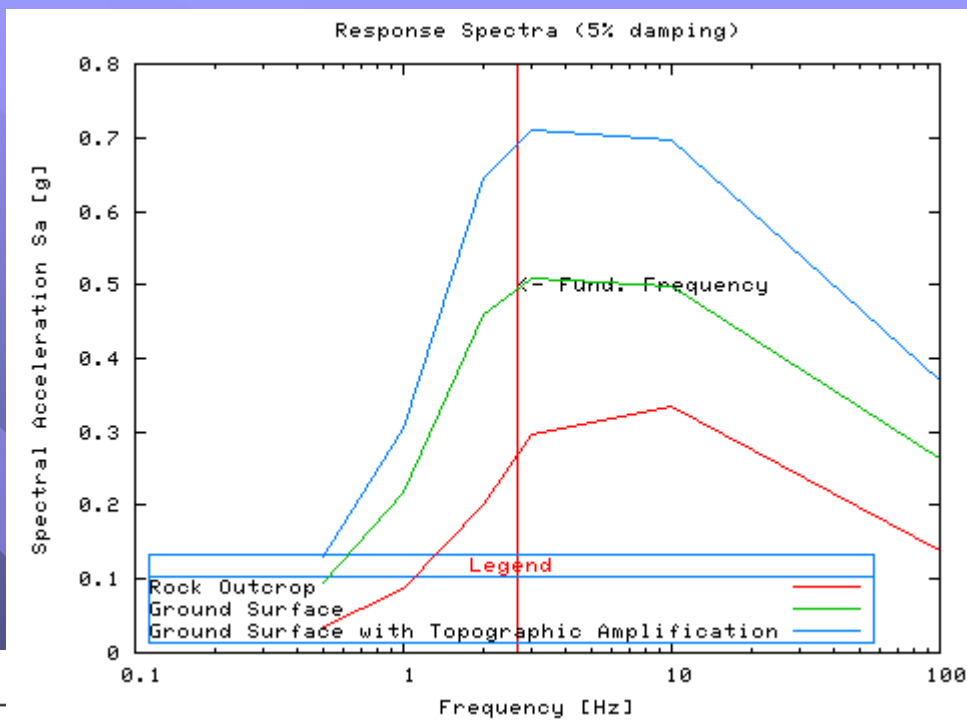**AESP** | Location | Structure | Site (1 of 2) | Site (2 of 2) | Analysis | Results | Offer

Info

Bedrock Depth (advanced method only)
This field is relevant for the estimate of site amplification.

Cyclic Mobility (advanced method only)
The information provided in this field (applicable to sands and gravels only) is relevant for site amplification assessment.

Uncertain Site Characteristics (advanced method only)
The information provided in this field is used to assess site amplification. In particular, it allows to establish a proper standard deviation value to be adopted in the convolution procedure, depending on the quality of the available geotechnical investigation. THIS FIELD IS CURRENTLY INACTIVE

Soil Plasticity (advanced method only)
The information provided in this field is used to estimate site amplification. In particular, it allows characterization of

Ground Characteristics

Bedrock Depth
15m

Cyclic Mobility
Select

Uncertain Site Characteristics
medium uncertainty

Soil Plasticity
low plasticity

Bedrock Shear Wave Velocity
1500m/sec

Site Fundamental Frequency
2.2 Hz

Shear Wave Velocity VS30
Seleziona

Building characteristics

Typical results

Response Spectra (5% damping)

Structural Damage

Currently in progress

- Development of amplification functions for cases where little information is available (e.g., soil category only, or soil category + V_{S30} only).

- Improvement of the advanced amplification functions considering uncertain site conditions (e.g., different levels of soil investigation).

- Introduction of a wider range of soil conditions and more complex layered sites.

- Possibility of adopting user defined structural vulnerability functions.

Conclusions

- A prototype on-line system for simplified seismic hazard assessment was developed and posted on the Internet.

- Advanced amplification functions accounting for soil non-linearity are currently available in a preliminary form, and will be improved.

- The system focusses on seismic hazard, but a simplified method for seismic vulnerability assessment is also included.

- Seismic hazard at the ground surface and seismic vulnerability are established based on a convolution procedure.

- A more complete system is available for off-line applications and has been tested during several research projects.

www.eriskzone.net

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