

Online Resource 1

The figures included in this Supplementary Material are the snapshots of the online Questionnaire used in: Cultrera G, Cornou C, Di Giulio G, Bard P-Y (2021) Indicators for site characterization at seismic station: recommendation from a dedicated survey. Bull Earthq Eng. <https://doi.org/10.1007/s10518-021-01136-7>

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Fig. A23 Topographic class according to a specific Seismic Building Code; it usually accounts for values of slope and morphologic elements (landform).

Fig. A24 Aggravation factor for basin and topography: ratio between 2D/3D/recorded-motion and 1D estimates for a given ground motion intensity measure; it can be scalar (e.g., PGA or Arias intensity) or frequency dependent (e.g. for STF, or amplification factor on response spectra).

Fig. A25 Geometrical parameter: any parameter related with 2D or 3D structure (surface topography or underground lithological heterogeneity).

Fig. A26 Stratigraphic column with geological unit description (1D log model).

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Fig. A28 Non-linear degradation curves: curves characterizing the change of mechanical properties with shear strain (γ), in terms of normalized stiffness modulus (G/G_0 , where G_0 is the small strain modulus), damping ratio (D), and/or excess pore pressure ratio ($R_u = \Delta u/p'$, where Δu is the excess pore pressure and p' is the mean normal effective stress).

Fig. A29 Geotechnical parameters: Piezocone test (CPTU), Flat dilatometer test (DMT), Standard penetration test (SPT), Dynamic probing super heavy test (DPSH), Vane test (VT), Static laboratory test (SLAB), etc.

Fig. A30 3-degrees priority scale ("mandatory", "recommended" or "optional") for ranking the indicators to be included in the site-characterization database.

Fig. A31 Report if some important site effects were missing or poorly represented by the proposed indicators.

EU-SERA WP7 : Questionnaire for site characterization in seismic site response studies

The objective of the WP7 "Networking databases of site and station characterization", of the SERA Project ("Seismology and Earthquake Engineering Research Infrastructure Alliance for Europe", Horizon 2020 grant agreement No.730900; <http://www.sera-eu.org/en/activities/networking>) is to propose a reliable and efficient European reference guideline for site characterization based on the requirements of seismic hazard and risk stakeholders.

Within the SERA Task 7.2 "Best practice and site characterization quality assessment", we have prepared this ONLINE Questionnaire in order to evaluate the site characterization indicators most relevant for seismic site response studies.

For each indicator, we kindly ask you :

- to select the best method of estimation of each indicator
- to indicate the feasibility index of each indicator (the feasibility index describes the level of difficulty for deriving that indicator, including data acquisition and method of analysis);
- to provide the approximate cost at one site for deriving each indicator.

As a final step, we kindly ask you to list, in order of priority, the most important parameters for site characterization.

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Fig. A1 Online Questionnaire: presentation page.

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Institution / Laboratory *

Country

What is your scientific field ? *

- Seismology
- Geophysics
- Geotechnical Engineering
- Engineering Seismology
- Civil Engineering
- Ground Motion Prediction Equation / PSHA
- Building Code
- Microzonation
- Risk Modeling
- Geology
- Other

In case you selected more than one field, please provide a sorted list from the most to the less appropriate

In case you want to receive the results of your questionnaire and to be informed on the outcomes of the questionnaire, please indicate your email address

Fig. A2 Online Questionnaire: Institution and scientific fields of participants.

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Fundamental resonance frequency (f_0)

Data acquisition and processing * Noise
 Earthquake
 Modeling
 I don't know

Noise *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
Earthquake *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
Modeling *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>

Noise	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Earthquake	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Modeling	< 1 keuros <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A3 Online Questionnaire: fundamental resonance frequency (f_0).

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Higher modes frequency peaks (f_1 , f_2 , f_3 , ...)

Data acquisition and processing * Noise
 Earthquake
 Modeling
 I don't know

Noise *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Earthquake *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Modeling *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Noise	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Earthquake	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Modeling	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>

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Fig. A4 Online Questionnaire: frequency peaks of higher modes (f_1 , f_2 , f_3 , ...).

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Amplitude at resonance frequencies (A0 A1 A2...)

Amplitude related to the resonance frequencies (fundamental and/or higher modes)

Data acquisition and processing * Noise
 Earthquake
 Modeling
 I don't know

Noise *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Earthquake *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Modeling *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Noise	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Earthquake	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Modeling	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A5 Online Questionnaire: amplitudes at fundamental frequency (A0) and higher modes (A1, A2, A3, ...).

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Site Transfer Function

Curve in the frequency domain describing the transfer function at a site

Data acquisition and processing *

- Noise
- Earthquake
- Modeling
- I don't know

		Easy	Intermediate	Difficult
Noise *		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Earthquake *		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Modeling *		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Noise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Earthquake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Modeling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A6 Online Questionnaire: Site Transfer Function.

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Preferential direction of ground motion

Predominant direction of ground motion (for example computed by particle motions; rotated spectra; ellipticity vector by covariance matrix method; and/or time-frequency polarization analysis)

Data acquisition and processing * Noise
 Earthquake
 Modeling
 I don't know

Noise *	Easy	Intermediate	Difficult	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Earthquake *	Easy	Intermediate	Difficult	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Modeling	Easy	Intermediate	Difficult	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Noise	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Earthquake	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Modeling	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free comments: (on data acquisition, processing, analysis, cost,)

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Fig. A7 Online Questionnaire: preferential direction of ground motion.

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Duration Lengthening

frequency-dependent lengthening of seismic ground-motion duration

Data Acquisition and Processing * Noise
 Earthquake
 Modeling
 I do not know

Noise *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Earthquake *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Modeling *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Noise	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Earthquake	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Modeling	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A8 Online Questionnaire: duration lengthening.

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Kappa0

high-frequency near-surface attenuation factor

Data acquisition and processing * Noise
 Earthquake
 Modeling
 I don't know

Noise *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Earthquake *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Modeling *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Noise	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Earthquake	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Modeling	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A9 Online Questionnaire: near-surface attenuation factor at high frequency.

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Frequency-dependent attenuation (e.g. Q, damping, kappa, ...)

Model for near-surface attenuation (k), Quality factor (Q) or damping as a function of frequency

- Data acquisition and processing * Non invasive (active and/or passive) seismic methods
 Invasive (measurements in boreholes)
 Earthquake
 Modeling
 I do not know

Non invasive (active and/or passive) seismic methods *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
Invasive (measurements in boreholes) *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
Earthquake *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
Modeling	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>

Non invasive (active and/or passive) seismic methods	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Invasive (measurements in boreholes)	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Earthquake	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Modeling	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A10 Online Questionnaire: frequency-dependent attenuation (e.g. Q, damping, kappa, etc.).

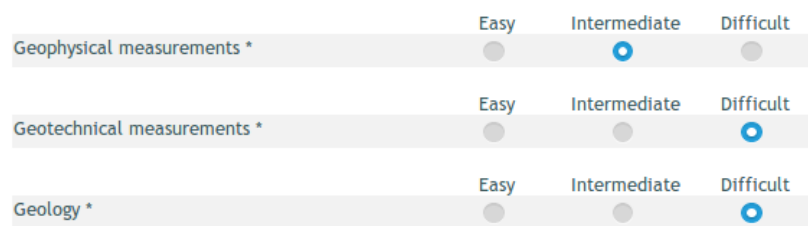
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Vs30

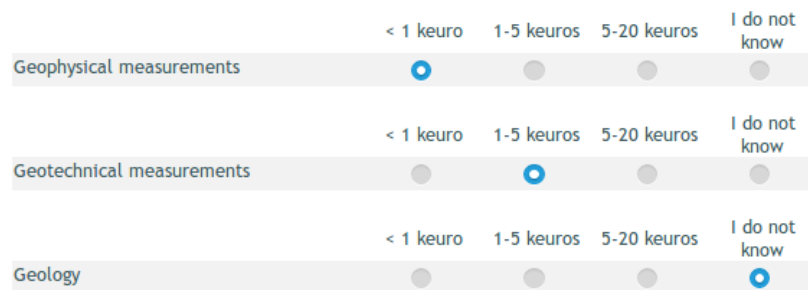
The time-averaged shear-wave velocity over the uppermost 30 m

- Data acquisition and processing
- Geophysical measurements
 - Geotechnical measurements
 - DEM (Digital Elevation Model)
 - Geology
 - Modeling
 - I do not know

Feasibility index (including data acquisition, processing and cost)



Cost (including field data collection and analysis)



Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A11 Online Questionnaire: travel time-averaged of shear-wave velocity (Vs) over the uppermost 30m (Vs30).

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Vsz (travel time-averaged shear-wave velocities up to 30 m)

Travel time-averaged of Vs at various depths up to 30 m (for example Vs10, Vs15, Vs20 considering an investigated depth of 10, 15 or 20 m, respectively)

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

Non Invasive (active and/or passive seismic methods) * Easy Intermediate Difficult

Invasive (measurement in boreholes) * Easy Intermediate Difficult

Non Invasive (active and/or passive seismic methods) < 1 keuro 1-5 keuros 5-20 keuros I do not know

Invasive (measurement in boreholes) < 1 keuro 1-5 keuros 5-20 keuros I do not know

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A12 Online Questionnaire: travel-time average of shear-wave velocity at various depths above 30 m.

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Vsz (travel time-averaged shear-wave velocities above 30 m)

Travel time-averaged of Vs at different depth above to 30 m (for example Vs50, Vs100, Vs150 considering an investigated depth of 50, 100 or 150 m, respectively)

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

	Easy	Intermediate	Difficult
Non Invasive (active and/or passive seismic methods) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Easy	Intermediate	Difficult
Invasive (measurement in boreholes) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Non Invasive (active and/or passive seismic methods)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Invasive (measurement in boreholes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A13 Online Questionnaire: travel-time average of shear-wave velocity at various depths below 30 m.

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Vs of the seismological bedrock

Please provide your favorite definition of a seismological bedrock (e.g. the impedance contrast related to the lowest resonance frequency peak; with Vs > 800 m/s; with Vs > 1000 m/s) *

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

	Easy	Intermediate	Difficult
Non Invasive (active and/or passive seismic methods) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Easy	Intermediate	Difficult
Invasive (measurement in boreholes) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Non Invasive (active and/or passive seismic methods)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Invasive (measurement in boreholes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free comments: (on data acquisition, processing, analysis, cost,)

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Fig. A14 Online Questionnaire: V_S of the seismological bedrock, corresponding to the geological unit that controls the lowest (fundamental) resonance frequency peak (f_0) through the impedance contrast with the upper layers.

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Depth of the seismological bedrock

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

Non Invasive (active and/or passive seismic methods) * Easy Intermediate Difficult

Invasive (measurement in boreholes) * Easy Intermediate Difficult

Non Invasive (active and/or passive seismic methods) < 1 keuro 1-5 keuros 5-20 keuros I do not know

Invasive (measurement in boreholes) < 1 keuro 1-5 keuros 5-20 keuros I do not know

Free comments: (on data acquisition, processing, analysis, cost,)

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Fig. A15 Online Questionnaire: Depth of the seismological bedrock (see figure caption of Fig. A14).

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Depth of the engineering bedrock

Please provide your definition of engineering bedrock *

- $V_s(z) > 760$ m/s
- $V_s(z) > 800$ m/s
- $V_s(z) > 900$ m/s
- $V_s(z) > 1500$ m/s
- Other

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

	Easy	Intermediate	Difficult
Non Invasive (active and/or passive seismic methods) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Easy	Intermediate	Difficult
Invasive (measurement in boreholes) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Non Invasive (active and/or passive seismic methods)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Invasive (measurement in boreholes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A16 Online Questionnaire: Depth of the engineering bedrock that corresponds to the depth where a conventional V_s value is first exceeded; the conventional value of V_s generally depends on the seismic code: typical values are 760 m/s for rock and 1500 m/s for hard rock in NEHRP (BSSC 2015) or 800 m/s in EC8 (2004).

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Vs(z)
Subsoil velocity profile of shear-wave (Vs) as function of the depth (z)

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

Feasibility Index (including data acquisition, processing and cost)

	Easy	Intermediate	Difficult
Non Invasive (active and/or passive seismic methods) *	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Invasive (measurement in boreholes) *	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Cost (including field data collection and analysis)

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Non Invasive (active and/or passive seismic methods)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Invasive (measurement in boreholes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

The feasibility and the cost depends on the depth of profile

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Fig. A17 Online Questionnaire: Subsoil velocity profile of shear-wave (Vs) as a function of the depth (z).

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Vp(z)

Subsoil profile of compressional velocity (Vp) as function of the depth (z)

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

Non Invasive (active and/or passive seismic methods) *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
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Invasive (measurement in boreholes) *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
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Non Invasive (active and/or passive seismic methods)	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
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Invasive (measurement in boreholes)	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
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Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A18 Online Questionnaire: Subsoil velocity profile of shear-wave (Vp) as a function of the depth (z).

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Dispersion curve

Surface-wave dispersion curve; apparent phase-velocity or slowness as a function of frequency or wavelength

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

Non Invasive (active and/or passive seismic methods) *	Easy <input checked="" type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
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Invasive (measurement in boreholes) *	Easy <input checked="" type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
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Non Invasive (active and/or passive seismic methods)	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
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Invasive (measurement in boreholes)	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
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Free comments: (on data acquisition, processing, analysis, cost,)

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Fig. A19 Online Questionnaire: Surface-wave dispersion curve: phase-velocity or slowness as a function of frequency for Rayleigh and/or Love waves.

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Rayleigh wave ellipticity curve

Data acquisition and processing * Non Invasive (active and/or passive seismic methods)
 Invasive (measurement in boreholes)
 I do not know

Non Invasive (active and/or passive seismic methods) *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
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Invasive (measurement in boreholes)	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
-------------------------------------	-------------------------------	---------------------------------------	------------------------------------

Non Invasive (active and/or passive seismic methods)	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
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Invasive (measurement in boreholes)	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
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Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A20 Online Questionnaire: Ellipticity curve of Rayleigh waves.

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Building Code Site Class
Ground class according to a specific Seismic Building Code

Please indicates the "Seismic Code" you usually refer to (e.g. EC8, NEHRP, AS, ...) *

Data acquisition and processing *
 Geophysical measurements
 Geotechnical measurements
 DEM (Digital Elevation Model)
 Geology
 Modeling
 I do not know

Feasibility Index (Including data acquisition, processing and cost)

	Easy	Intermediate	Difficult
Geophysical measurements *	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Geotechnical measurements *	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Cost (Including field data collection and analysis)

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Geophysical measurements	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geotechnical measurements	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A21 Online Questionnaire: Soil class according to a specific Seismic Building Code; it is also called "Ground Type" in EC8 (2004) or "Site Class" in some national building codes (BSSC 2015; NTC 2018).

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Surface geology
Geological/lithological information from available cartography (geological & thematic) and geological surveys

Data acquisition and processing * Cartography (geological,DEM,lithological...)
 Field survey
 I do not know

Feasibility Index (including data acquisition, processing and cost)

	Easy	Intermediate	Difficult
Cartography (geological,DEM,lithological...) *	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Field survey *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Cost (including field data collection and analysis)

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Cartography (geological,DEM,lithological...)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Field survey	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

Cartography should be at scale 1:10000 or 1:5000. The feasibility and cost depends if already available or not

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Fig. A22 Online Questionnaire: Surface geology: geological/lithological information from available cartography (geological & thematic) and geological surveys.

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Topographic factor

Different interval values of slope and morphologic elements, following for example Building Seismic Code provisions to compute the topographic amplification

Data acquisition and processing * Cartography (geological, DEM, lithological...)
 Field survey
 I do not know

Cartography (geological, DEM, lithological...) * Easy Intermediate Difficult
○ ○ ○

Field survey * Easy Intermediate Difficult
○ ○ ○

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Cartography (geological, DEM, lithological...)	○	○	○	○

	< 1 keuro	1-5 keuros	5-20 keuros	I do not know
Field survey	○	○	○	○

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A23 Online Questionnaire: Topographic class according to a specific Seismic Building Code; it usually accounts for values of slope and morphologic elements (landform).

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Aggravation factor for basin and topography

Period-dependent "aggravation factor". Defined for example as the ratio between 2D (or recorded motion) and 1D acceleration response spectra at the basin surface

- Data acquisition and processing * Geophysical measurements
 Geotechnical measurements
 DEM (Digital Elevation Model)
 Geology
 Modeling
 I do not know

Geophysical measurements * Easy Intermediate Difficult

Geotechnical measurements * Easy Intermediate Difficult

DEM (Digital Elevation Model) * Easy Intermediate Difficult

Geology * Easy Intermediate Difficult

Modeling * Easy Intermediate Difficult

Geophysical measurements < 1 keuro 1-5 keuros 5-20 keuros I do not know

Geotechnical measurements < 1 keuro 1-5 keuros 5-20 keuros I do not know

DEM (Digital Elevation Model) < 1 keuro 1-5 keuros 5-20 keuros I do not know

Geology < 1 keuro 1-5 keuros 5-20 keuros I do not know

Modeling < 1 keuro 1-5 keuros 5-20 keuros I do not know

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A24 Online Questionnaire: Aggravation factor for basin and topography: ratio between 2D/3D/recorded-motion and 1D estimates for a given ground motion intensity measure; it can be scalar (e.g., PGA or Arias intensity) or frequency dependent (e.g. for STF, or amplification factor on response spectra).

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Geometrical parameter (horizontal distance from lithological heterogeneities)

Distance from lithological heterogeneity (e.g. fault, basin boundaries.....)

Data acquisition and processing * Cartography (geological, DEM, lithological, ...)

Field survey

I do not know

Cartography (geological, DEM, lithological, ...) * Easy Intermediate Difficult

Field survey * Easy Intermediate Difficult

Cartography (geological, DEM, lithological, ...) < 1 keuro 1-5 keuros 5-20 keuros I do not know

Field survey < 1 keuro 1-5 keuros 5-20 keuros I do not know

Free comments: (on data acquisition, processing, analysis, cost,)

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Fig. A25 Online Questionnaire: Geometrical parameter: any parameter related with 2D or 3D structure (surface topography or underground lithological heterogeneity).

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Geo-stratigraphic 1D log model

Stratigraphic column including geological unit description

Data acquisition and processing * Non Invasive methods
 Invasive (measurement in boreholes)
 I do not know

Non Invasive methods *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
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Invasive (measurement in boreholes) *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>
---------------------------------------	-------------------------------	---------------------------------------	------------------------------------

Non Invasive methods	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
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Invasive (measurement in boreholes)	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
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Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A26 Online Questionnaire: Stratigraphic column with geological unit description (1D log model).

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Water table depth

Depth of the water table

Data acquisition and processing * Non Invasive methods
 Invasive (measurement in boreholes)
 I do not know

Non Invasive methods *

Easy	Intermediate	Difficult
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Invasive (measurement in boreholes) *

Easy	Intermediate	Difficult
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Non Invasive methods

< 1 keuro	1-5 keuros	5-20 keuros	I do not know
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Invasive (measurement in boreholes)

< 1 keuro	1-5 keuros	5-20 keuros	I do not know
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A27 Online Questionnaire: Depth of the water table.

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Non-linear curves (e.g. G/Gmax, damping shear-strain curves)

Subsoil non linear curves as a function of the shear strain (γ), in terms of normalized stiffness modulus (G/G_0 , where G_0 is the small strain modulus), damping ratio (D), and/or excess pore pressure ratio ($R_u = \Delta u/p'$, where Δu is the excess pore pressure and p' is the mean normal effective stress).

- Data acquisition and processing * Laboratory test
 In-situ measurements
 Earthquakes
 I do not know

Laboratory test *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
In-situ measurements *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Earthquakes *	Easy <input type="radio"/>	Intermediate <input type="radio"/>	Difficult <input type="radio"/>	
Laboratory test	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
In-situ measurements	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>
Earthquakes	< 1 keuro <input type="radio"/>	1-5 keuros <input type="radio"/>	5-20 keuros <input type="radio"/>	I do not know <input type="radio"/>

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A28 Online Questionnaire: Non-linear degradation curves: curves characterizing the change of mechanical properties with shear strain (γ), in terms of normalized stiffness modulus (G/G_0 , where G_0 is the small strain modulus), damping ratio (D), and/or excess pore pressure ratio ($R_u = \Delta u/p'$, where Δu is the excess pore pressure and p' is the mean normal effective stress).

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Geotechnical parameter (e.g. SPT, CPT, qu Plasticity Index, CRR....)

geotechnical parameters; e.g. SPT, CPTU, DMT, SPT, DPSH, VT, SLAB, CRR, Plasticity Index,.....:

- SPT Standard Penetration Test
- CPTU Piezocone testqu Unconfined compressive strength
- DMT Flat dilatometer test
- SPT Standard penetration test
- DPSH Dynamic probing super heavy test
- VT Vane test
- SLAB Static laboratory test
- CRR Cyclic Resistance Ratio

- Data acquisition and processing * Laboratory test
 In-situ measurements
 I do not know

Laboratory test * Easy Intermediate Difficult

In-situ measurements * Easy Intermediate Difficult

Laboratory test < 1 keuro 1-5 keuros 5-20 keuros I do not know

In-situ measurements < 1 keuro 1-5 keuros 5-20 keuros I do not know

Free comments (on data acquisition, processing, analysis, cost,)

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Fig. A29 Online Questionnaire: Geotechnical parameters: Piezocone test (CPTU), Flat dilatometer test (DMT), Standard penetration test (SPT), Dynamic probing super heavy test (DPSH), Vane test (VT), Static laboratory test (SLAB), etc.

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Most Important Indicators

Among the following indicators which are the ones that are important and should be available in site characterization databases ?

	Mandatory	Recommended	Optional	I do not know
Fundamental Resonance Frequency (f0) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Higher resonance frequencies (f1 f2 f3....) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Amplitude at resonance frequencies (A0 A1 A2....) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Site Amplification Function *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kappa0 *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Frequency-dependant attenuation (e.g. Q, damping, kappa(f) ...) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preferential direction of ground motion *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vsz (travel time-averaged value at various depths) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vs of the seismological bedrock *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Depth of the seismological bedrock *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Depth of the engineering bedrock *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vs(z) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vp(z) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water table depth *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dispersion curve *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rayleigh wave ellipticity curve *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
H/V curve *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geo-stratigraphic 1D log model *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Building code site class *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
vs30 *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Surface geology *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Morphology/topographic factor *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aggravation factor for basin and topography *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Non-linear curves (e.g. G/G0 and damping curves) *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geotechnical parameters *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Sort the parameters selected as "Mandatory", organizing within a list from the most to the less important parameter for you

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Fig. A30 Online Questionnaire: 3-degrees priority scale (“mandatory”, “recommended” or “optional”) for ranking the indicators to be included in the site-characterization database.

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Do you feel that some important indicators are missing for site characterization within site effects studies?

- yes
 no

If YES, please list the missing parameters:

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SUBMIT

Attention au vol de données : ne saisissez jamais de mots de passe dans un questionnaire.

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Thank you very much for your contribution !

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Fig. A31 Online Questionnaire: Report if some important site effects were missing or poorly represented by the proposed indicators.