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. A1 Presentation page
- Fig. A2 Institution and scientific fields of participants.
- Fig. A3 Fundamental resonance frequency (f0).
- Fig. A4 Frequency peaks of higher modes (f1, f2, f3, ...).
- Fig. A5 Amplitudes at fundamental frequency (A0) and higher modes (A1, A2, A3, ...).
- Fig. A6 Site Transfer Function.
- Fig. A7 Preferential direction of ground motion.
- Fig. A8 Duration lengthening.
- **Fig. A9** Near-surface attenuation factor at high frequency.
- Fig. A10 Frequency-dependent attenuation (e.g. Q, damping, kappa, etc.).
- Fig. A11 Travel time-averaged of shear-wave velocity (Vs) over the uppermost 30m (Vs30).
- Fig. A12 Travel-time average of shear-wave velocity at various depths above 30 m.
- Fig. A13 Travel-time average of shear-wave velocity at various depths below 30 m.
- **Fig. A14** 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.
- Fig. A15 Depth of the seismological bedrock (see figure caption of Fig. A14).
- **Fig. A16** 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).
- **Fig. A17** Subsoil velocity profile of shear-wave (Vs) as a function of the depth (z).
- Fig. A18 Subsoil velocity profile of shear-wave (Vp) as a function of the depth (z).
- **Fig. A19** Surface-wave dispersion curve: phase-velocity or slowness as a function of frequency for Rayleigh and/or Love waves.
- Fig. A20 Ellipticity curve of Rayleigh waves.
- **Fig. A21** 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).

- **Fig. A22** Surface geology: geological/lithological information from available cartography (geological & thematic) and geological surveys.
- **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).
- Fig. A27 Depth of the water table.
- **Fig. A28** Non-linear degradation curves: curves characterizing the change of mechanical properties with shear strain (γ), in terms of normalized stiffness modulus (G/G0, where G0 is the small strain modulus), damping ratio (D), and/or excess pore pressure ratio (Ru = $\Delta u/p'$, 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.

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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.

NEXT

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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 |
| | □ other |
| In case you selected more than or appropriate | ne field, please provide a sorted list from the most to the less |
| | |
| In case you want to receive the re outcomes of the questionnaire, pi | esults of your questionnaire and to be informed on the lease indicate your email address |
| | |
| PREVIOUS | NEXT |

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

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| Data acquisition and proce | ecina t 🖂 | | | | |
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| baca acquisicion and proce | | | | | |
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| | ☑ Moor | | | | |
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| | | | Easy I | ntermediate | Difficult |
| Noise * | | | 0 | 0 | 0 |
| | | | | ntermediate | Difficult |
| Earthquake * | | | 0 | 0 | 0 |
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| Modeling * | | | 0 | 0 | 0 |
| | | | | | I do not |
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| Noise | | 0 | 0 | 0 | 0 |
| | | < 1 keuro | 1-5 keuro: | s 5-20 keuros | I do not know |
| Earthquake | | 0 | 0 | 0 | 0 |
| | | < 1 keuros | 1-5 keuro: | s 5-20 keuros | I do not |
| Modeling | | 0 | 0 | 0 | 0 |
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| Free comments (on data | acquisition, pro | cessing, ana | iysis, cost, |) | |
| | | | | | |
| | | | | | |
| Question 1/29 | | | | | |
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| PREVIOUS | | | | | NEXT |

Fig. A3 Online Questionnaire: fundamental resonance frequency (f0).

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| Noise * Easy Intermediate Difficu O O O O Easy Intermediate Difficu O O O O Modeling * <1 keuro 1-5 keuros 5-20 keuros I do n know O O O O O <1 keuro 1-5 keuros 5-20 keuros I do n know O O O O O <1 keuro 1-5 keuros 5-20 keuros I do n know O O O O O O Modeling O O O O O Question 2/29 | | | | | | |
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| Earthquake * Easy Intermediate Officu Modeling * Can be intermediate Officu Easy Intermediate Difficu Can be intermediate Officu Can be intermediate Officu Can be intermediate Difficu Can be intermediate Officu Can be | | | | Easy | Intermediate | Difficult |
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| Modeling t | Lai diquane | | | 0 | 0 | 0 |
| 1 keuro | | | | Easy | Intermediate | Difficult |
| Noise O O O O O O O O O O O O O O O O O O O | Modeling * | | | 0 | 0 | 0 |
| Noise OOOO 4 keuro 1-5 keuros 5-20 keuros know know know know know know know know | | | < 1 kouro | 1.E kour | me E-20 kaurne | I do not |
| <pre> </pre> <pre> <pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre> | Noice | | | | | know |
| <pre></pre> | Noise | | 0 | 0 | 0 | 0 |
| < 1 keuro 1-5 keuros 5-20 keuros I do n know Modeling O O O Question 2/29 | | | < 1 keuro | 1-5 keur | ros 5-20 keuros | I do not know |
| Modeling OOOO | Earthquake | | 0 | 0 | 0 | 0 |
| Modeling O O O O Question 2/29 | | | < 1 keuro | 1-5 keur | ros 5-20 keuros | I do not |
| | Modeling | | 0 | 0 | 0 | |
| | | | | | | |
| | | | | | | |
| DREVIOUS | Question 2/29 | | | | | |
| | PREVIOUS | | | | | NEXT |

Fig. A4 Online Questionnaire: frequency peaks of higher modes (f1, f2, f3, ...).

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| Data acquicition and processing | t 🖂 neiss | | | | |
|---------------------------------|----------------|-------------|--------------|-------------|-----------------|
| Data acquisition and processing | Noise ☑ Earth | nunka | | | |
| | | | | | |
| | ☑ I don't | _ | | | |
| | | | | | |
| | | | , | ntermediate | Difficult |
| Noise * | | | 0 | 0 | 0 |
| | | | Easy I | ntermediate | Difficult |
| Earthquake * | | | 0 | 0 | 0 |
| | | | Easy I | ntermediate | Difficult |
| Modeling * | | | 0 | 0 | 0 |
| | | | | | |
| | | < 1 keuro | 1-5 keuros | 5-20 keuros | I do no know |
| Noise | | 0 | 0 | 0 | 0 |
| | | | | | I do no |
| | | < 1 keuro | 1-5 keuros | 5-20 keuros | know |
| Earthquake | | 0 | 0 | 0 | 0 |
| | | < 1 keuro | 1-E kourns | 5-20 keuros | I do no |
| Modeling | | O | 0 | 0 | know |
| | | 0 | 0 | | |
| Free comments (on data acqu | isition, proc | essing, ana | lysis, cost, |) | |
| | | | | | |
| | | | | | |
| | | | | | |
| Question 3/29 | | | | | |
| Quescion 3727 | | | | | |

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 | | | | |
| | | | | |
| I don't know | | | | |
| | | Easy | Intermediate | Difficult |
| Noise * | | 0 | 0 | 0 |
| | | Easy | Intermediate | Difficult |
| Earthquake * | | 0 | 0 | 0 |
| | | Easy | Intermediate | Difficult |
| Modeling * | | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keuros | 5-20 keuros | I do not know |
| Noise | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keuros | 5-20 keuros | do not know |
| Earthquake | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keuros | 5-20 keuros | I do not know |
| Modeling | 0 | 0 | 0 | 0 |
| Free comments (on data acquisition, proce | ssing, analysis, cost,) | | | |
| | | | | |
| | | | | |
| Question 4/29 | | | | |
| PREVIOUS | | | | NEXT |
| | | | | |
| | Report an abuse ca | se | | |

Fig. A6 Online Questionnaire: Site Transfer Function.

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| 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 | | | | | | | |
| ☑ Earth | | | | | | | |
| ✓ Mode | | | | | | | |
| ☑ I don' | t Know | | | | | | |
| Noise * | | Easy O | Intermediate O | Difficult O | | | |
| Earthquake * | | Easy O | Intermediate O | Difficult O | | | |
| Modeling | | Easy O | Intermediate O | Difficult O | | | |
| | < 1 keuro | 1-5 keuro | s 5-20 keuros | I do not know | | | |
| Noise | 0 | 0 | 0 | 0 | | | |
| | < 1 keuro | 1-5 keuro | s 5-20 keuros | I do not know | | | |
| Earthquake | 0 | 0 | 0 | 0 | | | |
| | < 1 keuro | 1-5 keuro | s 5-20 keuros | I do not know | | | |
| Modeling | 0 | 0 | 0 | 0 | | | |
| Free comments (on data acquisition, pro | cessing, ana | lysis, cost, . |) | | | | |
| | | | | | | | |
| | | | | | | | |
| Question 5/29 | | | | | | | |

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

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| frequency-dependent lengtheni | ng of seismic ground-mo | otion duratio | n | |
|---------------------------------|--------------------------|----------------|-------------------|----------------|
| | | | | |
| Data Acquisition and Processing | * V Noise | | | |
| | ☑ Earthquake | | | |
| | ✓ Modeling | | | |
| | ☐ I do not know | | | |
| Noise * | | Easy | Intermediate O | Difficult O |
| | | | _ | |
| | | - | Intermediate | Difficult |
| Earthquake * | | 0 | 0 | 0 |
| Modeling * | | Easy O | Intermediate O | Difficult O |
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| Noise | 0 | 0 | 0 | O |
| | < 1 keuro | 1-5 keuro | s 5-20 keuros | I do not |
| Earthquake | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keuro | s 5-20 keuros | I do not |
| Modeling | 0 | 0 | 0 | 0 |
| Free comments (on data acqui | sition, processing, anal | lysis, cost, . |) | |
| | | | | |
| 0 | | | | |
| Question 6/29 | | | | |

Fig. A8 Online Questionnaire: duration lengthening.

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| high-frequency near-surfa | ce attenuation fact | tor | | | |
|---------------------------|--------------------------------------------|------------|----------------|-------------------|-----------------|
| Data acquisition and proc | essing * ☑ Noise ☑ Earthqu ☑ Modelir | | | | |
| | ☑ I don't l | | | | |
| Noise * | | | Easy O | Intermediate O | Difficult O |
| Earthquake * | | | Easy O | Intermediate O | Difficult O |
| Modeling * | | | Easy O | Intermediate O | Difficult O |
| | | < 1 keuro | 1-5 keuro | os 5-20 keuros | I do no |
| Noise | | 0 | 0 | 0 | 0 |
| | | < 1 keuro | 1-5 keuro | os 5-20 keuros | I do no know |
| Earthquake | | 0 | 0 | 0 | 0 |
| | | | | os 5-20 keuros | I do no know |
| Modeling | | 0 | 0 | 0 | 0 |
| Free comments (on data | acquisition, proce | ssing, ana | lysis, cost, . |) | |
| | | | | | |
| Question 7/29 | | | | | |
| PREVIOUS | | | | | NEXT |

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

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| Frequency-dependent attenuation (e.g. Model for near-surface attenuation (k), Qualified frequency | | | | as a function | of |
|------------------------------------------------------------------------------------------------------|----------------|-------------|------|-----------------|------------------|
| Data acquisition and processing * 🛛 Non | invasive (acti | ive and/or | pass | rive) seismic m | ethods |
| | sive (measure | | • | | |
| | hquake | | | , | |
| ☑ Mod | eling | | | | |
| ⊡ I do | not know | | | | |
| Non invasive (active and/or passive) seismethods * | nic | Easy O | Int | termediate O | Difficult O |
| Invasive (measurements in boreholes) * | | Easy | Int | termediate O | Difficult |
| | | _ | | - | 0 |
| Earthquake * | | Easy O | Int | termediate O | Difficult O |
| Modeling | | Easy O | Int | termediate O | Difficult O |
| | < 1 keuro | 1-5 keu | uros | 5-20 keuros | I do not know |
| Non invasive (active and/or passive) seismic methods | 0 | 0 | | 0 | 0 |
| | < 1 keuro | 1-5 keu | uros | 5-20 keuros | I do not know |
| Invasive (measurements in boreholes) | 0 | 0 | | 0 | 0 |
| | < 1 keuro | 1-5 keu | uros | 5-20 keuros | I do not know |
| Earthquake | 0 | 0 | | 0 | 0 |
| | < 1 keuro | 1-5 keu | uros | 5-20 keuros | I do not |
| Modeling | 0 | 0 | | 0 | 0 |
| Free comments (on data acquisition, pro | ocessing, ana | lysis, cost | t, |) | |
| | | | | | |
| | | | | | |
| Question 8/29 | | | | | |
| PREVIOUS | | | | | NEXT |

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

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| Data acquisition and processing | Geophysical mea | surements | | |
|-----------------------------------|-----------------------|-----------------|-------------|------------------|
| | Geotechnical me | asurements | | |
| | DEM (Digital Elev | ation Model) | | |
| | Geology | | | |
| | Modeling | | | |
| | I do not know | | | |
| Feasibility index (including data | acquisition, process | ing and cost |) | |
| | | Easy I | ntermediate | Difficult |
| Geophysical measurements * | | | 0 | |
| | | Easy I | ntermediate | Difficult |
| Geotechnical measurements * | | | | 0 |
| | | | | |
| Geology * | | Easy I | ntermediate | Difficult |
| 5) | | | | |
| Cost (including field data collec | tion and analysis) | | | |
| | < 1 keuro | 1-5 keuros | 5-20 keuros | I do not know |
| Geophysical measurements | 0 | | | |
| | | | | |
| | < 1 keuro | 1-5 keuros | 5-20 keuros | I do not know |
| Geotechnical measurements | | 0 | | |
| | | | | |
| | < 1 keuro | 1-5 keuros | 5-20 keuros | I do not know |
| Geology | | | | 0 |
| | | | | |
| Free comments (on data acquisi | tion, processing, and | alysis, cost, . |) | |
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| Question 9/29 | | | | fi. |

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

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| 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 In ☑ Invasiv ☑ I do no | ve (measure | | | ethods) | | | |
| Non Invasive (active and/or passive seismic methods) * | | Easy O | Intermediate O | Difficult O | | | |
| Invasive (measurement in boreholes) * | | Easy O | Intermediate O | Difficult O | | | |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not know | | | |
| Non Invasive (active and/or passive seismic methods) | 0 | 0 | 0 | 0 | | | |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not know | | | |
| Invasive (measurement in boreholes) | 0 | 0 | 0 | 0 | | | |
| Free comments (on data acquisition, proc | essing, ana | lysis, cost, |) | | | | |
| | | | | | | | |
| Question 10/29 | | | | | | | |
| PREVIOUS | | | | NEXT | | | |

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

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| Data acquisition and processing * 🗹 Non In | vasive (acti | ive and/or p | assive seismic n | nethods) |
|---------------------------------------------------------|--------------|--------------|-------------------|------------------|
| | | ment in bo | reholes) | |
| ☑ I do no | C KNOW | | | |
| Non Invasive (active and/or passive seismic methods) * | | Easy O | Intermediate O | Difficult O |
| Invasive (measurement in boreholes) * | | Easy O | Intermediate O | Difficult O |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not know |
| Non Invasive (active and/or passive seismic methods) | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not |
| Invasive (measurement in boreholes) | 0 | 0 | 0 | 0 |
| Free comments (on data acquisition, proc | essing, ana | lysis, cost, |) | |
| | | | | |
| Question 11/29 | | | | |
| PREVIOUS | | | | NEXT |

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

<u>Webquestly.</u> Création de questionnaires, formulaires et sondages sur interne

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| Vs of the seismological bedrock | | | | | |
|----------------------------------------------------------------------|--------------------------|---------------------------|------------------------------|--------------------------------------|------------------------|
| Please provide your favorite defi related to the lowest resonance | nition of a frequency | seismologic peak; with | al bedrock (/s > 800 m/s | e.g. the impedar ; with Vs > 1000 | nce contrast m/s) * |
| | | | | | |
| Data acquisition and processing * | ☑ Non In | ıvasive (act | ive and/or p | assive seismic m | ethods) |
| | ✓ Invasi | eholes) | | | |
| | ☑ I do n | ot know | | | |
| | | | Easy | Intermediate | Difficult |
| Non Invasive (active and/or passi methods) * | ive seismic | | 0 | 0 | 0 |
| | | | Easy | Intermediate | Difficult |
| Invasive (measurement in boreho | oles) * | | 0 | 0 | 0 |
| | | < 1 keuro | 1-5 keuro | os 5-20 keuros | I do not know |
| Non Invasive (active and/or passi seismic methods) | ive | 0 | 0 | 0 | 0 |
| | | < 1 keuro | 1-5 keuro | os 5-20 keuros | I do not know |
| Invasive (measurement in boreho | oles) | 0 | 0 | 0 | 0 |
| Free comments (on data acquis | ition, proc | essing, ana | lysis, cost, |) | |
| | | | | | |
| Question 12/29 | | | | | |
| PREVIOUS | | | | | NEXT |
| | volunnet fr | - Poport an | abuso caso | | |

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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| Data acquisition and processing * 🗵 Non Inv Invasiv 🗵 I do no | e (measure | | | ethods) |
|---------------------------------------------------------------------|-------------|-------------|-------------------|----------------|
| | | | | |
| Non Invasive (active and/or passive seismic methods) # | | Easy O | Intermediate O | Difficult O |
| Invasive (measurement in boreholes) * | | Easy O | Intermediate O | Difficult O |
| | < 1 keuro | 1-5 keu | ros 5-20 keuros | I do not |
| Non Invasive (active and/or passive seismic methods) | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keu | ros 5-20 keuros | I do not |
| Invasive (measurement in boreholes) | 0 | 0 | 0 | 0 |
| Free comments (on data acquisition, proce | essing, ana | lysis, cost | ,) | |
| | | | | |
| | | | | |
| Question 13/29 | | | | |
| PREVIOUS | | | | NEXT |

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

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| Please provide your definition of engineerin | | | | | |
|---------------------------------------------------------|---------------|-------------|----------|----------------|------------------|
| * * * | > 760 m/s | | | | |
| | > 800 m/s | | | | |
| | > 900 m/s | | | | |
| | > 1500 m/s | | | | |
| O Other | | | | | |
| Data acquisition and processing * 🗵 Non Ir | nvasive (acti | ive and/or | pass | ive seismic me | ethods) |
| | ve (measure | | | | |
| ☑ I do n | ot know | | | | |
| | | | | | |
| | | Easy | Int | ermediate | Difficult |
| Non Invasive (active and/or passive seismic methods) * | : | 0 | | 0 | 0 |
| | | Easy | Int | ermediate | Difficult |
| Invasive (measurement in boreholes) * | | 0 | | 0 | 0 |
| | | | | | |
| | | | | | I do not |
| | | | iros | 5-20 keuros | know |
| Non Invasive (active and/or passive seismic methods) | 0 | 0 | | 0 | 0 |
| | < 1 keuro | 1-5 keu | ıros | 5-20 keuros | I do not know |
| Invasive (measurement in boreholes) | 0 | 0 | | 0 | 0 |
| Free comments (on data acquisition, prod | cessing, ana | lysis, cost | , |) | |
| | | | | | |
| Question 14/29 | | | | | |
| PREVIOUS | | | | | NEXT |

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 funct | ion of the de | oth (z) | |
| Data acquisition and processing * Non Invasive Invasive (mea | surement in | r passive seismic n boreholes) | nethods) |
| Feasibility index (including data acquisition, proc | essing and c | ost) | |
| | Easy | Intermediate | Difficult |
| Non Invasive (active and/or passive seismic methods) * | | 0 | |
| | Easy | Intermediate | Difficult |
| Invasive (measurement in boreholes) * | | | 0 |
| Cost (including field data collection and analysis < 1 ket Non Invasive (active and/or passive | | uros 5-20 keuros | I do not know |
| seismic methods) | | | |
| < 1 ket | uro 1-5 kei | uros 5-20 keuros | I do not know |
| Invasive (measurement in boreholes) | | | 0 |
| Free comments (on data acquisition, processing, The feasibility profile | | st,) depends on the de | epth of |
| Question 15/29 | | | |
| PREVIOUS | | | NEXT |
| webquest.fr - Repor | t an abuse case | 3 | |

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

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| Data acquisition and processing * 🗹 Non Ir | wasive (acti | ive and/or p | assive seismic me | ethods) |
|-----------------------------------------------------------|--------------|--------------|-------------------|------------------|
| | ve (measure | ement in bo | reholes) | |
| ☑ I do n | ot know | | | |
| | | Easy | Intermediate | Difficult |
| Non Invasive (active and/or passive seismic methods) * | | 0 | 0 | 0 |
| | | Easy | Intermediate | Difficult |
| Invasive (measurement in boreholes) * | | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not |
| Non Invasive (active and/or passive seismic methods) | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not know |
| Invasive (measurement in boreholes) | 0 | 0 | 0 | 0 |
| Free comments (on data acquisition, proc | essing, ana | lvsis. cost. |) | |
| ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | .,,, | , | |
| | | | | |
| Question 16/29 | | | | |
| PREVIOUS | | | | NEXT |
| | - Poport an | abura assa | | |

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

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| Surface-wave dispersion curve; apparent ph frequency or wavelength | ase-velocit | y or slowness | as a function o | f |
|-----------------------------------------------------------------------|----------------|--------------------------------|-------------------|------------------|
| Data acquisition and processing * ☑ Non In ☑ Invasiv ☑ I do no | e (measure | ive and/or pa ement in bore | | ethods) |
| Non Invasive (active and/or passive seismic methods) * | | Easy ● | intermediate O | Difficult O |
| Invasive (measurement in boreholes) * | | Easy ● | Intermediate O | Difficult O |
| Non Invasive (active and/or passive seismic methods) | < 1 keuro O | 1-5 keuro | s 5-20 keuros | I do not know |
| Invasive (measurement in boreholes) | < 1 keuro | 1-5 keuro | s 5-20 keuros | I do not know |
| Free comments (on data acquisition, proce | | | | |
| Question 17/29 | | | | |
| PREVIOUS webquest.fr | | | | NEXT |

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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| Data acquisition and processing * ☑ Non Inv ☑ Invasiv ☑ I do no | e (measure | | | | ethods) |
|-----------------------------------------------------------------------|-------------|-------------|------|-----------------|----------------|
| Non Invasive (active and/or passive seismic methods) * | | Easy O | Int | termediate O | Difficult O |
| Invasive (measurement in boreholes) | | Easy O | Int | termediate O | Difficult O |
| | < 1 keuro | 1-5 keu | ıros | 5-20 keuros | I do not |
| Non Invasive (active and/or passive seismic methods) | 0 | 0 | | 0 | 0 |
| | < 1 keuro | 1-5 keu | ıros | 5-20 keuros | I do not |
| Invasive (measurement in boreholes) | 0 | 0 | | 0 | 0 |
| Free comments (on data acquisition, proce | essing, ana | lysis, cost | , |) | |
| | | | | | |
| Question 18/29 | | | | | |
| PREVIOUS | - Renort an | | | | NEXT |

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

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| Building Code Site Class Ground class according to a specif | ic Seismic Building Co | ode | | |
|--------------------------------------------------------------------|-------------------------|--------------|--------------------------|------------------|
| Please indicates the "Seismic Code | e" you usually refer to |) (e.g. EC8, | NEHRP, AS,) ^s | × |
| Data acquisition and processing * | Geophysical mea | asurements | | |
| Feasibility index (including data | acquisition, process | ing and cos | st) | |
| C | | Easy | Intermediate | Difficult |
| Geophysical measurements * | | | 0 | |
| Geotechnical measurements * | | Easy | Intermediate | Difficult |
| Cost (including field data collect | ion and analysis) | | | |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not know |
| Geophysical measurements | | 0 | | |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not know |
| Geotechnical measurements | | 0 | | |
| Free comments (on data acquisit | tion, processing, and | lysis, cost | ,) | |
| | | | | fi. |
| Question 19/29 | | | | |
| PREVIOUS | | | | NEXT |

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 ava geological surveys | ilable car | tography (| geological & them | atic) and |
|---------------------------------------------------------------------------------|------------|-------------|-----------------------------------------|------------------|
| Data acquisition and processing * Cartogr Field su | ırvey | logical,DE | M,lithological) | |
| Feasibility index (including data acquisition | , process | ing and co | ost) | |
| Cartography (geological, DEM, lithological) | × | Easy | Intermediate | Difficult |
| | | | | |
| Field survey * | | Easy | Intermediate | Difficult |
| r letu sui vey | | | | |
| Cost (including field data collection and an | alysis) | | | |
| | < 1 keuro | 1-5 keu | ros 5-20 keuros | I do not know |
| Cartography (geological,DEM,lithological) | | | • | 0 |
| , | < 1 keuro | 1-5 keu | ros 5-20 keuros | I do not know |
| Field survey | 0 | | | |
| Free comments (on data acquisition, proces | ssing, ana | ilysis, cos | t,) | |
| | | | le 1:10000 or 1:50 if already availa | |
| Question 20/29 | | | | / |
| PREVIOUS | | | | NEXT |
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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 mor Seismic Code provisions to compute the to | | | ing for example | Building |
| | ography (geol d survey not know | logical,DEM,l | ithological) | |
| Cartography (geological,DEM,lithological. |) * | Easy O | Intermediate O | Difficult O |
| Field survey * | | Easy O | Intermediate O | Difficult O |
| Cartography (geological, DEM, lithological) | < 1 keuro O | 1-5 keuro | s 5-20 keuros | I do not know O |
| Field survey | < 1 keuro | 1-5 keuro | s 5-20 keuros | I do not know |
| Free comments (on data acquisition, pro | ocessing, ana | lysis, cost, . |) | |
| | | | | |
| Question 21/29 | | | | |
| PREVIOUS | 5- P | | | NEXT |
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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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| Data acquisition and processing * | ☐ Geop | hysical meas | urements | | | |
|-----------------------------------|-----------|----------------|-------------|-------|-----------------|-----------------|
| | ☐ Geot | eclinical med | ourement | 5 | | |
| | | (Digital Eleve | tion Mode | d) | | |
| | ☐ Geoli | 7-00 | | | | |
| | ☐ Mode | not know | | | | |
| | П | D. NEW | | | | |
| Geophysical measurements * | | | Easy | In | termediate O | Difficult O |
| Geotechnical measurements * | | | Easy | in | termediate O | Difficult |
| DEM (Digital Elevation Model) * | | | Easy O | In | lermediate O | Difficult |
| Geology * | | | Easy | in | termediate O | Difficult O |
| Modeling * | | | Easy | in | termediate O | Difficult |
| | | + 1 keuro | 1-5 kes | aros. | 5-20 keuros | I do no know |
| Geophysical measurements | | 0 | 0 | | 0 | 0 |
| | | < 1 keuro | 1-5 km | FOS. | 5-20 keuros | I do no |
| Geotechnical measurements | | 0 | 0 | | 0 | (now |
| | | < 1 keuro | 1-5 km | aros. | 5-20 keuros | I do no |
| DEM (Digital Elevation Model) | | 0 | 0 | | 0 | know |
| | | < 1 keuro | 1-5 kes | ros: | 5-20 keuros | I do no know |
| Geology | | 0 | 0 | | 0 | 0 |
| | | < 1 keuro | 1-5 km | aros: | 5-20 keuros | I do no know |
| Modeling | | 0 | 0 | | 0 | 0 |
| Free comments (on data acquisi | tion, pro | cessing, ana | lysis, cost | |) | |
| | | | | | | |
| Question 22/29 | | | | | | |
| | | | | | | |

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 dist Distance from lithological heterogeneity | | - | | |
|------------------------------------------------------------------------------------|---------------------------------------------|----------------------|-------------------|------------------|
| | rtography (geol eld survey o not know | logical, DE <i>l</i> | M, lithological, |) |
| Cartography (geological, DEM, lithologic | al,) * | Easy O | Intermediate O | Difficult O |
| Field survey * | | Easy O | Intermediate O | Difficult O |
| | | | ros 5-20 keuros | I do not know |
| Cartography (geological, DEM, lithological,) | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keu | ros 5-20 keuros | I do not know |
| Field survey | 0 | 0 | 0 | 0 |
| Free comments (on data acquisition, p | rocessing, ana | lysis, cost, |) | |
| | | | | |
| Question 23/29 | | | | |
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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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| Invasive meth | nods | | | |
|---------------|----------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| - | ment in b | oreh | oles) | |
| not know | | | | |
| | Easy O | In | termediate O | Difficult O |
| | Easy O | In | termediate O | Difficult O |
| < 1 keuro | 1-5 ke | uros | 5-20 keuros | I do not |
| 0 | 0 | | 0 | 0 |
| < 1 keuro | 1-5 ke | uros | 5-20 keuros | I do not know |
| 0 | 0 | | 0 | 0 |
| cessing, ana | lysis, cost | t |) | |
| - | | _ | | |
| | | | | |
| | | | | |
| | | | | |
| | < 1 keuro O < 1 keuro O | Easy O Easy O <1 keuro 1-5 keu O <1 keuro 1-5 keu O O <1 keuro 1-5 keu O O | Easy Into O Calculate the control of the control o | Easy Intermediate O O Easy Intermediate O O C STAN STAN STAN STAN STAN STAN STAN STAN |

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

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| Data acquisition and processing * 🗹 Non | | | | |
|-----------------------------------------|---------------------------|-------------|-------------------|----------------|
| | sive (measure not know | ment in bor | reholes) | |
| □ 1 00 | not know | | | |
| Non Invasive methods * | | Easy O | Intermediate O | Difficult O |
| | | Easy | Intermediate | Difficult |
| Invasive (measurement in boreholes) * | | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not |
| Non Invasive methods | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keur | os 5-20 keuros | I do not |
| Invasive (measurement in boreholes) | 0 | 0 | 0 | 0 |
| Free comments (on data acquisition, pro | cessing, ana | lvsis cost |) | |
| ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | ,,, | , | |
| | | | | |
| Question 25/29 | | | | |
| | | | | |

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

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| stiffness modulus (G/G0, where G0 is t excess pore pressure ratio (Ru = Δ u/p' mean normal effective stress). | | | | |
|----------------------------------------------------------------------------------------------------------------------|-----------------|--------------|------------------|-----------------|
| Data acquisition and processing * 🛭 L | aboratory test | | | |
| ☑ II | n-situ measurem | ents | | |
| | arthquakes | | | |
| ☑ 1 | do not know | | | |
| Laboratory test * | | Easy I | ntermediate O | Difficult O |
| In-situ measurements * | | Easy I | ntermediate O | Difficult O |
| Earthquakes * | | Easy I | ntermediate O | Difficult O |
| | < 1 keuro | 1-5 keuros | 5 -20 keuros | I do no know |
| Laboratory test | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keuros | 5-20 keuros | I do no know |
| In-situ measurements | 0 | 0 | 0 | 0 |
| | < 1 keuro | 1-5 keuros | 5-20 keuros | I do no |
| Earthquakes | 0 | 0 | 0 | 0 |
| Free comments (on data acquisition, | processing, ana | lysis, cost, |) | |
| | | | | |
| Question 26/29 | | | | |
| PREVIOUS | | | | NEXT |

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/G0, where G0 is the small strain modulus), damping ratio (D), and/or excess pore pressure ratio (Ru = $\Delta u/p'$, 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 | r, qu Plasticity | Index, CRR |) | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------|-------------------|------------------|
| geotechnical parameters; e.g. SPT, CPTI Index,: SPT Standard Penetration Test CPTU Piezocone testqu Unconfined com 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 | pressive streng | | , CRR, Plasticity | |
| Data acquisition and processing * 🕝 La | | | | |
| | situ measurem lo not know | ents | | |
| Laboratory test * | | Easy I | Intermediate O | Difficult O |
| In-situ measurements * | | Easy I | Intermediate O | Difficult O |
| Laboratory test | < 1 keuro | 1-5 keuro: | s 5-20 keuros | I do not know |
| Laboratory test | < 1 keuro | | s 5-20 keuros | I do not |
| In-situ measurements | 0 | 0 | 0 | O |
| Free comments (on data acquisition, p | processing, ana | lysis, cost, |) | |
| | | | | |
| Question 27/29 | | | | |
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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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| fundamental Resonance Frequency (f0) figher resonance frequencies (f1 f2 3) * unplitude at resonance frequencies (A0 11 A2) * ite Amplification Function * tappa0 * frequency-dependant attenuation (e.g. 0, damping, kappa(f)) * freferential direction of ground motion | Mandatory O O O O O | Recommended O O O O | Optional O O | I do not know O |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|--------------------|-----------------------|
| digher resonance frequencies (f1 f2 3) * unplitude at resonance frequencies (A0 t1 A2) * ite Amplification Function * tappa0 * frequency-dependant attenuation (e.g. to damping, kappa(f)) * | 0 0 0 | 0 | 0 | 0 |
| a) * Implitude at resonance frequencies (A0 of A2) * It A2) * It Amplification Function * It Ampa0 * It requency-dependant attenuation (e.g. of Amping, kappa(f)) * | 0 | 0 | | 0 |
| of A2) * ite Amplification Function * (appa0 * frequency-dependant attenuation (e.g. (), damping, kappa(f)) * | 0 | | 0 | |
| appa0 * requency-dependant attenuation (e.g. b, damping, kappa(f)) * | 0 | 0 | | 0 |
| requency-dependant attenuation (e.g. (g. damping, kappa(f)) † | | | 0 | 0 |
|), damping, kappa(f)) * | 0 | 0 | 0 | 0 |
| referential direction of ground motion | | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 |
| 'sz (travel time-averaged value at arious depths) * | 0 | 0 | 0 | 0 |
| 's of the seismological bedrock * | 0 | 0 | 0 | 0 |
| epth of the seismological bedrock * | 0 | 0 | 0 | 0 |
| epth of the engineering bedrock * | 0 | 0 | 0 | 0 |
| 's(z) * | 0 | 0 | 0 | 0 |
| 'p(z) * | 0 | 0 | 0 | 0 |
| Vater table depth * | 0 | 0 | 0 | 0 |
| ispersion curve * | 0 | 0 | 0 | 0 |
| ayleigh wave ellipticity curve * | 0 | 0 | 0 | 0 |
| I/V curve * | 0 | 0 | 0 | 0 |
| ieo-stratigraphic 1D log model * | 0 | 0 | 0 | 0 |
| uilding code site class * | 0 | 0 | 0 | 0 |
| s30 * | 0 | 0 | 0 | 0 |
| urface geology * | 0 | 0 | 0 | 0 |
| horphology/topographic factor * | 0 | 0 | 0 | 0 |
| ggravation factor for basin and opography * | 0 | 0 | 0 | 0 |
| Ion-linear curves (e.g. G/G0 and lamping curves) * | 0 | 0 | 0 | 0 |
| eotechnical parameters * | 0 | 0 | 0 | 0 |
| ort the parameters selected as "Mandatory mportant parameter for you | y", organizi | ng within a list fr | om the most | to the less |

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 characterizations effects studies? • yes | tion within |
|-----------------------------------------------------------------------------------------------------------|----------------|
| ○ no | |
| If YES, please list the missing parameters: | |
| | |
| PREVIOUS | SUBMIT |
| Attention au vol de données : ne saisissez jamais de mots de passe dans un d | 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.