Dataset of selected design-compatible waveforms for microzonation studies

Dataset

Author(s):
Panzera, Francesco; Bergamo, Paolo; Fäh, Donat

Publication date:
2023-09-27

Permanent link:
https://doi.org/10.3929/ethz-b-000633618

Dataset of selected design-compatible waveforms for microzonation studies

Authors: Panzera Francesco[1,2], Bergamo Paolo[1], Donat Fäh[1]

[1] Swiss Seismological Service (SED) at ETH Zurich, Switzerland

[2] Now at University of Catania, Catania, Italy

Corresponding author: Francesco Panzera francesco.panzera@unict.it

General description

This dataset collects 5 sets of 11 waveforms compatible with the elastic response spectrum as defined in the Swiss normative SIA261 (2020) for each seismic zone (zones 1a, 1b, 2, 3a, 3b). Specifically, each set of waveforms is compatible, in the period range 0.02 – 2.0s, with the elastic response spectrum defined by SIA261 (2020) – for a 475 years return period – for a soil class A site in the corresponding SIA261 (2020) zone. The compatibility is ensured by respecting the selection criteria listed in the Eurocode 8 (2022) draft released during the research project.

The full description of the selection procedure, data and criteria can be found in the report: "Panzera, F., Bergamo, P., Fäh, D. (2023). Database for design-compatible waveforms. Swiss Seismological Service, ETH Zurich, pp. 1-107 doi 10.3929/ethz-b-000633297".

This dataset was prepared for the Federal Office for the Environment (FOEN) within the project "Database for design-compatible waveforms". The findings, comments, statements or recommendations expressed in this document are exclusively of the authors and do not necessarily reflect the views and policies of FOEN or ETH Zurich. While undertaking to provide practical and accurate information, the authors assume no liability for, nor express or imply any warranty with regard to the information and data described hereafter. Users of information and data expressed in this report assume all liability arising from such use.

Recommendation for the use of waveforms

The provided waveforms are scaled to the elastic response spectrum of soil class A. This response spectrum refers to a rock subsoil, but the shear-wave velocity profile is not defined and the geotechnical description in SIA 261 (2020) also includes weathered rock. To account for this fact,

the SIA Working Group on Earthquakes introduced a factor of 1.6 (Duvernay et al., 2019) to determine the elastic response spectrum of ground class A in SIA 261 (2020) from the values of the Uniform Hazard Spectra of the national seismic hazard model SUIHaz15 (Wiemer et al., 2016). For this reason, it is recommended to reduce the amplitudes of the waveforms by this factor 1.6. Once this correction is implemented, the waveforms then refer to a well-defined reference rock condition (Vs30=1105 m/s; Poggi et al., 2011), which is the same for the national seismic hazard model (Wiemer et al., 2016). For the definition of the shear-wave velocity reference profile, see also: http://www.seismo.ethz.ch/en/knowledge/seismic-hazard-switzerland/for-professionals. It is important to note that the waveforms represent the earthquake ground-motion at a site on the soil surface, i.e. the outcropping reference rock once the amplitudes are reduced by applying the factor 1/1.6. In order to define the incident wave field at depth, it is recommended to perform a deconvolution to a depth where the reference velocity profile displays the same S-wave velocity of the bedrock used in the site response analysis.

Data description

The 5 sets of selected waveforms are provided in 5 subfolders, each dedicated to a single SIA 261 (2020) zone (subfolder /Z1a refers to zone 1a, subfolder /Z1b refers to zone 1b, subfolder /Z2 refers to zone 2, subfolder /Z3a refers to zone 3a, subfolder /Z3b refers to zone 3b). Each subfolder contains:

- **Metadata.txt**. Table with the metadata of the selected waveforms. *Recordnumbe*r = index running from 1 to 11; *Scalefactor* = scale factor applied to the waveform; *Filename* = name of the record in our database (ACC is acronym for acceleration, followed by a 5 digits number corresponding to the event code, then by the name of the station and finally by the component code [xa is North-South or Longitudinal; ya is East-West or Transversal]); *Vs30* = average S-wave velocity in the upper 30 m at the recording station (9999999 indicates NoData); *Mw* = moment magnitude; R_{JB} = Joyner Boore distance (in km); *DD.MM.YY*: day, month, year of the recorded event; *HH:MM:SS*: hour, minutes, seconds of the recorded event.
- **SA_compatible_selection.tif**. Figure displaying the spectra (in spectral acceleration) of the selected waveforms. Gray lines = spectra of selected waveforms; blue line = average of selected spectra: black line = target spectrum; red dashed lines = 0.75 and 1.3 times the target spectrum; green dashed line = 0.5 times the target spectrum; red vertical bands = they delimitate the period range considered for the compatibility with the target spectrum.
- **SD_compatible_selection.tif.** Figure displaying the spectra (in spectral displacement) of the selected waveforms. Color and symbol codes are the same as in SA_compatible_selection.tif.
- **Subfolder /waveforms_data_scaled.** It contains the selected scaled waveforms (i.e with applied scaling factor). Each txt file stores one waveform. The name of the txt file is defined as follows: ACC is acronym for acceleration, followed by a 5-digit number corresponding

to the event code, then by the name of the station, by the component code (xa indicates the North-South component; ya the East-West component) and finally by the string "scaled". The header of the txt file contains the following pieces of information: Line 1 = database of origin of the record; line 2 = ID of the event in the database of origin; line 3 (Event_date_YYYYMMDD) = date (year, month, day) of the event; line 4 (Event_time_HHMMSS) = hour, minutes, seconds of the event; line 5 (Station_code) = name of the recording station in the database of origin; line 6 (Stream) = name of recording component in the database of origin; line 7 (NPTS) = number of acceleration samples of the time history; line 8 (Sample_rate_(s)) = sampling rate (in s) of the time history; line 9 (Units) = unit of acceleration (e.g. cm/s^2); line 10 (Filter_type) = type of applied filer; line 11 (Filter_older) = order of the applied filter; lines 12 and 13 (Low_cut_frequency_(Hz) and High_cut_frequency_(Hz)) = low and high cut frequencies (in Hz) of the applied bandpass filter; line 14 (Trigger) = type of applied trigger. The header is followed by the time history in acceleration.

- **Subfolder /waveforms_pictures.** It contains the graphical representations of the selected scaled waveforms. Each tif file refers to a scaled waveform. The name of the tif file is defined as follows: ACC is acronym for acceleration, followed by a 5-digit number corresponding to the event code, then by the name of the station and finally by the component code (xa indicates the North-South component; ya the East-West component). Each figure contains three subplots, where the waveform is represented in acceleration (top subplot), velocity (center subplot) and displacement (lower subplot).

References

Duvernay, B., Fäh, D., Koller, M., und T. Wenk, 2019, Aktualisierung der Erdbebeneinwirkungen der Norm SIA 261:2014. Bericht z.H. der Normkommission SIA 261 und der Kommission für technische Normen (KTN). Referenz/Aktenzeichen: S041-0132. Bundesamt für Umwelt BAFU, Abteilung Gefahrenprävention.

Eurocode 8, 2022, Design of structures for earthquake resistance, General rules, seismic actions and rules for buildings, European Standard, European Committee for Standardization. prEN 1998-1-1:2022 (Draft)

Panzera, F., Bergamo, P., Fäh, D. (2023). Database for design-compatible waveforms. Swiss Seismological Service, ETH Zurich, pp. 1-107 doi 10.3929/ethz-b-000633297

Poggi, V., B. Edwards and D. Fäh, 2011, Derivation of a Reference Shear-Wave Velocity Model from Empirical Site Amplification, Bull. seism. Soc. Am. 101, 258-274.

SIA261 (Società svizzera degli ingegneri e degli architetti), 2020. Azioni sulle strutture portanti. Società svizzera degli ingegneri e degli architetti, Zurigo, 2020.