Dataset of selected design-compatible waveforms for structural analysis studies

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General description

This dataset collects 75 sets of 11 horizontal-component waveform couples; each set is compatible with the elastic response spectrum as defined in the Swiss normative SIA261 (2020) for each combination of seismic zone (zones 1a, 1b, 2, 3a, 3b) and soil class (soil class A, B, C, D, E). More in detail, each set comprises 11 pairs of horizontal-component waveforms, referring to the recording of one seismic event by the two horizontal components of the same station. Each set of waveforms is compatible, in a predefined period range, with the elastic response spectrum defined by SIA261 (2020) – for a 975 years return period – for each possible combination of SIA261 (2020) soil class and zone. The compatibility is ensured by respecting the selection criteria listed in the Eurocode 8 (2022) draft released during the research project. The three different period ranges over which the compatibility is enforced are the following: 0.02 – 1.0 s, 0.1 – 2.0 s, 0.25 – 4.0 s. These period ranges cover the buildings with resonance period between 0.10 – 0.66 s, between 0.50 – 1.33 s and between 1.25 – 2.66 s, respectively; in fact, according to Eurocode 8 (2022), the compatibility between the selected waveforms and the normative spectrum must be ensured in the range $0.2T_0$ – $1.5T_0$, where T_0 is the resonance period of the investigated building. In this dataset we additionally provide the vertical component of the selected horizontal-component recordings, modified with the same scaling factor applied to the horizontal components.

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

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Data description

The 75 sets of selected waveforms are provided in 3 main folders, each referring to a different period range: /0.02-1.0s refers to the period rage 0.02 – 1.0 s, /0.1-2.0s refers to the period range 0.1 – 2.0 s, /0.25-4.0s refers to the period range 0.25 – 4.0 s. In each folder there are 25 subfolders, each containing the selected waveforms for the corresponding combination of SIA261 (2020) zone and soil class. The name of the subfolders is defined as /Z*X*_*Y* where *X* indicates the seismic zone (1a, 1b, 2, 3a or 3b) and *Y* indicates the soil class (A, B, C, D or E). Each subfolder contains:

- **Metadata.txt**. Table with the metadata of the selected waveforms. *Recordnumber* = index running from 1 to 11; *Scalefactor* = scale factor applied to the waveform pair; *Filename* = name of the North-South component 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 North-South component code xa [the name of the corresponding East-West component record is identical except for the component code, which is ya]); *Vs30* = average S-wave velocity in the upper 30 m at the recording station (9999999 indicates NoData); *Mw* = moment magnitude of the event; 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. Each spectrum is obtained as the geometrical mean of the two horizontal components. 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; za the vertical 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; za the vertical component). Each figure contains three subplots, where the waveform is represented in acceleration (top subplot), velocity (center subplot) and displacement (lower subplot).

References

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

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