



Wegleitung zur Ermittlung der Referenzbodenbeschleunigung

(Version en français en bas; versione italiana di seguito; english version below)

Die Referenz-Bodenbeschleunigung auf SED-Referenzfels ($S_{a0,15SED}$) ist gegeben durch das schweizerische Erbebengefährdungsmodell - SUIHaz2015 (Wiemer, St.; Danciu, L. et al. 2016).

Die Referenzbodenbeschleunigung ist definiert als die in SUIHaz2015 gegebenen spektralen Beschleunigung bei Schwingzeit 0.15s ($S_{a0,15SED}$).

Aus dieser Bodenbeschleunigung kann die maximalen Bodenbeschleunigung auf Fels ($a_{gd,act}$) nach Ziffer 4.3.2.2 der Richtlinie Teil C3 ermittelt werden.

Die Referenzbodenbeschleunigung kann nach folgender Wegleitung ermittelt werden:

Der Bezug der Rohdaten erfolgt über das Datenportal der «European Facilities for Earthquake Hazard and Risk» (in englischer Sprache):

<http://www.efehr.org/en/hazard-data-access/hazard-spectra/>

Um die Gefährdung am Standort der Sperre zu erhalten sind folgende Angaben notwendig (die Eingabedialoge sind in Abbildung 1 gezeigt):

Schritt 1: Eingabe des Standorts der Sperre in Weltkoordinaten (WGS84, nicht Schweizer Koordinaten)

Schritt 2: Auswahl des Gefährdungsmodells = SUIhaz15

Schritt 3: Auswahl des Intensitätsparameters = SA (Spektrale Beschleunigung)

Schritt 4: Auswahl der Überschreitungswahrscheinlichkeit nach Richtlinie C3, Tabelle 1 Abschnitt 4.2.2

Schritt 5: Auswahl der Baugrundklasse = rock_vs30_1105ms-1

Schritt 6: Auswahl der Aggregation = 0.5 fractile (Median)

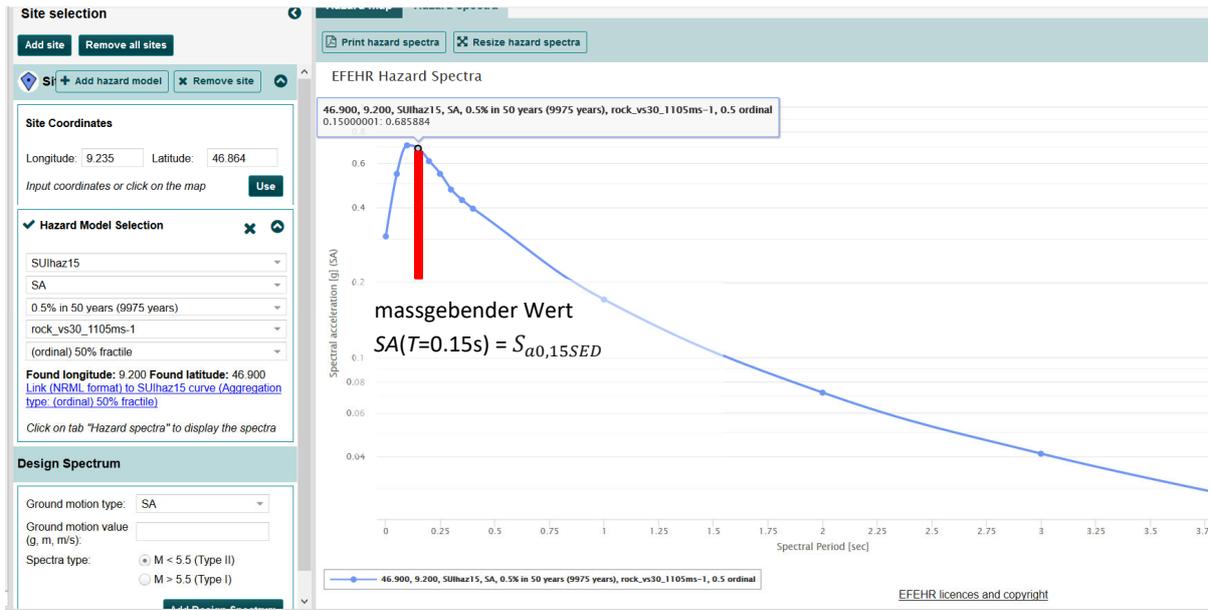
Abbildung 1: Eingaben zur Ermittlung der Erdbebengefährdung

The screenshot shows the 'Spectra' web application interface. The main title is 'Spectra'. There are two tabs: 'Hazard map' and 'Hazard spectra'. The 'Hazard spectra' tab is active. On the left, there is a 'Site selection' panel with buttons for 'Add site', 'Remove all sites', 'Site', 'Add hazard model', and 'Remove site'. Below this is a 'Site Coordinates' section with input fields for 'Longitude: 9.235' and 'Latitude: 46.864', and a 'Use' button. A red box highlights this section, with a red arrow pointing to a label 'Schritt 1'. Below the 'Site Coordinates' is a 'Hazard Model Selection' section with a list of options: 'SUIhaz15', 'SA', '0.5% in 50 years (9975 years)', 'rock_vs30_1105ms-1', and '(ordinal) 50% fractile'. Red arrows point from each of these options to labels 'Schritt 2' through 'Schritt 6' respectively. On the right, there is a 'Hazard map' section with 'Map Controls' and 'Print' buttons, and a map showing a hazard distribution with a color scale from green to red. A red arrow points from the 'Site Coordinates' section to the map.



Im Anschluss an die Eingaben wird das «Uniform Hazard Spectrum» am Standort der Sperre dargestellt (vgl. Abbildung 2). Aus diesem kann die spektrale Beschleunigung bei einer Schwingzeit von 0.15s ($S_{a0,15SED}$) abgelesen werden. Die maximale Bodenbeschleunigung auf Fels ($a_{gd,act}$) ergibt sich dann gemäss der Ziffer 4.3.2.2 der Richtlinie Teil C3.

Abbildung 2: Ermittlung der spektralen Beschleunigung bei einer Schwingzeit von 0.15s ($S_{a0,15SED}$) aus dem UHS





Guide pour la détermination de l'accélération de sol de référence

L'accélération de sol de référence pour la roche de référence SED ($S_{a0,15SED}$) est définie par le modèle de l'aléa sismique suisse SUIHaz2015 (Wiemer, St.; Danciu, L. et al. 2016).

L'accélération de sol de référence est définie comme l'accélération spectrale du modèle SUIHaz2015 à la période 0.15s ($S_{a0,15SED}$).

Avec cette accélération de sol, on peut déterminer l'accélération de sol maximale ($a_{gd.act}$) selon le paragraphe 4.3.2.2 de la directive relative à la sécurité des ouvrages d'accumulation, Partie C3: Sécurité aux séismes.

L'accélération de sol de référence peut être déterminée comme suivant:

Les données brutes sont obtenues par le portail de données de «European Facilities for Earthquake Hazard and Risk» (en anglais):

<http://www.efehr.org/en/hazard-data-access/hazard-spectra/>

Pour déterminer l'aléa sismique au site du barrage, les indications suivantes sont requises (les champs de saisies sont illustrés dans la figure 3):

Indication 1: Indication du site du barrage en coordonnées globales (WGS84, pas en coordonnées suisses)

Indication 2: Choix du modèle de risque = SUIhaz15

Indication 3: Choix du paramètre de l'intensité = SA (l'accélération spectrale)

Indication 4: Choix de la probabilité de dépassement selon la directive C3, tableau 1 paragraphe 4.2.2

Indication 5: Choix de la classe de sol de fondation = rock_vs30_1105ms-1

Indication 6: Choix de l'agrégation = 0.5 fractile (Median)

Figure 3: Indications pour déterminer l'aléa sismique

The screenshot shows the 'Spectra' web application interface. The main title is 'Spectra'. There are two tabs: 'Hazard map' and 'Hazard spectra', with 'Hazard spectra' selected. Below the tabs are 'Map Controls' and a 'Print' button. The 'Site selection' section includes 'Add site' and 'Remove all sites' buttons. Below that is a 'Site' section with 'Add hazard model' and 'Remove site' buttons. A red box highlights the 'Site Coordinates' section, which contains input fields for 'Longitude: 9.235' and 'Latitude: 46.864', and a 'Use' button. Below this is the 'Hazard Model Selection' section, which is checked. It lists several options: 'SUIhaz15', 'SA', '0.5% in 50 years (9975 years)', 'rock_vs30_1105ms-1', and '(ordinal) 50% fractile'. Red lines connect these options to labels 'Indication 2' through 'Indication 6'. A map is visible on the right side of the interface, with a red line pointing to a location on the map labeled 'Indication 1'.



Suite aux indications, «l'Uniform Hazard Spectrum» pour le site du barrage est déterminé (figure 4). De cette figure, on peut relever l'accélération spectrale à la période 0.15s ($S_{a0,15SED}$). L'accélération de sol maximale ($a_{gd,act}$) est déterminée selon le paragraphe 4.3.2.2 de la directive relative à la sécurité des ouvrages d'accumulation, Partie C3: Sécurité aux séismes.

Figure 4: Détermination de l'accélération spectrale à la période 0.15 s ($S_{a0,15SED}$) de l'UHS





Guida per la determinazione del valore di riferimento dell'accelerazione spettrale

Il valore di riferimento dell'accelerazione spettrale per la roccia di riferimento SED ($S_{a0,15SED}$) è definito nel modello di pericolosità sismica SUIHaz2015 (Wiemer, St.; Danciu, L. et al. 2016).

Il valore di riferimento dell'accelerazione spettrale è definito come valore dell'accelerazione spettrale nel modello SUIHaz2015 per un periodo di 0.15s ($S_{a0,15SED}$).
Da questo valore di riferimento è possibile determinare l'accelerazione massima al suolo ($a_{gd,act}$) secondo il paragrafo 4.3.2.2 della Direttiva sulla sicurezza degli impianti di accumulazione, Parte C3: Sicurezza sismica.

L'accelerazione spettrale di riferimento può essere determinata come segue:

I dati grezzi possono essere scaricati dal portale seguente : «European Facilities for Earthquake Hazard and Risk» (in inglese), <http://www.efehr.org/en/hazard-data-access/hazard-spectra/>

Per determinare la pericolosità al sito dell'impianto sono necessarie le seguenti indicazioni (i campi di input sono illustrati nella figura 5):

Input 1: Selezione del sito dell'impianto tramite coordinate globali (WGS84, non coordinate Svizzere)

Input 2: Selezione del modello di pericolosità = SUIhaz15

Input 3: Selezione del parametro di intensità = SA (accelerazione spettrale)

Input 4: Selezione della probabilità di superamento secondo la direttiva C3, tabella 1, paragrafo 4.2.2

Input 5: Selezione della classe di suolo della fondazione = rock_vs30_1105ms-1

Input 6: Selezione dell'aggregazione = 0.5 fractile (Median)

Figura 5: Indicazioni per la determinazione del valore di pericolosità sismica

The screenshot shows the 'Spectra' web application interface. The left sidebar contains the following sections:

- Site selection:** Includes buttons for 'Add site' and 'Remove all sites'. Below this is a 'Site' section with '+ Add hazard model' and 'x Remove site' buttons. A red box highlights the 'Site Coordinates' section, which contains input fields for 'Longitude: 9.235' and 'Latitude: 46.864', and a 'Use' button. A red line points from this box to the label 'Input 1'.
- Hazard Model Selection:** A list of options with red lines pointing to specific selections labeled 'Input 2' through 'Input 6':
 - SUIhaz15 (Input 2)
 - SA (Input 3)
 - 0.5% in 50 years (9975 years) (Input 4)
 - rock_vs30_1105ms-1 (Input 5)
 - (ordinal) 50% fractile (Input 6)

The main map area shows a topographic map with a color-coded hazard level overlay. The title 'Spectra' is at the top left of the interface.



Con le indicazioni sopra si ottiene «l'Uniform Hazard Spectrum» (UHS) per il sito dell'impianto (figura 6). Da questa figura si ottiene l'accelerazione spettrale per un periodo di 0.15s ($S_{a0,15SED}$). L'accelerazione massima del suolo su roccia ($a_{gd,act}$) è determinata in seguito secondo il paragrafo 4.3.2.2 della direttiva C3.

Figura 6: Determinazione dell'accelerazione spettrale per il periodo di 0.15 s ($S_{a0,15SED}$) dell'UHS





Guide to determine the reference ground acceleration

The reference ground acceleration for SED-reference-rock ($S_{a0,15SED}$) is given by the Swiss seismic hazard model - SUIHaz2015 (Wiemer, St.; Danciu, L. et al. 2016).

The reference ground acceleration is defined as the spectral acceleration at period 0.15s ($S_{a0,15SED}$) given in SUIHaz2015.

From this ground acceleration one can determine the peak ground acceleration on rock ($a_{gd,act}$) according to section 4.3.2.2 of the Directive on the Safety of Water Retaining Facilities, part C3: Earthquake safety.

The Reference ground acceleration can be determined according to this guide:

Raw data can be acquired from the database of the «European Facilities for Earthquake Hazard and Risk» (in English):

<http://www.efehr.org/en/hazard-data-access/hazard-spectra/>

To get the seismic hazard at the site of the dam, the following Inputs are necessary (the input dialogues are shown in Figure 7):

Step 1: Input of the dam site in global coordinates (WGS84, not swiss coordinates)

Step 2: Choice of the seismic hazard model = SUIhaz15

Step 3: Choice of the intensity parameter = SA (spectral acceleration)

Step 4: Choice of the probability of exceedance according to directive C3: Table 1, section 4.2.2

Step 5: Choice of the ground class= rock_vs30_1105ms-1

Step 6: Choice of the aggregation = 0.5 fractile (median)

Figure 7: Inputs for the acquisition of the seismic hazard data

The screenshot shows the 'Spectra' web application interface. The main title is 'Spectra'. There are two tabs: 'Hazard map' and 'Hazard spectra'. The 'Hazard spectra' tab is active. Below the tabs, there are 'Map Controls' and a 'Print' button. The interface is divided into two main sections: 'Site selection' and 'Hazard Model Selection'. The 'Site selection' section has buttons for 'Add site' and 'Remove all sites'. Below that, there is a 'Site' section with a map icon, '+ Add hazard model', and 'x Remove site'. A red box highlights the 'Site Coordinates' input fields, which include 'Longitude: 9.235' and 'Latitude: 46.864', and a 'Use' button. A red arrow points from a 'Step 1' label to this box. The 'Hazard Model Selection' section has a checkmark and a close button. It contains a list of options: 'SUIhaz15', 'SA', '0.5% in 50 years (9975 years)', 'rock_vs30_1105ms-1', and '(ordinal) 50% fractile'. Red arrows point from 'Step 2' to 'SUIhaz15', 'Step 3' to 'SA', 'Step 4' to '0.5% in 50 years (9975 years)', 'Step 5' to 'rock_vs30_1105ms-1', and 'Step 6' to '(ordinal) 50% fractile'. The background of the interface is a topographic map with a color gradient from green to red.



Subsequently to the data input the Uniform hazard spectrum will be displayed for the site of the dam (see figure 8). There, the spectral acceleration at a period of 0.15 s ($S_{a0,15SED}$) can be read out. The peak ground acceleration ($a_{gd,act}$) on rock can be calculated according to section 4.3.2.2 of the directive C3.

Figure 8: Determination of the spectral acceleration at period 0.15 s ($S_{a0,15SED}$) from the UHS

