

Characterization of local seismic site effects using ambient noise measurements: the case of the soil foundation class D in Geneva

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Compared to all Switzerland, Geneva is located in a low seismic zone. However considering a 1000 year return period and taking its high exposure into account, Geneva becomes one of the Swiss high seismic risk zones. For this reason, it is of prime importance to investigate the influence of local site effects.

Geneva is built on a Molasse basin, overlaid with fluvio-glacial and lake deposits. Following federal rules, the Geneva geological service elaborated a soil conditions map based on classes defined by the Swiss seismic building code 2003. One of the categories is a class D generally defined with more than 30 meters of unconsolidated fine sands, silts and clays. Based on the 3D geological model under development for Geneva, it can be seen that most of this deposit is located in a trough, called the “sillon du petit-Lac”, caused by past tectonic activities. The part of this structure which is on land is characterized by a maximum depth of 125 m, length of 9.4 km and width of 1.4 km and can be considered as a small shallow basin. This study focuses on the characterization of the seismic response of this trough.

About 90 sites have been investigated by using the seismic noise horizontal-to-vertical ratio technique (HVSR) to characterize the fundamental resonance frequency of the trough. Results show that frequency values vary between 1.2 to 4.7 Hz and amplification factors from 3 to 10.

Considering existing buildings and assuming the fundamental frequency of vibration of a building $f=10/\text{number of stories}$, it can be seen that in some areas, the rough estimation of fundamental frequencies is similar to the natural frequency of the soil.