CERIS Civil Engineering Research and Innovation for Sustainability

Seismic microzonation studies for Lisbon

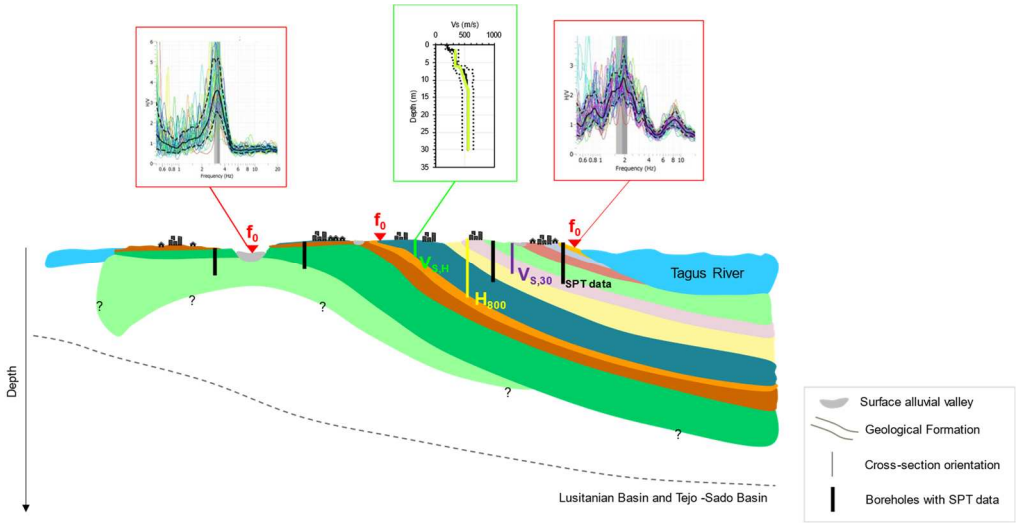
Summary

Lisbon has been affected by several moderate to strong earthquakes that caused considerable damage and produced large economic and social impacts (e.g., November 1st, 1755, earthquake). Due to its historical seismicity and its economic and social importance, Lisbon is considered to have moderate to high seismic risk. The implementation of seismic microzonation studies in cities (i) located in regions of the globe with significant seismotectonic activity, (ii) characterized by a geotechnical and geological environment that can impact the soil seismic response, and (iii) with relevant socio-economic interest, as is the case of Lisbon, aim to identify zones with similar seismic response to contribute for long-term urban planning and seismic risk mitigation. This work intends to characterize the seismic response of the ground in Lisbon using complementary and innovative methodologies and approaches. An extensive campaign of HVSR was performed in the city, complemented by surface waves-based methods.

An integrated approach to seismic ground characterization was developed based on a multidisciplinary dataset composed of surface geology, a geotechnical database, and a geophysical database that compiles all the available geophysical test results carried out in Lisbon. The geophysical database includes shear-wave velocity values from different surface seismic wave methods and HVSR results from ambient vibration measurements. Based on the shear-wave velocity results, a Vs geologic-based equation was computed for each geological unit. From the ambient vibration measurements, the peak frequency distribution in the city was assessed. Considering the obtained results, an estimation of the impedance contrast depth was computed. The results showed that for the first ~100m of depth, a robust relationship between the contrasts identified through different data is verified. However, higher dispersion and consequent uncertainty associated with the estimation were observed for higher depths. An estimate of seismic bedrock (H800) was also computed. The results will be interpreted to classify the ground profile considering the site classification scheme from the new version of Eurocode 8 (2nd generation), which includes the seismic bedrock. To identify local site effects and how the ground characteristics influence the surface seismic response and their impact on the structures, a 1D and 2D seismic site response analysis will be performed. Based on the experience gained, seismic microzonation guidelines will be proposed for Portugal to fill the existing gap.

Keywords

Surface seismic methods, integrated approach, fundamental frequency of the ground, seismic bedrock, 1D and 2D seismic site response analysis, seismic microzonation guidelines.



Schematic model of the ground of the city of Lisbon: identification and integration of the fundamental geophysical and geotechnical parameters for seismic microzonation studies.

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