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SECTION DE GÉNIE CIVIL

Seismic vulnerability of existing structures –

Large scale assessment of Basel city

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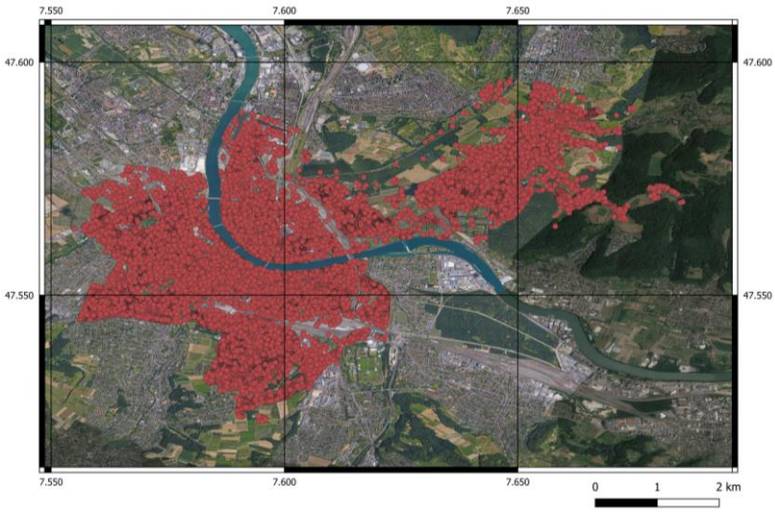
Abstract

The objective of this project is to study the seismic vulnerability of existing structures in Basel. In a large-scale assessment, it is not possible to analyze each building individually. Instead, each one of them is associated to a certain type to group them under similar mechanical behaviour. In the first part, this project focus on an advanced technique to determine the building type of the whole city of Basel which includes more than 30’000 buildings. By using data mining to have a list of features for the buildings and implementing a machine learning algorithm to interpret them, each building has a type attributed. A visual survey is also performed to validate the results from the machine learning method. To understand the taxonomy of buildings in Switzerland, the supervised algorithm called Random Forest (RF) was trained during another project with several Swiss cities such as Neuchatel, Yverdon-Les-Bains and Solothurn.

Survey

To perform the survey, around 10% of the building stock (2712 buildings) was studied. The recorded building types were reinforced concrete structures with shear walls (RCW: 14,01%), stone masonry structures (M3: 48,71% and M4: 1,55%) and unreinforced masonry structures (M5: 5,54% and M6: 30,12%).



QGIS map – Whole city distribution of Basel for analysis

Typical types of buildings in Basel

Damage assessment

Two methods were used to study the seismic behaviour of the city and the predicted damage grade.
First, the software OpenQuake was used with the 1356 historical seismic event (return period of 1’500 to 2’500 years). With this hazard, the exposure model resulting from the survey analysis and the fragility curves developed in a previous study of the EESD lab, the damage grade of each building was assessed.
The second method was the computation of the performance point of each building with its related response spectrum according to the microzonation. In Basel, there is 4 zones and 4 subzones that establish 8 response spectrum for the different part of the city. They are also developed for seismic hazards according to the Swiss code (earthquakes with a return period of 475 years). The computation is then carried out with the parameters of the building types. To be accurate, the optimization of the N2 method was also implemented for buildings with low periods to avoid overestimating the damage grade when the reduction factor is low or underestimating the damage grade when the reduction factor is high.

Conclusion

Both methods used in the damage assessment give the tools to predict the behaviour of the city under seismic hazard with different scale of magnitude. This is essential for the city to plan retrofitting of certain building type if needed or to organize beforehand the safety procedures.