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# Seismic vulnerability assessment at large scale - Case study: the canton of Basel-Stadt

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## Motivation

In Switzerland earthquakes are considered as the country's greatest natural hazards. This is mainly due to the country high potential of damage. Indeed, around 90 percent of structures in Switzerland have not been design with seismic safety regulation at all, or if they were, these are out of date. The Basel area, due to its relatively high seismicity and its high density of buildings, industrial plants and engineering works, belongs to the zone of highest seismic risk in Switzerland. There is thus a need to assess the seismic vulnerability of the whole building stock which can serve as a basis for seismic risk motivation program.

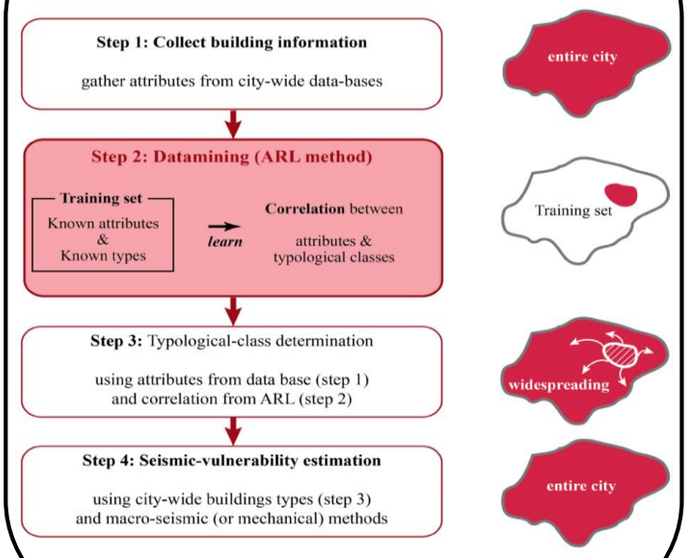
## Challenge

Due to the very large number of buildings and the lack of data, an exhaustive seismic study of each buildings would be very expensive and time consuming. For seismic vulnerability assessment at large scale, a solution is to classify buildings into structural types representing their seismic behavior and using simplified model to establish a correlation between seismic hazard and damage.

## Methods and parameters

- Three attributes were considered for establishing correlation with structural type: construction period, number of story and roof shape
- Two classification were used: one developed for the European building stock and another with new types that take into account swiss specificities.
- Two type of method have been applied for the vulnerability assessment:
  - an empirical method (LM1) based on visual observation from previous earthquake. This method use macroseismic intensities and vulnerability indexes to estimate the damage.
  - A mechanical method (LM2) based on simple modeling of the structure seismic behavior. This method require response spectra from microzoning study and capacity curves from pushover analysis.
- For mechanical method, the N2 method is used for the determination of the performance point and thus the damage. An optimization of the N2 method, which is more accurate compared to a non linear time history analysis is considered.

## Methodology




## Results

- Due to a combination of high seismic hazard and a high density of vulnerable buildings, the historic city center is the most vulnerable area.
- Globally, the canton of Basel-Stadt is not vulnerable to a design earthquake which generates slight to moderate damage.
- According to mechanical methods, Swiss types are more vulnerable than the European type they replace
- LM2 N2 gives more pessimistic results than LM1
- N2 optimized method leads to more optimistic results than the original N2 method
- The seismic risk cannot be directly deduced from the seismic vulnerability maps because they do not take into account the exposure of people and goods