# European Project Semester

## *PROJECT OUTLINE*

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| **Project dates:** March – June 2021 | |
| **Title:** Mapping the vulnerability of an urban area to seismic risk | |
| **Project activity areas:** risk assessment, civil protection, cartography | **Keywords:** maps, earthquake, vulnerability, exposure, risk, threat |
| **Tutor's name and coordinates**<br>Client : François Pérès – End-user: Regional Departmental Directorate<br>ENIT Technical Supervisor + contact: François Pérès | **Project origin**<br>Past PhD projects and Local authorities requirements |

## Project technical background:

The work will aim to map the vulnerability of an urban area through a multi-criteria analysis carried out at the scale of an agglomeration. Two complementary aspects will be addressed considering, in complementary approaches, the component level characterized by a building and the system level represented by an urbanized territory (district or municipality).

## Studied topics:

### Component level

In our region, and more particularly in mountainous areas located in seismic risk zones, there are two main types of buildings:

- the rather modern reinforced concrete buildings, built after the Second World War, which are mostly located on the outskirts of towns and villages ;
- masonry buildings, built with old materials (bricks, stone, pebbles), which are more generally found in historic urban centres.

The first stage of the study will seek to estimate the seismic vulnerability of individual buildings. Several criteria will have to be taken into account, distinguishing in particular, in a non-exhaustive list, their construction methods, age, architectural characteristics, positioning in relation to the seismic zoning. This study will make it possible to define classes of buildings and associate them with a criticality level on a scale that will itself be established in the framework of this work.

### System level

The analysis of the vulnerability of individual buildings will be complemented by a study of the indirect vulnerability of populations on the scale of a defined urban area. Here again, two types of analysis will be carried out for the definition of criteria at the system level:

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- Initially, it will be necessary to establish values in terms of the stakes linked, on the one hand, to the very function of the infrastructures affected (in particular in terms of public buildings, hospitals, emergency services, municipal services, etc.), to the population densities likely to be affected depending on the time of day of the event or the date of its occurrence during the year, and on the other hand to the economic impact (industrial activities, tourism) resulting from the disaster in the medium or long term.

- Secondly, the work will focus on the consequences on the populations, not directly affected by the disaster, of the disorganization induced by the occurrence of the earthquake and, in particular, the disruption of networks. Isolation from the flows normally passing through identified channels (food, energy, care, information) can very quickly constitute a phenomenon that aggravates and amplifies the loss of human life if it is not anticipated. A network is defined as a set of interconnected entities facilitating the transit of goods (food, medicines, clothing, blankets, etc.), equipment (tools, clearing machines, health infrastructures, etc.), services (healthcare, electricity, etc.) or useful information (telephone, internet). The multi-criteria analysis will integrate the vulnerability of the networks to earthquakes as complementary criteria to the risk mapping.

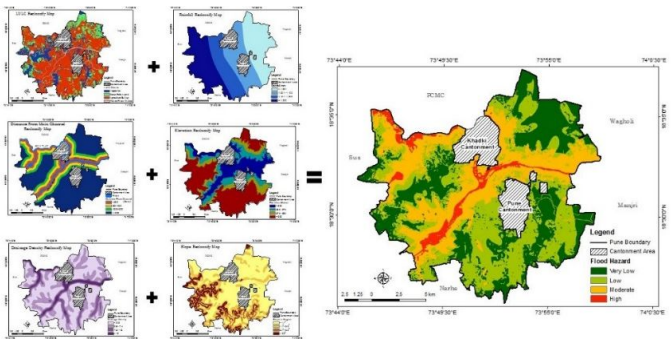
**Synthesis**

All the developments can be the subject of a graphic synthesis by Mapping techniques based on the use of dedicated software for the characterization of the dynamic criticality of the induced risks (by superimposing layers) and possibly the search for measures to safeguard the stakes (populations, services, infrastructures, etc.).

The first two parts related to the identification of component and level vulnerability factors have already been studied but will need to be completed. The work of the group will be then oriented towards:

- the analysis of the multi-criteria methodology to combine the different vulnerability criteria
- programming of maps for dynamic visualization of vulnerability levels

Minimal programming skills would be appreciated to carry out this project.



*Example of geographic risk mapping*