

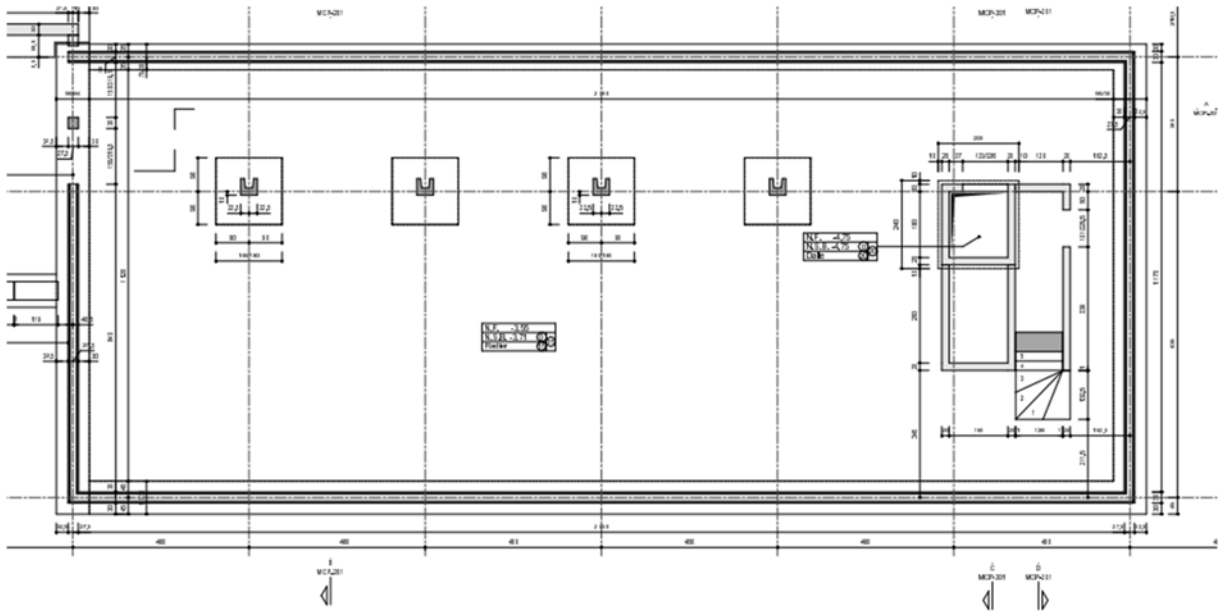
Paraseismic verification of a building according to Eurocode 8

Make the seismic verification of the new building of the sport center located in Liege according to the Eurocode EN 1998-1

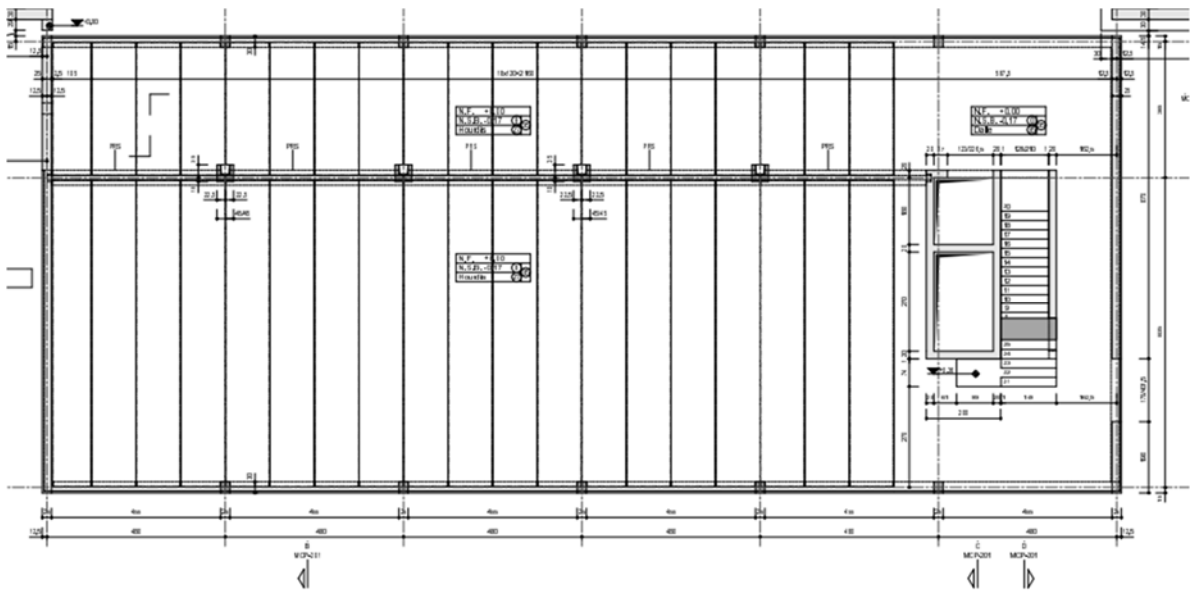
The building characteristics are:

- Rectangular building of dimensions 34 X 13 m
- 1 ground level + 1 level and an underground level → 3 levels
- Columns and central nucleus in concrete. All the other walls are in masonry except the underground walls which are in concrete
- The slabs are in concrete
- The building is in Liege with a soil class C according to EN 1998-1
- The building is an office building with meeting rooms
- Concrete is C 30/37 with an instantaneous non cracked Young's modulus of 35 000 N/mm²
- The dead masses of the floor are 700 kg/m² and 600 kg/m² for the roof
- The live loads are 500 kg/m²
- The vertical component of the earthquake can be neglected
- The behaviour q factor is taken equal to 1.5

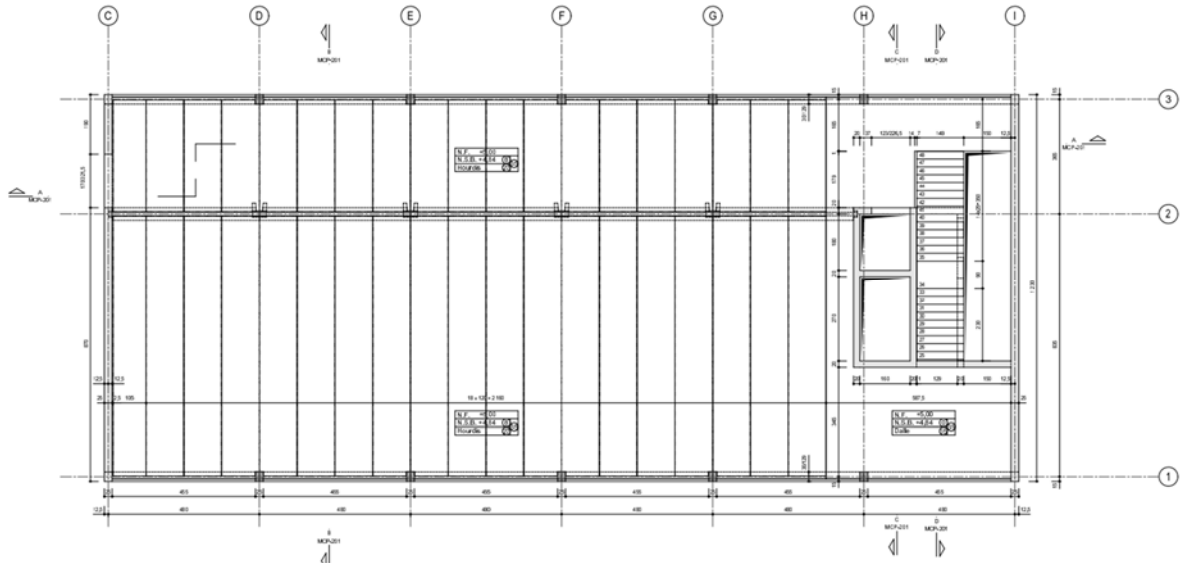
Views of the building are given in the next figures:



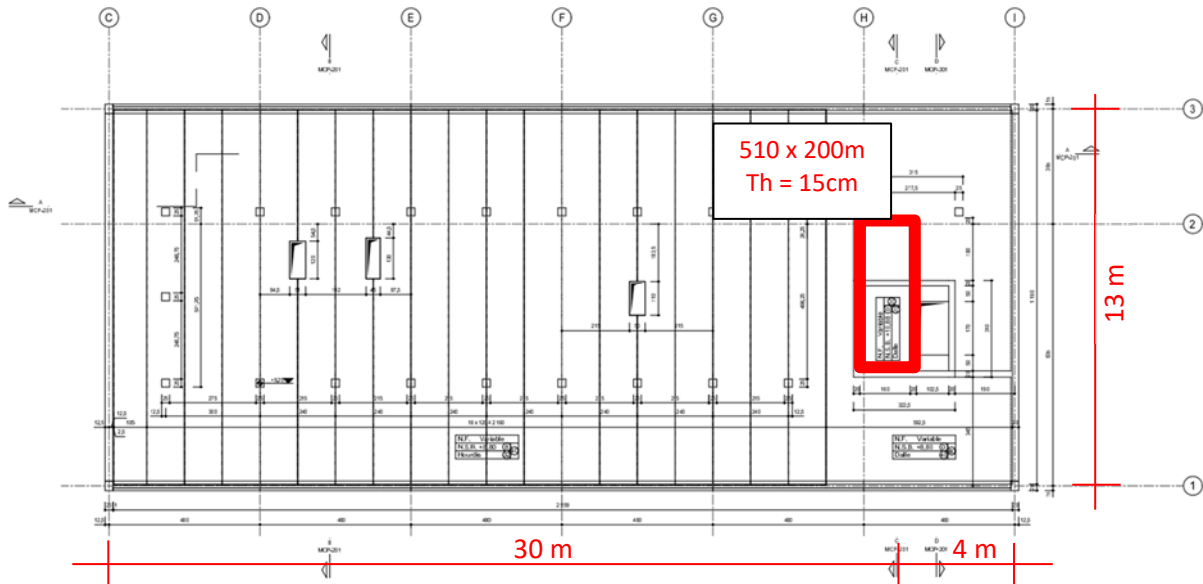
Plane view – underground



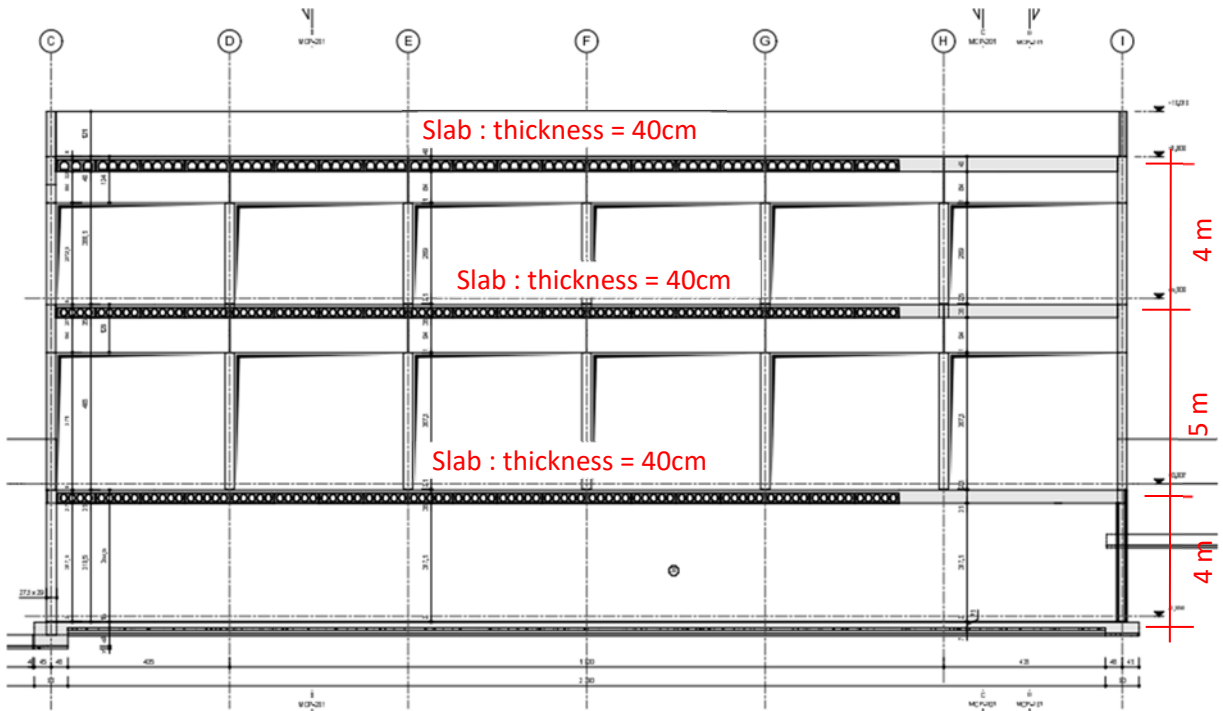
Plane view – level 0



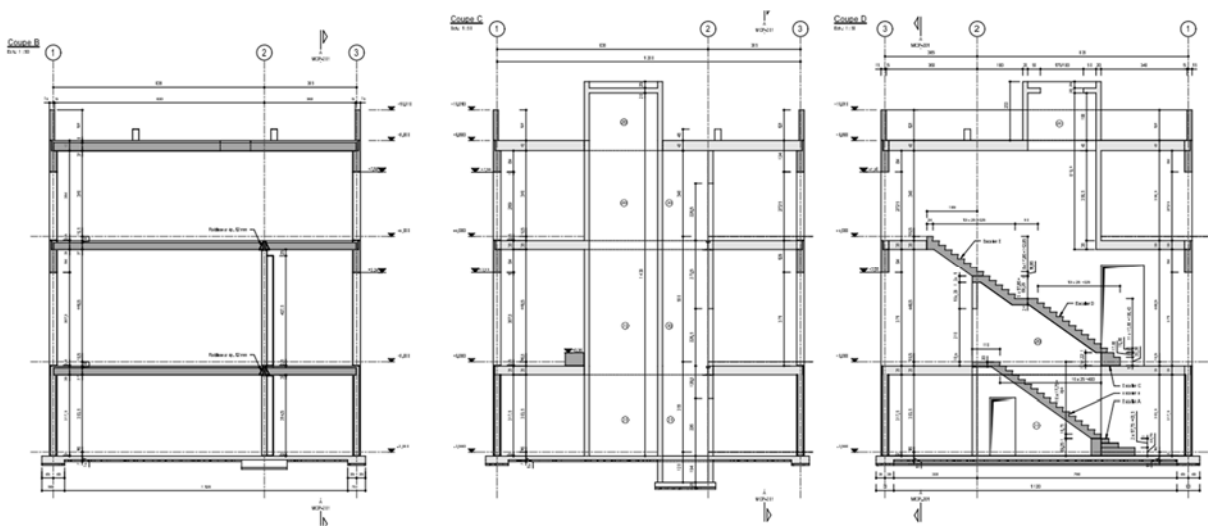
Plane view – level 1



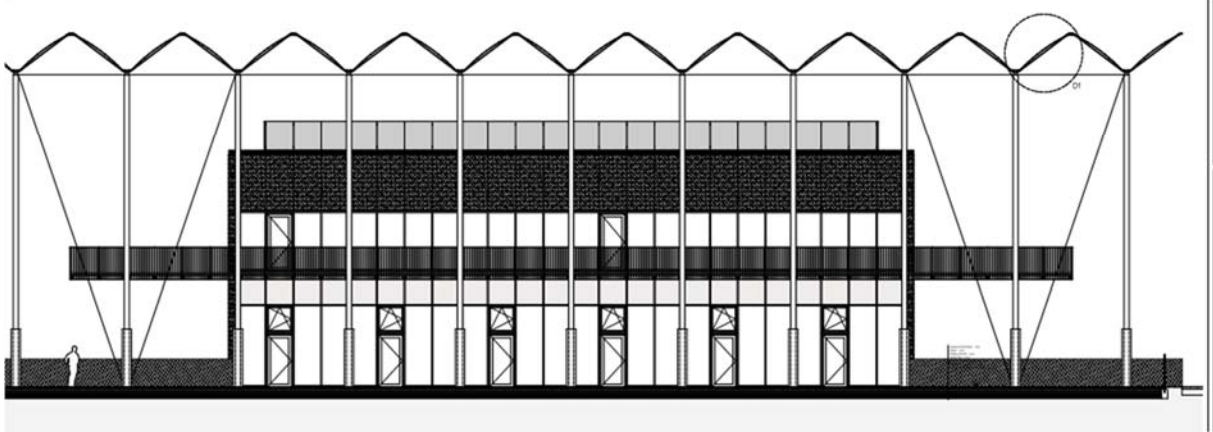
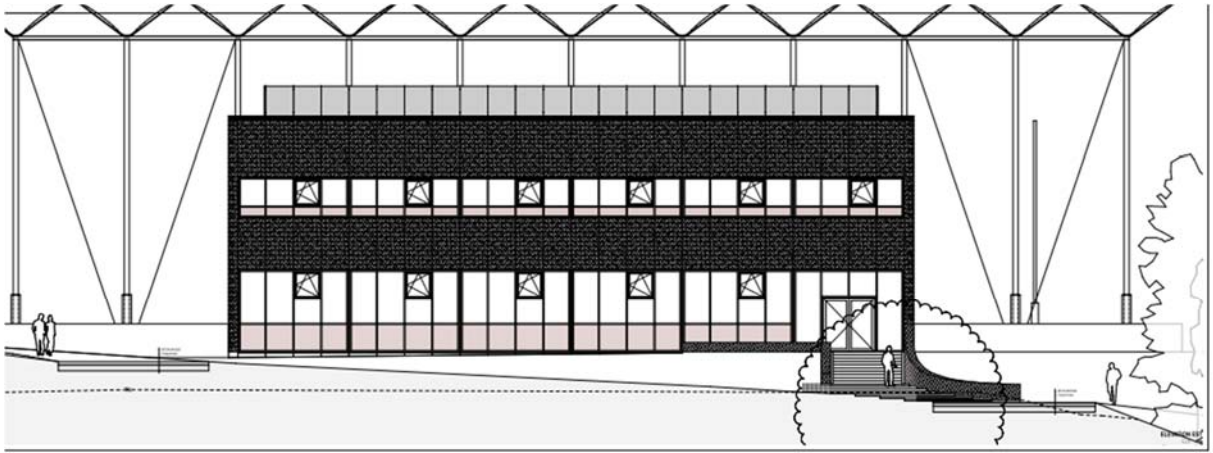
Plane view – roof



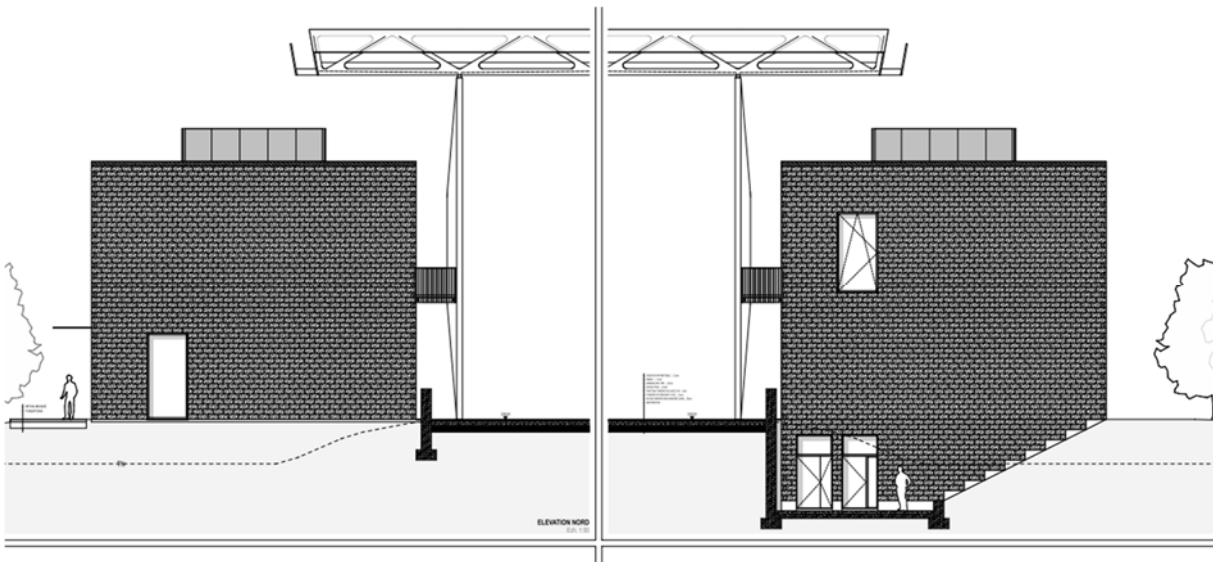
Elevation



Elevation



Façades



Façades

To make the paraseismic verification of the building, we ask you to:

1. Establish the static scheme of the structure
 - a. Simplify the structure to the lowest number of dofs possible to represent the dynamic behavior under earthquake. Use beam elements.
 - b. Make some modification to improve the torsion behavior
2. Frequencies and eigen modes
 - a. Establish and Compute the stiffness matrix of the system
 - b. Establish and Compute the mass matrix of the system
 - c. Compute the eigen modes and the frequencies
 - d. Draw the deformed shape of the first 2 modes (by hand sketch)
3. Modal properties
 - a. Compute the modal stiffness and mass of each mode
 - b. Compute the effective modal mass in both horizontal direction
 - c. Compute the modal share ratio for both horizontal direction
4. Paraseismic calculation
 - a. Establish the design acceleration spectrum according to EN 1998-1
 - b. Compute the response (displacements) of each mode in each direction
 - c. Compute the maximum response in each direction (SSRS) of the building top
 - d. Compute the support forces
 - e. Combine the support forces in the X and Y direction