

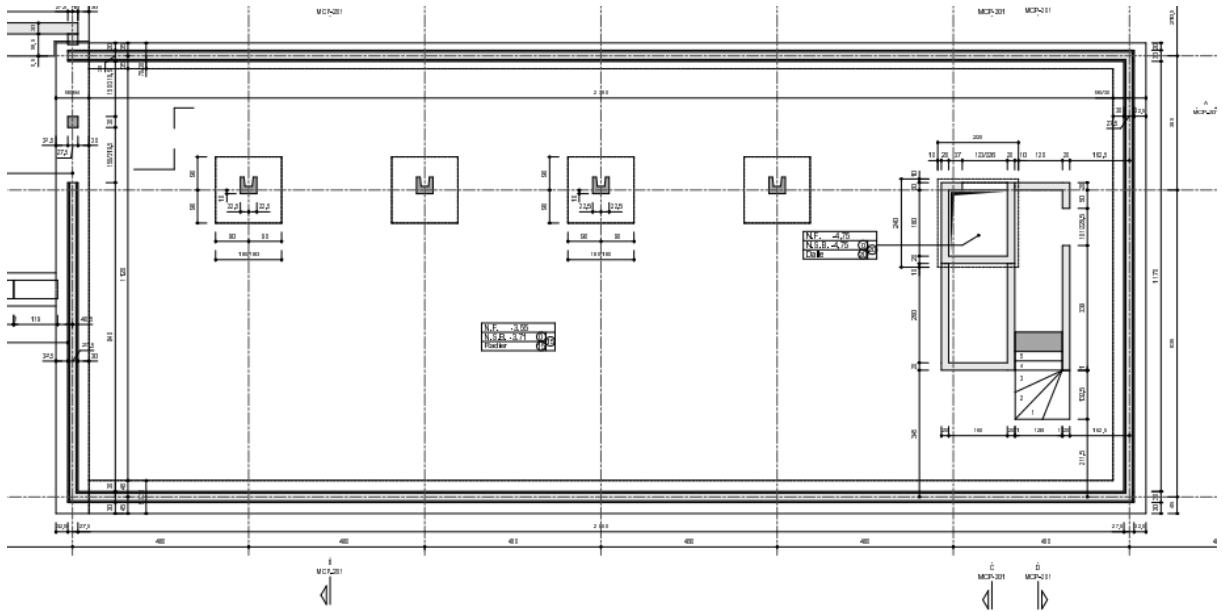
Sessions 3 – 4 : Parasismic verification of a building according to Eurocode 8

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

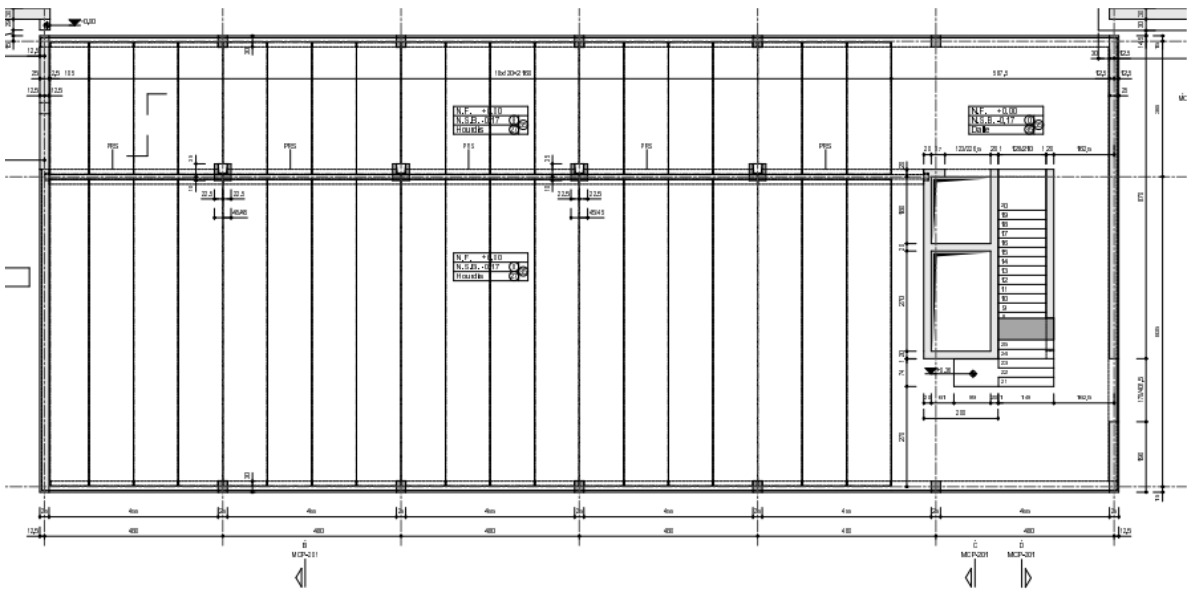
The building characteristics are:

- Rectangular building of dimensions 39 X 15 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 located 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 600 kg/m² and 500 kg/m² for the roof
- The live loads are 500 kg/m²
- The vertical component of the earthquake is not taken into account
- The behaviour q factor is taken equal to 1.5

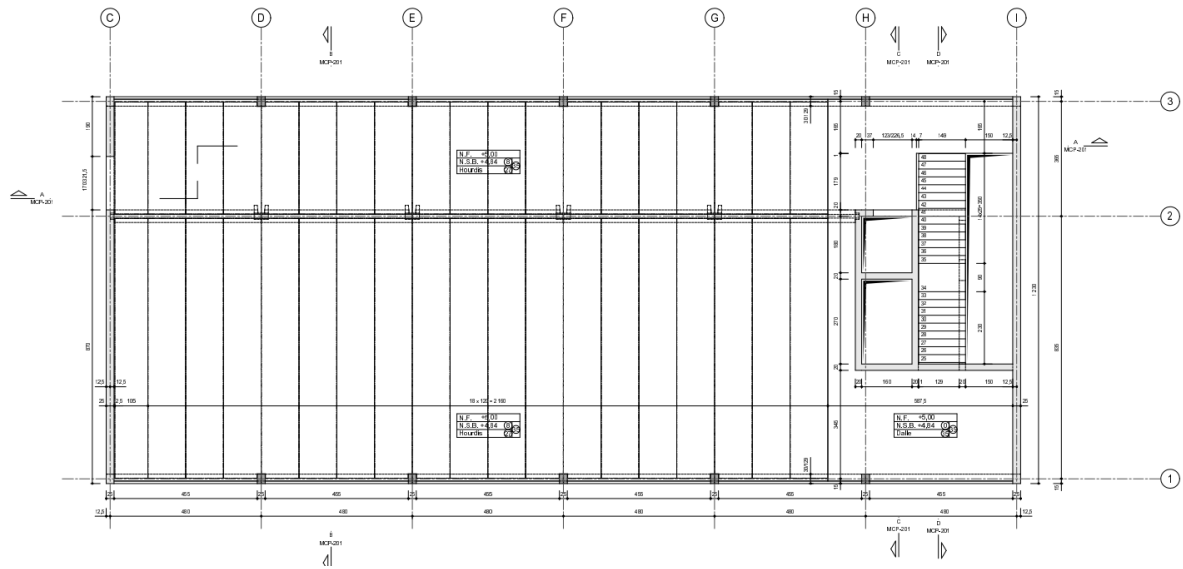
Views of the building are given in the next figures:



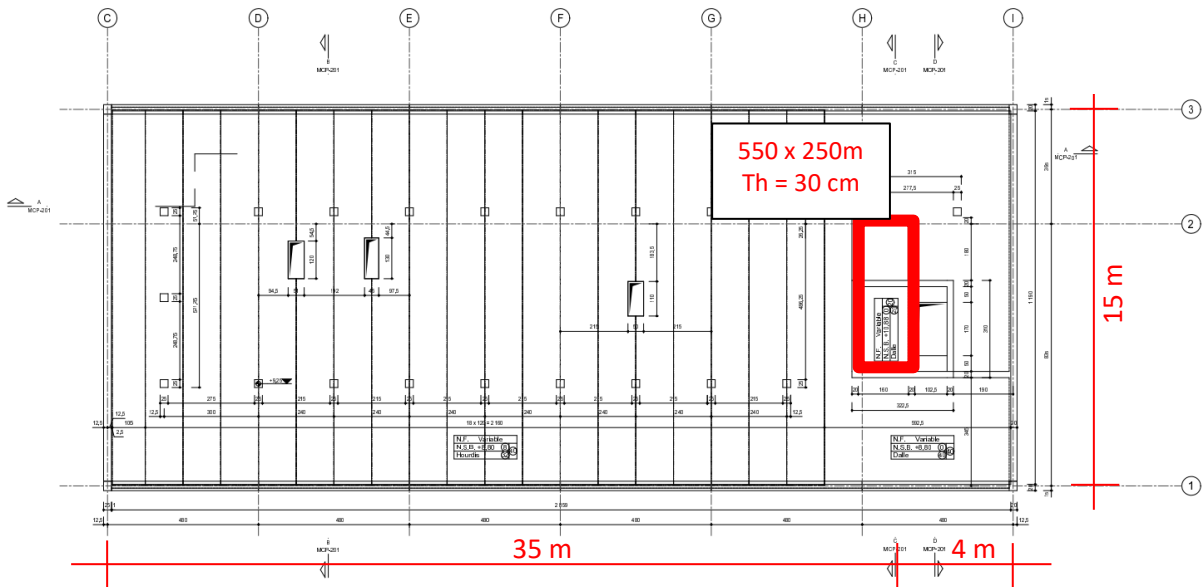
Plane view – underground



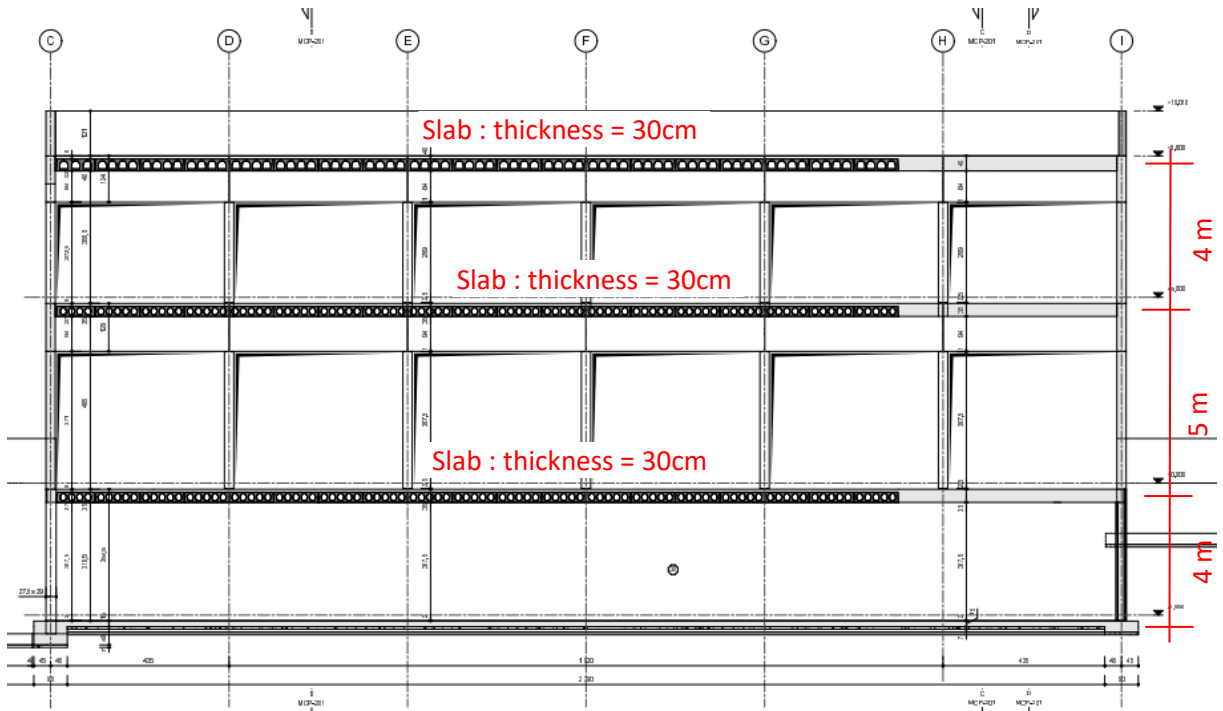
Plane view – level 0



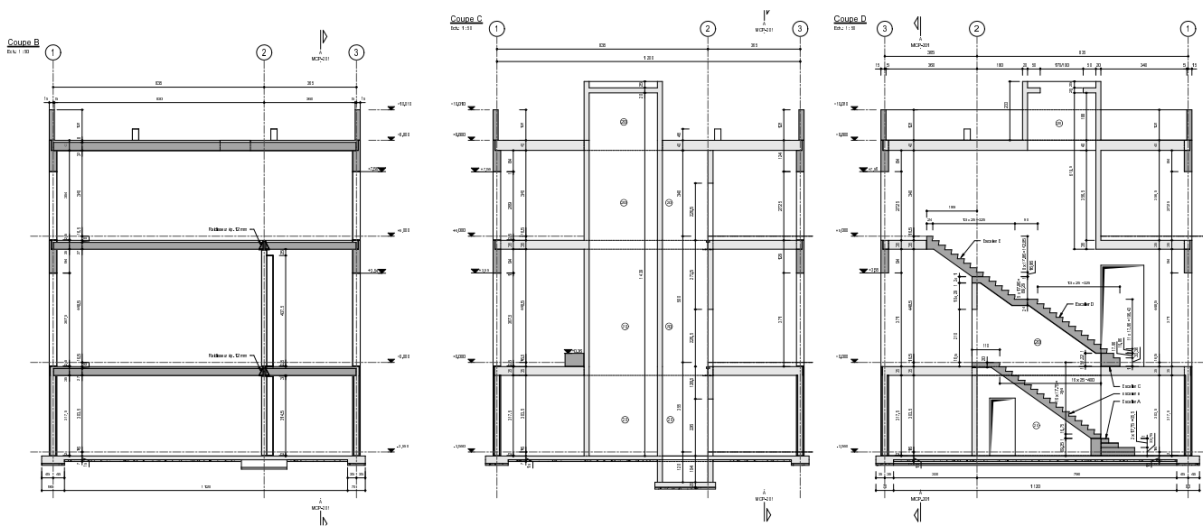
Plane view – level 1



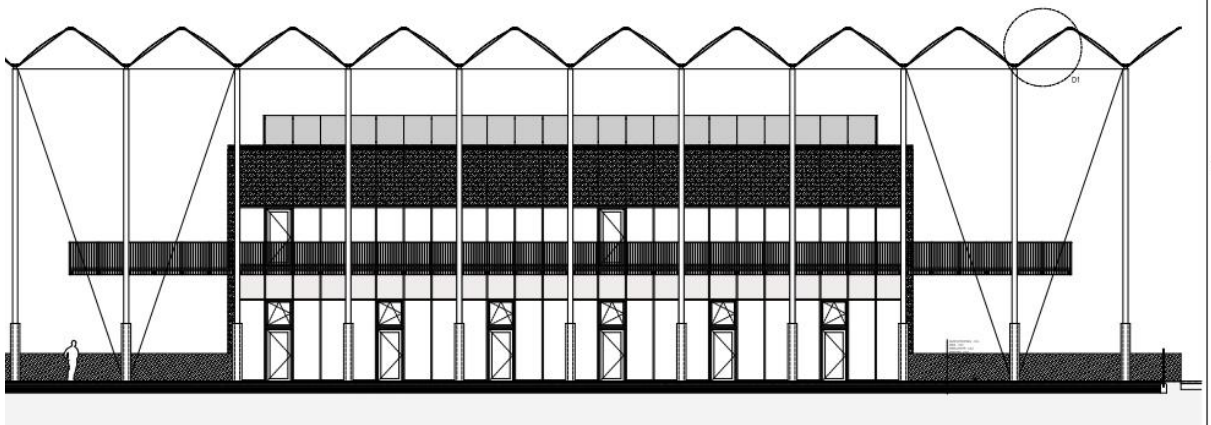
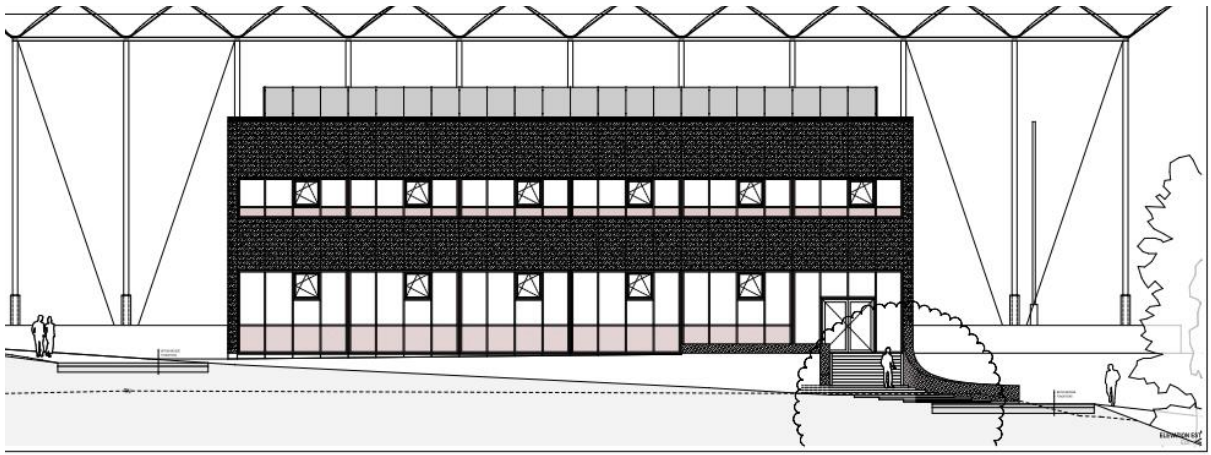
Plane view – roof



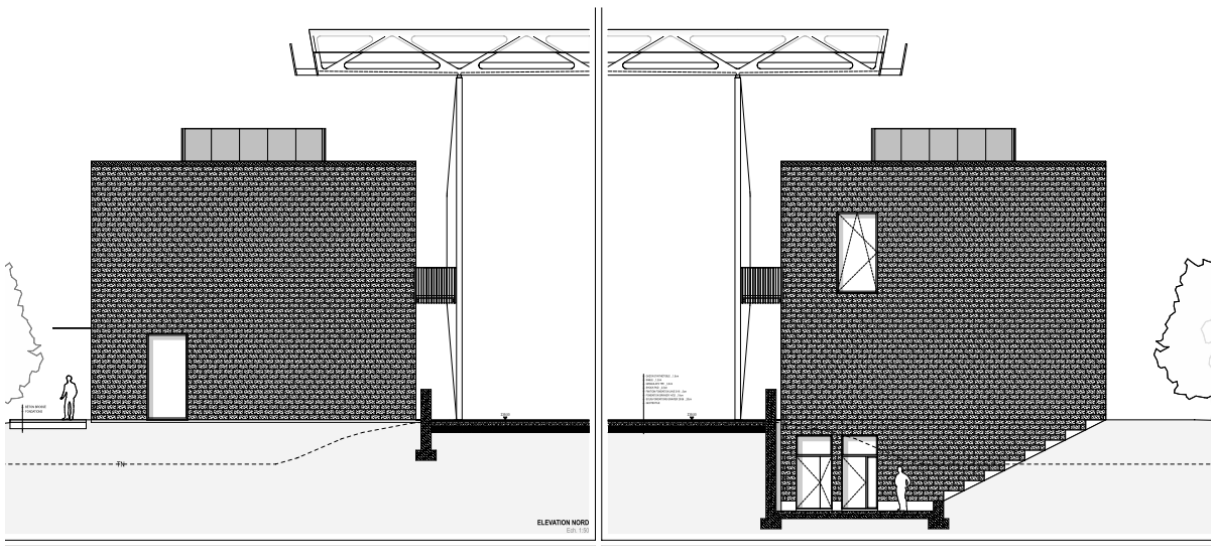
Elevation



Elevation



Façades



Façades

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

1. Establish the static scheme of the structure
 - a. Simplify the structure to focus on the horizontal behavior of the structure to represent the dynamic behavior under earthquake. Use beam elements.
 - b. Propose several (minimum 2) structure modifications to improve the torsion behavior
 - c. Make the next calculations (point 2 to 4) for the base solution and 2 variants
2. Frequencies and eigen modes
 - a. Make the modelization of the structure with MyFin. Use beam elements
 - b. Compute the first eigen modes and draw the first important eigen modes
 - c. Analyse the effects of the number of beams for the vertical columns, for the horizontal beams with MyFin
For the Octave calculations, keep the more simple model
 - d. Extract the stiffness and mass matrix of the system
 - e. Import the matrices in Octave (Matlab)
 - f. Compute the eigen modes and the frequencies
 - g. Compare with the MyFin solution
3. Modal properties
 - a. Compute the modal stiffness and modal mass of each mode
Modes normalized with maximum nodal displacement equal to 1
 - b. Compute the effective modal mass in both horizontal directions
 - c. Compute the modal share ratio for both horizontal directions
4. Parasismic 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 and CQC) of the building top
 - d. Compute the support forces (by modes, SRSS and CQC)
 - e. Combine the support forces in both horizontal directions
 - f. Compare the maximum displacements and reactions for the different variants