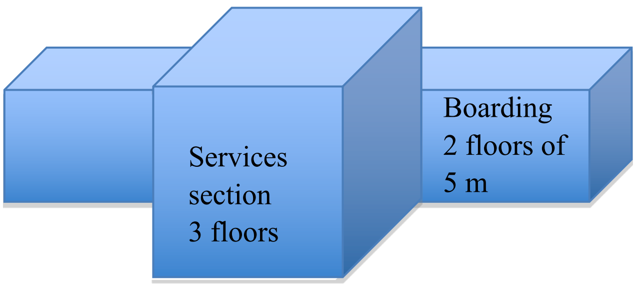
# EXERCISE BAT1: STABILISATION - SOLUTIONS

## Problem 1

Remember the shape of the building to be braced:



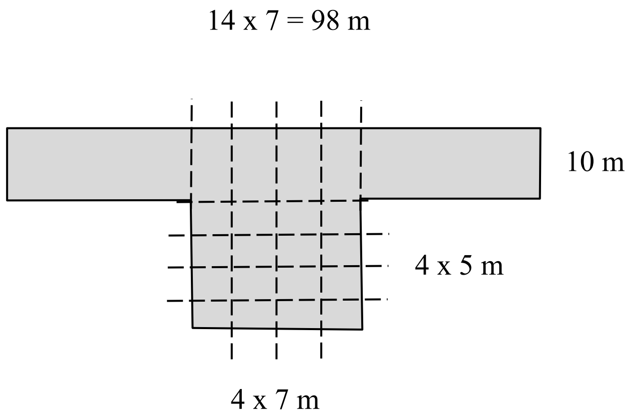
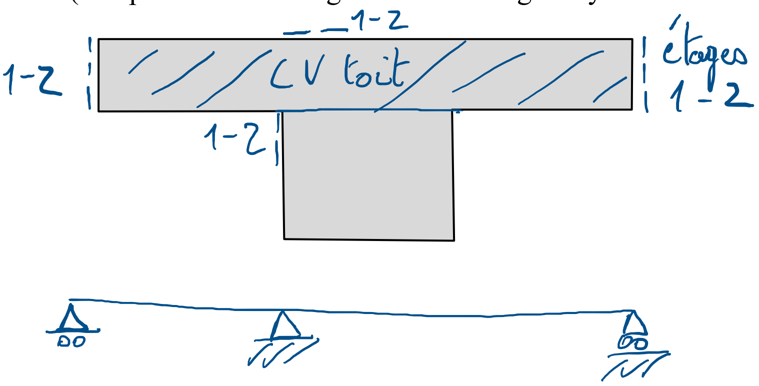
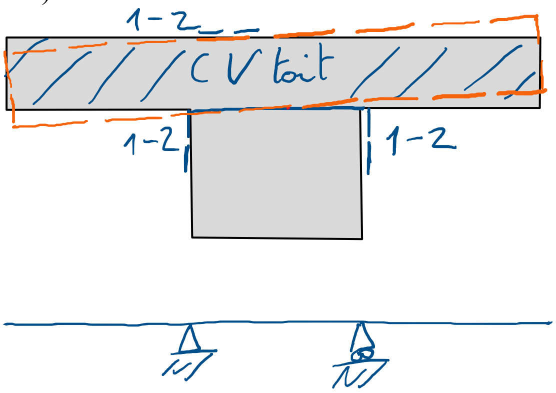



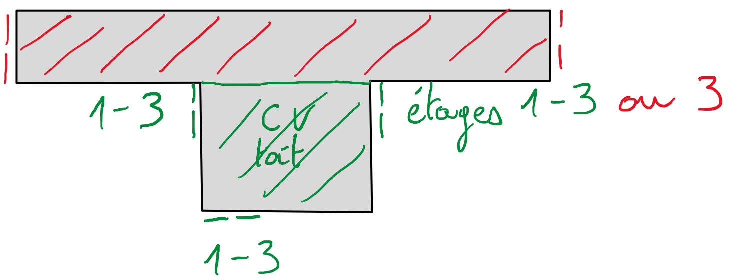

***Figure 1 -a)*** *3D view of the terminal volume.* ***b)*** *Plan view of a floor.*

Two solutions are proposed, but they are not the only ones possible. First, a few general thoughts. For vertical bracings, the boarding part has a very elongated geometry. The slenderness of this block is 98/10 = 9.8. So one cannot just put vertical longitudinal bracings at the end of this part, we also need to have a vertical ones on the facades of the services part, in order to have at least 3 vertical descents for the roof bracing (CV toit), see sketch. Vertical bracings at the end also make it possible to limit displacement/rotation of the boarding part (compared to installing vertical bracings only in the service area).

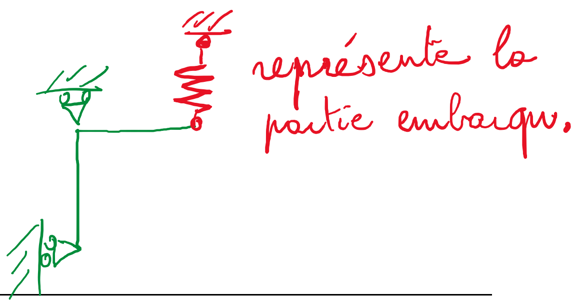



For the 3-storey services part, the vertical CVs must also prevent block rotation, particularly on the 3ème floor (min. 3 vertical descents). For floors 1 and 2, we can rely on the interaction between the 2 parts, shown in red (note that this does not comply with the design recommendations for earthquakes).







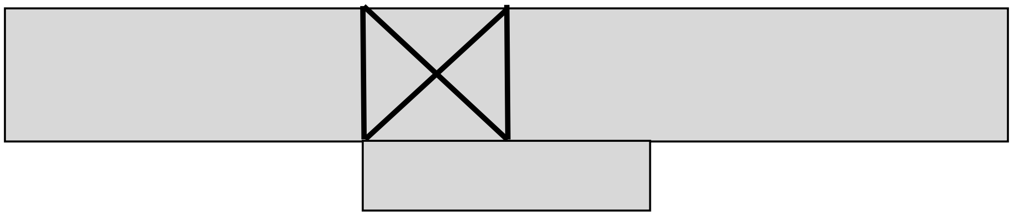
Following these considerations, we propose 2 possible solutions.

<u>1st solution:</u>

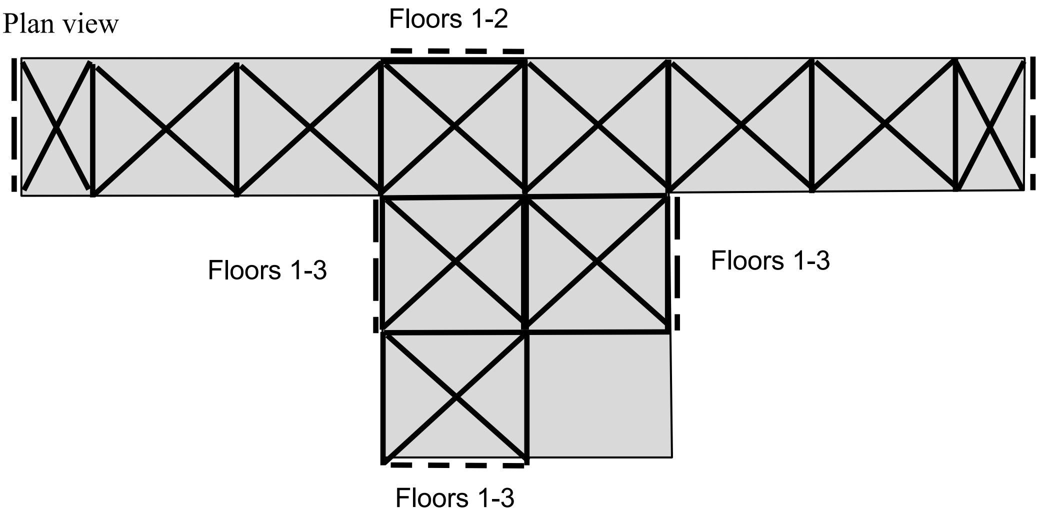
For roof-mounted CVs, 2 bays are used throughout, giving a maximum slenderness of 98/10 = 9.8 if only the ends are supported.

For the vertical CVs on the facade, we decided that the 2 parts should each be braced by 3 CVs (the minimum). As we have wide CVs on the roof, we take the same width, which gives very low slenderness, close to unity. This is very low, and therefore stiff, and can obstruct the view and the architecture, but does not pose structural design problems. We put 3-storey vertical CVs on each free face of the services part and against the boarding part in order to create direct supports for this part as well, and the last floor on the face of the boarding part (as seen above, we could have eliminated part of the CV on floors 1-2). Because of the angle of inclination of the bracing bars, on the faces with a 7 m grid size, a large cross is made on 2 levels. At the ends of the boarding part, on the other hand, we could envisage V- or X-shaped CVs on each floor.

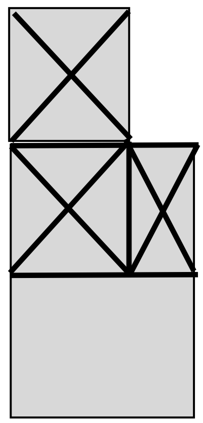
Elevation 1 :



Plan view




Elevation 2 :

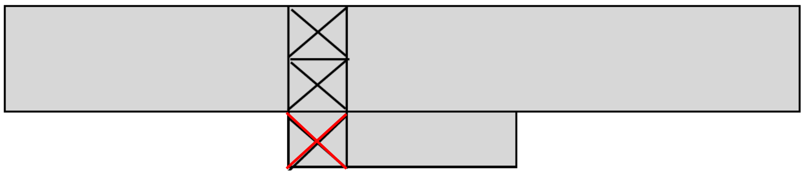


2nd solution :

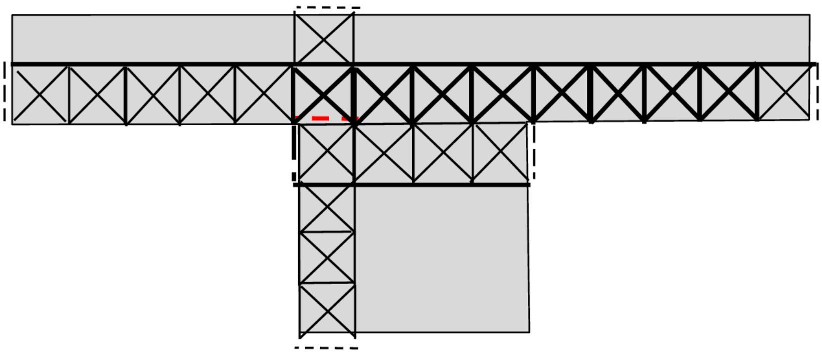
On the roof, the two sides of the services part (lattice girder on 4 supports) are taken from 1 single bay. The slenderness in the 3-storey section is 15/5 = 3.

The vertical CVs will also be made narrower. With regard to the wind acting on the long sides, this time we absolutely have to create a lattice girder on 4 supports for the boarding part (because if only on 3 supports the slenderness on the roof would be (28+35)/5 = 12.6, so too high, and too flexible). And in relation to the wind on the short facades, we put a first vertical bracing on the free face of the services part, a second on the other face, just for the 3rd floor, and the last on the face of the boarding part. The slenderness in the 3-stage part is 15/7 = 2.14. Note: the CV in red on the 3rd floor is not essential, but adds a link between the two building parts and makes the whole more rigid.

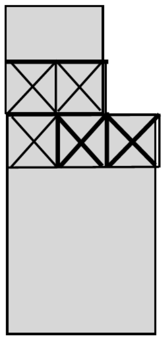
Elevation 1 :



Plan view

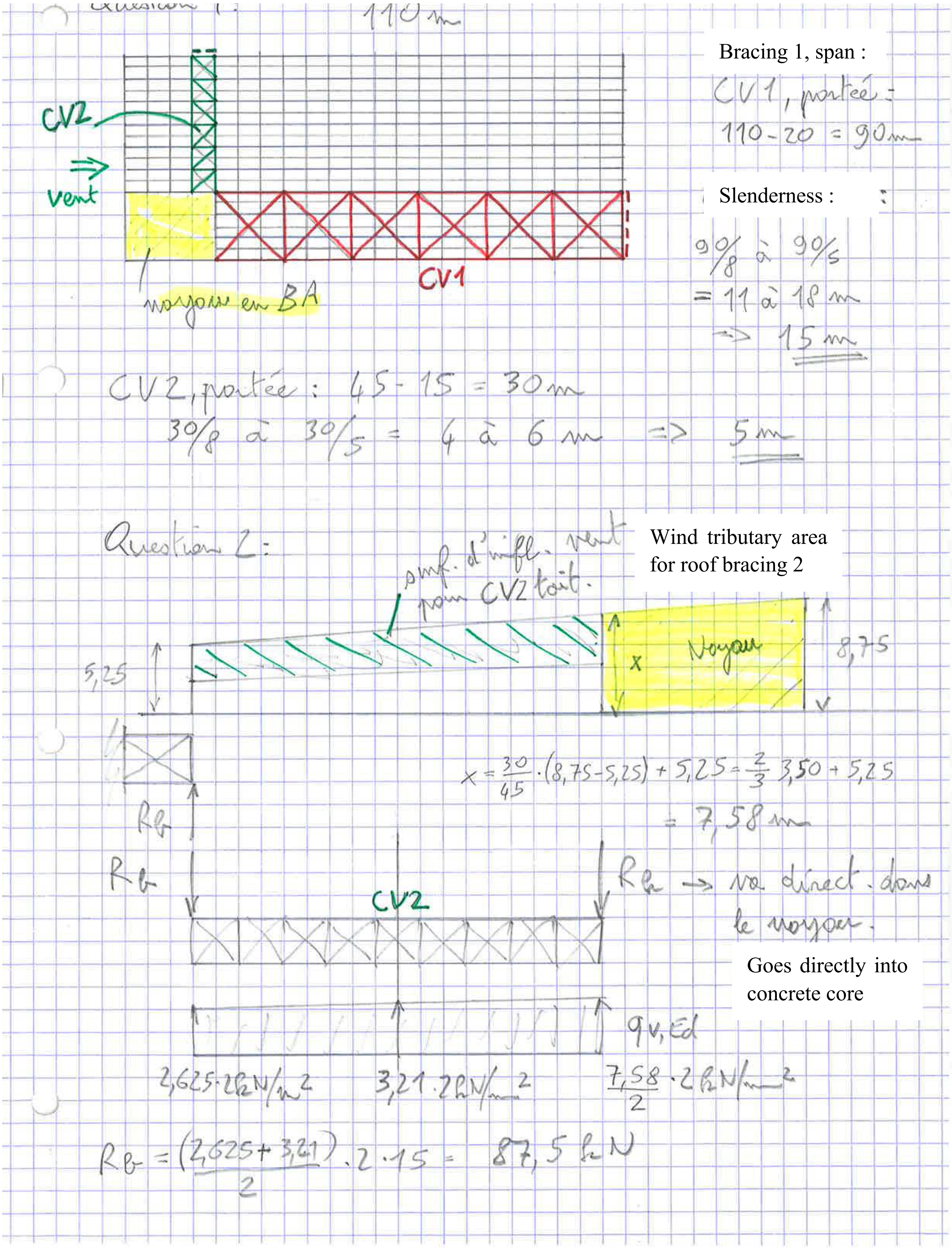


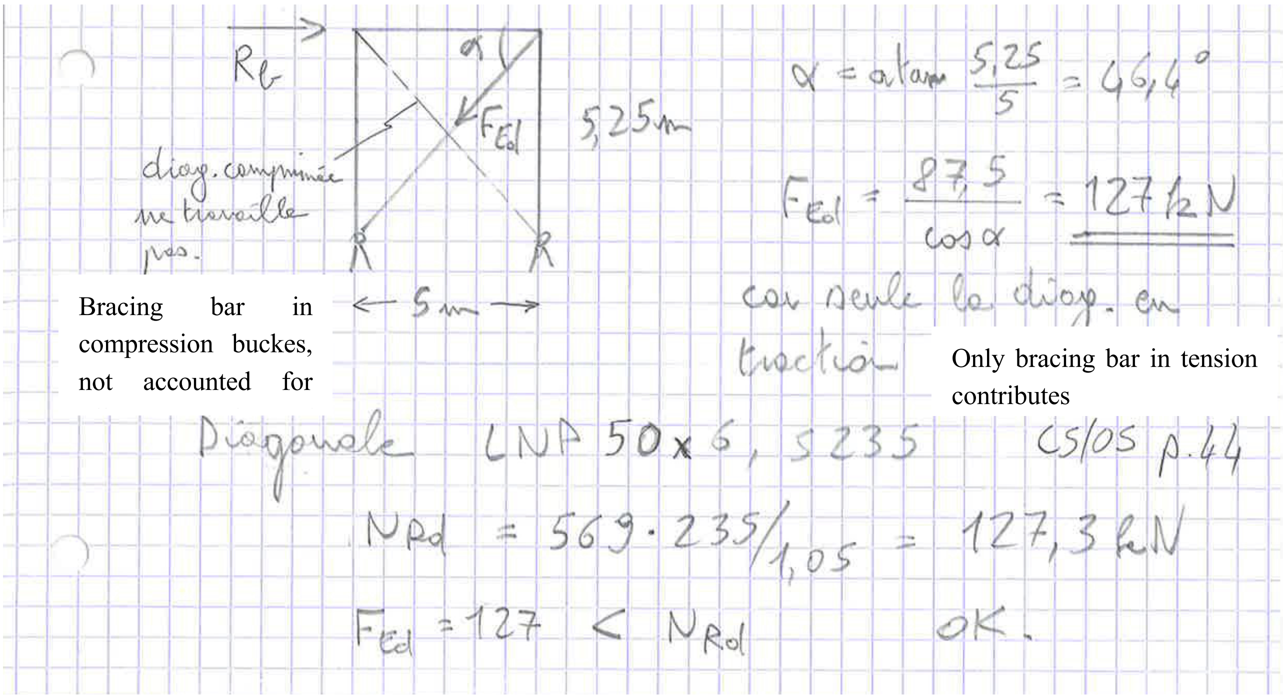
Elevation 2



# Problem 2

Question 1






## Problem 3

The internal forces on the inner column of level 1 are as follows :

$N_{Ed}$ = 3094 kN

$V_{Ed}$ = 0

$M_{Ed}$ = 0

The complete answer can be found in TGC 11, numerical example 13.8.1 (see also example 6.9.3 for information on determining actions and loads).