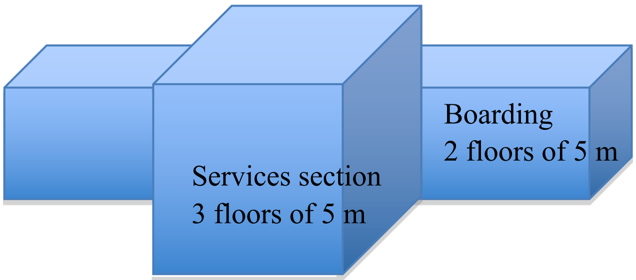
EXERCISE BAT1: STABILISATION - SOLUTIONS

Problem 1

Remember the shape of the building to be braced:



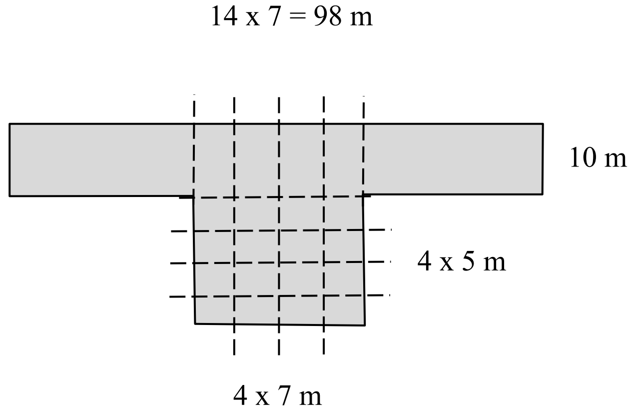
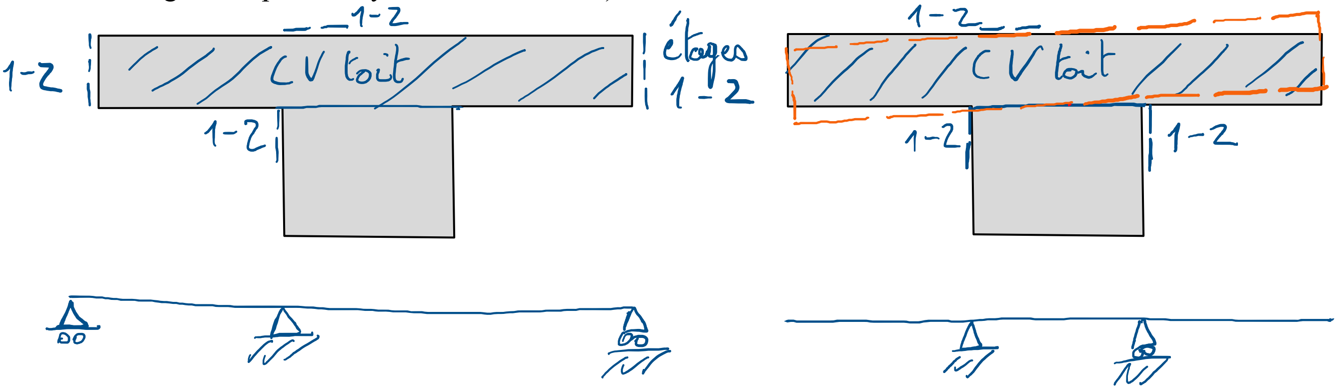
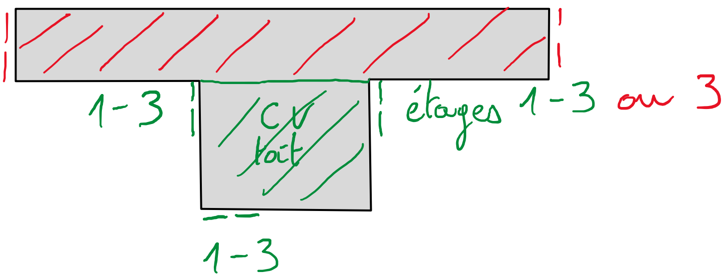


Figure 1 -a) *3D view of the terminal volume.* ***b)*** *Plan view of a floor.*

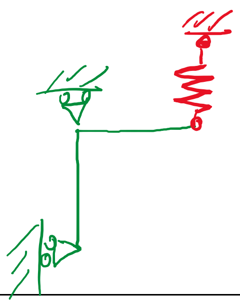
Two solutions are proposed, but they are not the only ones possible. First, a few general thoughts. For vertical CVs, the boarding section has a very elongated geometry. The slenderness of this block is 98/10 = 9.8. So we can't just put the vertical longitudinal CVs at the end of this section, we also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



For the 3-storey services section, the vertical CVs must also prevent rotation, particularly on the 3ème floor (min. 3 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).



Cas combin. des parties :



représente la partie embarqu.

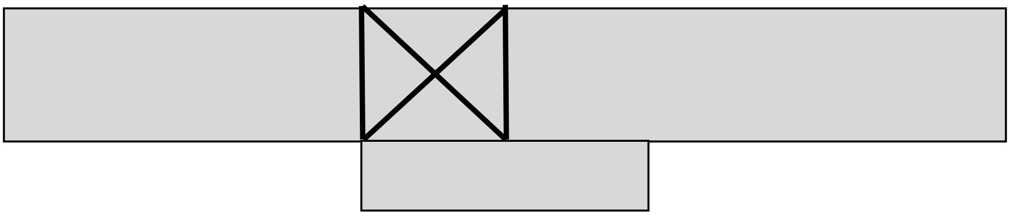
Following these considerations, we propose 2 possible solutions.

1ère solution:

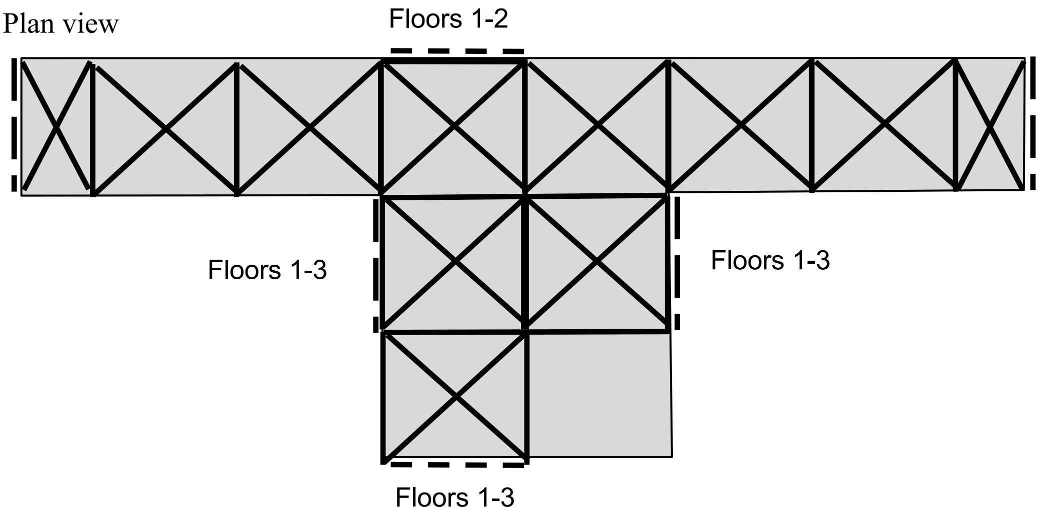
For roof-mounted CVs, 2 bays are used throughout, giving a maximum slenderness of 98/10 = 9.8 if only the ends are supported.

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 rigid, and can obstruct the view and the architecture, but does not pose any dimensional problems. We put a 3-storey companionway on each free face of the central section and against the boarding section in order to create direct supports for this section as well, and the last one on the face of the boarding section (as seen above, we could have eliminated part of the CV on floors 1-2). Because of the angle of inclination of the bars, on the faces with a 7 m grid, a large cross is made on 2 levels. At the ends of the boarding section, on the other hand, we could envisage V- or X-shaped CVs on each floor.

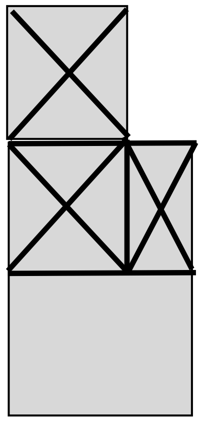
Elevation 1 :



Plan view



Elevation 2 :

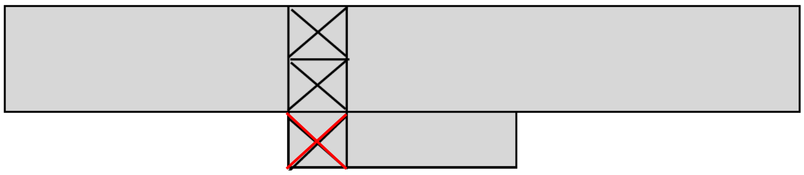


<u>$2^{\text{ème}}$ solution :</u>

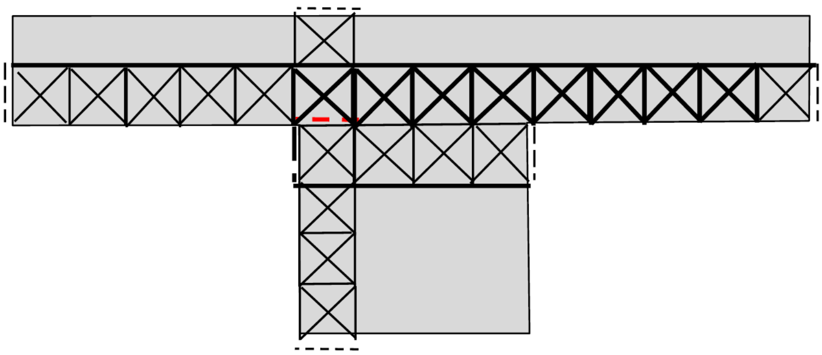
On the roof, the two sides of the services (lattice girder on 4 supports) are taken from 1 single bay. The slenderness in the 3-storey section is 15/5 = 3.

The vertical CVs will also be made narrower. With regard to the wind on the long sides, this time we absolutely have to create a lattice girder on 4 supports for the boarding part (because if uniqu. on 3 supports the slenderness on the roof would be (28+35)/5 = 12.6). And in relation to the wind on the gable facades, we put a downstand on the free face of the central part, the second on the other face, just for the $3^{\text{ème}}$ 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 $3^{\text{ème}}$ floor is not essential, but adds a link between the buildings and makes the whole more rigid.

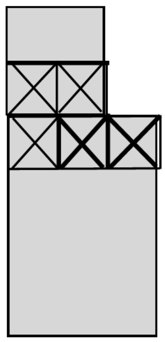
Elevation 1 :



Plan view



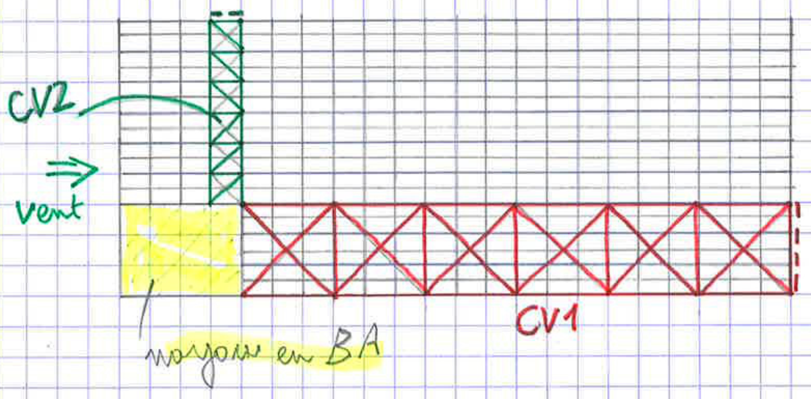
Elevation 2



Problem 2

Question 1 :

110 m



CV1, portée : 110 - 20 = 90 m

Élancement :

90/8 à 90/5

= 11 à 18 m

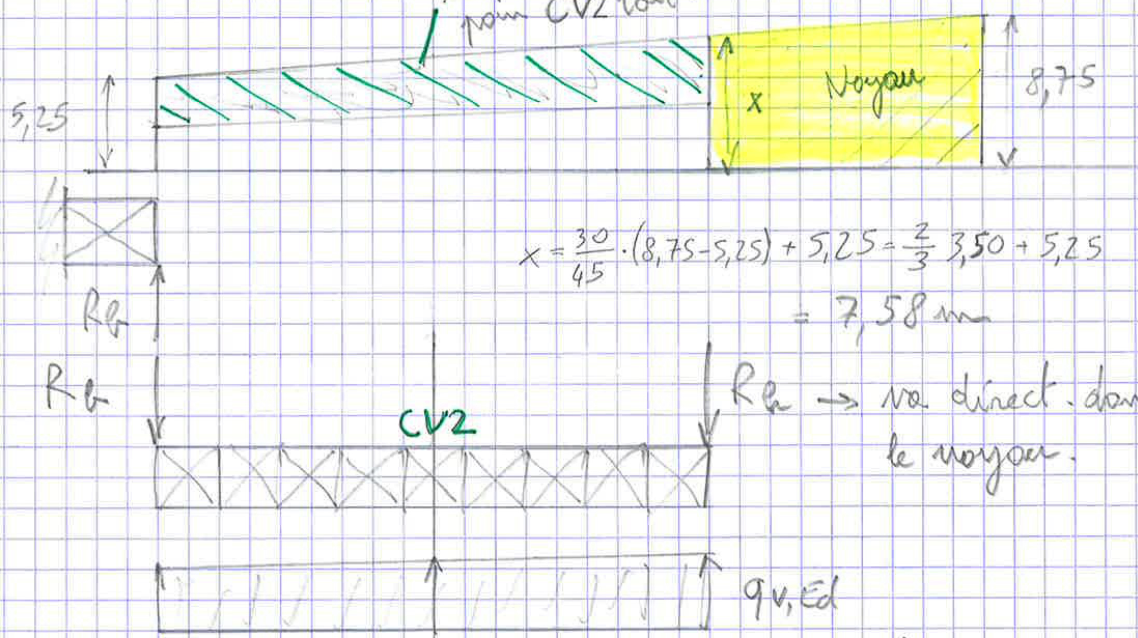
=> 15 m

CV2, portée : 45 - 15 = 30 m

30/8 à 30/5 = 4 à 6 m => 5 m

Question 2 :

surf. d'infl. vent pour CV2 toit.



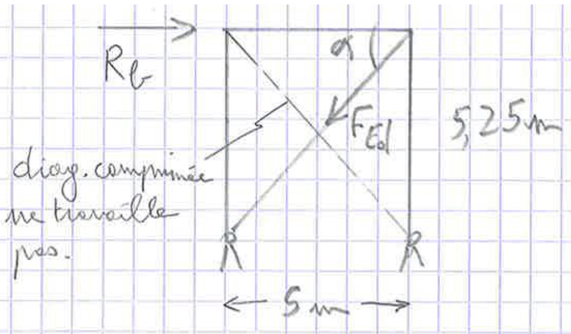
$x = \frac{30}{45} \cdot (8{,}75 - 5{,}25) + 5{,}25 = \frac{2}{3}\, 3{,}50 + 5{,}25$

$= 7{,}58$ m

R_B → va direct. dans le noyau.

$2{,}625 \cdot 2\,kN/m^2$ $\quad 3{,}21 \cdot 2\,kN/m^2$ $\quad \frac{7{,}58}{2} \cdot 2\,kN/m^2$

$R_B = \frac{(2{,}625 + 3{,}21)}{2} \cdot 2 \cdot 15 = 87{,}5\ kN$



$\alpha = \text{atan}\,\dfrac{5,25}{5} = 46,4^\circ$

$F_{Ed} = \dfrac{87,5}{\cos\alpha} = \underline{\underline{127\text{ kN}}}$

car seule la diag. en traction travaille.

Diagonale LNP 50x6, S235 C5/05 p.44

$N_{Rd} = 569 \cdot 235/1,05 = 127,3\text{ kN}$

$F_{Ed} = 127 < N_{Rd}$ OK.

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).