2.5 Exercise

The residential building of the sketch includes a basement of area $12\times18\ m^2$ and height $3\ m$, a ground floor and four storeys of identical dimensions and a top floor of area $4\times6\ m^2$ and height $2.5\ m$. The masses at levels 0, 1, 2, 3, 4 are equal to $M_G=220\ t$ and $M_Q=44\ t$, at level 5 to $M_G=180\ t$ and $M_Q=44\ t$, while at the top level to $M_G=20\ t$ and $M_Q=4\ t$. The building is situated in the seismic area Z_1 and the distribution of seismic accelerations is triangular. The design seismic acceleration-of magnitude $0.12g$ is applied at the center of mass of the building.

The calculation of the seismic and wind forces as well as a comparison between them is asked.

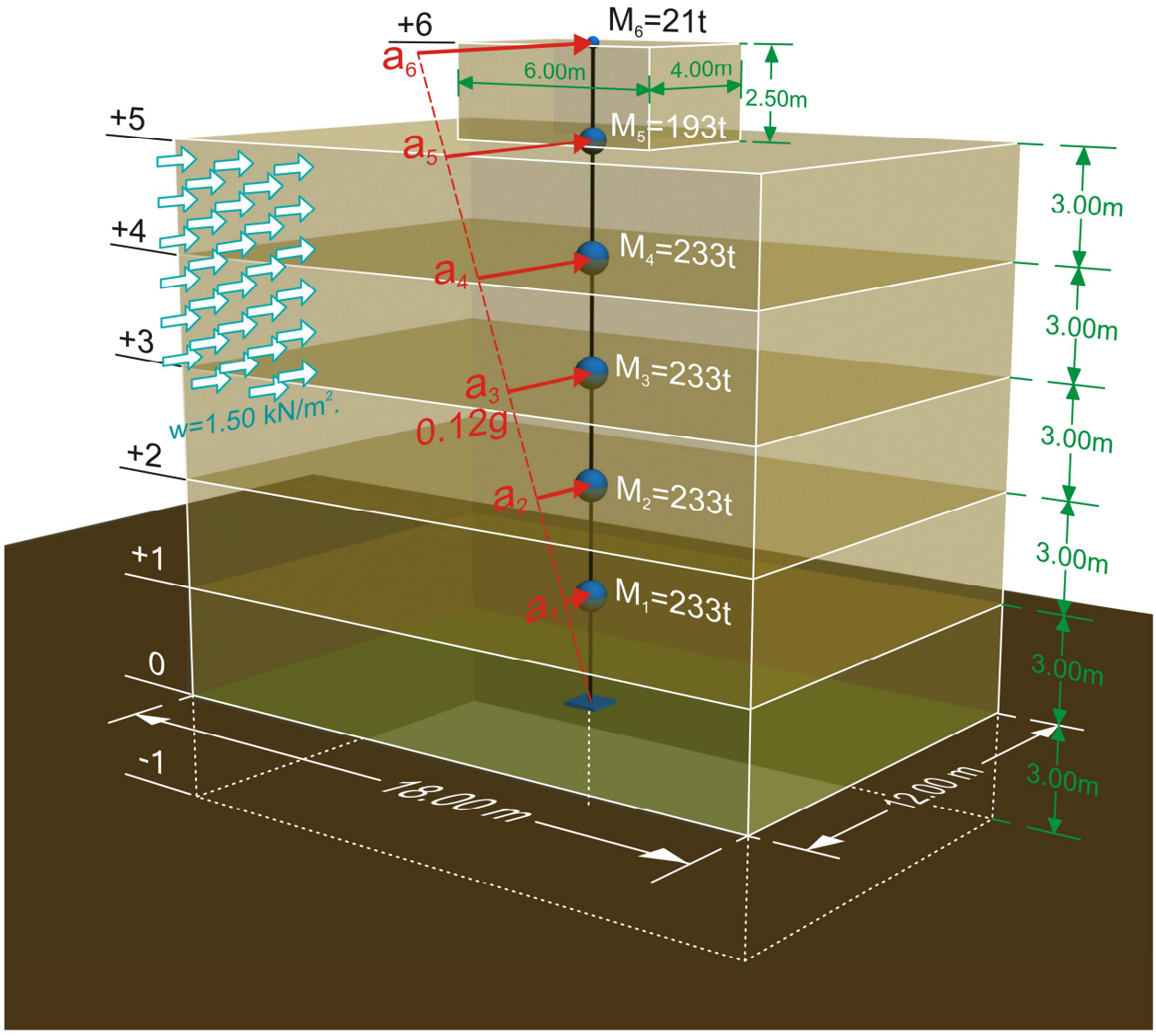

Figure 2.5-1: The geometrical and loading model of the building's wind and earthquake actions

$\boldsymbol{M_i}$ *[t]*: masses, $\boldsymbol{w}$ *[kN/m²]*: wind loads, $\boldsymbol{a_i}$ *[m/sec²]*: seismic accelerations

Since the building is residential $\psi_2=0.30$ and consequently during an earthquake the dynamic masses are evaluated as $M=M_G+0.30\cdot M_Q$. Thus, the dynamic masses at levels 0, 1, 2, 3 and 4 are equal to $M_{G+0.30Q,i=0\text{-}4}=220+0.30\times44=233\ t$, at level 5 is equal to $M_{G+0.30Q,5}=180+0.30\times44=193\ t$, while at the top level is equal $M_{G+0.30Q,6}=20+0.30\times4=21\ t$.

Figure 2.5-2: Wind forces F_w are less significant comparing to earthquake forces F_s.

W [kN]: gravity loads F_w [kN]: wind forces F_s [kN]: seismic forces

Assessment of seismic forces

The total mass of the building during earthquake is $M=4\times233+193+21=1146\ t$, while the CM (mass center) is located at distance z_o from the ground floor basis:

$$z_0=\frac{233\times3.0+233\times6.0+233\times9.0+233\times12.0+193\times15.0+21\times18.0}{1146}=\frac{10263tm}{1146t}=9.0\ m$$