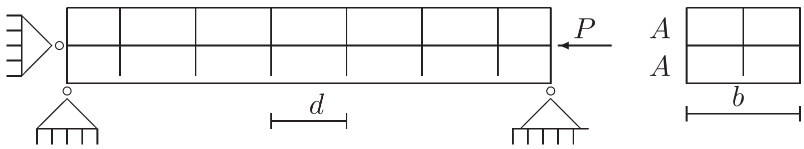
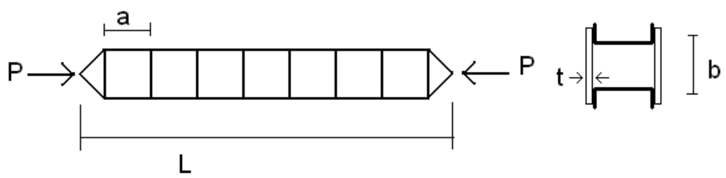
Stability of structures

7. exercise – effect of shear, batten columns

1. Determine the critical compressive force for a layered column composed by two timber beam nailed together. The distance between the nails is d, the width of the column b, total height $2h$ and length L. The Young's modulus of the wood (pine) is E_p, and for the steel nails E_n. The modulus of inertial of the nails is I_n.

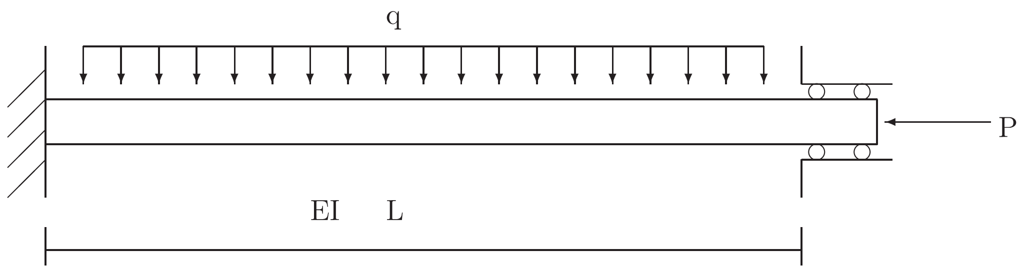


2. Determine the safety against buckling of a compressed, hinged build-up column. The compressive load is P= 80 MN. The material is steel Fe37 which have Young's modulus E = 210 GPa, Poisson's ratio ν = 0.3 and yield stress σ_y = 240 MPa.

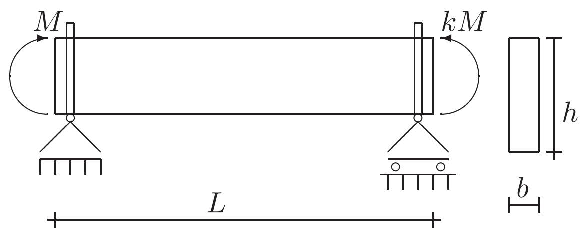


Home exercises 5 and 6

Home exercise 5. Determine the maximum defcetion and maximum monents at supports and in span as a function of the compressive force P for the beam shown below.



Home exercise 6. Determine the critical buckling moment in the form $M_{\text{cr}} = \lambda\sqrt{EI_yGI_t}/L$, where the parameter $\lambda = \lambda(k, h/L)$. Draw the critical load parameter λ as a function of k, when $k \in (-1, 1)$ and $L/h = 20, \nu = 0$. Use the principle of minimum potential energy or some other numerical method and use trigonometric trial functions.



The expression for the total potential energy is

$$\begin{aligned}\Pi &= \frac{1}{2}\int_0^L \left[GI_t(\varphi')^2 + EI_y(w'')^2 + 2(M_z^0\varphi)'w'\right] dx \\ &= \frac{1}{2}\int_0^L \left[GI_t(\varphi')^2 + EI_y(w'')^2 + 2(M_z^{0\prime}\varphi + \varphi' M_z^0)w'\right] dx.\end{aligned}$$