Please note that, this file is just an auxiliary material for reviewing this course, practices and thinking are still necessary to comprehend solid mechanics.

Please don't simply recite them, but try to understand the essence of each formula and think about in which case you can use it.

① axial load

normal stress: $\sigma_n = \dfrac{F}{A}$

normal strain: $\varepsilon_n = \dfrac{\Delta l}{l}$

axial deformation: $\delta = \dfrac{Fl}{EA}$

thermal deformation: $\delta_t = \Delta T \cdot \alpha \cdot l$

② torsion

polar moment of inertia $J = \begin{cases} \dfrac{\pi}{2} \cdot C^4, & \text{solid} \\ \dfrac{\pi}{2} (C_o^4 - C_i^4), & \text{hollow} \end{cases}$

shear stress under torsion: $\tau = \dfrac{T \cdot C}{J}$

twist angle: $\varphi = \dfrac{T \cdot l}{J \cdot G}$

③ analysis of beam

$\left\{ \begin{array}{l} \left. \begin{array}{l} \text{BMD} \\ \text{SFD} \end{array} \right\} \rightarrow \text{Pay attention to the sign of M\&Q} \\ \text{geometric properties: } I = \underset{\uparrow}{I_s} + Ad^2 \end{array} \right.$

about its self centroid axis

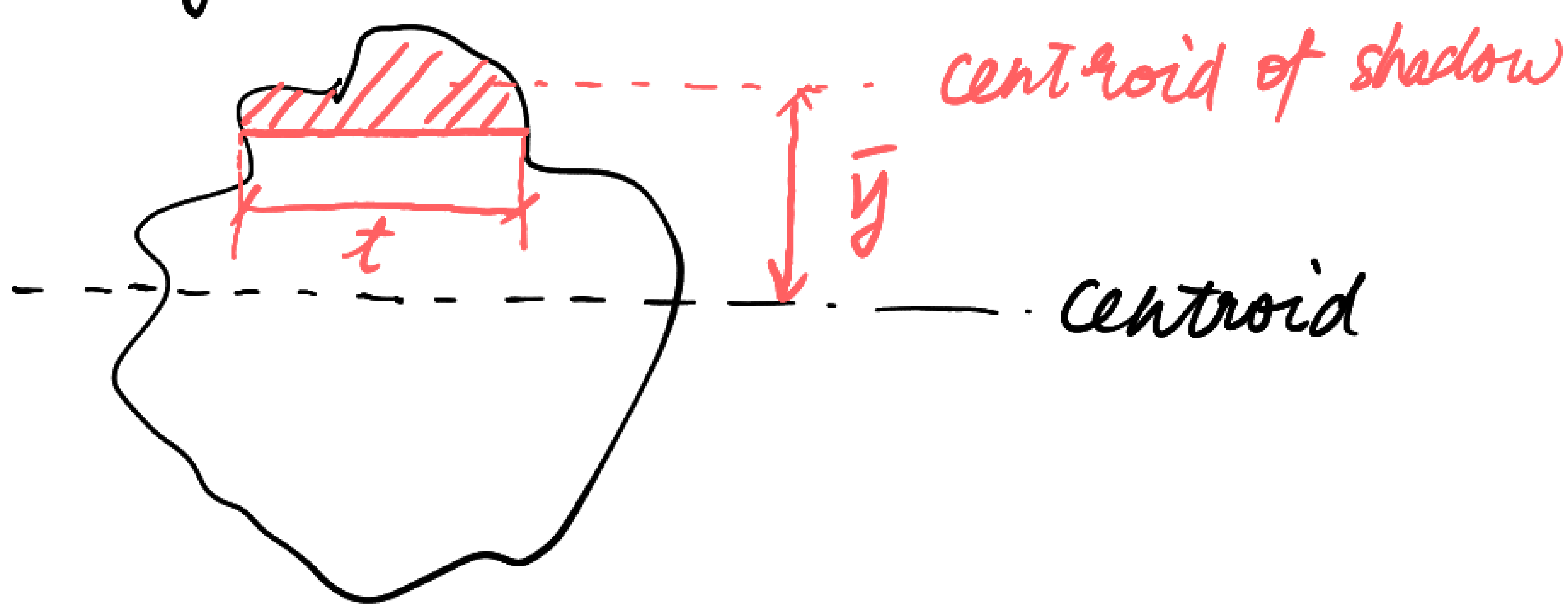
normal stress under bending moment:

$$\sigma_n = \frac{M}{I} \cdot y$$ (Pay attention to the value of y, depends on which stress you determine)

shear stress under shear force:

$$\tau = \frac{V \cdot Q}{I \cdot t}$$ (Pay attention to Q and t)

$Q = \bar{y} \cdot A'$



④ plane-stress transformation

pay attention to the sign of σ and τ

$$\sigma_{max,\,min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_x^2}$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_x^2}$$

$$\sigma_{ave} = \frac{\sigma_x + \sigma_y}{2}$$

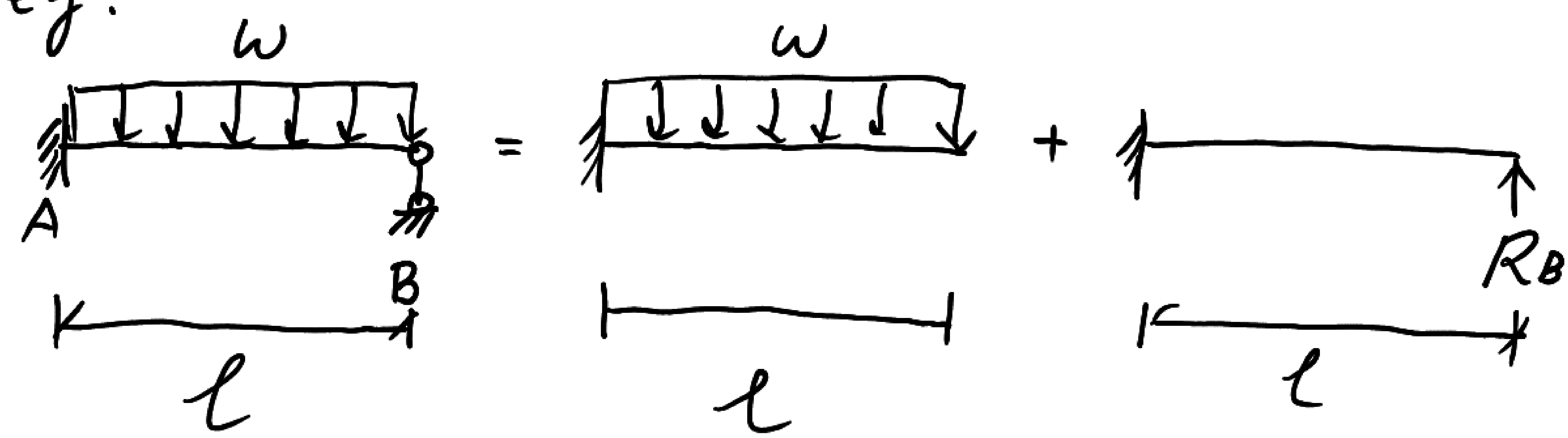
⑤ deflection of beam & statically indeterminate beam

$$M(x) = -EIy'' = -EI\frac{d^2y}{dx^2}$$

integral constant $C_1, C_2, \dots C_n$ are determined by using boundary condition and continuity condition.

Optional method to solve statically indeterminate beam is using principle of superposition.

eg.



⑥ buckling

$$P_{cr} = \frac{\pi^2 EI}{l_e^2}$$ (Pay attention to I and l_e)