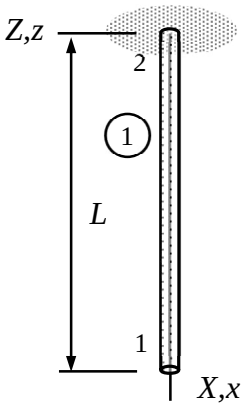
Name_____ Student number_____



Assignment 1

Determine the displacement of node 1 of the bar structure shown at the constant temperature $\vartheta°$. Use a linear approximation and assume that parameters E, A and α are constants. At the initial temperature $2\vartheta°$, length of the bar is L and stress in the bar vanishes.

Solution template

In stationary thermo-elasticity without external forces, the virtual work density of the bar model is given by

$$\delta w_\Omega = -\frac{d\delta u}{dx} EA \frac{du}{dx} + \frac{d\delta u}{dx} EA\alpha\Delta\vartheta .$$

Linear interpolants to axial displacement $u(x)$ and temperature change $\Delta\vartheta(x)$ are

$u(x) =$ _____ ,

$\Delta\vartheta(x) =$ _____ .

When $u(x)$ and $\Delta\vartheta(x)$ are substituted there, virtual work density simplifies to

$\delta w_\Omega =$ _____ .

Integration over the element gives

$\delta W = -\delta u_{X1}($_____$)$.

Principle of virtual work $\delta W = 0 \quad \forall \delta\mathbf{a}$ and the fundamental lemma of variation calculus imply the nodal displacement

$u_{X1} =$ _____ .