Bending of beams

configuration variables
space: primal complex
time: primal complex

source variables
space: dual complex
time: dual complex

\[ \langle 0, \phi_x \rangle \overset{\text{def}}{=} \int_{0}^{L} \phi_x \, dz \]

\[ - \frac{dM_x}{dz} = 0 \]

primal cycle
def

\[ f \]

constitutive equation

\[ \langle M_x, \kappa \rangle \overset{\text{def}}{=} \int_{0}^{L} M_x (\kappa \, dz) \]

fundamental equation

\[ - \frac{d}{dz} \left[ EJ_x \left( \frac{d\phi_x}{dz} \right) \right] = 0 \]

primal
dual

normal cross sections remain plane and normal to the neutral surface

\( \phi_x \) angle formed by the tangent and the \( x \)-axis

\( \kappa \) curvature

\( M_x \) bending moment

\( E \) elastic modulus

\( J_x \) second order moment

SOL1-8; http://discretephysics.dicar.units.it