Bar (or Truss) problem

For FEM

Strong form

$\frac{\mathrm{d}\sigma_{11}}{\mathrm{d}x_1} + \rho g_1 = 0$

Weak form

Using test function vectors $\hat{\mathbf{u}}$ in a line,

$\int_{x_1} A\frac{\mathrm{d}\sigma_{11}}{\mathrm{d}x_1}\hat{u}_1\mathrm{d}x_1 + \int_{x_1} A\rho g_1\hat{u}_1\mathrm{d}x_1 = 0$

where

$A = \int_{x_3}\int_{x_2}\mathrm{d}x_2\mathrm{d}x_3$

Similar to the general case of linear elasticity, we obtain

$\int_{x_1} A\sigma_{11}\frac{\mathrm{d}\hat{u}_1}{\mathrm{d}x_1}\mathrm{d}x_1 = \int_S At_1\hat{u}_1\mathrm{d}S + \int_{x_1} A\rho g_1\hat{u}_1\mathrm{d}x_1$

For GetFEM++

The term

$\int_{x_1} A\sigma_{11}\frac{\mathrm{d}\hat{u}_1}{\mathrm{d}x_1}\mathrm{d}x_1 \rightarrow$ "A * E * Grad_u(1,1) * Grad_Test_u(1,1)"

because,

$\sigma_{11} \rightarrow \sigma_{11} = E\frac{\mathrm{d}u_1}{\mathrm{d}x_1} \rightarrow$ "E * Grad_u(1,1)"

$\frac{\mathrm{d}\hat{u}_1}{\mathrm{d}x_1} \rightarrow$ "Grad_Test_u(1,1)"