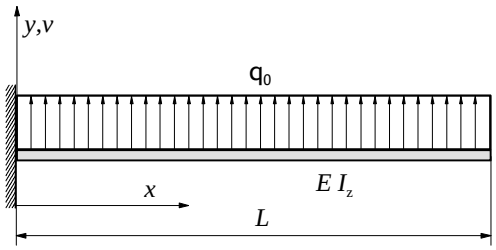
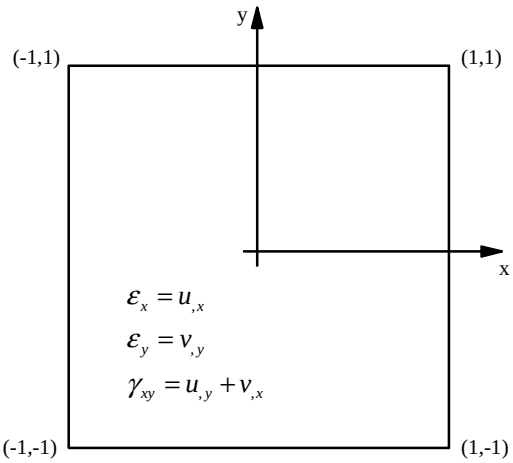
Tampere University of Technology

EDE-21100 Introduction to Finite Element Method. Exercise 3 Autumn 2013.

1. Solve the deflection curve $v(x)$ exactly for the beam shown



$$EI_z v_{,xxxx} = q_0$$



2. A displacement field

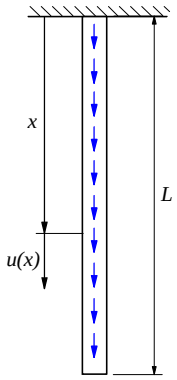
$$u(x,y) = 0.1 + 0.2 \cdot x + 0.3 \cdot x^3 + 0.2 \cdot x\,y^2$$
$$v(x,y) = 0.25 \cdot x\,y + 0.2 \cdot x^2$$

is imposed on the square element shown in Fig. 2.

(a) Write down the expressions for ε_x, ε_y and γ_{xy}
(b) Plot contours of for ε_x, ε_y and γ_{xy} using some computer software
(c) Find where ε_x is a maximum within the square
(d) Sketch the element deformed shape

3. Solve differential equation below exactly and by using the Galerkin's method. Choose suitable trial function from second degree polynomials selecting both boundary conditions as essential.

$$\begin{cases} u_{,xx} = x & x \in [0,1] \\ u(0) = 0 \\ u(1) = 1 \end{cases}$$



4. Compute the displacement $u(L)$ and the stress $\sigma(0)$ of the rod a) exactly, b) Galerkin's method with kinematically admissible ($\tilde{u}(0) = 0$) trial function $\tilde{u}(x) = Q_1(x/L) + Q_2(x/L)^2$ and c) Galerkin's method with trial function $\tilde{u}(x) = Q_1(x/L)$. The body force $f_x = \rho g$, Young's modulus E = 200 GPa, steel density ρ = 7850 kg/m^3, g = 9.81 m/s^2, L = 2000 m.