Assignment Number 6

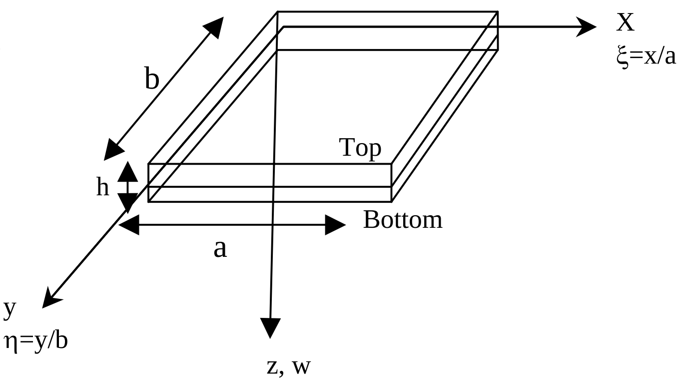
1) We are going to construct two-dimensional element for C^1 Problem. To reserve the continuity, we must guarantee that ϕ and ϕ_n are continuous along the element boundary. Describe on the continuity requirements for the following cases:

a) Rectangular element with sides parallel to the global axis, what nodal values need to be considered as DOF to assure C^1 continuity?
b) Answer (a) for rectangular element in general form
c) Answer (a) for non-rectangular element such as triangular element
d) If we specify ϕ, ϕ_x and ϕ_y at the corner node of a rectangular element sides parallel to the global axis, do we get ϕ_{xy} to be unique at the corner?

2) You wish to analyze a clamped plate for plate bending action under a linearly varying temperature change across the thickness, i.e. $\Delta T(x,y,z) = mz$ where m is a constant. Making use of the finite element notes on plate bending , derive the consistent load vector due to this temperature change. Show all steps clearly and calculate only the first term of the load vector. Use nonconforming plate bending element.

$$U = \frac{1}{2}\iint_A \left(-M_{xx}w_{xx} - M_{yy}w_{yy} + 2M_{xy}w_{xy}\right)dxdy$$

$$U = \frac{1}{2}\iint_A \{\bar{\varepsilon}\}^T[D]\{\bar{\varepsilon}\}dxdy$$



$$\{\bar{\varepsilon}\} = \begin{Bmatrix} -(w_{xx} - w^0{}_{xx}) \\ -(w_{yy} - w^0{}_{yy}) \\ w_{xy} - w^0{}_{xy} \end{Bmatrix}$$

$$[D] = \frac{Eh^3}{12(1-\nu^2)}\begin{bmatrix} 1 & \nu & 0 \\ \nu & 1 & 0 \\ 0 & 0 & 2(1-\nu) \end{bmatrix}$$

$$\Delta T_{Top} = -\Delta T_0$$

$$\Delta T_{Bottom} = \Delta T_0$$

linear variation across plate thickness

$$\Delta T(x,y,z) = \frac{2\Delta T_0}{h}z$$

$$m = \frac{2\Delta T_0}{h}$$

$$\varepsilon_{xx} = \alpha\Delta T \qquad \alpha = \text{coefficient of thermal expansion}$$

$$\varepsilon_{yy} = \alpha\Delta T$$