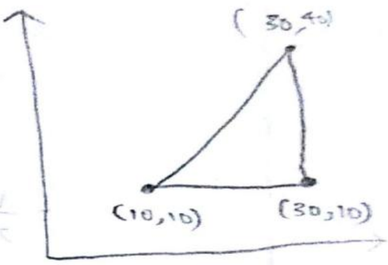
The nodal coordinates for an axis symmetric triangular element are given by $r_1 = 10\,mm$, $z_1 = 10\,mm$, $r_2 = 30\,mm$, $z_2 = 10\,mm$, $r_3 = 30\,mm$, $z_3 = 40\,mm$



$$A = \frac{1}{2}\begin{vmatrix} 1 & r_1 & z_1 \\ 1 & r_2 & z_2 \\ 1 & r_3 & z_3 \end{vmatrix}$$

$$= \frac{1}{2}\begin{vmatrix} 1 & 10 & 10 \\ 1 & 30 & 10 \\ 1 & 30 & 40 \end{vmatrix} = \frac{1}{2}\left[1(1200-300) - 10(40-10) + 10(30-30)\right]$$

$$= 300\,mm^2.$$

Coordinates $r = \frac{r_1 + r_2 + r_3}{3} = \frac{10+30+30}{3} = 23.3\,m$

$$z = \frac{z_1 + z_2 + z_3}{3} = \frac{10+10+40}{3} = 20\,m$$

$$\alpha_1 = r_2 z_3 - r_3 z_2 = (1200 - 300) = 900\,mm^2$$

$$\alpha_2 = r_3 z_1 - r_1 z_3 = -100\,mm^2$$

$$\alpha_3 = r_1 z_2 - r_2 z_1 = -200\,mm^2.$$

$$\beta_1 = z_2 - z_3 = -30\,mm$$

$$\beta_2 = z_3 - z_1 = 30\,mm$$

$$\beta_3 = z_1 - z_2 = 0\,mm$$

$$\gamma_1 = r_3 - r_2 = 0\,mm$$

$$\gamma_2 = r_1 - r_3 = -30\,mm$$

$$\gamma_3 = r_2 - r_1 = 20\,mm$$

Strain displacement Matrix,

$$[B] = \frac{1}{2A}\begin{bmatrix} \beta_1 & 0 & \beta_2 & 0 & \beta_3 & 0 \\ \frac{\alpha_1}{r}+\beta_1+\frac{\gamma_1 z}{r} & 0 & \frac{\alpha_2}{r}+\beta_2+\frac{\gamma_2 z}{r} & 0 & \frac{\alpha_3}{r}+\beta_3+\frac{\gamma_3 z}{r} & 0 \\ 0 & \gamma_1 & 0 & \gamma_2 & 0 & \gamma_3 \\ \gamma_1 & \beta_1 & \gamma_2 & \beta_2 & \gamma_3 & \beta_3 \end{bmatrix}$$

$$= \frac{1}{2\times 300}\begin{bmatrix} -30 & 0 & 30 & 0 & 0 & 0 \\ 8.576 \; \cancel{34.38} & 0 & 8.568 & 0 & -8.572 & 0 \\ 0 & 0 & 0 & -20 & 0 & 0 \\ 0 & -30 & -20 & 30 & 0 & 0 \end{bmatrix}$$

$$[B] = \begin{bmatrix} -0.05 & 0 & 0.05 & 0 & 0 & 0 \\ 0.0142 & 0 & 0.0142 & 0 & -0.0142 & 0 \\ 0 & 0 & 0 & -0.033 & 0 & 0 \\ 0 & -0.05 & -0.033 & 0.05 & 0 & 0 \end{bmatrix}$$