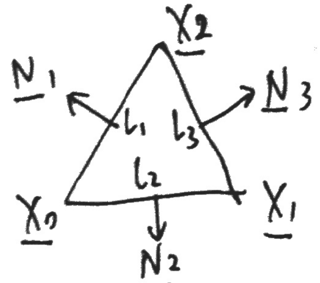
6. For 2D FVM,



$$[\underline{f}_1, \underline{f}_2] = \underline{P}\left[\frac{1}{2}(\underline{N}_1 l_1 + \underline{N}_3 l_3),\ \frac{1}{2}(\underline{N}_2 l_2 + \underline{N}_1 l_1)\right]$$

$$= \underline{P}\left[\frac{1}{2}\left(\begin{pmatrix} -(\underline{X}_2-\underline{X}_0)_2 \\ (\underline{X}_2-\underline{X}_0)_1 \end{pmatrix} + \begin{pmatrix} (\underline{X}_2-\underline{X}_1)_2 \\ -(\underline{X}_2-\underline{X}_1)_1 \end{pmatrix}\right),\ \frac{1}{2}\left(\begin{pmatrix} (\underline{X}_1-\underline{X}_0)_2 \\ -(\underline{X}_1-\underline{X}_0)_1 \end{pmatrix} + \begin{pmatrix} -(\underline{X}_2-\underline{X}_0)_2 \\ (\underline{X}_2-\underline{X}_0)_1 \end{pmatrix}\right)\right]$$

$$= \underline{P}\left[\frac{1}{2}\begin{pmatrix} \underline{X}_{0_2} - \underline{X}_{1_2} \\ \underline{X}_{1_1} - \underline{X}_{0_1} \end{pmatrix},\ \frac{1}{2}\begin{pmatrix} \underline{X}_{1_2} - \underline{X}_{2_2} \\ \underline{X}_{2_1} - \underline{X}_{1_1} \end{pmatrix}\right]$$

For 2D FEM,

$$D_m^{-T} = \frac{1}{\underbrace{2A_e^0}_{|D_m|}}\begin{bmatrix} X_{02} - X_{12} & X_{12} - X_{22} \\ X_{11} - X_{01} & X_{21} - X_{11} \end{bmatrix}$$

Therefore $[\underline{f}_1, \underline{f}_2] = \underline{P}\, A_e^0\, \underline{D}_m^{-T}$