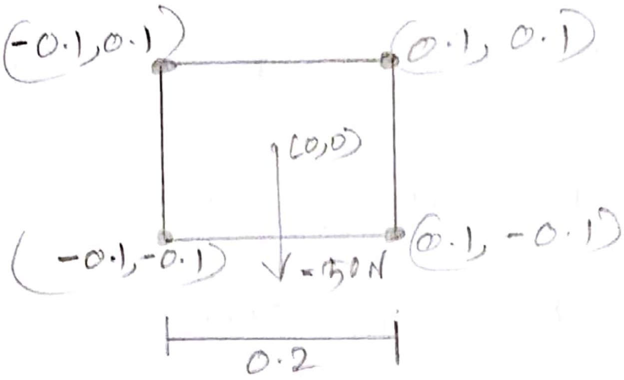
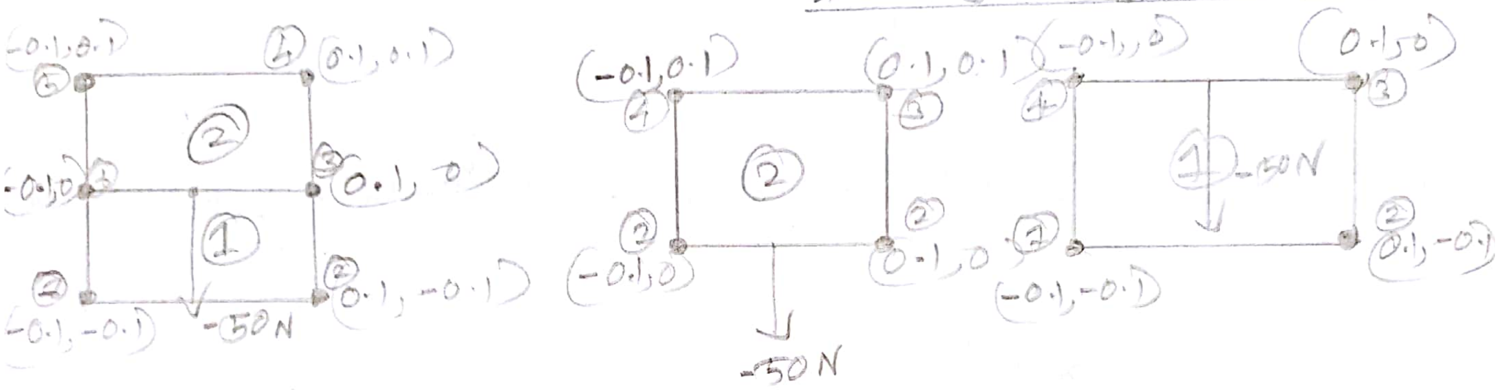
Load vector for 2L4 elements

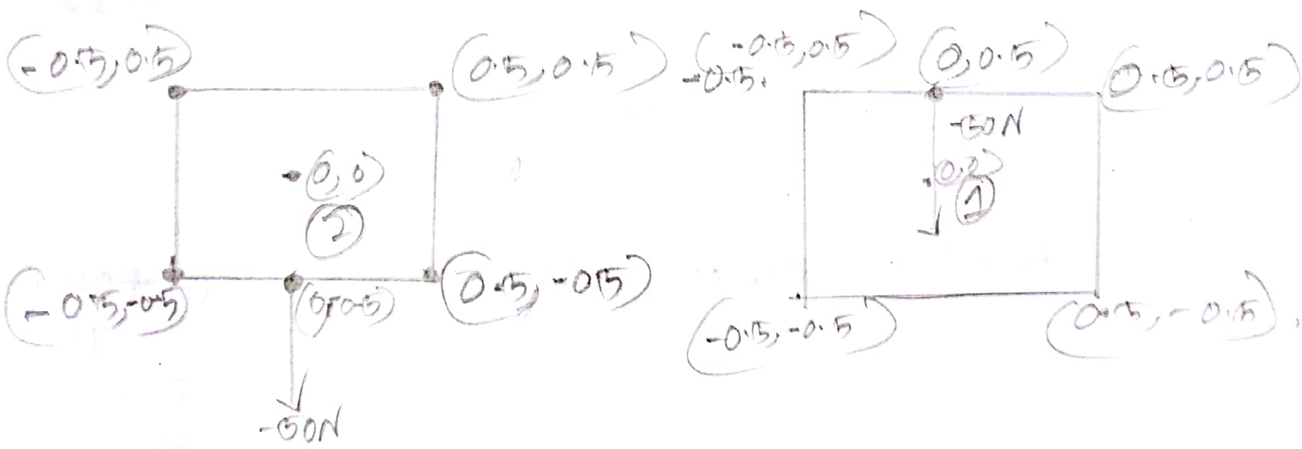
across the cross section:



In physical coordinates:



In Natural coordinates:



$$\delta L_{ext} = P\, F_{iI}\, N_i\, U_{Ir}$$

At the point of Load application $N_1 = 0, N_2 = 1$

$F_1 = \frac{1}{4}(1-\alpha)(1-\beta)$ $\quad$ $F_3 = \frac{1}{4}(1+\alpha)(1+\beta)$

$F_2 = \frac{1}{4}(1+\alpha)(1-\beta)$ $\quad$ $F_4 = \frac{1}{4}(1-\alpha)(1+\beta)$

Load ($-50\,N$) is applied in negative z-direction.

For the 1st element the Load is applied at the point $(0, 0.5)$ in Natural coordinates

$\therefore (\alpha, \beta) = (0, 0.5)$

$$\cancel{\delta L^{2}_{ext} = -50 \times \frac{1}{4}(1-0)(1-0.5) - 50 \times \frac{1}{4}(1+0)(1-0.5)}$$

$$\cancel{-50 \times \frac{1}{4}}$$

$\boxed{N_2 = 1}$

$$\delta L^{1}_{ext} = PF_1 U_{Z12} + PF_2 U_{Z22} + PF_3 U_{Z32} + PF_4 U_{Z42}.$$

$$= \left(-50 \times \frac{1}{4} \times (1-0)(1-0.5) U_{Z12}\right) - \left(50 \times \frac{1}{4} \times (1+0)(1-0.5) U_{Z22}\right)$$

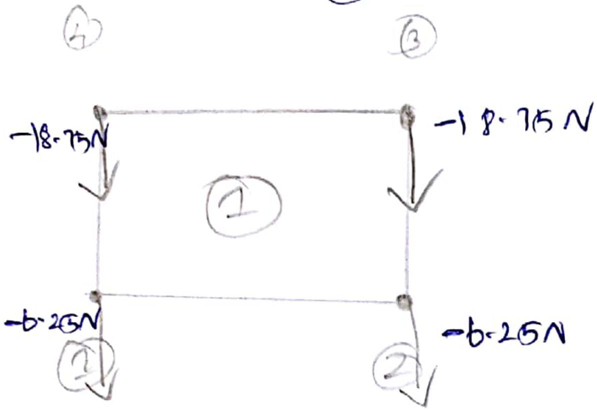
$$- 50 \times \frac{1}{4} \times (1+0.5)(1+0.5) U_{Z32}$$

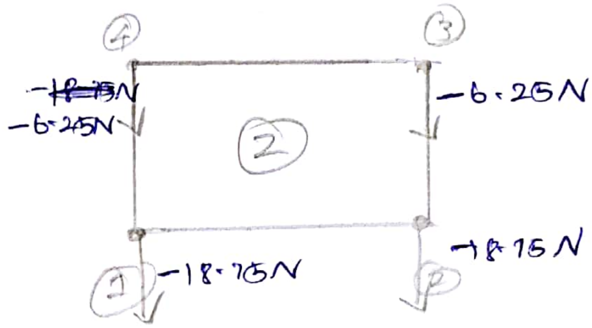
$$- 50 \times \frac{1}{4} (1-0)(1+0.5) U_{Z42}$$

$$= \underset{1}{-6.25 U_{Z12}} - \underset{2}{6.25 U_{Z22}} - \underset{3}{18.75 U_{Z32}} - \underset{4}{18.75 U_{Z42}}$$

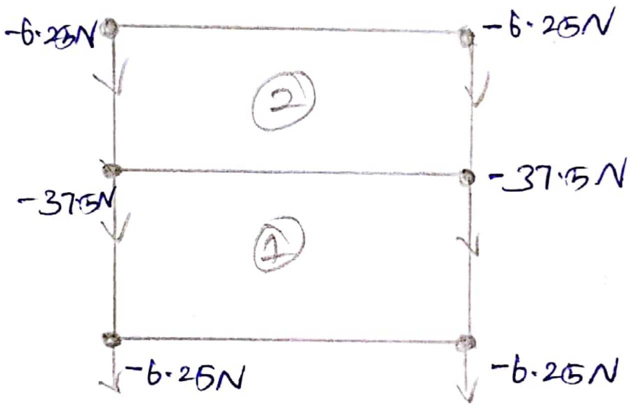
similarly $(\alpha, \beta) = (0, -0.5)$

$$\{f\}^{(2)}_{ext} = -18.75\, U_{Z_{12}} - 18.75\, U_{Z_{22}} - 6.25\, U_{Z_{32}} - 6.25\, U_{Z_{42}}.$$





After assembling the Load vector.



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