$y_c$ = distance of neutral plane at rupture from that fibre on the compression side which has just reached the elastic limit = $OP$ in Fig. 2.

$f_e$ = elastic limit stress in compression-endwise = $MH$ in Fig. 1, or $NP$ in Fig. 2.

$f_t$ = stress in extreme tension fibre at rupture = $KL$ in Fig. 2.

$T$ = total tensile stress on cross-section at rupture = triangle $KLO$.

$C$ = total compression stress on cross-section at rupture = area $HMNO$.

$\bar{y}_t$ = distance of C. of G. of tension area from neutral axis at rupture.

$\bar{y}_c$ = distance of C. of G. of compression area from neutral axis at rupture.

$M$ = moment of the internal stresses at rupture.

$W'$ = theoretical breaking load (calculated by Neely's formula).

From the above considerations and from the ordinary theory of the beam we have at once

$$f_e = f_c \qquad (1)$$

$$s_e = \frac{1}{E} f_e = \frac{6\Delta_e h}{l^2} \qquad (2)$$

Since this equation involves only the strains and the dimensions of the beam, it is true also at rupture. (Hyp. 1.)

Hence total strain $= s_c + s_t = \dfrac{12\Delta_r h}{l^2}$

Again, the area $KLO$ = area $HMNO$

$$\therefore \ \tfrac{1}{2} s_t f_t = s_c f_c - \tfrac{1}{2} s_e f_c$$

And from similar triangles

$$f_t = \frac{s_t}{s_e} f_c$$

$$\therefore \ \frac{1}{2} \frac{s_t^2}{s_e} f_c = s_c f_c - \tfrac{1}{2} s_e f_c$$

$$s_t^2 = 2 s_c s_e - s_e^2 = 2\left(\frac{12\Delta_r h}{l^2} - s_t\right) s_e - s_e^2$$

$$s_t^2 + 2 s_t s_e + s_e^2 = \frac{24\Delta_r h}{l^2} s_e = \frac{144\,\Delta_r \Delta_e h^2}{l^4}$$

$$\therefore \ s_t + s_e = 12\sqrt{\Delta_r \Delta_e} \cdot \frac{h}{l^2}$$

$$s_t = (2\sqrt{\Delta_r \Delta_e} - \Delta_e)\frac{6h}{l^2} \qquad (3)$$

$$s_c = 12\Delta_r \frac{h}{l^2} - s_t = (2\Delta_r - 2\sqrt{\Delta_r \Delta_e} + \Delta_e)\frac{6h}{l^2} \qquad (4)$$