FAQs

1. Write the expression for critical depth of neutral axis.

$$\sigma_{cbc} / \sigma_{st}/m = x_c / d-x_c$$

2. Write the expression for actual depth of neutral axis when $x \leq D_f$

$$b_f x.x/2 = mA_{st}(d-x)$$

3. Give the expression for moment of resistance for under reinforced flanged section when $x \leq D_f$

$$M = T X z = A_{st}\sigma_{st}(d-x/3)$$

4. Give the expression for moment of resistance for over reinforced flanged section when $x \leq D_f$

$$M = C X z = b_f x \sigma_{cbc}/2 (d-x/3)$$

5. Moment of resistance of singly reinforced flanged beam: **case (i) when $x \leq D_f$**

To find x_c

$$\sigma_{cbc} / \sigma_{st}/m = x_c / d-x_c$$

To find x

$$b_f x.x/2 = mA_{st}(d-x)$$

If $x < x_c$; it is under reinforced section

$$M_r = T X z = A_{st}\sigma_{st}(d-x/3)$$

If $x > x_c$; it is over reinforced section

$$M_r = C X z = b_f x \sigma_{cbc}/2 (d-x/3)$$

6. Moment of resistance of singly reinforced flanged beam: **case (ii) when $x > D_f$**

To find x_c

$$\sigma_{cbc} / \sigma_{st}/m = x_c / d-x_c$$

To find x

$$b_fD_f(x-D_f/2) + b_w(x-D_f)(x-D_f/2) = mA_{st}(d-x)$$

The moment of area of the web portion in compression is too small as compared to the flange portion and is generally neglected, hence,

$$b_fD_f(x-D_f/2) = mA_{st}(d-x)$$

To find M_r

$$M_r = C X z = b_fD_f (\sigma_{cbc}+\sigma_{cbc}^1)/2 (d-Y)$$

7. Find the moment of resistance of the T-beam of effective depth 400mm and flange width 1200mm. Depth of flange is 100mm and width of web is 200mm. Tensile steel consists of four 18mm dia bars. Use $\sigma_{cbc} = 7$ N/mm^2; $\sigma_{st} = 190$ N/mm^2.

To find x_c

$$\sigma_{cbc} / \sigma_{st}/m = x_c / d-x_c$$

x_c = 131.74mm

Assume $x < D_f$

To find x

$$\mathbf{b_f\, x.x/2 = mA_{st}(d-x)}$$

x = 84.48mm < D_f hence case (i)

and also $x < x_c$; it is under reinforced section; $\boldsymbol{\sigma_{st}}$ is known

To find actual $\boldsymbol{\sigma_{cbc}}$

$$\boldsymbol{\sigma_{cbc} \,/\, \sigma_{st}/m = x_c \,/\, d\text{-}x_c}$$

actual $\boldsymbol{\sigma_{cbc}}$ = 3.82 N/mm^2 < 7 N/mm^2

To find M_r

$$\mathbf{M_r = C\ X\ z = b_f\ x\ \sigma_{cbc}/2\ (d\text{-}x/3)}$$

M_r = 72.01 kNm.

8. A T beam has a permissible flange width of 1500mm, effective depth of 400mm, the thickness of floor 100mm and breadth of web 200mm. The beam is reinforced on tension side with 2190mm^2 of steel. Calculate the moment of resistance of beam. Take σ_{cbc} = 5 N/mm^2; σ_{st} = 140 N/mm^2.

To find x_c

$$\boldsymbol{\sigma_{cbc} \,/\, \sigma_{st}/m = x_c \,/\, d\text{-}x_c}$$

x_c = 159.66mm

Assume $x > D_f$

To find x

$$\mathbf{b_f D_f(x\text{-}D_f/2) = mA_{st}(d-x)}$$

x = 124.94mm > D_f

and also $x < x_c$; it is under reinforced section; $\boldsymbol{\sigma_{st}}$ is known

To find actual $\boldsymbol{\sigma cbc}$

$$\boldsymbol{\sigma_{cbc} \,/\, \sigma_{st}/m = x_c \,/\, d\text{-}x_c}$$

actual $\boldsymbol{\sigma_{cbc}}$ = 3.41 N/mm^2 < 5 N/mm^2

To find $\boldsymbol{\sigma_{cbc}^I}$

$$\boldsymbol{\sigma_{cbc}^I = \sigma_{cbc}\,(x - D_f) \,/\, x}$$

σ_{cbc}^I = 0.68 N/mm^2

To find Y

Y = 38.87mm

To find M_r

$$\mathbf{M_r = C\ X\ z = b_f D_f\,(\sigma_{cbc}+\sigma_{cbc}^1)/2\ (d\text{-}Y)}$$

M_r = 110.776 kNm