Topics

(a) Review of different Type of beams with various Loading and bracing and Locations - How Do we Find C_b?

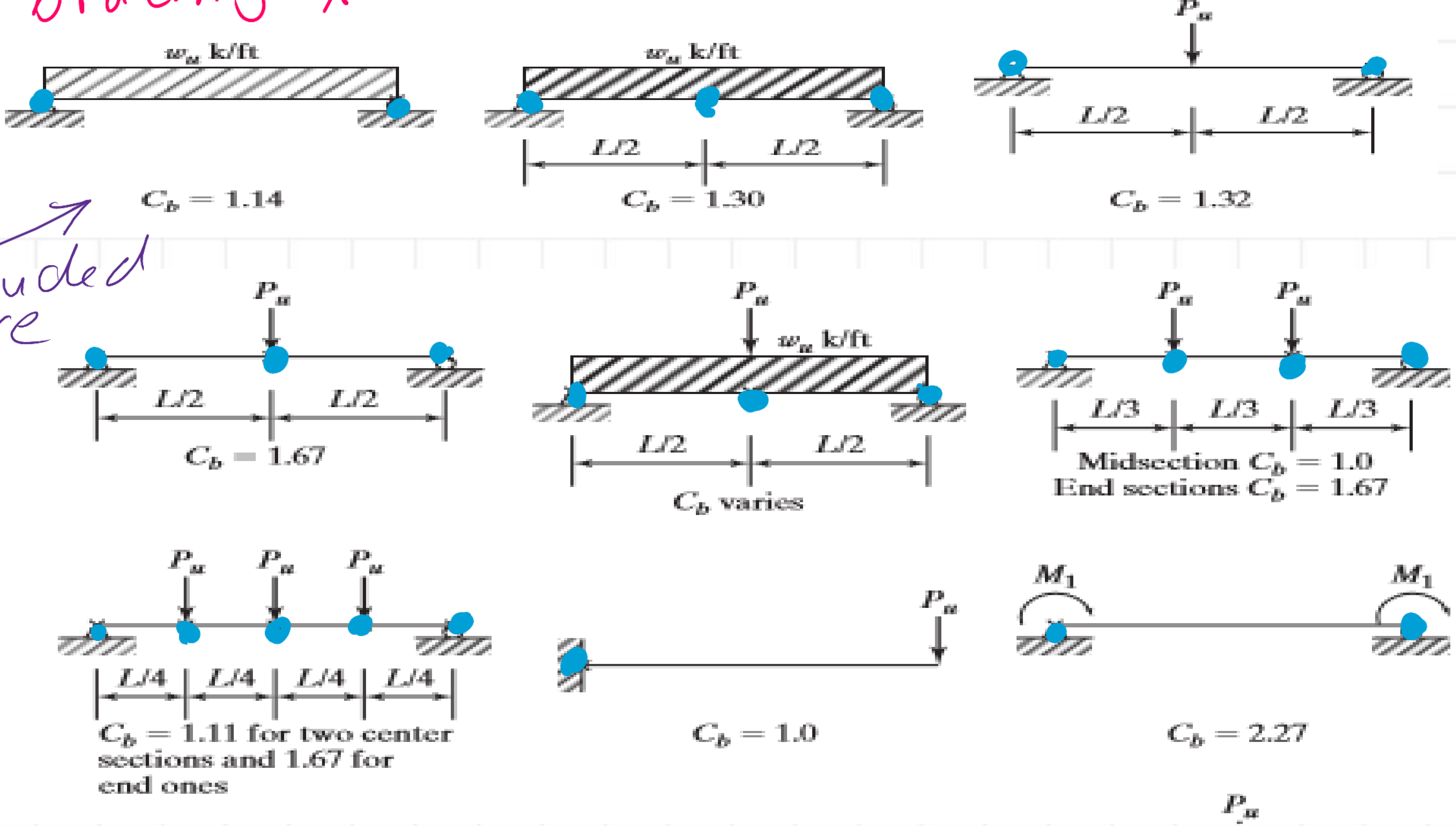
C_b: Coefficient of Bending.

Two Case (1) Simply Supported beam
(2) Fixed end beam

Prepared by Eng.Maged Kamel.

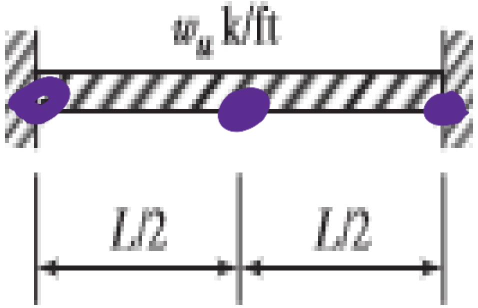
- bracing x

included here

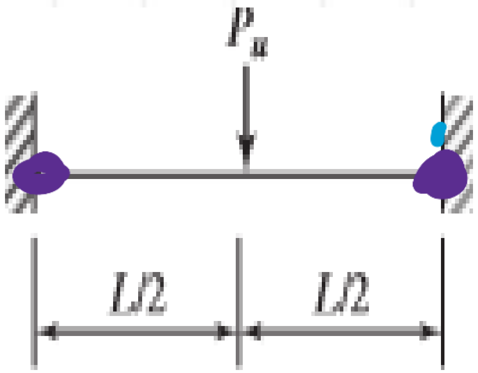


bracing

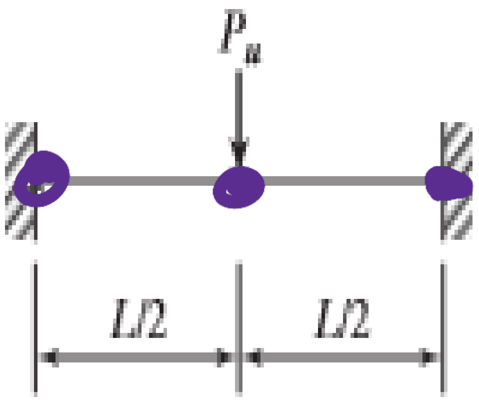
$C_b = 2.38$



$C_b = 2.38$



$C_b = 1.92$



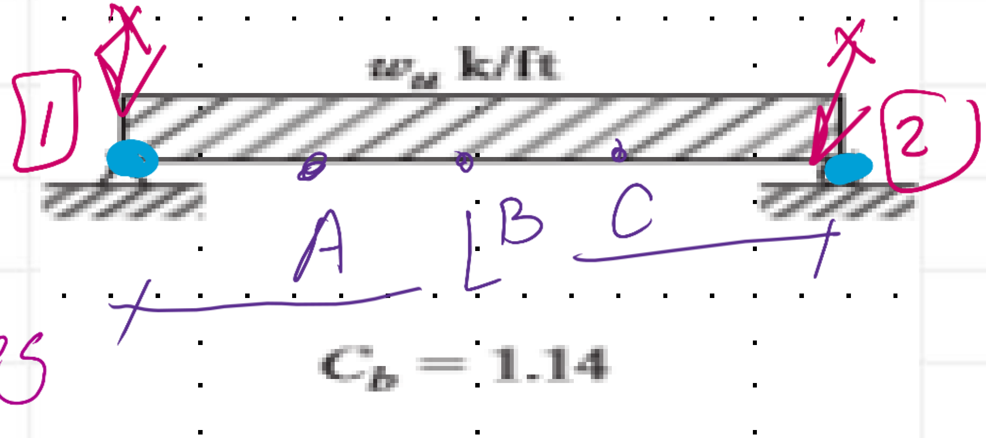
$C_b = 2.27$

W_u : Ultimate U.L

P_u : Ultimate C.L

bracing ✗

There is no internal bracing



① Divide the distance between bracings into Four Equal distance $\Rightarrow \ell \rightarrow \ell/4$

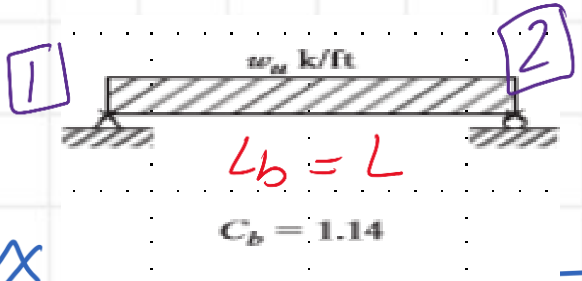
② Determine moment values $\begin{cases} A \\ B \\ C \end{cases}$

③ Use C_b : Equation

$$\frac{12.50\, M_{max}}{2.50\, M_{max} + 3M_A + 4\, M_B + 3M_C}$$

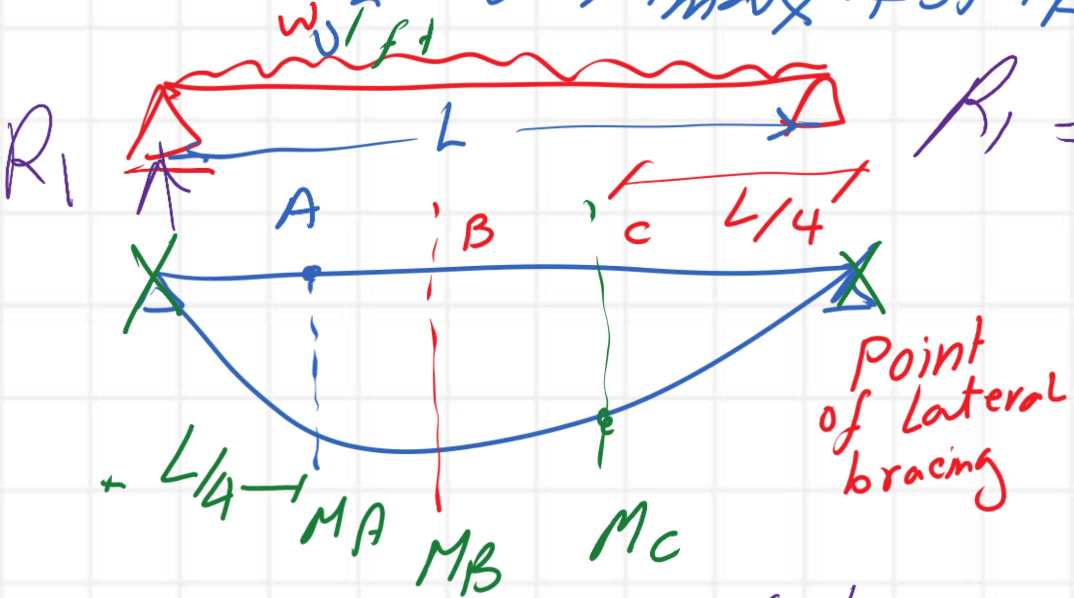
1st quarter, 2nd Quarter, 3rd quarter

C_B Equation



Case - 1 Non internal Bracing

$$C_b : \frac{12.50\, M_{max}}{2.50\, M_{max} + 3M_A + 4\, M_B + 3M_C}$$



$$R_1 = w_u \frac{L}{2}$$

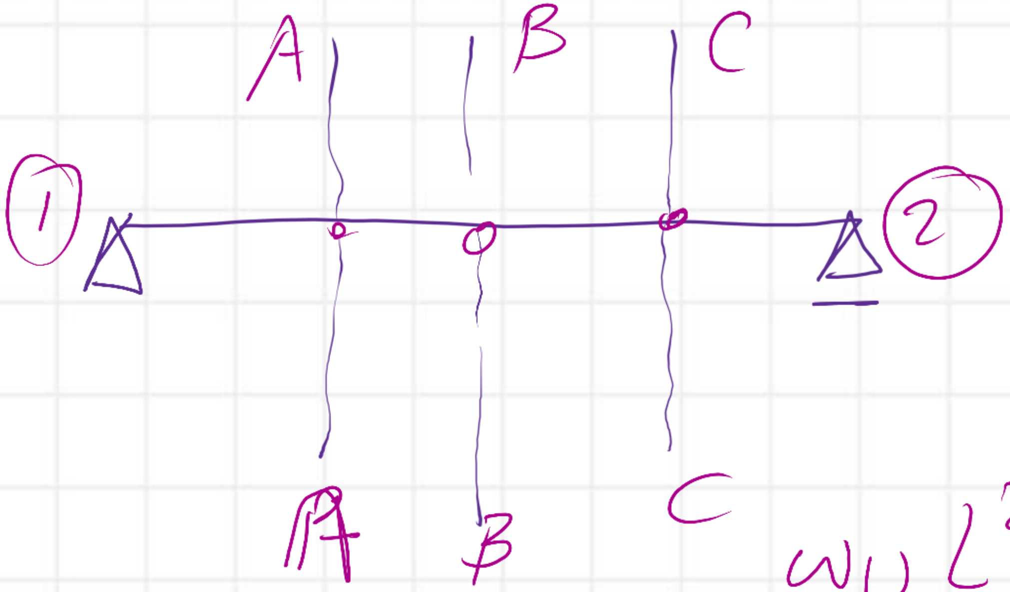
$$M_A = \frac{w_u L}{2}\left(\frac{L}{4}\right) - \frac{w_u L}{4}\left(\frac{L}{8}\right)$$

$$= \frac{w_u L^2}{8} - w_u \frac{L^2}{32}$$

$$M_A = w_u L^2 \left(\frac{1}{32}\right)(4-1) = \frac{3}{32} w_u L^2$$

$M_C = M_A$ = symmetry

Prepared by Eng.Maged Kamel.



$$M_B = w_u \frac{L^2}{8}$$

$$M_{max} = w_u \frac{L^2}{8}$$

$$\frac{w_u L^2}{32}(3)$$

$$\frac{w_u L^2}{8}$$

$$\frac{w_u L^2}{32}(3)$$

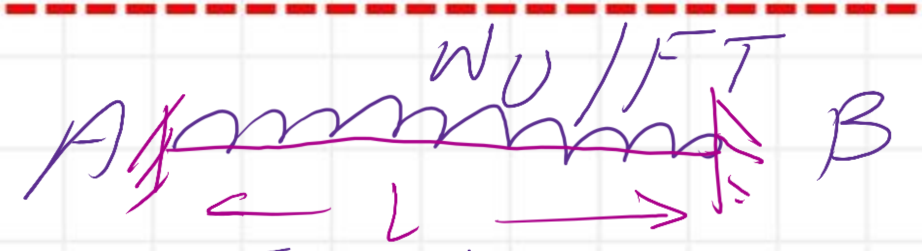
$$C_b = \frac{12.50\, M_{max}}{2.5 M_{max} + 3 M_A + 4 M_B + 3 M_C}$$

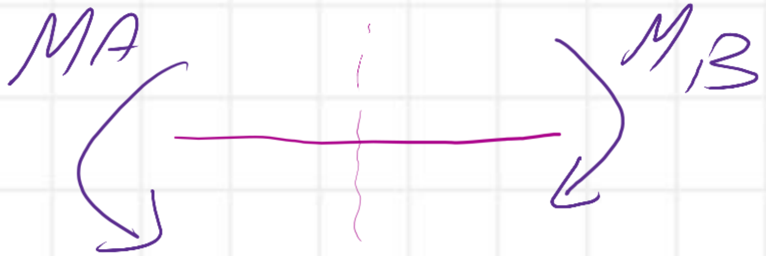
$$C_b = \frac{12.5\,(w_u L^2/8)}{2.5\left(\frac{w_u L^2}{8}\right) + 6\left(\frac{3}{32}\right) w_u L^2 + 4\, \frac{w_u L^2}{8}}$$

$$C_b = \frac{12.5\left(w_u l^2/8\right)}{2.5\left(\frac{w_u l^2}{8}\right) + 6\left(\frac{3}{32}\right) w_u l^2 + 4\,\frac{w_u l^2}{8}}$$

$$C_b = \frac{(12.5)/8}{\frac{6.5}{8} + \frac{18}{32}} = \frac{(12.5)}{(8)}\left(\frac{1}{\frac{26+18}{32}}\right.$$

$$C_b = \frac{12.5}{8}\left(32\right)\left(\frac{1}{44}\right) = 1.136 \simeq 1.14$$

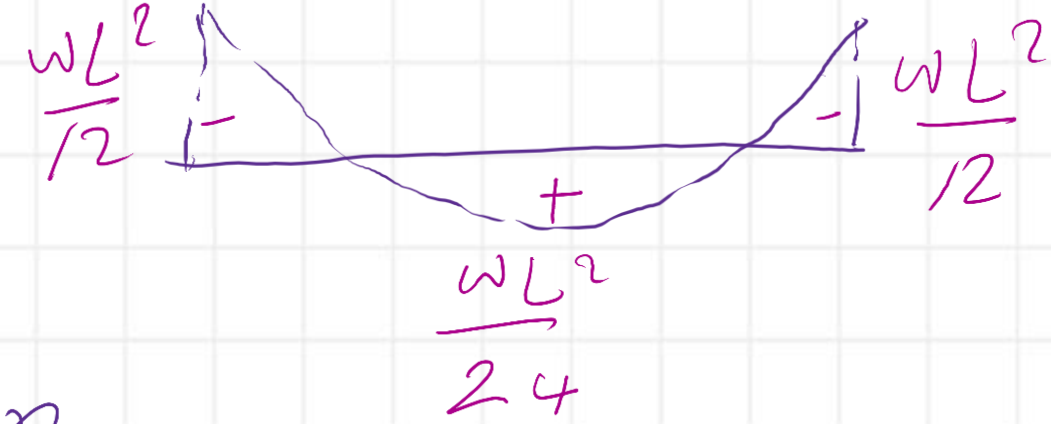




Case of A Fixed end Beam

$$M_A = \frac{w_u L^2}{12} = M_B$$

B.M



$$M_{+ve} = \frac{w_u L^2}{8} - \frac{w_u L^2}{12}$$

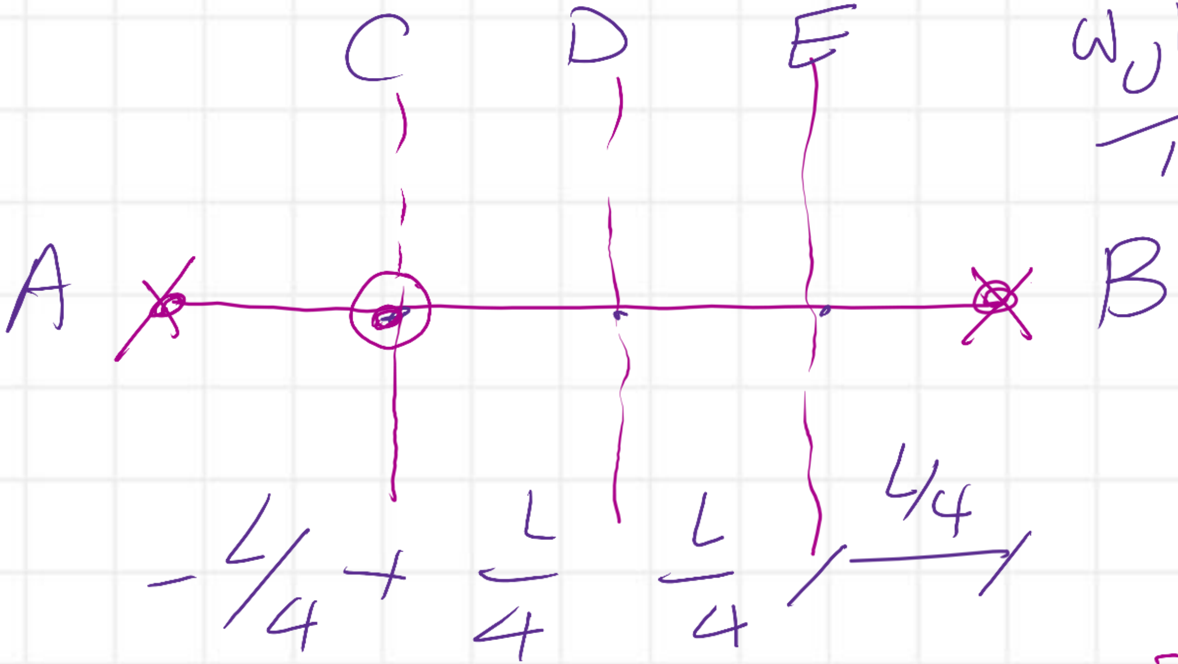
$$= w_u L^2 \left(\frac{3-2}{24}\right)$$

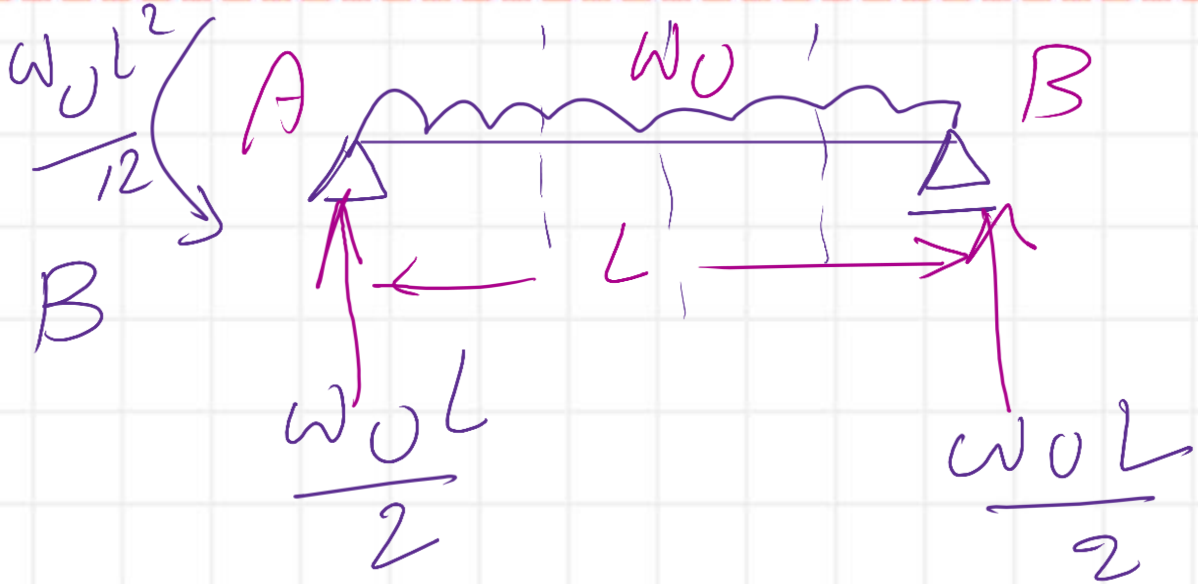
$$= w_u L^2 \left(\frac{1}{24}\right)$$

Drawn in Tension side

Steps to get C_b value

(a) Divide the Beam to Four Equal segments





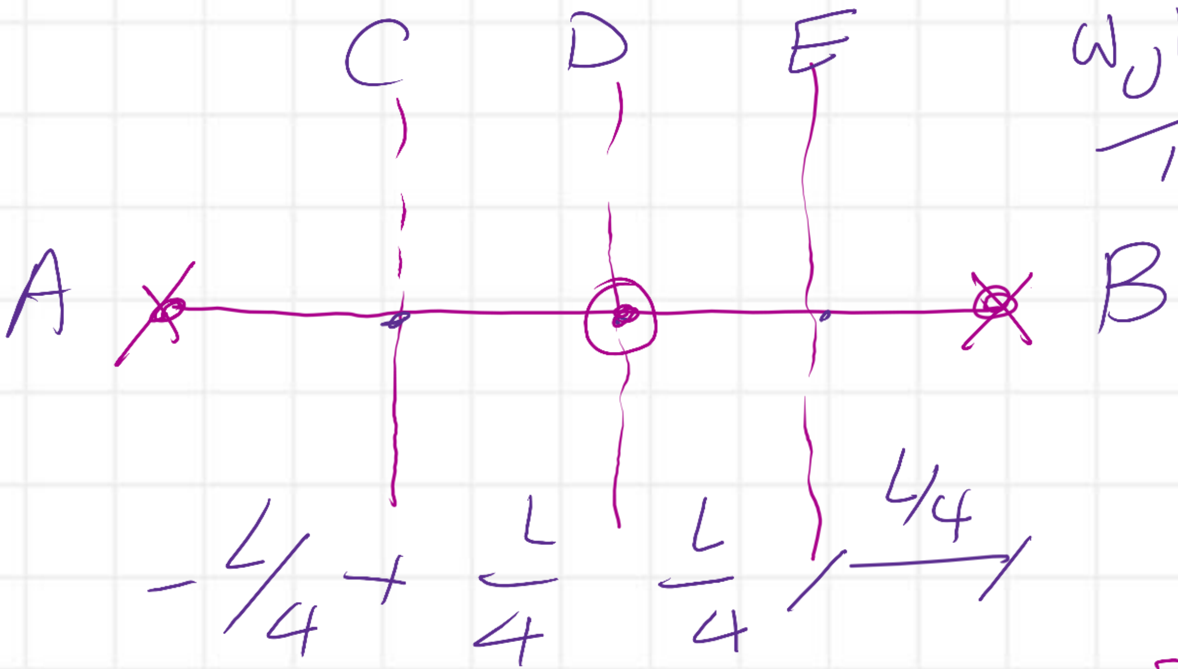
$$M_C = w_0 \frac{L}{2}\left(\frac{L}{4}\right) - \frac{w_0 L^2}{12} - w_0\left(\frac{L}{4}\right)^2\left(\frac{1}{2}\right)$$

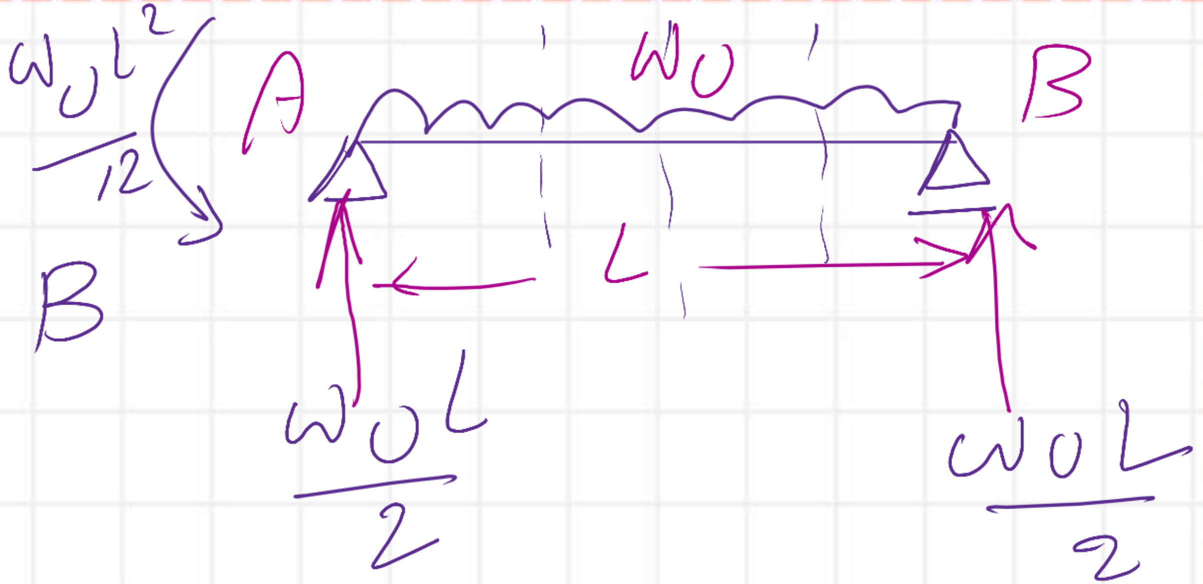
$$= w_0 L^2\left[\frac{1}{8} - \frac{1}{12} - \frac{1}{32}\right]$$

$$w_0 L^2\left[\frac{48-32-12}{(12)(32)}\right] = w_0 L^2 \left(\frac{1}{(3)(32)}\right)$$

$$= +w_0 L^2\left(\frac{1}{96}\right)$$

$M_E = M_C$ symmetry





$$M_D = w_0 \frac{L}{2}\left(\frac{L}{2}\right) - w_0 \frac{L^2}{12} - w_0 \left(\frac{L}{2}\right)^2 \left(\frac{1}{2}\right)$$

$$= w_0 L^2 \left[\frac{1}{4} - \frac{1}{12} - \frac{1}{8}\right]$$

$$w_0 L^2 \left[\frac{24 - 8 - 12}{96}\right] = w_0 L^2 \left(\frac{4}{96}\right)$$

$$= w_0 \frac{L^2}{24}$$

Apply C_B Equation

$$\frac{w_u L^2}{96}$$

$$\frac{w_u L^2}{24}$$

$$\frac{w_u L^2}{96}$$

$$\frac{w_u L^2}{12} \text{ Max}$$

$$C_b = \frac{12.5 M_{max}}{2.5 M_{max} + 3M_C + 4M_D + 3M_E}$$

$$M_C = M_E$$

$$C_b = \frac{12.5\,(w_u L^2/12)}{2.5\left(\frac{w_u L^2}{12}\right) + 6\left(\frac{w_u L^2}{96}\right) + 4\left(\frac{w_u L^2}{24}\right)}$$

$$C_b = \frac{(12.5/12)}{\left(\frac{2.5}{12} + \frac{6}{96} + \frac{4}{24}\right)}$$

$$C_b = \left(\frac{12.5/12}{\frac{2.5}{12} + \frac{6}{96} + \frac{4}{24}} \right)$$

$$C_b = \frac{(12.5/12)}{\frac{20+6+16}{96}} = \frac{12.5(96)}{12(42)}$$

$$C_b = \frac{12.5(8)}{42}$$

$$C_b = 2.38$$