8-32

Mccormac

Using the given sections, all of A992 steel, and the plastic theory, determine the values of P_n and w_n as indicated.

8-32.

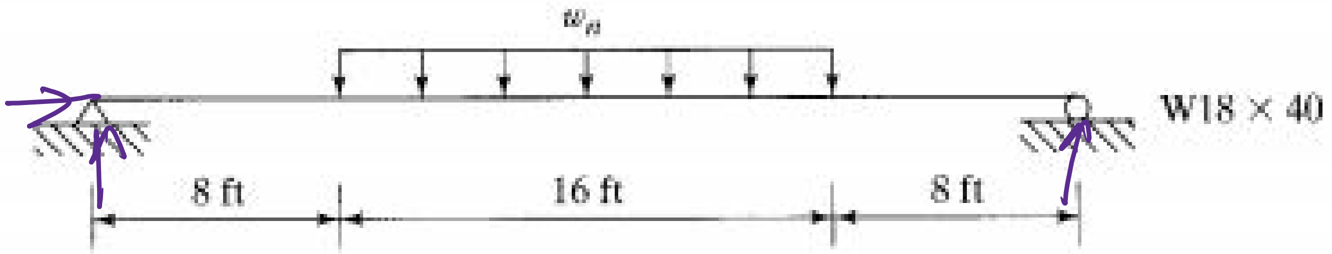


FIGURE P8-32

Solution

$Z_x = 78.40 \text{ inch}^3$

$F_y = 50 \text{ ksi}$

$M_n = F_y \cdot Z_x = 50(78.40) = 3920 \text{ inch.kips}$

$\hookrightarrow M_p = \frac{3920}{12} = 326.666 \text{ Ft.kips}$

8-32 Mccormac

Using the given sections, all of A992 steel, and the plastic theory, determine the values of P_n and w_n as indicated.

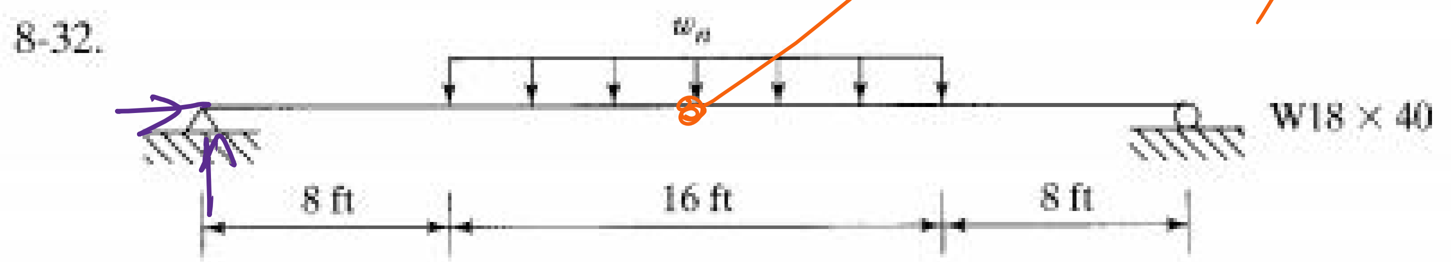


FIGURE P8-32

No. of reactions Except HL $= 2$

Deduct two Equations

$\Sigma Y = 0$

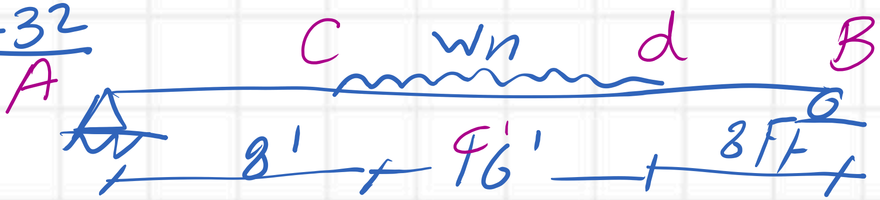
$\Sigma M = 0$

$2 - 2 + 1 = +1$

add 1 for Collapse mechanism

We need one hinge

Estimate 8-32
Wn

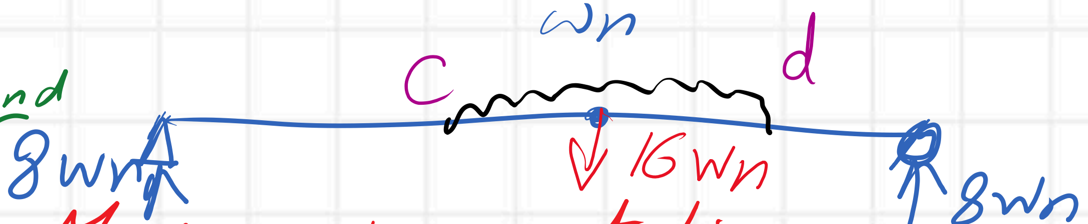


W18X40 $F_y = 50$ ksi

$$R_A = w_n (16) \frac{1}{2} = 8 W_n = R_B$$

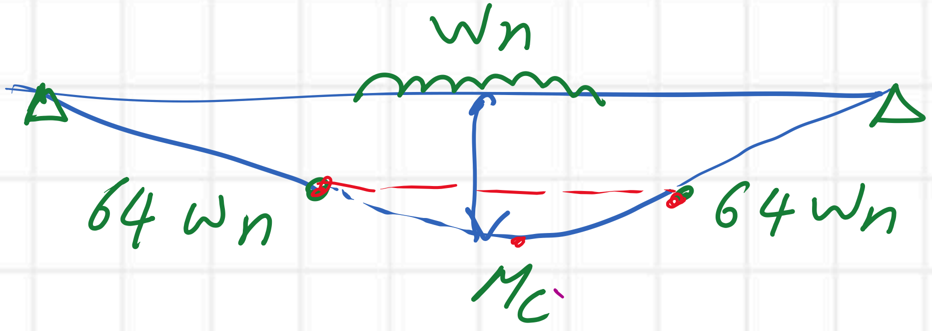
Solution

Lower bound



$$M_C = 8 W_n (8) = 64 W_n = M_D$$

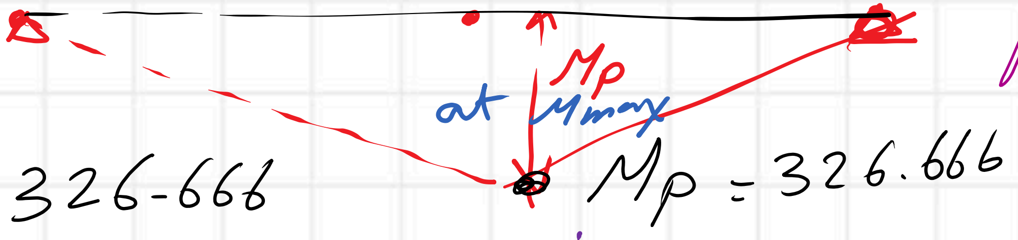
Estimate M+ve maximum at hinge



$$M_{C'} = M_C + \frac{wL^2}{8} = 64 W_n + \frac{w_n (16)^2}{8}$$

$$M_{C'} = 64 W_n + 32 W_n = 96 W_n$$

$$M_{C'} = M_p = 326.666 \text{ FT.Kips}$$

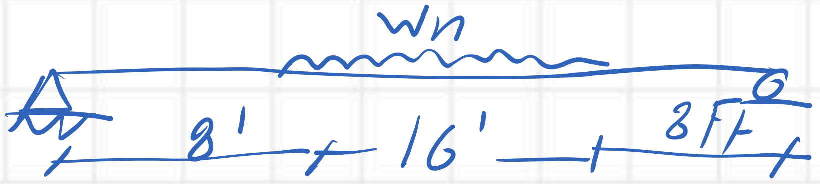


$$96 W_n = 326.666$$

$$W_n = \frac{326.666}{96} = 3.402 \frac{K}{Ft}$$

Prepared by Eng.Maged Kamel.

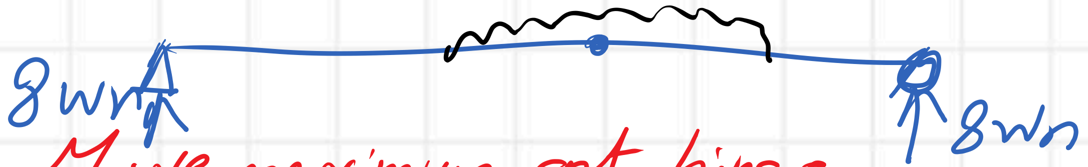
Estimate W_n



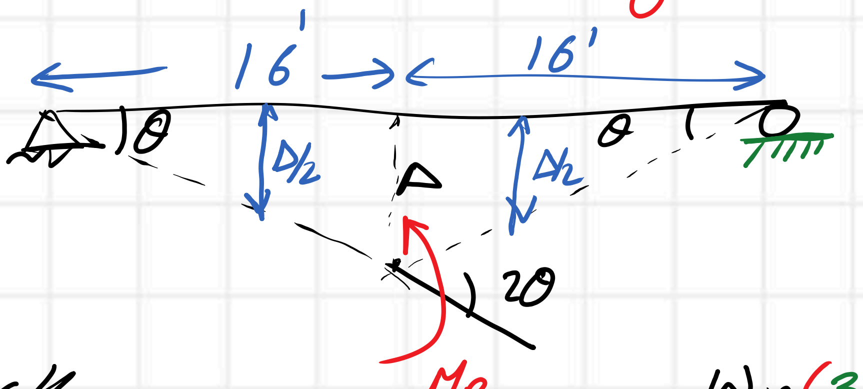
$W_{18}\times 40$ $F_y = 50\,ksi$

$M_n = M_p = 326.66$ Ft.kips

Solution: upper bound



Estimate M+ve maximum at hinge



=

External work $= w_n(32)\left(\frac{\Delta}{2}\right) - 2(w_n)(8)\left(\frac{\Delta}{2}\right)\left(\frac{1}{2}\right)$ average

$= 16 w_n \Delta - 4 w_n \Delta = 12 w_n \Delta$

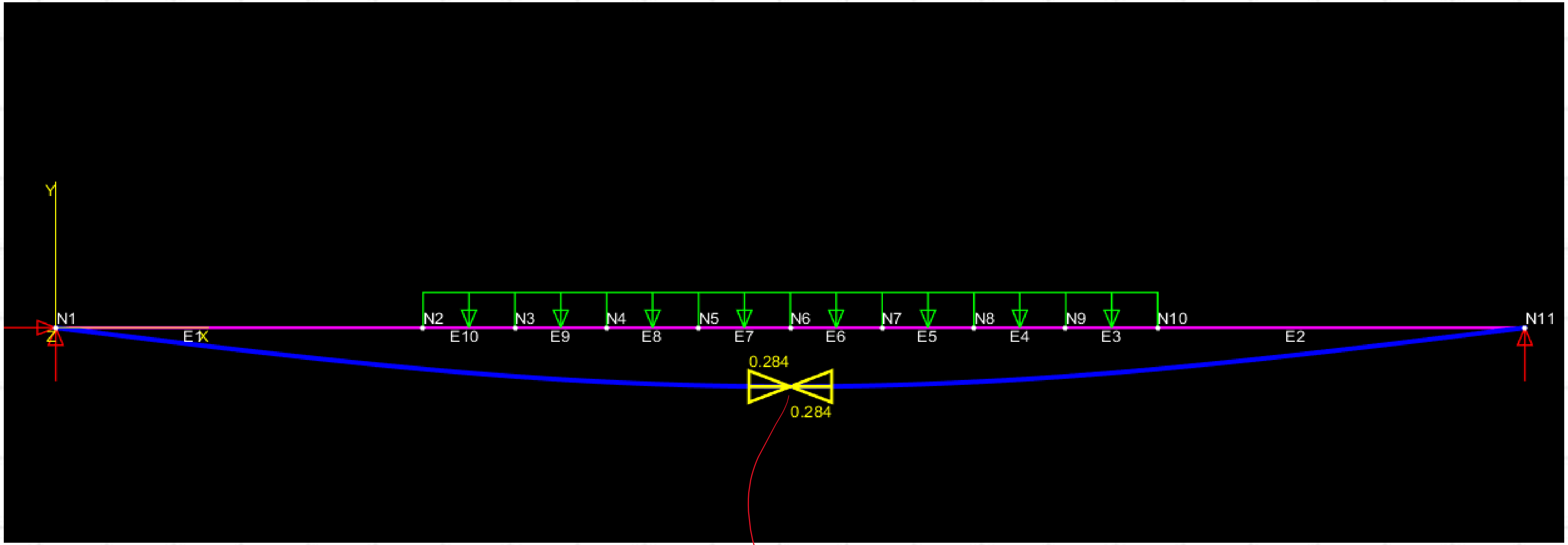
$12 W_n \Delta = M_p(2\theta) = M_p\left(2\,\frac{\Delta}{16}\right)$

$W_n = \frac{M_p}{96} = \frac{326.66}{96} = 3.402$ kips/ft → Same

Prepared by Eng.Maged Kamel.

$W_n = 3.402 \frac{K}{F}$ ⇒ Convert to kips / inch

For $\frac{K}{inch}$ ⇒ $\frac{3.402}{12} = 0.284$ kips/inch



E = 29000 ksi

Fy = 50 ksi

From MASTAN 2 ⇒ 0.284

Plastic hinge at the middle

10 increament of 0.10

Prepared by Eng.Maged Kamel.

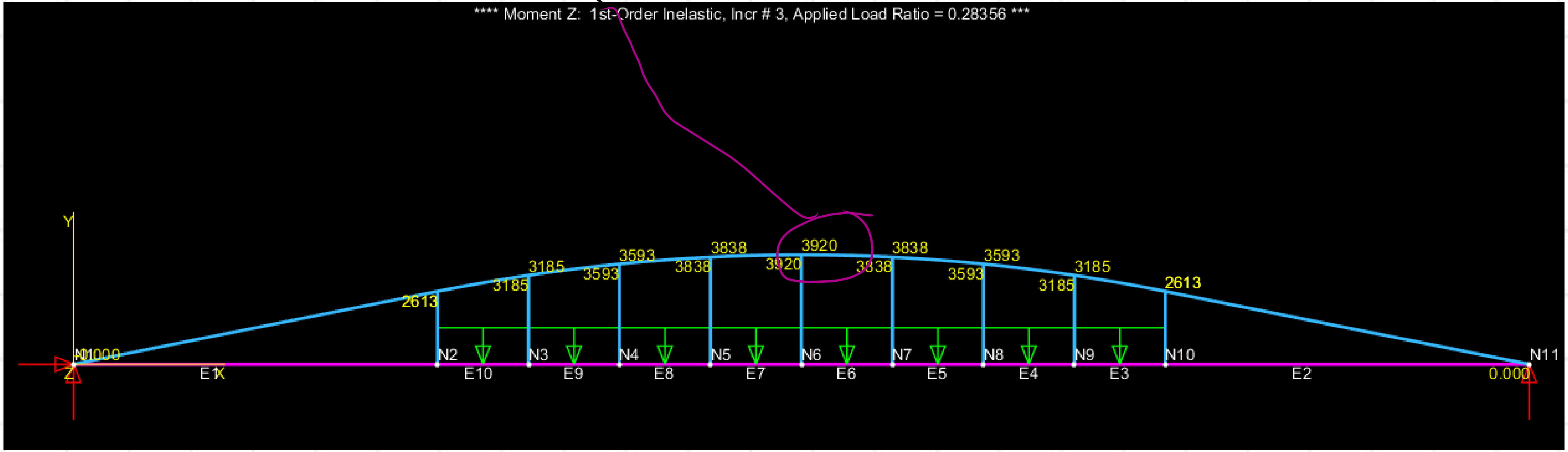
$M_z = M_n = M_p = 3920$ inch.Kip

$\lambda = 0.28356$

$W_n = 0.28356(1) = 0.28356$ Kip/inch

$0.28356(12) = 3.403$ K/Ft

Matches with M_n



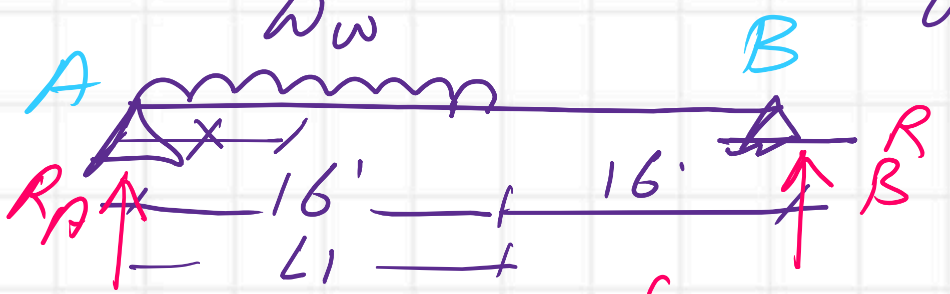
W_n is Similar to our Solution

$E = 29000$ ksi   applied Load 1 Kip/inch

Third increament 0.30 increaments

For a partial load at the left

W_w : working load



$$R_A = W_w(16)\left(\frac{24}{32}\right) = 12\,W_w$$

$$R_B = W_w(16)\left(\frac{8}{32}\right) = 4\,W_w$$

Check position of max. moment where $\frac{dM_x}{dx} = max$

$\Sigma Q_x = 0$

$R_A - W_w(x) = 0$ $\qquad 12\,W_w = W_w\,x \rightarrow x = 12'$

$\frac{x}{L} = \frac{12}{32} = \frac{3}{8}L$ $\qquad M_x = R_A(x) - W_w\left(\frac{x^2}{2}\right)$ $\qquad$ For $x = 12'$

where $\qquad M_{max} = 12W_w(12) - \frac{W_w}{2}(144) = 72\,W_w$

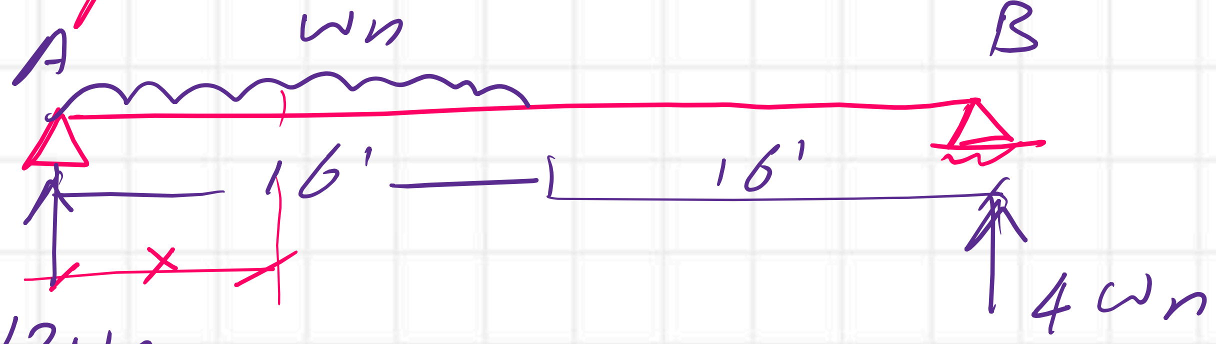
For particl Load at the left

W18 x 40

$F_y = 50$ ksi

$Z_x = 78.40 \text{ inch}^3$

Collapse Load W_n



but x distance can be found as follows

$R_A = 12w_n$

$M_p = F_y Z_x = 326.666$ FT. kips

Again check at $x = 12'$ $Q_x = 0$

$12w_n - w_n(12) = 0$ ok

$x = 12' \Rightarrow$ For w_n

$\Sigma M_A = 0$

$12w_n(6) = M_n = 326.666$

$w_n = 4.537 \ \frac{\text{kips}}{\text{FT}}$

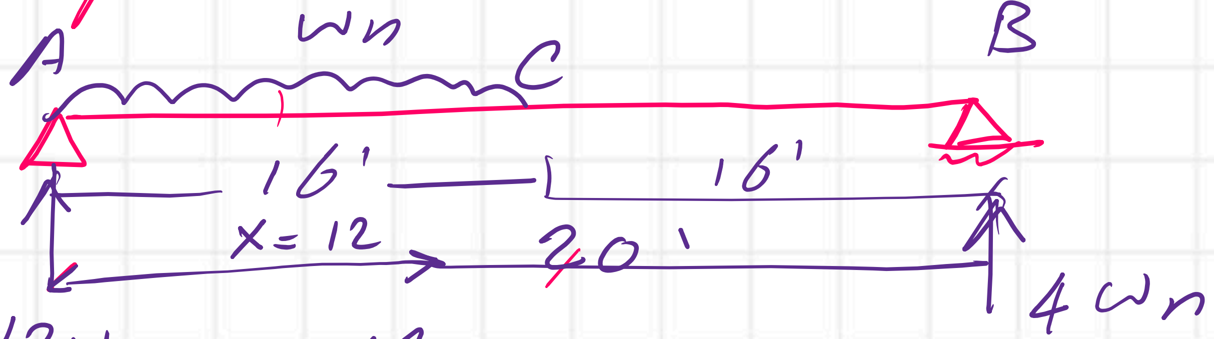
For particL Load at the left

W18 X 40

$F_y = 50\ ksi$

$Z_x = 78.40\ inch^3$

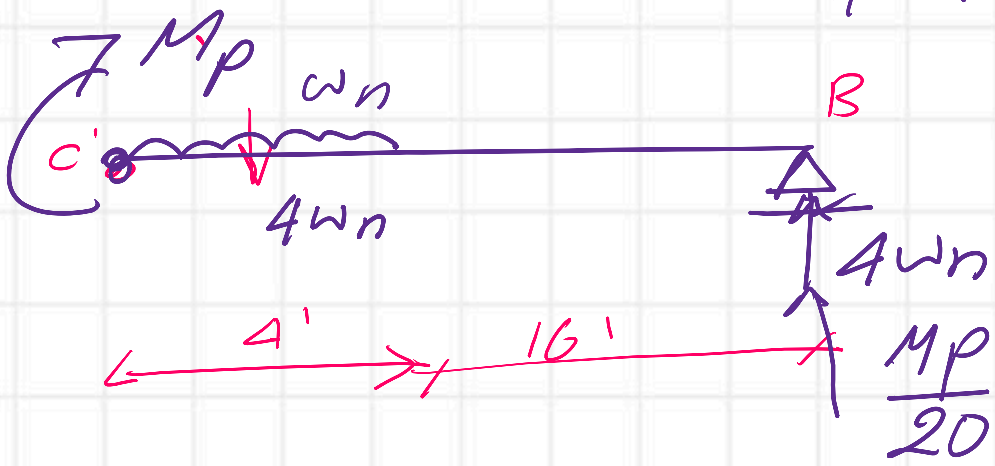
Collapse Load W_n



but x distance Can be found as follows

$R_A = 12w_n$

Check



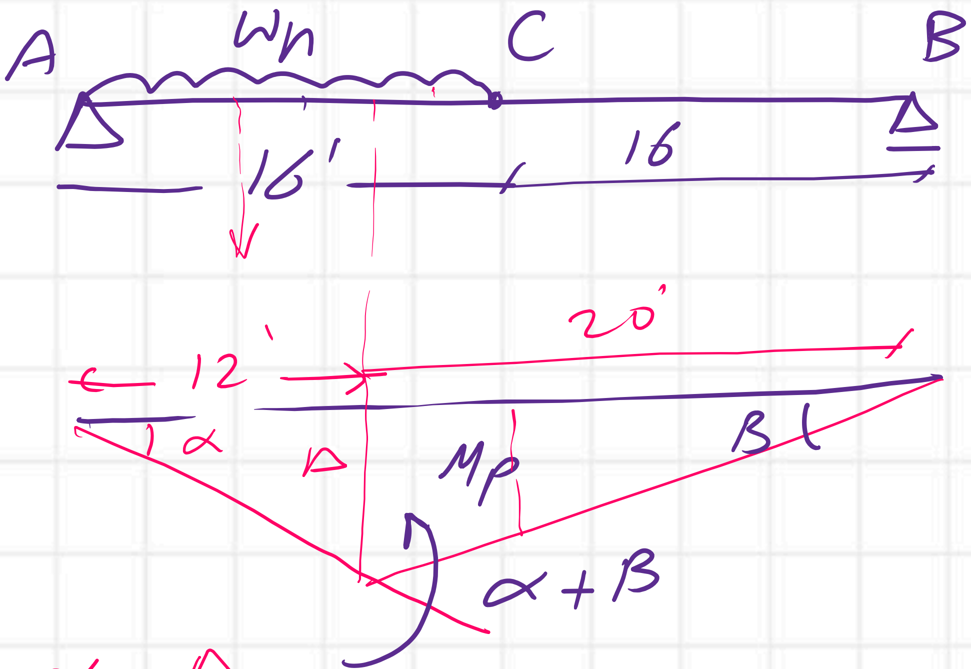
$M_p = F_y Z_x = 326.666$ FT. kips

$\Sigma M_B = 0$

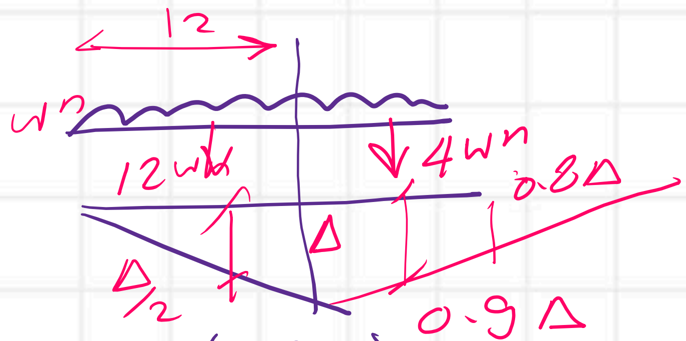
$4w_n(18) = M_p = 326.666$

$w_n = 4.537\ k/FT$

Using upper bound



Treat as Two C. Loads



$$W_e = W_i$$

$$W_e = 12 w_n \frac{\Delta}{2} + 4 w_n (0.9\Delta)$$

$$W_e = 9.6 w_n \Delta$$

$$W_i = M_p(\alpha + \beta)$$

$$9.6 w_n \Delta = 326.666\left(\frac{32\Delta}{240}\right)$$

$$\alpha = \frac{\Delta}{12}$$

$$\beta = \frac{\Delta}{20}$$

$M_p = 326.666$ FT-kips

$$\alpha + \beta = \frac{32\Delta}{240}$$

$$w_n = \frac{326.666(32)}{9.6(240)}$$

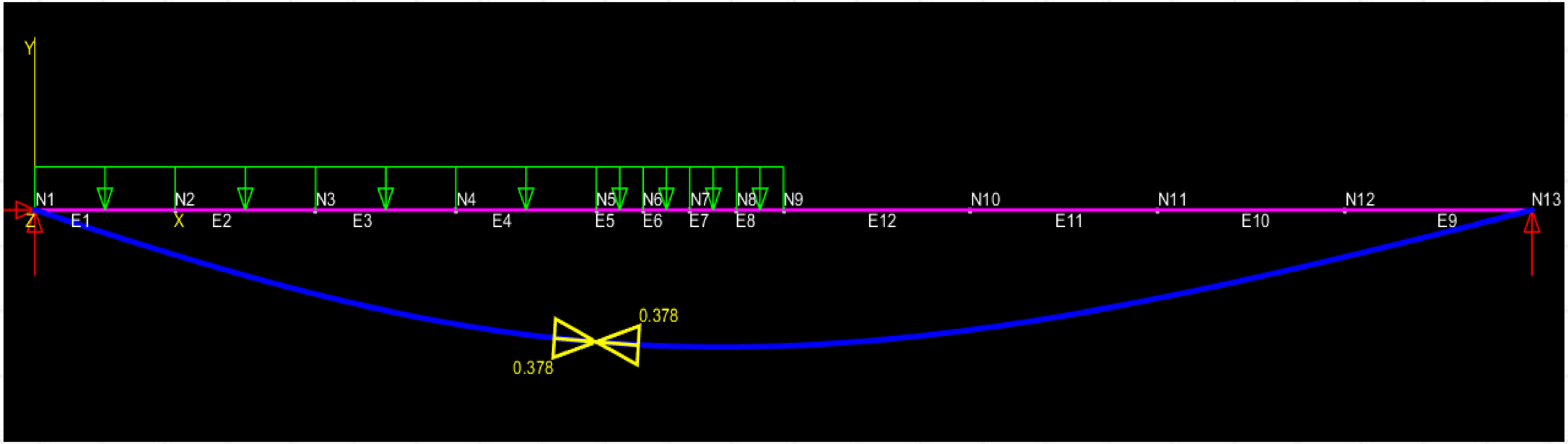
$w_n = 4.537$ k/F

From MASTAN 2

W = 0.378 Kip/inch

X 12 = 4.536 K/F → ≈ 4.54 K/F

Our solution: 4.537 Kip/Ft



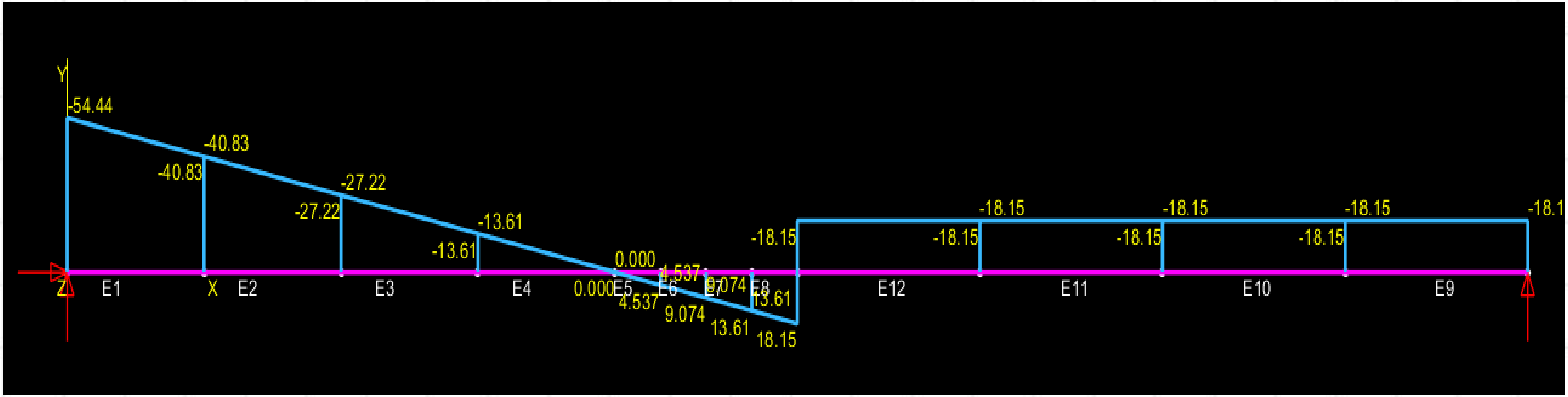
E = 29000 ksi

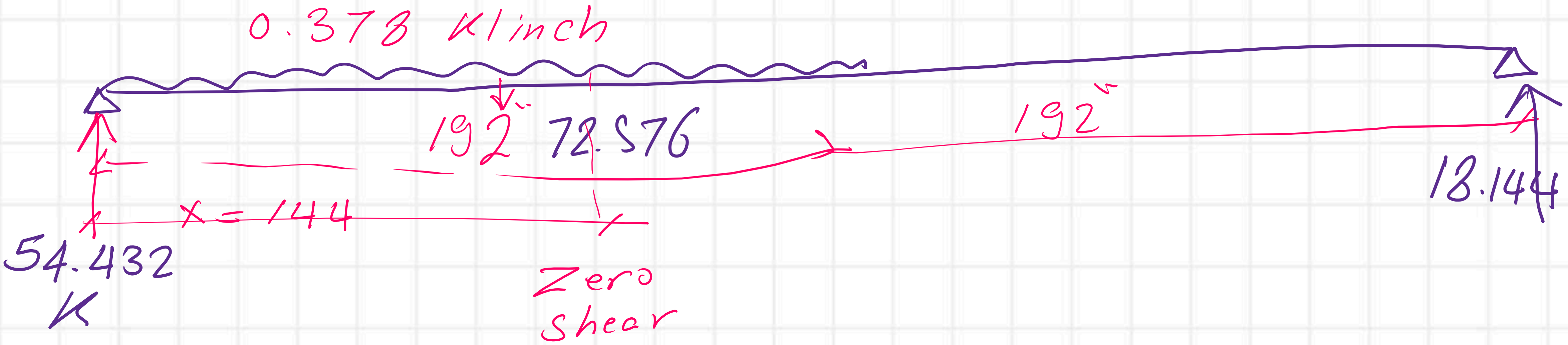
Fy = 50 ksi

X = 12' From left support

Prepared by Eng.Maged Kamel.

Shear diagram V_x

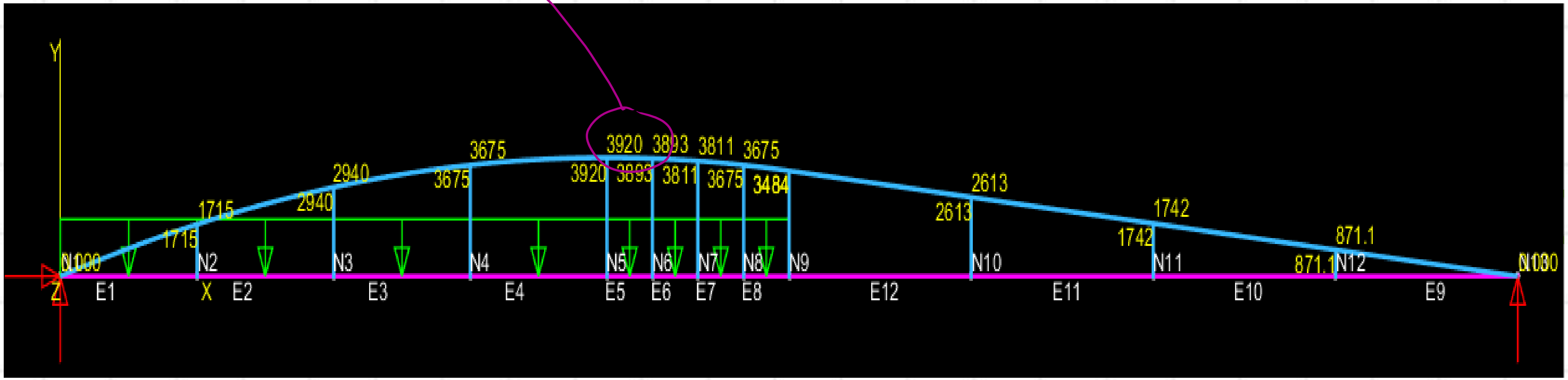




$M_p = 3920$ inch. Kips $= Z_x F_y$

$F_y = 50$ ksi

B.M. Diagram



$W_w = 1.00$ K/inch

$W_n = 1.00 \lambda$

Number of increment 100 — 0.10 — max: 10 ratio

Fourth increment

0.378

Prepared by Eng.Maged Kamel.