8-34 McCormac

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

① Ignore HL Reactions → ② Estimate Indeterminancy ID

8-34.

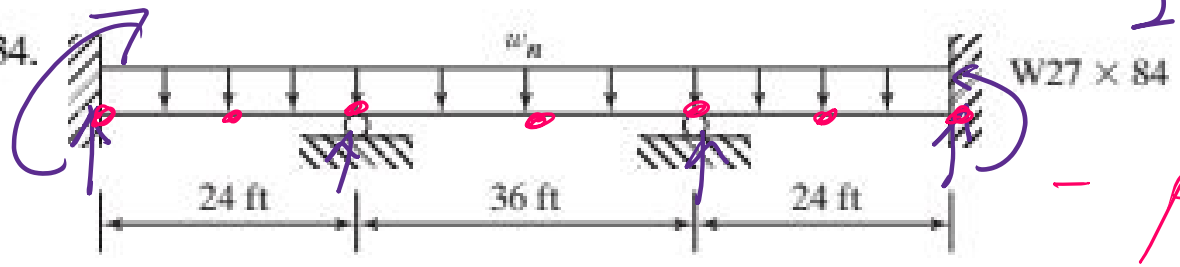


FIGURE P8-34

$ID = 6 - 2 = 4$

ΣY

$\Sigma \Lambda$

– Possible Hinges = 7

Mechanisms $= 7 - 4 = 3$

$F_y = 50$ ksi , $Z_x = 244$ inch^3 W27 X 84

$M_n = M_p = F_y \cdot Z_x = 50(244) = 12200$ inch.kip

→ M_p in FT.kips $= \frac{12200}{12} = 1016.66$ FT.kips

Hinges at places of maximum moments. We will Examine each mechanism

8-34.

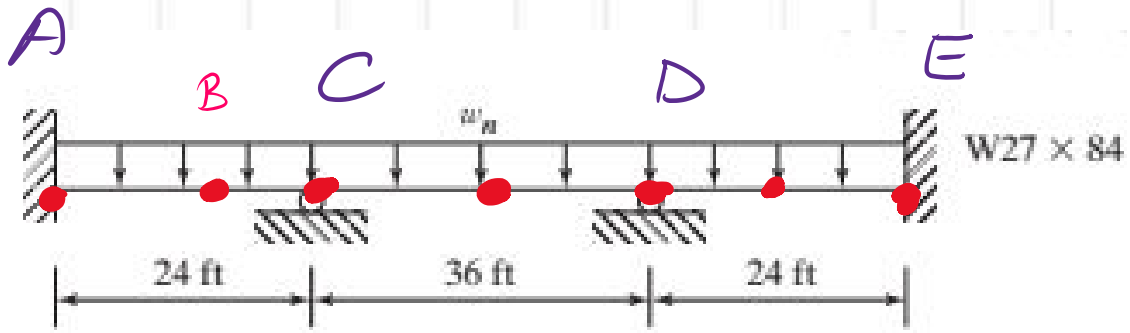
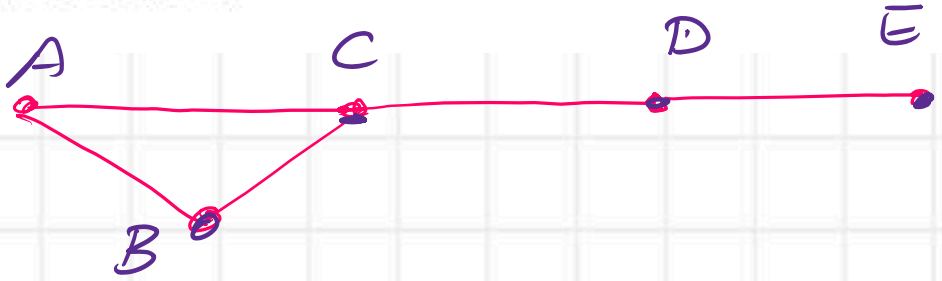
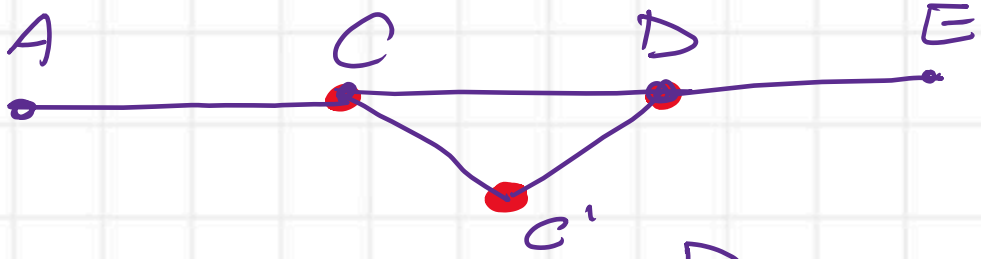


FIGURE P8-34

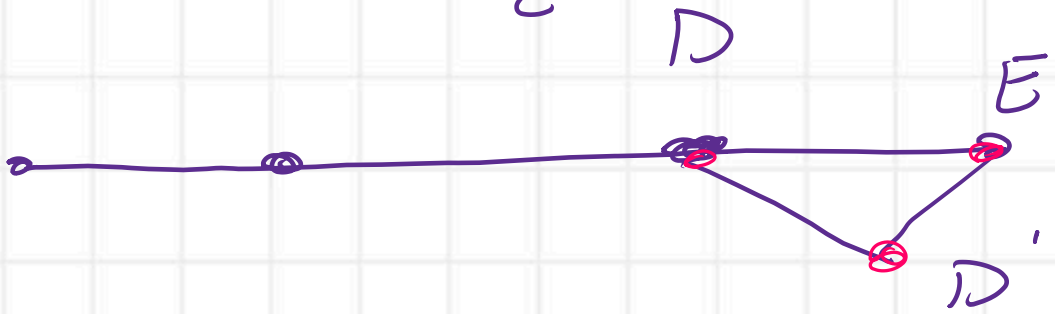
Different Mechanisms



First Mechanism
ABC Three hinges



2nd Mechanism
CC'D - Three hinges



3rd Mechanism
DD'E - Three hinges

8-34

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

First Mechanism span AC or span DE

L.B Lower bound

$M_p = 1016.66$ FT. kip

8-34.

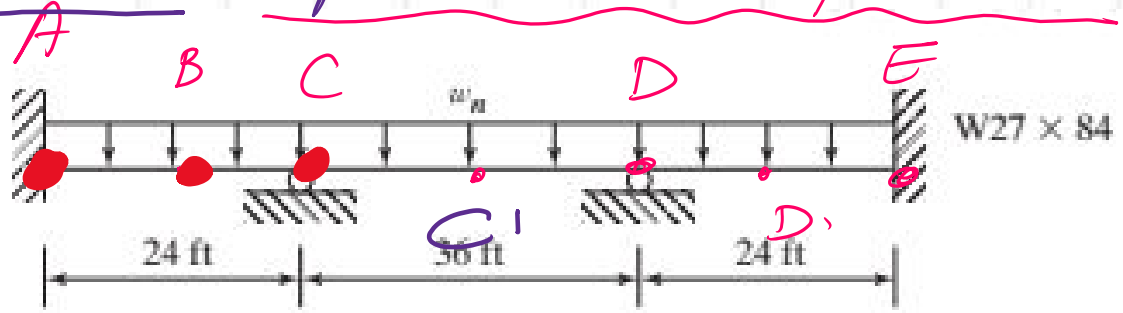
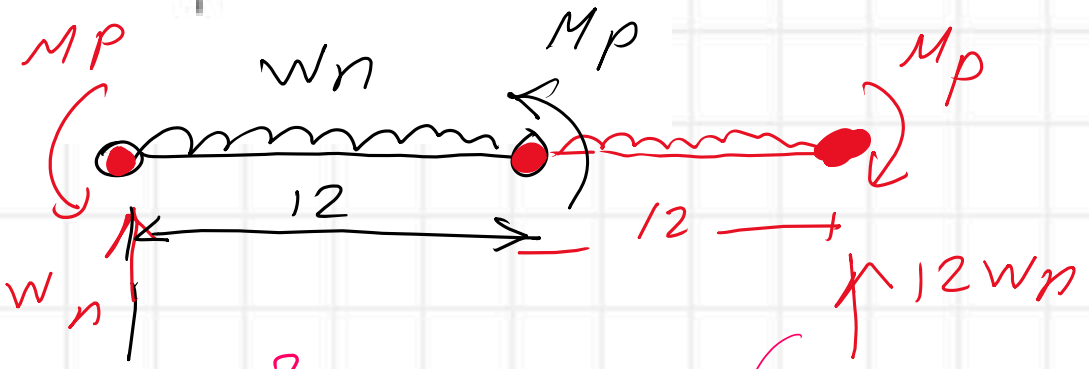


FIGURE P8-34

Solution

$R_A = 12 W_n$

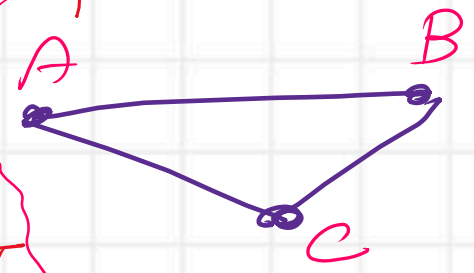


For three plastic hinges

$M_B = M_p \quad -M_p + 12 W_n (12) - \frac{12^2}{2} W_n = M_p$

$W_n (144 - 72) = 2 M_p$

$72 W_n = 2(1016.66) \Rightarrow \quad W_n = 28.24$ K/FT



or DD'E

8-34 Lower bound

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

span c-d: 3 plastic hinges

Examine 2nd span

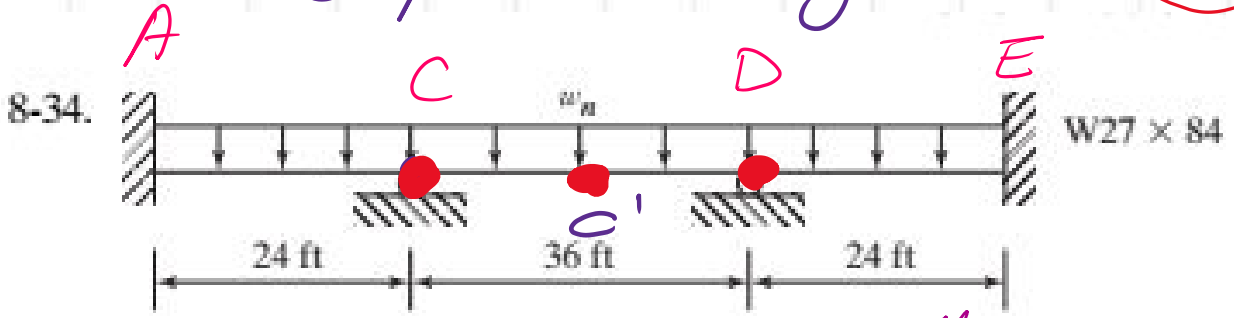
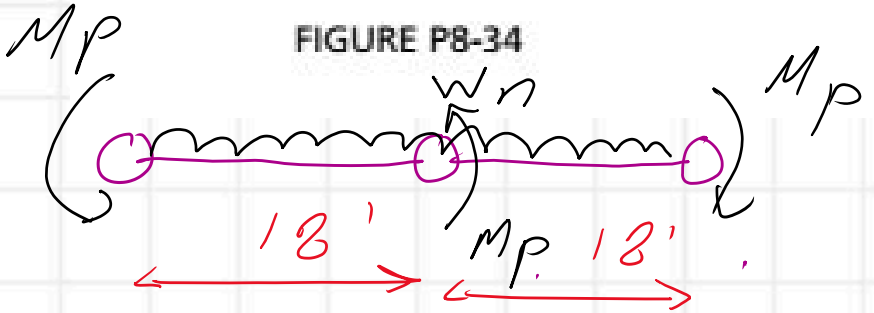
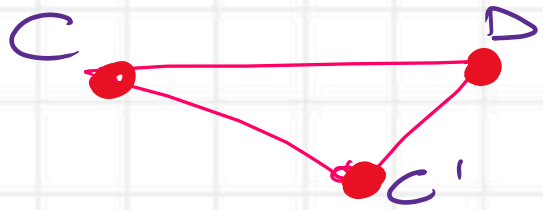


FIGURE P8-34

$M_p = 1016.66$ FT. kip





Moment at point f = M_p

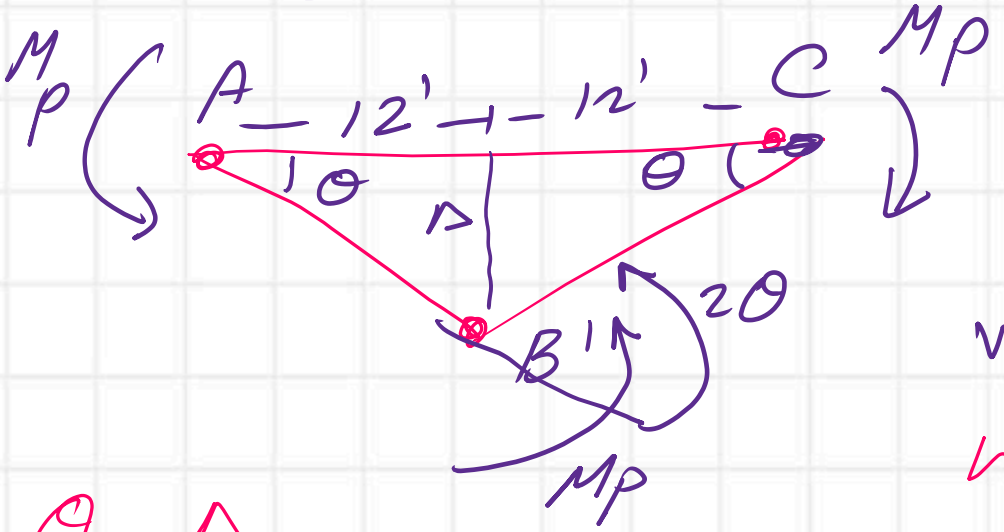
$$-M_p + 18 W_n (18) - w_n \frac{(18)^2}{2} = M_p$$

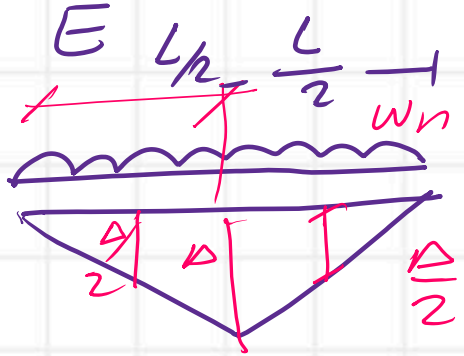
$$W_n (324 - 162) = 2M_p$$

$$W_n = \frac{2M_p}{162} = \frac{1}{81}(1016.66) = 12.551 \text{ K/Ft}$$

Upper bound span AC

$\ell = 24'$





$$W_e = w_n \frac{L}{2}\frac{\Delta}{2}(2)$$

$$W_e = w_n \Delta\left(\frac{24}{2}\right)$$

$$W_e = 12\, w_n \Delta$$

$$W_i = M_p(\theta + \theta + 2\theta) = M_p(4\theta)$$

$$W_i = M_p\left(\frac{\Delta}{3}\right) \Rightarrow 12\, w_n \Delta = M_p \frac{\Delta}{3}$$

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

$$4\theta = \frac{\Delta}{3}$$

But $M_p = 1016.66$ FT-Kips

$$w_n = \frac{M_p}{36}$$

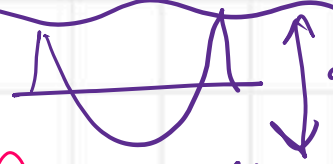
W27X84

$Z_x = 244$ inch^3

$F_y = 50$ ksi

$$w_n = 1016.66/36 = 28.24 \text{ K/F}$$

or



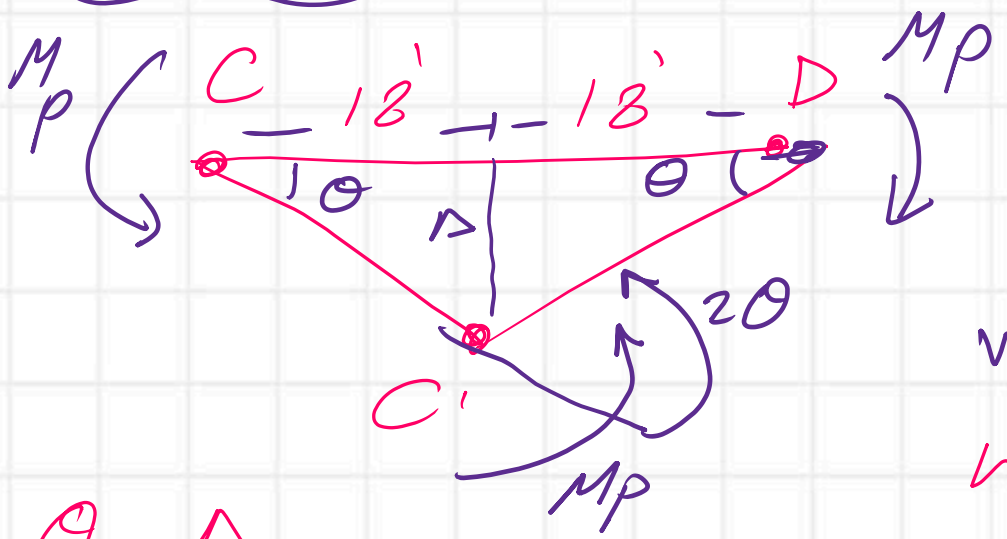
$$2M_p = w_n \frac{L^2}{8} \Rightarrow w_n = \frac{16}{L^2} M_p$$

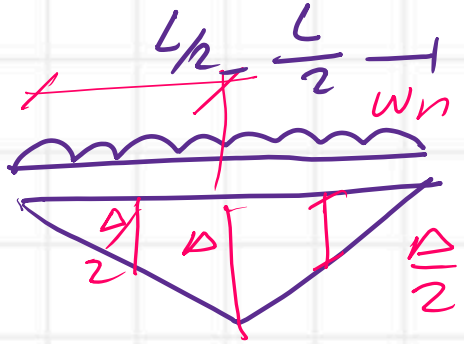
$$w_n = \frac{16 M_p}{(24)^2} = \frac{M_p}{36}$$

Same Expression

Upper bound span CD

$\ell = 36'$





$$W_e = w_n \frac{L}{2}\frac{\Delta}{2}(2)$$

$$W_e = w_n \Delta\left(\frac{36}{2}\right)$$

$$W_e = 18\, w_n \Delta$$

$$W_i = M_p(\theta + \theta + 2\theta) = M_p(4\theta)$$

$$W_i = M_p\left(\frac{2\Delta}{9}\right) \Rightarrow 18\, w_n \Delta = M_p\left(\frac{2}{9}\right)\Delta$$

$$\theta = \frac{\Delta}{18}$$

$$4\theta = \frac{\Delta}{9}2$$

But $M_p = 1016.66$ FT.Kips

$$w_n = \frac{M_p}{81}$$

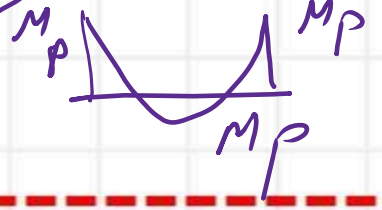
$$w_n = 1016.66 / 81 = 12.55 \text{ K/F}$$

W27X84

$Z_x = 244$ inch^3

$F_y = 50$ ksi

or $w_n \frac{L^2}{8} = 2M_p \Rightarrow w_n = \frac{16 M_p}{(36)^2} = \frac{M_p}{81}$



Same $w_n = 12.55$ K/F

8-34.

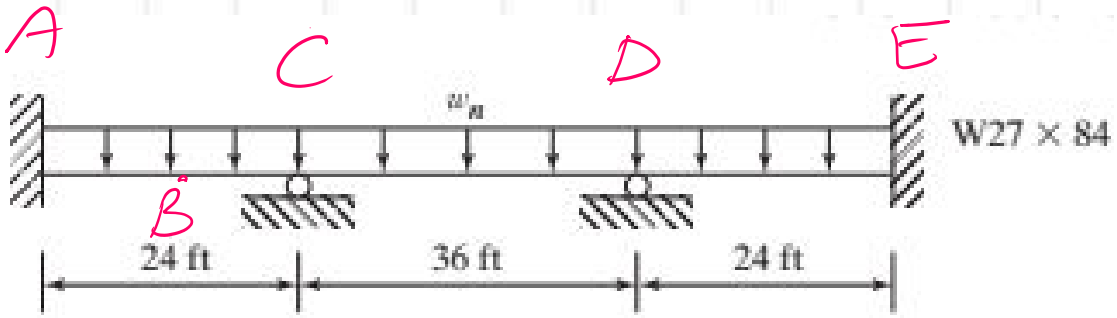


FIGURE P8-34

span AC

$w_n = 28.24$ k/F

span DE

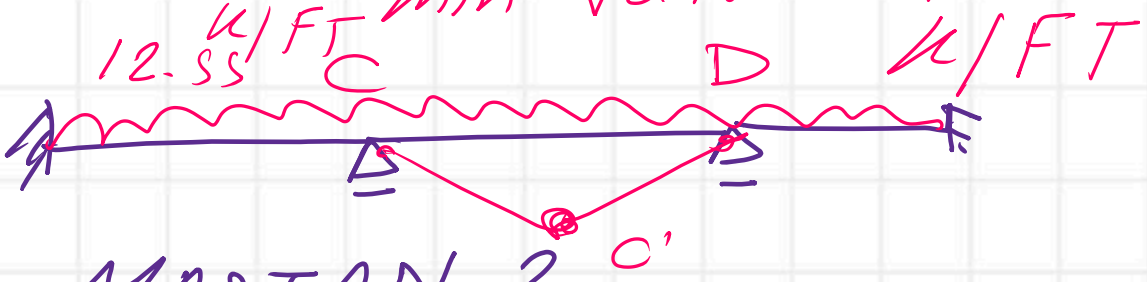
$w_n = 28.24$ k/F

span CD

$w_n = 12.55$ k/F

$\Rightarrow$ w_n Selected

min value = 12.55 k/FT

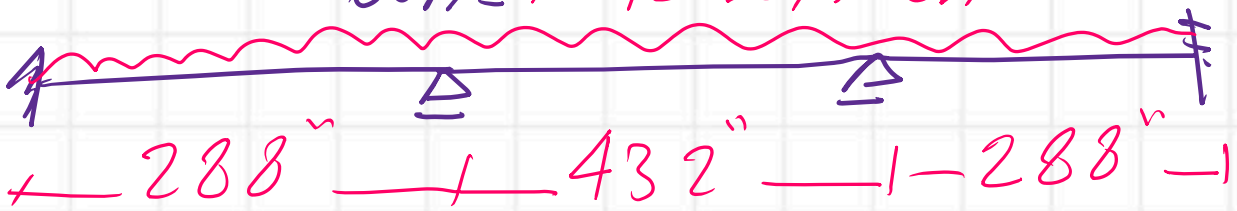


$w_n \Rightarrow 12.55$ k/F

$\Downarrow$ 1.0458 k/inch For MASTAN.2

span in inches = (288", 432", 288")

$W_n = 1.046$ k/inch



MASTAN-2

$E = 29000$ ksi

$F_y = 50$ ksi

Nominal W_n

$W_{working} = 1.0$ k/inch

$W_n = \lambda W_w$

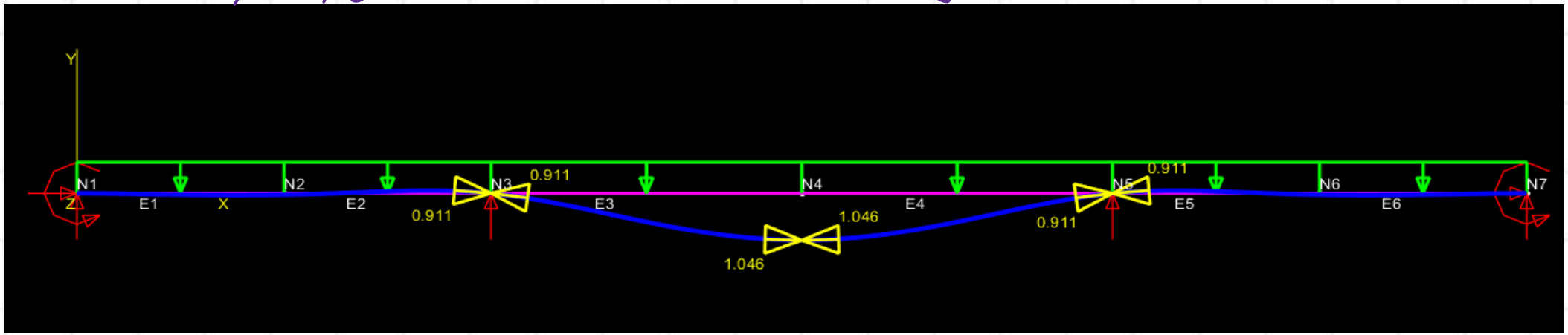
λ will be Found

15 increments, each increment = 0.10

$\lambda W_{max} = 1.5$

$\lambda = 1.046$

$W_n = 1.0(1.046) = 1.046$ k/inch

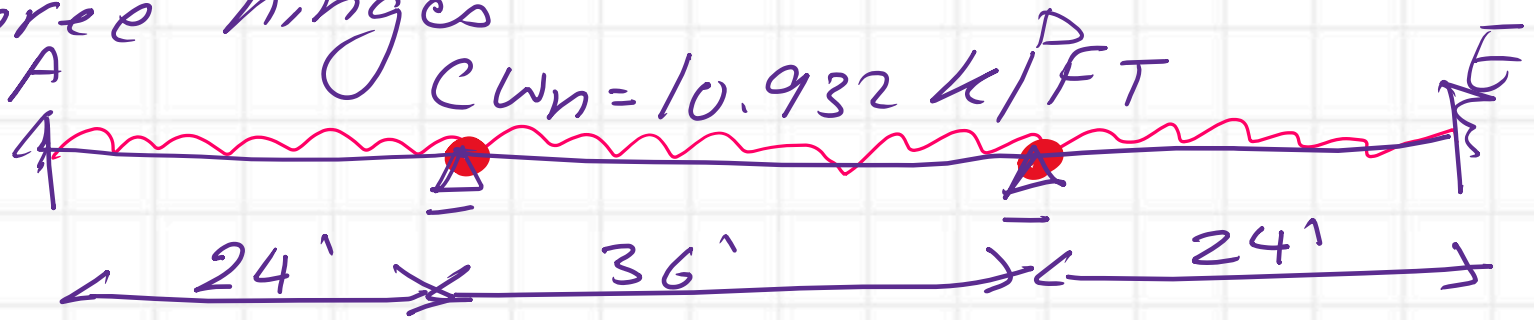


There are three hinges

$\lambda_1 : 0.911$

$\lambda_2 : 0.911$

$\lambda_3 : 1.046$

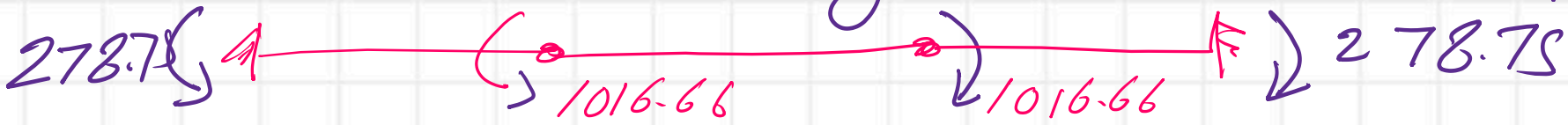


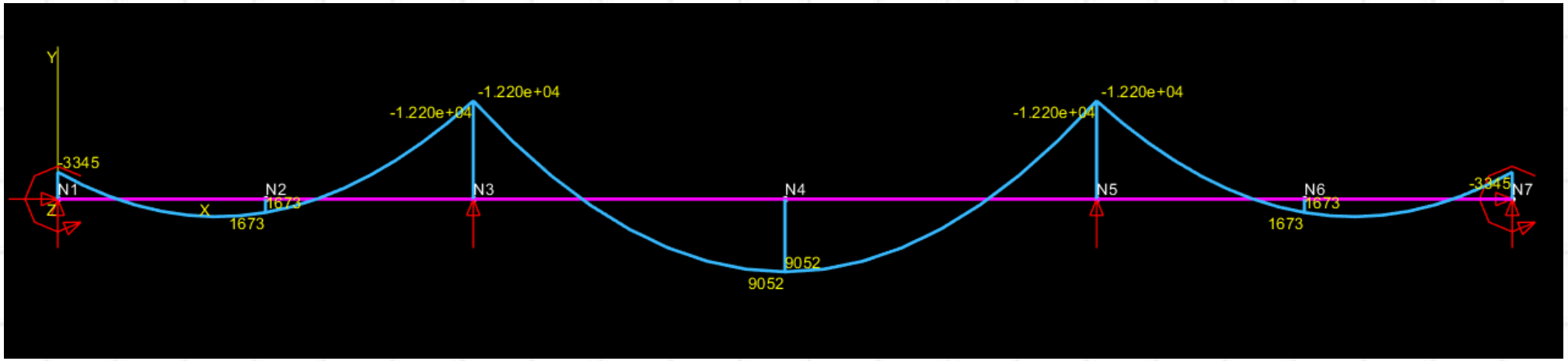
$w_{n_1} = 0.911$ K/inch $= 0.911(12) = 10.932$ K/FT

We have two Plastic hinges at C & D

FT. kip.

Why?





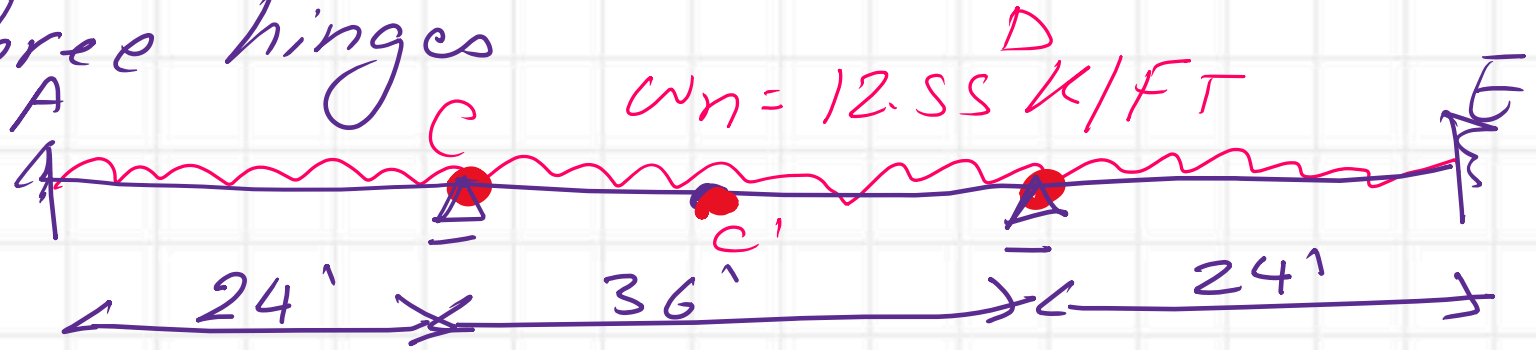
$M_{Diagram}$ inch kips

There are three hinges

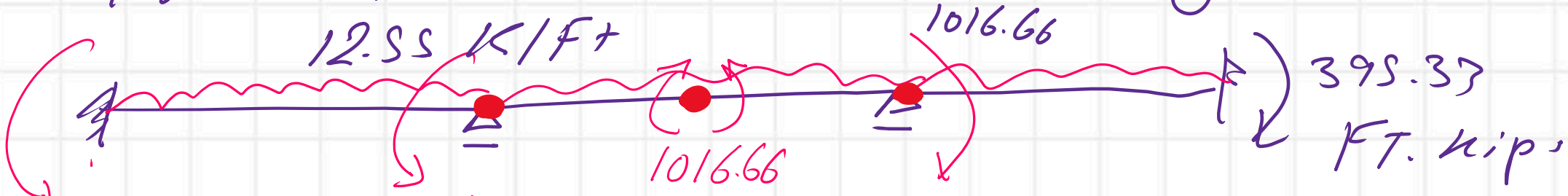
$\lambda_1 : 0.911$

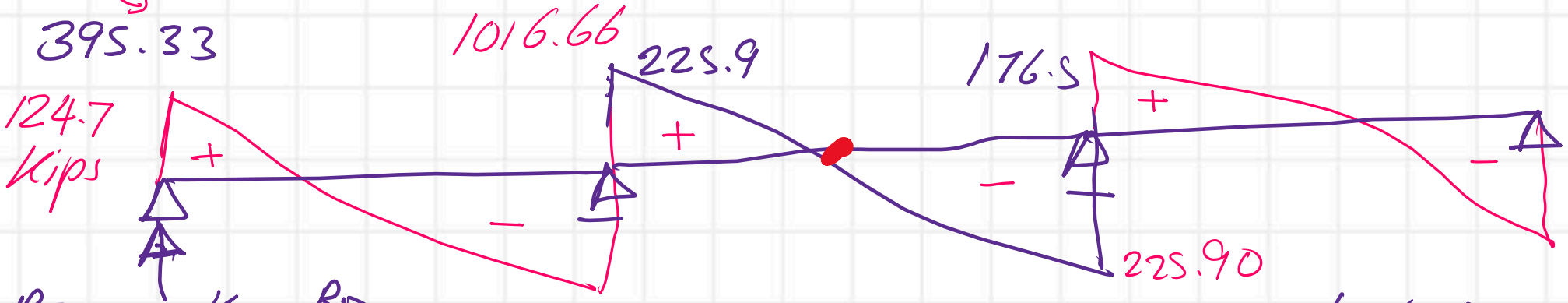
$\lambda_2 : 0.911$

$\lambda_3 : 1.046$



For $\lambda w = 1.046$ K/inch there are 3 hinges C, C', D





S. Diagram

$R_E =$ K $\quad R_D =$

$R_A = 124.7$, $R_C = 402.4$

$\Sigma VL = 12.55(2(24) + 36) = 1054.2$ K