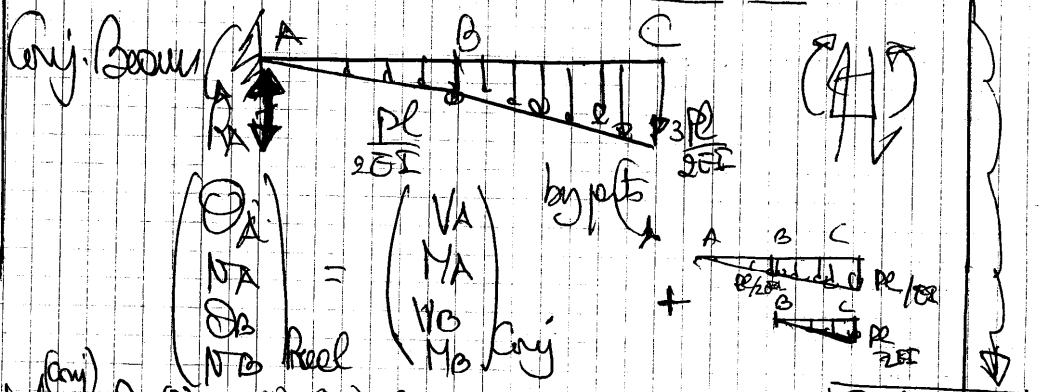
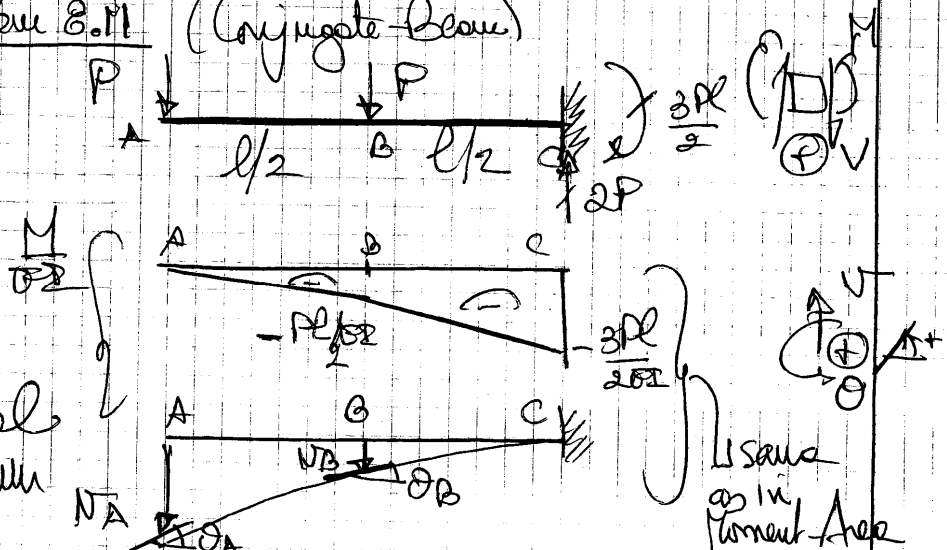


Problem 8.11 (Conjugate Beam)



$$\begin{pmatrix} \Delta_A \\ V_A \\ \theta_B \\ \theta_C \end{pmatrix}_{\text{Real}} = \begin{pmatrix} V_A \\ M_A \\ V_B \\ M_B \end{pmatrix}_{\text{Conj}}$$

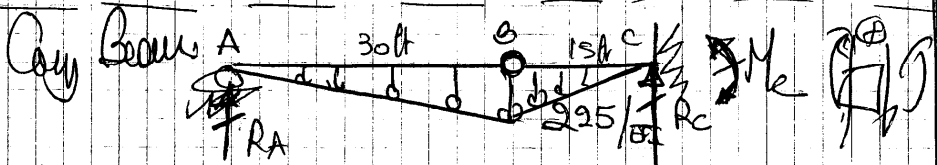
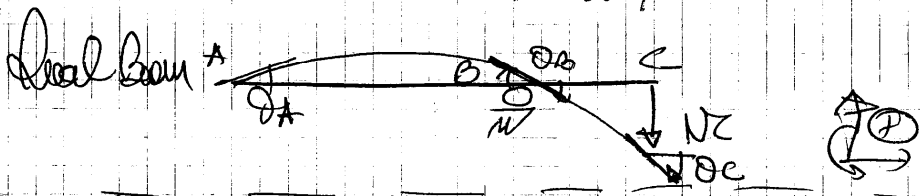
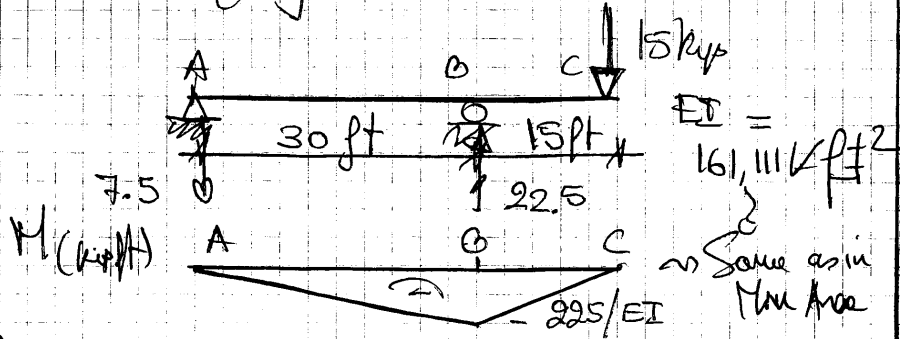
$$V_A^{(\text{Conj})} = R_A = \left(\frac{1}{2}\right) \left(\frac{Pl}{2EI}\right) \times l + \left(\frac{1}{2}\right) \left(\frac{Pl}{2EI}\right) \left(\frac{l}{2}\right) = \frac{5Pl}{8EI} \Rightarrow \boxed{\theta_A = \frac{5Pl^2}{8EI}}$$

$$M_A^{(\text{Conj})} = \left(\frac{1}{2}\right) \left(\frac{Pl}{2EI}\right) \cdot \left(\frac{2l}{3}\right) + \left(\frac{1}{2}\right) \left(\frac{Pl}{2EI}\right) \left(\frac{l}{2}\right) \left(\frac{l}{2} + \frac{2}{3} \cdot \frac{l}{2}\right) = \frac{7Pl^3}{16EI} \Rightarrow \boxed{\theta_B = \frac{7Pl^3}{16EI}}$$

$$V_B^{(\text{Conj})} = \left(\frac{1}{2}\right) \left(\frac{Pl}{2EI}\right) \cdot \left(\frac{l}{2}\right) = \frac{Pl^2}{4EI} \Rightarrow \boxed{\theta_B = \frac{Pl^2}{4EI}}$$

$$M_B^{(\text{Conj})} = \left(\frac{1}{2}\right) \left(\frac{Pl}{2EI}\right) \left(\frac{l}{2}\right) \left(\frac{l}{2}\right) = \frac{Pl^3}{8EI} \Rightarrow \boxed{\theta_C = \frac{Pl^3}{8EI}}$$

Problem 8.12 (Cant. Beam)



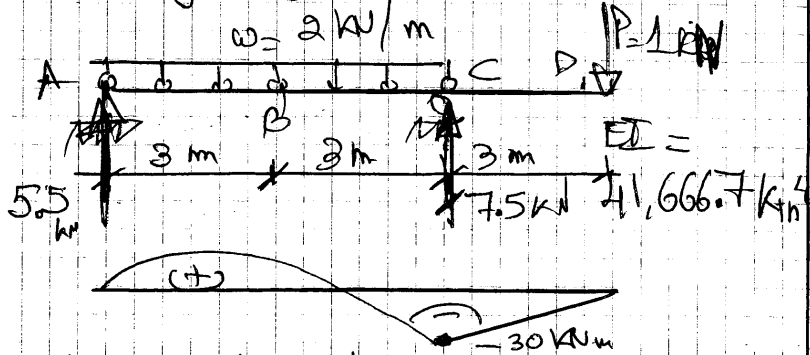
$\sum M_B = 0 \Rightarrow R_A \times 30 - \left(\frac{1}{2}\right) \left(\frac{225}{EI}\right) (30) \left(\frac{1}{3} \times 30\right)$
 $\Rightarrow R_A = \frac{1125}{EI} \quad (\Rightarrow \theta_{A, \text{real}} = \frac{1125}{EI} \downarrow)$

$\sum F_y = 0 \Rightarrow R_C = R_A - \frac{3937.5}{EI}$
 $\Rightarrow \theta_C^{\text{real}} = -\frac{3937.5}{EI} = -0.0244 \text{ rad} \downarrow$

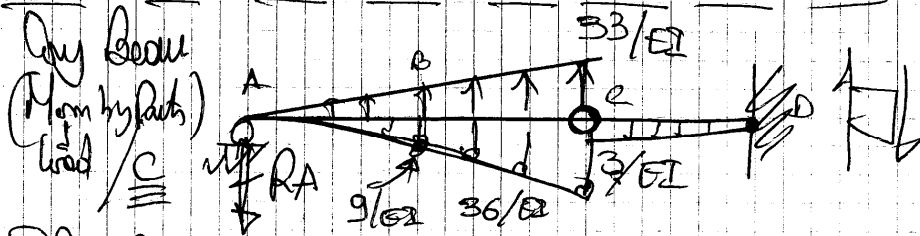
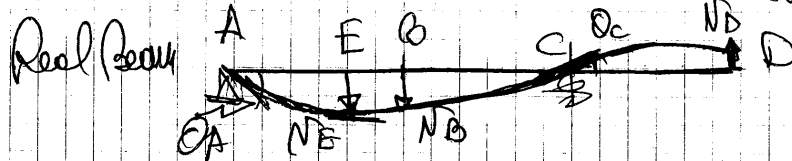
$\sum M_C = 0 \Rightarrow M_C = \frac{1125 \times 45}{EI} - \left(\frac{1}{2}\right) \left(\frac{225}{EI}\right) (30) (25)$
 $- \left(\frac{1}{2}\right) \left(\frac{225}{EI}\right) (15) \left(\frac{2}{3} \times 15\right) = -\frac{50,625}{EI}$
 $\Rightarrow \theta_C^{\text{real}} = -\frac{50,625}{EI} = 0.3142 \text{ ft} \downarrow$



Problem III: (Cant Beam)



See Moment Area \rightarrow Moment by Parts \rightarrow load up on Cant Beam



Solve beam:

$\sum M_C = 0 \Rightarrow R_A \cdot 6 - \frac{w \cdot 6^2}{2} \cdot 2 + P \cdot 3 = 0$
 $\Rightarrow R_A = \frac{15}{EI}$ (real)
 $\Rightarrow R_A = \frac{15}{EI} \text{ C.W}$

$\sum F_y = 0 \Rightarrow V_C = \frac{12}{EI}$ (real)
 $\Rightarrow \theta_C = +0.988 \times 10^{-3} \text{ rad CCW}$

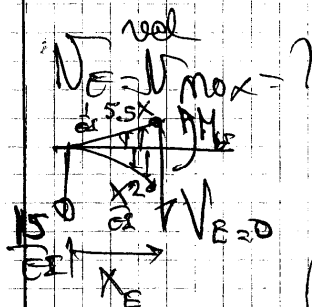
$\sum M_B = 0 \Rightarrow M_B = \frac{57}{EI}$ (real)
 $\Rightarrow N_B = -0.648 \times 10^{-3} \text{ m}$



Problem III (cont'd)

$(AD \Rightarrow M_D = 0 \quad \text{or} \quad CD \Rightarrow M_D = 0 \quad \leftarrow$

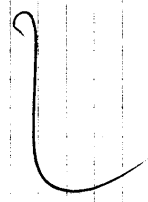
$\frac{12}{EI} \times 3 \times \frac{3}{EI} \Rightarrow M_D = \frac{12}{EI} \times 3 - \left(\frac{12}{EI}\right) \times \left(\frac{2}{3} \times 3\right) = \frac{27}{EI}$
 $\Rightarrow N_D = \frac{27}{EI} = 0.648 \times 10^{-3} \text{ m} \quad \leftarrow$



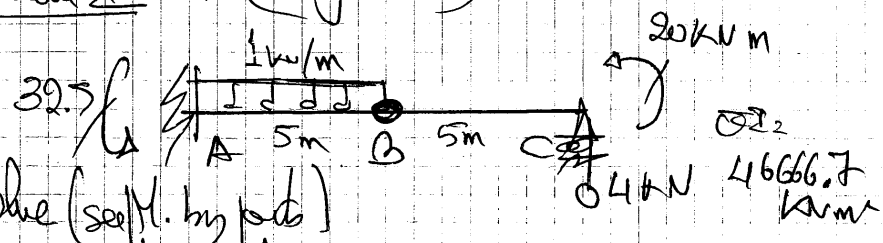
$M_{max} \quad \text{and} \quad V_{max} = 0$
 $\Sigma F_y = 0 \Rightarrow x_E^2 - 8.25x_E + 4.5 = 0$
 $\Rightarrow x_E = 2.9 \text{ m} \quad \checkmark$

$(\Sigma M_E = 0)$
 $\Sigma M_A = 0 \Rightarrow M_E = -\frac{27.04}{EI}$
 $\Rightarrow N_E = -0.649 \times 10^{-3} \text{ m} \quad \leftarrow$
 (max)

Note that $E \approx B$ & $N_E > N_B$
 but very close

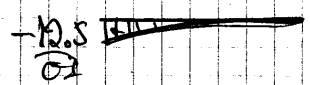
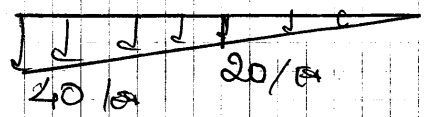
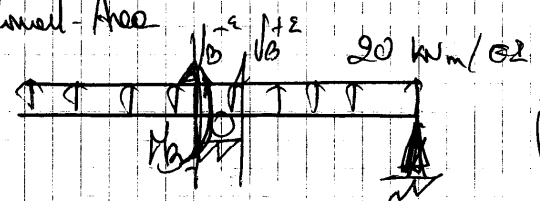


Problem 10 : (Cov Beam)



Solve (see M. by part)
 Maxwell-Arec

Cov Beam
Max/Part A



Solve



Solve Cov. Beam:

$$\begin{aligned}
 \Delta_B^{(real)}(-\epsilon) &= V_B^{(-\epsilon)}(cov) \\
 \Delta_B^{(real)}(+\epsilon) &= V_B^{(+\epsilon)}(cov) \\
 N_B^{(real)} &= N_B^{(cov)} \\
 \Delta_C^{(real)} &= V_C^{(cov)}
 \end{aligned}$$

} See Max-Arec results

