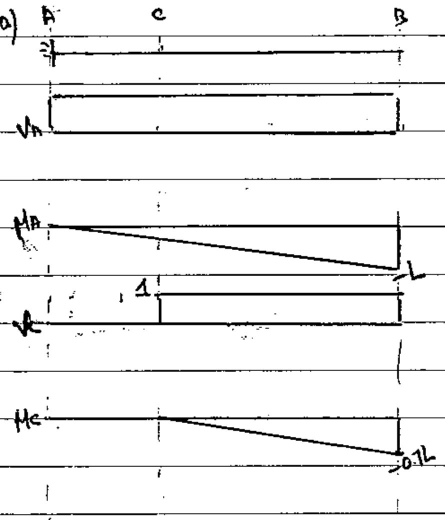
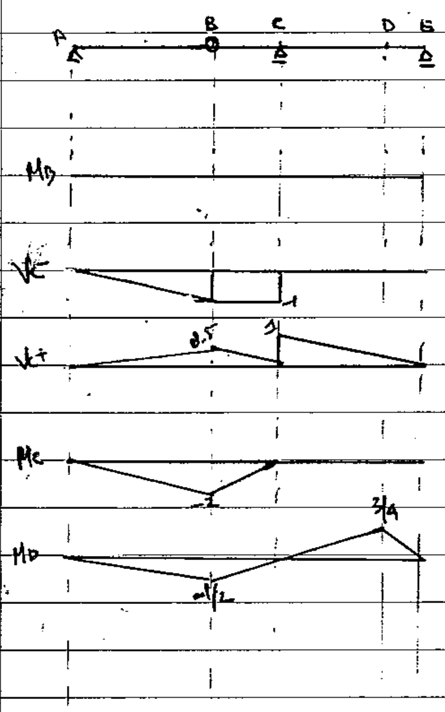
Yes, U can!

CV3101 - SEM I - 11/12

1 a)

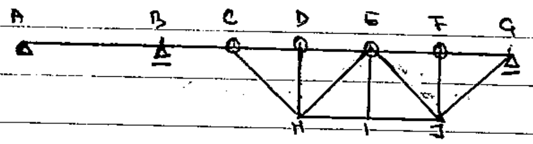


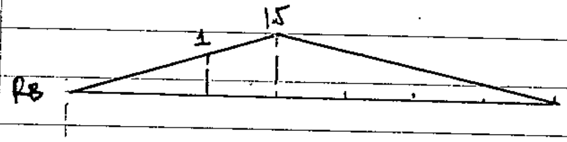
b)

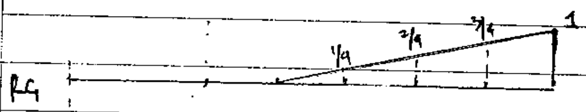


1 c)

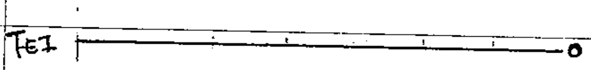
For supports B and G can use Muhller's method





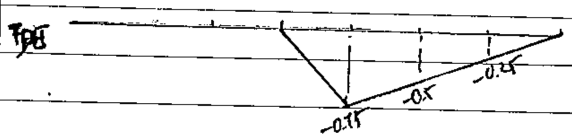


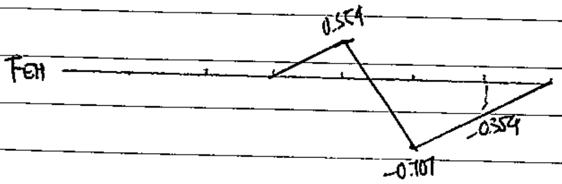
There will be no force in EI unless the load is acting at H-I-J span



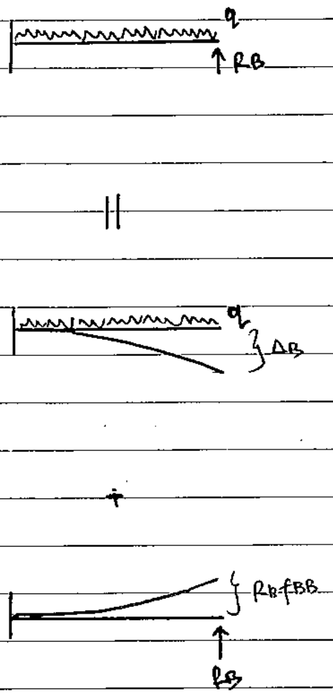
Tabulate method for FEH & FDE

Load location	F_{DE}	F_{EH}
<9	0	0
12	-0.75	0.354
15	-0.5	-0.707
18	-0.25	-0.354
21	0	0





2 a)



$$\Delta_B + R_b f_{BB} = -\frac{R_b}{k}$$

$$-\frac{qL^4}{8EI} + \frac{R_b L^3}{3EI} = -\frac{R_b L^3}{3EI}$$

$$\frac{2}{3}\frac{L^3}{EI}R_b = \frac{L^4}{8EI}q$$

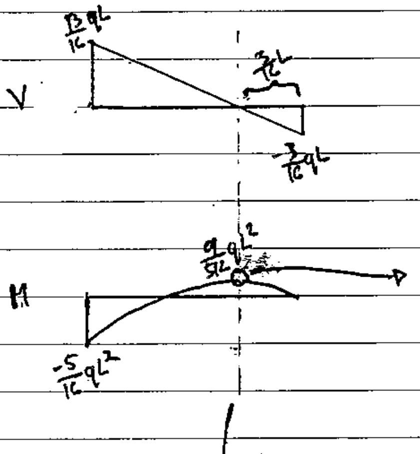
$$\rightarrow R_b = \frac{3}{16}qL \quad (\uparrow)$$

$$\rightarrow R_A = qL - \frac{3}{16}qL$$

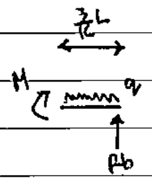
$$R_A = \frac{13}{16}qL \quad (\uparrow)$$

$$\rightarrow M_A = qL\left(\frac{L}{2}\right) - \frac{3}{16}qL(L)$$

$$M_A = \frac{5}{16}qL^2 \quad (\circlearrowleft)$$



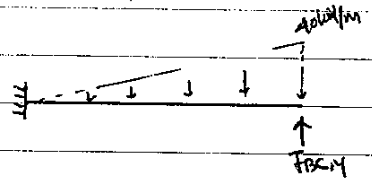
drawn in compression side



$$M = \frac{3}{16}qL\left(\frac{3}{16}L\right) - q\left(\frac{3}{16}L\right)\left(\frac{3}{16}L/2\right)$$

$$= \frac{9}{512}qL^2$$

2 b)



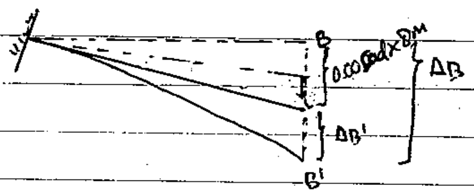
Note ΔB, $\Delta B''$ = deflection of B from original neutral axis / point

$\Delta B + \Delta B'' = 0$

$F_{BC,Y}$ as redundant

||

Real System



in M.

$\Delta B = -(0.005 \times 8 + \Delta B')$

$= -0.04 - \frac{11(40)(8)^4}{120(200)(200)}$ ← formula $\frac{11qL^4}{120EI}$

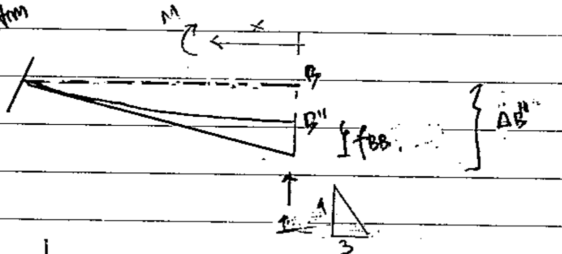
$\Delta_B = -415.41 \times 10^{-3}$ mm

↳ $F_{BC,Y} = 0$

can use formula

+

Virtual System



$\Delta B'' = -(0.005 \times 8 - f_{BB} \cdot F_{BC,Y})$

200 GPa $= 200 \times 10^9$ Pa $= 200 \times 10^6$ kN/m²

↳ $\bar{F}_{BC,Y} = 1$

strut BC

F_{BC} (under compression) $= -\frac{5}{4}$

$M = x$

$f_{BB} = \int_0^8 \frac{m^2\,dx}{EI} + \frac{n^2 L}{AE}$

$= \frac{\frac{8^3}{3}}{(200)(200)} + \frac{(-\frac{5}{4})^2 (5)}{(10^{-3})(200 \times 10^6)}$

$= 4.306 \times 10^{-3}$ M

2 b)

$\Delta_B + \Delta_B'' = 0$

$-415.47 \times 10^{-3} + -(0.04 - 4.306 \times 10^{-3} F_{BC,y}) = 0$

$F_{BC,y} = 105.78 \text{ kN} \quad (\uparrow)$

Note: Im not sure about the compatibility equation, but whatever your eq is, your M_A must be ↺ / ccw.

Moment at support A ;

$M_A = \left(\frac{1}{2} \times 40 \times 8\right)\left(\frac{2}{3} 8\right) - 105.78(8)$

$= 7.09 \text{ kNm} \quad (↺)$

3 a) DOF = θ_b, θ_c

FEM :

$AB = -\frac{200(5)(5)^2}{10^2} = -250$

$BA = +250$

$BC = -\frac{24(8)^2}{12} = -128$

$CB = +128$

$BD = 0$

$DB = 0$

$M_{AB} = \frac{2(2EI)\theta_b}{10} - 250$

$M_{BA} = \frac{4(2EI)\theta_b}{10} + 250$

$M_{BC} = \frac{4(2EI)\theta_b}{8} + \frac{2(2EI)\theta_c}{8} - 128$

$M_{CB} = \frac{4(2EI)\theta_c}{8} + \frac{2(2EI)\theta_b}{8} + 128$

$M_{BD} = \frac{4EI\theta_b}{10}$

$M_{DB} = \frac{2EI\theta_b}{10}$

3 a)

EQ,

① $M_{CB} = 0$

$EI\theta c + \frac{1}{2}EI\theta b + 128 = 0$

② $M_{BA} + M_{BC} + M_{BD} = 0$

$\frac{8}{10}EI\theta b + 250 + EI\theta b + \frac{1}{2}EI\theta c - 128 + \frac{4}{10}EI\theta b = 0$

$2.2\,EI\theta b + 122 + \frac{1}{2}\left(-128 - \frac{1}{2}EI\theta b\right) =$

$1.95\,EI\theta b + 58 = 0$

$\theta b = \frac{-29.74}{EI} \rightarrow \theta c = \frac{-113.13}{EI}$

end moments:

$M_{AB} = -261.90$

$M_{BA} = 226.21$

$M_{BC} = -214.31$

$M_{CB} = 0$

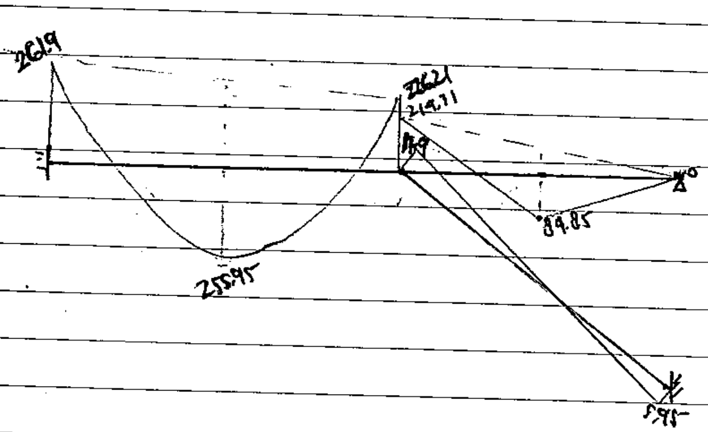
$M_{BD} = -11.90$

$M_{DB} = -5.95$

b) drawn in tension side

$M_{simple,AB} = \frac{PL}{4} = 500$

$M_{simple,BC} = \frac{wL^2}{8} = 192$



4 a)

FEM: $AB = -\frac{20(12)^2}{12} = -240$

$BA = 240$

$BC = -\frac{16(2.5)(2.5)^2}{5^2} = -10$

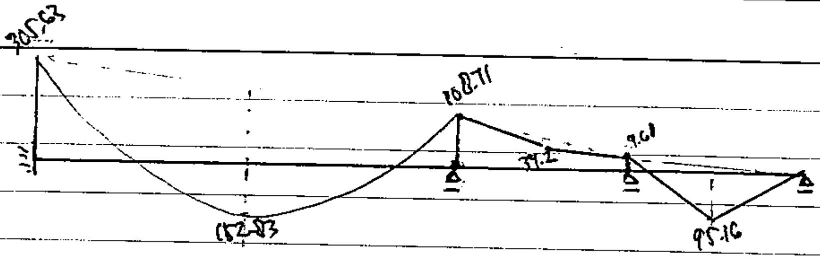
$CB = +10$

$CD = \frac{-80(2.5)(2.5)^2}{5^2} = -50$

$DC = +50$

joint	A	B		C		D
Member end	ab	ba	bc	cb	cd	dc
STIFF	0.8EI	0.8EI	0.8EI	0.8EI	0.8EI	0.8EI
D.F	0	0.5	0.5	0.5	0.5	1
FEM	-240	240	-10	10	-50	50
DIST	0	-115	-115	20	20	-50
CO	-57.5		10	-57.5	-25	
DIST	0	-5	-5	41.25	41.25	
CO	-2.5		20.625	-2.5		
DIST	0	-10.3125	-10.3125	1.25	1.25	
CO	-5.1563		0.625	-5.1563 +2.5782	2.5782	
DIST	0	-0.3125	-0.3125			
CO	-0.1563		1.2891	-0.1563		
DIST	0	-0.6446	-0.6446	+0.0782	+0.0782	
CO	-0.3223		0.0391	-0.3223		
DIST		-0.0196	-0.0196	0.1612	0.1612	
Σ	-305.63	108.71	-108.71	9.68	-9.68	0

4 b)

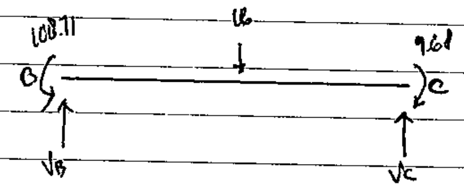


$M_{simple,AB} = \frac{(20)(12)^2}{8} = 360$

$M_{simple,BC} = \frac{16(5)}{4} = 20$

$M_{simple,CD} = \frac{80(5)}{4} = 100$

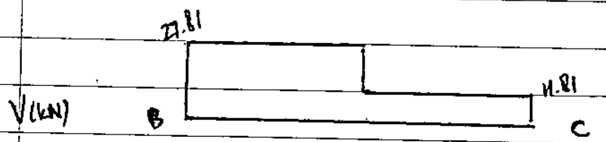
c)



$\Sigma M_B = 0$

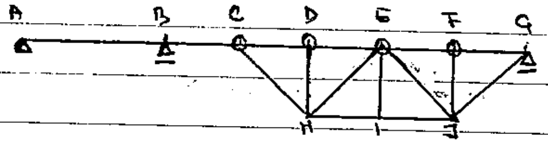
$-16(2.5) + 108.71 - 9.68 + V_C(5) = 0$

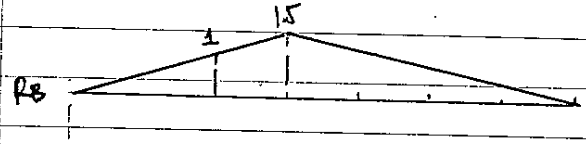
$V_C = -11.81$ kN $\rightarrow$ $V_B = 27.81$ kN

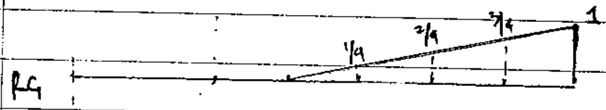


1 c)

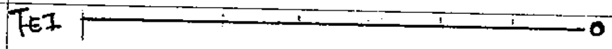
For supports B and G can use Mbhller's method







There will be no force in EI unless the load is acting at H-I-J span



Tabular method for F_{EH} & F_{DE}

Load location	F_{DE}	F_{EH}
<9	0	0
12	-0.75	0.354
15	-0.5	-0.707
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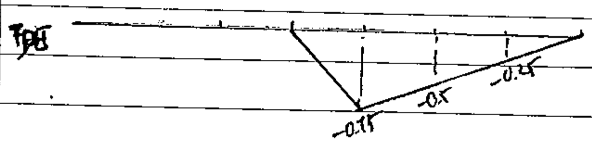
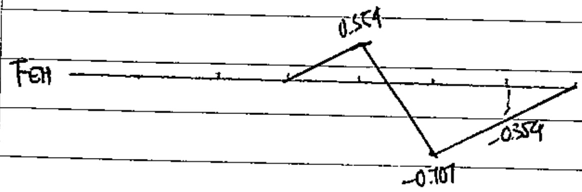
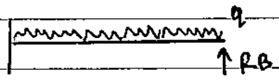
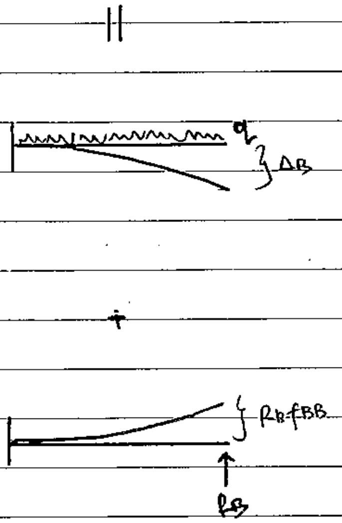




Yes, U Can!

2 a)





$$\Delta_B + R_b f_{BB} = -\frac{R_b}{k}$$

$$-\frac{qL^4}{8EI} + \frac{R_b L^3}{3EI} = -\frac{R_b L^3}{3EI}$$

$$\frac{2}{3}\frac{L^3}{EI} R_b = \frac{L^4}{8EI} q$$

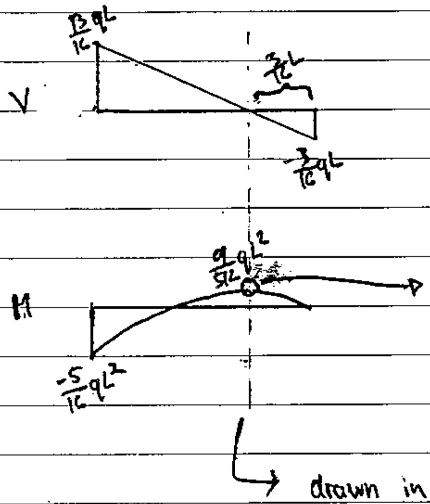
$$\rightarrow R_b = \frac{3}{16} qL \quad (\uparrow)$$

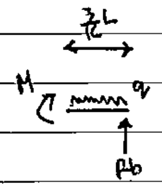
$$\rightarrow R_A = qL - \frac{3}{16} qL$$

$$R_A = \frac{13}{16} qL \quad (\uparrow)$$

$$\rightarrow M_A = qL\left(\frac{L}{2}\right) - \frac{3}{16} qL(L)$$

$$M_A = \frac{5}{16} qL^2 \quad (\circlearrowleft)$$

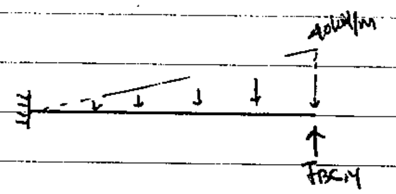




$$M = \frac{3}{16} qL\left(\frac{3}{16}L\right) - q\left(\frac{3}{16}L\right)\left(\frac{3}{16}L/2\right)$$

$$= \frac{9}{512} qL^2$$

2 b)



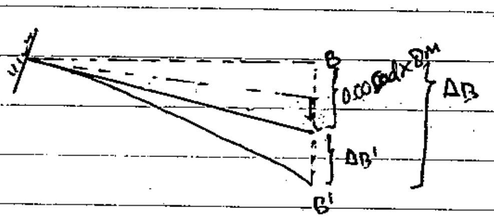
Note Δ_B, Δ_B'' = deflection of B from original neutral axis / point

$\Delta_B + \Delta_B'' = 0$

$F_{BC,y}$ as redundant

$\|$

Real System



$\Delta_B = -(0.005 \times 8 + \Delta_B')$ ← in m

$= -0.04 - \dfrac{11(40)(8)^4}{120(200)(200)}$ ← formulas $\dfrac{11wL^4}{120EI}$

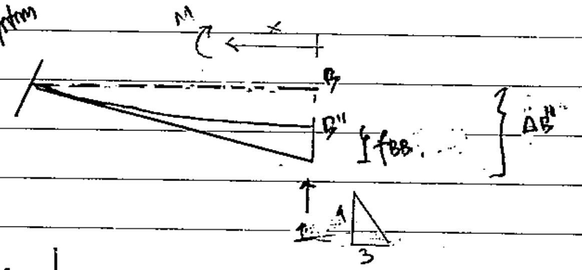
$\Delta_B = -415.47 \times 10^{-3}$ mm

↳ $F_{BC,y} = 0$

can use formula

+

Virtual System



$\Delta_B'' = -(0.005 \times 8 - f_{BB} \cdot F_{BC,y})$

200 GPa
$= 200 \times 10^9$ Pa
$= 200 \times 10^6$ kN/m²

↳ $\bar{F}_{BC,y} = 1$

strut BC

F_{BC} (under compression) $= -\dfrac{5}{4}$

$M = x$

$f_{BB} = \displaystyle\int_0^8 \frac{M^2\,dx}{EI} + \frac{n^2 L}{AE}$

$= \dfrac{\frac{8^3}{3}}{(200)(200)} + \dfrac{(-\frac{5}{4})^2(5)}{(10^{-3})(200 \times 10^6)}$

$= 4.306 \times 10^{-3}$ m

Yes, U can!

2 b)

$\Delta_B + \Delta_B'' = 0$

$-415.47 \times 10^{-3} + -(0.04 - 4.306 \times 10^{-3} F_{DC,y}) = 0$

$F_{BC,y} = 105.78 \text{ kN} \quad (\uparrow)$

Note: I'm not sure about the compatibility equation, but whatever your eq is, your M_A must be ↺ / ccw.

Moment at support A:

$M_A = \left(\frac{1}{2} \times 40 \times 8\right)\left(\frac{2}{3} 8\right) - 105.78(8)$

$= 7.09 \text{ kNm} \quad (↺)$

3 a) DOF = θ_b, θ_c

FEM:

$AB = -\frac{200(5)(5)^2}{10^2} = -250$

$BA = +250$

$BC = -\frac{24(8)^2}{12} = -128$

$CB = +128$

$BD = 0$

$DB = 0$

$M_{AB} = \frac{2(2EI)\theta_b}{10} - 250$

$M_{BA} = \frac{4(2EI)\theta_b}{10} + 250$

$M_{BC} = \frac{4(2EI)\theta_b}{8} + \frac{2(2EI)\theta_c}{8} - 128$

$M_{CB} = \frac{4(2EI)\theta_c}{8} + \frac{2(2EI)\theta_b}{8} + 128$

$M_{BD} = \frac{4EI\theta_b}{10}$

$M_{DB} = \frac{2EI\theta_b}{10}$

3 a)

EQ.

① $M_{CB} = 0$

$EI\theta_c + \frac{1}{2}EI\theta_b + 128 = 0$

② $M_{BA} + M_{BC} + M_{BD} = 0$

$\frac{8}{10}EI\theta_b + 250 + EI\theta_b + \frac{1}{2}EI\theta_c - 128 + \frac{4}{10}EI\theta_b = 0$

$2.2\,EI\theta_b + 122 + \frac{1}{2}\left(-128 - \frac{1}{2}EI\theta_b\right) =$

$1.95\,EI\theta_b + 58 = 0$

$\theta_b = \frac{-29.74}{EI} \rightarrow \theta_c = \frac{-113.13}{EI}$

end moments:
$M_{AB} = -261.90$
$M_{BA} = 226.21$
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b) drawn in tension side

$M_{simple,AB} = \frac{PL}{4} = 500$

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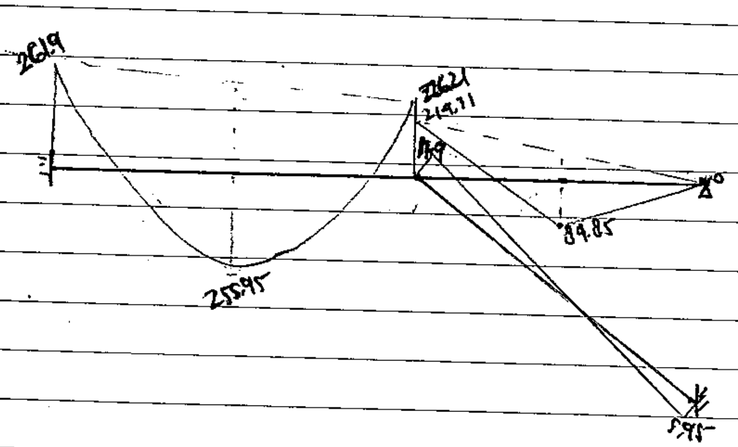


Yes, U Can!

4 a)

FEM: $AB = -\frac{20(12)^2}{12} = -240$

$BA = 240$

$BC = -\frac{16(2.5)(2.5)^2}{5^2} = -10$

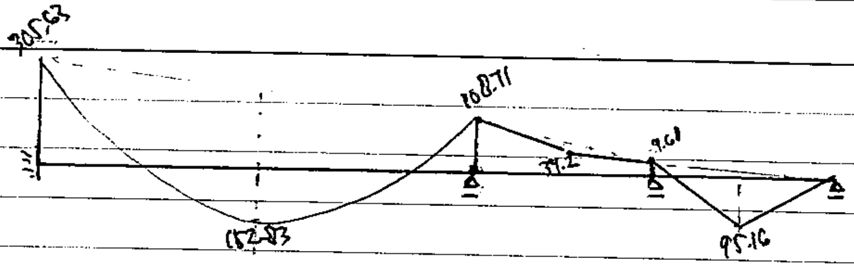
$CB = +10$

$CD = -\frac{80(2.5)(2.5)^2}{5^2} = -50$

$DC = +50$

joint	A	B		C		D
Member end	ab	ba	bc	cb	cd	dc
STIFF	0.8EI	0.8EI	0.8EI	0.8EI	0.8EI	0.8EI
D.F	0	0.5	0.5	0.5	0.5	1
FEM	−240	240	−10	10	−50	50
DIST	0	−115	−115	20	20	−50
CO	−57.5		10	−57.5	−25	
DIST	0	−5	−5	41.25	41.25	
CO	−2.5		20.625	−2.5		
DIST	0	−10.3125	−10.3125	1.25	1.25	
CO	−5.1563		0.625	−5.1563 +2.5782	2.5782	
DIST	0	−0.3125	−0.3125			
CO	−0.1563		1.2891	−0.1563		
DIST	0	−0.6446	−0.6446	+0.0782	+0.0782	
CO	−0.3223		0.0391	−0.3223		
DIST		−0.0196	−0.0196	0.1612	0.1612	
Σ	−305.63	108.71	−108.71	9.68	−9.68	0

4 b)

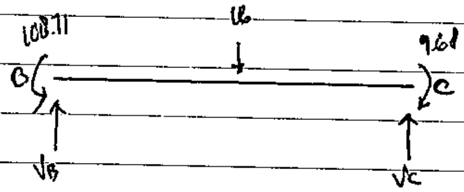


$M_{simple,AB} = \frac{(20)(12)^2}{8} = 360$

$M_{simple,BC} = \frac{16(5)}{4} = 20$

$M_{simple\,CD} = \frac{80(5)}{4} = 100$

c)



$\Sigma M_B = 0$

$-16(2.5) + 108.71 - 9.68 + V_C(5) = 0$

$V_C = -11.81$ kN $\rightarrow$ $V_B = 27.81$ kN