Now using BC

$$\Sigma F_y = 0$$

$$B_y = C_y \Rightarrow C_y = 99.28\ N$$

Shear Force at D,

$SF_D = \sum F_y$ up to D from left, or from right support

$SF_{D(L)} = A_y = -29.99\ N$

$A_{y(y)} = A_y \cos 30 = -25.97\ N$

or

$SF_{D(R)} = -60\cos 30 + 99.28\cos 30 = 25.97\ N$

$$BM_{D(R)} = B_y \cos 30 (1) - 60(1.75)$$

$$= 85.98 - 60(1.75)$$

$$= -19.02 \text{ Nm}$$

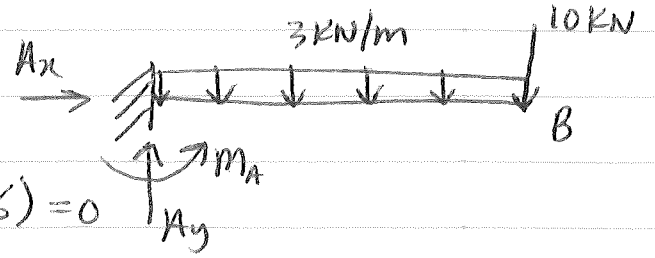
Or

$$BM_{D(L)} = -A_y \cos 30 (2\cos 30 - 1)$$

$$= 25.97 (2\cos 30 - 1)$$

$$= 19.01 \text{ Nm}$$

7 - 72



$$\sum M_A = 0$$

$$M_A - 3(6)\frac{6}{2} - 10(6) = 0$$

$$M_A = 114 \text{ KNm}$$

$$\sum F_y = 0$$

$$A_y = 3(6) + 10 = 28 \text{ KN}$$

$$SF_A = A_y = 28 \text{ KN}$$

AB:

At x from A,

$$SF_x = 28 - 3x$$

just before B,

$$SF_x = 28 - 3(6) = 28 - 18 = 10 \text{ KN}$$

at B

$$SF_B = 10 - 10 = 0 \text{ KN}$$

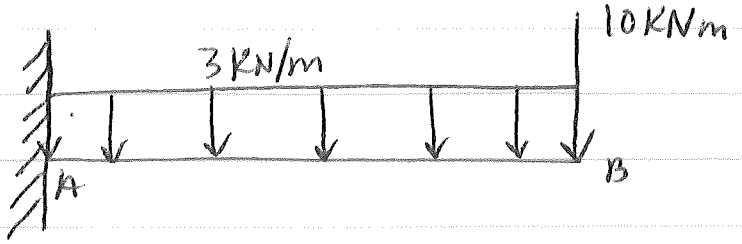
Bending Moment at A,

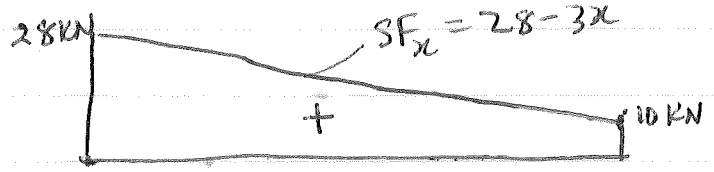
$$BM_A = M_A = 114 \text{ KNm}$$

at x from A

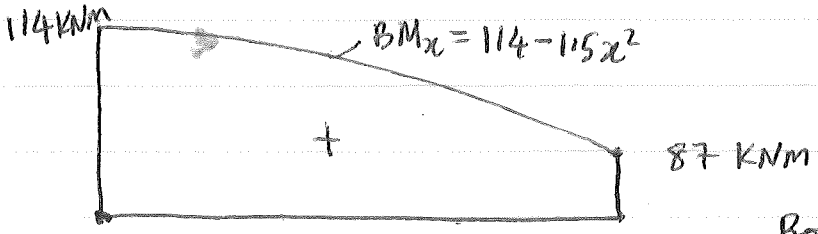
$$BM_x = 114 - 3x \cdot \frac{x}{2} = 114 - 1.5x^2$$

$$BM_B = 114 - 15\frac{(6)^2}{2} = 87 \text{ KNm}$$



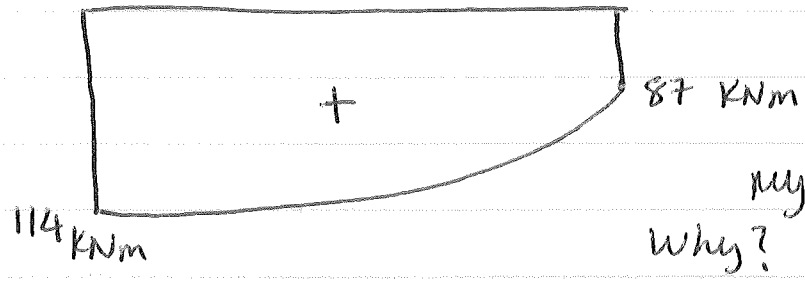


SFD



Book's convention

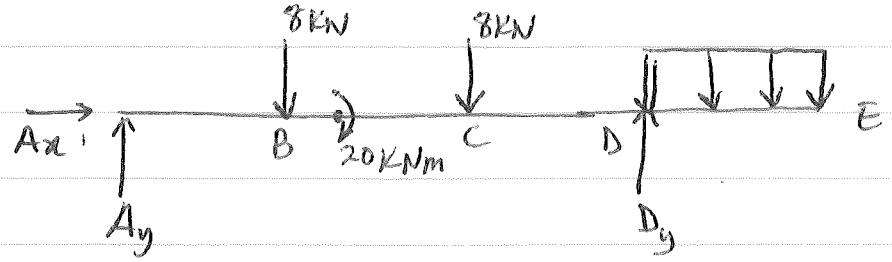
OR



My preferred convention

Why? This profile is the actual deformation of the beam bcos of the reactions and loads. This is ~~what~~ how you would see the beam if you had 'Superman' eyesight.

7 - 74



$$\Sigma M_A = 0$$

$$-8(1) - 20 - 8(2) + D_y(3) - 15(1)\left(\frac{1}{2}+3\right) = 0$$

$$D_y = 32.17 \text{ KN}$$

$$\Sigma F_y = 0$$

$$A_y + D_y = 8 + 8 + 15(1)$$

$$A_y = 31 - 32.17 = -1.17 \text{ KN}$$

$SF_A = -1.17$ KN

from A to just before B

$SF = -1.17$

$SF_B = -1.17 - 8 = -9.17$ KN

which remains until through just before C

$SF_C = -9.17 - 8 = -17.17$ KN

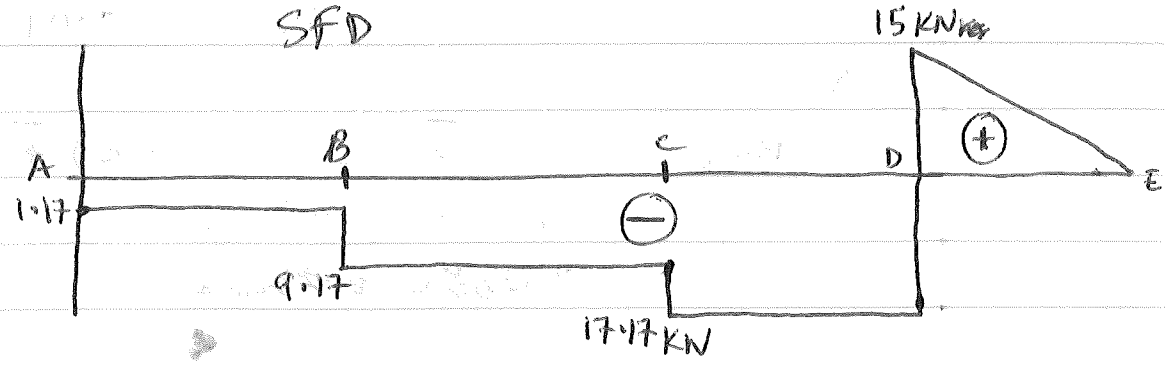
which remains through just before D

$SF_D = -17.17 + 32.17 = 15$ KN

at any x from D

$SF_x = 15 - 15x$

$SF_{x=1} = 15 - 15(1) = 0$.



Bending Moment

$BM_A = 0$

from A to B, at any distance x

$BM_x = -(-1.17)x = 1.17x$

$BM_B = 1.17(1) = 1.17$ KNm

from B to 0.25m from B

$BM_x = 1.17(1+x) + 8x$

just before $x = 0.25$m

$BM_x = 1.17(1+0.25) + 8(0.25) = 3.46$ KNm

$BM_{x=0.25 \text{ from } B} = 3.46 - 20 = -16.54$ KNm

towards C:

$BM_x = 1.17(1+x) + 20 + 8x$

$= 1.17 + 9.17x - 18.83$

$BM_C = 9.17(2) - 18.33 = 0.01$ KNm

CD

$BM_x = 8x + 20 + 8(1+x) + (-1.17)(2+x)$

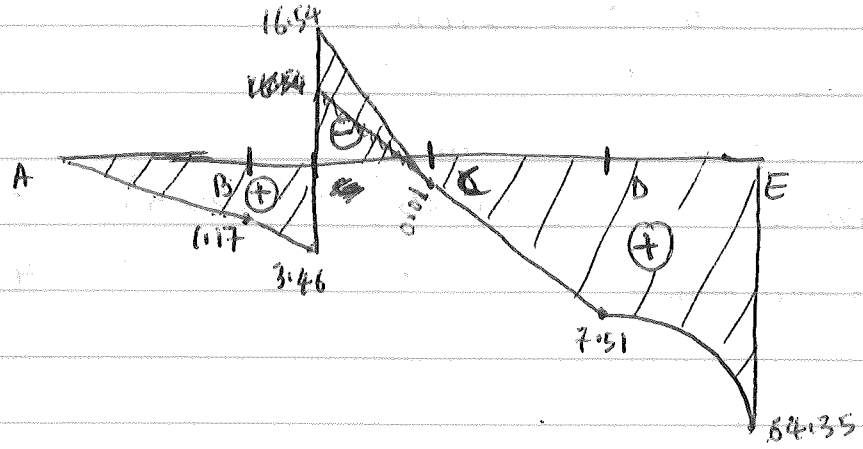
$= 17.17x - 9.66$

DE

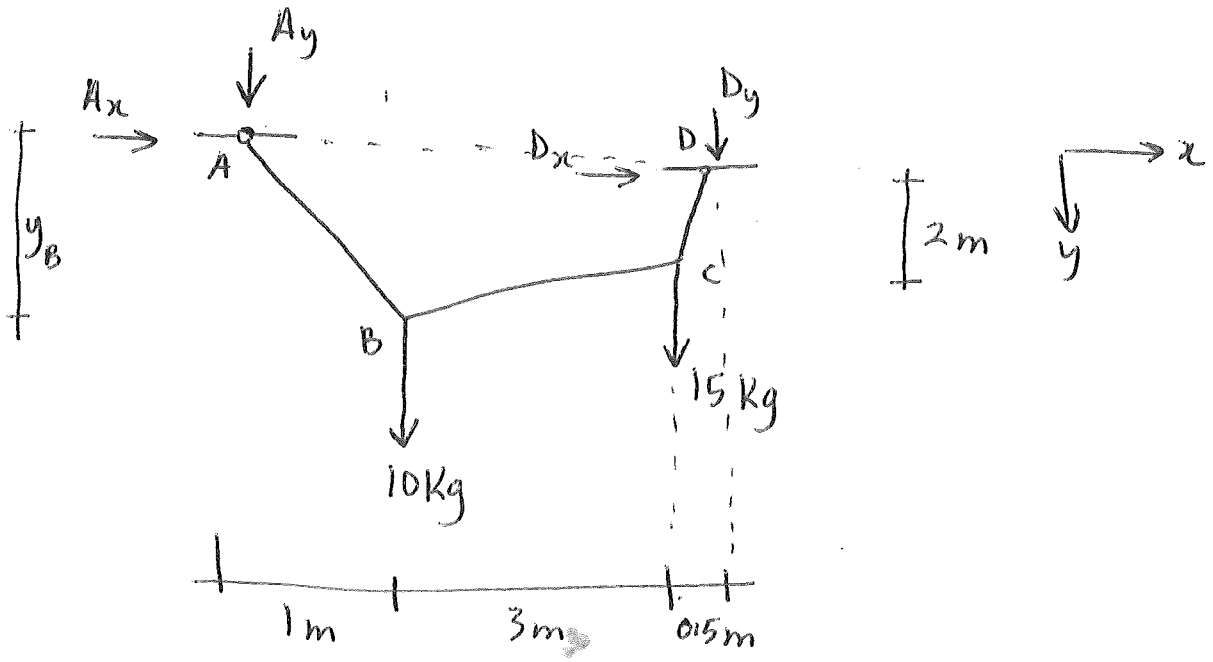
$BM_x = 15\frac{x^2}{2} - 32.17x + 8(1+x) + 8(2+x) - 20 - (-1.17)(3+x)$

$BM_x = 7.5x^2 + 49.34x + 7.51$

$BM_E = 7.5(1) + 49.34(1) + 7.51 = 64.35$ KNm



7 - 94



$$\sum M_D = 0$$

$$A_y(4.5) + 10^{9.81}(3.5) + 15(9.81)(0.5) = 0$$

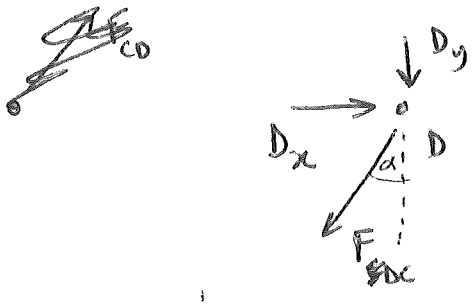
$$A_y = -92.65 \text{ N} \quad (\text{upwards})$$

$$\sum F_y = 0$$

$$A_y + D_y + 10(9.81) + 15(9.81) = 0$$

$$D_y = 92.65 - 10(9.81) - 15(9.81) = -152.6 \text{ N}$$

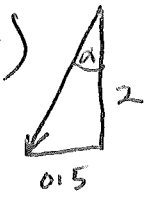
(upwards)



$$\sum F_x = 0$$

$$D_x - F_{EDC}\sin\alpha = 0 \quad -(1)$$

$$\alpha = \tan^{-1}\left(\frac{0.5}{2}\right) = 14.03°$$



$$\sum F_y = 0$$

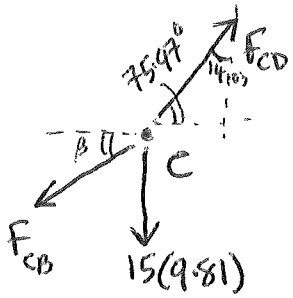
$$D_y + F_{DC}\cos\alpha = 0$$

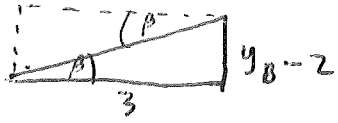
$$F_{DC} = \frac{-D_y}{\cos\alpha} = \frac{-(-152.6)}{\cos 14.03}$$

$$F_{DC} = 157.29\,N \text{ (tension)}$$

from (1)

$$D_x = F_{DC}\sin\alpha = 157.29\sin 14.03 = 38.13\,N$$





$$\sum F_x = 0$$

$$F_{CB}\cos\beta = F_{CD}\cos 75.97$$

$$F_{CB}\cos\beta = 38.13 = 157.29\cos 75.97$$

$$F_{CB}\cos\beta = 38.13 \quad -(2)$$

$$\sum F_y = 0$$

$$F_{CB}\sin\beta + 15(9.81) = F_{CD}\sin 75.97$$

$$F_{CB}\sin\beta = 5.44 \quad -(3)$$

(2)/(3): $\tan\beta = \frac{5.44}{38.13} \Rightarrow \beta = 8.13^\circ$

from (3) $F_{CB} = \frac{5.44}{\sin 8.13} = 38.47\ (T)$

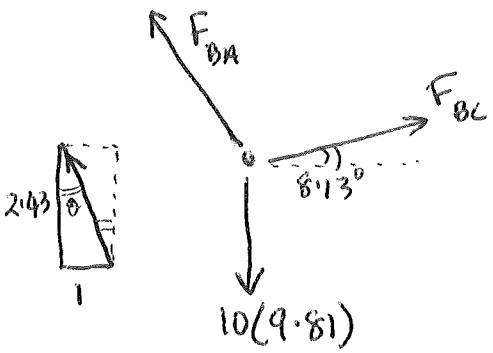
Also

~~$\sin 28.13 =$~~

$$\tan 8.13 = \frac{5.44}{38.13} = \frac{y_B - 2}{3}$$

$$y_B = \frac{5.44}{38.13} \cdot 3 + 2 = 2.43\ m$$

And finally



$\Sigma F_x = 0$

~~$F_{BA}\cos\theta$~~

$F_{BA}\sin\theta = F_{BC}\cos 8.13$

$F_{BA}\sin\theta = 38.08$ —(6)

$\Sigma F_y = 0$

$F_{BA}\cos\theta + F_{BC}\sin 8.13 - 10(9.81) = 0$

$F_{BA}\cos\theta = 92.66$ —(7)

(6)/(7):

$$\tan\theta = \frac{38.08}{92.66} \Rightarrow \theta = 22.34^\circ$$

from (6)

$$F_{BA} = \frac{38.08}{\sin 22.34} = 100.18\ (T)$$

So maximum tension is in cable section DC of value 157.29 N

Note that we selected joints to analyze in a way that we did not have to analyze joint A. You can come up with your own ~~strategies~~ strategies from experience.