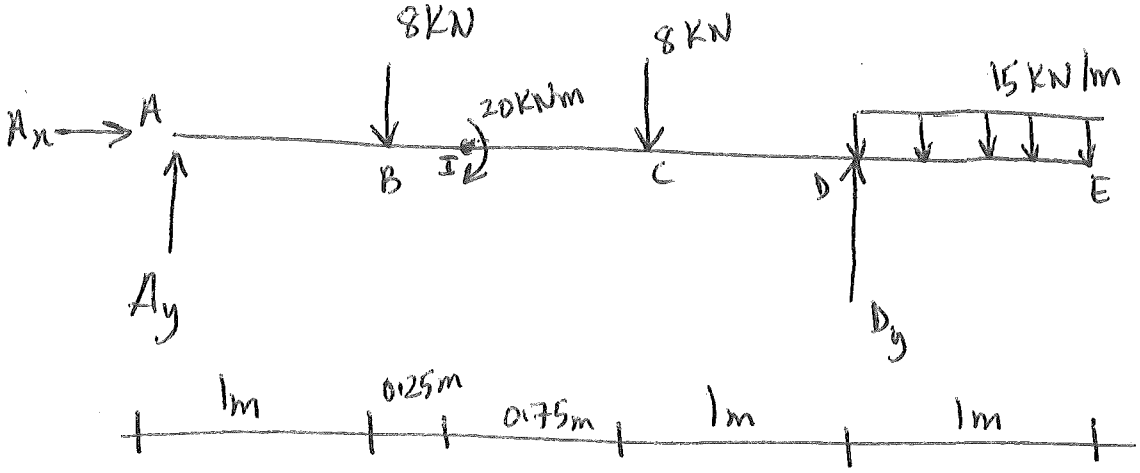
7-74



For overall structure

$$\Sigma M_A = 0$$

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

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

$$\Sigma F_y = 0$$

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

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

Shear Force

$SF_A = -1.17$ KN

which remains the same until just before B.

At B,

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

which remains the same until just before C, the applied moment does not contribute to shear

$SF_C = -1.17 - 8 - 8 = -17.17$ KN

which remains the same until just before we reach D. Now right at D we have.

$SF_D = -1.17 - 8 - 8 + 32.17 = 15$ KN

For a distance x from D for DE

$SF_x = 15 - 15x$

So to confirm,

$SF_D = 15(\text{}) - 15(0) = 15$ KN

and

$SF_E = 15 - 15(1) = 0$ KN

Bending Moment

$BM_A = 0$

at x from A towards B

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

so

$$BM_B = 1.17(1) = 1.17 \text{ KNm}$$

at x from B towards I

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

$$= 8.17x + 1.17$$

So $BM_B = 8.17(0) + 1.17 = 1.17$ (confirmation of previous)

Just before I,

$$BM_{I(L)} = 8.17(0.25) + 1.17 = 3.21 \text{ KNm}$$

then right at I we add the applied moment

$$BM_I = 3.21 - 20 = -16.79 \text{ KNm}$$

x from I towards C.

$$BM_x = -(-1.17)(1.25+x) + 8(0.25+x) - 20$$

$$= 1.4625 + 1.17x + 2 + 8x - 20$$

$$= 9.17x - 16.54$$

So

$$BM_C = 9.17(0.75) - 16.54 = -9.66 \text{ KNm}$$

x from C towards D.

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

$$= 2.34 + 1.17x + 8 + 8x - 20 + 8x$$

$$= 17.17x - 9.66$$

so

$$BM_D = 17.17(1) - 9.66 = 7.51 \text{ KNm}$$

We can repeat the same for x from D towards E. But let us ~~do~~ do a trick.

As we can see, it is now much less work if we take the bending moment from the right

So from the right,

$$BM_E = 0$$

x from E towards D,

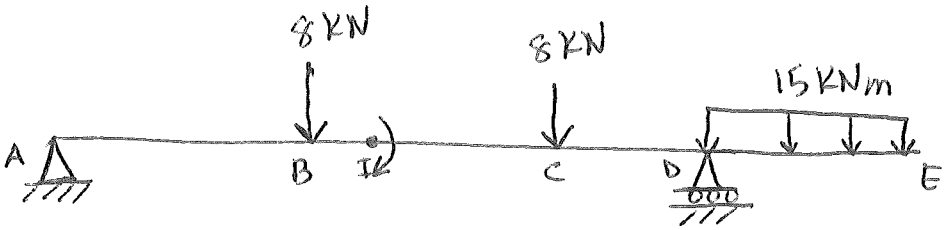
$$BM_x = -15x \cdot \frac{x}{2} = -7.5x^2$$

So $BM_E = 0$

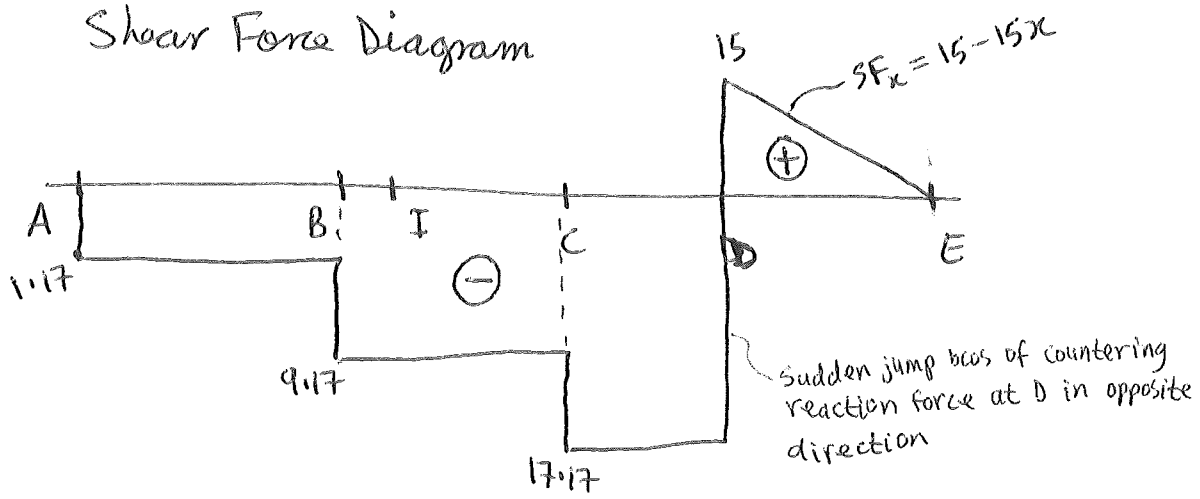
$$BM_D = -7.5(1)^2 = -7.5 \text{ KNm}$$

which matches with the previous one we calculated from the left.

Note that because we took it from the opposite end than the previous we shall also plot it in the opposite hemisphese as we would have had we continued taking moments from the left.



Shear Force Diagram



Bending Moment Diagram