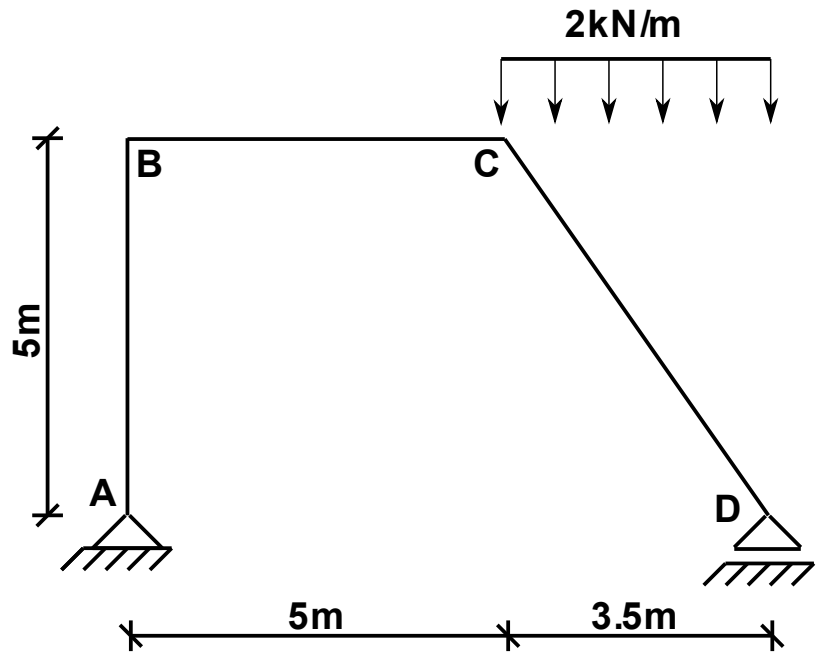
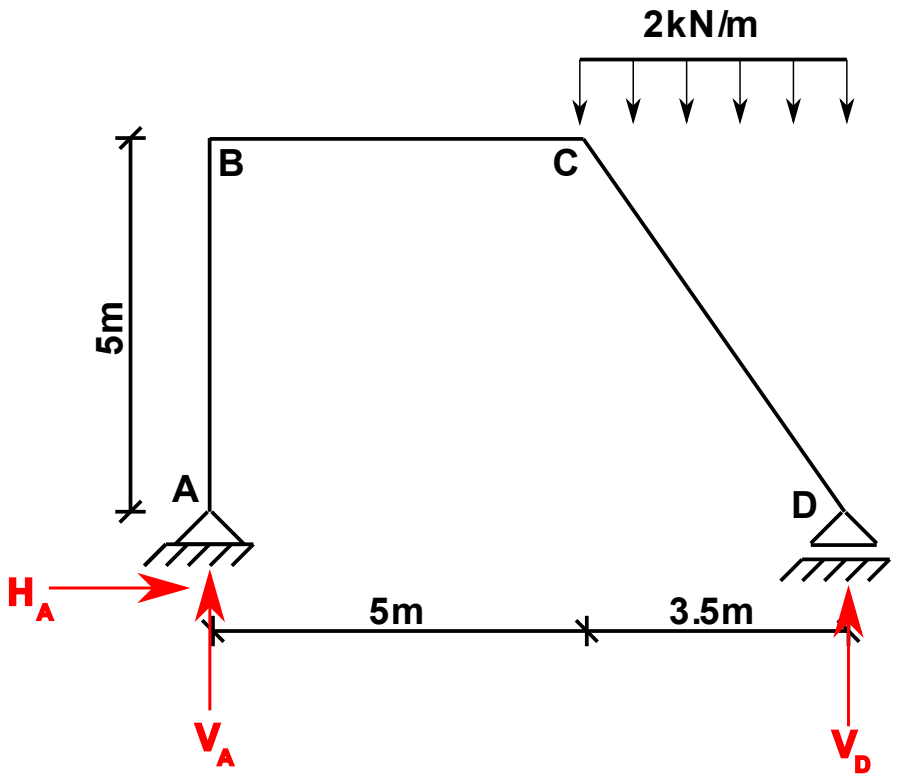
Statically determinate frame under distributed loading



We are looking for the bending moment (M), shear force (V) and axial force (N) diagrams

Step 1: Calculate the support reactions



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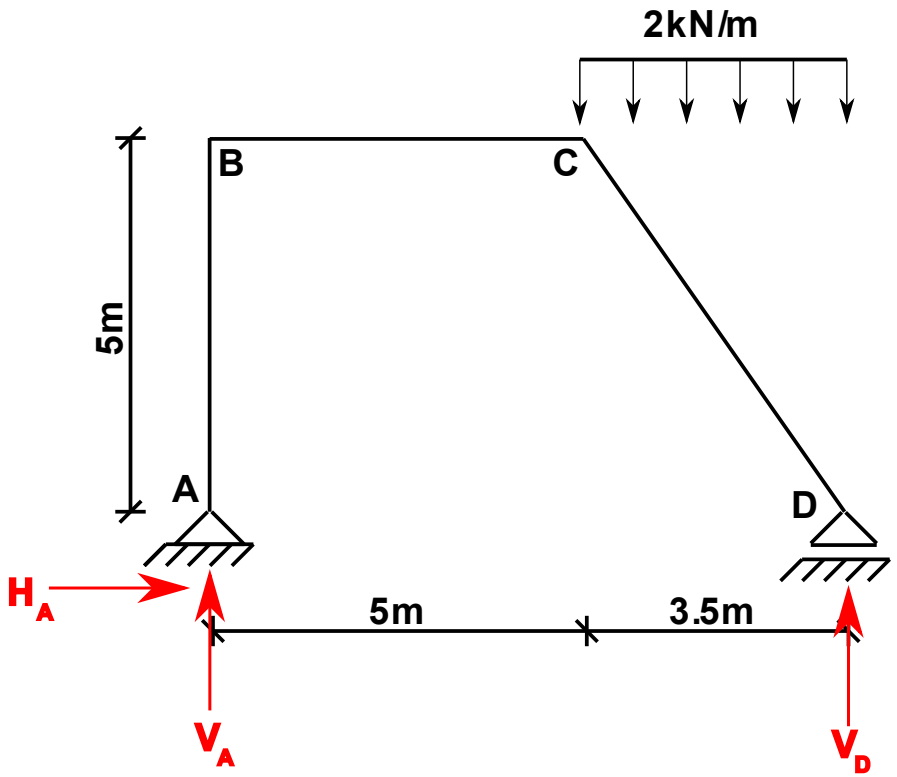


$$\sum M_A = 0$$

$$\Rightarrow V_D(5\text{m} + 3.5\text{m}) - \left(2\frac{\text{kN}}{\text{m}}\right)(3.5\text{m})\left(5 + \frac{3.5}{2}\right) = 0$$

$$\Rightarrow V_D = 5.559\text{kN}$$

$$\sum M_D = 0$$

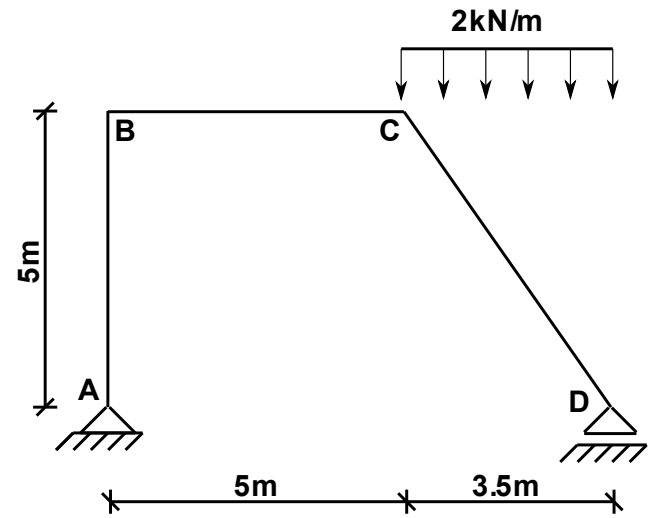
$$\Rightarrow \left(2\frac{\text{kN}}{\text{m}}\right)(3.5\text{m})\left(\frac{3.5}{2}\right) - V_A(5\text{m} + 3.5\text{m}) = 0$$

$$\Rightarrow V_A = 1.441\text{kN}$$

$$\sum H = 0 \Rightarrow H_A = 0$$

Step 2: Decompose the distributed load

We need to find the magnitudes of the distributed loads acting in directions along the member length and perpendicular to the member length for the member CD



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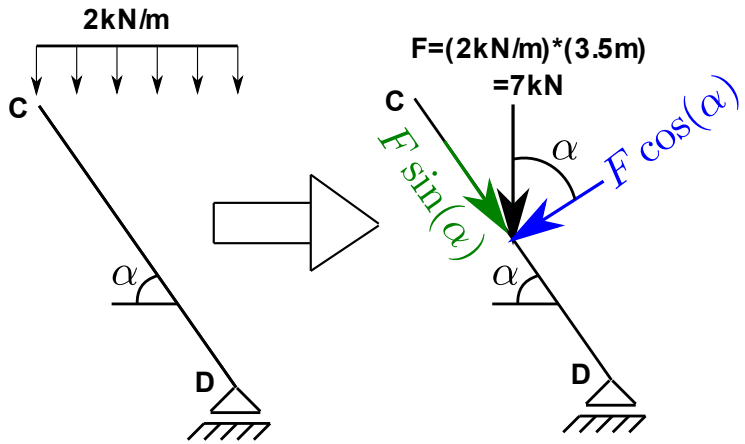
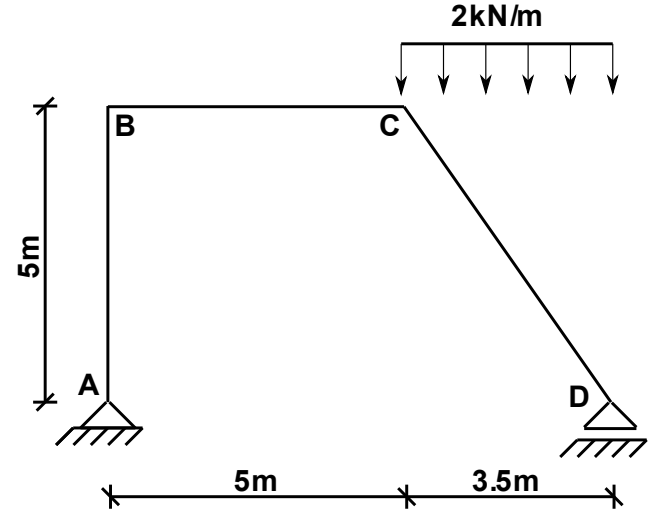
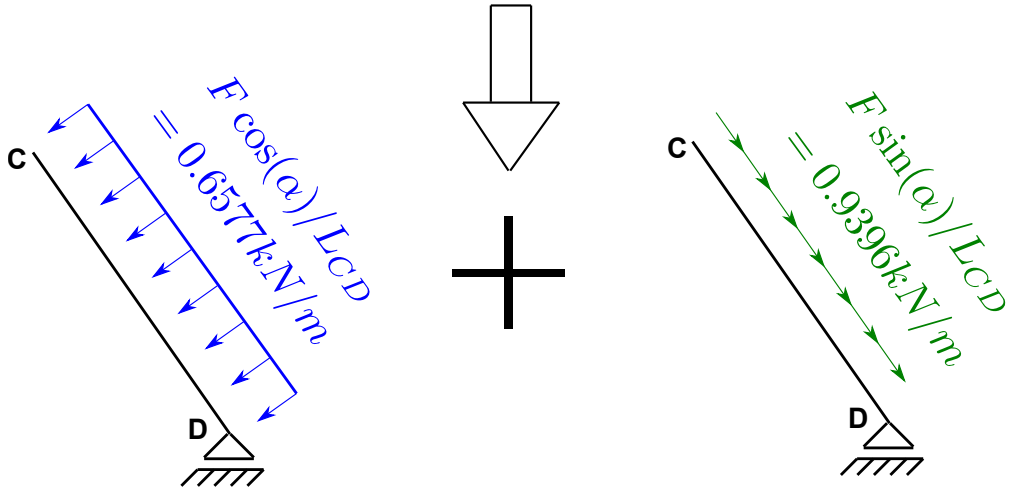




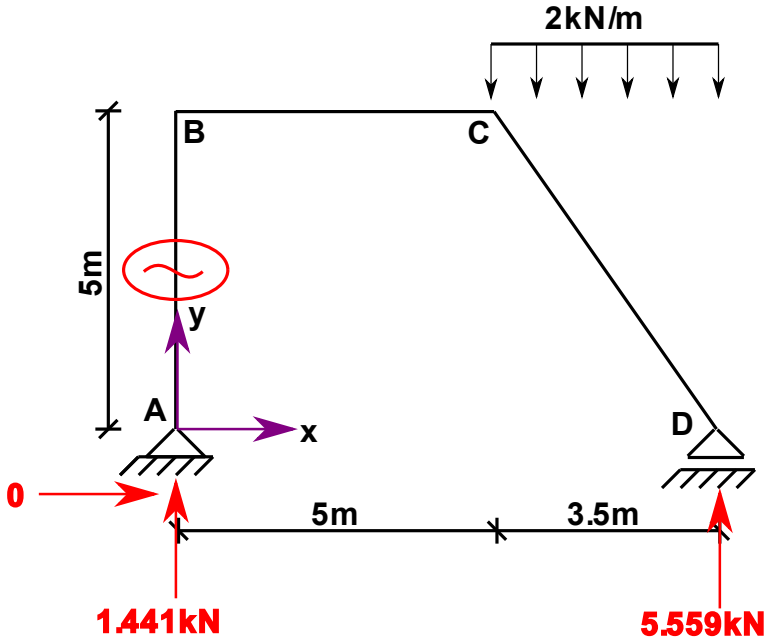
$$\alpha = \arctan(5/3.5) = 55°$$

$$L_{CD} = \sqrt{5^2 + 3.5^2} = 6.103m$$



Step 3: N, V, M equations

Member AB:



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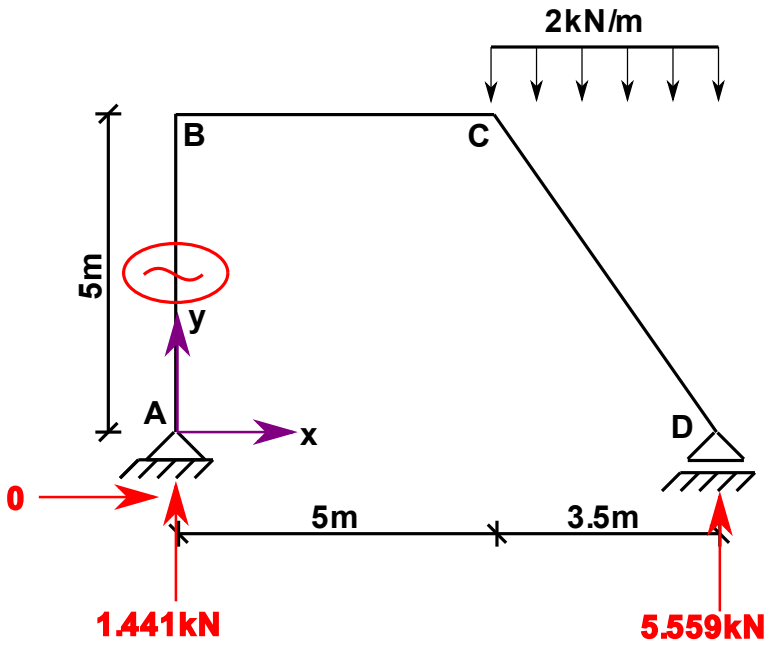

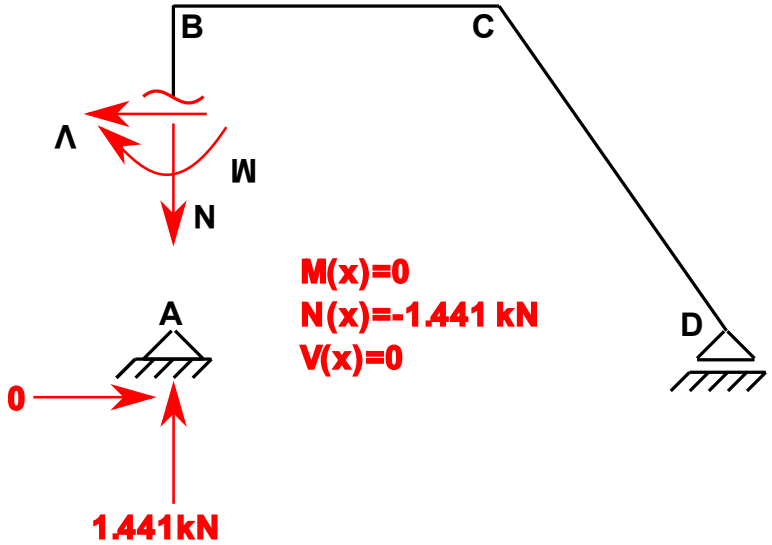

M(x)=0

N(x)=-1.441 kN

V(x)=0

Step 3: N, V, M equations

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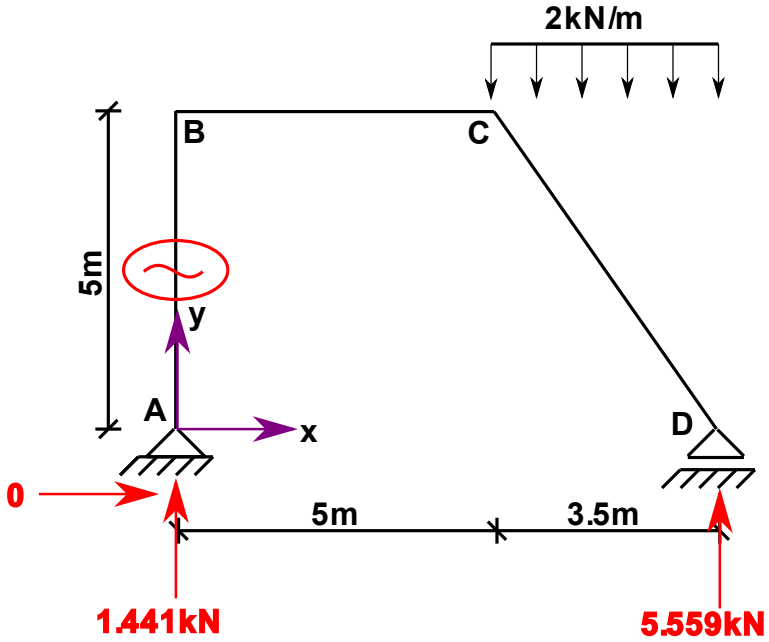
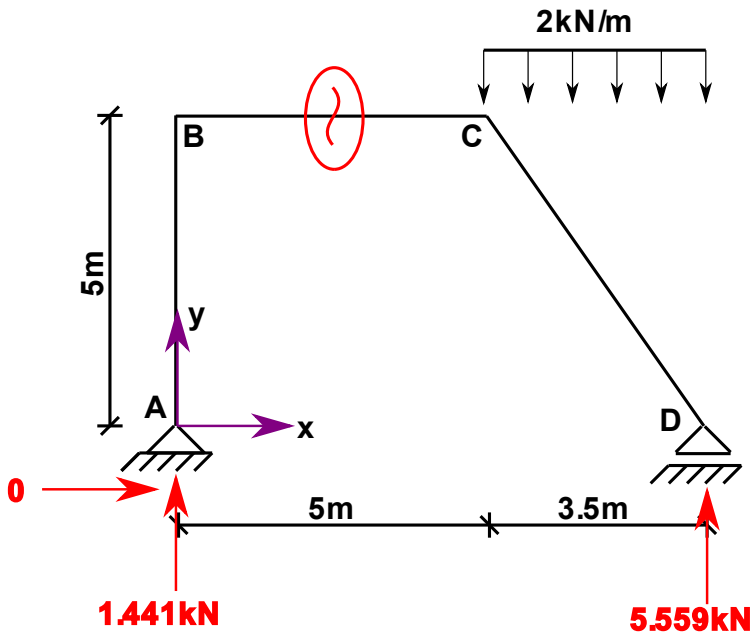
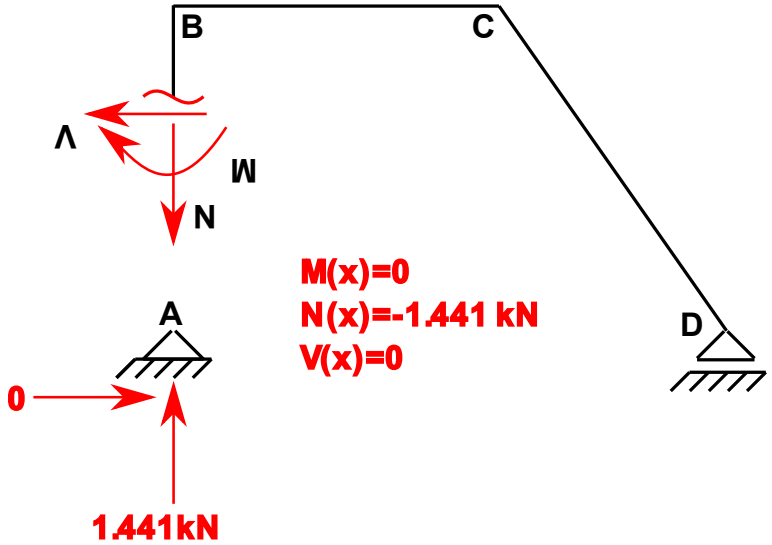


Member BC:





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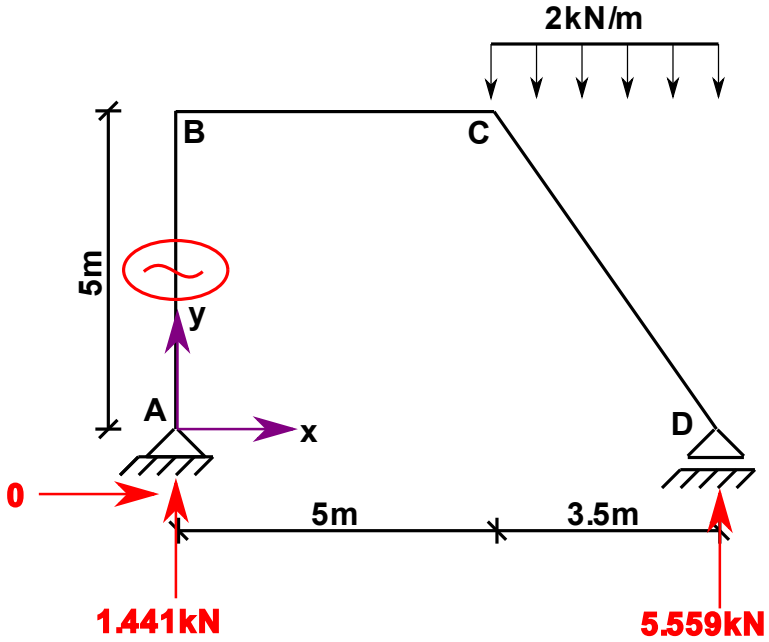

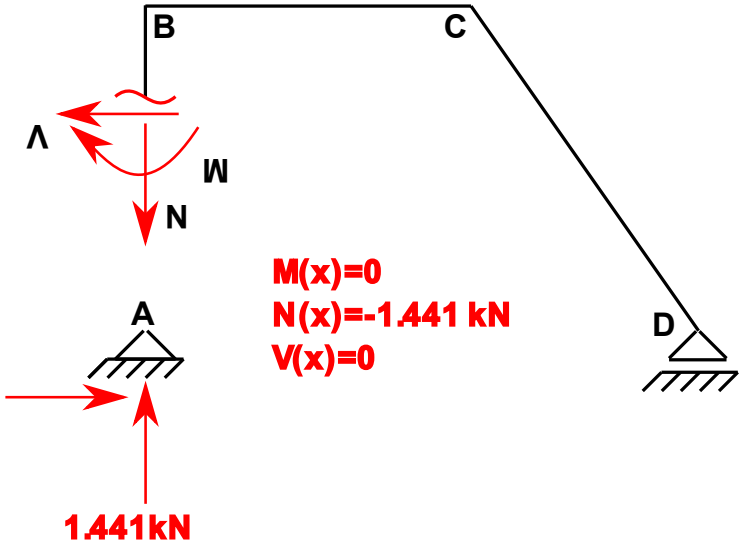

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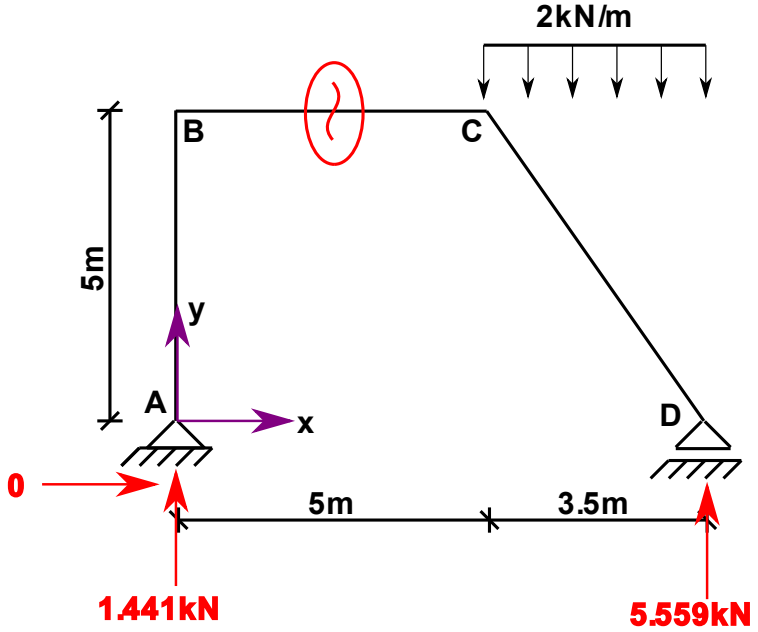

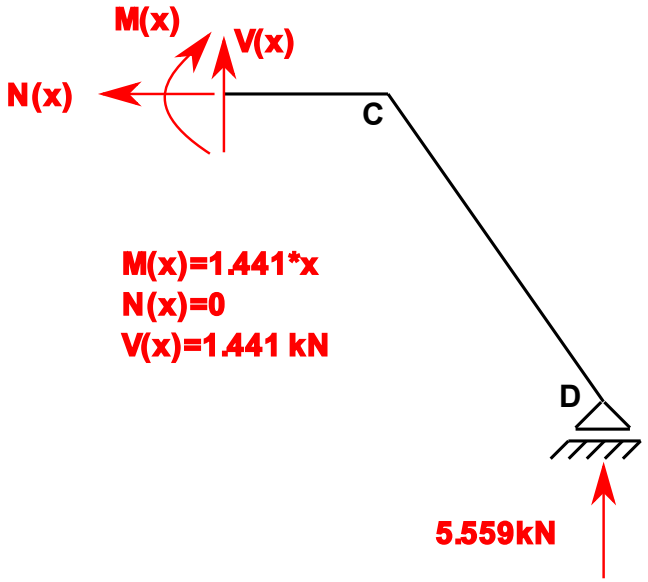

M(x)=1.441*x
N(x)=0
V(x)=1.441 kN

Step 3: N, V, M equations

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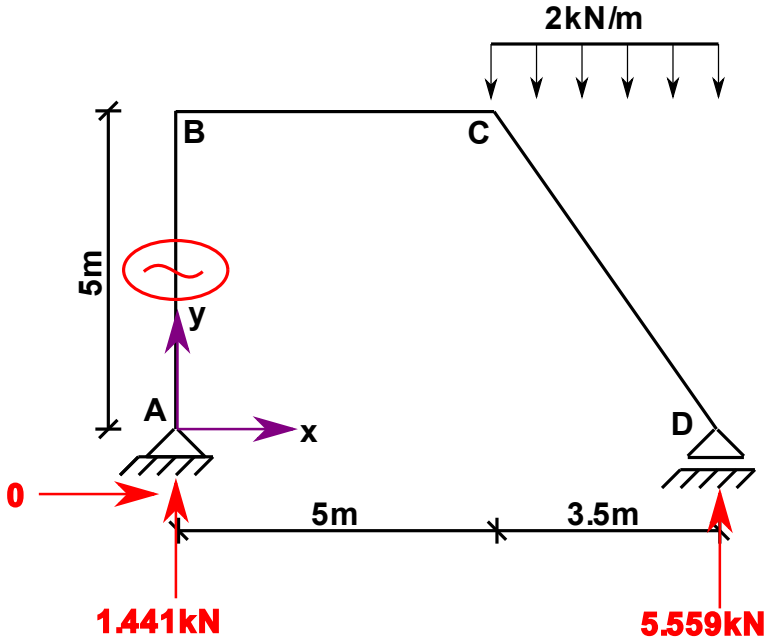

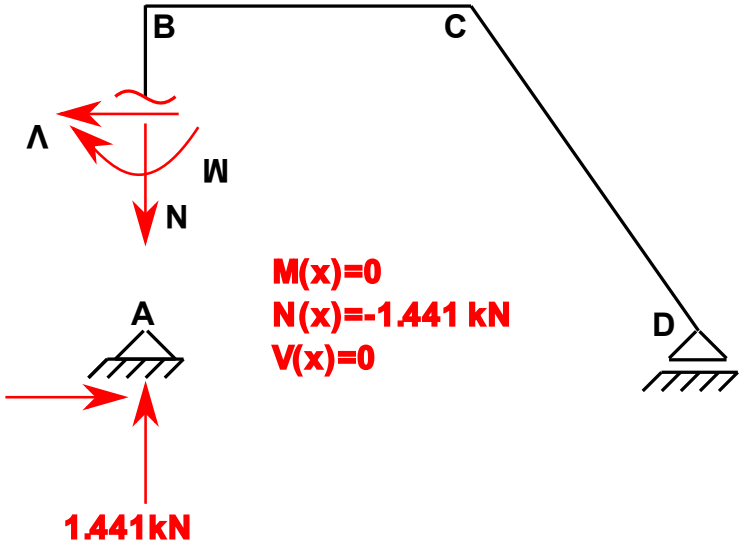

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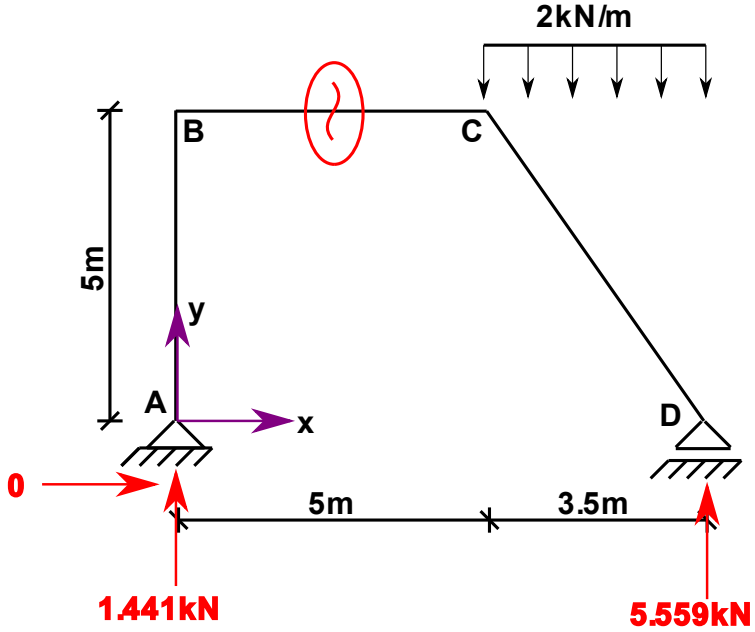

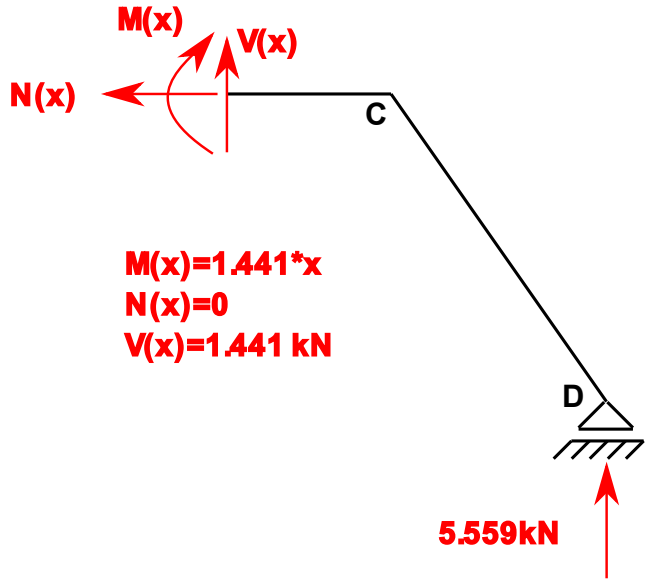

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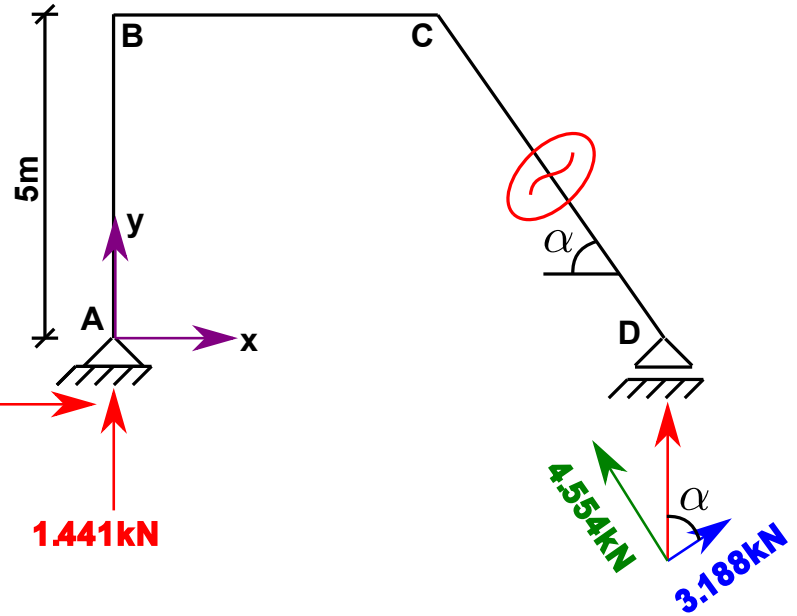

Step 3: N, V, M equations

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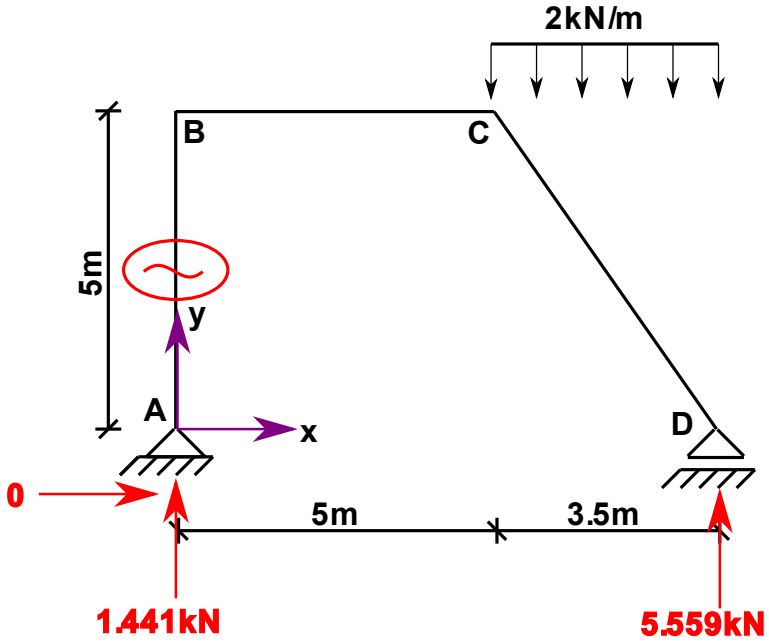

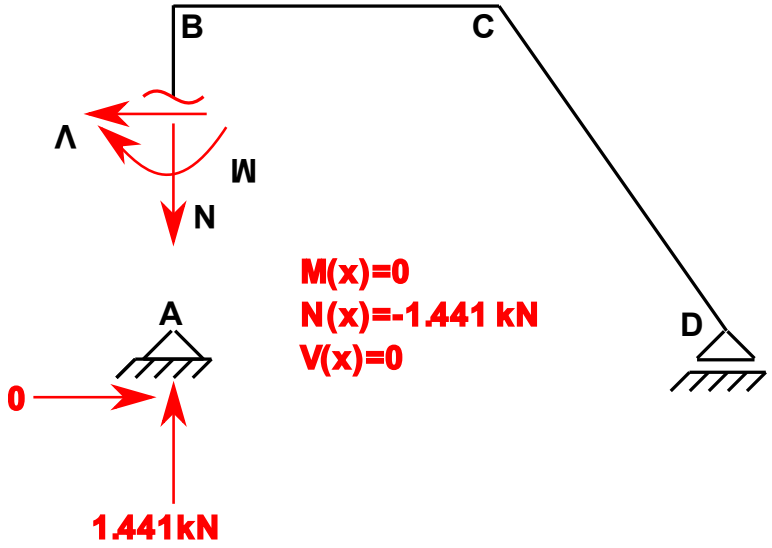

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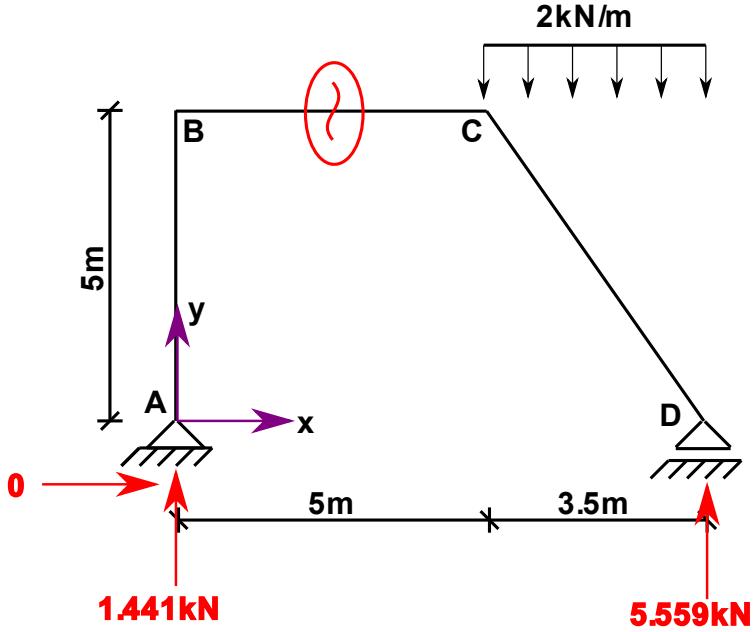

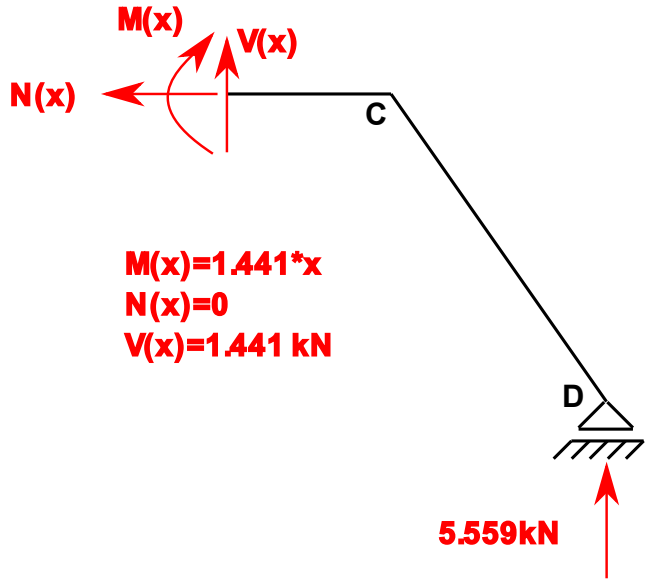

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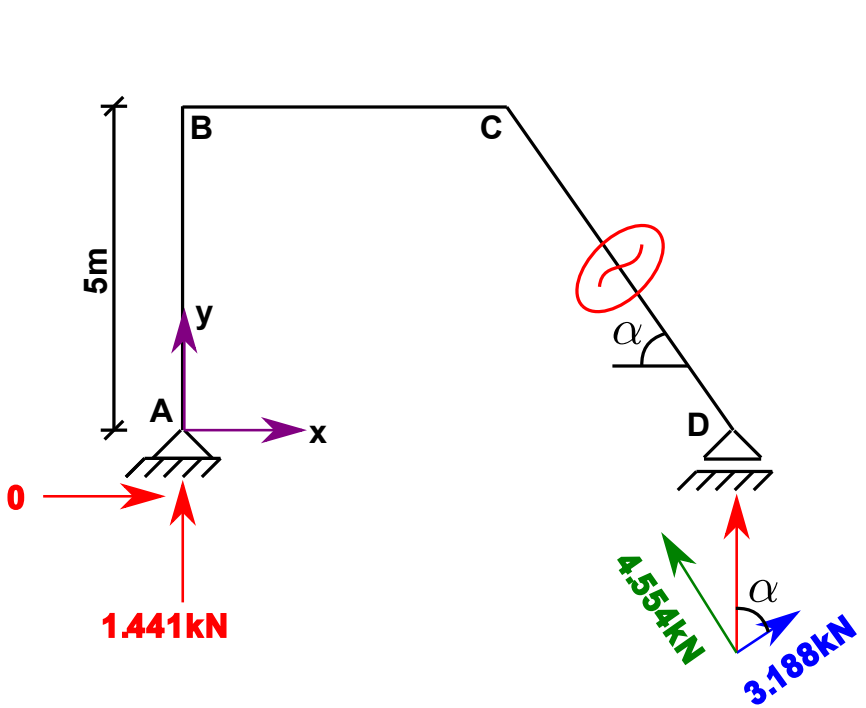
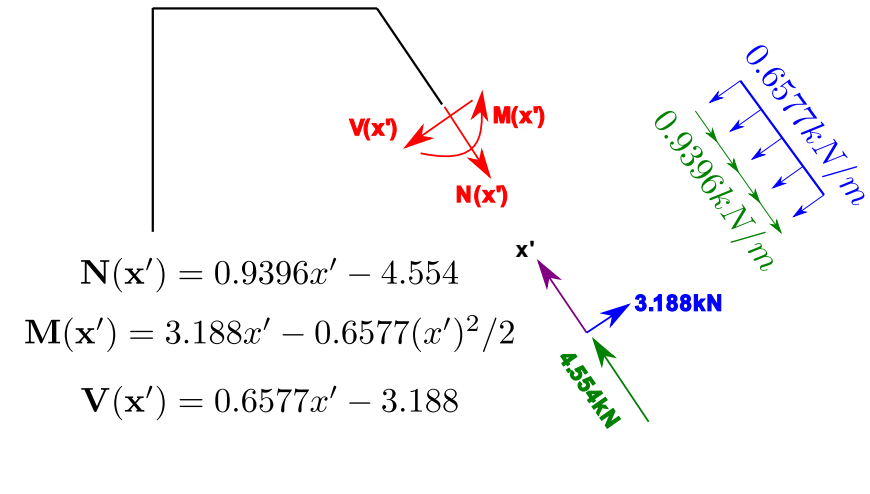


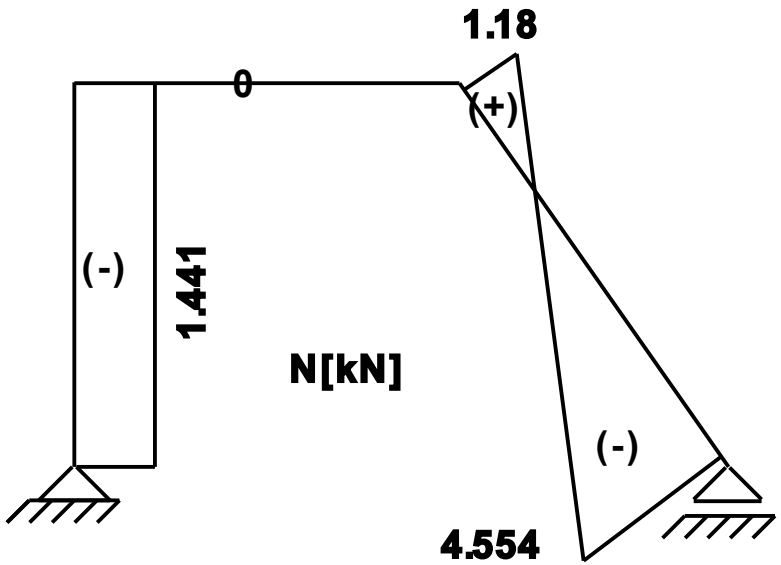


$$\mathbf{N}(\mathbf{x}') = 0.9396x' - 4.554$$

$$\mathbf{M}(\mathbf{x}') = 3.188x' - 0.6577(x')^2/2$$

$$\mathbf{V}(\mathbf{x}') = 0.6577x' - 3.188$$

Step 4: N, V, M diagrams



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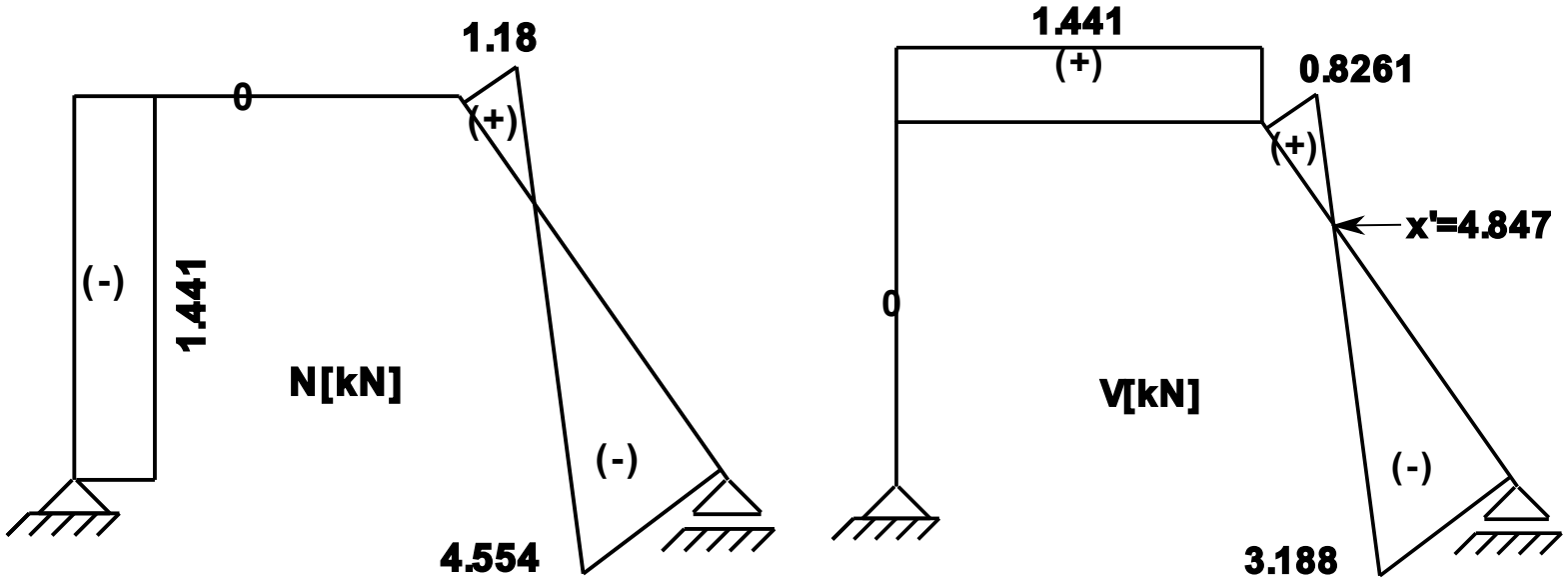

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