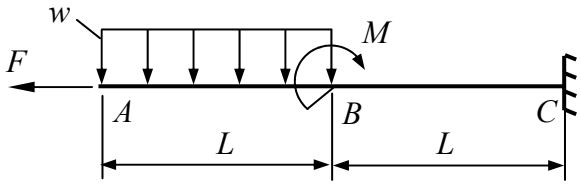
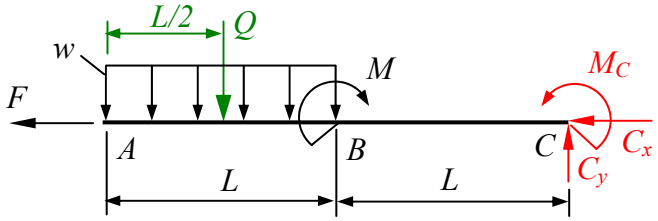
For the given beam construction determine:

1. the support reactions;
2. the internal forces and draw their diagrams.

F = 10 kN, M = 5 kN.m, w = 10 kN/m, L=2 m.



1. Free Body Diagram (FBD).



2. Applying the equilibriums to find the support reactions.

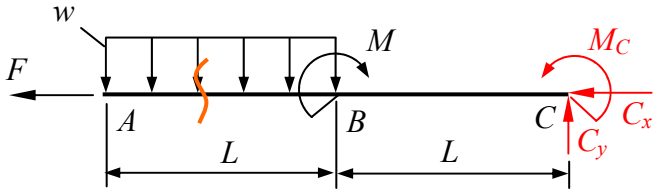
$$\sum F_x = 0 \;\Rightarrow\; F + C_x = 0 \;\Rightarrow\; C_x = -F \;\Rightarrow\; \boxed{C_x = -10 \text{ kN}};$$

$$\sum F_y = 0 \;\Rightarrow\; C_y - Q = 0 \;\Rightarrow\; C_y = w.L \;\Rightarrow\; \boxed{C_y = 20 \text{ kN}}.$$

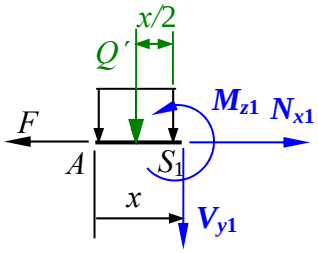
$$\sum M_{z_C} = 0 \;\Rightarrow\; M_C - M + Q.\frac{3L}{2} = 0 \;\Rightarrow\; M_C = M - Q.\frac{3L}{2} \;\Rightarrow\; M_C = 5 - 20.\frac{3.2}{2} \;\Rightarrow\; \boxed{M_C = -55 \text{ kN.m}}$$

3. Making of sections.

We need to make 2 sections. The first one is between points A and B.



We remove everything which stands to the right of the section.



$0 \le x \le L$

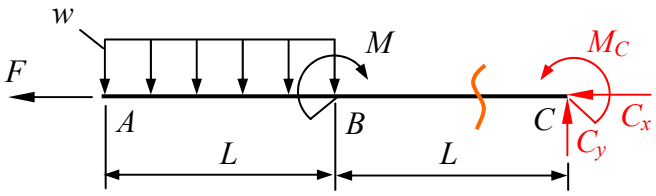
The internal forces can be found by applying the equilibriums.

$$\sum F_x = 0 \;\Rightarrow\; F - N_{x1} = 0 \;\Rightarrow\; N_{x1} = F \;\Rightarrow\; \boxed{N_{x1} = 10 \text{ kN}};$$

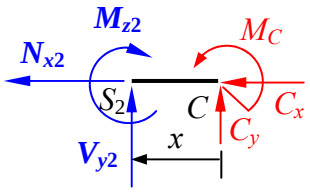
$$\sum F_y = 0 \;\Rightarrow\; Q' + V_{y1} = 0 \;\Rightarrow\; V_{y1} = -Q' \;\Rightarrow\; \boxed{V_{y1} = -10.x}.$$

$$\sum M_{z_{S1}} = 0 \;\Rightarrow\; Q'.\frac{x}{2} + M_{z1} = 0 \;\Rightarrow\; M_{z1} = -Q'.\frac{x}{2} \;\Rightarrow\; \boxed{M_{z1} = -5.x^2}$$

The second section is between points B and C.



We remove everything which stands to the left of the section and apply the equilibriums to find the internal forces:



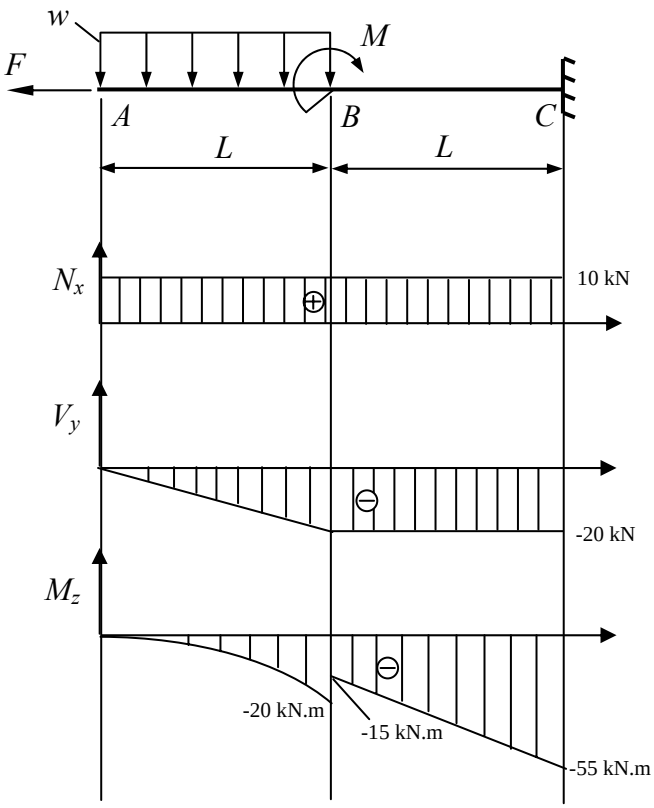
$0 \le x \le L$

$$\sum F_x = 0 \Rightarrow N_{x2} + C_x = 0 \Rightarrow N_{x2} = -C_x \Rightarrow N_{x2} = -(-10) \Rightarrow \boxed{N_{x2} = 10 \text{ kN}};$$

$$\sum F_y = 0 \Rightarrow C_y + V_{y2} = 0 \Rightarrow V_{y2} = -C_y \Rightarrow \boxed{V_{y2} = -20 \text{ kN}};$$

$$\sum M_{z_{S_2}} = 0 \Rightarrow M_{z2} - M_C - C_y.x = 0 \Rightarrow M_{z2} = M_C + C_y.x \Rightarrow \boxed{M_{z2} = -55 + 20.x}.$$

4. Internal forces diagrams



<u>First section</u>

$0 \le x \le L$

$V_{y1} = -10.x$

for $x = 0 \Rightarrow V_{y1} = 0$

for $x = L \Rightarrow V_{y1} = -20$ kN

V_{y1} is a linear function $\Rightarrow$ its graph is a line;

$M_{z1} = -5.x^2$

for $x = 0 \Rightarrow M_{z1} = 0$

for $x = L \Rightarrow M_{z1} = -20$ kN.m

M_{z1} is a square function $\Rightarrow$ its graph is a parabola;

<u>Second section</u>

$0 \le x \le L$

$V_{y2} = -20$ kN

V_{y2} is a constant;

$M_{z2} = -55 + 20.x$

for $x = 0 \Rightarrow M_{z2} = -55$ kN.m

for $x = L \Rightarrow M_{z2} = -15$ kN.m

M_{z2} is a linear function $\Rightarrow$ its graph is a line.