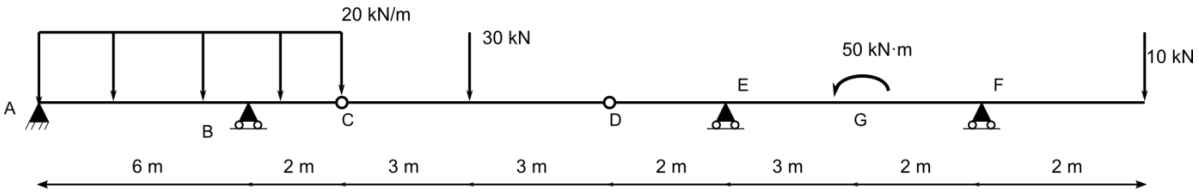
For the structure given in the figure, determine:

a) Reaction forces at the supports.

b) Force laws in the whole structure (shear forces as well as bending moment) in function of longitudinal coordinate "x".

c) Force laws diagrams obtained in part b) of the exercise.



From the equations of equilibrium at both hinge joints:

$$\sum M_C(\text{left}) = 0 \rightarrow 8.V_A + 2.V_B - 20.8.4 = 0$$

$$\sum M_D(\text{left}) = 0 \rightarrow 14.V_A + 8.V_B - 20.8.10 - 30.3 = 0$$

Solving the prior equation system:

$$\mathbf{V_A = 48,33\ kN}$$

$$\mathbf{V_B = 126,66\ kN}$$

Now using the three equations of equilibrium:

$$\sum M_F = 0 \rightarrow 21.V_A + 15.V_B - 160.17 - 30.10 + 5.V_E - 50 + 2.10 = 0 \rightarrow \mathbf{V_E = 27\ kN}$$

$$\sum F_y = 0 \rightarrow V_A + V_B + V_E + V_F = 20.8 + 30 + 10 \rightarrow \mathbf{V_F = 2\ kN}\ (\mathbf{downwards})$$

$$\sum F_x = 0 \rightarrow \mathbf{H_a = 0\ kN}$$

Now, we can calculate the force law diagrams and its corresponding diagrams cutting stretch by stretch the beam. These expressions, shear and bending, are summarized in the chart below.

Stretch (m)	V (kN)	M (kN.m)
$0 \geq x \leq 6$	$V(x) = 48{,}33 - 20x$	$M(x) = 48{,}33x - 10x^2$
$6 \geq x \leq 8$	$V(x) = 175 - 20x$	$M(x) = -10x^2 + 175x - 759{,}6$
$8 \geq x \leq 11$	$V = 15$	$M(x) = 15x + 120$
$11 \geq x \leq 16$	$V = -15$	$M(x) = -15x + 210$
$16 \geq x \leq 19$	$V = 12$	$M(x) = 12x - 222$
$19 \geq x \leq 21$	$V = 12$	$M(x) = 12x - 272$
$21 \geq x \leq 23$	$V = 10$	$M(x) = 10x - 230$