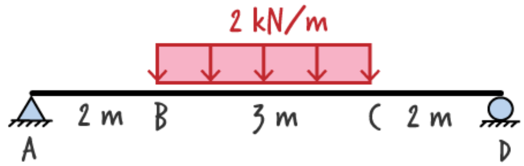
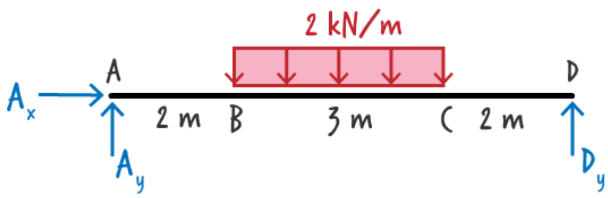
Statics– ST11 (Solution for Exercise Problem 4)
Shear Diagram for Statically Determinate Beams

Draw the shear diagram for the statically determinate beam shown below.

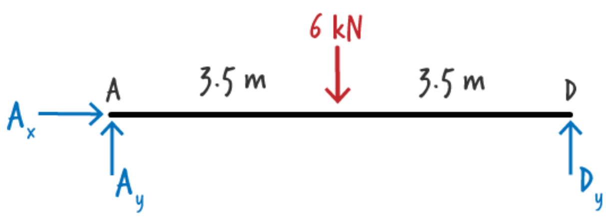


Solution

Draw the beam's free-body diagram.



Replace the distributed load with its equivalent concentrated load. The magnitude of the concentrated load is equal to the area of the rectangle, and the location of the load is the geometric center of the load area.



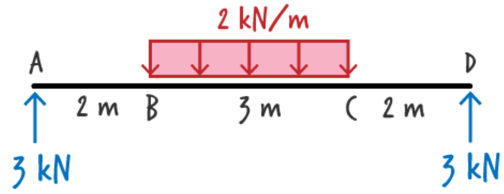
Now, write and solve the static equilibrium equations for the unknown support reactions.

$$\sum F_x = A_x = 0$$
$$\sum F_y = A_y + D_y - 6 = 0$$
$$\sum M_{@A} = (3.5)(6) - 7D_y = 0$$

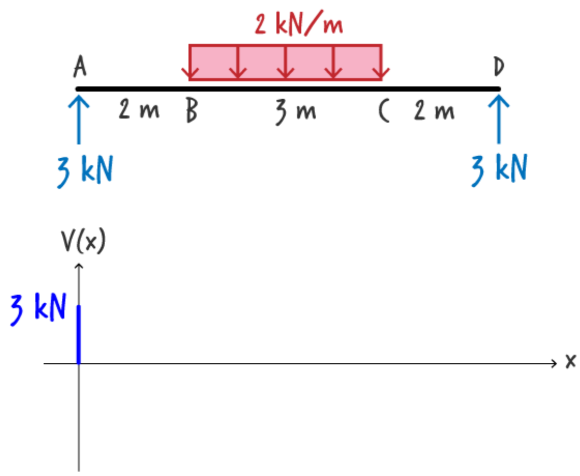
Solving the above equations for the unknown forces, we get:

$$A_x = 0 \qquad A_y = 3 \text{ kN} \qquad D_y = 3 \text{ kN}$$

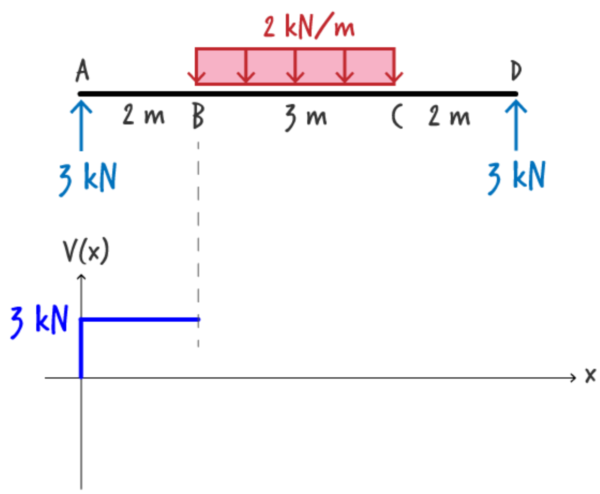
Knowing the support reactions, now draw the complete free-body diagram for the beam using the distributed loads.



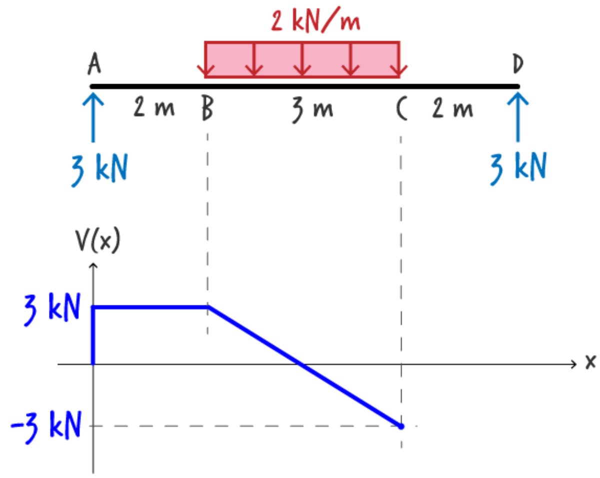
To draw the shear diagram, we start from the left end of the beam. Since there is an upward concentrated force of 3 kN at the left end of the beam, shear at the left end of AB is 3 kN,



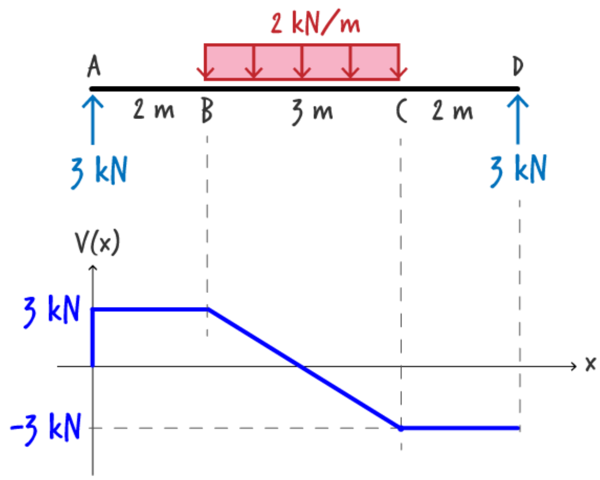
Shear remains 3 kN throughout AB, since the segment is not subjected to any loads.



For segment BC, shear at the left end of the segment is 3 kN. To determine shear at the right end of the segment, we subtract the area under the load diagram from 3 kN. The load area is that of the rectangle representing the load, it equals (2 kN/m)(3m) = 6 kN. So, shear at the right end of AB equals 3 – 6 = -3 kN. Since the load is uniformly distributed over the segment, shear is going to be represented using a straight line.

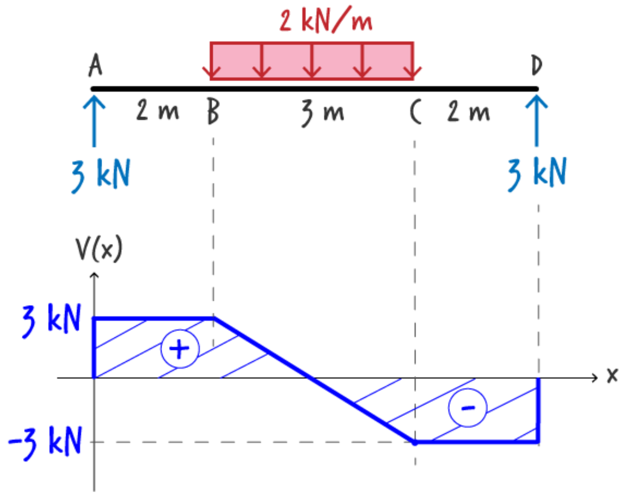


Shear remains constant in segment CD since there is no load acting on the beam from C to D.



Then, shear goes back to zero since there is an upward force of 3 kN at the right of the beam.

The complete shear diagram for the beam is shown below.


2 kN/m
A
B
C
D
2 m
3 m
2 m
3 kN
3 kN
V(x)
3 kN
-3 kN
x
+
-