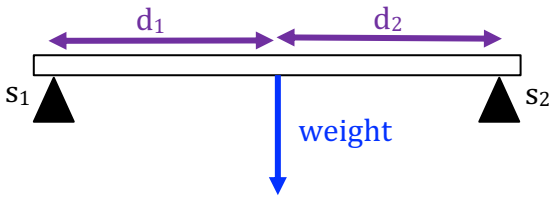
4.2.2 More on moments

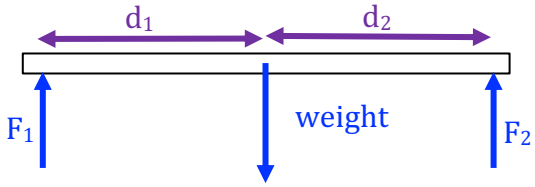
Problems involving more than one support

videos

We have already looked at problems involving objects supported from one point (called the pivot point). We will now look at problems involving 2 supports. Consider the beam in the following diagram:



The supports (s_1, s_2) produce upward forces (F_1, F_2) on the beam:



Because the beam is stationary, we can conclude that the upward force is balanced by the downward force:

$$weight = F_1 + F_2$$

Because the beam is not rotating, we can conclude that the turning forces (moments) are balanced:

Taking moments about the left-hand support (s_1):

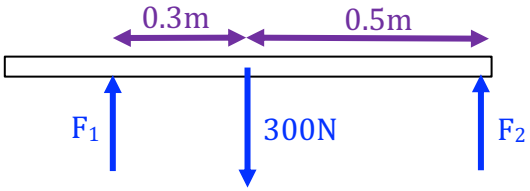
$$sum\ of\ clockwise\ moments = sum\ of\ anticlockwise\ moments$$

$$weight \times d_1 = F_2 \times (d_1 + d_2)$$

We could also take moments about the right-hand support (s_2):

$$F_1 \times (d_1 + d_2) = weight \times d_2$$

Let's look at an actual problem:



A 1.0m beam, weighing 300N, is supported at 2 points. We need to work out the upward forces F_1 and F_2.

(1) Write an expression for the balanced forces acting on the beam.

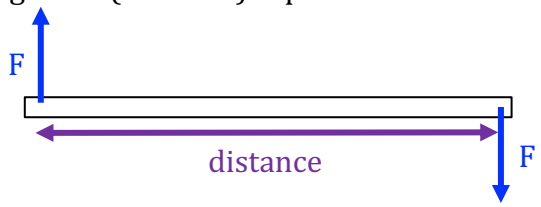
(2) Taking moments about the left-hand support, write an expression for balanced moments.

(3) Rearrange the expression for balanced moments (about the left-hand support) to make F_2 the subject and find a value for F_2.

(4) Substitute F_2 into the expression for balanced forces to find a value for F_1.

Couples

When two equal and opposite forces, which are parallel but act along different lines, a turning force (moment) is produced. This is called a torque.



$$torque = F \times distance$$

Torque is the turning force about any point on the beam. You are going to confirm this.

(5) Taking distance = 1.0m and F = 100N. Work out the moment about a point 0.2m from the end of the beam. (the beam is massless)

(6) Use the formula to calculate the torque on the beam. What do you notice?