Province of the
EASTERN CAPE
EDUCATION

DIRECTORATE SENIOR CURRICULUM MANAGEMENT (SEN-FET)

HOME SCHOOLING SELF-STUDY WORKSHEET

<table>
<tr><td>SUBJECT</td><td>FITTING & MACHINING</td><td>GRADE</td><td>12</td><td>DATE</td><td></td></tr>
<tr><td>TOPIC</td><td>FORCES (MOMENTS)</td><td>TERM 1 REVISION</td><td>(Please tick)</td><td>TERM 2 CONTENT</td><td>(√)</td></tr>
<tr><td>TIME ALLOCATION</td><td>1 hr 30 min</td><td colspan="4" rowspan="2"><u>TIPS TO KEEP HEALTHY</u>

1. WASH YOUR HANDS thoroughly with soap and water for at least 20 seconds. Alternatively, use hand sanitizer with an alcohol content of at least 60%.
2. PRACTICE SOCIAL DISTANCING – keep a distance of 1m away from other people.
3. PRACTISE GOOD RESPIRATORY HYGIENE: cough or sneeze into your elbow or tissue and dispose of the tissue immediately after use.
4. TRY NOT TO TOUCH YOUR FACE. The virus can be transferred from your hands to your nose, mouth and eyes. It can then enter your body and make you sick.
5. STAY AT HOME.</td></tr>
<tr><td>INSTRUCTIONS</td><td>Go through the material provided below and practice the activities given.</td></tr>
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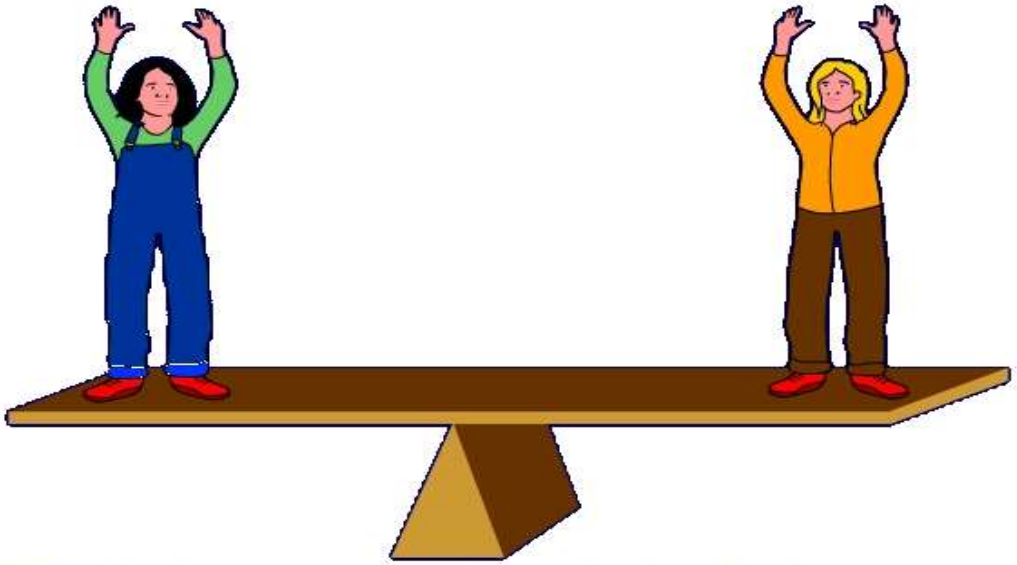
Principle of moments



If the anticlockwise moment and clockwise moment are equal then the see-saw is balanced. This is known as the **principle of moments**.

When something is balanced about a pivot:

total clockwise moment = total anticlockwise moment

DEFINITIONS

- **The moment of a force** is a measure of its tendency to rotate an object about some point.
- **Fulcrum**: The support, or point of rest, on which a lever turns in moving a body.

PRINCIPLE OF MOMENTS

Calculation:

Two girls are sitting on opposite sides of on a see-saw. One girl weighs 200 N and is 1.5 m from the pivot. Where must her 150 N friend sit if the seesaw is to balance?

When the see-saw is balanced:

total clockwise moment = total anticlockwise moment

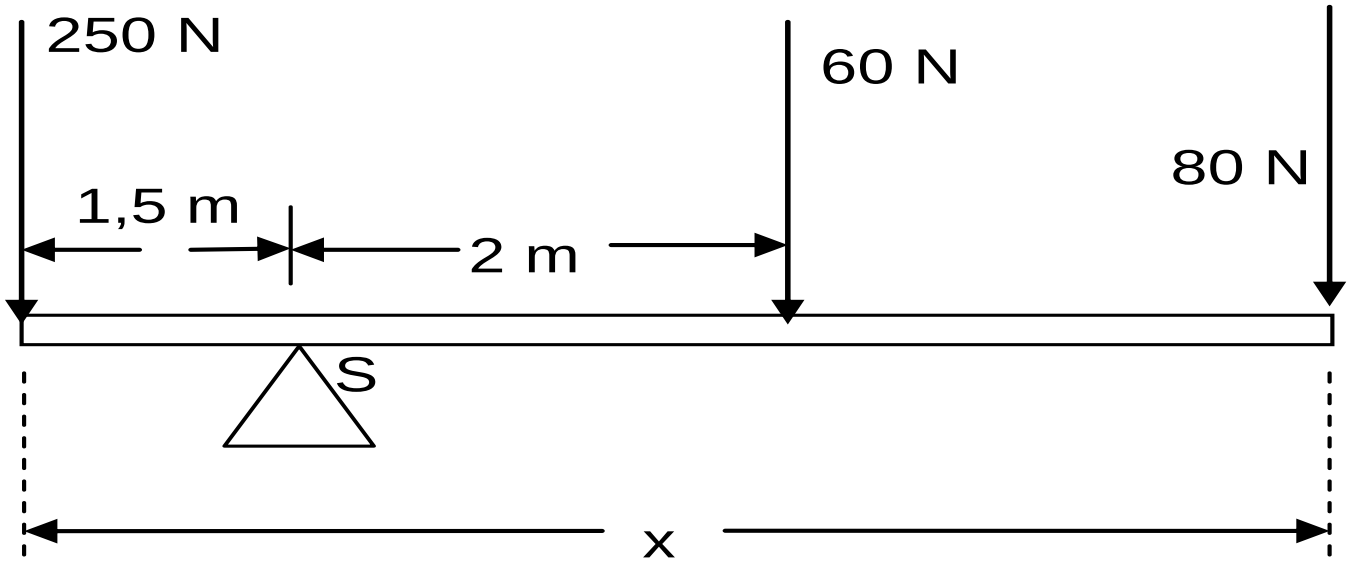
$$200\,N \times 1.5\,m = 150\,N \times \text{distance}$$

$$\frac{200}{150} \times 1.5 = \text{distance}$$

distance of second girl = 2 m

ACTIVITY 1

A lever is 6 m long and its fulcrum is 1.5 m away from the left end of the lever. A force of 250 N acts downwards on the left end. It also carries two other concentrated loads, one being 60 N and 3,5 m from the left end and the other being 80 N. Calculate the distance from the left end to the concentrated load of 80 N which will ensure that the lever is in equilibrium.



SOLUTION

Take moments about S

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

$$60\,(2) + 80(x-1{,}5) = 250(1{,}5)$$

$$120 + 80x - 120 = 375$$

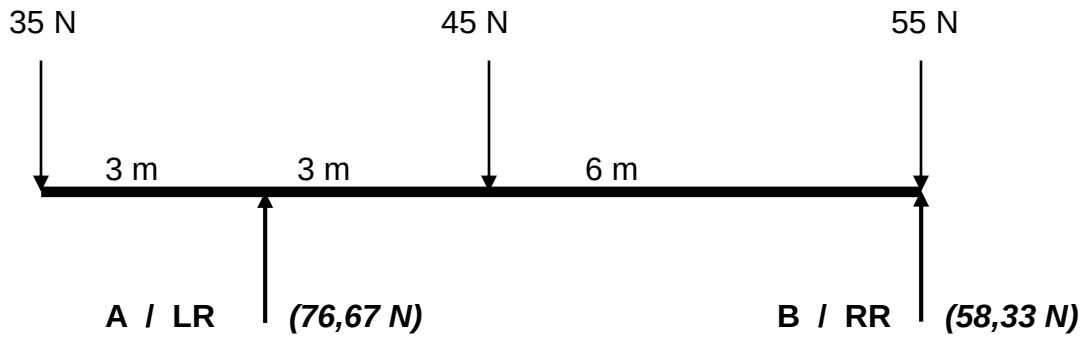
$$80x = 375$$

$$x = \frac{375}{80}$$

$$= 4{,}69 \text{ m}$$

CALCULATING REACTION FORCE

An easier method to calculate reactions and forces, etc.

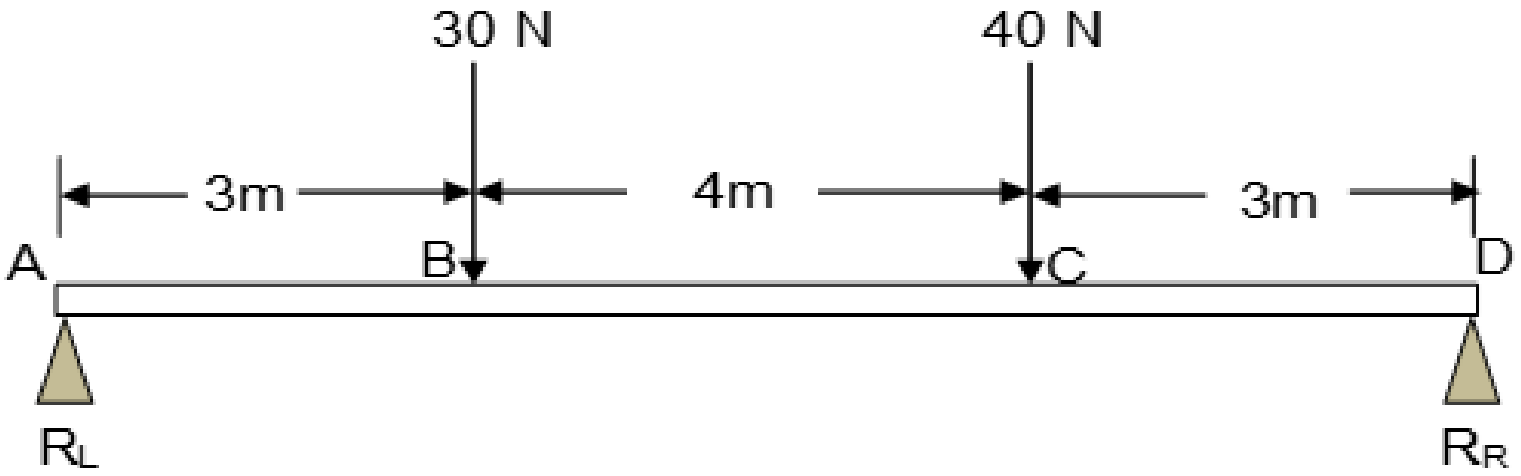


TAKING MOMENTS AROUND A (all anti-clockwise moments are Positive +)	
$+ \circlearrowleft M_A$	= (35 N x 3 m) + (- 45 N x 3 m) + (-55 N x 9 m) + (+ B x 9 m)
	= (105 Nm - 135 Nm - 495 Nm + B9M)
	= (- 30 Nm - 495 Nm) + B9m
	= - 525 Nm + B9m
$\frac{525\,Nm}{9\,m}$	= B
58,33 N = B	

TAKING MOMENTS AROUND B (all anti-clockwise moments are Positive +)
$+\circlearrowleft M_B$ = (35 N x 12 m) + (- A x 9 m) + (45 N x 6 m) + (- 55 N x 0 m)
= (420 Nm + 270 Nm – 0 Nm) – A9m
= 690 Nm – A9m 6
$A = \frac{690\ Nm}{9\ m}$
A = 76,67 N

TEST: ∑ all UPward forces = ∑ all DOWNward forces
LR + RR = 35 N + 45 N + 55 N
76.67 N + 58,33 N = 135 N
135 N = 135 N

ACTIVITY 2



a) Calculate reactions at the support R_L and R_R.

b) Prove that the beam is balanced. (conditions of equilibrium)

UNIFORMLY DISTRIBUTED LOAD

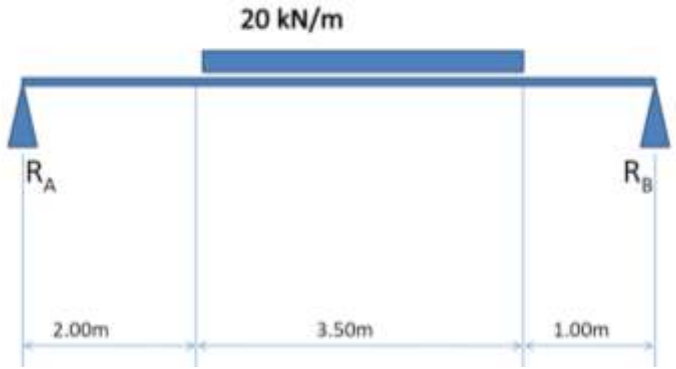
Definition:

A **uniformly distributed load** (UDL) is a load that is distributed or spread across the whole region of an element such as a beam or slab

Sometimes the load does not exist as point load, but as uniformly distributed across the lenth of the beam or slab.

BEAM WITH POINT LOADING

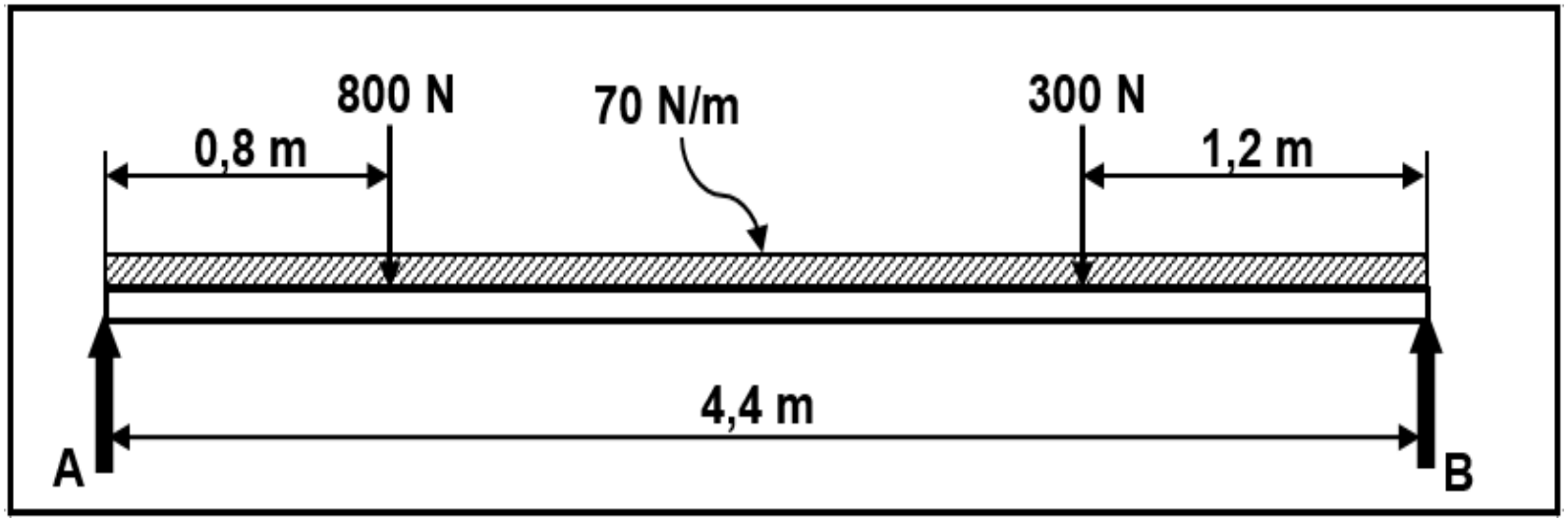
BEAM WITH UNIFORMLY DISTRIBUTED LOAD



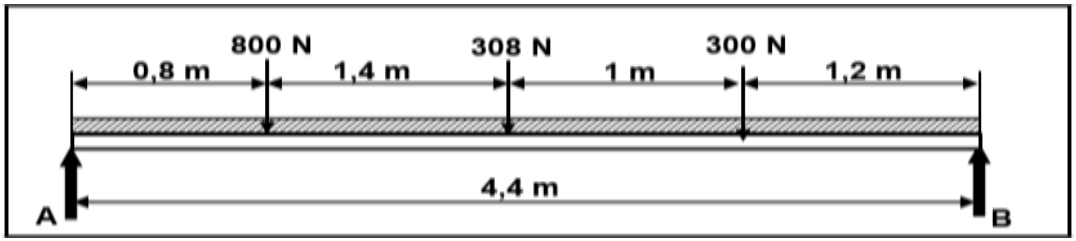
EXAMPLE

The diagram in figure below shows a beam supported by two vertical supports, **A** and **B**. Two vertical point loads of 800 N and 300 N as well as a uniformly distributed load of 70 N/m over the total length of the beam are exerted onto the beam. Calculate the magnitude of the reactions in support **A** and support **B**.

NB Start by redrawing the diagram to replace the uniformly distributed load by the point load.



Solution:



Single acting force:

$= 70\text{N/m} \times 4{,}4\text{m}$

$= 308\text{N}$ ✓

Calculate A.:
Moments about B.

$$\sum \text{RHM} = \Sigma \text{LHM}$$

$$(A \times 4{,}4) = (300 \times 1{,}2) + (308 \times 2{,}2) + (800 \times 3{,}6)$$

$$\frac{4{,}4A}{4{,}4} = \frac{3917{,}60}{4{,}4}$$

$$A = 890{,}36 \text{ N}$$

Calculate B:.
Moments about A.

$$\sum \text{LHM} = \Sigma \text{RHM}$$

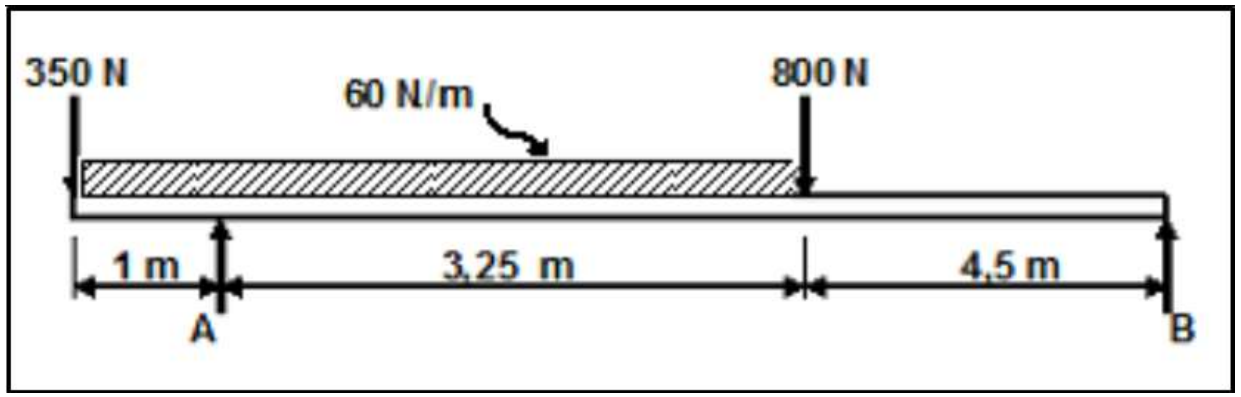
$$(B \times 4{,}4) = (800 \times 0{,}8) + (308 \times 2{,}2) + (300 \times 3{,}2)$$

$$\frac{4{,}4B}{4{,}4} = \frac{2277{,}60}{4{,}4}$$

$$A = 517{,}64 \text{ N}$$

ACTIVITY 3

The diagram in FIGURE 3 below shows a uniform beam supported by two vertical supports, **A** and **B**. Two vertical point loads, as well as a uniformly distributed force of 60 N/m over the distance between the two vertical point loads are exerted onto the beam.



Explain the expression Uniformly Distributed Load (UDL) in beams.

Determine by means of calculations, the magnitude of reactions in support **A** and **B.**

Provide any two applications of beams**.**