Principle of Moments

The turning effect on the bolt by the spanner is called a "moment".

The moment = the size of the force (N) multiplied by the length of the lever (m).

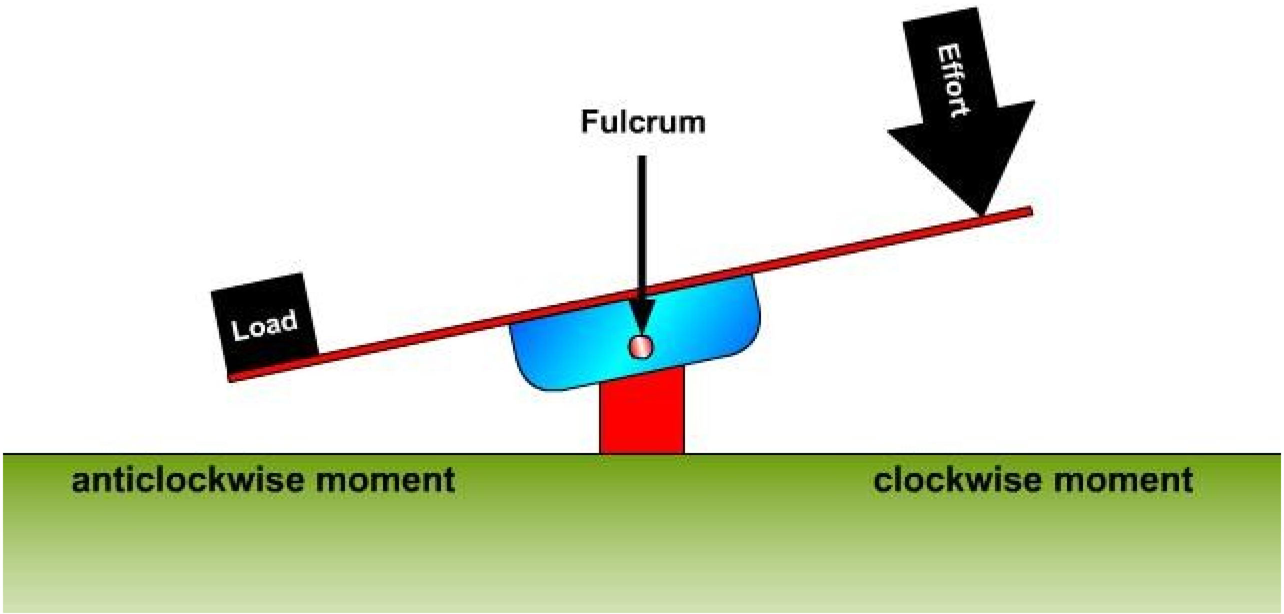
Moment = Force x Distance

Moments are measured in Nm

therefore: **moment (Nm) = force (N) x distance (m)**

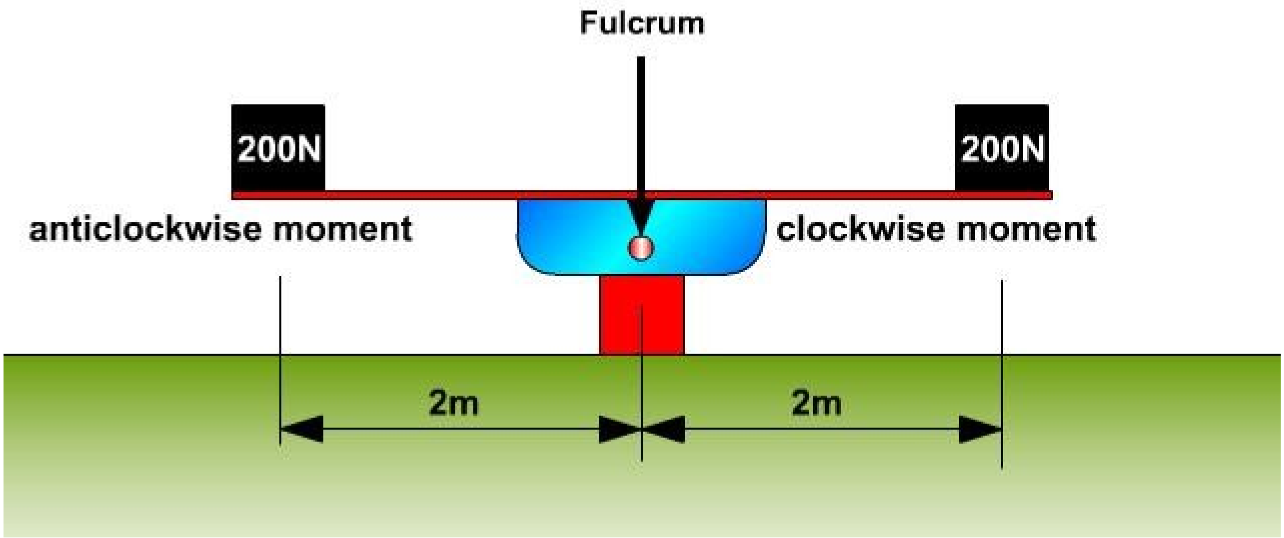
An object is in equilibrium, i.e. it is balanced and not turning or moving when:

- there is no force applied to the object, or
- the sum of the clockwise moments about a point is equal to the sum of the anticlockwise moments about the point.



A load on one end of a see-saw will create a turning effect about the fulcrum called a moment. A load is an example of a force.

Moment = Load X Distance (distance from the pivot/fulcrum to the load)



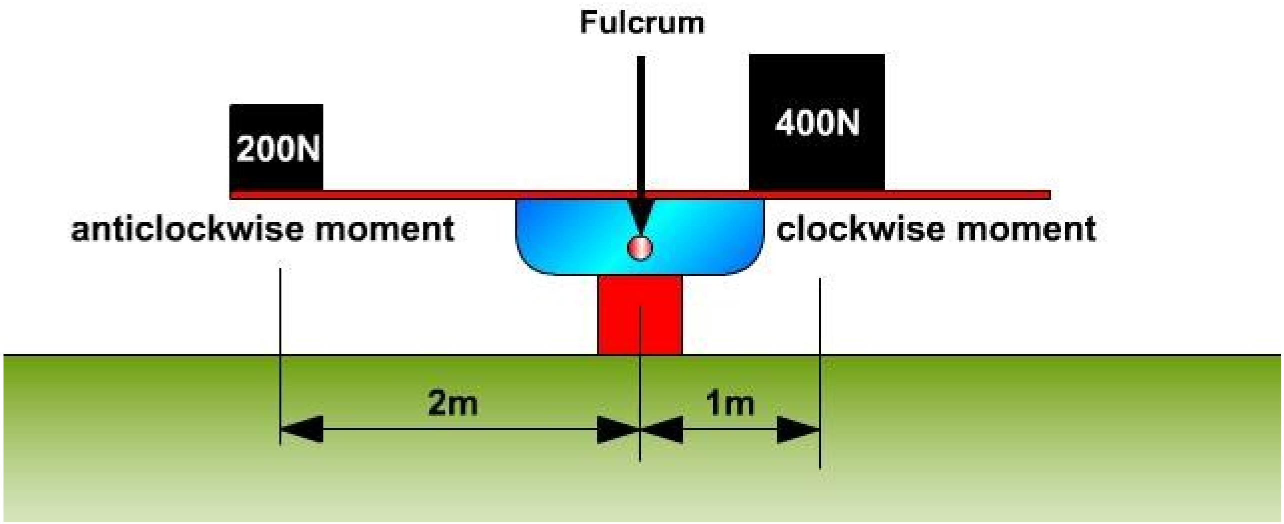
The diagram above illustrates loads of 200N placed equal distances from the fulcrum.

Moment = Force X Distance

The anticlockwise moment = 200N x 2 m = **400 Nm**
The clockwise moment = 200N x 2m = **400 Nm.**

The loads are in equilibrium because:

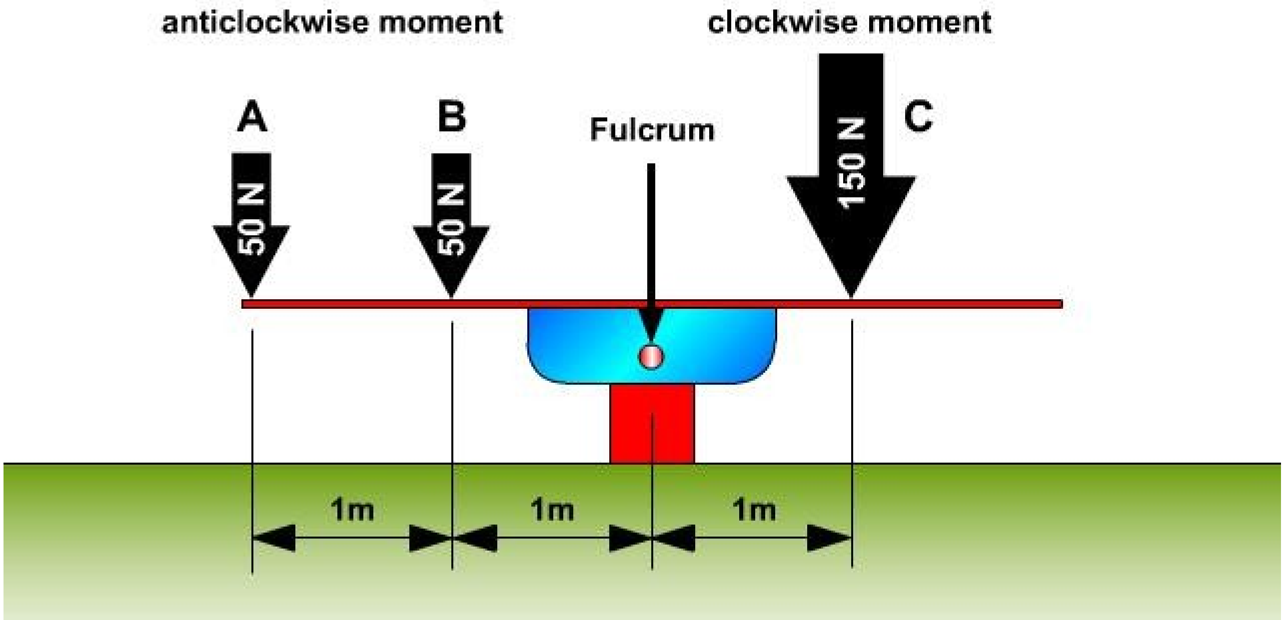
- the loads are equal
- the loads are placed equal distances from the fulcrum
- the anticlockwise moment equals the clockwise moment.



The diagram above illustrates two unequal loads placed on the seesaw.

The anticlockwise moment = 200N X 2m = **400Nm**
The clockwise moment = 400N X 1m = **400 Nm**

As the anticlockwise moment and the clockwise moment are equal, the see-saw is in equilibrium, i.e. it is balanced.



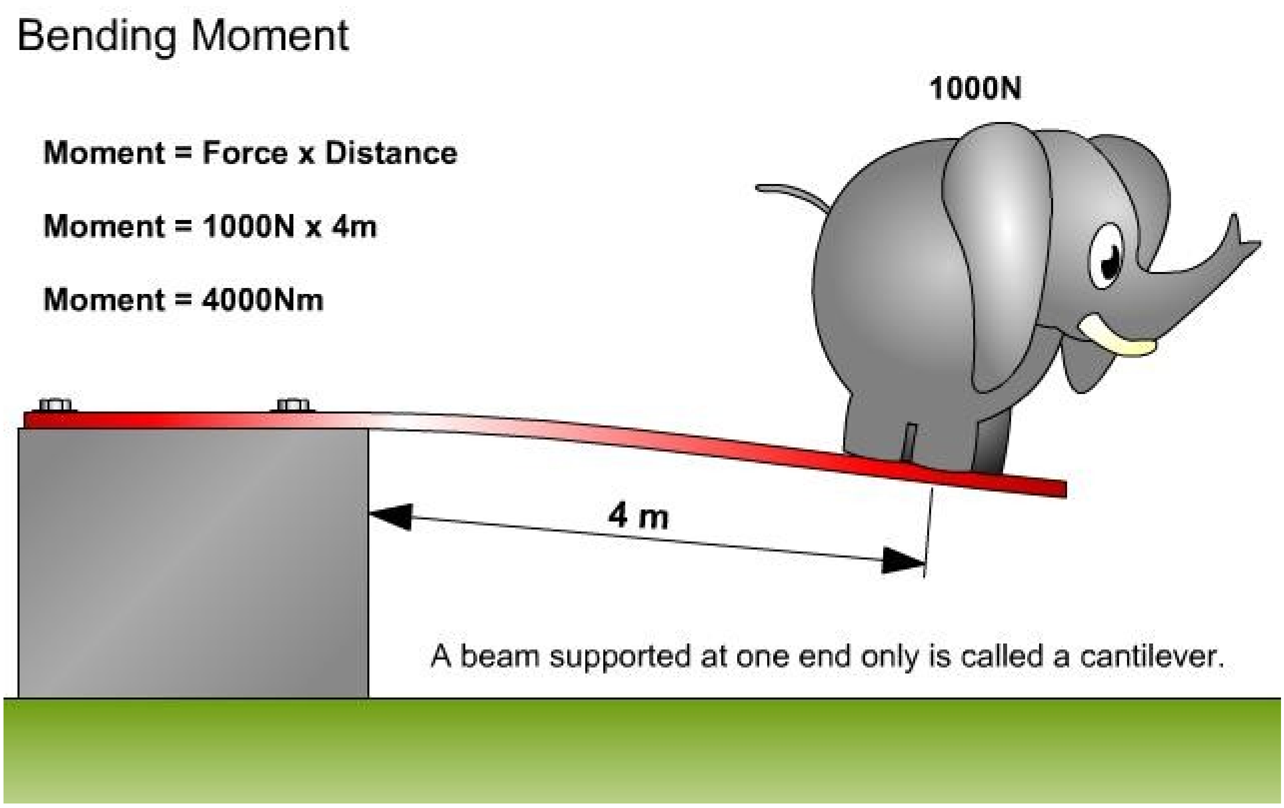
In the example above, two 50N loads are placed on one side of the seesaw and a 150N load is placed on the other. The see-saw is balanced because the clockwise moment is equal to the sum of the anticlockwise moments, i.e.

Moment = Force x Distance

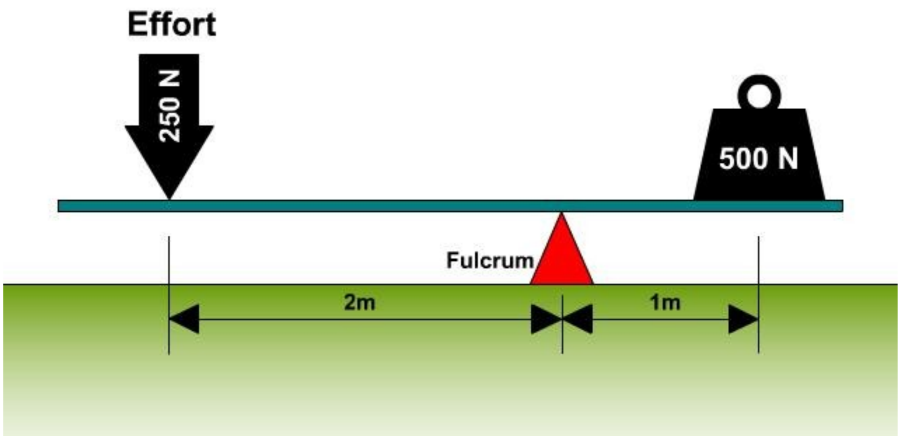
Moment at A = 50N x 2m = 100Nm anticlockwise moment
Moment at B = 50N x 1m = 50Nm anticlockwise moment

Anticlockwise moment at A + B = **150Nm**

Moment at C = 150N x 1m = **150Nm clockwise moment**

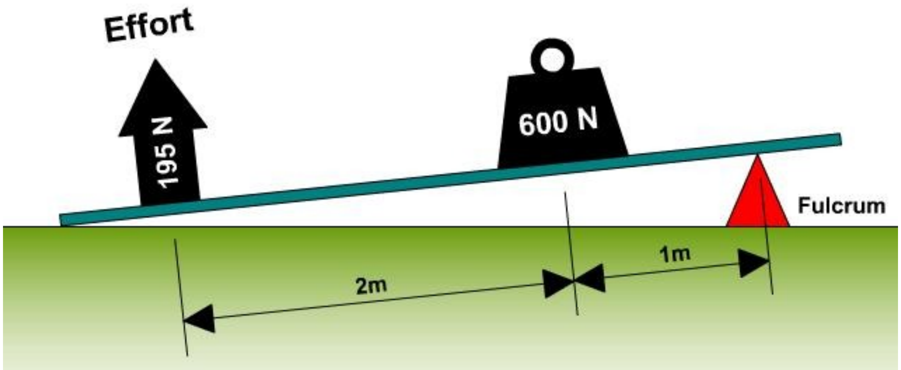


Moments acting on a Class 1 lever



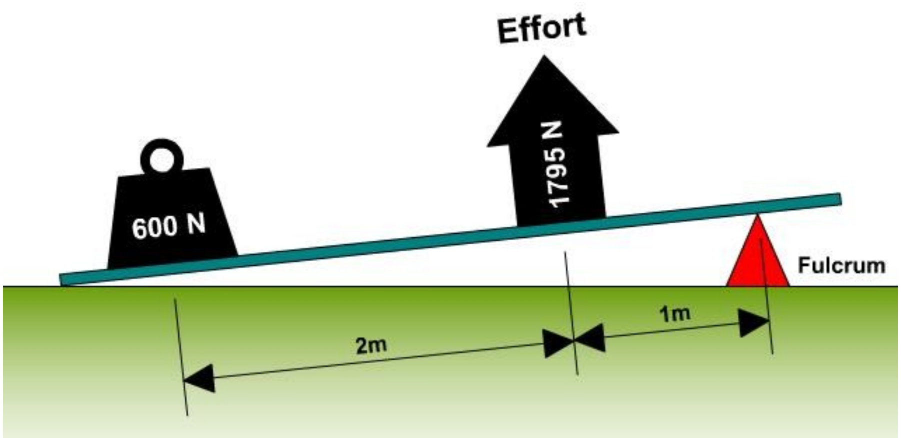
There is a 500Nm anticlockwise moment and a 500Nm clockwise moment, so the lever is in equilibrium.
In order to lift the 500N load higher, the effort must be increased or the distance from the effort force to the fulcrum must be increased.

Moments acting on a Class 2 lever



There is a 600N load acting on the lever 1 metre from the fulcrum so the anticlockwise moment is 600Nm.
There is a 195N effort acting on the lever 3 metres from the fulcrum so the clockwise moment is 585Nm.
In order to lift the load, an effort greater than 600Nm must be applied or the distance from the effort force to the fulcrum must be increased.

Moments acting on a Class 3 lever



There is a 600N load acting on the lever 3 metres from the fulcrum so the anticlockwise moment is 1800Nm.
There is a 1795N effort acting on the lever 1 metre from the fulcrum so the clockwise moment is 1795Nm.
In order to lift the load, an effort greater than 1800Nm must be applied or the distance from the effort force to the fulcrum must be increased.