MOMENT and its APPLICATION

Moment of Force

It is the turning effect produced by a force, on the body, on which it acts. The moment of a force is equal to the product of the force and the perpendicular distance of the point, about which the moment is required and the line of action of the force.

Mathematically, moment,

$M = P \times l$

P = Force acting on the body, and

l = Perpendicular distance between the point, about which the moment is required and the line of action of the force.

Moment in Glance

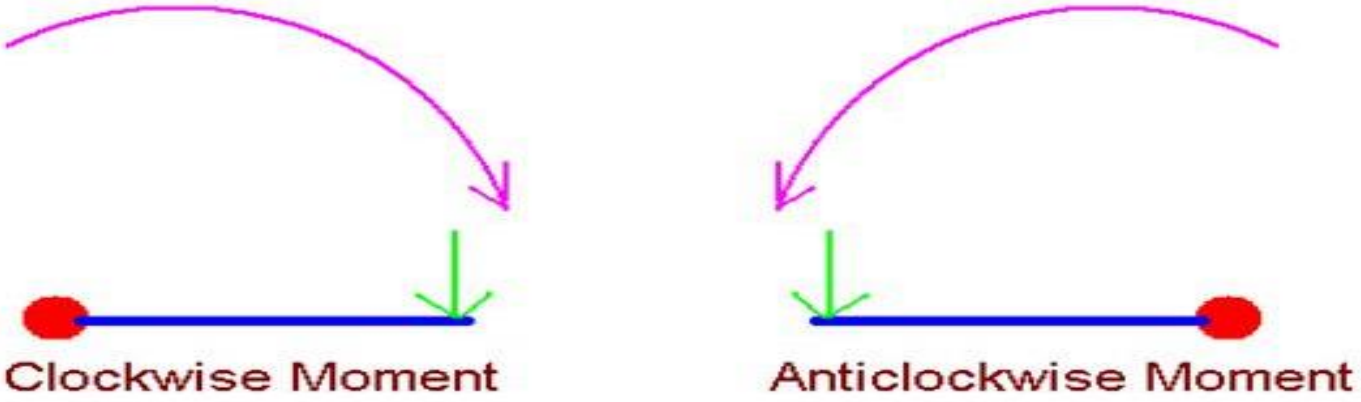
- Unit: KN-m, N-m, N-mm, KN-mm
- Types of Moment
  - Clockwise Moment: It is the moment of a force, whose effect is to turn or rotate the body, about the point in the same direction in which hands of a clock move.
  - Anti-Clockwise Moment: It is the moment of a force, whose effect is to turn or rotate the body, about the point in the opposite direction in which the hands of a clock move.

Types of Moment

Generally clockwise moment is taken as positive and anti clockwise moment is taken as negative.

There are two types of moments

1. Clockwise moments
2. Anticlockwise moments

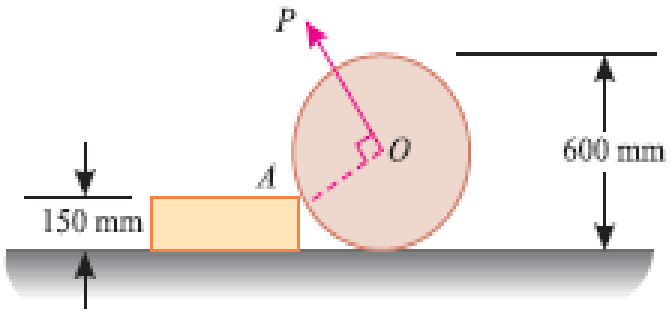


Varignon's Principle of Moment & Law of Moment

It states, "*If a number of coplanar forces are acting simultaneously on a particle, the algebraic sum of the moments of all the forces about any point is equal to the moment of their resultant force about the same point*."

Question

A uniform wheel of 600 mm diameter, weighing 5 KN rests against a rigid rectangular block of 150 mm height as shown in figure. Find the least pull, through the center of the wheel, required just to turn the wheel over the corner A of the block. Also find the reaction on the block. Take all the surfaces to be smooth.



Solution

Solution. Given : Diameter of wheel = 600 mm; Weight of wheel = 5 kN and height of the block = 150 mm.

Least pull required just to turn the wheel over the corner.

Let P = Least pull required just to turn the wheel in kN.

A little consideration will show that for the least pull, it must be applied normal to AO. The system of forces is shown in Fig. 3.9. From the geometry of the figure, we find that

$$\sin\theta = \frac{150}{300} = 0.5 \quad \text{or} \quad \theta = 30°$$

and $$AB = \sqrt{(300)^2 - (150)^2} = 260 \text{ mm}$$

Now taking moments about A and equating the same,

$$P \times 300 = 5 \times 260 = 1300$$

$$\therefore \quad P = \frac{1300}{300} = 4.33 \text{ kN} \quad \text{Ans.}$$

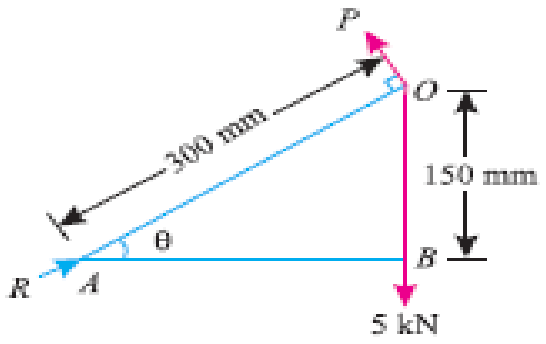


Fig. 3.9.

Reaction on the block

Let R = Reaction on the block in kN.

Resolving the forces horizontally and equating the same,

$$R \cos 30° = P \sin 30°$$

$$\therefore \quad R = \frac{P \sin 30°}{\cos 30°} = \frac{4.33 \times 0.5}{0.866} = 2.5 \text{ kN} \quad \text{Ans.}$$

Parallel Forces

Sometimes, the given forces have their lines of action parallel to each other. A little consideration will show, that such forces do not meet at any point, though they do have some effect on the body on which they act. The forces, whose lines of action are parallel to each other, are known as parallel forces.

Type of Parallel force

1. Like Parallel force: The forces, whose lines of action are parallel to each other and all of them act in the same direction are known as like parallel forces.
2. Unlike Parallel force: The forces, whose lines of action are parallel to each other and all of them do not act in the same direction are known as unlike parallel forces.

Couple

- A pair of two equal and unlike parallel forces (*i*.*e*. forces equal in magnitude, with lines of action parallel to each other and acting in opposite directions) is known as a couple.
- As a matter of fact, a couple is unable to produce any translatory motion (*i*.*e*., motion in a straight line). But it produces a motion of rotation in the body, on which it acts. The simplest example of a couple is the forces applied to the key of a lock, while locking or unlocking it.

Characteristics of a Couple

1. The algebraic sum of the forces, constituting the couple, is zero.
2. The algebraic sum of the moments of the forces, constituting the couple, about any point is the same, and equal to the moment of the couple itself.
3. A couple cannot be balanced by a single force. But it can be balanced only by a couple of opposite sense.
4. Any no. of co-planer couples can be reduced to a single couple, whose magnitude will be equal to the algebraic sum of the moments of all the couples.

THE END
THANK YOU