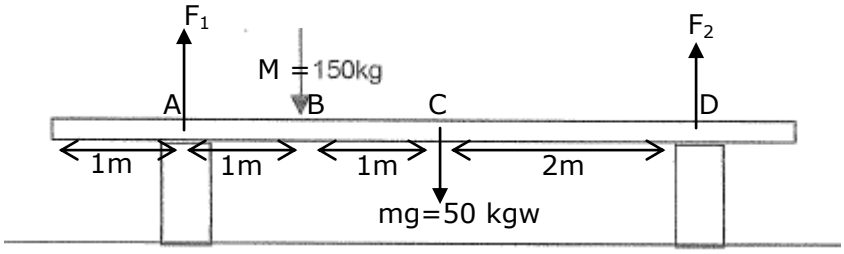
Q- A timber plank 6m long and mass 50 kg is supported horizontally by two posts 1m from each end. A mass of 150 kg is placed on the plank 1m inside of the left hand supporting post. What is the force in each of the two supports?



The weight of the plank mg is acting at its mid-point and the weight of the mass 150 kg is at 1m from the left support.

As the timber is in equilibrium, the net force acting on it will be zero and the net torque acting on it must be zero.

Let the force on the supports be F_1 and F_2 then according to Newton's third law an equal and opposite reaction on the plank will be there and hence the forces acting on the plank are, F_1 reaction of the left support upward, Mg weight of the mass downwards, mg weight of the plank downward and F_2 the reaction of the right support. Under these forces the plank is in equilibrium and net force must be zero and hence we have

$$F_1 - Mg - mg + F_2 = 0$$

Gives $F_1 + F_2 = Mg + mg = (150 + 50)*9.8 = 1960$ N ---------- (1)

As the plank is not rotating the net torque about any point must be zero and hence taking net torque about the left support we have (torque = force and perpendicular distance from axis of rotation)

$$F_1*0 - Mg*AB - mg*AC + F_2*AD = 0$$

Or $0 - 150*9.8*1.0 - 50*9.8*2.0 + F_2*4.0 = 0$

Gives $F_2*4.0 = 9.8*(150 +100) = 2450$

Or $F_2 = 2450/4.0 = 612.5$ N

And substituting F_2 in equation (1) we have

$$F_1 = 1960 - 612.5 = 1347.5 \text{ N}.$$

Hence the force in the supports will be **1347.5 N** on the left and **612.5 N** on the right.