Example 3.1

J. Frye

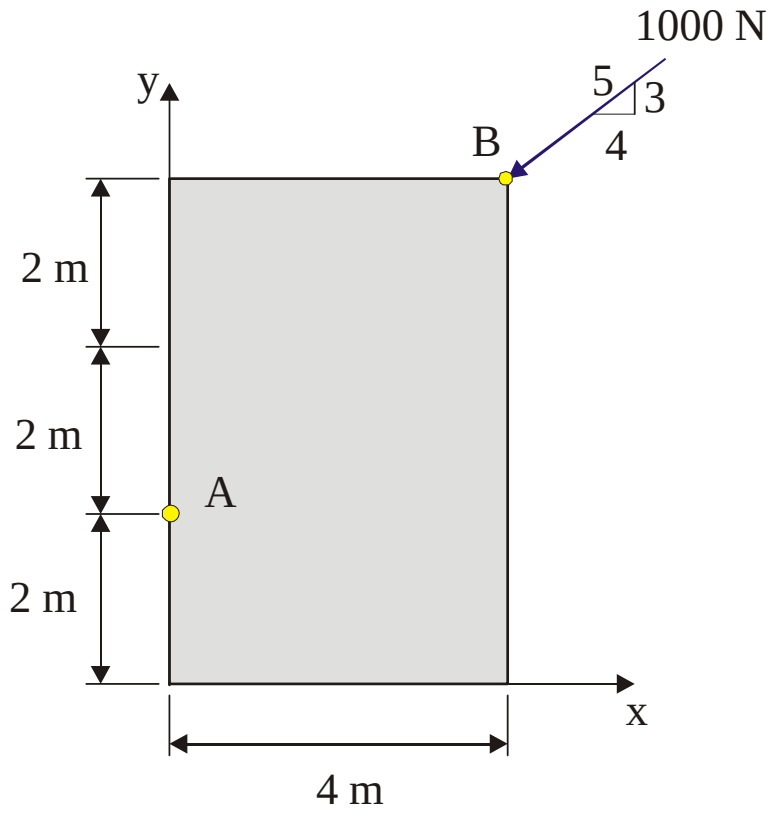
Example 3.1:

Consider the 4 m×6 m block with a 1000 N force applied at point B as shown.

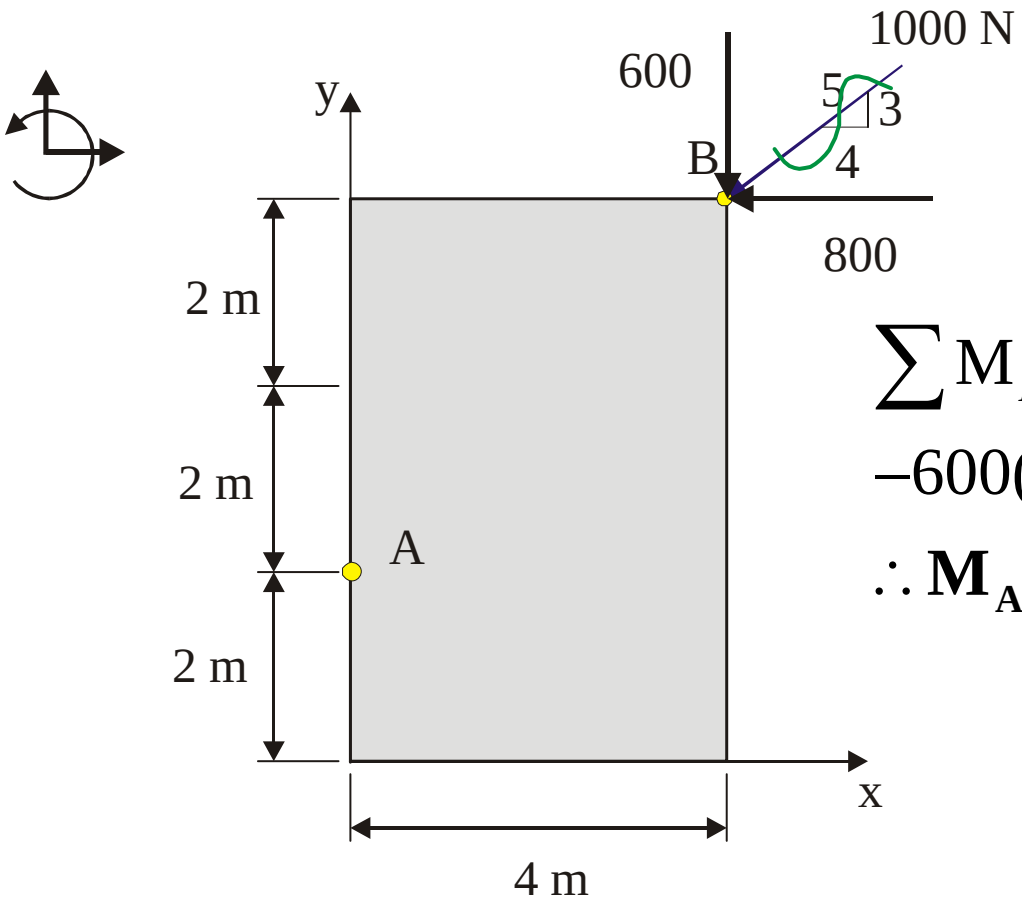
(a)Determine the moment of the 1000 N force applied at B about the point A by resolving the force along horizontal and vertical directions.

(b)The perpendicular distance from the line of action of the 1000 N force to the point A.

(c)Smallest force at B, which creates the same moment at A as in part (a).



a) Resolve all forces into rectangular components and then take moments:

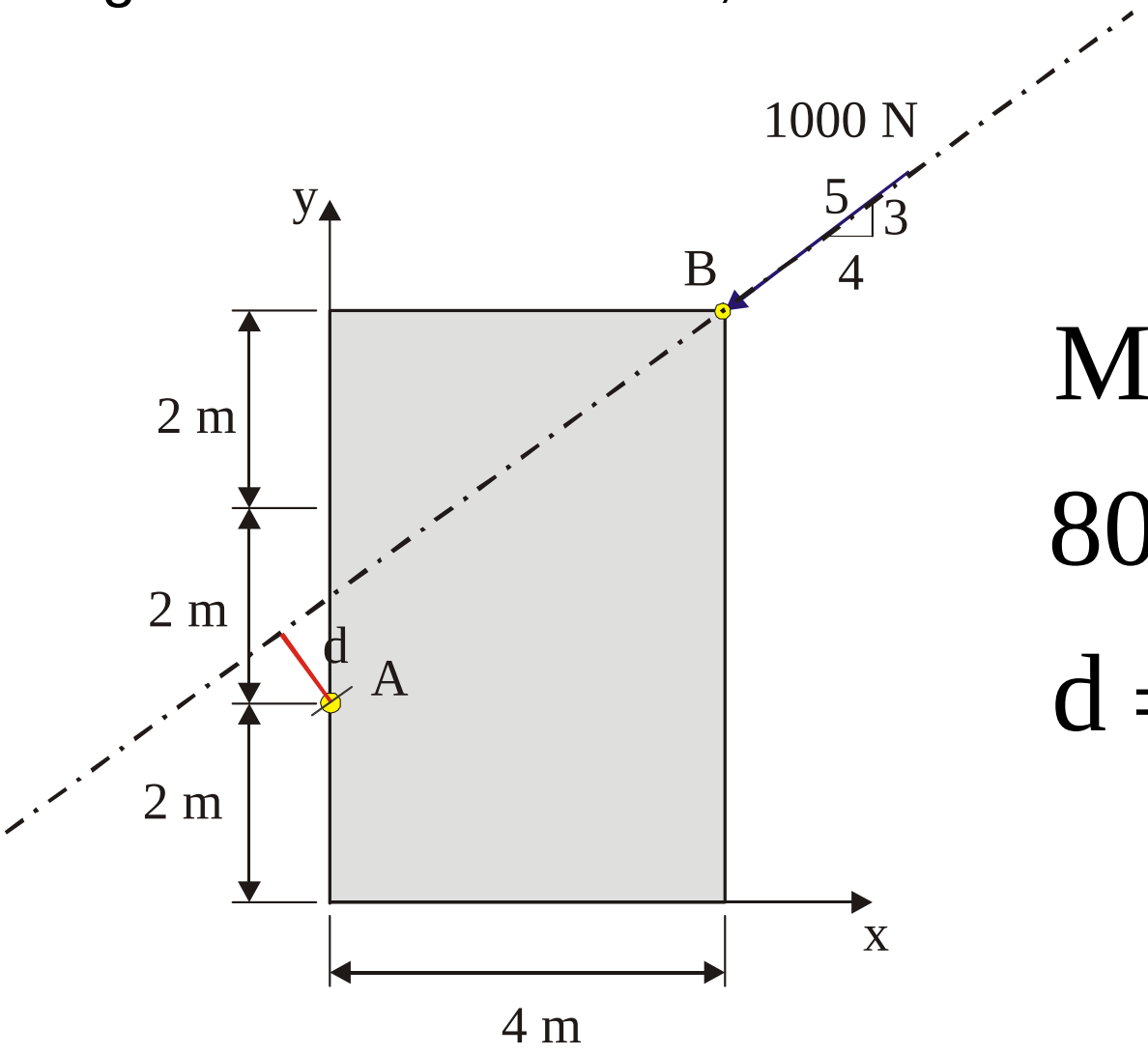


$$\sum M_A \circlearrowleft$$

$$-600(4)+800(4)=+800\,\text{N.m}$$

$$\therefore \mathbf{M_A}=800\,\text{N.m}\ \circlearrowleft$$

b) The perpendicular distance from the line of action of the 1000 N force to the point A is found by equating the magnitude of the moment, M to Fd.



$$M = Fd$$

$$800 = 1000d$$

$$d = 0.8m$$

Since $M = Fd$ or $F = M/d$

F gets smaller as d increases

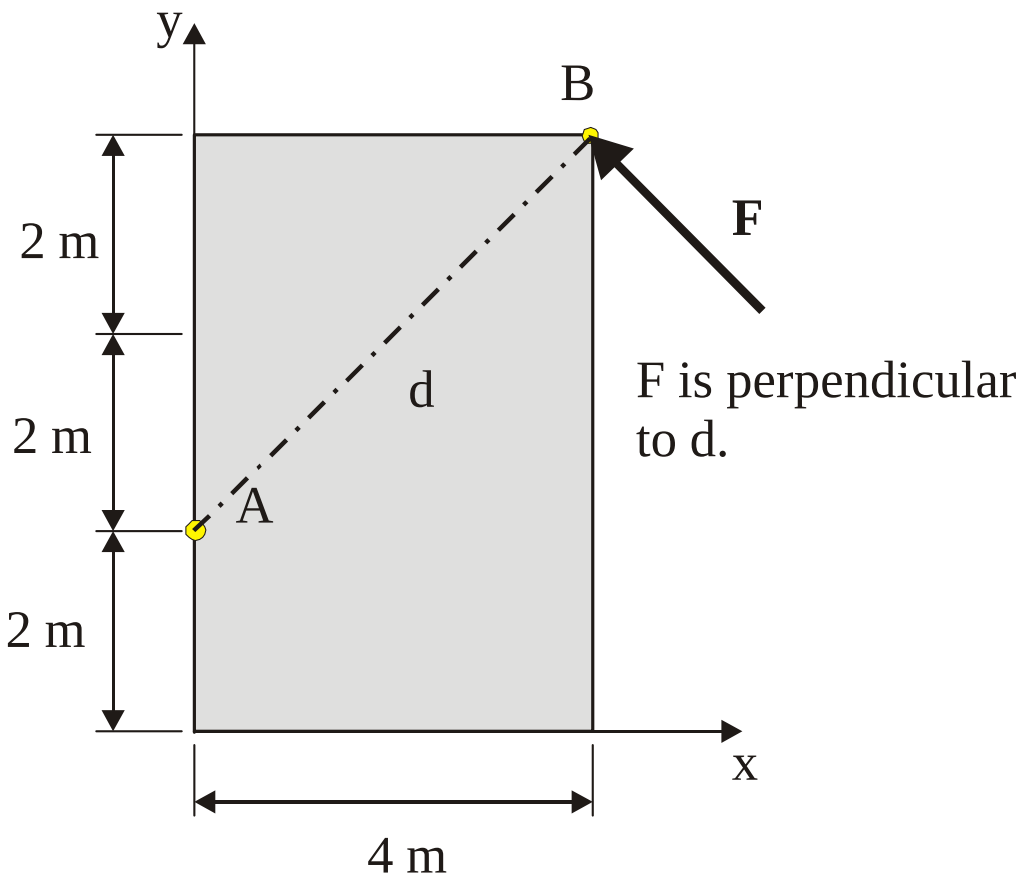
The minimum value of F occurs when the perpendicular distance, d from the line of action of the force to the point we are taking moment about is the largest distance.

In this problem since we have taken moments about Point A we identify point B as the point on the block that is furthest from point A.

We draw a line connecting point A and point B. The force F is therefore placed perpendicular to this line. The “sense” of F depends on whether the moment M is a clockwise or counter-clockwise moment

In our case, the moment in Part A of the question is positive (counter-clockwise). We therefore indicate the “sense” of F such as to produce a counter-clockwise moment about A

c) The smallest force F that will create the 800N.m counter-clockwise moment about point A.



$$M = Fd$$

$$\text{Where } M = 800\text{N.m}$$

$$d = \sqrt{4^2 + 4^2} = 5.66\text{m}$$

$$\therefore 800 = F(5.66)$$

$$F = 141.42\text{N}$$

$$\mathbf{F} = 141.42\text{N}$$