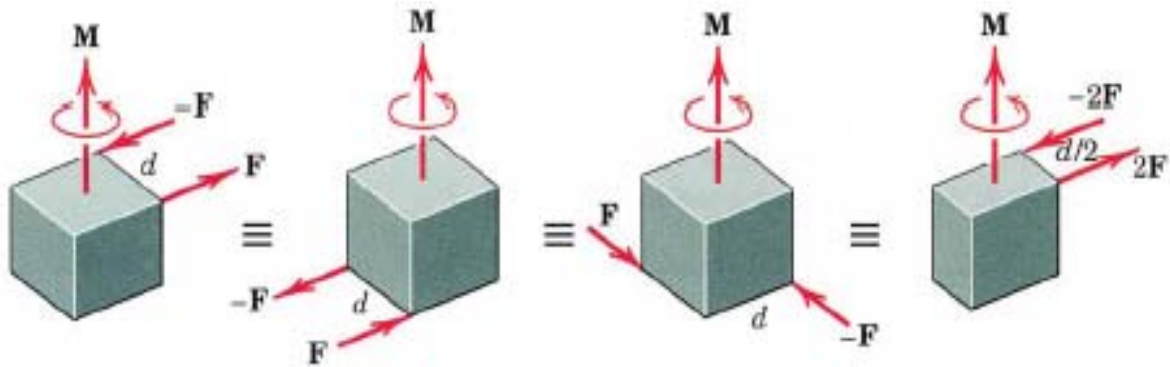# Moment of Couple

Couples :

A special case of moments is a couple. A **couple** consists of two parallel forces that are equal in magnitude, opposite in sense and do not share a line of action. It does not produce any translation, only rotation. The resultant force of a couple is zero. BUT, the resultant of a couple is not zero; it is a pure moment.
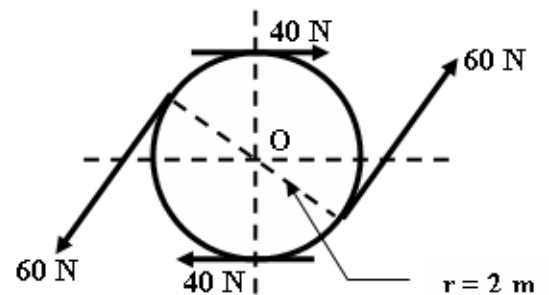

Ex (1)

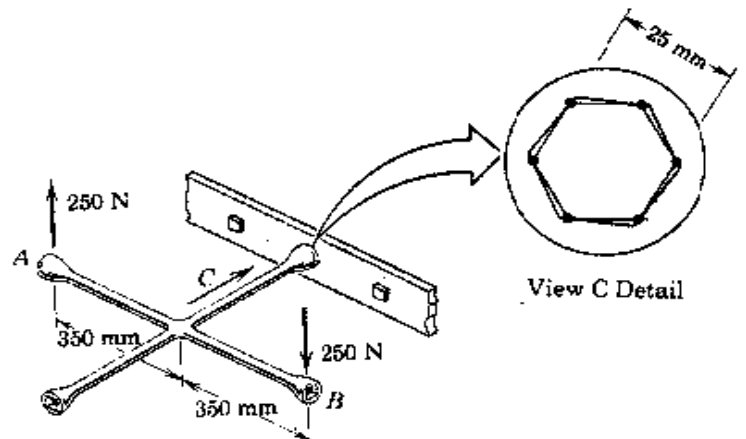Compute the magnitude and direction of the resultant couples action on the body shown

Solution :

Mc = 60 * 4 – 40 * 4

 = 240 – 160 = 80 N .m

Ex (2)

A lug wrench is used to tighten a hex-head bolt , Determine the magnitude (F) of the equal forces exerted on the six contact points as shown in fig.

Solution

On the lug wrench :

Mc = F * d

 = 250 * 350 *2

 = 175000 N . mm

On the nut :

Mc = 3 F * d

175000 = 3 F * 25

F = 175000 / 75 = 2333.33 N

Ex (3)
Determine the moment associated with the forces shown in fig.
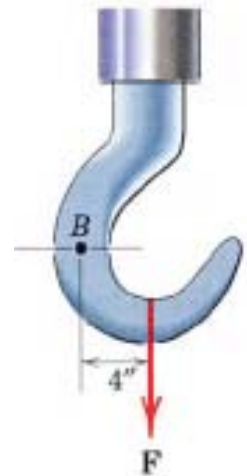

Solution
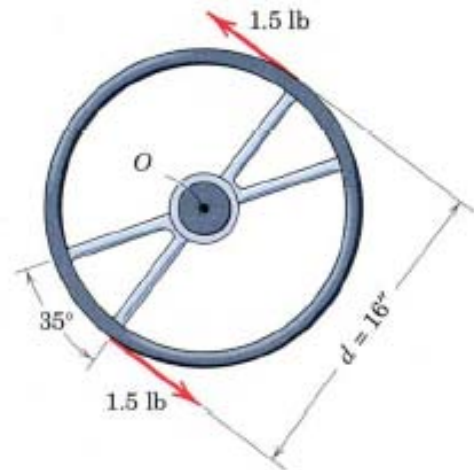
Mc = F * d
   = 1.5 * 16
   = 24 lb .in

Ex (4)
In the design of lifting hook , the action of the applied force (F) at the critical section of the hook is a direct pull at (B) and a couple . if the magnitude of the couple is (4000 N.m) , Determine the magnitude of the force (F) .
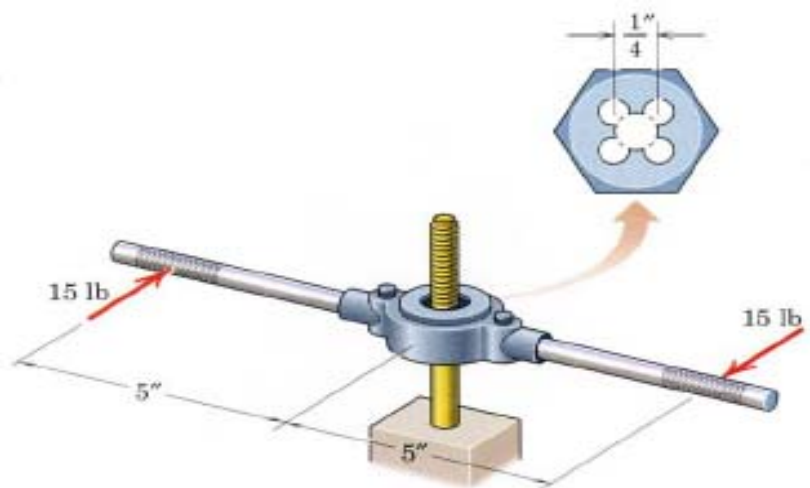
Solution
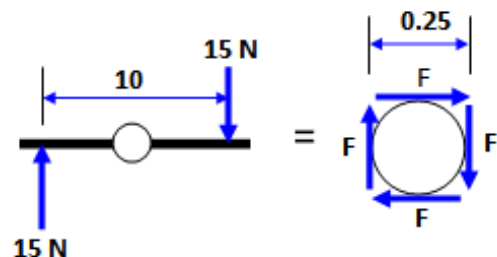Mc = F * d
F = Mc / d
  = 4000* 12 / 4
  = 12000 N

Ex (5) :
A die is being used to cut threads on a rod . if the (150 N) forces are applied as shown , Determine the magnitude of (F) of the equal forces exerted on the (1/4 ") rod by each of the four cutting surfaces so that their external effect on the rod is equivalent to that of the two (15 N) forces .

Solution

Mc = F * d = 15 * 10 = 2 * F * 0.25
F = 300 N
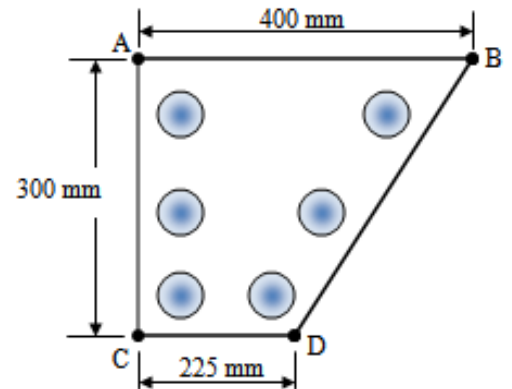
Ex (6) :

A multiple – drilling is used to drill simultaneously six holes in the steel plate shown in fig. . Each drill exerts clockwise couple of magnitude (5 N.m) on the plate . Determine an equivalent couple formed by the smallest possible forces acting :

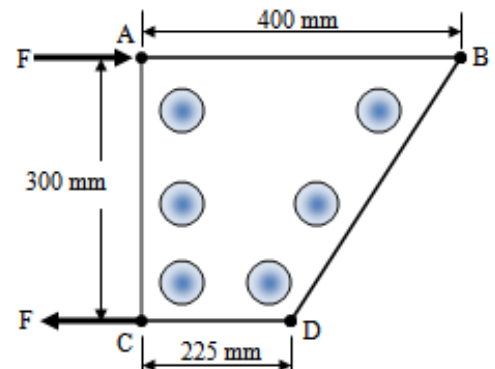a - at A and C
b - at A and D
c – on the plate

Solution

a –

     Mc = 5 N.m * 6 holes = 30N.m
     Mc = F * d
     30 = F * 0.3
     F = 100 N
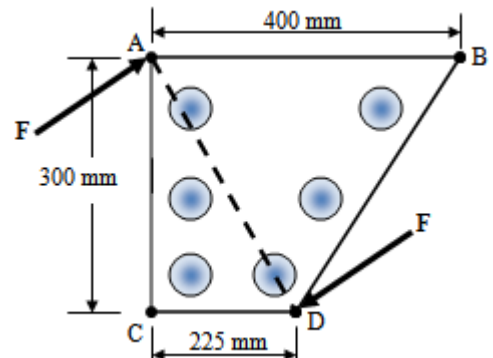

b -

$$AD = \sqrt{(225)^2 + (300)^2} = 375 \ mm$$
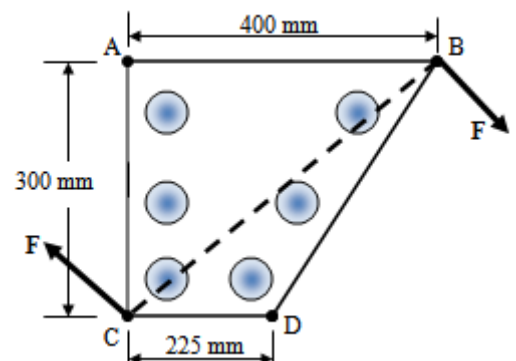
$$Mc = F * d$$

$$30 = F * 0.375$$

$$F = 80N$$

c –

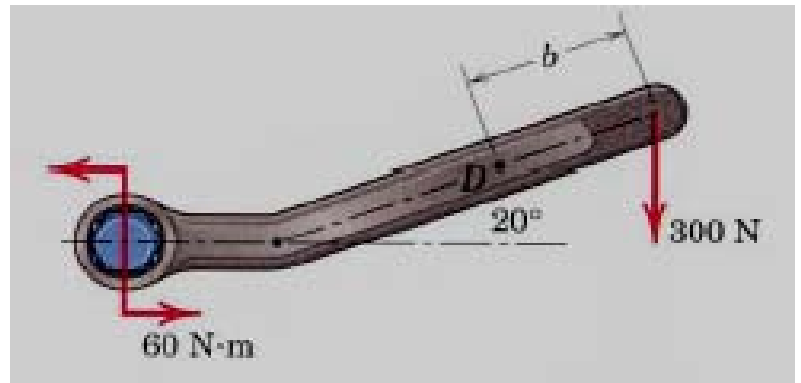$$BC = \sqrt{(300)^2 + (400)^2} = 500 \ mm$$

$$Mc = F * d$$

$$30 = F * 0.5$$

$$F = 60N$$

PROBLEMS

1 – Replace the couple and force shown by a single force (F) applied at a point (D) , locate (D) by determining the distance (b) .

2 – The indicated force – couple system is applied to a small shaft at the center of rectangular plate , Replace this system by a single force and specify the coordinate of the point on the y – axis through which the line of action of this resultant force passes .
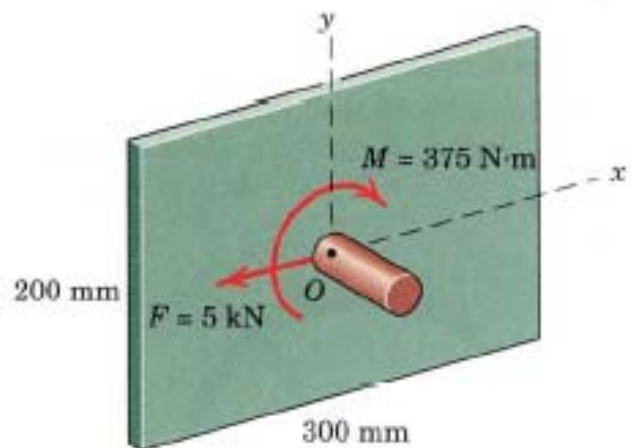
3 – The wrench is subjected to the (200 N) force and the force (P) as shown in fig. if the equivalent of the two forces is a force (R) at (O) and a couple of (20 N . m) , Determine (P) and (R) .