

Simplification of a Force and Couple System

Sometimes it is convenient to reduce a system of forces and couple moments acting on a body to a simpler form by replacing it with an equivalent system, consisting of a single resultant force acting at a specific point and a resultant couple moment.

من المفيد أحياناً رد (اختصار، تبسيط) جملة قوى وعزوم مؤثرة في نقاط جسم ما، إلى جملة مكافئة مؤلفة من:
(1) قوة محصلة واحدة تؤثر في نقطة محددة. (2) وعزم محصل واحد.



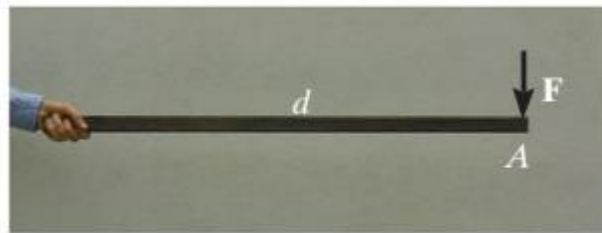
(a)



(b)



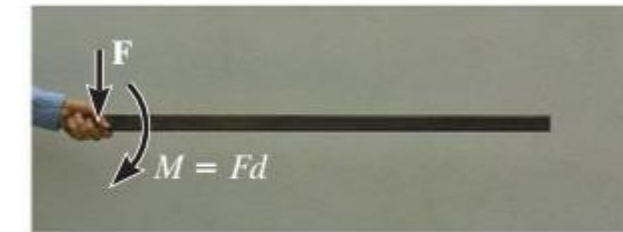
(c)



(a)



(b)



(c)

System of Forces and Couple Moments.

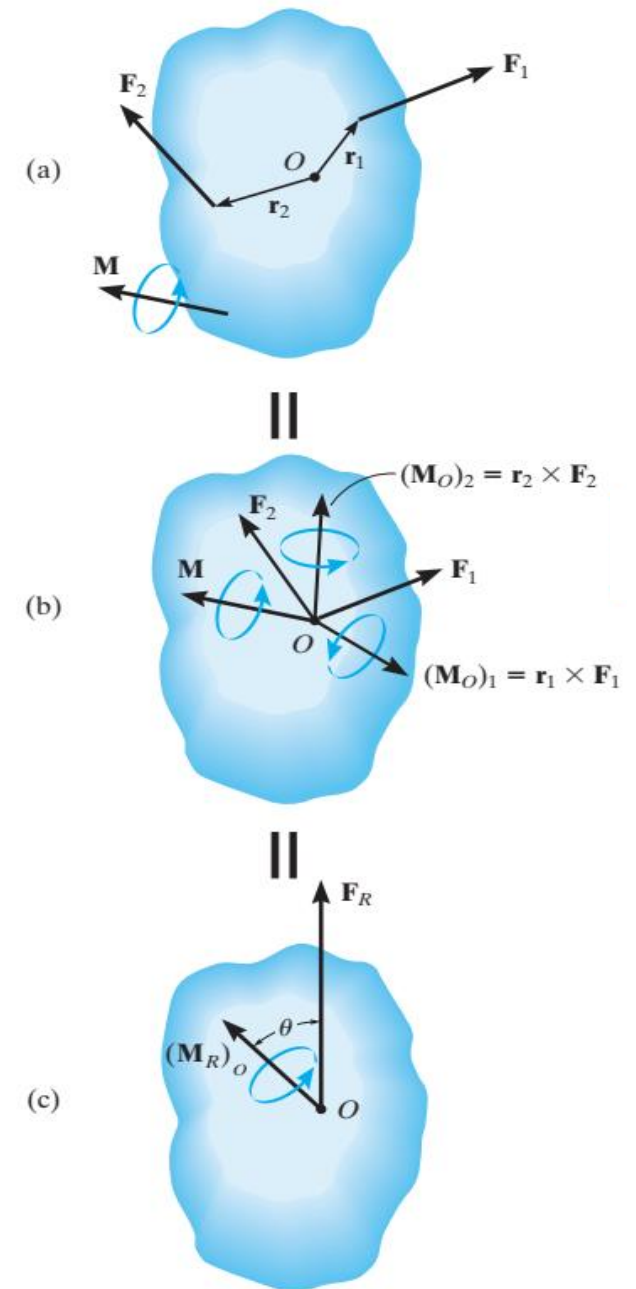
$$\mathbf{F}_R = \Sigma \mathbf{F}$$
$$(\mathbf{M}_R)_O = \Sigma \mathbf{M}_O + \Sigma \mathbf{M}$$

(1) المحصلة هي المجموع الشعاعي للقوى.

(2) والعزم المحصل هو المجموع الشعاعي لعزوم القوى ولعزوم المزدوجات.

في الحالة المستوية يمكن الاستغناء عن المجموع الشعاعي للقوى بمجموع المركبات على المحورين x & y ، وعن المجموع الشعاعي للعزوم بالمجموع الجبري للعزوم والمزدوجات على المحور z .

$$(F_R)_x = \Sigma F_x$$
$$(F_R)_y = \Sigma F_y$$
$$(M_R)_O = \Sigma M_O + \Sigma M$$



Example 1. Replace the force and couple system shown in Fig. (a) by an equivalent resultant force and couple moment acting at point O .

Force Summation.

$$\rightarrow (F_R)_x = \Sigma F_x;$$

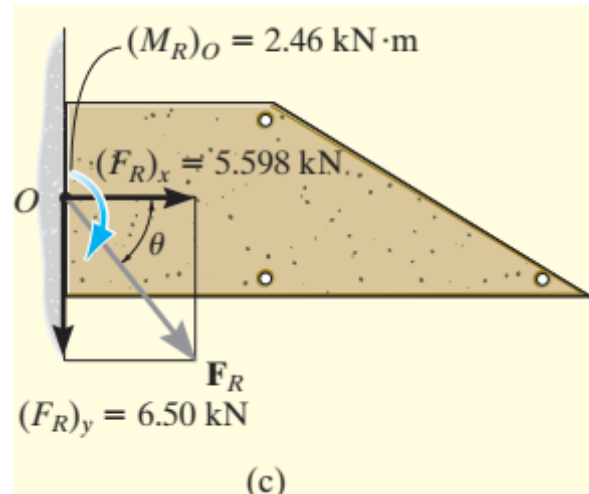
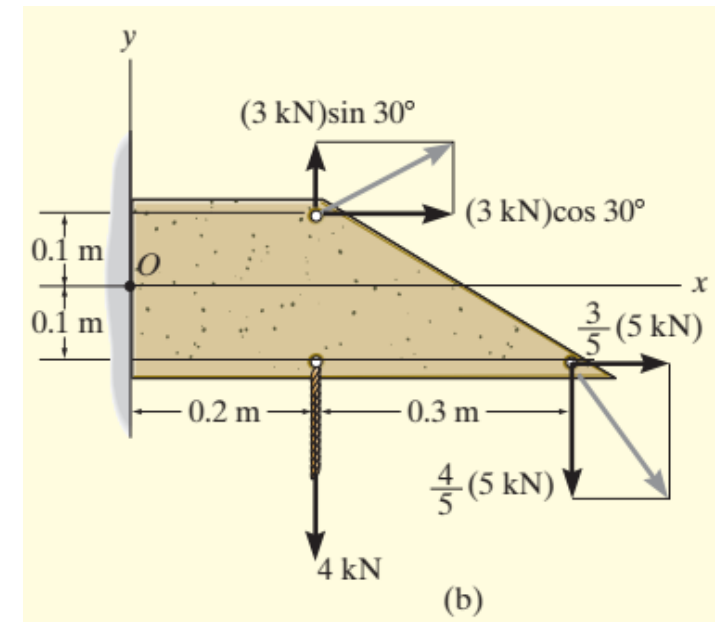
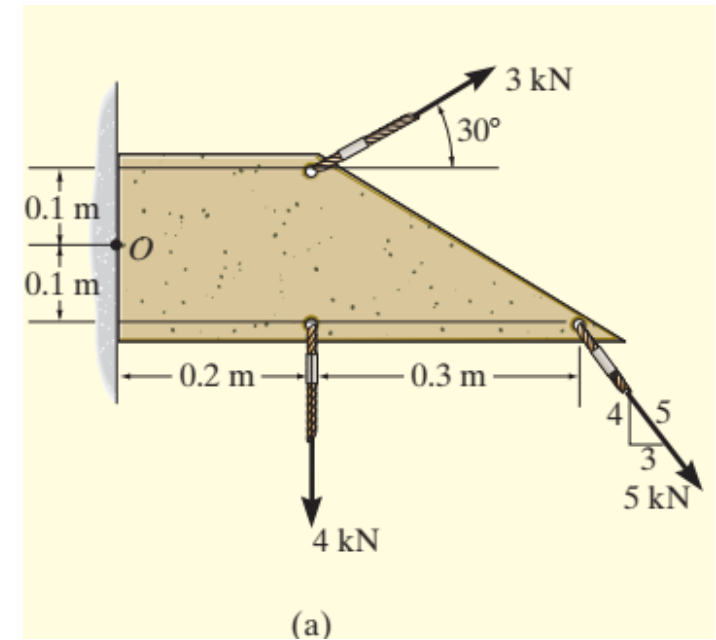
$$+\uparrow (F_R)_y = \Sigma F_y;$$

$$F_R = \sqrt{(F_R)_x^2 + (F_R)_y^2} =$$

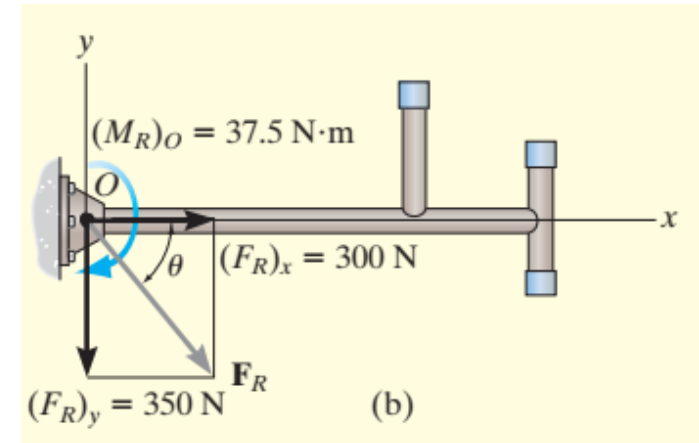
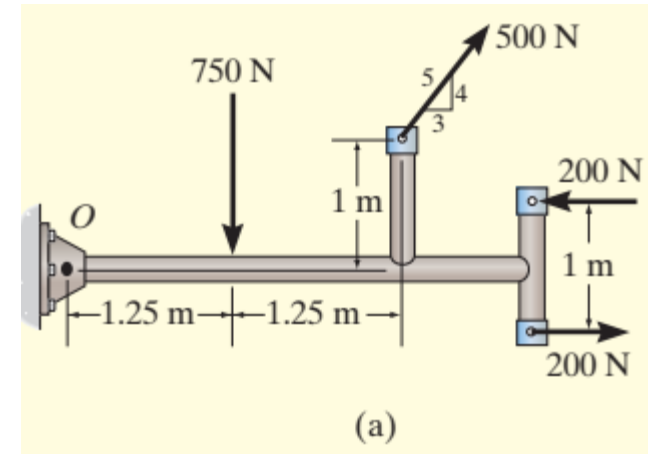
$$\theta = \tan^{-1}\left(\frac{(F_R)_y}{(F_R)_x}\right) =$$

Moment Summation.

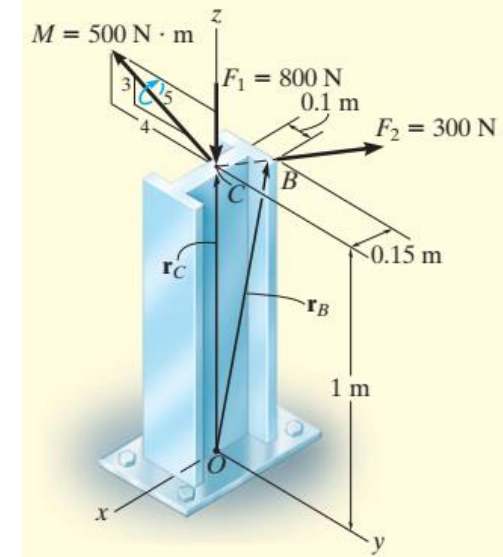
$$\zeta + (M_R)_O = \Sigma M_O;$$



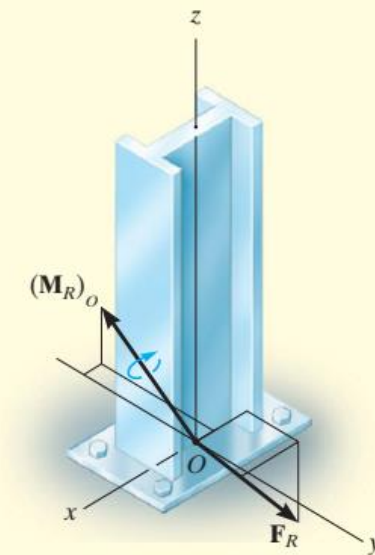
Example 2. Replace the force and couple system acting on the member in Fig. (a) by an equivalent resultant force and couple moment acting at point O .



The structural member is subjected to a couple moment M and forces F_1 and F_2 in Fig. (a). Replace this system by an equivalent resultant force and couple moment acting at its base, point O .



(a)



(b)