Section 4.3. Moment of a Force About a Line

Definition. The moment of $\vec{F}$ about a line L is the component of $\vec{M}_P$ parallel to L (where P is an arbitrary point on L; see Figure 4.18, page 153). If $\hat{e}$ is a unit vector along L, then the moment about L is

$$\vec{M}_L = (\hat{e} \cdot \vec{M}_p)\hat{e} = (\hat{e} \cdot \vec{r} \times \vec{F})\hat{e}$$

where $\vec{r}$ is a vector from L to the line of a action of $\vec{F}$.

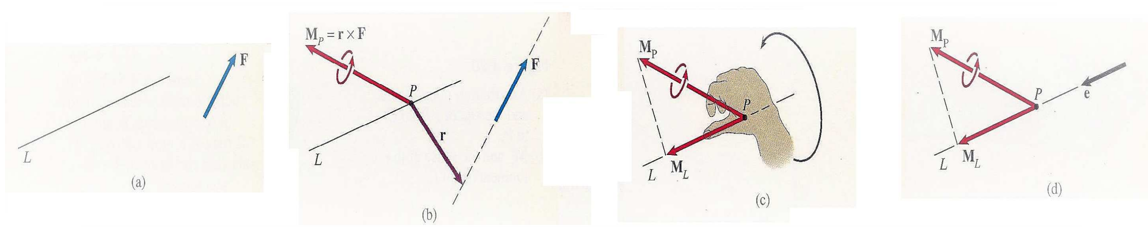

Figure 4.18. (a) The line L and force $\mathbf{F}$. (b) $\mathbf{M}_p$ is the moment of $\mathbf{F}$ about any point P on L. (c) The component $\mathbf{M}_L$ is the moment of $\mathbf{F}$ about L. (d) The unit vector $\mathbf{e}$ along L.

Note. If $\hat{e} \cdot \vec{M}_P$ is positive, $\vec{M}_L$ points in the direction of $\hat{e}$, and if $\hat{e} \cdot \hat{M}_P$ is negative, $\vec{M}_L$ points in the direction opposite to $\hat{e}$.

Note. The product $\hat{e} \cdot \vec{r} \times \vec{F}$ is called a *scalar triple product* (or "mixed triple product") and can be calculated as

$$\hat{e} \cdot \vec{r} \times \vec{F} = \begin{vmatrix} e_x & e_y & e_z \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}.$$

Example. Page 164 Number 4.106.

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