TABLE 6-1 Two-Dimensional Reactions at Supports and Connections

(1) FLEXIBLE CORD, ROPE, CHAIN, OR CABLE

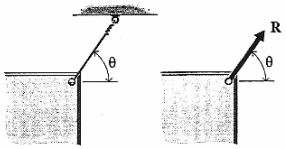

Figure 6-2

A flexible cord, rope, chain, or cable (Fig. 6-2) always exerts a tensile force **R** on the body. The line of action of the force **R** is known; it is tangent to the cord, rope, chain, or cable at the point of attachment.

(2) RIGID LINK

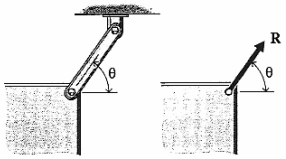

Figure 6-3

A rigid link (Fig. 6-3) can exert either a tensile or a compressive force **R** on the body. The line of action of the force **R** is known; it must be directed along the axis of the link (see Section 6-3-1 for proof).

(3) BALL, ROLLER, OR ROCKER

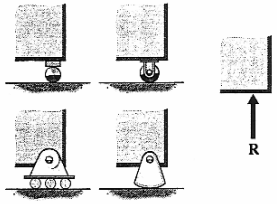

Figure 6-4

A ball, roller, or rocker (Fig. 6-4) can exert a compressive force **R** on the body. The line of action of the force **R** is perpendicular to the surface supporting the ball, roller, or rocker.

(4) SMOOTH SURFACE

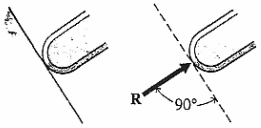

Figure 6-5

A smooth surface, either flat or curved (Fig. 6-5), can exert a compressive force **R** on the body. The line of action of the force **R** is perpendicular to the smooth surface at the point of contact between the body and the smooth surface.

(5) SMOOTH PIN

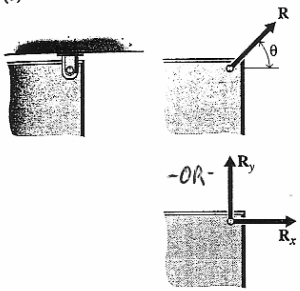

Figure 6-6

A smooth pin (Fig. 6-6) can exert a force **R** of unknown magnitude R and direction θ on the body. As a result, the force **R** is usually represented on a free-body diagram by its rectangular components $\mathbf{R}_x$ and $\mathbf{R}_y$.

(6) ROUGH SURFACE

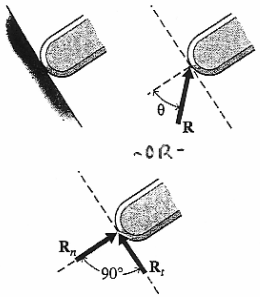

Figure 6-7

Rough surfaces (Fig. 6-7) are capable of supporting a tangential frictional force $\mathbf{R}_t$ as well as a compressive normal force $\mathbf{R}_n$. As a result, the force **R** exerted on a body by a rough surface is a compressive force **R** at an unknown angle θ. The force **R** is usually represented on a free-body diagram by its rectangular components $\mathbf{R}_n$ and $\mathbf{R}_t$.

(7) PIN IN A SMOOTH GUIDE

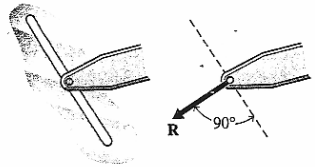

Figure 6-8

A pin in a smooth guide (Fig. 6-8) can transmit only a force **R** perpendicular to the surfaces of the guide. The sense of **R** is assumed on the figure and may be either downward to the left or upward to the right.

Table 6-1 (continues next page)

(8) COLLAR ON A SMOOTH SHAFT

A collar on a smooth shaft (Fig. 6-9) that is pin-connected to a body can transmit only a force **R** perpendicular to the axis of the shaft. When the connection between the collar and the body is fixed (Fig. 6-10), the collar can transmit both a force **R** and a moment **M** perpendicular to the axis of the shaft. If the shaft is not smooth, a tangential frictional force $\mathbf{R}_t$ as well as a normal force $\mathbf{R}_n$ can be transmitted.

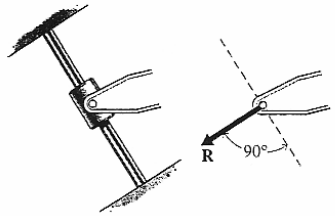

Figure 6-9

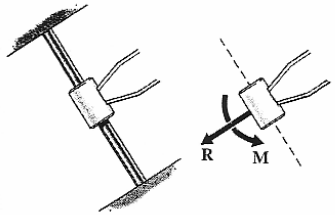

Figure 6-10

(9) FIXED SUPPORT

A fixed support (Fig. 6-11) can exert both a force **R** and a couple **C** on the body. The magnitude R and the direction θ of the force **R** are not known. Therefore, the force **R** is usually represented on a free-body diagram by its rectangular components $\mathbf{R}_x$ and $\mathbf{R}_y$ and the couple **C** by its moment **M**.

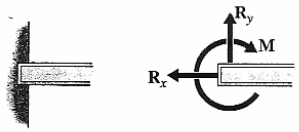

Figure 6-11

(10) LINEAR ELASTIC SPRING

The force **F** exerted on a body by a linear elastic spring (Fig. 6-12) is proportional to the change in length of the spring. The spring will exert a tensile force if lengthened and a compressive force if shortened. The line of action of the force is along the axis of the spring.

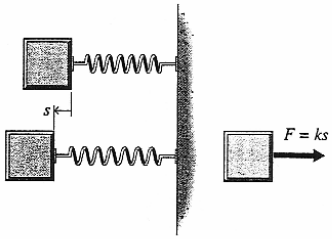

Figure 6-12

(11) IDEAL PULLEY

Pulleys (Fig. 6-13) are used to change the direction of a rope or cable. The pin connecting an ideal pulley to a member can exert a force **R** of unknown magnitude R and direction θ on the body. The force **R** is usually represented on a free-body diagram by its rectangular components $\mathbf{R}_x$ and $\mathbf{R}_y$. Also, since the pin is smooth (frictionless), the tension T in the cable must remain constant to satisfy moment equilibrium about the axis of the pulley.

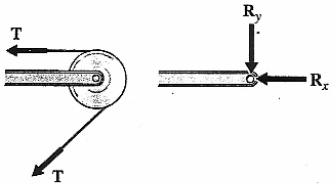

Figure 6-13

From Statics and Mechanics of Materials, Riley, Sturges and Morris, pp. 197-8.