4.2 Supports

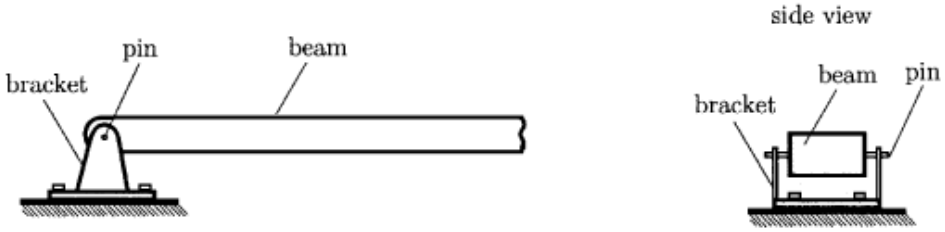
4.2.1 PLANAR SUPPORTS

The *reactions* are forces and couples exerted on a body by its supports.

Pin Support

Figure 4.2 shows a pin support. A beam is attached by a smooth pin to a bracket. The pin passes through the bracket and the beam. The beam can rotate about the axis of the pin. The beam cannot translate relative to the bracket because the support exerts a reactive force that prevents this movement. Thus a pin support can exert a force on a body in any direction. The force (Fig. 4.3) is expressed in terms of its components in plane,

$$\mathbf{F}_A = A_x\mathbf{1} + A_y\mathbf{j}.$$



Example 2

For the curved line shown in Fig. 2.10 the centroidal position is

$$x_C = \frac{\int x\, dl}{L}, \quad y_C = \frac{\int y\, dl}{L}, \tag{2.8}$$

where L is the length of the line. Note that the centroid C will not generally lie along the line. Next one can consider a curve made up of simple curves. For each simple curve the centroid is known. Figure 2.11 represents a curve

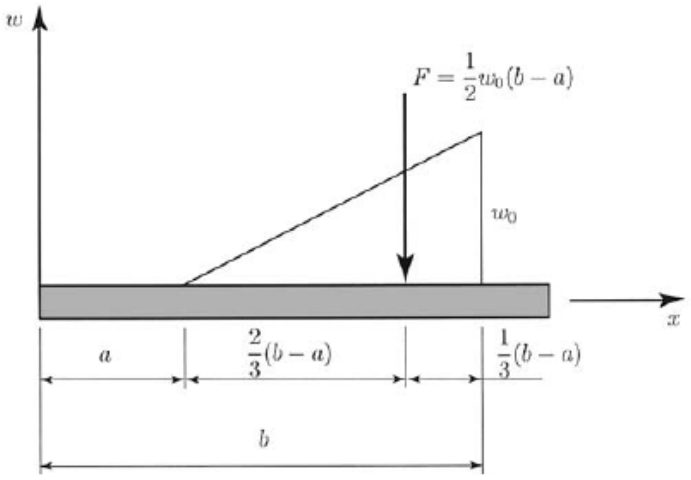


Table 1.2 *Physical Constants of Materials*

Material	Modulus of elasticity E		Modulus of rigidity G		Poisson's ratio ν	Unit weight w		
	Mpsi	GPa	Mpsi	GPa		lb/in^3	lb/ft^3	kN/m^3
Aluminum (all alloys)	10.3	71.0	3.80	26.2	0.334	0.098	169	26.6
Beryllium copper	18.0	124.0	7.0	48.3	0.285	0.297	513	80.6
Brass	15.4	106.0	5.82	40.1	0.324	0.309	534	83.8
Carbon steel	30.0	207.0	11.5	79.3	0.292	0.282	487	76.5
Cast iron, gray	14.5	100.0	6.0	41.4	0.211	0.260	450	70.6
Cooper	17.2	119.0	6.49	44.7	0.326	0.322	556	87.3
Douglas fir	1.6	11.0	0.6	4.1	0.33	0.016	28	4.3
Glass	6.7	46.2	2.7	18.6	0.245	0.094	162	25.4
Inconel	31.0	214.0	11.0	75.8	0.290	0.307	530	83.3
Lead	5.3	36.5	1.9	13.1	0.425	0.411	710	111.5
Magnesium	6.5	44.8	2.4	16.5	0.350	0.065	112	17.6
Molybdenum	48.0	331.0	17.0	117.0	0.307	0.368	636	100.0
Monel metal	26.0	179.0	9.5	65.5	0.320	0.319	551	86.6
Nickel silver	18.5	127.0	7.0	48.3	0.322	0.316	546	85.8
Nickel steel	30.0	207.0	11.5	79.3	0.291	0.280	484	76.0
Phosphor bronze	16.1	111.0	6.0	41.4	0.349	0.295	510	80.1
Stainless steel (18-8)	27.6	190.0	10.6	73.1	0.305	0.280	484	76.0

Source: J. E. Shigley and C. R. Mischke, *Mechanical Engineering Design*. McGraw-Hill, New York, 1989. Used with permission.