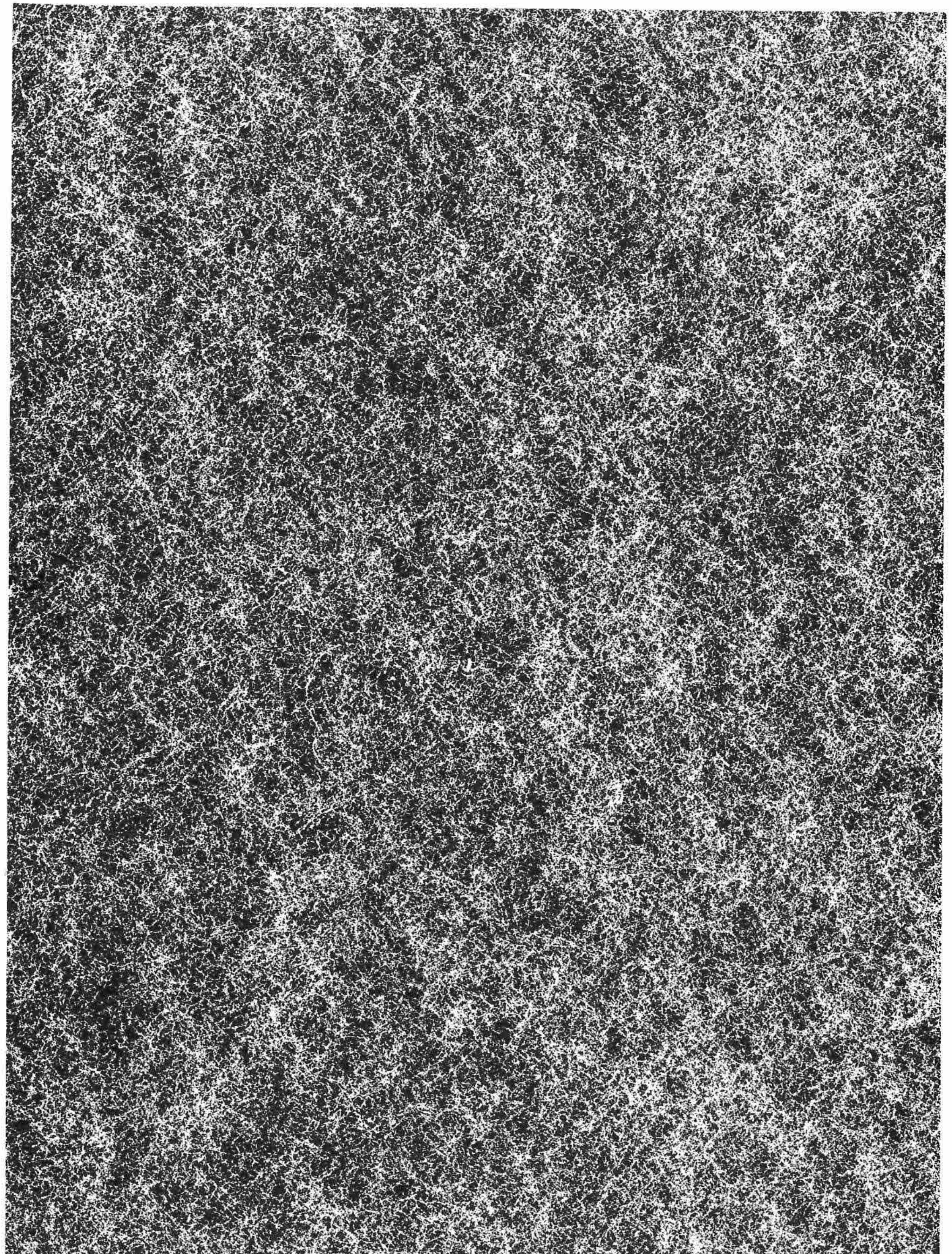

11 STATICS

Nomenclature

a	horizontal distance from point of maximum sag	ft
A	area	ft^2
c	parameter in catenary equations	ft
d	distance	ft
E	modulus of elasticity	lbf/ft^2
f	coefficient of friction	–
F	vertical force	lbf
H	horizontal component of tension	lbf
I	moment of inertia	ft^4
J	polar moment of inertia	ft^4
L	length, cable length from point of maximum sag	ft
m	mass	slugs
M	moment	ft-lbf
N	normal force	lbf
p	pressure	lbf/ft^2
P	load, or product of inertia	lbf, ft^4
r	radius of gyration	ft
S	maximum cable sag	ft
T	tension, or temperature	lbf, °F
w	load per unit weight, or weight	lbf/ft, lbf

Symbols

α	coefficient of linear thermal expansion	1/°F
δ	deflection	ft
ρ	density	lbm/ft^3

Subscripts

c	centroidal, or concrete
i	the ith component
R	resultant
s	steel

1 CONCENTRATED FORCES AND MOMENTS

Forces are vector quantities having magnitude, direction, and location in 3-dimensional space. The direction of a force **F** is given by its *direction cosines*, which are cosines of the true angles made by the force vector with the x, y, and z axes. The components of the force are given by equations 11.1, 11.2, and 11.3.

$$\mathbf{F}_x = \mathbf{F}\,(\cos\theta_x) \quad 11.1$$

$$\mathbf{F}_y = \mathbf{F}\,(\cos\theta_y) \quad 11.2$$

$$\mathbf{F}_z = \mathbf{F}\,(\cos\theta_z) \quad 11.3$$

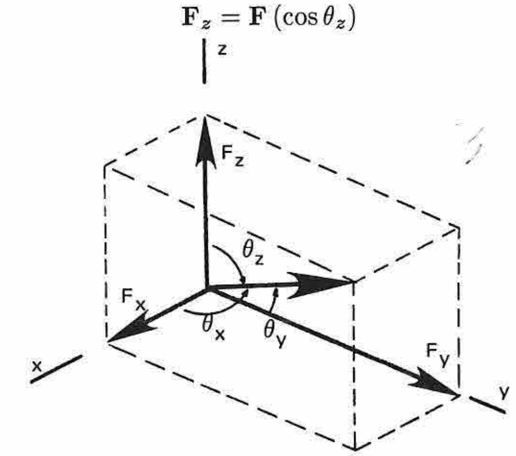

Figure 11.1 Components of a Force **F**

A force which would cause an object to rotate is said to contribute a *moment* to the object. The magnitude of a moment can be found by multiplying the magnitude of the force times the appropriate moment arm. That is, **M**=**F**·d.

The *moment arm* is a perpendicular distance from the force's line of application to some arbitrary reference point. This reference point should be chosen to eliminate one or more unknowns. This can be done by choosing the reference as a point at which unknown reactions are applied.