3 Stress

Forces acting at the surfaces of components were considered in the previous chapter. The task now is to examine forces arising *inside* materials, **internal forces**. Internal forces are described using the idea of **stress**. There is a lot more to stress than the notion of "force over area", as will become clear in this chapter. First, the idea of surface (contact) stress distributions will be examined, together with their relationship to resultant forces and moments. Then internal stress and traction will be discussed. The means by which internal forces are described is through the **stress components**, for example σ_{zx}, σ_{yy}, and this "language" of sigmas and subscripts needs to be mastered in order to model sensibly the internal forces in real materials. **Stress analysis** involves representing the actual internal forces in a real physical component mathematically. Some of the limitations of this are discussed in §3.3.2.

Newton's laws are used to derive the **stress transformation equations**, and these are then used to derive expressions for the **principal stresses**, **stress invariants**, **principal directions** and **maximum shear stresses** acting at a material particle. The practical case of two dimensional **plane stress** is discussed.