1 Differential Equations for Solid Mechanics

Simple problems involving homogeneous stress states have been considered so far, wherein the stress is the same throughout the component under study. An exception to this was the varying stress field in the loaded beam, but there a simplified set of elasticity equations was used. Here the question of varying stress and strain fields in materials is considered. In order to solve such problems, a differential formulation is required. In this Chapter, a number of differential equations will be derived, relating the stresses and body forces (**equations of motion**), the strains and displacements (**strain-displacement relations**) and the strains with each other (**compatibility relations**). These equations are derived from physical principles and so apply to any type of material, although the latter two are derived under the assumption of small strain.