Roughness and aperture are two important characteristic parameters controlling fluid flow in natural joints and fractures. It has been demonstrated by many authors that knowledge of roughness does not directly lead to that of aperture, and aperture should be handled as a separate geometrical descriptor. To determine the normal deformability and flow response of a fracture, the aperture distribution and the mechanical properties of the rock matrix are required. When shearing of joints and fractures is considered, roughness comes into play and affects the evolution of the aperture distribution. The aperture distribution can be evaluated by knowing the correlation between the asperity profiles of the rock walls of a rock fracture. Thus, the distributions of contact area and void space determine the fracture dilation and hydraulic properties during shearing. In the seismic characterization of fractured reservoirs, various equivalent medium theories describing the effective elastic properties of fractured media have been proposed. One relatively simple theory is based on the assumption of the linear slip interface or displacement discontinuity model of fractures. Two parameters are usually used in the linear slip interface model: the normal and shear fracture compliances defined as the ratio of normal (shear) displacement discontinuity and normal (shear) stress. Fracture compliances are by definition functions of mechanical aperture and are also influenced by the roughness (surface asperity distribution) of fracture surfaces. In this study, I investigate the effects of fracture roughness and apertures on the hydraulic and mechanical properties of fractured rock. Specifically, I focus on two kinds of fracture models which are commonly used in describing the effective hydraulic and mechanical (elastic) response of natural fractures. The first is the rough-walled fracture model and the second is an interface with distributions of contacts and voids (called the asperity fracture model).