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3.2.1 Crack Located at the Upstream Face of Core 3.2.2 Low Permeability of Core Soil; 3.2.3 Rapid Impounding; 3.2.4 Unsaturated Soil Core; 3.3 Mechanical Mechanism of Hydraulic Fracturing; 3.4 Modes of Fracture in Fracture Mechanics; 3.5 Summary; References; Chapter 4 Fracture Toughness and Tensile Strength of Core Soil; 4.1 Introduction; 4.2 Tested Soil; 4.3 Testing Technique on Fracture Toughness; 4.3.1 Testing Method; 4.3.2 Apparatus; 4.3.3 Testing Procedures; 4.3.4 Testing Program; 4.4 Testing Results on Fracture Toughness; 4.4.1 Suitability of Linear Elastic Fracture Mechanics 4.4.2 Influence Factors on Fracture Toughness 4.5 Testing Technique on Tensile Strength; 4.5.1 Testing Method and Apparatus; 4.5.2 Calculation of Tensile Strength; 4.5.3 Testing Procedures; 4.5.4 Testing Program; 4.6 Testing Results on Tensile Strength; 4.6.1 Water Content; 4.6.2 Dry Density; 4.6.3 Preconsolidation Pressure; 4.7 Relationship between Fracture Toughness and Tensile Strength; 4.8 Discussions; 4.8.1 Soils from References; 4.8.2 Rocks from References; 4.9 Summary; References; Chapter 5 Fracture Failure Criteria for Core Soil under I-II Mixed Modes; 5.1 Introduction 5.2 Experimental Technique 5.2.1 Loading Assembly; 5.2.2 Calculation Theory; 5.2.3 Testing Procedures; 5.2.4 Test Program; 5.3 Testing Results; 5.4 Fracture Failure Criteria; 5.5 Discussions; 5.5.1 Testing Technique; 5.5.2 Failure Criteria; 5.6 Summary; References; Chapter 6 Hydraulic Fracturing Criterion; 6.1 Introduction; 6.2 Failure Criterion; 6.2.1 Simplification of a Crack; 6.2.2 Criterion; 6.3 Cubic Specimen with a Crack; 6.3.1 Calculation of  $K_I$ ; 6.3.2 Calculation of  $K_{II}$ ; 6.3.3 Calculation of  $(K_I^2 + K_{II}^2)^{0.5}$ ; 6.3.4 Dangerous Crack Angle; 6.4 Core with a Transverse Crack 6.4.1 Calculation of  $K_I$

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#### Sommario/riassunto

Presents a systematic and comprehensive study of hydraulic fracturing, original in its concentration of core soil problems. There have been a number of well-studied cases in which dams have failed or been damaged by concentrated leaks for no apparent cause. In some of these experiences, investigators concluded that differential settlement cracks were the probable causes, even though no cracks were seen on the surface. In these examples, it was not determined whether the crack was open before the reservoir filled or whether it might have opened after

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