

LIST OF FIGURES

<i>Fig.No.</i>	<i>Figure caption</i>	<i>Page No.</i>
2.1	Infinitesimal element used in the derivation of continuity equation (Illangasekare et. al. 1992).	7
2.2.	Two rough fracture surface profile separated by distance b along with two reference plane separated by distance d (Zimmerman and Main, 2004).	11
2.3.	Various definitions for fracture aperture b (Zimmerman and Main, 2004).	13
2.4.	Different modes of two-phase flow (Ishii, 1975; Fourar and Bories, 1995).	17
2.5.	Flow regime chart showing flow in cracks with varying degree of roughness (Louis, 1969).	18
2.6.	Three independent modes of deformation at crack tip (Shi, 2009).	21
2.7.	Stress field at crack tip C , showing rectangular and polar-coordinate components.	21
2.8.	Fracture Process Zone (FPZ) in concrete (Shi, 2009).	23
2.9.	The relation between the tensile stress and the COD along the FPZ (Shi, 2009).	24
2.10.	Left: Comparison of plots of overflow height of water versus horizontal displacement at the top of dam for no-tension plastic analysis of a pre-cracked dam and for fracture analysis (full hydrostatic pressure is considered on pre-cracked portion of the dam cross section). Top right: Ottosen yield surface used. Lower right: Dam analyzed and meshes (Gioia et. al. 1992).	37
2.11.	Comparison of overflow-displacement curves for plastic and fracture analysis using realistic values of tensile strength and fracture toughness (Gioia et. al. 1992).	37
3.1(a).	Water flow and pressure distribution in existing crack (Without Cavitation) with moving walls (Javanmardi et. al. 2005a).	45
3.1(b).	Water flow and pressure distribution in existing crack (With Cavitation) with moving walls (Javanmardi et. al. 2005a).	45
3.1(c).	Water flow and pressure distribution in new crack with moving walls (Javanmardi et. al. 2005a).	45

3.2.	Assumed crack in opening mode.	47
3.3.	Assumed crack in closing mode.	49
3.4.	Control volume for calculation of stagnation point.	54
3.5.	Boundary conditions for dam-crown deflections.	60
4.1.	A typical cross-section of Rihand dam at non-overflow location.	67
4.2.	CMOD versus time (month) under FPZ creep effect.	72
4.3.	Locations of cracks in the body.	73
4.4.	Overall flow chart for dam model.	74
4.5.	A composite flow chart of uplift pressure calculation for opening and closing mode of the crack.	75
4.6.	Flow chart for calculating the uplift pressure during opening mode of the crack.	75
4.7.	Flow chart for calculating the uplift pressure during closing mode of the crack	76
4.8.	Flow chart for dam-crown deflection	77
5.1.	CMOD Vs. time plot of Equation 5.1	80
5.2.	CMOV Vs. time plot of Equation 5.2	80
5.3.	Pressure variation along the crack during opening mode at time $t=0.001, 0.01, 0.02$ and $0.07s$.	82
5.4.	Pressure variation along the crack during closing mode at time $t=0.375, 0.4, 0.43$ and $0.45s$.	83
5.5(a).	Monthly reservoir level (ft.) variation for the year 2005-06.	85
5.5(b).	Monthly reservoir level (ft.) variation for the year 2006-07.	85
5.5(c).	Monthly reservoir level (ft.) variation for the year 2007-08.	86
5.5(d).	Monthly reservoir level (ft.) variation for the year 2008-09.	86
5.5(e).	Monthly reservoir level (ft.) variation for the year 2009-10.	87
5.5(f).	Monthly reservoir level (ft.) variation for the year 2010-11.	87
5.6(a).	Uplift pressure variation at crack-1 (At the heel of the dam) for the year 2005-06 and 2006-07.	88
5.6(b).	Uplift pressure variation at crack-1 (At the heel of the dam) for the year 2007-08 and 2008-09.	88

5.6(c).	Uplift pressure variation at crack-1 (At the heel of the dam) for the year 2009-10 and 2010-11.	89
5.7(a).	Uplift pressure variations at crack-4 (Slope changing point) for the year 2005-06 and 2006-07.	89
5.7(b).	Uplift pressure variations at crack-4 (Slope changing point) for the year 2007-08 and 2008-09.	90
5.7(c).	Uplift pressure variations at crack-4 (Slope changing point) for the year 2009-10 and 2010-11.	90
5.8.	Discretization of dam-section with triangular element.	92
5.9.	Comparison of computed and field values of dam-crown deflection versus reservoir level for year 2005-06.	94
5.10.	Comparison of computed and field values of dam-crown deflection versus reservoir level for year 2006-07.	94
5.11.	Comparison of computed and field values of dam-crown deflection versus reservoir level for year 2007-08.	95
5.12.	Comparison of computed and field values of dam-crown deflection versus reservoir level for year 2008-09.	95
5.13.	Comparison of computed and field values of dam-crown deflection versus reservoir level for year 2009-10.	96
5.14.	Comparison of computed and field values of dam-crown deflection versus reservoir level for year 2010-11.	96
5.15.	Uplift pressures in cracks located in body and at the dam foundations for (a) present model and (b) USACE criteria.	99
5.16(a).	Factor of safety against sliding along the base of the dam for year 2005-06 and 2006-07.	100
5.16(b).	Factor of safety against sliding along the base of the dam for year 2007-08 and 2008-09.	100
5.16(c).	Factor of safety against sliding along the base of the dam for year 2009-10 and 2010-11.	101
5.17(a).	Factor of safety against sliding along the upstream slope-changing point of the dam for the year 2005-06 and 2006-07.	101
5.17(b).	Factor of safety against sliding along the upstream slope-changing point of the dam for the year 2007-08 and 2008-09.	102
5.17(c).	Factor of safety against sliding along the upstream slope-changing point of the dam for the year 2009-10 and 2010-11.	102