

STATIC AND DYNAMIC ANALYSIS
OF
GRAVITY DAMS ON FAULTED FOUNDATIONS

BY
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A Thesis
Submitted for the award of the Degree
of
DOCTOR OF PHILOSOPHY

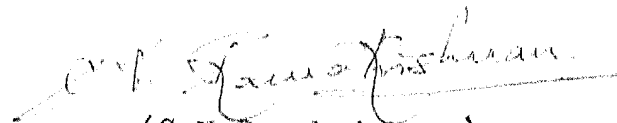
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(i)

CERTIFICATE

This is to certify that the thesis entitled 'Static and Dynamic Analysis of Gravity Dams on Faulted Foundations' being submitted by Mr. S.Kingston Samraj to the Indian Institute of Technology, Delhi for the award of the degree of DOCTOR OF PHILOSOPHY, is a record of bonafide research work carried out by him under my supervision and guidance. The thesis work, in my opinion, has reached the standard fulfilling the requirements for the award of the degree of DOCTOR OF PHILOSOPHY. The research report and the results presented in the thesis have not been submitted, in part or in full, to any other University or Institute, for the award of any degree or diploma.



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DEDICATED TO MY PARENTS

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ABSTRACT

The recent activity in the design and construction of gravity dams in the Himalayan region, where it is difficult to find any site without at least minor faults, has given considerable impetus to research on accurate description of stresses and deformations in the dam and the foundation. It is also necessary to predict the behaviour of these Dam-Foundation-Reservoir Systems under transient earthquake loadings, as these regions are severely seismic.

The main objective of this thesis has been to develop three general purpose two-dimensional finite element programs for the free vibration analysis, linear and non-linear stress analysis and transient analysis of the Structure-Foundation-Fluid System. The constitutive relationships for the foundation material as well as any inherent faults present therein are incorporated in the programs. The programs have been test run for reliability and the problem of a dam on faulted foundation studied in detail using the three programs.

The free vibration analysis is based on the subpolynomial iteration technique. It uses quadratic isoparametric elements and a frontal solution algorithm for solving the linear equations. The eigen values, mode shapes and the corresponding frequencies are calculated.

The effect of fault in the system has been studied in detail.

The non-linear analysis program uses the viscoplastic approach based on incremental theory of plasticity. It is assumed that the material in the fault is laminated and behaves as anelasto-viscoplastic material in one plane and is not capable of taking any tension in a perpendicular direction. The effect of the fault, its presence, orientation and thickness have been studied.

The transient analysis is carried out using an explicit time marching scheme. The dam-foundation-reservoir system has been studied for a simulated earthquake accelerogram. The effect of a fault being present in the foundation has been studied in detail.

CONTENTS

<u>CHAPTER</u>	<u>PAGE</u>
CERTIFICATE	(i)
ACKNOWLEDGEMENTS	(ii)
ABSTRACT	(iv)
CONTENTS	(vi)
LIST OF FIGURES	(x)
LIST OF TABLES	(xii)
NOTATIONS	(xiii)
1. INTRODUCTION	1
1.1 Gravity Dams	1
1.2 Dam Foundation	2
1.3 Method of Analysis	3
1.4 The Present Work	4
1.5 Organisation of the Thesis	5
2. SURVEY OF LITERATURE ON STATIC AND DYNAMIC ANALYSIS OF GRAVITY DAMS	6
2.1 General	6
2.2 The Finite Element Method	6
2.3 Eigen value Problem	9
2.4 Frequency and Time-domain Analysis	11
2.5 Soil-structure Interaction	12
2.6 Foundation Non-linearity	15
2.7 Effect of Fluid Interaction	17
2.8 Closure	19
3. DEVELOPMENT OF COMPUTER PROGRAM FOR FREE VIBRATION ANALYSIS USING SUB-POLYNOMIAL ITERATION METHOD	20
3.1 General	20
3.2 Equations of Motion	20
3.3 Method of Analysis	23

<u>CHAPTER</u>	<u>PAGE</u>
3.4 Sub-polynomial Iteration Method	24
3.4.1 Isolation of Eigenvalues	24
3.4.2 Computation of Shift	25
3.4.3 Inverse Iteration with Shift	27
3.5 Computer Program	28
3.6 Closure	30
4. RESULTS OF FREE VIBRATION ANALYSIS	32
4.1 General	32
4.2 Test Problem	32
4.3 Choice of Problem and Discretization	33
4.4 Dam on Rigid Foundation	34
4.5 Dam on Flexible Foundation with no Faults	35
4.6 Dam on Flexible Foundation with Faults	36
4.7 Conclusions	41
5. NON-LINEAR ANALYSIS USING VISCOPLASTIC APPROACH AND COMPUTER PROGRAM DEVELOPMENT	63
5.1 General	63
5.2 Stress Invariants	64
5.3 Elastic Stress-strain Relationship	66
5.4 Yield Criterion	66
5.5 Flow Rule and Plastic Potential	67
5.6 Yield Surfaces	69
5.6.1 Mohr-Coulomb Yield Criterion	69
5.6.2 Laminated Material in the Fault Zone	70
5.7 Yield and Failure	72
5.8 Solution Procedure	73
5.9 Time Step Length and Stability	75
5.10 Convergence	76
5.11 Computer Program	77

	<u>CHAPTER</u>	<u>PAGE</u>
6.	STATIC NON-LINEAR ANALYSIS OF DAM-FOUNDATION SYSTEM	80
	6.1 General	80
	6.2 Loading Conditions	80
	6.3 Material Properties	82
	6.4 Foundation Without Fault	83
	6.5 Fault at Centre of Base	83
	6.6 Fault at Heel of Dam	84
	6.7 Fault at Toe of Dam	85
	6.8 Effect of Orientation of Fault	85
	6.9 Effect of Thickness of Fault	86
	6.10 Effect of Concrete Plug	87
	6.11 Conclusions	88
7.	DEVELOPMENT OF COMPUTER PROGRAM FOR TRANSIENT NON-LINEAR ANALYSIS	116
	7.1 General	116
	7.2 Equations of Motion	118
	7.3 Central Difference Time Stepping Algorithm	120
	7.4 Solution Procedure	121
	7.5 Critical Time Length	121
	7.6 Computer Program	122
8.	EARTHQUAKE ANALYSIS OF GRAVITY DAM-FOUNDATION RESERVOIR SYSTEM	126
	8.1 General	126
	8.2 Cantilever Subjected to Free Vibration	127
	8.3 Cantilever on Harmonic Loading	127
	8.4 Hydrodynamic Forces on Dam	128
	8.5 Choice of Problem	130
	8.6 Results and Discussions	132
	8.7 Conclusions	135

<u>CHAPTER</u>	<u>PAGE</u>
9. CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK	147
REFERENCES	150
BRIEF BIO-DATA OF THE AUTHOR	161