Contents

Ac	Acknowledgements		хi		
Pro	eface		xiii		
Pa	Part 1 INTRODUCTION				
1	Site	Investigation	5		
	1.1	Introduction	5		
	1.2	Social and Economic Aspects	5		
	1.3	Technical Considerations	6		
		1.3.1 Location of the weir	7		
		1.3.2 Type of structure	8		
		1.3.3 Topographic survey	9		
		1.3.4 Soil investigation	9		
		1.3.5 Hydrological data	9		
Pa	rt 2 '	TOPOGRAPHIC SURVEY	11		
2	Top	ographic Survey of the Construction Site	13		
	2.1	Fixing Benchmarks	13		
	2.2	Topographic Survey of the Project Area	14		
	2.3	Location of the Weir	14		
Pa	rt 3 !	SOIL INVESTIGATION	17		
3	Soil	Investigation	19		
	3.1	Objectives of the Investigation	19		
	3.2	Soil Profile under the Foundation	20		
	3.3	Soil Classification	20		
	3.4	Permeability of the Foundation Soil	21		
	3.5	Unit Weight, Angle of Internal Friction and Cohesion of Soil	21		

	3.6	Conclusion	22
	3.7	Reference	22
Pa	rt 4	HYDROLOGICAL ANALYSIS	23
4	Hyd	Irological Analysis	25
	4.1	Introduction	25
	4.2	Maximum Design Discharge	25
	4.3	Mean River Discharge in the Design	26
	4.4	Minimum River Discharge	29
	4.5	The Design Discharge	29
		Frequency Analysis of Flood Records	31
	4.7	Theoretical Frequency Distribution	33
		4.7.1 The Gumbel distribution	34
		4.7.2 Confidence limits of the distribution	35
		4.7.3 Log Pearson type III distribution	37
		Measurement of Peak Discharge by the Slope-Area Method	40
	4.9	References	43
Pa		HYDRAULIC ANALYSIS OF SURFACE FLOW	45
5	Sur	face Flow Analysis	47
	5.1	Introduction	47
	5.2	General Design Consideration of the Weir	47
		5.2.1 Crest elevation	47
		5.2.2 Length of the weir	48
		5.2.3 Shape of the weir	49
	5.3	Discharge over Weirs	49
		5.3.1 WES-standard weir	51
		5.3.2 Horizontal broad crested weir	56
	5.4	Water Profile at the Weir Site	58
		5.4.1 Water profile downstream of the weir	59
		5.4.2 Water profile upstream of the weir	72
		Determination of the Tail Water Depth	80
	5.6	Flow Through Sluice Gates	81
		5.6.1 Design requirements	81
		5.6.2 Discharge through sluice gates	83
	5.7	Flow Between Piers	83
	5.8	Canal Head Regulator	84
		5.8.1 Open intake	85
	<i>5</i> 0	5.8.2 Design of culverts	85
	5.9	5	89
		5.9.1 Dimension of the basin	89
		5.9.2 Cleaning time of de-silting basin	90

Contents ix

	5.10	Automatic Discharge Control Intake	91
		5.10.1 The design procedure	91
	5.11	Trashrack Losses	94
	5.12	References	95
Pa	rt 6 1	UPLIFT PRESSURE UNDER	
	,	WEIR FOUNDATION	97
6	Upl	ift Pressure Under Weir Foundation	99
	6.1	Introduction	99
	6.2	Methods of the Seepage Analysis	100
		6.2.1 Bligh's creep theory	100
		6.2.2 Lane's weighted creep theory	101
		6.2.3 Flow nets	103
		6.2.4 Khosla's theory of independent variables	108
		6.2.5 Analytical method	118
		Energy Dissipators and its Effect on the Apron Length	118
	6.4	Protection Work for the Structure	120
		6.4.1 Length of the protection work	121 122
		6.4.2 Size of riprap stones	122
		6.4.3 Thickness of the layers 6.4.4 Grain size distribution of the filter materials	123
	6.5	References	125
	0.5	References	120
Part 7 SEDIMENT CONTROL DEVICES			
7	Sed	iment Control Devices	131
	7.1	King's Vanes	132
		7.1.1 The design procedure	133
	7.2	Vortex Vane	134
		7.2.1 The simplified design procedure	136
	7.3	Tunnel or Silt Platform	139
		7.3.1 The design criteria	139
	7.4	Vortex Tube	142
		7.4.1 Determination of the head loss	145
		7.4.2 The design procedures	148
	7.5	Tunnel Type Extractor in Main Canal	151
		7.5.1 The design criteria	151
	7.0	7.5.2 The design procedures	153
	7.6	Settling or De-silting Basin	155 157
	7.7	Design of the Escape Canal	157
	70	7.7.1 The design procedure Open Weir on Seasonal River	166
	7.0	7.8.1 Design of the weir	168
		7.8.2 Operation of the weir	168
	7.9	References	169

Part 8 STRUCTURAL ANALYSIS OF						
	DIVERSION WEIRS AND THE INTAKE STRUCTURES	171				
o C 4	4 1 A 1 CD 1 CD 1					
	uctural Analysis of Diversion Weir and ake Structures	175				
8.1	Main Weir	175				
	8.1.1 Acting forces on weir	175				
	8.1.2 General stability conditions	178				
	8.1.3 Critical cases to be considered	180				
	8.1.4 Weirs constructed non-monolithically with					
	the foundation	180				
	8.1.5 Weirs constructed monolithically with the foundation	184				
	8.1.6 Design of the weir and apron	187				
8.2	Design of the Retaining Walls	193				
	8.2.1 Active pressure in cohesionless soil	193				
	8.2.2 Cohesive soils	197				
	8.2.3 Passive force on the retaining wall	198				
	8.2.4 Stability analysis of retaining walls	198				
8.3	Structural Design of Intakes	200				
	8.3.1 Bridge-type intakes	200				
	8.3.2 Circular culverts	205				
	Constructions Joints	213				
8.5	References	214				
Part 9	FINANCIAL ANALYSIS OF	215				
	CONSTRUCTING WEIRS	215				
9 Fir	nancial Analysis of Constructing Weirs	217				
9.1	Cost of the Structure to the Farmers	217				
9.2	2 Selection of the Weir Construction Materials	220				
9.3	Reference	224				
Index		225				