

## CONTENTS

<b>Introduction</b>		<b>1-11</b>
<b>1</b>	1.1	Importance of Transportation 1
	1.2	Different Modes of Transportation 3
	1.3	Characteristics of Road Transport 6
	1.4	Importance of Roads in India 7
	1.5	Current Road Development Programmes in India 8
	1.6	Scope of Highway Engineering 10
<b>Highway Development and Planning</b>		<b>12-48</b>
<b>2</b>	2.1	Development of Road Construction 12
	2.2	Highway Development in India 15
	2.3	Highway Planning 22
	2.4	Planning Surveys and Interpretation 28
	2.4	Highway Planning in India 34
<b>Highway Alignment and Project Preparation</b>		<b>49-71</b>
<b>3</b>	3.1	Highway Alignment 49
	3.2	Engineering Surveys for Highway Alignment 54
	3.3	Drawings and Report 60
	3.4	Highway Projects 61
	3.5	Preparation of Detailed Project Report 68
<b>Geometric Design of Highways</b>		<b>72-166</b>
<b>4</b>	4.1	Introduction 72
	4.2	Highway Cross Section Elements 74
	4.3	Sight Distance 89
	4.4	Design of Horizontal Alignment 107
	4.5	Design of Vertical Alignment 145
	4.6	Design of Intersections 161
<b>Traffic Engineering</b>		<b>167-308</b>
<b>5</b>	5.1	Introduction 167
	5.2	Traffic Characteristics 169
	5.3	Traffic Engineering Studies and Analysis 177
	5.4	Traffic Flow and Roadway Capacity 219
	5.5	Traffic Regulation and Control 237
	5.6	Design of Road Intersections 267
	5.7	Design of Parking Facility 283
	5.8	Pedestrian Facilities 286
	5.9	Highway Lighting 289
	5.10	Traffic Planning and Management 296
<b>Highway Materials</b>		<b>309-387</b>

<b>6</b>	6.1	Materials used in Highway Construction	309
	6.2	Soil	311
	6.3	Stone Aggregates	339
	6.4	Bituminous Binders	352
	6.5	Bituminous Paving Mixes	369
	6.6	Portland Cement and Cement Concrete	382
<b>Design of Highway Pavements</b>			<b>388-495</b>
<b>7</b>	7.1	Introduction	388
	7.2	Flexible Pavements – Components and their Functions	395
	7.3	Factors Affecting Design and Performance of Flexible Pavements	398
	7.4	Stresses in Flexible Pavements	413
	7.5	Flexible Pavement Design Methods	424
	7.6	Rigid Pavements – Components and their Functions	440
	7.7	Factors Affecting Design and Performance of CC Pavements	445
	7.8	Stresses in Rigid Pavements	454
	7.9	Rigid Pavement Design Methods	465
<b>Highway Construction</b>			<b>496-588</b>
<b>8</b>	8.1	General Features of Highway Construction	496
	8.2	Embankment and Subgrade	499
	8.3	Excavation of Earth	512
	8.4	Construction of Flexible Pavements	515
	8.5	Cement Concrete Pavements	556
	8.6	Low Volume Roads	579
<b>Soil Stabilized Roads</b>			<b>589-616</b>
<b>9</b>	9.1	Introduction	589
	9.2	Mechanical Soil Stabilization	593
	9.3	Soil-Cement Stabilization	600
	9.4	Soil-Lime Stabilization	605
	9.5	Stabilization of Soil Using Bituminous Materials	608
	9.6	Special Problems in Soil Stabilization Work	611
<b>Highway Maintenance</b>			<b>617-689</b>
<b>10</b>	10.1	Importance of Highway Maintenance Works	617
	10.2	Deterioration and Damages in Road Infrastructure	624
	10.3	Maintenance Requirement in Different Road Components	628
	10.4	Distresses in Flexible Pavements and Maintenance Measures	631
	10.5	Structural Evaluation of Flexible Pavements and Strengthening by Overlay	650
vii			
	10.6	Distress in Rigid Pavements and Maintenance Measures	672
	10.7	Pavement Maintenance Management System	684
<b>Highway Drainage</b>			<b>690-709</b>

<b>11</b>	11.1	Objects of Highway Drainage system	690
	11.2	Requirements and Importance of Highway Drainage	691
	11.3	Surface Drainage System for Roads	692
	11.4	Hydrologic Analysis	694
	11.5	Hydraulic Design	697
	11.6	Sub-surface Drainage	703
	11.7	Drainage of Slopes and Erosion Control	706
	11.8	Road Construction in Water-logged Areas	707
<b>Hill Roads</b>			<b>710-735</b>
<b>12</b>	12.1	Introduction	710
	12.2	Alignment of Hill Roads	712
	12.3	Geometrics of Hill Roads	715
	12.4	Construction of Hill Roads	720
	12.5	Drainage Works on Hill Roads	725
	12.6	Maintenance Problems on Hill Roads	729
	12.7	Landslides	730
<b>Road-side Development</b>			<b>736-743</b>
<b>13</b>	13.1	Environmental and Social Issues in Highway Development	736
	13.2	Road-side Development and Arboriculture	737
	13.3	Control of Soil Erosion	742
<b>Highway Economics and Finance</b>			<b>744-763</b>
<b>14</b>	14.1	Introduction	744
	14.2	Highway User Benefits	745
	14.3	Highway Costs	748
	14.4	Economic Analysis	752
	14.5	Highway Finance	755
<b>Index</b>			<b>764</b>