
Contents

<i>List of illustrations</i>	xii
<i>List of contributors</i>	xix
<i>Preface</i>	xxi
<i>Acknowledgements</i>	xxiii

PART I

Planning

I

1 Roads and development

3

PETER BROCH, BRITHA MIKKELSEN AND RICHARD ROBINSON

- 1.1 The meaning of development 3*
- 1.2 Evolution of development theory 6*
- 1.3 Poverty 10*
- 1.4 Evolution of road development 13*
- 1.5 Impact of roads on economic development 14*
- 1.6 Transport and poverty 15*
- 1.7 Impact of roads on the transition to a market economy 20*
- References 21*

2 Policy

23

RICHARD ROBINSON

- 2.1 The nature of policy 23*
- 2.2 Government policy 24*
- 2.3 Organizational policy 26*
- 2.4 Integrated policy 28*
- 2.5 Dissemination 31*
- 2.6 Performance indicators 31*
- 2.7 Policy formulation 33*
- 2.8 Policy issues 36*
- References 37*

3	Traffic	38
	KENT FALCK-JENSEN, JAN KILDEBOGAARD AND RICHARD ROBINSON	
	3.1 <i>Introduction</i>	38
	3.2 <i>Traffic composition</i>	38
	3.3 <i>Traffic flows and growth</i>	42
	3.4 <i>Capacity and speed–flow</i>	43
	3.5 <i>Increasing capacity</i>	50
	3.6 <i>Traffic information and data</i>	51
	<i>References</i>	56
4	Traffic safety	57
	GOFF JACOBS AND CHRIS BAGULEY	
	4.1 <i>Background</i>	57
	4.2 <i>Nature of the problem</i>	57
	4.3 <i>Road accident costs</i>	59
	4.4 <i>Contributory factors</i>	62
	4.5 <i>Institutions and information systems</i>	64
	4.6 <i>Improving road safety</i>	65
	4.7 <i>Priorities for action</i>	75
	<i>References</i>	76
5	Roads and the environment	78
	WILLIAM V. KENNEDY	
	5.1 <i>Introduction</i>	78
	5.2 <i>Environmental impacts and their mitigation</i>	78
	5.3 <i>Environmental impact assessment</i>	86
	5.4 <i>Concluding remarks</i>	90
	<i>References</i>	91
6	Planning methods	92
	KNUD RASK OVERGAARD	
	6.1 <i>The nature of planning</i>	92
	6.2 <i>Strategic planning</i>	93
	6.3 <i>Physical network planning</i>	95
	6.4 <i>Transport demand forecasting</i>	98
	6.5 <i>Plan development and implementation</i>	106
	6.6 <i>Planning for rural transport infrastructure</i>	110
	<i>References</i>	112

7 Economic appraisal	114
RICHARD ROBINSON	
7.1 <i>Purpose</i>	114
7.2 <i>Preliminary consideration</i>	114
7.3 <i>Cost estimation</i>	117
7.4 <i>Assessment of benefits for major roads</i>	119
7.5 <i>Cost–benefit analysis for major roads</i>	122
7.6 <i>Minor road appraisal</i>	127
<i>References</i>	132
PART II	
Design	135
8 Soil investigation	137
BENT THAGESEN	
8.1 <i>Introduction</i>	137
8.2 <i>Evaluation of existing information</i>	138
8.3 <i>Field investigation</i>	144
8.4 <i>Laboratory testing</i>	147
8.5 <i>Soil classification</i>	157
<i>References</i>	161
9 Tropical soils and rocks	162
BENT THAGESEN	
9.1 <i>Introduction</i>	162
9.2 <i>Rocks</i>	163
9.3 <i>Soils</i>	165
<i>References</i>	177
10 Hydrology and drainage	178
TUE HALD, JAN HASSING, MICHAEL HØGEDAL AND ALAN JACOBSEN	
10.1 <i>Introduction</i>	178
10.2 <i>Rainfall</i>	179
10.3 <i>Flood discharge estimation</i>	183
10.4 <i>Hydraulic design</i>	188
10.5 <i>Longitudinal drainage components</i>	190
10.6 <i>Cross drainage components</i>	193
10.7 <i>Culvert design</i>	196
10.8 <i>Erosion and scour protection</i>	199
<i>References</i>	204

11 Geometric design controls	205
KENT FALCK-JENSEN	
11.1 <i>Basic considerations</i>	205
11.2 <i>Approach to selecting design standards</i>	207
11.3 <i>Classification of roads</i>	208
11.4 <i>Sight distance</i>	211
11.5 <i>Traffic</i>	215
11.6 <i>Cross-section</i>	215
<i>References</i>	223
12 Geometric alignment design	224
KENT FALCK-JENSEN	
12.1 <i>Geometric design elements</i>	224
12.2 <i>Horizontal alignment</i>	225
12.3 <i>Vertical alignment</i>	229
12.4 <i>Phasing</i>	234
12.5 <i>Alignment selection</i>	235
12.6 <i>Intersections</i>	239
12.7 <i>Low-cost roads</i>	241
12.8 <i>Computer-aided design</i>	242
<i>References</i>	243
13 Earthworks, unbound and stabilized pavements	244
BENT THAGESEN	
13.1 <i>Earthworks</i>	244
13.2 <i>Pavement structure</i>	251
13.3 <i>Unbound pavement layers</i>	253
13.4 <i>Design of gravel pavements</i>	256
13.5 <i>Stabilized pavement layers</i>	257
<i>References</i>	263
14 Asphalt pavement materials	264
RICHARD KOOLE AND BENT THAGESEN	
14.1 <i>Asphalt pavements</i>	264
14.2 <i>Bituminous binders</i>	264
14.3 <i>Surface dressing</i>	268
14.4 <i>Premixed asphalt</i>	273
<i>References</i>	283

15 Structural design of asphalt pavements	284
JOHN ROLT	
15.1 <i>Introduction</i>	284
15.2 <i>Basic empirical methods</i>	285
15.3 <i>Overseas Road Note 31</i>	286
15.4 <i>The AASHTO method</i>	289
15.5 <i>Theoretical-mechanistic design</i>	295
15.6 <i>Overlay design</i>	302
<i>References</i>	304
PART III	
Construction	307
16 Contracts and works procurement	309
TORBEN MIKKELSEN AND TIM WAAGE	
16.1 <i>Project execution methods</i>	309
16.2 <i>Types of contract</i>	313
16.3 <i>The FIDIC contract</i>	316
<i>References</i>	323
17 Contract supervision	325
TORBEN MIKKELSEN, BENT THAGESEN AND TIM WAAGE	
17.1 <i>Introduction</i>	325
17.2 <i>Supervision organization</i>	325
17.3 <i>Quality control</i>	329
17.4 <i>Measurement of work</i>	332
17.5 <i>Payment to the contractor</i>	333
17.6 <i>Progress control</i>	336
17.7 <i>Extension of time</i>	337
17.8 <i>Cost claims</i>	338
17.9 <i>Default of contractor</i>	341
17.10 <i>Supervision procedures</i>	342
<i>References</i>	344
18 Appropriate technology	345
JAN DE VEEN, RICHARD ROBINSON AND BENT THAGESEN	
18.1 <i>Technology options</i>	345
18.2 <i>Choice of technology</i>	345
18.3 <i>Intermediate methods</i>	352
18.4 <i>Equipment management</i>	364
<i>References</i>	367

PART IV	
Maintenance	369
19 Maintenance management	371
RICHARD ROBINSON	
19.1 <i>The road network as an asset</i>	371
19.2 <i>Road network management</i>	371
19.3 <i>Network information</i>	374
19.4 <i>Assessing needs</i>	376
19.5 <i>Determining options</i>	381
19.6 <i>Choosing actions</i>	383
19.7 <i>Implementation</i>	386
19.8 <i>Monitoring and audit</i>	389
19.9 <i>Information systems</i>	390
References	392
20 Maintenance operations	393
BENT THAGESEN	
20.1 <i>Introduction</i>	393
20.2 <i>Classification of maintenance activities</i>	393
20.3 <i>Safety</i>	394
20.4 <i>Asphalt pavements</i>	395
20.5 <i>Unpaved roads</i>	402
20.6 <i>Roadside areas</i>	407
20.7 <i>Drainage systems</i>	409
20.8 <i>Traffic control devices</i>	414
20.9 <i>Implementation</i>	414
References	415
21 The HDM-4 road investment model	416
HENRY KERALI	
21.1 <i>Introduction</i>	416
21.2 <i>Types of analysis</i>	417
21.3 <i>Structure of HDM-4</i>	420
21.4 <i>Components of HDM-4</i>	423
21.5 <i>Examples of applications</i>	431
References	437