

Principles of Highway Engineering and Traffic Analysis

Fifth Edition

Fred L. Mannering

Purdue University

Scott S. Washburn

University of Florida



WILEY

John Wiley & Sons, Inc.

Contents

Preface	v
Chapter 1 Introduction to Highway Engineering and Traffic Analysis	1
1.1 Introduction	1
1.2 Highways and the Economy	1
1.2.1 The Highway Economy	2
1.2.2 Supply Chains	2
1.2.3 Economic Development	2
1.3 Highways, Energy, and the Environment	3
1.4 Highways as Part of the Transportation System	3
1.5 Highway Transportation and the Human Element	3
1.5.1 Passenger Transportation Modes and Traffic Congestion	4
1.5.2 Highway Safety	4
1.5.3 Demographic Trends	5
1.6 Highways and Evolving Technologies	6
1.6.1 Infrastructure Technologies	6
1.6.2 Vehicle Technologies	7
1.6.3 Traffic Control Technologies	7
1.7 Scope of Study	8
Chapter 2 Road Vehicle Performance	9
2.1 Introduction	9
2.2 Tractive Effort and Resistance	9
2.3 Aerodynamic Resistance	10
2.4 Rolling Resistance	13
2.5 Grade Resistance	15
2.6 Available Tractive Effort	16
2.6.1 Maximum Tractive Effort	16
2.6.2 Engine-Generated Tractive Effort	18
2.7 Vehicle Acceleration	22
2.8 Fuel Efficiency	27
2.9 Principles of Braking	27
2.9.1 Braking Forces	28
2.9.2 Braking Force Ratio and Efficiency	30
2.9.3 Antilock Braking Systems	32
2.9.4 Theoretical Stopping Distance	32
2.9.5 Practical Stopping Distance	37
2.9.6 Distance Traveled During Driver Perception/Reaction	40

7.4	Development of a Traffic Signal Phasing and Timing Plan	237
7.4.1	Select Signal Phasing	238
7.4.2	Establish Analysis Lane Groups	241
7.4.3	Calculate Analysis Flow Rates and Adjusted Saturation Flow Rates	243
7.4.4	Determine Critical Lane Groups and Total Cycle Lost Time	244
7.4.5	Calculate Cycle Length	246
7.4.6	Allocate Green Time	248
7.4.7	Calculate Change and Clearance Intervals	250
7.4.8	Check Pedestrian Crossing Time	252
7.5	Analysis of Traffic at Signalized Intersections	253
7.5.1	Signalized Intersection Analysis with <i>D/D/1</i> Queuing	254
7.5.2	Signal Coordination	261
7.5.3	Control Delay Calculation for Level of Service Analysis	269
7.5.4	Level-of-Service Determination	274
Chapter 8 Travel Demand and Traffic Forecasting		285
<hr/>		
8.1	Introduction	285
8.2	Traveler Decisions	286
8.3	Scope of the Travel Demand and Traffic Forecasting Problem	287
8.4	Trip Generation	289
8.4.1	Typical Trip Generation Models	291
8.4.2	Trip Generation with Count Data Models	294
8.5	Mode and Destination Choice	296
8.5.1	Methodological Approach	296
8.5.2	Logit Model Applications	297
8.6	Highway Route Choice	303
8.6.1	Highway Performance Functions	303
8.6.2	User Equilibrium	304
8.6.3	Mathematical Programming Approach to User Equilibrium	310
8.6.4	System Optimization	311
8.7	Traffic Forecasting in Practice	315
8.8	The Traditional Four-Step Process	318
8.9	The Current State of Travel Demand and Traffic Forecasting	319
	Appendix 8A Least Squares Estimation	320
	Appendix 8B Maximum-Likelihood Estimation	322
Index		331
<hr/>		