



Continuing Project to Synthesize Information on Highway Problems: 2011

DETAILS

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AUTHORS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Sponsored by the American Association of State Highway and Transportation Officials and the Federal Highway Administration

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Research Results Digest 350

CONTINUING PROJECT TO SYNTHESIZE INFORMATION ON HIGHWAY PROBLEMS

A staff digest of the progress and status of NCHRP Project 20-05, "Synthesis of Information Related to Highway Problems," for which the Transportation Research Board is the agency conducting the research. Individual studies for the project are managed by Jon M. Williams, Director, Synthesis Studies, Donna L. Vlasak, Senior Program Officer, Gail R. Staba, Senior Program Officer, and Jo Allen Gause, Senior Program Officer, serving under the Studies and Special Programs Division of the Transportation Research Board, Stephen R. Godwin, Director.

INTRODUCTION

Highway administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to highway administrators and engineers. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and making it available to the entire highway community, the American Association of State Highway and Transportation Officials—through the mechanism of the National Cooperative Highway Research Program—authorized the Transportation Research Board to undertake a continuing study. This study, NCHRP

Suggestions for synthesis topics may be sent to the NCHRP Manager at any time by contacting the Cooperative Research Programs Staff, Transportation Research Board, 500 Fifth Street, NW, Washington, D.C., 20001. You can also submit your recommendation at: <http://www.trb.org/SynthesisPrograms/Public/SynthesisProgram.aspx> "Suggest an ACRP, NCHRP, or TCRP Synthesis Topic." Topics suggested must be accompanied by a brief (one or two paragraphs) scope statement, including a discussion of the problem. A title (preferably 10 words or less) and the name and affiliation of the submitter are also necessary. Identification of information sources is appreciated. A committee meets once each year, usually in the late spring, to make the final selections. To be considered at the next annual meeting, all submissions should be received by February 18, 2011. If a topic is not selected, it must be resubmitted the following year to be considered.

Interested in writing a synthesis? For details contact see the Synthesis homepage (address above) under "New Topics."

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Project 20-05, “Synthesis of Information Related to Highway Problems,” searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an NCHRP report series, Synthesis of Highway Practice.

THE SYNTHESIS PROJECT

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be most successful in resolving specific problems.

To develop these syntheses in a comprehensive manner and to ensure inclusion of significant knowledge, TRB employs a consultant to gather and analyze available information from numerous sources, including state departments of transportation. A panel of experts in the subject area is established to guide the consultants in organizing and evaluating the data collected on each topic and to review the synthesis report.

For each topic the project objectives are (1) to locate and assemble documented information; (2) to learn what practice has been used for solving or alleviating the problems; (3) to identify all ongoing research; (4) to learn what problems remain largely unsolved; (5) to organize, evaluate, and document

the useful information that is acquired; and (6) to disseminate the synthesis information to all who might benefit from it.

Each synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. New knowledge can be expected to be added to that which is now at hand and eventually the synthesis may need to be updated or redone. The readers and users of the syntheses are in the best position to know when this has occurred. Whenever you believe that a synthesis should be updated, it would be appreciated if you would contact TRB and propose a synthesis update by contacting the NCHRP Manager, Transportation Research Board, 500 Fifth Street, NW, Washington D.C. 20001.

Studies in Progress and Planned for 2011

Work is currently under way on the topics listed in Table 1. Topics selected for the current program are listed in Table 2. Questions on these topics should be addressed to the project study managers, Jon M. Williams, by e-mail at jwilliams@nas.edu, or by phone at 202-334-3245, Donna L. Vlasak, by e-mail at dvlasak@nas.edu, or by phone at 202-334-2974, Gail R. Staba, by e-mail at gstaba@nas.edu, or by phone at 202-334-2442, or Jo Allen Gause, by e-mail at jgause@nas.edu, or by phone at 202-334-3826.

Table 1 TOPICS BEING STUDIED

No.	Title	No.	Title
39-11	Performance of Thin Polymer Overlays for Bridge Decks	41-04	Sustainable Pavement Maintenance Practices
40-01	Recycled Materials and Byproducts in Highway Applications	41-05	Design Fires in Road Tunnels
40-07	Trade-off Considerations in Highway Geometric Design	41-06	Accelerating Implementation of Transportation Research Results
40-13	Recycling and Reclamation of Asphalt Pavements Using In-Place Methods	41-07	Operational and Institutional Agreements That Facilitate Regional Traffic Signal Operating Programs
41-01	Geometric Design Practices for Resurfacing, Restoration, and Rehabilitation	41-08	Implementing Race-Neutral Measures as State Disadvantage Business Enterprise Programs
41-02	Effective Delivery of Small-Scale Federal Aid Projects	41-09	Techniques for Highway Construction Projects in Congested Urban Areas
41-03	Engineering Economic Analysis Practices for Highway Investment	41-10	Developing Production Pile Driving Criteria from Test Pile Data
		41-11	Transportation Improvement Program Revision Process

Table 2 SYNTHESIS TOPICS SELECTED FOR THE FY 2010 PROGRAM

No.	Title	No.	Title
42-01	Practices and Guidelines for the Incorporation and Use of Geotechnical Information in Design-Build Projects	42-06	Performance-based Highway Maintenance and Operations Management
42-02	The Use and Application of the Census Bureau's Public Use Microdata Sample (PUMS) by States and Metropolitan Planning Organizations	42-07	Waterproofing Membranes for Concrete Bridge Decks
42-03	Practice and Procedures for Site-Specific Evaluation of Earthquake Ground Motions	42-08	Significant Findings from Full-Scale Accelerated Advanced Pavement Testing
42-04	Recent Geometric Design Research for Improved Safety, Operations, and Maintenance	42-09	Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control
42-05	Long-term Performance of Mechanically Stabilized Earth (MSE) Walls	42-10	Extent of Highway Capacity Manual Use in Planning
		42-11	Local Policies and Practices That Support Safe Pedestrian Environments
		42-12	Practices to Manage Traffic Sign Retro-reflectivity

Selection of Topics

NCHRP Project Committee SP20-05 meets each year to select topics for study using funds from the upcoming fiscal year. The membership of this committee is given in Table 3. Current funding allows for initiation of about 12 syntheses per year. These, plus some alternate topics, are selected by the committee at its annual project meeting.

The following factors are considered in the selection process for synthesis topics:

- The topic should address a problem that is widespread enough to generate broad interest in the synthesis.
- The topic should be timely and critical with respect to safety, economic, or social impact.
- The topic is appropriate if current practice is nonuniform or inconsistent from agency to agency, or if the validity of some practices appears to be questionable.
- The quality and quantity of useful available information should indicate a need to organize

Table 3 NCHRP PROJECT COMMITTEE SP20-5

Chairman Catherine Nelson Oregon Department of Transportation	
Kathleen S. Ames Michael Baker, Jr., Inc., Springfield, Illinois	Ananth Prasad Florida Department of Transportation
Stuart D. Anderson Texas A&M University	Robert L. Sack New York State Department of Transportation
Cynthia J. Burbank PB Americas, Inc., Alexandria, Virginia	Francine Shaw-Whitson Federal Highway Administration
Lisa Freese Scott County (MN) Public Works Division	Mary Lynn Tischer Federal Highway Administration
Malcolm T. Kerley Virginia Department of Transportation	Larry Velasquez QUALCON, Inc., Santa Fe, New Mexico
Richard D. Land California Department of Transportation	<i>Liaisons</i>
James W. March Federal Highway Administration (retired)	Jack Jernigan Federal Highway Administration
John M. Mason, Jr. Auburn University	Stephen F. Maher Transportation Research Board

and compress that which has already been learned and written on the topic.

- The topic should not be one where ongoing research or other activities in progress might be expected to render the synthesis obsolete shortly after completion.

Each year many more topics are suggested for the committee's consideration than can be programmed for study in Project 20-05. Nevertheless, the continued success of this project depends on a constant supply of worthy synthesis topics. The interest of those who have recommended topics is sincerely appreciated, and they are urged to continue. Candidate topics are suggested by members of the committee and by a variety of other sources, including state department of transportation personnel; FHWA, AASHTO, and TRB committees; and other practitioners and researchers.

Available Publications

The Syntheses of Highway Practice that have been completed under this project are listed in Table 4. Eight Research Results Digests on topics studied under the project are also listed. In addition, two unpublished reports are available. The unpublished reports are for information only, as they have not undergone the full review process of a published study. Copies of these Syntheses, Digests, and unpublished reports can be obtained from the publications office, Transportation Research Board, 500 Fifth Street, NW, Washington D.C. 20001; by calling (202) 334-3213; and through the Internet at <http://www.trb.org/bookstore>. All reports from No. 295 on (and some selected others) are available as online

publications (http://www.trb.org/news/blurb_browse.asp?id=5 "Cooperative Research Programs").

Index of Topic Subjects

Table 5 is an index to published syntheses, unpublished studies, and digests and topics in production.

Conduct of the Studies

Following the project committee's selection of topics, studies are initiated in the order of priority assigned by the committee. A panel consisting of practitioners and researchers is formed for each topic. At its first meeting, this topic panel thoroughly discusses the topic, refines the scope, suggests sources of information, and identifies and discusses potential topic consultants.

Following this meeting, a consultant is hired to gather information on the topic, synthesize it, and draft a report. Typically, the agreement covers a period of 12–15 months. Information gathering and preparation of the first draft of the synthesis report takes about 8 months. This draft is reviewed by the topic panel with the consultant, often at the second panel meeting. A revised draft is then prepared by the consultant. Subsequent drafts and meetings are scheduled, if needed, although this rarely occurs.

After the staff is substantially satisfied with the report, a final draft is sent to members of the topic panel for their last chance to review the report and then the NCHRP Project Committee SP20-05 for final approval. The report is subsequently published as an NCHRP Synthesis of Highway Practice.

Table 4 COMPLETED SYNTHESSES

No.	Title, Pages, Price	No.	Title, Pages, Price
1.	Traffic Control for Freeway Maintenance (1969) 47 pp., \$2.20	8.	Construction of Embankments (1971) 38 pp. (microfiche)*
2.	Bridge Approach Design and Construction Practices (1969) 30 pp. (microfiche)*	9.	Pavement Rehabilitation—Materials and Techniques (1972) 41 pp. (out of print)
3.	Traffic-Safe and Hydraulically Efficient Drainage Practice (1969) 38 pp. (microfiche)*	10.	Recruiting, Training, and Retaining Maintenance and Equipment Personnel (1972) 35 pp. (microfiche)*
4.	Concrete Bridge Deck Durability (1970) 28 pp. (microfiche)* (supplemented by Synthesis 57)	11.	Development of Management Capability (1972) 50 pp. (out of print)
5.	Scour at Bridge Waterways (1970) 37 pp. (microfiche)*	12.	Telecommunications Systems for Highway Administration and Operations (1972) 39 pp., \$2.80 (superseded by Synthesis 165)
6.	Principles of Project Scheduling and Monitoring (1970) 43 pp. (microfiche)*	13.	Radio Spectrum Frequency Management (1972) 32 pp., \$2.80
7.	Motorist Aid Systems (1971) 28 pp., \$2.40		

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
14.	Skid Resistance (1972) 66 pp. (microfiche)*	39.	Transportation Requirements for the Handicapped, Elderly, and Economically Disadvantaged (1976) 54 pp. (out of print)
15.	Statewide Transportation Planning—Needs and Requirements (1973) 41 pp. (microfiche)* (superseded by Synthesis 95)	40.	Staffing and Management for Social, Economic, and Environmental Impact Assessments (1977) 43 pp., \$4.00
16.	Continuously Reinforced Concrete Pavement (1973) 23 pp., \$2.80	41.	Bridge Bearings (1977) 62 pp. (microfiche)*
17.	Pavement Traffic Marking—Materials and Application Affecting Serviceability (1973) 44 pp., \$3.60 (superseded by Synthesis 138)	42.	Design of Pile Foundations (1977) 68 pp., \$4.80
18.	Erosion Control on Highway Construction (1973) 52 pp. (microfiche)*	43.	Energy Effects, Efficiencies, and Prospects for Various Modes of Transportation (1977) 57 pp., \$4.80 (supplemented by Synthesis 121)
19.	Design, Construction, and Maintenance of PCC Pavement Joints (1973) 40 pp. (out of print)	44.	Consolidation of Concrete for Pavements, Bridge Decks, and Overlays (1977) 61 pp., \$4.80
20.	Rest Areas (1973) 38 pp., \$3.60	45.	Rapid-Setting Materials for Patching of Concrete (1977) 13 pp. (out of print)
21.	Highway Location Reference Methods (1974) 30 pp., \$3.20	46.	Recording and Reporting Methods for Highway Maintenance Expenditures (1977) 35 pp., \$3.60
22.	Maintenance Management of Traffic Signal Equipment and Systems (1974) 41 pp. (microfiche)* (superseded by Synthesis 114)	47.	Effect of Weather on Highway Construction (1978) 29 pp., \$3.20
23.	Getting Research Findings into Practice (1974) 24 pp., \$3.20	48.	Priority Programming and Project Selection (1978) 31 pp. (out of print)
24.	Minimizing Deicing Chemical Use (1974) 58 pp. (microfiche)*	49.	Open-Graded Friction Courses for Highways (1978) 50 pp., \$4.00
25.	Reconditioning High-Volume Freeways in Urban Areas (1974) 56 pp., \$4.00	50.	Durability of Drainage Pipe (1978) 37 pp. (microfiche)*
26.	Roadway Design in Seasonal Frost Areas (1975) 104 pp. (microfiche)*	51.	Construction Contract Staffing (1978) 62 pp., \$6.00
27.	PCC Pavements for Low-Volume Roads and City Streets (1975) 31 pp. (microfiche)*	52.	Management and Selection Systems for Highway Maintenance Equipment (1978) 17 pp., \$4.40
28.	Partial-Lane Pavement Widening (1975) 30 pp., \$3.20	53.	Precast Concrete Elements for Transportation Facilities (1978) 48 pp., \$5.60
29.	Treatment of Soft Foundations for Embankments (1975) 25 pp., \$3.20 (supplemented by Synthesis 147)	54.	Recycling Materials for Highways (1978) 53 pp. (microfiche)*
30.	Bituminous Emulsions for Highway Pavements (1975) 76 pp. (microfiche)*	55.	Storage and Retrieval Systems for Highway and Transportation Data (1978) 30 pp., \$4.80
31.	Highway Tunnel Operations (1975) 29 pp., \$3.20	56.	Joint Related Distress in PCC Pavement—Cause, Prevention, and Rehabilitation (1979) 36 pp., \$5.20
32.	Effects of Studded Tires (1975) 46 pp., \$4.00	57.	Durability of Concrete Bridge Decks (1979) 61 pp. (microfiche)* (supplements Synthesis 4)
33.	Acquisition and Use of Geotechnical Information (1976) 40 pp., \$4.00	58.	Consequences of Deferred Maintenance (1979) 24 pp., \$4.40
34.	Policies for Accommodation of Utilities on Highway Rights of Way (1976) 22 pp. (microfiche)*	59.	Relationship of Asphalt Cement Properties to Pavement Durability (1979) 43 pp., \$5.60
35.	Design and Control of Freeway Off-Ramp Terminals (1976) 61 pp., \$4.40	60.	Failure and Repair of Continuously Reinforced Concrete Pavement (1979) 42 pp., \$5.60
36.	Instrumentation and Equipment for Testing Highway Materials, Products, and Performance (1976) 70 pp., \$4.80	61.	Changeable Message Signs (1979) 37 pp., \$5.60
37.	Lime-Fly Ash-Stabilized Bases and Subbases (1976) 66 pp. (microfiche)*	62.	Potential State Resources for Financing Transportation Programs (1979) 34 pp., \$5.20
38.	Statistically Oriented End-Result Specifications (1976) 40 pp., \$4.00	63.	Design and Use of Highway Shoulders (1979) 26 pp., \$4.80

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
64.	Bituminous Patching Mixtures (1979) 26 pp., \$4.80	91.	Highway Accident Analysis Systems (1982) 69 pp., \$7.60
65.	Quality Assurance (1979) 42 pp., \$5.60	92.	Minimizing Reflection Cracking of Pavement Overlays (1982) 38 pp., \$6.80
66.	Glare Screen Guidelines (1979) 17 pp., \$4.40	93.	Coordination of Transportation System Management and Land Use Management (1982) 38 pp., \$6.80
67.	Bridge Drainage Systems (1979) 44 pp., \$5.60	94.	Photologging (1982) 38 pp., \$6.80
68.	Motor Vehicle Size and Weight Regulation, Enforcement, and Permit Operations (1980) 45 pp., \$6.00	95.	Statewide Transportation Planning (1982) 54 pp., \$7.20 (supersedes Synthesis 15)
69.	Bus Route and Schedule Planning Guidelines (1980) 99 pp., \$8.00	96.	Pavement Subsurface Drainage Systems (1982) 38 pp., \$6.80
70.	Design of Sedimentation Basins (1980) 53 pp., \$6.80	97.	Transit Ownership/Operation Options for Small Urban and Rural Areas (1982) 28 pp., \$6.40
71.	Direction Finding from Arterials to Destinations (1980) 50 pp., \$6.40	98.	Resealing Joints and Cracks in Rigid and Flexible Pavements (1982) 62 pp., \$7.20
72.	Transportation Needs Studies and Financial Constraints (1980) 54 pp., \$6.40	99.	Resurfacing with Portland Cement Concrete (1982) 90 pp., \$8.40
73.	Alternative Work Schedules: Impacts on Transportation (1980) 54 pp., \$6.80	100.	Managing State Highway Finance (1982) 23 pp., \$6.40
74.	State Transit-Management Assistance to Local Communities (1980) 34 pp., \$6.00	101.	Historic Bridges—Criteria for Decision Making (1983) 77 pp., \$8.00
75.	Transit Boards—Composition, Roles, and Procedures (1981) 24 pp., \$6.20	102.	Material Certification and Material-Certification Effectiveness (1983) 17 pp., \$6.00
76.	Collection and Use of Pavement Condition Data (1981) 74 pp., \$8.00	103.	Risk Assessment Processes for Hazardous Materials Transportation (1983) 26 pp., \$6.40
77.	Evaluation of Pavement Maintenance Strategies (1981) 56 pp., \$7.40	104.	Criteria for Use of Asphalt Friction Surfaces (1983) 41 pp., \$6.80
78.	Value Engineering in Preconstruction and Construction (1981) 23 pp., \$6.40	105.	Construction Contract Claims: Causes and Methods of Settlement (1983) 58 pp., \$7.20
79.	Contract Time Determination (1981) 45 pp., \$7.20	106.	Practical Guidelines for Minimizing Tort Liability (1983) 40 pp., \$6.80
80.	Formulating and Justifying Highway Maintenance Budgets (1981) 49 pp., \$7.20	107.	Shallow Foundations for Highway Structures (1983) 38 pp., \$6.80
81.	Experiences in Transportation System Management (1981) 88 pp., \$8.40	108.	Bridge Weight-Limit Posting Practices (1984) 30 pp., \$6.40
82.	Criteria for Evaluation of Truck Weight Enforcement Programs (1981) 74 pp., \$7.20	109.	Highway Uses of Epoxy with Concrete (1984) 68 pp., \$8.80
83.	Bus Transit Accessibility for the Handicapped in Urban Areas (1981) 73 pp., \$7.60	110.	Maintenance Management Systems (1984) 49 pp., \$8.00
84.	Evaluation Criteria and Priority Setting for State Highway Programs (1981) 32 pp., \$6.40	111.	Distribution of Wheel Loads on Highway Bridges (1984) 22 pp., \$7.20
85.	Energy Involved in Construction Materials and Procedures (1981) 34 pp., \$6.40	112.	Cost Effectiveness of Hot-Dip Galvanizing for Exposed Steel (1984) 28 pp., \$7.20
86.	Effects of Traffic-Induced Vibrations on Bridge Deck Repairs (1981) 40 pp., \$6.80	113.	Administration of Research, Development, and Implementation Activities in Highway Agencies (1984) 49 pp., \$8.00
87.	Highway Noise Barriers (1981) 81 pp., \$7.20	114.	Management of Traffic Signal Maintenance (1984) 134 pp., \$10.80 (supersedes Synthesis 22)
88.	Underwater Inspection and Repair of Bridge Substructures (1981) 77 pp., \$7.60	115.	Reducing Construction Conflicts between Highways and Utilities (1984) 73 pp., \$8.80
89.	Geotechnical Instrumentation for Monitoring Field Performance (1982) 46 pp., \$6.80		
90.	New Product Evaluation Procedures (1982) 34 pp., \$6.80		

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
116.	Asphalt Overlay Design Procedures (1984) 66 pp., \$8.40	142.	Methods of Cost-Effectiveness Analysis for Highway Projects (1988) 22 pp., \$7.00
117.	Toll Highway Financing (1984) 29 pp., \$7.20	143.	Uniformity Efforts in Oversize/Overweight Permits (1988) 79 pp., \$10.00
118.	Detecting Defects and Deterioration in Highway Structures (1985) 52 pp., \$8.00	144.	Breaking/Cracking and Sealing Concrete Pavements (1989) 39 pp., \$8.00
119.	Prefabricated Bridge Elements and Systems (1985) 75 pp., \$8.80	145.	Staffing Considerations in Construction Engineering Management (1989) 42 pp., \$8.00
120.	Professional Resource Management and Forecasting (1985) 15 pp., \$6.80	146.	Use of Consultants for Construction Engineering and Inspection (1989) 64 pp., \$9.00
121.	Energy Conservation in Transportation (1985) 25 pp., \$7.20 (supplements Synthesis 43)	147.	Treatment of Problem Foundations for Highway Embankments (1989) 72 pp., \$9.00
122.	Life-Cycle Cost Analysis of Pavements (1985) 136 pp., \$10.80	148.	Indicators of Quality in Maintenance (1989) 114 pp., \$11.00
123.	Bridge Designs to Reduce and Facilitate Maintenance and Repair (1985) 65 pp., \$8.40	149.	Partnerships for Innovation: Private Sector Contributions to Innovation in the Highway Industry (1989) 45 pp., \$8.00
124.	Use of Weigh-in-Motion Systems for Data Collection and Enforcement (1986) 34 pp., \$7.60	150.	Technology Transfer in Selected Highway Agencies (1989) 38 pp., \$8.00
125.	Maintenance Activities Accomplished by Contract (1986) 42 pp., \$8.00	151.	Process for Recapitalizing Highway Transportation Systems (1989) 43 pp., \$8.00
126.	Equipment for Obtaining Pavement Condition and Traffic Loading Data (1986) 118 pp., \$11.20	152.	Compaction of Asphalt Pavement (1989) 42 pp., \$8.00
127.	Use of Fly Ash in Concrete (1986) 66 pp., \$8.40	153.	Evolution and Benefits of Preventive Maintenance Strategies (1989) 69 pp., \$9.00
128.	Methods for Identifying Hazardous Highway Elements (1986) 80 pp. (microfiche)*	154.	Recycling Portland Cement Concrete Pavements (1989) 46 pp., \$8.00
129.	Freezing and Thawing Resistance of High-Strength Concrete (1986) 31 pp., \$7.60	155.	Freeway Guide Sign Replacement: Policies and Criteria (1991) 37 pp., \$8.00
130.	Traffic Data Collection and Analysis: Methods and Procedures (1986) 58 pp., \$8.40	156.	Freeway Incident Management (1990) 23 pp., \$7.00
131.	Effects of Permit and Illegal Overloads on Pavements (1987) 99 pp., \$10.40	157.	Maintenance Management of Street and Highway Signs (1990) 134 pp., \$12.00
132.	System-Wide Safety Improvements: An Approach to Safety Consistency (1987) 20 pp., \$6.80	158.	Wet-Pavement Safety Programs (1990) 54 pp., \$8.00
133.	Integrated Highway Information Systems (1987) 31 pp., \$7.60	159.	Design and Construction of Bridge Approaches (1990) 45 pp., \$8.00
134.	D-Cracking of Concrete Pavements (1987) 34 pp., \$7.60	160.	Cold-Recycled Bituminous Concrete Using Bituminous Materials (1990) 105 pp., \$11.00
135.	Pavement Management Practices (1987) 139 pp., \$12.40	161.	Computer-Aided Design and Drafting Systems (1990) 24 pp., \$7.00
136.	Protective Coatings for Bridge Steel (1987) 107 pp., \$11.00	162.	Signing Policies, Procedures, Practices, and Fees for Logo and Tourist-Oriented Directional Signing (1990) 41 pp., \$8.00
137.	Negotiating and Contracting for Professional Engineering Services (1988) 75 pp., \$9.60	163.	Innovative Strategies for Upgrading Personnel in State Transportation Departments (1990) 35 pp., \$7.00
138.	Pavement Markings: Materials and Application for Extended Service Life (1988) 45 pp., \$8.00 (supersedes Synthesis 17)	164.	Measures to Curtail State Fuel Tax Evasion (1990) 14 pp., \$7.00
139.	Pedestrians and Traffic Control Measures (1988) 75 pp., \$9.00	165.	Transportation Telecommunications (1990) 92 pp., \$10.00 (supersedes Synthesis 12)
140.	Durability of Prestressed Concrete Highway Structures (1988) 65 pp., \$9.00		
141.	Bridge Deck Joints (1989) 66 pp., \$9.00		

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
166.	Traffic Signal Control Equipment: State of the Art (1990) 43 pp., \$8.00	191.	Use of Rumble Strips to Enhance Safety (1993) 74 pp., \$19.00
167.	Measurements, Specifications, and Achievement of Smoothness for Pavement Construction (1990) 34 pp., \$8.00	192.	Accident Data Quality (1993) 53 pp., \$12.00
168.	Contract Management Systems (1990) 74 pp., \$10.00	193.	Hot In-Place Recycling of Asphalt Concrete (1994) 69 pp., \$16.00
169.	Removing Concrete from Bridges (1991) 42 pp., \$8.00	194.	Electronic Toll and Traffic Management (ETTM) Systems (1993) 64 pp., \$15.00
170.	Managing Urban Freeway Maintenance (1990) 32 pp., \$7.00	195.	Use of Warranties in Road Construction (1994) 60 pp., \$15.00
171.	Fabrics in Asphalt Overlays and Pavement Maintenance (1991) 72 pp., \$9.00	196.	Highway Maintenance Procedures Dealing with Hazardous Materials Incidents (1994) 60 pp., \$15.00
172.	Signal Timing Improvement Practices (1992) 88 pp., \$11.00	197.	Corridor Preservation (1994) 43 pp., \$11.00
173.	Short-Term Responsive Maintenance Systems (1991) 43 pp., \$9.00	198.	Uses of Recycled Rubber Tires in Highways (1994) 162 pp., \$23.00
174.	Stormwater Management for Transportation Facilities (1993) 81 pp., \$9.00	199.	Recycling and Use of Waste Materials and By-Products in Highway Construction (1994) 84 pp., \$20.00
175.	Moisture Damage in Asphalt Concrete (1991) 91 pp., \$10.00	200.	Underwater Bridge Maintenance and Repair (1994) 54 pp., \$16.00
176.	Bridge Paint: Removal, Containment, and Disposal (1992) 60 pp., \$9.00	201.	Multimodal Evaluation in Passenger Transportation (1994) 84 pp., \$19.00
177.	Freeway Corridor Management (1992) 64 pp., \$9.00	202.	Severity Indices for Roadside Features (1994) 54 pp., \$12.00
178.	Truck Escape Ramps (1992) 56 pp., \$9.00	203.	Current Practices in Determining Pavement Condition (1994) 57 pp., \$16.00
179.	Latex-Modified Concretes and Mortars (1992) 58 pp., \$9.00	204.	Portland Cement Concrete Resurfacing (1994) 67 pp., \$15.00
180.	Performance Characteristics of Open-Graded Friction Courses (1992) 44 pp., \$8.00 (supplements Synthesis 49)	205.	Performance and Operational Experience of Crash Cushions (1994) 87 pp., \$20.00
181.	In-Service Experience with Traffic Noise Barriers (1992) 61 pp., \$9.00	206.	Highway Tort Liability Management Programs (1994) 40 pp., \$11.00
182.	Performance and Operational Experience of Truck-Mounted Attenuators (1992) 54 pp., \$9.00	207.	Managing Roadway Snow and Ice Control Operations (1994) 56 pp., \$15.00
183.	Knowledge Based Expert Systems in Transportation (1992) 52 pp., \$9.00	208.	Development and Implementation of Traffic Control Plans for Highway Work Zones (1994) 37 pp., \$11.00
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Table 5 INDEX TO SYNTHESSES AND STUDIES (2010)

511 phone systems 399	- pavements 30, 49, 59, 104, 152, 171, 175, 180, 260, 338	- construction 44, 53, 324, 345
Accelerated pavement testing 235, 325	- pre-overlay repair 388	- corrosion protection 257, 398
Access management 233, 304, 332, 337, 351, 404	- recycling 54, 160, 193	- deck joints 141, 319
Accident (crash) data 91, 192, 367, 369, 370	- rut resistant 274	- deck removal 169
Accident location 21, 91, 128, 202, 399	- surface treatments 223	- deck sealers 209
Adaptive Traffic Control Systems 403	Attenuators 182	- design for maintenance 123
Adopt-A-Highway 394	Automatic vehicle identification (AVI) 194	- drainage 67
Advance warnings 186, 399	Axial loading 360	- durability 4, 57, 86, 118, 140
Aid to motorists 7	Bases 37	- dynamic impact factors 266
Alternative contracting methods 379	Bearings for bridges 41	- expansion devices 141, 319
Archaeological investigations 347	Bidding	- fatigue 354
Artificial intelligence 183	- qualifications 190	- failure 396
Asphalt	- electronic 256	- foundations 42, 107, 253
- cement 59	Bituminous	- galvanizing 112, 257
- chip seal 342	- emulsions 30	- historic 101, 275, 327
- compaction 152	- patching 64	- increasing live loads, existing 249
- emulsions 30, UR24-10	- pavements (see Asphalt)	- inspection 88, 118, 353, 354, 375, 393, 398
- friction courses 49, 104, 180, 284	Bridges	- inspection standards 397
- hot mix 388	- approaches 2, 159, 234	- local interest 327
- moisture damage 175	- bearings 41	- maintenance 227, 257, 327, 353, 354, 393
- overlays 116, UR24-10	- below-water inspection 88	- management systems 227, 397
- patching 64	- below-water maintenance 200	- membranes 220
	- below-water repair 88, 200	- off-system 327
	- box beam 393	- overweight vehicles 359
	- cathodic protection 398	- paint removal 176, 251
	- concrete decks 4, 57, 86, 209, 220, 333	- painting 136

Table 5 (Continued)

- patching 45	- precast 53	- DOT design 277
- posting practices 108	- pre-overlay repair 388	- negotiating for services 137
- precast concrete 53, 119, 324, 393	- rapid test methods 187	Contaminated soils 226
- prefabricated 53, 119	- repair preparation 169	Context-sensitive solutions 373, 400
- prestressed, durability 140	- resurfacing 204	Continuously reinforced pavements 16, 60, 204, 211
- rating practices 359	- sealers 209	Contracting
- rehabilitation 327, 333	- temperature tracking 372	- bidding qualifications 190
- repair 398	- water reducers 129	- claims 105, 214
- scour 5, 200	Conduits	- Disadvantaged Business Enterprise 341
- scour critical 396	- trenchless installation 242	- maintenance 125, 246, 389
- steel 345	Consolidation of concrete 44	- management 168
- structural components RRD 274	Construction	- microsurfacing 411
- substructure repair 88, 200	- acceptance 263	- overhead 315
- wheel load distribution 111	- bases and subbases 37	- prequalifications 389, 390
- visualization 361	- bidding qualifications 190	- research 231
Bus transit planning 69	- bituminous pavements 30	- time determination 79, 215
Bypasses, impacts of RRD 210	- bridge approaches 2, 159, 234	Control of invasive species 363
	- bridge decks 4, 44, 57, 86	Convertible roadways 340
	- concrete pavements 16, 19, 27, 44, 144, 204, 211	Corridor management plans 289, 337, 363
	- consultants 146	Corridor preservation 197
	- contract claims 105, 214	Corrosion, bridges 398
	- contract time 79, 215, 379	Cost-effectiveness analysis 142, 223, 396, 407
	- delivery 372	Costs
	- embankments 8	- life-cycle 122, 222, 269
	- energy factors 85	- roadside litter collection 394
	- engineering 145, 146	- user and mitigation, 269
	- erosion control 18	Cost-plus-time bidding 379
	- insurance 308	Crash cushions 182, 205
	- lane occupancy 293	Crash reconstructions 369
	- management 51, 145, 413	Crash records systems 350, 367
	- Manager-at-Risk 402	Cross sections 299
	- material certification 102, 263	Culverts
	- pavements 16, 19, 27, 30, 44, 144, 152, 167, 204, 211	- assessment and rehabilitation 303
	- prequalifications 390	- durability 50, 254
	- quality assurance 38, 65, 212, 232, 263, 346	- inlets 3
	- recycling 54, 154, 193	- performance and service life 371
	- specifications 38, 212, 263	
	- staffing 51, 145	Data
	- subgrades 247	- bridge inspection 375
	- testing 36, 65, 187	- collection 124, 126, 130, 334, 335, 350, 370, 381, 401, 406, 410
	- traffic control 208, RRD 100	- quality 401
	- trenchless, conduits 242	- partnerships 288
	- urban area 413	- sharing 288, 312
	- utilities 115, 224	- storage 335
	- value engineering 78, 352	- systems 55
	- variability 232	
	- warranties 195	
	- weather 47	
	Consultants	
	- construction engineering 146	

Table 5 (Continued)

DBE 343	Edgedrains, maintenance 285	- off-ramps 35
D-cracking 134	Elderly, transportation for 39, 83	- project development 273
Debt financing 395	Electronic bids 256	- reconstruction 273
Deferred maintenance 58, 223	Electronic toll and traffic management systems 194	- repair 25
Deicing chemical use 24, 207, 344	Embankments 8, 234	Freight 230, 320, 374, 384, 406, 410
Design	Employees (see Personnel)	Friction courses 49, 104, 180, 284
- bituminous pavements 30, 116, 260	Emergency management agencies 392	Frost susceptibility 26
- bridge approaches 2, 159, 234	Emulsions 30	Fuel taxes 62, 164
- bridge bearings 41	End result specifications 38, 212	Funding, bridge management 397
- computer-aided 161	Energy	
- concrete pavements 16, 19, 27, 189, 211	- bituminous emulsions 30	Galvanizing 112, 257
- crossroads 332	- construction 85	Geographic information systems 301, 335
- exceptions 316	- transportation use 43, 121	Geology 357, 360
- for bridge maintenance 123	Enterprise resource planning 385	Geophysics 357
- frost 26	Environmental issues 272, 305, 341, 347, 363, 366, 394, 400, 411	Geotechnical
- geometric research 299	Epoxies 109, 333	- cone penetration testing
- pavement markings 356, 380	Equipment	- data 33
- pavement overlays 99, 116, 204	- accident removal 318	- exploration 33
- pavements 16, 19, 26, 27, 30, 189, 211, 260, 291	- cone penetration testing 366	- In situ strength measurement 278
- pile foundations 42, 253	- crash reconstruction 369	- instrumentation 89, 253
- roadways 26, 247	- for pavement data 126	- load and resistance factor design 276
- shoulders 63	- for testing 36	- pile foundation vibrations 253
- speed reduction 412	- for traffic control 166, 270, 399	- resilient modulus 382
- toll plaza 240	- management of 52, 245, 283	- rock-socketed shafts 360
- use of consultants 277	- procurement of 52	
- utilities 405	- selection of 52, 283	Glare screen 66
- value engineering 78, 352	Evacuation 392	Global freight villages 384
- visualization 361	Expansion devices for bridges 141, 319	Grade crossings 250, 271
Design-Bid-Build 376, 391, 402	Expert systems 183	GPS
Design-Build 376, 379, 390, 391, 402		- satellite positioning 258, 301
Direction finding 71	Fabrics for pavements 171	- technology 371, 385
Disadvantaged Business Enterprise 343	Falling weight deflectometers (FWDs) 381, 382	Ground penetrating radar 255, 372
Disadvantaged, transportation for 39	Field testing equipment 36, 126	Guaranteed maximum price 402
Drainage	Finance/budgets 62, 72, 80, 100, 117, 151, 243, 364, 366, 395	Guaranty of construction 195
- bridge 67	Fly ash 37, 127, 333	Guardrails 244
- culverts 303, 371	Fog 228	
- pavement 96, 174, 239	Foundations	Handicapped, transportation for 39, 83
- pipe durability 50, 254	- embankments 8, 29, 147, 234	Hazardous materials transportation
- sedimentation basins 70	- evaluation 357	- impacts on maintenance 196
- structures 3, 174	- pile 42, 253	- risk assessment 103
- drilled shafts 360	- shallow 107	- routing criteria 261
Driver licensing 348	- soft strata 29, 147	High-occupancy vehicles (HOV) 185
Driveway regulations 304, 404	- structure 360	High-speed weigh-in-motion (WIM) systems 386
Dynamic Message Signs 399	Fracture-critical members 354	Highway cost allocation 378
	Freeways	Highway-railroad grade crossings 250, 271
Ecology 302, 400	- corridor management 177, 351	Historic bridges 101, 275
Ecosystems 400	- incident management 156, 318	Historic preservation 347
Economic development 290, RRD327	- maintenance 1, 25, 170	

Table 5 (Continued)

Ice control operations 207, 344	Lighting	- traffic control 1, 25, RRD 100, 208
Impacts, economic	- roadway 371	- traffic signals 22, 114, 245
- development 290	Life-cycle costs 122, 269, 352	- training 10
- lane occupancy 293	Lime-fly ash 37	- tunnels 31
Incident clearance 318	Litter disposal 184, 394	- vegetation management 340
Incident management 156, 270, 318	Load and resistance factor design (geotechnical) 276	- winter 24, 207, 344
Indian reservation transportation 366	Load rating 359	Main tension elements 353
Information for motorists 7, 71, 162, 237, 309, 344, 348	Location reference methods 21, 91	Management
Information systems 133, 296, 350, 399	Long Term Pavement Performance 386	- access 351
Information technology 385	Low-volume pavements 27, 260	- bridges 397
Infrastructure improvements, investment 395	Maintenance	- construction 51, 145
Innovation by private industry 149, 265	- bituminous pavements 30, 64, 98, 388	- contract 168
In-pavement marker (IPM) system 380	- bridges 88, 123, 200, 227, 257, 319, 353, 375, 398	- corridor plans 289, 337
Inspection by consultants 146, 263	- budgets 80	- data 55, 350, 401
Inspection of bridges 88, 353, 393, 396, 398	- concrete pavements 19, 45, 56, 60, 98, 204, 211, 388	- freeway corridor 177
Institutional memory 365	- contract 125	- freeway incidents 156
Instrumentation 36, 235,	- contracting, performance-based 389	- letting program 331
Instrumentation, geotechnical 89, 253	- costs 58, 98, 223	- knowledge 365
Instrumentation, scour critical bridges 396	- culverts 303	- maintenance 10, 22, 46, 52, 58, 80, 110, 170, 173, 245
Insurance 308	- deferred 58, 223	- maintenance, environmental issues 272
Interchanges 299, 332	- edgedrains 285	- maintenance, equipment 283
Intermodal Facilities w/Freight 320, 384, RRD327	- equipment 52, 283	- major events 309, 392
Intersections 299, 310	- freeways 1, 25, 170	- pavement marking 408
Invasives 363	- hazardous materials impacts 196	- personnel 11, 120, 349
ISTEA	- invasive species 363	- project, systems 282
- 15 factors 217	- litter disposal 184, 394	- research 113, 231
- small MPOs 252	- management 10, 22, 46, 52, 58, 80, 110, 157, 173, 283	- risk, R-O-W 292
Joints, bridge deck 141, 319	- management systems 110, 173	- roadway information 133, 399
Joints, concrete pavement 19, 56, 98, 134, 211	- pavement costs 77, 98	- safety systems 322
Joints and cracks, sealing 98	- pavement joints 19, 56, 98, 134, 211	- snow and ice control operations 207, 344
Just-in-time logistics RRD 327	- pavements 9, 19, 25, 30, 45, 56, 60, 64, 98, 134, 388	- S.E.E. assessments 40
Knowledge management 365	- personnel 10, 344	- traffic signals 403, 409
Laboratory testing equipment 36	- preventive, value of 153, 223, 342	- training 11, 188, 349
Land development 233, 404	- public benefits 343	<i>Manual on Uniform Traffic Control Devices</i> 356, 380, 383, 412
Land use 93, 233, 320, 337, 406	- quality assurance 148	Materials
Latex-modified concrete 179	- records 46	- acceptance 263
Leadership 349	- recycling 54, 193	- assurances, structural RRD 274
Left-turn treatments 225, 404	- reporting 46	- certification 102, 263
Legal liability 106, 206, 318, 369	- rest areas 20, 246	- microsurfacing 411
Letting program 331	- scheduling 170	- pavement marking 306
Light-emitting diodes 380, 387	- signs 155, 157	- testing equipment 36, 263
	- snow and ice 24, 207, 344	Median
		- barriers 244
		- glare screen 66
		- openings 404
		- widths 281
		Metropolitan planning organizations (MPOs) 217, 252, 384

Table 5 (Continued)

Microsurfacing 411	Parking demands, truck 317	- striping 17, 138, 218
Mileposts 21	Partnerships	- studded tires 32
Mitigation	- data collection 350	- subgrade stabilization 247
- ecology 302, 400	- research 312	- surface texture 268
- lane occupancy 293	- public-private 391	- testing 235, 291
Modeling	- public and private 313, 362	- unbound pavement materials 382
- 3D and 4D 229	Patching 9, 45, 64	- widening 28, 221
- activity-based 406	Pavements	Pedestrian traffic control 139, 380
- capability 358	- asphalt 30, 49, 59, 116, 152,	Performance evaluation 306, 390
- dynamic network 406	160, 171, 175, 180, 260, 284	Performance measures 238, 300,
- freight and commercial	- bases 37	311, 326, 352, 364, 389, 397, 408
movement 406	- concrete 16, 19, 27, 44, 56, 60,	Performance-related specifications
- land use 406	99, 144, 204, 211	212
- statewide 406	- condition data 76, 126, 203, 330,	Permit operations 68, 143
- travel demand forecasting 364,	334	- driveway regulation 304
406	- construction 16, 19, 27, 30, 44,	- effects on pavements 131
Monitoring of projects 6, 263, 282	211	- overweight vehicles 359
Motorist aid systems 7	- CRCP 16, 60	Personnel
Motorist information 71, 162, 237,	- data collection 401	- bridge inspection 141
329, 399	- design 189, 260, 291, 382	- construction engineering 51, 145
Multi-disciplinary teams 373	- distress 9, 334	- maintenance 10
Multimodal transportation 201,	- drainage 96, 239	- planning for 120
286	- durability 59, 160, 274	- recruiting and maintaining 323,
National Bridge Inspection Standards	- effects of overloads 131	349
(NBIS) 397	- evaluation 76, 126, 203	- S.E.E. assessment 40
Native American transportation 366	- fabrics 171	- training 10, 11, 163, 188, 248,
Needs studies 72, 151	- friction 14, 158, 291	313, 346
NEPA (National Environmental	- friction courses 49, 104, 180, 284	Photographic traffic law enforce-
Policy Act) 400	- frost design 26	ment 219, 310
New-product evaluation 90, 150, 265	- joints 19, 56, 98, 134, 211	Photologging 94
Nondestructive testing/evaluation	- life-cycle costs 122, 269	Pile foundations 42, 253
354, 382	- light duty 260	Pipe durability 50, 254, 303
Noise barriers 87, 181	- low-volume 27, 260	Planning
Noise characteristics of pavements	- maintenance 9, 19, 25, 30, 45,	- access management 404
268	56, 60, 64, 98, 134, 211, 223,	- evacuation and reentry 392
Off-ramps 35	342, 388, 411	- forecasting models 358, 364
Older drivers 348	- maintenance costs 77, 98, 223	- freight 230, 314, 320
Open-graded surfaces 49, 104, 180,	- management 135, 222, 335, 401	- invasive species 363
284	- markings 17, 138, UR24-07,	- major events 309
Outsourcing 246, 313	306, 356, 371, 380, 408, 412	- MPOs 217, 252
Overhead 315	- moisture damage 175	- multimodal evaluation 201
Overlays 9, 49, 92, 99, 104, 116,	- noise characteristics 268	- personnel 120
144, 204, 338	- overlays 9, 92, 99, 116, 144,	- pre-project 347
Overload effects 131	204, 388	- public involvement 407
Overweight vehicles 359	- patching 9, 45, 64	- real-time traveler information 399
Owner Controlled Insurance	- pre-overlay treatments 388	- statewide transportation 15, 95,
Programs 308	- recycling 54, 154, 160, 193	286
Painting steel bridges 136	- rehabilitation 9, 25, 92, 134,	- strategic 326
Paint removal 176, 251	222, 335, 338, 342, 388	- toll road 364
Park-and-ride facilities 213	- rut resistant (asphalt) 274	- transit 69, 73
	- sealers 209	- transportation 73, 201, 332
	- skid resistance 14, 158	- value engineering 352
	- smoothness 167	- visualization 361

Table 5 (Continued)

Poor, transportation for 39	Reflection cracking 9, 92	Scour 5, 200, 396
Posting of bridges 108	Regulations	Sealers for PCC highway facilities 209
Pothole repair 45, 64	- driveway 304, 351	Security 392
Pozzolans 37, 127, 199	- utility location 405	Sedimentation basins 18, 70
Precast concrete 53, 119, 324, 327	Rehabilitation	Severity indices 202
Prefabricated structural systems 119, 327, 345	- bridges 327, 353	Sidewalks
Preferential lane treatments 185	- culverts 303	- maintenance 371
Preservation	- freeways 25	Signs
- historic bridges 275	- pavements 9, 56, 92, 99, 134, 204, 222	- advance warning 186
- rail corridors 374	- subgrades, stabilization 247	- changeable message 61, 237, 383
Prestressed concrete durability 140	Relationships 297	- dynamic message 399
Prevention	Research	- maintenance 155, 157, 371
- roadside maintenance 363	- contract 231	- motorist information 71, 162, 392
Preventive maintenance 153, 223, 330, 411	- implementation 23, 150, 355	Size regulation and enforcement 68, 143
Priority programming 48, 84, 222	- management 113	Skid resistance 14, 158, 291
Private sector involvement 149, 246, 265, 313, 355	- partnerships 312	Sleep deprivation 286
Process management 300	- performance measures 300	Slurry 411
Professional engineering services	- robust programs 280	Smart jobsites 385
- construction 146	Resilient modulus (MR) 382	Smoothness, pavements 167
- design 277	Rest areas 20, 287, 317	Snow and ice control 24, 207, 344
- negotiating 137	Resurfacing portland cement concrete 204	Soft foundations 29, 147
Programming 48, 72, 84, 151, 243	Retroreflectivity 304, 380	Soils
Program quality 300	Revenue forecasting 364	- erosion 18
Public involvement 407	Right-of-way	- measuring, in-situ 278, 368, 382
Project delivery 385, 402	- clearance 292	- remediation of contaminated 226
Project development 273, 292, 331, 361, 405	- utilities 34, 224, 405	Specifications 38, 65, 212, 306
Project scheduling 6, 215, 243, 282	Risk assessment, hazardous materials 103	Spectrum management 13
Public opinion data 377	Road pricing 210, 269, 377	Speed reduction 412
Public-private partnerships 391	Roadside hazard severity 202	Stabilization
Quality assurance 38, 65, 148, 212, 232, 263, RRD 274, 346, 375, 376	Roadway	- bases 37
Quality management 401	- convertible 340	- subbases 247
Quality control RRD 274, 346, 386, 411	- information systems 133, 399	Staffing
Radio communications 12, 13, 165	- incident diversion practices 279, 399	- construction 51, 145, 263
Radio frequency 13	- safety tools, localities 321	- maintenance 10
Railroad grade crossings 252, 271	Rock-socketed shafts 360	- planning for 120
Rail service 374	Routing, hazardous materials 261	- public involvement 407
Rails to Trails 374	Rubber tire uses 198, 199	- S.E.E. assessments 40
Rapid test methods 187	Rumble strips 191, 339	Standards, travel survey 236
Reconstruction 247, 273	Safety 1, 3, 7, 14, 32, 49, 66, 91, RRD 100, 128, 132, 156, 158, 182, 186, 191, 192, 202, 205, 244, 286, 295, 299, 306, 308, 310, 318, 321, 336, 339, 340, 348, 350, 356, 359, 370, 380, 383, 397, 403, 404, 408, 412	- historic bridges 275
Recreation travel 329	Safety analysis 295, 336	Statewide transportation planning 15, 95, 267, 286
Recycling highway materials 54, 154, 160, 193, 198, 199	Safety management systems 322	Statistical methods 295
Reduced visibility 228	Scheduling of projects 6, 222, 243, 292	Statistical specifications 38, 65, 212, 232
Reference methods 21		Stormwater management 174
Reference posts 21, 91		Stream scour 5, 200
		Strategic planning 326, 363
		Striping 17, 138, 218
		Structures (see bridges)

Table 5 (Continued)

Studded tires 32	Traffic control	Travel Demand Forecasting 364, 384, 406
Subbases 37	- calming 412	Travel Information Systems 399
Subgrades, stabilization 247, 382	- circles 264	Travel surveys 236
Subsurface information 33, 255, 405	- configuration management 294	Tribal Transportation 366
Subsurface Utility Engineering (SUE) 405	- construction RRD 100, 208	Truck
Succession 349, 362	- convertible lanes 340	- escape ramps 178
Superplasticizers for concrete 129	- crossroads 332	- increasing traffic 314
Surface courses 49, 104, 180, UR24-07	- devices 61, 166, 186, 237, 387	- operating characteristics 241
Surveying, GPS satellite 258, 301	- equipment 166	- parking demands 317
Surveys 410	- left-turn treatments 225	- trip generation 298
Systems, long-range planning 400	- maintenance 1, RRD 100, 208, 245	- truck weights and sizes 68, 82, 124, 143, 386
Systems, maintenance 283	- management centers 270	Tunnels, maintenance and operation 31
Systems, traffic control 307	- management plans 294	
	- pedestrian 139	Underwater bridge inspection 88
Taxes, fuel 62, 164	- plans 208	Underwater bridge repair 88, 200
Technology transfer 23, 150, 216, 231, 280, 355	- priority lanes 185	Urban freeways 25, 273
Telecommunications 12, 165	- ramps 35	Utilities 34, 115, 242, 405
Telephones 12, 165	- red light cameras 31	
Testing	- signal systems 245, 387, 403, 409	Value engineering 78, 352, 361
- cone penetration 366	- speed reduction 412	Variable message signs 61, 237, 383
- construction 36, 65, 263	- systems development 307, 387, 403	Vegetation management 363
- rapid 187	- work zones 1, RRD 100, 208	Vehicle attenuators 182
- soils (in-situ) 278	Traffic signals	Vehicles, larger 281
- equipment 36, 187	- equipment 166	Vibration from piles 253
- pavements 235, 291, 325	- left turns 225	Vibration of concrete 44
Toll	- maintenance 22, 114, 245, 371, 387, 403	Video monitoring
- collection 194	- operations 367, 403	- web-based 372
- financing 117	- preemption (rail) 271	Video traffic law enforcement 219
- modeling 364	- retiming 409	Visibility 228, 348
- plaza design 240	- timing 172, 403	Visualization 229, 361
- practices 262	Training of personnel 10, 11, 163, 188, 248, 346, 349, 354, 355, 362, 375	
- pricing 377	Transit	Warranties
- revenue collection 364	- boards 75	- construction 195
Tort liability 106, 206, 265	- development process 267	- microsurfacing 411
Tourism 329	- economic benefits 290	- pavement markings 408
Traffic	- elderly/handicapped 39, 83	Waste materials RRD 106, 199
- commercial vehicle and freight 384	- investment 290	Waterproofing membranes for bridge decks 220
- congestion 314	- management assistance 74	Weather 47, 344
- data collection 130, 350, 406	- management centers 270	Weigh-in-motion 124, 386
- incident clearance, quick 318	- ownership 97	Weight regulation and enforcement 68, 82, 124, 143
- law enforcement 219, 310	- planning 15, 69, 72, 73, 95, 151, 201, 230, 252, 331	Wetland mitigation 302
- management 383, 403	- system management 81, 93, 259	Whitotopping 338
- markings 17, 138, 218, 408		Widening of pavements 28, 221
- paint 17, 138, 218		Wildlife 305, 370, 400
- safety 1, 3, 32, 35, 66, RRD 100, 202, 205, 244, 350, 367		Winter maintenance 24, 207, 344
		Work schedules 73
		Work zone traffic 1, RRD 100, 208



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