



Continuing Project to Synthesize Information on Highway Practices: 2016

DETAILS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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Research Results Digest 398

CONTINUING PROJECT TO SYNTHESIZE INFORMATION ON HIGHWAY PRACTICES

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

You can submit your recommendation at: <http://www.trb.org/SynthesisPrograms/Suggest.aspx> "Synthesis Topic Submittals." 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 cycle, all submissions should be received by February 2016. If a topic is not selected, it may 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."

CONTENTS

Introduction, 1

The Synthesis Project, 2
 Studies in Progress and Planned for 2016, 2
 Selection of Topics, 3
 Available Publications, 4
 Index of Topic Subjects, 4
 Conduct of the Studies, 4

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continuing study. This study, NCHRP Project 20-05, “Synthesis of Information Related to Highway Practices,” 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 problem; (3) to identify all ongoing

research; (4) to identify gaps in knowledge and research needs; (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 2016

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; Gail R. Staba, by e-mail at gstaba@nas.edu, or by phone at 202-334-2442; Jo Allen Gause, by e-mail at jgause@nas.edu, or by phone at 202-334-3826; or Tanya M. Zwahlen, by

Table 1 Topics Being Studied

No.	Title	No.	Title
46-01	Public Perception of Mileage-Based User Fees	46-10	Application of Pedestrian Crossing Treatments for Streets and Highways
46-02	Roundabout Practices	46-11	Post-Extreme Event Damage Assessment of and Response for Highway Bridges
46-03	Performance Specifications for Asphalt Mixtures	46-12	Converting Paved Roads to Unpaved
46-04	Influence of Geotechnical Investigation and Subsurface Conditions on Claims, Change Orders, and Overruns	46-13	Practice of Rumble Strips and Rumble Stripes
46-05	Use of Reclaimed Asphalt Pavement and Recycled Asphalt Shingles in Asphalt Mixtures	46-14	Practices for High-Tension Cable Barrier
46-06	Use of Mobile IT Devices in the Field for Design, Construction, and Asset Management	46-15	Life-Cycle Cost Analysis for Management of Highway Assets
46-07	State Practices for Local Road Safety	46-16	Minimizing Roadway Embankment Damage from Flooding
46-09	Extending Bridge Service Life Through Field Welded Repair and Retrofits	46-17	Training and Certification of Maintenance Highway Workers

Table 2 Synthesis Topics Selected for the FY 2015 Program

No.	Title	No.	Title
47-01	Control of Concrete Cracking in Bridges	47-10	Resource Allocation of Available Funding to Programs of Work
47-02	Alternate Design/Alternate Bid Process for Pavement Type Selection	47-12	Use of Fiber Reinforced Polymers in Highway Infrastructure
47-03	Current Practices and Guidelines for the Reuse of Bridge Foundations	47-13	Relationship Between Chemical Makeup of Asphalt Binders and Engineering Performance
47-04	Leveraging Technology for Transportation Agency Workforce Development and Training	47-14	Effective Utility Coordination: Application of Research and Current Practices
47-05	Data Maintenance Practices	47-15	Traffic Signal Preemption at Intersections near Highway–Rail Grade Crossings
47-06	Strategic Program Delivery Methods	47-16	Highway Worker Safety
47-07	Evolving Debt Finance Practices for Surface Transportation	47-17	Statewide and Mega-Regional Travel Forecasting Models: Freight and Passenger
47-08	Pavement Management Systems: Putting the Data to Work		
47-09	Practices for Establishing Contract Duration for Highway Construction Projects		

e-mail at tzwahlen@nas.edu, or by phone at 585-315-1834.

Selection of Topics

NCHRP Synthesis Oversight Panel 20-05 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 15 syntheses per year.

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

Table 3 NCHRP Synthesis Oversight Panel SP 20-05

Chair	
Brian A. Blanchard Florida Department of Transportation	
Stuart D. Anderson Texas A&M University	Benjamin T. Orsbon South Dakota Department of Transportation
Socorro “Coco” Briseno California Department of Transportation	Randall R. “Randy” Park Utah Department of Transportation
David M. Jared Georgia Department of Transportation	Robert L. Sack New York State Department of Transportation
Cynthia L. Jones Ohio Department of Transportation	Francine Shaw Whitson Federal Highway Administration
Malcolm T. Kerley NXL, Richmond, VA	Joyce N. Taylor Maine Department of Transportation
John M. Mason, Jr. Auburn University	
Catherine Nelson Salem, Oregon	<i>Liaisons</i>
Roger C. Olson Bloomington, Minnesota	Jack Jernigan Federal Highway Administration
	Stephen F. Maher Transportation Research Board

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 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 Oversight Panel'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. Nine 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 <https://www.mytrb.org/store>.

Table 4 Completed Syntheses

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

Please send check orders to: TRB, PO Box 741494, Atlanta, GA 30374-1494, or fax to: 202/334-2519. All reports from No. 295 on (and some selected others) are available as online publications [<http://www.trb.org/Publications/PubsNCHRPSynthesisReports.aspx> “National Cooperative Highway Research Program (NCHRP) Synthesis Reports”].

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 Oversight Panel's selection of topics, studies are initiated in the order of priority assigned by the Panel. A Topic 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 selects a topic consultant.

Following this meeting, the consultant is hired to gather information on the topic, synthesize it, and draft a report. Typically, the agreement covers a period of 12 months. Information gathering and preparation of the first draft of the synthesis report takes about 6 months. This draft is reviewed by the Topic Panel with the consultant, at the second Topic Panel meeting. A revised draft is then prepared by the consultant.

After the staff is substantially satisfied with the report, a second draft is sent to members of the Topic Panel, along with two members of the Oversight Panel, for their final review, and a ballot on whether to publish the report. With this approval, a final draft is prepared and the report is subsequently published as an NCHRP Synthesis of Highway Practice.

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
11.	Development of Management Capability (1972) 50 pp. (out of print)	36.	Instrumentation and Equipment for Testing Highway Materials, Products, and Performance (1976) 70 pp., \$4.80
12.	Telecommunications Systems for Highway Administration and Operations (1972) 39 pp., \$2.80 (superseded by Synthesis 165)	37.	Lime-Fly Ash-Stabilized Bases and Subbases (1976) 66 pp. (microfiche)*
13.	Radio Spectrum Frequency Management (1972) 32 pp., \$2.80	38.	Statistically Oriented End-Result Specifications (1976) 40 pp., \$4.00
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 (supplemented by Synthesis 180)
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		

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
60.	Failure and Repair of Continuously Reinforced Concrete Pavement (1979) 42 pp., \$5.60	88.	Underwater Inspection and Repair of Bridge Substructures (1981) 77 pp., \$7.60
61.	Changeable Message Signs (1979) 37 pp., \$5.60	89.	Geotechnical Instrumentation for Monitoring Field Performance (1982) 46 pp., \$6.80
62.	Potential State Resources for Financing Transportation Programs (1979) 34 pp., \$5.20	90.	New Product Evaluation Procedures (1982) 34 pp., \$6.80
63.	Design and Use of Highway Shoulders (1979) 26 pp., \$4.80	91.	Highway Accident Analysis Systems (1982) 69 pp., \$7.60
64.	Bituminous Patching Mixtures (1979) 26 pp., \$4.80	92.	Minimizing Reflection Cracking of Pavement Overlays (1982) 38 pp., \$6.80
65.	Quality Assurance (1979) 42 pp., \$5.60	93.	Coordination of Transportation System Management and Land Use Management (1982) 38 pp., \$6.80
66.	Glare Screen Guidelines (1979) 17 pp., \$4.40	94.	Photologging (1982) 38 pp., \$6.80
67.	Bridge Drainage Systems (1979) 44 pp., \$5.60	95.	Statewide Transportation Planning (1982) 54 pp., \$7.20 (supersedes Synthesis 15)
68.	Motor Vehicle Size and Weight Regulation, Enforcement, and Permit Operations (1980) 45 pp., \$6.00	96.	Pavement Subsurface Drainage Systems (1982) 38 pp., \$6.80
69.	Bus Route and Schedule Planning Guidelines (1980) 99 pp., \$8.00	97.	Transit Ownership/Operation Options for Small Urban and Rural Areas (1982) 28 pp., \$6.40
70.	Design of Sedimentation Basins (1980) 53 pp., \$6.80	98.	Resealing Joints and Cracks in Rigid and Flexible Pavements (1982) 62 pp., \$7.20
71.	Direction Finding from Arterials to Destinations (1980) 50 pp., \$6.40	99.	Resurfacing with Portland Cement Concrete (1982) 90 pp., \$8.40
72.	Transportation Needs Studies and Financial Constraints (1980) 54 pp., \$6.40	100.	Managing State Highway Finance (1982) 23 pp., \$6.40
73.	Alternative Work Schedules: Impacts on Transportation (1980) 54 pp., \$6.80	101.	Historic Bridges—Criteria for Decision Making (1983) 77 pp., \$8.00
74.	State Transit-Management Assistance to Local Communities (1980) 34 pp., \$6.00	102.	Material Certification and Material-Certification Effectiveness (1983) 17 pp., \$6.00
75.	Transit Boards—Composition, Roles, and Procedures (1981) 24 pp., \$6.20	103.	Risk Assessment Processes for Hazardous Materials Transportation (1983) 26 pp., \$6.40
76.	Collection and Use of Pavement Condition Data (1981) 74 pp., \$8.00	104.	Criteria for Use of Asphalt Friction Surfaces (1983) 41 pp., \$6.80
77.	Evaluation of Pavement Maintenance Strategies (1981) 56 pp., \$7.40	105.	Construction Contract Claims: Causes and Methods of Settlement (1983) 58 pp., \$7.20
78.	Value Engineering in Preconstruction and Construction (1981) 23 pp., \$6.40	106.	Practical Guidelines for Minimizing Tort Liability (1983) 40 pp., \$6.80
79.	Contract Time Determination (1981) 45 pp., \$7.20	107.	Shallow Foundations for Highway Structures (1983) 38 pp., \$6.80
80.	Formulating and Justifying Highway Maintenance Budgets (1981) 49 pp., \$7.20	108.	Bridge Weight-Limit Posting Practices (1984) 30 pp., \$6.40
81.	Experiences in Transportation System Management (1981) 88 pp., \$8.40	109.	Highway Uses of Epoxy with Concrete (1984) 68 pp., \$8.80
82.	Criteria for Evaluation of Truck Weight Enforcement Programs (1981) 74 pp., \$7.20	110.	Maintenance Management Systems (1984) 49 pp., \$8.00
83.	Bus Transit Accessibility for the Handicapped in Urban Areas (1981) 73 pp., \$7.60	111.	Distribution of Wheel Loads on Highway Bridges (1984) 22 pp., \$7.20
84.	Evaluation Criteria and Priority Setting for State Highway Programs (1981) 32 pp., \$6.40	112.	Cost Effectiveness of Hot-Dip Galvanizing for Exposed Steel (1984) 28 pp., \$7.20
85.	Energy Involved in Construction Materials and Procedures (1981) 34 pp., \$6.40	113.	Administration of Research, Development, and Implementation Activities in Highway Agencies (1984) 49 pp., \$8.00
86.	Effects of Traffic-Induced Vibrations on Bridge Deck Repairs (1981) 40 pp., \$6.80		
87.	Highway Noise Barriers (1981) 81 pp., \$7.20		

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
114.	Management of Traffic Signal Maintenance (1984) 134 pp., \$10.80 (supersedes Synthesis 22)	140.	Durability of Prestressed Concrete Highway Structures (1988) 65 pp., \$9.00
115.	Reducing Construction Conflicts between Highways and Utilities (1984) 73 pp., \$8.80	141.	Bridge Deck Joints (1989) 66 pp., \$9.00
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 Seating 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		

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
165.	Transportation Telecommunications (1990) 92 pp., \$10.00 (supersedes Synthesis 12)	190.	Criteria for Qualifying Contractors for Bidding Purposes (1994) 40 pp., \$11.00
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 Syntheses and Studies (2015)

511 phone systems 399	Bases 37	- off-system 327
Accelerated pavement testing 235, 325, 433	Barriers 465	- overweight vehicles 359, 476
Access management 233, 304, 332, 337, 351, 404	Bearings for bridges 41	- paint removal 176, 251
Accident (crash) data 91, 192, 367, 369, 370, 451	Best management practices 444	- painting 136
Accident location 21, 91, 128, 202, 399, 451	Best value selection 471	- patching 45
Active traffic management 447	Bidding	- pile driving 418, 478
Adaptive Traffic Control Systems 403	- best value 471	- polymer overlays 423
Adopt-A-Highway 394	- electronic 256	- posting practices 108
Advance warnings 186, 399	- procurement 438	- precast concrete 53, 119, 324, 393
Aggregate 445	- qualifications 190	- prefabricated 53, 119
Aid to motorists 7	Bituminous	- prestressed, durability 140
Alliance contracting 466	- emulsions 30	- rating practices 359
Alternative delivery methods 481	- patching 64	- rehabilitation 327, 333
American Community Survey 434	- pavements (see Asphalt)	- repair 398
Archaeological investigations 347	Bridges	- scour 5, 200
Arterials 447	- approaches 2, 159, 234	- scour critical 396
Artificial intelligence 183	- bearings 41	- seismic design 428, 440
Asphalt	- below-water inspection 88	- steel 345
- cement 59	- below-water maintenance 200	- structural components
- chip seal 342	- below-water repair 88, 200	RRD 274
- compaction 152	- box beam 393	- substructure repair 88, 200
- concrete overlays 464	- cathodic protection 398	- waterproofing 425
- emulsions 30, UR24-10	- concrete decks 4, 57, 86, 209, 220, 333, 423, 425	- wheel load distribution 111
- friction courses 49, 104, 180, 284	- construction 44, 53, 324, 345	- visualization 361
- hot mix 388, 433, 435, 463, 477	- corrosion protection 257, 398	Bus transit planning 69
- mixtures 475	- deck joints 141, 319	Bypasses, impacts of RRD 210
- moisture damage 175	- deck removal 169	Byproducts 435
- overlays 116, UR24-10	- decks 441	
- patching 64, 463	- deck sealers 209, 423	
- pavements 30, 49, 59, 104, 152, 171, 175, 180, 260, 338, 417, 421	- design for maintenance 123	
- pre-overlay repair 388	- drainage 67	
- reclamation 421	- durability 4, 57, 86, 118, 140	
- recycling 54, 160, 193, 421	- dynamic impact factors 266	
- rut resistant 274	- expansion devices 141, 319	
- surface treatments 223	- failure 396	
Asphalt concrete pavements 435	- fatigue 354	
Asphalt mix segregation 477	- foundations 42, 107, 253, 418, 478	
Asset management 439	- galvanizing 112, 257	
Attenuators 182	- high performance concrete specifications 441	
Automated speed enforcement 482	- historic 101, 275, 327	
Automatic vehicle identification (AVI) 194	- increasing live loads, existing 249	
Axle load limits 476	- inspection 88, 118, 353, 354, 375, 393, 398	
Axial loading 360	- inspection standards 397	
	- load posting 453	
	- local interest 327	
	- maintenance 227, 257, 327, 353, 354, 393, 423	
	- management systems 227, 397	
	- membranes 220	

Table 5 (Continued)

Concrete	- material certification 102, 263	Corrosion, bridges 398, 478
- admixtures 127, 129	- pavements 16, 19, 27, 30, 44, 144, 152, 167, 204, 211	Corrosion 474
- bridge decks 4, 57, 86, 169, 333, 393, 425	- prequalifications 390	Cost-effectiveness analysis 142, 223, 396, 407, 430
- cast-in-place 441	- quality assurance 38, 65, 212, 232, 263, 346	Costs
- consolidation 44	- recycling 54, 154, 193	- cost recovery 472
- dry-cast 129	- specifications 38, 212, 263	- life-cycle 122, 222, 269
- durability 4, 57, 129, 140	- staffing 51, 145, 450	- roadside litter collection 394
- epoxies 109	- subgrades 247	- user and mitigation, 269
- fly ash in 127, 199	- testing 36, 65, 187	Cost-plus-time bidding 379
- foundations 360	- traffic control 208, RRD 100	Crash cushions 182, 205
- freezing and thawing 129	- trenchless, conduits 242	Crash reconstructions 369
- high performance 441	- urban area 413	Crash records systems 350, 367
- latex-modified 179	- utilities 115, 224	Crashes, rural 451
- overlays 99, 204, 338, 464	- value engineering 78, 352	Cross sections 299, 432
- patching 45, 463	- variability 232	Culverts
- pavement recycling 54, 154	- warranties 195	- assessment and rehabilitation 303
- pavements 16, 19, 27, 45, 56, 60, 98, 99, 134, 144, 204, 211	- weather 47	- durability 50, 254
- precast 53	Construction manager/general con- tractor 455	- inlets 3
- pre-overlay repair 388	Consultants	- performance and service life 371
- rapid test methods 187	- construction engineering 146	- service life 474
- repair preparation 169	- DOT design 277	- weight restrictions 453
- resurfacing 204	- negotiating for services 137	Data
- sealers 209	Contaminated soils 226	- bridge inspection 375
- temperature tracking 372	Context-sensitive solutions 373, 400, 422, 436	- collection 124, 126, 130, 334, 335, 350, 370, 381, 401, 406, 410
- water reducers 129	Continuously reinforced pavements 16, 60, 204, 211	- partnerships 288
Conduits	Contracting	- quality 401, 470
- trenchless installation 242	- alliance 466	- safety 458
Consolidation of concrete 44	- alternative methods 379	- sharing 288, 312, 458, 460
Construction	- alternative technical concepts 455	- storage 335
- acceptance 263	- best value selection 471	- systems 55
- bases and subbases 37	- bidding qualifications 190	DBE 343, 481
- bidding qualifications 190	- claims 105, 214	D-cracking 134
- bituminous pavements 30	- Disadvantaged Business Enterprise 341, 416, 481	Decision-making process 427
- bridge approaches 2, 159, 234	- indefinite delivery/indefinite quantity 473	Debt financing 395
- bridge decks 4, 44, 57, 86	- maintenance 125, 246, 389	Deferred maintenance 58, 223
- concrete pavements 16, 19, 27, 44, 144, 204, 211, 441	- management 168	Deicing chemical use 24, 207, 344, 449
- consultants 146	- microsurfacing 411	Demand modification 448
- contract claims 105, 214	- overhead 315	Design
- contracting 468, 471, 473, 481	- prequalifications 389, 390	- barriers 465
- contract time 79, 215, 379	- research 231	- bituminous pavements 30, 116, 260
- delivery 372	- time determination 79, 215	- bridge approaches 2, 159, 234
- embankments 8	Control of invasive species 363	- bridge bearings 41
- emergency 438	Convertible roadways 340	- computer-aided 161
- energy factors 85	Corridor management plans 289, 337, 363	- concrete pavements 16, 19, 27, 189, 211
- engineering 145, 146	Corridor preservation 197	- crossroads 332
- erosion control 18		- design controls and criteria 432
- insurance 308		
- lane occupancy 293		
- management 51, 145, 413, 438		
- Manager-at-Risk 402		

Table 5 (Continued)

- exceptions 316	Edgedrains, maintenance 285	Finance/budgets 62, 72, 80, 100, 117, 151, 243, 364, 366, 395, 452, 479, 480
- for bridge maintenance 123	Elderly, transportation for 39, 83	Fires 415
- frost 26	Electronic bids 256	Fleet management 452
- geometric design 417, 422, 432	Electronic toll and traffic management systems 194	Fly ash 37, 127, 333
- geometric research 299, 432	Embankments 8, 234	Fog 228
- highway 443	Emergency management 454	Foundation engineering 418
- pavement markings 356, 380	Emergency management agencies 392	Foundations
- pavement overlays 99, 116, 204	Emergency medical services 451	- embankments 8, 29, 147, 234
- pavements 16, 19, 26, 27, 30, 189, 211, 260, 291, 457	Emergency operations 468	- evaluation 357
- pile foundations 42, 253	Emergency training 468	- pile 42, 253
- practical 440	Employees (see Personnel)	- shallow 107
- roadways 26, 247, 435	Emulsions 30	- soft strata 29, 147
- seismic bridge 440	End result specifications 38, 212	- structure 360
- shoulders 63	Energy	Fracture-critical members 354
- solutions 443	- bituminous emulsions 30	Freeways
- speed reduction 412	- construction 85	- corridor management 177, 351
- toll plaza 240	- transportation use 43, 121	- incident management 156, 318
- tunnels 415	Energy development, effects on roads/bridges 468	- maintenance 1, 25, 170
- use of consultants 277	Enforcement, speed 482	- off-ramps 35
- utilities 405, 462	Engineering demand parameters 440	- project development 273
- value engineering 78, 352	Enterprise resource planning 385	- reconstruction 273
- visualization 361	Environmental issues 272, 305, 341, 347, 363, 366, 394, 400, 411, 430, 433, RRD 365, 449	- repair 25
Design-Bid-Build 376, 391, 402, 455	Epoxies 109, 333, 423	Freight 230, 320, 374, 384, 406, 410
Design-Build 376, 379, 390, 391, 402, 429, 455, 481	Equipment	Friction courses 49, 104, 180, 284
Direction finding 71	- accident removal 318, 451	Frost susceptibility 26
Disadvantaged Business Enterprise 343, 416, 481	- cone penetration testing 366	Fuel taxes 62, 164, 479
Disadvantaged, transportation for 39	- crash reconstruction 369	Full-scale accelerated pavement testing 433
Disaster planning 467	- for pavement data 126	Funding
Disaster relief 472	- for testing 36	- bridge management 397
Disinvestment 480	- for traffic control 166, 270, 399	- construction staffing 450
Drainage	- management of 52, 245, 283, 452	- small-scale projects 414
- bridge 67	- procurement of 52	- funding 459
- culverts 303, 371, 474	- selection of 52, 283	Galvanizing 112, 257
- pavement 96, 174, 239, 449	Erosion, control 430	Geographic information systems 301, 335, 446
- pipe durability 50, 254	Evacuation 392	Geology 357, 360
- sedimentation basins 70	“Every Day Counts” 429, 466	Geometric design 417, 422, 432, 436
- structures 3, 174	Expansion devices for bridges 141, 319	Geophysics 357
- drilled shafts 360	Expert systems 183	Geospatial technologies 446
Driver licensing 348	Fabrics for pavements 171	Geotechnical
Driveway regulations 304, 404	Falling weight deflectometers (FWDs) 381, 382	- cone penetration testing 368
Driven piles 478	Federal-aid projects 414, 416, 442	- data 33
Dynamic Message Signs 399	Federal disaster reimbursement 472	- exploration 33
Earthquakes 428, 440	Field inspection practices 470	- information practices 429
Earth walls 437	Field testing equipment 36, 126	- in situ strength measurement 278
Ecology 302, 400	Fiber additives 475	- instrumentation 89, 253
Economic forecasting 480		- load and resistance factor design 276
Economics 290, RRD 327, 424		
Ecosystems 400		

Table 5 (Continued)

- mechanically stabilized earth walls 437	Information for motorists 7, 71, 162, 237, 309, 344, 348	Leadership 349
- pile driving 418	Information systems 133, 296, 350, 399	Left-turn treatments 225, 404
- pile foundation vibrations 253	Information technology 385	Legal liability 106, 206, 318, 369
- resilient modulus 382	Infrastructure 439, 469	Letting program 331
- rock-socketed shafts 360	Infrastructure improvements, investment 395	Levels of service 426, 470
- site conditions 429	Innovation by private industry 149, 265	Light detection and ranging (LIDAR) 446
Geotechnical data visualization 467	In-pavement marker (IPM) system 380	Light-emitting diodes 380, 387
Glare screen 66	Inspection by consultants 146, 263	Lighting
Global freight villages 384	Inspections	- roadway 371
Grade crossings 250, 271	- earth walls 437	Life-cycle costs 122, 269, 352
GPS	- pipes 474	Lime-fly ash 37
- satellite positioning 258, 301	- road slope 430	Litter disposal 184, 394
- technology 371, 385, 446	Inspection of bridges 88, 353, 393, 396, 398, 425	Load and resistance factor design (geotechnical) 276, 418, 478
Ground motions 428	Institutional memory 365	Load posting 453
Ground penetrating radar 255, 372, 446	Instrumentation 36, 235,	Load rating 359
Guaranteed maximum price 402	Instrumentation, geotechnical 89, 253	Local public agencies 442
Guaranty of construction 195	Instrumentation, scour critical bridges 396	Location reference methods 21, 91
Guardrails 244	Insurance 308	Long Term Pavement Performance 386, 423, 433, 457, 463
Handicapped, transportation for 39, 83	Integrated corridor management 460	Low-volume pavements 27, 260
Hazard mitigation 467	Intelligent compaction 445	Maintenance
Hazardous materials transportation	Intelligent transportation systems 460	- 3R 417
- impacts on maintenance 196	Interchanges 299, 332, 432	- bituminous pavements 30, 64, 98, 388
- risk assessment 103	Intermodal Facilities w/Freight 320, 384, RRD 327	- bridges 88, 123, 200, 227, 257, 319, 353, 375, 398, 423, 425, 469
- routing criteria 261	Interoperability 458	- budgets 80
Heavy loads 469, 476	Intersections 299, 310, 432	- concrete pavements 19, 45, 56, 60, 98, 204, 211, 388
High-occupancy vehicles (HOV) 185	Invasives 363	- contract 125
High-speed weigh-in-motion (WIM) systems 386	ISTEA	- contracting, performance-based 389, 426
<i>Highway Capacity Manual</i> 427	- 15 factors 217	- costs 58, 98, 223
Highway cost allocation 378	- small MPOs 252	- culverts 303, 474
Highway–railroad grade crossings 250, 271	Joint development 459	- deferred 58, 223
Historic bridges 101, 275	Joints, bridge deck 141, 319	- edgedrains 285
Historic preservation 347	Joints, concrete pavement 19, 56, 98, 134, 211	- emergency 438, 454
Hydraulic fracturing 469	Joints and cracks, sealing 98	- equipment 52, 283
Hydrology 444	Just-in-time logistics RRD 327	- freeways 1, 25, 170
Ice control operations 207, 344	Knowledge management 365, 454	- funding 470
Impact fees 459	Laboratory testing equipment 36	- hazardous materials impacts 196
Impacts, economic	Land development 233, 404	- invasive species 363
- development 290	Land use 93, 233, 320, 337, 406	- litter disposal 184, 394
- lane occupancy 293	Latex-modified concrete 179	- management 10, 22, 46, 52, 58, 80, 110, 157, 173, 283, 426
Incident clearance 318		- management systems 110, 173, 470
Incident management 156, 270, 318, 454, 468		- pavement costs 77, 98
Indefinite delivery/indefinite quantity contracting practices 473		
Indian reservation transportation 366		

Table 5 (Continued)

- pavement joints 19, 56, 98, 134, 211	- risk, R-O-W 292	Motorist aid systems 7
- pavements 9, 19, 25, 30, 45, 56, 60, 64, 98, 134, 388, RRD 365, 469	- roadway information 133, 399	Motorist information 71, 162, 237, 329, 399
- personnel 10, 344	- safety systems 322	Multi-disciplinary teams 373
- preventive, value of 153, 223, 342, RRD 365	- S.E.E. assessments 40	Multimodal transportation 201, 286
- public benefits 343	- snow and ice control operations 207, 344	
- quality assurance 148, 426, 470	- traffic signals 403, 409, 420	National Bridge Inspection Standards (NBIS) 397, 453
- records 46	- traffic sign retroreflectivity 431	National Incident Management System 472
- recycling 54, 193, 421	- training 11, 188, 349	National Research Implementation Network 461
- reporting 46	- vehicle 452	Native American transportation 366
- rest areas 20, 246	<i>Manual on Uniform Traffic Control Devices</i> 356, 380, 383, 412, 431, 432	Needs studies 72, 151
- road slope 430	Manufacturing and construction by-products 435	NEPA (National Environmental Policy Act) 400
- scheduling 170	Materials	New-product evaluation 90, 150, 265
- signs 155, 157	- acceptance 263	Noise barriers 87, 181
- snow and ice 24, 207, 344, 449	- assurances, structural RRD 274	Noise characteristics of pavements 268
- sustainable RRD 365	- certification 102, 263	Non-coal combustion byproducts 435
- traffic control 1, 25, RRD 100, 208	- microsurfacing 411	Nondestructive testing/evaluation 354, 382
- traffic signals 22, 114, 245	- pavement marking 306	Non-nuclear methods/devices 456
- traffic signs 431	- reclaimed asphalt pavement 421	NPDES 444
- training 10, 468	- testing equipment 36, 263	Nuclear density gauge 456
- tunnels 31, 415	Mechanically stabilized earth walls 437	
- vegetation management 340	<i>Mechanistic-Empirical Pavement Design Guide</i> 457	Off-ramps 35
- winter 24, 207, 344, 449	Median	Older drivers 348
- work zone 482	- barriers 244, 465	Open-graded surfaces 49, 104, 180, 284
Main tension elements 353	- glare screen 66	Outsourcing 246, 313
Management	- openings 404	Overhead 315
- access 351	- widths 281	Overlays 9, 49, 92, 99, 104, 116, 144, 204, 338, 464
- bridges 397	Metropolitan planning organizations (MPOs) 217, 252, 384, 419, 420, 434	Overload effects 131
- construction 51, 145	Microsurfacing 411	Overweight vehicles 359, 476
- contract 168	Mileposts 21	Owner Controlled Insurance Programs 308
- corridor plans 289, 337	Mineral and quarry byproducts 435	
- data 55, 350, 401, 458	Mitigation	Painting steel bridges 136
- federal-aid projects 414	- ecology 302, 400, 449	Paint removal 176, 251
- freeway corridor 177	- lane occupancy 293	Park-and-ride facilities 213
- freeway incidents 156	Modeling	Parking demands, truck 317
- investment 424	- 3D and 4D 229	Partnerships
- letting program 331	- activity-based 406	- data collection 350
- knowledge 365	- capability 358	- public-private 391
- maintenance 10, 22, 46, 52, 58, 80, 110, 170, 173, 245	- dynamic network 406	- public and private 313, 362
- maintenance, environmental issues 272	- freight and commercial movement 406	- research 312, 461
- maintenance, equipment 283	- land use 406	Patching 9, 45, 64, 463
- major events 309, 392	- statewide 406	
- pavement marking 408	- travel demand forecasting 364, 406	
- performance-based 426	Monitoring of projects 6, 263, 282	
- personnel 11, 120, 349		
- project, systems 282		
- research 113, 231		

Table 5 (Continued)

Pavements	- studded tires 32	- <i>Highway Capacity Manual</i> 427
- aggregate 445	- subgrade stabilization 247	- invasive species 363
- asphalt 30, 49, 59, 116, 152, 160, 171, 175, 180, 260, 284, 457, 475	- superheavy loads 476	- major events 309
- bases 37	- surface texture 268	- MPOs 217, 252
- concrete 16, 19, 27, 44, 56, 60, 99, 144, 204, 211, 457	- testing 235, 291, 433	- multimodal evaluation 201
- condition data 76, 126, 203, 330, 334	- thin overlays 464	- personnel 120
- construction 16, 19, 27, 30, 44, 211	- unbound pavement materials 382	- pre-project 347
- CRCP 16, 60	- widening 28, 221	- public involvement 407
- data collection 401	Pavers 477	- real-time traveler information 399
- design 189, 260, 291, 382, 457	Pedestrian environments 436	- statewide transportation 15, 95, 286
- distress 9, 334	Pedestrian traffic control 139, 380	- strategic 326
- drainage 96, 239	Performance-based highway maintenance 426	- toll road 364
- durability 59, 160, 274	Performance-based seismic design 440	- traffic signal operations 420
- effects of overloads 131	Performance evaluation 306, 390	- transit 69, 73
- evaluation 76, 126, 203	Performance, fiber mixtures 475	- transportation 73, 201, 332, 434
- fabrics 171	Performance measures 238, 300, 311, 326, 352, 364, 389, 397, 408, 423, 426, 433, 439, 442	- value engineering 352
- friction 14, 158, 291	Performance monitoring 427, RRD 365	- visualization 361
- friction courses 49, 104, 180, 284	Performance-related specifications 212	Polymers 423
- frost design 26	Permit operations 68, 143	Poor, transportation for 39
- joints 19, 56, 98, 134, 211	- driveway regulation 304	Portable changeable message signs 482
- life-cycle costs 122, 269	- effects on pavements 131	Portland cement concrete 435
- light duty 260	- overweight vehicles 359, 476	Posting of bridges 108
- low-volume 27, 260	- superheavy loads 476	Pothole repair 45, 64, 463
- maintenance 9, 19, 25, 30, 45, 56, 60, 64, 98, 134, 211, 223, 342, 388, 411, 463, 464	Personnel	Pozzolans 37, 127, 199
- maintenance costs 77, 98, 223	- bridge inspection 141	Practical design 443
- management 135, 222, 335, 401	- construction engineering 51, 145	Precast concrete 53, 119, 324, 327, 441
- management systems 433	- maintenance 10	Prefabricated structural systems 119, 327, 345
- markings 17, 138, UR24-07, 306, 356, 371, 380, 408, 412	- planning for 120	Preferential lane treatments 185
- moisture damage 175	- recruiting and maintaining 323, 349	Preservation
- noise characteristics 268	- S.E.E. assessment 40	- historic bridges 275
- overlays 9, 92, 99, 116, 144, 204, 388	- training 10, 11, 163, 188, 248, 313, 346	- rail corridors 374
- patching 9, 45, 64, 463	Photographic traffic law enforcement 219, 310	Prestressed concrete durability 140, 441
- performance 457	Photologging 94	Prevention
- pre-overlay treatments 388	Pile driving 418	- roadside maintenance 363
- recycling 54, 154, 160, 193, 421	Pile foundations 42, 253, 478	Preventive maintenance 153, 223, 330, 411
- rehabilitation 9, 25, 92, 134, 222, 335, 338, 342, 388, 417	Pipe durability 50, 254, 303	Priority programming 48, 84, 222
- reclamation 421	Pipes 474	Private sector involvement 149, 246, 265, 313, 355
- rut resistant (asphalt) 274	Planning	Process management 300
- sealers 209	- access management 404	Procurement, emergency 438
- skid resistance 14, 158	- emergency 454	Procurement policies 466
- smoothness 167	- evacuation and reentry 392	Procurement, transparency 471
- striping 17, 138, 218	- forecasting models 358, 364	Professional engineering services
	- freight 230, 314, 320	- construction 146
		- design 277
		- negotiating 137

Table 5 (Continued)

Programming 48, 72, 84, 151, 243, 414, 419	Relationships 297	Sealers for PCC highway facilities 209
Program quality 300	Research	Security 392, 468
Project delivery 385, 402, 427, 450, 455, 466, 473, 481	- contract 231	Segregation 477
Project development 273, 292, 331, 361, 405	- implementation 23, 150, 355, 461	Sedimentation basins 18, 70
Project scheduling 6, 215, 243, 282	- management 113	Service life, culverts 474
Public involvement 407	- partnerships 312	Severity indices 202
Public opinion data 377	- performance measures 300	Sidewalks
Public-private partnerships 391	- robust programs 280	- maintenance 371
Public Use Microdata Sample 434	Resilience 467, 468, 472, 473	Signal control 448
	Resilient modulus (M_R) 382	Signs
	Resins 423	- advance warning 186
Quality assurance 38, 65, 148, 212, 232, 263, RRD 274, 346, 375, 376	Rest areas 20, 287, 317	- changeable message 61, 237, 383
Quality control RRD 274, 346, 386, 411	Resurfacing portland cement concrete 204	- dynamic message 399
Quality management 401	Retroreflectivity 304, 380, 431	- maintenance 155, 157, 371
	Revenue forecasting 364, 479	- median 465
	Right-of-way	- motorist information 71, 162, 392
	- clearance 292	- permanent 465
	- highway 462	- retroreflective 431
	- utilities 34, 224, 405, 462	Site-Specific Evaluations 428
	Risk assessment, hazardous materials 103	Size regulation and enforcement 68, 143
	Road pricing 210, 269, 377	Skid resistance 14, 158, 291
	Roadside hazard severity 202	Slags 435
	Roadway	Sleep deprivation 286
	- convertible 340	Slurry 411
	- incident diversion practices 279, 399	Small business programs 448
	- information systems 133, 399	Smart jobsites 385
	- safety tools, localities 321	Smoothness, pavements 167
	Road Weather Information Systems 449	Snow and ice control 24, 207, 344, 449
	Rock-socketed shafts 360	Soft foundations 29, 147
	Routing, hazardous materials 261	Soils
	Rubber tire uses 198, 199	- erosion 18, 430
	Rumble strips 191, 339	- measuring, in-situ 278, 368, 382
		- remediation of contaminated 226
	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, 415, 417, 420, 422, 431, 432, 436, 451, 453, 458, 482	Specifications 38, 65, 212, 306, 441
	Safety analysis 295, 336	Spectrum management 13
	Safety management systems 322	Speed management
	Scheduling of projects 6, 222, 243, 292	- work zones 482
	Scour 5, 200, 396	Speed reduction 412
	Scrap tire byproducts 435	Stabilization
		- bases 37
		- earth walls 437
		- road slope 430
		- subbases 247
		Staffing
		- construction 51, 145, 263, 450
		- forecasting 450
		- maintenance 10
		- planning for 120
		- public involvement 407
		- S.E.E. assessments 40

Table 5 (Continued)

Standards, travel survey 236	- modeling 364	- maintenance 22, 114, 245, 371, 387, 403
- historic bridges 275	- plaza design 240	- operations 367, 403, 420
Statewide transportation planning 15, 95, 267, 286	- practices 262	- preemption (rail) 271
Statistical methods 295	- pricing 377	- retiming 409
Statistical specifications 38, 65, 212, 232	- revenue collection 364	- timing 172, 403
Statistics, crash 451	Tort liability 106, 206, 265	Training of personnel 10, 11, 163, 188, 248, 346, 349, 354, 355, 362, 375, 416, 468
Steel pipe piles 478	Total maximum daily loads 444	Transit
Stormwater management 174, 444	Tourism 329	- boards 75
Stream scour 5, 200	<i>Toward Zero Deaths</i> 482	- development process 267
Strategic planning 326, 363	Trade-off considerations 422	- economic benefits 290
Striping 17, 138, 218	Traffic	- elderly/handicapped 39, 83
Structures (see bridges)	- calming 436	- investment 290
Studded tires 32	- commercial vehicle and freight 384	- management assistance 74
Subbases 37	- congestion 314	- management centers 270
Subgrades, stabilization 247, 382	- data collection 130, 350, 406, 458, 460	- ownership 97
Subsurface information 33, 255, 405	- incident clearance, quick 318	- planning 15, 69, 72, 73, 95, 151, 201, 230, 252, 331
Subsurface Utility Engineering (SUE) 405	- law enforcement 219, 310	- system management 81, 93, 259
Succession 349, 362	- management 383, 403, 447	Transportation asset management 439
Superplasticizers for concrete 129	- markings 17, 138, 218, 408	Transportation enhancement 414
Surface courses 49, 104, 180, UR24-07	- paint 17, 138, 218	Transportation improvement program 419
Surveying, GPS satellite 258, 301	- signs 431	Travel Demand Forecasting 364, 384, 406, 480
Surveys 410	- safety 1, 3, 32, 35, 66, RRD 100, 202, 205, 244, 350, 367	Travel Information Systems 399
Sustainable pavement maintenance RRD 365	Traffic control	Travel surveys 236, 434
Systems, long-range planning 400	- calming 412	Tribal Transportation 366
Systems, maintenance 283	- circles 264	Truck
Systems, traffic control 307	- configuration management 294	- escape ramps 178
Taxes, fuel 62, 164, 479	- construction RRD 100, 208	- increasing traffic 314
Technology transfer 23, 150, 216, 231, 280, 355, 461	- convertible lanes 340	- operating characteristics 241
Telecommunications 12, 165	- crossroads 332	- parking demands 317
Telephones 12, 165	- devices 61, 166, 186, 237, 387	- trip generation 298
Testing	- equipment 166	- truck weights and sizes 68, 82, 124, 143, 386, 476
- cone penetration 366	- left-turn treatments 225	Tunnels, maintenance and operation 31, 415
- construction 36, 65, 263	- maintenance 1, RRD 100, 208, 245	Unbound aggregate 444
- high performance concrete 441	- management centers 270	Unbound materials 456
- pile driving 418	- management plans 294	Underwater bridge inspection 88
- rapid 187	- pedestrian 139	Underwater bridge repair 88, 200
- soils (in-situ) 278	- plans 208	Urban freeways 25, 273
- equipment 36, 187	- priority lanes 185	Utilities 34, 115, 242, 405, 462
- pavements 235, 291, 325, 433, 435, 477	- ramps 35	Value capture 459
Test pile data 418	- red light cameras 31	Value engineering 78, 352, 361, 422
Thin polymer overlays 423	- signal systems 245, 387, 403, 409, 420	
Toll	- speed reduction 412	
- collection 194	- systems development 307, 387, 403	
- financing 117	- work zones 1, RRD 100, 208	
	Traffic operation 460	
	Traffic signals	
	- equipment 166	
	- left turns 225	

Table 5 (Continued)

Variable message signs 61, 237, 383	Warranties	Wetland mitigation 302
Vegetation management 363, 449	- construction 195	Whitetopping 338
Vehicle attenuators 182	- microsurfacing 411	Widening of pavements 28, 221
Vehicles, larger 281	- pavement markings 408	Wildlife 305, 370, 400
Vibration from piles 253	Waste materials RRD 106, 199	Winter maintenance 24, 207, 344, 449
Vibration of concrete 44	Waterproofing membranes for	Work schedules 73
Video monitoring	bridge decks 220, 425	Work zone traffic 1, RRD 100, 208, 482
- web-based 372	Weather 47, 344, 454	
Video traffic law enforcement 219	Weigh-in-motion 124, 386	
Visibility 228, 348, 431	Weight regulation and enforcement	
Visualization 229, 361, 467	68, 82, 124, 143, 453, 476	Zone of intrusion 465

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