



## Continuing Project to Synthesize Information on Highway Problems

### DETAILS

16 pages | | PAPERBACK

ISBN 978-0-309-42886-6 | DOI 10.17226/23347

### AUTHORS

BUY THIS BOOK

FIND RELATED TITLES

Visit the National Academies Press at [NAP.edu](http://NAP.edu) and login or register to get:

- Access to free PDF downloads of thousands of scientific reports
- 10% off the price of print titles
- Email or social media notifications of new titles related to your interests
- Special offers and discounts



Distribution, posting, or copying of this PDF is strictly prohibited without written permission of the National Academies Press. (Request Permission) Unless otherwise indicated, all materials in this PDF are copyrighted by the National Academy of Sciences.

continuing study. This study, NCHRP Project 20-5, “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, the Transportation Research Board analyzes available information assembled from numerous sources, including state departments of transportation. A panel of experts in the subject area is established to guide the researchers 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 2004

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 Williams by e-mail at [jwilliams@nas.edu](mailto:jwilliams@nas.edu), or by phone at 202-334-3245 or Donna L. Vlasak, by e-mail at [dvlasak@nas.edu](mailto:dvlasak@nas.edu), or by phone at 202-334-2974.

## Selection of Topics

NCHRP Project Committee SP20-5 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

**Table 1** TOPICS BEING STUDIED

No.	Title	No.	Title
33-10	Steel Bridge Erection Practices	35-05	Developing Transportation Agency Leaders
34-01	Centerline Rumble Strips on Rural Roads	35-06	Access Rights
34-02	Road Safety Audits	35-07	Inspection and Maintenance of Cable-Stayed Bridges
34-05	Effective Construction Management of Disadvantaged Business Enterprise Issues	35-08	Comprehensive Investigation of Bridges with Fracture Critical Details
34-06	Convertible Roadways and Lanes	35-09	Compliance with National Historic Preservation Act Requirements for Archaeological Investigations
34-07	Cooperative Agreements for Corridor Management	35-10	Improving the Safety of Older Road Users
34-08	Use of Ultra-Thin Whitetopping	35-11	Links Between Transportation and Economic Development
34-10	Winter Highway Operations	35-12	Transportation Technology Transfer Successes, Challenges, and Needs
35-01	State Quality Assurance Programs		
35-02	Chip Seal Best Practices		
35-03	Crash Reporting and Processing		
35-04	Value Engineering Practices in Transportation		

**Table 2** SYNTHESIS TOPICS SELECTED FOR THE FY 2004 PROGRAM

No.	Title	No.	Title
36-01	Bridge Rating Practices and Policies for Overweight Vehicles	36-07	Training Program Needs, Policies, and Practices
36-02	Practices for Monitoring Scour Critical Bridges	36-08	Use of Geophysics for Transportation Projects
36-03	New Technologies for Improving Safety Data	36-09	Statewide Travel Forecasting Models
36-04	Visualization for Project Development	36-10	Impact of Intermodal Freight Terminal Closures
36-05	Control of Invasive Species	36-11	Estimating Toll Road Demand and Feasibility
36-06	Pavement Markings—Design and Layout Details	36-12	Use of Rock-Socketed Shafts for Highway Bridge Foundations
		36-16	Tribal Government Transportation Programs

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 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 20-5. 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. Four Research Results Digests on topics

**Table 3** NCHRP PROJECT COMMITTEE SP20-5

	Chairman Gary D. Taylor CTE Engineers
Susan Binder Federal Highway Administration	John M. Mason, Jr. Pennsylvania State University
Thomas R. Bohuslav Texas Department of Transportation	Larry Velasquez New Mexico Department of Transportation
Donn E. Hancher University of Kentucky	Paul T. Wells New York State Department of Transportation
Dwight Horne Federal Highway Administration	<i>Liaisons</i>
Ysela Llort Florida Department of Transportation	William Zaccagnino Federal Highway Administration
Wesley S.C. Lum California Department of Transportation	Mark R. Norman Transportation Research Board

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://trb.org/bookstore>. All reports from No. 295 on (and some selected others) are available as online publications (<http://www4.trb.org/trb/onlinepubs.nsf> “Cooperative Research Programs”).

### Index of Topic Subjects

Table 5 is an index to published syntheses, unpublished studies, and digests and topics under study, as well as those expected to be started through 2004.

### Conduct of the Studies

Following the project committee’s selection of topics, studies are initiated in the order of priority as-

signed 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 NCHRP Project Committee SP20-5 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	13.	Radio Spectrum Frequency Management (1972) 32 pp., \$2.80
2.	Bridge Approach Design and Construction Practices (1969) 30 pp. (microfiche)*	14.	Skid Resistance (1972) 66 pp. (microfiche)*
3.	Traffic-Safe and Hydraulically Efficient Drainage Practice (1969) 38 pp. (microfiche)*	15.	Statewide Transportation Planning—Needs and Requirements (1973) 41 pp. (microfiche)* (superseded by Synthesis 95)
4.	Concrete Bridge Deck Durability (1970) 28 pp. (microfiche)* (supplemented by Synthesis 57)	16.	Continuously Reinforced Concrete Pavement (1973) 23 pp., \$2.80
5.	Scour at Bridge Waterways (1970) 37 pp. (microfiche)*	17.	Pavement Traffic Marking—Materials and Application Affecting Serviceability (1973) 44 pp., \$3.60 (superseded by Synthesis 138)
6.	Principles of Project Scheduling and Monitoring (1970) 43 pp. (microfiche)*	18.	Erosion Control on Highway Construction (1973) 52 pp. (microfiche)*
7.	Motorist Aid Systems (1971) 28 pp., \$2.40	19.	Design, Construction, and Maintenance of PCC Pavement Joints (1973) 40 pp. (out of print)
8.	Construction of Embankments (1971) 38 pp. (microfiche)*	20.	Rest Areas (1973) 38 pp., \$3.60
9.	Pavement Rehabilitation—Materials and Techniques (1972) 41 pp. (out of print)	21.	Highway Location Reference Methods (1974) 30 pp., \$3.20
10.	Recruiting, Training, and Retaining Maintenance and Equipment Personnel (1972) 35 pp. (microfiche)*	22.	Maintenance Management of Traffic Signal Equipment and Systems (1974) 41 pp. (microfiche)* (superseded by Synthesis 114)
11.	Development of Management Capability (1972) 50 pp. (out of print)	23.	Getting Research Findings Into Practice (1974) 24 pp., \$3.20
12.	Telecommunications Systems for Highway Administration and Operations (1972) 39 pp., \$2.80 (superseded by Synthesis 165)	24.	Minimizing Deicing Chemical Use (1974) 58 pp. (microfiche)*

**Table 4** (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
25.	Reconditioning High-Volume Freeways in Urban Areas (1974) 56 pp., \$4.00	48.	Priority Programming and Project Selection (1978) 31 pp. (out of print)
26.	Roadway Design in Seasonal Frost Areas (1975) 104 pp. (microfiche)*	49.	Open-Graded Friction Courses for Highways (1978) 50 pp., \$4.00
27.	PCC Pavements for Low-Volume Roads and City Streets (1975) 31 pp. (microfiche)*	50.	Durability of Drainage Pipe (1978) 37 pp. (microfiche)*
28.	Partial-Lane Pavement Widening (1975) 30 pp., \$3.20	51.	Construction Contract Staffing (1978) 62 pp., \$6.00
29.	Treatment of Soft Foundations for Embankments (1975) 25 pp., \$3.20 (supplemented by Synthesis 147)	52.	Management and Selection Systems for Highway Maintenance Equipment (1978) 17 pp., \$4.40
30.	Bituminous Emulsions for Highway Pavements (1975) 76 pp. (microfiche)*	53.	Precast Concrete Elements for Transportation Facilities (1978) 48 pp., \$5.60
31.	Highway Tunnel Operations (1975) 29 pp., \$3.20	54.	Recycling Materials for Highways (1978) 53 pp. (microfiche)*
32.	Effects of Studded Tires (1975) 46 pp., \$4.00	55.	Storage and Retrieval Systems for Highway and Transportation Data (1978) 30 pp., \$4.80
33.	Acquisition and Use of Geotechnical Information (1976) 40 pp., \$4.00	56.	Joint Related Distress in PCC Pavement—Cause, Prevention, and Rehabilitation (1979) 36 pp., \$5.20
34.	Policies for Accommodation of Utilities on Highway Rights of Way (1976) 22 pp. (microfiche)*	57.	Durability of Concrete Bridge Decks (1979) 61 pp. (microfiche)* (supplements Synthesis 4)
35.	Design and Control of Freeway Off-Ramp Terminals (1976) 61 pp., \$4.40	58.	Consequences of Deferred Maintenance (1979) 24 pp., \$4.40
36.	Instrumentation and Equipment for Testing Highway Materials, Products, and Performance (1976) 70 pp., \$4.80	59.	Relationship of Asphalt Cement Properties to Pavement Durability (1979) 43 pp., \$5.60
37.	Lime-Fly Ash-Stabilized Bases and Subbases (1976) 66 pp. (microfiche)*	60.	Failure and Repair of Continuously Reinforced Concrete Pavement (1979) 42 pp., \$5.60
38.	Statistically Oriented End-Result Specifications (1976) 40 pp., \$4.00	61.	Changeable Message Signs (1979) 37 pp., \$5.60
39.	Transportation Requirements for the Handicapped, Elderly, and Economically Disadvantaged (1976) 54 pp. (out of print)	62.	Potential State Resources for Financing Transportation Programs (1979) 34 pp., \$5.20
40.	Staffing and Management for Social, Economic, and Environmental Impact Assessments (1977) 43 pp., \$4.00	63.	Design and Use of Highway Shoulders (1979) 26 pp., \$4.80
41.	Bridge Bearings (1977) 62 pp. (microfiche)*	64.	Bituminous Patching Mixtures (1979) 26 pp., \$4.80
42.	Design of Pile Foundations (1977) 68 pp., \$4.80	65.	Quality Assurance (1979) 42 pp., \$5.60
43.	Energy Effects, Efficiencies, and Prospects for Various Modes of Transportation (1977) 57 pp., \$4.80 (supplemented by Synthesis 121)	66.	Glare Screen Guidelines (1979) 17 pp., \$4.40
44.	Consolidation of Concrete for Pavements, Bridge Decks, and Overlays (1977) 61 pp., \$4.80	67.	Bridge Drainage Systems (1979) 44 pp., \$5.60
45.	Rapid-Setting Materials for Patching of Concrete (1977) 13 pp. (out of print)	68.	Motor Vehicle Size and Weight Regulation, Enforcement, and Permit Operations (1980) 45 pp., \$6.00
46.	Recording and Reporting Methods for Highway Maintenance Expenditures (1977) 35 pp., \$3.60	69.	Bus Route and Schedule Planning Guidelines (1980) 99 pp., \$8.00
47.	Effect of Weather on Highway Construction (1978) 29 pp., \$3.20	70.	Design of Sedimentation Basins (1980) 53 pp., \$6.80
		71.	Direction Finding from Arterials to Destinations (1980) 50 pp., \$6.40
		72.	Transportation Needs Studies and Financial Constraints (1980) 54 pp., \$6.40
		73.	Alternative Work Schedules: Impacts on Transportation (1980) 54 pp., \$6.80



**Table 4** (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
74.	State Transit-Management Assistance to Local Communities (1980) 34 pp., \$6.00	100.	Managing State Highway Finance (1982) 23 pp., \$6.40
75.	Transit Boards—Composition, Roles, and Procedures (1981) 24 pp., \$6.20	101.	Historic Bridges—Criteria for Decision Making (1983) 77 pp., \$8.00
76.	Collection and Use of Pavement Condition Data (1981) 74 pp., \$8.00	102.	Material Certification and Material-Certification Effectiveness (1983) 17 pp., \$6.00
77.	Evaluation of Pavement Maintenance Strategies (1981) 56 pp., \$7.40	103.	Risk Assessment Processes for Hazardous Materials Transportation (1983) 26 pp., \$6.40
78.	Value Engineering in Preconstruction and Construction (1981) 23 pp., \$6.40	104.	Criteria for Use of Asphalt Friction Surfaces (1983) 41 pp., \$6.80
79.	Contract Time Determination (1981) 45 pp., \$7.20	105.	Construction Contract Claims: Causes and Methods of Settlement (1983) 58 pp., \$7.20
80.	Formulating and Justifying Highway Maintenance Budgets (1981) 49 pp., \$7.20	106.	Practical Guidelines for Minimizing Tort Liability (1983) 40 pp., \$6.80
81.	Experiences in Transportation System Management (1981) 88 pp., \$8.40	107.	Shallow Foundations for Highway Structures (1983) 38 pp., \$6.80
82.	Criteria for Evaluation of Truck Weight Enforcement Programs (1981) 74 pp., \$7.20	108.	Bridge Weight-Limit Posting Practices (1984) 30 pp., \$6.40
83.	Bus Transit Accessibility for the Handicapped in Urban Areas (1981) 73 pp., \$7.60	109.	Highway Uses of Epoxy with Concrete (1984) 68 pp., \$8.80
84.	Evaluation Criteria and Priority Setting for State Highway Programs (1981) 32 pp., \$6.40	110.	Maintenance Management Systems (1984) 49 pp., \$8.00
85.	Energy Involved in Construction Materials and Procedures (1981) 34 pp., \$6.40	111.	Distribution of Wheel Loads on Highway Bridges (1984) 22 pp., \$7.20
86.	Effects of Traffic-Induced Vibrations on Bridge Deck Repairs (1981) 40 pp., \$6.80	112.	Cost Effectiveness of Hot-Dip Galvanizing for Exposed Steel (1984) 28 pp., \$7.20
87.	Highway Noise Barriers (1981) 81 pp., \$7.20	113.	Administration of Research, Development, and Implementation Activities in Highway Agencies (1984) 49 pp., \$8.00
88.	Underwater Inspection and Repair of Bridge Substructures (1981) 77 pp., \$7.60	114.	Management of Traffic Signal Maintenance (1984) 134 pp., \$10.80 (supersedes Synthesis 22)
89.	Geotechnical Instrumentation for Monitoring Field Performance (1982) 46 pp., \$6.80	115.	Reducing Construction Conflicts between Highways and Utilities (1984) 73 pp., \$8.80
90.	New Product Evaluation Procedures (1982) 34 pp., \$6.80	116.	Asphalt Overlay Design Procedures (1984) 66 pp., \$8.40
91.	Highway Accident Analysis Systems (1982) 69 pp., \$7.60	117.	Toll Highway Financing (1984) 29 pp., \$7.20
92.	Minimizing Reflection Cracking of Pavement Overlays (1982) 38 pp., \$6.80	118.	Detecting Defects and Deterioration in Highway Structures (1985) 52 pp., \$8.00
93.	Coordination of Transportation System Management and Land Use Management (1982) 38 pp., \$6.80	119.	Prefabricated Bridge Elements and Systems (1985) 75 pp., \$8.80
94.	Photologging (1982) 38 pp., \$6.80	120.	Professional Resource Management and Forecasting (1985) 15 pp., \$6.80
95.	Statewide Transportation Planning (1982) 54 pp., \$7.20 (supersedes Synthesis 15)	121.	Energy Conservation in Transportation (1985) 25 pp., \$7.20 (supplements Synthesis 43)
96.	Pavement Subsurface Drainage Systems (1982) 38 pp., \$6.80	122.	Life-Cycle Cost Analysis of Pavements (1985) 136 pp., \$10.80
97.	Transit Ownership/Operation Options for Small Urban and Rural Areas (1982) 28 pp., \$6.40	123.	Bridge Designs to Reduce and Facilitate Maintenance and Repair (1985) 65 pp., \$8.40
98.	Resealing Joints and Cracks in Rigid and Flexible Pavements (1982) 62 pp., \$7.20	124.	Use of Weigh-in-Motion Systems for Data Collection and Enforcement (1986) 34 pp., \$7.60
99.	Resurfacing with Portland Cement Concrete (1982) 90 pp., \$8.40		

**Table 4** (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
125.	Maintenance Activities Accomplished by Contract (1986) 42 pp., \$8.00	150.	Technology Transfer in Selected Highway Agencies (1989) 38 pp., \$8.00
126.	Equipment for Obtaining Pavement Condition and Traffic Loading Data (1986) 118 pp., \$11.20	151.	Process for Recapitalizing Highway Transportation Systems (1989) 43 pp., \$8.00
127.	Use of Fly Ash in Concrete (1986) 66 pp., \$8.40	152.	Compaction of Asphalt Pavement (1989) 42 pp., \$8.00
128.	Methods for Identifying Hazardous Highway Elements (1986) 80 pp. (microfiche)*	153.	Evolution and Benefits of Preventive Maintenance Strategies (1989) 69 pp., \$9.00
129.	Freezing and Thawing Resistance of High-Strength Concrete (1986) 31 pp., \$7.60	154.	Recycling Portland Cement Concrete Pavements (1989) 46 pp., \$8.00
130.	Traffic Data Collection and Analysis: Methods and Procedures (1986) 58 pp., \$8.40	155.	Freeway Guide Sign Replacement: Policies and Criteria (1991) 37 pp., \$8.00
131.	Effects of Permit and Illegal Overloads on Pavements (1987) 99 pp., \$10.40	156.	Freeway Incident Management (1990) 23 pp., \$7.00
132.	System-Wide Safety Improvements: An Approach to Safety Consistency (1987) 20 pp., \$6.80	157.	Maintenance Management of Street and Highway Signs (1990) 134 pp., \$12.00
133.	Integrated Highway Information Systems (1987) 31 pp., \$7.60	158.	Wet-Pavement Safety Programs (1990) 54 pp., \$8.00
134.	D-Cracking of Concrete Pavements (1987) 34 pp., \$7.60	159.	Design and Construction of Bridge Approaches (1990) 45 pp., \$8.00
135.	Pavement Management Practices (1987) 139 pp., \$12.40	160.	Cold-Recycled Bituminous Concrete Using Bituminous Materials (1990) 105 pp., \$11.00
136.	Protective Coatings for Bridge Steel (1987) 107 pp., \$11.00	161.	Computer-Aided Design and Drafting Systems (1990) 24 pp., \$7.00
137.	Negotiating and Contracting for Professional Engineering Services (1988) 75 pp., \$9.60	162.	Signing Policies, Procedures, Practices, and Fees for Logo and Tourist-Oriented Directional Signing (1990) 41 pp., \$8.00
138.	Pavement Markings: Materials and Application for Extended Service Life (1988) 45 pp., \$8.00 (supersedes Synthesis 17)	163.	Innovative Strategies for Upgrading Personnel in State Transportation Departments (1990) 35 pp., \$7.00
139.	Pedestrians and Traffic Control Measures (1988) 75 pp., \$9.00	164.	Measures to Curtail State Fuel Tax Evasion (1990) 14 pp., \$7.00
140.	Durability of Prestressed Concrete Highway Structures (1988) 65 pp., \$9.00	165.	Transportation Telecommunications (1990) 92 pp., \$10.00 (supersedes Synthesis 12)
141.	Bridge Deck Joints (1989) 66 pp., \$9.00	166.	Traffic Signal Control Equipment: State of the Art (1990) 43 pp., \$8.00
142.	Methods of Cost-Effectiveness Analysis for Highway Projects (1988) 22 pp., \$7.00	167.	Measurements, Specifications, and Achievement of Smoothness for Pavement Construction (1990) 34 pp., \$8.00
143.	Uniformity Efforts in Oversize/Overweight Permits (1988) 79 pp., \$10.00	168.	Contract Management Systems (1990) 74 pp., \$10.00
144.	Breaking/Cracking and Sealing Concrete Pavements (1989) 39 pp., \$8.00	169.	Removing Concrete from Bridges (1991) 42 pp., \$8.00
145.	Staffing Considerations in Construction Engineering Management (1989) 42 pp., \$8.00	170.	Managing Urban Freeway Maintenance (1990) 32 pp., \$7.00
146.	Use of Consultants for Construction Engineering and Inspection (1989) 64 pp., \$9.00	171.	Fabrics in Asphalt Overlays and Pavement Maintenance (1991) 72 pp., \$9.00
147.	Treatment of Problem Foundations for Highway Embankments (1989) 72 pp., \$9.00	172.	Signal Timing Improvement Practices (1992) 88 pp., \$11.00
148.	Indicators of Quality in Maintenance (1989) 114 pp., \$11.00	173.	Short-Term Responsive Maintenance Systems (1991) 43 pp., \$9.00
149.	Partnerships for Innovation: Private Sector Contributions to Innovation in the Highway Industry (1989) 45 pp., \$8.00		

**Table 4** (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
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
184.	Disposal of Roadside Litter Mixtures (1993) 52 pp., \$12.00	209.	Sealers for Portland Cement Concrete Highway Facilities (1994) 85 pp., \$19.00
185.	Preferential Lane Treatments for High-Occupancy Vehicles (1993) 80 pp., \$10.00	210.	Road Pricing for Congestion Management: A Survey of International Practice (1994) 77 pp., \$19.00
186.	Supplemental Advance Warnings (1993) 83 pp., \$19.00	211.	Design, Construction, and Maintenance of PCC Pavement Joints (1995) 50 pp., \$12.00
187.	Rapid Test Methods for Asphalt Concrete and Portland Cement Concrete (1993) 47 pp., \$10.00	212.	Performance-Related Specifications for Highway Construction and Rehabilitation (1995) 48 pp., \$14.00
188.	Management Training and Development Programs (1993) 56 pp., \$15.00	213.	Effective Use of Park-and-Ride Facilities (1995) 45 pp., \$11.00
189.	State Highway Pavement Design Practices (1993) 45 pp., \$11.00	214.	Resolution of Disputes to Avoid Construction Claims (1995) 39 pp., \$13.00
190.	Criteria for Qualifying Contractors for Bidding Purposes (1994) 40 pp., \$11.00	215.	Determination of Contract Time for Highway Construction Projects (1995) 43 pp., \$11.00
191.	Use of Rumble Strips to Enhance Safety (1993) 74 pp., \$19.00	216.	Implementation of Technology From Abroad (1995) 44 pp., \$11.00
192.	Accident Data Quality (1993) 53 pp., \$12.00	217.	Consideration of the 15 Factors in the Metropolitan Planning Process (1995) 55 pp., \$14.00
193.	Hot In-Place Recycling of Asphalt Concrete (1994) 69 pp., \$16.00	218.	Mitigation of Nighttime Construction Noise, Vibrations, and Other Nuisances (1999) 93 pp., \$30.00
194.	Electronic Toll and Traffic Management (ETTM) Systems (1993) 64 pp., \$15.00	219.	Photographic Enforcement of Traffic Laws (1995) 67 pp., \$18.00
195.	Use of Warranties in Road Construction (1994) 60 pp., \$15.00	220.	Waterproofing Membranes for Concrete Bridge Decks (1995) 76 pp., \$21.00
196.	Highway Maintenance Procedures Dealing with Hazardous Materials Incidents (1994) 60 pp., \$15.00	221.	Effects of Highway Widening Improvements on Urban and Suburban Areas (1996) 43 pp., \$13.00
197.	Corridor Preservation (1994) 43 pp., \$11.00		
198.	Uses of Recycled Rubber Tires in Highways (1994) 162 pp., \$23.00		



**Table 4** (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
222.	Pavement Management Methodologies to Select Projects and Recommend Preservation Treatments (1995) 96 pp., \$22.00	247.	Stabilization of Existing Subgrades During Interstate Pavement Reconstruction to Improve Constructibility (1997) 75 pp., \$20.00
223.	Cost-Effective Preventive Maintenance of Pavements (1996) 103 pp., \$22.00	248.	Evaluating and Measuring the Effectiveness of Training (1997) 28 pp., \$15.00
224.	Longitudinal Occupancy of Controlled Access Right-of-Way by Utilities (1996) 30 pp., \$13.00	249.	Methods of Increasing Live Load Capacity of Bridges (1997) 66 pp., \$21.00
225.	Left-Turn Treatments at Intersections (1996) 87 pp., \$22.00	250.	Highway-Rail Crossing Surfaces (1997) 56 pp., \$20.00
226.	Remediation of Petroleum-Contaminated Soils (1996) 88 pp., \$22.00	251.	Lead-Based Paint Removal for Steel Highway Bridges (1997) 115 pp., \$26.00
227.	Collecting and Managing Cost Data for Bridge Management Systems (1996) 49 pp., \$15.00	252.	Response of Small Urbanized Area MPOs to ISTEA (1997) 35 pp., \$15.00
228.	Reduced Visibility on the Highway (1996) 51 pp., \$15.00	253.	Dynamic Effects of Pile Installations on Adjacent Structures (1997) 86 pp., \$24.00
229.	Applications of 3D and 4D Visualization Technology in Transportation (1996) 73 pp., \$19.00	254.	Service Life of Drainage Pipe (1998) 39 pp., \$15.00
230.	Freight Transportation Planning Practices in the Public Sector (1996) 47 pp., \$15.00	255.	GPR for Evaluating Subsurface Conditions for Transportation Facilities (1998) 37 pp., \$16.00
231.	Managing Contract Research Programs (1996) 92 pp., \$23.00	256.	Submittal of Bid Proposals in Electronic Format (1998) 26 pp., \$15.00
232.	Variability in Highway Pavement Construction (1996) 38 pp., \$14.00	257.	Maintenance Issues and Alternate Corrosion Protection Methods for Exposed Bridge Steel (1998) 90 pp., \$25.00
233.	Land Development Regulations that Promote Access Management (1996) 45 pp., \$14.00	258.	Applications of GPS for Surveying and Other Positioning Needs in Departments of Transportation (1998) 46 pp., \$17.00
234.	Settlement of Bridge Approaches (The Bump at the End of the Bridge) (1997) 75 pp., \$24.00	259.	Management of Surface Transportation Systems (1998) 26 pp., \$15.00
235.	Application of Full-Scale Accelerated Pavement Testing (1997) 110 pp., \$23.00	260.	Thin-Surfaced Pavements (1998) 112 pp., \$26.00
236.	Methods for Household Travel Surveys (1997) 57 pp., \$15.00	261.	Criteria for Highway Routing of Hazardous Materials (1998) 38 pp., \$16.00
237.	Changeable Message Signs (1997) 57 pp., \$19.00	262.	Tolling Practices for Highway Facilities (1998) 54 pp., \$23.00
238.	Performance Measurement in State DOTs (1997) 69 pp., \$20.00	263.	State DOT Management Techniques for Construction and Materials Acceptance (1998) 51 pp., \$23.00
239.	Pavement Subsurface Drainage Systems (1997) 44 pp., \$15.00	264.	Modern Roundabout Practice in the United States (1998) 73 pp., \$23.00 (Available on the Internet only)
240.	Toll Plaza Design (1997) 117 pp., \$25.00	265.	Managing Product Liability to Achieve Highway Innovations (1998) 63 pp., \$25.00
241.	Truck Operating Characteristics (1997) 66 pp., \$19.00	266.	Dynamic Impact Factors for Bridges (1998) 60 pp., \$25.00
242.	Trenchless Installation of Conduits Beneath Roadways (1997) 77 pp., \$23.00	267.	Transportation Development Process (1998) 48 pp., \$24.00
243.	Methods for Capital Programming and Project Scheduling (1997) 85 pp., \$23.00	268.	Relationships Between Pavement Surface Texture and Highway Traffic Noise (1998) 85 pp., \$29.00
244.	Guardrail and Median Barrier Crashworthiness (1997) 160 pp., \$27.00	269.	Road User and Mitigation Costs in Highway Pavement Projects (1998) 47 pp., \$24.00
245.	Traffic Signal Control Systems Maintenance Management Practices (1997) 63 pp., \$19.00		
246.	Outsourcing of State Highway Facilities and Services (1997) 69 pp., \$20.00		

**Table 4** (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
270.	Transportation Management Center Functions (1998) 69 pp., \$27.00	293.	Reducing and Mitigating the Impacts of Lane Occupancy During Construction and Maintenance (2000) 60 pp., \$27.00
271.	Traffic Signal Operations Near Highway-Rail Grade Crossings (1999) 90 pp., \$30.00	294.	Configuration Management in Transportation Management Systems (2001) 44 pp., \$23.00
272.	Best Management Practices for Environmental Issues Related to Highway Street Maintenance (1999) 103 pp., \$30.00	295.	Statistical Methods in Highway Safety Analysis (2001) 75 pp., \$29.00
273.	Project Development Methodologies for Reconstruction of Urban Freeway and Expressways (1999) 45 pp., \$22.00	296.	Impact of New Information/Communications Technology on Transportation Agencies (2001) 57 pp., \$28.00
274.	Methods to Achieve Rut-Resistant Durable Pavements (1999) 61 pp., \$26.00	297.	Building Effective Relationships Between Central Cities and Regional, State, and Federal Agencies (2001) 69 pp., \$29.00
275.	Historic Highway Bridge Preservation Practices (1999) 61 pp., \$27.00	298.	Truck Trip Generation Data (2001) 81 pp., \$32.00
276.	Geotechnical Related Development and Implementation of Load and Resistance Factor Design (LRFD) Methods (1999) 69 pp., \$27.00	299.	Recent Geometric Design Research for Improved Safety and Operations (2001) 134 pp., \$40.00
277.	Consultants for DOT Preconstruction Engineering Work (1999) 116 pp., \$31.00	300.	Performance Measures for Research, Development, and Technology Programs (2001) 97 pp., \$33.00
278.	Measuring In Situ Mechanical Properties of Pavement Subgrade Soils (1999) 73 pp., \$27.00	301.	Collecting, Processing, and Integrating GPS Data into GIS (2002) 65 pp., \$15.00
279.	Roadway Incident Diversion Practices (1999) 84 pp., \$29.00	302.	Mitigation of Ecological Impacts (2002) 100 pp., \$17.00
280.	Seven Keys to Building a Robust Research Program (1999) 64 pp., \$26.00	303.	Assessment and Rehabilitation of Existing Culverts (2002) 74 pp., \$15.00
281.	Operational Impacts of Median Width on Larger Vehicles (2000) 68 pp., \$28.00	304.	Driveway Regulation Practices (2002) 77 pp., \$16.00
282.	Project Management Information Systems (2000) 37 pp., \$22.00	305.	Interaction Between Roadways and Wildlife Ecology (2002) 78 pp., \$16.00
283.	Fleet Management and Selection Systems for Highway Maintenance Equipment (2000) 33 pp., \$22.00	306.	Long-Term Pavement Marking Practices (2002) 154 pp., \$19.00
284.	Performance Survey on Open-Graded Friction Course Mixes (2000) 38 pp., \$22.00	307.	Systems Engineering Processes for Developing Traffic Signal Systems (2003) 87 pp., \$17.00
285.	Maintenance of Highway Edgedrains (2000) 62 pp., \$27.00	308.	Owner Controlled Insurance Programs (2002) 133 pp., \$19.00
286.	Multimodal Aspects of Statewide Transportation Planning (2000) 58 pp., \$27.00	309.	Transportation Planning and Management for Special Events (2003) 71 pp., \$16.00
287.	Sleep Deprivation Countermeasures for Motorist Safety (2000) 92 pp., \$31.00	310.	Impact of Red Light Camera Enforcement on Crash Experience (2003) 57 pp., \$15.00
288.	Data Sharing and Data Partnerships for Highways (2000) 31 pp., \$22.00	311.	Performance Measures of Operational Effectiveness for Highway Segments and Systems (2003) 59 pp., \$15.00
289.	Corridor Management (2000) 58 pp., \$27.00	312.	Facilitating Partnerships in Transportation Research (2003) 76 pp., \$16.00
290.	Procedures for Assessing Economic Development Impacts from Transportation Investments (2000) 75 pp., \$28.00	313.	State DOT Outsourcing and Private-Sector Utilization (2003) 42 pp., \$14.00
291.	Evaluation of Pavement Friction Characteristics (2000) 66 pp., \$28.00	314.	Strategies for Managing Increasing Truck Traffic (2003) 83 pp., \$16.00
292.	Innovative Practices to Reduce Delivery Time for Right-of-Way in Project Development (2000) 73 pp., \$28.00	315.	Compensation for Contractor's Home Office Overhead (2003) 47 pp., \$15.00

**Table 4** (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
316.	Design Exception Practices (2003) 82 pp., \$16.00	333.	Concrete Bridge Deck Performance (2004) 101 pp., \$18.00
317.	Dealing with Truck Parking Demands (2003) 37 pp., \$14.00	334.	Automated Pavement Distress Collection Techniques (2004) 84 pp., \$17.00
318.	Safe and Quick Clearance of Traffic Incidents (2003) 143 pp., \$19.00	335.	Pavement Management Applications Using Geographic Information Systems (2004) 65 pp. \$16.00
319.	Bridge Deck Joint Performance (2003) 46 pp., \$15.00	336.	Road Safety Audits (2004) 127 pp., \$18.00
320.	Integrating Freight Facilities and Operations with Community Goals (2003) 58 pp., \$15.00	337.	Cooperative Agreements for Corridor Management (2004) In Press
321.	Roadway Safety Tools for Local Agencies (2003) 134 pp., \$20.00	338.	Thin and Ultra-Thin Whitetopping (2004) In Press
322.	Safety Management Systems (2003) 42 pp., \$14.00	339.	Centerline Rumble Strips on Rural Roads (2004) In Press
323.	Recruiting and Retaining Individuals in Transportation Agencies (2003) 59 pp., \$15.00	340.	Integrated Roadside Vegetation Management (2004) In Press
324.	Prefabricated Bridge Elements and Systems to Limit Traffic Disruption During Construction (2004) 48 pp., \$15.00	341.	Effective Construction Management of Disadvantaged Business Enterprise Issues (2004) In Press
325.	Significant Findings from Full-Scale Accelerated Pavement Testing (2004) 201 pp., \$23.00	342.	Convertible Roadways and Lanes (2004) In Press
326.	Strategic Planning and Decision Making in State Departments of Transportation (2004) 62 pp., \$16.00	<u>Research Results Digests (RRD)</u>	
327.	Cost-Effective Practices for Off-System and Local Interest Bridges (2004) 130 pp., \$20.00	100.	Safe Conduct of Traffic Through Highway Construction and Maintenance Zones (1978) 5 pp., \$1.00
328.	State Product Evaluation Programs (2004) 35 pp., \$15.00	106.	Use of Waste Materials in Highway Construction and Maintenance (1979) 2 pp., \$1.00
329.	Integrating Tourism and Recreation Travel with Transportation Planning and Project Delivery (2004) 53 pp., \$15.00	210.	Effects of Highway Bypasses on Rural Communities and Small Urban Areas (1996) 22 pp., \$13.00
330.	Public Benefits of Highway System Maintenance and Operations (2004) 45 pp., \$15.00	274.	Quality Assurance of Structural Materials (2003) 21 pp., \$10.00
331.	State Highway Program Letting Management (2004) 47 pp., \$15.00	<u>Unpublished Reports (UR)</u>	
332.	Access Management on Crossroads in the Vicinity of Interchanges (2004) 82 pp., \$17.00	Topic 24-07	Pavement Markings (1997)
		Topic 24-10	Asphalt Surface Treatments and Thin Overlays (1997)

\*These syntheses are available from TRB in microfiche form only at a cost of \$10.00 each.

**Table 5** INDEX TO SYNTHESSES AND STUDIES

Accelerated pavement testing 235, 325	- dynamic impact factors 266 - expansion devices 141, 319 - foundations 42, 107, 253 - galvanizing 112, 257 - historic 101, 275, 327 - increasing live loads, existing 249 - inspection 88, 118 - local interest 327 - maintenance 227, 257, 327 - management systems 227 - membranes 220 - off-system 327 - paint removal 176, 251 - painting 136 - patching 45 - posting practices 108 - precast concrete 53, 119, 324 - prefabricated 53, 119 - prestressed, durability 140 - rehabilitation 327, 333 - scour 5, 200 - structural components RRD 274 - substructure repair 88, 200 - wheel load distribution 111	- resurfacing 204 - sealers 209 - water reducers 129
Access management 233, 304, 332, 337		Conduits - trenchless installation 242
Accident data 91, 192		Consolidation of concrete 44
Accident location 21, 91, 128, 202		Construction
Advance warnings 186		- acceptance 263 - bases and subbases 37 - bidding qualifications 190 - bituminous pavements 30 - bridge approaches 2, 159, 234 - bridge decks 4, 44, 57, 86 - concrete pavements 16, 19, 27, 44, 144, 204, 211 - consultants 146 - contract claims 105, 214 - contract time 79, 215 - embankments 8 - energy factors 85 - engineering 145, 146 - erosion control 18 - insurance 308 - lane occupancy 293 - management 51, 145 - material certification 102, 263 - pavements 16, 19, 27, 30, 44, 144, 152, 167, 204, 211 - quality assurance 38, 65, 212, 232, 263 - recycling 54, 154, 193 - specifications 38, 212, 263 - staffing 51, 145 - subgrades 247 - testing 36, 65, 187 - traffic control 208, RRD 100 - trenchless, conduits 242 - utilities 115, 224 - value engineering 78 - variability 232 - warranties 195 - weather 47
Aid to motorists 7		Consultants - construction engineering 146 - DOT design 277 - negotiating for services 137
Artificial intelligence 183		Contaminated soils 226
Asphalt		Continuously reinforced pavements 16, 60, 204, 211
- cement 59		Contracting
- compaction 152		- bidding qualifications 190 - claims 105, 214 - Disadvantaged Business Enterprise 341
- emulsions 30, UR24-10		
- friction courses 49, 104, 180, 284		
- moisture damage 175		
- overlays 116, UR24-10		
- patching 64		
- pavements 30, 49, 59, 104, 152, 171, 175, 180, 260, 338		
- recycling 54, 160, 193		
- rut resistant 274		
- surface treatments 223		
Attenuators 182		
Automatic vehicle identification (AVI) 194	Bus transit planning 69 Bypasses, impacts of RRD 210	
	Capital programming 243 Changeable message signs 61, 237 Communications 7, 12, 13, 71, 165, 296 Compensation, 315 Computer-aided design 161 Computers 55 Concrete	
Bases 37	- admixtures 127, 129 - bridge decks 4, 57, 86, 169, 333 - consolidation 44 - dry-cast 129 - durability 4, 57, 129, 140 - epoxies 109 - fly ash in 127, 199 - freezing and thawing 129 - latex-modified 179 - overlays 99, 204, 338 - patching 45 - pavement recycling 54, 154 - pavements 16, 19, 27, 45, 56, 60, 98, 99, 134, 144, 204, 211 - precast 53 - rapid test methods 187 - repair preparation 169	
Bearings for bridges 41		
Bidding		
- qualifications 190		
- electronic 256		
Bituminous		
- emulsions 30		
- patching 64		
- pavements (see Asphalt)		
Bridges		
- approaches 2, 159, 234		
- bearings 41		
- below-water inspection 88		
- below-water maintenance 200		
- below-water repair 88, 200		
- concrete decks 4, 57, 86, 209, 220, 333		
- construction 44, 53, 324		
- corrosion protection 257		
- deck joints 141, 319		
- deck removal 169		
- deck sealers 209		
- design for maintenance 123		
- drainage 67		
- durability 4, 57, 86, 118, 140		



**Table 5** (Continued)

- maintenance 125, 246	Drainage	- off-ramps 35
- management 168	- bridge 67	- project development 273
- overhead 315	- culverts 303	- reconstruction 273
- research 231	- pavement 96, 174, 239	- repair 25
- time determination 79, 215	- pipe durability 50, 254	Freight 230, 320
Convertible roadways 342	- sedimentation basins 70	Friction courses 49, 104, 180, 284
Corridor management plans 289, 337	- structures 3, 174	Frost susceptibility 26
Corridor preservation 197	Driveway regulations 304	Fuel taxes 62, 164
Cost-effectiveness analysis 142, 223	Ecology 302	Galvanizing 112, 257
Costs	Economic benefits 290	Geographic information systems
- life-cycle 122, 222, 269	Edgedrains, maintenance 285	301, 335
- user and mitigation, 269	Elderly, transportation for 39, 83	Geotechnical
Crash cushions 182, 205	Electronic bids 256	- data 33
Cross sections 299	Electronic toll and traffic manage-	- exploration 33
Culverts	ment systems 194	- In situ strength measurement 278
- assessment and rehabilitation 303	Embankments 8, 234	- instrumentation 89, 253
- durability 50, 254	Employees (see Personnel)	- load and resistance factor
- inlets 3	Emulsions 30	design 276
Data	End result specifications 38, 212	- pile foundation vibrations 253
- collection 124, 126, 130, 334, 335	Energy	Glare screen 66
- partnerships 288	- bituminous emulsions 30	Grade crossings 250, 271
- sharing 288, 312	- construction 85	GPS satellite positioning 258, 301
- storage 335	- transportation use 43, 121	Ground penetrating radar 255
- systems 55	Environmental issues, highway	Guaranty of construction 195
DBE 341	maintenance 272, 305, 340	Guardrails 244
D-cracking 134	Epoxies 109, 333	Handicapped, transportation for
Deferred maintenance 58, 223	Equipment	39, 83
Deicing chemical use 24, 207	- accident removal 318	Hazardous materials transportation
Design	- for pavement data 126	- impacts on maintenance 196
- bituminous pavements 30,	- for testing 36	- risk assessment 103
116, 260	- for traffic control 166, 270	- routing criteria 261
- bridge approaches 2, 159, 234	- management of 52, 245, 283	High-occupancy vehicles
- bridge bearings 41	- procurement of 52	(HOV) 185
- computer-aided 161	- selection of 52, 283	Highway-railroad grade crossings
- concrete pavements 16, 19, 27,	Expansion devices for bridges	250, 271
189, 211	141, 319	Historic bridges 101, 275
- crossroads 332	Expert systems 183	Ice control operations 207
- exceptions 316	Fabrics for pavements 171	Impacts, economic
- for bridge maintenance 123	Field testing equipment 36, 126	- development 290
- frost 26	Finance/budgets 62, 72, 80, 100,	- lane occupancy 293
- geometric research 299	117, 151, 243	Incident clearance 318
- pavement overlays 99, 116, 204	Fly ash 37, 127, 333	Incident management 156, 270, 318
- pavements 16, 19, 26, 27, 30,	Fog 228	Information for motorists 7, 71, 162,
189, 211, 260, 291	Foundations	237, 309
- pile foundations 42, 253	- embankments 8, 29, 147, 234	Information systems 133, 296
- roadways 26, 247	- pile 42, 253	Innovation by private industry
- shoulders 63	- shallow 107	149, 265
- toll plaza 240	- soft strata 29, 147	Inspection by consultants 146, 263
- use of consultants 277	Freeways	Inspection of bridges 88
- value engineering 78	- corridor management 177	Instrumentation 36, 235
Direction finding 71	- incident management 156, 318	
Disadvantaged Business Enterprise 341	- maintenance 1, 25, 170	
Disadvantaged, transportation for 39		

**Table 5** (Continued)

Instrumentation, geotechnical 89, 253	- preventive, value of 153, 223	Mitigation
Insurance 308	- public benefits 341	- ecology 302
Interchanges 299, 332	- quality assurance 148	- lane occupancy 293
Intermodal Facilities w/Freight 320	- records 46	Modeling, 3D and 4D 229
Intersections 299, 310	- recycling 54, 193	Monitoring of projects 6, 263, 282
ISTEA	- reporting 46	Motorist aid systems 7
- 15 factors 217	- rest areas 20, 246	Motorist information 71, 162,
- small MPOs 252	- scheduling 170	237, 329
Joints, bridge deck 141, 319	- signs 155, 157	Multimodal transportation 201, 286
Joints, concrete pavement 19, 56,	- snow and ice 24, 207	
98, 134, 211	- traffic control 1, 25, RRD	Needs studies 72, 151
Joints and cracks, sealing 98	100, 208	New-product evaluation 90,
Laboratory testing equipment 36	- traffic signals 22, 114, 245	150, 265
Land development 233	- training 10	Noise barriers 87, 181
Land use 93, 233, 320, 337	- tunnels 31	Noise characteristics of
Latex-modified concrete 179	- winter 24, 207	pavements 268
Left-turn treatments 225	Management	Off-ramps 35
Legal liability 106, 206, 318	- construction 51, 145	Open-graded surfaces 49, 104,
Letting program 331	- contract 168	180, 284
Life-cycle costs 122, 269	- corridor plans 289, 337	Outsourcing 246, 313
Lime-fly ash 37	- data 55	Overhead 315
Litter disposal 184	- freeway corridor 177	Overlays 9, 49, 92, 99, 104, 116,
Load and resistance factor design	- freeway incidents 156	144, 204, 338
(geotechnical) 276	- letting program 331	Overload effects 131
Location reference methods 21, 91	- maintenance 10, 22, 46, 52, 58,	Owner Controlled Insurance
Low-volume pavements 27, 260	80, 110, 170, 173, 245	Programs 308
Maintenance	- maintenance, environmental	
- bituminous pavements 30,	issues 272	Painting steel bridges 136
64, 98	- maintenance, equipment 283	Paint removal 176, 251
- bridges 88, 123, 200, 227,	- major events 309	Park-and-ride facilities 213
257, 319	- personnel 11, 120	Parking demands, truck 317
- budgets 80	- project, systems 282	Partnerships
- concrete pavements 19, 45, 56,	- research 113, 231	- research 312
60, 98, 204, 211	- risk, R-O-W 292	- public and private 313
- contract 125	- roadway information 133	Patching 9, 45, 64
- costs 58, 98, 223	- safety systems 322	Pavements
- culverts 303	- snow and ice control operations	- asphalt 30, 49, 59, 116, 152,
- deferred 58, 223	207	160, 171, 175, 180, 260, 284
- edgedrains 285	- S.E.E. assessments 40	- bases 37
- equipment 52, 283	- training 11, 188	- concrete 16, 19, 27, 44, 56, 60,
- freeways 1, 25, 170	Materials	99, 144, 204, 211
- hazardous materials impacts 196	- acceptance 263	- condition data 76, 126, 203,
- litter disposal 184	- assurances, structural RRD 274	330, 334
- management 10, 22, 46, 52, 58,	- certification 102, 263	- construction 16, 19, 27, 30,
80, 110, 157, 173, 283	- pavement marking 306	44, 211
- management systems 110, 173	- testing equipment 36, 263	- CRCP 16, 60
- pavement costs 77, 98	Median	- design 189, 260, 291
- pavement joints 19, 56, 98,	- barriers 244	- distress 9, 334
134, 211	- glare screen 66	- drainage 96, 239
- pavements 9, 19, 25, 30, 45, 56,	- widths 281	- durability 59, 160, 274
60, 64, 98, 134	Metropolitan planning organizations	- effects of overloads 131
- personnel 10	(MPOs) 217, 252	- evaluation 76, 126, 203
	Mileposts 21	- fabrics 171

**Table 5** (Continued)

- friction 14, 158, 291	Planning	Rehabilitation
- friction courses 49, 104, 180, 284	- freight 230, 314, 320	- bridges 327
- frost design 26	- major events 309	- culverts 303
- joints 19, 56, 98, 134, 211	- MPOs 217, 252	- freeways 25
- life-cycle costs 122, 269	- multimodal evaluation 201	- pavements 9, 56, 92, 99, 134, 204, 222
- light duty 260	- personnel 120	- subgrades, stabilization 247
- low-volume 27, 260	- statewide transportation 15, 95, 286	Relationships 297
- maintenance 9, 19, 25, 30, 45, 56, 60, 64, 98, 134, 211, 223	- strategic 326	Research
- maintenance costs 77, 98, 223	- transit 69, 73	- contract 231
- management 135, 222, 335	- transportation 73, 201, 332	- implementation 23, 150
- markings 17, 138, UR24-07, 306	Poor, transportation for 39	- management 113
- moisture damage 175	Posting of bridges 108	- partnerships 312
- noise characteristics 268	Pothole repair 45, 64	- performance measures 300
- overlays 9, 92, 99, 116, 144, 204	Pozzolans 37, 127, 199	- robust programs 280
- patching 9, 45, 64	Precast concrete 53, 119, 324, 327	Rest areas 20, 287, 317
- recycling 54, 154, 160, 193	Prefabricated structural systems 119, 327	Resurfacing portland cement concrete 204
- rehabilitation 9, 25, 92, 134, 222, 335, 338	Preferential lane treatments 185	Retroreflectivity 304
- rut resistant (asphalt) 274	Preservation, historic bridges 275	Right-of-way
- sealers 209	Prestressed concrete durability 140	- clearance 292
- skid resistance 14, 158	Preventive maintenance 153, 223, 330	- utilities 34, 224
- smoothness 167	Priority programming 48, 84, 222	Risk assessment, hazardous materials 103
- striping 17, 138, 218	Private sector involvement 149, 246, 265, 313	Road pricing 210, 269
- studded tires 32	Process management 300	Roadside hazard severity 202
- subgrade stabilization 247	Professional engineering services	Roadway
- surface texture 268	- construction 146	- convertible 342
- testing 235, 291	- design 277	- information systems 133
- widening 28, 221	- negotiating 137	- incident diversion practices 279
Pedestrian traffic control 139	Programming 48, 72, 84, 151, 243	- safety tools, localities 321
Performance evaluation 306	Program quality 300	Routing, hazardous materials 261
Performance measures 238, 300, 311, 326	Project development 273, 292, 331	Rubber tire uses 198, 199
Performance-related specifications 212	Project scheduling 6, 215, 243, 282	Rumble strips 191, 339
Permit operations 68, 143	Quality assurance 38, 65, 148, 212, 232, 263, RRD 274	Safety 1, 3, 7, 14, 32, 49, 66, 91, RRD 100, 128, 132, 156, 158, 182, 186, 191, 192, 202, 205, 244, 286, 299, 306, 308, 310, 318, 321, 336, 339, 342
- driveway regulation 304	Quality control RRD 274	Safety analysis 295, 336
- effects on pavements 131	Radio communications 12, 13, 165	Safety management systems 322
Personnel	Radio frequency management 13	Scheduling of projects 6, 222, 243, 292
- bridge inspection 141	Railroad grade crossings 252, 271	Scour 5, 200
- construction engineering 51, 145	Rapid test methods 187	Sealers for PCC highway facilities 209
- maintenance 10	Reconstruction 247, 273	Sedimentation basins 18, 70
- planning for 120	Recreation travel 329	Severity indices 202
- recruiting and maintaining 323	Recycling highway materials 54, 154, 160, 193, 198, 199	Shoulders 63
- S.E.E. assessment 40	Reduced visibility 228	Signs
- training 10, 11, 163, 188, 248, 313	Reference methods 21	- advance warning 186
Photographic traffic law enforcement 219, 310	Reference posts 21, 91	- changeable message 61, 237
Photologging 94	Reflection cracking 9, 92	
Pile foundations 42, 253	Regulations, driveway 304	
Pipe durability 50, 254, 303		

**Table 5** (Continued)

- maintenance 155, 157	Testing	- economic benefits 290
- motorist information 71, 162	- construction 36, 65, 263	- elderly/handicapped 39, 83
Size regulation and enforcement	- rapid 187	- investment 290
68, 143	- soils (in-situ) 278	- management assistance 74
Skid resistance 14, 158, 291	- equipment 36, 187	- management centers 270
Sleep deprivation 286	- pavements 235, 291, 325	- ownership 97
Smoothness, pavements 167	Toll	- planning 15, 69, 72, 73, 95, 151,
Snow and ice control 24, 207	- collection 194	201, 230, 252, 331
Soft foundations 29, 147	- financing 117	- system management 81,
Soils	- plaza design 240	93, 259
- erosion 18	- practices 262	Travel surveys 236
- measuring, in-situ 278	Tort liability 106, 206, 265	Truck
- remediation of	Tourism 329	- escape ramps 178
contaminated 226	Traffic	- increasing traffic 314
Specifications 38, 65, 212, 306	- congestion 314	- operating characteristics 241
Spectrum management 13	- data collection 130	- parking demands 317
Stabilization	- incident clearance, quick 318	- trip generation 298
- bases 37	- law enforcement 219, 310	- truck weights and sizes 68, 82,
- subbases 247	- markings 17, 138, 218	124, 143
Staffing	- paint 17, 138, 218	Tunnels, maintenance and
- construction 51, 145, 263	- safety 1, 3, 32, 35, 66, RRD	operation 31
- maintenance 10	100, 202, 205, 244	Underwater bridge inspection 88
- planning for 120	Traffic control	Underwater bridge repair 88, 200
- S.E.E. assessments 40	- circles 264	Urban freeways 25, 273
Standards, travel survey 236	- configuration management 294	Utilities 34, 115, 242
- historic bridges 275	- construction RRD 100, 208	Value engineering 78
Statewide transportation planning	- convertible lanes 342	Variable message signs 61, 237
15, 95, 267, 286	- crossroads 332	Vehicle attenuators 182
Statistical methods 295	- devices 61, 166, 186, 237	Vehicles, larger 281
Statistical specifications 38, 65,	- equipment 166	Vibration from piles 253
212, 232	- left-turn treatments 225	Vibration of concrete 44
Stormwater management 174	- maintenance 1, RRD 100,	Video traffic law enforcement 219
Stream scour 5, 200	208, 245	Visibility 228
Strategic planning 326	- management centers 270	Visualization 3D and 4D 229
Striping 17, 138, 218	- management plans 294	Warranties in construction 195
Structures (see bridges)	- pedestrian 139	Waste materials RRD 106, 199
Studded tires 32	- plans 208	Waterproofing membranes for
Subbases 37	- priority lanes 185	bridge decks 220
Subgrades, stabilization 247	- ramps 35	Weather 47
Subsurface information 33, 255	- red light cameras 31	Weigh-in-motion 124
Superplasticizers for	- signal systems 245	Weight regulation and enforcement
concrete 129	- systems development 307	68, 82, 124, 143
Surface courses 49, 104, 180,	- work zones 1, RRD 100, 208	Wetland mitigation 302
UR24-07	Traffic signals	Whitetopping 338
Surveying, GPS satellite 258, 301	- equipment 166	Widening of pavements 28, 221
Systems, maintenance 283	- left turns 225	Wildlife 305
Systems, traffic control 307	- maintenance 22, 114, 245	Winter maintenance 24, 207
Taxes, fuel 62, 164	- preemption (rail) 271	Work schedules 73
Technology transfer 23, 150, 216,	- timing 172	Work zone traffic 1, RRD 100, 208
231, 280	Training of personnel 10, 11, 163,	
Telecommunications 12, 165	188, 248	
Telephones 12, 165	Transit	
	- boards 75	
	- development process 267	





These digests are issued in order to increase awareness of research results emanating from projects in the Cooperative Research Programs (CRP). Persons wanting to pursue the project subject matter in greater depth should contact the CRP Staff, Transportation Research Board of the National Academies, 500 Fifth Street, NW, Washington, DC 20001

## THE NATIONAL ACADEMIES™

*Advisers to the Nation on Science, Engineering, and Medicine*

The nation turns to the National Academies—National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council—for independent, objective advice on issues that affect people's lives worldwide.

[www.national-academies.org](http://www.national-academies.org)



### **Transportation Research Board**

500 Fifth Street, NW  
Washington, DC 20001