



Continuing Project to Synthesize Information on Highway Problems: 2010

DETAILS

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AUTHORS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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

Subject Areas: I Planning, Administration, and Environment; II Design; III Materials, Construction, and Maintenance; IV Operations and Safety; VII Rail; VIII Freight Transportation; IX Marine Transportation; X Security

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Research Results Digest 343

CONTINUING PROJECT TO SYNTHESIZE INFORMATION ON HIGHWAY PROBLEMS

A staff digest of the progress and status of NCHRP Project 20-5, "Synthesis of Information Related to Highway Problems," for which the Transportation Research Board is the agency conducting the research. Individual studies for the project are managed by Jon Williams, Program Director, Synthesis Studies, Donna L. Vlasak, Senior Program Officer, Gail Staba, Senior Program Officer, and Jo Allen Gause, Senior Program Officer, 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

Suggestions for synthesis topics may be sent to the NCHRP Manager at any time by contacting the Cooperative Research Programs Staff, Transportation Research Board, 500 Fifth Street, NW, Washington, D.C., 20001. You can also submit your recommendation at: <http://www.trb.org/SynthesisPrograms/Public/SynthesisProgram.aspx> "Suggest an ACRP, NCHRP, or TCRP Synthesis Topic." Topics suggested must be accompanied by a brief (one or two paragraphs) scope statement, including a discussion of the problem. A title (preferably 10 words or less) and the name and affiliation of the submitter are also necessary. Identification of information sources is appreciated. A committee meets once each year, usually in the late spring, to make the final selections. To be considered at the next annual meeting, all submissions should be received by February 2010. If a topic is not selected, it must be resubmitted the following year to be considered.

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

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Research Program—authorized the Transportation Research Board to undertake a 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, TRB employs a consultant to gather and analyze available information from numerous sources, including state departments of transportation. A panel of experts in the subject area is established to guide the consultants in organizing and evaluating the data collected on each topic and to review the synthesis report.

For each topic the project objectives are (1) to locate and assemble documented information; (2) to learn what practice has been used for solving or alleviating the problems; (3) to identify all ongoing

research; (4) to learn what problems remain largely unsolved; (5) to organize, evaluate, and document the useful information that is acquired; and (6) to disseminate the synthesis information to all who might benefit from it.

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

Studies in Progress and Planned for 2010

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, or by phone at 202-334-3245, Donna L. Vlasak, by e-mail at dvlasak@nas.edu, or by phone at 202-334-2974, Gail Staba, by e-mail at gstaba@nas.edu, or by phone at 202-536-5658, or Jo Allen Gause, by e-mail at jgause@nas.edu, or by phone at 202-334-3826.

Table 1 TOPICS BEING STUDIED.

No.	Title	No.	Title
39-11	Long-Term Performance of Polymer Concrete and Best Practices	40-06	Advanced Practices in Travel Forecasting
39-12	New Approaches to Ecological Surveys	40-07	Trade-off Considerations in Highway Geometric Design
39-13	Pavement Marking Warranty Specifications	40-08	Effective Speed Reduction Techniques for Rural High to Low Speed Transitions
40-01	Recycled Materials and Byproducts in Highway Applications	40-09	Freight Transportation Surveys—Existing Methods and Guidelines
40-02	Construction Manager-at-Risk Project Delivery for Highway Programs	40-10	Traffic Signal Retiming Practices in the U.S.
40-03	Adaptive Traffic Control Systems: Domestic and Foreign State of Practice	40-11	The State of Practice in Highway Access Management
40-04	Utility Location and Highway Design	40-13	Recycling and Reclamation of Asphalt Pavements Using In-Place Methods
40-05	Effective Public Involvement		

Table 2 SYNTHESIS TOPICS SELECTED FOR THE FY 2009 PROGRAM.

No.	Title	No.	Title
41-01	Geometric Design Practices for Resurfacing, Restoration, and Rehabilitation	41-08	Implementing Race-Neutral Measures in State Disadvantage Business Enterprise Programs
41-02	Effective Delivery of Small-Scale Federal-Aid Projects	41-09	Techniques for Effective Construction of Highway Projects in Congested Urban Areas
41-03	Engineering Economic Analysis Practices for Highway Investment	41-10	Developing Production Pile Driving Criteria from Test Pile Data
41-04	Sustainable Pavement Maintenance Practices	41-11	Transportation Improvement Program Revision Process
41-05	Design Fires in Road Tunnels	41-12	Microsurfacing Best Practices
41-06	Accelerating Implementation of Transportation Research Results		
41-07	Operational and Institutional Agreements that Facilitate Regional Traffic Signal Operations		

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 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.

Table 3 NCHRP PROJECT COMMITTEE SP20-5.

Chairman Catherine Nelson Oregon Department of Transportation	
Kathleen S. Ames Springfield, Illinois	John M. Mason, Jr. Auburn University
Stuart D. Anderson Texas A&M University	Ananth Prasad HNTB Corporation
Cynthia J. Burbank Alexandria, Virginia	Robert L. Sack New York State Department of Transportation
Lisa Freese Scott County (MN) Public Works Division	Francine Shaw-Whitson Federal Highway Administration
Malcolm T. Kerley Virginia Department of Transportation	Larry Velasquez New Mexico Department of Transportation
Richard D. Land California Department of Transportation	<i>Liaisons</i>
James W. March Federal Highway Administration	William Zaccagnino Federal Highway Administration
Mark A. Marek Texas Department of Transportation	Stephen F. Maher Transportation Research Board

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. Seven Research Results Digests on topics studied under the project are also listed. In addition, two unpublished reports are available. The unpublished reports are for information only, as they have not undergone the full review process of a published study. Copies of these Syntheses, Digests, and unpublished reports can be obtained from the publications office, Transportation Research Board, 500 Fifth Street, NW, Washington D.C. 20001; by calling (202) 334-3213; and through the Internet at <http://www.trb.org/bookstore>. All reports from No. 295 on (and some selected others) are available as online publications (http://www.trb.org/news/blurb_browse.asp?id=5 "Cooperative Research Programs").

Index of Topic Subjects

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

Conduct of the Studies

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

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

After the staff is substantially satisfied with the report, a final draft is sent to members of the topic panel for their last chance to review the report and then the NCHRP Project Committee SP20-5 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	9.	Pavement Rehabilitation—Materials and Techniques (1972) 41 pp. (out of print)
2.	Bridge Approach Design and Construction Practices (1969) 30 pp. (microfiche)*	10.	Recruiting, Training, and Retaining Maintenance and Equipment Personnel (1972) 35 pp. (microfiche)*
3.	Traffic-Safe and Hydraulically Efficient Drainage Practice (1969) 38 pp. (microfiche)*	11.	Development of Management Capability (1972) 50 pp. (out of print)
4.	Concrete Bridge Deck Durability (1970) 28 pp. (microfiche)* (supplemented by Synthesis 57)	12.	Telecommunications Systems for Highway Administration and Operations (1972) 39 pp., \$2.80 (superseded by Synthesis 165)
5.	Scour at Bridge Waterways (1970) 37 pp. (microfiche)*	13.	Radio Spectrum Frequency Management (1972) 32 pp., \$2.80
6.	Principles of Project Scheduling and Monitoring (1970) 43 pp. (microfiche)*	14.	Skid Resistance (1972) 66 pp. (microfiche)*
7.	Motorist Aid Systems (1971) 28 pp., \$2.40		
8.	Construction of Embankments (1971) 38 pp. (microfiche)*		

Table 4 (Continued)

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

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
64.	Bituminous Patching Mixtures (1979) 26 pp., \$4.80	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	114.	Management of Traffic Signal Maintenance (1984) 134 pp., \$10.80 (supersedes Synthesis 22)
87.	Highway Noise Barriers (1981) 81 pp., \$7.20	115.	Reducing Construction Conflicts between Highways and Utilities (1984) 73 pp., \$8.80
88.	Underwater Inspection and Repair of Bridge Substructures (1981) 77 pp., \$7.60	116.	Asphalt Overlay Design Procedures (1984) 66 pp., \$8.40
89.	Geotechnical Instrumentation for Monitoring Field Performance (1982) 46 pp., \$6.80	117.	Toll Highway Financing (1984) 29 pp., \$7.20
90.	New Product Evaluation Procedures (1982) 34 pp., \$6.80		
91.	Highway Accident Analysis Systems (1982) 69 pp., \$7.60		

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
118.	Detecting Defects and Deterioration in Highway Structures (1985) 52 pp., \$8.00	143.	Uniformity Efforts in Oversize/Overweight Permits (1988) 79 pp., \$10.00
119.	Prefabricated Bridge Elements and Systems (1985) 75 pp., \$8.80	144.	Breaking/Cracking and Seating Concrete Pavements (1989) 39 pp., \$8.00
120.	Professional Resource Management and Forecasting (1985) 15 pp., \$6.80	145.	Staffing Considerations in Construction Engineering Management (1989) 42 pp., \$8.00
121.	Energy Conservation in Transportation (1985) 25 pp., \$7.20 (supplements Synthesis 43)	146.	Use of Consultants for Construction Engineering and Inspection (1989) 64 pp., \$9.00
122.	Life-Cycle Cost Analysis of Pavements (1985) 136 pp., \$10.80	147.	Treatment of Problem Foundations for Highway Embankments (1989) 72 pp., \$9.00
123.	Bridge Designs to Reduce and Facilitate Maintenance and Repair (1985) 65 pp., \$8.40	148.	Indicators of Quality in Maintenance (1989) 114 pp., \$11.00
124.	Use of Weigh-in-Motion Systems for Data Collection and Enforcement (1986) 34 pp., \$7.60	149.	Partnerships for Innovation: Private Sector Contributions to Innovation in the Highway Industry (1989) 45 pp., \$8.00
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		

Table 4 (Continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
167.	Measurements, Specifications, and Achievement of Smoothness for Pavement Construction (1990) 34 pp., \$8.00	193.	Hot In-Place Recycling of Asphalt Concrete (1994) 69 pp., \$16.00
168.	Contract Management Systems (1990) 74 pp., \$10.00	194.	Electronic Toll and Traffic Management (ETTM) Systems (1993) 64 pp., \$15.00
169.	Removing Concrete from Bridges (1991) 42 pp., \$8.00	195.	Use of Warranties in Road Construction (1994) 60 pp., \$15.00
170.	Managing Urban Freeway Maintenance (1990) 32 pp., \$7.00	196.	Highway Maintenance Procedures Dealing with Hazardous Materials Incidents (1994) 60 pp., \$15.00
171.	Fabrics in Asphalt Overlays and Pavement Maintenance (1991) 72 pp., \$9.00	197.	Corridor Preservation (1994) 43 pp., \$11.00
172.	Signal Timing Improvement Practices (1992) 88 pp., \$11.00	198.	Uses of Recycled Rubber Tires in Highways (1994) 162 pp., \$23.00
173.	Short-Term Responsive Maintenance Systems (1991) 43 pp., \$9.00	199.	Recycling and Use of Waste Materials and By-Products in Highway Construction (1994) 84 pp., \$20.00
174.	Stormwater Management for Transportation Facilities (1993) 81 pp., \$9.00	200.	Underwater Bridge Maintenance and Repair (1994) 54 pp., \$16.00
175.	Moisture Damage in Asphalt Concrete (1991) 91 pp., \$10.00	201.	Multimodal Evaluation in Passenger Transportation (1994) 84 pp., \$19.00
176.	Bridge Paint: Removal, Containment, and Disposal (1992) 60 pp., \$9.00	202.	Severity Indices for Roadside Features (1994) 54 pp., \$12.00
177.	Freeway Corridor Management (1992) 64 pp., \$9.00	203.	Current Practices in Determining Pavement Condition (1994) 57 pp., \$16.00
178.	Truck Escape Ramps (1992) 56 pp., \$9.00	204.	Portland Cement Concrete Resurfacing (1994) 67 pp., \$15.00
179.	Latex-Modified Concretes and Mortars (1992) 58 pp., \$9.00	205.	Performance and Operational Experience of Crash Cushions (1994) 87 pp., \$20.00
180.	Performance Characteristics of Open-Graded Friction Courses (1992) 44 pp., \$8.00 (supplements Synthesis 49)	206.	Highway Tort Liability Management Programs (1994) 40 pp., \$11.00
181.	In-Service Experience with Traffic Noise Barriers (1992) 61 pp., \$9.00	207.	Managing Roadway Snow and Ice Control Operations (1994) 56 pp., \$15.00
182.	Performance and Operational Experience of Truck-Mounted Attenuators (1992) 54 pp., \$9.00	208.	Development and Implementation of Traffic Control Plans for Highway Work Zones (1994) 37 pp., \$11.00
183.	Knowledge Based Expert Systems in Transportation (1992) 52 pp., \$9.00	209.	Sealers for Portland Cement Concrete Highway Facilities (1994) 85 pp., \$19.00
184.	Disposal of Roadside Litter Mixtures (1993) 52 pp., \$12.00	210.	Road Pricing for Congestion Management: A Survey of International Practice (1994) 77 pp., \$19.00
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