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RESEARCH RESULTS DIGEST

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Responsible Senior Program Officer: Crawford F. Jencks

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 Stephen F. Maher, P.E. and Donna L. Vlasak, Senior Program Officers, serving under the Studies and Information Services Division of the Board, Stephen R. Godwin, Director.

INTRODUCTION

Administrators, practicing engineers, and researchers continually face highway problems on which much information already exists, either in documented form or in terms of undocumented experience and practice. Unfortunately, this information is often fragmented, scattered, and underevaluated. Often it is unknown to the person normally responsible for making decisions related to the topic. As a consequence, full knowledge of what has been learned about a problem is frequently not 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 exists a vast storehouse of information relating to nearly every subject of concern to highway administrators and engineers. Much of it resulted from research and much from successful application of the ideas of practitioners faced with problems in their day-to-day work. Because there had been no systematic means for bringing such useful information together and making it available to the entire highway community, the American Association of State Highway and Transportation Officials has, through the

mechanism of the National Cooperative Highway Research Program, authorized the Transportation Research Board to undertake a continuing study, NCHRP Project 20-5, "Synthesis of Information Related to Highway Problems." This study is intended to search out and synthesize useful knowledge from all possible sources and to prepare documented

Suggestions for synthesis topics may be sent to the NCHRP Program Director at any time (see address on back). You can also leave your recommendation at: <http://www2.nas.edu/trbcrp> under "GOT A SYNTHESIS TOPIC?" Topics suggested must be accompanied by a brief scope statement including a discussion of the problem (a paragraph or two). A title (preferably 10 words or less) and the name and affiliation of the submitter are also necessary. Identification of information sources would also be appreciated. Suggestions for updates of published syntheses are also welcome. A committee meets once a year, usually in the late spring, to make the final selections. To be considered at the next spring meeting, all recommended topics should be posted by **January 31**. If a topic is not selected, the problem statement must be resubmitted the following year to be reconsidered.

Interested in writing a synthesis? For details, contact Stephen F. Maher, P.E. by e-mail at smaher@nas.edu, or by phone at 202-334-3245 or Donna L. Vlasak, by e-mail at dvlasak@nas.edu, or by phone at 202-334-2974.

reports on current practices in the subject areas of concern. Reports from this endeavor constitute an NCHRP report series, *Synthesis of Highway Practice*, that collects and assembles the various forms of information into single concise documents pertaining to specific highway problems or sets of closely related problems.

THE SYNTHESIS PROGRAM

This synthesis series attempts to report on the various practices, making some recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems. The extent to which they are used in this fashion will be tempered by the breadth of the user's knowledge in the particular problem area.

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 evaluate the effectiveness of the synthesis after it has been in the hands of its users for a period of time.

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. As the processes of advancement continue, new knowledge can be expected to be added to that which is now at hand; 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 write to TRB (address on back) and let us know.

Studies in Progress and Planned for 1998

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, Stephen F. Maher, P.E. (202-334-3245) or Donna L. Vlasak (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 for initiation of about 12 syntheses per year. This number, plus some alternate topics, is selected by the committee at the 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. Three Research Results Digests on topics studied under the project are also listed. In addition, two unpublished reports are available. The unpublished studies 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, 2101 Constitution Avenue N.W., Washington, D.C. 20418; by calling (202) 334-3214; and through the Internet at <http://www.nas.edu/trb/index.html>.

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 1998.

Conduct of the Studies

Throughout the year, following the project committee's selection of topics, studies are essentially 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, an agreement is negotiated with a consultant to gather information on the topic, synthesize it, and draft a report. Typically, the agreement covers a period

of 15 months. Information gathering and preparation of the first draft of the synthesis report usually take from 6 to 9 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 the members of NCHRP Project Committee SP20-5 for their approval. At the same time, members of the topic panel have their last chance to review the report, which is usually published as an NCHRP Synthesis of Highway Practice.

Table 1
TOPICS BEING STUDIED

No.	Title	No.	Title
28-01	Best Management Practices for Environmental Issues Related to Highway and Street Maintenance	29-01	Effective Research Programs
28-02	Geotechnical Related Development and Implementation of LRFD Methods	29-02	Roadway Incident Diversion Practices
28-03	Project Development Methodologies for Reconstruction of Urban Freeways and Expressways	29-03	Performance Survey on Open-Graded Friction Course Mixes
28-06	Methods to Achieve Rut Resistant Durable Asphalt Pavements	29-04	DOT Project Management Systems
28-08	Historic Highway Bridge Preservation Practices	29-05	Operational Impacts of Median Width on Larger Vehicles
28-10	Transportation Management Center Functions	29-06	Consultants for DOT Design Work
28-12	Traffic Signals Near Highway-Rail Intersections	29-07	Management and Selection Systems for Highway Maintenance Equipment
		29-08	Measuring In-situ Mechanical Properties of Pavement Subgrade Soils

Table 2
SYNTHESIS TOPICS SELECTED FOR THE FY 1998 PROGRAM

No.	Title	No.	Title
30-01	The System Engineering Process: An Effective Methodology for Developing Traffic Control Systems	30-09	Quality Assurance of Structural Materials
30-02	Statewide Multimodal Planning	30-10	Maintenance of Highway Edgedrains
30-03	Corridor Management Plans and Policies	30-11	Design and Testing of Pavement Friction Characteristics
30-04	Risk Management Practices to Reduce Lead Time on Right-of-Way Clearance	30-12	Construction Techniques Using Lane Occupancy
30-05	Assessing Economic Development Benefits from Major Transportation Investments	<i>Alternate Topics</i>	
30-06	Sleep Deprivation Countermeasures for Motorist Safety	30-13	Impact of Maintenance Downsizing on Handling Quick Response Needs
30-07	Data Sharing and Data Partnerships for Highways	30-14	State Practices of Assessing Value of Access Points
30-08	Bridge Deck Expansion Joint Performance	30-15	Bridge Deck Overlay Performance

Table 3
NCHRP PROJECT COMMITTEE SP20-5

Chairman
 Jon P. Underwood
 Texas Department of Transportation (Retired)

Kenneth C. Afferton
 New Jersey Department of Transportation (Retired)

John J. Henry
 Pennsylvania Transportation Institute

Gloria J. Jeff
 Federal Highway Administration

C. Ian MacGillivray
 Iowa Department of Transportation

Eugene E. Ofstead
 Minnesota Department of Transportation

Henry H. Rentz
 Federal Highway Administration

Earl C. Shirley
 California Department of Transportation (Retired)

J. Richard Young, Jr.
 Mississippi Department of Transportation (Retired)

Liaisons

Richard A. McComb
 Federal Highway Administration

Robert E. Spicher
 Transportation Research Board

Table 4
COMPLETED SYNTHESSES

No. Title, Pages, Price	No. Title, Pages, Price
1. Traffic Control for Freeway Maintenance (1969) 47 pp., \$2.20	47. Effect of Weather on Highway Construction (1978) 29 pp., \$3.20
2. Bridge Approach Design and Construction Practices (1969) 30 pp. (microfiche)*	48. Priority Programming and Project Selection (1978) 31 pp. (out of print)
3. Traffic-Safe and Hydraulically Efficient Drainage Practice (1969) 38 pp. (microfiche)*	49. Open-Graded Friction Courses for Highways (1978) 50 pp., \$4.00
4. Concrete Bridge Deck Durability (1970) 28 pp. (microfiche)* (supplemented by Synthesis 57)	50. Durability of Drainage Pipe (1978) 37 pp. (microfiche)*
5. Scour at Bridge Waterways (1970) 37 pp. (microfiche)*	51. Construction Contract Staffing (1978) 62 pp., \$6.00
6. Principles of Project Scheduling and Monitoring (1970) 43 pp. (microfiche)*	52. Management and Selection Systems for Highway Maintenance Equipment (1978) 17 pp., \$4.40
7. Motorist Aid Systems (1971) 28 pp., \$2.40	53. Precast Concrete Elements for Transportation Facilities (1978) 48 pp., \$5.60
8. Construction of Embankments (1971) 38 pp. (microfiche)*	54. Recycling Materials for Highways (1978) 53 pp. (microfiche)*
9. Pavement Rehabilitation—Materials and Techniques (1972) 41 pp. (out of print)	55. Storage and Retrieval Systems for Highway and Transportation Data (1978) 30 pp., \$4.80
10. Recruiting, Training, and Retaining Maintenance and Equipment Personnel (1972) 35 pp. (microfiche)*	56. Joint-Related Distress in PCC Pavement—Cause, Prevention, and Rehabilitation (1979) 36 pp., \$5.20
11. Development of Management Capability (1972) 50 pp. (out of print)	57. Durability of Concrete Bridge Decks (1979) 61 pp. (microfiche)* (supplements Synthesis 4)
12. Telecommunications Systems for Highway Administration and Operations (1972) 39 pp., \$2.80 (superseded by Synthesis 165)	58. Consequences of Deferred Maintenance (1979) 24 pp., \$4.40
13. Radio Spectrum Frequency Management (1972) 32 pp., \$2.80	59. Relationship of Asphalt Cement Properties to Pavement Durability (1979) 43 pp., \$5.60
14. Skid Resistance (1972) 66 pp. (microfiche)*	60. Failure and Repair of Continuously Reinforced Concrete Pavement (1979) 42 pp., \$5.60
15. Statewide Transportation Planning—Needs and Requirements (1973) 41 pp. (microfiche)* (superseded by Synthesis 95)	61. Changeable Message Signs (1979) 37 pp., \$5.60
16. Continuously Reinforced Concrete Pavement (1973) 23 pp., \$2.80	62. Potential State Resources for Financing Transportation Programs (1979) 34 pp., \$5.20
17. Pavement Traffic Marking—Materials and Application Affecting Serviceability (1973) 44 pp., \$3.60 (superseded by Synthesis 138)	63. Design and Use of Highway Shoulders (1979) 26 pp., \$4.80
18. Erosion Control on Highway Construction (1973) 52 pp. (microfiche)*	64. Bituminous Patching Mixtures (1979) 26 pp., \$4.80
19. Design, Construction, and Maintenance of PCC Pavement Joints (1973) 40 pp. (out of print)	65. Quality Assurance (1979) 42 pp., \$5.60
20. Rest Areas (1973) 38 pp., \$3.60	66. Glare Screen Guidelines (1979) 17 pp., \$4.40
21. Highway Location Reference Methods (1974) 30 pp., \$3.20	67. Bridge Drainage Systems (1979) 44 pp., \$5.60
22. Maintenance Management of Traffic Signal Equipment and Systems (1974) 41 pp. (microfiche)* (superseded by Synthesis 114)	68. Motor Vehicle Size and Weight Regulation, Enforcement, and Permit Operations (1980) 45 pp., \$6.00
23. Getting Research Findings Into Practice (1974) 24 pp., \$3.20	69. Bus Route and Schedule Planning Guidelines (1980) 99 pp., \$8.00
24. Minimizing Deicing Chemical Use (1974) 58 pp. (microfiche)*	70. Design of Sedimentation Basins (1980) 53 pp., \$6.80
25. Reconditioning High-Volume Freeways in Urban Areas (1974) 56 pp., \$4.00	71. Direction Finding from Arterials to Destinations (1980) 50 pp., \$6.40
26. Roadway Design in Seasonal Frost Areas (1975) 104 pp. (microfiche)*	72. Transportation Needs Studies and Financial Constraints (1980) 54 pp., \$6.40
27. PCC Pavements for Low-Volume Roads and City Streets (1975) 31 pp. (microfiche)*	73. Alternative Work Schedules: Impacts on Transportation (1980) 54 pp., \$6.80
28. Partial-Lane Pavement Widening (1975) 30 pp., \$3.20	74. State Transit-Management Assistance to Local Communities (1980) 34 pp., \$6.00
29. Treatment of Soft Foundations for Embankments (1975) 25 pp., \$3.20 (supplemented by Synthesis 147)	75. Transit Boards—Composition, Roles, and Procedures (1981) 24 pp., \$6.20
30. Bituminous Emulsions for Highway Pavements (1975) 76 pp. (microfiche)*	76. Collection and Use of Pavement Condition Data (1981) 74 pp., \$8.00
31. Highway Tunnel Operations (1975) 29 pp., \$3.20	77. Evaluation of Pavement Maintenance Strategies (1981) 56 pp., \$7.40
32. Effects of Studded Tires (1975) 46 pp., \$4.00	78. Value Engineering in Preconstruction and Construction (1981) 23 pp., \$6.40
33. Acquisition and Use of Geotechnical Information (1976) 40 pp., \$4.00	79. Contract Time Determination (1981) 45 pp., \$7.20
34. Policies for Accommodation of Utilities on Highway Rights of Way (1976) 22 pp. (microfiche)*	80. Formulating and Justifying Highway Maintenance Budgets (1981) 49 pp., \$7.20
35. Design and Control of Freeway Off-Ramp Terminals (1976) 61 pp., \$4.40	81. Experiences in Transportation System Management (1981) 88 pp., \$8.40
36. Instrumentation and Equipment for Testing Highway Materials, Products, and Performance (1976) 70 pp., \$4.80	82. Criteria for Evaluation of Truck Weight Enforcement Programs (1981) 74 pp., \$7.20
37. Lime-Fly Ash-Stabilized Bases and Subbases (1976) 66 pp. (microfiche)*	83. Bus Transit Accessibility for the Handicapped in Urban Areas (1981) 73 pp., \$7.60
38. Statistically Oriented End-Result Specifications (1976) 40 pp., \$4.00	84. Evaluation Criteria and Priority Setting for State Highway Programs (1981) 32 pp., \$6.40
39. Transportation Requirements for the Handicapped, Elderly, and Economically Disadvantaged (1976) 54 pp. (out of print)	85. Energy Involved in Construction Materials and Procedures (1981) 34 pp., \$6.40
40. Staffing and Management for Social, Economic, and Environmental Impact Assessments (1977) 43 pp., \$4.00	86. Effects of Traffic-Induced Vibrations on Bridge Deck Repairs (1981) 40 pp., \$6.80
41. Bridge Bearings (1977) 62 pp. (microfiche)*	87. Highway Noise Barriers (1981) 81 pp., \$7.20
42. Design of Pile Foundations (1977) 68 pp., \$4.80	88. Underwater Inspection and Repair of Bridge Substructures (1981) 77 pp., \$7.60
43. Energy Effects, Efficiencies, and Prospects for Various Modes of Transportation (1977) 57 pp., \$4.80 (supplemented by Synthesis 121)	89. Geotechnical Instrumentation for Monitoring Field Performance (1982) 46 pp., \$6.80
44. Consolidation of Concrete for Pavements, Bridge Decks, and Overlays (1977) 61 pp., \$4.80	90. New-Product Evaluation Procedures (1982) 34 pp., \$6.80
45. Rapid-Setting Materials for Patching of Concrete (1977) 13 pp. (out of print)	91. Highway Accident Analysis Systems (1982) 69 pp., \$7.60
46. Recording and Reporting Methods for Highway Maintenance Expenditures (1977) 35 pp., \$3.60	92. Minimizing Reflection Cracking of Pavement Overlays (1982) 38 pp., \$6.80

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

Table 4 (continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
93.	Coordination of Transportation System Management and Land Use Management (1982) 38 pp., \$6.80	141.	Bridge Deck Joints (1989) 66 pp., \$9.00
94.	Photologging (1982) 38 pp., \$6.80	142.	Methods of Cost-Effectiveness Analysis for Highway Projects (1988) 22 pp., \$7.00
95.	Statewide Transportation Planning (1982) 54 pp., \$7.20 (supersedes Synthesis 15)	143.	Uniformity Efforts in Oversize/Overweight Permits (1988) 79 pp., \$10.00
96.	Pavement Subsurface Drainage Systems (1982) 38 pp., \$6.80	144.	Breaking/Cracking and Sealing Concrete Pavements (1989) 39 pp., \$8.00
97.	Transit Ownership/Operation Options for Small Urban and Rural Areas (1982) 28 pp., \$6.40	145.	Staffing Considerations in Construction Engineering Management (1989) 42 pp., \$8.00
98.	Resealing Joints and Cracks in Rigid and Flexible Pavements (1982) 62 pp., \$7.20	146.	Use of Consultants for Construction Engineering and Inspection (1989) 64 pp., \$9.00
99.	Resurfacing with Portland Cement Concrete (1982) 90 pp., \$8.40	147.	Treatment of Problem Foundations for Highway Embankments (1989) 72 pp., \$9.00
100.	Managing State Highway Finance (1982) 23 pp., \$6.40	148.	Indicators of Quality in Maintenance (1989) 114 pp., \$11.00
101.	Historic Bridges—Criteria for Decision Making (1983) 77 pp., \$8.00	149.	Partnerships for Innovation: Private Sector Contributions to Innovation in the Highway Industry (1989) 45 pp., \$8.00
102.	Material Certification and Material-Certification Effectiveness (1983) 17 pp., \$6.00	150.	Technology Transfer in Selected Highway Agencies (1989) 38 pp., \$8.00
103.	Risk Assessment Processes for Hazardous Materials Transportation (1983) 26 pp., \$6.40	151.	Process for Recapitalizing Highway Transportation Systems (1989) 43 pp., \$8.00
104.	Criteria for Use of Asphalt Friction Surfaces (1983) 41 pp., \$6.80	152.	Compaction of Asphalt Pavement (1989) 42 pp., \$8.00
105.	Construction Contract Claims: Causes and Methods of Settlement (1983) 58 pp., \$7.20	153.	Evolution and Benefits of Preventive Maintenance Strategies (1989) 69 pp., \$9.00
106.	Practical Guidelines for Minimizing Tort Liability (1983) 40 pp., \$6.80	154.	Recycling Portland Cement Concrete Pavements (1989) 46 pp., \$8.00
107.	Shallow Foundations for Highway Structures (1983) 38 pp., \$6.80	155.	Freeway Guide Sign Replacement: Policies and Criteria (1991) 37 pp., \$8.00
108.	Bridge Weight-Limit Posting Practices (1984) 30 pp., \$6.40	156.	Freeway Incident Management (1990) 23 pp., \$7.00
109.	Highway Uses of Epoxy with Concrete (1984) 68 pp., \$8.80	157.	Maintenance Management of Street and Highway Signs (1990) 134 pp., \$12.00
110.	Maintenance Management Systems (1984) 49 pp., \$8.00	158.	Wet-Pavement Safety Programs (1990) 54 pp., \$8.00
111.	Distribution of Wheel Loads on Highway Bridges (1984) 22 pp., \$7.20	159.	Design and Construction of Bridge Approaches (1990) 45 pp., \$8.00
112.	Cost-Effectiveness of Hot-Dip Galvanizing for Exposed Steel (1984) 28 pp., \$7.20	160.	Cold-Recycled Bituminous Concrete Using Bituminous Materials (1990) 105 pp., \$11.00
113.	Administration of Research, Development, and Implementation Activities in Highway Agencies (1984) 49 pp., \$8.00	161.	Computer-Aided Design and Drafting Systems (1990) 24 pp., \$7.00
114.	Management of Traffic Signal Maintenance (1984) 134 pp., \$10.80 (supersedes Synthesis 22)	162.	Signing Policies, Procedures, Practices, and Fees for Logo and Tourist-Oriented Directional Signing (1990) 41 pp., \$8.00
115.	Reducing Construction Conflicts between Highways and Utilities (1984) 73 pp., \$8.80	163.	Innovative Strategies for Upgrading Personnel in State Transportation Departments (1990) 35 pp., \$7.00
116.	Asphalt Overlay Design Procedures (1984) 66 pp., \$8.40	164.	Measures to Curtail State Fuel Tax Evasion (1990) 14 pp., \$7.00
117.	Toll Highway Financing (1984) 29 pp., \$7.20	165.	Transportation Telecommunications (1990) 92 pp., \$10.00 (supersedes Synthesis 12)
118.	Detecting Defects and Deterioration in Highway Structures (1985) 52 pp., \$8.00	166.	Traffic Signal Control Equipment: State of the Art (1990) 43 pp., \$8.00
119.	Prefabricated Bridge Elements and Systems (1985) 75 pp., \$8.80	167.	Measurements, Specifications, and Achievement of Smoothness for Pavement Construction (1990) 34 pp., \$8.00
120.	Professional Resource Management and Forecasting (1985) 15 pp., \$6.80	168.	Contract Management Systems (1990) 74 pp., \$10.00
121.	Energy Conservation in Transportation (1985) 25 pp., \$7.20 (supplements Synthesis 43)	169.	Removing Concrete from Bridges (1991) 42 pp., \$8.00
122.	Life-Cycle Cost Analysis of Pavements (1985) 136 pp., \$10.80	170.	Managing Urban Freeway Maintenance (1990) 32 pp., \$7.00
123.	Bridge Designs to Reduce and Facilitate Maintenance and Repair (1985) 65 pp., \$8.40	171.	Fabrics in Asphalt Overlays and Pavement Maintenance (1991) 72 pp., \$9.00
124.	Use of Weigh-in-Motion Systems for Data Collection and Enforcement (1986) 34 pp., \$7.60	172.	Signal Timing Improvement Practices (1992) 88 pp., \$11.00
125.	Maintenance Activities Accomplished by Contract (1986) 42 pp., \$8.00	173.	Short-Term Responsive Maintenance Systems (1991) 43 pp., \$9.00
126.	Equipment for Obtaining Pavement Condition and Traffic Loading Data (1986) 118 pp., \$11.20	174.	Stormwater Management for Transportation Facilities (1993) 81 pp., \$9.00
127.	Use of Fly Ash in Concrete (1986) 66 pp., \$8.40	175.	Moisture Damage in Asphalt Concrete (1991) 91 pp., \$10.00
128.	Methods for Identifying Hazardous Highway Elements (1986) 80 pp. (microfiche)*	176.	Bridge Paint: Removal, Containment, and Disposal (1992) 60 pp., \$9.00
129.	Freezing and Thawing Resistance of High-Strength Concrete (1986) 31 pp., \$7.60	177.	Freeway Corridor Management (1992) 64 pp., \$9.00
130.	Traffic Data Collection and Analysis: Methods and Procedures (1986) 58 pp., \$8.40	178.	Truck Escape Ramps (1992) 56 pp., \$9.00
131.	Effects of Permit and Illegal Overloads on Pavements (1987) 99 pp., \$10.40	179.	Latex-Modified Concretes and Mortars (1992) 58 pp., \$9.00
132.	System-Wide Safety Improvements: An Approach to Safety Consistency (1987) 20 pp., \$6.80	180.	Performance Characteristics of Open-Graded Friction Courses (1992) 44 pp., \$8.00 (supplements Synthesis 49)
133.	Integrated Highway Information Systems (1987) 31 pp., \$7.60	181.	In-Service Experience with Traffic Noise Barriers (1992) 61 pp., \$9.00
134.	D-Cracking of Concrete Pavements (1987) 34 pp., \$7.60	182.	Performance and Operational Experience of Truck-Mounted Attenuators (1992) 54 pp., \$9.00
135.	Pavement Management Practices (1987) 139 pp., \$12.40	183.	Knowledge Based Expert Systems in Transportation (1992) 52 pp., \$9.00
136.	Protective Coatings for Bridge Steel (1987) 107 pp., \$11.00	184.	Disposal of Roadside Litter Mixtures (1993) 52 pp., \$12.00
137.	Negotiating and Contracting for Professional Engineering Services (1988) 75 pp., \$9.60	185.	Preferential Lane Treatments for High-Occupancy Vehicles (1993) 80 pp., \$10.00
138.	Pavement Markings: Materials and Application for Extended Service Life (1988) 45 pp., \$8.00 (supersedes Synthesis 17)	186.	Supplemental Advance Warnings (1993) 83 pp., \$19.00
139.	Pedestrians and Traffic Control Measures (1988) 75 pp., \$9.00	187.	Rapid Test Methods for Asphalt Concrete and Portland Cement Concrete (1993) 47 pp., \$10.00
140.	Durability of Prestressed Concrete Highway Structures (1988) 65 pp., \$9.00	188.	Management Training and Development Programs (1993) 56 pp., \$15.00
		189.	State Highway Pavement Design Practices (1993) 45 pp., \$11.00
		190.	Criteria for Qualifying Contractors for Bidding Purposes (1994) 40 pp., \$11.00
		191.	Use of Rumble Strips to Enhance Safety (1993) 74 pp., \$19.00
		192.	Accident Data Quality (1993) 53 pp., \$12.00

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

Table 4 (continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
193.	Hot In-Place Recycling of Asphalt Concrete (1994) 69 pp., \$16.00	231.	Managing Contract Research Programs (1996) 92 pp., \$23.00
194.	Electronic Toll and Traffic Management (ETTM) Systems (1993) 64 pp., \$15.00	232.	Variability in Highway Pavement Construction (1996) 38 pp., \$14.00
195.	Use of Warranties in Road Construction (1994) 60 pp., \$15.00	233.	Land Development Regulations that Promote Access Management (1996) 45 pp., \$14.00
196.	Highway Maintenance Procedures Dealing with Hazardous Materials Incidents (1994) 60 pp., \$15.00	234.	Settlement of Bridge Approaches (The Bump at the End of the Bridge) (1997) 75 pp., \$24.00
197.	Corridor Preservation (1994) 43 pp., \$11.00	235.	Application of Full-Scale Accelerated Pavement Testing (1997) 110 pp., \$23.00
198.	Uses of Recycled Rubber Tires in Highways (1994) 162 pp., \$23.00	236.	Methods for Household Travel Surveys (1997) 57 pp., \$15.00
199.	Recycling and Use of Waste Materials and By-Products in Highway Construction (1994) 84 pp., \$20.00	237.	Changeable Message Signs (1997) 57 pp., \$19.00
200.	Underwater Bridge Maintenance and Repair (1994) 54 pp., \$16.00	238.	Performance Measurement in State DOTs (1997) 69 pp., \$20.00
201.	Multimodal Evaluation in Passenger Transportation (1994) 84 pp., \$19.00	239.	Pavement Subsurface Drainage Systems (1997) 44 pp., \$15.00
202.	Severity Indices for Roadside Features (1994) 54 pp., \$12.00	240.	Toll Plaza Design (1997) 117 pp., \$25.00
203.	Current Practices in Determining Pavement Condition (1994) 57 pp., \$16.00	241.	Truck Operating Characteristics (1997) 66 pp., \$19.00
204.	Portland Cement Concrete Resurfacing (1994) 67 pp., \$15.00	242.	Trenchless Installation of Conduits Beneath Roadways (1997) 77 pp., \$23.00
205.	Performance and Operational Experience of Crash Cushions (1994) 87 pp., \$20.00	243.	Methods for Capital Programming and Project Scheduling (1997) 85 pp., \$23.00
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207.	Managing Roadway Snow and Ice Control Operations (1994) 56 pp., \$15.00	245.	Traffic Signal Control Systems Maintenance Management Practices (1997) 63 pp., \$19.00
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