

National Cooperative Highway Research Program

RESEARCH RESULTS DIGEST

September 2001—Number 260

NCHRP Manager: 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., Manager, Synthesis Studies, and Donna L. Vlasak, Senior Program Officer, 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 undervalued. 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 reports on

Suggestions for synthesis topics may be sent to the NCHRP Manager at any time (see address on back). You can also submit your recommendation at: <http://www4.nationalacademies.org/trb/synthesis.nsf> "SUGGEST an NCHRP or TCRP 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 be appreciated too. 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.

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 contact TRB and let us know.

Studies in Progress and Planned for 2001

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 non-uniform 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 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, 2101 Constitution Avenue N.W., Washington, D.C. 20418; by calling (202) 334-3213; and through the Internet at <http://nationalacademies.org/trb/bookstore/>

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 2001.

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 made 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 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 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 subsequently published as an NCHRP Synthesis of Highway Practice.

Table 1
TOPICS BEING STUDIED

No.	Title	No.	Title
30-01	Systems Engineering Processes for Developing Traffic Signal Systems	32-03	Impact of Red Light Camera Enforcement on Crash Experience
30-08	Bridge Deck Joint Performance	32-04	Significant Findings from Full-Scale/Accelerated Pavement Testing
30-09	Quality Assurance of Structural Materials	32-05	Driveway Regulation Practices
31-01	Recent Geometric Design Research for Improved Safety and Operations	32-06	Public Benefits of Highway System Maintenance and Operations
31-03	Assessment and Rehabilitation of Existing Culverts	32-07	Performance Measures of Operational Effectiveness for Highway Segments and Systems
31-04	Performance Measures for Research, Development, and Technology Programs	32-08	Cost-Effective Structures for Off-System Bridges
31-05	Collecting, Processing, and Integrating GPS Data into a GIS	32-09	Transportation Planning and Management for Special Events
31-06	Facilitating Partnerships in Transportation Research	32-10	Compensation for Contractors Home Office Overhead
31-07	Long-Term Pavement Marking Practices	32-11	Interaction Between Wildlife Ecology and Roadways
31-12	Ecological Mitigation	32-12	Owner Controlled Insurance Programs
32-01	Dealing with Truck Parking Demands		
32-02	Strategies for Managing Increasing Truck Traffic		

Table 2
SYNTHESIS TOPICS SELECTED FOR THE FY 2001 PROGRAM

No.	Title	No.	Title
33-01	Design Exception Practices	33-11	Including Tourism and Recreation Travel in Metropolitan and Statewide Transportation Plans
33-02	Precast Structural Elements for Bridge Construction	33-12	Integration of Freight Transportation with Intermodal Facilities
33-03	State Product Evaluation Programs		
33-04	Management of Roadside Vegetation		
33-05	Quick Clearance of Traffic Incidents		
33-06	Roadway Safety Tools for Localities		<i>Alternate Topics</i>
33-07	Safety Management Systems in Practice	33-13	Tools for Predicting Bicycle and Pedestrian Use
33-08	Strategies for Recruiting and Maintaining Individuals in Transportation Related Jobs	33-14	Institutional Frameworks for Statewide Transportation Planning and Investment Decisions
33-09	Statewide Highway Letting Program Management	33-15	Alternative Fuels Evaluation Procedures and Selection Systems
33-10	Steel Bridge Erection Practices		

Table 3
NCHRP PROJECT COMMITTEE SP20-5

Chairman C. Ian MacGillivray Iowa Department of Transportation	
Kenneth C. Afferton (Retired) New Jersey Department of Transportation	Wesley S.C. Lum California Department of Transportation
Susan Binder Federal Highway Administration	Gary Taylor Michigan Department of Transportation
Thomas R. Bohuslav Texas Department of Transportation	J. Richard Young, Jr., P.E. (Retired) Mississippi Department of Transportation
Nicholas J. Garber University of Virginia	<i>Liaisons</i>
Dwight Horne Federal Highway Administration	William Zaccagnino Federal Highway Administration
Ysela Llort Florida Department of Transportation	Mark R. Norman 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	53.	Precast Concrete Elements for Transportation Facilities (1978) 48 pp., \$5.60
2.	Bridge Approach Design and Construction Practices (1969) 30 pp. (microfiche)*	54.	Recycling Materials for Highways (1978) 53 pp. (microfiche)*
3.	Traffic-Safe and Hydraulically Efficient Drainage Practice (1969) 38 pp. (microfiche)*	55.	Storage and Retrieval Systems for Highway and Transportation Data (1978) 30 pp., \$4.80
4.	Concrete Bridge Deck Durability (1970) 28 pp. (microfiche)* (supplemented by Synthesis 57)	56.	Joint-Related Distress in PCC Pavement—Cause, Prevention, and Rehabilitation (1979) 36 pp., \$5.20
5.	Scour at Bridge Waterways (1970) 37 pp. (microfiche)*	57.	Durability of Concrete Bridge Decks (1979) 61 pp. (microfiche)* (supplements Synthesis 4)
6.	Principles of Project Scheduling and Monitoring (1970) 43 pp. (microfiche)*	58.	Consequences of Deferred Maintenance (1979) 24 pp., \$4.40
7.	Motorist Aid Systems (1971) 28 pp., \$2.40	59.	Relationship of Asphalt Cement Properties to Pavement Durability (1979) 43 pp., \$5.60
8.	Construction of Embankments (1971) 38 pp. (microfiche)*	60.	Failure and Repair of Continuously Reinforced Concrete Pavement (1979) 42 pp., \$5.60
9.	Pavement Rehabilitation—Materials and Techniques (1972) 41 pp. (out of print)	61.	Changeable Message Signs (1979) 37 pp., \$5.60
10.	Recruiting, Training, and Retaining Maintenance and Equipment Personnel (1972) 35 pp. (microfiche)*	62.	Potential State Resources for Financing Transportation Programs (1979) 34 pp., \$5.20
11.	Development of Management Capability (1972) 50 pp. (out of print)	63.	Design and Use of Highway Shoulders (1979) 26 pp., \$4.80
12.	Telecommunications Systems for Highway Administration and Operations (1972) 39 pp., \$2.80 (superseded by Synthesis 165)	64.	Bituminous Patching Mixtures (1979) 26 pp., \$4.80
13.	Radio Spectrum Frequency Management (1972) 32 pp., \$2.80	65.	Quality Assurance (1979) 42 pp., \$5.60
14.	Skid Resistance (1972) 66 pp. (microfiche)*	66.	Glare Screen Guidelines (1979) 17 pp., \$4.40
15.	Statewide Transportation Planning—Needs and Requirements (1973) 41 pp. (microfiche)* (superseded by Synthesis 95)	67.	Bridge Drainage Systems (1979) 44 pp., \$5.60
16.	Continuously Reinforced Concrete Pavement (1973) 23 pp., \$2.80	68.	Motor Vehicle Size and Weight Regulation, Enforcement, and Permit Operations (1980) 45 pp., \$6.00
17.	Pavement Traffic Marking—Materials and Application Affecting Serviceability (1973) 44 pp., \$3.60 (superseded by Synthesis 138)	69.	Bus Route and Schedule Planning Guidelines (1980) 99 pp., \$8.00
18.	Erosion Control on Highway Construction (1973) 52 pp. (microfiche)*	70.	Design of Sedimentation Basins (1980) 53 pp., \$6.80
19.	Design, Construction, and Maintenance of PCC Pavement Joints (1973) 40 pp. (out of print)	71.	Direction Finding from Arterials to Destinations (1980) 50 pp., \$6.40
20.	Rest Areas (1973) 38 pp., \$3.60	72.	Transportation Needs Studies and Financial Constraints (1980) 54 pp., \$6.40
21.	Highway Location Reference Methods (1974) 30 pp., \$3.20	73.	Alternative Work Schedules: Impacts on Transportation (1980) 54 pp., \$6.80
22.	Maintenance Management of Traffic Signal Equipment and Systems (1974) 41 pp. (microfiche)* (superseded by Synthesis 114)	74.	State Transit-Management Assistance to Local Communities (1980) 34 pp., \$6.00
23.	Getting Research Findings Into Practice (1974) 24 pp., \$3.20	75.	Transit Boards—Composition, Roles, and Procedures (1981) 24 pp., \$6.20
24.	Minimizing Deicing Chemical Use (1974) 58 pp. (microfiche)*	76.	Collection and Use of Pavement Condition Data (1981) 74 pp., \$8.00
25.	Reconditioning High-Volume Freeways in Urban Areas (1974) 56 pp., \$4.00	77.	Evaluation of Pavement Maintenance Strategies (1981) 56 pp., \$7.40
26.	Roadway Design in Seasonal Frost Areas (1975) 104 pp. (microfiche)*	78.	Value Engineering in Preconstruction and Construction (1981) 23 pp., \$6.40
27.	PCC Pavements for Low-Volume Roads and City Streets (1975) 31 pp. (microfiche)*	79.	Contract Time Determination (1981) 45 pp., \$7.20
28.	Partial-Lane Pavement Widening (1975) 30 pp., \$3.20	80.	Formulating and Justifying Highway Maintenance Budgets (1981) 49 pp., \$7.20
29.	Treatment of Soft Foundations for Embankments (1975) 25 pp., \$3.20 (supplemented by Synthesis 147)	81.	Experiences in Transportation System Management (1981) 88 pp., \$8.40
30.	Bituminous Emulsions for Highway Pavements (1975) 76 pp. (microfiche)*	82.	Criteria for Evaluation of Truck Weight Enforcement Programs (1981) 74 pp., \$7.20
31.	Highway Tunnel Operations (1975) 29 pp., \$3.20	83.	Bus Transit Accessibility for the Handicapped in Urban Areas (1981) 73 pp., \$7.60
32.	Effects of Studded Tires (1975) 46 pp., \$4.00	84.	Evaluation Criteria and Priority Setting for State Highway Programs (1981) 32 pp., \$6.40
33.	Acquisition and Use of Geotechnical Information (1976) 40 pp., \$4.00	85.	Energy Involved in Construction Materials and Procedures (1981) 34 pp., \$6.40
34.	Policies for Accommodation of Utilities on Highway Rights of Way (1976) 22 pp. (microfiche)*	86.	Effects of Traffic-Induced Vibrations on Bridge Deck Repairs (1981) 40 pp., \$6.80
35.	Design and Control of Freeway Off-Ramp Terminals (1976) 61 pp., \$4.40	87.	Highway Noise Barriers (1981) 81 pp., \$7.20
36.	Instrumentation and Equipment for Testing Highway Materials, Products, and Performance (1976) 70 pp., \$4.80	88.	Underwater Inspection and Repair of Bridge Substructures (1981) 77 pp., \$7.60
37.	Lime-Fly Ash-Stabilized Bases and Subbases (1976) 66 pp. (microfiche)*	89.	Geotechnical Instrumentation for Monitoring Field Performance (1982) 46 pp., \$6.80
38.	Statistically Oriented End-Result Specifications (1976) 40 pp., \$4.00	90.	New Product Evaluation Procedures (1982) 34 pp., \$6.80
39.	Transportation Requirements for the Handicapped, Elderly, and Economically Disadvantaged (1976) 54 pp. (out of print)	91.	Highway Accident Analysis Systems (1982) 69 pp., \$7.60
40.	Staffing and Management for Social, Economic, and Environmental Impact Assessments (1977) 43 pp., \$4.00	92.	Minimizing Reflection Cracking of Pavement Overlays (1982) 38 pp., \$6.80
41.	Bridge Bearings (1977) 62 pp. (microfiche)*	93.	Coordination of Transportation System Management and Land Use Management (1982) 38 pp., \$6.80
42.	Design of Pile Foundations (1977) 68 pp., \$4.80	94.	Photologging (1982) 38 pp., \$6.80
43.	Energy Effects, Efficiencies, and Prospects for Various Modes of Transportation (1977) 57 pp., \$4.80 (supplemented by Synthesis 121)	95.	Statewide Transportation Planning (1982) 54 pp., \$7.20 (supersedes Synthesis 15)
44.	Consolidation of Concrete for Pavements, Bridge Decks, and Overlays (1977) 61 pp., \$4.80	96.	Pavement Subsurface Drainage Systems (1982) 38 pp., \$6.80
45.	Rapid-Setting Materials for Patching of Concrete (1977) 13 pp. (out of print)	97.	Transit Ownership/Operation Options for Small Urban and Rural Areas (1982) 28 pp., \$6.40
46.	Recording and Reporting Methods for Highway Maintenance Expenditures (1977) 35 pp., \$3.60	98.	Resealing Joints and Cracks in Rigid and Flexible Pavements (1982) 62 pp., \$7.20
47.	Effect of Weather on Highway Construction (1978) 29 pp., \$3.20	99.	Resurfacing with Portland Cement Concrete (1982) 90 pp., \$8.40
48.	Priority Programming and Project Selection (1978) 31 pp. (out of print)	100.	Managing State Highway Finance (1982) 23 pp., \$6.40
49.	Open-Graded Friction Courses for Highways (1978) 50 pp., \$4.00	101.	Historic Bridges—Criteria for Decision Making (1983) 77 pp., \$8.00
50.	Durability of Drainage Pipe (1978) 37 pp. (microfiche)*	102.	Material Certification and Material-Certification Effectiveness (1983) 17 pp., \$6.00
51.	Construction Contract Staffing (1978) 62 pp., \$6.00		
52.	Management and Selection Systems for Highway Maintenance Equipment (1978) 17 pp., \$4.40		

*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
103.	Risk Assessment Processes for Hazardous Materials Transportation (1983) 26 pp., \$6.40	154.	Recycling Portland Cement Concrete Pavements (1989) 46 pp., \$8.00
104.	Criteria for Use of Asphalt Friction Surfaces (1983) 41 pp., \$6.80	155.	Freeway Guide Sign Replacement: Policies and Criteria (1991) 37 pp., \$8.00
105.	Construction Contract Claims: Causes and Methods of Settlement (1983) 58 pp., \$7.20	156.	Freeway Incident Management (1990) 23 pp., \$7.00
106.	Practical Guidelines for Minimizing Tort Liability (1983) 40 pp., \$6.80	157.	Maintenance Management of Street and Highway Signs (1990) 134 pp., \$12.00
107.	Shallow Foundations for Highway Structures (1983) 38 pp., \$6.80	158.	Wet-Pavement Safety Programs (1990) 54 pp., \$8.00
108.	Bridge Weight-Limit Posting Practices (1984) 30 pp., \$6.40	159.	Design and Construction of Bridge Approaches (1990) 45 pp., \$8.00
109.	Highway Uses of Epoxy with Concrete (1984) 68 pp., \$8.80	160.	Cold-Recycled Bituminous Concrete Using Bituminous Materials (1990) 105 pp., \$11.00
110.	Maintenance Management Systems (1984) 49 pp., \$8.00	161.	Computer-Aided Design and Drafting Systems (1990) 24 pp., \$7.00
111.	Distribution of Wheel Loads on Highway Bridges (1984) 22 pp., \$7.20	162.	Signing Policies, Procedures, Practices, and Fees for Logo and Tourist-Oriented Directional Signing (1990) 41 pp., \$8.00
112.	Cost Effectiveness of Hot-Dip Galvanizing for Exposed Steel (1984) 28 pp., \$7.20	163.	Innovative Strategies for Upgrading Personnel in State Transportation Departments (1990) 35 pp., \$7.00
113.	Administration of Research, Development, and Implementation Activities in Highway Agencies (1984) 49 pp., \$8.00	164.	Measures to Curtail State Fuel Tax Evasion (1990) 14 pp., \$7.00
114.	Management of Traffic Signal Maintenance (1984) 134 pp., \$10.80 (supersedes Synthesis 22)	165.	Transportation Telecommunications (1990) 92 pp., \$10.00 (supersedes Synthesis 12)
115.	Reducing Construction Conflicts between Highways and Utilities (1984) 73 pp., \$8.80	166.	Traffic Signal Control Equipment: State of the Art (1990) 43 pp., \$8.00
116.	Asphalt Overlay Design Procedures (1984) 66 pp., \$8.40	167.	Measurements, Specifications, and Achievement of Smoothness for Pavement Construction (1990) 34 pp., \$8.00
117.	Toll Highway Financing (1984) 29 pp., \$7.20	168.	Contract Management Systems (1990) 74 pp., \$10.00
118.	Detecting Defects and Deterioration in Highway Structures (1985) 52 pp., \$8.00	169.	Removing Concrete from Bridges (1991) 42 pp., \$8.00
119.	Prefabricated Bridge Elements and Systems (1985) 75 pp., \$8.80	170.	Managing Urban Freeway Maintenance (1990) 32 pp., \$7.00
120.	Professional Resource Management and Forecasting (1985) 15 pp., \$6.80	171.	Fabrics in Asphalt Overlays and Pavement Maintenance (1991) 72 pp., \$9.00
121.	Energy Conservation in Transportation (1985) 25 pp., \$7.20 (supplements Synthesis 43)	172.	Signal Timing Improvement Practices (1992) 88 pp., \$11.00
122.	Life-Cycle Cost Analysis of Pavements (1985) 136 pp., \$10.80	173.	Short-Term Responsive Maintenance Systems (1991) 43 pp., \$9.00
123.	Bridge Designs to Reduce and Facilitate Maintenance and Repair (1985) 65 pp., \$8.40	174.	Stormwater Management for Transportation Facilities (1993) 81 pp., \$9.00
124.	Use of Weigh-in-Motion Systems for Data Collection and Enforcement (1986) 34 pp., \$7.60	175.	Moisture Damage in Asphalt Concrete (1991) 91 pp., \$10.00
125.	Maintenance Activities Accomplished by Contract (1986) 42 pp., \$8.00	176.	Bridge Paint: Removal, Containment, and Disposal (1992) 60 pp., \$9.00
126.	Equipment for Obtaining Pavement Condition and Traffic Loading Data (1986) 118 pp., \$11.20	177.	Freeway Corridor Management (1992) 64 pp., \$9.00
127.	Use of Fly Ash in Concrete (1986) 66 pp., \$8.40	178.	Truck Escape Ramps (1992) 56 pp., \$9.00
128.	Methods for Identifying Hazardous Highway Elements (1986) 80 pp. (microfiche)*	179.	Latex-Modified Concretes and Mortars (1992) 58 pp., \$9.00
129.	Freezing and Thawing Resistance of High-Strength Concrete (1986) 31 pp., \$7.60	180.	Performance Characteristics of Open-Graded Friction Courses (1992) 44 pp., \$8.00 (supplements Synthesis 49)
130.	Traffic Data Collection and Analysis: Methods and Procedures (1986) 58 pp., \$8.40	181.	In-Service Experience with Traffic Noise Barriers (1992) 61 pp., \$9.00
131.	Effects of Permit and Illegal Overloads on Pavements (1987) 99 pp., \$10.40	182.	Performance and Operational Experience of Truck-Mounted Attenuators (1992) 54 pp., \$9.00
132.	System-Wide Safety Improvements: An Approach to Safety Consistency (1987) 20 pp., \$6.80	183.	Knowledge Based Expert Systems in Transportation (1992) 52 pp., \$9.00
133.	Integrated Highway Information Systems (1987) 31 pp., \$7.60	184.	Disposal of Roadside Litter Mixtures (1993) 52 pp., \$12.00
134.	D-Cracking of Concrete Pavements (1987) 34 pp., \$7.60	185.	Preferential Lane Treatments for High-Occupancy Vehicles (1993) 80 pp., \$10.00
135.	Pavement Management Practices (1987) 139 pp., \$12.40	186.	Supplemental Advance Warnings (1993) 83 pp., \$19.00
136.	Protective Coatings for Bridge Steel (1987) 107 pp., \$11.00	187.	Rapid Test Methods for Asphalt Concrete and Portland Cement Concrete (1993) 47 pp., \$10.00
137.	Negotiating and Contracting for Professional Engineering Services (1988) 75 pp., \$9.60	188.	Management Training and Development Programs (1993) 56 pp., \$15.00
138.	Pavement Markings: Materials and Application for Extended Service Life (1988) 45 pp., \$8.00 (supersedes Synthesis 17)	189.	State Highway Pavement Design Practices (1993) 45 pp., \$11.00
139.	Pedestrians and Traffic Control Measures (1988) 75 pp., \$9.00	190.	Criteria for Qualifying Contractors for Bidding Purposes (1994) 40 pp., \$11.00
140.	Durability of Prestressed Concrete Highway Structures (1988) 65 pp., \$9.00	191.	Use of Rumble Strips to Enhance Safety (1993) 74 pp., \$19.00
141.	Bridge Deck Joints (1989) 66 pp., \$9.00	192.	Accident Data Quality (1993) 53 pp., \$12.00
142.	Methods of Cost-Effectiveness Analysis for Highway Projects (1988) 22 pp., \$7.00	193.	Hot In-Place Recycling of Asphalt Concrete (1994) 69 pp., \$16.00
143.	Uniformity Efforts in Oversize/Overweight Permits (1988) 79 pp., \$10.00	194.	Electronic Toll and Traffic Management (ETTM) Systems (1993) 64 pp., \$15.00
144.	Breaking/Cracking and Seating Concrete Pavements (1989) 39 pp., \$8.00	195.	Use of Warranties in Road Construction (1994) 60 pp., \$15.00
145.	Staffing Considerations in Construction Engineering Management (1989) 42 pp., \$8.00	196.	Highway Maintenance Procedures Dealing with Hazardous Materials Incidents (1994) 60 pp., \$15.00
146.	Use of Consultants for Construction Engineering and Inspection (1989) 64 pp., \$9.00	197.	Corridor Preservation (1994) 43 pp., \$11.00
147.	Treatment of Problem Foundations for Highway Embankments (1989) 72 pp., \$9.00	198.	Uses of Recycled Rubber Tires in Highways (1994) 162 pp., \$23.00
148.	Indicators of Quality in Maintenance (1989) 114 pp., \$11.00	199.	Recycling and Use of Waste Materials and By-Products in Highway Construction (1994) 84 pp., \$20.00
149.	Partnerships for Innovation: Private Sector Contributions to Innovation in the Highway Industry (1989) 45 pp., \$8.00	200.	Underwater Bridge Maintenance and Repair (1994) 54 pp., \$16.00
150.	Technology Transfer in Selected Highway Agencies (1989) 38 pp., \$8.00	201.	Multimodal Evaluation in Passenger Transportation (1994) 84 pp., \$19.00
151.	Process for Recapitalizing Highway Transportation Systems (1989) 43 pp., \$8.00	202.	Severity Indices for Roadside Features (1994) 54 pp., \$12.00
152.	Compaction of Asphalt Pavement (1989) 42 pp., \$8.00	203.	Current Practices in Determining Pavement Condition (1994) 57 pp., \$16.00
153.	Evolution and Benefits of Preventive Maintenance Strategies (1989) 69 pp., \$9.00	204.	Portland Cement Concrete Resurfacing (1994) 67 pp., \$15.00
		205.	Performance and Operational Experience of Crash Cushions (1994) 87 pp., \$20.00
		206.	Highway Tort Liability Management Programs (1994) 40 pp., \$11.00
		207.	Managing Roadway Snow and Ice Control Operations (1994) 56 pp., \$15.00
		208.	Development and Implementation of Traffic Control Plans for Highway Work Zones (1994) 37 pp., \$11.00
		209.	Sealers for Portland Cement Concrete Highway Facilities (1994) 85 pp., \$19.00
		210.	Road Pricing for Congestion Management: A Survey of International Practice (1994) 77 pp., \$19.00

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

Table 5
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