

# RESEARCH RESULTS DIGEST

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These Digests are issued in the interest of providing an early awareness of the research results emanating from projects in the NCHRP. By making these results known as they are developed, it is hoped that the potential users of the research findings will be encouraged toward their early implementation in operating practices. Persons wanting to pursue the project subject matter in greater depth may do so through contact with the Cooperative Research Programs Staff, Transportation Research Board, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

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## 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. The Principal Investigators responsible for the project are Sally D. Liff and Herbert A. Pennock, serving under the Special Projects Division of the Board.*

### 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 has 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 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 specific 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 utilized 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 highway and transportation departments. 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; (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.

#### *Available Publications and Studies in Progress*

The Syntheses of Highway Practice that have been completed under this project are listed in Table 1. Two Research Results Digests on topics studied under the project are also listed. Copies of these Syntheses and Digests can be obtained from the Publications Office, Transportation Research Board, 2101 Constitution Avenue N.W., Washington, D.C. 20418.

Work is currently under way on the topics listed in Table 2. Questions on these topics should be addressed to the project investigators, Sally D. Liff and Herbert A. Pennock, who can be reached at (202) 334-3242.

#### *Submission and Selection of Topics*

One part of the project procedures that is not widely understood is the process for submission and selection of topics. NCHRP Project Committee SP20-5 meets each Fall 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 11 or 12 syntheses per year. This number plus some alternative topics are selected by the committee at the Fall meeting. Topics selected for the current program are listed in Table 4. It is unlikely that those near the bottom of the list will be studied at this time.

The following factors are considered in the selection process for synthesis topics:

- The problem should be widespread enough to generate broad interest in the synthesis.
- The problem should be timely and critical with respect to economic impact, safety, or social impact.
- The problem 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 from a variety of other sources, including state highway and transportation department personnel, FHWA, and AASHTO and TRB committees.

Suggestions for synthesis topics may be sent to the NCHRP Program Director at any time (see address on back). Topics suggested must be accompanied by a brief scope statement or discussion of the problem (a paragraph or two). Suggestions for updates of published syntheses are also welcome.

#### *Conduct of the Studies*

Throughout the year, 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, an agreement is negotiated with a consultant to gather information on the topic, synthesize it, and draft a report. Typically, the agreement covers 30 to 40 work-days over a period of about one year. 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 at the second panel meeting. A revised draft is then prepared by the author and reviewed by the topic panel. Subsequent drafts and meetings are scheduled if needed, although this rarely occurs.

After the topic panel 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. Comments from these reviews are incorporated into the final report, which is usually published as an NCHRP Synthesis of Highway Practice.

#### *Index of Topic Subjects*

Table 5 is an index to published syntheses and topics under study, as well as those expected to be started through 1991.

Interested in writing a synthesis? For details, contact Sally Liff at 202-334-3242.

Table 1  
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 1 (continued)

No.	Title, Pages, Price	No.	Title, Pages, Price
93.	Coordination of Transportation System Management and Land Use Management (1982) 38 pp., \$6.80	131.	Effects of Permit and Illegal Overloads on Pavements (1987) 99 pp., \$10.40
94.	Photologging (1982) 38 pp., \$6.80	132.	System-Wide Safety Improvements: An Approach to Safety Consistency (1987) 20 pp., \$6.80
95.	Statewide Transportation Planning (1982) 54 pp., \$7.20 (supersedes Synthesis 15)	133.	Integrated Highway Information Systems (1987) 31 pp., \$7.60
96.	Pavement Subsurface Drainage Systems (1982) 38 pp., \$6.80	134.	D-Cracking of Concrete Pavements (1987) 34 pp., \$7.60
97.	Transit Ownership/Operation Options for Small Urban and Rural Areas (1982) 28 pp., \$6.40	135.	Pavement Management Practices (1987) 139 pp., \$12.40
98.	Resealing Joints and Cracks in Rigid and Flexible Pavements (1982) 62 pp., \$7.20	136.	Protective Coatings for Bridge Steel (1987) 107 pp., \$11.00
99.	Resurfacing with Portland Cement Concrete (1982) 90 pp., \$8.40	137.	Negotiating and Contracting for Professional Engineering Services (1988) 75 pp., \$9.60
100.	Managing State Highway Finance (1982) 23 pp., \$6.40	138.	Pavement Markings: Materials and Application for Extended Service Life (1988) 45 pp., \$8.00 (supersedes Synthesis 17)
101.	Historic Bridges-Criteria for Decision Making (1983) 77 pp., \$8.00	139.	Pedestrians and Traffic Control Measures (1988) 75 pp., \$9.00
102.	Material Certification and Material-Certification Effectiveness (1983) 17 pp., \$6.00	140.	Durability of Prestressed Concrete Highway Structures (1988) 65 pp., \$9.00
103.	Risk Assessment Processes for Hazardous Materials Transportation (1983) 26 pp., \$6.40	141.	Bridge Deck Joints (1989) 66 pp., \$9.00
104.	Criteria for Use of Asphalt Friction Surfaces (1983) 41 pp., \$6.80	142.	Methods of Cost-Effectiveness Analysis for Highway Projects (1988) 22 pp., \$7.00
105.	Construction Contract Claims: Causes and Methods of Settlement (1983) 58 pp., \$7.20	143.	Uniformity Efforts in Oversize/Overweight Permits (1988) 79 pp., \$10.00
106.	Practical Guidelines for Minimizing Tort Liability (1983) 40 pp., \$6.80	144.	Breaking/Cracking and Sealing Concrete Pavements (1989) 39 pp., \$8.00
107.	Shallow Foundations for Highway Structures (1983) 38 pp., \$6.80	145.	Staffing Considerations in Construction Engineering Management (1989) 42 pp., \$8.00
108.	Bridge Weight-Limit Posting Practices (1984) 30 pp., \$6.40	146.	Use of Consultants for Construction Engineering and Inspection (1989) 64 pp., \$9.00
109.	Highway Uses of Epoxy with Concrete (1984) 68 pp., \$8.80	147.	Treatment of Problem Foundations for Highway Embankments (1989) 72 pp., \$9.00
110.	Maintenance Management Systems (1984) 49 pp., \$8.00	148.	Indicators of Quality in Maintenance (1989) 114 pp., \$11.00
111.	Distribution of Wheel Loads on Highway Bridges (1984) 22 pp., \$7.20	149.	Partnerships for Innovation: Private Sector Contributions to Innovation in the Highway Industry (1989) 45 pp., \$8.00
112.	Cost-Effectiveness of Hot-Dip Galvanizing for Exposed Steel (1984) 28 pp., \$7.20	150.	Technology Transfer in Selected Highway Agencies (1989) 38 pp., \$8.00
113.	Administration of Research, Development, and Implementation Activities in Highway Agencies (1984) 49 pp., \$8.00	151.	Process for Recapitalizing Highway Transportation Systems (1989) 43 pp., \$8.00
114.	Management of Traffic Signal Maintenance (1984) 134 pp., \$10.80 (supersedes Synthesis 22)	152.	Compaction of Asphalt Pavement (1989) 42 pp., \$8.00
115.	Reducing Construction Conflicts between Highways and Utilities (1984) 73 pp., \$8.80	153.	Evolution and Benefits of Preventive Maintenance Strategies (1989) 69 pp., \$9.00
116.	Asphalt Overlay Design Procedures (1984) 66 pp., \$8.40	154.	Recycling Portland Cement Concrete Pavements (1989) 46 pp., \$8.00
117.	Toll Highway Financing (1984) 29 pp., \$7.20	155.	Sign Evaluation and Replacement Programs: Policies and Criteria for Freeways and Expressways (1991) (in press)
118.	Detecting Defects and Deterioration in Highway Structures (1985) 52 pp., \$8.00	156.	Freeway Incident Management (1990) (in press)
119.	Prefabricated Bridge Elements and Systems (1985) 75 pp., \$8.80	157.	Maintenance Management of Street and Highway Signs (1990) 134 pp., \$12.00
120.	Professional Resource Management and Forecasting (1985) 15 pp., \$6.80	158.	Wet-Pavement Safety Programs (1990) 54 pp., \$8.00
121.	Energy Conservation in Transportation (1985) 25 pp., \$7.20 (supplements Synthesis 43)	159.	Design and Construction of Bridge Approaches (1990) 45 pp., \$8.00
122.	Life-Cycle Cost Analysis of Pavements (1985) 136 pp., \$10.80	160.	Cold-Recycled Bituminous Concrete Using Bituminous Materials (1990) 105 pp., \$11.00
123.	Bridge Designs to Reduce and Facilitate Maintenance and Repair (1985) 65 pp., \$8.40	161.	Computer-Aided Design and Drafting Systems (1990) 24 pp., \$7.00
124.	Use of Weigh-in-Motion Systems for Data Collection and Enforcement (1986) 34 pp., \$7.60	162.	Signing Policies, Procedures, Practices, and Fees for Logo and Tourist-Oriented Directional Signing (1990) 41 pp., \$8.00
125.	Maintenance Activities Accomplished by Contract (1986) 42 pp., \$8.00	163.	Innovative Strategies for Upgrading Personnel in State Transportation Departments (1990) 35 pp., \$7.00
126.	Equipment for Obtaining Pavement Condition and Traffic Loading Data (1986) 118 pp., \$11.20	164.	Measures to Curtail State Fuel Tax Evasion (1990) 14 pp., \$7.00
127.	Use of Fly Ash in Concrete (1986) 66 pp., \$8.40	165.	Transportation Telecommunications (1990) 92 pp., \$10.00 (supersedes Synthesis 12)
128.	Methods for Identifying Hazardous Highway Elements (1986) 80 pp. (microfiche)*	166.	Traffic Signal Control Equipment: State of the Art (1990) (in press)
129.	Freezing and Thawing Resistance of High-Strength Concrete (1986) 31 pp., \$7.60	167.	Measurements, Specifications, and Achievement of Smoothness for Pavement Construction (1990) 40 pp., \$8.00
130.	Traffic Data Collection and Analysis: Methods and Procedures (1986) 58 pp., \$8.40	168.	Contract Management Systems (1990) (in press)
		170.	Managing Urban Freeway Maintenance (1990) 32 pp., \$7.00
<b>Research Results Digests</b>			
100.	Safe Conduct of Traffic Through Highway Construction and Maintenance Zones (1978) 5 pp., \$1.00	106.	Use of Waste Materials in Highway Construction and Maintenance (1979) 2 pp., \$1.00
<b>Syntheses in Editorial and Publication Process</b>			
169.	Removing Concrete from Bridges	13-07	Storm Water Management for Transportation Facilities
171.	Fabrics in Asphalt Overlays and Pavement Maintenance	17-05	Design, Construction, and Maintenance of PCC Pavement Joints
172.	Signal Timing and Optimization Procedures	20-06	Maintenance Management Strategies for Low-Volume Roads
173.	Operational Experience with Loop Detectors		

**Table 2  
TOPICS BEING STUDIED**

No.	Title	No.	Title
17-07	Durability of Drainage Pipe	21-10	Surface Recycling (Heat Scarification)
18-07	Freeway Corridor Management	21-11	Impacts of Hazardous Materials on Highway Maintenance
19-09	Moisture Damage in Asphalt Concrete	21-12	Truck Escape Ramps: Location, Design, and Operation
19-22	Status and Application of GPS Satellite Surveying for Departments of Transportation	21-13	State Highway Pavement Design Practices
20-04	Work Zone Traffic Control and Safety on Urban and Suburban Streets	21-14	Criteria for Qualifying Contractors for Bidding Purposes
20-05	Short-Term Responsive Maintenance Systems	22-01	Performance and Operational Experience of Truck-Mounted Attenuators
20-09	Bridge Paint: Removal, Containment, and Disposal	22-02	Uses of Recycled Rubber Tires in Highways
20-11	In-Service Experience with Traffic Noise Barriers	22-04	Underwater Bridge Maintenance and Repair
20-12	Latex-Modified Concrete	22-07	Current Practices in Determining Pavement Condition
20-22	Highway Tort Liability Management Programs	22-08	Disposal of Roadside Litter Mixtures
21-01	Performance Characteristics of Open-Graded Asphalt Friction Courses	22-09	Application of Expert Systems (A Branch of Artificial Intelligence) to Transportation Problems
21-02	Preferential Lane Treatments for High-Occupancy Vehicles	22-10	Use of Waste Materials and By-Products in Highway Construction
21-03	Management Training and Development Programs	22-11	Photographic Enforcement of Traffic Laws
21-06	Development of Professional Highway Maintenance Engineers	22-12	Truck Operating Characteristics
21-08	Development and Implementation of Traffic Control Plans for Highway Work Zones	22-13	Use of Rumble Strips to Enhance Safety
21-09	Supplemental Advance Warnings	22-14	Impacts of Highway Bypasses on Rural Communities and Small Urban Areas

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

Chairman Verdi Adam Gulf Engineers & Consultants	
Robert N. Bothman Oregon Dept. of Transportation	Edward A. Mueller Morales and Shumer Engineers
Jack Freidenrich The RBA Group	Earl Shirley California Dept. of Transportation
John J. Henry Pennsylvania Transportation Institute	Jon Underwood Texas Dept. of Highways and Public Transp.
Bryant Mather USAE Waterways Experiment Station	Thomas Willett Federal Highway Administration
Thomas H. May Pennsylvania Dept. of Transportation	Richard A. McComb (Liaison) Federal Highway Administration
Robert E. Spicher (Liaison) Transportation Research Board	

**Table 4  
SYNTHESIS TOPICS SELECTED FOR THE FY 1991 PROGRAM**

No.	Title	No.	Title
23-01	Accident Data Quality	23-10	Portland Cement Concrete Resurfacing
23-02	Rapid Test Methods	23-11	Changeable Message Signs
23-03	Managing Snow and Ice Control Operations	23-12	Reduced Visibility on the Highway
23-04	Multimodal Evaluation in Passenger Transportation	23-13	Park and Ride: Operation, Maintenance, and Funding
23-05	Relationship of Current Construction Specifications to Performance	23-14	Crash Test Performance of Permanent and Temporary Crash Cushions
23-06	Corridor Preservation	23-15	Subbases Under PCC Pavement
23-07	Guaranty of Road Construction by the Contractor	23-16	Public/Private Donations for Highway Maintenance and/or Operations
23-08	Minimization of Costs for Dealing with Hazardous or Toxic Materials	23-17	Longitudinal Occupancy of Limited-Access Right of Way by Utilities
23-09	Severity Indices for Roadside Hazards		

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