

## 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 Thomas L. Copas and Herbert A. Pennock, serving under the Special Technical Activities 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," which 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*, which 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.

#### Available Publications and Studies in Progress

The 88 published Syntheses of Highway Practice that have been prepared under this project to date 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. A check or money order must accompany orders totaling \$10.00 or less.

Work is currently under way on the 23 topics listed in Table 2. Questions on these topics should be addressed to the project investigators, Thomas L. Copas and Herbert A. Pennock, who can be reached at (202) 334-3242.

#### Submission and Selection of Topics

One part of 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 10 or 11 syntheses per year. This number plus some alternate topics are selected by the committee at the Fall meeting. Topics selected for the FY '82 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. State highway and transportation department personnel may submit suggestions for synthesis topics directly to the NCHRP Program Director or, if desired, through their State TRB Representative. Topics suggested must be accompanied by a brief scope statement or discussion of the problem.

#### 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 man-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 contains an index to published syntheses and topics now under study, as well as those expected to be started through 1982.

---

The NCHRP Projects Engineer responsible for Project 20-5 is Robert J. Reilly, who can be reached at (202) 334-3224.

Table 1  
COMPLETED TOPICS

No.	Title, Pages, Price	No.	Title, Pages, Price
<u>Syntheses</u>			
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., \$2.00	48.	Priority Programming and Project Selection (1978) 31 pp., \$3.20
3.	Traffic-Safe and Hydraulically Efficient Drainage Practice (1969) 38 pp. (microfiche only)*	49.	Open-Graded Friction Courses for Highways (1978) 50 pp., \$4.00
4.	Concrete Bridge Deck Durability (1970) 28 pp. (microfiche only)*	50.	Durability of Drainage Pipe (1978) 37 pp., \$3.60
5.	Scour at Bridge Waterways (1970) 37 pp. (microfiche only)*	51.	Construction Contract Staffing (1978) 62 pp., \$6.00
6.	Principles of Project Scheduling and Monitoring (1970) 43 pp., \$2.40	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 only)*	54.	Recycling Materials for Highways (1978) 53 pp., \$5.60
9.	Pavement Rehabilitation - Materials and Techniques (1972) 41 pp., \$2.80	55.	State Highway and Transportation Data Storage and Retrieval Systems (1978) 30 pp., \$4.80
10.	Recruiting, Training, and Retaining Maintenance and Equipment Personnel (1972) 35 pp., \$2.80	56.	Joint-Related Distress in PCC Pavement—Cause, Prevention and Rehabilitation (1979) 36 pp., \$5.20
11.	Development of Management Capability (1972) 50 pp., \$3.20	57.	Durability of Concrete Bridge Decks (1979) 61 pp., \$6.00
12.	Telecommunications Systems for Highway Administration and Operations (1972) 39 pp., \$2.80	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., \$4.00	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 only)*	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	63.	Design and Use of Highway Shoulders (1979) 26 pp., \$4.80
18.	Erosion Control on Highway Construction (1973) 52 pp., \$4.00	64.	Bituminous Patching Mixtures (1979) 26 pp., \$4.80
19.	Design, Construction, and Maintenance of PCC Pavement Joints (1973) 40 pp., \$3.60	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 only)*	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., \$4.00	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., \$6.00	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 only)*	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	75.	Transit Boards—Composition, Roles, and Procedures (1981) 24 pp., \$6.20
30.	Bituminous Emulsions for Highway Pavements (1975) 76 pp., \$4.80	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., \$3.20	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 (in publication)
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 (in publication)
37.	Lime-Fly Ash-Stabilized Bases and Subbases (1976) 66 pp., \$4.80	83.	Bus Transit Accessibility for the Handicapped in Urban Areas (in publication)
38.	Statistically Oriented End-Result Specifications (1976) 40 pp., \$4.00	84.	Evaluation Criteria and Priority Setting for State Highway Programs (in publication)
39.	Transportation Requirements for the Handicapped, Elderly, and Economically Disadvantaged (1976) 54 pp., \$4.40	85.	Energy Involved in Construction Materials and Procedures (in publication)
40.	Staffing and Management for Social, Economic, and Environmental Impact Assessment (1977) 43 pp., \$4.00	86.	Effects of Traffic-Induced Vibrations on Bridge Deck Repairs (in publication)
41.	Bridge Bearings (1977) 62 pp., \$4.80	87.	Highway Noise Barriers (in publication)
42.	Design of Pile Foundations (1977) 68 pp., \$4.80	88.	Underwater Inspection and Repair of Bridge Substructures (in publication)
43.	Energy Effects, Efficiencies, and Prospects for Various Modes of Transportation (1977) 57 pp., \$4.80	<u>Research Results Digests</u>	
44.	Consolidation of Concrete for Pavements, Bridge Decks, and Overlays (1977) 61 pp., \$4.80	100.	Safe Conduct of Traffic Through Highway Construction and Maintenance Zones, 5 pp., \$1.00
45.	Rapid-Setting Materials for Patching of Concrete (1977) 13 pp., \$2.40	106.	Use of Waste Materials in Highway Construction and Maintenance, 2 pp., \$1.00
46.	Recording and Reporting Methods for Highway Maintenance Expenditures (1977) 35 pp., \$3.60		

\*These syntheses are available from TRB in microfiche form only at a cost of \$4.00 each.

Table 2

TOPICS BEING STUDIED

No.	Title	No.	Title
8-10	Photologging	12-11	Bridge Designs to Reduce and Facilitate Maintenance and Repair
9-12	Welding and Inspection Practices in Bridge Fabrication	12-12	New Products Evaluation Procedures
11-04	Techniques for Minimizing Reflection Cracking of Pavement Overlays	13-01	Contract Claims: Causes and Methods of Settlement
11-05	Utilization of Information Systems in Construction Engineering Management	13-02	Methods of Cost-Effectiveness Analysis for Highway Projects
11-06	Geotechnical Instrumentation for Monitoring Field Performance	13-03	Managing State Transportation Finance
11-07	Pavement Subsurface Drainage Systems	13-04	Resurfacing with Portland Cement Concrete
12-03	Use of Data Processing and Accident Location Systems for Highway Accident Analysis	13-05	Statewide Transportation Planning
12-04	Resealing Joints and Cracks in Rigid and Flexible Pavements	13-06	Transit Ownership/Management Options for Small Urban and Rural Areas
12-06	Shallow Foundations for Highway Structures	13-07	Storm Water Management for Transportation Facilities
12-08	Coordinating TSM and Land-Use Planning and Implementation to Meet Development and Transportation Objectives	13-08	Bridge Posting Practices
		13-09	Highway Inventory Systems
		13-10	Risk Assessment Processes for of Hazardous Materials Transportation
		13-11	Criteria for Decisions Involving Historic Bridges

Table 3

NCHRP PROJECT COMMITTEE SP20-5

Chairman Ray R. Biege, Jr. Consultant	
Verdi Adam Louisiana Dept. of Transp. and Dev.	Thomas H. May Pennsylvania Dept. of Transportation
Robert N. Bothman Oregon Dept. of Transportation	Theodore F. Morf Consultant
Jack Freidenrich New Jersey Dept. of Transportation	Edward A. Mueller Reynolds, Smith and Hills
David Gedney DeLeuw, Cather and Company	Milton P. Criswell Federal Highway Administration
Sanford LaHue Federal Highway Administration	K. B. Johns Transportation Research Board
Bryant Mather USAE Waterways Experiment Station	

Table 4

SYNTHESIS TOPICS SELECTED FOR THE FY '82 PROGRAM

No.	Title	No.	Title
14-01	Practical Guidelines for Minimizing Tort Liability	14-12	Use of Epoxies for Repairing PCC Concrete
14-02	Maintenance of Traffic Signals and Surveillance Systems	14-13	Impact of Reductions-in-Force on State Highway Construction Contract Supervision and Control of Work
14-03	Reducing Delays, Damage, and Costs Through Improved Highway-Utility Coordination	14-14	Recruiting, Training, and Retaining Engineering Technicians
14-04	Asphalt Overlay Design Procedures	14-15	Hazardous Highway Element Identification Procedures
14-05	Material Certification and Material-Certification Effectiveness	14-16	Railroad-Highway Grade-Crossing Surfaces
14-06	Maintenance Management Systems	14-17	Traffic Data Collection, Analysis, and Forecasting Methods and Procedures
14-07	Maintenance Activities Accomplished by Contract	14-18	Highway Bridge Fracture Studies
14-08	Criteria for Use of Asphaltic Concrete Friction Courses	14-19	Techniques for Minimizing Pavement Roughness at Bridge Approaches
14-09	Energy Conservation in Transportation	14-20	Vehicle Downsizing and Roadside Safety Hardware
14-10	Truck Impacts on Highway Safety and Operations	14-21	Equipment for Obtaining Pavement Management Data
14-11	Research, Development, and Implementation Activities and Organization of State Highway and Transportation Departments		

Table 5

## INDEX TO SYNTHESSES AND STUDIES\*

---

Accident location 21, 12-03	Continuously reinforced pavements 16, 60
Aid to motorists 7	Contract claims 13-01
Asphalt	Contract maintenance 14-07
- cement 59	Contract time determination 79
- emulsions 30	Cost-effectiveness analysis 13-02
- friction courses 49, 14-08	Culverts
- overlays 14-04	- durability 50
- patching 64	- inlets 3
- pavements 30, 49, 59, 14-08	
Bases 37	Data systems 55
Bearings for bridges 41	Deicing chemical use 24
Bituminous emulsions 30	Deferred maintenance 58
Bituminous patching 64	Design
Bituminous pavements 30, 49, 59, 14-08	- bituminous pavements 30, 14-04
Bridges	- bridge approaches 2
- approaches 2	- bridge bearings 41
- bearings 41	- concrete pavements 16, 19, 27
- below-water inspection 88	- frost 26
- concrete decks 4, 57, 86	- pavement overlays 13-04, 14-04
- construction 44, 53	- pavements 16, 19, 26, 27, 30
- design for maintenance 12-11	- pile foundations 42
- drainage 67	- roadways 26
- foundations 42, 12-06	- shoulders 63
- historic 13-11	- value engineering 78
- inspection 88	Disadvantaged, transportation for 39
- patching 45	Drainage
- posting practices 13-08	- bridge 67
- precast concrete 53	- pavement 11-07
- prefabricated 53	- sedimentation basins 70
- scour 5	Drainage durability 50
- substructure repair 88	Drainage structures 3
- welding 9-12	
Bus transit planning 69	Elderly, transportation for 39, 83
	Embankments 8
Changeable message signs 61	Emulsions 30
Communications 7, 12, 13, 71	End-result specifications 38
Computers 55	Energy
Concrete	- bituminous emulsions 30
- bridge decks 4, 57, 86	- construction 85
- consolidation 44	- transportation use 43, 14-09
- overlays 13-04	Equipment
- patching 45	- management 52
- pavements 16, 19, 27, 45, 56, 60, 12-04, 13-04	- procurement 52
- precast 53	- selection 52
Consolidation of concrete 44	
Construction	Field testing equipment 36
- bases and subbases 37	Finance/budgets 62, 72, 80, 13-03
- bituminous pavements 30	Fly ash 37
- bridge approaches 2	Foundations
- bridge decks 4, 44, 57, 86	- embankments 8, 29
- concrete pavements 16, 19, 27, 44	- pile 42
- contract claims 13-01	- shallow 12-06
- contract time 79	- soft strata 29
- embankments 8	Freeways
- energy factors 85	- maintenance 1, 25
- erosion control 18	- off-ramps 35
- management 51, 11-05	- repair 25
- material certification 14-05	Friction courses 49, 14-08
- pavements 16, 19, 27, 30, 44	Frost susceptibility 26
- recycling 54	Fuel taxes 62
- specifications 38	
- staffing 51	Geotechnical data 33
- testing 65	Geotechnical exploration 33
- traffic control RRD 100	Geotechnical instrumentation 11-06
- value engineering 78	Glare screen 66
- weather 47	
- welding 9-12	Handicapped, transportation for 39, 83

---

\*Simple numbers represent published syntheses;  
hyphenated numbers are studies in progress.

- 
- Hazardous materials transportation
    - risk assessment 13-10
  - Highway inventory systems 13-09
  - Historic bridges 13-11
  
  - Information for motorists 7, 71
  - Inspection of bridges 88
  - Instrumentation, geotechnical 11-06
  - Inventory systems for highways 13-09
  
  - Joints, concrete pavement 19, 56, 12-04
  - Joints and cracks, sealing 12-04
  
  - Laboratory testing equipment 36
  - Land use 12-08
  - Legal liability 14-01
  - Lime-fly ash 37
  - Location reference methods 21
  - Low-volume pavements 27
  
  - Maintenance
    - bituminous pavements 30, 64, 12-04
    - bridges 88, 12-11
    - budgets 80
    - concrete pavements 29, 45, 56, 60, 12-04
    - contract 14-07
    - costs 58, 12-04
    - deferred 58
    - equipment 52
    - freeways 1, 25
    - management 10, 22, 46, 52, 58, 80, 14-06
    - management systems 14-06
    - pavement costs 77, 12-04
    - pavements 9, 19, 25, 30, 45, 56, 60, 64, 12-04
    - personnel 10
    - records 46
    - recycling 54
    - reporting 46
    - rest areas 20
    - traffic control 1, 25, RRD 100
    - traffic signals 22, 14-02
    - tunnels 31
  - Management
    - construction 51, 11-05
    - data 55
    - information systems 11-05
    - maintenance 10, 22, 46, 52, 58, 80, 14-06
    - personnel 11
    - S.E.E. assessments 40
    - training 11
  - Material certification 14-05
  - Materials testing equipment 36
  - Median glare screen 66
  - Mileposts 21
  - Monitoring of projects 6
  - Motorist aid systems 7
  - Motorist information 71
  
  - Needs studies 72
  - New product evaluation 12-12
  - Noise barriers 87
  
  - Off-ramps 35
  
  - Open-graded surfaces 49
  - Overlays 9, 49, 11-04, 13-04, 14-04
  
  - Patching 9, 45, 59
  - Pavements
    - asphalt 30, 49, 59, 14-04
    - bases 37
    - bituminous 30, 49, 59, 14-04, 14-08
    - concrete 16, 19, 27, 44, 56, 60, 13-04
    - condition data 76
    - construction 16, 19, 27, 30, 44
    - CRCP 16, 60
    - distress 9
    - drainage 11-07
    - durability 59
    - evaluation 76
    - friction courses 49, 14-08
    - frost design 26
    - joints 19, 56, 12-04
    - low-volume 27
    - maintenance costs 77, 12-04
    - overlays 9, 11-04, 13-04, 14-04
    - patching 9, 45, 64
    - rehabilitation 9, 25, 11-04
    - skid resistance 14
    - striping 17
    - studded tires 32
    - widening 28
  - Permit operations 68
  - Personnel training 10, 11
  - Photologging 8-10
  - Pile foundations 42
  - Pipe durability 50
  - Planning
    - statewide transportation 15, 13-05
    - transit 69, 73
    - transportation 73
  - Poor, transportation for 39
  - Posting of bridges 13-08
  - Pothole repair 64
  - Pozzolans 37
  - Precast concrete 53
  - Priority programming 48, 84
  - Programming 48, 72, 84
  - Project scheduling 6
  
  - Quality assurance 65
  
  - Radio communications 12, 13
  - Radio frequency management 13
  - Recycling highway materials 54
  - Reference methods 21
  - Reference posts 21
  - Reflection cracking 9, 11-04
  - Rehabilitation
    - freeways 25
    - pavements 9, 56, 11-04
  - Research implementation 23
  - Rest areas 20
  - Right-of-way
    - utilities 34
    - value engineering 78
  - Risk assessment, hazardous materials 13-10
-

---

Safety 1, 3, 7, 14, 32, 49, 66, 14-10, RRD 100  
Scheduling of projects 6  
Scour 5  
Sedimentation basins 18, 70  
Shoulders 63  
Signs, changeable message 61  
Size regulation and enforcement 68  
Skid resistance 14  
Snow and ice control 24  
Soft foundations 29  
Soil erosion 18  
Specifications 38, 65  
Spectrum management 13  
Stabilization of bases 37  
Staffing  
    - construction 51  
    - maintenance 10  
    - S.E.E. assessments 40  
Statewide transportation planning 15, 13-05  
Statistical specifications 38, 65  
Storm water management 13-07  
Stream scour 5  
Striping 17  
Structures (see bridges)  
Structures, precast 53  
Studded tires 32  
Subbases 37  
Subsurface information 33  
Surface courses 49  
  
Taxes, fuel 62  
Telecommunications 12  
Telephones 12  
Testing, construction 65  
Testing equipment 36  
Tort liability 14-01

Traffic control  
    - construction RRD 100  
    - devices 61  
    - maintenance 1, RRD 100  
    - ramps 35  
Traffic marking 17  
Traffic paint 17  
Traffic safety 1, 3, 32, 35, 66, RRD 100  
Traffic signal maintenance 22, 14-02  
Training of personnel 10, 11  
Transit  
    - barriers, elderly/handicapped 83  
    - boards 75  
    - management assistance 74  
    - ownership 13-06  
    - planning 69, 73  
Transportation planning 15, 72, 73, 13-05  
Transportation system management 81, 12-08  
Truck impacts on safety 14-10  
Truck weights and sizes 68, 82  
Tunnels, maintenance & operation 31  
  
Urban freeway reconditioning 25  
Utilities 34, 14-03  
  
Variable message signs 61  
Value engineering 78  
Vibration of concrete 44  
  
Waste materials RRD 106  
Weather 47  
Weight regulation & enforcement 68, 82  
Welding 9-12  
Widening of pavements 28  
Work schedules 73

---

**TRANSPORTATION RESEARCH BOARD**

National Research Council  
2101 Constitution Avenue, N.W.  
Washington, D.C. 20418

NON-PROFIT ORG.  
U.S. POSTAGE  
PAID  
WASHINGTON, D.C.  
PERMIT NO. 42970

000015M001  
JAMES W HILL  
RESEARCH SUPERVISOR  
IDAHO TRANS. DEPT DIV OF HWYS  
P O BOX 7129 3311 W STATE ST  
BOISE ID 83707