

NCHRP Research on Bridge Engineering

*An NCHRP staff digest of the progress and status
of bridge engineering research under the National
Cooperative Highway Research Program.*

Since its inception in 1962 the National Cooperative Highway Research Program (NCHRP) has included numerous studies of interest to bridge engineers. In recent years, concurrently with a growing national awareness of bridge problems, a substantial number of bridge research projects have been referred to NCHRP by the program sponsors, the American Association of State Highway and Transportation officials (AASHTO).

The purpose of this digest is to outline for easy reference the status of all NCHRP research related to bridges. Projects completed, in progress, and under development are included. A listing of all related research reports is also provided, with directions for obtaining copies.

NCHRP research covers a wide range of problem areas related to design, construction, and maintenance of bridges. Both durability and structural behavior are included, with particular emphasis on methods of prevention and repair of damage caused by fatigue in steel members or corrosion of reinforcement in bridge decks. However, the studies listed comprise only a portion of all bridge research carried out in the United States in recent years. A more comprehensive listing of current and planned research, including Federal Highway Administration (FHWA) contracts and state Highway Planning and Research (HP&R) studies, can be found in the documentation for FHWA's Federally Coordinated Program for Research and Development (FCP).

All available published reports on NCHRP bridge research are listed in Table 1.

Some 27 relevant publications in the NCHRP Report series are listed in Table 1a.

NCHRP Syntheses of Highway Practice concerned with bridge problems are

TABLE 1
REPORTS AVAILABLE

| No. | Title | Proj. No. | Research Agency | No. of Pages | Cost | Year of Publ. |
|------------------|--|--------------|-----------------------------------|-----------------|--------|------------------|
| (a) NCHRP Report | | | | | | |
| 1 | Evaluation of Methods of Replacement of Deteriorated Concrete in Structures | 6-8 | Bertram D. Tallamy Associates | 56 | \$2.80 | 1964 |
| 4 | Non-Chemical Methods of Snow and Ice Control on Highway Structures | 6-2 | Roy Jorgensen and Associates | 74 | 3.20 | 1964 |
| 16 | Protective Coatings to Prevent Deterioration of Concrete by Deicing Chemicals | 6-3 | Battelle Memorial Institute | 21 | 1.60 | 1965 |
| 23 | Methods for Reducing Corrosion of Reinforcing Steel | 6-4 | Battelle Memorial Institute | 22 | 1.40 | 1966 |
| 74 | Protective Coatings for Highway Structural Steel | 4-6 | Steel Structures Painting Council | 64 | 2.80 | 1969 |
| 74A | Protective Coatings for Highway Structural Steel--Literature Survey | 4-6 | Steel Structures Painting Council | 275 | 8.00 | 1969 |
| 74B | Protective Coatings for Highway Structural Steel--Current Highway Practices | 4-6 | Steel Structures Painting Council | 102 | 4.00 | 1969 |
| 80 | Oversize-Overweight Permit Operation on State Highways | 2-10 | Roy Jorgensen and Associates | 120 | 5.20 | 1969 |
| 83 | Distribution of Wheel Loads on Highway Bridges | 12-2 | Iowa State University | 56 | 2.80 | 1970 |
| 86 | Tentative Service Requirements for Bridge Rail Systems | 12-8 | Texas A & M University | 62 | 3.20 | 1970 |
| 90 | Protection of Steel in Prestressed Concrete Bridges | 12-5 | University of Denver | 86 | 4.00 | 1970 |
| 101 | Effect of Stress on Freeze-Thaw Durability of Concrete Bridge Decks | 6-9 | University of Illinois | 70 | 3.60 | 1970 |
| 102 | Effect of Weldments on the Fatigue Strength of Steel Beams | 12-7 | Lehigh University | 114 | 5.40 | 1970 |
| 105 | Dynamic Pavement Loads of Heavy Highway Vehicles | 15-5 | General Motors Corporation | 94 | 5.00 | 1970 |
| 106 | Revibration of Retarded Concrete for Continuous Bridge Decks | 18-1 | University of Illinois | 67 | 3.40 | 1970 |
| 109 | Elastomeric Bearing Research | 12-9 | Battelle Memorial Institute | 53 | 3.00 | 1970 |
| 116 | Structural Analysis and Design of Pipe Culverts | 15-3 | Northwestern University | 155 | 6.40 | 1971 |
| 141 | Changes in Legal Vehicle Weights and Dimensions: Some Economic Effects on Highways | 19-3 | Wilbur Smith and Associates | 184 | 8.40 | 1973 |
| 147 | Fatigue Strength of Steel Beams with Welded Stiffeners and Attachments | 12-7 | Lehigh University | 85 | 4.80 | 1974 |

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|-----|--|-------|------------------------------------|------------|------|------|
| 149 | Bridge Rail Design--Factors, Trends, and Guidelines | 12-8 | Texas A & M University | 49 | 4.00 | 1974 |
| 153 | Recommended Procedures for Vehicle Crash Testing of Highway Appurtenances | 22-2 | Southwest Research Institute | 19 | 3.20 | 1974 |
| 163 | Design of Bent Caps for Concrete Box-Girder Bridges | 12-10 | Portland Cement Association | 124 | 6.80 | 1976 |
| 164 | Fatigue Strength of High-Yield Reinforcing Bars | 4-7 | Portland Cement Association | 90 | 5.60 | 1976 |
| 165 | Waterproof Membranes for Protection of Concrete Bridge Decks--Laboratory Phase | 12-11 | Materials Research and Development | 70 | 4.80 | 1976 |
| 180 | Cathodic Protection for Reinforced Concrete Bridge Decks | 12-13 | USS Engineers and Consultants | 135 | 7.00 | 1977 |
| 181 | Subcritical Crack Growth in Steel Bridge Members | 12-14 | U. S. Steel Corporation | 82 | 5.60 | 1977 |
| 182 | Economic Evaluation of Ice and Frost on Bridge Decks | 6-11 | Midwest Research Institute | 73 | 4.80 | 1978 |
| 188 | Fatigue of Welded Steel Bridge Members Under Variable Amplitude Loadings | 12-12 | U. S. Steel Corporation | (in press) | | 1978 |

(b) NCHRP Synthesis of Highway Practice

| | | | | | | |
|----|---|----------|-------------------------------|------------|------|------|
| 2 | Bridge Approach Design and Construction Practices | 20-5 | Transportation Research Board | 30 | 2.00 | 1969 |
| 4 | Concrete Bridge Deck Durability | Topic #2 | Transportation Research Board | 28 | 2.20 | 1970 |
| 5 | Scour at Bridge Waterways | #3 | Transportation Research Board | 37 | 2.40 | 1970 |
| 33 | Acquisition and Use of Geotechnical Information | #5 | Transportation Research Board | 40 | 4.00 | 1976 |
| 41 | Bridge Bearings | #5-04 | Transportation Research Board | 62 | 4.80 | 1977 |
| 42 | Design of Pile Foundations | #6-09 | Transportation Research Board | 68 | 4.80 | 1977 |
| 44 | Consolidation of Concrete for Pavements, Bridge Decks, and Overlays | #5-04 | Transportation Research Board | 61 | 4.80 | 1977 |
| 50 | Durability of Drainage Pipe | #7-01 | Transportation Research Board | (in press) | | 1978 |

(c) NCHRP Research Results Digest

| | | | | | | |
|--------|--|----------|------------------------------|----|------|------|
| 14 | Waterproof Expansion Joints for Bridges | 12-3 | Southwest Research Institute | 3 | 1.00 | 1969 |
| 59 | Classification of Welded Bridge Details for Fatigue Loading | 12-15 | Lehigh University | 22 | 1.00 | 1974 |
| 60 | Fatigue of Welded Steel Bridge Members Under Variable-Amplitude Loadings | 12-12 | U. S. Steel Corporation | 21 | 1.00 | 1974 |
| 66 | Nondestructive Methods of Fatigue Crack Detection in Steel Bridge Members | 12-15 | Lehigh University | 13 | 1.00 | 1975 |
| 74 | Electroslag Weldments in Bridges | 10-10 | U. S. Steel Corporation | 23 | 1.00 | 1975 |
| 81 | Crash Testing and Evaluation of Attenuating Bridge Railing System | 22-1A | Texas A & M University | 10 | 1.00 | 1976 |
| 85 | Bridge Deck Repairs | 12-16 | Battelle Columbus Laboratory | 22 | 1.00 | 1976 |
| 98 | Safety at Narrow Bridge Sites | 20-7 | Texas A & M University | 9 | 1.00 | 1977 |
| Task 7 | | | | | | |
| 101 | Retrofitting Procedures for Fatigue-Damaged Full-Scale Welded Bridge Beams | 12-15(2) | Lehigh University | 7 | 1.00 | 1978 |

listed in Table 1b. These reports emanate from NCHRP Project 20-5, "Synthesis of Information Related to Highway Problems."

Table 1c lists NCHRP Research Results Digests on studies related to bridges.

Copies of publications listed in Table 1 can be obtained from the Publications Office, Transportation Research Board, 2101 Constitution Avenue, NW, Washington, DC, 20418. A check or money order payable to Transportation Research Board must accompany orders totaling \$7.50 or less.

Uncorrected copies of agency final reports listed in Table 2 can be obtained as noted.

Bridge engineering research projects currently in progress are listed in Table 3. Details on these studies can be found in the NCHRP Summary of Progress through 1977.

Research projects in the developmental stage and expected to start during the next 12 months are listed in Table 4.

Additional information may be obtained by contacting Robert J. Reilly, NCHRP Projects Engineer, at (202) 389-6741.

TABLE 2

UNCORRECTED AGENCY FINAL REPORTS TO NCHRP

| Proj. No. | Title | Research Agency | Avail- ^a ability |
|-----------|---|--------------------------------------|-----------------------------|
| 10-10 | Acceptance Criteria for Electroslog Weldments in Bridges (Phase I) | U.S. Steel Corp. | A |
| 10-11 | Development of a Performance Specification for Bridge Deck Joint-Sealing Systems | Howard, Needles, Tammen & Bergendoff | A |
| 12-1 | Deformation of Steel Beams Related to Permitted Highway Bridge Overloads | Univ. of Missouri | B |
| 12-4 | Thermal Characteristics of Highway Bridges | Southwest Research Institute | B |
| 12-6 | Prediction of Permanent Camber of Bridges | Univ. of Missouri | B |
| 12-12 | Welded Steel Bridge Members Under Variable-Cycle Fatigue Loadings | U.S. Steel Corp. | A |
| 12-15 | Detection and Repair of Fatigue Cracking in Highway Bridges | Lehigh Univ. | A |
| 18-2 | Use of Polymers in Highway Concrete | Lehigh Univ. | A |
| 22-1 | Concepts for Improved Traffic Barrier Systems | Walter W. White | B |
| 22-1A | Testing and Evaluation of Bridge Rail Concepts | Texas A & M Univ. Res. Foundation | A |
| 22-2(2) | Multiple Service Level Highway Bridge Railings--Performance and Design Criteria (Phase I) | Southwest Research Institute | A |

^aA: A copy of the uncorrected draft of the agency's report may be obtained on a loan basis by request to the NCHRP Program Director.

B: Information on securing copies of the agency report may be obtained by writing to University Microfilms International, 300 North Zeeb Road, An Arbor, MI 48106.

TABLE 3
RESEARCH IN PROGRESS

| Proj. No. | Title | Research Agency | Completion Date |
|-----------|--|---------------------------------|-----------------|
| 4-14 | Coating Systems for Painting Old and New Structural Steel | Georgia Institute of Technology | 3/31/80 |
| 10-10 | Acceptance Criteria for Electroslag Weldments in Bridges | U. S. Steel Corp. | 9/30/78 |
| 12-11/1 | Waterproof Membranes for Protection of Concrete Bridge Decks | Materials R & D | 6/30/78 |
| 12-13A | Field Evaluation of Galvanic Cathodic Protection for Reinforced Concrete Bridge Decks | Portland Cement Assn. | 1/15/80 |
| 12-15(2) | Retrofitting Procedures for Fatigue-Damaged Full-Scale Welded Bridge Beams | Lehigh Univ. | 8/31/78 |
| 12-15(3) | Fatigue Behavior of Full-Scale Welded Bridge Attachments | Lehigh Univ. | 3/31/80 |
| 12-16 | Influence of Bridge Deck Repairs on Corrosion of Reinforcing Steel | Battelle Columbus | 11/30/77* |
| 12-17 | Evaluation of Repair Techniques for Damaged Steel Bridge Members | Battelle Columbus | 4/30/78* |
| 12-18 | Development of an Integrated Bridge Design System | Multisystems, Inc. | 3/05/80 |
| 12-19 | Cathodic Protection of Concrete Bridge Structures | Corrosion Eng. & Res. | 12/31/80 |
| 12-20 | Bridges on Secondary Highways and Local Roads--Rehabilitation and Replacement | Univ. of Virginia | 11/30/79 |
| 18-2(2) | Polymer Concrete in Highway Bridge Decks | Lehigh Univ. | 12/31/78 |
| 20-16 | State Laws and Regulations on Truck Size, Weight, and Speed | R. J. Hansen Asso. | 9/1/78 |
| 22-2(2) | Multiple Service Level Highway Bridge Railings--Performance and Design Criteria | Southwest Research Institute | 7/31/78 |
| 20-5 | Synthesis of Information Related to Highway Problems <u>Topic 8-05, Precast Concrete Elements for Transportation Facilities</u> <u>Topic 9-01, Bridge Deck Durability</u> <u>Topic 9-12, Welding and Inspection Practices in Bridge Fabrication</u> <u>Topic 10-04, Truck Size and Weight Regulation, Enforcement, and Permit Operations</u> <u>Topic 10-06, Bridge Deck Drainage</u> | Transportation Research Board | Variable |

* Final Report Being Revised

TABLE 4
PENDING RESEARCH

| Project No. | Title | Remarks |
|-----------------------------|--|---|
| 10-13 | Ultrasonic Measurement of Weld Flaw Size | \$125,000 - 24 months start in late 1978 |
| Continuation of 12-15(3) | Fatigue Behavior of Full-Scale Welded Bridge Attachments (tentative) | \$150,000 start during 1979 |
| Continuation of 12-17 | Evaluation of Repair Techniques for Damaged Steel Bridge Members (tentative) | \$200,000 start in late 1978 |
| Continuation of 12-19 | Protection of Concrete Bridge Structures in Corrosive Environments (tentative) | \$125,000 start in late 1978 |
| 12-21 | Evaluation of Damage and Methods of Repair for Prestressed Concrete Bridge Members | \$60,000 - 15 months start in late 1978 |
| Continuation of 18-2(2) | Polymer Concrete in Highway Bridge Decks (tentative) | \$270,000 start during 1979 |
| Continuation of 22-2(2) | Multiple Service Level Highway Bridge Railings (tentative) | \$200,000 start during 1978 |
| Continuation of 22-2/1 | Recommended Procedures for Vehicle Crash Testing of Highway Appurtenances (tentative) | \$30,000 start in late 1978 |
| 24-1 | Manual on Subsurface Investigations | \$75,000 - 21 months start in late 1978 |
| 20-5 | Synthesis of Information Related to Highway Problems | |
| | Topic 10-08, Below-the-Waterline Inspec- tion and Repair of Bridge Substructures (tentative) | start during 1978 |
| | Topic 10-13, Relieving Rigid Pavement Pressures at Bridge Abutments (tentative) | start during 1978 |

TRANSPORTATION RESEARCH BOARD

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