ANNUAL REPORT OF ACTIVITIES OF THE MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION RESEARCH LABORATORY

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Research Laboratory Section
Testing and Research Division
Research Report No. R-986

Michigan State Highway Commission
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INTRODUCTION

The purpose of this report is to illustrate the scope of the activities of the Research Laboratory during the 1975 calendar year. By better informing Department personnel of these activities, we hope to implement the research which is being conducted, and to integrate our research findings into Departmental practice.

The report is divided into five sections. The first section outlines some of the highlights of the past year's research. Section two consists of an index to projects as well as a listing of the title, purpose, scope, progress past year, and projected activities for the coming year, for all active Departmental and Highway Planning and Research projects (H.P. & R. projects are denoted by an asterisk). The third section contains abstracts of all Research Reports published during 1975. Section four consists of a list of New Materials projects completed during the year, and the fifth section is a listing of Technical Investigations completed during the year.

Further information on any project described herein may be obtained by contacting L. T. Oehler, Engineer of Research, Motor Wheel Building, Lansing, Michigan.

RESEARCH HIGHLIGHTS - 1975

During 1975, a good deal of progress has been made in certain areas of research. Some of these have culminated in a Research Report, either closing out a project or describing significant progress made to date; others involve significant developments in on-going work in progress. Some of the more noteworthy projects are highlighted in this section of the Annual Report.

1) Skid test measurements were used to evaluate the effectiveness of a heater-planer machine in correcting slippery bituminous pavements. The heater-planer caused dramatic improvements in pavement friction with its melting and scraping of existing pavement surfaces. It will probably be used on future projects where immediate improvement in friction characteristics of bituminous surfaces is important (54 G-74).

2) Sound measurements were used to show that the new transverse groove texture constructed in plastic concrete caused no more noise than older types of texturing. Transverse groove texturing in plastic concrete is more effective and durable in providing better pavement friction than the burlap drag or transverse broom textures used in the past (74 TI-203).

3) Epoxy coated and galvanized reinforcement bars are being evaluated as a means of preventing corrosion in bridge decks. Small laboratory specimens, field exposure specimens, and full-scale experimental decks are included in this study. Evaluations of galvanized rebars are entering their sixth winter, and the epoxy coated specimens are being treated for the second winter, on simulated bridge deck specimens located at the MDSHT maintenance garage in Williamston. Five experimental bridge decks with galvanized rebars were built three years ago; three bridges, with epoxy coated rebars in their decks, are under contract and will probably be built next year. Both systems show considerable promise for reducing bridge deck deterioration (68 F-103).

4) Field work has begun on sampling of steel from girders of 76 older bridges throughout the State. Physical testing of the samples will determine yield strengths and associated properties so that designers can determine load restriction requirements as necessary (75 F-146).

5) An instrument to detect delamination of concrete in bridge decks has been constructed. This unit is patterned after a device developed by the Texas Transportation Institute and is based on an acoustic transmission and rebound principle. When a delaminated area is detected, paint is sprayed on the concrete to delineate the area and a permanent record is made showing the delaminated area (68 F-103).

6) An application was prepared, based upon surveys conducted by the laboratory, for Federal financial participation in constructing an 0.4 mile long concrete panel noise barrier between I 75 and the residences in the southeast quadrant of the I 75 - M 39 interchange (75 TI-299, Res. Report R-984). Another application was prepared requesting Federal participation for the construction of approximately four miles of noise barriers along I 275 and I 96. This is the Department's first application for funds under the provisions of Section 114 (for Type II projects) of the Federal-Aid Highway Act of 1973 (72 TI-109; 74 TI-238; 74 TI-258).

7) A progress report, "Development of Procedures for Replacing Joints in Concrete Pavements," a Highway Planning and Research project, was issued. It describes the materials and construction techniques developed for repair of concrete pavements. The results obtained from using developed techniques at 100 repair locations indicated that repairs made by using pre-cast slabs can be opened to traffic in approximately two hours or less; whereas cast-in-place repairs utilizing a nine-sack concrete mix with set accelerator added can be in service within eight hours after placement. The performance evaluation of the experimental repairs will continue (70 F-118, Res. Report R-968).

8) An evaluation of Iowa's low-slump, cement rich concrete method of thin bonded bridge overlayment is being conducted and evaluated as an alternate to our present latex modified concrete application. Two bridge decks were overlayed in the summer of 1975 using the Iowa method. Laboratory testing of specimens is continuing and a follow-up inspection and testing of the decks is planned (75 B-93).

9) The use of pea gravel as a coarse aggregate in concrete is being evaluated in test sections of curb, gutter, and sidewalk. A cement-treated permeable base, also using pea gravel as the only aggregate, is being evaluated as an alternate to asphalt-treated permeable base for use prior to concrete paving. Laboratory specimens are being tested for compression, freeze-thaw durability, and permeability (75 TI-288; 75 TI-300).

10) The first pressure injection of epoxy resin into delaminated areas of a bridge deck in Michigan was completed for the test bridge which carries Capital Ave over I 496 in Lansing. A workable method of pressure injection was developed and an evaluation of its effectiveness is being conducted (74 F-141).

11) A hot-poured PVC modified, coal tar sealant has been installed in ten joints in one of the short slab sections of the experimental pavement on US 10 near Clare. This material is being evaluated as a possible lower cost alternate to neoprene compression seals on short slab pavements (73 F-136).

12) This year's traffic paint field performance tests, on which the Department bases procurement of paints for roadway marking, includes a group of 'super' paints laid down in early October. These more durable, though more expensive, paints may prove to be advantageous for use as pavement marking in urban areas (47 G-36, 28a).

13) Following a U.S. Government report that trichloroethylene, a solvent used in both the Testing and the Research Laboratories, was a cancer causing agent, safety measures were set up to limit exposure of personnel. Alternate solvents chlorothene or perchloroethylene were substituted for testing applications.

14) Work has continued in outfitting a mobile laboratory for air quality monitoring; instrumentation problems have been generally resolved and a trial field test of wind direction and speed, and carbon monoxide monitoring equipment was completed. Programs for the Laboratory's in-house computer were written and tested for the transcription of air quality data from the data logger in the mobile laboratory onto magnetic tape; these will input information to the main computer for analysis and addition to the air quality data bank. Work was completed to update the computer program for the mathematical model used to prepare air quality estimates for environmental impact state-

ments. The revised model more accurately estimates pollutant concentrations for highway applications.

15) Implementation of results from recently completed research provides for a uniform laboratory calibration method for all nuclear gages used by the Department. This method is more accurate and less time consuming than previously used field calibration methods (75 E-52, Res. Report R-971).

16) A contract was let to Michigan State University for the purpose of developing improved techniques for relating soil properties and soil support values of Michigan soils to enable the Department to implement, more fully, the AASHTO "Interim Guide for the Design of Flexible Pavements" and to, hopefully, develop a method of calculating strength coefficients of other materials used in Michigan's flexible pavement structures (71 E-49).

17) Working plans were prepared for a frost-depth indicator to be used to obtain data for the development of procedures for more positive determinations of the time required for seasonal load restrictions to be applied to Michigan's highways. Twenty frost-depth indicators have been installed so far, mostly in District 1 (75 TI-268).

18) Cold weather testing got underway for evaluating the ice and snow melting properties of rock salt, pre-wetted with a solution of calcium chloride. If economically feasible, this method could result in a substantial reduction in the amount of salt used throughout the State for winter ice control (75 G-216).

19) For the first time in Michigan, nuclear moisture gages are being used on a large scale to obtain periodic measurements of moisture changes in pavement foundations. For this purpose, 24 permanent access tubes have been placed throughout the 12 experimental pavement designs used on US 10 west of Clare. Through these tubes, nuclear sources can be lowered to obtain moisture readings at any depth throughout the foundation. In this way, the relative effectiveness of each pavement foundation's drainage capability can be monitored (73 F-136).

20) A paper entitled, "State-of-the-Art Review of Paved Shoulders" was prepared for presentation at the Shoulder Design Session of the Transportation Research Board at their January 20th meeting in Washington, D.C. (73 F-133).

21) An evaluation of pavement wear caused by Perma-T-Gripper tire studs was made. It was found that these studs, when mounted in radial-ply tires, will meet Michigan's maximum pavement wear rate requirements (65 F-82, Res. Report R-970).

22) Existing shoulder material was recycled on I 69 shoulders between Perry and Flint. For the first time in Michigan an asphalt cement was added to the existing material while it was being crushed and mixed. This process shows great promise for salvaging existing pavements and shoulders (75 D-31).

23) An analysis was made of the structural effects on a portion of 11 Mile Rd and two bridges of the weight of an M-60 battle tank. The Chrysler Corporation had requested permission to occasionally drive such a vehicle on the State trunkline to get from their plant to a proving ground. After analyzing the structural effects, as well as safety considerations of vehicle traffic as discussed with the District Traffic Engineer, permission was granted. Considerable tax dollar

savings were realized, for the alternative would have been to haul the tanks on a low-boy trailer and charge the Government for it (75 TI-295).

24) The construction phase has been completed on the experimental concrete pavement, US 10 freeway relocation, west of Clare. Instrumentation and evaluation of the project will be carried out by the Laboratory. This project includes short slab concrete pavements, without steel reinforcement, both with and without dowel load transfer at the joints. Variable base types included regular aggregate, black base, and a special asphalt-treated drainage layer under some sections of the pavement (73 F-136).

25) Significant improvements were made in the Research Laboratory's physical facilities with respect to safety, including control of fumes and dust, chemical storage, and safety aisles, as well as such personnel protection devices as safety glasses and safety shoes, in response to OSHA requirements.

26) The Research Laboratory participated in a four and one-half day field project (FHWA Demonstration Project 33) on bridge deck evaluation techniques. A nine-year old deck on US 127 was selected for the FHWA team to demonstrate their corrosion cell detector, concrete cover meter, delamination detector, and sampling drill for chloride analysis of deck concrete. This also afforded the Laboratory an opportunity to directly compare its recently constructed delamination detector with that of the FHWA. Numerous city, county, and state engineers were able to see the various test devices, the FHWA mobile concrete laboratory, and discuss the results, all of which are proposed to assist in determining the extent of concrete deterioration prior to deck replacement or repair.

27) A progress report was issued evaluating the performance of six bridge deck joint sealing systems on 64 bridge structures. These systems were installed from 1971 through 1973. While there have been some problems, they are performing better than the steel sliding plate joint system (72 F-128).

28) Research has been completed on the evaluation of liquid de-icing chemicals and the findings conveyed to the Engineering Operations Committee. The study indicated that glycol and glycol-urea solutions were not suitable for ice control on bridge deck surfaces and that under certain conditions, could become a hazard, causing a more slippery roadway surface (72 G-187).

STATISTICAL ANALYSIS UNIT

Title

*72 G-191 - Aggregate Gradation Quality Control (22A Field Experiment)

Purpose

1. To develop practical and meaningful sampling procedures at the production and construction site for sieve analysis of 22A aggregate.

2. To develop, based on the suggested sampling procedures, practical and meaningful aggregate inspection practices either for stockpile inspection or in-place inspection.

Scope

Development of the sampling procedures and the inspection practices for 22A aggregate, based on three available production pits.

Progress Past Year

The review draft of the final report is being completed for editorial review. The research had achieved the proposed purposes of this project, and has generated a more efficient aggregate testing method which is proved to be equally as good as the current one in measuring the aggregate composition. The project has demonstrated the use of multivariate statistical analysis in the field of aggregate inspection.

Title

*73 G-193 - Accident Rates and Surface Properties -- An Investigation of Relationships

Purpose

To construct an intersection model which will predict wet accident percentages from skid number and other relevant variables.

Scope

Development of the wet surface accident model for state trunkline intersections from knowledge of percentage wet time, skid number, seasonal drying factors and dry surface accident incidence. Data are for the entire state of Michigan for the period 1963-74.

Progress Past Year

A preliminary draft has been prepared. It is intended to satisfy the project proposal within the HPR time limits, by presenting a complete wet intersection accident prediction model for the seven months not complicated by ice and snow. The model takes account of local precipitation, wet surface friction (skid number), dry surface accident incidence (local hazard) as well as seasonal factors affecting wetness retention time. Also, the research has generated two papers intended for presentation at the Second International Skid Prevention Conference. These papers summarize the model and show that it can be used in a skid testing and intersection resurfacing program.

Planned Program for Coming Year

The model will be extended over the remaining months provided that the complications of ice and snow can be overcome. Also, extension of the model to the four county area around Detroit utilizing the 80 SEMCOG (Southeast Michigan Council of Governments) weather station data in that area will provide the basis for a microclimatological analysis of the impact of a major urban development on area precipitation. Since most of the high accident intersections are from these counties, a highly refined regional model will be of value in accident forecasting and in the development of resurfacing criteria.

Title

57 B-39 - Use of Latex Modified Mortar and Concrete in the Restoration of Bridge Structures

Purpose

To monitor the preparation and application of latex modified mortar or concrete thin bonded overlays on selected deck repair projects. The long term performance of these overlays was to be evaluated by selected field inspections.

Scope

This project started by closely following latex mortar repair on one structure in 1957-58. Larger scale usage of latex overlays with District Maintenance forces was observed in 1969-71, followed by contract repair projects in 1972-75.

Progress Past Year

A complete field inspection was made of all latex overlayed decks done in 1969-74 plus many of the repair contracts of 1975. This included 73 structures done in 1969-74, some of which involved latex mortar on all or portions of new decks to increase cover over the top steel.

Planned Program for Coming Year

Report of the 1975 field inspection with recommended changes in construction procedure is to be issued in January. Latex overlay projects will continue to be followed in 1976 as well as additional inspections of selected older projects. Some selective coring with related laboratory work will be done to further evaluate performance and salt penetration.

Title

*61 B-58 - Control and Prevention of Deterioration of Concrete Bridge Decks

Purpose

A field inspection was made of selected post-war structures built since 1949-50. The results of this condition survey were to be evaluated to determine effect of design, construction, and maintenance factors on the long term durability of concrete bridge decks.

Scope

A selective sampling was made of 5 and 10 year old structures which included both steel and concrete girder systems. The structures inspected also included different areas of the state having wide ranges in traffic, weather exposure, and maintenance practices.

Progress Past Year

The final report draft is 90 percent complete.

Planned Program for Coming Year

Finish the final report for distribution early in 1976.

Title

72 B-90 - Experimental Use of Water Reducers in Slip-Formed Concrete Pavement

Purpose

The use of water reducers was tried both with and without a slight cement reduction on a number of concrete paving projects. The fresh concrete was sampled, placing and finishing observed, and finished pavement properties evaluated. Tests were to evaluate rideability as well as strength and durability.

Scope

Portions of a number of paving projects by several contractors were selected in which to use water reducers with 6.0 and 5.6 sacks of cement per cubic yeard. Extensive field sampling was done to evaluate strength and durability and profilometer tests were run to check riding qualities.

Progress Past Year

Based on the extensive test data from seven projects paved in 1972-74 the Department approved the use of water reducers in paving concrete with a slight reduction in cement.

Planned Program for Coming Year

Even though the basic test data from the seven paving projects has been transmitted within the Department, a final summary report is to be completed to close out the project.

Title

72 B-91 - Laboratory and Field Evaluation of Portland-Pozzolan Cement (Type 1P) in Concrete Pavement and Structures

Purpose

To determine the performance characteristics of portland-pozzolan cement concrete relative to our conventional concrete and recommend scopes of equal or superior usage.

Scope

One third of a concrete paving project was selected to directly compare type 1P cement with type 1A. Selective sampling was done to evaluate strength and durability. Structural grades of concrete are to be evaluated in a later phase of a bridge project.

Progress Past Year

Following familiarization work in the laboratory, the Type 1P cement made by the Dundee Cement Company was included in a field project along with Pozicon, a beneficiated fly ash product; this application was designed to evaluate the performance of fly ash pozzolans in slip-formed pavement concrete. The project (I 82293-04742A), which carries I 275 from Ford Rd north to the Rouge River, was completed during the summer of 1974. Although the report of this work has not yet been written, test data indicate the fly ash pozzolan concretes are ideally suited for slip-form applications where they provide equal strengths and superior consolidation to conventional concretes. Type 1P cement was approved for use as an alternate to type 1A in pavement grade concrete.

Planned Program for Coming Year

During the 1976 construction season the fly ash pozzolans will be field tested in bridge concrete to confirm the improved performance characteristics indicated by laboratory work. It is expected that they will improve the consolidation of the fresh concrete and increase the strength and reduce moisture permeability in hardened concrete. The fly ash pozzolans are able to do this because their tiny spherical particles act like ball bearings in fresh concrete to aid in vibrated consolidation and later react with lime in the hardened concrete to form additional cementing materials. The Dundee portland-pozzolan cement concrete will be field tested on the bridge that carries M 14 over the C&O RR tracks east of Plymouth (X01 and X03 of 82102B).

Title

72 B-92 - Experimental Bridge Deck Surfacing Methods

Purpose

To evaluate the initial construction phase and long term performance of two types of new bridge deck construction; namely, a revibrated deck and two-stage construction using thin bonded overlays.

Scope

Three structures were closely followed to evaluate construction phases of a revibrated deck, two-stage deck pour using 1-in. latex modified mortar, and a two-stage pour with 2-in. of a 7.5 sack concrete mix. Post construction performance was to be evaluated by periodic testing and inspections.

Progress Past Year

The three subject structures on US 23 in northeastern Michigan were monitored during construction in the summer and fall of 1972. They were inspected and corrosion cell tests run late in 1975.

Planned Program for Coming Year

A report covering the construction phase on all three structures plus follow-up inspection data will be issued soon after an inspection, corrosion cell tests and special cores in the spring of 1976.

Title

75 B-93 - Iowa Low-Slump Method of Bridge Deck Overlays

Purpose

Evaluation of low-slump concrete as an alternate to the presently used latex concrete method of bridge deck overlay.

Scope

Determine the effectiveness of low slump concrete overlay in rehabilitating spalled and chloride contaminated bridge decks. For this purpose two projects on I 96 were selected to monitor and evaluate this system. Long term performance will be evaluated by periodic post-construction testing.

Progress Past Year

Experimental overlay of three decks on two projects was done. Laboratory testing of the concrete, monitoring of the overlay placement, follow-up initial inspection and testing of the overlaid decks was performed.

Planned Program for Coming Year

Report on data gathered the past year. Inspection of the decks after

one winter to determine the effectiveness of the overlay, both on the surface and internally.

Title

75 B-94 - Evaluation of Type 1SA Cement When Used With Water-Reducer Admixtures

Purpose

To investigate the properties of this cement, and report on its characteristics, when used with and without a water reducer. Also, the curing properties of this type of cement at colder temperatures is to be evaluated.

Scope

A series of tests will be performed to compare properties of several grades of concrete made with type 1SA and type 1A cement with and without water reducers. Strength data will also be obtained at temperatures of 40 and 55 F to compare with normal room temperature.

Progress Past Year

Two barrels each of types 1SA and 1A cement were received from the JMT Cement Company. Initial planning of laboratory test program was started.

Planned Program for Coming Year

The Laboratory evaluation program is to begin early in the year and completed for reporting later in 1976.

Title

71 C-13 - Study of Aggregate and Mix Requirements for Durable and Skid Resistant Bituminous Mixtures

Purpose

This project was to re-evaluate the 1963 ban on the use of crushed limestone and high carbonate gravels in bituminous concrete wearing courses. Of particular concern was the effect of these restrictions on the skid resistance of bituminous mixes and the economic factors involved in obtaining suitable aggregate in critical areas.

Scope

Both bituminous concrete and bituminous aggregate skid data were re-examined on projects paved up to 1963 and also from 1963-72. Primarily, bituminous concrete projects were examined under Phase 1, and bituminous aggregate jobs and initial wear track construction were done under Phase 2.

Progress Past Year

As a result of this study, the use of high carbonate gravels in certain areas of the state was reinstated. The wear track was completed and series 1 tests were finished to start evaluating particular aggregate sources under controlled wear conditions.

Planned Program for Coming Year

Series 2 and subsequent tests will be completed on the wear track so that a progress report can be issued in mid-year. Later series will include wear tests on specific rock types from a special petrographic study.

Title

74 F-141 - Development of Procedure for Epoxy Injection Repair of Bridge Deck Delamination (Kansas Method)

Purpose

To adapt the bridge deck epoxy injection concept, as pioneered by the State Highway Commission of Kansas, to similarly afflicted Michigan bridges. To evaluate the permanence of this type repair by long term evaluation.

Scope

Select a test bridge in early stages of delamination to develop techniques of locating, drilling, injecting and evaluating hollow areas. Evaluation of injection repair in combination with surface patching is also to be made.

Progress Past Year

In a joint voluntary venture, which was initiated by the Eisenhour Construction Company, the Department sought to develop a procedure by which a bridge deck in early stages of deterioration could be restored to its original integrity without resorting to costly chipping and patching. The procedure involved locating the delaminated or "hollow" areas on the surface of the deck and pumping them full of an epoxy resin before they could grow

larger and spall. In this procedure the epoxy resin bonds the fatigued concrete back together again and halts the progress of this costly affliction. During the 1975 construction season, the bridge which carries Capitol Avenue over I 496 in the City of Lansing was repaired by this procedure.

Planned Program for Coming Year

In 1976, the Department plans to enter into a contract for further development work with a company specializing in epoxy injection work. It is hoped that during this time, the procedures for effective injection can be simplified to even further reduce the cost of restoring bridge decks. The Capitol Avenue structure will be closely monitored to evaluate the long term durability of this type repair.

Title

67 G-157 - Evaluation of Bridge Deck Surfacing for the Orthotropic Bridge Carrying Creyts Road over I 496

Purpose

The bridge was erected on an experimental basis to determine whether the orthotropic design and epoxy wearing surface were practical in this climate.

Scope

Two different epoxy mortars were selected for use on the two spans of the Creyts Rd structure. The field application was closely followed and annual inspections are made to determine long term performance of the surface.

Progress Past Year

Epoxy mortar surfacing was applied during September and October of 1969 to a minimum thickness of 5/8-in. Guardkote 250 mortar was applied to the south half of the bridge and Epon 815-Versamid 140 mortar to the north half. Subsequent inspections revealed several types of deterioration; shrinkage craze cracking was very distinct in the GK-250 and less prominent in the E815-V140; both mortars developed tensile fatigue cracks in negative moment areas of the deck; and changing features each year suggested significant traffic abrasion. The annual inspection of 1975 found spots where the GK-250 mortar had spalled off and left the steel deck exposed. At these areas it was discovered that the thickness of the mortar was 1/8 in. or less; traffic abrasion has removed approximately 1/8 in. of mortar per year. The rate of abrasion in the E815-V140 appeared to be less.

Planned Program for Coming Year

Laboratory research has disclosed epoxy mortars which are more resistant to shrinkage and tensile fatigue cracking, but all seem quite vulnerable to traffic abrasion. It would appear that epoxy mortars are not the best material to use for wearing surfaces on orthotropic bridge decks. This bridge is planned to be resurfaced during the 1976 construction season with an alternate material.

Title

71 G-180 - Effects of De-Icing Salts on the Chloride Levels in Waters and Soil Adjacent to Roadways

Purpose

To study the effects of de-icing salts on the chloride levels in water and soil adjacent to roadways, and to recommend remedial measures if environmental or health hazards are found to exist.

Scope

Monitoring of chloride levels in water and soil adjacent to roadways by water sampling at selected ground water wells and surface water sites.

Progress Past Year

Water sampling was conducted during the 1972 and 1973 winter seasons. The study was suspended in 1973 due to the resignation of the project leader. The project was reactivated near the end of 1975 and plans are under way to obtain surface and subsurface water samples to monitor chloride levels at a number of selected sites through the 1975-76 winter.

Planned Program for Coming Year

Re-establishment of ground water observation wells and surface water chloride monitoring stations at three of the original locations. Establishment of ground water observation well locations on a recently opened roadway. These four areas will be monitored on a year-around basis.

Title

74 G-205 - Pre-Engineering for Bridge Deck Rehabilitation

Purpose

To document and follow specific sampling, testing, and recommendations for particular deck repair projects programmed for major repair or widening contracts. This was to include jobs using thin bonded overlays or deck waterproofing systems.

Scope

The initial scope of this project was to cover data from special cores and corrosion cell tests on 26 Interstate structures scheduled for thin bonded overlays. Proposed limits on chloride content of the deck concrete and evaluation procedures of the FHWA initiated in 1974 prompted this open ended study. Subsequent deck repair projects were added as they were programmed by the Design Division for repair contracts.

Progress Past Year

Chloride and corrosion data from cores on the initial 26 Interstate structures were finished and transmitted in two packages. Data from cores on 29 additional primary structures and also a number of other structures were transmitted.

Planned Program for Coming Year

Sampling, testing, and evaluation of deck concrete of structures scheduled for repair will be reported as they become programmed. Also, it is planned to evaluate the large volume of chloride and corrosion data on hand to better assess concrete deck repair project factors as they may relate to future rehabilitation jobs.

Title

72 G-188 - Experimental Preformed Waterproofing Membranes for Concrete Bridge Decks

Purpose

To monitor and evaluate the application of three different sheet membranes applied to five widened and repaired structures prior to bituminous surfacing. Post construction testing and long term evaluation was to include visual inspections, resistance tests, and selected coring.

Scope

The initial work plan covered the use of three sheet membranes on five deck widening jobs on I 75 near Flint in the fall of 1973. A number of

other membrane waterproofing jobs done in 1974-75 were added to the study. The long term performance of these membrane jobs was to be evaluated by periodic inspections and selected testing.

Progress Past Year

Due to other high priority work only a part of the subject membrane jobs were inspected.

Planned Program for Coming Year

Complete the follow-up inspection and testing of 1974-75 jobs added to the study and inspect the original five structures after two winters exposure. Prepare a summary report on all the included membrane waterproofing jobs by the latter part of 1976.

Title

74 G-210 - Bituminous Aggregate Resurfacing with High Shale Content Aggregate

Purpose

To evaluate the wear and durability of bituminous aggregate surfaces made with a particular high shale content materials.

Scope

Laboratory wear tests and other related evaluations are to be run on the aggregate and bituminous aggregate surfacing containing high shale percentages. A comparison aggregate of intermediate shale content is also to be included.

Progress Past Year

Samples of the two test aggregates were received, screened, and preliminary petrographic tests run.

Planned Program for Coming Year

Wear track specimens will be run using both the high shale and intermediate shale materials. Field inspections of bituminous aggregate surfacing and skid tests will be run to assess the performance of actual projects using high shale aggregates.

A report covering both the laboratory and field testing should be ready later in the year.

Title

47 G-36(28a) - 1975 Supplemental Traffic Paint Performance Tests

Purpose

This project is the 1975 phase of annual, repetitive field performance and laboratory tests conducted on producer's samples to determine the most economical paints to be purchased for roadway marking in 1976.

Scope

This is a cooperative project with Traffic and Safety Division who assume responsibility for application of the paints in field performance tests while we assume responsibility for the field ratings, laboratory analyses, and the reporting. This year, the Traffic Control Devices Committee, which oversees the Department's pavement marking program, has authorized a complementary second testing of more durable and expensive samples that normally would not be submitted for the primary testing.

Progress Past Year

The project is on schedule with primary application of paints in field tests in the first week of June 1975. Periodic ratings were made with an interim progress report submitted to Committee for its November 20, 1975 meeting. Secondary application (super paints) was made in early October, 1975. Periodic ratings of paints in field tests continue.

Planned Program for Coming Year

Ratings of paints in field tests, both series, will continue until termination in early 1976, when results will be submitted in a formal report, ending the project.

Title

49 G-50 - Study of Protective Coatings for Structural Steel

Purpose

To determine the potential merit of a variety of paint-type coatings for structural steel in construction and maintenance painting, by means of laboratory and field service tests.

Scope

As noted by the number, the project was initiated in 1949 and is meant to be continuing in order to evaluate the latest developments in paint coatings. The project has two phases, (a) evaluation of paint systems by laboratory techniques, and (b) field evaluation on actual structures of the best performing systems as determined previously in laboratory tests. Since the service life of a good paint system is more than 10 years, determining the merits of paints under phase (b) is lengthy and time consuming.

Progress Past Year

No work was done on phase (a) testing. Under phase (b) evaluations about half the paint systems under field tests, were inspected for performance, with data to be compiled for subsequent, periodic reporting.

Planned Program for Coming Year

We may start phase (a) testing in the fall on new paints, and will inspect the other half of paint systems under phase (b). Phase (b) testing utilizes about 15 structures total.

Title

57 G-87 - Revision of Existing Paint Specifications

Purpose

As per title, to revise and update existing Department paint specifications (other than for highway structural steel).

Scope

Work under the project is periodic, and continuing. Automotive-fleet paints, sign paints, wood post paints, picnic table varnishes, etc., fall under this project, as do required surface preparation procedures and required solvents. Requested revisions are accomplished by our obtaining and furnishing technical background and meshing it with application requirements of the using Division, compiled in accordance to a Specifications Unit format.

Progress Past Year

The project has been inactive for several years. The last significant work was on No. 18(2) Highway Orange Automotive Paint in 1971.

Planned Program for Coming Year

No work is currently scheduled; it will be performed as needed.

Title

57 G-87(1) - Revision of Existing Structural Steel Painting and Cleaning Specifications

Purpose

As per title, to revise and update existing painting and cleaning specifications for structural steel required in construction or maintenance contracts.

Scope

Work under this project entails revision of standard Department painting specifications and also writing specifications for experimental paint systems scheduled for field service tests. Technical background information is often obtained from work under Research Project 49 G-50. Revisions are generally cooperative with the using Division and are drawn-up to a Specifications Unit format.

Progress Past Year

Minor revision of painting specifications for the 1976 edition of Standard Specifications. In previous years special painting specifications for the Mackinac, Blue Water, and Houghton bridges were written.

Planned Program for Coming Year

A definite schedule is not available, but believe specifications will be required for the Blue Water bridge and perhaps the Cut River bridge. Work will be done as needed.

Title

60 G-102(2) - Evaluation of Aluminum Coatings on Guardrails

Purpose

To field evaluate the merits of subject hot-dip aluminum coating on steel beam guardrails.

Scope

The Maintenance Division received and installed 40 subject guardrails and 12 standard galvanized controls at three locations (one Detroit and two Lansing) about mid-1970. The comparative performance was then to be monitored by us via periodic inspections.

Progress Past Year

We made no inspections of test railings in 1975, though we made several prior ones which were too early to indicate expected service life of the coating. In a drive-by in early 1975 we noticed that the test railings, plus adjoining other galvanized railings, on M 43, east of I 96, were replaced by the low-alloy type.

Planned Progress for Coming Year

Inspect railings in remaining test sites to determine current performance.

Title

62 G-113 - Evaluation of Galvanized Coatings on Highway Appurtenances

Purpose

To determine the merits and performance of galvanized coatings on highway structural steel, with emphasis on appurtenances.

Scope

The Department is specifying galvanized coatings on an increasing variety of highway hardware, from guardrails to bolts. Under this project, we are observing the performance of galvanizing in a variety of end-uses, i.e., bridge girders and diaphragms, girder-support hardware, guardrails and bridge railings, etc., as background information to be used in specifying protective coatings on highway steel.

Progress Past Year

Several inspections were made on field test installations including guardrails on M 78, and bridge beams and hardware on structures on M 78, and US 27 north of Houghton Lake.

Planned Program for Coming Year

Continue periodic inspections of test installations.

Title

62 G-114 - Peeling of Paint on Treated Wood Posts

Purpose

The current phase of this project involves following the comparative resistance of peeling of the standard oil-based white paint vs. a latex white on round wood posts of cable guardrail installations, maintenance repainted.

Scope

This project was reactivated in 1973 on request from the Maintenance Division to monitor the current phase, with field test installations in the Kalamazoo District. Their preference for use of a latex white paint has required our laboratory evaluation of several white latex formulas.

Progress Past Year

Three white latex formulas plus the standard oil-based white control were applied on wood post specimens and exposed on roof of Laboratory for performance purposes. The field test installations were not inspected.

Planned Program for Coming Year

Check performance of field and laboratory exposures and write latex specifications, if exposures provide adequate performance data.

Title

62 G-122 - Use of Low-Alloy Steel in Highway End-Uses

Purpose

To determine merits and/or service life of subject steel, unpainted, in highway end-uses, mainly on bridge beams, guardrails, and light posts.

Scope

Since accelerated laboratory tests are unsuited, we used field service tests to determine performance of unpainted subject steel in bridge girders and beam guardrail. The oldest bridge and beam guardrails date from 1964. In cooperative tests with the producer, exposed panels on the oldest bridge were removed periodically over an eight-year period to determine weight loss of metal through corrosion. Physical measurements of thick-

ness loss of steel are made at a few other test sites. Loss of girder metal was shown to be increased under leaking deck joints, with those localized areas now requiring shop and field painting in new construction, per our specifications.

Progress Past Year

We have made a cooperative, periodic inspection of the M 102 over I 75 test structure with producer personnel, and cursory inspections of two other structures. We have inquired about tardy panel weight loss report from other steel producer.

Planned Program for Coming Year

After receipt, review the report from the producer of the steel for the oldest bridge to give direction for future, continuing surveys, of existing steel. Since loss of girder metal is increased under leaky deck joints, make cooperative surveys of some existing bridges with regular bridge inspection teams, to determine whether preventive maintenance is recommended requiring either painting or joint sealer replacement on early bridges whose beam ends were not protected by painting.

Title

71 G-178 - Guardrail Wood Post Deterioration

Purpose

To determine the relative effectiveness of specification preservatives in minimizing decay, especially at ground line, on wood post supports for steel beam guardrails, via field inspections of installations.

Scope

The initial phase of the project covering preservative treatments allowed by past specifications was completed with Report No. R-954, which showed the water-borne treatment to be inferior. A current, secondary phase of the project endeavors to determine whether the current water-borne treatment (CCA) is superior to the former, superseded one (FCAP), and equivalent to the two organic-based treatments. The oldest known (CCA) treated posts are about seven years old.

Progress Past Year

Research Report No. R-954 was completed in January 1975. Surveys in most Districts showed all seven year old treated posts to be decay-free

though we did not find CCA treated posts in some Districts, and not many in others.

Planned Program for Coming Year

Complete the surveys of seven-year old post installations in the remaining two Districts. Locate six-year old treated post installations which may also be surveyed for relative performance in future inspections.

Title

73 G-197 - Investigation of Structural T's, Galvanized in Sections, in a Truss-Type Pedestrian Bridge (Work Plan No. 22)

Purpose

As per title, which is very descriptive. The test structure is P01 of 52042 over US 41 southeast of Marquette, completed in 1972.

Scope

The project is a "Category 2" experiment carried out in cooperation with FHWA as per MDSHT Work Plan No. 22, which was developed by the Department. After construction of the test structure, the project was transferred to us for follow-up surveys and reporting. The initial survey was covered by us in the First Progress Report No. R-896 issued January 1974. The report lists several contemporary pedestrian bridges for comparison of subject bridge's main features.

Progress Past Year

No work was done on subject project, as we requested the Upper Peninsula Bridge Inspection Team to transfer survey data to us for compilation and eventual reporting. This was done because of test site distance from Lansing.

Planned Program for Coming Year

Periodically, we will coordinate joint surveys of the test structure with the U. P. Inspection Team, and also joint surveys of the comparison structures with other, involved, Bridge Inspection Teams.

Title

62 G-116 - Extruded Neoprene Joint Sealer

Purpose

To evaluate the performance of neoprene seal installations.

Scope

Since neoprene has become a standard material, this project has been used to cover the study of special problems as they occur.

Progress Past Year

A field survey was made of most of the projects constructed since 1964 to determine the extent and nature of problems with neoprene sealed expansion joints.

Planned Program for Coming Year

Recommendations will be made as to possible modification of expansion joint design for future construction.

Title

72 F-128 - Evaluation of Various Bridge Deck Joint Systems

Purpose

To evaluate the effectiveness of various types of bridge deck joint systems covered by Category 2, NEEP Project No. 11.

Scope

Field inspections are made of each installation at least twice annually to rate the systems for watertightness, durability, ride, noise, etc.

Progress Past Year

Field surveys of seven different types on approximately 200 structures were made during 1975. A progress report was written covering installations made in 1971 through 1973.

Planned Program for Coming Year

Field surveys will continue and a progress report will be written covering all installations through 1975.

Title

*73 G-195 - Effectiveness of Neoprene Seals in Preventing Pavement Joint Deterioration

Purpose

To determine whether there is sufficient penetration of de-icing chemicals to cause joint deterioration; and the rate of concrete deterioration and chloride penetration if it proves to be significant.

Scope

Joints on construction projects of different ages and geographical locations are cored annually to measure de-icing chemical penetration and the amount of concrete deterioration. Samples of base materials are taken for permeability measurements.

Progress Past Year

Fourteen construction projects were cored and base materials were sampled. Chloride penetration, amount of concrete deterioration, and permeability of base materials were determined.

Planned Program for Coming Year

Construction projects previously cored will be re-cored for comparison and possibly newer construction projects will be added.

Title

73 G-199 - Preformed Elastomeric Pavement Joint Sealing Systems - Field Evaluation Phase

Purpose

To verify or modify as appropriate, by the conduct of a field study program, the tentative guide specifications developed under Project 4-9 (NCHRP). This is Project 4-9A assigned to the Utah State Highway Department with Michigan cooperating.

Scope

Neoprene seals from three different manufacturers were installed in a Michigan construction project near Belleville. Seal samples are removed every six months for a period of four years. Performance is rated under

the direction of the Utah representative and samples are tested by them for change in properties.

Progress Past Year

Two sets of seal samples were removed and their performance was rated. Seals removed were replaced with new material using a one-component urethane lubricant for installation. We are using this opportunity to study different techniques of seal installation.

Planned Program for Coming Year

We will continue to cooperate with Utah in their sampling and rating of seal performance.

Title

73 G-204 - Joint Sealing Materials for Sealing Bridge Expansion Joints

Purpose

To study available pourable sealants for sealing bridge expansion joints to determine if there are materials superior to the currently used two-component polyurethanes.

Scope

Laboratory evaluations are made on any available materials which are indicated by the literature to be suitable for the application. Upon favorable laboratory test results, a field installation would be recommended.

Progress Past Year

No new materials were evaluated during 1975.

Planned Program for Coming Year

New materials will be evaluated as they become available.

SPECTROSCOPY AND PHOTOMETRY UNIT

Title

73 G-200 - Experimental Settling and Oil Skimming Chamber

Purpose

To determine the quality with respect to sediment and oily material of water being discharged into Lake St. Clair from the storm sewer system serving I 696 between I 75 and I 94 in Oakland and Macomb Counties. Also, to determine the effectiveness of the settling and oil skimming chamber which has been built to remove sediment and oily materials from the storm sewer water.

Scope

The study is planned in three phases. Phase I provides for manual sampling of the water entering and exiting the skimmer chamber after completion of construction, but before the associated highway is open to traffic. Phase II is a continuation of Phase I after the highway is open to traffic. Phase III is an extensive program, using automated sampling equipment, designed to study the system after traffic on the highway and operation of the skimmer chamber has stabilized.

Progress Past Year

Construction of the skimmer chamber and associated pumphouse is complete but the storm sewer is not. Since there has been no water passing through the skimmer chamber Phase I of the project has only been started.

Planned Program for Coming Year

Since the completion of Phase I depends on a flow of water through the skimmer chamber progress on this project must be delayed until completion of the storm sewer. The estimated completion date is not available due to serious construction difficulties.

Title

54 G-73(3) - Revision of Specifications for Traffic Control Devices

Purpose

To develop specifications for traffic control devices, specifically, lights and lighting for hazard warning.

Scope

Evaluate the performance of warning and delineation lighting; prepare specifications and specification revisions.

Progress Past Year

One Type-B high intensity light was evaluated.

Planned Program for Coming Year

Continue to evaluate lights as sampled from construction sites by project engineers.

Title

68 G-165 - Edge-Marking Criteria from Contrast Ratios

Purpose

Develop a means of determining necessity for edge-marking based on visibility factors.

Scope

Evaluate visual contrast of shoulder and pavement materials under vehicle headlamp illumination. Develop a rank order need for edgestriping on various combinations of shoulder and pavement materials.

Progress Past Year

Visual contrast was evaluated on old and new bituminous, concrete, and gravel materials. Recommendations were made for priority ranking of roadway types to be edgestriped and a rough draft report completed.

Planned Program for Coming Year

Complete the final report.

Title

71 G-182 - Investigation of Air Quality Test Equipment and Procedures

Purpose

Assemble equipment and develop procedures for acquiring air quality information as required in preparing environmental impact statements.

Scope

Review State and Federal air quality regulations and determine their applicability to transportation projects. Review the literature on and performance of commercially available instrumentation and purchase measuring equipment. Review the literature, review the experiences of other agencies and develop procedures for measuring air quality. Develop a data bank of meteorological and air quality data.

Progress Past Year

Federal and State air quality regulations were reviewed as they were issued and a file maintained of material relevant to transportation. A van and instrumentation were purchased and construction of a mobile air quality laboratory was 80 percent completed. Instrumentation obtained included: two carbon monoxide analyzers, wind speed and direction recorder, nitrogen oxides analyzer and associated calibrator, motor generator for remote operation, and components to assemble a data logging system. The van was successfully field tested operating the wind speed and direction recorder and carbon monoxide analyzer with power from the on-board generator. An oxidant (ozone) analyzer and associated calibrator were ordered to be ready

to respond to new EPA requirements for measuring oxidant levels in the area of proposed transportation projects. Hourly meteorological readings for several airports, covering a period of five years, were added to data banks.

Planned Program for Coming Year

Continue to review Federal and State air quality regulations and maintain current files of regulations affecting transportation. Complete installation of instrumentation and data logging systems in the air quality van. Assemble battery operated samplers to collect air samples in plastic bags to be returned to the van for analysis. This will extend the area the van can monitor. Set up sampling programs to monitor air pollutants in areas where such data are required. Develop procedures for processing, analyzing and storing the data obtained. Monitor air quality and wind parameters at selected sites. Update and expand the data bank of meteorological information on file. Install instrumentation, data logger, and a generator in a trailer, which the Laboratory has, to ready a second mobile air quality laboratory. This unit will measure carbon monoxide, wind parameters, and possibly oxidants (ozone). Obtain information and maintain a current file on instrumentation available for monitoring air quality. Instrumentation purchased in the future to monitor air quality will have to meet Federal Standards for accuracy and reproducibility if our data is to be accepted.

Title

51 G-54 - Revision of Standard Specifications for Reflectorized Signs and Reflective Materials

Purpose

Develop specifications for reflective materials.

Scope

Evaluate reflective materials used for traffic control devices. Develop methods of evaluation and prepare specifications or specification revisions.

Progress Past Year

In conjunction with specific new materials evaluation projects; mechanical, photometric, and weathering tests were conducted on encapsulated bead reflective sheeting manufactured by the Seibu Polymer Chemical Co., the Fasson Corporation, and the American Decal Corporation. Assistance was given to the Traffic and Safety Division and to the Specifications Section in preparing revisions for the new edition of Standard Specifications.

Planned Program for Coming Year

Continue evaluation of reflective materials as submitted.

Title

73 G-198 - Specification for Roadway Luminaires

Purpose

To develop specifications for roadway luminaires, especially high-pressure sodium luminaires.

Scope

Evaluate the performance of roadway luminaires except tower lighting luminaires. Develop methods of evaluation. Correlate evaluation with the manufacturers. Prepare specifications and specification revisions and provide roadway lighting design criteria.

Progress Past Year

Photometric data collected from tests of sodium vapor luminaires supplied by four manufacturers were analyzed and collated. Lighting design criteria such as fixture mounting height, pole spacing, average illumination, uniformity ratio, half-maximum intensity, and utilization coefficients were computed and tabulated.

Planned Program for Coming Year

Furnish Design Division with design data along with graphs of photometric data. Evaluate low-pressure sodium vapor sources.

Title

73 G-202 - Evaluation of Various Reflectorized and Non-Reflectorized Signing, I 96 (Eckles Rd) to I 75

Purpose

To compare appearance of reflectorized sheeting signs with signs of reflector button legend and non-reflectorized background.

Scope

Measure luminance contrast of signs and evaluate surround lighting. Compare sign luminance with established criteria for sign legibility.

Progress Past Year

Signs have not been erected so no work has been performed.

Planned Program for Coming Year

None at present.

Title

75 G-214 - Forward Antiglare Screen Evaluation - Category II Experimental Project (Work Plan No. 43)

Purpose

To determine the suitability of the forward antiglare screen installed on concrete median barrier for general use.

Scope

Evaluate oncoming vehicle headlamp glare prior to, and after, installation of the antiglare screen at two locations. I 94 over the Dequindre Yard and on M 39 from Village Rd to the Penn Central Railroad in Wayne County.

Progress Past Year

The "before" study was completed. The "before" study consisted of recordings in each lane of approaching vehicle headlight glare along with commercial and roadway lighting glare. Recordings were made in conjunction with a video tape record of the driver's view.

Planned Program for Coming Year

The "after" study will be conducted using the same technique of evaluation as in the "before" study.

Title

*68 G-164 - Requisite Luminance and Legend Size of Reflectorized Signs

Purpose

To determine the luminance and legend size for signs erected at various distances from the side of the roadway and above the roadway. To evaluate reflective materials for use on roadway signs.

Scope

Measure the effect on sign brightness and legend size produced by sign set-back, overhead mounting, and variations of reflective materials. Measure headlamp illumination patterns. Measure legibility as it relates to legend size and brightness.

Progress Past Year

Prepared report on evaluation of I 69 signs as an interim report for this project.

Planned Program for Coming Year

None at present.

Title

73 G-192 - Evaluation of Glare Sources

Purpose

To provide data which can serve as a basis for legislation controlling glare sources.

Scope

Measure sources of glare designated by citizen complaint and visual evaluation by Department personnel. Determine driver task and determine luminance and luminance contrast necessary to perform the task. Develop criteria for specifying vision performance. Evaluate brightness of acceptable light sources. Propose basis for legislative control.

Progress Past Year

Data on nine previously identified glare sites were gathered. A literature survey was conducted to secure information and data with which to determine a method for specifying values of glare that would adversely affect driver vision. We attempted to evaluate the measured glare in terms of values that would indicate interference with a drivers' visual perfor-

mance, and requested the Traffic Division to submit an appraisal of acceptable bright lights.

Planned Program for Coming Year

Continue investigation to specify a glare value where glare becomes hazardous. If this is found we may be able to arrive at a more efficient method for evaluating glare sites. Investigate results of Traffic Division appraisal.

Title

68 G-163 - Delineator Condition Survey

Purpose

To determine type and possible cause of delineator failure in the field by periodic observations of representative delineators.

Scope

Observe delineator condition periodically on approximately 5,000 delineators on both urban and rural roadways in all counties in the lower peninsula. Record installation characteristics or parameters.

Progress Past Year

Three surveys of the delineators have been conducted. The data were entered into computer tape storage.

Planned Program for Coming Year

Next year this project will correlate failure and replacement rate with delineator, post, and roadway types, and manufacturer. Complete this project.

Title

73 G-196 - Experimental Tower Interchange Lighting (Federal Work Plans No. 21 and No. 31)

Purpose

To determine maintenance factors for tower lighting. To determine pavement illumination produced by tower lighting compared with design

levels of pavement illumination, and with pavement illumination produced by conventional lighting. To determine disability veiling glare of tower interchange lighting (roadway lighting mounted in tower clusters at heights above 50 ft) compared with conventional low-mounted interchange lighting. To determine the need for underbridge lighting at interchanges. To determine the aesthetic value of tower lighting. To determine the value of tower lighting during inclement weather--fog, haze, sleet, snow, and rain.

Scope

Work Plan No. 31 of this project will evaluate the parameters of pavement illumination (illuminance) and brightness (luminance), and system disability glare in six interchanges in the Grand Rapids area before installation of tower lighting and after installation of tower lighting at six month intervals up to 2-1/2 years. Work Plan No. 21 will investigate pavement illuminance and system glare for two interchanges in the Detroit metropolitan area after tower lighting installation. The project will provide design criteria to the Utilities Design Section.

Progress Past Year

A mobile data acquisition system was fabricated. A station wagon instrumented with a Pritchard telephotometer and recorder measured pavement luminance and disability glare. Just before installation of the tower lighting, disability glare and pavement illuminance and luminance were recorded for the conventional roadway lighting in the six interchanges in the Grand Rapids area.

Planned Program for Coming Year

Continue work involving transfer of instrumentation to a new van and continue calibration work and trial runs on roadway lighting in the vicinity of the Research Laboratory. Tower lighting at the eight interchanges will be evaluated twice with an intervening six months.

Title

*62 G-117 - Lights and Lighting for Warning and Delineation

Purpose

To determine photometric design requirements for hazard and delineation lighting, and develop a method for evaluating the psychological factors for hazard and delineation lighting. To ascertain the effectiveness of existing commercial lights as delineating or hazard warning devices.

Scope

This project will include an investigation of the psychological factors pertinent to the facilitation of perception and recognition of hazard warning and delineating lights of many types. Recommendations and specifications were written requiring the minimum intensity for a delineation light and the flash characteristics of a warning light such as the optimum flash rates and "on" times, and the minimum effective intensity. Specific color and deployment for delineation and hazard lighting were also endorsed by the recommendation.

Progress Past Year

The final review draft of the final report was completed and given approval by the FHWA.

Planned Program for Coming Year

Minor revisions in the review draft will be completed and the final report will be printed.

Title

57 E-15(2) - Sodium Chloride Stabilization - M 28 East of Bruce Crossing

Purpose

The objective of this project is to evaluate the effects of adding sodium chloride to a base course aggregate in a concentration much greater than is conventionally used and to compare salt-treated bases with untreated bases.

Scope

Sodium chloride in concentrations of 40 lb/ton of base course aggregate were used to stabilize two 1/2-mile test sections of a 24-ft bituminous paved roadway. Performance of these sections will be compared with that of alternating adjacent sections in which untreated aggregate is used in the base, and with sections constructed containing 12 lb/ton of salt, a concentration used as standard on the rest of this contract. Evaluation of the test sections will be made by field and laboratory compaction tests, laboratory measurement of base and subbase strength, frost susceptibility studies, and periodic rut depth measurements of the finished road surface over a five-year period.

Progress Past Year

Annual measurements of rut depths for all the test sections were continued, supplementing similar measurements made annually since construction was completed in 1972. To date, the average rutting depths have been higher for the higher salt content sections.

Planned Program for Coming Year

Continue annual inspection and rut depth analysis.

Title

68 E-42 - Evaluation of Component Layers in Bituminous Pavement Design

Purpose

To develop comparative thickness equivalency factors for asphalt-treated and untreated aggregate base course layers. A secondary purpose

is to provide knowledge needed to develop rationally based design procedures.

Scope

Implementation of a laboratory testing procedure for determining rheologic properties of each pavement layer. Develop computer capability for stress strain analysis of five or more layer systems. Determine rheologic properties of typical materials used in Michigan for constructing pavements. Develop theoretical equivalencies, based on AASHTO failure criteria, of base course materials, i.e., bituminous stabilized and gravels. The final phase will be verification of theoretical equivalencies developed by this study.

Progress Past Year

A study has been made of the resilient modulus test used in the laboratory and it was found to be questionable for evaluating bituminous materials, and possibly gravels, which are subjected to the type repetitive loading to be expected under pavement use. The contract let with MSU to determine soil support testing procedures includes development of procedures which may be directly applicable to all pavement layers with little or no modification. The MIT program for handling three-layer systems was found to be incompatible with the Department's computer system. For this reason, and because pavement structures are composed normally of four or more layers, attempts were begun to use the Chevron five-layer program, available from MSU, with the Department's computer. Procedures for developing equivalencies as outlined in NCHRP Report 128 were reviewed and appear to be applicable to the data we plan to develop.

Planned Program for Coming Year

In cooperation with the MSU project, develop capabilities for determining the rheologic properties of flexible pavement components. Attempt to get the Chevron program running on the Departments computer. Continue field testing of the 1 75 test sections.

Title

68 E-43 - Evaluation of Open Hearth Slag

Purpose

To determine the feasibility of using open-hearth and basic oxygen slags for base and subbase aggregates; specifically, to develop specifications and inspection testing procedures to assure adequate quality.

Scope

The project will require a review of all available information concerning existing projects constructed with these materials. Tests will be performed attempting to correlate heaving with particle size gradation, chemical composition (especially lime content), moisture absorption, and freezing. Where possible, these characteristics will be studied at particular locations before and after heaving.

Progress Past Year

The riding quality of comparative test sections of I 75 were measured with the rapid travel profilometer; this project has been substantially completed except for these long term comparisons. Laboratory testing has been completed. All of these tests indicate that the slag does expand but to varying degrees. Laboratory and field test sections have also shown that the slag is frost susceptible. Treatment of the slag by chemical means, as recommended by the producer, has not reduced the expansive characteristics. Chemical tests, although not conclusive, indicate that CaO and MgO are the cause of expansion.

Planned Program for Coming Year

Riding quality measurements will be made as scheduled. A final report will be prepared after the 1976 measurements are completed.

Title

71 E-49 - Development of Soil Support Values and Coefficients of Relative Strength of Michigan Highway Soils

Purpose

To develop a method for calculating the soil support values of subgrade soils used in Michigan and use the method for assigning typical values to soil groups, enabling the Department to more fully implement the AASHTO Interim Guide for the Design of Flexible Pavements. In addition, to develop a method to calculate strength coefficients of Michigan pavement materials.

Scope

Originally the project was to be conducted in the laboratories of the Research Laboratory using triaxial tests developed for the equivalency studies under Research Project 68 E-42. During 1975, however, the project was expanded, through a contract with Michigan State University, to develop additional testing methods and procedures for relating soil support

values to measured soil properties. The laboratory results will be correlated with field test site data to check the method developed for calculating soil support values. Tests will include cyclic triaxial, conventional triaxial and CBR, using cohesionless soils, supplemented by tests to determine the behavior of asphalt concrete, base and subbase materials under repeated loading. An in-depth study of existing multilayer elastic solutions and finite element techniques will be made to determine the test best suited for meeting project objectives.

Progress Past Year

A number of Michigan soils ranging in texture from clay to aggregates were tested under cyclic loading conditions and their resilient modulus determined. A tentative chart relating soil types to soil support values was prepared. A contract was let with Michigan State University for developing improved techniques for relating soil properties and soil support values.

Planned Program for Coming Year

Samples from the field test sites required for the MSU phase of the study will be obtained by Research Laboratory personnel and testing begun at MSU. Supplementary testing will be continued by the Research Laboratory both on measurement of soil support values in conjunction with the MSU studies and on our own soils testing program. Available data already developed by the Research Laboratory will be reviewed and all applicable material made available to the MSU study.

Title

72 E-50 - Shoulder Drains in Reinforced Shoulders

Purpose

To evaluate the effectiveness of improved subbase drainage as a measure of preventing heaving of concrete base shoulders.

Scope

Concrete base shoulders with and without supplemental shoulder drains were investigated.

Progress Past Year

The field work has been completed and the report preparation has been started. Several aspects of this study are beyond the scope of the project and limit analysis of the observed performance. Some of the problems

brought out by this study are now being studied under Departmental Research Project 75 E-56.

Planned Program for Coming Year

The project will be completed with the preparation of a final report.

Title

*73 E-51 - Transverse Cracking of Flexible Pavements

Purpose

To determine if the model, developed by Hajek and Haas, for predicting transverse cracking frequency is reliable for use in Michigan; and if necessary, revise the model to improve its accuracy. If the model is found not reliable, to make appropriate recommendations based on project findings.

Scope

To determine the actual frequency of occurrence of transverse cracks of flexible pavements located throughout Michigan and compare these results with crack frequency predicted by the model. In addition, to perform a laboratory study of actual bituminous stiffness in a section of pavement observed to have widely varying transverse cracking frequency but whose predicted cracking frequency is a constant.

Progress Past Year

Laboratory study and data analysis completed and report written.

Planned Program for Coming Year

Publish report.

Title

73 E-52 - Nuclear Gage Calibration Study

Purpose

To determine the most appropriate method for rapidly calibrating nuclear soil and asphalt gages in the laboratory using calibration samples prepared with soils and materials normally used in Michigan highway construction.

Scope

Field calibration data for the several gages now in use will be analyzed to determine the extent of bias and variance from existing factory calibration. Laboratory calibration samples of soil will be prepared and measured for overall weight-volume density and moisture content. Nuclear gage readings and Rainhart volumeter density values will be measured on each box sample. A direct transmission gamma-ray attenuation gage will be calibrated using soil specimens molded to AASHTO T-99 and T-180 compaction requirements. The attenuation gage will then be used to measure the uniformity of box samples and will provide a check on each of the density values measured on the box sample with the Rainhart device. Samples will then be oven dried for moisture content calibration. Findings resulting from this laboratory study will then be used to prepare calibration standard blocks of a permanent nature from such materials as natural cut stone, stabilized soils or bituminous aggregate mixtures.

Progress Past Year

Project was completed and the report distributed.

Title

74 E-53 - Development of a Field Permeability Test

Purpose

To develop a reliable field permeability test, easy to use in the field, and comparable to, for example, the standard density test in speed and simplicity of operation.

Scope

Limited to development of such a field test and its evaluation through trial field use.

Progress Past Year

Development of the method was completed, its accuracy checked by comparison with ASTM D 2434-68 standard method, trial field use was completed, and the report has been substantially completed.

Planned Program for Coming Year

Publish report of the project.

Title

75 E-54 - Use of Low Density Concrete as a Light Fill Material for Bridge Abutment (Work Plan No. 42)

Purpose

To determine the performance of a lightweight cellular (low density) concrete as a fill material to prevent further vertical movement in the area around a bridge abutment.

Scope

Approximately 3,500 cu yd of low density concrete will be used to replace a portion of the existing backfill material for the east abutment of this bridge structure. Annual visual and instrument surveys will be conducted to observe performance.

Progress Past Year

Preliminary studies of the material "Elastizell" were conducted and a work plan for the project prepared.

Planned Program for Coming Year

The fill is scheduled for placement during the 1976 construction season. The construction report and initial instrument readings are planned to be completed.

Title

75 E-55 - Evaluation of Cold-Mix Emulsion Black Base at the Secondary Complex

Purpose

To determine the handling, construction and performance of a cold-mix black base in relationship to conventional black base construction.

Scope

A cold-mix base will be included as part of a black base construction

using normal construction procedures so that a performance evaluation can be made under typical traffic and environmental conditions.

Progress Past Year

Experimental work plan prepared and construction specifications revised as needed.

Planned Program for Coming Year

Construction is scheduled for 1976; a progress report describing construction methods and problems is to be prepared in the fall of 1976 provided construction has been completed.

Title

75 E-56 - Subbase Drainage Criteria and Supplementary Drainage Design for Michigan Highways

Purpose

To investigate and calculate the time required for the subbase drainage. To investigate the best location of supplementary drains as well as their sizes.

Scope

Using Darcy's Law and the concept of effective porosity to develop approximate theoretical analysis method for subbase drainage. Different subbase cross-sections for various Michigan pavements are investigated and the minimum required material characteristic factors, k/ne, are calculated by this analysis method. Using program Dracy, a finite element computer program, to determine the quantity of flow for supplementary drains at various locations for different subbase cross-sections.

Progress Past Year

The investigation of subbase drainage time and the development of a theoretical analysis method for various pavement cross-sections' subbase drainage has been developed. A report was written for this part of research.

Planned Program for Coming Year

Reaction from various sources on the first part report will determine whether the second part should be accomplished.

Title

75 E-57 - Evaluation of Particle Index for Measuring the Influence of the Coarse Aggregate Fraction on Stability of Granular Mixtures

Purpose

To investigate the practical significance of being able to measure the geometric properties of the coarse aggregate fraction (+ No. 4 sieve) of granular materials, and an attempt will be made to establish how significant are the influences of geometric properties on stability compared to the influence exerted by gradation and density.

Scope

The study is limited to literature review and supplemental laboratory study sufficient to indicate the potential of the Particle Index Test as a means of measuring geometric properties. To minimize variables in this study only the -1 in. + No. 4 sieve size fraction will be studied.

Progress Past Year

Literature review and laboratory study have been completed.

Planned Program for Coming Year

Write and publish the report.

Title

75 E-58 - Relationship Between Pavement Performance and Subsurface Drainage Conditions

Purpose

To determine if the subsurface drainage condition of a flexible pavement's foundation can be related to pavement performance characteristics.

Scope

Test sites are limited to the flexible pavement portion of US 27 and I 75 where traffic volumes and pavement design are very uniform but performance varies from excellent to poor. The study is preliminary in nature, intended to provide a basis for future study of flexible pavement performance and its relationship with the engineering properties of its several layers.

Progress Past Year

The field work and laboratory testing has been completed. Approximately 1/4 of the data have been analyzed.

Planned Program for Coming Year

Complete data analysis and publish report.

Title

75 E-59 - Comparative Study on Performance of Bituminous Stabilized Bases (M 66 and M 20)

Purpose

To determine if there is any significant difference in the strength of the two base designs - aggregate base for M 20 and bituminous stabilized base for M 66.

Scope

Benkelman beam measurements will be conducted on comparable sites of these two pavements. Comparison of the strength of the two base layers is to be made based on the life expectancy of the pavements as calculated from the surface deflection data.

Progress Past Year

After consulting with the District Office and a study of the road plans, comparative sites for measurements were selected based on environmental factors and frost depth indicators were installed at these sites.

Planned Program for Coming Year

Benkelman beam measurements will be made beginning in the early spring and continue until the fall when an annual report will be prepared.

Title

75 E-60 - Use of Frost Depth Indicators and Benkelman Beams to Determine when Load Restrictions Should be Lifted

Purpose

Research will be conducted in District 1 to formalize procedures for

applying and lifting weight restrictions based on information provided by frost depth indicators. In addition, this study will also provide a procedure for approving overload requests based on Benkelman beam deflection. The procedures developed in this study would be applicable statewide.

Scope

The project will include study of up to 12 one-mile long sites in which frost depth, pavement surface deflection, climatological data and pavement foundation conditions will be utilized to achieve the projects purpose.

Progress Past Year

Fourteen frost depth indicators have been installed at sites selected by District 1 personnel.

Planned Program for Coming Year

A Benkelman beam will be modified for more rapid field testing. An automatic recording system will be built for measuring pavement surface deflection. Surface deflection measurements will begin in March. Climatological data will be collected for each site and soil surveys will be made at each site sufficient to determine the drainability of the pavement foundation.

Title

68 D-26 - Evaluation of Nuclear Methods for Asphalt Testing

Purpose

The purpose of this work plan is to outline procedures for continuing the study with the added provision for evaluating nuclear soil gages as well as a nuclear gage manufactured specifically for measuring the asphalt content of bituminous mixtures.

Scope

This study will consist of laboratory and field evaluation of both a Troxler Model 2226 Asphalt Content Gage and a Troxler Model 2401 Soil Density-Moisture Gage which may also be suitable for measuring asphalt content. The Model 2226 Asphalt Content Gage will be evaluated for accuracy and adaptability to job control by the Bituminous Technical Service Unit of the Testing Laboratory, in accordance with the work plan they have prepared which includes a preliminary study of the accuracy and precision of the instrument, followed by field evaluation on selected paving projects.

Progress Past Year

The Troxler Asphalt Content Gage, Model 2226, was evaluated by the Testing Laboratory and seems to be an accurate method capable of replacing conventional extraction procedures for certain operations, such as plant start-up and laboratory testing. Laboratory tests to evaluate the Troxler Model 2401 Soil Density-Moisture Gage are about 75 percent complete and indicate that further field evaluation (concerning asphalt content) would not be meaningful. Results concerning density evaluations have been published (Research Report No. R-745).

Planned Program for Coming Year

All test data and research information gathered during this project will be compiled and a final report concerning measurement of asphalt content of bituminous mixtures will be prepared.

Title

74 D-29 - Sulpher-Asphalt (Inactive)

Title

75 D-30 - Recycling of Asphalt Pavement

Purpose

The objective of this study is to evaluate the overall applicability and effectiveness of this specific recycling technique for rehabilitation of flexible pavements characterized by extensive cracking and roughness.

Scope

Altogether, 31 miles of I 75 freeway is to be rehabilitated in Otsego and Cheboygan Counties. Of this mileage, 11 miles of northbound roadway is to be recycled by mixed-in-place stabilization procedures, and will involve pulverizing, blending and compacting 254,000 sq yd of shoulder base and pavement material.

Progress Past Year

Samples obtained from the proposed construction site have been tested in the laboratory to determine design density and moisture content along with desirable asphalt stabilizer type and amount, environmental durability has also been determined by an experimental work plan (Category II) and

application for Federal-Aid Interstate funding has been submitted to FHWA for approval. Plans and specifications for construction are essentially complete.

Planned Program for Coming Year

Experimental construction involving field tests and observations will be completed. A report describing construction procedures will be prepared.

Title

75 D-32 - Reclaimed Rubber-Asphalt

Purpose

To evaluate the benefits of reclaimed ground rubber when included in asphalt paving mixtures with emphasis on the reduction of reflective cracking on resurfacing projects.

Scope

The study will involve laboratory tests of engineering properties for several mixtures and a field test road incorporating different thicknesses and mix proportions.

Progress Past Year

Several meetings were held with Testing Laboratory engineers for the purpose of planning an experimental and testing program.

Planned Program for Coming Year

A research proposal is to be prepared and experimental test sections constructed during the coming construction season.

Title

72 F-125 - Mixed-In-Place Stabilization

Purpose

The purpose of this study is to prepare guidelines and specifications for mixed-in-place construction of bituminous stabilized soils and aggregates with provision for reclamation of existing materials.

Scope

This study will consist of a literature study, laboratory testing, and a review of construction experience within the state. Literature will be reviewed in order to compile guidelines for the selection of materials (both soils and asphalts), appropriate test methods, specifications, construction equipment and methods. A laboratory testing program will be conducted to determine appropriate mix design and construction control tests. The relationship between mix designs based on stability and field tests of density will be determined so that existing conventional soil compaction inspection methods may be utilized as much as possible. Wherever possible, construction experience will be compared with the compiled information as a check on its appropriateness for Michigan conditions. The study will be initially limited to gravels and sands, either pit-run or processed and include pulverized bituminous mixtures.

Progress Past Year

Laboratory and field testing was completed and a final report was prepared in rough draft form. Construction projects using asphalt cements as well as cutbacks and emulsions as base stabilizers were observed and tests performed on engineering properties.

Planned Program for Coming Year

Final report will be completed.

Title

75 G-215 - Pavement Feedback System

Purpose

To establish a computerized, retrievable compilation of historical data and updated information on existing pavement systems for use in shaping decisions affecting optimum utilization of highway materials, overlays, upgrading.

Scope

For the present, the system will consist of information obtained on two sections of I 75 from the Oakland-Genesee Co. Line to Bridgeport. Eventually, the system should include 80 to 90 percent of the state trunkline system.

Progress Past Year

Initiation of the project on a need expressed in the July meeting of the Engineering Operations Committee (EOC). Definition of the project. Contacts made with personnel of involved Divisions in the Bureau of Highways to establish scope. One interim report sent to the EOC September 24, 1975.

Planned Program for Coming Year

To get started on the computer coding portion of the project. To be able to produce limited computer print-out of pavement identification.

Title

75 G-216 - Evaluation of Prewetted Salt for Ice Control

Purpose

The purpose of this investigation is to evaluate the effectiveness of the method with respect to efficiency and overall economy in ice control application of rock salt.

Scope

The Research Laboratory will make observations on both normal and prewetted sodium chloride ice control applications during the 1975-76 season. These observations will include the calibration of spreading equipment, testing the pattern of spread on the road, and its melting effectiveness during actual storm applications. Such observation will be made on both conventional and prewetted operations.

Progress Past Year

The proposal and experimental procedure for this study were prepared.

Planned Program for Coming Year

Field evaluations will be made during winter storm conditions during December 1975, January and February 1976. Comparisons between "prewetted" and conventional dry rock salt will be made using the Departments Photologging Unit and color infrared photography. A final report comparing the overall benefits of "prewetted" salt with conventional operations will be prepared.

Title

72 D-27 - Evaluation of Cold-Mix Black Base Construction

Purpose

To determine the handling, construction and performance of a cold-mix black base in relationship to conventional black base construction.

Scope

A cold-mix base will be included as part of a black base construction using normal construction procedures so that a performance comparison can be made under nearly equivalent conditions.

Progress Past Year

Test sections were inspected and found to be performing with no signs of distress. A memorandum report of performance was submitted to R. C. Mainfort on April 11, 1974.

Planned Program for Coming Year

Performance inspections will be made during the spring and fall of 1976 and a final report prepared.

Title

74 F-140 - Maintenance Procedures to Prevent Blow-Up of Concrete Pavement Joints

Purpose

To develop procedures for preventive maintenance of concrete pavements to delay the occurrence of joint failure due to compressive stress, and to try to prevent joint blow-up.

Scope

Procedures for rating pavement joints and selecting locations for joint replacement or installation of pressure relief joints were developed. These concepts were applied on approximately 80 miles of divided highway. Pressure relief joints and adjacent joints and cracks were instrumented at 10 locations on I 696 and 16 locations on I 75.

Progress Past Year

A report on pavement failures, and the pressure relief joint installer (R-949) was issued in January. Many meetings were held with Designers and District personnel to discuss the concepts involved, and to discuss problems on particular jobs. Condition surveys were made on all projects in the 8 to 18 year old category. Pressure relief joints and adjacent joints and cracks were instrumented at 26 different locations, and readings were taken four times. Condition surveys were made on completed preventive maintenance projects, and it was found that no blow-ups had occurred during the past summer. Investigations were made on several projects where filler was being ejected from the joints.

Planned Program for Coming Year

Existing projects will be monitored for performance. Recommendations will be made for modification of the joint types to be used on future projects. Further condition surveys will be made. Additional meetings will be held with Design and District personnel to discuss concepts, problems, and revised program and to make further recommendations.

Title

75 F-148 - Pavement Roughness for Non-Reinforced Ramps and Service Roads

Purpose

Compare riding quality of non-reinforced pavements with pavements which are reinforced.

Scope

Ramps and service roads are now being constructed of short length non-reinforced concrete slabs. A sample of these will be selected and measured for riding quality.

Progress Past Year

Project just established.

Planned Program for Coming Year

Select pavements for evaluation, measure their riding quality, and make a comparison of reinforced vs. non-reinforced construction.

Title

73 D-28 - Evaluation of Wet Bottom Boiler Slag for Bituminous Shoulder Wearing Courses, I 94 in Dearborn Heights

Purpose

Evaluate color contrast of shoulders constructed with wet bottom slag.

Scope

Wet bottom boiler slag was used as the fine aggregate in a bituminous mix used to construct shoulders along a 1.8 mile length of I 94.

Progress Past Year

Skid tests are planned for this year.

Planned Program for Coming Year

Skid test the shoulders and report results to Testing Laboratory.

Title

70 F-114 - Broomed Concrete Pavement Surfaces

Purpose

Develop, construct, and evaluate new methods of texturing new concrete pavements.

Scope

Develop or procure equipment for texturing concrete pavements during construction. Evaluate performance of the treated surface.

Progress Past Year

Modified standard specifications to require transverse combing of new concrete pavements. Different types of textures were constructed and tested.

Planned Program for Coming Year

Continue observing and testing experimental textures. Try new textures as they are conceived.

Title

*69 G-173 - Determination and Improvement of Relevant Pavement Skid Coefficients

Purpose

To investigate various factors affecting skid resistance and to develop means for improving skid resistance.

Scope

Using a new skid test unit obtained for this project, effects on skid resistance of rain, season, temperature, speed, etc. are being investigated.

Progress Past Year

Laboratory and field tests were made and some analysis was done.

Planned Program for Coming Year

Continue analysis and write report.

Title

54 G-74 - Survey of Skid Resistance of MDSHT Surfaces

Purpose

To conduct a program of skid testing, interpretation, and research.

Scope

A systematic program of skid testing Michigan's trunkline system throughout its service life is being conducted. Data from the program are used to locate slippery areas, evaluate surface textures, and study materials.

Progress Past Year

About 12,000 skid tests were made throughout the state.

Planned Program for Coming Year

Continue skid testing program.

Title

54 G-74(5) - High Accident Areas (For Traffic Research) (Survey of Skid Resistance of MDSHT Surfaces)

Purpose

To skid test areas where accidents on wet surfaces are disporportionately high.

Scope

All areas on the state trunkline system are under observation.

Progress Past Year

Over 1,000 skid tests were made and reported on.

Planned Program for Coming Year

Continue program.

Title

69 F-111 - Construction and Performance Evaluation of Mixed-In-Place Bituminous Stabilized Shoulder

Purpose

To evaluate the use of different bituminous materials for mixed-in-place stabilization of existing shoulders.

Scope

Five different bituminous materials were used to stabilize about 42 linear miles of shoulder on I 75 near Flint.

Progress Past Year

Shoulders were inspected.

Planned Program for Coming Year

Survey shoulders and write final report.

Title

65 F-82 - The Effects of Safety Studded Tires on Pavement Surfaces

Purpose

To evaluate the effects on pavement of studded tires.

Scope

Measurements are made of ruts woven in pavements throughout the state. Accident data related to tire studs have been analyzed, annual surveys of stud use are made, and legislation was developed regulating the use of studs.

Progress Past Year

Annual stud use surveys and pavement rut depth measurements were made. Perma-T-Gripper studs were evaluated and approved for use.

Planned Program for Coming Year

Draft amendment to tire stud law. Evaluate new studs for compliance

with pavement wear rules. Make annual surveys of use and pavement wear.

Title

39 F-7(14) - Performance of Postwar Pavements (Concrete Pavement Design)

Purpose

To evaluate the performance of concrete pavements built subsequent to World War II and recommend changes in design or construction practices where warranted.

Scope

The entire trunkline system of concrete pavements constructed after World War II are condition surveyed and used as sources of data for evaluating performance.

Progress Past Year

Condition surveys were made of pavements scheduled for such.

Planned Program for Coming Year

Continue surveys, investigate and report on problems of particular interest.

Title

72 C-14 - An Evaluation of Mastic-Type Paving Mixtures for Resurfacing a Roadway and a Bridge Deck

Purpose

To determine whether mastic-type paving mixes could be successfully placed without using special construction equipment. Then to evaluate the performance of the mastic surfaces.

Scope

Two different mastic-type surfaces were placed on a length of US 31 pavement south of Ludington and one of the mastic mixes was placed as part of a waterproof deck surface on a bridge on US 31. The two mastic mixes are known as Gussasphalt and Mastiphalt.

Progress Past Year

The surfaces were inspected, skid measurements were made, and the bridge deck was tested for permeability.

Planned Program for Coming Year

Inspect surfaces, and make skid measurements. Prepare report.

Title

69 F-105 - Effects of Transverse Saw Cutting PCCP on Reflection Cracking

Purpose

To evaluate the effectiveness of saw cutting concrete pavements prior to resurfacing in reducing reflection cracking in the overlay.

Scope

Two test sites are suggested, one in the north and one in the south, each with replicate sections of varying saw cut intervals and thickness of stabilized lift.

Progress Past Year

Efforts continued in locating suitable test sites.

Planned Program for Coming Year

Refer to Engineering Operations Committee for selection of test sites.

Title

74 F-137 - Performance of Pavement - 7-in. Plain Concrete with 6-in. Pozzolanic Base

Purpose

Evaluate performance of pozzolanic (slagcrete) base course for concrete pavement.

Scope

Pavements were designed and constructed by Oakland County. We observed construction and will conduct condition and profile surveys to evaluate performance.

Progress Past Year

Compression tests and freeze-thaw tests were conducted on cores removed from the pavement.

Planned Program for Coming Year

Continue observations of performance.

Title

75 F-142 - Predesign Evaluation of Pavement Serviceability

Purpose

Provide "Pavement Serviceability Index" for pavements as requested.

Scope

Compute "PSI" of a pavement based on roughness and condition surveys.

Progress Past Year

One request was responded to; I 75 from Gaylord to Indian River.

Planned Program for Coming Year

Respond to requests as received.

Title

74 F-138 - Review of Special Permits for Overloaded Vehicles

Purpose

Structurally analyze the affects of overloads on pavements to determine whether a special permit should be given for moving such overloads.

Scope

Requires an engineering analysis of stresses induced in the pavement system by extreme loads.

Progress Past Year

Three requests for special permits were responded to.

Planned Program for Coming Year

Requests will be responded to as they come in.

Title

75 F-147 - Pavement Riding Quality

Purpose

Conduct surveys with the Rapid Travel Profilometer to measure the roughness or riding quality of Michigan Pavements.

Scope

Conduct surveys and report results on all new construction and on past construction at five, 10, 15 and 20 year service levels.

Progress Past Year

3,050 lane miles of concrete, bituminous, and overlays were tested and data are on tape to be processed.

Planned Program for Coming Year

Continue with established survey procedures.

Title

74 G-209 - Investigation of Truck Litter Problem

Purpose

Document problem of highway litter from uncovered trucks to initiate legislative action for a bill requiring the covering of loads.

Scope

Initial plans involved several means of quantifying the type and amounts of material deposited along the roadways by uncovered trucks.

Progress Past Year

The literature search for this project revealed an extensive survey being conducted nationwide by the AAA Insurance Company. Correspondence with AAA revealed that public response to their survey resulted in negotiations with the Michigan Trucking Association. As of now a bill (H. B. No. 4223) has been passed by the House of Representatives and is scheduled for the third (and final) reading before the Senate on January 22, 1976.

Planned Program for Coming Year

Continued following of legislative action.

Title

75 C-16 - Performance Evaluation of Trinidad Asphalt Cement for Bituminous Pavement

Purpose

To assess the relative performance of Trinidad Asphalt cement compared with conventional 85-100 penetration grade asphalt in bituminous concrete mixtures.

Scope

To compare the qualities and properties of the asphalt concrete mixes and their service performance under traffic and weather conditions at an experimental site covering 4.9 miles of four-lane divided highway; compile and analyze field data in terms of surface compaction, skid resistance, riding quality, and surface durability in resisting long-term cracking, deformation, and other pavement failures; discuss construction problems if any; and compile and compare construction costs.

Progress Past Year

Construction project completed; field condition surveys conducted; and progress report published (Research Report No. R-962).

Planned Program for Coming Year

Continue seasonal surveys and field inspections of the experimental project until the resurfaced area is old enough for comparative evaluation; write subsequent progress reports as needed.

Title

73 G-203 - Experimental Evaluation of Extended Establishment Period for Freeway Landscape Projects

Purpose

To evaluate the results of extending the establishment period to two summer growing seasons following the completion of planting.

Scope

To assist the Roadside Development Section in evaluating the relative performance of two adjacent landscape projects (a conventional, one-growing season to be compared with an experimental, two-growing season); provide assistance for analyzing plant care work and interpreting maintenance cost records required for both experimental and control projects.

Progress Past Year

Field work completed and data gathered under study.

Planned Program for Coming Year

Conclude evaluation of field results and maintenance cost records; write a final report on this project.

Title

75 G-212 - No-Discharge Recirculating Sewage System for Freeway Rest Areas

Purpose

To evaluate Chrysler Recirculating Sewage System for use at rest areas.

Scope

To cooperate and participate in the proposed experimental installation of a Chrysler Aqua-Sans Recirculating Sewage System for the I 275 rest area (southbound) 58171, north of Monroe.

Progress Past Year

Detailed work plan presented and discussed.

Planned Program for Coming Year

Await the approval of the work plan by Health Agencies involved.

Title

74 G-207 - Sewage Treatment Systems at Freeway Rest Areas

Purpose

To develop methods of upgrading rest area sewage treatment systems to meet land treatment, disposal, and water control regulations.

Scope

To follow-up the development of this research project assigned to Michigan State University personnel.

Progress Past Year

Five experimental sites selected for groundwater monitoring test well borings and cross section plots for Sites No. 1 and 2 submitted to the Michigan Department of Natural Resources as standard procedure.

Planned Program for Coming Year

Waiting for further development of the proposed project.

Title

75 G-213 - Erosion Control and Turf Establishment on Roadside Slopes

Purpose

To assess the relative performance of three methods for turf establishment and erosion control under field conditions.

Scope

To provide assistance for evaluating the comparative performance of these methods; for determining the most feasible and economical way of controlling erosion; and for establishing roadside turf on selected projects.

Progress Past Year

Proposal submitted, discussed and revised.

Planned Program for Coming Year

Waiting for further development of the proposed project.

Title

75 F-145 - Rehabilitation of Old Concrete Pavement

Purpose

To determine the most feasible and economical way of recycling and rehabilitating old reinforced, concrete pavement located on US 2, Mackinac County.

Scope

Literature search and review in the areas related to concrete sawing, breaking and crushing and handling mesh-reinforced concrete slabs in place; also in the areas related to the characteristics of crushed concrete as aggregate material for recycling at job sites.

Progress Past Year

Portion of available information reviewed and filed.

Planned Program for Coming Year

Continue literature search and review.

Title

57 F-76 – Continuously Reinforced Test Project, I 96, M 66 to Portland

Purpose

To study durability, construction efficiency and costs as compared to standard jointed pavement practice.

Scope

The test pavement consists of approximately a four-mile long portion of I 96. It is composed of four distinct parts: continuously reinforced sections with deformed bar mat, continuously reinforced sections with welded wire mesh, a standard section with contraction joints spaced at 99 ft, and relief sections at the ends of the continuously reinforced sections.

Progress Past Year

Measurements on joint widths in the relief sections, on crack widths in the continuously reinforced sections, and on construction joint widths were taken on a semi-annual basis. Visual observations of the general conditions of the pavement were made periodically. A work plan (No. 36) was written and submitted to the FHWA for approval. It requested FHWA participation in rehabilitation of the mesh reinforced sections which have deteriorated to the point where such work is necessary.

Planned Program for Coming Year

Measurements and observations of the performance of the pavement

will be continued. Removal of steel samples from the bar mat reinforced sections for corrosion analysis will be made. If Federal approval of the proposed rehabilitation work is given, the mesh reinforced sections will be converted to essentially a standard pavement.

Title

61 F-64 - Continuously Reinforced Concrete Pavement No. 2, I 96, Phillips Rd to Meridian Rd

Purpose

To determine end movements of anchorage and crack openings at transverse cracks.

Scope

The test pavement consists of approximately 6 miles of mesh reinforced pavement on the eastbound roadway and an equal length of bar mat reinforced pavement on the westbound roadway. The ends of the continuously reinforced sections are anchored with lugs.

Progress Past Year

Semi-annual measurements on movements at end anchors and at crack openings were taken on the bar mat reinforced section. The mesh reinforced section has failed in continuity at close to 100 locations and measurements were discontinued on this section for that reason. Visual inspections of the failures and of the general condition of the pavement were made periodically. FAI funds for rehabilitation of the eastbound roadway were requested but this was denied.

Planned Program for Coming Year

The movements at end anchors and at selected cracks will continue on the bar mat reinforced section.

Title

61 F-64(1) - Continuously Reinforced Pavement (Seaway Freeway-Fisher Freeway)

Purpose

To establish design considerations for use on continuously reinforced

pavements in metropolitan freeway locations. To handle problems during construction, to follow performance and to make recommendations for future construction.

Scope

This project includes all continuously reinforced pavements in the Detroit Metropolitan area constructed by using equipment riding on pavement forms. Various types of reinforcement were used and free ends were anchored or allowed to move at special constructed WF joints. A variety of construction joints were used.

Progress Past Year

The performance of the pavement was observed by conducting twice-a-year inspections. Special attention is given to detect signs of corrosion of the steel, wide cracks, spalls and construction joint problems. The 1974 inspections revealed 30 areas where maintenance was needed. These locations and suggested maintenance procedures were transmitted to the Metro District but action was held in abeyance until the freeways will be closed for other type of work. The 1975 surveys revealed no other areas in need of maintenance.

Planned Program for Coming Year

The twice-a-year inspections will be continued and appropriate recommendation concerning maintenance will be made if warranted.

Title

67 F-95 - Evaluation of Acme Load Transfer Devices

Purpose

To evaluate Acme assemblies with respect to load transfer capability, joint movement restraint, joint deterioration and corrosion of load transfer unit. Also, to determine the feasibility of using a two part dowel assembly in construction joints.

Scope

The test section is located on M 52 south of Owosso and consists of about one mile of pavement containing Acme assemblies and one mile of standard pavement with steel dowels used for comparison purpose. Eight construction joints contain the new type of dowel bar assembly.

Progress Past Year

Joint width measurements were taken on a summer-winter basis. Annual surveys of transverse crack formation and of joint deterioration were conducted.

Planned Program for Coming Year

Monitoring of joint width variations, crack formation and joint deterioration will continue. Samples of dowel bars may possibly be removed for corrosion analysis.

Title

68 F-104 - Plastic Coated Dowels for Pavement Joints

Purpose

To evaluate plastic coated dowels with respect to load transfer capability, joint movement restraint, joint deterioration and corrosion of dowel.

Scope

The test section is located on M 52 south of Owosso and consists of 10 consecutive joints containing plastic coated dowels manufactured by Republic Steel Corporation.

Progress Past Year

Semi-annual joint width measurements were taken and crack formation and joint deterioration surveys were conducted.

Planned Program for Coming Year

Monitoring of joint width variations, crack formation, and joint deterioration will continue. Samples of dowel bars may possibly be removed for corrosion analysis.

Title

*70 F-118 - Development of Procedures for Replacing Joints in Concrete Pavements

Purpose

To develop procedures for replacement of distressed joints with permanent type repairs that can be opened to traffic within a few hours after installation.

Scope

A total of 100 lane repairs were made; 20 on westbound I 96 between Lowell exit and Thornapple River in Kent County; 40 on east I 96 also between Lowell exit and Thornapple River, and 40 on westbound temporary I 69 just west of the M 52 intersection in Shiawassee County. Various repair lengths, joint types, and both precast and cast-in-place repairs are included in the study.

Progress Past Year

Data on the following factors were obtained: changes in elevation between old and new slabs, changes in joint widths at the repairs, load deflection at leading joint of the repairs, rocking of slabs caused by moving load. A report covering the construction phase of study was issued.

Planned Program for Coming Year

Data collection on the above factors will continue. A report dealing with the evaluation of the repairs is planned.

Title

72 F-123 - Comparative Field Study of Joint Repair Techniques to Reduce Blowups

Purpose

To evaluate the merit of preventive maintenance of concrete pavements to eliminate blowups.

Scope

Approximately seven miles of US 127 between Mason and Leslie was selected for this project. The southbound roadway was pressure relieved by installing precast slabs, cast-in-place repairs, or relief joints at selected locations. The northbound roadway is used as a control section.

Progress Past Year

Semi-annual measurement of relief joint movements were made. Annual inspection of joint spall deterioration on both roadways were conducted. Records on yearly blowups or full depth repairs conducted on the northbound roadway were brought up to date.

Planned Program for Coming Year

Measurements of relief joint movements, inspection of joint deterioration, and blowup surveys will be continued.

Title

73 F-129 - Evaluation of Slipform Paving Methods for CRCP

Purpose

To determine if concrete is adequately consolidated, to determine accuracy of steel placement, and to evaluate the overall performance of slipformed CRCP.

Scope

All slipformed CRC pavements in Metropolitan areas as well as in rural areas are included. Various consolidation methods, steel placement procedures, and reinforcement sizes have been used.

Progress Past Year

Data on steel depth and tie bar position were obtained on a US 31 project. Crack formation and crack spacing surveys were conducted on selected test sections on I 196 and US 31 projects. Pertinent data were transmitted to Construction Division for their use.

Planned Program for Coming Year

Continued periodic surveys to monitor the performance of this type of pavement. Also, continue to check on construction procedures when the need arises, and assist Design and Construction Divisions in preparing plans and specifications.

Title

73 F-132 - Rehabilitation of CRC Pavement

Purpose

To determine the relative construction cost and performance of various rehabilitation methods.

Scope

The study will consist of rehabilitating about four miles of mesh reinforced pavement on the Portland CRCP test road on I 96. The methods will include installing dowelled and undowelled expansion and contraction joints at selected spacings.

Progress Past Year

A work plan, detailing proposed rehabilitation procedures was sent to FHWA for approval and FAI funding was also requested. Denial for FAI funds and comments on the work plan were received from the FHWA. A revised plan and a new request for FAI funds were sent to FHWA.

Planned Program for Coming Year

If FHWA approval is given attempts will be made to let a contract for the proposed work. The field work could possibly be completed during the summer, and initial evaluation work could be done.

Title

75 F-143 - Evaluation of Various Types of Railroad Crossings

Purpose

To evaluate the performance of new crossing materials, to obtain information on construction procedures, and to determine the relative cost of each crossing type.

Scope

This is an open end Category 2 project. Initially 10 crossing and three new materials were included. Three new crossings and two new materials have been added since the study was initiated.

Progress Past Year

Construction of two experimental crossings utilizing precast slabs has been completed, and initial evaluation data have been obtained. Three additional crossings have been authorized for construction.

Planned Program for Coming Year

Observation of the construction of authorized crossings will be made and evaluation data obtained on new as well as on last year's installation.

Title

75 G-217 - Maintenance of Neoprene Sealed Concrete Pavements

Purpose

The overall objective of the study is to develop a maintenance procedure for concrete pavements sealed with neoprene seals. Specific objectives are: a) to determine the suitability of various materials in fixing spalled joints, develop repair techniques, and design and develop devices for accomplishing the task, b) to determine seal type and installation method for resealing joints with oversized grooves where initial seal is lost or ineffective, c) to determine equipment requirement and seal type for resawing and resealing expansion joints prior to damage from excessive compression, d) to explore the possibility of effectively sealing open transverse cracks to prevent pavement "growth" from this source.

Scope

Basically, the project will consist of two phases. Phase 1 will consist of developing the maintenance procedures on a 1964-65 construction project. Phase 2 will entail the application of the procedures on a relatively new and several mile long pavement.

Progress Past Year

Preliminary proposal has been prepared and is currently being reviewed by the Maintenance Division.

Planned Program for Coming Year

A final proposal will be prepared for the Engineering Operations Committee approval. If approved, work will commence on the various type of proposed procedures.

Title

72 G-189 - Sources and Effects of Environmental Noise

Purpose

To investigate the various sources of transportation related noise and to determine their effects upon the environment.

Scope

This is a continuing research project which is intended to consist of a series of investigations into the varied aspects of vehicle generated noise.

Progress Past Year

Research was initiated pertaining to peak noise levels generated by various types of highway vehicles as they pass by a monitoring station. Measurements have been conducted at several sites in order to ascertain the effects of various roadway surfaces and grades. The resulting data base will provide information for setting limits in vehicle noise legislation in Michigan.

Planned Program for Coming Year

Completion of the vehicle pass-by peak noise level survey. Extension of existing "Traffic Noise Level Predictor Computer Program" to expediate barrier height predictions.

Title

75 G-211 - Noise Level Inventory of Michigan Freeways

Purpose

To provide an inventory of the existing and future noise levels along all Michigan freeways. The resulting data base will provide the information necessary to determine the priorities of noise abatement projects along our freeways.

Scope

To catalog the noise levels and respective land use categories in existence along all Michigan freeways.

Progress Past Year

The methods for obtaining the necessary field data have been established and two counties have been inventoried, using these methods, in order to gain insight as to what difficulties may be expected.

Planned Program for the Coming Year

Completion of the noise level inventory program statewide. A final report will be issued.

Title

72 G-190 - Improvement of Techniques for Handling Experimental Data

Purpose

To develop continually improved data processing techniques (programming and hardware) for the Laboratory.

Scope

This is a continuing project to design and develop programs or construct instruments for all Laboratory units.

Progress Past Year

a) Development of a technique to digitally compute road profiles, from analog raw data, b) design and development of an instrument to facilitate the acceptance testing of luminaires, traffic signals and other photometric devices associated with highways. This instrument will sample photometric data and store this information on magnetic tape for subsequent computer processing, c) construction of an electronic counter and timer for general laboratory use.

Planned Program for Coming Year

Continue to develop new techniques to meet the requirements of laboratory projects.

Title

65 F-84 - Damping Bridge Vibration During Construction Widening

Purpose

1. Initially: to monitor and report the magnitude of vibrations of the newly placed portions of the structures, caused by traffic on the original roadway. Temporary shoring was placed on some spans during deck placement. Several letters and reports were issued from 1965 through 1971.
2. Subsequently: to evaluate the performance of the widened portions of the decks. Yearly inspections and evaluations were made.

Scope

One hundred ten spans on 19 structures were included in the evaluation. Temporary shoring was placed on 44 of 94 spans that were subjected to traffic during deck placement.

Progress Past Year

A nine-year progress report (R-951) was issued in January. Yearly deck evaluations were completed in October. These evaluations included use of the Laboratory's delamination detector for the first time. Data reduction and analysis are under way.

Planned Program for Coming Year

Issue a final report for the project.

Title

68 F-101 - Experimental Concrete and Bituminous Shoulders (Experimental Work Plan No. 4)

Purpose

To determine the relative costs and performance of the experimental shoulder designs.

Scope

An experimental portland cement concrete shoulder design, two experimental bituminous shoulder designs, and the standard (1970) shoulder for Interstate construction were installed in a test area on a rural freeway. Three sections, approximately 1/2-mile in length, of each type, were built. Only the outside shoulders were included in the experiment.

Progress Past Year

A progress report was issued in January. Winter and summer readings were completed and the yearly condition survey was made. Since this is a long term evaluation, no other work was required. Data are kept tabulated and performance information is used in discussions pertaining to present design and construction practices.

Planned Program for Coming Year

Make periodic evaluations as in the past. Condition is still quite good, so the project will last several more years.

Title

*70 F-103 - Galvanized Steel Reinforced Concrete Bridge Decks

Purpose

To determine the feasibility of using galvanized reinforcement in Michigan bridge deck construction, and to evaluate the effect of galvanized reinforcement on the performance of laboratory specimens and full scale bridge decks.

Scope

Twenty-nine test slabs 3 ft x 4 ft x 7-1/2 in. were cast in the Laboratory and subjected to outdoor exposure with periodic applications of salt. A 30 ft x 5 ft composite simulated deck section was cast in the field for similar treatment. One half of the bars in the top mat were galvanized and the other half plain. Clear cover over the bars, and concrete mix were varied. Five experimental bridge decks were built, and approximately one-half of the top mat of reinforcement was galvanized on each deck.

Progress Past Year

Weekly treatment of the field exposure slabs was continued through the fifth winter. A delamination detector was built. Routine maintenance was done at the field exposure site. Field inspections, "corrosion-cell" readings and delamination detector surveys were completed on the five experimental decks. "Corrosion-cell" readings and condition surveys were completed on the field exposure specimens. All data were tabulated and records were brought up to date. Quarterly reports on the project were prepared for the FHWA.

Planned Program for Coming Year

Next year's work will be essentially the same as last year's. The project has been kept up to date and on schedule.

Title

70 F-113 - Experimental Concrete Pavement Ramps (Experimental Work Plan No. 7)

Purpose

To determine the relative cost and performance of experimental non-reinforced ramps.

Scope

Experimental unreinforced ramp pavements were built on two interchanges having considerable differences in projected traffic volumes. Thickness of the aggregate base course was increased to 6-in. to provide additional support for construction machinery and slight additional strength to the pavement system. Standard ramps were included for comparison.

Progress Past Year

A progress report was prepared for the FHWA, condition surveys, faulting and joint opening measurements, and profilometer surveys were completed, and all data were reduced and tabulated. Information derived from the project was used as background material in discussions pertaining to proposed changes in design and construction practice, and for the Clare test road.

Planned Program for Coming Year

Next year's work will closely follow that outlined above for the past year, as this is a long-range evaluation type project.

Title

70 F-116 - Experimental Joint Spacing Project (Work Plan No. 10)

Purpose

To determine the relative performance of the experimental pavement types.

Scope

Experimental pavements having 71-ft 2-in., 57-ft 3-in., and 43-ft 4-in. slab lengths, were installed in a test area on I 75 between M 55 and the Roscommon County line. All experimental joints have load transfer, with plastic coated bars. Sections of standard pavement with 71-ft 2-in., slabs and plain steel dowel bars are included for comparison. Joints are sealed with preformed neoprene seals. The weight of the reinforcing mats is the same in all slab lengths. No expansion joints were placed in experimental areas, except those at bridges. Experimental pavements have chamfered joint grooves.

Progress Past Year

A progress report was prepared for the FHWA. Condition and rough-

ness surveys, summer and winter joint readings were recorded, and all data reduced and tabulated.

Planned Program for Coming Year

Next year's work will be very similar to the work outlined above for last year. This is a long-range evaluation, and deterioration has not yet begun in any consequential amount. Therefore, we expect several more years of observation before having sufficient information available to issue a final report.

Title

70 F-117 - Bulkhead Joints for Concrete Base Shoulders (Work Plan No. 11)

Purpose

To determine the relative performance of concrete base shoulders with and without hookbolt ties.

Scope

Hookbolt lane ties were installed in the concrete base course widening for the rest area and ramps C and E of the LaPorte Rd interchange, I 94 near the Indiana line. Ramps A, B and F of the same interchange have no lane ties and are used as a control section.

Progress Past Year

A progress report was issued for the FHWA. Spring and fall readings were made on the instrumented joints to record relative vertical and horizontal movement of the slabs. All data were reduced and tabulated.

Planned Program for Coming Year

Spring readings will be taken on the project. At this time it appears that a report on the project should be appropriate after these data have been analyzed. This will complete the project.

Title

71 F-122 - Experimental Pressure Relief Joints, US 23 North of M 36

Purpose

To evaluate the performance of pressure relief joints placed at variable spacing.

Scope

Ten ethafoam pressure relief joints were placed, with spacing varied from approximately 400 to nearly 4,000 ft. Foam was placed in the joints without precompression, during the spring of the year. Joints were instrumented for measurement of closure.

Progress Past Year

Condition surveys were completed on the pressure relief area and the adjacent control section. Summer and winter joint readings were made, and data were reduced. Information from this project was used in the development of concepts for preventive maintenance.

Planned Program for Coming Year

This project will be monitored for a few more years to gain further information on the behavior of pressure relief joints over the long term. Readings and surveys will be continued.

Title

*72 F-124 - Fracture Toughness and Fatigue Properties of Steel Plate Butt Joints Welded by Submerged Arc and Electroslag Welding Procedures

Purpose

To investigate the electroslag welding procedure in comparison to the submerged arc welding procedure for fabricating steel plate butt joints for highway bridges.

Scope

Fatigue, impact and metallographic experiments were made on electroslag and submerged arc welds in ASTM A36 and A588 steels, 1-3/4 and 3-in. thick.

Progress Past Year

Experimental work was completed, and the final report prepared.

Planned Program for Coming Year

Submit the report for administrative and FHWA review, complete any revisions required, print and distribute the report.

Title

72 F-126 - Experimental Concrete and Bituminous Shoulders (Work Plan No. 13)

Purpose

To determine the relative cost of improved shoulder designs.

Scope

Twenty-nine projects were selected for installation of improved shoulder designs, including 16 bituminous and 13 portland cement concrete.

Progress Past Year

A progress report was prepared for the FHWA. Sixteen projects were reported in October 1974, several of the remaining projects are not scheduled for letting until 1976. Therefore further reports cannot be completed until the lettings are completed.

Planned Program for Coming Year

Check on letting schedule, report any new price information available.

Title

72 F-127 - Experimental Steel-Fiber-Reinforced Concrete Overlay (Work Plan No. 15)

Purpose

To determine the feasibility of batching, mixing, transporting, placing, and finishing fiber-reinforced concrete with conventional paving equipment in an urban construction environment, and to determine the relative performance of the experimental overlay in comparison to adjacent conventional overlay.

Scope

Approximately 520 cu yd (5,900 sq yd) of fibrous concrete were placed on a heavily traveled urban roadway, overlaying a 20-ft concrete pavement that was built in 1930, a 12-ft concrete widening lane placed in 1955, and new 6 and 10-ft base course widening. The overlay was designed for 3-in. minimum thickness. Two slab lengths and two different fiber percentages were used.

Progress Past Year

None of significance. The project is essentially complete and results have been reported. The project is kept active only to check the progressive deterioration of the small remaining section of pavement.

Planned Program for Coming Year

Make one more inspection and issue a brief final report to terminate the project.

Title

*73 F-131 - Epoxy Resin Coated Reinforcing Steel

Purpose

To determine the feasibility of using epoxy coated reinforcement in Michigan bridge deck construction, and to evaluate the effect of epoxy coated reinforcement on the performance of laboratory specimens and experimental decks.

Scope

The project includes three epoxy coatings previously evaluated by the FHWA and NBS, in comparison with galvanized and uncoated steel. Small specimens for laboratory testing, slabs for outdoor exposure, and full scale experimental decks are included.

Progress Past Year

Quarterly progress reports have been prepared for the FHWA. Small size laboratory specimens were cast, cured and placed under treatment. Contracts for three experimental bridges have been let. Weekly "corrosion-cell" readings have been made on the laboratory specimens. Field exposure specimens were treated periodically, and evaluated. "Corrosion-cell" readings were made on the field exposure specimens. Bars have been

coated for the experimental decks. All data have been recorded and kept current.

Planned Program for Coming Year

Continue treatment and evaluation of the laboratory and field exposure specimens. Monitor and document the construction of experimental decks, if contractors progress to that stage.

Title

73 F-135 - Experimental Concrete Glare Screen (Work Plan No. 28)

Purpose

To determine the relative cost, performance, and durability of concrete and metal mesh type glare screen.

Scope

Approximately 1,000 ft of experimental concrete glare screen is in direct comparison with a similar length of mesh. Subjective evaluation of another construction project was added at the request of the FHWA.

Progress Past Year

A progress report was prepared for the FHWA. Initial results of the project were used in discussions and recommendations concerning design and construction of concrete median shoulders, barriers and glare screen. Condition surveys were made.

Planned Program for Coming Year

Check condition of experimental glare screens, and report any significant developments.

Title

73 F-136 - Experimental Short Slab Pavements (Work Plan No. 34)

Purpose

To compare performance of several types of pavement systems.

Scope

Three experimental pavement types were installed at a rural freeway site. Plain concrete slabs with and without load transfer, on three different types of base course, were installed for comparison with the standard Michigan pavements with load transfer and reinforcement. Three, half-mile sections of each type were built. Asphalt treated porous base, a more conventional bituminous base and aggregate base courses were placed on sand grade.

Progress Past Year

The experimental pavements were built, instrumented and opened to traffic. Initial joint and fault measurements were recorded, and initial profilometer runs made.

Planned Program for Coming Year

Continue all experimental measurements and data reduction. Publish a construction report.

Title

74 F-139 - Study of Laminations and Other Rolling Flaws in Structural Steel Plates and Shapes

Purpose

To explore, document, and aid in the determination of acceptability of plates and shapes containing rolling flaws.

Scope

Work on this project is done only when one of the welding inspectors finds evidence of flaws in material delivered for girder fabrication. Therefore, the scope is somewhat indeterminate, depending upon the occurrence of such flaws in the steel purchased by fabricators.

Progress Past Year

Several consultations were held with welding inspectors, and a few specimens were prepared and polished to determine the extent of edge flaws.

Planned Program for Coming Year

Respond to any requests for assistance from the welding inspection group.

Title

75 F-144 - Fracture Toughness, Fatigue and Corrosion Properties of Steel Butt Joint Weldments

Purpose

To evaluate electroslag and submerged arc butt weldments for their fracture toughness, fatigue and corrosion properties, in two grades of steel commonly used in bridge construction.

Scope

Metallurgical and mechanical properties of the weldments will be determined. Fracture toughness will be measured by both charpy and fracture mechanics type evaluations. Cyclic loadings will determine fatigue crack initiation and propagation. Specimens will be prepared for outdoor exposure.

Progress Past Year

The project was initiated, a formal proposal was written, and approved by the Research Policy Committee. A considerable amount of preparatory and background work has been done, and necessary equipment has been ordered.

Planned Program for Coming Year

Obtain, install, and check out new equipment. Fabricate the experimental weldments. Begin specimen preparation and experimentation.

Title

75 F-146 - Steel Sampling, 76 Bridges

Purpose

To remove, test and evaluate, steel samples from girders of bridges throughout the state, to determine whether the bridges should be posted for load limits.

Scope

Samples will be taken from four girders each of 76 different bridges. Tensile, impact and chemical properties will be determined.

Progress Past Year

The project was requested by the Design Division, and approved by management. Necessary equipment and supplies were purchased, and a two man crew assigned to do the cutting in the field. The first bridge was sampled the week of December 1, 1975.

Planned Program for Coming Year

Complete field sampling, prepare and test specimens, obtain chemical analysis, and report.

Title

75 F-149 - Experimental Project for Variable Spacing of Expansion Joints

Purpose

To compare the performance of experimental roadways, having expansion space at various intervals.

Scope

This is a new project and the scope will not be entirely determined until it has been approved by the Engineering Operations Committee.

Progress Past Year

Project just requested.

Planned Program for Coming Year

Prepare research project proposal for Engineering Operations Committee approval. Coordinate with Design Division to select site and incorporate special provisions in the plans and specifications.

ABSTRACTS OF RESEARCH REPORTS
(January 1975 through December 1975)

R-951 - "Experimental Shoring to Reduce Vibration During Bridge Deck Widening: 9-year Progress Report," (65 F-84). C. J. Arnold, M. A. Chiunti, K. S. Bancroft

During the 1965 construction season, 19 bridges on I 94 in Berrien County were widened while traffic was still maintained over the structures. Since traffic would subject the new concrete to considerable vibration, the Construction Division placed temporary shoring on 44 of 94 spans and requested that the Research Laboratory measure its effectiveness. Research personnel observed placement of the widening sections and have conducted initial and annual surveys since construction. This report contains data from four surveys made during the past five years (no survey was conducted in 1972). For each structure, cracks, fracture-plane separation, and hollow areas have been monitored. The report concludes that no advantage is gained from temporary shoring as such; however, it does not preclude recommending shoring in certain situations.

R-952 - "Air Quality Report for M 20, Lee Township, Midland County to Indian St (US 10), City of Midland," (74 TI-263). J. T. Ellis, W. L. Frederick

This report was prepared as part of the Environmental Impact Statement for this proposed route location. In accordance with Federal directives, the terrain and demography, meteorology, existing ambient air quality, and pollution estimates were all explored. Pollution estimates are based on a model which includes as input: estimated peak and off-peak traffic volumes, worst and most probable meteorological conditions, road profile, and width of roadway sections. The report concludes that no adverse environmental effects are expected. Three potential problem areas were specifically investigated--an elementary school playground, a city playground, and a county park--and no adverse effects are expected at these areas as well.

R-953 - "An Overview of the Roadway Surface-Tire Pattern Interaction Noise System," (74 TI-203). G. H. Grove

The objective of this study was to determine whether transverse pavement grooving, added at intersections to improve skid resistance, increased the noise level generated by the tire-roadway interface system. Three test sites, considered typical of this type of grooved intersection, were surveyed using two types of tires. Noise levels were recorded and analyzed in the laboratory on a Loudness Analyzer. It was found that the grooving applied at the test sites did not appreciably affect the overall noise level for the tire types tested, although the snow tire did exhibit an increased frequency

shift in its noise spectrum. On the average, the noise level increased directly as the fourth power of vehicle speed.

R-954 - "Guardrail Wood Post Deterioration," (71 G-178). A. R. Gabel, J. L. McKenna

Because of reports that some wood guardrail posts were suffering appreciable ground-line rotting, a survey was completed in 1974 to determine the relative effectiveness in minimizing ground-line rotting of the three wood preservative treatments in use in Michigan: creosote, pentachlorophenol, and water-borne ('Osmosalts' and 'Tanalith'). An examination of 1,740 posts, in the six Districts of the Lower Peninsula, showed that creosote and pentachlorophenol provided good protection against ground-line rotting, while the two water-borne treatments did not do as well. Although a new type of water-borne treatment (containing chromated copper arsenate) that is allegedly better for ground-contact service has also been used, its use was initiated in 1970 and it has not been in service long enough for conclusions to be drawn. The report recommends that future new construction, and replacement elements, be treated with creosote or pentachlorophenol processes.

R-955 - "Investigation of Traffic-Induced Vibrations at 3018 Woodruff St, Lansing," (74 TI-257). C. J. Arnold, M. A. Davidson

As a result of a complaint by the owner of an apartment complex in Lansing, the Laboratory investigated alleged traffic-induced vibration damage at the site. Two accelerometers were installed at the site to measure horizontal and vertical accelerations in the ground. The maximum acceleration peaks were used for evaluation from 16 different commercial vehicles passing the site. Both horizontal and vertical averages were far below any values known to cause structural damage or human annoyance. Thus, any structural damage must have been due to other causes.

R-956 - "Laboratory Evaluation of 'Elastizell' as a Lightweight Fill," (75 TI-265). R. C. Mainfort

'Elastizell' is a lightweight porous material produced by air-entraining portland cement concrete such that the dry density of the mixture can be controlled within narrow limits at any point between about 20 to 140 pcf. The purpose of this project was to discover whether this product could be used as a lightweight backfill for certain special construction situations. As a result of laboratory tests on samples of three different densities, it was concluded that Elastizell would perform well as a lightweight fill material; however, due to poor freeze-thaw resistance and the fact that its good insulating properties might result in differential icing on the pavement, it was recommended that it be placed below the design maximum depth of frost penetration.

R-957 - "1974 Performance Tests of 'Fast-Dry' White and Yellow Pavement Marking Paints," (47 G-36(27a)). A. J. Permoda

Test stripes from one-drum quantities of 13 paints were applied on US 27 south of St. Johns and periodically rated by a visual inspection team. Ratings consisted of evaluation of the paints' appearance, durability, night visibility, and drying time. Seven were standard traffic paints, the other six were experimental mixtures. The results of these ratings were conveyed to the Traffic Control Devices Committee and they selected the producers for bids on the basis of these data.

R-958 - "Priority Rating for Replacement of Aluminum-Post Bridge Guardrail," (74 TI-222). C. J. Arnold, M. A. Chiunti

At a meeting of representatives of the Design, Maintenance, and Testing and Research Divisions, it was decided that two and three-tube aluminum post bridge railings, constructed in the late 50's and early 60's, should be replaced. The Research Laboratory was requested to conduct a survey to establish a priority order for their replacement. A rating system was devised, assigning values to the following conditions: traffic density, structure length and width, geometrics, lane movements, and special conditions. The priority rating was then based upon the product of these factors. Tabular listing, in priority order, of the 463 individual structures are included in the report and it was recommended that replacement follow these recommendations. Where the local situation permits, it was recommended that the GM type barrier be used, or in structures with sidewalks, parapet rail with grouted anchorages be installed.

R-959 - "Air Quality Report for M 21 in Lapeer and St. Clair Counties," (74 TI-269). J. T. Ellis, W. L. Frederick

This report was prepared as part of the Environmental Impact Statement for this proposed route location. In accordance with Federal directives, the terrain and demography, meteorology, existing ambient air quality, and pollution estimates were all explored. Pollution estimates are based on a model which includes as input: estimated peak and off-peak traffic volumes, worst and most probable meteorological conditions, road profile, and width of roadway sections. The report concludes that no adverse environmental effects are expected to occur.

R-960 - "Response to I 75 City of Taylor Noise Complaint," (73 TI-191). K. A. Allemeier (G. H. Grove)

As the result of a request from the City Council and concerned residents, the Department was requested to construct a noise barrier along I 75, City of Taylor. The Laboratory explored the various alternatives: take no action, indefinitely postpone it, postpone it until the statewide noise

level inventory is complete so that its priority could be determined, erect a barrier along the west side of I 75, erect barriers on both sides of I 75. Although the Department is not obligated to construct a barrier--due to the dates of planning and construction of the roadway--the Laboratory recommended that a 12-ft high barrier be erected on the west side of I 75; reducing the L_{10} dbA traffic noise levels in the adjacent areas from the present 77 - 78 dbA to a more acceptable 70 dbA. This recommendation was based upon noise level measurements, existing and predicted for the future, and the land use type existing in the area.

R-961 - "Cement Content of Low Strength, Type 1P, Concrete," (74 TI-256). C. V. Iansiti, H. L. Patterson

Because of low beam strengths in samples taken from a road widening project (Ann Arbor Rd at I 75), and a large underrun, the Laboratory was requested to perform a cement content analysis of the concrete. The cement content analysis indicated no apparent deficiency in this area; however, it is possible that errors in the measurement of the fine and coarse aggregate moisture contents might have resulted in part of the underrun. The poor strength may have been due to insufficient vibration of this fly-ash concrete.

R-962 - "Performance Evaluation of Trinidad Asphalt Cement for Bituminous Concrete Resurfacings," (73 C-16). C. A. Zapata

A 4.9 mile section of four-lane divided highway was resurfaced with both a conventional asphalt overlay and a Trinidad asphalt cement (a fluxed or blended Trinidad asphalt used as the bitumen) to compare the performance characteristics of each type of resurfacing. Field observations before, during, and after construction included: extent and severity of cracking of the old surface, mix design, plant production and paving operations, construction problems and costs, density, skid resistance, and riding quality. Initial characteristics showed little difference in the materials, except for the fact that Trinidad asphalt sections cost up to 76 percent more than the conventional sections. At this early date, the relative performance of the two sections is still inconclusive and field observations will continue to be conducted and reported upon.

R-963 - "Progress Report of Research Project 71 E-49, Development of Soil-Support Values and Coefficients of Relative Strength of Michigan Highway Support Materials," (71 E-49). R. C. Mainfort

This report covers the initial phase of the overall project, viz, to evaluate a modified triaxial resilient modulus determination method as to its feasibility and reasonableness of results, correlate the modulus values obtained with AASHTO soil support values and obtain structural coefficients from AASHTO data, and to determine the reasonableness of results by

comparisons with AASHTO and additional literature concerning the overall problem. As a result of testing some 125 soil samples of various materials and mixtures, this test seems suitable for evaluating soil-support values of Michigan soils; it is practical for laboratory use, and its test values are reasonably repeatable. Overall results seem to be reasonable and can be correlated with AASHTO values in a logical manner.

R-964 - "Michigan's Accident Experience with Glass Bead License Plate Reflectorization," (75 TI-286). L. F. Holbrook

This study attempts to briefly evaluate the effectiveness of glass-beam reflectorized license plates as a deterent to rear-end collisions. The three-year period before reflectorization (1968 - 1970) and the three-year period after (1971 - 1973) were used, incorporating reported accidents in Michigan. A measure statistic was applied to these--with multiplicative corrections to eliminate as many extraneous influences as possible--and the results computed for each year and shown graphically in the report. A cost-effectiveness study was conducted comparing the change in rear-end collision accident data between reflectorized license plates and another well-understood safety alternative--high accident intersection surface treatments. In terms of cost-effectiveness, it appears that the high accident surface treatment program is superior.

R-965 - "Air Quality Report for I 69, Charlotte to I 96, Eaton County," (74 TI-224). J. T. Ellis, W. L. Frederick

This report was prepared as part of the Environmental Impact Statement for this proposed route location. In accordance with Federal directives, the terrain and demography, meteorology, existing ambient air quality, and pollution estimates were all explored. Pollution estimates are based on a model which includes as input: estimated peak and off-peak traffic volumes, worst and most probable meteorological conditions, road profile, and width of roadway sections. The report concludes that no adverse environmental effects are expected. Six potential problem areas were specifically investigated--two churches, two subdivisions, a school, and a sportsman's club--and no adverse effects are expected at these areas as well.

R-966 - Not completed as of January 1, 1976.

R-967 - "Evaluation of Various Bridge Deck Joint Sealing Systems: Progress Report," (72 F-128). F. J. Bashore

This report considers the progress to date of six sealing systems on 64 bridge structures of three general types: metal reinforced polychloroprene pads; metal supported and anchored polychloroprene extrusions; and, modular polychloroprene compression seals. The report considers instal-

lation costs (which vary considerably), effects of deicing operations, and problems encountered with bridge joint systems. A rating system was devised and applied to the different installations. At this point, all the systems appear capable of providing a more water-tight seal than the conventional (sliding plate) systems; however, certain precautions are outlined that should be followed when installing these new systems. Further evaluation will be reported on these systems at a later date.

R-968 - "Development of Procedures for Replacing Joints in Concrete Pavement," (70 F-118). J. E. Simonsen

This report describes the development of two types of repair procedures for concrete pavement: precast slab repairs, and cast-in-place repairs using a 9-sack concrete mix with calcium chloride added for set acceleration. A few of the installations used doweled joints, though these were ultimately dispensed with due to construction difficulties. The procedures require full-depth diamond blade sawing of the repair limits, removal of the distressed concrete area without disrupting the existing base, and installation of sealed joints between the new and old slabs. A previously sawed area (12-ft long and one lane wide) can be replaced with a precast slab and opened to traffic in about 1-1/2 hours, or with a cast-in-place repair in six to eight hours (the short lane closure time for the precast slab is obtained at an increase in cost as compared with the cast-in-place repair). Evaluation of the repairs will continue for an extended period before final conclusions are reached; however, the nearly seven lane miles of pavement repaired so far appears to indicate that the methods are working well. Step-by-step instructions for such repair procedures, along with a sequence of photographs, are included in the report.

R-969 - "Air Quality Report for the I 94 and M 39 Interchange," (74 TI-214). J. T. Ellis, W. L. Frederick

This report was prepared as part of the Environmental Impact Statement for this proposed route location. In accordance with Federal directives, the terrain and demography, meteorology, existing ambient air quality, and pollution estimates were all explored. Pollution estimates are based on a model which includes as input: estimated peak and off-peak traffic volumes, worst and most probable meteorological conditions, road profile, and width of roadway sections. The report concludes that no adverse environmental effects are expected. Two potential problem areas were specifically investigated--two parks located near the proposed interchange--and no adverse effects are expected at these areas as well.

R-970 - "An Evaluation of Pavement Wear Caused by Perma-T-Gripper Tire Studs," (65 F-82). F. Copple

'Perma-T-Gripper' (PTG) tire studs differ from conventional studs in

that they use a core of tungsten carbide fragments bound together in a copper matrix (as against a solid core of tungsten carbide) and the PTG core extends about 1/2 the length of the device (as against the entire length). A survey was made of studies of PTG studs by various agencies and from these results it was felt that there is no doubt that PTG studs wear pavements much less than conventional studs. Though the evidence is indirect, it is assumed that they would lie about on the border of the wear allowance permitted by Michigan's rules when used in bias-ply tires, and would certainly comply if used in radial tires only.

R-971 - "Laboratory Calibration of Nuclear Soil Density-Moisture Gages," (73 E-52). J. H. DeFoe

This study was initiated in order to develop reliable calibration methods for unclear density-moisture gages which would be more efficient than field correlation methods, and yet be applicable to the wide range of soil conditions in Michigan. It also includes provisions for calibration of gages used for testing bituminous base and paving mixtures. The study showed that moisture and density calibrations of the gages can be performed in the laboratory in one day as compared with nearly one week required for field calibration. It is recommended that all gages be calibrated on one centrally located set of laboratory calibration blocks; calibration procedures should be consistent from gage to gage, and should include provisions for frequent reference standard readings.

R-972 - 'Reinforcement of Asphaltic Concrete Overlays with Petromat Fabric," (71 NM-286). C. A. Zapata, L. M. Bateman

'Petromat' is a black, non-woven polypropylene plastic fabric which, when used as reinforcement beneath asphaltic concrete overlays, is alleged to eliminate or reduce reflection cracking and prevent water infiltration into the lower pavement layers. A review of the experiences of other agencies was conducted and the installation of the material by the city of Ann Arbor was observed. Installation problems were noted; wrinkling and bubbling were prevalent, though when extra care was taken, tearing, flushing, and slippage could be reasonably controlled. Overlapping adjacent mats was time consuming, as was the unrolling of the fabric and the changeover of rolls. Results from other agencies seem to indicate that its reflection cracking control was far from satisfactory. Surveys of the Ann Arbor project will continue, and additional information will continue to be sought from other agencies using this material.

R-973 - " 'Pozicon' Fly-Ash Pavement Concrete: Second Progress Report," (71 NM-284). H. L. Patterson

Based on experiments described in a report issued in 1971 (R-799), a mix ratio of portland cement to Pozicon was found to be most encouraging

in improving the quality of pavement and bridge concrete while reducing the quantity of portland cement in the mix. Pozicon is a processed fly-ash material composted of spherically shaped, glassy mineral particles; it improves fluidity of the mix and combines chemically with the free lime that is generated as the cement hydrates, forming additional cementing materials. The report contains test data on bridge concrete mixes as well as a special slip-form paving mix. Testing of various mix proportions included compressive and flexural strength tests, freeze-thaw durability, surface scaling, length and weight variations, and absorption and salt penetration characteristics. The most superior of the mixes was then designated to be used in the field operation described in Report R-974 below.

R-974 - "Experimental Field Application of 'Pozicon' Fly-Ash in the Median Barrier of I 75 near the City of Flint," (71 NM-284). H. L. Patterson

Since no suitable pavement projects were to be found for the 1973 construction season, it was decided to use the Pozicon mix described in the prior report for a median barrier construction project. All phases of the job were observed by Research personnel and samples of the material were taken for laboratory analysis, both from fresh concrete and from cores cut from the barrier after curing. It was found that strength, specific gravity, absorption, and permeability averages were higher for the Pozicon mix than for the control mix. A moderately better concrete was produced at a slight savings in cost--and cement was conserved, while using a waste product, fly ash--thus this material is recommended as a preferred alternate to conventional concrete in the slip-form construction of barriers.

R-975 - Report not completed by January 1, 1976.

R-976 - "Corrosion Performance of Aluminum Culverts: Final Report," (60 NM-26). J. T. Ellis

Fourteen culvert installations, 10 aluminum and four steel, have been periodically inspected since their installation in 1965 to determine the corrosion resistance properties of the two materials, and to further determine what effect the environmental site conditions have on such corrosion. The culverts were visually inspected, adjacent soil and waters were sampled for pH and chemical analysis, polarization voltage measurements were tried as a possible method for predicting corrosion rates, soil resistivity measurements were made as a possible method for indicating soil corrosivity, and samples were cut from the culverts for laboratory metallurgical analysis. Photographic records have been kept from each inspection. Based on the results of these surveys, it has been found that aluminum culverts have been performing satisfactorily in the Upper Peninsula environment as compared with steel culverts, and a slight correlation was found between soil and water chemistry and corrosion attack.

R-977 - "Design of Binder Course Bituminous Concrete Pavement Mixtures," (73 E-51). E. C. Novak

A recent study of 300 miles of flexible pavements by the Laboratory indicated that surface cracking is the predominant source of flexible pavement failure. Samples of the binder and wearing courses were taken and tested to determine the tensile strength of each layer; it was found that the tensile strength of the binder course is about 1/2 that of the wearing course. Studies at the University of Michigan by Professor Tons suggest that bituminous mixes be redesigned with an emphasis toward uniform, dense gradation, and indicated two superior binder course mixes that might be used in place of the 9A mix currently in use. Based on our experiments, and certain technical papers of other researchers, it appears as though the traffic loading is exceeding the allowable tensile strain of the binder course layer. Load-induced strains could be reduced by increasing the stiffness of the base and/or subgrade; however, the same results may be achieved at less cost by increasing the tensile strength of the binder course, which will increase its allowable tensile strain. The report suggests that the current wearing course mixtures, used as binder courses, would achieve this.

R-978 - "Air Quality Report for M 59 from US 23 to Proposed M 275 in Livingston and Oakland Counties," (75 TI-292). J. T. Ellis, W. L. Frederick

This report was prepared as part of the Environmental Impact Statement for this proposed route location. In accordance with Federal directives, the terrain and demography, meteorology, existing ambient air quality, and pollution estimates were all explored. Pollution estimates are based on a model which includes as input: estimated peak and off-peak traffic volumes, worst and most probable meteorological conditions, road profile, and width of roadway sections. The report concludes that no adverse environmental effects are expected. Three potential problem areas were specifically investigated--two schools and one church--and no adverse effects are expected at these areas as well.

R-979 - "Experimental Installation of Chrome-Alloy Steel Dowels," (63 F-75). J. E. Simonsen

In 1964 a 4.9 mile section of I 196 in Grand Rapids was constructed using chrome-alloy dowel bars in order to compare their performance with that of the standard steel dowel. The corrosion and pull-out resistance of both types of dowel bar have been evaluated and condition surveys have been taken to ascertain the general condition of the two pavement sections (standard and chrome-alloy dowels). The chrome-alloy dowels do not appear to be functioning any better than the steel dowels in terms of pull-out or corrosion resistance. The pavement sections using the chrome-alloy dowels appear to be in generally better condition; however, this cannot be directly attributed to the dowels. Further joint conditions were noted that prompted the suggestion that this section of pavement be used for a further

study of expansion joint failures and repair. Since the Department is considering using only coated or stainless steel seleved dowels, further evaluation of the chrome-alloy dowels is not recommended.

R-980 - "Trial Installation of Rumble Strips in Asphalt Shoulders," (74 TI-236). J. E. Simonsen

Though Michigan has incorporated shoulder rumble strips in portland cement concrete shoulders, it hasn't been tried in asphalt shoulders. On the basis of information from Illinois, it was decided to install an experimental installation of such rumble strips, formed by impressing a template into the fresh asphalt by rolling over it with a steel wheeled roller. The objectives of the project are to assess the feasibility of the method and to determine whether the corrugations will retain their shape and roughness with time. An automobile equipped with a sound level meter was driven over conventional concrete pavement, concrete shoulder rumble strips, and the asphalt shoulder rumble strips. The asphalt rumble strips do approximate the sound of the concrete strips. The strips will be evaluated in one year's time to determine whether snow plow damage or general deterioration has occurred.

R-981 - "Evaluation of 'Wej-It' and 'Taper Bolt' Expansion Anchors," (75 NM-430). M. A. Chiunti

The purpose of this report was to determine the suitability of these two proprietary products as lane ties on highway projects. The two expansion anchor types were subjected to pull-out tests which are routinely used by the Laboratory for this type of evaluation. Based on the test results, it was recommended that these anchors not be used as lane ties, though one of them might prove suitable for attaching guardrail end-shoes to concrete parapet bridge rail on existing structures.

R-982 - "Summaries of Michigan Pavement Skid Resistance: 1974 Test Program," (54 G-74). P. M. Schafer, P. T. Luce

This survey is issued annually and reports the results of over 12,000 skid tests conducted throughout the State with the Department's skid test vehicle. Conventional portland cement concrete and conventional asphaltic concrete pavements were given an initial testing in order to determine their degrees of slipperiness (coefficient of wet sliding friction). Friction levels were determined for both types of pavement project after five and ten years of service and reported herein. Additionally, skid tests are performed and reported upon for certain experimental resurfacing projects to monitor their effectiveness. Also included in the report are the results of skid tests at high accident locations, determined by the Traffic and Safety Division, to provide data as to whether slipperiness might be a factor. A section is included of skid data compiled at locations throughout the State

by special request of other Divisions for their information. A final section of the report is devoted to special attention locations; those sites discovered during routine skid testing, that are found to be below a certain friction level. It should be noted that although all skid test results are included in this report for the year 1974, the 'high accident,' 'special request,' and 'special attention' locations are immediately reported out after testing via letter to the concerned parties.

R-983 - "Security Steel Insert and Deflected Locknuts," (75 NM-442). M. A. Chiunti

These proprietary products were submitted to the Department for consideration as to their suitability for highway usage. Because of the environmental conditions they would be subjected to in Michigan, the materials currently used in their manufacture are unsuitable; substitution of other materials (e.g., stainless steel) would make their price prohibitive. The manufacturer was notified and submitted an aluminum locknut for consideration; however, when constructed of this material, they could not meet the torque requirements for this type of fastener. They were not recommended as alternates for currently used products.

R-984 - "Application for Federal Financial Participation in Traffic Noise Barrier Construction Along a Selected Segment of I 75 in Southeastern Michigan," (75 TI-299). P. Milliman

This report consists of an application for Federal participation in the construction of a noise barrier along the east side of I 75, City of Lincoln Park, under regulations established for such participation for highways planned and constructed before the Federal environmental noise limitation regulations took effect. The adjacent area consists of a high density group of single-family dwellings, located along the southern edge of the metropolitan Detroit area. Supporting data are presented, such as noise level measurements, traffic density figures, prior experience of the Department in erecting barriers, etc. The Laboratory strongly urges that this barrier be constructed on the basis of these findings.

R-985 - " 'Improved Alert' and 'B-I-P' Reflective Liquids," (71 NM-291). A. R. Gabel

These two reflective liquids, submitted to the Department to be used for nighttime bridge pier delineation, were subjected to a field evaluation by the Laboratory. They were applied on four piers in 1971 along with the currently used material ('Codit') as a control comparison. Daytime ratings were made for visibility at 11-1/2, 23, and 51 months; nighttime ratings were made for reflectivity at 24-1/2 and 51 months. Both coatings proved to be inferior to that currently used by the Department.

LISTING OF NEW MATERIALS PROJECTS COMPLETED DURING YEAR

60 NM-26 - Aluminum Culvert Pipe

72 NM-333 - Dow Glycols for Ice and Snow Removers on Bridges

72 NM-339 - Isolv Ice Solvents

72 NM-344 - Chevron Concrete Joint Sealing System

74 NM-403 - Darex Pumping Aid-Admixture for Pumped Concrete

74 NM-419 - Darex Set Accelerator for Concrete (W. R. Grace Co.)

74 NM-420 - Molly Parabolt Concrete Anchor (U. S. M. Corp.)

75 NM-423 - Dexal Plastic Mahole Rings and Covers for Non-Traffic Areas

75 NM-426 - Transite Asbestos Cement Storm Drain Pipe and Fittings (Johns Manville Co.)

75 NM-427 - PVC Gravity Sewer Pipe and Fittings (Johns Manville Co.)

75 NM-429 - Plastic Garbage Cans for Traffic Control in Place of Drums

75 NM-430 - "Taper-Bolt," U. S. Expansion Bolt Co.

75 NM-436 - U. S. Steel New Fence Post (Hammerlok)

75 NM-437 - Armco Hugger Band

75 NM-439 - Aluminum Sign Supports (Magnade Products, Inc.)

75 NM-440 - Instant Spot Primer and Sealer (XIM Products, Inc.)

75 NM-441 - Plastic Underdrain Pipe (Keystone Concrete Pipe Co.)

75 NM-442 - Security Locknuts and Deflected Locknuts (Security Locknut, Inc.)

75 NM-443 - "Plasti-Flo" Semi-Circular Underdrain Pipe (Penn-Berks Corp.)

75 NM-444 - Nylon Sign Post Washers

75 NM-447 - General Tire "Gen Seal" Pavement Joint Seal

75 NM-448 - ABS Solid Wall Perforated Pipe (Armco Steel Corp.)

75 NM-449 - Pozzolith 122 H. E. Liquid Accelerator for Concrete (Master Builders)

75 NM-451 - Pre-Assembled Cable-In-Conduit System for Highway Lighting

75 NM-452 - "Patch" Epoxy Polymer Concrete Patching Mixture

75 NM-453 - "Wej-It" Expansion Anchor Bolt

75 NM-454 - Folding Aluminum Sign Supports (Walter Sign Corp.)

75 NM-457 - "Safe-Walk," Non-Skid Bridging Plate Laminate Assembly (Safe Walk, Inc.)

75 NM-458 - "Acro-Cade" Type I Traffic Barricade (Acrometal Products, Inc.)

LISTING OF TECHNICAL INVESTIGATIONS COMPLETED DURING YEAR

73 TI-163 - Evaluation of Fiber Optics Sign for Grand River in Detroit

73 TI-170 - Test Non-Contracting Probe for GM Profilometer

73 TI-191 - Noise Evaluation, I 75 to Taylor Township, Wayne County at Polk and Huron Streets

74 TI-203 - "Before" and "After" Skid Measurement and Noise of Grooved Pavement Sections

74 TI-208 - Seasonal Load Restriction Deflection Measurements

74 TI-210 - Noise Impact - M 51 from Main St to Pucker St, Niles

74 TI-214 - I 94/M 39 Interchange Reconstruction, Wayne County

74 TI-222 - Survey of Bridges with Aluminum Bridge Rail

74 TI-224 - Air Quality Impact - I 69, Charlotte to Lansing

74 TI-229 - Noise Complaint - Mrs. Gotts, I 675, Saginaw

74 TI-230 - Requalification of Electroslag Welding Process

74 TI-235 - Rapid Travel Profilometer Measurements - M 35, M 26 and US 45

74 TI-243 - Bulk Welding Test Procedures

74 TI-244 - Noise Impact on Improvement of Grand River Ave in East Lansing

74 TI-246 - Pavement Grooving or Alternate Methods of Improving Skid Resistance on Bridges

74 TI-249 - Noise Problem - City of Taylor, I 94

74 TI-250 - Chloride Determination - State St Bridge, City of Eaton Rapids

74 TI-251 - Slippery Bridge Deck Complaint, US 31 over Grand River, Grand Haven

74 TI-252 - Noise Problem, US 127 from Grand River Ave to Lake Lansing Rd

74 TI-254 - Noise Study - Square Lake Rd at Southeast Corner Updyke Rd

74 TI-256 - Investigation of Low Strength Concrete (Const. Project 82292-04743A)

74 TI-257 - Vibration Investigation on Woodruff St, Lansing - US 127

74 TI-259 - Air Quality Study - US 127 (Woodruff St)

74 TI-261 - Temporary I 69 (M 78) from Abbott Rd to Alton Rd - Noise Problem

74 TI-262 - I 96 Noise Problem - Highland Hills Estates

74 TI-263 - M 20 from US 10 BR to Meridian Rd, Midland County, Air Quality Impact Analysis

74 TI-264 - Use of "Pea Gravel" as Aggregate Blending Material

74 TI-265 - Evaluation of Elastizell as a Light Weight Fill Material

75 TI-266 - Measurement of Glare Through Glare Screen on Concrete Median Barrier

75 TI-269 - Air Quality Analysis - M 21 from M 24 to Wadhams in Lapeer and St. Clair Counties

75 TI-270 - Alleged Damages to Houses Adjacent to Borrow Area No. 2, I 275 at Monroe (I 58171, Job No.)

75 TI-271 Noise Impact on Papiernik Residence - Corner Fourth and West Ave, Jackson

75 TI-272 - Noise Impact I 94 at Entrance to Woodbridge East Condominium Association

75 TI-274 - Study of Methanol - Gasoline Automotive Fuel

75 TI-276 - Testing of the Components of Bull Gear of Aerial Tower No. 10-0042

75 TI-277 - Investigation of Skid Resistance, I 96 Service Roads (Schoolcraft) Between Telegraph and Newburgh Roads

75 TI-278 - Retro-Reflectivity of "STOP" Sign from Muskegon Involved in Accident

75 TI-279 - Noise and Dirt Complaint - I 96 and 9 Mile Rd

75 TI-280 - Proposed Specification for Reflectorized Bicycle Handlebar Tape

75 TI-281 - Expansion Anchors for Lane Ties - Frazer and Jones Co. (FJ - D-13)

75 TI-283 - Development of Pachometer Survey Procedures

75 TI-285 - Longitudinal Cracking - Integral Shoulder Construction, I 75 South of Monroe

75 TI-286 - Michigan's Accident Experience with License Plate Reflectorization (Glass Beads)

75 TI-287 - Air Pollution Impact Study - US 12 from US 127 to M 52

75 TI-289 - Noise Problem at Interchange I 96 and I 275 (Farmington Hills)

75 TI-290 - Frequency and Height Distribution of Tire Marks on Concrete Median Barrier on I 96 in Detroit

75 TI-291 - Evaluation of Weldability of Steel Beams for Bridge Widening

75 TI-292 - Air Quality Evaluation - M 59 Reconstruction from US 23 to Proposed M 275

75 TI-295 - Effect of Chrysler Tanks Being Driven on Eleven Mile Rd

75 TI-297 - Noise Barrier, Project F 81103-08472 (M 14 at Warren Rd Between Curtis and Vorhies Roads)

75 TI-298 - Noise Study - I 75 in Royal Oak - 4th to 6th and Forest to Mace

75 TI-302 - Noise Study on M 59 Reconstruction

75 TI-305 - Expansion Joint Seal Investigation, Ramp Pavement I 96 and I 275, Novi

75 TI-312 - Pedestrian Bridge Vibration Investigation - P02 of 50062

75 TI-314 - End Anchorage Cable for Break-Away Guardrail