MATES

MICHIGAN DEPARTMENT OF TRANSPORTATION

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MDOT'S SHRP IMAGE

The Department has been extensively involved in the Strategic Highway Research Program (SHRP, pronounced 'sharp') for quite some time, and this will become more apparent as this construction season's field activities begin. SHRP is administered as a unit of the National Research Council which is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering. SHRP is a nationwide, $150 million, five-year, contract research program which began in 1987. Contracts are awarded on a competitive basis to universities, private companies, and non-profit organizations. In cooperation and support, state highway agencies contribute a similar amount through representation on SHRP advisory committees, expert task groups and contract monitoring teams, loaned staff, and the office and field work and equipment necessary to accomplish some of this research. The four primary research areas of SHRP and their funding are: asphalt ($50 million), highway operations ($28 million), concrete and structures ($22 million), and long-term pavement performance (LTPP) ($50 million). It will be in the latter program area, LTPP, that MDOT involvement will become more visible this year.

The LTPP will include approximately 2,000 test site locations in the U.S. and Canada. The 'long term' in LTPP means up to 20 years, for though SHRP as a whole is currently authorized for only five years, it is intended that the LTPP continue. If it is to continue, it must be so authorised and funded in the next Federal Surface Transportation Assistance and Relocation Act. It also requires the long-term commitment and support of the state highway agencies.

Current pavement design practices are based on the AASHTO Road Test conducted more than 25 years ago. SHRP's LTPP program is a first-ever effort to measure pavement performance in different climates and soil conditions under actual, in-service traffic and using different maintenance practices. Recommendations for improved pavement design, maintenance, and rehabilitation procedures that will enable highway engineers to tailor designs and maintenance to specific conditions will be a key product of this research. SHRP will also establish a national long-term pavement data base.

Two sub-programs are included in LTPP: General Pavement Studies (GPS) and Specific Pavement Studies (SPS). GPS sites are in-service or existing pavement sections and the SPS sites are specially constructed pavement sections. The GPS involve several experiments that embrace a large array of site selection factors, and are expected to produce a broad range of products and results. The SPS will have their own sets of more limited goals, construction needs, and experimental approaches, aimed at more intensive studies of a few independent variables for each of a number of study topics.

Currently, Michigan has 13 GPS 500-ft test sections, each at a separate location, and five SPS locations, each consisting of several 500-ft test sections. The GPS test sections have been marked and signed and are located as follows: M 26 (northbound) two miles south of US 41; M 61 (eastbound) six miles west of Harrison; US 10 (westbound, two sections) one mile east of M 115; I 75 (southbound) south of M 18; US 131 (southbound) two miles north of M 20; US 131 (northbound), two miles north of M 46; I 96 (westbound) three miles east of M 66; M 57 (eastbound) three miles east of M 54; US 23 (northbound) south of M 50; I 69 (eastbound) west of M 19; I 75 (northbound) three miles south of M 54; and I 275 (southbound) three miles south of I 94.

Four of the SPS locations are located near the GPS test sections, one each on M 61, US 131 (northbound), US 131 (southbound), and M 57. These SPS locations are part of SHRP's nationwide maintenance cost effectiveness study. Each location will consist of four, 500-ft test sections, each with a different surface treatment. The treatments are chip seal, slurry seal, crack sealing, and thin asphalt overlay. In addition, MDOT plans to add 500-ft test sections at two of the locations to evaluate slurry and chip seals using emulsions containing additives with which we have had previous success. These sections will also be evaluated by SHRP. Contracts for SHRP test sections will be awarded and administered during construction by FHWA's Federal Lands Highway Division of Denver, Colorado. One contract will be let for SHRP's North Central Region which consists of 13 states including Michigan, plus two Canadian provinces.

Finally, the fifth SPS location will be constructed as part of US 10 (eastbound) reconstruction between Midland and Bay City. This particular SPS experiment, SHRP's concrete pavement rehabilitation study, will examine the comparative effects of various pavement preparation approaches ranging from minimal treatment (e.g., replacing joint seals) of the original portland cement concrete pavement to full-depth concrete pavement joint restoration as well as cracking and seating with overlay. A combination of levels and types of pavement preparation will be evaluated, both with and without the application of various thicknesses of asphalt concrete overlay. At the US 10 location, nine test sections (including a section in which nothing will be done, for comparison) will cover about two miles.

Periodically, performance monitoring will take place at each test section. SHRP contractors will conduct pavement deflection, roughness, and automated distress surveys. MDOT will measure tire-pavement surface friction and report all maintenance or construction on the test sections. Traffic data, including automatic vehicle classification and weigh-in-motion, also will be collected and reported by MDOT.

All field construction and the materials work described below on the SHRP test site locations are expected to occur this season. At the GPS locations, SHRP contractors will be conducting extensive materials sampling, including coring and test pit excavation. A typical test pit will be 6 ft wide by 4 ft long and dug through the pavement, base, and subbase to a depth of a foot or more into the subgrade. Construction of the four maintenance effectiveness study test site locations will be completed by September and the MDOT contractor has already started on the US 10 job which will include the SHRP concrete rehabilitation evaluation location.

All this work will take a tremendous amount of coordination, cooperation, and effort among the M&T, Transportation Planning Services, Construction, and Maintenance Divisions, the District offices involved, and SHRP contractors. Much has occurred already, but the pace is about to quicken!

-Dave Church

PERMEABILITY OF CONCRETE

The durability of concrete exposed to conditions of high moisture depends to a large degree on its ability to resist penetration by water. Lack of such resistance is called 'high permeability,' and is a measure of how freely water can flow through pores in the concrete. Water may contain deicing salts which attack embedded reinforcing steel, resulting in corrosion of the steel and disruptive expansion that causes the concrete to break. For many years the measurement of concrete permeability required a long-term ponding test. In this test a concrete test slab with small dikes around the edges was subjected to approximately three months of exposure to a ponded salt solution. Chemical analyses of powdered concrete samples obtained from various depths in the slab were used to determine the amount of chloride that had penetrated the concrete. The ponding test is limited to the evaluation of laboratory specimens, and cannot be readily performed on in-service pavements or structures. In 1981, a new rapid test for determining the chloride permeability of concrete was described in Federal Highway Administration Report FHWA RD-81/119. The test, now designated by the American Association of State Highway and Transportation Officials as AASHTO T277-83 ("Rapid Determination of the Chloride Permeability of Concrete"), greatly shortens the time required to evaluate such concrete specimens. The test can be conducted on core specimens from pavements and bridges as well as on laboratory prepared specimens.

The rapid permeability test determines the chloride permeability of concrete by applying a 60-volt direct-current electrical flow across a concrete slice 2 in. thick (cut from a 4-in. diameter specimem) with one end immersed in salt solution. The voltage is applied for a six-hour duration, and the total amount of electrical current is measured. The permeability of the concrete is directly related to the size of the charge passed by the specimen. A low charge indicates low permeability, whereas a high charge indicates high permeability. The concrete specimen is pretreated by vacuum-saturation before testing, which thoroughly wets the interior of the concrete. A test can be completed in a three-day period, including the pretreatment procedure.

The MDOT Research Laboratory currently uses a permeability tester which permits the anlaysis of four specimens simultaneously. The AASHTO test procedure includes a table indicating typical current values determined for selected types of concrete (Table 1). As indicated, test values varying between 2,000 to 4,000 can be expected in conventional concrete which typically has a water-to-cement ratio between 0.4 and 0.5. The table also indicates that concrete modified with latex or other additives is much less permeable, indicated by test values below 1,000. Such modified concretes are used in bridge deck overlays where resistance to moisture penetration is of particular importance.

Rapid permeability tests conducted at the MDOT Research Laboratory have produced results similar to those in the AASHTO table. Examples of typical tests on several types of concrete are shown in Figure 1. As in the AASHTO table, the conventional concrete sample recorded a test value in excess of 4,000, whereas the latex-modified concrete sample produced a test value of 1,000. A relatively new additive for concrete which has generated considerable interest is called silica fume. This material is a powder that is about 100 times finer than ordinary portland cement. Concrete with about 10 percent of this material added has recorded test values below 300, as indicated in the figure. Experiments are continuing to find ways to use such concretes in bridge decks.

The rapid permeability test has become a valuable time-saving and more accurate means for evaluating new types of concretes and additives. The test also has possible use in evaluating moisture barrier surface sealants. This test, and many others, assist laboratory staff members in developing better products for Michigan's motoring public.

-Bob Muethel

TABLE 1
CHLORIDE PERMEABILITY BASED ON CHARGE PASSED

Test Value (charge passed)*	Chloride Permeability	Typical of
>4,000	High	High W/C ratio, conv. PCC (=>0.6)
2,000-4,000	Moderate	Mod. W/C ratio, conv. PCC (0.4-0.5)
1,000-2,000	Low	Low W/C ratio, conv. PCC (<0.4)
100-1,000	Very Low	Latex-modified concrete Internally sealed concrete
<100	Negligible	Polymer impregnated concrete Polymer concrete

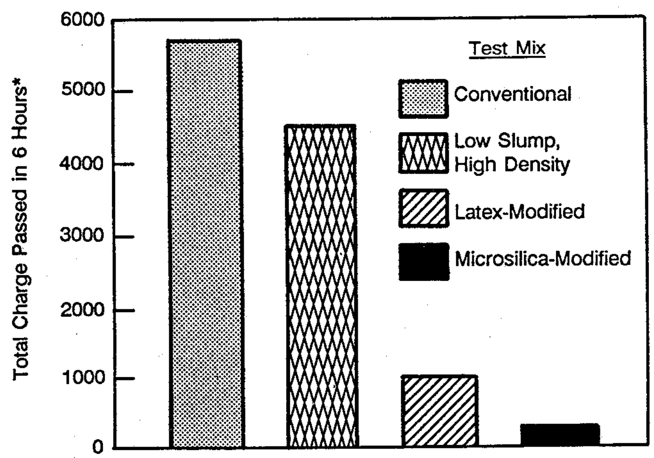

Figure 1. Rapid chloride permeability test.

*in coulombs. A coulomb is the electrical charge transported through a conductor by a current of 1 amp flowing for 1 second.

TECHADVISORIES

The brief information items that follow here are intended to aid MDOT technologists by advising or clarifying, for them, current technical developments, changes or other activities that may affect their technical duties or responsibilities.

NEW MATERIALS ACTION

The New Materials Committee recently:

Approved

Keystone Retaining Wall System
Ultra-Flo Storm Sewer Pipe

Approved for Trial Installation

Master Builders MD-SF Silica Fume Mineral Additive
Pultrusion Delineator Post
Tex Cote XL 70 Bridge Cote

It should be noted that some products may have restrictions regarding use. For details please contact Gail H. Grove at (517) 322-1632.

This document is disseminated as an element of MDOT's technical transfer program. It is intended primarily as a means for timely transfer of technical information to those MDOT technologists engaged in transportation design, construction, maintenance, operation, and program development. Suggestions or questions from district or central office technologists concerning MATES subjects are invited and should be directed to M&T's Technology Transfer Unit.

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