

State of Wisconsin/Department of Transportation
RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: March 31, 2006

Program: SPR-0010(36) FFY99		Part: II Research and Development	
Project Title: Test Method to Determine Aggregate/Asphalt Adhesion Properties as an Indication of Potential Susceptibility to Moisture Damage.		Project ID: 0092-05-12	
Administrative Contact: Nina McLawhorn		Sponsor: WHRP	
WisDOT Technical Contact: Judie Ryan		Approved Starting Date: Nov 1, 2004	
Approved by COR/Steering Committee: \$54,810		Approved Ending Date: Dec 31, 2005	
Project Investigator (agency & contact): Hussain Bahia, UW Madison			

Percent Complete: 47.2 %

Project Description:

Since the early 1990's the Wisconsin Department of Transportation (WisDOT) has used ASTM D-4867 to indicate specific mixture susceptibility to moisture damage. This testing is required for all mix designs and results of that testing, during the laboratory mix design phase, determines the need for, and use of an approved anti-strip additive.

Two previous WisDOT research projects (WisDOT 95-04: Relationship Between Laboratory and Field TSR Results, and SPR-0010(36) WHRP # 0092-01-03: HMA Moisture Damage as it Relates to Pavement Performance) have been conducted to investigate the effectiveness of the test method being used and its ability to predict either poor performing mixtures or poor performing aggregates and how either might be related to actual field performance. Along with those investigations was a directive to try and quantify the severity of moisture damage, as a general distress category, to Wisconsin pavements.

Conclusions from the previous WisDOT research studies suggest no real predictive value for the system currently in place, so while WisDOT may be gaining some benefit for use of anti-strip additives, the department may also be paying for additional additive use and not seeing any gained performance value. Historical WisDOT pavement performance measurements have also indicated that stripping and raveling are not a primary cause for early pavement distress seen in Wisconsin, but no hard evidence suggests a reason why, other than the system currently in place helping to make it so.

Additional costs to "all" projects (mix designs) in trying to predict the potential moisture susceptibility within the current prescribed system (requirement of ASTM D-4867) does not appear to be a cost efficient method or expenditure at this time so it is felt that a continuing investigation is warranted.

This investigation is needed to make more effective use of the ASTM D-4867 by screening aggregates more rapidly, identifying better protocols for preparing samples for this standard, and better methods of interpretation of results. Recently a few ideas have been proposed in the literature for testing adhesion of asphalt to aggregates and for using advanced methods for testing and analysis of the mixtures strength and fracture properties before and after conditioning. These ideas could provide a solution for improving the current practice.

Progress This Quarter:

(Includes project committee mtgs, work plan status, contract status, significant progress, etc.)

The work progress in this quarter was separated into three parts as follows:

1. IDT Testing: The technical issues from last quarter were resolved and IDT testing was performed on about 30 specimens in early January. However, the test data was found to be unreasonable by Haifang Wen of Bloom Consultants. It was suggested that the samples be reproduced and tested again to obtain better data. The specimens were reproduced, but extensive testing was further delayed because an LVDT was damaged during testing. A new

LVDT was ordered and arrived in approximately 5 weeks. The week of March 20 was the first full week that the IDT testing machine was back in operation. In the subsequent weeks a total of approximately 34 samples have been tested. This leaves us about 33% complete with the IDT testing. It is the goal of the research team to test 6-12 samples per week until testing has been completed. All IDT test results have been deemed satisfactory after preliminary investigation. A meeting has been scheduled for Wednesday, April 12 to discuss the results further. A summary of these results is given in the table below.

Table 1: Summary of IDT Results

Aggregate	Mix	Sample ID	Done?	Fracture Energy	Max Tensile Strength	Failure	
Granite	Fine 1	CFM1 A UC	1	-8718.57	-1433.20	Compressive	
		CFM1 B COND	1	-5389.04	-764.70	Tensile/Almost Collapsed in Bath	
		CFM1 C	1	NA	NA	Collapsed in Bath	
		CFM1 D UC	1	-9766.81	-1337.90	Compressive	
		CFM1 E COND	1	-9102.43	-786.90	Tensile	
		CFM1 F UC	1	-11225.20	-1341.30	Tensile	
	Fine 1 AS	CFMAS1 A COND	1	-17823.90	-1509.72	Tensile	
		CFMAS1 B UC	1	-11038.40	-1363.94	Tensile	
		CFMAS1 C COND	1	-10869.28	-1228.85	Tension w/some comp	
		CFMAS1 D UC	1	-12717.40	-1653.00	Tensile	
		CFMAS1 E COND	1	-7869.05	-1237.69	Tensile, some comp	
		CFMAS1 F UC	1	-10531.40	-1433.72	Tensile	
	Coarse 1	CCM1 A COND	1	NA	NA	Poorly Cut Sample	
		CCM1 B COND	1	-6539.55	-1283.62	Tensile	
		CCM1 C COND	1	-5871.13	-1144.75	Tensile	
		CCM1 D UC	1	-7438.39	-1751.28	Tensile	
		CCM1 E UC	1	-8804.41	-1962.18	Tensile	
		CCM1 F UC	1	-6919.98	-1947.48	Tensile	
		Coarse 1 AS	CCMAS1 A COND	1	-8141.62	-1413.00	Tensile/Some Compression
			CCMAS1 B COND	1	-6719.54	-1446.72	Compression
			CCMAS1 C COND	1	-11998.19	-1657.17	Tensile/Some Compression
			CCMAS1 D UC	1	-11066.77	-2230.88	Tensile
			CCMAS1 E UC	1	-10266.56	-1963.26	Tensile
			CCMAS1 F UC	1	-3771.04	-1839.75	Compressive
Gravel	Fine	GRAVF A UC	1	-7073.35	-2301.28	Tensile and Compressive	
		GRAVF B UC	1	NA	NA	Slipped in Saw	
		GRAVF COND	1	-7017.79	-1562.98	Tensile	
		GRAVF D UC	1	-7343.52	-2111.22	Tensile	
		GRAVF E COND	1	-6824.34	-1846.40	Tensile	
		GRAVF F	1				
	Fine AS	GRAVFAS A	1				
		GRAVFAS B	1				
		GRAVFAS C	1				
		GRAVFAS D UC	1	-7213.18	-1817.42	Tensile	
		GRAVFAS E UC	1	-10940.57	-2116.00	Tensile	
		GRAVFAS F UC	1	-8282.00	-2135.65	Tensile	

The period of time the testing equipment wasn't available was spent focused on sample preparation. It was determined that a total of 120 samples will need to be tested to fulfill the requirements of this project. Currently 42 (35%) of the samples have been produced. It is the hopes of the research team that testing and sample production to be performed concurrently throughout the rest of the project to expedite the progress. Furthermore, extra LVDT's have been ordered in advance in case another breakdown is experienced.

2. Stripping Test: Additional stripping tests were run throughout the quarter. At least 6 replicates have been tested for the mixes listed below. There is a total of 20 mixes that need to be tested. Currently testing has been

completed on five of the mixes, in addition, two more mixes are ready to be tested. Stripping tests are replicated until repeatable results are obtained.

Table 2: Summary of Stripping Test Results

Material	Source	Gradation	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Avg % Stripping
Granite	Cisler 1	CFM1							19.16%
		CFM1 AS							4.51%
		CCM1	22.00%	15.10%	17.10%	23.60%			19.45%
		CCM1 AS	4.70%	4.00%	3.20%	3.40%	4.20%		3.90%
Gravel	Muskego	GFM1	11.70%	14.70%	11.01%	12.20%			12.40%
		GFM1 AS	9.60%	7.80%	14.50%	11.40%			

Plan to run two more stripping tests on GFM1 AS later this week

Work Next Quarter:

- Perform IDT Tests on existing samples.
- Perform IDT and stripping tests on 2nd granite mix and coarse granite mix to compare to results to the mix that has been previously tested.
- Continue to concurrently test and produce samples in order to facilitate the completion of the project.
- Hold regular group meetings to maintain and evaluate project progress.

Circumstances Affecting Progress/Budget:

- Progress for IDT results was further delayed due to issues with the testing equipment. These issues have been resolved and testing has resumed. Extra testing equipment has been ordered to eliminate this problem.
- Some delays were also caused by identifying aggregates that require anti-stripping additives or materials that have low TSR values.

