

**State of Wisconsin/Department of Transportation**  
 RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: September 30, 2005

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title:</b> Field Validation of Wisconsin Modified Binder Selection Guidelines	<b>Project ID:</b> 0092-03-13
<b>Administrative Contact:</b> Nina McLawhorn	<b>Sponsor:</b> WHRP
<b>WisDOT Technical Contact:</b> Len Makowski	<b>Approved Starting Date:</b> Jan 31, 2003
<b>Approved by COR/Steering Committee:</b> \$125,006.00	<b>Approved Ending Date:</b> Jul 31, 2006
<b>Project Investigator (agency &amp; contact):</b> Hussain Bahia, UW Madison	

**Percent Complete:** 53 %

**Project Description:** The study will be conducted over 36 months, and be completed in 5 phases:

- Task 1: Select Field Section and Define Grades to be Compared
- Task 2: Collect Samples and Conduct Testing
- Task 3; Monitor Performance of Sections
- Task 4: Database Development
- Task 5: Reporting

**Progress This Quarter:**

Meetings

More projects were selected for the zero shear viscosity mixing and compaction temperatures with the help of Tom Brokaw. A total of 9 new projects were selected and the names and contacts for the contractors were obtained. The contractors are currently being contacted for arranging field visits and obtaining samples.

Testing

a) Mixing and Compaction

The testing was mainly focused on the mixing and compaction temperatures. Samples of binder and aggregate were obtained for two projects. The zero shear viscosity mixing and compaction temperatures and the Superpave mixing and compaction temperatures were obtained by testing the binders in the Brookfield viscometer. Also the mixing and compaction temperatures recommended by the providers were obtained from the contractors. Using the contractor mix design formula, two different set of samples were mixed and compacted using the Superpave gyratory compactor. The first set was mixed and compacted using the provider recommended temperatures. The second set of samples was mixed and compacted using the ZSV temperatures. Maximum specific gravity (rice test) was also done for both cases.

After testing, one of the projects was visited to obtain field data for the compaction temperatures and densification. The second project has being delayed so the field data will be gathered in the following quarter. Table 1 shows the summary of the testing results and field data for both projects.

Table 1: Summary of Mixing and Compaction Temperatures

Project	PG Grade	Mixing Temperatures [°C]			Compaction Temperatures [°C]		
		ZSV	Superpave	Provider	ZSV	Superpave	Field (Range)
Hanley Rd. Int. Hudson (7200-05-70)	70 - 28	161	179 - 184	160	150	168 - 173	71 - 111
Lindale Dr. Appleton (20050412025)	64 - 28	151	167 - 173	165	139	154 - 159	N/A

In both cases, the ZSV mixing and compaction temperatures are lower than the Superpave temperatures. However, the relationship between the ZSV temperatures and the temperatures recommended by the providers is not clear. As shown in the table, for the Hanley Rd. project, the provider suggested temperatures that are similar to the ZSV temperatures, but for the Lindale Dr. Project the recommended provider temperatures are higher than the ZSV temperatures .

For the Hanley Rd. project, all the lab samples (4) were mixed at 160°C, since both the provider recommended temperatures and the ZSV temperatures were close to this value. Some coating problems were observed in the mix (160°C). The problem was not observed in the field. For the Lindale Dr. project, the first set of samples (2) was mixed at 165°C (provider recommended) and the second set of samples was mixed at 151°C (ZSV). No coating problems were observed. Two rice samples were prepared per temperature per each project.

Regarding the laboratory compaction, no significant differences were found in any of the projects when the temperatures were changed from the one recommended by the provider to the ZSV. In the Hanley Rd. project, the compaction temperatures tried were 150°C (ZSV) and 135°C (provider). No significant changes in densification were found in the lab samples. For the Lindale Dr. Project, the compaction temperatures used were 139°C (ZSV) and 153°C (provider). No noticeable changes in densification were observed. Figure 1 shows the densification curves for the Lindale Dr. project Superpave gyratory compactor samples.

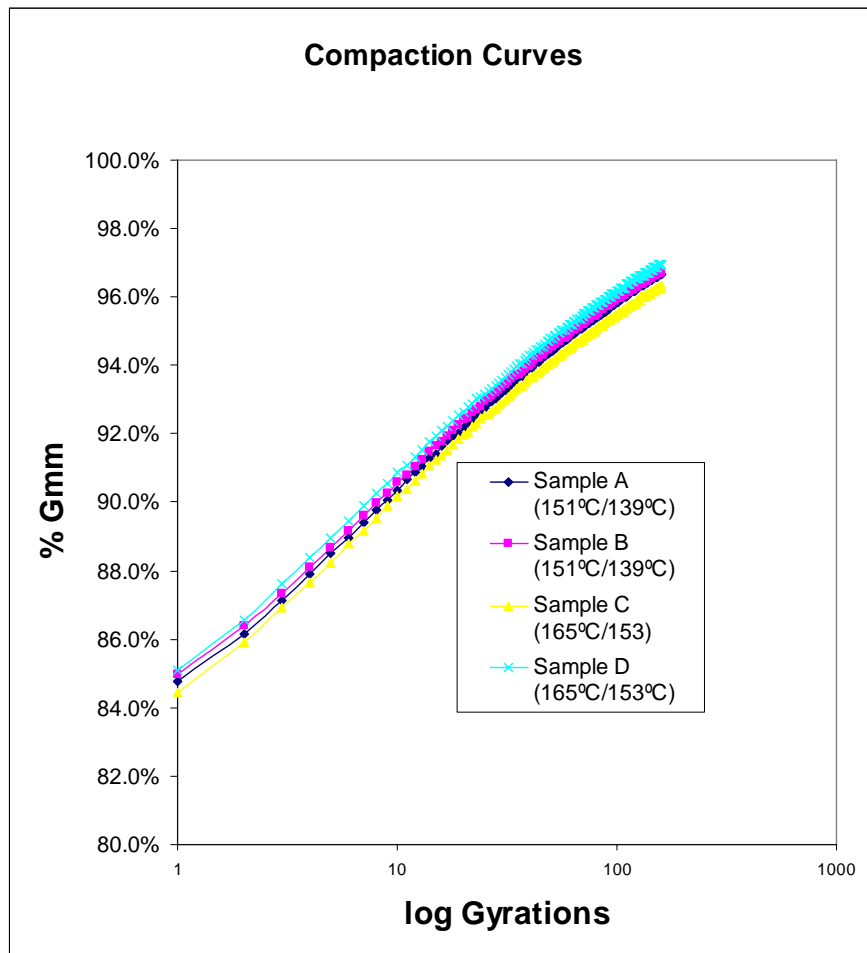


Figure 1: Densification Curves, SGC, Lindale Dr. Samples

The insignificant differences in the compaction results for the tested temperatures proves that for both projects, it would not have been of any benefit to use the Superpave mixing and compaction temperatures, which are much higher than the ones tried. The lack of temperature sensitivity is an indication that further increases in temperature would lead to more energy cost without benefits in compaction in the laboratory. The field data help confirm this trend. Table 2 shows the compaction data, with the final density after each roller type and the average compaction temperature for each roller in the Hanley Rd. project. It can be seen that the field compaction temperatures are lower than the ones used in the lab and the density results meet the specifications (91% minimum).

Table 2: Field Compaction Data

Roller Type	Density [lb/cf]	% Max. Density	Temperature, F
Paver	111	71%	232
Break Down (Vibratory Steel)	137	88%	184
Neumatic	142	91%	159
Cold (Vibratory Steel)	144	93%	129

a) Low Temperature Testing

The low temperature testing was continued. Tg test was carried for the project 91400770 (STH 64, PG58-34). The results are shown in table 3. Also DTT test was done for the 90400970 project (STH 17 Rhinelander, PG 58 – 34). The results for -30°C and two strain rates (3% and 1%) are shown in figure 2.

Table 3: Tg Results for 91400770 (PG 58-34)

Project #	PG	Tg [°C]	a <sub>1</sub> [10 <sup>-6</sup> /°C]	a <sub>2</sub> [10 <sup>-6</sup> /°C]	Cracking on Project
91400770	58 - 34	-30	585	343	No

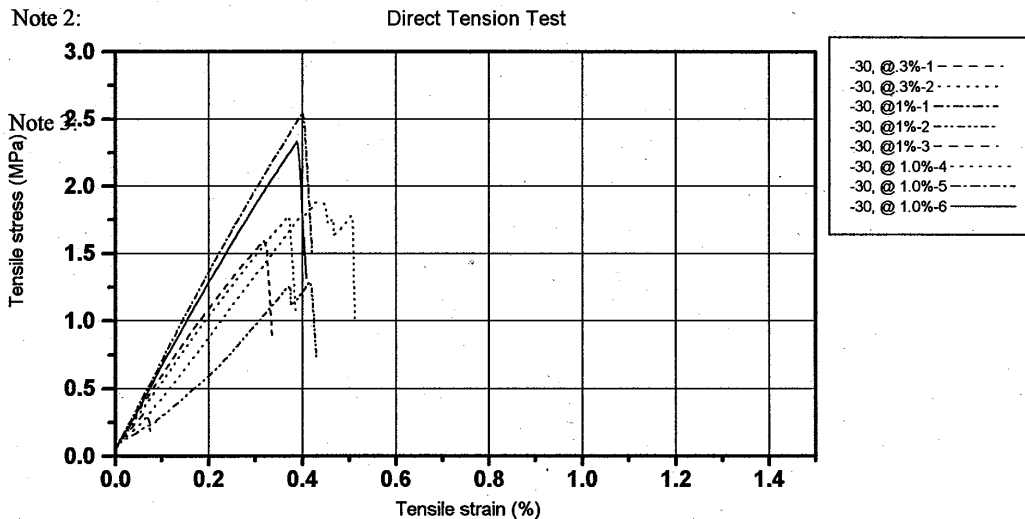


Figure 2: DTT Test for 90400970 (PG 58-34), -30°C, 1% and 3% SR

Work Next Quarter:

Field compaction data will be obtained from the Lindale Dr. Project (Appleton). Contacts will continue to try to get more field data on mixing and compaction temperatures. The low temperature testing and data analysis will be continued.

### Gantt Chart:

PROJECT I.D.		STARTING DATE	COMPLETION DATE	MONTH	REPORT #	PERCENT OF													
<b>PROJECT # WISDOT</b>		<b>Jan-31-03</b>	<b>Jul-31-06</b>	<b>JAN - 05</b>	<b>10</b>	Project Complete	Task Complete Last Report	Task Complete This Report	Project Complete										
CONSULTANT FIRM NAME		% TIME ELAPSED	TOTAL PROJECT FUNDING	CONTRACT FUNDING															
<b>UNIVERSITY OF WISCONSIN - MADISON</b>		79%	125.006	100%															
NAME OF STUDY																			
<b>FIELD VALIDATION OF WISCONSIN MODIFIED BINDER SELECTION GUIDELINES</b>																			
TASK *	YEAR	2003				2004				2005				2006					
	MONTH	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 5	Qtr 6	Qtr 7	Qtr 8	Qtr 9	Qtr 10	Qtr 11	Qtr 12	Qtr 13	Qtr 14				
<b>TASK 1 :</b> Defiene binder grades Select field sections		█	█	█	█	█	█									10	8	0	8
<b>TASK 2 :</b> Collect samples Conduct testing				█		█	█	█	█							50	29	4	33
<b>TASK 3 :</b> Monitor performance of sections										█		█		█		10	3	0	3
<b>TASK 4:</b> Database development												█	█	█	█	15	2	0	2
<b>TASK 5:</b> Reporting		█	█	█	█	█	█	█	█	█	█	█	█	█	█	15	7	0	7
SHOW PROGRESS BY USE OF A BAR CHART:		SCHEDULED																	
		COMPLETED													100	49	4	53	