RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: 3rd

Wisconsin Department of Transportation
DT1241 2009

Research, Development and Technology Transfer		
Program: (Choose One) ☐ **Policy Research** ☐ **Pooled Fund** **TPF #** ☒ **Wisconsin Highway Research Program** ☐ **Other**		
Project Title: Performance Evaluation of Open Graded Base Course with Doweled and Nondoweled Transverse Joints on U.S.H. 18/151 and S.T.H. 29		
Administrative Contact/Phone #: Peg Lafky/(608)266-3663	**WisDOT Project ID(s):**	
WisDOT Technical Contact/Phone #: James Parry, 608-249-7939	**Other Project ID:**	0092-09-03
Project Investigator/Phone # (agency & contact): Robert Schmitt, UW-Platteville, 608-342-1239	**Approved Starting Date:**	10/6/2008
WisDOT Comments:	**Original End Date:**	4/6/2010
	Current End Date:	4/6/2010
Sponsor: Wisconsin Department of Transportation	**Number of Extensions:**	0

Schedule Status:

☒ On schedule ☐ Ahead of schedule
☐ On revised schedule ☐ Behind schedule (Please explain below)

Total Project Budget	Expenditures Current Quarter	Total Expenditures	% Funds Expended	% Work Completed
$72,000.00	$6,250.00	$48,750.00	68%	65%

Project Description:

The objective of this study is to investigate the performance of 17 test sections along USH 18/151 in Iowa and Dane counties, and 4 sections along STH 29 in Brown County applying the following analytical tools:

(1) WisDOT Pavement Surface Distress Survey Manual and the Pavement Distress Index (PDI);
(2) International Ride Index (IRI);
(3) Falling Weight Deflectometer (FWD) testing to evaluate support conditions; and
(4) Additional analysis tools as detailed in this work proposal.

Progress This Quarter: (Includes project committee meetings, work plan status, contract status, significant progress, etc.)

Task 1. Literature Review

The objectives of Task 1 are to conduct a comprehensive literature review and investigate factors affecting PCC performance in doweled and undoweled pavements having varying base conditions.

Task 1 is 100% complete; however, developments will continually be monitored during the study.

Task 2 – Experimental Design

The objective of Task 2 is to design a field experiment to collect and analyze field data from the seventeen USH 18/151 test sections, four STH 29 test sections, and five USH 151 test sections. Task 2 is 100% complete.

Task 3 – Field Data Collection

The objective of Task 3 is collect field data. During this quarter, data were collected from the 3 test projects: USH 18/151 in Iowa and Dane Counties, STH 29/32 in Brown County, and USH 151 in Columbia County. Testing on USH 18/151 occurred on June 15-16, on STH 29/32 on June 30, and USH 151 on July 1. During this quarter, the collected data were formatted for analysis. This included manual data entry from PDI and PCI field forms to the

Task 3 is now 100% complete.

Task 4 – Data Analysis

Data analysis began this quarter with a preliminary analysis of USH 18/151 performance data from the Pavement Distress Index (PDI) and International Roughness Index (IRI). The sections were all constructed in 1988 as 10-inch concrete surfaces but with variable characteristics in base material type and subbase thickness, subsurface drainage features, transverse joint treatment as related to load transfer and joint sealing. A summary of the section variables and corresponding levels are shown in Table 1.

Table 1. Test Section Details and Levels (Adapted from Crovetti, 1995)

Test Section	Base Thickness	Base Type	Subbase Thickness	Subbase Type	Drain Design	Doweled Transverse Joints	Sealed Transverse Joints
1	4”	NSOG	4”	DGBC	PAD	No	Yes
2	4”	NSOG	4”	DGBC	PAD	No	No
3	4”	CSOG	4”	DGBC	PAD	No	Yes
4	4”	CSOG	4”	DGBC	PAD	No	No
5	4”	ASOG	4”	DGBC	PAD	No	Yes
6	4”	ASOG	4”	DGBC	PAD	No	No
7	--	--	6”	DGBC	TIC	No	No
7a	--	--	6”	DGBC	TIC	No	No
8	--	--	6”	DGBC	None	No	Yes
9	--	--	6”	DGBC	None	No	No
10	--	--	6”	DGBC	TIC	Yes	No
11	4”	CSOG	4”	DGBC	PED	Yes	No
12	4”	ASOG	4”	DGBC	PED	Yes	No
13	4”	NSOG	4”	DGBC	PED	Yes	No
14	--	--	6”	DGBC	None	Yes	No
15	--	--	6”	DGBC	None	Yes	Yes

NSOG	Non-Stabilized Open Graded Base Course
CSOG	Cement-Stabilized Open Graded Base Course
ASOG	Asphalt-Stabilized Open Graded Base Course
DGBC	Dense Graded SubBase Course
PAD	Pipe/Aggregate Longitudinal Drains
TIC	Transverse InterChannel Transverse Joint Drains
PED	Wrapped Trench with 4’ Pipe Longitudinal Edge Drain
None	No Edge Drains

Statistical models were investigated, but at this time, only simple plots are reported for each indicator and the variable levels of interest.

Performance Analysis Plots based on PDI

Figures 1 through 5 show the mean and range containing 95% of the observations based on PDI. An interesting relationship was the improved performance in PDI when the subbase thickness is increased from 4 in to 6 in, and joint is doweled and sealed (see Figures 1 through 3). The results for the impact of drain type on PDI appear inconclusive (Figure 4). It is not quite visible if one drain type performs better that the other. Field observations involving coring and field permeability tests revealed water flow problems for almost all pavement drainage systems. Figure 5 suggests that non-stabilized open graded (NSOG) bases outperform cement stabilized (CSOG) and asphalt stabilized open graded base courses (ASOG).

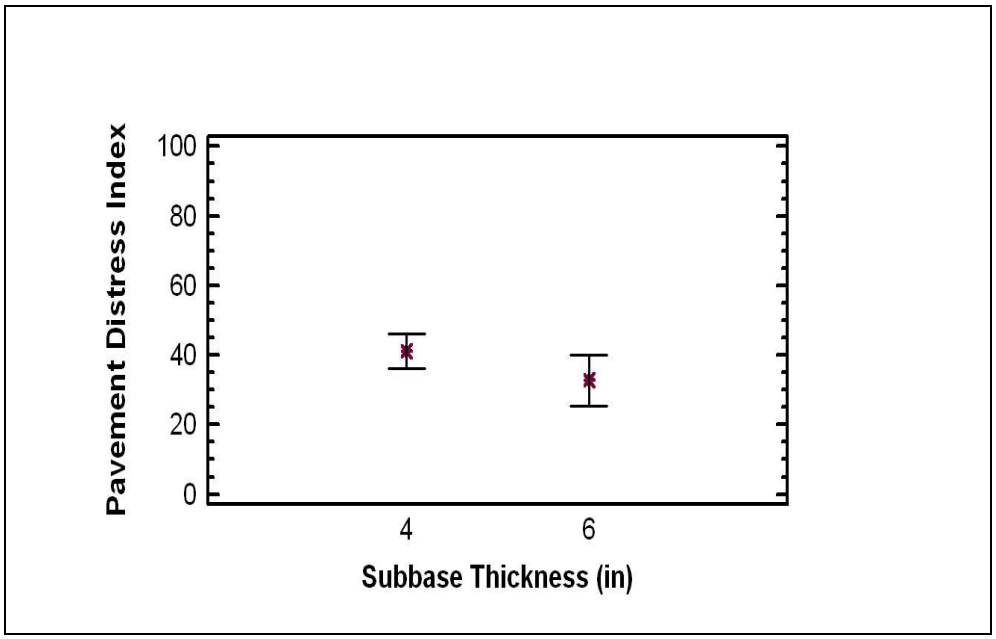

Figure 1. PDI variation with Subbase Thickness

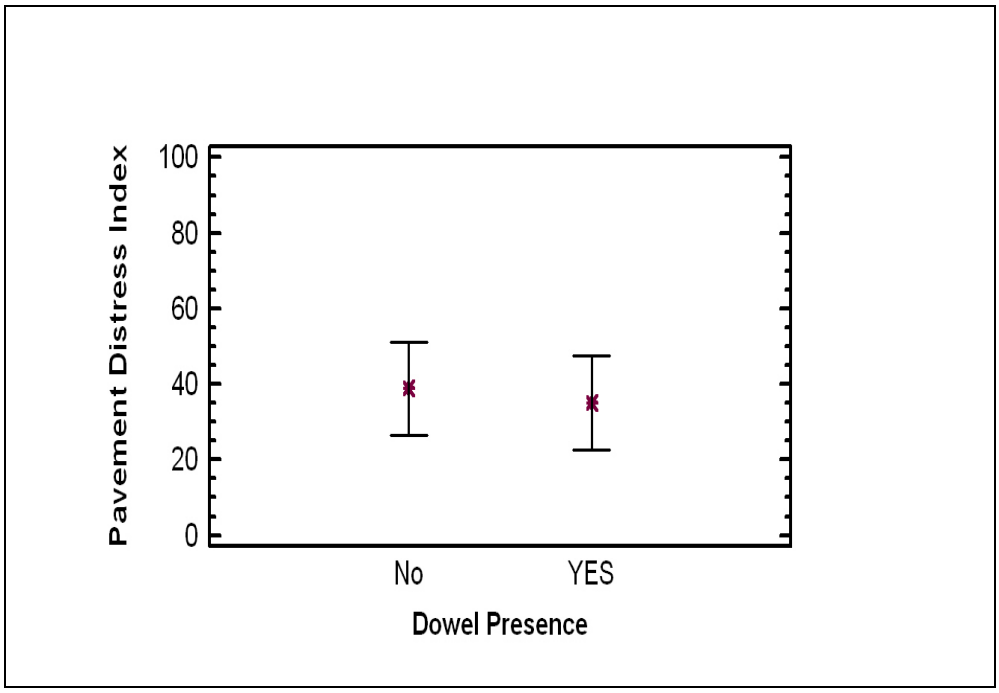

Figure 2. PDI variation with Transverse Joint Dowel Treament

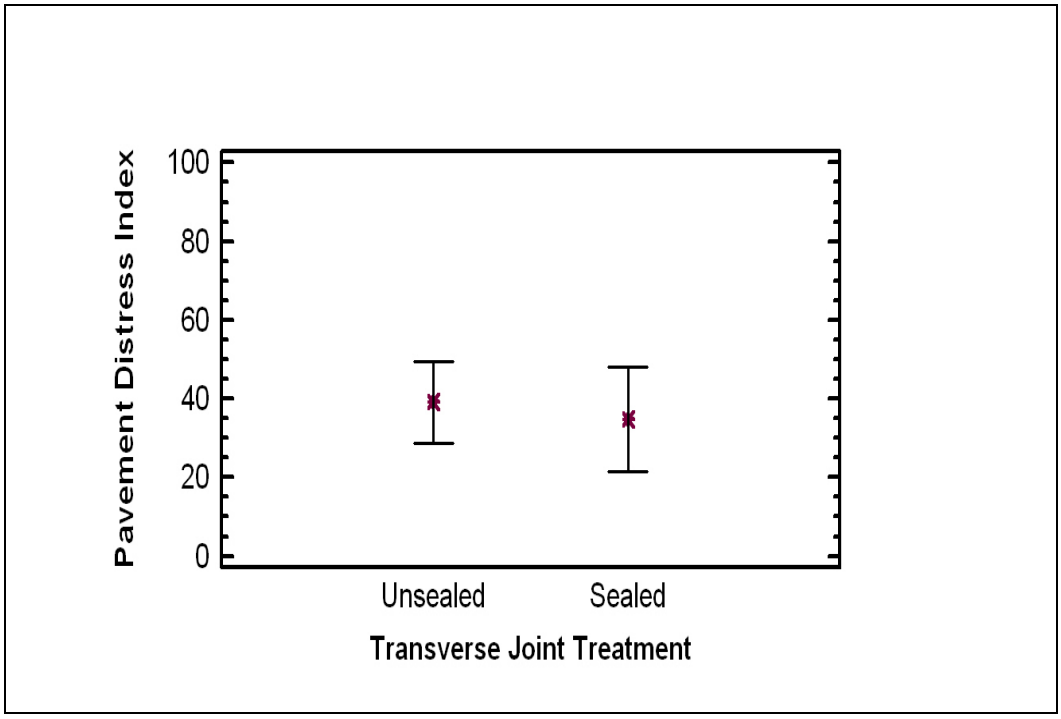

Figure 3. PDI variation with Transverse Joint Treatment

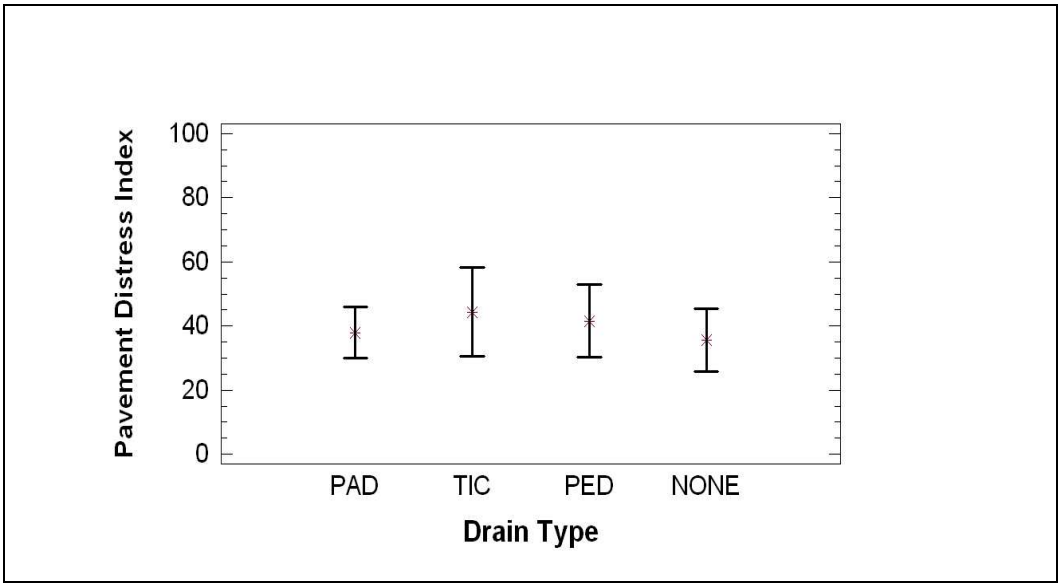

Figure 4. PDI variation with Subsurface Drainage Design Type

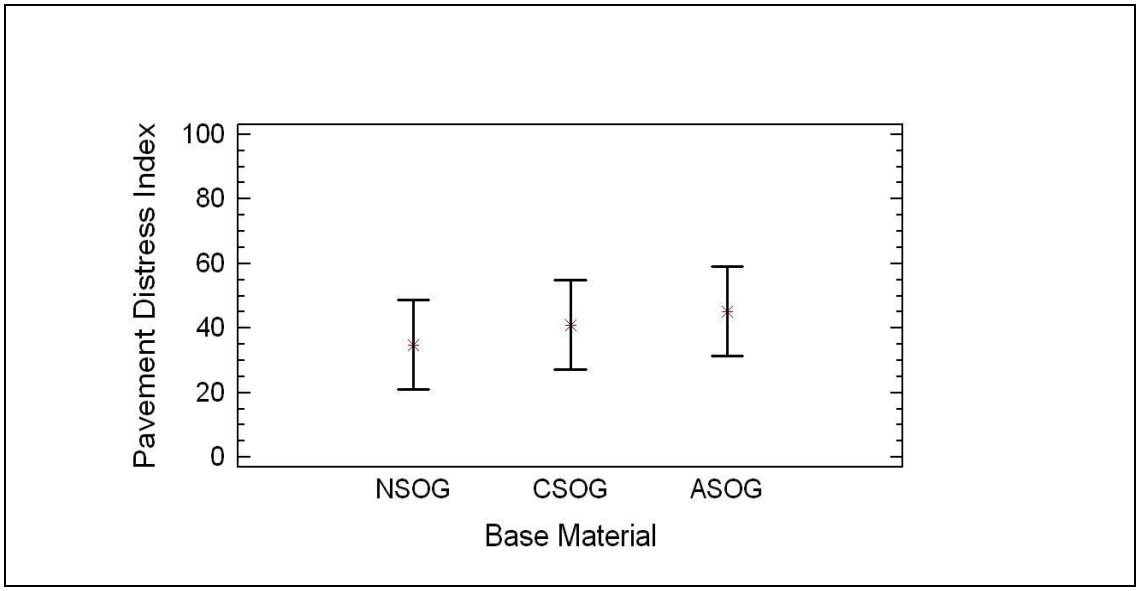

Figure 5. Base Material type on PDI

Performance Analysis Plots based on IRI (in/mile)

The performance analysis data was collected by the WisDOT pavement monitoring team and furnished to the research team. Figure 6 shows that increased subbase thickness does not necessarily translate to an improved IRI. On the other hand, a dowel jointed pavement can provide an improved ride quality as measured by the IRI (Figure 7). In addition, a sealed joint may contribute to poor ride quality (Figure 8). The IRI, which is measured within the wheelpath does not consider the sealant condition whether it is completely intact or partly exposed. If the latter is the case then this observation may be valid. Wrapped Trench with 4-inch pipe longitudinal edge drain (PED) appears to outperform all other drainage systems. Not having edge drains can result in higher levels of roughness (Figure 9). Cement stabilized and asphalt stabilized open graded base courses provide a much better ride quality than non-stabilized open graded base course (Figure 10). However, the difference in ride quality between cement and asphalt stabilized bases, as measured by the IRI, is not quite clear.

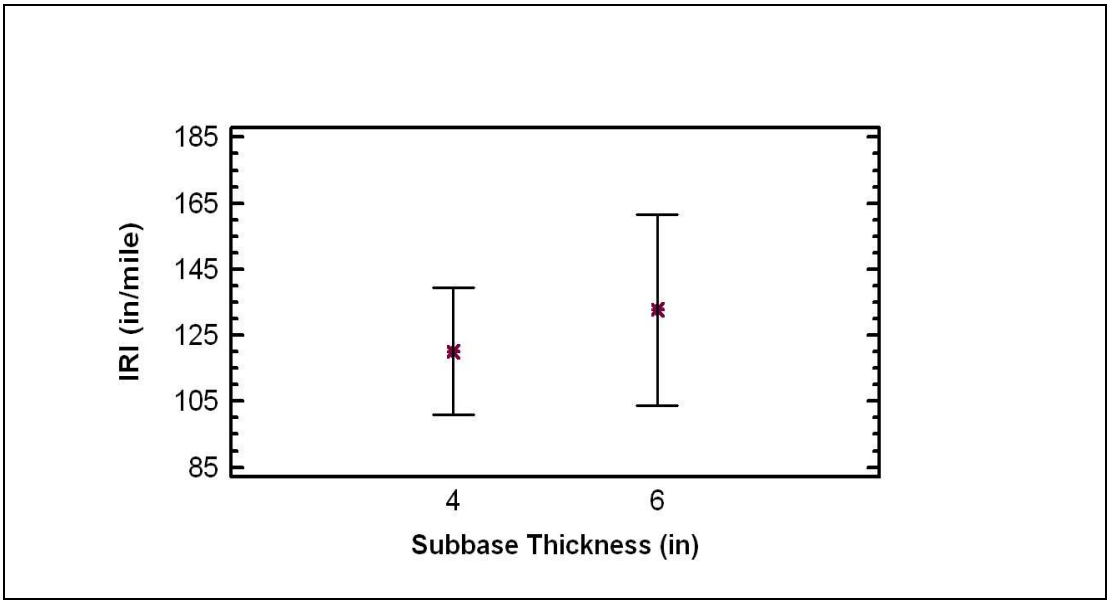

Figure 6. IRI variation with Subbase Thickness

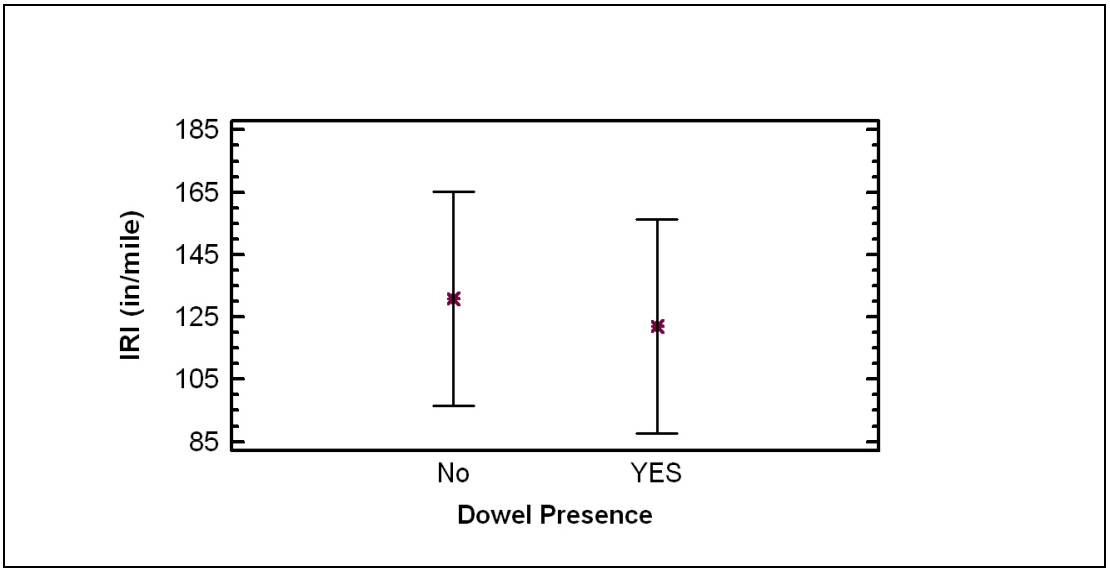

Figure 7. IRI variation with Transverse Joint Dowel Treament

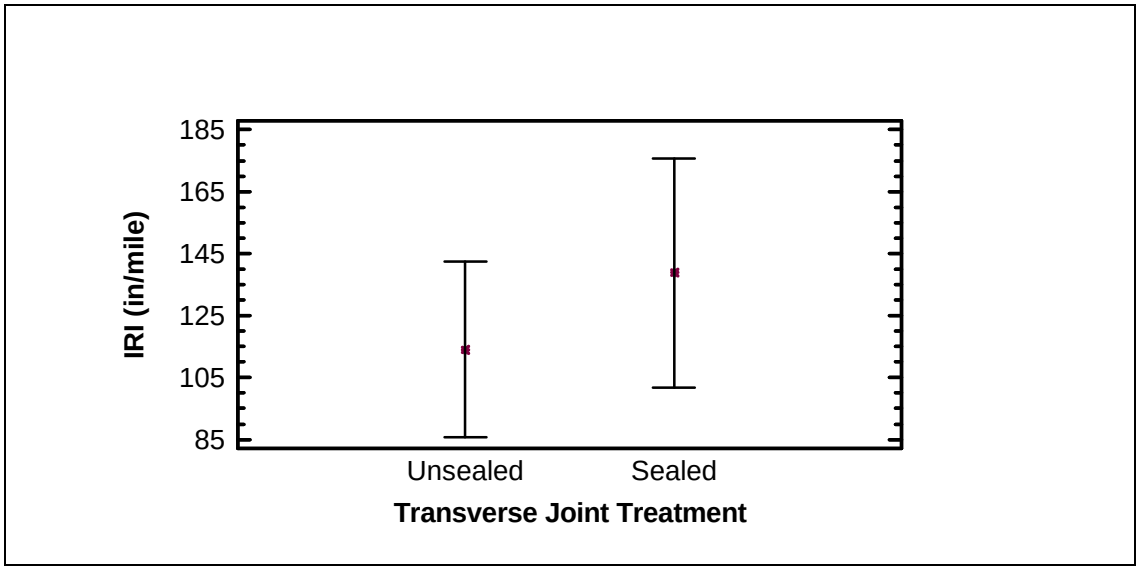

Figure 8. IRI variation with Transverse Joint Dowel Treament

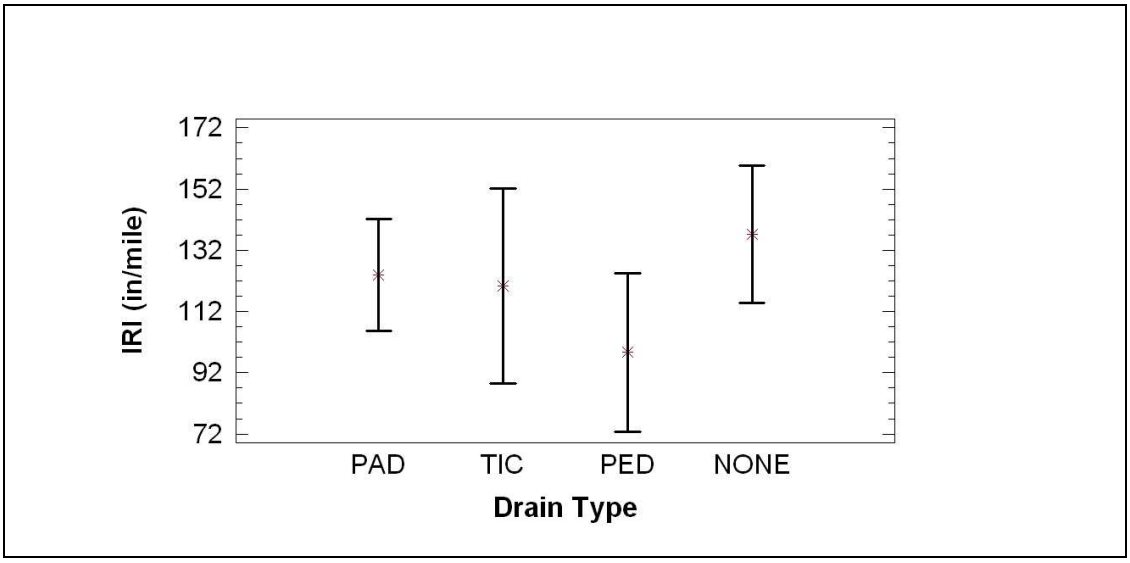

Figure 9. IRI variation with Subsurface Drainage design Type

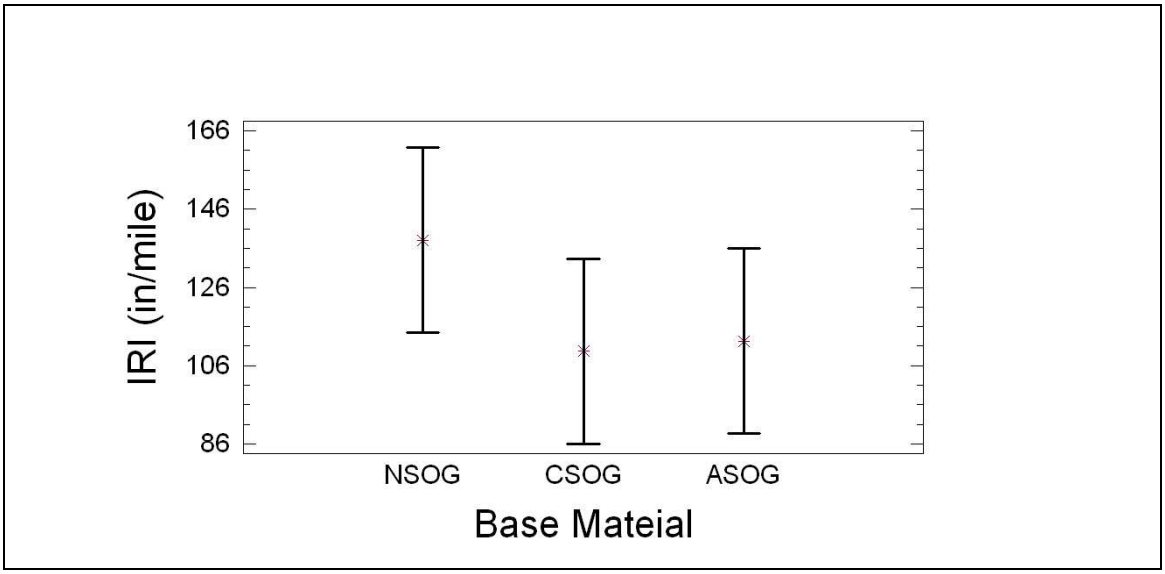

Figure 10. IRI variation with Base Material Type

Anticipated Work Next Quarter:

Task 1. Literature Review

Any new research or literature will be monitored.

Task 2 – Experimental Design

Task 2 is 100% complete.

Task 3 – Field Data Collection

Task 3 is 100% complete.

Task 4 – Data Analysis

Data analysis will continue on the field data.

Task 5 – Final Report

Work will begin on the final report.

Circumstances Affecting Progress and/or Budget:

None

Gantt Chart:

WHRP Project 0092-09-03 — Performance Evaluation of Open Graded Base Course Doweled and Nondoweled Transverse Joints on U.S.H. 18/151 and S.T.H. 29

		2008			2009											2010			Percent
Task	Description	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Complete
1	Literature Review																			
																				100
2	Experimental Design																			
																				100
3	Field Data Collection																			
																				100
4	Data Analysis																			
																				5
5	Final Report																			
																				0
	Proposed																			
	Actual																			65