

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

Program: SPR-0010(36) FFY99	Part: II Research and Development
Project Title: Wet Pavement Crash Study of Longitudinal and Transversely Tined PCC.	Project ID: 0092-00-08
Administrative Contact: Nina McLawhorn	Sponsor: WHRP
WisDOT Technical Contact: Jim Parry	Approved Starting Date: 12/15/1999
Approved by COR/Steering Committee: \$75,000	Approved Ending Date: 11/28/2005
Project Investigator (agency & contact): Dr. Alex Drakopoulos, Marquette University, Dept. of Civil Engineering, 414-288-5430.	

Percent Complete: 95%

Progress This Quarter:

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

Draft final report has been reviewed by Rigid TOC and comments given to PI at 9/29/04 meeting. Due to the extent of the modifications required by the TOC, the PI has requested a cost extension to some time in the early spring of 2005 and an extra \$10,800 to complete the project. WHRP Steering Committee has approved \$8,100 to go towards a cost extension. Alex is expected to send his budget and a short narrative for use in the amendment.

Work Next Quarter:

Project will be amended and work to complete the requirements set forth by the Rigid TOC will begin.

Circumstances Affecting Progress/Budget:

See comments under "Progress this Quarter."

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

Program: SPR-0010(36) FFY99	Part: II Research and Development
Project Title: Portland Cement Concrete Pavement Over Rubblized PCC Administrative Contact: Nina McLawhorn WisDOT Technical Contact: James Parry Approved by COR/Steering Committee: \$39,857 Project Investigator (agency & contact): Marquette University, James A. Crovetti	Project ID: 0092-00-11 Sponsor: WHRP Approved Starting Date: Mar 28, 2000 Approved Ending Date: Nov 28, 2005

Percent Complete: 85%

Project Description:

This project is investigating the feasibility of placing PCC pavements over rubblized PCC pavements with or without interlayers. Finite element analyses of PCC pavement systems were conducted to investigate the contributions of rubblized PCC base layers of variable stiffness to stress reductions in the PCC surface layer under loadings. Field investigations of constructed test sections will also be included to document performance results and to validate the results of computer modeling.

Progress This Quarter:

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

The project plans for the reconstruction of an 8.9-mile portion of the southbound lanes of I-39 in Portage/Marathon Counties, between CTH X and STH 34 and identified as WisDOT Project 1160-00-73, were obtained and reviewed. Primary pavement details include an 11 inch doweled JPCP slab placed over a 4 inch Crushed Aggregate Base Course, Open Graded No. 2. The pavement layers underlying the open graded base course include rubblized PCC, hot mix asphalt, non-rubblized PCC, and dense-graded crushed aggregate base course. Seven distinct base structures are in place as shown in Table 1. A review of the project limits was completed, considering base structure, horizontal and vertical alignments, appurtenant structures, and conflicting exit/entrance ramps. Based on this review, seven 500 ft test sections were identified for establishment as long-term monitoring sections to satisfy project objectives while providing minimal restrictions for traffic control (outer lane closure, closure length). Table 2 provides the details of these proposed test sections, all of which are located along the 4 mile section between CTH X and CTH DB in Portage County, between mileposts 167 and 171.

Table 1: In-Place Base Layer Details

In-Place Base Structure	North End Station	South End Station
8" Rubblized PCC over 6" CABC	1141+00 (Marathon Co.)	1929+00 (Portage Co.)
7" HMA over 6" CABC	1929+00	1918+00
4" HMA over 10" CABC	1918+00	1890+75
4" HMA over 9" PCC	1890+75	1857+70
4" HMA over 10" PCC	1857+70	1790+70
4" HMA over 9" PCC	1790+70	1765+70
9" Rubblized PCC over 6" CABC	1765+70	1684+00

Table 2: Proposed Monitoring Sections

Section ID	North End Station	South End Station	Base Layer Details
1R	1940+00	1935+00	8" Rubblized PCC over 6" CABC
1H	1926+00	1921+00	7" HMA over 6" CABC
2H	1900+00	1895+00	4" HMA over 10" CABC
1C	1885+00	1880+00	4" HMA over 9" PCC
2C	1805+00	1800+00	4" HMA over 10" PCC
3C	1780+00	1775+00	4" HMA over 9" PCC
2R	1750+00	1745+00	9" Rubblized PCC over 6" CABC

Work Next Quarter:

A field survey, including more detailed distress measurements and deflection testing will be conducted using either the Marquette University KUAB 2m-FWD or the WisDOT KUAB 2m-FWD. This testing will be used to characterize the PCC over rubblized PCC pavement structure and to provide comparative measures to other sections constructed without a rubblized PCC base layer. Testing will be completed during periods of cooler temperatures (<70F) to avoid joint lock-up and to minimize temperature curling effects.

Circumstances affecting progress/budget:

The I-39 construction project was completed in 2004 and represents the first significant PCC over rubblized PCC highway section in Wisconsin. Performance monitoring has begun on this section but it was not possible to schedule deflection testing during the quarter ending Sep 30, 2005. This work will be completed during the next quarter when PCC slab temperatures are more conducive to deflection testing. It is recommended that this study be extended for at least 12 months at no additional cost, to allow for performance data collection to at least 30 months of service.

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RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: September 30, 2005

Program: SPR-0010(36) FFY99	Part: II Research and Development
Project Title: Evaluation of Methods for Characterizing Air-Void Systems in Wisconsin Paving Concrete	Project ID: 0092-03-16
Administrative Contact: Nina McLawhorn	Sponsor: WHRP
WisDOT Technical Contact: Dave Larson	Approved Starting Date: March 3, 2003
Approved by COR/Steering Committee: \$199,965.00	Approved Ending Date: September 3, 2005
Project Investigator (agency & contact): Lawrence Sutter, MTU	

Percent Complete: 88%

Project Description:

- Literature Review
- Interim Report
- Prepare Concrete Mixes
- Testing of Fresh Concrete
- Testing of Hardened Concrete
- Data Analysis
- Final Report

Progress This Quarter:

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

Work at MTU

Researchers at MTU have completed the development of the flatbed scanner method for determining air-void system parameters of hardened concrete. The only remaining work at MTU is the petrographic analysis of freeze-thaw specimens. These specimens are being shipped from UNB and examination will be started next quarter.

Work at UNB

Freeze-thaw testing of the various mixes has been completed. The data is currently being analyzed. CT scanning will be conducted on selected samples from the freeze-thaw testing. The remaining samples are being shipped to MTU for further petrographic analysis.

Work Next Quarter:

- Complete petrographic analysis of freeze-thaw specimens
- Complete CT scanner analysis of selected freeze-thaw specimens
- Develop draft final report

Circumstances Affecting Progress/Budget:

None

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RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: September 30, 2005

Program: SPR-0010(36) FFY99		Part: II Research and Development	
Project Title: Research and Development of the Application of the Federal Highway Administration's HIPERPAV Model to Wisconsin		Project ID: 0092-04-11	
Administrative Contact: Ms. Nina McLawhorn		Sponsor: WHRP	
WisDOT Technical Contact: Mr. Kevin McMullen (WCPA)		Approved Starting Date: Oct 1, 2003	
Approved by COR/Steering Committee: \$49,998.00		Approved Ending Date: Jan 31, 2006	
Project Investigator (agency & contact): The Transtec Group, Inc. – Mr. J. Mauricio Ruiz, M.S.E., P.E.			

Percent Complete: 85%

Project Description:

Modification of the Federal Highway Administration's HIPERPAV model to accommodate local conditions within the State of Wisconsin.

Progress This Quarter:

After various customization changes incorporated, extensive beta testing to identify any possible bugs or inconsistencies in the software was performed during this quarter.

Also, during this quarter, a training workshop was scheduled to occur in mid November to introduce and train WisDOT staff and local paving contractors with the customized HIPERPAV-Wisconsin software.

Work Next Quarter:

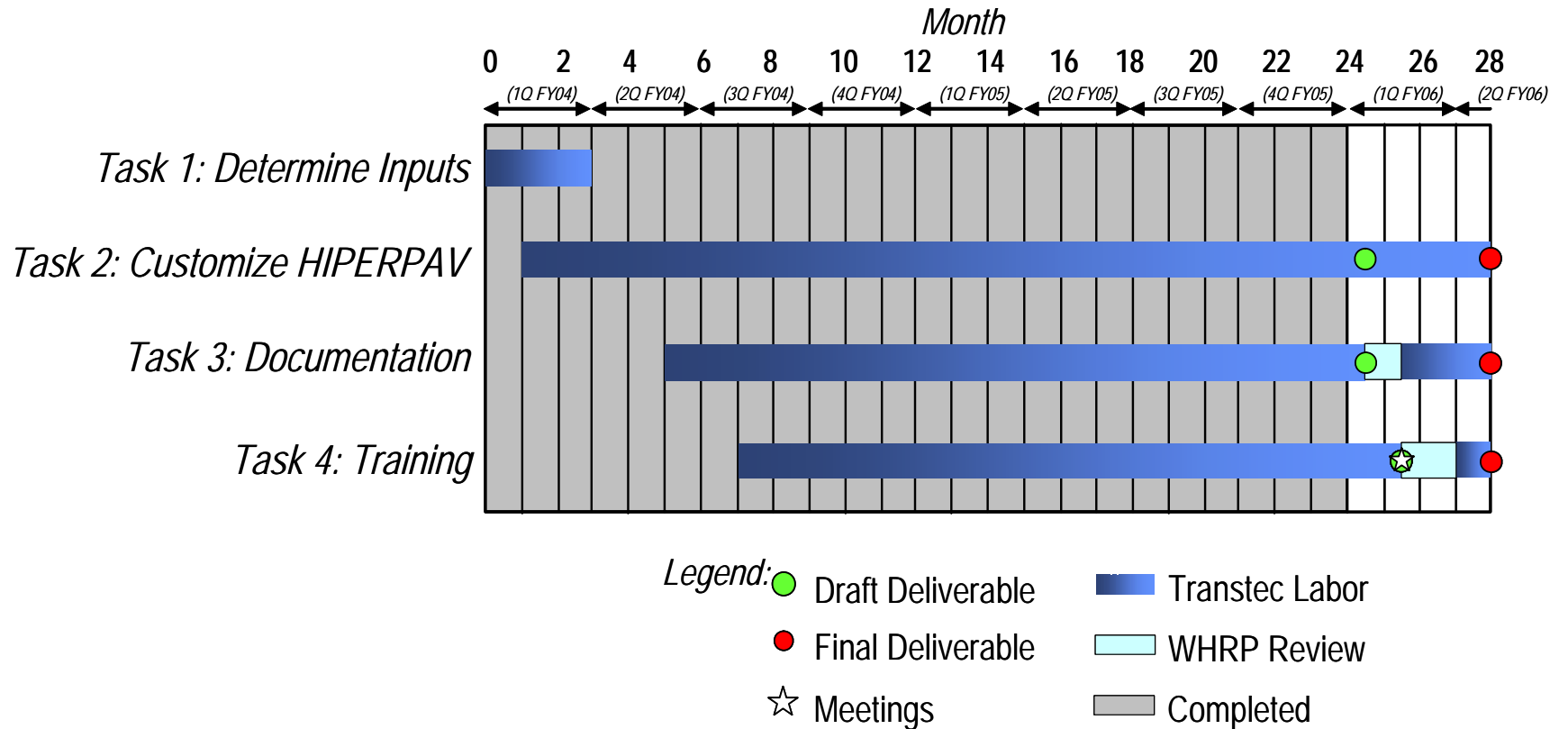
A copy of the HIPERPAV Wisconsin software will be sent to the WHRP for review.

The project team will develop technology transfer materials including PowerPoint presentations and case studies for use in training workshops.

A training workshop is scheduled to be delivered at the WisDOT offices in mid November.

Circumstances Affecting Progress/Budget: None.

Gantt Chart:



Note: Gantt chart shown in State Fiscal Year Quarters

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

Program: SPR-0010(36) FFY99	Part: II Research and Development
Project Title: Expanded Study on the Effects of Aggregate Coatings and Films on Concrete Performance	Project ID: 0092-04-12
Administrative Contact: Nina McLawhorn	Sponsor: WHRP
WisDOT Technical Contact: Jim Parry	Approved Starting Date: 10/1/2003
Approved by COR/Steering Committee: \$149,995	Approved Ending Date: 10/16/2006
Project Investigator (agency & contact): Steven M Cramer, UW-Madison	

Percent Complete: 36% of the modified work plan

Project Description:

The original objectives of this research were to 1) work hand-in-hand with WisDOT to establish and monitor a state-wide database regarding aggregate cleanliness, 2) determine conditions and locations when aggregates have cleanness values below chosen levels, verify the problem, and quickly move to obtain additional aggregate for testing, 3) conduct tests on the aggregate from objective 2 to identify the nature of the coating and to test concrete containing coated aggregates to further establish the cause of the deleterious impact and to research new methods of detecting such coatings. WisDOT is tasked with running the California Cleanness Test on coarse aggregate samples sent in from different DOT districts for project qualification. The UW's role is to monitor the test data and to conduct follow up investigation of aggregates that may present a performance problem in concrete. The project work plan was modified in August of 2005 to focus more on development of tests to detect deleterious aggregate coatings and to define the deleterious mechanisms of some coatings. Monitoring and follow-up activities were reduced in the modified plan.

Progress This Quarter:

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

The unfortunate delays suffered by the WisDOT in aggregate monitoring rendered it impossible to carry out the original research work plan. As a consequence, the research group elaborated during July a new research work plan with new objectives for the project that could report significant benefits to WisDOT. The new modified project was presented in early August to the WHRP Rigid Pavement TOC as the document titled "Expanded Study on the Effects of Aggregate Coatings and Films in Concrete Performance –Revised Work Plan". This revised plan was approved by the TOC. At present the research group is waiting for the final aggregate monitoring results for the 2005 peak construction season from WisDOT.

In the second half of August the research group was alerted to the presence of a potential harmful aggregate used in construction in Hwy 64 near Eau Claire. All the symptoms presented by cement paste and concrete made with this igneous aggregate were indicative of the possible presence of a harmful coating. The group moved quickly to get samples. Several analysis were performed to the aggregate (California Cleanness Test and X-ray analysis) and concrete (Scanning Electron Microscopy). The results that, even though the aggregate present acceptable values of the California Cleanness Test, the X-ray analysis have showed the presence of a Calcium Aluminum Silicate with similar characteristics of montmorillonite type of clays. These clays are characterized by their high ability of absorbing water and also modifying the rheology of suspension where are present. Also the pictures obtained in the Electron

Microscope have revealed a gap between the cement paste and the aggregate in the interfacial transition zone. These two factors could be the explanation of some of the unexpected behavior presented by the cement paste and concrete made with this aggregate.

In the theoretical part of the investigation, the research group efforts have been focused in simulating the detachment of aggregate coatings and abrasion conditions on a small scale that occur during mixing. A mechanical shaker has been used to simulate these conditions. The detachment process of aggregate coating in the mechanical shaker was studied under different shaker setting and the results were compared with those obtained in the 6 ft³ mixer. Several conditions were modified in the experiment such as, amount of aggregate, position and size of the vessel, and, finally, time and velocity of agitation. Only the time variable showed a strong influence in the amount of detached aggregate obtained. The size, position of the vessel and velocity of shaking were shown to have small influences in the detachment process performed in this mechanical shaker. These conditions will be applied in the study of the four laboratory clays selected.

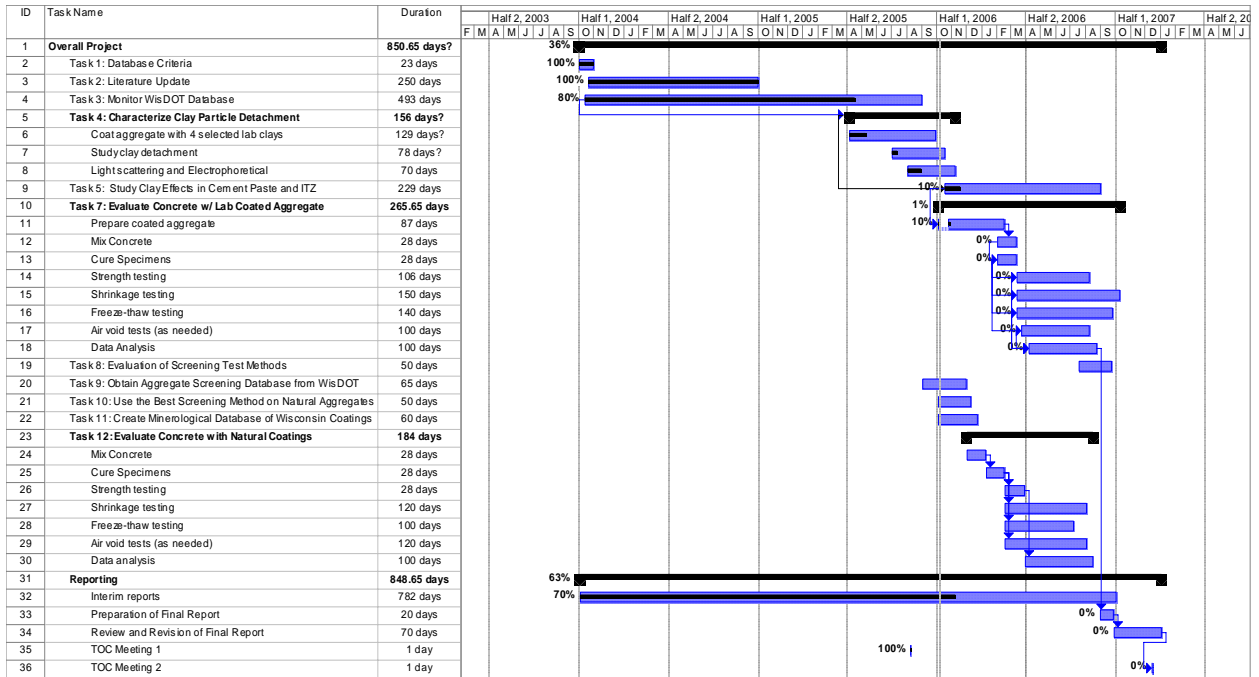
Work Next Quarter:

1. Maintain contact with WisDOT and collect new samples for the research.
2. Obtain additional aggregate samples.
3. Prepare concrete with the aggregate selected and perform the physical analysis.
4. Continue to quantify the detachment of clays using different analytical tools (Light scattering and Electrophoretic mobility measurements).
5. Characterize the properties of the samples of cement paste with and without coatings. Two properties will be monitored in the beginning: the kinetics of hydration by X-ray diffraction and the of the microstructure matrix of these cements by Scanning electron microscopy.

Circumstances Affecting Progress/Budget:

In adopting a modified work plan in response to the problems in aggregate monitoring, the project schedule has been disrupted. The new work plan has an ambitious project schedule currently ending in December of 2006. Some refinement of the overall project ending date may be necessary to further accommodate the change in work plan. The revised work plan adopted in August still depends on a lower level of WisDOT monitoring and our receipt of those results is now 1 month behind schedule.

Gantt Chart:



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

Program: SPR-0010(36) FFY99	Part: II Research and Development
Project Title: Effects of Ground Granulated Blast Furnace Slag in Portland Cement Concrete – Expanded Study	Project ID: 0092-05-01
Administrative Contact: Nina McLawhorn	Sponsor: WHRP
WisDOT Technical Contact: Jim Parry	Approved Starting Date: 7/1/2004
Approved by COR/Steering Committee: \$110,068	Approved Ending Date: 12/30/2005
Project Investigator (agency & contact): Steven M Cramer (UW-Madison)	

Percent Complete: 62% for both phase I and phase II. Phase I (with end date 12/30/2005) approx. 90% complete

Project Description:

This project examines the performance of portland cement concrete where portions of the cement are replaced with grade 120 ground granulated blast furnace slag (GGBFS). While ordinary portland cement concrete is a robust material that provides the necessary performance subject to a variety of mixing materials and conditions, the record suggests that GGBFS concrete may not be as robust. This project considers the strength development and deicer scaling resistance of GGBFS and ordinary concrete using 4 different brands of cement, 3 levels GGBFS, two aggregates and 4 different curing regimes.

Progress This Quarter:

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

This project consists of 3 tasks:

1. Monitoring GGBFS variability
2. Strength and air void development
3. Deicer scaling resistance

The research team meets every two weeks to keep the project on track.

Progress on Task 1: Monitor GGBFS Variability

We have now received and analyzed twelve monthly GGBFS samples; monthly sampling concluded with the twelfth sample. Variation of chemical composition and fineness among monthly samples has been small. Chemical analyses have also been performed on each of the four cement brands used in this project.

Slag activity testing has been completed for the four cement brands with the slag cement used for mixing. One of the four cements has been chosen to be used for slag activity testing with each of the twelve monthly slag samples. These tests will be completed during the month of October.

Progress on Task 2: Strength and air void development

Twenty-four mixes have been prepared thus far, leaving six left to complete. The remaining six mixes will be done in the fall of the year because they have to be mixed in temperatures at or near 40 degrees. These mixes will begin in October and be finished by the middle of November.

Strength testing is progressing as planned. To date, 1200 of 1740 strength tests have been completed. All 24 completed mixes have strength results through 56-days. One year strength testing will begin on these mixes starting in mid-October. All strength testing will be finished by 6/1/06. This is within the revised timeline for the strength testing portion of the project.

Results have been obtained for the first set of hardened air void samples. Nine samples were sent for testing and results were compared to the fresh air content readings. Results were not consistent between the fresh and hardened

air contents. The other fifteen hardened air void samples have been sent for analysis. It is possible that further analysis of the samples will be conducted to determine if there are “unusual” air void characteristics in the ggbfs samples compared to the OPC concretes. The final six samples associated with the 40 degree mixes will be sent for analysis after mixing is complete.

The shrinkage test results for the first 24 mixes are complete. There does not appear to be a significant increase in shrinkage with ggbfs concrete mixes, although results have not been consistent. Further statistical analysis is planned. The 40 degree mixes will also have shrinkage measured after they are mixed.

Progress on Task 3: Deicer scaling resistance

Mixing

All mixing of concrete for test specimens was completed previously.

Freeze-thaw cycling and scaling tests

Scaling tests were completed on September 6th. Data from these tests are now being compiled and refined.

Carbonation depth tests

Carbonation depth testing up to 80 days was completed on August 25th. Data from these tests up to 80 days are being compiled. Carbonation test samples have been retained so that future tests can be performed, if necessary. For several samples, it may be informative to conduct 6- or 8-month carbonation depth tests.

Work Next Quarter:

Work next quarter will include sample testing from the previously prepared samples and we will proceed with data analysis.

Circumstances Affecting Progress/Budget:

We fell behind schedule as part of the challenge of starting a large project. Work is proceeding but strength testing is behind schedule. We anticipate completing strength testing within the overall timeframe of the project.

Gantt Chart: See next page

ID	Task Name	Duration	Start	2005								2006				2007
				2nd Half		1st Half		2nd Half		1st Half		2nd Half		1st Half		
				Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1		
1	Overall Project Status	649 days	Thu 7/1/04													
2	Task 1: Monitor GGBFS Variability	362 days	Thu 7/1/04													
3	Obtain GGBFS samples	327 days	Thu 7/1/04													
4	Send out for fineness and chemical tests - Phase I	320 days	Mon 7/12/04													
5	Send out for fineness and chemical tests - Phase II	30 days	Mon 10/3/05													
6	Conduct activation tests - Phase I	317 days	Thu 7/15/04													
7	Conduct activation tests - Phase II	35 days	Mon 10/3/05													
8	Task 2: Strength & Air Void Development	388 days	Mon 7/19/04													
9	Obtain materials	75 days	Mon 7/19/04													
10	Prepare and check mix designs	15 days	Tue 8/10/04													
11	Prepare specimens - Phase I	238 days	Tue 11/2/04													
12	Prepare specimens - Phase II	25 days	Mon 10/3/05													
13	Curing, shrinkage and strength testing - Phase I	225 days	Thu 11/18/04													
14	Curing, shrinkage and strength testing - Phase II	60 days	Thu 9/29/05													
15	Air void tests - Phase I	213 days	Wed 12/8/04													
16	Air void tests - Phase II	21 days	Mon 10/3/05													
17	Analyze results - Phase II	55 days	Thu 10/27/05													
18	Task 3: Deicer scaling tests	282 days	Thu 3/17/05													
19	Scaling tests - series 1	110 days	Thu 3/17/05													
20	Scaling tests - series 2	110 days	Thu 3/31/05													
21	Scaling tests - series 3 - Phase II	110 days	Mon 10/3/05													
22	Scaling tests - series 4 - Phase II	110 days	Mon 10/3/05													
23	Analyze results	130 days	Mon 10/17/05													
24	Reporting	605 days	Wed 9/1/04													
25	Interim Quarterly Reports -Phase I	280 days	Wed 9/1/04													
26	Interim Quarterly Reports -Phase II	315 days	Mon 10/3/05													
27	Prepare interim report & TOC meeting	10 days	Wed 10/12/05													
28	TOC Meeting #1	2 days	Tue 1/4/05													
29	TOC Meeting #2	2 days	Mon 5/1/06													
30	Prepare draft final report	50 days	Wed 5/3/06													
31	Review/Revise/Submit final report	70 days	Wed 7/12/06													
32	Contingency	50 days	Wed 10/18/06													

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

Program: SPR-0010(36) FFY99	Part: II Research and Development
Project Title: Analysis of Conc. Pavt. Jts. to Predict Distress	Project ID: 0092-05-05
Administrative Contact: Mr. Greg Waidley	Sponsor: WHRP
WisDOT Technical Contact: Mr. Jim Parry, P.E.	Approved Starting Date: 1 October 2004
Approved by COR/Steering Committee: \$61,189.00	Approved Ending Date: 31 September 2005
Project Investigator (agency & contact): The Transtec Group, Inc. – Dr. Robert Otto Rasmussen, P.E.	

Percent Complete: 8%

Project Description: Three primary objectives have been identified by the WHRP for this project, each corresponding to a “phase” of the work to be completed. These include:

1. Investigate the nature of the JCP distress using advanced analytical methods including finite-element methods (FEM). Identify and develop the models as needed, and validate them using field observations.
2. Identify maintenance and/or restoration activities that can be used to slow or prevent the propagation of the observed pavement distresses.
3. Review current WisDOT design standards and specifications. Determine if the changes recently made are addressing the suspected causes of the premature failure. If needed, make additional recommendations for changes to the standards and specifications to prevent the observed distresses from occurring in the future on other projects.

Progress This Quarter: A kickoff meeting was conducted last quarter in Madison (3 May 2005). At that time, Drs. Rasmussen and Cramer met with WisDOT and other stakeholders to discuss the direction proposed for this project. A number of follow-up items were identified at that time, and have since been executed to different degrees. The majority of the short-term follow up included data gathering, which has continued in earnest this quarter.

Work Next Quarter: Next quarter will include additional data gathering and analysis tasks. Available data will continue to be collected, and potential hypotheses for the cause of the observed distress will be identified. Criteria for testing the various hypotheses will also be identified, and a well-defined plan will be established for the analysis in order to be thorough and efficient. The analysis will consist of both a relative assessment and an absolute validation. The former will allow the project team to evaluate the sensitivity of the various factors (e.g. joint spacing, subbase support) on the predicted distress (e.g. corner cracking). This allows the project team to focus in on those variables more likely to lead to problems in the field. The validation phase will include a comparison of the predicted distresses to those being observed in the field. It will use sampling techniques to identify representative segments for this purpose.

Circumstances Affecting Progress/Budget: WHRP has approved an extension of this project until May 2006. This was necessary since an attempt to coincide the kickoff meeting for this project was made with field repair work that was originally believed to have occurred earlier this year.

Gantt Chart:

