

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Dec 31, 2001**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Field Measurement of Water Cement Ratio for PCC - Phase II</b>	<b>Project ID: 0092-45-16</b>
<b>Administrative Contact: Nina McLawhorn</b>	<b>Sponsor:</b>
<b>WisDOT Technical Contact: Error! Bookmark not defined.</b>	<b>Approved Starting Date: Dec 6, 1999</b>
<b>Approved by COR/Steering Committee: \$55,510.00</b>	<b>Approved Ending Date: Jun 30, 2002</b>
<b>Project Investigator (agency &amp; contact): Steve Cramer: UW-Madison</b>	

**Description:** The objective of this study is to evaluate in the field, technologies previously identified that provide a relatively rapid, simple, and reliable method of determining in-place w/c for Portland cement concrete (PCC). It is anticipated that only one or two technologies from the laboratory study will show sufficient promise to warrant field evaluation. At least several construction projects that represent a range of concrete paving conditions will be identified and used as evaluation case studies. Construction projects will be identified with the assistance of the WisDOT and the Wisconsin Concrete Pavement Association. Comparisons between measured w/c ratios and ratios suggested by batch plant tickets will be conducted.

Total study budget	Current FFY budget	Expenditures for current quarter	Total Expenditures to date
<b>\$55,510.00</b>	<b>\$18,503.34</b>	<b>\$0.00</b>	<b>\$0.00</b>

**Progress This Quarter:**

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

The final report for this project was submitted and has been in administrative review in the WisDOT TOC. Comments were due on Dec. 21<sup>st</sup>, 2001. The research team has received one set of comments back from WisDOT to date.

**Abstract of Final Report:**

The water-cementitious material ratio (w-cm) is defined as the ratio by mass of free water to cementitious material in a concrete mix. This ratio controls concrete paste porosity and as a result, has long been viewed as a key mix parameter in determining concrete quality. The microwave oven method (AASHTO provisional standard TP23-93) and the nuclear water-cement gauge were evaluated in actual field trials at seven different concrete paving sites as potential methods to rapidly determine the water-cementitious material ratio during construction. Two standard Grade A-FA WisDOT mix designs with 19% and 30% fly ash replacement were used at these sites. The coarse and fine aggregates were either igneous-based or limestone depending on the project location. Separate laboratory evaluations were conducted on mixtures using the same materials to provide calibration points. The standard deviation of the error in predicting the water-cementitious ratio with the microwave oven ranged from 0.014 to 0.030 for laboratory mixes and 0.026 to 0.072 for field mixes. The mean error for laboratory tests was zero indicating that an experimental result has equal likelihood of being high as low. Since two samples were taken from each concrete batch, a measure of the test method error was obtained for the microwave oven method. The minimum error determined by the repeated tests was 0.023 for laboratory mixes. It is concluded that 0.02 is a minimum standard deviation of the error that can be expected when using the microwave with one sample. In the controlled environment of the laboratory, the nuclear gauge method resulted in standard errors of 0.010 and 0.014 for limestone mixes, but the errors were significantly higher for igneous mixes. The standard errors of the two mixes containing igneous aggregates were 0.046 and 0.066. Standard errors of the field mixes were higher and ranged from 0.012 to 0.089. In all cases, the higher field errors likely are not associated with the method but rather the uncertainty in the moisture content of field aggregates through the course of construction. The distinction between igneous and limestone aggregates was not pronounced in the field mix results. The data from the two consecutive tests performed on the nuclear gauge revealed the error inherent in the nuclear gauge method. This within test error in w-cm was 0.018 for limestone mixes and 0.072 for igneous aggregates.

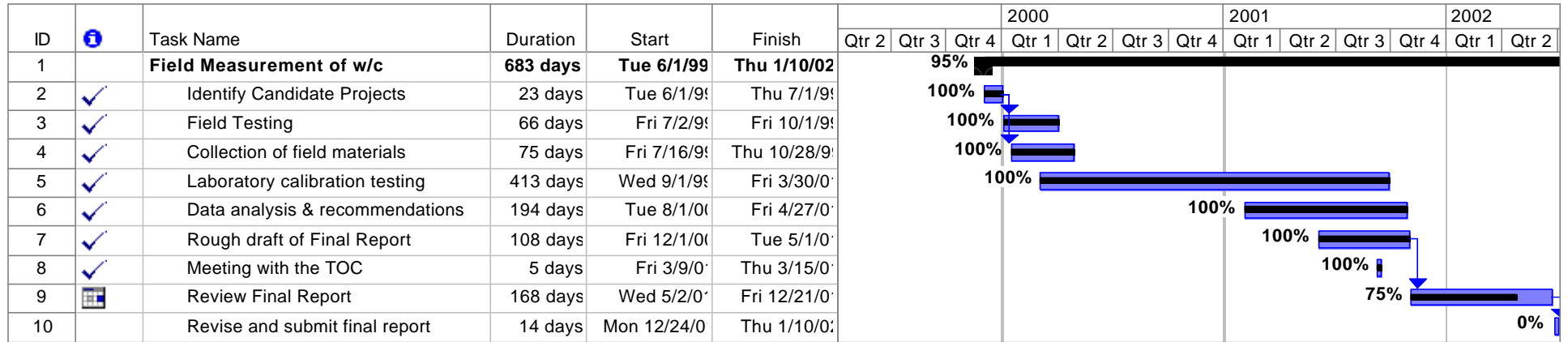
**Work Next Quarter:**

The research team will revise the final report based on comments received.

**Circumstances affecting progress/budget:**

Report review was temporarily delayed within WisDOT.

**Gantt Chart:**



**Note: Gantt chart shown in State Fiscal Year Quarters**

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Dec 31, 2001**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Effects of Aggregate Coatings and Films on Concrete Performance</b>	<b>Project ID: 0092-00-07</b>
<b>Administrative Contact: Nina McLawhorn</b>	<b>Sponsor:</b>
<b>WisDOT Technical Contact: Error! Bookmark not defined.</b>	<b>Approved Starting Date: Oct 1, 1999</b>
<b>Approved by COR/Steering Committee: \$97,740.00</b>	<b>Approved Ending Date: Feb 28, 2002</b>
<b>Project Investigator (agency &amp; contact): Steve Cramer: UW-Madison</b>	

**Description:** This research will consider the impact of different types of coarse aggregate coatings and films on concrete strength and durability and the potential relation to concrete performance.

Total study budget	Current FFY budget	Expenditures for current quarter	Total Expenditures to date
<b>\$97,740.00</b>	<b>\$32,580.00</b>	<b>\$4,522.79</b>	<b>\$40,951.96</b>

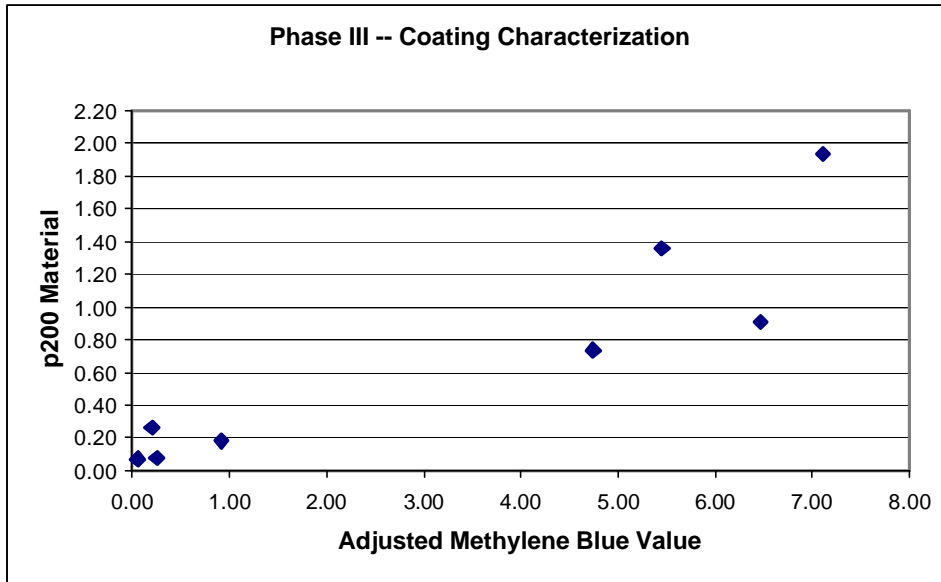
**Progress This Quarter:**

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

Work this quarter was directed toward obtaining materials by which a heavily coated coarse aggregate could be manufactured. This task was taken after naturally occurring coated coarse aggregates showed no degrade in performance compared to washed aggregates. Wash fines from Turtle Lake, WI were collected in October and used to manufacture a high fines mixtures using one of the previously collected coarse aggregates. Two aggregates were manufactured - p200 = 1.4% (CV = 82.0) and p200 = 2.0% (CV = 78.7) – and used for mixing in November. The mixture containing the washed aggregate from one source was remixed and will be retested due to inconsistent freeze-thaw results. Additional tests were conducted to determine whether the high fines mixtures influenced the effective water-cement ratio of the concrete mixes. Since the absorption values were similar to the coarse aggregate itself, it was determined that the effect was negligible. The fines did not appear to contain as much clay as expected since methylene blue testing resulted in a MBV of only 1.72. It was decided in December to pursue the collection of clayey material to manufacture a worst-case scenario aggregate.

Aggregate	P200 Value	MBV - Adjusted Cleanness Value	MBV - Adjusted P200 Value
Source C – Unwashed	0.26	0.05	0.21
Source C – Washed	0.07	0.03	0.06
Source E – Unwashed	0.74	1.00	4.74
Source E – Washed	0.16	0.15	0.84
Source E – 1.4% p200	1.36	0.72	5.45
Source E – 2.0% p200	1.94	0.78	7.10
Source H – Unwashed	0.91	0.97	6.47
Source H – Washed	0.17	0.09	0.25

After analyzing the data, it was also decided to use the p200 values to adjust the methylene blue values since this practice is consistent with past research and provides a larger scale with which to compare the data points.

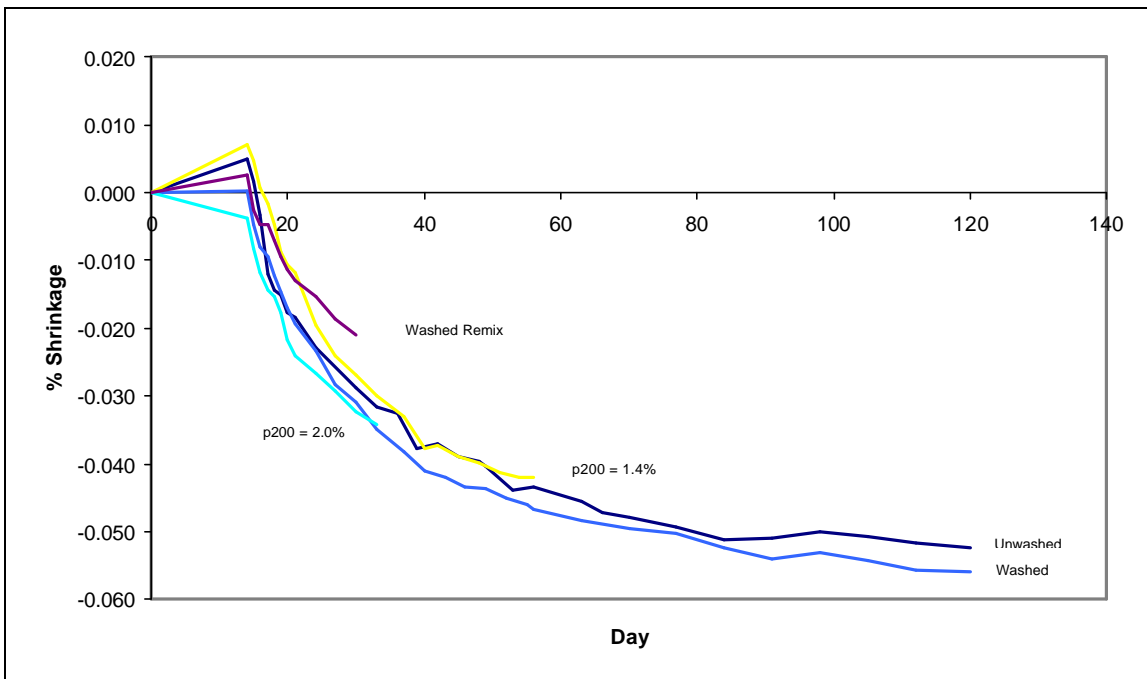


## Strength Testing

Although strength values from the manufactured fines mixtures were lower than the values from the washed Marathon aggregate mixture, the difference did not appear to be significant. The 1.4% fines mixture was 4% and 7% different with respect to compressive strength and tensile strength. The 2.0% fines mixture was only 2% and 3% different with respect to compressive and tensile strength. While the 1.4% fines mixture agrees with results obtained from previous research, the 2.0% fines mixture does not. In fact, the 2.0% fines mixture appeared to perform better than the 1.4% mixture.

## Shrinkage Testing

The washed aggregate remix provided a favorable change in the shrinkage data. As shown on the plot below, all the coated aggregate mixtures fall below the new washed mix.



As of Jan. 4, the 1.4% fines mix has been tested to 56 days, the 2.0% mix to 36 days, and the washed remix to 30 days. Testing will continue to 120 days.

## ***Freeze-Thaw Durability***

As of Jan. 4, 2002, 961 cycles have been completed on mixes C, E, and C' in the West F/T Cabinet, while 727 cycles have been completed on mix E' in the same cabinet. Meanwhile, 783 cycles had been run on mixes H and H' in the East F/T Cabinet. Testing was stopped on Jan. 2 on mixes H and H' with both mixes showing modulus degradation below 60% and weight loss of 92%. Mixes C and C' are nearing completion in the West Cabinet, while Mixes E and E' have shown the best durability of all the mixes. The remaining mixes will be tested at the beginning of February.

Price estimates were received from two vendors to conduct ASTM C457 air void testing.

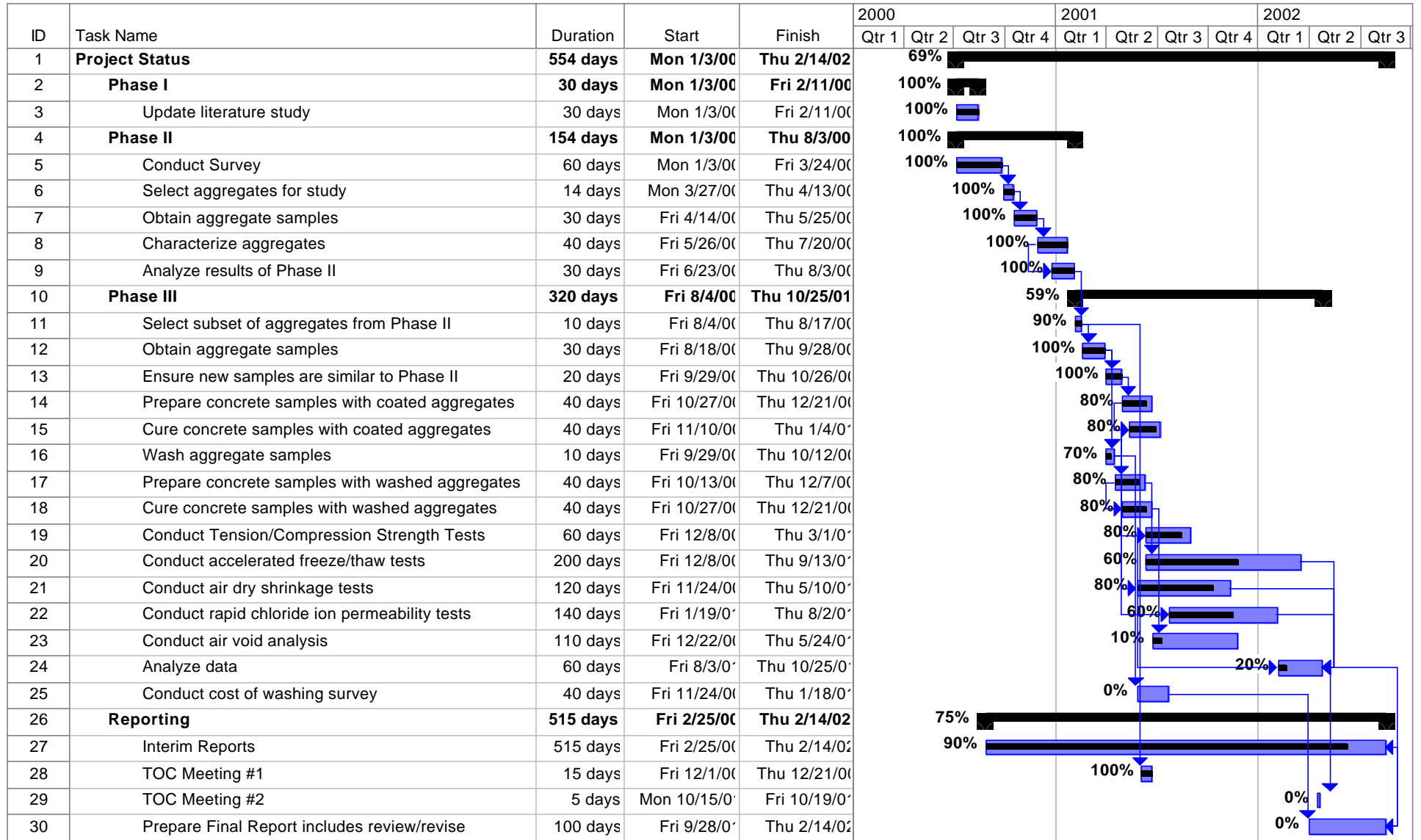
### **Work Next Quarter:**

Aggregate tests in the next quarter will include completion of in-house x-ray diffraction, CTL x-ray diffraction, and sample microscopy to study the aggregate/cement paste interface. A final concrete mixture will be prepared that will exceed the State specification on fine coatings of aggregate and will contain a large clay fraction.

### **Circumstances affecting progress/budget:**

The research team has had difficulty obtaining coated aggregates and identifying any negative impact from aggregate coatings for the mixtures evaluated to date. Existing literature shows that coatings do cause aggregate bond difficulties under some circumstances. The research plan has been slightly modified to include worst case scenario concrete where the coatings will begin to show a negative impact. A contract extension will be requested to allow this research to be completed after these difficulties.

**Gantt Chart:**



**Note: Gantt chart shown in State Fiscal Year Quarters**

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Dec 31, 2001**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Wet Pavements Accident Study of Longitudinal and Transverse Tined PCC Pavements</b>	<b>Project ID: 0092-00-08</b>
<b>Administrative Contact: Nina McLawhorn</b>	<b>Sponsor:</b>
<b>WisDOT Technical Contact: Error! Bookmark not defined.</b>	<b>Approved Starting Date: Dec 15, 1999</b>
<b>Approved by COR/Steering Committee: \$75,000.00</b>	<b>Approved Ending Date: Dec 14, 2001</b>
<b>Project Investigator (agency &amp; contact): Alex Drakopoulos: Marquette University</b>	

**Description:** Study would document relative safety characteristics of each type of tining to allow states to understand trade-off's made when departing from preferred transverse tining to a more quiet longitudinally tined pavement. Results would determine impact, either for or away from longitudinally tined pavements.

Total study budget	Current FFY budget	Expenditures for current quarter	Total Expenditures to date
<b>\$75,000.00</b>	<b>\$25,000.00</b>	<b>\$0.00</b>	<b>\$0.00</b>

**Progress This Quarter:**

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

PI and a research assistant are dedicated to the project during this period (PI has no teaching responsibilities during this quarter).

Crash data acquisition was completed after extensive communications with state DOTs, and FHWA. Data available for CA, WA, UT, MI, MN, IL, and VA. (Additional communications necessary with MN and IL to determine study locations.) The database includes 1991-1998 state-wide data.

Weather information processing program has been acquired. Data acquisition will proceed, pending project no-cost extension approval.

**Work Next Quarter:**

Pending approval of no-cost extension, the crash database will be finalized, weather data will be acquired and processed, crash rates will be compiled and statistics will be calculated.

**Circumstances affecting progress/budget:**

Tasks 1, 2, 3 and 4 are 17%, 17%, 51% and 15% respectively of the total project budget--completed parts of tasks during the current quarter, indicated on the next page, total to 13.6% of the total project budget.



**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Dec 31, 2001**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Early Opening of PCC Pavements to Traffic</b>	<b>Project ID: 0092-01-04</b>
<b>Administrative Contact: Nina McLawhorn</b>	<b>Sponsor:</b>
<b>WisDOT Technical Contact: Error! Bookmark not defined.</b>	<b>Approved Starting Date: Jun 18, 2001</b>
<b>Approved by COR/Steering Committee: \$58,648.00</b>	<b>Approved Ending Date: Dec 18, 2002</b>
<b>Project Investigator (agency &amp; contact): James Croveti: Marquette University-CEEN Hagg</b>	

**Description:** The Wisconsin Department of Transportation's (WisDOT) Standard Specifications for Highway and Structure Construction requires that a new Portland Cement Concrete (PCC) pavement obtain a concrete compressive strength of 3,000 pounds per square inch (psi) for an urban project and 3,500 psi for rural pavement construction. Once the pavement reaches this strength the roadway can be used by the contractor for hauling operations or it can be opened to public traffic. The use of traditional concrete mixes in Wisconsin usually means that this new roadway is not available for 2-7 days, depending on the project, time of year, temperatures, materials used, etc. This time period can pose problems for the contractors in terms of prosecution and progress of the work and completing the work in a more timely fashion. It also becomes a significant problem for the accommodation of property and business owners who must find alternative routes to travel, find temporary measures for transportation (parking off the project and walking to home) or utilize haul roads to get access to their property.

This research the impacts of opening a PCC pavement to traffic at lower compressive or flexural strengths than currently allowed by specification.

Total study budget	Current FFY budget	Expenditures for current quarter	Total Expenditures to date
<b>\$58,648.00</b>	<b>\$19,549.33</b>	<b>\$3,791.44</b>	<b>\$15,745.97</b>

**Progress This Quarter:**

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

Field sampling and specimen fabrication was completed during the construction of STH 57 in Fredonia, WI. Temperature probes were inserted into the mainline pavement and fabricated specimens to monitor internal temperatures and provided data necessary for the development of maturity curves. Cylinders and exposed dowel specimens were field fabricated and tested. Construction materials (aggregates, cement, fly ash) were obtained and transported to the Marquette lab to allow for additional fabrication and testing of specimens. A comparative analysis of cylinder compressive strengths was conducted using lab fabricated specimens of varying dimension (4x8 and 6x12 cylinders).

**Work Next Quarter:**

Laboratory fabrication and testing of cylinders and exposed dowel specimens will continue. The size of the exposed dowel specimens may be adjusted to better simulate pavement stress conditions under loading. The finite element analysis of early loading effects will be initiated to investigate dowel bearing stresses and used for comparative analysis of bearing stresses calculated using classical equations. A questionnaire on expected risks and benefits associated with early opening of PCC pavements will be distributed to paving contractors and selected state, county and municipal engineers.

**Circumstances affecting progress/budget:**

None

WHRP Project 0092-01-04  
 Early Opening of Concrete Pavements  
 Gantt Chart of Project Activities Through December 31, 2001

Project Task	Calendar 2001							Calendar 2002												% Complete
	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
1. Literature Review/Survey		■	■																	80
2. Interim Report		■	■	■	■	■	■													50
3. Pavement Analysis					■	■	■													0
4. Field Sampling/Testing							■	■	■	■	■	■	■	■						25
5. Final Report														■	■	■	■	■	■	0

Proposed ■  
 Actual ■

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Dec 31, 2001**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Performance of Shoulders Adjacent to Concrete Pavements</b>	<b>Project ID: 0092-02-05</b>
<b>Administrative Contact: Nina McLawhorn</b>	<b>Sponsor:</b>
<b>WisDOT Technical Contact: Error! Bookmark not defined.</b>	<b>Approved Starting Date: Sep 17, 2001</b>
<b>Approved by COR/Steering Committee: \$73,467.00</b>	<b>Approved Ending Date: Sep 17, 2002</b>
<b>Project Investigator (agency &amp; contact): Sam Owusu-Ababio: UW-Platteville</b>	

**Description:** Shoulders form an essential component of a highway system. When properly designed and maintained, they promote safe traffic operations and provide lateral support for the adjacent mainline pavement.

Total study budget	Current FFY budget	Expenditures for current quarter	Total Expenditures to date
<b>\$73,467.00</b>	<b>\$36,733.50</b>	<b>\$0.00</b>	<b>\$0.00</b>

**Progress This Quarter:**

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

**Task 1 - Literature Review**

*Subtask 1.1 - Reports and Papers*

The research team has identified, collected, reviewed, and synthesized literature on the design, standards, performance, costs, and maintenance practices of paved shoulders adjacent to PCC pavements. Sources of information had been identified through the TRIS database and the UWP library. The Wisconsin Concrete Pavement Association (WCPA) was initially contacted, but no literature sources were found.

The literature indicates that the majority of paved shoulder studies occurred between the mid 60s and mid 70s. Recent publications on shoulders have come from the Federal Highway Administration's Technical Advisory Committee on paved shoulders. The committee's report generally presents an outline of recommended practices for the design of shoulders.

The review is approximately 85% complete at this time, and will be completed next quarter.

*Subtask 1.2 - Survey*

A survey was designed by the research team in November 2001, and a meeting was held with the WHPR Rigid Pavements TOC on Friday December 7, 2001 to review the survey. TOC members suggested changes to the survey, including a separate survey to a design/construction contact in the 7 states, and a separate survey for each district within the 7 states targeted at maintenance engineers. It was also suggested that the length of the survey be reduced and a duplication of items be eliminated. The research team prepared two revised surveys and e-mailed them to David Larson, Rigid Pavements TOC Chair on Wednesday December 12, 2001.

The design/construction survey was designed to collect information regarding the policies and procedures used in paved shoulder type selection, shoulder design, drainage treatment, costs, and typical sections. The TOC had suggested a short survey, however, the revised survey is 4 pages in length to collect information useful to the study.

The maintenance survey was designed to seek information regarding maintenance practices and policies, costs, freeze-thaw behavior, shoulder condition evaluation method, and specific maintenance concerns. The research team felt that maintenance procedures and guidelines may vary greatly among districts, so each has been requested to provide their individual maintenance guidelines and procedures. For example, the maintenance practices in northern Wisconsin (Districts 6, 7, and 8) may vary with southern Wisconsin (Districts 1 and 2). The TOC had suggested a short survey, however, the revised survey is 4 pages in length to collect information useful to the study.

A distribution list was compiled for both surveys. The survey was mailed on December 26<sup>th</sup>, 2001 to 7 states: Illinois, Iowa, Minnesota, Michigan, Indiana, Ohio, and Wisconsin.

### *Task 2 - Identification and Review of Paved Shoulder Types in Wisconsin*

The objective of Task 2 is to identify and review the different paved shoulder types adjacent to mainline Portland cement concrete (PCC) pavements constructed in the last thirty years by WisDOT.

A meeting was held on Wednesday November 14, 2001, with Mr. Bill Duckert, Pavement Engineer, and Mr. David Friedrichs, Pavement Management Engineer, at the Pavement Research and Management Unit of WisDOT to help in the PCC identification process.

Five specific items were requested to help in the identification and review:

- WisDOT Pavement Distress Index (PDI) Manual
- Database of JPCP and CRCP
- PDI Calculator
- District 2 cross-sectional database details
- Shape Files for the Wisconsin Highway Network broken by District.

All the above items have been received and have been helpful in developing a list of pertinent information to collect at the districts for each project. The list includes: as-built cross-section geometric details for the PCC pavement and adjacent shoulder, structural design information, underdrain system design and construction, percentage of material passing the 75um (#200) sieve for crushed aggregate base course (CABC), and construction costs.

### **Task 3 – Shoulder Condition Survey**

The objective of Task 3 is to evaluate the field performance of paved shoulders.

The Wednesday November 14, 2001 meeting with Mr. Bill Duckert and Mr. David Friedrichs explored the potential of using the WisDOT automated distress survey van for this study. However, after learning of the capabilities and potential damage to the van while surveying the shoulders, it was determined that a manual data collection effort would be required. WisDOT may use the automated data collection method in the future, however, it may require more side-mounted cameras and an assessment of how the van and instrumentation will perform on rumble strips.

Since shoulders are often built with lower construction standards (e.g. lower compactive effort) and lower quality materials, environmental effects on shoulder performance are generally more severe than for mainline pavement performance. Hence, it was indicated by the TOC that a direct use of the WisDOT PDI method on mainline pavements may not be appropriate for shoulders. Some modification has to be made in order to apply it to shoulders.

**Work Next Quarter:**

### **Task 1 - Literature Review and Surveys**

## **Subtask 1.1 – Literature Review**

Work will conclude on Task 1, Literature Review, with a final synthesis of relevant literature. Robert Schmitt, Co-P.I., plans to attend the TRB Annual Meeting in January 2002 in Washington, DC to learn of any recent or on-going research efforts in this area.

### **Subtask 1.1 – Shoulder Surveys**

To ensure that the shoulder surveys are returned, follow-up phone calls will be made towards the end of January.

## **Task 2 - Identification and Review of Paved Shoulder Types in Wisconsin**

During January 2001, the research team plans to travel to each of the 8 districts to collect as-built cross-sectional details, structural design information, underdrain system design and construction, percentage of material passing the 75um (#200) sieve for crushed aggregate base course (CABC), and construction costs.

### **Task 3 – Shoulder Condition Survey**

A copy of the WisDOT PDI Manual has been obtained by the research investigators and is being reviewed to understand the current process for manually acquiring and analyzing distress data. This review will provide a background for modifying the process for use on shoulders.

The research team is also evaluating the seasonal influences upon the distress survey condition data. In particular, how frost-heave may affect the survey results will be analyzed.

Depending upon the review of literature and assessment of the seasonal influences, field condition surveys may begin as early as March 2002.

### **Task 4 –Data Analysis**

The research team will begin to analyze the shoulder survey data after the February 15<sup>th</sup> deadline given to respondents.

#### **Circumstances affecting progress/budget:**

The research project is about one month behind schedule.

**Gantt Chart:**

**Note: Gantt chart shown in State Fiscal Year Quarters**

Project Progress Chart  
 WHRP Project I.D. 0092-02-05

Updated: December 31, 2001  
 Performance of Shoulders Adjacent to Concrete Pavements.

Task	Description	2001			2002									Percent Complete	
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
1	Literature Review and Survey	█	█	█											85
2	Review of Shoulder Types	█	█	█											25
3	Shoulder Condition Survey		█			█	█	█	█	█	█				5
4	Data Analysis		█	█	█	█	█	█	█	█	█				0
5	Development of Guidelines									█	█	█	█		0
6	Final Report											█	█		0
Proposed		█													
Actual		█												Project	20

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Dec 31, 2001**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Effects of Ground Granulated Blast Furnace Slag in Portland Cement Concrete</b>	<b>Project ID: 0092-02-14a</b>
<b>Administrative Contact: Nina McLawhorn</b>	<b>Sponsor:</b>
<b>WisDOT Technical Contact: Error! Bookmark not defined.</b>	<b>Approved Starting Date: Nov 7, 2001</b>
<b>Approved by COR/Steering Committee: \$194,251.00</b>	<b>Approved Ending Date: Dec 31, 2003</b>
<b>Project Investigator (agency &amp; contact): Steve Cramer: UW-Madison</b>	

**Description:** Federal transportation directives encourage the use of by-product materials and mandate open and unrestricted competition for alternative cementitious materials. In 1995, the EPA listed ground granulated blast furnace slag (GGBFS) as a recyclable material in the Federal Register. GGBFS is a cementitious materials that replaces a portion of the portland cement in a concrete mix and is being used with increasing frequency for pavement in concrete in Wisconsin.

The production and use of GGBFS is more than 100 years old, yet significant levels of use in Wisconsin are quite recent. GGBFS is manufactured across the world but recently has been offered in Wisconsin by only one manufacturer.

Relevant questions associated with GGBFS use for Wisconsin include: 1) what replacement level of cement is most appropriate and what are the performance tradeoffs with different levels?

2) How do the fineness and activation characteristics vary from shipment to shipment of GGBFS among shipments of the current primary supplier and those of other new suppliers planning product introduction in 2001?

3) How does the GGBFS effect performance, change with different cement chemical compositions?

4) Are there undesirable interactions with admixtures or other additives?

Total study budget	Current FFY budget	Expenditures for current quarter	Total Expenditures to date
<b>\$194,251.00</b>	<b>\$64,750.33</b>	<b>\$0.00</b>	<b>\$0.00</b>

**Progress This Quarter:**

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

Funding/accounting for this project was received on December 18<sup>th</sup>. No research was initiated during this period of final exams.

**Work Next Quarter:**

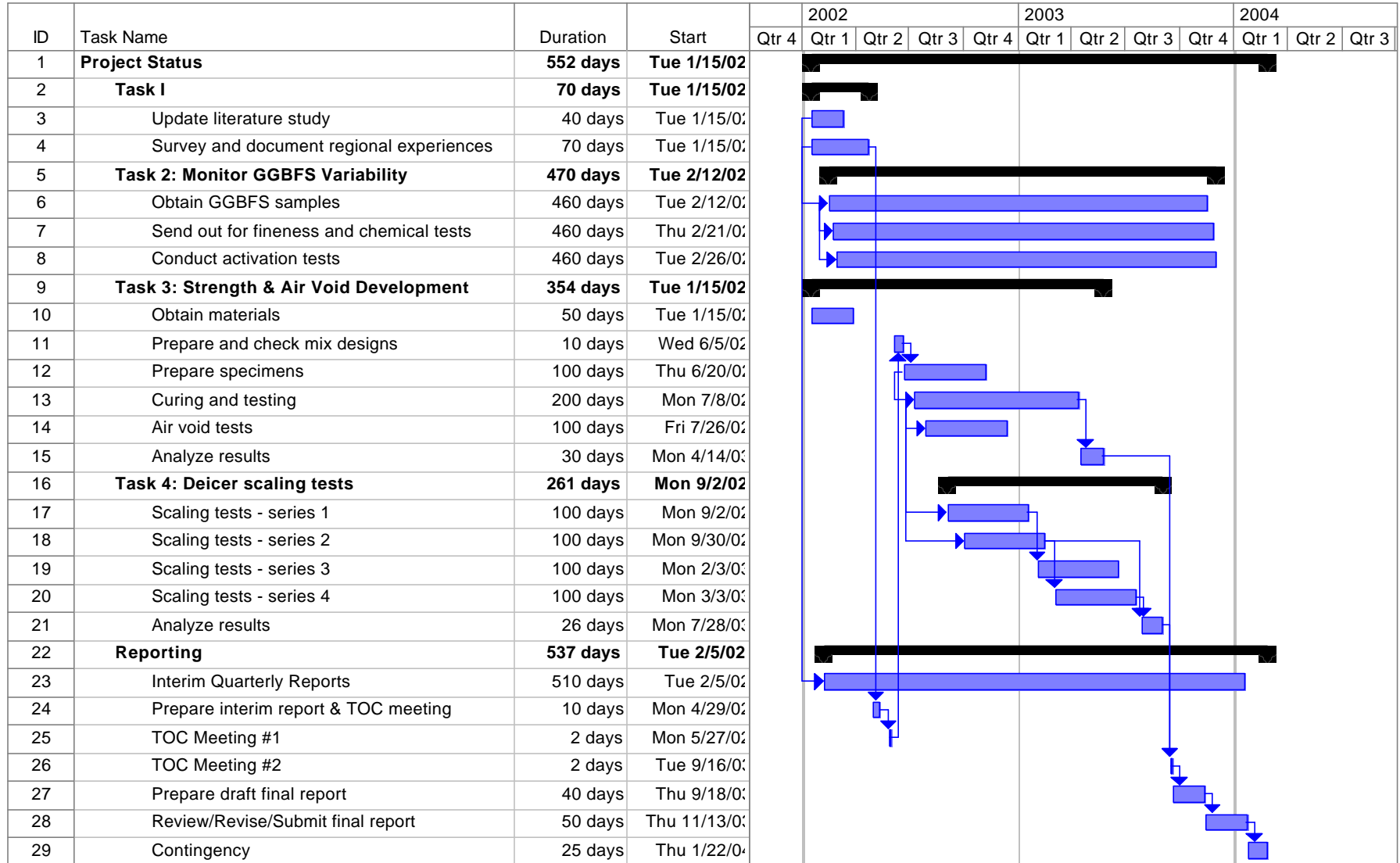
Complete literature review and check region for experiences with GGBFS. Review, revise if needed and initiate laboratory work plan.

**Circumstances affecting progress/budget:**

None

**Gantt Chart:**

Gantt chart with a revised starting date is shown.



**Note: Gantt chart shown in State Fiscal Year Quarters**