

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Jun 30, 2004**

<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, 2004</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	Percent Complete
\$194,251.00	\$48,562.75	\$10,215.86	\$118,597.59	90 (%)

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**Progress This Quarter:**

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

This project is currently over 90% complete and on track for completion in 2004 under the revised schedule.

**Task 2 Progress**

Collection of a monthly GGBFS samples continued from January. Blaine fineness and activation tests have been completed on samples collected through May. Both tests revealed little variability in the GGBFS product. The Blaine fineness ranged from 560 kg/m<sup>2</sup> to 580 kg/m<sup>2</sup>. Activation tests were conducted with each monthly sample and each of three brands of Type I portland cement. The ggbfs provided little variability at both seven and twenty-eight day testing when compared to samples of the same cement manufacturer. Comparing the slag activity index (SAI) averages of seven and twenty-eight day among different cements proved a little more interesting and showed variations in early strength as much as 20%. Overall, given the low variability of the GGBFS, the collection of monthly samples was terminated and Task 2 has now been completed.

**Task 3 Progress**

All remaining Task 3 tests are in-progress. The remaining tests include one-year concrete compression strength and one series of shrinkage tests. The last set of shrinkage tests will be completed in early July. Generally, concrete shrinkage is lowest with 0% and 50% GGBFS replacement levels and highest with 30% GGBFS replacement. The one year compression tests will run from June through November.

**Task 4 Progress**

Deicer scaling tests are in progress and will be completed in July. Except for data analysis, this activity will complete Task 4. As expected, scaling is impacted by the amount of GGBFS used to replace cement and the curing regime. Coarse aggregate type and curing regime appear to have little influence on surface scaling characteristics for concrete containing GGBFS.

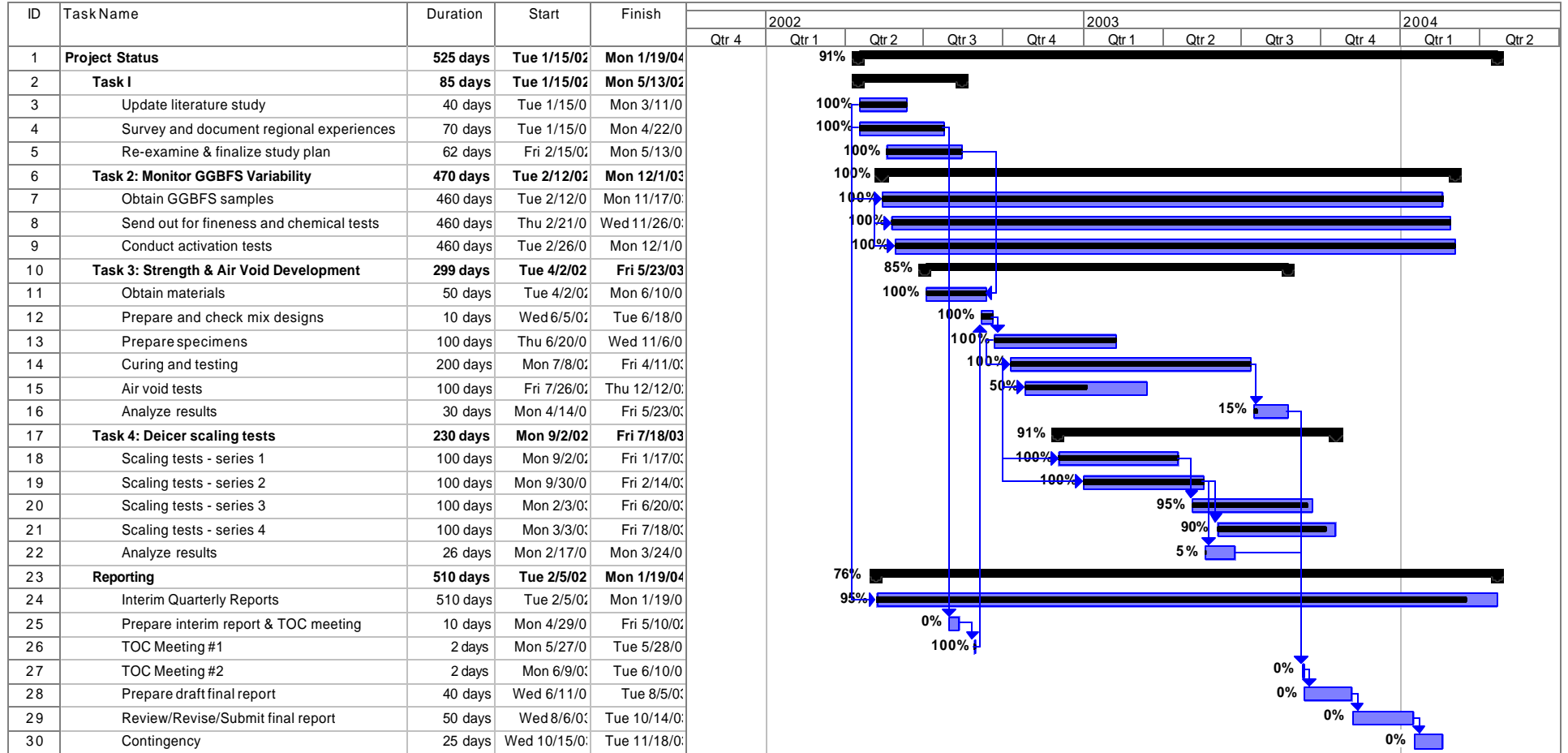
**Work Next Quarter:**

Work next quarter will include completion of Task 3 and Task 4 testing, data analysis and draft report writing.

**Circumstances affecting progress/budget:**

Project is on track for completion in 2004 as scheduled.

**Gantt Chart:**



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

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Jun 30, 2004**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Evaluation of Methods for Characterizing Air-Void Systems in Wisconsin Paving Concrete</b>	<b>Project ID: 0092-03-16</b>
<b>Administrative Contact:</b> Nina McLawhorn	<b>Sponsor:</b>
<b>WisDOT Technical Contact:</b> Dave Larson	<b>Approved Starting Date:</b> Mar 3, 2003
<b>Approved by COR/Steering Committee:</b> \$199,965.00	<b>Approved Ending Date:</b> Sep 3, 2005
<b>Project Investigator (agency &amp; contact):</b> Lawrence Sutter: <b>Error! Bookmark not defined.</b>	

**Description:** The study will be conducted over 30 months, and be completed in 7 phases:

1. Literature review
2. Interim report summarizing the Literature Review findings
3. Preparation of Concrete Mixtures
4. Testing of Fresh Concrete
5. Testing of Hardened Concrete
6. Data Analysis
7. Final Report

Total Study Budget	Current FFY Budget	Expenditures for Current Quarter	Total Expenditures to Date	Percent Complete
<b>\$199,965.00</b>	<b>\$66,655.00</b>	\$19,969.63	<b>\$34,578.77</b>	<b>30 (%)</b>

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**Progress This Quarter:**

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

During this reporting period, the interim report was finalized. 20 copies of the interim report were mailed on July 30, 2004 to:

Peter J Bosscher  
 Midwest Regional University Transportation Center  
 Wisconsin Highway Research Program  
 2205 Engineering Hall  
 1415 Engineering Dr.  
 Madison, WI 53706

Additionally, with the approval of the WHRP program manager Jackie Jiran, specimens were shipped to the University of New Brunswick where ASTM C 666 testing was started.

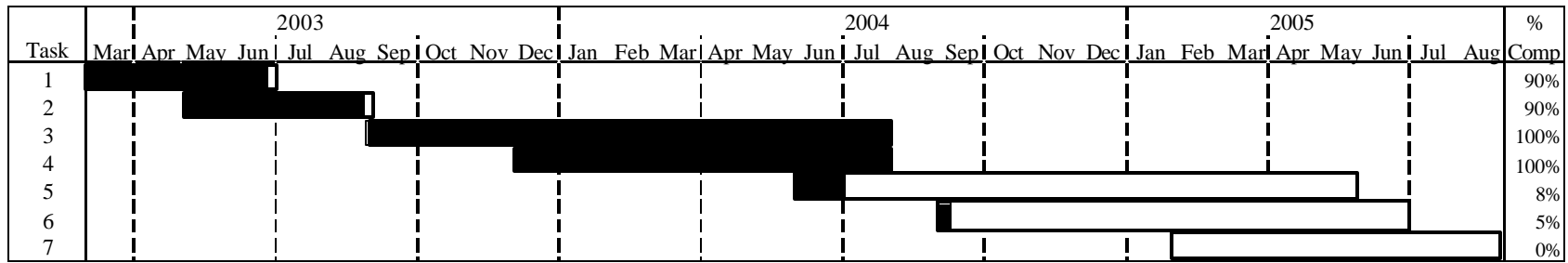
**Work Next Quarter:**

- Hold progress meeting with project principal investigators, WHRP, and WisDOT representatives after the panel has received and reviewed the interim report.
- Continue ASTM C 666 testing at the University of New Brunswick
- Perform ASTM C 457 analyses of the laboratory prepared mixes
- Begin evaluating the three emerging technologies for performing ASTM C 457 as described in the modified work plan provided in the interim report

**Circumstances affecting progress/budget:**

Project is very near the original projected schedule with no problems anticipated

**Gantt Chart:**



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

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: June 30, 2004**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Research and Development of the Application of the Federal Highway Administration's HIPERPAV Model to Wisconsin</b>	<b>Project ID: 0092-04-11</b>
<b>Administrative Contact:</b> Nina McLawhorn	<b>Sponsor:</b>
<b>WisDOT Technical Contact:</b>	<b>Approved Starting Date:</b> Oct 1, 2003
<b>Approved by COR/Steering Committee:</b> \$49,998.00	<b>Approved Ending Date:</b> Oct 1, 2004
<b>Project Investigator (agency &amp; contact):</b> The Transtec Group, Inc., Mr. J. Mauricio Ruiz, M.S.E.	

**Description:** Following is the project's work plan:

- Task 1: Research of HIPERPAV and Determination of Proper Inputs
- Task 2: HIPERPAV Customization
- Task 3: Documentation
- Task 4: Training

Total Study Budget	Current FFY Budget	Expenditures for Current Quarter	Total Expenditures to Date	Percent Complete
<b>\$49,998.00</b>	<b>\$49,998.00</b>	\$4189.43	<b>\$19,567.91</b>	<b>39 (%)</b>

**Progress This Quarter:**

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

During this quarter, Dr. Hani Titi with the University of Wisconsin-Milwaukee prepared a draft report that documents his investigation of parameters related to jointed plain concrete pavements in Wisconsin. This information has subsequently been extracted and prepared for the customization of the HIPERPAV-Wisconsin System. More specifically, this information will be used for identification of default input values, typical input ranges, and terminology that should be incorporated in the software.

In addition, the project team continued exploring options for customization of the graphical software interface including an investigation of possible geographical features that will be incorporated in the geography map of the software.

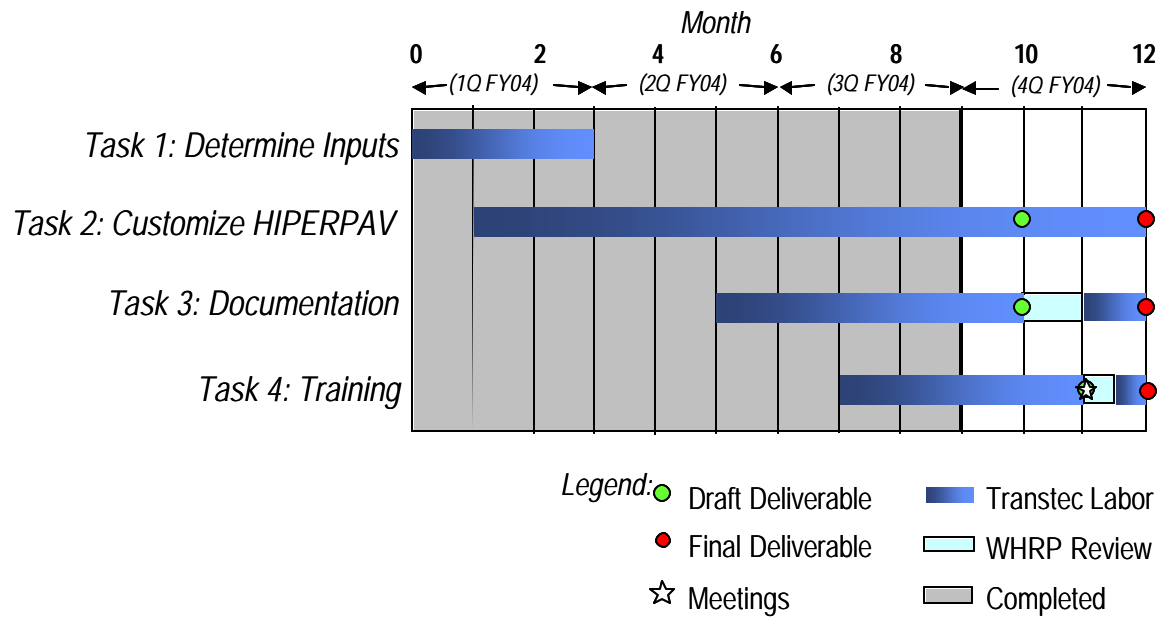
**Work Next Quarter:**

During the next quarter, the project team will prepare a list of features that will be incorporated in the HIPERPAV-Wisconsin System. This list will be sent to the WHRP oversight committee for approval before continuing with the customization. Upon approval, the project team will proceed with the customization of the HIPERPAV-Wisconsin system. It is anticipated that the majority of the software development effort will be conducted this quarter. In addition, coordination and initial preparations will be made for the final workshop, expected for later this year, or early in 2005.

**Circumstances affecting progress/budget:**

None (project proceeding as planned)

**Gantt Chart:**



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

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**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Jun 30, 2004**

<b>Program: SPR-0010(36) FFY99</b>	<b>Part: II Research and Development</b>
<b>Project Title: Expanded Study on the Effects of Aggregate Coatings and Films on Concrete Performance</b>	<b>Project ID: 0092-04-12</b>
<b>Administrative Contact:</b> Nina McLawhorn	<b>Sponsor:</b>
<b>WisDOT Technical Contact:</b> Error! Bookmark not defined.	<b>Approved Starting Date:</b> Oct 1, 2003
<b>Approved by COR/Steering Committee:</b> \$149,995.00	<b>Approved Ending Date:</b> Oct 16, 2006
<b>Project Investigator (agency &amp; contact):</b> Steve Cramer: UW-Madison	

**Description:** Following are the research objectives:

- 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

Total Study Budget	Current FFY Budget	Expenditures for Current Quarter	Total Expenditures to Date	Percent Complete
\$149,995.00	\$37,498.75	\$14,576.69	\$20,557.42	8 (%)

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**Progress This Quarter:**

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

The UW research team met every one to two weeks to monitor progress and to carryout the research. The research progress this quarter fell into two types of activities: 1) Assisting WisDOT to implement the California Cleanness Test (CCT) for monitoring aggregates and 2) research at the UW to characterize and understand the impact of clays on concrete performance.

The team worked with WisDOT providing training and guidance so that the California Cleanness Test can be implemented on coarse aggregate certifications for No. 1 stone. This requires an increase in the sample size submitted to WisDOT and WisDOT is notifying the districts of this need. The research team is concerned that 8 months into the project, WisDOT aggregate monitoring has not yet begun. The research team continues to study the influence of clay coatings outside the planned monitoring of aggregates. Thus the percent project complete does not reflect the true level of effort expended.

During this quarter the study of clay coating impact in concrete was conducted. The goal was to investigate the state of aggregation of clays as a function of clay structure and solution properties that could harmfully affect physical and chemical properties of concrete. To reach this objective, different experiments were running with selected clays:

- Analysis of clay structure with different techniques (Adsorption Isotherm of Nitrogen at 77 K and SEM)
- Sedimentation behavior under different condition (Ion strength, pH, clay concentration and mixing order)
- Measurement of particle size in dry and aqueous solution
- Electrophoretical mobility determinations

A preliminary mortar flow experiment was carried out. A primary outcome of this investigation is that different clays behave differently as the solution attributes change. Some clay coatings will have a significant effect on concrete rheology and the availability of water for cement hydration. This also means that the mere presence of clay may or may not be harmful and tests to predict the impact of clay coatings must be carefully chosen. While the California Cleanness Test is an appropriate screening tool based on what we know now, ultimately it may not measure the right parameters to detect the presence of harmful clays.

In late June, the UW team learned of a potentially harmful aggregate coating problem on a concrete paving job in northern Wisconsin. Lack of compression strength gain and inability to provide saw cuts were the observable problems. Working with the Wisconsin Concrete Paving Association, a sample was obtained and a California Cleanness Test was conducted. While the CCT value was in the safe zone, there was a considerable amount of suspended particles in the solution. Subsequently the team visited the job site and obtained larger sample of materials for further testing. Although this problem was not identified via WisDOT CCT monitoring, the research team is moving ahead with the analysis of this aggregate as it is the only aggregate so far in the project that has been identified as potentially problematic.

**Work Next Quarter:**

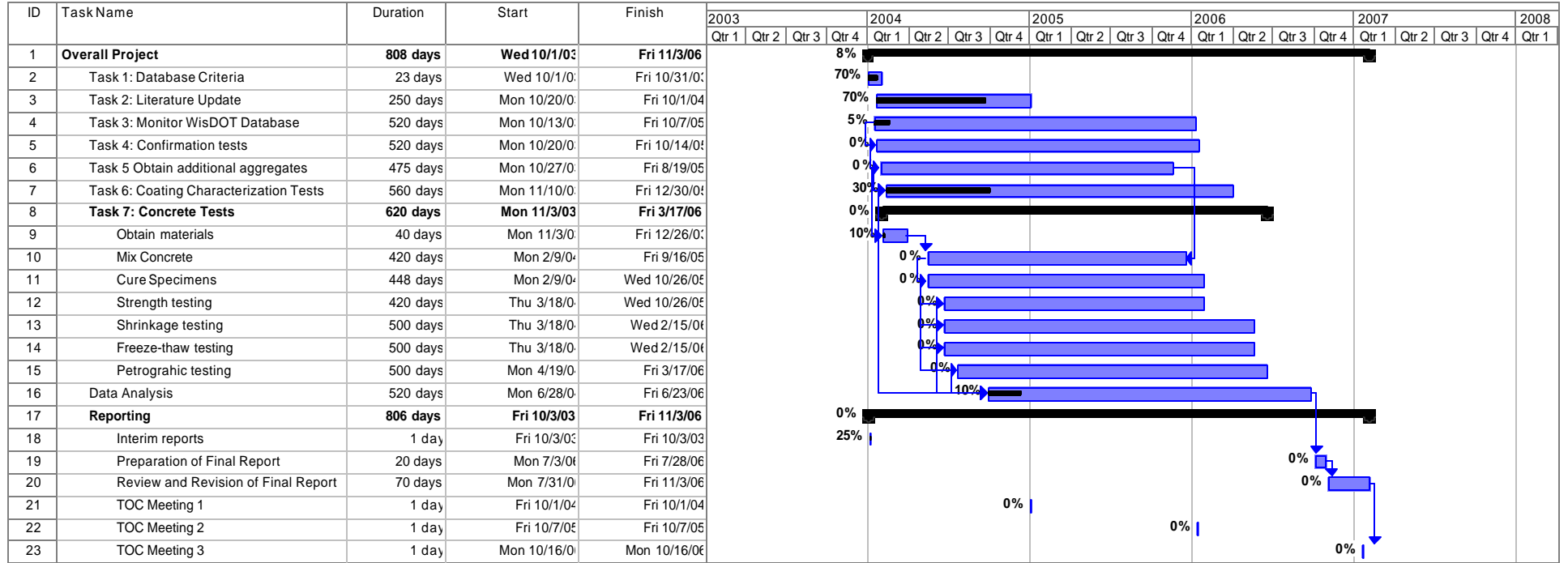
Work next quarter will include:

- Continue the experiments to relate the different clay structures and their behaviors in solutions to concrete rheology.
- Proceed with the analysis of aggregate recently collected from northern Wisconsin as the proposal reflects.
- Conduct X-ray Diffraction to study the influence on hydration reactions when clays are present.
- Continue the assistance to WisDOT to launch the sampling of aggregates.

**Circumstances affecting progress/budget:**

There has been considerable difficulty in positioning WisDOT to conduct the aggregate coating monitoring envisioned in this research. The primary obstacle appears to be staff time devoted to the effort. This portion of the project has fallen behind schedule.

**Gantt Chart:**



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