

**MONTHLY PROGRESS REPORT**  
**Slurry/Micro-Surface Mix Design Procedure**  
**February - March 2005**

**To:** T. Joe Holland, CALTRANS  
**Contract No.:** CALTRANS 65A0151  
**Contractor:** Fugro Consultants LP  
**Contract Period:** June 30, 2003 – Nov. 30, 2007  
**Prepared By:** Jim Moulthrop, Principal Investigator  
**Date Prepared:** April 19, 2005

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**PROJECT OVERVIEW**

The overall goal of this research is to improve the performance of slurry seal and micro-surfacing systems through the development of a rational mix design procedure, guidelines, and specifications.

Phase I of the project has two major components: 1) the first consists of a literature review and a survey of industry/agencies using slurry and micro-surfacing systems, 2) the second deals with the development of a detailed work plan for Phases II and III.

In Phase II, the project team will evaluate existing and potential new test methods, evaluate successful constructability indicators, conduct ruggedness tests on recommended equipment and procedures, and prepare a report that summarizes all the activities undertaken under the task.

In Phase III, the project team will develop guidelines and specifications, a training program, and provide expertise and oversight in the construction of pilot projects intended to validate the recommended design procedures and guidelines. All activities of the study will be documented in a Final Report.

NOTE: New information for the current month is notated by double-lines to the left of text, tables, or figures.

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**PHASE I—LITERATURE SEARCH AND WORK PLAN DEVELOPMENT**

**Task 1 Literature Review and Industry Survey—Completed**

The literature review process is completed with all sources of information on the design and use of micro-surfacing and slurry seals reviewed and summarized in Chapter 2 of the Phase I Report. The three survey questionnaires were included in the August 2003 monthly report and the results were summarized in the Phase I Report.

**Task 2 Work Plans for Phases II and III—Completed**

The Phase II Work Plan was included in Chapter 3 of the Phase I Report. The Phase III Work Plan was included in Chapter 4 of the Phase I Report.

All activities of Phase I are completed. The results are included in the Phase I Interim Report that was submitted to CALTRANS in March 2004.

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## PHASE II—MIX DESIGN PROCEDURE DEVELOPMENT

### Tasks 3 & 4—Evaluation of Potential Test Methods & Successful Constructability Indicators

All testing equipment has been acquired and is available in the CEL laboratory. The team is performing calibration and fine-tuning of the test systems before the actual test program begins.

The Principal Investigator visited the CEL laboratory in Oakland California mid-February. Following are notes and action items from the visit:

- ◆ Eurostar Device
  - Operating Instructions were lacking
  - Software was delivered-manual downloaded from [www.labworld-on.com](http://www.labworld-on.com)
  - Stirrer configuration was not acceptable. Had a “U” configuration and left unmixed material in the center of the stirrer
  - Viscoclick operation-no instructions and there appeared to be a gasket missing which would hold the device on the Eurostar. The Viscoclick measures the torque on the stirrer shaft whereas the Eurostar measures the torque in the motor.
  - Stirrer eccentricity could be a problem depending on the length of the shaft
  - Larger sized aggregate in the mix – stirrer would “scratch” the bottom of the glass beaker
  - Action Items:
    - Obtain new stirrer configuration – similar to one used by the Germans
    - Get directions on how to use the Viscoclick or send it back-it was on-loan
    - Become familiar with the software
- ◆ **The above action items have been addressed. We continue to work with IKA, the supplier of the Eurostar, to fine tune the stirrer configuration. The Viscoclick device could not be used because it was lacking the necessary attachments to affix it to the Eurostar device. The CEL staff has become familiar with the software.**
- ◆ French Wet Track Abrasion Test
  - The Hobart device that CEL has cannot be used because the table cannot be lowered to accept the test specimen. We plan to use specimens that contain the full gradation of material, not like the current ISSA TB 100 method, which scalps the aggregate retained on No. 4 Sieve.
  - Action Items:
    - Obtain the proper equipment in order to run the test
- ◆ **Regarding the action item, we have ordered a device from Benedict Slurry Seal Inc. and it should be delivered at the end of April.**



**Figure 1. French Wet Track Abrasion Test**

- ◆ Cohesion Test
  - Transducer not working properly and a local machine shop is repairing it and expects to have a replacement by 1 March
  - Action Items:
    - Obtain equipment and begin running tests
  
- ◆ The equipment has been repaired and CEL is running tests with the new equipment

Since the February meeting, the team has worked on solving the problems listed. The French WTAT will be refined by a visit to the SCREG laboratory in France since Mr. Holleran will be working in Europe in April. A Hobart N50 was purchased to allow the adjustments needed for the French WTAT. The mixing test has been commissioned and in use.

A range of conditions will be used in the test program of Task 3:

- Humidity: High and Low
- Temperature: 10, 25 and 30°C (50, 77 and 86°F)
- Cure time: 30, 60, 90 Minutes; 12 and 24 Hours
- Soak time: 1hour; 1,3,6 and 9 Days

Tentatively, five mixes are planned for inclusion in the test program. Four will be made of aggregates and binders known to perform well in slurry systems, and one will be made of materials for which the performance is unknown. The five mixes are:

- Mix 1 Ralumac + Table Mountain Aggregate (supplied by Koch)
- Mix 2 Ralumac + Lopke Gravel Aggregate (Koch formulation for emulsion)
- Mix 3 VSS PMCQS-1h + Table Mountain Aggregate
- Mix 4 Vestal PM CQS -1h + Lopke Gravel Aggregate
- Mix 5 Unknown

Testing of the Table Mountain and Lopke Gravel Aggregates is complete. Tests included sieve analysis, sand equivalent, Los Angeles abrasion, and sodium sulfate soundness testing. The results were noted in previous progress reports. The aggregates have been forwarded to Valley Slurry Seal and Koch Materials for the formulation of the emulsions.

The sodium sulfate testing had been re-done because an old solution was used for the initial testing and there is some concern that the results might not be valid. The results were included in Attachment A of the August 2004 progress report.

The standard suite of ISSA mix design tests was performed on both mixtures to establish “benchmarks” before progressing to the new and modified test procedures. The results were included in Appendix A of the November 2004 progress report.

### **Task 5—Ruggedness Tests of Recommended Equipment and Procedures**

In comparison with the testing in Tasks 3 and 4, the tests of Task 5 will be performed at a single set of temperature, humidity, and cure time conditions. “Standard” conditions were chosen by the team (e.g., 50 percent humidity, 25°C temperature). Slight variations in these parameters will be allowed to evaluate the ruggedness of the test procedures. The team is currently reviewing the test factorials proposed in the Phase II Work Plan.

### **Task 6—Phase II Report**

No Activity

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## **PHASE III— PILOT PROJECTS AND IMPLEMENTATION**

### **Task 7—Development of Guidelines and Specifications**

A list of references that contain guidelines and specifications has been drafted and is noted below:

- ◆ ISSA A105 Guidelines for Slurry—Available
- ◆ ISSA A143 Guidelines for Micro-Surfacing—Available
- ◆ TTI Report 1289-2F Use of Micro-Surfacing in Highway Pavements—Available.
- ◆ Report contains:
  - Methods and Materials Specifications
  - Quality Control and Assurance Tests (including field cohesion and vane shear tests)
  - Quality Control Guidelines (including materials acceptance tests and mixture design verification)
  - A Checklist
  - Usage Guidelines.
- ◆ ISSA Inspector’s Manual—Available
- ◆ Caltrans Maintenance Technical Advisory Guide Final Draft—Available
- ◆ The ISSA Workshop Folder—Available

The guidelines and specifications will be a concise collection, presented in AASHTO format. This is one area of Phase III where the team can work at present. At the end of Phase II, the document will be appended with findings and recommendations relative to the new tests developed in Phase II.

### **Task 8—Workshop Training Program/Pre-Construction Module**

The team agreed that work could commence in several chapters of the Reference Manual to be developed under this task. The Reference Manual will be a comprehensive, textbook-like document with background information, explanations, and pertinent information on the design and use of slurry systems.

A template for the Reference Manual has been produced and work has begun on the development. A draft outline of the Manual is presented here:

- ◆ Chapter 1. Introduction
  - Historical Developments
  - Why Slurry Systems
  - The Future of Slurry Systems
  - Objectives of the Manual
  - Organization of Material
- ◆ Chapter 2. Slurry Systems Review
  - What is Slurry Seal
  - What is Micro-Surfacing
  - Slurry Systems
- ◆ Chapter 3. Project Selection Criteria
- ◆ Chapter 4. Mix Design
  - Mix Design Flowchart
  - Binder Requirements
  - Aggregate Requirements
  - Blending Requirements
  - Test Methods
  - Mix Design Examples
- ◆ Chapter 5. SyRaMiD Specifications
- ◆ Chapter 6. Construction Considerations and Limitations
  - Project Geometry
  - Weather Limitations
- ◆ Chapter 7. Construction Operations
  - Equipment and Calibration Requirements
  - Surface Preparation
  - Workmanship Requirements
  - Stockpile Management
  - Mix Design Verification
  - Troubleshooting
- ◆ Chapter 8. Quality Control
- ◆ References
- ◆ Appendices
  - Test Protocols
- ◆ Glossary

### **Task 9—Pilot Projects/Procedure Validation**

The team developed guidelines for selecting pilot projects to be used by State agencies. The proposed pilot project layout contains six different sections:

- ◆ A control section placed using the ISSA current procedure.
- ◆ A bare section (do nothing)
- ◆ Improved mix design (using the method developed in Phase II), Replicate 1
- ◆ Another contractor-based control (ISSA design).
- ◆ Another bare section.
- ◆ Improved mix design (using the method developed in Phase II), Replicate 2

The final version of the Guidance Document was included in Appendix A of the October 2004 progress report. The document was forwarded to the participant State agencies and other agencies interested in participating in the pilot project study.

|| The project team would appreciate feedback on the guidelines and comments on the availability of project sites for the 2006 construction season.

### **Task 10—Final Report**

No Activity

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### **NEXT MONTH'S WORK PLAN**

The activities planned for next month are listed below.

- ◆ Coordinate with CALTRANS personnel on an as-needed basis.
  - ◆ Continue with Phase II and Phase III activities.
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### **PROBLEMS / RECOMMENDED SOLUTIONS**

|| All problems with the acquisition of the test equipment have been overcome. **The team is in the process of adapting and fine-tuning the equipment.** The team will make every effort to expedite the work and follow the initial testing schedule.