Progress Report
February 2006

FHWA POOLED-FUND PROJECT NUMBER: ***TPF5-(075)***

TITLE: Extending the Season for Concrete Construction and Repair – Phase II, Defining Engineering Parameters

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OBJECTIVE: To define the effect of the antifreeze admixtures developed in Phase I on the freeze-thaw durability of portland cement concrete. Develop guidance for using admixtures to enhance the service life of concrete in northern climates.

REPORTING PERIOD: 01 Oct 2005 through 01 Feb 2006

ITEMS IN THIS ISSUE:

- Progress since last report
- New accomplishments
- Looking ahead
- Phase III sponsors needed

Progress since last report: The Phase II project report has been drafted and is in technical review as of this writing. Laboratory testing demonstrated that concrete's freeze-thaw durability is enhanced by using the Phase I chemicals as antifreezers. However, this durability can be compromised if the dosage of admixture is too high. Findings suggest that 7.5% dry admixture by weight of cement may be the practical upper limit for admixtures before the advantage of using admixtures as durability enhancers is lost. Looking back at the Phase I data helps to explain why our freeze-thaw durability results back then seemed to change from mix to mix. Until we settled in on the current dosage recommendations for the –5°C protection limit, our testing dosage in Phase I varied above and below the 7.5% limit. The highest durability was achieved almost always at dosages below 7.5%. All Phase I mix designs were found to be durable. We now know that durability can be improved, either by decreasing the w/c ratio, increasing the cement factor, or both in an effort to keep the dry-admixture to cement ratio at a reasonable value. The Phase II findings provide us with more confidence in designing durable antifreeze concrete capable of resisting even lower temperatures than reported in Phase I.

New Accomplishments: ASTM C 1622, Standard Specification for Cold-Weather Admixture Systems, was published in October 2005. This new document will allow wider acceptance of antifreeze admixtures and greater flexibility for placing concrete in sub-freezing weather.

Concrete International published "Breaking the Freeze Barrier" in its November 2005, Vol 27, No. 11 issue. This article provides a nice overview of antifreeze admixture research the past decade. It is available for downloading at: http://www.crrel.usace.army.mil/concrete/Breaking_the_Freeze_Barrier.pdf

ACI 306, Cold Weather Concreting, is balloting a revised Chapter 4. The entire report is expected to be completed and ready for final review/balloting this calendar year. When published, it will provide the concrete industry with the latest in winter concrete construction practice.

ACI 212, Chemical Admixtures, has rewritten half its report and will send it out for ballot before summer. The balloted portion will include a chapter on cold weather admixtures.

The U.S. Air Force published an Engineering Technical Letter (ETL) on antifreeze admixtures. It can be viewed at http://www.afcesa.af.mil/userdocuments/publications/ETL/ETL%2005-8.pdf .It is based on our Phase I work.

Army manuals on Arctic Construction are being updated on cold weather concreting.

These are important advances that will eventually allow antifreeze technology to find its way into general practice. Thanks to all of you for being a part of this developing success.

***Looking ahead**:* The Phase II report should become available on our website within the next 2-3 months.

Phase III partially funded: FHWA records show that as of this writing, 5 states have committed funds to the wrap-up Phase III portion of this work. Briefly, we need to develop guidance for determining the optimum dosage of admixture to use at the jobsite. Phase I gave us a one-size-fits-all answer to cold weather. The –5°C capability is not always necessary, but at times it may not be sufficient to allow work to progress. We now know that we can push pass the –5°C limit of Phase I with confidence in durability as shown in Phase II. The objective of Phase III is to develop the criteria to optimize mixture design, economize materials costs, and better assure a desired outcome for the antifreeze admixture systems developed in Phase I in a wide range of weather conditions.

Please take a minute to review our Phase III proposal. We need a few more states to join in.