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MITCHELL E. DANIELS, JR., Governor
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September 6, 2005

Writer's Direct Line

MEMORANDUM
05-14

TO: Districts Directors
Toll Road Operations Engineers
District Materials & Tests Engineers
District Construction Engineers
District Area Engineers
Project Engineer/ Supervisors

FROM: Dennis A. Kuchler, Chief
Division of Contracts & Construction

RE: Fly Ash and GGBFS Cutoff Date for PCCP

Currently our standard specifications 501.03 and 502.04 permit the use of fly ash and ground, granulated blast furnace slag (GGBSF) in concrete pavements placed between April 1st and October 15th of the same calendar year. The date restriction is intended to address concerns that lower temperatures significantly influence the pozzolanic reaction for concretes made with fly ash and GGBFS. Such concretes are therefore more susceptible to freeze thaw durability and scaling distress during early spring or late fall placement.

In August of 2000 the JTRP approved a research project on the topic of "Technical Issues Related to the Use of Fly Ash and Slag in the Late-Fall Construction Season". The Draft Report was recently completed. A copy of the report's "Technical Summary" is attached to this memorandum for your information. The report basically stated that the limitation for using fly ash or GGBFS in concrete pavements could be extended throughout the year. However, the report also stated that for the pavement to perform properly it needed a compressive strength of at least 3,500 psi, a minimum air content of 6 % and air void spacing of less than 0.008 inches.

Knowing the above, the Study Advisory Committee (SAC) for this JTRP study wishes to avoid the current practice of a contractor writing a letter to the District Construction Engineer when October 15th draws near to request permission to continue to place pavement using fly ash or GGBFS after October 15th. This memorandum will be effective immediately and will allow all contractors to place concrete pavements with fly ash or GGBFS between the dates of October 15th and November 15th of the same calendar year without a request letter. The Contractor shall agree that the project will not be accepted by the Department until after May 30th of the following year. The contractor will have an extra month of cost savings for using these byproducts. Once November 15th arrives, no fly ash or GGBFS will be permitted in any concrete pavement mixtures.

INDOT wants to be assured that the pavement areas placed between October 15th and November 15th withstood the winter weather and deicing products placed on the pavement surface. The contractor and project engineer should determine the locations of the pavement sections placed using fly ash or GGBFS after October 15th. Those pavement sections will be inspected in the spring by the area engineer for scaling or other durability distresses. The contractor should be paid for the pavement at the time it is placed. If no problems were found, the contract would be accepted by the district. If scaling or other durability distresses related to the use of fly ash or GGBFS was evident, the pavement shall be removed and replaced. INDOT will not be requiring any credit to the contract for allowing pavements to be placed after October 15th with fly ash or GGBFS.

A contractor should determine when he bids if he anticipates that he may need to place or have to place some concrete pavement with fly ash or GGBFS after October 15th. If he feels that this could happen, then the operation and requirements need to be outlined in the contractor's Quality Control Plan for the contract.

Hopefully, the above change is an improvement to how things have been happening in the past and our Standard Specification may be changed to reflect this decision in the next few months.

DAK:dak

INDOT Research

TECHNICAL *Summary*

Technology Transfer and Project Implementation Information

TRB Subject Code: 32-1 Concrete Admixtures
Publication No.: FHWA/IN/JTRP-2005/5, SPR-2475

March 2005
Draft Final Report

Technical Issues Related to the Use of Fly Ash and Slag During the Late-Fall (Low Temperature) Construction Season

Introduction

Current INDOT specifications (Section 501.03) permit the use of fly ash and slag in concrete pavement only between April 1 and October 15 of the same calendar year. This limitation is intended to address concerns regarding the potential for inadequate durability performance of concrete containing such materials when the concrete is placed in the late fall construction season. The objective of this research was to evaluate whether concrete pavements containing with fly ash or ground, granulated blast furnace slag (GGBFS) can be constructed under conditions typical of those expected in the late fall in Indiana to provide adequate durability to freeze-thaw and salt scaling resistance.

The project is broadly divided in to two phases. Phase I contains the results of preliminary studies on materials, and concrete properties influencing scaling. In the Phase II, a more focused study on scaling of concrete containing supplementary cementitious materials (SCM) was performed. The whole project was divided in to six tasks. The first task focused on compilation of published data on the topics of freeze-thaw and scaling resistance, air-void analysis in hardened concrete, and maturity and strength development of concretes containing fly ash and slag. The second task focused on characterizing all materials including cements, fly ashes and slags approved by INDOT and formulating a logical method in selecting materials to be used in the subsequent experiments. Preliminary tests on various mortar and concrete mixture combinations were performed in Task 3. Mixture combinations were screened after this phase for further tests on concrete.

Based on these three primary tasks, need for more focused study on scaling behavior of concrete was identified. In the phase II, the entire study was conducted on the worst performing cement and fly ash combination identified in phase I. The fourth task covered the study of role of various materials on scaling performance. Additionally, scaling specimens were fabricated at two different slumps and were subjected to wide range of curing conditions. In addition, a microstructure and chloride ion penetration study was performed to assist in the interpretation of results. Finally, in task six, the discrepancy between laboratory results and field observations was addressed along with summary and conclusions based on entire study.

Findings

Models can be developed for strength prediction of cement mortars and Strength Activity Index (SAI) prediction of fly ashes using chemical composition and physical properties information provided by the supplier. These models can be successfully used to determine the sensitivity of strength (for cements) and sensitivity of SAI (for fly ashes) to changes in chemical composition and physical properties.

Mathematical models can be developed to express maturity parameters like ultimate strength and rate of reaction of mortar mixture in terms ofpercent weight of the materials contained in them, chemical composition and physical characteristics of the materials.

The maturity method could be used to effectively predict the age required to attain a given strength level for mortar mixtures cured under any temperature history.

Concrete containing fly ash or slag can be exposed to freeze and thaw cycles at relatively early ages without significant reduction in durability factor provided that it reaches compressive strength of at least 3500 psi and has low amounts of freezable water in addition to minimum air contents of 6 % and air-void spacing less than 0.008 inches.

Since all concrete mixtures tested were supposed to represent slowest hydrating systems under low temperature conditions, it is believed that mixtures prepared with similar fly ashes or slag, but using other cements, would also pass the freeze-thaw durability test.

Implementation

Based on the study on scaling in concrete containing fly ash, it can be recommended that the use of supplementary materials with current replacement levels and current INDOT temperature guidelines can be extended throughout the year for climatic conditions of Indiana for pavement construction. The reasons for this conclusion are evident in the entire study and have also been briefly listed below.

Experimental results showed that adequate F-T resistance can be obtained when concrete has a compressive strength of at least 3500 psi and has low amounts of freezable water in addition to minimum air contents of 6% and air-void spacing less than 0.008 inch.

In regard to scaling, the ASTM C 672 was found to be too severe and does not represent the climatic conditions observed in Indiana. Risk analysis indicated that the overall probability of scaling to initiate in any typical pavement in Indiana is very low.

The scaling resistance of concrete in actual pavement is most likely to be better than the corresponding laboratory specimens. This can be attributed to low slump, better finishing with slip-form paver, and most-favorable temperature profile developed during freezing due to a higher thickness of pavement compared to laboratory specimens.

Out of the total of seven different combinations of cementitious materials studied in this research, only one combination showed a scaled mass higher than the specified limit when studied as per ASTM C672. Moreover, for the same worst performing combination of materials when obtained again from the same source, no scaling was observed even in the laboratory. This indicates that the probability of getting the worst performing combination of materials is very low.

The worst performing combination of materials that showed severe scaling damage in the laboratory did not show any scaling when attempt was made to simulate the actual field conditions in the laboratory.

Survey information showed that out of 12 states having similar or more severe climatic conditions than Indiana, 9 states allow the use of fly ash or slag throughout the entire year. None of these states have reported any major problem of scaling associated with late fall construction season in the case of concrete pavement.

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