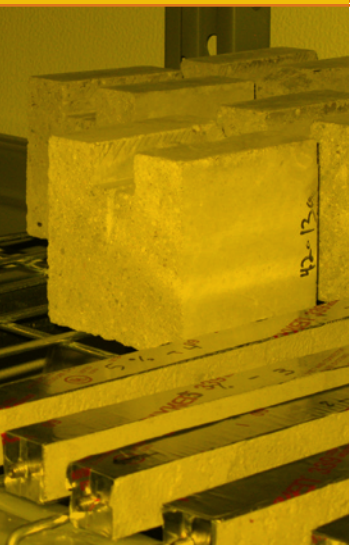
Benefits of High Volume Fly Ash

New Concrete Mixtures Provide Financial, Environmental, and Performance Gains

Exploratory Advanced Research . . . Next Generation Transportation Solutions



High volume fly ash (HVFA) concrete mixtures offer many benefits, including reduced cost, reduced energy content, enhanced environmental sustainability, and improved long-term performance. The aim of "Greatly Increased Use of Fly Ash in Hydraulic Cement Concrete (HCC) for Pavement Layers and Transportation Structures," an Exploratory Advanced Research (EAR) Program project, is to identify innovative methods to overcome existing barriers to use, and work towards the increased use of HVFA in pavements and transportation structures. The 24-month project, part of a Federal Highway Administration (FHWA) initiative, is being conducted by Purdue University in partnership with Auburn University, the National Institute of Standards and Technology, and the National Ready Mixed Concrete Association.

Obstacles to HVFA Use

Many producers and transportation agencies aim to increase the use of fly ash in the transportation infrastructure—however, several barriers exist to implementing new mixtures. A particular concern of many practitioners is the difficulty of predicting strength gain in full-scale structures. The project addresses this problem through the use of temperature management software and the development of a database with analytical prediction tools. In addition, agencies and contractors worry about potential incompatibilities between the fly ash, admixtures, and cement. To overcome this, the project team is developing screening procedures to identify the influence and properties of residual carbon on the rate of admixture absorption. Once all challenges are overcome, innovative strategies such as fly ash treatment, timing and rate of admixture addition, and prescreening of components for optimal performance can be implemented to improve the response of the overall system.

Moving Forward

The conventional approach to using fly ash has relied on the establishment of strict limits on the maximum amount of fly ash and the times of year that fly ash can be used in construction. Conventional applications also have set limits on the composition of the fly ash to enable the fly-ash-cement system to be treated the same way conventional portland cement has been treated in concrete. This project moves in a new direction by proposing innovative solutions to the use of fly ash in mixture proportioning. Fly ash is not used on a prescription basis, but on a performance basis—so that more fly ash can be used in concrete, and less will go to a landfill. New design methodologies are needed to predict strength, and new strategies to overcome issues associated with HVFA use. One example of innovation is the team's work with new internal curing technologies, with the intention of efficiently supplying water for hydration directly inside the concrete after placement. Another area of innovation is the use of low temperature calorimetry to determine the length of curing needed to ensure that concrete can ultimately be exposed to stresses brought on by freezing and thawing.

Concrete Solutions

The project kicked off with a literature review and consideration of the commercial, specification, and quality assurance impacts associated with the use of HVFA. The research and innovation phase of

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the project was designed to resolve identified issues by probing in new directions. Areas examined include investigating material compatibility, predicting property development, managing temperature and strength development, controlling internal and external curing, reducing early-age cracking, and improving freezing and scaling durability. In addition, carefully controlled large-scale test sections were prepared to evaluate the proposed solutions identified in each project phase. This form of large-scale testing is unique due to the ability to carefully establish and monitor the environment in which the HVFA concrete is placed while monitoring test structures.

Concrete of the Future

"The impact of this project on the materials used in the Nation's transportation systems and highway programs is expected to be significant," says Richard Meininger at FHWA. "Entirely new concepts are being put forward here that really get to the heart of the critical issues currently limiting the amounts and sources of fly ash used in construction," continues Meininger. "The implementation of the technologies being developed is expected to guide the concrete mixture designs and proportions of the future, ultimately offering pavements and other concrete structures with a smaller carbon footprint and lower embodied energy while also showing the improved long-time performance possible with fly ash."

Learn More

For more information on this EAR Program project, contact Richard Meininger at FHWA, 202-493-3191. (email: richard.meininger@dot.gov).

EXPLORATORY ADVANCED **RESEARCH**

What Is the Exploratory Advanced Research Program?

FHWA's Exploratory Advanced Research (EAR) Program focuses on long-term, high-risk research with a high payoff potential. The program addresses underlying gaps faced by applied highway research programs, anticipates emerging issues with national implications, and reflects broad transportation industry goals and objectives.

To learn more about the EAR Program, visit the Exploratory Advanced Research Web site at www.fhwa.dot.gov/advancedresearch. The site features information on research solicitations, updates on ongoing research, links to published materials, summaries of past EAR Program events, and details on upcoming events. For additional information, contact David Kuehn at FHWA, 202-493-3414 (email: david.kuehn@fhwa.dot.gov), or Terry Halkyard at FHWA, 202-493-3467 (email: terry.halkyard@fhwa.dot.gov).

Image other side:
Durability and Volume Change Specimens at Purdue University
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