Beneficial Use Case Study

University of Minnesota Recreation Center Expansion

Coal Combustion Product Type
Class F Fly Ash

Project Location
Minneapolis, Minnesota

Project Participants
Studio Five Architects, Cannon Design, JE Dunn Construction, Meyer Borgman Johnson, LKPB Engineers

Project Completion Date
2013

Project Summary
The University of Minnesota's (UMN's) Twin Cities campus accommodates one of the largest student populations in the United States, with over 50,000 enrolled. As student demand began to outgrow the capacity of the original recreation center, the university undertook an expansion that would nearly double the facility's size, adding climbing and bouldering walls, expanded weight and fitness areas, an indoor running track, and a four-story atrium, among other features. High-volume fly ash (HVFA) concrete was used extensively to strengthen the structural elements of the remodeled facility as well as for its aesthetic appeal as an exposed material.

Project Description
The expansion of the recreation facility involved approximately 160,000 square feet of new construction on an asymmetrical site on UMN's East Bank Campus in Minneapolis. To accommodate the complex site geometry, several structural systems were employed, including a cast-in-place concrete wide-module pan-and-joist system.

Fly ash was used to replace 30% of the required cementitious material in the concrete mixes for every concrete structural element in the expansion, including footings/foundation walls, shear walls, columns/pan-and-joist slabs, and slab on grade/slab on metal deck. According to engineer Michael Ramerth, of Meyer Borgman Johnson, the reasons to use HVFA were many and included the lower CO_2 emissions associated with its use vis-à-vis portland cement, as well as its enhanced durability, placability, and workability; its greatly lower cost compared with portland cement; and the opportunity to reduce landfilled ash.

"We've been over-cementing our mixes for decades," Ramerth told an audience at the American Concrete Institute's Spring Convention shortly after completion of the project. "We've had great results keeping many of our mixes down at 520 lbs. (of cementitious material per cubic yard)," he added. For UMN's recreation center, both the footings/foundation walls and the slab on grade/slab on metal deck used HVFA mixes with only 520 lbs. of total cementitious material to achieve compressive strengths of 6906 psi and 6460 psi, respectively.

Ramerth acknowledged that when using high-replacement mixes, lengthier set times can potentially boost labor costs, particularly in finishing the flatwork. However, on this project set times for slab on grade/slab on metal deck and columns/pan-and-joist slabs were, respectively, only 1 hour and 15 minutes and 1 hour and 25 minutes above those for straight cement.

"Not bad," Ramerth remarked. "Keep that mix temperature above 70 degrees by heating the water; it's very effective. Keep the aggregate somewhat protected in a temperate space where it doesn't get snowed on and left to the 20-below temperatures. And, of course, temporary heat on site during the day of the pour and the night before is critical," he added.

"These mixes do take a little extra care and a little extra effort, but they are wonderful mixes and they're green," Ramerth noted.

SOURCE: UNIVERSITY OF MINNESOTA RECREATION AND WELLNESS

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