Beneficial Use Case Study

Wacker Drive Renovation

Coal Combustion Product Type
Class F Fly Ash

Project Location
Chicago, Illinois

Project Participants
Chicago Department of Transportation, Wiss Janney, Elstner Associates Inc., University of Illinois-Chicago, Prairie Concrete, Headwaters Resources

Project Completion Date
2003

Project Summary
Three-quarters of a century after its initial construction, Wacker Drive—a 1.5-mile-long arterial road servicing Chicago's downtown Loop—was in need of rebuilding. The concrete structure of the two-level viaduct, which handles tens of thousands of vehicles daily, had been considerably degraded after decades of heavy traffic and the application of harsh deicing chemicals. Rebuilding occurred in two phases, with reconstruction of the east-west segment of the road completed in 2003 and the north-south portion completed a decade later.

Project Description
Owing to the road's importance to the flow of downtown traffic, the Chicago Department of Transportation stipulated that the rebuilt Wacker Drive should attain a service life of 75 to 100 years. To give added resistance against corrosion—as well as to protect against the potentially ravaging effects of freeze-thaw cycles—engineers specified a high-performance concrete using Class F fly ash for the new cast-in-place concrete structure.

Wiss Janney, Elstner Associates Inc., and the University of Illinois-Chicago were selected to design the concrete mixes. To avoid the potential for cracking of the deck due to thermal changes, their mixes aimed for durability over pure compressive strength. Ultimately, the final specifications incorporated concrete compressive strengths of between 6000 and 9500 psi in 28 days with chloride permeability in ponding tests of less than 2000 coulombs to prevent the ingress of deicing salts into the concrete.

The mix design included 525 lbs./yd^3 of cement, with 10% Class F fly ash, 15% ground granulated blast furnace slag, and 5% silica fume. The proportions of each were chosen to minimize permeability. Fly ash content was limited to 10% to reduce the impact of potential variations in chemical composition, while silica fume proportions were limited to 5% to avoid a high water demand.

Collectively, materials were chosen to offset the potential weaknesses of one against the strengths of the others. For example, use of Class F fly ash, together with other materials, helped to mitigate possible alkali-silica reactivity from local fine aggregates. Supplementary cementitious materials were used to achieve a less-permeable cementitious mix for enhanced corrosion protection.

Over the course of the two-year project to restore the east-west portion of Wacker Drive, more than 10,000 tons of Class F fly ash was sourced from Indianapolis Power & Light's Petersburg generating station, located in southwest Indiana.

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