Case Studies

BRIDGE CONSTRUCTION

LAFARGE NORTH AMERICA

High goal is not a reach

Strong concrete support structures help contractor meet bridge challenge

Lafarge's NewCem helped Virginia DOT create huge bridge foundations for a James River bridge.

The newly completed Pocahontas Parkway, just south of Richmond, Va., provides a critical link to handle the transportation needs of the fast-growing region.

Though only 8.8 miles long, the parkway (officially designated I-895) posed significant engineering challenges, especially where it crosses the James River. The Richmond Deepwater Port is located upriver from the parkway, so the bridge crossing the James had to be built high enough to accommodate oceangoing vessels passing beneath it. And because the terrain south of the river is low and flat, the approaches to the bridge also required unusually high supports.

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The support structures for the bridge and approach ramps were poured in place, and the size and complexity of these mass-concrete structures required careful management of temperature during the curing process. Engineers considered using Type V low-heat cement for the application, but ultimately chose a mix containing a high proportion of Lafarge NewCem ground granulated blast furnace slag (GGBFS) because of its strength and performance characteristics, as well as its resistance to heat of hydration during curing.

Widely used in concrete construction for roads and bridges, slag cement offers significant performance benefits, including improved strength and durability, reduced permeability that can protect against deterioration from freeze-thaw cycles and superior resistance to sulfate attack.

High slag content protects against thermal stress cracks.

Typically, slag cement mixes for mass concrete contain 50% GGBFS and 50% portland cement. In this project, the slag content was much higher: approximately 75% NewCem and 25% portland.

This mix increased resistance to thermal stress cracks—a critical consideration because of the size of the pours on this project.

A primary consideration in designing any mass concrete structure is prevention of thermal cracks due to temperature differentials as the concrete cures. Heat builds up in the center of a section and has no way to dissipate quickly, while the exterior cools much more quickly. When the temperature differential becomes great enough, thermal cracking can develop.

Used in high percentages, NewCem has been very effective in reducing both the maximum temperature of the concrete and the temperature differential between the center of the concrete mass and its exterior. In this project, the high NewCem content allowed very large pours. The mass pours for the footers were approximately 5,000 cu yd.

Engineers on the project used an innovative technology to ensure that the concrete masses met the high-strength requirements. The SureCure method uses thermocouple probes placed within the mass itself to monitor temperatures as the concrete cures. A test cylinder of the same concrete mix is blanketed with a heating device that precisely duplicates these temperatures. As a result, the test cylinder cures under precisely the same temperature conditions as the core of the mass concrete.