

Turnpike Specifies High Reactivity Metakaolin

The Pennsylvania Turnpike Commission is using white portland cement concrete to construct bridge and viaduct parapets on their Highways of Hope. The white concrete increases the visibility of the parapets and improves safety, especially at night and in wet conditions. To brighten the parapets even more, the



“Highways of Hope” describes a 100-miles long expansion of the Mon/Fayette Expressway and Southern Beltway in southwestern Pennsylvania. The \$3 billion highway project will improve access to Pittsburgh International Airport and is seen as an economic spur for the region. When the first sections of the Mon/Fayette Expressway were designed in 1995, the Commission adopted a policy of painting the parapets white. But after coatings did not perform as expected, the Turnpike Commission sought out an alternative.

“The use of the white cement in bridge parapets was adopted by the Pennsylvania Department of Transportation in 1995 as a safety enhancement,” says Dave Williams, design manager at Michael Baker Corporation, consultant to the Turnpike Commission. Penn DOT’s decision to use white cement was based, in part, on the New Jersey DOT’s successful use of white portland cement in barriers at toll plazas.



White concrete is especially important for visibility under wet conditions, as shown in the right photo.

According to ASTM Standardization News, February 2000, “More accidents occur at night per capita than during daylight hours. Why? The visibility of objects depends largely on the illumination provided by vehicle headlights. If objects are dark (such as the very road surface you are driving on) and absorb the headlight illumination, then no light bounces back to warn you.” In addition, “When grey concrete gets wet, it tends to darken,” explains Ray Pisaneschi of Lehigh Cement, a company that supplies white concrete to the project. “But when white concrete gets wet, it appears almost iridescent.” According to Bernard Zielinski, bridge engineer at the Commission, “Based on reflectance values, white cement is twice as bright as grey concrete in dry conditions and up to 3-1/2 to 4 times brighter in wet conditions.”

Pisaneschi was familiar with high reactivity metakaolin (HRM) and recommended it as an additive in the white portland cement mixture, noting that – in addition to whitening the finish – it would also strengthen the concrete and improve long-term durability. HRM is a pozzolanic supplementary cementitious material

that is increasingly being used to improve the performance of concrete. Unlike most other pozzolanic admixtures, however, HRM is bright white – even whiter than white portland cement. After conducting tests, the Turnpike Commission was pleased with the results and added HRM into their specifications for the expansion project.

White concrete has been found to be a cost-effective way to enhance the quality and safety of barriers and bridge parapets on highways. Not only is the cost of using white concrete and HRM in the barriers competitive with painting the barriers based on construction costs, it also yields big life-cycle cost savings. That is because the painted barriers can require repainting after as little as a year, but the white concrete is an almost permanent solution.

In addition to whitening and strengthening concrete, HRM will also be used “to control efflorescence by reacting with the free calcium hydroxide (lime) in the mix,” says Zielinski. Efflorescence is a common problem in concrete and can blemish the appearance and increase the porosity of concrete, leading to future problems with water penetration, corrosion, and diminished serviceability.

So far, the white concrete has held up well. Zielinski notes that the first parapets, erected in 1998, still look good. “In fact,” comments Pisaneschi, “some have questioned why we’re not doing the whole bridge white to improve visibility and safety.”

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