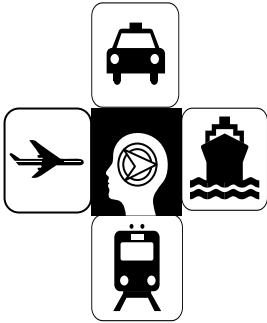


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"TURNING PROBLEMS INTO SOLUTIONS"



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Tech Brief

Geopolymer Coating Demonstration Project for Route I-295 Scenic Overlook

FHWA-NJ-2005-021

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SO, HERE'S THE PROBLEM...

- Proper maintenance of bridges provides extended life and a good aesthetic appearance. Maintaining a bridge as it ages becomes both expensive and time consuming.
- It is well known that the best way to protect bridge concrete substructures is to prevent liquid ingress that starts the deterioration.
- The liquid ingress can be reduced considerably by a coating. To be durable, this coating should allow vapor pressure release.

AND, HERE'S OUR SOLUTION...

- To create a durable coating, use a thin inorganic coating that allows vapor pressure release and is compatible with concrete.
- The coating is also graffiti resistant and potentially self cleaning and de-polluting. The last two aspects are under investigation.

We set out to evaluate this inorganic coating, known as Geopolymer, using a demonstration project.

THE GEOPOLYMER COATING...

Rutgers, The State University of New Jersey in cooperation with the New Jersey Department of Transportation (NJDOT) has developed an inorganic coating material that can be mixed to the consistency of paint and used as a protective coating. This Geopolymer coating material is about two orders of magnitude less permeable than concrete but allows for release of vapor pressure; that is, allows concrete to breath. The inorganic coating provides a glassy surface to which organic paints do not stick.

Some basic features of this material are as follows.

- The cementing part of the coating was developed for aircraft structures and subsequently modified for use as a coating material. The cementing part is a potassium alumina-silicate, or polysialate-silox with the general chemical structure:



- The resin is prepared by mixing a liquid component with silica powder. Fillers and hardening agents can be added to the powder component. The two components can be mixed to a paint consistency. Since the matrix is water based, tools and spills can be cleaned with water.
- All of the components are nontoxic and no fumes are emitted during mixing or curing. The excess material can be removed and discarded as general waste.
- The matrix bonds well with carbon and glass fibers and these fibers can be used as reinforcements.
- The Geopolymer coating can be applied to smooth or rough concrete surfaces with minimal surface preparation, as only excess dirt and standing water need to be removed before application.
- Common application procedures such as brushing, rolling, and spraying can be used to apply the Geopolymer coating to concrete, brick, wood, and steel.
- The pot life varies from 30 minutes to 3 hours for compositions that cure at room temperature. While it is curing, the Geopolymer coating has to be protected from direct rain or running water.
- The base coating material is white and hence other color schemes can be easily formulated using pigments. Various color schemes, including concrete and brick color coatings have been successfully developed.
- The coating is expected to have self cleaning properties because zinc oxide is one of the constituent materials.
- The coating has a high hardness and can not be scratched even with steel.
- The matrix can withstand temperatures up to 1000⁰C, and is not affected by UV radiation. Fire tests show that the flame-spread index is zero.

AND, HERE'S WHAT WE DID...

This application was aimed at demonstrating the viability of the new coating for relatively large surfaces encountered in transportation structures. The structure to be coated was a parapet wall located at the Scenic Overlook along I-295 South near Trenton, New Jersey. The surface to be coated consisted of sixteen blocks with a total surface area of about 1100 sq. ft. The surface was in good condition except for six sections that had some minor spalling on the surface.

The existing Geopolymer formulation with 1% discrete carbon fibers was modified using

pigments to obtain a white concrete color. Small slabs coated with the modified matrix (Figure 1) and small patch applications at the back of the structure were used to obtain NJDOT approval. A typical trial patch is shown Figure 2. The approved color for the coated surface looks closer to a white concrete surface.



Figure 1. Various Color Schemes to Match the Color of Parent Concrete Surface



Figure 2. Test Patch (more than two years old)

Application Procedure

The major steps of the application procedure were:

- Pressure washing of concrete walls. This was carried out by the NJDOT maintenance unit.
- The safety railing posts and adjacent floor slabs were taped off to protect them from any spills.
- The coating material was mixed in the field using a high shear mixture and applied using a roller and brushes.

AND, HERE'S WHAT IT LOOKS LIKE...

The uncoated concrete surface and coated surface are shown in Figure 3. A close-up view of uncoated and coated surfaces is shown in Figure 4. Another close-up view of the coated surface is shown in Figure 5.



Figure 3. Uncoated Concrete Surface (on the left) and Coated Surface (on the right)



Figure 4. Uncoated Concrete Block Next to a Coated One



Figure 5. Close-up View of Coated Surface

FINDINGS...

- The field demonstration project presented in this report shows that the inorganic-polymer coating can be easily applied to large surfaces. The application system was easy to work with and the Geopolymer coating was applied using paint rollers and brushes.
- Extensive surface preparations are not needed prior to the application of the coating. For this field demonstration, only pressure washing was done prior to the application of the coating.
- Finished surfaces provide an aesthetically pleasing appearance as shown in the photographs.

MONITORING...

The performance of the Geopolymer coating will be monitored as part of a research project supported by the National Science Foundation. The main features to be evaluated are durability, aesthetics, and the self cleaning and de-polluting properties of the coating.

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A final report is available online at:

<http://www.state.nj.us/transportation/refdata/research/>

If you would like a copy of the full report, please FAX the NJDOT, Bureau of Research, Technology Transfer Group at (609) 530-3722 or send an email to Research.Bureau@dot.state.nj.us and ask for:

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