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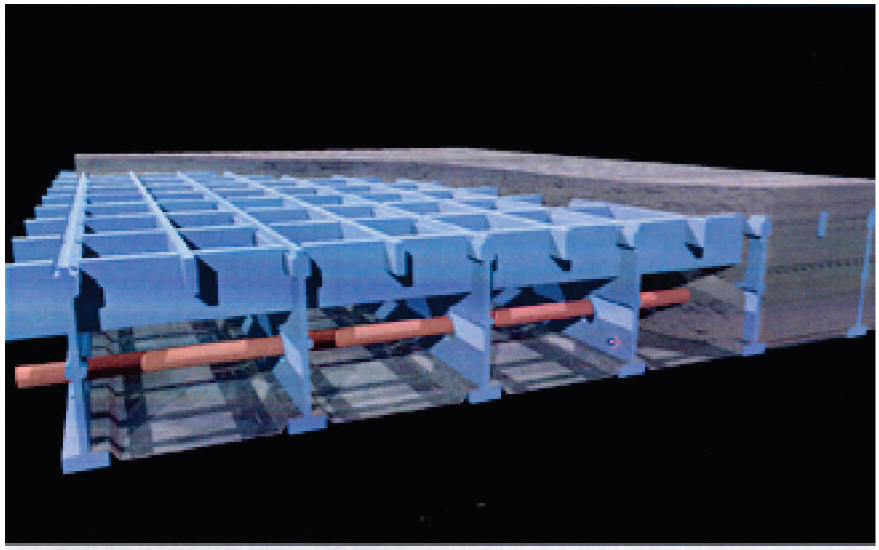
Use of Integral Overfills with Grid Reinforced Concrete Bridge Decks



Design Considerations

A Grid Reinforced Concrete Bridge Deck with a monolithic (integral) overfill is significantly stiffer than a comparable flush filled grid. When designing a Grid Reinforced Deck using the orthotropic plate model described in the AASHTO LRFD Bridge Code, this enhanced stiffness is taken into account through the use of plate constants, which vary depending on the presence of an overfill. Those plate constants, for both fully or partially filled grids, are given in AASHTO Article 4.6.2.1.8.

Construction Considerations

An overfilled grid installation allows a contractor to use conventional finishing equipment, and enables the deck to be completed in a single pouring operation. Finishing equipment used on an overfilled grid installation can handle cross-slopes, super-elevations, etc. in a conventional manner, and the equipment is familiar to all contractors. This technique has a very positive impact on installed costs.

Performance

In addition to structural advantages, an integral overfill creates a smooth, non-skid riding surface suitable for any structure and provides protection to the steel grid. This protection assures that the grid, and the depth of concrete within the grid, will be structurally sound when the original overfill needs to be replaced. This scenario is illustrated quite well by the following case study of the Verrazano Narrows Bridge.

L. B. Foster Fabricated Products
1016 Greentree Road
Pittsburgh, PA 15220
412-928-7854
Fax (412) 928-3514
www.lbfoster.com

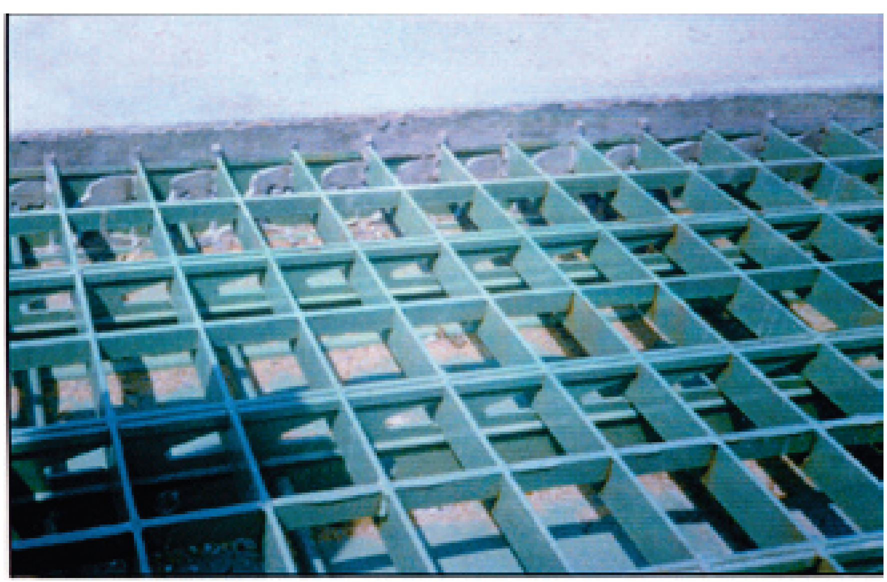
Integral Overfill Case Study: The Verrazano Narrows Bridge

The Verrazano Narrows Bridge consists of an upper deck placed into service in 1964, and a lower deck in 1968. A grid reinforced concrete bridge deck was chosen for use in order to reduce dead load on the 7200 long suspension bridge. A 4-1/4"-beam design was specified, and an integral overfill of 1-3/4" was used to achieve an overall deck thickness of six inches. All components of the steel grid were uncoated; therefore, the overfill was the only means of protection afforded the steel grid.

Through the mid 1980s, a minimal amount of patching to the overfill was required. As the amount of patching increased, a decision to investigate overlay options was considered. In 1997, after 30 years of service, approximately 100 deck cores were taken, extending to within 2" of the bottom of the deck. The cores revealed high chloride ion concentrations, but very little corrosion activity. (The ability of a grid to resist chloride has been previously documented. See reference to Angeloff report, listed below.)

At some sections of the deck, all of the concrete was removed and it was noted that the steel grid was in very good condition. Based upon that investigation, it was determined that the grid and concrete within the steel grid were in excellent structural condition, and that only a new overlay was necessary.

In 1999, an area of the lower deck, approximately 50'x 40', representing two floor beam bays, was used to demonstrate the suitability of an overlay replacement method. Approximately 3/4" of the original integral overfill was removed. The exposed concrete surface was then cleaned, and 1-1/2" of New York State DOT HP (high performance) concrete was placed on the cleaned surface. It is anticipated that the overfill of the entire deck will be replaced in this fashion.



For thirty years the original overfill provided a good riding surface and protected the lower portion of the deck (steel grid and contained concrete), while requiring minimal maintenance. The application of a dense concrete overlay will further serve to protect the integrity of the original steel grid. There is reason to believe that at the end of the useful life of the new overlay, the original deck will still be sound, and the deck would simply require an overlay replacement.

Summary

An integral overfill enhances the structural capacity of a Grid Reinforced Concrete Deck. It provides a high quality ride surface, protects the integrity of the grid and the concrete within the grid, is economical to install and easy to maintain. The cost implications of this scenario through a 60-70 year life of a major structure with extremely high traffic volumes, is significant.

References

"An Evaluation of the Comparative Effects of Chlorides on the Deterioration of Reinforced Concrete Slab and Concrete Filled Grid Bridge Decks" Angeloff, Carl (1977)

AASHTO LRFD Bridge Design Specifications, 2nd Edition, 1998