

## Corrosion Protection Options for Grid Reinforced Concrete Decks

History has shown that both uncoated and coated grid reinforced concrete decks have out-performed standard reinforced concrete decks and have a documented history of service life greater than 75 years. The first generation of filled grid decks were typically uncoated on the interior of the grid and even though they were installed in the 1930's and 40's, some are still in service today. Several studies conducted in the late 1970's and early 1980's (Copeland) surveyed hundreds of filled grid deck installations throughout Ohio and Pennsylvania. More than 90 percent of the 511 bridges surveyed in the Pennsylvania study with grid reinforced concrete decks were in service and in exceptional condition at the time of the studies. Bridges such as the South 10th St. Bridge in Pittsburgh, Walt Whitman Bridge in Philadelphia, and Mackinac Bridge in upstate Michigan have all provided a service life of 50 years or more, and are just a few examples showing the time-tested reliability of filled grid decks.



*South 10th Street Bridge, Pittsburgh PA*

However, a small percentage of flush filled grid decks investigated in the studies mentioned above did experience the phenomenon called "grid growth". Grid growth is caused by corrosion and expansion of the steel grid over time and was usually found on decks with uncoated flush filled grid systems. Although this phenomena occurred in only a very small percentage of grid reinforced concrete decks that on average were in service more than 30 years, it was still a major issue to design engineers and owners. Partially in response to these concerns, installation of hot-dipped galvanized steel grid panels and an integral concrete overfill became more commonly specified in the 1980's to prevent grid corrosion and thus eliminate the problem of grid growth. It should also be mentioned that Exodermic™ decks are not susceptible to grid growth since the concrete is cast on top of, rather than around, the steel grid.

Galvanized grid decks are typically specified to meet the requirements of ASTM A123 which requires a 3.9 mil thick (minimum) zinc coating metallurgically bonded to the steel surface. Based on this minimum zinc thickness, the American Galvanizers Association (AGA) estimates a minimum service life of the corrosion protection system to be more than 70 years (AGA, 2006). The AGA defines "service life" as the time required until 5% of the steel substrate is rusting and does not imply that there is any loss of integrity to the steel member. This predicted life is consistent with the findings of a field investigation of the galvanized finish on the Exodermic™ deck of the Russell Road Bridge which crosses the New York State Thruway near Albany. Measurements of the thickness of zinc remaining after 7 to 8 years of exposure to heavy salt spray from the Thruway below correlate to a remaining service life of 60 years for the galvanized coating (EBDI, 1995). This information clearly highlights the durability and longevity of a galvanized finish on grid reinforced concrete decks. At current (Continued)



*Hot-Dip Galvanized Grid Deck Panel*

pricing levels, the cost of providing a galvanized finish is also very affordable at approximately \$2.50 to \$5.00 per square foot depending on the weight of the grid system selected. Galvanizing does have some drawbacks, however they can typically be overcome through proper detailing and use of an experienced galvanizing vendor. The most prominent limitation is maximum panel size which can be coated in a single dip into the galvanizing tank. Tank sizes vary depending on the facility, but it can be assumed that galvanized grid panels up to 8 feet wide and approximately 42 feet in length are readily available.



*Installation of Galvanized Grid and Rebar*

While the *Bridge Grid Flooring Manufacturers Association* recommends hot-dipped galvanized grid panels for all installations, ultimately the choice of providing a protective coating to the steel grid is up to the owner. The use of uncoated carbon steel and uncoated weathering steel on fully filled grids that utilize an integral overfill is occasionally selected by owners and these deck systems have performed well on numerous installations. Typically, exposed steel on the bottom of the grid panel is painted to match the coating system used on the structural steel members at a cost that is approximately equal to the cost of galvanizing the entire panel. Painting can be the best corrosion protection system on projects which require fabrication tolerances more stringent than industry standards or on projects with panel sizes larger than can be hot-dipped galvanized.

Many bridge owners are currently designing their structures for an estimated life of 75 to 100 years and avoiding the need to repair or replace the deck system during that time period is the goal. Deteriorated traditional concrete deck systems remain one of the leading reasons for structurally deficient ratings on bridges around the nation and making these repairs is not only costly, but also a major inconvenience to motorists. However, the use of galvanized grid reinforced concrete decks with an integral overfill will give engineers the 75 to 100 year service life they are designing for!

## REFERENCES

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EBDI, "Over 60 Year Life Forecast for Exodermic Steel Grid", ExoNews Winter 1994/95, Exodermic Bridge Deck Institute, Inc., 1995



Bridge Grid Flooring Manufacturers Association  
300 East Cherry Street  
North Baltimore, OH 45872  
p 419.257.3561 f 419.257.2200

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