Rebar Tending: Quite an Art

U.S. Department of Transportation
Federal Highway Administration

One of every four bridge decks in the United States (many of which are less than 20 years old) is badly deteriorated, and the price tag for those needing rehabilitation or replacement over the next decade has been estimated as high as $25 billion. As problems in existing decks are eliminated, ways had to be found to avoid re-creating the same problems and to prevent new decks now being built from adding to the backlog of needed repairs in years to come. A concerted research effort directed by the Federal Highway Administration's (FHWA) Office of Research and Development has produced enormous payoffs by ensuring much improved durability for new decks.

PROBLEM

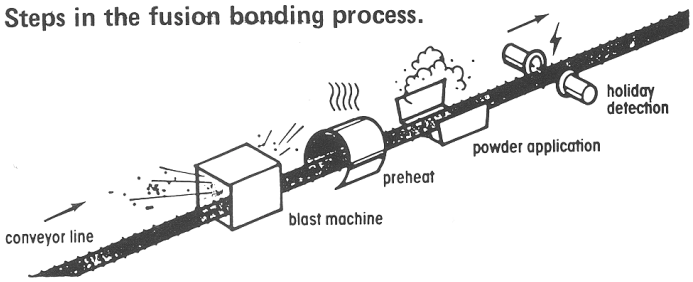
In the early 1970s, when it became evident that the major bridge deck deterioration problem was due to corrosion of reinforcing steel in chloride-contaminated concrete, FHWA decided to build on one of the conclusions made in NCHRP Report 23: "... that for new reinforced concrete construction a protective coating is the best single means for keeping steel from corroding." The report recommended an asphalt-epoxy as the best organic coating to investigate.

At that time, no specifications existed for an organic barrier coating for reinforcing steel. Epoxy coatings were considered by at least one commercial company, but the idea was discarded due to the perceived difficulty of marketing such a product. A few cases did exist in which "painting" epoxy coatings on steel in place had been tried, but widespread application of such technology had not been attempted. Therefore, the need was there to develop specifications for the type of epoxy coatings that would provide a permanent barrier to the transmission of the chloride ion to the surface of the reinforcing steel and, at the same time, would be durable enough to allow coating of the steel before fabrication, bending, and placing.

SOLUTION

As a part of a comprehensive project exploring a number of feasible approaches the National Bureau of Standards (NBS) was retained by FHWA to search the marketplace for a suitable coating material and coating process. FHWA provided the criteria for the screening of available materials and worked closely with NBS researchers during the study. As a result of this effort, four commercially available powder epoxy coatings were identified that could satisfy the criteria set up for the study. Specifications were developed and a coating process was identified that would provide an economical epoxy-coated rebar. Coatings were evaluated on the basis of their chemical and physical durabilities as well as their protective qualities. Attention was also directed to the application methods and surface preparation of the reinforcing steel.

Steps in the fusion bonding process.



APPLICATION

It was found that the pipe-coating industry could coat rebar with some minor modification of existing plants. Accordingly, FHWA researchers conferred with epoxy-coating producers, pipe coaters, and potential users to work out the problems of introducing a new product. Experimental application was undertaken in 1973 in Pennsylvania, only 3 years after the initiation of the study. This field-evaluation verified the practicality of epoxy-coated rebar and led to rapid implementation on a nationwide basis. FHWA continued research to further verify the long-term durability of the epoxy-coating material and process and to refine the specifications for the product.

BENEFIT

Analyses of life-cycle costs indicate that the use of epoxy-coated reinforcing steel in both mats of a typical bridge deck results in significant savings compared with any alternative option available to designers. Based on current U.S. construction of approximately 2.5 million yd^2 per year of bridge deck requiring a protective system. the estimated costs over the design life of the bridges for epoxy-coated rebar are approximately $5 million per year below those for any other system. Although the saving on any single bridge deck, or in some particular region, will vary due to local conditions, the wide-scale use of epoxy-coated rebar today is evidence that this research and development effort has paid off.

In 1982, nationwide sales of epoxy-coated rebar exceeded 100,000 tons, and the market continues to expand. Currently, epoxy-coated reinforcing steel is being specified by more than 40 of the 50 state highway agencies. Use of epoxy-coated rebar has spread beyond bridge decks and substructures to many other types of structures; for example, parking garages, marine structures, waste-water treatment plants, cooling towers, and subways. The product is now covered by AASHTO and ASTM standards, which vary only slightly from the recommendations initially developed by FHWA research.

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