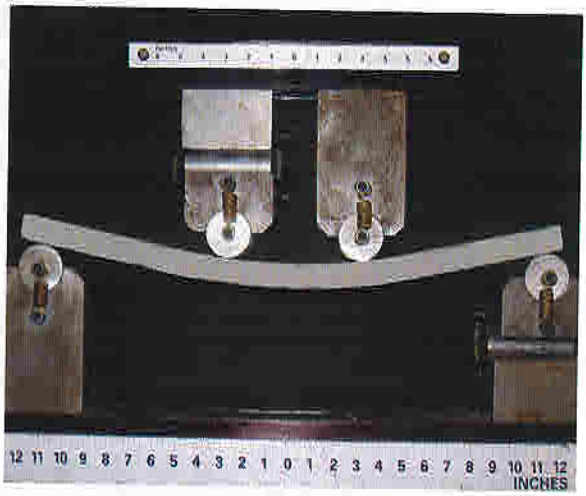
Unique ductile concrete installed on bridge



This ductile concrete is designed to be lighter and much more flexible than conventional concrete under excessive loading. Photo courtesy of U-M Advanced Civil Engineering Material Research Laboratory.

For a city of approximately 23,000 people, Ypsilanti, Michigan, boasts an impressive list of claims to fame. The birthplace of Domino's Pizza also was home to the short-lived Tucker Corp., which produced its innovative "Car of Tomorrow" in 1948, and now hosts an annual festival dedicated to Elvis Presley. Contributing to the city's pioneering heritage, one of its bridges will soon feature a new type of concrete that has never been used in Michigan and much of the U.S.

"The broad field of micromechanics has tried to understand how composite materials behave," says Victor Li, Professor of both Civil and Environmental Engineering and Materials Science and Engineering at the University of Michigan (U-M) (Ann Arbor, Michigan). "We went one step further and used the understanding as a material design approach in the development of Engineered Cement Composites [ECC]." Li leads a research team that has been developing the bendable, fiber-reinforced concrete for the past decade.

According to U-M, ECC looks like regular concrete but is 500 times more resistant to cracking and can be much lighter in weight. In fact, one version of the ECC can float on water. Designed to overcome the lack of durability and sustainability, failure under severe loading, and resulting repair expenses that have plagued traditional concrete, ECC contains materials that are meant to maximize ductility. Although other types of fiber-reinforced concrete exist, Li contends the U-M concrete is superior because it is engineered. He explains that the ductile concrete, which contains no coarse aggregate, contains microscale fibers that act as ligaments to bond the concrete more tightly. Moreover, he maintains that the ingredients in the concrete itself are designed specifically to enhance the concrete's flexibility under excessive loading.

The Michigan Department of Transportation (MDOT) (Lansing, Michigan) will use the ECC to retrofit a section of the Grove Street bridge deck over Interstate 94 in Ypsilanti. U-M states that an ECC slab will replace the expansion joint and link the adjacent concrete slabs to form a continuous deck. "The ECC material has promise for solving some of the deck durability issues we face, such as premature cracking," says Steve Kahl, Supervisor, Experimental Studies Group with MDOT's Construction and Technology division. "We're hoping the ECC will work well and possibly lower the cost when experience is gained on large-scale production."

The material also has been used on projects in Japan, Korea, Switzerland, and Australia and is experiencing a rapid increase in usage in the U.S., says Li. In one application, the newly constructed Mihara Bridge in Hokkaido, Japan, has a 38-mm-thick deck of ECC overlaid on a 12-mm steel plate. Li says that the ECC/steel deck is 40% lighter than a similar type of deck using traditional concrete, and it has an expected service life of 100 years.

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MP

—M.V. Veazey

NACE CORROSION NETWORK NCN

Continued from MP *Forum, page 11.*
The following NCN items relate to materials selection & design.

Please be advised that the items are not peer-reviewed, and opinions and suggestions or recommendations are entirely those of the inquirers and respondents. NACE does not guarantee the accuracy of the technical solutions discussed. MP *welcomes additional responses to these items. They may be edited for clarity.*

Predicting service life from accelerated corrosion test results

Q Does anyone have any information correlating accelerated corrosion test results (ASTM B117) to service life? I am particularly interested in the combination of:

- Substrate: cold-rolled steel
- Coating: 2 mils (51 µm) powder coating (polyester epoxy hybrid)
- Service condition: indoor.

A In general, results of salt spray (fog) tests run according to ASTM B117, "Standard Practice for Operating Salt Spray (Fog) Apparatus," do not correlate with service performance/life. The reason for this primarily stems from differences in corrosion mechanisms that are observed in the test and in service. There are a number of other corrosion tests that can be used for that purpose, especially for indoor environments.

The salt spray test is useful for quality assurance and for comparing similar materials. It is quite valuable and is used widely for these applications.

Here are some other useful references:

- "Comparison of Accelerated Test Methods with Exterior Exposure," B. van Leeuwen, *Protective Coatings Europe* 1, 11 (1996), pp. 42-45.
- "Accelerated Testing: Correlation Between Four Accelerated Tests and Five Years of Offshore Field Testing,"