Brady Street Bridge

Aesthetics on a Tight Budget

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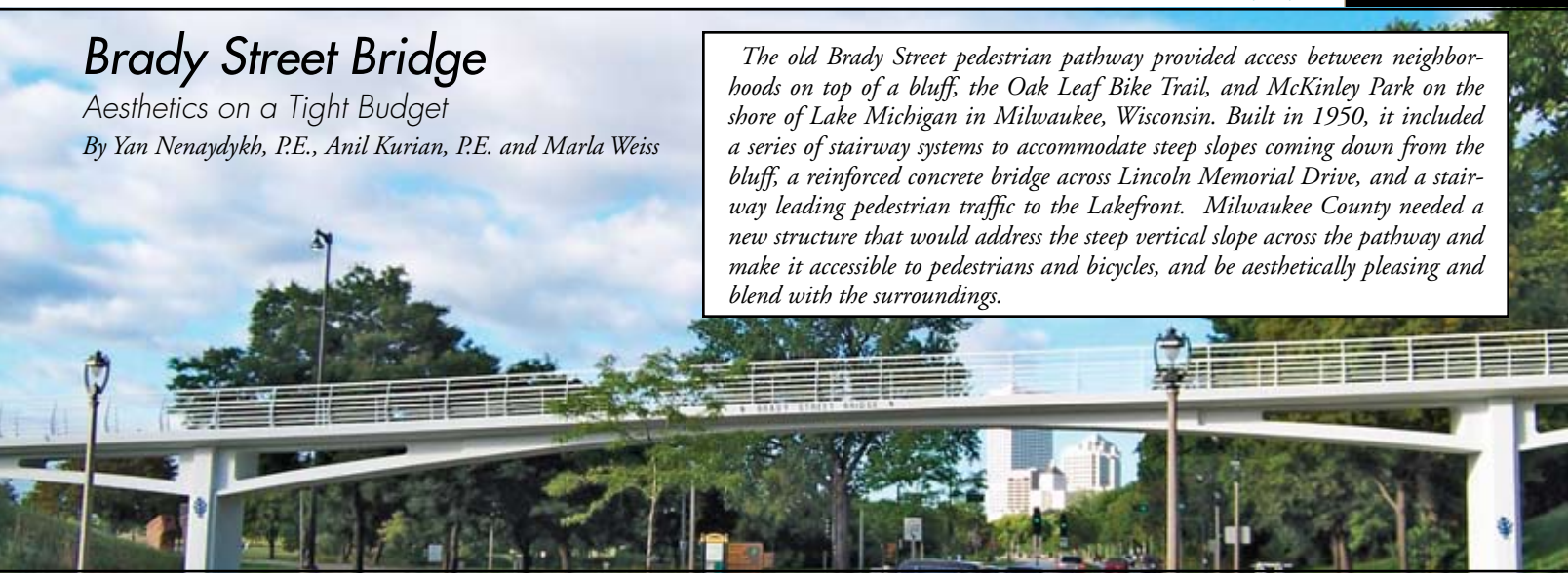
The old Brady Street pedestrian pathway provided access between neighborhoods on top of a bluff, the Oak Leaf Bike Trail, and McKinley Park on the shore of Lake Michigan in Milwaukee, Wisconsin. Built in 1950, it included a series of stairway systems to accommodate steep slopes coming down from the bluff, a reinforced concrete bridge across Lincoln Memorial Drive, and a stairway leading pedestrian traffic to the Lakefront. Milwaukee County needed a new structure that would address the steep vertical slope across the pathway and make it accessible to pedestrians and bicycles, and be aesthetically pleasing and blend with the surroundings.



Brady Street Bridge Looking South.

The underlying philosophy while developing bridge alternatives was to create a concept that was simple yet elegant in its design; aesthetically pleasing, while not compromising on function; economical; and easy to construct and maintain. Bloom Consultants, LLC provided the necessary expertise to address these unique challenges.

Best aesthetic results for modern day pedestrian bridges are achieved utilizing thin and continuous superstructures, with structural member shapes that reflect the forces acting on them. The aesthetic value of a bridge is also dependent upon its context. Special attention must be given to the structures in close proximity to the project as well as the relationship between the proposed bridge and the surrounding landscape.

The new Brady Street Bridge is a three-span, post-tensioned rigid frame concrete structure. The center span is 125 feet and the end spans are each 40 feet. The superstructure has a shallow arch bottom with a minimum thickness of 1.75 feet at the middle of the center span. This gives a whopping center span to depth ratio of 71, underlining the aesthetic philosophy behind the design. Triangular openings (spandrels) were provided in the superstructure on either side of the pier to reduce the volume of concrete used and enhance the structural beauty.

The design selected requires the least amount of maintenance possible. There are no bearings or joints on the bridge that will deteriorate with seasonal changes. With the combined effect of post-tensioning and conventional reinforcement, there is an increased reserve load capacity and load distribution, resulting in better resistance to damaging loads.

This alternative exploits the current post-tensioning technology to the fullest by eliminating the need for a pier in the median, and enabling a 125 feet long center span. This reduced the construction time for the bridge and the overall cost of construction.

The bridge superstructure is a concrete slab section of varying thickness within the span. High performance concrete (specified compressive strength, f′c = 6,000 psi) was used for the superstructure. Properties of high performance concrete, such as exceptional durability and high strength, help extend the service life of structures and reduce maintenance concerns.

The steel bridge railing is light, airy and does not distract the viewer from the overall beauty of the bridge. Instead, it enhances the visual slenderness of the superstructure.

*The Brady Street Pedestrian Bridge, Milwaukee, Wisconsin, was one of ten award winners in the 2006 PCA Biennial Concrete Bridge Awards Competition sponsored by the Portland Cement Association (**www.cement.org**).*

Bridge Art.

The complete bridge was modeled as a rigid frame. A 3D model was created using 4-noded plate elements, and a 2D model using 2-noded beam elements. The 3D model yielded slightly lesser bending moments and midspan deflections than the 2D model. Because the finite element method is an approximate method, one can arrive at different solutions when comparing different modeling techniques for the same structure. During the design process, the 2D model was chosen to design the Brady Street Bridge. This approach was judged to be much more reliable than the 3D model and the results were sufficiently accurate for design purposes.

The post-tensioning forces were modeled as external compressive forces and couples applied to the beam elements of the superstructure. Immediate and long-term deflections were calculated based on the ACI-318 and PTI Design Manual. The predicted immediate deflection at the middle of the center span and the measured deflection on site when the falsework was removed were comparable – the difference between the two was ¼ inch, testament to the effectiveness of the modeling technique. In the coming years, the long-term effects of creep and shrinkage will be studied and compared with the model predictions.

The Brady Street Bridge serves the twin purpose of functionality and architectural expression while enhancing the beauty of its natural surroundings. Total construction cost was just $385,000. The success of this project can encourage bridge designers to make use of the best technology available to design beautiful bridges that challenge the imagination.▪