

Solution blends

ENGINEERING & ART



A longtime bottleneck on Chicago's Lakefront Trail is elegantly relieved

FEW ENGINEERING PROJECTS HAVE achieved the perfect balance of form, function and aesthetics as the Navy Pier Flyover, the pedestrian bridge that now fully connects the north and south paths of Chicago's Lakefront Trail.

Formerly a particularly awkward and congested section of the 18.5-mile trail, the heavily traveled passage required users to navigate a narrow path that was uncomfortably close to the street and pass through several intersections with stoplights and heavy traffic.

Spanning the Chicago River and abutting the famous Lake Shore Drive, the new flyover weaves its way up into the air and then down again. Walkers, runners and bicyclists now have a long-desired, uninterrupted and safe access to the trail as it continues its paths north and south, while allowing users to make easy stops at the top tourist attraction in the city, Navy Pier, as well as the parks and beaches that dot the length of continuous lakefront.

Blending engineering and art

Beautification of the city was a priority for the past three mayors, and their plans included making the lakefront as friendly as possible for recreation, bicyclists and pedestrians. This particular 1,750-foot stretch presented a challenge. It ran beneath Lake Shore Drive and included a confluence of heavy pedestrian traffic and vehicle crossing points, missing or deteriorated pavement markings, a lack of signage, poor riding surfaces and limited vertical and horizontal clearances.





Project Facts

- 1,750 feet long
- \$60 million budget
- The bridge's central spine is fabricated from 30-inch diameter steel pipe, from 1¼-inch to 1¾-inch thick, depending upon span and strength requirements.
- The flyover spine is supported by steel columns created from 1¼-inch steel plates bent into a 30-inch by 22-inch elliptical shape along the main alignment and by cantilevered concrete abutments at its ends. At three locations, the path is supported directly from the existing bents of Lake Shore Drive.
- At one point, the flyover is within inches of a 70-floor tower.

“The previous configuration was inconvenient for users,” said Tony Shkurti, HNTB project manager. “The city also wanted the structure to be attractive architecturally while being sensitive to the events that take place in that area year-round, especially in summer.”

The flyover had to stretch from the Ohio Street Beach on the north side of the Chicago River to DuSable Harbor on the south, with a spur ramp to Navy Pier. Users also would be seeing the structure up close and personal, from both above and below, and so the Chicago Department of Transportation specifically wanted a project that blended engineering and architecture into a piece of multimodal art.

Threading the needle

The project required an elevated level of coordination between the architectural and structural teams as well as the civil, geotechnical, electrical, landscaping and wayfinding professionals. In addition to CDOT, numerous stakeholders were involved, including the Chicago Park District, Navy Pier, the U.S. Army Corps of Engineers, the Illinois Department of Natural Resources, the Society of Historic Preservation, the Environmental Protection Agency and others. In addition, part of the flyover's pathway traversed a Superfund site, creating a situation which required a solution that would minimize excavation and avoid costly remediation.

Most challenging of all, though, was the pathway itself.

“The feat of getting the bridge to connect those northern and southern points required us to negotiate a number of obstacles,” Shkurti said. “We called it ‘threading the needle.’”

To accomplish that task, the bridge follows a serpentine alignment, which allows it to maneuver through an urban landscape with established parks, streets, buildings and waterways.



The flyover squeezes between Lake Shore Drive and Lake Point Tower, a 70-floor condominium building and an iconic feature on Chicago's lakefront, utilizing both horizontal and vertical curves. A section of the east shoulder was removed and expanded, supported by new brackets that protrude from the Drive's framing columns; this also enabled HNTB to preserve the sidewalk space beneath. At one point, the flyover is a mere 2 inches away from Lake Point Tower's retaining wall. So, in cooperation with the tower's homeowners association, it was agreed that a mesh wall would be erected along that section of bridge to increase safety for users while protecting the wall.



Chicago's Lakefront Trail and the Navy Pier Flyover

The Lakefront Trail is an 18.5-mile path that runs north and south along Chicago's lakefront and, according to *USA Today*, is one of the top 10 urban trails in the U.S. It goes through the city's four major lakefront parks – Jackson, Burnham, Grant and Lincoln – as well as the museum campuses and many other tourist attractions. It's also one of the most heavily utilized recreational features in Chicago. The number of users in the warmer months are an estimated 12,500 during the week and approximately 23,000 on the weekends.

The section of the Lakefront Trail between Navy Pier and the Chicago River is one of the most heavily used portions. Before the Navy Pier Flyover project was conceived, a survey was conducted to measure user satisfaction along the length of the trail. The results highlighted opportunities to enhance the user experience between Navy Pier and the Chicago River.

Opportunities to improve user experience were:

- Alleviate congestion from heavy pedestrian traffic
- Reduce vehicle crossing points
- Revamp pavement markings
- Redesign signage
- Improve riding surfaces
- Upgrade vertical and horizontal clearances

Key improvements made by the flyover were:

- Separate pedestrian and vehicle traffic
- Elimination of shared crossing points
- Improved access to Navy Pier
- Improved riding surfaces, signage and pavement markings



Strength and beauty

“Oftentimes the architectural and structural teams can work more independently as an ornamental cladding is added to a structure,” Shkurti said. “But this time the structure was bare and, at the same time, was the prominent aesthetic component.”



HNTB developed the concept of an easily manipulated central steel spine and a longitudinal spine-rib support system that allows the bridge to curve up, down and around as needed, which also provides dynamic visual impact. The spine is fabricated from a steel pipe that ranges from 1¼-inch to 1¾-inch thick and 30 inches in diameter. T-shaped webs and flanges are welded to the top of the pipe for additional strength, providing a surface for sheer studs and allowing for composite action between the steel and the path’s 6-inch thick, 16-foot-wide concrete deck.

“It was a pleasure to work with the HNTB team in the execution of this unique and demanding project,” said Dan Burke, Chicago Department of Transportation managing deputy commissioner and chief engineer. “The single-rib structural element design that they came up with is a unique and elegant solution that effectively addresses the needs of carrying the trail over the streets, connecting users safely across those intersections and solving what had been a lingering safety problem for all users of the Lakefront Trail.”

Ribs fabricated from steel plates are connected to each side of the spine on 8-foot centers that gracefully taper from just more than 2 feet at the spine to less than 5 inches at the outer deck. A longitudinal steel channel runs parallel to the spine, bolted to the end of the ribs to support the railing that runs along the flyover.

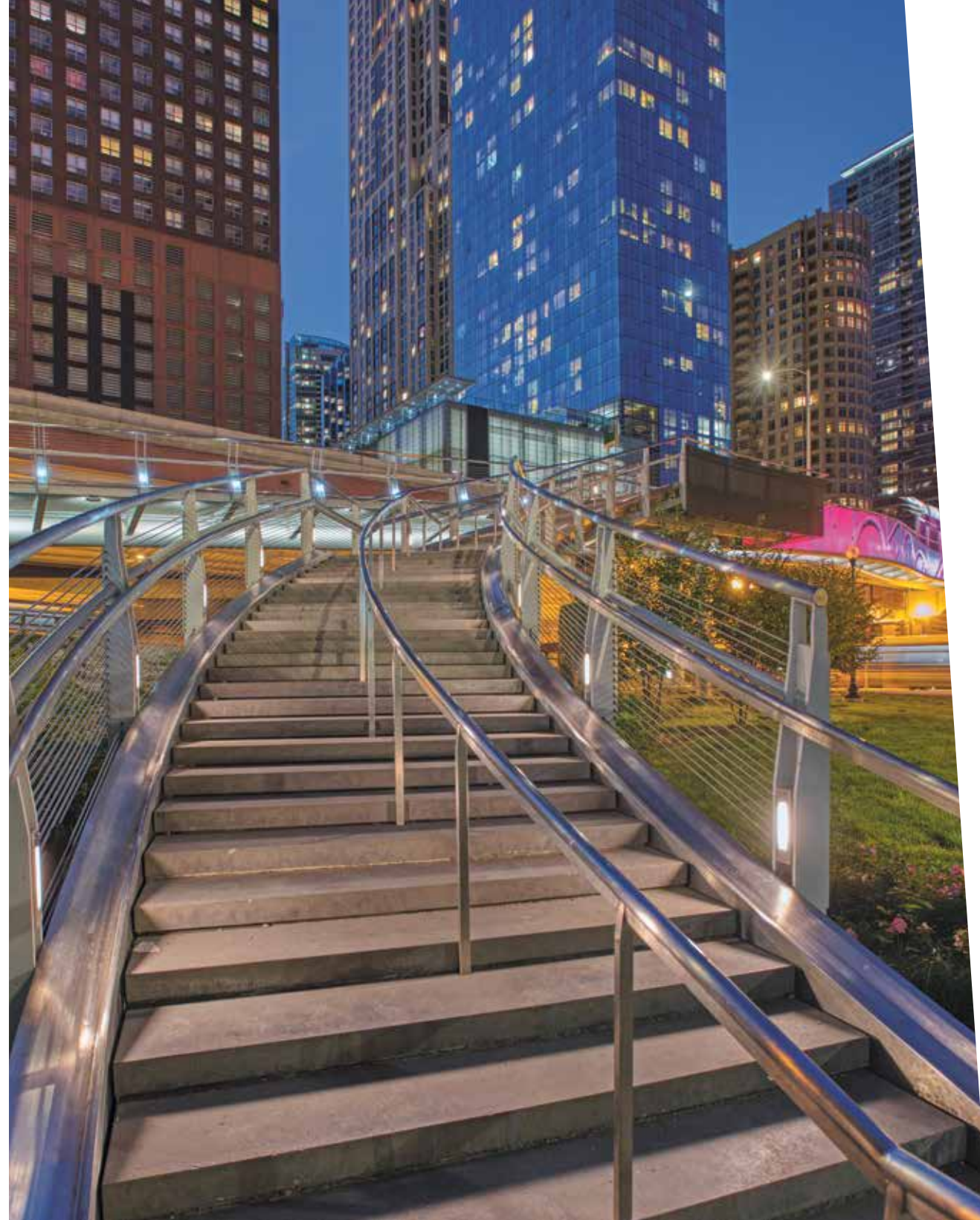
Another unique aspect of the project is the point at which the flyover splits into a “Y,” with one path descending slightly, then upward, then down again to Navy Pier, and the other beginning its upward, twisting path between upper Lake Shore Drive and the condominium building before descending to ground level at the northernmost point.

“The spine of a giant dinosaur”

The flyover has been described as looking like *“the spine of a giant dinosaur”* or an airplane taking off and soaring into flight. Users have expressed appreciation for the unimpeded and safer path that is actually faster.

“Eliminating the street crossings and avoiding the congestion of people and traffic around Navy Pier have greatly improved the Lakefront Trail,” said Dale Erdmier of the Chicago Area Runners Association.

“This flyover makes a great deal of sense, enhances safety, and bikers won’t have to stop and dismount nearly as often,” said Russ Klettke, a veteran triathlete who has been an enthusiastic user of the entire lakefront for more than 35 years.



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“The structural joining of the two pipes as they intersect in space demanded a custom-fit connection load path and design,” Shkurti said. “The first pier support had to bear the weight of two spines. No small task.”

Torsion was an area of extra focus, and not only in the design. The heavy use that the flyover will experience on any given day will increase substantially for special events. Those include Bike the Drive, an annual charity event during which Lake Shore Drive’s 30-mile length is closed to motor vehicles for five hours while more than 2,000 bicyclists take the road, and the summer-long biweekly fireworks displays at Navy Pier. During those, and other events, great crowds are expected to gather on one side of the bridge or the other.

“We only have one structural element resisting torsion and that is the spine,” Shkurti explained. “We also had to deal with dynamic behavior of excited crowds and the sustained pounding it would take from runners’ footfall when there is a race or something similarly challenging going on.”

The supporting columns are topped with a saddle-like configuration that transitions the load downward. Specially designed lugs were created to link expansion joints to provide torsional continuity and allow for temperature-driven expansion and contraction. They also support any torque coming through the joint from imbalances that may occur on the surface or vibrations from asymmetrical loading.

Extra touches bring color, light and safety

The design also incorporated architectural steel railings and panels, custom steel deck nosing and special lighting. The paint for the structure is not the typical zinc/epoxy/urethane system used on highway bridges but a three-coat system that includes a primer, intermediate coat and fluoropolymer finish coat. Usually used on architectural applications, it is highly durable and enhances color and finish.

Other features include a comprehensive LED lighting system with conduits for its power supply embedded in the concrete curb and within the steel column sections. The ribs, spines and columns are illuminated from below and from the cable railing posts above. Custom designed downspouts follow the path of ribs and columns for drainage, and a 3/8-inch-thick stainless-steel curb cover extends along the deck edges to create an even more uniform shape and appearance.

Strength from cooperation and teamwork

Ongoing communication and cooperation played a major role in developing and building the Navy Pier Flyover, given its many stakeholders. The project’s highly public nature made vetting necessary through numerous civic and governmental organizations.

“It is a great example of teamwork and being able to balance the demands of structural and architectural issues and serviceability,” said Luis Benitez, chief bridge engineer, CDOT. “HNTB’s hands-on approach helped troubleshoot many of the unique design challenges of this project.”

HNTB and Shkurti’s relationship with Chicago and its bridges has a long history. In fact, HNTB ran the city’s bridge inspection program for seven years. This new structure has drawn praise from everyone involved.

As Shkurti himself says, with no small amount of pride, “It’s a jewel. It’s beautiful to see and walk, run or ride on. It’s state-of-the-art and architecturally as beautiful as the City of Chicago deserves.” □

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