



## Creating an Icon

### *The Dublin Link Pedestrian Bridge*

The Dublin Link was designed to create an iconic destination for Dublin, Ohio, activate the Scioto River corridor, and literally tie together the Eastern and Western sides of the city. The formal aesthetic and structural methods were developed simultaneously to create a single coherent vision. The resulting bridge is the longest single-sided suspension S-curve bridge in the world. It is supported by an expressive central pylon that the bridge deck passes through, conceptualized as the gateway between the historic town center and the newly developed mixed-use district on the East bank. The form and arrangement of the tower and bridge cross-section were developed through theoretical stress-shaping and refined through digitally-driven optimization.

The Scioto River bisects the City of Dublin, resulting in a shift in the urban fabric from East to West. This offset became the impetus for the bridge's unique S-Shape in plan, directly tying together the historic downtown and the newly revitalized East Bank. This formal solution has its historical precedent in the S-Bridges used to efficiently cross streams in eastern Ohio during the construction of the National Road in the early 19<sup>th</sup> Century.

At flood stage, the river inundates much of its western riverbank, rising nearly twenty feet around the base of the central pylon. The pylon's cross-section subtly twists as it descends below the bridge deck in order to minimize fluid drag during 100-yr events.

The bridge's slenderness resulted in a susceptibility to lateral vibration in strong wind events. Also, the central pylon's unique form required resolution of the thrust created as it flows around the bridge deck. Both problems were addressed by including two viscous, tuned-mass dampers as a method of dissipating energy while maintaining stability.

Wind tunnel testing revealed the possibility of instability in the triangular box girder caused by vortex shedding under constant wind stream. An inverted wind vane was installed along the bottom of the section to provide stability. This not only stabilized the bridge section but provided a surface for indirect lighting of the bridge's underside.

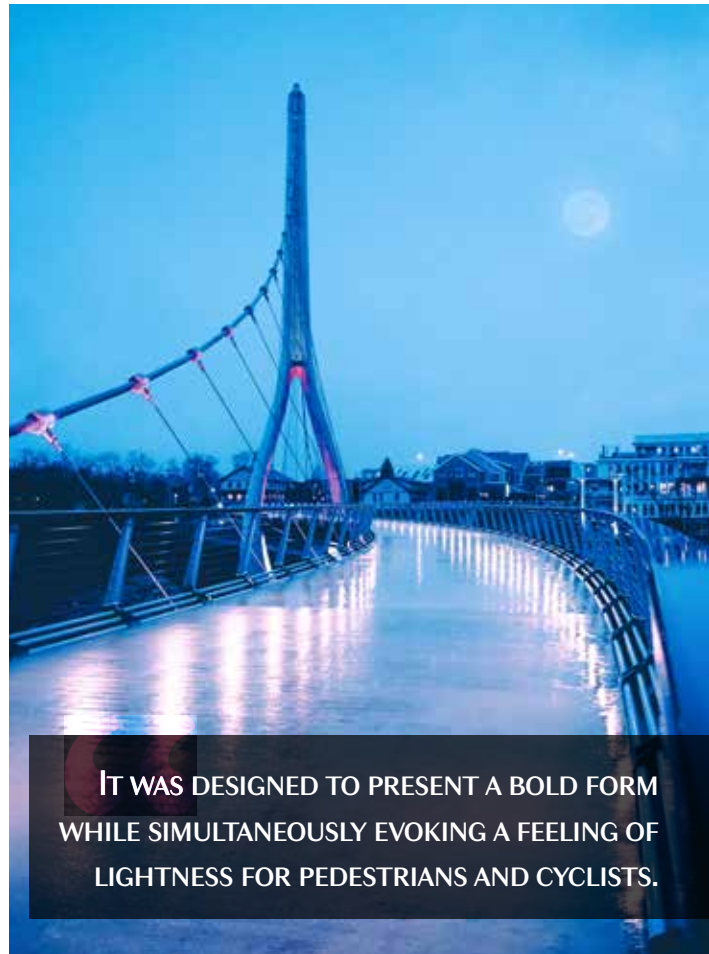
The Dublin Link was designed to present a bold form while simultaneously evoking a

feeling of lightness for pedestrians and cyclists as they cross above the riparian corridor. To accomplish these two goals, the design team utilized geometric optimization and stress-shaping principles to create maximum impact with minimal material.

The expressive form of the tower was only possible by using the bridge deck to tie the sides of the needle's eye together. The cross-section area stays nearly constant from the top of the tower to the bridge deck, resolving the increasing flexural demand by morphing the cross-section and precisely locating it relative to the central axis. With the basic form of the tower set, a digital optimization process was used to further refine the flowing concrete form.

The single-sided stay cables were critical to creating open, shifting views of the river and surrounding town. To minimize the impact of this spatial goal, the bridge's cross-section morphs as it approaches the tower, thereby aligning the section's shear center with the line of action of the stay cable. By keeping the cables installed on the inside of each curve, the primary forces are fixed in the bridge deck, and the incidental torsion created through construction tolerances and installed material weight is balanced.

The complexity and required precision of the central tower for both aesthetics and structural performance posed one of the biggest construction challenges. Hundreds of precisely milled CNC form inserts were created from the digital model and installed in a reusable outer form. The design team used the model to precisely lay out every piece of rebar for the central tower to aid in the speed of placement during construction. The constructor developed their own model independently, which was compared directly to the design team's model as part of the quality control program.



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While the Dublin Link is a showcase of leading-edge design and construction techniques, its role is also as a symbol for a historic town with a long connection to the surrounding land. Merging these two identities was primarily the work of the material of the bridge. The concrete was sourced from a nearby white-sand quarry, the light-colored aggregate was sourced, and white GGBC pozzolan was used as a cementitious replacement instead of dark silica fume. The effect of this was to connect the concrete of the deck, central pylon, and abutments to nearby limestone cliffs that are endemic to the region. This limestone is also used in many historic buildings in the adjacent downtown. ■



*Endrestudio was an Outstanding Award Winner for the Dublin Link Pedestrian Bridge project in NCSEA's 2020 Annual Excellence in Structural Engineering Awards Program in the Category – New Bridges or Transportation Structures.*