The Aesthetics of Short- and Medium-Span Bridges

by Frederick Gottemoeller

Bridges over dramatic canyons or other memorable natural features are actually the easiest to make attractive, as the site itself offers features which the bridge can (and must) react to. Such bridges often require long spans (greater than 150 ft), so there are opportunities to shape the structural elements in ways that attract attention. Bridges with spans less than 150 ft, especially those in flat terrain that pass low over railroads, wide stretches of water, or other highways, offer fewer opportunities to create aesthetic interest. So, how can the appearance of such bridges be improved?

It's hard to beat the economy of precast concrete beams for spans of less than 150 ft. Notwithstanding their considerable economic and functional benefits, precast concrete beams don't offer much for people's aesthetic imaginations to latch on to. So, designers have to look to other elements of the bridge—piers, abutments, parapets, railings, and even the lighting and landscaping—to capture people's attention.

The place to start is to identify the audience: who will be seeing the bridge, and from where? For a bridge over a highway, one audience will be the users of the undercrossing highway. The occupants of vehicles on that highway will be moving at approximately the speed limit of that road. Their ability to see and appreciate the features of the bridge will be limited compared with that of users of the sidewalks on the overpass, who will have time to notice details and stop to appreciate particular features.

If a bridge spans a riverside path or park, its audience will not only have time to appreciate its features but will also have higher expectations. They will want the bridge to respect the natural features that they are enjoying as they walk. Finally, pedestrians *on* the bridge will want to enjoy the view from the bridge, as well as the details of the railings and sidewalks.

Bridges over wide rivers, lakes, or bays have an additional audience: people on the riverbanks upstream and downstream, or along the lake or bay shore, who can see the bridge from their homes, offices, or nearby bridges. They will want the bridge to be aesthetically attractive and to be a scenic asset within whatever landscape or civic space the bridge occupies.

Because every bridge has its own unique combination of audiences, it's impossible to offer a one-size-fits-all set of recommendations. Instead, here are three examples that can serve as inspiration.

1. **Typical ramp pier: an economical way to add aesthetic interest to a simple pier design**
For low bridges in rural areas, where the audience for the bridge is relatively small, or for highway overcrossings, where the audience is moving too fast to appreciate much detail, there is still a need to make the bridge attractive in some economical way. The pier shown in **Fig. 1** demonstrates several ways of doing that. The top of the pier is flared outward to achieve sufficient width without a pier cap or stub cantilever. The result is a geometrically simple shape that viewers can quickly grasp and that is easy to form. The edges are chamfered, making the pier seem narrower. And there is a very simple pattern of vertical grooves to add visual interest. The pattern also makes the pier appear narrower. Note that this particular pier carries a box girder, but it could as easily carry U-beams or other precast concrete girders.
The same techniques can be applied to a pier for a wider bridge. For example, on a wider pier, the pattern of grooves could be repeated once or twice, with similar positive effects. The basic principle is to make the pier a unified, geometrically simple shape, and then enhance its appearance with easily formed refinements, such as the chamfered edges and vertical-groove patterns.
Of course, there are many possible refinements. For example, if the grooves are split in the center at the level where the flare begins and diverted to follow the flared edges of the pier, the result would be an inverted triangle of smooth concrete at the top center of the pier. Deciding whether that improves the pier's appearance is up to the designer. They can exercise their own tastes on an element that will have a large impact on appearance but very little impact on the final cost.

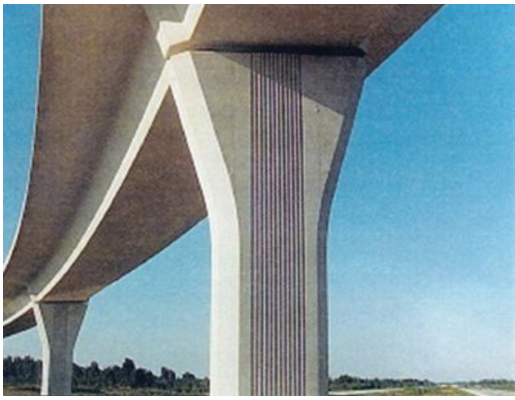

Figure 1. A simple geometric shape with a simple pattern of vertical grooves makes this pier both visually interesting and economical. Photo: Frederick Gottemoeller.

2. **Stewart Street Bridge, Dayton, Ohio: a low bridge over a wide river combining 85- and 25-ft-long precast concrete box beams with custom piers, parapets, railings, and lighting**
Dayton's rivers are wide but not deep, allowing fairly short spans that are well within the range of standard precast concrete beams. Beams such as those used here are the default choice for new superstructures because of their overwhelming cost advantages. The challenge for designers is how to economically add visual character to these city-center bridges. In the case of the Stewart Street Bridge (**Fig. 2**), this challenge inspired some creative thinking about the piers, parapets, and lighting.

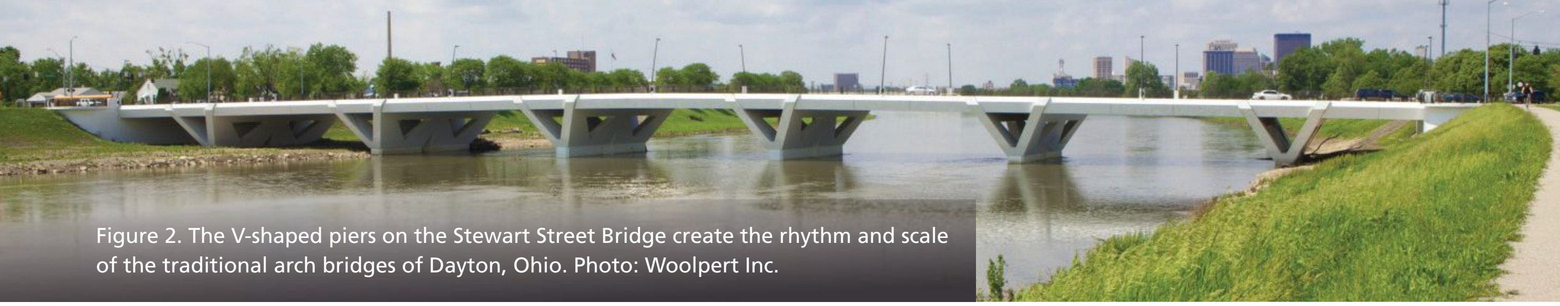

Figure 2. The V-shaped piers on the Stewart Street Bridge create the rhythm and scale of the traditional arch bridges of Dayton, Ohio. Photo: Woolpert Inc.

The bridge is adjacent to the University of Dayton's new research campus, so the city wanted a bridge with a contemporary appearance as well as the rhythm and scale of the filled-arch bridges that were Dayton's historic solution. A V-shaped pier provides a repeated, standardized, easy-to-build element that economically meets this goal. The pier creates 110-ft spans with 85-ft-long, 42-in.-deep precast concrete box beams between the piers and similar precast concrete box beams connecting the tips of each V providing the remaining 25 ft of each span. The necessary variation in pier height was created not by widening or lengthening the V, but by lengthening the vertical stem at the bottom of each V, which allowed all of the Vs to be cast using a single set of standardized forms. The triangular openings in the slanted cross wall lighten the visual (and physical) weight of the piers and make them more transparent.

A cast-in-place concrete fascia covers and unites the edge beams. As a continuation of the angular theme of the V-piers, the face of the fascia is split horizontally into two slanted planes. The upper plane is slanted toward the sky and catches more light, while the bottom plane is slanted toward the river and is darker. The result is a bright horizontal band sweeping from bank to bank, interrupted just briefly at the piers. Even the highway lighting poles are slanted to pick up the angular theme. The inverted pyramidal spaces within the piers create opportunities for colored LED lighting that reflects off the river and enlivens the nighttime appearance of that whole reach of the river (**Fig. 3**). (See the Summer 2011 issue of *ASPIRE*® for more information on this bridge.)

Figure 3. Colored LED lighting within the V-shaped piers of the Stewart Street Bridge enliven the nighttime appearance of the Great Miami River in Dayton, Ohio. Photo: Woolpert Inc.

3. **NJ 52 over Great Egg Harbor Bay, Ocean City, N.J.: a long bridge over water combining 140- to 160-ft standardized bulb-tee girders with custom piers and LED lighting**

For a long bridge over water, the appearance of multiple piers, seen all at the same time, is a major aesthetic opportunity. In this structure (**Fig. 4**), the striking Y-shaped piers are adapted to changing pier heights by simply lengthening the shaft. The "branches" of the Ys at the tops of the piers are all the same, which allowed all of the Ys to be cast in standardized forms. The faces of each pier are split vertically into two halves. Each half is in a different plane, so that the plan section of the shaft resembles a bow tie. Each face catches the light differently, so that one half seems brighter than the other. The geometry of these angled planes also creates a slight taper in the Y branches, so that they widen slightly as they meet the pier cap. The overall effect is to make the pier seem both slimmer and more interesting.

Finally, the soffit of the pier cap between the branches of the Y is a convenient place to mount a simple LED light strip. From this location, the light strip can illuminate not only the void within the branches but also the shaft of the pier itself. The LED lights are programmed to change color in timed sequences, so that waves of color appear to be moving across Great Egg Harbor Bay (**Fig. 5**). (See the Winter 2013 issue of *ASPIRE* for more information on this bridge.)

These three examples show how creative shaping of piers, parapets, and lighting can create a striking bridge even with standardized superstructure elements. Similar effects can be obtained by customizing abutment features and landscaping. Decisions about which features of a bridge to emphasize give designers an opportunity to exercise their imaginations and tastes. Of course, their choices should be rooted in structural efficiency and economy, while also recognizing the context of the bridge as well as the needs and expectations of the audiences who will be using and seeing the bridge.

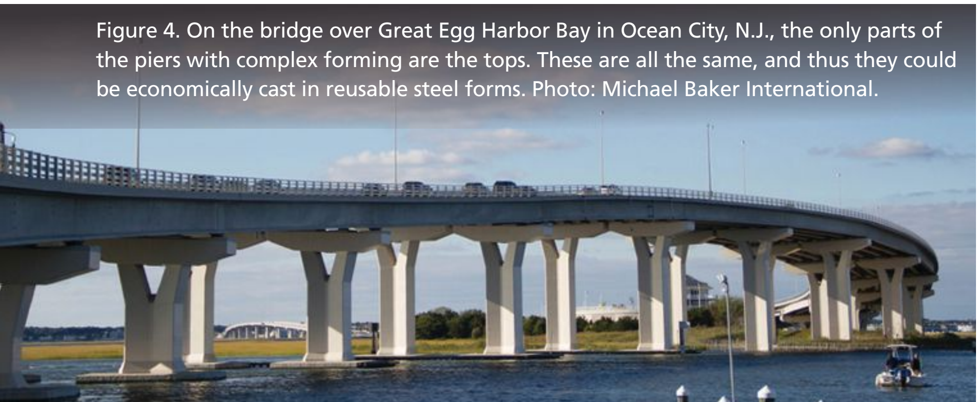

Figure 4. On the bridge over Great Egg Harbor Bay in Ocean City, N.J., the only parts of the piers with complex forming are the tops. These are all the same, and thus they could be economically cast in reusable steel forms. Photo: Michael Baker International.

Figure 5. Timed sequences of color change in the LED pier lighting produce the illusion of waves of color moving across Great Egg Harbor Bay. Photo: Michael Baker International.