

# Bridge Architecture: The Good, the Bad, and the Ugly

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The aesthetic element of bridge design is more complex than many bridge design engineers realize. Some view aesthetics as something that gets in the way of a true engineering solution, adds excessive costs, and slows up the project. Others consider visual quality to be as important as structural integrity. A truly beautiful structure has the balance of visual elements that will give it a pleasing appearance throughout time. To achieve visual quality it is important to include an architect who is experienced in transportation architecture on the design team at the very beginning of a project. This early involvement on the design team will give the architect a chance to ask questions and make suggestions in the early stages that will affect the visual quality of the whole project. Individual components, such as bridges, retaining walls, noise barriers, location and style of light standards, sign bridges, transfer facilities, utility conduits, or other attachments to transportation structures, all need to be visually coordinated. Study models and sketches during the design process will give the architect and design engineers the ability to coordinate the visual and structural requirements. Our transportation environment deserves our best efforts.

**T**his paper will not give any magical rules or mathematical formulas that can be used to create beautiful bridges, just as no article of this length could convey the expertise required to design bridges. The important point is the need to consider

appearance during the early design of bridges and other transportation structures. An effective process that can be used to incorporate aesthetics into the design of bridges and other structures in the transportation corridor is sketched out here. Good aesthetics create both a pleasant journey and a safer one. The big picture includes the design of all transportation structures, but the focus of this paper will be mainly on bridge aesthetics.

At this point we should decide what beauty is as it relates to a bridge. Bridge design must be governed by valid visual properties that create order and good proportion. Generally, if we consider the development of bridge design from an aesthetic viewpoint, there is a preference for very slender structures supported by slender, well-proportioned piers. Simplicity and a minimum of elements are also preferable, along with continuous and steady longitudinal lines, either straight or in smooth curves that relate to moving traffic. These qualities make a bridge, sign, or transportation corridor safer and more comfortable for drivers. For example, by limiting distracting visual clutter, signs are easier to read.

We have all heard the saying "Beauty is in the eye of the beholder," which is true. The task is to help create more "beholders" who look at your bridge as beautiful. More beholders are created by considering and incorporating aesthetics into the bridge design process.

We have also heard that beauty is only skin deep but that ugly goes clear to the bone. This seems to be true

with bridge design, because the whole structure must be considered from the very start of design to incorporate aesthetics. If aesthetics are not considered until after the structural design is completed, it is virtually impossible to make an ugly structure attractive by adding surface textures or some kind of false panels (the skin).

Why, then, are some bridges beautiful (and therefore have more beholders) and others are visually unattractive or downright ugly? Maybe some designers do not know how to incorporate aesthetics into their designs. Perhaps some are not concerned with the visual quality of our built environment, wanting only to get from here to there. But, whatever the reason, the features of an ugly bridge result from using principles opposite those that are inherent in beautiful bridges.

What leads to the creation of a beautiful bridge? The most important element is early involvement of someone experienced in transportation architecture. The second important principle is coordination of the designs of all structures in the transportation corridor (bridges, retaining walls, noise walls, signage, sign bridges, lighting, landscaping, rest areas, information centers, etc.). Architectural design guidelines were developed and published in a booklet used by design engineers on the \$2.5 billion I-90 freeway in Seattle (1). A completely new corridor is designed differently from an existing corridor where some structures remain or where a bridge is being replaced. The third important principle is the formation of a multidisciplinary design team.

The multidisciplinary design team consists of all of the design professionals who will collaborate on the project (such as the bridge designer, foundation or geotechnical engineer, traffic engineer, illumination designer, utilities engineer, acoustics engineer, landscape architect, the project engineer, and the transportation architect). The disciplines and size of the team depend on the complexity of the project. One way to explain the effect of such a team is that it "greases the skids" on the design process by drawing on the expertise of a diverse group from the very beginning of the design. For example, if a noise wall ends or starts at a bridge, the acoustics engineer and the bridge designer will find they need to create a junction of some type before they start designing their portions of the project.

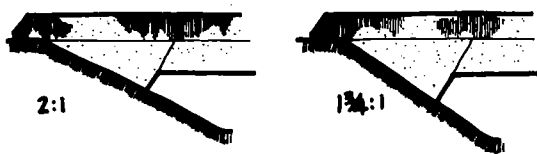


FIGURE 1 Abutments can appear too massive if the slope angle is increased.

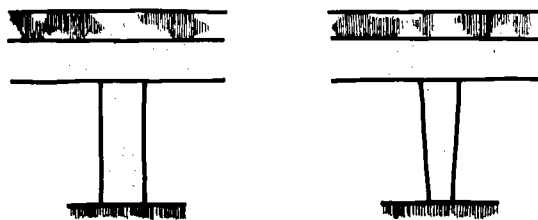


FIGURE 2 Avoid short, stubby piers. Note the visual improvement obtained by making a slight change of the shape of the pier.

As mentioned, this paper will not give rules or mathematical formulas, but the following are insights into the vital visual design elements that should be considered during the design process:

- Scale and proportion: the size as it relates to the surroundings and other parts of the bridge. This involves the abutments, piers, the depth of the superstructure, the span, and the sizes of openings between the piers.
- Line and mass: the appearance of lightness; the flow of the horizontal line.
- Harmony: the relationship to the environment and other structures.
- Order and balance: the orderly arrangement of visual elements.
- Clarity of function: how the form serves its structural purpose.
- Simplicity: a form's lack of complication. Seek simplicity and purity of structure and limit complicated elements. Avoid all useless additives or ornamentation.
- Color and texture: the placement of texture and color to highlight the design elements.
- Aesthetics: the creative combination of all of these elements to form a beautiful structure.
- Constructability: this is not a visual element but must be considered in the design process.
- Economics: just because a bridge has a pleasing appearance does not mean it has to cost more. A beautiful bridge may even cost less than an unattractive bridge. Early involvement by an experienced design team will provide the most economical results.

How do we apply the visual elements listed here to the different parts of a bridge? The following are some useful methods and some parts of a bridge that should be looked at when gathering aesthetic contributions from the design team:

- Sketches and drawings: the quantity and the amount of detail depend on the size, visual impact, and complexity of the bridge.

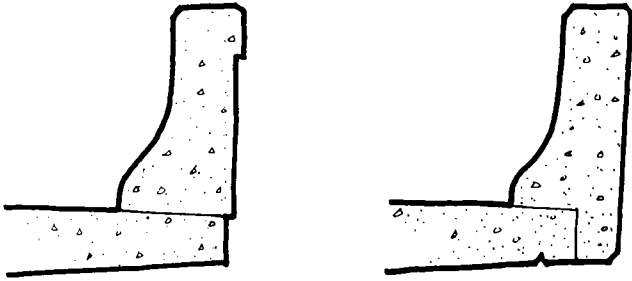


FIGURE 3 Textures and shapes on the bridge barrier face will affect the appearance of the bridge. Also, note the drip groove on the bottom of the deck slab.

- Models: use models to study conceptual ideas during the design process and to present options or proposals to the public or governing bodies.
- Abutments: the size of the abutment must be in proportion to the span and depth of the bridge. A steep slope may make an abutment appear too massive (Figure 1).
- Slope protection: the materials used for slope protection should relate to the bridge or to the surrounding landscape.
- Piers or columns: the type and size of piers depend on the style, width, length, and height of the bridge. Tapered piers are more pleasing than stubby ones (Figure 2).
- Traffic barriers: traffic barriers should have simple clean lines and extend to the bottom of the roadway slab. Put a texture on the outside face to control staining and slope the top to drain to the inside. Specify a sample panel of the texture to be constructed for ap-

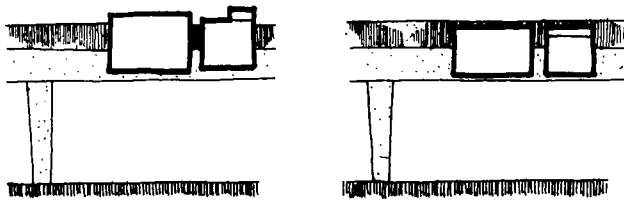


FIGURE 4 As a last resort, attach signs to a bridge, but keep them within the silhouette of the bridge.

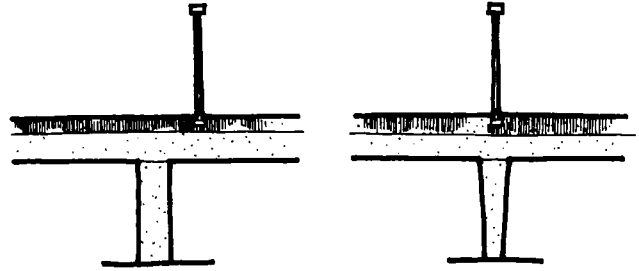


FIGURE 5 Poor placement of light standards can unbalance the visual appearance.

proval before the actual construction of the barrier (Figure 3).

- Signs: if signs must be attached to a bridge, they should fall within the silhouette of the bridge. If there is more than one sign, they should be the same height if possible. Exit number signs should be the same width as the sign below. These guidelines also work with sign bridges (Figure 4).
- Light standards: light standards and other attachments to the bridge that extend above the deck should line up with the pier lines (Figure 5).
- Drip grooves: drip grooves on the underside of the overhang will control staining of the outside face of the bridge girder caused by the construction of the concrete traffic barrier (Figure 3).
- Concrete stain: the use of concrete stains substantially improves the appearance of concrete structures. It not only hides blotchy surfaces but seals and protects the concrete. Graffiti is easier to remove if the concrete stain is also a sealer.

It is up to us to form our own design teams and apply these principles. We can develop a growing following of beholders. It is critical to make the extra effort to gather this team early in the design process. The built environment is worth our best efforts.

#### REFERENCE

1. *I-90 Architectural Design Standards*, revised edition. Washington State Department of Transportation, Olympia, Dec. 1986.