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.

This 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 some­
one experienced in transportation architecture. The sec­
ond important principle is coordination of the designs
of all structures in the transportation corridor (bridges,
retaining walls, noise walls, signage, sign bridges, light­
ing, 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 geo­
technical engineer, traffic engineer, illumination de­
signer, 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.

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 con­
sidered during the design process:

- Scale and proportion: the size as it relates to the
surroundings and other parts of the bridge. This in­
volves the abutments, piers, the depth of the superstruc­
ture, 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 vi­
sual elements.
- Clarity of function: how the form serves its struc­
tural purpose.
- Simplicity: a form’s lack of complication. Seek sim­
plicity and purity of structure and limit complicated ele­
ments. 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 ap­
pearance 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.
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 approval 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