BRIDGE ESTHETIC GUIDELINES

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Introduction

The appearance of bridges is too often disregarded by engineering designers. Concerned with function, safety, and cost, they do not always value the esthetic need. An important public construction as a bridge, which intrudes upon man's environment for generations and is seen by countless numbers of people, obviously should have esthetics as one of its important concerns. To that end, this guideline has been prepared to assist bridge designers in making appropriate esthetic choices based upon a general consensus of judgments of contemporary architects, landscape architects, and bridge engineers.

As esthetics is not an exact science, differences of opinion do occur, even between experts; however, studies have found that in most cases statistical preferences do exist. It is these preferences which are presented in this guideline. For the convenience of the designer, a format using systematic diagrams of the component parts of short and medium length highway bridges as currently used in the state of Virginia is employed. Diagrams illustrating less preferred designs, augmented with brief statements concerning the rationale, are shown.

These guidelines in no way are intended to be absolute or exhaustive. Unique situations of site, function, materials, and the like encountered in bridge design require the designer to be ever alert to special conditions. A list of recent references on the subject of bridge esthetics is presented at the end of these guidelines for those who wish to study more deeply research, philosophies, and additional examples of good esthetics.

Basically, these guidelines are a take-off from the prevailing code of bridge building practice in Virginia, modified to enhance the visual appearance of such types of bridges. Additional costs, if any, are thereby minimized by not drastically altering prevailing design and construction practices. Because of their extensive use, primarily girder type structures are illustrated. As the need arises, supplements to this manual will be issued to cover other bridge types as trusses, arch, stayed girder, and suspension. Although these guidelines are not in themselves complete, it is hoped that they will serve to develop an esthetic consciousness on the part of the designer which will be transferable to any and all bridges.

One cautionary note concerning the use of the diagrams is that there are no rigid standards in the art of esthetics. A certain amount of variety, in fact, is essential to the appreciation of beauty. Thus, each bridge should be individually considered as to its location, form, visual importance, and other related factors.

GIRDERS

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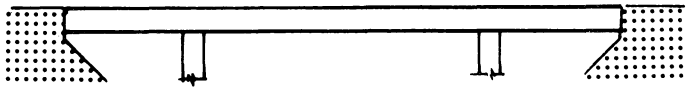
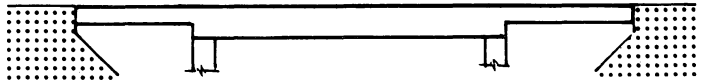
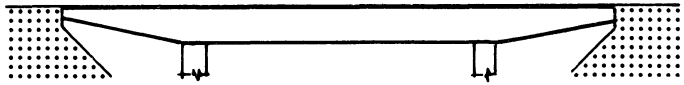


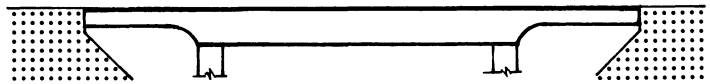
Has clear simple lines. (Unseen interior girders of end spans may be of lesser depth.)



Visual lines are abruptly broken at end spans.

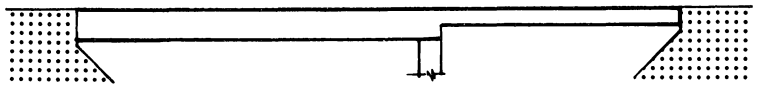


End spans express functional size reduction without abrupt changes in lines.



Awkward transition between deep and shallow girders.

Symmetrical configuration has visual balance.



Unsymmetrical configuration is upsetting.

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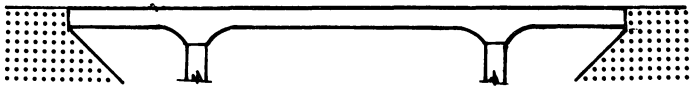
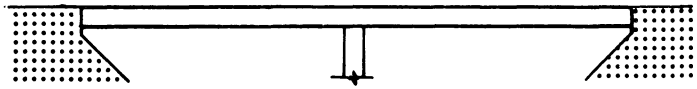
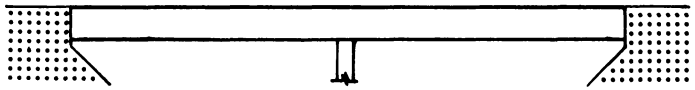
Long haunches are graceful and suggest arch forms.



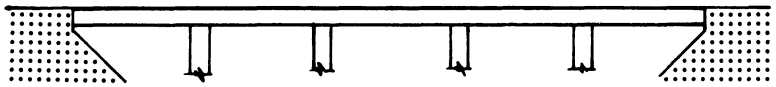
Short haunches diminish grace of lines.



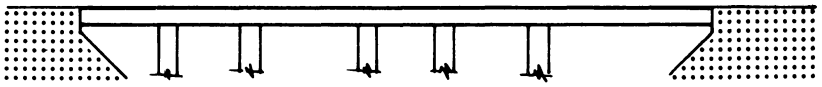
Girder and pier are harmoniously proportioned.



Girder is overly proportioned in relation to pier.



Evenly spaced supports create rhythmical pattern. Minimum number of piers reduce clutter. Odd number of spans looks better than even number.



Uneven spacing destroys rhythm. Too many supports create visual clutter.

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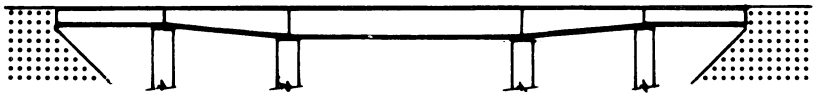
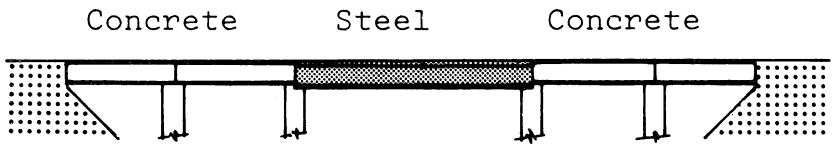
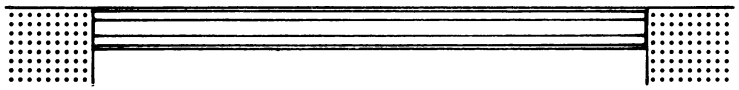


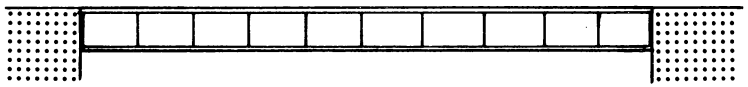
Use of the same girder material throughout (concrete or steel) shows relatedness of overall design. Note avoidance of abrupt change in depth.



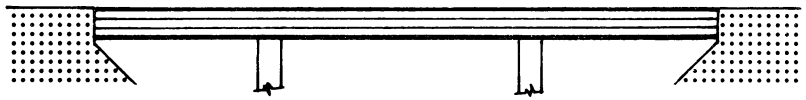
Mixing concrete and steel girders is discordant and suggests that overall design is not harmoniously integrated.



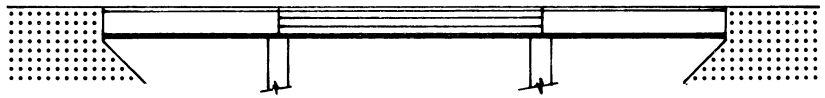
Stiffeners on steel girder should be concealed on inside face, but if exposed, they should be horizontal to reinforce the basic horizontal lines.



Vertical stiffeners on steel girder run counter to the fundamental horizontality of the span, and tend to make the girder look too deep.



Horizontal stiffeners should run the full length of bridge to express the horizontality of the structure.



Terminated horizontal stiffeners disrupt the visual horizontal lines and overemphasize the center span.

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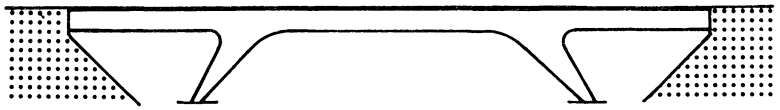
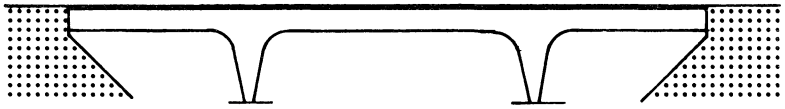
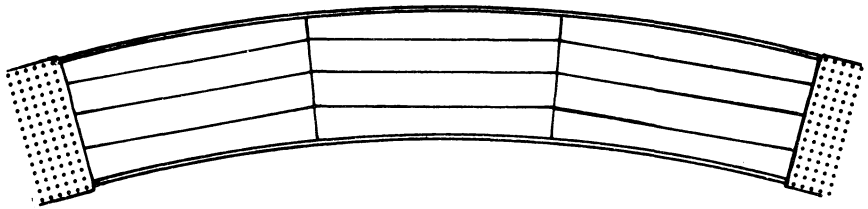


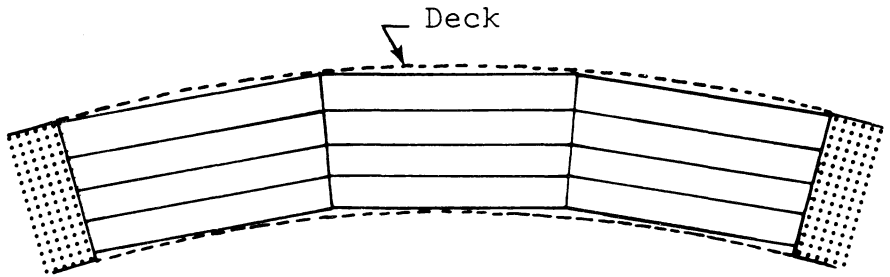
Slant legs of rigid frame are gracefully shaped and suggest pleasing arch form.



Vertical legs appear too static.



Curved exterior girders of bridge on horizontal curve present a smooth, continuous appearance. The deck slab relates uniformly to exterior girders. If interior girders are also curved, appearance is further improved.



Straight girder segments have a choppy look. Deck slab projects out nonuniformly from exterior girders.

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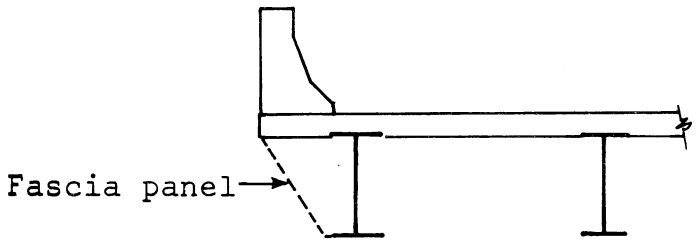
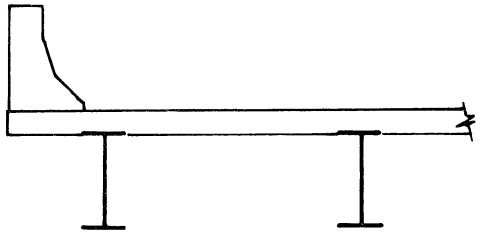
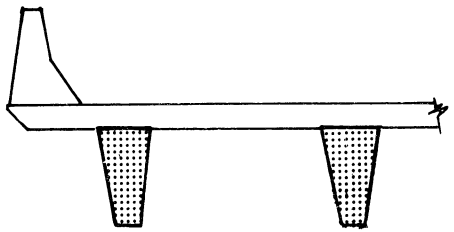


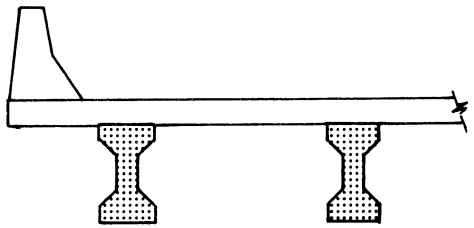
Removable metal or plastic fascia panels would give the bridge a cleaner look.



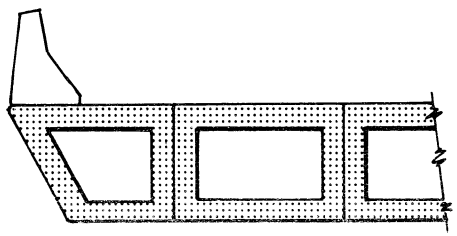
Exposed edge of flanged girder on exterior presents a weak look.



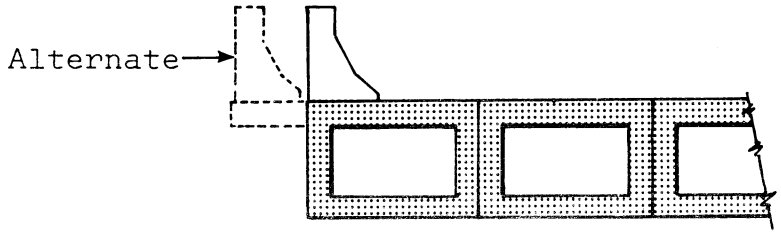
Girders with smooth sloping faces present a clean graceful look from beneath as well as from the side. Slope on parapet and deck edge enhances gracefulness and relates to slope of girder.



Too many surfaces exposed to view create confused lines and shadows.



Flared edge box beam directly relates girder to deck and parapet, creating soft shadow lines.



Squared forms are unimaginative and stiff. Projection of deck relieves bluntness somewhat.

PARAPET, CURB, SIDEWALK AND RAILING

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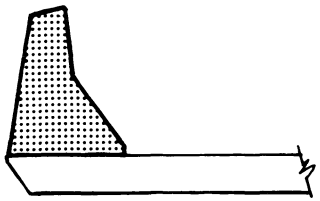
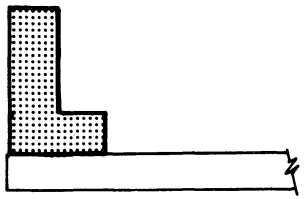
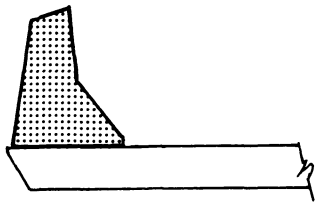


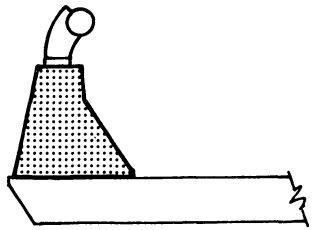
Sloped outside surface presents a thin edge to view.



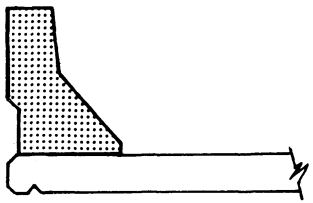
Exterior view is dull and inside view has too many awkward angles.



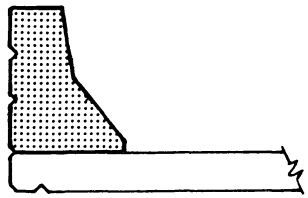
Omission of handrail allows for a simple parapet. Sloped top aids visibility of motorists and discourages parapet walking.



Metal handrail introduces extraneous visual clutter.



A single large groove between slab and parapet expresses distinction between the two.



Additional arbitrary grooving in parapet has no real relationship to rest of bridge structure.

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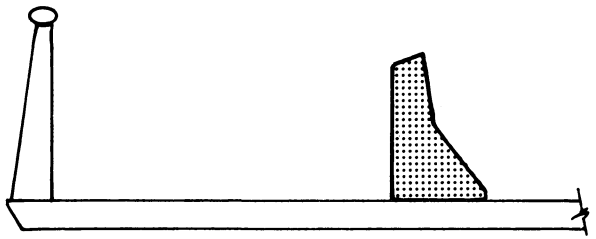
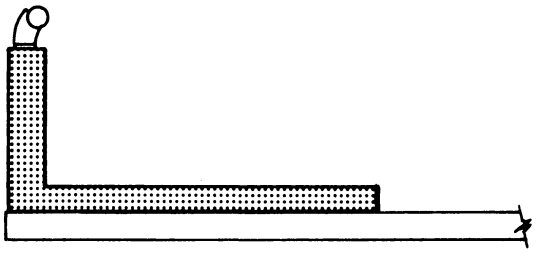
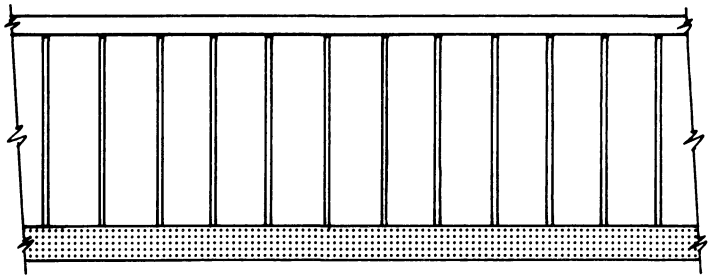


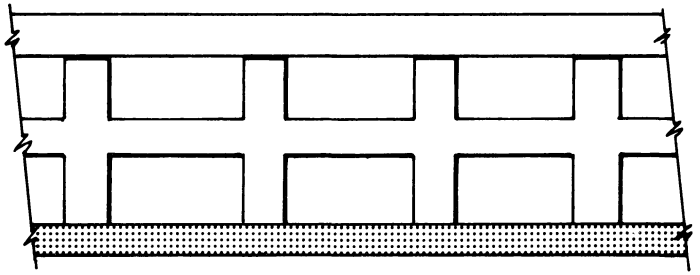
Parapet between sidewalk and roadway not only protects pedestrians but permits a light open handrail. The bridge is thus seen as less massive.



Bridge profile takes on a heavy look. Pedestrians have little protection from vehicles.



Pedestrian railing with thin vertical supports (metal or concrete) presents a light appearance and minimally obstructs view of motorists.



Railing with horizontals blocks view of motorists. Vertical supports clash with horizontal members, creating unnecessary complexity.

PIERS AND PIER CAPS

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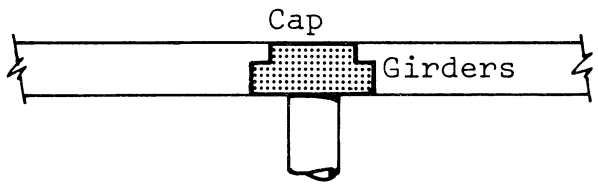
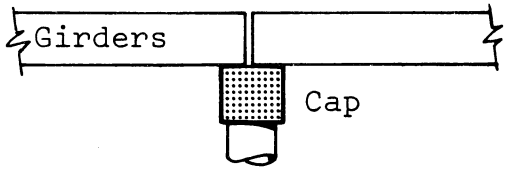
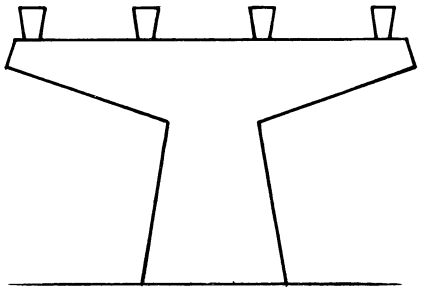


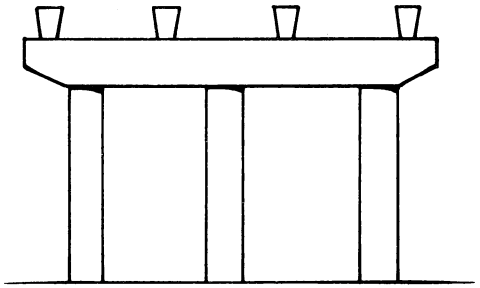
Pier cap concealed within girders presents a strong unbroken horizontal form for the superstructure.



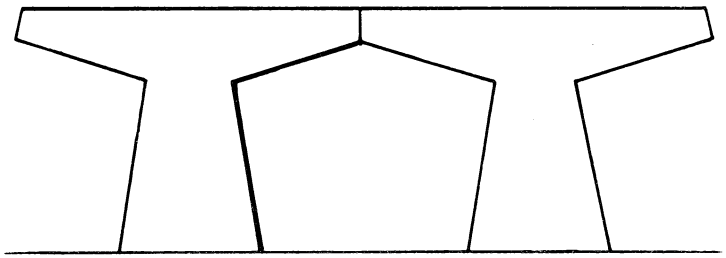
Pier cap set below girders introduces an additional visual element distracting from the primary horizontal lines of bridge.



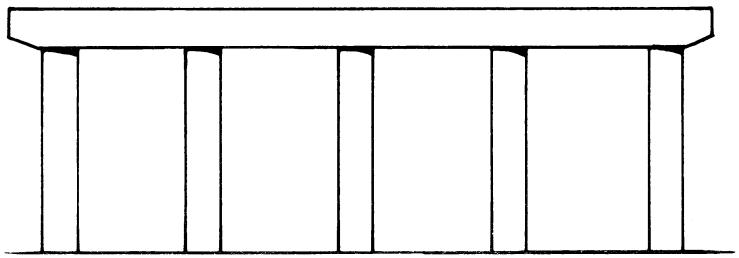
T-shaped support unifies pier and cap into a single attractive form.



Multiple elements of piers and cap create visual complexity of different shapes and surfaces.



For wide bridges, several T forms can be joined to generate intersecting arch-like spaces between.



Many piers have a very cluttered look.

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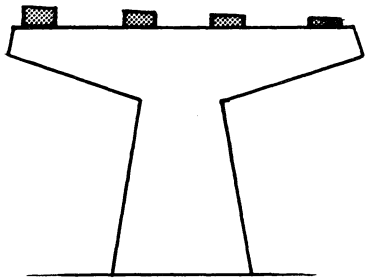
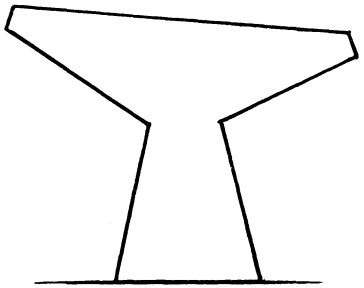
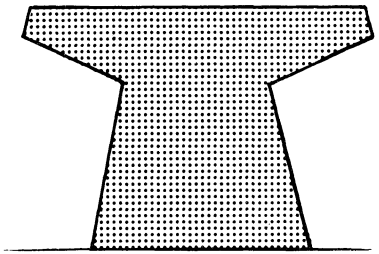


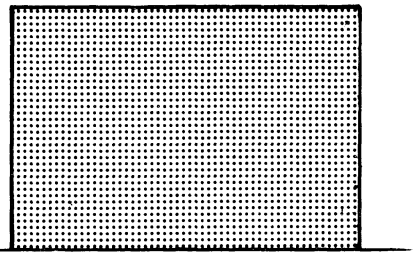
For small deck superelevations, keep top of pier horizontal and step girder bearing seats.



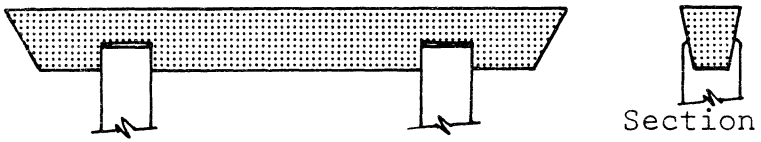
Sloped top of pier suggests unstable appearance.



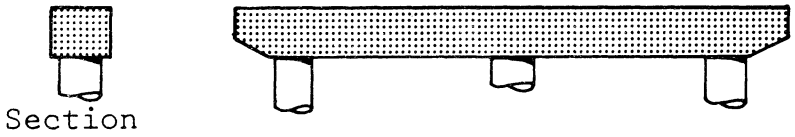
Pier with expressive shape says something esthetically in suggesting flow of forces.



Solid pier is expressionless, dull and overly heavy looking.



Use of the minimum number of piers produces a simple look. Cradling the cap accentuates the supportive nature of the pier. Square pier relates most harmoniously to prismatic cap, although round pier is also acceptable.



Ends of cap lack decisive shape.

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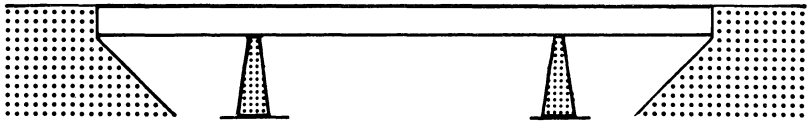
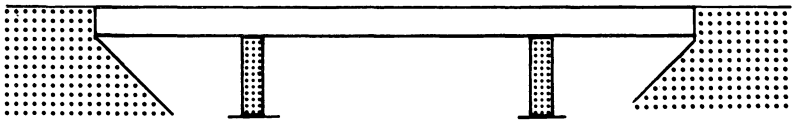
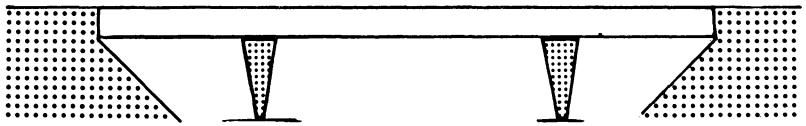


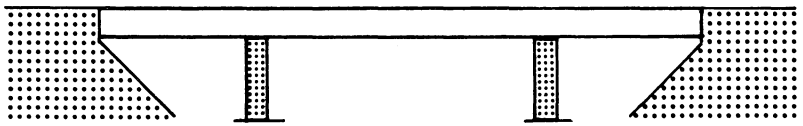
Tapered piers visually emphasize horizontality of deck structure, expressing the piers as supporting the girders.



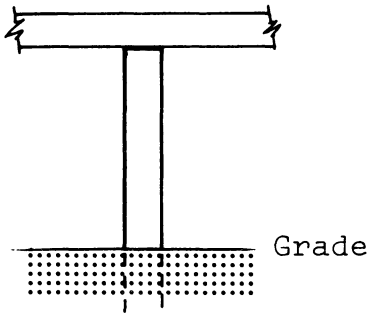
Adequate, but relatively unexpressive solution.



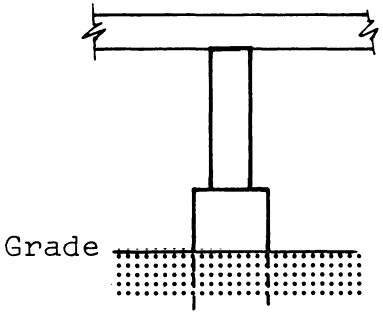
Taper ofpiers draws together span and piers and expresses structure as being supported at the ground line.



Lacks interest and variety.



Pier taken down below grade offers a clean form to view.



Pier resting on exposed foundation or plinth presents an unnecessary visual obstruction.

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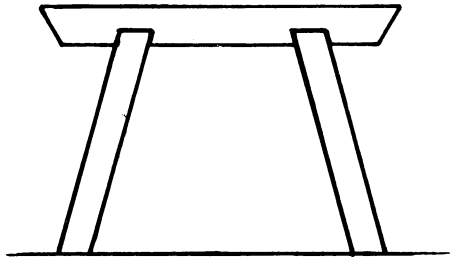
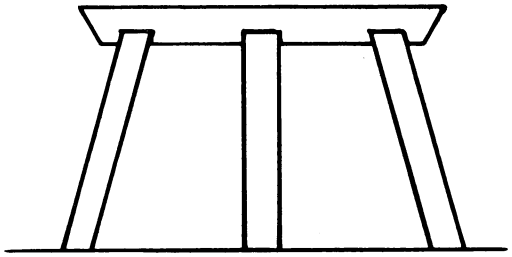
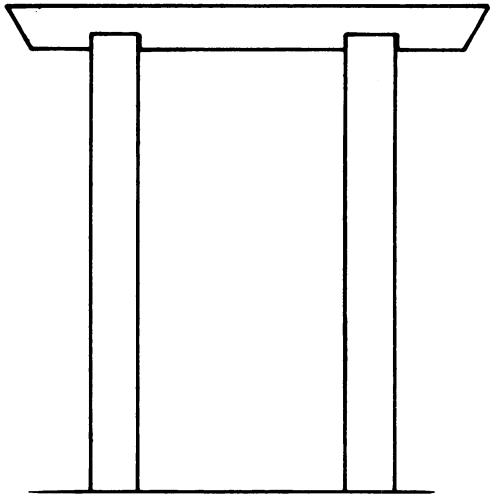


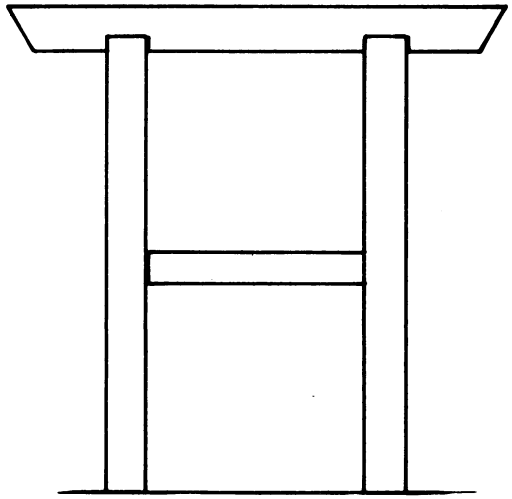
Battered piers or piles standing alone clearly express lateral stability.



Mixed vertical and battered piers or piles create a confusing image.



Simple, self-supporting tall piers accentuate vertical slenderness of the structure.



Braced piers introduce an undesirable horizontal element to a basically vertical structure.

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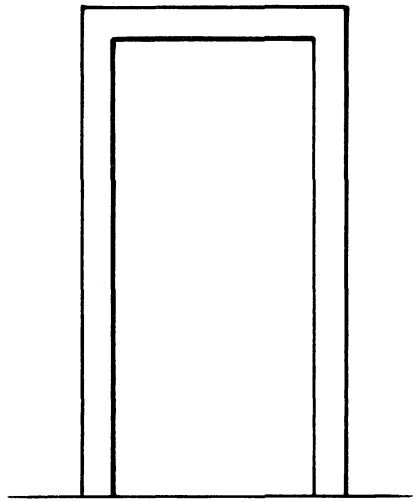
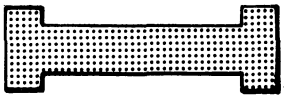
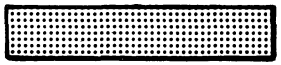
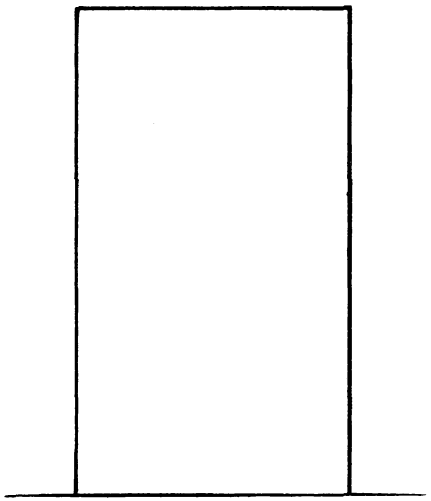




Section



Section



Solid pier with edges framed lightens the heaviness of a large concrete mass.

A simple form is desirable in a small mass, but in a large pier it lacks expression and interest.

ABUTMENTS, BRIDGE TERMINALS AND SLOPE PROTECTION

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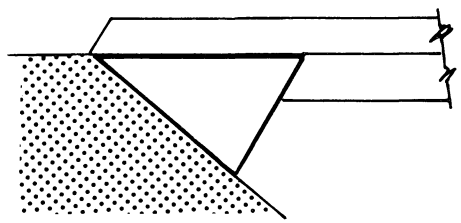
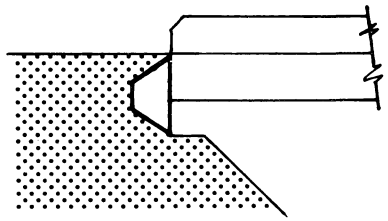
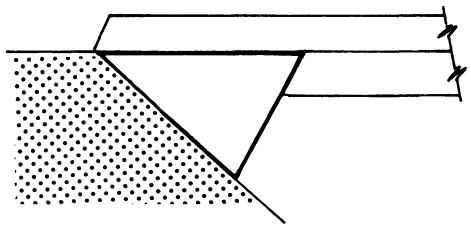


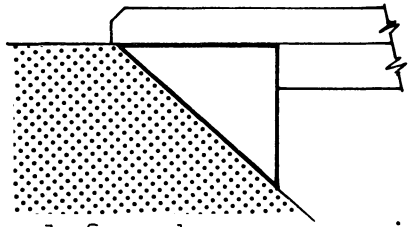
Relatively large sidewall of abutment visually anchors bridge to earth. Wall paralleling bridge defines axis of bridge.



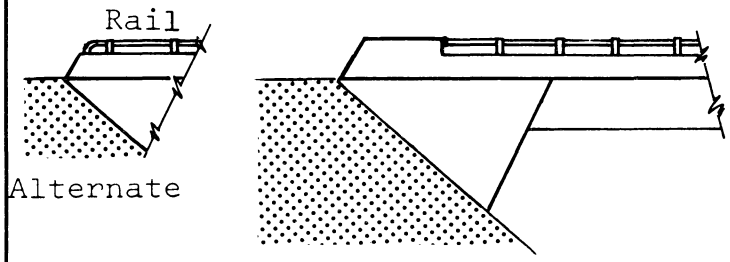
Small visible abutment appears weak and is likely to be hidden by weeds. Wing walls, projecting out, tend to look clumsy and cause harsh break in land contours.



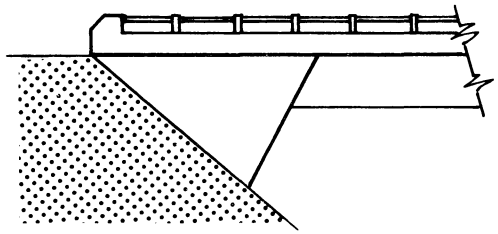
Sloped face adds excitement and suggests arch form.



Vertical face has no special interest.



Where railings are used, enlarged terminal wall reflects the strength of the abutment wall. End slope has a clean decisive look. Omission of raised end of wall entirely is an alternative solution; it produces straight, clean lines.



Terminal wall next to rail has a weak look.

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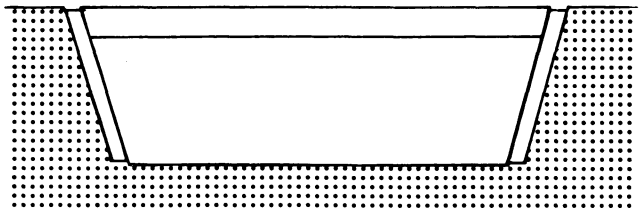
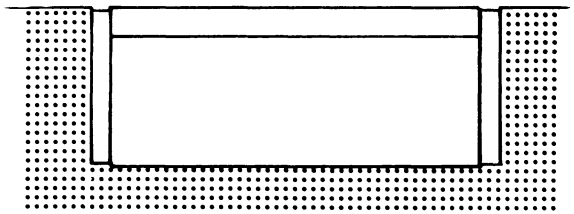
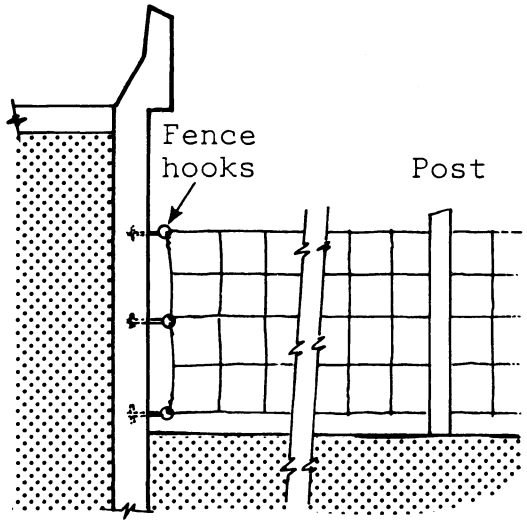


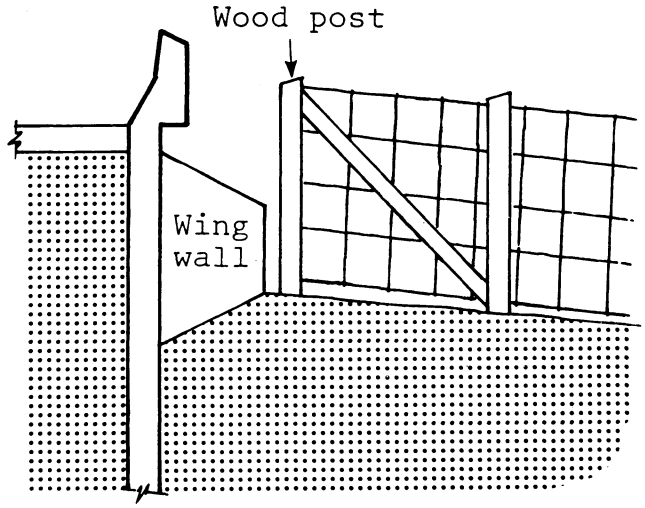
Sloped retaining walls in cut tend to open up the depressed area. Textured or brightly colored wall surface would compensate for loss of view.



Vertical walls generate a closed in feeling. Plain, bare concrete walls tend to look dingy over the years.



By attaching protective fence directly to side wall of bridge abutment, with first post visually distant from bridge, a designed relationship between fence and bridge is established.



Fence is totally unrelated to bridge in form, material and construction.

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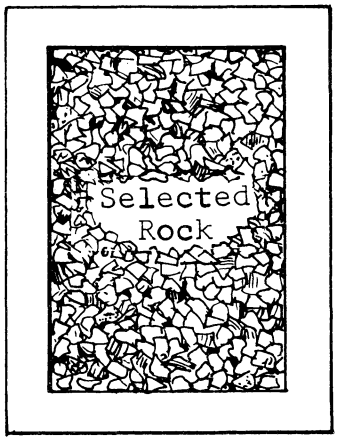
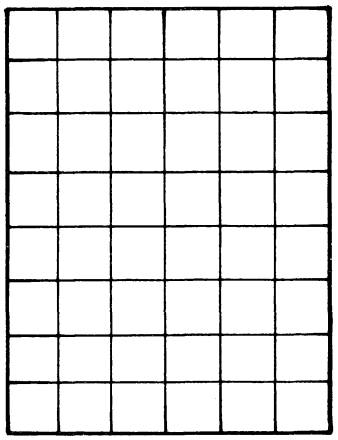
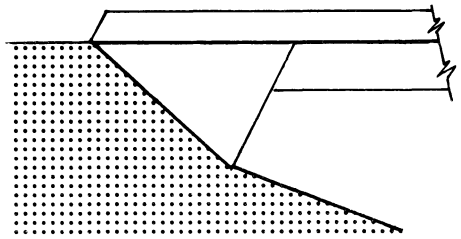


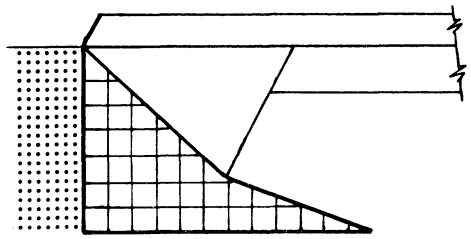
For slope protection under bridge, selected rock edged with concrete tends to blend harmoniously with landscaping.



A solid slab of concrete as slope protection visually overemphasizes the underside of the bridge and is disconcerted with adjacent landscaping.



Slope protection should be confined to areas under bridge where no vegetation can grow.



Excess exposed concrete slope protection gives the ends of the bridge a hard, barren look incompatible with normal landscaping.

MISCELLANEOUS DETAILS

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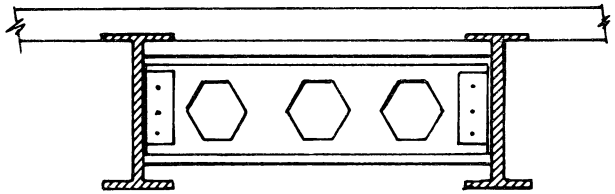
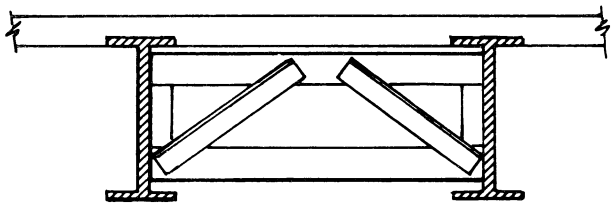
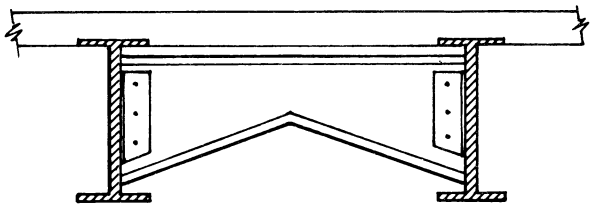


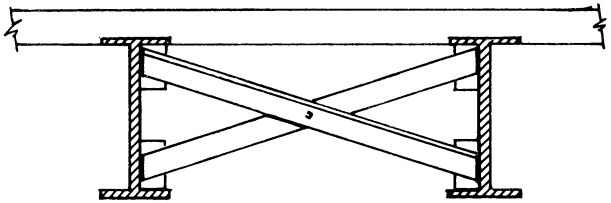
Solid or castellated diaphragm as bracing has a tidy appearance.



Angle bracing system has a terribly cluttered look.

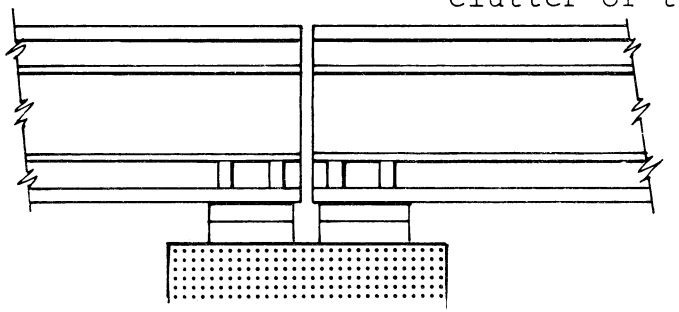


Solid diaphragm as shaped above lends lightness to a clean look.

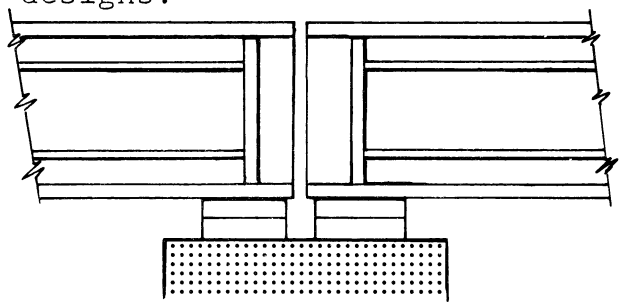


Angles are cluttered in appearance.

Note: Where the two preferred designs above are prohibitively expensive the underside of the bridge should be painted black to obscure the clutter of the less preferred designs.



Lines of horizontal stiffeners on girder are best unbroken by vertical stiffeners.



Terminated horizontal stiffeners block visual flow.

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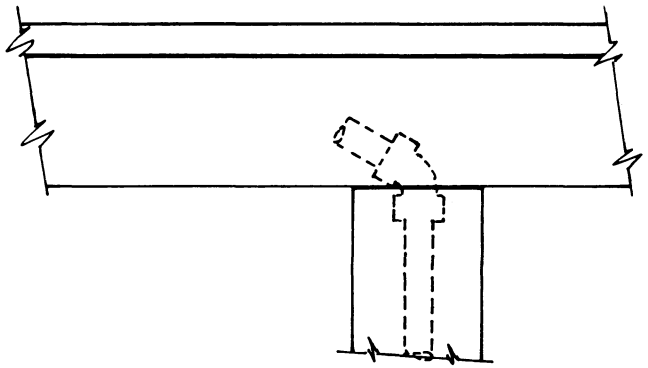
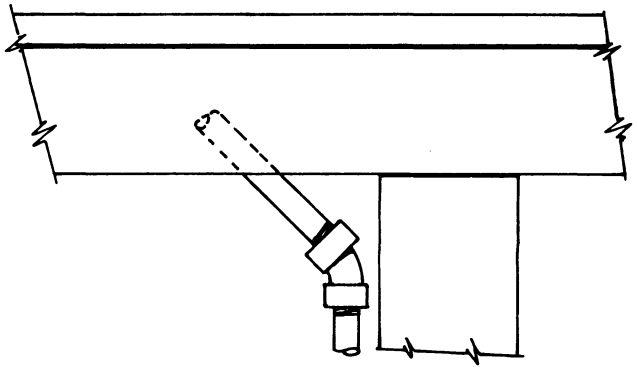
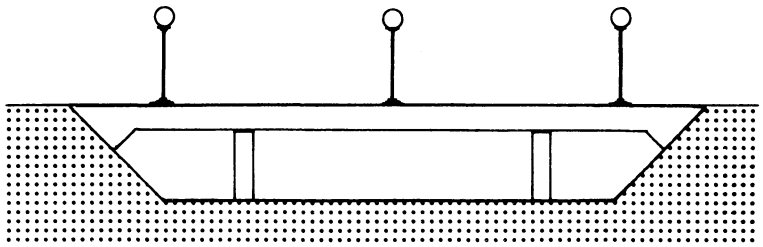


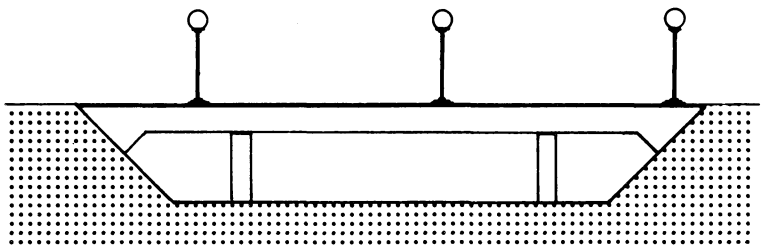
Drains concealed within structure by inclusion or recession present a well finished appearance.



Highly visible drain pipes give the bridge a makeshift look.



Light poles on bridge should relate to symmetry or geometric features of bridge, as supports and abutments.



Light poles unrelated to geometry of structure appear disordered.

COLOR AND TEXTURE

PREFERRED	(Compare horizontally)	LESS PREFERRED
Steel painted in colors as green, light blue, yellow or white. (Natural corrosion of weathering steel, if uniform, is also acceptable.)		Steel painted in colors as aluminum, gray, black, brown, or red.
Concrete in colors as white or pastel, earth colors as tan or reddish ocher.		Concrete in colors as natural gray or dark colors as blue or green.
Use of a single applied color, other than natural colors, relates to surroundings easily.		Multiple colors are too distractive and may clash.
Large concrete surfaces as walls which are surface textured or sculpturally embossed to provide visual shades and shadows. (Such wall treatment however requires careful handling as there are no simple esthetic rules to go by.)		Plywood form finish on large concrete surfaces is visually plain and monotonous.
Where an entire concrete surface cannot be colored, textured or sculptured, limited accent features as inset colored or sculptured panels relieve the visual dullness on large expanses of concrete. (This treatment requires special handling as every situation is likely to be different.)		Plain finish on large surfaces is visually flat and dull.

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3. Brown, H., Concrete Finishes for Highway Structures, VHTRC, Report 75-R27, Jan. 1975.

4. California Department of Transportation, Manual of Bridge Design Practice, Sect. 16.1.0, Aesthetics in Bridge Design, 3rd Ed., 1971.

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7. Federal Highway Administration, Highway and Its Environment Annual Awards, 1974, 73, ---- 68, Washington, D.C., 1974, 73, ---- 68.

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11. Wengenroth, R. H., Bridge Engineer Looks at Esthetics of Structures, Proc. ASCE, ST4, April 1971, pp. 1227-1237.

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15. Zuk, W., Public Response to Bridge Colors, TRB 507, 1974, pp. 1-5.

16. Zuk, W., Esthetic Considerations for Steel Bridges, ASCE Specialty Conference on Metal Bridges, St. Louis, 1974, pp. 29-41.