

# THE THREE MYTHS OF BRIDGE AESTHETICS

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## **Abstract**

This article is a critical review of the conventional wisdom on bridge aesthetics. If bridge design is to be recognized as a valid and distinct means of artistic expression, then bridges must reflect the truths that define the fundamental essence shared by all works of art, regardless of the medium of expression. By extension, for these truths to be embodied in bridges, their existence and importance must first be acknowledged in the conceptual frameworks used by designers to guide their decisions in the design process.

A fundamental attribute of the essence of art is to challenge existing ideas, and hence to defy dogmatic notions of how to create art works that are in “good taste”. The conventional wisdom on bridge aesthetics, however, is actually nothing more than such a set of dogmas. These include: (1) Form Follows Function (structural efficiency is a sufficient condition for aesthetic significance), (2) The Customer Is Always Right (art is not created by artists, but by the public), and (3) Architects Do It Better (the discipline of structural efficiency and the expressive potential of the flow of forces are irrelevant). The works of Maillart, Roebling, and other masters of bridge design show that designers need to be free from such dubiously founded restrictions to create works of artistic significance.

## **1. Introduction: Creating Bridges as Art**

If bridge design is a valid means of aesthetic expression in its own right, then it is certainly one of the most confused. As an art form, bridge design is torn between its vast and largely untapped potential, and a prevailing culture that severely inhibits the creation of aesthetically significant works.

The potential of bridge design as a means of artistic expression is evident in masterpieces such as Roebling’s Brooklyn Bridge and Maillart’s Salginatobel Bridge. These structures have been recognized as works of aesthetic significance by scholars within the engineering profession [1] and by important writers in other fields [2] [3].

Billington [1] has argued convincingly that these structures are not works of sculpture or architecture, but rather belong to a medium of their own, distinguished from the other two by its use of the discipline of structural efficiency as the primary basis for the creation of new and significant visual forms.

The differences between bridges and works of architecture are analogous to the differences between, for instance, novels and dramatic works, in the sense that the differences arise from the distinct creative possibilities offered by the unique characteristics of each medium. Given the prevailing tendency among both practitioners and laymen to lump bridge design together with architecture, it is important for bridge designers to be aware of the extent to which these two art forms are indeed distinct and of the complexity of the factors that distinguish the two. Awareness of the differences between bridge design and other forms of art must not, however, overshadow the fact that as an art form, bridge design must inevitably share certain fundamental characteristics in common with all works of art, regardless of medium.

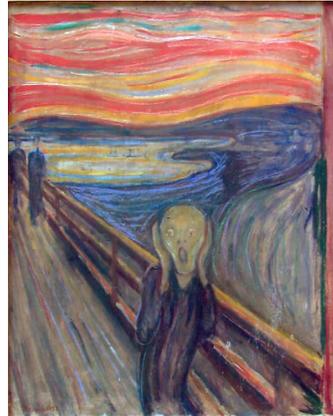


Figure 1 Edvard Munch (1893) *The Scream*. Nasjonalgalleriet, Oslo

In the context of the prevailing culture of bridge aesthetics, the most important of these characteristics is that *art challenges existing ideas in meaningful ways*. Our use of words such as “revolutionary”, “ground-breaking”, and “visionary” in referring to works of art reflects an awareness that works of art can and do indeed challenge commonly held views. The qualifier “in meaningful ways” has been included to emphasize that works that are gratuitously shocking are excluded from consideration. A meaningful challenge to existing ideas is one that can maintain its ability to awaken emotions or to stimulate ideas long after any shock value has worn away. A formal proof of the proposition that art challenges existing ideas in meaningful ways will not be attempted. Instead, examples will be used to illustrate the ways in which this fundamental characteristic manifests itself in works of art in both classical media and in bridge design.

Edvard Munch’s 1893 painting *The Scream* (Fig. 1) depicts the distorted face of a screaming man, deep in emotional torment. When this painting first appeared, its troubling subject matter and dream-like technique bore little resemblance to any other painting seen before. By this aspect alone, the work unequivocally challenged the contemporary perspective on what paintings should look like. A more fundamental significance of the challenge laid down by *The Scream*, however, can be seen in the influence it had on important works that followed it in the history of modern painting. The power of Edvard Munch’s vision remains undiminished to this day, as *The Scream* continues to challenge viewers to confront the dark emotions that lie within.

Art that challenges need not be based on troubling themes. The music of Mozart, for example, gives listeners great pleasure. The richness and complexity of his musical ideas, though, were a significant departure from the music of his contemporaries. The significance of the challenge inherent in Mozart's music is clear from the profound and lasting influence Mozart has had on the history of music, and from the ways in which his work continues to inspire new interpretations by modern performers.

Aesthetically significant bridges also embody meaningful challenges to existing ideas. The Pont de la Tournelle in Paris (Fig. 2), constructed in 1928, is indicative of the contemporary ideals of good bridge aesthetics. Although the structure is reinforced concrete, it is faced with stone veneer and detailed to resemble a masonry bridge of a former era. Through its use of the concrete structure itself as the means of expression Maillart's Salginatobel Bridge (Fig 3), represents a radical departure from the prevailing artistic tastes represented by the Pont de la Tournelle. It is no coincidence that the bulk of Maillart's work was built in rural Switzerland, where the economy of his well engineered bridges mattered more to the local authorities than did the differences between his aesthetic vision and conventional wisdom.



Figure 2 Pont de la Tournelle, Paris



Figure 3 Salginatobel Bridge

If the essence of art includes raising a challenge to existing ideas, then that art cannot be the result of the mere application of predetermined rules, conventions, or other systems of dogma. If bridge design is to be regarded as a valid and distinct medium of artistic expression, then this statement must also hold true for bridges. The reality, however, is quite different. Bridge design is currently practiced within a rigid framework of conventional wisdom that severely restricts the ability of designers to create works that challenge existing ideas. Three primary dogmas can be identified in this regard: (1) bridges that are structurally efficient are always aesthetically pleasing ("Form Follows Function"), (2) bridges that are liked by the public are always aesthetically pleasing ("The Customer Is Always Right"), and (3) engineers on their own are incapable of designing aesthetically significant bridges ("Architects Do It Better"). These

propositions, referred to collectively as the “Three Myths of Bridge Engineering”, will be discussed in greater detail in the following sections.

## **2. First Myth: Form Follows Function**

The proposition “Form follows function” has its origin in the personal aesthetic of American architect Louis Sullivan, who played an influential role in the development of the form of the modern skyscraper [4]. In the context of Sullivan’s work, “form follows function” relates to the notion that visual elements must be a consistent reflection of the functions carried out in a given building. For example, Sullivan opposed horizontal visual separation between office floors of tall buildings, since such a statement would have been inconsistent for storeys with essentially identical functions. This reasoning led to the strong visual expression of vertical elements of tall buildings, as exemplified by his seminal Wainwright Building in St. Louis, U.S.A.

“Form follows function” has taken on a new life as the cornerstone of conventional wisdom on bridge aesthetics, albeit with a meaning that differs significantly from Sullivan’s. In the context of bridge design, “Form follows function” is generally understood to mean that efficient structural behaviour and low construction cost are sufficient conditions for visual elegance. This interpretation is supported by the overwhelming majority of texts written on bridge aesthetics over the past fifty years. The following statements are indicative of this perspective:

*Aesthetics are inherent in good bridge design. The classic phrase, “form follows function”, is a basic principle in bridge engineering. A properly proportioned bridge is attractive. The size and shape of the structure’s components provide a definition of its purpose. That’s what people appreciate when it comes to bridge aesthetics. Innovative solutions automatically make a structure aesthetically pleasing. [5]*

*There must be inherent beauty in cable-stayed bridges because most cable-stayed bridges are beautiful despite our best efforts to make them ugly. [6]*

Both quotations allude to beauty that is “inherent” in well designed bridges, i.e., structurally efficient ones. Buckland in particular refers to an essence of elegance that is so strong (presumably because of the high visibility of the function of the main structural members) that it can actually prevail when the designer’s creative efforts prove to be ill-founded. It is significant that neither quotation contains any reference to creative effort directed specifically towards the aesthetic aspects of the design. One could certainly conclude from these statements that, by applying the prevailing interpretation of “Form follows function”, it is possible to become an artist without even trying.

Although the two statements quoted above are by no means isolated examples, they are admittedly somewhat extreme. Even more moderate perspectives, however, can generally be traced back to the premise that structural efficiency leads to aesthetic

quality. Following a series of studies comparing “ordinary” and “better” bridges, for example, Gottemoeller [7] sums up the characteristics of the “better” bridges as simplicity, thinness, continuous lines, and member shapes that reflect the forces acting on them. All of these, of course, are visible attributes of structural efficiency. The implication is that an improvement in aesthetic quality can be obtained when structural efficiency is increased, which is essentially identical to the bridge designer’s interpretation of “Form follows function”.

Structural efficiency is a property that can be measured. When it becomes the primary determinant of “aesthetic quality”, there is a tendency also to regard aesthetics as a property that can be measured, and hence optimized. Instead of focusing on the development of new creative ideas, bridge design is thus transformed into a process directed towards achieving objectives that are known from the outset to be “aesthetically pleasing” because they correspond to structural systems of high structural efficiency. The bridges that result from this perspective are generally similar in appearance and are often pleasant to look at. Precisely because they have been designed to conform with existing ideas rather than to challenge them, however, they generally lack the richness that is generally associated with significant works of art.

This perspective on “Form follows function”, together with the engineer’s penchant for working with numbers, has led to proposals to develop quantitative methods for dealing with aesthetic issues in design. Zuk [8], for example, has developed an “expert system” based on 177 statements on bridge aesthetics extracted from texts on the subject. For a given girder bridge, the system rates its appearance from “zero for a bridge grossly ugly to 10 for a bridge sublimely beautiful”. Designers would presumably optimize the visual characteristics of a given bridge and increase its rating until the budget for the project was reached. Because the highest ratings will be awarded to designs that are similar to those that are in closest accord with the statements in the expert system’s database, this process will produce only copies of tried and true designs. The creative component of bridge design is thus effectively transformed into a process of following rules rather than challenging them.

The applications of “Form follows function” described above are fundamentally flawed because they allow the appearance of a given bridge to be determined with no specific consideration of aesthetic issues. The designs and writings of Maillart, Roebling, Ammann, and other masters of bridge design clearly show that there is an important link between structural behaviour and aesthetic significance, but that this relation is far more complex than current conventional wisdom would indicate. Taken by themselves, structural efficiency and economy have no aesthetic significance. Billington [1] has demonstrated, however, that in the hands of gifted designers, the discipline imposed by efficiency and economy can help to generate and refine visual forms that would not otherwise have been created.

### 3. Second Myth: The Customer Is Always Right

There has been a trend on recent bridge projects towards greater public involvement in the design process. The public is demanding involvement partly out of concern for the appearance of the bridges that are to be built in their neighbourhoods, and they are convinced that these concerns will not be properly addressed without their participation. On several major projects, when transportation agencies have tried to proceed in opposition to the public and without having consulted them, the resulting backlash from community groups has led to major delays and even cancellations. To avoid such problems on future projects, many owners have decided to grant the public meaningful involvement in the design process.

Owners and their consultants have developed programs for public participation. Gottemoeller [7] describes one such program in which workshops were held to allow the public to develop bridge alternatives. These concepts were then studied by professionals on the project staff and the results of this study were presented to the public for review and further development. In this sense, the public was truly a major participant in the design process, whereas the work of the design professionals at this stage of the project was strongly focused on providing the public with technical support. On several projects, the public has actually been allowed to select the primary features of major structural components through a voting process [9].

The results of these exercises have not all been stellar. The process described by Gottemoeller, for example, produced a three-span concrete box girder where each span supports an arch rib completely devoid of structural function (Fig. 4). It is clear from Gottemoeller's account that the public wanted arches and they were given arches. This was accomplished, however, by means of a solution that is far removed from the discipline of structural efficiency and economy. The bridge appears as though the arch ribs were added as



Figure 4 Rainbow Bridge, U. S. A.

an afterthought to a haunched girder bridge that was already complete, both structurally and visually. Arches are one of the boldest, most expressive elements available to bridge designers. It is unfortunate that in this case they were used merely to deceive.

There are no simple answers to the problems relating to public participation on bridge projects. The problem tends not to be public involvement per se, but rather a mindset that the primary focus of the design process must be transformed into one of building

consensus as quickly as possible. When bridges are designed on this basis, it is unlikely that they will have the capacity to raise meaningful challenges to existing ideas, because their entire *raison d'être* is to conform rather than to challenge.

#### **4. Third Myth: Architects Do It Better**

The conventional wisdom on bridge aesthetics allows only one exception to “Form follows function”: the “Signature Bridge”. This category includes all those bridges for which owners truly want to make a unique visual statement. (Presumably, such a statement would constitute a visual “signature” of a city or region, hence the term.) Remarkably, owners have determined that structural efficiency alone will not provide the level of aesthetic quality required for signature bridges. Owners have usually been prepared to devote larger budgets to signature bridges and have generally retained the services of architects to play a major role in determining the visual aspect of these bridges.

The participation of architects on bridge projects is not a recent phenomenon. Their hand can be immediately recognized in the highly ornamented urban bridges of the late nineteenth and early twentieth centuries. In fact, laymen commonly refer to bridge designers as “architects”, regardless of their actual profession. The debate regarding who “owns” the creative aspects of bridge design has also been with us for many years. Given that the engineering profession’s understanding of bridge aesthetics has for many years been limited to “Form follows function”, and given the lacklustre bridges that have resulted from this perspective, it is not surprising that there is broad support for increased participation of architects in the creative aspects of bridge design.

It is not the intent of this article to join in the debate of which profession owns bridges. Ultimately, each owner must decide for himself whether he wants to work with architects or not. This article does, however, advocate that this choice be made on an informed basis. By adhering to a dogmatic belief that architects are the only ones who can design aesthetically pleasing bridges, owners deprive themselves of the richness of the engineer’s unique vision, founded in the discipline of structural efficiency and economy and epitomized by the works of masters such as Maillart and Roebling.

Architects deal with the arrangement of abstract and symbolic visual forms. There is very little in their training, day to day experience, and overall perspective that equips them or inclines them to work effectively in a medium which seeks to give meaningful visual expression to loads, equilibrium, and forces. When architects enter the realm of bridge design, their contributions are usually applied over the structure, in the form of abstract or symbolic ornamentation. This, of course, is consistent with their particular professional background. When they venture into the arrangement and form of main structural components, their contribution has typically been to make forces flow the “wrong” way, along visually expressive but circuitous paths. If owners consider these measures to be visually pleasing, and if they are prepared the price, then so be it.

Engineers, architects, and owners, need to remember, however, that there is another source or rich visual meaning, epitomized by Maillart's Salginatobel Bridge. This bridge, which has been recognized for its aesthetic significance by engineers, architects, and laymen, could not have been designed by someone who was not deeply aware of structural behaviour, because only with this perspective could he create a work that used the flow of forces in such a unique and expressive way. By definition, this person is an engineer, not an architect. If owners want to build structures that mine this rich vein of aesthetic potential, they need to work with engineers.

## 5. Concluding Remarks

The aesthetic vision of the engineer is rooted in the creative possibilities offered by the visual expression of the flow of forces. It is an aesthetic that derives creative impetus from the discipline imposed by the economy of materials and means.

Bridge design has long been plagued by dogmatic notions of what bridges should look like and who should design them. For bridge design to grow and develop as an art form, it is certainly necessary to dispel these notions, in order to create an intellectual framework for creative work and criticism that is on equal footing with other artistic media. This, however, is not sufficient. Given the importance of technology as a source of creative ideas that can be visually expressed, it is also critical that designers work to move bridge technology forward at a more rapid pace.

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