Zeitschrift: IABSE congress report = Rapport du congrès AIPC = IVBH Kongressbericht

Band: 11 (1980)

Artikel: Bridge aesthetics: 1925-1933

Autor: Billington, David P.

DOI: https://doi.org/10.5169/seals-11226

I

Bridge Aesthetics: 1925 – 1933

L'esthétique des ponts: 1925 – 1933

Brücken-Aesthetik: 1925 – 1933

DAVID P. BILLINGTON
Professor in Civil Engineering
Princeton University
Princeton, NJ, USA

SUMMARY
A review of ideas on bridge aesthetics during the founding period of the International Association for Bridge and Structural Engineering brings out a central question: the role of the architect in bridge design. Many thought that bridge design should be a collaborative effort between engineers and architects, with the architects primarily responsible for aesthetics. Some, however, believed that engineers should make the designs alone and that they should themselves seek forms that were both technically correct and aesthetically satisfying. The article refers also to Robert Maillart, an engineer whose best known designs of that period were made without collaboration.

RESUME
Un coup d'oeil rétrospectif sur les conceptions de l'esthétique des ponts à l'époque de la fondation de l'Association Internationale des Ponts et Charpentes pose la question centrale suivante: quel est le rôle de l'architecte dans le projet d'un pont? Beaucoup de personnes pensaient que le projet d'un pont devait être l'objet d'une collaboration entre architectes et ingénieurs, les architectes étant responsables de l'esthétique; d'autres étaient d'avis que les ingénieurs devaient projeter les ponts seuls, et trouver des formes qui satisfassent simultanément aux critères de la technique et de l'esthétique. L'article mentionne Robert Maillart, ingénieur dont les ouvrages les mieux connus de cette époque ont été projetés sans collaboration d'un architecte.

ZUSAMMENFASSUNG
Ein Rückblick auf die Vorstellungen über die Aesthetik im Brückenbau während der Gründungszeit der Internationalen Vereinigung für Brückenbau und Hochbau wirft folgende wichtige Frage auf: Welche Funktion übernimmt der Architekt beim Entwurf einer Brücke? Viele sind der Meinung, dass der Entwurf einer Brücke ein gemeinsames Werk von Architekt und Ingenieur sein sollte, wobei der Architekt hauptsächlich für die ästhetische Wirkung des Bauwerks verantwortlich ist. Einige waren jedoch überzeugt, dass die Ingenieure den Entwurf allein ausführen und nach Formgebungen suchen sollten, welche sowohl technisch einwandfrei als auch ästhetisch zufriedenstellend sind. Der Artikel erwähnt Robert Maillart, ein Ingenieur, dessen bekannteste Werke jener Zeit selbständig und ohne Mithilfe eines Architekten entstanden sind.

During the eight-year period from 1925 to 1933, there appeared substantial discussion of bridge aesthetics both in Europe and in the United States. The primary aesthetic question in this period, and to a large extent the primary question today, is the role of architecture in bridge design. Although some writers of the earlier period took the position that architecture and engineering, having regrettably gone separate ways in the nineteenth century, should re-unite, with the architect setting form, nearly all writers took one of two other positions. The first group agreed that for technical reasons the engineer should be the principal designer but that an architect was needed for aesthetic advice; while other writers held that the engineer should set the form alone and should learn to combine technique and aesthetics in design.

Bridge Design by Collaboration

Many writers and most designers believed in some sort of collaboration between the architect and the engineer. Perhaps the most detailed survey of bridge aesthetics from this point of view appeared in a four-part 1930 treatise by a young Austrian engineer Paul Abeles [1].

Abeles surveyed the writings of various architects and he then discussed critically the writings of a series of engineers. Abeles singled out two papers presented at the second International Meeting for Bridge and Structural Engineering in Vienna in 1928. One of these was by F. Hartmann who had just published a book on Bridge Aesthetics in Vienna [2]. From analyzing these works Abeles concluded that bridge form must come primarily from engineers. Since in his view the engineer was preoccupied with technical study, however, Abeles recommended the use of an architect as an "astistic consultant". This type of collaboration became common practice on many important bridges and is still widespread.

One of the most significant American writers of this period, Wilbur Watson, recognized the same problem of the busy engineer by comparing pre-nineteenth century designers such as Jean Perronet to twentieth century ones for whom "modern conditions demand far more training and experience than can be expected from an individual" [3]. He concluded that "Collaboration between architects and engineers is, therefore, necessary, and should begin with the inception of the work". Abeles discussed but did not recommend this position because, in his view, the resulting work would lack unity, being a compromise between the ideas of two designers.

The Engineer as Bridge Designer

Hartmann's Vienna presentation stressed the negative role architects had played in bridge design by adding useless decoration. Hartmann emphasized that modern design required a break with established rules and that proper design required a new theoretical knowledge that was foreign to architects. Hartmann concluded that engineering students should be taught aesthetics from several professors so that later judgments would be free from the dogma of a single teacher and would represent the designer's own ideas.

This Vienna paper by Hartmann has substantial historical interest because of the prominence both of the author and of the paper within the 1928 Congress itself [4]. Friedrich Hartmann (1876-1945) was the president of the entire 1928 Congress and he opened the proceedings by outlining its scope and goals in a speech "which had left an exalting impression on all delegates". Hartmann, a professor at the Technical Institute in Vienna, was a distinguished engineer of international stature. The fact that he chose to speak in the technical sessions on the subject of aesthetics marked a significant departure from similar technical meetings.

But the paper's importance also comes from its location as the opening report at

the Congress and its stimulus to an extensive discussion. Only two other report topics out of the twenty given received as much discussion. Even more significant to this present paper is the fact that Hartmann began his essay by discussing the role of the architect in bridge design. His argument is characterized by the following quote:

"Today the dogma is held that a masterpiece of bridge design can be gotten only by the close collaboration between engineers and architects even at the outset of the design. However, experience shows that a masterpiece of art hardly ever comes through collaboration but rather only through the direction of one master. That the architect is not that one who today can create alone a masterpiece of bridge design hardly anyone would doubt. The design of bridges depends upon so many different conditions, which only the engineer understands, that the engineer themselves, therefore, must also deal with the artistic side of bridge structure."

This emphasis upon the engineer taking on the complete design including aesthetics had, for Hartmann, consequences for education as well as for practice. Just as engineering designers should consider all aspects of design so should teachers of bridge structures, thus aesthetics should not be just a separate course but more important it should be integrated into each course on structures. "So it will be best if each professor will concern himself basically with the aesthetics of his specialty and discuss that with his students." His implication was that there should be a unity in teaching as much as in design and that the professor should strive for the same completeness in teaching as does the practitioner in designing.

Hartmann's paper and his book are of especial value today because of their numerous illustrations and of his critical comments on them. Particularly instructive is his discussion of reinforced concrete bridges largely because he is critical of their heavy appearance, just the feature, stone-like heaviness, that appealed to so many writers of this period. Hartmann clearly preferred steel bridges largely because they appeared lighter. His criticisms of the largest reinforced concrete bridges in Switzerland are perceptive and useful even today. Because his book appeared in 1928, it predated the mature works of Robert Maillart; some of Hartmann's criticism reflects aesthetic ideas that Maillart would put into constructed form during the twelve years between the Vienna meeting and his death in 1940.

Hartmann's book was not a systematic treatment and we would not today agree with all his judgements; but he did make judgements and he tended to avoid general arguments based on rules. But most significant was his emphasis on the importance of the engineers thinking out the problems of bridge aesthetics freed from the proscriptions of the past so often based upon architectural ideas no longer appropriate to the building materials of the twentieth century.

Many of the ideas of the period 1925-1933 were also summarized in a 1933 book on bridge aesthetics "Brückenästhetik" by Herman Rukwied, an engineer for the German highway authority. Rukwied saw bridge aesthetics as a part of architecture the analysis of which followed from such "concepts as unity, variety, symmetry, line, contrast ... proportion" [5]. Although Rukwied stressed what he believed to be the architectural character of bridge aesthetics, his book stimulated perhaps the first clear expression of bridge aesthetics as a characteristic of modern engineering.

On March 11, 1933, Werner Jegher wrote a review of Rukwied's book for the 'Schweizerische Bauzeitung' in which Jegher strongly criticised Rukwied's attempt to apply "eternal standards" to modern works of engineering [6]. According to Jegher, modern engineering has little relationship to the architecture of past times and "it does not do to stand in an isolated place and to wish to compre-

hend today's bridge by contemplation as if it were a Greek temple".

This critique continued in the October 28, 1933, issue of the 'Schweizerische Bauzeitung', in an article by the editor on several deck-stiffened arch bridges of Robert Maillart [7]. Rukwied had criticized Maillart's Valtschielbach bridge for having too thin and too flat an arch. For Rukwied, the heavy, solid-walled Via Mala bridge nearby was "magnificant and well-proportioned". The editor of the 'Schweizerische Bauzeitung' (probably Jegher) criticized this judgement with relish, noting that the poor mountain people of the region Graubünden and Berner Oberland happily were not "infected with aesthetic scruples when they requested from their engineer the least costly solution" for their bridges. The editor noted further that "the results must be pleasing in an everyday sense; it is not for Sunday dress that they reach".

The editor stated the goal that "a structure in the first place must be true to its inherent features, a pure expression of its being, of its purpose. Thus, an expensive beautiful heavy masonry arch for this bridge (Valtschielbach) would be a lie even if the proportions of deck and arch were handled with subtlety". The Maillart bridge was "simple and true and the aesthete will have to learn to see and to appreciate the beauty of these newly created forms and proportions. Then he will no longer condemn those works automatically on the basis of a comparison with works formed under totally different conditions and appropriate only to their time".

The 'Schweizerische Bauzeitung' editor put forward a radically new idea for bridge aesthetics in which beauty arose from the solution of new problems. In his view, to understand the aesthetics required an understanding of the technical and economic conditions under which the work was designed. In the case of the Valtschielbach bridge, Rukwied did not understand that the arch could be thin and flat because it was stiffened by a deck girder. This new technical idea made possible a new form of aesthetic expression which altered the conventional proportions of deck and arch.

Two major reasons for the special insight of the 'Schweizerische Bauzeitung' into bridge design were, first, the emphasis of the magazine on individual works and individual designers, and second, a policy of giving aesthetic judgements mainly on works about which it also gave considerable detail on the structural behavior and costs. For the 'Schweizerische Bauzeitung', Robert Maillart was the most important contemporary Swiss Bridge designer of the 1925-1933 period and it was therefore no accident that the editor used one of Maillart's bridges as the example with which to refute Rukwied's thesis.

From Valtschielbach to Schwandbach

The 'Schweizerische Bauzeitung' criticism came in the context of a discussion of Maillart's 1933 Schwandbach bridge. The progression from the Valtschielbach to Schwandbach bridges gave new evidence of the aesthetic possibilities of engineering by engineers [8].

Contrary to the views of writers who thought the technical problems too time-consuming to permit aesthetic study, Maillart's thirty year experience with arch behavior gave him the insight essential to simplify radically the technical analysis for the Valtschielbach bridge. As a result, he did not need long hours of study to analyze the form but could draw upon long years of technical experience.

Valtschielbach represented not merely a culmination of technical experience, but also a new beginning in the aesthetic possibilities of deck-stiffened arches. While Valtschielbach is a technical masterpiece, still in fine condition after fifty-five years of service in the harsh, high-altitude environment of Graubünden,

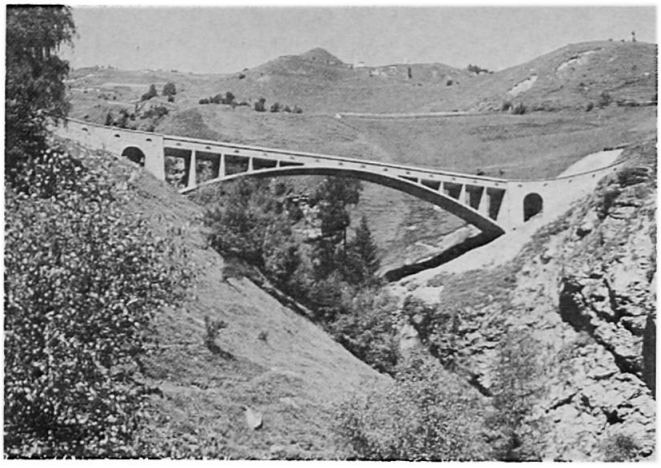

Fig. 1: Valtschielbach Bridge

it is not an aesthetic masterpiece (Fig. 1).

At Valtschielbach, a U-curve across a ravine is accomplished by a straight roadway deck and arch combined with sharp transition approach curves (Fig. 2). At Schwandbach, however, the same U-curve is achieved by one smooth elliptical curved deck supported by an arch whose concave side is curved in plan and whose convex side is straight in plan (Fig. 3). At Valtschielbach, the approaches are of heavy stone Romanesque arches. The arch is curved and merges with the parapet at the crown. At Schwandbach, the approach structure is light and open and has a girder of the same depth as the deck stiffener. The arch is polygonal and is separated from the lighter deck girder up to the crown.

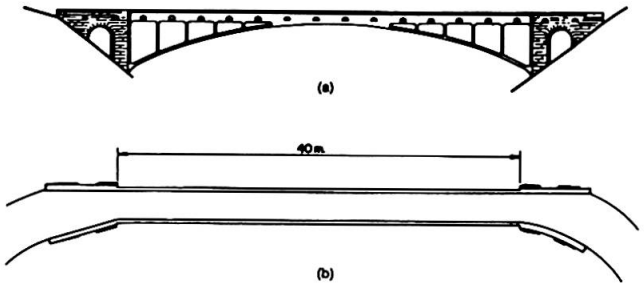

Fig. 2: Valtschielbach Bridge Plan

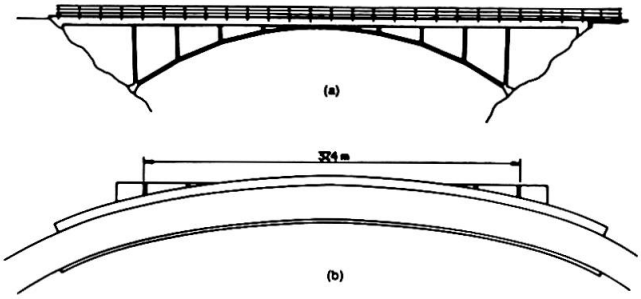

Fig. 3: Schwandbach Bridge Plan

The most dramatic difference between the two bridges, though, lies in how Maillart has connected the arch to the deck. In the 1925 bridge, the arch and the deck were exactly parallel and rectangular cross walls easily connected them. At Schwandbach, however, the arch was wider than the deck. Maillart introduced trapezoidal cross walls that provided not just a technically correct transition of forces but also gave a visually striking transition in form (Fig. 4).

Fig. 4: Schwandbach Bridge

Maillart defended his Schwandbach design in the 'Schweizerische Bauzeitung' in early 1934 by showing how alternative solutions proposed by an engineer F. Bohny from Sterkrade (Rheinland) would have been inferior both technically and aesthetically [9], Figure 5, taken from Ref. [9], illustrates Maillart's defence of his design. The first drawing shows the bridge as built, the second as proposed by Bohny and the third suggested by Bohny's argument. Of the second, Maillart noted that the constant width arch (follwing the plan of the curved roadway) gave the appearance of tipping toward the right whereas his design by having a wider arch at

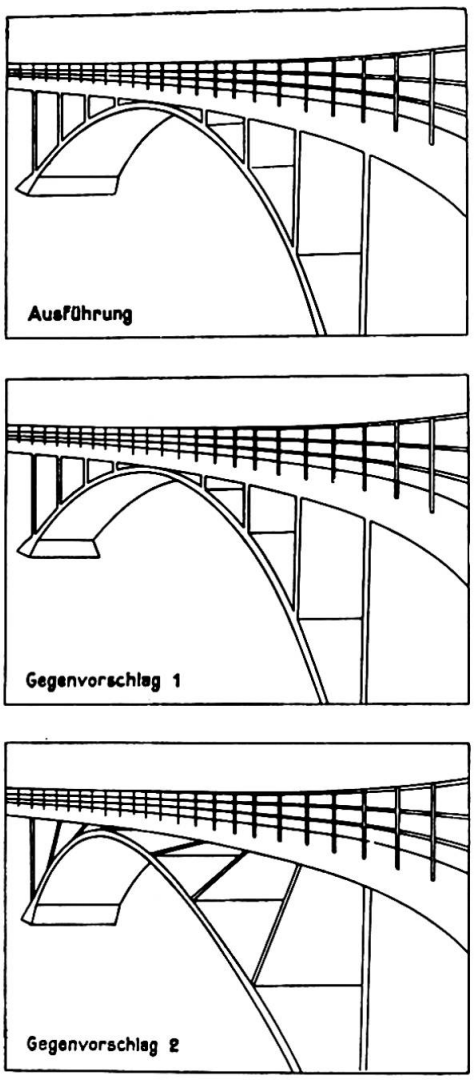

Fig. 5: Schwandbach Bridge and alternate proposals

the support "gave the appearance of stability and rest". As for the third design, where the arch would be straight in plan, Maillart commented that in addition to its greater cost und use of more materials, "also its aesthetic result is barely worth even discussing". His reply also including a careful technical discussion of how the loads were carried.

In this and in later writings, Maillart showed an inseparable concern for both technical and aesthetic excellence. In his eight-year experience between 1925-1933, he consulted no other designer. His three principles, articulated in the 'Schweizerische Bauzeitung', were to work within the constraints of the relatively new material of reinforced concrete, to apply his original insight into deck-stiffened behavior, and to achieve minimum cost. There was no imposition of aesthetic rules in his designs but there was a strong desire for aesthetic results.

At the close of this eight-year period, discussion of bridge aesthetics waned but the record of those years still provides a sound basis on which to analyze works of the 1980s: to achieve a more perfect integration of high technical quality, low cost, and aesthetic excellence in bridges.

Acknowledgement

The research for this paper was supported by grants from the National Endowment for the Humanities and the National Science Foundation for the writing of a biography of Robert Maillart. Support has also been provided by the National Endowment for the Arts, a Federal agency in Washington, D.C. Finally, I would like to acknowledge posthumously Dr. Paul Abeles who not long before his death kindly sent me his 1930 paper on aesthetics which stimulated this present paper.

References

[1] Abeles, P. "Ueber die künstlerische Gestaltung von Ingenieurbauwerken", Oesterreichische Bauzeitung, No. 2, 3, 4 and 5, 1930.
[2] Hartmann, F. "Aesthetik im Brückenbau", Leipzig and Vienna, 1928.
[3] Watson, W.J. "Bridge Architecture", Wm. Helburn, Inc., New York, 1927.
[4] Report of the 2nd International Congress for Bridge and Structural Engineering, Vienna, Sept. 24-28, 1928, Vienna, 1929. Hartmann's paper appears on pages 12-25. Pages 1-11 describe (in three languages) the organization of the Congress and Hartmann's prominent role in it.
[5] Rukwied, H. "Brückenästhetik", Berlin, 1933, p. 75.
[6] Jegher, W. "Review", Schweizerische Bauzeitung, Vol. 101, 1933, pp. 121-122.
[7] "Gekrümmte Eisenbeton-Bogenbrücken", Schweizerische Bauzeitung, Vol. 102, 1933, pp. 218-219.
[8] D.P. Billington "Robert Maillart's Bridges", The Art of Engineering, Princeton University Press, 1979, pp. 94-98, from which come Figs. 2 and 3.
[9] "Discussion", Schweizerische Bauzeitung, Vol. 103, 1934, pp. 132-133.