

## Holistic Design Methods for Hybrid Arch Bridges

Matthias Weißbach  
Structural Engineer  
Schlaich Bergemann  
und Partner (sbp)  
Stuttgart, Germany  
[m.weissbach@sbp.de](mailto:m.weissbach@sbp.de)



Matthias Weißbach, born 1972, received his engineering degree from the TU Berlin and his PhD from the University of Stuttgart.

He is a structural consulting engineer and hold a lectureship at the faculty of architecture of the University of Stuttgart.

### Summary

The entire analysis of arch bridges on various consideration-levels linked with the historical knowledge of the art of vaulting and the modern principles of light-weight structures and composite construction lead to hybrid arched structures and suitable construction methods. This opens up new qualities for arch bridge design and construction caused by synergetic effects.

Statical and functional advantages as well as aesthetical and economical advantages prove, that hybrid arches of steel and concrete make a fundamental contribution to a quantum leap in the development of arch bridges.

**Keywords:** design methods, bridge design, arch, arch bridge, light-weight structures, sandwich, composite structures, construction method

### 1. Introduction

Arches are characteristics of outstanding masterpieces of architecture. As a formal and functional important structural element they had a decisive influence on the genesis of the architectural technology.

To cross an impassable terrain – the original task of a bridge – is associated with the arch. Bridge design and construction in the past was dominated by arched structures for a long time. That's why the arch was very often the origin of innovation for the design and the construction of bridges up to the middle of the 20<sup>th</sup> century. The genesis of steel structures in the 19<sup>th</sup> century and concrete structures at the beginning of the 20<sup>th</sup> century, which was connected with a plenty of new structural systems, did not stop the further development and competitive ability of arched structures.

Caused by industrialisation and standardisation of bridge construction in the second half of the 20<sup>th</sup> century the arch lost his innovative role and with it considerably of his importance. This was followed by the normative standardization of regulated and simplified bridge designs. The further development of arch bridge construction of the last decades is characterised by a transfer of structural features and construction methods from girder bridges. It is caused by the aim to integrate the arch in the industrialized bridge construction connected with the hope of economical advantages. But this process was mainly followed by disadvantages for arch bridges.

For example the recent construction method of large reinforced concrete arch bridges, the use of the cantilever erection with temporary stays, is contradictory to the typical characteristics of concrete arch structures.

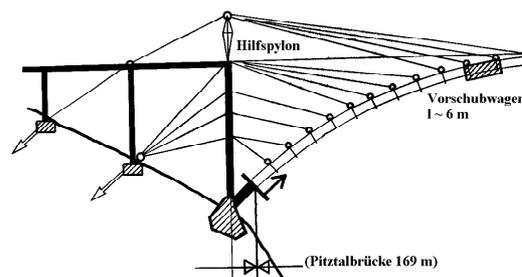


Fig. 1 *Cantilever erection of a concrete arch with temporary stay [Pauser, A. (1987)]*