

Structural Engineering Documents

**15**

**Engineering History  
and Heritage  
Structures – Viewpoints  
and Approaches**

Eberhard Pelke  
Eugen Brühwiler



International Association for Bridge and Structural Engineering (IABSE)

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Editors

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Eugen Brühwiler



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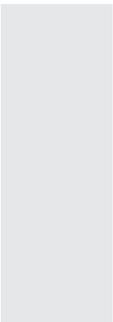
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# Preface

## Foreword

The roots of modern construction historiography reach back to the 19th century when for example in France the engineer Auguste Choisy (1841–1909) began to explicitly analyze the construction of historic buildings and to place them in the center of construction history.<sup>1</sup> In the last third of the 20th century, such approaches followed systematically and in an increasingly professional way. A long arch spans from the works like those by Jacques Heyman (1925) who interpreted ancient techniques and theories related to vaults by means of modern structural engineering approaches,<sup>2</sup> to the historic–theoretical research and publications like those by Karl-Eugen Kurrer (1952).<sup>3</sup>

In the meantime, several chairs and professorships in construction history were created and there is an impressive variety of conferences and publications. Every three years since 2003, the scientific community gathers at the International Congress on Construction History (ICCH). There is no doubt that construction history has established and consolidated internationally as an independent discipline.

Actually, what is construction history? Professor Werner Lorenz, member of the IABSE WG9 Construction History, defines construction history as follows:

*Structural engineering is the entity of the practices and products of conceptual design, dimensioning and construction of technical structures and components in the process of the constructional designing of the environment. Construction history describes and interprets these practices and products in their historic sequence. For that purpose, construction history interrogates the products of construction and all associated written and pictorial sources. Both the historic construction research and the methods of static-constructive and scientific engineering analyses belong to the methodical cornerstones.*

Construction history involves architects, monument conservators, historians and engineers in a transdisciplinary approach to fulfill scientific, cultural, didactic and also structural engineering tasks and requirements.<sup>4</sup>

IABSE WG9 Construction History has the general objective to promote this new science and to demonstrate its importance for structural engineers. The three main objectives of the WG on construction history are to:

- increase awareness among structural engineers of historical and cultural aspects of structures and structural engineering;
- illustrate and propagate the social and technical achievements of civil engineering;
- improve methods and practice in structural engineering by showing ways for systematic and targeted integration of historical and cultural aspects in intervention projects to adapt or modify structures of cultural value for future demands.

IABSE WG9 focuses on the role of construction history in the structural engineering practice and is thus intentionally complementary to the classical construction history as understood by the ICCH Community. The main concern of WG9 is thus to implement construction history in the daily work of structural engineers and to demonstrate the importance of cultural values as a basic design parameter when interventions on existing structures are required.

The present *Structural Engineering Document (SED)* is structured accordingly. It shall be understood as an introduction into construction history and how to consider the cultural values of structures in intervention projects. Although this *SED* is addressed primarily to IABSE structural engineers, it may also be useful for nonengineers.

This *SED* begins with the Editorial written by one of the “deans” of construction history: Tom F. Peters. Personal statements by several WG9 members testify a surprising variety of ways how the access to construction history was found and how it influenced professional activities. In the next chapter, Nicolas Janberg provides a worldwide survey on the activities and contacts in the domain of construction history. In the following, the papers by Max Johann Beiersdorf and Josef Steiner are contributions similar to essays on the aspects of construction history.

Twenty-five case studies on rehabilitation and modification of structures form the core material of this *SED*. Every case study outlines on a maximum of four pages the cultural values of the structure and highlights the appropriate measures for its respectful preservation. References and contact data of the author serve the reader to obtain detailed information. The case studies obviously range from ancient to modern structures and from medium to high cultural values, comprising various types of structures. Requirements of cultural heritage shall be taken as inspiration (and no longer as “hindering constraint”) for better intervention projects on existing structures. Construction history and cultural values of structures have yet to be understood as basic structural engineering disciplines.

With the present *SED*, the IABSE WG Construction History intends to make a significant contribution to modern structural engineering and to provide access to construction history for practicing structural engineers.

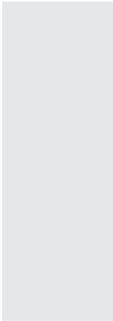
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**Eberhard Pelke, Chairman of IABSE Working Group 9 Construction History  
August, 2017**



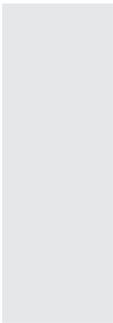
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## Afterword: Learning from the Past to Build the Future

The present SED is a compilation of contributions devoted to the vast topic of history of structural engineering as well as interventions on heritage structures and structures of high cultural values. Various, sometimes opposed, viewpoints and approaches are expressed and presented.

IABSE Working Group 9 “Construction History” is aware of the rather heterogeneous and controversial nature of the content of this SED. However, this shall stimulate and provoke lively discussions within the structural engineering community who needs to increase the awareness of historical and cultural aspects of structures and structural engineering. Current structural engineering methods and practice are only at the very beginning of effective engineering integrating historical and cultural aspects in the assessment of existing structures and in intervention projects to adapt or modify structures of cultural values for future demands.

Current structural engineering is predominately driven by a spirit to design and build new structures “out in the green”. Today’s structural engineers’ vocation still is to *design and build*, even when dealing with existing structures ! For many structural engineers, the opinion still prevails that an existing structure has a finite service life of 80–100 years and then needs to be replaced by a new structure. While this spirit was maybe rational 50 years ago, it is nowadays far away from modern society’s demands calling for a focused approach on existing structures, in particular those of high cultural values. Existing structures are an asset and wealth of a society, and structural engineers are called upon to maintain and enhance the existing structures effectively, within the availability of limited (public) funds ... instead of replacing existing structures by new construction.

The main problem is that most structural engineers have little or no education in the engineering of existing structures, including history of structures. They are not even aware of the opportunities available for the effective modern engineering of existing structures. This problematic situation is due to traditional civil engineering curricula at most of the technical universities still focusing largely on the design of new structures in reinforced concrete, steel and may be timber following provisions of current codes and standards. Considering this rather bureaucratic and uninspiring design education of structural engineers, it is not surprising that most design engineers are nowadays considered and treated as “code checkers”. They often have a limited understanding of the broader context of their design solutions and insufficient skills to collaborate with other professionals like architects and environmental engineers.

IABSE Working Group 9 “Construction History” largely discussed these professional issues during its meetings and excursions, and concluded that *structural engineers definitely need to learn from the past to build the future !*

However, this discussion is not specifically reflected in the present SED, and as a conclusion, WG 9 decided to highlight this issue in this afterword. Two topical issues should be developed further in the near future within IABSE and its Working Groups:

- Education of structural engineers needs a fundamental change. Modern curricula should be based explicitly on the needs of “Engineering of existing structures”. Design of new structures should be relegated. In addition, “History of structures and structural engineering” needs to become a mandatory fundamental engineering discipline. Greater emphasis should be given to principles comprising the essentials of all construction materials in both existing and new structures. Obviously, new technologies like monitoring of structures, advanced computational models for structural analysis as well as novel high-performance materials and structural systems are part of a modern curriculum.
- Information and data regarding ideas and solutions of structural engineering in the past should be scientifically analyzed and exploited. This “mining” process shall produce and enhance novel knowledge and know-how to design innovative interventions on existing structures and to create new structures. In the past, several innovative ideas could not be realized because of lack of appropriate means (materials, methods and tools) available in former times. Current and future technologies, in particular the computer-based ones, may help to implement and enhance former structural systems using high-performance materials. Understanding of the past is a rich source of inspiration for structural engineers.

*Knowing the past is indispensable for modern structural engineering !* With the present SED, the IABSE Working Group “Construction History” wanted to make a contribution to this important goal.

**Eugen Brühwiler, Professor at the Swiss Federal Institute of Technology (EPFL),  
Lausanne, Switzerland, Vice-Chairman of IABSE Working Group 9  
“Construction History”  
August, 2017**

# Structural Engineering Documents

## Objective:

To provide in-depth information to practicing structural engineers in reports of high scientific and technical standards on a wide range of structural engineering topics.

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The International Association for Bridge and Structural Engineering (IABSE) operates on a worldwide basis, with interests of all type of structures, in all materials. Its members represent structural engineers, employed in design, academe, construction, regulation and renewal. IABSE organises conferences and publishes the quarterly journal *Structural Engineering International (SEI)*, as well as reports and monographs, including the SED series, and presents annual awards for achievements in structural engineering. With a membership of some 4,000 individuals in more than 100 countries, IABSE is the international organisation for structural engineering.

## Publisher:

The International Association for Bridge and Structural Engineering (IABSE) was founded as a non-profit scientific association in 1929. Today it has more than 3200 members in over 320 countries. IABSE's mission is to promote the exchange of knowledge and to advance the practice of structural engineering worldwide. IABSE organizes conferences and publishes the quarterly journal *Structural Engineering International*, as well as conference reports and other monographs, including the SED series. IABSE also presents annual awards for achievements in structural engineering.

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## **Engineering History and Heritage Structures – Viewpoints and Approaches**

The present Structural Engineering Document (SED) is a compilation of contributions devoted to the vast topic of history of structural engineering as well as interventions on heritage structures and structures of high cultural values. Various, sometimes opposed, viewpoints and approaches are expressed and presented. The rather heterogeneous and controversial nature of the content of this SED shall stimulate lively discussions within the structural engineering community who needs to increase the awareness of historical and cultural aspects of structures and structural engineering. Current structural engineering methods and practice are only at the very beginning of effective engineering, really integrating historical and cultural aspects in the assessment of existing structures and in intervention projects to adapt or modify structures of cultural values for future demands. Knowing the past is indispensable for modern structural engineering !