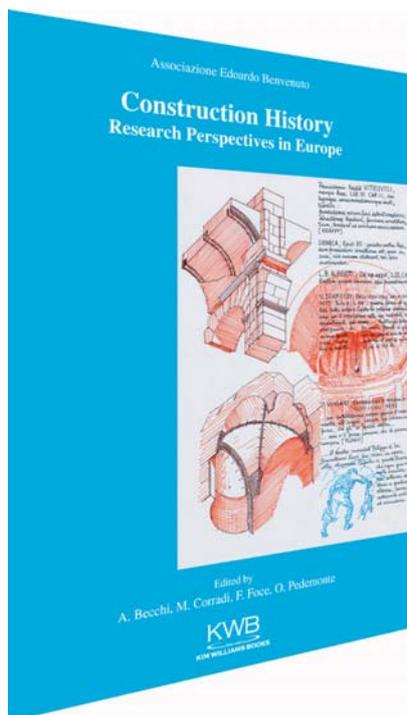


Karl-Eugen Kurrer “Construction History in Austria, Germany, Switzerland”

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Construction History Research Perspectives in Europe

A. BECCHI, M. CORRADI, F. FOCE AND O. PEDEMONTE, EDS.

This is vol. IV in the book series “Between Architecture and Mathematics”. The Associazione Benvenuto for research in the Science and Art of Building in their historical development assigned to a few international “observers” the task of styling a map of Construction History in their various countries. Obviously, we are not dealing here with an exhaustive map, but rather with a first attempt to identify some of the significant lines of research and to put into contact the individual scholars. A small step towards the constitution of an international scientific community that is interested in architecture as well as mechanics; in construction as well as its history. A community which, up to the present, has not known how to find the essential points of contact and dialogue, and which has avoided the onus of long-term initiatives. The present volume is an aid for establishing solid collaborative research projects, knowing that this can happen only if the studies are so rigorous and detailed that those emphatic recall to arms of interdisciplinarity, sure signs of problems set forth badly, are rendered superfluous.

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REPORT ON THE STATE OF CONSTRUCTION HISTORY IN AUSTRIA, GERMANY AND SWITZERLAND

Karl-Eugen Kurrer

1 Tasks and objectives of Construction History

Historians have hitherto shown little interest in Construction History. Only a small number of contributions dealing with the origins, historic development, cultural embedding and social significance of construction engineering can be found at conferences about the history of science and technology, or in relevant journals or collected editions. This awareness gap in Construction History is of a passive nature. For example, it is often assumed that the structural stability of buildings is guaranteed *a priori*, that structural know-how integrates naturally, so to speak, with the structure and is absorbed by it – disappears – and is thus no longer evident. This is not a case of suppression through the recipients, but is based in the nature of the construction process. After all, at the start of the industrial revolution, structural theory was claimed to be a “mechanical theory derived from the nature of building” (Gerstner, see section 1.6). Public opinion leaders only tend to remember the existence of Construction History in cases of failure. As a part of Construction History, the historic development of structural theory thus followed the historical traces of modern construction methods. The result was that the historic contribution of structural theory to the development of building was considered to a greater or lesser degree within the history of construction (which is oriented towards structural engineers), and was indeed encompassed by it.

The historiography of science also treats the history of structural theory as a derivation. If it does focus on structural theory as a whole at all, it only sees it as one of many applications of mechanical theory. As a basic discipline of construction engineering, structural theory is part of the profession of structural engineers, but they only rarely manage to make themselves heard beyond the boundaries of their discipline.

Nevertheless, over recent years a proto-disciplinary, but still heteromorphous, identity of Construction History began to emerge. Two quotes that were discussed at the round-table discussion on the “history of construction technology”, organised by the “Department for Construction History and Structural Preservation” for the German Research Foundation (DFG) 27-29 March 2003 at Brandenburg University of Technology, Cottbus (BTU Cottbus) (see section 3.10) illustrate this:

Prof. HEINZ DUDDECK (TU Braunschweig): “Construction history involves highlighting the basic structural engineering principles of past and present buildings and construction projects (including water, transportation and urban structures) and their significance for today's construction sector”.

Prof. WERNER LORENZ (BTU Cottbus): “Construction engineering is the entirety of the practices and products of design, dimensioning and realisation of technical structures and components involved in the process of shaping our environment through construction activities. Construction history describes and interprets these practices and products in their historic sequence. It examines the products of the construction process and all associated written or visual sources. The methodological cornerstones include historical construction research and structural/constructive and engineering analysis techniques”.

In the following sections, the author elaborates his views of the aims and objectives of Construction History.

1.1 Scientific tasks. Like any scientific cognitive process, the techno-scientific cognitive process of construction engineering includes a historic element in so far as the reproduction of the scientific development inherent in the cognitive state of a subject area forms a necessary basis for innovative scientific ideas: Science is genuinely historic. Reflections about the formation and development of the subject of construction engineering invariably become part of the techno-scientific cognitive process, if competing or coexisting theories are taken up in a more abstract theory—possibly in a fundamental theory of a basic techno-scientific discipline (e.g. structural theory and fluid dynamics for water engineering).

1.2 Practical engineering tasks. Each structure develops within space and time. The question about the reasons of this development is the question about the history of the structure, and about the history of its creation, utilisation and nature. The first dimension of the historicity of buildings consists of the design and construction process, the second dimension includes the history of the building and its interaction with the environment. The third dimension of the historicity of buildings is the historicity of the know-how about buildings and their theory, and its influence on the history of the buildings. In reality, the history of the development, the utilisation and the nature of the building constitute a unit. Nevertheless, the historicity of buildings continues to be split into its three dimensions: Whilst for new buildings, the first dimension is usually parametrised into schedules for those involved, the recording of the second dimension is a subject of Construction History, the preservation of historic monuments and construction research, and of the emerging history of structural engineering and construction. Making a significant contribution to the development of the third dimension would be a task of Construction History, for

example, through the processing, adaptation and re-interpretation of historic vault theories. Its practical engineering tasks do not remain restricted to the increasing construction activities within the historic stock. The knowledge developed by the Construction History could become the functional element of the modern construction process, since the unity of the three-dimensionality of the historicity of buildings as an anticipation is fundamentally inherent in it: because the formation of techno-scientific theories and experimental research, the design, calculation and construction as well as the production, installation and utilisation can no longer be separated from conversion, safeguarding of the stock and preservation. The task of Construction History not only consists of feeding the planning process through inspiration from its historic knowledge base, but also of contributing its experience with building within the historic stock into the modern construction process.

1.3 Didactic tasks. In Germany, Austria and Switzerland, degree courses in techno-scientific subjects are mostly structured into undergraduate studies (“Grundstudium”), basic specialised studies (“Grundfachstudium”) and specialisation (“Vertiefungsstudium”), which students experience as a separation of the basic disciplines from the techno-scientific specialist disciplines. The latter are often only presented in the form of applications of such disciplines such as mathematics or mechanics. Many students even see applied mechanics, an obligatory component of the undergraduate studies for many techno-scientific subjects, merely as a comprehensive collection of brazen laws that are illustratively worked off using ideal technical objects. Closely related is the division of the techno-sciences during specialization. They are not learned as a scientific system consisting of specific internal interrelationships, but as an amorphous collection of independent specialist disciplines that only deal with a narrow range of technical objects. The integrative character of the technical sciences appears in the shape of the additive composition of a variety of individual scientific insights with the result that students learn the fundamental techno-scientific disciplines largely as a series of recipes. The history of structural theory (as a part of Construction History) for example has the task of contributing to a change in this recipe-like approach to learning structural theory by the students. The separation of structural theory into separate disciplines for structural engineers and architects is a particular challenge. ROLF GERHARDT (see section 3.3) came up with proposals for a didactification of structural theory through historicification. With the historicification of the structural material taught during the project-oriented phase of degree courses in the shape of a historic-genetic structural theory, structural techniques could be understood, experienced and illustrated as a logical-historic development product, and thus become more popular.

1.4 Cultural tasks. Scientists have a fundamental form of social responsibility: the democratisation of scientific know-how through popularisation. This is how scientists publicly account for their work, which is, after all, enabled by society as a whole. Popular science contributions not only serve to make the scientific knowledge that has emerged through reflection on the social context of scientific methods accessible to a readership beyond the boundaries of their discipline, but also to stimulate discourse about the aims and objectives of the sciences. Construction history also has intrinsic cultural value. The individual sciences of physics, biology and even chemistry continue to cross the Rubicon beyond their own scientific community. This may be due to their role as constituents of world views and their close relationship with philosophy and history. The same does not apply to the technical sciences; even fundamental techno-scientific disciplines have difficulty in interpreting their role within society. The fragmentation of the technical sciences hinders the cognition of their objective interrelationship, their position and function within the ensemble of the scientific system and therefore their relationship as an entity with society, which forms and surrounds them. Perhaps it is because of this that HEINZ DUDDECK, emeritus professor for structural theory, pleaded for a change of paradigm in the technical sciences in speeches, essays and articles. This would basically lead to a merger of the technical and humanistic sciences (see section 1.6).

1.5 Aims. Construction history therefore aims to solve the above-mentioned scientific, engineering, didactic and cultural tasks. Construction history includes aspects of didactics, philosophy of science, history of science, history of technology, aesthetics, biography and bibliography.

1.6 References

- DUDDECK, Heinz. 1996. Und machet Euch die Erde untertan...? *Bauingenieur* 71, H. 6: 241-248.
- GERSTNER, Franz Joseph Ritter von. 1789. *Einleitung in die statische Baukunst*. Prag: Schriften der k. k. Normalschul-Buchdruckerei.
- LORENZ, Werner. 2003. *Geschichte der Bautechnik—Rundgespräch der DFG*. Cottbus, März 2003. Abschlußbericht.

2 Austria

Like the history of technology, Construction History has not yet become an institutionalised discipline at Austrian universities or polytechnics. Nevertheless, various research facilities are dealing with different aspects of Construction History. In summary, it can be noted that the focus is on practice-oriented research and analysis for the protection of historic monuments and for refurbishment projects. Particularly noteworthy are the relevant project studies carried out at the Institute for Engineering Geology (Faculty of Civil

Engineering, Vienna University of Technology) and at the Institute of Architectural History and Preservation (Faculty of Civil Engineering and Architecture, University of Innsbruck) (see section 2.1), which were carried out in co-operation with the Centre for Architectural Conservation of the Federal Office for Care and Protection of Monuments.

However, aspects and issues that are relevant to the history of construction technology also appear in a teaching context, as evidenced in the lecture series on “Technische Gesteinskunde” (technical petrology) and “Sanierung von Bauwerken aus Naturstein” (restoration of natural stone buildings) at the Institute for Engineering Geology (Faculty of Civil Engineering, Vienna University of Technology) and within the framework of the lecture series on “Erhaltung und Erneuerung von Hochbauten” (preservation and refurbishment of buildings), where the construction and dimensioning techniques employed during different periods are examined in the context of structural aspects of building refurbishment, or in the seminar on “Bautechnische Analysen” (structural engineering analyses) offered at the Institute for Building Construction and Industrial Architecture at the same faculty, which focuses on building surveying techniques and basic principles of structural assessment of buildings (see section 2.2).

Within the framework of documentation and inventarisation of historic buildings and structures, Construction History is one of the main research aspects in scientific projects undertaken at the Institute for History and Theory of Architecture and Historic Building Survey (Faculty of Architecture and Regional Planning, Vienna University of Technology).

At Vienna University of Technology, in 2002/03 mineralogy studies were carried out under the supervision of the Faculty of Civil Engineering (Prof. JOHANN LITZKA) as part of the comprehensive refurbishment of a church (Project title: “Gesteinskundliche Untersuchungen zur Generalsanierung der Otto Wagner-Kirche am Steinhof”).

The Centre for Architectural Conservation of the Federal Office for Care and Protection of Monuments at Kartause Mauerbach more or less permanently carries out research studies on various aspects of Construction History, such as *Freiluftverwitterungsversuche für Gesteine* (open-air studies on rock weathering) or *Strukturelle Festigung von Naturstein* (structural strengthening of natural stone), often in co-operation with the Institute for Engineering Geology at Vienna University of Technology.

Museums, particularly the traditional open-air museums at Stübing (Styria), Kramsach (Tyrol) and Großgmain (Salzburg), but also technical and industrial museums, are scientifically engaged with Construction History and its

presentation. One current project covering very different aspects of Construction History involves the establishment of a “Museum für Baukultur” (Museum for construction culture) at Neutal in Burgenland by the society “Stein auf Stein. Verein für die Erforschung des burgenländischen Bauwesens” (Association for researching Construction History in Burgenland), which was established in 2003. The focus is on the term construction culture, with particular emphasis on the boiler and furnace masons from the Neutal village (Fig. 1) in central Burgenland, because furnace and chimney masonry has a particularly strong tradition in this region. The first steps of the scientific study of the subject are the establishment of an archive and the publication an exhibition catalogue. Co-operation with universities and polytechnics for the purpose of researching specific local characteristics and national interrelationships is envisaged, as well as networking with existing museums regarding their contents on the subject of construction and with historically significant structures in Burgenland.



Fig. 1. Furnace masons during chimney construction. Photograph from the collection of FRANZ REINER, now located in the archive of the Museum for Construction Culture at Neutal

Current research projects:

- BENEDIKT KLOSS is working on a dissertation under Prof. REINHOLD REITH at the Institute for History (University of Salzburg) on the subject of “Hans Haunschild (1842-1901) and his significance for the modern cement industry”.
- A current doctoral dissertation at the Institute for Building Construction and Industrial Architecture (Faculty of Civil Engineering, Vienna University of Technology) looks at the history of building regulations in Austria.
- In a current research study at the Institute of Building Material Sciences, Building Physics and Fire Protection (Faculty of Civil Engineering, Vienna University of Technology), MARKUS BRANDSTETTER and PHOTIS CHARALAMPOPOULOS are dealing with the long-term restoration of historic structures.
- At the Institute for History and Theory of Architecture and Historic Building Survey (Faculty of Architecture and Regional Planning, Vienna University of Technology), LINDE WAGNER is looking at the assessment and recording of damage symptoms in historic structures as part of her Ph.D thesis. VALENTIN WILLE is researching the history of the Flak Towers in Vienna as part of his dissertation at the same institute.

2.1 Rainer Graefe (University of Innsbruck). The content of modules and lectures is determined by the fact that architecture and civil engineering are currently located in the same faculty at the University of Innsbruck. The historic development of structural design is therefore a focal point. *Geschichte des Konstruierens* (history of construction), i.e., the processes through which historic structures were created, has been the main research topic for many years, with the Institute of Architectural History and Preservation examining a wide range of construction methods and development phases (shape and design, vault structures, iron in the nineteenth century, light-weight structures, membrane structures, temporary structures).

2.2 Alfred Pauser (Vienna). Prof. ALFRED PAUSER can without doubt be regarded as the leading representative for concrete bridge construction in Austria. He has an international reputation that extends far beyond the Austrian borders. Between 1982 and 1998, Pauser taught and researched at the Institute for Building Construction, Faculty of Civil Engineering, Vienna University of Technology. During this time, the Institute significantly expanded the science field of “Historisches Mauerwerk” (historic masonry) in the form of dissertations, doctoral dissertations and research reports. Numerous lectures and seminars on the preservation and refurbishment of old building substance were held and

expert reports prepared. For example, for Austrian Railways (ÖBB), Pauser examined the load-bearing capacity of semi-circular masonry bridge arches as part of a project for the refurbishment of the “Semmeringbahn” and achieved the preservation of this unique example of bridge construction from the early days of railway engineering in Austria.

In 1983, Pauser established the “Österreichische Gesellschaft zur Erhaltung von Bauten” (Austrian society for the preservation of buildings), which made a significant contribution to the preservation of civil engineering structures such as halls and bridges, but also dealt with historically sympathetic conversions of old lofts. For those sectors, the society developed guidelines for the Federal Office for Care and Protection of Monuments, where Pauser is a member of the advisory board.

In addition to journal articles on the history of bridge and reinforced concrete construction, Pauser published a monograph on reinforced concrete construction (see section 2.3). In his book on concrete bridges (see section 2.3), he integrates Construction History knowledge and demonstrates its relevance for bridge design in practical terms.

For 2005, the publication of a civil engineering guide on bridges for the city of Vienna is planned.

2.3 References

- BARNIK-BRAUN, Kerstin, ed. 1998. *Das Hundert-Jahre-Buch 1898-1998*. Graz.
- DICKIE, Martin. 2000. *Die Anfänge der Eisenbetonbauweise in Wien*. Innsbruck: Diplomarbeit Universität Innsbruck.
- FISCHER, Manfred W. K., Christian DIRNINGER, Roman HÖLLBACHER, Fritz LORBER, and Roland FLOIMAIR. 1997. *Historische Wirtschaftsarchitektur in Salzburg. Bauten—Einrichtungen—Werkzeuge*. Salzburg: Anton Pustet.
- FUCHS, Gerald. 2001. Montangeschichtliche Denkmale in der Walchen bei Öblarn, Steiermark. *res montanarum* 26: 18-26.
- GEORGEACOPOL-WINISCHHOFER, Ute. 1998. *Vom Arbeitshaus zur Großindustrie. Ein Beitrag zur Geschichte des Industriebaus in Wien von den Anfängen bis nach dem Ersten Weltkrieg unter besonderer Berücksichtigung der Leopoldstadt*. Wien: Österreichischer Kunst- und Kulturverlag.
- GMEINER, Hans, ed. 1994. *Bauten für die Welt. Eine Dokumentation der Ingenieurleistungen der VOEST*. Linz: Gutenberg.
- IDAM, Friedrich v. 2003. Gelenkte Entwicklung. Industriearchäologie in Hallstatt. Industrielle Muster unter der alpinen Idylle. Ph.D. Thesis, Technische Universität Wien
- KNALL-BRSKOVSKY, Ulrike, and Karl NEUBARTH. 1999. Baugeschichte der Kartause im 17. und 18. Jahrhundert. *Österreichische Zeitschrift für Kunst und Denkmalpflege* 53: 453-492.

- KOCH, Rudolf. 1999. Die mittelalterliche und vorbarocke Klosteranlage von Mauerbach aus bauhistorischer Sicht. *Österreichische Zeitschrift für Kunst und Denkmalpflege* 53: 431-452.
- KREITNER, Thomas. 1999. Ein Bericht zum gegenwärtigen Stand der bauarchäologischen Untersuchungen 1996 bis 1999 in der Kartause Mauerbach. *Österreichische Zeitschrift für Kunst und Denkmalpflege* 53: 411-430.
- MAFTOON-KEBRIAL, Marjan. 1993. *Die Anfänge der Stahlbetonbauweise in Österreich*. Vienna: Diplomarbeit Technische Universität Wien.
- MATIS, Herbert, and Dieter STIEFEL. 1994. "Mit der vereinigten Kraft des Capitals, des Credits und der Technik". *Die Geschichte des österreichischen Bauwesens seit 1869 am Beispiel der Allgemeinen Baugesellschaft—A. Porr Aktiengesellschaft*. 2 vols.. Vienna: Böhlau.
- NEUERER, Christian. 1999. *Das Hochhaus in der Zwischenkriegszeit in Österreich*. Innsbruck: Diplomarbeit Universität Innsbruck.
- PAUSER, Alfred. 1987. *Entwicklungsgeschichte des Massivbrückenbaues*. Vienna: Verlag Österreichischer Betonverein.
- . 1994. *Eisenbeton 1850-1950. Idee—Versuch—Bemessung—Realisierung. Unter Berücksichtigung des Hochbaus in Österreichs*. Vienna: Manz.
- . 2002. *Massivbrücken ganzheitlich betrachtet. Geschichte—Konstruktion—Herstellung—Gestaltung*. Düsseldorf: Verlag Bau + Technik.
- PICHLER, Norbert. 1997. Die Architektur der Eisen- und Stahlindustrie im oberen Mürztal. *Historicum* : 20-27.
- ROHATSCH, Andreas. 1998. Die Baugesteine des Wiener Stephansdomes. In: R. Seemann and H. Summesberger, *Wiener Steinwanderwege. Die Geologie der Großstadt*. Vienna: Brandstätter.
- ROHATSCH, Andreas. 1999. Die Bau- und Dekorgesteine der Kartause Mauerbach. *Österreichische Zeitschrift für Kunst und Denkmalpflege* 53, 2/3/4: 727-733.
- . 2000. Die schwarzen Dekorgesteine der Stiftskirche von Lilienfeld. *Denkmalpflege in Niederösterreich* 23: 38-39.
- . 2003. Gewinnung und Verarbeitung von Werkstein. In: *Nutzbare Gesteine von Niederösterreich und Burgenland. Band: Gesteine—Gewinnung und Verarbeitung*. B. Schwaighofer und W. Eppensteiner, eds., Pp. 27-41. Vienna.
- ROHATSCH, Andreas and G.. 2003. Natursteinverfestigung in der Baupraxis. *Österreichische Bauzeitung* 28/29: FLEISCHER 33-36.
- SCHWÄRZLER, Franz L. 1999. *160 Jahre Bauunternehmen Seraphin Pümpel & Söhne in Feldkirch. Seine Bedeutung für die Vorarlberger Baugeschichte im 19. und 20. Jahrhundert*. Innsbruck: Diplomarbeit Universität Innsbruck.
- STADLER, Gerhard A. 2001. *Das industrielle Erbe Niederösterreichs. Geschichte, Technik, Architektur*. Vienna: Habilitationsschrift Technische Universität Wien.
- STEINER, Dietmar. 1994. *Architektur Beispiele Eternit*. Kulturgeschichte eines Baustoffes. Vienna.
- WEHDORN, Manfred. 1979. *Die Bautechnik der Wiener Ringstraße. Mit einem Katalog technischer Bauten und Anlagen in der Ringstraßenzone*. Wiesbaden: Franz Steiner.
- Zement + Beton Handels- und Werbeges. m.b.H. (ed.). 1994. *100 Jahre Vereinigung der Österreichischen Zementindustrie 1894-1994*. Vienna: Agnes-Werk Geyer+Reisser.

3 Germany

Before the re-unification of Germany in 1990, the historiography of construction engineering was institutionally anchored only at Dresden University of Technology, Leipzig University of Applied Sciences, Essen University, TU Berlin, TU Munich, and the universities of Karlsruhe and Stuttgart.

At the “Zentrum für Geschichte der Technikwissenschaften” (centre for the history of engineering sciences) (established in 1978) within the former section of “Philosophie und Kulturwissenschaften” (philosophy and humanities) at Dresden University of Technology, THOMAS HÄNSEROTH offered lectures and seminars on the history of basic scientific principles of construction engineering. In 1984, he was promoted to professor, based on this work entitled *The beginnings of modern building and construction engineering. The history of industrial construction*. He made a name for himself, particularly through publications on Construction History in the journal *Dresdener Beiträge zur Geschichte der Technikwissenschaften* (Dresden papers on the history of engineering sciences), which was founded in 1980. Examples are Hänseroth's paper entitled “Zur Vorgeschichte der Baumechanik” (The history of structural mechanics) and KLAUS MAUERSBERGER's study material for the lecture series “Geschichte der Technikwissenschaften/Maschinenwesen” (The history of engineering sciences and mechanical engineering) (see section 3.20).

At Leipzig University of Applied Sciences, Prof. HERBERT RICKEN was director of the science area of “Kulturtheorie/Geschichte der Technikwissenschaften” (cultural theory/history of engineering sciences) at the “Marxism/Leninism” section: In addition to Construction History lectures and seminars, between 1985 and 1990 a total of six scientific colloquia on the “History of structural engineering sciences” took place, the results of which were published as part of the “Leipzig University of Applied Sciences scientific reports” series. Furthermore, Prof. Ricken published the monographs *Der Architekt—Geschichte eines Berufes* (The Architect—History of a Profession) and *Der Bauingenieur—Geschichte eines Berufes* (The structural Engineer—History of a Profession) and, since the early 1990s, he regularly published articles on Construction History topics in the journal *Bautechnik* (Construction engineering) (see sections 3.9 and 3.20). Dr.-Ing. KLAUS-DIETER HEIDRICH continued the science area established by Prof. Ricken at Leipzig University of Applied Sciences under the name of “Technikwissenschaftsgeschichte und Kulturwissenschaften” (Engineering sciences history and humanities), although it was discontinued in the early 1990s.

Essen University (Prof. ERNST WERNER): Systematic integration of Construction History within structural theory and technical didactics for building and construction engineering from the middle of the 1970s, numerous

books and journal publications on Construction History (see section 3.20). The academic discipline of “history of technology” largely ignored the work of ERNST WERNER, just like it failed to pick up initial work on Construction History in the 1980s and early 1990s. The first systematic Construction History approach in West Germany came to a rapid end in 1989 with the early death of Prof. Werner.

In West Germany, Prof. KLAUS PIEPER (Technical University of Braunschweig) was the first person to develop a systematic approach for the preservation of historic buildings, and in 1983 Pieper published a textbook under the title *Sicherung historischer Bauten* (see section 3.20); His disciple FRITZ WENZEL continued this work at the University of Karlsruhe. On his initiative, in 1985 the German Research Foundation (DFG) established a special research unit entitled “Erhalten historisch bedeutsamer Bauwerke—Baugefüge, Konstruktionen und Werkstoffe” (Preserving Historically Important Buildings) (SFB 315) at the University of Karlsruhe (see section 3.20), where architects, engineers, scientists, building historians and preservers of historic monuments successfully co-operated systematically for the first time in the development of solutions for structural design and material science tasks. The research results from SFB 315, which existed for more than a decade, were published in a 13-volume book series (see section 3.20) and inspired several scientists to work on the advancement of Construction History (see sections 3.1, 3.2, 3.5 and 3.15). One example of the successful implementation of the research results from SFB 315 and their further development by Prof. WOLFRAM JÄGER from Dresden University of Technology is the completion of the work on the building shell of the re-built Frauenkirche at Dresden on 22 June 2004—the journal *Mauerwerk* (Masonry) devoted the whole of issue 3/2004 to the occasion (see sections 3.9 and 3.20).

Since the winter semester of 1985/86, Prof. EBERHARD SCHUNCK from the department for Building Design and Construction (“Planung und Konstruktion im Hochbau”) at the Faculty of Civil Engineering and Surveying, University of Stuttgart, had been organising presentations on the history of civil engineering. When Prof. Schunck took up a position at TU Munich, these presentations were continued there until the winter semester 2002/03. Prof. Schunck published the presentations under the title *Beiträge zur Geschichte des Bauingenieurwesens* (Papers on the history of civil engineering) as a departmental publication.

From 1986/87 to 1998, Prof. MIRON MISLIN was head of the department “Baugeschichte mit besonderer Berücksichtigung der Bautechnik” (Construction history with particular consideration of construction engineering) at the Faculty of Architecture at TU Berlin (see section 3.12) and consolidated the teaching material in his book *Geschichte der Baukonstruktion und Bautechnik* (The

history of structural design and construction engineering), of which two editions have been printed (see section 3.20); work on the second volume envisaged by Prof. Mislin is still in progress.

Further remarkable work was carried out at the former “Hochschule für Architektur und Bauwesen Weimar” (Weimar university for architecture and construction engineering—today: Bauhaus University Weimar), TU Berlin and University of Stuttgart:

- Professorial dissertation “Das Eisen in der Architektur des 19. Jahrhunderts. Beitrag zur Geschichte eines neuen Baustoffs” at Hochschule für Architektur und Bauwesen Weimar by CHRISTIAN SCHÄDLICH (see section 3.20).
- Professorial dissertation “Entwicklung der Eisen- und Stahlbauweise im Industrie- und Gesellschaftsbau bis zur Mitte des 20. Jahrhunderts” at Hochschule für Architektur und Bauwesen Weimar by FRANK WERNER; much of this professorial dissertation was later published as a book under the title *Der Eisenbau. Vom Werdegang einer Bauweise* (see section 3.20).
- Publications by Prof. WILHELM VON WÖLFEL from Hochschule für Architektur und Bauwesen Weimar on hydraulic engineering in antiquity; Prof. von Wölfel continued his work and published it in the journal *Bautechnik* (Construction engineering) (see sections 3.9 and 3.20).
- Prof. OSKAR BÜTTNER (Hochschule für Architektur und Bauwesen Weimar): Systematic consideration of Construction History in architecture courses; publication of the two-volume book *Bauwerk—Tragwerk—Tragstruktur* (Building—load-bearing structure—structural system) with Prof. ERHARD HAMPE as co-author (see section 3.20).
- As voluntary editor, Prof. ISTVAN SZABÓ shaped the journal *Humanismus und Technik* published by the “Gesellschaft von Freunden der Technischen Universität Berlin” for a long time; in 1977, the papers on the history of mechanics published in this journal formed the basis for his book *Geschichte der mechanischen Prinzipien*, the third edition was published in 1996 (see section 3.20).
- At the civil engineering faculty of the University of Stuttgart, Dr. KNUT GABRIEL promoted the subject of the history of civil engineering through the allocation and supervision of dissertations and Ph.D theses and by initiating relevant publications, for example the book *Die ersten Drahtkabelbrücken* (see section 3.20).

After the reunification of Germany, the development of Construction History continued in a non-uniform, uncoordinated and disintegrated manner. Papers on Construction History continued to appear within the framework of different disciplines:

- The doctoral theses by BERTRAM MAURER (see section 3.20) and MARTIN TRAUTZ (see sections 3.19 and 3.20) supervised by Prof. EKKEHARD RAMM at the Institute of Structural Mechanics, University of Stuttgart;
- Scientists from the former Institute for Lightweight Structures at the University of Stuttgart continued to discuss issues relating to the history of construction. Examples are RAINER GRAEFE (see section 2.1), BERTHOLT BURKHARDT, JOS TOMLOW (see section 3.18) and FREI OTTO; the latter, for example, published on the subject of *Alte Baumeister. Was können die alten Baumeister erfunden haben?* (see section 3.20);
- At the Institute of Structural Design II at the University of Stuttgart, the doctoral dissertation of HOLGER FALTER supervised by Prof. JÖRG SCHLAICH (see section 3.20), the book *Kuppel aller Zeiten— aller Kulturen* published by ERWIN STEINLE together with Schlaich (see section 3.20) and the *Ingenieurbauführer Baden-Württemberg* published by Schlaich and MATTHIAS SCHÜLLER (see section 3.20);
- The historic/scientific doctoral dissertations by ECKHARD BOLENZ on the development from building official to freelance architect and consulting structural engineer in Prussia/Germany between 1799 to 1931 and HELMUT HILZ on the formation of the first iron construction companies in southern Germany (see section 3.20);
- The exhibition “The old Vistula Bridge at Tczew (1850-1857)” put together under the guidance of Prof. WIELAND RAMM at Kaiserslautern University in close cooperation with TU Gdansk;
- The biography of HERMANN RIETSCHEL published by Prof. KLAUS W. USEMANN (Kaiserslautern University) as part of a history of heating and ventilation technology in Germany (see section 3.20);
- The entertaining history of building physics by HELMUT KÜNZEL from the Fraunhofer Institute for Building Physics at Stuttgart and Holzkirchen (see sections 3.9 and 3.20);
- The publication by the industrial architect Prof. GERD HEENE on the organisation of the building site for the Pantheon in Rome (see section 3.20);
- The work by Dresden-based consulting structural engineer Dr.-Ing. WILFRIED WAPENHANS on the history of the development of composite steel construction in Germany (see section 3.20) and the

- publication, with extensive comments by JENS RICHTER, of the world's first structural calculations of 1742 for the cupola of St. Peter's in German (see section 3.20 and <http://www.wundr.com>);
- The history of structural design by PAULGERD JESBERG written from a humanistic perspective (see section 3.20);
 - The three-volume compendium of typical structures between 1860 and 1960 prepared by Dr.-Ing. RUDOLF AHNERT and KARL HEINZ KRAUSE, which offers support for the planning of repair and conversion of older buildings (see section 3.20);
 - The doctoral dissertation by WILMAR KARLEMANN WEBER on arched railway bridges supervised by Prof. KONRAD ZILCH (Department of Concrete Structures, TU Munich) (see section 3.20);
 - The doctoral dissertation by LARISSA SABOTTKA on the iron bridges of the Berlin S-Bahn supervised by Prof. ACHIM HUBEL (Professor for the preservation of historic monuments at Bamberg University) (see section 3.20).

Nevertheless, a 'centre of gravity' for Construction History began to form in the Berlin-Brandenburg region with the establishment in 1992 of the department for "Geschichte der Konstruktion" (history of structural engineering) at Potsdam University of Applied Science (see section 3.6), the creation in 1993 of the department for Construction History at TU Cottbus (see section 3.10), and the establishment of the "Technikgeschichte" (history of technology) working group of 'VDI-Bezirksverein' Berlin-Brandenburg in 1996 (see section 3.9).

Over recent years, Construction History topics increasingly became the subject of research in departments dealing with the preservation of historic monuments and construction research, for example at the universities of Bamberg (see section 3.16), Dortmund (see section 3.5) and Aachen (see section 3.15).

In contrast, the historiography of hydraulic engineering, water management and water supply still focuses on antiquity and is largely dealt with by specialist societies such as the 'Deutsche Wasserhistorische Gesellschaft' or the Frontinus-Gesellschaft. Like for the preservation of historically significant infrastructure structures in general, the 'Rheinisches Amt für Bodendenkmalpflege' (based in Bonn) plays a particularly active role in this area.

The extensive area of geotechnology, which has become more and more significant within the ensemble of structural engineering sciences, has so far not yet been dealt with in a contiguous historiographic way, although over recent years several journal articles have been published, for example by JÜRGEN HANISCH, ULRICH SMOLTZYK or HEINRICH OTTO BUJA (see section 3.20). The situation is similar for the areas of tunnel engineering, construction

management and construction industry. The only relevant publication to date is the overview of the history of crane technology by OLIVER BACHMANN, HEINZ-HERBERT COHRS, TIM WHITEMAN and ALFRED WISLICKI (see section 3.20). The only reference book on the history of the construction industry to date is the book entitled *Geschichte der Bauwirtschaft* by *Karlheinz Pfarr* dating back to 1983 (see section 3.20), while the book by GÜNTHER BINDING on medieval construction management still offers a detailed introduction to the subject with numerous references (see section 3.20).

In mid-2004, INES TETZLAFF started a research project under the supervision of Prof. FRANZ-JOSEF HILBERS at Berlin University of the Arts (UdK) on the influence of calculation methods and material on design, planning and execution of iron structures in Berlin between 1850 and 1925. Finally, two further current doctoral theses at Bauhaus University Weimar should be mentioned:

- EVA MARIA FROSCHAUER: „An unsere Leser!': Architektur und Medien, 1900 bis 1914 in Berlin—Darstellung und Vermittlung von Baukunst in ausgewählten Fachzeitschriften” (supervisor: Prof. MARCO DE MICHELIS, Venice)
- GERNOT WECKHERLIN: “Ernst Neuferts Handbücher: Zur Systematisierung des architektonischen Wissens” (supervisor: Prof. GERD ZIMMERMANN)

The “Geheimes Staatsarchiv Preußischer Kulturbesitz” (Secret Central Archives) organised an exhibition under the heading “Mathematisches Calcul und Sinn für Ästhetik” (mathematical calculus and sense for aesthetics) at the premises of Kunstbibliothek Berlin, 16 February to 26 March 2000. The history of Prussian construction management between 1770 and 1848 was documented using material from the extensive inventories, collections and legacies of the Secret Central Archives, lead by archive director REINHART STRECKE, who wrote a professorial dissertation on the subject (see section 3.20).

Architecture Museum at TU Munich. The Architecture Museum at TU Munich (<http://www.architekturmuseum.de>), managed by Prof. WINFRIED NERDINGER (see section 3.1), goes back to the teaching collection for architecture students established in 1868 at 'Neue Polytechnische Schule'—the predecessor institution of TU Munich. It features the biggest specialist architectural collection in Germany: 330,000 architect's drawings, 100,000 photos, 500 architectural models und 100 metres of archive material. Over the last 20 years, the Architecture Museum organised more than 40 exhibitions. Of relevance for Construction History are the exhibitions on LEO OF KLENZE in 2002 (see section 3.10 and section 3.20) and WERNER SOBEK in 2004 (see section 3.20). For 2005 an exhibition on FREI OTTO is planned. The Architecture Museum at TU Munich publishes catalogues for all exhibitions.

German Architecture Museum (Frankfurt am Main). Prof. INGEBORG FLAGGE has been director of the German Architecture Museum in Frankfurt (<http://www.dam-online.de>) since 2001. With the exhibit *leicht weit—Light Structures. Jörg Schlaich—Rudolf Bergermann* (22 November 2003 to 8 February 2004), the German Architecture Museum presented the work of structural engineering consultants for the first time. The exhibition catalogue (see section 3.30) provides plenty of inspiration for the historiography of construction—particularly in terms of a creative adoption of historic structural system for functionally and aesthetically demanding structural designs.

Deutsches Museum (Munich). The sections on bridge and road construction have been of part the exhibition on civil engineering since the beginnings of the Deutsches Museum, which was established in 1905 and until 1925 was located in the buildings of the National Museum at Prinzregentenstraße. Subsequently, a separate area was dedicated to bridge construction in a new exhibition building that was opened in 1925, while the exhibits from the road construction section could be seen in the hall for railway construction. After World War II, bridge and road construction were consolidated and re-opened in 1959, initially only temporarily. During subsequent years the exhibition remained closed, because the adjacent exhibition on water, canal, and harbour construction was also being renewed. The exhibition on bridges and road construction was not re-opened to the public until 1963. Apart from minor modifications and additions, it remained largely unchanged until 1995. In 1979, BERT HEINRICH published an associated museum publication entitled *Am Anfang war der Balken. Zur Kulturgeschichte der Steinbrücke* (see section 3.20), which in 1983 appeared under the title *Brücken. Vom Balken zum Bogen* in the paperback series entitled “Kulturgeschichte der Naturwissenschaften und der Technik”, sponsored by the former Federal Ministry of Education and Science (see section 3.20). The same paperback series, which strongly focussed on didactics, also featured GÜNTHER GARBRECHT's publication entitled *Wasser. Vorrat, Bedarf und Nutzung in Geschichte und Gegenwart* (see section 3.20). In another publication, BERT HEINRICH interpreted the site model of the Seine bridge near Neuilly (opened in 1772), which for the exhibition had been prepared exceptionally well from a didactic point of view, from a technology history perspective as labour history (see section 3.20)—an approach that has not yet been developed further within the area of Construction History. The history of construction labour has so far only been the subject of discussion within the historiography of the trade union movement (see section 3.20).

After a fundamental transformation, the exhibition on bridge construction of the Deutsches Museum was opened on 7 May 1998 (see section 3.20), featuring a spatially curved steel/glass pedestrian bridge designed by Schlaich Bergermann and partners as its centrepiece. Directly adjacent are exhibits from the areas of

tunnel engineering, hydraulic engineering, hydropower, waterways and an area for special exhibitions on various construction engineering topics that can be served from the significant collection of originals and models from construction engineering and municipal infrastructure held by Deutsches Museum as required. The road construction exhibits were made available on loan by the German Road Museum at Germersheim (see section 3.14).

In 1997, through Campus Verlag the research institute of Deutsches Museum started publishing a series entitled “Beiträge zur Historischen Verkehrsforschung”, which is edited by HELMUT TRISCHLER, CHRISTOPH KOPPER and HANS-LIUDGER DIENEL. Four volumes have been published so far.

Deutsche Wasserhistorische Gesellschaft—German Water Engineering History Association (DWhG). As part of a restructuring process relating to the establishment of the “International Water History Association” (IWHA, Homepage: <http://www.iwha.net>) on 23 August 2000 in Paris under the aegis of UNESCO, the “Studienkreis für Geschichte des Wasserbaus, der Wasserwirtschaft und der Hydrologie” (SKGW), which had been in existence since 1963, became the “Deutsche Wasserhistorische Gesellschaft” (German Water Engineering History Association—DWhG), in order to continue the long-standing tradition of water engineering history research in Germany in concentrated form on an international level. The IWHA met for the first time in August 2001 at Bergen (Norway) at a meeting entitled “The Role of Water in History and Development”. It is intended to develop into an international platform of scientists from a variety of specialist fields, presenting its research results in a seven-volume book series: *The Idea of Water* (Vol. 1), *Water and Human Settlement* (Vol. 2), *Water and Food* (Vol. 3), *Water and Health* (Vol. 4), *Water, Science and Technology* (Vol. 5), *Water: Law, Politics and Economy* (Vol. 6), *Water and Humanity: Historical Overview* (Vol. 7).

Between 1975 and 1990, SKGW had organised seven meetings under the management of GÜNTHER GARBRECHT from the Leichtweiß Institute at the Technical University of Braunschweig. A total of 21 issues of the *Mitteilungen aus dem Leichtweiß-Institut für Wasserbau* dealt with topics relating to the history of hydraulic engineering. After the retirement of Prof. Garbrecht in 1987, this series of events was continued by Prof. HENNING FAHLBUSCH from Lübeck University of Applied Science. DWhG (<http://www.dwhg-ev.de>) has members not only from Germany, but also from the Netherlands, Switzerland and Austria. The intention is to develop DWhG into the German section of IWHA, with a view of promoting scientific research, education and information on the history of water engineering and related areas through relevant meetings and publications such as the *Schriften der DWhG*, of which four volumes have been released so far.

Forschungsgesellschaft für Straßen- und Verkehrswesen—Road and Transportation Research Association. The German Road and Transportation Research Association (FGSV) has been publishing the *Archiv für die Geschichte des Straßenwesens* since 1970. Eighteen issues dealing with the history of road engineering in Germany have been published so far.

Frontinus-Gesellschaft (Frontinus Society). The Frontinus Society (<http://www.frontinus.de>) was established in 1976 and supports science, research, and education in the areas of history of pipe, energy and hydraulic engineering and specialist education in the complete range of hydraulic engineering subjects. It realises this through sponsorship of one or several scientific institutes; scientific events and lectures; initiation, support and handling of research and development projects; scientific publications; and involvement in the above projects.

Current scientific research results are published in the “Schriftenreihe der Frontinus-Gesellschaft”, the book series “Geschichte der Wasserversorgung” published by Verlag Philipp von Zabern and further monographs. An example from the above-mentioned book series is the monograph *Wasser im Heiligen Land* (Water in the Holy Land) by WIEL DIERX and GÜNTHER GARBRECHT, which was published as supplementary volume no. III (see section 3.20). The society maintains its own scientific library at the Gas-Wasser-Zentrum in Bonn with more than 1000 books on the history of technology.

Graduiertenkolleg “Kunstwissenschaft—Bauforschung—Denkmalpflege” (post graduate programme on aesthetics and art history, construction research and preservation of historic monuments). The Graduiertenkolleg “Kunstwissenschaft—Bauforschung—Denkmalpflege”, founded in 1996 by the German Research Foundation (DFG), which also provides the funding, is the result of co-operation between Bamberg University and TU Berlin. The Graduiertenkolleg, currently run by Prof. JOHANNES CRAMER, is an interdisciplinary project that offers supervision of doctoral dissertations for architects, art historians, historians and restorers, organises regular meetings between Ph.D students and professors, carries out seminars and excursions and enables collaborative research projects. The subjects covered by the Graduiertenkolleg include Construction History topics ranging from ancient Egypt to the architecture of the 1950s.

Koldewey-Gesellschaft (Koldewey Society). The Koldewey Society (<http://www.koldewey-gesellschaft.de>) was established in 1926 in Bamberg with the following aims:

- Promotion of and support for work in all areas of construction research and excavation, and contribution to the preservation of historic monuments and artworks;
- Involvement of trained architects in such research in jointly responsible roles;
- Training of young architects in the area of construction research;
- Initiation and maintenance of foreign contacts in the area of construction research with the aim of international co-operation.

Every two years, the Koldewey Society organises meetings for excavation science and construction research and publishes them under the heading “Berichte der Tagungen für Ausgrabungswissenschaft und Bauforschung”. Furthermore, it edits the so-called *Studien zur Bauforschung* (studies on construction research), one of which was *Untersuchungen zur Lastabtragung in spätantiken Kuppelbauten* by DIERK THODE (see section 3.20). Finally, the Koldewey Society also supports relevant publications.

The Koldewey Society is currently chaired by Prof. DOROTHÉE SACK from the Institute of Architectural History, Architectural Theory and Conservation of Historical Monuments at TU Berlin.

Max Planck Institute for the History of Science (Berlin). “Wissensgeschichte der Architektur—Epistemic History of Architecture” is a research initiative of the Bibliotheca Hertziana (Rome), Max Planck Institute for Art History (Rome) and the Max Planck Institute for the History of Science (Berlin):

http://www.wissensgeschichte.biblherz.it:8080/WdA/WdA/WdA_coll/description

Until relatively recently, the construction sector was based on practice-oriented knowledge traditions of craftsmen, master builders and architects: Design know-how, knowledge of materials, construction techniques and the organisation of logistical procedures usually remained tacit (i.e., undocumented), and prior to the scientification of construction activities in the nineteenth century were usually passed on through participation in the construction process and verbal instructions.

This tacit knowledge is the subject of the “Epistemic History of Architecture” project. Case studies will be used to try and reconstruct on what intellectual basis the technical and logistical problems associated with specialised construction activities were solved. The research includes the construction of ordinary domestic buildings and settlements as well as monumental cult and infrastructure structures. The case studies initially cover the early advanced civilisations, antiquity, and early modern Italy.

Over recent decades, the history of construction engineering and logistics has increasingly started to be considered within the framework of research on

architecture. However, theoretic basic principles have hitherto only played a role in exceptional cases. Epistemic history uses this aspect as a guiding principle, because the term “knowledge”, its structure, communication, extension and modification is a crucial key for understanding historical construction engineering and logistics.

The central questions of the research initiative are: How were structures designed? What knowledge about materials and structural engineering issues and what logistical competencies were required for their realisation? What written and visual media were used for the concrete application of such knowledge during the construction process? How did practical knowledge systems develop in different cultures and times, and what role did the availability of building material play?

Verein Deutscher Ingenieure (VDI) (The Association of Engineers). In the working groups on “Technikgeschichte” (history of technology) of the regional VDI associations, Construction History only features occasionally. Only the working groups on “Technikgeschichte” (history of technology) and “Bautechnik” (construction engineering) of the regional VDI association of Berlin-Brandenburg have been dealing systematically with Construction History since 1996 as a focal point within the framework of events held at the German Museum of Technology in Berlin (see section 3.9).

In continuation of the monograph “Wegbereiter der Bautechnik”, “VDI-Gesellschaft Bautechnik” (VDI association for construction engineering) has been publishing a paper on outstanding structural engineers every year since 1990 in its “Bautechnik” yearbook. The paper in the 2004 issue of the yearbook is entitled *Rudolph Bredt (1842-1900)—Wissenschaftlich-technischer Begründer des industriellen Kranbaus* (see section 3.20).

3.1 Rainer Barthel (Munich University of Technology). Construction history research focuses on the structures of historic buildings, the systems of which are researched through examination of the structure itself and through studying historic sources. The structural behaviour is examined based on substance and damage documentations, and through deformation analyses and structural calculations. The aim of the research activities is to gain knowledge in the area of construction engineering history and further insights for evaluation, securing and maintenance of old buildings. The focus is on ‘gentle’ and appropriate handling of old structures.



Fig. 2. Gothic tracery window of St. Georg church at Nördlingen, c. 1519
(photo: *R. Barthel*)

Concrete structures and restoration measures are the starting point and provide examples for verification of the research. Practical measures undertaken at the structure are accompanied scientifically. One example is the restoration of the 12.29 m high and 3.68 m wide late Gothic tracery window at St. Georg church in Nördlingen (Fig. 2). The extensive planning by RAINER BARTHEL as consulting engineer for restoration benefits the research on the structure. The work is undertaken in close co-operation with the Bavarian state department for the preservation of historic monuments.

The research at the university is carried out within the framework of student projects, undergraduate dissertations, doctoral dissertations and research projects financed by third parties. Depending on the topic and particular case, co-operation occurs with other members of the faculty, who also deal with topics relating to the history of construction engineering: Prof. GERT MADER (specialist field: old structures), Prof. WINFRIED NERDINGER (specialist field: history of architecture and structural design), Prof. NORBERT HUSE (art history), and Prof. ERWIN EMMERLING (preservation science).

3.2 Sergej Fedorov (University of Karlsruhe). SERGEJ FEDOROV's contributions to Construction History are based on his collaboration in the special research units on "Natural structures" (SFB 230) at the University of Stuttgart, sub-project "History of construction", and "Preservation of historically significant structures" (SFB 315) at the University of Karlsruhe, sub-project "Historic research on structural design and construction engineering". Fedorov regards Construction History as part of the history of the architecture of the industrial age in its reciprocal interdependence with general cultural history. Among Fedorov's latest work are monographic publications and essays, as well as practical studies on outstanding historic buildings of the time; the latter work is partly undertaken within the framework of studies and dissertations at technical universities. His research concentrates on the formation and development of the Russian/German (western European) relationships in the construction field and on structural engineering studies and preservation work at St. Petersburg/Russia (see section 3.10).

3.3 Rolf Gerhardt (RWTH Aachen University). The teaching and research activities at the Department of Structural Design at RWTH Aachen University include the following:

- teaching of basic principles of applied structural theory, taking account of historical aspects: presentation of historic construction engineering development processes and their theoretical penetration, the influence of theory formation on the development of structural design, examination of historic construction techniques for load-bearing structures;
- examination of historic techniques of structural theory for their didactic suitability for applied structural theory (for example "reactivation" of graphic techniques due to their clarity), derivation of simple approximation methods from historic dimensioning approaches;
- analysis of historic supporting structures in lectures and seminars;
- co-operation with Construction History and preservation activities, one example being involvement in the lecture series on the "history of structures";
- analysis of the formation of civil engineering and the relationship between structural design and architecture.

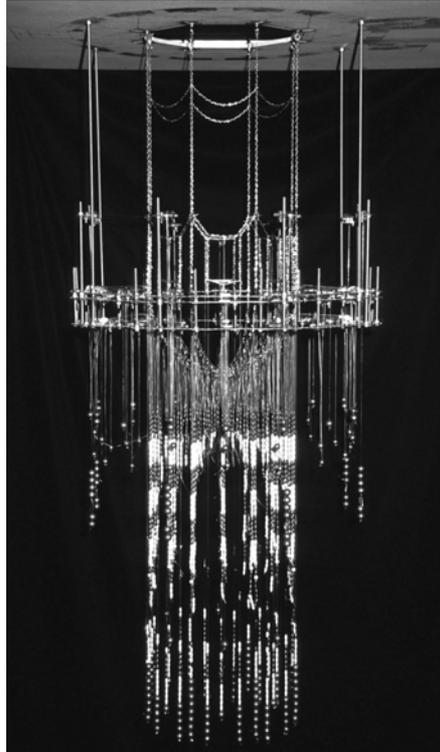


Fig. 3. Three-dimensional hanging model for examining the dome of Aachen cathedral. (Coursework by S. Seyedahmadi and T. Daniel carried out at the Department for Construction History and preservation of historic monuments and the Department for Structural Design, RWTH Aachen University. Supervisors: B. Schindler and R. Gerhardt)

One example for the inclusion of Construction History aspects in education is the coursework by SOHEIL SEYEDAHMADI and TOBIAS DANIEL on “The dome of the Pfalzkapelle at Aachen” (2002), supervised by BRUNO SCHINDLER and ROLF GERHARDT: The three-dimensional hanging model (Fig. 3) provided insight into the hoop forces acting within the iron ring beams inserted into the vault structure that date back to Carolingian times. The model also enabled statements to be made about the raw density distribution of the stone masonry work in the upper dome area.

3.4 Klaus Grewe (Rheinisches Amt für Bodendenkmalpflege, Bonn). Among the official tasks of the “Rheinisches Amt für Bodendenkmalpflege”, Bonn, are supervision, research and protection of historic technical monuments in the Rhineland region. These include: roads, bridges, tunnels, water conduits and others.

- Roads: A research project on Roman roads in the Rhineland region has been ongoing for several years. Due to the large number of road relics in the Rhineland region, for the time being the project focuses on the Cologne/Trier and Cologne/Jülich/Tongeren/Bavais roads. Research on the Cologne/Trier road is expected to be completed by 2009. Research on the Cologne/Jülich/Tongeren/Bavais is an international project;
- Bridges: In the Rhineland region, no projects are currently undertaken on the subject of bridges;
- Tunnels: The project on the Roman tunnel through the Drover mountain near Düren was completed several years ago, and the results have been published. The medieval Fulbert tunnel at Maria Laach has been researched and the results published. The research project on the late medieval Tiergarten tunnel of Blankenheim is in its final stages and should be completed in 2005;
- Water conduits: The research project on the Roman water conduit between the Eifel region and Cologne is completed, and the results have been published. As part of the research project on the late medieval water conduit to Blankenheim castle (see section on tunnels), a final archaeological examination will be carried out this year. An international Frontinus symposium will be held in 2005 at Blankenheim on the subject of “water supply in medieval castles”, including a presentation on the final research results from the Blankenheim project;
- Teaching: For several years, RWTH Aachen University has supported a lectureship on the subject of “Mittelalterliche Sachkultur und Technikgeschichte” (medieval artefacts and history of technology). In this context, students gain technical knowledge based on the practical experience from the above-mentioned research topics.

3.5 Uta Hassler (Dortmund University). The Faculty of Architecture and Civil Engineering at Dortmund University is an interdisciplinary 'reform faculty' in the tradition of polytechnic education. In the “Dortmund model”, structural engineers and architects are trained together for the first time in Germany. The lectures and seminars of the joined courses focus on project work. Research at the faculty is also interdisciplinary. In the area of historical/analytical and Construction History topics, techniques from the humanities are used in parallel with computer-aided models and natural science techniques.

The department for preservation of historic monuments and construction research focuses on the stock of the industrial age as well as design, construction

and subject history of the modern age, but also on issues relating to dealing with outstanding pre-industrial monuments as objects of historical construction research. The link between research projects and teaching activities promotes the interest in research and the scientific qualification of teachers and students alike is. The range of research topics touches on fields from adjacent disciplines from engineering and material science to Construction History. Construction history issues are researched jointly with structural engineers. The department for preservation of historic monuments and construction research offers the subjects of 'resource management in the construction sector' and 'building within the existing stock' as an option for specialisation, including an interdisciplinary project on existing stock in co-operation with civil engineering and construction management/construction industry departments.

3.6 Andreas Kahlow (Potsdam University of Applied Science). While numerous departments deal with the history of technology science in Germany, the history of design engineering or Construction History are rarely represented at engineering faculties. The Department for the History of Structural Engineering at the Faculty of Civil Engineering of Potsdam University of Applied Science has been in existence since 1.10.1992. A number of international conferences and colloquia have been organised, including: "Zeichnung, Grafik, Bild in Technikwissenschaften und Architektur" (1993), "Vom Nützlichen und Schönen. David Gilly 1748- 1808" (1998) and "Brücken in der Stadt. Der Potsdamer Stadtkanal und seine Brücken" (2001) (Fig. 4). The latter two conferences also featured exhibitions, for which catalogues were published.

At Potsdam University of Applied Sciences, the subject of Construction History is offered for structural engineers and architects, from April 2004 also for students of the new "building preservation" Masters course. The subject of "history of technology" is offered for restorers. At the Faculty of Civil Engineering, the introduction of the Masters course on "building preservation and building within the existing stock" currently features prominently.

Current work particularly focuses on the project "Der junge Röbling", in the context of which several publications and an exhibition at "Berliner Stadtmuseum" are envisaged for 2006. Apart from Potsdam University of Applied Sciences, the project also involves scientists from the Technical University of Braunschweig, Brunswick College of Fine Arts (see section 3.11), the "Westfälisches Amt für Denkmalpflege", and the Berliner Stadtmuseum.

A project for editing the diaries of HEINRICH GERBER (1832-1912) in co-operation with KARL-EUGEN KURRER (see section 3.9), chief editor of the journal *Stahlbau*, and the company MAN is in preparation.



Fig. 4. In addition to a reader accompanying the “Brücken in der Stadt” conference held at Potsdam University of Applied Science, in 2001 a catalogue was published for the exhibition that was organised under the same title at the old town hall in Potsdam. The work on the restoration of the “Potsdamer Stadtkanal”, which will continue over the next few years, provided the occasion for discussions on the history and aesthetics of bridge construction

The department is also planning the establishment of a digital drawing archive using a large scanner and special software for managing drawings, which is particularly aimed at older drawing documents that are difficult to access.

3.7 Klaus Knothe (Technical University of Berlin). During his time as a full-time university lecturer, KLAUS KNOTHE started dealing with issues relating to the history of technology, and he is continuing these activities after his retirement.

His research includes the work of technology-oriented scientists of the nineteenth and twentieth century, some of which is attributable to Construction History. He has been researching the work of the following persons in particular (subject area in brackets):

- GEORG PRANGE, 1885-1941 (basic principles of structural theory);
- EMIL WINKLER, 1835-1888 (railway construction, bridge construction, structural design);
- JOHANN WILHELM SCHWEDLER, 1823-1894 (bridge construction, railway construction);
- HERMANN ZIMMERMANN, 1845-1935 (railway construction, structural theory);
- JOHANN ANDREAS SCHUBERT, 1808-1870 (all-round engineer, bridge construction);
- ALFRED TEICHMANN, 1902-1971 (aircraft construction, structural theory).

The aim of his studies was and still is to prevent the work of and documents relating to the above-mentioned persons from falling into oblivion. Initially this involves recording all accessible work (bibliography), followed by attempts to make non-accessible work (manuscripts etc.) accessible. A further aim is to try and establish what processes played a crucial role in the career of the above-mentioned persons.

3.8 Rolf-Herbert Krüger (Berlin). The structure and mode of operation of the royal Prussian construction management in the eighteenth century is the main subject of ROLF-HERBERT KRÜGER's work on Construction History: Particularly noteworthy is the man who was in charge of the buildings of Friedrich II. in Potsdam, FRIEDRICH WILHELM DITERICHS (1702-1782), who was not only regarded as one of the main Prussian master builders in the eighteenth century, but also provided significant impetus for the process of professionalisation of Prussian construction management. In due course, Rolf-Herbert Krüger is planning to research the history of the prefabricated reinforced concrete skeleton construction method in the former GDR.

3.9 Karl-Eugen Kurrer (Ernst & Sohn publishers, Berlin). The focal point of KARL-EUGEN KURRER's contribution to Construction History is the historiography of structural theory in a science history dimension, with practical engineering and didactic intention and in its cultural context. Closely related are his proposals for establishing an "historical engineering science", initial systematic ideas for which originated from his collaboration in the "European encyclopaedia of philosophy and sciences" project, which was published in 1990 (see section 3.20). Kurrer therefore has been working and continues to work on

the historiography of structural theory from a perspective of didactics, Construction History, aesthetics, biography, literary history, science and epistemology:

- since 1979: History of structural theory and applied mechanics; formulation of basic ideas for a historical/genetic structural theory and their partial implementation within the framework of his work as a tutor in the department for structural design at TU Berlin (1979-1981);
- since 1980: Popular presentation of topics relating to the history of construction engineering in numerous newspaper and journal articles;
- 1981: Undergraduate dissertation on the development of vault theory from the nineteenth century to today using the example of structural calculations for a single-arch bridge at the department for structural design at TU Berlin (see section 3.20);
- since 1982: Support for the research activities relating to the history of the “Fleisch” bridge in Nuremberg (built in 1598), which were initiated by Prof. WOLFGANG VON STROMER (University of Erlangen-Nuremberg), continued by HOLGER FALTER (University of Stuttgart), and will be completed by CHRISTIANE KAISER towards the end of 2004 (see sections 3.6 and 3.20);
- since 1984: Biographical work on structural engineers and philosophy of technology;
- 1986/1987: Scientific collaboration in the area of “constructive civil engineering” for the exhibition “Der Kongreß denkt”, held between 14.6.1987 and 1.11.1987 in the re-opened Congress Hall at Berlin (West) (see section 3.20);
- since 1988: History of reinforced concrete construction;
- since 1992: Collaboration in the network of researchers entitled “Between Mechanics and Architecture” established by PATRICIA RADELET-DE GRAVE and EDOARDO BENVENUTO;
- since 1996: History of steel construction and publishing history, with special consideration of structural engineering literature;
- 1998/99: Publication of a concept for a “historical/genetic structural theory” (see section 3.20).

Karl-Eugen Kurrer integrated the knowledge acquired over the course of more than two decades in his monograph on *Geschichte der Baustatik* (history of structural theory), published in November 2002 by Ernst & Sohn (see section 3.20). In addition to continued efforts on the historiography of structural theory,

in 2004 he once again started to work on the subject of “prolegomenon to a historical approach to engineering science”.

Events on Construction History held at the German Technikmuseum Berlin are an important cornerstone of the programme of events organised by the working group on “Technikgeschichte” (history of technology) of VDI-Bezirksverein Berlin-Brandenburg, which Karl-Eugen Kurrer has been running since 1996.

Ernst & Sohn, publishers for architecture and technical sciences, was established in 1851 in Berlin and has been part of the international, New York-based science publishing group John Wiley & Sons since 1996. As programme director for the company, Kurrer promotes the journalistic presentation of Construction History in the technical-scientific journals, books and electronic media published by Ernst & Sohn. Under the respective chief editors, who are responsible for their content, the following journals publish papers on historical topics relating to the technical-scientific disciplines dealt with by the above-mentioned journals:

- *Bauphysik* (building physics) (chief editor: Dipl.-Ing. CLAUDIA OZIMEK) http://www.wiley-vch.de/ernstsohn/zeitschriften/bauphysik/bauphysik_info.html
- *Bautechnik* (construction engineering) (chief editor: Dr.-Ing. DORIS GREINER-MAI) http://www.wiley-vch.de/ernstsohn/zeitschriften/bautechnik/bautechnik_info.html
- *Beton- und Stahlbetonbau* (reinforced concrete construction) (chief editor: Prof. Dr. Dr. KONRAD BERGMEISTER) http://www.wiley-vch.de/ernstsohn/zeitschriften/betonstahl/betonstahl_info.html
- *Mauerwerk* (masonry) (chief editor: Dr.-Ing. PETER SCHUBERT) http://www.wiley-vch.de/ernstsohn/zeitschriften/mauerwerk/mauerwerk_info.html
- *Stahlbau* (steel construction) (chief editor: Dr.-Ing. KARL-EUGEN KURRER) http://www.wiley-vch.de/ernstsohn/zeitschriften/stahlbau/stahlbau_info.html

In addition to the respective print versions, since 2004 the papers have also been available online at <http://www.interscience.wiley.com>. An online journal search facility is available free of charge. Also noteworthy is Karl-Eugen Kurrer's scientific collaboration for the exhibition “1799-1999. Von der Bauakademie zur Technischen Universität Berlin. Geschichte und Zukunft”, which was held at TU Berlin between 3.12.1999 and 30.1.2000 (Fig. 5): The exhibition catalogue under the same title, commissioned by the president of TU Berlin and edited by KARL SCHWARZ, was published by Ernst & Sohn (see section 3.20).

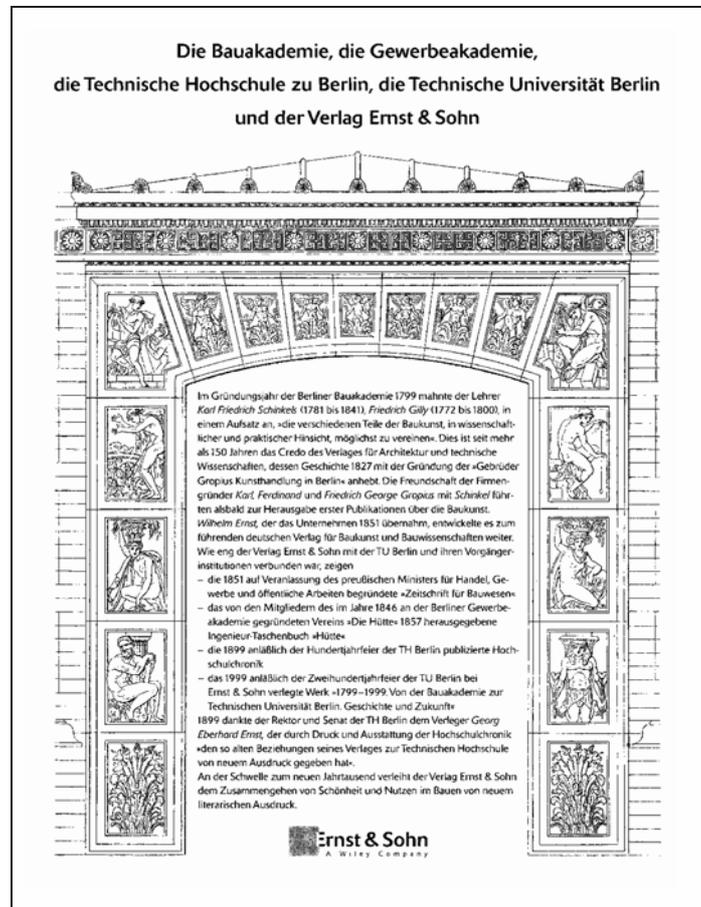


Fig. 5. Advertisement by Ernst & Sohn publishers with integrated motive of the left portal of the Bauakademie, built in Berlin between 1832 and 1836 by Schinkel, which was published in the monograph *1799-1999. Von der Bauakademie zur Technischen Universität Berlin. Geschichte und Zukunft* (see section 3.20)

3.10 Werner Lorenz (Brandenburg University of Technology Cottbus). The establishment of a department for Construction History has its origins in the foundation concept of Brandenburg University of Technology Cottbus (BTU Cottbus), which was established in 1990. The aim was for the newest technical university in Germany to use an interdisciplinary approach for teaching and research, combining natural science, technology and humanistic content. The department, of which Prof. Dr.-Ing. WERNER LORENZ has been director since 1993, is part of the Faculty for Architecture, Civil Engineering and Urban Planning. In 2003, it was renamed “Department for Construction History and

Structural Preservation”, to account for the expansion of the work of the department relating to the refurbishment und strengthening of load-bearing structures. Due to the diversity of activities, it has now become one of the largest departments with the faculty.

It advocates a Construction History that is based on technical/constructive development processes. The historical work closely interacts with current construction issues; practical historic issues and practical construction issues are mutually dependent. On the one hand, the former is oriented towards criticism and enrichment of the latter, on the other hand it develops and sharpens its topics and issues in dealing with it.

The link between historical construction practice is particularly clear when it comes to teaching. The mandatory integration of the subject of “history of construction engineering” within the Bachelor course on civil engineering is a novelty in the German university scene. The department is also responsible for the first large mandatory project during the first year of study, in which the load-bearing structure and detail of a historic structure is systematically recorded, documented and evaluated. A Masters course on structural engineering is currently in preparation. It will offer opportunities for specialisation in specific techniques of engineering analysis, restoration and strengthening of historic buildings. The already existing “Masters course on Building and Conservation” specifically conveys competence for building within the existing stock and the qualified management of older buildings. In addition to the mandatory subject of “history of construction engineering”, the department is also responsible for the mandatory module on “techniques for building within the existing stock”, in which students are trained in the expert description and evaluation of historic structures and a comprehensive understanding of their functionality. The topics on offer range from analyses of load-bearing structures of historic buildings to techniques for damage recording and analysis, restoration and strengthening. Interdisciplinary study is a mandatory component of all courses offered at BTU Cottbus. Relevant topics offered by the department are the interaction of construction, technology and art, and the identity and tasks of structural engineers past and present. After the introduction of the Bachelor/Masters course in 2005, the department will also be anchored in the architecture programme offering several lectures, seminars and tutorials. Diploma, Bachelor and Masters dissertations will deepen an understanding of historical and structural analyses during research on selected buildings and personalities. (For a current overview see <http://www.tu-cottbus.de/bautechnikgeschichte>).

In contrast to teaching, the research spectrum of the “Department for Construction History and Structural Preservation” principally deals with historical aspects. Engineering questions relating to the development of suitable

and 'gentle' strengthening solutions for historical structures are only treated in passing. The historical research deals with processes as well as products, and with design as well as structures. The focus is on interactions between design, science, architecture and art, as well as history and historicity of identity and attitudes of structural engineers as the basis for a historically sound criticism and enrichment of modern construction practices. From a history of development point of view, the main focus is on the industrially-oriented design and Construction History, particularly of the nineteenth and twentieth century, and its buildings. From a material technology point of view, the focus is on iron, steel and reinforced concrete construction. A regional focus is on Berlin-Brandenburg, with previous projects having dealt with historic technical monuments and industrial archaeology.

Methodological cornerstones are general literature and source work, and techniques and methods of historic construction research—transferred to engineering design questions—(archive work, site studies, structural surveys using techniques that are as little invasive as possible), and structural analysis.

While the main research focus has previously been primarily on Germany, since 2002 a first research priority outside Germany has started to develop involving detailed studies of the roof and ceiling structures at the Eremitage complex in St. Petersburg (Fig. 6). These iron structures, mainly dating back to around 1840 and largely still intact, are unparalleled in Europe. The long-term research project, which is being developed in co-operation with the State Eremitage of St. Petersburg and SERGEJ FEDOROV (see section 3.2), aims to learn to understand the development processes of a new “construction language” (in this case iron construction), through precise examination and documentation of the structures and their origins.

Beyond the framework of BTU Cottbus, the department is involved in the coordination of the multiplicity of activities relating to the history the construction engineering in the German-speaking region. In March 2003, an initial round-table discussion on the history of construction engineering was realised at Cottbus with funding from the German Research Foundation (DFG) (see section 1.6). One of the outcomes was the establishment of the “Forum Bautechnikgeschichte” newsgroup, which is managed from Cottbus.

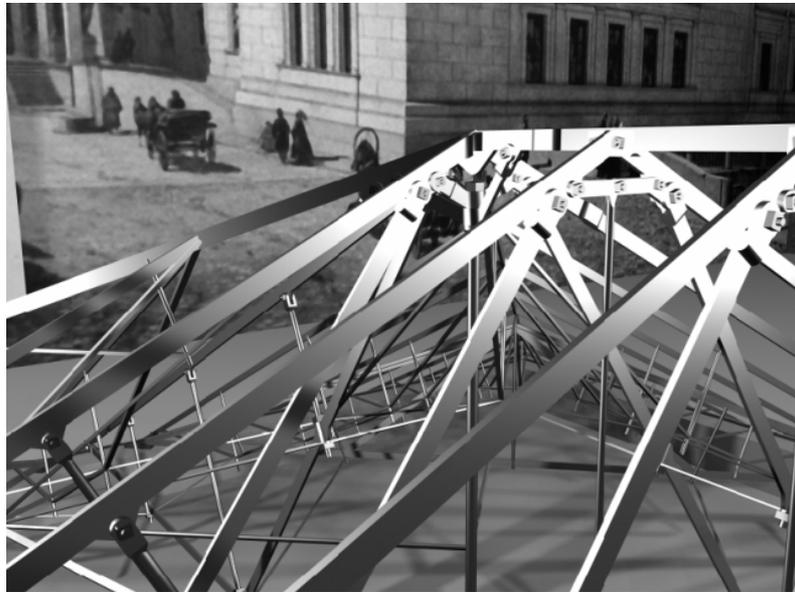


Fig 6. St. Petersburg, New Eremitage (1839-52), CAD visualisation of the roof structure above the south-western pavilion (© BTU Cottbus, Dep. for Construction History and Structural Preservation, 2003)

3.11 Michael Mende (Brunswick College of Fine Arts). While Construction History is not offered as a separate course at Brunswick College of Fine Arts, students of art education, industrial design and aesthetics and art history are offered regular lectures and seminars dealing with Construction History.

Within the framework of a lecture series for second-year students on architectural history using examples from Brunswick, the development of visible form of construction is explained from their relationship with the respective historic purpose and design, i.e. their structural engineering preconditions. This kind of synopsis is expanded in seminars during subsequent semesters that hitherto dealt with structures in tension using examples of suspension bridges, forces in arches and domes, or steel frameworks or frame constructions. Particular emphasis is placed on achieving a deeper understanding of the diagrams and reading material through the construction of models.

In his research on Construction History, MICHAEL MENDE deals with the construction of suspension bridges in the 1830s and 1840s, the skeleton construction of the “Bremer Baumwollbörse” (1929, 1932), movable bridges of the nineteenth and early-twentieth century in north-western Germany, and— together with NELE GÜNTHEROTH and ANDREAS KAHLOW (see section 3.6)— early bridge designs by JOHANN AUGUST ROEBLING.

3.12 Miron Mislin (Technical University of Berlin). MIRON MISLIN was head of the department for “Baugeschichte mit besonderer Berücksichtigung der Bautechnik” (Construction History with particular consideration of construction engineering) at the institute for “Baugeschichte, Architekturtheorie und Denkmalpflege” (Construction History, architectural theory and preservation of historic monuments) at Faculty VII “Architecture, Environment, Society” of TU Berlin since the winter semester of 1986/87. The lectures and seminars offered between 1987 and 1998 dealt with Construction History including structures, mechanics, history of urban construction, history of technology and economy. Structures were not only classified according to building materials, but were always examined in the context of technological progress and structural and construction management aspects of the respective period. Since 1998/99, research and education have been concentrating on the history of industrial architecture, mainly of Berlin, but also the USA and England. The seminars were complemented by field trips to existing historic factory sites and building surveys. Architecture students were able to choose to undertake the seminar work as a mandatory or voluntary part of their undergraduate course with associated weighting. Particular emphasis was on the preservation of older industrial facilities and transportation structures in Berlin.

In January 1999, the department organised the exhibition “Anfänge der Industriearchitektur in Berlin 1850-1910” at the Technical University of Berlin, which was subsequently shown at the La Sapienza University (Rome) in June 2000, at Vienna University of Technology in March 2001, and at the Polytechnic University of Madrid in January 2003.

3.13 Werner Müller (Ludwigshafen). WERNER MÜLLER submitted work on the history of stereotomy several decades ago. In 1990, he published a monograph on construction engineering during the Gothic period. Together with NORBERT QUIEN, he opens up the area of computer-aided simulation for historical architecture (see section 3.20). Currently, Müller is undertaking research into the following topics:

- History of stereotomy in central Europe, France and Italy;
- Technological style comparison between German late Gothic and German baroque under special consideration of the stonemason craft;
- Studies on the relationship between architecture from a history of technology and history of art perspective, particularly in terms of their different notion of space;
- Computer-aided edition of vault designs from the Austrian and Bohemian-Saxon late Gothic period in the “Codex miniatus 3” of the Austrian national library in Vienna;

- Position of the “perspective” of Hans Vredeman de Vries in ceiling frescos and stage sets;
- Anamorphic techniques.

3.14 Eberhard Pelke (Hessisches Landesamt für Straßenwesen—Regional Highways Agency for Hesse). In 1995, EBERHARD PELKE was appointed to serve on the civil engineering advisory board of the German road museum at Germersheim (www.deutsches-straßenmuseum.de) on behalf of the highways and transport administration of Hesse. The German road museum at Germersheim was established in 1989. In 1995, it was included in the list of specialist German technical museums. Along the three stages of the life of a road—design, construction and operation—it illustrates the history and the technical state of the art of road engineering.

In the road museum advisory board, Pelke was charged with illustrating the civil engineering structures found along roads (bridges, tunnels, support structures). The section on civil engineering is divided into so-called “topic boxes”, aided by the solid wall plan of the armoury building in which it is housed. For designing the technical content of the individual topic areas, the advisory board sought support from external experts, leading to exhibition boxes for tunnel engineering, structural design and stability, steel production and construction, pre-stressing technology, history of reinforced and pre-stressed concrete, geotechnology, mechanisation of construction methods, preservation and maintenance of structures.

Finally, together with KLAUS STIGLAT (see section 3.17), Pelke was charged with illustrating the history of slab-type bridges. The exhibition is chronologically structured into three main areas, i.e. 1. bridges from pre-antiquity and antiquity, 2. post-Roman bridge construction, and 3. the time of the engineers (bridge construction from 1750). The aim was to illustrate the development of bridge structures based on the four basic types, i.e. beam, arch, suspension bridge and cable-stayed bridge, on which today's bridge construction techniques are based, and to link them with the main engineers. The exhibition part was opened to the public at the end of 2002. The exhibition on the history of bridges in the German road museum generated a lot of interest and was accompanied by a talk by Pelke entitled “Le temps des ingénieurs—the development of the beam and arch bridges” that was repeated several times. The talk also touched on ‘occupational policy’ by highlighting the hegemony of jurisprudence and business administration in building projects and building products, with the intention of counteracting the spirit of the age of the “disappearing engineer” (WERNER LORENZ). These activities culminated in a conference under the heading “Technikgeschichte für Ingenieure—Die Wurzeln des modernen Brückenbaus” (history of technology for engineers—the roots of

modern bridge construction), which was organised by the “Vereinigung der Straßen- und Verkehrsingenieure Hessen—VSVI-Hessen”) (association of road and transportation engineers of Hesse) and held on 21 April 2004 at Friedberg.

As executive editor of the VSVI-Hessen journal, Pelke ensures that Construction History features regularly in the journal.

At the Faculty of Architecture and Urban Planning at the University of Stuttgart, Pelke is responsible for a seminar on road bridge design, which over the last three years he expanded with the subject “history of bridges, or the search for structural design”. The students use case studies of suspension and cable-stayed bridges, and reinforced and pre-stressed concrete bridges. For their assessed seminar work, the students research the biography of a bridge engineer and examine one or several of his structures.

3.15 Hartwig Schmidt (RWTH Aachen University). In terms of Construction History, the conservation department at RWTH Aachen University mainly focuses on two issues:

- Historic lime kilns:
In the course of industrialisation during the nineteenth century, small, manually operated lime kilns that had been used since the Middle Ages for producing quick lime were abandoned. The railways and companies with share capital, such as in the brick industry, enabled the construction of continuously operating kilns (shaft kilns and Hoffmann kilns) and the utilisation of coal as a fuel. With the introduction of rotary kilns and the increased application of cement in the building industry, demand for lime as a building material fell sharply. Today, the material is used almost exclusively for the restoration of historic buildings. The aim of the research into the history of lime utilisation, lime kilns and lime technology is the reintroduction of this building material into the preservation of historic monuments in the widest sense.
- Concrete and reinforced concrete construction:
The search for a waterproof bonding agent lasted almost exactly one century—from 1755, starting with initial trials by JOHN SMEATON (1724-1792) via the experiments of JOHN ASPDIN (1778-1855) and his patent for “Portland cement” to industrial production in the middle of the nineteenth century. Only half a century later, concrete had become the dominant building material in place of pre-industrial construction methods—starting in 1847, when FRANÇOIS COIGNET (1814-1888) developed the composite construction method to MATHIAS KOENEN’s 1886 concrete reinforcement brochure, which can be regarded as the theoretical basis of reinforced concrete

construction. It all started with efforts to replace the short-lived and flammable building materials (wood, wrought iron) and ended with a completely new construction method that opened up previously undreamt-of creative and constructive options for architecture and civil engineering.

The history of reinforced concrete construction is one aspect of the research activities. The other research area aims to develop techniques for appropriate restoration of concrete structures. Some modern reinforced concrete buildings are beginning to show their age and associated defects and require repair. The customary techniques used for this purpose destroy artistic exposed concrete surfaces. The research on the history of reinforced concrete structures forms the basis for the evaluation of their significance and recognition as historic monument. The time frame for the research topics therefore extends from the early days of concrete construction during the second half of the nineteenth century to now. The research is interdisciplinary and involves co-operation with building material technologists and structural engineers.

Since 2003, Schmidt has been editor of the *Ingenieurbaukunst* (structural design) series of the journal *Beton- und Stahlbetonbau* (concrete and reinforced concrete construction) (see section 3.9), in which two to four articles on the history the concrete and reinforced concrete construction are published per year.

3.16 Manfred Schuller (Bamberg University). Construction research is a method that aims to decipher historic buildings, with the structures or their remains themselves serving as the source of cognition. This method is particularly significant where other types of sources such as written or visual documents do not exist, which is the case for many structures from antiquity and the Middle Ages, and for most anonymous buildings. The basis for understanding them is precise knowledge of the structure in question, involving in most cases accurate survey drawings that precisely document all noticeable details. In principle, it is irrelevant whether a building originates from antiquity or the Baroque, whether it is a monumental cathedral or a simple farmhouse. Accordingly, the research interests since the establishment of a chair for construction research and Construction History at the institute for preservation of historic monuments and construction research at Bamberg University in 1986 covers the whole spectrum from antiquity up to approximately 1840, when the introduction of the steam engine and of structural theory signified the start of a new era. Historical construction engineering features strongly in almost all research projects of the institute and of Ph.D students. Finding answers to the question of “how” is crucial, regardless of whether the topic is the manufacturing process of a medieval roof structure or the surface treatment of the ashlar walls of a Greek temple.

In teaching—mainly for a postgraduate, one-year Masters course for students who take it as a subsidiary subject and for participants of a post graduate programme—construction engineering plays a central role in lectures and tutorials, some of which are very practice-oriented. One example is the demonstration of stonemason techniques using old tools in old quarries. Students also gain precise insights in the subject of timber, particularly in the context of roof structures.

3.17 Klaus Stiglat (Karlsruhe). KLAUS STIGLAT undertakes research into the creation and particularly into the continued presence of old iron and concrete bridges in Germany and France. He does this not with scientific meticulousness, but through individual descriptions that try and interpret development trends. The results so far have been published in a book on early bridges, a kind of engineer's travel guide. Closely related is the continuous expansion of an already existing private specialised library containing books printed from approximately 1790.

For many years, Stiglat has been collecting biographic data of structural engineers from the German-speaking region who have made important, albeit often small contributions to development of construction. His monograph entitled *Bauingenieure und ihr Werk* (structural engineers and their work) published in 2003 contains 100 biographies (45 of which are self-descriptions).

In collaboration with EBERHARD PELKE (see section 3.14), he put together the exhibition on the history of bridges at the German road museum in Germersheim. Furthermore, Stiglat is a member of the advisory board of the archive for architecture and civil engineering in south-western Germany at the University of Karlsruhe. The archive collects legacies of outstanding architects and engineers from the region of south-western Germany.

3.18 Jos Tomlow (University of Applied Sciences Zittau/Görlitz). The cornerstones of Construction History activities in the specialist field for “basic principles of design and preservation of historic monuments” at the University of Applied Sciences Zittau/Görlitz are:

- Research into the life and work of ANTONI GAUDI;
- The history of reception Gaudi's theory (“Gaudinismo” = Gaudinism);
- Optimisation of load-bearing structures throughout history;
- History of structural design;
- Research into regional building traditions;
- Analysis of complex geometrical concepts in the history of construction;

- Preservation of historically significant regional structures (appropriate analysis, repair, restoration);
- Technical aspects of classical modernity in architecture.

3.19 Martin Trautz (Kelkheim). The contributions by MARTIN TRAUTZ on the subject of Construction History focus on four priorities.

- 1) Genealogical studies of construction methods and types in architecture and civil engineering in the context of the state of the art in theory and practice at the respective time.
 - a) Railway bridge construction in Germany during the second half of the nineteenth century:
 - Application of the established techniques of classic structural theory in bridge construction (trussed framework theory, beam theory etc.).
 - Significance and content of structurally optimised load-bearing systems vis-à-vis constructive conditions with non-structural causes for railway bridge construction.
 - b) Examinations of historic vault designs and structures:
 - Vault designs and their consequences on structural behaviour.
 - Application of structurally optimised forms in historic vault construction.
- 2) Historical/critical studies of civil engineering structures and the work of engineers in terms of their technical and non-technical significance.
 - a) The half-parabolic girder structure of the Hammer bridge near Düsseldorf from 1870 and its significance in the context of contemporary bridge construction.
 - b) The construction of the Eiffel Tower by G. EIFFEL, which was based on ideas developed by chief engineer M. KOEHLIN.
- 3) Comparative and evaluative examination of historical and contemporary analysis methods for truss structures and vaults.
 - a) The application of thrust line theory and its results compared with modern material/non-linear finite element techniques.
- 4) Reconstruction and translation of historic construction instructions and methods and their classification within current nomenclature.
 - a) Examination and modern interpretation of ANDREA PALLADIO's written work on the construction of timber bridges.

3.20 References

- AHNERT, Rudolf and Karl Heinz KRAUSE. 2000-2001-2002. *Typische Baukonstruktionen von 1860 bis 1960*. 3 vols. Berlin: Verlag Bauwesen.
- BACHMANN, Oliver, Heinz-Herbert COHRS, Tim WHITEMAN, Alfred WISLICKI. 1997. *Faszination Baumaschinen—Krantchnik von der Antike zur Neuzeit*. Isernhagen: Giesel Verlag für Publizität.

- BINDING, Günther. 1993. *Baubetrieb im Mittelalter*. Darmstadt: Wissenschaftliche Buchgesellschaft.
- BÖGLE, Annette, Peter Cachola SCHMAL, Ingeborg FLAGGE. 2003. *leicht weit—Light Structures. Jörg Schlaich—Rudolf Bergermann*. München/Berlin/London/New York: Prestel Verlag.
- BOLLENZ, Eckhard. 1991. *Vom Baubeamten zum freiberuflichen Architekten. Technische Berufe im Bauwesen (Preußen/Deutschland, 1799-1931)*. Frankfurt/M: Peter Lang.
- BÜHLER, Dirk. 2000. *Brückenbau*. München: Deutsches Museum.
- BÜTTNER, Oskar and Erhard HAMPE. 1977. *Bauwerk—Tragwerk—Tragstruktur*. Vol. 1. Berlin: VEB Verlag für Bauwesen.
- . 1984. *Bauwerk—Tragwerk—Tragstruktur*. Vol. 2. Berlin: VEB Verlag für Bauwesen.
- BUJA, Heinrich Otto. 2003. Die Bohrtechnik im Wandel der Zeiten. Vom Löffelbohrer der Steinzeit bis zum vollhydraulischen Großdrehbohrgerät. *Bautechnik* 80, 9: 651-662.
- DIERX, Weil and Günther GARBRECHT. 2001. *Wasser im Heiligen Land. Biblische Zeugnisse und archäologische Forschungen. Schriftenreihe der Frontinus-Gesellschaft*. Supplementband III. Mainz: Verlag Philipp von Zabern.
- DIETRICH, Richard Johann. 1998. *Faszination Brücken. Baukunst—Technik—Geschichte*. Munich: Georg D. W. Callwey.
- FALTER, Holger. 1999. Untersuchungen historischer Wölbkonstruktionen—Herstellverfahren und Werkstoffe. Dissertation, Universität Stuttgart.
- GARBRECHT, Günther. 1985. *Wasser. Vorrat, Bedarf und Nutzung in Geschichte und Gegenwart*. Reinbek bei Hamburg: Rowohlt Taschenbuch Verlag.
- Geheimes Staatsarchiv Preußischer Kulturbesitz (eds). 2000. *Mathematisches Calcul und Sinn für Ästhetik. Die preußische Bauverwaltung 1770-1848*. Berlin: Duncker & Humblot.
- GROSSMANN, G. Ulrich. 1993. *Einführung in die historische Bauforschung*. Darmstadt: Wissenschaftliche Buchgesellschaft.
- HANISCH, Jürgen. 1997. „Wegweiser“ auf dem Wege zu einem neuen Abschnitt in der Geschichte des Erd- und Grundbaus. Von Coulomb zu Fellenius über die probabilistische Sicherheitstheorie zum EUROCODE 7. *Bautechnik* 74, 5: 287-300.
- HÄNSEROTH, Thomas. 1980. Zur Vorgeschichte der Baumechanik. *Dresdener Beiträge zur Geschichte der Technikwissenschaften* no. 1: 35-72.
- . 1984. Der Aufbruch zum modernen Bauwesen. Zur Geschichte des industriellen Bauens. Dissertation B, TU Dresden.
- HEENE, Gerd. 2004. *Baustelle Pantheon. Planung—Konstruktion—Logistik*. Düsseldorf: Verlag Bau + Technik.
- HEINLE, Erwin and Jörg SCHLAICH. 1996. *Kuppeln aller Zeiten—aller Kulturen*. Stuttgart: Deutsche Verlags-Anstalt.
- HEINRICH, Bert. 1979. *Am Anfang war der Balken. Zur Kulturgeschichte der Steinbrücke*. Munich: Deutsches Museum.
- . 1981. Aus der Geschichte der Bauarbeit: Szenarium zu einem Großbau im 18. Jahrhundert. Pp. 283-307 in *Technikgeschichte als Geschichte der Arbeit*, Ilse Schütte, ed. Bad Salzdetfurth: Verlag Barbara Franzbecker, Didaktischer Dienst.

- . 1983. *Vom Balken zum Bogen*. Reinbek bei Hamburg: Rowohlt Taschenbuch Verlag.
- HILZ, Helmut. 1993. *Eisenbrückenbau und Unternehmertätigkeit in Süddeutschland*. Stuttgart: Franz Steiner Verlag.
- JESBERG, Paulgerd. 1996. *Die Geschichte der Ingenieurbaukunst*. Stuttgart: Deutsche Verlags-Anstalt.
- KLÖNNE, Arno, Hartmut REESE, Irmgard WEYRATHER, Bernd SCHÜTT. 1989. *Hand in Hand. Bauarbeit und Gewerkschaften—eine Sozialgeschichte*. Frankfurt am Main: Büchergilde Gutenberg.
- KORTE, Arnold. 1992. *Two Railway Bridges of an Era. Zwei Eisenbahnbrücken einer Epoche. Firth of Forth and Firth of Tay*. Basel/Boston/Berlin: Birkhäuser.
- KURRER, Karl-Eugen. 1981. Entwicklung der Gewölbetheorie vom 19. Jahrhundert bis zum heutigen Stand der Wissenschaft am Beispiel der Berechnung einer Bogenbrücke. Diplomarbeit am Fachgebiet „Statik der Baukonstruktionen“ der TU Berlin.
- . 1987. Konstruktiver Ingenieurbau. Pp. 178-183 in *Wissenschaften in Berlin: Begleitband 2 (Disziplinen) zur Ausstellung „Der Kongreß denkt“ v. 14.6.1987 bis 1.11.1987*, eds. T. Buddensieg, K. Düwell and K.-J. Sembach. Berlin: Gebr. Mann Verlag.
- . 1992. Philosophische Überlegungen zum Begriff der Technikwissenschaften. *Blätter für Technikgeschichte* (1989/90) 51/52: 67-82.
- . 1999. Plädoyer für eine historisch-genetische Statiklehre. Thesen zur ganzheitlichen Statiklehre für Architekten und Bauingenieure. *Baukultur* 2: 32-35.
- . 2002. *Geschichte der Baustatik*. Berlin: Ernst & Sohn.
- . 2004. Rudolph Bredt (1842-1900)—Wissenschaftlich-technischer Begründer des industriellen Kranbaus. Pp. 463-502 in *VDI-Bau. Jahrbuch 2004*, VDI-Gesellschaft Bautechnik. Düsseldorf: VDI-Verlag.
- KÜNZEL, Helmut. 2002. *Bauphysik. Geschichte und Geschichten*. Stuttgart: Fraunhofer IRB Verlag.
- LAMPRECHT, Heinz-Otto. 1996. *Opus Caementitium—Bautechnik der Römer*. 5. Düsseldorf: Verlag Bau + Technik.
- MAUERSBERGER, Klaus. 1983. Studienmaterial zur Vorlesung „Geschichte der Technikwissenschaften/Maschinenwesen“. Teil 1: Von den Anfängen bis zur Herausbildungsperiode (1850). *Dresdener Beiträge zur Geschichte der Technikwissenschaften*, no. 7. *Mauerwerk* 8 (2004), vol. 3.
- MAURER, Bertram. 1998. *Karl Culmann und die graphische Statik*. Berlin/Diepholz/Stuttgart: Verlag für Geschichte der Naturwissenschaft und der Technik.
- MISLIN, Miron. 1988. *Geschichte der Baukonstruktion und der Bautechnik*. Düsseldorf: Werner-Verlag.
- MORGAN, Conway Lloyd. 2004. *Show me the future. Engineering and Design by Werner Sobek*. Ludwigsburg: avedition GmbH, Verlag für Architektur und Design.
- MÜLLER, Werner. 1990. *Grundlagen gotischer Bautechnik. Ars sine scientia nihil*. Munich: Deutscher Kunstverlag.

- . 2003. *Barocke Raumphantasien. Gebaute Wirklichkeit und konstruierter Schein*. Petersberg: Michael Imhof Verlag.
- . 2002. *Von Guarino Guarini bis Balthasar Neumann. Zum Verständnis barocker Raumkunst*. Petersberg: Michael Imhof Verlag.
- . 2002. *Steinmetzgeometrie zwischen Spätgotik und Barock. Eine Bautechnik auf dem Wege vom Handwerk zur Ingenieurwissenschaft*. Petersberg: Michael Imhof Verlag.
- . Forthcoming. *Steinmetzgeometrie, Alchemie und Perspektive. Rationalitätsformen der böhmischen Renaissance*.
- MÜLLER, Werner and Norbert QUIEN. 1999. *Spätgotik virtuell. Für und Wider die Simulation historischer Architektur*. Weimar: Verlag für Datenbank und Geisteswissenschaften.
- . 2000. *Erdachte Formen—Errechnete Bilder. Deutschlands Raumkunst der Spätgotik in neuer Sicht*. Weimar: Verlag für Datenbank und Geisteswissenschaften.
- . 2000. *Böhmens Barockgotik. Architekturbetrachtung als computergestützte Stilkritik*. Weimar: Verlag für Datenbank und Geisteswissenschaften.
- . Forthcoming. *Virtuelle Steinmetzkunst der österreichischen und böhmisch-sächsischen Spätgotik: Die Gewölbeentwürfe des Codex miniatus 3 der österreichischen Nationalbibliothek in Wien*.
- NÉRDINGER, Winfried, ed. 2002. *Leo von Klenze*. München/Berlin/London/New York: Prestel Verlag.
- OTTO, Frei. 1994. Alte Baumeister. Was können die alten Baumeister erfunden haben? Ancient Architects. What could the Ancient Master Builders have invented? *Mitteilungen des Instituts für leichte Flächentragwerke (IL) Universität Stuttgart* 37. Stuttgart: Karl Krämer.
- PFARR, Karlheinz. 1983. *Geschichte der Bauwirtschaft*. Essen: Deutscher Consulting Verlag.
- PIEPER, Klaus. 1983. *Sicherung historischer Bauten*. Berlin/München: Verlag von Wilhelm Ernst & Sohn.
- POTTGIEßER, Hans. 1985. *Eisenbahnbrücken aus zwei Jahrhunderten*. Basel/Boston/Stuttgart: Birkhäuser.
- RICKEN, Herbert. 1977. *Der Architekt. Geschichte eines Berufes*. Berlin: VEB Verlag für Bauwesen.
- . 1994. *Der Bauingenieur. Geschichte eines Berufes*. Berlin: Verlag für Bauwesen.
- , ed. 1998. *Zur Geschichte der Bauingenieurkunst und -wissenschaft. Bautechnik Spezial* (Sonderheft). Berlin: Ernst & Sohn.
- SABOTTKA, Larissa. 2003. *Die eisernen Brücken der Berliner S-Bahn. Bestandsdokumentation und Bestandsanalyse*. Berlin: Gebr. Mann Verlag.
- SCHÄDLICH, Christian. 1967. *Das Eisen in der Architektur des 19. Jahrhunderts. Beitrag zur Geschichte eines neuen Baustoffs*. Habilitationsschrift, Hochschule für Architektur und Bauwesen Weimar.
- SCHLAICH, Jörg and Matthias SCHÜLLER. 1999. *IngenieurbauFührer Baden-Württemberg, hrsgn. von der Ingenieurkammer Baden-Württemberg*. Berlin: Bauwerk Verlag.
- SCHUNCK, Eberhard, ed. *Beiträge zur Geschichte des Bauingenieurwesens*, nos. 1-14. München: Technische Universität München, Lehrstuhl für Baukonstruktion.

- SCHWARZ, Karl, ed. 2000. *1799-1999. Von der Bauakademie zur Technischen Universität Berlin. Geschichte und Zukunft*. Berlin: Ernst & Sohn.
- SMOLTCZYK, Ulrich. 2001. 50 Jahre Deutsche Gesellschaft für Geotechnik. *Bautechnik* 78, no. 2: 132-134.
- STRECKE, Reinhart. 2000. *Anfänge und Innovation der preußischen Bauverwaltung. Von David Gilly zu Karl Friedrich Schinkel*. Köln/Weimar: Böhlau Verlag.
- SZABÓ, Istvan. 1977. *Geschichte der mechanischen Prinzipien und ihrer wichtigsten Anwendungen*. Basel: Birkhäuser Verlag.
- . 1966. *Geschichte der mechanischen Prinzipien und ihrer wichtigsten Anwendungen*. 3rd ed. P. Zimmermann and E. A. Fellmann, eds. Basel: Birkhäuser Verlag.
- THODE, Dierk. 1975. Untersuchungen zur Lastabtragung in spätantiken Kuppelbauten. *Studien zur Bauforschung* 9, ed. Koldewey-Gesellschaft. Darmstadt.
- TRAUTZ, Martin. 1998. Zur Entwicklung von Form und Struktur historischer Gewölbe aus der Sicht der Statik. Dissertation Universität Stuttgart.
- USEMANN, Klaus W. 1993. *Entwicklung von Heizungs- und Lüftungstechnik zur Wissenschaft. Hermann Rietschel. Leben und Werk*. Munich/Vienna: Oldenbourg Verlag.
- VDI-GESELLSCHAFT BAUTECHNIK IM VEREIN DEUTSCHER INGENIEURE, eds. 1990. *Wegbereiter der Bautechnik. Herausragende Bauingenieure und technische Pionierleistungen in ihrer Zeit. Klassiker der Technik*. Düsseldorf: VDI-Verlag.
- WAGNER, Rosemarie and Ralph EGERMANN. 1987. *Die ersten Drahtkabelbrücken*. Düsseldorf: Werner-Verlag.
- WAPENHANS, Wilfried. 1992. *Zur Entwicklung des Stahlverbundbaus in Deutschland bis 1992*. Dresden: Eigenverlag.
- WAPENHANS, Wilfried and Jens Richter. 2002. Die erste Statik der Welt vor 260 Jahren. *Bautechnik* 79, 8: 543-553.
- WEBER, Wilmar Karlemann. 1999. Die gewölbte Eisenbahnbrücke mit einer Öffnung. Begriffserklärungen, analytische Fassung der Umrißlinien und ein erweitertes Hybridverfahren zur Berechnung der oberen Schranke ihrer Grenztragfähigkeit, validiert durch einen Großversuch. Dissertation TU München 1999.
- WENZEL, Fritz, ed. 1987-1997. *Erhalten historisch bedeutsamer Bauwerke. Jahrbücher des Sonderforschungsbereichs 315 der Universität Karlsruhe*. Berlin: Ernst & Sohn.
- WERNER, Ernst. 1974. Die ersten eisernen Brücken (1777-1859). Dissertation TU München.
- . 1980. *Technisierung des Bauens. Geschichtliche Grundlagen moderner Bautechnik*. Düsseldorf: Werner-Verlag.
- WERNER, Frank. 1985. Entwicklung der Eisen- und Stahlbauweise im Industrie- und Gesellschaftsbau bis zur Mitte des 20. Jahrhunderts. Dissertation B, Hochschule für Architektur und Bauwesen Weimar 1985.
- WERNER, Frank and Joachim SEIDEL. 1992. *Der Eisenbau. Vom Werdegang einer Bauweise*. Berlin/München: Verlag für Bauwesen.
- WÖLFEL, Wilhelm von. 1990. *Wasserbau in den alten Reichen*. Berlin: VEB Verlag für Bauwesen.
- . 1997. Brunnen, Brücken, Aquädukte. Berichte zum Bauen in der Antike. *Bautechnik Spezial* (Sonderheft). Berlin: Ernst & Sohn.

———. 1999. Kanäle, Brücken und Zisternen. Berichte aus den antiken Kulturen Ägyptens, Mesopotamiens, Südwestarabiens, Persiens und Chinas. *Bautechnik Spezial* (Sonderheft). Berlin: Ernst & Sohn.

4 Switzerland

The book entitled *Die Geschichte der Bauingenieurkunst*, published in 1949 by HANS STRAUB and re-published in 1992 in its fourth, revised and extended edition by PETER ZIMMERMANN, is still regarded as the standard work on Construction History. It appeared in English as early as 1952 under the title *A History of Civil Engineering* (see section 4.4).

In the 1980s, TOM F. PETERS researched the history of the construction of large bridges, the formation of the modern construction industry in the nineteenth century and the development of suspension bridge construction at ETH Zurich (see section 4.4). During this time, he was regarded as one of only few people who systematically examined Construction History issues in the German-speaking region.

In the early 1990s, the civil engineer FRITZ SCHEIDEGGER tried to continue the work of his colleague HANS STRAUB with the edition the two-volume work, *Aus der Geschichte der Bautechnik* (see section 4.4).

The work by Prof. ULRICH PFAMMATTER (Lucerne University for Technology and Architecture) on Construction History focused on the historic aspects related to the training and occupation of modern architects in the nineteenth and early twentieth century (see section 4.4).

Prof. WILLI H. HAGER from the Laboratory of Hydraulics, Hydrology and Glaciology (VAW) at ETH Zurich has been working on topics concerning the history of hydraulics for fifteen years. In 2003, he published the first volume of his work *Hydraulicians in Europe 1800-2000*. The publication of a second volume is planned for 2006. In 2003, on the occasion of the 200th birthday of HENRY PHILIBERT GASPARD DARCY (1803-1858), together with GLENN O. BROWN and JÜRGEN D. GARBRECHT, he edited a collection of twenty articles on the history of hydraulic engineering with particular emphasis on the work of Darcy (see section 4.4).

Apart from those mentioned above, according to information provided by Prof. PETER MARTI, the following engineers and scientists are also engaged with the subject of Construction History in Switzerland:

- Dr. RUDOLF MUMENTHALER, ETH library
(mumenthaler@library.ethz.ch)

- Prof. Dr. WERNER OECHSLIN, director of the Institute for the History and Theory of Architecture, ETH Zurich (oechslin@gt.aech.ethz.ch)
- Prof. Dr. AURELIO MUTTONI, EPFL/ENAC/IS/BETON Lausanne (aurelio.muttoni@epfl.ch)
- PIERRE FREY, EPFL/ENAC/INTER/ACM Lausanne (pierre.frey@epfl.ch)
- Prof. Dr. MASSIMO LAFFRANCHI, Accademia di architettura, Mendrisio (mlaffranchi@arch.unisi.ch)
- Dipl.-Ing. JÜRGEN CONZETT, Conzett, Bronzini, Gartmann AG, Chur (cbg@cbg-ing.ch)

The Chair for the History of Technology at ETH Zurich. This chair has been in existence since 1997, initially as an assistant professorship and since 2001 as a full chair. The professorship is currently held by the historian Dr. DAVID GUGERLI. His work concentrates on the nineteenth and twentieth centuries. The work published by his department includes the paperback *Institutsmittelungen*, published by Chronos of Zurich under the title *Interferenzen*. Among those, the following issues deal with construction engineering:

- No. 1: *Vermessene Landschaften, Kulturgeschichte und technische Praxis im 19. und 20. Jahrhundert* (surveying, cartography). Zurich: Chronos 1999.
- No. 6: *Helvetische Meliorationen. Die Neuordnung der gesellschaftlichen Naturverhältnisse an der Linth* (straightening of the river Linth, draining of swamps). Zurich: Chronos 2003.
- No. 7: *Die Internationalität der Eisenbahn 1850-1970* (on the internationality or railways). Zurich: Chronos 2003.

According to information provided by Gugerli, the Chair for the History of Technology is currently not undertaking any work on aspects of Construction History.

Verein für wirtschaftshistorische Studien (Society for studies on the history of the economy). This society was established in 1950. Every year, it publishes two brochures under the main heading “Schweizer Pioniere der Wirtschaft und Technik” (Swiss pioneers of economy and technology) (<http://www.pioniere.ch>). Now and again, they deal with construction engineering pioneers, such as,

- Vol. 36: *Otto Jaag (1900-1978)—Ein Leben für den Gewässerschutz. ETH-Professor und Direktor der Eidg. Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz (EAWAG) an der ETH Zürich;*

- Vol. 41: *Fünf Schweizer Brückenbauer: Othmar H. Ammann (1879-1965), Richard Coray (1869-1946), Guillaume-Henri Dufour (1787-1875), Hans Ulrich Grubenmann (1709-1783), Robert Maillart (1872-1940)*;
- Vol. 49: *Ernst Göhner (1900-1971)—Bauen in Norm*;
- Vol. 53: *Drei Schweizer Wasserbauer: Conradin Zschokke (1842-1918), Eugen Meyer-Peter (1883-1969), Gerold Schnitter (1900-1987)*;
- Vol. 60: *Arnold Bürkli (1833-1894)—Aufbruch in eine neue Zeit* ;
- Vol. 66: *Ludwig von Tetmajer-Przerwa (1850-1905), Gründer der EMPA, Pionier der Materialprüfung und -forschung* ;
- Vol. 64: *Drei Generationen Geilinger* ;
- Vol. 69: *Alpenbahn-Ingenieure* ;
- Vol. 78: *Jakob Tuchschnid (1822-1895), Jakob Tuchschnid (1858-1909), Walter Tuchschnid (1893-1963) – Vom Holzkochherd zu Stahl-Glas-Konstruktionen*.

Schnitter-Fonds für Technikgeschichte (Schnitter fund for the history of technology). In 1993, structural engineer NIKLAUS SCHNITTER established the “Gerold und Niklaus Schnitter-Fonds für Technikgeschichte der ETH Zürich”. His main interest was the history of construction engineering and the provision of funds for relevant publications, meetings and exhibitions. The main beneficiaries include the “Schweizerische Gesellschaft für Technikgeschichte und Industriekultur” (Swiss association for the history of technology and industrial culture) and the Chair for the History of Technology at ETH Zurich. A variety of applicants from within and outside the university sector are also supported.

It is worth mentioning that Schnitter has gained a personal reputation within the field of the history of hydraulic engineering through the publication of numerous articles and two books.

Gesellschaft für Ingenieurbaukunst (Society for structural design). The “Gesellschaft für Ingenieurbaukunst” (Society for structural design), which was established in November 1995 by ETH professor Dr. *Peter Marti* (e-mail: monsch@ibk.baug.ethz.ch), who still runs the society, every year organises an exhibition at the “Museum für Ingenieurbaukunst” (museum for structural design) at the Hänggigturm, Fabrikstraße 9, in CH-8755 Ennenda, and documents these in a well presented exhibition catalogue. So far, the following volumes have been published:

- *Heinz Isler – Schalen* (1994)
- *Robert Maillart – Beton-Virtuose* (1995)
- *Historische Alpendurchstiche in der Schweiz* (1996)

- *Christian Menn – Brückenbauer* (1997)
- *Wasserkraft in der Schweiz* (1998)
- *Heinz Hossdorf* (1999)
- *Schweizer Eisenbahnbrücken* (2000)
- *Schweizer Ingenieurholzbau* (2001)
- *Alexandre Sarrasin* (2002)
- *Ingenieur-Betonbau* (2003)
- *Flußbau in der Schweiz* (2004)

For 2005, an exhibition about transportation structures in Switzerland is planned.

SATW “Kommission für Technikgeschichte” (commission for the history of technology). The “Swiss Academy of Engineering Sciences” (SATW) has a permanent commission for the history of technology (“Kommission Technikgeschichte”). It is currently run by Dipl. Arch. Dr. ANTOINE WASSERFALLEN and is devoted to teaching history of technology at secondary schools. Presentations, exhibitions and electronic media are used for this purpose.

4.1 Hans-Peter Bärtschi (Winterthur)

Construction history was first introduced in Switzerland in the 1970s by Prof. HEINZ RONNER as a subject at the Swiss Federal Institute of Technology Zurich (ETH Zurich). As a research associate at the Institute for the History and Theory of Architecture (gta), HANS-PETER BÄRTSCHI had been working closely with Prof. Ronner between 1979 and 1981. For the purpose of practical illustration for the students, Bärtschi played a leading role in the projects and seminar weeks under the titles “Ruhrpott” (Ruhr Valley) in 1979, “Industrie-Ensembles in der Schweiz” (industrial ensembles in Switzerland) in 1980, and “Industriearchäologie in England” (industrial archaeology in England) in 1981. After Ronner's death, in the mid-1980s the subject was no longer taught with the same intensity at ETH Zurich.

In 1979, Bärtschi established his “Arias-Industriekultur” bureau at Winterthur (<http://www.Arias-Industriekultur.ch>). Construction history represents a large proportion of the around 10000 surveys of technical cultural objects that have been undertaken by the bureau to date. Commissions for preservation studies of disused factories frequently require historical analyses to be carried out. In the 25 years since the bureau was established, a wealth of practical knowledge on issues relating to Construction History has been accumulated.

Between 1984 and 2003, during the winter semester Bärtschi offered lectures on “Technikgeschichte” (history of technology) at “Zürcher Hochschule Winterthur”. Between 1998 and 2001, he offered students the subject of

Construction History as a joint project between structural engineering lecturers and architects. In the course of efforts to reduce the duration of university degrees and due to the amalgamation of departments, history of technology was removed from the range of subjects on offer.

A further research and teaching resource is offered by the “Iron Library”, a foundation established by Georg Fischer Ltd. in Schaffhausen. In 2003, the twenty-fifth annual technology history meeting took place there. The meetings focus on iron as a construction material. About every third meeting focuses on a particular Construction History aspect. The presentations are published in the *Nachrichten aus der Eisenbibliothek Ferrum*.

Arias-Industriekultur bureau is currently, publishing information about important historic Swiss construction projects on the internet in collaboration with the Swiss association for the history of technology and industrial culture; An internet portal in three languages is available under <http://www.industriekultur.ch>, <http://www.patrimoine-industriel.ch>, and <http://www.industrial-heritage.ch>.

4.2 Eugen Brühwiler (École Polytechnique Fédérale de Lausanne)

As professor for the preservation of buildings at the Swiss Federal Institute of Technology at Lausanne (EPFL), EUGEN BRÜHWILER would like “Bauwerksgeschichte” (structural history) to be regarded as a specialist field that forms an essential basis for the successful management of existing civil engineering structures. “Bauwerksgeschichte” is alive! Many “historic” structures are still in use and will have to continue to be used for a long time—not least for macroeconomic reasons. Most existing structures were built over the course of several generations. They therefore have a history that must be understood and passed on.

But modern structural engineers in particular no longer have the time and cultural background or basic professional ethical attitude (supposedly) for consciously and systematically dealing with the origin and development of their fine profession and civil engineering structures. Many engineers do not know their predecessors and the structures they built. This is a serious shortcoming, which becomes particularly apparent when engineers have to co-operate within an extended professional environment with architects or preservers of historic monuments, which today and in the future will be increasingly the case, and quite rightly so. According to Brühwiler, the history of structural design should be a compulsory component of structural engineering degree courses. However, such a position is still far from reality.

In his efforts to offer engineering students insight into historical aspects of structural design whenever an opportunity presents itself, in all lectures on

preservation and safety of structures Brühwiler tries to offer at least short glimpses of historical aspects of the individual structures being discussed, sometimes very spontaneously. In his lecture series on the “aesthetics of civil engineering structures”, he presents a more systematic introduction into the history of structural design from an aesthetics point of view. Within the framework of this lecture series, Brühwiler requires students to submit coursework that deals with an evaluation of the aesthetic qualities of civil engineering structures, in which usually historical aspects (have to) come in “naturally”, in order to be able to understand the “existence” and appearance of existing civil engineering structures. He regards this as an example for his claim that “Construction History” should not be treated in isolation, but as part of a holistic approach.

Furthermore, within the framework of the “science – man – society” projects, which are mandatory for all EFPL students, Brühwiler regularly offers topics on structural design. Several significant pieces of work had their origins in such projects, such as those on the collapse of the Mönchenstein bridge (Switzerland) in 1891, the construction of arched bridges from Antiquity to the Middle Ages, a historical/cultural evaluation of steel bridges in the Ticino, or a “bridge guide” for western Switzerland.

In 2001 and 2002, the legacy of the regionally (western Switzerland) renowned and influential concrete engineer ALEXANDRE SARRASIN was examined and made accessible to the public in co-operation with the “Archives de la Construction Moderne” at EPFL (ETH Lausanne). In 2002, the work was presented to the wider public for the first time as the main theme of the annual exhibition of the Swiss society for structural design. The exhibition was accompanied by the publication of an associated exhibition volume entitled *Alexandre Sarrasin – Kreativität im Betonbau* (creativity in concrete construction). The exhibition was also shown at ETH Zurich and EPFL and at St.-Maurice (Wallis canton).

Further noteworthy work includes the revision and extension of the chapter on the development of concrete bridges (“Entwicklung der Betonbrücken”) in the recently published book on reinforced concrete bridges (*Stahlbetonbrücken*), in which, together with CHRISTIAN MENN, Brühwiler summarised the main development stages of concrete bridge construction in a 50-page chapter (see section 4.4).

Brühwiler also deals with historical aspects in his work as a consultant for the inspection of existing bridges and buildings and the planning of intervention measures. Time and again, he finds that many engineers and architects have very inhibited attitudes towards cultural aspects of structural design. Ignorance and incompetence regarding cultural aspects sometimes leads to qualitatively

unsatisfactory projects, which (quite rightly) do not meet with approval. As a federal expert for aspects of civil engineering structures within the framework of the preservation of historic monuments in Switzerland, Brühwiler regularly deals with historical aspects of some outstanding buildings. These consultancy cases further enrich his lectures.

4.3 Daniel L. Vischer (ETH Zurich)

DANIEL L. VISCHER is a civil engineer who worked on water and tunnel projects for a Swiss engineering company between 1957 and 1970. Between 1970 and 1998 he was professor for Hydraulic engineering at ETH Zurich and director of the Laboratory of Hydraulics, Hydrology and Glaciology. In 1980, as a sideline Vischer started to work on the history of hydraulic engineering, particularly in Switzerland. On this subject he published in a variety of journals and participated in relevant meetings abroad. His main interest was focused on biographies of famous water engineers, hydraulic engineers and hydrology engineers, as well as descriptions of historic systems for hydropower utilisation, river engineering (Fig. 7), torrent control and lake level control.

In the Swiss public, Vischer supports the cause of the history of technology in general and the history of construction engineering in particular in his capacity as president of the “Schweizerische Gesellschaft für Technikgeschichte und Industriekultur”, as a member of the board of the “Verein für wirtschaftshistorische Studien”, and as a member the commission for history of technology of the “Swiss Academy of Engineering Sciences”. He was very involved in pushing for the establishment of a Chair for the History of Technology at ETH Zurich.

Today, Vischer is president the governing body of the Schnitter fund for the history of technology at ETH Zurich and a member of the Swiss society for structural design. His international contacts are limited to membership of the “Deutsche Wasserhistorische Gesellschaft” (German Water Engineering History Association).

Vischer is currently completing a project on flood protection in Switzerland from the beginnings to the nineteenth century. The project was commissioned by the Swiss Federal Office for Water and Geology. Accordingly, the main results were published in form of a comprehensive brochure (see section 4.4). More detailed aspects will be discussed in follow-up publications.



Fig. 7. Cartouche from a map of the course of the river Birs near Basle from 1798. Surveyors' equipment and river engineers' tools. Source: Staatsarchiv Basel, Plan T 148, Photo *M. Rickenbacher*

Within the framework of a shortly opening exhibition of the Society for structural design on Swiss river engineering, Vischer deals with the section on historic work before 1800.

In a new project that has only just started, Vischer will examine aspects of monastic hydraulic engineering during the Middle Ages in the region of today's Switzerland. While monastic hydraulic engineering is well documented in the surrounding countries, no overview is yet in existence for Switzerland. This is due to the fact that Swiss archaeology has only started to deal with the subject in the 1990s.

The results have so far only been used incidentally during courses at ETH Zurich, and the curricula for students of structural, civil, surveying and environmental engineering have not yet featured any lectures or seminar dealing with the history of technology.

4.4 References

- BROWN, Glenn O., Willi H. HAGER, Jürgen D. GARBRECHT, eds. 2003. Henry P. G. Darcy and other pioneers. In *Hydraulics: Contribution in celebration of the 200th birthday of Henry Philibert Gaspard Darcy*. American Society of Civil Engineers (ASCE).
- BRÜHWILER, Eugen and Christian MENN. 2003. *Stahlbetonbrücken*. 3rd ed. Vienna/New York: Springer Verlag.
- HAGER, Willi H. 2003. *Hydraulicians in Europe 1800-2000*. International Association of Hydraulic Engineering and Research (IAHR).
- PETERS, Tom F. 1981. *Time is Money. Die Entwicklung des modernen Bauwesens*. Stuttgart: Julius Hoffmann.
- . 1982. *Die Entwicklung des Großbrückenbaus*. Zürich.

- . 1987. *Transitions in Engineering. Guillaume Henri Dufour and the Early 19th Century Cable Suspension Bridges*. Basel/Boston: Birkhäuser.
- PFAMMATTER, Ulrich. 1997. *Die Erfindung des modernen Architekten. Ursprung und Entwicklung seiner wissenschaftlich-industriellen Ausbildung*. Basel/Boston: Birkhäuser.
- . 2000. *The making of the modern Architect and Engineer. The origins and development of a scientific and industrially oriented education*. Basel/Boston: Birkhäuser.
- SCHEIDEGGER, Fritz, ed. 1992. *Aus der Geschichte der Bautechnik*. No. 2, 2nd ed. Basel: Birkhäuser Verlag.
- . 1994. *Aus der Geschichte der Bautechnik*. No. 1, 2nd ed. Basel: Birkhäuser Verlag.
- SCHNITTER, Niklaus. 1992. *Die Geschichte des Wasserbaus in der Schweiz*. Oberbötzberg (CH): Olythus.
- . 1994. *A History of Dams, the useful pyramids*. Rotterdam: A.A. Balkema.
- STRAUB, Hans. 1949. *Die Geschichte der Bauingenieurkunst*. Basel: Birkhäuser Verlag.
- . 1952. *A History of Civil Engineering*. London: Leonhard Hill.
- . 1992. *Die Geschichte der Bauingenieurkunst*. 4th ed. Peter Zimmermann, ed.. Basel: Birkhäuser Verlag.
- VISCHER, Daniel L. 2003. Die Geschichte des Hochwasserschutzes in der Schweiz. Von den Anfängen bis ins 19. Jahrhundert. *Bericht des Bundesamt für Wasser und Geologie*, Serie Wasser Nr. 5, 2003.

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