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Cover picture: Former factory building with factory owner's villa at Zwinger 4-6, today location of the KDWT and the monument scientific chairs and professorships (Tobias Arera-Rütenik)

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Foreword by the Publishers

A great location for a 'minor' subject

With the establishment of a postgraduate course in heritage conservation at the University of Bamberg (Otto Friedrich University Bamberg) in 1982, Bamberg was the first and initially the only place in Germany to offer this subject as a proper, university-based training opportunity. It was not until the 1990s and later that others followed this example with training courses of more or less similar descriptions. From the very beginning, the close ties with the federal state offices for the preservation of historical monuments, learning by doing and the statement on current heritage discourses were key features of the heritage sciences at the University of Bamberg and contributed significantly to their success.

In order to represent adequately the diverse issues associated with heritage conservation, the range of subjects covered by the heritage conservation study programme was expanded accordingly in 1986 by the appointment of a Professorship in Building Archaeology and Building History and, in 2000, by the establishment of a Professorship for Preservation Sciences in heritage conservation. In order to focus on issues relating to building archaeology, a dendrochronological laboratory was set up. And a digital tool for object documentation in preservation sciences was procured for the first time – this too is unique to the German university educational landscape of today. Furthermore, the close connection to art history, the archaeological disciplines as well as the establishment at a university with a focus on the humanities in general can be seen as a unique selling point for a heritage conservation study programme that is usually associated with architecture and design courses elsewhere. The link to the engineering sciences was established at the University of Bamberg as far back as 1998 when it merged with Coburg University of Applied Sciences and Arts. This integration, within a special technical context, was finally reinforced once again in 2000 through the merger of the disciplines into the joint Institute of Archaeology, Heritage Sciences and Art History.

Despite the early development of its own profile in the field of historical monuments, it has always succeeded in responding to current requirements in an appropriate and far-sighted manner. With the conversion of the postgraduate study programme into a consecutive Master of Arts in 2002, the

University of Bamberg was again the first institution to adapt its teaching of heritage conservation to the Bologna Process. The rapid technological developments have led at this point to the emergence of a stand-alone subject, which the University of Bamberg, in close cooperation with Coburg University of Applied Sciences and Arts, has recognised by creating a Master of Science in "Heritage Technologies", which has been a useful addition to the existing Master of Arts since 2017. As a result of this high level of involvement stretching back several decades, the University of Bamberg has now become an internationally-recognised quality label in the field of heritage sciences.

This pioneering role in academic heritage conservation is reflected, among other things, in the numerous national and international achievements in education, research and application. These include standard works on the theory and practice of heritage conservation, exemplary large inventories, networking with organisations, associations and initiatives, the co-initiation and implementation of inter-university graduate colleges and, of course, the large number of around 1000 well-trained graduates in what is, mind you, a 'minor' subject. Today, these graduates hold key positions in institutional heritage conservation in various German federal states and European countries; are now themselves university lecturers involved in heritage conservation courses or have established themselves as freelance building archaeologists in restoration companies or in architect firms with a focus on construction work on existing buildings. Furthermore, a fruitful correlation exists between the high profile of heritage conservation at the University of Bamberg and the City of Bamberg as an ideal location for issues relating to historical monuments. One of the departments of the Bavarian State Office for the Preservation of Monuments is situated here in Seehof Castle; and an extraordinary number of companies in the area of building survey, building research, building restoration, material analysis and the planning of architectural monuments are based here. And the civic community here became involved in the conservation of its historical monuments as far back as in the late 1960s. Furthermore, exactly 25 years ago to-

day, UNESCO honoured the outstanding universal value of Bamberg's Old Town by including it on the World Heritage Site List.

Against this background, it seems well-nigh a logical consequence that the university's management has, since 2012, promoted as a main focus the expansion of the heritage sciences at this special location. With both the creation of the Master of Science in 2017 and upon the approval by the responsible ministry in 2016, it was able to establish a Centre for Heritage Conservation Studies and Technologies. The Free State of Bavaria initially granted funding for this undertaking for a limited period of five years. And the formal founding act officially took place in March 2016. In this context, a new building for the monument disciplines, which were previously distributed across the entire city, was established; according to the needs of the subject group, it was not set up in a new building, but in the restored former factory building and the adjacent manufacturer's mansion of the company Rupp + Hubrach. The building's ceremonial opening took place on 4 December 2017. The Excellence Centre moved in or rather was merged and so did the four heritage chairs or heritage professorships, including the associated laboratories. Owing to the considerable success that the Centre for Heritage Conservation Studies and Technologies (KDWT) had been enjoying two years after its foundation and because of the recognition that such an institution for heritage conservation had gained with regard to its uniqueness and national and international significance, the Bavarian government decided to provide the research institute with long-term funding by way of the provision of eight permanent appointments with effect from July 2018.

The Centre for Heritage Conservation Studies and Technologies is headed by a centre council, whose activities are monitored by an assigned advisory board. A spokesperson elected by the centre council represents the KDWT externally. According to the statute, the centre's core tasks consist of the expansion of knowledge transfer and technology transfer to non-university research institutions and to business and trade; the expansion of technical excellence through the extension of the transfer programmes and the supplementing of the range of courses; the support in terms of content and technical equipment for research, teaching, transfer and service; as well as the internationalisation of research. In order to consider the scientific differentiation of heritage sciences and

heritage technologies adequately, the KDWT is divided into four separate departments, each representing their respective subfield with exceptional, sound technical experience and expertise in teaching, research and, above all, real-world scenarios. In this sense, the department of *Heritage Conservation* enhances the image of heritage conservation culturally and in terms of art history by profiling key elements in the areas of the theory and history of heritage conservation, monument sociology as well as the cultural theory of architectural monuments. The research area of *Digital Technologies in Heritage Conservation*, ensures the centre's capacity for innovation through the expansion of digital recording, archiving, analysis, monitoring, simulation and planning processes. The department of *Building Archaeology, Building History and Building Preservation* contributes to the close connection with the material evidence, by means of appropriate building documentation, building technology analysis, building construction analysis and historico-cultural analysis as well as building preservation. Finally, the department of *Preservation Sciences* is dedicated to historical material sciences; to the applied conservation sciences with a technical orientation; to digital 3D methods; as well as to non-contact and non-destructive material testing; and the digital microanalysis of material science and natural science backgrounds of the heritage sciences at the KDWT. And the associated *Laboratory for Dendrochronology and Structural Analysis* researches the history of building construction using scientific dating methods.

This publication attempts to do justice to the breadth of the spectrum of disciplines, which represents the characteristic quality of the institution and its unique selling point, by devoting a main chapter to each of the four departments and by providing each with its own profile focus. The allocation of richly illustrated individual depictions of the projects and plans is intended to explain to the reader the respective department's targeted activity, in a manner that can be generally understood. A fifth main section follows that compiles in the form of lists the diverse services, in relation to transfer, networking and publication activities, with which the staff have jointly ensured the KDWT's visibility both nationally and internationally. At the very end, an organisation chart provides information on the structure of the centre team. Short C.V.s introduce the contributors of this publication. By means of this approach, the publishers hope to provide a clear picture of the institute's activities from 2016 to 2018.



HERITAGE CONSERVATION

The University of Bamberg's heritage sciences can broadly be defined as a theoretically sound, application-based as well as technology-based scientific discipline. The unique selling point is the interdisciplinary expertise between the humanities, engineering and material science. Through the establishment of the KDWT, the successful profile of an object-based and theory-driven heritage science could be more clearly delineated and built out as an interface between theory and practice.

At the interdisciplinary centre, the heritage conservation department occupies the established field of heritage research with a humanities and cultural studies orientation. This includes topics relating to monument studies and, generally, research into the history and theory of heritage conservation within the framework of the KDWT, with the explicit aim of increasing the conveyance of research in practice-related fields and the generating of interdisciplinary, linkable results. A further aim is to reflect critically on topics and trends in international heritage research. The merging of the traditional archaeologically object-based concept of monument with younger, more socially-based ideas of (cultural) heritage thus presents a particular challenge.

International exchange – regional networking

The aim must be to understand better the complex and conflicting social processes that go hand in hand with 'heritage' and that are currently being unleashed with new severity in many regions of the world. As the KDWT is in the process of establishing itself as an international player in the field of culture and technology transfer, it is necessary to reflect on its own framework for action and, specifically, on a broad inclusion of the specific social contexts, without which knowledge and technology transfer cannot generate sustainability. As a first consequence, the department has strengthened specifically the networking of the various stakeholders through numerous cooperation projects that rely on close cooperation with research institutes and specialist authorities as well as with local authorities, civic interest groups and other stakeholders. Here local and regional networking is just as important as the expansion of international contacts.

With funding guaranteed long term, the KDWT provides the opportunity to achieve profiling through substantive focus. Essential for this purpose is the acquisition of third-party funds, where

major successes have already been achieved. An invaluable strategic advantage is that appropriate projects can be brought to proposal through the targeted use of its proprietary funds and staff resources. In this way, two thematic priorities in the Heritage Conservation department could be expanded in a relatively short time, which contribute significantly to the profile of the newly founded KDWT and have already generated great feedback within the research community: the profile area of *City and Heritage Conservation* and the profile area of *Values and Valorisation, Participation*, where productive synergies occur in many cases, as is clear from the project descriptions.

Profile focus of City and Heritage Conservation

The subject area of *City and Heritage Conservation* has long been a research focus of the chair holder and head of the department. At a time when, for the first time in history, more than half of all people live in cities, traditional settlement areas are subject to great dynamism. City growth exists alongside shrinking processes and the depopulation of rural regions. Familiar living spaces and the uses and structures assigned to them are changing. Complex structures such as historic urban areas or village centres are often threatened, the loss of which can significantly weaken binding forces and integrating effects. In a situation such as this, it is a key challenge to have heritage conservation expertise play a bigger role in planning and development processes.

An important aspect is thus to understand better, from an historical perspective, the relationship between protective measures and planning processes and their close association. Everywhere there is a visible need to make 'historical' urban spaces the guiding principle of planning processes, if not to imitate them or to create them in the first place, as has happened or is currently taking place in Dresden, Frankfurt, Potsdam and Lübeck. The profile focus of *City and Heritage Conservation*, developed under the responsibility of Dr. Carmen Maria Enss at the KDWT, thus started, in light of the current developments, with the conference: *Product Old Town*, funded by the German Research Foundation (DFG). In the context of the conference, the phenomenon previously mentioned was analysed both in its genesis and with regard to the social conditions. The findings have been published in a much-cited standard work on the making of 'historical' urban spaces (see the *Product Old Town*

project). Recently, this focus was supplemented by a new anthology with articles on “Value Attributions and Planning Rationale in Historic City Spaces”. Beyond the classic old town and using various sample locations, the anthology traces how heritage conservation and urban development processes are linked.

By way of another third-party funded project, *heritage planning* is being examined with a focus on Italy. Here, too, there is a dual interest: on the one hand, the beginnings of a century-old history of planning approaches are to be researched, which represent a traditional approach and thus involve preservation and development goals in equal measure. At the same time, the KDWT hopes that this will provide important stimuli for current planning debates, where issues such as city repair, conversion and development are more current than ever, and monument expertise has to be introduced more into the relevant debates (see the *Product Old Town* project).

The 'making' also of 'historical' urban spaces is particularly evident in the reconstruction after the Second World War. It is no coincidence that many of today's reconstructive projects are seen as a second reconstruction. An international KDWT collaborative project is now researching the fundamentals of reconstruction by painstakingly archiving the maps of the damage that were created at the time and examining how and to what extent preliminary decisions for urban developments in the post-war reconstruction had already been made using these procedures. This too is an important contribution to the study of an era that is significant in terms of the profile of European cities and that provides new insights not only for world cities like Warsaw or Berlin but also for Franconian towns like Augsburg and Nuremberg (see the *Atlas of War Damage* project).

Notably in Bavaria, great importance is attached to urban heritage conservation. However, heritage conservation will face new challenges in the environment outlined in order to contribute to a development that is sustainable and compatible with heritage conservation. New technical bases need to be strengthened for credentialed participation in historically informed planning processes. This also includes the more consistent inclusion of different groups of stakeholders as well as the introduction of new participation models and forms of knowledge transfer.

The project of *Municipal Heritage Plan (KDK) Bavaria*, implemented jointly with the Bavarian State Office for Preservation of Monuments (BLfD), can be seen as part of this undertaking. It is also an example of how university research and hands-on heritage conservation can prove to be a fruitful cooperation. The Bavarian State Office for the Preservation of Monuments has set up the Municipal Heritage Plan as a new, informal planning tool to make the local authorities more responsible players in matters relating to urban development and heritage conservation. In the pilot project, the KDWT is cooperating with the BLfD in order to explore specifically opportunities for associative participatory processes in urban heritage conservation. In this context, the integration of various local stakeholders and networks in the negotiation process regarding preservation and further development is of particular importance. With this orientation, it is also a cross-sectional project on the second profile focus of *Values and Valorisation, Participation* (see the '*Municipal Heritage Plan Bavaria*' project).

Profile focus of Values and Valorisation, Participation

The second profile focus of the Heritage Conservation department sees heritage conservation both as an object-related and socially enshrined science. Currently virulent questions regarding the social evaluation of monuments or, more broadly, of cultural heritage by different *heritage communities* are coming to the fore. The profile area of *Values and Valorisation, Participation*, under the responsibility of Dr. Stephanie Herold, covers a topic for the future where various challenges relating to current debates on heritage conservation are bundled together.

In addition to the previously presented more practice-oriented project of *Municipal Heritage Plan Bavaria*, that serves as a cross-sectional project for both profile areas it is important to us to examine the wide range of topics centred around participation, also within the broad, international and interdisciplinary theoretical framework, and to relate this critically to the objectives of the international monument conservation and protection institutions (ICOMOS, UNESCO). The aim here is to bundle theoretical discussions and thus contribute to the creation of a concept for sustainable solutions, particularly at local and urban levels. This is also the context of a research project led by Lisa Marie Selitz, who has been associated with it since

2016 through her dissertation project on participatory approaches in the DFG Research Training Group of *Identity and Heritage* (see the *Participatory Heritage Conservation* project).

The collaborative research project of *Architecture and Planning Collectives in the GDR* deals with questions relating to professional evaluation (as part of a social valorisation process), which will be developed in cooperation with the Leibniz Institute for Research on Society and Space (IRS) in Erkner. The project examines the organisation and production methods of collectively organised architectural work in the GDR and explores the question as to a possible specificity of these 'works' that are essentially authorless. For one, this closes a research gap in regard to the evolutionary history of the buildings; secondly, it makes a theoretical contribution to evaluation issues (to some extent long neglected) of architectural objects (see the *Architecture and Planning Collectives in the GDR* project).

The valorisation processes, which are the focus of the main profile, are characterised by emotional and affective aspects that have not been adequately taken into consideration by scholars in the field of heritage conservation. The handling of cultural heritage is actually linked to a multitude of different emotional processes, which often go hand in hand with appropriation and valorisation on the one hand and differentiation and exclusion on the other. In a collaborative research project (currently in the application process) that brings together researchers from different institutions and disciplines, the concept of heritage is to be re-examined with the inclusion of the emotional aspect. This research project, developed under the aegis of the University of Bamberg's Chair in Heritage Conservation, is particularly contemporary, since it arises from the globally articulated variants of nationalist, racist and fundamentalist-tinged populist movements and *heritage politics*. Thus it is an urgent desideratum to grasp more clearly the processes and practices of identity-forming and value-adding processes also in their emotional foundations (see the *Emotion and Heritage* project).

Research, transfer, documentation

In addition to the aforementioned key elements of profiling, transfer and documentation are fields of activity in which the Heritage Conservation department has successfully launched its first projects. One KDWT project is the participation in the transnational research network *Big Beautiful Build-*

ings, which deals with research and transfer issues and was founded as part of the European Year of Cultural Heritage (ECHY 2018), subsidised by the Federal Government Commissioner for Culture and Media (BKM) and the CityBuildingCulture NRW initiative (StadtBauKulturNRW). The University of Bamberg's contribution examines outstanding examples of buildings from the 1960s and 1970s in Franconian cities. Research into this group of monuments is seen as the first step in the development of communication strategies for an 'unpopular' group of monuments in Franconia that have received little attention (see the *Big Beautiful Buildings* project).

Another focus of the KDWT is the testing and application of innovative – in particular digital – methods in the field of heritage conservation (see the projects of *Digitisation and Inventory of the Core Area of the Temple of the Tooth in Kandy, Castle Landscape Altmuehl Valley (Burgenlandschaft Altmühlthal) – Digital Recording, Analysis and Visualisation of Medieval and Early Modern Noble Seats* in this publication). This development presents entirely new challenges in regard to the reflection upon and justification of our activities. The Heritage Conservation department at the KDWT has set itself the task of providing critical support to the new field of work and constructively promoting the dialogue between the various fields of science and practice (see the *Digitisation and Heritage Conservation* project).

The Laboratory for Dendrochronology assigned to the chair of heritage conservation and headed by Dr. Thomas Eißing has become one of the leading institutions of its kind in Germany. The laboratory, which has been in existence since 1993, serves mainly the state offices for the preservation of historical monuments in Bavaria, Thuringia and Saxony-Anhalt. From the outset, it pursued the methodologically close interaction between material analysis, structural design and architectural history with cultural and historical issues. Long-term archiving is an essential aspect of long-lasting verifiability of dates. With the digitisation of the extensive sample inventory now under way, the KDWT is fulfilling a vital requirement for long-term data protection and provides research with a comprehensive basic data set from which many will benefit (see the *Digitisation of the Dendrochronological Archive* project).
(Gerhard Vinken)

Product Old Town



Fig. 1: New building of the "Junger Esslinger" House, Frankfurt am Main [DomRömerGmbH 2015].

Head:	Prof. Dr. Gerhard Vinken
Editor:	Prof. Dr. Gerhard Vinken, Doctorate in Engineering (Dr.- Ing.) Carmen M. Enss
Duration:	Since 2015
Funding:	German Research Foundation, Oberfrankenstiftung, Universi- tätsbund Bamberg (conference)



Fig. 2: Auf dem Rothenberg, in Cologne [Willy Horsch 2009].

In the functionalist urban development of classic modernity, the old town has assumed its own special function since the First World War – that of fostering a sense of identity for the modern city. This observation in Gerhard Vinken's post-doctoral habilitation thesis, *Zone Heimat* (2010), was the beginning of new research about the old town at the University of Bamberg. The research project of *Product Old Town* belongs to the profile focus of City and Heritage Conservation of the Heritage Conservation department at the KDWT. It examines heritage productions for cities both past and present. It uses methods from the heritage sciences and the history of urban development research: research is conducted on stakeholders and target images of old town production on the one hand and on urban transformations in historic urban areas in the context of planning and the history of urban development on the other hand.

For the development and reshaping of old towns, special urbanistic and architectonic means were often used to mark the old town as a heritage zone and to maintain its recognisability. The special building in and for old town zones had become so well established by the Second World War that after the war, in the case of Munich for example, the impression and the function of old towns of fostering a sense of identity could be invoked again with newer means of architecture. This is documented in the book 'Munich's Planned Old Town', (Carmen M. Enss, 2016). Since then, redesigned old town areas often detach themselves completely from traditional structures or buildings and approximate historical thematic architectures.

The international conference entitled 'Product Old Town. The Making of the Old Town' that Gerhard Vinken organised jointly with Carmen M. Enss in Bamberg in 2015, looked at the question of how the wave of today's old town productions came about, most recently in Germany in Frankfurt am Main, Potsdam, Dresden and Lübeck (cf. Vinken's contribution *In the Name of the Old Town* in the conference transcript). New old towns are also emerging worldwide – the distinction between historic city centres and their imitations is becoming increasingly irrelevant in the process. The international conference brought together the latest research for this purpose. The papers that were published in the volume *Product Old Town, Historic City Centres in Town Planning and Heritage Conservation* looked for the 'production' of old towns since their beginnings in the early 20th century and classified them in the urban history of modernism. The range cov-

ers heritage protection, reconstruction, postmodern and contemporary reconstruction projects, examining hygienic, aesthetic and heritage conservation issues as well as changing uses and stakeholder constellations.

Due to its own historical development, heritage conservation is critical, even self-critical about old town productions. It is committed to the principle of 'preserving, not reconstructing', which developed in Italy in the late 19th century and took root in German-speaking countries at the beginning of the 20th century. Since then it has been reinforced in internationally recognised charters for the conservation and restoration of monuments and sites. On the other hand, heritage conservation has always been part of traditional movements that make historical materials and traditional civil engineering techniques a part of modern building culture. Heritage conservation has been committed to a mindful building culture since its beginnings as a discipline, particularly in the immediate proximity of monuments that the Italian monument theorist Gustavo Giovannoni designated with the notion of *ambiente* in the early 20th century. Research and the differentiation of tradition as a part of the new way of building, compared to old town surrogates, is currently the task of the heritage sciences.

While old town research deals specifically with defined old town areas and traditional pockets, other historical concepts of *heritage planning* are also being researched within the context of the profile focus of *City and Heritage Conservation* that developed alongside the old town idea and seek to link heritage and urban development on a general level (*Planned Heritage* project). The beginnings of this development have already been addressed at the *Product Old Town* conference in Klaus Tragbar's contribution on the urban design and monument theorist Gustavo Giovannoni. The project *Atlas of War Damage* is also linked to old town research, for it is no coincidence that in places where reconstruction concepts earmarked traditional areas, particularly detailed mappings of historical buildings are still available.

As a result of the currently springing up of old town surrogates, the head of the Heritage Conservation department and chair holder, Gerhard Vinken is always in demand for his expertise on matters relating to new old towns.

(Carmen M. Enss)

VINKEN, Gerhard: *Geschichte wird gemacht – es geht voran? Die neue Frankfurter Altstadt ist so banal wie fatal*, in: *Die immer Neue Altstadt. Bauen zwischen Dom und Römer seit 1900*, ed. Philipp STURM and Peter CACHOLA SCHMAL, Katalog Deutsches Architekturmuseum Frankfurt a.M., Berlin 2018, pp. 160–167.

ENSS, Carmen M.: *Baupflege für die Nachkriegsstadt. Verhandlungen um moderne bürgerliche Bauweisen*, in: *Architektur und Akteure. Praxis und Öffentlichkeit in der Nachkriegsgesellschaft*, ed. Regine HESS, Bielefeld 2018, pp. 105–118.

VINKEN, Gerhard: *Escaping Modernity? Civic Protest, the Preservation Movement and the Reinvention of the Old Town in Germany since the 1960s*, in: *Cities Contested: Urban Politics, Heritage, and Social Movements in Italy and West Germany in the 1970s*, ed. Martin BAUMEISTER, Bruno BONOMO and Dieter SCHOTT, Frankfurt a.M. / New York 2017, pp. 169–191.

ENSS, Carmen M.: *Ambiente. Theodor Fischers und Gustavo Giovannonis frühe Aneignungen der alten Stadt für die moderne Großstadt nach 1890*, in: *Die schöne Stadt. Begriffe und Debatten, Theorie und Praxis in Städtebau und Architektur*, ed. Uwe ALTROCK and Sandra HUNING, *Planungsrundschau* 24, 2017, pp. 143–169.

ENSS, Carmen M. / VINKEN, Gerhard (eds.): *Produkt Altstadt. Historische Stadtzentren in Städtebau und Denkmalpflege*, Bielefeld 2016.

ENSS, Carmen M.: *Der Weg des Städtebauers Theodor Fischer von den Münchner Altstadt-Experimenten zur Kritik homogenisierender Altstadt-Produktion*, in: *Produkt Altstadt. Historische Stadtzentren in Städtebau und Denkmalpflege*, ed. Carmen M. ENSS and Gerhard VINKEN, Bielefeld 2016, pp. 75–90.

VINKEN, Gerhard: *Im Namen der Altstadt. Stadtplanung zwischen Modernisierung und Identitätspolitik. Einführung in eine wechselhafte Geschichte*, in: *Produkt Altstadt. Historische Stadtzentren in Städtebau und Denkmalpflege*, ed. Carmen M. ENSS and Gerhard VINKEN, Bielefeld 2016, pp. 9–26.

VINKEN, Gerhard: *Neue Heimat or Constructing the Old Town. The Example of Cologne, 1930-1960*, in: *Studies in Urban Humanities*, ed. Institute for Urban Humanities, The University of Seoul, vol. 8/1, 2016, pp. 67–95.

Planned Heritage

Monument theorist and urban planner Gustavo Giovannoni in Italy

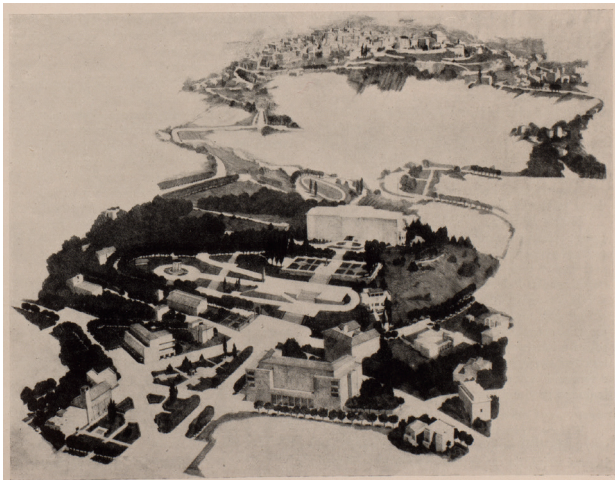


Fig. 1: Landscape planning for Fuiggì, Mario Paniconi, topographical connection between the old town and the new centre [Architettura 1933].

Head:	Dr.-Ing. Carmen M. Enss
Editor:	Dr.-Ing. Carmen M. Enss
Partner:	Bibliotheca Hertziana, Max Planck Institute for Art History in Rome; University of Innsbruck, Dr. Luigi Monzo, department of Building History and Heritage Conservation
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The *Planned Heritage* project explores the beginnings of a century-old tradition of redevelopment, remodelling and urban satellite planning, where the aim was to align the preservation of sites of historic interest with a future-oriented concept. These early approaches to *heritage planning* extended to international modernism in the urban development and still shape our concept of an ensemble of monuments today.

In the Heritage Conservation department at the Centre for Heritage Conservation Studies and Technologies, the knowledge base from this historical research is used in order to strengthen further the interworking between urban development

and heritage conservation in real-world scenarios today. To this end, the theoretical basis of the heritage sciences will be examined with regard to urban heritage and updated in an international and interdisciplinary dialogue.

Gustavo Giovannoni (Rome, 1873–1947)

While travellers around the world would have loved to liberate their Italian idylls, such as Venice, from modern development, Italy, a young nation state, pursued the path towards a new infrastructure and modern development from the beginning of the 20th century. Gustavo Giovannoni, as an engineer part of this movement, nevertheless proposed sophisticated planning processes for the country's cities and territories: In addition to development areas, he called for residential places of quiet and relaxation in the modern city. According to Giovannoni's notion, these places could grow out of historical and regional circumstances and thus would remain a living part of the new and not have to disappear.

The Roman engineer made a name for himself in Italy as a leading expert in antiquities and urban development when he published a seminal study on the modernisation of the old town of Rome in 1911. With his vision of reformed urban planning that would integrate history and modern development, he advanced several research disciplines in Italy with theoretical, organisational and structural principles: architectural science, historical building research and building history, urban hygiene, landscape planning and archaeology. He was also an important player in the building policies of fascist Italy. In this role, he shaped the international discourse of experts on heritage conservation and town planning around 1930. His urban development publication, *Vecchie città ed edilizia nuova* (*Historic Cities and New Construction*, 1931), is still a seminal work on this, but has since been forgotten.

Research questions

The figure of Gustavo Giovannoni is very present in Italian research, but is virtually unknown abroad, as measured by the key role he has played in the history of European urban development. The aim of the research is to provide a monography of him as an historic town planner. A subproject examines and pursues the typological and structural



Fig. 2: Adalberto Libera: *Casa Pigione, Rome; Facade reconstruction of an old town house* [Architettura 1933, p. 638].

planning approaches Giovannoni proposed for the development of the old town that were further developed by his students for decades right through to the 1970s. Another subproject examines the political and social environment in which Giovannoni developed and modified his ideas. In collaboration with international partners, new light is shed on the history of architecture and spatial planning in Italy during the interwar period from the perspective of techniques of passing on knowledge. While Giovannoni's political and urban development approaches are time-bound, the basic questions of urban design that Giovannoni worked on remain constant:

How do we appropriate the architectural heritage of our city whilst at the same time adapting our built environment for today's purposes?

(Carmen M. Enss)

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Maps of War Damage from the 1940s – Atlas of War Damage



Fig. 1: Nuremberg, War Damage Map, detail.

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Editor:	Dr.-Ing. Carmen M. Enss, Georg Sedlmeyer M.A.
Partner:	Ass. Prof. Dr. Jerzy Elzanowski, University of Carleton/Ottawa
Duration:	2019-2021
Funding:	German Research Foundation

Damage maps that were created in numerous cities worldwide during and after the Second World War, are an historical source that has scarcely been investigated in the past. They document how war-damaged cities assessed what remained in terms of their architectural heritage and reappropriated it. As historical fundamental research for the assessment of structures damaged by the war, the project has been assigned to the profile focus of *City and Heritage Conservation* at the KDWT. By researching the appropriation processes of post-war heritage, using damage maps, we strive to gain a better understanding of what local authorities and citizens refer to as “indispensable material heritage” or “heritage of cities’ structures” in the light of future developments. In the context of a collaborative project with the Heritage Conservation department at the University of Carleton, Ottawa, war damage maps have been tapped into, as a first step, and made accessible to scholarship. The aim for the future is to study these documents comparatively within a national and international context.

Recent studies have challenged the common assumption that the changes in the appearance of post-war cities increased in relation to the level of war damage. Instead, as is now becoming clear, active decisions in town planning and emergency management shaped the reconstruction or new construction as a pivotal stage in urban development in the 20th century. In the course of clearing the rubble and restructuring, entire urban areas were newly ‘cultivated’ (cf. Düwel/Gutschow, *A Blessing in Disguise*, Berlin 2013).

Source inventory with comparison possibilities

The majority of the maps that emerged after the end of the war were planning instruments, making them not only sources of the history of war but also of the history of heritage conservation and architecture. In addition to war damage, many maps also documented heritage values or the need for change. By evaluating the building stock, the authors of the damage maps also assessed the future viability of architecture and its heritage value when preparing the maps. Damage maps were often used as a preliminary investigation for a subsequent clearance and construction phase, i.e. for urban redevelopment on a vast scale. Furthermore, because the execution of the clearing started immediately, the damage maps were of far-reaching significance.

Documents on damage recordings are stored mostly in city archives and have been difficult to compare in the past. The digitisation of these documents opens up a new source for heritage research.

The development of a digital atlas in Ottawa

Around 50 war damage maps and associated documents from 26 German cities are stored in the archive of the Canadian Carleton University in Ottawa. An extensive and unique collection of damage recordings, which affords the project rare insights into damage structures of the cities and the way in which people and institutions worked and thought at that time. The archive collection is part of a legacy that stems from the architect and town planner Konstanty Gutschow, a pioneer in damage assessment and reconstruction planning during and after the war.

In the context of a four-week work trip to Carleton University in Ottawa, Canada, project collaborator Georg Sedlmeyer prepared an archive col-

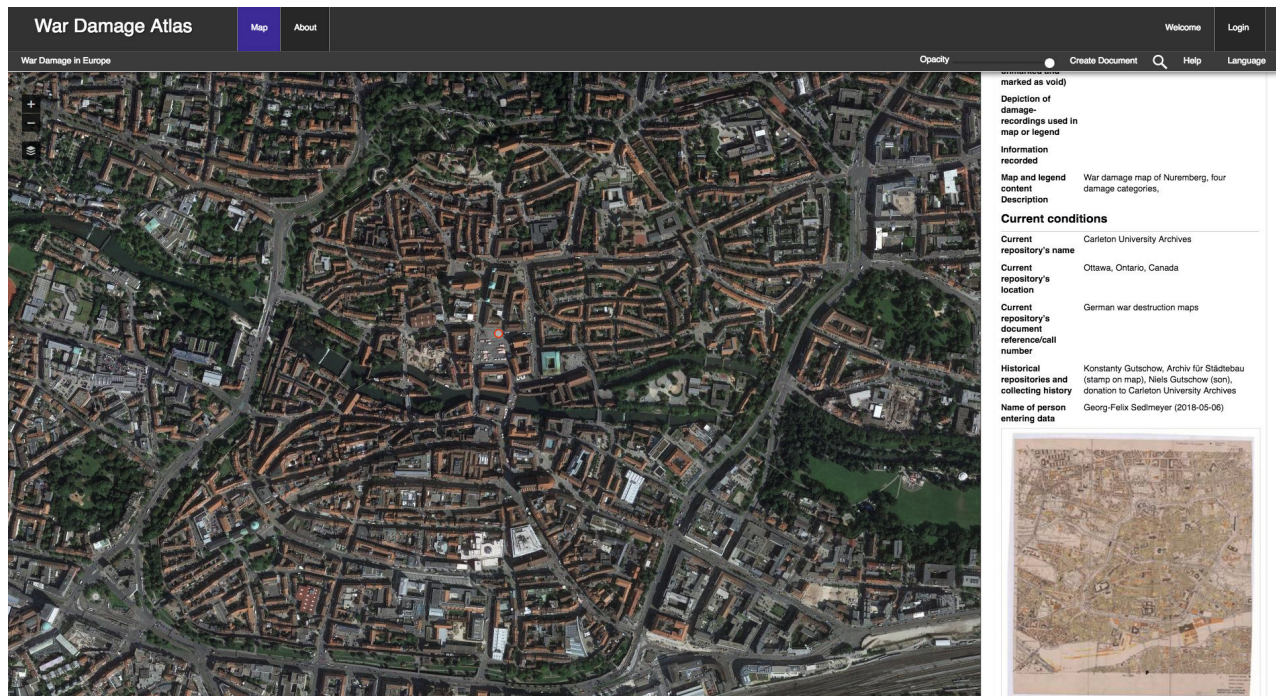


Fig. 2: War Damage Atlas, Example Nuremberg, Joint Research Platform Bamberg/Ottawa [screenshot].

lection on damage recordings of German cities. In addition to examining, processing and digitising the archive materials, a digital atlas (*War Damage Atlas*) was developed. This atlas, now upgraded with the processed archival material, benefits the research partnership both in Ottawa and in Bamberg and in the future will be able to integrate similar data from archives worldwide. Training in the development of digital atlases, a job on site and familiarisation were provided by the Geomatic and Cartographic Research Center (GCRC) based at Carleton University, where the online atlas will continue to receive IT support.

Results

As mentioned above, initial results show that damage maps in many cases assessed not only the physical condition of buildings but also the importance of architecture and urban structures with regard to the city's future. For example, some areas of the old town – such as ancient ruins – were mapped in great detail, while areas where restructuring was welcomed were, in extreme cases, identified as ready for wholesale demolition. We also find explicit assessments of urban development structures such as road curbs or visual axes that were to be included in the urban design.

Damage maps thus show two things: firstly, new forms of analytical mapping for the city's architectural heritage were created *ad hoc* for

reconstruction, which shows that the architectural heritage was consciously dealt with through planning during reconstruction; secondly, the variety of forms of assessment, which were for the most part not created by monument experts but by architects, military personnel, civil protection officers, housing experts, engineers or employees of regulatory authorities, shows that the question of heritage was widely discussed in cities, both specifically in regard to individual buildings and to city structures and views. We, therefore, regard this assessment of the historical building stock and the reformulation and integration in the city of reconstruction as an active heritage process; as a *heritage making moment*.

(Carmen M. Enss)

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Municipal Heritage Plan Bavaria (KDK)

A collaborative project with the Bavarian State Office for the Preservation of Monuments (BLfD)



Fig. 1: Viechtach, Town Square; Citizens' Festival 2017. Through the projection of historical images and an exhibition on the content of the Municipal Heritage Plan (KDK) attention was drawn to the importance of preserving the building stock [Selitz 2016].

Head:	Prof. Dr. Gerhard Vinken
Editor:	Lisa Marie Selitz M.A.
Partner:	Bavarian State Office for Monument Protection, Arbeitsbereich Städtebauliche Denkmalpflege (Dr. Thomas Gunzelmann, Dr. Gerhard Ongyerth, Judith Sandmeier MA)
Duration:	2016-2020
Funding:	KDWT's proprietary funds, Bavarian State Office for Monument Protection

How can you support local authorities in preserving and developing heritage in terms of architectural culture and urban development? The collaborative project of *Municipal Heritage Plan Bavaria* addresses this question. The project's aim is to develop concepts and practices for an historically informed, sustainable and citizen-oriented planning practice in village and urban structures; and

to implement these in close cooperation with the Bavarian State Office for the Preservation of Monuments and partners at the local authorities. The University of Bamberg supports the BLfD on the academic side in further developing and conceptually strengthening the newly developed instrument of the 'Municipal Heritage Plan'.

By gaining insights into the practical work in and with the local authorities, current theoretical questions can be reflected on and used in an application-oriented manner. The KDWT is researching, among other things, strategies and instruments for informal, participatory and space-based heritage conservation, both nationally and internationally, and their relevance for, and transferability to, Bavarian local development. In this respect, the collaborative project is a classic cross-sectional project of the Heritage Conservation department at KDWT, which intertwines the two main profile areas of *City and Heritage Conservation* and *Values and Valorisation, Participation*.

The local challenge

Underpinned by the amendment to the German Building Code in 2013, 'internal development before external development' became one of the defining principles in urban development. The designation of new construction areas on the city outskirts has not only contributed to land use and the development of interchangeable housing developments for a long time, it has also led to increasing vacant properties in historic town centres. In many places, the prioritisation of inner city development means that urban heritage conservation is more in demand than ever, actively contributing to urban development issues through its specialist knowledge and establishing itself as an important issue for the community. Only in this way, in addition to dealing with the classic monuments, can the reflected development of the 'structure particularly worth preserving', of location and structure-defining buildings and the inherited city structures that characterise the historical fabric of a city, be realised with care. Urban heritage conservation in particular, which established itself in the 1970s and 1980s, has always been presented with the challenge of integrating heritage conservation

concerns and heritage conservation expertise into processes of urban development planning and negotiating heritage conservation values inclusively within planning at a higher level. The compact, mixed-use and socially integrated city (Leipzig Charter, 2007) is still a European model, even in times of demographic and structural change, serving as a sustainable and reliable linchpin. Inner city development always calls for a debate on the building stock.

A lack of building maintenance, building extensions and demolitions in urban areas that do not take into account the urban context as well as the insensitive overprinting of traditional urban structures, however, lead in many places to a progressive loss and endangering of historical 'identification sites'. Small and medium-sized municipalities, in particular, often do not have the human, technical and financial resources to face the current urban development challenges on their own. Classic instruments of systematic inner city development, such as building and land use planning, the application of local authority statute law in the design, preservation and renovation statutes and the establishment of local authority support programmes, often – if they are actually already being used – do not meet the requirements of urban heritage conservation.

This is exactly where the Municipal Heritage Plan (KDK) comes in that offers support through a new informal and communicative planning tool. In this way, new stimuli for urban development are created and financing options are worked out in order to revitalise places and buildings weakened by the demographic and structural change brought about by urban development changes and to retain their function as an identification site.

Historically informed planning

It is now undisputed that in areas of interest in heritage conservation, such as in well-preserved town centres or historically important quarters, expertise in the field of heritage conservation is of vital importance for the future viability of the communities. Beyond that, we are also convinced that every location can benefit from 'historically informed planning'. Sustainable town planning and development is often only possible through a more intensive study of one's own history, of the building structures and the historical structures that are still recognisable.

The KDK was set up to support municipalities and empower them to deal with their historical make-up through reflection and to attack this head on as a starting point for urban development. In doing so, the BLfD acts as the competent authority, a



Fig. 2: Viechtach, town square; in 2014, one side of the central and ensemble-protected town square, opposite the town parish church, was demolished. The square is not built up in 2019 either. In the KDK, historical buildings and urban structures worthy of preservation were explored in order to derive guidelines for future urban development [Listl 2016].



Fig. 3: Küps; in the castle community, there are several vacant properties in the historical and ensemble-protected town centre, while families settle in the surrounding new development areas. A KDK is created to maintain and establish the old location as an identification site, also for the other districts and incorporated areas. Building surveys and feasibility studies were commissioned for the Upper Castle (middle picture) and the Weidmannshaus (bottom picture) in order to offer support in the search for possible new and permanent uses for the two monuments that shape the townscape [Selitz 2017].



Fig. 4: Citizens' Workshop in Küps, November 23, 2017; the planning office responsible for the KDK presents an interim progress report from the KDK surveys. Afterwards, topics such as 'Town structure, town image', 'Identity, image, unique selling points' are debated in small groups. The questions centred around what is special about the town centre, what is lacking, where does action need to be taken and what ideas are there for the old town. Many voiced the desire for a new central hub and meeting point [Selitz 2017].

consulting partner that creates strategic objectives for urban development in cooperation with experienced planners, local administrations and policy makers, local volunteers, the lower-tier monument protection authorities and, if necessary, in cooperation with (state) sponsors. It is precisely this diversity of stakeholders in urban development and urban renewal that demands a high degree of communication, exchange and commitment to the topic in order to pursue mutually agreed objectives together.

Explore potential for action together

With regard to implementation, the KDK is a further development of the 'Heritage Conservation Survey Form', which, as an expert in heritage conservation and contributor of many years standing, constitutes an important component of the procedures for Bavarian village renewal. The survey form is used to research and document the complex interwoven relationships in a credentialed inventory registration that become manifest as heritage values through the interplay of geographical/topographical situation, political, economic and socio-cultural environment in the built environment (module 1). In addition, the KDK specifies the requirements and potential for action arising from the building stock and the building structures

(module 2) and feeds them into implementation and urban development approaches (module 3). This modular process can only be successful if local decision-makers and citizens are involved at all stages and if the concept developed is adapted to the needs of the city and its citizens. It is for this reason that participatory processes are a particular focus of the research project. The KDK offers the opportunity to make the stakeholders involved aware of the issues of urban heritage conservation and reflective urban development and to promote joint responsibility for the quality and meaningfulness of urban spaces. The fact that currently (in 2018) there are already 30 municipal heritage conservation plans in various stages of preparation proves that we are on the right track.

Practice-oriented and Bavaria-wide insights

Cooperation with the BLfD enables the KDWT practice-oriented and Bavaria-wide to gain insights into the development processes of the Municipal Heritage Plan locally and into the control and coordination procedures in higher-level processes of urban renewal. The results of scientific analysis are brought together in an internal platform, which collects the parameters of the concept creation – such as specific problems, funding conditions, classification in the planning process, genesis of the concept, stakeholders, important process steps and partial results – in order to work on them comparatively in a second step. A further qualification of young scholars has already emerged as an important desideratum on the way to a historically oriented and community-based planning practice in order to familiarise planning offices and young monument scholars with the new concept. This is already taking place in part within the framework of courses in the Master of Arts degree programme in Heritage Conservation at the University of Bamberg. Another goal is the development of standardised advisory services aimed at enabling citizens, local authorities and planners to carry out historical location analyses independently, thereby enabling local authorities responsible for historically informed urban development to determine development goals and the level of participation in the implementation themselves.

The KDK's scholarly support at the KDWT facilitates closer cooperation with the BLfD in research and teaching, through joint workshops, lectures and publications, etc. The important future topic of urban heritage conservation in urban renewal is

thus actively fed into other scientific and practical contexts. In this way, new contacts for urban heritage conservation are established and the concept is enhanced in an interdisciplinary way.

(Lisa Marie Selitz)

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SELITZ, Lisa Marie: *Schnittstellen als Herausforderung*, lecture as part of the workshop of the Bavarian State Office for Monument Protection (BLfD) on the subject of Exchange of Experience Municipal Heritage Plan – Interfaces, Local Authorities, State Office, University, Planner, Citizens, Thierhaupten, 23 November 2017.

SELITZ, Lisa Marie: *Kommunales Denkmalkonzept Bayern*, lecture during a study visit by a delegation from the Council of Europe and the EU initiative Community-led Urban Strategies in Historic Towns, Bamberg, 26 July 2016

Participatory Heritage Conservation



Fig. 1: Expert workshops "Citizen Participation in Urban Heritage Conservation and Urban Development", 28 June 2017 Otto Friedrich University Bamberg [Leonhard Salzer 2017].

Head:	Prof. Dr. Gerhard Vinken
Editor:	Lisa Marie Selitz M.A.
Duration:	2016–2020
Funding:	KDWT's proprietary funds

Information – consultation – cooperation – self determination: The themes of participation and citizen involvement are increasingly coming into the focus of heritage conservation. More broadly, at an international level, a change from a materials-based to a social understanding of monuments is already becoming apparent.

Since the 1960s, civic demands for participation in the design of living spaces and the shaping of democracy have become established. In the heyday of heritage conservation, the citizens' movement and monument protection were still closely aligned in Germany. In urban renewal in particular they had common goals, namely preservation and careful urban renewal instead of 'demolition and reconstruction'. While the modern monument protection laws, in place since the 1970s, promoted the institutionalisation of academically credentialed heritage authorities, the solidarity among citizens and citizens' initiatives lost its importance. However, the question as to how the responsibility for dealing with monuments and urban spaces can be shared and distributed among those who want to participate actively in the conservation of their heritage must today be renegotiated. This was the starting point for the research

project that was set up at the KDWT in 2016. The project developed a synthesis of interdisciplinary and international perspectives on participatory approaches in the broader area of a predominantly civic and urban development 'heritage protection' in theory and in practice so as to provide new food for thought for heritage conservation in Germany. Through the thematic focus, the research combines the two profile areas of *Values, Valorisation and Participation* and *City and Heritage Conservation*. Lisa Marie Selitz is currently working on a dissertation in this context on the subject of *Preservation – Renewal – Participation. Participatory Approaches for Urban Heritage Conservation in the Context of Urban Renewal* (working title). Through her dissertation project, supervised by Prof. Dr. Gerhard Vinken, she has been associated, since October 2016, with the interdisciplinary DFG Research Training Group 2227 *Identity and Heritage* (TU Berlin / Bauhaus University Weimar).

Heritage communities – community in cultural heritage?

Academic areas related to heritage conservation, such as town planning, new museology and cultural landscape conservation are already diverse in the theorising and application of participation processes. In the cultural and social sciences, the dynamic societal character of cultural heritage and power structures, engendered by the definition and appropriation of material and immaterial heritage, is reflected. In addition to empowering social groups through cultural heritage, its (political) instrumentalisation is also considered here. With the shift in the subject under consideration, in this broad interpretation of 'heritage maintenance', from the preservation of the historical material

substance towards the communities or *heritage communities* that are currently being established with an emphasis on cultural heritage, the question also arises as to what type of participation is possible. These perspectives are increasingly finding their way into heritage conservation and into *heritage studies*.

Especially since supranational platforms for 'heritage maintenance', such as UNESCO, ICOMOS, ICCROM, the UN and the EU, assign cultural heritage an essential meaning for social cohesion, inclusion, democratisation and the establishment of local, national and international networks through a mutual appreciation within cultural diversity. *Communities* and the contemporary social influences of cultural heritage are thus increasingly in the focus of their considerations, their strategies and in the narratives of 'sustainable development' and social 'well-being'. And it was with the same impetus that the European Heritage Year took place in 2018. Both in the strategic perspective on the 'cultural heritage resource' and in the critical engagement with it, local players and civic or social groups who embrace a cultural heritage and symbolically value it in this way become key figures. Together with them, 'cultural heritage' is to be identified, negotiated, maintained and managed.

The importance of the local context

Particularly striking is the demand by players from the social sciences, political sphere as well as civil players for instruments of citizen participation and the involvement of 'local communities' and their perception and assessment strategies in the development of historical, urban areas. A *heritage community* is by definition not bound to one place but often the objects of interest can only be understood in a local context and must be dealt with in the context of local authority planning mechanisms. Through its planning autonomy and its organisational powers, administration and policy making, the city creates living spaces that can become a mirror of social participation. Heritage conservation as a discipline and institution is called upon to weigh in reflexively in renewal and transformation processes with its knowledge of the development and 'fabricated' nature of the cities and think about conservation in an inclusive way.

(Lisa Marie Selitz)

SANDMEIER, Judith / SELITZ, Lisa Marie: *Expertenworkshop Bürgerbeteiligung in städtebaulicher Denkmalpflege und Stadtentwicklung*, in: *Denkmalpflege Informationen* 168, 2018, pp. 89–91.

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SELITZ, Lisa Marie: *Managing the Historic Urban Landscape of Bavaria in respect to the 'participatory turn'*, lecture as part of the Heritage Communities conference, Université de Québec à Montréal, Canada Research Chair on Urban Heritage, Montréal 27 September – 29 September 2017.

Expertenworkshop Bürgerbeteiligung in städtebaulicher Denkmalpflege und Stadtentwicklung, Organisation and Implementation, KDWT, Bamberg University, 28 June 2017.

Emotion and Heritage



Fig. 1: 'Palace of Doubt', Lars Ramberg, Berlin 2005 [Jula2812 2005].

Head:	Prof. Dr. Gerhard Vinken
Editor:	Prof. Dr. Gerhard Vinken, Dr. Stephanie Herold, Svenja Hönig M.A.
Partner:	Collaborative research project in the application process
Funding:	KDWT's proprietary funds, third-party (requested)



Fig. 2: Berlin City Palace, new building [Hönig 2017].

The research focus *Emotion and Heritage* aims to re-examine the concept of heritage by understanding heritage as a process that is also constituted by emotions and affects. The Heritage Conservation department at the KDWT is thus setting new historical-theoretical priorities and is also oriented towards international heritage research, which by means of cultural and social science approaches stands for a critical, multi-perspective, democratic and participative view of cultural heritage and offers an explicit approach to the topic of emotion. Cultural heritage is seen as the result of social negotiation and appropriation processes, whereby 'heritage' itself becomes a process that gains its social relevance through the attribution of values and meanings. The fact that emotions are closely linked to this 'heritage' is illustrated by debates centred around and dealing with identity, home or beauty. The poster campaign "*Beautiful, but a piece of home is missing*" by the German Foundation for Monument Protection exemplifies this, as do the debates about the demolition of the Palace of the Republic and the new construction of the Berlin City Palace. The relevance and bearing on the present of the topic are evident in numerous current fields of application, for example, in the currently prevalent right-wing populism, the political demands for integration, respect for an alleged 'dominant culture' (Leitkultur) or in the post-colonial debates revolving around restitution of expropriated cultural heritage.

The reorientation of the concept of heritage associated with the focus on emotional aspects is thus highly topical but, at the same time, provides a link to fundamental theoretical considerations concerning monuments, particularly from the time the academic subject was founded. As far back as at the beginning of the theoretical formation of the subject, emotional aspects played a crucial role in regard to monument consideration and evaluation, be it in Dehio's ideas of 'piety' towards the monument or in the 'age value' stated by Riegl. However, emotional approaches to the monument lost importance in the course of the scholarly research into heritage conservation and against the background of a positivist understanding of science. At the same time, emotional aspects in the practical engagement with the built heritage remained relevant.

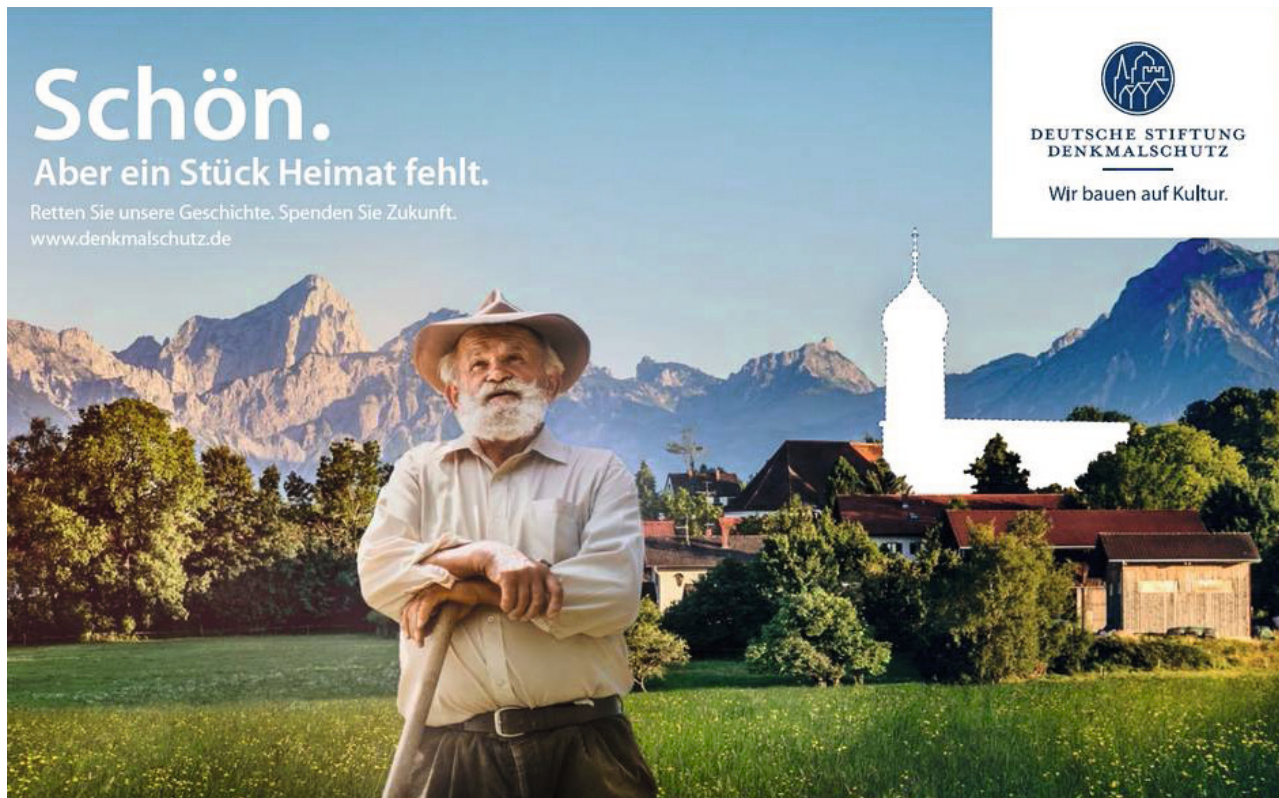


Fig. 3: Poster campaign of the German Foundation for Monument Protection [Deutsche Stiftung Denkmalschutz 2016].

Collaborative research project (in the application process)

Emotions as a topic of scholarly research can currently be contextualised in various disciplines. In particular, there seems to be a trend towards a 'holistic' understanding of science: It is precisely the connection between rational-objective and sensual-subjective, emotional understanding of the world that is gaining interest. Against this background, the KDWT's Heritage Conservation department, as part of an interdisciplinary collaborative research project with colleagues from the fields of sociology, anthropology, philosophy and literary studies (*memory studies*), would like to harmonise these supposed divergent approaches in the construction and valorisation of (architectural) heritage.

The aim of this collaborative research project, which is in the application stage, is to conduct basic research on the role emotions play in the process of heritage. The phenomena that come to the fore with the new perspectivation of heritage as a decidedly emotional event include, in addition to emotionally shaped moments of self-assurance (such as the populist instrumentalisation of alleged national heritage), moments of emotional refusal, traumatisation, and experiences of discrimination and exclusion, which can be described as aspects of a powerful heritage formation.

Against this background, the collaborative research project aims to understand better the mechanisms and reproductive logic of cultural heritage, for example, in terms of their performance and of current issues, such as integration and identification but also for different variants of nationalistic, racist or fundamentalist-tinged *heritage politics*.

PHD project: Terms and concepts of 'built heritage' anchored in the emotional

The doctoral project is intended to help understand built heritage at its various levels of meaning. These extend beyond the pure basic structure of a building and its 'objectively measurable values' and include, among other things, emotional evaluations.

The theme of built heritage is one that can be received and is receivable on a broad and versatile basis. The variety of terms swirling around the subject is also paradigmatic for its great complexity. Monument, cultural heritage and heritage are just a few of the typical expressions from the (German-speaking) examination of architectural heritage. The starting point of the investigation is the term of heritage understood as a process, which arises from social appropriation and negotiation. The dissertation seeks answers to the questions of how the relevant terms can be theoretically contextualised and how they relate to each other and to 'heritage'.



Fig. 4: The towers of the former Nazi Party rally grounds in Nuremberg [Hönig 2016].



Fig. 5: Garden gnomes in a forest of flags on a Munich balcony [Hönig 2015].

One challenge is the embedding of the terms in different specialist traditions (e.g. heritage sciences, cultural and social sciences) and the simultaneous negotiating and debating of these in new, global contexts. In their application, the boundaries between the different terms often blur, which also leads to uncertainty about the concepts behind the definitions.

For the examination, 'emotion' provides the lens through which the built heritage is to be re-examined. The potential of this dimension is that 'emotion' as well as 'heritage' are seen as a phenomenon of social negotiation and construction. This abstraction of emotion and heritage, linked back to the concrete object of the built heritage, can contribute to the thinking together of subject- and object-related factors of cultural heritage in terms of a contemporary understanding of science.

(Stephanie Herold, Svenja Hönig)

HEROLD, Stephanie: *Bilder vergangener Utopien. Inszenierungen des Leerstands in der Bildproduktion der Urban Explorer*, in: Vakanz. Ästhetiken und Semantiken architektonischen Leerstands, ed. Julian BLUNK, kritische berichte 3/2018, pp. 47–54.

HEROLD, Stephanie: *Heritage und ‚Denkmal-Kultus‘. Industriedenkmale zwischen ‚material turn‘ und Alterswert*, in: Denkmal – Erbe – Heritage. Begriffshorizonte am Beispiel der Industriekultur, ed. Birgit FRANZ et al., Dokumentation der Jahrestagung des Arbeitskreises Theorie und Lehre in der Denkmalpflege 2017, Holzminden 2018, pp. 38–45.

HEROLD, Stephanie: *„nicht, weil wir es für schön halten“*. Zur Rolle des Schönen in der Denkmalpflege, Bielefeld 2018.

VINKEN, Gerhard: *Zum (notwendigen) Wandel des Denkmalbegriffs. Nachgedanken zu einer Tagung*, in: Strukturwandel – Denkmalwandel. Umbau, Umnutzung, Umdeutung, ed. Birgit FRANZ and Ingrid SCHEURMANN, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V. 25, Holzminden 2016, pp. 206–210.

VINKEN, Gerhard: *Gefühlssache. In der Ferne so nah. Heinrich Heine in der Bronx. Hans-Rudolf Meier zum 60. Geburtstag*, in: Strukturwandel – Denkmalwandel, ed. Birgit FRANZ and Ingrid SCHEURMANN, Umbau, Umnutzung, Umdeutung, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V. 25, Holzminden 2016, pp. 16–18.

HEROLD, Stephanie: *What a feeling...? Die Begegnung mit dem Objekt als emotionaler Prozess*, lecture as part of the lecture series of the Research Training Group „Identität und Erbe“, Technical University Berlin, 30 October 2018.

HEROLD, Stephanie: *‚Authentic‘ emotions and curated decay. Urban wastelands as refuges and sights*. Lecture as part of the workshop From horror vacui to spaces of re-enchantment: art, ecology, and urban wastelands, University of the Arts Berlin, 18 May 2018–19 May 2018.

HEROLD, Stephanie: *Erhaben, kitschig, atmosphärisch. Ästhetische Praxen der Urban Explorer zwischen Ästhetisierung und ‚authentischer‘ Gefühlsäußerung*. Lecture at the Cool Retro Camp Trash conference. Aesthetic Concepts in Popular Culture, Centre for Popular Culture and Music, Freiburg 2 May 2018–5 May 2018.

Architecture and Planning Collectives of the GDR

Structures and processes in socialist architectural production

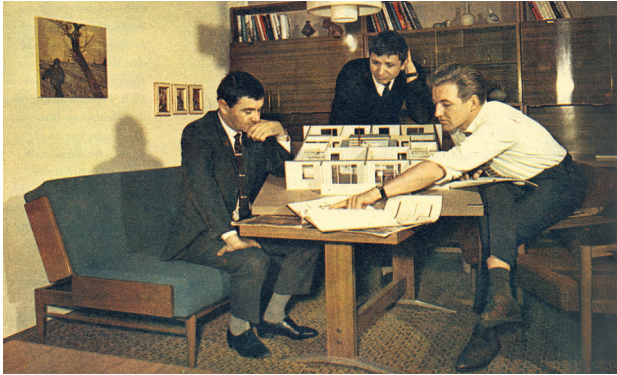


Fig. 1: The P2 collective (Wilfried Stallknecht, Herbert Kuschy, Achim Felz, from left to right) at the beginning of the 1960s with an architectural model in a show flat of the (prefabricated) panel building series [IRS Erkner, Scientific Collections].

Head:	Dr. Stephanie Herold
Editor:	Dr. Stephanie Herold, Sophie Stackmann M.A.
Partner:	Leibniz Institute for Research on Society and Space (IRS)
Duration:	2019–2021
Funding:	German Research Foundation

Ever since the 18th century, when the notion of genius gained in importance in the fine arts, the evaluation of architecture has been closely linked with the designing and planning architect. The individual work is integrated into the oeuvre of an architect, as a small tessera of an art-historical canon. In this context, the work becomes an auratic object, takes on the character of something outstanding, something absolute. Notions of originality, autonomy and unity also play an important role through their continued association with the term 'work'. Where this allocation is not possible, the established evaluation mechanisms fluctuate. It is against this theoretical backdrop that the DFG-funded research project on Architecture and Planning Collectives of the GDR, carried out joint-

ly with the Leibniz Institute for Research on Society and Space (IRS), is situated. The extensive abolition of private architecture firms and the transfer of the design process to architecture and planning collectives since the early 1950s had far-reaching consequences for work processes, the self-image of those professional groups involved as well as for the architecture produced in the GDR and its subsequent evaluation. The aim is both to contribute to the history of the collectivisation of planning in the GDR and examine the dynamics of the collective creative processes with regard to the objects created and their effects up to the present day. The analysis of the complex work processes is intended to lead to a reassessment of the architectural work of the collective in the GDR.

In order to assess better the historical significance of planning collectives, they need to be analysed with regard to their local application (urban or rural), their size and their political and strategic significance (e.g. special buildings such as the Palace of the Republic or the inner city planning example of Bernau), since these parameters had a major influence on their scope of action, their resources as well as on their direct political control. After all, there were a multitude of different types of collectives in the history of GDR planning, from the top-class 'star collective', with famous architects for notable state-related objects, to the small collective in the province with responsibilities in regard to standard housing construction.

Another range of topics covers the investigation of the artistic work in the collective. Forms of collective creative work are to be examined in a further historical (from the 1920s to present day discussions) and spatial (international) context, with questions not only about the collective employee's artistic self-image but also about the possible effects of this specific creative style on the respective objects. The term 'collective' is seen, on the one hand, as an historically localised designation of a (politically motivated) organisational unit in production; and on the other hand as a (self-)attribution of



Fig. 2: The experimental panel building of type P2 in Berlin Fennpfuhl from 1961 is now a listed building [IRS Erkner, Scientific Collections].

groups working in design that – mostly in contrast to a notion of artistic genius – focus on the group-specific aspects of their work. The examination of this context forms the basis for an in-depth look at the work of the planning collectives in the GDR, which can be assessed both in terms of their peculiarities and in terms of possible historical continuities. Here too, the investigation of the respective player constellations in different collectives is a particular focus. The focus is on questions such as the individual architect's relationship with other colleagues in the collective and the significance of the respective manager in relation to the creative work; the nature of the relationship between artistic collective management and the collective management at a political or administrative level; and how these internal relationships of the collective players influenced the planned architectural objects. Possible tensions between the players involved are also to be researched.

In keeping with the interdisciplinary focus, architecture and planning collectives in the GDR are examined from two perspectives in the project:

- as institutional organisations in terms of

structures and work processes; the projects of the collectives in their integration in the political and institutional system of the GDR with its hierarchies; and the relationship between architect and engineer;

- in relation to the artistic work in the collective in its historical dimension and impact on the objects created and the associated questions of authorship and creative scope for action by the architects.

For this purpose, exemplary projects conducted by GDR planning collectives (of an urban planning or architectural nature) are examined as case studies in their execution, based on architectural and historical aspects and taking historical sources into account. In addition to the classification in a historical context, there will be an exploration of the question as to the way in which the role allocation and way of working within the collective influenced the respective work result. The aim is to review systematically the planning practice of the GDR in order to create a basis for today's (art-historical) classification and evaluation of the structures and objects created in this context.

(Stephanie Herold)

‘Big Beautiful Buildings’ in Franconia



Fig. 1: Still Brutalism or Now Postmodern? Central University Library in Würzburg [KDWT, Heritage Conservation 2018]

Head:	Prof. Dr Gerhard Vinken
Editor:	Dr.-Ing. Carmen M. Enss, Dr. Stephanie Herold
Partner:	International Network <i>Big Beautiful Buildings</i> (TU Dortmund inter alia) as part of the European Cultural Heritage Year (ECHY 2018)
Duration:	Since 2018
Funding:	KDWT’s proprietary funds



Fig. 2: Dinkelsbühl grammar school, interior view of the staircase following the historic restoration in 2011, in accordance with the specifications of heritage conservation [KDWT, Heritage Conservation 2018].

The project '*Big Beautiful Buildings*' in Franconia deals with late modern buildings and urban structures from the 1960s and 1970s. As part of the International Research Network based in Dortmund, the Heritage Conservation department sheds light on these modern structures in a region in which old towns and older historical architectures dominate and have, so far, enjoyed virtually undivided attention from heritage studies. The investigation of large structures, to be found especially around the large cities of Würzburg, Nuremberg and Erlangen, includes fundamental research work in the field of architectural history and heritage conservation and furthermore connects the two main profile areas of (*City and Heritage Conservation* and *Values and Valorisation, Participation*) of the Heritage Conservation department at the KDWT. A parallel seminar with students of the M.A. programme in Heritage Conservation in the winter semester of 2018-19, in which students will develop the basics 'in the field', opens up new prospects for a fruitful cooperation from which both sides can benefit.

Buildings completed in the 1960s and 1970s have recently become the main focus of interest of the professional heritage conservation and a wider public. The exhibition *SOS Brutalism – Save the Concrete Monsters*, which opened in November 2017 at the *German Architecture Museum* in Frankfurt, is an example of this and directs attention away from the architecture of the first post-war modernist era to the buildings of the 1960s and 1970s. These buildings are often characterised by their size and a specific, often complex, building structure (as architectural and urban megastructures) and by the distinctive materials used. The use of exposed concrete as a structural and design element thus became known as *béton brut* for the buildings of this era. Despite an increased interest in buildings of the 1960s and 1970s, both among experts and architecture enthusiasts – documented in numerous Internet blogs on the subject – many of these buildings are still seriously threatened by substantial changes or demolition. Against this background, the international project *Big Beautiful Buildings* (BBB), based at the University of Dortmund, has set itself the task of not only researching the buildings of this period but also addressing their architectural qualities and differences; thus, by conveying their complexity, it questions in different ways the now common image of

the 'concrete monster'. The Heritage Conservation department at the KDWT of the University of Bamberg would like to focus, as a partner in this cooperative project, on sample buildings from that period in northern Bavaria. While regions such as the Ruhr area are obviously characterised by post-war buildings and these became identity-forming in many places, in Bavaria they are often given less attention. This is reflected, among other things, in the fact that so far only a few buildings from this period have been catalogued as monuments. Even though buildings like the Norishalle in Nuremberg (Heinrich Graber, 1965–67) or the Dinkelsbühl grammar school (Bernhard Heid, 1967–70, Fig. 2), for example, are listed, this does not apply to buildings of a similar quality like the central university library in Würzburg (Alexander von Branca, 1973–77, Fig. 1) or the St. Andreas Church there (Lothar Schlör, 1967). A comprehensive inventory in this area still needs to be conducted. The fact that this could potentially have major implications in terms of dealing with these buildings, can be seen in the renovation example of the Gewerkschaftshaus (trade union building) in Nuremberg (Gerhard Dittrich, 1969–1972), whose distinctive concrete facade relief is now hidden behind sound absorbing panels. The building stock from this era formed an architectural and cultural heritage that is often still not regarded as historic and thus is in large part threatened in its substance by demolition or a major reconstruction.

The aim of the project, which through its connection with a seminar on the same topic at the University of Bamberg is an example of the integration of teaching and applied research, is the exploration and visualisation of the architecture of the 1960s and 1970s in the region. The special buildings are the legacy of a boom phase that also shaped Franconia, not least through the strengthening of the education system. With the project, the KDWT wants to draw students' attention to the specific qualities of buildings from the late post-war modernist era as well as to civil engineering, structural peculiarities, architecturally and spatial peculiarities and to the historical backgrounds of their development. In a second step, participants will communicate these qualities through local research and as part of a final publication. Essentially, the project is intended to contribute to the visibility and valorisation of buildings of the 1960s and 1970s in Franconia within the framework of a Europe-wide initiative.

(Carmen M. Enss, Stephanie Herold)



Fig. 3: Interior view of the cafeteria, University of Würzburg [KDWT, Heritage Conservation 2018].



Fig. 4: Heilig-Kreuz-Kirche, Erlangen, G. Neundorfer und P. Seemüller, 1968/69 [KDWT, Heritage Conservation 2018].

Digitisation and Heritage Conservation



Fig. 1: Cover publication: *Digitisation and Heritage Conservation* [AKTLD 2017].

Head:	Prof. Dr Gerhard Vinken
Editor:	Prof. Dr Gerhard Vinken
Partner:	Arbeitskreis Theorie und Lehre der Denkmalpflege
Duration:	Since 2016
Funding:	various



Fig. 2: *The Girl with ... the Digital Camera* [unknown artist, based on Vermeer 2012].

The 'digital revolution' is well under way. For heritage conservation, digital applications have opened new perspectives – this can also be seen in many impressive projects at the Centre for Heritage Conservation Studies and Technologies – for example, in the interactive visualisation of lost conditions, in the monitoring of endangered sites and artefacts or in the complex networking of heterogeneous knowledge stores (see e.g. the projects *Digitisation and Inventory of the Core Area of the Tooth Temple in Kandy and the Castle Landscape of Altmühl Valley – Digital Recording, Analysis and Visualisation of Medieval and Early Modern Noble Seats* in this publication). Limits and unresolved problems in the use of digital technologies are becoming clearer, for example, in terms of the sustainability of the rapidly growing amount of data. The University of Bamberg and the Free State of Bavaria responded to this in 2016 by creating a new Professorship in Digital Heritage Technologies, which is based in the Department of Heritage Sciences of the Institute for Archaeological Sciences, Heritage Sciences and Art History (IADK) and is closely affiliated with the KDWT. In the meantime, the KDWT has also become an important player in the use of digital technologies in the field of heritage conservation and cultural property protection.

However, in terms of digitisation, we are not only dealing with a mere 'technical' innovation. This development presents entirely new challenges in regard to the reflection on and justification of our activities. The effort to preserve the digital heritage will not only transform the museum as an institution with the assignment to document, research and publish cultural assets. It can further be observed that with the new abundance of digitally generated images, scientific standards are changing. Another underestimated aspect of the digital revolution is a shift of the awareness in the 'market' of sciences. The Heritage Conservation department at the KDWT has set itself the task of providing critical support to the new field of work and to promoting constructive dialogue between the various fields of academic study and practice. Probably the most striking consequence of the digital promise of an accurate, lossless reproduction of what has been lost is that in recent times, and

with every spectacular destruction of well-known monuments, there is a knee-jerk demand for reconstruction. It is becoming clear that digitisation has an inherent affinity towards reconstruction, insofar as its performance capacity lies in the translation of all information into a binary code, offering seemingly lossless storage and copying. In the digital age, the distinction between original and copy will probably lose relevance – also at the price of a total manipulability of the data and of reality. Heritage conservation does not need to reinvent itself in the digital age. But even a “Keep up the good work!” does not seem possible: in an age, whose technical basis is the exact and unlimited reproduction (of the digital code), the status of analog objects will also change; and with it also the demands on the sciences that deal with the tradition of these objects. Inevitably, however, the reflection lags behind the technological development.

IT technology now raises many more fundamental problems than, for example, photography when it comes to the question of originality and reproduction. The differences between 'analog original' and 'digital simulations' are still far from ironed out, despite *augmented reality* and virtual worlds. It is also less an indistinguishability between original and simulation that poses a threat in the digital age, but, as Baudrillard predicted, more that this distinction loses relevance. For heritage conservation and, to a certain extent, also for tourism, the 'authentic' (as the what has developed; not what has been made) is still an important point of reference and an emotional anchor – even if only as an illusion. This distinction has become less relevant for many social practices: In the recesses of the Internet, everything is embedded in a flow of signs and images.

The widespread use of digital technologies is clearly changing the view of the monument and of cultural heritage. Does a previously unknown reproducibility weaken or strengthen the aura of the original? Does the distinction between original and simulation or (digital) print lose relevance? Does the prospect of a digital 'rescue' of war-damaged monuments lead to a second devaluation of the monument? Where is the line between democratising knowledge and confining it to commercial or even political interests? At a conference,

co-organised by the author, at which fellows of the KDWT also presented their considerations and research results to an interdisciplinary specialist public, these problems were discussed (*Digitisation and Heritage Conservation. Inventory Registration – Heritage Mediation – Data Archiving – Reconstruction of Lost Objects*; 29th of September to the 1st of October 2016 at the Bauhaus University in Weimar, Working Group Theory and Teaching of Heritage Conservation, in cooperation with the Working Group Archaeological Monuments (Arbeitskreis Bodendenkmäler) of the Fritz Thyssen Foundation and the Klassik Stiftung Weimar). Other events are planned at the KDWT. It is important to us to link more closely technological and humanities approaches with regard to KDWT's activities.

(Gerhard Vincken – parts of this text appeared in greater detail in Vincken 2017, please see publications)

FRANZ, Birgit / VINKEN, Gerhard (eds.): *Das Digitale und die Denkmalpflege. Bestandserfassung - Denkmalvermittlung - Datenarchivierung - Rekonstruktion verlorener Objekte*, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V. 26, Holzminden 2017 (<https://doi.org/10.11588/arthistoricum.263.348>).

VINKEN, Gerhard: *Das Digitale und die Denkmalpflege. Einführung in eine komplexe Beziehung*, in: *Das Digitale und die Denkmalpflege. Bestandserfassung – Denkmalvermittlung – Datenarchivierung – Rekonstruktion verlorener Objekte*, ed. Birgit FRANZ and Gerhard VINKEN, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V. 26, Holzminden 2017, pp. 12–19 (<https://doi.org/10.11588/arthistoricum.263.348>).

Digitisation of the Dendrochronological Archive



Fig. 1: Samples before and after the revised labelling and processing [Dendro Laboratory 2017].

Head:	Dr.-Ing. Thomas Eißing
Editor:	Susanne Schödel, Katja John M.A
Duration:	until 2020
Funding:	KDWT's proprietary funds

The Dendrochronological Laboratory at the University of Bamberg was founded in 1993. Dendrochronology is a procedure based on scientific methods that can determine the felling year of a tree by means of tree ring width comparisons. The characteristic feature of the approach pursued here is the methodologically close relationship between fabric study, structural design, architectural history and cultural and historical issues. As a result, a great deal of information can be obtained that goes far beyond the dating of the timbers. Based on the tree ring series and material findings on the timber, conclusions can be drawn, for example, about the temporally and spatially divergent use of the types of wood, about historically and locally different types of forest operations or about the history of rafting.

As part of the scientific development of object dating and evaluation, an extensive archive of wood samples was created (over 70,000, as of 2018). Sustainable archiving is an essential aspect for the long-term verifiability of dating. It was not until 2008 that the technical equipment had reached a certain level of sophistication because the drill cores could now also be scanned at high resolution so that the measurement on the digital image could be repeated even with the loss of the drill core. However, no digital images are available for the 12,000 samples that were archived between 1993 and 2008. The tree ring width measurement can only be checked on the sample itself or on a photographically high-resolution image. The source material of the sample obtained dendrochronologically is not fully recognised in heritage conservation practice. This can be seen, among other things, in that there is no generally accepted procedure for heritage conservation or building research with regard to the documentation of the sampling on site and the archiving of the drill cores in analog and digital form. The recommendations of the state heritage conservation authorities for dealing with dendrochronological dating focus more on the quality of the dendrochronological reports than on a systematic solution to the problem of archiving. A procedure is now being developed for this within the framework of the KDWT-funded project. The basic principle is that a certain number of projects with all documents are filed in a folder (analog and digital) and an archive box with the samples from these objects is created. This sorting enables very quick access to the objects and a clear organisation of the sample storage and has been tried and tested since 2008. The samples and reports studied up until 2008 will be checked in regard to the dating and where necessary corrected. Furthermore, the samples are recorded and archived centrally by laboratories with our partners.

Of the 12,000 old samples, 3638 samples from 1993–1996 had already been verified by the spring of 2018 and brought up to date. The dating was checked, and measurement errors were corrected. Of these, 145 samples could be dated subsequently and 29 re-dated. 49 datings were withdrawn.

In 2011, a cooperation agreement was established with the Thuringian State Office for Monument Conservation and Archaeology (TLDA) in Erfurt.

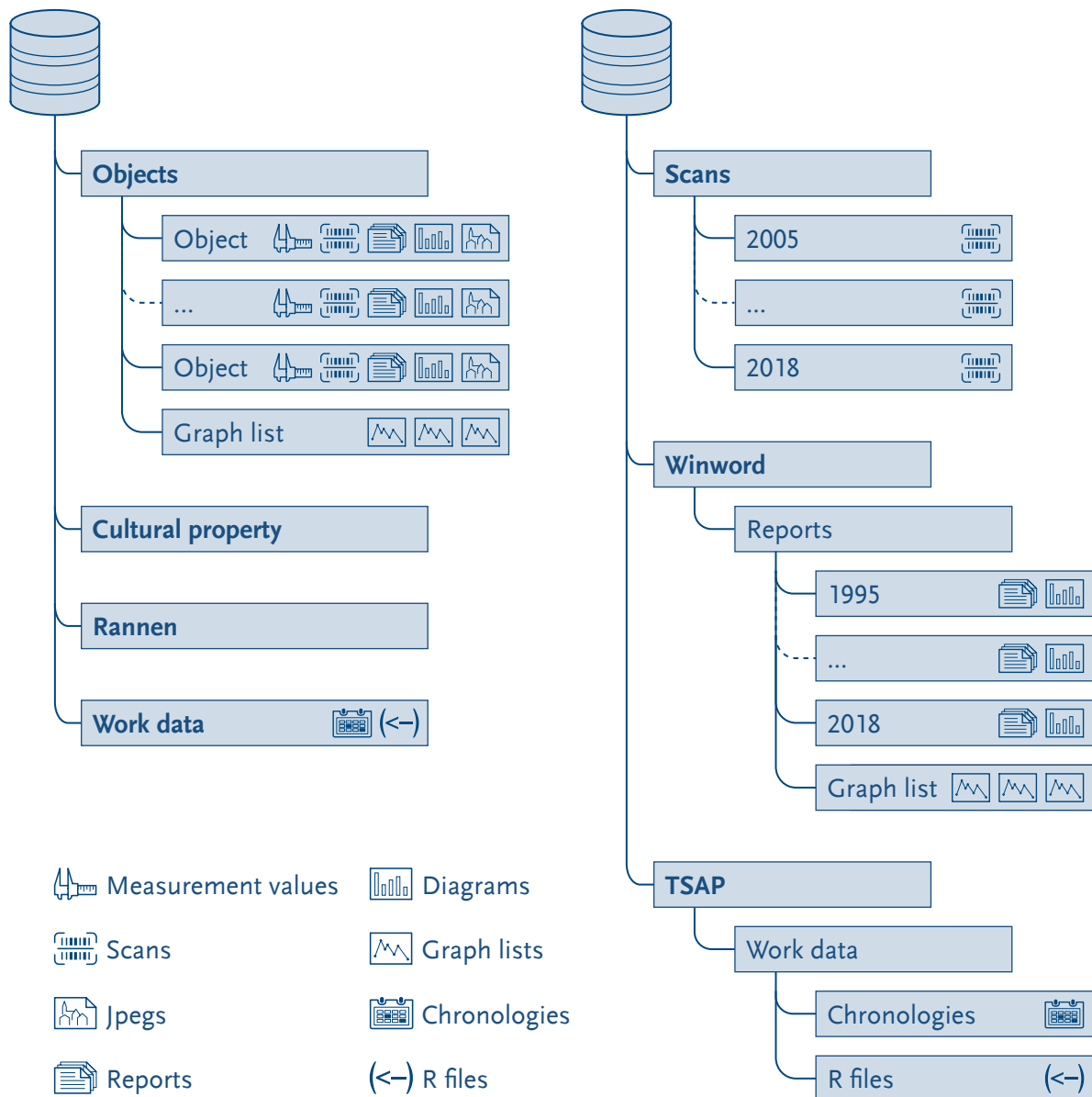


Fig. 2: Comparison of the old (right) and new path structure (left). The new file path structure saves all important files such as reports, scans of samples and drilling logs, bar charts and measurement values for one object in one and the same folder. In the old file path system, the individual files for an object were stored in different folders, which makes it difficult to list the files available for an object [Dendro Laboratory/ Arera-Rütenik 2018].

In 2017, 383 samples were evaluated as part of this cooperation agreement. 304 objects were entered into our database from the Friederike Gschwind Laboratory in Munich. A new TSAP-WIN input mask was developed, which is yet to be implemented by the programmer Frank Rinn (Heidelberg). New regional chronologies for oak were created for North Rhine-Westphalia and Rhineland-Palatinate. In order to foster knowledge transfer in the field of archiving, guest doctoral student Urs Gut

from ETH Zurich held a workshop on archiving archaeological samples at the end of 2016. Apart from that, there were visits to various dendrochronological laboratories, among others in Hemmenhofen and Zurich (10/05/2017–11/05/2017) as well as in Cologne and Mannheim (18/03/2018–20/03/2018). The topics covered there were the expert dialogue on archiving and digitisation as well as the initiation of possible future collaborations. (Thomas Eißing)



DIGITAL TECHNOLOGIES IN HERITAGE CONSERVATION

In October 2017, the research area “Digital Technologies in Heritage Conservation” – unique to Germany – was added to the Heritage Sciences department at the Centre for Heritage Conservation Studies and Technologies. This research area as well as the new Chair in the Heritage Sciences department will be headed by Prof. Dr. Mona Hess. She brings with her extensive experience in interdisciplinary and international projects as well as extensive knowledge of new methods, networks and partners. The research area complements the expertise of affiliated research areas with an engineering component.

Orientation of the research area

The Digital Technologies in Heritage Conservation research area creates a distinct profile for itself in the field of engineering-guided, multimodal and optical 2D and 3D imaging processes for data analysis, visualisation and interpretation of cultural assets (monument buildings and sites, museum objects, structural ornamentation, sculpture) and collections (mass digitisation and archiving). The aim is to integrate these processes into the workflow of museums, restoration workshops and authorities.

The main driver for this is the increasing relevance of digitisation in the heritage conservation, museum studies and the recording of cultural assets. These areas benefit from the use of modern sensor technology and digital recordings. The integration and adaptation of digital technologies in heritage conservation presents new and, for the most part, unknown challenges. The sustainable management of the resulting data serves to improve research into monuments and cultural assets. Capturing digitally the objects for research and reproducing them by means of virtual reality or 3D printing enables questions and answers from art, culture and heritage conservation to be conveyed to a broad audience. Virtual and augmented reality (VR/AR) also enable interactivity between the viewer and the object in a way that until now has not been possible. The division’s remit focuses on the issues raised by players in the areas of cultural assets protection, heritage conservation and museum studies and on making available practical and outcome-oriented content. The interdisciplinary team in the

department and the chair of Digital Technologies in Heritage Conservation represents a wide range of specialist areas: 2D and 3D imaging processes, art history, digital humanities, heritage conservation, engineering surveying and machine learning. Each of these disciplines provides crucial support to research and teaching in the digitisation of cultural objects in many dimensions and scales.

Engineering focus

The research area Digital Technologies in Heritage Conservation is not only concerned with the presentation of cultural assets captured digitally, for example, by means of virtual reality. In order for a museum object’s 3D data record to convince the end user of cultural heritage being a valuable ‘3D asset’, it must provide quantifiable evidence of the geometric and colorimetric quality. The basis for sustainable, scientific and reproducible data acquisition lies in the correct metrological recording and post-processing with transparency in the individual steps up to the digital end product.

From an engineering perspective, the directives for optical non-contact measurement are mature, and guidelines and their verification are available from metrology, i.e. measurement technology (VDI/VCI 2643 – optical measurement systems, BSI PD 6461-1995, ISO/DIS 10360-8). Measurement technology offers a systematic framework in which sensors can be studied and compared, irrespective of the actual objects.

Profile focus on museum acquisition and multimodal imaging methods

One of the main concerns of restorers is the documentation of museum objects before and after conservation treatment. The codes of conduct require written and graphical records (ECCO 2004) and the application of the highest possible standards in the context of the diagnostic examination and recording of an object. This not only includes a photographic overview but also extends to other forms of imaging, such as textual descriptions, microscopic documentation or modern three-dimensional images. Digital data such as 3D models are increasingly being recognised by museum specialists as a way of making research, exhibition presentations and education accessible to the general public. Traditional documentation techniques (sketches, true-to-scale

hand drawings and isometric drawings, texts, photos, restorative inventory) are translated into modern digital formats (e.g. digital room book, digital damage mapping). The digital humanities are therefore increasingly demanding a common infrastructure.

Unfortunately, the data recorded digitally is not yet integrated in the workflow of the conservation laboratory or comprehensively integrated in computer-aided collection management systems. Administrative factors, such as high costs and data management in museums, present a major obstacle in the development of a guideline for handling digital 3D images of exhibition objects. At the same time, however, the museums are trying to provide a better service with regard to conservation, scientific research and public exhibition.

Curators and restorers are interested in direct measurements with high accuracy as well as in the virtual reconstruction and presentation of this data. All steps and decisions from the acquisition to post-processing and right through to the final models are to be carried out in accordance with the London Charter ("For the use of 3-dimensional visualisation in the research and communication of cultural heritage", 2006). Experts require documentation of the origin of the object itself, its conservation treatment and the 'digital origin' (digital provenance) of the acquired data, for example, information about the imaging technology used.

Research in the field of digital heritage technologies aims to facilitate heritage specialists in describing precisely and clearly the process of creating digital assets before it is started. The joint goal is to broaden the understanding of the value of artefacts and to develop high-quality data sets that contribute to a comprehensive documentation and understanding of the objects or buildings.

Research projects and technological equipment

In 2018, the Digital Technologies in Heritage Conservation team worked on various projects. The major projects include the multispectral 3D digitisation of cultural assets and natural history collections (3DSpectral) in cooperation with RBINS (Royal Belgium Institute for Natural Sciences). Furthermore, development work of a metric test object for quality assurance of sensors based on geometry and colour according to

metrological rules was carried out. An execution protocol is also intended to be feasible for non-engineers or experts from the cultural and art sector ("improving automated 3D reconstruction methods via vision metrology solutions").

Smaller projects include, for example, a database for the geographical recording and representation of coats of arms in Bamberg's city centre ("Heraldry on Site") in cooperation with the Professorship for Historical Basic Sciences (Prof. Dr. Christoph Rolker) as well as the development of a construction plan for an inexpensive computer-controlled turntable that can be used for fully automatic structure-from-motion (SfM) recordings.

The Chair for Digital Technologies in Heritage Conservation, since being filled in 2017, has acquired a range of technical equipment that has since been used in research and teaching. The equipment includes eight digital single-lens reflex cameras with tripods and various lenses, a 360-degree camera, virtual reality headsets, a portable 3D scanner with a tablet for use in the field and a latest-generation 3D printer. The cameras are used for photogrammetry. The 360-degree camera is used particularly for the rapid detection of internal structures. The resulting 3D models can then be viewed using the headsets. The models can also be printed as physical objects. Next year, the department will also purchase equipment that enables multimodal recordings of cultural assets.

Teaching: Master's degree programme M.Sc. in Digital Technologies in Heritage Conservation

The new Master of Science in Digital Technologies in Heritage Conservation is all about the digitisation of heritage conservation. Today, in building heritage conservation, museum studies and cultural asset protection, innovative paths of digitisation are being followed. The digital recording of buildings and objects has become a standard for a basic determination, in keeping with heritage protection, as has the permanent monitoring of a building's condition with intelligent sensor systems. The Master's degree programme, unique in Germany, provides an overview of the capabilities and limits of modern technologies. At the end of four semesters, it leads to a second professional qualification with a broad application-oriented profile. The course of studies

is run by the University of Bamberg in cooperation with the Coburg University of Applied Sciences and Arts and headed by Prof. Dr. Mona Hess. In terms of development, the Chair is supported by the Free State of Bavaria and the Technology Alliance Upper Franconia (TAO).

The course is designed to appeal to a diverse group of people, with the aim of offering a tailored programme with many options. The interdisciplinary team of lecturers, the unique job description and the cutting-edge technical equipment guarantee up-to-date training.

The aim of this programme is to impart theoretical and practical knowledge in four areas: computer science (cultural informatics and media informatics), digital technologies and their applications (2D and 3D optical imaging processes, acquisition of buildings and objects, data analysis, monitoring, simulation), engineering basics (building physics and support structure and structure analysis) and sensors. In addition to Heritage Building Information Modelling (HBIM), Finite Element Modelling (FEM) is also taught, which supports the assessment of buildings and the decision-making process for any repairs that may be necessary; while numerical analysis in building physics can help to avoid long-term damage and to increase the energy efficiency and usability of buildings. The aim is to develop students' skills in critical evaluation and in an object-oriented solution to problems.

Given the growing demand for innovative technologies to support research, conservation and public relations, it is essential that cultural heritage professionals be trained accordingly. It is equally important that technology experts are made aware of the special problems of cultural heritage. The course responds to the need for specialists at the interface of heritage conservation and technology. Graduates of Digital Technologies in Heritage Conservation, the future stakeholders in the field of cultural heritage, are made aware of the potential of new technologies and methods for cultural heritage and can promote and facilitate the exchange of knowledge in both areas. The first graduates of this programme will start working in 2020.

More information on the Master of Science in Digital Technologies in Heritage Conservation can be found on the Chair's website at <https://www.>

[uni-bamberg.de/ddt/ma-digitale-denkmaltechnologien/](https://www.uni-bamberg.de/ddt/ma-digitale-denkmaltechnologien/).

Profile focus on continuing education

Based on our experience through cooperation with cultural heritage institutions, the Digital Technologies in Heritage Conservation team would like to develop further the following offerings in order to promote and improve the use of new digital technologies in this sector.

- 1) Increased knowledge exchange between academia and the heritage sector. This can range from simply raising awareness of the potential of technology to supporting the goals of cultural institutions, through to developing capacities for the use of relevant technologies within the institutions themselves.
- 2) A central industry-wide directory of training and continuing education opportunities in digital heritage technologies, which can help to make specialists aware of the variety of available new technologies and to meet the special needs and requirements of specialists. As well as a formalised training opportunity, to ensure that the experts continue to be informed about relevant technological advances.
- 3) While the above recommendations focus on an exchange of knowledge and skills from science to the cultural heritage sector, academic researchers would also benefit from working with professionals in the protection of cultural property, whose experience can help steer research priorities and open up new opportunities.

Partnerships and international relations

In order to promote the international exchange of researchers and students, the research area and the Chair for Digital Technologies in Heritage Conservation constantly cultivate and build relationships with relevant technical institutions. This refers to the establishment of an Erasmus programme for exchange with the Università di Catania (Italy) as well as cooperation with academic and non-academic institutions in Great Britain (UCL Civil, Environmental and Geomatic Engineering, UCL Heritage Science / Sustainable Heritage), with the 3D Survey Group of the Politecnico Di Milano (Italy) and with the Royal Belgian Institute for Natural Sciences (RBINS).

(Mona Hess, Mark Wernsdorfer)

Coburg Doll Museum Interactive Installation



Fig. 1: Shot in a doll's house [Hess, DDT 2018].

Head:	Prof. Dr. Mona Hess
Editor:	Mark Wernsdorfer M.A., Dr. John Hindmarch
Partner:	Doll Museum Coburg; Cooperation with the Coburg University of Applied Sciences and Arts: Students and lecturers from the Faculty of Design and of the General Studies course "Der Coburger Weg"
Duration:	2018
Funding:	Chair's proprietary funds

The Coburg Doll Museum has a large number of doll's houses from the past centuries to the present day. Doll's houses are scaled-down models of houses, with all of the details of the structural equipment, the décor and also the clothes of the (doll) residents. They are fascinating because of their scale and almost realistic materiality and serve children as visual aids and practical exercises for the future and for play. In this way, they enable the visitor to gain an intriguing insight into the contemporary history of interior design and of the residential buildings at different times, e.g. electrical equipment and sanitary facilities, but also an insight into social history or the changing understanding of roles.

In November 2017, the students of the Master's degree programme in Digital Technologies in Heritage Conservation visited the doll museum with Mona Hess. Initially, the task was to document the exhibition "*Models that Mean the World. How Knowledge Forms*" after its opening. In talks with the director of the Doll Museum, Christine Spiller, however, an idea for the exhibition came up with regard to the development of an interactive virtual application for visitors' use. These methods are used in research to change designs in virtual reality, digitally and interactively, i.e. collaboratively or individually. The interiors of doll's houses are spaces that may never have existed in this constellation and that can never be built in this way, thus they can be experienced from a first-person perspective.

Wouldn't it be fascinating to be able to move around like a resident inside one of the doll's houses? This was an idea put forward by one of the students that led to its implementation by the Digital Technologies in Heritage Conservation team in the form of an immersive digital and virtual experience of different rooms in four doll's houses.

Technically, this can be realised by means of a 360-degree image or film with a panoramic camera that is transferred to a stereoscopic headset. The details of the interior and their highly detailed craftsmanship can be viewed at will. Interactive control with a hand pointer enables the visitor to switch between different rooms and to compare different houses with one another. The scale is broken in the film by the appearance of a giant – a stranger's view of the doll's house from the outside.

The exhibition of this project ran from May to October 2018 at the Coburg Doll Museum within the framework of the exhibition, "*Models that Mean the World*". The exhibition design was created in cooperation with the design course at the Coburg University of Applied Sciences and Arts and was used as a place of teaching and learning in preparation, implementation and during the period of the exhibition. An exhibition catalogue with articles by all participants brought all contributions into a scholarly-historical and cultural-historical context.

(Mona Hess)



Fig. 2: Dr. John Hindmarch and Mark Wernsdorfer coordinate with Laura Jahn (Volunteer Coburg Doll Museum) the digital recordings in the doll's house [Hess, DDT 2018].



Fig. 3: Dr. John Hindmarch and Mark Wernsdorfer control the shot with the panoramic camera using an application on a smartphone [Hess, DDT 2018].

Hess, Mona: *Das Puppenhaus als Vorläufer des immersiven virtuellen 3D-Modells*, in: *Modelle, die die Welt bedeuten. Wie Wissen entsteht*, ed. Barbara FUCHS, Christian HOLTORF, and Christine SPILLER, Bamberg 2018, pp. 60–65.

The Corpus of Baroque Ceiling Painting

Arnstorf Castle in Lower Bavaria

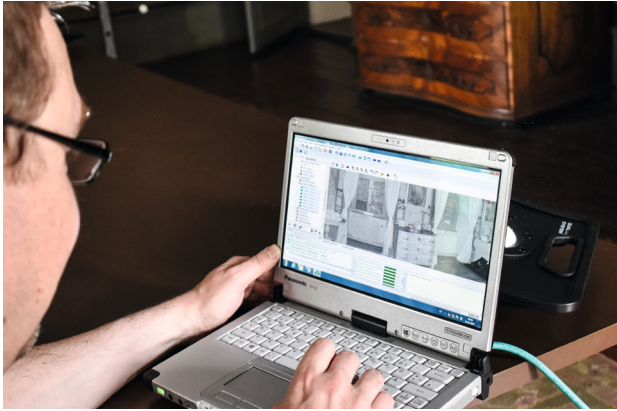


Fig. 1: Dr. John Hindmarch controls the 3D scan of the Fish Hall [Hess, DDT 2018].

Head:	Prof. Dr. Mona Hess
Editor:	Max Rahrig M.A., Dr. John Hindmarch, Mark Wernsdorfer M.A.
Partner:	Department of Art History, Ludwig Maximilian University Munich, project of the Bavarian Academy of Sciences and Humanities: The Corpus of Baroque Ceiling Painting in Germany
Duration:	2018
Funding:	KDWT's proprietary funds

A cooperative project between the KDWT with a focus on Digital Technologies in Heritage Conservation and the Institute for Art History of the LMU Munich and the Corpus of Baroque Ceiling Painting in Germany was initiated in early 2018. In this project, new methods and approaches for high-resolution documentation and research on magnificent baroque ceiling paintings are being developed. The Corpus of Baroque Ceiling Painting is a project in the academy programme of the German Academies of Sciences with two offices in Munich and Marburg. It is overseen by the Bavarian Academy of Sciences. Its goals centre around the research and digital documentation of the wall and ceiling

paintings in castles, churches, monasteries and in profane, urban buildings made in the region of today's Federal Republic of Germany between around 1550 and 1800.

Now closer collaboration with LMU's Institute for Art History is being pursued, which will involve the heritage sciences and art history students. Both working groups can expect special synergy effects through their coordinated documentation of buildings with wall and ceiling paintings.

The cooperation with the KDWT facilitates the project in developing feasibility studies for different spatial experiences. The first results were presented using as an example the Kaisersaal in the New Residence in Bamberg.

For this purpose, a joint campaign was carried out in the spring of 2018 in a private castle in Lower Bavaria that was made available to the team for one week. The following aspects were dealt with on site by the LMU art history team: first conclusions on architectural history from sources and on site, iconographic considerations of the magnificent apartments on the second floor, which were painted entirely in frescos by the painter Steidl. At the same time, orthographic pictures were taken by the photographers from Foto Marburg. The KDWT team supplied the digital documentation of the Kaisersaal and the adjoining hall converted into a theatre. Especially in the theatre, the original ceiling painting with the theme of a festive feast is difficult to capture due to the fixtures, and a virtual reconstruction without fixtures is intended to provide more clarity about the composition of this space. Another dining room was also recorded photogrammetrically. Through the inclusion of certified standards and registration marks and by means of the photography of two participants (KDWT and Uni Passau), when calculating the 3D model, quality standards of colour acquisition versus geometry are to be compared with the images of the Riegl 3D laser scanner (terrestrial laser scanner Riegl VZ-400i).

Close cooperation between the Digital Technologies in Heritage Conservation division at the KDWT and that of the Digital Art History at the



Fig. 2: Panoramic picture of the Kaisersaal in Arnstorf shown as a developed view [Wernsdorfer, DDT 2018].

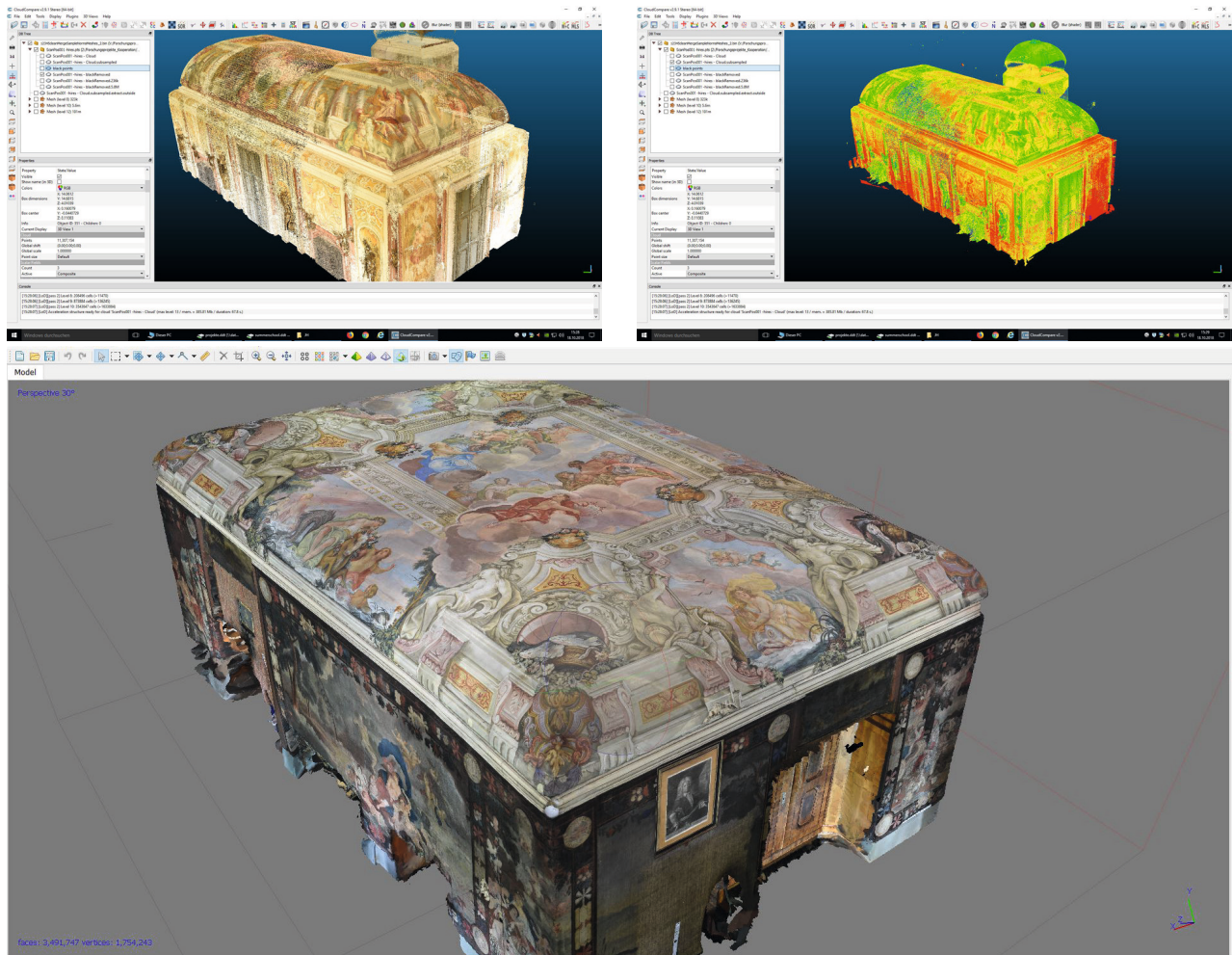


Fig. 3: 3D representations of rooms in Arnstorf Castle; top left: Kaisersaal with photographically coloured point cloud; top right: Kaisersaal in intensity false colours; below: photogrammetric calculation of the interior of the Fish Hall, shown from the outside as axonometry [Hindmarch, DDT 2018].

LMU is planned for the future. The adaptation and development of digital technologies for heritage conservation and art history will be the main focus in addition to the profiling of this new research topic in Bavaria.
(Mona Hess)

HESS, Mona / DREWELLO, Rainer / ENGEL, Ute / RAHRIG, Max: *Welttheater in 3D. Wie barocke Deckenmalereien ihre Geheimnisse offenbaren*, in: *Der universelle Wert. Neue Perspektiven auf das Welttheater in Bamberg und in aller Welt*, Uni.vers Forschung Mai 2018, pp. 20–23.



BUILDING ARCHAEOLOGY, BUILDING HISTORY, BUILDING PRESERVATION

When the historical monument protection laws were introduced in the federal states of the Federal Republic of Germany in the 1970s, building research gained a permanent place in institutionalised heritage conservation. In the course of this, the obligation was invoked to record and document the monument stock generally but particularly with regard to change measures. By assigning heritage conservation to the area of culture and education and due to the cultural sovereignty of the federal states, different responsibilities were established in the offices. For example, administrative departments for building research can be found at the state monument offices in the area of stocktaking or in that of 'practical monument conservation'.

In addition to the embedding of building research within authorities responsible for monuments, the heritage conservation boom has, since 1975, the year of monument protection, led to the development of a professional field for "free" building research firms and, for the most part, for independent building researchers, which has facilitated a clearly defined profile for the subject and facilitated its significance for planning and construction work on the monument.

Building research in German-speaking countries has also gained a firm place in the canons of specialist subjects at universities and technical colleges through 16 nominations of professorial chairs. Its recognition as a 'minor subject' demonstrates its professional and methodological independence and the importance it has gained. Within the cultural and historical research field, building research has been able to become specialised and differentiated in a variety of ways. It unlocks today's traditional stages of construction for historical studies as a rich primary source. Diverse groups of monuments and construction engineering from different historical periods are researched by institutions and subjects with different orientations, each of which assigns a place to building research within their discipline.

In government agencies, on the free market and in the university landscape, building research has been able to establish itself as an interface subject in cultural history, in 'practical heritage conservation' and with regard to building in the building stock with its own methodology, training courses and subject-specific issues in archaeological subjects; as well as in architectural history, art history

and cultural history subjects, in the context of monument science; in the basic determination within the context of the planning process; as well as in the preparation of preservation and renovation measures.

Methods and focus

In accordance with legal provisions and administrative requirements and recommendations, building research plays its part in heritage conservation in the recording and stocktaking of the monuments and prepares documentation in textual, visual, and professionally-qualified descriptions as well as in critical investigation reports and analytical representations. At the building on site, building research involves examining the current situation; clarifying the spatial and constructive connections; determining construction changes, construction joints and connection directions; documenting construction details and various object properties; as well as ageing and damage processes on the various building parts and materials. From this, the relative chronology of the different parts of a building and its supporting structure is determined. It is only then that absolute dating of individual elements takes place. Through the recording of the traditional condition in the building age plans and by reconstructing the history of a building and its surroundings in the construction phase representations, historical references of the typical remodelling and expansion measures are revealed. This determination of the characteristics of the monument provides the basis for the analysis of the historical design and change plans and for the classification of the individual findings in the general history of the building and cultural history. Thus it provides reliable evidence for the determination of the source or testimonial value of the building substance.

In addition to their importance in terms of archaeology, the history of building construction and building technology and other cultural and historical sciences as a basis for the determination of monument characteristics and monument values, all of these aspects have – a direct value for concrete measures on the monument. An in-depth understanding of historical construction and the materials used is essential for preserving and developing long-term treatment and usage strategies. The differentiation of cases and the examination of different planning and execution variants, which to a greater or lesser extent intervene in the

building substance, can by and large do justice to the historical construction whose sustainability or reversibility can be classified differently and which influence the source and monument value in different ways, belong today to the standard of professional 'practical heritage conservation'. Hence qualified building researchers can gain reliable, verifiable knowledge and thus security in planning.

This open-ended approach of building research – respecting the object in its traditional abundance of evidence with all its peculiarities that are often perceived as defects – has proven itself in many heritage conservation projects since the 1980s to be viable for an independent planning method that is in keeping with the preservation of monuments. The principle of the systematic use of building research in heritage conservation is the use of its results both with regard to the determination of the value of the historical monument and with regard to the determination of deficits and available resources, with the first and primary goal of preserving the structure of the building and its different meanings as a testimony to cultural history.

Current situation

Building research is booming. Ever since the German Archaeological Institute expanded the architecture department, established positions for building researchers in external departments and supported research, management and renovation projects with German building research all over the world by means of 'rapid response task forces', the subject and its specific forms – with the close linking of historical research and planning measures in line with heritage conservation – has become widely known.

Building research has also established a presence in heritage conservation and in the education system of the German federal states. However, the ideas centred around its regular and systematic deployment for building measures as regards existing structures could not be realised extensively here nor in equal measure for all monument groups.

The infinity of the describable phenomena in terms of a historical building structure and the testimony value of the building fabric – which can be endlessly expanded depending on the context of interpretation – in addition to a barely assessable variety of available sources in terms of the actual content of building research, of the individual

buildings, historical construction methods, dating criteria, building and building part typologies and a building history based on the object, is always faced with limited resources in terms of time and finances and the need for appropriate limitation and concentration on specific issues with regard to the respective plans.

In recent years, it has become clear that high quality and appropriate care of the architectural monuments is only guaranteed by building research if there are enough independent building research firms with sufficient orders that are in an economically stable situation. Building research continues to rely above all on the whole spectrum of both the procedures for investigation and documentation and the historical and building-typological topics being regularly requested, tendered and commissioned by the monument authorities or called for by the building contractors.

Even at German universities, the 'minor subject' can only successfully assert itself in terms of obtaining third-party funding against the changes in courses and priorities, in committees and research associations and with regard to constant technical differentiation, if it introduces its Janus-faced nature between the cultural-historical classification on the one hand and the concrete construction measure on the other hand as a methodically convincing core competence.

If these financial and structural resources are no longer available, many qualifications will not be available in the long term, especially for small building research firms and for the 'minor subject' at German universities. The supervision and research of entire monument groups or monument landscapes will suffer as a result.

Challenges, perspectives and the task of the KDWT in building research

Despite its size and the mostly limited resources of its protagonists, building research is confronted with a whole range of challenges, not least those to do with the digitisation of society, the need for ever closer integration across the disciplines and across institutions and the constantly changing planning and construction sector. With the Centre for Heritage Conservation Studies and Technologies, the subject now has, with its own department, a facility that is unique nationwide and that, thanks to its permanent equipment, can address these tasks in the long term and in a responsible manner through the *expansion of technical expertise*

in building research as shown below in more detail. The variety of modern building documentation technologies, available due to the rapid progress in this field, has already crystallised into an independent subject in terms of heritage technologies. Building research's task at the KDWT is to ensure these processes and the equipment remain permanently available and to examine them continuously in user-specific application scenarios with regard to their scientific significance, connectivity and inventory assignment; and to drive forward and further develop *quality standards* based on its own methods and to push them through in the form of recommendations.

The expansion of technical excellence also enables building research to improve the availability of its knowledge, be it on the construction site and in 'practical heritage conservation' or in conveying its complex and multilayered perspectives on historical buildings in the cultural and object studies. The new technologies require a completely different, more integrative and sustainable way of stocktaking, structured in different recording depths, which thus enable new forms of *knowledge distribution*. After all, countless initiatives in the context of the expansion of the 'digital society' relate to cultural and architectural monuments and provide building research with new tasks and contributions.

Through the *merging of presentation and documentation methods* as well as through the development and implementation of strategies for *data management in building research*, technical skills are expanded at KDWT and tested in application projects that use the special interrelationships between construction and historical research in a new way and thus enable condensed forms of *networking and participation* of different interest groups in the monument process. In engineering, object-oriented strategies have prevailed when planning existing buildings, which open up a broad field of activity for building research. The monitoring of historical buildings is regarded as a value-preserving package of measures and offers a market beyond the building measures that still dominate in the area of monuments. This market could develop in favour of building research. Ultimately, the demand for building research has, interestingly, currently also resulted in larger planning offices and other specialist groups providing elements of the range of services.

Building research as an interface discipline can take advantage of this potential through a dense *interweaving into the architectural heritage conservation, in the construction sector, in handicraft and in the engineering sciences*. What could initially be seen as a too detailed view of the historical monument and as a far-reaching restriction of the planning freedom with regard to measures with regard to the building stock has turned out to be a valuable suggestion and a driving force for the development of a wide range of handicraft and technical constructions and materials in a constantly growing heritage conservation market. And finally, according to a survey, 33.1% of architects in Germany describe building in the stock as the most important topic of the future.

These opportunities are mirrored in various ways in the departments's portfolio at the KDWT. The expansion of technical skills in the field of *engineering and technical building analysis* enables *tighter management of historical and technical building research*. On the other hand, increased involvement in *building preservation* is also ensured through the integration of building research concerns in building and planning law procedures, in building execution and maintenance, in institutional structures and in standardisation initiatives.

The subject areas shown in the Building Research department at the KDWT, which are discussed in more detail on the following pages in individual project presentations, are not intended merely to make the subject more compatible and future-proof. Since building research, within the range of subjects at the KDWT, also occupies an interface position between the humanities-oriented heritage conservation, the science-based analytics in preservation science, and the engineering-oriented heritage technologies, the priorities set here can, based on the technically well-founded, high standard used to establish a profile for the entire heritage sciences, contribute to the Otto Friedrich University and thus strengthen the Bamberg location in a national and international context.

(Stefan Breitling, Tobias Arera-Rütenik)

BREITLING, Stefan / GIESE, Jürgen (eds.): *Bauforschung in der Denkmalpflege – Qualitätsstandards und Wissensdistribution, Forschungen des Instituts für Archäologie, Denkmalkunde und Kunstgeschichte* 5, Bamberg 2018.

Building Documentation at the KDWT

Safeguarding quality standards in building research



Fig. 1: Building documentation with photogrammetric procedures using UAV [Arera-Rütenik 2017].

Head:	Prof. Dr.-Ing. Stefan Breitling
Duration:	since 2016
Funding:	KDWT's proprietary funds

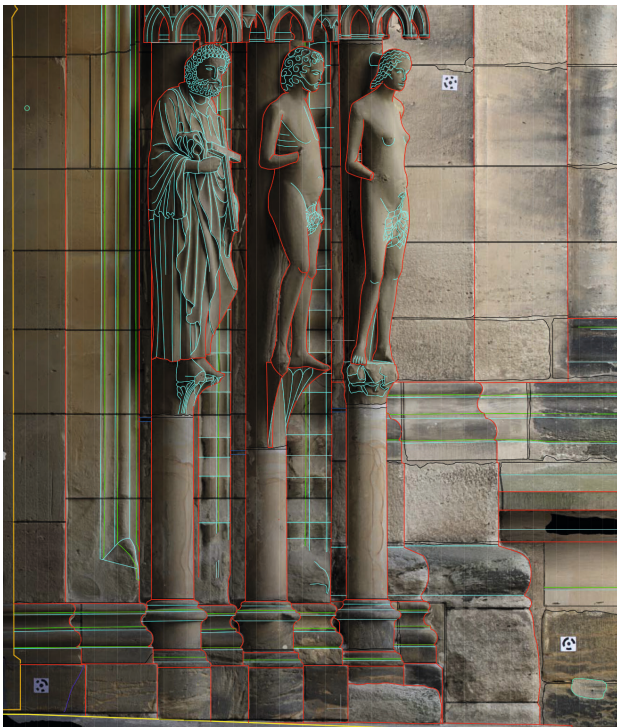


Fig. 2: Together, a 3D point cloud calculated orthophoto and the overlaid digital outline drawing form a hybrid product. [Giese 2015].

In the historical monument protection laws of the Federal Republic of Germany, the scientific research of monuments is formulated as an mission, in the fulfilment of which building research makes an important contribution with its own methods. ‘Research’ always means in this respect both historical and technical, because culturally historical and technology historical insights as well as technical judgement follow arising from each observation on an existing building construction, carried out by building research. Technical judgement is required particularly in the context of repair measures, which can be accomplished sustainably and appropriately, if building archaeological investigations make timely reference to resources and risks of the traditional building substance. Building research clarifies spatial and structural interrelationships in this context; analyses the development and change history of buildings and ensembles; reconstructs the genesis of building damage; draws attention to the fragmenting, layers and overlays constituting the condition of today; and makes visible the historical and cultural source value of a building as well as of its equipment; and categorises them in further developments. The recognised monument values are thus both culturally and historically of an idealistic nature as well as, in the truest sense of the word, a ‘value’; a yardstick for the efficiency of the existing building fabric in the context of contemporary use. Essential for each building-archaeological investigation is a scientific building documentation whose methods and forms of result exhibit a variety, which has developed precipitously, especially in recent years. The starting point of each documentation that can be used in building research is thus the question concerning the forms of result, adapted to the object and issue. The efficiency of the forms of result ranges from the pure surface view right up to the complete penetration of the structural and formal details of an object. It is only after a definition of the forms of result that a meaningful combination of the assigned techniques can be arranged in order to guarantee a smooth workflow and generate the desired forms of result as

economically feasible as possible. Based on the tried and tested methods mastered both in terms of technology and personnel at the Professorship in Building Research and Building History, the set of tools made available upon the establishment of the KDWT could be supplemented and developed by means of up-to-date techniques. This enables the KDWT to create building documentation with the most diverse forms of result for objects of each period, size and complexity.

Forms of result

Three categories of forms of result are to be differentiated here: non-interpretive products, interpretive products and what are known as hybrid products. Non-interpretive are all point clouds, and this does not mean only the well-known 3D point cloud but includes 2D point clouds that are usually referred to as digital photographs. The latter are particularly interesting for building documentation if, apart from colour values, geometric information can be inferred from them. Therefore they play a predominant role in their special form as an undistorted image or as what is known as an orthophoto (Fig. 2). In both forms of result, an object or parts of an object is/are projected mapped orthogonally on one level, so that – just as with a graphical representation – dimensions can be taken directly. All point clouds are always based on an automated production, in the sense that during production adherence to the metrological accuracy is necessary and the mapping of the object must be considered as objectively and completely as possible; however, not the analytical penetration in terms of content of that which is represented.

The great strength of point clouds lies in the fact that after a comparatively short stop at the object, a model of the object can be brought to the computer, of which dimensions can be taken from all points that the cloud covers. For example, 3D point clouds of vaults have proved very successful. With their help, deformations and thus the structural behaviour can be analysed with engineering technology. What are known as flat deformation analyses are also highly efficient, where the deviation of each point of the cloud is determined by comparison with a reference surface. Where a large number of cuts is needed without a 3D point cloud in order to track deformations, a single flat

evaluation is now sufficient, which can be easily calculated on the basis of the 3D data.

However, one must also be aware of the disadvantages of the point clouds, since the automated detection does not distinguish between relevant and irrelevant points as regards the respective question. The decision with regard to the relevance of dimensions and the localisation of building part boundaries, which is indispensable for constructional penetration, must be carried out by the users themselves. And they do not do this directly on the object but at the computer workstation. They must therefore be sure that they can address building parts and their demarcations in the cloud just as reliably as they are on the actual object. In practice, it can be seen that certain building part classes, such as a brick wall without plaster with light joint mortar, are well suited for this purpose. Others, however, such as a roofing base, the knot of a hanging column or a natural stone wall built with coloured joint mortar are highly unsuitable. The on-site principle in building research, which has proved very fruitful and thus indispensable, must therefore not be abandoned when using point clouds in favour of exclusive 'remote sensing'. It should also be noted that the archiving and long-term usability of digital data is still an unresolved problem.

The interpreting forms of result have completely different properties. They are mainly the 2D line drawings, which can be created either manually or digitally. Their strengths lie first of all in the – during the drawing process – ongoing simultaneous processes of stressing and omitting, of the merging of fragmentary information, of the making visible of the invisible, *summa summarum*, also of the interpretation (Fig. 2). In contrast to the non-interpretive forms of results, their creation now requires not only technical expertise but also content expertise. In addition, it is a form of result with which an object can be fully represented by the complexity of a building structure – and the completeness does not extend only to difficult-to-reach building parts but also even to completely concealed building parts, whose existence, thanks to historical plans or with the aid of special measurement techniques such as thermography or geophysical methods, can be proven. Digital

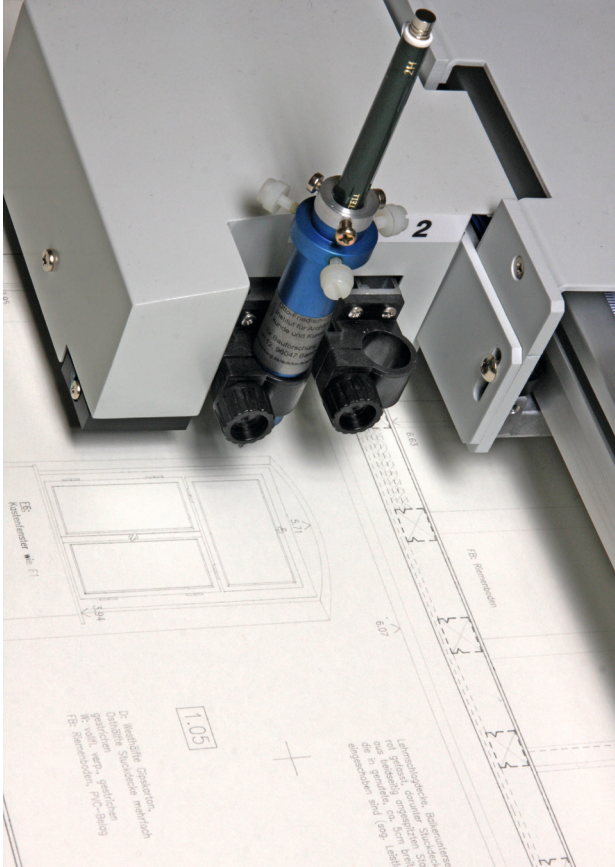


Fig. 3: Using the pencil plotter, digital 2D vector drawings are converted into archivable analog pencil drawings [Giese 2014].



Fig. 4: Devices available at the KDWT for various digital measurement techniques that are appropriate to the respective usage scenario can be applied and combined accordingly [Giese 2018].

line drawing, in particular, also has the advantage that it can be easily updated and seamlessly integrated into planning processes. All these features result in it being the most commonly used result form for building documentation.

The analog line drawing, i.e. the drawing applied by hand in pencil on cardboard or foil, does not have the advantage of seamless updating. However, in the presentation of surface portraits and in the development of small-scale and fuzzy findings, it has a higher analytical potential than the digital vector drawing. With regard to building parts that require the recording of such details and reveal their significance only after the most inconspicuous findings have been recorded – as is usually the case on archaeological excavations for example – it is also of great importance in the digital age.

The question of archiving and long-term use of line drawings may be considered solved since the digital data can be plotted in ink on archival paper and drawings created by hand on the appropriate medium are archivable on their own. Such drawings are thus an important building block for the fulfilment of the social mission of heritage conservation, which is to preserve the cultural heritage for future generations in legible form.

The advantages of digital and analog line drawings can even be combined. Pencil plotting technology, unique to Germany, is available at the KDWT for this purpose. A cutting plotter was converted so that it could be equipped with clutch pencils established as standard for manual drawings and suitable for displaying even the finest details, in order to plot out digital drawings in pencil on archival cardboard (Fig. 3). With the aid of this, it is possible to produce firstly a purely digital plan set, to a defined degree of detail, for example for a refurbishment project, which then undergoes a two-track update: For one, it serves as the basis for the purely digital planning process; secondly, it is used as the basis for construction-phase building research. Building research uses the finished drawings to transfer them into documentation, without their own elaborate measurements, by means of manual additions, which capture analytically all findings and thus also satisfy scientific requirements.

The virtual models, known as 3D volume models, also fall into the category of interpreting products.

A strict distinction needs to be drawn between these and what are known as surface models, which are created by automated meshing of 3D point clouds. In volume models, on the other hand, a structure is modelled part by part in order to give access to the link with a structure information system. When created carefully, the analytical potential of such models can exceed the performance of line drawings; but volume modelling typically forces a generalisation and simplification of the underlying data, so that volume models are not suitable as a primary form of result of a building documentation, only as a secondary form of result. Transferring the quality standards already achieved in digital and analog line drawings to virtual volume models is one of the tasks that the KDWT is confronted with.

The predominantly digital forms of result of the building documentation lead to a variety of combination possibilities for what are known as hybrid products (Fig. 2). Since the digital 2D line drawing is the only form of result that can fully represent buildings, except for the 3D volume model, it usually serves as the basis into which other forms of result are incorporated on a selective basis. For example, the scan of a hand drawing can be integrated in order to make use of the density of findings and informative value contained in it. Elsewhere, an orthophoto may appear in order to capture the colour values missing in drawings or simply to save the redrawing of the information contained in it. In the future, the 3D volume model will also increasingly serve as a framework for such hybrid products.

Measuring techniques

In order to produce both geometrically reliably and economically all the above-mentioned forms of result of the construction documentation, all common geodetic techniques are available at the KDWT, i.e. tachymetry, photogrammetry, laser scanning and satellite-based measurement, which are supplemented by manual measurements during work on site. Tachymetry is fundamental for every building survey because it is used to set up reliable fixed point fields for geocoding as well as to enable high-precision point detection (Fig. 4). With its help, digital line drawings are created directly in the face of the object, so that it is pre-

pared for the acquisition of difficult-to-interpret building parts; or is used to supplement and verify evaluations that are based on processes of remote sensing and thus have detection gaps or ambiguities. With regard to large-scale objects, such as entire urban complexes or cultural landscapes, the process is supplemented by the centimetre-precision, satellite-based survey using GNSS (Fig. 4).

The photogrammetric procedures use the structure from motion method (SfM) at the KDWT, where a 3D point cloud is automatically calculated from a large number of digital images of an object, from which orthophotos can be created, as needed. The strength of this method for building documentation lies in the fact that the measuring sensor – i.e. the camera – is very mobile, unlike all other methods. Small objects or the bases of building structures are photographed by hand. For objects up to 8 m high, specially adapted, hand-guided high tripods are available at the KDWT (Fig. 4), and a professional UAV (drone) is used for even higher altitudes (Fig. 1, 4), for whose operation the KDWT also provides the technical and human resources. With this equipment, the millimetre-precision surface detection at any height and of objects of any size is made possible. The flying camera sensor even allows the measurement of areas, which are not visible on account of the device locations, using tachymetry and laser scanning methods. For towers and façades, this process is therefore the first choice.

Finally, the terrestrial laser scanner is a useful alternative to photogrammetry, especially for interior spaces, since the blind spots caused by the device's positioning have far fewer serious effects than in the outdoor spaces and a lot of effort goes into the creation of uniformly exposed photos (Fig. 4). Laser scanning provides just as reliable data for geometry acquisition as tachymetry, but it is inferior to photogrammetry – which is based on high-quality photographic documentation – for the assessment of surface structures.

Through the expansion of the technical expertise at the KDWT, the technically sound, high level of the Bamberg building documentation remains suitable against the background of rapid technological development, thereby guaranteeing the existing quality standards for the future. (*Jürgen Giese*)

The Underground Sites of the Domberg in Bamberg

Building recording, archive studies, data referencing, inventory



Fig. 1: Bamberg, Domberg (Cathedral Hill); view from southeast, insert of the eastern part (current state), grey: probable reconstruction around 1300; here the information density on cellars, tunnels and underground sites is lower; 4D city model Bamberg [Breitling / Buba / Fuhrmann 2011].

Head:	Prof. Dr.-Ing. Stefan Breitling
Editor:	Dipl.-Ing. (FH) Christian Schalk M.A., Roman Schöpplein M.A.
Partner:	Bavarian State Office for Monument Protection
Duration:	since 2016
Funding:	KDWT's proprietary funds



Fig. 2: Remains of a former castle tower of the Domberg inside the cellars of the Curia Sts. Philip and James II [Schalk / Schöpplein 2016].

The Domberg is considered to be the most important nucleus that once led to the founding of Bamberg. For many centuries it was also the spiritual and cultural heart of the town and housed the government administration of the prince-bishopric. While much attention has been paid to Bamberg Cathedral and the prince-bishop's residences, at least parts of the cathedral courts that, since secularisation, have been converted, rebuilt and some even demolished, have not yet received the same attention as the ensemble has in its overall construction and in its urban integration as a World Heritage Site.

In the course of the continuation of the inventory, *The Art Monuments of Bavaria*, under the auspices of the Bavarian State Office for the Preservation of Monuments, the cathedral courts are currently the focus of the investigations. At the invitation of the regional office, the KDWT records, examines and evaluates the underground sites of the Domberg and classifies them according to cultural and developmental history. With the previous building research project, *4D City Model Bamberg around 1300*, the digital foundation was laid for the localised, (time-) layered recording of information about the town core of historical significance (Fig. 1). Conclusive results of the three subprojects outlined below have been incorporated into the 4D city model and thus updated.

Preliminary investigations, cellar cadastre, archival work

Remarkably, although there may currently be rudiments of a cellar cadastre for the City of Bamberg, there is no complete view of the manifold underground sites in the city area, in which all known, suspected, accessible, buried and remote cellars are recorded in terms of construction, usage and cultural history and in which they are geometrically located. The necessity and usefulness of such a cadastre is still being debated in the professional community. For the small area of the Domberg, in relation to the total stock, one is at least being pursued (Fig. 2).

In the course of the preliminary investigations, all the visible cellar openings above ground were first mapped in rising walls. The accessible cellar structures were inspected, documented

photographically, measured orientatively and entered into a Domberg base map created by the KDWT. Additionally, relevant documents could be viewed and archived, including, thankfully, old documents from the town planning office and the building registry of the City of Bamberg as well as data from the city archaeology of Bamberg; also relevant research and publications on the cathedral Curiae, documents on ownership structures, building encumbrances and responsibilities at the Domberg; as well as water management and surveying archives. Thankfully and courtesy of the responsible persons, the entire building files of the archives of the archbishopric of Bamberg could be inspected in full, and numerous archival documents at the building department of the archbishopric ordinariate of Bamberg be inspected cursorily. The evaluation and analysis of these two newly explored archives goes beyond the scope of this project work. However, we can say today that a detailed history of the building maintenance on the Domberg can be derived from the building files of the archbishopric's archive. This certainly applies to those Curiae that are the responsibility of the archbishopric ordinariate and at least to the period since the entry into force of the Bavarian monument protection legislation in 1973.

Analysis, data referencing, building preservation

The second part of the project serves the project preparation with regard to a data referencing model for future building maintenance on the Domberg. An attempt is to be made, in a kind of synopsis, to compile information from a wide range of knowledge areas on the buildings, their integration into the environment, their underground sites and the soil and framework conditions and to evaluate and reference it. The information is to be collected and archived in digital form, classified and evaluated historico-culturally, functionally and technically, examined for its durability, for any damage and hazards, and the results placed in context. In this way, duplications in the collection of information and errors can be easily recognised. Necessary measures for monitoring the existing building fabric are to be determined and described. Existing areas of knowledge are also used from geoinformation systems (GIS) of public and semi-public bodies (supply and disposal, waste water, gas, electricity, drinking water, media, etc.) and referenced with the research results.

The results will be used to formulate recommendations and forecasts on necessary building maintenance measures for the future.

The cathedral Curiae are largely situated along the current slopes of the Domberg. Further investigations, such as geoscientific investigations using minimally invasive dynamic and drilling probes, can be used to develop tachometric images of hypsometric layer plans and topographical sections. It is also expected that insights into former topographic-geological conditions, also on the historical course of the site and its history of change, will be gained. These insights are intended to contribute to the last part of the project.

Reconstruction of medieval building development

If one considers Bamberg's Domberg as a 'special building area Curia', which it probably was for many centuries up until the 19th century, it stands to reason that it underwent different construction processes and applied different building development strategies than other municipalities that were influenced (purely) by profane building.

The early history of the building and settlement of the Domberg is a research gap that has yet to be closed. Furthermore, light is to be shed on the history of construction and change of the individual cathedral courts and, among other things, the inventory initiative of the Bavarian State Office for the Preservation of Monuments is to be supported. The medium-term objective of the inventory of the cellar structures of the cathedral courts, which can provisionally be described as prospecting, is to provide a scientifically sound reconstruction of the medieval development of the Domberg on the basis of comprehensive, well-founded building research, which is the third subproject. In addition to the classical tools of historical building research and depending on the requirements, stone and brick types, for example, are to be mapped, mortar analyses conducted and structural design features recorded.

We can expect – from a combination of the individual project parts into a 'triad' of data accumulation with archival study, engineering science recording and building history research, in conjunction with the addition of the 4D city model – an appropriate and valuable contribution to the construction and historico-cultural development and structure of the Domberg as well as to the history of its settlement.

(Stefan Breitling, Christian Schalk)

Choir and West Tower of Ulm Minster

Construction-phase building research in cooperation with the State Office



Fig. 1: Ulm, Minster, West Tower [Kraft 2008].

Head:	Prof. Dr.-Ing. Stefan Breitling
Editor:	Prof. Dr.-Ing. Stefan Breitling, Claudia Eckstein M.A., Tobias Apfel M.A.
Partner:	Baden-Württemberg State Office for the Preservation of Monuments
Duration:	since 2012
Funding:	Landesamt für Denkmalpflege Baden-Württemberg

With the start of construction of the Ulm Minster in 1377, renowned architects such as Ulrich von Ensingen and Matthäus Böblinger not only built one of the most important late Gothic churches in Germany. Upon completion of the building 513 years later, with the help of preserved medieval

plan drawings, the tower emerged in 1890 as one of the world's most spectacular historical reconstruction of historical towers (Fig. 1).

Associated with this was the refoundation of the Münsterbauhütte (cathedral workshop), which since then – as is usually the case with such buildings – has been conducting safety and maintenance work virtually non-stop. The scaffolding erected at the Choir and the West Tower also offers a unique opportunity to take a close look at essential parts of the building, thus answering questions raised about the long history of research; and ultimately, laying robust foundations for appropriate preservation measures.

In order to do justice to the importance of the building and take appropriate advantage of the opportunity offered by the installation of scaffolding, the competent State Office for the Preservation of Monuments Baden-Württemberg commissioned the building research department at the University of Bamberg with the investigation of this important monument during the construction phase, because it is here that the expertise for large medieval buildings and for the use of building research in building preservation is available. The proven, close cooperation of state offices and universities in the supervision and research of large buildings ensures the relevance of building research findings for prudent preservation measures and guarantees sustainable incorporation of the results into academic discourses.

The cooperation between the State Office and the university finally made it possible to update documentation results reciprocally. The Bamberg building researchers were given a reliable, photogrammetric plan set, which served as a reference and basis for the subsequent compaction of shape-accurate and stone-precise plan information. It forms the basis for the localisation of findings and the mapping of numerous phenomena from the origin of the materials used right up to the signs left by the stonemasons of the past.

The various findings derived from this procedure include statements about the progress of the construction as well as about the individual construction phases on the choir, including the embedding into the topic area of medieval brick production in Ulm and beyond. This includes the demarcation of construction phases on the tower,

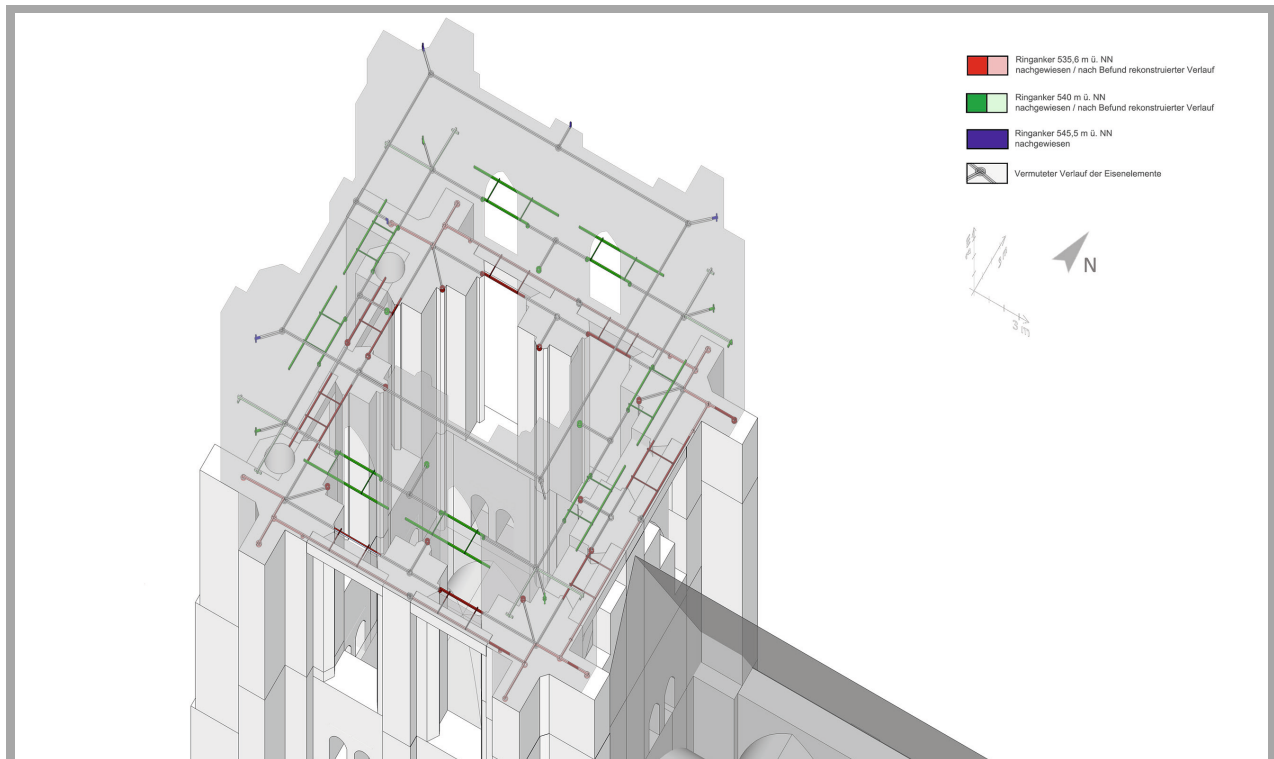


Fig. 2: Ulm, Minster, West Tower, visualisation of the medieval, wrought-iron ring anchor system; the diagram describes the workings of an historical engineering construction and at the same time supports the preservation of a statically relevant element [Eckstein 2018].

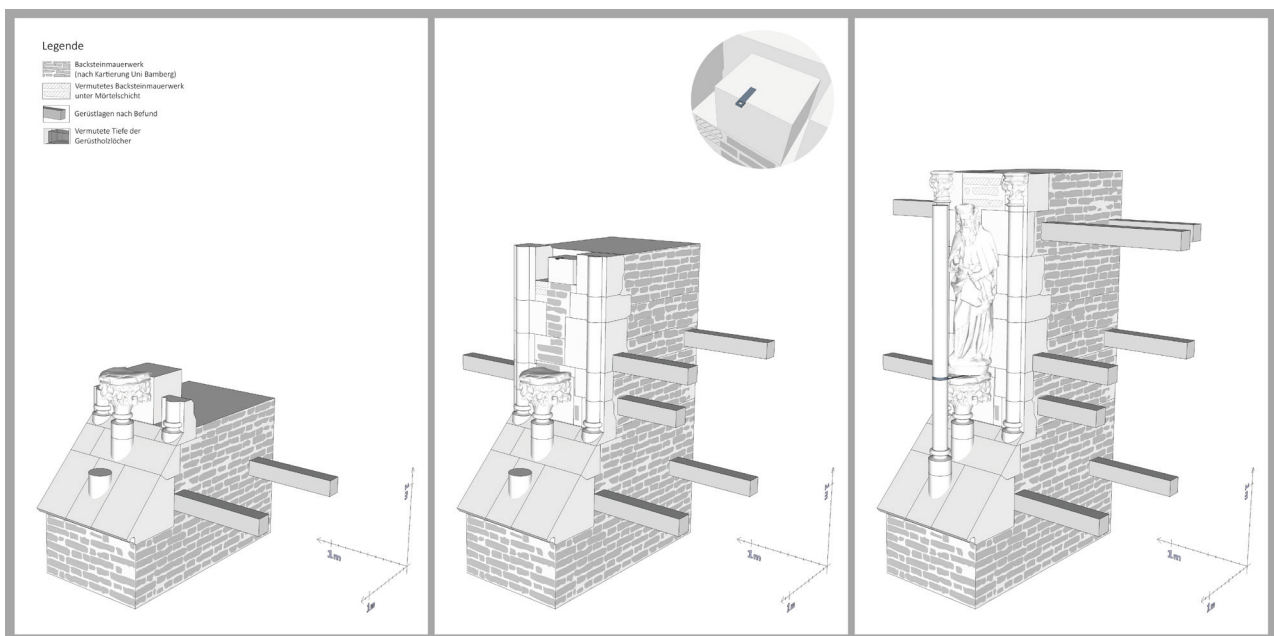


Fig. 03: Ulm, Minster, Choir; the reconstruction of the installation process of the figure tabernacles on the buttresses proves the original affiliation of the figures as well as the original material mixture [Eckstein 2017].

the description of constructional features, the analysis of the entry and exit of craftsmen in the Middle Ages and, finally, the review of the construction plans of the 19th century, in terms of the actual executed building fabric of the West Tower.

(Tobias Arera-Rütenik, Claudia Eckstein)

BREITLING, Stefan / APFEL, Tobias / ECKSTEIN, Claudia: *Bauforschung am Ulmer Münster 2012-2017 – Eine Projektkooperation zwischen dem Landesamt für Denkmalpflege und der Otto-Friedrich-Universität Bamberg*; in: *Denkmalpflege in Baden-Württemberg – Nachrichtenblatt der Landesdenkmalpflege*, 2018, pp. 31–37.

Data Management in Building Research and Heritage Conservation

Merging of presentation and documentation methods

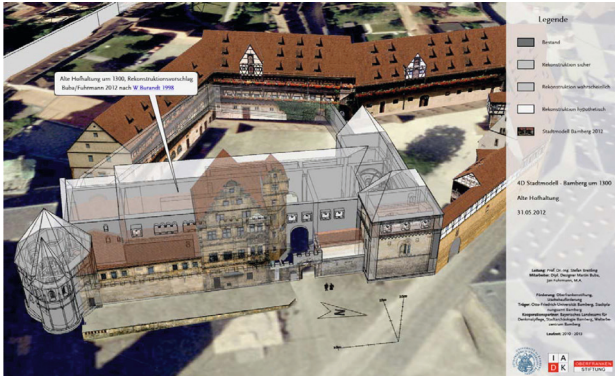


Fig. 1: Digital media offers new, user-specific forms of access to information; 3D models guarantee the aggregation and access to diverse, object-specific background data; such forms of presentation present the results of building research in related cultural studies-based disciplines, planners and the interested public in a meaningful and appealing manner; '4D city model, Bamberg around 1300' [Breitling / Buba / Fuhrmann 2011].

Head:	Prof. Dr.-Ing. Stefan Breitling
Editor:	Dr.-Ing. Tobias Arera-Rütenik
Duration:	since 2016
Funding:	KDWT's proprietary funds

In building research, the specific material evidence is always the starting point of any debate. Unlike a text, for example, objects must never be stored directly. Only images can be created that merely transport a fragment of reality. Filtering is, however, an interpretive act. Building research, in particular, as an object science with a corresponding claim to objectivity regarding its inventory products therefore relies on a wide range of different media types in order to document as diversely as possible and thus present its objects of investigation in the form of plans, spatial representations, images, texts, diagrams and tables. In addition, there are analyses, interpretations and planning specifications that are available in equally heterogeneous formats.

The results are of particular value because building research, as an interface discipline, provides primary data for cultural studies as well as a reliable basis for appropriate, resource-saving building and modification measures and acquires its justification from the inventory task. For this reason, extensive amounts of information have been produced for decades by independent building researchers, institutional heritage conservation bodies and through university monument research, not to mention the data of the operators, planners and executors of the monument objects.

In particular, the changes brought about by digital progress offer building research new opportunities to make its multi-layered results more integrative; to network more closely with one another; and above all to disseminate in a form adapted to the respective user context and thus to improve significantly the ability to distribute its own results to the public (Fig. 1). Another potential for digitisation in building research lies in the fact that large amounts of information can be efficiently evaluated in the sense of 'big data' and thus facilitate entirely new approaches and questions in research (Fig. 2). And finally, the updating and enhancement of digital data is particularly suitable for the use of architectural conclusions in monument monitoring and monument management. This way, they promote the networking and participation of different interest groups through collaborative cooperation in all matters regarding the respective monument.

In contrast to this potential is the current situation with regard to the results from building research. The savings constraints in all areas of monument management with simultaneous real estate boom, the short-term financing of third-party funds in academic research, the rapidly changing technologies with ever new forms of documentation, the pressure to innovate, the need for long-term archiving of inventory products, and finally the steadily increasing additionally transported quantity of test results arising from scientific differentiation are the reasons that the opportunities regarding availability, networkability and connectivity of building research data have still not been fully exploited.

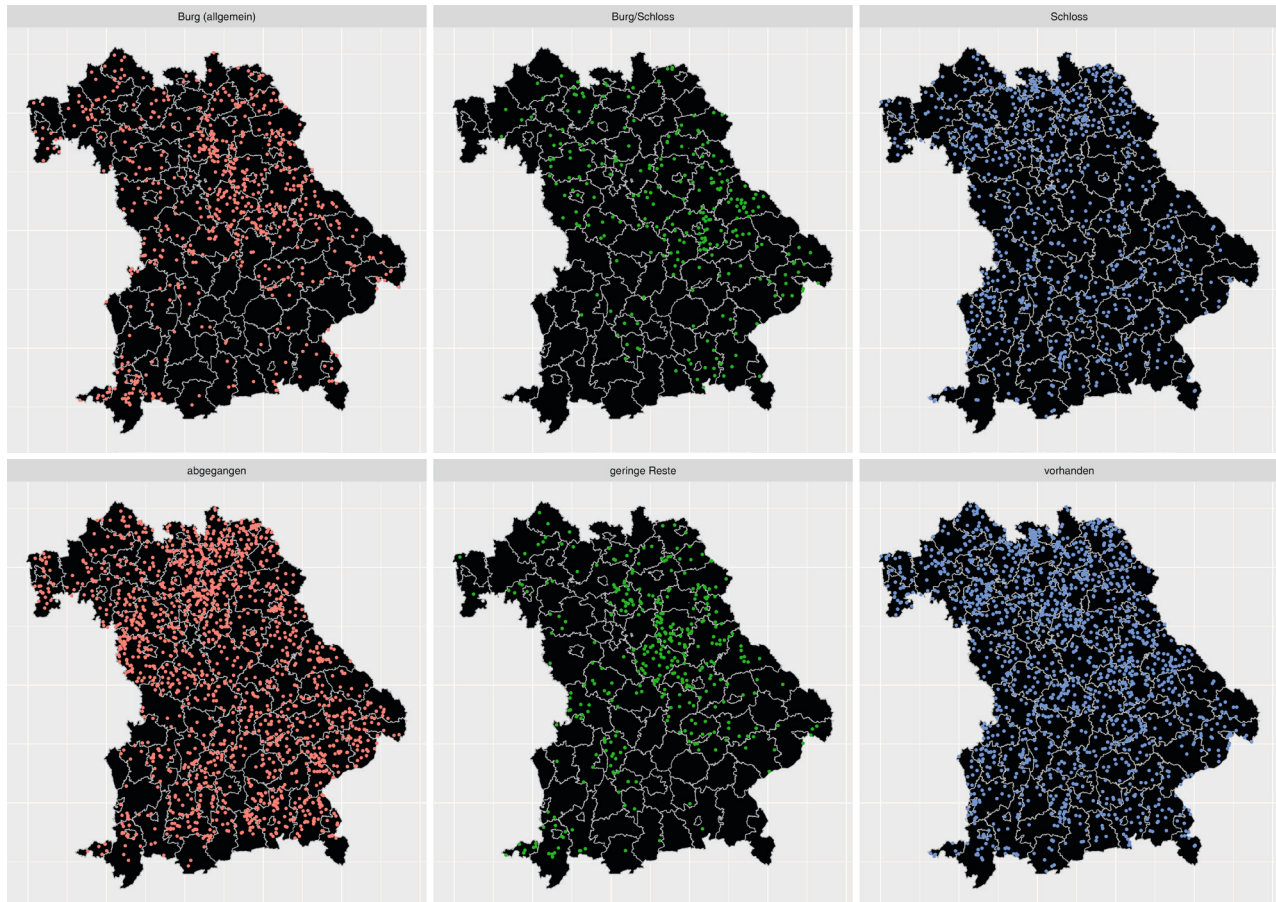


Fig. 2: 'Big Data' in building research using the example of web scraping data obtained from Wikipedia on approximately 4300 Bavarian castles, palaces, fortifications and fortified churches and their statistical evaluation; top row: mapping of the approximately 2000 sites still in existence according to the type of construction; bottom line: mapping of all structures according to their state of preservation; even if the quality of the information remains questionable in individual cases, the mass evaluation shows interesting patterns; the statement here would be that the conspicuous accumulation of castles in the picture on the top left is not due to an increase in their construction in certain regions but that they were seldom completely abandoned and replaced there by new castle buildings and ultimately very little remains available today; the figure also conveys the seamless transformation between forms of representation; in this case, from tables to maps [Arera-Rütenik 2017].

The Building Research department at the KDWT would like to make better use of digitisation's potential for its own subject and has therefore made *data management in historical building research and practical heritage conservation* a priority topic. This is not about the development of innovative technologies, the clarification of the question of long-term archiving or the creation of more detailed and more in-depth documentation using modern processes – i.e. the production of new data. Data management in building research at the KDWT means instead the selection, application, evaluation and combining of existing technologies and digital workflows against the background of specific issues, methods and strengths of one's own field. The *merging of forms of presentation*

and documentation was worked out as a suitable means for this.

Requirements

The structure of the data is essential for the building recordings, divided into different depths of collection, as well as the multifaceted thematic perspectives of building research to be related to one another while maintaining their own quality standards and for documentation products from different sources be aggregated with one another and, ultimately, for the reuse of information already produced for follow-up projects or completely different user contexts be made possible. Only if it is clear from the outset what information is to be expected at which point in a data record can

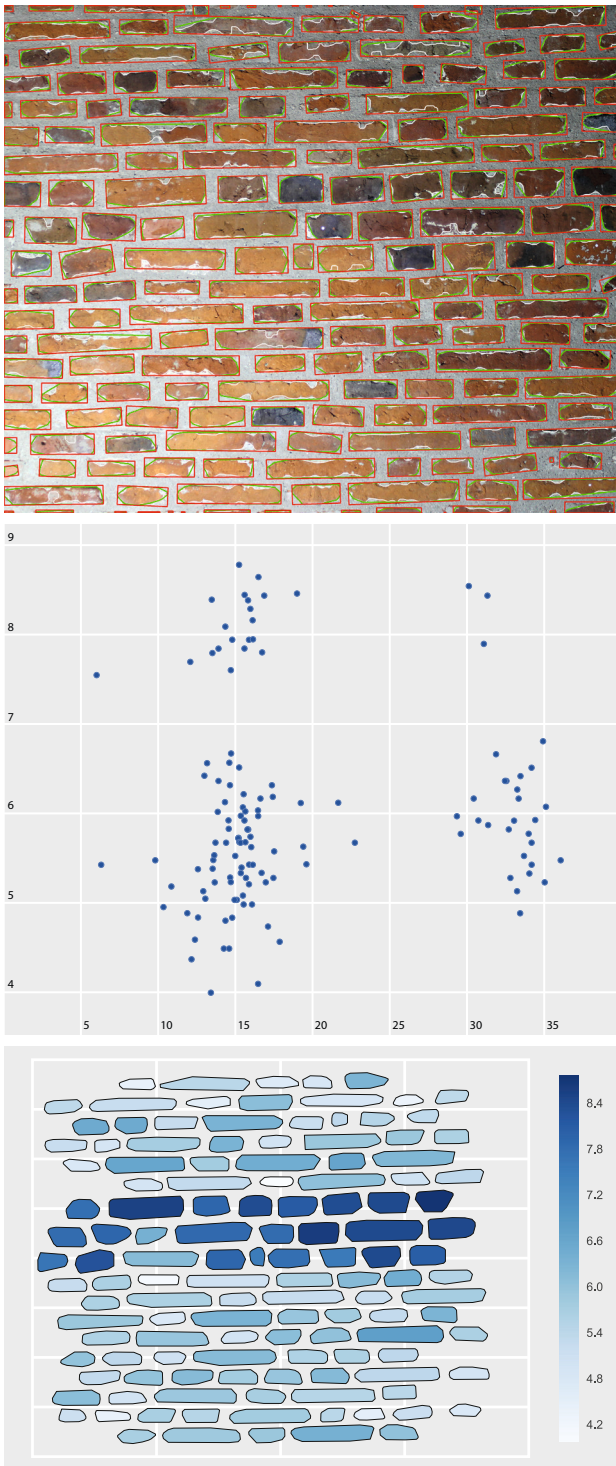


Fig. 3: Digital building research enables new forms of analysis and presentation; here, automated evaluation of the orthophotos of a brick wall to evaluate the formats; above: Separation of the bricks by edge detection (contour, shell, bounding box); centre: Representation of the measured values in the scatter plot clarifies the runner and binder in two formats and allows an exact description of the properties; below: The retransfer of the measured values (here, height) by means of a colour gradient into the automatically created redrawn illustrates the use of two formats [Arera-Rütenik / Eckstein 2017].

the mass exchange of information and the tools produced for this be largely lossless and error-free, even without checking the content of the individual case. Such structures improve the scientific nature of the data itself, for it can be used to show, among other things, the sources of datings, reconstructions or interpretations and thus critically prove or evaluate their quality.

In addition to the structures, agreements on the actual content play an important role for the informative value of information from building research and for its interconnectivity when working with digital methods. The aggregation of the semantic content of descriptive terms, which exist in different languages and in different specialist fields, ensures precise exchange and meaningful analysis without an individual case verification; i.e. it must be known and digitally available that for example a '5/8 conclusion', a 'polígono de cinco lados' or a 'choir extension with five sides of an octagon' denote the same shape.

In order to ensure clear data structures and definitive content, one thing is particularly important: the development and, above all, consistent application of appropriate data standards or norm data as well as controlled vocabularies that are adapted to the needs of historical building research, 'practical heritage conservation' and architectural history research. Existing labelling standards, such as EDM (Europeana Data Model), CIDOC-CRM etc. or existing vocabularies, such as Getty AAT or Iconclass, are tested, evaluated, possibly expanded or completely new solutions created, due to their object-oriented perspective, their ability to map complex spatial structures and their ability to make complex thematic statements. The background to such considerations is always the grown qualities of documentation, analyses and interpretations in building research, which have proven themselves as primary data providers in cultural studies and as a reliable basis for planning in line with heritage conservation in the past, 'analog' decades of the successful specialist field.

User-specific accounts

Analog or 'semi-analog' building documentation usually refers to a compendium of plans of different scales and levels of accuracy, documentation of findings in the form of a room book, evaluation reports, continuous text and thematic mapping,

e.g. building age plans, damage mapping, preservation plans with reference points for dealing with historical structures. Since in paper format this media can only be stored linearly one after the other, an extensive room and results numbering system guarantees cross references between the forms of representation and thus the references of the pieces of information to one another. This approach has several disadvantages. First of all, the data is available with multiple redundancies. For example, a stone pincer hole is entered manually on a result sheet in the room book, as a dating criterion in the result report and in a map as a symbol. This makes data entry inefficient and prone to errors. Secondly, the material, which is often extensive, is quite confusing due to the necessary breakdown into different forms of presentation. It is therefore sometimes no longer fully taken into account in 'practical heritage conservation' or in maintenance planning because time pressure no longer allows for a detailed study. And thirdly, the updating of the room books that was originally envisaged did not prevail during the construction phase since it did not take sufficient account of the way the planners work. There is a risk, owing to the deficits mentioned, that such documentations are no longer tasked and thus ultimately a risk of having to do without the testimony value of historical architecture on a large scale.

This is where the previously mentioned structured data comes into play, which is supplemented by appropriate tools and allows user-specific perspectives on the stock of information. This means that the documentation can now be arranged in multiple dimensions using digital methods. References are interactive and the navigation through the material is therefore determined individually by the user. According to the respective user scenario, the same database can be compiled or visualised on a case-by-case basis, without the need for additional work. The wealth of findings can be organised, for example, in the interactive position plan. If necessary, individual findings can be tracked here during an inspection by monument conservators, architects and craftsman's businesses. In a similar way, it is also possible to use 3D models as an access medium for object-specific stored background information – a type of display that also appeals to the interested public (Fig. 1). De-

pending on the issue, topics can be mapped out in inventory plans or 3D models and even overlaid. Finally, results collections in the form of picture overviews, 'classic' findings sheets or tables can be displayed simultaneously and sorted according to the respective initial question by location, type, dating or relevance.

In addition to the integration of more or less known and proven forms of representation, digital methods, especially for data evaluation, also offer completely new types of visualisation (Fig. 3). A large repertoire is available in computer-aided statistics to illustrate dependencies, accumulations, developments or structures. Compared to the classification and interpretation in cultural studies, the valuable results of building research can be conveyed in a more targeted manner, possibly generating new knowledge at the same time.

The department at the KDWT develops corresponding user scenarios and brings together presentation and documentation forms in reference projects on a case-by-case basis. The individual representations on the *Castle Landscape of the Altmühl Valley* and the *Nuremberg Large Churches* also chronicle this on the following pages.

(Tobias Arera-Rütenik)

ARERA-RÜTENIK, Tobias: *Digitale Technologien in der Bauforschung und in der Praktischen Baudenkmalpflege - Entwicklung, Aufgaben, Perspektiven*, in: *Das Digitale und die Denkmalpflege. Bestandserfassung – Denkmalvermittlung – Datenarchivierung – Rekonstruktion verlorener Objekte*, ed. Birgitt FRANZ and Gerhard VINKEN, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V. 26, Holzminden 2017, pp. 60–67.

ARERA-RÜTENIK, Tobias: *Digital Humanities in der Bauforschung. Systematik und Potential kodierter Bau- und Befundbeschreibungen als Wissensgewinnungs- und Wissensdistributionswerkzeug*, in: *Bauforschung in der Denkmalpflege – Qualitätsstandards und Wissensdistribution*, ed. Stefan BREITLING and Jürgen GIESE, Forschungen des Instituts für Archäologie, Denkmalkunde und Kunstgeschichte 5, Bamberg 2018, pp. 219–242.

Specialist Service Building Archaeology and Historical Monument Preservation

Distribution of knowledge to the specialist community



Fig. 1: Randomly selected book covers give an impression of the variety of existing publications that building research and historical heritage conservation can access [Schalk 2017].

Head:	Prof. Dr.-Ing. Stefan Breitling
Editor:	Dipl.-Ing. (FH) Christian Schalk M.A., Eva Basse M.A.
Partner:	University Library (planned)
Duration:	since 2016
Funding:	KDWT's proprietary funds

In the daily practice of historical building research and that of the practical monument conservator, the focus is usually on the recording, localisation, classification, analysis, testing and evaluation of an object at the beginning of measures concerning the monument and the historical inventory. The basic and intensive 'grasping' of an historical building with its origin, genesis, history of construction and change is an essential prerequisite for any further handling of a building that we have inherited.

It is this way of dealing with historical building

structures that is the subject of various specialist disciplines and a subject that comes in a wide variety of formats. Historical and contemporary elaborations on the preservation of monuments and on building within existing structures have as their aim the desire to be the instruction manual for 'those involved in the construction' and to provide orientation.

The federal structure of the FRG leads to state building regulations and the associated building and monument law at state level. The building regulations, the planning law of the federal government and the local or statute law generally affect historical 'old building' substance and, in the case of individual monuments, is supplemented by the monument law of the respective federal state. Nature conservation, energy supply, pollution control and labour law, to name but a few, complete the range.

The state offices for the preservation of monuments, as institutional organisations for heritage conservation, are naturally part of this federal system and, together with the lower monument protection authorities, significantly shape the handling of individual monuments and monument ensembles.

Technical rules, standards, ordinances and ancillary provisions are usually agreed under private law, unless they are building regulations introduced by the building authorities as technical rules, for example, as contractual terms and conditions or as part of a service owed. The latter affect every historical building substance, where the monumental character of a building usually – merely – requires a more careful, preservation-oriented handling of the building substance and moderation in use.

The field of 'regulations' is manageable; private or contract law and monument-relevant part is much larger and denser. Accordingly, there are a large number of publications on numerous topics and work areas that can hardly be surveyed. In addition to the monument protection authorities and experts, case law often decides on their validity and applicability for the individual monument.

Thus practical historical heritage conservation may essentially be in the convenient position of being

able to draw on a wealth of knowledge when planning and implementing construction tasks; but, in practice, the knowledge of the historical building structure is not immediately available, cannot be retrieved, is out of date, out of stock or simply unknown. But above all, it is not referenced. Providers of major for-payment services offer different, often good solutions, but the commercial platforms are naturally not automatically interested in free or grey literature and content published outside of academia.

The 'digital collection' and 'specialist service for building research and historical heritage conservation' were developed out of this conflict situation.

Project 'Specialist Service' and subject areas

The KDWT has set up a digital, searchable collection from its own resources, which is made accessible and continuously updated by means of a specialist service. The contents of the collection include building research, the history of construction, practical heritage conservation, institutionalised monument protection, building and planning law, standards and engineering research on existing buildings as well as craft instructions and procedures in heritage conservation and construction in the building stock.

Goals and target group

The aim of the specialist service is to open up and make accessible across disciplines and competencies a collection of documents in order to be able to offer an effective, digital tool for daily work in research, teaching, administration and practice.

The target groups are building researchers, building historians, lecturers, practical monument conservators, monument protection authorities, the state offices for heritage conservation as well as all those who are professionally involved in the existing building stock, such as specialist lawyers, the engineering sciences working in the existing building stock, practitioners, the skilled trades, project engineers, specialist companies, citizens, specialised organisations and specialised associations.

Contents of the collection, selection and implementation

The collection includes, inter alia, specialist literature, publications by state offices, specialist authorities, research institutions, building regulations authorities, restorers, preservation societies, citizens, associations, technical building regulations introduced by the building authorities and relevant normative stipulations.

For a development overview to be created, not only current and applicable, but also past and lost publications are collected. Processes and procedures will receive greater attention. The result is a comprehensive, purely digital 'pool of knowledge' of documents published in book form, as a handout and as grey literature.

All documents available in digital form, as PDFs, are indexed, labelled according to a uniform system and archived on a central storage medium.

Using the literature management programme 'Citavi', the literature is compiled in a bibliography and assigned to the digital document. The content is indexed using logical terms and, through their assignment to the developed categories and groupings, is located and linked/networked with one another.

In this way, the documents can be selected based on the publishers and stakeholders involved but also based on the subject areas, and the content can be scanned according to specific search terms, building parts, measures, regulations and processes. Even connections in terms of the content between the documents can be recognised in this way.

In simple terms, editing the documents and content makes it possible to 'google' the collected specialist publications. The Specialist Service thus opens up the content for specific applications and questions from theory and practice.

For example, the terms thankfully given to us by the Bavarian State Office for the Preservation of Historical Monuments from consulting practitioners were incorporated as a search and outline vocabulary and compiled in a bibliography. In the future, they will be stored as standard searches and will be available with individual documents and literature references.

In addition, thematic and content-related standard queries were created, e.g. on typical damage patterns or building research methods, and literature lists created from them.

The large number of topics makes it necessary to limit the content of the collection with an editorial focus.

The selection is not made subjectively restrictive or judgemental. The relevance of a publication for the Specialist Service is also measured based on the degree to which it has contributed and participated in the specialist discourse. The criteria that counts include scientific and technical quality, acceptance in specialist circles, degree

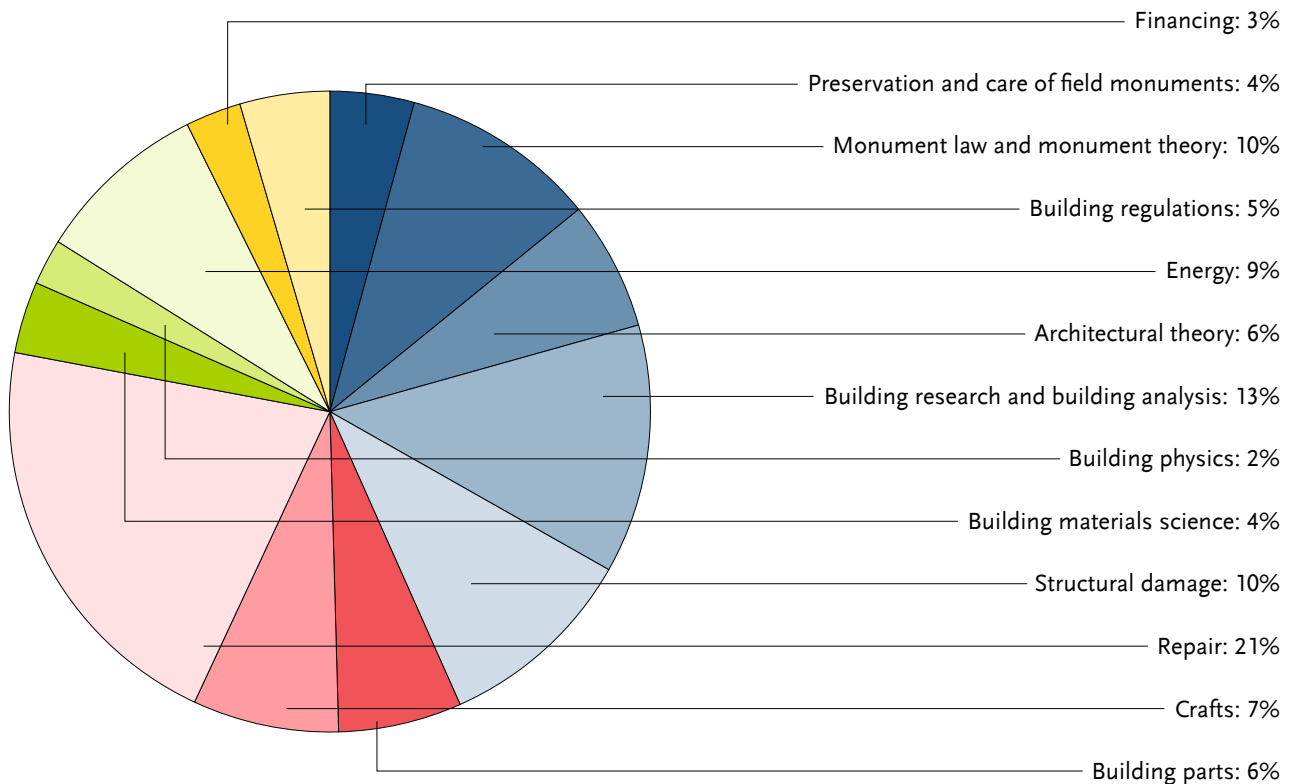


Fig. 3: The presentation of the subject areas previously represented in the collection also illustrates the technical differentiation in building research and heritage conservation [Arera-Rütenik / Basse 2018].

of distribution and the reputation of the publisher or author.

However, it is important to differentiate between what specialist circles consider necessary, technically correct and generally binding – which in turn succeeds better in an overview.

Interdisciplinary approach and application

When working with the content of the collection, well-known procedures come to the fore and new processing categories or fields of investigation become apparent. Links, divisions and collectives can be better recognised, and connections, content and dependencies in the collection areas can be found.

It is possible to show what topics were dealt with more frequently, in some instances without gaining new knowledge, and where the focus of the work lies. It is also possible to show what fields have not been worked on or not worked on in depth. This should be illustrated using a few examples.

Weaknesses come to light, such as interaction – which can be further developed, in comparison to engineering sciences – of the historical building research with the coverage, the general conditions, the outdoor sites and the urban context of an historical building.

Terms, vocabularies and their levels of meaning, such as building typology, building type, use and construction, are used by building historians, art history and construction lawyers alike, albeit with a different 'legal definition'. In material science, 'timber construction' has a different meaning to that in the planning sciences, where it refers to profitability, for instance. In terms of building regulations, 'construction type' means something quite different than the value determination of built-up land. And 'construction method' in art history is wholly distinct from the meaning in preventive fire protection.

Organisational systems of various kinds are proposed for many areas of the historical stock, for example, for building constructions. The change in methodology, tendencies and trends within different specialist disciplines can be compared thematically, in terms of time and content. Links become clear, for example, from building law to relevant standardisation, to foundation engineering and to soil mechanics as well as to essential aspects of the history of construction technology.

Insights from the collection can also be gained for planning and concrete implementation, as is illustrated by examples. The maintenance of the historical building substance and measures in heritage

conservation, which should ultimately take place on the construction site, are always directly related to regulations, rules and recommendations. Historical building regulations – also part of the collection – are of interest because they were often in the form of fire protection regulations when a building was constructed. If they have been observed, inventory protection can be given to such building parts and constructions. This can be derived from precisely such historical laws, ordinances or normative stipulations that are no longer valid today. Then as now, there were 'trade regulations' and 'private law agreements', also early forms of 'standardisation' and the drive to standardise techniques and processes.

It is these construction and planning processes, the processes in the trades and on the construction site that are examined and discussed in the broad field of process analysis and process control. They can be compared for information purposes.

(New) questions

If one deals with the content at the level of the individual documents, it is striking that, for example, relevant topics on heritage conservation and practical building preservation were dealt with a few decades ago but have so far not been updated. The reasons for this may be varied; perhaps some methods are already so sophisticated that they cannot be improved upon to this day.

On the other hand, the question of 'research gap', 'neglect' or 'standard/state of the art' arises. Here, the collection serves as a practical basis for work and research. From the point of view of the authors, the question of the validity of recommendations that have been withdrawn, or 'wrong' recommendations, does not arise or, if it does, only to a limited extent.

In addition, 'historical' contributions document the level of knowledge and the handling of our architectural heritage – perhaps also the thinking of those involved – in an era of heritage conservation.

Restrictions and availability

The collection and the Specialist Service are also designed to be an open participation system that benefits from the involvement and support of specialist groups. However, due to the complex copyright that must be protected in any case, the collection will initially only be available to project partners, research and teaching. For this reason, the Specialist Service can currently only be reached

via secure computers from the university and via the university's intranet, currently using the 'Citavi' program in conjunction with the 'Citavi Cloud'. The question as to whether, when and how 'public' access beyond commercial use can be made possible is the subject of intense debate.

Basically, the collection of literature, perhaps expanded to include the term 'grey/digital literature', remains a priority for the libraries. The University of Bamberg's library is to be acquired as a project partner in the medium term, and contacts and coordination processes have already been established. In the library, there are excellent structures and expertise, especially in regard to legal issues that need to be used.

Outlook, relevance and transfer

The collection and the Specialist Service must be constantly maintained, further developed and technically improved. The KDWT is now established as a central scientific research facility at the University of Bamberg and is therefore a secure project management organisation. In the long term, it will be important to consider whether a kind of 'mixed system' can be set up for online research, whereby public domain works can either be downloaded directly or a download link refers to the specific provider. It would also be conceivable to offer specialist research as a service or the system of a semi-public library with the assignment of user rights to specially equipped secure workstations at the university as a digital reading room.

In light of the different views and interests in the preservation of monuments, it currently remains to be seen whether those involved in the field actually view as relevant the question: "Is standardisation/harmonisation in the preservation of monuments necessary?" In regard to the debate centred around this range of issues, the collection and the Specialist Service do their bit as a platform and summary work dealing with the question of who published/contributed to what and when; and in which topic areas.

The tried and tested, guaranteed methods in monument practice enable valuable conclusions to be drawn about the handling of existing buildings, regardless of whether they are individual monuments or historical buildings.

The procedures and processes of heritage conservation can be transferred, in an adapted form, to the broad field of building in existing structures. The transfer of knowledge should be made explicitly possible. (*Christian Schalk, Eva Basse*)

Digital Capture of the Altmühl Valley Castle Landscape

Distribution of knowledge to the public



Fig. 1: View of Kipfenberg Castle in the 19th century [Domenico Quaglio the Younger, approx. 1815-18].

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Editor:	Dr.-Ing. Tobias Arera-Rütenik, Manuel Hunziker M.Sc., M.A.
Partner:	European Castles Institute
Duration:	since 2016
Funding:	Bayerische Sparkassenstiftung

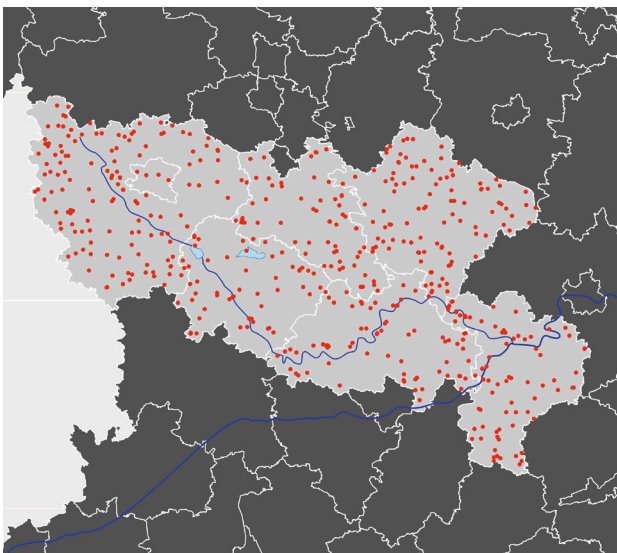


Fig. 2: Mapping of the seats of the nobility in six counties of the Altmühl Valley [Arera-Rütenik 2016].

Castles in particular serve romantic notions of medieval life, and that is mainly why they enjoy increased public attention (Fig. 1). However, historical seats of the nobility also represent an excellent starting point for scholarly research in the search for new knowledge. From the perspective of history, the political, economic and social organisation crystallises in them. They chronicle the expansion of the state and power, the culture of rule and economic development. This type of monument offers building research and building history a diverse subject for the research of typological and constructional developments; for the establishment of chronological series; and last but not least for clarifying the changing interplay between economic and military purpose, as well as political and cultural representation.

The Building Research and Building History department at the KDWT has therefore set itself the goal of recording and researching the medieval and early modern seats of the nobility, of which there are approximately 4,500, in the Free State of Bavaria. The first reason for this undertaking is a project sponsored by the Bavarian Sparkassenstiftung in cooperation with the European Castles Institute (German Castles Association), in which a tourist app for the castles and palaces of the Altmühl Valley is to be created. Six selected counties have around 520 castles, castle ruins, abandoned castle squares and seats of the nobility that have been converted into modern palaces (Fig. 2).

Project structure and objectives

Since Otto Piper published his castle study at the end of the 19th century, numerous research reports, building documentation and sometimes widely distributed publications on individual castles, partial aspects or on entire assemblies have appeared. Together with the enormous amount of archival material, images, photo documents, map series and plan drawings, there is already a wealth of information on historical seats of the nobility in Bavaria and in the Altmühl Valley, which comes from very different specialist disciplines such as

History, Architectural History and Art History as well as Archaeology, or else was drawn up in the course of preservation measures.

Building research is an interface subject that is based both on the specific subject matter and on its historico-cultural classification. The expertise and main task of the building researchers at the KDWT is to research relevant sources of the participating subject groups; to evaluate them with regard to their informational content; to structure them meaningfully and to store them according to the object; and finally to make them accessible in the respective user context (see Fig. 3 top register). For this purpose, the project group has created a digital platform that serves as a material evidence-based documentation tool, can offer user-specific, interactive access in real time to a wide audience and, in terms of sustainability, uses common data formats for later use (lower register). Basically, the data material is divided into three main blocks (middle register): The building structure or ensemble is broken down into sub-objects within a hierarchical tree, the structure of which reflects the actual conditions. The advantage of this approach is that the structure network can be updated and differentiated at any time, depending on the state of research and application (right). The second block is data on historical and building events, which are categorised and given their sources (centre). The third block contains historical players, such as noble families and artisans (left). What is essential for the informative value of the material is, above all, the possibility of being able to build a network of links between objects and sub-objects, historical events or dates, and the people. I would also like to mention here that a 'real database' with regard to portability and connectivity has been dispensed with.

In this way, countless statistically verifiable, digitally evaluable interpretation options are created that can be made accessible in interactive applications. As a result, building researchers can refine dates of construction types, construction forms and construction methods; historians can analyse the expansion of domains of power; and tourists are offered explanatory models for difficult to recognise building structures including their age.

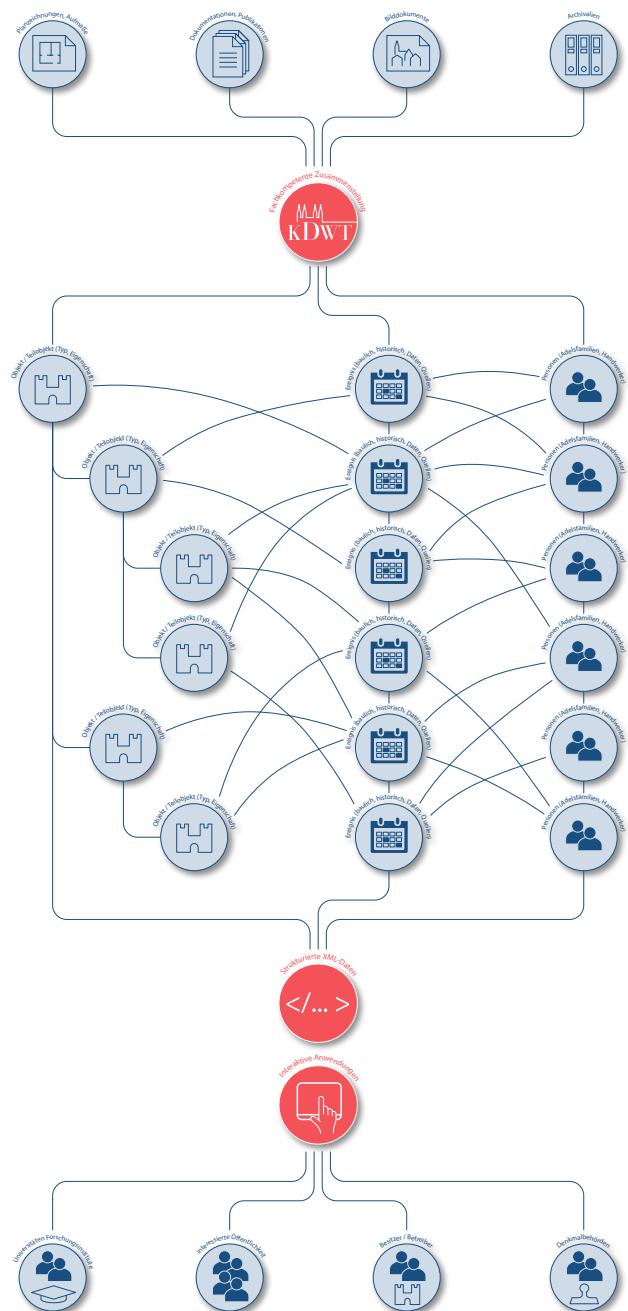


Fig. 3: Schematic diagram of the project process and the data structure: The heterogeneous source material is made up of countless existing sources that are selected and evaluated by the staff at the KDWT (upper tab). The staff enters the data into an object-specific structure with itemised and closely linked partial information (middle tab). The data is available in internationally distributed metadata formats as highly structured and schema-validated XML files and can be mapped or made available by interactive applications, depending on the purpose, in a way that is specific to the respective user group (lower tab). The structures and data formats used ensure connectivity and sustainability [Tobias Arera-Rütenik 2017].



Fig. 4: Interactive map dynamically generated from the database with display of selected noble families resident in the castles; such representations provide historians with a proven basis for research into the expansion of dominions and give tourists a vivid insight into the territorial and political contexts of bygone days [Arera-Rütenik / Hunziker 2017].

Cyclists, historians ... explorers

Finally, the potential user groups mentioned are also reflected on a small scale within the specific application project. By way of a proposal for a tourist app for the castles and palaces in the Altmühl Valley, various interactive representations were drawn up, which represent different possible users (tourists' interests) and are also intended more broadly to illustrate in an exemplary manner the potential of the highly structured database.

The tourist app offers access to the information through three main display modes or perspectives. These include: 1. an *overview* of the objects, either as a list or image tile view with search functionality, 2. an *interactive map* for various topics and 3. a *detailed view* for the individual object with short texts, timeline displays and interactive building plans (including navigation function). Furthermore, these individual presentations provide information about possible nearby destinations. In particular, the map and the individual view can be played with different contents, depending on which user scenario it is, as will be explained in more detail below.

The *bicycle tourist and water tourist* wants to explore the Altmühl Valley actively and visits

castles or palaces primarily as a welcome change or stopover on their route – initially, there is ostensibly no particular interest in the group of monuments. As an introduction, this user group is shown on the map how 'worthwhile visiting' a castle or palace is from the point of view of this tourist. Two pieces of information from the database are essential for this. The state of preservation is represented by a symbol (largely preserved, significant remains, very little remains and no remains) and the accessibility by the colouring (freely accessible, accessible at opening hours, restricted accessibility and not accessible). By clicking on the symbol, an overview photo of the respective site appears, which finally invites the tourist to visit the monument. A list of nearby castles (with the distance indicated) is intended to encourage visitors to go to see other objects.

For those *interested in the nobility*, the objects are represented on the map instead by the coats of arms of the resident noble families, since they are also stored in the respective digital castle edition (Fig. 4). This way, those interested in nobility can follow certain families on their routes through the Altmühl Valley and survey dominions.

The fact that the seats of the nobility were, of course, owned by various families throughout their centuries-old history, is a fact that the *tourist well-versed in history* is almost certainly aware of. For this user group, the nobility map previously described is additionally equipped with a slider that can represent the vested rights or the area of a particular dominion at a specific point in time, since this information is also available by linking events and people in the database. Clicking on a symbol takes this user to the detailed view, which not only offers an informative continuous text on the history of the owner but also shows all the events associated with the castle in a timeline.

Those *interested in building history* focus less on historical events than on visiting the actual cultural material evidence. This tourist can see castle or types of building part as a symbol in the overview map and their age as a colour. Very different query scenarios are possible here, because the hierarchical breakdown of the overall object into sub-objects enables statements to be made about the castle as a whole as well as about specific building parts – both are linked to the events in the database, that is to say they are dated. The individual presentation delves into the building history with a corresponding informative text. Architectural and historical events are highlighted in colour and juxtaposed in the timeline. Finally, an interactive building age plan with navigation function directly on the object explains the chronological history of the creation of a structure and answers the popular question: "How old is that structure there?" (Fig. 5). Finally, the interactive floor plan also serves the *explorer* as a suitable mediation medium. Using the given geo coordinates, they can find a remote, forgotten castle site in the forest, and the findings that are difficult to interpret – the moats and ramparts, the ruins of buildings and walls – can be explained by the interactive floor plan, since not only the age as well as the name and the function of the individual buildings/building parts can be read from the database and imported into the plan. Finally, since the digital descriptions are also linked to a controlled vocabulary, further explanations and definitions of terms can be stored, so that the explorer can find out what a chemise



Fig. 5: Interactive geo-coded building plans are shown via aerial photos and facilitate navigation in the terrain, show the age of building parts and offer further explanations of their original purpose and typology; the navigation between the drop-down menu and the interactive map can be performed alternately at any time [Arera-Rütenik / Hunziker 2017].

is, how a donkey path could serve water supply and that a keep is a defence tower that is usually uninhabited.

Through the scenarios presented, the project aims to highlight the variety of technical aspects of the group of monuments by offering scientifically sound information and by combining methods of presentation, to encourage their exploration and thus ultimately to convey their value to a wide audience on the basis of the respective interests. The project's effectiveness is not, however, reserved exclusively to the targeted user and monument group. The approach is intended to be seen as a transferable attempt to elaborate methods of networking databases of different disciplines more broadly and to offer them according to the respective question. (Tobias Arera-Rütenik)

The Nuremberg Large Churches

Networking and participation on the monument construction site



Fig. 1: St. Lorenz, Nuremberg; northern choir ambulatory of the hall choir, built 1439–77, with Sacrament House from 1493–96 [Arera-Rütenik 2008].

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Partner:	IFIS of the University of Pas- sau, Medieval Art History of the University of Bamberg
Duration:	01/02/2018–31/01/2021
Funding:	Federal Ministry of Education and Research

Nuremberg has undergone tremendous economic growth and cultural advancement since the 13th century, which important edifices still bear witness to today. The large churches of St. Sebald and St. Lorenz in particular reflect the improvement in the self-image of medieval citizens. The churches, which are closely associated with the city dwellers, chronicle the change from the episcopal to civil construction in the conflict area between developing technical and artistic skills. These monumental edifices can be viewed as complex 'collections'

of a large number of individual objects, such as portals, columns, arch profiles, sculptures and high-quality ornamentation, which transport a broad spectrum of information with regard to social, art and architectural history as well as constructional, material and conservation information. And beyond that they stand in relation to one another within a differentiated spatial structure and form a meaningful space.

Using the parish church of St. Lorenz as a reference object, a digitisation initiative was applied for and approved as an interdisciplinary cooperation project between art historians, building researchers, restoration scholars, architects, monument authorities and operators in cooperation with computer scientists, which puts the information content of the object itself in the foreground and takes account of the spatial dimension of built architecture. The aim of the project is the generation of user-specific subject-related data records, their mutual referencing and their provision in linked-open-data-capable form (LOD).

The requester can use the MonArch monumental archiving system as a platform. With the aid of this system, digital copies of archival material can be stored within a virtual building structure, which can be hierarchically (partonomy) or graphically structured. To achieve the aforementioned goal, MonArch is now meant 1. to obtain an LOD connection and 2. to have a document-centred perspective with an object-centred perspective added. The representation of the complex building structure by means of partonomy or graph, in particular, facilitates the three-dimensional itemisation of sub-areas right through to the individual engineered stone and thus guarantees the building part-specific referencing of relevant data. If the technical information is related to individual building parts, the object constitutes the intersection or the facilitator between the disciplines involved. The arbitrarily differentiable network of sub-objects within the representation of the building structure (partonomy) thus enables subject-specific depth of field and the possibility of differentiating questions in data queries by means of a variable level of detail.

In order to add a visual spatial component to the virtual building structure, a set of realistic plan drawings and 3D models, which are essential for building history research and heritage conservation, are merged. The resulting graphical material is prepared in such a way that it is available in an open, platform- and program-independent vector format or object format, can be linked to the paratomy and can also be stored with a 'semantic layer'.

This 'semantic layer' consists above all in the digital documentation of art, building research and conservation findings, their location within the paratomy and their connection with the corresponding drawing elements in the interactive plan material. With this, the importance of the object as a source is to be taken into account. In order to categorise it in the context of architectural history and art history and – in addition to documents that have already been extensively digitised in preliminary projects – the inclusion of other archival materials in collaboration with graphical collections and museums will also be continued. This information is also stored in a building part-specific manner and is referenced with both representations and in relation to the findings of the object.

The project result finally consists in the provision of LOD-compatible data with building part-specific references to findings descriptions as well as digitised sources, which are linked to controlled vocabularies and, in addition, are given a spatial dimension by referencing digital plan sets, which are also available in open vector or 3D formats.

Networking through collaboration and participation by distribution of results

The networking of data across disciplines also fosters close collaboration between those involved, whether it be involvement in historico-cultural interpretation and classification or in implementation-oriented planning. Art historians already have an idea of the state of the respective object when archiving it, which the building researchers have documented within the platform using their findings report. Conversely, archival information enables the latter to attribute absolute datings to relatively chronologically determined building

sequences. The architects and restorers commissioned with planning and conservation benefit from the documentation of the construction geometry as well as the assessment of the testimony of individual objects through the building research findings report, which can be incorporated into the careful planning and appropriate execution of construction and maintenance measures.

However, added value is not created merely by the seamless, fine-grained exchange of results. Working on a common platform and with a common data set also enables the issues of the respective other department to be addressed and further developed in the process. For example, plans uncovered by the art historians in the archive of an old excavation of the earlier site of a choir separation existing today not only allow better-secured reconstructions of earlier conditions but also promote the consideration of surviving findings in the rising masonry as well as the well-founded interpretation of alleged 'damage spots' in the connection area and thus the planning and implementation of adequate measures. Conversely, the construction process documented by the findings may help to understand better and safely locate altar consecrations documented by archival records. Finally, the building part-specific, 'layered' aggregation of a large number of test procedures, expert reports, investigation reports and the documentation of measures taken enables the maintenance of an overview and thus efficient and long-term monument monitoring and monument management. The involved trades can be individually activated for the relevant information. Structural changes can be tracked in real time, as it were. Last but not least, the networked data stocks convey the complex monument concerns to the interested public, be they community members, Nuremberg citizens or tourists who visit the church, since the data is publicly accessible, subject to legal requirements, in program- and platform-independent, LOD-capable format.

Consequently, the aim of the project is to link the building as an object in different professional and user-oriented contexts with the digital world, thereby making it possible to experience it together and ultimately highlighting the richness of tradition.

(Tobias Arera-Rütenik)

Key Findings

Digital collection of primary sources of building archaeology



Fig. 01: Collegiate Church Walbeck, state of discovery of an Ottonian window in the southern choir wall [Breitling 2001].

Head:	Prof. Dr.-Ing Stefan Breitling, Dr.-Ing. Tobias Arera-Rütenik
Editor:	all staff of the department and specialist field
Duration:	since 2017
Funding:	KDWT's proprietary funds

Findings on the building as the primary source of knowledge and for planning the practical handling of the monument are not only essential for building archaeology. For all monument sciences as object-oriented disciplines, the material evidence itself serves as the very first basis for any professional debate.

Numerous methodological works have appeared in building archaeology since the 1980s, which represent 'grammars' of science. However, cross-building or cross-part overviews of findings, thematically, topographically or chronologically sorted, are totally missing. Thus there is a dearth of 'vocabulary' or 'dictionaries' on the subject.

Of course, countless findings are collected in the context of individual documentation, presented on forms and compiled in systematically structured catalogues, which end up stored in the archives of the state monument offices. The theses in the Heritage Conservation study programme at the University of Bamberg, of which there are more than 1,000, have in many cases compiled extensive room books with building findings, since the proper approach to findings is one of the quality features of the training in this area at Bamberg.

However, due to the limited space in publications or due to the total absence of publications in the field of building archaeology, only a fraction of this valuable knowledge finds its way into the specialist community, never mind the public. Since building findings cannot be extensively researched and cross-references can seldom be established, knowledge about building techniques, datings and overarching construction comparisons ultimately remains – for the relevance of a phenomenon or the associated preservation strategies – reserved as 'personal' knowledge just to one experienced building archaeologist in a specific region. That is why the team in the Building Archaeology department at the KDWT, together with its partners in preservation science, is committed to the systematic compilation of such findings. Building archaeology concerns itself, in particular with findings from construction history, the Middle Ages and the early modern period. Another focus concerns the subject of constructional conservation and repair (see also the individual presentation of the topic of the same name).

Application of digital technologies

The use of EDP technologies, in particular the use of modern database systems, facilitates totally new possibilities for documenting findings or

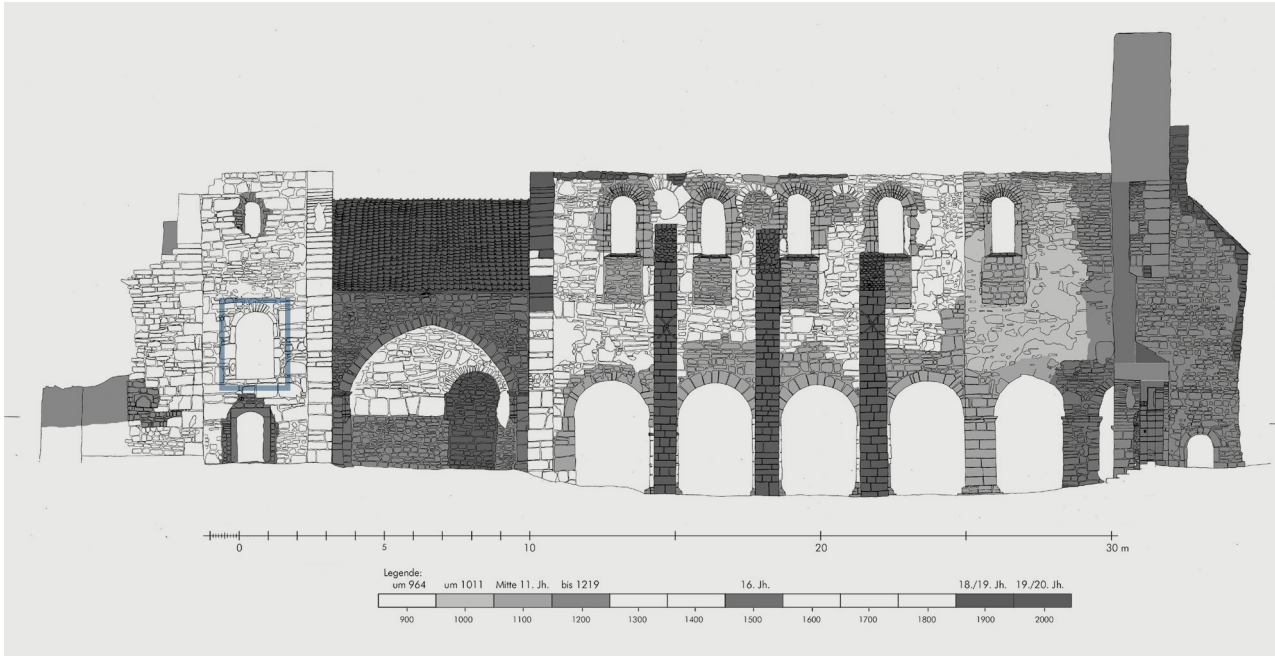


Fig. 3: Collegiate Church Walbeck, building age plan in longitudinal section to the south; the finding is dated by its position in the stratigraphic structure; the Ottonian window therefore belongs to construction phase I, which can be dated to around 964 due to a traditional consecration date [Breitling / Cramer 2001]

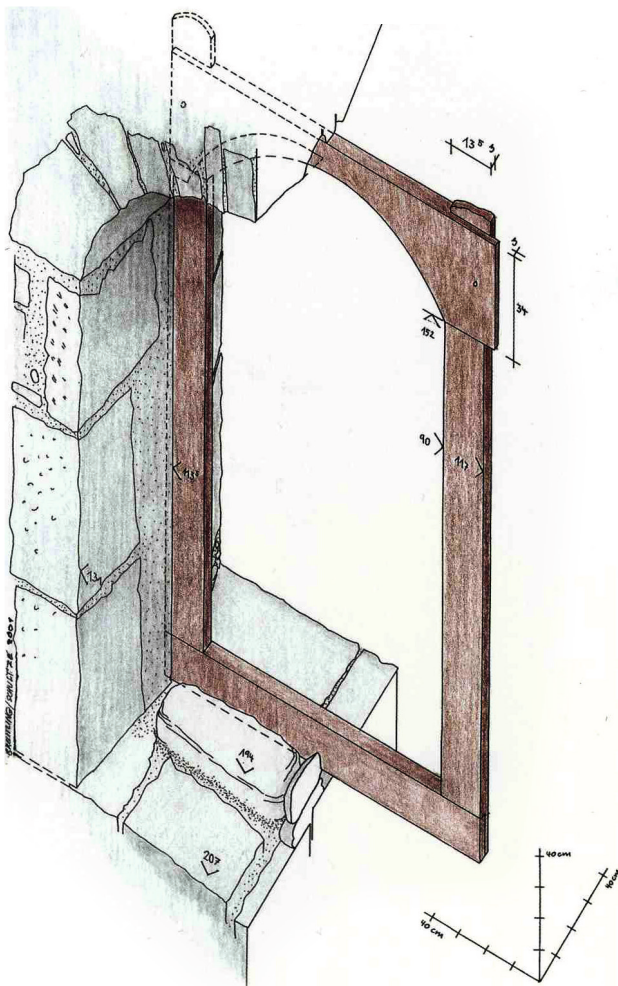


Fig. 4: Collegiate Church Walbeck; axonometric reconstruction of the Ottonian window based on the findings in Fig. 2 [Breitling 2001].

simply, it describes two points in time, before and after which a certain finding can be located, without it being possible to specify an exact date. Absolute dating, on the other hand, is mostly based on written sources, such as written records in archival documents or building inscriptions or historical illustrations; or on comparisons to another building that has similar features, has better dating and can therefore be used as an analogy. Analogy conclusions can be drawn based on formal or structural similarities.

There are highly complex relationships that can hardly be overlooked by the human mind even in a large individual building, since relative chronologies are not one-dimensional but often form chains of dependencies that are also located on a three-dimensional object. Analogy conclusions with a reference building (or reference buildings) can in turn encounter relative chronological sequences, and finally a particular finding sometimes cannot be dated by itself but, instead, is dated by an adjacent phenomenon within the same temporal entity (and here again by comparison with a reference building with a similar problematic). Quite apart from this, historical sources do not provide a fixed date out of the box but are likewise the result of long research work in the historical sciences. It is therefore hardly surprising



Fig. 5: Collegiate Church Walbeck, reconstruction model of its state around 964 (white: preserved original substance); the key finding also serves to reconstruct lost windows on the building [Breitling / Cramer 2001].

that, for the sake of simplicity, certain schools of thought regarding the chronological classification of certain characteristics have become established and are passed on in the specialist literature, although their date of origin is hardly possible to determine or is hardly ever actively reflected on and critically questioned.

This is exactly where digital technologies create their essential added value in terms of their scientific significance. With their help, the complex network of dating conditions can be searched and the safest documented chronological classification – the ‘key finding’ – can be filtered out. There is, so to speak, a semi-automatic evaluation of findings. In a way, this procedure approximates the absolute chronology. In addition, however, findings that are dated relatively chronologically and have similar characteristics in different buildings can be interpreted as instances of a ‘key findings group’. Even when an absolute date is totally missing here, the temporal range of an individual finding, which is sometimes quite extensive, can be restricted more and more by overlaying the dating conditions, the greater the number of individual instances that have joined.

In order to be able actually to implement such extremely effective dating methods for building archaeology, cooperation with IT and statistical

mathematical sciences will be required in the future.

Referencing

Finally, there is one point that concerns the scientific nature of working with building findings. As the primary source of any technical reasoning, the key finding must of course be able to be referenced or cited. The technologies of the Semantic Web enable the assignment of unique identifiers or permalinks that guarantee the addressing of a key finding long term. Once the technical possibilities have been exhausted, reliable evidence can be given in future in plans, evaluation reports and interpretations of findings by clearly referring to key findings.

Within the network of relationships in the collection of findings, the referencing of authorships and sources also plays an important role, especially for dating. Only when known who proposes which date based on which methodology can the certainty of a chronological classification be reliably proven and assessed.

By expanding the technical expertise at the KDWT, a knowledge network is established with the setting up of a digital collection of key findings that is devoted to a core topic of building archaeology, research results are made available and thus the scientific-methodological quality of architectural history research is improved significantly.

(Tobias Arera-Rütenik)

Infrared Thermography in Technical Building Analysis

Close coupling of historical and technical building research



Fig. 1: VarioCAM [Luib 2018].

Head:	Prof. Dr.-Ing. Stefan Breitling
Editor:	Anna Luib M.A.
Duration:	since 2017
Funding:	KDWT's proprietary funds

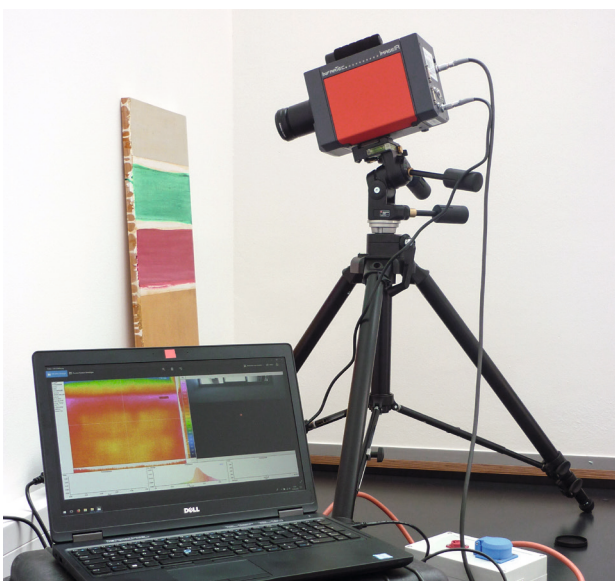


Fig. 2: ImageIR [Luib 2018].

Infrared thermal cameras document the surface temperatures of objects without contact by displaying the intensity of the object-specific electromagnetic radiation in the infrared range. This radiation, which is no longer in the visible spectral range for the human eye, is converted as a thermogram into visible false colour representations, from which the measured temperature differences can be read. Accordingly, what are known as thermograms can under certain circumstances represent object properties that remain hidden in the range of visible light and therefore to the human eye.

Infrared thermography as a non-destructive examination method (NDT)

Infrared is used without contact. No contact with the measurement object is necessary. This enables measurements on very sensitive objects as well as on difficult to reach or inaccessible objects. Recordings are – similar to photography – also possible over long distances, depending on the resolution of the thermograms. Above all, the measurements remain completely non-destructive; there is no need to take samples, and there is no interaction between the measurement object and the measurement device. Changes in material or surface due to the measurement processes can be ruled out.

Infrared thermography is an imaging NDT process that can output the measured data directly and as area temperature information in various display options. These visualisations can be reproduced at any time and be evaluated on site during the measurement process. The speed of the measurement process is also important. Thermography cameras work within very short measuring and response times; thermograms can be evaluated immediately, similar to digital photography, and sequence recordings can be viewed in real time.

This NDT process is mainly used in material testing, industrial production and energy technology. In the building sector, infrared thermography is predominantly used to clarify structural-physical issues. The localisation and evaluation of heat losses via façades and roofs, construction-specific

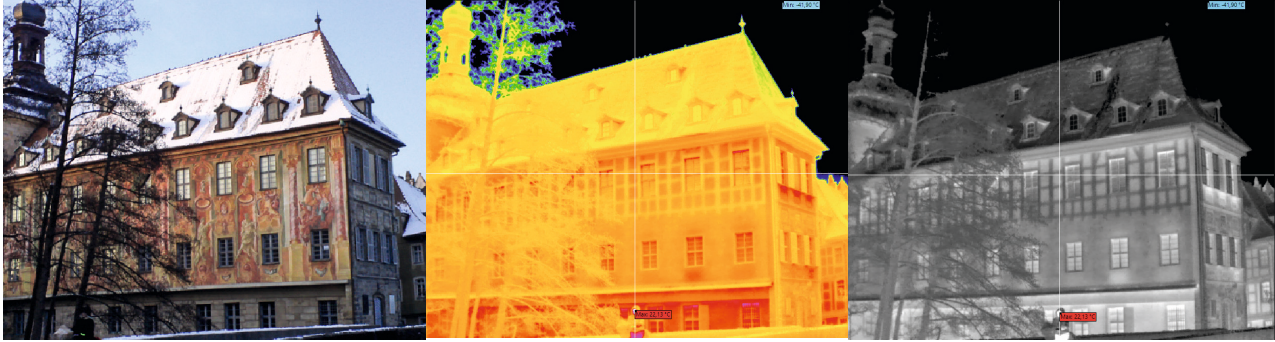


Fig. 3: Thermogram of a façade with a coloured frame; half-timbered structure clearly visible on the upper floor [Luib 2018].

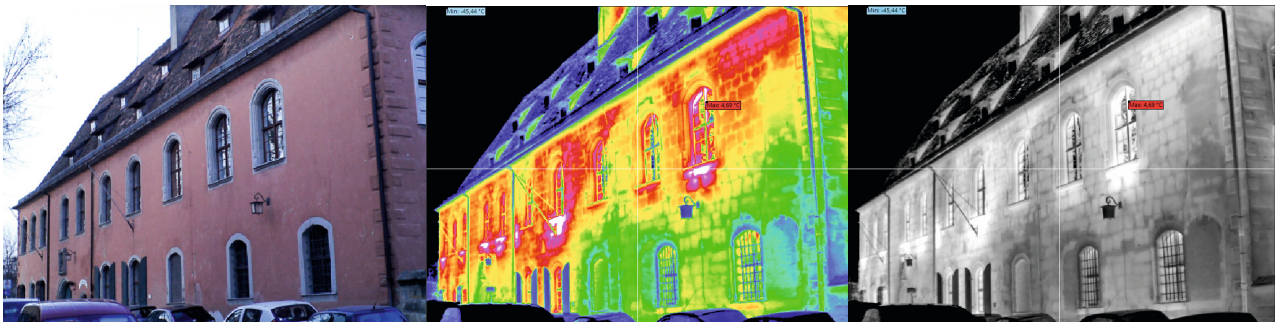


Fig. 4: Thermogram of a plastered outer wall; masonry structure, added openings and construction joints become visible without interfering with the substance underneath the plaster [Luib 2018].

thermal bridges and the condition and performance of the thermal insulation are often the focus of such studies.

Furthermore, the IRT is well suited for visualising the moisture distribution in building parts and for localising potential mould and moisture damage. The IRT has proven itself as a non-destructive test method, particularly in damage documentation and the preparation of energy-related renovation measures.

Applications in building research

So far, the IRT has been used to examine historical buildings to a much lesser extent than in building physics. The principle of the visualisation of electromagnetic radiation in the infrared range is, in addition to the basic readability of the surface heat

conditions, quite suitable for the investigation of other material parameters. Depending on the specific surface temperature, statements can be made about thermal conductivity, heat storage capacity, material properties and the structure of building parts. Thermograms offer the opportunity to draw conclusions about the arrangement of individual parts and their connections as well as entire constructions, since the thermal behaviour at transitions between materials and building parts often varies compared to the interior of the part.

As soon as there is a temperature difference between the front and back of the building part or the connection, the behaviour of the heat flows can be read on the building part surfaces using a thermal camera. Typically, these environmental conditions

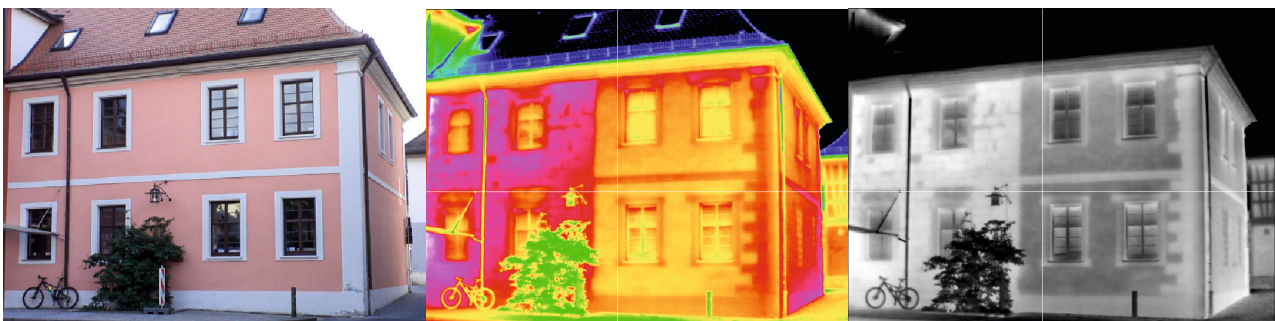


Fig. 5: Thermogram of a plastered extension; construction joints and material changes show clearly different heat behaviour [Luib 2018].

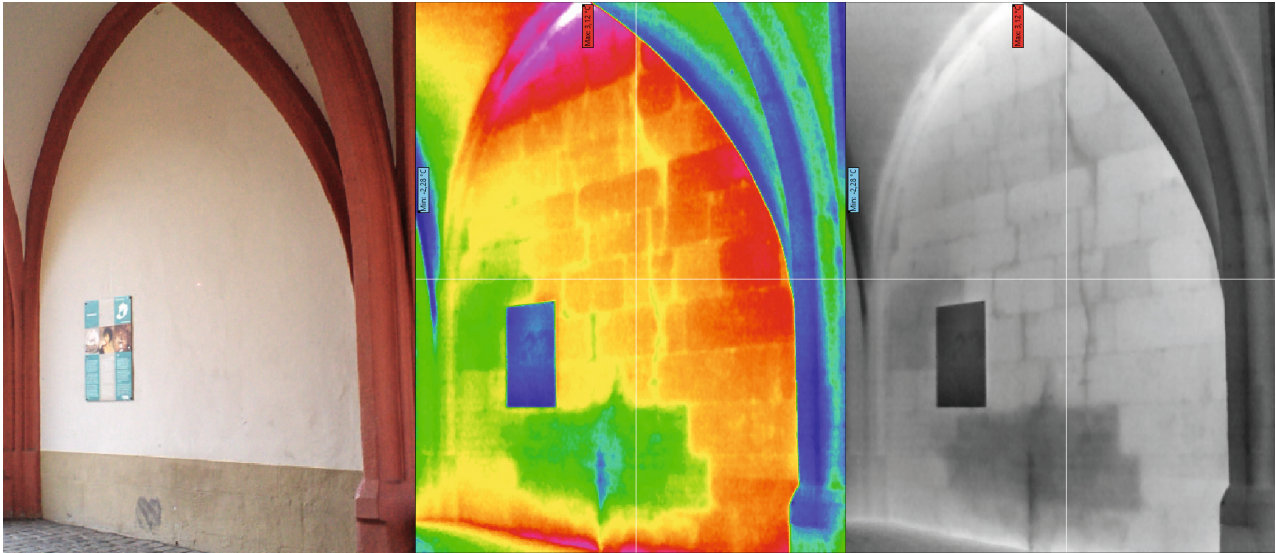


Fig. 6: Thermogram of a frontal wall with adjoining vault; crack patterns and natural stone varieties are clearly recognisable [Luib 2018].

arise in winter when there are low temperatures outside and comparatively warm, heated interiors or even with intense solar radiation of façades that varies during the day. If there are no internal temperature differences of the building part, for example with a uniform temperature distribution in the interior, a temperature gradient can be generated by thermally stimulating the objects to be examined on one side.

With the aid of this individually controllable stimulation option, infrared thermography can be used for a variety of construction research issues. The IRT can contribute to clarification, particularly in the area of non-destructive preliminary examinations, façade documentation, construction and structural analyses, construction joints and connections or even in the case of building parts that have been subsequently changed. The procedure is also suitable for damage analysis and documentation. Cracks and voids, material degeneration, surface changes and moisture can be shown in thermograms under the appropriate ambient conditions.

Especially in combination with other, complementary, non-destructive analysis methods, issues from architectural research and heritage conservation as well as archaeological or restoration questions can be examined and clarified comprehensively. However, there are still no comprehensively illustrated or fully accessible evaluations of this non-destructive test procedure in building research. Even general empirical val-

ues and standards derived from them are scarcely available.

Research approach

In the field of technical building analysis, the possibilities and framework conditions for the use of infrared thermography in building research, restoration and heritage conservation are examined at the KDWT. As a non-destructive investigation and documentation process, the IRT offers great potential for Bamberg's monument sciences. This will be evaluated in the context of the existing building archaeology methodology. In addition to this, it is important to explore findings-based combinations of different examination methods with the IRT.

Methods and integration

First, the range of objects and questions that could be examined and documented was explored, from overview-like preliminary examinations through to detailed object analyses. This includes the processing of the current state of research in the field of infrared thermography in building research and the development of an individual analysis profile. Based on this, various processing depths and levels of detail of examination variants are currently being tested. First of all, the object-specific investigation is carried out, and with increasing empirical values, object-independent examination standards will also be developed. At the same time, an evaluation of the framework conditions of IRT in building research takes place, which, among oth-

er things, shows the feasibility, the ratio of effort to the meaningfulness of the test results and the potential of thermographic measurements. In addition to this determination of the significance of thermography in technical building analysis, the possible uses in adjacent subject areas such as preservation sciences, heritage technology and archaeology will be tested. In addition, another important task will be to test the integration of IRT in the methodology of non-destructive testing methods and to work out promising synergy effects of examination and documentation techniques.

The preliminary results of the main examination of façades and wall structures show promising results: masonry structures, half-timbered structures, construction joints, added wall openings, subsequent changes, additions and conversions can be clearly visualised in the thermograms (Fig. 3–6). Damage such as cracks, gaping joints, saturated building parts or material degeneration can also be depicted well under suitable ambient conditions – but always subject to a supplementary structural research confirmation of the interpretation of the findings. The same applies to the detailed examinations of individual constructions and building parts.

Project goal

The aim of the evaluation of thermographic examinations at the KDWT is to explore the possibilities and limits of use of infrared thermography in the field of building research, preservation sciences and digital object detection and analysis; and to place them in a corresponding scientific context. For one, this is intended to expand the range of methods for the non-destructive recording, analysis and indexing of complex objects in the preservation of buildings and monuments. Secondly, these investigations aim to develop further digital presentation and documentation methods and to test new combination methods. The focus should not only be on conventional questions regarding damage analysis or monitoring options but above all on the assessment and scientifically sound presentation of technical building parameters and building qualities more broadly.

Device technology

The KDWT has two thermal cameras for different wavelength ranges. This combination of different

camera systems guarantees a wide spectrum of applications in the field of building research thermography. The ImageIR 8380 is an infrared thermal camera with a cooled InSb detector and an integrated Stirling rotary cooler. It is equipped with a 12 mm lens, which is particularly suitable for shooting indoors. The temperature changes on building materials, building parts, frames and paintings fluctuate little and therefore require a particularly good temperature resolution of the sensor with a sufficiently large detector format. Measurements and examinations with the ImageIR can be tracked and checked in real time on the notebook supplied with the associated software. Processing of the recordings during data recording is possible. An overview of possible findings can also be displayed quickly and with little effort.

While the ImageIR covers the middle spectral range (MWIR 2.0–5.7 μm), the second VarioCAM thermography camera supplements it with the longwave range of 7.5–14 μm , thus expanding the infrared measurement spectrum of the devices available at the KDWT. The uncooled microbolometer system of the VarioCAM has the advantage of a much lighter, more compact design; it can be used anywhere thanks to battery operation and can be used without restriction in complex or difficult to access measurement situations. With these prerequisites, it can prove excellent when used for preliminary examinations of entire systems and buildings as well as for time-efficient, overview-like representations of the current status of historical objects. The measurement objects can be viewed and checked directly via the integrated display without having to rely on an external screen. Preliminary examinations and unclear findings can be specifically adapted and temporarily evaluated. Gaps, defects or measurement errors can be quickly identified and supplemented and completed directly as part of the investigations. The use of thermography thus facilitates a compelling combination of historical and technical building research and has invaluable potential with regard to non-destructive testing and visualisation methods, especially in building analysis. (*Anna Luib*)

Building Preservation in Existing Buildings

Familiar tasks and new focus



Fig. 1: Preserve (how)? – construction mix at a Nuremberg town house [Schalk 2018].

Head:	Prof. Dr.-Ing. Stefan Breitling
Editor:	Dipl.-Ing. (FH) Christian Schalk M.A.
Duration:	since 2016
Funding:	KDWT's proprietary funds



Fig. 2: Joins and joining – what can historical construction in Weismain do? [Schalk 2018].

Building stock naturally forms the majority of all real property. The term 'real property' refers in respect to land register law, often also statistical, built and undeveloped land. Studies have shown that the net fixed assets of buildings with estimated property values for settlement areas and traffic areas in Germany are estimated at an impressive 10.1 trillion euros.

The low interest rate policy that has prevailed for some time is promoting the flow of capital into the property sector. The price range in most cities is high. Even in the surrounding area and in the large 'catchment area' top prices are demanded and also paid. Historical buildings and monuments are also affected.

The pressure to buy can open up development and conservation opportunities for this group of objects, which is to be welcomed. But top prices may require a high degree of utilisation on purely economic grounds. The pressure to change the substance can increase particularly if supposed 'contemporary' floor plans, uses and structures are to be created in the existing building.

From the wide field of energy-oriented refurbishment in connection with the associated financing models, for example KfW funds, a multitude of measures on the building stock inevitably follows. But also user requests and ideas, urban planning, design, technical requirements and legal requirements 'tug' at the historical stock.

When does building stock come into being?

There is no normative stipulation as to when a 'new building' (building) or a 'new development' (land) changes to 'existing building stock'. For the past 3–5 years or so, the term 'old building' has not only disappeared from property portals, it has been replaced by the softer 'year of construction'. Building stock remains in the realm of one's imagination and undefined. So when does the building stock come into being or when does a comprehensive redevelopment become building stock? A definition for 'becoming building stock' could be derived from various legal areas in which a specific point in time is discussed or determined. For example, VOB (German Construction Contract Procedures), tax law, relevant standardisation and case law can be drawn upon. In this case, new

buildings and major refurbishments and maintenance measures become building stock as soon as they are completed, i.e. immediately, or at the latest around two years after their completion. This means that almost everything that has been built can become building stock in a very short time.

Handling building stock

While usage can start, at least partially, during the construction phase, the handling of the building stock begins, more broadly speaking, at the latest upon becoming building stock. The conceptual variety for the handling of existing buildings, which is well-nigh colloquial, is impressive but largely indefinite. Here is a selection of terms that are deliberately hierarchical:

1. observe, maintain, service, preserve, repair
2. refresh, retrofit, renew, modernise, renovate
3. get into working order, upkeep, (core) refurbishment, restoration
4. coring, replacing, reconstructing, building

Number 1 suggests a rather low-threshold approach without any special measures; from the very beginning, number 2 indicates interventions in the substance; number 3 signifies a specific reference to measures with loss of substance; number 4 points to 'dismantling', i.e. demolition and partial demolition.

Taking the built substance as a whole, at least from number 2 onwards, all measures are associated with changes and losses. This also applies to any historical building substance, irrespective of the point in time at which the building substance may be viewed or addressed as historical by the experts. The basic questions behind such terms are: old or new? Preserve, eliminate or replace? How much substance will remain and in what form and in what interdependency?

Monument protection and historical building structure

'Substance loss' and 'substance preservation', in particular in the system of monument protection and institutionalised heritage conservation, the specialist community for heritage conservation, the preservation sciences and historical building archaeology, are being picked up on as central

themes.

As mentioned at the beginning, the building stock constitutes the bulk of all buildings. Depending on the building and monument law of the federal states, the individual monuments and monument ensembles are (merely) a defined group of existing buildings with 'access requirements' and 'permission requirements', which are not however required to have any uniform structural or material properties. Architectural history or art history depicts a variety rather than a type.

The 'becoming a monument' is subject, among other things, to legal, declarative, professional and cultural-political (assessment) processes and dynamics, whose development is not rigorous. The way in which historical monuments are handled has changed continuously in the course of the history of heritage conservation and monument studies and is less defined.

In terms of its preservation, historical building fabric certainly does not mean a classification in terms of art history or architectural history. The unprotected building stock is addressed here as historical if it belongs to an era in terms of technical history and the history of building construction that has ended. Buildings and constructions of this kind are seldom recognised for their significance and valued. The original structure of both groups is and remains indispensable. It must be seen as an exhaustible resource.

Building in existing buildings

The handling of existing buildings and building fabric in terms of planning and design is often described as 'building in building stock'. The architecture faculties of the universities teach and research in these areas. The discipline is supplemented with methods for building stock recording, renovation technologies, analysis methods and application rules (engineering building research). Technology can make an important contribution to the preservation of building fabric: its methods have been researched and tested and shown to be effective.

However, this system shows weaknesses in its fixation on 'damage', 'upgrading' and the 'redesign' of the building structure. The resulting devaluation of the stock can be the starting point for a process in which little or no importance is attached to the original substance. If the 'refurbishment' is undertaken as a 'recovery', demolition and replacement appear obvious. If the building substance



Fig. 3: Cause and effect, loss of substance from neglect [Schalk 2018].

perceived as 'defective and faulty' is destroyed, then the economic values that were already created will be lost. The destruction of building fabric is perhaps also an expression of a throw-away society that has not yet been able to be taught to see 'old buildings as a resource'. Building preservation is therefore also a contribution to the reuse of built values.

Building preservation – fundamentals and goals

From the conflict situation described, it has become clear that historical buildings, whether they be protected or unprotected, can definitely be regarded as an endangered resource.

Building preservation thus crystallises as a new area of responsibility for those involved in construction. Broken down to the object level, i.e. to the building itself, building preservation is meant to be understood in the literal sense. As much substance as possible must be retained, and authenticity should remain preserved.

Building preservation is the sum of all individual contributions to the preservation, safeguarding and updating of existing building structures in situ, i.e. in terms of their meaning, effect and materiality in the context of the construction and the parts of a historical building.

Localised historical, original substance is regarded as a cultural asset worthy of protection and a primary source for research. It makes an authentic contribution to building and cultural history, is an expression of the craftsmanship and artistic creativity of our ancestors and thus also part of our collective cultural heritage.

The primary goal of all organisational-administra-

tive, investigative, invasive, preventive and technically constructional measures – which take place, also in combinations, in and on the (historical) building stock – must be the preservation of buildings and building culture.

In practice, this goal is achieved through a systematic, graded and careful approach:

1. Building exploration and building analysis
2. Building documentation/building description
3. Presentation of the capabilities of constructions, SWOT analysis, naming faults and conflicts, comparison of target and actual values
4. Estimation of the durability of existing structures
5. Formulation of preservation goal
6. Formulation of recommendations for building preservation:
 - a.) without reference to measures *non-invasive, preventive, investigative* careful use, appreciation of service, maintenance and care, observation and monitoring
 - b.) with reference to measures *less invasive, low threshold* repair, service, maintenance
 - c.) with construction measures *invasive, intervening* retrofitting, remodelling, conversion, redesign, exchange, dismantling, demolition

In order to enjoy general acceptance, the target definition must never be pedantic, partial or short-sighted. It must do justice to the owner and user and take due account of their wishes and of opportunities for development.

As a result, the knowledge of the building must lie with those involved – the owners, users and administrators must know how to deal with their building in regard to its long-term maintenance.

Building preservation always begins with an appropriate use and 'care' for the building fabric. Maintenance, inspection and care, for example cleaning gutters, are not trivial – they are essential prerequisites for ensuring that small damage that is easy to repair does not lead to major damage.

So the question to be asked is: what exists, what can it still do and for how much longer and what needs to be done to maintain the values long term



Fig. 4: Inventory recording to determine technical parameters [Schalk 2018].

that have already been created?

Constructional conservation

If prevention has failed, there are design errors or there is damage caused by external factors such as weather or the effects of traffic and changes in the ground, further measures must be initiated. These are referred to as constructional conservation.

Constructional conservation on an historical building is usually a rather invasive contribution to the long-term preservation of load-bearing/stiffening building parts and building structures. It is based on precise, purposefully planned and conducted technical and historical building research. The aim is to preserve the historical construction connection and interdependency in situ. At the beginning, the recording of the state of preservation, the technical parameters of the existing structures and the preparation of a preservation forecast is an essential task. All interventions can only be planned and carried out effectively on the basis of the knowledge of historical building structures in their development history. Building and construction type, the architectural, repair and change history of a building must be analysed in detail.

Outlook

In summary, building conservation means the development of appropriate, including economically justifiable strategies for the long-term preservation of buildings and their valorisation. Building conservation is an essential contribution to resource conservation and a call to appreciate what exists. The Building Research department at the KDWT will shortly be launching the “Bamberg Recommendations on Building Preservation”. (Christian Schalk)



Fig. 5: Total loss (left); preservation, repair and careful addition (right) [Schalk 2018].



Fig. 6: Short-term preservation intention; poor implementation [Schalk 2018].



Fig. 7: Demolition or preservation of living environments? [Schalk 2018]



PRESERVATION SCIENCES

The Preservation Sciences department can be classified between conservation science and practical restoration. While conservation science sees itself as the pure teaching of object conservation, defines its core task as the prevention and optimisation of framework conditions for preservation and pushes the manual application of objects far into the background, restoration sees itself primarily as a manual activity, requiring artisanal expertise, which must necessarily intervene in order to 'preserve substance' and make lost references to meaning legible again. The Bamberg restoration department is situated between the poles with profile areas that can be summarised under the umbrella terms of object documentation, material analysis and cultural techniques. In any case, the focus is on the individual object, be it a building or museum exhibit, an object of cultural history or an archaeological find. The object establishes the actual method of a science of restoration, without which an object would be like an orchestra without a musical score. Restoration scientists see themselves as interpreters of objects in all their forms who use different instruments.

The requirements for the profile areas of the discipline vary accordingly. In principle, a reading of the object properties comes first. Taking scientific methods from other branches of science into account, this means carrying out the documentation of the geometry, topology and colour of the object to be documented as objectively as possible and in a manner that is all but neutral in terms of value. This can be done in drawings, photographs or with common digitally supported and software-supported instruments. In the age of IT and AI applications, digital recording technologies are of course the methods of choice because they provide information about the material conditions of the objects in question that would otherwise be difficult to obtain and because digital data has the advantage of being suitable for web applications, 3D models and visualisations. The question as to whether one does oneself a favour with a preference for digital technologies while ignoring analog plans and drawings remains open. There is good reason to remain sceptical as long as no reliable form of digital archiving exists. The poten-

tial of the new tools for preservation sciences and what the archiving of digitised materials requires practically and technically is looked at in detail in the profile area of non-contact and non-destructive material examination – known as NDT methods ('non-destructive testing methods').

Profile focus on NDT methods

The non-destructive documentation of three-dimensional objects has a long tradition at Bamberg. In the beginning it was sculptures or complex and decorated surfaces, but the development increasingly included wall surfaces, archaeological finds and areas of World Heritage monuments. The methodological spectrum was expanded to include scanning methods for large and small objects and refined through assisting technologies. Fields of work were monuments that were placed on the list of endangered objects of cultural history as part of the Heritage at Risk initiative by international organisations and the Federal Foreign Office. Secondly, there were questions about the verifiability of the effects of conservation treatments that needed to be clarified. In the case of large objects, the current stock and its peculiarities were to be recorded in a kind of digital 3D fast recording, and the local staff were to be trained. And for the monitoring, work routines had to be developed in accordance with the scientific dictum of reproducibility. Monument recording was based on the entire scanner portfolio, while high-resolution 3D LED scanning became the heart of monitoring. Combined with photographic techniques and/or shearography, it provided key information on the time-dependent effects of the climatic environment and the suitability of conservation materials. The instruments were applied to the Sri Dalada Maligawa Temple in Kandy (Sri Lanka), cathedrals and other large churches of Cologne, Pisa, Vienna and Vitoria (Spain) and the medieval choir screen paintings in the Cologne Cathedral.

Profile focus on microanalysis

The second area of work includes the microanalysis of sample material to be examined in the context of the humanities and cultural studies as well as of archaeology. The samples are referenced with very specific questions that are usually guided by

the desire to receive maximum information about the object and information about its history of change. The kinds of questions raised include the composition of unknown coatings, the layer structure of particles, with regard to colour sequences, the painting technique, the binders and pigments, the ageing and corrosion horizons and the local distribution of corrosion products or preservatives. Here the natural and material sciences have a special function as auxiliary sciences for the history of art and culture and the monument sciences. Due to the high value of material findings and the importance of originals themselves, only minimal sample quantities are allowed to be used for examination purposes. In this context, minimal actually refers to micro and means particles or substance quantities on the millimetre scale or milligramme range.

There are two different analysis methods available for a meaningful characterisation: firstly, what is known as complementary analysis, in which complementary examination methods are used and the combination of which brings added analytical value. As a result, the object remains unchanged – it was only viewed with different methods from different aspects. This is followed by minimally invasive interventions, not unlike those in medical technology. The situation is different with the second analysis route that focuses on the controlled breakdown of small amounts of substance. In the end, the substance is broken down into its components, gases and oxides. The whole, of course, was more than the sum of its parts. To find something special, you have to carve out the particle sum by identifying the individual findings and restore the contextual connection. The methodology is known as *partinomic microanalysis* and is similar to the separation processes known in classical chemistry with the difference that today's analysis technology seldom requires any sample material, uses no solvents and enables a continuous observation of the decomposition process.

The umbrella term for both determination methods used at the KDWT can be described as *minimally invasive and low-destruction microanalysis* due to minimum use of the materials. The essence of the Bamberg investigation routine is formed by

the first method, namely *complementary microanalysis*. It encompasses an initial orientation of the sample material and starts with fibre and light microscopic documentation, followed by the analysis of individual particles using light and infrared microscopic methods. Cross sections are made from selected layer packages, and sub-millimetre-sized individual particles are characterised in more detail by means of infrared spectroscopy. After defining the layer sequence, the layer horizons and element distribution within the individual layers are determined with the aid of analytical scanning electron microscopy (SEM-EDS), and the results are correlated with the light and IR microscopic examination. The fact that this routine is complex and time-consuming is due to the mostly rich history of change in the objects under investigation and the long exposure time. With medieval colour schemes in the outdoor area, for example, it can easily amount to 20 different layers from four change phases. Thus the evaluation of the measurement results is correspondingly demanding.

A separate field of work deals with *partinomic microanalysis*. The minute quantities of unknown composition are initially thermally treated and the split products are separated, recording the time and temperature-dependent weight loss of the entire sample (thermogravimetry, TGA). The resulting gaseous compounds are then recorded using infrared spectrometry (IR) and fed to a gas chromatograph (GC) with a mass spectrometer (MS). Here the connection modules are analysed individually and correlated with the thermal and IR data.

The special feature of the method lies in its coupling, through which the entire analysis cycle can be tracked and interpreted in stages. A current application at the KDWT is the determination of complex historical tree resins, which come from archaeological grave finds; mortars and plasters from the years 500 to 1800 were added with the aim of improving their processing properties and increasing resistance to external influences.

The coupled technology was developed for special applications in substance synthesis and materials science and requires a high level of understanding of apparatus and analysis. It is being

run at the KDWT in a pilot project as a public-private partnership with the device manufacturer involved in technical and personal know-how (PerkinElmer Reference Laboratory at the Centre for Heritage Conservation Studies and Technologies).

Profile focus on cultural techniques in construction

The third profile area refers to the increasingly endangered craft trades that are responsible for the construction of architectural monuments, including their crafted surfaces and equipment made of wood, glass, metal, textile or other materials: without master builders, foremen, craftsmen and artists, there can be no monuments. Indeed, the list of professions that have disappeared has become long, disquietingly long. Established professional groups ('stonemason', 'church painter', 'gaffer', 'blacksmith', etc.) are at risk of loss without replacement or will lose their image and expertise due to reorientation in unrelated fields. However, without skilled workers and specialists and without knowledge of the tricks and secrets of our ancestors, the future of heritage conservation looks bleak. One should counteract this.

It remains to be seen whether university institutions and scientific bodies are able to influence social and economic trends effectively. The right to freedom in research and teaching makes it possible, however, with scientific meticulousness to draw attention to deficits that are hidden as a consequence of the loss of traditional ties and manual skills. In this respect, the setting up of a profile area called *Cultural Techniques on the Monument* is the institutionalised attempt to raise awareness of the values and content that traditional craftsmanship per se contains and embodies.

Theory of key findings

Documentation and analyses, however well done, are no guarantee for scientific added value. Ultimately, these are individual events that, under certain conditions and written at different times, have no right to comparability. Even records made at the same time and the comparative serial exami-

nation by various players have the disadvantage of individual observation and fall prey to the sword of Damocles of incomparable framework conditions, resulting in their actual testimonial value being low. In spite of all restrictions, an attempt is to be made at the KDWT to produce what is known as key findings for the monument sciences. However, this is not possible independently – only in concert with building research and monument sciences (see p. 70–73), since the theoretical concept is based on the merging of all accessible (and archive-worthy) data of buildings (dating, building phases, plasters, mortar, equipment, wooden construction, colour, etc.) and their semantic annotation and digital archiving. The object and individual investigations recorded in the course of previous investigations are to be used for a better classification of the typological characteristics of monuments, to facilitate regional and temporal assignments (datings) and to reinforce concepts of historical developments. The basis of the evaluation is a broader data foundation and its semi-static evaluation.

In this context, preservation sciences can make a contribution by processing pigments, binders, work techniques and – conditionally – mortars. Detection of individual or combined uses of the substances mentioned would allow datings *terminus ante quem*, especially since time series for pigments have been well studied and published, binders afford good starting points from the 19th century onwards and there are indications typical of the time that are useful for work techniques. At the beginning of the theoretical work, there would be a review of the reports available in archives, monument offices and laboratories with queries that would need to include the following points: What was examined and where? What is the result? When were the examinations carried out? Which determination methods were used? And, with a self-critical impetus: How reliable are the findings from the past, including all those that were created in a constrained time environment? (Rainer Drewello)

Profile Areas of Preservation Sciences



Fig. 1: Profile area NDT methods; the Comet L3D Structured Light Scanner by Steinbichler Optotechnik used for high-resolution 3D measurement of a monitoring area; Saint Bavo's Cathedral, Ghent, Belgium [Höpfner 2017].

Head:	Prof. Dr. Rainer Drewello
Editor:	Max Rahrig M.A., Dipl. Geol. Martina Pristl
Duration:	since 2016
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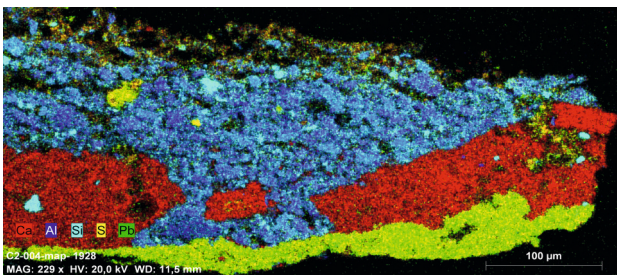


Fig. 2: Profile area Microanalysis; determination of elements of frame layers by scanning electron microscopy (SEM); Notre Dame, Paris [Tenschert 2017].

Profile area NDT methods

A wide variety of technologies for documenting and examining historical objects have been tested at the KDWT in recent years. One focus was the adaptation of non-destructive testing methods (ndt methods), which are used in the areas of materials testing and industrial manufacturing. In particular, optical examination methods and imaging techniques were used, such as digital pho-

tography that was supplemented by other spectral ranges beyond the range visible to the human eye. In the EU research project Nano-Cathedral, which aimed to develop and test new preservatives, the weathering behaviour of the new products in the UV range and near-infrared range was studied. Exciting and innovative approaches have emerged for use at the KDWT in the investigation of historical wall paintings by means of the application of active IR thermography in the medium and long IR spectral range, including shearography. With both methods, it was possible to penetrate without contact and in a non-destructive way the existing surface of the historical stock and to visualise previous colour concepts (active IR thermography) or defects, material changes and painted layer detachments (shearography). In addition, with the aid of high-resolution 3D documentation, new approaches for deformation-compliant monitoring of historical objects could be developed, by means of which corrosion processes can be detected and measured with sub-millimetre precision. Each technique in itself already offers great potential for applications in the protection of cultural property; but the added value lies in the targeted, complementary application of the investigation methods, which enables the respective strengths to be optimally exploited and possible weaknesses to be negated with the aid of other techniques. An example is the ivory crucifix from the Bamberg Cathedral Treasure. In the 3D scan, processing traces and surface details can be recorded precisely; however, the colour information, essential for a comprehensive scientific analysis of the object, is missing. The combination of photography and 3D scanning in a photo-realistic, textured 3D model provides the best basis for viewing the surfaces in order to make statements about manufacturing techniques and historical repair measures. But what about the 'inner values'? By looking at the surfaces only, we lose them entirely. This is remedied by computer tomography, which for the first time provides insights into the crucifix and shows important construction details in addition to relic subjects.

(Max Rahrig)

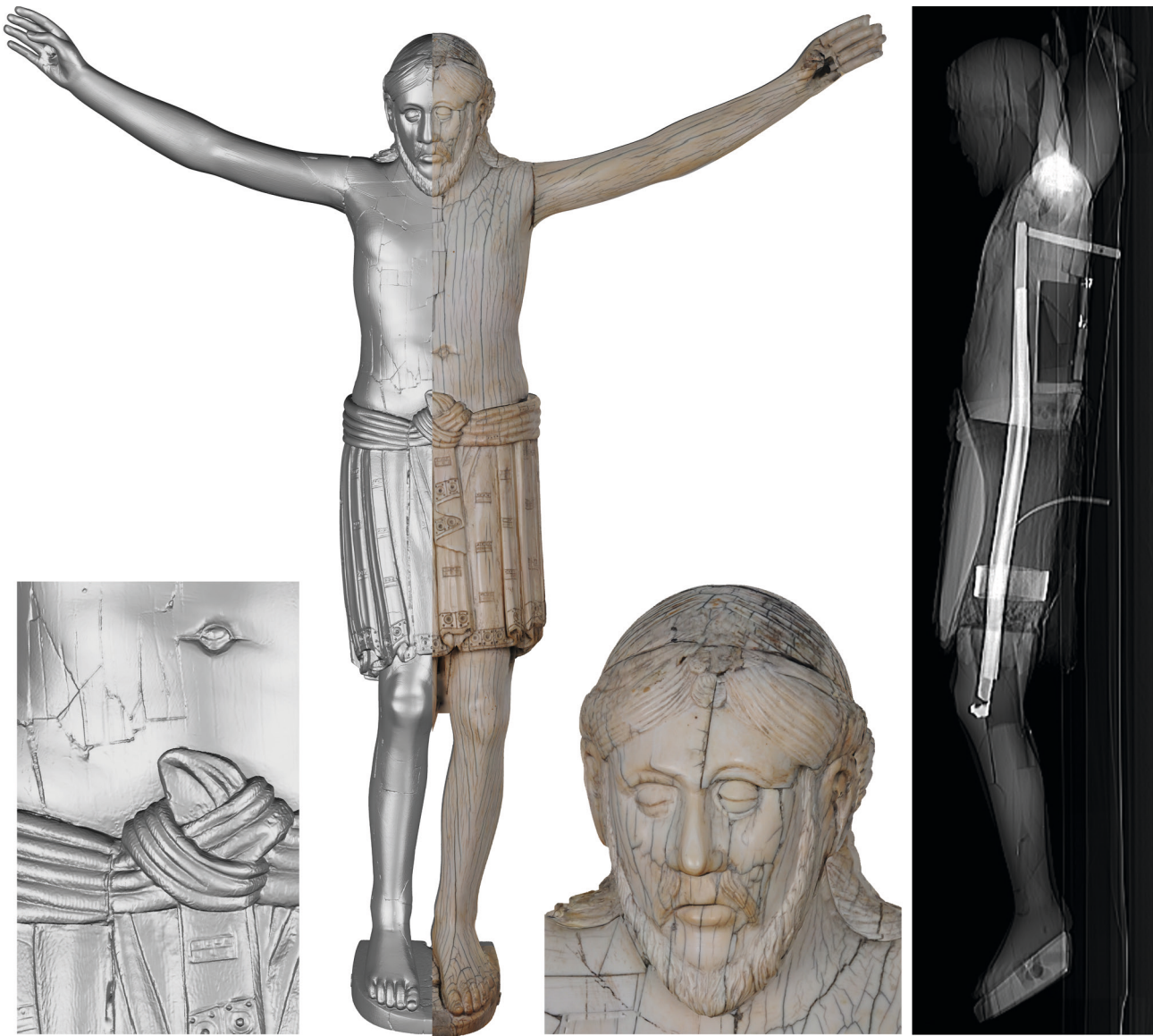


Fig. 3: Ivory crucifix from Bamberg's Cathedral Treasure; left: photo montage from 3D scan and textured 3D model [photograph: A. Schmidpeter 2015, 3D scan and combination: Max Rahrig 2019]; right: Computed tomography (CT) with constructional details [Prof. Dr. Markus Lenhart, Clinic for Diagnostic and Interventional Radiology, courtesy of Dr. Norbert Jung and Dr. Holger Kempkens].



Fig. 4: Use of optical examination methods or imaging techniques as NDT methods; right: working set-up to create a UV fluorescence image of a sample area, Cologne Cathedral; left: high-resolution VIS documentation of a monitoring area with a Hasselblad H2D and a Broncolor flash system; Saint Bavo's Cathedral, Ghent, Belgium [Rahrig 2017].

Projects

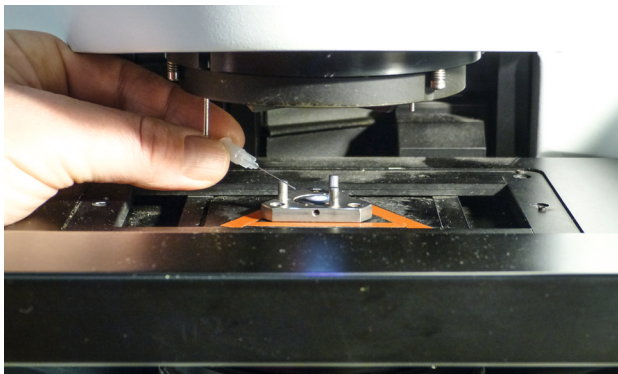
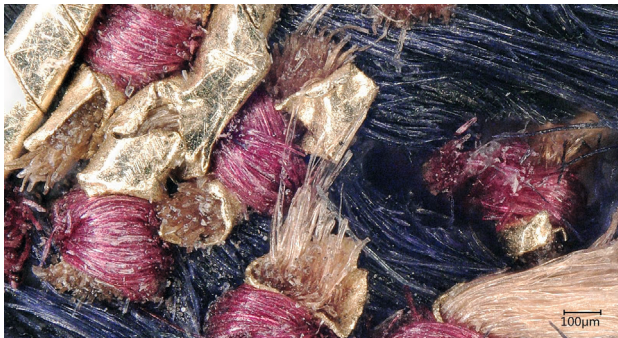
Profile area microanalysis

Complementary microanalysis: a look behind and into the specimens. (Standard procedure for characterising samples)



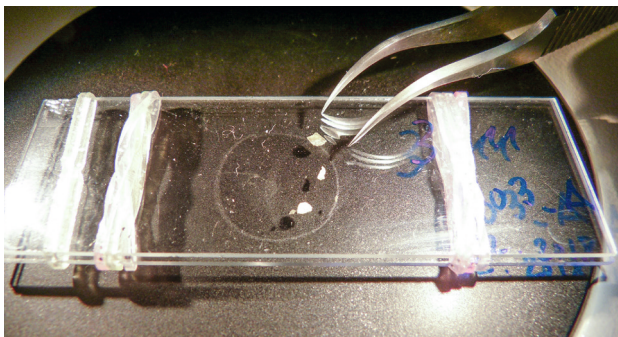
Light microscopy (LM)

Structure, colour, layers – textile fabric:



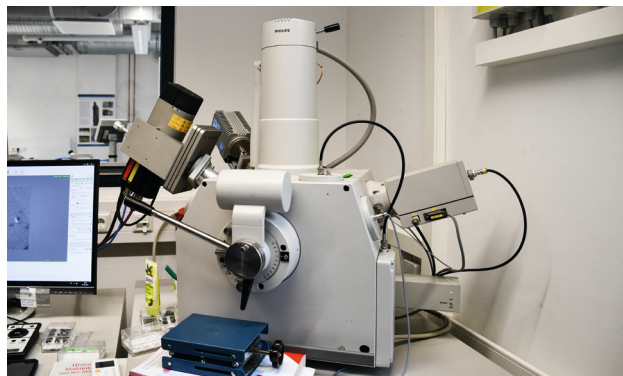
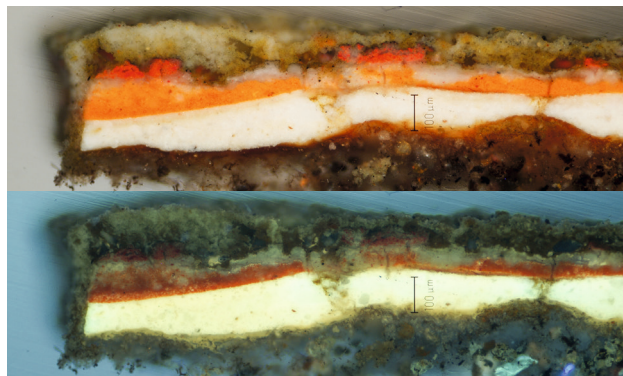
FTIR microscopy (FTIR)

Single particle analysis – pigments and layers:



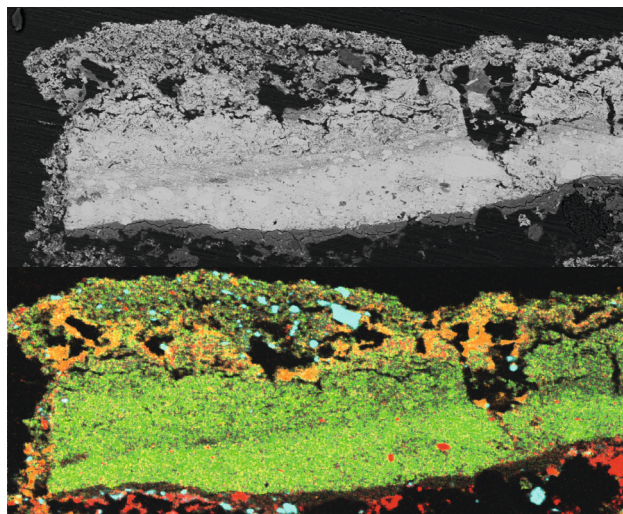
Sample preparation (PP)

Layer sequences – colour versions:



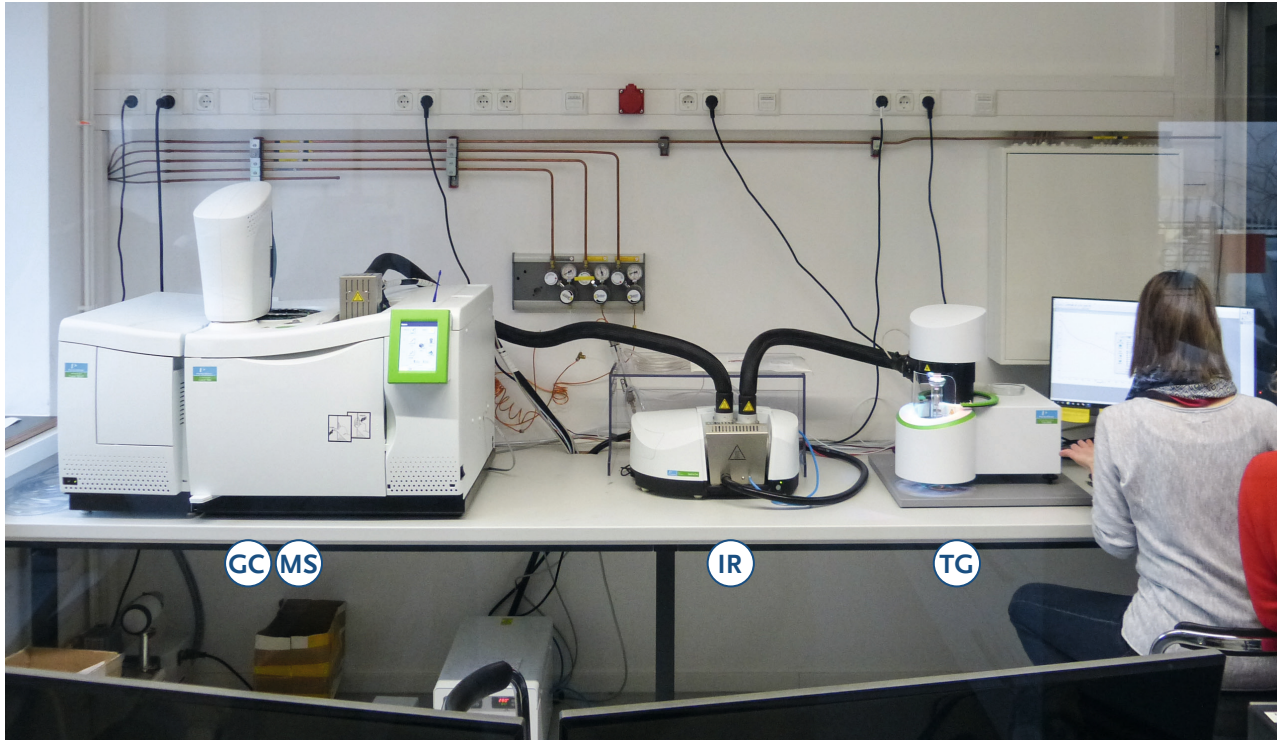
Electron microscopy (SEM)

SEM element determination – ageing horizons:

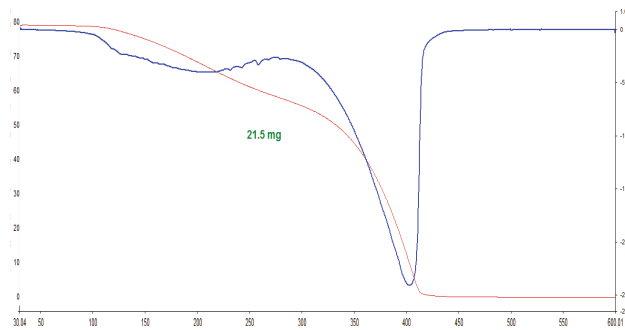


partinomic microanalysis: the breaking down of samples into ash, dust and gas.

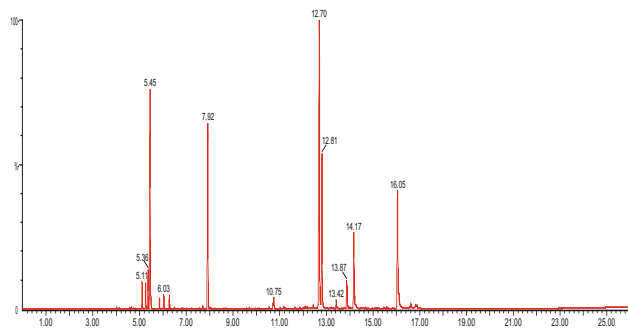
(Separation process for exact substance determination. Reference laboratory PerkinElmer) (*Rainer Drewello*)



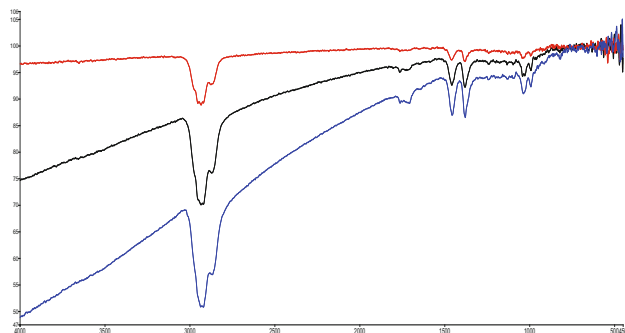
Thermogravimetry (TG) – loss of mass [ma %]
Weight loss of substances
Elemi natural resin



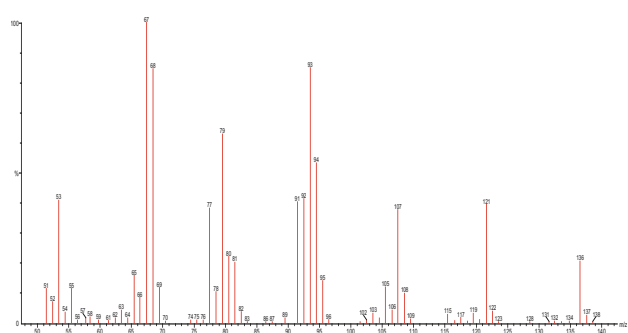
Gas Chromatography (GC) – Retention Time [T_R]
Separation of mixtures of substances
Chromatogram Elemi



IR gas analysis (IR) – wave number [cm^{-1}]
banding, twisted rocking of molecules
IR gas spectrum Elemi



Mass Spectrometry (MS) – Mass to Charge [M/z]
Determination of the mass of atoms and molecules
Mass Spectrogram 545



Monitoring of Historical Services

Use of shearography and structured light scanning



Fig. 1: High-resolution documentation of choir screen painting using structured light scanning (top) and shearography (bottom) [Hoepner 2015].

Head:	Prof. Dr. Rainer Drewello
Editor:	Desireé Lang, Sophie Hoepner, Max Rahrig M.A.
Partners:	Metropolitan Chapter of Cologne Cathedral, Dombauhütte
Duration:	2014-2017
Funding:	theses in the master's degree programme in Heritage Conservation, KDWT's own resources

The choir screen paintings dating from the 14th century in Cologne Cathedral are seen as fragile and endangered. Problems arise from the use of hygroscopic preservatives in the 20th century and the climatic conditions in the cathedral. With a strongly fluctuating relative humidity above 60% in conjunction with fluctuating temperatures, substance-damaging processes are inevitable.

As a basis for planned conservation measures, monitoring for the analysis and observing of the endangered historical surfaces on the choir screens was carried out, consisting of a combination of two non-contact and non-destructive test methods.

Shearography

Shearography (digital speckle shearing interferometry) is a laser-optical micrometre technique in which light serves as a standard for determining surface topographical changes. In a controlled double exposure process with shifted ('sheared') images, the induced changes in length and deformation of the layers near the surface are compared after a brief stimulation of the surface by vacuum, sonic waves or temperature. The degree of deformation due to stretching and shrinking is then visualised using interferometric techniques. The thermal method with a temperature excitation of 2°K was used to examine the painting on the choir screens. With shearography in particular, cracks, cavities, material differences and the sensitive behaviour of paint layer patches could be made visible. Within the framework of the project, the ISIS 1100 shearography system from Steinbichler was used in conjunction with halogen lamps for thermal stimulation.

Structured light scanning

In addition, a three-dimensional and high-resolution documentation of the surface topography was carried out using structured light scanning. A Comet L3D with a 45 mm measuring field from Steinbichler was used for this. This high-resolution macro measuring field facilitates surface documentation with a point spacing of up to 18 µm. For a single measurement, however, only an area of approx. 5 x 5 cm is recorded. For the documentation of larger areas, such as the monitoring areas on the St. Peter choir screen painting, several individual scans were combined with an overlap of more than 50%. By repeatedly measuring the same area over a longer period of time and then superimposing the surface reliefs, changes such as movements, application or loss of material can be specifically recorded and visualised.

Combination of the methods

The complementary use of shearography, structured light scanning and photo documentation for monitoring endangered murals showed unexpectedly good and reliable results. In addition to the detailed documentation of the overall condition of the paintings, conservation measures such as the consolidation of individual layers of paint to a depth of approx. 4 mm could also be demonstrated.

The general documentation of the condition was conducted using colour photography. In this way, damage can be determined and localised quickly and easily. Subsequently, monitoring areas can be specifically selected for the use of the other measurement techniques. The 3D surface comparison allows changes and movements in the paintings to be recorded over a longer period and measured precisely. This technique also provides clear indications of the scope and direction of movements. For example, lifting and lowering patches of paint or a loss of material. However, with structured light scanning, it is not possible to look under the historical surfaces. Here lies shearography's big advantage. The short thermal stimulation of the surface not only facilitates the differentiation of active, inactive or even stabilised cracks but also the detection of cavities at depths of up to 4 mm. The direction or the extent of the movements cannot be determined metrically using shearography, though.

As the example of the tempera painting of the St. Peter choir screen in Cologne Cathedral shows, complementary techniques offer great potential for non-destructive and contactless documentation and monitoring of historical surfaces. In future projects at the KDWT, process combinations are to be further tested and optimised in order to research specifically the change behaviour of sensitive historical composite materials. (Max Rahrig)

RAHRIG, Max / LANG, Desirée / HOEPNER, Sophie / DREWELLO, Rainer / FÜSSENICH, Peter: *High Resolution Monitoring of Historical Surfaces by using Shearography and Structured Light Scanning*, 3D Imaging in Cultural Heritage Conference, The British Museum, London 09 November –10 November 2017 (poster presentation).



Fig. 2: Detailed view of a monitoring area with a protruding paint patch [Hoepner 2015].

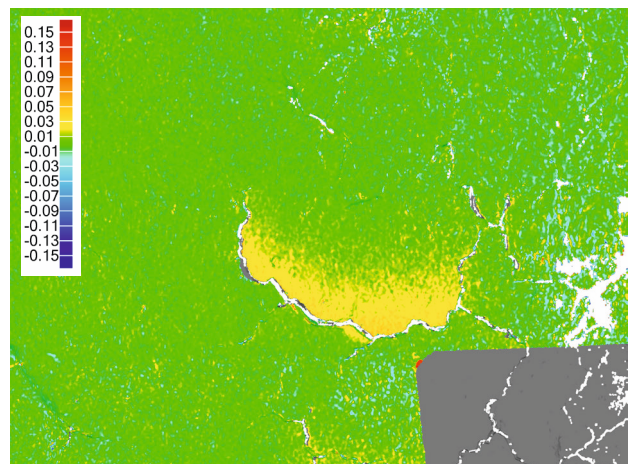


Fig. 3: 3D surface comparison of two scan campaigns and the visualisation of deforming patches up to 0.15 mm [Hoepner / Rahrig 2017].

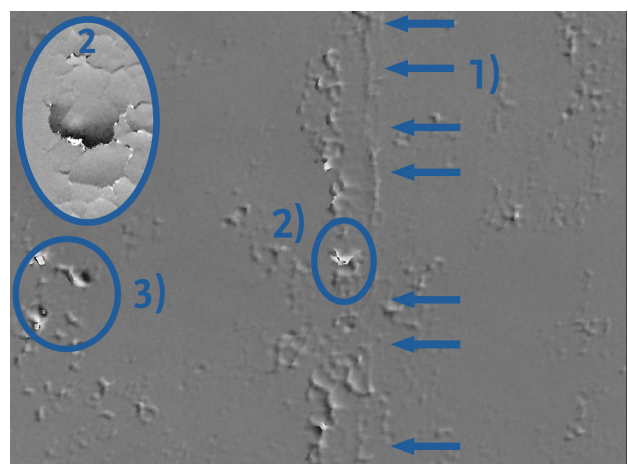


Fig. 4: Shearography of a larger image section: 1. Linear structure, which reflects the joint lying under the plaster surface; 2. Detail area of the patch-like test surface (Fig. 2, 3); 3. Area with anomalies that indicate cavities below the layer of plaster [Lang 2015].

The Core Area of the Temple of the Tooth in Kandy (Sri Lanka)

3D digitisation and inventory



Fig. 1: Sri Dalada Maligawa, view of the main shrine with the tooth relic [Rahrig 2014].

Head:	Prof. Dr. Rainer Drewello
Editor:	Max Rahrig M.A. (Coordinators), Anna Luib M.A., Annika Reeb M.A.
Partners:	Sri Dalada Maligawa – The Temple of the Sacred Tooth Relic of Lord Buddha, Media & Special Project Bureau; Format4plus GmbH Digital Measuring Techniques; Format4asia (Pvt) Ltd.; Infosurv Lanka Ltd.
Duration:	2015-2017
Funding:	German Federal Foreign Office, Cultural Preservation Programme



Fig. 2: Central courtyard with main shrine as coloured 3D point cloud [Rahrig/Luib 2017].

The sacred tooth temple – Sri Dalada Maligawa – is the most important Buddhist pilgrimage site in Sri Lanka. The temple and its surrounding buildings form the centre of the Sacred City of Kandy UNESCO World Heritage Site in the central highlands of the island. The religious centre is located right next to the historic city centre, on the north side of Kandy Lake. The entire complex includes both Buddhist and Hindu temples, shrines and stupas. A Catholic church, St. Paul's, was also built in the area during the British colonial period. At the eastern end of the site, on a terrace above the surrounding area, is the former Royal Palace. The buildings date from the end of the 17th century. At that time, Kandy was the capital of the Sinhalese kings. The sacred tooth of Buddha has been a symbol of royal power for centuries. That is why a first temple was built inside the palace for the relic's safekeeping.

There have been various structural changes over the centuries: Today, the old royal buildings such as the King's Palace, Queen's Palace, Audience Hall and the Queen's Bath are grouped around the temple buildings in a spacious, open park. The temple buildings themselves are part of a grown structure with old buildings from the 17th/18th centuries such as the Pattirippuwa (octagonal tower), which now contains an important library of historical Buddhist Sanskrit scriptures. There are also more recent parts, such as the New Shrine Room and the Museum at the eastern end of the complex that was built in 1936. In the centre of the building is an open courtyard in which the sanctuary is located – a two-story shrine that houses the tooth relic (Fig. 1, 2). To protect it against the heavy monsoon rains, the shrine is now covered by a modern gilded roof (Fig. 3).

Everywhere in the temple area there are filigree, richly ornamented decorations, such as wall paintings, wood carvings, decorative stones and gilded surfaces. The Audience Hall, which dates from the 17th/18th century, is an open-air hall on a carved out stone plinth. The hall roof is supported by a wooden structure with 64 columns. Each column and most of the horizontal beams are decorated with complex carved floral ornamentation. What



Fig. 3: An aerial view of the core area of the temple; the golden roof in the top right of the picture marks the location of the main shrine with the tooth relic [Ratnayake 2015].

are known as moonstones are located in front of each entrance to the temple and most of the adjacent buildings.

Moonstones are traditional doorsteps with a central meaning in Buddhist culture (Fig. 5, 6). During the Kandyan period, a unique style developed, in which the mostly triangular stones with a round lotus flower in the centre – also called full moon – are depicted and surrounded by rows of flowers. The lotus symbolises nirvana, surrounded by material wishes and desires. When the believers enter the temple via a moonstone, they will lose all material wishes and desires, analogous to the transition to nirvana. More than 15 historical moonstones have been preserved on the site of the Sri Dalada Maligawa.

The shrine itself is probably the most elaborately decorated part of the entire complex. On both sides of the shrine there are murals with ornaments, figures, animals and mythical creatures. The ground floor is surrounded by a veranda. Its roof is colourfully painted, framed by ornate ceiling beams. In picture fields, among other things, the story is told of how the holy tooth reached Sri Lanka and became a royal status symbol. The main side of the shrine, which faces west to the Drum Beating Corridor, contains a portal with silver-studded doors and a coloured, stone door frame.

Heritage at risk

Because of its significance as Sri Lanka's most important Buddhist site, several thousand pilgrims from all over the world visit Sri Dalada Maligawa every day to pray or to make a sacrifice before the holy tooth. It is also one of the most popular tourist attractions on the island. These very high visitor numbers are an enormous burden for the historical structures. The constant pushing and shoving along the historical areas causes damage and losses due to increased wear and tear.

Owing to its religious and cultural significance and importance as a tourist attraction, the temple was also a major target for terrorist attacks, most recently in January 1998, when the Tamil Tigers (LTTE) blew up the main entrance. 17 visitors lost their lives during the attack, and the historic buildings were severely damaged by the explosion and the associated tremors. The detonation was so powerful that surrounding temples and shrines to the west of the entrance, as far as St. Paul's Church 150 metres away, were affected. The detonation destroyed the entire entrance with its historical, pictorial reliefs and an important moonstone. In addition, the foundations and the top walls on the main façade of Sri Dalada Maligawa were badly damaged.

Most of the building structures were repaired during the remedial maintenance, but no structural monitoring or static assessment took place after the work was completed. Many deep and intricate cracks are visible in the masonry today. Given its location in an area prone to environmental and climatic disasters such as earthquakes or heavy monsoons, the Sri Dalada Maligawa is considered an endangered cultural heritage due to the existing static damage.

To date, repairs and structural reinforcements have mainly focused on the religious and spiritual usability of the buildings. For quick usability, this unfortunately all too often means replacement and new construction. The irretrievable loss of the material heritage resulting from these processes is a problem that those responsible are only slowly realising. To preserve and protect the World Heritage Site for future generations, local colleagues need support in the practical and conceptual care and preservation of their cultural heritage.

Research question

Since the terrorist attack, both the local population and the general public have worried about their holy site. However, comprehensive monitoring and general documentation of the status quo were lacking until the project started. The temple management did not have the construction plans that are absolutely necessary as a basis for ongoing and future work or for the design of a new visitor guidance system or even an escape route map.

In cooperation with the Temple of the Tooth's Special Projects and Media Bureau and three SMEs from Sri Lanka and Germany, a research project

was conducted in October 2015 for an initial documentation of the temple, which was funded by the German Federal Foreign Office's Cultural Preservation Programme. The project's duration was initially fixed for one year, starting with six weeks for the high-resolution documentation on site. During this time, the entire temple complex with all its buildings and numerous details had to be documented three-dimensionally. The aim of the project was to prepare the data for the creation of CAD drawings and to create a basis for the monitoring of damaged areas as well as for 3D animations and other visualisations for facility management and escape route maps (Fig. 4). The documentation was carried out using terrestrial laser scanning (TLS) and structured light scanning (SLS). Another important requirement for the project was the transfer of knowledge – the training of local skilled workers – with the aim of facilitating the Sri Lankan monument conservators in being able to analyse and further evaluate the 3D data independently and for the long term (Fig. 5). To that end, they were involved in all relevant processes of data collection and evaluation.

Results

In the course of the project, eleven historical moonstones were documented in high resolution using SLS. The photorealistic 3D images include almost all surface features, such as cracks, surface roughness and of course the geometry and ornamentation. In addition, the models are furnished with high-resolution textures that reflect the stone's grain (Fig. 6). The models serve as the basis for animations and visualisations of the Special

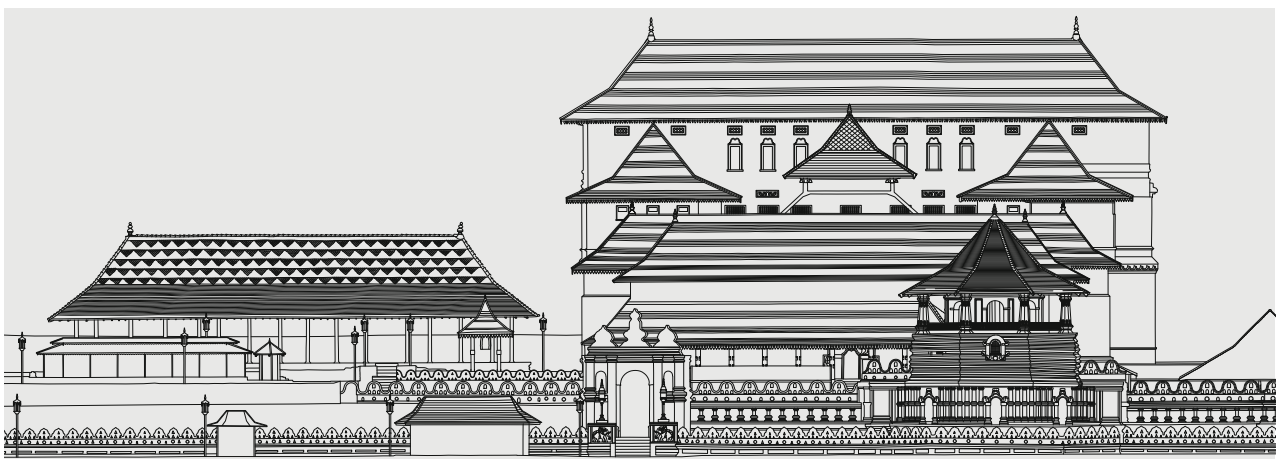


Fig. 4: Main façade of the Tooth Temple (detail); the 3D scans also serve as the basis for the creation of true-to-form, two-dimensional plan drawings [Luib 2017].

Projects and Media Bureau and also for scientific observations by art historians and archaeologists from the University of Kelaniya.

The high-resolution TLS data form the basis for comprehensive monitoring. Initially, three exemplary inventory plans were generated (a floor plan, a longitudinal section and a façade view, see Fig. 4). Copies of all data are stored and archived in the temple and in the participating research institutes. In order to complete the documentation of missing areas and inventory plans, further research projects and doctoral theses are planned. To this end, a cooperation with the University of Kelaniya and the Central Cultural Fund of Sri Lanka was initiated. (Max Rahrig)



RAHRIG, Max / LUIB, Anna: *Sri Dalada Maligawa – 3D-Scanning and Documentation of the Temple of the Sacred Tooth Relic at Kandy, Sri Lanka*, in: ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci., IV-2/W2, 2017, pp. 229–236.

RUPPERT, Godehard / RAHRIG, Max / LUIB, Anna: *Presentation of the project results, University of Kelaniya (Sri Lanka) 22 May 2017.*

RUPPERT, Godehard / RAHRIG, Max / LUIB, Anna: *Final presentation of the project results, Sacred Tooth Temple in Kandy (Sri Lanka) 23 May 2017.*

RAHRIG, Max / LUIB, Anna: *Sri Dalada Maligawa – 3D-Scanning and Documentation of the Temple of the Sacred Tooth Relic at Kandy, Sri Lanka*, ICOMOS/ ISPRS International Scientific Committee on Heritage Documentation (CIPA) 26th International CIPA Symposium – Digital Workflows for Heritage Conservation, 28 August – 1 September 2017, Ottawa (Canada) 28 August – 01 September 2017.

RAHRIG, Max: *High-tech for preserving Sri Lankan Cultural Heritage Sites – 3D-Documentation of the Temple of the Sacred Tooth Relic in Kandy* (Plenary Speaker), 3rd International Conference on the Humanities (ICH). Building Alliances for Global Knowledge through Digital Scholarship, Kelaniya (Sri Lanka) 26 October – 27 October 2017.



Fig. 5, 6: So-called “moonstones”, above: SLS by one of the Singhalese cooperation partners; below: non-textured and textured 3D model [Rahrig / Siebe 2015].

Risk Figures

Record environmental damage to sculptures and evaluate them objectively



Fig. 1: Apollo from Park Sanssouci [SPSG 2017].

Head:	Prof. Dr. Rainer Drewello
Editor:	Dipl.-Rest. Carolin Pfeuffer M.A.
Partners:	Laboratory Köhler (Potsdam), Prof. Dr. Rolf Snethlage
Duration:	2016-2018
Funding:	German Federal Foundation for the Environment

The decision concerning conservation works on sculptures made of marble or sandstone is usually made during a discourse between the owner, the monument conservator, the restorer and the expert. And in the course of this decision-making

process, arguments are weighed up and measures defined. In the oral and written formulations of those involved, terms about the state of preservation and the expected damage progression are used – such as, this sculpture is 'very/gravely at risk', the marble is 'slightly/moderately/highly' weathered, the surface of the sculpture is 'slightly/scarcely/seriously' affected – to the extent that 'important/irreplaceable' design details are in danger of falling by the wayside. While these evaluations are based on accurate observations and measurements, they are highly influenced by the speaker's individual personality in terms of how they express themselves. Moreover, they cannot be presented in a decision matrix in this form because their use does not follow a generally accepted guideline. The consequence of this is that the decisions reached are not objectively comprehensible later on.

The concept of risk figures pursues the approach of replacing qualitative, subjective terms with quantitative, objective measures. All observations and measured values recorded on an object and its surroundings are combined into a single number, the risk figure, which combines the condition and the preservation perspective in a single numerical value. The individual parameters are arranged thematically in separate data sheets. The end result of the calculations is a single number, the risk figure, which is used to express the overall condition and the risk to the sculpture. This figure is always between zero and one, corresponding to zero or 100% risk.

The individual parameters are summarised according to their properties in data sheets 1 to 12:

1. Object description
2. Art-historical evaluation B (KB)
3. History of restoration R (RGS)
4. Environment exogenous risk Factors R (U)
5. Natural stone endogenous risk factors R (N) for marble
6. Natural stone endogenous risk factors R (N) for sandstone
7. Risk caused by human vandalism R (V)
8. Mechanical damage material loss R (M)
9. Surface changes R(OF)
10. Ultrasound diagnostics R(US) I

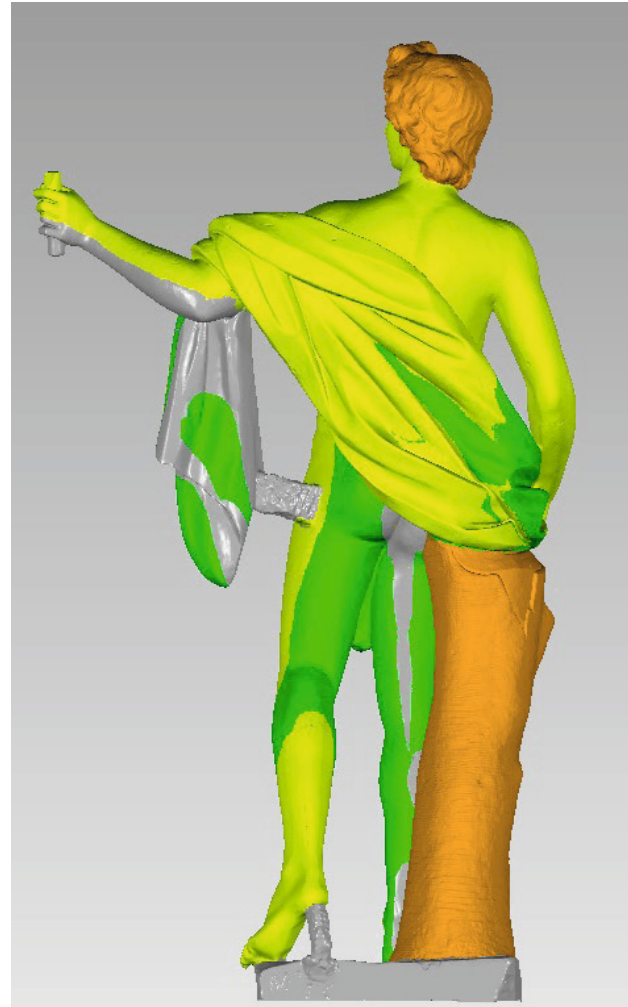


Fig. 2: Apollo from Park Sanssouci; mapping of surface roughness [Pfeuffer 2017].

11. Ultrasound diagnostics R(US) II
12. Overall rating R (total)

With this comprehensive documentation of the investigations and the decisions derived from them, a basis is to be created for future generations in order to be able better to recognise changes objectively that have occurred in the condition of the monument in question and to be able to assess the possibly increased threat to its continued existence. The contribution is aimed at all decision-makers involved in the care and preservation of sculptures: art historians, architects, scientists, restorers, administrators in public and private institutions. These people are often faced with the question as to which figures are particularly vulnerable in their parks and which are less at risk; or which sculptures are so vulnerable that they cannot be left outdoors and have to be brought into the protective interior. (Rolf Snethlage)

DREWELLO, Rainer (ed.): *Risikoziffer. Umweltschäden an Marmor- und Sandsteinskulpturen erfassen und objektiv bewerten*, Forschungen des Instituts für Archäologische Wissenschaften, Denkmalwissenschaften und Kunstgeschichte 12, Bamberg 2018.

PFEUFFER, Carolin / RAHRIG, Max / SNETHLAGE, Rolf / DREWELLO, Rainer: *3D mapping as a tool for the planning of preservation measures on sculptures made of natural stone*, in: *Environmental Earth Sciences* 77:312, 2018.

SNETHLAGE, Rolf: *Die Möglichkeit einer sachlichen Argumentation: Eine Risikoziffer für die objektive Zustandsbeschreibung als Grundlage für die Planung von Denkmalpflegemaßnahmen*, Bundesverband Deutscher Steinmetze, Leipzig 09 November 2018.

SNETHLAGE, Rolf: *Erfassen und Bewerten – die Risikoziffer als Werkzeug zur Zustandserfassung von Skulpturen im Freien*, IFS, Mainz 06 December 2018.

Long-Term Archiving of 3D Data

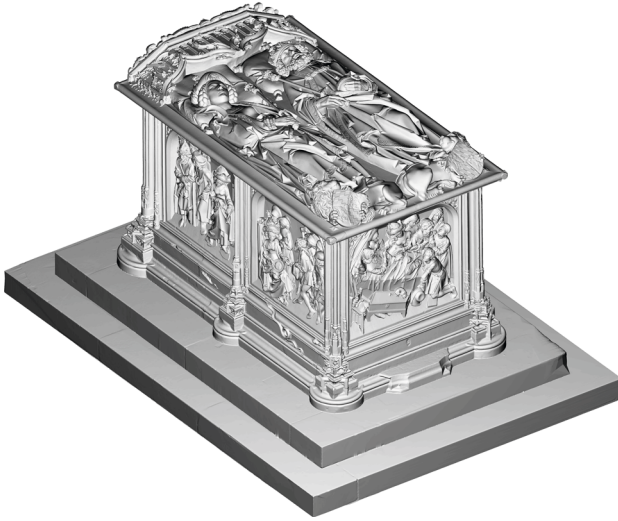


Fig. 1: 3D model of the Imperial Tomb of Henry II and Cunegunde in Bamberg Cathedral [Rahrig 2016].

Head:	Prof. Dr. Rainer Drewello
Editor:	Max Rahrig M.A.
Partners:	3D Working Group of the Bavarian State Office for Monument Protection
Duration:	2016-2017


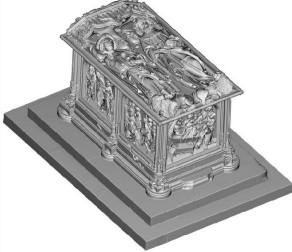

The creation of 3D models of significant cultural assets has developed into a commonly used documentation tool. In recent years, in particular, more and more low-cost technologies and open source software solutions have been developed that enable objects to be digitised and the data processed with little effort.

In large-scale research projects, entire scan streets have been developed, with which museum collections can be recorded – literally – on the assembly line in the shortest possible time. The reasons for three-dimensional recording sometimes differ enormously, ranging from scientific questions – the clarification of which a detailed surface documentation is required – to the creation of distortion-free orthophotos as the basis for mappings of all kind, right through to the web-enabled presentation of the objects on the websites of the museums and collections. The virtually complete sur-

face documentation of an object through its digital image is seen as a great advantage, particularly in the case of endangered cultural goods, and is also often used to justify the creation of a 3D model. Individual institutions even go a little further and are tempted – due to the ever better and higher-resolution 3D documentation techniques – into regarding the digital 3D data record as a possible replacement for an original:

“If the original is lost, the photo-realistic 3D models still make the image and form available and the context can be grasped. With this digital ‘3D conservation’, objects are conserved for future generations.” (Fuhrmann, Constanze / Santos, Pedro / Fellner, Dieter.“ (FUHRMANN, Constanze / SANTOS, Pedro / FELLNER, Dieter: 3D Mass Digitisation – A Milestone for Museum Use , in: Museology 80.1, 2015, 58–61). A statement that must be viewed critically. Instead, the 3D models should be understood as a digital reminder of the original at the time of the recording or as independent digital cultural heritage.

But what exactly happens to the data after it has been created and evaluated? How exactly is the 3D data of cultural assets of significance for future generations preserved? National and international cultural portals have tackled this problem and are making their data available online to a broad public. But museums, collections and state offices are also obliged to protect and preserve the digital cultural heritage long term. Therefore copies of the data records in the archives of the institutions must be stored permanently. In the course of the high-resolution, three-dimensional documentation of Bamberg’s Tomb of the Emperor, an outstanding masterpiece of medieval sculpture by Tilman Riemenschneider, uniform data formats and a standardised filing structure were defined within the 3D Working Group of the Bavarian State Office for Monument Preservation (BLfD), with whose help 3D data on durable transparent DVDs are to be archived. In this way, 3D data of significant cultural assets, such as the existing data records of the Bamberg Horseman and the Tomb of Pope Clement II, as well as newly recorded data will be archived at the BLfD. Cost and labour-intensive data maintenance, as required by standard storage media due to its very limited lifespan, is to be significantly reduced in the future. (Max Rahrig)

Das Kaisergrab im Bamberger Dom		01.03.2017
hochauflösende 3D-Dokumentation der Oberflächen		Seite 1/2
Auftraggeber: Erzbistum Bamberg Dr. Norbert Jung Leiter der Hauptabteilung Kunst und Kultur Domplatz 5 96049 Bamberg Tel. Fax E-Mail:		Auftragnehmer: Otto-Friedrich-Universität Bamberg Prof. Dr. Rainer Drewello Prof. für Restaurierungswissenschaften Am Kranen 12 96047 Bamberg Tel. E-Mail:
Objekt: Objektart: Grabmal des Kaiserpaars Heinrich II und Kunigunde Material: Algenknollenkalkstein Größe: 3,46 x 2,48 x 1,95 m (inkl. Sockel, LxBxH)	Verwendete Technik: Gerät: Steinbichler Comet L3D, Messfeld 800 mm, Oberflächenauflösung 0,5 mm, Messverfahren: Structured-Light-Scanning (SLS)	
Standort: Dom zu Bamberg, Mittelschiff.	Bearbeiter: Datenaufnahme und Aufbereitung: Frau Julia Trautwein im Rahmen ihrer Masterarbeit an der Universität Bamberg, Technische Hilfestellung: Max Rahrig M.A. und Ruth Tenschert M.A.	
Datum der Vermessung: Juli – August 2016	Zeitraum der Bearbeitung: Juli – Oktober 2016	
Datenformat der Rohdaten: Steinbichler CDB-Format, Einzelscans exportiert als *.TXT	Datenformat der finalen Daten: *.STL (geschlossenes 3D-Oberflächenmodell, ohne Texturinformation)	
Ziel der Maßnahme / Fragestellung an die Vermessung: Vollumfängliche, dreidimensionale Dokumentation des Kaisergrabs im Rahmen der Masterarbeit „Archivfähige 3D-Modellierung komplexer Oberflächen am Beispiel des Kaisergrabs im Bamberger Dom“ von Julia Trautwein im Masterstudiengang Denkmalpflege an der Universität Bamberg, 2016.		
Übersicht 01: 	Übersicht 02 oder Anmerkungen: 	
3D-Modell des Kaisergrabs	Detailansicht der Seelenwägung	

Das Kaisergrab im Bamberger Dom		01.03.2017
hochauflösende 3D-Dokumentation der Oberflächen		Seite 2/2
Ordnerstruktur und Inhalt des Datenträgers:		
Disk 1		
Report:		
<ul style="list-style-type: none"> ▪ Kaisergrab_3D-Report.pdf → Dieser Report ▪ Kaisergrab_10p.pdf → 3D-PDF mit dem Oberflächenmodell des Kaisergrabs in 10% Auflösung 		
Rohdaten:		
<ul style="list-style-type: none"> ▪ 502 TXT-Dateien der Einzelscan (Typ: Punktwolken, Maßeinheit: Millimeter) 		
Disk 2		
Report:		
<ul style="list-style-type: none"> ▪ Kaisergrab_3D-Report.pdf → Dieser Report ▪ Kaisergrab_10p.pdf → 3D-PDF mit dem Oberflächenmodell des Kaisergrabs in 10% Auflösung 		
3D-Modelle:		
<ul style="list-style-type: none"> ▪ Kaisergrab_100p.stl → Flächenmodell des Kaisergrabs, Maßeinheit Meter, Oberflächenauflösung 100% ▪ Kaisergrab_010p.stl → Flächenmodell des Kaisergrabs, Maßeinheit Meter, Oberflächenauflösung 10% 		
Orthofotos:		
<ul style="list-style-type: none"> ▪ Kaisergrab_Aufsicht_M1-1.tiff → Orthofoto, Maßstab 1 zu 1, 300 DPI, Pixelmaß: 0,084 mm ▪ Kaisergrab_Links_M1-1.tiff → Orthofoto, Maßstab 1 zu 1, 300 DPI, Pixelmaß: 0,084 mm ▪ Kaisergrab_Rechts_M1-1.tiff → Orthofoto, Maßstab 1 zu 1, 300 DPI, Pixelmaß: 0,084 mm ▪ Kaisergrab_Vorne_M1-1.tiff → Orthofoto, Maßstab 1 zu 1, 300 DPI, Pixelmaß: 0,084 mm ▪ Kaisergrab_Hinten_M1-1.tiff → Orthofoto, Maßstab 1 zu 1, 300 DPI, Pixelmaß: 0,084 mm 		

Fig. 2: Report on 3D documentation [Rahrig 2016].

RAHRIG, Max: *Wohin mit all den Scans? – Über die dauerhafte Archivierung von 3D-Daten bedeutender Kulturgüter am Beispiel des Bamberger Kaisergrabs*, in: *Das Digitale und die Denkmalpflege. Bestandserfassung – Denkmalvermittlung – Datenarchivierung – Rekonstruktion verlorener Objekte*, ed. Birgitt FRANZ and Gerhard VINKEN, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V. 26, Holzminden 2017, pp. 130 – 139.



Fig. 3: Tomb of the Emperor Henry II and Cunegunde, Bamberg Cathedral, 3D model, top view of the richly decorated cover plate [Rahrig 2016].



Fig. 4: Relief plate of the Imperial Tomb ("Ploughshare Wonder") as a photo-realistic, textured 3D model with clearly recognisable gold applications on the vestments of the imperial couple [Rahrig 2016].

EU Project Nano-Cathedral

New products with nanotechnology for stone conservation



Fig. 1: David Höpfner during the IR reflectography of a test area in Vitoria [Luib 2016].

Head:	Prof. Dr. Rainer Drewello
Editor:	Dr. Zoltán Juhász (Bamberg Centre for Empirical Studies BACES), Tamara Bock B.Sc., Christine Campen M.A., Max Rahrig M.A., Alexandra Schmölder M.A., Anna Luib M.A., David Höpfner
Partners:	19 partners from 6 countries (Italy, Germany, Spain, Austria, Belgium and Norway) under the aegis of Prof. Andrea Lazzeri (National Inter University Consortium of Materials, Science and Technology, Pisa)
Duration:	2015-2018
Funding:	EU Horizon 2020 (646178)

The Nano-Cathedral project facilitated international cooperation between institutions, universities and cathedral workshops (Dombauhütten) in six European countries with the aim of developing and testing new, tailored strengthening and waterproofing agents based on nanotechnology for

the conservation of weathered stones. In addition to large-scale experiments in the laboratory, limited areas at five outstanding historical cathedrals (Ghent, Cologne, Pia, Vitoria-Gasteiz and Vienna) and at the modern opera house in Oslo served as a test area. There were different types of rock (limestone, sandstone and marble) in different climatic areas with different weathering processes.

The University of Bamberg participated in the Nano-Cathedral project with two very different areas of expertise. A refined monitoring system with photographic methods was used to map, document and monitor the test areas at the churches and the Oslo Opera House during the test phases. Changes on the stone surface could be made visible in this way and also provided information about the effectiveness of the applied, new nano products. In contrast to the usual methods, no sample material was required for examinations.

Secondly, the expertise of the Bamberg Centre for Empirical Studies (BACES) was required to investigate the economic, social and cultural effects of the introduction of the newly developed nano-based protective and strengthening agents. Various target groups such as the producers of stone preservation agents, the users of such products and the general population were surveyed.

Monitoring

Five analysis methods, all of which belong to the NDTs (Non-Destructive-Testing Methods), were combined in the monitoring. It is also an imaging technique. With the aid of photogrammetry, the different result images are superimposed without distortion and merged into a CAD plan. UV fluorescence photography, VIS photography (colour photography), infrared reflectography, 3D scanning and 3D surface comparisons were used.

Two monitoring campaigns were implemented within the project. With the first campaign in April/May 2016, the initial condition of the test areas was documented. The documentation served as the basis for detailed preliminary examinations for the restorers of the cathedral workshop who were involved. Damage phenom-



Fig. 2: Max Rahrig and Anna Luib during the 3D digitisation of a test area at the Oslo Opera House (Norway) [Höpfner 2016].

ena and surface details such as paint residues could be easily differentiated, characterised and mapped on the plans. Based on this information, the restorers were able to determine preparatory measures before treatment with new products. In some cases, the surfaces only required cleaning with distilled water. Other test areas were covered with black crusts, which required cleaning by microparticle emitters. After completing the preparatory measures, the test fields were treated in summer 2017 with the newly developed consolidating and hydrophobising agents. The second monitoring campaign was subsequently carried out in October/November 2017. By comparing the two campaigns, surface changes due to one year of weathering, cleaning measures and treatment with the new materials can be demonstrated and visualised. The 3D comparison shows surface changes of up to 20 mm. In contrast, it is difficult to detect the surface loss in the VIS image, but possible colour changes due to the materials applied

can easily be detected. Some of the materials used are visible in the UV fluorescence image. It is therefore a suitable method for documenting the weather behaviour of UV-active preservatives, while the growth of algae, lichens and crusts can be recorded using IR reflectography. The overlay of the different techniques in a joint plan can significantly increase the value of the observation and analysis of the surfaces, and changes between several monitoring campaigns can be compared directly.

Studies of economic, social and cultural effects

BACES has focused on studying the social impact and made significant contributions to all issues. Italian partners were primarily involved in the analysis of the economic effects, and Austrian partners were primarily involved in the analysis of the cultural effects. Among other things, BACES conducted a broad representative survey of the populations in the project countries in order to determine the acceptance of new technologies and

in particular nanotechnology. In one-on-one interviews, representatives of the relevant producers of stone conservation products were asked to give an assessment of the potential of stone treatment agents based on nano. Finally, the users of strengthening and protective agents were also asked about their expectations and reservations about the newly developed agents. This was done in several workshops and particularly intensively in the context of group discussions with the stonemasons and restorers of the Cologne cathedral workshop.

The economic consequences of introducing new nano-based stone conservation products can be seen at various levels, as shown by a market analysis among the producers. The market for tailored strengthening and protection agents for stone conservation is therefore not limited to the area of heritage conservation and includes new buildings. Nanotechnology is not a major challenge for most producers, since nanomaterials are already being used in some cases, investments are constantly being made and the existing strict occupational health and safety laws are sufficient for protection during manufacture.

The population surveys in all of the countries studied showed a high degree of openness to new technologies, which the majority rated as particularly important for the development of their countries. The respondents considered themselves generally to be more technologically friendly than society as a whole. The greater the knowledge about nanotechnology, the higher the acceptance. In summary, the use of stone treatment agents on the basis of nanotechnology would currently be considered by the population as largely unproblematic.

The respondents in the countries surveyed considered the preservation of cultural assets and monuments as an important social responsibility. In their opinion, monument protection should also be promoted with public funds. However, significantly more respondents in Spain and Italy rated this aspect as more important than in Germany, Austria or even Norway. There is broad agreement that the protection and preservation of historical monuments promotes the population's cultural identity as well as tourism. A large majority prefer façades

that have been renovated and cleaned. It is interesting to note that modern architectural monuments in good condition fostered the perceived attractiveness to an even greater extent. The use of modern protective agents for the conservation of stones is generally supported.

However, the assessments by the restorers and stonemasons with regard to the use of new strengthening and protective agents were more reserved owing to their experience. There were doubts as to whether new agents have a high added value compared to conventional agents, even if the agents currently available are not always adequate. Bad experiences in the past with numerous innovations and agents, which did not live up to their expectations or even damaged the monuments, also played a role. Nevertheless, the users were open to innovations and showed interest in nanotechnology and its use in the area of monument protection. In recent decades, the field of restorers and stonemasons has also changed for the better with the introduction of different and new techniques, tools and agents.

Outlook

The Nano-Cathedral project has started a new phase in the treatment of architectural monuments. In the field of strengthening agents, the connection to mineral grain surfaces has been significantly improved through nanotechnology; more efficient bridging has been reached and a lower shrinkage behaviour has been attained than with silicic acid esters. The advantage of the new products is that they can be combined with conventional strengthening agents. However, it is still too early for a final assessment. The plan is to continue monitoring, following completion of the project, in order to test the long-term effects of the stone conservation products.

(Alexandra Schmölder, Zoltán Juhász, Max Rahrig)

RAHRIG, Max / DREWELLO, Rainer / LAZZERI, Andrea: *Opto-Technical Monitoring – A standardized methodology to assess the treatment of historical stone surfaces*, in: *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLII-2, 945–952 (<https://doi.org/10.5194/isprs-archives-XLII-2-945-2018>).

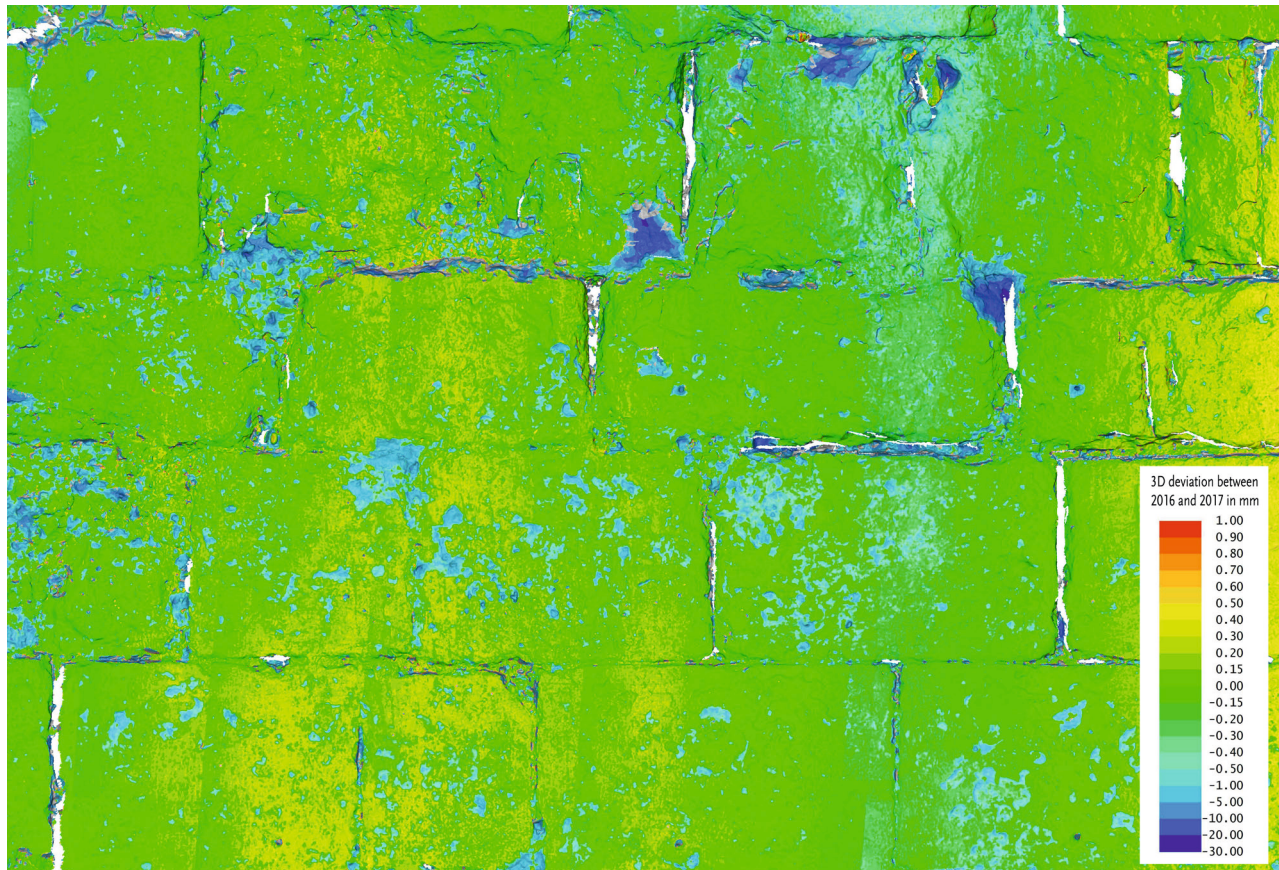


Fig. 3: Test area of Santa María in Vitoria (Spain), 3D surface comparison of the campaigns 2016 and 2017; the green areas are unchanged between the campaigns; blue shows a surface loss of up to 2.0 cm [Rahrig/Vill / Altmann 2017].

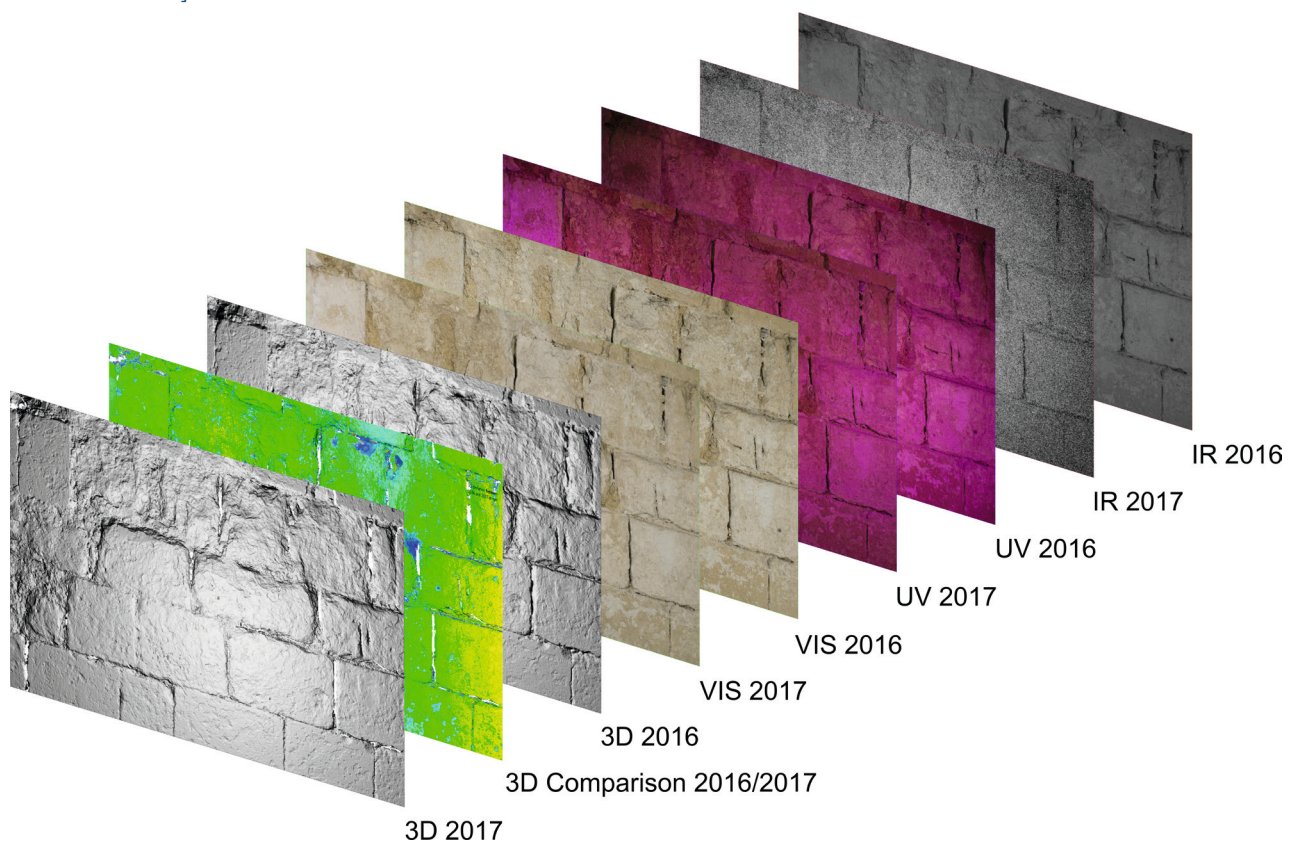


Fig. 4: Schematic structure of a CAD plan with the exact overlay of the individual measurement images of the campaigns 2016 and 2017 [Rahrig 2018].

The Emperor's Clothes in Transformation

Gold embroidered staging of the past



Fig. 1: Fibre microscope image sample K01; a gold-coloured surface with traces of processing appears under the black layer [Pristl 2018].

Head:	Prof. Dr. Stephan Albrecht
Editor:	Dipl. Geol. Martina Pristl, Dr. Tanja Kohwagner-Nikolai, Textile Conservator-Restorer Sibylle Ruß
Partners:	Dr. Holger Kempkens (Bamberg Diocesan Museum), Dipl. Biol. Ursula Drewello (Laboratory Drewello & Weißmann GmbH)
Duration:	2015-2020
Funding:	German Research Foundation

The 'emperor's clothes' of Bamberg's Cathedral Treasure (Fig. 2) are the oldest preserved textiles of European rulers worldwide, and have been associated for centuries with the name of the holy imperial couple Henry II († 1024) and Cunegunde († 1033). However, in 1127, only one 'imperial robe' was mentioned in the treasure list that could be traced to the founders of the diocese of Bamberg. Over time, the textiles varied in number from over ten to six robes in the 18th century.

Not only the liturgical meaning of the vestments has been reinterpreted over the centuries. The textiles were also repaired several times and 're-

stored', sometimes in a definitely questionable way. To the extent that all the gold embroidery was cut from the original carrier material and embroidered on new silk fabrics. As a result, the outward appearance of some the 'emperor's clothes' changed significantly. It is believed that gold embroidery was partially rearranged to promote the imperial cult and cult of the saint around Henry and Cunegunde.

Thus every textile as it appears today is not only a mixture of different 'interpretations' but also categorically made of different materials from different times. The broad-based DFG project is now shedding light on the development history of the 'emperor's robes' as well as on the manual implementation and the conceptual design.

The KDWT is to use scientific material comparisons of the different gold embroidery, gold threads, embroidery and fabrics to clarify which changes have been made to the textiles over the centuries. To that end, all six of Bamberg's 'emperor's clothes' were sampled, cross-sections of the specimens were made and investigations carried out using light microscopy (Olympus/AX 70) and fibre microscopy (Keyence/VHX 5000) as well as analytical scanning electron microscopy with energy-dispersive spectral analysis (REM: Philips/XL 40; EDS: Bruker/AXS X Flash Detector 5010). And analytical infrared spectroscopy in transmission with a diamond cell (FT-IR: PerkinElmer/Frontier/Spotlight 400) as well as with mobile X-ray fluorescence analysis (RFA: Analyticon/ Niton XL3t) were also measured.

The results can now, with textile technology and art historical analyses, be put into context with one another as well as with other early Romanesque textiles. For example, greyed threads of gold (Fig. 1), found next to gold ones, were scientifically studied on the 'blue Cunegunde coat'. This greying results from the corrosion of the metal thread, which does not actually consist of pure gold but of silver, with a wafer-thin layer of gold. Over time, the silver diffused through the gold layer and corroded to silver sulphide and hence to 'grey'.



Fig. 2: The "Bamberg Imperial Clothes" in the Diocesan Museum in Bamberg [Hendrik Steffens, Archbishop's Ordinariate Bamberg 2018]

These gold-like yet essentially silver threads are called 'Nürnberger gold' or 'Zwischen gold' and were probably an inexpensive replacement for pure gold threads. Although common as far back as in the 12th century, the production of these threads only caught on in the 15th century. This would fit well into the period of time of the first proven major restoration of the clothes, in which the gold embroidery was cut out and applied to new silk fabrics.

Also found on the 'blue Cunegunde coat' microscopic, small, whitish particle residues, which were analysed in a piece of gold embroidery on the original carrier material. It is a mixture of bone ash (hydroxyapatite) and gypsum, which is bonded with protein (glue; casein). We can assume due to this composition that they are traces of preliminary drawings. The mass of painting medium (bone ash and gypsum) and binding agent could have been painted on wet or have been used as a solid piece of chalk, similar

to the tailor's chalk of today. For the liquid application, it is likely that a warm preparation of the preliminary substance was used in situ. As chalk, it may also have been on offer commercially. In the Middle Ages, the use of bone ash was common in many areas of life; in the art of painting it was mainly used as a pigment and filler in paints and plastering mortars. For example, sketches were also found on the 'horseman coat' and identified as orpiment. This indicates that this robe may have been made in Italy. Further investigations were carried out on all 'emperor's clothes'. Elemental analysis comparisons, gold thread thickness measurements or dye analyses sometimes showed close matches – but also striking differences.

Now these scientific results have to be correlated with the humanities analyses within the framework of the DFG project in order to study the history of textiles in more depth.

Martina Pristl

Late Neolithic Stone Axe from Königsfeld/Bamberg County



Fig. 1: Green stone axe (front and back) with red lines that can be interpreted as painting [Pristl 2018].

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Editor:	Dipl. Geol. Martina Pristl; Prof. Dr.-Ing. Rainer Drewello; Dr. rer. nat. Harald Hilbig, AG Chemie
Partner:	TU Munich, Centre for Building Materials and Materials Testing
Duration:	2018–2019
Funding:	KDWT's proprietary funds

Around 5500 BC, one of the most significant upheavals in human history took place in Central Europe: the change from a nomadic hunter-gatherer community to the settled life of farmers and cattle breeders.

The previous way of life changed completely through the cultivation of edible plants, the domestication of wild animals and founding of the first permanent settlements. Regular harvests increased the population size, which also fundamentally changed the social and societal structures. To date, the exact processes of this 'Neolithic Revolution' have not been clarified in detail. They

constitute the starting point for various research projects.

Diverse neolithic settlements in the region and on the Northern Franconian Jura have been studied in recent years. Archaeological excavations by the University of Bamberg found, among other things, the oldest ditch system in Europe in a low mountain range near Königsfeld in Upper Franconia, which enclosed a settlement of the Linear Pottery culture as a fortification structure in the 50th century BC.

In 2016, a late neolithic hatchet (approx. 4200-3500 BC) was found by a volunteer collector on a freshly ploughed field, which was promptly handed over for analysis to the Chair for Pre- and Protohistoric Archaeology in Bamberg. Although it comes from the area of the early neolithic settlement, it is considerably younger than that and is probably linked to a ritual dump. An associated settlement of what is known as the Michelsberg culture is likely to be found on the nearby Kirchberg, close to Königsfeld, as stray finds of the same period from there are common.

What is striking about the find is that it resembles what are known as jadeite hatchets, whose raw material comes from the area around Monte Viso (northern Italy). These prestige objects were traded throughout Europe as far as Scandinavia for several centuries. A closer examination of the compact carrier material, using a fibre microscope, scanning electron microscopy and infrared spectroscopy (FT-IR) actually indicates a sodium aluminium silicate that corresponds to jadeite. Elevated levels of calcium and magnesium could indicate a characteristic association of the jadeite with nephrite, which would point to a different deposit. Whether the hatchet actually comes from Piedmont could not be clarified beyond doubt and requires further investigation, in particular in terms of geological investigations.

Another, much more striking feature of the stone object is, however, the brownish-red lines that appear on both sides, which could represent some kind of painting (Fig. 1). This finding would make the hatchet totally unique. In order to clarify the red marks, investigations were conducted at the KDWT, which focused on the material composition of the coloured application.

High-resolution microscope images (Keyence/

VHX 5000) showed that this 'painting', which can be interpreted as lines, dashes and dots, is a colour applied in several layers. The application is available as a colour agglomerate on the remaining preserved areas. Indications that they could be inorganic iron pigments in a binder matrix were concluded based on the high content of fine-grained iron compounds, which 'bleed' rusty-brown at the edges and changed the colour of the stone interface beneath the painting to reddish-brown. The shiny crusts, formed secondarily and to be found partly on the surface of the somewhat thicker lines, point to mobilised iron oxides (Fig. 2).

The 'bleeding' and crust formation relate to the small particle size of the iron pigments. These particles, which are only 0.002 to 0.063 mm in size, migrate through moisture and diffusion and deposit themselves on surfaces in thin but colour-intensive layers. Scanning electron microscopic analyses (SEM: Philips/XL 40; EDS: Bruker/ AXS X Flash Detector 5010) confirmed the supposition. It was also shown that the iron pigments are integrated in an organic matrix. This is inhomogeneous and interspersed with micropores and foreign particles, reminiscent of cell tissue. In addition to the typical elements of rock, such as Na, Mg, Al and Si, measurements showed above all carbon compounds with significant concentrations of Ca and Mg, Na and K, S, Cl and Fe and P (Fig. 3).

With a view to formulating a first hypothesis on the origin of the organic matrix, the comparison with the composition of blood plasma was used, from which parallels can be derived. Thus the binder of the red painting could have been a suspension of cellular components, plasma proteins, fatty acids and the electrolytes and haemoprotein found in blood. This would also explain the inhomogeneity of the matrix.

The fact that these elements can be found despite the great age of the hatchet and, above all, the long soil storage, can be explained by the protective effect of the iron crusts on the lines as well as by the secondary silicification of the layer through the deposit of microcrystalline SiO₂ due to the soil storage. FT-IR measurements (PerkinElmer/Frontier/Spotlight 400) also confirmed the finding of an organic binder and the presence of inorganic iron pigments. The latter is a mixture of iron (III) ox-



Fig. 2: Detail shot; bleeding out of the red layer and gloss effect of the thin iron crust [Pristl 2018].

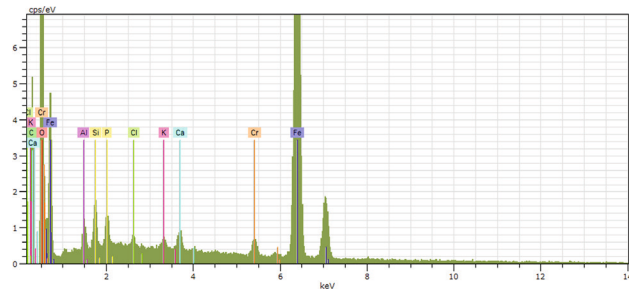


Fig. 3: Elemental analysis of SEM-EDS images of an iron oxide particle of the red lines [Pristl 2018].

ide (haematite) and umber varieties. The organic binder of the matrix can be addressed by IR spectroscopy as degenerate proteins with fatty acids (lipids). To interpret the microporous structure, the boiling of the iron pigments in a decoction of blood with remnants of fatty acid-containing tissue would be conceivable, which could result in a mass that was applied as a pastose 'paint' on the jadeite hatchet.

For the preliminary clarification of the findings, the Königsfeld hatchet was compared with another jadeite hatchet from the holdings of the Bayreuth Historical Association that was found in 1997 near Prüllsbirkig close to Pottenstein. This jadeite hatchet can also be dated to the late neolithic period. The substantial similarities are striking. This was confirmed, among other things, in analyses of the hatchets using ICP-MS measurements, which were carried out at the Technical University of Munich's Centre for Building Materials and Materials Testing in a non-destructive manner. The Pre- and Protohistoric Archaeology department is now presented with the task of debating the application of paint in a historical context with other neolithic finds and with shedding more light on the extraordinary neolithic settlements and finds in northern Bavaria in future projects.

Martina Pristl

Decorative Panel Plaster in Southern Steigerwald

Study and documentation of the preserved stock



Fig. 1: On excursions in the Hassberge Hills, outbuildings with rich plaster design [Wenderoth 2017].

Head:	Dr. Thomas Wenderoth
Editor:	Dr. Thomas Wenderoth, Dipl.-Rest. Felix Oldenburg
Partners:	Franconian Open Air Museum Bad Windsheim, Bavarian State Office for Monument Protection, Thierhaupten Building Archives
Duration:	since 2017
Funding:	KDWT's proprietary funds



Fig. 2: Großropperhausen, municipality of Frielendorf, Hesse; barn wall with rich ornamentation in the panel sections [Scherb 2006].

Ornamental panel plaster infill is the generic term for an architectural tradition that has been cultivated by painters and plasterers, particularly in rural areas, and for which the name 'scratched plasterwork' is frequently used. Common to all of these plasters is a design of the surface that involves scraping, scratching, stippling, smoothing, etc. Both the relief and the contrast of smooth to rough surfaces characterise the appearance. The individual panels are left untreated or are subsequently whitewashed extensively. In comparison, colour accents of decoration only occur occasionally.

Ornamented panel plastering is an artisanal technique that was once popular. References can be found in Hesse, Thuringia, Baden-Württemberg and Hamburg (Fig. 2–4). In Bavaria, the traceable stock extends across the three Franconian administrative districts. The occurrence has so far not been proven nationwide but rather sporadically. In between regions with an abundance lie other regions that have become known only for panel plastering without designs.

Research issue

The economic revival of the old Federal Republic also included a structural change in the traditional building trade. Old techniques disappeared and made room for modern construction and renovation techniques. In the final analysis, it is clear that the radical repair methods of the 20th and 21st century have caused the destruction of the existing historical structure on a large scale. As a result of this development, the existence of buildings with decorative panel plasterwork in the research area has dropped to less than 100.

Project

The Franconian open air museums in Fladungen and Bad Windsheim conducted an initial campaign in 2008-2009. At that time, the plaster building stocks in Lower Franconian villages of the Haßberge and Rhön-Grabfeld counties were recorded. In a new campaign in 2017-2018, the existing stock in the region around Uffenheim in western Middle Franconia were documented.

Handicrafts – preserving traditions

The investigations not only deal with the aesthetic design but with its materiality and method of manufacture. The material properties of the plasters largely determine their appearance, including the colour of the sand, its grain sizes and the properties of the binding agent. Secondly, the material properties account for the condition of the plaster sections. The fact that in some areas of investigation (e.g. Haßberge, Thuringia) historically decorative panel sections have been preserved on such a large scale over a long period of time is almost certainly due to the dolomitic amount in the binder there, while the clay-containing lime plasters along the Regnitz in Upper Franconia are largely missing. Sustainable maintenance and repair concepts as well as suitable repair mortars can only be developed based on a precise knowledge of the material.

Clarification of the manufacturing techniques is also essential for the practical preservation of monuments, since in many cases it will be a matter of a selective supplementation of at least individual defects, in addition to a purely conservational securing of the stock.

Building types

Generally, the buildings recorded so far are farm buildings of farmsteads or barns. For the 20th century, the secluded field barns on the edge of the village are also of significance. Residential buildings with decorative panel plasterwork are the exception. One reason for this could be the more frequent renovation intervals.

Traditional building stock

Most of the buildings with decorative panel plasterwork date from the first half of the 20th century (Fig. 5). However, there are also buildings from the 2nd half of the 19th century with plastering that have been preserved.

Plaster panels from the 18th century could only be reported at a storage building at the churchyard wall in Bullenheim, Ippesheim district. The age of the surviving building stock of commercial buildings corresponds to this distribution in the study area. Due to an extensive wave of new buildings in the 19th and 20th century, there is hardly an older outbuilding in half-timbered construction



Fig. 3: Hellingen, Thuringia, panel sections mid-19th century [Wenderoth 2017].



Fig. 4: Bonigen, Filderstadt, Württemberg, Haupt Strasse 7A, gable barn with wavy bands 2nd half of the 18th century [Marstaller 2017].

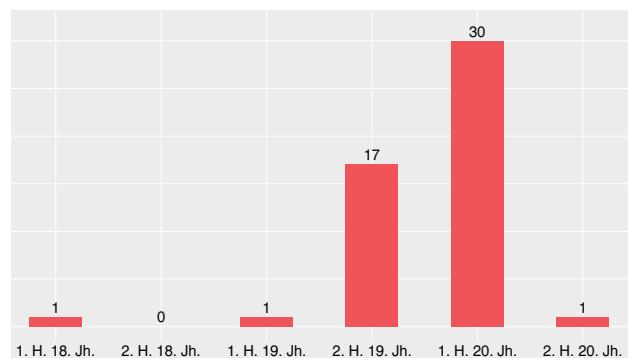


Fig. 5: Existing stock of the 18th, 19th and 20th century [Oldenburg / Arera-Rütenik 2018].

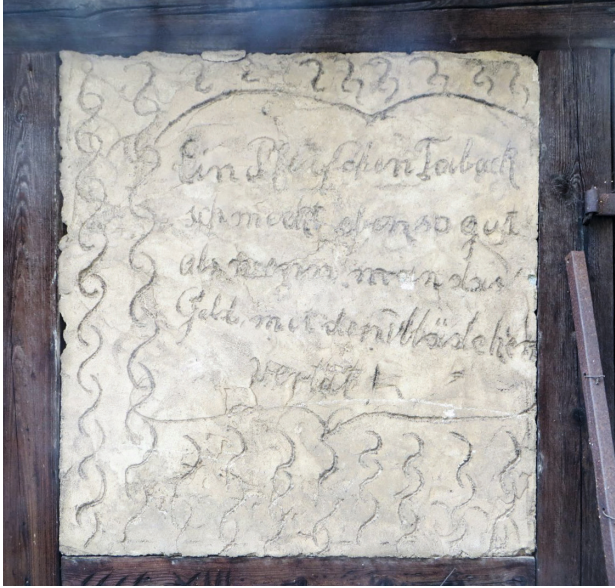


Fig. 6: Ippesheim, County Neustadt an der Aisch-Bad Windsheim (NEA), barn eaves side, panel with motto, 1922: "A pipe of tobacco tastes just as good as when you squander money on the girls" [Oldenburg 2017].



Fig. 7: Reusch, County Neustadt an der Aisch-Bad Windsheim (NEA), gable barn 2nd half of the 19th century detail; paragraph pattern with alternating dotted line [Oldenburg 2017].



8 Leesten, County BA Zur Mühle 17, gable barn 1901, renovation in 1884 [Wenderoth 2017].

and therefore no decorative panel plastering. The quantitative distribution of this design phenomenon can therefore no longer be proven for the 18th century. With the hall in Bullenheim, however, it has been proven that the tradition as a whole goes far back in time. In the 1st half of the 20th century, the design underwent another golden period. The tradition of half-timbered barns with ornamented plastering stretches back to the 1930s of the 20th century.

Distribution of ornamented half-timbered buildings

With 19 buildings, the district of Ippesheim in the county of Neustadt/Aisch - Bad Windsheim and the surrounding towns, Herrnberchtheim and Bullenheim, has the largest cumulation of properties with decorative panel plastering. With eight buildings in Herrnberchtheim, the highest concentration of the stock has been observed, most of which date from the first half of the 20th century. The regional occurrence continues to the north into southern Lower Franconia and to the west in the Main-Tauber region. So far, decorative panel plastering has only been found there sporadically.

Year dates, names and mottoes

Fortunately, a large number of the decorative half-timbered buildings are furnished with dates that have been inscribed, which in the main enable reliable dating of the buildings or the designed panel plastering. Builders and craftsmen have often immortalised themselves on the façades with initials, names and/or dates as well as places of origin.

Occasionally, mottoes with religious or secular content were scribed into the panels (Fig. 6). Figurative decorations have so far only been found once in Gülchsheim on Obere Dorf Strasse.

Material and work technology

The panel infill usually consists of quarry stone or brick and in rare cases of lime and pole infill. In the 20th century, the panels were increasingly lined with pumice concrete stones.

Then a single-layer of lime plaster would be applied. After smoothing the surface, the ornamentation would be scraped or carved into the plaster while still damp but resistant to pressure.

The tools used for this were probably triangular trowels or sharper scribing tools. To this day, no

patterns with moulds or besoms have been found in the study area that have been impressed or stippled. All surfaces recorded so far were intended purely for plaster investigation purposes. There were a few objects where the panels were covered during a later renovation phase.

A scientific analysis of the plaster stock is still pending. It is assumed that the plastering mortar used is usually bonded with non-hydraulic lime. In some cases, there is evidence of air lime mortar with hydraulic content. Superficial signs of weathering make the presence of dolomitic content unlikely. Mostly sands of medium-sized granulation with rounded off to round grains were used.

National comparison

Compared to the areas in northern Hesse, southern Thuringia, the Franconian counties of Rhön-Grabfeld and Haßberge, it can be seen that there is a decrease in the variety of ornamental and artistic design. This also applies to the work techniques used in the manufacture of the plaster ornamentation. In the regions of southern Lower Franconia, Middle Franconia and Main-Tauber Franconia, there is less ornament and work technique.

The Upper Franconian regions with ornamented panel plastering along the Regnitz and northwest of Bamberg have not yet been sufficiently researched to be able to reach final conclusions here (Fig. 7).

It is striking, however, that the design of ornamented panel plastering extends far beyond the previously known Tauber-Franconian area to the southwest into Swabia. So far, however, the only examples that have come to light there are those that correspond to the simpler tradition found in the current study area.

Pattern

The most frequently encountered design is ornamentation with scratched or scraped wavy lines that are usually vertical. These waves were either drawn as a line in one movement or executed as a 'paragraph pattern' or 'walking dog' (Fig. 8). In most cases, these wavy lines alternate with straight dotted, dashed or solid lines. Increasingly rare are panels with arched or straight dotted lines in the existing stock. (Fig. 9).

Clay panels designed with scratch patterns have



Fig. 9: Bullenheim County Neustadt an der Aisch-Bad Windsheim (NEA Hs. No.115, interior wall of inn, around 1850, detail: curved dotted lines [Wenderoth 2012]).

been well documented, particularly for indoor applications. The dispute continues as to whether this is a deliberate decoration or merely an improvement in the etching primer for a subsequent lime plaster layer. Now that an ornamental design can also be demonstrated for lime plaster panels inside the building (Fig. 9), the decorative aspect of the clay panels must also be re-evaluated as a conscious design technique.

Living tradition

Craftsmanship is still practised in some places in Franconia (Fig. 10) today. It is by no means inferior to the enduring tradition in Hesse. The aim of the research of the stocks is to raise awareness about this craft. (Thomas Wenderoth, Felix Oldenburg)



Fig. 10: Seinsheim, County KT, annexe to Bachgasse 2, with refurbished panel plastering from 2012 [Oldenburg 2017].

Historical Cultural Techniques in Construction



Fig. 1: Franconian Open Air Museum Bad Windsheim; Mr. Gottschalk explains the historical façade design [Wenderoth 2018].

Head:	Dr. Thomas Wenderoth
Editor:	Dr. Thomas Wenderoth
Partners:	Building Archives of the Bavarian State Office for Monument Protection, Thierhaupten; Franconian Open Air Museum Bad Windsheim
Duration:	KDWT's proprietary funds
Funding:	since 2017

In the last 100 years, we have experienced a rapid social change that also has an impact on architectural culture. Centuries-old handicraft traditions have given way to industrialised manufacturing techniques and construction methods. As a result, traditional ways of working are no longer in demand and have been forgotten. Thus the practical knowledge that has developed over many generations is in danger of being lost forever.

Intangible heritage

Historical cultural techniques on the monument or simply on the building are an essential part of an integral heritage conservation, which is not narrowly focused on the conservation of material substance. One may, and must, absolutely rank this knowledge of craftsmanship among humanity's

intangible heritage. Associated with this is the obligation to preserve the heritage for humanity and pass it on to the generations to come. As in the practical preservation of historical and art monuments, it is not a question of a museumisation of the heritage but of enshrining and enhancing traditional knowledge in the present. Sometimes, it seems that heritage conservation is heritage conservation's enemy, in the sense that better is the enemy of good. Preservation of historical monuments reduced to the terms of conservation and the dogma that all modern additions must be recognisable as such, strictly speaking leaves no room for traditional ways of working. With such conceptual requirements, only (modern) conservation techniques are in demand. It can only be building in the existing building – and as its innermost core, the restoration of monuments – that keeps these traditional handicraft techniques alive. Since the renovation of old buildings is primarily about repairs and not new production, the use of historical handicraft techniques is also limited here; the focus is mostly on historical repair techniques. Large-scale additions/renovations are only required if the historical stock has already been lost. If the idea of adding areas lacking in traditional handicraft techniques for the respective property were to be considered and practised when restoring historical monuments, the tradition of these building techniques and thus the preservation of the intangible heritage would appear realistic. The order volume would be sufficient to utilise to capacity a critical number of craft businesses through orders for the survival of the respective craft.

Public

The aim of this department is to familiarise the students and the public with the importance of handicraft techniques for our cultural memory. This includes information and, in particular, practical seminars, in which basic knowledge about various construction trades is imparted. One focus of the work is the collection and documentation of handicraft material evidence and manufacturing processes. Cooperation with other players is essential. First and foremost, the craftsmen themselves should be mentioned here: church painters,



Fig. 2: Intensive week in the Thierhaupten Building Archive; development of sample areas [Wenderoth 2018].

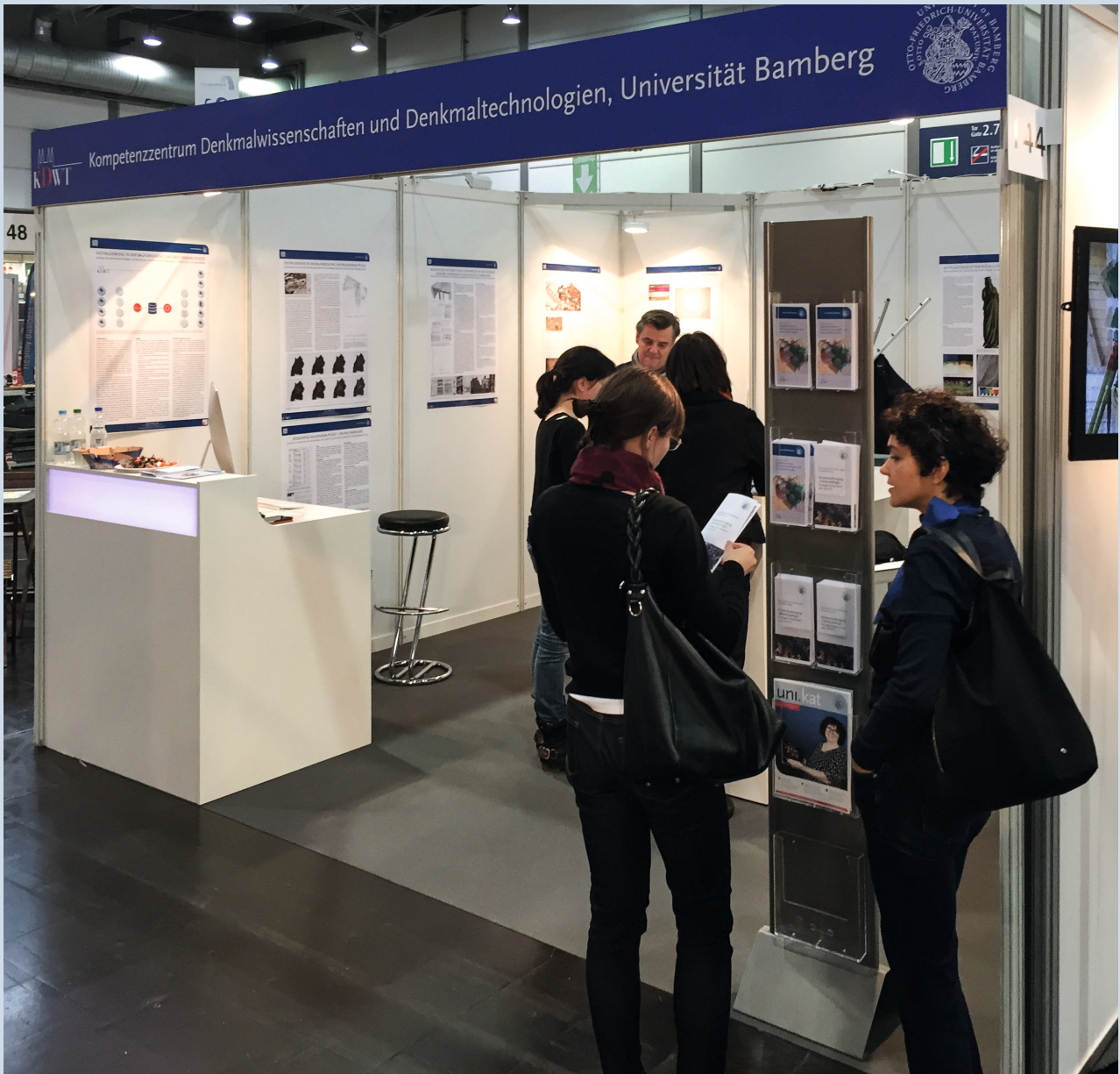
plasterers, carpenters, joiners, blacksmiths... and the corresponding restorers. Cooperation with various institutions is just as important: the Chambers of Crafts, the Stone Centre Wunsiedeln, training institutions for heritage conservation in Thierhaupten (Bavaria), Mauerbach (Austria) and Fulda (Hesse) as well as the Franconian Open Air Museum in Bad Windsheim.

Integration into the preservation sciences

With the support of the natural science laboratory at the institute, it is also possible to check empirical knowledge that has developed over centuries for its causality and thus to perpetuate the oral tradition. Scientifically based, the historical cultural techniques can also have a positive impact on modern building and the development of modern building materials, since historical building techniques are characterised by values such as sustainability and reparability. All products are usually 100% recyclable and free of pollutants. These values need to be rediscovered and they will probably be necessary to ensure a viable and liveable future for our planet. Dealing with historical cultural techniques in construction focuses on the past and the future. (Thomas Wenderoth)



Fig. 3: Intensive week Building Archive Thierhaupten; production of dry-erased lime mortar in the mortar trough by adding layered lime and sand (top); extinguishing the lime; the resultant heat leads to water vapour formation (below) [Wenderoth 2018].



TRANSFER, NETWORKING AND PUBLICATIONS

The task of the excellence centres at the University of Bamberg is primarily to pool technical expertise in order to transfer scientific knowledge to research practice and training practice as well as practical application. In this sense, the establishment of a Centre for Heritage Conservation Studies and Technologies has served from the beginning the local network and the international image of the wide-ranging monument subjects at the University of Bamberg. The projects illustrated on the previous pages can prove to be a multiplier effect of the basic financial resources in terms of content and technical equipment support for research simply by the staff of the KDWT having succeeded since 2016 – via the German Research Foundation, the Federal Foreign Office, the Federal Ministry for Education and Research, the European Commission as well as other foundations and sponsors – in acquiring and processing a substantial amount of third-party funds so as to promote the training of suitable young people and ultimately to strengthen the Bamberg location.

In addition to the implementation of projects and the processing of specialist focal topics, the activities of the past two and a half years are also listed in the following, which not only led directly to proper research projects but ensured the transfer of expertise and skills through close networking with monument authorities, national and international universities and research institutes, associations, societies and businesses; through commitment to teaching, through technical support, technical advice, testing and assessment; and through the institute's visibility at trade fairs, conferences, workshops and meetings as well as in the sphere of publishing. Thanks to this commitment, the KDWT was able to establish a presence in various German federal states, in numerous European countries and ultimately on at least three continents.

Events to be highlighted, which are carried out jointly by all departments, include, for example, participation in international trade fairs (see picture on the left) and the organising of *open days*, which are now to be held annually thanks to the favourable response. In addition to this shared commitment, a significant part of the transfer and networking services was provided by the individual departments:

Highlights for the *Heritage Conservation* include international, national and local involvement in the Research Training Group 2227 "Identity and

Heritage", in the Arbeitskreis Theorie und Lehre der Denkmalpflege e.V. (Theory and Teaching of Heritage Conservation Working Group) and during the European Heritage Year 2018 as well as the close partnerships with the BLfD, the World Heritage Centre Bamberg and the VHS.

The *Digital Heritage Technologies* presented their new work and research area, unique to Germany, in numerous publications and lectures to a specialist audience. The department was also presented to the public through technological demonstrations and work at Bamberg Cathedral during the "International Summer School Monitoring Heritage 2018". The department is affiliated with the international "Digital Heritage" community.

The *Building Archaeology, Building Research, Building History and Building Preservation* department participated, among other things, in monitoring groups, on scientific advisory boards, in expert groups and through advisory services related to UNESCO World Heritage Sites and UNESCO World Heritage candidates in Bamberg, Maulbronn, Schwerin, Mainz, Berlin and Hamburg. The department also works closely with several state offices for the preservation of historical monuments, the Chamber of Commerce and Industry and Upper Franconia Chamber of Crafts as well as with the Bavarian Chamber of Architects.

Significant contributions were made by the *Preservation Sciences* department to networking and knowledge transfer from the university to society and consisted in making contact with the Fraunhofer Institutes as established institutions for applied research, the research departments of the Leibniz Museums and the natural and engineering departments of technological faculties. Good examples of networking and transfer work are the participation in the Tandem Series at the university, with "3D Processes in the Heritage Conservation" and the establishment of a dual BA study programme in Building Preservation and Historical Work Techniques, in cooperation with the University of Applied Sciences and Arts Coburg.

On the following pages, previously undisclosed activities of the individual team members are presented in the form of lists. These activities have contributed, beyond the proper research projects, to the awareness of the Centre for Heritage Conservation Studies and Technologies through transfer, networking and, in the sphere of publishing, in science and scholarship as well as teaching and practice.

Transfer and Networking

Successful third-party funding applications and ongoing research projects

ARERA-RÜTENIK, Tobias / BREITLING, Stefan / DREWELLO, Rainer / ALBRECHT, Stephan / FREITAG, Burkhard / STENZER, Alexander: *Die Nürnberger Großkirchen. Best Practice für die digitale Erfassung komplexer Baudenkmale – Ein semantisch annotierter Plansatz (NGK) / The Nuremberg Large Churches. Best Practice for the Digital Acquisition of Complex Architectural Monuments – A Semantically Annotated Plan Set*, jointly with the Institute for Information Systems and Software Technology (IFIS) of the University of Passau and the Chair in Art History, esp. Medieval Art History at the Otto Friedrich University Bamberg, funded by the eHeritage programme of the German Federal Ministry of Education and Research, 2018–2021.

ARERA-RÜTENIK, Tobias: *Zusammenführung von Darstellungs- und Dokumentationsmethoden in der Bauforschung und praktischen Baudenkmalpflege – Datenmanagement und visualisierte Analyse / Merging of Presentation and Documentation Methods in Building Archaeology and Practical Monument Preservation – Data Management and Visualised Analysis*, financed with KDWT's proprietary funds, since 2016.

BREITLING, Stefan / ARERA-RÜTENIK, Tobias: *Schlüsselbefunde – Digitale Sammlung von Primärquellen der Bauforschung / Key Findings – Digital Collection of Primary Sources of Building Archaeology*, financed with KDWT's proprietary funds, since 2018.

BREITLING, Stefan / ARERA-RÜTENIK, Tobias: *Digitale Erfassung der Burgenlandschaft Altmühltal zur Vorbereitung einer touristischen Präsentation / Digital Capture of the Castle Landscape Altmühl Valley in Preparation for a Tourist Presentation*, jointly with the European Castles Institute of the German Castles Association, financed by the Bavarian Sparkassenstiftung, since 2016.

BREITLING, Stefan / SCHALK, Christian / SCHÖPPLEIN, Roman: *Die mittelalterliche Bauung des Bamberger Dombergs / The Medieval Development of Bamberg's Domberg*, joint initiative for large inventory, with the Bavarian State Office for the Preservation of Historical Monuments (BLfD), financed with KDWT's proprietary funds since 2016.

BREITLING, Stefan / ECKSTEIN, Claudia / APFEL, Tobias: *Baubegleitende Bauforschung am Ulmer Münster. Chor und Münsterturm / Construction Phase Building Archaeology at the Ulm Minster. Choir and Minster Tower*, jointly with the State Office for the Preservation of Historical Monuments Baden-Wuerttemberg, financed by the State Office for the Preservation of Historical Monuments Baden-Wuerttemberg, since 2012.

DREWELLO, Rainer / RAHRIG, Max: *Die „Wolkenmädchen“ von Sigiriya, Sri Lanka – Digitalisierung, Dokumentation und Konservierung bedrohter Wandmalereien / The “Cloud Damsels” of Sigiriya, Sri Lanka – Digitisation, Documentation and Conservation of Endangered Wall Paintings*, jointly with the University of Kelaniya (Sri Lanka), the Central Cultural Fund (Sri Lanka), the Department of Archaeology (Sri Lanka), financed by the Gerda Henkel Foundation, since 2018.

DREWELLO, Rainer / GRÜN, Gunnar: *Innovative Lösungen für die Ertüchtigung von historischen Bestandsfenstern unter Aspekten des Klimaschutzes - Lebenszyklusbetrachtungen und Demonstration in der Alten Schöfflerei, Kloster Benediktbeuern / Innovative Solutions for the Upgrading of Historical Existing Windows Under Aspects of Climate Protection – Life Cycle Considerations and Demonstration in the Alte Schöfflerei, Benediktbeuern Monastery*, jointly with the Fraunhofer Institute for Building Physics (IBP), financed by the Bavarian State Ministry for the Environment and Consumer Protection, since 2018.

DREWELLO, Rainer / SNETHLAGE, Rolf: *Messen und Bewerten: Eine Risikoziffer als Werkzeug, anthropogene Umweltschäden an Marmor und Sandsteinskulpturen zu erfassen und rationale begründete Entscheidungen zu deren Konservierung zu treffen / Measuring and Evaluating: A Risk Figure as a Tool to Record Anthropogenic Environmental Damage to Marble and Sandstone Sculptures and to Make Rational Decisions Based on their Conservation*, financed by the German Federal Environmental Foundation, 2016–2018.

DREWELLO, Rainer / JUHÁSZ, Zoltán / SCHMÖLDER, Alexandra / BOCK, Tamara / RAHRIG, Max: *Nano-Cathedral. Nanomaterials for conservation of*

European architectural heritage developed by research on characteristic lithotypes, jointly with 19 project partners from 6 different countries (Italy, Germany, Spain, Austria, Belgium and Norway), under the direction of Prof. Andrea Lazzeri (National Inter University Consortium of Materials, Science and Technology, Pisa), from the Otto Friedrich University of Bamberg the KDWT's Preservation Sciences department and the Bamberg Centre for Empirical Studies (BACES), financed by the Horizon2020 funding programme of the European Commission, 2015–2018.

DREWELLO, Rainer / RAHRIG, Max: *3D-Digitalisierung und Bestandsaufnahme des Kernbereichs des Zahntempels in Kandy (Sri Lanka) / 3D Digitisation and Inventory Registration of the Core Area of the Tooth Temple in Kandy (Sri Lanka)*, jointly with the Sri Dalada Maligawa – The Temple of the Sacred Tooth Relic of Lord Buddha Media & Special Project Bureau, Format4plus GmbH Digital Measuring Techniques, Format4asia (Pvt) Ltd and Infosurv Lanka Ltd, funded by the German Federal Foreign Office, 2015–2017.

ENSS, Carmen M.: *Project application for Kriegsschadensaufnahme des Zweiten Weltkriegs als Heritage-Making Moment / War Damage Recording of the Second World War as a Heritage-Making Moment*, funded by the German Research Foundation, 2019–2021.

ENSS, Carmen M.: *Geplantes Erbe. Gustavo Giovannonis und Theodor Fischers Stadtplanungen für historische Stadtbereiche der Jahre 1889 bis 1929 / Planned Heritage. Gustavo Giovannonis' and Theodor Fischer's Urban Planning for Historical Urban Areas from 1889 to 1929*, funded by the German Research Foundation 2015–2018.

HESS, Mona / HINDMARCH, John / WERNSDORFER, Mark: *Coburger Puppenmuseum. Interaktive Installation / Coburg Doll Museum. Interactive Installation*, jointly with the Coburg Doll Museum and the Coburg University of Applied Sciences and Arts (teachers and students of the Design and General Studies faculty), Chair self-financing, 2018.

HESS, Mona / HINDMARCH, John / WERNSDORFER, Mark / RAHRIG, Max: *Corpus Barocke Deckenmalereien. Schloss Arnstorf in Niederbayern / The Corpus of Baroque Ceiling Painting. Arnstorf Castle in Lower Bavaria*, jointly with the Department of Art

History, Ludwig Maximilian University of Munich, project of the Bavarian Academy of Sciences, KDWT's proprietary funds, 2018.

HEROLD, Stephanie: *Architektur- und Planungskollektive der DDR – Institutionelle Strukturen und kreative Prozesse in der sozialistischen Architekturproduktion / Architecture and Planning Collectives of the GDR – Institutional Structures and Creative Processes in Socialist Architecture Production*, jointly with the Leibniz Institute for Research on Society and Space (IRS), funded by the German Research Foundation, 2019–2021.

KEMPGEN, Sebastian / DREWELLO, Rainer / RAHRIG, Max / TENSCHERT, Ruth: *Digitalisierung des sprachlichen Kulturerbes – Die Inschriften von Sveti Naum (Makedonien) / Digitisation of Linguistic Cultural Heritage – The Inscriptions by Sveti Naum (Macedonia)*, jointly with the Professorship in Slavonic Linguistics at the Otto Friedrich University Bamberg and the University of Bitola (North Macedonia), funded by the Bavarian State Ministry for Science, 2015–2016.

LUIB, Anna: *Infrarot-Thermographie in der technischen Bauwerksanalyse. Engführung historischer und technischer Bauforschung / Infrared Thermography in Technical Building Analysis. Close Coupling of Historical and Technical Building Archaeology*, testing NDT processes in building archaeology and building preservation, in particular, on the basis of historical town halls, financed with KDWT's proprietary funds, since 2017.

RAHRIG, Max / KOCH, Julia: *Scanning Paphlagonian rock-cut tunnels in 3D*, financed with KDWT's proprietary funds, 2016–2017.

RAHRIG, Max / KOCH, Julia: *Top Tepe Tümlüsü Kurtarma Kazısı – 3D-Scanning and Documentation*, jointly with Samsun Müzesi Müdürlüğü and Prof. L. Summerer (Kastamonu University), financed with KDWT's proprietary funds, 2016.

RAHRIG, Max / DREWELLO, Rainer: *Wissenschaftliche Begleitung einer Maßnahme zum präventiven Schutz vor Umwelteinflüssen in Schloss Linderhof / Scientific Support of a Measure for Preventive Protection Against Environmental Influences in Linderhof Palace*, jointly with the Bavarian Palace Department, financed by the German Federal Environmental Foundation (DBU), 2013–2018.

SCHALK, Christian / BASSE, Eva: *Fachdienst Bauforschung und Baudenkmalpflege / Specialist Service for Building Archaeology and Architectural Monument Preservation*, digital collection of publications, handouts and standards, in consultation with the university library of the Otto Friedrich University Bamberg, financed with KDWT's proprietary funds, since 2016.

SCHALK, Christian: *Baukonstruktiver und verfahrensrechtlicher Bauerhalt / Constructive and Procedural Building Preservation*, project to create handouts in the planned series *Bamberg Recommendations for Building Archaeology and Architectural Monument Preservation*, financed with KDWT's proprietary funds, since 2016.

SELITZ, Lisa Marie: *Kommunales Denkmalkonzept Bayern (KDK) / Municipal Heritage Plan Bavaria (KDK)*, cooperation project with the Bavarian State Office for the Preservation of Historical Monuments (BLfD), financed with KDWT's proprietary funds and the Bavarian State Office for Preservation of Historical Monuments (BLfD), since 2016.

TORGE, Manfred / DREWELLO, Rainer / RAHRIG, Max: *Weiterbildung von polnischen Fachkräften zur*

Sanierung umweltgeschädigter Glasmalereien und nachhaltige Maßnahmen zur Rettung gefährdeter Farbverglasungen von hohem Wert / Further Training of Polish Specialists for the Restoration of Environmentally Damaged Stained Glass and Sustainable Measures to Save Endangered Coloured Glazing of High Value, jointly with the Federal Institute for Materials Research and Testing (BAM), funded by the German Federal Environmental Foundation (DBU), since 2017.

VINKEN, Gerhard / ALBRECHT, Stephan: *Mittelalterbilder und Denkmalpflege. Leitbilder und Bildproduktion der Denkmalpflege am Beispiel mittelalterlicher Sakralbaukunst in Deutschland und Frankreich / Middle Ages Images and Heritage Conservation. Mission Statements and Image Production of Heritage Conservation using the Example of Medieval Sacral Building Architecture in Germany and France*, funded by the German Research Foundation, 2014–2018.

WENDEROTH, Thomas: *Mietwohnungsbau in der Stadt vom Mittelalter bis zum Reichsdeputationshauptschluss / Construction of Rental Apartments in the City from the Middle Ages to the End of the Imperial Deputation*, financed with KDWT's proprietary funds, since 2018.

Current application procedures, project and cooperation initiations

ARERA-RÜTENIK, Tobias: ongoing application process *Sprache der Ewigkeit. Jüdische Grabinschriften in Deutschland von der Frühen Neuzeit bis zur Emanzipation / Language of Eternity. Jewish Epitaphs in Germany from Early Modern Times to Emancipation*, jointly with Prof. Dr. Susanne Talabardon (Otto Friedrich University Bamberg) and the Salomon Ludwig Steinheim Institute in Essen, academy application made to the academies Düsseldorf and Munich, 2017.

ARERA-RÜTENIK, Tobias: Cooperation initiation with the Junta de Andalucía for research into Islamic and Christian defensive fortifications from the 10th to 16th centuries in Andalusia, 2017.

ARERA-RÜTENIK, Tobias: Project initiation on the subject of *Conversion of Mosques, Churches and Synagogues in Europe*, jointly with the Centre for Religious Studies (CERES) of Ruhr University Bochum, the Centre for Jewish Art of Hebrew University Jerusalem, the Institute for Art History

(Islamic Art History) of the University of Vienna and Scan-3D GmbH Berlin, submission planned for the European Commission, 2017.

ARERA-RÜTENIK, Tobias / RAHRIG, Max: Project initiation on the subject of *Dokumentation historischer Denkmale in Kuba, am Beispiel der Altstadt von Baracoa / Documentation of Historical Monuments in Cuba, using as an example the Old Town of Baracoa*, jointly with Dr. Anja Heidenreich, Prof. Dr. Till F. Sonnemann and Annette Zeischka-Kenzler M.A. (Otto Friedrich University Bamberg), submission planned to BayLat, 2016–2017.

ARERA-RÜTENIK, Tobias: Initiation of cooperation with the State Office for the Preservation of Historical Monuments Baden-Wuerttemberg, Dept. Building Research on the subject of *Weiterentwicklung digitaler Dokumentations- und Distributionsmethoden in der Bauforschung / Further Development of Digital Documentation and Distribution Methods in Building Research*, 2016.

BREITLING, Stefan / SCHALK, Christian: Project initiation on the topic *Reparatur / Repair*, jointly with the Technical University of Braunschweig, the Brandenburg University of Technology in Cottbus, the Technical University of Berlin and the engineering office Barthel & Maus, 2017.

DREWELLO, Rainer / RAHRIG, Max: Project application for *Training and Education of Local Specialists in Sri Lanka in Handling Digital Surveying Techniques, Transfer of Knowledge and Technology for a Documentation of the Temple of the Sacred Tooth Relic of Lord Buddha in Kandy*, jointly with Sri Dalada Maligawa, Media & Special Project Bureau, University of Kelaniya, Department of Fine Arts, Central Cultural Fund and Cultural Triangle Project, submitted to the German Federal Foreign Office, 2016 (rejected).

HESS, Mona: ongoing application process *Establishing Digital Practices in Rare Subjects for Material Cultural Heritage* for the Volkswagen Foundation on the subject of “World Knowledge – Structural Strengthening of ‘Small Subjects’”, jointly with Prof. Dr. Christoph Schlieder, Prof. Dr. Andreas Hendrich and Prof. Dr. Christoph Rolker (Otto Friedrich University Bamberg), 2018.

HOLL, Kristina: Project application on the subject of *Klima und Kulturgut. Evaluierung von klimatisch induzierten Bewegungen an Kunstwerken und Bewertung ihres Schädigungspotenzials / Climate and Cultural Property. Evaluation of Climatically Induced Movements in Works of Art and Evaluation of their Damage Potential*, submitted to the German Federal Ministry for Education and Research in the programme for the Promotion of Young Scientists in the Humanities and Social Sciences Small Subjects, 2018.

KILIAN, Ralf / HESS, Mona / DREWELLO, Rainer / SCHÜTZ, Astrid: Project application on *SmartMuse – Smart Solution for Preventive Conservation of Collections*, jointly with the Fraunhofer Institute for Building Physics (IBP) submitted to the European Commission NMBP – 33 (proposal 814718), 2018 (rejected).

MACH, Martin / DREWELLO, Rainer et al.: Project proposal for *3D-Scan und mathematische Ähnlichkeitsanalyse am Beispiel der Bildreliefs der Bronzetür des Augsburger Doms aus dem 11. Jahrhundert – Messung der Oberflächengeometrie und topologischen Oberflächenanalyse als komplementärem Hilfsmittel zur Verifizierung kunsthistorischer Fragestellungen*

/ 3D Scan and Mathematical Similarity Analysis using the Example of the Image Relief of the Bronze Door of the Augsburg Cathedral from the 11th Century – Measurement of Surface Geometry and Topological Surface Analysis as a Complementary Tool for the Verification of Art- Historical Issues, jointly with the Bavarian State Office for the Preservation of Historical Monuments (BLfD), applied for through the eHeritage programme of the German Federal Ministry of Education and Research, 2016 (withdrawn in favour of the project *Die Nürnberger Großkirchen / The Nuremberg Churches*).

RAHRIG, Max / KOCH, Julia: Project initiation for archaeological *3d-Dokumentation und Erforschung von hellenistisch/römischen Tunnelanlagen in Paphlagonien (Türkei) / 3D Documentation and Research into Hellenistic/Roman Tunnel Systems in Paphlagonia (Turkey)*, jointly with Prof. L. Summerer (Kastamonu University) and the Justus Liebig University Gießen, 2016–2017.

SCHALK, Christian: Cooperation initiation on the topic *Reparaturtechniken im historischen Bestand / Repair Techniques in the Historical Stock*, jointly with the Technical University of Munich, Chair of Modern Monument Preservation (Prof. Andreas Putz), 2018.

SCHALK, Christian: Cooperation initiation for an initiative on the subject of *Qualitätssicherung der Planung und Ausführung in der Baudenkmalpflege / Quality Assurance in the Planning and Execution in Monument Preservation*, jointly with the Bavarian Chamber of Architects Munich, 2017.

SCHALK, Christian: Initiation of cooperation to organise information events on *Anwendung von Vorschriften in der praktischen Arbeit am Baudenkmal / Application of Regulations in Practical Work on the Monument*, jointly with the Chamber of Industry and Commerce (IHK) and the Chamber of Crafts Upper Franconia, 2017.

SELITZ, Lisa Marie: Participation in the international course *Promoting People-Centred Approaches to the Conservation of Nature and Culture – PCA17*, ICCROM and IUCN, Rome, Ercolano, Trento, 10/10/2017–20/10/2017.

VINKEN, Gerhard (app. spokesperson) / **HEROLD, Stephanie:** Interdisciplinary research group *Emotion und Erbe / Emotion and Heritage*, applied for at the German Research Foundation, 2018.

WENDEROTH, Thomas: Project application on the subject of *Inventarisierung und Erforschung ornamentierter Gefacheputze in den Landkreisen Bamberg und Forchheim* / *Inventory and Research on Ornamented Panel Plastering in the Counties of Bamberg and Forchheim*, submitted to the Oberfrankenstiftung, 2018.

Focus and support of conferences, workshops and exhibitions

ADAM, Bernd / ONNEN, Elke / PANTLI Heinz / SPOHN, Thomas / WENDEROTH, Thomas: Conceptualisation of the annual conference of the Arbeitskreis für Hausforschung e.V. 2018, *Die neuen Häuser in den neuen Städten. Neuerungen im Hausbau unter dem Einfluss der Landesherren und ihrer Baumeister zwischen 1650 und 1830* / *The New Houses in the New Cities. Innovations in House Construction under the Influence of the Rulers and their Master Builders between 1650 and 1830*, Schwerin 03/10/2018–07/10/2018.

ALBRECHT, Stephan / BREITLING, Stefan / DREWELLO, Rainer: Organisation and implementation of the international final conference of the BMBF project *Mittelalterliche Portale als Orte der Transformation* / *Medieval Portals as Places of Transformation*, Otto Friedrich University Bamberg, 11/01/2018–14/01/2018.

ALBRECHT, Stephan / BREITLING, Stefan / DREWELLO, Rainer: Organisation and implementation of the conference *Mittelalterliche Portale und ihre Benutzung* / *Medieval Portals and their Use*, Otto Friedrich University Bamberg, 23/11/2016–24/11/2016.

BREITLING, Stefan: *Interaktives digitales 4D-Stadtmodell, Bamberg um 1300* / *Interactive Digital 4D City Model, Bamberg around 1300*, Trade fair presentation at EXEMPLA 2018 „Handwerk und das kulturelle Erbe“, trade fair for handicrafts and design of the Chamber of Crafts for Munich and Upper Bavaria, Munich, 07/03/2018–13/03/2018.

DREWELLO, Rainer / RAHRIG, Max: Organisation and implementation of the workshop of the 3D-AG of the Bavarian State Office for the Preservation of Historical Monuments (BLfD), Otto Friedrich University Bamberg, 31/05/2016.

EISSING, Thomas: *Workshop Dendrochronologie und Gefügeforschung im Rheinland* / *Workshop Dendrochronology and Structural Research in the Rhineland*, LVR-Amt für Denkmalpflege im Rheinland, Brauweiler, 29/04/2017–30/04/2017.

ENSS, Carmen M. / MONZO, Luigi: Organisation and implementation of a double section *Townscapes in Transition. Transformation and Reorganisation of Italian Cities and their Architecture in the Interwar Period* / *Paesaggio in transizione: Trasformazione, riordinamento e continuità nell'architettura della città italiana tra le due guerre*, annual conference of the American Association for Italian Studies (AAIS), Sorrent (Italy), 14/06/2018–17/06/2018.

ENSS, Carmen M. / MONZO, Luigi: Workshop *Continuare la città. Principi e tendenze nella ricerca architettonica ed urbanistica di una città moderna all'italiana 1919–1945*, Bibliotheca Hertziana / Max Planck Institute for Art History, Rome, 12/07/2018–13/07/2018.

HESS, Mona / SONNEMANN, Till F. / HINDMARCH, John / WERNSDORFER, Mark: *International Summer School Monitoring Heritage*, Otto Friedrich University Bamberg, 30/07/2018–03/08/2018.

SANDMEIER, Judith / SELITZ, Lisa Marie: Organisation and implementation, *Expertenworkshop Bürgerbeteiligung in städtebaulicher Denkmalpflege und Stadtentwicklung* / *Expert Workshop on Citizen Participation in Urban Heritage Conservation and Urban Development*, Bamberg University, 28/06/2017.

SCHALK, Christian: Preparation, conceptualisation and implementation of the presentation of the KDWT at the *Welterbewochenende* / *World Heritage Weekend*, jointly with the World Heritage Centre, Ziegelbau 02/06/2018–03/06/2018.

SCHALK, Christian: Preparation, conceptualisation and implementation of the trade fair presentation of the KDWT, with own trade fair stand at *Monumento 2018* in Salzburg, Jan. 2018.

SCHALK, Christian: Preparation, conceptualisation and implementation of the trade fair presentation of the KDWT with own trade fair stand at *denkmal 2016* in Leipzig, Nov. 2016.

Scientific advisory boards, expert groups, board members, commissions

ARERA-RÜTENIK, Tobias: Member of the expert group on the UNESCO World Heritage nomination *Jüdische Großstadtfriedhöfe des späten 19. und frühen 20. Jh. in Mittel- und Osteuropa / Jewish City Cemeteries of the Late 19th and Early 20th Centuries in Central and Eastern Europe*, of the Landesdenkmalamt Berlin, ICOMOS Germany and Poland, as well as the Szent István University Budapest.

ARERA-RÜTENIK, Tobias / RAHRIG, Max / HESS, Mona: Members of the working group *3d-Rekonstruktion / 3D Reconstruction* in the Regional Association *Digital Humanities im deutschsprachigen Raum e.V (DHd)*.

BREITLING, Stefan: Chairman of the Scientific Advisory Board on the UNESCO World Heritage nomination *Das Residenzenensemble Schwerin – Kulturlandschaft des romantischen Historismus* des Landes Mecklenburg-Vorpommern / *The Residence Ensemble Schwerin – Cultural Landscape of Romantic Historicism* of the State of Mecklenburg-Western Pomerania.

BREITLING, Stefan: Member of the ICOMOS Monitoring Group for the UNESCO World Heritage Site *Maulbronn Monastery*.

BREITLING, Stefan: Scientific Advisory Board of the Initiative of the City and the World Heritage Centre Bamberg for the *Creation of a Management Plan for the UNESCO World Heritage Site Bamberg*.

BREITLING, Stefan: Scientific Advisory Board of the *Deutschen Burgenvereinigung e. V. (German Castles Association)* in Braubach.

BREITLING, Stefan: Appointment Committee for the W3 Chair *Archäologie des Mittelalters und der Neuzeit / Medieval and Modern Archaeology* at the Otto Friedrich University Bamberg.

BREITLING, Stefan: Appointment Committees *Intelligentes Monitoring und Simulation / Intelligent Monitoring and Simulation* at Coburg University of Applied Sciences and Arts.

BREITLING, Stefan: Chairman of the Appointment Committee for the W2 Professorship *Restaurierungswissenschaften in der Baudenkmalpflege / Preservation Sciences in Building Preservation* at the Otto Friedrich University Bamberg.

BREITLING, Stefan: Managing Director of the *Instituts für Archäologie, Denkmalwissenschaften und Kunstgeschichte / Institute for Archaeology, Heritage Sciences and Art History (IADK)* of the Otto Friedrich University Bamberg.

BREITLING, Stefan / DREWELLO, Rainer / VINKEN, Gerhard: Members of the *Deutsches Nationalkomitee für Denkmalschutz / German National Committee for Monument Protection (DNK)*.

DREWELLO, Rainer / RAHRIG, Max / HESS, Mona / LUIB, Anna: Members of the *3D-Arbeitsgruppe / 3D Working Group* of the Bavarian State Office for Monument Protection (BLfD).

DREWELLO, Rainer: Advisory Board of the Fraunhofer Centre Benediktbeuern.

DREWELLO, Rainer: Advisory Board for projects of the Deutschen Bundesstiftung Umwelt / German Federal Environmental Foundation (DBU).

DREWELLO, Rainer: Member of the review board in accreditation procedures at Potsdam University of Applied Sciences and the Rhein-Main University.

DREWELLO, Rainer: Chairman of the Board of Trustees of the *Doctor Robert Pfleger Foundation*.

HESS, Mona: Member of the advisory group *Big Picture* for the handling of large volume data sets in the context of digitising three-dimensional objects, funded by the Bayerisches Wirtschaftsministerium (Bavarian Ministry of Economic Affairs).

HEROLD, Stephanie: Member of the board (secretary) of the *Arbeitskreises Theorie und Lehre in der Denkmalpflege e.V. / Working Group Theory and Teaching in Heritage Conservation*.

LUIB, Anna: Member of the *AG Gleichstellung / Equalisation* of the Otto Friedrich University Bamberg as a representative of the mid-level faculty.

LUIB, Anna: Member of the *AG Nachhaltigkeit / Sustainability* of the Otto Friedrich University Bamberg as a representative of the mid-level faculty.

RAHRIG, Max: Member of the *Centre Council of the KDWT* as a representative of the staff.

RAHRIG, Max: Representative of the scientific staff in the appointment committee for the W3 Professorship *Digitale Denkmaltechnologien / Digital Technologies in Heritage Conservation* at the Otto Friedrich University Bamberg.

VINKEN, Gerhard: Chairman of the *Arbeitskreis-Theorie und Lehre der Denkmalpflege e.V / Working Group Theory and Teaching of Heritage Conservation*.

VINKEN, Gerhard: Member of the *Dehio-Vereinigung e.V. / Dehio Association*.

VINKEN, Gerhard: Member of the jury of the 3rd ICOMOS student competition *60plus – U-Bahnen und Verkehrsanlagen / the Underground Railways and Traffic Infrastructure*, Berlin 2018.

VINKEN, Gerhard: Member of the jury of the 9th Messeakademie. A student competition: *DenkMal Nutzung (Monument Utilisation)*, Leipzig 2016.

VINKEN, Gerhard: Member of the DFG Research Training Group 2227 „*Identität und Erbe / Identity and Heritage*“ (Bauhaus University Weimar / Technical University Berlin).

VINKEN, Gerhard: Member of the jury of the 10th Messeakademie. A student competition: *Entwerfen im historischen Umfeld - Altbau.Umbau.Neubau / Design in an Historical Environment – Old Building. Reconstruction.New Building*, Leipzig 2018.

VINKEN, Gerhard: Member of the appointment committee for the W2 Professorship *Restaurierungswissenschaften in der Baudenkmalpflege / Preservation Sciences in Building Preservation* at the Otto Friedrich University Bamberg.

VINKEN, Gerhard: Chairman of the appointment committee for the W3 Professorship *Digitale Denkmaltechnologien / Digital Technologies in Heritage Conservation* at the Otto Friedrich University Bamberg.

Content, methodical and technical support and consultation

ARERA-RÜTENIK, Tobias: Advising the Generaldirektion Kulturelles Erbe, Rheinland-Pfalz (Directorate-General for Cultural Heritage, Rhineland-Palatinate) and the University of Heidelberg on documentation and monument management for the UNESCO World Heritage Initiative *SchUM (Jüdisches Erbe in Speyer, Mainz und Worms / Jewish Heritage in Speyer, Mainz and Worms)*.

ARERA-RÜTENIK, Tobias: Advising the Denkmalschutzamt Hamburg on documentation and monument management for the UNESCO World Heritage Initiative *Jüdischer Sephardenfriedhof in Hamburg-Altona / Jewish Sephardic Cemetery in Hamburg-Altona*.

HESS, Mona: Advising the Bamberg State Dom-
bauhütte on imaging procedures for the *Replika der Kunigunde am Diözesanmuseum / Replica of the Cunegunda at the Diocesan Museum*, which was carried out at the Erlangen Fraunhofer Development Centre for X-ray Technology EZRT.

LUIB, Anna: Consulting on and preparation of surveying technology, transport and usage planning for the project *Archaeological, Architectural and Historical Prospections of a Medieval District Rab-e Rashidi, Tabriz, Iran (Gerda Henkel Foundation)*, Chair in Islamische Kunstgeschichte und

Archäologie (Islamic Art History and Archaeology) of the Otto Friedrich University Bamberg.

LUIB, Anna: Methodical and technical support for the preparation and implementation of the scanning campaign in the cathedral in Zeitz; evaluation of possible uses of infrared thermography for the investigation of historical vaults, University of Coburg (Prof. Olaf Huth).

LUIB, Anna: 2D and 3D measurement and creation of true-to-form plan sets for the project *Moschee und Siedlung von Cuatrovitas. Archäologische und baugeschichtliche Untersuchung einer almohadenzeitlichen Moschee und Wüstung / Mosque and Settlement of Cuatrovitas. Archaeological and Architectural History Investigation of an Almohad Mosque and Lost Settlements (DFG)*, Chair in Islamische Kunstgeschichte und Archäologie (Islamic Art History and Archaeology) of the Otto Friedrich University Bamberg.

PRISTL, Martina: technical and equipment support for 11 master's theses and 4 doctorates in the NCh Laboratory.

RAHRIG, Max: technical and equipment support for 12 master's theses and 3 doctorates in the ndt Laboratory.

RAHRIG, Max: scientific and technical support for graduates of the Master's degree programme in Heritage Conservation on issues concerning the use of digital documentation techniques.

RAHRIG, Max: technical and equipment support for the project *Bamberger Dom Digital / Bamberg Cathedral Digital*.

RAHRIG, Max: Support of the *Corpus der barocken Deckenmalerei in Deutschland / Corpus of Baroque Ceiling Painting in Germany* of the Bavarian Academy of Sciences and Humanities through the development of alternative documentation techniques to record the ceiling paintings, since 2016.

RAHRIG, Max: 3D scan of two coats of arms of the Würzburg Cathedral for the Rothkegel company as the basis for the creation of custom-fit recording devices for the medieval panes for presentation in the exhibit *Julius Echter – Der umstrittene Fürstbischof – Eine Ausstellung nach 400 Jahren / Julius Echter – The Controversial Prince Bishop - An Exhibition 400 Years Later*, Würzburg, 22/06/2017 – 17/09/2017.

RAHRIG, Max: scientific, technical support for the project *Risikoziffer – Entwicklung eines konservatorischen Bewertungssystems zum Schutz anthropogen geschädigter Sandstein- und Marmorskulpturen sowie dessen modellhafte Evaluierung am Beispiel national bedeutender Sammlungen / Risk Figure – Development of a Conservation Rating System for the Protection of Anthropogenically Damaged Sandstone and Marble Sculptures as well as its Exemplary Evaluation using as an Example Nationally Significant Collections*, 2016–2018.

RAHRIG, Max: scientific and technical support for the archaeological excavations of the *Roman Metropolis of Pompeiopolis* (Turkey), 2016–2017.

SCHALK, Christian: scientific and technical support for the repair of the *Synagogue in Laudenbach*, jointly with the Verein Synagoge Laudenbach e.V., 2018.

VINKEN, Gerhard: Advising the *Wissenschaftsausschusses (AG Denkmalpflege) / Scientific Committee (AG Heritage Conservation)* of the Bavarian State Parliament.

Support and implementation of courses

The Heritage Sciences department at the Otto Friedrich University Bamberg and the highly successful degree programmes based here benefit from the close networking with the Centre for Heritage Conservation Studies and Technologies. Research and teaching by the professors taking the lead at the KDWT are essential in the four fields of Heritage Conservation, Building Archaeology, Preservation Sciences and Digital Heritage Technologies for the development of the profile of the study programmes based at the department. Furthermore, the staff at the KDWT have enriched the curriculum of the heritage conservation courses with additional offers, or represented the institute's expertise through guest courses in other study programmes at the University of Bamberg, or in courses at other universities and colleges:

ARERA-RÜTENIK, Tobias: *Building Ceramics/Large Ceramics in Building History*, seminar, subsidiary subject on Kulturgutsicherung (cultural property protection), Otto Friedrich University Bamberg; winter semester 2018/19.

ARERA-RÜTENIK, Tobias: *Medieval Large Buildings*, seminar and intensive week with excursion to the castles in Anlautertal, Master's degree in Heritage Conservation, Otto Friedrich University Bamberg, summer semester 2018

ARERA-RÜTENIK, Tobias: *Introduction to Scientific Work*, guest seminar as part of the Master's programme in Bühnenbild und Szenischer Raum, Technical University Berlin, summer semester 2016.

ARERA-RÜTENIK, Tobias: *Introduction to Scientific Work*, guest seminar as part of the Master's programme in Bühnenbild und Szenischer Raum, Technical University Berlin, summer semester 2016.

EISSING, Thomas: *Roof Constructions*, lecture and seminar (day-long), Bachelor's degree in Civil Engineering, University of Applied Sciences Würzburg, 09/01/2018.

EISSING, Thomas: *The Development of Roof Constructions from Antiquity through to the 19th Century*, Building History II. Lecture series, Bachelor degree in Architecture, Technical University Berlin, 28/06/2016.

ENSS, Carmen M. / HEROLD, Stephanie: *Giants in the City. Qualities of Large Buildings of the 60s and 70s in Franconia*, seminar, Master's degree in Heritage Conservation, Otto Friedrich University Bamberg, winter semester 2018/19.

ENSS, Carmen M.: *Heritage Conservation in Nuremberg from 1900 to Present Day*, seminar, Master's programme in Heritage Conservation, Otto Friedrich University Bamberg, winter semester 2016/17.

HESS, Mona / WERNSDORFER, Mark: Technical support for the seminar *Heraldry on Site* through a geospatial database, Historical Basic Sciences (Christoph Rolker), Otto Friedrich University Bamberg, summer semester 2018.

HÖNIG, Svenja: *History and Theory of Heritage Conservation I*, seminar for the lecture, Master's degree in Heritage Conservation, Otto Friedrich University Bamberg, winter semester 2018/19.

LUIB, Anna: *Introduction to Infrared Thermography*, guest lecture in the seminar on Digital Heritage Technologies (Mona Hess), Otto Friedrich University Bamberg, 23/10/2018.

LUIB, Anna: *System-Compatible Renovations? Monument Repair 1975–1995 using the Example of Historic Town Halls in Franconia*, guest lecture in the advanced seminar on Historical Geography (Andreas Dix), Otto Friedrich University Bamberg, 17/05/2018.

PRISTL, Martina: *Mortar Analysis*, seminar, Master's degree in Heritage Conservation, Otto Friedrich University Bamberg, summer semester 2016, winter semester 2016/17, summer semester 2017, winter semester 2017/18.

RAHRIG, Max: *Evaluation and Post-Processing of 3D Data*, block seminars, Master's degree in Heritage Conservation, Otto Friedrich University Bamberg, winter semester 2015/16, winter semester 2017/18.

SCHALK, Christian: *Fire Protection in the Architectural Monument*, guest contribution in the lecture "Fundamentals of Building Archaeology and Building Preservation" (Stefan Breitling), Master's degree in Heritage Conservation, Otto Friedrich University Bamberg, winter semester 2017/18.

WENDEROTH, Thomas: *Historical Plastering Techniques*, seminar and intensive week with excursions to the Bauarchiv (Building Archive) of the Bayerisches Landesamtes für Denkmalpflege (Bavarian State Office for Monument Protection), Thierhaupten, Master's course in Heritage Conservation, Otto Friedrich University Bamberg. Summer semester 2017, summer semester 2018.

WENDEROTH, Thomas: *Quality Assurance in Heritage Conservation – Concept Development*, seminar with excursions, Master's degree in Heritage Conservation, Otto Friedrich University Bamberg, winter semester 2018/19.

WENDEROTH, Thomas: *Introduction to the Theory and Practice of Heritage Conservation*, seminar with excursion, Institute of Art History, Friedrich Alexander University Erlangen-Nuremberg, winter semester 2018/19.

WENDEROTH, Thomas: *Energy Consultant for Architectural Monuments*, lecturer on the subjects: Architectural History, Heritage Conservation, funding opportunities, Q Punkt Nuremberg, since 2014.

Publications and Lectures

Independent and non-independent written works, publishers

ARERA-RÜTENIK, Tobias: *Aparejo toledano – Kosteneffizienz und Rationalisierung in der Architektur Zentralspaniens zwischen dem 10. und 16. Jahrhundert*, in: „Mit den wohlfeilsten Mitteln dauerhaft, feuersicher und bequem“. Sparsamkeit als Prinzip, Rationalität als Weltsicht?, ed. Stefan M. HOLZER et al., Schriftenreihe der Gesellschaft für Bautechnikgeschichte 2, Dresden 2019, pp. 17–32

ARERA-RÜTENIK, Tobias: *Digital Humanities in der Bauforschung. Systematik und Potential kodierter Bau- und Befundbeschreibungen als Wissensgewinnungs- und Wissensdistributionswerkzeug*, in: Bauforschung in der Denkmalpflege – Qualitätsstandards und Wissensdistribution, Forschungen des Instituts für Archäologie, ed. Stefan BREITLING and Jürgen GIESE, Denkmalkunde und Kunstgeschichte 5, Bamberg 2018, pp. 219–242 (<https://doi.org/10.20378/irbo-51734>).

ARERA-RÜTENIK, Tobias: *Transformation von Moscheen zu Kirchen auf der Iberischen Halbinsel*, Berliner Beiträge zur Bauforschung und Denkmalpflege 14, Petersberg 2017.

ARERA-RÜTENIK, Tobias: *Digitale Technologien in der Bauforschung und in der Praktischen Baudenkmalpflege – Entwicklung, Aufgaben, Perspektiven*, in: Das Digitale und die Denkmalpflege. Bestandserfassung – Denkmalvermittlung – Datenarchivierung – Rekonstruktion verlorener Objekte, ed. Birgitt FRANZ and Gerhard VINKEN, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V. 26, Holzminden 2017, pp. 60–67 (<https://doi.org/10.11588/arthistoricum.263.348>).

ARERA-RÜTENIK, Tobias / KOLLATZ, Thomas: *Interdisziplinäre Perspektiven auf Grabmale und Visualisierung räumlicher Strukturen. Ergebnisse eines Projektes zu historischen jüdischen Friedhöfen*, in: Objekt und Schrift. Beiträge zur materiellen Kultur des Jüdischen, ed. Katrin KESSLER et al. Jüdisches Kulturerbe 1, Braunschweig 2016, pp. 25–29.

BENTLIN, Felix / HEROLD, Stephanie / HUTTERER, Florian: *Städtebauliche Motive im Hobrechtschen Berlin*, in: Das Hobrechtsche Berlin. Wachstum, Wandel und Wert der Berliner Stadterweiterung, ed. Gabi DOLFF-BONEKÄMPER, Angela MILLION and Elke PAHL-WEBER, Berlin 2018, pp. 140–167.

BENTLIN, Felix / HEROLD, Stephanie / HUTTERER, Florian: *Das Quartier Bellermannstraße*, in: Das Hobrechtsche Berlin. Wachstum, Wandel und Wert der Berliner Stadterweiterung, ed. Gabi DOLFF-BONEKÄMPER, Angela MILLION and Elke PAHL-WEBER, Berlin 2018, pp. 154–171.

BREITLING, Stefan / GIESE, Jürgen (ed.): *Bauforschung in der Denkmalpflege – Qualitätsstandards und Wissensdistribution*, Forschungen des Instituts für Archäologie, Denkmalkunde und Kunstgeschichte 5, Bamberg 2018 (<https://doi.org/10.20378/irbo-51734>).

BREITLING, Stefan / GIESE, Jürgen: *Digitale Kartierungen in der Bauforschung und der Baudenkmalpflege*, in: Bauforschung in der Denkmalpflege – Qualitätsstandards und Wissensdistribution, ed. Stefan BREITLING and Jürgen GIESE, Forschungen des Instituts für Archäologie, Denkmalkunde und Kunstgeschichte 5, Bamberg 2018, pp. 163–186 (<https://doi.org/10.20378/irbo-51734>).

BREITLING, Stefan: *Bauforscher in der Denkmalpflege. Aufgaben, Berufsfeld und Perspektiven*, in: Bauforschung, Österreichischen Zeitschrift für Kunst- und Denkmalpflege 72.1/2, 2018, pp. 22–33.

BREITLING, Stefan / APFEL, Tobias / ECKSTEIN, Claudia: *Bauforschung am Ulmer Münster 2012-2017 – Eine Projektkooperation zwischen dem Landesamt für Denkmalpflege und der Otto-Friedrich-Universität Bamberg*, in: Denkmalpflege in Baden-Württemberg – Nachrichtenblatt der Landesdenkmalpflege, 2018, pp. 31–37.

BREITLING, Stefan / BUBA, Martin / FUHRMANN, Jan: *Building Knowledge Spaces – Scientific Reconstruction and Modelling of the Medieval City of Bamberg*, in: Virtual Palaces, Part II. Lost Palaces and their Afterlife. Virtual Reconstruction between Science and Media, ed. Stephan HOPPE, Stefan BREITLING and Heike MESSEMER, PALATIUM e-Publication 3, Munich 2016, pp. 201–208 (<http://www.courtresidences.eu/uploads/publications/virtual-palaces-II.pdf>).

BREITLING, Stefan: *Denkmalpflege digital. Interview*, in: Restauratoren Handbuch 2016/2017, ed. Restauero, München 2016.

BREITLING, Stefan: *Das Bauwerk als Erlebnis- und Forschungsraum. Bauforschung und Baugeschichte analysieren das architektonische Erbe unserer Kultur*, in: Uni.vers Forschung Juni 2016, Blühende Vielfalt im Wissenschaftsgarten. Warum kleine Fächer für Universitäten eine profilbildende Bedeutung haben, 2016, pp. 44–47.

CHIZHOVA, Maria / GURIANOV, Andrej / HESS, Mona / LUHMANN, Thomas / BRUNN, Ansgar / STILLA, Uwe: *Semantic segmentation of building elements using Point Cloud Hashing*, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci. 42-2, 2018, pp. 241–250 (<https://doi.org/10.5194/isprs-archives-XLII-2-241-2018>).

DREWELLO, Rainer (ed.): *Risikoziffer. Umweltschäden an Marmor- und Sandsteinskulpturen erfassen und objektiv bewerten*, Forschungen des Instituts für Archäologische Wissenschaften, Denkmalwissenschaften und Kunstgeschichte 12, Bamberg 2018.

DREWELLO, Rainer / DREWELLO, Ursula: *Materialtechnische Anforderungen zur Konsolidierung hydrophober historischer Feinputze – ein praxisbezogener Modellversuch*, in: Schriftenreihe des Bayerischen Landesamtes für Denkmalpflege 17, 2017, pp. 143–154.

DREWELLO, Rainer / DREWELLO, Ursula: *eine eigene von mir selbst erfundene geheime Manier*, in: Für Thron, Altar, Salon. Der Modelleur Carl Schropp (1794–1875) in Erfurt und Bamberg, ed. Horst GEHRINGER, Regina HANEMANN and Robert ZINK, Schriften der Museen der Stadt Bamberg 52 (= Stadtarchiv Bamberg 25, Schriftenreihe of the Historischer Verein Bamberg 46), Neustadt an der Aisch 2016, pp. 79–85.

EISSING, Thomas: *Nachhaltigkeit und dauerhafte Archivierung dendrochronologischer Datierungen*, in: Bauforschung in der Denkmalpflege – Qualitätsstandards und Wissensdistribution, ed. **Stefan BREITLING** and Jürgen GIESE, Forschungen des Instituts für Archäologie, Denkmalkunde und Kunstgeschichte 5, Bamberg 2018, pp. 197–212 (<https://doi.org/10.20378/irbo-51734>).

EISSING, Thomas: *Dendrochronologische Datierung des hölzernen Figureschmucks vom Paradiesportal des Hohen Doms in Paderborn*, in: Gotik – Der Paderborner Dom und die Baukultur des 13. Jahrhunderts in Europa, ed. Christoph STIEGEMANN, Fulda 2018, pp. 97–105.

EISSING, Thomas: *Das Neue Brau- und Backhaus des Franckeschen Waisenhauses von 1739 in Halle*, in: Keltern, Brauen, Brennen – Baulichkeiten der Produktion und der Lagerung, ed. Michael GOER et al., Jahrbuch für Hausforschung 67, Fulda 2018, pp. 191–202.

EISSING, Thomas / KRAUS, Sabrina: *Vom Pirckheimer Stübchen zum Koberger Schrankstübchen – Neue Erkenntnisse zu einer außergewöhnlichen Holzkonstruktion des späten 15. Jahrhunderts*, in: Wartburgjahrbuch 2016, ed. Günter SCHUCHHARDT, Regensburg 2017, pp. 131–167.

ENSS, Carmen M.: *Baupflege für die Nachkriegsstadt. Verhandlungen um moderne bürgerliche Bauweisen*, in: Architektur und Akteure. Praxis und Öffentlichkeit in der Nachkriegsgesellschaft, ed. Regine HESS, Bielefeld 2018, pp. 105–118.

ENSS, Carmen M.: *Stadt und Landschaft kuratiert. Denkmalpflege und Städtebau in Bergamo und an der Amalfiküste*, in: Uni.vers Forschung Mai 2018, Der universelle Wert. Neue Perspektiven auf das Welterbe in Bamberg und in aller Welt, 2018, pp. 32–36.

ENSS, Carmen: *Ambiente. Theodor Fischers und Gustavo Giovannonis frühe Aneignungen der alten Stadt für die moderne Großstadt nach 1890*, in: Die schöne Stadt. Begriffe und Debatten, Theorie und Praxis in Städtebau und Architektur, ed. Uwe ALTROCK and Sandra HUNING, Planungsrundschau 24, 2017, pp. 143–169.

ENSS, Carmen M.: *Münchens geplante Altstadt. Städtebau und Denkmalpflege ab 1944 für den Wiederaufbau*, München 2016.

ENSS, Carmen M.: *Neue Leitlinien für die Denkmalpflege*, in: Strukturwandel – Denkmalwandel. Umbau, Umnutzung, Umdeutung, ed. Birgit FRANZ and Ingrid SCHEURMANN, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V. 25, Holzminden 2016, pp. 96–103.

ENSS, Carmen M.: *Der Weg des Städtebauers Theodor Fischer von den Münchner Altstadt-Experimenten zur Kritik homogenisierender Altstadt-Produktion*, in: Produkt Altstadt. Historische Stadtzentren in Städtebau und Denkmalpflege, ed. **Carmen M. ENSS** and **Gerhard VINKEN**, Urban Studies, Bielefeld 2016, pp. 75–90.

ENSS, Carmen M. / VINKEN, Gerhard (eds.): *Produkt Altstadt. Historische Stadtzentren in Städtebau und Denkmalpflege*, Urban Studies, Bielefeld 2016.

FRANZ, Birgit / VINKEN, Gerhard (eds.): *Das Digitale und die Denkmalpflege. Bestandserfassung – Denkmalvermittlung – Datenarchivierung – Rekonstruktion verlorener Objekte, Veröffentlichung des Arbeitskreises Theorie und Lehre der Denkmalpflege e.V.* 26, Holzminden 2017, pp. 12–19 (<https://doi.org/10.11588/arthistoricum.263.348>).

GOER, Michael / EISSING, Thomas / MAY, Herbert / STIEWE, Heinrich / SCHMID-ENGBRODT, Anja (eds.): *Bauernhausforschung in Deutschland und der Schweiz. Bericht über die Tagung des Arbeitskreises für Hausforschung e.V. in Villingen-Schwenningen vom 1. bis 3. Oktober 2012*, Jahrbuch für Hausforschung 63, 2018.

GOER, Michael / EISSING, Thomas / MAY, Herbert / STIEWE, Heinrich / SCHMID-ENGBRODT, Anja (eds.): *Fassaden – Historische Gestaltung von Bauten und des öffentlichen Raumes. Bericht über die Tagung des Arbeitskreises für Hausforschung e.V. in Basel vom 29. September bis 3. Oktober 2014*, Jahrbuch für Hausforschung 65, 2018.

GOER, Michael / EISSING, Thomas / MAY, Herbert / STIEWE, Heinrich / SCHMID-ENGBRODT, Anja (eds.): *Kellern, Brauen, Brennen – Baulichkeiten der Produktion und der Lagerung. Bericht über die Tagung des Arbeitskreises für Hausforschung e.V. in Neustadt an der Weinstraße vom 3. bis 6. Oktober 2016*, Jahrbuch für Hausforschung 67, 2018.

GUNZELMANN, Thomas / SANDMEIER, Judith / SELTZ, Lisa Marie / VINKEN, Gerhard: *Das »Kommunale Denkmalkonzept«. Eine Perspektive für mehr Eigenverantwortung von Kommunen und Bürgergesellschaft im System Denkmalpflege*, Die Denkmalpflege 75/1, 2017, pp. 20–26.

HEROLD, Stephannie: *Heritage und ‚Denkmal-Kultus‘. Industriedenkmale zwischen ‚material turn‘ und Alterswert*, in: *Denkmal – Erbe – Heritage. Begriffshorizonte am Beispiel der Industriekultur*, ed. Simone BOGNER et al., Veröffentlichungen des Arbeitskreises Theorie und Lehre der Denkmalpflege 27, Holzminden 2018, pp. 38–45 (<https://doi.org/10.11588/arthistoricum.374.531>).

HEROLD, Stephannie: *„nicht, weil wir es für schön halten“.* *Zur Rolle des Schönen in der Denkmalpflege*, Edition Kulturwissenschaft 138, Bielefeld 2018.

HEROLD, Stephanie: *Bilder vergangener Utopien. Inszenierungen des Leerstands in der Bildproduktion der Urban Explorer*, in: *Vakanz. Ästhetiken und Semantiken architektonischen Leerstands*, ed. Julian BLUNK, Kritische Berichte 3/2018, Zeitschrift für Kunst- und Kulturwissenschaften 46, 2018, pp. 47–54.

HEROLD, Stephanie: *Disziplinäre und ideengeschichtliche Hintergründe*, in: *Das Hobrechtsche Berlin. Wachstum, Wandel und Wert der Berliner Stadterweiterung*, ed. Gabi DOLFF-BONEKÄMPER, Angela MILLION and Elke PAHL-WEBER, Berlin 2018, pp. 106–123.

HEROLD, Stephanie: *Utopische Momente im Bebauungsplan von 1862*, in: *Das Hobrechtsche Berlin. Wachstum, Wandel und Wert der Berliner Stadterweiterung*, ed. Gabi DOLFF-BONEKÄMPER, Angela MILLION and Elke PAHL-WEBER, Berlin 2018, pp. 124–139.

HEROLD, Stephanie: *Bilder des Hobrechtschen Berlin. Von der modernen Metropole zur Metropole der Moderne*, Das Hobrechtsche Berlin. Wachstum, Wandel und Wert der Berliner Stadterweiterung, ed. Gabi DOLFF-BONEKÄMPER, Angela MILLION and Elke PAHL-WEBER, Berlin 2018, pp. 346–357.

HEROLD, Stephanie: *Das Hobrechtsche Berlin als Werk*, in: *Das Hobrechtsche Berlin. Wachstum, Wandel und Wert der Berliner Stadterweiterung*, ed. Gabi DOLFF-BONEKÄMPER, Angela MILLION and Elke PAHL-WEBER, Berlin 2018, pp. 358–371.

HEROLD, Stephanie: *Die Substanz des Plans und die geplante Substanz. Der Berliner ‚Hobrechtplan‘ als städtebauliches Erbe*, in: *Denkmalpflege braucht Substanz. Jahrestagung der Vereinigung der Landesdenkmalpfleger in der Bundesrepublik Deutschland und 83. Tag für Denkmalpflege*, 7. – 10. Juni 2015 in Flensburg, ed. Landesamt für Denkmalpflege Schleswig-Holstein, Beiträge zur Denkmalpflege in Schleswig-Holstein 6, Kiel 2017, pp. 136–148.

HEROLD, Stephanie: *Schön und gut. Moralvorstellungen in ästhetischen Stadtkonzepten*, in: *Die schöne Stadt. Begriffe und Debatten, Theorie und Praxis in Städtebau und Architektur*, ed. Uwe ALTROCK and Sandra HUNING, Planungsrundschau 24, 2017, pp. 169–208.

- Hess, Mona / GREEN, Susie / MATHYS, Aurore / GUERY, Julien: *3D laser scanning* (p. 199), *Structure From Motion* (p. 243), *Photogrammetry* (p. 229), in: *Digital Techniques for Documenting and Preserving Cultural Heritage*, ed. Anna BENTKOWSKA-KAFEL and Lindsay W. MACDONALD, Kalamazoo 2017 (<https://www.jstor.org/stable/j.ctt1xp3w16>).
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EISSING, Thomas: *Fränkische Tafelmalerei des Spätmittelalters – Kontexte, Funktionen, Techniken. Erste Ergebnisse der dendrochronologischen Datierung, Holzherkunftsbestimmung, Holzqualität und Holzbearbeitung für ausgewählte Nadelholztafeln des Germanischen Nationalmuseums (Franconian Panel Painting from the Late Middle Ages – Contexts,*

Functions, Techniques. First results of the dendrochronological dating, determination of the origin of the wood, wood quality and wood processing for selected softwood panels of the Germanic National Museum), Meeting of experts, Germanic National Museum Nuremberg 02/06/2016 – 03/06/2016.

EISSING, Thomas: *Flößerei von Bauholz. Die ungebundene und gebundene Flößerei und ihr Nachweis im Bestand (Rafting of construction timber. The Unbound and Bound Rafting and its Evidence in the Stock)*, Propstei Johannesberg 31/05/2016 – 01/06/2016.

EISSING, Thomas: *Von der Bausubstanz als Bedeutungsträger. Das Waisenhaus und das Lange Haus der Franckeschen Stiftungen – die Analyse des materiellen Bestands als Beitrag zum Verständnis von Franckes Bauintentionen (Of the Building Structure as a Carrier of Meaning. The Orphanage and the Long House of the Francke Foundations – the Analysis of the Material Stock as a Contribution to the Understanding of Francke's Building Intentions)*, Die andere Seite des Barock. Sozialfürsorge und Bildungsbauten im 17. und 18. Jahrhundert, historisches Waisenhaus Halle 06/04/2016 – 08/04/2016.

EISSING, Thomas: *Zum Problem von dendrochronologischen Datierungen im 19. und 20. Jahrhundert in Bayern (On the Problem of Dendrochronological Datings in the 19th and 20th Century in Bavaria)*, University of the German Federal Armed Forces in Munich 04/02/2016.

EISSING, Thomas: *Reorganisation der Dendrochronologie nach den historischen Holztransportwegen in Bayern (Reorganisation of the Dendrochronology According to the Historical Timber Transport Routes in Bavaria)*, Friedrich Alexander University Erlangen 27/01/2016.

ENSS, Carmen M. / MONZO, Luigi: *Paesaggi in transizione in un'Italia che si rinnova*, Continuare la città. Principi e tendenze nella ricerca architettonica ed urbanistica di una città moderna all'italiana 1919–1945, Bibliotheca Hertziana / Max Planck Institute for Art History, Rome, 12/07/2018.

ENSS, Carmen M.: *Heritage Planning for a polycentric city. Symposium Urban Integration - From Walled City to Integrated City*, Transforming City Regions III, Zeche Zollverein, Essen 29/05/2018.

ENSS, Carmen M.: *Eingeschränkte Spielräume. Münchner Architekten zwischen Sanierung und Neuplanung (Limited Scope. Munich Architects between Renovation and New Planning)*, Architektur und Akteure in der Nachkriegsgesellschaft: Praxis, Öffentlichkeit, Ethos, Technical University of Munich 22/06/2017.

ENSS, Carmen M.: *Rebuilding Munich, "Post war cities"*, Bauhaus University Weimar 28/01/2017.

ENSS, Carmen M.: *Stunde Null? Wiederaufbauplanungen für München (Zero Hour? Reconstruction Planning for Munich)*, Evangelische Akademie Tutzing 13/01/2017.

ENSS, Carmen M.: *La ricostruzione a Monaco di Baviera tra 1945 e 1958*, Dipartimento di Architettura der Università degli studi di Napoli Federico II 22/04/2016.

ENSS, Carmen M.: *Designing Urban Transformation: Historic cities in Italy and Germany between 1890 and 1940*, Grand Tour del terzo millennio, giornata di studio curata da Giuseppe Bonaccorso e Claudia Conforti, Università di Roma 2, Tor Vergata 21/04/2016.

HESS, Mona: *Digitale Denkmaltechnologien – optische Vermessungsmethoden und Sensortechnik integriert in der klassischen Denkmalpflege (Digital Heritage Technologies – Optical Measurement Methods and Sensor Technology Integrated in Classic Monument Preservation)*, Geodetic Colloquium, Jade University of Oldenburg, 06/12/2018.

HESS, Mona: *Digitale Denkmaltechnologien (Digital Heritage Technologies)*, 1. Oberfränkischer Masterstag der Technologieallianz Oberfranken, Bayreuth University, 01/12/2018.

HESS, Mona: *Digital Technologies in Heritage Conservation – integration of optical surveying and measurement methods and sensor technologies into classical heritage conservation*, Colloquium in Digital Cultural Heritage, University of Cologne 31/10/2018.

HESS, Mona: *Digitale Denkmaltechnologien – Digitalisierung von Kulturgut in allen Maßstäben und Dimensionen (Digital Heritage Technologies – Digitisation of Cultural Assets at All Levels of Scale and Dimension)*, Inaugural Lecture, Otto Friedrich University Bamberg, 24/10/2018.

Hess, Mona: *Digitales Erbe. Vortrag über die Möglichkeiten der Digitalisierung im Bereich Denkmalpflege und Museumskunde (Digital Heritage. Lecture on the Possibilities of Digitisation in the Field of Preservation of Historical Monuments and Museum Studies)*, lecture series 25 Jahre Kulturerbe Bamberg und Akteure der Denkmalpflege – Berichte aus der Praxis, Bamberg, 29/05/2018.

Hess, Mona: *Überblick über das neue Kompetenzzentrum Denkmalwissenschaften und Denkmaltechnologien (Overview of the new Centre for Heritage Conservation Studies and Technologies)*, Stiftung Domstadt Bamberg 18/05/2018.

Hess, Mona: *Education and professional development towards cross-disciplinary roles in 3D imaging and digital heritage technologies in Europe*, Konferenz 3D Imaging in Cultural Heritage, with the Support of IPERION-CH (Integrated Platform for the European Research Infrastructure on Cultural Heritage), British Museum London 09/11/2017–10/11/2017.

Hess, Mona: Object-based teaching and learning for a critical assessment of digital technologies in arts and cultural heritage, Internationales Symposium CIPA “Digital Workflows for Heritage Conservation”, Carleton University Ottawa (Canada) 28/08/2017–01/09/2017.

Herold, Stephanie: *What a feeling...? Die Begegnung mit dem Objekt als emotionaler Prozess (What a feeling...? The Encounter with the Object as an Emotional Process)*, lecture as part of the lecture series of the Research Training Group 2227 “Identity and Heritage”, Technical University Berlin 30/10/2018.

Herold, Stephanie: *„Authentic“ emotions and curated decay. Urban wastelands as refuges and sights*, Workshop “From horror vacui to spaces of re-enchantment: art, ecology, and urban wastelands”, University of the Arts Berlin 18/05/2018–19/05/2018.

Herold, Stephanie: *Erhaben, kitschig, atmosphärisch. Ästhetische Praxen der Urban Explorer zwischen Ästhetisierung und ‚authentischer‘ Gefühlsäußerung (Sublime, Kitschy, Atmospheric. Aesthetic Practices of the Urban Explorer between Aestheticisation and ‘Authentic’ Expression of Feelings)*, „Cool Retro Camp Trash. Aesthetic Concepts in Popular Culture“, Centre for Popular Culture and Music, Freiburg 02/05/2018–05/05/2018.

Herold, Stephanie: *Heritage und ‚Denkmal-Kultus‘. Industriedenkmale zwischen ‚material turn‘ und Alterswert (Heritage and ‘Monument Cult’. Industrial Monuments between ‘Material Turn’ and Age Value)*, Heritage – Inheritance – Monument. Horizons of Terminology, annual meeting of the Arbeitskreis für Theorie und Lehre in der Denkmalpflege e.V. and the DFG Research Training Group 2227 “Identity and Heritage”, Technical University Berlin, 05/10/2017.

Hönig, Svenja: *Neue Kompetenzen auf bewährtem Fundament: Das KDWT und der Masterstudiengang Denkmalpflege in Bamberg (New Competencies on a Proven Foundation: The KDWT and the Master’s programme in Heritage Conservation at Bamberg)*, annual conference of the Vereinigung der Landesdenkmalpfleger, European Cultural Heritage Year (ECHY) 2018 – Erinnerung und Aufbruch, Trier 10/06/2018–13/06/2018.

Holl, Kristina / Rahrig, Max: *Monitoring von klimatisch bedingten Bewegungen mit Hilfe des Structured Light-Scannings am Beispiel der historischen Ausstattung von Schloss Linderhof (Monitoring Climate-Related Movements with the Help of Structured Light Scanning using the Example of the Historical Equipment at Linderhof Palace)*, 3D–Durchblick oder Datenmüll? Dreidimensionale Scan-Verfahren in der Konservierung/Restaurierung, expert conference of the Verband der Restauratoren, University of Fine Arts Dresden 01/03/2018–03/03/2018.

Holl, Kristina / Rahrig, Max / Janis, Katrin: *Monitoring of microclimate changes on wooden panels in Linderhof Palace*, Wood Science and Technology II. Microclimates for Panel Paintings, Maastricht 20/10/2016–21/10/2016.

Koch, Julia / Rahrig, Max: *Decorated Sarcophagi from Pompeiopolis - Approaches of Reconstructing the εὐώνιον οἶκον*, Contextualising Pompeiopolis. Urban Development in Roman Anatolia from a Comperative Perspective, Taşköprü (Turkey) 09/07/2016–10/07/2016.

Luib, Anna: *Infrarot-Thermographie in der Bauforschung und Bauwerksdokumentation - Einsatzmöglichkeiten und Grenzen (Infrared Thermography in Building Archaeology and Building Structure Documentation – Possible Uses and Limits)*, Autumn Conference of the Verband der Restauratoren im Zimmererhandwerk e.V., Coburg 20/10/2018.

RAHRIG, Max / VOGELPOHL, Melanie: *Welche Themen, Ziele, Materialien etc. sollten die Konservierungswissenschaften in den kommenden Jahren vorantreiben? (Which Topics, Goals, Materials Etc. Should the Conservation Sciences Advance in the Coming Years?)*, Moderation of Subject Area 2, Quo vadis Konservierungswissenschaften, Conference of the German Federal Environmental Foundation, Kunstgewerbemuseum Berlin, 19/06/2018–20/06/2018.

RAHRIG, Max / DREWELLO, Rainer / LAZZERI, Andrea: *Opto-Technical Monitoring – a standardized methodology to assess the treatment of historical stone surfaces*, ISPRS TC II Mid-term Symposium “Towards Photogrammetry 2020”, Riva del Garda (Italy) 04/06/2018–07/06/2018.

RAHRIG, Max: *Wohin mit all den Scans? Über die dauerhafte Archivierung von 3D-Daten bedeutender Kulturgüter am Beispiel des Bamberger Kaisergrabs (What to do with all the Scans? On the Permanent Archiving of 3D Data of Important Cultural Assets using the Example of the Bamberg Imperial Tomb)*, working meeting of 3D-AG, The Bavarian State Office for Monument Protection (BLfD), Ludwig Maximilian University Munich, 29/01/2018.

RAHRIG, Max: *Monitoring of the Trial Areas, Nano-Cathedral 4th Workshop*, Vitoria-Gasteiz (Spain) 25/01/2018–26/01/2018.

RAHRIG, Max / LANG, Desireé / HOEPNER, Sophie / DREWELLO, Rainer / FÜSSENICH, Peter: *High Resolution Monitoring of Historical Surfaces by using Shearography and Structured Light Scanning*, Poster presentation, 3D Imaging in Cultural Heritage Conference, The British Museum, London 09/11/2017–10/11/2017.

RAHRIG, Max: *High-tech for preserving Sri Lankan Cultural Heritage Sites – 3D-Documentation of the Temple of the Sacred Tooth Relic in Kandy*, Plenary Speaker, Building Alliances for Global Knowledge through Digital Scholarship, 3rd International Conference on the Humanities, Kelaniya (Sri Lanka) 26/10/2017–27/10/2017.

RAHRIG, Max / LUIB, Anna: *Sri Dalada Maligawa – 3D-Scanning and Documentation of the Temple of the Sacred Tooth Relic at Kandy, Sri Lanka*, Digital Workflows for Heritage Conservation, ICOMOS/ISPRS International Scientific Committee on Heritage Documentation, 26th International CIPA Symposium, Ottawa 28/08/2017–01/09/2017.

RAHRIG, Max / LUIB, Anna / RUPPERT, Godehard: *3D-Dokumentation und Bestandserfassung des Kernbereichs des Zahntempels in Kandy (3D Documentation and Inventory Registration of the Core Area of the Tooth Temple in Kandy)*, final presentation, Kandy (Sri Lanka) 23/05/2017.

RAHRIG, Max / LUIB, Anna / RUPPERT, Godehard: *Gastvorträge zur Präsentation des Projekts 3D-Dokumentation und Bestandserfassung des Kernbereichs des Zahntempels in Kandy (Guest Lectures on the Topic of the Presentation of the Project 3D Documentation and Inventory Registration of the Core Area of the Tooth Temple in Kandy)*, University of Kelaniya (Sri Lanka) 22/05/2017.

RAHRIG, Max / DREWELLO, Rainer / SPICALE, Victoria: *Topographische Aufnahmeanalyse barocker Decken – Methodenvergleich am Beispiel von Prunkräumen der neuen Residenz Bamberg (Topographic Image Analysis of Baroque Ceilings – Method Comparison using the Example of State Rooms of the New Bamberg Residence)*, Digitale Raumdarstellung. Barocke Kunst im Kontext aktueller Zugriffe der Spatial Humanities, Marburg 03/04/2017–04/04/2017.

RAHRIG, Max / LUIB, Anna / TENSCHERT, Ruth: *3D-Dokumentation und Bestandserfassung des Kernbereichs des Zahntempels in Kandy (3D Documentation and Inventory Registration of the Core Area of the Tooth Temple in Kandy)*, working meeting of the 3D-AG, the Bavarian State Office for Monument Protection (BLfD), Otto Friedrich University Bamberg 31/05/2016.

RAHRIG, Max / LUIB, Anna / HÖPFNER, David: *Nanomaterials for conservation of European architectural heritage developed by research on characteristic lithotypes*, working meeting of the 3D-AG, Bavarian State Office for Monument Protection (BLfD), Otto Friedrich University Bamberg, 31/05/2016.

RAHRIG, Max / TENSCHERT, Ruth: *3D-Systemvergleich am Beispiel des Elfenbein-Kruzifixus aus dem Bamberger Diözesanmuseum (3D System Comparison using the Example of the Ivory Crucifix from the Bamberg Diocesan Museum)*, working meeting of the 3D-AG, Bavarian State Office for Monument Protection (BLfD), Otto Friedrich University Bamberg, 31/05/2016.

RAHRIG, Max / TENSCHERT, Ruth: *3D-Dokumentation und Bestandserfassung des Kernbereichs des*

Zahntempels in Kandy (Sri Lanka) (3D Documentation and Inventory Registration of the Core Area of the Tooth Temple in Kandy (Sri Lanka)), workshop discussion of the IADK, Otto Friedrich University Bamberg, 29/01/2016.

SANDMEIER, Judith / SELITZ, Lisa Marie: *Das Kommunale Denkmalkonzept Bayern (The Municipal Heritage Plan Bavaria)*, Stadterneuerung in Klein- und Mittelstädten, Arbeitskreis Stadterneuerung, Technical University Kaiserslautern 21/07/2018–22/07/2018.

SCHALK, Christian: *Konstruktiver Bauerhalt an Wohngebäuden im Raum Nürnberg 1975–1995 (Constructive Building Conservation of Residential Buildings in the Nuremberg Area 1975–1995)*, workshop discussion at the IADK, Otto Friedrich University Bamberg 06/07/2018.

SCHALK, Christian: *Erschließung der Archivalien des Erzbischöflichen Bauamts und Archivs des Erzbistums. Kelleranlagen der Domkurien – Vorbereitung eines Kellerkatasters zum Domberg (Access to the Archival Documents of the Archbishop's Building Control Office and Archives of the Archdiocese. Cellar Facilities of the Cathedral Curiae – Preparation of a Cellar Cadastre for the Cathedral Hill (Domberg))*, fourth editors' meeting of the Kunstdenkmäler-Inventar Bamberger Domberg, Bamberg 03/11/2017.

SCHÖPPLEIN, Roman: *Der Bamberger Domberg – Seine strukturelle und bauliche Gestalt vom Frühmittelalter bis zum Ende des Hochmittelalters (The Bamberg Cathedral Hill – Its Structural and Architectural Form from the Early Middle Ages to the End of the High Middle Ages)*, Advanced Colloquium in Art History, Otto Friedrich University Bamberg 01/07/2017.

SCHÖPPLEIN, Roman: *Die Kuriengebäude des Bamberger Dombergs – Archäologie, Archivbestände (The Curia Building of the Bamberg Cathedral Hill – Archaeology, Archive Holdings)*, third meeting of the editors of the Inventory of the Kunstdenkmäler-Inventar Bamberger Domberg, Bamberg 31/05/2017.

SCHÖPPLEIN, Roman: *Der ‚vicus judeorum‘ in Bamberg (The ‚vicus judeorum‘ in Bamberg)*, inter judeos – Topographie und Infrastruktur jüdischer Quartiere, workshop of the Arbeitsgruppe Mittelalter im Netzwerk Jüdisches Kulturerbe, Erfurt 12/05/2017.

SCHÖPPLEIN, Roman: *Zwischenergebnisse der Prospektionen auf dem Bamberger Domberg (Interim Results of the Pprospections on the Bamberg Cathedral Hill (Domberg))*, second meeting of the editors of the Kunstdenkmäler-Inventar Bamberger Domberg, Bamberg 21/11/2016.

SELITZ, Lisa Marie: *Schnittstellen als Herausforderung (Interfaces as a Challenge)*, practical workshop of the Bavarian State Office for Monument Protection (BLfD) on the subject Erfahrungsaustausch Kommunales Denkmalkonzept – Schnittstellen, Kommunen, Landesamt, Universität, Planer, Bürgerschaft, Thierhaupten 23/11/2017.

SELITZ, Lisa Marie: *Managing the Historic Urban Landscape of Bavaria in respect to the ‚participatory turn‘*, Heritage Communities, Université de Québec à Montréal, Canada Research Chair on Urban Heritage, Montréal 27/09/2017–29/09/2017.

SELITZ, Lisa Marie: *Ein interdisziplinärer Blick auf das städtebauliche Erbe (An Interdisciplinary View of Urban Heritage)*, Wissenschaft zur Mittagszeit, Welterbezentrum Bamberg 02/07/2017.

SELITZ, Lisa Marie: *Kommunales Denkmalkonzept Bayern (Municipal Heritage Plan Bavaria)*, study visit by a delegation from the Council of Europe and the EU initiative „Community-led Urban Strategies in Historic Towns“, University of Bamberg, 26/07/2016.

VINKEN, Gerhard: *„Wessen Erbe?“ – „Wer Spricht?“ Sharing Heritage und seine Grenzen („Whose Heritage?“ – „Who speaks?“ Sharing Heritage and Its Limits)*, lecture series of the Research Training Group 2227 „Identity and Heritage“, Technical University Berlin 28/11/2017.

VINKEN, Gerhard: *Roundtable Chiang Mai – a new candidate for the UNESCO World Heritage List?*, Otto Friedrich University Bamberg 18/10/2017.

VINKEN, Gerhard: *Denkmal – Erbe – Heritage. Begriffshorizonte am Beispiel der Industriekultur (Monument – Inheritance – Heritage. Conceptual Horizons using the Example of Industrial Culture)*, panel discussion, „Industrie.Erbe.Landschaft – Identitätskonstruktion in ‚post‘-industriellen Gesellschaften“, working group Theory and Education of Heritage Conservation / Research Training Group 2227 „Identity and Heritage“ 05/10/2017 – 07/10/2017.

VINKEN, Gerhard: *Municipal Heritage Conservation Plans and Participation. Laboratory Citizen Participation*, panel discussion, Das Kommunale Denkmalkonzept Bayern, Science Day of the Nuremberg Metropolitan Region 28/07/2017.

VINKEN, Gerhard: *Die Lust am Digitalen (The Desire for the Digital)*, Das Digitale und die Denkmalpflege, annual conference of the working group Arbeitskreis Theorie und Lehre der Denkmalpflege e.V., Bauhaus University Weimar 29/09/2016.

VINKEN, Gerhard: *Freistellung – Rahmung – Zonierung: Die „Bildmacht“ des Denkmals als Ergebnis räumlicher Praktiken (Release – Framing – Zoning: The “Image Power” of the Monument as a Result of Spatial Practices)*, Die Bildmacht des Denkmals. Ikonisierung und Erlebnis archäologischer Denkmäler im Stadtbild, Arbeitskreis Bodendenkmäler im Rheinland / Archäologisches Gedächtnis der Städte of the Fritz Thyssen Foundation, Apostelnkloster Cologne 07/04/2016 – 08/04/2016.

VINKEN, Gerhard: *Unstillbarer Hunger nach Echtem? Lübecks Altstadt zwischen Wiederaufbau, Rekonstruktion und Themenarchitektur (Insatiable Hunger for the Real Thing? Lübeck’s Old Town between Rehabilitation, Reconstruction and Theme Architecture)*, lecture series: Wo steht Lübeck morgen?, Lübeck 20/01/2016.

WENDEROTH, Thomas: *Typenhaus und serielles Bauen in der Barockzeit – Der Erfolg des „Erlanger Hauses“ (Typical House and Serial Construction in the Baroque Period – The Success of the “Erlangen House”)*, Die neuen Häuser in den neuen Städten. Neuerungen im Hausbau unter dem Einfluss der Landesherren und ihrer Baumeister zwischen 1650 und 1830, annual meeting of the Arbeitskreis für Hausforschung e.V., Schwerin 04/10/2018.

WENDEROTH, Thomas: *Das Pfarrhaus in Mittelfranken – die fachgerechte Erhaltung wichtiger Kulturzeugnisse (The Rectory in Middle Franconia – the Professional Preservation of Important Cultural Evidence)*, meeting of the Bezirksheimatpflege Mittelfranken, Franconian Open Air Museum Bad Windsheim 06/07/2018.

WENDEROTH, Thomas: *Mietshaus und Mietwohnung auf dem Land bis 1800 – Entwicklung, Verbreitung und Typologie am Beispiel des Nürnberger Umlandes (Tenement and Flat in the Country until*

1800 – Development, Distribution and Typology using the Example of the Nuremberg Surrounding Area), workshop discussion by the IADK, Otto Friedrich University Bamberg 06/07/2018.

WENDEROTH, Thomas: *Denkmalpflegerischer Umgang mit historischer Farbigkeit (Preservation of Historical Colours)*, Akteure in der Denkmalpflege, Otto Friedrich University Bamberg 08/06/2018.

WENDEROTH, Thomas: *Die separate Wohnungerschließung bei städtischen Mietshäusern vor 1800 (The Separate Development of Flats in Municipal Tenements before 1800)*, annual meeting of the Arbeitskreis für Hausforschung e.V., Regionalgruppe Bayern, Münnerstadt 08/06/2018.

WENDEROTH, Thomas: *Die Entwicklung der Fensterkonstruktion ab 1500 – Ein Überblick zur Geschichte des Fensters (The Development of the Window Construction from 1500 – An Overview of the History of the Window)*, theme day at the Bauernmuseum Frensdorf 06/05/2018.

WENDEROTH, Thomas: *Fenster im Denkmal - Was tun? Möglichkeiten und Alternativen (Window in the Monument – What Can Be Done? Possibilities and Alternatives)*, theme day at the Bauernmuseum Frensdorf 06/05/2018.

WENDEROTH, Thomas: *Pfarrhäuser und Denkmalpflege in Mittelfranken (Parsonages and Preservation of Monuments in Middle Franconia)*, „Nicht Dorfhäuser und nicht Villa... das evangelische Pfarrhaus“, Franconian Open Air Museum Bad Windsheim 18/11/2017.

WENDEROTH, Thomas: *Erlangen – Eine komplexe barocke Stadtplanung? (Erlangen – A Complex Baroque Urban Planning?)*, Planned Communities in the Age of Enlightenment, international conference, Institute of East European History, University of Vienna, 27/10/2017.

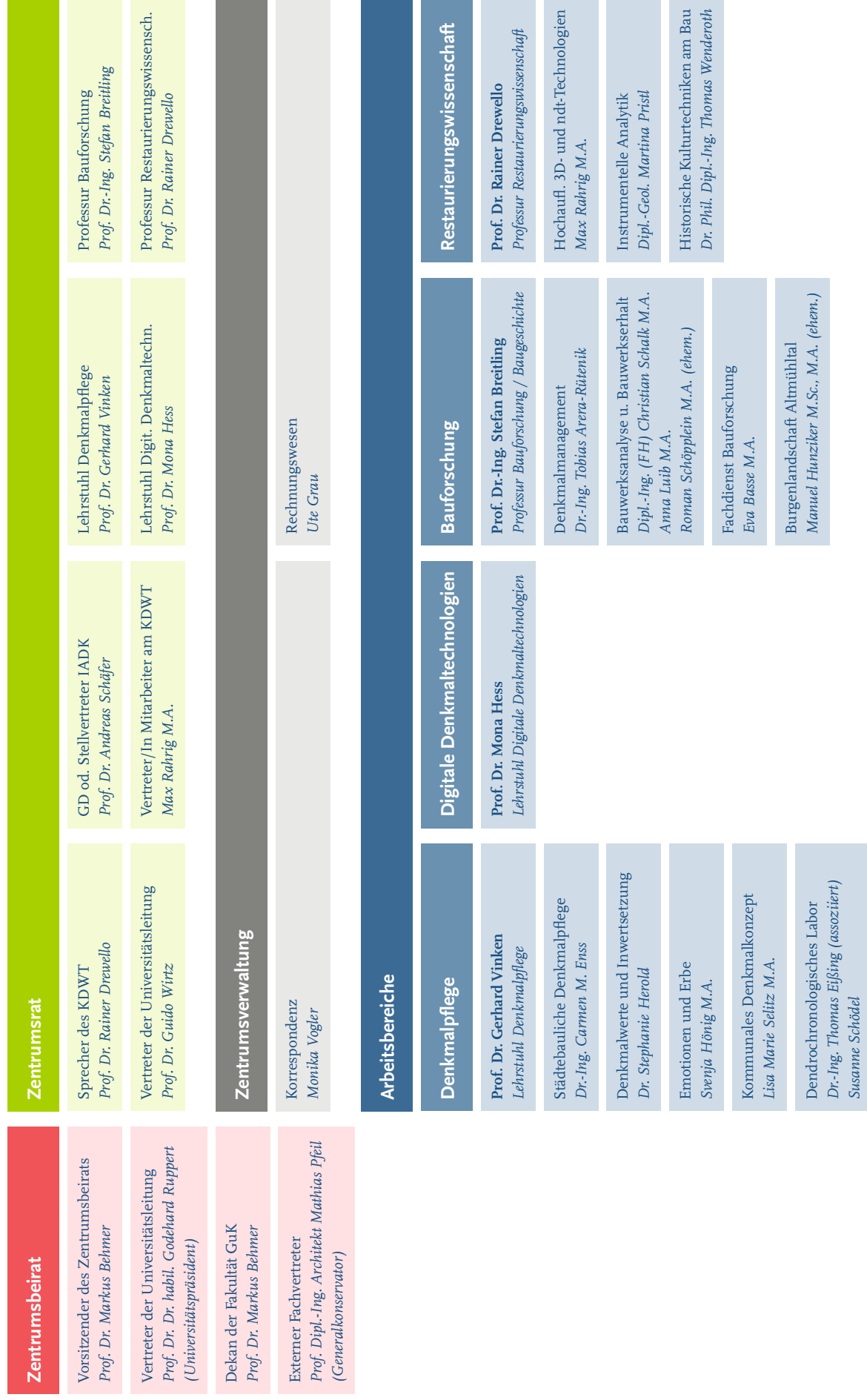
WENDEROTH, Thomas: *Möglichkeiten der energetischen Sanierung aus denkmalfachlicher Sicht (Possibilities for Energy-Efficient Renovation from a Monumental Perspective)*, General Meeting of the Verein Restauratoren im Handwerk e.V., Regionalgruppe Süd, Emishalden 23/09/2017.

WENDEROTH, Thomas: *Architektur von Einwanderern versus Architektur für Einwanderer? – Baukulturelle Zeugnisse des 17. Jahrhunderts in Franken*

(Architecture by Immigrants versus Architecture for Immigrants? –Reference Material on Architectural Culture of the 17th Century in Franconia), section: Ein Zuhause in der Fremde. Architektur von Einwanderern zwischen 1600 und heute, Kunst lokal – Kunst global, 34. Deutscher Kunsthistorikertag, Technical University Dresden 11/03/2017.

Organisation chart of the Centre for Heritage Conservation Studies and Technologies (2016–2018)

Organisation Chart



List of Authors

Tobias Arera-Rütenik

studied architecture at the Technical University in Berlin between 1998 and 2007, where he worked as a research associate in the field of building and urban construction history from 2007 to 2016 and led several third-party funded research projects in Germany and abroad. His doctorate at the same institution was devoted to the transformation of mosques to churches on the Iberian peninsula. He has been responsible for monument documentation and monument management in the Building Archaeology, Building History and Building Preservation department at the KDWT since 2016.

Eva Basse

studied art history at the Philipps University Marburg from 2003 to 2015, as part of a Magister degree programme, minoring in classical archaeology and pre- and early history. Following a placement at the Lower Monument Protection Authority and in building archaeology, the focus on architecture led to a Master's degree in Heritage Conservation at Bamberg in 2013. Since 2016, she has been working at the KDWT on the literature development project "Specialist Service Building Archaeology".

Stefan Breitling

studied classical archaeology in Freiburg im Breisgau and architecture at the Technical University in Berlin. From 1998 to 2003, he was a research associate, then became a research assistant in the specialist area of building and urban construction history at the Technical University in Berlin. In 2001, he completed his doctorate on the subject of "Noble Seats between the Elbe and Oder 1400–1600" at the Faculty of Architecture of Leibniz University Hannover. Since 2006, he has been Professor in Building Archaeology and Building History at the Otto Friedrich University in Bamberg. From 2017 to 2019, he headed the Institute for Archaeological Sciences, Art History and Heritage Sciences as managing director.

Rainer Drewello

completed professional training as a stonemason and sculptor and was employed as a restorer at the Bavarian State Office for the Preservation of Historical Monuments. He then studied chemistry with the elective subject of computer science at the University of Erlangen-Nuremberg, was employed as a research assistant at the Institute for Materials

Sciences and received his doctorate in 1998 on the subject of Microbial Corrosion of Silicate Glass. From 1997, he headed the Natural Science Laboratory at the Germanic National Museum in Nuremberg. He has been Professor of Preservation Sciences at the University of Bamberg since 2000. He was vice president for Research and Young Scientists from 2004–2008 and has been the spokesperson for the KDWT of the University since 2016.

Claudia Eckstein

studied historical linguistics and classical archaeology at the Humboldt University in Berlin from 2008 to 2011 and then completed a Master's degree in "Heritage Conservation" at the Otto Friedrich University in Bamberg by 2014. She has been Research Assistant there at the Professorship in Building Archaeology and Building History since 2014. She works as part of a project cooperation (LAD Baden-Württemberg/Building Archaeology Bamberg University) on the Ulm Minster and as a freelance Building Archaeologist. A dissertation on Late Medieval Brick Construction in the Bavarian Swabia Region is currently being developed.

Thomas Eißing

After completing his training as a carpenter in Gladbeck, Benediktbeuern and Bad Tölz, he studied woodworking in Hamburg. After completing his thesis on the subject of dendrochronological dating of the Wartburg and the setting up of a reference chronology for Thuringia, he completed the postgraduate programme in Heritage Conservation at Bamberg, which he finished in 1992 with a thesis on the Roof Structures of the Bayreuth Spitalkirche. With the DFG project "Structural Science and Dendrochronology" 1993–97, the Dendrochronological Laboratory at the Otto Friedrich University was set up. From 1997, Research Assistant at the IADK. Focus: recording, evaluating and dendrochronological dating of historical wooden structures, half-timbered buildings, panel paintings and sculptures. In 2004, doctorate in Berlin, as Dr.-Ing., on the topic of "Church Roofs in Thuringia and Southern Saxony-Anhalt. Dendrochronology – Rafting – Construction". Reorganisation of dendrochronology in Bavaria, based on historical timber transport routes, in the DFG project "Dendroprovenancing in Bavaria" 2005–2011.

Carmen M. Enss

studied architecture and heritage conservation in

Weimar, Munich and Bamberg. She received her doctorate in 2013 from the Technical University in Munich with a thesis on building history ("Munich's Planned Old Town. Urban Development and Preservation of Historical Monuments from 1944 for the Reconstruction", Munich 2016). She has been involved in research at the University of Bamberg since 2013; in 2015, she acquired her own position in the DFG project "Planned Heritage" on urban planning and monument theories in the first third of the 20th century. Since the end of 2017, she has been responsible for Urban Preservation as a Research Assistant at the KDWT.

Jürgen Giese

completed a postgraduate course in Heritage Conservation at the University of Bamberg after studying classical archaeology and completing training as a surveying technician. From 2003 to 2007, he worked as a research assistant in the specialist field of historical building archaeology at the Technical University in Berlin. He has been working in the Department of Building Archaeology and Building History of the Otto Friedrich University since 2007 and teaches subjects in Building History as well as Procedures and Techniques of Building Documentation in the Master's programme in Heritage Conservation. He devoted his doctorate to the subject of the Dionysos Temple on Santorini as well as late classical masonry decorations.

Stephanie Herold

studied art history, folklore/European ethnology and heritage conservation in Bamberg, Bergen (Norway) and Berlin. After completing her Master's degree in Heritage Conservation at the Technical University Berlin, she worked as a research assistant in the heritage conservation department of the Institute for Urban and Regional Planning there between 2008-2016. She completed her doctorate in 2016 on the subject of the Role of the Beautiful in Heritage Conservation. Since 2016, she has been a Research Assistant, with a focus on evaluation and valorisation as well as emotion and heritage in the Heritage Conservation department at the KDWT.

Mona Hess

completed her studies in architecture (Dipl.-Ing. Univ., TUM) and heritage conservation (M.A.) and received her doctorate in "3D Imaging Metrology for Cultural Heritage" (PhD, Geomatic Engineering, UCL, UK). Since 2004, she has worked in scientific research and as a Project Manager for

interdisciplinary research projects on the subject of 3D Imaging Processes, Digital Documentation and Visualisation of Historical Buildings and Museum Objects at the University of Bamberg, Getty Conservation Institute and University College London. Since October 2017, she has been establishing the field Digital Heritage Technologies (Digital Technologies in Heritage Conservation) at the University of Bamberg as Professor, Chair Holder and Head of the study programme (M.Sc.).

Svenja Hönig

Bachelor's degree in French Art History and Philology at the Ruhr University in Bochum (2010–2014). Master's degree in Heritage Conservation at the Otto Friedrich University Bamberg (2014–2016). Since 2016, Research Assistant at the Centre for Heritage Conservation Studies and Technologies, Heritage Conservation department. Since 2016, doctoral thesis in the field of Heritage Conservation on the subject of Emotion and Architectural Heritage. The research focus areas are Monument Theory, Value Concepts, Monument Awareness, Emotion Research, Heritage Studies.

Zoltán J. Juhász

studied political science and international relations at the University of Bamberg, George Washington University and University of South Carolina. In the United States, he worked for the International Studies Association between 1984 and 1988. He received his doctorate at the University of Bamberg in 1994 and worked as a research assistant until 2000 at the Chair in Political Sociology. Until 2004, he worked as a project manager at GMS, a social and market research institute. Since 2004, he has been the Managing Director of the Bamberg Centre for Empirical Studies and is responsible for conducting empirical studies from the conceptual phase through to evaluation.

Anna Luib

studied Architecture at the Biberach University of Applied Sciences from 2010 to 2013 and then completed her Master's degree in Heritage Conservation at the Otto Friedrich University in Bamberg. Since 2015, she has been involved in various research projects in the fields of Building Archaeology and Preservation Sciences. Since 2017, she has been working at the Centre for Heritage Conservation Studies and Technologies in the area of Technical Building Analysis, in particular Infrared Thermography in Building Archaeology. In this context, her doctoral thesis

on the subject of Monument Repair is currently being developed.

Felix Oldenburg

Between 2000 and 2003, he completed an internship with the restorer Hans Hangleiter in Oetzberg b. Darmstadt. From 2003 to 2008, he studied art technology, conservation and restoration at the Dresden Academy of Fine Arts, specialist course for Wall Painting and Architectural Colouring with Prof. Heinz Leitner. Since graduating with a degree, he first worked as a freelance restorer in Dresden. Since 2012, he has been working in Nuremberg. He worked as a graduate assistant at the KDWT from July 2017 to July 2018.

Martina Pristl

studied geosciences at the LMU Munich (degree in 1998) and as a result became involved with palaeontological excavations in South Africa and palaeoanthropological research in Malawi. Subsequently, she worked as a research assistant at the Geographic Institute of the University of Cologne with a focus on sedimentology and geochemistry. From there, it was just one small step, via archaeological findings, into the field of Instrumental Analysis of the Preservation Sciences at the KDWT.

Max Rahrig

studied Archaeology from the Middle Ages and the Modern Age, Preservation Sciences and Building Archaeology and Building History at the Otto Friedrich University Bamberg (receiving his Magister Artium in 2012). After completing his studies, he initially worked at Arctron Vermessungs- und Softwareentwicklungs GmbH near Regensburg, where he was employed in the area of digital documentation of art and cultural assets. In 2014, he moved back to Bamberg, initially to set up Format4plus GmbH Digital Measuring Techniques, which he headed as managing director until mid-2016. In 2014, he became a research assistant in the Professorship for Preservation Sciences. Since 2016, he has been responsible for the support of high-resolution 3D and NDT technologies at the KDWT and is completing his doctorate in the same area.

Christian Schalk

studied architecture from 1989 to 1994 at the Georg-Simon-Ohm University of Applied Sciences in Nuremberg, graduating with a degree in Architecture. After a stay abroad in the United States, he worked in various architecture offices. From 2006

to 2008, he participated in the Master's degree programme in Heritage Conservation at the Otto Friedrich University in Bamberg and was involved in various building research projects. Since 1999, he has been working as a self-employed freelance Architect, with offices in Nuremberg and Bamberg and a focus on building in existing buildings and architectural heritage conservation. At the Centre for Heritage Conservation Studies and Technologies, he works in the area of Building Preservation and is completing his doctorate on this topic.

Alexandra Schmölder

graduated in art history at London University in 1985. She then became Press Officer at Christie's auction house. After staying at home with her family for a period of time, she obtained a Master's degree in Heritage Conservation from Bamberg University in 2012, with a focus on Bamberg's World Cultural Heritage and Inventory of Cultural Landscapes. Since 2016, she has been a Research Assistant at the Centre for Heritage Conservation Studies and Technologies, where she initially supervised the EU project Nano-Cathedral, and has been working on a project by the Bavarian Ministry of the Environment on the topic of historical flat glass since 2018.

Lisa Marie Selitz

From 2010, she studied art history, as well as cultural and social anthropology at the University of Münster and then Heritage Conservation at Bamberg. Since 2016, she has been a Research Assistant and doctoral student in the Heritage Conservation department of the Centre for Heritage Conservation Studies and Technologies. She works in the cooperation project "Municipal Heritage Plan Bavaria" in partnership with the Bavarian State Office for Historical Monument Preservation. Since 2016, she has also been associated with the Research Training Group "Identity and Heritage" at the Technical University in Berlin and the Bauhaus University in Weimar.

Rolf Sneathlage

was born 1944 in Bayreuth. Studied geology and mineralogy at the Ludwig Maximilian University in Munich, graduated and received his doctorate and title Dr. rer. nat. in 1974 and habilitation in Applied Mineralogy in 1983. Appointed Ass. Professor in 1991. Since 1977, employee at the Bavarian State Office for the Preservation of Historical Monuments and Head of the Central Laboratory. Lecturer in Natural Stone Conservation at the

University of Bamberg up until 2015. Initiator and partner in numerous national and international research projects. Retired in 2009.

Gerhard Vinken

After studying art history, history and philosophy, doctorate at the Free University of Berlin ("Cult and Building Structure. Romanesque Sacral Architecture in Auvergne", Worms in 1997) and Habilitation at the University of Bern ("Home Zone. Old Town in Modern Urban Development", Munich/Berlin 2010). Professorships in Architectural Theory at RWTH Aachen University and for Interdisciplinary Urban Research at TU Darmstadt. Since 2012, Chair in Monument Preservation/Heritage Sciences at the University of Bamberg. The main areas of research are History and Theory of Cultural Heritage, Urban Conservation, Heritage and Emotions, Spatial Theory.

Thomas Wenderoth

born 1969. From 1990 to 1997, he studied Architecture in Darmstadt, Glasgow and Zurich. After a period as a research volunteer at the Bavarian State Office for the Preservation of Historical Monuments between 1997–1998 and employment

as project manager at the architecture office Theo Keller, Munich, between 2002–2017, he worked as an area consultant for the practical maintenance of architectural and art monuments at the Bavarian State Office. At the same time, he taught at the Friedrich Alexander University Erlangen-Nuremberg. In 2018, he completed his doctorate to become Dr. phil. on Early Modern Rental Housing Construction. He undertook further research into historical architectural surfaces and construction techniques, monument restoration and methods of heritage conservation.

Mark Wernsdorfer

studied Philosophy from 2005 to 2010 and Computer Science between 2008 and 2010 at the Otto Friedrich University Bamberg. Between 2011 and 2018, he did his doctorate in the Cognitive Systems Department at the Faculty of Information Systems/Applied Computer Science on the topic of the Simulatability of Subjective Cognitive Processes. His research is localised technically in the area of machine learning and theoretically in the philosophy of the mind. He has been working as a technician at the Chair in Digital Heritage Technologies since 2018.



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Press

The Centre for Heritage Conservation Studies and Technologies (KDWT) was founded in spring 2016 as a central research institute of the Otto Friedrich University Bamberg. The core tasks of the KDWT are the expansion of knowledge and technology transfer to non-university research institutions, business and crafts, the expansion of technical excellence, the supplementation of the range of courses, the support in research, teaching, transfer and service in terms of content and technical equipment as well in the internationalisation of research. The centre is divided into four departments: Monument Preservation, Digital Heritage Technologies, Building Research and Restoration Science and thus covers both the foundations in the humanities as well as engineering and scientific approaches.

The first volume of the “Reports of the KDWT” series presents the technically diverse work of the first two and a half years since the KDWT was established in a format with colour illustrations. Four main chapters represent the four departments mentioned. First, the fundamental aims and focus of each subject are outlined. This is followed by individual presentations of the respective research projects, which also would like to bring the content closer to the non-expert reader, especially through the illustrations provided. For a better overview, basic information and thematically linked publications have been added to the projects.

For example, the Monument Preservation department reports on various projects related to the theme, city and heritage conservation, addresses participatory heritage protection, emotions and heritage as well as a municipal monument plan for Bavaria, to name just a few. The digital heritage technologies outline projects in the area of 3D documentation. The building research area analyses large medieval buildings, develops concepts for building preservation and improves technical skills in building analysis. Finally, the area of restoration science explains the use of non-destructive methods of investigation and microanalysis based on international and local projects, be they Singhalese temple sites, European cathedrals or medieval textiles from the Bamberg cathedral treasury. The aim of the project presentations is to clarify to what extent each sub-area represents the KDWT with extraordinary, professionally sound experience and expertise in teaching, research and above all in practice.

In order to do justice to the extensive transfer, networking and research activities of the individual members, a fifth main chapter lists all individual services in alphabetical order until mid-2018.



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