

NKFIH (OTKA) Research  
**No. 112906**  
(2014-2018)

# Final Report

Title of research:

**Architectural drawing and education –  
contributions to the emergence of a  
discipline**

**[Építészeti rajz és építészképzés -  
adalékok egy tudományág  
fejlődéstörténetéhez]**

Principal Investigator:  
**Dr. János Krähling**

Department of History of Architecture  
and Monument Preservation  
Budapest University of Technology  
and Economics  
Műegyetem rkp. 3. K. 282.  
H-1111 Budapest, Hungary

## Summary

Duration of the project from 1 September 2014 till 31 August 2017, with extension to 31. August 2018.

The primary achievement of the research is the catalogue and the scientific assessment of the identified 6,000 drawings and nearly 4,000 photos and slides from the period before 1945, preserved at BUTE Dept. of History of Architecture and Monument Preservation that opens the collection for research and form an easy-to-use system with search images. (Website in the repository of BME OMIKK) The database contains a unique collection of documents of the first nine decades of the history of architectural education at BUTE. The assessment of the library (equipment) catalogue of the former department of medieval architecture provides further knowledge on training concerning the use of gypsum models, pattern designs, competition plans and photos. The analysis of the drawings prove the process that points from the 1870s to the mid 20th century demonstrating the changing role of historical architecture and the spread of specialized planning. The International Congress of Architects held in Budapest in 1930 – and the researched drawings of its section at BUTE – also improved design education. The special role of load-bearing structures, building constructions, new materials in today's sense of design has gained an increasingly important role since the 1930s. The research of the collection has revealed a high number of plans of distinguished professors such as Schulek, Steindl, Möller or Kismarty-Lechner, that had been hidden so far, representing their academic and artistic skills.

## Project flow

### *First research Phase (Sept 2014-Aug 2015)*

In the first project phase, following the research plan, the necessary inventory works were completed. A metadata structure has been elaborated with the central library (BME OMIKK) of Budapest University of Technology and Economics (BUTE). By the end of the first project phase, 5000 drawings and 2220 photos were catalogued. That means, by processing the records during this period about 120,000 data fields have been entered into the catalogue. The one of the main time consuming part of this project was to identify some drawings. Regarding the process of digitization we have decided for a preliminary photographic reproduction of the collection. A reprographic photo workshop was set up in one of the department's offices enabling us to take a picture of each drawing, and making a repository of search images. Even if the quality of these pictures did not meet the highest graphical criteria, they were absolutely suitable to set up the catalogue with image search function and to provide a collection for preliminary research and identification. (In the following phase of

research we are going to carry out a professional digitalization project involving professional experts financed by other sources resulting high resolution files of 300-400 MB.)

#### Database

The final archive system that will enable researchers to carry out specialized or targeted researches is now under construction. The core software of this facility will be realized after this project as a DSpace database, including high resolution photos. This will be a sustainable continuation of the OTKA research, using other project support (NKA) for the development of the software. The demo homepage of the research can be visited at <http://hdl.handle.net/10890/5621> on the BME OMIKK homepage. The actual results of the database are presented in a graphical layout – see pdf files in the repository of the Hungarian Academy of Sciences (MTA). The original metadata fields of the research process have been completed in excel sheets that can later be exported into any archiving library system.

#### *Second research Phase (Sept 2015-Aug 2016)*

In the second research phase, the processing of drawings to be involved into the plan collection had been completed following the work processes of the first phase. The core of the collection with 6000 historic drawings include historic drawings from before WW II.

The data collection had been realized by the participating researchers and assisting students, the professional processing and identification of the items had been carried out by the involved professors and the PhD students of the Department of History of Architecture and of Monuments. Cataloguing, attribution and digitization of the material has been completed following the work processes of the first phase. The plan legacy of former high-rank professors of the department were processed by extending the first stage's activities. One of the most important results of the research carried out in the second phase is the two-volume publication of the Catalogue. The first and second volume of appeared with additional 2000 records (Nos 102003-104000) as a continuation of the first catalogue volume that was also reedited and corrected.

#### Relevant plan collections in Hungary and Berlin – Workshops in 2016

In the second year of research, we have built up connections with relevant plan collections, archives, and museums in Hungary (and one in Germany, the Berlin Architectural Museum) for finding connections where matching parts of the university drawing stock may appear. We carried out a preliminary research by visiting research-related collections, mapped relevant materials of architectural drawings (amount, type of collected material, general content). Approaching the issues with the intention of a systematic answer, we have organized on 9 June 2016 in the building of BME a scientific workshop entitled 'Architectural Drawing and the Training of Architects - Architectural Drawing Collection Workshop' inviting the representatives of all relevant institutions (head or senior researchers). The event was highly successful in many aspects, the issues raised in the discussions showed that there was no similar event organised in the last decades with the involvement of all collections concerned, and there is a high demand for to continue the dialogue. In addition to answering the scientific issues very important profession-related themes have been highlighted. By introducing every collection we could get information about their work system (museum /

collection / archive), about the circumstances of their establishment in the beginning, their size and their portfolios of collection, about their specific units, about the size and problems of researchers/assisting staff, about systems and size of the storage capacity, the degree of the digitized materials, about the system of databases and online catalogues, about the service fulfilling the outward researchers' needs, and about their plans for the future. The workshop reviewed the procedures and problems of digitization and restoration that are closely related to digitization, which may virtualize the collection, and also facilitates to connect detached bequests, thematic units between different collections in a virtual way. The international outlook has been achieved with the involvement of director of the Berlin Architectural Museum (Architekturmuseum der TU Berlin). The consultation and lecture of Dr. Nägelke was a very important event organised at the end of June 2016. It is one of the most important model institutions on European level regarding our tasks. His lecture covered in general the same aspects that were overviewed during the workshop, moreover, with a relevant European overview. His presentation has given us important intellectual support to our research and organisation activities.

### *Third research Phase (Sept 2016-Aug 2017)*

In the third stage of the research, the identification, attribution, the dating work and the whole processing of the drawings had to be carried out according to the research plan. Main focus was put on the analysis of data. By completing these tasks, another series of drawings according to the previous years' methodology have been processed. The number of processed valuable drawings rose to over six thousand, and the third volume of the catalogue series was completed and published, containing additionally 2000 records. The preparation and edition of the third catalogue volume resulted the planned analysis phase of the drawing material in the time plan, that was accepted by the board of the research fund and for the completion of the research they permitted a prolonged research period.

One of the main results of a summary of the research work is the elaboration of complete catalogue in three volumes containing two thousand drawings each, illustrated with low resolution photos (search images) that made the collection open to researchers within the reading room of the department's library. The volumes can be accessed in the online repository of MTA.

By the end of the third research phase, the whole number of processed material – including the educational slides of professor Jenő Rados - rose to more than 10,000 pieces.

Following the second year's efforts to organise workshops with the competent plan collections in the research field, public collections being relevant in the preservation of the country's architectural blueprints, have been continuing their activities in 2017 with a series of scientific workshops held at the Lechner Knowledge Centre, the BUTE Department of History of Architecture and the MÁV Archives titled "Designs and Architectural Training - Architectural Drawing Collection Workshop", presenting at local presentations their blueprints' processing with all of their elaboration phases. The focus of the lectures at the

conference held at BUTE was put on the issues of digitization and storage. The lectures aimed at answering important specific questions like processing of special collection items (written documents, blueprints for various media, photo, film, etc.). The participating institutions included the Hungarian Architectural Museum, the Secondary School of Fine Arts and Applied Arts, the Lechner Knowledge Center, the Archives of Budapest Capital, the Architectural Collection of the Kiscelli Museum, the MÁV Archives and the Forster Center. This is important practical result of the research is the common knowledge transfer that has been performed by the capital's public drawing collections that has been expanded to an international level.

#### *Fourth research Phase (Sept 2017-Aug 2018)*

Due to the data processing and catalogue editing realized in the first three years of the project, whose extent was more than planned, extended with a series of workshops and lectures held with the participation of similar collections, an extension of the project was allowed. In this additional research period our research was focused on Jenő Kismarty-Lechner's oeuvre, on architectural survey and the teaching of structures, and the impact of the International Architects' Congress held in Budapest in 1930. The in-depth analysis of the drawings aimed to follow the previous years' methodology basing on the seven main hypothetical research topics. By the summarizing overview of the whole collection, an important finding has been involved into the research. In the course of processing the collection of drawings, the book title catalogue of the former medieval architecture department (one the predecessors of the actual Department of History of Architecture and Monument Preservation) was found among the unprocessed materials. It dates according to our research from the 1870s, from Imre Steindl's professorship to 1933. The catalogue enlisted also important educational materials. The title catalogue shows, on the one hand, the library's accession, and on the other hand - as a sort of inventory list - it provides important methodological contributions to the theoretical and methodological questions of the Middle Ages and the sources of drawings to be made by the students. Therefore, we strived to publish and to analyse its records in parallel with the thematic issues of the drawing collection. The publication of the book catalogue also serves as a basic contribution to the sources of the late historicist architecture in Hungary and beyond.

As a final stage of the research, we organised an exhibition with BME OMIKK, the central library of BUTE. Besides the exposition of valuable drawings and photos of different periods of education, a digital catalogue was also edited and displayed.

(About the opening of the exposition: <http://www.omikk.bme.hu/hirarchivum/14-hirarchivum-konyvtar/1410-a-muegyetemi-oktatas-egyedulallo-emlekeinek-bemutatasahoz-biztosit-helyet-konyvtarunk.html> ;

the poster: <http://www.bme.hu/node/5526> ;

the digital catalogue: <http://real.mtak.hu/id/eprint/85085> )

The success of the exposition is measured by the fact that other exhibition venues have indicated their willingness to accept the drawings and we have also received an option to print the catalogue as a supplement of a periodical.

## Results

The amount and proportion of the drawings analysed in the collection can be characterized by the following topics:

subject	drawing pcs	total	%
professors	1891	6000	31,51
student drawings	3069	6000	51,15
pattern books	320	6000	5,33
monument survey	3400	6000	56,66
design in styles	30	6000	0,5
design in the first part of the 20th century	645	6000	10,75
drawings with an international context	35	6000	0,58
structural drawings	155	6000	2,58
artistic drawings (figure drawing)	30	6000	0,5

The analysis of the drawing collection suggests that the vast majority of the drawings belonged to the former department of medieval architecture of the Faculty of Architecture at BUTE. Accordingly, the assessment and evaluation of education of medieval architecture shall receive greater emphasis in the analyses.

For the whole research, the processing of the material and the in-depth analysis has been carried out following the seven main research themes or key research questions in the detailed work plan.

1. Which were the main theory and pattern books for architecture students in the 19th century? How do they appear in the content of the drawings?

The presupposition of our research was that the early form of architecture drawing instruction has based upon the process of copying figures of different pattern books of architecture.

The title catalogue (“title list”) of the former department of medieval architecture came to light in the course of the processing of the drawing collection preserved at the Department of History of Architecture and Monument Preservation of Budapest University of Technology and Economics, which dates according to our research from the 1870s, from Imre Steindl's professorship to 1933, containing books, periodicals and other educational materials of the department. A fair copy of the title catalogue to the actual form was written during the time of István Möller's leadership. The research of this historic catalogue included from 2017 a precise typed version of the titles involved in order to make them public for further researches. This finding has great importance for the exploration of the knowledge base of education, as it involved not only the books but other sources – gypsum models, model photo series of buildings and their details as well as books that were disassembled into sheets so as to make them easily available for students. The catalogue involves – regarding the series of books and periodicals catalogued under one number – about 1500 items.

The books numbered in the catalogue appear to be in a timeline with respect to their release date and their original – or reconstructed – position in the list of titles.

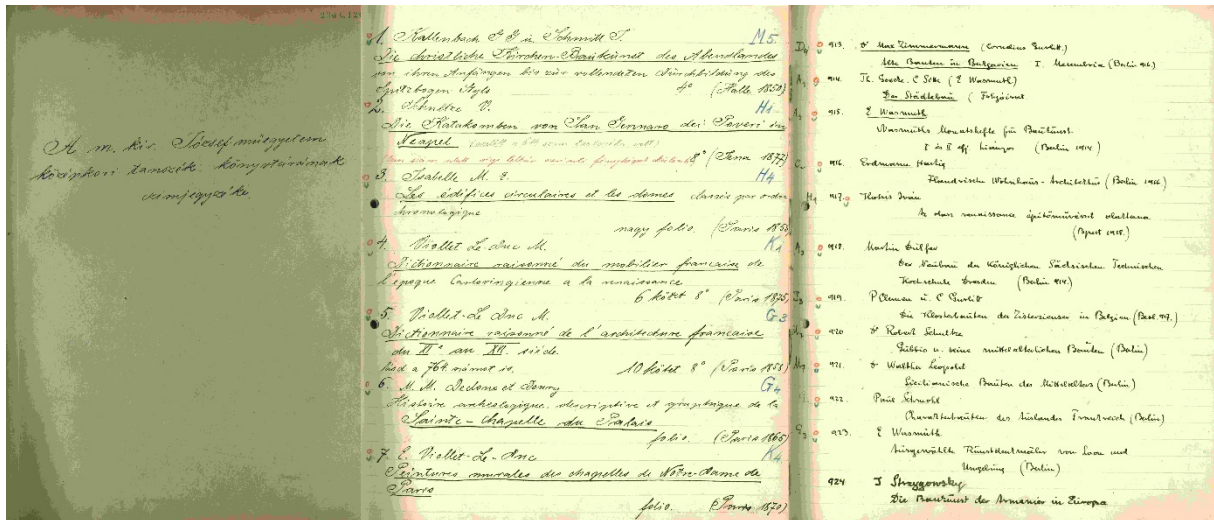


Figure: The title page and the two written versions of pages in the book catalogue of the former department of medieval architecture (Source: BUTE Dept. of History of Architecture and Monument Preservation)

By reviewing the works in the catalogue, we can find basic books in terms of a historiographic approach to the education and research of medieval architecture. It shows also the intention to keep the department library up to date and to grow.

The title catalogue satisfies the thematic criteria that can be set up against libraries for the education and research of medieval architecture. The global picture gained from the catalogue appear to be proportional and widespread, with special focus on the architecture of the Middle Ages. By reviewing the book list, we can confirm that it was a specialist library on European-level for the department of medieval architecture. Not surprisingly, the backbone of the collection was the German-language literature, which had a significant number of actual works dealing with the architecture of the Middle Ages. Another reason for this was partly the professors' graduate education in German speaking countries and the common foreign language of the Monarchy determining Central European culture. The books on Hungarian architecture (mostly in section/bookshelf "F"), despite the poverty of our literature in the history and theory of architecture, appear to be relatively rich and was accomplished by the basic works of medieval history.

A book collection can be characterized by its richness of different thematic sections. It provided a basic source for the cultivation of architectural theory. Among the most comprehensive works of architecture, the Handbuch der Architektur (Numbers 236 and 862) played the key role. A considerable part of the collection belonged to the topics of history of architecture, art history, monument protection and archaeological heritage. Due to the library's orientation on the Middle Ages, the number of classical treatises and books on column orders were small.

Building monographs as scientific sources but also as sample reference works constituted another big part of the collection of books. A great number of books relating to interior design, decorative art of medieval architectural, pattern books and model sheets indicate the importance of these areas. A large number of German and French monument records and inventories were also of value, but they could also serve as a methodological example for the emerging institutions of Hungarian monument preservation. The works of engineering, building construction and building engineering sciences were important because of the special architectural profile of the department.

The library's scientific profile has been completed by a significant proportion of basic works for architectural design. The professional books on architectural design covered thematically many types of buildings from the category of public buildings and residential homes. Among the great architectural monographs, the works of Otto Wagner and Johannes Otzen have to be highlighted.

The catalogue's journal stock shows the same wealth as the wide scope of professional books, reflecting the spiritual vivaciousness of the late 19th and early 20th century architecture with its primary role in public affairs. The list of periodicals confirms the specialty of the library, the influence of German architecture in the early stage of architecture education at the Technical University.

As part of the medieval architectural morphology education, students could use the library, including the books of architecture and archeology of the Middle Ages, as well as of structural issues. The books or folders that were used as sample materials for architecture education include works of Mothes, Ungewitter and Mohrman, Max Hasak, Rivoira, v. Statz, Pannewitz, Zeller, Haupt and Choisy.

## *2. What was the role of monument survey in the teaching of architecture?*

The earliest survey documents preserved in the drawing collection originate from the second half of the 19th century, which were made by students during summer study tours. We have little information on the tools and the circumstances of the work, but it is quite likely that devices used today for manual measurement (plummet, measuring tape, water leveler, theodolite) were used.

In the investigated period, the organization and reform of the new architectural education system was in progress. In this process Imre Steindl and Frigyes Schulek took on a key role in transmitting their Viennese master's - Friedrich von Schmidt's - training method used in the school named Wiener Bauhütte. Schmidt's third Hungarian student, a member of Wiener Bauhütte, Ferenc Schulcz would certainly have run an active university career if his early death did not prevent him. Many elements of the system similar to a medieval guild established at the Vienna Academy of Fine Arts in 1860, such as individual studio consultations, summer survey camps are up to now valid.



An important feature of Schmidt's master school was the architectural design based on mostly medieval styles, the distinction between architectural styles, which, of course, interacted closely with the European architectural tendencies of the era. Since the members of the Schmidt school had "used" medieval architecture at the design level, it was not a sealed, past style, but a live system present, in which their own set of planning tools were defined. After completing the József Politechnikum in Buda, Steindl spent a year at the architecture department of the Vienna Academy of Fine Arts when he was recalled in Hungary in 1860 as an assistant professor in building constructions. Frigyes Schulek, in these years, was his student. A few years later, he entered Friedrich von Schmidt's masterclass in Vienna Academy of Fine Arts. From 1862, the students founded a self-governing association, which was renamed in 1864 Wiener Bauhütte by its honorary president, professor Schmidt. The association organised summer survey exercises and study tours from 1861, the results of which were published from 1862 onwards in the volumes of the series "Publikationen des Vereines Wiener Bauhütte". Accordingly, based on the collection of publications and the monographs and original drawings preserved in the drawing collection of the Department at BUTE, the variegated destinations of Wiener Bauhütte from 1860 to 1868 included the territories of Austria, historic Hungary and the Czech Lands, moreover, German, French, Italian and Polish towns have also been visited.

A coherent set of drawings remained from 1875, which includes a survey of the church and castle of Zvolen/Zólyom made by Steindl's pupils, Ottó Tandor and Ferenc Pfaff. This set of drawings proves that the method of survey in the 19th century coincided with the current manual survey: as a first step the sketches for the measurement were made: the manual, that made it possible to measure the building in detail, and then, with the knowledge of the dimensions, the final drawing was completed with drawing tools.

The summer surveys camps were regular until 1882, and then Steindl was in charge of the design of the House of Parliament for which he also had the assistance of his student. Until 1895, however, the survey of some of the Transylvanian buildings, such as some in Gyulafehérvár/Alba Iulia, were organized. Thus, in the first period of architectural training including the four last decades of the 19th century, the survey was an integral part of the education.

In most cases, the survey drawings were multiplied for the purpose of providing a series of model drawings for further practical education, which were used by students as a study material, and as a model of study assignments (drawing, structural exercises, design). From the studying periods of Imre Steindl and Frigyes Schulek, their original drawings also remained (the apse of the St. Bartholomew church in Kolín, and the plan of the Zápolya chapel in Csütörtökhely / Spišský Štvrtok) that were later also copied and printed, and educational samples were made after them. Several student drawings also confirm that these sample surveys were used also during Frigyes Schulek's professorship and even later in the 1920s. The research in the library proved also that the copied drawings of Bauhütte were used together with other model plans, see No 930 in the book catalogue (the inscription says that "Some pages are among the other Bauhütte pages").

Another important use of the surveys was the design education specialized in monument preservation. Summer practices were supported by the Temporary Committee of the

Monuments (Műemlékek Ideiglenes Bizottsága), and Steindl provided the Commission with the surveys which became thus the basic data for the restoration. Steindl, Schulek and Schulcz likewise used the survey of Vajdahunyad Castle (Transylvania, Romania) made in the in Wiener Bauhütte programme from 1867 to 1868 as all three of them were involved in the renovation works.

There is no doubt that the styles meant quite different concepts from today's meaning that were used by the students in the education system in the 19th century based on Friedrich von Schmidt's masterclass and by the architects who were active in the second half of the 19th century. Because of the fact that designing in the style was one of the study tasks at the university, students were forced to consider the construction of the structures according to the style and the architecture of the corresponding era. This could be done thanks to the survey work done during the summer, because drawing during the survey campaigns made it possible to understand the structural logic of the building. Therefore, Gothic or Romanesque (and perhaps the concept of style) was for them not merely the sum of all the stylistic symbols, but the building system and logic characteristic for a special era. This is evidenced by the memory of Ernő Foerk, who said that on summer surveys could be learnt more than on the lessons.

### *3. How did design in historic styles contribute to the training in design at the end of the 19<sup>th</sup> century?*

The practice of survey and the use of its results used in architectural education as outlined in the previous section followed in the beginning the Viennese educational pattern. According to the records in the book catalogue, some items were used as "pattern drawings for practice". An important part of the practical training were the campaign-like monuments survey actions whose results – the drawings – were later used as patterns for design assignments to be completed in historic styles.

In Friedrich von Schmidt's master school architectural design based mostly on medieval styles. They applied medieval architecture at design level, and it meant for them an applicable system. The publications (multiplied copies) of the Bauhütte plans and other previous actions made the morphology of medieval architecture into an adaptable reference. In terms of teaching methodology, both the books and folders of drawings, as well as catalogued sample designs, competition designs and gypsum models prove the decisive role of the Schmidt school in Vienna at the time of Imre Steindl and later of Frigyes Schulek.

The study and education of styles required a "visualized" approach. From the first decade of the 20th century, the ever-expanding collection of photo slides appear as visualizing tools of education and thus served to its development in efficiency.

Photos or photo reproduced drawing as a visual tool and as a drawing pattern played an important role in the methodology of education. As the book catalogue of the medieval department proves, it had already a major role in the teaching of the Steindl department. The nominated photographers were Baudry, Ducher, Wlha, Armand Guérinet, János Müllner,

A. Lehoczky. The printed photos of the National Committee of Monuments (Műemlékek Országos Bizottság) have also been used. In addition to the photo prints, in the 1910s, the slide show - apparently for the illustration of the lectures - and the stereo photo was also used. The gypsum models were also important methodological tools during Imre Steindl's and later Frigyes Schulek's professorship.

In the drawing collection there is a series of pictures taken in the 1890's depicting important buildings of the Ottoman Empire. By analysing this valuable collection that has its parallels in Paris and New York, it turned out that Ignác Alpár, a significant architect of Hungarian Historicism, purchased some of these photographs, and has used for design pattern, especially the 'Tombs of Mamluks, Cairo', that may be a source for establishing a Hungarian national style and was used also for one of his designs in the Pest city park (See the publication of Kovács M G-Rabb P –Krähling J).

In the knowledge base of medieval styles geometry had an important role, which has contributed not only to the design of buildings but also in the conceptual plan of the load-bearing structure through the science of graphostatics. The research article entitled "Geometry methods of medieval architecture in the in the light of Hungarian professional literature" presented by Krisztina Fehér and Balázs Halmos investigates important parts on the issue of the beginnings of architectural drawing and education process, following the formation of theory background to the present. Regarding the number and proportion of drawings relating to medieval architecture the research report is very relevant to the topic. In the essay, a summary is presented to the geometrical and proportional systems and design methods of medieval architecture in the light of Hungarian and international historiography aspects, by analysing the theories of Imre Henszlmann, Viktor Myskovszky, Vilmos Fröde and Franz Rziha.

The use of the book series Handbook of Architecture (Handbuch für Architektur) determined the common language of architecture from historic surveys to specialised design, involving all the technical aspects and unifying the language of architecture at the end of the 19<sup>th</sup> century.

The rich thematic content of the library (and equipment store) of the department of medieval architecture makes clear that it provided fundamental knowledge for high-quality education, both for the study of medieval architecture and in particular, for design. The content in the remained catalogue enlisting also other special educational items can be regarded as evidences and important methodological means of the training that are supposed to be beyond the department of medieval architecture, and characterized also the methodology of the department of the architecture of antiquity and later the department of early modern architecture as well.

An important section of the library contained the main model plan collections of German architectural education institutions and universities of Berlin (4 books) Stuttgart (2 books), Hannover, Danzig, Dresden and Nürnberg. German universities including the Berlin Bauakademie, had a growing and decisive role in the first decade by the turn of the 20<sup>th</sup> century in Hungary before the methodology of practical education coming from Vienna.

#### 4. How did the subject of design develop in the first part of the 20th century? What was the role of competitions in education?

The main tendencies of design education in the first decades of the 20<sup>th</sup> century can be characterized by the growing importance of structural education and the relative decreasing importance of historic subjects. From 1898 on, the issue of design was boosted by the foundation of the department of applied science of strength of materials. The design of the structures meant at that time more to construct from various architectural elements known from the *Handbuch der Architektur* or from practical exercises. The department added a new approach to the design process that developed to a conscious load-bearing structure design in the 1930's. The changing role of historical approaches in design education is indicated by the change of attitude that followed after Frigyes Schulek's professorship. István Möller reorganised the ever-expanding collection of the department of medieval architecture, photo slides were used to visualize the lectures. While putting less emphasis on artistic quality of historic drawings, Möller emphasized the scientific approach in history teaching and expanded the theoretical and methodological bases of education of the architecture of Middle Ages with scientific sources.

New technologies and materials emerging at the turn of the century created a contradiction between the opportunities offered by steel and glass and the traditional forms, and the answers for this issue were the manifestoes of modern architecture. The representatives of the profession have expressed the expectation that the training of architects should keep up with new trends and techniques. As a result of the frequent reform of the curriculum, architectural knowledge was increasingly divided into branches, as it had to teach the constructions, building engineering, economics and construction law knowledge on separate subjects. The teaching of architectural history has become one of the auxiliary disciplines, but this is not the case with the new demands, it is questioned from time to time as compared to other groups of subjects. The teaching of reinforced concrete as material and as a construction for architects first began at the Technical University in the 1906-1907 academic year as part of the Applied Strength of Materials Course, and later continued the education of reinforced concrete in the years 1916-1917 as a compulsory subject. A specific knowledge in building design provided the subject of "Covering of Larger Span Spaces" started in 1910, on which based the elaborated system of education of modern load-bearing structures of Pál Csonka and then of József Pelikán.

The most important event of this development was the foundation of the department of design (by reorganising the structure of the department of Hungarian literature set up in 1901 and ceased to end after the death of its professor József Ferenczy) in 1926. Its first professor, Iván Kotsis became assistant professor from 1914, and in 1920 obtained his doctor title upon his dissertation of "The History of the development of the Italian Renaissance Architecture". His appointment as a regular professor was on 3. June 1928. The drawing collection does contain only few drawings relating to Iván Kotsis's design course. The role of Kotsis symbolizes the emerging discipline of design following the new needs of functionality – especially in residential building design taught by him – but does not deny the historic

architectural background. His concept of design education focused first of all on the art of space creation, so he did not allow to give his students assignments that included incomprehensible technological aspects.

In the teaching methodology applied at the time of Imre Steindl, competition drawings could be used in some form as high-artistic illustrative tools. This can be clearly deduced from the content of book (equipment) catalogue (Numbers 86-94). These competition drawings of the Opera House in Budapest and the Elisabeth Bridge were later handed over to the General Library of the University. Competition reports and journals specialised in thematic were important sources and architectural thinkers in the department of medieval architecture (Sammelmappe hervorragender Concurrenz Entwürfe, Neubauten und Concurrenzen in Oesterreich und Ungarn, Die prämierten Entwürfe der Hamburger Rathausconcurrenz, Concours D'Architecture). It is also evident that the thematic content of this folders fit to the design tasks of Steindl (Parliament, city halls, churches).

As a further outlook, the research of Gy. Istvánfi on the reforms of education after WWII are based on the traditions of architecture training of 80 years covered by our research. Using the drawing collection, he analysed the tendencies how the primary aesthetic aspects of the training have been modified under the auspices of dominating industrialised building technology after WWII.

*5. How did the International Congress of Architects held in Budapest in 1930 and especially its students' works exhibition displaying the main aims and efforts of the Faculty of Architecture and in broader sense the relation of Hungarian architecture education to its international context*

During the International Congress of Architects held in Budapest in 1930, an international exhibition was organized, and in parallel to this, professor Iván Kotsis organized an exhibition of the students' plans at the Technical University of Budapest. This venue was an additional exhibition place to the Múcsarnok (Exhibition hall) and the National Salon. The main curator was Iván Kotsis, professor of the department of design at the Technical University. The exhibited plans made in the design subjects were arranged in terms of modernity according to the departments' leading teachers, as the aim of the exhibition was to show the quality of education and its trend how much the architect's degree can keep pace with modern architecture. The actuality of the student's exhibition was also provided by the Congress' first program point in the agenda, which set new tasks and limitations of education in the new world of special building technologies. The audience - most likely at the opening on September 7th - was guided by Kotsis at the university. The exhibition gained generous recognition, although in his autobiographical writing Kotsis recalled that the foreign press evaluated the exhibited plans as "greenhouse breeding". However, Italian guests thought that "they were not wing trial attempts, but wing-strokes of powerful knowledge."

A series of drawings from the drawing collection suggest that they could be exhibited at this occasion. A duly dating and the uniform five-language format inscriptions indicate that it could be included in this exhibition. The theme of the drawings are not reflecting the modern

spirit, but contain excellent student drawings of the medieval history of architecture education. This 22 drawings are perhaps the only witnesses that Kotsis has presented to the foreign professional audience not only the design subjects, but also the works of other groups of subject, as it can hardly be found any hint on this in the contemporary press.

The exhibition at the Technical University was divided into two sections – that can only be learned from the contemporary press after very persistent collecting work. In addition to the group of designs, in the other section, in a smaller amount, illustrated drawings related to other subjects of the training were exhibited. In the second group, drawings of building construction and strength of materials, architectural and drawing subjects have been placed. The fact that the works of the architectural history group were also exhibited is not specifically mentioned anywhere, however, the unique description in five languages and the dating of the drawings refers to this section.

The exhibited drawings show how the architectural drawings of the students changed from the beginning of the 19th century to the period between the two world wars. In presenting design tasks, the modern approach radically transformed the graphics of professional and student plans. The technique of 19th century drawings with watercolor and artistic detail, often appear as virtuosos (which could be exemplified by Pollack's highly acclaimed exhibited drawings in 1930 in the Múcsarnok). The exhibited drawings show a strong sense of graphicness, light-shadow effect, intensifying contrast and plasticity. This change of view is most noticeable in the morphology details of the drawing collection drawn with an Indian ink pen with pointed-cut tip. In parallel, it can be seen that the drawings of architectural history have gradually lost their structural character, and are more focused on the subtle and decorative nature of the details. This process is reflected of course in the architectural theory at the beginning of the 20th century, which considered the obsolete historicizing planning method mistakenly only as a copy of the decorative elements without understanding its deeper structural features. Most of the drawings of architectural history have unfortunately deplored the constructive representation of the construction and become a simplified copy of the old templates. Some of the drawings exhibited can be traced back to their original pattern drawings or templates. For example, there is a table showing consoles (No. 103262), the "original" of which appear to be the Vajdahunyad dragon-type console that is to be found in the folder of Wiener Bauhütte (year VI. semester II). The ground plan of the palace of Vajdahunyad was also drawn up after the surveys of students lead by Friedrich von Schmidt in the 1860s on Vajdahunyad. Likewise, the drawings depicting the Zápolya chapel were made on the basis of sample drawings - one of the earliest survey drawings of this building was made by Frigyes Schulek in 1862.

The Congress and its reception honestly reflects the division of Hungarian architectural circles between the two world wars. Representatives of the profession expected continuously from the architectural training at the university to follow the fast-paced processes in the building industry. The relationship between history of architecture and contemporary design has changed completely since the 19th century, and the amount and the justification of the courses of the architectural history subjects had to be justified at the time of the 1930 curriculum reform. The debate about architecture education on the level of theory between

Marcell Komor, Iván Kotsis and Dezső Hüttl in the turn of the 1930's gives the scope of history drawings exhibited at the Technical University.

*6. What role did structural education play in the researched period and how did it appear in the design works of the students? How did it appear in the schedule of education and is it reflected in the drawings?*

During the first half century of architectural education at the Palatin Joseph Technical University (the predecessor of BUTE), three consecutive periods can be observed.

1. Period. Since the formation of the department of architecture at the Technical University, the subjects of strengths of materials and load-bearing structures emerged from the teaching of mechanics and of its subject group. This was primarily a series of theoretical lectures, and the practical training at that time had only a small proportion. By 1885, the students of the architectural department participated in the mechanics lectures with students of mechanical and civil engineering. Graphostatics was taught by Antal Kherndl, mechanics was presented by Kálmán Szily and Ignác Horváth and later by Dezső Nagy. The leaders of the university decided in 1894 for independent graphostatics education for the Department of Engineering and for Architecture. The theoretical background of building structures was based on Carl Culmann's book. Antal Kherndl, and Adolf Czakó, who studied at Culmann at the Eidgenössische Technische Hochschule in Zurich, were essentially teaching according to Culmann's method.

2. The beginning of the second phase of the education of load-bearing structures is marked by the establishment of the department of applied science of strength of materials in 1898. Professor Adolf Czakó, the leader of the department formulated the aim of education as follows: "The designer architect as the creator of the entire work, even if he does not perform the detailed calculations, may have the necessary expertise in the solutions to be considered and not to be a mere viewer of the structural solution conceived by others."

3. The third stage in the development of education meant the involvement of building of reinforced concrete structures and the understanding of its behavior. The most important change was made by Hugo Lampl and Elemér Sajó in 1914 with their book on reinforced concrete. In addition, effect of the Hungarian representative of the Hennebique patent, Szilárd Zielinski's work and the constructions of the engineering structures of Győző Mihailich were of extraordinary significance. As already mentioned, the teaching of reinforced concrete as material and as a construction for architects began in the academic year 1906-1907 as part of the "Applied strength of materials" course, and later continued in the years 1916-1917 as a compulsory subject. The subject of "Covering of Larger Span Spaces" started in 1910. This was the basis on which the education of modern load-bearing structures of Pál Csonka and then of József Pelikán was elaborated.

Based on the structural overview of student drawings and teaching aids, we can conclude that the relationship between the design of load-bearing structures and architectural form-

giving has changed significantly compared to the beginning of architectural education in the 19th century. The earliest documents show that the design culture of historicism has not only integrated the formal motifs of the historic ages, but integrated also their structural and constructional features. The presence of statics and reinforced concrete in education was in line with the reforms in architecture. The new materials and structural systems that turned up at the turn of the century demanded other design methods. Special load-bearing systems were best known by specialized engineers and contractors, and the architect had some knowledge that was indispensable for the design and layout of the spaces. The number of subjects related to load-bearing structures increased, as the knowledge base was also expanded. However, this does not mean that structural design has started to play a greater role in architectural design from the beginning of the 20<sup>th</sup> century than in the period of historicism.

The student drawings and sample prints from the 19th century show that education and the related summer surveying practices have provided a deeply structured knowledge to the design tasks of historical planning. As, for example, with the appearance of reinforced concrete or steel, new supporting structure systems have emerged, in which each element has its own role, it can be argued that historic architecture also worked with a toolkit that constituted such a system.

We assume that planning in historic styles actually meant thinking in a structural system rather than composing external stylistic citations. This assumption must, of course, be clarified, since in the 19th century there were quite different spatial and functional needs than the historical style of his own age. The masters of historicism, however, were well-educated in the architecture of past ages and were well-adapted to their modern needs.

A detailed research report (manuscript for an article – in Hungarian) in this topic can be found at <http://real.mtak.hu/id/eprint/85874> (Fehér Krisztina – Sajtos István – Krähling János: A tartószerkezeti oktatás fejlődése és hatása a műegyetemi építészképzés 1945 előtti rajzfeladataira.)



7. How does the architectural designs of the professors (realised or just planned or entered for competitions) relate to the main tendencies of education?

The analysis of the drawing collection regarding the professors' legacies (drawings, photo prints):

professors		drawing pcs	photo prints pcs	sum	drawings total	phooprints total (Exc. slides)	sum total	% drawing	% photo	% sum
professors	Dümmerling	115	0	<b>115</b>	6000	2000	8000	<b>1,91</b>	<b>0</b>	<b>1,4375</b>
	Rados	72	60	<b>132</b>	6000	2000	8000	<b>1,2</b>	<b>3</b>	<b>1,65</b>
	Czigler	4	0	<b>4</b>	6000	2000	8000	<b>0,067</b>	<b>0</b>	<b>0,05</b>
	Kotsis	6	0	<b>6</b>	6000	2000	8000	<b>0,1</b>	<b>0</b>	<b>0,075</b>
	Csányi	10	43	<b>53</b>	6000	2000	8000	<b>0,167</b>	<b>2,15</b>	<b>0,6625</b>
	Friedrich Loránd	60	0	<b>60</b>	6000	2000	8000	<b>1</b>	<b>0</b>	<b>0,75</b>
	Hajnóczi	10	0	<b>10</b>	6000	2000	8000	<b>0,167</b>	<b>0</b>	<b>0,125</b>
	Möller	370	30	<b>400</b>	6000	2000	8000	<b>6,167</b>	<b>1,5</b>	<b>5</b>
	Hauszmann	4	12	<b>16</b>	6000	2000	8000	<b>0,067</b>	<b>0,6</b>	<b>0,2</b>
	Sztehlo Ottó	17	0	<b>17</b>	6000	2000	8000	<b>0,283</b>	<b>0</b>	<b>0,2125</b>
	Steindl	586	25	<b>611</b>	6000	2000	8000	<b>9,76</b>	<b>1,25</b>	<b>7,6375</b>
	Schulek	210	28	<b>238</b>	6000	2000	8000	<b>3,5</b>	<b>1,4</b>	<b>2,975</b>
	Wälder	45	5	<b>50</b>	6000	2000	8000	<b>0,75</b>	<b>0,25</b>	<b>0,625</b>
	Vargha László	55	0	<b>55</b>	6000	2000	8000	<b>0,917</b>	<b>0</b>	<b>0,6875</b>
	Kismarthy-Lechner	245	0	<b>245</b>	6000	2000	8000	<b>4,083</b>	<b>0</b>	<b>3,0625</b>
Lux Kálmán	41	32	<b>73</b>	6000	2000	8000	<b>0,683</b>	<b>1,6</b>	<b>0,9125</b>	
Lux Géza	41	32	<b>73</b>	6000	2000	8000	<b>0,683</b>	<b>1,6</b>	<b>0,9125</b>	
<b>sum</b>		<b>1891</b>	<b>267</b>	<b>2158</b>						

The drawings of Ferenc Schulz, Otto Tandor, and Dezső Várnai are each less than 10. It was difficult to determine the consulting professors of the drawings, but the vast majority of the records belong to the department of medieval architecture. The former slide collection of Jenő Rados (as a separate section) include 2000 slides (mainly reproductions). The percentage of students' drawings in the collection is 51,15% (3069 records out of 6000 drawings). In contrast to the department of medieval architecture, not many of the works of the former heading professors of the department of ancient architecture survived, and also the numbers of students' drawings consulted by them are modest. Alajos Hauszmann's legacy consists of 4 plans and that of Czigler's of two plans only, while no drawing survived from Virgil Nagy, and Dezső Hüttl is represented by two items only. The plan heritage of Gyula Wälder (head from 1923 on) is relatively rich: 45 originals remained, and it may deserve a more accurate further analysis.

The photo legacy of former high-rank professors of the department display in several aspects extremely valuable records of important monuments of Historic Hungary like of the Vajdahunyad/Hunedoara castle, the cathedral of Gyulafehérvár/Alba Iulia, the castle of Léka/Lockenhaus, and the Early Christian Necropolis of Pécs, all in the context of Möller's and Csányi's professional activities. Renowned photographers have been identified in the photo collection such as Mór Erdélyi, György Klösz and Róbert K. Kertész.

The analysis of the drawing collection points out that Steindl's time could be best understood by the joint symbiosis of design and education. The collection of books and equipment included Steindl's competition plans, complemented by a library's rich thematic collection. The most common professor name in the collection is Steindl.

The research paper prepared by Katalin Maróty with his PhD student Márton Székely focuses on one of the most valuable pieces of the collection, on Steindl's competition project to the Reichstag in Berlin. These fourteen sheets from the 1872 competition plan seem to be almost complete. The research examined the importance of these plans in the oeuvre of Imre Steindl, emphasising his role in the design competitions of the era. Parallel to this, the collection possesses several plans of the new city hall building in Budapest from 1869-70 — also made by Steindl. These neo-gothic and neo-renaissance styled plans are relevant in the the evolution of building styles in the late 19th century Hungarian architecture. The research provided a profound analysis of the significance of building styles in the late 19th century design competitions — using the available documents in the collection.

In Schulek's time, this coexistence of education and design appear to be still significant, but later on the tasks in education appear more and more appropriate to the specific monument preservation requirements.

The research paper by Krisztina Fehér - Balázs Halmos entitled "The research of medieval editing methods in István Möller's oeuvre" publishes important research results. The report analyses an important part of the Drawing repository, an estimate of about 370 drawings by István Möller, professor of architecture of the Middle Ages. The examined details of the Möller legacy are valuable in terms of methodology. Möller tried to get closer to the question of medieval geometry with meticulous and lengthy research work. The validity of its geometry hypotheses has to be critically considered, however, he has recorded remarkable results that are both significant in the history of science and in the history of architecture. It is presumable that his educational activity and his professorship from 1914 provided a common opportunity to publish his research results jointly.

One of the treasures of the legacy of Schulek in the drawing collection is the plan series of the Reformed Church in Szeged. The building is a significant iconic element of the Protestant - but we can say, universal - church architecture, which is the unique, inventive solution of the Y-form space organization, that did not occur in the contemporary European historic architecture except for some Norwegian churches. The plan can also be regarded as a precedent for the Protestant church-building manifesto in term of "Wiesbaden Programme". Schulek's plan is also exemplary for the development of its structures. The methodology of

the church planning can be traced back to his researches on medieval architecture. (Published by: Krisztina Fehér, Balázs Halmos and János Krähling).

The designs of great professors, regarding the number of complete plans without the signed students' drawings is most richly documented by Jenő Lechner (Jenő Kismarty-Lechner, department of ancient architecture). His rich legacy – among them 170 church designs - deserve further research and publications. The effects of the efforts for modern church architecture from the late 1920s can be clearly traced in his buildings erected in the 1930s. In addition to his use of reinforced concrete, it is presumably mainly of his following of the German model and taking advantage of the facilities provided by the concrete structures, he used pointed arch openings, portals and windows. The roots of his architectural solutions lead to German Catholic church architecture, which seems to be renewed in the liturgical movement. (A publication in preparation by E. Baku and Z. Vukoszávlyev).

A research completed by Anna Kóródy highlights a set of student plans in the archive that refer to the education of design in the 1930s and 1940s. A number of student designs suggested the rebuilding of rural medieval churches with an asymmetrically positioned one-side-nave resulting a T-floor layout. This design task also appears in the architectural work of Géza Lux, demonstrating the live connection between the design education and the professorship, the link between theory and practice. The analysis showed that the importance of building survey and historic aspects of design education remain relevant in the period before WWII.

## **Sustainability and future of the project's results**

The published drawing collection of the department and the scientific assessment of the identified drawings, photos and slides from the period before 1945 made this extremely rare collection open to the research community.

The preservation of the material needs restoration that will be the theme of future projects. The professional digitization in extremely high resolution images is in progress, and it will be stored in special computers with suitable screens for research. This method will protect the drawings in their actual physical form and enables to connect the catalogue to other collections digitally, uniting the plan collections split in different institutions in Hungary and abroad through the web.

By the summary of the research we mentioned that some aspects of the catalogued material may deserve more attention and further investigation – like the plan legacy of Wälder etc. These topics can be elaborated by future PhD researches.

The department owns another considerable number of monument surveys, study drawings, plans and photos from the period after WWII. The assessment and cataloguing of this material appear evident as a continuation of this project.

**List of publications** (all with remarks of NKFIH (OTKA) grant No 112906):

Articles in periodicals:

1. Baku Eszter: A 20. század első felének centrális templomai: Pecz Samu templomépítészeti elveinek hatása a két világháború közötti protestáns templomépítészetben, CREDO: EVANGÉLIKUS MŰHELY 2: pp. 27-37. (2015), 2015. <http://real.mtak.hu/id/eprint/28908>
2. Fehér Krisztina - Halmos Balázs: A középkori építészet szerkesztési módszerei a hazai szakirodalom tükrében, Építés – Építészettudomány 43(3-4)237–285 DOI: 10.1556/EpTud,43,2015,3–4.7, 2015. <http://real.mtak.hu/id/eprint/29283>
3. Gergő Máté Kovács-Péter Rabb-János Krähling: The Ottoman Sultan's Albums at Budapest University of Technology and Economics, Turkish Historical Review 6 (2015) Issue 2 pp. 1-13. Doi 10.1163/18775462-00602001, 2015. [https://brill.com/abstract/journals/thr/6/2/article-p138\\_2.xml](https://brill.com/abstract/journals/thr/6/2/article-p138_2.xml)  
<http://real.mtak.hu/id/eprint/86019>
4. Istvánfi Gyula: Adatok a magyar építészkepzés műegyetemi történetéhez 1945–1990. - Rendszerváltozástól rendszerváltozásig, Építés – Építészettudomány 43 (1-2) 1–54. DOI: 10.1556/EpTud.43.2015.1–2.1, 2015. <http://real.mtak.hu/id/eprint/29229>
5. Krähling J. – Halmos B. – Marótyz K. – Sajtos I. – Vukoszávlyev Z. – Baku E. – Józsa A. – Kiss Zs.– Fehér K. – Kovács G.: Architectural drawing and education – Principles to the evaluation of the historic plan collection at Budapest University of Technology and Economics, Architectura Hungariae Vol.14. (2015) No.1. 7-18., 2015.
6. Fehér Krisztina - Halmos Balázs: Középkori szerkesztőmódszerek kutatása Möller István életművében. + Függelék: Részletek Möller István kiadatlan kéziratából, Műemlékvédelem, LX. évf. (2016) 1-2., 2016. <http://real.mtak.hu/id/eprint/64199>
7. Márton Székely – Katalin Marótyz: Imre Steindl's neo-gothic approach in the Hungarian design competitions of the 1870s [Imre Steindl a jeho poňatie neogoticky v architektonický súťažiach sedemdesiatych rokov 19. storočia v Maďarsku]. Architektúra a Urbanizmus 2016. 1-2. pp. 93-103.
8. Krisztina Fehér, Balázs Halmos, János Krähling: Frigyes Schulek's Calvinist Reformed Church in Szeged: The Particular Case of Medieval Design in Historicism, Periodica Polytechnica Architecture 48 (1), pp. 28-34, 2017. <https://doi.org/10.3311/PPar.11135>, 2017  
<https://pp.bme.hu/ar/article/view/11135>
9. Pilsitz Martin: Drawing and Drawing in Architecture - Architectural History as a Part of Future Studies, Periodica Polytechnica Architecture 48(1), pp. 72-78, 2017 <https://doi.org/10.3311/PPar.11310>, 2017

<https://pp.bme.hu/ar/article/view/11310>

10. Pilsitz Martin: Construction History in Theory and Teaching Periodica Polytechnica Architecture 49 (2018 ) 2, pp. 1-9, <https://doi.org/10.3311/PPar.13139>

11. Fehér Krisztina: Felmérés az építészképzésben. 1945 előtti műemlékfelmérési rajzok az építészoktatás első nyolc évtizedéből. Architectura Hungariae 16 (2017) 2. szám 33-53. (Nyomtatás alatt). <http://real.mtak.hu/id/eprint/85082>

Book/catalogue:

12. Krähling János - Baku Eszter: Építészettörténeti rajztár 1, BME Építészettörténeti és Műemléki Tanszék, Budapest, 2016. <http://real.mtak.hu/id/eprint/64193>

13. Krähling János - Baku Eszter: Építészettörténeti rajztár 2, BME Építészettörténeti és Műemléki Tanszék, Budapest, 2016. <http://real.mtak.hu/id/eprint/64242>

14. Krähling János - Baku Eszter-Fehér Krisztina: Építészettörténeti rajztár 3, BME Építészettörténeti és Műemléki Tanszék, Budapest, 2017. <http://real.mtak.hu/id/eprint/64243>

15. Fehér Krisztina-Krähling János: Kincsek az építészképzés 150 éves történetéből. Válogatás a BME Építészettörténeti és Műemléki Tanszék Rajz - és Fotótárának eddig rejtett legszebb darabjaiból. A Budapesti Műszaki és Gazdaságtudományi Egyetem Építészettörténeti és Műemléki Tanszéke és az Országos Műszaki Információs Központ és Könyvtár közös kiállításának katalógusa. BME OMIKK Aula, 2018. május 9-31. Budapest, 247.p. <http://real.mtak.hu/id/eprint/85085>

16. Krähling János – Fehér Krisztina – Jobbik Eszter – Kollár Mária: A Műegyetem középkori építéstan tanszékének címjegyzéke - Oktatásmódszertani és könyvtártörténeti adalékok a magyar építészképzés történetéhez. Architectura Hungariae 17 (2018) 2. szám 33-159. [Megjelenés alatt]. <http://real.mtak.hu/id/eprint/85059>

17. Fehér Krisztina – Krähling János: Építészettörténet és építészeti tervezés - Az építészoktatás megújulásának kérdései az 1930-as nemzetközi építészkongresszus műegyetemi kiállítása kapcsán. Építés-Építészettudomány 2019. DOI: 10.1556/096.2018.012 [Megjelenés alatt.] <http://real.mtak.hu/id/eprint/85573>

Conferences:

18. Krähling János - Baku Eszter - Fehér Krisztina: Építészeti rajztár: A BME Építészettörténeti és Műemléki Tanszékének rajzgyűjteménye, Építészeti rajztár workshop, BME Építészettörténeti és Műemléki Tanszék szervezésében, 2016. 06.09.Budapest, 2016. Konferencia közlemény

19. Baku Eszter, Fehér Krisztina, Krähling János: From Monument Survey to Design in Styles through Architectural Education: Analysis of the Plan Collection and Archives of BME Department for History of Architecture and o, International conference: Collections - Scholars - Interpretations, Tbilisi, Georgia, 02-04.05.2017., Ivane Javakhishvili Tbilisi State University, 2017.

20. Kóródy Anna: Churches extended in T-shape - An analysis of historic design methods in the early 20th century based on the archive of the Department of History of Architecture and Monu, „The Art of Drawing&Form 2017” (Nemzetközi konferencia, BME 2017. április 11-12.)

21. Krähling János: Építészettörténeti rajzgyűjtemény a Műegyetemen. A Konferencia címe: “130 éve alapítva, 50 éve a palotában – szemelvények a Budapesti Történeti Múzeum, a főváros múzeuma történetéből” Budapest, Budapesti Történeti Múzeum, 2017. szeptember 8.

22. Krähling János – Baku Eszter – Fehér Krisztina – Pilsitz Martin: The historic architectural form and the design - an analysis of historic design methods in the archive of the Department of History of Architecture and Monuments, „The Art of Drawing&Form 2017” (Nemzetközi konferencia, BME 2017. április 11-12.).

Report (Manuscript) for an article

23. Fehér Krisztina – Sajtos István – Krähling János: A tartószerkezeti oktatás fejlődése és hatása a műegyetemi építészképzés 1945 előtti rajzfeladataira. Kézirat. <http://real.mtak.hu/id/eprint/85874>

Budapest, 30. September 2018.

/Dr. János Krähling/  
principal investigator