

Collaborative network tools for the architectural analysis in conservation research

CYBER-REAL DESIGN 1998

Bia³ystok, POLAND 23-25 April 1998

**Institute of History of
Architecture
and Monument Preservation**

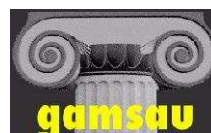


**Cracow University of Technology
Faculty of Architecture**

Instytut HAIKZ WA PK, ul Kanonicza 1,
31-002 Kraków, POLAND
Tel . (48) 012 421 87 22

gamsau

Groupe d'études pour l'Application des Méthodes
Scientifiques à l'Architecture et à l'Urbanisme



URA CNRS 1247

Ecole d'Architecture de Marseille-Luminy
184, av. de Luminy 13288 Marseille Cedex 09
FRANCE

Tel . (33) 04 91 82 71 70
<http://www.gamsau.archi.fr>

Iwona Dudek, mgr inż.arch.

Email : iwona@kanonicza.usk.pk.edu.pl

Jacek Czubiński, Dr arch.

Email : paczubin@cyf-kr.edu.pl

Jean-Yves Blaise, architect, teacher cum researcher

Email : Jean-Yves.Blaise@gamsau.archi.fr

Pierre Drap, Dr computer Science, CNRS researcher

Email : Pierre.Drap@gamsau.archi.fr

ABSTRACT

Development of net-based tools initiate a new architecture-computer science junction, offering a possibility to investigate distant exchange and updating of research work on architectural artefacts.

Tools such as CAD platforms, rendering software and DBMS are integrated to the every day work of more and more architects and conservationists. Computer tools, which have been introduced in the process of analysing architecture as drawing and data management platforms, now bring to the fore a deeper change: distant analysis. The development of web technologies and the object oriented approach to knowledge representation give us an opportunity of research in the fields of collaborative work on architectural data models. The research presented in this paper focuses on a first set of network operative tools for a co-

operation program aimed at developing web-enabled architectural data models referring to the evolution of Cracow's Old Town Hall.



ill.Erreur ! Argument de commutateur inconnu.
B.Głsiorowski, Ratusz Krakowski before its demolition

Objectives of the research

Concern for the architectural and urban preservation problems has been considerably increasing for more than a century. Our background research and exchanges program, named ARKIW focuses on the architectural patrimony and on the elaboration of a knowledge tool using the architectural model as the core of an interdisciplinary representation.

The ARKIW programme deals with questions related to the representation of architecture in the computer science discipline, to the process of the historical evolution of Kraków's Old Town Hall and to conservation techniques and knowledge. It will also address the key issue of how to enable collaborative work between the various specialists involved. Therefore, relevance of this interdisciplinary approach relies on the *ability* of a computer-based system to convey within the simulation process the whole information it detains (historical, architectural, morphological, etc.).

Steps of this analysis are:

- definition and representation of architectural models taking into account individual objects, composition rules, and federating non-morphological data;
- simulation of phases of architectural evolution in order to investigate reconstructional hypothesis;
- web-based information platform providing an understanding of the theoretical studies and analysis.

Computer science intervenes as the mean to represent the knowledge handled in the conservation discipline. The successive reconstructions of our case study, Kraków's Old Town Hall, correspond to several styles and trends of the European architecture. The edifice therefore clearly reveals elements of permanence or of variability within the architectural language. The knowledge to be represented and handled features both stable concepts (the roofing, the opening, etc.) and their historical variations. A relevant answer to the issue of how to deal with this question is offered by the object oriented approach in computer science which enables a description of concepts stemming from the phenomenon to be studied through a semantic hierarchy.

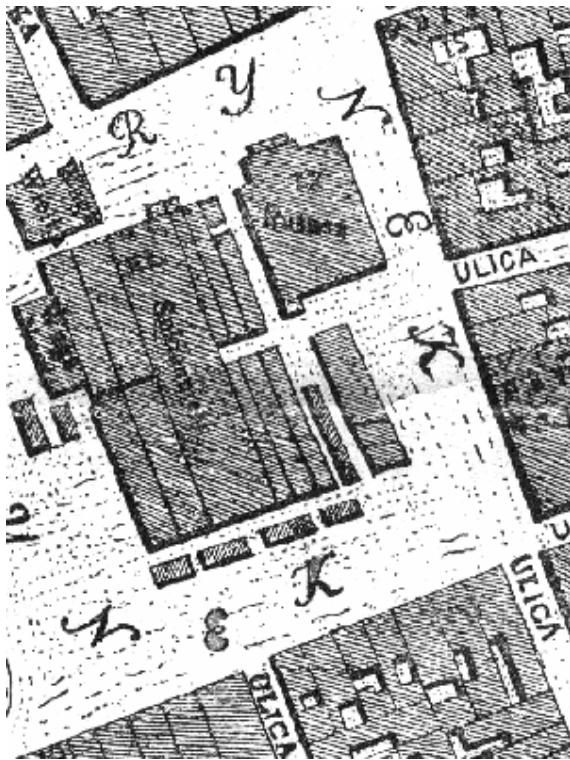
Objectives of the research include favouring a global understanding of the architectural evolution of Kraków's Old Town Hall (*Ratusz Krakowski*) and enabling the representation of reconstructional hypothesis used in conservation studies. This presupposes a thorough investigation of each of this evolution's steps in order to identify and organise sets of non-ambiguous *objects* (i.e. primary concepts of architecture). The analysis of the architectural vocabulary thereby conducted is continued in the development of the case study's building dictionary presented in this paper along with the on-line sources database.

Kraków's town hall

elements of history

The context of this case study is the Old Town Hall of Kraków, former capital of Poland, and its evolution through history.

The main body of the Town Hall in Kraków was demolished in the early XIXth century and only its Gothic tower was left standing. Some relics of the main building of the Town Hall still exist under the level of Main Market Square pavement. They were examined and their detailed descriptions accompanied with hypothetical reconstructions are available. It gives the opportunities of creating reconstructional models of development of the Town Hall in different periods.



ill. **Erreur ! Argument de commutateur inconnu.**
Ratusz Krakowski and the Main Square, plan
 Ko³³¹tajowski 1785, fragment [B¹kowski K.]

chiming clock and revolving statuettes is smaller in cross section and forms a ledge at its base. This ledge was used as the watchman's gallery.

The original town hall of timber was built when city was founded. Probably it had a very simple layout of the earliest type, consisting of a market hall on the ground floor and a *wietnica* or assembly hall on the first floor. A new town hall of stone and brick was raised in 1383. It had a tower which still stands today, whose northern wall adjoined a rectangular building which was rebuilt in 1454. The interior consisted of the vestibule, an assembly hall and the *Stuba advocatialis*, in the single line. In the cellar there was a wine lodge and a prison. The ground floor of the tower contained a treasury, and above it there was a chapel. A walled-in courtyard adjoined the rectangular building from the west.

The main body of the town hall, greatly enlarged at the time of Renaissance was demolished in 1820. The lower part of the town hall is of stone, the upper mostly brick with stone facing in parts. The rich decorative details resemble the stone facings of some of Krakow's churches. The top part of the tower, containing a

Outcomes and sources

Handling the exchange of experiences and skills covering the wide scope of the architectural conservation discipline requires the use of models that are able to represent diverse points of

view and experiences. The Ratusz's analysis gives way to the drawing up of a network tool that will use architectural models in order to investigate reconstructional hypothesis.

A substantial number of sources have been looked through during the early phases of this research. Numerous historians, architects, archaeologists, have studied the evolution of that edifice either from the point of view of the surveyor (starting from the XVI th century) or from the point of view of the researcher (XIX th century). They have formalised their conclusions (surveys or reconstructional hypothesis) in documents including textual or graphical descriptions of diverse evolution end elements of the building under consideration.

The availability of these sources (bibliographic and cartographic researches, drawing records listings) through a web-based platform should favour the efficiency of the ongoing investigations.

Methodology

Following an analysis of the available historical data, a drawing up of several contradicting reconstructional hypothesis is carried out. These hypothesis point out elements of *architectural meaning* to which we attach annotations (links to diverse specialised data).

Factorising information

The object-oriented programming languages now give an opportunity to formalise and handle models of complex knowledge fields. The field of knowledge is split into elementary concepts, structured through refinements of classes.

Organising the architectural corpus according to an object oriented approach requires isolating univocal individual objects (named entities) using as parameters in their determination function and morphology. Once they are identified, these entities are structured through a hierarchy of classes, each class defining a set of properties and a behaviour mode. Abstract classes represent generic objects used as a mean of gathering properties at a higher level of abstraction.

The entity

The description of the architectural model stems from the study of the architect's vocabulary [Pérouse De Montclos]. Architectural elements are conceptualised ; the analysis of the architect's vocabulary is carried out with the aim of splitting the building into significant elements. The object-oriented programming approach lets us gather generic entities into hierarchies of elements sharing properties or common behaviours or attributes, each property added giving birth to a new, more specialised (lower in the hierarchy), generic element .

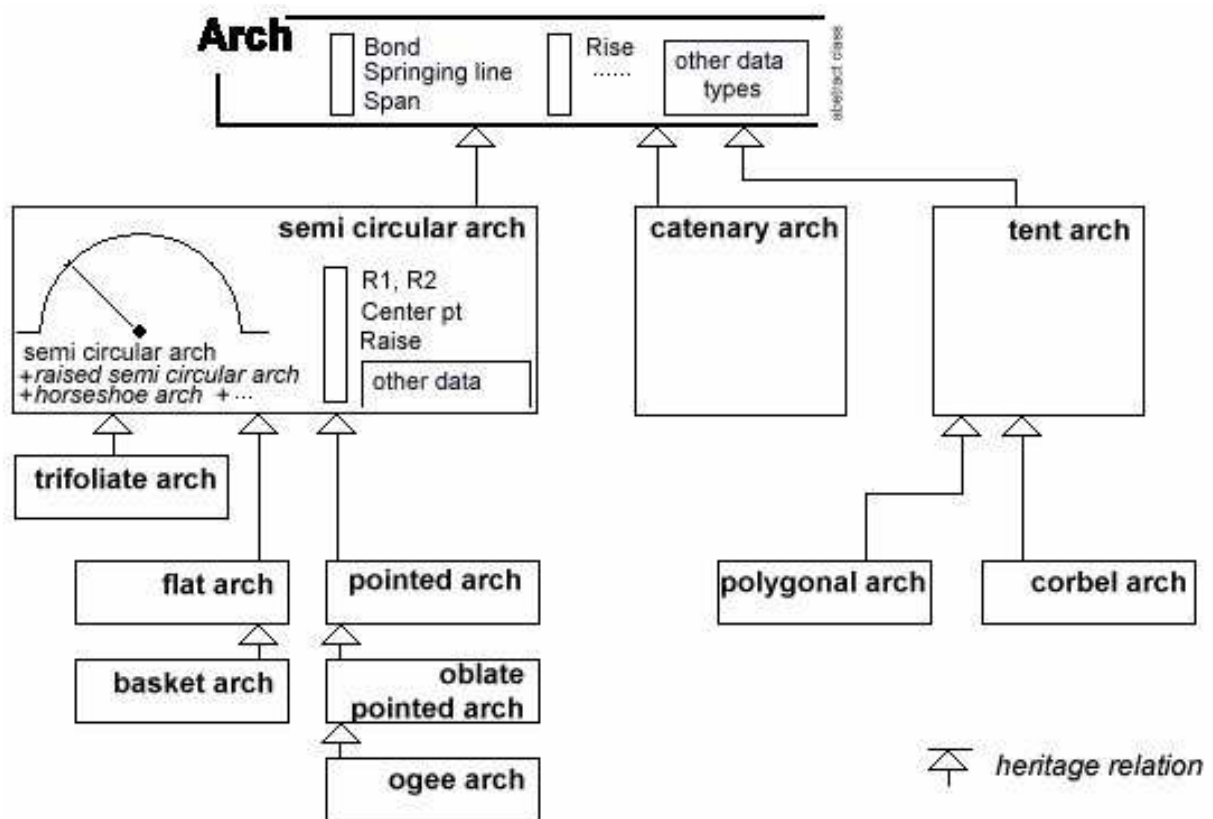
Methodological principles applied can be summed up as the splitting of the building into elementary , univocal objects, that we call architectural entities, organised with the help of relations stemming from the architectural vocabulary (perpendicularities, relations to an axis, topological behaviours, ...)

Elements of a building will be described as entities providing that they meet two requirements :

- An entity is a unique " object " identified by a single element of the architectural vocabulary.
- An entity has an obvious and permanent role in the physical structure of the building.

A typical example of this approach can be found in the description of the classical column : its base, shaft and capital are entities (one word, one role, indivisible) ; the column itself isn't (one word, several objects, divisible).

The discipline is therefore handled in this research as using combinations of elementary elements in which properties define a specific morphology, position and function within the building, as well as related non-graphical information. A typical hierarchy of classes (arches example) is shown on ill.3.



ill. Erreur ! Argument de commutateur inconnu. Hierarchy of entities: a part of the arches tree

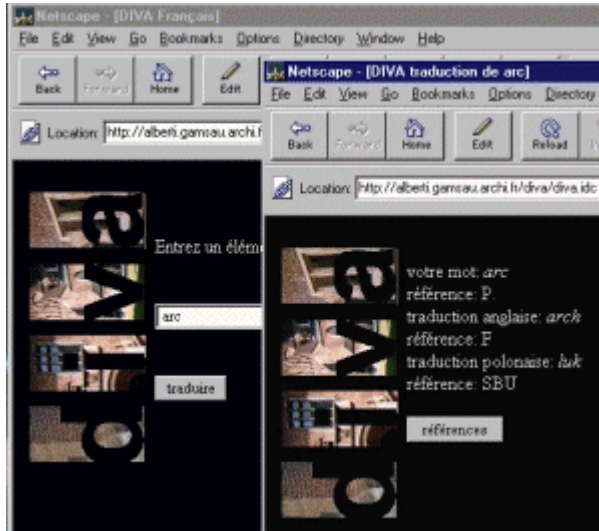
The methodological experimental tools

The architectural trilingual methodological dictionary

The definition of a common and precise vocabulary to name concepts and objects used in the architecture of the *Ratusz* has appeared of fundamental importance in this programme's early stages. That is why an experimental methodological dictionary is currently implemented. It should ease communication during the undergoing experiment and be of great help during the

research programme. The web-based implementation of this tool will allow searches by word, key-images and categories.

Furthermore, as a consequence of the knowledge representation technique we have chosen (Object oriented approach), three vocabulary groups can be identified:



- The **item group**, corresponds to the entities or each of their properties (the **arch**, the **keystone**, the **intrados**, ...)
- The **concept group**, corresponds to the entities and all their properties
- The **classification group**, corresponds to the highest level of abstraction (abstract classes).

A bibliographical reference is attached to each item of the vocabulary. A link will be established between all three search entries (word, key-images and categories) and the three vocabulary groups in order to implement knowledge oriented searching.

ill. Erreur ! Argument de commutateur inconnu..

Item search interface

The development of DIVA started using a relationnal database platform, the OO approach will be carried out with JAVA. Items taken into consideration in this experimental web dictionary are naturally limited to elements of the architectural vocabulary that have to do with our case study.

Vocabulary group <i>example</i>	item <i>keystone</i>	class (concept) <i>pointed arch</i>	classification <i>arches</i>
Search entries	word	key-images	categories

a bibliographical updating tool

Basic methodology of research includes indicating, organising and analysing sources. ARKIW's bibliographical referencing modus operandi draws a link between data gathered on architectural elements and a central bibliographic database. In the case of our collaborative research this database has to allow distant access and easy updating in order to provide each researcher involved with an efficient bibliographical database. Therefore, we have implemented a web-based data retrieval and append platform.

Users involved in the research programme have access to the thorough sources database and may contribute with more data. Other users have access to partial data sets that correspond to specific views on the sources database (localisation of archives for example).



ill. Erreur ! Argument de commutateur inconnu. On

themes ranging from urban context to materials and techniques.

The updating procedure is splitted in 3 steps.

- Identification of the user (researcher involved or visitor) monitors access to the updating of the database
- New entries are added following guidelines on themes and fields.
- Modification of entry (notification of availability, comments, ...) is allowed on chosen fields and with the relevant rules: append or replace

A strong focus is thereby put on the updating issue: localisation and relevance of each entry is commented, and its content can be analysed by each researcher involved.

Conclusion

Recent developments in the fields of knowledge representation and of network tools arise wide opportunities for new multidisciplinary collaborative approaches of patrimonial studies. The major stake in this research is the development of a model federating the multidisciplinary knowledge related to the architectural heritage. Initial outcomes have focused on the analysis of the domain and gave way to web-based developments enhancing collaborative work between researchers involved.

The research continues with a focus on the object oriented formalisation, used in order to formalise the heterogeneous data encountered in the architectural field. This approach of the architectural heritage opens up researches aiming at the definition of new building analysis tools (Development of a data management system dedicated to the architectural heritage, representation of archeological hypothesis, network platform developments)

Process and methodology of drawing up reconstructional hypotheses of an edifice that has disappeared requires detailed and systematic studies of various data. Many suggestive information may be gathered by interpreting records that are not necessarily connected with the building itself.

Old plans and maps, publications dedicated to urban development, archaeological surveys, descriptions and constructional analysis of objects that have the same roots (author. workshop, period and function, materials and technology of construction, etc.) may be of the great importance for researches. Basing on the same set of information researchers can come up with different achievements. The puzzle-like character of the constructing of hypothesis and the collaborative aspect of our work show clearly the importance of setting up a dependable and reliable bibliographical tool.

Entries of the Bibliography, which include both texts and graphics, are splitted in diverse

Illustrations:

ill. 1 Original in Muzeum Narodowe w Krakowie, Pracownia Ikonografii Krakowa

ill. 2 Original in Muzeum Historyczne Miasta Krakowia

References:

- Adam J-P, « La construction romaine, Matériaux et techniques » Édition A. et J. Picard, Paris, 1980.
- Bąkowski K. „Dzieje Krakowa”, Spółka Wydawnicza Polaska, Kraków 1911
- Borusiewicz W., „Budownictwo murowane w Polsce”, PWN. Warszawa, Kraków 1985
- Brayer A., „Rynek Krakowski”, Nakł. Towarzystwa Miłośników Historii i Zabytków Krakowa, Kraków 1956
- Budd T., - « An introduction to Object Oriented programming. » Addison-Wesley 1991
- Dmochowski Z., „Dzie³a architektury w Polsce”, The Polish Research Centre, London 1956
- Eastman Charles M., - « A data model for design knowledge. » Automation in construction, Elsevier juillet 1994
- Essenwein A., „Die Mittelalterlichen Kunstdenkmate der Stadt Krakau”, Leipzig 1869
- Florenzano M., Blaise J.Y., Drap P., „Paros, le sens de la mesure. Photogrammétrie et modeles architecturaux: le cas du forum antique de la ville d'Arles., XVIIIth Congress of ISPRS, „International Archives of Photogrammetry and Remote Sensing”, T. XXXI, cz. B3 Comission V, ss. 167-172, Vienna 1996
- Florenzano M., Blaise J.Y., Drap P., „Paros - Close Range Photogrammetry and Architectural Models.’, CAA97 Computer Applications and Quantitative Methods in Archeology, Birmingham 1997
- Ginouvès René et Martin R., Dictionnaire méthodique de l'architecture grecque et romaine, tomes I et II Ecole française de Rome 1985 (tI) et 1992 (tII)
- Jean-Paul Haton, Nadjet Bouzid, François Charpillet, M-C Haton, B Lâasri. H Lâasri, P Marquis, T Mondot, A Napoli, « Le raisonnement en intelligence artificielle, modèles, techniques et architectures pour les systèmes à base de connaissance ». Paris : InterEditions, 1991.
- Kadłuczka A., „Relikty monumentalnej zabudowy Rynku Krakowskiego - ocena stanu zachowania i możliwości ekspozycji”, „Ochrona zabytków”, nr 1 (188), R. XLVIII, Warszawa 1995, ss. 13-19,
- „International Symposium of Relicts of Medieval Monumental Architecture”, Warszawa-Lednica 1994, ss. 17-25
- Kremer K., „Wiadomości o Ratuszu Krakowskim”, Sprawozdania Towarzystwa Naukowego, Kraków 1852
- Le Moigne J-L, La theorie du systeme general - theorie de la modelisation Presses Universitaires de France 1990
- Muczkowski J., „Dawny Krakowski Ratusz”, Rocznik Krakowski, T. VIII, Kraków 1906
- Pérouse De Montclos J-M, « Architecture vocabulaire - principe d'analyse scientifique » Imprimerie Nationale 1972-88
- Odlanicki-Poczobutt M., Taranczewska-Białek Z., „Plan Kołłątajowski źródłem informacji o Krakowie”, Rocznik Krakowski, T. XLVIII, ss. 9-18, Kraków 1977
- Tomkowicz S., „Wieża dawnego Ratusza na Rynku Krakowskim”, Rocznik Krakowski, T. XXIII, Kraków 1932
- Watanabe S. - « Knowledge integration for architectural design. » Automation in construction, Elsevier juillet 1994
- Zin W., „Kronika prac i problemów konserwatorskich Krakowa za rok 1965 ”, Rocznik Krakowski, T. XXVIII, Kraków 1966