The Visualization – Visual Comparative Analysis of Early Romanesque Churches

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The paper presents educative aspects of visualization techniques performed in order to achieve the visual comparison of early romanesque or pre-romanesque churches of rotunda type. It explains and renders how computer techniques are used in order to achieve reliable basis for comparison of dimensions, volumetrics, material, proportions and other features.

Keywords: *visualisation; computer aided education; computer aided research; reconstruction.*

The concept of the application

The process of education in history of architecture is about explanation of facts and achievements often related to non-existing objects. Once erected they were transformed, converted, demolished or destroyed in the course of events of the past, clouding the perception of original shapes and forms, which may be decoded most times from nothing more than the remnants of foundation parts. Certainly this is the case when it comes to discuss the problems of early buildings from the very beginning of European culture. An idea was developed to form an addendum to the program of education in history of architecture to illuminate deeper the significant issues and aspects of history of buildings. The concept was to use CAD and visualization technologies to fulfill this aim.

The implementation of CAD techniques in the process of teaching of history of architecture has the purpose of joining various important pieces of information on monuments from distant past in order to broaden the understanding of what these monuments were, how they were built and what it meant for builders of the ancient times to undertake such constructions (cf. Agostinho, 2005). Encouraging students to visualize the non-existent objects according to specified method gives them opportunity to place themselves in the role of master builder e.g. from medieval times. The "ArcHiVist" program introduces visualization techniques to embrace the concepts of form, structure, building techniques and referential or comparative information.

The assimilation of historical knowledge is selective. Very often it leads to oversimplification and misleading ideas that can be avoided only when explaining the roots of architectural solutions. A good example is the idea of rotunda type, early romanesque churches in Poland and the gallery (*empora*), where place for prince or king was reserved, with its relevance to the presence or absence of other architectural structures in the area. The rotunda type of churches was selected to be the main subject of the program because of its structural simplicity. It seemed to be the most efficient way to implement visualization techniques by forcing students to work with relatively simple objects – CAD was used as media to understand aspects of history of architecture.

The supplementary program – CAD in teaching history of architecture

The plan of the monument neither explains the real impact object has on the environment nor on the landscape. The size of the building described by the scale measure relevant to the plan is informative, but too abstractive to "feel" the reality of the analyzed building. The program, that was supplementary to the core didactic contents of history of architecture lessons, relied on few exercises composing the full students' research on early romanesque churches (Barelkowski, 2006).

The ArcHiVist program assumes, that 3D model of the object has to be built. It introduces simultaneously three tasks in recreating the monument. First task is to remake the structure of the building – here virtual structure – using all necessary elements – foundations, taken from real measurements or from archaeological interpretations as a result of excavations, main walls with analysis of thickness differences and material content, wall openings, basic interior elements (galleries if indicated in source information), roof structure including geometry. Second task is to adopt the model to known building construction techniques of the past by recreating virtual representation of carpentry, stonework, size of the building using some basic structural calculations to approximate e.g. the height of rotunda in relevance to foundation size and indicated wall thickness composed with ascertained way of use of the interior. Third task is to understand fully the form of the building, also by attaching appropriate material and by selecting proper size of building units. The monument is created not as conceptual visual representation suited only for selected views, but as fully structural model that involves analysis of construction detailing (e.g. simplified detail of laying timber on stone walls) and finally allows comparison with other objects (created by the same student or other students).

Additionally the idea to visualize the objects allows precise and illustrative rendering of human scale by inserting human model into the scene. Then composition of multiple objects – in the discussed paper rotundas – gives more complementary idea of how these buildings looked, what were the similarities and differences, what influenced several details or entities to be various from other examples.

Pre-romanesque and early romanesque churches

The subject of the research was to elaborate the comparative analysis of rotundas, typical 10th and early 11th century simple oval buildings made mainly with stonework. These relatively small size, well fortified, massive and compact churches evolved from basic one apsis form into various types: one apsis with entrance on main axis type 1A, one apsis with entrance on the southern facade type 1B, two apsis type 2 (bikonchos), four apsis type (tetrakonchos) 4. Visualization in 3DStudio platform combined with the use of precise AutoCAD techniques of creation model contents for several details allowed for both realistic rendering, recreating the form of selected churches and in the same time it gave opportunity, how the type choice made by medieval builders affected the size and proportions of the building.

One existing rotunda was used as a reference object to establish basic parameters and estimate the tolerance for structural estimation. Students work involved then composing various non-existing rotundas and checking, whether assumed dimensions could be applied to specified object. Among elaborated exam-

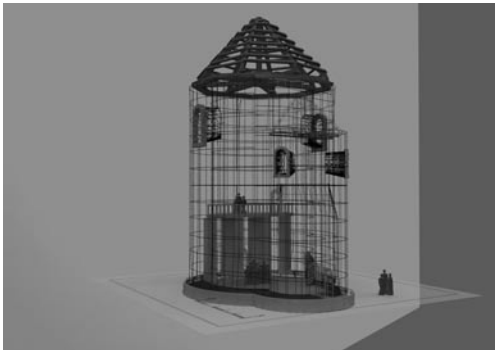

Figure 1
Lekno rotunda wireframe model. According to A. Wyrwa and R. Barelkowski. Model: J. Chodor

ples were rotunda in Cieszyn, Lekno, Poznan and two rotundas (bikonchos and tetrakonchos) in Krakow.

Cieszyn, as the only existing and well preserved example, shows many interesting features. After composing the 3D model students discover the relationship between the plan and the construction – the size of the apsis is exactly responsive to the needs of timber work responsible for roof geometry. This type 1A church was used as grod church from 11th century. Yet even more interesting discoveries for students emerge when working with 3D models of Lekno, Poznan and Krakow churches. Lekno (unconfirmed type 1B ?) was initially also grod church, having greater central nave and apsis, and consequently the size of walls and foundations. The northern extension to the foundation suggests that probably staircase to the gallery was situated there. But unlike case of Cieszyn Lekno shows no indication of permanent structure supporting the gallery. The walls are proportionally thinner. The model was based on data provided by the main research group examining excavations in Lekno (Wyrwa, 2003).

Poznan rotunda is 1B type, however its distinct feature is that it formed one ensemble with palatium (early Piast dynasty Poznan residence), large two storey building, connected on the higher level with prince's gallery, thus probably having no staircase. This object is of older origin, from mid 10th century. The reconstruction assumes that the material used in erection of church of Holy Mary the Virgin was similar or identical with one used for the palace – it means it was different from Lekno and Cieszyn. That earlier example of preromanesque architecture shows (probably) the miscalculation of ancient builders in assigning the geometry of the apsis, while the resulting roof structure was slightly deformed. Recreation of carpentry used to cover the apsis with a roof was a challenging task and is educative even as an unconfirmed supposition. Archaeological research was conducted recently, but still many pieces of information are hidden and await to be revealed (Kocka-Krenz, 2005).

Krakow examples are very interesting because they indicate unique spatial distributions, proportions and architectural concepts (cf. Swiechowski, 2000). These concepts are becoming evident when working with 3D model trying to reflect the structural features of the original. Students discover that even if preromanesque church called "B" church (bikonchos) shows relevance to typical rotundas, the nave / apsis ratio is definitely different ("B" church has ratio 0,72 comparing to other churches – Cieszyn 0,49, Poznan 0,49, Krakow tetrakonchos 0,58, Lekno 0,56). St. Felix and St. Adauctus church has a form of tetrakonchos. While it has exceptional and complex shape composed of main central nave, four apses, additional annex and mysterious building, adjacent to northern part of the church, it appears to be the smallest. When working with structure and mapping of the object it becomes obvious that on one site – Wawel hill – two Krakow churches built around the same period and in the very same place were constructed with diverse type of stone, the first from limestone, the latter from sandstone.

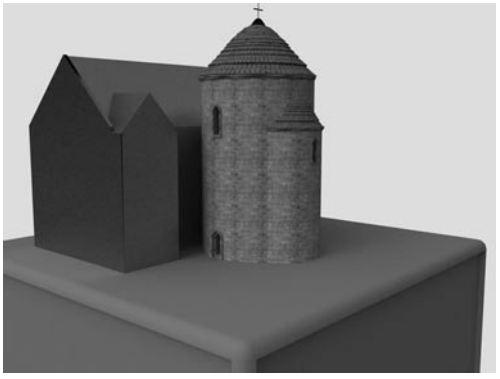

Figure 3
Poznan rotunda model. According to H. Kocka-Krenz and R. Barelkowski. Model: J. Chodor

Figure 2
Lekno rotunda rendering on site. Photo: RB. Model and photo editing: J. Chodor

Comparative analyses

Modeling the buildings gives many new information on the specificity of their construction, human perception of the architecture, but it establishes platform to discuss similarities and dissimilarities, as it was already mentioned above. The church models have been put together to grasp the differences, dimensional fluctuations, other architectural aspects.

Collated building representations displayed evidently main parameters, like internal diameter of the nave, diameter of the apsis (or apses), height of the building, its total capacity so, that all these attributes could be related to other included in the exercise.

Computer aided architectural education

It seems to be obvious that the potential of CAD technology lies not only in practice and research. Various IT techniques are used to support teaching and it seems to be beneficial to introduce modeling and visualization techniques in the process of education in history of architecture. While alternative method to understand structures of the past is to built models, it is more time consuming and thus appears to be more selective, narrowing possibilities to make many models from different periods of architectural evolution.

This research type approach in students activities is no mere introduction to "scientific" activities, but it is seen by the author of the program as tool to initiate analytical thinking on architecture both ancient and contemporary, thinking on principles in design, thinking on how to understand works of other architects (even if one cannot fully comprehend the socio-cultural background of e.g. medieval times), finally imagining what CAD implementation brings to the design practice if it is applied without consciousness of the real aspects of building design and construction.

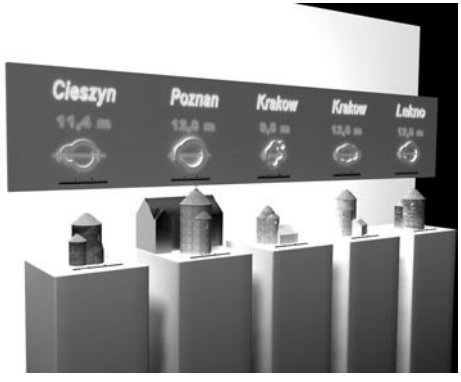

Figure 4
Comparative analysis model. According to R. Barelkowski. Model: J. Chodor

Note

The research leading to formulation of ArcHiVist education program has been conducted under supervision of Robert Barelkowski, the author of the program. All models presented in the paper are elaborated by Jerzy Chodor.

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