Reconstruction of "Capella Speciosa"

within the Framework of the Research Project "Computer-Assisted Representation of Architecture" Promoted by Funds for the Promotion of Scientific Research

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The present contribution describes the further advancement of computer-assisted representation of architecture of art-historical research work by means of the reconstruction of the so-called "Capella Speciosa".

Art-Historical Preliminaries

The "Capella Speciosa" in the Monastery of Klosterneuburg (Lower Austria) was built by Duke Leopold VI of Austria as court chapel of his residence and consecrated in 1222. In 1799 the since 1787 profaned chapel was demolished and parts of its interior architecture were incorporated in the Romantic "Franzensburg" in Laxenburg in 1801. Two drawings dating from approx. 1750, - the north side from the outside and the interior south wall - show how the chapel looked like.

Despite this incomplete and fragmentary picture of the Capella Speciosa art-historical constructional research has been deeply interested in this structure ever since the 19th century, as the close affinity of form details with works of art of the French Gothic had already been discovered in those days. Up to now, a graphic partial reconstruction of 1861 by August Essenwein had been of major importance regarding its appearance, archeological excavation work of the foundation masonry walls of the Klosterneuburg chapel unveiled interesting details on this structure in 1953.

Interdisciplinary Research Project

Within the framework of an interdisciplinary research project in the period of 1993-1995 the reconstruction and spatial representation of Capella Speciosa was attempted based on the available data and indications making use of advanced CAAD-technology. Based on the secured data, i.e. the excavation findings of the foundation masonry walls and the constructional members incorporated in Laxenburg such as the blind arcades, vault girders and a columnar portal, were defined and positioned within this experimental, stepwise reconstruction procedure like building bricks. Continuous counterchecking and correcting the representation both regarding base dimensions and specific details clearly resulted in inconsistencies with August Essenweins` reconstruction, so far not even having been compared with the findings of the foundation excavation. Essential details, however, proved true both concerning substance and formal reliability of the drawings of 1750. The very complicated vault formation as depicted in the historical interior view having been misinterpreted by Essenwein as actually spatially unconstructable, can be found in reference examples of French Cathedral building art of the two first decades of the 13th century (Reims, Auxerre). Thus art historical research proof had been produced that the Capella Speciosa, created by French building artists as court chapel of the influential Babenberg Duke Leopold VI, is to be deemed a work of art of extraordinary overregional significance throughout Europe to be regarded stylistically at the peak of Gothic architecture.

Scientific Findings

Though not preserved in its entirety, the Capella Speciosa has been regained illustratively as initial construction of Gothic architecture in Austria by means of computer-assisted architecture representation work. The research findings of spatialized representation of this (art-) historically outstanding Capella provide clear evidence for the efficiency of a experimental model whereby a computer-assisted architecture reconstruction not only delivers unequivocally defined specifications as demonstrated by the well-known reconstructional visualization of the Abbey Church of Cluny III, but also, particularly by putting findings of not-to-scale, - complicated and interlaced in

nature -, to use as well as relying on multiply verifiable consistency checks of structure specifications. Considerable significant findings resulted while developing the visualization model making for essential conclusions as to the original function of the chapel: the independence in mean room height at the longitudinal walls and at the wall passage running around the apsis polygon of the royal gallery provided by the respective differences in level and the specific staircase supported the assumptions due to stylistic and architecturonologic comparisons with contemporary buildings in France and Germany that the mentioned wall passage of Capella Speciosa served as a precious reliquary shrine for the exhibition of articles of worship brought by the duke from his cruises. A similar dedication is found in the collegiate choir of the Naumburger Dom. The perhaps most monumental reliquary shrine in chapel form from those days is Sainte Chapelle of King Louis IX of France in Paris, built, however, two decades after Capella Speciosa. This is to say, that the Klosterneuburg Capella is to be traced back to older French models in the field of religious reliquary worship, thus posing new questions e.g. as to function of the obviously exemplary annular chapels of the Cathedral of Reims making a perfect match to those of the Capella Speciosa in significant details of the complicated wall formation.

The present research work is worth more than the utilization application of visualization of non-existing architectural structures. It is to be regarded as a practically hardly implemented tool of interdisciplinary approach to building monuments of the past comprising constructive and style-approach aspects as well as architecturalonologic fields and thus to the conceptual-historical features of the time of creation.

EDP-Technical Solutions

In order to produce digital models from existing plans, constructional drafts, photographs etc. generally tools from four different categories are implemented:

A: digitizing/ processing

B: CAD/modeling

C: visualizing - walk-through

D: output

Software Products

In the course of the present research project the following software products of above categories A to C were put to use:

A: Digitizing/ Processing

Adobe Photoshop

Patterns, both picture point- and pixel-based picture material (such as pictures, drafts) or vector-based patterns (such as plans, construction drawings etc.) can be directly scanned into this image processing program. The platform-overlapping software "Photoshop" provides for scanning images into the program by means of "plug-in" for immediate manipulation. Changes in screening pattern, contrast, brightness, depth of shade and scaling serve as preparation for model generation.

B: CAD/Modeling

ArchiCAD

ArchiCAD for PC and Macintosh is an architecture-based software for the production of plans. This application makes for working out exact ground plans and models (2 1/2D or 3D) from pixel- or vector-based digital data.

GDS

GDS is an object-based, modular-designed CAD-system. The modules are structured thematically, e.g. the generation of 2D-graphic (Module XGRAPHIC), determining type and aspect of the drawing window (Module XWINDOW), handling of a group of selected objects (Modules XOBJECT), configuration of user surface (Module XMENU), spatial construction of members (Module XSOLID), their visualization (Module XSVS) etc.

Microstation

In Microstation - a CAD-package available on PC, MacIntosh and SG - the CAD-functions are supplemented by interesting and useful 3D-modeling functions exceeding the capabilities and the user comfort of other CAD-standard applications. The interfaces in Microstation comply with the standard AutoCAD-converters, furthermore, specific formats are available. Data export on below visualization applications results very smoothly.

C: Visualizing - Walk-Through

Wavefront

In Wavefront (on system platform SiliconGraphics - SG) any definitions of materials like textures are made. An internal modeler provides for desired corrections on the model. In Preview (module of Wavefront) the camera movements and light changes are optimized. The render-module makes for high-quality rendering of image-material.

Inventor

Inventor on SG is a programmable model-viewer granting interactive walk-through accessibility apart from spatial checking of models in tinted mode. Special applications as the dialogue-based correction of texturing, pre-programming of camera and light movements are to be performed in this program.

Performer

The last quality criteria is offered by the interactive walk-through accessibility of the model providing material, lighting, textures, images. Performer on SG representing an optimized data-bank results in interactive experiencing of the CAD-model. Stereo-spectacles and head-mounted-display add to the spatial perception effects.

Two Stages of Reconstruction of the "Capella"

Reconstruction work of the "Capella" was performed in two stages, the findings thereof as described below. The concluding outlook results in a promising future for further developments of the recent and present state of the art.

In Stage 1 the following hard- and software combinations were put to use:

Hardware:

- Workstation: DEC5000/240 (Digital Equipment)
- AO-Digitizer:TEK 4958 ((Tektronix)
- AO-Penplotter: (Mutoh IP 530)

Software:

- CAD: GDS (GDS-Corporation)
- Image Representation Program XV (Shareware of John Bradley)

Phase 2 put a principally altered configuration to use:

Hardware:

- Workstation: SG Indy and SG RE2-Onyx
- AO-Plotter: HP DesignJet 750C

Software:

- CAD/Modeling: Microstation
- Visualizing/ Walk-Through: Wavefront, Performer, Inventor

Valuable experience in the following fields was based on the research findings:

1) CAD-modeling and visualizing

2) Comparison of software and methods: suitability of methods, instruments and techniques

3) Definition of fields of applications for "computer-assisted representation of architecture".

Stage 2 was aimed at optimizing the use of computer in art history research work throughout the mentioned areas.

Experience

Items of experience of major interest:

Capability of program

CAD-programs do not really disclose how they handle complex data, many programs being restricted to approx. 10.000 polygons; therefore, CAD-packages with newer software concepts (full 3D-modeling, object orientation) were introduced within the course of the research project.

Complexity of models

Filigree elements (e.g. chapiters) proved problematic, furthermore, free form surfaces and curves of a higher degree (e.g vaults, cross-rib constructions, rosettes, etc.); the proportion of larger and smaller quantities and their processing possibilities (e.g. simultaneous availability of various views, simultaneous representation of detail and general view, spontaneous switching in working mode from detail to general view, perspective view possibilities, zoom functions, free-form and 3D-tools) proved of major importance.

Scalability

Regarding complexity of CAD-models their scalability and automatic simplification represent essential prerequisites for visualizing and walkthroughs, i.e. large, memory-intensive models not being handy otherwise. Without scalability parts of a model have to be excluded.

Detail accuracy

Considering modeling the required detail accuracy as upper limit of complexity, required sharp definition and detail reliability as well as performance of hard- and software is to be adequately defined.

Combination of software

An efficient combination of various tools proves wise. In line with the findings in stage 2 the combination of Photoshop, Microstation, Wavefront, Inventor/Performer each on SG proved meaningful.

Visualizing and verification

The present research project demonstrates the qualification of the CAAD-instruments in art-historical research both within the field of visualizing and reconstruction as well as for the verification of art and building historical assumptions (e.g. heights, constructive details, drawings from former days etc.).

Outlook

The experience gained within this project together with the rapid development of hardware and software encourage expectations as to major implementations of digitally assisted techniques in the field of spatial simulation and reconconstruction.

Among others, the following fields of application are specifically aimed at art historical research:

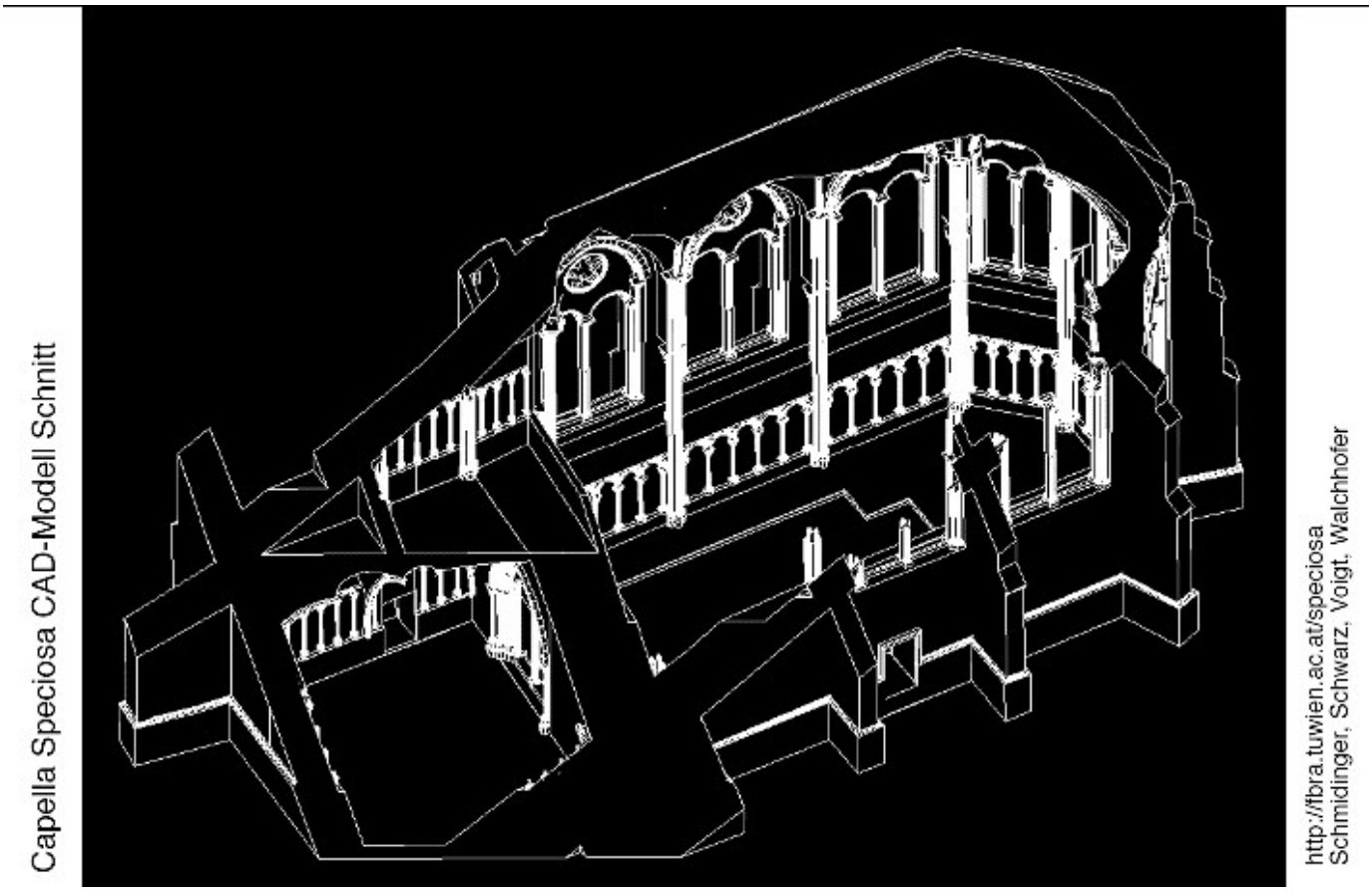
1. Creation of information systems containing all essential information concerning the space viewed such as art historical findings and descriptive data.
2. Establishment of a spatial simulation data bank enumerating the necessary information for - so required - a computer-assisted anastylosis (re-construction), the erection of any such protective buildings and the historical reconstruction by means of a trip back into the past.
3. Co-utilization of indicated data stocks for the management of excavation premises (Facility Management) providing for sophisticated public relations work and sightseeing tours.

The following sections as described below deserve further attention regarding computer-assisted architecture within art historical research projects:

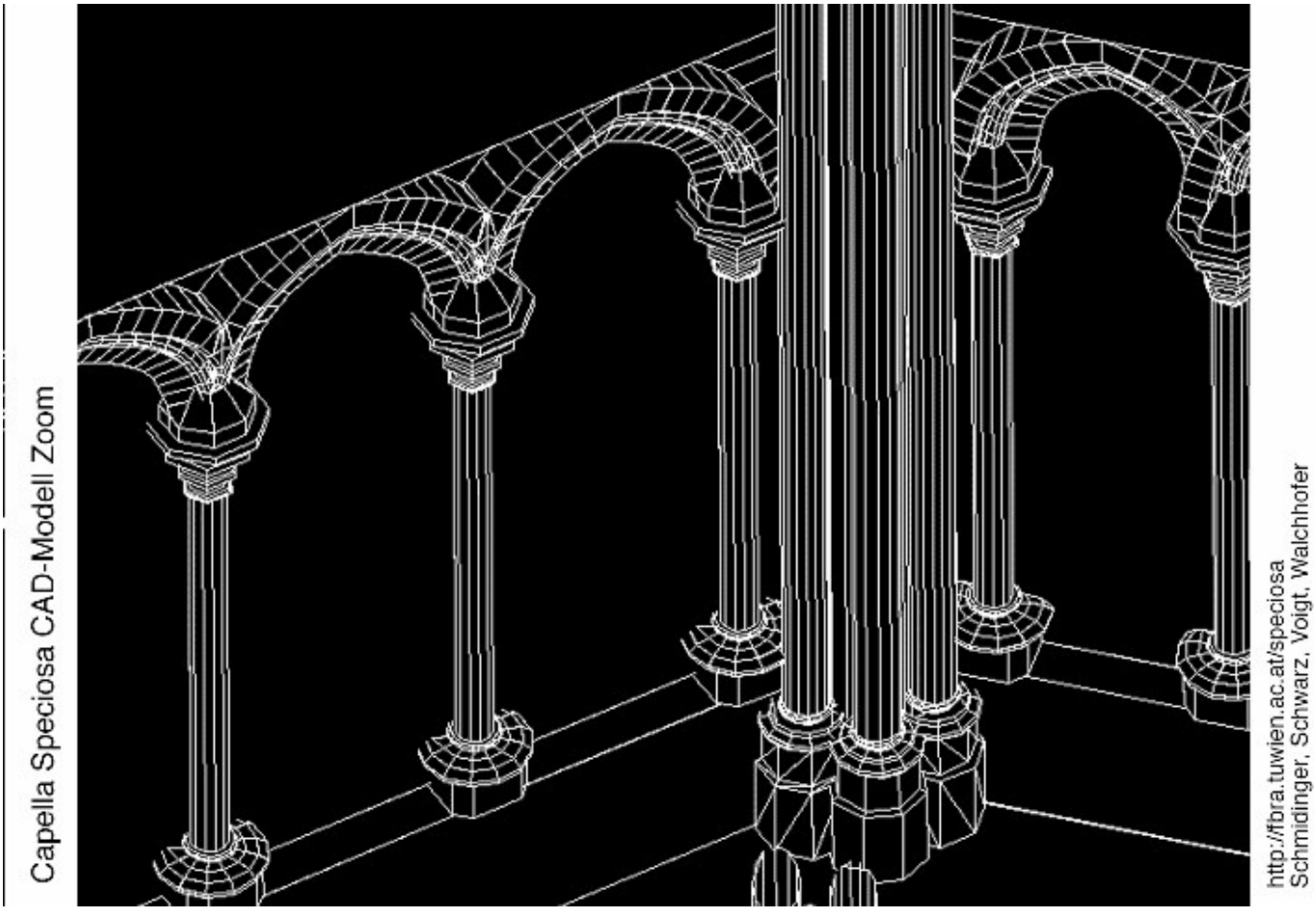
1. Optimizing of computer simulation regarding clearness (e.g. texture mapping, lighting, etc.) and volume of view (scaling of models, determining of levels of detail taking view conditions into account, application of advanced concepts such as "Open-GL Optimizer", spatial scene-graphs, efficient combination of hard- and software by dislocating render-processes to the CPU, approximation processes for surfaces etc.);
2. Consideration of haptic requirements: implementation of stereo-lithography (STL) for the production of physical models on the basis of digital CAD-models;
3. Visualizing of structural construction principles (as basis for reconstruction) and thus creation of bases for the reconstruction;
4. Visualizing of (reconstructed) objects in their structural, urban spatial context;
5. Optimizing of digital data flow (import, processing and export of data); configuration of continuous digital recording, assessment and planning processes.

The mentioned areas will involve a great deal of additional work, particularly regarding the development and advancement of digital techniques considering the fields of application. The present findings - such as those of this contribution - clearly demonstrate the importance of pursuing work teaming up with specialized disciplines.

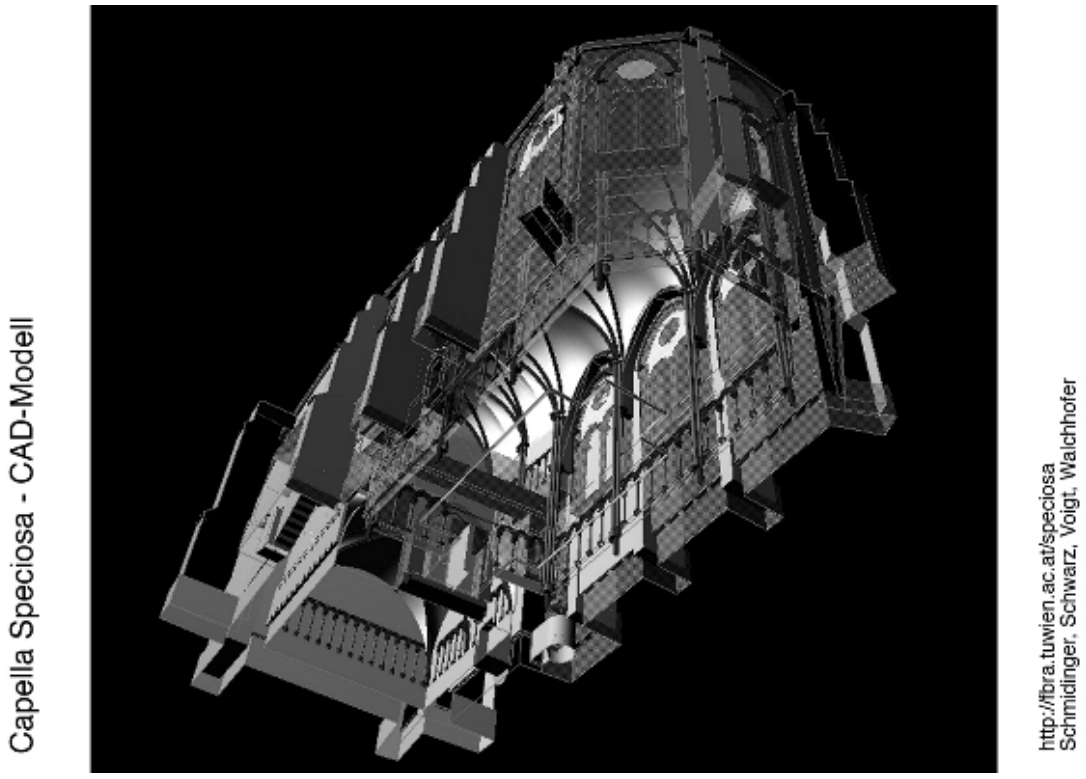
Construction:



Section Capella Speciosa (isometric projection)

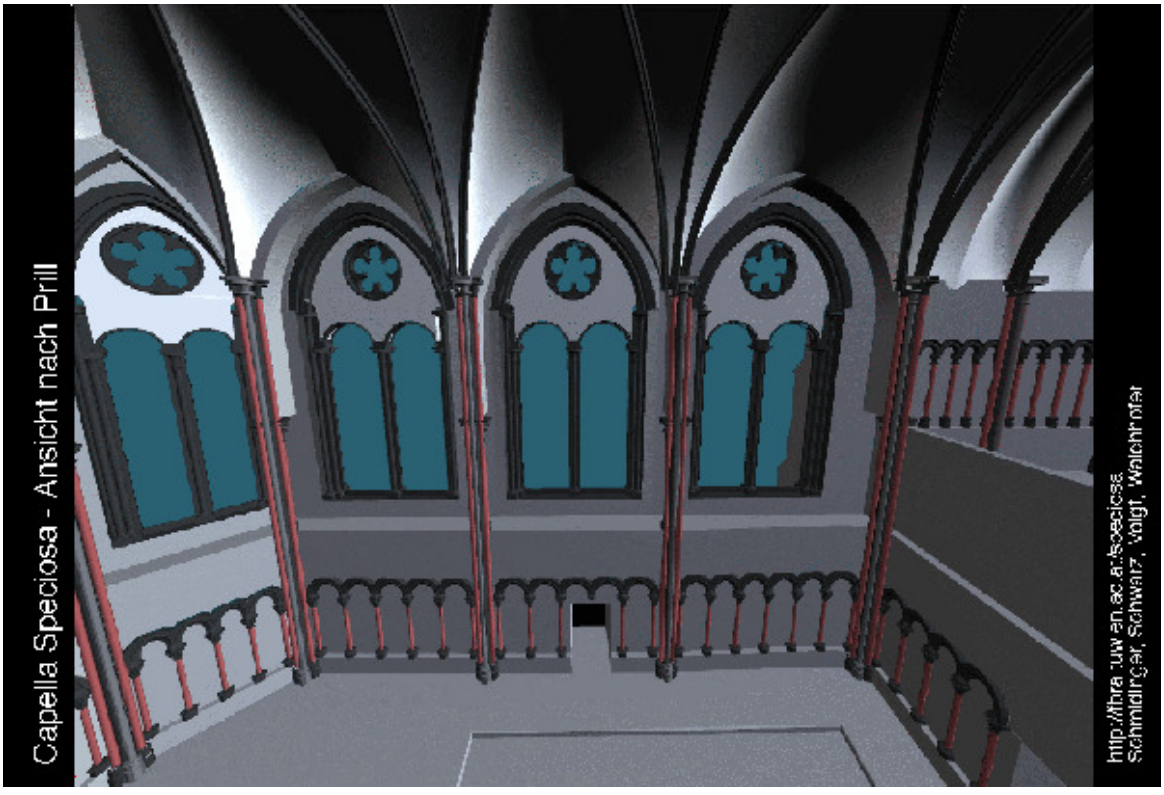


Arcades (original ones in Franzensburg)

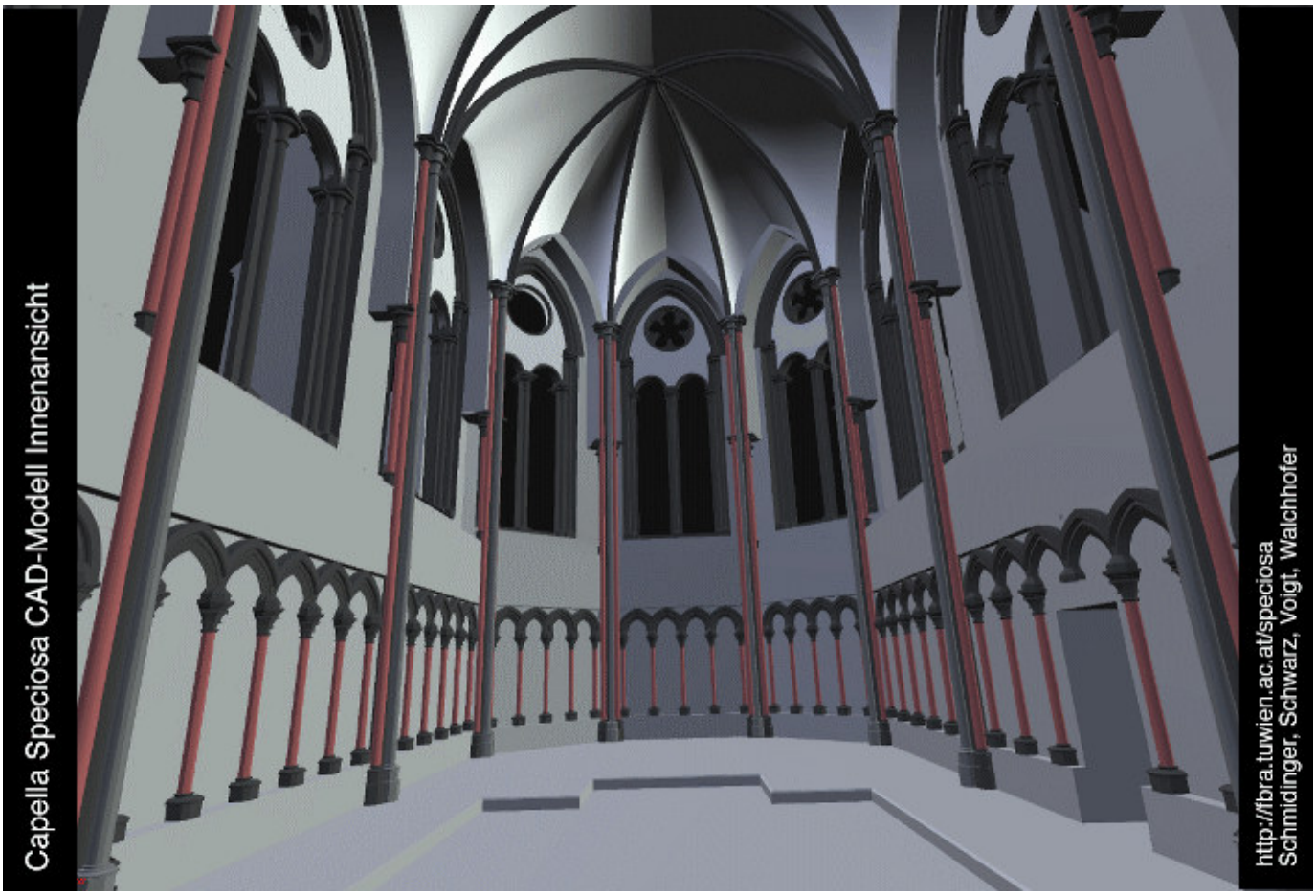


View into Capella Speciosa from below (transparent floor and wallparts)

Renderings:

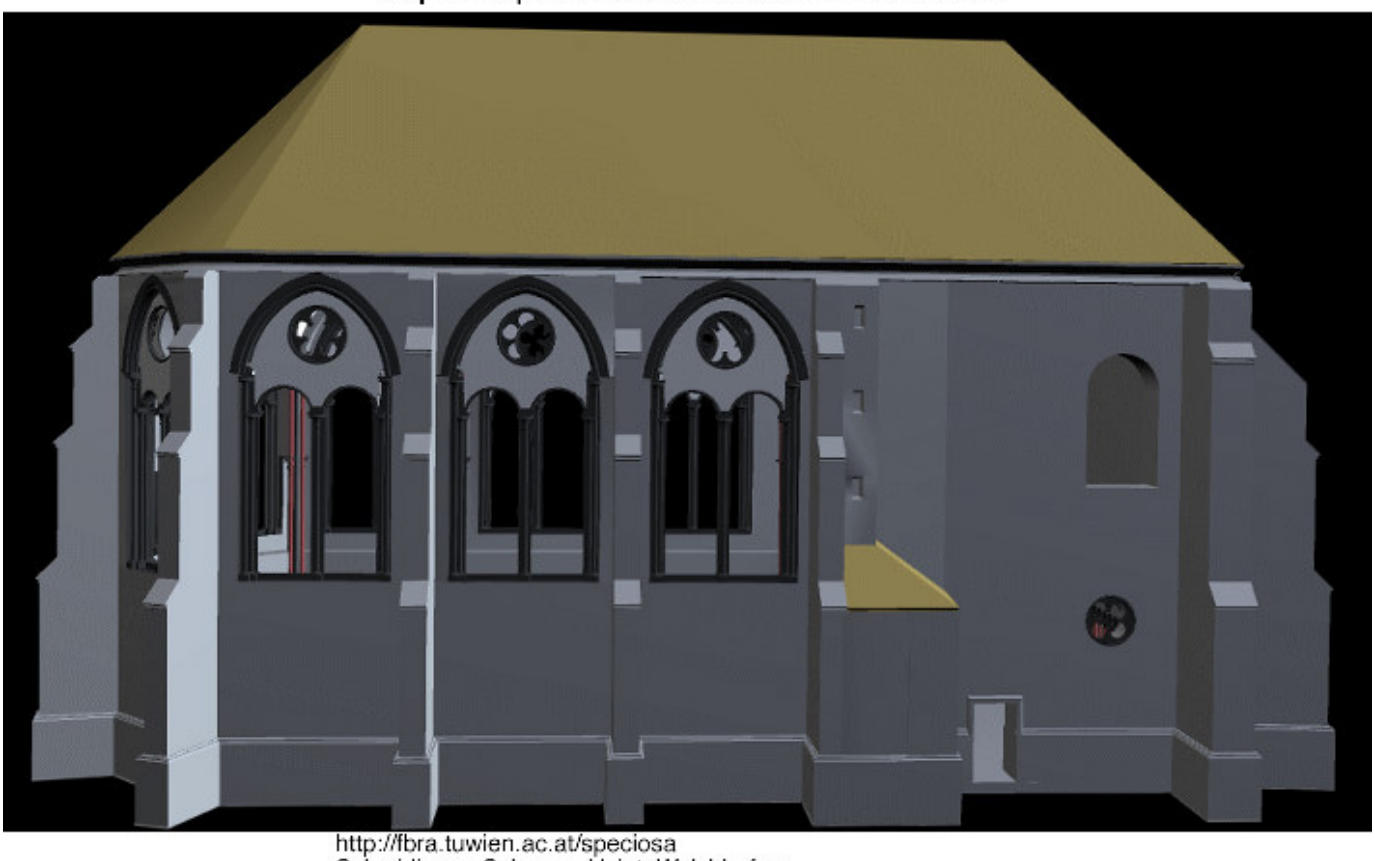


View into main hall



View into choir area (main hall)

Capella Speciosa CAD-Modell Außenansicht



http://fbra.tuwien.ac.at/speciosa
Schmidinger, Schwarz, Voigt, Walchhofer

Photorealistics:

Interior view of Capella Speciosa (position Prill)