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Virtual Reconstruction of the Cistercian Monastery of Pilis

This work and its defense approved by:

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RESEMBLANCE OF THE LONG EXISTING:

THE VIRTUAL RECONSTRUCTION OF THE CISTERCIAN

MONASTERY OF PILIS, HUNGARY

A Thesis submitted to the

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of the College of Design, Architecture, Art, and Planning

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ABSTRACT

Since computer reconstruction of ancient monuments is a relatively new field, many of its aspects and potentials have not yet been fully utilized or explored. This research will demonstrate that the usual emphases in computer reconstruction, such as data gathering and visual realism, both miss the essential fact that such reconstructions are, in the end, interpretive. It will also be shown that since the exact form and characteristics of now-destroyed monuments are often unknown, computer reconstructions can exploit a more open-ended set of educational, interpretive, interactive, theoretical, and analytical capacities, including revealing the uncertainties of the reconstruction itself.

My aim in this research is to explore the advantages and limitations of the application of computers for study and preservation through the partial virtual reconstruction of the Gothic Cistercian Abbey of Pilis, in Hungary, that was founded in 1184. Besides creating a computer model of the site and the structure, the capacities of the new medium as a tool for studying ancient monuments will be investigated, specifically in utilizing historical representational techniques. The approach will help in understanding the history of the monastery and provide an analysis of the significant forms and geometries of the building. Furthermore, issues arising from a theoretical consideration of this medium, such as the meaning of a “reconstructed reality,” and the way our perceptions are affected by these media, will be discussed. These problems will
be illustrated with three-dimensional models and images that are layered into the treatments of the monument itself. For example, possible alternatives for the reconstruction of the site will be developed and compared to each other. I will take advantage of graphic devices such as hiding certain elements, or transforming them into wire frame models, in order to analyze the inner structure of the abbey and to generate different interpretations of the computer-reconstructed edifice.

A series of images, animations and interactive slideshows are presented, portraying the monument in various interpretations, along with text and graphic segments illustrating the theoretical approach to the reconstruction. Through such techniques, audiences are drawn not merely to realistic forms of representation, or to final renderings of a single interpretation, but also to deeper analytical and educational content. As a prototype, “Virtual Pilis” will contribute to the growing scholarship on “virtual heritage”; in particular its capacity to deliver content to audiences, rather than merely to present images, which is the norm.

**Keywords**

Virtual reconstruction, visualization techniques, Cistercian architecture, fountain, Abbey of Pilis, Hungary
DEDICATION

To my Mother, Wife ad Daughter
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INTRODUCTION

Buildings of the distant past are today’s remembrances of history, and are sometimes among the only remnants of civilizations and cultures that have vanished over time. To study and investigate such monuments, to find out their possible structural and spatial arrangements and to see them rebuilt again, has always been a fascinating challenge regardless of the tools and the methods of research. Where contemporary computer technology meets the world of ancient buildings, the field of computer reconstructions can present guiding structuring principles, spatial organizations, architectural understanding and their aesthetical representations in a new way.

Even though this study is generally associated with the ever-developing world of computers, image processing techniques and virtual realities, it is still important to begin by investigating the principles and methods concerning representing and reconstructing a building. The realm of the virtual urges us more than ever before to find out how to represent, for example, the different levels of accuracy and certainty, or how to give graphical insight to the reconstruction process regardless of the medium employed, whether it is interactive virtual reality, animation or simply still images. This work does not criticize any of these formats, but attempts to give universal concepts regarding the aspects of representation above that are applicable to all, no matter what sort of medium is used in specific applications.
Undoubtedly, these “universal concepts” in digital reconstruction that would be applicable to all types of medium, should also work in the most basic format: still images. From there on the image can become a frame of an animation, where the model is looked at from different angles, or through historical development over time. A series of animations can be connected and organized, for example, in an interactive framework, where the viewer can choose among them. Ultimate interactivity is reached with the invention of real-time virtual reality environments which can be regarded as an animation that is not pre-arranged and contains a set of still images that the viewer decides to view, moment to moment. In search of general principles, this thesis proposes to investigate examples in the long tradition of historical representational techniques, where drawings and paintings, the equivalent of the still images that compose all digital media, have already opened up most of the theoretical issues in great detail.

The aim of this thesis and the accompanying reconstruction study is not to produce a real-time virtual reality model, since today both the appropriate software and hardware are not yet available for a wide audience. Nevertheless, it is still important to critically examine the newest findings and research conducted in this area. Although not necessarily from the technological point of view, it is, still essential to investigate the basic methodologies of how key aspects such as uncertain elements, structural order or the visual metadata are represented.

The first chapter will give an overview of a selection of historical representational techniques in architecture and will shed light on the importance of these already established and effective methods. Most of the rendering techniques commonly employed in architecture today have a historical background and a long tradition. For example, orthogonal drawings, such as plans and elevations, axonometric projections and perspectives have been used and applied in architectural
representations for centuries. Like computer reconstructions today, these illustrations, drawings, etchings and paintings also portrayed and graphically analyzed long vanished buildings; therefore it is essential to investigate their potential usefulness in theorizing our approaches to the virtual world. The list of representational methods will begin with from the more analytical examples, such as those of the French École des Beaux-Arts, which used a rational approach, and will end with some of the Romantic artists who emphasized “atmospheric” and emotional qualities of the places they portrayed. As the works of the former have a greater impact in abstract architectural thinking, the latter become more instructive in how we might depict the finalized computer model, especially to public audiences.

Following the summary of historical precedents in depiction and illustration, the second chapter will review selected contemporary examples of computer reconstructions. As the first chapter will demonstrate a variety of representation techniques, the second will draw attention to various types of digital media, such as images, animations and interactive virtual realities. This thesis argues that computer reconstructions can be best utilized to convey content when the representation methods, for example analytic or atmospheric, and the types of the medium are not necessarily linked, but can be selected and optimized independently. For example, a wire frame model showing structural hierarchy can be rendered in interactive virtual reality or as a single image.

This work is only partially based on the overview of contemporary projects in the study of virtual heritage, and on the discussion of various historical precedents in architectural representation. Another key argument of the thesis is that such research in computer reconstruction should also focus on the historical and architectural context of the analyzed building. Thus, the thesis is
Based on three separate disciplines: the already established graphical concepts and traditional ideas of representation, it is also founded on the analysis of the current developments in virtual reconstructions and media, and the thorough historical and architectural study of ancient buildings.

Using these three ideas as the foundations for the research, this thesis attempts to look behind the scenes, to explore aspects of the reconstruction that are normally hidden during the digital modeling of the historical site, and to discover other ways of understanding buildings and architectural styles of the past apart from the realistic and photographically convincing still images or real-time interactive environments. It is not the aim of this thesis to work out the newest methods of realistic computer representations, but to enrich the range of possibilities for portraying the content. It draws attention to the analytical aspects of a reconstruction: for example, the fact that not everything that has been modeled is known with certainty whether or not the latest rendering technique has been applied. In order to shed light on the scope and limits of these interpretive assumptions, the aim of this thesis is to virtually reconstruct architectural elements of the Cistercian Abbey of Pilis. The computer modeling process will be the vehicle and example of the research in order to explore a broader range of analytical possibilities than typical approaches digital reconstruction and interactive media can offer.

The virtual reconstruction process requires familiarity with geometrical and other design guiding principles that were significant for various eras in architectural history. Such morphological studies are not only important for understanding the architectural context, but they also enable us to reconstruct ancient buildings that were planned according to these rules. This thesis argues that no computer reconstruction of an ancient building is complete without the thorough study of
its historical, architectural and cultural background. Therefore, the third chapter will explore the architectural and historical context of the Cistercian Abbey of Pilis. This Abbey, which was founded in 1184, and was destroyed in the 18th century, played a significant role in introducing Christianity in Hungary and was an important cultural, economic and academic center. The profound, but simple and powerful Cistercian architecture played a crucial role in spreading the late Romanesque and early Gothic styles all across Europe.

Two centuries after its nearly complete destruction, this magnificent building is now almost forgotten. Today the site is abandoned. Only a few column-bases remain, although numerous structural pieces and stone carvings are exhibited in museums. Even though computer reconstructions cannot revive buildings of the long past in their physical form, the digital models have the ability to create awareness and explain such unknown pieces of architecture for a general audience. From abstract analytic drawings for academic viewers to the more comprehensible perspective renderings, the fourth chapter deals with the virtual revival of long-vanished architecture, in this case, the Cistercian Abbey of Pilis.

In the fourth and final chapter of this thesis, the ideas and concepts discussed in the first three will be synthesized in a series of digital reconstructions and renderings. The final aim of this work is to create images with interpretive, analytic and also “atmospheric” qualities. Firstly, these representations will demonstrate the usefulness of the techniques discussed in the first and second chapters and will explore their applicability in virtual media. Secondly, these images will provide an unprecedented visualization of the lost architecture of the abbey.
CHAPTER ONE – TRADITIONAL ARCHITECTURAL REPRESENTATION TECHNIQUES

CHAPTER OBJECTIVES

Within the field of computer-aided architectural design, emerging work on the virtual reconstruction of historic buildings is a well researched and fast developing specialty. Like CAD in general, “virtual heritage” typically pre-supposes a dependence on new and emerging technologies.¹ As a result, the power and effectiveness of representational ideas, methods, and media invented during past historical periods is perhaps no longer being adequately understood or utilized to their full potential in new digital contexts. The aim of this chapter is to reassess these traditional techniques for their potential usefulness and to adapt them within virtual media, thereby enriching the array of effective new methods of architectural representation, both for virtual heritage work and beyond.

The study of buildings of the past, and the methods of architectural delineation that support it, did not first come to life with the introduction of computers and virtual reconstructions.

Powerful methods of depicting the original reality of still-existing buildings, or of imagining long-vanished ones, were invented and mastered by skilled artists, architects and archaeologists in previous centuries. Indeed, most of the specific techniques of virtual reality and reconstruction known today have been practiced for hundreds of years, and the basic methods of approach have already been formulated. Examples include: the use of descriptive geometry in orthogonal or perspective projection; the analytical comparison of elevation, section and plan; the detailed structural breakdown of buildings through graphical techniques such as axonometrics; and the use of color, mood, perspective, and detail to create context and to influence the sensibilities of an audience. The significance of these historical methods can be re-invigorated and enhanced anew through their applicability within digital design and media.

The following examples will analyze the major categorical approaches traditionally used in the portrayal of historical buildings. First, there is a highly descriptive, objective and analytical approach, perfected by the French, notably Auguste Choisy, and symbolized by a dry, precise, and intellectual drawing style. The visual language of these works consists of clear-cut line drawings, and shaded elevations and sections, often laid out in highly creative orthogonal projections. In such portrayals, the buildings are removed from their architectural context, taken apart into structural elements, seen from viewpoints not available to normal human perception, and examined through the lens of technical delineation. This results in drawings that are highly abstract and hence less understandable to a wider audience, but useful as tools for archaeological analysis or as examples in architectural education.

A second approach represents buildings within their historical and cultural (or sometimes varying emotional) contexts and therefore achieves a “romantic” or an “atmospheric” effect. The
idea of representing ruins, the remains of buildings of the distant past overgrown by vegetation or subjected to the vagaries of time, was a favorite topic of the Romantic artists in the mid-to-late 18th century, such as Giovanni Battista Piranesi. Nature, weather, light and the seasons played an essential role in expressing emotions and feelings towards the otherwise inert and lifeless ruins. These artists placed the viewer immediately adjacent to or within buildings, giving a powerful meaning to a specific moment of architectural encounter that could never be repeated. In most cases the ruins evoked metaphors of time and death, with long-lost civilizations carrying the inevitable fate of humanity and its deep and multiple meanings.

This chapter presents an analysis of the works of key figures in the history of architectural representation, such as G. B. Piranesi, E. E. Viollet-le-Duc, David Roberts and Auguste Choisy, with the following issues in mind: 1. the extent to which each one has formed our present architectural perceptions and analytical approaches towards the built environment; 2. the still-relevant strength and power of their representational choices; and 3. the potential for adapting those strengths within the exercise of digital architectural media today.

To a certain extent, the widespread debates within “virtual heritage” practice today parallel the conflicting aims of these two general approaches – the analytical and precise as against the evocative and engaging. The advancement of this field, and these questions, hinges on its ability to understand better the virtues and limitations of such conflicting views, and to apply them more intelligently within purpose-driven and audience-specific venues. Moreover, there is no exact borderline between these approaches, as distinctions among artists, architects, media technicians, and archaeologists are also becoming increasingly blurred. The applicability of these
approaches, as analyzed in this chapter, will be further explored within a demonstration of virtual reconstruction case studies at the Abbey of Pilis presented in digital media in the fourth chapter.

During the last few years there has been much creative work in computer-aided design and reconstruction, and many buildings of the long distant past have been “revived.” It seems particularly ironic then, that we have given so little attention to the architectural representation methods of the past, and the extent to which they might enrich and inform these endeavors. This chapter proposes to balance the record by exploring potentially useful but forgotten techniques which deserve a renewed scrutiny within our new, digital worlds.

**THE FLATTENED SPACE – J. N. L. DURAND**

Technical architectural representation methods, such as plans, sections and elevations are orthogonal projections of a building; two dimensional abstractions of a three dimensional object. Such depictions not only serve as plans for a future building and therefore provide guidelines for its construction; in the practice of architectural history and archeology the orthogonal rendering methods are the essential and fundamental tools for documenting, measuring and representing a building. Here the descriptive drawings may come long after the building has been built, or in many cases after it has been compromised or destroyed. This two-dimensional documentation is
the first step in understanding, analyzing and, if necessary, reconstructing the missing parts and details of the historical building.

The French architect, engineer and scholar, Jean-Nicolas-Louis Durand (1760-1834), was one of the most influential architectural theorists of the early 19th century. In one of his major works, *A Parallel of Architecture* (1800), he illustrates public buildings of different periods and countries arranged by type, according to his theory of modular proportions. As a catalog of building types, there are more than one hundred plates carefully drawn in strict technical delineation. The black and white line drawings each explore one building type, drawn to the same scale on each plate, and arranged in a symmetrical order when possible. Durand sometimes drew in different scales for sections, plans and elevations. There are no perspective views or axonometric projections; the same orthogonal vocabulary guides the viewer throughout the entire series of drawings.

Durand intended his work to serve educational purposes, mainly for architectural students. The drawings are too abstract for a general audience, since they are purely technical and mechanical. Durand’s comparative approach removes the building from its architectural context, and considers it as a mere object to be graphically described. As the same strict logic is applied to every topic of his analysis, the reconstruction process is not explained; only a final, complete reconstruction is drawn.

Although this method too is abstract for a general audience, its significance lies in its simplicity. Architects, architectural historians and archaeologists share Durand’s objectivist language and intent. The drawings, by their directness, let their reader quickly understand the building’s

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organization and composition, and its comparative morphological relationship to other buildings.

The creation of a three dimensional model from such sources is therefore very simple. In Durand’s clear-cut, linear drawings the same technique is applied to every part of the building and the uncertain details that Durand may have hypothetically added to the reconstructed ruins are not revealed.

I. Amphithéatres. One plate of the Parallel of Architecture.
The axonometric view is used infrequently today in everyday architectural and archeological practice. Like orthographic renderings (plans, sections and elevations), this representational technique is also a parallel projection created with the aid of descriptive geometry. Therefore they also do not correspond the way we humans perceive the world, because, unlike perspectives, dimensions do not shorten with distance. Although this technique has the illusion of three-dimensionality, it still retains its technical characteristics, such consistent scale.

An engineer by training, Auguste Choisy (1841-1909) in his book, *Histoire de l'architecture* (1899), explored important periods in the history of architecture, which he interpreted from prehistoric times to the present in terms of continuous technical development.\(^4\) Like Durand’s work, his study is intended for educational purposes particularly for architects. It includes descriptions of buildings in textual and graphical form, and maps, diagrams and short summaries of historical events that had an impact on architecture. The main source of information is the text; the drawings serve mainly as illustrations. The book is divided geographically and chronologically into locations from ancient Greece to the architecture of the Far East.

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As in the giant plates of *A Parallel of Architecture*, one characteristic style dominates Choisy’s book. The straightforward and consistent method is technical delineation. It considers buildings and other pieces of architecture as isolated objects and the environment is only depicted when it is crucial in understanding the building itself. For example, not only is the morphology of the Parthenon discussed in detail, but also the way the building is revealed when the visitor approaches it from the gates of the Propylea.⁵

Choisy extends the “conventional” methods of architectural representation (plans, sections and elevations) by introducing axonometric views. His illustrations integrate the individual orthographic projections in one single image, attaining the illusion of a three dimensional appearance without losing the drawing’s technical capacity. This method of superimposing discrete views draws attention to spatial relations within the building and through its interpretation of all three dimensions eliminates the possibility that discrete plan, section or elevation drawings would not match. For instance, in drawings of Greek temples, Choisy demonstrates their structure by combining plans with axonometric worm's-eye-views. He slices the building at varying heights at different rows of columns, creating a three dimensional section and showing different constructive layers of the edifice in a single drawing. By combining plan, elevations and several different sections, the interior and hidden components of the building, such as roof trusses, are revealed, as well as the construction of the building. All of this synthesized dimensional information leads to a higher understanding of the building’s form, mass, space and structure.

⁵ Ibid. p 329-331.
Choisy also applies this method of cutaway axonometric views to the visualization ancient building systems and components. For example, when discussing the Doric order, he depicts only a fragment of a typical colonnade, and removes certain pieces to show the general layout: for example, cutting away one part of the architrave or one of the columns in order to see the capital above it. Such drawings are accompanied by smaller explanatory illustrations of details: molding profiles and cross-sections that are not readable from the axonometric view. This “analytic ruin” technique demonstrates the relations of discrete pieces of the edifice to each other in three dimensions, and explains how the buildings are built in reality.

2. The Temple of Olympia
3. The Doric order
Even though these illustrations provide a sense of three-dimensionality, they are still too abstract and complex to be useful for a wide audience. Like axonometric views, these abstractions of form and space are far away from recognizable. Choisy uses this projection method to maintain a distance between the viewer and the building, since it is not portrayed primarily as a piece of architecture in reality, but rather through the lens of a uniform representational technique. This analytical “distance” or removing the building from its multiple “contexts” allows him to examine the historical buildings with a more objective, or scientific approach, considering only morphology, and not the way, for example, people might have used, inhabited or interacted with them.

Choisy’s work proposes an important question: can the same representational technique be applied to all pieces of architecture, whether a Greek stoa or a Japanese temple? Viewers, who can gain only a “second-hand” experience through his analytical drawings, can see only the morphological and structural differences, but not the different “contexts”: such as the building’s cultural, social, physical, topographical, etc. In some cases Choisy saw the limitations of his method: he rendered the previously mentioned Acropolis “walkthrough” in perspective.

4. Entering through the gates of the Propylea
5. Approaching the Parthenon
Eugène Emmanuel Viollet-le-Duc (1814-1879) was a French architect and theorist, best known for his reconstructions and graphical analyses of medieval buildings. His view of architectural history was a fusion of romantic enthusiasm for and a rational architectural analysis of the middle ages. He considered the mid-thirteen-century Gothic style as the summit of architectural and artistic achievement, and the Renaissance as an age of decline. He was a central figure in the Gothic Revival in France and helped to create a public discourse on “honesty” in architecture, which eventually transcended all revival styles to inform the emerging spirit of Modernism.

In the early 1830s, the beginnings of a movement for the restoration of medieval buildings appeared in France. Viollet, returning in 1835 from a study trip to Italy, was ordered to restore the abbey church of Madeleine at Vezelay. This work marked the beginning of a long series of restorations, including the cathedral of Notre Dame in Paris, which brought him into national attention. Compared to modern conservation practices, Viollet-le-Duc’s restorations were too interpretive and subjective, but many of the monuments he restored would otherwise have been lost. Throughout his career, Viollet-le-Duc also kept notes and drawings, not only of the buildings he was working on, but also on Romanesque, Gothic and Renaissance buildings that

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were soon to be demolished. His study of the medieval and Renaissance periods was not limited to architecture, but was also extended to studies of furniture and clothing.\(^7\)

Viollet-le-Duc saw beyond the romantic, atmospheric fascination that drew his British contemporaries to Gothic architecture, to what he conceived of as its rational structural systems and their implications for modern building materials such as cast iron. He practiced as archaeologically precise a style of restoration as he could manage, but his own designs were also remarkably innovative. His approach to both medieval and modern architecture was severely rational, in keeping with his own unsentimental appreciation of the Gothic achievement.

One of the most influential parts of Viollet-le-Duc’s architectural theory was applied to building restoration and hypothetical reconstruction. He deliberately aimed to put the building into an imaginary “ideal stage” where, in reality, it may never have existed. He stated: “To restore a building is not to repair or to rebuild it but to reestablish it in a state of entirety which might never have existed at any given moment.”\(^8\) These reconstructions, however, were highly investigative and analytic, excluding the notion of uncertainty from the perspective of his audience.

Compared to other professors at the Ècole des Beaux-Arts, Viollet’s drawings retain the technical approach, but place the buildings in perspective and with certain contextual or atmospheric qualities, such as light, shadow, and human occupation. Such representational characteristics are more appealing to human perception that the drier axonometric or orthogonal projections.

\(^7\) Ibid. p 282-285.
Viollet-le-Duc also used the “analytic ruin” concept, where, similarly to Choisy, he disassembled building structures. But Viollet, unlike Choisy, rendered them in perspective: for example, when depicting an interior of a Roman building covered by a series of cross-vaults, he portrayed the first bay in high detail, as it might have looked, but the second bay is depicted in a structural from in a more technical fashion.

6. Disassembled Roman building  
7. The Doric order  
8. Roman public building interior  

9. Roof structure of a Roman building  
10. Roman ruins
Viollet-le-Duc thus fused the analytic and “atmospheric” approaches in architectural representation. His main goal was to teach, and to illustrate his distinctive and innovative concepts of architectural history. Still, compared to those of Choisy, his works can also be considered artistic and yet purely analytic. Unlike the similar, dry style of technical delineation, he used shading, showed textures of different materials and sometimes added colors. In contrast to axonometric rendering, where the scale of the drawing is easily readable, perspective rendering requires a different set of tools for explaining the size of the portrayed building, and for this purpose he included people and other contextual elements in his illustrations. Ironically, the principles of perspective rendering were invented in the Renaissance, a period that Viollet-le-Duc considered the beginning of the decline of architecture, and yet the Renaissance emphasis on a human-centered world and a human point of view informed his representational techniques.

**Analytic Romanticism – Giovanni Battista Piranesi**

Giovanni Battista Piranesi (1720-1778) was an Italian architectural theorist and artist trained as an engineer and architect, he was best known for his numerous engravings of Roman antiquities. His dramatic views of Roman ruins and his imaginative reconstructions of ancient Rome inspired a new recognition of antiquity. As art historian Luigi Ficacci notes, it was in Piranesi’s art
“where the landscape composition coincides with archeological interest and the style of rendering becomes perfectly expressive of his intention and archeological demonstration.”

Although considerable study has been devoted to Piranesi as a graphic artist of technical brilliance and great expressive range, less attention has been given to the Enlightenment world of his ideas. Insufficient interest has been given to his creation of a range of technical illustrations and engineering studies conducted upon antique structures. As an artist, he played a crucial role in the Graeco-Roman debate of the 1760s and became heir to the historic belief in the indigenous characteristics of Italian civilization, as founded by the Etruscans and perfected by the Romans, therefore being arguably superior to the Greek.

Piranesi’s productive life-work includes etchings of ruins, depictions of structural details and analyses of historical styles in architecture. His four volume treatise, *Le Antichità Romane* (1756), contained an unprecedented wealth of technical and visual drawings about the architecture, engineering and ornament of ancient Rome. This work included 250 plates of etchings and revolutionized the range of technical and archaeological illustrations. The absence of color, which would be the most essential tool for an artist of his time, is compensated for by Piranesi’s accuracy and completeness in the way he depicts the context of the ruins: he illustrates the sky and the clouds, light and shadow, and exhibits the ruins overgrown by vegetation.

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12 Ibid. p 9.


12. Giovanni Battista Piranesi. *Basilica of Maxentius*

13. Partially reconstructed ruin overgrown by vegetation

14. Section and detail depicted in the same style

15. Ruin and reconstructed plan

16. Comparative drawing of plan, section and elevation

17. Study of capitals
Piranesi’s art and explorations in architectural history not only consisted of “atmospheric” depictions of ancient ruins; he made several other contributions to the graphical representation of architecture. Although he preceded the analytically-minded professors at the École Des Beaux-Arts discussed earlier, he created the concept of the “analytic ruin” by disassembling the structural components of the building at a very high level of detail and accuracy. Like Viollet-le-Duc, he rendered buildings and their parts in perspective and also portrayed their environment. His “assembly drawings” show how different structural and mechanical components or ornamental details were integrated or assembled into whole buildings. He also created an almost encyclopedic catalogue of details, again arranged in compositions, studying them separately but re-integrating them with the totality of the building. These drawings and all this complex information were consistently synthesized in beautiful evocative compositions, similar to the “analytiques” of a century later at the École Des Beaux-Arts in Paris.

DEPICTIONS OF ANCIENT EGYPT – DAVID ROBERTS AND OTHERS

The British painter and traveler, David Roberts (1796-1864), during the early 19th century made long journeys in the Middle East and Egypt, which seemed to Europeans at that time a mysterious, strange and sensuous land. Among the many explorers, Roberts represented the desire of Western Europe to study and learn about the architectural wonders and the distinct cultures of these Biblical places. A few archaeologists and travelers had already embarked on
such journeys to this land and had attempted to understand its history though studies of the ruins and artifacts found there. Nevertheless, in the mid-19th century, the scientific need to explore blended with the Romantic fascination that prevailed after the Enlightenment. Being the first British artist to explore the Middle East and Egypt, Roberts presented his works in a series of views published between 1842-1849, entitled *The Holy Land, Syria, Idumea, Egypt and Nubia*.\(^\text{14}\)

The Romantic attitude towards the unexplored Orient can also be traced in paintings portraying Biblical scenes.\(^\text{15}\) The master of such spectacles, English artist John Martin, blurred the line between fine art and popular entertainment by depicting cityscapes of ancient Egypt while favoring subjects portraying Biblical divine judgments. David Roberts’s oil painting made six years later was compared to his predecessor, Martin, yet he avoided the “terrible sublime,” a term critics had used about Martin’ paintings. Both Martin’s and Roberts’ works, like those of German artist Caspar David Friedrich, used buildings as one of the many elements, along with

\[\text{14} \quad \text{Mancoff, Debra N.} \quad \text{David Roberts: Travels in Egypt and the Holy Land.} \quad \text{San Francisco: Pomegranate Communications, 1999, p 10.}\]

\[\text{15} \quad \text{Ibid. p 36.}\]
light, clouds, etc., that could help achieve a Romantic or “atmospheric” effect. On the other hand, Roberts treats a reconstructed ancient Egyptian city with greater detail and brings the reconstructed architectural forms into more focus; his works are less “entertaining” than Martin’s and are less atmospheric than Friedrich’s. Similar to other Romantic artists, these painters concentrate more upon the context of the building rather than the buildings themselves, although the reconstruction of the historical forms is inevitable in order to portray them.

Roberts was not the first European to record the architectural forms of Egypt. A scholarly commission accompanied Napoleon’s troops on his Egyptian campaign, with Dominique Vivant Denon (1747-1825) among them, Napoleon’s Supervisor of the royal collection of antique gems, as well as a diplomat and an artist. These scholars made a careful record of antiquities in the region, measured monuments, recorded their state of preservation and made meticulous renderings and drawings of the notable sites. These clear-cut illustrations, reproduced as full-

page engravings in the *Description de l’Egypte* reflected the straightforward manner and the dry, accurate style of French historical analysis.

Traveling to Egypt forty years later, David Roberts made several drawings at Thebes, and did sketches, particularly of the Colossi of Memnon, huge statues that Denon had also visited.\(^{17}\) Roberts chose a low vantage point to emphasize the size of the magnificent statues and to show how they dominated the surrounding low plains. He also depicted members of his crew climbing on one of them, thus showing how they dwarf human scale. In this case it is the ruin that is in the center of the painting, and not merely the landscape containing the ruin. Denon on the other hand, had attempted to capture reality and portray the monuments “as they were,” without using any artistic tools to alter the viewers’ impressions of his works.

23. David Roberts. *Thebes (the Colossi of Memnon Seen from the Southwest).* 1846-1849

By comparing the two works of art, by the French and the British travelers, it is most striking to see that the condition of the statues is not the same. It seems that they are in a more ruinous state.

\(^{17}\) Ibid p 62.
in Denon’s drawing; however, he was at the site almost forty years earlier. David Roberts, following his Romantic predilections, partially reconstructed the statues; for example, the upper arm of the figure closer to him. He also removed the cracks from both of the statues. In another painting, where the two statues can be seen from behind, the condition of the upper arm is the same as in Denon’s drawing. This suggests that the French scholar was striving for a realistic, accurate and truthful portrayal of the actual condition of the statues, since he was on a mission of cataloguing, measuring and describing the monuments of ancient Egypt, while David Roberts, as one of the first travelers from his country, saw the ruins from a more artistic point of view; he was also guided by his imagination.

In most cases, the portrayal of the ruins plays an important part in the composition of the paintings. They are not merely one component among many, nor do they act as stage sets for the events occurring in front of them. If they are in the background, they provide context for the foreground, dwarfing the human scale, and they act as a metaphor for the past. Roberts may have added colors to them where the original paint had already weathered away, or he may have reconstructed them partially, as in case of the Colossi of Memnon, but he played an important role in introducing the ancient architecture of Egypt to the Western world.
According to art historian Wieland Schmied, the works of 19th century German Romantic painter, Caspar David Friedrich (1774-1840) are characterized by “exactitude and spirit, portraying fixed objects, giving them a special luminosity within the context of a composition.”

His Romanticism manifested itself in depicting nature as an important component in his paintings, for example, sunsets, winter scenes or vast landscapes with misty mountains. In many cases he included architectural ruins in his paintings, portrayed through the same lens as his vision of the seasons, colors and sometimes dying nature. The ruinous buildings served as huge set-pieces in his art, underlying the idea of passing time, the evanescence of existence and human life.

In the first painting, Monastery Graveyard in the Snow (1817-19), the ruin of a monastery is framed by two oak trees that echo dying nature during winter in their truncated, branchless forms. Only the entrance and the choir remain of the ruined church, which is represented as having greater height than it would have had in reality. The vertical linearity of the two oak trees reappears in the tracery of the Gothic windows, and also as a counterpoint to the background of the surrounding forest. Similar to the ruins, the cemetery in the foreground symbolizes the temporality of human life. The significance of the painting, besides its artistic value, is that the

ruin of the monastery is based upon the still-intact Marienkirche in Stralsund, Germany.\textsuperscript{19} The artist thus imagined how it would look in the future in a ruinous form, even as he was in fact, in 1817 making designs for the altar of this church in detailed orthogonal drawings.

The second painting by Friedrich shows the ruin of the Temple of Juno at Agrigento. The contrast between the dark ruins and the setting sun portrays not only the passing of time, but the evanescence of all existence. The contrast between the orange sky, with its intense color, and the dark ruin is striking; yet again the portrayal of the ancient temple is not the main goal of the painting. It is rather the passing of time which is not only rendered visible with the metaphor of a ruin, but also with the aid of the setting sun.

The significance of these paintings lies in their treatment of the ruins. Friedrich used the general concept of a ruin as a vehicle for portraying the Romantic melancholy about time passing. Among the many tools he employed, such as color, atmosphere and nature, the built forms are

treated as metaphors, and not merely as architectural objects. The portrayal of the buildings does not have to be as accurate as the drawings for the more analytical approach; they are represented in perspective, and are sometimes altered to give them a more melancholy look.

Today, in the world of computer representations, this method of depiction, that is, appealing to reality and working with historical metaphors, has the ability to give the reconstructed building an emotional appeal for a wide audience. It also reflects the fact that what we see today no longer exists as it is reconstructed; and that it is equally important to show the ruinous condition as well as the reconstruction.

**CONCLUSION**

The list of historical representation techniques described in this chapter differ significantly in their treatment of the portrayed buildings and ruins. From the analytic approach to the more atmospheric treatments, the focus shifts from the building itself towards its context. The works of Durand and Choisy rarely portray the surroundings, but Friedrich’s ruins become almost unified with it. The audience is also different: the drawings of Durand and Choisy were dedicated to academics and researchers, whereas the artistic paintings of Roberts and Friedrich were intended for a wide popular appeal.
The historical representation techniques discussed in this chapter are also applicable on computer models in the digital medium. In fact, similar to the process of architectural design, the various examples in this chapter showed how, from orthogonal drawings to perspective renderings, these representational techniques reflect the steps taken in the practice of computer reconstructions, namely; thinking and drawing in two dimensions (in plans, sections and elevations); then synthesizing these distinct renderings with the aid of the computer into a virtual object; then constructing it further in axonometric views; and then finally creating perspective renderings, sometimes with atmospheric qualities added.

Unlike today’s digital world, these historical techniques had only one possible output medium, what we call today “still images:” pictures on a flat surface that do not move or interact with their viewer. What may be a simple and modest method of architectural representation today, when real-time interactive virtual realities provide almost first hand experience with the buildings, these historical precedents are yet potentially valuable as examples of how to convey more types of architectural information besides simply a final rendering of the reconstruction. In this chapter emphasis was laid not on the various medium types, such as still images, animations or interactive virtual realities, but on the treatment of the model itself, with special attention to the somewhat neglected analytic qualities of Piranesi, Viollet-le-Duc or Choisy.

Digital models, like drawings on paper, are merely a representation of the original buildings: for example, they don’t contain structural elements that otherwise would be hidden, unless showing them is necessary. Looking inside the hollow shell of a finished digital model, like surrounding it with “atmospheric” qualities, is a conscious intentional procedure that may be chosen in order to emphasize or reveal the structure of the building, or to represent degrees of uncertainty in
decisions made during the reconstruction process. The drawings, etchings and paintings of Piranesi, Viollet-le-Duc or Choisy give a simple yet effective answer to the question of how to create such analytical studies. These artists, architects and scholars had to work on paper: their portrayed buildings also had to be reconstructed, and their structure also had to be reinvented in a “virtual space” similar to digital models. With the advent of computer technology, these analytical methods and ideas can be developed further by applying them to digital models in three-dimensional virtual space.

From the works of the artists, architects and scholars mentioned in this chapter, the most successful and applicable methods to computer reconstructions are potentially the ones that can synthesize both the analytic and “atmospheric” approaches. For example Piranesi and Viollet-le-Duc created works that explained structure, construction and morphology, and yet simultaneously appealed to the human perception of the world. They sought historical accuracy and yet were also very successful in making their works easily interpretable and understandable. In computer reconstructions it should be our goal to follow the path of such historical representation methods.
CHAPTER TWO – EXPLORING THE VIRTUAL WORLD

CHAPTER OBJECTIVES

The role of 3D computer graphics in interpreting, analyzing and reconstructing historical sites has grown significantly during the past decade. The rapid development of digital rendering techniques and ever more elaborate virtual models have also hastened the process. The following examples of digital reconstructions will show that most often such renderings, created by using the newest technologies, tend to make the viewers forget that what they are seeing is merely a representation, a portrait of the original. Most of these reconstructions presuppose the primacy of a normal, human vantage point; our own way of perception is reflected in them without question. This thesis is grounded in the belief that instead of merely increasing the resemblance of these virtual models a supposed physical reality, computer reconstructions should exploit their potential to be both more critically interpretive and more engaging for a wide audience.

Following the overview of traditional architectural and artistic representation methods in the first chapter of this thesis, the second chapter will discuss precedents from digital reconstructions as a 
foundation for further analysis. The emphasis will not merely be laid on computer techniques, but will be grounded in a more theoretical approach, which will examine the interplay of perception, engagement, and interpretive scope in selected representative examples of virtual reconstructions. Then, after the historical and morphological analysis of the Cistercian Abbey of Pilis in the third chapter, the main aim of the fourth chapter will be to conduct the research in tandem with, and strengthened by, these practical experiences. The Pilis reconstructions will be informed both by the study of historical representational techniques and by the emerging uncertainties and alternatives encountered during the computer reconstruction process.

There are numerous architectural representation methods available in digital media. Some of them require computer resources well beyond average, but technology seems to set no limits upon the rapid growth of computer speed and memory; and the size and cost of computers have become less over the past few years. New inventions also enrich the variety of the medium: virtual reality applications create and give a new meaning to virtual space by expanding to the World Wide Web.\textsuperscript{20} The following examples vary in their treatment of the reconstructed buildings and in their forms of the chosen media, but they share the common goal: to see what no longer exists.

It is not the aim of this work to focus on technical aspects of the finished computer models in detail. Regardless of the essence of the model, it can be represented as a series of still images, animations or within an interactive virtual reality. Technology itself cannot compensate for a lack of the deductive and analytical approaches to the reconstruction process, and by no means

\textsuperscript{20} For various examples consult: Kalay, Yehuda E. “Virtual learning environments.” \textit{ITcon} Vol. 9, Special Issue 2003. p 195-207.
can a model be considered more truthful and accurate when it is presented with the aid of more technologically advanced tools. Therefore, this thesis argues that a digital reconstruction, as an interpretation of a once existing architectural form, should take advantage of the analytical characteristics of computer representations. The following chapter will discuss projects that can serve as case studies, reflecting the advantages of virtual reconstructions done in the past years.

**IMAGES OF THE NO LONGER EXISTING**

Most of the medium types mentioned here, like the representational techniques discussed in the first chapter, can be dated back in history. Their usages in the digital world have been preceded a long time ago: paintings and drawings were followed by photography, which more than a century later led to the invention of digital photography. Following this long tradition, computer renderings can also be considered as depictions of objects, but unlike the methods mentioned above, they capture images of digital models; thus they can be considered as photographs of a virtual reality.

William J. Mitchell’s book “The Reconfigured Eye - Visual Truth in the Post-Photographic Era” addresses the question of what our relationship is to an ever-changing medium, and the
truthfulness of the resembled reality.\textsuperscript{21} Although we are familiar with the effect of the invention of photography on the visual arts, especially on painting, we are not yet fully aware that the time of analog pictures has passed.\textsuperscript{22} According to the author, we live now in the “post-photographic era.” Shortly after the invention of photography, the painter Paul Delaroche exclaimed, “Painting is dead.” Mitchell states that photography is also permanently displaced after 150 years of its invention.\textsuperscript{23} Since the 1950’s, when the first digital image was captured, it became increasingly widespread following the general use of computers. New devices were introduced that capture, store, transmit, and display digital images. Yet despite of the new technology, many principles of analog photography were inherited by its digital successor.

Although a photograph can be considered as fossilized light and is believed to correspond with reality, Mitchell argues that this medium is not merely a projection of reality. The book opens with the discourse and history of image manipulation, how this method of capturing reality is only seemingly objective, and how we, as viewers, take these imprints for granted as true. The author draws a clear parallel between photography and painting, describing the difference between them, what can be accomplished and represented in one and not with the other. Despite the differences, the two media share many characteristics in common: for example they do not depend as much on technology, as their digital counterparts and they have their physical appearances, unlike digital images, which have a certain limit in resolution, since they consist of discreet pixels.


\textsuperscript{22} One of the best studies about the effects of photography on the perception of art is Walter Benjamin’s famous essay “The Work of Art in the Age of Mechanical Reproduction.”

The images rendered of virtual models share much in common with digital pictures. Their nature is the same; nevertheless, no matter how accurate, computer renderings cannot represent “reality,” but only an artistic and artificial resemblance of it. Digital photography inherited its characteristics from its predecessor, analog photography. On the other hand, the “photographer” in virtual space has the ultimate liberty of depicting anything, even non-existing buildings of the long past, or the imagined future.

Mitchell’s book was written in 1992. The thirteen years since are only a short time in the history of painting and even of photography, but a rather long time-span compared to the age of digital images. Yet the book accurately demonstrates all the processes that can happen to a digital image: from varying spatial and tonal resolution to sophisticated actions, for example using filters, revealing hidden information by manipulation, or radically changing the content with the creation of montages. From the distance of time, this part of the book sheds light on principles and theoretical aspects of image treatment methods that stay the same no matter how fast technology evolves. Owing to their long tradition in architectural representation, still images and slideshows have a well-established role in depicting computer reconstructions. For instance, slideshows are the outcome of the challenging project of reviving the Aztec Templo Mayor Precinct conducted by Professor Antonio Serrato-Combe, from the University of Utah. In his paper, Serrato-Combe argues that although there are many virtual reconstructions of ancient sites from Ur in Iraq to the Cahokia mounds on the Mississippi, in most cases the end product is poor in quality. Computer visualization techniques are not used up to the highest levels, in other words, the “ability to explore, to interpret and to appropriately use the digital tools needs to
aspire to greater and more penetrating abilities to reconstruct the past. These ideas call for a more analytic, interpretive approach in computer reconstructions supported by graphical aids.

Not only the creation of final result was approached in a critical manner, but the researchers of the project had to face several problems at the beginning, as well. Firstly, there was very little architectural evidence of how the Aztec Templo Mayor Precinct might have looked. Unlike other great sites of antiquity, for example those in Greece, Rome and Mesopotamia, this area was almost completely destroyed by the Spanish conquerors shortly after its discovery in 1519. Secondly, although the available data for the reconstruction was scarce, many of the drawings made by the European explorers were not accurate. This architecture was uncommon to them, unlike even the Maya and Inca designs; they saw it through the lens of their own cultural biases.

Serrato-Combe argues that previous efforts to reconstruct the site were not accurate, but not only because of architectural reasons, such as incorrect proportions or false assumptions about which building materials were used. According to Serrato-Combe, these earlier visualizations were also lacking the appropriate representational approach, since neither did French Beaux Arts look, nor perspective delineation drawings were appropriate to the subject. Serrato-Combe states that the Aztec buildings were created in the spirit of representing the energized relationships between the temples and the mountains, between social groups and between human beings and their gods. Therefore the visualization of the site is a perfect example of the need to graphically represent instincts, emotions and feelings. The question of how to interpret these ideas in digital renderings, beyond the geometric reconstruction itself, was proposed.

This project is an excellent demonstration of the fact that a final representational technique can be created specifically for the object of the reconstruction. Unlike the artists, architects and architectural historians discussed in the previous chapter, notably members of the École Des Beaux-Arts, who applied their own style and the same technique to every historical building they portrayed, Serrato-Combe and his team revived not only the geometrical forms of the Templo Mayor with the highest accuracy, but also wanted to draw attention to the more subtle cultural qualities and the context. In other words, the researchers sought after more unique and specific attributes of representation; for example, they portrayed vast landscapes with dramatic sunsets, placed human skulls in front of the buildings and used saturated colors, mainly reds and oranges.

These engaging and highly dramatic renderings take on the “atmospheric” approach in order to visualize the buildings with emotional elements, such as the red sunset in the background or lightning above the buildings. These graphical tools already set the quality of the images and direct the viewer towards the understanding of the culture of the Aztecs, who lived and died for
their gods.\textsuperscript{25} Even though the creators of the reconstructions and the accompanying representations were aware of the cultural differences between the site and its visitors, most of the images reflect their own approach to reality. When presenting these visualizations, the audience sees the ancient buildings from the perspective of Professor Serrato-Combe and his team.

This project was demonstrated with a series of images at the Architecture That Isn’t There Symposium.\textsuperscript{26} Not only the vast “atmospheric” landscapes were shown, but also a few axonometric and wireframe renderings that emphasized the interpretive nature of these reconstructions. Although there was a great variety of images that explained the reconstruction process and exhibited the final result, the series of slides did not always follow Serrato-Combe’s lecture. This type of medium requires a passive audience, and like illustrations in a book, the connection of images with textual information is highly important.

\textbf{Movies of the Virtual}

Like motionless digital renderings, computer animation in architectural representation is also a result of more than a century long tradition: its predecessor is film. As Takehiko Nagakura

\textsuperscript{25} This work is documented in high detail in: Serrato-Combe, Antonio. \textit{The Aztec Templo Mayor: A Visualization}. Salt Lake City: University of Utah Press, 2001.

\textsuperscript{26} Symposium: \textit{Architecture That Isn’t There}, University of Cincinnati, April 15-16, 2005.
notes, a film that is shot on a location is a sequence of photographic images that look realistic. Although they may seem equal, there is difference between the first-hand experience on the location and the constructs in the audience’s mind. Viewers of a movie are seeing the result of different sets of directorial decisions on camera, lighting, montage and other cinematic parameters.  

Architectural forms by their nature are non-moving and physically constant: in most cases the subject of the movie does not change and remains passive. Their exploration happens by the camera’s motion where it is the director’s responsibility to guide the viewer towards the understanding of the building. As Rudolf Arnheim points out, human vision is not limited in its field of vision, but the film frame restricts the view of the audience. It is up to the director to make a conscious selection from the infinity of real life. Framing can focus on details or leave out unimportant elements. Lighting can also direct the viewer to particular features of the building, and with the interplay of shadows it is possible to make a mere geometric form look realistic. The montage and cutting can unite disconnected pieces and change the order and nature of real events. 

As the digital world in architectural representation is intended to serve as an imitation of reality, the creation of movies of virtual buildings obeys the same rules and principles as in film making, such as camera movement, framing, lens size, colors, depth of field and lighting. Today’s visualization technology allows the audience to see photo-realistic renderings of architectural forms, even those of the long past. These movies provide the viewers a remarkably realistic

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spatial experience, similar to that in a film of a real piece of architecture still existing in its physical form. Like the traditional methods of filmmaking, where the director has a different spatial experience on the location than the audience, digital renderings are also subjected to their creators’ approach.

Nagakura argues that there are other challenges to architectural representation in computer animations. “Virtual architects” are confronted by the need to determine the means of controls and methods when transforming archival documentation into reality in virtual space. They already have a profound idea about how to present the model with textures, lighting and camera angles. These choices are sometimes similar to those in reality. But a creation of motion graphics may also require the setting of moving cameras, cutting of shots and synchronized sound.

28. A frame from the Danteum movie
These challenges were faced when Nagakura and his team visualized the *Danteum*, Giuseppe Terrangi’s architectural interpretation of the Dante’s *Divine Comedy* that was designed in 1938, but was never realized. The final result of Nagakura’s project, a short movie starts from the entrance and without any scene cuts, goes through all the interior spaces. The sleek and clear photorealistic rendering took advantage of lights and shadows, and the transparency of glass columns. There were no colors, or any atmospheric effects, the portrayal of the building focused purely on its geometry.

Similar to the vast landscapes of the Aztec Templo Mayor project, cultural and architectural aspects are reflected through the attitude of the movie. The renderings attempt to graphically interpret and portray the formal clarity of this iconic modern work. The movie does not aim to add anything more than what is already prescribed in the original plans of the building, and stays faithful to the overall concept of the original idea: a walkthrough with an architectural understanding of Hell, Purgatory and Paradise from Dante’s *Divine Comedy*. Also, there is no exterior establishing shot of the building; the movie focuses only on interiors, similar to Dante’s epic poem, which starts by entering the gates of Hell.
The EarthWorks Project produced by CERHAS at the University of Cincinnati explores the giant mounds of earth built between 8 and 24 centuries ago in the Ohio and Mississippi valleys. These earthworks constitute the largest concentration of monumental earthen architecture in the world. Unlike the architecture of other great ancient civilizations, such as the Egyptians or the Greeks, the earthworks became invisible once the cultures that created them had gone. They became slowly hidden after being covered by forests, or were simply destroyed after the expansion of modern cities and agriculture. The size of these mounds, enclosures and embankments is so immense that they extend over dozens of acres and are almost impossible to grasp from human eye level. Imaging their structure and layout when standing on the site is almost impossible.

Visualizing this “invisible” architecture was one of the greatest challenges of the reconstruction project. As in reality, the virtual earthworks were hardly able to be grasped on the monitor screen when the viewing point was set to the human eye level. Therefore the creators of the models decided to show all of the earthwork models from birds-eye views. Another representation problem was the scale of the mounds. If looking at a digital model of a building,

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29 The main outcomes if this project were a CD ROM, museum exhibits, and posters.
its size can be easily determined considering its details such as doorways that relate to the human scale. The earthworks are so huge and so abstract that a human figure standing next to them simply vanish as it becomes less than a pixel high when the entire model is seen. The notion of scale was finally given with trees – ninety foot oak trees surrounding the sites. The earthworks were textured light brown as bare earth, capturing the hypothetical moment of construction and therefore providing contrast against the rest of the terrain, rendered in green.

Like the reconstruction of the Aztec temples, the problem of representation was the cultural distance between the ancient creators of these forms and today’s audiences. The computer models and the accompanying visualizations were created to appeal to our perception of the world: the earthworks were placed in a typical summer setting with blue sky, green grass and haze over the river. All of the scenes were treated similarly, following this simple, but effective way of representation.

29. One of the best preserved and modeled earthworks: Fort Ancient
30. Sunset over Marietta
Although highly realistic and comprehensible, these renderings do not show reality, or the way these earthworks might actually have looked. Today’s computer representation is different from how the ancient builders perceived their creations. For example, they were not able to fly above them the way they are portrayed in rendered aerial views. The earth-colored barren mounds could not have stayed that way for long before they became covered with grass. Inevitably we see the forms of the long past through our own lens of approach, and according to our perceptual preferences or conceptual needs, though profound manipulations of reality that cannot be avoided.

Not only the portrayal of reality is unique in the EarthWorks Project, but also the way the audience discovers and navigates among the digital models of the sites. Animations and slideshows are embedded in a multi-media structure, where the viewer can go through layers of information: first from the network of sites moving to a set of earthworks and finally exploring them piece by piece and discovering cultural stories within them. This structure, going from a large area to pieces of the earthworks expresses the two-dimensionality of the models, similarly to a zooming in and out on a map. Text can almost never be seen, everything is presented visually. The graphical interface directs the viewer though a thread of videos and computer animations with narrations.

The EarthWorks Project is a good example of how a theme that requires a sensible approach can be represented with simple tools in an exciting, educational and entertaining way. Since the objective of the project is to reach a wide audience and to draw attention to unfortunately forgotten, but remarkable pieces of architecture, it is not necessary that the cutting edge of technology be used here. Such advanced technologies would require greater than average
computer resources that are not yet available to a general audience. Instead, the layers of videos and animations controlled by simple navigation buttons create a structure that is easy to explore.

The other significant aspect of structuralizing and layering the animations is the partial control of the author. Although the viewer can decide which site to explore and can reach a certain movie from different directions, the individual animations and videos are already given. This hybrid system of interactivity and passive perception gives the traveler the freedom of exploration, but it also fulfills the requirements for the content, such as the narration of the movie. At the same time the digital models are approached with fixed camera angles and viewed in a carefully conceived and scripted animation. This interface that does not require great computer resources, synthesizes the prescribed content with interactivity in a successful way.

**EXPLORING VIRTUAL REALITIES**

Virtual reality models are undoubtedly one of the most fascinating and technologically advanced methods of computer-aided architectural representation today. This tool allows the viewer to navigate interactively in real time through the digital model. Here, action and sensation, input and output between the user and the computer directly follow each other.31 Requiring computer

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resources which are still above average, interactive virtual realities are the newest inventions in the long tradition of representation methods. They are not yet available for general audiences, but considering the growth of computer resources and the developments in computer games, the time will soon come.32

A paper by Bernard Frischer et. al., “From CVR to CVRO: the Past, Present, and Future of Cultural Virtual Reality,” first explains the history of virtual reality (VR).33 It is described as the use of three-dimensional displays and interaction devices to explore real-time computer-generated environments, which results in real-time interactivity. The theory and practice of Cultural Virtual Reality (CVR) originates from the early 1990s, when computer technology was applied to archeological problems, and the three-dimensional modeling of archeological sites began.

The article draws attention to problems in virtual reconstructions; some of which have not lost their relevance even today:

1. Known structural elements of the reconstruction should be distinguished from the hypothetical.

2. Reconstruction projects should not primarily demonstrate the capacities of computers; they also should be archeologically and architecturally accurate.

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3. It is important to communicate archeological and historical information besides the finished model, since there may be more than one possible interpretation of the archeological findings.

The authors argue that an association named the Cultural Virtual Reality Organization (CVRO) should be formed, in order to define and defend the interests of its members; holding an annual meeting for the exchange of information; hosting a Web site; and developing aesthetic, scientific, and technical standards for cultural virtual reality models. Unfortunately, the organization did not come to life, but the questions the authors raise are still relevant.

Among the many available digital representation techniques, interactive virtual reality best “imitates” the visually perceived world. It is more than a series of still images bound up in an animation, since each frame is rendered spontaneously as the viewer navigates through the digital models. This tool simulates reality more truthfully compared to still images and animations, and can be more deceptive about the accuracy of the models, making the reconstruction much more believable. It is therefore essential, more than ever before, to analyze how such a model can depict more than merely the end result of the modeling process – not only providing one possible scenario among the many, but giving insight to the analytical and interpretative nature of historical reconstructions.

The authors of the paper advocate a solution to the problem of how to include more visual information in the models apart from showing merely the “realistic” final result. Such important additions would include the distinction between initial data and parts that were added.

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34 Ibid. p 1.
to the model during the reconstruction process. The authors also suggest that more than one possible alternative reconstruction should be offered, followed by metadata, which in most cases stands for providing textual information to the computer model that cannot be represented with visual aids. In this case the viewer can switch between the possible reconstructions with a touch of a button, making the digital model interactive not only in virtual space and time, but also among different versions of reality.

Taking advantage of interactive virtual reality, Rebeka Vital from the Cultural Virtual Reality lab (CVR) at the University of California in Los Angeles (UCLA) describes a digital reconstruction project with a unique approach: instead of visual sources, the Temple of Herod in Jerusalem was modeled after the writings of Josephus, a First century Jewish historian. As “one picture is worth a thousand words,” textual sources can be much less informative, therefore it was a challenging task to imagine, reconstruct and represent a building only from written descriptions. Nobody knows today how accurate Josephus’s writings were, or if for example he wanted to exaggerate the dimensions of the building on purpose, making it much more significant of its time. In order to pursue the accuracy of the reconstruction and answer these questions, a scientific committee was set up that worked together with the modelers’ team.

During this project the roles of the scientific committee and the modelers were blurred. The latter were not merely drafting the model, but also had to make design decisions, since sometimes the available information was scarce. The gaps were filled in by considering contemporary Roman buildings as examples for morphology, styles and materials. The interior

space of the reconstructed building was left unfinished on purpose, because they had little detail about its appearance. The primary objective of the reconstruction was to create volumes and depict scales for the scientific committee, who later had the chance to walk through the digital model.

Rebeka Vital stated that the application of virtual reality technology was in this case essential, because this method allowed the viewers to experience the building similarly to the people two thousand years ago. The author shares the opinion that the interactive digital medium gives a comprehensive understanding of space, proportions, scale, texture and their relationship to each other. These models undoubtedly convey more information than the traditional methods of architectural representation, such as those discussed in the first chapter, are capable of. She emphasizes the novelty of interactive virtual reality and considers it a medium that can demonstrate archeological findings and research in history of architecture in an unprecedented way.

Similar to the Temple of Herod project, the house designed by Austrian architect Richard Neutra was also represented with the aid of interactive virtual reality. The paper describing the reconstruction process was given by Andrew Bryant from the CVR lab in UCLA. Since there were no final plans or elevations, the model was created from a series of historical photos, sections and plans from an unfinished stage. Built in 1939, the house was a true representative of Neutra’s modernist residential work. This helped the modelers in understanding the spatial

arrangement of the building. The study of the Neutra’s other works implied certain material types, such as the steel cladding of the walls covered with aluminum paint.

![Image](image1.png)

31. Neutra's house: north facade looking south
32. Interior view: bathroom looking south west

Emphasis was laid again on the human experience of the digital reconstruction. Undoubtedly an interactive virtual model allows spontaneous exploration and simulates the “being on the site” experience. Nevertheless this experience should not only consider the volume, spatial arrangement and lighting of the building, it should also analyze the process of reconstruction. Instead of only one final result, multiple choices should be offered.
CONCLUSION

Creating a digital model, or in other words, rebuilding the physical form in virtual space, means obtaining comprehensive morphological knowledge of the once-existing physical form regardless of the digital media type within which it is represented. No matter what purpose it is constructed for, the same model can be used with different treatments of lighting or materials for various proposes. For example the first – analytical and interpretative – stage of the reconstruction process can be demonstrated by using the finalized model in hidden wire frame form.

Since it may contain uncertain elements, a virtual model can never be finished; it represents the current stage of knowledge, and it will always be considered as a “work in progress.” With images created for focusing on the formal properties of the model, the logic of the reconstruction can be traced back in the future and it can be modified if necessary. Such representation methods will clearly resemble the works of French architectural historians Auguste Choisy and Viollet-le-Duc, whose technical delineations, seen in the first chapter, explore structure and morphology.

In computer reconstructions the questions of the digital medium type (virtual reality, animations and slide shows) should be considered independently from the representation technique (photorealistic rendering or wire frame models). In many cases technology fully substitutes the analytic aim of the reconstruction, for example a finalized model of the Temple of Herod was shown as a subject of examination. Interactive virtual reality was considered as the tool for analysis, but in this case the model should have been represented in a different way. The medium type, whether it is an animation or a series of still images, is secondary. A model that shows for example the uncertain elements with a different treatment of textures, and works as a three dimensional analytic drawing, can demonstrate the process of reconstruction regardless of the medium type it is put in. Cut-away perspectives, similarly to those of Viollet-le-Duc can shed light on structural interconnections, relationships between interior and exterior, lighting and so on.

Reconstructing and presenting a historical site or a building is a great responsibility for its creators. The audience of the reconstruction gets only the second hand experience, they see “what probably had been there” through the lens of the ones who make the final representation. Interactive virtual reality can shorten this distance, where only the model is given, but the path of gaining the experience is up to the viewer, who can walk through the reconstruction without restrictions. On the other hand, as seen in case of the EarthWorks Project, a hybrid interactive medium that guides the audience on a preset network can provide much more information, than if the viewer merely wandered in a giant earthwork virtual reality model.
CHAPTER THREE – HISTORY AND RECONSTRUCTION

CHAPTER OBJECTIVES

The objective of this chapter is to introduce the reader to the Cistercian Abbey of Pilis and to locate it in its architectural and historical contexts. As a result, it will be demonstrated on the following pages that computer reconstructions cannot stand alone as self-proving entities as they themselves are not able to draw attention to their interpretative nature. As we might take what we see on the monitor screen for granted to be the only truth, there should be other sources of data explaining the uncertainties, the important decisions during the reconstruction process and the procedure of the background research.

Regardless of the medium, the practice of computer reconstructions does not merely stand for the study of the morphology of the ancient monument or the architectural period. Instead, the drawings on paper or the models projected on the monitor screen definitely should be of a secondary significance, as they must be located in their historical and geographical context. Therefore, the task of reconstructing something today that exists only in history has to start with and should be based upon elaborate research. Such study explores the historical and architectural background of the given era and the monument. The main argument in this chapter
is that in order to be able to build a complex reconstruction of a monument, one has to learn
thoroughly about its history.

The final aim of this thesis is the partial and basic computer reconstruction of the abbey, thus the
study of the possible morphological arrangement by also taking account of characteristics of the
late Romanesque and early Gothic period. Besides examining the historical and geographical
context, the second half of the chapter approaches the Cistercian Abbey of Pilis from the
morphological point of view.

THE CISTERCIANS

In the next section the history and origin of the Cistercian order will be explored followed by a
description of their architecture. The Cistercians’ way of living greatly influenced their
architectural style and the mass and floor plan arrangements of their abbeys and monasteries. As
more and more monasteries were founded, they had an important role in spreading the Gothic
style of architecture.
History of the Cistercian Order

In the 11th century Saint Robert, who was born to a noble family in Champagne, France, first became a Benedictine monk and later an abbot. He settled at the town of Molesme near Chatillon, where he was very much discontented with the manner of life and with the religious observance of the Benedictine order. In 1098, as a protest against the secularization of the Benedictine order and looking for a more “pure” way of following the rules of Saint Benedict, he
journeyed with twenty of the monks to Citeaux in the diocese of Châlons, close to Dijon (Burgundy, France).

With Count Odo of Burgundy as their patron, they built a monastery called Novum Monasterium (New Monastery) where they began to live a life of strict observance following exactly Saint Benedict's rules. The next year Robert was compelled by papal authority to return to Molesme. His successor, St Alberic held the office as an abbot of the Citeaux Abbey until his death in 1109. He was followed by the Englishman St Stephen Harding, who attached a clause called “Carta Caritatis” to the original Benedictine Regula and introduced it as the new directive for the Cistercian order.

In the first years of Stephen's abbacy the new institute did not seem to prosper as only a few novices came, which almost led to failure. In 1112, however, Bernard of Clairvaux and thirty others offered themselves to the monastery, which eventually led to a fast and vast development of the order. The next three years witnessed the foundation of the four great daughter-houses of Citeaux: La Ferté, Pontigny, Clairvaux and Morimond. At Stephen's death in 1134 there were over 30 Cistercian houses, at Bernard's death in 1153 over 343, and by the end of the century over 500. The Cistercian influence in the Roman Catholic Church also grew along with this material expansion, so that St Bernard saw one of his monks ascend to the papal chair as Pope Eugenius III.

The most important characteristic of the Cistercian life was a return to a literal observance according to St Benedict's rule. The Cistercians rejected all mitigations and developments, tried to reproduce the life exactly as it had been in St Benedict's time, although in various points they went beyond it in austerity. The most striking feature of their reform was to follow the Benedictine “Ora et labora” regulation, which meant the return to manual labor, especially to fieldwork. The latter became one of the special characteristics of Cistercian life and helped in establishing self-sufficient monasteries. They were great farmers as many of the improvements in the various farming operations were introduced and propagated by them.

The Cistercians at the beginning renounced all sources of income arising from benefices, tithes, tolls and rents, and depended for their income wholly on the land, which was unusual in these centuries. This developed an organized system for selling their farm produce, cattle and horses, and notably contributed to the commercial development of the countries of Western Europe. On the other hand, farming operations on such an extensive a scale could not be carried out by the monks alone, whose choir and religious duties took up a considerable portion of their time; therefore from the beginning the system of lay brothers was introduced on a large scale.

These lay brothers were engaged from the peasantry and were simple uneducated men, whose function consisted in carrying out the various fieldwork duties and they therefore formed a body of men who lived alongside the choir monks. The two groups lived separated from each other, as the laymen did not take part in the canonical office, but had their own fixed round of prayer and religious exercises. A lay brother was not a member of the order, and never held any office of superiority. This system of lay brothers allowed the Cistercians to play their distinctive part in the progress of European civilization. Nevertheless, the number of the lay brothers often
exceeded what the resources of the monasteries would have allowed. Sometimes there were as many as 200 or 300 in a single abbey. The polarization resulting from the strict and definite spatial separation of laymen and monks can be observed in the arrangement of a typical Cistercian monastery.

Founded to reform the Benedictine order, the Cistercians went through a few of their own reforms (such as the Savigny congregation in 1134), but the strict regulations prevented the order from the split. The Carta Caritatis, introduced by Stephen Harding, established the fundamental of the organizational system, the strict maternal-abbey filiation relationship. This rule meant that the newly founded monastery was dependent on its founder abbey and on the beginning of the foundation chain, Citeaux. This structure may be regarded as a compromise between the primitive Benedictine system, whereby each abbey was autonomous and isolated, and the complete centralization of Cluny, whereby the abbot of Cluny was the only true superior in the body. Citeaux, on the one hand, maintained the independent organic life of the houses as each abbey had its own abbot, elected by its own monks, its own community, belonging to itself and not to the order in general. Furthermore, each has administered its own property and finances were administered by itself, without interference from outside.

On the other hand, all the abbeys were subjected to the general chapter, which met yearly at Citeaux, and consisted of the abbots only: the abbot of Citeaux was the president of the chapter and of the order, the visitor of each and every house. The abbot of Citeaux also had a predominant influence and the power of enforcing everywhere exact conformity to Citeaux in all details of the exterior life observance, chant and customs. The principle was that Citeaux should
always be the model to which all the other houses had to conform. In case of any divergence of view at the chapter, the side taken by the abbot of Citeaux was always to prevail.

By the end of the 12th century the Cistercian houses numbered 500, in the 13th a hundred more were added; and in the 15th, when the order attained its greatest extension, there were nearly 750 houses. Nearly half of the houses had been founded directly or indirectly from Clairvaux, since St Bernard's influence and prestige was enormous. He is almost to be regarded as the founder of the Cistercians, who have often been called Bernardines. The order was spread all over western Europe, mainly in France, but also in Germany, England, Scotland, Ireland, Sweden, Poland, Hungary, Italy and Sicily, Spain and Portugal.

For a hundred years, till the first quarter of the 13th century, the Cistercians supplanted Cluny as the most powerful order and the chief religious influence in Western Europe. But then in turn their influence began to fade because of the rise of the mendicant orders that ministered more directly to the needs and ideas of the new age. But some of the reasons of Cistercian decline were internal.

In the first place, there was the permanent difficulty of maintaining its first commitments while it also grow to a body containing hundreds of monasteries and thousands of monks spread all over Europe. As the Cistercian underlying principle consisted of being a reform, a return to primitive monasticism, to field-work and severe simplicity, any failures to live up to that ideal entailed greater failure among Cistercians than among mere Benedictines. The latter were intended to live a life of self-denial, but not of great austerity. Nonetheless, relaxations were gradually introduced in regard to diet and to simplicity of life, also in regard to the sources of income, rents
and tolls being admitted and benefices incorporated, as was being done among the Benedictines. The farming operations tended to produce a commercial fortitude; wealth and splendor invaded many of the monasteries, and the monks abandoned fieldwork. The later history of the Cistercians is largely one of attempted revivals and reforms of their early times.\(^{41}\)

Cistercian Architecture

According to the order directives arguing for simplicity, the builders of Citeaux and its first daughter-houses copied the plainest possible forms of the current Burgundian style. Although these buildings were still basically part of what we call Romanesque, they already displayed some elements of the early Gothic, such as the pointed arches. Consequently, many art historians have called the style, which was adopted and propagated by the Cistercians, the "transitional" style.\(^{42}\)

The monastery was usually located next to water, a natural lake or a spring in a desolate valley surrounded by forest. A church was built according to the traditional cruciform Benedictine plan, but with a rectangular apse as a significant Cistercian characteristic. The buildup of the ground plan consisted of a nave and two aisles, regularly of east-west direction, introduced by a porch and crossed by the transept that was flanked with chapels of square or rectangular plan formed by party walls. The choir began at the transept and extended toward the nave. Since Cistercian churches were inaccessible to the public, there was no space reserved for them. In the sanctuary there was only the high altar. Instead of the usual chevet – the apsidal end of a church,

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in which the apses or chapels radiate round the choir aisle, a familiar arrangement in both Romanesque and Gothic churches – in most of the Cistercian churches the rectangular apse was surrounded by angular chapels.\(^{43}\)

There were almost no towers on the church, except above the crossing. The walls inside and outside were left blank, even the application of the highly decorative flying buttresses was rare. Only the traditional rose windows broke the monotony of the flat end walls of the western façade, the apse or the transept, though they were usually small and of the simplest design. Since figured sculpture was not allowed, the only explicitly decorative element of the interior was found in the columns that ended in a formal capital with a wide plain leaf or geometrical figures at each corner.

Although Cistercian churches, in a deliberate protest against Cluniac splendor, were lacking almost completely any ornamental elements, the effect of their purely architectural features became all the more impressive. The lines of the wide pointed arches, the concordance of the cross vaults with powerfully emphasized ribs, the piers and the fine proportion of the details of the structure were distinctive characteristics of the early Cistercian architecture. These features in such purity are not found even in the most lavishly decorated Cluniac churches.\(^{44}\)

The usual site of the cloister was between the south wall of the church and the transept, the latter elongated by a sacristy, chapter hall and scriptorium. To the west along the cloister was a


smaller warming room, a large dining hall set with its narrow end to the gallery of the cloister, and the kitchen. The remaining section of the cloister, closing the square toward the southern wall of the church, included the dining room for lay brothers and different storerooms. The separation of the lay brothers and the monks was therefore not only ideological, but physical as well. On the second floor above the chapter hall the monks' dormitory was located, connected directly with the church by a stairway. The dormitory of the lay brothers was above the storage room and their own dining room. Across the door from the refectory, the pavilion of the washing-fountain was usually located, a wide flat basin with many tubular openings. The infirmary, the novitiate, the guesthouse, the workshops, the mill and other buildings for gardening and farming were built apart from the monastery. In the early Cistercian monasteries there was no library in the literal sense of the word because of the scarcity of books; those few volumes absolutely necessary for liturgical services and spiritual reading were stored in a small chamber adjoining the sacristy, called the armarium.

The largest rooms in the Cistercian monasteries were always the chapter house and the dining hall. Although the rigid rules of simplicity were strictly applied in their interiors as well, the grouping of columns in one or two rows, the magnificent rib vaults of various designs gave them a dignity no ornamentation could supply.

Another decorative feature of Cistercian monasteries was the cloister itself. Though much simpler than the same part of Benedictine houses, the gallery, arranged in a quadrangular scheme with its open arcades, always presented a challenge to architects. The cloister was really the focal point of monastic life, connecting the vital parts of the building with one another. It was the place where the monks performed their domestic tasks, spiritual reading or meditation, where
they spent their free time and where sometimes conversation was allowed. The arches of the continuous arcades usually were supported by double columns, applied alternately with massive piers. The capitals were only modestly carved with some traces of early Gothic forms; however, the original design was frequently changed to a more elaborate ornamentation.45

The earliest Cistercian establishments in France rarely survived the vicissitudes of centuries as they are with some few exceptions all in ruins or have vanished completely. Among the best-preserved monuments, the church of Pontigny, the second daughter-house of Citeaux, can be regarded as the purest sample of the Cistercian architecture in the 12th century. In addition, the almost intact building of Fontenay, now a public monument, may serve as a model of the original Cistercian monastery. The early monuments of Cistercian architecture outside of France bore similar characteristics to those mentioned above, although they soon adopted and continued to develop national artistic traditions. However, the real significance of the Cistercian order lies in the fact that they were almost everywhere in Europe, so the pioneers of the highly advanced French architecture could promote mainly the development of Gothic over a wide area.

Since the Chapter of 1157 prohibited Cistercian lay brothers and artisans from assisting in the construction of secular buildings, the direct influence of the Cistercian order through its own trained architects was only sporadic. However, in those countries where Cistercians represented the only advanced style, their indirect influence, as models and sources of constant artistic inspiration, was considerable for centuries. Even in France, the Cistercian influence prevailed until the era of the great cathedrals, especially among the newly founded or reformed religious orders. The Premonstratensians, for example, copied exactly the austere Cistercian pattern in both their legislation and building activities. Through the Knights of the Temple, organized under St. Bernard's support, the Cistercian artistic program invaded even the Holy Land. After the development of the Gothic style the Cistercians themselves were about to abandon their
original simplicity, the Mendicants, lacking any ambition to create a style of their own, imitated the plainest available model of the Cistercians and continued to build their churches in similar fashion until the Renaissance.

THE CISTERCIAN ABBEY OF PILIS

Location of the Site

The site of the Abbey of Pilis in Central-Northern Hungary belongs to a larger geographical region that is one of the most picturesque reaches of the Danube in Hungary. The river bed was carved out of the local volcanic mountains during the many hundreds of thousands of years of the ice age and leaving the valley in the shape of an ”S” curve. This area was attractive to people in ancient times as well, though probably not because of its beauty but rather as a good place for settling down. This location where river and dry-land roads met generated the emergence of early market places.

It is no surprise then that the Hungarian state was physically born here. The land was owned by the Hungarian royal family and was the scene of important events in the history of medieval Hungary, leaving to later generations a rich collection of historical artifacts and monuments. For instance all the important Hungarian medieval cities can be found around the Pilis Royal Forest.
(such as Esztergom, Fehérvár, Óbuda) as well as the first church institutions and bishoprics. The Abbey of Pilis belongs to this group of buildings as the first written document about the abbey originates from 1184. The Hungarian King Béla III (1172-1196) founded the Abbey, named it after the Holy Cross and donated it to the Cistercian order. Pilisszentkereszt is today a small village with 2000 – mainly Slovakian – inhabitants 35 kilometers north of Budapest.

History of the Site before the Cistercians

The archaeologist László Gerevich conducted archeological excavations between 1967 and 1981 and found earlier settlement layers before the Cistercian Abbey on the site. According to his findings there was an early 10-11th century cemetery from the age of the Árpád Dynasty and some domestic buildings of a small village. Furthermore Gerevich proved that a Benedictine monastery before the 12th century was established here that was used for building material during the construction of the Pilis Abbey. Even parts of the earlier foundation walls were found

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47 Pilisszentkereszt is a compound geographical name from the 18th century, meaning Pilis + Holy (Hung. “szent”) + Cross (Hung. “kereszt”). The name “Pilis” is of Slavic origin, and stands for “barren hill.”
48 His findings were written down in two major articles: one by himself entitled *A Pilisi Ciszterci Apátság*. (Hung. The Cistercian Abbey of Pilis) Szentendre: Museums in Pest County; whereas a more detailed study appeared in German entitled „Ausgrabungen in der ungarischen Zisterzienserabtei Pilis.“
49 The first royal dynasty of Hungary, ruled between 1001-1301.
along the abbey’s cloister. Unfortunately, no written data in the ecclesial historiography remained about this earlier building.

The Era of Cistercian Foundations

After the foundation of the Hungarian state more than a millennium ago in 1001 AD, King Stephen I and his successors became aware of the important role that monks and monasteries play in spreading and strengthening Christianity in the country. As the Carpathian-basin was located geographically and politically between the Papal authority and the Byzantine Empire, the influence of East and West has reached the country simultaneously. To the west of the Danube the Christianizing Benedictines appeared, whereas to the east the Byzantine impact was more significant. In this split situation King Stephen I organized the structure of the state and the church, the latter with Italian and German intervention. The goal was, therefore, to hold the balance between the Eastern and the Western influence, but being committed to the West. The clerical system was organized according to the Western example and the crown was accepted from the Pope in Rome. Later the conflict between Byzantium and the Papacy escalated as a result of the Islamic incursion and several religious debates, leading to the schism in 1054. Simultaneously, by the end of the 12th century, there were Benedictine abbeys in every major region of the Hungarian kingdom.

51 According to Gerevich, the only written data about the Benedictine monastery exists in the writings of Blanchot who was the chronicler of the mother church in France. Gerevich’s findings correspond with Blanchot’s description that tells us about an existing Benedictine monastery. For more information on this issue see Gerevich, László. A Pilisi Ciszterci Apátság. (Hung. The Cistercian Abbey of Pilis) Szentendre: Museums in Pest County, 1984. p 4-5.

By the second half of the 12th century there was a strong need to reform the clerical and the governing system because of the changes in the domestic and foreign political situation. After King Géza II resigned in 1162, his balanced era was followed by succession conflicts. On the other hand, plans for a Hungarian-Byzantine union failed due to the Byzantine emperor Manuel’s policy and because of the crisis of the Byzantine Empire. Furthermore the secular power of the Papal State started to decay, the French Kingdom on the other hand grew stronger, where the incursion of new cultural, scientific, philosophical, ideological and artistic currents was encouraging the development of the Gothic style.

In 1173 King Béla III, who was educated and raised in the Byzantine court, acceded to the Hungarian throne. He was the first Hungarian king to have a French wife, Ann Chatillon, the daughter of crusader Rajnald Chatillon, Prince of Antioch. Ann died in 1184, whereafter the king married Capet Margot, the sister of the French king Philip Augustus II. With these marriages the bond between the French and the Hungarian royal court became very strong.\(^{53}\)

The open-minded Hungarian king’s Byzantine education and background helped him to realize the importance of committing his country decisively to a Western orientation. He introduced to the kingdom the progressive French cultural and clerical trends best represented by the Cistercians with their new approaches towards agriculture, crafts and education. Understanding that there were parts of the country that had fallen behind in development for decades, and that much of the land was uncultivated, he decided that not only one monastery should be built, but there should be many abbeys founded. The king negotiated with the main abbey, Citeaux itself, and in 1183 he invited the abbot of Citeaux to Hungary. The king assured him with a charter that

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the Cistercian abbeys in Hungary would have the same rights and privileges as in France. The significance of these foundations outgrew the simple establishment of a new order; they resulted in the reorganization of the whole clerical system in the country. The invitation of the Cistercians had a great impact on Hungarian medieval architecture, as they introduced the advanced form of the Burgundian transitional style (from late Romanesque to early Gothic) and brought many craftsmen with them from France.  

A series of abbeys were founded by the Cistercians, some of directly from France, later from Hungarian predecessors. For example, in 1179 Egres from Pontigny, in 1182 Zirc from Clairvaux, in 1184 Pilis from Acey, in 1184 Szentgotthárd from Tois-Fontaines. They were followed by in 1191 Pásztó founded from Pilis and in 1202 Kerc from Egres. Although the exact consecration date of Pilis is not known, it was finished probably by 1225.

*Between Two Invasions and Devastation*

Starting in 1241, the Tartar invasion hit the country devastating most of its monasteries; however the Abbey was able to recover to some degree from the destruction. Although most of the damage was restored after the disaster due to the excellent organizational skills of the order, the golden age of the Cistercians was already in decline. The lingering strength of the Abbey is shown in the fact that the monks of Pilis were able to supervise another monastery in the vicinity of Veszprém from 1240, and also contribute to the establishment of another monastery in Majs

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(which is called Ábrahám today and lies in the vicinity of Dombóvár) in the Southwest part of Hungary in 1270. But more Cistercian abbeys were not founded after that date in Hungary.\textsuperscript{56}

Two hundred years later, under the reign of the great Hungarian king Matthias Corvinus (1458-90), seven Hungarian monasteries – among them the Abbey of Pilis– were revitalized with the help of German abbots. Despite this short recovery effort, however, all seven monasteries were still in a very bad condition before Hungary’s invasion by the Turks. The Turkish army destroyed Pilis Abbey on September 7, 1526.\textsuperscript{57} The monks were able to repair some of the damage so that they could use the building. The transept and altars were very badly damaged, and the monks enclosed the Western part of the church with a lower vault and placed three new altars in the side-aisles. After the full Turkish invasion and complete destruction in 1541 the ruins became a target of thieves for many centuries. The Turkish soldiers plundered the tombs and the stones of the abbey were used for erecting a fortress in Esztergom.\textsuperscript{58}

Eighteen abbeys belonged to the Cistercian order before the Turkish invasion, but the order could claim only the after the Turkish army was finally forced out of the country. The abbey of Pilis in 1712 and the abbey at Pásztó in 1702 were united with an abbey at Velehard in Moravia.\textsuperscript{59} In 1734 the abbey in Szentgotthárd was restored with the aid of monks from Heiligenkreuz and in 1762 the abbey in Zirc was rebuilt with Silesian help. In all four cases the King returned to the abbeys their previous rights, lands and holdings, but with the following conditions for the Cistercians: the monks had to receive help from the order from abroad, the


\textsuperscript{57} Ibid.

\textsuperscript{58} Ibid.

\textsuperscript{59} Békefi, Remig. \textit{A pilisi apátság története}. (Hung. The History of the Cistercian Abbey at Pilis) Pécs, 1891-1892. p 43.
buildings had to be restored, and mass should be performed in the buildings the immediate vicinity. These requirements remained in most cases unfulfilled: in Pilis the monks were not able the claim the site back, much less carry out restoration. The ruins in Pilis were occupied by the Pálos order (Ordo Sancti Pauli primi eremita) who believed that the birthplace of their order was there, at the Church of Sante Crux. Later the Pálos order was dismissed by King Joseph II in 1787. In 1814 King Francis I united three abbeys (Pilis, Pásztó and Zirc) under the control of the abbot at Zirc.60

35. Cistercian Abbeys in Hungary

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The Site

The Church

36. The plan of the Abbey of Pilis
The 186 feet (57 meter) long church was divided into three naves by eight pairs of pillars. According to the strict rules of Cistercian architecture, one section of vault in the central nave equals two sections of vault in the side-aisles. On both sides of the church two cross aisles were established, each 15 feet (4.7 meters) long. On both sides of the main sanctuary two chapels were erected. Semi columns 15 ¼” (38.5 cm) standing next to the pillars supported the ribs of the vaults. From the pillars facing the central nave thinner columns 8” (20 cm) supported the groin vaults of the central nave. The ribbed groin vault of the central nave was most likely supported by consoles. In the middle of the keystones of the vaults in the central nave an empty disk was placed, which held engraved marbled leaf-ornamented panels.6162

The pillars and the column heads were adorned with abstract, simplified plant motifs such as multi-foiled acanthus-like leaves. This showed a tendency towards a more natural, although not naturalistic, representation. The Cistercians emphasized an austere use of details that reflected the structure and essence of the plant displayed in the ornament. The key principles of Cistercian aesthetics were evident at Pilis: clear systemization, exact sizes, strict proportions, and overall harmony.63

62 In the description of the church László Gerevich’s article A Pilisi Ciszterci Apátság. (Hung. The Cistercian Abbey of Pilis) served as a main source. p 6-15.
63 Ibid.
Villard de Honnecourt mentioned in his Album that was in Hungary three times. In one of his reports he wrote that he has spent “several days” in Hungary and described some types of floor-plates that he saw during his stay in a church. In a 15th century representation, he is displayed as a soldier with the following caption: “this is Villard de Honnecourt who has been to Hungary.” The image shows the importance of this visit. During the excavations of Pilis, the three types of floor-tiles were found which de Honnecourt had noted in his Album. The patterns of three plates matched his drawings in the Album, confirming that he had indeed visited Pilis Abbey; moreover, he might have contributed to the last stages of the building construction. Honnecourt’s visit to Hungary indicates symbolically the heyday of French architectural influence there.64

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39. Reconstruction of the brick mosaic in the church
40. Brick patterns from the church and the monastery
41. Floor tiles with circular pattern

42. Floor plates found in the Pilis Abbey
43. Drawings of floor plates in Villard de Honnecourt’s Album compared to floor plates found in the Pilis Abbey
The Monastery

The ground plan of the monastery, with the exception of its southern side, corresponds to the typical Cistercian layout. The irregularity is due to the fact that there were some preexisting buildings on the Southern side of the site. The ground plan organization of the monastery is strictly regulated. The East wing is a direct continuation of the side-aisle, the main functions of the monastery (Chapter house, monks’ dayroom) laid out with the same module as the church, a 15 feet (4,7 meter) square unit. All the buildings around the church and in the cloister reveal a unified building effort. The continuation of the west wall of the church into the east wall of the lay brothers’ room is a further indication of the careful, unified design of the abbey.65

First the east wing of the monastery was built, followed by the crossing and the cross aisles. This is evident from the differences in the wall assemblages and footing. After the completion of the cloister the eastern archway and the well-house were built, along with the adjacent refectory at the southwestern corner of the cloister. The east wing of the monastery was in all likelihood two-stored, with the monks’ sleeping room upstairs. The sacristy attached to the church served in the first phase of the building construction as an oratory, as the excavated altar stones reveal. South of the sacristy was the Chapter house, next to the day stairs to the dormitory above it. On the east edge of the south wing a kitchen was built from used building materials.66

The monastery cloister and the fountain-house were built in the 1220s. Péter Gerecze excavated the foundations and the ruins in 1913. He discovered a conduit-pipe carved into stone divided

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66 Ibid.
and lead the water to the yards of the abbey. Evidence suggests that the original pipes were later replaced in the 14th or the 15th century. With the aid of stone pipes the monks delivered water from the surrounding slopes. There was also a water-mill reconstructed next to the abbey, which delivered the waste water into the canals.67

The impressive scope and details of the abbey buildings confirm that the Abbey of Pilis was one of the biggest building complexes established in Central Europe during the glory days of the Cistercian order, also showing how a unified medieval Europe was emerging on the map.

46 - 47. The site today

48 - 49. The remains of the cloister

50 - 51. Column bases
CHAPTER FOUR – REVIVING THE LONG EXISTING

CHAPTER OBJECTIVES

Computer modeling is an excellent tool for studying the principles of design, for doing formal and compositional analysis and for clarifying the structural techniques of historic buildings. There are many verbal descriptions and static diagrams about key topics in architectural interpretations of computer reconstructions, and yet a more visual, model-based approach using the new media can better demonstrate these ideas. To synthesize theory and practice, the fourth chapter will be supported by computer modeling and visualization experiments. The following reconstruction process provides a list of interpretive and thematic issues and the illustrations for them.

In this chapter it will be demonstrated, with accompanying images, how techniques in the first chapter can be applied on a virtual reconstruction. These illustrations are orthogonal, axonometric and perspective projections of three dimensional computer models. This means that the medium is independent of the treatment in which it is presented; for example, a disassembled analytic model can be explored with the aid of a series of slide shows and in the shell of an
interactive virtual reality. In this thesis they are portrayed as still images, since these illustrations have to appear on paper; nevertheless, they have the potential of being transformed to any of the medium types discussed in the second chapter.

As a case study, the cloister and the fountain of the Cistercian Abbey of Pilis will be displayed in a range of representational techniques. In reality, a building in its physical form may turn into a ruin or be completely destroyed. During a reconstruction, the opposite happens: once existing architecture is revived and, in the virtual world, is remodeled. As it will be shown in this chapter, some analytic concepts will turn the models again into ruins in order to reveal their structure and massing arrangement. Following the “analytic ruin” idea, not only are the once existing architectural forms remodeled, but is created the effect of time as well. For instance, the virtual fragments of the fountain were dissembled from a finished model, which first had to be completed and created according to the remaining physical evidence.

THE FOUNTAIN OF THE PILIS ABBEY

The archeological excavations on the site of the Abbey unearthed the foundation of complex buildings based on a unified design. Both these and the fragments of extremely high quality ornamental features found nearby attest to the Hungarian reception of French early Gothic design in the late 12th and 13th centuries.
In particular, excavations have brought to light a dozen fragments now preserved at the Hungarian National Gallery which used to belong to the 13th century fountain of the monastery. Most of them were found in the vicinity of the octagonal fountain house that opens out from the south wing of the cloister. These fragments helped in the almost complete reconstruction of the fountain, as seen in the digital model. Their material is white limestone and another kind of compact, hard limestone quarried near Pilis, and traditionally called “red marble” for its reddish color. Morphologically, these extant fragments and the ones lost since 1913 but known from the excavation documents can be grouped into eight categories. Art historian Imre Takács describes in his article in great detail the preserved ruins of the fountain.

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68 The excavations were conducted by László Gerevich. A detailed report of his work is to be found in the appendix of Imre Takács’s article on the reconstruction of the fountain. p 14-5.
The following pieces served as a basis for the reconstruction: 69

1. Flat blocks of hard limestone. Originally, these belonged to the lower section of an object erected on a circular ground plan. On the curved outer side the moldings include a flat vertical section, a groove and a bead. On the top, a thin horizontal band can be seen interrupted by deep mortises.

2. Fragments of solid red limestone decorated with foliage. On the side, a concavity introduces a bead followed by a massive projection. On the top, traces of a circular rim can be seen. The overhanging part is decorated with two superimposed layers of leaves. Of the two extant fragments, one is of full height, the other consisting of small details of the bead and the foliage.

69 The description of the ruins follows Imre Takács's article in which he describes the pieces preserved in the Hungarian National Gallery and according to photos of the Hungarian National Monument Protection Authority. p 2-5.
3. A “red marble” fragment belonging to an object of a circular plan. The profile of the side includes a vertical section and a round molding of a quarter-circle. On the top there is a horizontal joint; its bottom and inner sides are broken. It is known only from a reconstruction drawing from 1913.

4. Fragments of the “red marble” brim of a circular object belling upwards. The tops and bottoms are horizontal planes, with traces of jointure on the latter. On the outside there is a vertical flat molding of quarter circle. On the top there is a horizontal joint; its bottom and inner sides are broken.
5. An Attic base carved of limestone and placed on a square plinth. A round borehole runs along its vertical axis. It is known only from on-site photos, from the excavation report and the reconstruction drawing of 1913.

6. The fragment of a round limestone shaft with a vertical borehole in the middle, known only from the reconstruction drawing and the report of 1913. These suggest that it belonged to the base point 5.

7. Fragments of the side of a circular basin carved of soft limestone. On the edge of one of the fragments traces can be found of an outward slanting borehole once piercing the side of the basin.
8. Fragments of a square pinnacle of soft limestone adorned with bead moldings at the corners. Traces of a vertical borehole can be discerned in the middle. Black staining can be seen around the edge of the hole. The larger fragment shows traces of holes connecting the central borehole and the sides.
A key to Imre Takács’s reconstruction of the fountain is the red marble fragment decorated with foliage whose plan can be completed by mirroring the ornamental pattern and the quadrangular surface of jointure extending into it across the face of the side. The reconstruction of the plan, based on the hypothesis of regular repetitions, is confirmed by a photo of 1913. This interpretation of the fragment suggests that this was a part of a capital of a pier of unusual dimensions – 49 ¼” (125 cm) in width and 5 ¾” (14.5) cm in height. It confronts a type of piers, called “pilier cantonne” in French, developed by the architect who designed the Cathedral of Chartes around 1194. It is probably inspired by a pier composition of Guillaume de Sens at the Cathedral of Canterbury; he surrounded the cores of nave piers with alternating round and polygonal colonettes. This idea was soon adopted in Rheims and Amiens with slight modifications. As the fragments reveal, the designer of the Pilis fountain must have known these examples. Composite piers of similar structure supported the vaults of the Pilis cloister built about the same time as the fountain.70

The compound pier is assumed to have supported the red marble basin reconstructed from the fragments described in points 3 and 5; water flowed into the lower basin through holes in its side. The fragments grouped in point 1 belong to the base of the lower basin. The deep mortises atop it suggest that the base carried a tall parapet. All this and an analogy from Maubuisson permit the assumption that it was a fountain with a secondary function: also used as a water tower. The column with the borehole in the middle, fragments of whose base and shafts (pieces 5 and 6) are shown by drawings made in 1913, must have risen from the red marble basin. Presumably, the

column of about 11 ¾” (30 cm) in diameter supported the smallest uppermost basin (piece 7) which was probably crowned by the slender pinnacle (piece 8) also with a hole in its middle. 71

The fountain was fed by waters from springs dammed up in the mountain-side west of the monastery. The water arrived in the cloister through a stone conduit running under the room of the converts. It rose to the level of the pinnacle through a lead pipe in the central axis of the fountain and trickled through four holes into the upper bowl, as one of the fragments testifies. Unmistakable traces of the lead pipe can be found in the discolored interiors of the pinnacle fragments. Excess water was drained from the lower basin through an underground pipe into the covered sewer running along the southern side of the buildings. This water system, just like other aspects of the monastic complex of Pilis, was strictly adjusted to the scheme of Cistercian architecture. 72 The fountain rising in three tiers obtained its natural polychromy from the stones that were used. The color contrast between the polished red marble and the white stone was used as immanent decoration for architectural structures not only in Pilis but also in several other places in medieval Hungary. Thus the fragments of the fountain not only confirm the rapid and high-quality reception of contemporaneous French architectural types but also provide valuable information as to the relationship between workshops as early Gothic art was spreading within Hungary.

71 Ibid. 12-3.
72 For further reading, contact

Besides the reconstruction of the fountain, Imre Takács draws his readers’ attention to its metaphorical meaning, occupying the heart of the building complex. The fountain symbolizes the goal of the Cistercian reform – ‘ad fonts,’ to go back to the original sources. The Latin word ‘fons’ means fresh spring water and fountain, so the fountain house symbolizes the essence of Cistercian life and architecture. The Cistercian order rejected the ornaments and the luxury of Clunaic architecture and established a highly rationalist and technically developed modern building: the Cistercian monastery. The building, with its technical inventions and clearly-ordered arrangements, is the product of a complex worldview, simultaneously conservative yet somehow modern as well, that the Cistercian order represented in the middle ages.

64. Schematic drawing of the fountain of Maubuisson that served as a watertower
65. The fountain of Maulbrunn

RECONSTRUCTION AND REPRESENTATION

In architectural practice, buildings are portrayed by abstracting space, in orthogonal projections: plans, sections and elevations. The understating of an object begins with a reading of these drawings. Here, the Pilis fountain is portrayed in these projections, like to Durand’s works, not as plans for a building being built in the future, but as portrayals of already existing architectural forms. These renderings bear explicit information about dimensions and shapes, but they are too abstract to appeal to a wide audience.

66. Plan view of the fountain of Pilis
67. Section and elevation
Following the general architectural representation method of plans, sections and elevations, a more complex understanding of the layered structure can be achieved with Durand’s methods. The projections are still orthogonal, but discrete levels of the edifice are combined in a single drawing. This treatment of the fountain takes advantage of its symmetry, similar to the example of different amphitheatres from the *Parallel of Architecture* discussed in the first chapter.

68. Bottom view showing discrete layers of the edifice
69. Axonometric worm's-eye view and section of the fountain
70. Section of a bay of the cloister
71. Axonometric rendering of the bay, synthesizing plan and section
Like the corresponding examples in the first chapter, axonometric worm’s eye views of the cloister and the fountain synthesize plan, section and elevation. Compared to orthogonal drawings, these methods of depicting buildings emphasize spatiality without losing any of the dimensional relations. The shaded section and the axonometric view of the cloister both express three dimensions; yet only the latter retains the technical information of discrete plans, sections and elevations.

Viollet-le-Duc used the “analytic ruin” idea to disassemble a reconstructed building and therefore to demonstrate the structural systems and relationships between interior and exterior. One bay of the cloister was turned into a ruin, alluding to the deteriorating effect of time. Even though put into perspective, these renderings take the architectural form out of its context. Though these renderings are excellent technical tools for creating formal studies, they are still too abstract for a general audience.
In archaeological practice and architectural history, piecing together the remaining physical evidence of the once existing building is crucial during the reconstruction process, but can be difficult to visualize. It can be verified later by placing the still existing pieces into the completed digital model. Fragments of the fountain of Pilis Abbey made from a complete, rendered computer can be highlighted like “digital ruins”, and positioned within the complete reconstruction depicted only in hidden wireframe.
Colors, shading and contextual elements, such as water in the fountain, bring the model to life. In Figures 79-83, the cloister and the fountain are shown, in a photo-realistic rendering, with the focus on the pure architectural form. Excluding the context, it represents a compromise between the analytic and atmospheric approaches. The colors correspond with the archaeological
findings. This rendering makes the edifice accessible and interpretable to a mixed audience, to archaeologists, architectural historians and the general public alike. The model aims at accuracy, but photo-realism may obscure the possible questions of uncertainty about the reconstructed forms.
These images might remind one of the postcards sold in the Abbey gift shop of an extant site. They not necessarily depict reality, but rather reflect human perception, where the built forms are portrayed through the lens of their author. Contextual elements, such as water, sunlight and vegetation create a more complete depiction of the full experience of being on the site. These
images, while emotional and subjective, say more about a work of architecture, and how it affects us: unlike the dry technical delineations, they can be interpreted in multiple ways, such as evoking a personal connection to the site or nostalgia after the long exiting.

84 - 85. Perspective, “atmospheric” rendering of the fountain and its context
CONCLUSION

This thesis has explored the new, ever-changing realm of computer reconstructions of ancient architecture, has described traditional visualization methods and has demonstrated its findings on the Cistercian Abbey of Pilis in Hungary. These ideas were discussed in four chapters, each contributing to the final reconstruction project. The first chapter looked at historical architectural representation techniques, which became the methodology for the reconstruction. The second chapter analyzed contemporary projects in this area, focusing not merely on technical aspects, but emphasizing interpretive scope. The third chapter explored the historical and architectural context of the Cistercian Abbey of Pilis. Finally, the fourth chapter illustrated the computer reconstruction of the abbey, synthesizing the ideas of the first three chapters.

The first chapter demonstrated that even though many techniques are known and are used in computer representations in architecture today, most of them were invented and exploited for centuries by skilled architects, artist and art historians. These still works represent a great diverse selection of ideas in architectural representation: analytical technical drawings of plan, section and elevation; investigative perspective renderings of structures; and landscapes with distant and imagined buildings filled with emotional and atmospheric appeal. However far they may be from each other in their approaches to the problems of visualization, these techniques
share one thing in common: all depict the non-existing and seek to rebuild the lost architecture of the long-ago past.

The goals of today’s computer reconstructions have not changed. It is therefore important to take into account these historical methods that have already been improving over centuries, and have a well-established role in architectural education, art and even entertainment. The analytic approaches mentioned in the first chapter can serve the need of emphasizing the technical aspects of the building, while also highlighting the interpretive nature of digital reconstructions. For example, the explanatory illustrations of Choisy shed light on spatial and planar correlations; the disassembled buildings in the drawings and etchings of Piranesi and Viollet-le-Duc portray structural systems that would otherwise be hidden. The “atmospheric” treatment, on the other hand, of Roberts and others draws attention to the architectural context and appeals more to human perception, but can exaggerate the emotional aspects. From analytic to atmospheric, the sequence of exploration of these techniques reflects the process of reconstruction itself: from plans and sections to three-dimensional models placed within contextual environments.

Following the analysis of representational techniques, the second chapter discussed recent computer reconstruction projects. Different types of the medium were described and analyzed, from still images to animations to interactive virtual realities. Most of these methods can be traced back in history and all have inherited their characteristics from their predecessors: for example, a digital image shares many qualities with photography. New methods have also been invented: for example, real-time virtual realities let the viewer explore the building interactively. It was also shown in this chapter that the more the chosen medium depends on technology and computer resources, the less control the creator of the reconstruction has over how the content
will appear. Still images, as in the history of photography, can be altered and manipulated after being rendered from the digital model. It is also the author’s choice to decide on various attributes of the picture. At the other end of the spectrum, where the ultimate interactivity is provided, only the creation of the model depends on the author; it is up to the viewer to explore it freely.

This thesis argues that any of the discrete representational techniques can be demonstrated with any of the medium types mentioned in the second chapter. These two separate categories are not linked together: for example, a dissembled building can be explored in virtual reality. The works of architects, artists and art historians were manifested in what is equivalent to digital images in the virtual world, but today’s computer technology can enrich the experience further.

The application of these ideas on a digital model was demonstrated in the fourth chapter. Various visualization techniques were used in modeling and portraying the fountain and the cloister of the Abbey of Pilis, proving examples of how to present specific analytical and archaeological information, and not merely a finalized and realistic image of the reconstruction. Here, the destroyed abbey was partially revived, but also with a focus upon the “analytic ruin” concept of Viollet-le-Duc and Piranesi and with the emphasis on spatial and planar interpretations following Choisy’s ideas. This analytical capacity was developed further when the remaining physical evidence was placed into the finalized model, and therefore the reconstruction process was graphically verified and explained, and levels of uncertainty were indicated.
By a synthesis of traditional representational techniques, an analysis of contemporary digital reconstruction projects, and an historical overview of the site, this thesis has attempted to shed light on emerging questions in computer reconstructions. This work has utilized ideas of scholars in architectural education to reflect more upon the educational, analytical and interpretive capacities of digital models. These concepts were transformed into the virtual world to create images of the Cistercian Abbey of Pilis that show more than a finalized, mostly photo-realistic rendering. The images of Pilis demonstrate that the infinite possibilities in the digital world may be utilized to create three-dimensional visualizations of abstract analytic thinking, exploratory perspective drawings and atmospheric renderings all at the same time. All these techniques in combination provide a rich, multi-dimensional visual and intellectual experience that goes beyond the merely resemblance of the long existing.
REFERENCES


