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Bringing Time and Change to Life in the Visualization of Greek Architecture

Abstract: The Classical architecture of Greece is widely admired and is of canonic significance for architects, in large part because of its sculptural and visual refinements. Yet there is no extensive, comparative analysis in digital media to help scholars, archaeologists, architects, and the public to visualize the changes that took place in this architecture over the centuries. These transformations have been repeatedly depicted in the literature using traditional static media, and numerous specific Greek monuments and sites have been digitally reconstructed, using various techniques. However, the capacities of new digital media to more vividly present the chronological and stylistic transformations and the optical refinements of the temples have yet to be tapped. New media can help visualize not only works of architectural history, but also the changes in architectural history and design.

Introduction

The aim of this paper and the accompanying virtual reconstructions is to demonstrate a method of comparative analysis that illustrates the morphological, geometrical, and structural differences between key landmark buildings and their significant details throughout time. The emphasis will be placed on the Doric refinement processes and their variations both geographically and over the centuries. Innovative media treatments (3D morphing, exaggeration, animation) will be used to more accurately visualize:

- changes in the Doric order from the early Archaic to the Classical period, namely from the Heraion of Olympia to the Parthenon of Athens and to the Temple of Zeus at Nemea;
- visual exaggerations such as entasis and stylobate curvatures at the Parthenon; and
- virtual explorations of the built forms using historical representation techniques as precedents.

This study will take advantage of the power of digital visualizations to deliver insights about architecture and archaeology to diverse audiences. The aim is to present not only the finalized virtual model, but to look behind the scenes and examine its construction, subtle details, curvatures and its place in the refinement process of the Doric order. Using the well-established traditional methods of architects, scholars and archaeologists in architectural representation combined with contemporary digital media, these models are excellent tools for architectural and archaeological education, analysis and research.

The Analytique

The 2D Collage – École des Beaux-Arts

At the École des Beaux-Arts, understanding detail as a significant generator of the character of a building called for a unique architectural depiction method. The result was the analytique, a graphic representation of a surveyed or reconstructed building where detail plays a predominant role (FRASCARI 1996, 498–516). The building is explored in two dimensions only, without portraying depth: there are only orthogonal projections and almost no axonometric or perspectival views. This flattening of the edifice creates an abstract, even artistic representation, where floor plans, elevations and architectural details are pieced together, each on a different scale according to their importance. Sometimes the complete building is present in the drawing, but more often only a significant façade is shown. Yet these are shown on such a small scale that they seem a detail among details (ESPOUY 1981, 17).

The analytique was developed in a period in which architects did not have to create working drawings showing the construction of details. There are hardly any dimensions visible and the different scales of the building pieces are independent of each other. This provides room for a more interpretive

approach, especially for architectural reconstruction: the author as a guide can emphasize the more important or distinctive details, and hide those of lesser significance *(Figs. 1 and 2)*.
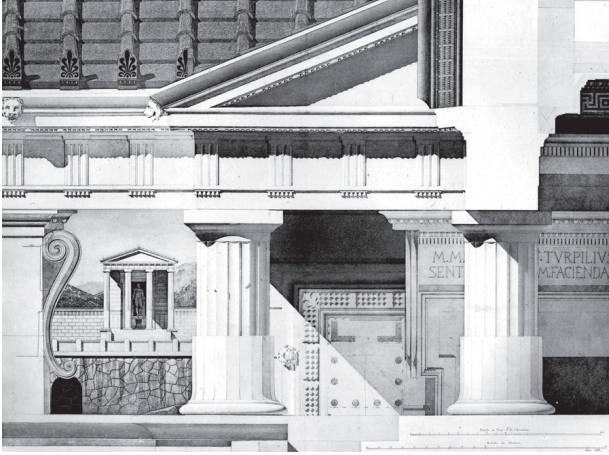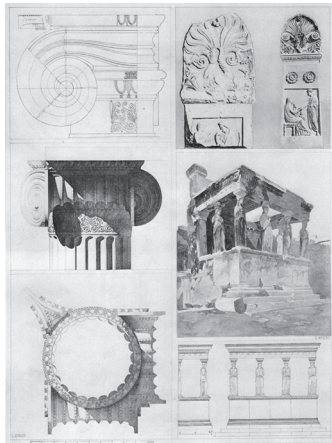

Fig. 1. Temple of Hercules at Cori.

Fig. 2. Erechteum on the Acropolis.

the process, since not only the exterior, but also the interior layout had to be recreated. The arrangement of the columns inside, for example, is visible on the floor plan placed within the collage. Compared to hand drawings, where the level of detail follows the scale, all details of the temple (column capitals, triglyphs and cornices) had to be modeled to the greatest accuracy, since they would appear on different scales within the analytique. Finally, also as in its paper predecessors, the complete building is placed within the final model *(Figs. 3 and 4)*.
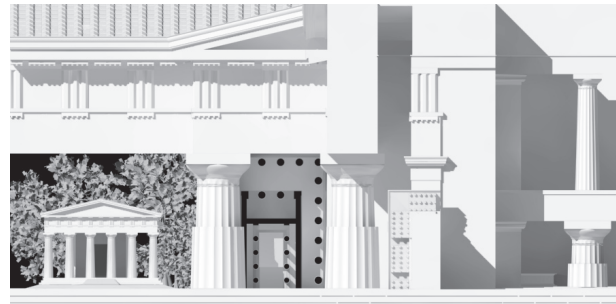

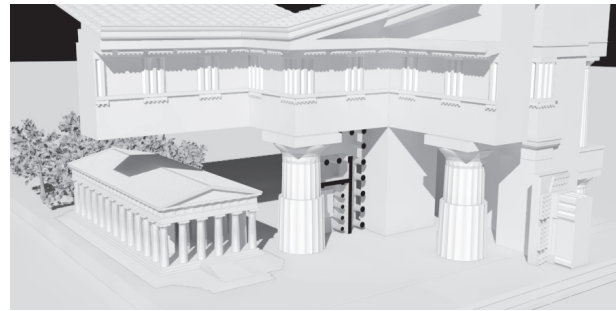Fig. 3. Analytique of the Temple of Zeus at Olympia.

Fig. 4. Perspective view of the three-dimensional analytique.

The 3D Collage of a Virtual Greek Temple

When using both traditional and digital media, the creation of an analytique is preceded by the complete reconstruction of its subject, the building. Whether it is drawn on a sheet of paper or modeled in virtual space after its completion, it has to be cut up and reassembled again. The arrangement of this three-dimensional collage, however, is not necessarily related to that of the building, but depends on the author's individual artistic approach.

The Temple of Zeus at Olympia – built in the 5th century BC – was first completely virtually reconstructed from archaeological data (CURTIUS 1876–81). The modeling of the temple took the longest time in

The Analytic Ruin

The concept of the analytic ruin is similar to the analytique: a completely reconstructed building is taken apart and analyzed. Here, however, neither the scale nor the arrangement of the pieces changes; rather only those that reveal significant architectural, structural or historical information are shown. This treatment of the complete reconstruction focuses more on the role the individual elements play as parts of the building, and does not necessarily draw attention to details that the artist, architect or historian considers important. This idea has been used extensively over the past centuries in both art and architectural history. Architects, artists and scholars have created methods of depicting ancient build-

ings that explore, analyze and educate, rather than just showing the building in its finalized form.

Historical Precedents: Piranesi, Choisy, Viollet-Le-Duc

Italian architectural theorist and artist Giovanni Battista Piranesi's (1720–1778) 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 (WILTON-ELY / PIRANESI 2002, 9). He rendered buildings and their parts in perspective within their environment and disassembled their structural components to a very high level of detail and accuracy. He also created an almost encyclopedic catalog of details, again arranged in compositions, studying them separately but reintegrating 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 the next century at the École des Beaux-Arts in Paris *(Fig. 5)*.

Fig. 5. Piranesi: Partially reconstructed ruin.
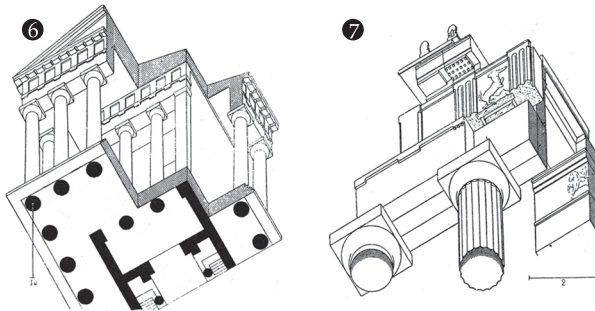

Fig. 6. Choisy: The Temple of Zeus, Olympia.
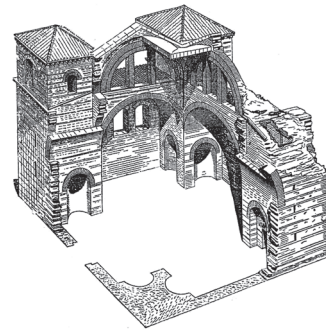Fig. 7. The Doric Order.

Fig. 8. Disassembled Roman building.

An engineer by training, Auguste Choisy (1841–1909) explored important periods in the history of architecture (CHOISY 1899, 25). His study was intended for educational purposes, particularly for architects. 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 eliminates the possibility that discrete plan, section or elevation drawings would not match.

In drawings of Doric temples and details, Choisy shows their structure by combining plans with axonometric worm's-eye-views *(Figs. 6 and 7)*. 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. Although this technique has the illusion of three-dimensionality, unlike the analytique it still retains its technical characteristics, such as a consistent scale.

Eugène Emmanuel Viollet-le-Duc (1814–1879) was a French architect and theorist, best known for his reconstructions and graphical analyses of medieval buildings (VIOLLET-LE-DUC 1866, 14). They were highly investigative and analytic, and left nothing ambiguous or uncertain (KRUFT 1994, 282–85). Compared to other professors at the École des Beaux-Arts, Viollet's drawings retain the technical approach, but place the buildings in perspective by showing them together with certain contextual or atmospheric qualities, such as light, shadow, and human occupation. Such representational characteristics are more appealing to human perception than the drier
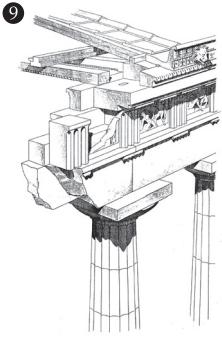
Fig. 9. Roman public building interior.
Fig. 10. The Doric Order.

axonometric or orthogonal projections. Viollet-le-Duc also used the analytic ruin concept, where, similarly to Choisy, he disassembled building structures, but unlike Choisy, rendered them in perspective *(Figs. 8, 9 and 10)*.

The Disassembled Digital Ruin

The techniques described above were employed in the digital model of the Temple of Zeus at Olympia. As mentioned previously, not only the major exterior pieces and important details were modeled, but the interior layout as well. Thus this model can be used for multiple purposes; for example it demonstrates

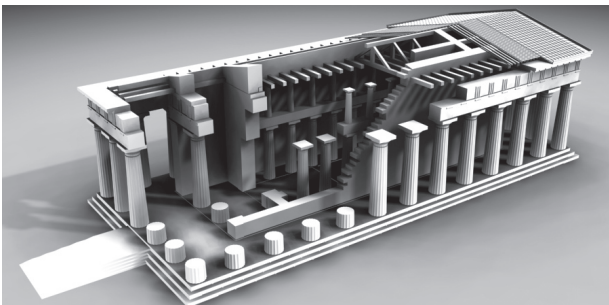Fig. 11. Axonometric view of the temple.

Fig. 12. Perspective view of the temple.

relations between the floor plan and the building, reveals hidden structural components and shows relationships among exterior and interior elements. The model, created for such purposes, does not

contain other details, such as metopes, pediments or the statue of Zeus inside *(Figs. 11 and 12)*.

The Refined Column

As Frank A. Bourne notes, "in the early examples [the column's] purpose had been purely structural, but later it was used to produce an important part of the effect of the building, and while still utilized for structural purposes, it was treated as a decorative unit, until finally the column becomes the very basis of Classic architectural design." (BOURNE / COOLIDGE 1925, 125). The changes of proportions and details of the Doric column best illustrate this refinement process. For example the echinus, the most distinctive of all the sections invented by the Greek, spreads out far beyond the column shaft and is more round in section in earlier examples, until in the Parthenon it is refined to an almost straight line with a steeper angle. The height of the columns gradually changed as well, becoming taller and more slender (BOURNE / COOLIDGE 1925, 129).
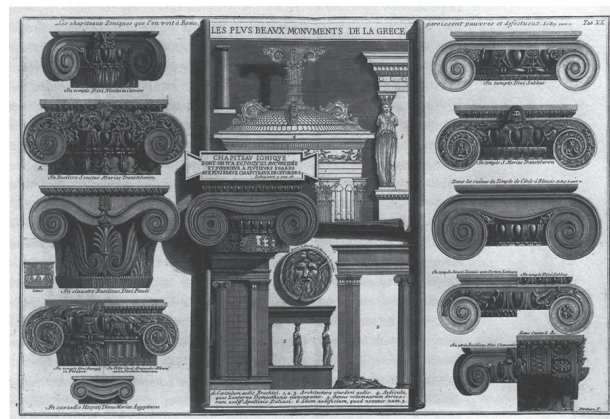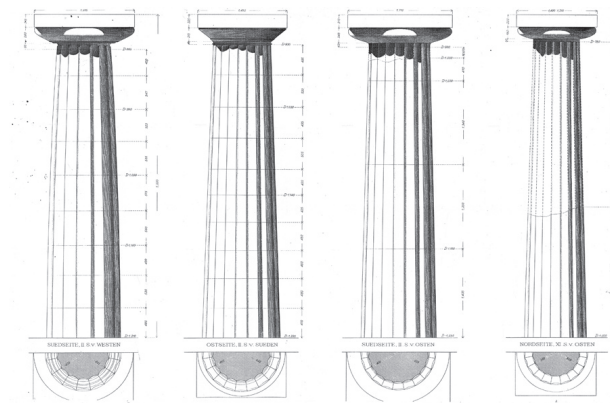

Fig. 13. Roman and Greek Ionic columns.

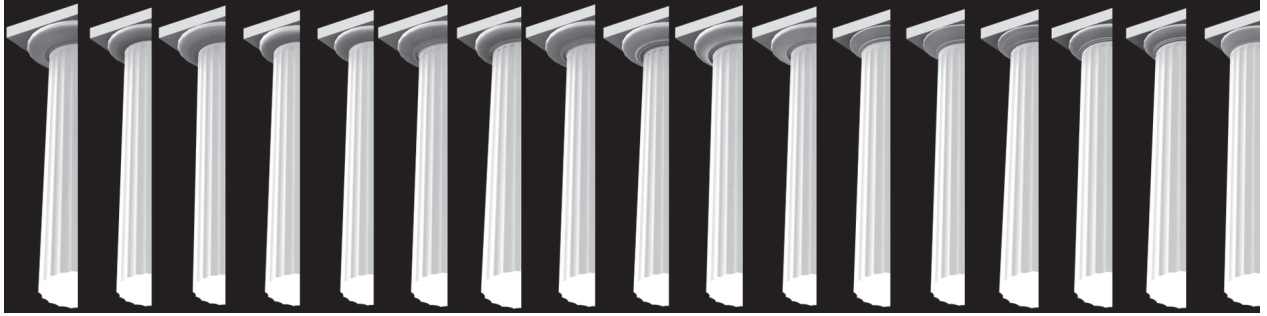Fig. 14. Four columns of the Temple of Hera.

Fig. 15. Columns of the Heraion.

Traditional Depiction Methods

In archaeological practice there are numerous precedents for cataloging, depicting and analyzing various instances of structures belonging to the same order or historical type. Piranesi, for example, placed a variety of Roman and Greek Ionic columns next to each other for comparison, including complete buildings among them as well, utilizing the concept of the analytique *(Fig. 13)*. This method shows their relationships arranged in space, however, with the aid of the digital medium, we are able to see these arranged throughout time as well.

Columns of the Heraion

In the Temple of Hera at Olympia, built around 600 BC, the wooden columns and other parts of the building were gradually replaced by stone equivalents. There were six columns standing on both ends, and sixteen on the sides, each having different proportions, varying almost 30 centimeters in diameter, and one bearing sixteen flutes instead of twenty (BROWN / LAWRENCE 1996, 141). The variety of these columns is also illustrated in archaeological sources (CURTIUS 1876–81), one being referred to when creating their digital model *(Fig. 14)*. The model of the Heraion contains 18 reconstructed columns, almost all of them having different proportions. From left to right, they are compared to each other according to their echini, the one having the lowest angle on the left and the highest on the right *(Fig. 15)*.

Columns of Six Temples

Columns of different temples built over centuries can also be compared to each other. Here those of six landmark buildings are portrayed from left to right: the Temple of Hera, Olympia (600 BC); the Temple of Hera, Paestum (550 BC); the Temple of Zeus,

Fig. 16. Comparison of six different columns.
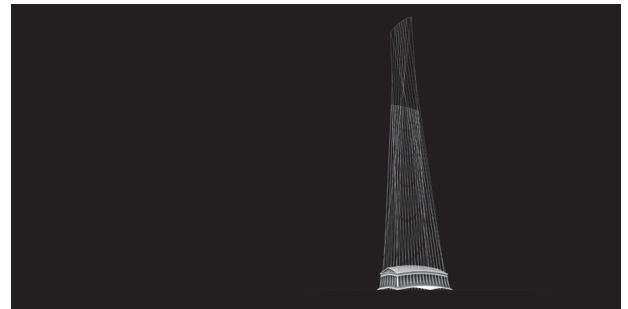

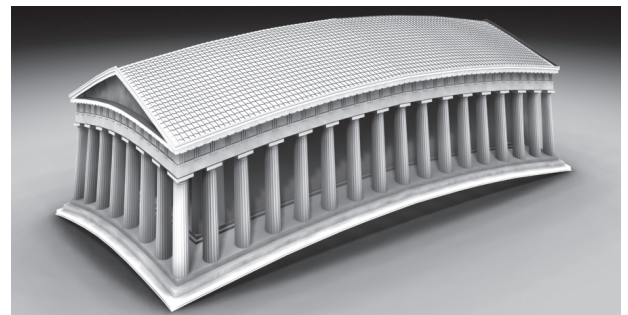Fig. 17. Details of the columns.

Fig. 18. A distorted Parthenon.

Fig. 19. The inclination of the columns.

Fig. 20. Gradually distorting the Parthenon – the actual distortion would correspond to the second frame.

Olympia (456 BC); the Parthenon, Athens (5th century BC); the Propylaea, Athens (432 BC) and the Temple of Zeus, Nemea (330 BC). The models clearly show how the proportions have changed over time: from less than 4 to 5½ diameters in height *(Figs. 16 and 17)*.

Optical Refinements

Besides the apparent details, subtle optical effects were applied on the temples. In the Parthenon, considered one of the best examples of architecture of all time, the columns around the building stand on a slight angle. They follow two sets of ruled surfaces between the base and two lines about two and five kilometers above them, making the columns at the corners incline the most (KORRS 1999, 79–104). These refinements are best illustrated with great exaggeration, as seen in the model *(Figs. 18, 19 and 20)*.

Conclusion

With the aid of the digital medium, this paper demonstrated an innovative approach to visualizing ancient Greek architecture. These buildings of the long past were revived as three-dimensional virtual models, with emphasis laid on historical accuracy, detail and proportion. Furthermore, taking advantage of spatiality, the accompanying images revealed subtle curvatures within the Parthenon and also changes in column proportions throughout time from the Temple of Hera at Olympia to the Temple of Zeus at Nemea.

Another aim of this study was to articulate the continuity between traditional and contemporary representation techniques. It applied well-established historical precedents in the digital medium,

for example the analytique and the analytic ruin. Methods invented and used by architects, archaeologists and historians, such as Piranesi, Viollet-Le-Duc, Choisy and examples from works at the École des Beaux-Arts were utilized. By showing more than just the finalized, complete building, these approaches add another dimension to digital imagery and reconstruction practices.

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J. WILTON-ELY / G. B. PIRANESI, Paestum & Soane (London 2002).

Illustration Credits

Fig. 1. Erechtheum on the Acropolis. Restoration of the Caryatids by Emmanuel Brune (1836–1886).

Fig. 2. Temple of Hercules at Cori. Rendering by Victor Blavette.

Figs. 3–4. Author.

Fig. 5. G. B. Piranesi, Le Antichità Romane (1756).

Figs. 6–7. See Choisy 1899, 367.

Figs. 8–10. E. E. Viollet-Le-Duc, Discourses on architecture (Boston 1875).

Figs. 11–12. Author.

Fig. 13. G. B. Piranesi, Le Antichità Romane (1756).

Fig. 14. See Curtius 1876–81, Plate 25.

Figs. 15–20. Author.