

# International Symposium on the Conservation of Monuments in the Mediterranean Basin

(2024)

Proceedings of the 11th MONUBASIN (2024)



Scientific integration of 2D documentation sources for the digital representation of architectural monuments: its contribution to cultural heritage management.

Zoe I. Kanetaki, Eleni I. Kanetaki

doi: [10.12681/monubasin.8332](https://doi.org/10.12681/monubasin.8332)

Copyright © 2025, International Symposium on the Conservation of Monuments in the Mediterranean Basin



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/).

## To cite this article:

Kanetaki, Z. I., & Kanetaki, E. I. (2024). Scientific integration of 2D documentation sources for the digital representation of architectural monuments: its contribution to cultural heritage management. *International Symposium on the Conservation of Monuments in the Mediterranean Basin*, 263–269. <https://doi.org/10.12681/monubasin.8332>

# **Scientific integration of 2D documentation sources for the digital representation of architectural monuments: its contribution to cultural heritage management.**

**Zoe I. Kanetaki**, University of West Attica, *Dep. of Mechanical Engineering*, Athens 12241, Greece, [zoekanet@uniwa.gr](mailto:zoekanet@uniwa.gr)

**Eleni I. Kanetaki**, University of West Attica, *Dep. of Conservation of Antiquities & Works of Art*, Athens 12243, Greece, [elkanet@uniwa.gr](mailto:elkanet@uniwa.gr)

**Abstract.** The elaboration of 2D documentation sources, including all relevant historical, architectural, archaeological as well as artistic (textual and iconographical) data, are usually collected and evaluated, while an architect-engineer/conservator is conducting a restoration and rehabilitation project. In addition, all other relevant documentation may be used in a digital application, where 2D drawings and plans can be applied, for the virtual representation of heritage monuments, existing or non-existing ones (lost), either partially damaged or even having undergone severe deformations during the passage of time by nature or by man-made actions. The offered documentation and representation techniques vary, and of course, as digital technology develops, the related evolutionary steps can offer an important contribution to the faithful restitution of architectural monuments. Yet, what happens in other cases, where the architectural monuments and the complex of historic buildings, or the archaeological sites do not survive up to our times? The submitted paper will try to highlight relevant applied techniques as used in recent cultural heritage projects by means of their comparative analysis and presentation.

**Keywords:** 2D Documentation, Digital representation, Cultural Heritage Management.

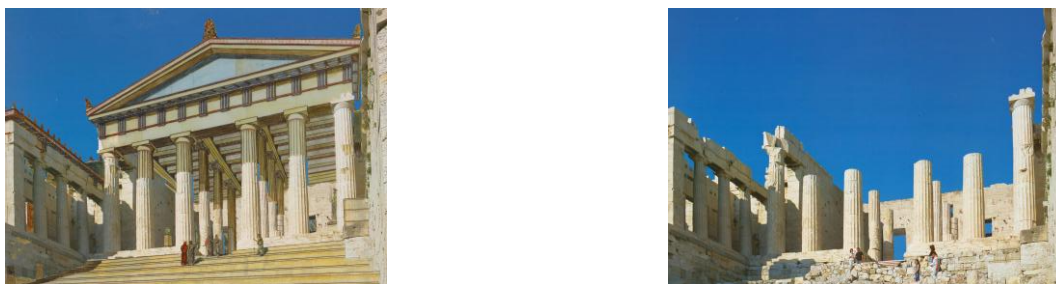
## **1 Scientific architectural documentation through 2D sources.**

### **1.1 Contribution of 2D documentation data for the representation of architectural monuments: case study of ancient buildings.**

The architectural structural measured survey & the documentation of an architectural monument require a thorough knowledge of a building's construction, materials, as well as the state of its condition. Therefore, the process that takes place is usually the result of the interdisciplinary collaboration between specialists from various fields: architect engineers with specialized studies in Conservation, civil engineers, and topographers, while in many cases the contribution of archaeologists is quite helpful for the historical background and former use of a monument.

2D documentation sources include, therefore, all relevant historical, architectural, archaeological as well as artistic (textual and iconographical) data: their evaluation allows us to proceed to a structural reconstruction and representation of the monument, while this research is most important for the restoration and rehabilitation project. More specifically, in cases when a digital application of the building's reconstruction is elaborated, the conducted survey plans of 2D drawings for the virtual representation provide the basis of the project.

A similar procedure of architectural survey, a study of the monument's structure and materials is here applied, which assisted later in its restoration.



**Fig. 1.** Propylaea, Acropolis: elaboration of the monument's architectural survey and its graphic representation (G. Antoniou, 2008, *Ancient Greece. The Monuments then and now*, p. 12).

The monument has been architecturally surveyed and studied [1], as its restoration project was included in the major restoration and consolidation works to be carried out on the Acropolis hill by the Acropolis Restoration Service (YSMA). The conducted 2D drawings have been most useful, as in this case, the combination of the photographic material and formerly collected records were combined with free hand reconstruction and representation of all the missing parts of the monument.

The paper will focus on relevant applied techniques in cultural heritage projects by means of similar case studies, aiming at their representation and cultural management: the here selected ones are chosen due to the difficulties encountered.

## **2 The architectural representation of a monument.**

### **2.1 Creating a digital representation (digitization) for recording and documenting an architectural monument: a case study of 18<sup>th</sup> c. buildings.**

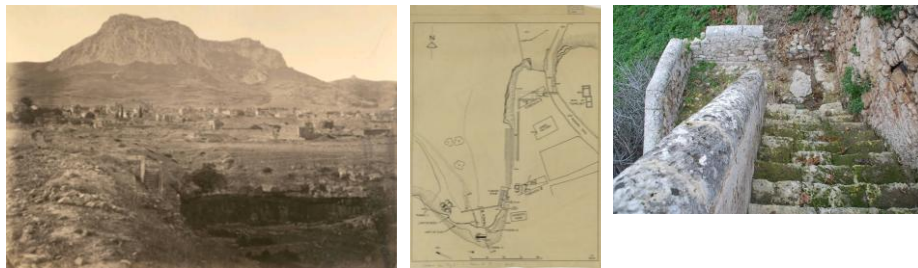
The application of various survey and documentation techniques –according to the technological knowhow, as well as to the overall budget of a project, may provide a faithful reconstruction of a monument: the use of architectural and archaeological Photogrammetry is one of these techniques, already applied in the previous decades; while 3D laser scanning gathers high quality records of the building's current state and document it by collecting millions of data points and its digital measurements from a project location, as technology is advancing rapidly; the recent use of digital twins, as applied in the simulation of a heritage site, uses modern technology and its tools enabling us to work on the accurate digital representation and digitization of cultural artifacts, architectural monuments, archaeological sites, and many other purposes, as an interaction between actual physical objects-the buildings, and their representation-their virtual image, can be produced; the insertion of augmented reality is also a newly applied option, as digital cultural content can be overlaid onto the physical entity of an architectural monument, (as well as of any physical artifact, sculpture, or archaeological find), creating a personal experience for the visitor.

The use of the above-mentioned techniques can be mostly applied in cases of existing buildings of importance and objects. Yet, there are many other cases where the architectural monument and the complex of historic buildings, or the archaeological sites do/did not survive up to our times, may even be found partially damaged or having undergone severe deformations during the passage of time by nature or by man-made actions. Since there can be no 2D documentation sources collected to be elaborated and scientifically integrated, the role of the restorer is mainly focused on the parallel study of other existing important data in order to represent the lost object.

### **2.2 The documentation of an Ottoman period architectural complex of monuments: the case study of Ottoman Corinth and its settlement.**

The following case study will present relevant issues about Ottoman Corinth [3]: the urban expansion of the site and its monuments were recently thoroughly studied (2014-15). The Research Programme *COPIS: Corinth in the Ottoman Period through Interdisciplinary Study*, elaborated for the Department of History, Archaeology & Social Anthropology at the University of Thessaly (Volos), Greece, has produced new scientific research about the whole area of Ancient Corinth; Dr. Eleni Kanetaki conducted the architectural and historical study, while Dr. Seyyed Taghi Shariat-Panahi provided all historical data about the Ottoman manuscripts and their transcription.

During the course of 18<sup>th</sup> c., the saray of the powerful Ottoman commander Kiamil Bey was constructed at the north end of the main road along a promontory at the lower terrace of Corinth, constituting another suburb, the Bey mahalla. The Saray (palace) of the Ottoman commander formed the political and administrative centre of the town. It was set at a well-selected location, overlooking the wide-spread gardens with fruit trees, the running water from the fountain of the so-called “*Baths of Aphrodite*”, as well as the plain. Kiamil (Kâmil), the wealthy Ottoman Bey, who had governed the region and owned vast properties in the region and elsewhere in the Peloponnese, had well-chosen these northern promontories of Corinth for his seraglio: a remarkable complex built in a large enclosure with harems, baths, kiosks and gardens, exhibiting its oriental feature. Although it doesn’t survive till today, the remaining parts of a damaged hammam/bath have been traced, as well as the monumental stone stairway at the site «*Loutra Aphrodite (Λουτρά Αφροδίτης, Baths of Venus)*», which must have led to the prominent palace). Its structure was documented in many 18<sup>th</sup> c. engravings; among others, William Gell and Carl Haller von Hallerstein have depicted the monumental complex, which was also well described in the memoirs of European travellers who had had the luck of visiting it. Yet the elaboration of previously collected material, former topographical survey plans<sup>1</sup> by John Travlos -the Greek architect, architectural historian & archaeologist and the American School of Classical Studies- in the 1960’s, as well as old photographs and engravings, along with in situ architectural survey drawings conducted by dr. E. Kanetaki, during 2014-15, provided important data for this remaining architectural feature (see Fig. 2).



**Fig. 2.** Kiamil Bey Palace site: old photo (1869) by Granges, Paul Baron & archival survey plans by ASCSA- J. Travlos, with in situ conducted architectural surveys (E. Kanetaki, 2015).

### 2.3 The documentation of an architectural complex of monuments dated in the Ottoman period: the case study of 18<sup>th</sup> and 19<sup>th</sup> c. buildings.

The urban layout form of Ancient Corinth settlement and the urban transformations of its grid, during the Ottoman times, were both studied as part of the Research Programme *COPIS: Corinth in the Ottoman Period through Interdisciplinary Study* with the help of various technological equipment and data.

At the beginning of 19<sup>th</sup> c. after the Liberation from the Ottoman Rule, the New Greek Governor Ioannis Kapodistrias commissioned the French military officer, geographer-engineer & cartographer Jean-Pierre-Eugène-Félicien Peytier (1793-1863)<sup>2</sup>, member of the French Military Expedition in Morea, to draw the plan for the new city of Ancient Corinth. Peytier worked on the topographical survey map of Corinth (“*Plan de Corinthe*”/Λεγε φινισσαντ λ’ηβερ δε 1829-1829, scale 1:2000, Dépôt de la Guerre) depicting the area in detail, as the urban fabric is drawn with great accuracy (in red ink and red watercolour). He also proposed a new street plan (in yellow watercolour). The topographical survey map records the names of three neighbourhoods, the Küçük mahalla, the Hadji (Hacı) Mustafa mahalla and the Kalamata mahalla, along with the ruins of Kiamil Bey’s palace with a tower and two baths; three ruined mosques (the market mosque was in use as a barrack and a gaol); churches; three public fountains; the temple of Apollo and other ancient and Byzantine ruins. These neighbourhoods-distinct suburbs, were separated one from the other by fields of corn, as well as by gardens with lemon trees, cypresses and other fruit trees, and they were related to the main street connecting the mahallas. Small other secondary streets formed a net of irregular patterns, leading to private properties.

During the architectural and urban study of the area by Dr. E. Kanetaki for COPIS, quite interesting results were produced, as a comparative juxtaposition of Peytier’s topographic plan was made in accordance to the modern urban fabric of Ancient Corinth village, using data from Google Earth.

<sup>1</sup><http://ascsa.net/id/corinth/drawing/223%20001?q=classification%3A%22%7C%20Corinthia%20%7C%20Ancient%20Corinth%22%20bath&t=&v=list&sort=&s=5>.

<sup>2</sup> <http://eng.travelogues.gr/travelogue.php?view=68&creator=952071&tag=8843>.

The map (now in the Depot de la Guerre/Cartes/4.10.C.65.1.0057, 86x58,50 pencil drawing, ink, Paris, 1829) [6], was depicting important monuments of the area. A part of Peytier's plan was enlarged, and the "cut image" was overlapped on the extracted data from Google Earth, showing the modern urban fabric, producing stunning results<sup>3</sup>: the urban form of the village has remained quite unaltered, as the lines depicting small streets and plots of land were traced till our modern times (see Fig. 3).



**Fig. 3.** The central area of Ancient Corinth -Du Moncel, (Mosqué turque a Corinth, 1843). The topographical map by P. Peytier (1829) & the relevant overlapping of the under-study area with its important Ottoman monuments, using images extracted from Google Earth.

During the centuries that followed its establishment since antiquity, the urban fabric contour of remained the same due to the fact that its reproduction through the ages was merely a result of superimposed layers of buildings one over the other. Peytier's plan records the same layout division of the former Ottoman city, with small in extent neighbourhoods interspersed with fields and the centrally located market area (bazaar) with its dense urban fabric. The new city plan was mainly a proposal to straighten and broaden the streets, preserving and widening the existing streets of the city.

### 3 Contribution of various representation techniques for cultural heritage management by use of modern technology.

#### 3.1 The documentation of two 19<sup>th</sup> c. urban mansions & their representation.

The twin Patsiadou urban mansions in southeastern Piraeus were constructed by the German architect Ernst Ziller (1837-1923) during 1894-95 in the (yet) undeveloped area of Alexandras square, Kastella facing the port of Zea, commissioned by Panayiotis Patsiadis, a wheat merchant of the time. They were in close proximity to the 7 mansions ("Villen-Colonie Ziller") constructed by E. Ziller as summer houses-villas, which he rented to wealthy Athenians of 19<sup>th</sup> c. -a site documented in the topographic map of Athens "Karten von Attika" by E. Curtius & J.A. Kaupert (1862-1897), a monumental cartographic work of high quality and accuracy displaying in 32 map sheets a huge amount of information, not only of archaeological heritage mapping but also of the landscape at the last quarter of the 19<sup>th</sup> c.

The smart technology digital application "*Piraeus Archwalks: virtual cultural itineraries for the historical city centre of Piraeus and its Neoclassical urban nucleus*" was elaborated by Aegean Solutions Company for Aik. Laskaridi Foundation, Piraeus, Greece, during 2022-23 and is currently offered for free [6]. Among the suggested itineraries, a research study of the Patsiadou mansions was presented in order to digitally represent and reconstruct the two buildings by combining all related documentation found: the original architectural plans, drawn in scale 1:50 by E. Ziller (1870), kept at the Ziller Archive of the National Gallery-Alexandros Soutsos Museum (Athens), numerous old archival photographs and other historical data, contributing to the digital renderings and the morphological restoration of the buildings' complex. Only one of the two houses exists, as the missing Patsiadou mansion was demolished in 1973 and a five-storey apartment building was constructed in its place. The 2<sup>nd</sup> mansion, although declared a listed building by the Hellenic Ministry of Culture, shows signs of decay [6].

During the elaboration of the digital renderings, it became necessary to conduct a comparative study of other Ziller's works in Athens since many architectural structural elements were not well defined -the

<sup>3</sup> I would therefore like to thank Georgios Antoniou, architect engineer NTUA, MA in Buildings' Conservation, IoAAS UoYork, for his help in the elaboration of the Google Earth data.

watercolour plans in scale 1:50 were rather vague. Other projects were studied, such as the Ziller-Loverdou private house (Mavromichali 6 str., Athens), “Mpageion hotel” (Omonoia square, Athens city centre), as well as Sp. Metaxa mansion (Vas. Georgiou str., Piraeus), since similar architectural features found in these buildings were copied and applied. As an outcome, it seems that many of the drawn architectural morphological & decorative elements were either not realized or had been modified in later interventions (see Fig. 4).



**Fig. 4.** The twin Patsiadou mansions (1870), hand-drawn side façade design by Ernst Ziller -plan kept at the Ziller Archive at the National Gallery-A. Soutsos Museum, Athens and architectural elements deriving from other buildings designed by the architect, used for their detailed digital representation: i.e., a drawing for a Karyatide at Loverdou mansion façade in Athens, his home in late 19<sup>th</sup> c. & details from Sp. Metaxa mansion in Piraeus, depicting 4 male figures.

The results of this study have been incorporated in the digital application offering valuable architectural and historical documentation for 120 neoclassical and eclectic buildings of the 19<sup>th</sup> c. in Piraeus, as well as the archaeological sites of the city found along the proposed cultural routes. Dr. E. Kanetaki conducted the scientific architectural research. Digital renderings were produced by I. Plakotaris as a collaborator of Aegean Solutions Company.

### 3.2 The documentation of the 19<sup>th</sup> c. Piraeus Clock and its representation.

The Old Town Hall (“Roi”) of Piraeus, also known as the Town House of the city, was initially constructed in 1869-73 after the plans of city engineer Gerasimos Metaxas, housing later the Stock Exchange. The Clock that became the landmark of the area was erected in 1873. According to a few archival sources, the building functioned only for one year for these financial transactions. Later on, it hosted the city’s Commercial Club for many years, and on its premises, balls and charity events were thrown. Also, since 1874, the Mavrokordatos Library was housed there. Since 1880, the ground floor was used as a coffee shop, while later, on its floors the municipal services of the city were installed. The building was demolished in 1968 by order of Mayor A. Skylitsis.

The digital application *Piraeus Archwalks: virtual cultural itineraries for the historical city centre of Piraeus and its Neoclassical urban nucleus*, included this listed building into the digital representations of Piraeus characteristic monuments [5], [6].

Yet there have been former attempts to digitally document and represent the Piraeus Clock, as almost 30 years ago (1994-6), the School of Rural & Surveying Engineering Department at the NTUAthens [2] had worked on the first attempt to digitally represent and reconstruct it: they used old postcards and amateur photographs, which they elaborated into photogrammetric data processing for the digital rectification and the reconstruction of the 3d model. Simple digital photogrammetric techniques were applied, resulting in the following representation as shown below<sup>4</sup>.

Similar techniques were used for the digital app *Piraeus Archwalks* (see Fig. 5).

<sup>4</sup> I therefore would like to thank Prof. Charalambos Ioannidis, Professor at the Lab of Photogrammetry, School of Rural & Surveying Engineering, NTUA, for providing me the relevant information about their former project and Congress publication.

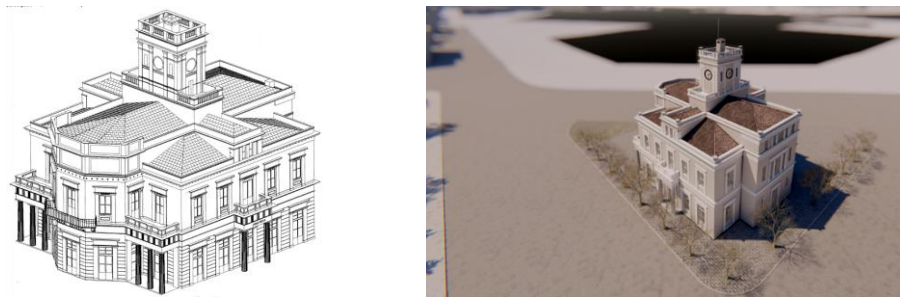


Fig. 5. 3D model of Piraeus clock (Ioannidis, Badekas, Potsiou 1994-6 & Plakotaris, 2023).

The Clock of Piraeus has been digitally represented, and a 3D model of its structural shell was produced, as no construction plans were found nor architectural survey plans were done due to its demolition in 1968. Although technology progresses quite quickly, the result of the 1996 photogrammetric representation model [2] appears most accurate and corresponds to old photos of the time, which were also used in the recent (2022-23) digital representation.

#### 4 The contribution of various documentation techniques for the cultural heritage management of monuments.

The paper has tried to highlight a few applied techniques used in recent cultural heritage projects by means of multiple documentation data: existing monuments, metrically measured with a thorough documentation of their structure & state of conservation, as well as demolished buildings, with no survey plan to assist their reconstruction and representation. The management of cultural heritage requires novel approaches [5], for promoting & preserving architectural heritage and cultural artifacts.

#### Acknowledgements

The publication/registration fees were covered by the University of West Attica.

#### References

1. Antoniou, G., in N. Drosou Panaiotou “Ancient Greece. The Monuments then and now (Αρχαία Ελλάδα. Τα μνημεία τότε και τώρα)”, An Illustrated Guide with Architectural Reconstructions of the Ancient Monuments by G. Antoniou, Papadimas publishing house, Athens 2008.
2. Ioannidis, C., Potsiou, C., Badekas, J.: 3D Detailed Reconstruction of a Demolished Building by Using Old Photographs. In: XVIII Congress of International Society for Photogrammetry and Remote Sensing, on Proceedings, pp. 16–21, ISPRS Archives Volume XXXI, Part B5, Vienna (1996).
3. Kanetaki, E., Lolos, I., Sanders, G., Seyyed Taghi Shariat-Panahi, M., Varalis I.: Ottoman Corinthia. 2nd edn. University of Thessaly editions, Volos (2015).
4. Kanetaki, E., Plakotaris, I.: Representing the twin mansions Patsiadou in Piraeus: reconstruction and digital recovery-morphological restoration of the whole complex through the original plans of Ernst Ziller (Αναπαριστώντας τις δίδυμες κατοικίες Πατσιάδου στον Πειραιά: ανασύσταση και ψηφιακή απεικόνιση – μορφολογική αποκατάσταση του συνόλου μέσα από τα σχέδια του Ernst Ziller). In: 6<sup>th</sup> Panhellenic Conference on Restoration, org. Society of Research and Scientific Restoration of Monuments (ETEPAM) on Proceedings, in digital form, no page numbers. ETEPAM editions, Thessaloniki (2023).
5. Kanetaki, E.: A Contribution to the Heritage digitization of Piraeus historic city in Greece. In: Opportunities for Heritage Fostering Innovation, Conservation, and Sustainability Conference, GUTECH, under print, Muscat, Oman (2024).
6. Piraeus Archwalk: a digital application for the Architecture in the city of Piraeus, Aikaterini Laskaridi Cultural Foundation, (Piraeus), Greece (2023), last accessed 2024/06/02.
7. The French Expedition to the Morea (Work of the French Scientific Expedition to the Morea 1829-38): Melissa Publishing House, Athens (2012).