A DETAILED GEOMETRIC DOCUMENTATION OF THE ATHENS ACADEMY PUBLIC MEETING HALL

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ABSTRACT:

During the 19th century, while Athens was rebuilding itself, trying to become a European Capital, a lot of prominent Architects offered their services towards this end. Theophilus Hansen from Denmark, among other wonderful buildings, designed and constructed the Athens Academy in 1859. It is one of the three most prominent buildings in the centre of Athens, the Athens University and the National Library. Hansen was inspired by the Greek classical architecture of the 5th century BC.
The Public Meeting Hall of this building is an oblong-shaped room, the length of which is lined on both sides amphitheatrically with three rows of marble seats. Its ceiling is decorated with panels of great beauty. All the Hall's sides are sheathed to a certain height with marble revetments, on which the names of the Academy's Donors and Benefactors are recorded. The Hall's painted decoration extends from the western side all the way to the southern side, a distance of more than 50 meters. The pictorial ensemble decorating the Academy's Public Meeting Hall was effected over the two-year period from 1878 to 1880; it is the result of Theophil Hansen's inspired design, realised by the Austrian artist Christian Griepenkerl (1839-1916). The latter was a student of the great artist Karl Rahl and a Professor at the Academy of Fine Arts of Vienna.
Special photogrammetric and geodetic methodologies developed, implemented and tested in previous occasions during the long collaboration of the Laboratories of General Geodesy and of Photogrammetry, of National Technical University of Athens, were improved and applied for the detailed geometric documentation of the Main Hall. According to the technical specifications the compilation of a network of horizontal and vertical sections, in vector and raster (orthophotos) format, was required. Although there was no demand for 3D representation and nearly all important details, i.e. the paintings, were on flat surfaces, special tests for using laser scanning, either independently or in combination with the photogrammetric procedures, especially for the documentation of complicated objects and sculptures that exist in the internal area of the Main Hall.
In this paper the various methodologies employed for the fieldwork and the data collection are briefly described, the difficulties encountered are reported and their solutions are also described, while details are given for the peculiarities of the data processing. The geodetic and photogrammetric outputs are assessed for their accuracy and completeness and their integration to the final products is described in detail. The final drawings are presented and evaluated.

1. INTRODUCTION

1.1 Historical Background

The impressive building of the Athens Academy constitutes one of the three parts in an "architectural trilogy" consisting of the National Library, the Athens University and the Academy. The latter was designed in 1859, by the Danish architect Theophil Hansen (1813-1891), the younger brother of the University's architect, Christian Hansen. It is considered Hansen's most important work and is regarded by experts as the most beautiful neoclassical building worldwide (Figure 1). The architect's source of inspiration was the classical architecture of 5th century B.C. Athens, as portrayed in the monuments of the Acropolis. In particular Hansen emulated the aspects of the Ionian rhythm that dominate the Building of the Academy, from the Erechtheion monument. The epitome of all ancient Greek tradition can be found in the Building's sculptural and pictorial decoration; simultaneously the character of that era's Hellenism and its visions for the future are also expressed.

Figure 1. The Ahens Academy

In 1856, Simon Sinas made a substantial donation to the Greek state for the erection of a building where the future Academy would be accommodated. Concurrently he appointed the architect Theophil Hansen to design the plans for that building. Over the two-year period between 1859 and 1861, the construction of the Academy's Building progressed rapidly. Meanwhile, at the start of 1861, the execution of Hansen's architectural designs was assigned to his student, the architect Ernst Ziller (1837-1923). In 1868 Hansen assigned the sculptural decoration of the Academy's Building to the sculptor Leonidas Drosis (1843-1884), who had studied in Munich and Dresden and was Professor at the "Scholeion Technon", as the NTUA was then known. In 1871, he assigned the building's painted decoration to the Austrian artist Christian Griepenkerl (1839-1916), a student of the great painter Karl Rahl (1812-1865), who went on to become Professor at the Academy of Fine Arts in Vienna in 1874. At a total cost of 2.843.319 gold drachmas the project's completion occurred in 1885, thirty-one years after the announcement of Sinas' donation in 1856, and twenty-eight years since its cornerstone was laid in 1859 (http://www.academyofathens.gr).

1.2 Description of the Building

1.2.1 The Exterior

The Building consists of a central part with two wings, and displays characteristics of the Ionian rhythm. Its central part is designed along the lines of an amphiprostyle temple. The Building of the Athens Academy has a rich sculptural decoration, which was executed over the course of a decade, from the 1870s up to the mid 1880s. The main sculptural decoration is found on the pediment of the entrance to the Academy. This masterly work of art is a multiple-figured composition, based on a design by the great Austrian painter Karl Rahl. It is the work of Drosis and elicited the first prize at the exhibition of Vienna in 1872.

On either side of the building's prostyle there are two 4m high statues: On the right that of Apollo the guitar-player and on the left that of Athina the defender. Both are mounted on pillars in the Ionian rhythm (the overall height is 23.25 m.), and are works by Drosis. In the forecourt to the entrance of the Academy, there are two more statues, both seated; on the left that of Plato and on the right that of Socrates. The models for these statues were executed by Drosis and they were then sculpted out of marble from the mountain of Penteli by the Italian sculptor Piccarelli. On the same site there are also marble lamp-posts. Their bases are decorated on all four sides with heads of Zeus in relief, and on the four corners with owls sculpted in the round base.

1.2.2 The Interior

A visitor to the Academy entering through the propylaea, finds himself in a long corridor connecting the Building's two wings. The corridor is dominated on the right by the marble statue of the Benefactor of the Academy Simon Sinas, a work by Leonidas Drosis, originally placed at the end of the Academy's Public Meeting Hall. At the end of the corridor, to the right, the Eastern Hall is located, the ceiling of which is decorated with panels of exquisite artistry. This Hall houses libraries and collections of art deriving from donations, and is where scientific conferences and exhibitions take place. On the left of the corridor are the offices of the academic authorities along with the offices of the Academy's services, and these are also decorated with paintings and other works of art.

Off the corridor internal staircases lead to the building's first floor, where the Academy's Library is housed and where the Network Operation Centre is located.

The Academy of Athens' Public Meeting Hall (Figure 2) is an oblong-shaped room, the length of which is lined on both sides amphitheatrically with three rows of marble seats. Its ceiling is decorated with panels of great beauty. All the Hall's sides are sheathed to a certain height with marble revetments, on which the names of the Academy's Donors and Benefactors are recorded. The Hall's painted decoration extends from the western side all the way to the southern side, a distance of more than 50 meters. The two thresholds, entering the Hall and exiting into the Academy's garden, are flanked on both sides by pillars in the Ionian rhythm. At the four corners of the Hall there are three marble busts and a bronze relief depicting a clock, all of which are donations made by the Benefactors of the Academy. The Hall's decor is completed by four sculpted marble lamp-holders.

Figure 2. The Public Meeting Hall

The pictorial ensemble decorating the Academy's Public Meeting Hall is the result of Theophil Hansen's inspired design, realised by the Austrian artist Christian Griepenkerl (1839-1916). The latter was a student of the great artist Karl Rahl and a Professor at the Academy of Fine Arts of Vienna. This pictorial ensemble begins thematically with Aeschylos' Promitheas Desmotis, but also relies on the international tradition of references to Promitheas. It extends down the western side of the Academy's Great Hall, in eight representations depicting successive phases in the myth of Promitheas.

Figure 3. The interior decoration of the Public Meeting Hall

The pictorial decoration begins with the representation referring to Themida's prophecy concerning the theft of Fire and the ensuing suffering of her son Promitheas. This representation is succeeded by those showing the theft of Fire with the aid of the Goddess Athina, the creation of Man by Promitheas and his attempts to give him life with Fire, the clash of the Titans, and

Promitheas as torchbearer offering Man the gift of Fire. The representations go on to illustrate Promitheas captive on the Caucasus, the release of Promitheas by Hercules, and the reception of Promitheas by the Gods on Mount Olympos.

1.3 Specifications

Athens Academy approached the Laboratories of General Geodesy and of Photogrammetry of the School of Rural & Surveying Engineering of NTUA for a detailed geometric documentation of the Public meeting Hall, probably the most important part of this magnificent building. Complying to the established practice, as there are no international standards for such tasks (Ioannides et al. 2005) it was decided to produce six drawings: A floor plan, a ceiling plan and two twofold crossections, one along the hall's axis and one perpendicular to it. The crossections ought to include the roof for obvious comleteness. All drawings at a scale of 1:50, i.e. with an accuracy of 12.5mm. It was also decided to combine these conventional drawings with imagery products, i.e. orthophotomosaics, where the wonderful decoration presented special interest. Moreover, special care would be given to certain objects, which were of great artistic value and of high detail and which would be drawn at a larger scale, i.e. 1:20 or 1:10.

2. DATA ACQUISITION

2.1 Methodology and Instrumentation

In order to produce the above specified products, accurate and detailed measurements and high density metric photography should be carried out (Georgopoulos et al 2004). The use of a terrestrial laser scanner was an alternative solution, which was rejected because:

- there was a need for 2D products and not for a 3D object model
- the objects in the interior of the Public meeting Hall, where the use of laser scanner was considered to be appropriate (such as sculptures or complicated architectural decorations), are located either at the corners and very close to the walls or at very high places and on the ceiling where the use of laser scanner is very difficult.
- the available laser scanner, a time-of-flight HDS2500, is not appropriate for the high accuracy demands (better than 5mm) that are necessary for the detailed decorative characteristics.

Despite all that, special tests with the acquisition of dense laser scanning data (3mm point cloud) were made for the documentation of a lamp-holder, either independently or in combination with the photogrammetric procedures (use of the point clouds as DSM for the production of orthoimages).

Finally, for technical and financial reasons, it was decided to employ classical methodologies, i.e. surveying and photogrammetric techniques for the data acquisition phase. Hence, a Leica TCR307 reflectorless total station was used for the geodetic measurements and a Zeiss (Jena) UMK 1318/100 terrestrial metric camera, modified to accommodate roll film, for the photography. Additionally a calibrated Canon Mark II 8MB digital SLR camera was used for imaging inaccessible objects.

The combination of accurate survey measurements and metric photography would enable the establishment of a rigid and accurate framework, within which the various details would be added either in the form of line drawings, or as imagery products, where necessary. For the processing of the images acquired digital techniques were employed. The colour metric photography were scanned at a resolution of 1,200 dpi with a Z/I PS1 photogrammetric scanner, in order to use the photogrammetric software for producing the orthophoto-mosaics.

2.2 Fieldwork

The main workload of the field work was executed during weekends or evening hours in order not to disrupt the works of the Academy and the usage of the Hall. A team of five surveyors were concerned with the purely geodetic measurements inside and outside the building.

In parallel a second team of four photogrammetrists and a specialised photographer carried out the photogrammetric fieldwork, which consisted of establishing the necessary control points, premarked with little targets where possible, and planning and executing the photography (Figure 4a). For imaging necessary details which were very high within the hall, a home made bipod was employed in order to hoist the digital camera and enable mono or stereo imaging as necessary (Figure 4b). The success -or not- of each photograph could easily be controlled with the help of the digital camera. For ensuring the ideal lighting conditions two large format electronic flash soft boxes were used for all interior images.

(a) (b)

Figure 4. (a) Photo acquisition with the metric camera,
(b) preparation for mounting the digital camera to the bipod

The fieldwork of this project is an example of harmonious interdisciplinary co-operation, as the team, except the surveyors, the photogrammetrists and the photographer, was completed by an experienced architect, whose task was to point out the acquisition of the necessary data and direct the measurements to certain details, which would by needed later during the processing phase. Despite that a few short completion visits were required later. The main fieldwork lasted for a few days of full time work.

3. DATA PROCESSING

3.1 Multidisciplinary Approach

The interdisciplinary co-operation was continued and increased during the data processing phase until the extraction of all final products. There is a long tradition of close cooperation between the Laboratories of General Geodesy and of Photogrammetry of NTUA with specialised architects, archaeologists and scientists of other fields during the architectural and archaeological surveys. It has been proved in practice that this cooperation is necessary both at the stage of data collection and field measurement and at the following stage of information extraction and the composition output products. The higher the demands for detailed restitution of complicated object characteristics the more urgent the need for interdisciplinary co-operation becomes, and the better output products are provided (Ioannidis et al 1997; Balodimos et al 2003).

At the present application, besides the pure topographic and photogrammetric data processing, such as network solution, photogrammetric orientations and DSMs extraction, all other procedures were made with simultaneous contribution of surveyors, photogrammetrists and architects. During the work but also at the final evaluation of the results, it was proved that this cooperation was not a luxury but a real necessity.

3.2 Data Editing

Best results in complicated architectural applications can be achieved only by using a combination of topographic and photogrammetric techniques (Georgopoulos, Ioannidis 2005). At Academy’s Hall recording, the photogrammetric techniques were made at the Digital Photogrammetric Workstation SSK of Z/I Imaging and they included:

- stereorestitutions of the surfaces of the perimetric walls, the sloped ceiling (which is composed by decorative wooden and glass parts), the marble decorations at the edges of the seats in the internal and of the roofs at the external parts, the four sculptures at the corners of the Hall and the four sculpted lamp-holders.
- orthophoto production for the parts of the facades of the walls that are covered by pictorial decoration.

Detailed editing of the photogrammetric drawings and radiometric processing of the orthoimages followed. Special efforts were made for the correct projection and representation of the decoration elements of the internal ceiling at the four crossections. It was proved that the most appropriate solution was the production of the 3D digital model of the ceiling and next the creation of intersections at particular planes. The images acquired by the bipod helped significantly the representation of the details, such as at the joints of the decorative elements at the upper part of the walls.

3.3 Final Products

According to the technical specifications, the products were:

- Vector drawings of the sculptures and of the various elements of the architectural decoration, at scales 1:20 and 1:10 (according to their size). Figures 5 and 6 show by example such drawings, so that the density of information included will be understood. Figure 5 shows the drawing of the back façade of a marble decoration of the ceiling and part of the right digital image of the stereopair from which the restitution was made. Figure 6 shows a lamp-holder; at the upper part is the plan of its façade and at the lower part it is the upper side of its base. The location of the premarked control points is also shown.

- Six (6) drawings at a scale of 1:50: floor plan, ceiling plan and crossections; they consist a combined representation of vector and raster information. Figures 7 and 8 show two of the crossections.

Figure 5. Image and drawing (not at scale) of the facade of a marble complexion at the top of the roof

Figure 6. Photos and drawings (not at scale) of a façade and the horizontal intersection of the lamp-holder

Figure 7. The crossection to the south, along the hall's axis

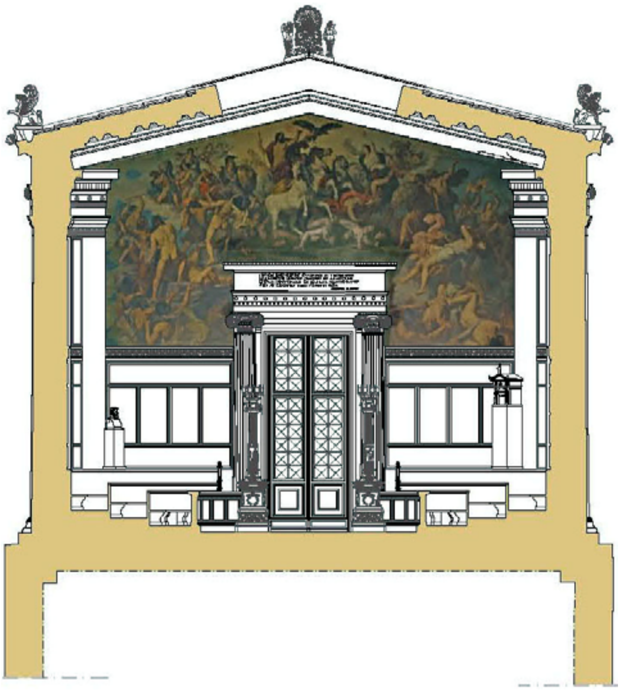

Figure 8. The crossection to the east, perpendicular to the hall's axis

4. CONCLUDING REMARKS

The integrated and detailed geometric documentation of the cultural heritage monuments of great national and international importance, is doubtless necessary. It demands both the multidiscipline cooperation at all stages of the project and the combined use of technical recording methods. The compilation of drawings at scales 1:20 or larger and consequently the achievement of relevant accuracies means the use of expensive instrumentation for data collection and the execution of careful and detailed measurements.

Experience derived from this project shows that for the detailed recording of complex objects it is preferable to create their 3D stereo models, even if the specifications demand only the production of 2D drawings. Consequently, it should not be considered an extreme the introduction of 3D models and photorealistic products at the demands of the technical specifications for the documentation of such important monuments. On the contrary, it increases the level of available information to the users and it creates impressive representation and visualization results.

The derived products from the application of such techniques at the Athens Academy's Hall are considered to be of significant value, regarding the accuracy, the completeness and the quality of visualisation. So, the extension of the project for the geometric documentation of the whole building is most likely; a time consuming task of special difficulty due to the size and complexity of its elements, especially at the outside surfaces of the building. It is sure that there will be high demand for advanced methods of 3D recording, using the acquired experience and know-how but also the terrestrial laser scanner and the sophisticated modelling techniques.

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