

THE PREPARATION OF THE ARCHITECTURAL SURVEYINGS WITH PHOTOGRAMMETRIC MEASUREMENT TECHNICS OF EMIR ISHAK BEY TOMB AND 3D MODELLING

MuratYakar¹,FerruhYıldız¹, Azim Metin¹, Fırat Uray, İlker Kahya¹, Volkan Çiçek¹, Fatmagül Batuk²,Gönül Toz³,Omer Mutluoglu¹,Engin Kocaman¹,HacıMurat Yılmaz

Selcuk University, Engineering Faculty, Geomatic Engineering, Selçuklu/Konya,TURKEY
yakar@selcuk.edu.tr,yildiz@selcuk.edu.tr,trazm-mtn@hotmail.com,kocaman@selcuk.edu.tr

²Yildiz Technic University, Engineering Faculty, Geomatic Engineering,Istanbul, TURKEY
batuk@yildiz.edu.tr

³Istanbul Technic University, Engineering Faculty, Geomatic Engineering,Istanbul, TURKEY
gtoz@itu.edu.tr

Keywords : Survey, Photogrammetry, Konya, PhotoModeler, 3D Modeling

Abstract:

Cultural heritage forms the most valuable assets inherited from our ancestors. Transferring these unique artifacts to future generations is the dream of every conscious man. However, as these items of cultural heritage are damaged by natural or human impacts, it is necessary to document them in order to preserve them for future generations. Documentation enables not only the creation of a planning base for the reconstruction of the piece if it gets damaged, but also examination, analysis and identifying changes in the artifact. It has come to be necessary to use modern technologies in documentation studies generally conducted by architectures at the present time. In classical architectural documentation, in other words, in preparation of relief studies and restitution projects, frequently simple measurement tools and techniques are used and, as outputs, the drawings of pieces are presented totally in the form of paper prints.

In this statement, process flow will be presented according to topographic photogrammetry in a relief study, administrative and legal dimensions of the studies will be discussed and the duties and authorities of geodesy- photogrammetry engineers in this type of projects will be examined. Photogrammetric methods are used to take make measurements of Emir Ishak Bey Tomb. The tomb is located in the north of Serafettin Mosque and in Şems Public Garden, which was previously a cemetery.

Based on the foundation date of 1505M, the historian İ. Hakkı Konyalı reported that this tomb, which is one of the first Ottoman monuments in Konya, was made for Emir İshak and the epigraphic gravestone contained in it was destroyed and was transformed to a storehouse in time. In addition, he notes that Hatice Hatun Tomb, which is located in the quad of Şems Mosque, and is thought to be the wife of İshak Bey, was destroyed in 1944. There is no information about Emir İshak Bey in accessible sources. Above the door of the tomb, İshak Pasha is written instead of Emir İshan Bey, and this is another issue to be researched.

Photogrammetric control points are measured with a total station to prepare the relief project forming the basis of the restoration project, and to form the 3 dimensional point data. Photographs of the tomb are taken using a calibrated, high-resolution camera. These images and the control point data are used to construct a detailed 3-dimensional model of the tomb in PhotoModeler software. Also, 2D measurements are made by converting the model in horizontal areas to a vertical model and relieve drawings are formed by preparing plans, sections and views.

1. INTRODUCTION

Every region and city of modern Turkey contains artifacts of significant historical and cultural value. The Anatolian region has been home to various civilizations. According to the records of The Ministry of Culture and Tourism, in 2002, there were 66,251 cultural and natural assets in Turkey registered in the single structure scale, 7,186 of which were located in the Central Anatolian Region (KTB, 2005). Documentation, preservation and, when necessary, restoration of these artifacts are of great importance in handing them down to future generations.

Georgopoulos and Ioannidis (2004) defined the documentation of cultural heritage as follows: "The action of acquiring, processing, presenting and recording the necessary data for the determination of the position and the actual existing form, shape and size of a monument in three dimensional space at a particular given moment in time". There are many methods of documentation of historical and cultural heritage (Böhler and Heinz, 1999). These methods are indispensable tools for the preservation of cultural heritages. These are methods conducted by hand, topographic method, photogrammetric method and scanning method (Bohler and Heinz 1999, Scherer 2002).

Digital terrestrial photogrammetry is a beneficial and effective method for documenting these artifacts. This method, in addition to the other usage areas, is used in determining historical and archeological assets; producing scaled drawings of buildings; preparation and execution of urban preservation plans; determination of cracks, abnormalities and deformation; for damage assessment; pre and post restoration attitude controls; and for digitization of a building through determined coordinates (Yılmaz et al., 2000; Sienz et al., 2000).

The present study reports on the documentation of Emir İshak Pasha Tomb using photogrammetric methods.

2. THE LOCATION OF EMİR İSHAK PASHA TOMB

Emir İshak Pasha Tomb is located in Karatay, which is one of the central districts of Konya (Figure 1). The tomb is located in the north of Şerafettin Mosque and in Şems Public Garden, which was previously a cemetery. Şerafettin Mosque was first constructed by Sheik Şerafettin in 12th century, repaired by Karamanoğlu İbrahim Bey the Second in 1444, and was demolished and reconstructed in 1636 by Çavuşoğlu Mehmet Bey. It was repaired with the help of people of Konya and benefactors in 1881. The mosque is located in the east of Alaaddin Hill, north of a government office, south of Mahkeme Public Bath, and at the end of an avenue opening to government offices from City Hall.



Figure 1. Emir İshak Pasha Tomb and its location

3. EMİR İSHAK PASHA TOMB

İ. Hakkı Konyalı, historian, writes based on the foundation dated 1505 M that this tomb, which is one of the first monuments of Ottomans in Konya, was made for Emir İshak, and epigraphic grave stone in it was destroyed and it was transformed to storehouse in time. In addition, he notes that Hatice Hatun Tomb, which is located in the quad of Şems Mosque and is thought to be the wife of İshak Bey, was destroyed in the year of 1944.

There is no knowledge about Emir İshak Bey in accessible sources. Above the door of the tomb, İshak Pasha is written instead of Emir İshan Bey, and this is another issue to research.

4. PHOTOGRAMMETRIC STUDIES

The photogrammetric documentation of historical and cultural heritages is conducted in two stages - field and desk studies. In field studies, the coordinate system of the object is described, the control points on the object are measured and images of the object are taken. The subsequent desk study involves camera calibration, the transfer of pictures to a computer system and drawing and assessment studies using photogrammetric software. The operations in this study are explained below:

4.1. Field Studies

A local traverse net mesh was established surrounding the tomb. The points were coordinated with a Topcon GPT 3007 geodesic measurement tool by providing the starting coordination to these traverse net established.

It is necessary to use control points with known coordinates (X,Y,Z) on the object, to balance the photographs of the object and to bring them to the location where they are pictured. Therefore, the sketch of the tomb was superimposed over the photographs by sketching the 95 control points on the pictures of the tomb such that there were three points in each picture



Figure 2. The restoration works on Tomb

After establishing the control points, coordination was given to the control points on Tomb with Topcom GPT 3007 geodesic measurement tool which can measure without reflector. The accuracy of the measurement tool used is $\pm(2 \text{ mm}+2 \text{ ppm})$. The accuracy of measurement was tested by coordinating the control points from two different traverses. Using control studies conducted in 17 points, quadratic mean error in control points was calculated as $m_x= 1.1 \text{ mm}$, $m_y= 1.0 \text{ mm}$ and $m_z= 0.9 \text{ mm}$.

Seventy pictures were taken from different positions with a SONY DSC-W50 digital camera with 6 Mp resolution [in accordance with](#) photogrammetric bases. During the assessment, the most appropriate pictures were used. After the field studies reached to field, it was completed in 2.5 hours with a peaceful work pace.

4.2 Office Studies

The assessment of the photographs of the object and acquisition of outputs were made via PhotoModeler photogrammetric software, which is a Windows- based Eos System. This software is used to make 3D modeling and metrical measurements of an object from digital images. The 3-dimensional model is composed of a set of spatial points, corners and/or curves. Textural data and sides or surfaces can be added to the basic framework model to create a realistic, solid model. Distance measurements and other metrical operations are made easily in this software. Three-dimensional models can be transferred in dxf (2D and 3D) or 3D studio, Wavefront OBJ, WRML (1 and 2), Raw and Microsoft DirectX formats.

The PhotoModeler software includes a calibration test mesh function that was used for camera calibration. Sixty-four photographs taken from different points of the object were transferred to the program. The photographs were opened individually and the 79 control points were added as reference coordinates. After

marking field and picture points, balancing operations were performed according to coordination values and any points that showed a large error were removed from the dataset. After balancing, the drawing of the tomb was done and details of the pictures drawn from different angles were drawn.

5. CONCLUSION

The preservation of historical and cultural heritage is an important issue for the history of humanity in our day. The protection and restoration of these necessitates documentation and creation of a digital cultural heritage archive.

Digital terrestrial photogrammetry is an efficient and productive method in documenting cultural heritage that allows drawings, frame and three-dimensional models of historical and cultural items to be produced rapidly and sensitively. Three-dimensional photomodels can be produced by adding textual data on the three-dimensional objects documented. The records produced through photogrammetric methods are enduring and permanent, and can therefore be used as reference data to determine subsequent deterioration in restoration works and objects.

Many items of historical and cultural heritage are at the risk of destruction in Turkey and around the world as a result of natural impacts and neglect. Documentation to assist in their preservation can be completed rapidly and economically with photogrammetric methods. This method uses only mathematical equations and photographs of the objects, thereby eliminating the measurement risk present in other methods. With all these features, photogrammetric method is a method that can be used in this kind of documentation and three-dimensional modeling studies.

6. REFERENCES

- [1] Akasheh, T., Shaer, M., Khrisat B., Naes, M., Sarayrah, R., 2005. Report presented to Prodomea, an EC funded project under INCO-Med program FP5, contract number (ICA 3 - CT - 2002 - 10021).
- [2] Al-kheder, S., Al-shawabkeh, Y., and Haala, N., 2009. Developing a documentation system for desert palaces in Jordan using 3D laser scanning and digital photogrammetry. *Journal of Archaeological Science*, 36(2), pp. 537-546.
- [3] Cabrelles, N., Galcerá, S., Navarro, S., Lerma, J.L., Akasheh, T., Haddad, N., 2009. Integration of 3D laser scanning, photogrammetry and thermography to record architectural monuments. Proc. of the 22nd International CIPA Symposium, pp. 6. Kyoto, Japan, 11-15 Oct. 2009.
- [4] Dorffner, L., Forkert, G., 1998. Generation and visualization of 3D photo-models using hybrid block adjustment with assumptions on the object shape. *ISPRS Journal of Photogrammetry & Remote Sensing*, 53(6), pp. 369-378.
- [5] Heipke, C., 1997. Automation of interior, relative, and absolute orientation. *ISPRS Journal of Photogrammetry and Remote Sensing*, 52, pp. 1-19.

[6]Helmut, M., 2008. Issues for image matching in structure from motion. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Beijing, China, Vol. 37, Part B3a, pp. 21-26.

[7]Lerma, J. L., Navarro, S., Cabrelles, M., Villaverde, V., 2010. Terrestrial laser scanning and close range photogrammetry for 3D archaeological documentation: the upper palaeolithic cave of Parpalló as a case study. *Journal of Archaeological Science*, 37(3), pp. 499-507.

[8]Navarro, S., Seguí, A. E., Portalés, C., Lerma, J. L., Akasheh, T., Haddad, N., 2009. Integration of TLS data and non-metric imagery to improve photo models and recording. A case study on Djin Block No. 9, Petra (Jordan). *IEEE Computer Society. Proceedings of the 15th International Conference on Virtual Systems and Multimedia VSMM 2009*, pp.: 58-63.. Vienna, Austria, September 9-12.

[9]Schouteden, J., M. Pollefeys, M. Vergauwen, L. Van Gool, 2001. Image-based 3D acquisition tool for architectural conservation. *Proceedings of the XVIII International Symposium of CIPA, ISPRS International Archive of Photogrammetry, Remote Sensing and Spatial Information Sciences* Vol. 34, Part 5/C7, pp. 301-305. monuments. Proc. of the 22nd International CIPA Symposium, pp. 6. Kyoto, Japan, 11-15 Oct. 2009.

[10]M.Cabrelles, A.E. segui, S.Navarro, S.Galcera, C.Portales, J. Jerna 2010 3D Photorealistic Modelling Of Stone Monuments By Dense Image Matching *International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XXXVIII, Part 5 Commission V Symposium, Newcastle upon Tyne, UK. 2010