

# **Documentation of Afyonkarahisar Mevlevi Lodge by Digital Close Range Photogrammetry**

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**Key words:** Digital Close Range Photogrammetry, Cultural Heritage, Mevlevi Lodge

## **SUMMARY**

Conservation of the historical monuments and transferred for next generation is important task for human being. Historical buildings have often been destroyed or damaged by natural events and human activities. Photogrammetry such as many application of field is very important in architecture, documentation and conservation of historical monuments. Architectural photogrammetry is oldest branch of photogrammetry and is used in 3D models of building with high accuracy. Recently, progress in 3D modeling method is developed in using field of 3D models. Three-dimensional digital models are needed in many applications such as inspection, navigation, object identification, visualization and animation. It becomes a very important and fundamental step for cultural heritage digital archiving

In this study, Afyonkarahisar mevlevi lodge is documented with photogrammetry. And a rollove of the mosque is prepared. Afyonkarahisar mevlevi lodge is the most important center of mevlevi order that comes later head lodge at Konya. Afyonkarahisar mevlevi lodge was made in 1710. However, this building was destroyed and rebuilding in 1844 by Sultan Abdulmejid. Afyonkarahisar mevlevi lodge as a result of a big fire, repaired again in 1905 by the Sultan Abdülhamit II. Afyonkarahisar mevlevi lodge are used today as a mosque.

# Documentation of Afyonkarahisar Mevlevi Lodge by Digital Close Range Photogrammetry

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## 1. INTRODUCTION

Conservation of cultural heritage and transferring them to future generations is one of important tasks of mankind. Most of historical buildings destroyed or damaged by natural phenomena and human activities. Documentation of cultural heritage must be fulfilled against these threats. Photogrammetry, as in many fields is very important in architecture documentation and conservation of historical monuments. Architectural Photogrammetry is one of the oldest branches in photogrammetry and used in the production 3D models of building with high geometric accuracy. Together with advances in methods of 3D modelling in time, usage of 3D models has also become widespread. Camera calibration and image orientation processes are required to obtain reliable 3D information.

The Venice Charter for the Conservation and Restoration of Monuments and Sites is a treaty that gives an international framework for the preservation and restoration of ancient buildings. Article 2 of Venice charter; the conservation and restoration of monuments must have recourse to all the sciences and techniques which can contribute to the study and safeguarding of the architectural heritage (URL-1).

Several techniques are used in the documentation of cultural heritage. (Böhler and Heinz 1999). Such techniques are important tools for conservation of cultural heritage. The techniques used for the documentation of cultural heritage are traditional manual methods, topographic methods, photogrammetric methods, and scanning methods (Böhler and Heinz 1999, Scherer 2002).

Afyonkarahisar mevlevi lodge is the most important centre of mevlevi order that comes later head lodge at Konya. Afyonkarahisar mevlevi lodge was made in 1710. However, this building was destroyed and rebuilding in 1844 by Sultan Abdulmejid. Afyonkarahisar mevlevi lodge as a result of a big fire, repaired again in 1905 by the Sultan Abdülhamit II. Afyonkarahisar mevlevi lodge are used today as a mosque. (URL-2).This study documented Afyonkarahisar Mevlevi Lodge using the digital close range photogrammetry. Façade plans producing by the means of digital close range photogrammetry.

## **2. DIGITAL CLOSE RANGE PHOTOGRAMMETRY**

Photogrammetry is a technique for obtaining information about the position, size and shape of an object by measuring images of it instead of by measuring it directly. The term “close range photogrammetry” is used to describe the technique when the extent of the object to be measured is less than about 100 meters and cameras are positioned close to it (Atkinson, 1996).

Digital Close range photogrammetry measures objects directly from photographs or digital images captured with a camera at close range. Digital cameras, visualization and automated image measuring software, and desktop computing power, have made digital close range photogrammetry a useful, practical tool for construction (Yakar, et al, 2008,).

The measurements of historical monument environment and control points coordinates are essential work. Especially, measurements of control points coordinates have vital importance for stereo model restitution. In general, signalised points and natural points are used as control point in close range photogrammetry.(Yastikli and Alkis,2003)

## **3. CASE STUDY (AFYONKARAHISAR MEVLEVI LODGE)**

Afyonkarahisar is in west part of Anatolia and also has the most important historical monuments. Afyonkarahisar is located on junction of east-west and north-south connected roads and rail. One of the most important historical places that are cultural heritages is Afyonkarahisar Mevlevi lodge (Figure 1).



**Figure 1** Location of Afyonkarahisar and Mevlevi Lodge

A local network covering Afyonkarahisar Mevlevi lodge is created to measure of ground control points. 139 Ground control point selected on surface of Mevlevi lodge was measured. Ground control points were measured by using reflectorless total station South NTS-352R (Figure 2). Measurement accuracy is  $\pm(2 \text{ mm}+2 \text{ ppm})$  for South NTS-352R total station. The images of Afyonkarahisar mevlevi lodge are taken with Samsung S730 digital camera. Samsung S730 is a non-metric camera (Figure 3). Samsung S730 digital camera is calibrated by using Photomodeler software. Calculated camera parameters of the Samsung S730 digital camera;

$$\begin{aligned}
 f &= 5.5587 \text{ mm} \quad x_0 = 2.6135 \text{ mm} \quad y_0 = 1.9137 \text{ mm} \\
 \mathbf{K}_1 &= 5.476e-003, \quad \mathbf{K}_2 = -1.867e-004 \\
 \mathbf{P}_1 &= -1.867e-004, \quad \mathbf{P}_2 = -6.718e-004
 \end{aligned}$$

Where;

$f$ : focal length

$x_0, y_0$ : coordinates of principal point

$K_1, K_2, P_1, P_2$ : distortion parameters

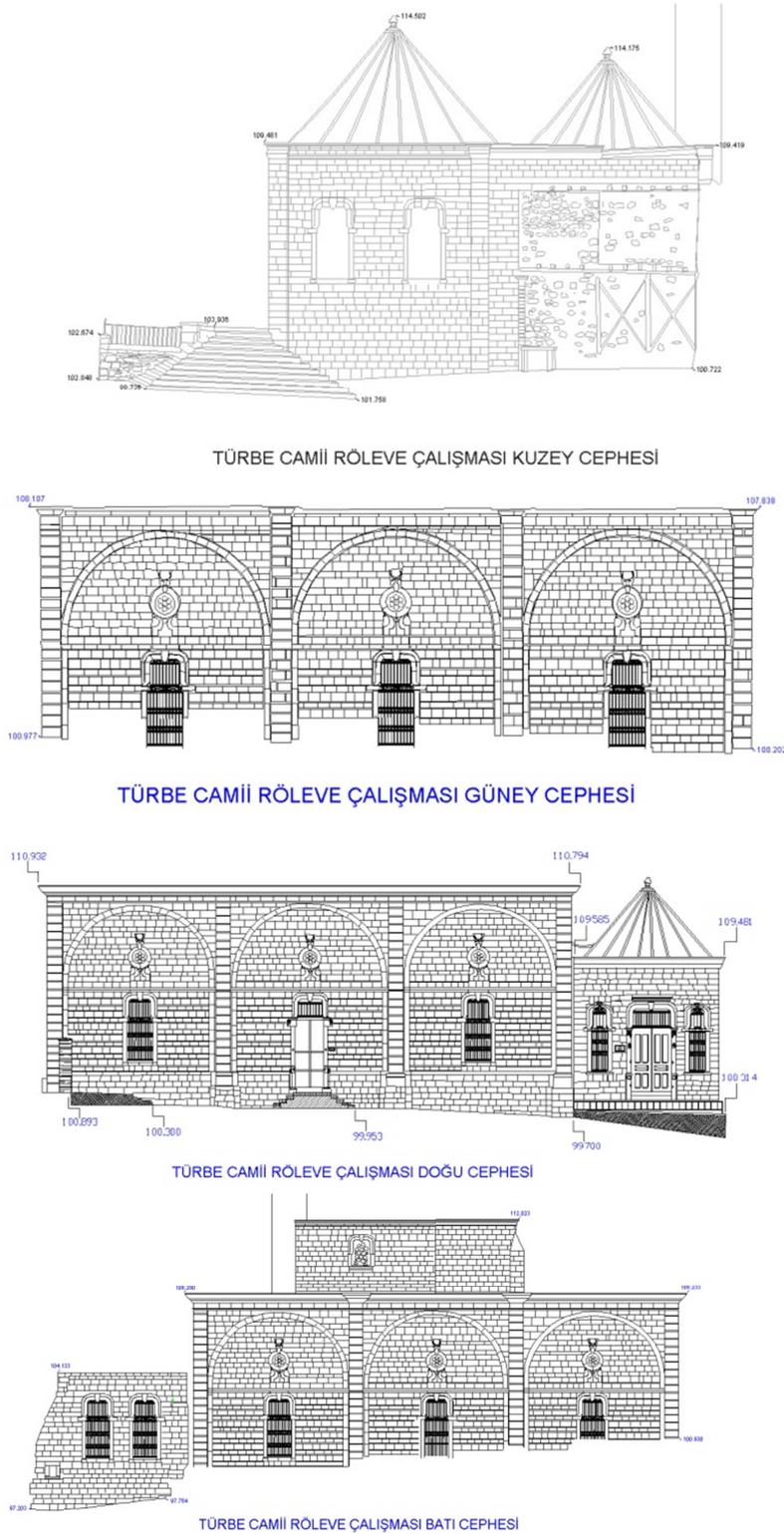


**Figure 2** South NTS-352R



**Figure 3** Samsung S730

Restitutions and drawings of images of objects are realized by Photomodeler Software. PhotoModeler Software is developed by Eos Systems Inc. PhotoModeler photogrammetry software provides image-based modeling, for accurate measurement and 3D models in engineering, architecture, etc. Façade plan of Afyonkarahisar mevlevi lodge was carried out by the means of digital photogrammetric method (Figure 4).



**Figure 4** Façade drawings of Afyonkarahisar mevlevi lodge

#### 4. CONCLUSIONS

Most of the cultural heritages are lost or destroyed in the time. Conservation of cultural heritage and transferring them to future generations is important task. Close range photogrammetry is used for documentation of cultural heritage for many years. Close-range photogrammetry is very fast, powerful and reliable for documentation of cultural heritage. Digital close range photogrammetry is an important technique for documentation of cultural heritage.

In this study, documentation of Afyonkarahisar Mevlevi lodge is presented. Façade drawings of Afyonkarahisar Mevlevi lodge were successfully obtained by the means of digital photogrammetry. Photomodeler software was used in this study.

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URL-2, [http://www.sultandivanimuzesi.com/foto\\_galeri.php](http://www.sultandivanimuzesi.com/foto_galeri.php)

## **BIOGRAPHICAL NOTES**

Assistant Professor Dr. Murat UYSAL, was born in 1974. He graduated in 1995 as Dipl.-Ing. in Geodesy and Photogrammetry Engineering at Selcuk University. He obtained Msc degree in 1999 at Kocatepe University and obtained his doctorate degree in 2009 in Photogrammetry and Remote Sensing at Yildiz Technical University. He is since 2009 Assistant Professor of Engineering Faculty, Kocatepe University.

Tamer BAYBURA was born in 1966 at Sulz am Neckar/Germany. In 1991 he graduated from The University of Selcuk; Department of Engineering and Architecture Faculty as a Geodesy and Photogrammetry Engineer. He finished his M.Sc. in 1994 at Graduate School of Natural and Applied Sciences that is within The University of Selcuk in Konya/Turkey. His PhD completed in 2001 at Graduate School of Natural and Applied Sciences that is within The Technical University of Istanbul. He worked as an research assistant in The University of Selcuk; Department of Engineering and Architecture Faculty between 1992 and 2000. Continuing from 2000, and current to date, he is working as Assistant Professor in Afyon Kocatepe University; Department of Engineering Faculty. Baybura has many studies on the area like highway and railway alignment geometry and deformation measurements and analysis.

Ibrahim YILMAZ was born in 1970 at Afyonkarahisar, Turkey. In 1992 he graduated from The University of Selcuk; Department of Engineering and Architecture Faculty as a Geodesy and Photogrammetry Engineer. He finished his MSc in 1996 and completed his PhD in 2002 at Graduate School of Natural and Applied Sciences that is within The University of Selcuk. He worked as Research Assistant in The University of Selcuk; Department of Engineering and Architecture Faculty between 1992 and 2002. Continuing from 2002, and current to date, he is working as Assistant Professor in Afyon Kocatepe University; Department of Engineering Faculty. Yilmaz has many studies on the area like cartography, historical maps, georeferencing and colour science.

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