Photogrammetric Measurement for the Kizil Kilise (Red Church)

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SUMMARY

Aksaray, history of which dating back to Christ 8.th thousand, coming up to now preserving all its civilizations cultural existence, with natural beauty and with being trade centre, has not lost importance from any period. Aksaray as being a door to Capadoccia, with cultural existence also with natural richness has been offering visitors different cultural heritages. Aksaray is in Middle part of Anatolia and also one of the most important centres of historical Silk Road. Aksaray is located on junction of east-west and north-south connected roads. One of the most important historical places that are cultural heritages is KIZIL KILISE (RED CURCH) As it was built by using red cut stones, it is called “red church”. It is in Sivrihisar village, in Güzelyurt. The central dome of the building rests on four pillars. The frescoes were damaged. There are the portraits of the apostles and the paintings of biblical scenes in frescoes. The church dates from V. and VI. Centuries. This church has been involved in the list of hundred historical arts of the world, which are at the most risky in 2008 years, by World Monument Fund. In this study, red church has been evaluated by close range photogrammetry methods.

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1. INTRODUCTION

Harvey (1997) defines cultural heritage as the entire set of goods, real property, tangible and intangible assets, privately owned property, property pertaining to public and semi-public institutions, church property and national assets which have great historic, artistic, scientific and cultural value and which, therefore, are worthy of preservation by nations and peoples, serving as permanent features of people's identity down through the generations.

Monuments are undeniable documents of world history. Their thorough study is an obligation of our era to mankind's past and future. Surveying and photogrammetric methods are based on direct measurements of lengths and angles, either on the monument or on images thereof. They determine three-dimensional point coordinates in a common reference system and ensure uniform and specified accuracy. Moreover they provide adaptability, flexibility, speed, security and efficiency. All in all they present undisputed financial merits, in the sense that they are the only methods, which may surely meet any requirements with the least possible total cost and the biggest total profit (Georgopoulos and Ioannidis 2004; Fraser 1996).

There are several documentation techniques available (Böhler and Heinz 1999). Such techniques are indispensable tools for the conservation of heritage monuments. The conservation has to be carried out prior to the buildings destruction, transformation or undertaking of any intervention. These methods are envisaged to provide the building with a co-ordinates system (X,Y,Z) (Sienz et al., 2000). The methods and equipment commonly used for the documentation and surveying of buildings are (Scherer 2002): traditional manual methods, topographic methods, photogrammetric methods, and scanning methods.

Computers methods and close-range photogrammetry are proposed as a preventive method which allows to detect measure and track the temporal evolution of some structural problems detected, and also to assess the degree of conservation of the materials employed. Monuments and monumental groups are constructions of great value because they represent the history and memory of the communities where they are placed (Arias et al., 2005).

This church has been involved in the list of hundred historical arts of the world, which are at the most risky in 2008 years, by World Monument Fund (URL-1). In this study, red church has been evaluated by close range photogrammetry methods.

2. CLOSE RANGE PHOTOGRAMMETRY

Photogrammetry technigues allow you to convert images of an object into a 3D model. Using a digital camera with known characteristic (lens focal length, imager size and number of pixels), you need a minimum of two pictures of an object. If you can indicate the same three

object points in the two images and you can indicate a known dimension you can determine other 3D points in the images.

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.
The short duration of field work measuring time is a remarkable feature of photogrammetry. Photogrammetric works are normally performed without any contact with the object. For further information see Kraus (1997) and (2000). The use of the methods has spread world-wide due to factors such as the support granted by some international organizations (UNESCO, ICOMOS and CIPA). Three main types of architectural photogrammetric surveying are to be considered (Carbonell 1989): very accurate photogrammetric surveys, accurate photogrammetric surveys, and fast and simple photogrammetric surveys. The final result will be registered in the ‘‘construction photogrammetric files’’. These files are of great importance because they hold all the information needed to make any measurement or plan when required, either immediately subsequent to the surveying or later.

3. CASE STUDY (RED CHURCH)

Aksaray is in Middle part of Anatolia and also one of the most important centres of historical Silk Road. Aksaray is located on junction of east-west and north-south connected roads. One of the most important historical places that are cultural heritages is KIZIL KILISE (RED CURCH) (Figure 2). As it was built by using red cut stones, it is called “red church”. It is in Sivrihisar village, in Güzelyurt. The central dome of the building rests on four pillars. The frescoes were damaged. There are the portraits of the apostles and the paintings of biblical scenes in frescoes. The church dates from V. and VI. Centuries.

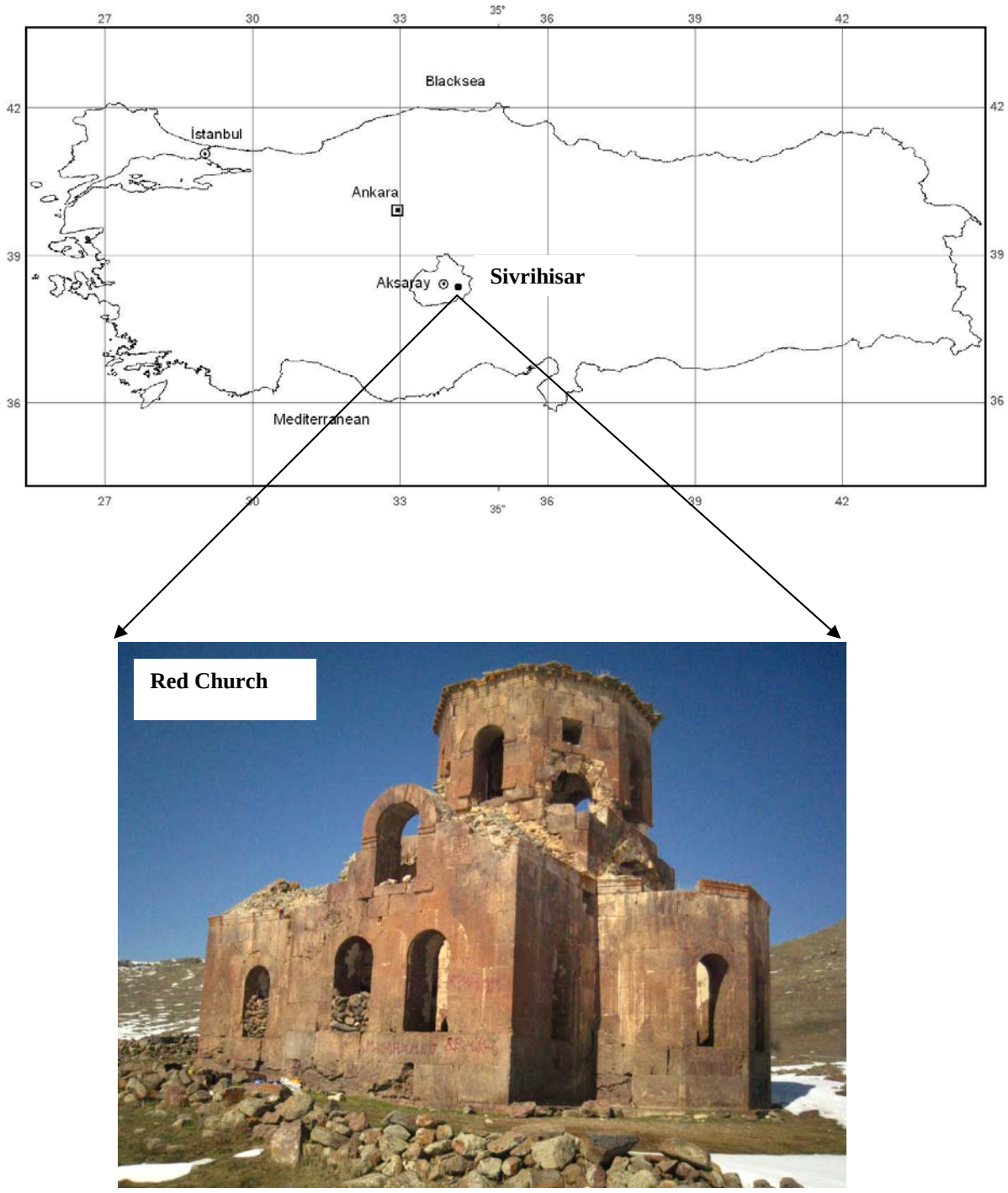

Figure 1 Location of Aksaray (Sivrihisar) and Red Church

3.1 Field Studies

Primarily, field studies should be completed at photogrammetric measurement studies. As is known, control points (target points) are essential because the image cannot be adjusted into its true position without accurate control points which surround the whole objects.

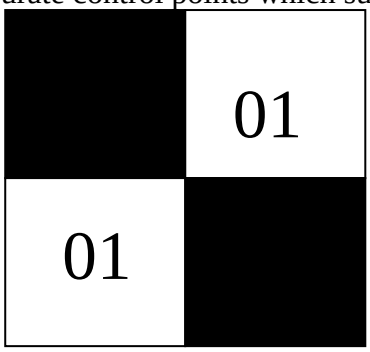

Figure 2 Mark Plate

For this purposes, 20*20cm2 paper number plates (target plates) which can be recognize on the photographs were prepared to use field studies (Figure 2)

To be able to make photogrammetric evaluation of Red Church traverse points have been established around the church and surveyed at local coordinate system. The geodetically measurement is very important to measure the control marks of the objects and connect all measurements together for 3D modeling. The precision of the all geometrical results is depended the precision of the geodetically measurement of the traverse points.

Target number plates were fixed conveniently distributed on the surface of the church and measured from traverse points by using reflectorless total station. The Topcon GPT-3007 Series are Pulse Laser Total Stations with a superior non-prism measurement capability. Making use of an updated optical system, the GPT-3007 Series incorporates special techniques to provide accurate, reliable and safe non-prism distance measurement over a range of up to 1200 meters. Measurement accuracy is ±(2 mm+2 ppm) for Topcon total station. After the adhering the target number plates on the surfaces of the church, photographs of the object were taken by CANON IXUS I7 ZOOM digital camera from different locations as stereoscopically.

The software provides complete functionality to carry out all surveying and stake out routines and calculations and to store all data in the instrument itself.

3.2 Photogrammetric Studies

In this study; PhotoModeler software was used. PhotoModeler is a windows based photogrammetry software developed by Eos System Inc. This software has been used to accurately model and measure a physical object from digital images. In PhotoModeler, a 3-D object model consists primarily of a set of spatial points, edges, and/or curves. Surfaces and

textures can later be conveniently added to the basic wire frame model to create a realistic solid model. Measurements of distances between two points, lines and points, points and surfaces, etc. can be made using the measurement tool. 3-D models can be exported in DXF format to AutoCAD , VRML format and other well-known formats.

To use of the digital cameras at photogrammetric evaluation procedures; calibration of camera should be completed. In this study, calibration process was completed with using photomodeler calibration module. A simple procedure is used in PhotoModeler to carry out a camera calibration by analyzing a grid of targets. A total of eight images are needed for calibration purposes. Processing of the eight photographs in PhotoModeler produces the following camera parameters: principal point coordinates (the intersection of the optical axis with the image sensor); principal distance (the distance from the center of the lens to the principal point); lens distortion characteristics (radial and tangential); and sensor format size (pixel size and number of pixels).Calculated camera parameters of the CANON IXUS I7 ZOOM digital camera;

f=6,3943mm xpp=2.7955mm ypp=2.1083mm

6 basic steps were needed to create the 3D-model out of the photographs.

1. Photo-Import, i.e. the photographs had to be scanned
2. Marking of object points: Every object point, which would build the 3D model, had to be marked in every photograph.
3. Identify and reference the identical marked object points.
4. Calculation of the camera positions and orientations. During the same procedure, also the 3D coordinates of every marked and referenced object point are calculated. The result is the basic 3D-model with estimates of errors for every point.
5. Adjustment ad Scaling the model: this is done by telling the program the real distance between two object points, which was measured during the recording procedure (in our case the measured target points were used).
6. Export of the data to other CAD packages to render the model, produce animations. dxf (2D ve 3D), 3D studio, Wavefront OBJ, WRML (1 ve 2), Raw ve Microsoft DirectX etc. (Photomodeler 5.0 Handbook, 2006; URL-2).

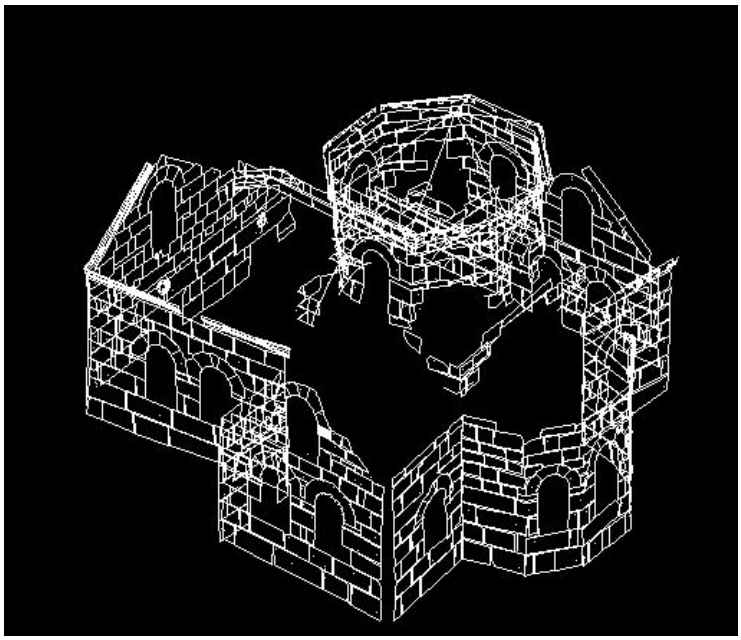

Figure 3 3D view of the Red Church

Photogrammetric evaluation procedures can be completed depending of the experience of the technicians and object details in one or a couple days. 3D autocad drawings of the Red Church are seen in Figure 3.

4. CONCLUSIONS

Historical and cultural heritages are one of the most important connections between old civilizations and today's modern societies. Conservations of cultural heritages and transfer to next generations are both personal and social duties.

As is in the whole world, Turkey also is very rich in terms of cultural heritages. Although this riches, sufficient sensitivity aren't being showed to these worthy. Determination of the present position of these cultural heritages, documentation, and restotaration are historical responsibility. As both personal and administrative; we have to hold these cultural heritages in a good condition. Most of the cultural heritages are about to destroyed due to lack of interest.

In recent years, photogrammetric methods are being used for documentation of human being' common cultural heritages. With this technique, documentation studies can be completed much more economically and at short time with respect to classical methods. Because, photogrammetry use only mathematical equations and photographs. There is no need extra technical employee. There is no contact with object directly. For this reason, it is reliable method.

In turkey as soon as possible, saving of the cultural heritages from the disappearing will be the most important study in the name of human being. Photogrammetric methods can be used for these projects

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