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3D Modelling of Kayseri Tekgöz Bridge

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ABSTRACT

Thousands of years of civilization and history as an activity, created by both people, and nature and is called Cultural Heritage studies today, is an important event for all humanity. Metric, written and visual documentation, It can be used as basic data protection in any study to identify cultural heritage and current situation and problems and to solve these problems. In addition, these works are transferred to future generations by documenting cultural heritage. Today, the close picture photogrammetry method is also frequently used in the documentation of cultural heritage. In this study, the survey study of Tekgöz Bridge, which is located 30 km northwest of Kayseri province, was done by the photogrammetric method. As a result, the three-dimensional model and drawings of the facade of the bridge were obtained. The study shows that the close picture photogrammetry method provides great convenience in the documentation studies of historical and cultural works. With the photogrammetry method, both field and office studies are completed in a short time. As a result of the study, it is concluded that the photogrammetry method can be effective in documenting historical artifacts.

1. INTRODUCTION

Turkey has hosted many civilizations throughout history. It is possible to encounter historical and cultural monuments in almost every area. Kayseri is one of the richest cities in terms of historical and cultural monuments. According to the Ministry of Culture and Tourism's 2009 data, the number of cultural heritage registered in Kayseri is 829. In this geography with many cultures, a social bridge is established between the past and the future (Şasi and Yakar, 2018). In order to strengthen this social bond, the whole world should support the protection of cultural heritage.

Georgopoulos and Ionnidis (2004). In their study; He defined the documentation of historical and cultural works as a study that aims to investigate the historical or cultural structure of the current work, to determine and re-evaluate the changes in its shape and size. Historical and cultural heritage must be carefully documented to transfer historical artifacts to future generations and preserve human history. Various methods are used to document historical artifacts.

These methods generally classical documentation method, topographic methods, photogrammetric methods and scanning methods (Böhler & Heinz, 1999; Scherer, 2002).

The method of documenting by writing is one of the oldest methods used to document historical and cultural heritage studies. Three-dimensional documentation methods have started to be used with the advances in technology. As the three-dimensional documentation method, the most effective method is the laser scanning method. However, the laser scanning method is not preferred in terms of cost. The photogrammetry method, which shows superior performance in terms of cost and speed, is often preferred in three-dimensional documentation. The photogrammetry method is subdivided like many methods. In this study, close picture photogrammetry, a photogrammetry method, was used.

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The close picture photogrammetry method is used in many areas such as determining the structure of historical and archaeological sites, making scale drawings of the building facade, preparing and applying the urban conservation plan, crack and deterioration analysis, damage, and deformation assessment, architectural restoration. (Yilmaz et al, 2000; Sienz et al, 2000).

In this study, the historical Tekgöz Bridge documentation study in Kayseri province was carried out with the close picture photogrammetry method. Drawings and three-dimensional models of both sides of the bridge were obtained.

2. STUDY AREA

The Tekgöz Bridge in the northwest of Kayseri is built on the Kızılırmak River, 30 km from the city center (Figure 1). The bridge was built by Sultan Süleyman Şah Rükneddin (1202). It is one of the most important works in Kayseri, an important industrial and commercial center in Central Anatolia. Thanks to the repairs made at various times, it has survived to the present day.

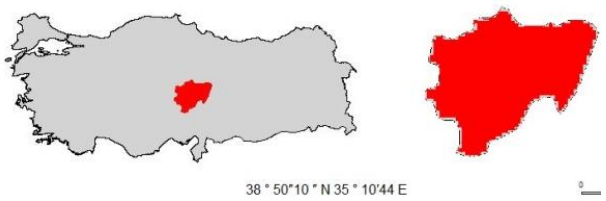

Figure 1. Tekgöz Location – Kayseri/TURKEY

No inscription belonging to the bridge was found (Figure 2). However, according to the inscription found during the restoration of the bridge in 1538, the bridge was built by Dulkadiroğlu Bey Şahruh and restored by his son Mehmet. The arch part of the bridge was established on the Kızılırmak River, its length is 161 meters (528 ft) and its width is 6.2 meters (20 ft). The highest point of the bridge is 11 (36 ft) meters long. The bridge is still actively used.

Figure 2. Tekgöz Bridge

3. METHODS

The photogrammetry method was preferred to document the historical Tekgöz bridge in 3D. Photogrammetry is a method that allows to re-determine the properties of the object in 3D without contact with the object (Kraus, 2007).

Photogrammetry is an independent method in the documentation process. This method is based on at least two images with overlapping data to guarantee the surface passing process (Yakar & Doğan, 2017). Therefore, there is a need for at least two pictures taken from different angles of the object to be applied photogrammetry. The first and the most important stage for the object to be documented to be successful is the stage of photographing.

After providing good photo data, the photogrammetry method can be applied. There are several ways to obtain photo data. The most basic of these is to take photos locally. The processing of photographs taken terrestrially by digital photogrammetry makes important contributions in terms of cost and speed. Digital photogrammetry can produce a precise three-dimensional model of an object or part of the world, depending on the image quality (Akçay et al., 2017).

Historical and cultural heritage documentation works are carried out in two stages: the study of field study and office.

During the field study, the coordinate system is defined to identify the measured object. After measuring the characteristics of the object, photographs of the object are taken.

The first thing to do in the office is to calibrate the camera. Then the coordinates of the object are entered on the photo data. The 3D model is obtained from 2D images by the photogrammetry method. Finally, the necessary detailed drawings and surface coating are made.

3.1 Studies of Field

First, necessary discovery activities are carried out around the bridge. Then measurement points are determined where appropriate. The measurement device shown in figure 3 is installed in the designated places and necessary detail measurements are made. After the detail measurement is made, the photo data of the object is collected. Photos were taken with the digital handheld camera shown in figure 4. The photo data of the object was taken in an overlay with each other. 28 detail points of the bridge were measured in the land. The photo data of the bridge is 220 pieces.

Figure 3. Topcon 3007 totalstation

Figure 4. Canon digital camera

3.2 Study of Office

Various software is available to apply the photogrammetry method used to document historical artifacts. In this study, Photomodeler software was preferred as photogrammetry software. The most important reason for choosing this software is that a detailed drawing can be made after the 3D model is created.

Photomodeler software can automatically perform most of the steps that form the basis of the photogrammetry method. First, the software is introduced to the camera calibration parameters. Then, the measurements made from the field are added to the photographic data. Thanks to these measurements, the real position, and dimensions of the object are provided. Balancing is required to obtain a 3D model from 2D photos.

Photomodeler software can perform the balancing process according to the reference points you have determined. The 3D model is obtained after the balancing process has been completed successfully. After creating a 3D model in real dimensions and location of the work, the detail drawing is started. Documentation work is completed after drawing the details that contain the characteristic features of the historical bridge (Figure 5).

But textural data and basic facade or surface models must be added to create a real model. Finally, texture and surface coating is made on the 3D model with detailed drawings (Figure 6).

Objects that have a 3D model on the digital platform can then be transferred to internationally supported computer-aided formats (DXF, CAD, etc.) for use in other studies.

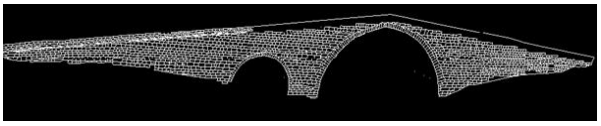

Figure 4. Tekgöz Bridge wirefrime model

Figure 5. Textured model

4. CONCLUSION

In countries such as Turkey, the historical process and damage caused by natural disasters are a danger both to destroy the cultural heritage.

Preservation of these works is a very important issue in terms of human history. Documentation work should be done not only to be restored but also to create a digital archive of cultural heritage.

The digital close-range photogrammetry method, recently in parallel with the developments in electronics and computers have shown great improvement. Thanks to this method can be easily solved complex problems and processes can be completed in a short time. Therefore, it is a highly effective and efficient method commonly used in the documentation of cultural heritage.

The photogrammetry method is successfully applied in the rapid and accurate creation of a three-dimensional model in the desired scale of cultural heritage and archaeological sites. With this method, three-dimensional models documented by adding texture data can be covered with real texture. The preservation of historical and cultural monuments and documentation studies that will prevent extinction frequently benefit from photogrammetric methods. The whole process can be done in a short time and accurately with the photogrammetry method. Considering all these features, it shows that 3D modeling with the photogrammetry method can be easily used in documentation studies.

In this study, Historical Tekgöz Bridge was documented by the photogrammetry method. In the study, 25 photographs of the work were used. 8 of the measured points were used.

With this study, it is mentioned that documentation studies can be done with a small but enough data.

REFERENCES

Akcay, O., Erenoglu, R. C. and Avsar, E. O. (2017). The effect of jpeg compressıon ın close range photogrammetry, *International Journal of Engineering and Geosciences* (IJEG), Vol;2, Issue;01, pp. 35-40, February, 2017, ISSN 2548-0960, Turkey, DOI: 10.26833/ijeg.287308

Böhler W. and G. Heinz (1999). *Documentation, surveying, photogrammetry, XVII CIPA Symposium. Recife, Olinda.Brazil*, 1999. DOI: 10.26833/ijeg.328919

Georgopoulos A. and G. Ionnidis (2004). Photogrammetric and surveying methods forthe geometric recording of archaeological monuments, archaeological surveys, *FIG Working Week 2004 Athens, Greece*, May 22-27, 2004.

Kraus K. (2007). Fotogrametri, Fotoğraflardan ve Lazer Tarama Verilerinden Geometrik Bilgiler, Çeviri, İTÜ, (Çevirenler M.O.Altan vd.)

Scherer M. (2002). About the synthesis of different methods in surveying, *XVIII International Symposium of CIPA*, Posdam, Germany, 2002.

Sienz J., Szarvasy I., Hinton E. and Andrade M.L. (2000). Copputational modelling of 3D objects by using fitting techniques and subsequent mesh generation, Computers and Structures 78, 2000, 397-413

Şasi, A. and Yakar M. (2018). Photogrammetric modelling of hasbey dar'ülhuffaz (masjid) using an unmanned aerial vehicle, *International Journal of Engineering and Geosciences* (IJEG),Vol; 3; , Issue; 1, pp. 006-011, February, 2018, ISSN 2548-0960, Turkey

Yakar, M. and Doğan, Y. (2017). GIS and three-dimensional modeling for cultural heritages, *International Journal of Engineering and Geosciences* (IJEG), Vol; 3; Issue; 2, pp. 050-055, June, 2018, ISSN 2548-0960, Turkey, DOI: 10.26833/ijeg.378257 Research Article

Yılmaz H. M., Karabörk H. and Yakar M. (2000). Yersel Fotogrametrinin Kullanım Alanları, *Niğde ÜniversitesiMühendislik Bilimleri Dergisi* 4, 2000, 18-28.