CULTURAL ASSETS PRESERVATION USING DIGITAL PHOTOGRAMMETRY METHODS

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ABSTRACT

This paper is about data acquisition by digital photogrammetry method for the preservation of cultural assets. As the result of this study, precise digital depth model could be developed on a personnel computer. The model can be than kept together with the image data to be used as a recording system for the preservation of cultural assets.

1. Introduction

There are many cultural assets in Korea, distributed countrywide and most of them originated a long time ago, some dating back to more than a thousand years. Besides having historic values, the architecture of these structures can disclose cultural background of the originating time.

But because of rapid industrialization as well as natural hazards such as earthquakes, fires, and floods, most of the structures are fragile to damage and deterioration.

Digital photogrammetry, referred to as the 4th generation phase of photogrammetry, processes digital data rather than analog data used in analytical photogrammetry. Digital photogrammetry began to be recognized in the eighties and active research is still going on in this field.

The benefits of digital photogrammetry is automation and systematic management of the photogrammetry procedures, preservation of data and easy reconstruction of photogrammetric conditions. In this study digital photogrammetry techniques were applied to acquire basic data and to do various analysis and evaluation.

An experiment was carried out on the main stone statue of Buddha which is inside the Suk-Gul-Am, one of the oldest structures in East Asia. Also maps are generated of Chum-Sung-Dae the oldest astronomical observatory. Analysis of these structures based on acquired data such as formative ratio of Suk-Gul-Am is also performed.

2. Digital Photogrammetry

Topographic maps are usually made from stereophotographs using analytical plotter. Even in the case of digital stereoscopic images, which can be get from SPOT satellite, analytical plotter is usually used. But, in this case, digital images at first must be transformed to photographs on film or paper because

analytical plotter can not treat digital images directly. It is a disadvantage of this method that the form transformation spends extra time and money, and causes new distortion of images. Therefore, it can be said that a digital photogrametric system is better than an analytical plotter to make topographic maps from digital stereoscopic images.

An automatical DEM extraction method has been developed on this PC-based digital photogrametric system. Stereo conjugate points can be determined by stereo-matching using a personal computer. The errors of stereo-matching, which are serious problems for automatical DEM extraction and which are difficult to be avoided by present technology, can be checked and corrected easily in this system by using the 3D display module. When observed through liquid shutter glasses, correct points are positioned on the surface of a model of a mountain and error points are positioned in the air or under the ground. These error points can be corrected by the mouse easily.

The main features of this DEM extraction method are as follows.

(1)The most part of the work to extract DEM from stereoscopic omages is executed automatically by a personal computer.

(2)The results of computer processing can be checked and corrected using 3D display module in order to get accurate final results.

(3)Positioning of ground control points in stereoscopic images can be determined exactly by using the 3D model of stereoscopic images on the 3D disply module.

3. Characteristics of Structures and Results of Experiment

3.1 Characteristics of Structures

3.1.1 **Suk-Gul-Am** : The most general characteristics of ancient architectures in Korea is that they had been affected from Budddism which have encouraged for defensing the mother country and wishing her peace. The Suk-Gul-Am which is the oldest modelling structure in the east Asia is the one of the symbolitic structures related with Buddism.

The Suk-Gul-Am was constructed in 790 AD and has gone through 3 major renovation constructions. This indicates the importance of precise data for effective preservation. The figure below shows the structure of Suk-Gul-Am and the position of the main Buddha statue.

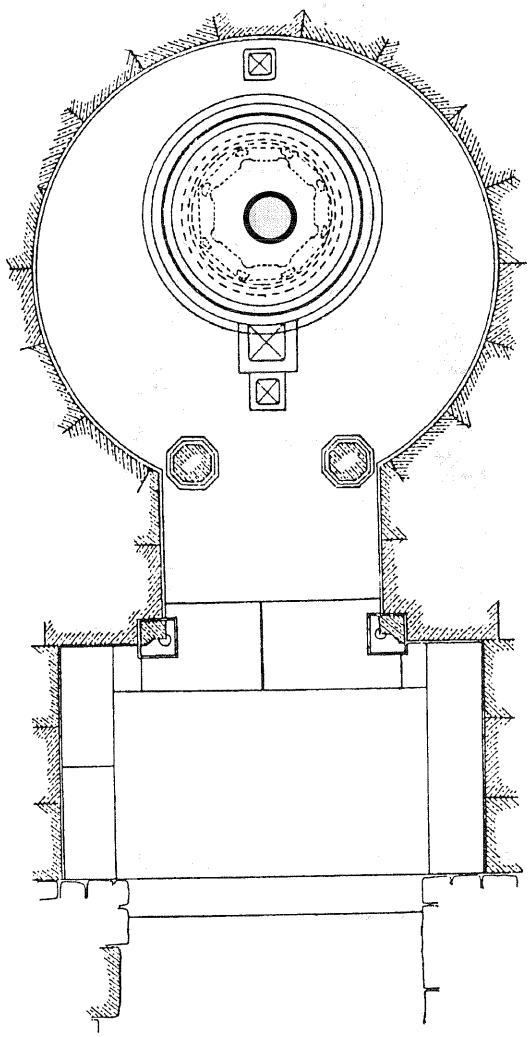

Fig 1 Structure of Suk-Gul-Am and the position of main Buddha statue.

3.1.2 **Chum-Sung-Dae** : Chum-Sung-Dae was constructed in the year 645 AD and is known to be the oldest astronomical observatory. It was constructed with bricks and has a stable structure with a wide bottom and getting narrow as the height increases. As in figure 2 a ladder leads to the top observatory post through a door in the center portion of the structure.

But recently deformation is reported due to pollution and acidic rain following increase in industrial activities of surrounding areas.

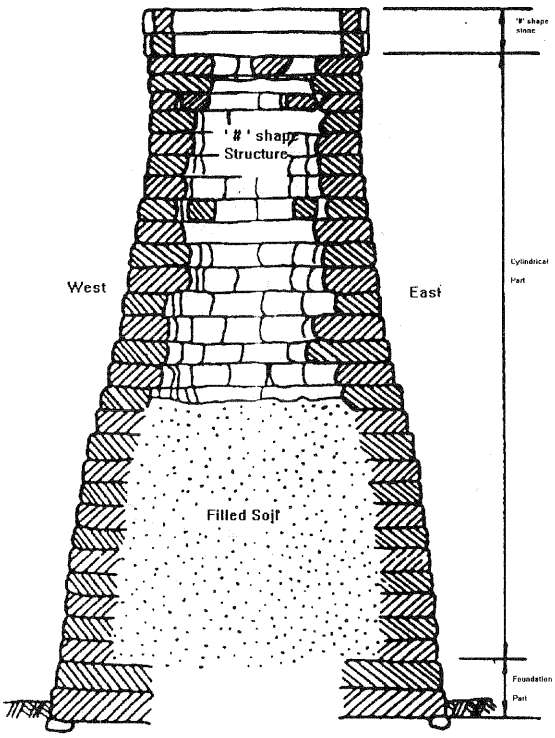

Fig. 2 Structure of Chum-Sung-Dae

3.2 Photograph and Digital Compilation of Objects

Photographs were taken of both Suk-Gul-Am and Chum-Sung-Dae. Access to the cultural assets were difficult because of restriction by law to attach anything on the object itself. Fortunately, past photographs and measurement for the Suk-Gul-Am was available but for Chum-Sung-Dae only temporary target points were used for measurements. Terrestrial metric camera SKB-120 was used for Suk-Gul-Am and Rollei-6006 was used for the Chum-Sung-Dae. The photographs were scanned and the digital photogrammetric software of Leica DVP (digital video plotter) was used for the compilation and mapping of the structure. The software structure is as in figure 3.

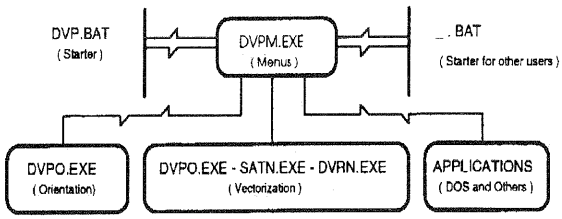

Fig. 3 DVP Software Structure

The result of compilation after orientation of the photographs of the objects are as in the following figures.

Fig. 4 Result of digital compilation of the Suk-Gul-Am

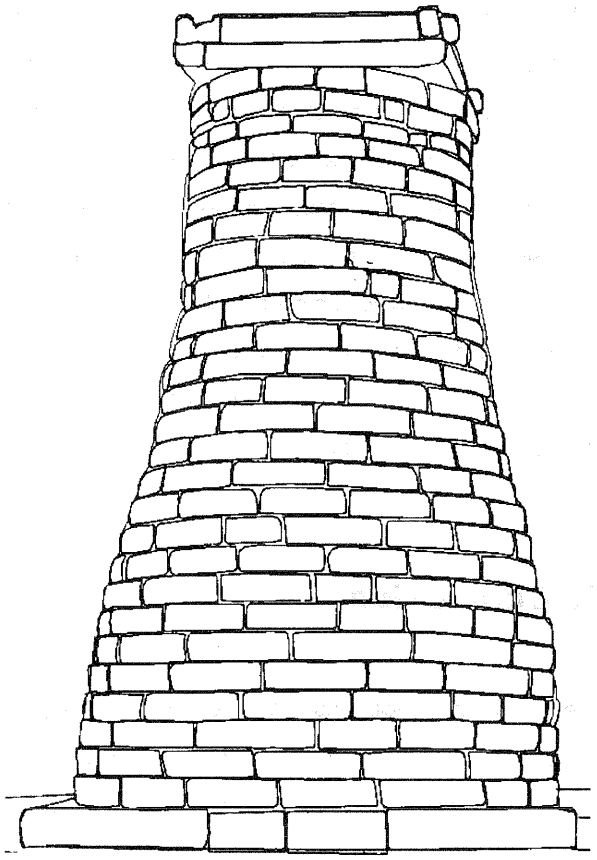

Fig. 5 Result of digital compilation of Chum-Sung-Dae

As can be seen from the figures, it can be seen that accurate data could be acquired for the Suk-Gul-Am because of the existence of past photographs and accurate measurements, whereas for Chum-Sung-Dae the output data is not as precise.

4. Application of acquired data

The experiment data acquired has been evaluated as being useful for the a preservation of records and because of its digital form, it can be used for various analysis. The formative ratio of the Suk-Gul-Am was analysed in this study. The formative ratio of figure 6 is believed to have been used in determining the scale and structure of the main Buddha statue. The 2 geometric concept is also believed to have been applied in the overall design.

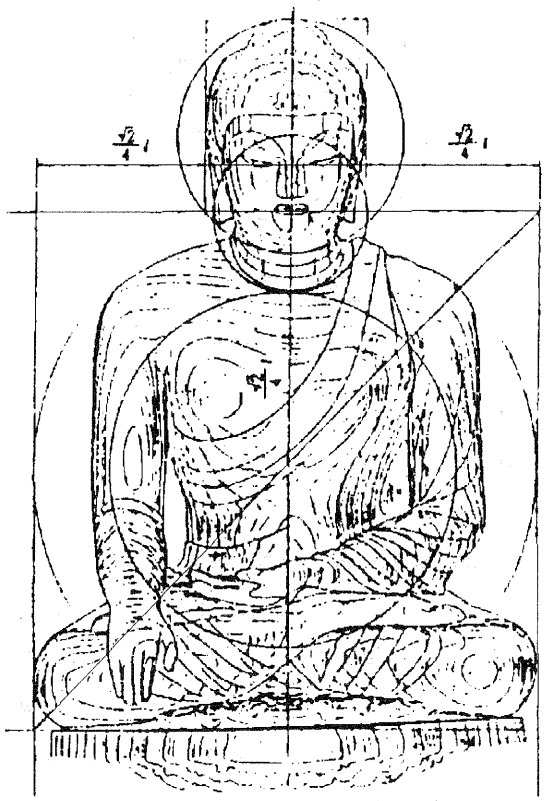

Fig. 6 The determination of size and scale of the main Buddha statue

In the determination of detail structures of the main Buddha, the following figure was developed referring to the length of the rulers and scale bars which are reported to have been used during that period.

From the below figures and diagrams of precise photogrammetric compilation, it can be seen that the main Buddha statue of Suk-Gul-Am is composed of 11 radial circles.

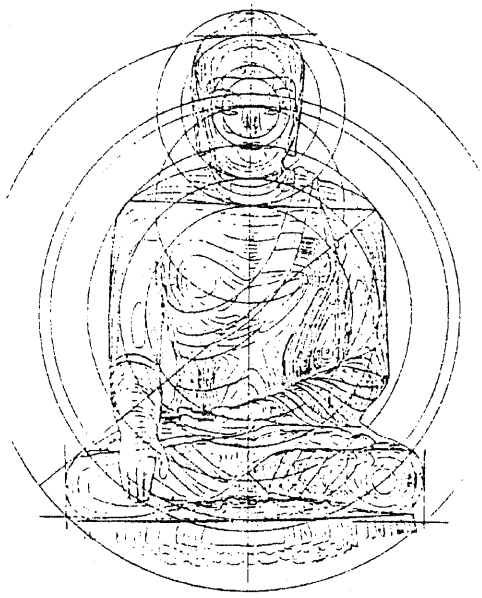

Fig. 7 Result of formative ratio analysis of main Buddha statue

As for Chum-Sung-Dae, each detail parts are being analysed to be able to preserve its original state. It is hoped that this data will be maintained for future preservation and renovation in case of any damages. Parts of the Chum-Sung-Dae diagram is enlarged and after setting a centerline the digital vector lines are superimposed onto the digital image of the structure. The result is as in the following figure.

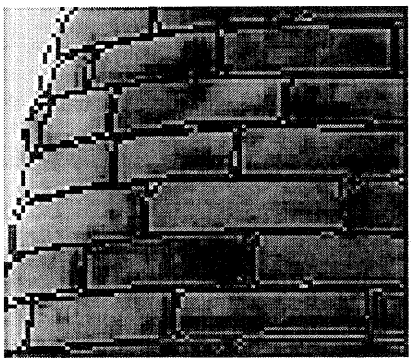

Fig. 8 Image of enlarged portion of Chum-Sung-Dae

Digital photogrammetry was used for the observation of cultural assets and the acquired data was used for analysis as well as for preservation.

Cultural assets of national interest should be preserved effectively, and it was shown in this paper that digital photogrammetry is an effective tool for such purpose and it was also shown that other useful data can be acquired and recorded through analysis of formative ratio, of position of structural parts and of the state of the structure. Digital photogrammetry will prove to be more useful through continued researches on the enhancement of the accuracy of data acquisition and on the increase of types of data collected.

5. Conclusion

The following conclusions can be made through the application of digital photogrammetry for acquisition of data on cultural assets and the analysis of the acquired data.

1. The digital depth model of cultural assets acquired by digital photogrammetry meets with the requirement for preservation purpose.

2. The acquired data can be used for various analysis of the cultural assets.

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