

PHOTOGRAMMETRIC WORKS ON TONYUKUK MONUMENTS IN MONGOLIA

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Abstract:

Tonyukuk Monuments are located on the upper side of Tola river in Bayn Tsydo area in Mongolia. The monuments consist of statues and two inscription with four faces which were constructed by Bilga Tonyukuk in (732-734 ?) who was the vizier of II. Kokturk Khans.

Inscriptions of Bilga Tonyukuk and statues in monument are drawn by photogrammetric methods. Photographs are taken with Rollei D7 digital camera and Leica R5 optic camera. Additionally, the ground control points are measured by Sokkisha Power Set 2000 Total Station. Pictran and Photomodeller software are used on photogrammetric restitution and drawing of these statues and inscriptions. All restitution results obtained from this study are submitted to the Turkish International Cooperation Agency (TICA).

Root mean square of the ground control points are computed as $m_x = \pm 1\text{mm}$, $m_z = \pm 1\text{mm}$, $m_y = \pm 2\text{mm}$.

1. INTROUCTION

Tonyukuk monument was constructed by Bilga Tonyukuk who was a vizier of II. Kokturk Khan in (732-734?). Tonyukuk monument was located on the upper side of Tola river in Bayn Tsydo area in Mongolia. The monument consist of man-statues, two inscription, altar-table being andornamented stone, floors, tiles, bricks and clays. Inscriptions have four side. Historical events of Kokturk State Period were described in Bilga Tonyukuk inscriptions. According to inscriptions, events in Kokturk State Period were transferred from past to present. Other parts in the monument also transfer some information to culture and civilization of Kokturk State Period. Two inscriptions were spoiled, abrasioned and spilled. Other parts in Bilga Tonyukuk monument were seriously destructed.

The project of Turk Monument in Mongolia was started with the agreement between Turkish Republic State and Mongolia State. This task was taken on Turkish International Cooperation Agency (TICA). The aim of this study is to obtain the photogrammetric rolove which work of arts in Bilga Tonyukuk Monument displayed on present status. The work of photogrammetric rolove display a support for restoration works. Besides, these work of arts are determined the present status of monument before it was trasferred into museum which was built about 500 m distance.

2. MATERIAL and METHOD

Gorund control points were selected on side of work of arts and measured for photogrammetric restitution. Triangulation points, which were established before in order to obtain topography map, were used for this task. Ground control points marked on side were measured by Sokkisha Power Set 2000 Total Station.

Paper reflector was used for measurement of selected point on side. Photographs were taken with Rollei D7 digital camera and Leica R5 optic camera. Photogrammetric restitution was determined by Pictran software (Technet GmbH, Germany) and Photomodeller software. Distance precision of measurement by Sokkisha Power Set 2000 Total station is $m_s = \pm(4\text{ mm} + 3\text{ppm} \cdot D)$ and precision of angle is $\pm 1''$ as dictated by user manuel. Root mean square of the ground control points are computed as $m_x = \pm 1\text{mm}$, $m_z = \pm 1\text{mm}$, $m_y = \pm 2\text{mm}$. The calibrated parametres of Leica R5_50 camera are

a- image coordinates of principal point

$$x_0 = 0.013\text{ mm} ; y_0 = 0.065\text{ mm}$$

b- focal lenght

$$c = -50.696\text{ mm}.$$

The calibrated parametres of Rollei D7 digital camera are

a- image coordinates of principal point

$$x_0 = -0.170\text{ mm} ; y_0 = 0.260\text{ mm}$$

b- focal lenght

$$c = 7.520\text{ mm}.$$

3. APPLICATION

Ground control points were marked by an appropriate number for bundle adjustment and covering on all side. The photographs were taken from about 2 m distance. The points which could be transformed from ground coordinate system to surface coordinate system on side were selected and measured for fixing of surface coordinate system(Fig.1). Photogrammetric restitution of inscriptions were evaluated by Pictran software(Fig.2). Photogrammetric restitution of statues was determined by Photomodeller software. As a result of photogrammetric restitution, drawing of all objects were transferred into Autocad(Fig.3)(Fig.4).



Figure.1 Transformasyon from ground coordinate system to surface coordinate system.

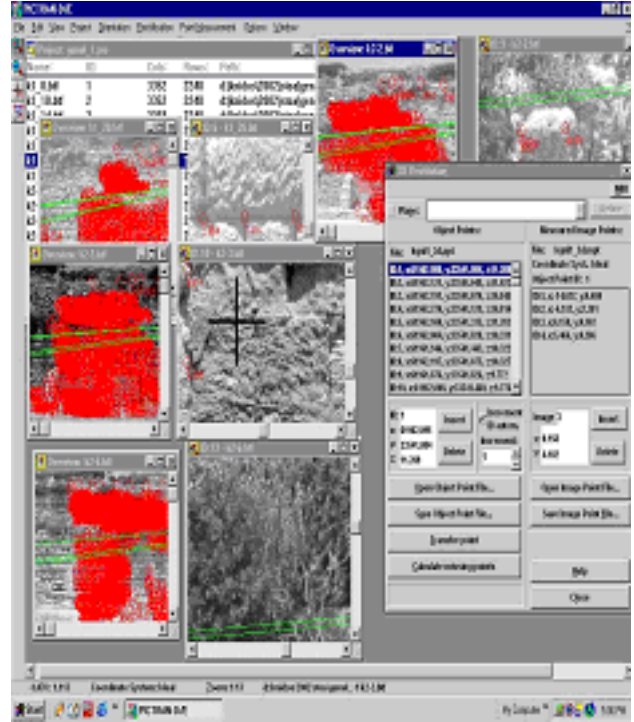
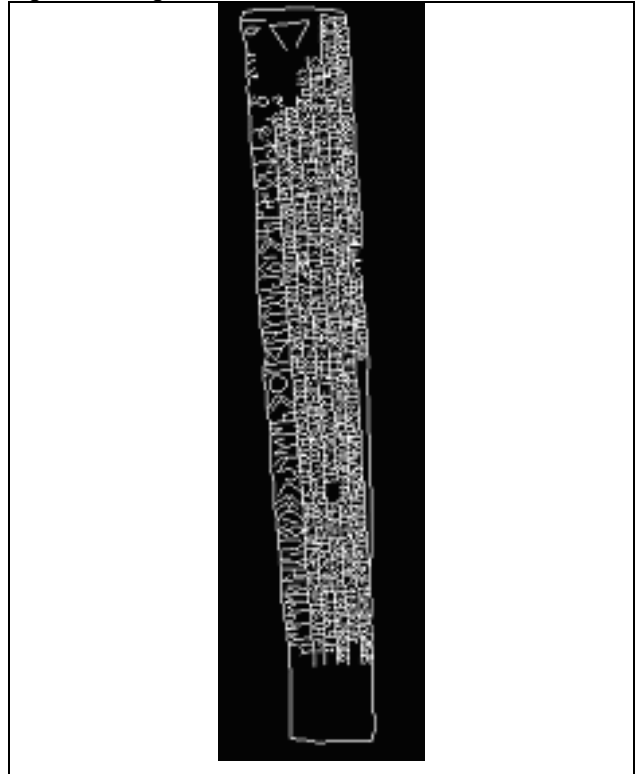


Figure.2 Photogrammetric Restitution in Pictran Software.



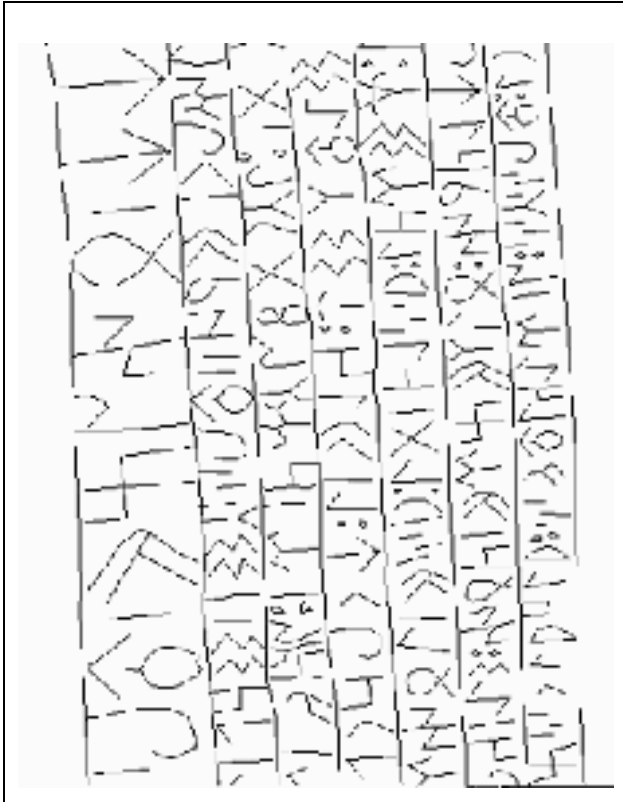


Figure.3 West Surface of first Inscription at Bilga Tonyukuk Monument.

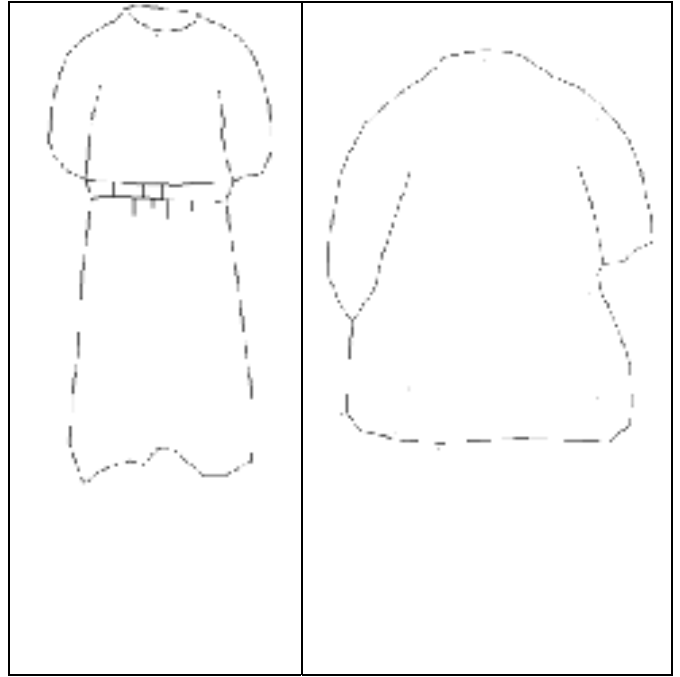
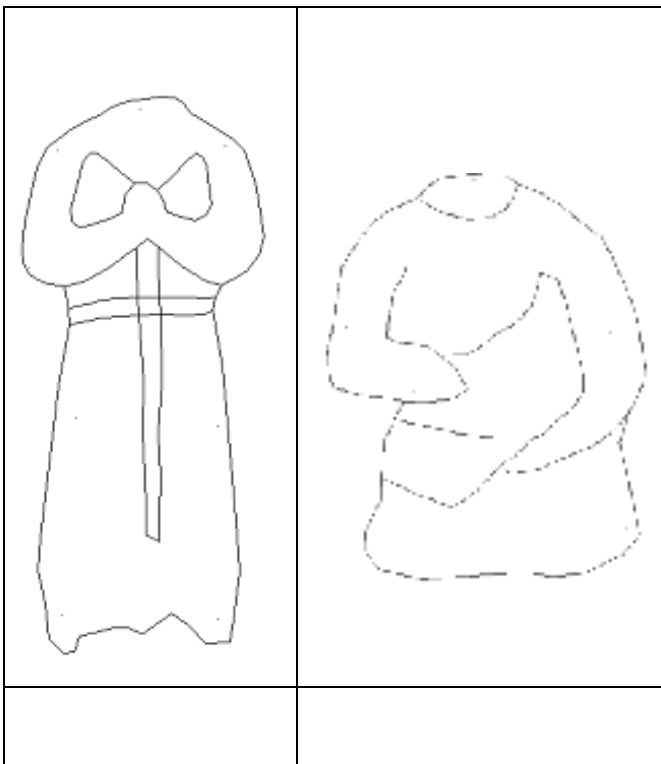


Figure.4 Drawing of statues at Bilga Tonyukuk Monument



4. CONCLUSIONS

The photogrammetric restitution of work of arts in Bilga Tonyukuk Monument was successfully obtained. As a result, status of work of arts in 2001 were documented. After this work, except for two inscriptions, all other parts were transferred into museum being near to monument. Winter in Mongolia is very long and severe. There are many Turkish Monuments in Mongolia. The work-period of historians, language researchers and architects on these work of art is very limited. Writing of inscriptions can be seen on certain period of day's according to sunlight. Because of insufficient writing depth on inscriptions, when sunlight is not convenient, writing of inscriptions is not visible. Therefore, documented historical, language research and architectural is disrupted. Similarly, this condition exists on the document of ornament on statues. The photograph of objects were only taken on suitable duration and position of sunlight. The site works could be only completed to measure the ground control points on the objects at any time. Restitution works were then completed at office to overcome the difficulties on the site works for historical, architectural and language research subjects.

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