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Detailed documentation and 3D model creation of Dalal Bridge using terrestrial photogrammetry in Zakhu, northern Iraqi Kurdistan *K.Pavelka*

Abstract

In the period 2006-2009, many Czech – Iraq projects have been carried out for the reconstruction of monuments in northern Iraq with the aim of primary monument documentation, archaeological investigation, finding appropriate technology for documented objects restoration and final restoration of selected objects. Among the major projects, the Choli minaret documentation and restoration in Erbil, primary mapping and documentation of the Al-Qala citadel in Erbil and detailed documentation of the Dalal Bridge in Zakhu by the Turkish border in northern Iraqi Kurdistan can be mentioned. This bridge is erected over the Khabur River. It consists of a wide and high arch in the middle and other smaller arches on the sides. Totally there are five arches; the length of the bridge is about 115m, the width is less than 5m and the maximal height is about 16m. The state of the bridge is poor; it was many times repaired regardless of its historical price. In 2008, the Dalal Bridge was documented by terrestrial digital photogrammetry using a calibrated digital camera Canon 20D and necessary geodetic measurement. Photomodeler ver.6 and AutoCAD software were used for creating a 3D model. The aim of this project is creating of necessary basic documentation of this valuable cultural heritage as a 3D model with all curved stones and other parts. This model will be used for future restoration of the bridge, which is now only under planning.



Dalal Bridge

Figure 2: Vectorising of joints between the stones

Outputs

The detailed 3D model with all necessary details and stones was planned. Both software AutoCAD and 3D Max Studio were used for construction and visualization. The model will be used for future restoration of the bridge, which is now only under planning. As the second step, a special database for information about stones (quality, material, exposition, damage ...) will be created, which can be useful for planned restoration. Mouse clicking on a stone in the model will depict the related data. Similar system has been developed at the Czech Technical University in Prague and used for the Charles Bridge (Prague, UNESCO heritage).

The origin of the Dalal Bridge is not clear; probably it is from the Roman period, but there are other theories, which assign it to the Greek period or the period of Alexander the Great. However, the legendary battle field at Gaugamel, where Alexander the Great beat Dareios III. in 331 B.C. is located in Iraq near Erbil. Some of the archaeologists in the Iraqi think it might be erected by one of the Badinan Sultans; it is certain that the bridge was erected on the remains of an ancient one.



Figure 1: The Dalal Bridge in Zakhu



Photogrammetric documentation

During only 2 days, in September 2008, the Dalal Bridge was documented by terrestrial digital photogrammetry using a calibrated digital camera Canon 20D. A total station Trimble with self-reflecting distance meter was used for necessary geodetic measurement. Photomodeler ver.6, AutoCAD and 3D Max software were used for creating a 3D model. About 120 digital images were originally taken, including vaults. 69 images and about 100 control points were used as a background for a 3D model in vector format. More than 1100 object points and hundreds of edges were evaluated from the images. A raw model was created using Potomodeler and exported to the AutoCAD software. Using AutoCAD, the model was adapted and edited; and after this, a rendered model from original photos was created. Achieved accuracy of control points was approximately 1-2cm, in the case of processed non-signalised object points about 2-5cm. However, after all processing steps the absolute accuracy is below 10cm.

Figure 3: Final 3D model with photo rendering

Summary and contacts

This work is focused on documentation of the Dalal Bridge in Zakho in northern Kurdistan in Iraq by using easy and non-expensive technology. This work was supported by the grant MSM 6840770040 . Prof.Dr.ing.Karel Pavelka, CTU Prague, Faculty of Civil Engineering, Dept. of Mapping and Cartography, Lab.of Photogrammetry, Thákurova 7, 166 29 Prague , Czech Republic

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