Refining a monitoring workflow based on experiences from Candi Sari , a Temple in Java, Indonesia

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ABSTRACT

Although Buddhist and Hindu Religions are nearly vanished in the every day life in the center of Java, Indonesia their sacral buildings are still an important part of the cultural heritage. With syncretistic symbolisms they represent a main feature if the every day life of the most populated island of the Indonesian Archipelago. The most famous temples Borobudur and Prambanan are part of the UNESCO World Heritage list and are also top-ranked tourist destinations.

Situated at the Pacific Ring of Fire, a tectonic subduction zone, environmental catastrophes such as earthquakes, volcanic eruptions have to be expected. In Indonesia, earthquakes occur almost daily at levels 5 to 6 of the Richter scale. Therefore, the preservation of historical monuments in the region represents a particular challenge. In an interdisciplinary approach experts of architecture at the University of Technology Vienna and Universitas Gadjah Mada, Yogyakarta are collaborating with experts in archaeology to find fast and reliable solutions for the continuous monitoring of temples as a base for further preservation works.

In previous, yet unpublished work, monitoring workflows were presented to analyse variations in geometry of these temples to gain understanding about structural changes after seismic events. Within this workflow photogrammetric data sets are proposed to be compared to a combined laser-scanning and UAV-supported image match point cloud model. Building documentation by photogrammetry was chosen as a quick or even preliminary monitoring technique as it is easily accessible and with absence in necessity of an expensive measurement device appears plausible to be applied even to a larger number of affected objects at one time - as is the case after seismic events. While methodology has already proved useful, aspects have been discovered that still need to be refined. Also, further understanding about structural composition of the objects under investigation and what changes of geometry are expected to be found within the analysis after earthquakes needs to be collected.

In this paper the continuous work on the case study object, *Candi Sari* within the Special Region of Yogyakarta, will be elaborated. An analysis of changes within the structure after several years and numerous seismic events will be presented to further understand what impact earthquakes, even of limited magnitude, have on the structure of the *Candis* and how their geometry changes. Further this re-evaluation by laser scanning will be compared to a set of image-match models to investigate

factors that have impact on reliability and accuracy of such models. Manuals drafted by the project team explaining how to capture image data to be processed into photogrammetric models are at hand. Didactic changes to such manuals will also be extracted from experiences collected through the continuous work on the Candi Sari case study object presented in this paper.

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