A COMBINATION OF MODERN AND CLASSIC METHODS OF SURVEYING HISTORICAL BUILDINGS – THE CHURCH ST. VALENTIN IN THE SOUTH TYROL

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KEY WORDS: cultural heritage, observations, surveying accuracy, combination, cooperation, TLS, visualization

ABSTRACT:

The modern, geodetic surveying offers a large potential to extend the possibilities of the classical building - recording and increase their efficiency. However only a part of the building researchers faces the integration of these methods positively. An important group sees these innovations rather as a symptom of cultural decline. This unsatisfying situation lead us to investigate the diverse methods of measuring and visualisation and to show up and exemplify how the combination of geodetic and classic methods can yield results satisfying for both groups. The project demonstrates the principle possibility of combining both methods. Condition for that is the knowledge about capturing data (measurement), the combination of heterogeneous data and the visualisation of the results. The combination – method is a time-saving tool for analysing buildings, simultaneously fulfilling the demand of intensive grappling with the building and its character and construction principles. Many advantages inhere in it to be accepted by building – researchers.

KURZFASSUNG:

Die moderne, geodätische Vermessungstechnik bietet ein großes Potential, die Möglichkeiten der klassischen Bauaufnahme zu erweitern und ihre Effizienz zu steigern. Der Integration dieser Methoden steht allerdings nur ein Teil der Bauforscher positiv gegenüber. Eine bedeutende Gruppe sieht diese Neuerungen eher als ein Symptom des kulturellen Verfalls.
Diese unbefriedigende Situation hat uns veranlasst, die diversen Methoden und Darstellungsmöglichkeiten in der Bauforschung anhand eines Beispieles zu untersuchen, und zu veranschaulichen, wie die Kombination von geodätischen und klassischen Methoden zu beiderseits befriedigenden Ergebnissen führen kann.
Das Projekt zeigt, dass es prinzipiell möglich ist, die unterschiedlichen Messmethoden sinnvoll zu kombinieren. Voraussetzung ist das technische Know-how zur Erfassung der Daten (Messung), deren Verknüpfung und der Darstellung der Ergebnisse. Diese Kombinationsmethode ist ein zeitsparendes Hilfsmittel zur Analyse eines Bauwerkes, wobei gleichzeitig die Forderung der Auseinandersetzung mit dem Bauwerk und dessen Wesen und Konstruktion erfüllt wird. Sie hat alle Vorzüge, um von allen Bauforschern akzeptiert zu werden.

1. INTRODUCTION

1.1 The object

We decided to take the church St. Valentin in Seis (South Tyrol - Italy) as an example for verifying our considerations (figure 1). The church is of roman origin. According to the eldest sources the tower was finished in 1244. The bulb – shaped roof was set on the tower in 1811. In 14th and the beginning of the 16th century the nave was rebuilt and brought into the present condition.. Remarkable are the fresco - paintings from the 14th century, which are in an extraordinary good condition. Recently the tower has been renewed completely and the roof covered with new shingles. The position of the church on a high plateau is singularly with an amazing view of the South – Tyrol mountain region. Therefore St. Valentin is a high frequented area for walkers.

Figure 1. Church St. Valentin

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1.2 Motivation

The surveyors transfer their geometrically determined criteria from accuracy and completeness to the methods of the building researchers and notice there large need of modernization. For the building researchers however the pure accuracy of geometry does not stand in the centre of interest solely. With them the intensive occupation with the object and the deep understanding of history, constructional properties and its deviations following from that have the same priority. They argue, that this "feeling " for the object can easily be lost by the comprehensive and not reflected use of fotogrammetry, TLS (terrestrial laser scanning)and tacheometry.
On the other hand the traditional building - recording cannot compete concerning accuracy and efficiency with the three-dimensional measuring geodetic procedures. It exceeds the borders of its operational area , if the goal of the building - recording is beyond the historical building investigation, if for example a 3D - visualization is demanded.

1.3 Aims

Goal of this project is to combine diverse measuring-methods and to sound out their pros and cons. Further on we intended to get a useful basis for the evaluation and illustration of the object. Depending upon need
this basis should be suitable for evaluation in different grades of detail and for examination of the essence and the character of the building.

2. MAIN BODY

2.1 Applied methods

Fotogrammetry:
- Digital images from three positions using a calibrated Sony DSC P200
- Deriving a wireframemodell by Photomodeler
- Combining fotogrammetry with online – tacheometry and TLS
- Processing of data by CAD and completion with hand-drawings

Tacheometry:
- On-line Tacheometry using a LEICA TCR 1105 and Tachycad-Software
- 12000 reflectorless measured points from 65 stations
- combination to a wireframemodell by means of 60 transformation points
- Processing by means of AUTOCAD, Rhinoceros and Max 3D

3D Scan:
- Measurement of the exterior and interior part of the church using a TRIMBLE GX 3D
- Software: Pointscape (measurement) and Realworks Survey (registration and processing)
- Result: 3D – point-cloud, measured from 15 stations, in a mean scanwidth of 2 x 2 cm and a spatial accuracy of 3 mm
- Measurement of transformation points for the combination tacheometry – Scan using the Surveytool of Pointscape

Hand-measurements:
- To complete the geodetic methods and for supplementation at unapproachable places reference dimension were taken.

2.2 Results

2.2.1 Details window: The images made with the calibrated digital camera were processed to a wireframe-model (figure 2) applying Photomodeler.

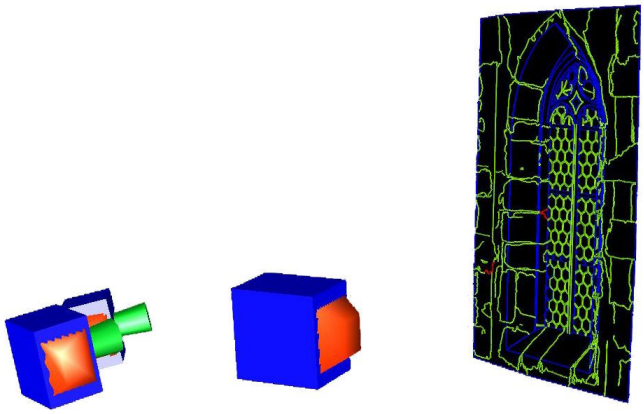

Figure 2. Wireframe-model

This in such a way generated framework (figure 3) serves as basis for the further graphic processing.

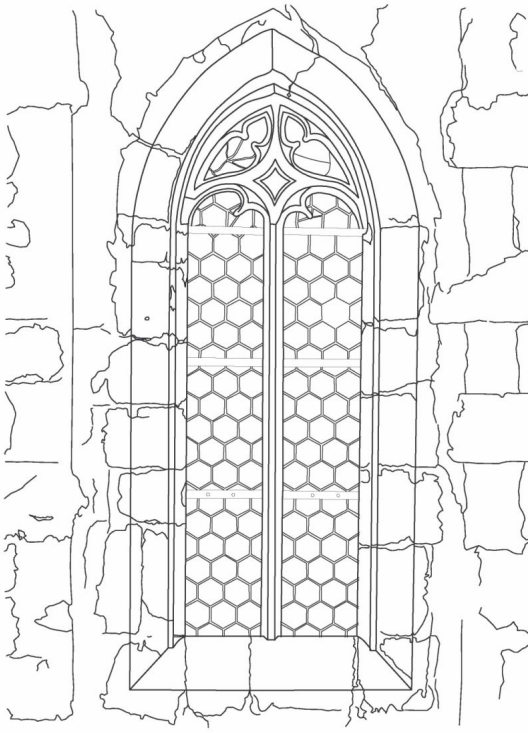

Figure 3. Framework

To meet the requirements of a stone-detailed picture, a hand-drawing (figure 4, figure 5) is preferred to CAD. According to the building-researcher's task a mere CAD-drawing can be sufficient, when the character of the building is not demanded.

Figure 4. Hand-drawing on a CAD basis

Figure 5. Finished Hand-drawing

2.2.2 3D SCAN: Parallel to this method the interior and exterior part of the church was measured by TLS (figure 6).

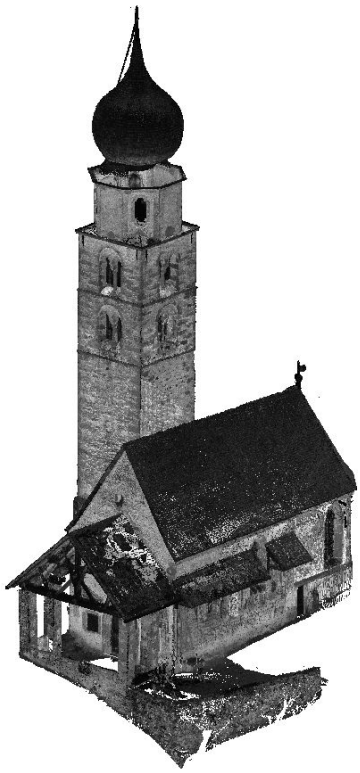

Figure 6. Pointcloud

By that it became possible to expose single parts of the object (figure 7) and to view them more particularly

Figure 7. Pointcloud of window

Further on it is possible to derive useful sections from the exposed object and to complete them by hand-measurements.

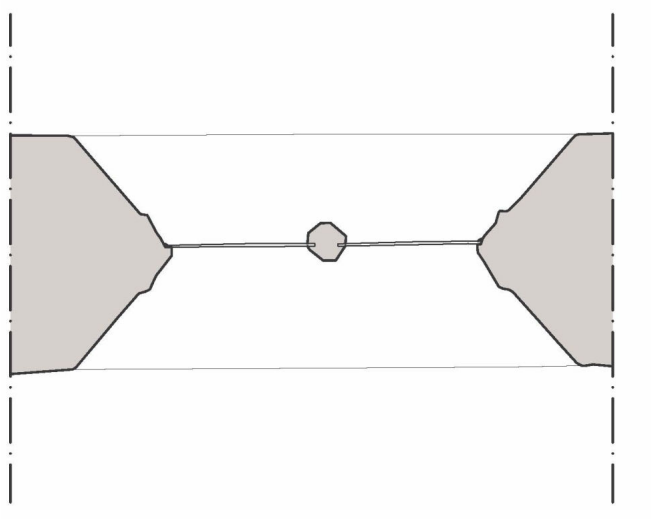

Figure 8. Horizontal section

Also in this case the character and the material of the section can be perceived better by an hand-drawing (figure 9).

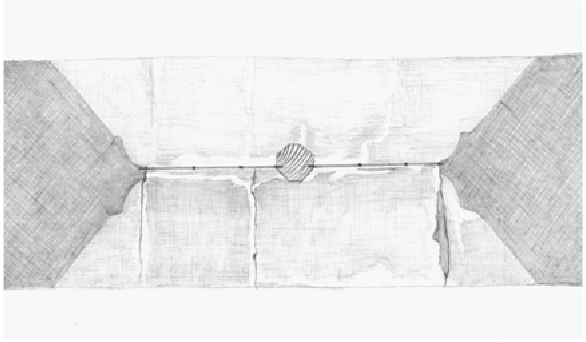

Figure 9. Hand-drawing

2.2.3 Detail portal: As a basis for plotting this detail we selected a tacheometric surveying (figure 10). Like already in the case of fotogrammetry we have an essential structure which can be further worked out, according to the requirement, in different extents of details.

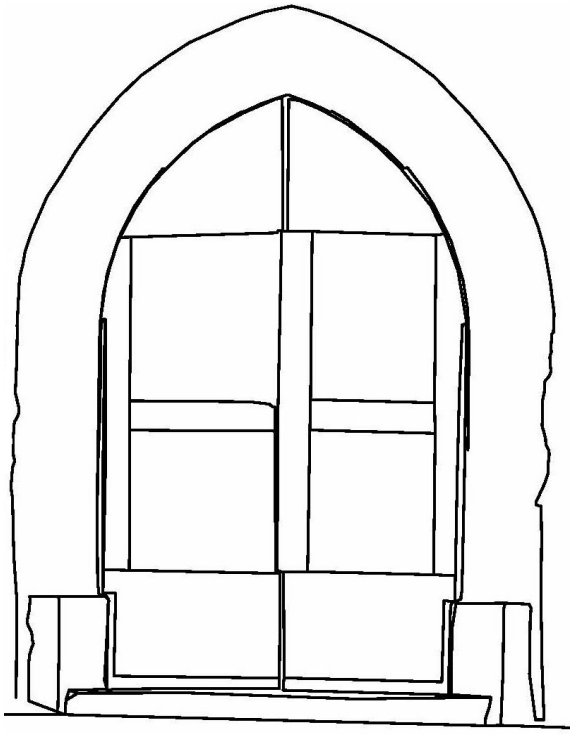

Figure 10. Tacheometric basis

To meet the requirements of the material we added a hand drawing (figure 11).

Figure 11. Hand-drawing of the portal

The horizontal section of the portal is a combination of TLS, tacheometry and hand-drawing (figure 12). The foundation walls result from TLS, the structure of the portal from tacheometry. This shows up how the cooperation of the various techniques meet the expectations of deformation-fairly building-surveying.

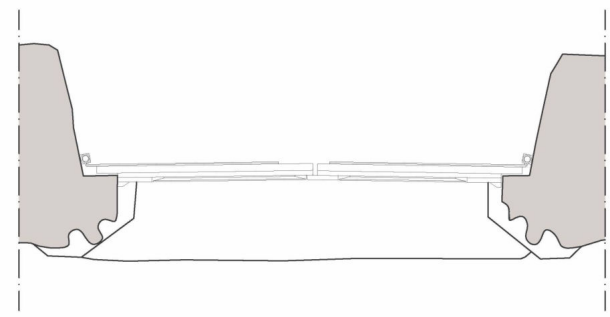

Figure 12. Horizontal section

Also with this example we made hand-drawings for getting a better impression of the details (Figure 13). Important is to select a sensible scale for the drawing.

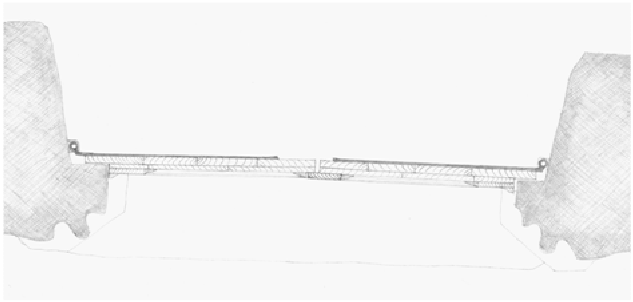

Figure 13. Hand-drawing of the horizontal section

3. CONCLUSION

Using the diverse modern and traditional methods of building-surveying makes it possible to combine the advantages of the different areas usefully. The skilful selection of the diverse techniques makes it possible to get exact results in an economic way, without neglecting the aspect of intensive studying of the building. Based on the technical know how one can succeed in showing up the character of an object by applying the diverse methods of visualisation. The different requirements on a building-documentation determine the level of detail of the work and the selection of the measurement method. The dialogue between modernity and tradition makes it possible to cover the missing aspects of the individual methods in a satisfying way.