



Geodetic and Microgravity Measurement used in St. Mary's Assumption Chapel

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Abstract. With an intersection on modern technologies into the sphere of geodesy and geophysics, there increase the number of possibilities of these technologies to be used. There are also ways to make the research and measurements more attractive for general public. There can be not only interest in the way of final results but also from the processing points of view. For example the sizes of historical sites need to be measured but the semi-product of processing can be also 3D model of the object. This product can be used for increasing of object attractiveness or as a base for next research. This is also the direction needed to be selected, to make the science more attractive and interesting for the public.

1 Introduction

The chapel of St. Mary's Assumption is placed near city Púchov, Trenčín region, Slovakia. It was built round 1880 in neo-Baroque style as a one-sided sacral structure with two identical towers. The construction was initialized by Florián Augustín Balogh (1821-1898), who acts in local church as a Roman Catholic priesthood in 1846-1898. He was also known as a Slovak historian, but also as promoter of a modern industry and fruit-growing. He was buried hand in hand with the parents and brother in this chapel. In history, this chapel was used for funerary prays, because of the position of the chapel. As a cultural monument it was declared 7.11.1963. That is the reason, why for the research was impossible the destructive methods to be used. On 16.04.2018 there was done a measurement in the St. Mary's Assumption chapel by using of 3D scanner- Leica ScanStation C10, relative gravimetre CG5 and GPR radar Sir System-3000. The measurement was focused on observation and research of the subsoil. There were no found some graves so there was supposition of being of underground cavities or tombs in subsoil.

2 Geodetic measurements of the area

Geodetic measurements of historical objects are always challenging. This is caused by the irregularity of their architecture, frequent rebuilding of these objects, often irregular wall thickness and at last their neglected condition. Significant improvements of measurement and documentation of historic objects occurred with the invention of 3D laser

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scanners. With these devices we can capture millions of points in a very short time, difficulty of the shape and irregularity of the object we measure.

The microgravimetric survey is conditioned by the determination of the dimensions and the volume of the walls of the building in which the microgravimetric survey is carried out. The best way to determine these values is to create a 3D model of a measured object. Therefore, before we started with a microgravimetric survey in the St. Mary's Assumption Chapel, it was necessary to measure the chapel with a 3D scanner. We used the Leica C10 scanner for both interior and exterior measurements. The complete scan of the chapel consisted of two interior scans and five exterior scans. After registering all of the scans and their subsequent cleaning from points outside the object of interest, we build a chapel composed of the point cloud with total number of **11 411 026** points. Exterior and interior of this model is displayed in Figure 1.



Fig. 1. Interior and exterior chapel model

From this model we can easily create its floor plan and then model the 3D wall model, which we will need after the microgravimetric survey. The floor plan of the St. Mary's Assumption chapel can be seen in Figure 2.

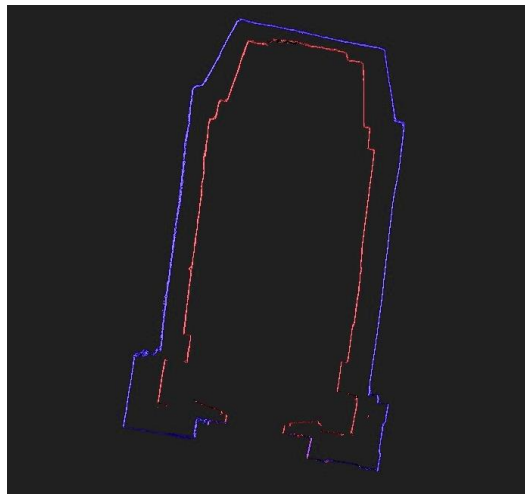


Fig. 2. Floor plan of the St. Mary's Assumption chapel

3 Microgravity measurements of the area

The method of microgravity is one of the basic methods in geophysical research. It depends on measuring and calculation of gravity anomalies that are directly connected to the weight as well as to density, also these anomalies can be interpreted as density anomalies in subsoil. For the definition and indicating of these anomalies it is necessary to measure in regular distance, the best way is to use regular perpendicular grid. After elimination of physical influences such as influences of gravimetre, elimination of free-air anomaly, elimination of local density homogeneities or topocorrections we became the map of complete Bouguer anomalies map.

After a review of locality were by using of microgravity measured points in regular square grid with length of 1.0x1.0m. The measurement was done in the whole object area in total number of 41 points; it was done by relative gravimetre CG5 with precision of measuring 5 μ Gal. The geodetic measurement by using of 3D scanner was used to define the relative elevation of measured points. The result of calculation was the complete Bouguer anomalies map.

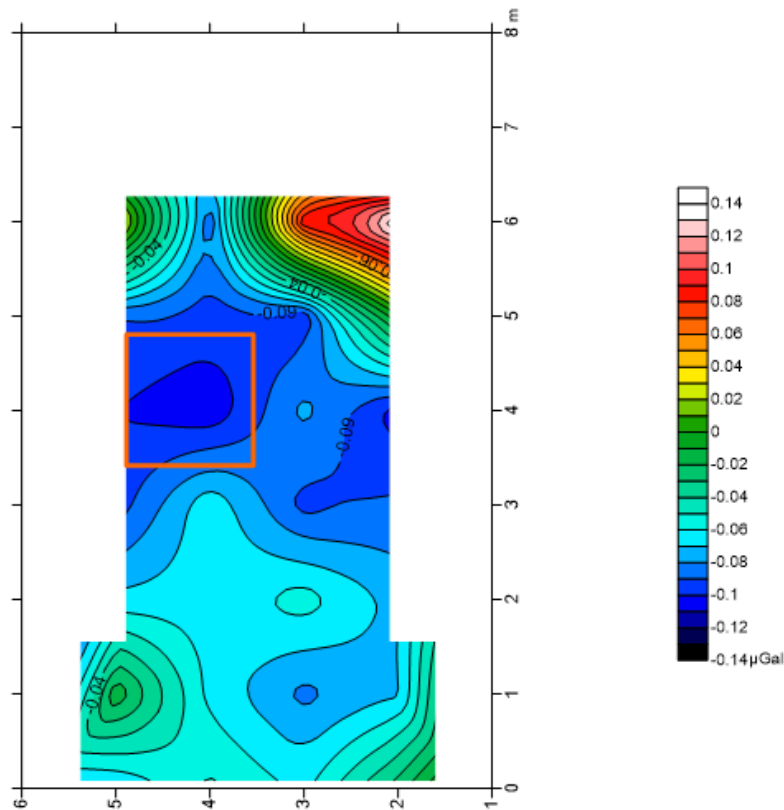


Fig. 3. Complete Bouguer anomalies map in St. Mary's Assumption Chapel.

The result of the measurement showed, there is an area, where the absence of gravity is demonstrable. On the left middle from the entrance into object, there is some anomaly in subsoil as it is displayed in Figure 3 by red square.

4 Conclusions

On 16.04.2018 were done the geodetic and microgravity research of historical site in St. Mary's Assumption Chapel in Horné Kočkovce, part of Púchov city. For the microgravity measurement were used relative gravimetre CG5 and GPR radar Sir System 3000. Bought methods shows the same result of an existence of anomaly, which is represented by absence of gravity in left part of the object. To confirm the results, on 10.05.2018 was done an exploratory well by using of endoscopic camera. This observation confirms the existence of cavity placed 0.60m under the floor. There was found a room in approximate size of 2.0x2.0m.

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