

# DIGITIZATION OF CULTURAL HERITAGE OF SLOVAK REPUBLIC



OPERAČNÝ PROGRAM INFORMATIZÁČIA SPOLOČNOSTI  
TVORÍME VEDOMOSTNÚ SPOLOČNOSŤ



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## Digital monuments fund

The Slovak national project Digital Monuments Fund (DMF) funded by the Operational Programme Information Society (OPIS) lasted between 2012 and 2015. This project covers The Monument Board of the Slovak Republic (MBSR) and is implemented under Priority Axis 2 Development of repository institutions and modernization of their national infrastructure. The aim of this project is to improve the system of acquisition and processing of data about the cultural heritage of the Slovak Republic (SR) and the subsequent use of digital content for the purpose of protecting the cultural heritage values of objects SR.

The process of digitizing the cultural heritage of the SR was realized in 2 ways - by external suppliers and by internal component of the MBSR. The task of both components together was digitization of 1,855 selected objects of the cultural heritage.

Types of the heritage groups	Heritage groups	Historical objects
Castles and castle ruins	46	833
Churches	59	106
Folk and burges architecture	30	56
Mansions	6	76
Monasteries	5	45
Memorials	4	12
Historical town reserves	3	394
Mills	3	6
Bridges	2	3
Cemetery areas	5	206
Archeological sites	5	6
Altars and iconostasis	6	28
Other groups	11	84
Together	185	1,855

Table 1. Overview of digitalized object types

The digitization of large objects and larger sites where it also UAV technology was needed, ensures external contractor STUDIO 727. The documenting of smaller structures with the emphasis on precision drawings was realized by Department of digitization and graphic documentation MBSR. The output of the digitization process is the spatial point cloud, 3D models, orthoimages, drawings, videos and photographs.

## The internal digitalization

The internal component MBSR - Department of digitization and graphic documentation (DDGD) is a specialized institution, which was created for the needs of the project, based on an existing Department of Graphic documentation. Thanks to the project, the department purchased modern surveying equipment, there was set up a new server room with a large repository and high-end computing workplace. DDGD mostly used 3 modern surveying methods: terrestrial laser scanning (TLS), digital photogrammetry (DP) and an optical 3D scanning.

The task of DDGD was the measuring of 400 historical objects. They consist of very various types and sizes. The largest group of digitized objects represented:

1. Sacral objects – churches, belfries, altars, iconostasis, baptismal fonts
2. Folk and burges houses – knocker, wooden and stone houses
3. Technical objects – bridges, mills, tug

Among other things there were measured also various archaeological sites, areas of cemeteries and small movable objects.

## The external digitalization

External digitalization of historic buildings and urban conservation was secured by the company STUDIO 727 in cooperation with other contractors.

Their task was the measuring of 81 large heritage groups (these groups include 1,455 historical objects). They can be divided into the next categories:

1. Small objects - these were mostly small churches, castle ruins or simple memorials
2. Midsize objects - here were bigger castles and manor houses
3. Large objects - historical town areas.

External partner of the digitalization mostly used following modern surveying methods – photogrammetry, laser scanning and combination of these methods in a new software Reality Capture created during the project of digitalization. The main reason for the use of the combination of technologies was an effort to use benefits of each method and to eliminate major weaknesses. This approach is unique, because after a comprehensive analysis of existing commercial products, it was found there is no optimal software solution that addressed these issues.

During the project there was established cooperation with CapturingReality software company. This company is dedicated to the development of photogrammetric software. They created a unique software that allows a combination of automated processing photogrammetry and scanned data and can work with huge number of data.

An example of use of the software Reality Capture is illustrated in object Sala Terrena situated at the castle ervený Kame . Sala Terrena is a ground floor room with a rich early Baroque decoration (Figure i. -1).

This combination has managed to significantly increase the geometrical and textural accuracy and detail. Comparison of a model obtained only from TLS data with the model of data supplemented by photogrammetric images are shown in Figure i.

One of the unique features of used method is the fact that this increase in the rate of detail is (depending on the input) very significant. The final model contained in the photos is up to half the resolution of the real image, the texture information may be maintained practically in the ratio 1:1.

During the project there were taken more than 2,000,000 pictures from the land, more than 100,000 elevation pictures (mainly from the drone and helicopters) and more than 18,000 scan positions.

## Example of internal digitalization

From measured data of 400 objects were postprocessed diverse outputs like pointclouds (textured or with intensity), 3D polygonal models, vector models, orthoimages, panoramas and completed technical documentation of the objects (situation, contour plan, facade views, ground plan section, cross section view, longitudinal section view ...). All of them can be used by architects, historians, restorers, for educational and presentation purposes. Examples of outputs are shown on following figures (Figures a.-h.)

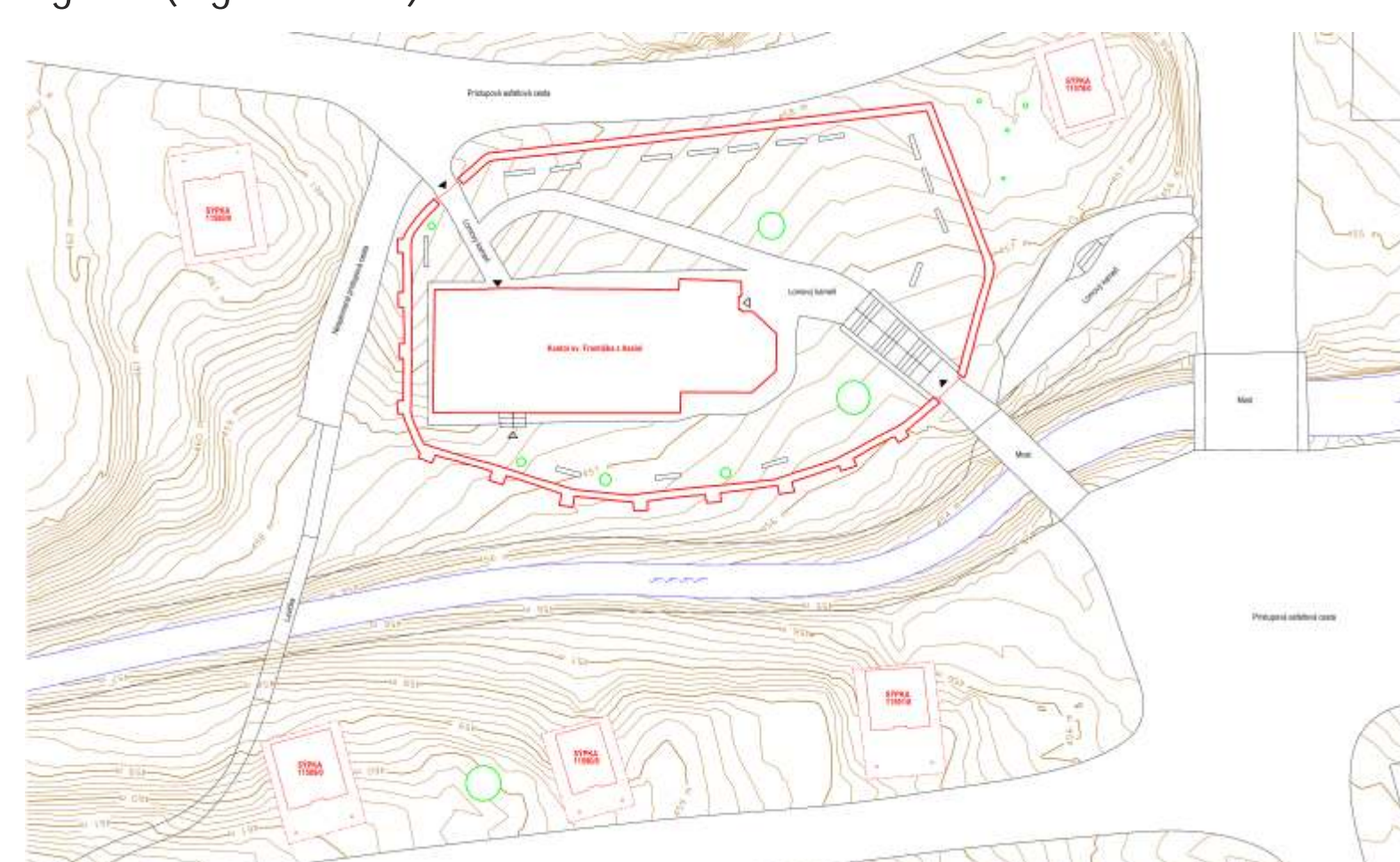


Figure a. Hervartov, The Church of St. Francis of Assisi, situation and contour plan

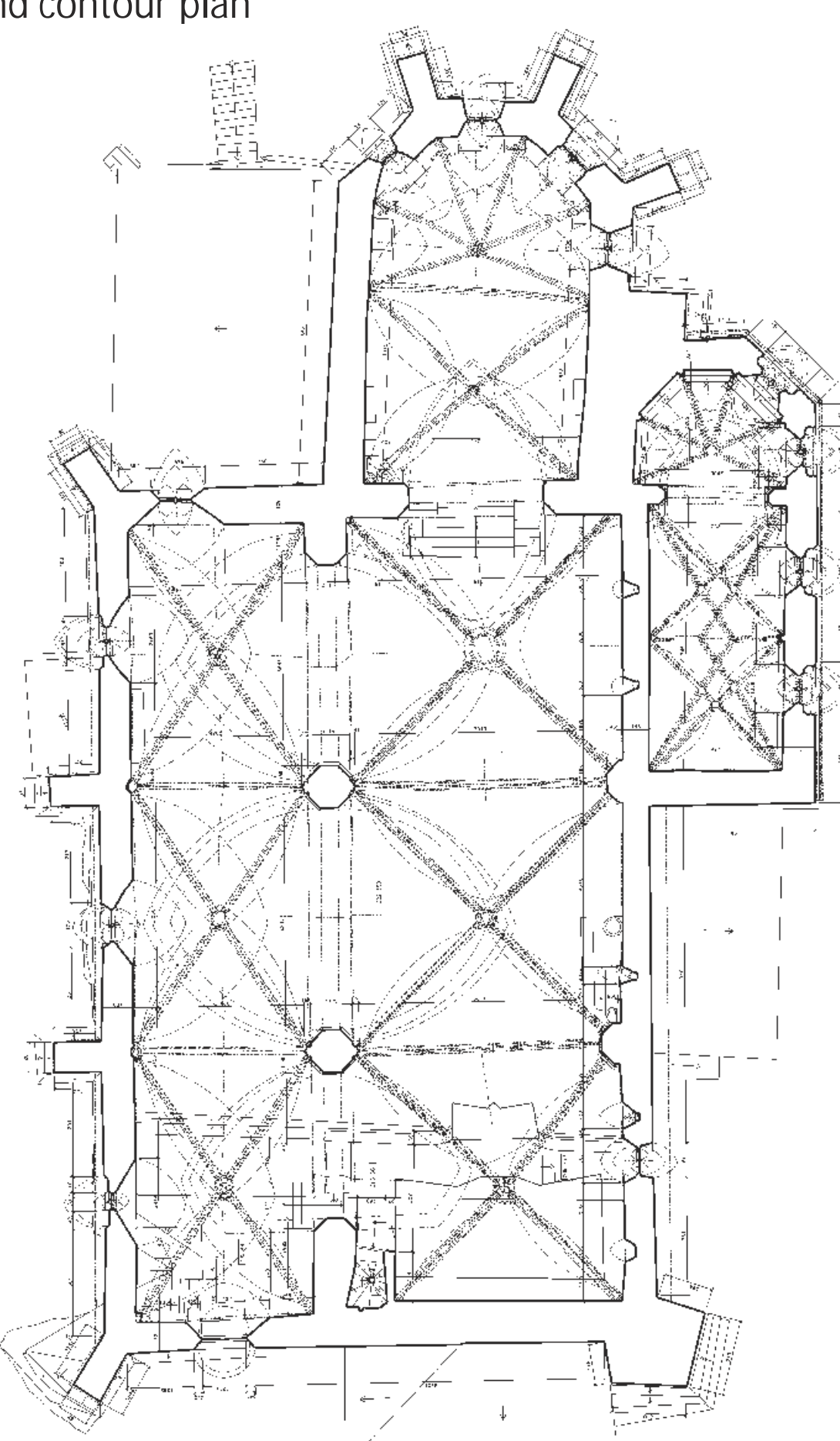


Figure b. Svätý Jur, The Church of St. George, ground plan section



Figure c. Banská Štiavnica, The Knocker, picture

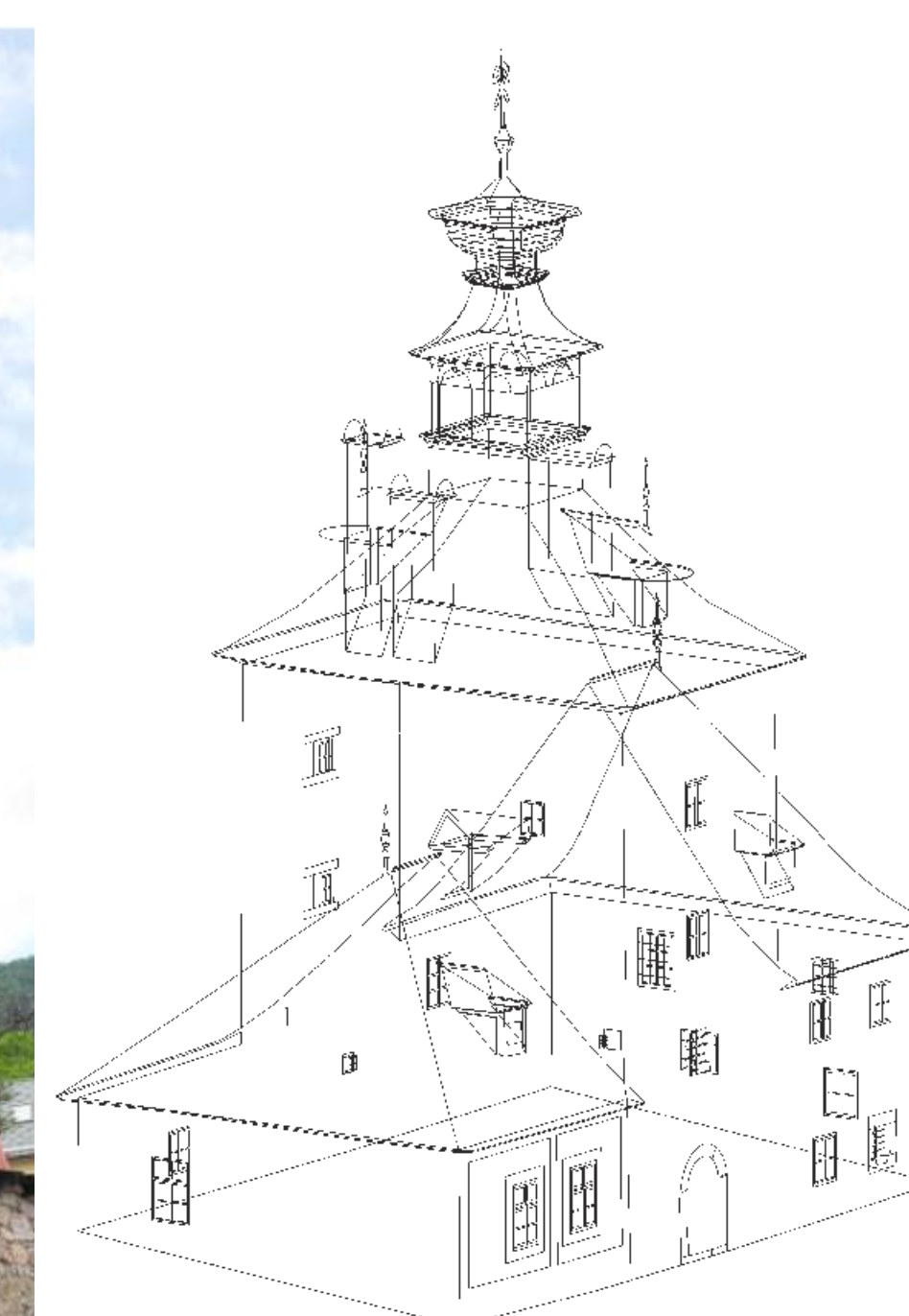


Figure d. Banská Štiavnica, The Knocker, 3D vector model

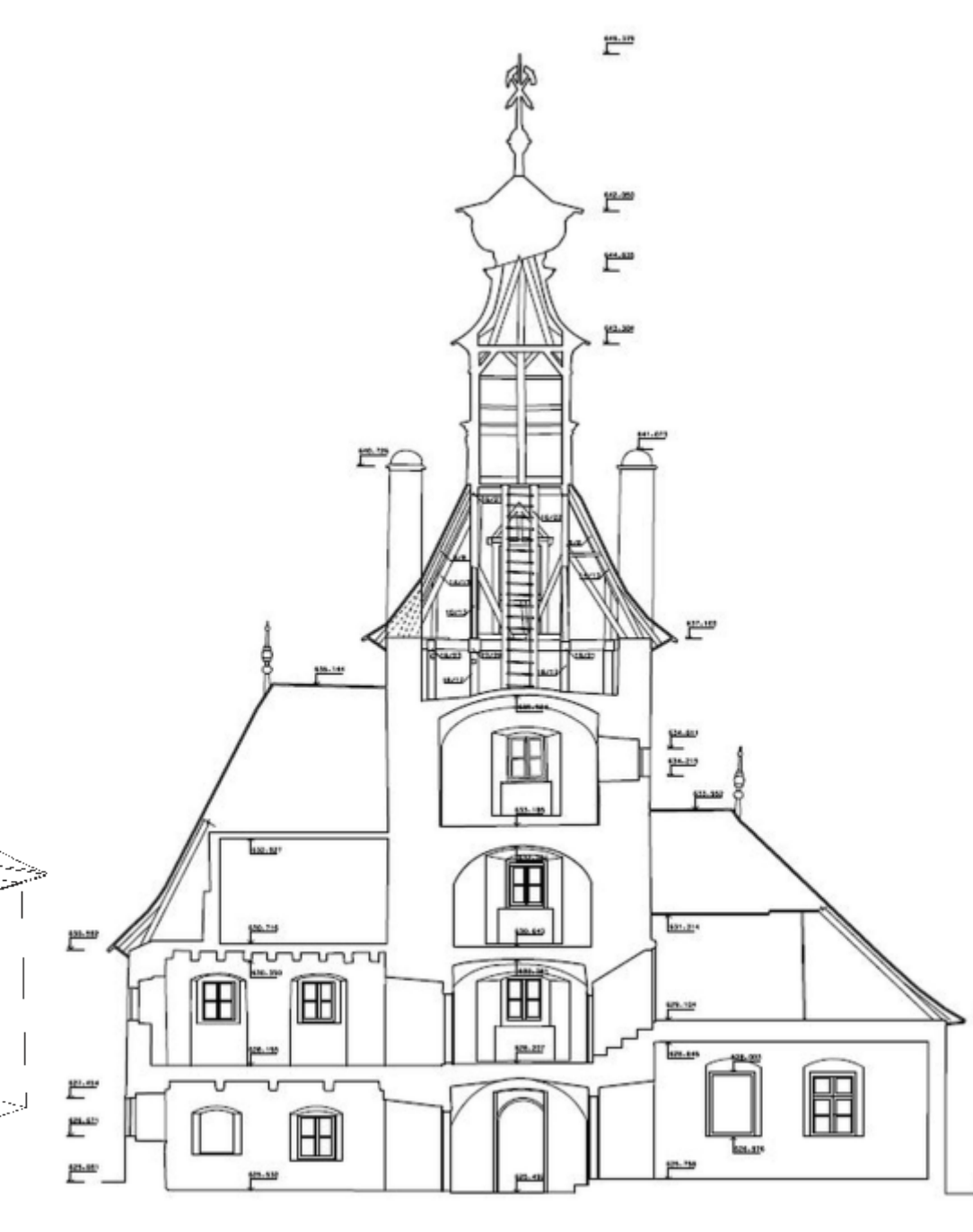


Figure e. Banská Štiavnica, The Knocker, cross-section view



Figure f. Kráľová pri Senci, baroque bridge, pointcloud



Figure g. Kráľová pri Senci, baroque bridge, untextured polygonal model

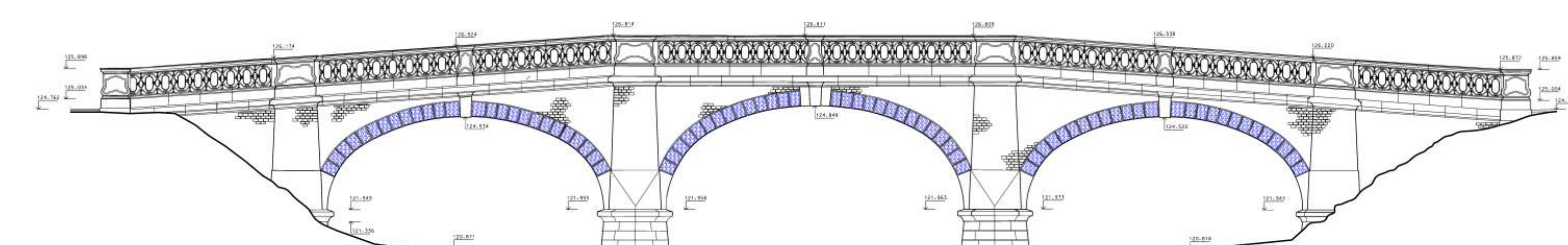


Figure h. Kráľová pri Senci, baroque bridge, north facade view

## Example of external digitalization

Because of dimensions of digitized objects, together there were taken hundreds scan positions and thousands pictures on each object. The measurement and postprocessing of data took sometimes also few months. Final models of digitized objects are very detailed and relatively accurate (e.g. in case of huge castles up to 1cm). From all obtained data can be created variety of outputs: polygonal and vector models, orthoimages, drawings, animations. In following pictures (Figure m.-r.) are shown examples of these outputs.



Figure m. Spišský Štvrtok, Záposky chapel, longitudinal section view

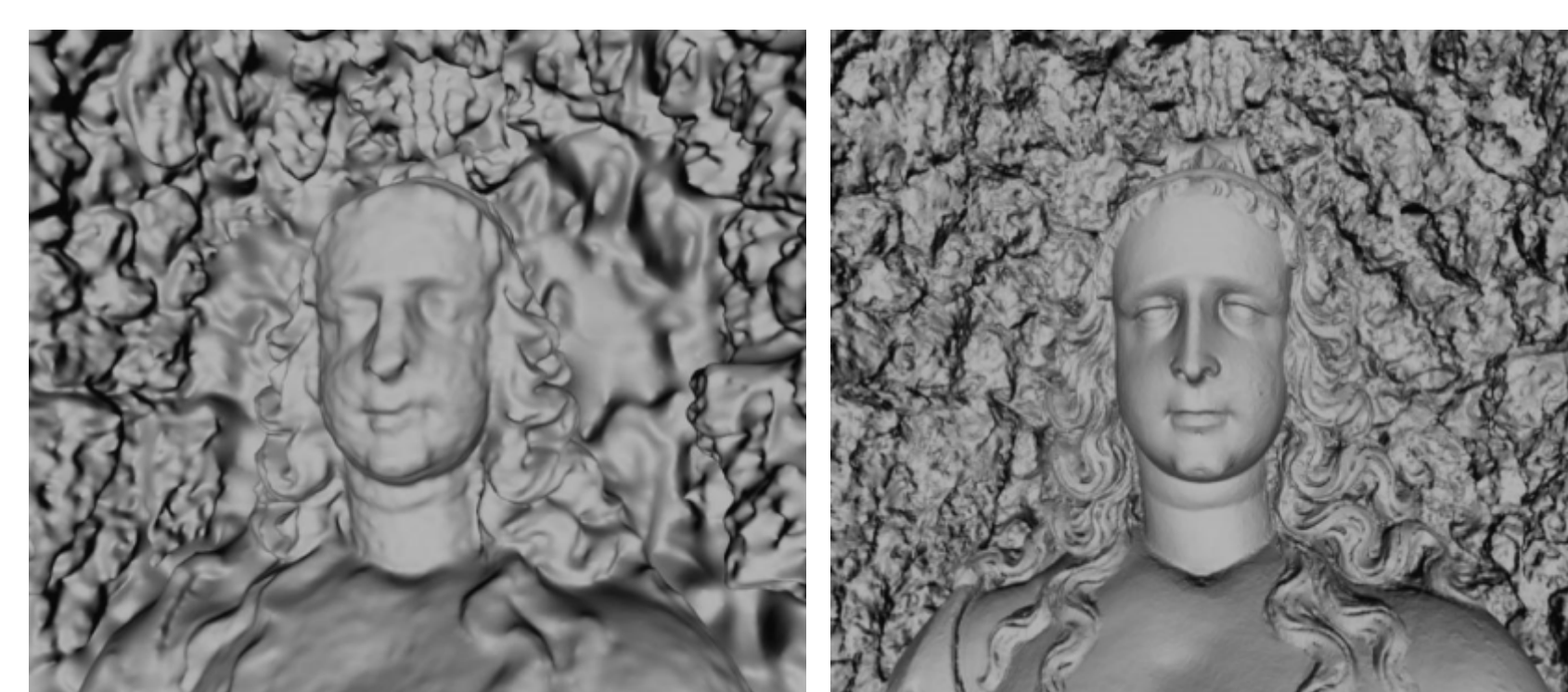


Figure i. astá, ervený Kame Castle, statue model in Sala Terrena created from TLS data and model after addition of DP data



Figure j. astá, ervený Kame Castle, textured 3D model of Sala Terrena

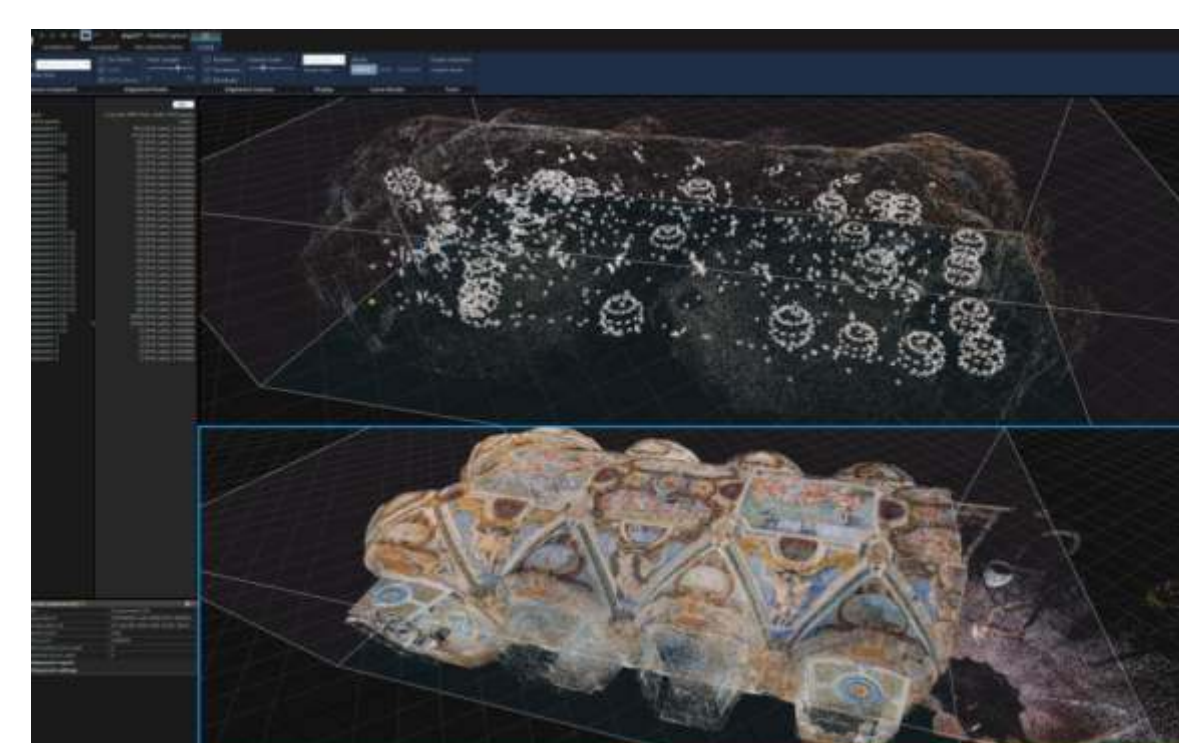


Figure k. astá, ervený Kame Castle, representation of the images positions (up) and obtained pointcloud (down)



Figure l. astá, ervený Kame Castle, detail of the statue model represented by textured faces (left) and by edges (right)

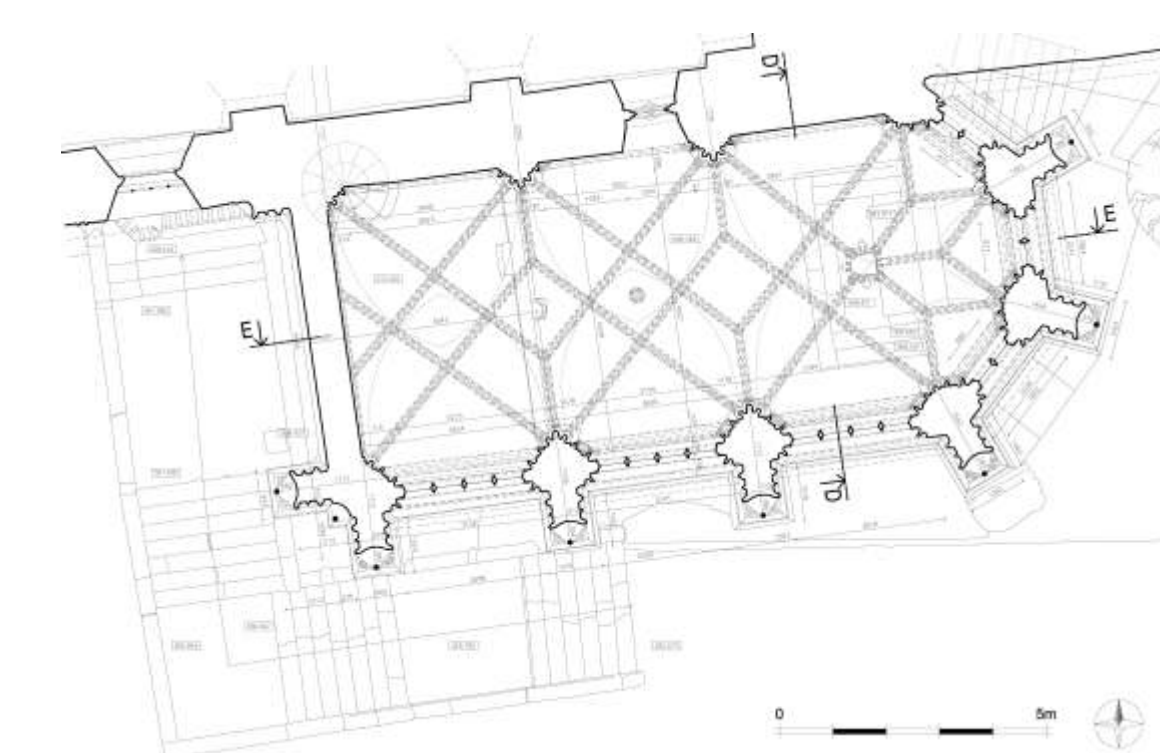


Figure n. Spišský Štvrtok, Záposky chapel, ground plan section



Figure o. Banská Štiavnica, The Virgin Mary Assumption Church, picture (left) and model (right)



Figure p. Banská Štiavnica Town, pointcloud of town reserve with stole Glanzenberg



Figure q. Banská Štiavnica Town, untextured polygonal model



Figure r. Banská Štiavnica Town, textured polygonal model