SECONDARY DATA COLLECTION AND HERITAGE DOCUMENTATION - CASE STUDY OF A REMOTE DOCUMENTATION OF TRAVNIK'S VAROŠKA MOSQUE

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ABSTRACT:

After two disastrous fires in Travnik in 1903, the Austro-Hungarian administration designed a new and secure mosque building model typology following a distinctive style of Habsburg-Bosnia. In order to understand the interventions which were carried out in that time, the research team examined the limited plan documentation from the 1990s. and collected the basic measurements by working on-site. Because of extended requirements, and new target areas being developed later in the project, more data for further research was needed. This paper will examine the possibilities of supplementing the existing materials collected on site by including new secondary sources into the processing. It will discuss the extent of combining data from different sources collected by means of crowdsourcing to conduct photogrammetric models and improve the quality of its result. Also, it will show how this material can refine already existing data and contribute to the precise documentation of the built heritage of Travnik, in particular to the 3D plan set of Varoška Mosque.

1. INTRODUCTION

Travel restrictions caused by the pandemic at the beginning of 2020 meant a change of the usual investigation habits and methods for researchers from various fields. The growing awareness of the ecological effects of travel as well as some areas being affected by difficult political situations or war are already greatly changing the ways of handling historical architecture, and opening the door to different preservation methods. Thus, *remote research* ceased to be just one of the components, and became a meaningful approach in research work. By *remote research* we understand methods, approaches, and concepts that enable us to document and investigate an object from a distance. By that we don't mean remote research is an integral part of every scientific work, but an adapted form of collecting and supplementing essential data remotely.

Initial data of Varoška Mosque was collected in early 2019, when TU Wien students of architecture based themselves in Travnik in central Bosnia to investigate the mosques of Travnik, which two disastrous fires destroyed in September 1903. As photographic evidence of the mosques from before and after reconstruction shows, the mosques were re-interpreted in the new style mentioned above . Building material and construction technology followed the standards of the new building code of Bosnia, which the Habsburg administration implemented in 1880, after first bad experiences with a fire hazard in Sarajevo (Jaeger-Klein et al., 2021).

Four of the freshly reconstructed mosques (Lončarica, Zulići, Kahvica and Šumećka mosque) that look quite similar might have been rebuilt after a model plan (Sujoldžić, 2013). Varoška Mosque gained through its reconstruction a totally different look. Before the fire, the five mosques did not differ much from each other. Varoška Mosque after its 1906 reopening definitively had changed its character from a traditional Bosnian suburban (mahale) mosque, with a hipped roof above a compact cubic main body, to a distinct metal-covered cupola mosque with a monumental portico –entrance façade. Because of the lack of original plans of the mosques, the research team based their hypothesis on the hand measurements of a local engineer and historian, Enver Sujoldžić (Sujoldžić, 2013) who documented all of the mosques of Travnik in hastily drawn-up plans during the wartimes of the 1990s.

Investigation of structural appearances of these objects, material, construction techniques, as well as the inspiration of its design through further oriental architecture increased the need for contour- and surface accurate documentation in plan.

During the initial campaign on-site in Travnik in 2019, tachymetric measurement of several typical mosques was conducted with the help of students in order to analyze and understand the basic geometry. Using the method of measuring discrete points as well as indiscrete points along a section line using a motorized movement of the station along the external and internal geometry of the facades, data on their position and height was collected, from which it was later possible to produce basic plan documentation. In supplement to this vectoral survey an excerpted photogrammetric survey of facades with their characteristic pattern articulation was carried out. Considering that each of the mosques has one or two typical facades, on a square or rectangular floor plan, the focus of the photogrammetry was given primarily to two representative facades. In addition, it would have not been possible to access some of the mosques from all four sides, which also led to incomplete documentation for wider research. In general, the material resulting from the 2019 campaign was sufficient for task at hand and the surveying effort was not extended beyond this, as time was limited, and the focus was set to other parameters within the historic fabric of Travnik.

In the case of the Varoška Mosque, all four facades were photographed from a terrestrial viewpoint, which met the requirements of the initial investigations. Considering that Varoška is one of two such mosques with a dome from the turn of the nineteenth and twentieth centuries, the focus was later extended to the area of the roof. This alone led to the need for a

Figure 1. Varoška Mosque in Travnik (C. Jäger-Klein)

more complete 3D documentation, i.e. the need to complement terrestrial photo documentation done on-site with drone photos which would allow to extract and draw the basic geometry of the dome.

This paper will investigate in which way the existing digital metric documentation of the Varoška Mosque in Travnik can be supplemented with material from secondary sources such as photos and videos of tourists created for purposes other than research. Also, it will discuss to what extent can the collected data be complemented by using citizen science or data mining and if this kind of *remote survey* is able to provide results of sufficient quality.

In the following, we will discuss the development of the 3D SfM (Structure from motion) model of Varoška Mosque conducted from professional data with crowdsourced images and amateur drone videos collected from publicly available web sources. In doing so, three individual point clouds created from three different data packages will be evaluated, and the most optimal workflow for constructing a new and more complete model of the mosque will be proposed. In the first part, we will present a case study and how the need for supplementing existing documentation from secondary data sources was developed. We will also encompass copyright regulation and distinct goals of the fair use policy when utilizing online data for research purposes. After that, the calculation processes of the SfM Model from three different data packages will be presented and the conducted results will be evaluated by comparing its parameter matrix with chosen reconstruction projects.

2. MATERIALS AND METHODS

2.1 Case Study

Varoška Mosque is one of the most interesting cultural objects under the Habsburg legacy over Bosnia, which lasted from 1878 to 1918. It is one of only two newly erected cupola mosques of its time. The city fire of 1903 completely destroyed its wooden predecessor from the sixteenth century, but it was rebuilt by Ziba-hanuma Kopčić (née Arnautović). The suburban mosque differs from the Ottoman standard type of a provincial domed mosque mainly by the addition of a narrower portal that is higher than the dome cube. This specific composition suggests a direct influence by the synagogue project in Zenica, which also features a protruding and elevated central section with coupled windows. The onion-shaped dome rests on an octagonal tambour, partially perforated with round windows. Today, dark anodized sheet iron cover it, and an *alem* closes it off. The transition from the square main structure to the dome on the inside clearly shows that it is a structural wooden dome and not a statically "real" dome. The pendentives here are therefore purely decorative, without this constructive background for the transition from the square of the ground plan to the circle of the dome. Otherwise, the suburban mosque, like other buildings from the Habsburg period, is basically a completely plastered brick building on a natural stone base (Jaeger-Klein et al., 2021).

In the overall phenomenon, the suburban mosque stands out as a monumental domed mosque from the Habsburg era. With its pointed or keel arches, it demonstrates the perceived obsolescence of the horseshoe arch windows and the horizontal plaster banding (covering all surfaces) after 1900. It thus represents the last phase of eclectic-historical Orientalism.

Varoška Mosque is positioned on a relatively prominent stretch that leads from the city Centre to the Travnik fortress, which is one of the most frequent tourist routes (Fig.1). Regardless, it appears the mosque does not draw extensive interest within groups of tourists passing by, judging by the lack of images with the building as main motif that were to be found. Given that it is positioned diagonally to the street, and that the front facade does not face the road directly, two facades are best visible from the perspective of passersby. The fortress provides a clear view of the frontal façade, whereas the southwest side remains hidden from important viewpoints and is therefore not captured in any tourist photos. In the following, we will discuss how these collected images and other crowdsourced data can be included in the process.

2.2 Crowd sourcing in documentation of cultural heritage

In recent years, the significance of crowd sourcing has increased, and despite some criticism, its application in cultural heritage documentation undoubtedly yields valuable outcomes. Crowd sourcing is defined as a form of digitally enabled participation that promises deeper, more engaged relationships with the public via meaningful tasks of supplementing cultural heritage collections (Ridge et al., 2021). It includes processes in which the public is actively involved in data collection of some research and thus represents mutually beneficial engagement. Other than crowd sourcing, which means active engagement in the documentation process, tourists' photos of a specific location represent passive engagement that can also contribute to documentation. While collecting valuable material from secondary sources for the documentation of cultural heritage may not yield professional grade quality, it does provide information from a different approach, and makes a valuable contribution to the overall outcome. In the case of using tourists' photos for the purposes of documentation, i.e., the reconstruction of research objects, a certain problem arises, given that the data was not created with that goal in mind. So, in the case of the Varoška Mosque, tourist photos cover only three facades that are the most attractive or are located on the walking route. In contrast, professional documentation should encompass all facets of the object to ensure a thorough and comprehensive understanding of the structure. Aside from the geometry that professional documentation should include, textures, materials and colors of its facades should also be taken into consideration when doing this kind of survey. In addition to professional equipment, the deciding factors for this are also the weather conditions under which the object is being documented. Finally, as tourists' photos usually do not produce extensive sets of photos, the inclusion of a larger range of authors and devices into the process reduces accuracy in alignment and parameter approximation with the SfM process. All these aspects are the reason why amateur photography is not an ideal source for building reconstruction and can only be a secondary source of information.

A way to process 3D virtual models from photos from secondary sources, such as crowdsourcing data, is possible by using the method of photogrammetry. Ideally the data was collected with the objective of thoroughly documenting the object, ensuring that the photos captured all visible aspects while adhering to the fundamental rules of collecting data for photogrammetry. But, if the data is not complete, as in the case of this case study, the calculation process of the 3D model needs to be adapted to the collected data. Such approach comes into use when, due to inaccessibility of the object or its partial or even complete destruction, secondary data becomes the last available data, and amateur tourist photographs therefore represent the last best chance of drawing information about the previous state of the structure.

In countries like Syria or Afghanistan, conflicts and intolerant ideologies have, unfortunately, caused the direct and willful destruction of heritage sites. Regrettable examples of this include the Aleppo Mosque, the ancient city of Bosra and Palmyra. The mentioned areas are also on the UNESCO List of World Heritage in Danger. The Temple of Bel was one of the historical buildings from that area, which was one of the most important ancient buildings of the Middle East. Unfortunately, it was destroyed beyond recognition in 2015, so the only sources that we have today that document its appearance, construction, and the art that adorned it are the photos of its past visitors. In the contribution of (Wahbeh et al., 2016) the process of image-based digital reconstruction of the Temple of Bel is described based on sets of photos from different sources. A similar approach, but using solely crowdsources data, was chosen in the case of destroyed Plaka Stonebridge in (Stathopoulou et al., 2015).

On the other hand, (Bitelli et al., 2020) applied and compared different methods of image-based digital reconstruction in the field of archeology. In order to evaluate quality of obtained data, in (Somogyi et al., 2016)open access GEO tagged images from tourist sites in Budapest were processed to a 3d Model and compared with laser scanner and DSLR data. Similar approach with registering online images using GNSS tags was presented in (Hartmann et al., 2016). Contribution of (Snavely et al., 2006) showed how this kind of digital reconstruction from crowdsources images can work by presenting structure-from-motion and image-based rendering algorithms.

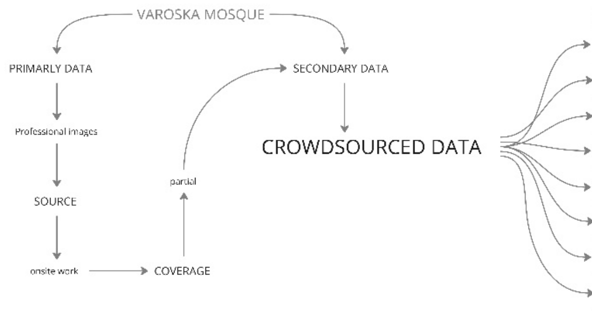
There is an extensive literature discussing the incorporation of crowdsourced data into the documentation of cultural heritage. The quality of the results varies depending on the source data types, photogrammetry software used, and the workflows employed. To determine the best conditions for a successful digital reconstruction from secondary sources, we will define the parameters used in three different papers with those used in the case of reconstruction of the Varoška Mosque. Using this information, we will evaluate the workflow employed in the reconstruction of the mosque.

2.3 Copyright implications

There is a large amount of data that is placed daily on various Internet channels, which makes it available to everyone. For this very reason, data extracted from social media is becoming an increasingly serious source for research in various areas. In the case of cultural heritage, such online data represents a value base of images for digital reconstructions using SfM methods. Although there are databases that openly provide their data for use, in the case of social media there is a certain copyright for all data that is produced and distributed there. In the case of the Varoška Mosque video from YouTube, for purposes of digital reconstruction we received authors permission to process and publish conducted data. However, as YouTube's data is protected by the Fair use policy, processing the video for research purposes without the author's permission does not violate copyright. Fair use is a legal principle that permits utilization of copyrighted material in specific circumstances without the need for autorisation from the owner (YouTube, 2023). Based on criteria for fair use, incorporating social media content for educational or research purposes, as often done in digitalization of cultural heritage, should be acceptable and does not violate copyright law. Fair use applies when only a portion of the images is employed and transformed in a manner that no longer resembles the original images, for example transforming drone flight video into a 3d model (Themistocleous, 2016). In that case, the use drone video undergoes several modifications, and its ultimate result is entirely different from the source. Although such rules differ on different social media channels, the principle when utilizing social media images should function similarly. Despite these regulations, deviations from these guidelines are still possible, and it is advisable, if possible, to seek author's permission for any processing of online data.

2.4 Parameter matrix

In order to define the parameters for the most optimal calculation of the digital model from secondary sources, three projects briefly mentioned in the literature overview part were selected. First project was reconstruction of Temple of Bel (Wahbeh et al., 2016) which is particularly interesting because, like in the our case study, it processed the reconstruction based on combination of professional and amateur data - the first data set consisted of professional panoramic images conducted on-site, and another data set of tourists' images available on the Internet. By using spherical photogrammetry, it was possible to georeferenced conducted 3d model and thus increase its accuracy. Another digital reconstruction was made in the case of Plaka stone bridge (Stathopoulou et al., 2015). Like the Temple of Bel, this is a structure that was completely destroyed, but in this case, crowdsourced images from a large number of different sources represent the only existing data for a possible reconstruction. Secondary data sources were also included in the processing of the digital reconstruction of the two archaeological sites Cahuachi / Tiwanaku in Peru and Bolivia (Bitelli et al., 2020). The Team tested and assessed the process of extracting and selecting images from 4k amateur videos of archeological sites in Peru and Bolivia. Extracted images were then processed together



Parameter	Temple of Bel	Plaka bridge	Cahuachi / Tiwanaku
IMAGE DATA	two data packages	one data package	one data package
FORMAT	image	image	video
SOURCE	Internet and professional	Internet	Internet
COVERAGE	partial	partial	partial
GNSS	yes	no	yes
ADDITIONAL SURVEY DATA	no	no	yes
PROCESSING SOFTWARE	Agisoft PhotoScan	Agisoft PhotoScan	Context Capture
ACCURACY OF THE RESULT	high	medium	medium

Figure 2. Parameter matrix for evaluating of crowdsourced data (E. Kodzoman)

with georeferenced data gathered from previous professional surveys. Based on these three examples of digital reconstruction that also processed secondary data, eight parameters were defined that will be used to evaluate the quality of the final result (Fig.2). The following section will present data packages used for model calculations of Varoška Mosque.

2.5 Data packages

To be able to conduct processes for supplementing the existing data of the Varoška Mosque, the existing material was divided according to its source, purpose, and characteristics into three data packages. The first data package consists of a series of seventy metric terrestrial photos without GNSS positions collected on-site, and covering all four facades documented in one round around the mosque. Since the focus was on the layout of the facades in the beginning of the research project, these photos do not contain sufficient information about the appearance and geometry of the roof and the dome. Photos in the first data package all have portrait orientation and image size of 4000x6000 pixel, and were taken with Sony ILCE-7 camera and 24 mm focal length. The photos were taken under cloudy weather conditions, resulting in partial shading of the facades and dome. Given that these images are in RAW format, which opens up the possibility of adjusting similar settings for all images (like adjusting exposure and shadows), by processing the images it was possible to reveal hidden details that may be essential for later registration. Based on the basic tachymetric measurement of the geometry of this building for the Varoška Mosque, the first data package was assigned control points with the measurements of one facade, and thus this data package will be defined as the master package.

Second data package consists of photographs that were not taken with the aim of capturing the object for purposes of digital reconstruction model. These are amateur photos of project partners from Travnik. and photos of tourists collected from the Internet. Photos in this package have different orientations, dimensions, and different degrees of zoom, which is by no means optimal for the model calculation process. Considering that the photos from this dataset were taken from various angles and elevations, we can obtain first information regarding the relation of the dome to the roof and facades. An issue for the processing is the quality of some of the photos, particularly regarding the parts essential for reconstructing the roof and dome, but this will be discussed later.

Third data package consists of drone photos extracted from an amateur YouTube 4k video. Primary purpose of this video was not to document the objects geometry but rather to show it from various viewpoints. First, the number, i.e. the interval of the frames which will be extracted from the video, was defined. Considering that the speed of the drone in the video was relatively slow, the interval of the extraction was set on 5 seconds. This resulted in a around eight hundred of images. It was then necessary to remove irrelevant images. Some of the photos show close-up of parts of the roof and dome of the Varoška Mosque, and the others were captured from a great distance, and do not cover all facets of the object comprehensively. Also, since it is an online video, the quality of the video, and thus the photos, is limited.

3. RESULTS

Photogrammetry calculation processes were carried out in Reality Capture (RC) software to create a 3d model from a series of photographs (Fig.3). There is little literature and published papers on this software that discuss different application possibilities for calculating the photogrammetry model, and its benefits with respect to other photogrammetry software. Moreover, in some analyses, it appears that RC is relatively unfavorably rated in comparison to other software (Kingsland, 2020). However, because of its possibility of handling a variety of data types very well, it was used in the case of data processing of the Varoška Mosque. As already mentioned, three data packages consisting of professional photos, amateur photos, and an amateur video of a drone flight were included in the process of digital modeling of the Varoška Mosque. To reconstruct the complete geometry of the object, two different workflows of processing the images were tested. In the first step, the data packages were processed individually, and in the second all the data packages were processed at once, resulting in one 3d point cloud.

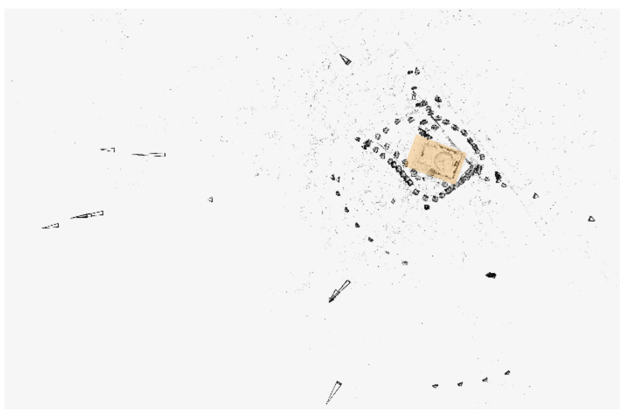


Figure 3. Camera positions of all three data packages (E. Kodzoman)

3.1 Individual processing of data packages

The crucial part of photogrammetric processing is the registration (alignment) of the images, since that is the step which sets the foundation for the quality of subsequent processes. If this part is done successfully, all the images are saved in one component. In the case of our first data package, after the initial image registration of 71 images, the point cloud consisted of 123,443 points that were aligned after one attempt in one component using mostly standard settings but increasing the value of preselector features. This value was set to 40,000, which represents half of the maximum features per image, so the half of the best detected features was used for the alignment. Image overlap, which was set to "low" for the registration of the first package, refers to the amount of shared visual information between two or more images that capture the same object, followed by the reconstruction process set to "normal" detail. The second data package, as mentioned above, contained amateur images captured using various cameras, with differing orientations, zoom levels, and qualities. These images were processed and aligned in multiple components, which was not ideal for the ultimate objective. As a result, the alignment failed, most likely due to inadequate image overlap rather than to different image features. Since this data set covers mostly two prominent facades of the object, the result showed insufficient overlapping points with other two facades. Photos from this data set could not be registered as one component even after positioning the control points. In the following step, images from third data package extracted from a drone video were processed and aligned in multiple components. Given that the video was made from a great distance from the object and covered only two perspectives, the conducted point cloud did not contain enough overlapping points to be aligned into one component. Also, images were extracted from eight different sequences of the video, so every component consisted of photos from a singular sequence. After distributing control points to the parts visible on multiple frames, images were registered to one component with 38,663 points, and reconstructed in normal detail.

3.2 Joined processing of data packages

In the next step, all three packages were processed at once. The first data package, which included measurements from the tachymetric survey, was used as master package and served as a foundation for all other images. For the first image registration, only first data package was added, and the images were aligned in one component. After that initial step where the entire set was successfully registered, the alignment of the solved image connections in the first data package were locked for further alignment. By locking the aligned images of the first data package, their position and orientation were fixed and defined a stable base for alignment of remaining data packages.

In the next step second data package was added to the image section. Before further processing, control points were added to the areas visible in both data packages. Considering the goal of the processing that we defined -- which was to combine information about the roof and the dome with the quadrangular model of the mosque -- the control points were mainly positioned on the roof, around the gutters, and at the corners of the tambour. It was important to define control points in as many images as possible because more images containing the same control point meant more accuracy of the result. Since the second data package contains information about both the facades, and the roof, it was included in the processing next. After the alignment, most of the images were registered in one component together with images from previous packages, but with few exceptions showing mostly the roof areas. After this processing, newly aligned images were also locked in orientation and position and the third image package was added.

Existing control points were also marked in the third data package and the alignment was started. This package had several errors in alignment, and, after the first processing, it was not successfully registered with the existing model in one component, but in several. In this case, well-registered images in the first package were excluded from further processing (disable alignment), and only failed alignments were open for further

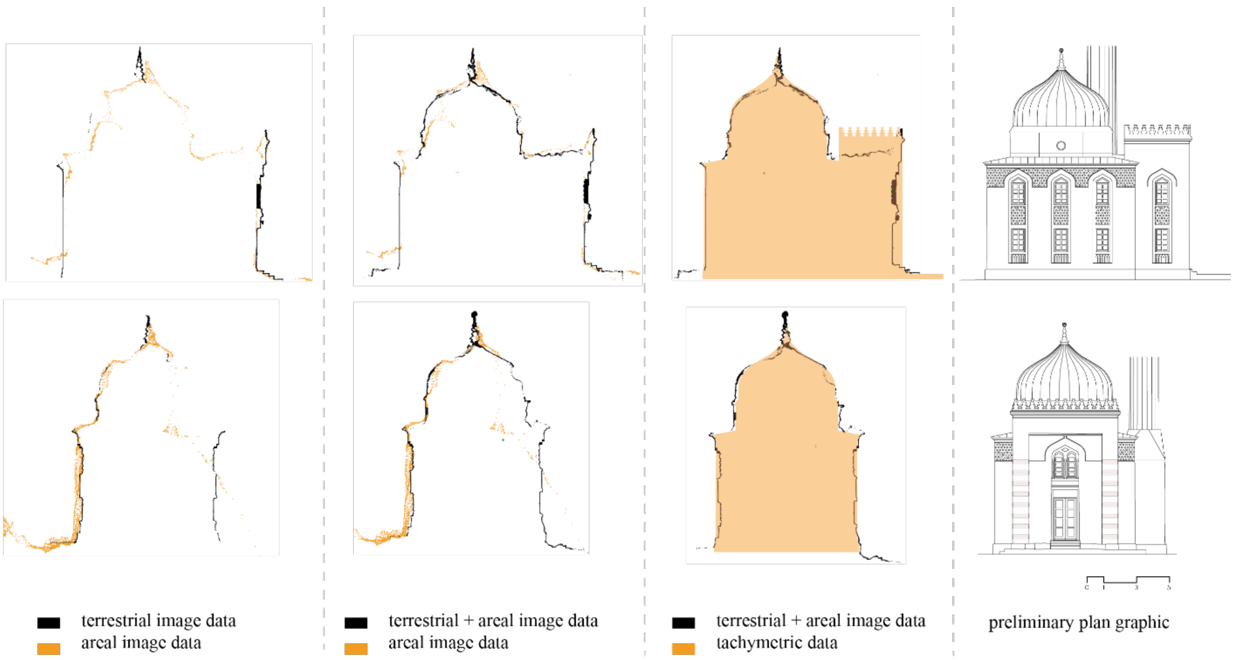


Figure 4. Sections through point clouds deployed from different data packages (E. Kodzoman)

registration, this time without the influence of the master component. For Reality Capture to try and align the weak connections rather than the strong ones (Balabanian, 2021), some of the accurately aligned images that cover similar areas as some images in failed alignment have been enabled and processed again together. After that, failed aligned images were also aligned correctly and processed again with all the images. As a result, there are 152 out of 157 aligned images with the reprojection error of 0.49 pixel.

Based on the results of the previous processing, it was determined that the tree data packages cannot operate independently. After processing all three data packages at once, obtained point cloud showed good quality of the reconstruction of the facades. Because of to the lack of information in both terrestrial and areal images, the dome was not fully covered in the model. Areas that were recorded from a long distance in the video sequences did not produce enough points for the reconstruction of the complete geometry of the dome, but obtained results provided sufficient information for the basic reconstruction of its shape (Fig.4).

4. DISCUSSION

By supplementing the existing material with additional crowdsourced data obtained from the Internet, the requirements for the reconstruction of the roof and dome of Varoška Mosque were fulfilled. In the case of the Varoška Mosque, we processed three different data packages to single point cloud, one of which was created with the intention of documenting the object. A similar situation is visible in the digital reconstruction of Temple of Bel (Wahbeh et al., 2016) where, in addition to the package of crowdsourced data, professional panoramic images were included in the processing. The Cahuachi / Tiwanaku project (Bitelli et al., 2020), other than crowdsourced video data, had the best condition for this objective because it used the point cloud from the laser scan as a base. In Plaka bridge case (Stathopoulou et al., 2015), there was no professional data included in the processing. Professional data in the case of Temple of Bel and Cahuachi / Tiwanaku sites was geopositioned, which provided the object with not only basic measurements, but also with their exact position and orientation in the Global Coordinate system. For Varoška Mosque, the professional package contained images created for the purpose of documenting the object, but because of lacking GNSS it has been assigned only with scaled control marks obtained from tachymetric measurement. Incorporating metric data is an important factor in utilizing secondary data for digital reconstruction, because it can be vital for the processing workflow. Any type of survey, conducted with the objective of documenting the object, which includes at least one measurement collected on-site, can be utilized for this purpose.

Digital reconstruction of Cahuachi / Tiwanaku sites was, as in the case of Varoška Mosque, supplemented with online video data which produced uneven coverage, unwanted occlusions, and holes in the point cloud. In the results of the Varoška Mosque, the north, south and east side of the roof and dome, although the most covered with information from drone videos and terrestrial images, also showed an uneven structure with blurry areas, but provided basic information about the geometry of the dome. The western side of the dome as well as the facade, which is the least covered in our sources, gave unfavorable result (Fig.5). Digital reconstruction of Temple of Bel on the other hand resulted in almost complete point cloud with only minor incomplete horizontal areas. As also in the case of Varoška Mosque, the most attractive areas of Temple of Bel and Plaka bridge, were reconstructed in detail.

When using different software for this kind of task, it is probable that the challenge of merging data from diverse sources is similar problematic in each of them and poses comparable issues. Moreover, the outcome mostly depends on the methodology employed in the workflow. For Varoška Mosque it was systematic aligning of images to one point cloud and defining control points what brought the best result. Although the positioned control points were crucial for connecting different data, due to the poor resolution especially of images extracted from the video, it was not possible to precisely position them. With the end result where almost all images from three different data packages are registered, a significant error in control point accuracy is visible.

5. CONCLUSION

In this paper, using the example of the Varoška Mosque in Travnik, we presented the processes of digital reconstruction, by supplementing existing data with data from secondary sources.

Figure 5. Orthographic projections of new digital reconstruction of Varoška Mosque from Reality Capture (E. Kodzoman)

This refers to data that was not created for the purpose of documentation of an object. In our example, in addition to professional data, photos of tourists who visited the site and an amateur video of a drone flight were included in the process. We learned that tourist photos from different internet sites, apart from being made for different purposes, often have poor quality and do not give us important camera and lens details necessary for successful processing. Also, they mostly cover only the most prominent parts of the object. Similar to tourist images, the ones extracted from drone videos also face the same issue of inadequate coverage and insufficient overlap with the facades necessary for combining with terrestrial data. The obtained model of the Varoška Mosque satisfied our need for the extraction of the basic geometry of the dome, which served as a base for the basic planning documentation. The digital reconstruction of the facades, compared to that of the roof and the dome, is much more successful due to more professional filming and higher quality photos. In contrast to the roof and dome, the digital reconstruction of the facades was considerably more successful, mainly due to higher quality of the images and more professional capturing approach. Although the data of the roof and dome had limited overlap and lower resolution, it still provided good base for further investigations. As we could see in other examples of digital reconstruction from crowdsourced data, most successful results are those that have professional georeferenced data as a base. It is important to emphasize that -- despite the prospect of digital reconstruction based ono crowdsourced data, or data collected via so called *remote survey* the developed 3d model cannot serve as a substitute for original structural heritage and detailed research which one would conduct on-site. This is also the case for destroyed archeological sites. In the case of the need for detailed and precise documentation, it would be important to make a georeferenced laser scan which would provide greater geometrical accuracy of the digital model.

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