DIGITAL SURVEY: HOW IT CAN CHANGE THE WAY WE PERCEIVE AND UNDERSTAND HERITAGE SITES

○R. Vital*1

Keywords. : Laser scanning; photogrammetry; augmented reality; virtual reality; heritage.

1. Introduction

Architectural survey is an evolving field in architecture that has changed significantly during the past decades by the technological advancements in the field of 3D data acquisition. Several methods and tools for data acquisition are available today, namely laser scanning, photogrammetry by images from the ground and photogrammetry by images from the air. Such tools make the survey process much more efficient and accurate than it used to be with conventional methodologies and produces a three-dimensional database. This raises the question of how does digital survey pave the way to innovative ways of representing and explaining heritage to both professionals and the broad public?

2. Digital survey as a forerunner to digital representation

This short paper aims to show how methodologies of digital documentation, like laser-scanning and photogrammetry, can be a starting point for involving digital tools for the representation and understanding of heritage for both professional and lay audiences. Several digital documentation projects will be shown as case-studies, that led to different end products for the representation of sites.

3. Case-studies

3.1. TWO-DIMENSIONAL DRAWINGS VS. A BIM DATABASE

The church of Emanuel in Jaffa, Israel, a building under preservation, was documented through laser scanning, which gave a three-dimensional point cloud. From there, a two-dimensional architectural set was produced for the preservation specialists (Fig.1). Why do we need to go from a three-dimensional database to two-dimensional drawings?

This method of work, namely to create a two-dimensional architectural set from a 3D point cloud database, is compared to the documentation through laser scanning of an orange-packing house from the beginning of the 20th century in the Tel Aviv area. In this case, the point cloud was integrated directly into a Building Information Model (Fig.2) and became part of the three-dimensional database of the architectural retrofitting project, to which all consultants had access to. Thus, the material did not need to be transliterated into two-dimensional drawings. The end-product was the retrofitting of the building, as well as a design intervention that works in balance with the existing old structure.

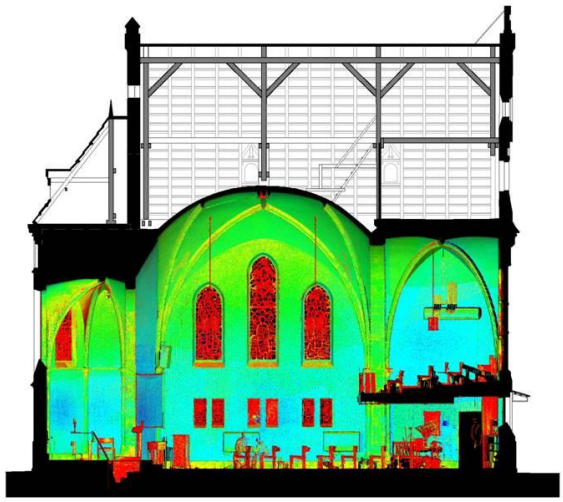

Figure 1. Section in point cloud of laser scanning of Emanuel Church in Jaffa, Israel

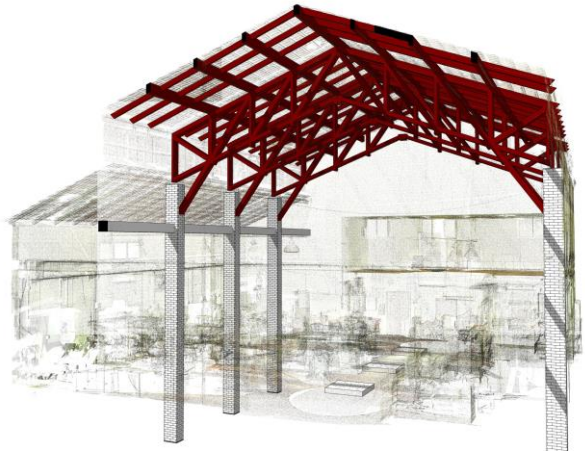

Figure 2. Point Cloud of laser scanning of Orange Packing House in Ramat Gan, Israel within BIM database

3.2. VIRTUAL REALITY

The next case study is the archaeological site of Tel Gezer, Israel. The underground water channel of an Iron Age settlement on the site was documented though laser scanning. The laser scanning methodology helped create an accurate three-dimensional documentation of the amorphic shaped tunnels. The documentation served as a basis for the creation of a virtual reality reconstruction that is displayed on-line and can disseminate information about the site and its activity during the time period of the Iron Age settlement all over the world.

3.3. AUGMENTED REALITY

The next case study is the documentation of the fortress of Masada in the Judean Dessert. Masada is one of the most visited archaeological parks in Israel. Here, the team started exploring how having a digital documentation (Fig.3) can help creating an augmented reality platform that can be accessed from smartphones and tablets by the visitors on site and would allow them to view various reconstructions (Fig.4). The digital documentation would allow for the virtual reconstructions to connect accurately with the existing site and give a seaming-less experience to the user through augmented reality.

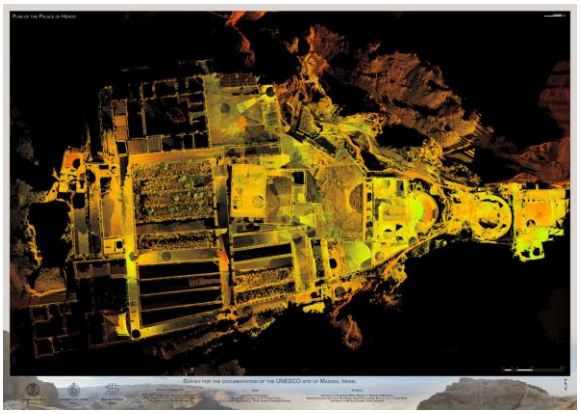

Figure 3. Laser scanning of Masada, Israel – Top view of point cloud

Figure 4. Augmented reality application that shows the reconstructed archaeological site

3.4. 3D PRINTING

The next case study is the documentation through laser scanning of an intricated and sculptural church façade in Pavia, Italy. With this project one can demonstrate the potential of going from digital documentation to digital fabrication and to a physical scaled model for display in a museum or visitor's centre (Fig.5).

Figure 5. 3D printed scaled model of elevation of church in Pavia, Italy.

3.5. DESIGN INTERVENTION IN HISTORICAL SITES

This project deals with an Ottoman bath house in deteriorating conditions, in the old city of Acre in Israel. The interiors of building were documented by laser scanning and the exteriors by drone photogrammetry (Fig.6), due to the lack of accessibility to the roof within the dense urban fabric. The digital documentation served as a basis for creating an architectural intervention design proposal and representing it to the city of Acre for consideration.

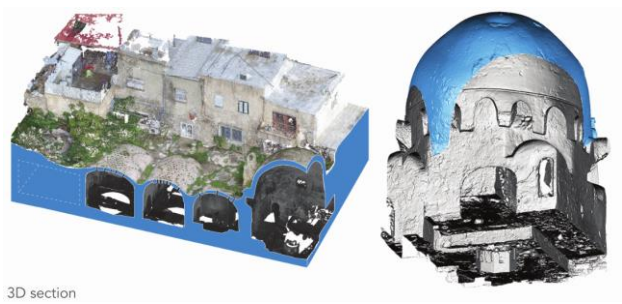

Figure 6. 3D model from drone photogrammetry and laser scanning of Ottoman bath house in Acre, Israel.

3.6. TEACHING ELEMENTARY SCHOOL KIDS ABOUT HERITAGE

The last case study is an outreach project for elementary school kids in Nazareth, Israel. The kids participated in flying a drone that photographed the important heritage sites of their city. Once the images were downloaded, the kids used photogrammetry software to produce simple 3D models of the sites. This project illustrates how current digital tools can engage young kids in the process of documenting their heritage and create a fun didactic activity that teaches them the importance of their heritage, its documentation and its preservation.

4. Conclusions

Digital documentation of historical sites can serve as a basis for the creation of applications like augmented reality in archaeological parks, virtual platforms that allow visiting a reconstructed archaeological site on-line, or VR portals that can allow students or the public to have an immersive experience in a reconstructed historical site and learn about its architecture, literature and politics. Once a site has been digitized and exists as a three-dimensional database, it can easily serve as the raw material to build a realistic model of the existing condition, as well as of different reconstruction theories. Through augmented reality on tablets and smartphones, lay audiences can see the various reconstructions in a dynamic graphic way, ‘on location’. Interactive interfaces within smart devices can allow for additional information to be accessible, like architectural drawings, archival pictures, objects that have been removed from the site, notes from experts etc. Thus, the digitization of a site has positive consequence on how the site can be represented further on, in the process of preservation, whether it is physical preservation or virtual reconstruction.

Acknowledgements

The laser scanning and drawings for the Emmanuel church in Jaffa were done by Mabat 3D. The architect of the retrofit of the Orange Packing house in Ramat Gan is studio Geotectura. The research projects of Masada, Israel and the church in Pavia, Italy are a collaboration between Shenkar, the University of Florence and the University of Pavia. The project in Acre is a collaboration between Shenkar and the University of Milano.

References

1） Bitelli, G., Dellapasqua M., Girelli V.A., Sbaraglia S. and Tini M.A.: 2017, Historical Photogrammetry and Terrestrial Laser Scanning For the 3D Virtual Reconstruction of Destroyed Structures: A Case Study in Italy, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-5/W1, Geomatics & Restoration – Conservation of Cultural Heritage in the Digital Era, Italy, 113-119.

2） Quagliarini E., Clini P and Ripanti M.: 2017, Fast, Low Cost and Safe Methodology for the Assessment of the State of Conservation of Historical Buildings from 3D Laser Scanning: The Case Study of Santa Maria in Portonovo (Italy), Elsevier, Journal of Cultural Heritage, Volume 24, March-April 2017, 175-183.

3） Volk R., Stengel J. and Schultmann F.: 2014, Building Information Modeling (BIM) for existing building – Literature review and future needs, Automation in Construction, V.38, March 2014, 109-127. 3） Minsk, M. L.: 1990, Process models for cultural integration, Journal of culture, 11(4), 49–58.

.

＊1 Shenkar: Design-Engineering-Arts, Israel, Senior Lecturer