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Hypothetical Reconstruction for the Conservation, Preservation and Valorisation of Cultural Heritage: the Kampanopetra Basilica in Salamis, Cyprus

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Abstract

This article describes a digital documentation and visualisation project pursued by the Andreas Pittas Art Characterization (APAC) Laboratories of the Science & Technology in Archaeology and Culture Research Center (STARC) in the framework of the work of the Technical Committee for Cultural Heritage (TCCH), funded by the EU and implemented by United Nations Development Programme (UNDP) in Cyprus. The project's aim was to create a hypothetical 3D (virtual reconstruction and maquette) of the Kampanopetra basilica in ancient Salamis, one of the largest Early Christian churches in Cyprus. The basilica complex is an archaeological site excavated more than 50 years ago and is in need of continuous conservation and special protection. The 3D outcome is useful to map the present state of preservation, for its future conservation and cultural valorisation. The workflow included 3D on-site documentation with image and range-based techniques combined with topographic measurements. The 3D hypothetical reconstruction model included 3 main parts: the documentation process, the authoring process and the integration of the model within the collaborative platform. The 3D reconstruction benefitted from the plans and drawings included in the archaeological report, combined with the utilisation of the 3D documentation of the site along with comparative material - namely examples of contemporary basilica structures in Cyprus and the broader Eastern Mediterranean basin. The produced Reconstruction Models are hosted in two different Web Viewers, the 3D HOP and ATON. The research team pursues key questions, research problems and innovative approaches in archaeology and cultural heritage through the application of advanced science and technology and integrated expertise in humanities, digital heritage and visualisation. The hypothetical reconstruction provides a general visualisation which can be used to inform the general public but also to provide the basis for its systematic and archaeologically detailed representation in the future.

CCS Concepts

***• Computing methodologies** → Mesh geometry models; Point-based models; Image processing; Texturing; Virtual reality; **• Hardware** → Sensor devices and platforms; **• Information systems** → Web applications;*

1. Introduction

The digital documentation of cultural heritage assets has seen significant growth over the past decades, benefiting from advances in technology and its availability, as well as fast and reliable recording and documentation tools and methods. The two main areas of development for these activities are represented by reality-based modelling and non-reality based modelling approaches. Reality-based reconstructions imply the presence of physical remains, which are usually digitised using active and passive sensors, while non-reality based reconstructions are realised using traditional computer graphics techniques complemented by more traditional humanities-focused studies, the close study of textual and visual sources, as well as automated procedural modelling techniques [FCA*17].

The article describes the workflow applied to create the hypothetical 3D reconstruction of the Kampanopetra Basilica with the following steps: a. an accurate documentation and 3D representation of the remains which drew from a fieldwork survey campaign at the archaeological site, followed by post processing of the collected data, b. the creation of the 3D Hypothetical Reconstruction Model based on the plans and drawings published in the archaeological report of the excavator of the site, combined with the 3D documentation of the site and comparative material and c. hosting of the produced 3D model in open Web viewers (e.g., 3D HOP, ATON).

The 3D reconstruction was driven by a series of objectives as defined in the project proposal: a. to raise awareness of the importance and value of the Kampanopetra basilica complex at local,

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national and international levels; b. to support learning activities, research, and studies by allowing a virtual visit and experience of the monument; c. to contribute to the digital preservation of monument with the use of advanced digital technologies; d. to foster the use of technological tools for innovation on cultural heritage sites; e. to support the development of qualified professionals in knowledge management and knowledge sharing regarding cultural heritage sites; f. to engage hard-to-reach audiences who do not participate in cultural heritage-related activities and g. to foster social innovation in cultural heritage projects [UND24].

2. The Kampanopetra Basilica in Salamis

The great basilica of Kampanopetra is located in the south-eastern part of the ancient city of Salamis on the east coast of Cyprus [Nic13], [Pap86], [Rou98], [GC19], [RIM19], [KC98]. The site, which is next to the seashore, takes its name (meaning "stone of the bell") from a local tradition identifying as "kampanopetra" the standing door jamb from the central gate of the main atrium of the complex. The surviving architectural element possibly reminded locals of a belfry.

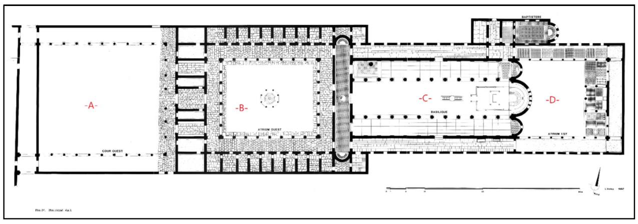

Figure 1: *Plan of the Basilica from George Roux [Rou98].*

The basilica complex (Figure 1), which is dated in the early 6th century, is organised from west to east in the following parts: first, a rectangular courtyard, which was later covered on its north, south and eastern side with colonnaded stoas (wooden roofs with tiles). From its western side, three passageways led to a rectangular atrium with covered stoas on all four sides. A series of rooms developed behind the north and south stoas, as well as on its eastern side and specifically in the spaces that were not used as the aforementioned passageways. In the middle of the atrium's open courtyard, there was an octagonal fountain. The atrium structure is believed to have been a two-storey building with the second floor being organised in a very similar way to the ground level. A range of wooden roofs bearing tiles provided cover.

From the atrium, four doorways led to a long narthex with its north and south sides ending in apses, like in the nearby Basilica of Saint Epiphanius and the Basilica of Kourion. From the narthex, three doors corresponded to the three aisles of the basilica church, with each one leading to semicircular apses. The main apse featured a stepped synthronon, which accommodated the clergy participating in the liturgy. Galleries serving as the women's quarters and/or katechoumenia (spaces for religious teaching and instruction) were located over the side aisles and the narthex. The basilica was covered with elaborate wooden roofs which bore roof tiles. The central aisle was raised above the roofs of the side aisles and the narthex with a series of windows allowing ample light to shine inside the church from above. The basilica's interior was decorated with luxury and imported materials. Two colonnades (twelve columns) with marble bases, shafts and Corinthian capitals separated the aisles. Opus sectile floors and walls covered with colourful marble revetment provided a lavish interior. A magnificent ambo with two opposing staircases was located in the middle of the central aisle. An underground cistern, which seemingly was accessed by visitors and pilgrims, possibly as a holy water fountain, was located at the western end of the north aisle of the church.

Two covered long corridors, each one along the north and the south side of the church respectively, connected the narthex and the church's side aisles with an atrium located immediately to the east of the main basilica building. The atrium's western side was articulated by the three protruding apses from the church's exterior eastern façade. Colonnaded, covered with wooden roofs, stoas enveloped the eastern atrium in its north, east and south sides. Their floors were decorated with opus sectile patterns. In front of the middle of the east stoa, there was an impressive ciborium covered with a wooden tiled roof. The existence of such an atrium is unique in Cyprus and rather rare in Early Christian architecture, with the great basilica of the Anastasis (Resurrection) in Jerusalem providing a useful comparison of the practice. It was an arrangement which pointed to the pilgrimage importance of the complex. The presence of the ciborium suggests the existence of important relics, which can justify the elaborate organisation of the broader complex. At a later date, possibly at the end of the sixth century, the south corridor- specifically its eastern end- was blocked with the construction of an apse along with its western door leading to the narthex. Retaining access only with the south aisle of the basilica church, it became a subsidiary chapel, which seemingly served funerary functions – preserved sarcophagi and burials point to its use. It is also worth mentioning that additional annexes were excavated north of the north corridor of the complex, featuring three rooms and a small chapel with three more rooms to its east. Archaeological excavations also revealed a large bath complex immediately to the east of the east atrium. Bath spaces and rooms were lavishly decorated with beautiful opus sectile floors still preserved onsite. The baths extended almost to the sea, highlighting the close relation of the broader basilica complex with the port of Salamis. Overall, the basilica's location explains its main function, which was directly related to the activity of the Salamis port and the arrival of hundreds of sailors. The presence of the bathhouse is also pointing to the port activity and the needs of seamen, while the basilica and its baptistery provided spiritual cleansing for the arriving sailors, many of whom were Christianised and baptised in Cyprus. The city of Salamis suffered from various natural disasters during its long history. Historical sources attribute the destruction and decline of ancient Salamis to earthquakes in the fourth century, with archaeological evidence confirming the violent collapse of buildings and the disturbed geomorphology of the site being the result of the terrible tremors that devastated the Cypriot metropolis. Kampanopetra was constructed after this destruction and as part of the fourth century efforts to renew the city as Salamis-Constantia (after Emperor Constantius II). The complex was affected and destroyed by the Arab raids of the seventh century, which led to the final decline of the city.

3. Methodology

3.1. Digital documentation and 3D representation of the archaeological remains

3.1.1. Data collection

The project's fieldwork survey campaign was carried out at the archaeological site of Kampanopetra Basilica complex, including the Baths area in the broader archaeological park of Salamis. Image and range-based modelling techniques were applied for the digitisation of the site, combined with topographic measurements. The fieldwork lasted a total of 6 working days.

3.1.1.1. Range-Based Techniques Two different instruments were used for the laser-scanning documentation of the area in order to cover the whole area in time [Mil11], [SGR16]. The first, a Surphaser 25HSX phase shift terrestrial laser scanner, with a certified accuracy of 5mm at 5m, was used to create a high-resolution 3D point cloud of the East Atrium, Basilica and West Atrium structures, describing all the morphological features and architectural details of the remains. In order to avoid gaps in the documentation produced, the scanner was placed in 208 positions, yielding an average distance scanner-object of 3 m. The X-Y resolution for each point cloud was calculated to be 2.5 mm, equivalent to 25 lines per degree (LPD). However, the resolution can be considered higher due to the overlap of the different point clouds and the redundancy of the 3D data. The second instrument was a time-of-flight scanner enhanced with Waveform Digitising (WFD) technology. A Leica BLK360 G1, with a certified accuracy of 4mm at 10m, was used for the creation of a high-resolution 3D point cloud of the West Atrium Courtyard, the Baths area and the surroundings, describing all the morphological features and architectural details of the remains. In order to avoid any gaps in the documentation produced, the scanner was placed in 154 positions, yielding an average distance scanner-object of 3 m. The X-Y resolution for each point cloud was calculated in 4 mm, as the high-density setting was chosen. However, the resolution can be considered higher due to the overlap of the different point clouds and the redundancy of the 3D data.

	Surphaser 25HSX	Leica BLK360 G1	Total
Number of scans	208	154	362
RAW data format	`.c3d`	`.blk`	N/A
RAW data size	106 GB	41.4 GB	147.4 GB
Exported format	`.ptx`	`.e57`	N/A
Exported format size	75.3 GB	238 GB	313.3 GB

Table 1: *Information on the range-based techniques used for the digital documentation of the archaeological complex. The columns show the laser scanners used for the documentation, and the rows summarise the technical information about the data captured. The last column summarises the total size of the data gathered.*

3.1.1.2. Digital Imagery Aiming at applying RGB values to the reality-based 3D model, an image-based survey, both terrestrial and aerial, was carried out. For this purpose, a Canon 80D camera, 24.2 – megapixel sensor device, equipped with a Canon 24 mm prime lens, was used for the terrestrial digital image acquisition. A total of 5,868 images were taken to describe the site. Aerial photogrammetry was performed using a DJI Phantom 4 Pro. Two different flight altitudes were chosen, and both vertical and oblique images were taken. A total of 1,243 images were taken from the drone.

	Canon 80D	FC6310R (DJI Phantom 4 Pro)
Number of images	5,868	1,243
RAW data format	`.cr3`	N/A
RAW data size	185 GB	-
Exported format	`.jpg`	`.jpg`
Exported format size	100 GB	10.1 GB

Table 2: *Information on the digital imagery techniques used for the documentation of the archaeological site. The columns report on the type of cameras used and the rows summarise the technical information on the data captured.*

3.1.1.3. Topographic measurements In order to integrate the different datasets into a common reference system, a topographic network was established by means of GNS System. The network allowed the acquisition of the necessary measurements of Ground Control Points (GCPs), which were previously placed on site in all directions. All the measurements were made in WGS 84/ UTM zone 36N and ellipsoid heights.

3.1.2. Post Processing

In the next stage, the post-processing analysis of all the collected data, various software applications were used [GLDL18]. For the post-processing of the scanning data, JRC Reconstructor (https://gexcel.it/en/10-software/jrc-3d-reconstructor), Cyclone Register 360 Plus (https://leica-geosystems.com/products/laser-scanners/software/leica-cyclone/leica-cyclone-register-360) and Autodesk Recap (https://www.autodesk.com/products/recap/overview) software were used. Images were first edited in Adobe Lightroom (https://lightroom.adobe.com/) and then processed in both Reality Capture (https://www.realityscan.com/en-US/news/realityscan-20-new-release-brings-powerful-new-features-to-a-rebranded-realitycapture) (Figure 2) and Agisoft Metashape Professional (https://www.agisoftmetashape.com/) software (Figure 3). The scans were cleaned from noise (e.g., operators and equipment captured by the scans). The cleaned and georeferenced scans were exported in .e57 format in both cases for the next stage of post-processing.

Figure 2: *Post Processing in Reality Capture, all data integrated, scans, terrestrial and aerial images.*

Different datasets were created to serve and support the different

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Figure 3: *3D model created from aerial images.*

outcomes of the next stage. A high-resolution georeferenced 3D point cloud consisting of 279 million points of 5mm spacing, and a high-resolution georeferenced mesh of 546 million faces was generated for the accurate and updated documentation of the site. A medium resolution 3D point cloud of a 2cm spacing point cloud of 44 million points in a local system was used as the main source of information for the reconstruction process. Finally, a local subsampled model with a high-resolution texture was created to support visualisation in WebGL.

Type of dataset	**Points/Faces**	**Purpose**
High resolution 3D point cloud (Figure 4)	279 m points of 5mm spacing	Required by [UND24], for the accurate and updated documentation.
Medium resolution 3D point cloud	44 m points of 2cm spacing	Main source of information for the reconstruction process
High resolution mesh (Figure 4)	546 m faces	Required by [UND24], for the accurate and updated documentation.
Subsampled mesh with high resolution textures	20 m faces	Support the visualisation in WebGL

Table 3: *Different models for different purposes.*

3.2. Creation of the 3D Hypothetical Reconstruction Model/ Authoring Process

The creation of the 3D Hypothetical Reconstruction Model included three main phases: the documentation process, the authoring process and the integration of the model in a collaborative platform. The 3D Hypothetical Reconstruction Model was based on the plans and drawings included in the publications of the archaeologist who excavated the site, the 3D digital representation

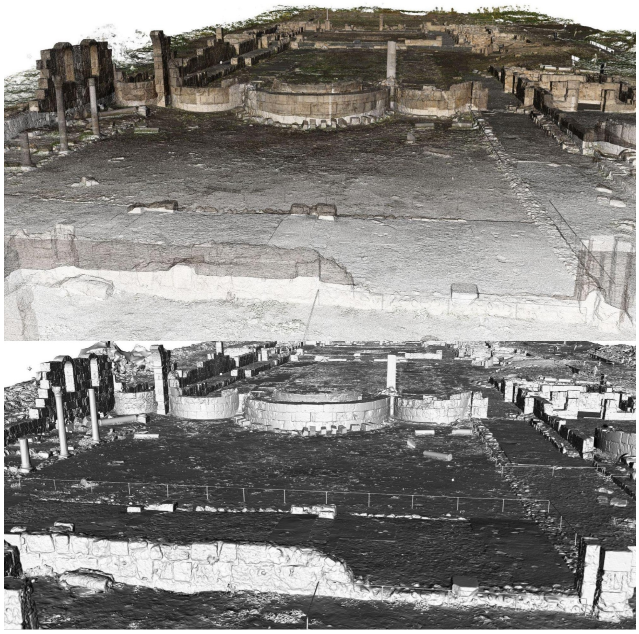


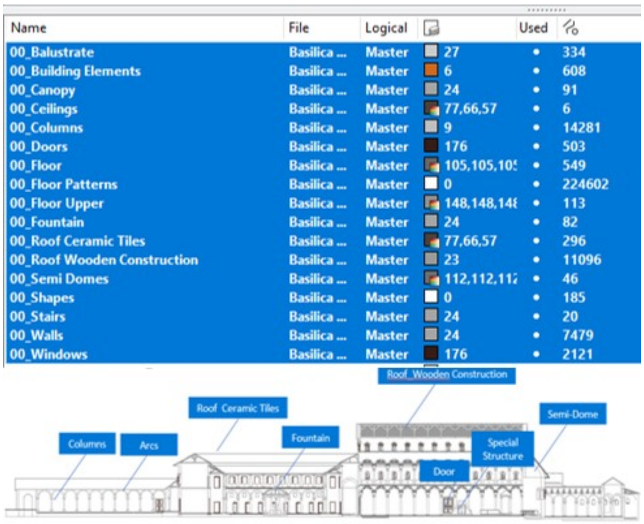
Figure 4: *Visualisation of the 3D representation of the Basilica: high resolution 3D point cloud (upper image); high resolution mesh (lower image).*

of the site's remains and on coeval, comparative material. The location's geological shifts and disturbances were documented in the data collection stage of the site. It presented challenges to the team's efforts to align the preserved situation onsite with the reconstructed 3D model. The team had no other choice but to hypothesise about a more-or-less levelled base upon which the basilica complex was erected. The 3D reconstruction of the Basilica was based primarily on the plans and drawings included in George Roux's [Rou98] publication. In addition, the team was also able to utilise the 3D documentation of the site along with comparative material - namely examples of contemporary basilica structures in Cyprus and the broader Eastern Mediterranean basin, along with the capital Constantinople, Thessaloniki, Jerusalem and other centres of Early Christianity in the Mediterranean.

3.2.1. The Hypothetical Reconstruction Model

Prior to the authoring process, the building was "deconstructed" to its architectural components by performing a sort of reverse engineering. The analysis of the architecture of the complex provided a catalogue of the building components along with their semantic definition and the description of their physical characteristics (Figure 5). This catalogue was used to create a taxonomy that assigns the building components to classes with common attributes, such as their appearance and their unique functional information: walls, columns, floors, arcs, timber roof construction, semi-domes, stairs, etc.

One of the critical challenges in the reconstruction process is ensuring scientific reliability, which can be compromised by inconsistencies between the computer graphics output, archaeological evi-



Name	File	Logical		Used	
00_Balustrate	Basilica ...	Master	27	•	334
00_Building Elements	Basilica ...	Master	6	•	608
00_Canopy	Basilica ...	Master	24	•	91
00_Ceilings	Basilica ...	Master	77,66,57	•	6
00_Columns	Basilica ...	Master	9	•	14281
00_Doors	Basilica ...	Master	176	•	503
00_Floor	Basilica ...	Master	105,105,10!	•	549
00_Floor Patterns	Basilica ...	Master	0	•	224602
00_Floor Upper	Basilica ...	Master	148,148,148	•	113
00_Fountain	Basilica ...	Master	24	•	82
00_Roof Ceramic Tiles	Basilica ...	Master	77,66,57	•	296
00_Roof Wooden Construction	Basilica ...	Master	23	•	11096
00_Semi Domes	Basilica ...	Master	112,112,112	•	46
00_Shapes	Basilica ...	Master	0	•	185
00_Stairs	Basilica ...	Master	24	•	20
00_Walls	Basilica ...	Master	24	•	7479
00_Windows	Basilica ...	Master	176	•	2121

Figure 5: *Semantic Definition of the Building Components.*

dence, and the 3D survey data. The proposed methodology seeks to address this by fostering a high level of interaction and feedback among these three components, thereby optimising the mutual validation of data and improving the accuracy of the final model.

During the development of the Reconstruction Model, the Point Cloud Data from the digital survey was the main source of information, as most objective, and drawings excerpted from the literature, including "Plan IV. Plan restitué: état I", "Plan V. Coupe longitudinale est / ouest et restitution proposée", "Plan VI. Coupe transversale nord / sud et restitution proposée", "Plan VII. Axonométrie, vers le sud-est" from Georges Roux publication as a complementary source. An iterative comparison between these two sources and other reference sources from archaeological research contributed to a more coherent result regarding the final composition of the architectural elements. Areas of uncertainty due to the lack of related information were reconstructed based on archaeological comparisons and typological observations from other examples of Early Christian Basilica architecture in Cyprus and the broader Eastern Mediterranean, like for example the churches in Kourion and Paphos, or the basilica of Agios Demetrios in Thessaloniki (Greece), [Spi84], [Cur10], [Man85], [Pap85], [Meg74]. For reasons of modelling consistency, the chosen Level of Development of the Reconstruction Model is LOD 350, meaning the geometry of the 3D building elements is represented with specific size, shape, location and orientation. Before generating the 3D geometry, the point cloud data was segmented into specific areas and architectural components in CloudCompare (https://www.danielgm.net/cc). The spatial segmentation was based on the building's layout, dividing the space into the East and West Atrium, the Basilica, the Baptistery, and the Courtyard - a spatial layout also reflected in the referenced document [Rou98]. Architectural components selected for segmentation included the remaining structural elements that provided sufficient information for reconstruction, such as standing columns, wall fragments, and preserved bases. This process enabled a better management of the point cloud data and a more focused analysis. The processed data was then integrated into a 3D modelling environment of Open Buildings Designer (https://www.bentley.com/software/openbuildings-designer/) that supports point cloud input, where it was used alongside previously developed 2D drawings. By extracting a series of cross-sections along the three spatial axes, reference lines and surfaces were defined, allowing the creation of 3D volumetric representations of the architectural features. This method contributed to a more precise and informed reconstruction of the building components. Considering that the authoring process had to reflect the interpretive limits of the reconstruction, the development of a scheme map dividing the building's components into four categories helped to address the related challenges and hypotheses.

1) The first category includes the elements that identify structures that part of them is extant in XYZ dimensions, thus their 3D shape is detectable with the 3D capturing methods. In the Kampanopetra Basilica Complex, such structures are the ruins of the walls, the columns, some parts of the stone paved and the mosaic flooring.

2) The second category identifies structures whose part(s) is/are extant in XY dimensions, meaning we can see only their footprint (Figure 6). Walls' shape and orientation, as well as the location of columns, are extracted from the existing footprint.

Figure 6: *Shape extraction from the 3D Model of the existing condition.*

3) The third category includes architectural elements reconstructed from George Roux's [Rou98] publication (Figure 7). These elements were modelled based on the sketches and drawings in the document, including the wall openings, the typology of doors and windows, and the wooden roof structure with its specific inclination. Additionally, key features such as the fountain in the West Atrium and the Ambon within the church were also derived from the provided documentation.

4) The fourth and last category includes the elements that were created based on archaeological and architectural observations and interpretations, as no other evidence was available. Such elements are the wooden roof structures of the Atriums, parts of the flooring and the walls of the upper floor of the West Atrium.

3.2.2. The 3D Hypothetical Reconstruction Model

After the completion of the authoring process, the 3D Model reflects the hypothetical reconstruction of the basilica complex (Figure 8), the 3D Model of the existing structure and from the information extracted from Georges Roux's book and the archaeological research. The native file format of these models is DGN.

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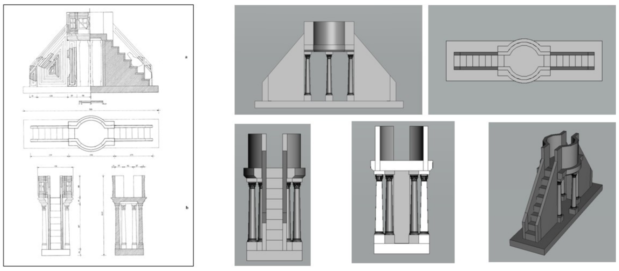

Figure 7: *The ambon of the Basilica as presented in "Salamine de Chypre – La Basilique de Kampanopetra" document and in the 3D Reconstruction Model.*

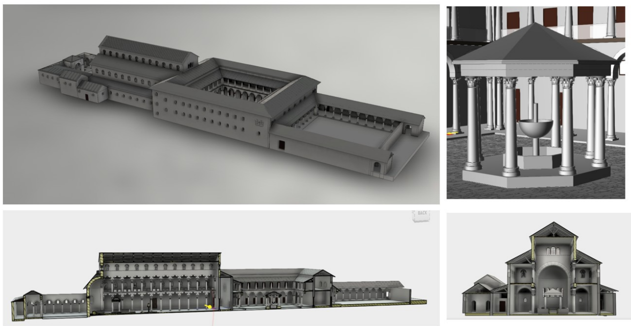

Figure 8: *Views of the 3D Hypothetical Reconstruction Model.*

3.2.3. Proxy Model of the Reconstruction

The file is further processed with shades and colouring in order to produce a second version of the 3D Model, which visualises with a colour scheme the four categories (Figure 9) of the modelling construction and identifies the reliability level of the architectural elements. The DGN Models were exported to .OBJ format to be integrated in Web Viewers.

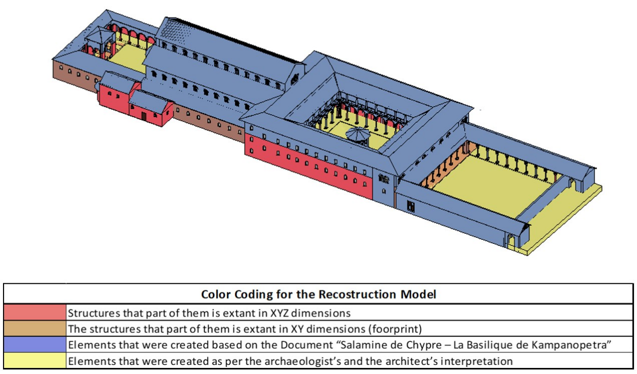

Figure 9: *Colour Coded Visual Representation*

3.3. Hosting of the produced data in Web Viewers

The final step in the workflow is the integration of the generated 3D models into open Web viewers. Such tools play an important role in the monitoring and preservation of cultural heritage by providing accessible and interactive solutions for experts and stakeholders involved in the management and conservation of cultural assets. Using web-based 3D viewers, heritage assets can be explored in detail remotely, supporting conservation efforts and continuous condition assessment. These tools also enhance public engagement by providing immersive experiences that allow users to better understand and learn. Finally, yet importantly, these web viewers can be used as promotional tools, enabling virtual tours and previews of cultural sites, which can stimulate interest and guide visitor planning, ultimately supporting sustainable cultural tourism strategies.

3.3.1. 3DHOP

The tool that the team decided to use was 3DHOP (https://3dhop.net/index.php), an open-source tool that can be embedded in Web Platforms without the need to host the data by a third party. 3DHOP provides various tools to visualise and interact with 3D models. Such as measurements, point-picking, sections, but most importantly, it allows the use of layers and transparency, which are particularly effective for the transparent reconstruction visualisation. 3DHOP supports the implementation of 3D models as .ply or .nxz formats. The 3D models of the existing remains were directly exported from Reality Capture software in .ply format and with a texture map in .JPG format. The models were then run in the NEXUS model converter (https://vcg.isti.cnr.it/vcgtools/nexus/) to convert the .ply files to the multiresolution .nxz format. NEXUS converts the 3D models into a data structure that reduces the size of the original files and makes the models load faster for the first interaction. The process for the hypothetical reconstruction presented several challenges. The data was exported from the modelling software in .OBJ format. Two models were generated, a shaded model to represent the geometry and to be used later for creating a textured representation of the hypothetical reconstruction; and the previously mentioned proxy model that represents the relatability of the reconstruction. Both models were imported into CloudCompare to create "normals" and to convert the textures into RGB colours, and then they were exported in .ply format. The HTML file is designed with 4 layers to accommodate different visualisation options. The first layer is the landscape surroundings of the site; the second layer is the site itself in its current condition. The third layer is a transparent visualisation of the reconstruction that allows the user to see through the elements of the reconstruction (Figure 10). The fourth layer is the proxy model. A toolbar with checkboxes was also added to allow the user to move freely among layers. The user can choose to visualise any combination of the layers together or separately. Figure 11 represents the different tools implemented in 3DHOP.

3.3.2. ATON

In order to further improve the user interaction, the models were implemented in the ATON platform (https://osiris.itabc.cnr.it/aton/), [FG24]. ATON is an open-source framework to create Web3D/WebXR apps interacting with

Figure 10: *Data hosted in 3DHOP, with the visualisation of 3 layers and other tools for interacting with the 3D model.*

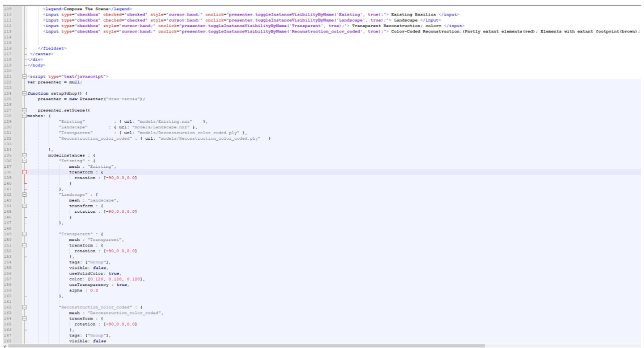

Figure 11: *HTML source code for complex scene settings, which involves separating the models into layers and assigning different visualisation options.*

CH objects and 3D scenes on the Web. It supports a first-person experience with heritage assets, the possibility to integrate semantic annotations, as well as advanced functionalities as advanced rendering of 3D objects (PBR). To be able to host and support a more engaging 3D model, the team created a textured model to provide an outline impression of how a basilica complex of the period could have looked like in the past. The textured model requires further work and is currently in preparation. The platform supports Cesium 3D tiles for the reality-based models as well as .gltf and .glb file formats. The same layer structure was implemented in ATON as well. The reality-based models and the files of the hypothetical reconstruction were converted to .glb format using Blender software (Figure 12). For the implementation in the platform, the same four layers were created, in addition to several first-person predefined viewpoints that guide the user into the inner spaces of the basilica.

3.4. Final Outcomes

The paper describes the methodology followed for the creation of a high-resolution documentation and a 3D hypothetical reconstruction of this important monument (Figures 13 and 14). Additionally, and per the agreement with UNDP, the project generated several outcomes with multiple potential applications. Such as plans (Figures 15 and 16), elevations of the hypothetical reconstruction, and

Figure 12: *Data hosted in ATON, with the 3 layers.*

Figure 13: *Renders produced to provide an impression of how the basilica complex could have looked like in the past (Autodesk 3ds Max).*

3D printed models of the whole complex (Figure 17). Moreover, animations and virtual video tours have been created to promote the project.

4. Concluding remarks

The article describes the entire workflow implemented for the creation of the hypothetical 3D reconstruction of the Kampanopetra basilica in Salamis. The reconstruction was based on the combination of reality-based techniques (laser scanning and photogrammetry) and interpretive methods (bibliographical sources and archaeological research) to ensure the appropriate accuracy for the hypothetical representation and to promote the valorisation of the archaeological site. Therefore, the 3D model was de-

Figure 14: *Renders with the implementation of some of the surviving mosaics on the 3D model (Autodesk 3ds Max).*

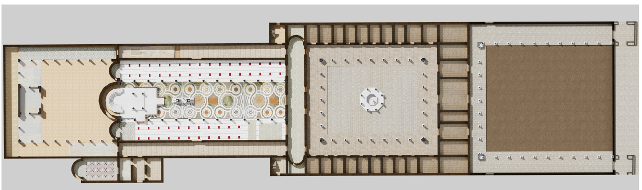

Figure 15: *Ground Floor Plan of Hypothetical Reconstruction*

veloped with careful and systematic categorisation of the represented structural details in order to best reflect levels of evidentiary certainty, thus directly communicating the details of historical interpretation. The project aimed to provide an outline impression of how a basilica complex of the period could have looked like in the past. It is a dynamic scientific visualisation

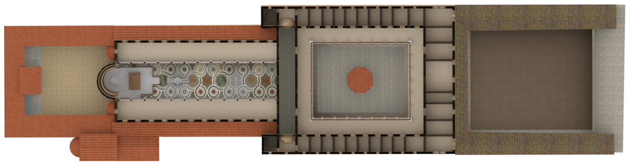

Figure 16: *First Floor Plan of Hypothetical Reconstruction*

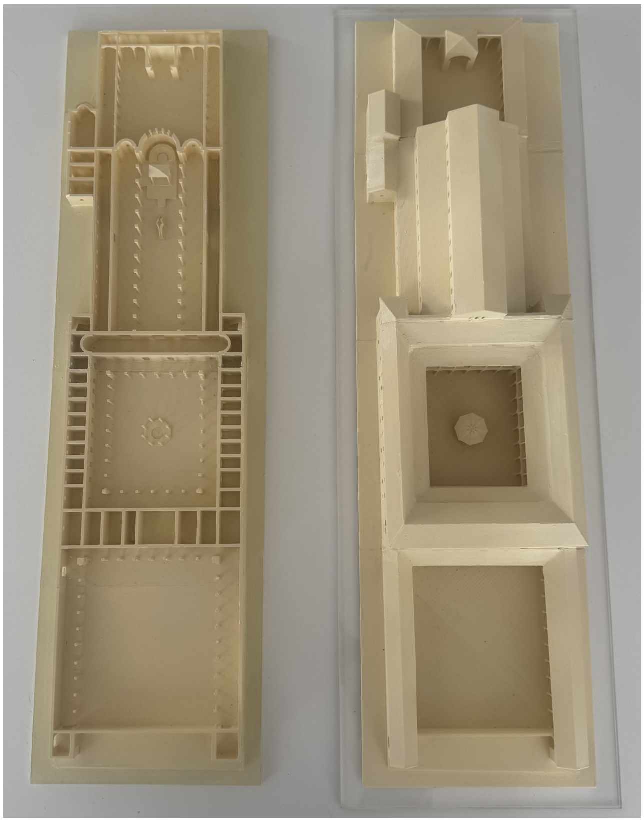

Figure 17: *3D Printed versions of a section and a completed model of the complex.*

effort that can be used as the basis for further development, in detail and accuracy, drawing on expert input and archaeological evidence. This project and its methodological approach were implemented within a pre-defined, tight timeframe, namely between April and June 2024. The produced Reconstruction Models are hosted in two different Web Viewers, the local meshes are hosted in 3DHOP and ATON to enable accessibility to multiple users and allow them to interact with the site remotely. Furthermore, the Reconstructed Models visualised through the cited Web Viewers are embedded in the Cyprus Digital Heritage Platform, an initiative of the Technical Committee on Cultural Heritage (TCCH) aimed at preserving and sharing the cultural heritage of the island (https://www.cyprusdigitalheritage.com/kampanopetra-basilica-in-archeological-site-of-salamis/) for showing to the public the richness of the research and the reconstruction process.

Overall, the hypothetical reconstruction of Kampanopetra contributes to interdisciplinary efforts in heritage protection and valorisation, providing a model methodology that integrates archaeological research, digital innovation and public dissemination strategies. In addition, the use of web platforms to disseminate 3D visualisation material can enable accessibility to multiple users, engaging wider and diverse audiences.

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