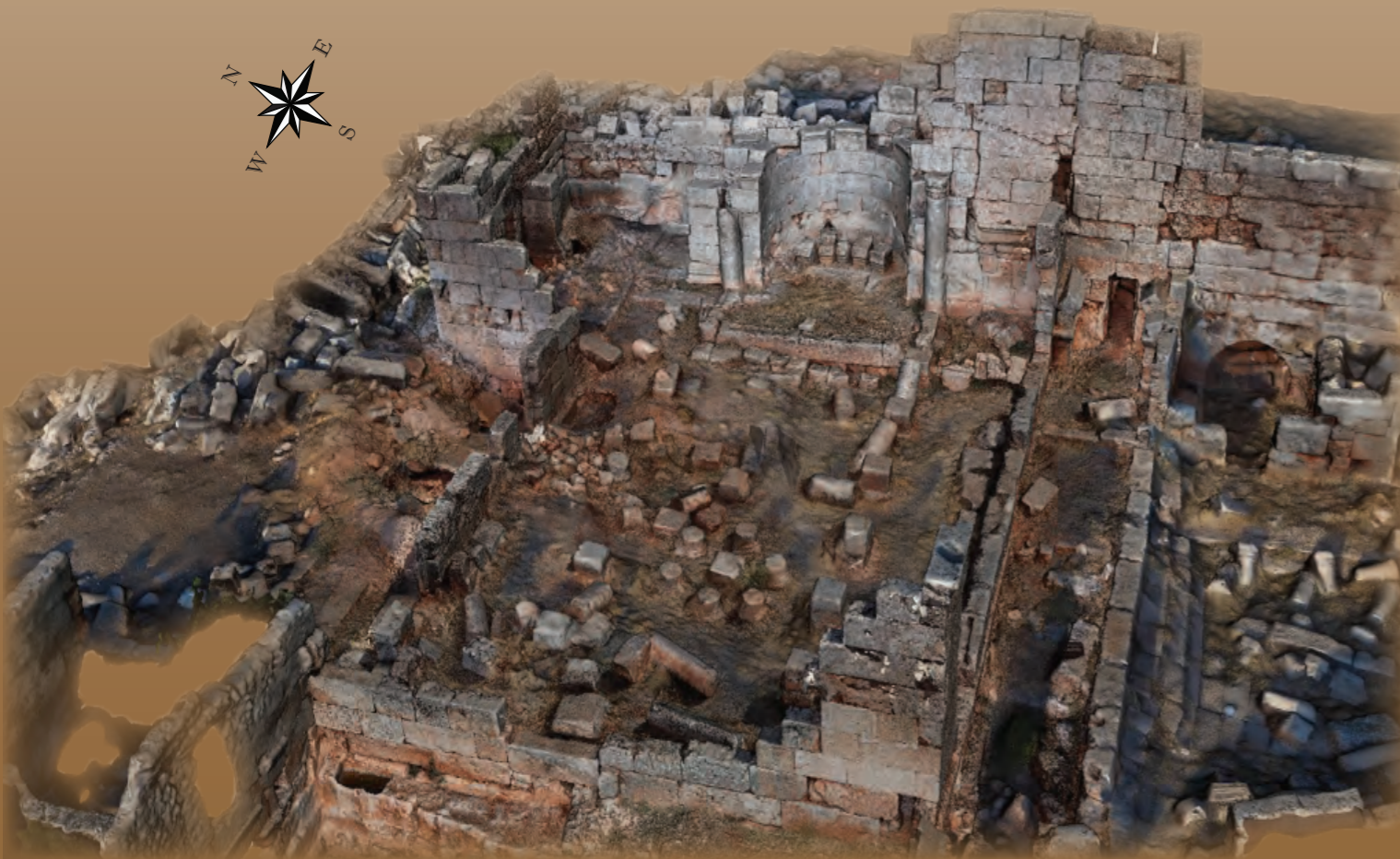


Serjilla



Akira Tsuneki  
Nobuya Watanabe  
Sari Jammo

A Series of Photogrammetry for Protection of Syrian Cultural Heritage

Ancient Villages of Northern Syria

Vol. 3

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## 1. Ancient Villages in Northern Syria Photogrammetry Project: Church at Serjilla

Akira TSUNEKI

Since 2016, the University of Tsukuba has received financial support for the protection of Syrian cultural heritage from the Agency for Cultural Affairs of the Japanese Government. We are now executing three basic operations: 1) Teaching young Syrians about the importance of Syrian cultural heritage, 2) Documentation of endangered Syrian cultural heritage, and 3) Preparation of manuals regarding the safeguarding of cultural heritage in the field and museums. This booklet is the third result of our second operation, 2) Documentation of endangered Syrian cultural heritage.

For the second operation, we conducted a photogrammetry project at one of six Syria's World Heritage sites, the "Ancient Villages of Northern Syria." The Ancient Villages of Northern Syria are located in the limestone mountains of northwestern Syria, consisting of Jabal Saiman in the north, Jabal Barish and Wastani in the middle, and Jabal Zawiye in the south, extending for about 2000 km<sup>2</sup>. Archaeological investigations of the limestone mountains (Le Massif Calcaire) starting

with those conducted by Vogue (1865-1877) and Butlar (1920) have identified a huge number of Roman-Byzantine settlements in the area. Systematic investigations by Tchalenko (1953) revealed evidence of over 700 ancient settlements that prospered during the Roman-Byzantine periods (from the 1<sup>st</sup> to 7<sup>th</sup> centuries) (Figs. 1 and 2). The villages in these mountains flourished as a result of olive oil production and trade. The production of this local olive oil occurred at the end of the prosperity of



Fig.1 Location of Serjilla (Source, Abdulkarim, and Charpentier 2016)

the Roman Empire. The combination of well-preserved building remains and limestone mountains create an impressive historical landscape, and this unique cultural heritage has long attracted the interest of archaeologists and the public.

However, severe damage to the architecture of these sites have been reported repeatedly during the recent conflict. Therefore, we decided to begin documenting the architecture of these unique cultural heritage sites. We dispatched our Syrian colleagues to the sites, where they took digital photographs of the target architecture. Using these photographs, we created 3D images of the target architecture. Among the enormous amount of Roman-Byzantine architecture at the sites, we focused on recording early churches. The remains of the early churches in the limestone mountains provide a wealth of information about the appearance and development of churches (Butler 1920, Tchalenko et Baccache 1978-1980).

A church at Qalb Lozeh was our first target for documentation, and the results were published as *A Series of Photogrammetry for Protection of Syrian Cultural Heritage: Ancient Villages of Northern Syria Vol. 1: Qalb Lozeh* (Tsuneki, Watanabe, and Jammo 2017). A 5<sup>th</sup>-century church at Al-Bara was our second target, and the results were published as *A Series of Photogrammetry for Protection of Syrian Cultural Heritage: Ancient Villages of Northern Syria Vol. 2: Al-Bara* (Tsuneki, Watanabe, Jammo, and Takizawa 2017). The 3D images of churches at Qalb Lozeh and Al-Bara can be viewed and utilized via the following URL.

<http://rcwasia.hass.tsukuba.ac.jp/bunka/>

A 4<sup>th</sup>-century church at Serjilla was selected as our third target for 3D documentation and is outlined in this booklet.

**Serjilla** (سيرجيلة) 35°40'15"N, 36°35'01"E altitude: 460m

Serjilla is located 5km east of the contemporary large settlement of Al-Bara in the Zawiye Mountains. It was built on both sides of a small valley, consisting of monumental tombs; public buildings such as baths, inns, a church compound and olive oil presses; and many domestic houses

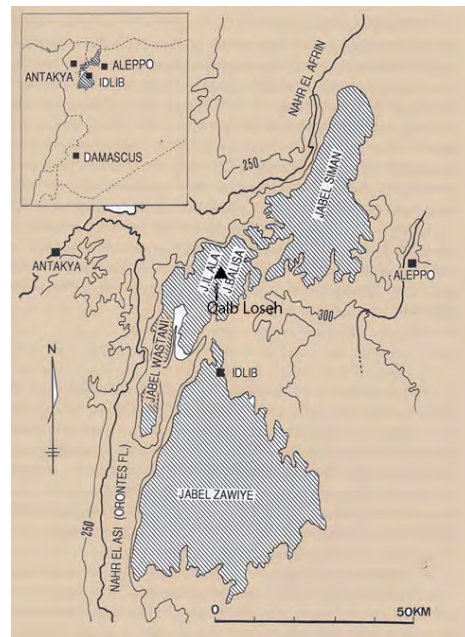


Fig. 2 Limestone mountains of Northwestern Syria



(Fig. 3). One of the olive oil presses is large, measuring 15 x 10m, and well-preserved. It is able to successfully convey the condition of Roman-Byzantine olive oil production. The village itself dates back to the 1<sup>st</sup> century AD and was abandoned in the 7<sup>th</sup> century AD.

A church compound was discovered on the eastern slope of the small valley. The compound itself is large, but its state of preservation is relatively poor. The apse is preserved up to the springing of the half dome. Based on the form of the Basilica (Fig. 4) and the style of the door-cap, both Butler (1920) and Tchalenko (1958) suggested that this church dated to the middle of the fourth century A.D. Therefore, this Serjilla church is an example of the early style of churches in northwestern Syria

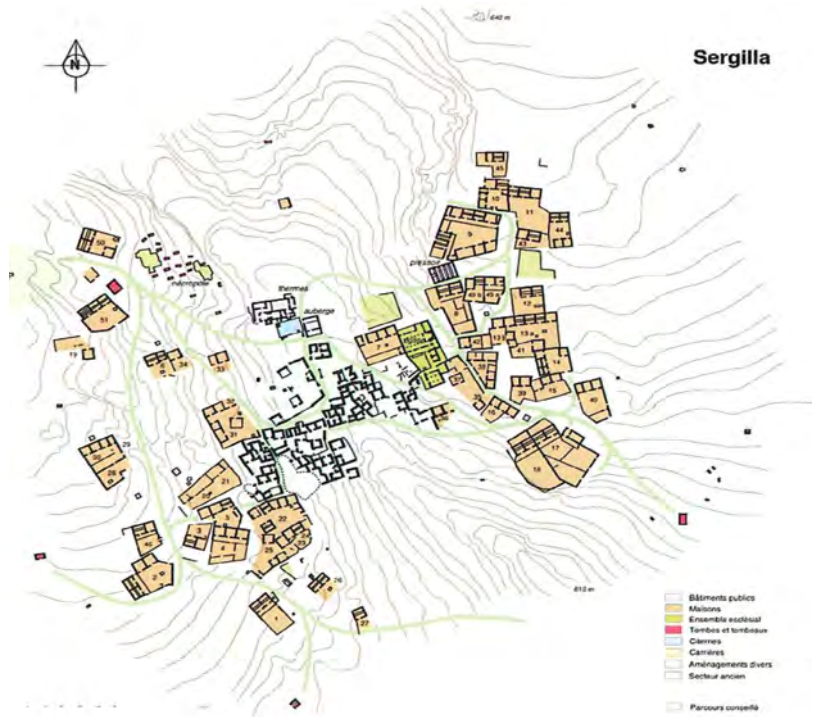


Fig. 3 Map of Serjilla village (Source, Abdulkarim and Charpentier 2016)

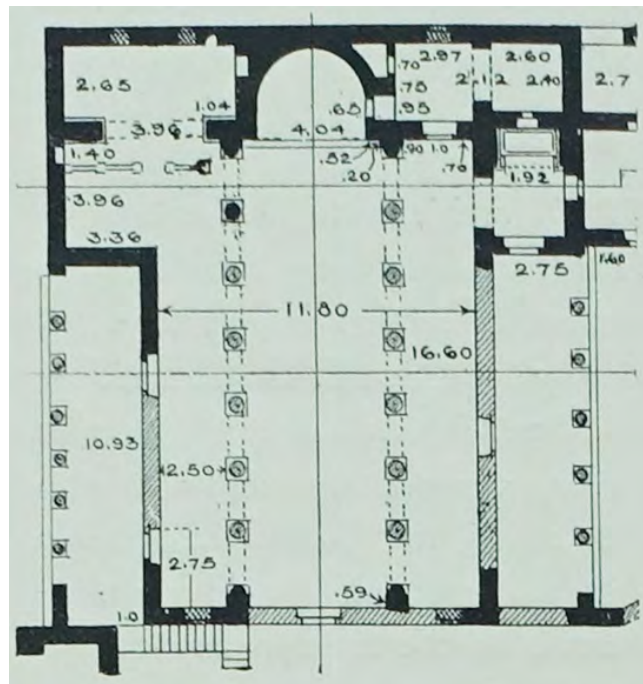


Fig. 4 A plan of Serjilla 4th Century Church (Butler 1920, ill. 22)

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## 2. Serjilla :Preservation Status, Current Condition and 3D Photogrammetry Sari JAMMO

### 1. Abstract

Serjilla is one of the best-preserved Byzantine-era sites in the Ancient Villages of Northern Syria. Serjilla is located to the south of Idlib city in the Jebel Zawiye area, close to the ruins of Al-Bara. Archaeological work began in this region in the 1930s with an archaeological mission directed by the French scholar G. Tchalenko (Tchalenko 1953). Excavation and survey works in the area have provided abundant information about the history of these cities, indicating that occupation of this region began in the first century AD. The region reached the summit of its development and prosperity with the spread of Christianity. Serjilla is spread over a small valley and surrounding hills. The settlement includes a remarkably well-preserved church, inn, public baths, olive oil presses, tombs, and several villas, representing a complete typical village of the period (Fig. 1).

Since 2011, a large number of archaeology sites, standing ruins, and museums have suffered from an excessive level of vandalism and destruction, mainly due to military action and looting (Jammo 2015). Furthermore, some of the sites seem to have been intentionally and systematically destroyed to the extent that they may eventually disappear, such as in Al-Bara Ancient city. Recently, the most common and pressing phenomena is the dismantling of archaeological ruins, as the stones are recycled into carved or hewn blocks and are sold to local people for use in new houses (Tsuneki, Watanabe, and Jammo 2017). Unfortunately, most of the Ancient Villages of Northern Syria sites have been subjected to this kind of vandalism. In some instances, the ruins become

quarries and the main stone sources for modern building, and people freely access and extract the stones (Tsuneki et al. 2018).



*Figure 1 General view for Serjilla*

## 2. Paramilitary Survey in Serjilla

In continuation of our previous projects over the past two years in Qalb Lozeh Church and al-Bara Ancient city, the Serjilla site was selected for 3D modeling due to its importance and that of the church in particular. Fortunately, at the time of the project, the site had survived military actions; it was surprisingly well-preserved and had withstood the wave of destruction of cultural properties, unlike adjacent sites in the same region (Fig. 2). The site was protected by an armed group of locals who prevented the public from accessing the site in order to protect the ruins from being used as a quarry for stone for modern buildings. Most, if not all, of the buildings remained intact; however, evidence of clashes that have



*Figure 2 The current condition of Serjilla's buildings*

taken place in or near the site could be seen through traces of shelling on the external walls of some buildings (Fig. 3).

Even though the condition of preservation in Serjilla is better than that of other sites in the region, instances of vandalism were documented; limited illegal excavations were observed in several parts of the site. Luckily, these illegal excavations did not cause considerable damage to the site or to the buildings that had been affected. For instance, six holes measured about 1.5 meter in diameter and 1.5 meter in depth were identified along the external and interior sides of the northern wall and near the apse (Fig. 4).





*Figure 3 Traces of munitions fire*



*Figure 4 Illegal excavations*



### 3. Building description

The church building has a T-shape with an axis that is aligned east–west (apse-entrance). The structure is not complete, and the walls are not high apart from in some parts of the apse and entrance sides. The church is connected to other annex buildings at the west and south. Before the entrance to the church’s main building or “sanctuary,” there is an entrance to an attached building. The church has two side aisles on the right and left and another in the center leading to the apse. The side aisles have doors that lead to small rooms located on the right and left of the apse.

The church sanctuary is divided into three aisles (right, central, and left) by a row of eight stone columns. All of the sanctuary columns have collapsed; their stone fragments are scattered on the ground but their bases are still standing. Only two columns on the right and left side of the apse stand intact. The right and left aisles have the same plan and end with a door in the east. The central aisle ends at the church apse, which has a small door-opening leading to the right-side small room (Figs. 5, 6).



*Figure 5 Aerial photo showing the plan of the church and attached buildings*





*Figure 6 The apse small door-opening*

#### **4. Photogrammetric process**

Sergilla is a relatively large site and contains many beautiful buildings. The church was chosen as the object of 3D modelling because it is one of the oldest churches in the region.. The small size of the church building and its relatively low walls allowed photos to be taken freely from all sides and directions. The tools, as usual, were simple: a camera, pole, and drone. Most of the work was undertaken using the photos taken at ground level. The camera pole was sufficient for reaching the higher elevation and taking photos from above. The work was successfully accomplished, step by step, wall by wall, layer by layer, employing more than a 70% overlap of horizontal and vertical photos, appropriate timing, dead spots, shadows, and following all instructions in the photogrammetry for cultural heritage brochure (Watanabe 2017).

About 4,000 ground and aerial photos and some video footage were required to cover all the internal and external facades. While the ground photos only covered the church, the aerial photos covered the church and the attached building. This helped us to build a 3D model of the entire targeted area in the site.

#### **5. Conclusion**

Archaeological sites and cultural properties in Syria are the country's most distinguishing features. Therefore, local people in Syria have a responsibility to safeguard and protect their heritage.

Unfortunately, many people do not share this sense of responsibility, and the resulting lack of cultural awareness is visible through vandalism of archaeological sites. The wish is that these documentation projects working in cooperation with civil organization groups will contribute towards safeguarding Syrian cultural heritage. It is also hoped that these projects will pay significant attention to improving knowledge provision and building awareness for locals in relation to Syrian cultural heritage. Further, these documentation projects will facilitate future reconstruction work in the case that any of these buildings face the destiny of destruction.

**Photo annex**



*Interior eastern facade*





*View from the north*



*Interior north eastern facade*





*Southern side attached building*



*Sanctuary*



*Aerial photos*











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### **3. Digital documentation of the Church in Serjilla**

**Nobuya WATANABE**

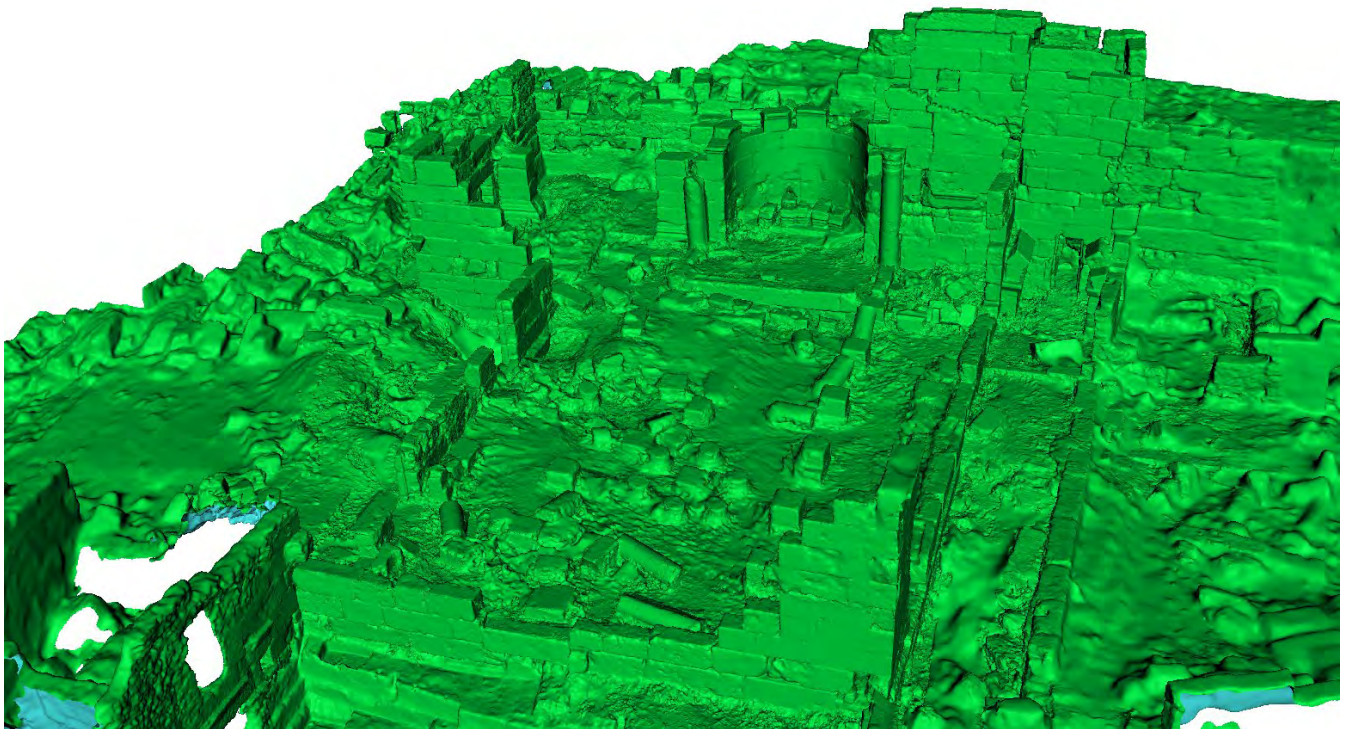
Digital documentation was conducted using photogrammetric techniques to record the church in Serjilla. Photographs were collected by local cooperators and were sent to the researchers via the internet. Photographs were taken using both handheld cameras and unmanned aerial vehicles (UAV). The final 3D model was built by combining the models derived from each set of photographs. The 3D model was processed with SfM software (Agisoft PhotoScan Pro) and was cleaned and edited using Meshlab, CloudCompare, and Blender. Further documentation such as digital drawings, 360 degrees movies, and VR contents were implemented based on this 3D model. The results of the 3D model and the derived contents will be introduced in this report.

#### **1. Derived 3D model**

About 130 UAV photographs and 2,000 handheld photographs were used to generate this model. 3D models at different detail levels were prepared for different uses (e.g. the higher-level model for measurement, the lower for visualization). The figures in this chapter are based on the middle-detail model (about 7,500,000 faces).



1.1. View around the apse

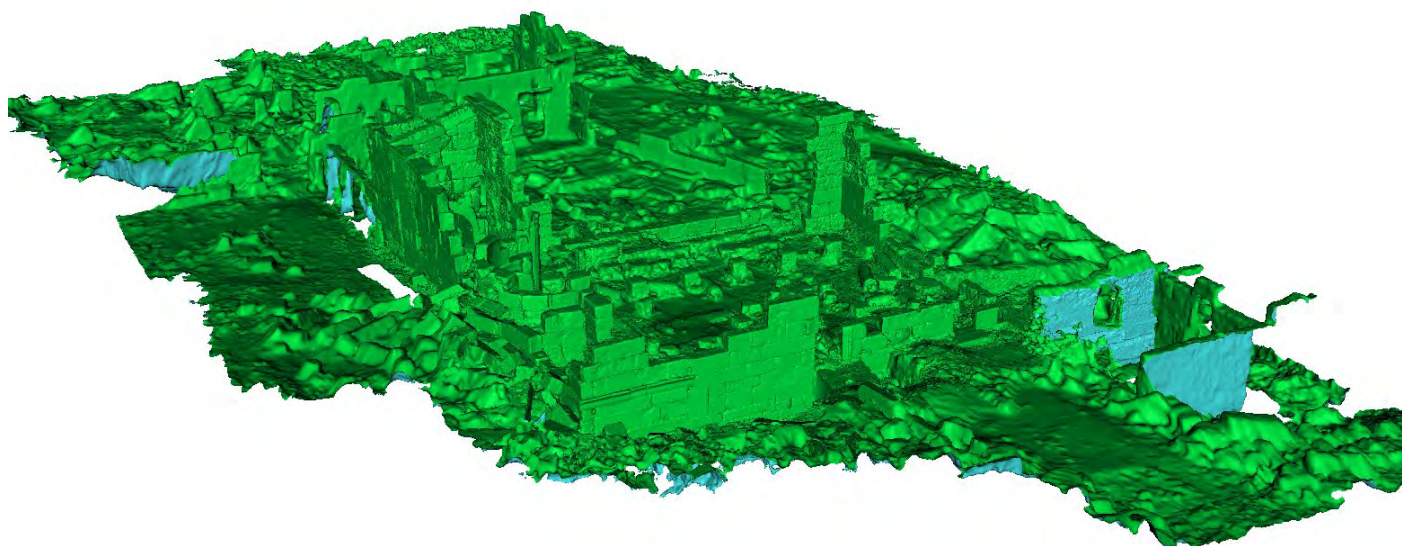


**Fig. 1** Upper: Colored 3D model around the apse (looking from the west)

**Fig. 2** Lower: Same view in shaded 3D model



1.2. View from the north

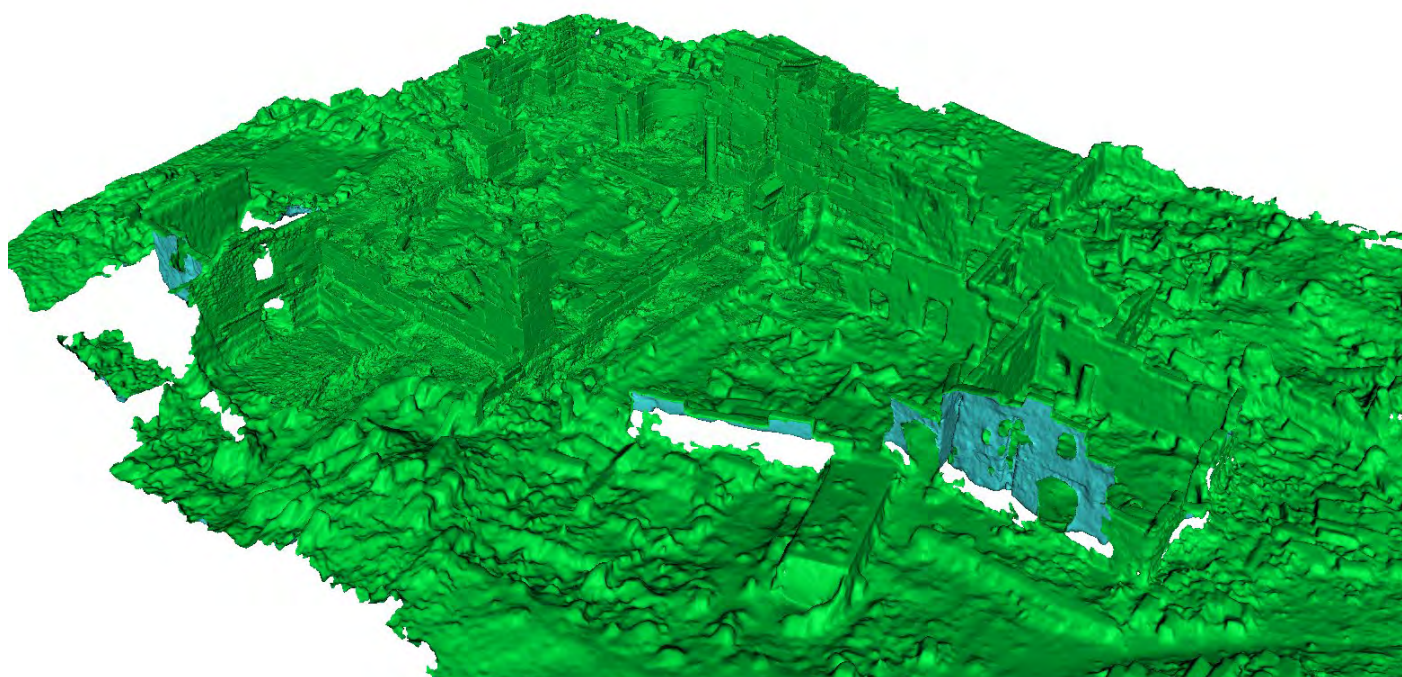


**Fig. 3** Upper: Colored 3D model (looking from the north)

**Fig. 4** Lower: Same view in shaded 3D model



1.3. View from the south

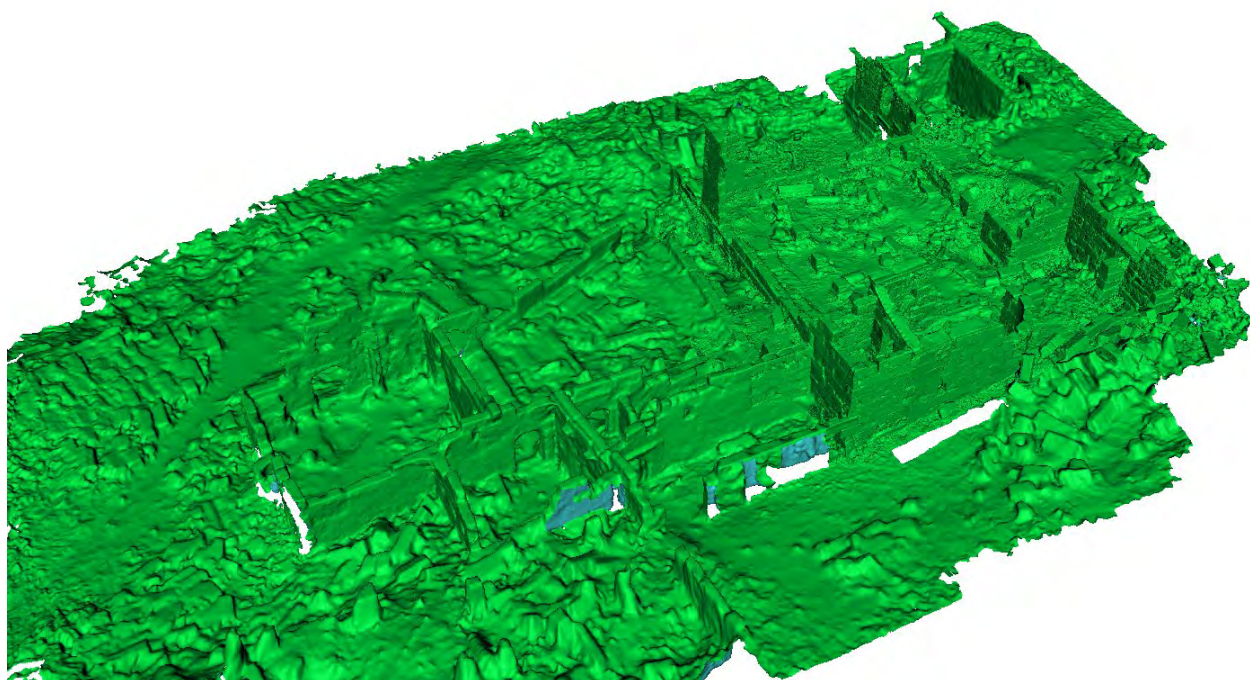


**Fig. 5** Upper: Colored 3D model (looking from the south)

**Fig. 6** Lower: Same view in shaded 3D model



1.4. View from the east

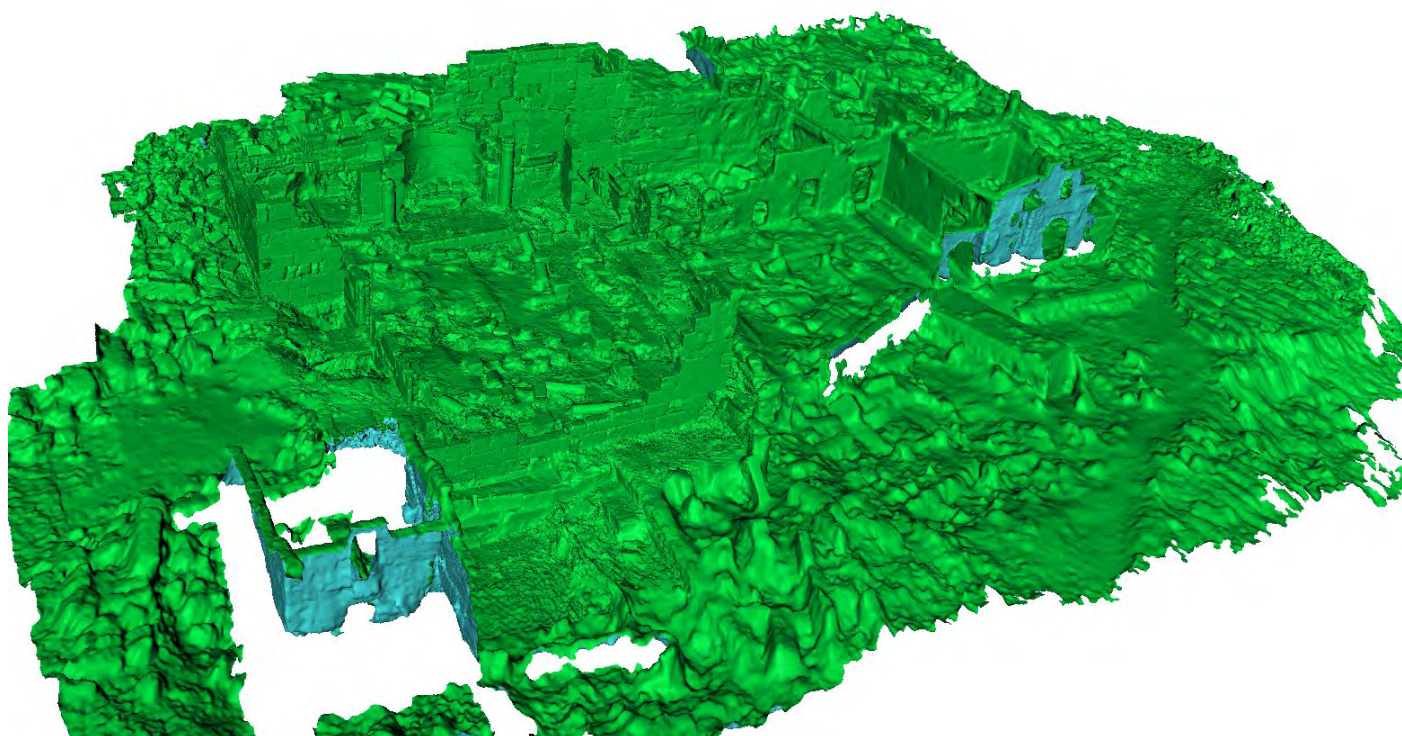


**Fig. 7** Upper: Colored 3D model (looking from the east)

**Fig. 8** Lower: Same view in shaded 3D model



1.5. View from the west



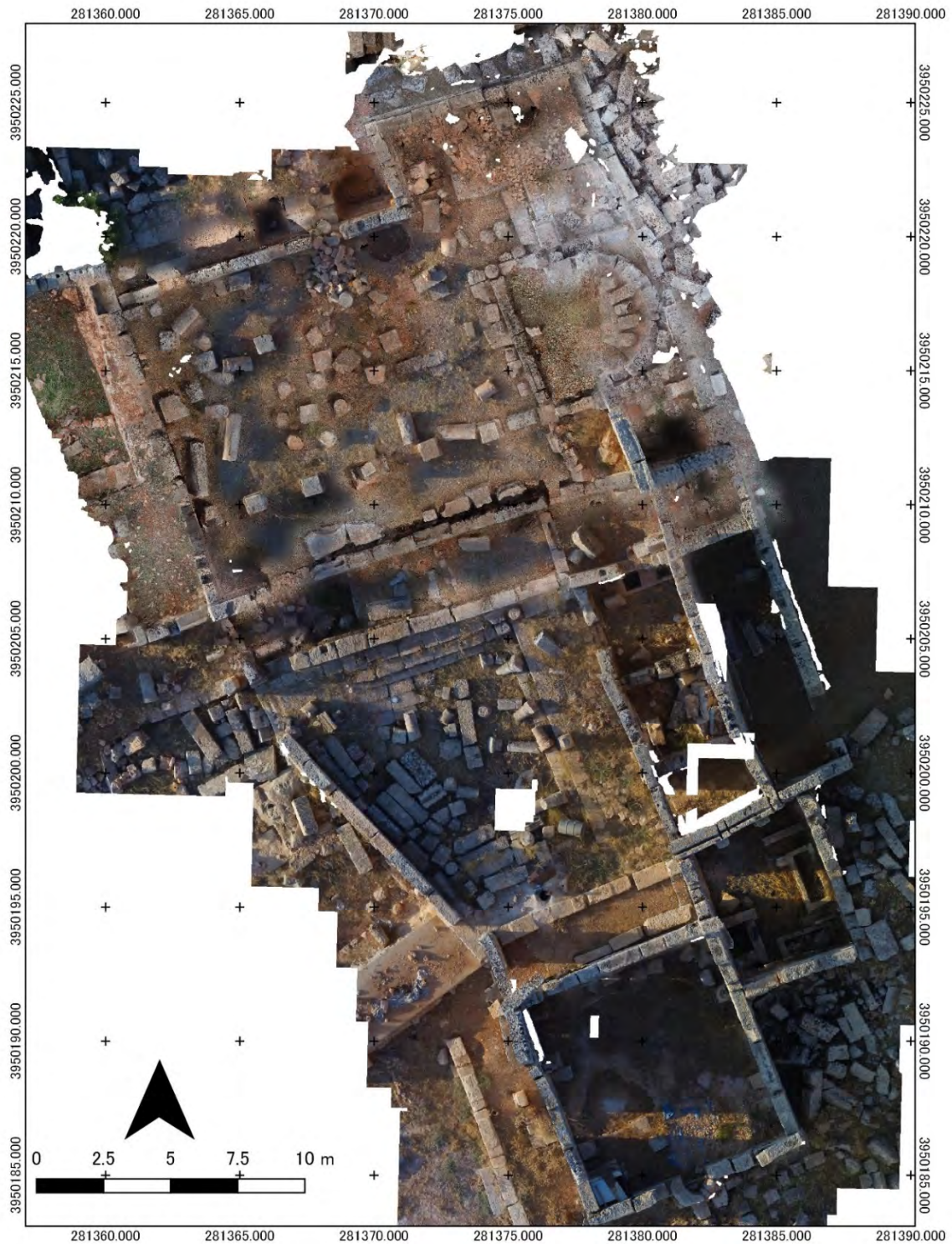
**Fig. 9** Upper: Colored 3D model (looking from the west)

**Fig. 10** Lower: Same view in shaded 3D model



## 2. GIS data (Geocoded orthophoto data)

GIS raster data (orthophoto) was generated with coordinates (in WGS84 LatLon and WGS84 UTM Zone37N). Following is an example of map derived by GIS using this data.



**Fig. 1** Map derived by GIS software using geocoded orthophoto.

### 3. Othophotos and drawings for plans

#### 3.1. Floor plan



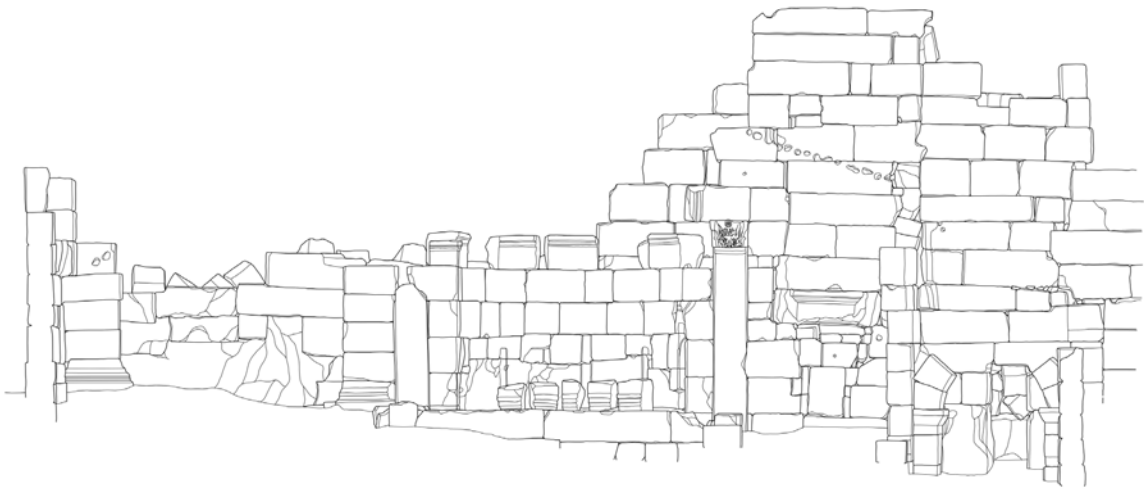
**Fig. 2 Left: Orthophoto of the floor plan Right: Digital traced floor plan**

#### 3.2. Elevation plan (Apse)



**Fig. 3 Orthophoto of the elevation plan around the apse.**



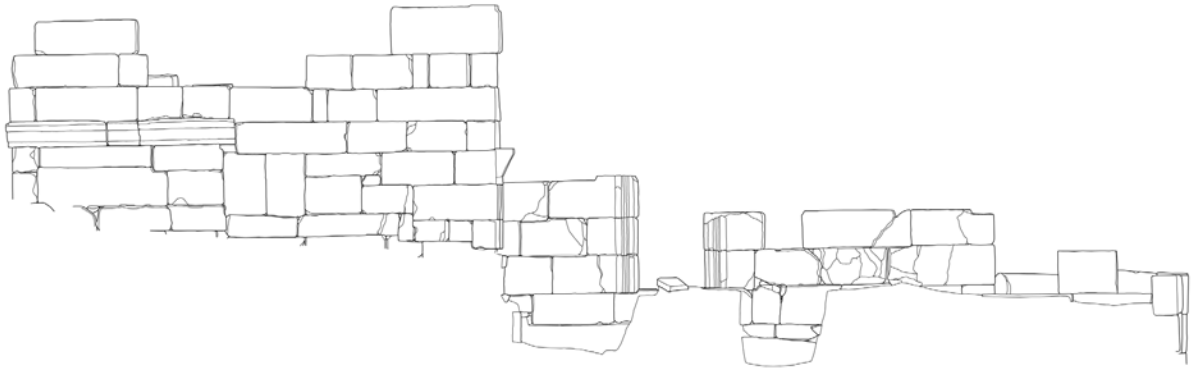


**Fig. 4 Digital traced elevation plan (around the apse)**

3.3. Side elevation plan (from northwest, outer wall)

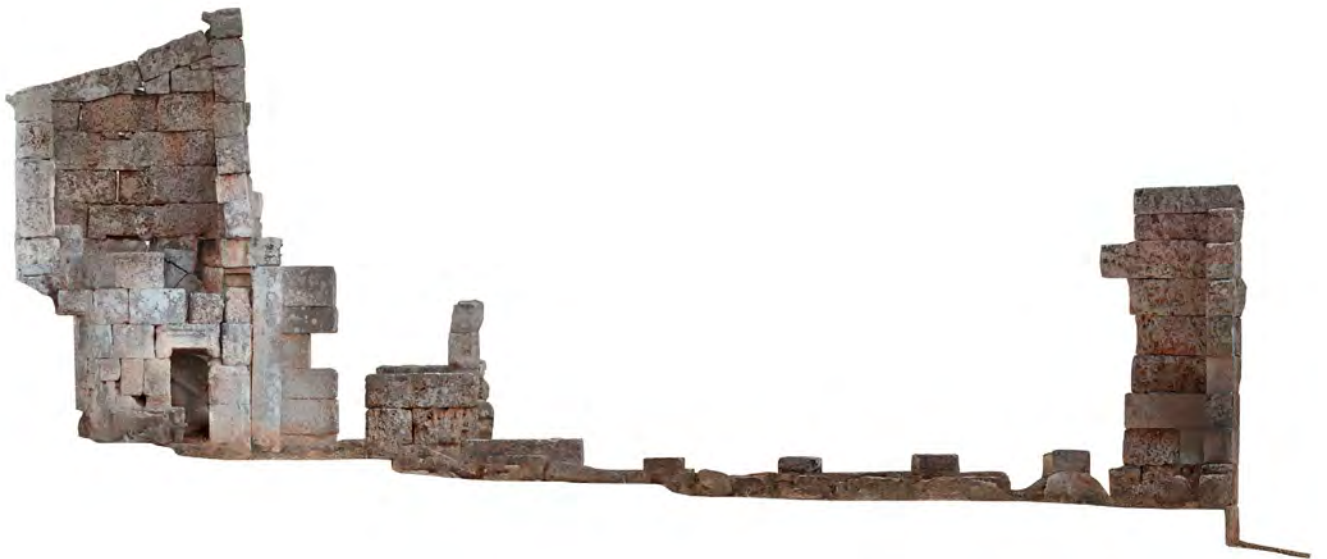


**Fig. 5 Orthophoto of the side elevation plan (northwest outer wall)**



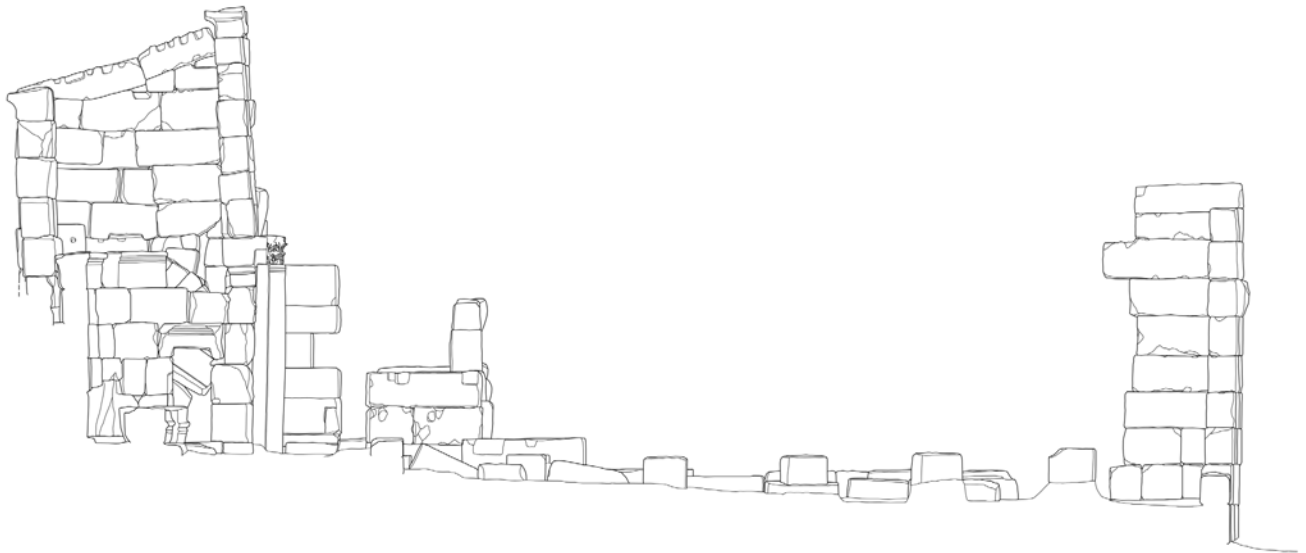
**Fig. 6 Digital traced side elevation plan (northwest outer wall)**

3.4. Side elevation plan (from northwest, inner walls)



**Fig. 7 Orthophoto of the side elevation plan (northwest inner wall)**

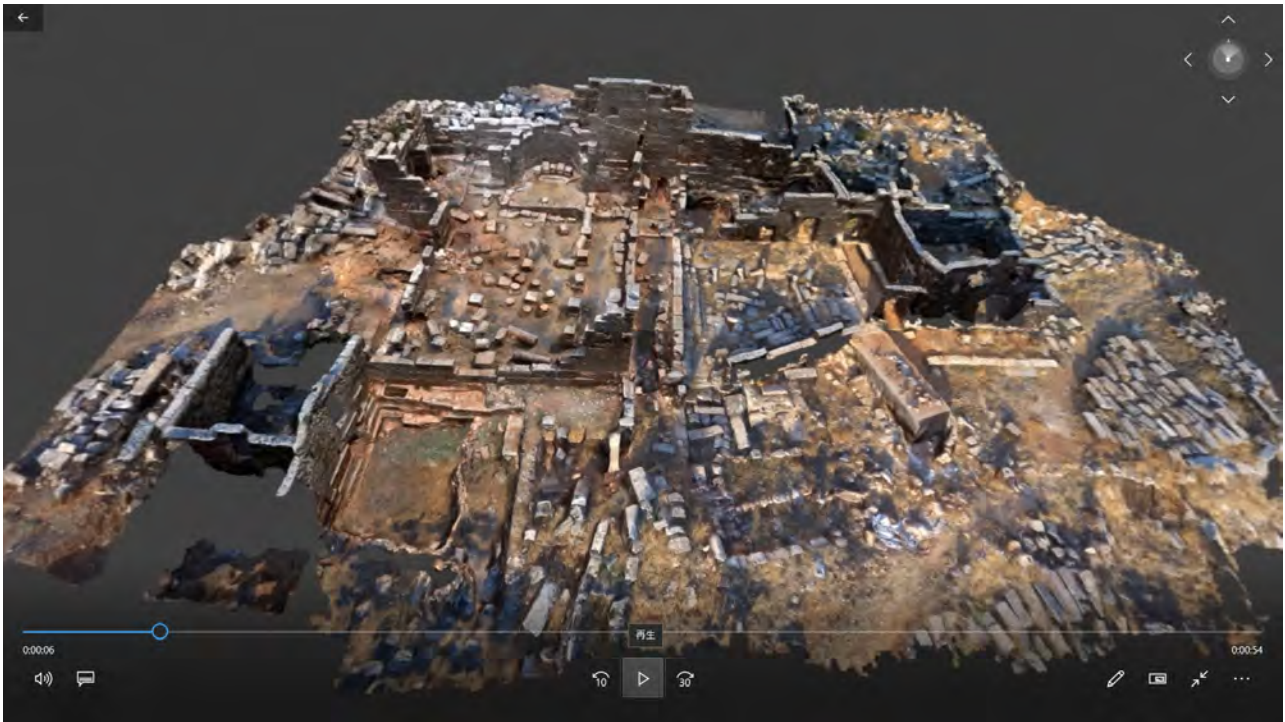




**Fig. 8 Digital traced side elevation plan (northwest inner wall)**

#### 4. 360 degree 3D movie for the Head Mount Displays (HMD)

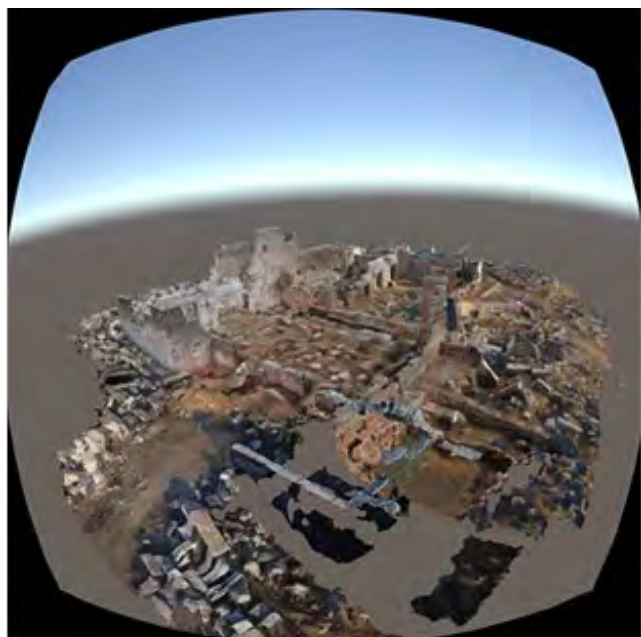
A 360-degree 3D movie was prepared from the 3D model. This movie can be played by a movie viewer with 360 degree (and 3D) capabilities or with HMD. HMD allows users to look around the sites in 3D (it is also possible to drag and turn the viewer's perspective when using a PC and supported software).



**Fig. 9 360 degree 3D movie (played in Movies & TV app in Windows10)**

#### 5. VR contents for Oculus GO (Virtual tour of Serejilla)

VR contents have been created that allow the user to virtually move around Serjilla. These contents can be displayed in Oculus GO or on a PC to take virtual tours of the reconstructed site.



**Fig. 10 Virtual tour image displayed on Oculus GO**