

SIMPLIFIED PHOTOGRAMMETRICAL DOCUMENTATION AND VISUALIZATION OF HISTORIC OBJECTS IN PERU

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Abstract: *This paper deals with the possibilities of creating a 3D model and visualization technique for presentation of three-dimensional objects in Peru. The project Nazca/Peru documents several historic objects. This paper discusses documentation and visualization of five of them: The Church in San Jose, San Xavier Church, Santa Ana Church, Hacienda de La Pena and archeological site Sechín. All objects are damaged by earthquake. Some have been repaired; some are on the list of company World Monuments Fund, a company which receives funds for the repair of major historic monuments. Processing documentation of these objects is different. Level first, PhotoModeler software was used for photogrammetric data processing of acquired images. The principle of PhotoModeler is based on the intersection photogrammetry method. It combines images and coordinates of points in three-dimensional space. It can create 3D models and export in another software. Another possibility of creating a 3D model is CADs software Microstation, which was used for the model of **San Xavier Church** as well as a 3D model of the **Santa Ana Church**. The same procedure was chosen for creating a 3D model of **Hacienda de La Pena**. Documentation of archeological site **Sechín** was created the photomaps of enclosure wall. The wall is thanks mythological scenes very valuable. The 3D model of **San Jose Church** was created in software Google SketchUp, which is used for creating, editing and sharing three-dimensional models. The model presentation was using the 3D Warehouse models and it can be visualized in application Google Earth. San Jose Church visualization is on this web page:*

<http://sketchup.google.com/3dwarehouse/details?mid=686f08d983d09eb18d5fe60d2287ac66>

The models can be used for reconstruction of these damaged objects.

1. INTRODUCTION

Around Nasca and Palpa villages there are many interesting historic objects there are very acceptable for documentation. The objects of interest are churches, haciendas or archeological sites. Among the objects that have been processed and visualized are the San Jose Church, San Xavier Church and the church in Maca in Colca canyon, hacienda de La Pena and archeological site Sechin. Most of these objects were destroyed by earthquake. Data for processing these objects were acquired during expeditions in Peru.

2. OBJECTS OF INTEREST

2.1 Church San Jose

San Jose Church can be found in southwest Peru in San Chose village (geographic coordinates 14° 40' 15'' S; 75° 07' 45'' W). San Chose lies in the El Ingenio region approximately 30 km northwest of Nasca City. The church was built in 1744 in baroque style. Dominating the church are two towers built of wood and

covered by plaster. Under the church are found 12 crypts. The church is written on the list of company World Monuments Fund [6] that is engaged in raising funds for the repair major historical monuments. [1]



Figure 1: 3D model of San Jose Church in Google Earth



Figure 2: Original picture of San Jose Church used for presentation

2.2 Church Santa Ana

Santa Ana Church is situated in Maca village, 23 km west of Chivya, capital city of the Caylloma. Province was almost completely destroyed by repeated eruptions of the Sabancaya volcano in the autumn of 1980 and the earthquake in 2001. [2]



Figure 3: Santa Ana Church



Figure 4: Simple 3D model of Santa Ana Church

2.3 Church San Xavier

San Xavier Church is a culture heritage from the period of Spanish colonization. The Church dominated by two cylindrical towers in its front part and two sacristies in the rear. It is located 35 km northwest of Nasca City, in Isidro village. For poor technical condition of the building it is not used for religious ceremonies. [3]



Figure 5: San Javier Church



Figure 6: 3D model of San Xavier Church

2.4 Hacienda de La Peña

Hacienda de La Peña is in ruins, it used to be an estate of the same name. It was probably built in 17th century, when there used to be fertile soil suitable for growing vine. This area is gradually drying up and the hacienda is now deteriorating. The Hacienda is located about 3 km east of the centre of Palpa city. The object consists of two gateways, two buildings. Only one building is now inhabited. [4]



Figure 7: 3D model of Hacienda de La Peña in Google SketchUp



Figure 8: Hacienda de La Peña, photo (k.Pavelka)

2.5 Sechin

Archeological locality Sechin is part of an extensive site, which occupies an area of roughly 10 km². The whole complex is called Sechin Alto and includes four local sites Sechin bajo, Taukachi-KonKan, Sechin alto and Sechin temple.

Sechin Temple is located at an altitude of 90 m, around 370 km north of Lima at the confluence of the rivers Casma and Sechin, 10 km from the Pacific coast. The nearest city is called Casma.

The Sechin Alto Complex is among the oldest and according to some archeologist, the largest archeological sites in Peru and possibly in the entire Pre-Columbus American. It is estimated to come from the so-called archaic period, i.e. 1600 years before Christ. It was discovered in 1937 by a Peruvian explorer Julius C.Tell.



Figure 9: 3D model of Sechin Temple



Figure 10: Representation of Sechin Temple by Julius C. Tell

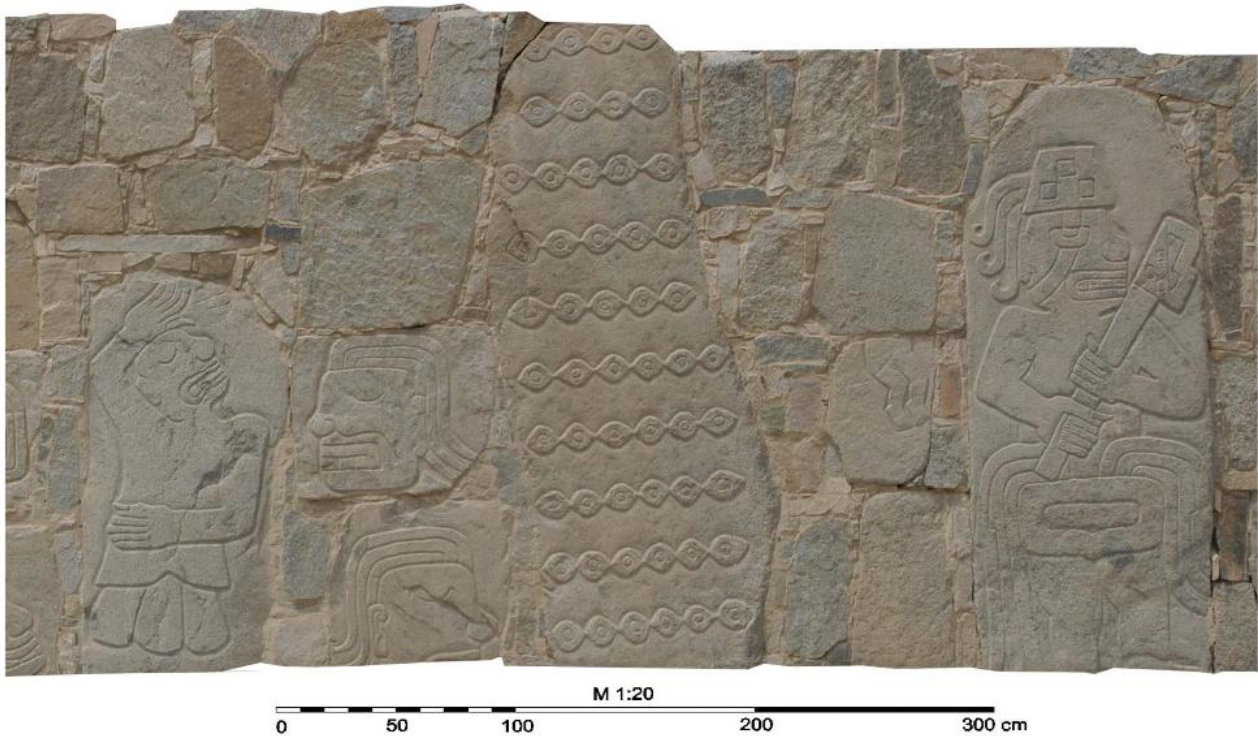


Figure 11: Photoplans of walls

Sechin Temple covers an area of about 5 ha. It is assumed that the circumferential wall is lined along the length of a set of stone slabs (monoliths) carved with motifs. To this day almost 400 slabs were discovered. So far, the north, east and west walls were uncovered. The south wall is uncovered from the east side at a length of around six meters. The wall is 2,5 m high; the highest stone reaches up to 4 m above the surrounding terrain.

The materials used for the construction of rooms were clay bricks, which were stored in clay mortar and then covered to create the inner walls of the temple. [5]

3. PROCESSING AND VISUALISATION OF OBJECTS

3.1 Pre-processing of photogrammetrical data

Before creating the 3D model it is necessary to use calibration of photogrammetrical data. Calibration was performed in software PhotoModeler Scanner (PMS). PMS is intended for noncontact 3D measurement. The principle is based on the method of intersection photogrammetry. It combines images and determines the coordinates of points in three-dimensional space. It can be used for creating 3D models, which can be exported to other programs. This is the superstructure of the program which can acquire images of cloud points (like laser scanner). It can fairly reliably create a 3D cloud of points on the basis of two, appropriately configured images.

3.2. Evaluation

For processing and visualisation of objects of interest various methods were used. To create 3D models program Google SketchUp can be used; it is software for creating, modification and 3D data sharing. The present model can be linked through the 3D gallery of objects in application Google Earth. [1]

The next possibility to creating a 3D model is in program Microstation. This is one of the most popular CAD products, which is used to create 2D and 3D drawings. As the basic format is chosen

DGN but is able to work with formats DWG or DXF. The resulting outputs can be written in formats BMP, JPEG, animation in AVI and 3D scene in VRML and PDF. [2]

Another possibility how historical objects can be documented is through photomap. Photomap is a redrawn photographic surveying image of flat objects or the ground in the desired scale. [7] Ordinary photographs formed a central projection; they should be converted into photomap (orthogonal projection). If the axis of view is perpendicular to the object, is to convert just about scale. In another case is possible to use collinear transformation.

4. RESULTS

The 3D models were created of all objects of interest. Some models have been published on the internet through Google Earth. Visualization of the objects of interest can be either a basis for reconstruction or for simple advertising of historical objects in areas where are not financial environment at the accurate targeting geodetic methods or laser scanning.

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