# 3D MODELING BY ADVANCED TOTAL STATION

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**KEY WORDS:**  Low cost technology, modelling, visualization, cultural heritage

**ABSTRACT:**

Most recent trend is the laser scanning for modeling, visualization and drawing of cultural heritage. Due to high cost of the laser scanner, an alternative technique is developed. Reflectorless Robotic Total Station is a motor driven total station which capable of reflectorless measurement. It can be handled via hand computer. Additionally, it can be used image taken with different cameras. So, we can select for scanning area on image. Both image point and ground point can be measured. The transformation is realized between image coordinates and ground coordinate system. The selected area on image is scanned by requested interval and the point cloud of object is obtained. The point cloud is processed by software which can be processed data obtained by laser scanner.
In this paper, the surveying of the sarcophagus is obtained by Reflectorless Robotic Total Station. The Sarcophagus is typical of sidamara and belongs to Roman Period 250-260 A.D.   Modeling of sarcophagus has been carried out by commercial software.

## 1.  INTRODUCTION

Cultural Heritages are inherently vulnerable. Therefore, it is important to record cultural heritages. But recording cultural heritages which consist of major details has always been a challenge. Though recording cultural heritage is so far realized by classical and photogrammetric methods, most recent trend is the laser scanning for modeling, visualization and drawing of cultural heritage. Due to high cost of the laser scanner , an alternative technique is developed. Reflectorless Robotic Total Station is a motor driven total station which capable of reflectorless measurement. It can be handled via hand computer. Additionally, it can be used image taken with different cameras.
In this paper, the surveying of the sarcophagus is obtained by Reflectorless Robotic Total Station. The Sarcophagus is typical of sidamara and belongs to Roman Period 250-260 A.D. Modelling of sarcophagus has been carried out by commercial software.

## 2.  MATERIAL AND METHOD

### 2.1  The Sarcophagus

In this study, The Sarcophagus is typical of sidamara and belongs to Roman Period 250-260 A.D.



Figure.1 The Sarcophagus

### 2.2  Reflectorless Robotic Total Station

This tool is the one operating in a way closest to laser scanning as the results are point-clouds as well.
The new improved Topcon Auto Tracking total stations offer the very best performance using the latest laser communication and pulse-laser distance measurement technology. The GTS-820A series and GPT-8200A series are the latest generation Auto Tracking Total Stations that form the central part of the Topcon Solo Surveying System which is completed by adding the unique Optical Infrared communications device Topcon RC-2II, Topcon Field controller and Topcon software TopSURV.

The GPT-8200A also uses a Class 1 Laser for non-prism distance measurement. This ensures the instruments are safe for use in busy public areas or on the construction site where regulations may restrict the use of some types of laser.

*Measurement Specifications*

Long Range Non-Prism Measurement (GPT-8200A)

The GPT-8200A has dual mode non-prism measurement. Standard mode to measure upto 120m with an accuracy of ± 3mm and Long mode to measure upto 1,200m. A new Pulse Laser technique is used for this long range distance measurement without a prism. A distance of 1,200m can be achieved to a Kodak grey (white surface) but the real power of this non-prism distance measurement is when measuring to difficult surfaces at shorter distances. For example, measurements made to asphalt can be made more accurately and consistently than ever before. The standard non-prism mode has improved accuracy of ± 3mm from 25m distance up to 120m.

Angle measurement

The GPT-8200A series (and GTS-820A series) each consist of 4 models, GPT-8201A (GTS-821A), GPT-8202A (GTS-822A), GPT-8203A (GTS-823A) and GPT-8205A (GTS-825A), with 1" (0.3mgon), 2" (0.6mgon), 3" (1.0mgon)and 5" (1.5mgon) angle measurement accuracy's respectively. The first two models have 0.5" (0.1mgon) minimum reading and second two models have 1" (0.2mgon) minimum reading. All models have absolute encoder system for angle measurement.

**Additional data storage**

PCMCIA or Flash card slot is on the instruments for additional data handling flexibility. Memory cards are available from Topcon which are suitable for more extreme environmental conditions, but standard compact flash cards can also be used.
Topcon Auto Tracking Total stations are loaded with Topcon's 'Standard Survey Software' offering full functionality for field surveying, calculations and stake-out. For the Total Station Controller there is now new Topcon software, TopSURV. TopSURV includes all the functions of the Total Station software bringing the power of the instrument to the prism position.
The Topcon system also gives the possibility to use third party hardware and software so users can adapt the system to their own specific needs if required. TopSURV is an integrated field controller package with, in addition to the total station data logging and Solo Survey total station control, also controller software for Topcon GPS systems. The 2 modules are available separately or combined, providing a seamless integration between Topcon surveying total stations and GPS.

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Figure.2 Total Station and measurement of sarcophagus

| Technical Specifications GPT-8200A | |
|---|---|
| **Telescope** | |
| Length | 166mm |
| Objective lens | 50mm |
| magnification | 30X |
| Field of view | $1^0$ 30' |
| Resolving Power | 3" |
| Minimum focus | 1.3m |
| Focusing | 2 speed |
| **Distance Measurement(NP)** | |
| Measurement range | Standard mode: 3-120m / Long mode : 30-1,200m |
| Measuring accuracy | Standard mode: 3-25m ±(10mm)m.s.e |
| | Standard mode >25m ±( 3mm+2ppm)m.s.e/ Long mode: ±(10mm+10ppm) |
| **Angle Measurement** | |
| Method | Absolute encoder |
| Detecting | Horizontal : dual Vertical : dual |
| Minimum reading | 0.5" (0.1 mgon)/1" (0.5 mgon) 1" (0.2 mgon)/5"(1.0 mgon) |
| Accuracy | 1" (0.3 mgon) 2"(0.6 mgon) 3"(1.0 mgon) 5"(1.5 mgon) |
| **Tilt sensor** | |
| Type | Dual axis |
| Compensating range | ±4' |
| **level sensitivity** | |
| Circular level | 10'/2mm |
| Plate level | 30"/2mm |
| **Others** | |
| Water/ Dust protection | IP54 (IEC 60529 standard) |
| Display and keyboard | 2 sides (GTS-822A/823A/825A: 1 side) |
| Dimension / Weight | 325x229x211mm/GPT-8200A:7kg, |
| Optical Communication | Optional RC-2 II (laser class 2) |
| **Optical Plummet** | |
| Magnification / Focusrange | 3x / 0.5m to infinity |

Table.1 Technical Specifications GPT-8200A

## 3. RESULTS

A network was constructed for modeling of object. The network was referenced with local coordinate system. So, Integration of coordinate system was established for all facade of object. The images were taken with Colpix Nikon 950 digital camera. This camera was calibrated by PI 3000 software.

The information of camera calibration and image taken with this camera was transferred into Total Station. Four points were selected on this image and measured by Total Station. The transformation result between image coordinate system and local coordinate system was controlled and accepted by operator. An area requiring measurement was selected on image. This area was scanned with distance resolution 2 cm. These processes were realized by other facade. The point clouds were transformed into the Polyworks and integration of point clouds is obtained from same software. At last, 3D modeling of Sarcophagus was generated.
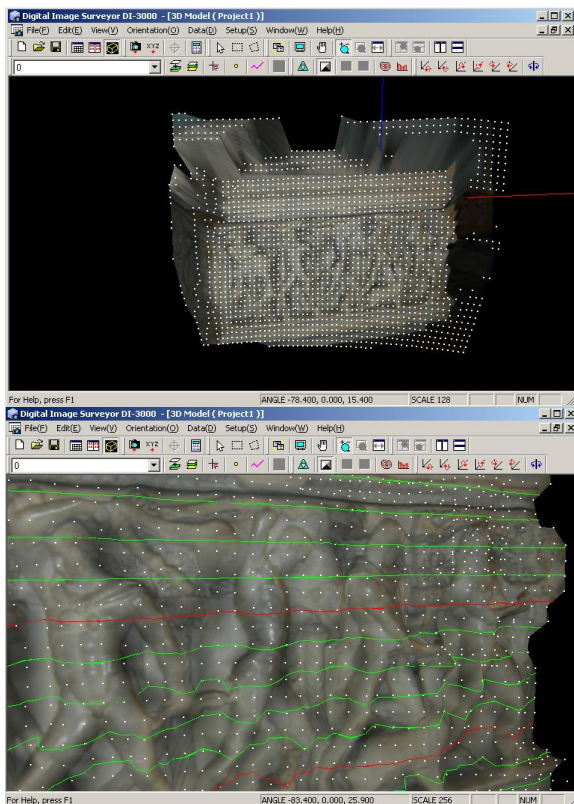


Figure 3. View of sarcophagus

## 4. DISCUSSION

3D modeling of Sarcophagus was generated by means of point clouds obtained from Total Station. Although selected area was scanned with distance resolution 2 cm, scanning process is time costuming. High Distance resolution is generally selected for measurement of detailed object. So, use of Total Station is not practical for scanning of detailed object. In addition, we recommend that total station may be used for scanning of object without detail and land topography. However, researchers may be use the Total Station to obtain 3D modeling although it require more time to proceed when the laser scanning is not available due to its high purchasing cost.

### 4.1 Acknowledgements

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