# A POSSIBLE ROUT TO DRIVING AN AIR-CONDITIONING RING GALLERY INTO THE TUMULUS OF THE FRESCOED THRACIAN TOMB IN THE VILLAGE OF ALEXANDROVO, HASKOVO REGION

## **Dimitar Anastasov**

**Georgy Stoyanchev** 

University of Mining and Geology "St. Ivan Rilski" Sofia, 1700 Bulgaria E-mail: danast@mgu.bg danastasov@hotmail.com University of Mining and Geology "St. Ivan Rilski" Sofia, 1700 Bulgaria **Milko Armutliev** 

Eko Tok Ltd, 16, Rozova dolina Sr. Haskovo, 6300 Bulgaria E-mail: armurliev@abv.bg

#### SUMMARY

The need to develop an underground mining technology for an access into the Thracian tombs comes as an alternative to the open exploration method, which leads to demolishing of the tumulus pile.

The realization of the design and engineering solutions for constructing a ring air-conditioning gallery inside the tumulus of the Thracian tomb in the village of Alexandrovo will be a continuation of the experience gained during the excavations of the Thracian temple in the village of Starosel. This paper deals with the possibility to drive a gallery constructed entirely of prefabricated THN-16,5 and THN-29 metal units and supplied with box holes of

impregnated timber. The implementation of a mining technology aims at establishing control over the microclimate in the gallery and preserving the frescoes in the chambers of the Thracian tomb as well as at keeping the authentic mound pile.

## INTRODUCTION

The development of a mining technology for access into the Thracian tumuli and their exploration is an important process. Being an alternative to the open exploration (implementing bulldozers and load-hauld-dumps) it will prevent the destruction of the mound pile and give more chances for air-conditioning and preservation of the original frescoes.

#### MINING CONSTRUCTIVE PART

The air-conditioning ring gallery is 41,90 m long. It has two straight sections - left and right (13,00 and 15,40 m long, respectively) and a circular 13,50 m long one.

The straight sections of the gallery are trapezium-shaped keeping the ceiling gradient of 10° for installing a hydrolyzing layer, which will drain the moisture from the mound section.

The dimensions of the air gate in its straight sections are the following (fig. 1 and fig. 2):

- height of the inside wall 3.00 m;
- height of the outer wall 2.68 m;
- width of the air gate at the ceiling 1,41 m;
- width of the air gate at the floor 1,44 m.



- 1. Hydroizolation layer 2. Steel bar
  - 7. Support foot pad
- 3. Fractional prop 8.
- 4. Steel strut
- 8. Slick sheet coating
- 5. Steel saddle
- 9. Steel lacing

Figure 1. Longitudinal-section of the inner wall of the gallery in straight section of its inside wall.

At the beginning the earth from the mound pile is excavated with pick hammers. Then under the supervision of an archeologist the excavations continue manually with pickaxes regarding the cultural layers.

The loading of the excavated earth is manual. It is spaded into wheelbarrows and transported out of the site.

The section is lined with metal supports comprising 2 frictional steel THN-16,5 props. Each prop has an upper and lower part joined by 3 metal saddles. Their load capacity is 200 kN. The upper parts of the two props end with planks and cylindrical spikes 25 mm in diameter and 50 mm high. The steel bar, also made of THN-16.5, is fixed by the spike, which enters a round opening drilled into the bar.



- 1. Slick sheet coating d=8 mm 5. Steel lacing
- 2. Hydrolization laver d=5 mm 6. Slick sheet coating d=5 mm
- 3. Fractional prop
- 7. Steel saddle 4. Drainage pipe 8. Steel bar

Figure 2. Cross-section of the gallery in its straight section

The gallery ceiling is coated with steel sheets 8 mm thick. Seven headboards 20 cm wide and 50 cm long are put above each of the bars.

The inside wall is covered with steel lacing No 8. 10 cm is distance between the crosslinks of the lacing. Six 1.00 m x 0,40 m modules are used (fig. 3).



Figure 3. Steel lacing No 8 far the straight section

The outer wall is covered with steel sheets 5 mm thick. The six sheets are 0,4 m x 0,5 m at 3, 00 m height.

The steel bars are installed at every 0,4 m. They are stabilized by metal sleepers (2 for each frame) and metal hooks 24 mm in diameter and 0.32 m long.

The ceiling and the outer wall are coated with waterproof layer.

The 28,40 m long straight sections thus laid out need 71 frames placed in every 0,4 m.

#### THE SECTION OF THE GALLERY ROUNDING THE TOMB CHAMBER

The section of the gallery rounding the tomb chamber is 13.50 m long and is in the form of a semicircle with an inner radius of 2,90 m and outer radius of 4,30 m (fig. 4).



Figure 4. Cross-section of the support around the round tomb chamber

This configuration of the gate requires 25 THN-29 frames placed in every 0,6 m at the outer radius. The distance between the frames at the inner radius is 0.4 m.

The inside wall of the gate is 4,20 m high while the outer one is 3,95 m. The set gradient of the bar is 10°. But the two frictional props (fig. 5) and the bar a lateral strut is also foreseen. It is set at 2,0 m from the floor.

The driving of this section is combined with the driving of the box holes (fig 6), which ensure the pealing of the stone blockage of the mound. The box holes will be supplied PVC pipes for ventilation and conduct of the climate in the gate and in the frescoed chambers.

The box holes are closely lined with acacia timber elements, which were preliminary, impregnated.

The upper part of the box holes, the upper part of the frame and the outer wall of the section are isolated by a hydrolising layer.



Characteristics:

- 1. Working resistance 200 kN
- 2, Maximum height 2900 mm
- 3. Minimum height 1800 mm
- 4. Weight-98 kg



Figure 6. Cross-section of the round chamber. A variant with box holes with timber lining

## CALCULATION PART OF THE SUPPORTS [1, 2,3]

The supportive frames, the metal coatings and the planks were calculated according to the technique of Prof. Tsimbarevich applied to weak and incompetent rocks. The load capacity of the supports was calculated 1.5 and 2 times higher in order to ensure their durability (set for 50 years). The choice of the corresponding profile is according to the resistance moment. The profiles THN-16,5 and THN-29 meet best the requirements of conditions.

Recommended for publication by Department of Underground mining, Faculty of Mining Technology **The support units will be manufactured** by the Single Owned Company Rockstal from Pernik.

#### COSTS CALCULATION

According to the preliminary estimations the project needs 5 months for realization. The funds needed are proportioned as follows:

- 1. Mechanization 8%
- 2. Labour 15%
- 3. Materials 42%

Other expenses (transport, storage costs, travel costs, digging of a site, timber, geodesic tracing and control, etc.) - 35%.

### CONCLUSION

In conclusion the authors would like to note that the support is composed entirely of prefabricated units (No welding works in the gate are foreseen). The metal elements are preliminary treated with anti-corrosion varnish.

This technology can provide an easy repair (when necessary) and maintenance of the particular elements of the supportive constructions.

We find that the air-conditioning of the two chambers in Thracian tomb in Alexandrovo will benefit from the suggested gate.

The preliminary calculations appraise the realization costs of the project to about 85 000 Euro. Its completion will take 5 months.

As a comparison the restoration of the Thracian tomb in Svesthari has lasted for 20 years. 2 500 000 Euro have been spent on the works.

The mining technology suggested herewith allows controlling the microclimate in the gallery. Thus the frescoes in the chambers of the Thracian tomb will be preserved and the authentic pile of the mould will not be destroyed.

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