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Bronzové artefakty nalezené v depotech na hradišti „Tabulová hora“ u Klentnice. Srov. studii A. Navrátila. Foto J. Špaček.
A foto of bronze artifacts found in hoards in the hill fort „Tabulová hora“ near Klentnice. See the study of A. Navrátil. Photo by J. Špaček.

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Archeologický ústav AV ČR, Brno, v. v. i.
Královopolská 147
612 00 Brno
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CONSTRUCTION OF A HYPOTHETICAL "CELTIC" GATE TO A SACRED AREA IN THE FRAME OF THE ARCHAEOLOGY MUSEUM AT LIPTOVSKÁ MARA

STAVBA HYPOTETICKEJ "KELTSKEJ" BRÁNY KULTOVÉHO OKRSKU V ARCHEOLOGICKOM SKANZENE V LIPTOVSKEJ MARE

Oto Makýš

Abstract

The article deals with the design and construction of a hypothetical gate tower, which was built in the frame of the Archaeological open air museum at Liptovská Mara, Slovakia. It describes two different approaches towards its mock-up construction, which were realized before and now and with gained experience – from two different points of views: scientific (technology) and operational. Construction of the gate resulted from a co-operation among the Archaeological Institute of the Slovak Academy of Science (AÚ SAV), Slovak University of Technology in Bratislava (STU BA), Institute of Architectural Heritage Conservation of the Slovak republic (PÚ SR) and the Museum of Liptov in a frame of the project "Ochrana a záchrana historických pamiatok na Slovensku ako integrálna súčast' európskeho kultúrneho dedičstva (koncepcia a realizácia)" / "Protection and Preservation of Cultural Heritage in Slovakia as an Integral Part of European Cultural Heritage (Concept and Realising)".

Keywords

Research, museum of archaeology, mock-up presentation, experimental reconstruction, construction technology.

1. Location

The archaeological site Liptovská Mara I situated on the Havránok Hill, cadastral territory of Bobrovník, in Liptov Region of Northern Slovakia belongs to the most important sites of the Púchov ("Celtic") culture in Central Europe from late La Tène–early Roman Empire Period, 2nd cent. BC–1st cent. AD (Pieta 1996) (Fig. 1).

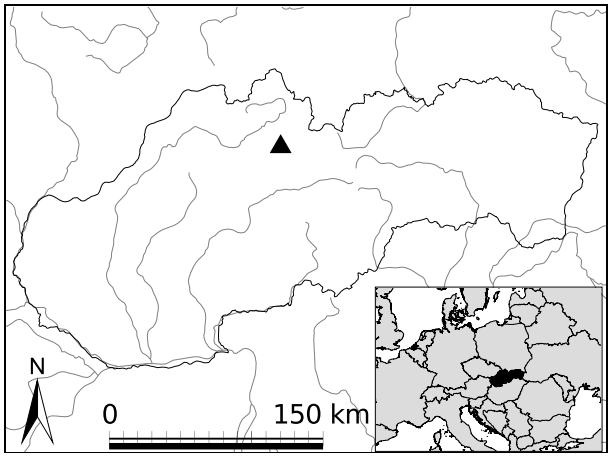

Fig. 1. Location of the reconstructed gate on the map of Slovakia.
Obr. 1. *Lokalizacia rekonstruovanej brány na mape Slovenska.*

2. Open Air Museum of Archaeology

The excavations have been taking place under the leadership of Karol Pieta from the Archaeological Institute of the Slovak Academy of Science (AÚ SAV) since 1965. During 1986–1992 the first stage of the project of experimental reconstruction of chosen buildings in the area of excavations took place. Its aim was in introducing visitors to the 3-D depiction of the mentioned era on its original site. All constructions fell under the control of the Museum of Liptov in the frame of the first archaeological open-air museum in Slovakia.

Up to now following buildings (*e.g.* areas) have been reconstructed: a farmstead with the main residential building and some surrounding buildings, the sacrificial area with pavement, columns and a sacrificial hole, fragments of the defensive walls of the sacred area on the Eastern terrace with a gate tower, a gate to the upper hill fort together with parts of its walls, a wooden Grubenhaus, a medieval fort on the top of the hill.

For reconstruction projects several different methods of presentation were chosen – in some situations in a way of a "complete" reconstruction, in some situations only in a way of conceptual reconstruction. All reconstructions are exactly based on original archaeological finds, but a lot of details of the constructions are – of course – results of formulated hypothesis.

3. Excavation

The original structure of the gate tower to the sacred area from the east has not been preserved. The archaeological research uncovered a wall built from large flat blocks of sandstone, quarried probably on site in the form of large slabs (5–15 cm thick). The building blocks were overlapping and connected with clay. At the gate area the wall was interrupted and the ground surface was cobbled with middle size pebbles. The presumed gate tower was preserved only in a form of four post-holes in the cor-

Fig. 2. Original state of the previous mock-up gate tower at the start of the reconstruction project in 2003.
Obr. 2. *Pôvodný stav predchádzajúcej náznakovej prezentácie brány na začiatku rekonštrukčných prác.*

ners of an irregular trapezoid. The post-holes were originally about 60–90 cm deep. The placing of posts corresponds with recesses in the preserved adjacent walls on both sides. Based on the depth of the post-holes it was presumed that the structure was a tower-like building, maybe up to some floors high (Pieta, 1996).

4. Experimental reconstruction – 1st stage

During the first stage of the reconstruction a tower-like structure was built on the site of the original entrance. As there was not enough information on its design it was built as a conceptual mock-up tower (Pieta 1996). The shape of the structure was mainly presented only with lines of the load-bearing posts and beams at the height of the presumed floors, as of the presumed pyramidal roof.

To recapture the original design of the buildings of ancient era, original building material (wood) was respected. As construction material old electric-posts, which were originally machine shaped and pressure impregnated with a chemical preservative agent were used. The exception was one of the posts, which was made from freshly cut pine tree without chemical treatment. The floor, wall and roof line were made from commonly available timber, also without any special treatment. As it was only a conceptual mock-up, no special attention was paid to the construction details and the joints were made with common nails of adequate sizes.

The lack of appropriate maintenance showed on the tower construction with the decay of the pine post in the contact zone of ground-air and its general weakening. Part of the rungs was destroyed and rot (domestic Dry Rot Fungus / *Serpula Lacrymans*) had developed in most of the joints – caused by the collecting of rain water. The centres of the tops of the electric posts were also damaged – to about 0,3–0,5 m depth. The posts were cracked – some of the cracks reached nearly 2/5 of their diameter. After assessing the situation the mock-up tower building was rated as in a state of disrepair (Znalecký štandard 1993) with a rapid stabilisation necessary.

5. Experimental reconstruction – 2nd stage

Because of the condition of the tower, it was necessary to dismantle the entire structure and joints with the exception of three of the load-bearing (originally industrially treated) posts which were decided to leave in their original positions. Thanks to the scale of the work it was decided to reassess the original building design. The project was (for its 2nd stage) therefore determined by two main view points – methodological and technical. A combination of both points of views brought many interesting problems which were to be solved.

Finished outer construction of the tower – planked roof cladding and wooden skin photographed from approximately same angle of view as Fig.1 in 2004. Obr.2 – Hotová vonkajšia konštrukcií veže – dosková strešná krytina a drevený plášť, fotografovaný z približne toho istého uhla akom na obr. 1.

The methodological point of view has concerned presentation. The experience with the open-air museum confirmed that the original idea that a 3-D presentation of chosen structures would substantially increase the value of the area even with a regard to the uncertainty of the original design. The wooden construction of the tower has fulfilled its function as its shape (although only suggestive) enlivens the whole of the sacred area and gives visitors the chance to imagine its design in its ancient era.

The technical point of view concerned mostly the use and maintenance of the structure. Several years of experience has shown that to secure a continuous, uninterrupted and through maintenance of an uncovered wooden free standing skeleton structure exposed to the weather is impossible for many reasons (financial, organisational, technical, human power etc). Without maintenance the lifespan of a substantial reconstruction would be again only several years. To organize an expensive reconstruction, bordering on a complete rebuild, within such short intervals (10–15 years) was assessed as impossible. Therefore it was decided to construct the gate tower with roof and a circumferential cover.

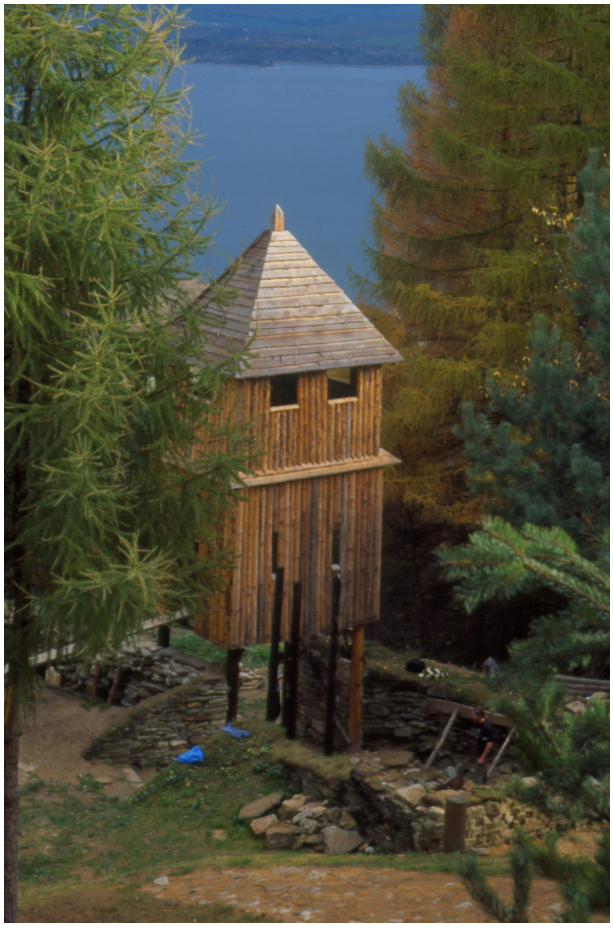

Fig. 3. Finished outer construction of the tower – planked roof cladding and wooden skin photographed from approximately same angle of view as Fig. 1 in 2004.
Obr. 3. *Hotová vonkajšia konštrukcií veže – dosková strešná krytina a drevený plášť, fotografovaný z približne toho istého uhla akom na obr. 2 v roku 2004.*

5.1 Shape and size of the tower

The tower, despite the above case, is still to be a mock-up presentation as the information about its original design is minimal. But now it presents not only its outline, but a complete model of a possible tower construction above the gate. The current elevation of the mock-up building from its 1st stage was therefore preserved and vertically the tower was divided into three floors. The first floor presents its gateway, the second a walk through floor with an added defence function and the third guards and defensive position. The second floor is passable transversally (following the line of the walls), the third one is accessible only by stairs. The height of the floors respects technical restrictions (making use of recesses ready in the posts, originally made for the attachment of rungs), but it is close to the current typological agreement on ancient wooden fortifications in Europe, where the height of the gateway is about 3,5 m (height of a rider with a spear pointing upwards) and the height of the walk through floor is about 3 m (standing warrior with a spear).

5.2 Technology of construction details

Because of the chosen method of a mock-up construction details and joints were not a matter of reconstruction of ancient building techniques. The details have to be – for the first – resistant as much as possible to weathering and vandals. Because of the scale of the damage to the current structure only three (in original electric, pressure impregnated) posts were left; the rest of the wooden construction was replaced with new elements. The left posts were repaired in the following fashion:

Fig. 4. Finished tower with a partly reconstructed stone masonry wall in its close surroundings in 2007.
Obr. 4. *Hotová veža s čiastočne rekonštruovaným kamenným múrom v jej tesnej blízkosti v roku 2007.*

The biggest cracks and woodpeckers' holes were plated (with thin lamellas from the waste from other parts of the building of impregnated posts, glued with exterior adhesive Duvilax). The nests of decay at the joints with rungs was cleaned back to the healthy wood and plated like the cracks and woodpeckers' holes.

The rotting tops of the posts (centres) were cut of and replaced with new parts from impregnated wooden posts. They were joined by overlapping (to at least 0,5 m length) while the cut surfaces were at right angles on both sides. The joint were strengthened with exterior adhesive (Duvilax) and nails (at least 200 mm nails, hammered towards each other at angle of at least 30°).

5.3 Realising of the reconstruction

During the work several problems occurred. It was necessary to solve them on the spot. The experience of preparation and execution of an unusual reconstruction of an unusual building carried out in an unusual way can be rounded up as follows:

Within the given time it was shown to be impossible to obtain and bring to the site of the hill fort a fourth industrially impregnated electric post more than 10 m long – therefore a freshly cut spruce has to be used instead.

The original setting in concrete of the other three main posts proved to be in a very good condition and the condition of wood in the contact zone ground-air was, despite long term use, satisfactory – therefore the fourth post was also set in concrete, but the setting of the new post into the original hole was done in a reversible way. According to the respect towards the request of reversibility accepted in the Recommendation of ISCARS, 1999 and the Charter of ICOMOS, 2003 blocks of sandstone were embedded into the concrete. If necessary it will be possible to break these and pick the concrete out in pieces.

Fig. 5. Finished works on the wooden part of the gate tower to the sacred area – a look through the gate (2007).
Obr. 5. *Hotová práca na drevenej časti vstupnej veže do posvätného obetiska – pohl'ad cez bránu (2007).*

The slots on the second floor were narrowed to about 15 cm (the tested minimum width necessary for the use of a bow and at the same time maximum protection for the bowman) at 80 cm above the floor (tested maximum height to allow shooting at the space immediately in front of the gate). The slots were placed in both opposite walls to allow for shooting both outside and inside the fortification of the sacred area.

The door openings on the first floor were placed at an angle to follow the natural line of the wall walk while their width (about 70 cm) is a compromise between the need for as narrow an opening as possible for defensive reasons and a wide opening for a comfortable and fast run through.

6. Future of the experiment

Some of the recent experimental constructions seem to concentrate only on research, plan and execution of the building. The question of further maintenance has been neglected. Nearly every construction can have apart from the research also an important and interesting presentation function. This means securing the further existence of the constructions. It is therefore necessary to include the problem of maintenance in the planning of the experiment. That does not only influence the current solution of the construction but it might also instigate different solutions of some unknown elements – maybe even solutions closer to the original data. The constructions from organic materials are usually buildings of a high utility value and can survive for a long time. The key lays in the preparation of building materials, construction methods and mainly in continuous maintenance.

Therefore the details of the reconstructed tower were designed according to needs of long technical life and as little complicated maintenance as it was possible. The protection of timber construction (Žák, Reinprecht 1998) is mostly given by means of the construction in such a way that it minimises the possibility of rain water getting into details and joints, secures as fast a flow off the structure as possible, secures as fast drying as possible of leaked or blown in water. Chemical treatment is therefore to be understood as an additional measurement.

Ways to repair wooden buildings with exchange of single damaged parts for new ones, without dismantling the whole construction, have existed probably as long as wooden structures and were part of the constructors' know-how. The design of the tower has respected this standpoint and the tower is designed in two easy to separate layers – main load bearing constructions and their cover by outer constructions (roof claddings and wooden skin of the tower).

6.1 Future protection of the tower

The main load-bearing construction (rough structure from vertical and horizontal elements) was built from industrially impregnated old electric posts, which show elsewhere at the grounds (in the same conditions) a very good state of preservation. The placing of wooden beams into constructions was done in a way to prevent water penetration into the structure, to allow its run off and dry out of the organic material as fast as possible. Even then it is not possible to prevent the wooden structures from getting wet, especially the posts, roof and the cladding.

The casing (roof, walls) and floor was done in such a way as to allow the dismantling and replacement of them in future (in a frame of needed maintenance) without the necessity to dismantle the main tower structure. At the same time they were made from cheaper wooden material (planks, split logs) so that the cost of their renewal was kept as low as possible. The parts exposed to weathering (especially the roof) were treated with chemical preservatives. The posts was placed in ground using concrete (this method has been shown in other parts of the area to increase the lifespan of the wooden posts) with stone collars at surface level to blend in with the surrounding cobbling. The structure was strengthened at every vertical and horizontal plane with triangle and cross ties. The joints were secured with nails.

Regular maintenance (at least once a year – in the spring) means the clearing away off grass, self-seeded trees and the lowering of soil deposits along the wooden constructions. Regular airing of the inner rooms is very sufficient and therefore the tower is constructed in such a way, which allows fast natural drying out by airing. During maintenance it is also

Fig. 6. Finished tower as a part of hypothetically the reconstructed sacred area – insight view from the inner area of the fortress (2007).
Obr. 6. *Hotová veža ako súčasť hypoteticky rekonštruovaného posvätného obvodu obetiska – pohľad z vnútra hradiska (2007).*

necessary to pay attention to the condition of the roof and immediately repair any damage which would allow water penetration. It is also useful to check the building during strong or long lasting rains which reliably show any openings.

Under condition where the humidity level in the construction does not cross 10%, or respectively 20% limits for more than 3 months, the structure has a chance of a long technical lifetime. Use of chemical preservatives is debatable, because their effect is on one hand time limited (it is necessary to renew it after certain time) and on the other technologically dependant (the most effective method is pressure impregnation). But their use for posts placed into ground is practically unavoidable and the same is to recommend in maintaining the roof cladding and the wooden skin of the tower.

If a fungi infection is discovered the action depends on its origin. If the infection came with the building wood then the infected part (and often also the adjacent parts) should have to be immediately and carefully removed and burnt at a safe distance to stop the‘infection spreading.

In any case it is necessary to take into account that after some time it would be necessary to replace some elements of the building. The organic roof cover if it is not continuously preserved by smoke, has to be replaced under normal conditions every 10 to 20 years.

7. Role of volunteers

Archaeological construction experiments are often done by enthusiasts. Either specialists, archaeologists, historians without technical education, or volunteers (usually students) with various backgrounds. The advantages are low cost and enthusiasm together with a willingness to look for the most suitable construction and technological solutions during the work, without which the experiment probably cannot be carried out. The disadvantages are the long time of execution and the need to devote time to work with volunteers. The use of professional craftsmen eliminates these disadvantages. On the other hand it brings the danger of using modern solutions of construction details and techniques and usually much higher costs.

These ways of operating and maintaining a building close to the original is demanding on time, expenses and human power. Dependence on volunteers is not a solution, as it is possible to say from experience that volunteer groups are mercurial (usually they endure the upkeep of a structure for about 3–5 years). Therefore the best solution is the cooperation with a professional body (Museum of Liptov) which has to guarantee the regular appropriating of both human power and money necessary for the maintenance.

8. Conclusions

On the basis of described hypotheses and rules the project of the tower reconstruction was prepared and realised during the summers of 2003–2005. The work was carried out by the technicians from the AÚ SAV and students from the Faculty of Civil Engineering of STU BA and other Slovak and Czech Universities, together with the NGO Strom života. Building material was provided by Liptov Museum. Supervision was provided by Oto Makýš and Karol Pieta. Static scheme was approved by Vladimír Kohút. During following years 2005–2008 also a part of stone masonry of the original fortification system placed close to the tower was reconstructed. But in general the whole reconstruction of described part of the fortification is still not finished in its appropriate extend – this is a kind of a challenge for another project in future.

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Resumé

Príspevok sa zaoberá návrhom a realizáciou hypotetickej vstupnej brány – veže, ktorá bola vybudovaná v rámci Archeologického muzea v prírode pri Liptovskej Mare na Slovensku. Popisuje dva odlišné prístupy k jej hypotetickej konštrukcií, ktoré boli realizované predtým

a dnes, spolu so získanými skúsenosťami – z dvoch uhlov pohľadu: vedeckého (technologického) a prevádzkového.

Konštrukcia veže vyšla zo spolupráce medzi Archeologickým ústavom SAV, Slovenskou technickou univerzitou v Bratislave, Pamiatkovým úradom SR a Liptovským múzeom v rámci projektu: "Ochrana a záchrana historických pamiatok na Slovensku ako integrálna súčasť európskeho kultúrneho dedičstva (koncepcia a realizácia)".