A Computer Aided Study of Late Iron Age Buildings

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Abstract

More than 40 buildings were unearthed during the course of the excavations at the Late Iron Age site Sajópetri-Hosszú-dűlő (Hungary) from 1995 to 2003. Their analysis and comparison with similar buildings led to the discovery of a specific workshop building type. This building type has a floor plan which is different from what the dwellings have, and there is a small number of other examples of this building type from other archaeological sites, but their function has not yet been identified. The present study focuses on the possibilities offered by computer technology and the methods used in theoretical reconstruction. The use of CAD also made it possible to use the original pit contours to simulate the building process.

Keywords

Late Iron Age, settlements, building types

1. Introduction

More than 40 buildings of the La Tène B/C period were unearthed during the course of the excavations at the Late Iron Age site Sajópetri-Hosszú-dűlő (Hungary) ranging from the year 1995 to 2003[1]. The analysis of the building structures (Timár 2007) allowed us to study them in detail and to draw certain conclusions which may represent a new addition to our knowledge about Prehistoric architecture.

The first Hungarian attempt to sketch the possible appearance of a Late Iron Age house was made by P. Patay (Patay 1959), and his reconstruction based on a shepherd's hut was widely accepted. However, that building type seems to be insufficient for long-term human habitation. Meanwhile, the archaeological research has reached a stage, where a new approach can be made concerning the problem of the Celtic sunken-feature houses.

The site of Sajópetri-Hosszú-dűlő (*Fig. 1*) was not just rich in buildings: in many cases the finds inside the building remains as well as the joining structures (e.g. pottery kilns heated from a workshop-type building) helped us understand their original function. It is very important, because most of the structures reveal no information about their original use: distinguishing between house and storage hut

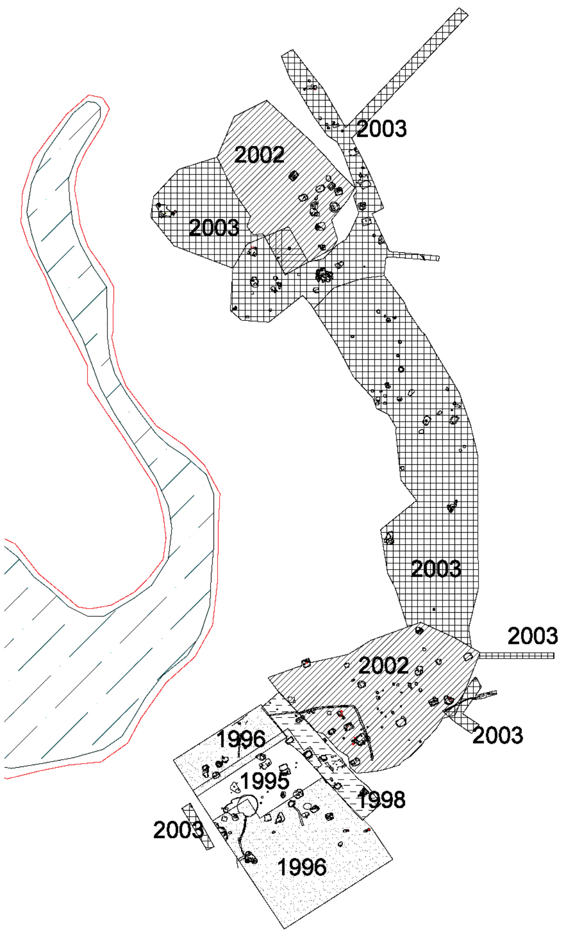

Fig. 1. Site map of Sajópetri-Hosszú-dűlő (the numbers show the year of the excavation).

1 The excavation was initiated as a rescue excavation by the Herman Ottó Museum of Miskolc in 1995. A year later the Institute of Archaeological Sciences of the Eötvös Loránd University was invited to participate, and the excavation continued under the leadership of prof. Miklós Szabó in a French-Hungarian cooperation. The exploration of the surface of 41,010m² was finished in 2003. The present article enjoys benefit from the National Research Fund (project nr. OTKA 68824).

seems to be impossible (see Czifra 2006), although it does not seem to be not unlikely that the majority of the buildings had more functions.

There is little need to explain how the use of the computer-aided-design became indispensable in this phase, because the handling of the 3D building models ensures precise results. Another important feature is that the digital processing of the excavation plans is becoming more widespread: computer-based visualization is a logical consequence. This is a process beginning with the digitalization of archaeological features and ending with a reconstruction which represents how we understand the discoveries.

1.1. Aim of the research

So-called pit-houses or sunken-featured houses are a common phenomena in the Late Iron Age archaeology of Hungary. Despite the fact that they are very simple buildings, their reconstruction remains problematical. The main reason is that they were made of perishable materials and what we can explore now is only their foundations. Many attempts have been made to reconstruct them – although the understanding of their structure seems to be more important than their appearance. In other words: if we have some kind of evidence (for example: how they were used, what kinds of human activities are related to them), we can develop our version of a sunken-feature house and compare it with the excavated building remains. This is the point where the computer – or better: CAD programs – becomes indispensable. Before we get involved in computer matters, we might take a look at the archaeological problem itself.

The analysis of the ancient sources has very disappointing results. Some authors – like Vitruvius (*De Architectura* II.1.1–8) or Strabo (*Geographica* IV,4,3) – describe the buildings of the 'natives', but there are virtually no details. Our visual sources are the columns of Trajan and Marcus Aurelius: the Germanic and Dacian houses represent buildings similar to the Celtic houses, yet their details are hard to understand. A certain type of house-urn of the Celtic tribe of the Latobici (see Petru 1971), who were situated in the south-western periphery of the Carpathian Basin, represent an abstract image of the houses only.

Pit-houses were once common in Hungarian vernacular architecture. They were often referred to as 'parallels' to the archaeological sunken-featured houses, and they often inspired reconstructions. We can make some observations of our own, too. There are two main types of the pit-houses in the vernacular architecture: the first is a very simple building intended to provide shelter; the second is a relatively large and complex house which represents an 'entrenched' version of the so-called 'Middle-Hungarian house type'. While the first type is not very sophisticated, the second is too complex to compare with the Iron Age houses. We have to note that the main reason for building sunken-feature houses was the need to save wood, because of the numerous restrictions applied to the peasants in the 18th–19th centuries (Zentai 1991, 25–26).

The more buildings we have excavated, the more kinds of details we get – and this is not empty rhetoric. Sometimes the structural details survive, and we may discover the – often surprising – details. *Fig. 2* shows houses where traces of the wall construction could be discovered. The most important evidence is that the 'rounded' (filleted) corners and the adobe walls are reinforced with posts and stakes.

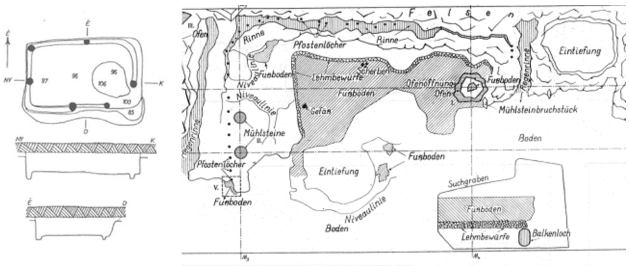

Fig. 2. Pit-house details. Left: Balatonmagyaród-Homoki-dűlő (Horváth 1987, 71 fig. 3/3) and right: Gellérthegy nr. 16, after Bónis 1969.

The 'classical' way of documenting reconstruction results in some kind of hand-made drawings. Some of them are cheesy scenes of idyllic landscapes with people, houses and animals (eg. Szabó *et al.* 1997, 88 fig. 81) – the others are more or less detailed technical drawings.

One may wonder what kinds of difficulties can emerge concerning such simple buildings. Let us take a look at them.

The first problem is the lack of sense for geometry. *Fig. 3* shows a reconstruction where the reconstructed building does not fit into the original pit. Another problematic house is shown in *Fig. 4*, where the shape of the floor does not correspond to the shape of the reconstruction. Both reconstructions have the same concept: a log cabin is placed into the pit. Unfortunately, the straight walls do not correspond to the curved sides of the pits.

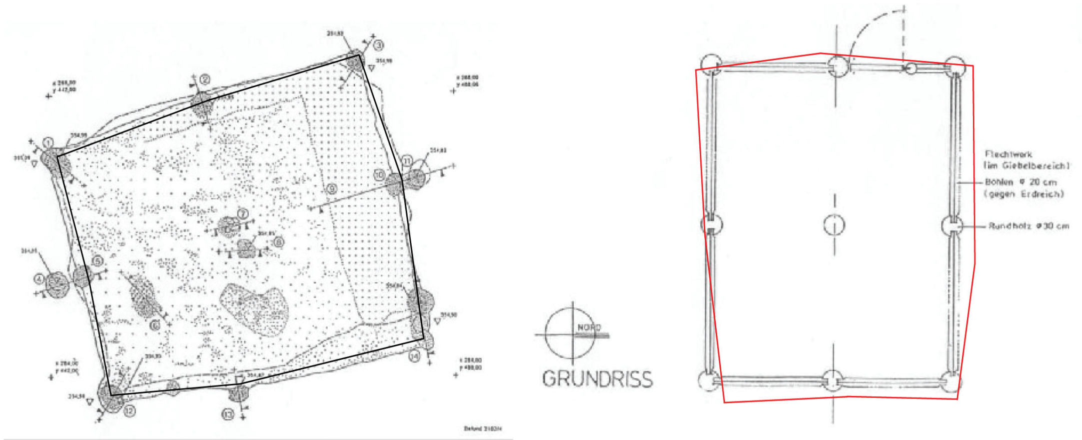

Fig. 3. House at Hochdorf (Germany) with reconstruction. The dark outline shows the original pit contour. After Bader 1999, 230 fig. 12.

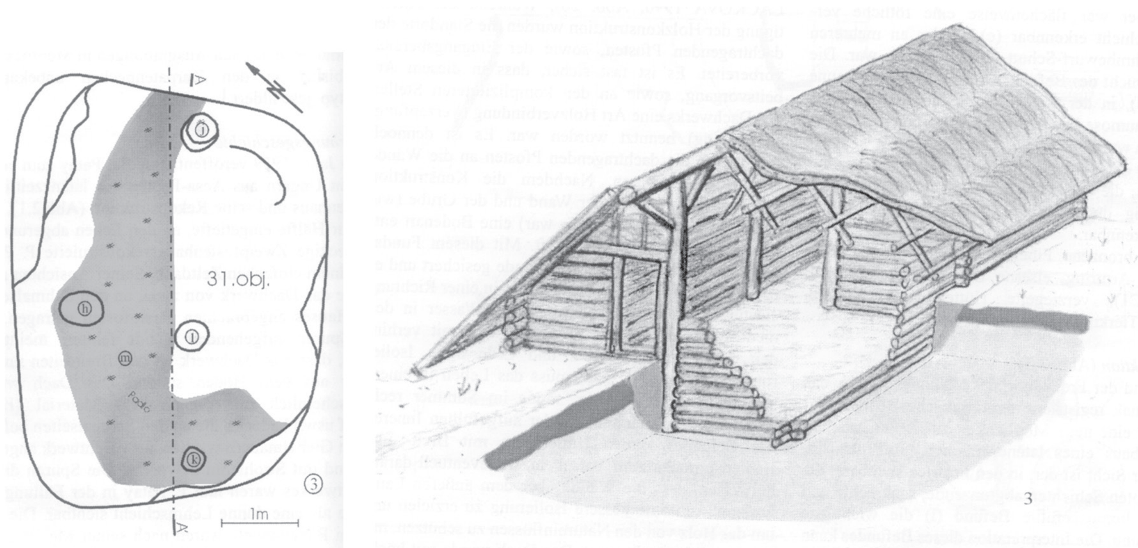

Fig. 4 House at Ménfőcsanak (Hungary) with reconstruction. The rectangular reconstruction does not correspond to the irregular floor and pit shape. After Tankó 2004, 106 fig. 2.

The second problem is more complex. A pit-house with a gabled roof placed on the soil surface has a low gable height providing insufficient height for an entry (*Fig. 5*). Moreover, a low gable means a low ceiling height inside the building, where people cannot walk erect and cannot get close to the sides of the building interior. The result is an inner volume insufficient for either making fire or just sleeping inside with a closed door. Sometimes excavations reveal a fireplace in the corner: such a low roof would likely be ignited by the hearth.

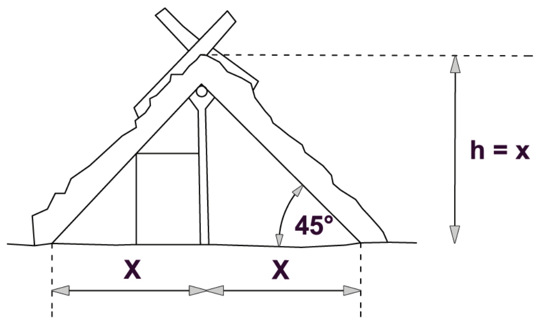

Fig. 5. Relation between gable height and building width. Late Iron Age pit-houses have a width of 3–4 meters, therefore the calculated gable height is about 1.5-2.0 meters at the highest point.

The third problem is that the remains do not actually represent all kinds of buildings. When we take a look at *Fig.6*, we can assume that ground-level buildings do not need foundations – they can be placed on large flat stones. The consequence is the loss of archaeological evidence: such buildings have no traces, when they get destroyed (there is a very small number of excavated ground-level buildings). Another problem is that the foundations evidently do not represent the exact geometry of the superstructure: *Fig. 7* shows a building with curved posts. The position of the post-holes and the supporting points of the roof are not the same. This

Fig. 6. House with no permanent foundation. After Kós 1989, 86.

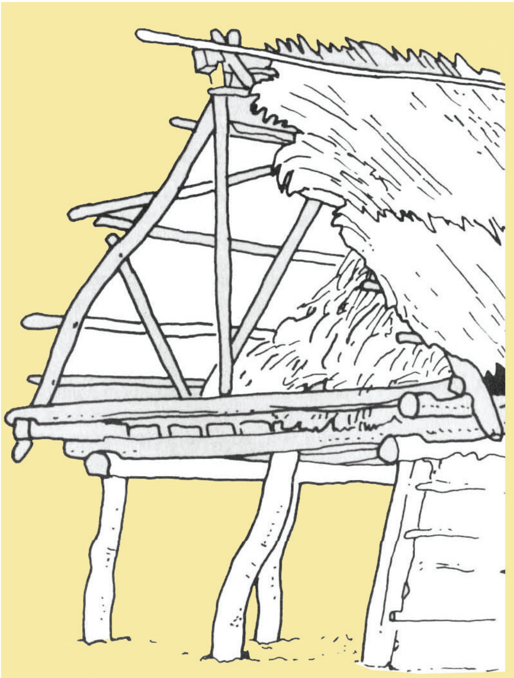

Fig. 7. House with curved posts. After Kós 1989, 247.

is a warning for us: we do not have to believe that the irregularity of the postholes is a consequence of the irregularity of the walls and the roof.

2. A brief description of the method

Now the computer technology has many advantages. When we are analysing the building structures we simply cannot renounce the precision offered by CAD programs. We have seen above that the analysis of the building remains is inevitable. Using computer technology we are able to display difficult structures as well as to remodel their remains and use them as a basis for reconstructions. The ease of design allows us to develop many alternatives for one floor-plan. We can study every detail and choose the most correct reconstruction variant.

During the evaluation of the excavation at Sajópetri and Polgár we identified a special building type. It belongs to the group of the sunken-featured buildings having a broad lateral entry facing to the south. Not just uniform floor-plans, but the finds (loom weights, pieces of slag or pottery kilns attached to the house) suggest that they were workshops. Their functions gives us some idea about their inner proportions – that is why they were chosen for the present study.

Fig. 9 shows different reconstruction variants for the building 02.A.93. at Sajópetri (*Fig. 8*). As we understand from the remains, pottery and metalworking was exercised there. The minimal interior (ceiling) height must have allowed the masters to rise their hammers overhead and the kilns and fireplaces could not be too near to the roof. Darkness is needed to check the colour of the metals during smithing and annealing (that is the cause why

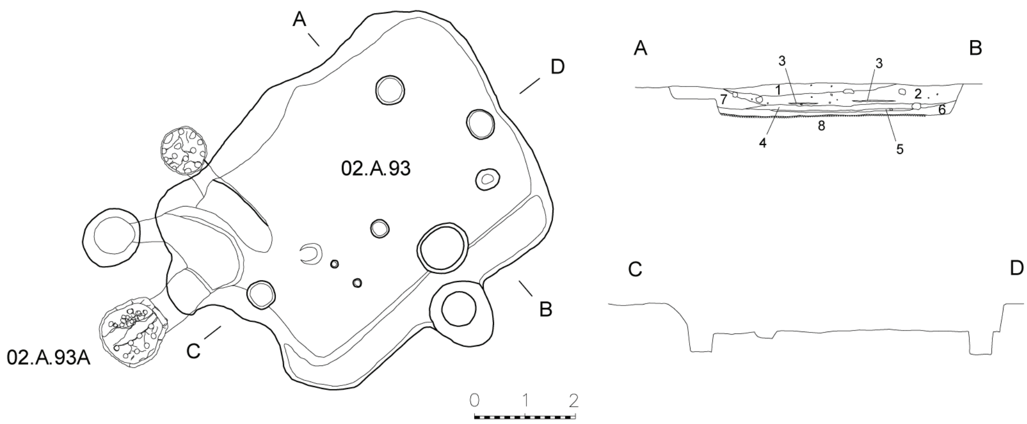

Fig. 8. Building 02.A.93 at Sajópetri.

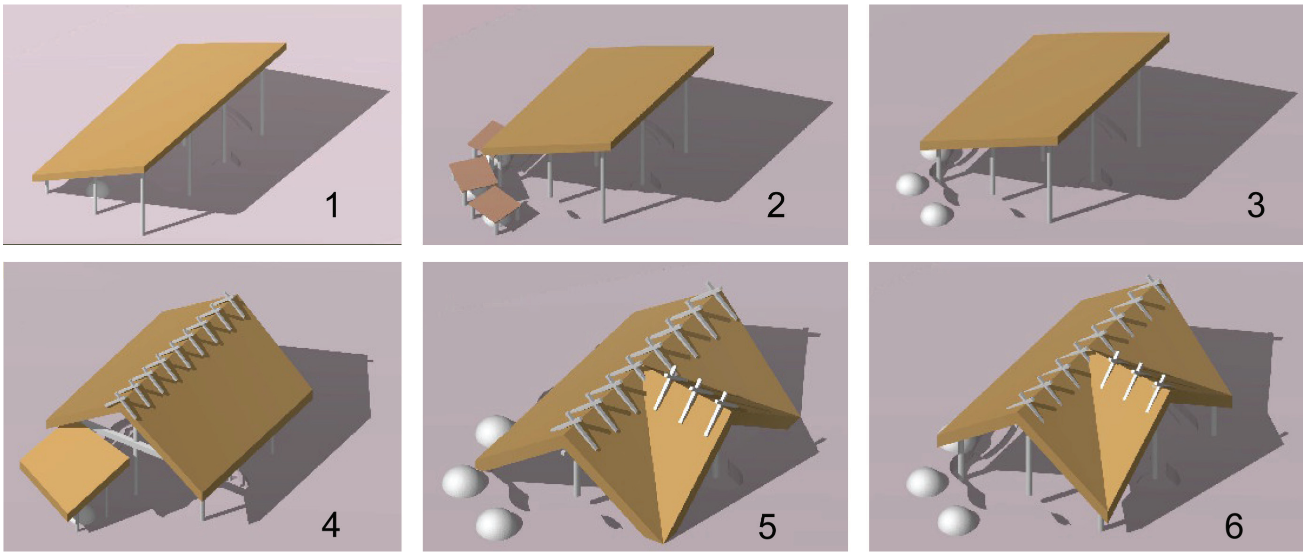

Fig. 9. Reconstruction variants for Fig.8.

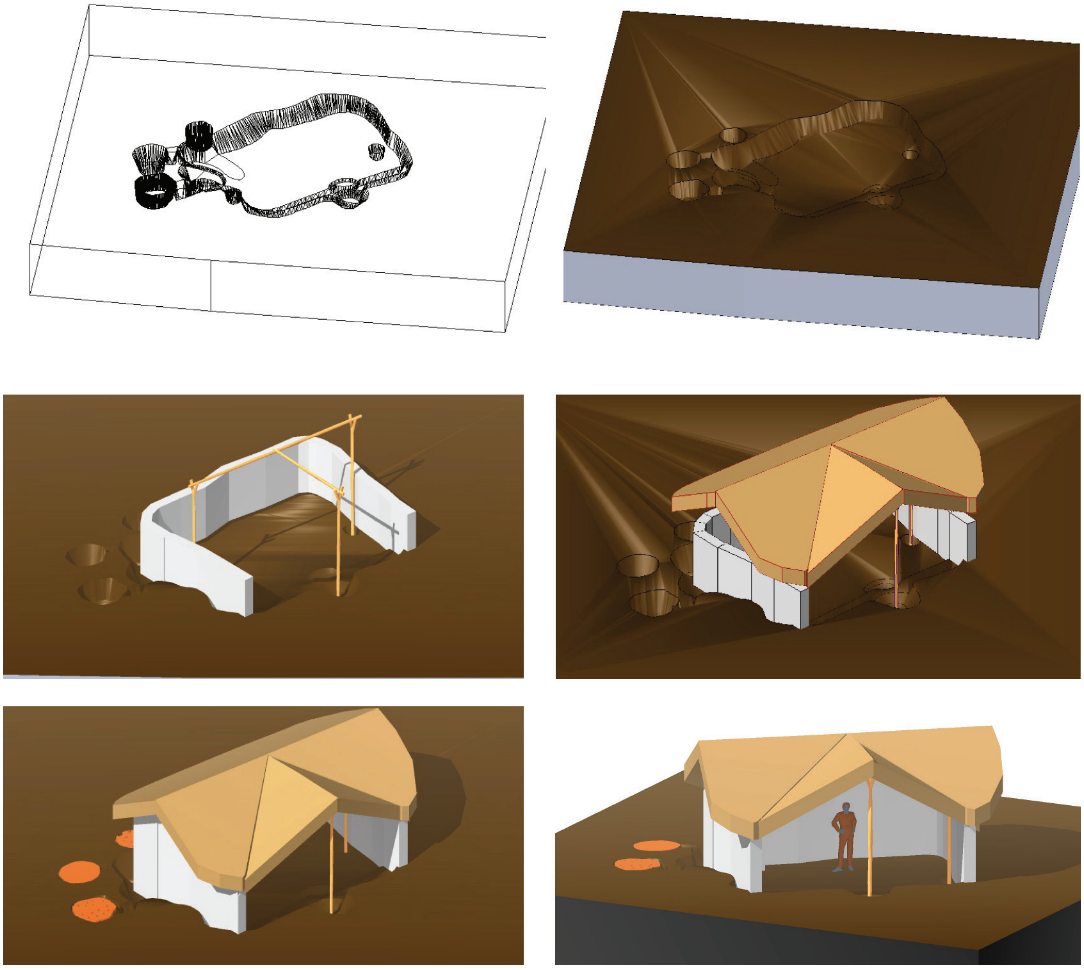

Fig. 10. Reconstructing Sajópetri 02.A.93 from scratch based on variant 6 of Fig. 9.

it is seldom practised outside of buildings where the heat is not unbearable otherwise), but light is also needed for precision working. Therefore, variant 6 seems to be the most likely: its roof is not on the ground and it has a broad opening over the entry. We think the direction of the entry was chosen to ensure the maximum brightness inside the building.

After we have chosen one from the many templates we can develop it further. *Fig. 10* shows how the building can be built up. It is a very important issue that we use the original pit (or trench) contours in order to avoid the common mistakes detailed above. We can also simulate the building process, halt at different stages and check the details whether they can be realized or not.

Fig. 11 shows the building #100 from Polgár, site nr. 1 (see Szabó *et al.* 1997 and Szabó *et al.* 2008). Its floor-plan is similar to the 02.A.93 at Sajópetri, hence among the finds there were loom weights. We have a very nice Hallstatt urn from Sopron where decoration tells us how the weaving was practised in the Early Iron Age. We have also got classical vase paintings which show looms: we can assume that the looms used in the La Tène period were of similar build: high frames with hanging weights for overhead working (see Barber 1990, 106–111 and Horváth and Marton 2002).

When we put the 3D model of the loom into the model of the house pit and build a virtual house over it (*Fig. 12* – assuming that the loom was not disassembled every time when it was taken inside and outside), we get a house very similar to the Sajópetri 02.A.93 – both in details and volume (*Fig. 13*). This is also the control of the reconstructions: we have the same results for the two buildings.

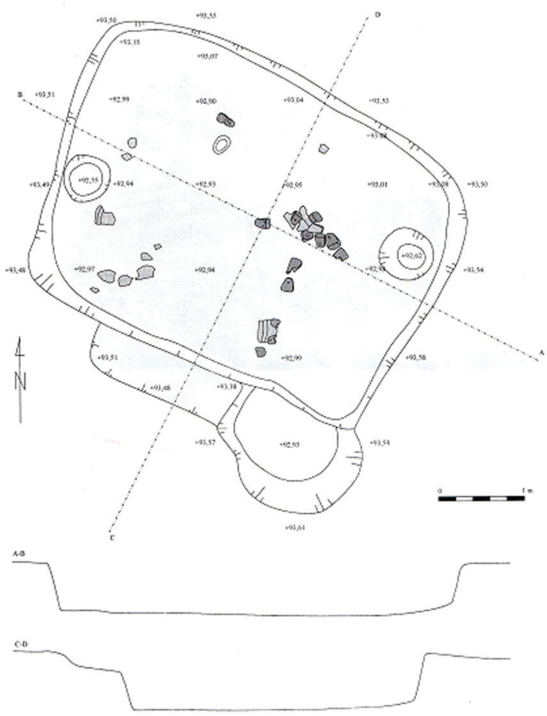

Fig. 11. House #100 at Polgár site nr. 1.

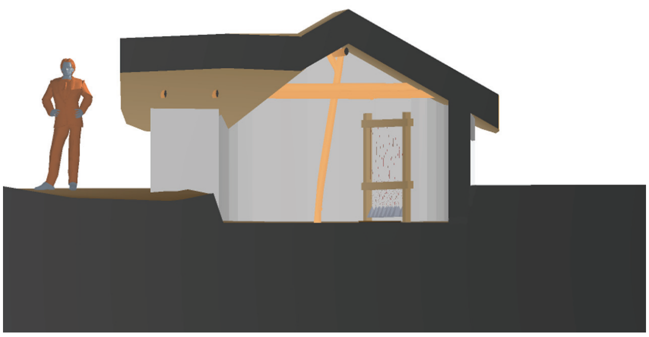

Fig. 12. House #100 at Polgár site nr. 1 – reconstructed cross-section.

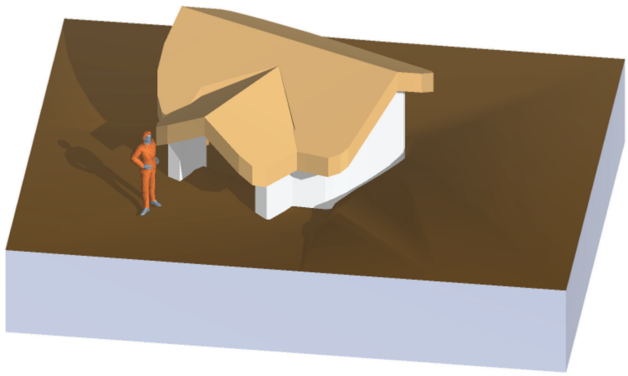

Fig. 13. House #100 at Polgár site nr. 1 – reconstructed view.

3. Conclusion and further perspectives

Our future plans include a systematic collection of Late Iron Age building features. The majority of the excavated buildings reveal no details except the shape of their pits, but some of them show one or two traces of the original constructions. Their analysis will probably lead to more revelations. Unfortunately the majority of the building remains does not show any distinctive detail. According to the few observations there is a chance to find the remains of the foundations where the soil erosion or the perturbation was not too extensive. The lower subhumus layers of the rubble filling the pits are usually homogenous, but in the upper layers – if they are still present – there are many traces. Unfortunately, the upper layers are hard to identify because they are close to the humus. The 3D modelling of the archaeological layers could allow us to reconstruct the building in its collapsed state and to calculate the amount and nature of the materials used. It is also very important to recognize which traces belong to the building parts that became buried in oblique position.

Fig. 14 shows the principal problems: the excavation method is based on horizontal cuts, which means that the perishable materials in oblique position are indicated by small dots on the different levels. Only a 3D computer model could reveal their real position, because it is impossible to extract and preserve them.

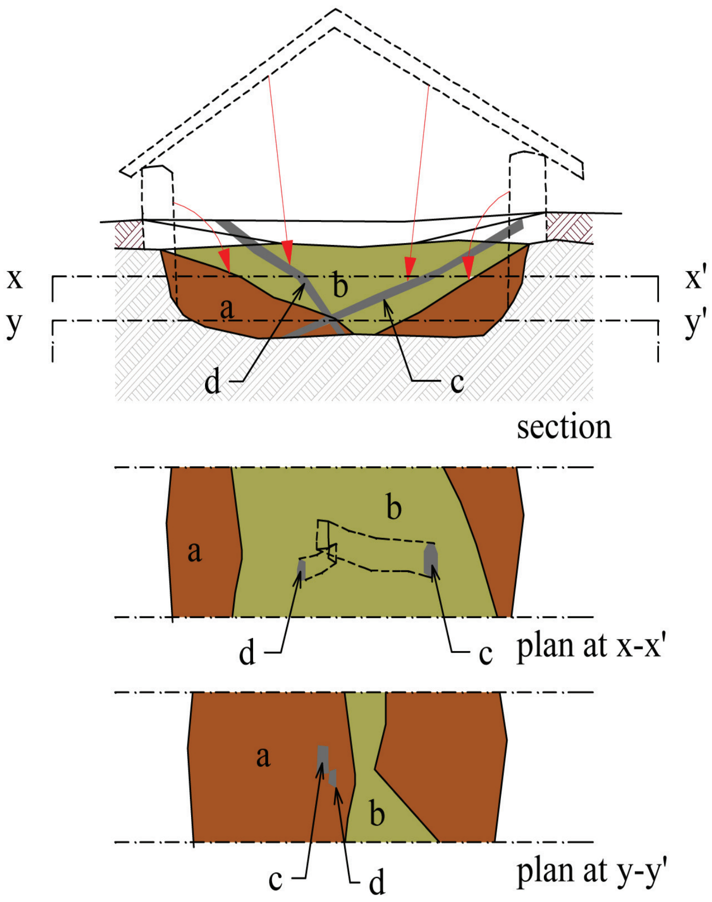

Fig. 14. Identification of the structural parts: the principal problems.

The most important precondition for the method described above is the presence of a longer series of precise observations. An opportunity for this will hopefully be available in the near future.

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