

## „FAST ARCHAEOLOGY”: APPLYING NEW TECHNOLOGIES IN THE ARCHAEOLOGICAL RESEARCH IN THE CIVILIAN CITY OF AQUINCUM AND IN ITS TERRITORY

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### Abstract

*The sharply rising number of building investments on archaeologically protected territories in Budapest represents a particular challenge for archaeologists in the capital. The Budapest Historical Museum can only adapt itself to these demands if we apply new technologies in documentation and survey. Photogrammetry, geophysical survey and laser-scanning, to date mainly have been used to complement traditional documentation, have also been tested in excavation circumstances last year. Examples will be presented concerning the Roman villa-estates, the western and central part of the Aquincum Civil Town and its aquaduct. These types of documentation, sometimes carried out in a few hours, were not only of help to the archaeological research, but also yielded new archaeological information: that shed light on previously unexplained data from old excavations at the Civil Town of Aquincum.*

KEYWORDS: AQUINCUM, URBAN ARCHAEOLOGY, PHOTOGRAMMETRY, GEOPHYSICAL SURVEY, LASER-SCANNING

KULCSSZAVAK: AQUINCUM, VÁROSI RÉGÉSZET, FOTOGRAMMETRIA, GEOFIZIKAI FELMÉRÉS, LÉZER-SZKENNELÉS

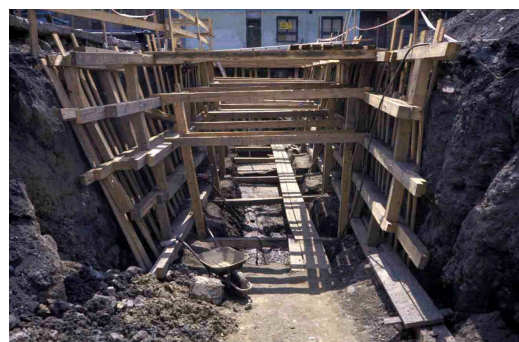


**Figure 1.** Historical areas in Budapest (BTM Archives)

### *New demands: growing number of excavations in Budapest*

The growing number of building investments on archaeologically protected territories, represents an ever increasing challenge for archaeologists throughout Hungary. The situation is especially critical in Budapest, where building activities bring to light the finds and ruins of Prehistoric, Roman and Medieval Óbuda, Buda and Pest.

In the last 15 years, since the change of the regime - more than 600 excavations were carried out by the Budapest Historical Museum, responsible for the archaeological excavations all over in Budapest (Bodó 2005, 8.). As the building activity has been increasing in these years, our statistics show that the number of planned and control-excavations decreased and practically disappeared, while those connected to building activities is still steeply increasing.



**Figure 2.** Excavating in deep: the foundations of future buildings can destroy archaeological sites (photo of the author)



**Figure 4.** Parts of the Roman settlement complex of Aquincum (BTM Aquincum Museum Archives)

These last include the building of shopping centres, housing estates or office-buildings with deep garages which once and for all destroy the cultural heritage. (**Fig. 2.**) What makes it even worse, the primary intention of investors, even if they are interested in archaeology, is to have the excavation carried out by the Museum as soon and as cheaply as possible. The demand is similar when public utilities are being constructed or in the case of public transport. Museums - and so is the Budapest Historical Museum - can only adapt themselves to these demands if they apply new technologies in documentation and survey.

### ***New technologies: different sites-different intentions***

The Aquincum Museum – in the framework of the Budapest Historical Museum – is responsible for all the Roman period sites in the capital. The capital of the province Pannonia Inferior was Aquincum, which included different settlement-units: the legionary fortress, the military town surrounding it, the Civil Town and the villa-estates up in the Buda hills. (**Fig. 3.**) As the right bank of the Danube, the Buda side, is scattered with Roman period remains, building activities also endanger the sites. To fulfil the above mentioned expectations concerning the excavations, the Aquincum Museum has long been trying to apply new technologies. Photogrammetry, geophysical survey and laser-scanning have been tried to complete traditional documentation.

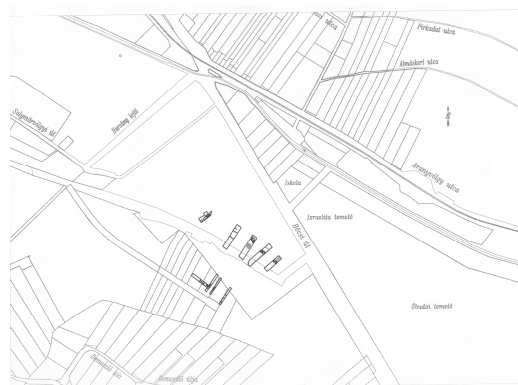
Testing these new technologies took place in the territory of the Civil Town, that is to say in the area of the villa-estates and in case of the Civil Town itself as well.

Both areas required different types of technologies: the territory of the Civil Town is largely still unbuilt and undisturbed by modern building activity, so geophysical survey can be carried out. The area of the Civil Town is partly built in, mainly by modern roads and railways, so here photogrammetry and laser-scanning can be of great help, though there are areas where geophysical survey can also be helpful, as we will see below.

### ***The territory of the Civil Town***

#### **The so- called Testvérhegy-villa**

The remains of a Roman building-complex, which is located by the main northwest-southeast road, that connected Aquincum to Brigetio (modern Szőny) was first excavated in the 1930's by S. Garády and again between 2002 and 2005 connected to the building of a large housing estate. (**Fig. 4.**)



**Figure 4.**

Location of the so called “Testvérhegy-villa” (BTM Aquincum Museum Collection of drawings)

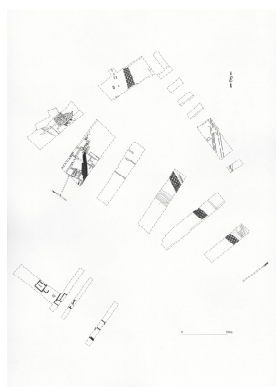


**Figure 5.**

View of the entrance-unit of the so called “Testvérhegy-villa” (photo of the author)

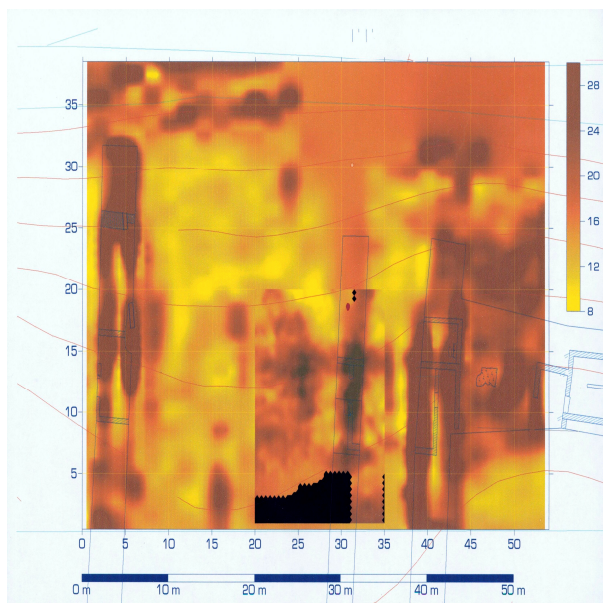
**Figure 6.**

Excavated parts of the villa-complex. Geodesy (BTM Aquincum Museum Collection of drawings).



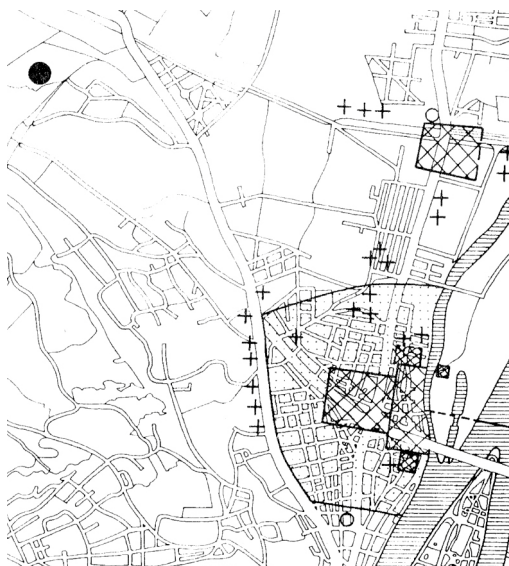
During this recent campaign, parts of the above mentioned road, graves lining the road, entrance and fence of the Roman estate, building of economic purposes and parts of the dwelling-houses on the neighbouring slopes came to light (Garády 1936, 88-96., Garády 1938, 184-187., T. Láng 2003a, 95-110., 2004, 90-105., 2005a, 214-215., 2005b, 343-360, 2005c, 657-666.: **Fig. 5-6.**)

As the present owner of the site intended to reconstruct part of the Roman buildings and at the same time wanted to know how far the Roman remains extended, geophysical analyses were carried out on the slopes. The analyses resulted several “new” walls, as well as modern disturbances and also a curving structure, which can be interpreted as an apse belonging and maybe connecting two buildings (T. Láng 2005b, 357, fig. 9.: **Fig. 7.**).

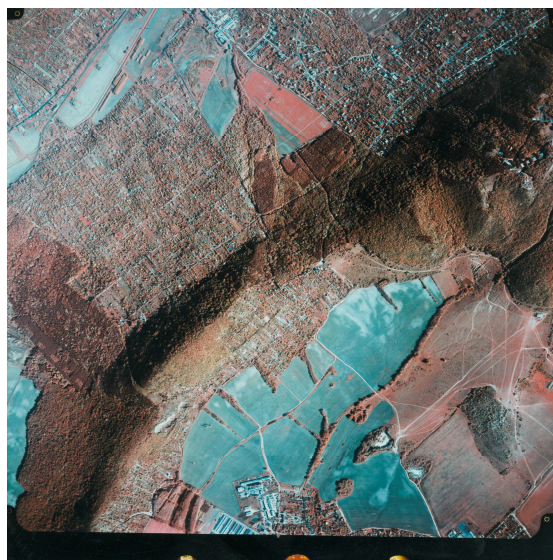
**Figure 7.**

Geophysical analysis of the area of the villa-buildings with the suspected apse (Geomega Ltd.)



**Figure 8.**

Location of the “Csúcshegy-Harsánylejtő” area (BTM Aquincum Museum Collection of drawings)

**Figure 9.**

Arial photo of the “Csúcshegy-Harsánylejtő” site (BTM Aquincum Museum Collection of photos)

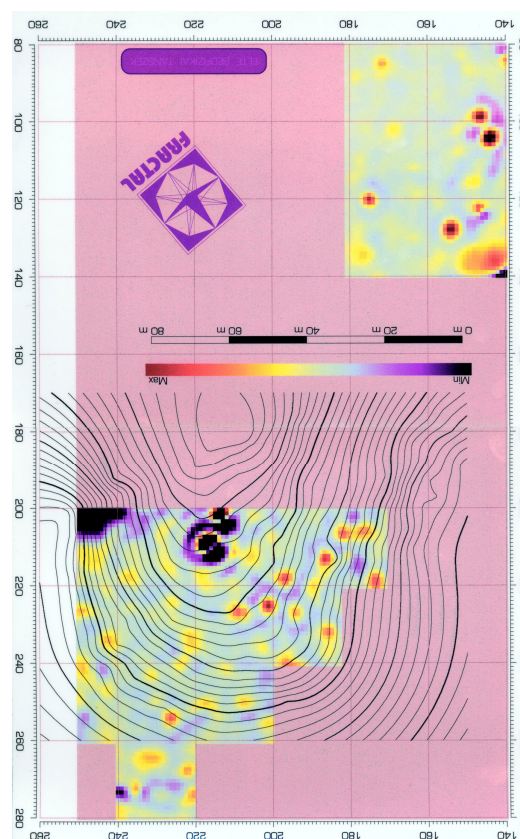
If so, this could have been a similar main building of a Roman estate, as that of the so-called Csúcshegy villa nearby (Nagy 1937, 27-60). Excavations are still going on the slopes, thus a more complete ground plan of the building-complex could be expected (Havas 2006, in press)

### Prehistoric, Roman and Medieval remains in the Csúcshegy-Harsánylejtő

North-west of the above mentioned Roman settlement-fragment, another large area was investigated by new technologies. Here, in the eastern part excavations were first carried out in 1996 by P. Zsidi, then remains of a Medieval village, part of an early Roman settlement and traces of a Roman period earth-wood construction were identified (Zsidi 1997, 58-65., **Fig. 8-9.**) Geophysical analyses were also carried out by a curving structure, close to the earth-wood construction (op.cit, fig. 23 and 24.) The analyses were carried out by Fractal Bt. (**Fig. 10.**)

Later site-surveys resulted Roman ceramics and bricks suggesting a settlement somewhere in the area (T. Láng 2005d, 216-217.)

Excavations were carried out here again in 2005 by Z. Havas, Z. Kárpáti and G. Szilas. The owner of the plot decided to build a housing estate here. Postholes and pits datable to the Bronze Age, Roman pits and remains of the above mentioned 11<sup>th</sup> c. village came to light (Havas et alii 2006, in press).

**Figure 10.**

Result of geophysical analysis of the earth-wood construction at “Csúcshegy-Harsánylejtő” (Fractal Bt.)



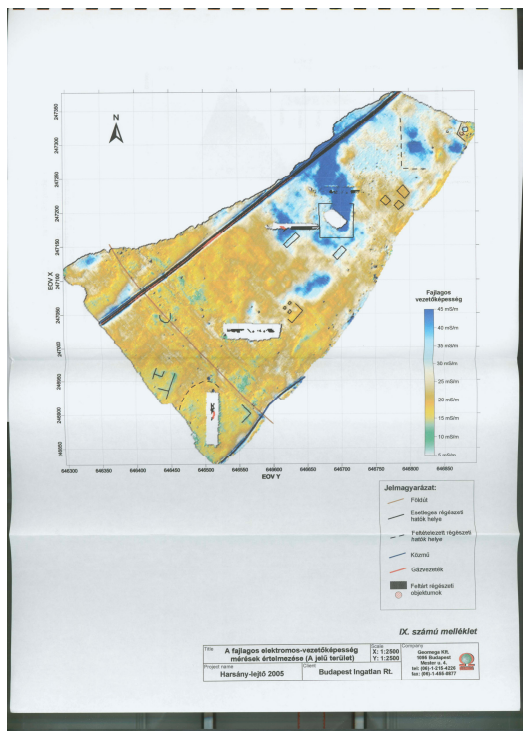


**Figure 11.**

Area of the 2005-year excavation at "Csúcshegy- Harsánylejtő" with Prehistoric and Medieval objects. Laser-scanned point-cloud (Piline Ltd.)

Part of the excavated area was documented by laser-scanning too, carried out by Piline Ltd. (Fig. 11.)

Research was also carried out in the western part of the area, where beside opening trenches, common decision was made to carry out geophysical analyses. The area is large and the results could make planning easier, avoiding the destruction of eventual Roman remains by garages or house-bases. (Fig. 12.). The analyses resulted possible walls and debris concentrating at the southern extremity of the site and also in the middle, which were partially identified by our trenches.



**Figure 12.**

Result of geophysical survey at the western part of "Csúcshegy-Harsánylejtő"(Geomega Ltd.)



**Figure 13.**

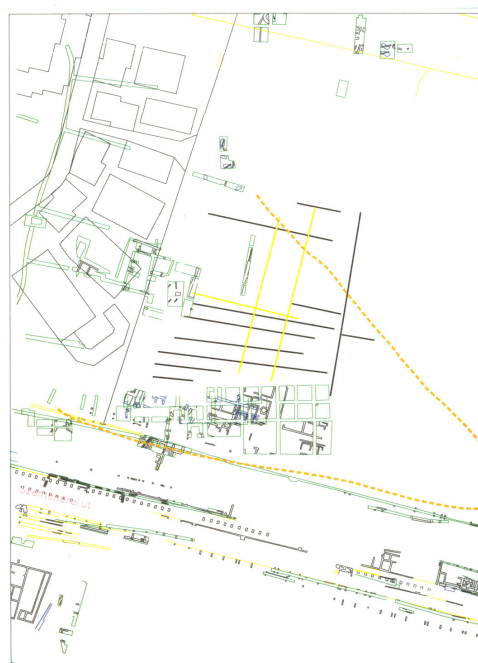
Walls of an unidentified building of the Roman period (photo of the author)

The analyses were carried out here by Geomega Ltd., too. Here excavations revealed Roman walls of an unknown complex, a waste-pit and a rectangular building of the same period, all in heavily ploughed condition (T. Láng 2006a, in press, Fig. 13.). Although the archaeological research will be continuing in 2006 as well, the geophysical data already give us an idea of the areas most intensively built in.

### *The Civil Town of Aquincum*

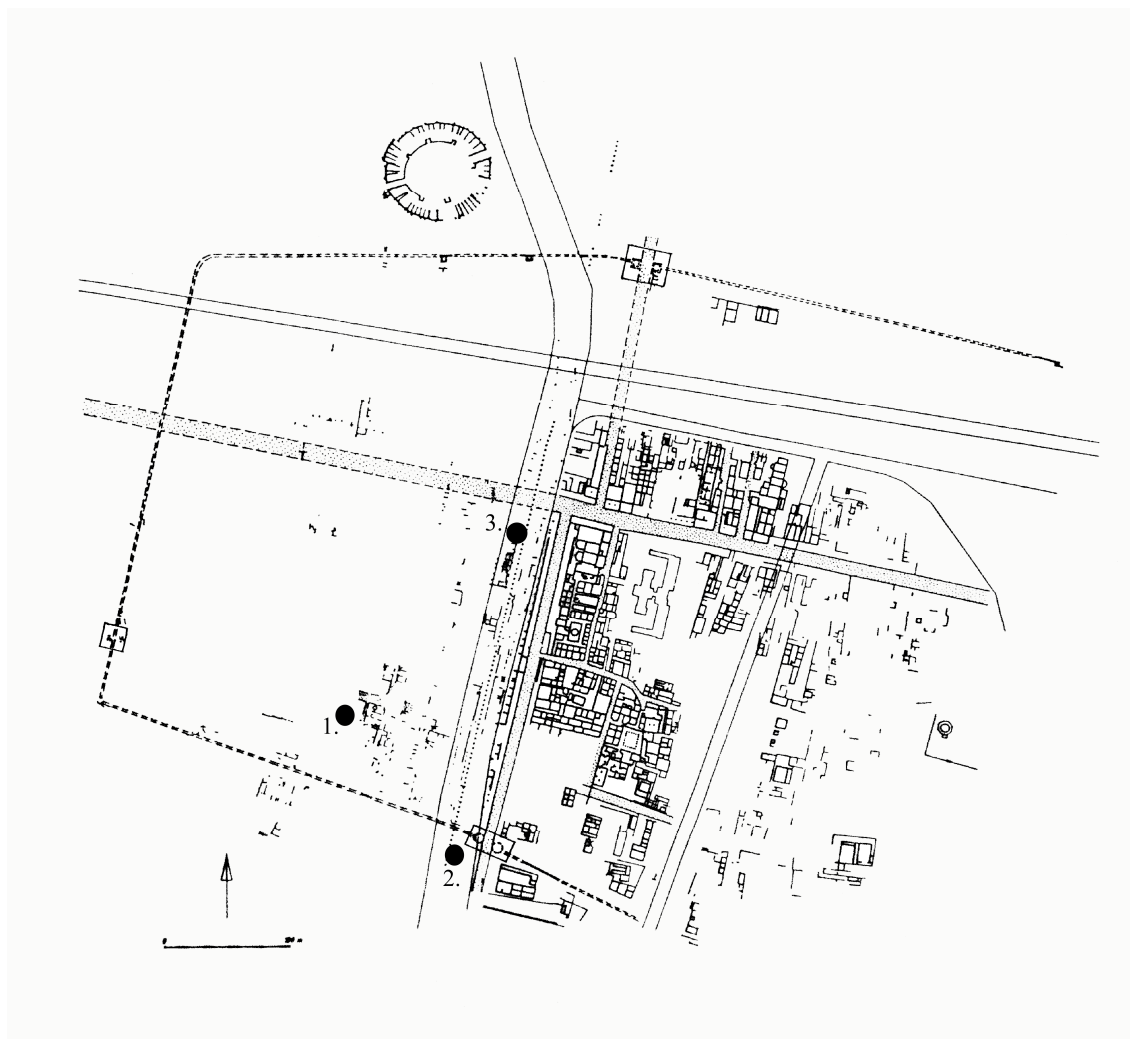
#### **Aquincum-West**

The area of the Aquincum Civil Town has been continuously excavated in the past 100 years, but mostly its eastern zone.



**Figure 14.**

Result of the geophysical survey carried out in the south-western part of the Civil Town of Aquincum (Fractal Bt.)



**Figure 15.** Groundplan of the Civil Town of Aquincum I. South-western part of the town; II. Aquaeductus; III. Railway-line

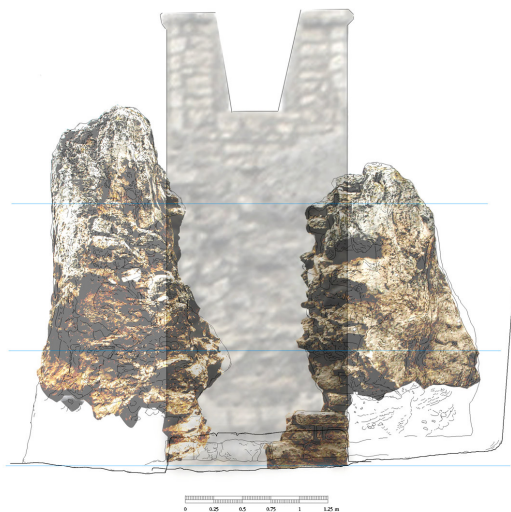
The area of the western part of the Civil Town of Aquincum is largely unexcavated, only small scale researches have been carried out here, especially in its south-eastern zone where a bath-complex was uncovered previously and by its main east-west road where shops, storerooms and workshops came to light (Póczy 1984, 21. Forschungen..2003, 151-152. and 157., **Fig. 15, 1.**) Being an undisturbed area, it seemed ideal to give a try to geophysical surveys. Although a full-scale survey is still awaiting, probes were made in the south-eastern area in the nineties. The surveys were carried out by Fractal Bt. (**Fig. 14.**) The analyses resulted a grid-system, which most probably reflect the street-system of this zone of the town. Surveys will hopefully continue in the future to give a more complete picture of the ground-plan of the western part of the town, without excavating.

### The aquaeduct

The water-conduit, that supplied the Civil Town of Aquincum and the main bath- complex of the legionary fortress some 5 km to the south, originates from the area of the so called Roman Open Air Bath to the north, where well-houses were constructed and sanctuaries were built. (**Fig. 15, 2.**)

As this conduit follows the main north-south road used in all periods, the pillars of the aquaeduct were always in the focus of archaeological research. The largest systematical research was carried out between 1975 and 1979 by P. Zsidi and M. Kaba, when the Szentendrei road was widened and the pillars of the aquaeduct, its structural elements, their immediate neighbourhood together with road-fragment and shops were identified (Kaba 1976, 225-230., Zsidi 1984, 461-462.)



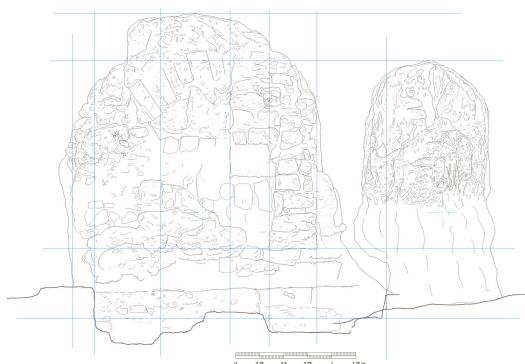


**Figure 16.**

Photogrammetrical analysis of a pillar of the Roman aquaeductus (drawing by J. Vajda and I. Györfy)

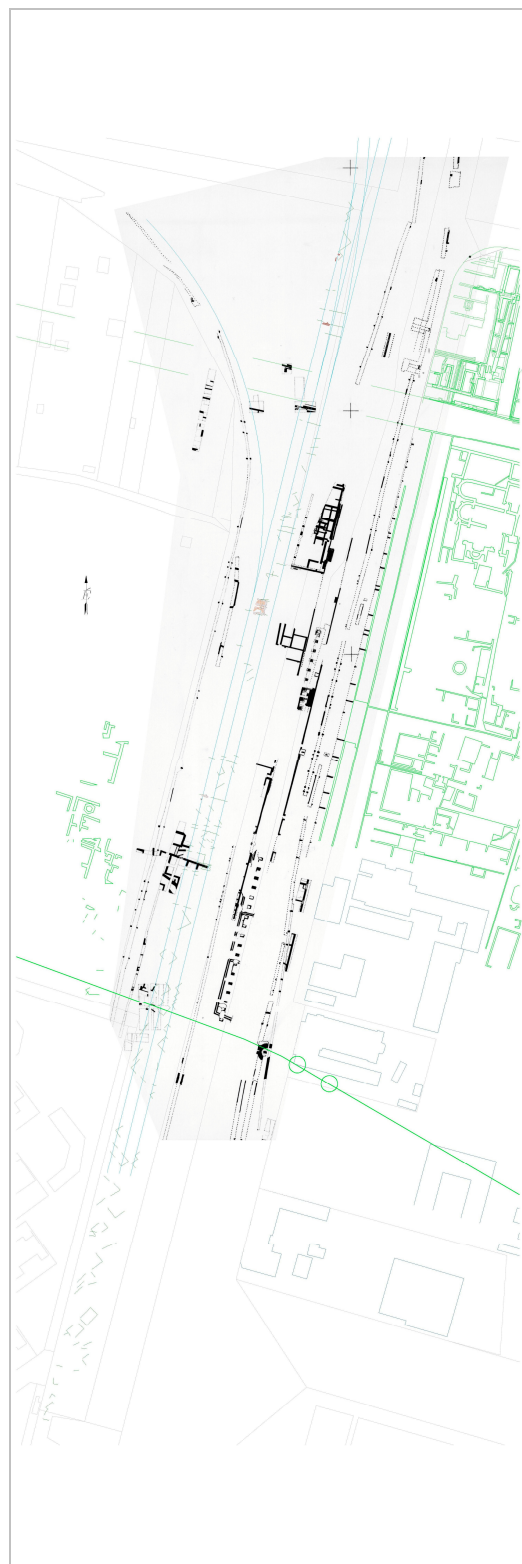
Reconstructed pillars outside the southern town wall were “touched” again during a control-excavation in 2003 connected to a road reconstruction (Havas 2004, 61-65.). As the time was very short and only ten pillars could be studied, photogrammetry was applied to document the remains of the pillars and the limestone blocks above them.

Photogrammetrical analyses were carried out by Vajda J. and Györfy I. (Fig. 16-17.) These analyses shed light on to the structure of the conduit, the static condition of the pillars as well as to its functional problems and eventual repairs.



**Figure 17.**

Photogrammetrical analysis of a pillar of the Roman aquaeductus (drawing by J. Vajda and I. Györfy)



**Figure 19.**

Result of the geophysical survey carried out during the reconstruction of the railway line in the Civil Town of Aquincum (Geomega Ltd.)



**Figure 18.** Excavating at night during the reconstruction of the railway line in the Civil Town of Aquincum (photo by G. Lassányi)

In spite of the fact that almost the entire row of pillars was fully excavated earlier, new data were gained from the photogrammetrical survey of the recently re-examined pillars and their immediate neighbourhood.

*Centre of the Civil Town: the reconstruction of the railway-line*

Applying new technologies in archaeological research in extreme conditions first took place this year. The reconstruction of the railway-line for the Szentendrei HÉV required special attention as it crosses the Civil Town of Aquincum in north-south direction. (Fig. 15, 3) Comparing the plans of the transport company (BKV Rt.) and information gleaned from previous excavations made it clear that the reconstruction work could affect Roman layers. The strictly scheduled project only allowed 16 hours for archaeological work to be completed. The excavation was conducted by G. Lassányi, P. Hárshegyi, P. Zsidi and T. Láng. (Fig. 18)

Taking up the tracks meant that a circa 400 m long and 10 m wide stripe of the Roman settlement came, more-or-less, to light. The first step was a geophysical survey, which was

especially important as there was no possibility to excavate deep layers. The analyses resulted walls of different orientations, roads, and intensively built in areas outside the southern town-wall. (Fig. 19.) Although the results of the research are still await evaluation, these are all new and essential data in understanding the topography of the town.

Following the geophysical survey, the ground surface was cleaned. At this time buildings of unknown purpose came to light together with traces of terrazzo and heating channels. (Fig. 20.) The documentation of this building together with other wall-fragments was carried out by laser-scanning during the night and also in rain. Beside digital and 3D images, traditional type of documentation (namely drawings) was also produced by this method. (Fig. 21-22.)

These types of documentation, carried out in a few hours, were not only of help to the archaeological research, but thus far unexplained data from previous years of excavation in the Civil Town of Aquincum could be explained and it was possible to further complement the topographical-chronological picture of this part of the Roman town.



**Figure 20.**

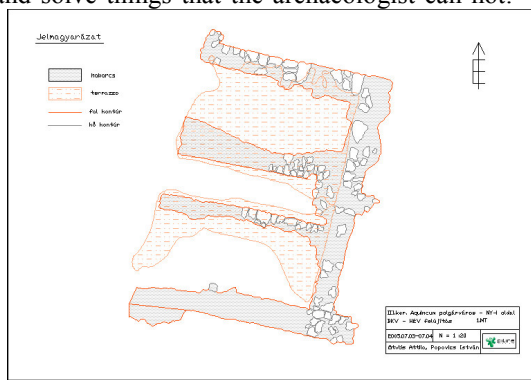
Remains of a Roman building with heating channel during recovering in the Civil Town of Aquincum (photo of the author)

### ***New technologies: conditions and usability***

Having tried new methods in archaeological research in Budapest, we can now outline under which conditions can these be useful. First of all it is important to emphasise, that archaeologists must see what these technologies are good for (e.g. partly replacing traditional documenting methods) and rely on the results.

As investors pressure the Museum towards fast work, it is also essential that these technologies should be quickly implemented and not only at the site, but also with the fast results.

A geophysical survey of a site or laser-scanning of a wall-structure will do not do the work alone and solve things that the archaeologist can not:

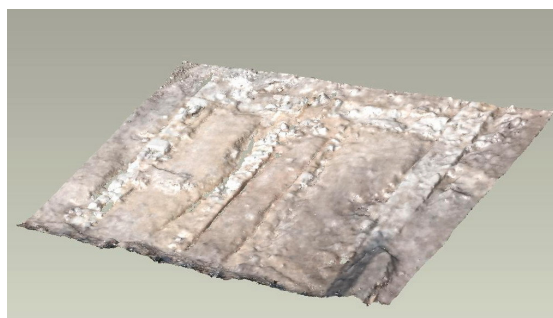
**Figure 21.**

3D model, based on the point-cloud of the laser-scanned Roman walls recovered during the reconstruction of the railway line in the Civil Town of Aquincum (Piline Ltd.)

that is to say the processes require continuous consultation with the archaeologist-in-charge.

There are cases when work has to be done in the rain or at night. These technologies should be used in extreme conditions: in cellars, at night, in bad weather.

Last but not least: museums are known to be mostly in financial difficulties. These technologies can only be paid by the investors, as in the case of the excavations according to Hungarian heritage law. Therefore these surveys should be affordable to make owners see: it is worth using them, either because it makes documentation quicker or either because it is a faster way of getting data of a site before building even without destructive - and costly -excavation methods.

**Figure 22.**

Drawing based on the laser-scanned Roman walls recovered during the reconstruction of the railway line in the Civil Town of Aquincum (Piline Ltd.)

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