Vienna Archaeological GIS (VAGIS): A Short Outline of a New System for the Stadtarchäologie Wien

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Abstract

The first archaeological systematical research in the city of Vienna was conducted by Josef Nowalski de Lilia and Friedrich von Kenner. Their work on mapping the archaeological sites in Vienna set the fundations for the archaeological map of Vienna. Their data was upgraded after a century of archaeological research in Vienna and presents the basis for the present sites and artefacts database called VAGIS (Vienna Archaeological GIS). In this paper we present how artefacts locations and plans of sites registered on historical maps from the year 1819 were transferred to the modern database.

Keywords: Vienna archaeological GIS, Franziszeischer Kataster, Nowalski de Lilia, Stadtarchäologie Wien, Vienna

1. Introduction

Cities are never "finished". Even if they came into being according to a development plan, they are constantly in "statu nascendi" – they are constantly adapted to the needs of their inhabitants (Artner/Krenn 1995:45).

The growth of the 2 million population of the City of Vienna has increased many times over the past decades. An increasing number of green areas have been designated as development areas. Over 1000 ha have been designated for new residential, infrastructure and roads to be constructed during the next decade. (Jakob 2000:76)

One of the tasks of the Stadtarchäologie Wien is to develop strategies, which help to prevent uncontrolled destruction of our cultural heritage.

1.1. Morphological and historical background

For those unfamiliar with the characteristics of the Viennese landscape and its archaeological record, we will give a short introduction here.

A political slogan coined during the 1990s stated that: "Vienna is different." This statement is also applicable to the city's geography and to its history.

Geographically, Vienna can roughly be divided into 3 parts: the area north of the Danube, the terraced landscape south of the Danube and the wooded hills of the Wienerwald to the west.

The Vienna Basin provides an excellent environment for settlements and has therefore attracted settlers since prehistoric times.

The Danube served as an east-west-highway for water transport, fords by which the branched-out Danube could easily be crossed provided an ideal north-south-communication.

The area south of the Danube with its terraces formed during the ice ages and by rivers, in particular, offered the greatest incentive to settle. Settlements dating back to the Neolithic can be found at the heights and slopes of these hills.

After the Vienna area was attached to the Roman Empire, the Romans found a relatively flat platform, protected by brooks and rivers in what is today the first district. The location was ideal for building a fort (Mosser 1998:74). The civilian town (Zivilstadt) was situated in the third district (Mader 1998:89). Roman Villas and smaller towns could be found near other watercourses (Wölfl 1998:113).

The northern part of Vienna, districts 20 to 22, is less favourable to settlements because of its morphological features. The area is not terraced and the height-differences are negligible. Until its regulation the constantly changing bed of the Danube and the formation of new branches have largely destroyed all evidence of settlements. Most designated development areas are situated in those districts, which will therefore increasingly draw the attention of our archaeological research.

2. Fundamentals

Archaeological research has a long tradition in Vienna. The first Roman finds were mentioned in the 15th century. Until the 19th century collection was the top priority. Serious research of archaeological remnants did not begin until late in the 19th century. The fall of the bastions, the fortifications that hemmed in Vienna's growth for centuries, triggered an impressive building boom beginning in 1870. At this time Josef Hilarius Nowalski de Lilia, a Polish emigrant (Wielowiejski 1989:89), arrived in Vienna and started systematically recording archaeological evidence and collecting finds from the various building sites, particularly from the city centre. His notes and sketches have been preserved to a large extent and form the basis of our site database (Stipanits 1998:67).

2.1. Database

Before we were given the idea for a Geographical Information System, our first step was to sift through the existing notes on finds and known sites. Eight years ago the first database was constructed, first with the program Superbase, then with Access, as it saves a lot of work.

Each site is given a number, the site code, consisting of the year the excavation took place and a consecutive number. In the meantime about 2000 numbers are in use. All other numberings, e.g.

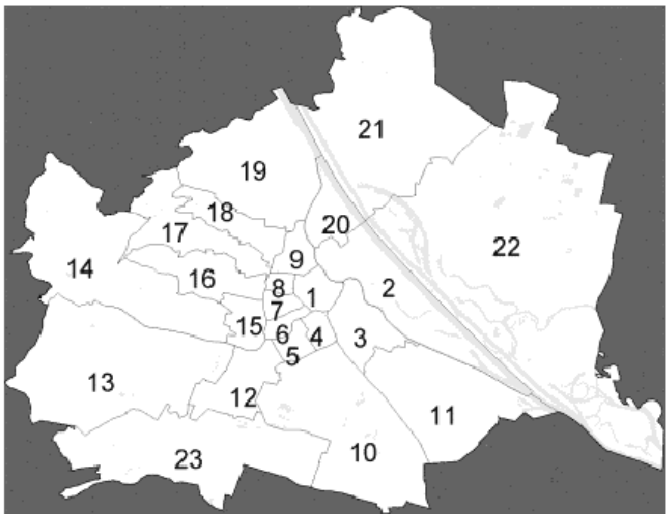

Figure 1: The districts of Vienna.

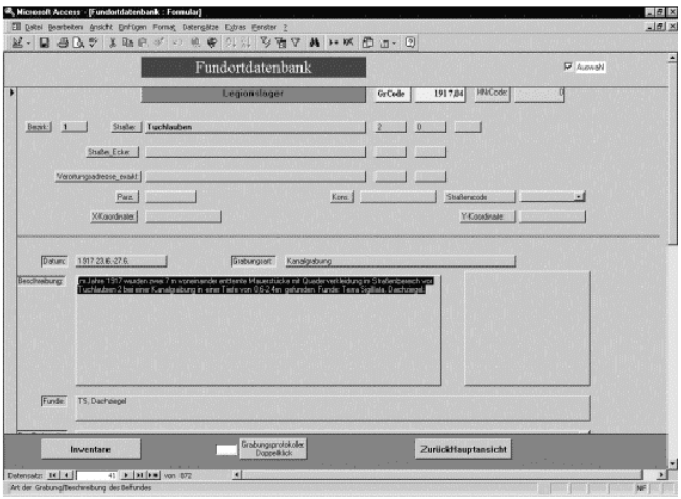

Figure 2: Site-Database of the Stadtarchäologie Wien.

for artefacts, photos or context sheets, are based on this code (Börner 1998:52, Turecek 1999:55).

The first database created was the site database of Stadtarchäologie Wien listing all sites in the urban area. For each site there is a short characterisation and description. This main database is linked by the site code with all other databases, like inventory, photo, excavation and so on. Additionally to the site database, an excavation database has been set up and is at disposal to our field teams.

Because we wanted to include as many earlier excavations as possible, different methods of excavation had to be taken into account at developing this database. The integration of the Harris-Matrix in the database management system is planned for the near future.

3. CAD

Shortly after we began developing this set of databases, it was decided to transfer all existing plans of the contexts and sketches into a CAD System. This proved to be quite easy for excavations that were already linked to a system of coordinates.

Mr. Nowalski's sketches of sites were more problematical. In the past years our experiences have shown that the sites depicted in these sketches have been surveyed very accurately. Yet, it was difficult to establish a link to today's city map. Luckily Nowalski also drew property borders or the walls of houses. All we had to do was to find a map of Vienna from before the building boom. The "Franziszeische Kataster" turned out to be especially useful. (Börner and Mosser 1997:9)

3.1. The "Franziszeische Kataster"

Emperor Franz I. of Austria succeeded in abolishing legal and technical obstacles and in establishing a complete change. With his land tax patent of the 23 December 1817 he founded the Austrian Land Register. On the whole, the guideline of this patent is still valid today.

The land register is also called "Franziszeischer Kataster" after his creator, or stable land register. "Stable" because the rates of net proceeds used for calculating taxes were meant to be invariable, that is without consideration for possible higher profits as a result of exceptional diligence – with the exception of the total or partial loss of the soil's fertility due to natural disasters (Fischer 1995:39f.). The land survey was based on scientific principles.

Before this land register was digitised and transformed by today's city map its accuracy was reviewed.

3.1.1. Review of the land register's accuracy

The terms of reference were an analysis of the accuracy and the transformation of the "Franziszeischen Kataster" for the third district. For the first district a transformation of the "Franziszeischen Kataster" was carried out in summer 1996. On account of the high number of identical objects, a transformation „house after house" could be made. Non-identical areas were transformed together with identical objects. In this case identical means objects existing in nature today, which were already in existence at the time the "Franziszeische Kataster" was made and were shown on the plans.

This method didn't work with all land register plan in question, because the number of identical objects were lower than in the plan of the first district, furthermore identical objects were not situated as close to each other.

Since completely different methods of survey were in use at the time the maps were made, one cannot say the land register plan is inexact. Rather it is to be admired how precise the depiction of Vienna in maps of those days really is. Therefore we refrained from a bit-by-bit transformation to preserve the geometry of these old maps. Determination of the scale was done according to the Mekenkamp method and the transformation of identical points was done after Helmert.

3.1.2. Determination of points

First of all each sheet of the land register was divided at random into zones and columns, to guarantee an indisputable identification of points.

3.1.3. Mekenkamp method

By this method identical coordinates are taken from both the digitised "Franziszeischen Kataster" and today's digital map of Vienna.

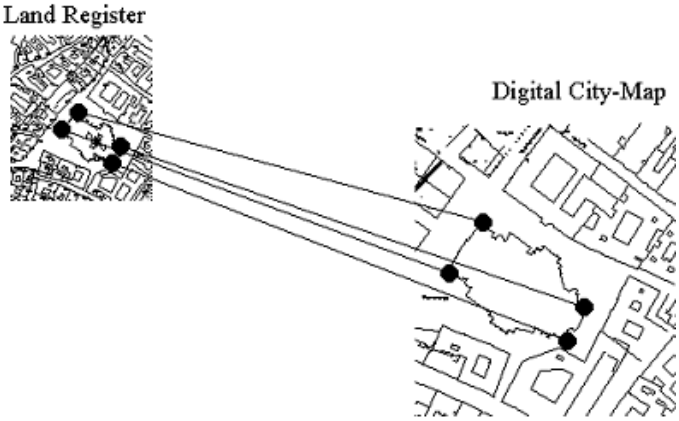

Figure 3: Scrutiny of the land register's accuracy (Identical Points - Transformation house after house).

After that all possible distances between all points are calculated for both bodies of maps separately. Matrices are drawn up and an average scale is calculated. Furthermore a standard deviation expressed in percent can be calculated for each point. With this method exceedingly deviating identical points were found.

3.1.4. The Helmer-transformation

The Helmertransformation is a transformation from one system of coordinates into another with several identical points (coordinates). When solving the problem a shift, a distortion and a mean change of scale has to be calculated between the two systems of coordinates. The Helmertransformation works according to the principle of the balance account.

3.1.5. Results

	Scale	Deviation	Deviation for 100 m
Initially intended	2880	0	100.00 m
Sheet XVII	2924	44	101.53 m
Sheet XXIII	2904	24	100.84 m

A paper warped by 1 mm equals an object shift of 2,9 m!

Results of the Helmerttransformation:

	Scale	Rotation [gon]	Linear translation parameter - Gk	
Sheet XVII	2924	0.332199	3023.40	338079.01
Sheet XXIII	2904	0.317054	3033.73	338081.17

(Twaroch 1998)

With the help of these fundamental maps roughly 95% of all sketches could be fitted in. This land register, however, does not serve only one purpose, for in the past years it turned out to be even more valuable.

After the basics had been created, it was time to think about linking all data.

The task of Stadtarchäologie is not only to react to reports of finds, but also to set preventive measures.

That was the hour of birth of Vienna Archaeological GIS.

The first theoretical considerations dealt with the question of which thematic layers should be included.

It was decided to create 3 groups of thematic layers:

1. The Archaeological Layer (plans of contexts, maps of the distribution of find a.s.o.)
2. Historical Layer (Franziszeischer Kataster and earlier city maps, Map of the Danube with contour lines from the year 1849 - that is from before the regulation of the Danube)
3. Auxiliary Layer (modern digital city map, geo-referenced aerial photos, geological maps, mains system register a.s.o.)

3.1.6. Archaeological layer

Every archaeological site shown on the map is marked with the site code. Each entry is cross-referenced to a record in the site database. This reference is multilayered. The topmost layer contains information about the excavation and a description of the site. All other layers contain further information about the archaeological contexts of the site.

3.1.7. Historical layer

At the moment the main focus of our work is on digitising and analysing historical maps.

As mentioned before, the “Franziszeische Kataster” is not only used to localise earlier sites by tying them to specific coordinates, but also to recognise the courses of small rivers, which have either completely disappeared or have been regulated and put underground.

Since the land register was drawn up as an aid for taxation and written tax assessments also exist, it is possible to deduce the quality of the soil.

Of course, historical settlement areas can be made out on this body of maps, which comprises 180 maps for Vienna (Banik-Schweitzer 1998:19).

By combining the “Franziszeische Kataster” with other maps, e.g. the “Donauplan” of 1849 with aerial photos, and with the digital terrain model of today’s citymap, and of course, all known archaeological sites, areas favourable for settlements can be determined.

Particular attention will be focused on the districts north of the Danube, because several large building projects are planned for this area for the near future.

3.1.7. Auxiliary layer

The digital map of Vienna is of outstanding importance for positioning our sites.

The digital Topographical Database of the City of Vienna is better known under the misleading name “Mehrzweckstadtkarte” (MZK) (Wilmersdorf 1995:46). Since all available information of the topographical database is never shown on one and the same series of maps, the name is not quite suitable.

The Topographical Database is saved centrally and contains detailed information about all objects on the surface like buildings, fences, property borders, landscape features, vegetation, road network and other details.

The data acquisition is made tachymetrically within the road areas and photogrammetrically within the building complexes.

The accuracy of the tachymetrical measurements is around ±0,01 m, those of the photogrammetrical measurements around ±0,25 m. Therefore the absolute accuracy of 3D-models of the city is limited to ±0,25 m. For the generation of the terrain model (DTM resp. Digital Terrain Model) only tachymetrically calculated heights should be used in any case (Halmer 1999:43).

The Topographical Database contains records for the entire urban area with the exception of the wooded areas at the outskirts of the city. It is updated every three years.

The GIS-Software Arc-Info is used for the administration of the data described in the lecture, that is the thematic layers and the archaeological finds and context data, as well as for the photographic archive.

As Stadtarchäologie Wien does not have this GIS-software at the moment, the preliminary work is first carried out in an AutoCAD Map and later transferred into ArcInfo with the help of the division of graphic data processing.

A prototype of the Vienna Archaeological GIS will be presented to a wide public on the occasion of an event organised by the city of Vienna and called “Global Village”, whose theme will be the remote-controlled city, in June 2000.

4. Outlook

Based on these fundamentals, we would like to develop a strategy for the preservation and research of our historical heritage in cooperation with the city-planning bodies, as well as with private developers (Kobermaier et al. 1998:37).

Considering that it is impossible to be present at each and every building site, it is necessary to construct and maintain a body of maps that will not only show all the known archaeological sites but will also help in identifying the broader areas in which archaeological implications are most likely to occur in the course of their development.

Besides processing the material from earlier excavations this will be our task in the forthcoming years.

We cannot prevent building sites, but we can raise peoples’ awareness of our past through public relations and the publication of appropriate maps. This process should begin in school.

For this reason Stadtarchäologie Wien runs two projects besides the research prescribed by law: the Junior and the Senior Archäologie. Both initiatives actively involve Viennese citizens in the archaeological exploration of the city (Strohschneider 1998:38, 44).

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