

Three-dimensional excavation plans and 3D Studio Max

Experiences from the excavations of the medieval town of Naantali, Finland

Kari Uotila

University of Turku
20014 Turku, Finland

Carita Tulkki

Muuritutkimus ky.
Suovillankatu 3
20780 Kaarina, Finland

Abstract: During fieldwork all structures and soil layers were documented according to the matrix and a drawing was made straight from a total station to a laptop. The archaeologists used a Finnish land survey program called 3Dwin.

The data is imported in DXF format from the land survey program into AutoCAD, where the code of the third field moves straight into different layers. This means that you can treat the measured data by units and combine, for example, wooden and stone structures or different groups of finds. The basic work on the research material is carried out in AutoCAD and the finished excavation plans are printed from there. Additionally, the chosen objects to be modeled can be imported, for example, in DXF format into 3D Studio MAX.

A quick model of the example case has been created in 3D Studio MAX, in which you can adjust the visibility of different structures and soil layers. This means that you can easily examine the different units and the relations between them.

The stratigraphy of different layers can also be easily modeled and presented with the help of 3D Studio MAX. In this picture, the soil layers and structures of the example case are seen from several different directions.

Introduction

In Finland archaeologists began collecting digitized research material during excavations in the 1990s. On prehistoric excavation sites – such as Stone Age excavations – finds such as flakes and potsherds were recorded as points. On historical sites, however, finds are mainly recovered in large quantities and documented in bulk, and therefore measuring different features as lines or points became the focal point. One of the first wider research surveys in Finland was the measuring of a palisade in the Episcopal castle of Kuusisto, where over 3 000 pine posts in large palisade in one-metre-deep water were mapped during 1992-93. Mapping the most important features as 3D polyline was also used in, for instance, the research of the Aboa Vetus -museum (In Turku) in 1993-94 and in the excavations of the Bridgettine Convent Church in Naantali in 1996-97.

Excavations in Naantali in late autumn 2000

In October 2000, archaeologists unexpectedly had to document a trench dug in the street for sewerage work in the small medieval town of Naantali, located near Turku on the southwestern coast of Finland. The town of Naantali grew next to a Bridgettine monastery in the 1440s and remained a small coastal trading town throughout the centuries. Today Naantali is one of the most popular travel destinations in the country and tourists know the town especially from its Moominworld. (fig 1.)

Naantali's well-preserved wooden town quarter and its plan date from the 19th century, and there is very little information about the earlier town. There had previously only been one larger excavation in the area of the old town in the 1980s, so the sewerage works offered a new opportunity to study the history of Naantali.

In Finland, the light and temperature conditions in October and November are not the most favourable for archaeological excavations. Documentation had to be carried out so that archaeologists supervised the digging. Monitoring the soil layers removed by machine, the digging was only stopped in order to record clear features. It was a salvage excavation, where archaeologists tried to recover the most important archaeological data.

Right from the beginning of the excavations, the chosen method for documentation was digital measuring carried out with total station, which the archaeological excavation company Muurutkimus ky has specialized in already for a few years. New to Finland at least, all new significant features (both stone and wooden) were measured digitally and that all observed soil layers were measured as stratigraphic units. Each unit was given its own context number according to the principles of the Harris matrix and the bounding edges of each unit were measured three-dimensionally. Additionally, during excavation the

positions of all observed artefact finds and different kinds of soil samples were measured with the total station prior to being collected. In this way, a completely three-dimensional digitized research material was created already in the field.

Documentation was carried out during the excavations in such a manner that all significant features and natural soil layers were numbered according to the matrix and a drawing was made straight from the total station to a computer, and thus it could be viewed instantly on a laptop. The archaeologists also had an A3-sized printer that was used for printing site plans and sections as needed and small details were added to them – such as the details of wooden structures, small stones and fragments of brick. When making the final drawings, these hand-drawn additions were added to the AutoCAD drawings as raster images by setting them at the right level in the measured layers and features.

Handling the measured data

The measured data is transferred from the total station to a computer with the help of a Finnish land survey program (3Dwin), which is used in Finland both by private companies as well as the state and the municipalities. A common program was chosen in order to have functioning relations between all parties carrying out detailed surveys. The idea is that using a common program offers good opportunities for archaeologists to cooperate with, for instance, the town of Naantali. The town officials can deliver the needed measured data in the right format for fieldwork and the archaeological measurements can be transferred directly to the use of the town planning organization even during the same day. Additionally, having as many users of the program as possible guarantees that there will be technical help and cooperation partners available around the country. (fig. 2.)

The digitized data is transferred from the survey program either to a database program (such as MS Access) or to an actual map drawing program, which in our case is AutoCAD. Using an accurate engineering program for drawing has its origin at the beginning of the 1990s, when the cooperation contacts of archaeologists were directed towards the CAD world and contacts with universities and their GIS programs were few. It is difficult to take a stand on the everlasting question of which one is the better program, but at least in our experience AutoCAD is fast and accurate in composing a functioning set of archaeological drawings – at least in 2D form. We have had experience of this from different research sites for almost ten years. (fig 3.)

Documenting the measurements functions so that we normally use four different code fields in the program during fieldwork, to which you can input different types of data about the context being measured. When needed, the program can use altogether six code fields. The most essential factor of the code fields is that the code of each field is transferred into its own layer in AutoCAD. This has the benefit of being able to immediately separate the units measured with the same code from the other layers – in other words, the measured data is arranged in exactly the same way as the person who was drawing planned it in the

field. Each unit stands out as its own and each artefact find can be positioned accurately. (figs 2-3)

Making a plan three-dimensional

The measured data is transferred in 3D form from the land survey program to AutoCAD, where the data can, in principle, be viewed three-dimensionally, but distinguishing the different lines and features is very difficult and certainly not very visual. With developing technology, 3D visualization of an excavation area has become a new opportunity, which in my opinion opens up completely new ways to interpret the sometimes complex combinations of units and wide excavation areas. However, modeling illustrative excavation sites has been restricted mainly by the fact that 3D mesh models use a great deal of computer resources.

In our case, the tool used for visualization in different kinds of multimedia and virtual reality projects has for several years already been the 3D Studio MAX program, which now runs in its fourth version. The "Terrain" command, which was a new feature introduced in version 3, has made it easier to model simple and sometimes more complex 3D meshes. With the help of the program you can also model the bottom surface of a pit-like layer, as long as it has been measured during excavation. (figs 4-6)

The carefully documented data from the excavations at Naantali can, thus, first be transferred to the land survey program, and from there to AutoCAD for the actual drawing, after which the ready units and features can be imported into 3D Studio MAX where a 3D model of the excavation area can be created. It is true that you also have to modify and model the data at each stage of this process, but in principle the excavation site is as accurate in 3D Studio MAX as it was during the measuring stage in the field. (figs 4-6)

In 3D Studio MAX, the colour and material of each stratigraphic unit can be specified, as well as, for example, their transparency. It is relatively easy to visualize relationships between layers and features, and stratigraphy can also be easily presented for instance with the help of animation, as all of those who were present at the CAA seminar in Visby could see.

The time when any archaeologist can create a 3D model of an excavation area in a simple, functional and inexpensive manner is not quite yet at hand, because the price of the required computer equipment and programs is perhaps some 10 000 euros, but the equipment clearly has developed and new opportunities are on the horizon.

As regards the excavations at Naantali, 3D modeling of the data has so far been mainly used in visualization and in testing and developing measuring equipment, but as the excavations continue in 2002, a collection of all the data from the researched area will be completed. We can use this information to make observations that are important for research and will perhaps be able to outline the nature of the whole medieval town and the village settlement that preceded it.

Figures

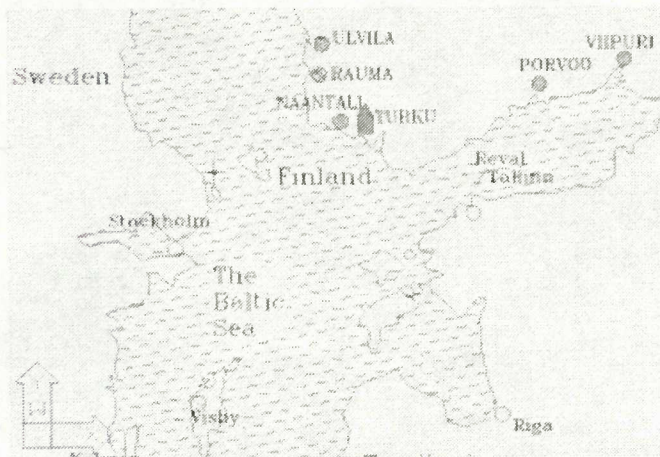


Figure 1. In the Middle Ages there were altogether six towns in Finland, the most important one being the Cathedral city of Turku. Naantali was the last town to be founded during the Middle Ages and it grew next to a Bridgettine Convent founded in 1443. The population of the town in the Middle Ages was perhaps some 300-400 people, so it was a fairly small town in Finland's circumstances. Naantali has retained its old town plan and wooden buildings, which mainly date already from the beginning of the 19th century. (Drawing K. Uotila)

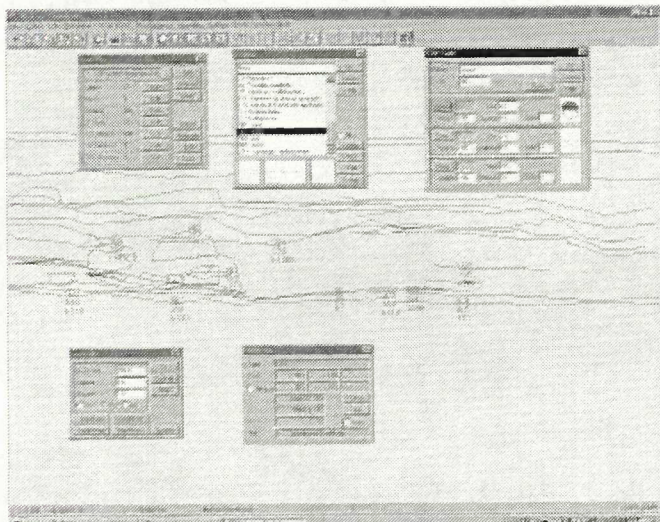


Figure 2. During fieldwork, all structures and soil layers were documented according to the matrix and a drawing was made straight from a total station to a laptop. The archaeologists used a Finnish land survey program called 3Dwin. In this example, soil layers from the eastern section of the excavation can be seen. (Drawing P. Hakanpää & C. Tulkki)

Point info – in this example there are four fields in use in the code section of the window. The first of them (904 in the picture) documents the type of soil, the second gives the number of the measured line (305 in the picture), the third has the context number (110) and the fourth gives the number of the measured point (273 in the picture). Additionally, it is possible to collect different kinds of data into two open fields in the program.

In this example, the program is showing the soil type (in the middle of the picture e.g. 901), the measured line (352) and the context number of the points in the section. In the program you can choose which of the measured data you wish to display for study.

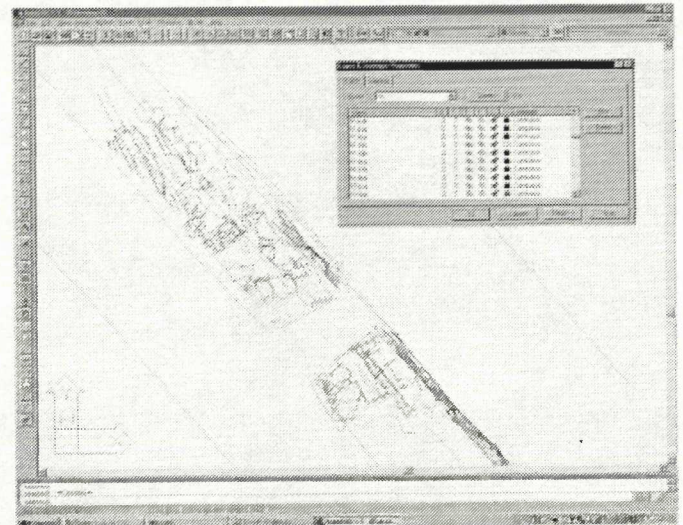


Figure 3. The data is imported in DXF format from the land survey program into AutoCAD, where the code of the third field moves straight into different layers. This means that you can treat the measured data by units and combine, for example, wooden and stone structures or different groups of finds. The basic work on the research material is carried out in AutoCAD and the finished excavation plans are printed from there. Additionally, the chosen objects to be modeled can be imported, for example, in DXF format into 3D Studio MAX. (Drawing P. Hakanpää)

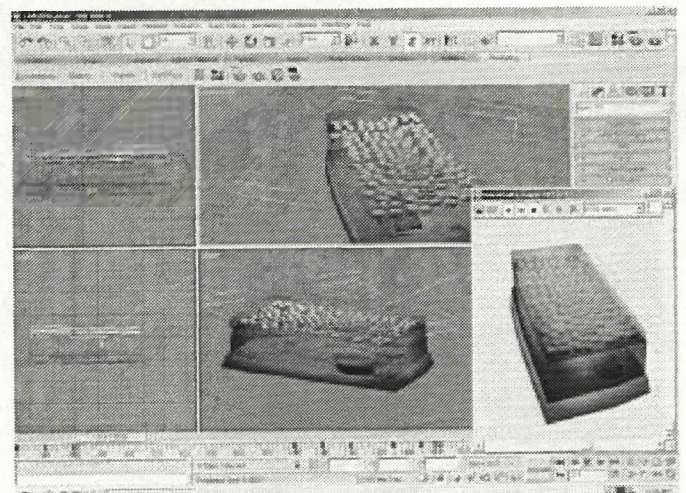


Figure 4. A quick model of the example case has been created in 3D Studio MAX, in which you can adjust the visibility of different structures and soil layers. This means that you can easily examine the different units and the relations between them. In this example picture, one can see the higher street paving and the layers related to it. (Drawing K. Uotila)

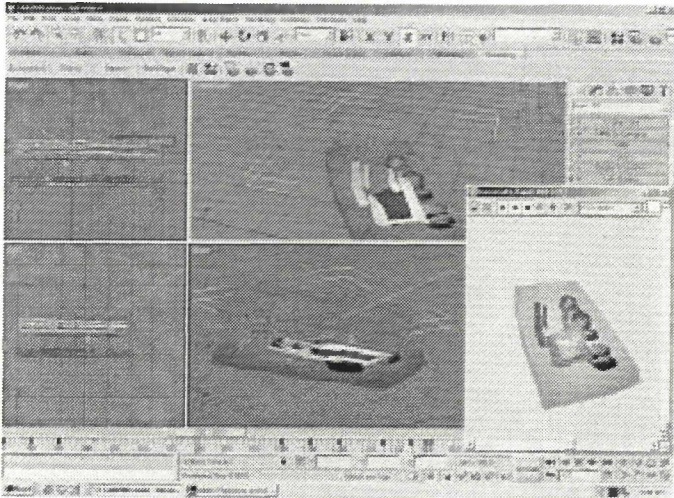


Figure 5. In this picture one can see the lower wooden structure and its stone foundation. (Drawing K.Uotila)

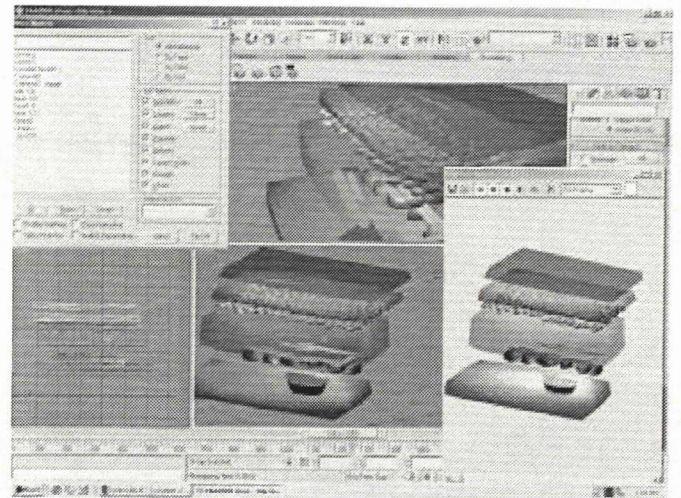


Figure 6. The stratigraphy of different layers can also be easily modeled and presented with the help of 3D Studio MAX. In this picture, the soil layers and structures of the example case are seen from several different directions. Similarly, the stratification of soil layers can easily be presented in an animation, which shows the chronological sequence of the stratified layers in the area. It is obvious that these kinds of animations are impressive to look at, but they also have scientific significance when analysing wide and complex excavation areas. (Drawing K. Uotila)