

Building, building on the wall...

A reflection of actual building dimensions?

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Abstract: By now it goes without saying that Geographical Information Systems enable archaeologists to conduct a variety of spatial analyses. Even though traditionally utilized for landscape analyses, GIS are increasingly being used for intra-site analyses as well. Another example of an intra-site analysis is presented in this paper. MapInfo, though not a fully-fledged GIS, was adequate enough to conduct a comparative analysis of the wall, to door and window ratio dimensions of actual buildings at an Aegean Bronze Age site, with ancient artists' depictions of buildings. An initial comparison of these two data sets reveals that in almost one in two instances the depictions of buildings were painted with door and window proportions equivalent to those of actual buildings.

Key words: artefeatures, spatial database, comparative analysis, ratio factors, Akrotiri wall paintings

The GIS journey continues...

As archaeologists continue on the GIS journey and move away from the usual analyses of ancient landscapes, a variety of intra-site investigations come into sight. Because archaeological data excavated at a site is defined by space, it can be mapped and accommodated quite appropriately by a GIS. Consequently there are numerous spatial analyses that can easily be performed on intra-site data once it is stored in a "GIS format". For instance there is the spatial analysis of artefact-types across a site; or the investigation of major features, and their spatial relationship to each other or to building structures at a site.

These types of intra-site GIS investigations are related to those of inter-site studies. They are related by the fact that the location of an artefact or feature (from now on referred to as "artefeature") can be used to derive distances between one artefeature to another, as is the distance between one site to another, or to some feature in the natural environment. The distances between "objects" whether a site or artefeature are measured and analysed for a variety of reasons. For instance by recording the element of distance in either scenario, the distribution of sites across a landscape can then be determined, as is the corresponding distribution of artefeatures across a site.

Moving along further with a GIS, the element of location, and hence distance, can be transposed to that of the element of dimension for each of the artefeatures found at a site. As such a GIS can then be used to analyse each artefeature not only for its relative position found at a site, but for the added dimensions of an artefeature's height, length and width. Standard databases can also cater for the storage and analysis of such dimensional factors of an artefeature. However, a GIS, when taken further to this "micro-level", is more appropriate because it can be used to centralize the details for both location and dimensions of an artefeature. This more detailed database can then be used to plot the occurrence of a particular dimension of any artefeature

across a site. As such more specific and detailed distribution plots can then be performed for a site under investigation.

In effect a GIS can be used to create a "spatial database" for two major elements: those of location and dimension. In either case, by using the spatial capabilities of a GIS a variety of analyses can then be performed within the range of or in combination with each of these two "spatial" elements. For instance the element of dimension may be used for the task of formulating a pottery typology by analysing particular dimensions of pottery at a site. On the other hand, by combining the locational and dimensional data in a GIS database can allow for a detailed distribution plot of one type of artefact within a certain dimensional range to be made in relation to its location in any particular area of the site.

By travelling down another GIS path, archaeologists may arrive at an even more detailed analysis for each individual artefeature. Characteristic markings or other aspects on the surface of artefeatures can also be analysed by using a GIS in what may be termed as "surface analysis". The surface of an artefeature can be spatially analysed by using techniques developed for inter-site studies. Some sort of pattern may be determined if particular markings are distributed in a certain way across the surface of an artefeature. The GIS journey is also extending into the future with further developments, especially in the areas of Artificial Intelligence and Neural Networks (Claxton, 1995). It may then be more feasible to use a GIS to efficiently record and then use locational and dimensional data to piece back together again even the tiniest fragments of artefacts found in a room or well defined area of a site.

Only a few of all the numerous types of possible intra-site investigations that can be assisted by a GIS have been mentioned above. Research continues along the GIS road in the area of intra-site analyses. Most recently reported is a system to manage stratigraphic information and visualize excavation data

at the site of Pompeii (Carafa et. al, forthcoming). The list of possible GIS analyses is confined by not only the available technology and resources, but also by the questions archaeologists ask of the excavated data, unique as it is, at each site. There are many questions that can be asked about data excavated at the Aegean Bronze Age site of Akrotiri, on Thera. This paper explores and presents an analysis of both its ancient buildings and representations of them, by using the spatial element of dimension.

As such the analysis of the buildings' dimensions is not only limited to the actual buildings themselves. It involves an analysis of the depictions of ancient buildings and actual buildings by using a GIS for the comparison of particular ratio dimensions. MapInfo was used to store dimensions of the depicted buildings of the miniature frieze found in the West House at Akrotiri and the Town Mosaic found at Knossos, on Crete. The dimensions include the length of walls, windows and doors as the artist has depicted them in the past. These measurements were then compared by a ratio factor with the measurements of buildings actually present at the site of Akrotiri on Thera.

By using MapInfo for this analysis there has been a move away from the traditional analysis of sites in ancient landscapes to a specific dimensional analysis of architecture and how it was represented in the past. The buildings that were depicted by ancient artists were scanned from photos and then digitised for analysis by MapInfo. Appropriate ratios of length were formulated and then compared with those from digitised plans of actual buildings at the site of Akrotiri. The primary purpose of this exercise was to test how accurately the depictions of windows and doors on the buildings come to portraying reality.

Aegean Bronze Age Building Depictions

From early cave paintings, and later wall paintings, to modern multi-media depictions, people have continually been seeking ways of portraying images of reality. It seems that there always has been a need to internalize, or bring indoors, external scenes by any means of representation that was and is available. Over time various depictions of the outside world have varied as to their degree of accuracy in reflecting reality. This may be due to the artists' relative skill in portraying reality, or is simply a reflection of a particular style that was chosen.

The great variety of representation techniques may lead onto questions such as what was the aim of the artist by representing images of their world in the way they did? How did this aim influence the artist's choice of style in portraying reality? Did the artist choose to depict a scene as close to reality as possible or was it more an abstraction of reality? A study of artists' depictions of reality, such as those of the Akrotiri wall paintings, can have a two-fold purpose. Firstly how accurately do the paintings reflect reality, and secondly what can they tell us about daily life? If features of the buildings in the wall paintings can be shown to approach reality it then follows that we are more likely to treat other images that are portrayed more positively regarding their reflection of reality.

The question that MapInfo assisted in answering in this instance was how close to reality were the dimensions of the depicted doors and windows of the buildings? If they were depicted close to reality then what other details can we learn from them? More light may eventually be shed on features of architectural remains that have since disappeared from a prehistoric society by a study of architectural features portrayed in images. For the purposes of this paper two different types yet related depictions of buildings were chosen: a) the depictions of buildings in the Akrotiri wall paintings were supplemented by b) the Knossos Town Mosaic.

The Akrotiri Wall Paintings

The site of Akrotiri on Thera was inhabited without a break from about the middle of the Early Bronze Age until the cataclysmic eruption of the volcano at around 1500 BC. Early on in the Late Bronze Age many of the buildings were rebuilt after an earthquake had damaged them (Doumas, 1978:777). It was during this last reconstruction phase that it can be assumed that the more recent wall paintings were applied on the newly built walls of many buildings at the site. The numerous wall paintings uncovered in the buildings at Akrotiri offer a wealth of material for investigating scenes of life in the Aegean during the Bronze Age. Televantou (1990) has carefully researched data relating to the reconstruction of the wall paintings of the West House. It appears that five distinct "towns" were depicted in the miniature frieze located in room 5 on the upper floor of the West House building. The wall paintings are in themselves a decorative architectural feature of the room yet also provide further visual clues as to the original state of the relatively well-preserved buildings at the site of Akrotiri.

The buildings in the miniature frieze of the West House present a valuable glimpse of architectural features and the past organisation of buildings in rural and town settings. The pictorial representations of the variety of scenes in the miniature wall paintings have been analysed in detail by Morgan (1988). Apart from the scenes depicting towns, others depict herding activities, battles at sea, and scenes of wildlife along a river. It appears that the artist(s) chose a single perspective from which the buildings in the town scenes were depicted. Given that the buildings would have been built on different levels, as towns were often built on an incline from the shoreline, it was difficult to represent all buildings at the same level. So the artist(s) overcame this difficulty of perspective by depicting the buildings as if viewed from a considerable distance and as if suspended in mid-air (Morgan, 1988:70).

Even based on a purely visual analysis of building types in the wall paintings of town scenes it is clear that the representation of the buildings in the miniature frieze closely reflect the architecture at Akrotiri (Morgan, 1988:70,92). Since a variety of building-styles have been depicted in the Akrotiri wall paintings it is possible to learn more about past buildings by using the depictions as evidence for architectural features that have since disappeared. The possible function of buildings may also be determined by studying them in their portrayed contexts, see Figure 1. Measurements from these depicted buildings may also reflect actual building ratios that were used at the site.

The Knossos Town Mosaic

The great array of buildings constructed at Knossos, on Crete were also decorated with wall paintings in many circumstances. However it is a collection of small individual "mosaic" pieces depicting buildings that are of more interest in this case. Most likely to have been originally used as inlays in a wooden box a number of small individual faience plaques were found at Knossos in an early Middle Minoan III deposit (Lawrence, 1983:40). Apart from depicting various scenes of people, animals and plants, most of the plaques are those of houses and towers which were all probably used in a mosaic to represent a fortified city by the sea perhaps during a seige (Robertson, 1929:20).

The houses come in an array of colours, displaying a variety of building techniques. Some of the houses are shown as though composed of large blocks of stone. Some have horizontal stripes, perhaps representing timber. Doors and windows are clearly displayed, see Figure 2., and offer complementary material to the miniature frieze at Akrotiri. However most of the plaques are partially destroyed and the restorations may not always be accurate (Lawrence, 1983:40). These depictions of buildings were primarily selected to supplement the images of buildings available at Akrotiri because the Knossos Town Mosaic offers a very close parallel to the buildings depicted in the Akrotiri wall paintings (Morgan, 1988:68).

The Knossos Town Mosaic was selected to increase the sample of data available for analysis. This was done on the basis not only because the houses in the Town Mosaic closely parallel those in the wall paintings, but also because the actual buildings at the site of Akrotiri display strong links with Minoan styles, and hence with Crete. Hood (1990) examined the actual buildings and proposed that the Minoan style of architecture at Akrotiri suggests a strong Minoan presence at the site. Apart from the architectural elements, the numerous artefacts and pottery also attest to a strong Minoan influence on the island of Thera, or at the very least at the site of Akrotiri. Many of the internal architectural features are clearly Minoan in nature, however the extent of Minoan domination at the site remains debatable (Shaw, 1978). Regardless as to the extent and nature of the Minoan influence at Akrotiri, the clear links that this site had with Crete at the time allows for the inclusion of the Town Mosaic in the repertoire of building depictions that can be used for analysis.

Aegean Bronze Age Architecture

Buildings are one of the most fundamental aspects of a settlement. People's lives revolved in and around the buildings they created to cater for many purposes and functions. In most cases the buildings were constructed according to traditions established by either local people or ideas introduced by other cultures, or a combination of both. Styles and techniques evolved and developed into a distinguishable architecture at each site, which was influenced by the unique environment, availability of building material, prosperity and social expectations of its inhabitants. By analysing the architectural design of buildings at a site factors that determined the form and function of the

buildings may be derived (Palyvou, 1990:44).

A number of still developing approaches can be used to analyse the architecture of a site. Palyvou (1990:55) has suggested that a systematic analysis of form and structure is one approach in the attempt to come to an understanding of architectural remains. Architectural design may be determined by investigating whether models, with any number of variations on a basic design, were adopted at a site (Palyvou, 1990:46). Apart from the observations that are made during the excavation process there are other possible methods for investigating architecture in its own right. For instance determining the functional purpose of a building is one aspect of investigating why or for what purposes a building was built in the past. The size, shape or form of a building may certainly be easy to determine and record, but when it comes to the reasons why a particular building displayed certain characteristics a methodology to investigate a building's function still has to be fully developed and implemented (Palyvou, 1997). As more architectural studies delve into greater detail concerning the remains of past buildings, it is more likely that new methodologies will develop to lead us into a deeper understanding of the form and function of buildings from any era in the past.

Since GIS effectively stores, manages and analyses spatial dimensions, using the capabilities a GIS has to offer can now enhance architectural studies. Most archaeological analyses of architecture are primarily descriptive, even though dimensions may occasionally be provided. No systematized standard or statistical methodology has been thoroughly developed for the study of architectural remains. It is proposed that GIS can be utilised as a tool for systematically analysing social space. Hence a GIS can be adapted to systematically approach the study of architectural remains of the past. This paper presents one very small step in this direction.

Ultimately any analysis that can lead onto new information about the original design, layout and intended purpose of a building is necessary for an all-encompassing understanding of past buildings. By representing buildings in a digitised format that can be used by a GIS program, data pertaining to dimensions such as the area of rooms, thickness of walls, length of walls, doors and windows can be easily and quickly provided. A building in its archaeological context can only be analysed for so many characteristics. For instance the West House at Akrotiri as portrayed in Figure 3., can be examined for a number of features such as material that was used, and the building techniques that were employed for its construction. Traditional "paper-based" plans of the building can also provide dimensions, however when digitised the resulting plans, see Figure 4., can then be used more efficiently for a variety of measurements to be made.

To come to an understanding of the architectural design of any remains of buildings is an important aspect of archaeological research. Palyvou (1990) has noted that many of the buildings at Akrotiri were constructed by altering basic models of design. It appears that during the Middle Bronze Age the Minoan civilisation infiltrated that of the Cyclades, especially at Akrotiri on Thera, and many elements including building techniques were adapted by the local culture (Doumas 1979:96). Many of the

houses at Akrotiri reproduce Minoan architectural features on a smaller scale. Irregularity of shape, pier-and-door partitions, angled stairways leading to upper storeys, and a number of large windows, opening up, though unlike in Minoan settlements, to narrow, convoluted streets below (Lawrence, 1983:71). One of the major Minoan building characteristics, ashlar masonry, is also used at Akrotiri. Given the conglomeration of Minoan elements in the buildings at Akrotiri, local traditions may be able to be traced by not only what remains of the structures, but also by the images of buildings portrayed in the wall paintings. It is these wall paintings that this present paper has analysed to determine how accurately they reflect the proportions of windows and doors in the remnant buildings at the site.

From Depictions to Reality: A Methodology

A GIS can assist architectural analyses of ancient buildings by initially facilitating the scanning and subsequent digitisation of buildings from paper-based site plans. Then a number of analyses can be applied to these digitised plans of the buildings. However, apart from analysing only building plans from sites, wall paintings and other depictions of ancient buildings can also be analysed. Effectively two data sets are potentially available for architectural analysis: data pertaining to both real and depicted buildings. When these two data sets are merged together then a comparison of the results of related analyses can be used in order to enhance our understanding or even determine patterns of building in the past. In this case length ratios were determined from the depicted lengths of doors and windows from the Akrotiri wall paintings and Knossos Town Mosaic, and the door and window lengths from the Akrotiri building plans. A comparison was then made of these length ratios determined from the depicted buildings with those of the building plans.

Analysis can encompass a variety of approaches. The basic questions fundamental to any sort of analysis are: 1. What should be tested, and 2. How should it be tested? For the purposes of this paper the corresponding answers are: 1. How accurately the representations of buildings in the Akrotiri wall paintings and Knossos Town Mosaic reflect actual door and window dimensions, and 2. The measurements of window, door and wall lengths of actual and depicted buildings are to be compared by ratio factors. The dimensions of wall, window and door lengths are converted to L/WL and L/DL ratio factors, where L=wall length; WL=window length; and DL=door length. The analysis requires the production of two data sets that are to be used for a comparative analysis.

By digitising both site plans and depictions of ancient buildings two data sets became available in order to determine ratios and then make a comparison of these two sets of ratios to see if the artists' impressions of the buildings matches reality. However a number of assumptions have been made for this test. Firstly that the measurements from the building depictions may be a reflection of reality. That is that the depicted door and window ratio lengths relate to the ratio lengths from the plans of the actual buildings at the site. A further assumption is that the buildings that are depicted are Minoan in style and character and are closely related to the buildings actually present at the

site of Akrotiri.

The two data sets were digitised and derived from a) actual plans, and b) images of buildings. This resulted in a database of measurements from the actual buildings that can be compared with a database of measurements of the depicted buildings.

Data set one: Digitised site plan

The site plan of Akrotiri on Thera was scanned and then MapInfo was used to digitise each of the buildings. The digitised image of the buildings is associated with a table of data containing dimensions of the wall, door and window lengths. These are grouped by floor level, since in some cases, the second and even third storey of a building has been preserved. However in the final analysis all window lengths were used regardless of which floor level they were located on. This was also the case for the depicted windows in the wall paintings and mosaic pieces. Effectively for this present analysis all window ratios were analysed as a unit of data with no distinction being made for floor level.

Data set two: Digitised building depictions

For the purposes of this paper the depictions were limited to the wall paintings from Akrotiri on Thera and the Town Mosaic from Knossos on Crete. MapInfo was used to digitise scanned images of buildings from the wall paintings and mosaic pieces. These digitised images then allowed for dimensions to be measured and stored in a database. Each building was measured, wherever possible, and in some cases the measurements are extrapolations of the possible original intention of the artist. Questionable restoration and even the fact that ancient artists may have made alterations to the images in an attempt to depict true-to-life scenes, meant that generalisations had to be made in some cases. That is why the depictions of the buildings were critically analysed by modern day artist and icon-painter, Stratos Kranidiotis who also assisted in the compilation of the digitised images. Mr. Kranidiotis advised what possible images the artist may have been viewing and how they may have chosen to depict them.

GIS strikes again: Results and Conclusions

Many comments have previously been made regarding the physical appearance of the depictions of buildings in the Akrotiri wall paintings and the Knossos Town Mosaic in relation to the remains of actual Minoan buildings. On the other hand this present study concentrated on a comparison of the dimensions of the depicted doors and windows with those of actual buildings. The analysis used a GIS for the easy acquisition and subsequent measurement of lengths from both the depicted and real buildings. This analysis revealed that in almost half of the cases the proportions of the windows and doorways of the depicted buildings are reflected in reality.

Even though a relatively small sample of data was available for testing, the major purpose of this analysis was essentially to demonstrate a methodology for using a GIS to store and compare data from two different sources. The two separate lists of wall/

door and wall/window length ratios of the depictions of buildings were compared with those ratios from reality. This comparison resulted in the following:

46 % of all the depictions of doors are in proportion to their corresponding door ratios as determined from the Akrotiri site plan, and

48% of all the depictions of windows are in proportion to their corresponding window ratios as determined from the Akrotiri site plan.

It is important to note that the results are limited by the relatively small sample of data that was used for analysis. So far the database of digitised depictions of buildings is limited to the Akrotiri wall paintings, and Knossos Town Mosaic. Future work is to develop a more comprehensive database and include more examples for other comparisons of buildings and depictions of buildings not only for the site of Akrotiri but with any other related and relevant sites. Another future investigation would also be to measure the height of the buildings as depicted by ancient artists and then extrapolate from the architectural remains the possible height of the original buildings.

One purpose of this paper was to illustrate another way of viewing archaeological data and then use a GIS to map and analyse spatial elements other than those used by traditional landscape investigations. Consequently another aim of this paper was to stimulate thought in order to demonstrate other ways of using GIS to map and analyse spatial elements from the various aspects of data excavated at a site. Therefore, ultimately not only landscape analyses stand to benefit by using a GIS, but each site and even each artefeature found at a site may eventually come under more analysis with a GIS. Some of the other ways of using a GIS for analysis within one site are suggested in summary to be dimensional analyses of artefeatures, plotting distributions of particular artefeatures, or even performing a surface analysis of each individual artefeature. By continuing to apply the many capabilities of GIS to various aspects of archaeological research, only time will tell what other ways of using a GIS can be thought up. As we contemplate other possibilities on the GIS journey, the sky's the limit for using a GIS in archaeological research.

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Figures

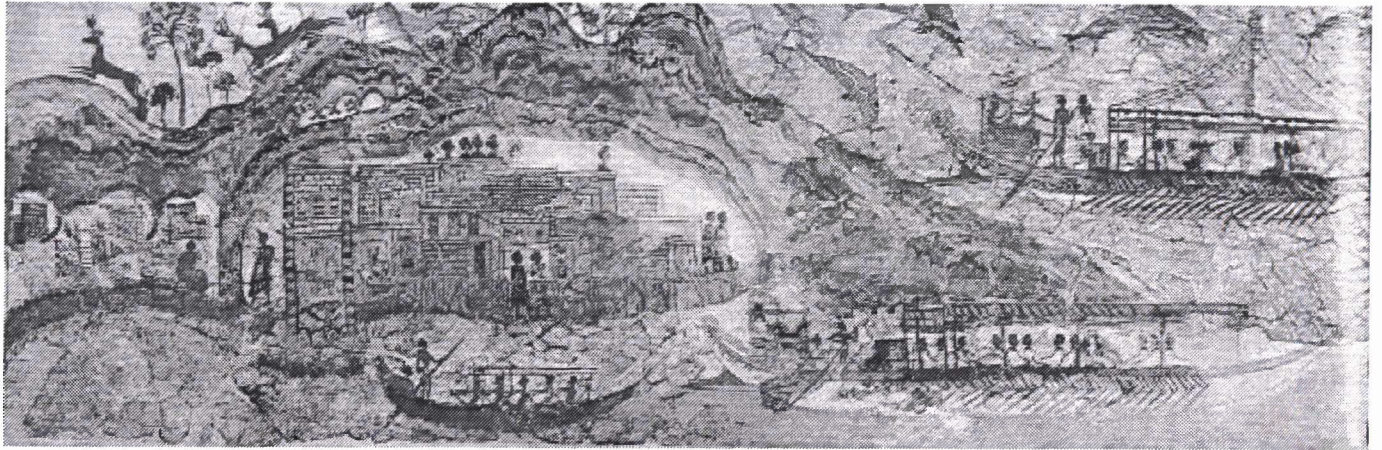


Figure 1. Section of the miniature frieze from the West House at Akrotiri: A town scene. (From Dumas, 1992)

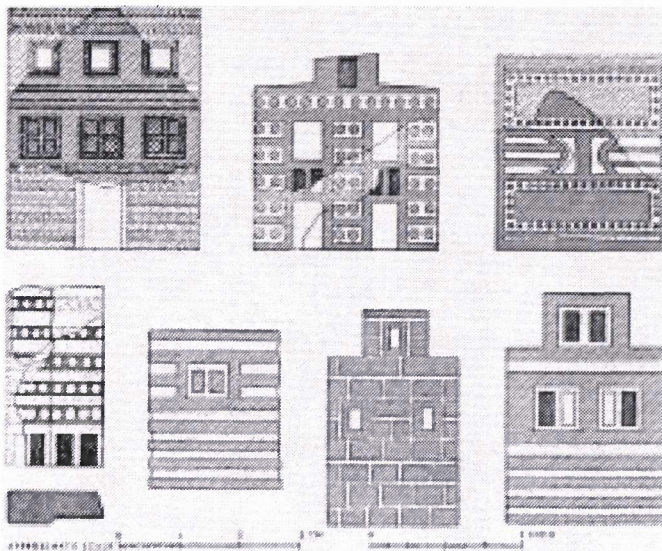


Figure 2. A selection of restored faience house plaques from the Knossos Town Mosaic. (From Lawrence, 1983)

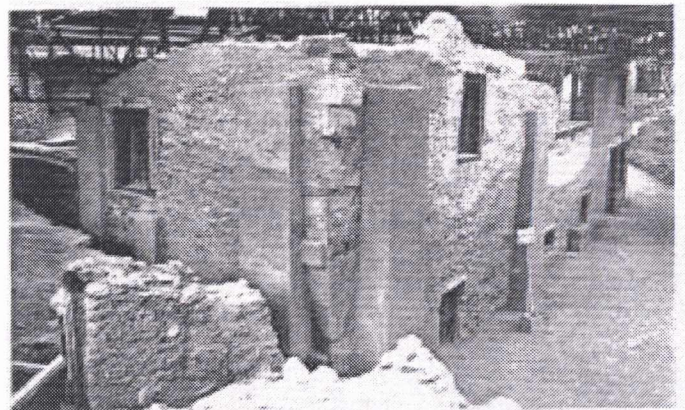


Figure 3. View of the West House at Akrotiri. (From Palyvou, 1990)

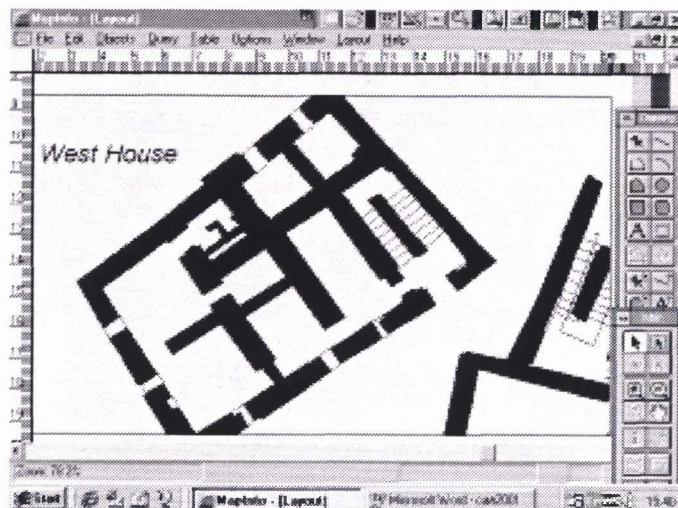


Figure 4. Digitised view of the West House at Akrotiri. (Ground and first floors are superimposed).