



**Universiteit
Leiden**
The Netherlands

Analecta Praehistorica Leidensia 28 / Interfacing the past : computer applications and quantitative methods in archaeology CAA95 Vol. II

Kamermans, Hans; Fennema, Kelly; Kamermans, Hans; Fennema, Kelly

Citation

Kamermans, H., & Fennema, K. (1996). *Analecta Praehistorica Leidensia 28 / Interfacing the past : computer applications and quantitative methods in archaeology CAA95 Vol. II*. Retrieved from <https://hdl.handle.net/1887/32944>

Version: Not Applicable (or Unknown)

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/32944>

Note: To cite this publication please use the final published version (if applicable).

ANALECTA PRAEHISTORICA LEIDENSIA

28

PUBLICATIONS OF THE INSTITUTE OF PREHISTORY
UNIVERSITY OF LEIDEN

INTERFACING THE PAST

COMPUTER APPLICATIONS AND QUANTITATIVE
METHODS IN ARCHAEOLOGY CAA95 VOL. II

EDITED BY
HANS KAMERMANS AND KELLY FENNEMA



UNIVERSITY OF LEIDEN 1996

Graphic design: Henk de Lorm

Computer graphics: Peter Heavens

Copy editor: Marianne Wanders

Copyright 1996 by the Institute of Prehistory, Leiden

ISSN 0169-7447

ISBN 90-73368-10-3

Subscriptions to the series *Analecta Praehistorica Leidensia* and single volumes can be ordered from:

Institute of Prehistory
P.O. Box 9515
2300 RA Leiden
The Netherlands

contents

VOLUME I

Hans Kamermans
Kelly Fennema

Preface

Data Management

Jens Andresen
Torsten Madsen

IDEA – the Integrated Database for Excavation Analysis 3

Peter Hinge

The Other Computer Interface 15

Thanasis Hadzilacos
Polyxeni Myladié Stoumbou

Conceptual Data Modelling for Prehistoric Excavation Documentation 21

E. Agresti
A. Maggiolo-Schettini
R. Saccoccio
M. Pierobon
R. Pierobon-Benoit

Handling Excavation Maps in SYSAND 31

Alaine Lamprell
Anthea Salisbury
Alan Chalmers
Simon Stoddart

An Integrated Information System for Archaeological Evidence 37

Jon Holmen
Espen Uleberg

The National Documentation Project of Norway – the Archaeological sub-project 43

Irina Oberländer-Târnoveanu

Statistical view of the Archaeological Sites Database 47

Nigel D. Clubb
Neil A.R. Lang

A Strategic Appraisal of Information Systems for Archaeology and Architecture in England – Past, Present and Future 51

Nigel D. Clubb
Neil A.R. Lang

Learning from the achievements of Information Systems – the role of the Post-Implementation Review in medium to large scale systems 73

Neil Beagrie

Excavations and Archives: Alternative Aspects of Cultural Resource Management 81

Mark Bell
Nicola King

The MARS Project – an interface with England's past 87

Archaeometry

- M.J. Baxter
H.E.M. Cool
M.P. Heyworth
Detecting Unusual Multivariate Data: An Archaeometric Example 95
- Jon Bradley
Mike Fletcher
Extraction and visualisation of information from ground penetrating radar surveys 103
- Gayle T. Allum
Robert G. Aykroyd
John G.B. Haigh
Restoration of magnetometry data using inverse-data methods 111
- W. Neubauer
P. Melichar
A. Eder-Hinterleitner
Collection, visualization and simulation of magnetic prospection data 121
- A. Eder-Hinterleitner
W. Neubauer
P. Melichar
Reconstruction of archaeological structures using magnetic prospection 131
- Phil Perkins
An image processing technique for the suppression of traces of modern agricultural activity in aerial photographs 139
- Statistics and Classification**
- Clive Orton
Markov models for museums 149
- Juan A. Barceló
Heuristic classification and fuzzy sets. New tools for archaeological typologies 155
- Kris Lockyear
Dmax based cluster analysis and the supply of coinage to Iron Age Dacia 165
- Christian C. Beardah
Mike J. Baxter
MATLAB Routines for Kernel Density Estimation and the Graphical Representation of Archaeological Data 179
- John W.M. Peterson
A computer model of Roman landscape in South Limburg 185
- Sabine Reinhold
Time versus Ritual – Typological Structures and Mortuary Practices in Late Bronze/Early Iron Age Cemeteries of North-East Caucasia ('Koban Culture') 195
- Leonardo García Sanjuán
Jesús Rodríguez López
Predicting the ritual? A suggested solution in archaeological forecasting through qualitative response models 203
- Johannes Müller
The use of correspondence analysis for different kinds of data categories: Domestic and ritual Globular Amphorae sites in Central Germany 217
- J. Steele
T.J. Sluckin
D.R. Denholm
C.S. Gamble
Simulating hunter-gatherer colonization of the Americas 223

Paul M. Gibson	An Archaeofaunal Ageing Comparative Study into the Performance of Human Analysis Versus Hybrid Neural Network Analysis 229
Peter Durham Paul Lewis Stephen J. Shennan	Image Processing Strategies for Artefact Classification 235
Gijsbert R. Boekschoten Dick Stapert	A new tool for spatial analysis: "Rings & Sectors plus Density Analysis and Trace lines" 241
Susan Holstrom Loving	Estimating the age of stone artifacts using probabilities 251
Oleg Missikoff	Application of an object-oriented approach to the formalization of qualitative (and quantitative) data 263

VOLUME II

Geographic Information Systems I

David Wheatley	Between the lines: the role of GIS-based predictive modelling in the interpretation of extensive survey data 275
Roger Martlew	The contribution of GIS to the study of landscape evolution in the Yorkshire Dales, UK 293
Vincent Gaffney Martijn van Leusen	Extending GIS Methods for Regional Archaeology: the Wroxeter Hinterland Project 297
Trevor M. Harris Gary R. Lock	Multi-dimensional GIS: exploratory approaches to spatial and temporal relationships within archaeological stratigraphy 307
Philip Verhagen	The use of GIS as a tool for modelling ecological change and human occupation in the Middle Aguas Valley (S.E. Spain) 317
Federica Massagrande	The Romans in southwestern Spain: total conquest or partial assimilation? Can GIS answer? 325
Shen Eric Lim Simon Stoddart Andrew Harrison Alan Chalmers	Recent examples of geographical analysis of archaeological evidence from central Italy 331
Vincent Gaffney Krištof Oštir Tomaž Podobnikar Zoran Staničič	Satellite Imagery and GIS applications in Mediterranean Landscapes 337
Yvette Bommeljé Peter Doorn	The long and winding road: land routes in Aetolia (Greece) since Byzantine times 343

- Javier Baena Preysler Application of GIS to images and their processing: the Chiribiquete Mountains Project 353
 Concepción Blasco

Geographic Information Systems II: The York Applications

- Julian D. Richards From Site to Landscape: multi-level GIS applications in archaeology 361
- Harold Mytum Intrasite Patterning and the Temporal Dimension using GIS: the example of Kellington Churchyard 363
- A. Paul Miller Digging deep: GIS in the city 369
- Julian D. Richards Putting the site in its setting: GIS and the search for Anglo-Saxon settlements in Northumbria 379
- Jeffrey A. Chartrand Archaeological Resource Visibility and GIS: A case study in Yorkshire 389

Visualisation

- John Wilcock A description of the display software for Stafford Castle Visitor Centre, UK 405
- Christian Menard Pictorial, Three-dimensional Acquisition of Archaeological Finds as Basis for an
 Robert Sablatnig Automatic Classification 419
- Katalin T. Biró Simple fun – Interactive computer demonstration program on the exhibition of the Szentgál-Tűzköveshegy prehistoric industrial area 433
- György Csáki Documentation and modelling of a Roman imperial villa in Central Italy 437
 Ferenc Redő
- Maurizio Forte Archaeology, GIS and desktop virtual reality: the ARCTOS project 443
 Antonella Guidazzoli
- Germà Wünsch Dissecting the palimpsest: an easy computer-graphic approach to the stratigraphic
 Elisabet Arasa sequence of Túnel VII site (Tierra del Fuego, Argentina) 457
 Marta Pérez
- David Gilman Romano Remote Sensing and GIS in the Study of Roman Centuriation in the Corinthia, Greece 461
 Osama Tolba
- F.J. Baena An application of GIS intra-site analysis to Museum Display 469
 F. Quesada
 M.C. Blasco

Education and Publication

- Robin B. Boast Teaching with objects 479
 Sam J. Lucy

Martin Belcher Alan Chalmers Andrew Harrison Simon Stoddart	Teaching the Visualisation of Landscapes – Approaches in Computer based learning for Archaeologists 487
Anja C. Wolle Stephen J. Shennan	A Tool for Multimedia Excavation Reports – a prototype 493
G. Gyftodimos D. Rigopoulos M. Spiliopoulou	Exploring Archaeological Information through an Open Hypermedia System 501
Martijn van Leusen Sara Champion Jonathan Lizée Thomas Plunkett	Toward a European Archaeological Heritage Web 511
Mike Heyworth Seamus Ross Julian Richards	Internet archaeology: an international electronic journal for archaeology 521
Virgil Mihailescu-Bîrliba Vasile Chirica	A Survey of the Development of Computer Applications in Romanian Archaeology 529
Kris Lockyear	Computer-aided publication in practice 535

Documentation and modelling of a Roman imperial villa in Central Italy

1 Introduction

Of the possible archaeological adaptations of computer techniques, this paper is devoted to documentation.

1.1. ABOUT THE DOCUMENTATION

The importance of archaeological documentation cannot be overestimated. Field archaeologists are aware of the fact that their activity, in most cases, leads to the complete destruction of archaeological sites. Theoretically, the various layers of a stratified settlement are peeled off one after the other until the earliest level is reached. Finally, even the last stratum is shaved off to make sure that nothing is left underneath. It may be stated therefore that when the archaeologist's work is accomplished nothing is left and subsequent visitors can admire only the natural environment of important prehistoric sites trying to imagine the original landscape and its inhabitants. Being a Roman Period archaeologist (FR), I am specialized in a period which is characterized by a better than average preservation of archaeological features. It is not necessary to remove stone walls since nothing can be expected below them. Floor levels, however, with the exception of occasionally occurring mosaic floors of great aesthetic value, have to be systematically removed. In this rare case, one may add, non-scientific considerations are given priority: deposits under the floor are not studied for the sake of presenting a beautiful design. This type of presentation means that a moment of history is arbitrarily emphasized, although earlier and later finds must be investigated as well.

It is common archaeological experience that any surface is in the best condition at the time of recovery. That is the time when it must be documented using the broadest range of methods possible including drawing, photographing, film and video recording, verbal description as well as digital procedures. Computerized data gathering and analysis has created an opportunity for introducing new methods in this work opening perspectives that cannot even be fully appraised at this point.

1.2 ABOUT THE SITE

Excavations at the Piano dei Santi baulk near the village of San Potito di Ovindoli in Italy have been carried out

within the framework of a cooperation between the Archaeological Institute of the Hungarian Academy of Sciences, the Soprintendenza dell'Archeologia degli Abruzzi and the Comune di Ovindoli (Gabler/Redő 1986, 1988, 1991, 1994a, 1994b). This archaeological site, a villa from the Roman Imperial Period, is a fortunate case in which the most characteristic level could be pinpointed relatively easily. Most of the stratigraphy is horizontal, vertical components mean that previous features were damaged already by Roman Period construction activity. Layers within the periodization correspond to variations in the size of the habitation area.

Three elements in the documentation of this site will be presented here. Some details of this work were already presented to a professional audience in Ravello in 1993 (Csáki *et al.* 1995). Since that meeting, however, major developments have taken place both in the quantity of documented detail and the scope of methods applied.

2 Documentation of the environment

A digitalized map was prepared showing the site's broader environment. Data of the topographic contour lines in this map were used in preparing a surface model. Constructing this type of surface models often requires the introduction of artificial distortions. Eroded elevations and silted river beds sometimes changed only by centimetres; however, even such small differences may be of significance and must therefore be shown. Fortunately, such a distortion was not required in the case of San Potito since modelling the narrow valleys in the Abruzzo mountains could be carried out using contour lines indicating 10 m elevation, which resulted in a copious pattern.

Our model makes the exclusive selection of coeval topographic data both in a geographical and a historical sense, thereby showing Roman Period relationships between settlements, roads and water surfaces (Grossi 1991). Constructing the model itself will not be discussed in detail. One practical experience, however, is worth mentioning here: a high resolution model showing the excavation's immediate surroundings is equally necessary.

The model that perfectly represents the broader hilly environment shows the site itself within one level, since no



Figure 1. A digitized part of the geometric decoration of a pavement.

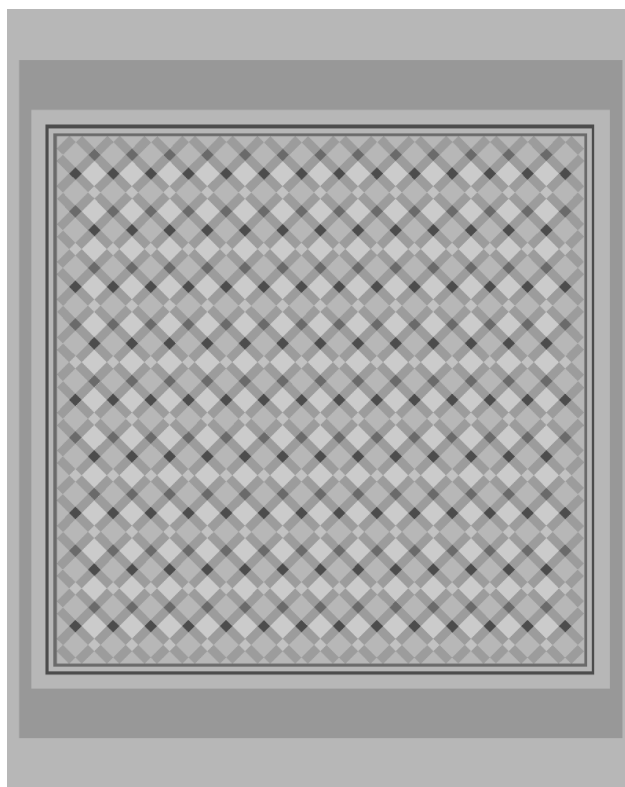


Figure 2. The fully reconstructed geometric pavement.

differences in elevation exceeded 10 m at the settlement (Csáki *et al.* 1995). At the same time we know that there were major differences in the levels of various features within the villa as is evidenced by the presence of stairs between the inner courtyards. Our measurements are indicative of more than three metres of vertical difference between the lowest and highest points of the Roman Period floor levels. The orientation of the villa's drainage system was also carefully laid out. It is for this reason that a stepwise surface model is required that will bridge contradictions in the data and will make the satisfactory documentation of excavation results possible.

3 Documentation of mosaic pavements

The size and luxurious character of the villa under discussion here was well above even the Italian average. On the basis of data available to date, one may say that the residential section, made up by rooms around an approximately 50 by 70 m inner courtyard, was built with care and reflects wealth. It was equipped with glass windows and decorated with wall paintings as well as mosaic floors.

The documentation of mosaic floors was an interesting task. Theoretically, data could be recorded in two different ways. Photographs and drawings of the floor could be either scanned, or digitalized drawings could be used.

3.1 DIFFERENT METHODS OF DOCUMENTATION

My experience is that computerized data recording does not save the tedious work of making precise drawings. The poor state of mosaic floors in the field circumstances of recovery usually does not make 'objective', that is non-commented, documentation possible. Fragmented surfaces cannot be cleaned to the degree that is required for the taking of informative photographs. Field drawings, on the other hand, also have their limitations set by scaling, the thickness of pencil points and our eyesight. These may be modified by the beneficial influence of additional information gathered on the object. It is not an accident therefore that this type of hand-drawn field documentation also contains quantities of written, that is, non-visual information. It is at this point that the tremendous advantage offered by digitalization can be exploited. This computerized technique makes the recording of features in natural size possible. The amount of

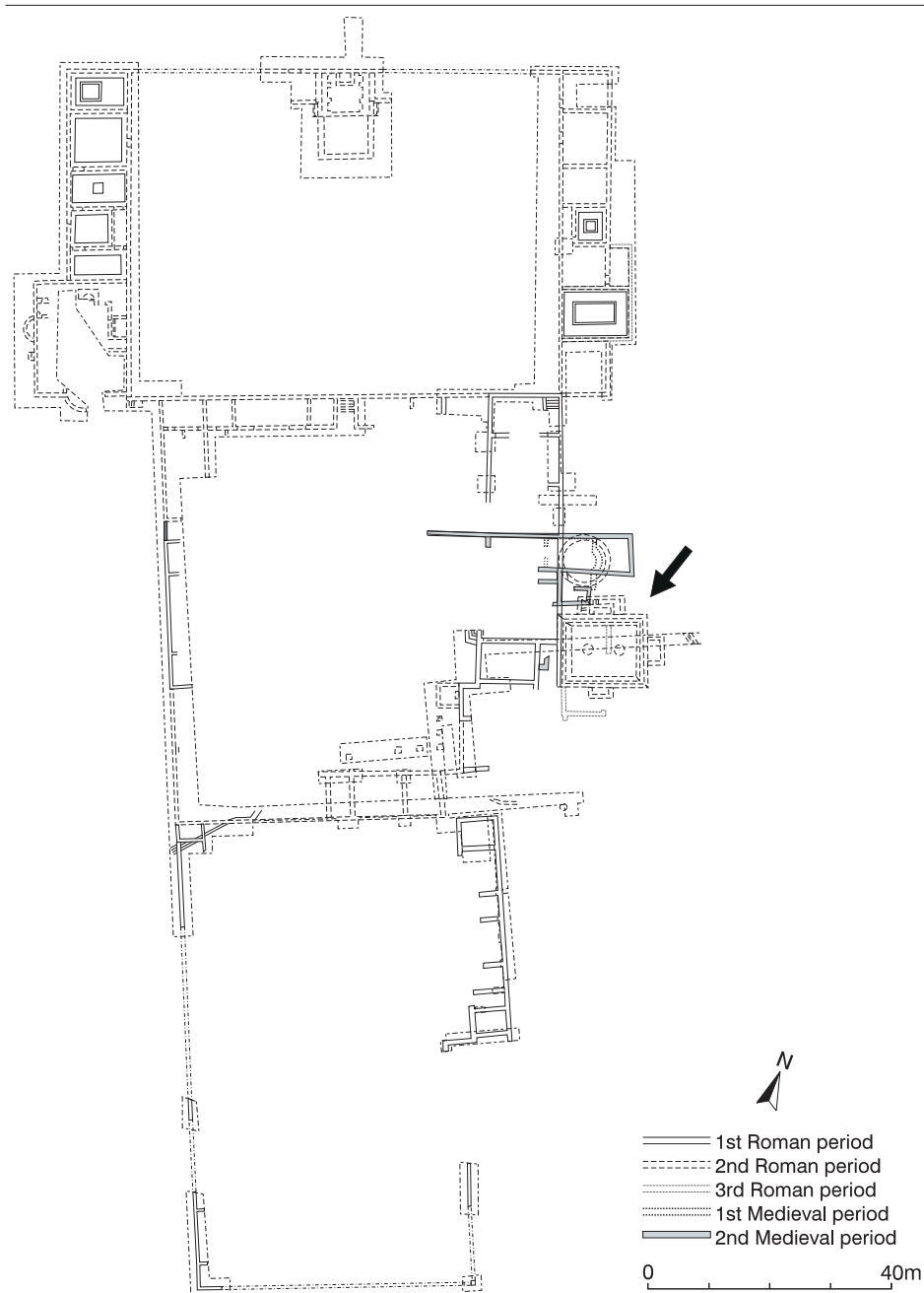


Figure 3. Ground plan of the villa, with the double walled construction.

detail and precision in such records, however, is far beyond physical visibility, falling within the realm of knowledge. Consequently, the possibly most complete data set may be compiled (fig. 1).

Naturally, not every detail in such a data set is utilized simultaneously and constantly. On the other hand we have a

data base at our disposal that is as complete as possible and can be exploited to the degree required.

3.2 RECONSTRUCTION AND PUBLICATION

Of the examples discussed here, the completion of mosaic floor surfaces may be considered the most exciting. The

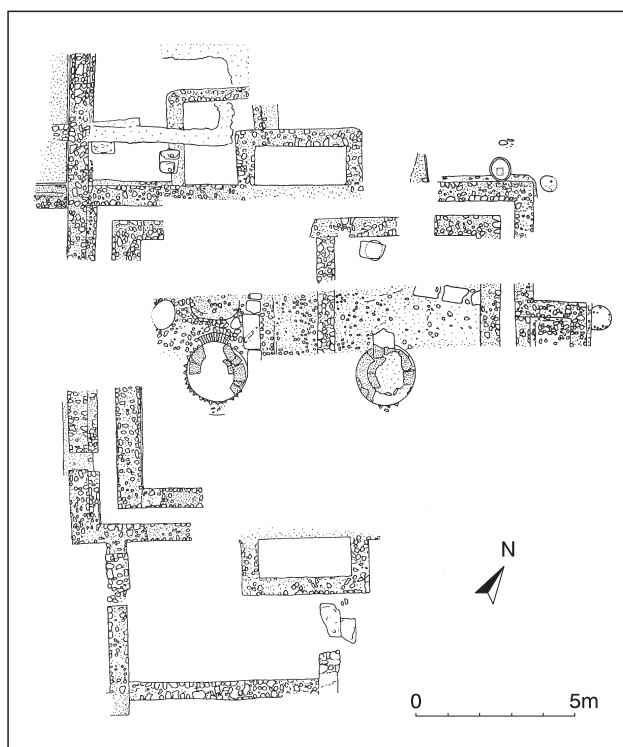


Figure 4. Compiled drawing of the double walled construction.

examples presented here include floors with geometric patterns that could be completely reconstructed (fig. 2), and floors with figural decoration that could only be partially reconstructed.

A special advantage of digitalized drawings is that the material becomes accessible for computerized image processing for the purposes of publication (Gabler/Redó 1994). Colour pictures as well as black and white half tone reproductions can be equally created: the excess information included is an excellent means for mediating our expertise.

4 Three-dimensional modelling of different features

The third area of use is a novelty both in the analysis of this site and in our personal experience. This is the topic of 3-D modelling.

It has been a challenge for a long time, that following the reconstruction of hills and valleys including the roads and water surfaces, the villa itself should be 'built' within this landscape. This would be a formidable task, however, at this point it has to be abandoned in the absence of additional data. First, further details of the site plan must be recovered. Even full knowledge of the building's plan, however, would not shed light on the structure of vertical

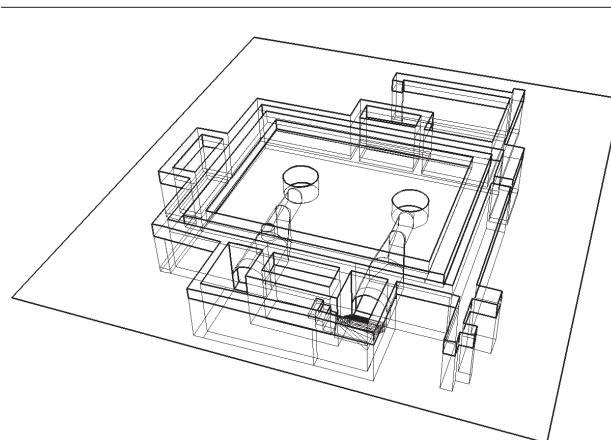


Figure 5. A transparent perspective view of the feature.

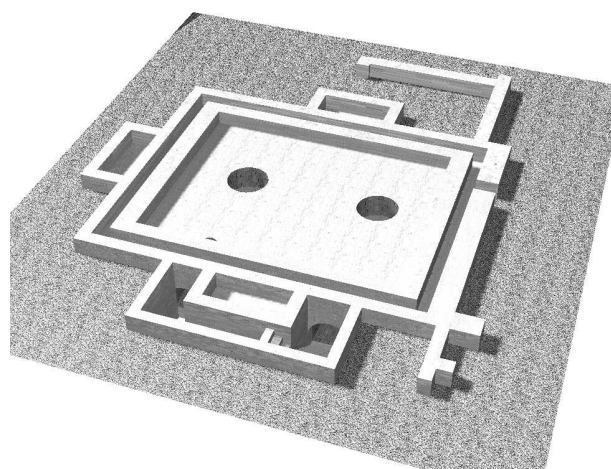


Figure 6. The double walled feature viewed from the north.

walls which therefore remain unknown. Reconstructing these, as well as the roof and windows of the villa would introduce a speculative element in the reconstruction that could not be controlled by the archaeologist alone.

Possibilities of 3-D modelling were therefore tentatively used in solving a specific problem. There is a section within the villa that could not be identified (fig. 3). Specialists neither in Italy nor in Hungary could even comment on this detail. Aside from the rarity of the feature in question, its mysterious character is partly due to the fact that it has never been fully visible and it could therefore not be appropriately presented for the purpose of consultations. The site's location at an altitude of 1000 m as well as the frost that may last for five months every year make the annual re-burial of each excavated and documented feature necessary. As a result, the feature under discussion here was excavated in three consecutive seasons and could never

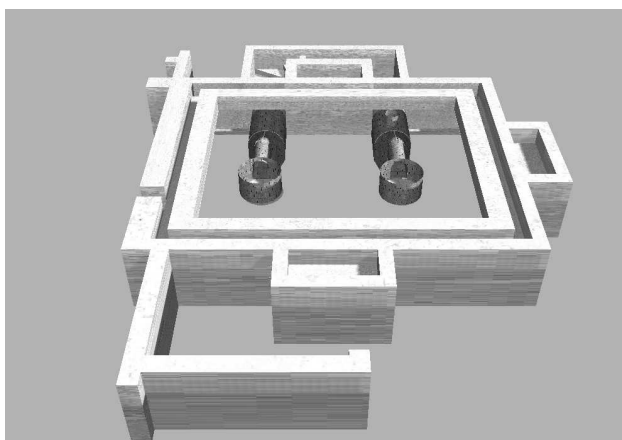


Figure 7. The double walled feature viewed from the south (without the surface).

be entirely seen. In addition, some of its sections still lay unexcavated (fig. 4).

This feature is particularly suited for the purpose of 3-D documentation, since it extends 2.8 m below the surface and is interrupted by tunnels and shafts. In other words, it is an unusually complex structure whose 3-D reconstruction can be carried out without unnecessary speculation. All sections and aspects of this feature were digitalized providing data for the construction of its computerized model. The result of our work can be viewed and measured from any angle (fig. 5). Its data points, edges and surfaces can be made visible or removed from the picture as requested.

It must be mentioned here that the working process itself, the unambiguity required by the technical solution, helped clarify our thoughts and refine the relevant hypotheses. Real



Figure 8. An inner view of the western tunnel of the double walled feature.

results, however, will facilitate the selection of the most characteristic aspects, help ‘walking around’ the feature’s subterranean sections and offer an inside look at the construction (figs 6, 7, 8). This high quality information will permit the presentation of the identification problem in a way that can be appreciated and discussed by an international audience of experts.

Acknowledgements

The excavation was carried out, and the original drawings made by Dénes Gabler and Ferenc Redő. Grateful thanks are due to Annamária Csáki and Csilla Sebestyén who digitalized, as well as Gábor Németh, who contributed the figures to this study. The help of László Bartosiewicz in the compilation of this chapter must also be acknowledged.

references

- Csáki, Gy.
E. Jerem
F. Redő
- 1995 Data recording and GIS applications in landscape and intra-site analysis: case studies in progress at the Archaeological Institute of the Hungarian Academy of Sciences. In: G. Lock/Z. Stančič (eds), *Archaeology and Geographical Information Systems: A European Perspective*, 85-99, London: Taylor & Francis.
- Gabler, D.
F. Redő
- 1986 Gli scavi della villa romana a San Potito di Ovindoli (AQ) 1983-1984, *Acta Arch. Hung.* 38, 41-87.
- 1988 *Gli scavi a San Potito di Ovindoli 1985-1986*. Seconda relazione preliminare, Specimina nova dissertationum ex Instituto Historico Universitatis Quinque-ecclesiensis, 69-94.
- 1991 Gli scavi della villa romana di San Potito di Ovindoli. In: U. Irti/G. Grossi/V. Pagani (eds), *Il Fucino e le aree limitrofe nell'antichità. Atti del convegno di archeologia, Avezzano 1989*, Avezzano, 478-500.
- 1994a Scavi nella villa romana di San Potito di Ovindoli (AQ) 1989-1990, *Acta Arch. Hung.* 46, 127-193.
- 1994b Gli scavi della villa romana di San Potito di Ovindoli. In: G. Hajnóczi (ed.), *La Pannonia e l'Impero Romano: Annuario dell'Accademia d'Ungheria 1994*, Roma 277-296.
- Grossi, G.
- 1991 Topografia antica della Marsica (Aequi-Marsi e Volsci): quindici anni di ricerche, 1974-89. In: U. Irti/G. Grossi/V. Pagani (eds), *Il Fucino e le aree limitrofe nell'antichità. Atti del convegno di archeologia, Avezzano 1989*, Avezzano, 199-237.

György Csáki
Hungarian Geodetic and Mapping Company Limited
Bosnyák tér 5
1149 Budapest
Hungary
e-mail: csaki@geodezia.hu

Ferenc Redő
Archaeological Institute of Hungarian Academy of Sciences
Úri utca 49
1250 Budapest
Hungary
e-mail: h231red@ella.hu