



**NATIONAL TECHNICAL UNIVERSITY
of ATHENS**

**Spatial Information System:
A need for integrated Monument's Documentation**

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Geographic Information System is a tool for:
 legal, administrative and economic decision making
 planning and development
 emphasis on geographical reference

Spatial Information System

for applications on Monuments, as:

- **Attribute element** equally important as **Geographical element**
- **Spatial datum** is the local environment of the site

Components of a Spatial Information System

- Data entry subsystem
 geometric documentation
 attributes on relational Database
- Data storage and retrieval subsystem
 large volume of geometric 2D/3D data
- Data manipulation and analysis subsystem
 interactive process between SIS – User
 automated processes complexity of object
- Data visualisation subsystem
 2D and 3D representations in vector and raster format
 3D textural scenes - Modelling
 Augmented Reality

Archaeological Spatial Information System:

Why ?

- Multi-level and Multi-purpose Documentation
- Interrelation of different kinds of information
- Ease retrieval of information through queries
- Avoiding multiple storage of data
- Entry of new types of data and updating of information
- Other special reasons depending on the application

Where ?

- ✓ Restoration of a monument
- ✓ Conservation of a monument
- ✓ Development of an archaeological site

How ?

3 examples on 3 different monuments

Procedure stages

- 1st stage: Geometric recording
 Photogrammetric procedures
 Field surveys
 Terrestrial Laser scanning
- 2nd stage: Development of the SIS
 Structure of the system
 Data Management
- 3rd stage: Implementation of the SIS
 Provision of products

**A. Restoration of a monument:
Application on the Wall of Ancient Messene**

General Information

- Established in 369 B.C.
- Political & Cultural centre until the 3rd A.C. century
- 9 km Wall Hellinistic fortification-skill
 Irregularly rectangular
 construction system
 2.45 – 2.80 m wide
- 2 main Gates: Arcadian and Laconic Gate



Object of the study: part of the Wall of 70m length
 355 scattered blocks-stones in situ

Geometric Recording

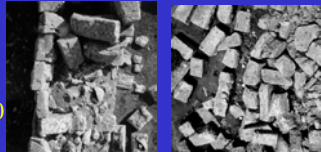
Photogrammetric procedures

Aerial photos **more than 200 photos**

- Helicopter
camera UMK13x18
7 photos in 2 strips
photo-scale 1:300



- Balloon
camera Rolleiflex6006
multi-coverage 23 strips
photo-scales 1:90 – 1:200



Photogrammetric procedures

Terrestrial photos **more than 80 photos**

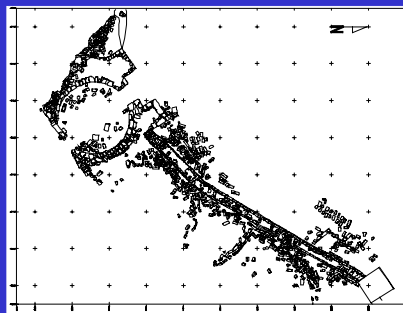
North and South façade of the Wall
camera Rolleiflex6006
photo-scale 1:100 – 1:150

Dense network of premarked control points
field surveys
aerial-triangulation



High accuracy results : rms < 1.5cm
3D compilation of the wall and the scattered blocks

2D vector products



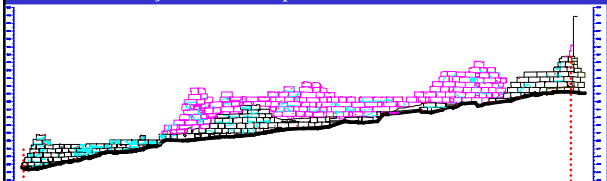
Planimetric view

Part of the Façade of the Wall



2D vector and raster products

The southern Façade: a. Vector plan



b. Orthophoto-mosaic

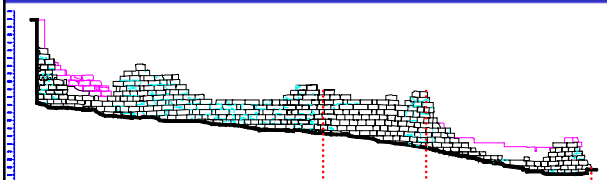


Restoration proposal using the SIS

- 3D recording
photogrammetric procedures
field surveys
direct measuring of all surfaces of each scattered block
- Database for scattered blocks
number of the stone
morphological characteristics
structural characteristics
geometrical characteristics
direction of falling
location of landing surfaces
- Use of visualisation tools
interactive procedure **Level of automation ?**

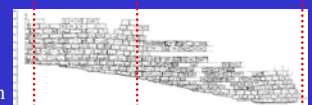
Results

The northern Façade



The existing situation

The restoration plan



B. Conservation of a monument: Application on the Dafni Monastery

Katholikon of the
Byzantine Monastery of Dafni
11th century

At the southwestern suburbs
of Athens



- Masterpiece of Byzantine architecture
- Fine mosaics in the interior

An earthquake at 7 Sept. 1999 caused severe damages

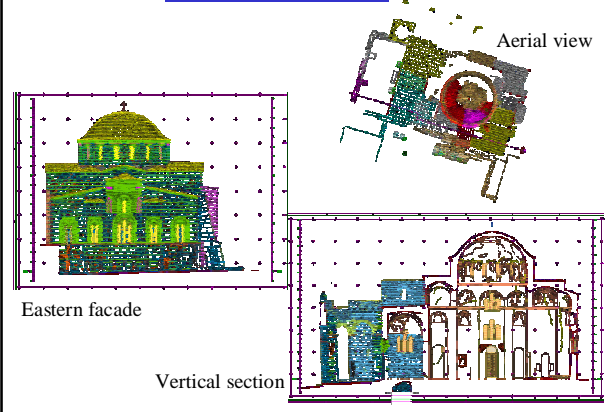
Aim of the study

Creation of SIS with detailed DataBase suitable to record and manage the geometric and qualitative information of every constructural element on the monument's surface

Geometric data

- Vector drawings at a scale of 1:25
- Orthophotos of the facades at a scale of 1:25
- 5 horizontal sections
- 20 vertical sections
- Orthoimages of all the mosaics at a scale of 1:5

2D vector products



2D raster products



Attribute information

- Geological properties
- Deterioration-degradation type
- Surrounding connecting material
- Type and date of intervention
- Dimensions
- Name of the mosaic

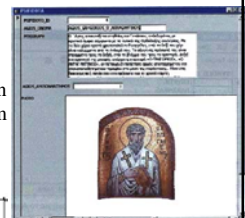
Data Base design

- Conceptual scheme
- Logical scheme
- Implementation in the physical level

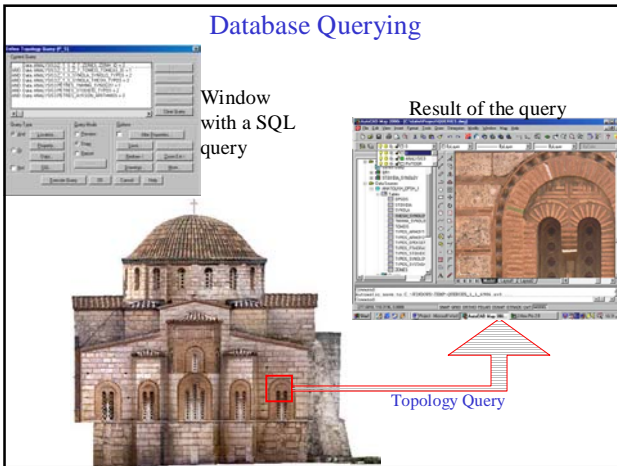
Insertion, Update, Modification of information

- Quality characteristics of constructural elements
- Quality characteristics of Images - Mosaics
- Texts
- Video & sound

Information
Form



Database Querying



Closing Remarks

- ✓ Fast recovering of information and attributes about each element of the monument
- ✓ Ability to relate quantitative and qualitative attributes to each other and to space
- ✓ Re-specification of the database components according to the users' needs

C. Development of a site: Application on Archaeological site of Mycenae



MYCENAE : Historical Information

- Location: 150km southwest of Athens
- The biggest center of Prehistoric Hellenism 2nd Millennium BC
- Human settlements since 19th century BC, best period:1300-1100BC
- Two disasters: 10th century & 468 BC, final abandonment at Roman Times
- Elements of the Archaeological site:
 - Acropolis 3.2 hectares: ruins of palaces, temples, houses, etc
 - Cyclopean Walls and the famous Lion Gate
 - 60 hectares at the western and south-western side of the Acropolis:
 - Tholos tombs of great art
 - Ruins of buildings, store-houses
- Golden and clay excavation finds

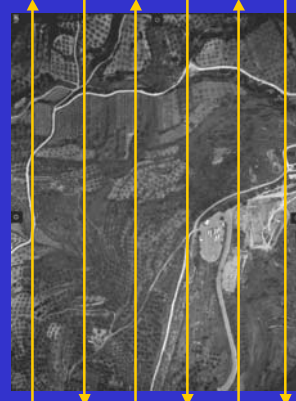
Geometric Recording of the site Photogrammetric procedures

- Airphotos taken by helicopter (UMK 13x18, c=100mm)
 - 45 photos-6 strips, scale 1:2000
 - 6 photos, scales between 1:500 - 1:1000
 - 7 photos-1 strip, scale 1:600
 - 18 photos- 3 x 6 tombs (semi-destroyed), scales 1:200 – 1:300
- 25 Control Points GPS
- Aerial-triangulation BINGO
- Digital Photogrammetric Stations:

SoftPlotter	Autometric
Archis Plus	SISCAM

 - Automated DEM, Breaklines
 - Orthophotos & Orthophoto-mosaic
 - Stereo-restitutions

General view of the site Aerial photo with the flight lines



Photogrammetric procedures

- Terrestrial photos
internal parts of the Walls,
palace facades,
staircases,
parts of Grave Circle A
internal facades of each one of the Tholos Tombs
- Control Points Field surveys
- Rectifications ARCHIS
- Orthophotos DPS ARCHIS PLUS
- Stereo-compilations DPS Stereometric

2D Vector products



Planimetry of the Acropolis

Section of a tomb



3D vector product

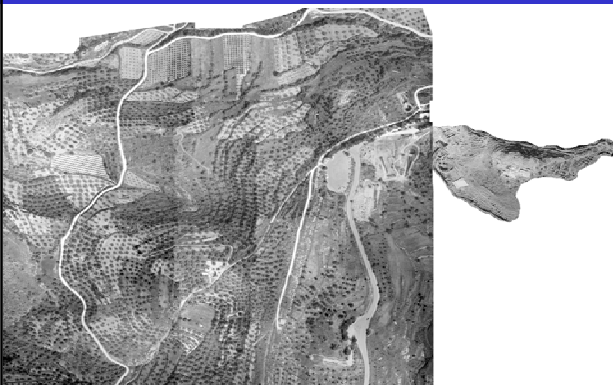


3D view of the vector data of the Acropolis



Produced by AutoCAD & ArcView-3D Analyst

2D raster products



Orthophoto-mosaic of the Archaeological Site

Spatial Information System

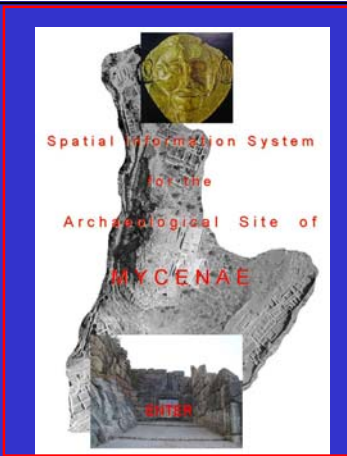
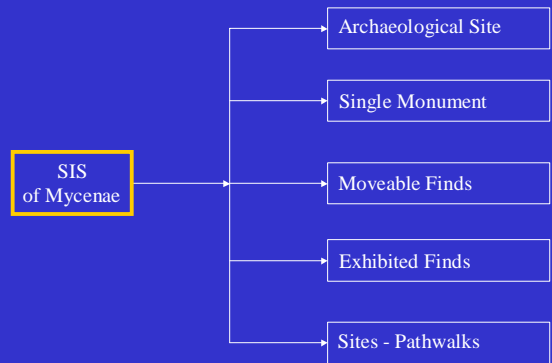
General Principles

- To avoid the unreasonable insert of existing data of large volume
- To make best use of the SIS as a decision making tool both for demonstration purposes and for research support, usable by tourists/visitors and by professionals
- ARCVIEW v3.1 of ESRI with 3D Analyst
3D Studio MAX for model visualization
Adobe Premiere for video producing and editing

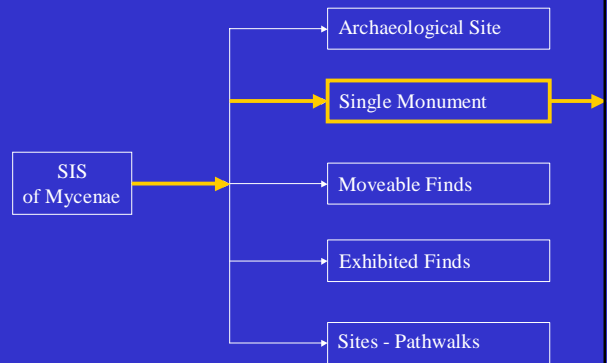
Data of the SIS

- All products of the detailed geometric documentation
 - 2D plans
 - 3D views
 } at various detail levels, time periods and historic phases
- Texts from historic sources and literature
- Digital images
 - recent or old photos
 - excavation photos
 - old graphs
 - recreations of the site
 - video
- Videos of tour paths with a pre-defined walk-through and flyovers

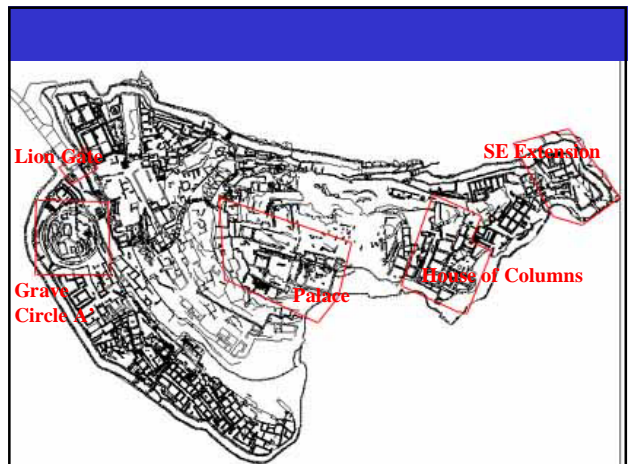
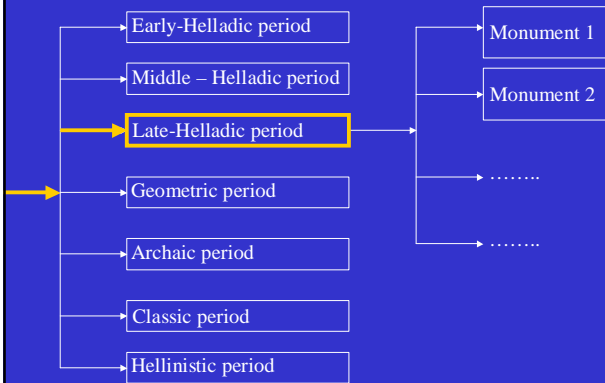
STRUCTURE OF THE SIS (1)

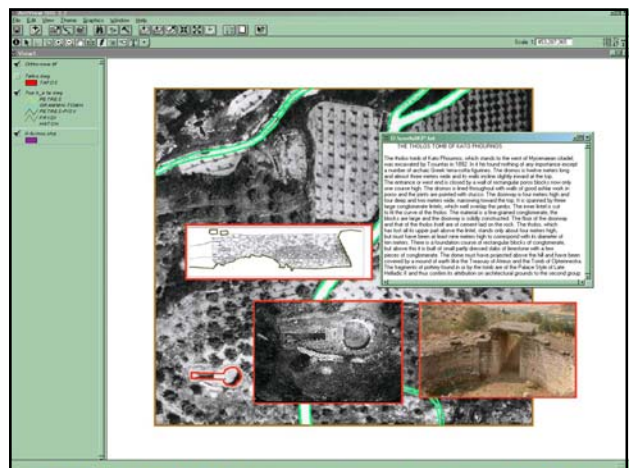
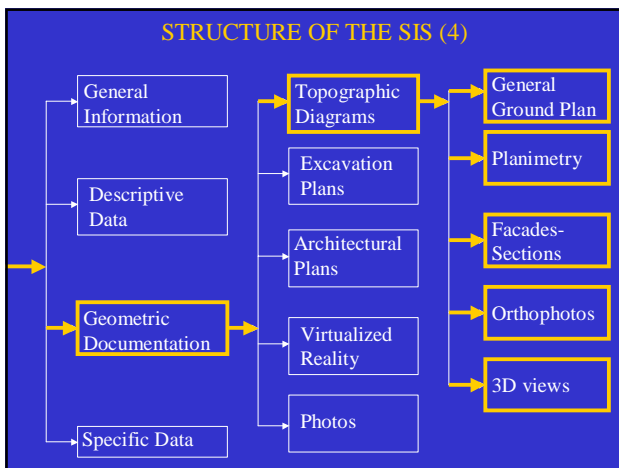
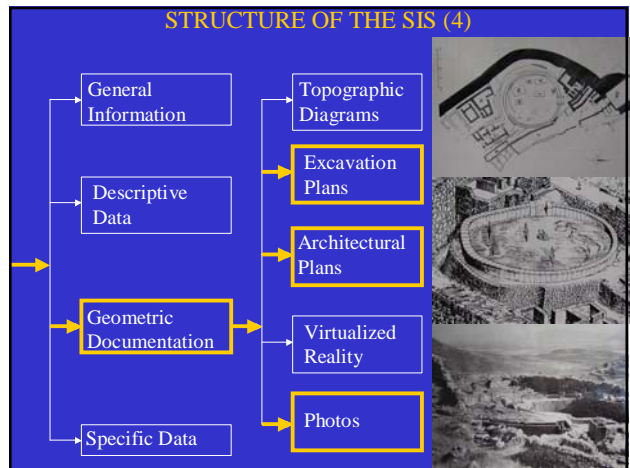
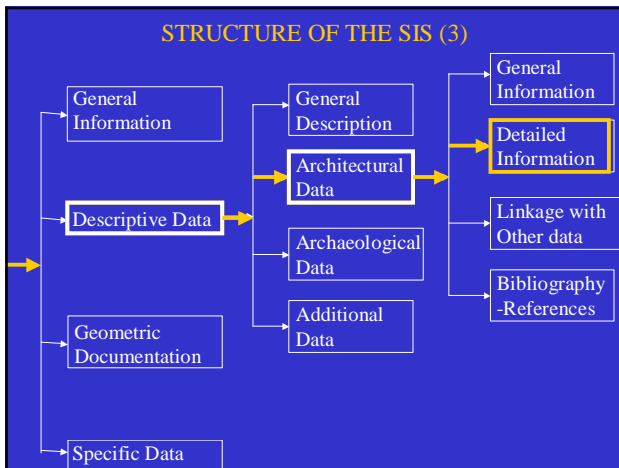
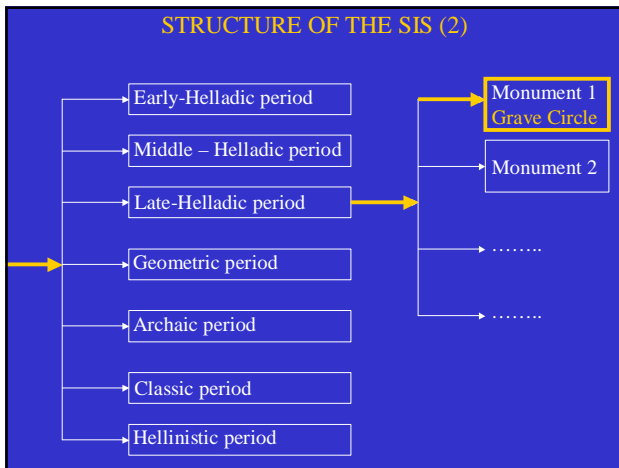


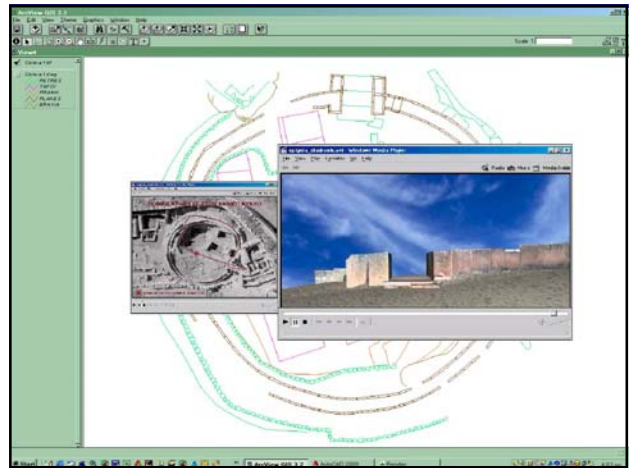
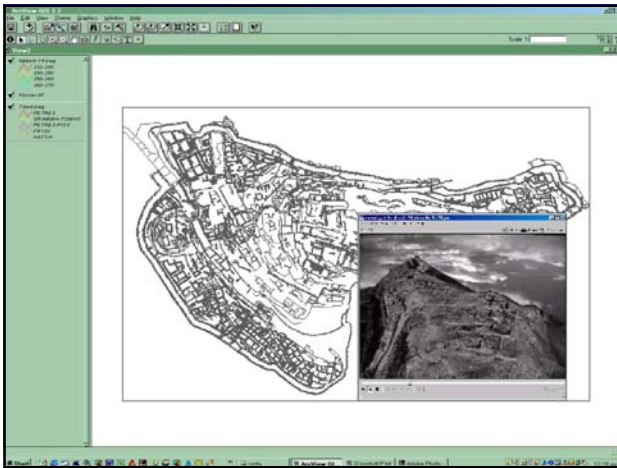
STRUCTURE OF THE SIS (1)



STRUCTURE OF THE SIS (2)







Conclusions

- **Traditional methods** for the documentation of the archaeological sites **are changing radically** due to the use of Spatial Information Systems
- There is a need for **3D recording, editing and visualisation** for applications on monuments despite the fact that the 3D processes are laborious and time-consuming
- **Integration** of all types of data should be possible and encouraged
- The implementation of an **Archaeological SIS** confronts the monument and the related pieces of information in a unique way; it contributes essentially to the study of the monument