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DG XII programme: retrofitting of museums for antiquities in the Mediterranean countries

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Abstract

This project has studied a selection of 16 typical museums for antiquities in five Mediterranean countries and was partly funded by the JOULE III of the European Commission DG XII.

Through an elaborate analysis and complete refurbishment of the Archaeological Museum of Delphi, the programme has provided an example for an innovative museum design based on present-day know-how. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

In most museums issues of bioclimatic, environmental-friendly and energy-conscious design have been completely ignored. Good reasons seem to support the opinion that museums should be lit, heated and ventilated by artificial means. This leads to buildings fully dependable on M/E installations. The sensitivity of the objects exhibited is the main argument to justify this position. The exhibits are considered to be better preserved when light, temperature etc. are fully controllable and adjustable according to the special requirements of the exhibits.

However, there is a wide spectrum of application for natural and energy efficient environmental control in museums for antiquities and especially antique sculpture. Often, sculpture is not affected or damaged by daylight, on the contrary daylight often even makes the best out of sculpture.

Special conservation requirements can often be dealt with locally rather than conditioning the whole museum space for the needs of a few objects.

2. Project objectives

From the wide range of museums that exist, the JOULE III programme has particularly addressed itself to museums for antiquities with an emphasis on sculpture and other smaller artefacts. It has studied a selection of 16 typical museums for antiquities in five different Mediterranean countries.

Having defined their problems and energy consumption, the project has set an example for an innovative museum design based on present-day know-how through the retrofitting of the Archaeological Museum of Delphi.

The following aspects were treated with priority.

- Daylighting
- Passive heating and especially passive cooling
- Natural ventilation
- Use of innovative energy-saving artificial lighting components
- Use of efficient energy management systems
- Use of environmentally friendly materials
- Acoustics

The application of the acquired know-how is aimed at resulting in museum buildings with:

- An enhanced exhibition of the objects on display,
- A better indoor air quality,
- Maximum visual, thermal and acoustic comfort,
- Low energy consumption and rational use of energy.

3. Methodology

The programme consisted of three major phases:

1. *The analysis of museums*: a selection of 16 archaeological museums in five Mediterranean countries were short-term monitored, spot-measured, analysed and evaluated in order to gain an overview of the situation

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of archaeological museums in the Mediterranean countries, their generic problems and potential.

2. *The research and evaluation of the Museum of Delphi*: in this task long-term monitoring, analyses and evaluations were performed. The aim was to gain a thorough picture of all important aspects of the museum building of Delphi, which form the basis of the exemplary proposal design.
3. *A proposal design for the Museum of Delphi based on the evaluation and extensive simulations*: extensive energy, lighting and acoustic simulations and the according derivation of an innovative architecture, electro/mechanical, lighting and acoustic proposal design were carried out. The aim of this stage was an innovative retrofitting design for an archaeological museum, which serves as an example to other museums in the Mediterranean countries.

4. Analysis of museums

The following museums were chosen for the study:

Portugal	Conimbriga, Silves, Lisbon
Spain	Seville, Cordoba, Merida
France	Arles, Nimes
Italy	Bologna, Aquileia, Marzabotto
Greece	Nauplion, Cycladic Art (Athens), Delphi, Samos, Ioannina

The results of the analysis show the following similarities.

- The majority of buildings originally depended on daylight and natural ventilation and consists of older shells that were transformed to house museums (e.g. Museum of Lisbon, Fig. 1) with many problems of obsolescence (e.g. problematic lighting conditions, Fig. 2).
- The pace of finding new archaeological sites has often been slowed down considerably, so few new buildings are being erected. But the old ones have a great need of expansion in order to accommodate new findings from the existing sites.

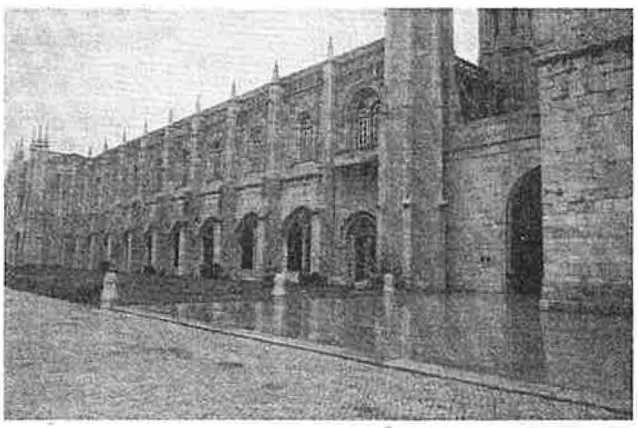

Fig. 1. Archaeological Museum of Lisbon, exterior view.

Fig. 2. Archaeological Museum of Nauplion, problematic li conditions.

- The great majority of buildings belong to the public s with tight budgets and administration restrictions. Ol ing data has not always been easy.
- The majority of buildings have a strong relation t adjacent environment, either because they are act part of an archaeological site, or because they are marks tied to their historic context.
- There is an increasing need for "peripheral" uses su shopping rooms, lecture rooms, cafeterias etc. enhances the idea of the modern museum as a r functional didactic and research centre.
- Many museums have strong qualities in terms of s organisation and passive properties, which forms a basis for contemporary retrofitting.
- In most cases there is a great need for improvement electro/mechanical systems, including retrofitting, u ing and replacement.
- There is a prevailing trend among museum auth towards the hermetically sealed museum-box that s provide a better control. Even in older shells, that u depend on natural light and ventilation, new interve call to blocking the skin apertures.
- Generally there is a strong potential for retrofitti museums for antiquities, which can bring about subs benefits in quality, comfort, sustainability and finan
- There are some positive exceptions to some of the tive observations.

4.1. Potential for retrofitting

Despite the problems of original design mistak maintenance, overcrowding etc., many museum bui

for antiquities prove to have strong qualities in terms of spatial organisation and relation to the environment. So the analysis of this type of building and the proposal for a retrofitting methodology are worth the effort, and if realised, would drastically improve the function and the image of the building. The effort should be addressed to all parties involved, but mainly to museum authorities and responsible public services in order to convince for the necessity and the viability — both in a scientific and an economic way — of the retrofitting process.

4.2. General conclusions

- There is a great need and also a great "market" for retrofitting of older museum buildings in order to accommodate the increased needs.
- There is need to convince the authorities of the economic and cultural benefits for retrofitting by the use of passive methods.
- Any suggestions in order to be realistic should take into consideration the timing and technical restrictions of any public sector.

5. Research and evaluation of the Museum of Delphi

The review of the museum building of Delphi (Figs. 3 and 4) showed the following main characteristics.

- The building consists of an old shell with many problems of obsolescence concerning lighting, acoustic and thermal comfort as well as exhibition quality and technology.
- The building's energy consumption is very high as compared to the comfort conditions provided.
- The pace of finding new archaeological items in the greater area of Delphi has been slowed down considerably so the need of a better handling of the existing exhibits is prevailing over the need of expansion in order to accommodate new findings.
- The museum belongs to the public sector with tight budgets and administration restrictions.
- The building has a strong relation to the adjacent environment, being virtually a part of the archaeological site.
- The environment is relatively unpolluted.
- There is a well stated need for "peripheral" uses such as a vending room, a multi-purpose room, a cafeteria, stores and workshops etc. that will enhance the image of the museum as a multi-functional didactic and research centre.

Concluding, the museum shows a strong potential for energy efficient retrofitting, due to the positive passive properties of the building. The obsolete conditions result from obsolete technology, both for the exhibition itself and the environmental control in combination with mal-operation and non-existent control mechanisms.

6. Proposal design for the Museum of Delphi

The project includes the complete renovation and re-exhibition of artefacts of the Archaeological Museum of Delphi plus an extension that incorporates a new entrance hall, supporting facilities and a hall for the famous sculpture of the Charioteer. Natural ventilation, acoustics and especially daylighting are three of the main concerns of the design.

The strategy for the new energy, daylighting and acoustics focuses on the following aspects:

- Maximisation of the positive aspects of the existing building, regarding mainly its use of natural daylight, thermal mass and ventilation,

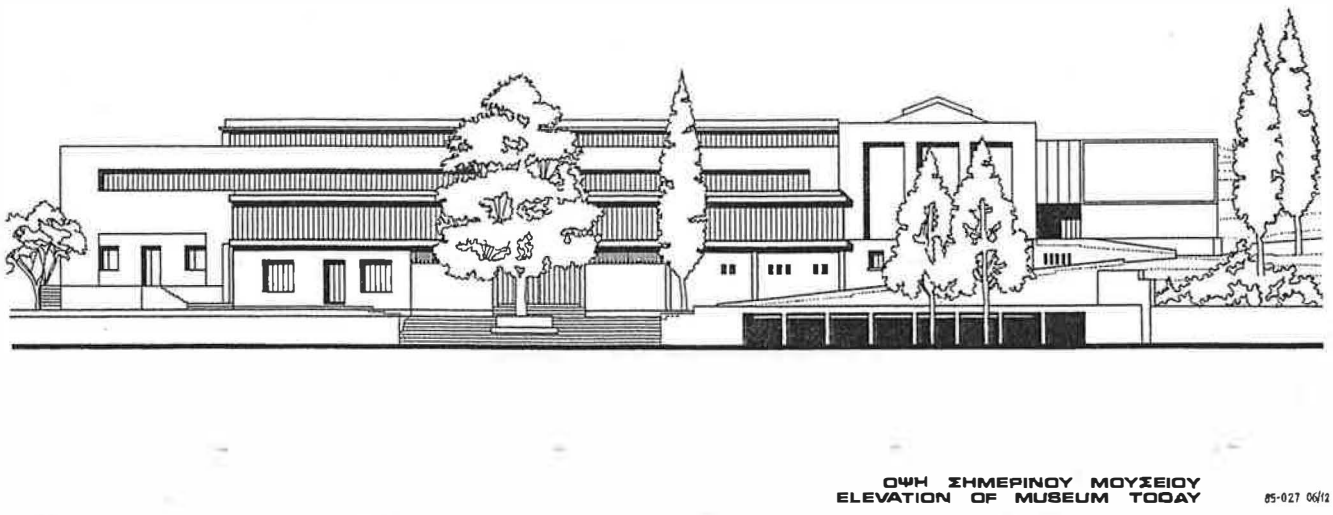

Fig. 3. The Museum of Delphi, elevation before retrofitting.

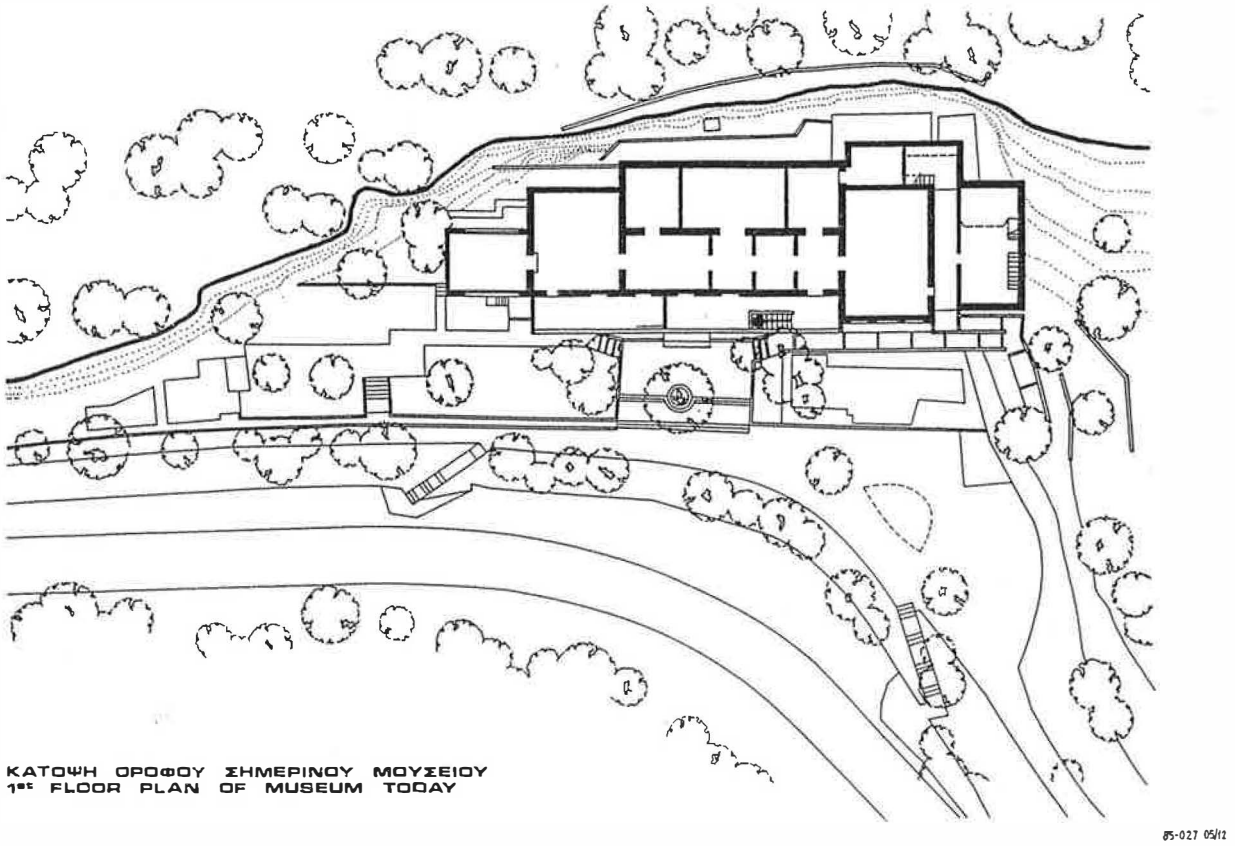

Fig. 4. Delphi, 1st floor plan before retrofitting.

- Correctional actions for the negative aspects of the old building, regarding mainly heat losses, acoustics and obsolete M/E installations, and
- Improvement of the daylighting practices in the main rooms of the extension building.

The design for the extension part focuses on the Charioteer room with a new roof configuration and sidewall openings for daylighting (Figs. 5 and 6). The idea is to give a better daylight factor and enhance the statue while avoiding the direct light from above suggested by the previous design.

The redesign of the reception area followed the common logic of the continuous path, incorporating at the same time more advanced techniques for artificial lighting.

The design for the existing building focused on the following matters:

- Rearrangement and treatment of exhibits as parts of a whole and as separate parts in independent rooms (see also Fig. 7),
- New openings in internal partitions for the creation of the new movement and visual axes,
- New skylight openings and treatment of the ceiling plane as a light directing and acoustic device,
- Incorporation of state-of-the-art M/E networks, outlets and controls and the proposed light fixtures,
- New roof configuration for the Siphnians room.

Extensive simulations on the aspects of energy (Fig. 8), acoustics and daylighting were carried out in order to optimise comfort conditions, the visual display of exhibits and the energy performance of the building.

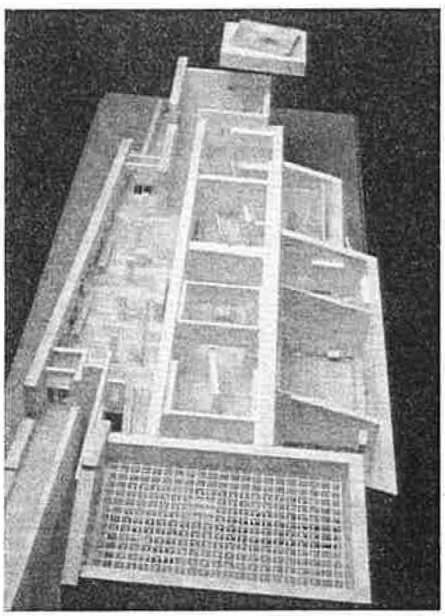

Fig. 5. Delphi, open roof model.

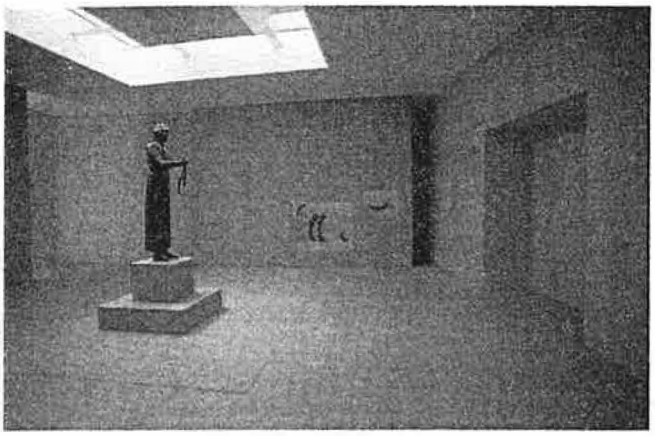

Fig. 6. Inside model view of the Charioteer room.

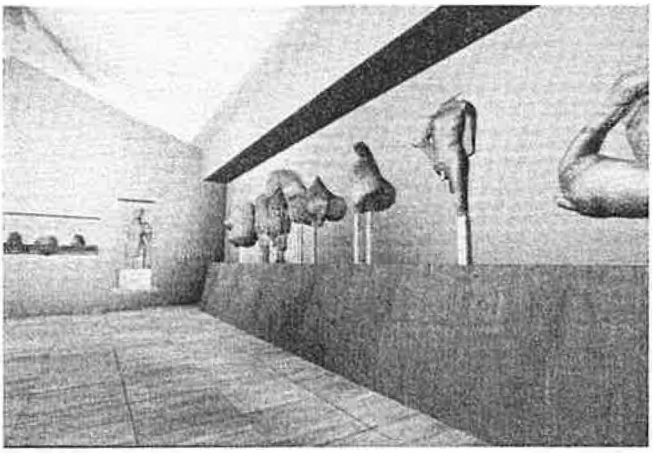

Fig. 7. Computer visualisation of museum space.

The proposed daylighting design is complemented and backed up by a comprehensive artificial lighting design, that is used to accentuate places of interest under daylight conditions and provide exhibit and additional unobtrusive general illumination during lack of daylight. The artificial lighting system is designed in such a way so as to gradually

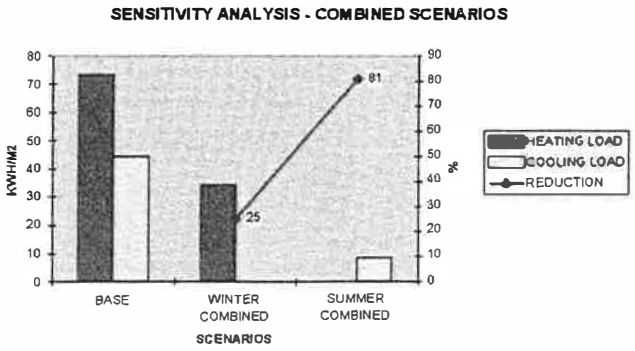

Fig. 8. Thermal study, reduction of heating and cooling loads through combined scenarios.

substitute daylight while providing a similar effect through the placement and choice of luminaires and controls.

Acoustically, absorbent finishings have been applied to the formerly hard and reflective surfaces according to the museum's needs for reverberation, noise levels and speech intelligibility, given by visitor amounts and patterns.

It was found that with the correctional actions the overall energy consumption of the Delphi Museum could be reduced by about 70%. At the same time comfort conditions would reach the desired high standard.

6.1. Project teams

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- Department of Applied Physics, University of Athens, Greece
- Low Energy Research Unit, University of North London, Great Britain
- Bartenbach Lichtlabor, Austria
- PRAVAC Projectos e Estudios Térmicos, Portugal
- Seminario de Arquitectura y Medio Ambiente, SAMA S.C., Spain
- Energie and Architecture, France
- Ricerca and Progetto, Italy