Traditional Environmental Architecture in re-use: The "Courtyard of Miracles" in Athens, Greece

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Abstract: - While working out an architectural research on a quarter of buildings called the "Courtyard of Miracles" in Athens, the Directorate of Restoration of Modern and Contemporary Monuments revealed and studied certain 19th century methods of environmental cooling, heating and insulating the houses. Therefore, the Restoration Service faces a double challenge: it has to preserve the traditional ways of environmental architecture and propose contemporary methods of maintaining the thermal balance, taking into account the re-use of the whole quarter as a museum. New suggestions should not offend the traditional ones, but on the contrary they should bring them out.

Key-Words: - Traditional Building, Heritage Architecture, Ecological Restoration, Historic Sites

1 Introduction

Folk architecture in Greece, both urban and provincial, respects certain building values, in order to guarantee certain standards of comfort. More specifically, during architectural research for a certain block of folk and neoclassical buildings, known as the "Courtyard of Miracles", dating to the 19th century in the historical center of Athens, the Restoration Service of the Hellenic Ministry of Culture found out the houses followed particular construction rules, which formed an early ecological way of building.

Fig.1 Aerial photo of the historical center of Athens, early 1900's.

This environmental approach provided the houses with cooling during summer and heating during the winter months. Consequently, traditional methods of reconstruction have been combined with modern nineteenth century materials, in order to achieve high quality results. The challenge for the Restoration Service was to maintain and use this traditional environmental architecture and simultaneously to introduce new ecological methods to these buildings, so as to create the best possible environment for their reuse as part of the Greek Folk Art Museum.

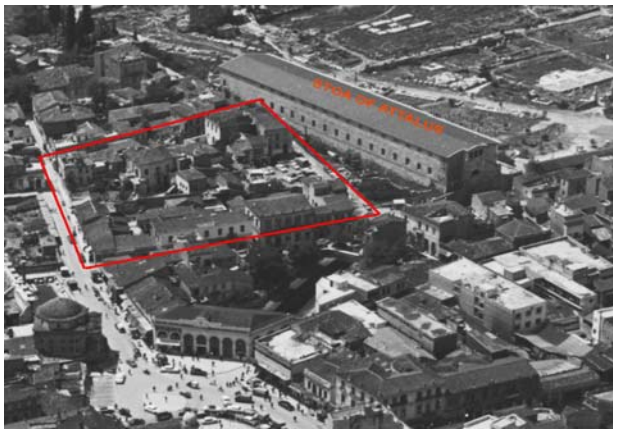

Fig.2 The quarter of the "Courtyard of Miracles" in the historical center of Athens.

In order to follow the line of argument of the architectural research and to arrive at certain propositions, it is essential to develop the historic background of this certain quarter and to analyze the ecological constructing methods.

2 Historic background

Fig.3 Aerial photo of the historical center of Athens.

The specific quarter is defined by Areos-Kladou-Vrysakiou-Hadrianou streets at the southwest edge of Plaka, the Athenian historical centre.

Fig.4 The quarter of the "Courtyard of Miracles" in Stauffert's 1836 plan of Athens.

It concentrates in a unique way a large number of characteristics of the historical, economical, architectural and urban evolution at one of the oldest parts of the city of Athens.

Fig.5 The quarter of the "Courtyard of Miracles", 2008 Google Earth view.

Remnants of the Late-Roman city wall are embodied in 20th century buildings at the quarter, while remnants of the Ancient Agora of Athens are found in buildings of the 18th until 20th century.

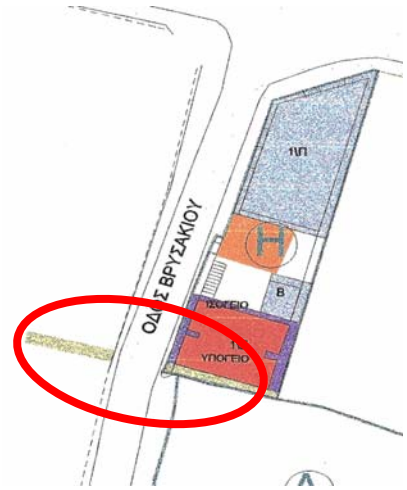

Fig.6 Visible remnants: Part of the Post-Roman city wall.

Remnants of Byzantine and post Byzantine churches (Saint Thomas and Saint Elissaios), and wealthy mansions of the late Ottoman domination (Chomatianou-Logothetis' mansion), are visible at the quarter.

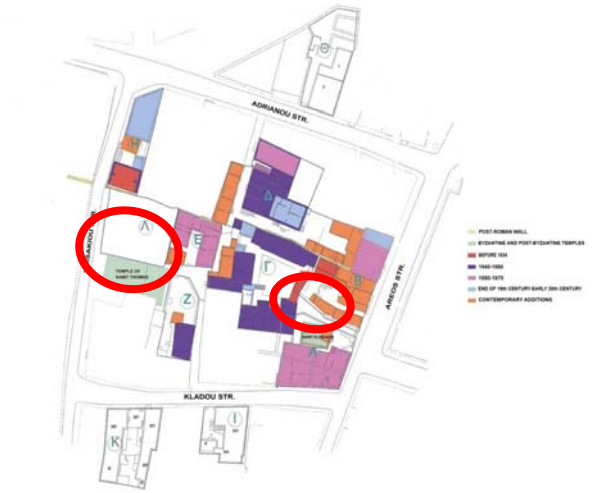

Fig.7 Remnants of Byzantine and Post-Byzantine churches (Saint Thomas and Saint Elissaios).

The quarter contains damaged and dilapidated 19th and 20th century folkloric houses (one and two floor houses), as well as shops.

Fig.8 Nowadays this quarter contains damaged and dilapidated 19th and 20th c. folkloric houses (one and two floor houses) and shops.

Around the quarter stand important historical monuments. At the west side there is the fully restored Hellenistic Stoa of Attalos and at the east side the reconstructed church of Saint Elissaios of Plaka.

In completion of these monumental and symbolic borders of the Ancient Greek and Byzantine heritage comes the well known as "Courtyard of Miracles", a living monument of the urban planning history of Athens in the first years after the Liberation from the Ottoman domination. That is why the monument demands our attention.

3 Environmental approaches in urban architecture

Dealing with 19th century buildings needing conservation and restoration, a number of specialists have observed that architects and traditional craftsmen of the past have adopted certain methods and used specific materials in order to overcome environmental difficulties. The houses at the quarter of the "Courtyard of Miracles" followed particular structural rules that provided them with heat and sound insulation.

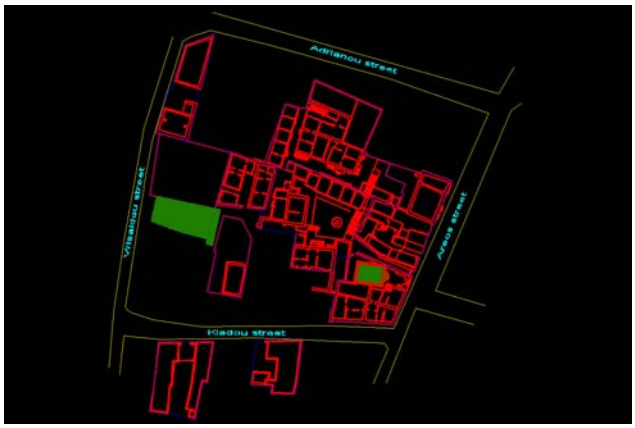

Fig.9 Ground plan of the "Courtyard of Miracles", demonstrating the various residences and churches.

The microclimate of the area

In order to describe better these methods, it is significant to determine the microclimate of the historical center of Athens, where the houses of the "Courtyard" stand. The historical center of the city is about 6 km. away from the shore, so the sea wind cannot cool it.

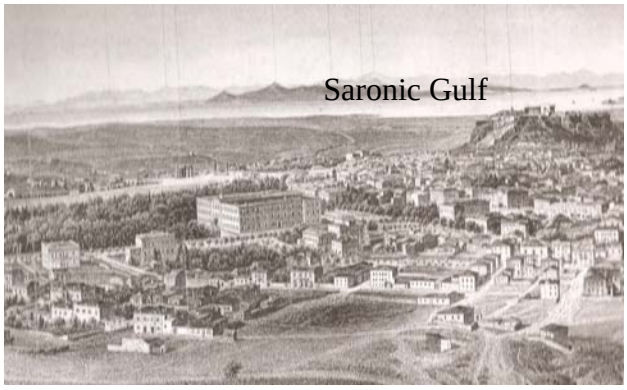

Fig.10 The historic center is about 6 klm. away from sea shore.

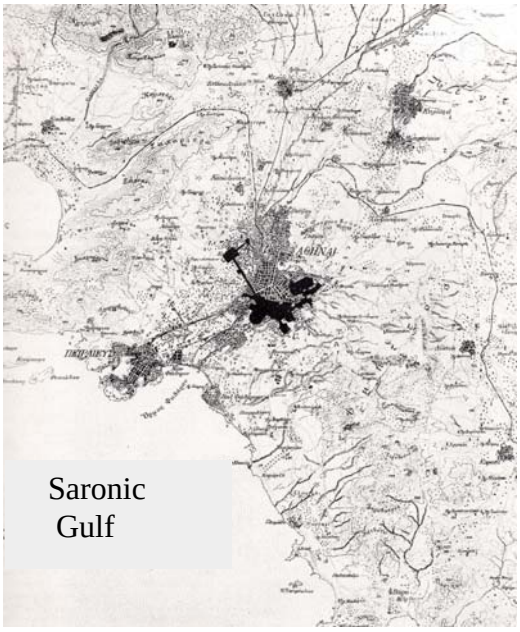

Fig.11 The historic center is surrounded by soft hills, which guarantee high temperatures most of the year.

Moreover, the mountains surrounding the area also protect it. The ones at the north and northeast sides, mounts Parnitha and Penteli, are approximately 1400 m. height and obstruct the cold winter winds.


Fig.12 The yard of the Logothetis' mansion.

The basin of Athens is mostly hot, having high temperatures during most of the year. Since rainfalls are not frequent, the climate is also dry. Therefore, the houses should be shielded mainly against heat and, as city centers are always loud and noisy, also against unpleasant sounds.

Traditional methods of insulation

The houses at the quarter of the "Courtyard of Miracles" used contemporary thermal and sound insulation know-how from roof to floor. In particular:


Fig.13 Thick roof planking.

(1) Wide tiles, being firmed up to a thick layer of clay, sealed the roof from both heat and cold. Moreover, thick planking of 0.04 m. prevented warmth from penetrating the roof.


Fig.14 High floors (approximately 3.00 m.).


Fig.15 Windows of small dimensions.

(2) Each floor was particularly high, approximately 3.0 m., whereas the windows were of

small dimensions. This ratio permitted the cooling of the house: warm air rose to the ceiling away from human level, as cooler air kept coming in from the windows.

Fig.16 Venetian blinds direct the incoming air.

(3) Venetian blinds direct the incoming air towards the ceiling, the floor or another opening.

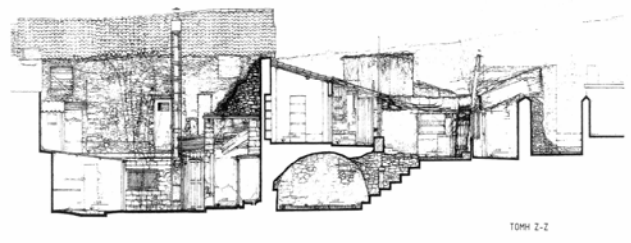

Fig.17 Thermal insulation gap between the floor and the ground.

(4) The floor was uplifted well enough, in order to create a thermal insulation gap between the floor and the ground.

Fig.18 Lower layer filled with seaweeds and sand.

(5) The lower layer below the floor was filled with seaweeds and sand; they both consist of natural thermal and sound insulation materials.

Fig.19 Stone masonry approximately 0.60 m. thick .

Fig.20 Thick masonry insulates the buildings from high temperatures.

(6) The masonry of buildings consists of stone about 0.60 m. thick. The stone, as a structural material, has very low heat conductivity. The

thickness of masonry also plays a fundamental role in the insulation of a building. This principle is particularly useful, since there is a wide variation of temperature during the day in the hot-dry climate of Athens.


Fig.21 Vegetation in the "Courtyard of Miracles".

(7) The existing vegetation prevents solar radiation from entering the houses directly and shades them in a natural way. Specifically, the mulberry tree in the internal courtyard provides a strong protection against the sun with its rich leafage during summertime.


Fig.22 The mulberry tree in the internal courtyard.

And reversely, during winter, as it is a deciduous tree, its naked branches allow sunlight to enter and to heat up the interior spaces.

4 Current propositions for the development of traditional methods

The Directorate of Restoration of Modern and Contemporary Monuments had to satisfy a double requirement: on the one hand to preserve and restore the buildings of the "Courtyard of Miracles" including their insulation system and on the other to propose its development, respecting its environmental approach.

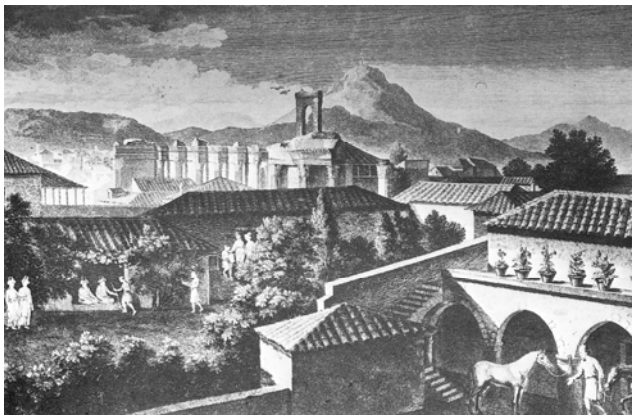
Fig.23 The James Stuart and Nicholas Revett engraving (late 18th century) shows the "Courtyard of Miracles" during the Ottoman domination.

In order to meet this last obligation the Restoration Service undertook a conservation project introducing bioclimatic techniques. More specifically:

4.1 Basic assumptions for effective cooling strategy

The heat design strategy can be achieved by controlling sunlight via permanent, adjustable or seasonal elements of shading. In particular:

(1) Placing of deciduous trees and creepers in the building surroundings.


Fig.24 Existing vegetation should be reinforced.


Fig.25 Trees and creepers guarantee shading.

(2) At the eastern and western side of the buildings there should be openings covered with Venetian blinds, which allow the sunlight to enter during the winter and prevent it during summer.


Fig.26 The openings are covered with Venetian blinds.

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4.2 Means of heat insulation

(1) Double glass panes.

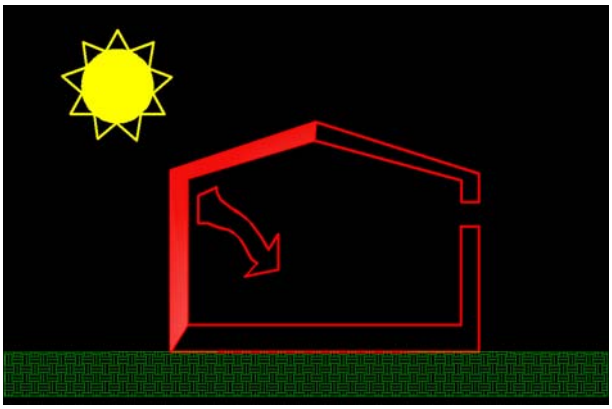
Fig.27 Well-insulated exterior masonry.

(2) Well-insulated exterior masonry retains cool air and prevents heat from penetrating. The masonry of northern side should be well insulated since it is less exposed to sunlight, hence coolest.

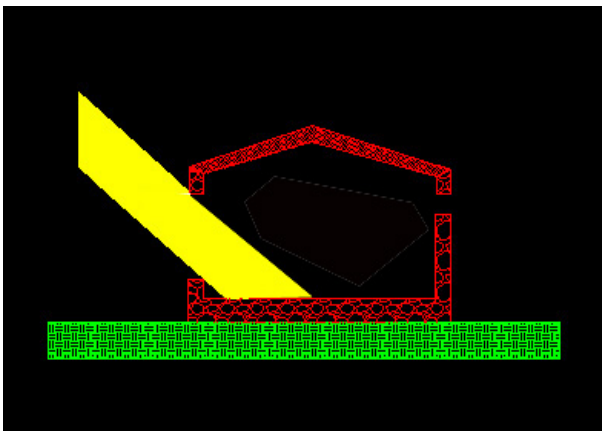
Fig.28 Well-insulated exterior masonry.

(3) At the southern side of the buildings the openings will allow the heat to enter during winter in order to heat the interior.

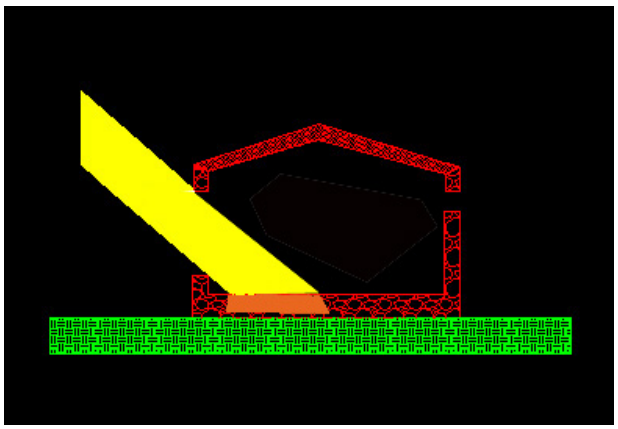
Fig.29 At night stored heat is radiated into the interior spaces.

4.3 Means of ventilation

Even when a building is shaded and insulated, so that thermal exchange and flow of external heat are limited, the internal temperatures in the hot - dry climate during summer are probably higher than the external ones. Ventilating with cold air using natural means, such as the wind or the air pressure, could only have positive results:


Fig.30 Ventilation strategies: Small openings at the loft of the buildings.

(1) The loft or the roof can have small openings (skylights), thus the hot air of the interior will go up naturally and will slip from the skylights.

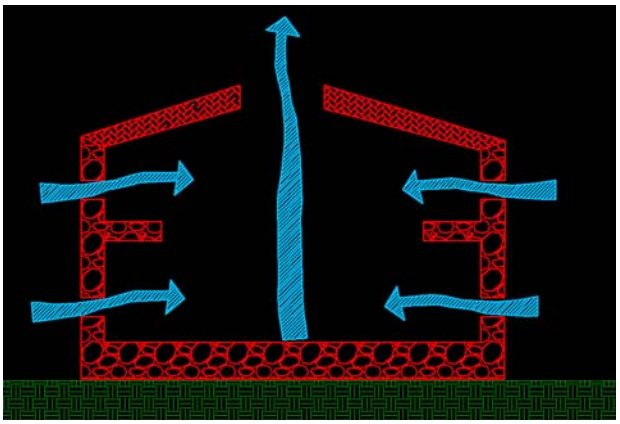
Fig.31 Ventilation through small openings.

(2) Cooling from underground spaces:


Fig.32 Ventilation is cooler by passing through underground spaces.

Since the soil temperature below certain depths is colder than the air temperature and remains more or less constant during the whole year, the air for the ventilation of the buildings can be cooled down by passing through underground air-duct.

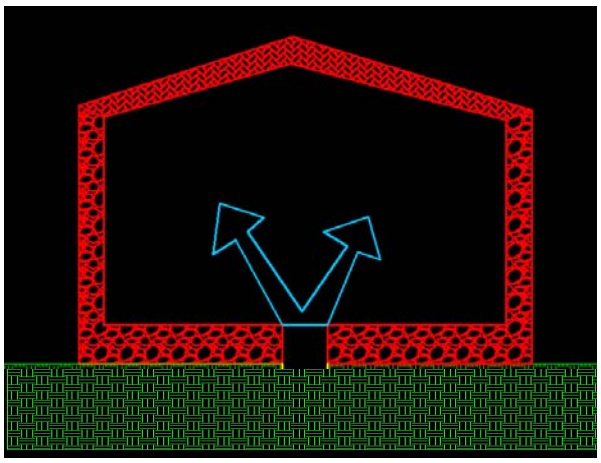
Fig.33 An underground air-duct helps the temperature decrease.

The cooling process constitutes a combination of transport of heat and evaporation, provided that the ground is humid.

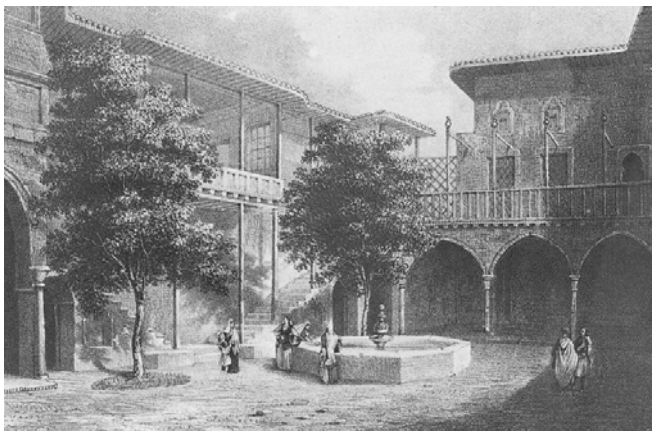
Fig.34 The engraving by Von Stackelberg (1810) depicts a similar courtyard in the historical center of Athens. The central position of the fountain ensures the cooling of the air by the water evaporation.

3) Cooling using evaporation: In order to transform water into steam a certain sum of heat is required (latent quantity of evaporation). When this heat is provided by hot air, air temperature falls and humidity increases. The effect of cooling by evaporation can be better ensured, if ponds are being used, fountains and squirts at the surroundings of the buildings, so that the air used for ventilation cools down before it enters the building.

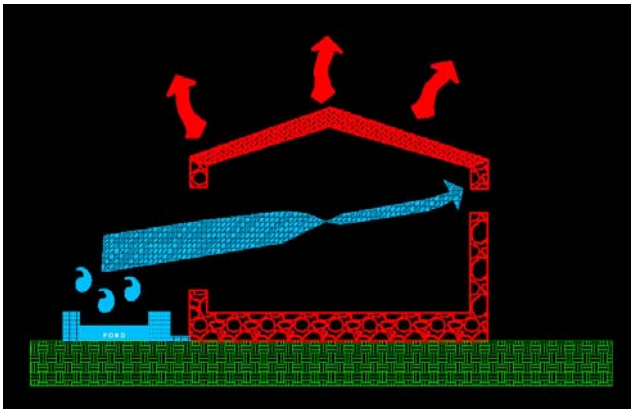
Fig. 35 Cooling using evaporation

Therefore, elements of water, such as ponds, are proposed, which, combined with the existing and new vegetation, will compose a microclimate that will ensure the humidification and, hence, the cooling of air.


Fig. 36 The main entrance to the Courtyard.

5 Conclusions

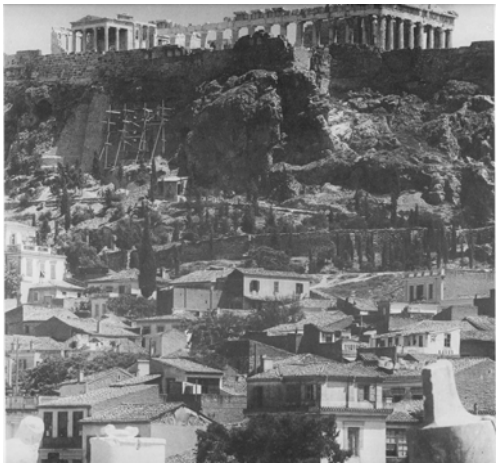
Fig. 37 Residences of the same architectural type in the neighbourhood of the "Courtyard of Miracles".

The houses of the "Courtyard of Miracles" provide an excellent example of 19th and early 20th century climatic design.


Fig. 38 Traditional heat and sunlight insulation methods in the same neighbourhood (Le Roy, 1758).

These environmental principles can also be found in other residences of the same period in the historical center of Athens, as well as in other districts in Greece. However this quarter, as a case study, demonstrates in a unique way the bioclimatic behavior of folk houses in urban area.


Fig.39 Today's east entrance to the Courtyard. The church of Saint Elissaios has been recently restored.

The restoration aims at the preservation of the historic and architectural values respecting the initial design purpose and the authentic features. In the present case, the restoration study takes into account the re-use of the monument and in particular, the need to serve as exhibition rooms of the Greek Folk Art Museum. In order to achieve this objective we must keep in mind the dual status of the ruin-monument and its new utility, which demands its

restoration in a way that results in a safe and functional structure. The study of the preservation and the reuse applies mild techniques in order to obtain an ecological restoration of these buildings, avoiding, at the same time, any alteration of their initial type.

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