



# Evaluation of a sustainable Greek vernacular settlement and its landscape: Architectural typology and building physics

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## ABSTRACT

Sernikaki is a Greek vernacular settlement that can be imagined as a living organism is the outcome of centuries of optimization of material use, construction techniques and climate considerations. Being mountainous and isolated, this small vernacular settlement has preserved old types of dwellings longer than other areas in Phokida, in mainland Greece, and it can, thus, provide rich material for the understanding of architectural continuity and evolution. In this study, various types of adobe dwellings are surveyed and their response to climate, in terms of site and building design, is evaluated. In addition, the techniques of creating microclimatic conditions by incorporating the existing environmental parameters into the design are considered. Bioclimatic design employs appropriate technologies and design principles based on a thoughtful approach to climate and environment. It is concerned with the layout of the buildings (orientation in relation to sun and wind, aspect ratio), the spacing (site planning), the air movement, the openings (size–position, protection), and the building envelope (walls: construction materials–thickness, roof construction detailing). This paper evaluates specific vernacular dwelling types and their response to climate, based on passive design principles that could be adapted to current architectural practice in the area, in order to optimize the relationship between site, building and climate.

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## 1. Introduction

The architecture of vernacular settlements reflects Greek lifestyle and cultural values of the past. These building types and their site planning have evolved through time and they have reached their form and layout through trial and error methods. They were able to respond to the needs of their inhabitants, the climatic conditions, and the topography, because of the simplicity of the building processes, the techniques and the local materials employed (adobe, stone and timber).

In the vernacular architecture of Sernikaki one can easily observe an absence of purely conceptual and aesthetic purposes, and a focus on a holistic approach that considers the role of the environment as a major one, within the limits of the resources available. Within this view, the traditional builders were concerned with a variety of parameters that affected a building as well as with the quality of the building itself. Traditionally designed buildings are often considered as the predecessors of modern bioclimatic design [1]. They display years of embodied experience built on the relationship between building and climate, implying a logical analysis, the consideration of appropriate principles, and a rational

use of resources. These buildings, therefore, can be studied as models of environmentally responsive and sustainable architecture. In our days, the need for energy thrift design has been well understood and for this purpose appropriate regulations have been drafted [2,3]. There is also a greater awareness of the importance of the socio cultural identity of a place. Both issues make the study of vernacular settlements, such as Sernikaki, very important.

The aim of this paper is to evaluate the Greek vernacular settlement of Sernikaki, in terms of its architectural typology and building physics. This paper shows that such a building environment acts as a living organism that is inherently sustainable through the use of various bioclimatic concepts applied in its original construction, is tightly integrated with the landscape and has a minimum waste of resources. The subsequent analysis is comprised of two major parts: 1) a study concerning the evolution of the built environment (typological analysis, site planning, construction materials and techniques); and 2) an evaluation of specific vernacular dwelling types and their response to climate, based on passive design principles that are responsible for the bioclimatic character of the settlement.

## 2. Bioclimatic concepts and building physics

Bioclimatic design, by definition, satisfies the needs of human beings (thermal, luminous and acoustics). It considers climatic

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conditions, uses techniques and materials available in the region and attempts to integrate the building with its surroundings. Moreover, bioclimatic design relies on building physics, which is the ability and knowledge of how to allow sunlight, heat, and airflow through the building envelope when necessary, at certain moments of each day and month of the year [4].

The vernacular architecture of Sernikaki may be defined as bioclimatic since, it can be argued, the traditional builder of Sernikaki understood bioclimatic concepts, aspects of building physics, and the strong relationship between site, climate and building that made him aware of the consequences of design choices. The ways vernacular architecture of Sernikaki considers the effects of climatic conditions on the buildings' envelope suggests knowledge of the building physics at an empirical level. This empirical knowledge pertains to basic concepts of thermal properties and of heat transfer, air movement and solar geometry.

### 3. Sernikaki: a Greek vernacular settlement in Phokida

#### 3.1. Location and history

Sernikaki is a mountainous village located in Phokida, in mainland Greece, 6 km Southeast of Amfissa with approximately 300 inhabitants (Fig. 1). It is located at 22° 23' 60" East longitude, 38° 28' 60" North latitude and at an altitude of 307 m above sea level. It is one of the oldest vernacular settlements established in the area around the ancient olive plantation of Amfissa. It was relatively isolated throughout its historical course, and thus protected from outside influences. The smooth development of the built environment was frequently interrupted by earthquakes, the most recent ones being in 1870 and 1894, which caused enormous destruction along the region. Most of the houses date back to the second half of the 19th century and they have totally replaced older structures or been added to older house-cores.

#### 3.2. Climatic data

Due to its location Sernikaki enjoys a moderate climate with warm summers and moderately cold winters. Getting correct climatic data of Sernikaki is not easy since it is a village without a meteorological station. The climatic data shown in Table 1 uses the nearest station data, about 60 km away. Air temperature reaches a mean maximum of 27.1 °C and a mean minimum of 8.3 °C. The summer months have an average temperature of 26.2 °C, while the winter months have an average temperature of 9 °C. The annual

average temperature is about 17 °C and the relative humidity varies from 55% to 78%. North easterly winds characterize the warm season, thus bringing warmth, while the cold season is characterized by strong North westerly winds [5].

#### 3.3. Mahoney indicators

The climatic data has been incorporated in the Mahoney Tables which provide preliminary design recommendations. They are grouped under eight headings: layout, spacing, air movement, openings, position of openings, protection of openings, walls, and roofs. The following is a summary of the recommendations for Sernikaki: a) Layout: buildings oriented on an east–west axis to reduce sun exposure; b) Spacing: compact planning; c) Air movement: rooms double-banked with temporary means for wind passage; d) Openings: medium-sized openings, 20–40% of wall area; e) Position of openings: openings in north and south walls at body height on windward elevation, as well as including openings in internal walls; f) Protection of openings: protection from direct sunlight; g) Walls: high mass; and h) Roofs: high mass [6].

### 4. Analysis of the built environment

Sernikaki has a strong vernacular character of great interest, both morphologically and structurally, with a unique landscape pattern. This study examines the most important architectural forms found in Sernikaki that played a significant role in the evolution of vernacular architecture in Phokida and which are subject to preservation. The collected data is the outcome of personal field work, i.e., the author measured, sketched, observed, and interviewed inhabitants, local designers as well as public and private experts relating to the energy aspects of the buildings.

#### 4.1. Typological analysis

In the microcosm of Sernikaki, certain types of mainland Greek dwellings were introduced to central Greece by building guilds. These types of dwellings gradually evolved according to the needs of the population. Dwellings were the result of collaboration among many people over many generations including collaboration between builders and owners. In Sernikaki, there is clarity in the general layout of the dwellings both in its architectural synthesis as well as in its structural formation; the building envelope is simple, clear, and easy to grasp. Two main themes are constant, i.e., massive building forms and extensive courtyards. A thorough investigation of the existing dwellings of Sernikaki, resulted in the identification of four major types of buildings and their respective variations. The classification and typological analysis is based on functional characteristics, i.e., use-patterns and variations of the basic form (Table 2).

#### 4.2. Site planning

Sernikaki developed in response to orientation, wind direction, and topography (Fig. 2). It has a clear-cut organization that defines the use of space and determines the distinction between public and private areas. Dwellings are detached with extensive courtyards and sinuous streets of varying shape, width, and position (flat, inclined or stepped with stone stairways) that connect buildings to one another (Fig. 3). The main zones of circulation are found at the lower level whereas several secondary ones of smaller size connect the building in other levels. A number of relationships and size ratios between streets and houses are recorded, all indicative of the human scale of the settlement (Fig. 4).

As for the private gardens, they are pleasant spaces where outdoor activities take place almost throughout the year. Dwellings and gardens have developed in harmony and interdependence.

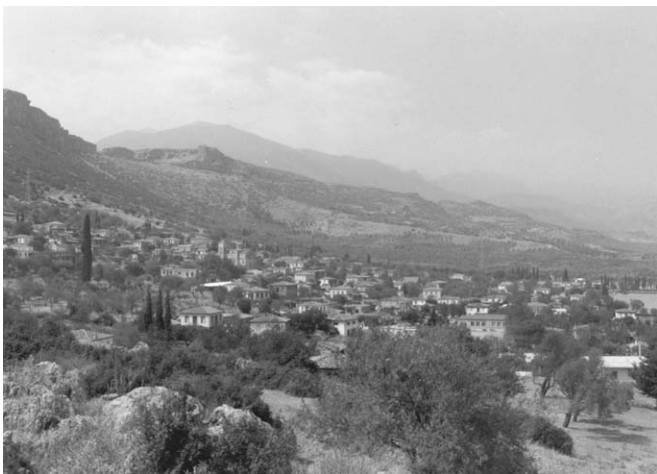


Fig. 1. Overview of the settlement.

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