

Climate-responsive urban morphology and social spaces in selected Cycladic towns

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Abstract

This study examines social spaces in small Cycladic towns as an urban and architectural response to climatic conditions. The study focuses on three case studies: Chora (Folegandros island), Plaka (Milos island) and Chorio (Kimolos island). The study adopts a qualitative comparative approach based on methodological triangulation, combining urban morphological analysis, patterns of spatial use and qualitative assessment of local microclimatic conditions. The aim of the study is to examine how urban morphology and local microclimatic conditions jointly influence the environmental performance and everyday use of social spaces in traditional Cycladic settlements. The findings suggest that differences in urban structure are associated with distinct microclimatic conditions, which in turn correspond to different temporal and spatial patterns of social activity. Semi-public micro-spaces, such as thresholds, steps and narrow passages, play a crucial role in enabling social interaction under high summer thermal stress conditions. The study demonstrates the relevance of traditional Cycladic settlements as references for contemporary climate-responsive architectural and urban design.

Introduction

Contemporary debates on the residential environment increasingly indicate that architecture cannot be analyzed in isolation from climatic conditions. In the context of rising temperatures, prolonged heatwaves and the increasing frequency of extreme weather events, design strategies enabling the adaptation of the built environment to changing environmental conditions are becoming particularly important. In this regard, spatial structures that emerged under natural constraints and developed solutions enabling the maintenance of outdoor spatial comfort despite adverse thermal conditions constitute a significant field of research.

One of the examples of such structures can be found in the small towns of the Cycladic archipelago. Their architecture is often interpreted primarily through an aesthetic lens, as a composition of white cubic forms, narrow streets, and picturesque panoramas. However, this perspective overlooks a fundamental aspect of their functioning, namely the close relationship between spatial form and the Mediterranean climate, characterized by intense solar radiation, strong seasonal winds (*meltemi*), and a limited availability of shaded outdoor spaces. In reality, the urban layouts of these settlements are the result of a long-term adaptation to environmental conditions, in which spatial form functions as a microclimatic regulator.

In the climatic conditions of the southern Aegean Sea, the number of days with air temperatures exceeding 30°C ranges on average from several dozen to over 80 per year, with a high level of solar exposure reaching approximately 10–12 hours per day during the summer season (Santamouris 2013; Oke 1987). Under such conditions, the usability of outdoor space is directly dependent on local microclimatic factors. This means that, in the summer period, thermal comfort in outdoor environments becomes a critical rather than merely qualitative factor.

The significance of these relationships is confirmed by research on the microclimate of urban spaces, which demonstrates that thermal conditions have a direct impact on the use of public spaces, determining both the intensity and character of social activities, including duration of stay, frequency of stops and spatial preferences within the urban environment (Nikolopoulou, Lykoudis 2006; Nikolopoulou et al. 2001). In this perspective, social space is not solely the result of a functional programme, but an outcome of the interaction between architectural form, environmental conditions and user practices. This implies that the quality of social spaces may be understood not only in compositional or functional terms, but also as a result of their capacity to shape microclimatic comfort.

Despite the growing interest in climate-related issues in architecture, most studies focus on large urban structures or simulation-based analyses, while less

attention is given to small settlement systems in which the relationship between spatial form and climate is particularly legible. Although some studies combine morphological analysis with observations of actual spatial use, such integrated approaches remain relatively limited, particularly in small traditional settlements. This study contributes to this discussion by examining small Cycladic settlements as examples of climate-responsive spatial systems.

The aim of the article is to analyze the social spaces of three Cycladic towns, Chora on Folegandros, Plaka on Milos, and Chorio on Kimolos, in relation to their microclimatic conditions. The study focuses on the relationships between urban structure, environmental conditions and patterns of space use by inhabitants. The article adopts an urban and architectural perspective, in which spatial form is treated as an active factor shaping everyday use of social spaces.

The study addresses the following research questions:

1. How does the urban structure of the towns studied here modify local microclimatic conditions?
2. How does the variability of climatic conditions during the day influence patterns and intensity of social space use?
3. Can shaping semi-public micro-spaces be interpreted as originally climatic adaptive strategies that subsequently acquire social functions?
4. What design implications emerge from the analysis of these structures in the context of contemporary residential environment design?

To answer these questions, this paper study examines three case studies representing different spatial configurations and investigates the relationships between urban form, microclimatic characteristics and the observed patterns of spatial use.

Theoretical framework

Social space as an architectural experience

From an architectural perspective, social space is not limited to formally designated public areas such as squares or streets. It is increasingly understood as a continuum that also includes semi-public and transitional spaces, which play a key role in everyday user interactions. As Jan Gehl (2010) notes, the quality of space becomes most evident at the human scale, in opportunities for stopping, observing and engaging in spontaneous social contact. This human-centred perspective corresponds to Christopher Alexander's concept of recurring spatial patterns, according to which everyday social interactions emerge from appropriately configured spatial relationships rather than from formally designated functions (Alexander et al. 1977: 163–167).

Henri Lefebvre (1991), in turn, emphasizes that space is simultaneously a product of social relations and a factor that actively shapes them. This implies that architectural form is not a neutral backdrop for human activity, but actively influences behavioural patterns and the organization of social life.

In the context of small towns of Mediterranean islands, particular importance is attached to transitional micro-spaces such as thresholds, staircases, narrow street sections and fragments of walls. The boundaries between public, semi-public and private space become blurred, and everyday social interactions often take place outside formally defined meeting areas. These spaces are not designed as social spaces in a programmatic sense; rather, they become social through patterns of use. Similar observations have been reported in studies of vernacular settlements in the Eastern Mediterranean, where thresholds, semi-open spaces and transitional zones constitute essential elements of everyday social life (Philokyprou et al. 2017, 2021).

This article assumes that the significance of these micro-spaces results not from their formal function, but from the relationship between spatial form, environmental conditions and user practices. Social space is therefore understood as an outcome of a dynamic interaction between architecture and climate, rather than as a static urban category.

Urban morphology and microclimate

Research on urban morphology suggests that spatial configuration significantly influences patterns of spatial use. According to Bill Hillier (1996), spatial configuration influences patterns of movement and the distribution of social activity by creating different levels of spatial accessibility and integration. In this sense, space operates as a structure that organizes social life. However, subsequent research has demonstrated that spatial configuration interacts with environmental factors rather than determining patterns of use independently. This relationship between spatial configuration and environmental performance has also been discussed in climate-sensitive urban design, where urban morphology is considered one of the principal factors affecting local environmental conditions (Emmanuel 2005).

In the context of the Mediterranean climate, however, this relationship becomes more significant. Spatial form influences not only social flows but also microclimatic conditions, such as air movement, solar exposure, shading conditions and outdoor thermal comfort. Classic studies of urban climatology have long demonstrated that street geometry, building density and urban canyons substantially modify solar access, air movement and heat exchange processes (Oke 1987).

Another important aspect of contemporary climate-responsive design is the role of green and blue infrastructure in modifying urban microclimate. Vegetation, water elements and permeable surfaces may contribute to temperature

regulation, shading and improved environmental conditions. However, traditional Cycladic settlements represent a specific context characterized by limited vegetation and water availability. Therefore, this study focuses primarily on urban structure strategies embedded in the built structure itself, while recognizing green and blue infrastructure as an important direction for future research.

Previous studies have demonstrated that urban morphology can contribute to lower surface temperatures and improved outdoor thermal comfort indices such as Physiological Equivalent Temperature (PET) and Universal Thermal Climate Index (UTCI) (Santamouris 2013). At the same time, research on environmental perception suggests that thermal comfort is not only a physical condition but also a subjective one, dependent on users' capacity for behavioural adaptation (Nikolopoulou, Steemers 2003). More recent studies have further expanded this perspective by demonstrating how urban morphology influences local microclimatic conditions, thermal comfort and patterns of outdoor activity in different climate contexts (Kouklis, Yiannakou 2021). Review studies further confirm that urban form plays a central role in shaping pedestrian thermal environments and mitigating urban heat through spatial configuration, shading and ventilation (Yang et al. 2023; Schmidt 2024; Liu et al. 2024). Empirical studies conducted in dense urban environments demonstrate the influence of street geometry and building morphology on local thermal comfort (Zhang et al. 2022).

These findings suggest that the use and experience of social space are dynamic rather than fixed, varying according to environmental conditions and temporal patterns of activity. Consequently, studies examining social spaces should account for their dynamic character and temporal variability, including diurnal and seasonal changes in environmental conditions and patterns of use.

Building on the theoretical perspectives discussed above, this study adopts an analytical framework in which urban morphology and microclimate are treated as interrelated factors influencing environmental conditions and the everyday use of social spaces. The following sections examine how these relationships are manifested in three selected Cycladic towns. In the specific context of the Cyclades, traditional settlements have long been recognized as examples of climate-responsive vernacular architecture adapted to harsh environmental conditions (Kabre 2016).

Research gap

Existing research has extensively examined the relationships between urban morphology, public space and microclimate in a variety of urban contexts, including large cities as well as selected Mediterranean settlements (Santamouris 2013; Philokyrou et al. 2014, 2017, 2021; Kabre 2016). These studies have significantly advanced understanding of climate-responsive urban form, outdoor thermal comfort and environmental adaptation. However, they generally address these

issues separately or focus on specific aspects of environmental performance.

Recent studies have demonstrated significant relationships between urban morphology and microclimatic performance in Mediterranean and other warm-climate contexts (Kouklis, Yiannakou 2021; Philokyprou et al. 2021; Zhang et al. 2022; Li et al. 2023). However, these studies primarily focus on measurable environmental parameters or simulation-based assessment, while less attention is given to the relationship between environmental conditions and observed everyday practices within small traditional settlements.

Relatively few studies integrate urban structure, local microclimatic characteristics and the observed patterns of everyday spatial use within a single analytical framework, particularly in relation to small traditional island settlements of the Cyclades. Consequently, the interaction between spatial configuration, extreme environmental conditions and everyday social practices remains insufficiently explored in these contexts.

By combining urban and architectural analysis with qualitative observations of spatial use, this study seeks to contribute to a more integrated understanding of how urban form and local typical summer heat conditions jointly influence the functioning of social spaces. Rather than viewing traditional Cycladic settlements solely as historical urban forms, the research examines their potential relevance for contemporary climate-responsive urban design.

Methods

The study adopts a qualitative comparative case-study approach based on methodological triangulation. Field research was conducted in 2025 in three Cycladic towns located on the islands of Folegandros, Milos and Kimolos. The research strategy combined morphological analysis, qualitative interpretation of microclimatic conditions and systematic observation of patterns of spatial use.

Selection of case studies

Three main towns on three selected islands were chosen for analysis: Chora (Folegandros), Plaka (Milos), and Chorio (Kimolos). The selection was purposive and driven by the need to capture morphological diversity while maintaining a shared climatic and cultural context. The analysis did not encompass the entire urban area of each settlement. Instead, it focused on representative fragments of the historic urban structure characterized by the highest concentration of everyday social activity. These included the principal public spaces, main pedestrian routes, connecting streets and adjacent semi-public transitional spaces that constitute the core of everyday community life within each settlement.

The selected cases represent a typical model of compact Cycladic settlement, while differing in topographical conditions (flat versus terraced layouts), degree

of spatial compactness, scale and organization of social spaces. The selected observation areas were comparable in terms of their urban function and represented the characteristic spatial structure of each settlement, allowing consistent comparison of urban features, environmental conditions and patterns of spatial use.

This configuration enables a comparative analysis of how spatial form influences microclimatic conditions and patterns of space use.

Operationalization of concepts

To avoid a purely descriptive approach, a set of analytical categories was introduced to enable systematic comparison of the cases studied here.

Spatial morphology includes street and pedestrian pathway width, building height, spatial proportions (H/W ratio) and the presence of constrictions and spatial sequences.

Microclimatic conditions are analyzed through the degree of solar exposure, the presence and continuity of shaded zones, ventilation potential (wind exposure) and potential heat accumulation resulting from materials and spatial form.

Patterns of spatial use were assessed on the basis of observed duration of stay, intensity of stops and the location of social concentration points.

Behavioural adaptation refers to observable changes in the location and type of outdoor activities in response to varying environmental conditions throughout the day.

These categories enable the analysis of relationships between spatial form, environmental conditions and user behaviour.

Research procedure

Fieldwork was conducted in August 2025, during a period of high temperatures and intense solar radiation, allowing for the observation of spatial use under conditions of peak thermal stress.

The fieldwork was carried out over a 10-day period in total. Within each of the three towns, a set of 4–5 observation points was selected to represent the principal types of social spaces, including main squares, widened street sections, pedestrian routes and semi-public transitional spaces. The observation points were chosen to capture variations in spatial configuration, solar exposure and patterns of everyday use.

Observations were carried out in three time intervals:

- 10:00–12:00 (increasing heat load),
- 14:00–16:00 (maximum solar exposure),
- 18:00–21:00 (temperature decline and increased social activity).

At each observation point, observations were recorded at 30-minute intervals using an observation sheet, documenting the number of users present in the

spaces being analyzed, the dominant type of activity (movement, stationary behaviour, social interaction), duration of stay (where observable), the spatial distribution of users and relationship observed between occupied areas and shaded or sun-exposed zones.

Morphological analysis included the documentation of proportions of the streets (enclosure ratio $[H/W]$), street orientation, continuity of building frontages and the presence of architectural elements affecting shading and ventilation, such as arcades, narrow passages and building setbacks. These characteristics were recorded using photographic documentation and on-site mapping.

The assessment of microclimatic conditions was qualitative in nature and based on direct observation, taking into account the presence and extent of shade, the degree of solar exposure and perceived air movement.

Supplementary material

An additional source of information consisted of informal conversations with residents conducted during fieldwork. These played a supporting role and served to aid the interpretation of the phenomena observed, particularly in relation to everyday spatial practices and climate-related preferences.

These data did not constitute an independent analytical basis but served a contextual and validity function.

Limitations of the study

The study did not include instrumental measurements of microclimatic parameters or direct calculations of thermal comfort indices such as PET or UTCI. This limitation results from the qualitative nature of the research and its field-based methodology.

Consequently, the findings are interpretative in character and do not allow for quantitative comparison of microclimatic differences between the spaces undergoing analysis. However, the use of methodological triangulation, combining behavioural observation, morphological analysis and peak summer thermal conditions supports the reliability and internal consistency of the conclusions.

Results

The comparative results obtained for the three settlements are summarized in table 1. The table presents the principal morphological characteristics, observed microclimatic conditions and patterns of spatial use, providing a framework for the detailed case descriptions discussed in the following sections.

Table 1. Comparative characteristics of the settlements based on the adopted analytical

framework

Analytical category	Indicator	Chora (Folegandros)	Plaka (Milos)	Chorio (Kimolos)
Urban morphology	urban layout	compact, orthogonal-organic	terraced, heterogeneous	compact, irregular
	street width	1.5–2.5 m	2–4 m	1–2 m
	building height	2–3 storeys	1–2 storeys	1–2 storeys
	dominant spatial structure	squares connected by narrow streets	terraces, staircases, intermediate levels	narrow streets, semi-public micro-spaces
	predominant H/W ratio	high	variable	high
Microclimatic conditions	shade availability	high, temporally variable	variable depending on topography	high, relatively stable
	estimated ventilation potential	limited	good (wind exposure)	moderate
	observed variability of environmental conditions	high	high	low
Patterns of spatial use	dominant activity areas	shaded streets (day), squares (night)	staircases and terraces	thresholds, micro-spaces
	temporal variability of use	high (day–evening)	medium	medium/low
	activity concentration	strong concentration in selected spaces	distributed between several micro-spaces	dispersed throughout the settlement

Source: author's own work.

Chora on Folegandros

Chora is the historic capital of Folegandros, situated on a rocky plateau approximately 200 m above sea level in the central part of the island. The settlement represents a well-preserved example of traditional Cycladic urban structure, characterized by compact low-rise development organized around a sequence of interconnected public squares and narrow pedestrian streets.

The urban layout of Chora on Folegandros is compact and sequential in character. It is dominated by narrow streets ranging from 1.5 to 3.0 metres in width, enclosed by buildings of two to three storeys. The spatial structure is organized as a sequence of small squares connected by constrictions, resulting in a clearly rhythmic spatial experience.

Under summer conditions, between 10:00 and 12:00, parts of the street network remain shaded due to the height-to-width (H/W) ratio (figure 1). However, during the 14:00–16:00 interval, open spaces become considerably less occupied during periods of intense solar exposure. At this time, a significant decline in the use of squares was observed (0–3 users), accompanied by sustained activity in shaded streets (8–15 users) (figure 2).



Figure 1. Chora on Folegandros during midday hours (between 10:00 and 12:00): streets remain in shade and social activity concentrates in these areas

Source: author's own work.



Figure 2. Chora on Folegandros during midday hours (between 14:00 and 16:00): continued presence of activity in shaded locations

Source: author's own work.

After 18:00 a clear shift occurs. During the evening period, when thermal conditions became more favourable and ventilation conditions improve, open spaces once again become the primary locations of activity (20–50 people). This represents more than a tenfold increase in usage intensity compared to midday hours (figure 3).



Figure 3. Chora on Folegandros during the evening: a clear increase in the intensity of activity in streets and squares

Source: author's own work.

From the perspective of the patterns of spatial use observed, Chora functions as a sequential spatial system in which transitions between light and shade define both the rhythm of movement and points of rest. Shaded areas act as natural focal points of concentration, regardless of their formal function.

This pattern suggests that social space does not have a fixed location here. Its “centre” shifts throughout the day in response to changing microclimatic conditions. The observations suggest that spatial structure contributes to regulating the temporal distribution of social activity rather than determining a fixed spatial centre.

Plaka on Milos

Plaka is the historic capital of Milos, located on a steep hillside overlooking Milos Bay. Unlike Chora, the settlement is strongly shaped by topography, resulting

in a terraced urban structure composed of staircases, intermediate platforms and panoramic public spaces.

In the case of Plaka on Milos, the key differentiating factor is topography. The spatial layout develops along a slope, generating numerous staircases, terraces and intermediate levels. Compared to Chora, the structure is more spatially complex and offers greater diversity of exposure to sun and wind.

Field observations suggest that locations exposed to the prevailing *meltemi* wind appeared to offer more favourable thermal conditions and attracted higher levels of activity during the hottest part of the day. During peak solar exposure (14:00–16:00), activity concentrates in areas combining shade and airflow, mainly staircases and semi-levels (10–18 people), while sun-exposed terraces remain almost unused (1–5 people).

In the evening, activity shifts towards open spaces, especially viewpoint terraces (25–50 people), where improved microclimatic conditions coincide with landscape-related qualities (figure 4).



Figure 4. Plaka on Milos during the evening: a shift of activity towards squares and open spaces

Source: author's own work.

In contrast to Chora, Plaka does not exhibit abrupt fluctuations in the intensity of use, but rather a redistribution of activity within the available micro-spaces. The topography enables the simultaneous existence of multiple microclimates, which increases the flexibility of user behaviour (figure 5).



Figure 5. Plaka on Milos during the evening

Source: author's own work.

From a perspective of these patterns of spatial use, the space here has a vertical character; the architectural experience is not limited to horizontal movement but also involves changes in elevation, which influence exposure to wind and sunlight.

The observed pattern suggests that morphological diversity increases the potential for solutions increasing the system's resilience to climatic conditions. Observed activity remained distributed between several micro-spaces throughout the day.

Chorio on Kimolos

Chorio is the historic settlement of Kimolos, the smallest island included in this study. It has retained its traditional Cycladic character, with a compact low-rise urban structure organized around an irregular network of narrow pedestrian streets and fragmented public spaces. Streets are often less than 2.0 metres wide, creating a highly enclosed urban environment.

Under the summer conditions observed here, a considerable proportion of the street network remained shaded throughout most of the day owing to its compact urban structure. As a result, the amplitude of observed microclimatic variation appeared lower than in the other two settlements.

Observations revealed only minor differences in user presence between the morning and periods of peak solar exposure (3–10 users in semi-public micro-spaces). Activity is primarily concentrated at the interface between private

and semi-public space, including door thresholds, staircases and fragments of walls (figures 6, 7).



Figure 6. Chorio on Kimolos during the morning: concentration of activity at the interface between private and public space

Source: author's own work.



Figure 7. Chorio on Kimolos during midday hours: concentration of activity in artificially shaded locations

Source: author's own work.

In the evening, activity increases but does not concentrate. A greater dispersion across the entire spatial structure is also observed (15–30 people) (figure 8). There is no clearly defined social centre, and everyday life unfolds simultaneously across multiple small points.



Figure 8. Chorio on Kimolos in the evening

Source: author's own work.

From the perspective of these patterns of spatial use, the space is experienced as sheltered and intimate. The constant presence of shade reduces contrast in usage of space at different times of the day, which results in a more continuous user experience.

The observed pattern suggests that in Chorio the microclimate is part of the everyday functioning of space, it does not restrict the patterns of spatial use. Adaptation is continuous rather than appearing in a specific times of the day, as observed in Chora.

Comparative analysis

The comparison presented in table 1 reveals three distinct patterns of climate-related spatial adaptation. Although all settlements share the characteristics of compact Cycladic urban structures, differences in topography, spatial configuration and shade availability are associated with different patterns of outdoor activity.

1. Sequentially variable model (Chora on Folegandros)

Diurnal variability in microclimatic conditions leads to the migration of social activity. Space operates temporarily, depending on the weather conditions.

2. Topographically variable model (Plaka on Milos)

Differences in elevation and exposure generate parallel microclimates, which stabilize the pattern of spatial use and increase its adaptability.

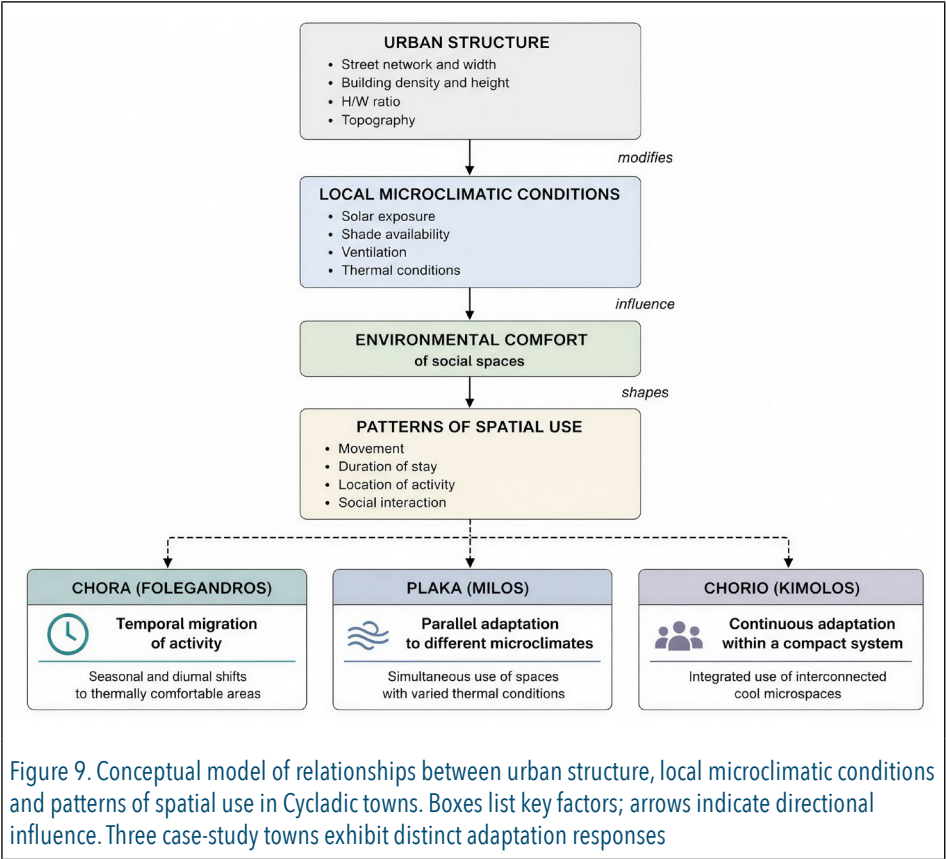
3. Stable model (Chorio on Kimolos)

Compact structure of the village ensures relatively constant usage conditions, supporting continuous and dispersed social activity.

The comparison suggests that the location and intensity of social activity are closely associated with the availability of shade and ventilation. This indicates that microclimate functions as an important organizing factor of social life, while the formal function of space plays a secondary role.

Importantly, these findings challenge the rather widespread but simplified assumption that the “liveliness” of space is primarily determined by its programme. The observations suggest that, in the settlements analyzed here, favourable environmental conditions appear to play an equally important role as functional programme in shaping the temporal distribution of outdoor activities.

The comparative analysis demonstrates that urban structure, local microclimatic conditions and patterns of social space use are closely interrelated. Although the relationships differ between these towns, all three cases suggest that environmental conditions influence where and when social activities occur. To facilitate the interpretation of these findings, figure 9 presents a conceptual model synthesizing the relationships identified in this study.



Source: author's own work.

The model proposed here illustrates how urban structure influences local microclimatic conditions, which in turn affect environmental comfort and patterns of spatial use. The three towns represent different adaptive responses to this common mechanism, depending on their spatial configuration.

Discussion

The results of this research indicate that the relationship between urban structure and social life, as described in classical urban theories, requires a substantial extension to include the climatic dimension. The analysis of cases from the Cycladic archipelago shows that social space cannot be understood solely as a product of spatial configuration or functional programme, but rather as a dynamic outcome of the interaction between architectural form, environmental conditions and users' behavioural adaptation (Gehl 2010; Hillier 1996; Lefebvre 1991; Nikolopoulou, Steemers 2003; Kouklis, Yiannakou 2021).

Spatial configuration and climatic conditions

In the framework developed by Hillier (1996), spatial configuration generates specific movement patterns and potential for social interaction. However, the fieldwork results indicate that in hot climate conditions this relationship is conditional rather than deterministic. This finding is consistent with research demonstrating that urban form influences outdoor air temperature, ventilation and thermal comfort, while the resulting environmental conditions affect the way urban spaces are used (Kouklis, Yiannakou 2021).

In the cases analyzed here, particularly in Chora on Folegandros, spaces with high integrative potential, such as central squares, remain temporarily unused during peak solar exposure. This indicates that spatial configuration alone is not sufficient to generate social activity. A necessary condition for its activation is the achievement of a minimum level of microclimatic comfort.

Conversely, in Plaka on Milos, greater topographical differentiation leads to the emergence of parallel microclimatic zones, enabling partial independence of social activity from the diurnal cycle. In this case, spatial configuration does not merely determine movement, but increases system adaptability by diversifying environmental conditions.

The findings suggest that morphological analysis models require extension by a climatic component. Spatial integration should therefore be understood not only in terms of accessibility and connectivity, but also as the capacity of space to maintain usability under variable environmental conditions.

Reinterpretation of the human scale

Jan Gehl's (2010) concept of the human scale is based on the assumption that spatial quality results from its adaptation to human perception and behaviour. In light of the present study, however, it requires extension to include a physiological dimension.

In Mediterranean climatic conditions, spatial scale is not exclusively a visual or functional category. Street proportions, building height and the presence of intermediate elements such as partial shade or spatial constrictions directly affect the possibility of occupying space. This implies that the concept of human scale may be extended by including a thermal dimension, defined by the relationship between the user's body and environmental conditions.

The case of Chorio on Kimolos illustrates this relationship particularly clearly. The constant presence of shade and limited solar exposure result in a stabilization of social activity throughout the day. Despite its small scale and lack of formal squares, the space functions as an environment supporting continuous user presence.

In this sense, the implementation of "human-centred" design principles in hot climates is dependent on ensuring appropriate microclimatic conditions. Without them, even formally well-designed spaces remain inactive.

Microclimate as a determinant of social behaviour

Research on outdoor comfort conducted by Nikolopoulou and others (Nikolopoulou et al. 2001; Nikolopoulou, Lykoudis 2006; Nikolopoulou, Steemers 2003) highlights the importance of behavioural adaptation to changing environmental conditions. The results of the Cycladic analysis confirm this thesis while also indicating that architecture can actively support or constrain this adaptation.

In Chora, a clear migration of social activity over time is observed, corresponding to the shifting of shaded zones. In Plaka, users select spaces according to their exposure to sun and wind, utilizing topographical variation as an environmental resource. In Chorio, by contrast, the spatial structure enables stable and dispersed use without the need for significant behavioural changes during the day.

This implies that architecture is not merely a backdrop for social processes but an active instrument in their modulation. Micro-spaces such as thresholds, staircases or street constrictions function as regulators of environmental conditions and thus become primary units organizing social life.

Architecture as a climatic adaptation system

The findings suggest that traditional Cycladic settlements may be interpreted not only in terms of their visual and architectural qualities, but also in relation to their environmental responsiveness and their influence on everyday patterns of social space use. The structures analyzed in this paper can be understood as an integrated system of climatic adaptation in which spatial form performs a regulatory function in relation to environmental conditions. This interpretation is consistent with research on traditional Cycladic dwellings, which identifies the close relationship between building form, site, climate and thermal comfort as a defining characteristic of traditional design strategies (Kabre 2016).

Unlike contemporary design models, where environmental comfort is often achieved through technical systems, the settlements studied here use spatial geometry as the primary tool for shaping microclimate. These findings suggest that local environmental conditions should be considered an important factor influencing the relationship between urban structure and patterns of social behaviour.

In the context of contemporary climate change, these findings are particularly significant. The cases demonstrate that microclimatic design can function not only as an environmental optimization tool, but also as a fundamental mechanism for shaping social relations and activating public space.

Transferability of findings to other climatic contexts

The results of this study raise the question of their applicability beyond the Cycladic context. The structures analyzed here developed under specific Mediterranean climatic conditions characterized by high solar radiation, low humidity

and seasonal strong winds. Therefore, not all spatial strategies observed can be directly transferred to other climatic zones.

At the same time, some of the identified mechanisms are universal in nature. The broader literature on climate-responsive urban form indicates that the relationship between spatial morphology, microclimatic conditions and thermal comfort can be identified across different climatic and urban contexts, although the specific performance of individual spatial configurations remains context-dependent (Kouklis, Yiannakou 2021). This suggests that the relationship between urban structure and microclimatic conditions may be considered a transferable design principle, provided that its application is adapted to local environmental conditions and patterns of user behaviour.

In temperate climates, such as those of Central Europe, the key challenge is not only overheating in summer but also ensuring solar access during colder periods. This means that strategies based solely on maximizing shade cannot be applied directly. Instead, it is necessary to design structures that allow seasonal variability of use conditions, for example through differentiated spatial exposure or the introduction of intermediate elements with variable functions.

Of particular importance is the concept of a distributed system of micro-spaces offering diverse environmental conditions within a single urban structure. This approach increases spatial flexibility and allows users to select locations depending on current climatic conditions, regardless of geographical context.

It can therefore be concluded that while specific formal solutions are strongly rooted in local climate, the underlying design logic based on the integration of urban structure and microclimate is transferable and may form the basis of contemporary design strategies.

Model of climate–space–pattern of spatial use

The analysis of cases allows for the formulation of a synthetic model describing relationships between architectural form, environmental conditions and social activity. This model is relational in nature and is based on feedback between three core components, namely, urban structure, microclimate and patterns of spatial use.

Spatial structure shapes local microclimatic conditions by regulating solar exposure and airflow, which subsequently influence perceived thermal comfort and patterns of spatial use. These environmental perceptions influence user behaviour, including duration of stay, route selection, and location of social activity. This relationship between microclimatic conditions, thermal perception and patterns of use is consistent with previous research demonstrating that environmental conditions influence both the behaviour and spatial choices of users in outdoor urban spaces (Nikolopoulou et al. 2001; Nikolopoulou, Lykoudis 2006).

The model conceptualizes social space as a dynamic system in which urban structure, microclimatic conditions and user behaviour continuously interact and vary according to changing environmental conditions.

Limitations of the study and interpretative context

Despite the use of methodological triangulation, the study has several important limitations that should be taken into account when interpreting the results. First, the analysis was conducted during the summer period under maximum climatic stress conditions. This means that the usage patterns that were observed may not reflect behaviour in other seasons.

An additional factor influencing the results is the presence of tourism, which constitutes a significant component of spatial dynamics in the locations analyzed in this paper. User behaviour may therefore be partially shaped by visitor patterns, making it difficult to clearly distinguish local practices from seasonal ones.

It should also be noted that no instrumental measurements of microclimatic parameters, such as perceived temperature or wind speed, were conducted. Consequently, the analysis is based on qualitative observation and reference to literature data, which limits the possibility of precise quantification.

These limitations do not undermine the main relationships identified in the study, but rather indicate the need for further research combining behavioural observation with environmental measurements and accounting for seasonal variability and socio-cultural context.

Conclusions

The analysis of three towns in the Cycladic archipelago suggests that microclimatic conditions appear to be one of the key factors associated with both the intensity and spatial distribution of social activity. A consistent relationship was observed between the presence of shade, ventilation and reduced solar exposure, and the location as well as the nature of space use.

In contrast to dominant design models, in which climate is treated as a secondary or technical factor, Cycladic spatial structures show that it can function as a primary organizing parameter of spatial systems. This implies a necessary shift in emphasis from designing form and function towards designing environmental conditions that enable them in the first place.

Based on this research, the following design-oriented conclusions can be formulated.

First, microclimate conditions should be treated as an important design parameter equivalent to function and form. It is not merely a backdrop for spatial use, but a prerequisite for its actual functioning. Spaces with high social potential remain inactive if they do not provide a minimum level of thermal comfort.

Second, spatial proportions, particularly the relationship between building height and street width (H/W), have a direct impact on shade availability and thus on the usability of space at different times of day. This parameter should be consciously shaped as a tool for regulating microclimatic conditions, rather than treated solely as a compositional device.

Third, morphological diversity resulting from topography, orientation and spatial layout increases the resilience of the built environment to extreme climatic conditions. The case of Plaka demonstrates that the coexistence of multiple microclimates within a small area enables the continuation of social activity even during periods of high temperature.

Fourth, semi-public micro-spaces such as thresholds, staircases and street constrictions play a crucial role in the structure of social life. Their significance does not stem from functional programming but from their location within environmentally favourable zones. In this sense, they constitute basic units of climatic adaptation.

Fifth, variability in climatic conditions over the diurnal cycle should be treated as an active design parameter. In Chora on Folegandros, the migration of activity that was observed shows that social space can be dynamic in nature, with its “centre” shifting over time. Design approaches should account for this variability rather than aiming to produce homogeneous and static configurations.

Finally, the findings indicate the need to move away from the model of large, homogeneous public spaces towards distributed systems based on networks of interconnected micro-spaces with varied environmental conditions. Such structures demonstrate greater flexibility and adaptive capacity in response to changing climatic conditions.

In summary, this article demonstrates that integrating morphological, climatic and social analysis enables a new interpretation of traditional urban structures. In the context of contemporary climate change, this approach may constitute an important design tool, enabling the creation of environments that are not only environmentally efficient but, above all, genuinely used and socially active.

Summary

The analysis of three Cycladic towns demonstrates that microclimate appears to be one of the key factors influencing the distribution and intensity of social activity. Spatial form regulates access to shade and ventilation, contributing to the usability of space. Traditional architecture functions as an adaptive system, while semi-public micro-spaces act as primary units organizing social life. The findings highlight the need to integrate climate-responsive strategies into contemporary design.

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Informed Consent Statement

Informed consent was not required for the observational component of the study, as no identifiable personal data were collected. Informal conversations with residents were used only as contextual information and were not recorded, transcribed, or analysed as individual research data.

Data Availability Statement

The materials underlying the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Generative AI Use

Generative AI tools were used during the preparation of this manuscript for language editing and proofreading. The author remains fully responsible for the content, accuracy, and integrity of the manuscript.

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The author declares that there is no conflict of interest related to this article.