

Assessment of Sustainable Design Elements of Walled City, Nicosia Based on Architectural Context

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Abstract—The contemporary construction context in the urban areas of the Walled City of Nicosia contains an architectural style with a long history. For the island's urban historic centers to revive, this history must be protected and conserved. Research on vernacular architectural sustainability is required because it is one of the essential characteristics, especially in a community that supports sustainability. Resources are used more wisely, and environmental protection and development are working together more effectively. In order to maintain the values associated with sustainability, the traits in the quickly changing context of contemporary cities must be critically identified, protected and preserved. The purpose of this study is to examine the sustainable design aspects found in the buildings of Nicosia's Walled City in Cyprus, based on architectural context. Systematic review of literatures was conducted with the addition of some survey and personal observations which was analyzed using systematic literature review analysis approach.

Keywords: Sustainability, design elements, walled city, Nicosia, architecture, Cyprus.

I. INTRODUCTION

Vernacular architecture is commonly recognized in terms of semi-open and open space arrangement, settlement pattern, building proportion layout, as well as materials and construction techniques, adapts well to the climate, topography, and resources available in the area. As a result, vernacular architecture is a profound climate-responsive and architecture that is environmentally friendly [1]. However, most conventional environmental design concepts have been disregarded in recent years, and modern architecture does not have an advantage from vernacular architecture that is locusspecific and ecologically motivated, resulting in structures with a large environmental trace. The ability to customize passive-cooling design approaches to a specific locale. In order to improve human thermal comfort and acclimatize indoor-air conditions, commercial and residential structures can be purpose-built and changed. A variety of cutting-edge vernacular passive-cooling solutions are offered that deal with the sustainability of an assigned concept in reference to its location and weather features. The low cost of passive-cooling design strategies contrasts dramatically with the high cost of active-cooling design techniques, technological, and unique environmental solutions that are commonly used throughout the board, diverse areas, independent of the cultural, physical and socioeconomic settings of each [2]. Although vernacular residences spotlight many sustainable layout ideas, they typically require to be modified further to fulfill contemporary

sustainability needs and construction norms, according to "The Case of Rural and Urban Traditional Settlements in Cyprus" Even though improving the long-term viability of vernacular houses is not incompatible with preserving its authenticity, in terms of priority, there is some conflict of interest determined during these procedures. As a result, a ratio must be struck between retrofitting for energy and the environment, as well as the preservation of vernacular houses' definite and indefinite features. The aim of this review is to assess the sustainable design elements existing in the buildings of the Walled City of Nicosia, Cyprus based on architectural context. This will be carried out through review of many literature reviews that explains the sustainable design features and their suggestions will be used to deduce conclusion of this research.

II. METHODOLOGY

The preliminary qualitative analysis, diagnosis, and evaluation of the traditional dwellings and sustainable urban tissue of Nicosia are used in the research project. The main objective is to validate every element of the so-called "sustainable environmental approach in local vernacular architecture" through rigorous and scientific research. An in-depth investigation of numerous ethnic, social and historic variables that played a role in a series of events, such as the city's placement in a specific location site and relationship to the built environment's evolution was first undertaken through historic documents. The rethinking of the evolution of cities and investigation of interconnected Components of structural and morphological nature yields important knowledge about the origins of features such as urban tissue and shape, building kinds, and architectural qualities that may encompass an environmental essence. The study of survey maps from various times is another key instrument of considerable importance. "Types at the area and city level", "types at the urban tissue level," and "types at the building level" are some of the terms used to describe the relative information gleaned from the maps. The data implies to geo morphological features, macroclimatic conditions and landscape features, metropolis structure and shape at the "region and city level". The "urban tissue level" investigates street direction, shade and sunlight sources, ventilation and cooling variables, as well as urban vegetation and the quality of open and semi-open places. At the "building



Figure 1: Map of the Walled City of Nicosia [25]

types level," we look at typology in terms of space organization (ventilation, enclosures, etc.), construction equipment and procedures, cooling and heating systems, and the utilization of local resources like water. A field study is critical at this stage of the investigation. It contains current information on the fusion of civic components as well as historical stratification. Furthermore, direct engagement with people, who are the actual consumers of vernacular housing and the city form, improves assessment of the satisfaction provided by particular buildings and the specific urban tissue. Because of the large distinction between objective and subjective comfort, residents' observances, views, and familiarities are an important instrument in both understanding the houses' sustainable element function and evaluating its contribution to the attainment of comfort. The findings are organized by city level (location, geomorphology, topographic restrictions), urban tissue level (urban development), neighborhood level (urban development), and building level (applied sustainable techniques) (cooling, heating, lighting and ventilation of the environment strategies). Similar procedure was adopted by [3], [4] both of them uses similar method to analyze the sustainable features of Nicosia, which is surrounded by walls. The method was adopted with the addition of some survey and personal observations which will be analyzed using quantitative analysis approach method.

A. Climate

Climate was discussed here because of its importance and relationship with the building styles of a region. Climate dictates how a regional building should be, for example; in Nicosia the buildings were having thick walls, tiny roads and yellow bricks, these are related with the climatic condition of Nicosia been it a too cold region during winter, and too hot when summers. Therefore, studying the climate of Nicosia is very important in this study. Cyprus is a typical East Mediterranean island, with a

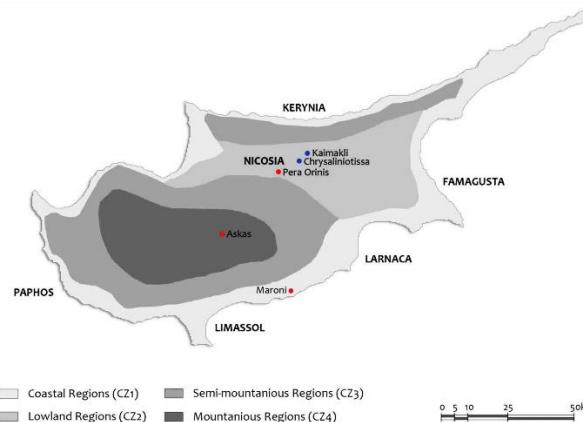


Figure 2: Rural (marked red) and Urban (marked blue) On a map of Cyprus, the settlements under consideration are located in distinct geomorphological and climatic zones [5].

climate with hot and arid summers, it's classified as a subtropical fusion of semi-arid and Mediterranean climates (hot temperatures, intense sun radiation), and extremely cold winters (rainy, hazy skies) (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006). According to the System of classification by Köppen-Geiger is separated into four distinct climate zones: coastal, lowland, semi-mountainous, and mountainous zones. The considerable variance between day and night is a key aspect of the Cypriot weather [5]. In the winter, the predominant storms are east and southwest, and at summer, west and north. In three distinct places/regions, five communities both in urban and rural locations in Cyprus were researched in depth, each with its own geomorphological and climatic characteristics (Figure 2). In the lowlands, there are three communities (two urban, Chrysaliniotissa and Kaimakli, and a third rural, Pera Orinis).one rural settlement, Maroni, is located on the coast, and one rural settlement, Askas, is located in the mountains. It's worth mentioning that the island's vernacular architecture is quite distinctive. follows the principal architectural concepts and forms in the eastern Mediterranean region, making it for in-depth investigation, a typical and representative case study that could oversee to the development of widespread enforced environmentally peaceful preservation proposals.

III. LITERATURE REVIEW

A. Overview

This review of literature revised the articles that talks about the sustainability and sustainable building elements found in the buildings of Nicosia's walled city. These articles were picked based on their relationship with the topic of this research and were analyzed later based on the result and lessons gotten from each of them.

B. Urban Identity

Cities are locations that have been changing from the beginning of time. The city's social structure, as well as the traditions and the economy of the era, play a significant part in this progression. Cities, regardless of their qualities, shape the relationships between humans in practically every period. Cities are made up of more than only edifices that suit the housing needs of people; they also have a lot of shared requirements as

a result of collective living. Cities have a lot of built-up areas or spaces as a result of development, managerial investments or cultural structure that suit these requirements, whose qualitative and quantitative values change throughout time and location. The structured and unstructured areas that make up a city's texture are referred to as "urban space" in this context [6], [7]. These urban areas encompass all locations where human functions such as sheltering, working, entertaining, resting, and transit are carried out [8]. According to Bolkaner, İnançoglu, & Asilsoy, (2019) [10], a city is the collection of interconnected systems that exist within the fields of various assets and are in use. Individuals' lifestyles, social structures, private, semi-private or public places, the city's nature, as well as all other aspects of the city are examples of these systems. All of these characteristics are markers of the city's identity. Urban identity, in this sense, is an expression of all cultural and physical components from history to the future. One of the key aim for building a nice environment, is metropolitan character [11]. Citizens should believe that they own a piece of the environment, both personally and collectively and that they are responsible for it. The environment at the city level should inspire citizens to participate and relate to each self. Those who define what it means to be a part of a city frequently assert cities have their own inherent dynamics, much like humans. According to urban designer scholars around the year 1998, considers Urban Identity as a significant ongoing development that is influenced by the city's cultural, socioeconomic, historical, and formal factors in the creation of the city's image. This urban image also achieves the concept of sustainability and includes the Individuals' experiences of living in the city as a continuous journey from the past to the future. Metropolitan furnishings, being one of the physical elements that make up the urban environment, can be claimed to be at this time factors of urban identity. The physical position of urban furniture is responsible for the creation of this circumstance as a significant aspect of urban identity. As a result, urban furniture devices are placed in public areas where all municipal contacts take place, in the city residents presence [12]. As a result, urban furniture plays a crucial role in the construction of a comprehensive city identity.

C. Urban furniture

Where the user is unclear, fixed service equipment and structures for open space functions are available, they are commonly referred to as urban furniture. Furniture for the city, as well as the consequences of a specific procedure, the city idea comprises of elements meant to suit the rising and expanding needs of consumers [13]. The arrangements of items that are visually placed in a harmonious manner in urban design, develop photos that are extremely memorable and eye-catching. Bolkaner, (2018) [14] argue that urban furniture, as a distinctive aspect of the city image, plays an active part in urban design as a whole, whether in terms of practical or aesthetic dynamics. In the meantime, a city's symbol could be well-designed urban furniture that reflects or completes the metropolis [15]. Urban furniture is defined as streets, squares, highways, avenues, and other public spaces have urban landscape components that support and promote basic activities, as well as facilitate social life by providing lighting, communication, shelter, protection, sieges, transportation, consultation, and as a symbol of well-being and environmental stewardship [12]. The features of

countries and cities influence the diversity of urban furniture (Fig. 3). These components play a crucial part in fostering urban disposition and communal life. These urban equipment, as stated by Bayrakçı, (1989), are items that enable residents' social and personal lives, which provide communication among people inside the urban fabric and contain various qualities that provide spaces for working and aesthetical meanings. As a result, they are vital not only for their utilitarian reasons, but also for their revitalizing influence on the urban landscape.

D. Vernacular architecture in Nicosia

It is commonly assumed that vernacular architecture reflects the local climate. Following an assessment of the city of Nicosia's historic and socioeconomic growth, the essential paperwork for identifying those environmental design aspects is obtained. The early building types in Nicosia (Fig. 4) when equal to the usual pastoral dwellings of the plains communities.



A



B



C

Fig. 3: Showing different kinds of urban furniture in the walled city of Nicosia in (A, B & C)

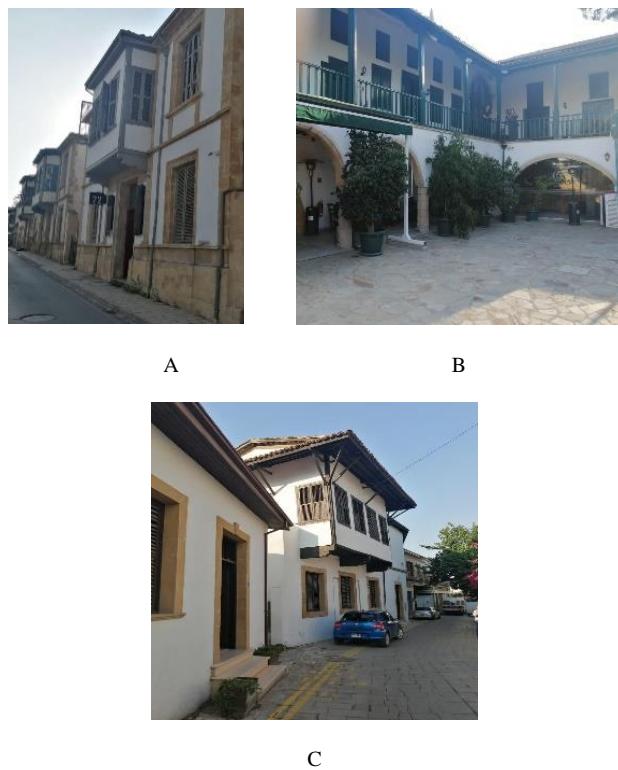


Fig. 4 (A, B, & C): In Nicosia, representative building forms with various environmental characteristics are shown in A-B.

The dwellings covered a broad area and were designed to blend in with the surrounding environment, and the early building types in Nicosia (Fig. 4) resembled the typical rural homes of the plains communities positioned in such a way that the courtyard's longest façade, or main section, has the best orientation. Personal apartments (Closed and partially open areas) were arranged around a vast ragged lot [17]. As long as the degree of urbanization and space availability did not impose any restrictions, the primary model for building orientation was climatic; thus, features such as sun shading and a substantial role was provided by cross ventilation.

The available space was limited until the city was fortified (Lusignan and Venetian Times), at which point a method of land fragmentation began. The 1920s and 1930s saw the fresh growth of the urban tissue emphasized the importance of construction in close proximity to the roadway, eventually undermining the value of environmental requirements [4]. Aside from the building's location in the plot, there have been minor typological alterations. "The transformation of the conventional courtyard home a "serial type dwelling," which was significantly smaller in size and had a similarly small yard, was aided by serial allotments along key streets [17]. Nonetheless, as portion of a cultural manifestation of the way of Mediterranean life, the semi-open coated areas, generally positioned south of the structure and referred to as "iliakos" locally remained extant [4]. Throughout the British occupation (late 19th century), the city expanded near the periphery of the historic district, The "Green Line" was established in 1963, and in 1974, the "Buffer Zone" was established, resulting in the partition of the city. as well as the historic core's deterioration and partial abandonment. As a

result, certain neighborhoods have maintained their original character without considerable changes to architectural elements, building scale, or urban tissue, resulting in a rich constructed legacy that may be studied and researched.

E. Sustainability and vernacular building

Over time, vernacular homes have been repurposed, tailored to local conditions, and passed down as cultural relics that provide an immediate link to the past. They have a sustainable identity because the basic methods to meet human requirements, make use of traditional materials and resources from the area, and incorporate environmental design principles. With the goal of incorporating considerations of sustainability into methodological approaches to the conservation of traditional homes. The data reported here are the result of two diverse research programs that spanned several years. Although many sustainable design aspects can be found in vernacular homes, the qualitative and quantitative analysis found that they often require to be further modified to fulfill modern sustainability needs and norms of construction [3]. Even though improving the long-term viability of vernacular houses is not incompatible with preserving its authenticity. In terms of the priorities established during these procedures, there is some conflict of interest. As a result, a harmony must be struck between Retrofitting for energy and the environment, as well as the concrete and intangible benefits characteristics of traditional homes. As a significant part of their heritage, vernacular architecture combines a number of substantial and intangible characteristics i.e. Environmental, aesthetic, social, historical) as well as other factors (authenticity sustainability) that must be considered social, historical, aesthetic, during the process of conservation. Local needs have been met by adapting vernacular homes, and so persisted as cultural and civilizational confirmations, establishing an immediate link to the past. A remodeled structure tells the story of both the people's culture and who built it and the generation that changed it had a different culture. Over time, conservation methods have improved in order to be modified to recent discoveries and socio-economic criteria in mandate to fulfill the ever-increasing needs of today's way of life.

IV. RESULTS AND DISCUSSION

The study in respect to the environment, vernacular architecture and its long-term viability began early in the 1980s [18]. This is connected to movements toward a better-constructed habitat that is more in harmony with nature in edict to assure a more Architecture's environmentally friendly futures, as well as the oil crisis that took place both at once. Simultaneously, an evaluation of traditional architecture can provide an inexhaustible basis for producing valuable outcomes for the built setting that are environmentally friendly that react to the societies requirements. Recent studies have emphasized the sustainable elements built into the conceptualization and design of vernacular building. (urban fabric, architectural layout, a central courtyard exists: [19]. Passive environmental design ideas are applied in Mediterranean vernacular architecture, in particular, have fully been examined recently [20]. The significance of utilizing optimum orientation to shield residents from sun radiation when designing, tinting procedures, opening sizes, external surfaces in light colors, appropriate Studies by Canas & Martín., (2004) [21] have emphasized the

importance of vegetation and a compact building shape and for Greece and Spain, respectively. All emphasized the importance of thermal mass in sustaining a constant interior room temperature in vernacular dwellings (Greece). Furthermore, Collet, Serres, Mirel, & Bart., (2006) [22] demonstrated the Clay materials' significant traditional brickwork has thermal inertia as well as a temporal delay in thermal wave propagation. Numerous studies mention particularly, ventilation. During the cooling season, nocturnal ventilation is necessary, as a critical bioclimatic cooling approach that contributes to a calming thermally speaking place by regulating air flow in indoor spaces [23]. In order to assess vernacular dwellings' thermal performance, researchers have used a variety of approaches. When it comes to investigating Values of vernacular architecture in terms of environmental design, such as bioclimatic design concepts and the evaluation of numerous architectural aspects, socio-cultural issues, as well as regional variety, qualitative analysis is frequently used. The creation of bioclimatic charts required by a vast number of studies that differ based on outdoor environmental characteristics such as temperature and relative humidity of dried bulbs, as well as bioclimatic studies psychometric charts. Simultaneously, Field assessments of environmental characteristics are part of a series of quantitative studies looking into how vernacular homes perform thermally in a quantitative manner [24]. When updating historic vernacular buildings and solving day lighting challenges, some researchers take a multi-criteria approach to decision-making (MCDM) to arrive at a statistically based, objective solution.

In terms of the environment, traditional settlements are by definition sustainable, and resources that surround them. The vernacular architecture behavior in relation to the environment is interesting and investigated in this study, as well as the identification among the many factors that go into creating a good environment and traditional structures and their surroundings provide thermal comfort. This examination is part of a larger continuing study covers temperature, humidity, and ventilation on the field. Measurements using weather stations and data loggers, making it the first study of its kind on Cyprus' traditional architecture. The findings indicate characteristics of Cyprus' traditional architecture that are bioclimatic in design. Passive heating (thermal mass, thermal inertia and solar gains), as well as stimulating (sun-shading, ventilation), and strategies for improving microclimatic conditions in the environment (planting, evaporation). The investigation indicates a rather constant internal temperature regardless of outside temperature fluctuations due to the considerable thermal mass of the structure. The data also shows that the indoor temperature peaks later in the day than the outside environment. This is because the building's envelope has thermal inertia, which slows the transport of heat from the outside to the interior. The importance of the inside courtyard, which acts as a microclimate regulator and maintains a warmer temperature than the surrounding habitat during the winter was highlighted in this study. The necessary skills for ecologically friendly built environment methods can be developed by considering the long-term viability of society as a whole will gain from vernacular architecture.

V. CONCLUSIONS

Special attention was given to cooling techniques in Cyprus's urban traditional architecture as opposed to heating ones. Strategies for cross-ventilation, stack effect (openings), and shading have probably all increased due to the region's intense heat (pergolas, shutters, iliakoi etc.). Thus, ancient homes in Nicosia have good thermal behavior throughout the summer that is rather close to thermal comfort without the help of any external cooling support. About half of the households in the research use the majority of the cooling techniques that have been developed. The combination of shade and night cooling reduces and keeps the interior temperature at levels that are just below thermal comfort. On the other hand, because of the relatively limited heating strategies employed, such as little south-facing surface exposure and few, small windows in the south façades, the residence was unable to completely benefit from the warmth of the sun throughout the winter. This study further emphasizes the courtyards' great significance by pointing out the various environmental benefits they offer, which are beneficial all year round (the vicinity's direct solar gains, cross-ventilation, vegetation, and water features). In the structures under examination, the "L"-shaped configuration of the rooms surrounding the yard, which is the preferred plan, exposes more façades to the yard and leads to the construction of more appropriate apertures. In the traditional homes of Nicosia, a walled city, the analysis above outlined the most common bioclimatic methods employed to create a comfortable interior environment. Due to the country's hot climate and the need to lessen the adverse high summer temperatures inside of these traditional homes, courtyards, semi-open spaces, and cooling solutions in general are given more consideration. The main focus of monitoring of the temperature and humidity levels in particular buildings will be the subject of future research. The thermal and physical characteristics of local building materials used in the construction of traditional structures (such as stone, mud brick, wood, etc.) will also be evaluated in order to determine how much the bioclimatic design components contribute to the thermal comfort of a building's interior.

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