

Evaluation of a Sustainable Ayvalik Housing Architecture and its Ecologic Approach: Architectural Typology and Building Physics

Bedriye Asimgıl

Balıkesir University Engineering and Architecture Faculty,
Department of Architecture, Çağış- Balıkesir/Turkey

Abstract: To understand climate is a pre-requisite for energy efficient to optimize natural energies creating comfortable living conditions without use of sophisticated mechanical devices. Most buildings in the past were constructed consistent with climate. However, a rigorous climate analysis is necessary. This analysis must contain precise information regarding climate. Detailed research about climate may give directions in building design as its building shapes, location, orientation and the use of appropriate building materials. For this study, long term averages of temperature, humidity, rainfall, sky condition data are retrieved from the website of the Bureau of Meteorology, Balıkesir, Turkey. To this end, in this study, climate data sheets, Mahoney tables and Building Bioclimatic chart to formulate strategies have been used for building design. This paper defines climatic characteristics that are an integral part of building orientation of Ayvalık settlement, in Balıkesir, Turkey.

Key words: Sustainable architecture • Ayvalık • Building typology • Vernacular architecture

INTRODUCTION

The architecture of civil settlements reflects Turks lifestyle and cultural values of the past. Assessing building types and their site planning of civil architecture, 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 (stone and timber).

A remarkable feature of vernacular architecture is the use of local building materials to construct housing that makes such good use of passive energy that almost no extra energy is required to maintain the housing. In other words, vernacular architecture provides the local inhabitants with a comfortable living environment, while at the same time, having minimum impact on the natural environment [1]. The term “vernacular architecture” is used to refer to traditional buildings that have been designed and built to match the local climate and culture. Much research has been carried out on vernacular architecture, but mostly from humanities or social science perspectives and very little from an environmental engineering angle. Both issues make the study of

vernacular settlements, such as Ayvalık, very important.

In the vernacular architecture of Ayvalık, a holistic approach that considers the role of the environment as a major one, within the limits of the resources available can be easily observed. The building lacks aesthetic concept. Within this view, a variety of parameters concerned with the traditional builders 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 [2]. They display 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 will be studied as models of environmentally responsive and sustainable architecture. The greater awareness of the importance of the sustainable architecture is now underway in countries throughout the world. One aspect of this trend is the keen interest being shown in the high environmental performance of vernacular architecture.

The aim of this paper is to evaluate the Turkey vernacular settlement of Ayvalık, in terms of its architectural typology and building physics. This vernacular settlement of Ayvalık 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:

- A study concerning the evolution of the built environment (typological analysis, site planning, construction materials and techniques); and,
- 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.

Bioclimatic Design Concept and Building Physics: To build a bioclimatic house, the first and very important concern must be regional climate conditions and then local climate conditions of actual location influenced by the above factors. Sustainable design conserves resources and maximizes comfort through design adaptations to site-specific and regional climate conditions. Bioclimatic design, by definition, satisfies the needs of human beings (thermal, luminous and acoustics). It considers climatic 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 [3].

The vernacular architecture of Ayvalık can be argued as bioclimatic concepts, aspects of Building Orientation and Form, Building Envelope and Materials and the strong relationship between site, climate and building that made him aware of the consequences of bioclimatic design choices. A building has to guarantee a thermally comfortable indoor environment for the activities that are conducted inside. To optimize thermal comfort it is necessary to reduce the loss of thermal energy through the building envelope. The effects of climatic conditions on the buildings' envelope suggest knowledge of the building physics at an empirical level. For this reason, this empirical knowledge pertains to basic concepts of thermal properties and of heat transfer, air movement and solar geometry.



Fig. 1: Overview of the settlement

Ayvalık: A Turkey Vernacular Settlement in Balıkesir

Location and History: Ayvalık was established in Balıkesir Province of Turkey's Aegean coast and opposite the island of Lesvos. Ayvalık is a coastal settlement located on the northern Aegean part of Anatolia with 22 small islands surrounding its shore and secure port.

The smooth development of the built environment was frequently interrupted by earthquakes, the most recent ones being in 1865, 1901, 1911 and 1944 [4]. It is one of the oldest vernacular settlements established in the area around the ancient agriculture plantation of Mısyra. It was relatively isolated throughout its historical course and thus protected 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.

There are some villages, such as Gömeç at northeast and Pergamum and Dikili at south (province of Izmir). Ayvalık is a collection of islands. Kaşık, Poyraz, Kamış, Büyük Kuruada and Güvercinada are some of them. The headlands and bays along the coast have occurred. The town has 34 km long of coasts at the Aegean. At Ayvalık, the mountains extend perpendicular to the sea coast so coasts are indented jagged Sea.

Climatic Data: An energy conscious building aims to optimise the use of passive solar energy, natural ventilation and natural light to create a comfortable and energy efficient working environment.

Table 1: Climatic Data for Balıkesir [6]

Season	Winter			Spring			Summer			Autumn		
Month	Decber	Janary	Febary	March	April	May	June	July	August	September	Octber	November
Mean temperature (°C)	6.5	4.5	6.0	8.0	12.5	17.0	21.5	24.5	24.5	20.5	15.5	10.0
Max. temperature (°C)	11.0	9.0	11.0	14.0	19.0	24.0	29.0	32.0	32.0	28.0	22.0	16.0
Min. temperature (°C)	2.0	0.0	1.0	2.0	6.0	10.0	14.0	17.0	17.0	13.0	9.0	4.0
Amount of rainfall (%)	15.3	16.6	13.1	12.3	11.4	4	4	2	1	6.1	8.2	7.1
Relative humidity (%)	76.0	76.0	73.0	68	60	58	50	51	56	56	66	72
Days of Rainfall	12.3	9.9	9.5	8.8	7.4	4.5	2.5	1.4	1.0	1.7	5.8	8.8

It is important to consider the local climate during the first stage of building design. An energy conscious design which results in an energy efficient building has to be based on the local climate. Wind is the motion of air relative to the surface of earth and is one of the most highly variable climatic elements, both in speed and direction.

To facilitate the ventilation for cooling, wind is necessary at almost all times in summer, morning to evening in autumn and noon to evening during spring months. For the purpose of this study, montly wind speed record from Bureau of Meteorology, Balıkesir has been used in preparing wind roses for corresponding building direction. Due to its location Ayvalık enjoys a moderate climate with warm summers and moderately cold winters. The accurate climate data has been taken from the Directorate of Balıkesir Meteorology. The climatic data shown in Table 1 uses the nearest station data, about 58 km away.

In buildings, the shape and the orientation of the building should be first defined considering the climate of the area, the wind, the temperature, amount of rainfall and relative humidity. Air temperature reaches a mean maximum of 32.0°C and a mean minimum of 4.5°C. The summer months have an average temperature of 24.0°C, while the winter months have an average temperature of 6°C [5]. The annual average temperature is about 15°C and the relative humidity varies from 50% to 76%. North easterly winds characterize the warm season, thus bringing warmth, while the cold season is characterized by strong North westerly winds.

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 and protection of openings, walls and roofs.

The Following Is a Summary of the Recommendations for Ayvalık:

Layout: Buildings oriented on an east-west axis to reduce sun exposure; b) Spacing: compact planning; c) Air movement: rooms single and 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; h) Roofs: high mass[7].

Analysis of the Built Environment: Ayvalık’s vernacular architecture is ancient and elegant structure morphologically and structurally with a unique landscape pattern. The buildings are built according to the principles of traditional Turkish house. The understanding of village life about vernacular architecture is dominated. It is believed that the house is continuation of social life, because agriculture and animal husbandry are people’s source of subsistence

This study examines the most important architectural forms that found in Ayvalık settlement that played a significant role in the evolution of vernacular architecture.

The collected data which is measured, sketched and observed by authors, is the outcome relating to the energy aspects of the buildings.

Typological Analysis: In Ayvalık, certain types of Greek dwellings were introduced. These types of dwellings gradually evolved according to the needs of the population. Effects of the community structure were seen in architectural space.

It is easy to grasp of Ayvalık’s architectural synthesis and lifestyle of societies. There are clarity and legibility as its structural formation and the building surroundings. Energy losses depend on the temperature

difference between the inside and outside face of the wall, mainly. Building materials of Anatolian houses varies by region. The tradition of building stone that is called “Garlic Stone” is especially common in the vicinity of the Ayvalık Region.

The building walls of the traditional building at Ayvalık were been designed with stone and timber materials considering the high insulating properties of these materials.

The Garlic stone, which has a distinctive and original color, creates the characteristic of Ayvalık home, essentially. The positive features of Garlic stone in terms of visual impact has provided to be preferring of this stone outside of Anatolia.

When evaluated Ayvalık houses in terms of the plan typology, Ayvalik Houses, incorporate the relationship between planning and life style. Traditional houses rising from the shore toward the hill are small and adjacent structures. The entrance facades of one or two-storey houses are in the direction of street. Rear courtyard have layout. Economy based on olives, olive oil production and the sale, has contributed to sustainability of city as an industrial and port city, greatly. One and a half or two-storey houses, that their ground floor or basement, shop is planned for use in terms of storage space, appeared as a result of the settlement of this vital characters units. The ground floor of houses is allocated space for sale and storage of production as fully commercial aimed.

Ayvalık Greek House Plan Types Divided into Two Groups:

- Side/edge-courtyard /hall plan type
- Central-courtyard/hall plan type

According to this grouping, all the houses in the district have the courtyard/hall plan type. The classification and typological analysis is based to functional characteristics, i.e. use-patterns and variations of the basic form (Table 2).

Site Planning: Ayvalik town developed in response to orientation and topography (Fig.3). Ayvalık house is a product that is the result of transparent organization that which architectural space will be used and what for aimed. Houses are built in the adjacent layout, the streets are narrow and some streets are dead-end street (Fig.4). Houses are configured onto the streets descending vertically towards the sea in the streets. The ratios between the streets and houses, the ratio dimensions are in the human scale.



Fig. 2: Ali Devlen House in Ayvalik, with Sub-floor shops and the upper floor housing (In varying shape).



Fig. 3: Plan of the settlement



Fig. 4: Dwellings detached with sinuous streets (Varying Shape, Width and Position), And narrow streets of Ayvalik

In the ground floors of traditional Ayvalık house, (Fig.5) the original store / shops are located as well as courtyard houses. The courtyards does not represent the absolute use because of their adjacent layout approach. There is plurality housing without courtyard. There is no sample housing which can be reached from the street to courtyard or from the courtyard to housing. In other words; the street frontage in all of the traditional Ayvalık housing is located. The most common location is status which can be reached from the street to courtyard or from the street to courtyard as well as. This placement is seen in the corner parcels, largely. Housing in the corner parcel courtyard planned, there is housing facade and courtyard facade that they are road frontage [8].

Table 2:

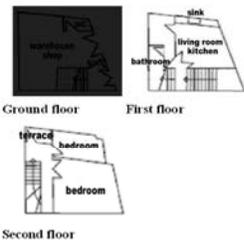
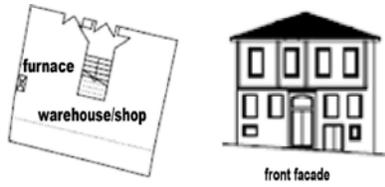
Types of Architectural typology dwellings	
Plan scheme	Description
<p>SIDE/EDGE-COURTYARD /HALL PLAN TYPE</p>  <p>Ground floor</p> <p>First floor</p> <p>Second floor</p>	<p>All activities take place in first and second room.</p> <p>The ground floor is used as warehouse shop.</p> <p>Warehouse / shop entrance and residential entrance doors have different form and characteristic.</p> <p>Living and sleeping spaces are on the front facade of building.</p>
<p>CENTRAL-COURTYARD/HALL PLAN TYPE</p>  <p>Ground floor</p> <p>First floor</p> <p>Second floor</p>	<p>The ground floor is used as warehouse shop.</p> <p>The first floor and second floor are used as residence.</p> <p>It is divided into three rooms separated by a corridor. Bedrooms are private spaces.</p> <p>House plan is in the square or rectangular form.</p> <p>Corners and window frames of the building were emphasized with white stone.</p> <p>Ceiling, floor and doors were wooden.</p> <p>Interior wooden staircase leads to the first and second floor.</p>
<p>TYPOLOGY OF GOUND FLOOR</p>	
<p>Plan scheme</p> <p>When examined in terms of the original plan typologies of traditional houses, should be evaluated according to their planning diversity that first and second floors associated interrelated and the ground floor of building is independent from the upper floors (Fig.2).</p> <p>In the original usage of houses, there is no place to live on the ground floor. The main reason for this, the ground floor was separated into commercial functions.</p> <p>The connection between ground floor and first floor stairs is provided by the door of stair leading to the first floor.</p>	<p>Description</p> <p>In traditional Ayvalık houses, first and second floors have plan schemes in certain types while the ground floor planning varies widely. The ground floors are planned as in independent from the upper floors. While in the ground floor there is an outward-looking usage, there is inward -usage in architectural space of the upper floors of housing.</p> <p>On the ground floors, three significant typology is seen, such as;</p> <ul style="list-style-type: none"> •The ground floors without shop •Single-paned warehouse / shop •Multi-paned warehouse / shop. <p>The ground floors without shop (Production priority)</p> <p>The warehouse / shop doors determine the status of priorities of production and sales functions.</p> <p>The production for commercial purposes is a priority element in housing without the warehouse / shop door. In these houses, production sales was as wholesale because of indirect connection between entrance gate and street.</p>
 <p>courtyard</p> <p>WC</p> <p>kitchen</p> <p>warehouse</p> <p>terrace</p> <p>front facade</p>	<p>Single-paned warehouse / shop (Production priority)</p> <p>In some houses, when door/warehouse door used as an input door, ground floor consists of a single space.</p>
 <p>warehouse</p> <p>shop</p> <p>front facade</p>	

Table 2: Continue

Single-paned warehouse / shop (Sales priority)



Multi-paned warehouse / shop (Sales priority)(Fig.3)

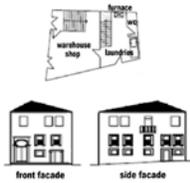


Fig. 5: Typical Ayvalik dwelling

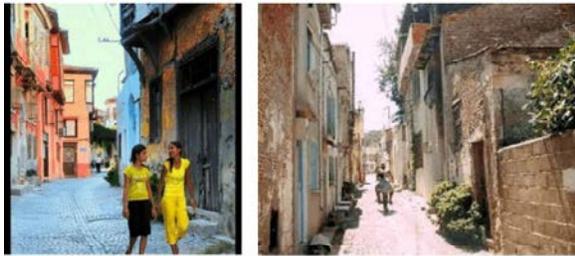


Fig. 6, 7: Human scale of the settlement



Fig. 8, 9: Sema Karagülle dwelling (Dwelling on the top floor, and shop on the ground floor entrance)

The bottom floor of Ayvalik housing is devoted to olive oil and soap commerce; the upper floors are used as a residence (Fig. 8, 9). The street relationship of the lower floor is a direct relation used as commercial streets, whereas, the housing portion is designed as more introverted (Fig. 10). Terraces is located on the upper floors of the houses. In a very large extent, terraces located on the upper floors provide access to each of them because of their adjacent planning. Architectural space quality of terraces in housing often does not enable

to user for comfort. The layout of narrow streets and adjacent layout of housing with overhang that can be open overhang / closed overhang are another feature of housing that allowing you to switch between housing.

According to another rumor; passing each other in the corridors of the ground floors of the houses is also possible to escape through. In some home, that interior

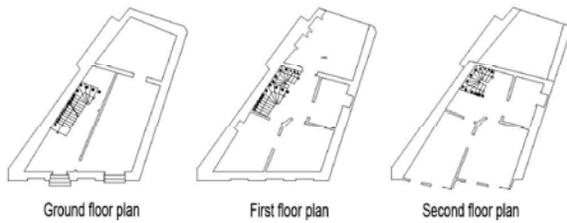


Fig. 10: Entrances directly from the street

space can be seen, it is seen that there is secret exit from the upstairs bedroom to the roof. It is thought that smuggling and Greek population in living here, the adjacent houses was constructed defense aimed [8].

Its relationship with the sea determines the all layout of architectural spaces in urban architecture. There is a settlement rising gradually from the coast towards the hill. The street orientation is in the direction of sloping topography from the flat topography. This feature protects the streets from effects of wind and keeps it warm in the winter. Thanks to positive climatic, sea breezes are transmitted to street ranges in the summer days. With the parallel and perpendicular street layout, historic city sustains a regular grid plan.

Construction Materials and Techniques: The building materials used are: wood and crushed stone. Sarımsak stones used in construction are the local material. Generally, the most common building method in Ayvalık is a single manner of construction, with lower floor is stone and upper floors are wood building construction (Fig. 10). All of single-family houses and some of the two-storey housing are constructed with stone material. Cut stone and plaster over stone masonry are the most commonly used techniques.

In wooden constructions, filling material between the wooden slats is made called "Bağdadi application". Generally, cut stone masonry is used in front facade of buildings. This mesh has been continued if another side wall exists extending to another street. The rear facades of housing were constructed with masonry stone and with plastered wall mesh [9].

The main building material used for constructing the load-bearing walls of the dwellings was stone, since topography is the most plentiful resource in the region. Sarımsak stone was obtained from in Badavut region.

The stone walls have a thickness of 0.60-0.75m and an average height of 3.25m. Construction material of buildings is the ashlar masonry material.



Fig. 11: Ayvalık's construction manner

Upper floor of building walls were built with horizontally set timber ties of various dimensions (6cm×8cm or 10cm×12cm), spaced at 0.70-0.90cm. These timber ties go around the buildings, ensuring that the structures are solid and resistant to earthquakes. The creation of these horizontal ties at regular intervals permitted the continuation of construction at higher levels. Buildings were protected against to sudden subsidence and cracking of the walls with constructional methods. The first set of timber ties was usually placed above a stone base in order to be protected from humidity and water.

Overhangs and balconies are located above the ground floor. Overhangs and balconies are supported by wooden consoles from the bottom.

The structure called “timber frame” were built up from the wooden floor and were very light in construction. The empty spaces in between were filled with bits of wood, cane, seaweed or shavings. The walls had a top layer of plaster, which covered all the empty spaces and made them look like ordinary walls despite their being extremely light.

A ceiling of the houses in the region has the original ceiling decoration art that were applied by Greek period. In the region, the most original ceiling decoration exists in the buildings

The roofs were most often four pitched: oak, juniper, pine and cypress; common timber types used for the roof structure. The roofs were most often covered with tiles. There are cupboards on the walls of the rooms. The empty space between the ceiling and the cupboards provided natural ventilation.

Evaluation

Architectural Typology and Building Physics: Vernacular dwellings of Ayvalık are evaluated in terms of building physics criteria that pertain to solar geometry, thermal mass, heat transfer, air movement and solar geometry.

The design strategies are formulated considering the comfort analysis and preliminary recommendations from Mahoney tables [7]. Following are the specific design recommendations for Ayvalık:

Street layout, securing neighborhood sunshine, building orientation, building structure, roof design, windows and ventilation, shading devices, courtyard option.

Moreover, the evaluation is based on the design variables proposed by Mahoney as the ones that promote the creation of buildings responsive to the climate. These are: a) the layout of the buildings (orientation in relation

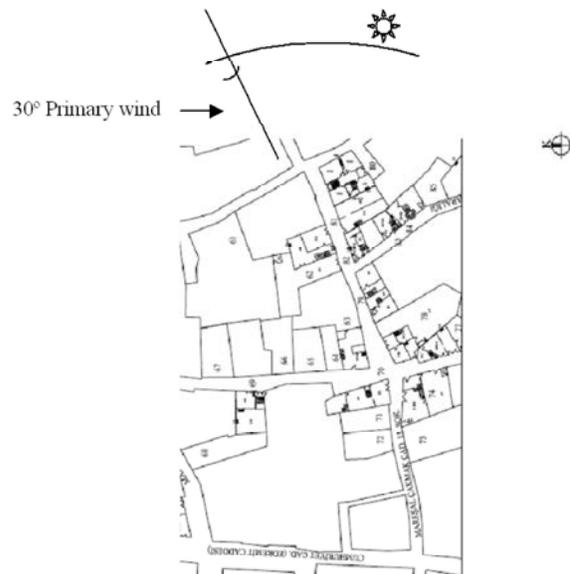


Fig. 12: Street layout considering sun and wind movement

to sun and wind, aspect ratio); b) spacing (site planning); c) air movement; d) openings (size-position, protection); and e) building envelope (walls: construction materials-thickness, roof construction detailing) [10].

Street Layout: Orientation and layout of streets have significant effects on accessing sun and wind in buildings. To maximize cross ventilation and air movement in streets, dwellings in Ayvalık were been oriented towards 30 degree east-west axis. Major street orientation within the angle of approximately 20-30 degree on either direction of the prevailing breezes is highly recommended (Fig 12). Stone houses positioned facing the sea has directed to sea view. This direction allows taking sea wind blowing in north-west direction. The top floor overhang of house allows to take sea view, as well as.

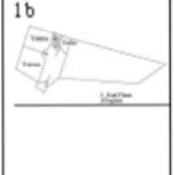
The term “aspect ratio” is used to denote the ratio of the longer dimension of a rectangular plan to the shorter. The N/W and S/E walls are longer than the N/E and S/W and the “aspect ratio” varies from 1.0 to 2.0.

Securing Neighborhood Sunshine: Buildings in Ayvalık require solar radiation in winter months. An ideal organization of streets, open spaces and building for solar utilization at maximum density is to elongate buildings in the east-west direction and spacing in the north-south direction. This placement allows buildings facing north to collect sun and they are far enough apart not to shade each other. However, because of the topography or

Table III: a Evaluation of the Ayvaliks' architectural typology

Types of residence	Orientation	Spacing Site planning	Air movement Plan layout	Openings		Building envelope	
				Size-Position	Protection	Walls	Roofs
		Detached Extensive "so fa" 	Single Blanked	N: -% S: -% E:23% W:33%	External wooden window at the West facade	High thermal mass with Stone walls	Rooms of medium thermal mass
		Detached Extensive "so fa" 	Single Blanked	N: 30% NW:10% W:20% S: -%	Closed - overhang at the Northwest External wooden shutters	high thermal mass with Stone walls+ Timber walls	Rooms of medium thermal mass
1c 		Detached Extensive "so fa" 	Single Blanked	N:22% S: 33% E:34% W: 34%	Closed - overhang at the East facade	High thermal mass with Stone walls +Timber frame	Rooms of medium thermal mass

Table III: b Evaluation of the Ayvaliks' architectural typology

Types of residence	Orientation	Spacing Site planning	Air movement Plan layout	Openings		Building envelope	
				Size-Position	Protection	Walls	Roofs
1a 		Detached Extensive "so fa" 	Double blanked axial corridor	N:10% S: 23% E:10% W:13%	External wooden window at the Southwest and West facade	Stone walls of high thermal mass	Rooms of medium thermal mass
1b 		Detached Extensive "so fa" 	Single Blanked	SW:30% NE: -25% W:31% S:26%	Courtyard at the east facade and rectangular window layout	Stone +timber walls of high thermal mass	Rooms of medium thermal mass
1c 		Detached Extensive "so fa" 	Single Blanked	N:17% S: 32% E:29% W: 25%	External wood shutter at the east facade to maintain building to sun light	High thermal mass with plaster and Adobe Stone walls	Rooms of medium thermal mass

pre-existing conditions, many streets do not have an east-west orientation so the Figure 13 shows several variations in buildings and open space layout, along with their implication for solar access as structural densities.

Building windows, in addition to the functional layout, is in relation with climate. In Ayvalık, having hot climate and sea breezes, both numbers of windows is more as numerically and window openings are great. To breathe of interior space and to provide the necessary wind flow, longitudinal large rectangular window openings are very important. Building windows are architectural items, transformed seated area as theatrical areas, especially in facade architecture, without a balcony and front yard of house.

Ayvalık: A Sustainable Turkish Vernacular Settlement: Many traditional building only aims at achieving climatic and vital comfort for usage without the need of any mechanical systems.

They were also concerned about their energy, combination of building materials, orientation of building, sunlight and shade efficiency and ventilation adequacy to maintain thermal comfort. Many 19th and early 20th century buildings in rural areas have been constructed to provide satisfactory energy performance as their function and construction. This combination was been achieved with their design and performance integration.

Traditional masonry and stone buildings have high thermal mass. In summer months; the high thermal mass building slows the transfer of outdoor heat to the inner cooler surfaces of the building, allowing a comfortable internal temperature. This is particularly beneficial approach especially in locations where the nights are significantly cooler. The fact that Ayvalık traditional settlement shows that it has maintained its qualities for more than a hundred years and suggests that the techniques of its construction and the building materials well thought. These choices are professional choices aiming at sustainability.

Therefore, the vernacular architecture of Ayvalık can be defined as sustainable architecture. The criteria that lead to the creation of sustainable vernacular settlements are: 1) design recommendations, which minimize the adverse environmental effects in building; 2) use of materials with low maintenance and energy efficiency; 3) selection of building materials that provide thermal comfort; 4) use of natural resources; 5) reduction of energy consumption by maximizing passive thermal comfort; 8) improvement of environmental quality; and 9) provision for comfortable living spaces [11].

Present-day Condition Ayvalık: Today, Ayvalık is relatively an untouched settlement. However, with additions to the traditional dwellings or new constructions added to the vernacular core are being built considering the Ayvalık climate less. The specific regulations and legislations for restoring and preserving to such an important traditional settlement have not been precisely set. The specific guidelines, codes, regulations and legislations that will be created for particular Ayvalık settlement will be contribute to energy conservation of buildings. Government regulations are mainly concerned with the heavily on mechanical systems to provide thermal comfort instead of installation of new sustainability measures such as energy efficient heating, hot water systems, water tanks or other systems. This tendency constitutes a threat to change the entire character of the settlement.

Whereas, the current architectural practices mentioned above constitutes a guide that provide recommendations on the orientation of buildings, the size and position of the openings and the characteristics of walls and roofs.

Such an approach was learned from traditional architecture, may serve as a model for sustainable design, in response to climate, energy use and notions of environmental quality [12].

CONCLUSIONS

Ayvalık is a traditional Turkish settlement with advantage of climate and application of design elements. The building technology providing energy preservation ensures comfortable dwelling conditions.

Ayvalık dwellings are good example as climatic building design for hot dry climatic condition. The settlement consists from appropriate building examples as to thermal insulation and heat capacity of the building envelope. These buildings are positive examples providing shading of the buildings against to solar radiation. The small size window and door openings provide ventilation as building holes for winter season.

Many early period buildings are sensitive to impacts of wind and sun.

The buildings have been constructed as will be destroy of negative effect of sun and wind. This approach is a positive approach to improving for the building microclimate.

To understand traditional building behavior, this paper is concerned with the fundamental practice of sustainability. The traditional dwelling types and their

responsibility to climate based on design principles are evaluated that could be adapted to current architectural practice. The relationship among settlement, building and climate is evaluated in order to optimize sustainability concept in the past.

The secrets about durable, compatible, elegant, reliable and eco-efficient buildings are revealed in the Ayvalık settlement particularly. It can be presumed that these traditional characteristics considering the climatic benefits are been generated by society who had lived in there.

Most of the people living in Ayvalık have recently moved into new buildings having heavily on mechanical systems to provide thermal comfort. According to them, the new buildings are not as comfortable as the traditional ones.

Therefore, it can form design recommendations that could be incorporated into current architectural practices in the area. The Ayvalık dwelling suggests an economical use of local resources sensitive to climatic conditions using low-energy design principles that provide human comfort. One of them is "Garlic stone" that is provided from Badavut village, as regularly.

Design principles are consistent with the form, orientation and materiality of the buildings. Design and material combination with engineering and architecture reveals an aesthetic quality. Their combination of engineering and architecture reveals an aesthetic quality.

This study allows to our learning about sustainable building tradition with examples. Mostly houses are in desolate positions. The local inhabitants are very friendly and humanist. To protect their homes or to provide the hygiene of the houses, they do not having adequate protection culture.

For continuity of Ayvalık settlements, its traditional architecture typology is important.

There is a need to new formation processes in these settlements. For this, firstly, there is a need understanding the formation process of the existing traditional ecological and sustainable settlement.

Secondly, it must be determined that this traditional structure how will continue and the router frame how will be created.

The thresholds determining architectural spatial analysis and sustainable development for Ayvalık settlement should be addressed. In this context, the

physical thresholds and its natural boundaries (topography, other) determining continuation of Ayvalık settlements should be considered.

"Eco-centric planning" approach extremely important that adopted and continued in Ayvalık settlement in the past where is hosting the natural resources.

This approach is a holistic approach ecologically based that deciphers the relationship among natural resources, human life functions and its user. This approach envisages ecological spatial structure taking into climatic data account, sensitive to the natural environment.

In Ayvalık settlement, the basic unit of traditional structure constitutes of buildings and open or semi-open areas surrounding it. Buildings and open spaces are confidential and proprietary spaces created with taking into consideration the climatic data. Courtyards incorporate many functions as life, garden, open spaces.

Open fields serve to vital activities in the area of social and cultural life also. Open spaces, as a venue for a gathering of the family, serve different formations and environments as wedding, engagement, requiring being together. These areas also may be without walls, as high courtyard walls that require privacy, are separated by a low wall or fence. The size of indoor and outdoor areas in parcel, their distribution, positions, orientations and functions depending on the sun angle, plays a role in determining the nature of the ecological structure of traditional tissue.

Most of the times, the relationship between structure and road evolving according to topography, has a decisive role in the formation of traditional tissue.

Ayvalık settlement is in form of sparse, open, less dense structure in the islands which are large gaps in the settlement tissue affected by the type of tissue in the climate.

This tissue type allows maximum benefit to buildings to take beneficial effects of sun and wind.

The boundaries between building and road convert to the building parcel to permeable or introverted character. For example, the high courtyard wall prevents to appearing activities from outside. In contrast, low-level courtyard or fence with does not form an enclosure between the interior parcel and road. Ayvalık traditional settlement, with natural construction, local materials and local production system has a structure that implements appropriate building orientation, sparse structure, occupancy-space balance.

REFERENCES

1. Shuzo Murakami and Toshiharu Ikaga, Evaluating Environmental Performance of Vernacular Architecture Through Casbee, Institute of Building Environment and Energy Conservation, 2008.
2. Coch, H., 1996. "Bioclimatism in vernacular architecture", Renewable and Sustainable Energy Reviews, 2(1-2): 67-87.
3. Szokolay, S., 2004. Introduction to architectural science: the basis of sustainable design, Elsevier Ltd.
4. Internet:(<http://www.ayvalikda.com/ayvaliktarihi.html>).
5. Anonim, 2006. Balıkesir İline Ait Uzun Yıllardaki Meteorolojik Veriler.
6. www.dmi.gov.tr
7. Upadhyay, A.K., 2007. "Understanding climate for energy efficient or sustainable design", XXXV IAHS Francis Group. World Congress on Housing Science, September 4-7, 13. Melbourne, Australia, pp: 7.
8. Bilge YILDIRIM, B.G., 2004. Batı Anadolu' daki kültürel çeşitliliğin geleneksel konut mimarisindeki değişime yansıması: 19. ve 20. Yüzyıllarda Ayvalık", İzmir, Yüksek Lisans Tezi.
9. Akyürek, B., 1978. "Kırkağaç, Soma,Savastepe, Ayvalık, Bergama Civarının Jeolojisi, MTA Raporu", Ankara, s. 23.
10. Heerwagen, D., 2004. "Passive and active environmental controls: informing the schematic designing of buildings", McGraw-Hill.
11. Godfaurd, J., D. Clements-Croome and G. Jeronimidis, 2005. "Sustainable building solutions: a review of lessons from the natural world", Building and Environment, 40(3): 319-328.
12. Asquith, L. and M. Vellinga, 2006. "Vernaculararchitecture in the twenty-first century: theory, education and practice", Taylor and Francis, Londonand New York Francis, London and New York.