

# Sustainable Construction as a Strategy of Real Estate Marketing: A Case Study in Istanbul

Ismet Osmanoglu

Department of Architecture

Faculty of Architecture, Trakya University

Edirne, Turkey

## ABSTRACT

*Sustainable design can be performed from the design structure scale to urban scale. From the view of the ecological structure, the state of being approximately half of the energy consumption used in structures increases the importance of structure designs. Minimizing the energy used in structures with the design features of the structure and the systems which provide benefits from renewable energy sources to be integrated to the structure, are one of the measures to be taken against environmental pollution. When it is considered that sustainable design and planning include issues such as ending actions and habits harmful for the environment, using sources effectively and correctly, protecting coherence of individual, society and ecosystem, supporting economic progress, usage of renewable energy sources such as energy efficiency, air-conditioning, natural ventilation, insolation, natural enlightenment systems, user's health and comfort, smart front and roof systems, active and passive thermal comfort systems, photovoltaic panels and issues such as building and energy control systems, efficiency in terms of functionality are important consequences of ecological structure applications. It is seen that the reflecting of these consequences on the public opinion by written and visual media creates awakening and awareness about ecology and sustainability in society.*

*In this direction, it is seen that approaches sensitive to the environment and energy in the field of structural design and architecture are increasing as a result of awakening public opinion and awareness of society and parallel to this concept such as sustainable construction and architecture are begun to be used as a strategy in the sales of real estate projects by structure producers. Such structure options gain currency as a result of the user's awareness and need. As many real estate manufacturer sees the decrease of awareness in society and rise of green buildings' values in the market, are emerging with the projects shown as if they are sensitive to the environment, though they are not really. Since the general tendency in such projects is to provide maximum income with minimum cost in a short time, integrated and concrete ecological structure projects in which ecological parameters are entirely used cannot be performed. Instead of this, one or two of the ecological criteria are being used but the project is entirely presented as a "sustainable construction" exhibited as a sustainable architecture design product. Although the sustainability concept is used as a commercial sale strategy in such projects, it can be considered that the issue contributes to the social awareness by being revived via written and visual media.*

*In this study, if we exclude the expressions that real estate market presents as an additional advantage to sales competition under its own advertisement rules, with the approaches putting important edges for mankind such as energy crisis in the whole world, high consumption of natural sources, getting harm of the ecosystem and whether buildings and complexes put forward to include nature and environment friendly or sustainability concepts really fulfill this function, deserve this quality, briefly, to what extent the constructions which are trying to be compatible with nature or at least define themselves in this way can perform the mentioned aim will be studied. In this context, by analyzing the "Solarkent Housing Estate Area" adopting "sustainable construction" approach improved in the frame of housing marketing strategy parallel to the housing demand increased recently in İstanbul, an analytical evaluation model related to the issue will be created.*

**Key Words:** Sustainability, Sustainable Construction, Environmental Assessment Method, Real Estate Marketing,

## 1. INTRODUCTION

Humanity has always aimed to develop by creating innovations from the day it existed, and for this reason it has been in constant change and development. The continuity of social life means that the physical environment that the society brings to the stage is also constant under the determined conditions. On the one hand, change, on the other hand, the dilemma of maintaining the existence of humanity and its civilization constitutes a dialectic that determines the continuity of social life and natural circulation (Şahin, 2004).

In this respect, human beings who have made new discoveries in fields such as industry and technology have used this to increase their comfort and quality of life. During all these developments, however, they forgot that they were not a dominant being alone in nature, but only a part of natural life, which led to the destruction of ecological equilibrium. Along with the harmful effects created by this destruction on the earth and humanity, it has been realized that natural resources are not limitless, in this context concepts such as planned resource use and sustainability have emerged. Although we have the knowledge that nature and environment-sensitive approaches to urban planning and building design are rather old, the history of comprehensive, scientific and international community work is quite new.

These studies include sustainability, sustainable development, sustainable urbanization, sustainable building or ecological planning, ecological design, ecological architecture, and so on (UN, 1973; Meadows vd., 1972; UN, 1982; UN, 1987). In order to be able to leave a livable world for future generations and to ensure the sustainability of the natural balance, the dimensions, principles and necessity of sustainability have been started to be discussed at global and local scale in search of renewable energy sources and applications of effective energy use, use of materials and resources, design and materials that do not harm nature (UN, 1992). At the same time, it was aimed to inform the public with the campaigns carried out by environmental organizations and to make sustainability a mere scientific concept and transform it into a direct way of life. An important point in terms of sustainability is to adapt the life styles and standards according to the natural environment capacity. To inform people about this issue has become the most important aim of sustainability (Osmanoğlu, 2018a).

In this context, sustainable architecture and building approaches also emerged in the field of architecture. Sustainable architecture makes it necessary to design in such a way as to enable future generations to benefit from the opportunities available. It requires people's needs to be met in harmony with the natural environment, without harming it, is living in harmony with the environment.

## **2. LITERATURE SURVEY**

The relationship between real estate/investment environment and sustainable construction/green building has been investigated in a series of studies. Some of the related articles are: "Exploring the relationship between the sustainability of construction and market value: Theoretical basics and initial empirical results from the residential property sector" (Lorenz, et al., 2007); "The sustainable competitive advantage model for corporate real estate" (Heywood and Kenley, 2008); "The impact of sustainability on the investment environment" (de Francesco and Levy, 2008); "Market Distortions When Agents Are Better Informed: The Value of Information in Real Estate Transactions" (Levitt and Syverson, 2008); "How Risky Are Sustainable Real Estate Projects? An Evaluation of LEED and ENERGY STAR Development Options" (Jackson,2009); "The market for green building in developed Asian cities—the perspectives of building designers" (Chan, Qian and Lam, 2009); "Review Articles: Environmental Sustainability: Drivers for the Real Estate Investor" (Falkenbach et al., 2010); "Conceptual Modelling of Construction and Real Estate Crisis with Emphasis on Comparative Qualitative Aspects Description" (Kaklauskas et al., 2010); "Barriers to Implement Green Strategy in the Process of Developing Real Estate Projects" (Zhang et al., 2011 ); "The value of sustainability in real estate: a review from a valuation perspective" (Warren-Myers, 2012); "Green real estate development in China: State of art and prospect agenda—A review" (Zhang, 2015); "Sustainability evolution in the Australian property market: Examining valuers' comprehension, knowledge and value", (Warren-Myers, 2016); "Measuring Long-term Effects of the Fukushima Daiichi Nuclear Power Plant Accident on Real Estate Prices" (Yukutake and Sugawara, 2017).

## **3. METHODOLOGY**

This study seeks to question whether the concept of sustainable construction is being used appropriately as part of the real estate marketing strategy. For this purpose, a housing development project made by a large-scale large scale construction company in Istanbul will be examined as a "case study". Firstly, the literature studies on the subject have been mentioned. Secondly, sustainable construction concepts as sustainable and real estate marketing strategy are examined. Third, the Environmental Assessment Methods for housing will be investigated, and Information on the approach of green building rating systems such as LEED, BREEAM, CASBEE and SBTool will be provided. Fourth, the "Solar Kent" project will be evaluated according to "Environmental Assesment Method of BREEAM". This section will also reveal the findings. It will be questioned how many of the sustainable housing criteria are included in the project. It will be investigated whether the concept of sustainable construction is used only as a real estate marketing strategy. The findings will be explained in the conclusion section.

## **4. SUSTAINABLE CONSTRUCTION AS A STRATEGY OF REAL ESTATE MARKETING**

If sustainable construction and design are considered to include issues such as ending harmful actions and habits of the environment, using resources effectively and properly, protecting the integrity of individuals, society and ecosystems, and promoting economic development (CIB, 1999). In this respect, it is observed that the concepts of nature, environment and energy sensitive approaches in the field of architecture and construction are becoming more and more public and social conscious, and accordingly, concepts like sustainable construction or ecological construction are being used as a strategy in the sale of real estate

projects for construction producers. Such construction preferences come into the spotlight due to the awareness of the user and/or the fashion or brand facts loaded into these concepts in the direction of a marketing target.

There are many big construction companies and many projects which are positively approaching the sustainable structure in real estate market. Apart from these, many major companies such as Soyak, Tekfen, Metro, Eczacıbaşı, Ağaoğlu have been investing in sustainable design and green building issues. Certificate systems are usually used as a prestige and marketing tool in Turkey. If it is considered that one of the common purpose of certificate systems is to take building market to ecological structure design, it can be seen as a positive approach to this goal (Osmanoğlu, 2018b). However, it is observed that sustainability, sustainable construction and green construction concepts are used as attractive concepts, and projects that are not suitable for the content of these concepts are also produced and offered to buyers in the real estate market.

In parallel with the increasing demand for housing in recent years, the ecological and sustainable construction approach developed within the framework of the residential marketing strategy, the image of the project and product presented is generally liberated from the content and the image's effect of appealing to the senses is sought. In this sense, as the strategy and the main objective of residential marketing, they try to influence the decision mechanism of the buyer instead of giving actual information promising more than the design and visual content, and through virtual images that are not really relevant to the product to be sold.

In this context, with the development of sales strategies before the structures have yet to emerge, rather than the representation of the product features that will emerge, the effect of virtual images and images on the product choice, the symbolic presentation of only one or both of the promised sustainable and/or ecological construction features, the construction is transformed into a product that has nothing to do with the promised reality and is only circulating in the market. However, it should be remembered that sustainable construction also raises costs. Housing producers also take into account the purchasing power on the market. Another is the fact that the inability of the number of housing in urban areas in Turkey. In this context, it is obvious that organs of government usually interested in numeric growth and goals rather than a sustainable, eligible estate development policy that primarily focuses on environmental quality (Osmanoğlu, 2018c).

## **5. SUSTAINABLE HOUSING AND RESIDENTIAL SETTLEMENTS**

Historically, sustainable housing and residential settlements have always been part of the traditional architectural heritage. But the traditional architectural heritage which contains sustainability criteria has largely disappeared through industrialization, population growth and the problems caused by the rapid urbanization, and the urban plans that need to contribute to the solution of these problems. The cities having a rich historical heritage especially such as Istanbul, Kütahya, Bursa, and Antalya lost their cultural heritage to a great extent except the monumental works through zoning laws and plans (Şahin, 1990). This loss has led to the forgotten consciousness and knowledge of sustainable construction in the past that existed in Turkey until the 1990s. The main objective of the sustainability of residential settlements is that the relationship between the natural environment and the structured environment requires a new and holistic approach to make sustainability possible. This approach implies the redefinition of the relationship between the urban environment, the structure and the whole of the building's internal and external environment in the context of environmental (eco-system), economic, social and cultural sustainability. Sustainable housing construction is also accompanied by a certain financial burden.

The issue is often addressed by researchers. Especially, topics like "assessment of sustainable housing affordability" (Mateus and Bragança, 2010; Mulliner, Smallbone, and Maliene, 2013; Said, Majid and Nozin, 2016), "multi-criteria decision-making approach for sustainable house" (Raut, Kamble and Jha, 2016), "environmental sustainability assessment of multi-family housing" (Lee, 2003) are studied. In this context, different environmental assessment methods have been developed for sustainable housing in many countries (Table I).

The "BREEAM International New Construction Standard" developed by the Building Research Establishment (BRE) in the UK for housing also includes homes and commercial buildings. BREEAM New Construction system is evaluated in 10 main categories: Management, Health and wellbeing, Energy, Transport, Water, Materials, Waste, Land use and ecology, Pollution and Innovation. Each category includes a number of environmental issues (BREEAM, 2016). Since 2007, Code for Sustainable Homes, prepared by "Communities and Local Government", has been used in the UK. This system measures sustainability by evaluating environmental performance in nine main categories: Energy and CO2 Emissions, Water, Materials, Surface Water Run-off, Waste, Pollution, Health and Well-being, Management and Ecology and defines a set of well-known environmental impact issues and sets up performance measures. Each main category also includes environmental sub-issues (CSH, 2010).

In Japan, "CASBEE for Home", an evaluation system for the housing scale of the CASBEE system developed by Japan Green Build Council (JGBC) / Japan Sustainable Building Consortium (JSBC) and used in 2007, evaluates the overall environmental performance of houses. The assessment consists of two main and three sub-categories:

Q. Evaluation of the level of environmental quality: Q1. Healthy and Safe Indoor Environment; Q2. Ensuring a Long Service Life; Q3. Creating a Richer Townscape and Ecosystem

LR. Evaluation of efforts to reduce the environmental load by load reduction : LR1. Conserving Energy and Water; LR2. Using Resources Sparingly and Reducing Waste; LR3. Consideration of the Global, Local, and Surrounding Environment. Below each subcategory are environmental assessment topics (CASBEE, 2008).

One of the most comprehensive coverage of sustainable housing evaluation systems is the LEED for Homes Rating System, developed and implemented by the US Green Building Council (U.S. Green Building Council)/USGBC). The "LEED for Homes Rating System" developed for residential buildings can only be implemented within local boundaries. The concept of sustainable housing and housing design is evaluated with 8 categories in the housing evaluation system and their sub-environmental topics, and the overall performance of the system is measured. The main categories are listed as Innovation and Design Progress, Location & Linkages, Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, Awareness & Education (USGBC, 2008).

SBTool is a software system formerly known as GBTool, that is designed to assess the environmental and sustainability performance of buildings. SBTool is the software implementation of the Sustainable Building Challenge (SBC) assessment method that has been under development as the GBC process since 1996 by a group of more than a dozen teams. The GBC process was launched by Natural Resources Canada, but responsibility was handed over to the International Initiative for a Sustainable Built Environment (iiSBE) in 2002. The generic method and software is calibrated by national teams to suit their local conditions, and is then tested on case study buildings. Results are displayed at international SB conferences, the most recent of which was the Tokyo SB05 conference in late September 2005 (SBTool, 2007). SBTool method creates a general assessment framework and includes a method which proposes constituting main performance criteria adaptable to every different country, region or local conditions. The performance criterias SBTool base on for assessment are stated in 8 categories as: Site Location, Available Services and Site Characteristics; Site Regeneration and Development, Urban Design and Infrastructure; Energy and Resource Consumption; Environmental Loadings; Indoor Environmental Quality; Service Quality; Social, Cultural and Perceptual Aspects; Cost and Economic Aspects (Larsson, 2016).

The main categories of sustainability in the homes and residential areas seem to have similar characteristics in all environmental assessment methods (Table I).

**Table I. A Comparative table of the Main Categories of Several Environmental Assessment Methods**

BREEAM	CSH	LEED	SBTool	CASBEE
Management	Management	Awareness & Education	Service Quality	Q.Evaluation of the level of environmental quality
Health and Wellbeing	Health and Wellbeing	Indoor Environmental Quality	Indoor Environmental Quality	Q1.Healthy and Safe Indoor Environment
Energy	Energy and CO2 Emissions	Energy & Atmosphere	Energy and Resource Consumption	Q2.Ensuring a Long Service Life
Water	Water	Water Efficiency	Environmental Loadings	Q3.Creating a Richer Townscape and Ecosystem
Materials	Materials	Materials & Resources	Site Regeneration and Development,	LR.Evaluation of efforts to reduce the environmental load by load reduction
Land use and ecology	Ecology	Sustainable Sites	Urban Design and Infrastructure	LR1.Conserving Energy and Water
Pollution	Pollution	Location & Linkage	Site Location	LR2.Using Resources Sparingly and Reducing Waste
Innovation	Surface Run-off, Water	Innovation and Design	Social-Cultural and Perceptual Aspects	LR3.Consideration of the Global, Local, and Surrounding Environment
Waste	Waste		Cost and Economic Aspects	
Transport				

## 6. CASE STUDY: SOLARKENT RESIDENTIAL SETTLEMENT

Türkiye’de It is possible to say that sustainability applications in Turkey have been attracting attention since the beginning of the 1990s and have attracted considerable interest both in the construction sector and in society. In addition to large-scale building projects, many small-scale projects have received international green building certifications such as LEED and BREEAM. The use of passive and active solar panels in building applications, the application of green roofs, the introduction of ecological building materials and the sale of environmental goods on the building market and their relative interest are developments showing positive sustainable approaches in the architecture and building sector. International certification programs are far from assessing each country's own circumstances. In countries with numerous historical and cultural heritages like Turkey, the socio-cultural and identity perceptions of the people are strong, which directly affects the construction culture (Osmanoğlu, 2018d). On the other hand, main criteria such as "Social-Cultural and Perceptual Aspects" are not found in environmental assessment methods like LEED, BREEAM etc. but only briefly addressed in sub issues. However, so far no work has been done on any environmental performance assessment method that takes into account national conditions.

For this reason, BREEAM was selected as the Environmental Assessment Method. "BREEAM International New Construction Standard" also includes homes and commercial buildings. The case study "Solar Kent project" will be evaluated according to the main categories of BREEAM. These categories are in 10 main headings as Management, Health and Wellbeing, Energy, Water, Materials, Land use and ecology, Pollution, Innovation, Waste, Transport.



## 6.1. Basic Data on Project Area

Solar Kent residential settlement project is located in the newly developing district of Esenyurt in the west of Istanbul Metropolitan Area. The project area is very close to the D100 highway, Istanbul's main transport artery. Solar Kent is built on an area of 28.000 m<sup>2</sup>. It is 6 km to the Port of Ambarlı, 26 km to the Airport, 28 km to the MIA Fatihe, 33 km to Mija Mecidiyekoye, 29 km to Yenikapi Port and 32 km to Eminönü Port. Within the walking distance, there are no urban facilities (Health Care, Education and Public Buildings, Theater, Cinema, Market, Recreation Area etc.). Solar Kent is designed as a concept of gated communities. The project area is located on a slightly inclined area facing south-west.

Istanbul Metropolitan Area, where the project area is located, is dominated by a warm and temperate climate. Köppen Geiger can be called Csa according to climate classification. The intensity of sunshine is 300.1-325 cal / cm<sup>2</sup> and the sunshine duration is between 6.3-7.2 h daily. Annual global solar radiation is 1,390-1,470 kWh / m<sup>2</sup>. August is the hottest month of the year and has a temperature of 23.2 °C. The average temperature in January is 5.7 °C, which is the lowest average of the year. Istanbul has an average annual temperature of 14.1 °C. The average temperature during the year varies by around 17.5 °C. The dominant wind direction is north (32%) and northeastern (26%) and the average annual wind speed is 2.4-3 m/sec. Istanbul In the winter months there is much more precipitation than in the summer months. It is the driest month of July with 24 mm of precipitation. The maximum amount of rainfall is observed in December with an average rainfall of 124 mm. The difference in rainfall between the driest and wettest month of the year is 100 mm. The average annual precipitation is 800-1000 mm. The average number of days covered with snow is between 4.04 and 17.4 days. Annual average moisture distribution is between 70.6% and 78.3%. The daily total open surface evaporation amount is in the range of 4.21-5.19 mm. The soil temperatures vary between 15.7-17.4 C for 5 cm depth, 15.6-17.2 C for 10 cm, 15.4-17.1 C for 20 cm, 15.6-17.1 C for 50 cm and 15.5 17 C for 100 cm.

The project area 2 is located in the earthquake zone. The ground structure is Çukurçeşme Formation (Çf). This formation consists of gravelly sand layers with a thickness of about 25 m, or clay layers or lenses. Çukurçeşme Formation is an important aquifer because it is very porous. But the water he carries is dirty. This unit, which can be considered as a weak middle ground, has developed a type of rotational shear movement due to water retention.

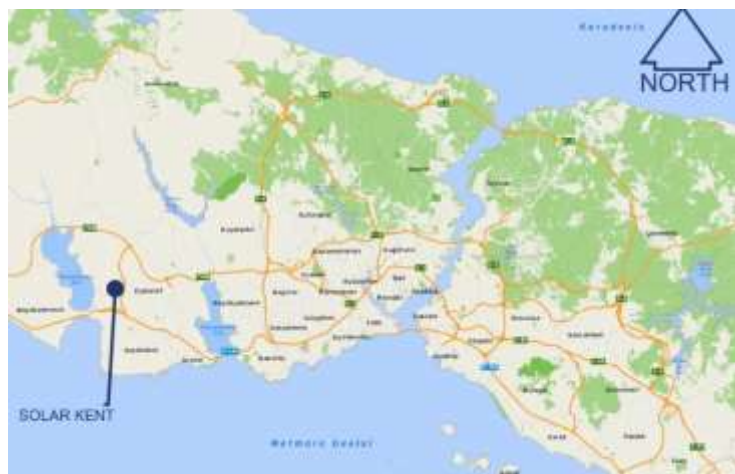


Figure 1. Location of Solar Kent in İstanbul



Figure 2. Regional location of Solar Kent

## 6.2. Solar Kent Residential Settlement<sup>1</sup>

The project consists of 4 blocks with 30 floors and 866 residences which consist of 10 different types of apartments with sizes ranging from 52 m<sup>2</sup> to 128 m<sup>2</sup>. There are 6-8 apartments on each floor. Within the project scope, 4300 m<sup>2</sup> parking area, 4 residential blocks with a total floor space of 3200 m<sup>2</sup>, 1 400 m<sup>2</sup> prayer room, 1 801 m<sup>2</sup> commercial area, 1 2910 m<sup>2</sup> social facility, 11.500 m<sup>2</sup> open area, 2 49 m<sup>2</sup> children's playground, 1 tennis courts, 1 football field, 1 basketball-volleyball court, fitness and SPA center, walkways and seating and rest areas are designed. The construction area/land area of buildings with a total construction area of 130 000 m<sup>2</sup> has reached a very high figure of 4.64. The construction of the houses started in 2009 was completed and sold completely. The residential blocks are positioned in parallel to the northern edge of the park, two of them in the northeast and two in the northwest. Between the two blocks, a social facility was installed parallel to the north front. There are parking lot along the south side of the land and solar batteries on the parking lot. The buildings were built as reinforced concrete with a tunnel formwork system on the fore-grounded raft foundation on the floor.

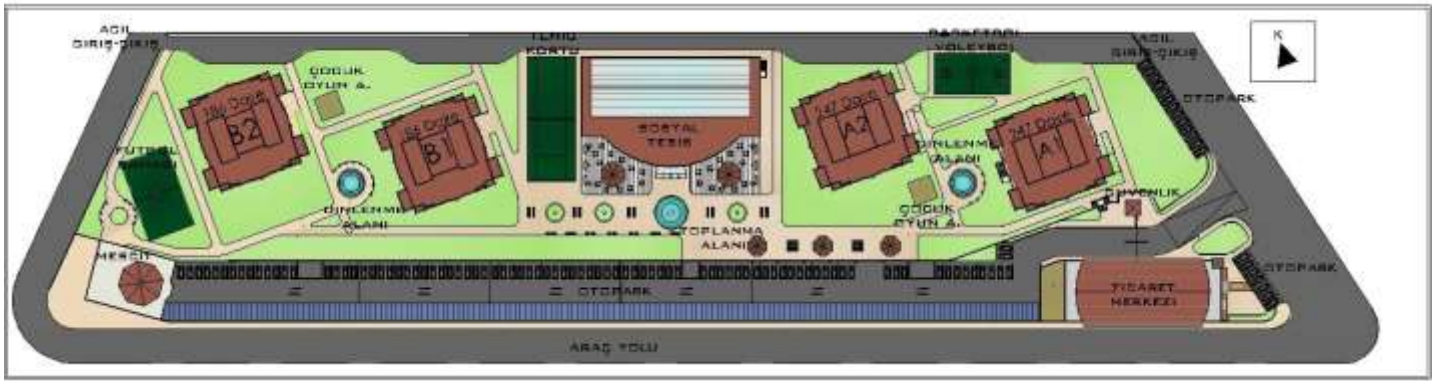


Figure 3. Site Plan of Solar Kent

There was no design for activities such as running and cycling on the ground. It is seen that biotope was not established in the settlement and that not enough green space was allocated for a population of 3000 people assumed to be brought by 866 apartments. As a road covering material, granite cube stone was used as a durable and natural material and granite plaque stone was used as a sidewalk. However, the use of rubber based materials in children's play areas was not found favorable. Also taking advantage of the elevation, the parking lot located along the south side of the land and adequate parking space is available. However, the number of hard floors and the width of 19 m and the length of the parking lot 300 m long are reserved for parking, and 4 residential blocks of approximately 30x30 m in size are removed as terrace roofs to obtain large surface covered with flooring material. Again, positioning the residential blocks and housing blocks in the dominant wind direction has a cutting effect on the natural air corridor, but it can also be expected to have a cutting effect on the daylight of the surrounding area with its height and large volumes reaching 30 floor. With the construction of 30 floor of residential blocks, there is a problem of related adaptation to the local built environment consisting of 4-6 floor apartment buildings as a ratio and scale. It is also a fact that the altitude, volume and precedent constructions will bring enormous underground and overhead infrastructure loads to the neighborhood.



Figure 4. Air photo of Solar Kent



Figure 5. A view from Solar Kent

### 6.3. The Evaluation For The Critics Of Bream Environmental Assessment Method

BREEAM was selected as the Environmental Assessment Method. "BREEAM International New Construction Standard" also includes homes and commercial buildings. Solar Kent settlement was evaluated in accordance with BREAM main categories and sub issues. No numerical score/value was used in the evaluation. The assessment was done in the form of High, Medium (Med), Low, Minimal (Min) and Not Available (NA) to see if each issue was met. In the category evaluation order, the booklet "BREEAM International New Construction 2016: Technical Manual" was applied accordingly (Table II).

#### 6.3.1. Management

Execution of the design of the project and management of construction applications was carried out professionally. No technical team was set up for long-term maintenance after construction. Site management has been established for the management of housing after the implementation, maintenance, repair, cleaning and service services have been observed to be good.

#### 6.3.2. Health and Wellbeing

Since there is no planning decision in relation to the direction, there are residential units and living spaces in every aspect of the space organization. In the case of natural lighting, the apartments are not able to make full use of daylight, especially in the north



direction due to the fact that the orientation is not used optimally. In the apartments looking east and west, only the morning and afternoon sunlight can be used. Therefore, housing units facing different directions will have different heat losses and different measures will need to be taken in order to provide an equal level of interior comfort in the housing units.

There are no panels and sunlight-shattering façade systems to prevent the summer from overheating and to compensate for the interior temperature. Again, no thermal system has been installed in the building structure or reinforced concrete plates in order to help cool down during the summer months and to stabilize the indoor air temperature in the spring months, such as circulating water (18-19 degrees) in the pipes. All the spaces in the building have enough windows to provide enough light and scenery. Although natural ventilation can be provided through the opening wings of the windows, it is not possible to cross ventilate with appropriate window openings in the rooms. Again, systems such as dirty air cushions have not been used to maintain and improve the indoor air quality of the rooms.

In common spaces such as stairs and elevators, natural ventilation systems that will provide natural ventilation and will evacuate dirty air, like solar chimneys, are not designed. Due to the fact that the roof is planned as a terrace and covered with walkable material, it can be seen that heating and cooling problems can occur in the summer and winter periods and solar heat island effect can be created in the houses located under the roof. There are no precautions such as light shelves in the windows to maximize the use of the sunlight and to reach the inside of the rooms in order to increase the quality of indoor environment. In order to save money without artificial illumination, it has been observed that there is no use of sensor lighting systems etc. The use of double glazing in windows was found favorable in terms of thermal comfort and reducing the amount of noise entering the interior. There is no study of sound insulation between floors or between spaces.

There are no panels or control systems that allow users to see the amount of energy they use in their own places by controlling the light, temperature and sunlight in their homes and to adjust their personal comfort levels within certain limits. PVC joinery used in windows are also high-energy and not ecologically mentioned before, this material also causes the volatile organic compound known as "vinyl chloride" to spread to the center. Although it is known that the settlement does not have a suitable area in terms of the ground, it is not known whether or not the carrier system has a high resistance in terms of earthquake. However, it is a positive undertaking to carry out the carrier system and static works under the consultancy of ITU Faculty of Civil Engineering.



Figure 6. Floor plan of A Housing Block, a.1 to 18. floors



Figure 7. Floor plan of A Housing Block, a.9 to 30. floors

### 6.3.3. Energy

The only and sustainable project to sustain the project is to plan the production of electricity with solar cells (photovoltaic) for use of active solar energy. In this context, it is envisaged to establish a solar power plant with a capacity of 550 KW and a power generation capacity of 780,000 KW-hours per year, in the 4280 m<sup>2</sup> area, which is located as a roof over the parking lot open area along the south side of the project area. It is planned to use 2,600 panels on the parking lot, each of which is 220w. The cost of the power plant will be approximately 2.100.000 Euro excluding the land and construction costs. That means a cost of 3.81 euros per watt. From this plant to the direct network, a minimum of 780,000 kWh of energy will be produced annually. According to article 6 of the energy production law of renewable energy sources; it is expected that an average of 320.000 USD income will be generated from the sale of the produced energy when the electricity purchase price obtained from solar power plants is accepted as 28 Euro. Therefore Solar Kent solar power station will bring an average income of 30 USD to the residents of the site. This will be equivalent to the monthly electricity cost of a house. Thanks to the activation of the system, a single subscription system is planned. For this reason, the electricity meter with a prepayment will be used in the houses. The contribution of the energy

generated by solar panels to the country's economy will be more than 66.660 USD per year in energy cost per kWh. As a result of consumption of the generated energy, annual network maintenance and service costs will be saved on average 200.000 USD.

Natural gas usage is provided for both heating and hot water. However, it has been understood that a more favorable situation has not been observed in terms of energy saving by going to a system of multiple fuel (solar, thermal energy, natural gas, etc.) supporting natural energy sources. Glazed surfaces on the facade or walls that absorb sunlight are not used to increase energy efficiency. However, it is aimed to save energy by using insulating materials which are used extensively on the external facades. Moreover, it is seen that direction of the buildings are not considered very important in the floor plans and especially the places of living face every direction. The presence of 6 residences on one floor causes such a situation. For this reason, glass surfaces created without consideration of direction will cause heat losses. Electricity generation from solar energy is a very positive initiative, but using energy sustainably as much as gaining it is also a big step in sustainable architecture. In this context, it has been found that there will not be any work to use energy more economically and efficiently in the operation of heating and cooling, lighting, light level control and ventilation systems in indoor and outdoor areas, and automation systems that control energy use.

### 6.3.4.Transport

Although it is located close to the main roads, it is not possible to use the public transport system directly, since there are no pedestrian axles that provide access to the stops on the E5 (D100) road. Users' access to public transport or to the center without the need for pedestrian axles and their own vehicles due to distance. The settlement is close to the lower center located in Beylikdüzü, although it is quite far away from Istanbul city center..

### 6.3.5.Water

There has not been any suggestion for the use of water in the residential interiors as a standard for reducing the use of showers, washbasins, kitchens, toilet waters and building users. There is no recommendation for the use of double-button reservoirs in toilets and the use of sensed plumbing elements, washbasins and shower taps to provide low flow or sparing of water. In the outdoors, an inland drainage system has been established to collect the rainwater and transport it to the water reservoir, and the accumulated water will be used in the garden watering system. With this approach being positive, it was not understood whether the roof was designed to be transported directly to the water tank or to be transported to the tank with drainage pipes as if it were in the open water area, and that the tank was not designed as a biopool. Again, there is no attempt to use this water in reservoirs. Therefore, it is debatable whether this system is a complete rainwater recycling system. In addition, the use of plants resistant to drought is not foreseen in the field planting. A treatment and recycling system for wastewater use is also not provided.

### 6.3.6.Materials

As it is commonly used in general construction in Turkey, the construction system is composed of concrete (structure), low energy materials (0.01%), concrete (0.2%) and high energy material concrete (14%) because the construction technique is reinforced carcass. In the case of rough construction, bricks (1.2%), PS thermal insulation board (3.9%), cement (2.2%), lime (1.5%) and low energy sand (0.01%) were used as medium energy materials. As finishing materials, it is planned to use exterior facade lining and exterior facade paint on the walls of the residential blocks with a mixture of cement, lime and sand. The use of PVC (10%), which is known to be eco-friendly and highly energetic, is provided in the windows. As a facade material in social facilities and trade center, low energy wood compact laminates (0.1%) and natural and organic porcelain finishes are preferred. Again in the prayer room, the exterior is designed with a low-energy wood compact laminate (0.1%) and medium-energy glass (6.0%) curtain wall.

In the parking lot, concrete (0.2%), which is a low energy material in the ground, was preferred to exterior concrete paint on the facade. It is understood that the use of recyclable and low energy production building materials commonly used in construction such as sand, cement, brick, ready-mixed concrete, etc., is easily related to the general practice in the construction sector rather than a conscious choice. Since these materials can be supplied cheaply and easily, it can be obtained from the nearby environment, thus saving both transport costs and reducing the amount of harmful gas released from the vehicle exhausts to the atmosphere during transportation. Likewise, the use of recyclable and easy-to-find materials such as ceramics, laminate parquet, doors and kitchens used in interior spaces on the floor of the interior is a conscious choice but rather a general but positive application for the construction sector. It can be said that low and medium energy other than reinforced concrete steel and PVC are suitable for the sustainable construction approach of the overall system of the project and the rough building materials.

However, plates used for insulation purposes, PVC windows used in windows, and paints used in walls are of high energy and inorganic origin. They are not easily destroyed in the land and have chemical contents that can harm the natural balance and they leave polluting particles and fibers such as asbestos fibers, lead. Although designing 6 flats on one floor in residential blocks seems to have saved material and resources, the other negative aspects of such a design are more disadvantageous in terms of sustainability. There is no evidence of indoor and outdoor use of materials and colors, or of designing the surfaces to be most suitable for daylight. In the same way, the exterior surfaces are also free of the color, texture or material for the most appropriate use of heat and light. There is no effort to plant new trees in place of the timber used during construction.



### 6.3.7. Waste

In the scope of the project, an application such as the separation of non-recyclable materials and recyclable materials for the use of waste materials has not been planned. No data on construction waste management was found. There is no positive initiative to support the frugal and conscious use of resources such as the provision of a treatment or recycling system for the recovery of used water and sewage, or the use of waste as a fertilizer for decomposing waste.

### 6.3.8. Land use and ecology

The project area has the typical climate characteristics of the Marmara region. In general, summers are hot and humid; winters are cold, rainy and sometimes snowy. The dominant wind in the region is blowing in the north, northeast direction. The prevailing wind direction for Istanbul changes along the wind direction depending on the weather conditions and the seasons during the year. In winter, the winds are dominant in the northeast, west-southwest in March, northwest and north in April and May, north and northwest in summer, and southwest and northwest in autumn. The settlement has a cut-off effect on the natural air corridor with a parallel construction parallel to the north-south direction. Although it has been stated that the ground improvement is made by the field surveys, it is known that this area has remained in the domain of Harami Dere in the past and the existence of aged alluvium is also the subject of the earthquake, and its suitability for a building of this volume and height of 30 floor is becoming quite controversial. There is not enough green area because 11,500 m<sup>2</sup> of the building area of the area and 7500 m<sup>2</sup> of the building floor area are separated by vehicles and pedestrian roads and other hard floors. There has been no target in the direction of the subject such as the selection of the local tree and the use of local plants, roof garden, balcony and facade planting.

Although the attention to mass shaping and orientation in land layout is taken into account in the building design, due to the fact that there are 6 apartments on each floor, it is observed that the spatial organizations are independent of the directional concern and the direction factor is not considered in the distribution of living spaces and service spaces. Furthermore, there is no decision to use the surrounding people for all the green areas in the field in order to support social sustainability and a closed settlement was established with the project.

### 6.3.9. Pollution

For the electricity in the settlement, the use of solar energy is considered, the use of natural gas in heating will have a decreasing effect on air pollution. As it is known, fossil energy sources, such as coal and petroleum cause emissions of harmful gases such as CO<sub>2</sub>, sulfur dioxide (SO<sub>2</sub>) as well as the mixing of dust particles into the air. In this context, the use of solar energy and the preference of heating with natural gas in the Solar Kent public housing area will reduce the amount of CO<sub>2</sub> gas released to the atmosphere by an average of 500,000 kg per year. Therefore, there is a positive situation regarding waste gases. No noise pollution and light pollution were created, and no attempt was made to regulate street lamps or waste heat.

### 6.3.10. Innovation

It seems that the project team is not striving to create a creative design that will increase the environmental performance outside the use of solar batteries and will be friendly, conscious about the environment, except that they are not in an attitude like trying to design a building which is different than normal. For electricity in the settlement, the prediction of the use of solar energy is seen as an innovative attitude for design. It is also understood that no decision has been made in the design to ensure social and cultural continuity.

## 7. RESULTS AND DISCUSSION

Solar Kent, one of the recent examples, has shown that applications that stand out in the name of sustainable and ecological design are energy production with solar batteries; storage of rain water and use of stored water in garden water, besides very few criteria have been evaluated. Sustainable design criteria are rarely and unwittingly applied in many countries of the world, such as using traditional construction techniques and materials commonly used in the construction industry, insulating or double-glazed joinery, etc., and no decision has been made to meet almost any sustainability criterion as demonstrated by the study and analysis on the example. It is understood that no studies have been conducted to identify and solve the known problems of construction on the environment. In addition, no effort has been made to create creative and innovative designs that take into account microclimate and ecosystem and support recycling, energy, materials, resource and water efficiency and sustainability. However, the use of the concept of sustainable construction is reflected in the example of housing sales positively reflected. All the houses built were sold. This type of building preference indicates that users are considered partly of housing producers in view of their interest in sustainable and ecological building concepts (Table II).

**Table II. The Results Of BREEAM Environmental Assesment Method for Solar Kent  
(Definition: High; Medium/Med; Low; Minimal/Min; NotaAvailable/NA)**

Nu	Criterias	Issues	High	Med	Low	Min	NA	Assessment
01.	Management	Man 01. Project brief and design		O				Med
		Man 02. Life cycle cost and service life planning					O	NA
		Man 03. Responsible construction practices	O					High
		Man 04. Commissioning and handover		O				Med
		Man 05. Aftercare		O				Med
02.	Health and Wellbeing	Hea 01. Visual comfort		O				Med
		Hea 02. Indoor air quality		O				Med
		Hea03.Safe containment in laboratories					O	NA
		Hea 04. Thermal comfort				O		Min
		Hea 05. Acoustic performance				O		Min
		Hea 06. Accessibility			O			Low
		Hea 07. Hazards		O				Med
		Hea 08. Private space		O				Med
		Hea 09. Water quality				O		Low
03.	Energy	Ene 01, Reduction of energy use and carbon emissions	O					High
		Ene 02. Energy monitoring					O	NA
		Ene 03. External lighting			O			Low
		Ene 04. Low carbon design					O	NA
		Ene 05. Energy efficient cold storage					O	NA
		Ene 06. Energy efficient transport systems					O	NA
		Ene 07. Energy efficient laboratory systems					O	NA
		Ene 08. Energy efficient equipment					O	NA
		Ene 09. Drying space					O	NA
04.	Transport	Tra 01. Public transport accessibility				O		Min
		Tra 02. Proximity to amenities					O	NA
		Tra 03. Alternative modes of transport					O	Min
		Tra 04 Maximum car parking capacity	O					High
		Tra05. Travel plan					O	Min
		Tra 06. Home office		O				Med
05.	Water	Wat 01. Water consumption				O		Min
		Wat 02. Water monitoring					O	NA
		Wat 03. Water leak detection and prevention					O	NA
		Wat 04. Water efficient equipment					O	NA
06.	Materials	Mat 01. Life cycle impacts					O	NA
		Mat 02. Hard landscaping and boundary protection		O				Med
		Mat 03. Responsible sourcing of construction products			O			Low
		Mat 04..Insulation		O				Med
		Mat 05. Designing for durability and resilience					O	Min
		Mat 06. Material efficiency					O	Min
07.	Waste	Wst 01. Construction waste management					O	NA
		Wst 02. Recycled aggregates					O	NA
		Wst 03. Operational waste					O	NA
		Wst 04. Speculative finishes -			O			Low
		Wst 05. Adaptation to climate change					O	NA
		Wst 06. Functional adaptability			O			Low
08.	Land Use and Ecology	LE 01. Site selection		O				Med
		LE 02. Ecological value of site and protection of ecological features					O	Min
		LE03. Minimising impact on existing site ecology					O	NA
		LE 04. Enhancing site ecology					O	NA
		LE 05. Long term impact on biodiversity					O	Min
09.	Pollution	Pol 01. Impact of refrigerants					O	NA
		Pol 02. NOx emissions					O	NA
		Pol 03. Surface water run-off		O			O	Med
		Pol 04. Reduction of night time light pollution					O	NA
		Pol 05. Reduction of noise pollution					O	NA
10.	Innovation	Inn 01. innovation					O	NA
<b>Total Score</b>		<b>3 issues in High / 6 issues in Low / 10 issues in Min / 12 issues in Med / 26 issues in NA</b>						

## 8. CONCLUSION

Sustainable buildings and systems for evaluating environmental performance for the residential area, which have been in use since the early 1990s, have made tremendous contributions to the settlement of environmental awareness in the building sector on a global scale. Considering that 50% of the total energy used on the planet is spent by the constructions, it is found that the reduction

of energy, water, material and resource attenuation and environmental burdens in building production and use is very important in terms of protection of the natural environment and/or ecosystem.

Accordingly, in Turkey as well from the beginning of the 1990s onwards, it has been observed that sustainability has been consistently held on the agenda by public institutions, academicians and professionals, and a high level of consciousness has been created in public opinion. Depending on this knowledge, a large number of well-designed sustainable buildings/green buildings have emerged in Turkey for 15 years and have received considerable attention.

It is understood that this concept is also perceived by real estate producers, and the concepts of sustainability and ecology are brought into the market as a guiding and increasing phenomenon. Therefore, many real estate producers come up with sustainable building projects because they see the increased awareness of society and the value of green buildings in the real estate market. Many of these projects have earned green building certification from international rating systems. However, some real estate companies claim that the project is an "ecological or sustainable structure" project, with only one or several of the sustainable building criteria in the project. This attitude appears to have emerged as a real estate marketing strategy.

As this example demonstrates, sustainable housing construction and sales are observed to be shaped by some real estate firms around properties that are not in their content and unrelated to the product to be sold, transforming it into a real estate marketing strategy that is shaped around visual images in a simple sense of information or promotional purpose.

The most important reason for this is that homebuilders and real estate companies must be aware of the interest and sensitivity of society in the society against green building and sustainable construction. But it is a fact that building a sustainable structure increases the costs to a certain extent. For this reason, it is obvious that some companies do not increase costs by placing one or more of the sustainable building criteria in the project, and besides tries to attract the attention of the society. The concepts of sustainability, ecological structure and green building appear to increase both marketing value and value as identity in the real estate sector.

## ACKNOWLEDGMENT

All information and data about Solarkent Housing settlement has been obtained from the authorities implementing the project. Thanks to them for their support.

## REFERENCES

- [1] BREEAM, (2016). *BREEAM International New Construction 2016:Technical Manual*. BRE Global Ltd, Watford, UK <https://www.breeam.com/discover/technical-standards/newconstruction/>
- [2] CASBEE, (2008). *CASBEE for Home (Detached House)*. Edited by Japan GreenBuild Council (JaGBC) / Japan Sustainable Building Consortium (JSBC), 2007 edition, Published by Institute for Building Environment and Energy Conservation (IBEC), Tokyo:RENGO. P. CO. <http://www.ibec.or.jp/CASBEE/english/download.htm>
- [3] CIB, (1999). *Agenda 21 on Sustainable Construction*. CIB Report Publication 237. Rotterdam: CIB. <http://cic.vtt.fi/eco/cibw82/A21text.pdf>
- [4] Chan E.H.W., Qian K. Q.,Lam, P.T. I., (2009). The market for green building in developed Asian cities—the perspectives of building designers. *Energy Policy*, Volume 37, Issue 8, 2009, pp. 3061-3070, Elsevier Ltd.
- [5] CSH, (2010). *Code for Sustainable Homes, Technical Guide November 2010*. Communities and Local Government Publications (CLG). London, pp.30-266. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/5976/code\\_for\\_sustainable\\_homes\\_techguide.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/5976/code_for_sustainable_homes_techguide.pdf)
- [6] de Francesco, A. J., Levy, D. (2008). The impact of sustainability on the investment environment. *Journal of European Real Estate Research*. Vol. 1 Issue: 1, 2008, pp.72-87, Emerald Group Publishing Limited.
- [7] Falkenbach, H., Lindholm, A.L. Schleic, H., (2010). Review Articles: Environmental Sustainability: Drivers for the Real Estate Investor. *Journal of Real Estate Literature*, Vol. 18, No. 2, 2010, pp. 201-223. American Real Estate Society Publication, Clemson SC
- [8] Heywood, C., Kenley, R. (2008). The sustainable competitive advantage model for corporate real estate. *Journal of Corporate Real Estate*, Vol. 10 Issue: 2, 2008, pp.85-109. Emerald Group Publishing Limited.



- [9] Jackson, J. (2009). How Risky Are Sustainable Real Estate Projects? An Evaluation of LEED and ENERGY STAR Development Options. *Journal of Sustainable Real Estate*., Vol. 1, No. 1, 2009, pp. 91-106. American Real Estate Society Publication, Clemson SC
- [10]Kaklauskas, A., Zavadskas, E.K., Bagdonavicius, A., Kelpsiene, L., Bardauskiene, D., Kutut, V. (2010). Conceptual Modelling of Construction and Real Estate Crisis with Emphasis on Comparative Qualitative Aspects Description. *Transformations in Business & Economics*, Vol. 9, No 1(19), 2010, pp.42-61
- [11]Lee, K. (2003). A Study on the Environmental Sustainability Assessment of Multi-Family Housing Estates in Korea, *Journal of Asian Architecture and Building Engineering*, vol.2 no.2, 2003, pp.83-94
- [12]Levitt, S. D., Syverson, C. (2008). Market Distortions When Agents Are Better Informed: The Value of Information in Real Estate Transactions. *Review of Economics and Statistics*, Volume 90, Issue 4, 2008, pp.599-611
- [13]Lorenz, D. P., Trück, S., Lützkendorf, T. (2007). Exploring the relationship between the sustainability of construction and market value: Theoretical basics and initial empirical results from the residential property sector. *Property Management*, Vol. 25 Issue: 2, 2007, pp.119-149. Emerald Group Publishing Limited.
- [14]Mateus, R., Bragança, L. (2010). “Sustainability Assessment of an Affordable Residential Building Using the SBTool Approach” *Proceedings of the International Conference, Portugal SB10: Sustainable Building Affordable to All*, 2010. In L. Bragança, M. Pinheiro, R. Mateus, R. Amoêda et al (eds.), ISBN 978-989-96543-1-0, 2010, pp. 581-588. Vilamoura, Portugal
- [15]Meadows, D., H., Meadows, D., L., Randers, J., and Behrens III, W.,W. (1972), *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*. 1972, New York: Universe Books.
- [16]Mulliner, E., Smallbone, K., Maliene, V. (.2013). An assessment of sustainable housing affordability using a multiple criteria decision making method. *Omega*, Volume 41, Issue 2, 2013, pp.270-279. Elsevier Ltd.
- [17]Osmanoğlu, İ. (2018a). Comparison Of Three Architectural Projects in İstanbul, According To The LEED Criterias In The Context Of Sustainable Construction. *International Journal of Innovative Research in Engineering & Management*. Volume-5, Issue-4, 2018, pp. 135-142.
- [18]Osmanoğlu, İ. (2018b). Cultural And Natural Heritage As Inputs Of Sustainable Planning: A Theoretical Framework. *International Journal of Advance Engineering Research and Science*. 5(8), 2018, pp. 182-193 <https://doi.org/10.22161/ijaers.5.8.23>
- [19]Osmanoğlu, İ. (2018c), Architectural And Environmental Identity And Qualiyy Satisfaction In The Public Housing Areas, İstanbul Halkalı Example. The Most Recent Studies In Science And Art, in H. Arapgirlioğlu; A. Atik; S. Hızıroglu; R.L. Elliott; D. Atik,eds. Vol.2, 2018, pp. 1560-1578. Ankara: Gece Publishing
- [20]Osmanoğlu, İ. (2018d). The Relationship Between Architecture And The Socio-Cultural Structure And Social Perception With An Example Of İstanbul City. The Most Recent Studies In Science And Art, in H. Arapgirlioğlu; A. Atik; S. Hızıroglu; R.L. Elliott; D. Atik, eds. Vol.2, 2018, pp. 1579-1592. Ankara: Gece Publishing
- [21]Raut, R. D., Kamble, S., Jha, M. K. (2016). An assessment of sustainable house using FST-QFD-AHP multi-criteria decision-making approach. *International Journal of Procurement Management*, 9(1), 2016, pp.86-122. Inderscience Publishers
- [22]Said, R., Majid, R. A., Nozin, A. S. (2016). Assessment of Sustainable Housing Affordability in Malaysia based on People's Perception Using COPRAS Method. *International Real Estate Research Symposium (IRERS)*. April 2016, Kuala Lumpur, Malaysia
- [23]SBTool, (2007). *An Overview of SBTool, September 2007, Release*. International Initiative for a Sustainable Built Environment / iisBE. [http://www.iisbe.org/sites/default/files/SBTool\\_notes\\_Sep07.pdf](http://www.iisbe.org/sites/default/files/SBTool_notes_Sep07.pdf)
- [24]Şahin, İ. (1990). *Türkiye’de Taşınmaz Kültür ve Tabiat Varlıklarının Koruma Olayı ve Korumaya Halkın Katılımı Konusunda Yardımcı Bir Araştırma*, Y. Lisans Tezi, İstanbul Teknik Üniversitesi (İTÜ), Fen Bilimleri Enstitüsü, 1990, pp.22-35. İstanbul

- [25] Şahin, İ. (2004). *Türkiye’de Kentsel Koruma Politikalarının Gelişimine Yardımcı bir Yöntem Denemesi, Örneklem: İstanbul Tarihi Yarımada*. Doktora Tezi, İstanbul Teknik Üniversitesi (İTÜ), Fen Bilimleri Enstitüsü, 2004, pp.1. İstanbul
- [26] UN, United Nations. (1973). *Report of the United Nations Conference on the Human Environment*. 5-6, June, Stockholm. pp.3-36, UN Publications: Switzerland. [http://www.un.org/ga/search/view\\_doc.asp?symbol=A/CONF.48/14/REV.1](http://www.un.org/ga/search/view_doc.asp?symbol=A/CONF.48/14/REV.1)
- [27] UN, United Nations. (1982). *World Charter for Nature*, United Nations General Assembly Resolution. A/RES/37/7, 48th plenary meeting, 28 October 1982, New York. <http://www.un.org/documents/ga/res/37/a37r007.htm>
- [28] UN, (1987). Report of the World Commission on Environment and Development: Our Common Future. 20 March 1987, Oslo. <http://www.un-documents.net/our-common-future.pdf>
- [29] UN, United Nations. (1992). Rio Declaration on Environment and Development. *Report of The United Nations Conference on Environment and Development*. 3-14 June, 1992, Rio de Janeiro. <http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>
- [30] USGBC, (2008). *LEED for Homes Rating Systems*. U.S. Green Building Council (USGBC), January 2008. <https://www.usgbc.org/Docs/Archive/General/Docs3638.pdf>
- [31] Warren-Myers, G. (2012). The value of sustainability in real estate: a review from a valuation perspective. *Journal of Property Investment & Finance*. Vol. 30 Issue: 2, 2012, pp.115-144. Emerald Group Publishing Limited
- [32] Warren-Myers, G. (2016). Sustainability evolution in the Australian property market: Examining valuers’ comprehension, knowledge and value. *Journal of Property Investment & Finance*. Vol. 34 Issue: 6, 2016, pp.578-601, Emerald Group Publishing Limited.
- [33] Yukutake, N., Sugawara, S. (2017). Measuring Long-term Effects of the Fukushima Daiichi Nuclear Power Plant Accident on Real Estate Prices. *Journal of Sustainable Real Estate*. 2017, Vol. 9, No. 1, 2017, pp. 3-21, American Real Estate Society Publication, Clemson SC
- [34] Zhang, X., Shen, L., Wu, Y., Qi, G. (2011). Barriers to Implement Green Strategy in the Process of Developing Real Estate Projects. *The Open Waste Management Journal*. 2011, 4, pp. 33-37, Bentham Open Journals, UAE
- [35] Zhang, X. (2015). Green real estate development in China: State of art and prospect agenda—A review. *Renewable and Sustainable Energy Reviews*. Volume 47, 2015, pp.1-13. Elsevier Ltd.