HOUSING AS A SUSTAINABLE ARCHITECTURE IN TURKEY: A RESEARCH ON TOKİ HOUSING

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ABSTRACT

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Turkey, as a developing country, requires substantial amount of housing stock. TOKİ (Toplu Konut İdaresi – Housing Development Administration), as the pioneer housing project builder, has a great significance in the housing production of Turkey. However both in TOKI projects and in general, sustainability has not been a central issue for the architectural practice in Turkey. On the other hand sustainability is an in evitable issue when the environmental, social, cultural and economical benefits are concerned. Especially sustainability in TOKI projects has a significance due to their potential to establish a re-production model.

This thesis explores the benefits of sustainability for the housing project design in Turkey. The existing situation of three different types of TOKİ housing projects will be critically evaluated. In the end, it will be tried to attain proposals for the development of sustainable housing in Turkey.

Keywords: Sustainability, Sustainable Housing Design, TOKİ Housing

ÖZ

SÜRDÜRÜLEBİLİR BİR MİMARLIK OLARAK TÜRKİYE'DE TOPLU KONUT: TOKİ İLE İLGİLİ BİR ARAŞTIRMA

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Gelişim sürecinde olan Türkiye'nin büyük bir konut gereksinimi bulunmaktadır. TOKİ (Toplu Konut İdaresi) Türkiye'deki konut üretiminde giderek artan bir pazar payına ve konut üretimini doğrudan etkileme gücüne sahiptir. Öte yandan gerek TOKİ eli ile üretilen, gerekse diğer konut projelerinde sürdürülebilirlik temel bir tasarım kriteri olarak ele alınmamaktadır. Oysa sürdürülebilirlik günümüz ortamında çevresel, sosyal, kültürel ve ekonomik etkileri düşünüldüğünde kaçınılmaz olarak tasarım süreçlerinde ele alınması gereken bir kavramdır. Özellikle lider toplu konut üreticisi TOKİ'nin bu kavramı benimsemesi örnek bir model oluşturması açısından çok önemlidir.

Bu tez toplu konutta sürdürülebilirlik kavramının faydalarını araştırmayı ve Türkiye'deki toplu konutlara sürdürülebilir tasarım açısından bir girdi sağlamayı amaç edinmiştir. TOKİ toplu konutlarından üç farklı örnek eleştirel bir gözle değerlendirilecek ve sonuç olarak Türkiye'nin gelecekteki sürdürülebilir toplu konutları için bir dizi öneri sunulmaya çalışılacaktır.

Anahtar Kelimeler: Sürdürülebilirlik, Sürdürülebilir Toplu Konut Tasarımı, TOKİ Toplu Konutları

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CHAPTER 1

INTRODUCTION

The concept of sustainability and sustainable housing projects are crucial for developing countries. In Turkey, neither sustainable housing design nor sustainability philosophy seems to become a major determinant for architectural design process. Yet, the country shares the same problems with the others in the world. Sustainable design is not a choice, but a requirement in the world since the sustainability paradigm emerged in the last quarter of the 20th century. It offers not only a healthy ecosystem, but also many advantages for both the dweller and the country in terms of environmental, economical, social, cultural and health issues.

After numerous earth summits and declarations, the developed countries such as US and England have started to act in the light of sustainability concept. After 30 years of sustainability history, it is still clear that these countries are still the leaders of the sustainable development model itself as well as sustainable housing design. New regulations and innovative practices are seen in these countries. In the year 2008, both U.S. and England published their new sustainable housing design ratings to encourage the architects and society to live in both sustainable homes and sustainable society.

Although Turkey benefits from the same atmosphere, it is still in its infancy in terms of this paradigm. The country has lack of knowledge and practice in the building of sustainable housing projects. Nature preservation approach has not adequately integrated into the Turkish architectural domain. Innovative sustainable examples are unfortunately hardly seen. The governments have supported or promoted neither sustainable architecture nor a culture of sustainability for the society so far. However, she has signed the Kyoto Protocol in the end this year. This shows that a more sustainable life style will be offered to us as well in the near future.

As the subject of the thesis, the existing situation of the housing stock of the country is far from being satisfactory. Adequate quality in terms of environmental benefits is not offered for the people in these buildings. Mostly, the basic needs for the people are provided in these new blocks

regardless of any philosophical approach like sustainability. Since the country has a great deal of new housing project requirement today, the architectural policies should be established more carefully. Yet, sustainability is not a major concern for most of the new housing projects. Besides, sustainability does not seem to become a significant cultural issue.

This thesis defends that applying sustainable design principles in the housing projects in Turkey will be beneficial not only for the occupants and the society, but also for the country itself. Firstly, it will have environmental benefits like preserving nature and its resources. Employing this paradigm to the new buildings will be a possible step to reach a better quality environment. Secondly, it will have social benefits such as increasing the quality of the housing blocks as well as the occupants' life. Moreover, it will strengthen community ties. It will help to sustain cultural and regional issues. Furthermore, it will help the dweller to be aware of the sustainable life style. Thirdly, it will have economical benefits in the short and long term.

As the pioneer Turkish housing builder, TOKİ can play a very significant role towards a sustainable environment. The administration has a great potential to apply and promote this approach to the whole housing projects of Turkey since it is a governmental administration which controls the decision making mechanism. If it applies the sustainability paradigm, it will be a model for the housing projects in the whole country. The new 500.000 dwellings project of the administration is a remarkable chance to apply and utilize the sustainable housing design principles.

The general aim of this study is comprehending, utilizing and promoting sustainable housing design in Turkey. Besides, the study also aims to understand the relations between sustainability and housing design. In other words, it is considering the influence of the sustainability paradigm towards architectural housing design. A critical research on the housing production in Turkey will be realized to understand the limits of housing projects in terms of sustainability. Also, as an outcome of this critical research, significant proposals and suggestions will be realized towards utilization of the sustainability concept as a dominant input in the design process in the frame of the housing construction domain.

The frame of this thesis will be as follows: The theoretical background exploration of sustainable housing design; exploring the benefits of sustainable housing design with the help of the categories of the 2008 LEED (Leadership of Environmental Ecological Design) for Homes Rating System[1] (without utilizing its grading system); criticizing the existing situation of the

[1] This is a rating system arranged in 2008 by Green Building Council to evaluate the sustainability level of the dwelling projects in the United States.

housing production in Turkey on TOKİ housing case studies; collecting and concluding some data for the TOKİ housing projects.

The categories of the most recent sustainable housing rating system, the 2008 LEED for Homes Rating System, was chosen as a base to frame the sustainable housing design in the thesis. An already arranged categorization peculiar to housing projects is required to consider and utilize sustainability in housing projects due to the fact that sustainable housing design consideration is not rigid. The emphasis of sustainable housing design differentiates according to the countries or communities applied this approach. However, they are more or less similar to each other in spite of the changes in the grouping of the subheadings. For instance, while an issue is accepted in LEED, it is ignored by BREEAM. Without a classification it was almost impossible to frame the so broad sustainable housing design issue in a master thesis.

As a method to understand the design criteria ignored in terms of sustainable housing design, case study method will be utilized. Three different TOKİ projects were chosen and critically evaluated. These projects are differentiated from each other with their project types. The project types are a social housing project, an urban slum transformation project and a revenue-sharing project. After considering the flaws in terms of sustainable design in the case studies, several proposals will be created to increase the sustainability level of TOKİ housing.

The thesis consists of five chapters. First one is this introduction part where a general framework for the content of the thesis is introduced. In the second chapter, the sustainable housing design will be considered with the help of the theoretical background of sustainability. Firstly, the sustainability paradigm and its facets will be examined. Then, why and how the concept of sustainability influences architectural design will be searched. In other words, the relation between sustainability and sustainable architecture will be studied. Lastly, the limits of sustainable housing design notion will be tried to be understood. This part will be the theoretical part of the thesis. In the third chapter, to understand the limits of sustainable housing design, the LEED for Homes Rating System will be used. Under its eight subheadings, the different aspects of sustainable housing design will be identified. Moreover, in the fourth chapter, the three TOKİ housing case study projects will be critically evaluated in terms of sustainable housing design. The fifth chapter contains conclusion and proposals.

The main references of this thesis will be the 2008 LEED for Homes rating system of US, the book of Brian Edwards “Sustainable Housing : Principles & Practice”, the book of Sue Roaf “Eco-House” and the book of Terry Williamson “Understanding Sustainable Architecture”. The categories of LEED are utilized to frame the sustainable housing concept, yet the rating system

itself is not used. The LEED pays attention to the rates. Rating the sustainability level of housing complexes is not a subject of the thesis. Thus, the other main references are utilized to understand the limits of sustainable housing design. Moreover, to get information about the case studies, interviews were made with several TOKİ officers and the project director of the Parkoran project. Most of the documents of the case studies were provided by TOKİ.

CHAPTER 2

SUSTAINABLE HOUSING DESIGN IN THE FRAME OF SUSTAINABILITY

2.1. A conceptual Framework of Sustainability

The increase in the deterioration of the earth and its ecological system are accelerated in recent years. Global warming is now accepted as a scientific fact. Average annual temperatures are likely to rise by 1.5°C over the next 50 years. The climate of the earth has changed many times during the history of the planet, with events ranging from ice ages to long periods of warmth. Yet, today's situation appears to be different. "Starting from the late 18th century, human activities associated with the 'Industrial Revolution' have also changed the composition of the atmosphere and therefore very likely are influencing the Earth's climate".[2] Since the industrial revolution, the development policies regardless of any nature consideration resulted in some undesirable problems as follows: Air quality problem, acid rains, the growing ozone hollow, the loss of biodiversity, rainforest destruction. In other words, the main problem is humankind is devastating the natural and nature itself. These problems threaten both the living species of the ecosystem and humans. According to the Brundlant Report[3]:

> "Each year another 6 million hectares of productive dry land turns into worthless desert. Over three decades, this would amount to an area roughly as large as Saudi Arabia. More than 11 million hectares of forests are destroyed yearly, and this, over three decades, would equal an area about the size of India. Much of this forest is converted to low-grade farmland unable to support the farmers who settle it. In Europe, acid precipitation kills forests and lakes and damages the artistic and architectural heritage of nations; it may have acidified vast tracts of soil beyond reasonable hope of repair. The burning of fossil fuels puts carbon dioxide into the

[2] Environmental Protection Agency Website. (n.d.). Retrieved October 20, 2008, from http://www.epa.gov/climatechange/basicinfo.html

[3] The Brundtland Report of the World Commission on Environment and Development convened by the United Nations in 1987 was the first endeavor to attract global attention to the concept of sustainability and sustainable development. The Report, called *Our Common Future,* represents an overview of the current state of the world, and then offers certain general characteristics and a common consensus on the scope of sustainable development.

> atmosphere, which is causing gradual global warming. This 'greenhouse effect' may by early next century have increased average global temperatures enough to shift agricultural production areas, raise sea levels to flood coastal cities, and disrupt national economies. Other industrial gases threaten to deplete the planet's protective ozone shield to such an extent that the number of human and animal cancers would rise sharply and the oceans' food chain would be disrupted, industry and agriculture put toxic substances into the human food chain and into underground water tables beyond reach of cleansing."[4]

These problems are not the only ones. Moreover, in the course of time the problems are getting more threatening. In less than a generation, human destroyed a third of all virgin habitats in the world. "Extinction is for ever. No genetic cloning will bring back lost biodiversity."[5] If such an unconscious human behavior continuous with the same acceleration, or even the same speed, it seems that our environment will not survive due to these effects. After the nature's reaction to human in some undesirable ways, it was crucial to find a new solution to the harmful impacts of human to nature, and the deteriorating situation of the earth. It was time to describe the nature-human relationship from the start, and make peace with her again. Consequently, the concept of sustainability and sustainable development thinking entered as a new paradigm in the humanity's life.

The first efforts towards sustainability date back to the beginning of the 1970s when the United Nations organized a worldwide Conference on the Human Environment for the first time.[6] It was a significant milestone that set a new agenda for sustainable development. However, the term 'sustainability' began to be widely used since the Brundlant Report in 1987. There have been many meetings and reports about sustainability, since it was first defined.

> Sustainability is a word that has become fashionable over the last decade. However, sustainability is not a matter of fashion, but survival. The United Nations, in its latest Global Environmental Outlook, outlined a series of possible environmental scenarios for the next thirty years. At worst, it foresaw crises triggered by increasing water shortages, global warming and pollution. It suggested that these trends might be slowed, but only if nations work together to address radically the global consumption of natural resources and energy, and to halt man's degradation of the environment. [7]

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[4] Report of the World Commission on Environment and Development: Our Common Future (Brundlant Report). (1987). Retrieved October 28, 2008, from the United Nations Documents Website from http://www.un-documents.net/ocf-ov.htm.

[5] Andrew Grant. (2000). In Brian Edwards and David Turrent (Eds.), *Sustainable Housing: Principles & Practice* (pp. 44). London, New York: E & Fn Spon.

[6] It was met at Stockholm, Sweden, on 5 - 16 June 1972.

[7] The Philosophy of Foster and Partners. (n.d.). Retrieved October 28, 2008, from http://www.fosterandpartners.com/Data/Philosophy.aspx.

In its broadest sense, the strategy for sustainable development aims to promote harmony among human beings and between humankind and nature.[8] It is an obligation of new interaction with nature. No longer, human can see himself in the origin of the universe. It is time to comprehend and appreciate being a part of nature and respecting her.

> Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. [9]

This is the most popularized description of 'sustainable development' or 'sustainability' defined in 1987 in the Brundlant report. The aim of this definition is to point out the necessity of a broader, longer-term vision in order to achieve sustainable development. It frames this paradigm within two key concepts. The first one is 'the concept of 'needs', specifically the essential needs of the world's poor and 'the idea of limitations imposed by the state of technology and social organization.'[10] These limitations refer to the restrictions for human beings consuming beyond the carrying capacity of the world while encouraging the progress of civilization and humanity.

> The human capacity to consume energy and materials and create waste and nature's capacity to recycle the waste and produce new energy sources and materials are on a collision course.[11]

There is a capacity of sources that nature can give to human. She needs time to renew the sources by transforming wastes. Sustainability is the "use of an organism, ecosystem or other renewable resource at a rate within its capacity for renewal".[12] The focus mentioned here is not ignoring human comfort in order to maintain sustainability of the ecosystem. The report also emphasizes "improving the quality of human life while living within the carrying capacity of supporting

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[8] The Philosophy of Foster and Partners. n.p.

[9] Brundlant, 27.

[10] Ibid.

[11] Ken Yeang. (2000). *The Green Skyscraper: The Basis for Designing Sustainable Intensive Buildings.* Munich, London, New Yoyk: Prestel, 121.

[12] Caring for the Earth: A Strategy for Sustainable Living. (1991). Retrieved October 30, 2008, from the Australian National University Web site from http://coombs.anu.edu.au/~vern/caring/care-earth5.txt, 211.

ecosystems".[13] Similarly, Manzini defines sustainability as "a form of organization of human activities whereby, on a planetary and on a regional level, the ecosystem need not be disturbed beyond the threshold of its resilience."[14] The shift is established on efficient use of anything. For instance, one of its tasks is to find "the most efficient forms of using resources without threatening the survival of nature and people".[15] In other words, similar to the Van der Rohe's expression of the shift in modernization 'less is more', 'producing more with less'[16] seems to be the next magic expression of the sustainable future. Foster expresses this as:

> Sustainable architecture can be simply defined as doing the most with the least. The Miesian maxim 'Less is more' is, in ecological terms, exactly the same as the proverbial injunction, 'Waste not, want not'.[17]

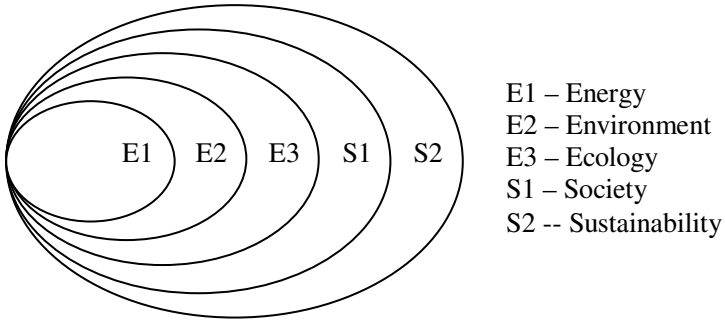

Figure 2.1: The concept diagram of sustainable development

Brian Edwards and David Turrent. *Sustainable Housing : Principles & Practice.* (E & Fn Spon, 2000), 20.

Sustainable development is a very wide concept consisting of various relations between economy, society, energy, ecology and the environment. Figure 3.2 shows the concept diagram of sustainable development. Indeed, it is a 'process of change' of anything including lifestyles. It is a new development model to sustain not only the environment and ecological system, but also

[13] Caring for the Earth: A Strategy for Sustainable Living. (1991). Retrieved October 30, 2008, from the Australian National University Web site from http://coombs.anu.edu.au/~vern/caring/care-earth5.txt, 211.

[14] Ezio Manzini. (1997). Designing Sustainability-Leapfrog: Anticipations of a Possible Future. *Domus, 789*, 46-47.

[15] A. Escobar. (1995). *Encountering Development: The Making and Unmaking the Third World.* Princeton: Princeton University Press, 196. Quoted in Arsan

[16] Brundtland, 15.

[17] Norman Foster. (2003). *Architecture and Sustainability.* Retrieved November 1, 2008 from Foster and Partners website from http://www.fosterandpartners.com/content/essays/Architecture%20and%20Sustainability.pdf

the economical and social systems. It is a totalitarian development model because the crises "are not separate crises; an environmental crisis, a development crisis, an energy crisis. They are all one."[18] The Brundlant report launched the sustainable development strategy as the wonderful alternative for former development practices. At this point, it is useful to see the concept of the essential principles of sustainable development according to the Brundlant Report to understand the whole picture:[19]

Holism: The transformations toward sustainable development are devoted to the growth and development of the whole of humanity and the protection of the planet for future life.
Long-Term View: Sustainability requires thinking long-term and assuming responsibility for the future.
Green Growth: The report also proposes that economic growth or development is still possible as long as it is green growth.
Polluter Pays: The costs of environmental damage should be paid by those who cause them.
New Forms of Development: Sustainability implies new forms of development that no longer harm the Earth but are in harmony with its natural processes.
Betterment of Living Quality: To improve the quality of living conditions of every people is one of the primary goals of sustainability.
Betterment of Ecological Quality: Sustainability supports the policies that give priority to bettering ecological quality as a basis for improving other aspects of life.
Ethical and Social Responsibility: The term sustainable development reintroduces the ideas of ethical and social responsibility through the adoption of lifestyles within the planet's ecological means.
Inter- and Intra-Generational Equity: All people, currently alive or not yet born, have an equal right to benefit from the use of resources, both within and among countries.
Social Solidarity and Justice: The report encourages people to work together to create healthy communities; all citizens should have the opportunity to improve the quality of their lives.
Civic Engagement: Sustainable communities necessitate the creation of full opportunity for citizens, business and communities to participate in and influence the decisions that affect them; effective citizen involvement in decision-making is proposed.
Resources and Energy: The report proposes to conserve non-renewable
resources as far as possible, to minimize the production of waste and to encourage efficient use of renewable energy sources.

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[18] Brundlant, 11.

[19] Zeynep Durmuş Arsan. (2003). *A Critical View of Sustainable Architecture in Turkey: A Proposal for the Municipality of Seyrek.* Doctoral Dissertation, İzmir Institute of Technology, İzmir, 33.

Consumerism: Sustainable consumption is related to sustainable production concerning the more responsible consumption of more sustainable products. Sustainable communities should not only consume in more socially and environmentally responsible ways, but also should consume less.

As is seen in the following list, such a concept requiring such a differentiated system cannot be a simple system. Each item in this list is already a complex system. Consequently, sustainability and its relations with these systems are very hard to appreciate. What the pursuit of sustainable development exactly requires are the following:

- A political system that secures effective citizen participation in decision making,
- An economic system that is able to generate surpluses and technical knowledge on a self-reliant and sustained basis,
- A social system that provides for solutions for the tensions arising from disharmonious development,
- A production system that respects the obligation to preserve the ecological base for development,
- A technological system that can search continuously for new solutions,
- An international system that fosters sustainable patterns of trade and finance,
- An administrative system that is flexible and has the capacity for self-correction.[20]

It is seen that it is impossible to reach a sustainable environment, economy and community without a holistic approach to this philosophy. The environmental problems within the current development process reveal the need to produce macro-scale policies and global solutions economical, social, and environmental terms. In this respect, to understand and to take action for a sustainable future, individuals, volunteer organizations, businesses, institutes, and governments should work together. With the holism principle of the Brundlant report working for 'the growth and the development of the whole of humanity', all people should be a part of this almost obligatory life style. Inhabitant participation, central and local government agents, private sector, investors and academicians are fundamental elements in many sustainable projects of the world. Sustainability can be evaluated under three parts; environmental, economical and social sustainability. It is useful to see the three differentiated but related issues of the concept.

Environmental sustainability is one of the main goals of sustainability. Its most crucial point is concerning ecological system protection and nature-friendly decisions and actions. Any kind of nature conservation action can be evaluated under this heading. For instance, a safe and sustainable energy pathway is required in this issue. It is obvious that one of the main issues of

[20] Brundlant.

environmental sustainability is energy. In today's world, efforts are saving energy, water, natural resources, ecology, habitat, and natural species. Any kind of nature conservation action can be evaluated under this title.

Economical sustainability is also one of the main issues of sustainable development. "Ecology and economy are becoming ever more interwoven locally, regionally, nationally, and globally into a seamless net of causes and effects."[21] Sustainable development idea is familiar since the late 1980s. It can be assumed that economic growth desire is the reason to the world's recent situation such as pollution, climate change, energy scarcity, loss of biodiversity and depletion of resources since 1950. The existing model was damaging nature. Therefore, a new economic model needs to be developed called sustainable development. According to EPA (Environmental Protection Agency), sustainable development links two important concepts, "that environmental protection does not preclude economic development and that economic development must be ecologically viable now and in the long run."[22] Thus, economic sustainability cannot be separated from the environmental sustainability.

Environmental and economic aspects of sustainability cannot be evaluated as a choice for individuals, groups and societies. It requires social sustainability. Participation of each individual is significant. In the course of the current globalization process, regardless ethnicity, religion or culture, the society should respect nature in the light of this paradigm. The studies on sustainable development point out that the process should require a major shift toward the formulation of a sustainable approach as a social project. When it is thought that all countries depend on one biosphere to sustain their lives, the project can be understood better. Sustainable development requires more ecologically-adapted lifestyles which are ecologically friendly. Ecology-adapted consumption habits should be developed for the society. In developed countries, owing to the wealth of people, consumption increases day by day. The rich earn more, consume more natural resources, and disturb the ecological system more than consumers in less developed countries. In the light of the sustainability paradigm, consumption habits should be revised. Moreover, over-populations can increase the pressure on resources. The Brundlant report asks: "How can such development serve next century's world of twice as many people relying on the same environment?"[23] Thus, governments should take measures to control population growth because sustainable development can only be pursued if population size and growth are in harmony with

[21] Brundlant, 15.

[22] United States Environmental Protection Agency Website. (n.d.). Retrieved November 3, 2008, from http://www.epa.gov/.

[23] Brundlant, 10.

nature and the changing productive potential of the ecosystem. The social aspect of sustainability also emphasizes the importance of community sense, the maintenance of cultural values and 'mending community ties'.[24] In the modernization and globalization period, there appears to be a return towards cultural values.

In the light of all facets of sustainability, the Brundlant report concludes: "Yet in the end, sustainable development is not a fixed state of harmony, but rather a 'process of change' in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs. We do not pretend that the process is easy or straightforward. Painful choices have to be made."[25]

2.2. Sustainable Architecture and Housing Design

2.2.1. Sustainable Architecture

Although the sustainability concept has been used in a more abstract sense since 470-399 BC[26], it has gained significance in the last 30 years due to huge threats to nature. This concept is a new 'paradigm change'[27] influencing any part of life as well as architecture. Considering that in the industrialized world, buildings and the activities within them consume almost half the energy they generate and are responsible for half the carbon dioxide emissions[28], it was inevitable to change the architectural approaches of the society. Consequently, sustainable architecture occurred in the architectural domain after the sustainability paradigm was first defined. Thus, architects will play a significant role in challenging this equation.[29]

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[24] Arsan, 35.

[25] Brundlant, 30.

[26] It was first used by Sokrates while building in terms of sustainability by utilizing the sun. Anderson, B. (1977). Quoted in Demet Eryıldız. (n.d.). Ekolojik Mimarlık. *Ekoses Ekolojik Yaşam Portalı*. Retrieved November 15, 2008, from http://www.ekoses.com/ekolojikyasamportali/bpg/publication_view.asp?InfoID=147012&iabspos=1&vjob=vkwd,ERYILDIZ

[27] Yaldiz Y. Eid and Magdi H. Barakat (n.d.). *Re-thinking Concepts of Sustainable Architecture.* Retrieved November 15, 2008, from King Saud University Web Site from http://faculty.ksu.edu.sa/hs/ArchCairo%202004%20Conference/YaldizEid%20%20%20MagdiBarakat%20%20paper.doc

[28] The Philosophy of Foster and Partners. n.p.

[29] Ibid.

> A sustainable building should address major environmental problems on the global, local and internal levels like climate change, resources, internal environment, external environment and wildlife[30].

In the light of the description of the sustainability in the Brundlant report, sustainable architecture can be defined as "the architecture that meets the needs of the present without compromising the ability of future generations to meet their own needs." [31] It is an outcome of sustainability in architectural domain. It is "a revised conceptualization of architecture in response to a myriad of contemporary concerns about the effects of human activity."[32] According to Williamson, after the harmful effects of human to nature are seen, "the concept of good architecture has shifted to encompass the notion of a building that is sensitive to its environment – one that will adequately protect the environment from the potential pollution and degradation caused by human habitation in many ways the built environment, the very means by which we attempt to create secure conditions, is itself seen as becoming a source of danger and threat."[33] It can be evaluated as a new paradigm owing to its new thinking about architectural design. By designing more 'sustainable architecture' we not only protect nature but also "perform a 'beautiful act'"[34]

> Sustainable buildings are high-quality buildings; they last longer, often cost little or no more to build than conventional designs, cost less to operate and maintain, and provide occupant satisfaction. The benefits of sustainable design are measurable in terms of environmental, economic, and social impacts. The economic benefits come from reduced operating costs and improved occupant performance[35]. The social benefits come from the improved health and comfort of the occupants. The environmental benefits derive from the reduced impact of the building's construction and operations on air, water, landfills, and non-renewable energy resources.[36]

The aim of architecture is to improve both the quality of life and the environment. According to Kremers, the intention of architecture is not only to save resources but to reorder them to serve

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[30] S. Hui. (2002). *Sustainable Architecture: Selected articles.* Quoted in Eid.

[31] Williamson, 1.

[32] Ibid.

[33] Ibid.

[34] Daniel E. Williams. (2007). *Sustainable Design : Ecology, Architecture, Planning.* New Jersey: Wiley, Hoboken, 14.

[35] M. Lewis. (2002). Special LEED Section: Explaining the need for LEED. In *Environmental Design and Construction*, July-Aug., 2002. Quoted in Eid.

[36] Eid, n.p.

better to people.[37] The smart architect thinks rationally about a combination of issues including sustainability, durability, longevity, appropriate materials, and sense of place[38].

> A building exists both in terms of its physical being form, siting and structure and its functional aspects, i.e. the systems and operations that sustain it during its useful life. Both aspects involve the built structure in relationships with the natural environment which take place over time. The built acts like a living organisms; in place of food, it uses of energy and materials, and also produces outputs into its environment. Our theoretical structure should model these exchanges.[39]

The terminology of sustainable architecture is very broad. To avoid confusions, it is useful to point out that sustainable architecture consists of the whole environment friendly building development. Besides, it is not only environmentally-friendly, but also economically-, culturally-, socially-, aesthetically- and health-friendly. Terminologically, the terms that are used for nature-friendly movements in architecture are altering in time. Actually, there is a lack of a comprehensive history of sustainable architecture.[40] There are differentiated keywords depending on time. In 1970's 'environmental design' was the keyword to mention nature-friendly buildings. In 1980's the word was transformed into 'ecological' or 'green' design. Since 1990's, especially after the Rio Summit in 1992, sustainable architecture appeared simultaneously. According to Madge, sustainability concept had already been treated in design disciplines starting in the early 1980s, and it became globally known by the early 1990s, a turning point for sustainable architectural discourse.[41] "These terms are, in fact, quite transposable, whereas such substitution is one indication of shifting attitudes in sustainable design. They are simply the keywords to investigate different facets of the last thirty years." [42] After the discussions on this issue, in the frame of this thesis 'sustainable architecture' is not only "used to describe the movement associated with 'environmentally conscious architectural design'"[43], but also used to describe the movement associated with culturally and economically conscious architectural design.

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[37] J. Kremers. (1995). Defining Sustainable Architecture. In *Architectonic*, vol. 4, no. 3, Dec. 1995. Quoted in Eid.

[38] S. Mockbee and M. Fox. (2001). Building Dreams: an Interview with Samuel Mockbee. In *Sustainable Architecture White Papers* by Earth Pledge. Chelsea: Green Publishing Company. Quoted in Eid.

[39] Yeang, 2000, 63.

[40] Arsan, 57.

[41] P. Madge. (1997). "Ecological Design: A New Critique." *Design Issues* (13, 2): 44-54.

[42] Arsan, 57.

[43] Eid, n.p.

Especially, there are some discussions to show there is a distinction between 'sustainable' and 'green' design. According to Cole, green buildings are defined to achieve incremental improvements in performance buildings relative to a typical practice, whereas sustainable buildings achieve more radical 'absolute' performance measured against global 'biosphere health' and 'carrying capacity criteria'.[44] 'Sustainable architecture' comprises of 'green architecture' as well as the others such as 'environmental design', 'ecological architecture', 'environmentally friendly architecture', 'energy design', 'energy-saving architecture', 'energy-efficient architecture', 'energy-conscious architecture', 'low energy building design', 'bio-architecture', 'bio-climatic architecture', 'climatic design', and recently, 'smart design' and 'intelligent building design'. Terminology's scope is widening in theory and practice continuously. Even the color levels are impressive in architectural domain such as: "A 'deep green building' would have a circular metabolism while a 'light green building' would have a linear though reduced metabolism."[45]

> While architects cannot solve all the world's ecological problems, we can design energy efficient, socially responsible buildings and we can influence transport patterns through urban planning. Importantly, sustainability also implies a way of building that is sensitive to its location and the culture that has shaped it. Although we work on a scale unimaginable 40 years ago, sustainability is an issue that has driven the work of the practice since the early days and continues to inform what we do today. It is a thread that runs through from the very beginning to the present and on into the future.[46]

Although, hundreds of pessimistic questions are still being asked against sustainable architecture such as what exactly it is, the 'sustainable architecture' word has become the overall symbol of the latest environmental movement in architectural domain. According to Faucheux, "the approach of sustainability potentially offers holistic, comprehensive and variable responses to the environmental crisis; and that is why sustainability is not considered a single path or approach, but the notion of sustainability often appears as a 'black box'."[47] What is a sustainable building, or what makes a building sustainable is a still confusing question waiting for its answer. The broadening frame of sustainable building results in this. As Cook and Golton point out, "the designation 'green' is extremely wide ranging, encompassing many viewpoints and open to broad

[44] Cole. (1999). quoted in G. Farmer and S. Guy. (2002). Interpreting Green Design: Beyond Performance and Ideology. *Built Environment, 28-1*, 17.

[45] Haughton. (1997). quoted in G. Farmer and S. Guy. (2002). Interpreting Green Design: Beyond Performance and Ideology. *Built Environment, 28-1*, 18.

[46] The Philosophy of Foster and Partners, n.p.

[47] S. Faucheux, D. Pearce and J. Proops. (1996). *Models of SustainableDevelopment: New Horizons in Environmental Economics.* Cheltenham: Edward Elgar, 2. Quoted in Arsan

interpretation." It is an "essentially contestable concept."[48] Recently, when any principle of sustainable design is applied for a housing project, the project is evaluated as an example of sustainable housing project. For instance, if a building employs technology to reach low energy, water or material consumption, it can be called as sustainable. Similarly, using renewable resources, green technologies, climate, healthy and recycled materials or even just using passive design principles can mark a building as sustainable. All these interpretations have made it more difficult to find the answer to the question what the sustainable architecture is. Sustainable architecture can be appreciated as any kind of environmental-friendly approaches to architecture as well as culture-friendly and economy-friendly ones. To achieve a real sustainable building, none of these parameters can be ignored. As Foster declared above, architects cannot solve all the ecological problems. However, they can be a part of this inevitable movement. Whatever it is, it is useful to accept the principles of this paradigm and try to change our life styles. This is significant in the new millennium for the well being of the ecosystem.

> Sustainability requires us to challenge this equation and to think holistically. The location and function of a building; its flexibility and life span; its orientation, form and structure; its heating and ventilation systems and the materials used; together impact upon the amount of energy required to build, maintain and use it, and travel to and from it.[49]

To be a real sustainable architectural project, it includes a context-specific design problem concerning ecological, social, spiritual, aesthetic, and economic conditions of the case area. For instance, besides ecological design, a regional approach to design is also essential. Climatic and topographic features of the site cannot be ignored in the design period. On the other hand, cultural and regional character of the region should be tried to be sustained as well. Moreover, the spiritual and aesthetic requirements of the people who live in the region should be provided by design. This means that a holistic approach is unavoidable to reach sustainable buildings, environment, cities and community. According to Foster, only by finding new solutions to the existing problems will it be possible to create sustainable forms of buildings for the future.[50] One of the main mistaken ideas about sustainability in the architectural practice is that it is seen just as the energy performance of the building against global warming. Sustainable architecture is not just energy-efficient architecture, indeed, as Foster declares, "the optimum design solution

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[48] Sara J. Cook and Bryn L. Golton. (1994). Sustainable Development: Concepts and Practice in the Built Environment. *Sustainable Construction CIB TG 16, Nov. 1994:* 677–685. Quoted in Guy and Farmer.

[49] The Philosophy of Foster and Partners, n.p.

[50] Ibid.

integrates social, technological, aesthetic, economic and environmental concerns."[51] Braungart radically criticizes the consideration of sustainable design as just energy efficiency:

> Design is the complete opposite of sustainability. We would still live on trees if we were sustainable. Sustainability just keeps the same things over and over again. Instead we should celebrate being human beings and our creativity, which is far more important than sustainability…We are just too stupid to do the right design… Eco-efficiency is really ugly…efficiency doesn't resolve anything. It just makes it perfectly wrong. If you do something wrong, don't make it perfect, because then it is perfectly wrong. Beautiful design just happens to be perfectly inefficient.[52]

It seems that he is against sustainable design so far in the essay. Yet, at the end of the essay he asks the designers "why they do not start making good things, things that will produce only nutrients in ten years time. Then you can actually support the planet and everyone living on it." He mentions that sustainable design should not only be energy efficient, but also be a real part of nature. For instance, after 50 years time, the building materials can transform themselves to nutrients for the living creatures of the ecological system.

It is the holism of all the aspects to apply for the sustainable building. There is another holistic approach for sustainable design. It is applying the concept as a whole for the regions and the countries. Sustainability will not be achieved if it is appreciated only by several blocks. Several perfectly sustainable houses cannot cause the concept to succeed. The concept should be applied, not just at the scale of individual buildings, but beyond that at the scale of communities and regions, as a matter of survival. Guy and Farmer's sustainable architecture logics grouping will be considered in the next part to consider sustainable architecture deeper.

2.2.2. Different Facets of Sustainable Architecture

Six Logics of Sustainable Architecture

The broadening sustainable architecture concept is tried to be framed by the academicians and architects; however, it can be said that the most famous grouping of sustainable architecture is made by Guy and Farmer. They identify different approaches to sustainable design as 'six

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[51] Norman Foster. (2003). *Architecture and Sustainability*. Retrieved November 20, 2008, from Foster and Partners Web Site from http://www.fosterandpartners.com/content/essays/Architecture%20and%20Sustainability.pdf

[52] Michael Braungart (n.d.). *Is Sustainability Boring?*.Retrieved December 10, 2008, from Green Building Web Site from http://www.greenbuilding.co.za/index.php/Vol2-Issue10/Is-Sustainability-Boring.html

alternative logics'. The roots of the logics compete in terms of environmental conceptions and explore "the ways in which each logic prefigures technological strategies and alternative visions of sustainable places."[53] The logics are eco-technic, eco-centric, eco-aesthetic, eco-cultural, eco-medical and eco-social logics.

The eco-technic logic

The eco-technic logic is based on a techno-rational, policy-oriented discourse which represents a belief in incremental, techno-economic change and that science and technology can provide the solutions to environmental problems.[54] Energy efficiency is prioritized here. The role and context of sustainable buildings becomes prioritized in terms of global action and local reaction. Ecological modernization which "indicates the possibility of overcoming the environmental crisis without leaving the path of modernization"[55] is promoted in this logic. "The only possible way out of the ecological crisis is by going further into industrialization."[56] It is possible to say that there is a high-tech approach to sustainable buildings with this issue. This approach tends to be overwhelmingly quantitative. Success is expressed in the numerical reduction of building energy consumption, material-embodied energy, waste and resource-use reduction, and in concepts such as life-cycle flexibility and cost-benefit analysis.

The technical image forefronts the measurable environmental facts of the constituents of air, lighting and noise level, resource consumption, along with equally measurable economics. Success can also be measured by reduced energy consumption, reduced embodied energy in materials, internal temperatures and lighting levels within desired levels, reduced initial and operating costs. The key is rationality and efficiency in planning, material use and systems.

The eco-centric logic

Contrary to the eco-technic logic with its emphasis on incremental technical change and optimism in the adaptability of institutions to accommodate environmental demands, the eco-centric logic is founded on a need for a radical reconfiguration of values.[57] In this logic, each

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[53] S. Guy and G. Farmer. (2001). Reinterpreting Sustainable Architecture: The Place of Technology. *Journal of Architectural Education 54 (3, Feb):* 140.

[54] Ibid.

[55] Gert Spaargaren and Arthur P.J. Mol. (1992). Sociology, Environment and Modernity: Ecological Modernisation as a Theory of Social Change, *Society and Natural Resources 5 (1992):* 323–344. Quoted in Guy and Farmer, 2001.

[56] Ibid.

[57] Guy and Farmer, 2001, 142.

building is seen as an act against nature, each of them is a parasite.[58] As a framework of analysis, it emphasizes both the epistemological holism implicit in ecology and the metaphysical reality of ecological wholes.[59]

The eco-aesthetic logic

The eco-aesthetic logic differentiates from the previous two logics in terms of the efficient resource use and ecological footprint reduction. It is an issue beyond these. "Here the role of sustainable architecture is metaphorical and, as an iconic expression of societal values, it should act to inspire and convey an increasing identification with nature and the nonhuman world, what is required is a 'new language in the building arts.'[60] "[61] How to represent the epoch shift of the new millennium and the transition to a holistic, ecological worldview or zeitgeist is searched under this logic. It tries to create a new universal architectural iconography that has transformative value in altering our consciousness of nature.

The eco-cultural logic

The eco-cultural logic emphasizes a fundamental reorientation of values to engage with both environmental and cultural concerns.[62] The issue in this logic is preserving the diversity of the existing cultures instead of promoting a new universal culture. The authenticity and the notion that truly sustainable buildings need to be more related to the concept of locality and place are the keywords here. The *genius loci* emphasis is intended to counteract the deficiencies of abstract modernist space and is a reaction against the globalism of the International Style. In the light of this logic, our ethical responsibilities must resist to the phenomena of universalization prevalent in modern culture. According to Frampton, "sustaining any kind of authentic culture in the future will depend ultimately on our capacity to generate vital forms of regional culture."[63] Sustainable architectural approaches should move away from universal and technologically based design methodologies as these often fail to coincide with the cultural values of a particular place or people.[64] The transformation and reuse of traditional construction techniques, building

[58] Steve Curwell and Ian Cooper, "The implications of urban sustainability," *Building Research and Information* 26/1 (1998):17–27.

[59] Guy and Farmer, 2001, 142.

[60] James Wines. (1993). The architecture of ecology. *The Amicus Journal, Summer 1993:* 23. Quoted in Guy and Farmer, 2001, 143.

[61] Guy and Farmer, 2001, 143.

[62] Ibid, 144.

[63] Kenneth Frampton. (2007). *Modern Architecture: A Critical History.* London: Thames and Hudson, 317.

[64] Guy and Farmer, 2001, 144.

typologies, and settlement patterns, each with a history of local evolution and use can be utilized to appreciate this logic.

> The cultural image portrays a distinct and meaningful genius loci of which architecture is a part. It mirrors an anthropological view that promotes keeping people culturally in place, combined with a belief that 'the local culture knows best'…New building is expected to rework rather than reproduce the vernacular, to be identifiably contemporary while eminently respectful of the past.[65]

The eco-medical logic

The eco-medical logic is a more humanistic and social concern for sustaining the individual health. It is generated through a medical discourse that tends to relate "the health of the individual to an increasingly important condition: a healthy environment."[66] A new relationship of human beings to the environment has been legitimated through an understanding that the health of individuals is conditioned by the external environment.[67] In the building scale, the eco-medical logic tends to focus a critical attention on the interior of buildings, where the concept of sick buildings is a familiar emblematic issue applied to both working and domestic environments.[68] In sick building syndrome, it seems that our health is literally threatened by the technologies that were created to protect it. Many people spend their lives in anonymous, universal environments which are artificially lit, mechanically ventilated, and effectively cut off from the outside world. Human factor must be taken into account more than the existence to protect the dweller's health. Spiritual well-being is also an inseparable part of health. What is required is "healing environments," ones in which we feel "balanced, relaxed and at one with the world," an architecture that can "honor the senses."[69]

> Mental health accompanies physical health: a healthy mind in a healthy body in a healthy building, in which humans and other creatures live in happy harmony.[70]

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[65] Williams, 30.

[66] Isabelle Lanthier and Lawrence Olivier. (1999). The Construction of Environmental Awareness. In Eric Darier (ed.), *Discourses of the Environment*. Oxford: Blackwell, 65. Quoted in Guy and Farmer, 2001, 145.

[67] Guy and Farmer, 2001, 145.

[68] Sick building syndrome is a term used to describe a set of commonly occurring symptoms that affect people at their place of work, usually in office type environments. These include headaches, fatigue, irritation to the eyes, nose, and skin, a dry throat, and nausea.

[69] Pearson. (n.d.). *Making Sense of Architecture*, pp. 68–69. Quoted in Guy and Farmer, 2001, 145.

[70] Williams, 28.

The eco-social logic

The eco-social logic addresses the emblematic issue of democracy as the key to an ecological society.[71] It is as much social as technical and aesthetic, and it highlights the political issue of democratic control over technology and expertise. It extends the sustainability paradigm beyond individual concern. It points out that the root cause of the ecological crisis stems from wider social factors. "It is only through a model of community that is created to serve common needs and goals, where humans experience true freedom and individual self-realization that they will be able to live in harmony with the natural world."[72] The design approach in this logic aims to express the organic formation of society with links to the natural locality within which communities are developed. As a consequence of this, the human will become more aware of his impact on the environment.

[71] Guy and Farmer, 2001, 145.

[72] Ibid.

Table 2.1: Guy and Farmer's six competing logics of sustainable architecture

S. Guy and G. Farmer. *Reinterpreting Sustainable Architecture: The Place of Technology.* (Journal of Architectural Education, 54, 2001), 141.

Logic	Image of Space	Source of Environmental Knowledge	Building Image	Technologies	Idealized Concept of Place
Eco-technic	global context macrophysical	Technorational scientific	commercial modern future oriented	integrated energy efficient high-tech intelligent	Integration of global environmental concerns into conventional building design strategies. Urban vision of the compact and dense city.
Eco-centric	fragile microbiotic	systemic ecology metaphysical holism	polluter parasitic consumer	Autonomous renewable recycled intermediate	Harmony with nature through decentralized, autonomous buildings with limited ecological footprints. Ensuring the stability, integrity, and "flourishing" of local and global biodiversity.
Eco-aesthetic	Alienating anthropocentric	sensual postmodern science	iconic architectu ral New Age	pragmatic new nonlinear organic	Universally reconstructed in the light of new ecological knowledge and transforming our consciousness of nature.
Eco-cultural	cultural context regional	Phenomenology cultural	Authentic ecology harmonious typological	local low-tech commonplace vernacular	Learning to "dwell" through buildings adapted to local and bioregional physical and cultural characteristics.
Eco-medical	polluted hazardous	medical clinical ecology	healthy living caring	passive nontoxic natural tactile	A natural and tactile environment which ensures the health, well-being, and quality of life for individuals.
Eco-social	social context hierarchical	sociology social ecology	democratic home individual	Flexible Participatory appropriate locally managed	Reconciliation of individual and community in socially cohesive manner through decentralized "organic," nonhierarchical, and participatory communities.

Generally, as an alternative to the six logics, sustainable architecture issues are also sorted under only three- or four-titles including natural, cultural and technological facets of sustainable design. In other words, they are the environmental, social and economical facets of the paradigm. These three images have been implicitly presented as corners of a triangle. [73]

> The sustainability of all three – environmental, socio-cultural and economic systems – is sometimes called the 'triple bottom line' by which the viability and success of design and development should be assessed.[74]

In the environmental sustainability of architecture, the key to architectural sustainability is to work with, not against, nature; to understand, sensitively exploit and simultaneously avoid damaging natural systems.[75] The natural image assumes purity in the environment. According to Williams, the principles of ecological sustainability involve: a) the rates of use of renewable resources not exceeding the rate of regeneration; b) the depletion rates of non-renewable resources not exceeding the rate at which renewable substitutes are invented and invested; c) rates of pollution not exceeding the assimilative capacity of the environment; and d) waste emission not exceeding the assimilative capacity of the local environment. [76] Environmentally sensitive buildings can be described as living species[77] that will harvest all their own water and energy needs on site.[78]

In economical sustainability of architecture, the key to architectural sustainability is economy and an economic development model. It influences not only the inhabitants, but also the country. With sustainability paradigm, for instance, the regions will gain an ability to provide all their needs on their lands. As a result of this, their economical system will work efficiently. On the other hand, in the dweller scale, the dweller who will benefit from this issue owing to the sustainable building, will not spend more money than usual. The primary constraint hampering the achievement of economic sustainability is the need to balance economic benefits generated by

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[73] Williams, 25.

[74] Williamson, 4.

[75] Williams, 27.

[76] Rebecca L. H. Chiu (2003). *Sustainable Development: A New Perspective for Housing Development,* 4.

[77] J. F. McLennan. (2002). How Buildings Behave, Part 1 - Buildings as Species. *Environmental Design and Construction, Jan-Feb., 2002*. http://www.edcmag.com/CDA. Quoted in Eid.

[78] Eid, n.p.

an activity with the economic costs. [79] The costs of inputs, extraction and/or processing are crucial. The availability of inputs and the demand for the product are also important for sustaining economic activities. Moreover, environmental costs (e.g. the damage to the ecological system due to the use of natural resources or the reduction in the stock of renewable resources as consumption exceeds the speed of replenishment) theoretically need to be accounted as production costs, though this may prove difficult, if long term sustainability and equity are to be sought as mandated by the advocacy of sustainable development (Munro, 1995).[80] Considering that, in developing countries, like Turkey, economy is a major parameter for architectural design, it will be seen that this issue has a wider potential to influence the people in terms of sustainable architectural design in Turkey.

The social sustainability of architecture is a people-oriented interpretation. It refers to maintaining or improving the well-being of people for the present and future generations. The emphases are social cohesion and integrity, social stability and improvement in the quality of life. [81] Thus, there needs to be equitable distribution and consumption of resources, harmonious social relations and acceptable quality of life to be sustainable. This interpretation of social sustainability reminds us the principles of sustainable development defined by WCED in terms of equity and social justice for the present and future generations. Cultural sustainability is also mostly evaluated under the social sustainability of architecture.

[79] Chiu, 6.

[80] Ibid.

[81] Chiu, 7.

Table 2.2: Three images of architectural sustainability

Daniel E. Williams. *Sustainable Design : Ecology, Architecture, Planning*. (Wiley, 2007), 25.

Image	Dominant concerns	Dominant horizon	Symbolism/aesthetics	Approach
Natural	Environmental place, ecosystems, health, balance	Local	'Touching the earth lightly' with forms echoing nature	Study local natural systems; emphasize sensitivity and humility in relation to nature
Cultural	Cultural place, people, genius loci, difference, cultural sustainability	Local	Highly contextual with forms, materials and construction methods and echoing the local vernacular	Study local culture and building; emphasize local ivolvement and local expertise
Technical	Technologies, global environmental impacts, cost-benefit analysis, risk management	Global	Leading edge contemporary international systems	Study science, economics and technology; emphasize transnational expertise

As is seen, the sustainability level of a building is a very complex issue to measure and evaluate. Building assessment programs have been employed mostly by northern countries to attain international standards needed for labeling buildings as sustainable. However, simultaneously, they were criticized due to the fact that "they do not necessarily help people design (though that is usually their intent), and may actually mislead because they cannot cope with the complexities and uniqueness of a particular design situation. In this sense they can be 'unecological', given that the concept of ecology has taught us to take account of complexity, interconnectedness and uniqueness."[82] On the other hand, "by using indicators to model or monitor performance, the full complexity of sustainable development could be reduced to measurable parts. It will not tell you

[82] Williams, 13.

the whole picture, but as a design or management tool it could point in the right direction."[83] As a consequence, it seems that a new model recognizing the interpretative flexibility of the sustainability concept is required.[84]

> Rather than searching for a singular optimal technological pathway, it is vital that we learn to recognize and listen to the number of voices striving to frame the debate and the visions they express of alternative environmental places.[85]

Rather than viewing sustainable design practice as the "implementation of a plan for action, it should be viewed as an on-going transformational process in which different actor interests and struggles are located."[86] It seems beneficial to understand the strategic priorities of those involved in its design and construction.[87] The sustainable development is complex and many types of solutions are possible depending upon the priorities or conditions of a particular site.

> As decision-makers we inevitably place the priorities on objectives which reflect our values, but we should note the general hierarchy of ecological, social and built contexts.[88]

Building assessment tools are mostly used to evaluate sustainable buildings in the world. However, it can be mentioned that even they are not enough to measure all the facets of sustainable design. "Without an extensive concept of context, architecture will not be able to identify and integrate the larger dynamics of sustainability." [89] Innovative building assessment programs should be developed according to the regions concerning all the facets of sustainable design such as environmental, social and economical. "Merely teaching architects the technical components, systems, conservation strategies, and their integration in ''environmental control''

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[83] Brian Edwards and David Turrent. (2000). *Sustainable Housing : Principles & Practice.* New York, London: E & Fn Spon, pg29

[84] S. Guy and G. Farmer. (2002). Interpreting Green Design: Beyond Performance and Ideology. *Built Environment, 28-1,* 12.

[85] Guy and Farmer, 2001, 146.

[86] Norman Long and Ann Long. (1992). *Battlefields of Knowledge: The Interlocking of Theory and Practice in Social Research and Development*. London: Routledge, 9. Quoted in Guy and Farmer, 2001.

[87] Guy and Farmer, 2002, 20.

[88] Williams, 136.

[89] Kiel Moe. (2007). Compelling Yet Unreliable Theories of Sustainability. *Journal of Architectural Education, 60-4,* 28.

courses limits the horizon of sustainability."[90] There should be a deeper knowledge about sustainable design. Otherwise, there will appear unwanted problems. The paradigm itself will be used for different intentions. It will be like an illusion of change. William McDonough points out this as follows:

> Relying on eco-efficiency to save the environment will in fact achieve the opposite—it will let industry finish off everything quietly, persistently, and completely. We are focused here on a new way of designing industrial production. As an architect and industrial designer and a chemist who have worked with both commercial and ecological systems, we see conflict between industry and the environment as a design problem—a very big design problem.[91]

Arranging a universal rating system does not seem to be the most beneficial solution to the framework and utilization of sustainable design. According to Williams, "each society must define its needs in its own way."[92] In other words, each society's priorities differentiate depending on the regions. Thus, each society or country should create their own sustainable design rating systems.

To be green in more than a token fashion, Sylvan recommends having some commitment to containing or reducing the environmental impact of humans on the earth or region of it:

- Human population reduction, or
- Less impacting life styles for many humans, or
- Improvements of technology to reduce overall impact."[93]

He puts them in the form of the equation:

El = P x C x T, or

Environmental Impact of a group = Population x Consumption x Technology"[94]

Sustainable architecture should be comprehended holistically. The concept can be framed under six, three or four logics. Yet, the aim of the concept should be realized and implemented correct.

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[90] Ibid., 25.

[91] McDonough, n.p.

[92] Williams, 75.

[93] Richard Sylvan and David Bennett. (1994). *The Greening of Ethics*. Cambridge, UK : White Horse Press ; Tucson, USA : University of Arizona Pres. Quoted in Edwards, 23.

[94] Edwards and Turrent, 47.

The different facets of the concept should be utilized as much as possible according to the priorities.

2.2.3. Sustainable Housing

It is possible to define sustainable housing as 'housing that meets the perceived and real needs of the present in a resource efficient fashion whilst providing attractive, safe and ecologically rich neighborhoods."[95] Housing is not only the most implemented project type in the world, but also the most affective one to the human life. Edwards puts it in the center of the sustainable design triangle: "The concept of sustainable development embraces a compact between society today, environmental resources and society's future needs. Put simply there is a triangular structure of interdependencies at a strategic or global level with housing at the centre."[96] According to Lock, housing has a greater impact upon global and social harmony than any other building type. Housing needs to support family life, community cohesion, and ecological well-being.[97] Besides its specific features such as supporting family life, housing also has to be healthy, comfortable and cheap to run. Housing has invisible crucial tasks in terms of sustainability. For instance, no society is balanced and sustainable unless housing addresses difficult issues such as social exclusion, crime, employment opportunities as well as the usual priorities of energy and environmental performance. Along with job security and education, housing is central to the public's perception of quality of life.[98]

> Green housing is not easy to achieve, especially within the constraints of typical housing budgets, but when over a quarter of all CO2 emissions are the result of how we heat, light and ventilate dwellings, there is no alternative approach to housing design.[99]

There is an extra capital cost of a sustainable housing complex. It varies according to the design and specification but is usually 5-15% greater than the norm. Just adding about 8% to

[95] Ibid., 20.

[96] Ibid., 28.

[97] David Lock. (2000). In Brian Edwards and David Turrent (Eds.), *Sustainable Housing: Principles & Practice*. London, New York: E & Fn Spon, 38.

[98] Ibid., 124.

[99] Ibid., 122.

construction costs with a payback period of about six to ten years will maintain a potential sustainable house.[100] The customer benefits are the low energy bills while the government benefits are the lower national CO2 emission levels. According to the Edwards, five conditions for sustainable housing are as follows:

- Low resource use: energy, water, other resources (land, minerals etc.)
- Safe: security through design
- Healthy: physical health, mental health (stress)
- Productive: socially, economically
- Beautiful: aesthetically, spiritually, ecologically[101]

According to Edwards, to implement sustainable housing two distinct strategies are needed. Firstly, "a campaign of persuasion and demonstration projects to show that the new demands can be met in an attractive fashion." [102] This is a very significant issue to achieve for architects due to the fact that ugly, anti-aesthetical buildings will not be chosen. A new sustainable architecture aesthetic needs to be created. Secondly, "there will need to be greater regulation of the housing market by stricter planning controls, tougher performance standards for new houses, and higher upgrading levels for the existing stock. Such measures are needed not just in the energy field but in water use, environmental and waste management, in transport policy, and in action to create local biodiversity in housing areas."[103]

> Housing by nature is multi-faceted. It consumes natural resources and produces impact on the natural environment. It constitutes a major economic activity and impacts on the general economy. It is an important component of social development and quality of life. It is often used by governments to achieve political and economic ends. It is also a cultural attribute, manifesting the aesthetic value and the way of life of man in his particular setting. A holistic perspective is therefore needed if we wish to chart the future of housing development. The sustainable development paradigm offers such a possibility.[104]

Chui, in her paper *Sustainable Development: A New Perspective for Housing Development,* clearly explains different facets of sustainable housing. She points out that by applying the

[100] Lock, 24.

[101] Edwards and Turrent, 140.

[102] Ibid., 32.

[103] Ibid.

[104] Chiu, 1.

framework, housing issues will be considered in a more holistic and long-term perspective.[105] Similar to the previous part in sustainable architecture, in addition to 'ecological sustainability', the concepts of 'economic sustainability', 'social sustainability', and 'cultural sustainability' have also been incorporated as key dimensions of sustainable housing. Chiu adds: "The linkages between these different dimensions of sustainability should be fully taken into account, and that they should not be isolated from one another." [106]

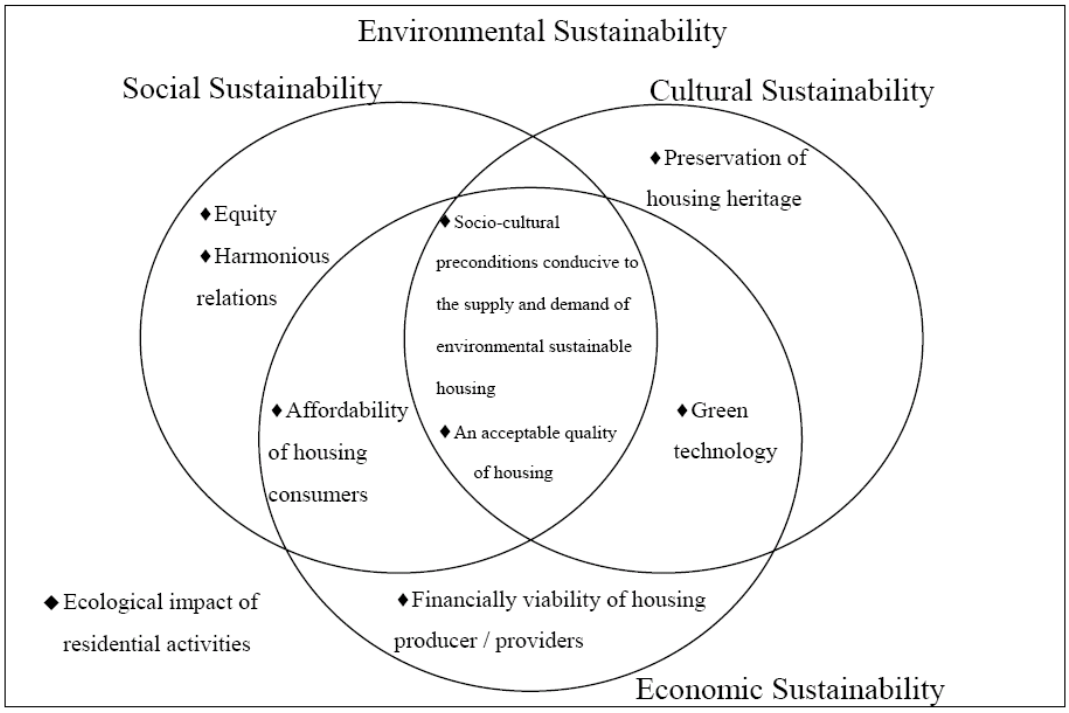

Figure 2.2: Different Facets of Sustainable Housing [107]

Rebecca L. H. Chiu. *Sustainable Development: A New Perspective for Housing Development* (2003), 4.

Sustainable housing should not be merely about meeting basic needs, but should also improve livability. Improved livability does not only mean larger space and more facilities, but also healthy, safe, affordable and secure living within a neighborhood with provision for piped water, sanitation, drainage, transport, health care, education and child development. Moreover, a home protected from environmental hazards, including chemical pollution. It is also significant to meet

[105] Chiu, 12.

[106] Ibid., 2.

[107] Ibid., 14.

the needs related to people's choice and control, including homes and neighbors which they value and where their social and cultural priorities are met.[108]

> There is a little genuine social progress without good quality housing. Housing is at the root of cultural and economic vitality because it is the agent that cements communities.[109]

In this chapter, sustainability, sustainable architecture and their relations were considered before coming to sustainable housing. It was seen that sustainability as a philosophy influences the whole human life as well as the architecture. Therefore, sustainable architecture influences housing which is the cement of it. All the features of sustainable architecture such as the six logics are also available for sustainable housing. These logics will be utilized in the next chapter. In the next chapter, the subheadings of 2008 LEED for Homes Rating System will be pointed out to understand the limits of sustainability in housing environments.

[108] Chiu, 3.

[109] Edwards and Turrent, 12.

CHAPTER 3

2008 LEED FOR HOMES RATING SYSTEM AS A FRAMEWORK FOR SUSTAINABLE HOUSING DESIGN

To utilize the concept of sustainability in architectural design and overcome the difficulties caused by the complexities of the concept, different rating systems are used. There are numerous sustainable design rating systems in the world right now such as LEED in the United States, BREEAM in England, TGBRS in India, CASBEE in Japan, NABERS in Australia, HQE in France, European Eco-Labeling in European Union, Ecocerto in Italy, Ecolab in Holland, SIB in Sweden, BauBioDatabank in Germany and LCA tool in Canada.[1] All the countries are arranging their rating systems according to their consideration to preserve the environment.

In the frame of the thesis, the Leadership in Energy and Environmental Design (LEED) rating system was chosen. The LEED for Homes Rating System "encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria."[2] There are some reasons to choose this system. First of all, it is the most developed rating system with its widest coverage in terms of sustainable design. The wide coverage of the system maintains a wide base to the thesis trying to understand the limits of sustainable design. It is one of the most significant developments in the transition towards more sustainable design.[3] Another reason is that it was created by a highly respected council of the world in terms of green design, the U.S. Green Building Council.[4] In the past 15 years, the council designed various sustainable building

[1] Selda K.Karaosman and Özlem Eren. (2008). Sürdürülebilir ve Akıllı Binalarda Çevresel Değerlendirme Araçlarının Kullanımı. *Batı Akdeniz Mimarlık, 40*, 95.

[2] US Green Building Council Web Site. (n.d.). Retrieved December 10, 2008, from http://www.usgbc.org/displaypage.aspx?CMsPageID=222

[3] J. F. McLennan and P. Rumsey. (2002).The Green Edge: Is LEED the Holy Grail of Sustainable Design?. *Environmental Design and Construction. July-Aug., 2002.* Quoted in Eid.

[4] It is a non-profit community of leaders working to make green buildings available to everyone within a generation in the United States. US Green Building Council Web Site, n.p.

rating systems such as ‘New Construction’, ‘Existing Buildings: Operations and Maintenance’, ‘Commercial Interiors’, ‘Core and Shell’, ‘Schools’, ‘Retail’, ‘Healthcare’, ‘Neighborhood Development’ and ‘Homes’. In 2008 February, the council published the LEED for Homes Rating System peculiar to the dwelling design. This is the other reason to choose the LEED as a reference considering the subject of the thesis is housing.

It is useful to point out that the rating system will not be utilized to evaluate or grade the case studies. Considering that TOKİ barely takes sustainability into account in their projects, it seems to the writer irrelevant to conduct a comparative study with the LEED rating system. The credit categories defined in the system will be used to understand sustainability criteria for housing design before criticizing the TOKİ projects.

The 2008 LEED for Homes Rating System with its widest coverage maintains a broad understanding of sustainable housing design. The system measures the overall performance of a home in eight categories:[5]

1. Innovation and Design Progress (ID): It concerns special design methods, unique regional credits, measures not currently addressed in the Rating System, and exemplary performance levels. (Maximum point available: 11)
2. Location & Linkages (LL): It concerns the placement of homes in a socially and environmentally responsible ways in relation to the larger community. (Maximum point available: 10)
3. Sustainable Sites (SS): It concerns the use of the entire property so as to minimize the project’s impact on the site. (Maximum point available: 22)
4. Water Efficiency (WE): It concerns water-efficient practices, both indoor and outdoor. (Maximum point available: 15)
5. Energy & Atmosphere (EA): It concerns energy efficiency, particularly in the building envelope and heating and cooling design. (Maximum point available: 38)
6. Materials & Resources (MR): It concerns efficient utilization of materials, selection of environmentally preferable materials, and minimization of waste during construction. (Maximum point available: 16)
7. Indoor Environmental Quality (EQ): It concerns improvement of indoor air quality by reducing the creation of and exposure to pollutants. (Maximum point available: 21)

[5] LEED for Homes Rating System. (2008). The Leadership in Energy and Environmental Design (LEED), U.S. Green Building Council.

8. Awareness & Education (AE): It concerns the education of homeowner, tenant, and/or building manager about the operation and maintenance of the green features of a LEED home. (Maximum point available: 3)

The LEED for Homes Rating system works by requiring a minimum level of performance through prerequisites and rewarding improved performance in each of the above categories. According to the numbers of points earned, the level of performance is indicated by four performance tiers. They are Certified, Silver, Gold and Platinum.

Table 3.1: LEED for Homes Certification Levels

U.S. Green Building Council. *The Leadership in Energy and Environmental Design (LEED) for Homes Rating System.* (2008).

LEED for Homes Certification Levels	Number of LEED for Homes points Required
Certified	45-59
Silver	60-74
Gold	75-89
Platinum	90-136

The system is a performance indicator concerning many calculations to show the holistic performance of the buildings in terms of sustainable design. In this chapter, it is expected to use the system as a base and a reference to understand its approach to sustainable housing design. The sustainability criteria of the system for housing design are used in this study whereas its grading part is ignored. The subheadings of the 2008 LEED for Homes Rating System will be the subheadings of the following two chapters. The subheadings of the system are as the following: Innovation and Design Process, Location and Linkages, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality and lastly Awareness and Education. Under the rating system's subheadings, the issues concerning sustainable design will be examined with the help of not only the LEED system, but also the other main resources of the thesis such as the books of Edwards and Roaf. In this chapter, the issues under the eight categories of the LEED will be examined, and in the fourth chapter, they will be searched on TOKİ case studies before some proposals are made with the help of good practices.

3.1. Innovation and Design Process

3.1.1. Integrated Project Planning

Architectural design is gradually becoming a more complex process while it seeks to embrace the various aspects of sustainability. The way how the buildings are affected by their own shape and materials, its impact on urban and natural environment, and how this will affect the building, turns into a critical issue of the design process for sustainable architecture. Cadima points out that "the architectural design process should be dynamic and look holistically at all building technologies and systems, including the urban dimension. Designing towards sustainability is designing with an integrated approach."[6] Integrated design approach cannot be separated from sustainable design. This issue is also called 'whole building design'. According to Zachman, this is not a kind of design consisting of different parts. It is even greater than the sum of its parts.[7] No longer can sustainable housing project be seen as an individual design for architect. It requires an integrated design process. The aim of integrated project planning is to "maximize opportunities for integrated, cost-effective adoption of green design and construction strategies."[8] The importance of an integrated project team cannot be ignored in sustainable housing design either. "No matter how beautiful or low energy usage the design may be, the creation of sustainable housing requires team effort and the ethos of partnership."[9] During the design process, wide groups including architects, city planners, civilians, engineers, sociologists, ecologists, meteorologists, geologists, and economists should come together in order to create building projects. They should do essential analysis and design sustainable strategies for the subject building.

3.1.2. Durability Management Process

Generally, the housing project is expected to be durable. Yet, it is an obligation for sustainable housing to be durable. The target of this process is to "promote durability and high performance

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[6] Paula Cadima. (2007). *An Integrated Building Design Approach*. European Commission, EACI - Executive Agency for Competitiveness and Innovation, Brussels, Belgium.

[7] W. Zachmann. (2001). "Whole Building" Approach to Sustainable Design**.** *Environmental Design and Construction, Jan-Feb., 2001*. Quoted in Eid.

[8] LEED for Homes Rating System. (2008). The Leadership in Energy and Environmental Design (LEED), U.S. Green Building Council, 19.

[9] Edwards and Turrent, 12.

of the building enclosure and its components and systems through appropriate design, materials selection, and construction practices."[10] The building enclosure is very significant for energy efficiency of the building. As a principle of sustainability, it should last long with low maintenance, or no maintenance. Problems such as moisture should be prevented not to damage the enclosure.

3.1.3. Innovative or Regional Design

Sustainable housing project, concerning many issues, cannot be exactly framed by one code system such as LEED. For instance, with the help of performance analyses, it is possible to measure the environmental or economical sustainability of a building while it is not so easy to measure the social or cultural sustainability of it. Thus, this makes sustainable design open to any kind of innovative or regional design issues. In the LEED system, the goal of this approach is described as to "minimize the environmental impact of the home by incorporating additional green design and construction measures that have tangible and demonstrable benefits beyond those in the LEED for Homes Rating System."[11]

Innovative approaches to sustainable housing design must appear continuously with the help of practice. "There are often links between the ecology of a building, which is measurable, and the poetic dimensions of architecture, which are more difficult to quantify."[12] For instance, in a project, the eco-aesthetic logic of sustainable housing can be used, as a priority, more than its other logics. This approach will also add a sustainable value to the building according to the grouping of Guy and Farmer. Sustainability cannot only be measured in terms of energy efficiency, or even other environmental issues such as water efficiency or material choices. It should be open to innovative sustainable design approaches.

Regional design provides both environmental and cultural sustainability. In the regional design, in environmental terms, the climate and the topography of the site is taken into account in the design period. The same typology of buildings is not constructed on totally different regions. In social terms, the culture of the region is sustained by design. The existing pattern of the region, the existing architectural features of the buildings, the existing life styles of the inhabitants, the

[10] LEED, 21.

[11] Ibid., 23.

[12] Foster, 2003, 2.

existing cultural issues are taken into account in the design period in regional design. Regional design replies to the aims of eco-cultural logic.

3.2. Location and Linkages

3.2.1. LEED Neighborhood Development (LEED ND)

LEED Neighborhood Development is a rating system that includes a broad range of issues from city scale to housing scale. It is composed of four parts: Smart location & linkage, neighborhood pattern and design, green construction and technology, and lastly, innovation and design process. Showing each parameter of LEED ND will be a wide issue as a matter of this thesis. Thus, the following issues are defined under 'Design Phase' title in the next chapters: Settlement of the blocks, the slope design of the site, user profile, flexibility and adaptability of the building.

The settlement of the blocks issue should be very well considered while calculating the energy efficiency of the complex. The settlements should be arranged according to sun and wind to benefit from them throughout the life cycle of the buildings. Direct solar access to each block should be provided to benefit from the sun in terms of both heat and light. Overshadowing should be prevented. The blocks should be oriented and designed to give solar access to surrounding areas and other building forms.[13]

Dominant wind directions should be considered to utilize in summer and to avoid in winter in climatization of the site and the buildings. Roaf declares that to utilize the wind while designing, first of all, the correct wind should be chosen and entitled. It should be taken into account while configuring the buildings. "The wind can be an agent of terror or delight, it can soothe or destroy and it is one of the most important of the invisible building blocks of architecture."[14]
She explains the following advices for passive conditioning of outdoor air:[15]

- Wind breaks: These can be used not only to lessen the impact of strong hot or cold wind but also, if shrubs and trees are used, the air will pick up moisture from the leaves and so increase its humidity, so cooling the air.
- Dust: Use air that has passed over natural planted groundcover to reduce dust levels.
- Natural air-conditioning: Use air that has travelled over water or vegetation, for coolth.

[13] Yeang, 2006, 125.

[14] Sue Roaf. (2001). *Ecohouse: A Design Guide*. Oxford: Architectural Pres, 96.

[15] Ibid., 107.

- Sound barriers: If the site is noisy build a substantial garden wall to keep the noise out.
- Coolth ponds: This works with cooler air descends principle.
- Sun traps: If higher air temperatures inside the house are required, expose the ground surface in a sheltered sun spot facing towards the south or west, and shelter from the incident wind.
- Basement coolers: Use the prevailing wind and the coolth of a basement to lower the temperature of the air around the house before it is taken in to ventilate the building.
- Wind catchers or ducts through which air travels before reaching the house can reduce or increase the temperature of the air entering the building, as air issuing from ducts in the wall can be cooler or warmer than the incoming air.
- Use pavements around the house to condition the air.
- Use 'breeze walls' around the garden of the building or on roof parapets.
- Heat-scape the external envelope of the building
- Choose your location in the street carefully

Concerning the slopes of the site in order to maintain the dweller comfort is another aspect of LEED ND. Ramps should be promoted instead of stairs. Naturally sloped ramps are useful for cyclists and disabled people if slope ratios are considered as about 6%. The slope ratio which is more than 15% makes even the pedestrian walking very difficult. Yeang proposes to accept slope constraints not to disturb the land. His advice is "to excavate only when essential."[16]

Building dwellers will differ from each other in their needs and preferences. Thus, the buildings should be constructed in different alternative models. The user profile should be analyzed before the construction as a crucial input to the design. Concerning the user profile is not enough in a sustainable building, but the buildings should be flexible. To be sustainable, we must build for the long term. Flexibility is a key consideration.[17]

> Social sustainability in housing requires adaptability of the structure. House types need to change in order to avoid the need for families to move. Sustainable communities are lasting communities where families invest long periods of time in their neighborhood.[18]

[16] Ken Yeang. (2006). *Ecodesign: A Manual for Ecological Design*. Great Britain: Wiley-Academy, 124.

[17] Foster, 2008, 5.

[18] Edwards and Turrent, 25.

Adaptability is also one of the most important tools in sustainable architecture. The constant cycle of demolition and rebuilding puts a huge strain on natural resources and energy usage; in terms of sustainability, demolition should be the option of last resort. "In Britain alone demolition produces a staggering 70 million tonnes of waste materials annually. Construction of new buildings uses approximately 4 per cent of Britain's total energy consumption and generates 40 million tons of carbon dioxide each year. Up to 60 per cent of the energy and resources used in construction is spent on the shell and core of a building, so retention of a building's structure through conversion makes sound ecological sense." [19] In this sense, converting the existing buildings into more sustainable ones will be more beneficial to reach a more sustainable environment and community. However, unfortunately, "most effort is directed towards the design of new housing, not the upgrading of existing buildings.[20] Extendable design is also an important issue of sustainability. Potential extensions should be foreseen from the start to apply the right infrastructure and building types.

3.2.2. Site Selection

The goal of site selection parameter is to 'avoid development on environmentally sensitive sites.'[21] Instead of green fields, brown fields should be chosen to build the housing projects. The restricted green areas have been more important than any time for the last 20 years. In addition to preserving the remaining green fields, the brown fields should also be converted into the green ones. Cultural, historical and environmental values of the site should also be considered in terms of sustainable design. Foster points out the significance of site selection issue for sustainable design with a question:

> If sustainability is to be more than a fleeting fashion, architects in the future must ask themselves some very basic questions. For example, why do we still insist on using green-field sites when we could build on reclaimed land in our cities?[22]

[19] Foster, 2003, 6.

[20] Edwards and Turrent, 18.

[21] LEED, 26.

[22] Foster, 2003, 12.

3.2.3. Preferred Locations

Sustainable housing cannot be considered as sterile housing projects in the hearth of a forest or a virgin part of a city. Both sustainable housing architecture and sustainable community can be achieved as well when they integrate into the existing architecture and community. Like the site selection issue, in this issue, building on previously developed lots is seen as important as building on green fields.

3.2.4. Infrastructure

Infrastructure is a very important issue of housing. Building closer to the existing infrastructures instead of creating a new one in sterile environments is crucial for sustainable housing. This is what the LEED searches under this issue. Whether a new infrastructure is applied is asked under this title in the system. If it is possible to reuse the previous one, it will be a positive decision in terms of sustainability. On the other hand, while loading a new infrastructure, it will create a chance to choose a more efficient one. Effective equipments such as long-lasting and nature-friendly pipes should be chosen while building a new infrastructure.

3.2.5. Community Resources / Public Transport

The goal of this issue is encouraging the housing "in development patterns that allow for walking, biking, or public transit."[23] This approach will result in reducing the usage of personal automobiles and their harmful environmental impacts. Accessibility is a key factor in the success of places. Lock declares that "communities that are not readily accessible inside their boundaries and out are hardly sustainable."[24] On the other hand, the housing should be close to some community resources to reduce the requirements of transportation. In the LEED rating system, in the frame of this issue, the types of community resources are pointed out such as arts and entertainment center, bank, community or civic center, convenience store, daycare center, fire station, fitness center or gym, laundry or dry cleaner, library, medical or dental office, pharmacy, police station, post office, place of worship, restaurant, school, supermarket, other neighborhood-serving retail and other office building or major employment center. The project should maintain a specific quantity of community resources around itself to gain points in terms of this issue.

[23] LEED, 29.

[24] Lock, 40.

Transportation is one of the main reasons of the harmful emissions to the atmosphere. For instance, 29% of UK CO2 emissions are the result of mostly private car-based transportation.[25] This means that a new sustainable transportation system should be arranged besides sustainable building blocks. This does not mean that cars should be totally excluded. They still exist but their "penetration and physical presence should be limited."[26] Instead of personal automobiles, public transport should be promoted by the municipalities.

> By giving priority to public transport (or transit as the Americans call it), the planning of new or revitalized older neighborhoods take on an immediate web of sociability and reduced ecological impact.[27]

Besides public transport, walking as a form of transportation should be encouraged as well. Walkable neighborhood principle should be comprehended in the design phase. To do this, the pavements need to be wide, safe and free of obstacles. Perhaps a protective barrier of trees between cars and people and a separate marked cycle way all created within the current street dimensions can be designed by restricting cars to one narrow lane.[28] Moreover, stations and trains should provide cycle storage to promote cycling. Cycling is an excellent green transportation vehicle. Cycle ways, cycle storages and cycle parks should be created in the projects. As another transportation vehicle, electronic cars may well become as efficient as electronic trains.

According to Edwards, to reduce the transportation CO2 emissions and to reach a sustainable environment and community the following should be considered: [29]

- Vehicle efficiency improvements
- City traffic management
- Improved public transport
- Lower speed limits
- Encourage journeys on foot or cycle
- Remove company car incentives

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[25] Ibid., 38.

[26] Lock, 39.

[27] Ibid.

[28] Lock, 41.

[29] Edwards and Turrent, 130.

- Integrate land uses
- Compact development without zoning

3.2.6. Access to Open Space

The aim of this issue is to 'provide open space to encourage walking, physical activity, and time spent outdoors.'[30] This approach is directly related to the psychological needs of human. Thus, it can be evaluated as eco-medical logic of sustainable housing of Guy and Farmer. Use of open space as streets, parks and squares to facilitate social interaction and ecological wellbeing should be appreciated. Creation of natural habitats integrated with housing should be maximized. As a part of nature, human will need time to spend with it to relax or to do some physical activities.

> Nature can be brought indoors to enhance spiritual and physical well-being.[31]

Proximity to nature has many benefits for communities such as health, social well-being, tranquility and visual amenity. According to Grant, "the view of a tree or being able to hear bird song is a good indicator of sustainability." [32] Yeang also proposes to "increase external circulation space and to consider integrated indoor-outdoor spaces with habitats for wildlife."[33]

3.3. Sustainable Sites

3.3.1. Site Stewardship

The goal of this issue is to 'minimize long-term environmental damage to the building lot during the construction process.'[34] The disturbed area of site should be minimized in the frame of this issue. There are two different approaches to the area as previously developed and undeveloped sites. Respecting nature and green, leaving some parts of the site undisturbed are the main

[30] LEED, 31.

[31] Edwards and Turrent, 33.

[32] Grant,48.

[33] Yeang, 2006, 125

[34] LEED, 33.

approaches in terms of this issue of LEED. Yeang also proposes to "limit and restrict cleared areas and regard uncleared areas as a source."[35]

3.3.2. Landscaping

Landscape design is very significant part of housing complexes. It can help educate people about the complex dependencies present in the environment.[36] It cannot be seen just marketing cosmetics. [37] Choosing plants for the site is more important than supposed in the past. It is crucial to avoid invasive species and minimize demand for water and synthetic chemicals in order to reduce water consumption and pollution prevention. In the LEED rating system, even reducing the amount of traditional turf is a goal for sustainability. According to Yeang, biodiversity must be increased instead of monoculture. He proposes to "consider schemes of higher species diversity and with a greater range of plant forms, which can provide habitat diversity and enhance the connectivity of habitats."[38] Flora and fauna consideration on the site is very significant for him. He defends to site and design to allow natural movement of animals, plants and processes such as shifting fauna movements and water to pass under buildings where possible. Moreover, he advices to use textured and naturals materials where possible to provide habitat for insects and food for birds and lizards. Furthermore, water bodies can also be created with habitat.

3.3.3. Local Heat Island Effects

Local heat island effect is the effect that negatively influences the comfort of the pedestrian due to the fact that the land or walkway is over heated by the sun. These effects should be reduced in the landscape design of sustainable housing. Trees or other plants should be located where required to provide shadings of sidewalks, patios and drive ways to reduce these effects. Moreover, landscape elements or buildings can also be used to achieve this goal.

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[35] Yeang, 2006, 124.

[36] Grant, 46.

[37] Ibid., 44.

[38] Yeang, 2006, 126.

3.3.4. Surface Water Management

The aim of this issue is to minimize erosion and runoff from the home site. It includes the management of water both on site and roof of the building. There are some principles described such as permeable lot to succeed in this issue. Before loosing the water, directing it to the point in need of water is the main principle. Yeang proposes to use porous surfaces instead of hard surfaces to succeed in this issue. According to him, on site water use is very significant to design the building like living species. [39]

3.3.5. Compact Development

According to Foster, there is a crucial relationship in urban terms between energy consumption, carbon emissions and density. The sprawling lowest density cities are huge per-capita energy consumers. On the other hand, very high-density cities have low levels of energy consumption. Somewhere in the middle there is an interesting balance. He mentions about a city that is high density and economical with its mixture of uses; it is socially diverse; people live and work in the same locality; it is well served by public transport and the pedestrian experience is enjoyable.[40] As Foster points out, compactness or density is a crucial part of sustainability. It is very beneficial in terms of maintaining energy efficiency and reducing transportation requirement. It is a prerequisite. [41] It will promote walking as a healthy activity for the inhabitants. Smaller and denser cities promote walking and cycling rather than driving. According to Edwards, it will not only maintain energy saving and better transportation, but also safety, security and community ethos.[42] In Foster's opinion, unchecked urban sprawl is one of the chief problems facing the world today. Instead of growing horizontally and swallowing up more and more land, thus enforcing people to travel greater distances between home and work, the cities can grow vertically due to the fact that, for instance between 1900 and 2000 the average distance travelled by an individual per day in Britain increased from 1.5 miles to 25 miles; and today 90 per cent of all shopping trips in Britain are made by car.[43] For Foster, high urban density leads to improved quality of life when housing, work and leisure facilities are all close by. Yeang also proposes

[39] Yeang, 2006, 124.

[40] Foster, 2008, 4.

[41] Edwards and Turrent, 14.

[42] Ibid., 132.

[43] Foster, 2003, 3.

high-rise ecological buildings. Reducing the footprint of the project, considering going up, reducing internal circulation space, and leveling space for wildlife movements are his design concepts.[44]

Contrary to Foster and Yeang, over-compactness can reduce the life quality of the dwellers due to the lack of providing silent zones. Density is a prerequisite but it should be held carefully. When the complex is built with a low-density, the sustainability level of the housing reduces, for instance in energy terms. On the other hand, in an over-compacted housing complex some problems occur:

> High density can reduce the sense of 'livability' of public areas and lead to anonymous building design. As density rises, greater tolerance of other people's noise or antisocial behavior is needed.[45]

People will need to accept less privacy and less silence as sustainable housing takes hold. Society has to accept the 'forgiveness factor' to shift to high density, mixed land-use lifestyles. Yet, it seems that in the near future, the old separation of living, working, education and leisure will end, and instead there will be overlapping communities of people, lifestyles and urban activities.[46]

3.4. Water Efficiency

Water is an essential component of healthy living and a significant indicator of quality of life. It is very significant for human life. Due to the global warming and drought, it is increasingly seen as tomorrow's oil.[47] However, it is often wastefully used in the home and opportunities for recycling or rainwater collection are not taken. For instance, 40% of all water in the UK is consumed in dwellings.[48] However, average consumption of water use is rising. Water regulations are relatively weak on water conservation. Compared with low energy design, water

[44] Yeang, 2006, 125.

[45] Edwards and Turrent, 132.

[46] Ibid., 33.

[47] Ibid., 22.

[48] Edwards and Turrent, 22.

is rather taken for granted as a resource.[49] Water use still has to be a central theme of any national strategy towards sustainable housing.[50]

Using recycled water, or offsetting central water supply through the capture and controlled reuse of rainwater or gray water is the aim of this issue. Rainwater harvesting is a significant part of this approach by collecting it and using it later for landscape irrigation or indoor water use. On the other hand, gray water is as significant as rainwater in sustainable housing. It is also used for irrigation and indoors. Washing machine waste water is suitable for garden irrigation while bath waste water is for toilet flushing. Moreover, waterless toilet flushing, reduced flow taps with automatic cut off, better washing machines that use less water are available today. In the US, in some regions it is also possible to use municipal recycled water provided by municipality.

> Capital cost may be higher for a house designed to conserve water and the occupiers will also need to exercise restraint in certain areas (e.g. power showers, dish washers). Also, the engineering of the house will be a little more complicated with more complex controls (e.g. water recycling) but there will be reduced water charges, the house will be more environmentally friendly, and the designer or developer can reflect upon the enhanced professionalism of the service. After all, ecology and ethics are at the root of the concept of the sustainable development.[51]

According to Turrent, for water preservation strategy, to be more sustainable the following should be applied in the sustainable housing design:

- Specification of low flush or dual flush WCs
- Use of flow restrictors and spray taps
- Collection of rainwater for garden irrigation
- Recycling of grey water for use in flushing WCs.
- Where space is available use of reed beds for cleaning rainwater or even treating solid waste
- Design of permeable surfaces externally to reduce run-off
- Use of water meters to raise awareness of water consumption.[52]

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[49] David Howarth. (2000). In Brian Edwards and David Turrent (Eds.), *Sustainable Housing: Principles & Practice*. London, New York: E & Fn Spon, 64.

[50] Ibid., 62.

[51] Howarth, 64

[52] Edwards and Turrent, 118.

Waste and pollution management strategies should be improved in the frame of sustainable housing projects.[53] With their help, the buildings can act in the environment like living species owing to its non-harmful effect to nature in terms of wastes. This issue is available both in the construction period and after the period. Waste cycle of the complex can be solved in itself. Yeang calls it 'site sanitation'. Moving wastes to specific locations which are out of the site must be restricted. [54]

3.5. Energy and Atmosphere

3.5.1. Optimize Energy Performance

In this issue of LEED, Energy Star[55] is used to measure the energy performance of the housing complexes. Improving the overall energy performance of housing is the goal of optimizing energy performance issue. Energy performance of a building is a wide issue. Energy itself is regarded the most important aspect of sustainability. In the frame of this thesis, neither Energy Star is going to exactly be examined, nor will the energy performances of the case studies be measured. Some passive design strategies and the importance of renewable energy in the sustainable housing projects will be mentioned.

According to Edwards, energy usage is the first target of sustainability. "How much energy is used per household and per design type is central to any strategy for reducing carbon emissions. A typical house in Britain produces 8 tons of CO^2 per year in heating and lighting, although this has been reduced to about 4 tons in 1998 through the evolution of better designs, higher insulation standards and the exploitation of renewable energy.[56]"

Passive heating, cooling, ventilation and lighting strategies can be widely utilized by architects for heating, cooling, ventilating and lighting of the buildings. The direction of the block is very significant. South orientation is the keyword of energy efficient houses. Passive solar gains can make an important contribution to reducing energy consumption in housing (by as much as 18%

[53] Ibid., 30.

[54] Yeang, 2006, 124.

[55] Energy Star is another rating system by GBC in the USA concerning energy performance of the buildings. For more information about Energy Star visit www.energystar.gov

[56] Edwards and Turrent, 21.

without house type change).[57] According to LEED, the direction of the block must be in east-west direction to maximize the solar gain from south façade. Putting the block 15 degree inclined to the east-west axis will improve the quality of light penetrating into the block.[58]

To be more sustainable, the buildings should be designed as passive solar buildings. Taking the sun into account is very significant. All passive solar features involve the transmission of solar radiation through a protective glazing layer on the sun side of a building, into a building space where it is absorbed and stored by thermal mass. [59] The energy of the sun is collected; stored by the floors and the walls; and lastly distributed by radiation, convection and conduction to space. There are several types of passive solar systems used in homes. The most common are direct gain, indirect gain and isolated gain. The figure 3.1 shows the systems in principle. The drawings below seem to show single house figures, yet these systems can also be applied to high-rise buildings.

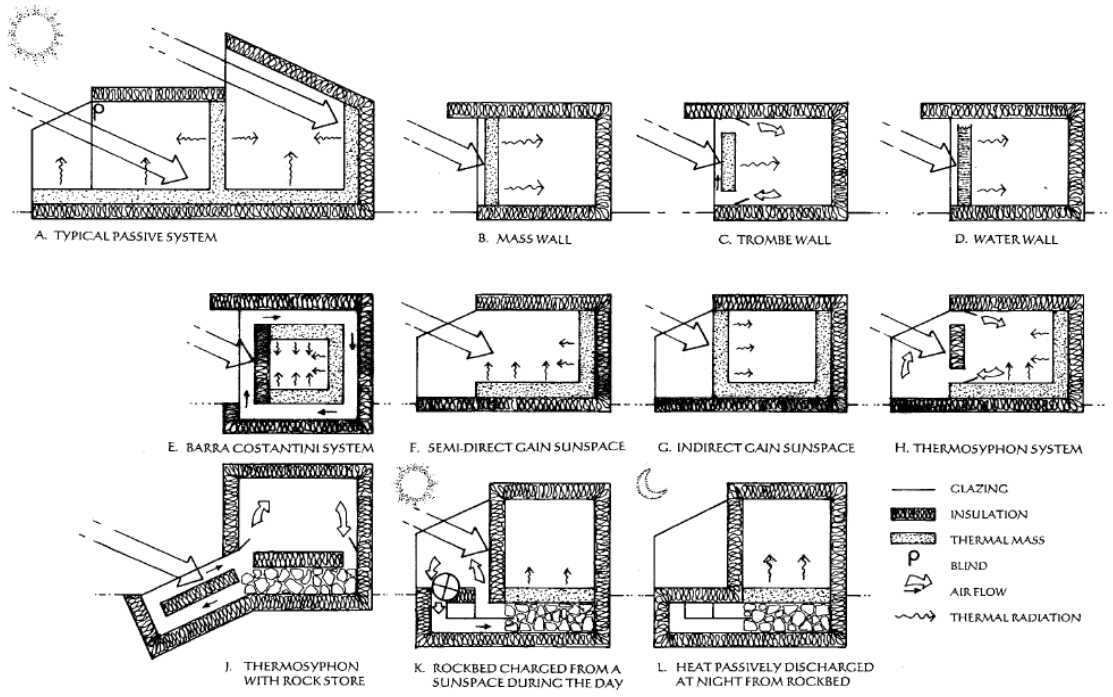


Figure 3.1: Passive solar systems: A, a typical passive solar system; B, mass wall system; C, Trombe wall system; D, water wall system; E, Barra Constantini system; F, semi-direct gain sunspace; G, indirect gain sunspace; H, thermosyphon system; J, thermosyphon system with rock bed; K, underfloor rock bed actively charged from a sunspace during the day; L, underfloor rock bed passively discharged by radiation and convection at night.

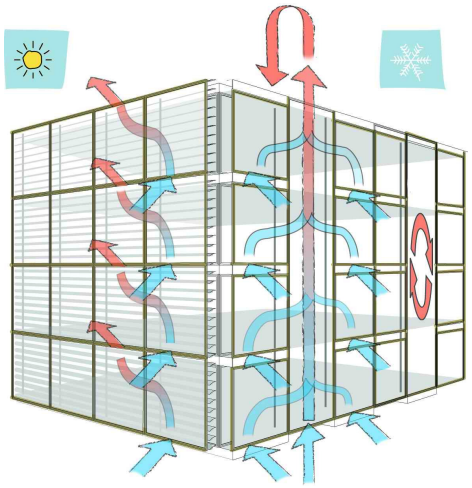
Sue Roaf. *Ecohouse: A Design Guide*. (2001), 153

[57] Edwards and Turrent, 129.

[58] LEED, 20.

[59] Sue Roaf. (2001). *Ecohouse: A Design Guide*. Oxford: Architectural Pres, 151.

For high-rise buildings, double skin façades also present many advantages over the conventional, single skin façade. Double skin buildings are able to reduce energy consumption by 65%, running costs by 65% and cut CO2 emissions by 50%, in the cold temperate climatic prevalent in the United Kingdom when compared to advanced single skin building.[60] Buildings employing a double skin may cost as little as 2.5% based on its internal floor area.



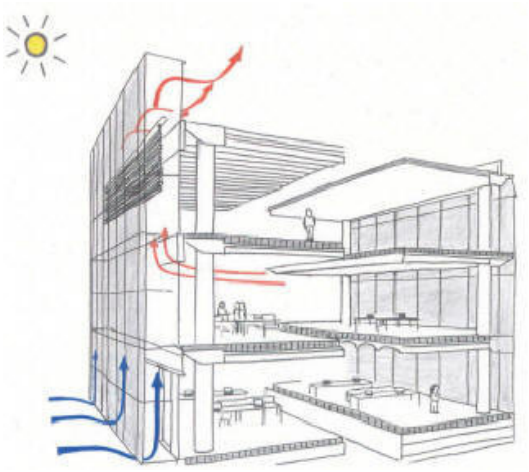


Figure 3.2 and 3.3: Double skin façade.

Harris Poirazis Web Site,http://www2.ebd.lth.se/ebdhome/avd_ebd/main/personal/Harris/main /Home%20Page.htm, (accessed February 27, 2009).

It is useful to consider that sun can be a friend or an enemy in buildings. Poor climatic design of buildings causes many buildings to overheat, even in temperate or cold climates where such problems traditionally never existed. The power of the sun should be understood and respected by good designers. Roaf explains the five things a designer needs to know for a good passive solar design are:[61]

1. How strong the sun at the site is at different times of the year;
2. Where the sun will be at different times of the year in relation to the site;
3. How much of the sun's heat a building will need, or not need, at different times of the year to enable the building occupants to be comfortable;
4. How much storage capacity the building should have in relation to the available solar gain at the site to meet those needs;

[60] M.Wigginton, and B. McCarthy. (2000). *Environmental Second Skin Systems*. Retrieved February 27, 2009, from http://www.battlemccarthy.com/Double%20Skin%20Website/doubleskinhomepage.htm

[61] Roaf, 148.

5. What the additional requirements are for controlling the heat gain from direct solar radiation, convection or conduction in a design and how they can be met by envelope performance, building form and ventilation.

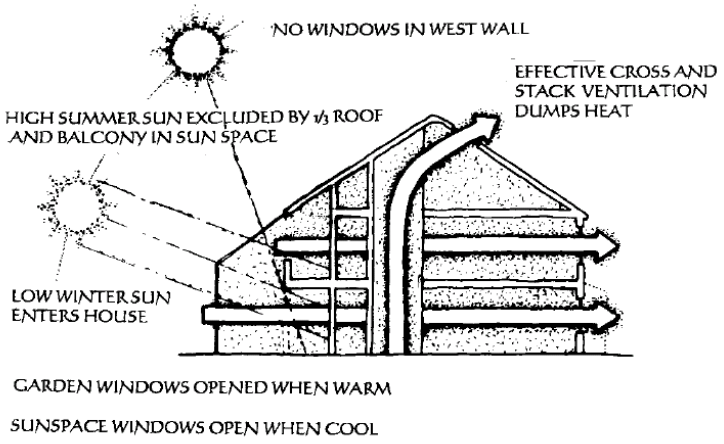


Figure 3.4: A passive solar design section. Different angles of the sun according to the seasons are considered. The sunspace on the southern façade controls both heat and ventilation.

Sue Roaf. *Ecohouse: A Design Guide.* (2001), 145.

Space organization is also crucial in passive solar heating. "Passive solar heating depends on an integrated design approach that positions the majority of glazing and the most frequently used rooms on the southerly side of the house."[62] Living rooms should be on the southern façade while bathrooms or bedrooms on the north. Thermal mass should also be used to store solar heat gains in a sustainable house. With high quality windows with high insulation capacity and using the building fabric as a heat source, the passive solar heating of the building can be maximized.

> There is in fact no real energy shortage. There is only a crisis of human choices in respect to our energy practices.[63]

Energy dependence on fossil fuel use lies at the hearth of sustainable design.[64] Instead of fossil fuel, renewable energy is an alternative and clean energy. It is the key to long term

[62] Derek Taylor. (2000). In Brian Edwards and David Turrent (Eds.), *Sustainable Housing: Principles & Practice*. London, New York: E & Fn Spon, 51.

[63] David Nye. (1998). *Consuming Power: A Social History of American Energies.* Cambridge: MIT Press, 217–64. Quoted in Moe.

[64] Turrent, 117.

sustainability.[65] Renewable energy can be used to provide electricity, mechanical power, heat or fuel. Sun, wind, water power, geothermal and bio fuels can be used as renewable energy sources. The certain renewable energy technologies are "the fastest growing global energy sources, currently expanding at grow rates not seen since the early days of microcomputers."[66] It is time for renewable energy today to preserve the environment.

Sun is the best source of heat and light. Besides passive design strategies, active energy systems can also be applied to the projects. For instance, for electricity, photovoltaic panels can be loaded to the building to produce free and clean electricity. On the other hand, passive systems such as thermal mass usage can be integrated into mechanical systems to create a hybrid heating or cooling system. Wind turbines can also be applied to produce energy for the building. Wind is a very clean renewable energy source as well as bio fuels. Unlike most other forms of renewable energy, biofuels can be stored for use when required, provided sufficient space is available.[67]

3.5.2. Insulation

Insulation installation for housing is to minimize heat transfer and thermal bridging between inside and outside. There are standards about choosing appropriate insulation and thickness of it. Some calculations should be done by mechanical engineers to apply the most appropriate insulation.

3.5.3. Air Infiltration

With the lack of the high quality workmanship or successful details, while constructing, some problems may occur such as air infiltration. Air infiltration is uncontrolled air leakage between inside and outside of the building enclosure. The aim of this issues is to minimize energy consumption caused by these uncontrolled leakages. There are acceptable limits of leakages. However, the smaller leakage the more energy-efficient, thus, the more sustainable a building is. "Airtightness is important in achieving a highly insulated wall and in controlling moisture penetration. Leakage of air is often hard to detect but can account for significant heat loss."[68]

[65] Taylor, 59.

[66] Ibid., 50.

[67] Ibid., 57.

[68] Edwards and Turrent, 135.

3.5.4. Windows

Windows are inevitable parts of architecture as well as sustainable architecture. When compared to solid walls, the windows are not adequately effective to resist to the heat transfer between inside and outside. In sustainable housing, windows should be maximized in terms of energy performance. There are some standards about window performances as well. Energy efficient windows should be preferred.

In terms of windows, according to LEED system, the north-south walls window area must be 50% greater than the east-west walls window area. However, south orienting the building and putting huge windows on the south façade will also create some problems such as over heating. In the LEED system, 90% of the south facing windows of the building must be shaded somehow. For instance, solar louvers or trees that pour their leaves in winter should be preferred to do this.

3.5.5. Heating and Cooling Distribution System

This issue is also about the mechanical systems of housing: Heating and cooling distribution systems. Thermal bridges and leaks in the heating and cooling distribution system should be minimized to reduce energy consumption.

3.5.6. Space Heating and Cooling Equipment

This issue is about energy-efficiency of mechanical equipments. The HVAC systems used in the housing their selves should be energy-efficient. The highly insulated, airtight house requires the same level of design care given to the HVAC systems. A low water content boiler with a lighter heat exchanger, efficient burners and a modulating gas and air supply can be chosen.[69]
In the low energy house the boiler will not often be on because casual gains (solar, cooking, people, lights,etc.) may be sufficient for space heating for much of the year. Full central heating

[69] Edwards and Turrent, 137.

may not be the best solution here and separate room heaters can offer economies of cost and fuel bills.[70]

3.5.7. Water Heating

The goal of this issue is to reduce energy consumption associated with the domestic hot water system, including improving the efficiency of both the hot water system design and the layout of the fixtures in the housing. It includes efficient hot water distribution, equipment and pipe insulation of the housing. For instance solar water heating systems of a few square meters in area can provide two thirds of the hot water requirements of a household in UK.[71] It makes a lot of sense to pre-heat the cold water by using passive solar water heaters.[72]

3.5.8. Lighting

Lighting is also an inevitable part of architecture. It is such a crucial parameter that it should be put into design starting from the sketching phase. It improves the quality of the inhabitants' life. According to a research conducted in 2000 classrooms, the students in the well lit classrooms are 20% more successful than the others in the bad lit ones. Similarly, the patients in green hospitals are discharged from hospital 2.5 days before the others. In the same way, the productivity level of the stuff working in green offices 16% increases. [73] Mostly, in the energy consumption of housing, lighting is the second in the row. Appreciating the importance of it will improve the quality of the dwellers. On the other hand, energy consumption associated with interior and exterior lighting should be reduced. It can be achieved by using energy efficient light bulbs, fluorescent light bulbs, motion sensor controls and photo voltaic cells outside. Promoting natural lighting will not only reduce electricity bills, but also improve the life quality of the dwellers.

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[70] Ibid., 138.

[71] Taylor, 52.

[72] Edwards and Turrent, 137.

[73] Mikdat Kadıoğlu. Sera Gazı Emisyonlarını Düşürecek Büyük Bir Fırsat: Yeşil Binalar. (2008, July 9). *Hürriyet.* Retrieved December 20, 2008, from http://old.mo.org.tr/gzt/hurriyet/20080709-1.doc

3.5.9. Appliances

This issue is a mechanical one. The appliances used in housing such as refrigerator, washing machine, dish washer and ceiling fans should be chosen from energy-efficient ones. Lately, some appliances offer energy savings up to 70%. This is extremely remarkable in terms of sustainability.

3.5.10. Renewable Energy

After comprehending the destructive impacts of non-renewable energy from non-renewable resources, the architecture has bent to renewable energy from renewable sources. In LEED rating system, this issue is related specifically to electricity production. With the help of photo voltaic cells, now it is possible to maintain the electricity for the building itself, even selling the remaining electricity to the line.

3.6. Materials and Resources

3.6.1. Material-Efficient Framing

The issue's aim is to optimize framing materials use. Waste factor limit[74] and off-site fabrication are evaluated under this title. It is clear that sometimes the materials of the construction are extra ordered. This results in extra costs and environmental deterioration; thus, prefabricated materials are the most preferable ones in terms of this issue.

3.6.2. Environmentally Preferable Products

Before choosing the materials of the project, briefly, the following headings should be considered. They are mentioned in The Green Building Handbook (Woolley et al., 1997) as follows:[75] Environmental impact owing to production; energy use; resource depletion; global warming; acid rain; toxins; potential for reuse/recycling and disposal; and health hazard.

[74] Waster factor is defined as the percentage of framing material ordered in excess of the estimated material needed for construction.

[75] Woolley, T., Kimmins, S., Harrison, P. and Harrison, R. (1997). The Green Building Handbook. E & FN Spon, London.

Environmentally friendly products have low emission rates against nature. Some products have zero emissions. To measure the environmental friendliness of the building materials, there appears a new concept called 'embodied energy'. The embodied energy of a material refers to the energy used to extract, process and refine it before use in product manufacture.[76] Usually embodied energy is about 10-20% of the total energy in use over 50 years.[77] The embodied energies of the building components combine and create the total embodied energy of the building. On the other hand, in this issue the life of the materials are ignored. Foster criticizes this issue as follows:

> The longer the building lasts, the greater the investment in its embodied energy will be. This tends to reinforce the argument for the use of high-quality materials that will have a long life. But it is here that the numerical equations for embodied energy become more difficult. For example, the refinement of aluminum requires such an enormous energy input that it has been dubbed an 'unsustainable' material. But high-quality aluminum can last for decades without maintenance. Lower grade materials which may appear to be more sustainable might need to be repaired or replaced in the same period, leading to a greater consumption of energy. In these terms, sustainability can be equated with durability, and the pleasure that people derive from things of quality; sustainability does not mean lack of comfort or amenity.[78]

Material	*Density*	*Low value*		*High value*	
	(kg m^{-3})	*GJ tonne^{-1}*	*GJ m^{-3}*	*GJ tonne^{-1}*	*GJ m^{-3}*
Natural aggregates	1500	0.030	0.05	0.12	0.93
Cement	1500	4.3	6.5	7.8	11.7
Bricks	~1700	1.0	1.7	9.4	16.0
Timber (prepared softwood)	~500	0.52	0.26	7.1	3.6
Glass	2600	13.0	34.0	31.0	81.0
Steel (steel sections)	7800	24.0	190.0	59.0	460.0
Plaster	~1200	1.1	1.3	6.7	8.0

GJ = giga joule, a unit of energy, 1 GJ = 278 kWh.
Source: Building Research Establishment, 1994.

Figure 3.5: Embodied Energy of Building Materials

Sue Roaf. *Ecohouse: A Design Guide.* (2001), 47.

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[76] Sustainable Design Award Web Site. Retrieved December 25, 2008, from http://www.sda-uk.org/materials/principles/embodied_energy.htm

[77] Edwards and Turrent, 24.

[78] Foster, 2003, 6.

Although its embodied energy has a high value, steel framed house is also seen as advantageous owing to its greater quality control through factory production and enhanced speed of construction. Half of all new steel in the UK consists of recycled steel. According to Edwards, "There are green arguments in the material's favour."[79] Being a recyclable and long-lasting material is very significant for sustainability. Foster also defends this approach. Yet, according to Viljoen, "stainless steel and aluminium are both very likely to be recycled, but have very high environmental impacts as a result of their initial manufacture. Their extensive use in buildings cannot be considered ecological."[80] Yet, compared to the reinforced concrete steel appears to be more sustainable. Yeang compares them as follows:

> Reinforced concrete-frame construction has almost the same amount of embodied energy as steel, but it is less recyclable at the end of its useful life than steel. Structural steel can generally be recycled and reused virtually in its original use, whereas concrete can be reused mostly in a downgraded form, and with limitations, can be recycled again for structural purposes.[81]

The plastics have extremely high embodied energies. PVC (polyvinyl chloride) is the most used one in Turkey. Similar to steel, they have both advantages and disadvantages. They are waste products of petroleum production. Thus, it can be argued that by using plastics we reduce the accumulation of waste material. Yet, on the other hand, "the use of plastics helps to support the very industry that is responsible for a large amount of CO2 emissions and for over half of all toxic emissions to the environment."[82] Moreover, plastics tend to release gases into the atmosphere called volatile organic compounds (VOCs) which can be harmful to human health if breathed in any quantity.

It is clear that "local building materials and those requiring the minimum processing should be selected in preference to highly processed materials and those from further afield."[83] Non-toxic products should be preferred instead of materials containing chemically treated toxins. The durability of materials is very significant as well. This will affect the lifespan of a building. "The longer a low-energy house lasts, the less relative impact its materials will have."[84]

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[79] Ibid., 135.

[80] Andre Viljoen and Katrin Bohn. (2001). In Sue Roaf (Ed), *Ecohouse: A Design Guide*. Oxford: Architectural Pres, 49.

[81] Yeang, 200, 141.

[82] Viljoen, 49.

[83] Ibid., 60.

[84] Ibid.

3.6.3. Waste Management / Recycling and Reusing

Its aim is to reduce waste generation to a level below the industry norm. After the demolition, the materials of the demolished building should be recycled or reused for another construction. On the other hand, recycled and reused materials should be preferred for the building instead of new materials. This is an environmentally friendly act. According to Turrent, to be sustainable in terms of building materials the following should be considered: [85]

- An embodied energy audit can provide useful guidelines for consideration at the design stage
- Consideration should be given to the use of recycled materials such as timber, bricks, roofing tiles
- Cellulose insulation made from recycled newsprint can be used safely in timber frame construction
- New components such as masonite beams offer a high strength to weight ratio and make use of recycled timber
- Prefabricated or factory made components reduce the amount of waste generated and minimize dust contamination on site
- Natural materials such as timber, stone and linoleum should be used in preference to polymer based products.

3.7. Indoor Environmental Quality

In the LEED for Homes Rating System, the aim of this issue is to improve the overall quality of housing indoor environment by installing an approved bundle of air quality measures.[86] Being one of the most important aspects of sustainable housing design, indoor air quality has also its own ratings in the USA called Energy Star with Indoor Air Package. Ventilation in the home is important to:

- Maintain healthy conditions for occupants
- Control humidity (and hence combat condensation)
- Reduce dust mite pollutions (and the risk of asthma attacks)
- Disperse pollution from combustion or fabric emissions.[87]

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[85] Edwards and Turrent, 118.

[86] LEED, 86.

[87] Edwards and Turrent, 136.

Indoor and outside air quality is an important issue in reducing ill health. In modern homes, dust mites are a major threat to health and comfort. It has been estimated by the BRE that in poorly ventilated, modern carpeted houses, there may be as many as 14,000 dust mites per square meter of floor, and that 10% of the weight of feather filled pillows or duvets may be mites and their droppings.[88] These can be a major cause of illness. On the other hand, cold, damp and poorly ventilated dwellings lead to both high levels of energy usage and human health problems, mainly in the form of asthma, bronchitis and arthritic ailments.[89]

According to Roaf, the buildings are ventilated because of three reasons: For fresh air supply; for direct comfort ventilation to cool or heat the occupants of the space by convection; and for indirect comfort ventilation, for heating and cooling the actual structure of a building to indirectly enhance the comfort of the room's occupants and to use 'free energy' more efficiently. In this way, day-time solar warmth can be stored in the structure and used at night, or cool from night air can be stored to cool the people indoors during the day.

> While we frequently explore the newest technologies to find appropriate solutions, we frequently also seek inspiration from forgotten traditions: the use of natural ventilation, or finding ways to reflect natural light into an interior space, for example.[90]

The ventilation of the house can be maintained by an active or a passive ventilation system. Edwards mentions that "opening windows, though fairly cheap and popular, are a common source of house burglaries. Mechanical ventilation consists of extract fans, room ventilators with heat recovery and whole house systems with heat recovery. They offer fine control over ventilation but can be noisy and expensive to run although they recover up to 90% of the extracted heat." [91] In the light of sustainable design, naturally conditioned systems such as natural lighting, heating, cooling and ventilation, as risk-free operations, or mixed systems combining modest levels of mechanization with climatic concerns should be preferred. A sustainable housing project should only use mechanical systems as a last resort. Natural ventilation strategies

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[88] Edwards and Turrent, 136.

[89] Ibid., 138.

[90] Foster, 2003, 2.

[91] Ibid., 137.

should be preferred. Roaf (2001) explains the trick of passive ventilation in her book: "The trick is to create that pressure gradient. This can be done in two ways:

1- Using pressure differences around the outside of the building caused by wind;

2- Using pressure differences caused by the pressure variations within the house. Warm air is less dense than cold air, therefore pressure variations that cause warm bodies of air to rise also cause cold bodies of air to fall. This is called the 'stack' effect and can be used to ventilate a space."[92]

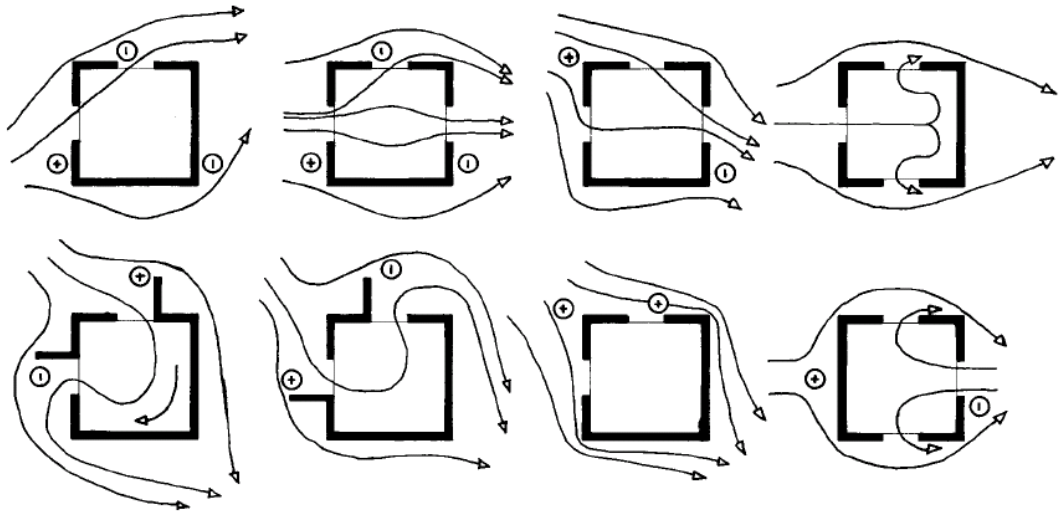

Figure 3.6: Positive (+) and negative (–) wind pressures around different building configurations.

Sue Roaf. *Ecohouse: A Design Guide.* (2001), 96.

[92] Roaf, 95.

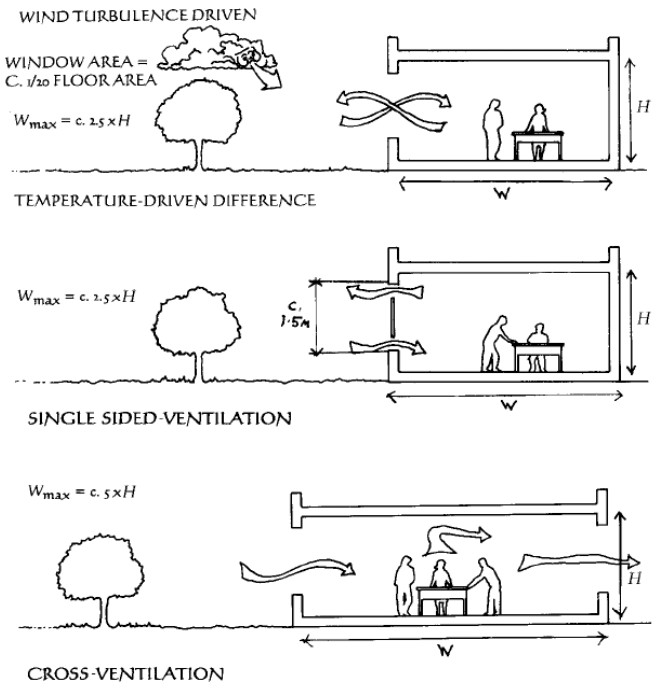

Figure 3.7: Single-sided and cross-ventilation

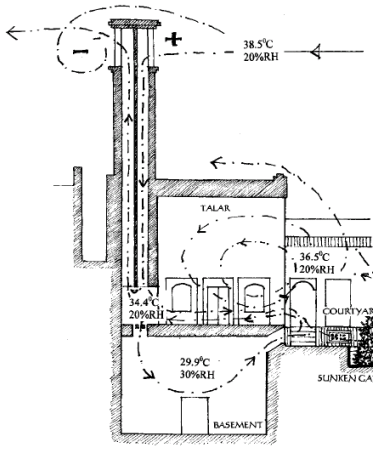

Figure 3.8: Stack effect

Sue Roaf. *Ecohouse: A Design Guide.* (2001), 113 and 109.

The positive and negative wind pressures should be taken into account while settling the building to benefit from the wind optimum. There are different ventilation strategies such as single sided ventilation and cross ventilation. Stack effect is also used to ventilate indoor spaces. "Ventilation in houses can be used at different times of the day and year to modify the core temperatures of a building to enhance the comfort of its occupants. The main ways in which this is done is by warming the building through passive solar heating and cooling it using night-time ventilation."[93] Night-time ventilation is the process by which heat is removed from the structure of a building by passing cooler night air over the surfaces of the building. This decreases the temperatures of the walls, floors and ceilings of the rooms.

The key to good ventilation is control.[94] The highly insulated house needs to pay particular attention to air infiltration and ventilation. Unless they are well controlled, infiltration and ventilation can be the main source of heat loss for the projects.

[93] Roaf, 113.

[94] Edwards and Turrent, 129.

3.8. Awareness and Education

3.8.1. Education of the Homeowner or Tenant

The aim of this issue is to maintain the performance of the home by educating the occupants about the operations and maintenance of the housing's features and equipment. Public awareness and participation is crucial. Users need to be involved in the process of design and management of their estates.[95]

> There is no future for sustainable housing without a culture change in society.[96]

Part of the loss of the natural world is caused by the accelerating consumption rate. Today, the people in the West consume three times more food than they need to stay fit and healthy. The UK produces three times the carbon dioxide per person compared to the world average. Grant points out that "growth is not in itself a problem, but how we grow and consume is."[97] Moreover, the expectations of lifestyle are continuously rising. This puts pressure on energy, wastes and other resources often in unexpected ways. For instance, the drive for healthy living means an increase in fresh imported foods. Research in the USA has shown that every glass of orange juice consumed requires two glasses of oil to get it to the breakfast table. [98] Rising standards of living worldwide and the increasing population result in ever more CO2 released to the atmosphere. The consumption habits should be altered. The awareness of the inhabitants about sustainability should be increased. It seems and necessitates hard work. However, it is useful to remember "lifestyle change cannot be imposed but it can be encouraged by good design." [99]

3.8.2. Education of Building Manager

The aim of this issue is to maintain the performance of the home by educating the building manager about the operations and maintenance of the housing's features and equipment. The building managers are quite suitable for increasing public awareness. Firstly, managers will be educated, then, public will follow.

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[95] Ibid., 117.

[96] Ibid., 126.

[97] Grant, 46.

[98] Edwards and Turrent, 33.

[99] Ibid., 124.

As an alternative framework for sustainable housing, Williams proposes in his book the following limits:

1- Environmental Limits of Sustainable Housing

a- Climate Change

- Reducing the need for heating and cooling through building form, materials and control systems
- Using forms of energy in the operation of the building that do not produce greenhouse gases
- Using highly energy efficient appliances, water heating and space heating and cooling systems
- Using materials and equipment where the use of fuels producing greenhouse gases in their extraction, manufacture and transport is low
- Allowing for uncertain future climate
- Planting trees

b- Pollution

1- During construction:

- Reducing waste materials
- Using components that have caused little pollution in extraction, manufacture and transport

2- During building operation:

- Using non-polluting energy sources
- Avoiding potential polluted surface water run-off
- Recycling water

3- At end of building or component life:

- Using long-life materials
- Using biodegradable materials
- Using recyclable materials

c- Resource Depletion

- Using renewable resources (eg. plantation timber, managed regrowth timber, solar energy)
- Using plentiful resources (eg. many building stones, clays, silicon, iron ore)
- Very careful, appropriate use of rare and non-renewable resources
- Building small

d- Biodiversity

- Avoid building in places that are particularly significant for biodiversity
- Using timber with an authoritative certificate of origin
- Shifting use of rainforest timbers to low-volume, high value applications
- Creating landscapes rich in biodiversity

e- Indigenous Flora and Fauna

- Minimal building footprint
- Minimal disturbance to surrounding vegetation
- Leaving wildlife movement corridors
- Designing to avoid bird strikes on windows, wind turbines, etc.

2. Social and Cultural Limits of Sustainable Housing

a- Society and Culture

- Using locally-sourced materials
- Designing to enable the use of locally-sourced skills for construction and future maintenance
- Adapting existing buildings
- Maintaining existing mix of spaces for living, trade and social activities
- Maintaining existing scale and typologies of buildings
- Emphasizing public space
- Respecting existing built context
- Using pre-used 'blighted' sites rather than green field sites.

b- Occupants

1- Health:

- Designing for high fresh air change rate (above minimum requirements)
- Using materials with authoritative guarantees of non-toxicity
- Designing for easy cleaning and maintenance

2- Comfort:

- Designing so that the building itself offers internal conditions that are within or approach culturally acceptable limits
- Using energy-using systems only when appropriate in relation to other sustainability issues

3- Economical Limits of Sustainable Housing

a- Economic Performance

- Designing for low imported energy use
- Design for low maintenance

b- The Building

- Adapting and using existing building stock rather than building new

- Designing for adaptability and future change of use
- Using long-life materials
- Allowing provision for possible future services
- Using measures to protect from place-dependent risks such as bush fires and corrosive seaside air
- Designing for low maintenance and easy serviceability
- Allowing for uncertainty for future climate

3.9. A Good Practice: BedZED Housing Development[100]

Beddington Zero Energy Development (BedZED), built in 2000, consists of 83 mixed tenure homes, workspaces, retail, and leisure uses. It is a good practice of sustainable design which was designed by an integrated project team including architect Bill Dunster and Arup. It seeks to "offer its occupants the opportunity to live and work with a completely carbon-neutral lifestyle, making this choice attractive, cost-effective, and appropriate to modern living." In this part, the sustainable features of Bed ZED project will be examined.

> BedZED was conceived to show that in large-scale construction a high level of sustainability can be practical and cost effective. If the sustainability concept is to have any sort of meaningful overall effect on the environment, it must move into the volume mainstream, satisfy economic and social objectives, and benefit all stakeholders.[101]

[100] These documents of BedZED are taken from this journal: C. Twinn. (2003). BedZED. *The Arup Journal, 2003-1, 10-16.* Retrieved February 27, 2009, from http://www.arup.com/_assets/_download/download68.pdf

[101] Ibid., 11.

Figure 3.9: Aerial view of BedZED

C. Twinn. BedZED. *The Arup Journal, 2003-1, 10-16.* (2003), 10.

		Car mileage	Car ownership manufacture maintenance road infrastructure	Public transport	Air travel	Electricity and gas	Water	Domestic waste	Office footprint energy and paper	Food including transport but not packaging	Overall eco-footprint	
Typical UK lifestyle	Owns car Yearly holidays by plane Recycles 11% Eats out of season, highly packaged, imported food	0.90 10 000 km/yr	0.41	0.00	0.30	0.45 22 500kWh/yr electric and gas	0.002 140 litres/day	1.70	0.80 Brown energy and virgin paper	1.63	6.19	
BedZED Conventional lifestyle	Owns car and commutes to work by public transport Yearly holidays by plane Recycles 60% Moderate meat eater and some imported food	0.45 5000 km/yr	0.32	0.30 4000 km/yr	0.30	0.10 Waste wood CHP inc landfill diversion credit	0.001 91 litres/day	1.02	0.80 Brown energy and virgin paper	1.06	4.36	
BedZED Ideal	Lives and works at BedZED Recycles office paper No car - ZED car member Two-yearly holidays by plane Recycles 80% at home Low meat diet with local fresh food	0.09 1000 km/yr	0.04 20 people per club car	0.30 4000 km/yr	0.15	0.10 Waste wood CHP inc landfill diversion credit	0.001 91 litres/day	0.34	0.16 Closed-loop office paper scheme	0.72	1.90	
Global Average											2.40	
Global Available	Leaving 18% of bio productive land for wildlife										1.90	

Figure 3.10: Ecological footprint for UK lifestyle in ha/person, based on a four-person household

C. Twinn. BedZED. *The Arup Journal, 2003-1, 10-16.* (2003), 10.

Sustainability decision should be made from the start, while choosing site. BedZED occupies an urban brownfield site in South London and transforms the site into a new living environment. Thus, it does not consume any more limited greenfield. High build-density is chosen by the project in order to use the land optimum. Moreover, this approach results in building coherent communities and providing critical mass for facilities like public transport.

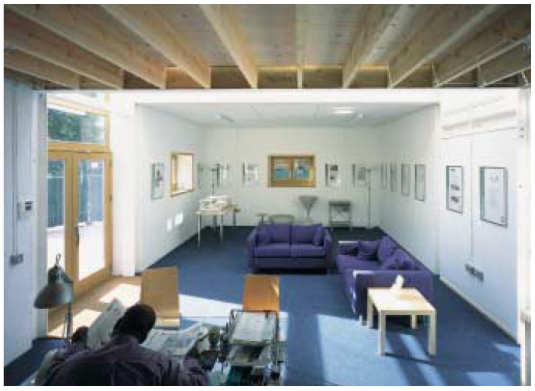

Figure 3.11 and 3.12: Live / work space.

C. Twinn. BedZED. *The Arup Journal, 2003-1, 10-16.* (2003), 11,16.

South orientation is utilized for passive solar design and daylight access. To increase the ecological value of the site and its carbon absorbing ability, the roofs areas are designed green, covered by grass. This also provides private gardens to the dwellers.

Figure 3.13: A private garden on the third floor

Figure 3.14: PV cells on the windows

Photos were taken by Mete Sezer, 2008.

Advanced analytical techniques are explored to learn that how passive systems could be enhanced enough to allow active systems to be completely omitted. Renewable energies are used in the project. Although PV cells are expensive, to show environmental awareness and highlight new energy technologies, they are used. For room comfort and the cost-effectiveness of the buildings, passive solar heating and passive cooling strategies are used. Internal heat gains from people and their activities such as cooking and washing are also considered as energy sources.

The size of the insulation and the thermal mass heat storage are chosen with the help of calculations in order to provide space heating through day and night. From glazing arrangement to thermal capacity and thermal insulation characteristics of materials, many issues are taken into account. Computer analysis and simulation tools and weather data sequences establish the material performance and building massing. Analyses are done for 'design worst' cases. Terraced block typology is used in order to reduce overall heat loss. Building envelope airtightness is provided in order to prevent unwanted heat loss as well.

Different orientations are required for the varying building uses of homes and workspaces. Offices are designed on the north façade owing to their potentially high occupancy levels and office machine heat gains. On the other hand, homes are designed on the south façade due to the fact that they have less occupancy density and less internal heat gains. Passive cooling and cool night natural ventilation is utilized to maintain summer comfort conditions.

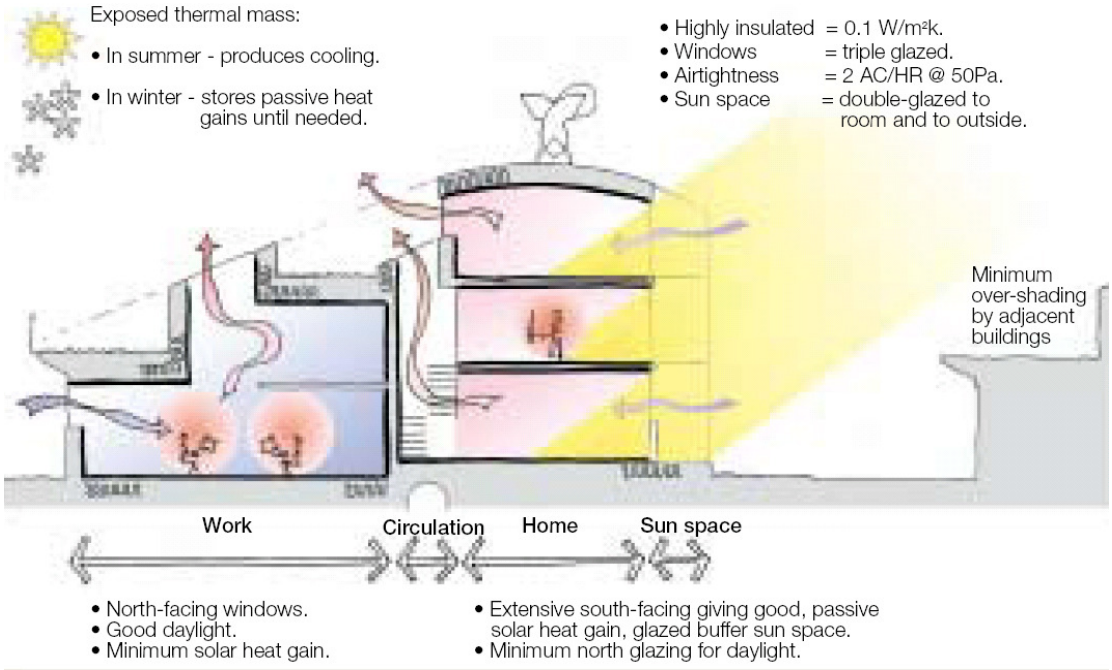

Figure 3.15: Building physics

C. Twinn. BedZED. *The Arup Journal, 2003-1, 10-16.* (2003), 12.

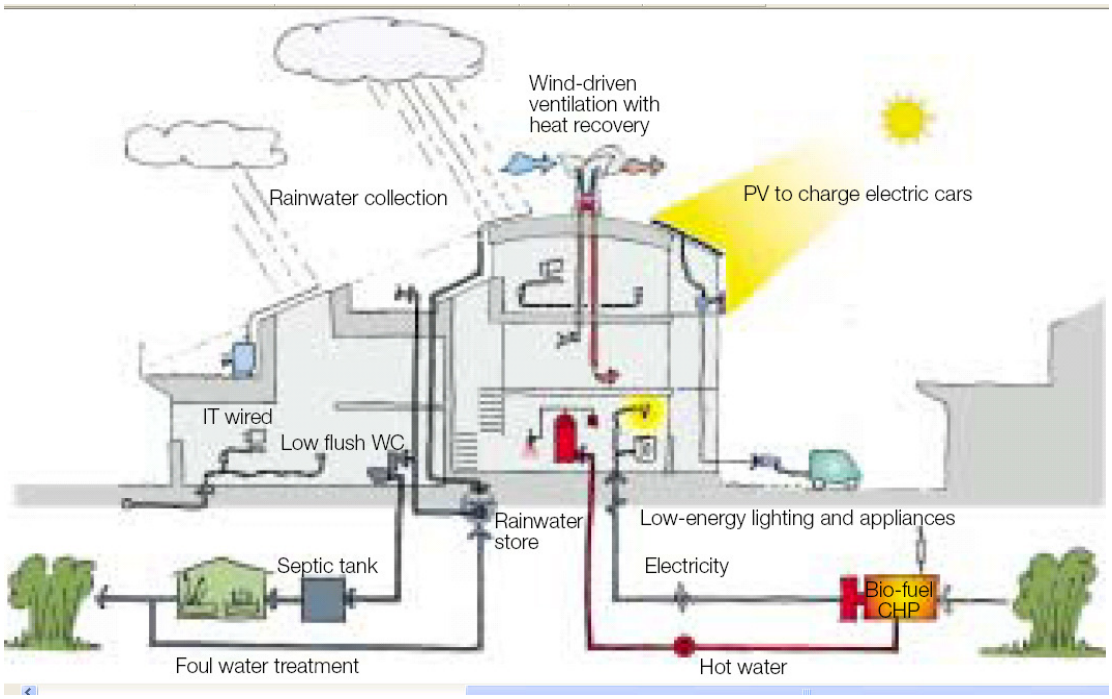

Figure 3.16: Mechanical and electrical systems

C. Twinn. BedZED. *The Arup Journal, 2003-1, 10-16.* (2003), 12.

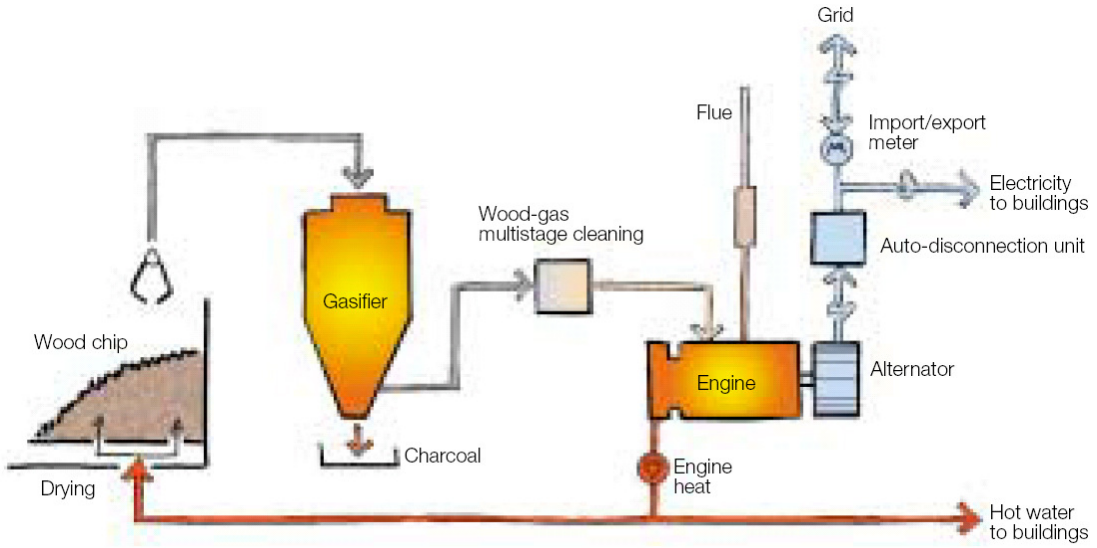

Figure 3.17: Bio-fuelled combined heat and power

C. Twinn. BedZED. *The Arup Journal, 2003-1, 10-16.* (2003), 13.

Bio-fuelled combined heat and power (CHP) is used in the complex. Tree prunings are used as low cost energy source; no fans or pumps are used. EU 'A' rated domestic appliances, low-energy compact fluorescent luminaries, and meters visible to the consumers are used in order to

reduce electrical energy demand. The Grid electricity import/export connection is used as a cost-effective alternative to conventional standby boiler plant. Therefore, the total heat and domestic hot water demand is provided by a CHP unit sized to match the annual electricity demand.


Figure 3.18 and Figure 3.19: BedZed Ventilation strategy: Heat-recovery moving wind cowls

Photos were taken by Mete Sezer, 2008.

A new ventilation system was developed for the project called the 'wind cowl system'. It delivers preheated fresh air to each home and extracts its vitiated air, complete with heat recovery from the extracted ventilation air. It harnesses even low velocity wind, and is the first that introduces heat recovery using wind power, with both positive and negative wind pressure used to deliver supply air and extract vitiated air. The project is not using solar collectors because of their expensiveness, yet it is future-proofed to accept solar collectors on their southern façades in anticipation of when PV costs reduce.

The project also considers its occupants' lifestyle eco-footprint, and the significant carbon emissions due to transport fossil fuel. It benefits from electric cars. 95% of all urban journeys, less than 40km, are made by these cars. Building-mounted PV cells are used to reduce electric and charge 40 zero carbon emissions urban-use cars. Charging points are installed and occupants can have free parking and charging if they choose electric cars. "Whereas PV providing electrical power to buildings had a payback of around 75 years, using it instead of the high-taxed petrol reduced this to approximately 13 years."[102]

The project reduces treated potable water demand by more than 50%. It treats the effluent on site. Pressure showers, meters visible to consumers, EU 'A' grade water-consuming appliances, and very low/dual flush toilets are used. Rainwater is collected from roof surfaces and stored in underground tanks for irrigation and toilet flushing. Moreover, an ecological on-site foul water

[102] Twinn, 14.

treatment system was added to the project. The system treats the water to a high standard and collects it in the rainwater storage tanks. Surface water runoff is handled for surfaces where there may be slight contamination by cars, animals, or garden treatments. To avoid draining surface water into the local sewers, permeable hard surfaces, foundation filter media for cleaning any contamination and site water holding features are used. The rainwater slowly soaks into the ground and local watercourses.

Figure 3.20 and 3.21: Interiors

C. Twinn. BedZED. *The Arup Journal, 2003-1, 10-16.* (2003), 13,16.

Regional materials were chosen that much of the heavier building materials were sourced within a 55km radius to reduce transport impact and allow source checking. Reused structural steel was used in the workspace framing structure, and reclaimed timber for internal partition studwork. Certified wood was used. Waste was addressed both at construction and for the buildings in-use. Building waste was segregated on site and sent for recycling. A domestic segregation strategy was agreed with the local authority for the homes. Segregation bins were provided in all kitchens and around the site for local authority collection.

Access to Broadband is available to the occupants, giving them the potential of almost instantaneous Internet access as well as the option of being permanently on-line. BedZED is simple and easy to operate. Occupants manually control their dwellings such as opening windows, without any computerized automatic controls.

BedZED complex is a good practice of sustainable design. It considers not only environmental issues of sustainable housing design, but also economical and social issues of it. The following table shows the sustainability ‘triple bottom line’ of the project holistically.

Table 3.2: BedZED sustainability 'triple bottom line'

C. Twinn. BedZED. *The Arup Journal, 2003-1, 10-16.* (2003), 10.

Social amenity	Financial effectiveness	Reduced environmental impact
• mixed tenure, home type, and occupiers • living and working community activity • urban density community critical mass • proximity to wider community facilities • private open space for homes • sunlight and daylight amenity • air quality and comfort • reduced need for car • local car pool • community-led management • community internet • individual choice for carbon-free lifestyle	• housing association build costs • affordable / key worker accommodation • high demand for private sale elements • commands margin over market value • planning gain to add development value • live / work to assist business start-ups • links improve public transport viability • addresses fuel poverty • low energy running bills • Internet links: community / local businesses / service	• zero fossil fuel • 100% renewable energy use • zero heating homes • passive solar heating • PV power for 40 electric vehicles • 50% reduced potable water • on-site ecological water treatment • wind-powered ventilation systems • low embodied energy materials • recycled timber • reused structural steel • urban tree waste bio-fuelled CHP • improved site ecological value • land as a finite resource • bike facilities • recycling facilities

In this chapter, the limits of sustainable housing design are tried to be understood. The broad understanding of the concept was tried to be framed by the categories of the LEED for Homes Rating System and pointed out by the reference books. After comprehending the limits of sustainable housing concept, a good practice was examined. In the next chapter, the frame of sustainable housing concept which was created in this chapter will be used to examine the situation of TOKİ housing case projects in terms of this concept.

CHAPTER 4

THE TURKISH EXPERIENCE: TOKİ HOUSING CASE STUDIES

Sustainable design is an excellent opportunity for Turkey which brings numerous benefits not only to the environment and community, but also to the country itself. Despite of its thirty years of history, it has not influenced the architectural domain of Turkey yet. Arsan defines the following reasons to point out why sustainability has not been achieved so far:

> 1 - Sustainable architecture is still in its infancy. So far, very little attention has been paid at the national level. Therefore the concept of sustainability has been dealt with in limited scope and with only a few examples by individual efforts.
> 2 - There are very few architectural practices in which the sustainable viewpoint is the main starting point for the design. The others are buildings whose initial design problem is not sustainability, yet the key concepts for sustainable design are adhered to unconsciously.
> 3 – Because of their scope and location, most of the examples do not confront the difficulties of what it is to practice sustainability within the context of Turkey. There is almost no project concerned with the physical deterioration of current settlements, social transformations or disruptions, affordability problems, environmental degradation, and so on, because they are located either on university campuses, untouched natural environments or far from any existing settlements. Sustainable architectural practices in Turkey, therefore, are mostly sterile projects located in sterile environments.
> 4 – The precepts posed by the concept of sustainability have not been scrutinized or comprehended properly. The perception of what it means to build in a sustainable manner manifests itself more in the design of environmentally friendly and technologically advanced energy-efficient buildings. [103]

Specifically for housing projects, the sustainability paradigm is crucial. For instance, 31% of the energy of Turkey is consumed by buildings; much of the energy is consumed by houses. On the other hand, houses cause much of the CO2 emissions in the atmosphere. When transportation is also considered as an issue of sustainable design, it is seen that the concept concerns more than 50% of the energy consumption of the country. In the light of this information, sustainability starts to be an absolute necessity. Yet, unfortunately, the importance given to the concept is not enough in Turkey.

[103] Arsan, 4.

In this chapter, in the light of the previous chapter, the present situation of TOKİ (Toplu Konut İdaresi – Housing Development Administration) housing experience will be critically evaluated in terms of sustainable housing design. The framework which was created in the previous chapter with the help of LEED categories will be used to evaluate. Three projects of TOKİ were chosen as case studies. Comparisons will be made between the cases where required. The case projects will be evaluated as 'positive' or 'negative' in terms of the subject issue. In order to avoid using 'sustainable' word for every issue, this 'positive-negative' evaluation system was chosen. In the end, some suggestions will be proposed for each subheading to reach a new sustainable architecture and community. It is intended that these proposals will not only be used by TOKİ, but in all housing projects of Turkey; this will result in meeting the holistic approach requirement of sustainable housing design.

There are several reasons to choose the three TOKİ projects in this case study. As the pioneer Turkish housing builder, TOKİ can play a very significant role in the application of this paradigm. TOKİ is a governmental administration dependent on the prime ministry which controls the decision making mechanism. TOKİ can regulate its own rules. It builds not only housing complexes but also different kinds of public buildings which contribute to the housing complexes. The administration has a great potential to promote this design approach to all housing projects of Turkey. If it applies the sustainability paradigm, it will be a huge advertisement for the housing projects in the whole country.

Another reason to choose TOKİ is its huge slice in the housing sector. TOKİ builds almost 25% of all housing in Turkey every year.[104] It is a huge amount to start with if it is intended to reach a sustainable housing level for the country. To be sustainable, a holistic approach is required. Applying sustainable design concept for one fourth of all the housing projects in the country will be remarkably beneficial for our environment and nature. However, in terms of sustainability, there is almost no step taken by the administration. There is a great lack of knowledge about sustainable housing design in TOKİ.

In February 2007, a research was made by METU (Middle East Technical University), MATPUM (METU Research and Implementation Center for Built Environment and Design) and TOKİ to improve the quality of housing projects in terms of universal and sustainable design. As

[104] Taken from the TOKİ catalogue.

a consequence of this research, several design standards were offered to TOKİ to benefit. The items, in the list, that are related to sustainable housing design are as follows:[105]

- Designing minimum 10% of the total area as open green areas,
- Choosing the plants which requires minimum water,
- Leaving 2.5% of the lot empty to be designed later as a social area,
- Caring and developing the ecological features of the site,
- Reducing the amount of heat absorbing reflective pavements to 20% of the total area and shading them by trees,
- Using no grass area if possible,
- Integrating landscape designers and ecologists to the project group,
- Considering the climate of the area,
- Considering water storage,
- Considering local heat island effects according to seasons and planting shading devices,
- Building wide green parks for each 5.000 dwellings population,
- Considering waste management strategies,
- Considering energy efficiency of the projects in order to provide minimum demand for heating, cooling, lighting and ventilation,
- Using heat pumps,
- Using PV cells to provide minimum 5% electricity for common areas and car parks ,
- Collecting rain water to use later for irrigation and car washing,
- Utilizing renewable energy such as wind, sun, geothermal, biogas and hybrid,
- Using maximum natural light in the projects,
- Using energy efficient and motion censored bulbs,
- Filtering grey water to use for irrigation,
- Designing the roofs as grass roofs if possible,
- Employing insulation to the outside of the enclosure,
- Using low-e glasses for energy efficiency,
- Using energy efficient HVAC systems and central systems for heating, instead of individual ones,
- Providing minimum 50% of hot water by solar collectors on roofs,
- Preferring natural and regional materials,
- Measuring the indoor air quality of the houses,
- Using energy efficient electrical motors and transformers in the buildings,

[105] Toplu Konut Alanlarında Kentsel Çevresel Standartları Oluşturmak İçin Gerekli İnsan-Çevre İlişkileri Verilerinin Derlenme Yönteminin Geliştirilmesi Araştırma Çalışması. (May 2007). METU, MATPUM and TOKİ.

TOKİ does not take into account sustainable housing design issues; thus, this list is remarkable because it shows sustainable housing design principles and informs the organization in terms of sustainable design. The existing situations of TOKİ housing projects are far from satisfactory. On the other hand, there are some improvements in terms of sustainability in the frame of the administration. For instance, by a report from METU, in 2008, six already decided project tenders were cancelled by TOKİ to be changed with more sustainable ones.[106] This shows that if more research is carried out in terms of sustainable design, the administration has a potential to change its strategy. Today, the administration announces architectural competitions concerning sustainable design issues.

In this thesis, as a method, to understand the flaws of the TOKİ housing projects in terms of sustainable design, three different types of TOKİ housing were chosen as case study projects. The first one is a social housing project; the second one is an urban transformation project; and the last one is a revenue-sharing project. In terms of sustainable design approach, there appear no huge differentiations between the cases studies in terms of sustainable architecture. However, there are different potentials that can make the different project types more sustainable. For instance, social housing projects and urban transformation projects are built for poor people while revenue-sharing projects are built for wealthy people. This results in the difference of the sustainability potential. The first two case projects are quite similar to each other in sustainability terms because TOKİ builds these buildings itself. However, revenue-sharing projects are designed outside the organization. Kayseri 6th Region Melikgazi Housing in Kayseri is a case study for social housing project while Denizli Center Slum Transformation Project is a case study for a transformation project. As a revenue-sharing project, Parkoran Housing complex in Ankara was chosen. The cases were chosen randomly because there is no difference between TOKİ projects in sustainable design terms.

As a method for evaluation, interviews and conversations were held with TOKİ officers and project directors. The great contributions of the TOKİ officers, the director of strategy development Suat Orgun, the director of urban transformation Gürol Konyalıoğlu, the director of fixtures Atilla Demir, the director of reconstruction plan Ayşe Sümen, the director of health constructions Elif Atagündüz, Eyüp Can, and architect Caner Sarı, architect Özlem Eldemir and the project director of Parkoran construction Ali Onak Çetin are acknowledged. The collected information will not be referred specifically to the individuals. It will be mentioned in the text as

[106] TOKİ "Ekolojik" Şehir İçin 6 İhaleyi İptal Etti. (2008, October 9). *CNN Türk*. Retrieved December 20, 2008, from http://www.cnnturk.com/2008/ekonomi/genel/10/09/toki.ekolojik.sehir.icin.6.ihaleyi.iptal.etti/496100.0/index.html

'according to TOKİ officers'. All the documents, projects and data were mostly provided by TOKİ.

Kayseri Social Housing Project:

Figure 4.1: Kayseri Melikgazi project

Emlak Kulisi Web Site, http://www.emlakkulisi.com/haber.asp?id=5095&Categoryid=16, (accessed January 5, 2009).

Melikgazi 6th Region Housing is a social housing project in Kayseri. It includes 308 122 m2-C type and 448 132 m2-C2 type dwellings; 756 dwellings in total. As a social housing project, it can be generalized to all TOKİ social housing projects in Turkey. TOKİ's first task is building dwellings for poor and middle income people. Thus, providing a basic shelter for these people economically becomes the main aim of the administration. The cheaper, the more suitable is the principle. As its working method; the organization gives one of its typical projects to construction companies to implement on sites. Typical projects are applied for any site in Turkey. Therefore, all the end products become the same. The same blocks appear on any site regardless of any sustainable design approach.

In Turkey conditions, TOKİ housing is observed as a high quality one compared to the other buildings built by private contractors. There is a huge demand for their projects. However, in this study, it is seen that they do not have enough quality. Sustainable design approach will improve their quality.

Denizli Center Urban Transformation Project:


Figure 4.2 and 4.3: Photos of Denizli project. Slums on the background.

Denizli Urban Transformation Housing Project is an ongoing project which started in 2004, in Denizli. This is the first urban renewal project trial of TOKİ. The aim of this project is to reform the slums which were built on public or private lots with any lack of engineering design and are the source of deformed and disorganized urbanization.[107] Built in the Dokuzkavaklar Region, the project consists of 448 dwellings of 94 m² and 120 m². The system is a 'transfer housing production' system in which the new housing blocks are finished in another lot before the squatters move out of their slums. 187 of the families that moved in the new blocks were registered squatters, while 259 of them were occupiers. After this renewal project, a huge area of 160.000 m² was gained. Moreover, TOKİ plans to extend this project in Denizli with 1500 new dwellings.

Urban transformation projects will most likely appear more in the future in the frame of the administration. As Turkey has a huge slum problem, especially in big cities like İstanbul and Ankara, the necessity of this kind of projects increases. In 2008, TOKİ leads the construction sector in terms of urban transformation. In Ankara, İstanbul, İzmir and more cities in Turkey, there are numerous transformation projects in progress. TOKİ steps forward in terms of renewal projects.[108]

The urban transformation projects share the similar problems with the social housing projects of TOKİ. They are also built for poor people who will be homeless in case of being moved out of their slums. Like the social housing case, in the frame of this case, economy is the keyword. Thus, all the economic principles mentioned in the previous case are also valid for this case.

[107] It is taken from the documents given by TOKİ to CNN Turk TV Channel.

[108] TOKİ`den gecekondu dönüşüm projesi atağı. (2006, February 20). Retrieved December 20, 2008, from http://www.tumgazeteler.com/?a=1353943

Ankara Parkoran Revenue-Sharing Project:

Figure 4.4 and 4.5: Models of Parkoran project

Document were maintained by Parkoran project director.

Parkoran Housing complex is a revenue-sharing project of TOKİ, with Mesa and Aktürk, in Oran, in Ankara. It is a huge housing project with its 31 storied 12 towers and 7 storied 5 blocks; 1832 dwellings in total. It is situated nearby Panora Shopping Center which is one of the biggest shopping centers in Ankara. Before evaluating this case study, it is useful to see the revenue-sharing project potentials in terms of sustainable housing design principles.

Revenue-sharing projects are the projects that are constructed with private sector construction companies. Contrary to the houses that were built for poor and middle income people, TOKİ implements these projects for wealthy people. In this system, TOKİ gives the lot to private companies and shares the money that the company earns from the construction. The administration uses the earned money for further projects. Considering that about 50% of the earnings are taken by TOKİ, higher quality projects are expected from the administration in the future.

Revenue-sharing project implementations of TOKİ are sometimes open to discussion. According to Eyüp Muhçu[109], "While TOKİ housing projects are being constructed, public spirit is ignored. The buildings that are unsuitable for the historical pattern of the sites are constructed. People move into the building and live without neighborhood relations. The values of the city are left to the fairness of global companies. Moreover, due to lack of regulations, low quality buildings are produced." This evaluation is remarkable when the built projects are observed. For instance, in

[109] Gökçe Uygun. TOKİ'nin projeleri tartışmalı. (2005, July 22). *Cumhuriyet.* Retrieved December 20, 2008, from http://www.arkitera.com/news.php?action=displayNewsItem&ID=3229 (It was translated by the author)

the frame of Parkoran project, cultural, social and environmental sustainability are all ignored by the administration.

In this system, TOKİ makes its decisions and arranges its own regulations. It defines the square meter that will be built up before giving the work to construction companies. Afterwards, the construction company builds its strategy and project for the site. From this point of view, it is possible that the construction company builds sustainable housing projects if it wants. However, according to the Parkoran project director, in practice it cannot build what it wants due to the remarkable economic restrictions imposed by TOKİ. It is significant to reach construction companies as well as TOKİ to make them aware about sustainable housing. Environmental awareness of the client is also significant. In the course of time, it is expected that the environmental awareness of Turkish people will also improve and the sustainable housing demand will increase with the help of new green design practices in the field of architectural.

Economy, the main problem of the first two cases, is not very significant for this case. Thus, this type of buildings has a great potential in terms of sustainable design. Reaching an acceptable sustainable level is easier in these buildings because the capital costs of the buildings can be afforded by wealthy dwellers. For instance, the capital costs of solar collectors or photovoltaic panels are more affordable in these projects. The crucial point here is to make the contractor and/or client aware of sustainable housing. Both will influence each other.

The Evaluation of TOKİ Projects

4.1. Innovation and Design Process

4.1.1. Integrated Project Planning

TOKİ has a collaborative design approach which includes different departments and tens of technical staff such as architects, city planners and engineers. Each department is well organized; the system works efficiently. However, there is no 'green design expert'[110] in the team. Thus, sustainable design is not taken into account during the design phase. A green design expert should take place in the team to make the buildings more sustainable.

[110] A green design expert can be defined as an expert, most probably an architect, who has a wide knowledge about sustainable design.

As in developed countries energy consultant companies mostly take place in design phases, it would be useful for TOKİ as well to reduce energy consumption with the help of some companies or energy experts in its structure. In terms of reducing the energy consumption, it is crucial to take some decisions from the start. Some decisions cannot be changed, such as building direction or space organization, after the project started to be built. Thus, the administration should demand services from outside or educate its existing officers in terms of sustainable design. In both Kayseri and Denizli projects, there is almost no sustainable design approach due to the fact that they are produced by TOKİ itself.

Revenue-sharing projects are not created by TOKİ. The construction company gives the project to an architectural office or it designs the project in its own structure. In both cases, the decision making mechanism is not TOKİ. Thus, the architectural firm which projects the dwellings gains more importance. The firm should have a green design expert in its structure or should have a green design consultant outside. In the frame of the Parkoran case, the creator of this project, ACE Mimarlık has no green design expert in its structure. This means, the project is inadequate in terms of this issue.

TOKİ needs professional help about sustainable housing design. It should be an obligation not only for TOKİ, but also for all builders to consider sustainable housing design strategies and utilize them. It seems that the government and the municipalities should impose regulations on all building companies.

The organization can demand assistance from outside, such as sustainable architectural design consultants. This will be helpful if the source of the service is experienced and expert enough and the service is well integrated to the design and construction process. Furthermore, TOKİ can use the university professors as consultants until this kind of consultancy companies will have been established. On the other hand, it can keep a sustainable architectural design expert in its structure to increase the sustainability level of the projects. Considering that TOKİ subcontracts most of the projects to different groups, for revenue-sharing project types, the projects should be designed by architectural offices who take into account sustainability in their design strategy.

4.1.2. Durability Management Process

In every housing project, even if there is no intent of sustainability, choosing and implementing the right system and materials is a logical act. However, according to TOKİ officers, when the budget is restrictive, as in social housing projects, it is not possible to choose long lasting

materials. TOKİ should spend money for more durable houses for poor people. Slight increases in the capital cost for high quality materials do not mean that the building costs higher. The administration should foresee the future existence of the buildings. It should offer long-lasting dwellings to the occupants. In terms of moisture, it is possible to be optimistic about TOKİ due to the fact that it uses moisture barriers to prevent corruption in the building enclosures. TOKİ housing can be durable if the administration intents it. However, the existing situation is far from satisfactory. This situation is valid for both social housing projects like Kayseri and transformation projects like Denizli. In Parkoran, insulation and moisture control barriers are also used in the building enclosure. However, the building enclosure of the project is foreseen to be more durable than the other two cases due to the fact that higher quality materials are used in Parkoran. The durability of the building enclosure is crucial. Energy concern should be improved. The enclosure itself should be loaded by optimum insulation and moisture barriers. High quality materials should be used for building enclosure for it to be durable for long years. Employing high quality and durable materials will not increase the capital costs very much. On the contrary, for instance, it will reduce both the energy consumption and the money that will be paid in the long term. TOKİ should consider this strategy and afford the capital costs of the housing projects.

4.1.3. Innovative or Regional Design

In the LEED for homes rating system, this option is used to evaluate the new green ways of sustainable housing design which are not taken into account by the system. TOKİ does not even meet the existing sustainable housing design strategies.

In terms of regional design, TOKİ does not reply to the needs either. Climatic condition of the region is not utilized efficiently by the organization. Just the temperature of the region is taken into account to find the thickness of the block insulation. Sun or dominant winds are ignored. Passive heating strategies are not utilized. Typical blocks are built on different regions. Topography is not considered well either. Furthermore, in terms of preserving cultural or regional values, TOKİ again ignores cultural design approaches. Typical projects which do not reflect any feature of any region are built regardless of any regional design intention. Yet, a few examples can be seen in terms of cultural sustainability in TOKİ. For instance, for the Sulukule transformation, TOKİ aims to design new buildings instead of its typical blocks. According to Kadir Topbaş, the major of İstanbul, the transformation project will sustain the culture which is

living there instead of deteriorating it.[111] This kind of projects can provide social and cultural sustainability, and be successful examples of preserving culture provided that they are designed and implemented well. In Kayseri, Denizli and Parkoran projects, there is no innovative or regional design approach.

New ways of sustainable design should be searched in the structure of TOKİ. Sustainable architectural design appears to be the next trend in the country. This means that the administration will have an opportunity to promote sustainability. If the team including a green design expert is established as soon as possible, innovative outcomes will have a chance to appear earlier. In terms of regional design, the organization should consider the climatic, topographic, cultural and regional character of the site; utilize of its environmental character; and build new buildings reflecting the features of the region. Cultural sustainability should be taken into account for any city of Turkey. New typologies may be designed peculiar to cities.

4.2. Location and Linkages

4.2.1. Design Phase

In design phase of a housing settlement, there are some principles that should be taken into account for sustainability. In this issue, the building settlements of the case studies will be evaluated. These strategies are the crucial parts of sustainable housing settlement design.

[111] Serdar Canıpek. Sulukule`ye yeni çehre. (2006, January 14). Retrieved December 30, 2008, from http://www.tumgazeteler.com/?a=1278842

Figure 4.6: Site plan of Kayseri project

Document was provided by TOKİ.

Figure 4.7: Site plan of Denizli project

Document was provided by TOKİ.

Figure 4.8: Satellite view of Kayseri project

Figure 4.9: Satellite view of Denizli project

Documents were provided from Google Earth.

Figure 4.10: Site plan of Parkoran project

Document was provided by Parkoran project director.

Settling the blocks according to the sun principle was not utilized by any of the case projects. In Kayseri project, the blocks were put in an over crowded order regardless of shadow analysis. This is seen in the satellite view. Similarly, in Denizli project as well, the site is over crowded due to the blocks. In the Parkoran project, considering that it is a revenue-sharing project, actually, it is expected to be more livable in a less crowded area. Contrarily, the project is extremely crowded. On the close environment of the site, there is no 31-storey-block rising up. In the figure showing the site plan of Parkoran that used above, even the shadow directions are

drawn wrong. Instead of north sides, the blocks cast shadows on their south sides. This clearly shows that the sun was totally ignored by the architect. In all the three cases, there is no sun utilization. There is no sun light analysis for the blocks in order not to cast shadow onto the other. In the design period, the specific angles of the sun depending on the seasons are not taken into account. The distances between the buildings are not enough to avoid casting shadow onto the others. Therefore, the sun is not used efficiently as a heat and light source.

Utilizing the sun is very significant in terms of energy performance of building and comfort of the inhabitants. For instance, for a project in Ankara, first of all, it should consider the sun path diagram of Ankara.

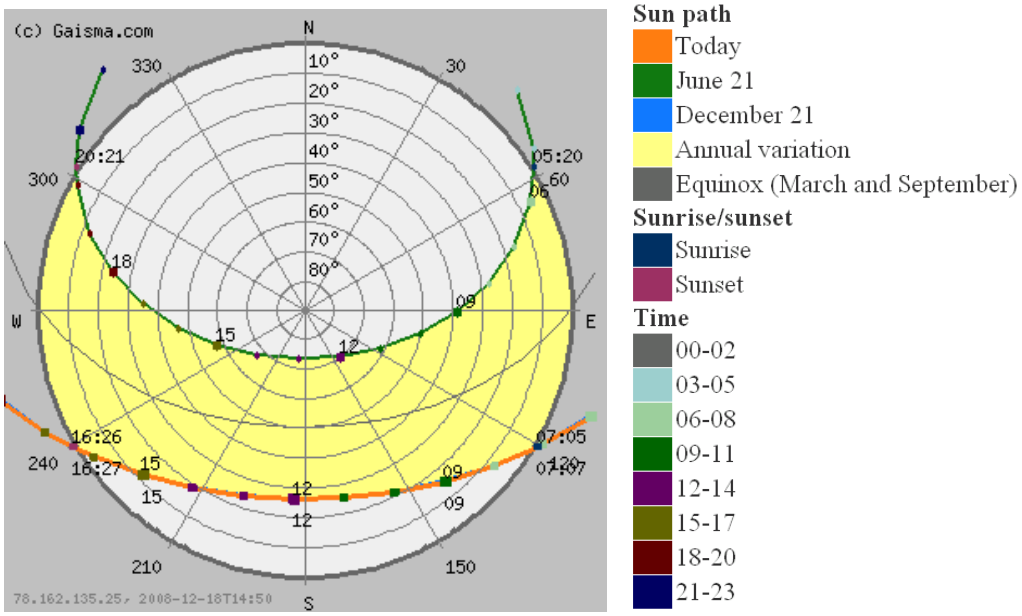

Figure 4.11: The Sun Path Diagram of Ankara (Taken on the 18th of December)

Gaisma Web Site, http://www.gaisma.com/en/location/ankara.html, (accessed January 5, 2009).

This diagram shows the path of the sun depending on days, even on hours, in Ankara. It shows that the angle of the sun for Ankara differentiates between 27 and 73 degrees in a year, depending on the season. Thus, while settling the blocks and the block itself, these degrees should be utilized to use maximum direct sun light.

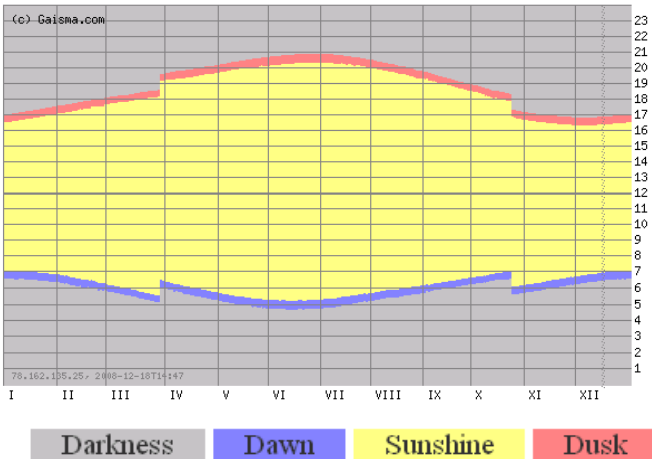

Figure 4.12: Sunrise, Sunset, Dawn and Dusk Times Graph of Ankara

Gaisma Web Site, http://www.gaisma.com/en/location/ankara.html, (accessed January 5, 2009).

The graphic above shows the duration of the shining sun in a year, in Ankara, depending on months. This graphic should also be used to consider the energy potential of the site. Therefore, the sun can be utilized passively, or actively, in order to provide the energy demand which is required in the building.

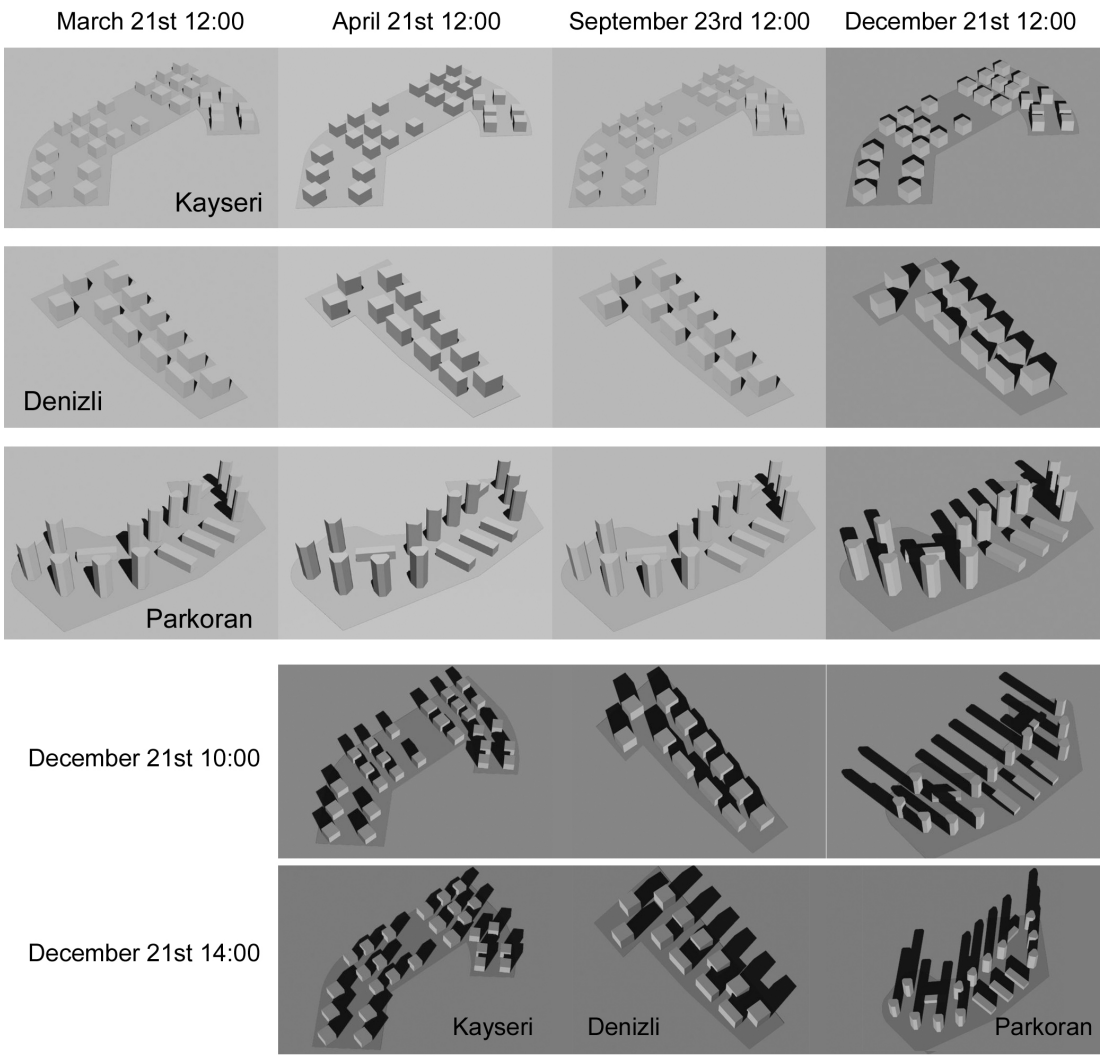

Figure 4.13: Shadow analyses of the case projects

Several analyses should be done by TOKİ to utilize the sun light and heat maximum. The illustrations above which were created with the help of a computer program are the shadow analyses of the case projects. The illustrations clearly show that there is no sun light utilization intention in the projects. The blocks cast shadows onto each other.

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Insolation, kWh/m²/day	0.44	1.13	2.47	4.03	5.60	5.96	5.92	4.62	3.06	1.51	0.66	0.31
Clearness, 0 - 1	0.33	0.41	0.48	0.51	0.55	0.53	0.55	0.52	0.49	0.41	0.38	0.31
Temperature, °C	1.75	1.42	2.91	6.07	10.88	14.32	16.79	17.03	13.64	9.87	5.61	2.88
Wind speed, m/s	8.17	7.34	7.14	6.35	5.92	5.36	5.69	5.86	6.73	7.36	7.37	7.55
Precipitation, mm	46	30	38	36	45	51	66	62	67	69	67	54
Wet days, d	17.1	12.1	14.0	11.9	12.0	11.8	12.3	13.0	15.4	16.8	18.6	17.5

Figure 4.14: Solar Energy and Surface Meteorology of Ankara

NASA Atmospheric Science Data Center, http://eosweb.larc.nasa.gov/sse/, (accessed January 5, 2009).

Besides the analyses made by design team, some already arranged data should also be used by the administration. For instance, this table which is taken from the NASA Atmospheric Science Data Center shows the potential of Ankara in terms of sunlight, wind and precipitation. It is possible to take the data for any city of Turkey from the site of this organization. Moreover, the Turkish State Meteorological Service also offers numerous data for the whole cities of the country. The sun and the wind can be used as energy sources, while the precipitation amount can help to calculate the water demand of the project.

In terms of utilizing dominant summer winds and avoiding dominant winter winds, all the three cases are unsatisfactory. They have no wind strategy or any wind benefit to ventilate or cool the site and the buildings. In summer, wind is very significant to utilize for natural ventilation. Thus, the settlement should be designed according to the dominant summer wind. Contrarily, in winter, the dominant wind direction should be resisted by some trees or blocks to leave outside less windy for inhabitants. Turbulence must be prevented. These principles are totally ignored in these case studies. Wind usage is a significant issue provided that it should be used carefully. For instance, for Ankara, the dominant wind direction depends even on the districts of the city. In the center of Ankara, the northeast dominant wind should be taken into account, while for Dikmen it is west, or for Etimesgut it is southeast.[112] Thus, the dominant wind should be considered well and used consciously to provide the expected effect on the site.

Besides these analyses, several more analyses should be done by design team such as panorama analyses and aesthetical analyses. Panorama analyzes provide the utilization of the panorama maximum while aesthetical analyses help to create not only a sustainable housing project, but also a piece of art. Housing complexes will be high quality and sustainable with the help of these analyses.

[112] Ankara Governor's Office Web Site. Retrieved January 3, 2009, from http://www.ankara.gov.tr/turkce/konu_detay.aspx?uid=59

According to TOKİ officers, they take into account to avoid creating deep slopes on sites. In terms of this issue, all the three projects seem conventional. According to the Parkoran project director, they try to avoid creating stairs as much as possible to leave the area usable for cyclists and disabled dwellers. However, in other cases, ramps are not considered and assessed adequately to ease the access of cyclists and disabled people. Considering 12% of the Turkish people are disabled, they should also be taken into account while designing projects. To promote ramps instead of stairs will increase both the life quality of disabled people and cyclists, and the sustainability level of the complex.

User profile consideration is ignored in social housing and transformation projects of TOKİ. Same typologies are applied for different users regardless of human factor. In Kayseri project, there are just two different dwelling choices for the occupants as well as in Denizli project. Generally, in social housing projects, TOKİ chooses two or three types of blocks and builds them. It is polemic that they are enough for different user profiles. The choices are not enough, yet the poor people have to be pleased with them. On the other hand, in the Parkoran project, user profile is extremely considered. There are 4 types of blocks and 25 types of flats. This seems adequate to meet different user profile needs. Thus, in terms of this issue, this project is satisfactory. Unlike the first two case projects, affordability and choosing opportunity of rich people directly influence the flat type amount in Parkoran.

None of the case studies are flexible or extendable. The possible future alterations and/or extensions, such as integration of new houses or other complexes, are not foreseen. The projects are built just for the existing requirements, not for the possible future development. These approaches are unsustainable. The typologies should be flexible. It is impossible to think the house without human factor. The human will make the house a part of himself by using his features and preferences. The opportunity to form his own house should be given to him. For instance, to give the dweller an opportunity to form his life, the inside walls of the dwellings may be constructed as movable walls which are made of light materials. A sustainable housing project should also be extendable. All area or region should be designed in the beginning of the construction. Possible extensions should be foreseen. From infrastructure scale to architectural organization and design scale, every issue should be designed for long term and applied before the construction period of the projects.

4.2.2. Site Selection

Except transformation projects and several projects, TOKİ builds on empty sites. This means that it continuously consumes more land. According to the TOKİ officers, they try to develop sites into green fields by planting trees. Planting trees is seen as making the site sustainable by the administration so far. In Melikgazi project, the site is seen as an empty green field. Then, it is planned totally from the start by the planners. No disturbed natural land is left. It is an incorrect approach in the light of sustainable design. In Denizli project, Denizli municipality provided an empty lot for the new dwellings. Similar to Melikgazi project, the site was seen as an empty field and filled with maximum amount of blocks. Even if the site was a totally green field, it would not change anything due to the huge housing requirement. In other words, whether the site is a brown field or a green field would not change the result. It is hard to see site respect in this case as well. In Parkoran case, the site was not empty like the other cases. In terms of site selection, environmentally, this project seems positive. Instead of consuming more land, it uses a previously developed land. However, there is another issue concerning cultural sustainability in this case. A special building complex, the old Grand National Assembly parliamentarian houses designed by Behruz Çinici, existed there before the Parkoran project. The site selection of this project is very polemical. It has taken place in the media. The Chamber of the Architects has also defended the cultural values of the subject site long time.[113] Being a very valuable lot, the site is used to earn maximum money by TOKİ regardless of any cultural values thus cultural sustainability. The demolished houses were seen as the cultural values of the republic era.

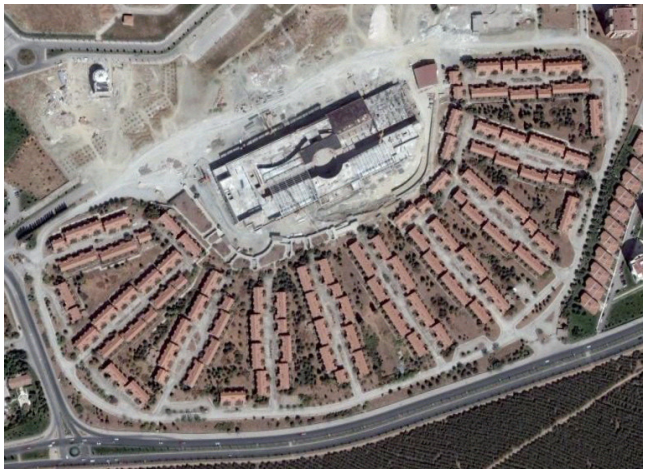

Figure 4.15: Satellite view of the site before Parkoran project

Document was provided from Google Earth.

[113] Cumhuriyet Dönemi Mimarlığı: TBMM Milletvekili Lojmanları'ndan Ayakta Kalan Konutların Korunması Yönünde Bir Karar. (2008). *Mimarlık, 344*. Retrieved January 3, 2009, from http://old.mo.org.tr/mimarlikdergisi/index.cfm?sayfa=mimarlik&DergiSayi=357&RecID=1933

In this picture, the previous situation of the Parkoran site is seen. Instead of such a humanistic settlement, high-rise blocks were designed for the site. In the previous situation of the site, as it is seen in the picture, there was a green band by the motorway that separates the dwellings from the way. It was both creating a visual relaxing effect and providing sound protection for the dwellings. According to the project director, in the beginning of the project, the workers moved all the trees on the construction lot to the green band willingly. The green band transformed into a green forest band. However, someday, the municipality workers destroyed all the trees in order to widen the motorway. In terms of site selection, Parkoran project can be called environmentally positive, yet culturally negative. Unfortunately, the cultural sustainability is not considered by TOKİ either. Furthermore, TOKİ uses no traditional element, material or symbol peculiar to building regions in none of the three cases.

In terms of this issue, instead of green fields, brown fields should be chosen as project sites. This issue is more related to policy. Firstly, the politicians or the decision making mechanisms should be made conscious about this issue. The restricted green fields should be tried to be maximized by planting more trees instead of using them as construction lots. Brown fields which have no values should be developed for housing projects. In this period, brown field will turn into a green field spontaneously with the help of sustainable design principles.

4.2.3. Preferred Locations

TOKİ is mostly criticized due to the fact that it builds projects far from city centers. It seems right when the projects were observed. The lots in the city centers are selected for revenue-sharing projects whereas social housing projects are removed from city centers. This policy shows that rich and poor are separated from each other. The rich is isolated in his expensive and safe residence while the poor is removed from the city center regardless of transportation problem. In the light of sustainability, there should be equity between people. Social connection should be enforced. In the frame of this issue, TOKİ is far from satisfactory.

Melikgazi project is far from the city center. Thus, in terms of this issue, the case is negative. In Denizli case, despite the project's name is Denizli center transformation project, it is hard to say that the site is in the center of the city. However, compared to common social housing projects, this case can be evaluated as being close to the city center. In suchlike sites, there exists a great potential to develop the sustainable design concept.

Building on previously developed lots is a more sustainable approach than building on green fields. In other words, transformation projects are one step further than new built projects in terms of sustainable site selection. In this case, it seems that new land is consumed instead of using the slum lots. However, after the dwellers move in their new homes, the previous slum lots will also be used to build more houses. It is hoped that the new housing projects will be more sustainable. In terms of site location, Parkoran project is positive. It is approximately in the city center from now on owing to the growing city center of Ankara and the altering understanding of city center. Thanks to its site location, it has a very big potential to promote sustainable design to the people who live in the city. Yet, no sustainable design approach appears in this project. On the other hand, being a project built on a previously developed lot, Parkoran can be called positive for this issue unintentionally.

In terms of preferred location, lots close to city centers should be chosen to promote sustainable living. The promotion of sustainability will appear when the people without sustainability thinking can reach the sustainable housing projects. To promote this kind of housing design approach and life style, instead of widening the city center towards the green outside the city, it can be tried to redesign the previously developed lots in the city center.

4.2.4. Infrastructure

Building outside the city results in requirement of a new infrastructure for the buildings. Thus, in Melikgazi project a new infrastructure had to be built. In terms of this issue, the project can be called negative. However, the projects in the city center like Denizli and Parkoran projects can be considered satisfactory in this issue owing to their previously developed infrastructures of their lots. Adequate importance should be given to infrastructure systems. Possible future developments should be foreseen while applying them. Moreover, the materials that are used should be durable in order not to dig the whole site time after time like it is done in the existing situation of Turkey.

4.2.5. Community Resources / Public Transport

TOKİ, as a general principle, tries to create a holistic land use including housing blocks, retails, primary schools, social buildings and mosques. In Turkey's conditions, it is remarkable. In terms of sustainable design, this approach is positive. However, in Melikgazi project, it is not easy to affirm that it is positive as well. There are only housing blocks rising on the site except the retail

center in the far corner. According to TOKİ officers, the first aim was to build maximum number of dwellings regardless of anything. Similarly, Denizli project includes just housing blocks and a retail unit. Although the dwellings were finished long time ago, the retail unit is still waiting to be built. On the other hand, in the frame of this project, proximity to the community resources was not considered. On the site, there are just housing blocks. Thus, the people will have to leave the site each time for their needs. Moreover, they will use their cars or other transportation vehicles to go somewhere. They have big car parks. The existing situation of this project includes just the housing blocks and the car parks.

Compared to the other cases, Parkoran project offers more community resources to its dwellers. First of all, one of the biggest shopping centers of Ankara, the Panora Shopping Center including shops, bars, sports center, restaurants, amusement areas, ice skating track, cinemas and various more social activities, is just several steps far from the housing complex. It is a huge advantage for the inhabitants of the project. Besides Panora, on its site, there will be social and retail areas such as shops, cafes, restaurants, open sports areas, fitness center, swimming pool, amusement spaces and open green social meeting spaces. In other words, the project offers a city in the city. The proximity to the community resources are not only considered, but also brought into the complex. In terms of this issue, Parkoran project is remarkably positive. The weakness of this project is, contrary to the suchlike projects in İstanbul like Metrocity or Kanyon project complexes, the living-working relations of the dwellers are ignored. Some parts of the project could be designed as offices.

Kayseri and Denizli cases have no specific approach to transportation issue. There is no cycle way, cycle storage or any promotion of car-free transportation. Instead of them, the projects have huge car parks to promote car usage. It is not a sustainable approach for transportation. On the other hand, besides building the car parks under ground, cycling is also promoted in Parkoran project. According to the project director, despite there is no extra way for cyclists on the site, the slopes on the site are tried to be minimized to promote cycling. Moreover, there will be bike parks by the blocks. It is a really remarkable decision in Turkey's conditions. Although most of the European countries promote cycling on city scale, bicycle still could not find a place for itself as a transportation vehicle in our country. For instance, in Denmark, being such a cold and windy country, everyone, including 7-year-old children to 70-year-old ladies, use their bikes to transport even in winter. The choice of bike is neither an obligation nor a result of their poverty. It is a result of sustainability mentality. It is a habit for the society. In Ankara as well as in Turkey, bicycle is not given adequate significance. No cycle ways and cycle parks exist. However, if they are promoted in case projects, it is expected that someday the municipalities will also be

influenced by these approaches and start to project cycle roads for the cities. In terms of this issue, Parkoran's approach is positive.

The requirements of inhabitants should be provided on site as much as possible. The projects should be seen as 'city in the city' projects in order to keep the dwellers as much as on sites. TOKİ, as the pioneer housing project builder in Turkey, can fulfill this approach in housing projects. Houses, retails, schools and social areas should be designed close to each other. This kind of implementation will reduce the usage of personal automobiles. Designing cycle ways, parks and storages can play a significant role to reach a new sustainable transformation and community.

4.2.6. Access to Open Space

Although open green areas are essential for physical and psychological requirements of dwellers, they are generally ignored by TOKİ. In social housing and transformation projects, trees are rarely seen on sites; they are restricted by blocks. Kayseri and Denizli projects are called inadequate in terms of this issue. The green areas designed for poor dwellers could be wider than the present one. It is possible to afforest the remaining parts of sites which were remained from the blocks but it is not adequate to be sustainable alone. In the frame of Parkoran project, open green areas and an artificial lake which was harmonized with cafes, social areas and relaxing spaces are offered to the dwellers. According to the project director, open green areas are tried to be maximized. This is an environmentally sustainable approach to design. Parkoran is far more adequate in terms of open green spaces than the other two cases.

Open green areas are meeting points of many relations, such as human to human relations, human to nature relations, from physical to psychological relations. TOKİ should never forget to create them in its projects. Green can not be ignored in social housing projects either. The importance given to parks and water element in the landscape should be increased. TOKİ should have social responsibility to people. It should improve the quality of their life. All people regardless of their wealth need open green areas for their both physical and psychological health. With the help of sustainable housing design, not only will the quality of the dwellers' life be improved, but also the quality of our environment will be sustained by promoting green areas.

4.3. Sustainable Sites

4.3.1. Site Stewardship

The kind of construction technique that is used in building is significant in this issue. TOKİ's construction technique is reinforced concrete tunnel formwork system. All the three case projects use this system. It has many advantages besides its disadvantages. It is speedy and economic that it is possible to build one whole storey in one day. It is long-lasting that it can be used many times with the same quality. Furthermore, it minimizes construction site failures made by workers. Moreover, it reduces wood mould usage; thus, our restricted wood stock is preserved. The tunnel formwork system can be evaluated as a sustainable system in terms of both environment and economy. On the other hand, evaluating just the construction technique does not make building structure sustainable. Reinforced concrete is not a sustainable material compared to others such as steel, wood and stone, in terms of embodied energy. During concrete production, there appear chemical reactions harmful to nature. Moreover, the concrete is carried from outside by mixers. The footprint of the operation which occurs outside the lot is also taken into account owing to the fact that sustainable housing design is a holistic approach. The case projects are all constructed with the same technique and materials. Thus, they are positive in terms of construction system but negative in terms of construction materials.

In construction period, how many percent of the site was left undisturbed is also significant. In all the three cases, all sites are completely disturbed. Thus, they are not positive in terms of this issue.

Instead of using such an unsustainable material like reinforced concrete, there should be used more sustainable materials such as steel, wood and stone for low-rise projects. Steel seems more expensive than concrete to use in Turkey so far; however, it provides various advantages. On the other hand, steel industry should be improved by the government. It does not mean that all projects must be steel construction. Renewable materials such as wood and stone should be used in low-rise projects. Moreover, recycled and reused materials should also be promoted in buildings in terms of this issue.

4.3.2. Landscaping

In social housing projects like Melikgazi and transformation projects like Denizli, landscape projects are not designed properly due to lack of time and money. Mostly, there appears no

landscape design. Moreover, as an ongoing flaw, empty areas are designed as grass areas. Considering even reducing the amount of traditional turf is a goal for sustainability in the LEED rating system, this approach should be discarded due to the fact that grass needs much water to grow and live. Leaving some parts of lot as soil can help landscape designers. On the other hand, the landscapes of this kind of projects are not worked as successfully as the landscapes of revenue-sharing projects. In sustainability mentality, TOKİ could design better landscapes for poor citizens as well.

In Parkoran case, the first landscape project was given to an awarded English landscape firm in order to be designed. Although the firm was detached from the project in the course of time due to economic restrictions, it shows that a great deal of money is spent for landscape projects in the revenue-sharing housing projects. However, grass is still promoted for all empty areas in Parkoran. Normally, this is not a sustainable approach. Nevertheless, in this project, the used water from baths and sinks will be filtered and used to irrigate them and the other plants. According to the project director, reused water will extremely be adequate to irrigate all the plants on site, and the extra water will be given to the grid.

Choosing landscape plants is a significant issue. Vernacular plants should be preferred instead of tropical trees from outside the country. From vernacular plants, the plants which consume the least water should be chosen. If there is water reusing strategy in order to provide adequate irrigation water for the plants on site, such as rainwater collection or grey water usage, this issue will not be problematic.

4.3.3. Local Heat Island Effects

In Melikgazi and Denizli Projects, this approach is not considered enough. Trees rarely appear along several pathways. There are trees by car roads, yet there is nothing seen by pathways inside. Furthermore, the trees drawn in the design phases are mostly left on AutoCAD files. They are not planted. On the other hand, Parkoran project can be called positive in terms of this issue. There will be trees on both sides of the pathways in order to shade the ways. At least, more care will exist than the first two cases of TOKİ. The walk ways will be shaded by trees and landscape elements.

The materials which are used in landscape are also significant to achieve this goal. Some materials absorb sun light while the other reflects it. Materials like steel and concrete reflect light and disturb the people who walk on the way. On the other hand, materials like wood and stone

are more preferable not only for their materialistic aspects, but also for psychological requirement of inhabitants. The first two cases have no landscape designs. However, according to the project director, natural materials will be used in the landscape design of Parkoran project. Stone and wood will be mostly used in order to create more natural atmospheres.

According to the sun and wind, trees should be planted to one or both sides of pathways Moreover, various landscape elements can be designed in order to provide some shaded area of both walk ways and relaxing lots. Moreover, natural materials should be used in landscape designs.

4.3.4. Surface Water Management

In all the three cases, there is no aim in order to benefit from surface water. Contrarily, water is seen as a matter to get rid of as soon as possible. This approach should be changed as soon as possible. Efficient drainage systems should be established on site in order not to lose the rainwater totally. Porous surfaces should be designed to utilize the rainwater. On the other hand, the water can be collected in one side of sites in order to be used when required.

4.3.5. Compact Development

The aim of TOKİ is to build maximum number of dwellings on sites. It seems quite normal and logical to construct compact buildings when it is considered that Turkey has 400.000 new dwellings requirement every year. However, as the super power of the Turkish construction sector, TOKİ seems limitless in terms of increasing the density of lots. Huge square meters of dwelling areas are tried to be fit in narrow sites. Maximum square meters that should be built on the lot are not specified by compactness analyses in TOKİ. This is valid for all the three cases, all of which are over compact.

The over compactness of projects will negatively influence the life of its inhabitants. Although compact development is a result of sustainable design, unorganized projects will reduce the livability of the complexes. If Melikgazi and Denizli projects had been based on sustainable design principles, even such compact developments would not have influenced the quality of the dwellers' lives very much. However, the Parkoran project is extremely crowded. Due to the square meter which are defined by TOKİ, the architectural office had to raise the blocks in order to leave more ground to dwellers. The square meter decision of TOKİ was a huge restriction for

the architect. Actually, the two extremely different types of blocks, one is 31-storey while the other is 7-storey, show that there is a big paradox in the project. The normal block type that had to be chosen could be the low-rise one. Compactness is an inseparable part of sustainable design, yet not to such a large extent.

The compactness on site scale has to be reduced or defined more flexible by TOKİ. If the administration applies the sustainable housing design approach, the requirement of decreasing the compactness of the buildings will be seen clearly. The compactness ratio should be defined with the help of some analyses. Reducing the footprint of the building is an aim of sustainable design, yet only when applied by a green design expert.

4.4. Water Efficiency

In Melikgazi and Denizli projects, there is no water efficiency strategy. Rainwater is not collected; indoor water is not reused; or water efficient fixtures and fittings are not used. Contrary to these two cases, there is a water reusing strategy in Parkoran. Two grey water lines were designed. One of them comes from the toilets whereas the other comes from the baths and sinks. Black water is filtered and given to a company to get rid of it. After filtering them, the wastes could be used for the plants which exist on the site. The second grey water line is filtered and used for the landscape irrigation. This is remarkable in a city like Ankara where there is water shortage. In terms of water efficiency, the Parkoran project can be called positive while the others are negative.

Water preservation strategies should be established by TOKİ. Water consumption levels in dwellings should be calculated and limited. Water meters should be used to raise the awareness of its consumption. People's awareness of water preservation should be raised. Water should be reused as grey water. For instance, grey water from sinks and baths should be used for toilets or landscape irrigation. In the water crisis, in 2007, in Ankara, it was observed that all people used this strategy without being aware of it. However, after the water crisis ended, everything went on as it used to be. Water reusing systems are cost effective and easily applied systems resulting in huge water preservation. These systems will not only reduce water consumption, but also reduce the dwellers' water bills.

Rainwater collection is also crucial in water strategies. Rainwater from roofs can be collected in top floors of the blocks or in storage tanks in the gardens. Collecting it in the top will result in

easy usage because no water pump will be required to pump it again. The collected water can be used for toilets, sinks and landscape irrigation later.

Water efficient fixtures and fittings should be used to minimize indoor water demand. Water efficient faucet, shower and toilet should be used in dwellings by TOKİ. Applying these equipments will not only be beneficial for inhabitants, but also for the country itself.

4.5. Energy and Atmosphere

4.5.1. Optimize Energy Performance

In this part, energy efficiency critics will be on building scale. Although the direction of the block is very significant, it is ignored by TOKİ in all the case projects. Instead of aligning the blocks according to the sun, the panorama or the motorway axis are taken into account as reference points. If the motorway is 15 degrees inclined to the east-west axis, the building will be positive in terms of this issue. The case projects sometimes find the right direction unintentionally. For instance, Denizli project blocks are settled about 45 degrees inclined to the east-west axis, yet unintentionally. This is acceptable in terms of light quantity and light quality indoors. In Melikgazi and Parkoran projects, some blocks were rotated regardless of sun light. Observing just the block B of Parkoran, it is possible to say that there is no energy concern due to the fact that the same type of block is seen in another place as rotated 30 degrees.

The form of the blocks can be called positive for all cases. After the cylinder, the most compact forms are the square prism and the rectangular prism. Thus, TOKİ is positive in terms of block forms unintentionally. It is an inevitable outcome of tunnel formwork system. The compact forms of the buildings will help reducing energy consumption. The building forms of TOKİ seem positive, yet not the most sustainable ones. Whether the sun or winds played a role in shaping the block is important in sustainable design. Some building forms are directly created by the sun or winds in the projects in the world. In other words, the angles of the sun light or the directions of the wind create the form of the building spontaneously. In the frame of these case projects, there is no approach similar to this.

The case projects are not positive in terms of space organization either. Heating and lighting requirements of the spaces were not considered and measured. Usage time and duration of the spaces were not analyzed.

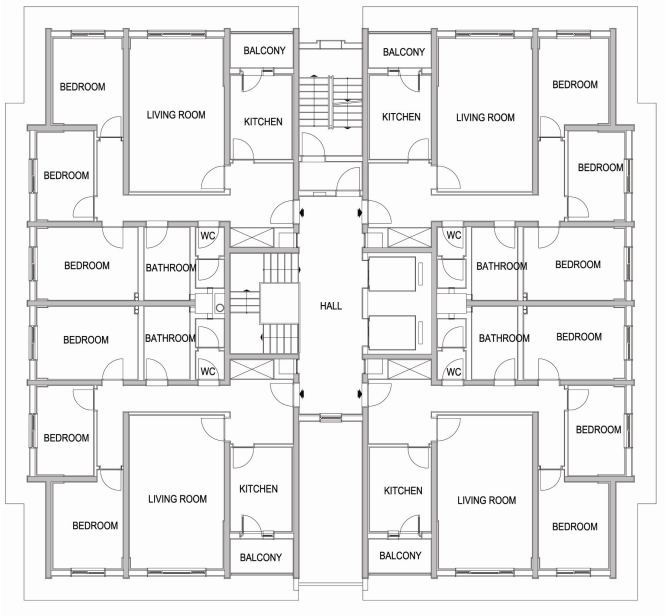

Figure 4.16: Plan of the C type block of Kayseri project

In C type block of Melikgazi project, one apartment was situated on the south façade of the block with its two walls whereas the opposite one was situated on the north façade. The energy requirements of these buildings are not the same or even closer. The plan of one apartment was mirrored two times on the plane. This kind of approach is against sustainable housing design due to the fact that the sun and winds are not the same in every direction. Thus, it is not possible to design the same thing for every façade. For instance, the while living area is a bright and comfortable space in one apartment, even the light quantity of the space is not adequate in another one. Similarly, while one kitchen was situated in a perfect condition on the east or north facade, the other kitchen was situated on the west wall, the least suitable wall for the kitchen.

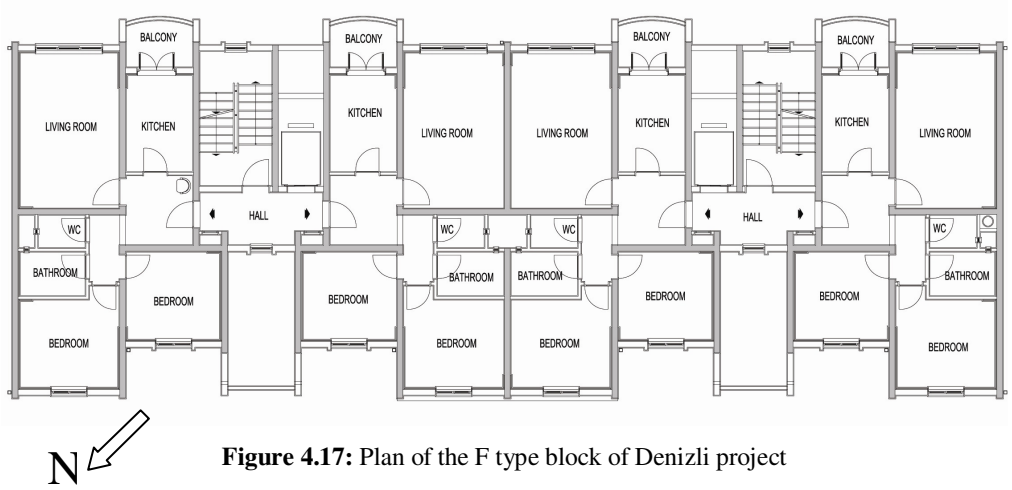

Figure 4.17: Plan of the F type block of Denizli project

There are two types of blocks in Denizli project; the C and F types. The C type block is the same type as the previous case. Thus, the F type block will be analyzed this time. Although no analyses

exist, there are some positive decisions in terms of sustainable design in the F type block. This type seems more acceptable than type C. The living areas of the F type block are situated in the south part of the apartment whereas the sleeping areas are located on the north. This is a positive decision in terms of heating and lighting requirement. Moreover, locating the spaces which require less light, such as a bathroom and a toilet, in the center of the block is also a positive approach. The deepness of the rooms is quite positive in terms of light quantity. Overheating in the kitchen, in the southern façade, is avoided by locating a balcony in front of the kitchen. Despite not having particular focus on space organization, the F type block is positive in terms of this issue.

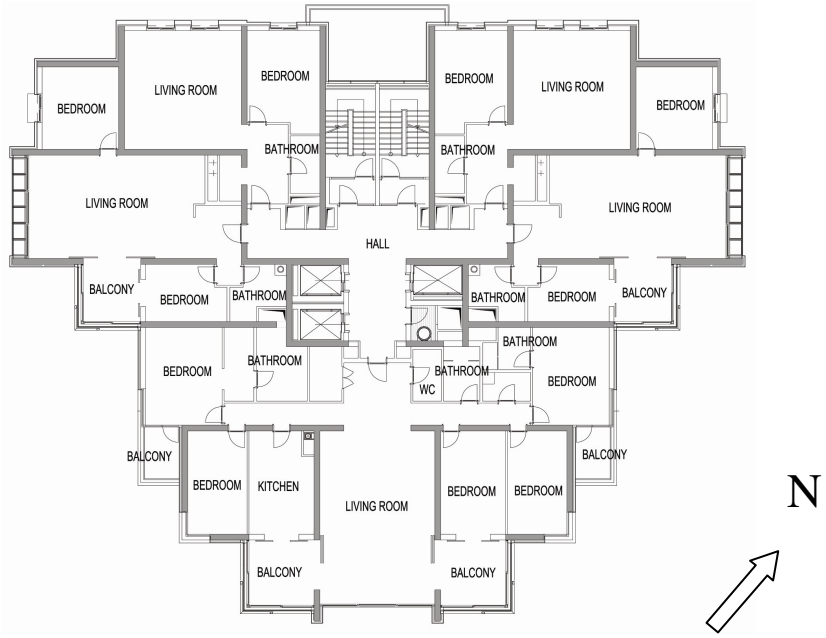

Figure 4.18: Plan of the A type block of Parkoran project

In A type block of Parkoran project, the directions of the blocks are quite positive, although this was not intended. The angle of the blocks is about 15 degree inclined to the east-west axis. According to the settlement analyses of LEED, 15 degree is the best angle for the interior light quality and the energy performance of the block. Actually, in this project, the intention was putting the blocks parallel to the Panora shopping center. The first remarkable point in the plan is that the widest flat, the most expensive one, was located on the south façade of the block. All the rooms of this flat are situated on the south façade. On the other hand, there are four flats on the backside of the block. Two of the flats which were located on the east and the west sides of the block provide more advantages than the other two. However, the one-plus-one-roomed flats will especially never take direct sun light. Thus, they will gain the least natural heat and direct sun light. As a result of this, higher energy consumption levels will appear for these flats and higher bills for their dwellers. On the other hand, overheating will occur in the flat which is on the west

N

façade. Except the most expensive flat, sun utilization of the other flats is totally ignored. In term of this issue, this block type is negative.

Figure 4.19: Plan of the D type block of Parkoran project

The D type block is aligned according to the road. This decision shows that there is no space organization concern like the B type block. The angle of the D type block which is on the right side of the plot is correct, despite this was not intended. Putting the living areas on the south façade is a right decision whereas putting the bedrooms on the north. However, the south façade is not preferable for kitchens. Locating the staircase on the south façade which is the most valuable façade is incorrect; instead, it could be situated on the north façade. This block type is negative in terms of space organization. However, it is more satisfactory than the A or the B block, at least in terms of equity of the flats. All the flats have equal directions thus equal energy gain. On the other hand, the settlement of the C type block is incorrect. Buildings should not be aligned according to the north-south axis if energy efficiency is intended.

In the LEED system, the buildings are expected to have 40 m² south facing roof areas in order to load solar collectors or PV cells in the future. In Kayseri and Denizli projects, it is possible thanks to their pitched roofs. However, the flat roofs of the Parkoran project are not suitable for this kind of implementation.

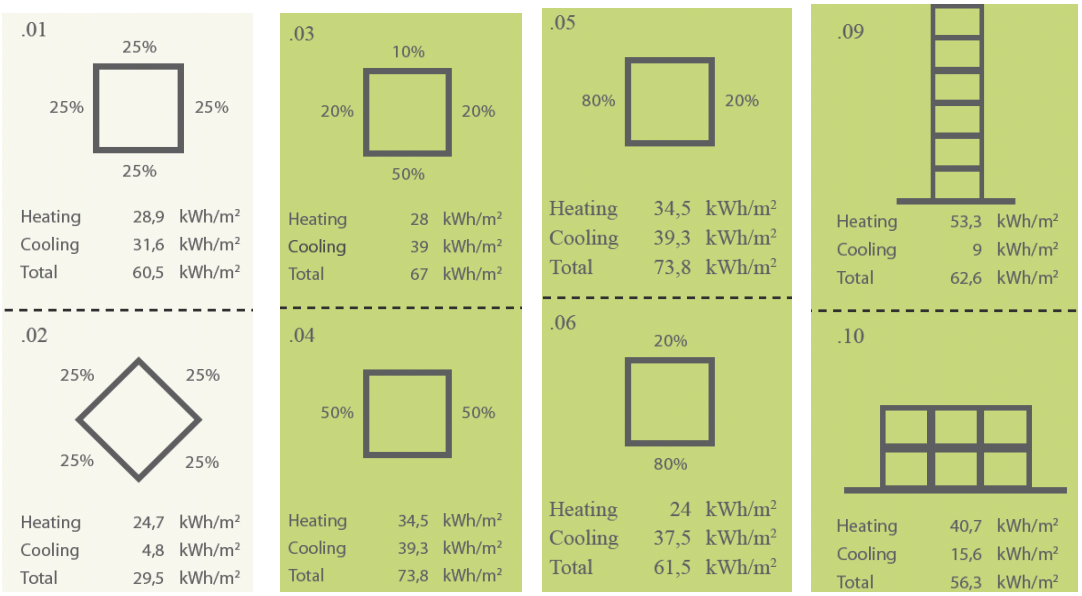

Figure 4.20: Several Energy Efficiency Analyses

Mete Sezer, Sebastian Liszka and Lukasz Lodzinski. *Sustainable Architecture: Passive Building Development.* (Aalborg University, 2008), 38.

Essential analyses, such as block rotation, window proportion and place, block height and solar louver usage, should be made in the design phase in order to create more energy efficient buildings. Computer programs can be used to calculate the energy performances of all options, thus the most energy efficient option can be chosen. The figure 4.20 shows several outcomes of an energy analysis which was made to choose the most energy efficient option. They were calculated by a Danish energy simulation program. The parameters are the rotation and the height of the block, the proportion and the places of the windows and the solar louver usage. The outcomes which were written down on the figures are the heating, cooling and total energy requirement of the options. In the light of these analyses, it is possible to mention that rotating buildings inclined to the east-west axis remarkably alters the energy performance of the building; south orientation is crucial; the compactness of the flats alters the energy performance.

For revenue-sharing projects, new building forms which are created according to the sun and the dominant winds can be experienced. These buildings may be successful examples of sustainable housing design with their innovative forms. By showing themselves in the international area, these projects can offer new opportunities, such as advertising both themselves and the country. Perimeter / area ratios are significant while creating new forms. In the design phase, advanced energy simulation programs should be used to choose the optimum form.

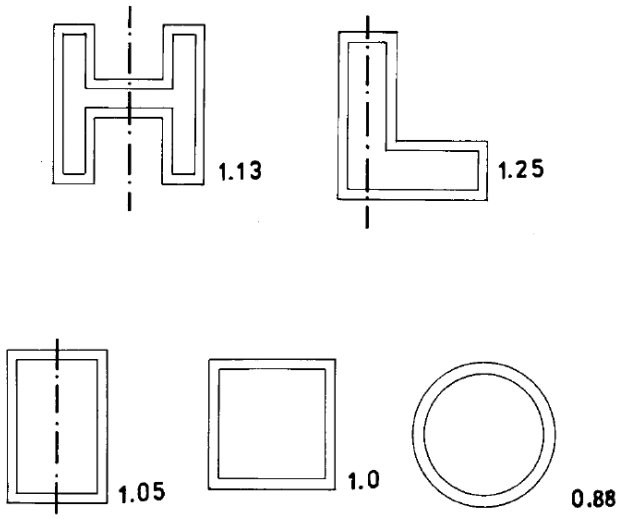

Figure 4.21: Buildings have very different perimeter / area ratios depending on their plan form

Sue Roaf. *Ecohouse: A Design Guide*. (2001), 19.

In terms of space organization, the sun path diagram of the region should be considered. In Turkey, the east, the south and the west facades of the buildings take direct sun light in a day. The north façade never takes direct sunlight. The rooms of the houses should be located in the light of this data. For instance, the living room which is the most used space in the home should be put in the south or west façade of the flat. West façade is over heated in summer; thus, the spaces which require tepidness, such as kitchen and bedrooms, should not be located in this façade. The north and the west façades are the least preferable ones. The north façade is very cold in winter whereas the west façade is very hot in summer. Therefore, they can be used for less used spaces, such as bathrooms and toilets. On the other hand, east façade is suitable for bedrooms and kitchens owing to the fact that the façade is not over heated ant time of the year. Moreover, the sun will wake up the dwellers in the mornings thus it will positively affect their psychology.

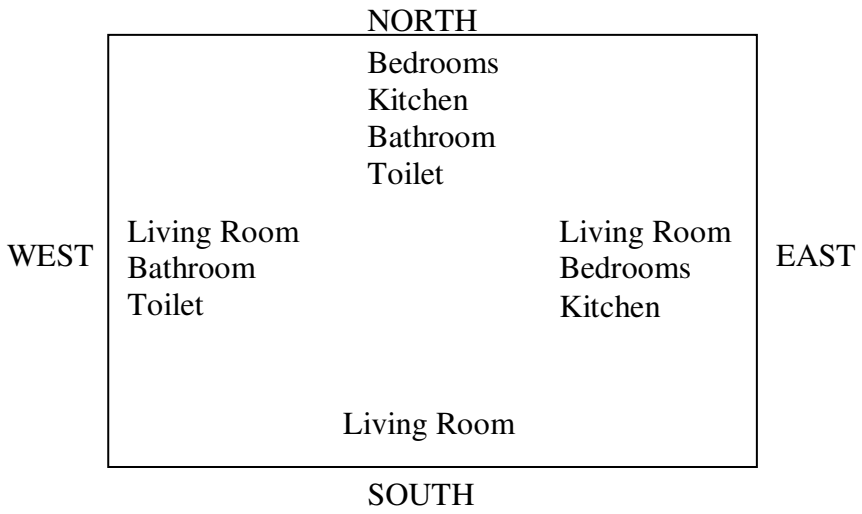

Figure 4.22: Preferable Space Organization in a Flat in terms of Energy Efficiency

Natural light quantity and quality are also significant for dwellings. Day light should be used as much as possible. It should be considered that each space has its own lighting requirement. For instance, lighting requirement of a kitchen and a bedroom are not the same. The kitchen's lighting requirement is more than the bedroom's lighting requirement. On the other hand, locating less used spaces, such as bathrooms, in the center of a block is a positive decision in terms of daylight usage. The deepness and the height of the rooms, the proportion and the height of the windows are also crucial in gaining adequate daylight inside. In the design period of the building, daylight analyses should be made with the help of daylight simulation computer programs in order to find the optimum option which benefits from daylight maximum and increases the light quality and quantity of each room. Therefore, the project can be revised according to the daylight issue before its construction phase. This approach will maximize daylight usage thus minimize electricity consumption.

4.5.2. Insulation

TSE 825 insulation standards are applied in TOKİ housing. Each building's insulation thicknesses which depend on the regions are calculated by the TOKİ engineers. The insulation of blocks was used to be loaded to the inside of the building enclosure in TOKİ in the past. This was not a suitable choice in terms of energy efficiency. To keep inside warm, the building enclosure must be kept warm. Lately, TOKİ also started to load the insulation to the outside of the building enclosure. This is a suitable choice in energy terms for the blocks. All the three case projects have insulations which were applied to the outside of the building enclosures. In Parkoran case,

the insulation of the dwellings may be higher quality than the social housing projects of TOKİ owing to the high quality material usage. Not only is the building enclosure insulated in Parkoran, but also there is insulation which works as a heat and noise barrier between the stories.

The insulation issue is one of the most significant issues of energy efficient projects. The TSE 825 insulation standards are poor compared to the EU countries, yet they are also being developed in time. In order to create more energy efficient dwellings, improved insulation standards should be utilized.

4.5.3. Air Infiltration

In the frame of all the three cases, air leakages are not tested after the construction period. In a sustainable housing project, the air leakages are measured with special mechanical devices after the construction period, before the usage of the dwelling. The air leakages are totally ignored in all the three case projects. The significance of this issue should also be considered by TOKİ.

4.5.4. Windows

The typical projects of TOKİ have the same amount of glazing on its every façade. The key word 'south orientation' is not considered by any of the case projects. This is a huge flaw ongoing. The window areas of the blocks were not designed according to the sun or winds. The buildings have no south orientation, no big windows for solar gain in the south face, no small windows in order not to lose heat in the north façade. No louvers or other shading elements are used in the south or the west facades to prevent over heating in summer. There is no equity between the apartments in terms of solar gain. The apartment which is located in the south façade is always preferable and more expensive than the others. Sun light gain should be taken into account carefully for each apartment. Melikgazi, Denizli and Parkoran projects are all negative in terms of these issues.

In the light of the LEED system, the north-south walls window areas must be 50% greater than the east-west walls window areas. The new housing types of TOKİ should be designed according to the energy efficiency strategies. No longer can the existing block types of the administration be used. Professional help is required in terms of energy efficiency calculations.

In Kayseri and Denizli projects, double glazed windows were used. This can be seen as a progress in energy efficiency terms. However, developed countries started to use triple glazed

windows for more energy efficient houses. At least, TOKİ also started to take into account the energy efficiency of the windows. Similar to the insulation issue, in Parkoran case, it is also possible to mention that the windows of the dwellings may be higher quality than the social housing projects of TOKİ because high quality windows and frames are used. The window sector has also improved the energy performances of the windows and the frames. The relatively expensive elements that are used in Parkoran will improve the energy performances of the buildings in total. Innovative window technology should be used in order to be more energy efficient. New technology seems more expensive than the older one, yet it tolerates the difference in several years.

4.5.5. Heating and Cooling Distribution System

In Kayseri and Denizli projects, cooling system was totally ignored. As a heating system, central heating system was used. The cheapest systems are applied for social housing and transformation projects in TOKİ. In the Parkoran project, the heating system will be a central heating system model, yet the energy which is consumed in the home will be measured separately and controlled manually by the inhabitants. The more energy is used, the higher bill is paid. On the other hand, unlike the previous case projects, Parkoran project has a cooling strategy. Each flat will have a split air conditioning in their living rooms.

The heating systems of the projects should be energy efficient. With the help of passive design principles, the heating system's work will be eased; more energy will be preserved. Sustainable housing design improves the quality of inhabitants. Cooling which provides dweller comfort in hot summer days is also an inseparable part of this design approach. It cannot be ignored. Passive cooling strategies, such as natural ventilation, should be preferred in order to cool the building. Mechanical systems can also be used to cool the building, as a last stop, provided that PV cells are employed for the electricity of these systems.

4.5.6. Space Heating and Cooling Equipment

In TOKİ social housing and transformation projects, the cheapest equipment is employed by TOKİ. On the other hand, in Parkoran, the heating and the cooling equipment will be chosen from 'A class' equipments. Thus, the equipments will be energy efficient and the project will be positive in terms of this issue. The space heating and cooling equipments should be durable and energy efficient in TOKİ projects.

4.5.7. Water Heating

Regardless of their budget, none of the three case projects use water heating solar collectors for free hot water. In terms of water heating collectors, Turkey's situation is satisfactory. The country mostly uses these systems in hot regions as well as exports them to other countries. There is a remarkable solar collector systems industry in Turkey. Employing these systems for TOKİ housing will reduce the energy consumption. Today, water is generally heated by natural gas in Turkey. As 96% of the natural gas is imported from other countries, using it as an energy source so much is not a logical choice for Turkey.[114] Applying water heating solar collectors will not only be beneficial for the dweller, but also for the country.

4.5.8. Lighting Equipment

PV cells and motion sensor controls are not preferred by TOKİ social housing and transformation projects due to the expensiveness of the equipments. However, according to the TOKİ officers, energy efficient light bulbs are being used in the projects as a start. Contrarily, in Parkoran project, energy efficient bulbs will not be used. According to the project director, spots which consume much more energy will be preferred instead of energy efficient light bulbs due to the fact that these flats will be wealthy people dwellings. Yet, motion censored lights are intended to be used in car parks in the future.

The usage of lighting equipment should be minimized with the help of lighting simulations in TOKİ. Energy efficient light bulbs, fluorescent light bulbs, motion sensor controls and photo voltaic cells should be used to be positive in terms of this issue.

4.5.9. Appliances

In Kayseri and Denizli projects, mechanical appliances, such as refrigerator, dishwasher and washing machine, are chosen and brought by dwellers. Thus, educations of the dwellers gain significance in this point. On the other hand, in Parkoran project, the flats are submitted fully decorated to dwellers. The appliances, such as refrigerator, washing machine and dishwasher are

[114] Barış Doster. Enerji Kamu Önceliği Gerektiren Bir Sorun. (2008, January 12). Retrieved January 3, 2009, from http://www.halkinhaklari.com/yazi_oku.asp?sayfa_no=166&b=enerji_kamu_onceligi_gerektiren_bir_sorun__baris_doster

chosen by the contractor. According to the project director, all the machines will be chosen from 'A class' ones. Therefore, this case is positive in terms of this issue. The mechanical appliances such as refrigerator, washing machine, dish washer and ceiling fans should be chosen from energy-efficient ones by TOKİ.

4.5.10. Renewable Energy for Electricity

There is no work on this issue in the frame of all the three cases. PV cells seem expensive so far. However, the costs will decrease in the future. These systems can be used to lighten some parts of the projects such as staircases and car parks for now till the costs decrease. In the near future, these systems can be applied not only to provide the electricity requirement of the project, but also to earn money by selling the extra electricity to the line.

4.6. Materials and Resources

4.6.1. Material-Efficient Framing

The construction system of TOKİ is not a prefabricated construction system. All the three cases are on-site constructions. Thus, the building system deteriorates the region more than prefabricated constructions. The cases are negative in this issue. However, its mould system is a plus in terms of sustainable design owing to the fact that it reduces worker failures thus the waste factor limit of the materials. On the other hand, in order to gain this issue's credits in the LEED system, there must be arranged an excellent construction plan. The better and more detailed plan, the less material consumption is the principle. Building systems should be chosen as prefabricated systems as much as possible. This will have many advantages like preserving construction sites and nature. Moreover, there should be arranged an excellent construction plan and material management strategy to be positive in this issue.

4.6.2. Environmentally Preferable Products

In the frame of TOKİ, on account of having no green design expert in its design process, building materials are not chosen according to the greenness of them. They are chosen according to the TSE standards. Generally, the cheapest materials are preferred by TOKİ. Building materials

peculiar to specific regions are rarely employed by TOKİ. Vernacular materials are not applied. Neither Kayseri nor Denizli projects can be called positive in terms of this issue. There is no specific aim to use more sustainable materials in Parkoran project either. However, it uses more expensive and high quality materials. Considering that the companies which produce high quality materials concern sustainability in their production policies, it can be foreseen that these approaches will affect the sustainability level of the Parkoran project implicitly.

More environmentally preferable products should be applied by TOKİ. In the present situation of the administration, environmentally friendly material usage is totally ignored. If environmentally friendly materials are chosen in the projects, the amount of their demand will increase. Therefore, their industry will grow. TOKİ should also play a role in terms of this issue. It should both use and promote environmentally preferable products.

4.6.3. Waste Management / Recycling and Reusing

Although recycling and reusing strategies are very significant for both environmental and economical sustainability, they are totally ignored in the frame of all the three case projects. In the regulations, it is still defined that the contractor has to use 'new materials'. This can be the main reason which resists to material recycling and reusing. New strategies should be created in terms of this issue. This will help to reduce both the economic and environmental costs. Recycled and reused materials should be promoted in the projects. TOKİ has a great potential to do it and advertise recycled and reused materials for the housing projects of the whole country. However, related specifications and control is extremely important.

4.7. Indoor Environmental Quality

In all the case projects, ventilation and indoor environmental quality are ignored except the ventilation shaft of the bathrooms and the toilets. It is possible to ventilate the buildings by opening the windows, yet the crucial point here is whether natural ventilation strategies and dominant winds are used. Unless the winds are used efficiently, opening windows begins to be the main reason of heat loss. As it is mentioned before, winds are not taken into account by TOKİ. This results in unwanted heat transfers towards outside in winter. Dominant summer and winter winds should be considered in order to benefit from them for the building ventilation. Stack effect can also be utilized by using solar chimneys where required. Besides single sided ventilation, cross ventilation should also be used in the ventilation strategy. Indoor air quality of

the buildings should be measured. The effects of the winds should be considered. For medium-rise buildings like Denizli and Kayseri projects, it is possible to use single sided and cross ventilation strategies. On the other hand, for high-rise buildings like Parkoran, the wind pressure on the upper floors can be problematic for both the energy efficiency and the dweller comfort. Thus, double skin facades can be preferred in order to naturally ventilate the blocks. Atriums can also be designed to naturally ventilate them.

Mechanical ventilation is the last stop in sustainable housing design. It can also be employed when required. However, when applied, heat recovery units should also be employed in order to prevent heat loss. These units result in higher capital and operation costs, yet they are very effective that they preserve almost 90% of the indoor heat while ventilating. It will be useful to employ simple fans or mechanical ventilation systems provided that the electricity which is used by these systems is produced from renewable energy sources.

In energy efficient house design studies, numerous on-going innovative progresses appear in terms of sustainable ventilation. It is possible to ventilate the house without loosing its heat by some pipes which are constructed under ground as a kind of infrastructure. In this system, the fresh air is heated or cooled under the soil before coming inside. There is no mechanical system here except a fan in some situations. TOKİ should consider preserving the health and comfort of dwellers. Thus, no longer can the administration build houses without any ventilation strategy.

4.8. Awareness and Education

4.8.1. Education of the Homeowner or Tenant

There is almost no sustainability approach in the policy of TOKİ. Thus, it is impossible to suppose that dwellers would be educated by the administration. This is valid for Kayseri and Denizli projects. Contrarily, in Parkoran project, a booklet will be given to the whole inhabitants while moving in their flats. This is remarkable as well as necessary. The dwellers will be educated about living in their flats in terms of several issues, such as using the machines of the dwelling, learning the rules and facilities of the complex. This seems quite useful. However, in terms of sustainable design, the project is very poor either. As this ‘awareness and education’ issue exists in order to educate the dwellers in terms of sustainable life style, the Parkoran project is negative either.

4.8.2. Education of Building Manager

Similar to the education of the homeowner, it is also hardly possible to suppose that the building manager would be educated by TOKİ. In some rare cases, the building manager is educated by a private company during one year about how to manage the complex. However, it is not about sustainability either. This is valid for Kayseri and Denizli projects. In Parkoran project, this issue is seen as a future decision by the project director. In the future, a company will be employed to manage the complex. Similar to the previous option, these management strategies will not be about sustainable life style.

Table 4.1: The evaluation of TOKİ housing in terms of sustainable housing design principles ('0' means there is no approach in terms of the issue; '1' means there is a weak approach or an approach without being aware in terms of the issue; '2' means the issue is considered by TOKİ)

Sustainable Housing Design Principles	Social Housing (Kayseri)	Urban Renewal (Denizli)	Revenue-Sharing (Ankara)	BedZED (London)
Innovation and Design Process				
Integrated Project Planning	0	0	0	2
Durability Management Process	0	0	2	2
Innovative or Regional Design (or Cultural Sustainability)	0	0	0	2
Location and Linkages				
Considering the sun while settling the blocks	0	0	0	2
Considering the wind while settling the blocks	0	0	0	2
Avoiding Deep Slopes	1	1	1	1
User Profile Consideration	0	0	2	2
Flexible or Extendable Design	0	0	0	2
Waste Management Strategies	0	0	0	2
Site Selection	0	1	1	2
Preferred Locations	0	1	1	1
Infrastructure	0	1	1	1
Community Resources	0	0	2	2
Transportation	0	0	2	2
Access to Open Space	0	0	2	2
Sustainable Sites				
Site Stewardship	1	1	1	2
Landscaping	0	0	2	2
Local Heat Island Effects	0	0	2	1
Surface Water Manag.	0	0	0	1
Non-Toxic Pest Control	0	0	0	0
Compact Development	1	1	1	2

Sustainable Design Strategies	Social Housing (Kayseri)	Urban Renewal (Denizli)	Revenue-Sharing (Ankara)	BedZED (London)
Water Efficiency				
Rainwater Harvesting System	0	0	0	2
Grey Water Reuse System	0	0	2	2
High-Efficiency Fixtures and Fittings	0	0	2	2
Energy and Atmosphere				
South Orientation	0	1	1	2
Glazing Arrangement	0	0	0	2
Shading	0	0	0	2
Building Form	1	1	1	2
Space Organization	0	1	1	2
Maximum Daylight Usage	1	1	1	2
Insulation	1	1	1	2
Air Infiltration	0	0	0	2
Windows	1	1	1	2
Heating System	0	0	1	2
Cooling System	0	0	1	2
Water Heating	0	0	0	1
Appliances	0	0	2	2
Renewable Energy for Electricity	0	0	1	2
Materials and Resources				
Material-Efficient Framing	0	0	0	1
Environmentally Preferable Products	0	0	1	2
Waste Management / Recycling and Reusing	0	0	0	2
Indoor Environmental Quality	0	0	0	2
Awareness and Education				
Education of the Homeowner or Tenant	0	0	0	2
Education of Building Manager	0	0	0	2

CHAPTER 5

CONCLUSION

In the frame of this study; the sustainability philosophy was searched with its different facets; how this paradigm influences on architecture was examined; the different considerations of sustainable architecture were pointed out; the six logics of Guy and Farmer were utilized to frame sustainable design; the importance of housing for a sustainable community was explained; the credit categories defined in the 2008 LEED for Homes Rating system was utilized for a deeper understanding of sustainable housing design; three different types of TOKİ projects were critically evaluated in the light of the LEED categories; and finally, some proposals were pointed out for TOKİ and the other housing projects in Turkey.

Sustainable design strategy is not a major consideration for TOKİ. The sustainable design principles are rarely utilized without being aware in the projects of the administration. However, they are not enough to call the projects sustainable. In the 'positive-negative' evaluation system, the administration is mostly negative. Except insulation and double-glazed windows, there is almost no sustainable approach. If the administration applies the sustainable housing design principles, this will be a remarkable decision to reach a real sustainability level for the country. TOKİ can play a very significant role in the application of this paradigm. The administration has a great potential to apply and promote this approach to the whole housing projects of Turkey since it is a governmental administration which controls the decision making mechanism. If it applies the sustainability paradigm, it will be a model for the housing projects in the whole country. The new 500.000 dwellings project of the administration is a remarkable chance to apply and utilize the sustainable housing design principles.

Sustainable design is more than energy efficiency and using renewable energy. It is even more than environmentally friendly design. Guy and Farmer's six logics of sustainable design should be comprehended well. All issues of sustainable design should be taken into account and applied to the projects maximum according to the priorities. On the other hand, rating systems which are

peculiar to Turkey should be arranged. Already developed systems like LEED can also be utilized.

Sustainable design is not only environmentally beneficial, but also economically and socially beneficial. In other words, it is not only beneficial for nature, but also beneficial for the dwellers and the country. From the environmental point of view, the environment will be preserved with the help of energy savings, renewable energy usage, water preservation strategies, material preference; from the economical point of view, the costs will be reduced with the help of energy savings, recycling, reusing and water preservation strategies; from the social point of view, healthy and high quality spaces will be provided for dwellers, community ties will be strengthened. Many benefits appear, thus building sustainable projects is a logical act. In the light of this study, to conclude and bring together the proposals in the case study chapter, the following list was created. In order to be sustainable, TOKİ should take into account this list. TOKİ should should:

Table 4.2: Proposals for sustainable housing design for improving housing design in Turkey

Proposals	**Criteria**
• Keep a green design expert in its structure, or demand consultancy services from outside, or educate its existing officers in terms of sustainable design • Employ high quality and durable materials for the building enclosures • Reflect regional and cultural issues in the projects	**Innovation and Design Process**
• Settle the buildings according to the sun on the site. (15 ºC inclined to the east-west axis) • Use sun path diagram in order to use the right angles of the sun depending on the regions • Do sun-shadow analysis • Take into account the climate of regions and use the collected climate data such as sun, wind and precipitation • Control the summer and winter dominant winds; benefit or avoid from the winds on site scale • Consider the panorama of the site • Consider the aesthetical effect of the building on the site • Disturb the ecology of the site minimum and leave the area natural	**Location and Linkages**

as much as possible • Avoid creating deep slopes and prefer ramps instead of stairs if possible • Take into account user profile variety and design alternative life styles • Design flexible and extendable • Arrange waste management strategies • Choose already developed lands to build instead of consuming more land • Choose the lots which are close to city centers • Develop brown fields into green fields instead of developing green fields into grey fields • Use existing infrastructure as much as possible; employ high quality and durable materials while creating a new infrastructure • Take into account the proximity of the site to community resources; design 'city in the city' projects • Reduce personal automobile usage; promote cycling, walking and public transport; built cycle ways, parks and storages • Design open green areas for both physical and psychological needs of the dwellers	
• Build with prefabricated building elements instead of on-site construction • Leave some parts of the sites empty for future plans of the dwellers • Use vernacular plants which consume the least water • Use natural landscape materials • Consider local heat island effects and shade the pavements • Benefit from surface water by designing porous surfaces • Design compact developments to reduce the footprint and the energy demands of the projects.	**Sustainable Sites**
• Collect rainwater • Benefit from grey water to reduce water consumption • Filter grey water for further usage • Use water efficient fittings and fixtures • Use water meters to raise the awareness of water consumption	**Water Efficiency**
• Use renewable energy instead of fossil energy	**Energy and**

• Let the sun and winds form the buildings • Arrange space organizations according to the sun • Leave empty areas on roofs in order to employ PV cells and solar collectors in the future • Orient the building to the south • Design window heights and places with the help of analyses • Use solar louvers where required • Use simulation programs in order to find the optimum option • Benefit from day light maximum • Employ adequate and durable insulation for enclosures • Take into account the air leakages • Employ high quality, durable and energy efficient windows and frames • Provide that the north-south walls window areas must be 50% greater than the east-west walls window areas • Use central, durable and energy efficient heating and cooling systems • Utilize passive design strategies like thermal mass usage • Use solar collectors for free hot water • Prefer PV cells and motion censored, energy efficient lighting equipments • Prefer energy efficient appliances for the building	**Atmosphere**
• Arrange well organized construction plans in order not to waste materials • Use nature- and healthily-friendly materials • Use regional materials which have low embodied energy ratios • Use and promote recycled and reused materials	**Materials and Resources**
• Utilize natural ventilation strategies in order to increase the health and comfort level of the dwellers • Use cross ventilation, stack effect and double skin where required • Use heat recovery systems if mechanical systems are essential	**Indoor Environmental Quality**
• Make the dwellers aware of sustainable life style • Make the building manager aware of sustainability • Promote sustainable housing design and sustainable life style for all the people in the country	**Awareness and Education**

Awareness is seen as one of the most significant issues of sustainable design in order to reach sustainable houses and communities. The dweller, the contractor, the building manager, the architect, the engineer, TOKİ, the government, they all have to be educated in term of sustainability. Life style plays a crucial role in sustainability philosophy. The sustainability philosophy must be accepted by people. Otherwise, all the efforts like this study will have no sense. The unsustainable life styles of the people in the country should be altered. They should be made conscious about this inevitable paradigm by media, such as TV channels, radios, billboards and internet. It is useful not to forget that lifestyle changes cannot be forced, yet they can be promoted by good design. Architects will have a significant role in promotion of this philosophy. The government also has to play a role in sustainability promotion.

In the end of the study, eight outcomes were observed.

1. TOKİ is very significant in application of sustainability concept for housing projects. It builds a huge amount of the building stock of the country. Thus, it has a potential to be a model for the rest of the country in terms of sustainable housing design.
2. TOKİ mostly takes into account cost and construction duration. Cost and construction duration do not prevent to be sustainable. There still some decisions to make the building more sustainable such as building orientation, window location or different design decisions. It is possible to save more energy and damage the nature less by good design without increasing the capital cost.
3. Generally, designing high density lots and using the same typology on every site are the main source of the problems in TOKİ housing projects. Regional features such as topography, climate, cultural or regional differences are ignored by the organization. In other words, both environmental and cultural sustainability are disregarded in the projects.
4. Adequate significance is not given to site plans of the projects. Site plan is not considered as an integrated part of design; instead, it is seen as an after-design-attachment including parks and trees.
5. TOKİ should have stronger relations with the organizations or individuals who study about sustainable design concept. It should benefit from the existing knowledge better.
6. TOKİ should consider and apply sustainability concept as a design input besides flat amount, construction speed and cost issues. It should take into account this concept in the presentation and evaluation of the projects. It should inform the people about this concept.
7. It is observed that there appears no huge differences between the projects despite there are differences between them in terms of budget, bigness and location. Instead, equipment and material qualities are shown to prove the quality of the buildings in revenue-sharing projects. Yet, in these types of projects, it is possible to design more sustainable buildings owing to the fact that there will be less economic restrictions. With little increases in the capital costs, the energy demand of the projects can be minimized.

8. Projects should not be designed as isolated projects from the city center. Instead, they should be taken in hand as joints with the existing city pattern and the other projects. They should foresee creating common spaces and systems.

Sustainability level of a housing project can be critically evaluated in two ways: A prescriptive way or a performance-based way. The first way is the way that this thesis used. It is composed of checklists which show the sustainability issues that the project takes into account. The second way is the real evaluation measuring the sustainability level of a project. For instance, the amount of carbon emissions and the energy performances of the buildings are optimized in the design period with an integrated design approach. Afterwards, it gets possible to criticize the building in terms of sustainability. The performance-based system is healthier to call a building sustainable.

In Turkey, considering that the sustainable design concept is not appreciated well enough in the country scale, putting the housing projects of the country in the same basket with the LEED for Homes Rating System seems so ironic; because LEED is a performance-based system. If awareness of sustainability is seen as a process, it is clear that Turkey is not ready for evaluation systems like LEED. However, critically evaluating the buildings in terms of sustainability in a prescriptive way can be a step for the future of sustainability in Turkey. In the end, the performance-based evaluation system will be a necessity for all.

As a consequence, sustainable housing design approach will improve the quality of the housing projects in the country. It is expected that TOKİ will apply this approach to reach a real sustainable environment and community in Turkey.

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