ABSTRACT

Sustainable built environment aims to enable people to live in healthy and comfortable way without damaging the environment and spoiling the legacy they will leave future generations. A considerable portion of energy consumed for built environment. Energy consciousness has become increasingly popular in building design because of the shortage of energy sources in today’s world. Therefore, energy consumption should be reduced and optimum use of natural energy resources should be provided in the design of sustainable built environment.

For this purpose, the aim of this paper is to examine the parameters effect on sustainable built environment design and to present suggestions related to design from the energy conservation point of view. This will contribute to the development an architectural concept achieving one of the main objectives of modern societies: use of natural energy resources, realization of a sustainable energy and sustainable environment.

Keywords: Built Environment, Energy Conservation, Design Parameters, Sustainability, Sustainable Design

INTRODUCTION

The aim of today’s design and construction is to achieve secure, healthy and comfortable environment which at the same time addresses sustainability and impact on natural environment.

In 1987 the Brundtland Report, also known as Our Common Future, alerted the world to the urgency of making progress toward economic development that could be sustained without depleting natural resources or harming the environment. Published by an international group of politicians, civil servants and
experts on the environment and development, the report provided a key statement on sustainable development, defining it as: “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland Report, 1987).

The definition of sustainability does not specify the ethical roles of humans for their everlasting existence on the planet. It also fails to embrace the value of all other constituents participating in the global ecosystem (Jong-Jin, 1998, 6).

Environment; in sense of ecology is a concept which is consumed for industrialization and rapidly changed especially in the second period of our century. This concept should be overviewed parallel with human-nature study developments; otherwise the studies will be inadequate with respect to the local and global interactions.

SUSTAINABLE BUILT ENVIRONMENT, ENERGY RESOURCES AND BUILDING LIFE-CYCLE

Sustainable built environment has become one of the most important tasks of architectures in today’s world.

Architects have a larger share of responsibility for the world consumption of fossil fuel and global warming gas production (CO₂) than any other professional group. In the world at large, half of all energy used is in relation to heating, lighting, cooling and the ventilation of buildings. The structures architects and engineers design, the way buildings are serviced, and how they are adapted over time, all directly influence the volume of fossil fuels consumed and lead directly to the tones of CO₂ released into atmosphere, raising planetary temperatures. Decisions about buildings, towns and their spatial distribution are the key to creating a future built upon the concept of sustainable development. The urban scene with its complex matrix of buildings, activities, services and transportation consumes 75% of the world’s energy resources and produces the vast bulk of its pollution and climate changing gases. Decisions made by architects are crucial to the achievement of a sustainable future (Edwards, 1999, xv).

For each building, from the design stage to the construction and disposal stage the cost of life-cycle must be taken into consideration and studied with the environmental effects and economical parameters.

First of all total cost of life-cycle must be analyzed as energy conservation and social costs. Then as architectural parameters lightness, natural light and usage of light by using fine sections, aesthetics of comfortable space use, changeable and reuse of spaces must be taken into account. The possibilities of disassemble,
demountable buildings and reuse of materials must be the parameters that we aimed.

The conventional model of the building life cycle is a linear process consisting of four major phases: design; construction; operation & maintenance; demolition (John-Jin, 1998).

Energy consumed in every stage of life-cycle of buildings. The relation between energy resources and the building life-cycle is given below in Figure 1.

Fossil energy resource is still one of the major energy resources used by the human beings at the present time. Coal, Oil and Gas are called fossil fuels because they have been formed from the fossilized remains of prehistoric plants and animals. Coal provides around 28% of our energy, and oil provides 40%.

Fossil fuels are not a renewable energy resource. Once we’ve burned them all, there isn’t any more, and our consumption of fossil fuels has nearly doubled every 20 years since 1900. Although there are some advantages of fossil fuels, basically, the main drawback of fossil fuels is pollution. Burning any fossil fuel produces carbon dioxide, which contributes to the greenhouse effect, warming the Earth. (www.darvill.clara.net/altenerg/fossil.htm)

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**Figure 1.** Energy Requirement in Building Life-cycle

Energy must be required at each stage in the building’s life-cycle. In recent years nuclear energy is one of the common energy used as an energy resource. Nuclear power is generated using Uranium, which is a metal mined in various parts of the world. Although it has some advantages and not much waste is produced, it is
harmful for human and environment. It must be sealed up and buried for many years to allow the radioactivity to die away. Nuclear power is reliable, but cost of measures aimed at controlling of this power is high and difficult. As it is known, a nuclear accident can be a major disaster. (www.darvill.clara.net/altenerg/fossil.htm)

Therefore, consumption of fossil fuel and nuclear power must be minimized and renewable energy resources should be used in buildings. The energy crisis which Turkey has been experiencing over the last few years has emphasized the importance of an efficient and more productive use of natural and renewable energy resources such as solar and wind energy. Due to its geographical position Turkey has a considerable potential of solar energy which, however, is not being used sufficiently. The most efficient solution to ensure a building design with minimal energy consumption is to use renewable energy resources as basic energy source of the coming years.

THE PARAMETERS EFFECT ON SUSTAINABLE BUILT ENVIRONMENT DESIGN

The objective of modern built environment design and construction is provide healthy and safety space requirements and comfort conditions such as

• thermal comfort by controlling the influence of climatic elements;
• visual comfort by controlling the natural light;
• acoustic comfort by reducing the noise to an acceptable level.

At the same time built environment addresses sustainability. Sustainable built environment aims to enable people to live in healthy and comfortable way without damaging resources of future generations. Therefore, optimum use of natural energy resources should be provided. As in Turkey a considerable portion of energy is used for heating, cooling and lighting of buildings first heating, cooling and lighting energy consumptions in buildings should be minimized.

The design parameters, which considered in this context are,

• user related parameters;
• physical environmental parameters;
• building related design parameters;
• legal parameters.

All this parameters related to each other and they should be taken into consideration depending on each other at the design stage. Moreover the designer restrict-
ed in the scope of his/her planning by the framework of related parameters such as

- social-cultural parameters;
- economical parameters;
- technological parameters.

**Figure 2. The Parameters Effect on Sustainable Design**

**User Related Parameters**

User related parameters are effective on users’ performance and achievement climatic and visual and acoustic comfort conditions in a built environment. Such as users’ age, sex, position in a room, clothing and activity are effective on determining of the comfort conditions. In other words user related parameters are effective on determining of energy requirement in order to provide the required internal conditions. Furthermore, other user related parameters such as, psychosocial condition, health, privacy and social requirements should be taken into consideration.

**Physical Environmental Parameters**

Physical environmental parameters are natural factors have a determining influence on the outdoor environment. They are beyond the control of the designer and must be considered with their given values. These parameters are;

- Outdoor air temperature;
- Solar radiation;
- Outdoor humidity;
• Outdoor wind velocity;
• Outdoor illumination level.

**Design Parameters**

The built environment is defined as designed and constructed by man, and can be considered under different criteria of scale. The parameters attributed to this group may be considered on the basis of a settlement unit, a building, a room or an element. The main design parameters related to the built environment with an influence on the control of climate, light and sound, as well as energy conservation is given below (Koçlar et al, 2004).

**Design Parameters on the Settlement Unit Scale**

• Dimensions and orientation of external obstacles;
• Solar radiation reflectivity of surrounding surfaces;
• Light reflectivity of surrounding surfaces;
• Soil cover, and nature of the ground (plant cover and groups of trees).

**Design Parameters on the Building Scale**

• Orientation of the building;
• Position of the building relative to the noise source;
• Position of the building according the other buildings;
• Building form.

**Design Parameters on the Room Scale**

• Position of the room within the building;
• Dimensions of the room and its shape factor;
• Orientation of the room;
• Absorption coefficient of the room for solar radiation entering through the transparent component;
• Sound absorption coefficients of the surfaces inside the room;
• Total sound absorption coefficient of the room;
• Light reflection coefficients of the surfaces inside the room.

**Design Parameters on the Element Scale**

The design parameters related to be structural elements can be differentiated in two groups - as opaque and transparent components - and considered separately:
a) Properties of the Opaque Components of the Building Envelope

- Thickness, density, specific heat of the materials;
- Heat conduction coefficients of the materials;
- Light absorption and reflection coefficients;
- Sound transmission coefficient;
- Porosity and roughness and sound absorption coefficient of the surface;
- Construction of the surface (flat, with interstices, ribbed);
- Single or multilayer structure;
- Depth of the cavity between the layers;
- Thickness and sound absorption of the insulating material used inside the cavity;
- Kind of connection between layers of different materials, and their number.

b) Properties of the Transparent Components of the Building Envelope

- Dimensions of the transparent component;
- Number of layers of the glazing;
- Heat transmission coefficient of the glazing;
- Absorption, reflection and transmission coefficient of the glazing for solar radiation;
- Transmission coefficient of the glazing for diffuse light and direct sunlight;
- Transmission coefficient of the glazing for sound;
- Type of frame used for the transparent component;
- Maintenance factor of the glazing.

Legal Parameters

Legal parameters are regulations and standards related to sustainable environment. In Turkey, studies which are to develop regulation on sustainable built environment are not sufficient. In this context, energy regulations should be discussed because energy consumption is one of the most important problems in Turkey. The regulation on heating energy conservation, which came into force in Turkey in 2000, is based on calculation methods containing incomplete and insufficient data, and completely disregards the natural energy potential. Energy regulations
which can be achieved with the proper methods and data are of particular importance for a threshold country with limited resources such as Turkey (Koçlar et al., 2002). In order to achieve sustainable energy and environment, designers, manufacturers and decision-taking organs meanwhile regard investigation, identification and application of measures designed to save energy in buildings as one of their main tasks.

The standards and legal regulations related to organization and measurement of building design has an important role in life-cycle process with respect to sustainability such as Specifications For Structures To Be Built in Disaster Areas, Ts 498 Design Loads For Buildings, TS 500 Requirements For Design and Construction of Reinforced Concrete Structures, TS 407 Lightweight Concrete Hollow Blocks and Plates for Ribbed Floors, TS 543 Design and Construction Methods for Reinforced Brick Slats.

Social-Cultural Parameters

The environment that the human beings are lived is directly effects the psychological behavior of people. The open and close areas, the color, shape, surface of the architectural elements and the light, sound and the amount of air that comes from the outer space is the major factor effects on the people psychology. Also the sociological background of a human being is a very important factor effects the forms of the built environment.

The social-cultural parameters effected the form of buildings have some differentiations according to language, religion, family life, privacy, educational level, economical level, social structural differences, urbanization of the community. In the design process, social-cultural parameters have also important role besides the other parameters mentioned before.

Economical Parameters

There is a continuous flow of resources, natural and manufactured, in and out of a building. This flow begins with the production of building materials and continues throughout the building’s life span to create an environment for sustaining human well-being and activities. After a building’s useful life, it should turn into components for other buildings (Jong-Jin, 1998).

Economy involves the effective use of materials, site area and also the proper and logical cost of construction. This concept may be occurred by architects’ preferences without high cost or impossible construction (Vitrivius, 1998,11).

In sustainable design, decision about resources and the economical usage of resources, is a very important parameter.
By economizing resources, the architect reduces the use of nonrenewable resources in the construction and operation of buildings.

**Technological Parameters**

As it is known technology can be described as a method or methodology used by human beings that applies technical knowledge or tools to create environment. Successful application of the sustainable design decisions depends on convenient technological strategies.

In order to achieve sustainable built environment, the optimum values of all parameters should be determined in the design stage. The sustainable architecture is the result of the integration of optimum values of all parameters mentioned above and technology.

**EVALUATION AND CONCLUSION**

The main steps of design and evaluation of sustainable built environment which serves the purpose of optimum use of natural energy resources are given below;

- Determinations of the values related to physical environmental parameters;
- Determinations of the values related to built environment;
- Determination of indoor conditions;
- Preparation of the alternatives(models);
- Comparison of the determined indoor conditions with the required conditions(comfort conditions) for different alternatives.

The main objective is to achieve comfort conditions in the built environment that ensure energy conservation has been. The evaluation process comprises a comparison of the determined indoor conditions, which are results of the considered with the required indoor conditions (comfort conditions). As the result of this comparison the alternative which meets comfort conditions by using minimum artificial energy is selected as appropriate alternative (Figure 3).

If the evaluation leads to the conclusion that none of the alternatives taken into consideration satisfies the required indoor conditions, a decision must be taken on which parameters with an influence on the built environment are to be changed in order to ensure the comfort conditions in the indoor environment. This process is to be repeated until a suitable set of parameters is found. Among different alternatives the alternative which achieves the required conditions by minimum energy cost is qualified as the most appropriate one and it is possible to develop an application project. In this approach the evaluation process is considered as a sub-
process of the design procedure, which offers the opportunity to evaluate a project before the actual construction process is initiated. Such and evaluation is important with respect to ensuring comfort conditions of the built environment at the final stage of the project, as well as the determination of the optimal values for the design parameters. At the design stage, these studies can permit the determination of appropriate design parameters with the objective to reduce the amount of energy consume without compromising comfort conditions. Moreover such studies will contribute to achieve sustainable energy and sustainable environment.

Figure 3. Design and Evaluation Process
REFERENCES


http://www.darvill.clara.net/altenerg/fossil.htm