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## ECOSYSTEM AND ARCHITECTURAL DESIGN

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**ABSTRACT** : Ecological Environment is composed of four parts which are not strictly separated but interdependent to each other and forms a system. This ecosystem with its parts, the atmosphere, the hydrosphere, the geosphere, and the biosphere has its dynamism and ecological balance. On the other hand man, with developing tools interferes with this system. Architecture creates one of the impacts of man on the system.

Architecture, in view of ecology, has two important roles: First, it provides a controlled environment to the human being, so it has to balance the needs of the human being with the environmental forces. Second, with the existence of architectural artifact there will be an impact on the natural environment which may change or affect the ecological balance.

Thus, in design process, these two factors should be recognized. Environmental factors related to architectural design which are used to be considered during design process will be compared with the factors of ecosystem and its sensitivity towards impact of a new building.

## EKOSİSTEM VE MİMARİ TASARIM

**ÖZET** : Ekolojik çevre, birbirinden tamamen ayrılmamış, fakat bağımsız bir sistem oluşturan dört parçadan meydana gelmiştir. Ekosistem, parçalarıyla : Atmosfer, Hidrosfer, Jeosfer ve Biosfer den oluşur, kendi dinamizmi ve ekolojik dengesi bulunmaktadır. Diğer taraftan, gelişen araç-gereçleri ile insan da sisteme dahil olur. Mimarlık insanın sistem üzerindeki etkilerinden biridir.

Mimarlığın ekolojik açıdan iki önemli rolü vardır. Birincisi, insana kontrollu bir çevre kazandırdığı için, insanın gereksinimleri ile çevresel kuvvetler arasında denge kurmalıdır. İkincisi olarak, mimari yapının oluşması sonucu, tabii çevreyi etkileyen ve çevredeki ekolojik dengeyi bozan bir etki meydana gelmektedir.

Bu nedenle, tasarım sürecinde bu iki faktörün farkına varılması gerekir. Tasarım sürecinde kullanılagelen, mimari tasarıma bağlı çevresel faktörler, ekosistemin elemanları ile karşılaştırılınca, yeni yapılarda etkisinin görüleceği açıktır.

## 1. INTRODUCTION

A large part of national resources are usually used in the construction and maintenance of buildings, and buildings play an important role both in production and providing services to the community. Especially developing countries, which have limited resources, devote a large proportion of their national product to construction without any sacrifice of their capacities, since generally more resources will be required for producing food and other commodities.

Using methodological approaches and planning techniques, the same amount of material and work would be consumed in such a way that the higher efficiency could be managed.

The cheapest building is not necessarily the most economical, but is the one that provides the best value for money, that is the one that is of good appearance and convenience in relation to construction, running and operating in it.

This subject is concerned with a complex system which includes ecosystem and its relation to architectural design. In this study, nearly all of the sides of the problem put altogether, so that one can observe or perceive different relations and use them as tools in creating new techniques for designing according to the criteria studied in this subject.

In each part, it is tried to make clear that only in design process, this and these kinds of intricate relations can be studied, and all parts of the whole complex can be examined in detail.

At the end of this study, it is hoped that the people, who are responsible in studying the subjects which have inputs from the environment, and impacts on organisms (including the man) living in this environment, will be conscious of the fact that ecological awareness and rational design decisions are the most important sides of the subject studied.

After presentation of this study, I noticed that I have to add a new part, showing that in a seminar or in any field of study, relation of the seminar subject to the special field, can be constructed carefully and an example should be given to show that this relation is studied in detail.

The above statement is also true for any student or researcher in faculty of architecture too; because, only by using this system one can have a study which is leading to an accumulation in that field. In university education, this can be clearer by having a specific study subject and many other supporting subjects oriented around this specific subject. According to our accumulation, in an architectural education, the main subject is architectural design and ecology, structure, construction, etc., are the supporting study subjects.

## 2. MAN AND HIS VALUES

" An individual at any stage of his development is the product of organic and environmental factors working hand in hand. What he is, what he does, what he

becomes, in short, how he reacts and behaves in all life situations, can be explained in terms of these two interacting forces" (1).

The individual alters in the environment and the environment in turn produces profound changes in the individual and his behaviour. No organism, regardless of its potentialities and basic qualities, can survive in the absence of a favorable environment.

In order to understand the man and his environmental relationship, we must know that man has biological, psychological, social structure, and lives in the two different environments, which are natural and cultural. Because of uniqueness, culture may have been man's tool for surviving in his natural environment. For this, he needs education which is defined as a process in which an individual acquires knowledge and skills that improve his adaptation to his natural and cultural environment.

### 2.1 Nature of Man

Man is an animal, with developed cerebrum, so gained the intelligence, insight, memory, and learning, which created the culture. Culture led to evolution of social institutions that were established to fulfill man's needs.

Man is unique among the creatures of the earth. Because he has exceptionally large brain, and has developed the faculty of abstract thought and reasoning, he can adapt himself to the environment and at the same time, he can adapt the environment to himself. So, man has begun to think of the environment as his environment, and use it for his own advantage, and upset environmental balance. But in fact, there are laws of natural world that are certain, inflexible and applicable to all creatures including man.

According to Mete Turan: " Human involvement in the life process is active and his products are concrete embodiments of his activity " (2).

The products of man, on the one hand are the expression of his labor-power, and on the other hand are not a true expression of his potentialities, create alienation.

" In order to understand full range of man's cognitive activities, developing through his relation with environment, it is necessary to consider productive dimensions of human activity" (3).

Man has many kinds of needs such as physical, biological, psychological etc. The totality and interactions among all of these needs, result as a demand for shelter.

### 2.2 Man and Environment

All civilisations so far have been built on an orderly system of relationships linking man to nature, but these relations are being disrupted all over the world by technological forces and high population densities.

Man has undoubtedly made amazing technological advances at an ever accelerating rate. Communication systems have become incredibly accurate and complex. Computers have helped the solution of problems previously never even remotely within our grasp. But the

important fact is that we have aimed at solutions of specific problems and have not had the capacity to analyse the indirect effects of these solutions. This shortcomings become increasingly important as technology improves and thereby gains added capacity for increased impact. The standart of living around the world is rising. Projections of present trends show that man will require 10 times as much energy in the year 2000 than as he is able to generate today. This of course, will lead to greater pollution and greater concentration of poeple causing greater administrative difficulties in government and to a deterioration of the quality of life which as an extreme point, may cause the elimination of man. All of these arguments are true for developed countries but for developing countries like Turkey, the problem is totally different because in Turkey there are people who are living in 18 th. century instead of living in 20 th. century. This situation can be considered as an advantage for the designers in Turkey, and they can use the advantages of not going through all of the wrong decisions, they can skip many stages and find proper ways fitting to their conditions.

### 2.3 The Nature Of Ecosystem

Ecology, is the study of relationships between organisms and their environments, and ecosystem is the interaction of biotic and abiotic factors.

There are seven important laws of ecology which are Laws of INOPTIMUM, APHASY, TOLERANCE, PERSISTANCE, FACTORIAL CONTROL, IRREVERSIBILITY, and DOMESTICATION. Also there are two important laws of ecosystem ; first is that everything in the environment is related to everything else, and the second is that man's activities tend to reduce the complexity of ecosystem.

Here it needs to emphasize the importance of the relationships between the laws of ecology and charecteris-tics of design process, e.g. Law Of Tolerance or Law Of Irreversibility can very well fit to the conditions in a design process. In a design process, there may be certain decisions that you can not reverse, or there may be certain optimizations (i.e. tolerance) in a design stage.

Ecological relationships are manifested not in a vacuum, but in physico-chemical settings, sets of nonliving or abiotic environmental substances and gradients. They also include such physical factors and gradients as moisture, wind, currents, and solar radiation with its concomitants of light and heat

Ecosystems are like a pond, or a field, a forest, an ocean or even an aquarium ; they are also abstract in the sense of being conceptual schemes developed from a knowledge of real systems. Ecosystem is also undirectional and noncyclic.

Although the process of energy flow and mineral cycling are indeed fundamental, they are not the whole of ecology. No organism is self-sufficient. So is an ecosystem. Ecosystems are not decretiventities delimited sharply from other ecosystems. One of the most important fact about ecosystem is that in any ecosystem, there is continual

demand for energy and no ecosystem is static. (Functioning of an ecosystem is measured by the rates of energy flow and nutrient cycling.)

**Some Basic Principles Of Ecology :**

" Pradation : defined as the behaviour of capturing and feeding an another organism with the latter being consumed wholly or in part. Man was a direct predator during almost all of his tenancy on earth.

Symbiosis : refers to a long-term interspecific relationship in which two species live together in more or less intimate association. This is not a social system but an ecological association involving some transfer of energy or adaptive benefit. Are of three types generally, commensalism, naturalism, and parasitism.

Competition : In an ecological sense, is a struggle between organisms for food, space, mates or any other limited resources. The basis for this struggle has been expressed as Gause's Principle, which states that two species that occupy the same niche (way of life) come together in space and time, as a general rule there are three possible results ; extinction, competitive exclusion, character displacement" (4).

Ecosystems are never closed systems. An ecosystem is highly integrated series of interactions between the nonliving earth and living organisms. They are complex dynamic entities, which must be seen as such before they can be understood. Inputs from and outputs to other ecosystems are normal characteristics of all natural ecosystems.

### 3. PROCESSES

Man have two ways of mental process. One is the knowledge acquired (cognition), and the other is the knowledge not acquired. As a result of each process, there is a material production. But first one has certain advantages in understanding complex systems, e.g. as it happens. Because cognition may have analysis and synthesis in its system and also design process is a cognitive activity. Of course - whether it is sufficient to create complexity and try to solve it or not having simple but incomplete results - is a question. In this question, it is wrong to take the design process as a simple process, because it includes decision making stages needing valuable data collection in any field, but it is a very complex system.

" One of the ways in which a person perceives the organization of a housing environment is through the psychological functional relationship of inner and outer spaces. This is processed through the individual's cognitive facilities which depend upon factors within the personality system -- past experiences, immediate needs, present psychological condition etc. Therefore, only a design goal that takes into consideration all aspects of the individual's existence can achieve the requirements of an environment that will ... guide the inevitable interaction of structured space and man in meaningful and beneficial patterns, "and" permit an interaction which will

contribute to mental health. Rather than to tension and frustration (5).

Architecture is a profession which includes many activities, stages e.g. pre-planning, planning, design, application etc.

Each stage has input and outcome relation with each other, and if an input is not sufficient, then following stage may be influenced adversely ; e.g. if the cognition in design stage does not create required input, then in application stage desired result can not be achieved.

#### 4. DESIGN PROCESS

In order not to have a design process which is repeating all of the wrong, misleading points in each case, it is necessary to analyse all the points influencing the wrong applied conditions in building process. For this study, it is necessary to visualize that, architectural design, its parts and relations to the other fields must be examined altogether. As an example, we can have a look into relation between design and ecosystem.

In design process, we have certain stages that include ecological factors in creating the rational product which will satisfy the needs of the humanbeing.

In a decision-making sequence, in designing a building, first of all, designer prepares a program which includes all the stages and relations among them, feed-back mechanism and dates that he goes from one stage to other. After program-ing stage, he must begin collecting data about the needs of the client, and about the site, the available material, workers quality, and other relevant factors.

In choosing site, he must consider topography, orientation, climate, landscape, possibilities of having vehicular and pedestrian access to the site, and possible infrastructure as sewage system, water, electricity, coal-gas or other heating and cooling systems, etc. But all of these subjects influence design in a very positive way if the designer considers ecosystem as an important system in utilising all of the natural resources and balances energy system in the environment. The condition of surrounding environment is also important, eg. forest, water, pool, open areas, schools, hospitals, or shopping centers, administrative buildings, all having different settlement characteristics so indirectly affect design and ecologic balance in that environment.

When the designer collects the data, he begins to analyse, ie. makes groups, or arranges the data according to his needs and importance of the items, so that they become useful for other stages.

By using the inputs from the first stage, he can easily decide upon the form, dimensions and structure of the building and make spatial organization (ie. open, semi-open, or closed spaces and functional relationships among them) and can specify the material and detailing to be used in construction stage.

During this process, he must consider that the energy balance of the environment will be

changed and the impact of the environment to this product (building) and the impact of building to the environment, can be very critical, if the designer does not pay attention to this type problems. For instance, use of any material for covering the roofs will differentiate the solar heat gain and loss of the buildings, because of heat absorption or reflection coefficients of the covering material, or the texture of material and the area or form, or the angle of the roof will directly affect the interior living conditions of the building.

In deciding upon the façades of the buildings, the study of ecology is also needed, because each opening (window or door) each solid and void facade elements and the use of cantilivers or balconies, terraces etc. may change ecological inputs. So the quality, comfort conditions of inner spaces may increase or decrease accordingly. Because of the influence of diffused light, especially in interior spaces, designing forms and sizes of openings, deciding upon the dimensions of spaces and painting, textures of the walls or furniture, have important role in having sufficient spaces for living. In fact, having interior gardens, pools, shady corners, or use of trees having large leafs may introduce a sufficient micro climate which can be preferred in hot and dry climatic conditions.

In considering ecological impacts in an environment, area covered with different roofs create a textural surface for solar radiation and absorption. That's why if we want to control the ecological effects, it is a better way to have larger settlements, and design according to the ecological principles.

In a city, the open spaces, streets and other areas covering large surfaces on earth, have very critical ecological effects in the organization of forms and deciding about the heights of buildings. For instance, streets' width may affect the speed and direction of wind so indirectly affects heat gain and loss in building.

Multiple dwellings decisively increase the density of population, aggravating problems with solid waste disposal, transportation, air and water pollution. Yet they displace less natural environment than the sprawled city.

Landscape designers are also responsible in considering ecological principles, because they can arrange green areas as filters for air and water pollutions. Visual comfort of the humanbeing is also affected by the form and arrangement of the buildings and the intricate use of landscape elements. So in order to have positive effects we must be very careful in planning and designing to achieve desired environmental quality, because expected results, sometimes can not be achieved in due time, if correct projections on the subject are not properly set, and all of the known facts must be considered as much as possible. These are a few examples showing that how much important is the design and ecosystem relation, if it is studied in detail. Architecture is a tool of gaining back all the lost values by the impact of man on the environment. So we must learn and have researches about how to use this tool.

## 5. BUILDING PROCESS

In previous part of the study, it is tried to present importance of ecosystem in the design process. In this part, another argument in building process will be pursued, and the dynamic nature of human activity, his demand system, capacity of changing the speed of adaptability to the environmental conditions, limitations in environmental flexibility will be discussed.

"Environment, particularly the housing environment, where man is supposed to have shelter, rest, leisure, solitude, and comfort must only be in congruance (agreement) with man's praxis but must also provide a supportive system for his actions and movements. Therefore, any design process that provides for the exigencies (urgent requirements) of actual life activity must have its own consciousness. .... The uncontrollability of environmental loads appears to be a major factor in the unsuccessful coping process" (6).

Sometimes it is tried to prove that because a man's dynamic nature in his activities, he needs environmental flexibility. But there is a conflict between the cognitive activity of the individual and static nature of building and adaptability in environment. That is, increase in environmental flexibility causes no technological inputs in building process. But at the same time, in order to answer to the needs of humanbeing, technology brings certain necessary inputs to the environment. Which have constant and variable design requirements in housing, and changing variables and reorganizing static side in time. So the optimum solution of the problem is to balance the needs of man and the flexibility in environment.

"Structural elements -- window openings, furniture, shutters, etc. -- are of relatively a static character. Flexibility gives a dynamic character to the environmental elements. Therefore, the flexibility provided in design process is the predominant characteristics of an environment" (7).

It is designer's responsibility, to find out how much flexibility in each stage in building process will be required in order to set conditions fitting to the rules of ecosystem. He can organize his knowledge about ecosystem and architectural design in order to cope with the dynamics of social, psychological demands made upon people which will not contradict with the static nature of the built environment.

Architecture is in fairly critical state, because new buildings will be really pleased the users and the architectural profession as a whole is viewed with considerable suspicion by the society it is supposed to be serving. In a building process, self-expression, efficiency, productivity and cost control follow each other continuously. At the same time, rational building must have five conditions ; e.i. commoditie, firmness, delight, at the right time and at the right price. In order to fit all of the above conditions, architect must control the environment very carefully and he must know ecosystem and its impact on design. For example, heat loss and gain by solar energy bring a new cost control for

building. But to utilize solar energy in heating and cooling there are special factors in designing to control radiation or absorption or reflection of solar rays.

## 6. CONCLUSION

In this study, the aim was to bring an awareness to the important relationship between ecosystem and architectural design. It must be understood that in a short period to have a complete research and prepare a perfect study is difficult and sometimes not possible. That's why, I do not intend to argue that this study is a complete study about design and ecosystem. But, to be able to cope with many interrelated subjects and to try to prepare an introduction to this subject, many sides of the problem are presented altogether, so that it is hoped that a consciousness about the importance of ecosystem in building process can be realized through this study.

In the real life, men constantly change their ways of life and living places. The most man can do, on the one hand, is to make sure that the environmental changes he brings about do not outstrip his adaptive potentialities, and furthermore to govern his adaptive responses in such a manner that he does not decrease the qualities of his life.

"Biological (genetic) evolution is far too slow to permit affective adaptation to the rapid changes that commonly occur in the physical environment at the present time" (8).

It is important to recognize that no solutions to environmental problems are "all right" or "all wrong". All alternatives must be considered with the recognition that there are benefits and liabilities resulting from each action for reaching decisions that bring the most beneficial solutions with the least liability. The process must include not only traditional economic considerations but also consideration of natural economic principals as well. Environmental decisions have been repeatedly based on limited informations and projections. We are infact threatening our own survival by this process. It is imperative that environmental decision making be based on planning that to the highest degree possible, takes into account the intricacies of ecosystems and the impact of our decisions on these systems.

"The only hope for man appears to lie in a concentrated effort to change the cultural environment in a way that supports the natural environment" (9).

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