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**O 14. THE USE OF ECOLOGICAL AND SUSTAINABLE MATERIALS IN LANDSCAPE
DESIGNS**

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ABSTRACT: To create the ideal ecological design model is possible by following the constantly renewed ecological information and analysis. In line with this information and analysis, application-oriented eco-materials can be selected and even new ones can be developed. Since "Ecology" is a concept with many variables, techniques and materials differ for each ecological design application. Therefore, the most appropriate eco-material selection can be made in line with the criteria shaped according to the ecological design model, whose main principle is "minimum resource consumption and destruction with maximum benefit, sustainable design". It will be possible to choose the most suitable eco-material in line with the formed criteria. Sustainability could be summarized as "Meeting the needs of today without damaging the ability of future generations to meet their own needs". In this study, ecological and sustainable materials were mentioned and examples were given.

Keywords: *Sustainable materials, Landscape inanimate*

INTRODUCTION

One of the most important problems of the current century is the deterioration of the ecological balance that occurs in parallel with environmental pollution (Yazici et al., 2017). The survival of living things is possible with the sustainability of their living environments. Today, urbanization, which is rapidly increasing with industrialization and developing technology, causes damage to ecological balances and destruction of cultural and historical values. In this context, ecological criteria that should be applied in architectural designs for a sustainable future have been investigated (Yazici et al., 2018; Ankaya et al., 2018; Gülgün et al., 2014;).

Man is a part of nature. Architectural design studies should be handled in a way that it ensure a healthy sustainability in the nature-human-society as a whole. Design, which includes ecological principles, defines the difficult task of adding spatial content to the relations of natural systems and social systems. "The basic basis of the concepts of environment, ecology and sustainability in planning is to create residential areas compatible with nature or to ensure the continuity of residential areas by making them compatible with nature. Bioecology, also known as bionomics or ecology, is a branch of science that examines the relationships between living things and the living and inanimate environment surrounding them (physical-chemical factors of the soil, climate, the topography and appearance of shelters, animal and plant competition). Nowadays, with the increasing human-nature relations and environmental problems gaining importance, the term ecology; is used in the field of science that supports the conservation of nature and its cycles with the use of renewable and harmless energy as well as the relationships of living species. Sustainability is related to basic human needs such as clean air, clean water, healthy and sufficient food, relationships with plants, animals and other people, protection, participation, creativity, freedom, love and beauty. The key element in ecological planning and building is sustainability.

Evaluation Criteria of Landscape Designs in Terms of Sustainability

Sustainability, one of the most important concepts of today, is a key concept that aims at high efficiency, which foresees the continuous functioning of any social, economic or ecological system without disturbing and consuming the resources used.

• **Effective Use of Microclimatic Data:** Climatic data such as insolation, wind directions, heat, radiation should be used in an efficient and energy-saving way in planning, urban design and architecture.

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- **Energy and Material Conservation:** Access to the central business area, internal circulation, lighting / heating / ventilation etc. of the central business areas. Arrangements should be made to ensure the minimum use of energy in the design of the microclimatic environment (at environmental / building scales).
- **Recovery of Energy and Waste:** Electricity, solar, natural gas etc. used in central business areas. Technologies related to recycling of energy should be used, wastes (solid / liquid waste, solid liquid biological wastes, etc.) should be separated on-site, and recycling technologies should be used.
- **Development of Energy and Material Resources:** Solar energy in the heating and illumination of buildings. Biomass energy, electricity, alcohol-powered environmentally friendly vehicles in central business areas; waste should be used for heating and fuel. Recyclable wastes, (paper, glass, metals, chemicals, etc.) should be recycled by establishing a separation facility, the existing building stock in the area should be used until its economic life is over, then the material should be utilized to the maximum extent.
- **Efficient Use of Topographic Data:** Infrastructure and superstructure problems arising from the land should be minimized. The geological structure, soil capability, and the fertile soils located in the building construction area should be evaluated by moving it into the green areas.
- **Efficient Use of Natural Resources:** Today, existing vegetation, streams, flora, fauna, etc. should be developed by utilizing natural resources. Green standards for central business areas per person should be increased as much as possible, and the rate of green in squares / areas / buildings should be kept at high proportion.
- **Evaluation of Vegetation:** Its the use of existing vegetation by improving it in planning, researching the plant species unique to the region, its use in parks, open and closed spaces.

Based on the above principles, we can examine landscape design projects under 6 headings in terms of sustainability.

These are;

- Water collection systems integration
- Use of renewable energy
- Use of natural resources and materials
- Plant selection
- Permaculture (natural garden)
- Streuobst method

ECOLOGICAL AND SUSTAINABLE BUILDING MATERIALS

While evaluating whether the materials are ecological or not; Not only are they evaluated in terms of social, economic and practical aspects, there are also classifications in line with other features. The properties of materials that can be used in sustainable and ecological terms are given in Table 1.

Table 1. Eco-material usage in landscape application areas.

Material Name	Place of Use / Function	Natural / Artificial	Transformation / Reuse	Local / Foreign *
Compacted tile and stone powders	Flooring	Natural	Re-use	Local
Natural stone particles	Flooring	Natural	Re-use	Local
Concrete blocks	Flooring	Natural	Re-use	Local
Converted glass	Flooring	Natural	Transformation	Foreign
Compost	Soil improvement	Natural	Re-use	Local
Straw	Wall	Natural	-	Local
Adobe	Wall	Natural	-	Local
Irrigation heads	Irrigation	Artificial	-	Foreign
Rain and surface water tanks	Irrigation	Artificial	-	Foreign
Sun tunnel	Lighting	Artificial	-	Foreign
Sun sensor	Lighting	Artificial	-	Foreign

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solar panel	Energy production	Artificial	-	Foreign
Wind turbine	Energy production	Artificial	-	Foreign
Wind chimney	Energy-saving	Artificial	-	Local
Traverse	Reinforcement	Natural	Re-use	Foreign
Converted steel	Reinforcement, Fence	Artificial	Transformation	Foreign
Natural stone	Floor covering, Wall	Natural	-	Local
Wood composite	Floor covering, Fence, Reinforcement	Artificial	Transformation	Foreign
Nutshells	Ground covering, Soil improvement	Natural	Re-use	Local
Waste metal	Fence, Reinforcement	Artificial	Re-use	Local
Waste wood	Fence, Reinforcement, Wall	Natural	Re-use	Local
Natural Wood	Floor covering, Reinforcement, Wall, Fence	Natural	-	Local
Plant	Floor covering, Fence, Energy Design, Wall	Natural	-	Local
Rubble waste	Floor covering, Wall	Artificial	Re-use	Local
Wood chips	Soil improvement, Ground covering	Natural	Re-use	Local

Wood

It has been used as a carrier element, window joinery, floor roof element and exterior cladding in buildings, and it continues to be used. Among the building materials, wood has always been among the preferred materials due to its advantages.

Wood does not cause adverse environmental effects throughout its life cycle. For this reason, wood joinery produced from environmentally friendly wood is one of the indispensable building materials preferred in building production.



Figure 1. Examples of the use of wood (Url 1)



Figure 2 Examples of the use of wood (Url 2)



Figure 3. Examples of the use of wood (Url 3)



Figure 4. Examples of the use of wood (Url 3)

Among the building materials, wood has always been among the preferred materials due to its advantages. In landscape applications wood is used for various purposes. The most common use is for reinforcement elements such as floor covering, Pergola, Fence, Gazebo, and bench (Figure 1; Figure 2; Figure 3; Figure 4).

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Straw bale

It is a great insulation material. Straw can provide 3 times better insulation than other insulation materials. Heating and cooling costs can be saved by 75%. It is also a material that provides very good sound insulation. It does not harm the environment.



Figure 5. Examples of the use of hay bales (URL 4, Figure 5)

Production and transportation of materials such as cement and brick requires high energy. However, straw is a sustainable material that is produced by solar energy and can be obtained every year. It can easily be obtained from every place where grain is produced, it needs low energy for baling. It has no harm to the environment, it mixes with the soil when the buildings collapse. It can even be used as compost.



Figure 6. Examples of the use of straw bales (URL 6; Figure 7)

Moreover, utilizing straw bale as a building material alleviates the gas emission caused by burning unnecessary straw. It is economical. The cost of straw bale houses is very low. As it provides thermal insulation, it also reduces the cost of heating in the long run.

Sandstone

It is called clastic sedimentary stones formed by combining sand grains with a diameter of 1 / 16-2mm with a natural cement.

It is a building material that is compatible with human nature and has a history of thousand years. Centuries ago buildings made of sandstone still stands today. While most building materials gain an ugly appearance after years, stones gain their own unique appearance and attain their true beauty. It is possible to reuse previously used stone material for a different purpose. This feature contributes to the protection of natural resources.



Figure 7. Sandstone (Url 8)

It is a building material that is compatible with human nature and has a history of thousands of years. Buildings made of sandstone centuries ago still stand today. In our country there are different colors and features of sandstone resources. The widespread use of sandstones as a carrier material in walls and columns, as coating material on interior and exterior surfaces, as flooring material on the floor will contribute to the creation of a healthy living environment and protection of the natural environment.



Figure 8. Use of sandstone in cultural assets (Url, 9; Url 10).

Plaster

In this way, even though they absorb moisture, shrinkage, cracks like concrete and wood they do not change their size and shape. The acquisition, applying and maintenance of plaster and plaster element is easy and cheap.



Figure 9. Plaster (Url 11)

It enters the structure fully finished, does not require additional labor and expense. Since the plaster element contains very small gaps, it reflects by reducing the sound waves on it. In volumes where acoustics are important, it controls the sound transmission between the volumes well. Due to its construction and adhesion properties, plaster can be added to a different material as well as being a hydraulic binder. These are some of the building materials.

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Natural Stones

Natural stone; is a natural product whose properties vary according to its type, and the way the minerals that makes it up are bonded. Natural stone differs from all construction materials with these features.



Figure 10. Cut stone (Url 12)

Natural stone is not a uniform industrial product and bears the traces of its formation process. Natural stone is almost ready in nature to be used as a building material. Energy is only required to quarry and process the stone, which is much less than for other building materials.



Figure 11. Cut stone (Url 13)



Figure 12. Natural stone (Url 14)



Figure 13. Natural stone (Url 15; Url 16)



Figure 14. Natural stone (Url 17; Url 18)

Adobe

Adobe is a natural and sustainable building material. In addition, adobe is a 100% recyclable and waste-free material.

The properties of adobe and brick's properties are similar. The adobe mortar, which is kneaded with water and shaped in molds by making use of the bindingness of clay as a raw material, is dried under the sun. After drying, a building material whose compressive strength is not as high as brick and that has low water resistance is obtained. The most important difference between adobe and brick is that it is dried with sunlight without consuming any energy, while brick is baked in an oven at 900 C.



Figure 15. Examples of using adobe (Url 19; Url 20)

The adobe structure keeps the humidity of the interior in balance by absorbing the moisture in the air due to the porous structure of the adobe paste. Adobe provides the protection of heat and moisture balance due to its heat retaining feature. It provides a more livable, clean and healthy bioclimatic comfort in the building.

The most important element of ecological landscape designs is planting design. Planting design includes vegetative applications in a landscape area. The most important point in this design is the selection of plant in vegetative applications. The area to be treated in plant selection and use of native plants of the region is extremely important. The use of natural plants will facilitate the adaptation to the area to be

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culturally created, and the plants that are easy to adapt will also contribute aesthetically to the visual presentation as they can show their natural development.



Figure 16. Examples of using adobe (Url 21)

Planting



Figure 17. New Generation Green Roofs (Url 22)



Figure 18. Green Roof (Url 23).

CONCLUSION AND RECOMMENDATIONS

Ecological pressures as a result of intensive housing need to be addressed at the land scale as well as the building scale. In ecological design decisions to be developed in this direction, buildings and outdoor

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spaces cannot be considered independently from each other. Natural and cultural landscape areas support and compensate the building in terms of reducing or preventing life-related environmental problems. The selection of eco-materials suitable for ecological design goals varies according to the location, quality and type of the landscape application area.

Techniques, tools and materials developed to reduce human-caused environmental impacts with the beneficial use of technology are increasing day by day. Creating the ideal ecological design model is possible with the continuous monitoring of ecological information and analysis. With the beneficial use of technology increasing day by day techniques, tools and materials are developed to reduce to reduce human-induced environmental impacts.

Creating the ideal ecological design model is possible with constantly updated ecological information and continuous monitoring of analysis. In line with the said information and analysis, application-oriented eco-materials can be selected and even new ones can be developed. The use of living materials as well as artificial materials in landscape architecture applications provides a great advantage in achieving ecological design goals. Plant material, offers many functional usage possibilities. It provides various ecological benefits such as energy efficiency, water efficiency, biocomfort, soil reclamation, erosion control, and biodiversity with vegetative design in accordance with ecological design criteria.

With the aim of reducing the energy used for cooling and heating in buildings, it is possible to provide climate control in all seasons with the energy efficient vegetal design to be made. Plant material not only provides biocomfort for human use, but also offers suitable climatic conditions and living spaces required by all living creatures living in that region. Thus, it contributes to the biological diversity targeted by ecological design. Since ecology is a concept with many variables, techniques and materials differ for each ecological design application. Therefore, its main principle is "to provide maximum benefit with minimum resource consumption and destruction, it will be possible to choose the most suitable eco-material in line with the criteria shaped according to the ecological design model, which is "sustainable design".

In order to reduce the percentage of the material in the formation of increasing environmental problems today, various decisions must be taken and implemented as a manufacturer, designer, user and the state. These are;

1. The production and use of local materials should be increased and their conditions should be reviewed in accordance with environmental principles.
2. Increasing the use of traditional materials regionally on the basis of resources (natural stone, forest or soil) and climatic conditions (such as adobe) should be encouraged.
3. A Green Building evaluation system should be developed nationally, based on all issues in building production. Material selection and usage principles should also be determined in accordance with climatic conditions and resources.
4. It should be ensured that the wastes generated in the process from the beginning to the end of the constructions are used as resources in the same or different buildings.
5. Every waste (plant, industry) must be the source of another production. Considering the regional annual production as a renewable resource, it should be encouraged to use plant wastes directly or indirectly in the production of building materials, and the production of these products should be started on an industrial scale. The prevention of environmental pollution caused by these plant wastes will benefit the country's economy in terms of economic support and energy use for the producer.
6. Regardless of the function, construction system, and form, designing each building to create a resource in the production of another building after completing its useful life will increase efficiency in energy use by reducing material production.
7. State policies should be revised in order to raise awareness of not only designers or material producers, but also the society and to have national and even international sanctions.
8. Legal arrangements should be made to encourage and encourage producers, designers and users to produce buildings in accordance with ecological criteria. Today, it is necessary to enter into a social organization in order to be in a livable environment and to be able to inherit a world that can be lived tomorrow.

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