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Research Article

DESIGNING FOR SUSTAINABILITY ON A UNIVERSITY CAMPUS: ERCIYES UNIVERSITY EAST CAMPUS SOCIAL CENTER PROJECT

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ABSTRACT
Activities in the construction sector have several negative effects on the natural environment because they consume energy and resources. However, the intention of sustainable practices is to produce nature-friendly buildings with reduced negative effects on human health and the environment. There are a variety of evaluation and certification systems in the world and in Turkey that are addressed to identify the environmental sensitivity level of the buildings that were designed in accordance with sustainability criteria. In this study, the principles for sustainable building design are determined as sustainable land use, energy efficiency, water efficiency, material selection, waste management, indoor air quality and green transportation. The city of Kayseri in central Anatolia was selected as a working area. A project that was designed in Erciyes University campus in Kayseri was examined within the context of these criteria. It can be expressed that Erciyes University East Campus Social Center Project meets ecological and sustainable design criteria. Considering Erciyes University's sensitivity and effort to become a sustainable campus, it is thought that this project can be accepted as a starting point and will act as an example for future projects.

Keywords: *Erciyes University, Green Campus, Design for Sustainability, Sustainable Building*

1. INTRODUCTION

The construction sector is an important contributor to the environmental problems that we face in the world and Turkey. Research reveals that 17% of the fresh water resources, 25% of the forest resources, 40% of the materials and energy in the world are consumed by the construction sector (Say and Wood, 2008). Dixon (2010) reports that 50% of the solid waste in cities, 23% of the air pollution, 50% of the greenhouse gas production and 40% of the water pollution are environmental problems that are caused by buildings. At this point, Schttich (1997) argues that construction can never be an ecological activity, and he adds that sustainable buildings may minimize the possible impact. The intention of sustainable, ecological, green or environmentally friendly practices, as they are variously known, is to produce nature-friendly buildings with reduced negative effects on human health and the environment. The Indian Green Building Council, one of the world's major green building councils, defines a green building as: "one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building" (IGBC, 2012).

In architecture, sustainable buildings are being designed for a variety of functions from education to housing and from hospitals to factories. Nowadays, university campuses are also drawing attention as an area where sustainable building designs are coming to the forefront. It is important that universities, playing an important role in the development of new technologies and training the individuals that would act as role models for the society, maintain their existence with sustainable campus approaches that are sensitive to the environment and contribute to development. It is expected that the universities, starting their paths with this objective, will demonstrate sustainability principles in the building designs of their campuses.

One of the systems assessing sustainability efforts in university campuses is the UI GreenMetric World University Ranking, which was developed by the Indonesian University in 2010 and ranks many participating universities every year by infrastructure, energy and climate change, waste, water resources, transportation and education. GreenMetric is a platform that draws attention to issues related to sustainability and aims to raise global awareness for environmental conscience. Higher Education Institutions are ranked based on the scores they get from these assessments. The 2018 GreenMetric assessment ranked Erciyes University as the fourth in Turkey and the 243th in the world (GreenMetric, 2018). Considering Erciyes University's objectives of becoming a sustainable campus, it is important to create its physical environment with the same sensitivity and launch architectural designs with this conscience. With university's environmental sensitivity goals, it is important to consider sustainability criteria for new building designs on campus. This study examines Erciyes University East Campus Social Center Project[1] because it was designed with environmental awareness.

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The purpose of this study is to analyze the sustainability criteria in new building designs on university campuses, and act as a guide for new designs. With this purpose, the second section of the study presents the research methodology. The third section reviews the most well-known (LEED v4 for Building Design and Construction, BREEAM-International New Construction 2016) and a local (ÇEDBİK-New Homes) green building certification systems to determine the sustainability criteria in new building designs. The fourth section analyzes in context of sustainability criteria the East Campus Social Center Project for Erciyes University Campus, and presents the findings. The results are reported in the fifth section.

2. RESEARCH METHODOLOGY

This study identifies the sustainability principles for new building designs, and evaluates Erciyes University East Campus Social Center Project in line with these principles. The study used green building certification systems when demonstrating sustainability principles. Of these certification systems, the study examined LEED v4 for Building Design and Construction, BREEAM-International New Construction 2016 and ÇEDBİK-New Homes evaluation criteria. LEED and BREEAM were examined because they are the first, leading certification systems in the world, and are used commonly; ÇEDBİK was examined because it is the first and only certification system that was developed in accordance with the conditions in Turkey. Based on the information from the selected green building certification systems, the study analyzed the sustainability approaches in Erciyes University East Campus Social Center Project. The case as hopefully able to contribute a sustainable design approach in a university campus in Turkey.

3. ARCHITECTURAL DESIGN FOR SUSTAINABILITY

Sustainable design approaches are becoming increasingly important in building design. The World Congress of Architects (1993) challenged architects to lead the way into the new field of environmentally conscious architecture and sustainable development, minimize future poverty and restore already degraded environments.

When architectural design uses sustainability criteria, positive outcomes are achieved in resource utilization, environmental effects and waste. Sustainable buildings raise environmental awareness in society by bringing the environment and its occupants closer together. These buildings also remind us that we can respect the environment and live in harmony with it (Özçuhadar, 2007).

There are a variety of evaluation and certification systems in the world that are addressed to identifying the environmental sensitivity level of the buildings that were designed in accordance with sustainability criteria. These certificates evaluate the buildings by scoring them in accordance with certain criteria. Among these certification systems; LEED v4 for Building Design and Construction, BREEAM-International New Construction 2016 and ÇEDBİK-New Homes that assess the designs of new buildings were examined within the scope of the present study and their evaluation criteria were discussed.

When LEED v4 for Building Design and Construction, which is the most current version of LEED, is examined, the sustainability criteria for new buildings are analyzed under the main headings of location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation and regional priority (LEED, 2019).

An analysis of BREEAM's most current version –BREEAM International New Construction 2016- shows that the sustainability criteria are evaluated under the main headings of management, health and well-being, energy, transportation, water, materials, waste, land use and ecology, pollution and innovation (BREEAM, 2016).

The certification system that was developed and brought into use by Turkish Green Buildings Council (ÇEDBİK) addressing to the conditions of Turkey assesses only new buildings. In scope of this certificate, buildings are evaluated under the main headings of integrated green project management, land use, water use, energy use, health and comfort, material and resource use, living in the housing, management and maintenance, and innovation (ÇEDBİK, 2018).

According to the criteria in the certification systems that were examined in this study, a design that is targeted to be sustainable approaches topography respectfully, reduces the consumption of energy and water, encourages the use of reusable/recyclable materials, produces less amount of waste, ensures to have healthy indoor space conditions, leaves fewer carbon footprints, and supports low-carbon transportation. An analysis of the literature review showed that there were seven prominent main headings in sustainable buildings design. These main headings are listed as: **sustainable land use, energy efficiency, water efficiency, material selection, waste management, indoor air quality, green transportation.** The project that was examined in this study was also evaluated in accordance with these criteria.

4. FINDINGS AND DISCUSSION

In this study, a project designed at the Erciyes University Campus in the province of Kayseri in Central Anatolia is examined. As the presented project was designed in the light of environmental factors, climatic data will be explained firstly. Kayseri has a cold semi-arid climate, with cold and snowy winters, hot and dry summers. The hottest months are July and August, the coldest months are December, January and February. The average temperature is 10.4 degrees Celsius. According to the annual averages, the number of closed days in Kayseri is quite low. The average number of closed days is 68 and the number of sunny days is around 110 days. The average rainfall is 375 kg per square meter (Republic of Turkey Ministry of Culture and Tourism, 2019).

In the satellite image given in Figure 1a, the marked area has been selected for the implementation of the building design. The main activities in the project, which was prepared by the request of the university rectorate to meet the need for a social center in the eastern development area of the campus, are shaped around social events, commercial activities and a faith center (Figure 1b).

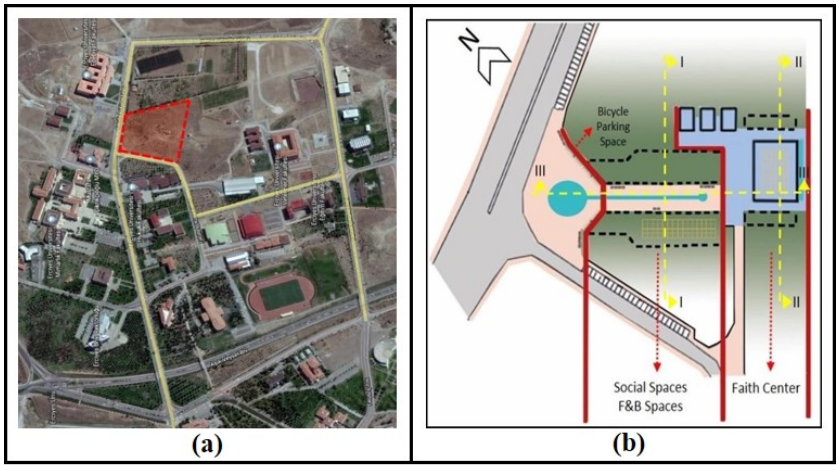

Fig. 1. (a) A Satellite Image of the Design Site on Erciyes University Campus and (b) Layout

4.1. The Sustainable Features of Erciyes University East Campus Social Center Project

Although awareness about being a sustainable campus at Erciyes University has begun to rise, none of the existing buildings in the campus were designed using an ecological approach. This makes the East Campus Social Center Project a significant new step since it is a project that attributes importance to ecological design approach.

This section of the study will evaluate the sustainability criteria for the East Campus Social Center Project in line with the headings in the third section of the study. The design decisions were conveyed by means of sectional principles (Figures 2, 3 and 4).

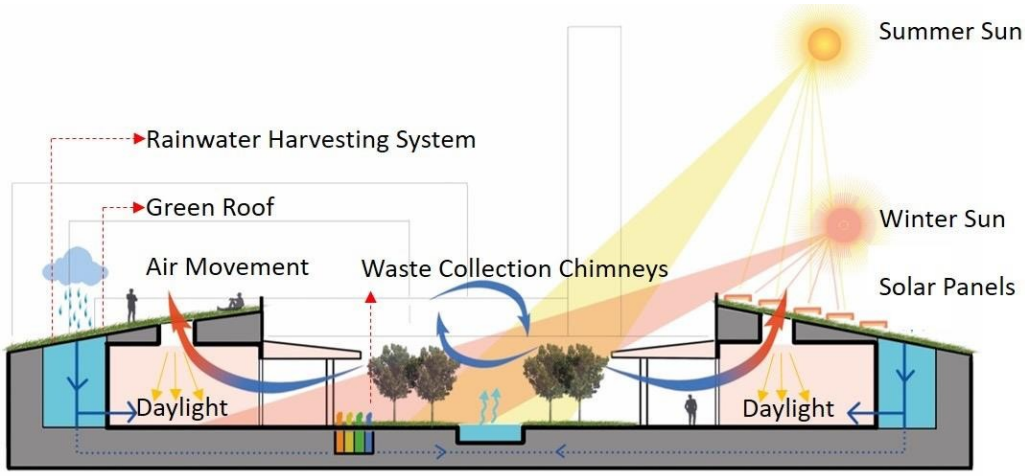

Fig. 2. Design Decisions from an Ecological Perspective in Section I-I

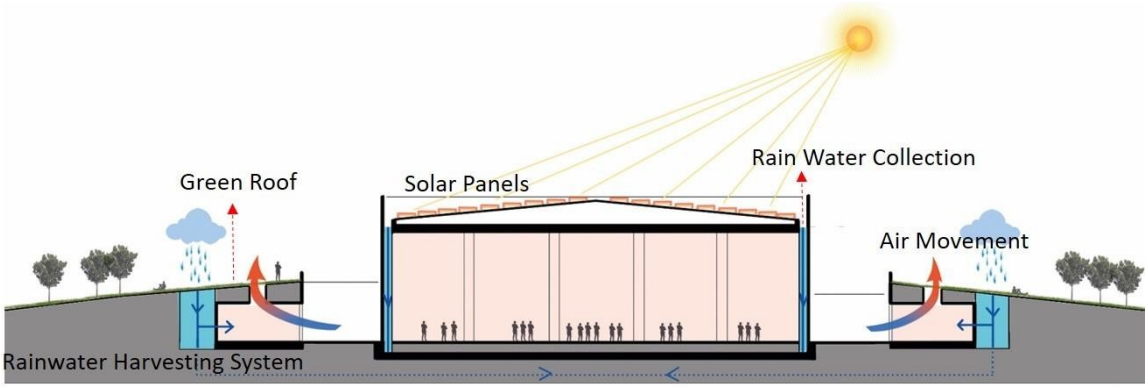

Fig. 3. Design Decisions from an Ecological Perspective in Section II-II

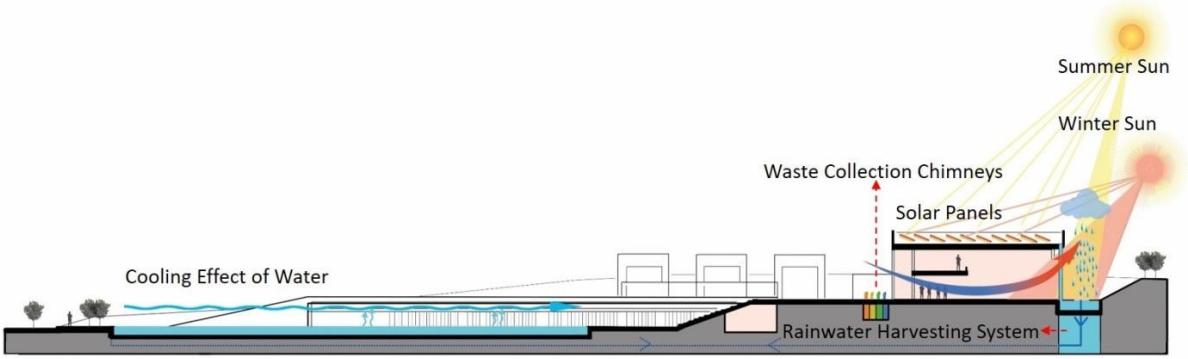

Fig. 4. Design Decisions from an Ecological Perspective in Section III-III

4.1.1. Sustainable Land Use

The project site has a topography that rises on a slope. The primary goal of the design is to locate with minimal intervention in the topographic structure of the site. Nature will be protected, and the resource consumption of excavating and land-filling will be avoided this way. Therefore, a building embedded on the topography was designed rather than a building that rises on the slope. The top of the building was left green (Figures 1b and 5). Since the absorption of CO_2 and other pollutants in urban areas has been another hot topic in recent years, a key strategy in this regard is green roofs. Not to be confused with roof gardens which are for beautification, green roofs are designed specifically for pollution absorption.

Fig. 5. The Sustainable Features of Erciyes University East Campus Social Center Project

4.1.2. Energy Efficiency

Design decisions were developed to ensure low energy consumption in the building. The main decisions were placing a part of the building into the soil and finishing it with a green roof. Although soil is not an insulation material on its own, it effectively balances the temperature between indoor and outdoor spaces thanks to its quality to hold the energy. This

balance is related to its energy holding capability. Since the hot or cold air in the building cannot escape, energy consumption is reduced (Öztürk Sarı, 2013). Covering the building partially or completely with soil contribute to energy conservation by creating a thermal barrier around the building (Yüksek and Keke, 2016). It is thought that this project will contribute to energy conservation thanks to the placement of social activity and F&B units under the soil and the design of their tops based on green roof principles (Figure 2).

West-facing solar panels that will be placed with an appropriate slope on the green roof surfaces will contribute to the building's heating system. It is also planned that hot water production will be supplied by the energy coming from these panels.

The design attributes importance to the use of daylight in the units for social events and F&B spaces, which lie from east to west. To minimize the use of artificial lighting, the connection of these units with the courtyard is planned to be completely transparent. To reduce the effect of the sun's overheating and glare, loggia was added to these transparent surfaces, creating enclosed, semi-open and open spaces. Natural light also streams into the building through roof windows that are designed in accordance with the sloped green roof. Photochromic glass is recommended to be used to reduce the effect of disturbing sunlight that can come through these windows at different angles depending on the season (Figure 2).

A cooling effect, especially in high humidity air, is created by the water placed across the courtyard on the ground level. The water lowers the temperature of the air that strikes its surface, contributing to the lowering of the ambient temperature. Since water warms and cools more slowly, air circulation can be achieved by utilizing the heat and pressure difference between faster warming and cooling surfaces (Tokuç, 2004). The outdoor space will be cooler in summer due to natural air flow in the courtyard (Figure 4).

4.1.3. Water Efficiency

The technologies developed for collecting water are an important step to ensure the sustainability of ecological life and the more efficient use of underground and surface water resources (Koç Aslan and Arslan Selçuk, 2018). In this project, several design decisions were made to optimize water usage in the building. A number of details were created to collect rainwater. Using a rainwater harvesting system is a good way to minimize the environmental impact of water usage. The water that accumulates on the green roofs of the buildings, which are designed to lie from east to west, will be collected under the soil (Figure 2). Similarly, the water that is collected on the roof of the mosque will be accumulated under the ground through downspouts (Figures 3 and 4). The rainwater harvesting systems is designed to collect water for flushing toilets and plant irrigation.

4.1.4. Material Selection

Selecting construction materials in accordance with sustainability criteria reduces buildings' negative effects on the natural environment, which leads to an increase in energy efficiency and a reduction in the expenses of operation, maintenance and repairs. It also creates healthy and comfortable spaces for occupants (Sev, 2009). Using local materials requires less energy to transport raw materials, reduces CO_2 emissions during transportation and contributes to the local economy. It can be expressed that the materials for this building were selected according to these principles. Raw concrete and glass predominates in the design. Since these materials can be easily obtained in Kayseri, it can be claimed that transportation costs and CO_2 emissions will be reduced.

4.1.5. Waste Management

Decisions about management of solid and C&D waste were also included in the design. The decisions related to the selection of products were important for the prevention/reduction of the waste that would be produced in the construction process. While the product decisions were made in the implementation project phase, the coordination between the size of the building and the size of products were taken into account. The design phase involves selecting building materials that can be reused or recycled, such as concrete, glass and aluminum.

To collect individually the solid and packaging waste to be produced during the usage phase of the building, waste collection chimneys were placed at points that were determined in the site plan. These chimneys are coded with four colors for the separate collection of paper, glass, metal/plastic and organic waste (Figures 2 and 4). It was aimed that all the waste groups that will be dropped through the chimneys will be collected separately underground.

4.1.6. Indoor Air Quality

Designing buildings in accordance with natural ventilation criteria is important in terms of indoor air quality, energy conservation, economic gain and user health. In this project, natural ventilation is provided by removing polluted air and circulating clean air in the building. Sections of the buildings (Social and F&B spaces) allow natural ventilation with "hot air rises and cold air comes in to takes its place" principle. Air streams into the building through the courtyard and leave

the building from roof windows that are designed in accordance with the sloped green roof (Figures 2 and 3). The openings were designed to provide sun light and air circulation.

4.1.7. Green Transportation

It can be put forward that Kayseri Metropolitan Municipality is highly concerned about public and low-carbon footprint transportation. It is important that this awareness should be maintained on campus as well. University students can get to the campus using the Kayseray light rail system and buses. Bicycles can be rented from KayBis bicycle stations located at certain points on campus. A KayBis station was added to the project to the ensure sustainability of the city's green transportation system on campus (Figure 1b). A separate bicycle parking lot was designed for students that travel on their own bicycles. The researchers believe that this will reduce the carbon footprint in transportation to and within the campus.

5. CONCLUSION

Buildings, the outcomes of architecture, involve more resource and energy use than other fields of activity and create serious environmental problems. To mitigate these problems, the primary responsibility of designers is to produce buildings using environmentally sensitive approaches. It is important to design new buildings, regardless of their function or location, that are environmentally friendly, low-consuming and low-polluting.

Although the concepts of ecological building practices have gained recognition in Turkey, the number of these practices is expected to be increased. Universities have particularly important ecological responsibilities, playing a leading role in various fields in society, to have sustainable campus approaches that are sensitive to the environment and contribute to development. Sustainable building design is an important pillar of the sustainable campus approach. For this reason, it is expected that new building designs in university campuses should be tackled in sustainable approaches that respect the environment.

The present study examined Erciyes University East Campus Social Center Project that was designed with this consciousness. When the project was evaluated in terms of the sustainability criteria, it was found that decisions were made in accordance with ecological awareness. However, it would be suitable to assess this design as a starting point. It is expected that sustainable building design approaches continue and develop both at Erciyes University and other universities.

To increase ecological building applications, it is important that the sustainable design criteria for campus buildings should base on obligation rather than volunteering. This should be a part of university policy in new construction process. Educating construction teams about the benefits of sustainability is important, too. The behavioral management of all building users is needed. With this aim, developing training programs to teach all occupants in how buildings operate is important to ensure sustainable behavioral change.

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