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**ARAŞTIRMA MAKALESİ** **RESEARCH PAPER**

# Examination of Campus in Terms of Ecological Landscape Design Criteria: KTU Kanuni Campus

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**Abstract:** Today's cities face many problems, such as excessive population growth, environmental pollution, transportation, housing, economy, climate change, and natural disasters due to rapid urbanization. Due to these problems, the nature-human relationship in cities is also deteriorating. To regulate this relationship, it is necessary to create healthy and livable cities by integrating practical resources, energy, and water use with nature. At this point, ecological design criteria emerge in urban planning. Ecological design criteria create nature-friendly designs within the city. By providing energy and resource conservation in urban areas, it creates spaces that are close to nature and climate-friendly. At this point, many areas are suitable for ecological design in cities. University campuses are also suitable places for determining and implementing ecological design criteria. Campuses are areas where academic activities are carried out and also offer essential living spaces where environmental sustainability can be ensured. Therefore, campuses must be designed in line with ecological criteria to create a model for city centers. At this point, one of the campuses that is ecologically self-sufficient produces and uses its energy and offers sustainable solutions to increasing environmental problems, which is examined within the scope of the study. Thus, the KTÜ Kanuni campus, located within the borders of Trabzon City, was selected as the study area. The current situation of the study area was evaluated according to ecological design criteria. Thus, the importance of how much university campuses' current potential contributes to a city's sustainability and ecology was emphasized.

**Keywords:** Ecological design, ecological design criteria, university campuses, KTU kanuni campus.

# Yerleşkenin Ekolojik Peyzaj Tasarım Kriterleri Açısından İncelenmesi: KTÜ Kanuni Yerleşkesi

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**Öz:** Günümüz kentleri, hızla kentleşme bağlı olarak aşırı nüfus artışı, çevre kirliliği, ulaşım, barınma, ekonomi, iklim değişikliği ve doğal afetler gibi birçok sorunla karşı karşı kalmaktadır. Bu sorunlara bağlı olarak kentlerde doğa-insan ilişkisini de bozulmaktadır. Bu ilişkinin düzenlenebilmesi için etkin kaynak, enerji ve su kullanımlarını doğa ile bütünleştirerek sağlıklı ve yaşanabilir kentler oluşturulması gerekmektedir. Bu noktada kentsel planlamada ekolojik tasarımlar kriterleri ortaya çıkmaktadır. Ekolojik tasarımlar kriterleri, kent içerisinde doğa dostu tasarımlar oluşturmaktadır. Kentsel alanlarda enerji ve kaynak korunumu sağlayarak, doğaya yakın ve iklim dostu mekânlar oluşturmaktadır. Bu noktada kentlerde ekolojik tasarım için uygun birçok alan bulunmaktadır. Üniversite kampüleri de, ekolojik tasarım kriterlerin belirlenip uygulanması açısından uygun mekanlardan bir tanesidir. Kampüsler, sadece akademik faaliyetlerin yürütüldüğü alanlar değil aynı zamanda çevresel sürdürülebilirliğin sağlanabileceği önemli yaşam alanları sunmaktadır. Bu nedenle kent merkezlerine model oluşturabilmek adına kampüslerin ekolojik kriterler doğrultusunda tasarlanmasın oldukça önemlidir. Bu noktada çalışma kapsamında ekolojik olarak kendi kendine yetebilen; kendi enerjisini üreten ve kullanan, artan çevre sorunlarına sürdürülebilir yaklaşımlarla çözümler sunan kampüslerden bir tanesi incelenmektedir. Böylece çalışma alanı olarak Trabzon kenti sınırları içerisinde bulunan KTÜ Kanuni kampüsü şeçilmiştir. Çalışma alanı mevcut durumunu ekolojik tasarım kriterlerine göre değerlendirilmiştir. Böylece üniversite kampüslerinin mevcut potansiyellerinin bir kentin sürdürülebilirliğine, ekolojisine ne kadar katkı sağladığının önemi vurgulanmıştır.

**Anahtar kelimeler:** Ekolojik tasarım, ekolojik tasarım kriterleri, üniversite kampüsleri, KTÜ kanuni yerleşkesi.

## INTRODUCTION

Cities are a structuring that consists of small units where people perform functions such as accommodation, settlement, education and recreation (Keleş, 1998). Today, this structure of cities has become unsustainable cities where environmental quality has decreased, nat-ural resources have been depleted, and the natural environment

has deteriorated (Leitmann, 1999). However, a positive effort was made for the concept of sustainability, which first appeared in the Brutland report in 1987. In this respect, planning approaches that aim to transfer the sustainability of today's conditions to future generations and support the harmony between human and ecology should be kept at a high level (Yalçıner Ercoşkun, 2007).

The creation of sustainable cities is ensured by ecological urban designs compatible with nature. Protection of the environment and resources, rural-urban space planning, pedestrian-vehicle road organization, environmental impact assessments are among the subjects of sustainable ecological cities (Erdoğan & Öztürk, 2019; Yaşar & Düzgüneş, 2013). The ecological planning approach is provided by incorporating natural processes into small and large-scale planning for a sustainable planning. Since this process will be difficult in cities, especially due to the scarcity of natural areas, nature and ecological designs have gained importance in order to protect my existing resources (Korkut et al., 2017).

Ecological urban designs: It is to ensure the continuity of natural resources as a part of social, economic or urban ecological systems that provide continuity (Kartal, 2009). The basic principles of ecological designs McHarg (1969) developed the concept of ecology and is included in today's planning and design decisions, keeping its currency. According to McHarg (1969), the development processes of cities should be evaluated over time ac-cording to current conditions by including natural processes in planning and design studies. Especially since the places where the city users are will change over time according to their needs and environmental conditions, they should be designed with sus-tainable approaches by making plans according to the future climate and environmental conditions. Ecological designs are very effective in solving the current problems of the city and its region. The spaces designed in this context positively affect the environmental air conditioning and air quality, ensure water conservation, and make water reusable, protect and develop the biological diversity in the city by supporting the existence of natural plants, and provide natural resource conservation with the use of natural materials compatible with nature (McHarg, 1969; Selim,2021 Tregay, 1986).

Ecological landscape design: It aims to minimize energy consumption by protecting natural resources to make the city and its immediate surroundings more livable. In this way, it is an approach based on obtaining maximum benefit by mediating minimum re-source use in cities. However, with such design approaches, existing resource potentials are preserved, increasing the level of use and controlling the change over time (Alpay et al., 2013; Leitão & Ahern, 2002). The change of human use in cities with the understanding of design, the evaluation of current approaches to the solution of ecological problems in the city, and the establishment of human-nature relationship can be achieved with ecological landscape design (Cranz, 2000). Campuses are the most suitable places where ecological design criteria can be applied (Li et.al.,2018; Aksoy et.al.,2024). Campuses, like cities, are areas where social structure is created by creating a biological and physical network (Çorbacı et al.,2005; Ahern, 2007). Because campuses are compact city models by including all the factors that cities contain. In both areas, vital activities such as shelter, rest, transpor-tation, and work; as well as sustainable elements such as social, ecological and economic (Dober, 2000; Ertekin & Çorbacı, 2010; Şahin Körmeçli, 2022). While revealing the dynamic structure of cities and the human-nature relationship, campuses create an innovative and ecological lifestyle thanks to their users, mostly young people(Chen et.al., 2018; Cano et.al., 2023).

In this study, ecologically self-sufficient; It is aimed to create campuses that produce and use their own energy and offer solutions with sustainable approaches to increasing environmental problems. Campus areas, which can be considered as a small model of cities, are discussed. For this purpose, university campuses were examined in terms of ecological criteria. KTU Kanuni campus, which was determined as the study area, was evaluated according to the ecological design criteria within this scope.

## MATERIAL AND METHOD

***Materials:*** The study was carried out at the Kanuni Campus of Karadeniz Technical University in Trabzon. Trabzon city is in the Eastern Black Sea Region, between $40^0$ 33' and $41^0$07' northern latitudes and $39^0$07' and $40^0$30' east longitudes, the part not including the coastline is mountainous and hilly. The climate structure of the city is rainy in all seasons, hot in summers and warm in winters winters (Bayramoğlu, 2016). The study area, on the other hand, has the characteristics of the climate and topographic structure of the city due to its location. The campus has a sufficient level of open green space in terms of its natural and cultural structure and ecological and functional aspects (Bayramoğlu, 2016; Güneroğlu & Bekar, 2017).

Established in 1995 within the city of Trabzon, the campus includes 49 undergrad-uate and 36 associate degree programs in 12 faculties, 1 college, 8 vocational colleges; It has an area of 1,053,839 m² with 92 master's and 61 doctorate programs in 6 institutes (Karadeniz Technical University, 2023). With the vegetative presence of the open green areas on the campus, it not only meets the social needs of the campus user, but also provides an ecological environment on the campus. The campus is very rich in terms of natural plant existence and distribution

balance in the region. In this context, in order to evaluate the ecological planning criteria as a working environment, the KTU campus area was chosen and evaluated due to its location (Figure 1), density of use and the presence of open green areas.


**Figure 1.** Study area KTU Campus area.

***Method:*** The methodological setup of the study is shown in the Figüre 2. In this direction, the methodologically used elements in the study are visualized.

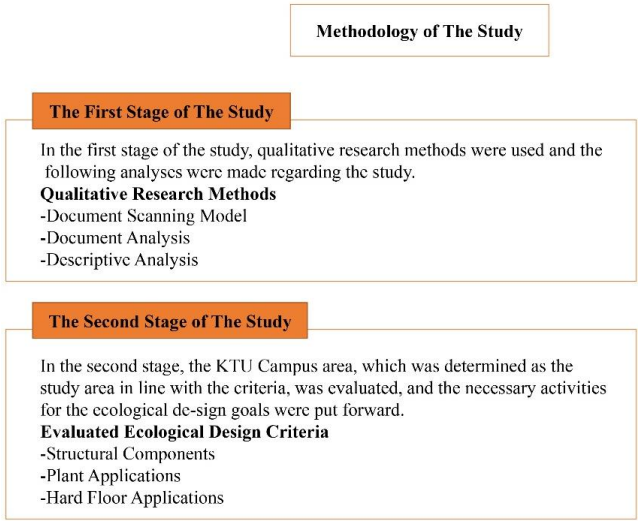


**Figure 2.** Methodology of The Study.

In the first stage of the study, document scanning model, one of the qualitative re-search methods, was used as a method. Qualitative research methods allow the researcher to access the data source directly. It provides detailed explanations necessary for a thorough understanding of the facts and context and generalizations in the light of the information obtained as a result of synthesis (Büyüköztürk, 2011). Document analysis was used in the process of obtaining and interpreting data within the qualitative research model. Document analysis is defined as the systematic handling of both printed and web-based in-formation and documents (Bowen, 2009). Descriptive analysis was performed to determine ecological design criteria. Structural components, vegetative application and hard-ground applications are discussed from ecological design criteria. According to Yıldırım and Şimşek (2008), In descriptive analysis, themes are predetermined, and data are summarized and interpreted according to these determined themes. In descriptive analysis, direct quotations are frequently used, and it is aimed to reflect the data requested to be researched in a striking way. descriptive analysis: It is important in terms of ensuring that the findings obtained are presented in an organized and interpreted way.

In the second stage, the KTU Campus area, which was determined as the study area in line with the criteria, was evaluated, and the necessary activities for the ecological de-sign goals were put forward. Suggestions were developed by determining the ecological design criteria. Evaluated ecological design criteria;

- **Structural components;** Bicycle path used for transportation, pedestrian and vehicle roads, all circulation routes, parking areas and roadside parking areas, permeability status of floor coverings.
- **Plant applications;** existence of natural plant species, wind curtain and shading ef-fect of plant tissue creating an ecological corridor, balance of plants' water needs in terms of water conservation, use of appropriate maintenance techniques.
- **Hard floor applications;** the use of ecological and recyclable materials in structural designs, a design approach suitable for the climatic conditions of the region, and ener-gy-efficient design approaches (water, wind and sun).

## FİNDİNGS AND DİSCUSSİON

First, the current situation and analysis of the KTU Kanuni Campus area, the scope of which was evaluated, was made. For this purpose, the campus area was evaluated according to the vegetative and hard floor applications criteria determined in the method section. By analyzing the determined criteria, suggestions were developed according to the ecological campus design at the campus city scale.

***Structural components:*** The entrance and exit points of the education and admin-istration buildings in the KTU Campus area operate according to their general functions and functions. Campus main entrance, A, B, C, D gates and vehicle and pedestrian en-trances are provided

by security controls. Vehicle roads provide the skeleton transporta-tion of the campus on the main arterial road. This road route serves public transportation vehicles and all other vehicle roads are connected to this main transportation network (Figure 3). The fact that public transportation vehicles are only on the main axis is positive in terms of reducing air and noise pollution. Vehicle roads are positioned to serve education and administration buildings. The vehicle road also provides opportunities for pedestrian transportation. There is a pedestrian access system on campus to building entrances, activity areas and dormitories (Kalayci Onac et.al., 2021). As Öner 1999 stated, pedestrian paths should carry pedestrians to assembly areas by providing uninterrupted circulation. Similarly, the pedestrian access in the campus area provides access to the assembly areas. However, although the festival area on the campus is sufficient in terms of use, it has problems in terms of transportation. The separation of pedestrian and vehicle roads is not clear. When the safety of pedestrian roads at night is examined, while night lighting is sufficient for areas with intensive use, the access roads on secondary roads, especially dormitories, are not sufficiently illuminated.

**Figure 3.** Structural components in the KTU Campus area (roadside parking lot).

There is no bike path on campus. This type of transportation vehicles come to the fore in sustainable planning approaches that provide great convenience in transportation and aim to reduce motorized transportation vehicles from the most important ecological trend to pedestrianization. The use of the BinBin Scooter, which is used as an alternative to cycling on campus and in the city, has also become widespread. The scooter, which provides pleasant, environmentally friendly and fast transportation to the campus, is also economical. However, the KTU Campus area does not have a suitable transportation network for scooter use. Using vehicle roads poses a security threat. It is aimed to reduce the use of vehicles, which is considered as an ecological planning approach, to increase the possibility of public transportation and to reduce carbon dioxide emissions with pe-destrian-oriented transportation. For this purpose, vehicle use should be reduced, espe-cially in campuses where pedestrianization would be most appropriate.

The other structural component is parking areas. Türeyen (2002) states that the parking areas within the campus should be in suitable numbers in suitable areas where vehicle roads and pedestrian roads meet (Figure 4). Similarly, the campus area is arranged near the educational buildings and in connection with the pedestrian paths. However, the parking areas on the campus do not meet the number of academic and student vehicles. Vehicles are parked along the main transportation axis of the road. This situation negatively affects the constantly flowing traffic, pedestrian transportation, bicycle and scooter use.

**Figure 4.** Structural components (pedestrian, bicycle and scooter transportation) in the KTU Campus area.

Within the scope of the study, completing the deficiencies of the structural components of university campuses in line with the ecological design principles would contribute to the spatial sustainability of the campuses (Telli & Aydın, 2024). Elements such as open and green areas, water elements, vehicle-pedestrian circulation systems, and building density stand out among the structural components on university campuses. Each of these elements has been seen to play a critical role in energy efficiency, conservation of natural resources, biodiversity, and user health, which are the basic principles of ecological design. Studies on this subject have been conducted in the literature. Interest in applying ecological planning principles to educational areas such as campuses has increased. Açıkay, 2025 and Ardıçoğlu et.al., 2024, especially in the studies carried out on the campus scaleemphasized the necessity of correlating spatial criteria such as ecological infrastructure, green area continuity, and building-green ratio. Yılmaz & Askan (2024) stated that green infrastructure on campuses is essential not only for aesthetics but also for increasing microclimatic comfort and supporting ecosystem services. As a result of the study conducted by Kawali (2021), it was seen that the widespread use of pedestrian-first transportation networks throughout the campus was effective in reducing the carbon footprint. Orenstein et.al., 2019 emphasized that many existing campuses are under urban growth pressure and that sustainable land use and transitional zoning strategies should be developed for their structural components. In this direction, this study revealed the necessity of conducting user experience-based evaluations

by considering the structural elements of campus areas quantitatively and qualitatively. It was argued that campuses should be evaluated not only as educational areas but also as an active part of the urban ecosystem. While this approach requires rethinking ecological design in the context of structural components, it also reveals the importance of multidisciplinary collaborations in campus planning.

***Plant applications:*** In ecological landscape design criteria, the selection of species used in plant designs, healthy, well-grown, very little maintenance and application methods gain importance. Because the plant elements in the open green areas soften the climate of the city, provide permeable floors, and add an aesthetic dimension to the city. Vegetal designs should be planned sustainably, and the existing vegetation should be preserved and continue in accordance with the new designs. In herbal designs to benefit from the sun in winter; broad-leaved and dense-textured trees, evergreen, dense-textured tree-tree and shrub groups that aim to save energy by creating a shadow effect in summer should be used in plant designs. Climbing and climbing ivy species on the walls, gradual vegetation and creating a shielding effect for the winds provide heat gain (Birişçi et al., 2012). To cut the wind; Designs that are dense and sequential in the direction of the blowing wind, taking into account the seasonal prevailing wind directions, forming mounds and hillocks should be included (Alpay et al., 2013).

**Figure 5.** Plant applications in the KTU Campus area.

Kaya Şahin et al., (2020) determined that there are natural plants with high value in their study of plant taxa on campus. However, according to the study, the number of exotic plants was found to be close to the number of natural plants. In the study of Güneroğlu and Pektaş (2022) to determine the presence of edible fruit plants on campus (Figure 5), 46 different plant taxa with aesthetic and functional properties were identified. For this reason, nature-compatible plant groups should be preferred by giving place to more natural plant groups on campus. Because natural plant species do not require much maintenance, support sustainable design and are sensitive to current climatic conditions. At the same time, the water demands of natural plant groups are compatible with the climate of the region. Bayramoğlu (2016) examined the water demand levels of the plants in the main artery in accordance with xeric landscaping principles in KTU Kanuni Campus, and concluded that only 10 of the 53 plant species detected had low water de-mand, 13 had low/moderate water demand and 4 had high water demand.

Ecologically, one of the appropriate design criteria in plant applications is the selection of plant species that consume less water (Çorbacı & Özyavuz, 2024). Grass areas are the most consuming plant in landscaping applications. In the study conducted by Bayramoğlu (2016), she stated that grass mixtures are used extensively in herbal applications on campus. For this purpose, alternative species suitable for landscaping in terms of aesthetics and functionality should be preferred instead of these species. As an alternative to grass, instead of large grass surfaces, mulch, rubber, colored stones and glass shards can be used to cover the soil surface by keeping it moist. In terms of water management, applications that use and store water on campus and then use in open green areas should be preferred.

This study has revealed that plant applications should be evaluated in line with ecological design principles to contribute to spatial sustainability and ecosystem services on university campuses. Scientific studies, especially those on a campus scale, have also emphasized the importance of plant applications in campus system services.

Sarı & Karaşah, in their 2023 study, evaluated the ecosystem services provided by 147 woody plant taxa used in campus landscaping. The study revealed that campus plants provide cultural services such as air quality regulation, erosion control, pollination, aesthetic values , and education. Özdemir, in his 2024 study, showed that plant practices are essential in increasing spatial quality in an analysis conducted in the context of biophilic design principles on various university campuses in Türkiye. Tuna (2006) proposed a conceptual model for sustainable landscape planning on campuses. In the model developed within the framework of the green design approach, plant practices were evaluated in terms of their water management, energy saving, and habitat creation functions. These studies show that integrating plant practices with ecological design principles on university campuses can increase environmental sustainability, user satisfaction, and education quality. Considering factors such as local climate conditions, water consumption, maintenance requirements, and aesthetic values in planning plant arrangements will contribute to creating sustainable and functional campus areas.

***Hard floor applications:*** Material selection and design features of floor coverings also gain importance in ecological planning approaches. Floor coverings cause the surface temperature to increase even more in hot regions.

For this reason, it also increases the urban heat island effect in spaces. For this reason, it is necessary to prefer to use materials that will reflect and absorb heat, especially in hot climatic regions. In humid and rainy areas, permeable floor coverings should be used to prevent surface water flow. Especially in these regions, the use of grass joint coating is appropriate. Since the study area is located in a rainy climate zone, permeable materials that prevent surface water flow and bring water together with underground water resources should be used. From this point of view, the campus area is insufficient in terms of permeable flooring materials. Vehicle roads are asphalt and walking paths consist of cobblestones. In certain periods when precipitation is high, water flows from sloping elevations and accumulates on vehicles and walking paths and threatens security (Büyükkurt, 2019).

In terms of environmental sustainability and user comfort on university campuses, hard floor applications should be integrated with ecological design principles. The widespread use of hard surfaces with impermeable materials causes problems in rainwater drainage, increases the heat island effect, and negatively affects biodiversity (Ardıçoğlu et al., 2024). At this point, applications such as sustainable material selection and permeable surface use are of critical importance in terms of the ecological performance of campuses. Hersek & Korkut, (2021) examined the xeriscape approach on the Tekirdağ Namık Kemal University campus and stated that microclimatic comfort decreased and green area continuity was disrupted due to the high impermeable rates of hard surfaces. In this study, it was suggested that permeable paving materials be spread by ecological design principles. Ak & Apaydın (2022) evaluated the hard floor covering materials used in landscape architecture according to visual impact and naturalness criteria and revealed the effects of user perception on material selection. This evaluation draws attention to the importance of a hard floor design that meets functional but also aesthetic and psychological needs. Açıkay emphasized the functional roles of hard floors in terms of user orientation, spatial definition, and pedestrian circulation in his study conducted in 2015, and stated that these components should be planned together with the plant texture and within ecological integrity. Finally, in the study of Ardıçoğlu et al. (2024), different campus typologies were compared regarding sustainability criteria, and the distribution of hard floors throughout the campus was evaluated regarding accessibility and water permeability. In this study, it is recommended that the rate of hard floors in campus design be reduced and natural materials used. These studies show that hard floor applications play critical roles not only in terms of spatial comfort and orientation functions, but also in terms of microclimate regulation, water cycle management and visual quality. Therefore, permeable, natural and user-friendly hard floor strategies that support ecological design on university campuses are indispensable for achieving sustainability goals.

## CONCLUSION

Urban ecosystems are environments that construct the nature-human relationship in a heterogeneous and dynamic structure. Cities are spatial structures in which the foundations of sustainability are processed, and ecological functions are included in the design concept. Process and harmony are important in spatial planning for ecological functions to reach abiotic, biotic and cultural goals (Ahern, 2007).

Campuses are compact spaces of cities where natural and cultural elements come together. For this reason, it should be included in the planning with a holistic approach as a part of the cities, not separately from the cities. Campuses for educational purposes should be provided with opportunities where nature education can be practiced. For this purpose, campuses are also described as natural exhibition areas. When campuses are evaluated according to ecological criteria, they should be handled according to campus design components. Structural components, hard ground and vegetative applications should be planned and applied in this sense. In terms of architecture, energy use in buildings, plant preference suitable for the climate and floor coverings should be preferred.

Considering transportation from an ecological point of view, it is necessary to in-crease transportation with public transportation, reduce the use of private vehicles, and encourage users to use pedestrianization and bicycles. For transportation purposes, ed-ucation and management institutions should be designed in accordance with pedestrian transportation. For the ecological planning approach, facilities should be provided for non-motorized vehicles such as walking and bicycles. In order to save energy, the existing transportation route should be provided with ring services within the campus by in-creasing the public transportation opportunity, and the use of existing scooters should be made safe.

In addition to the presence of natural plants, natural plant species should be pre-ferred to reduce maintenance and cost costs in other planting designs. Water conservation approaches in cities should be adapted to campuses and supported for rainwater collection, storage and use in recreational activities.

Considering the intensity of use of campuses at all times of the year and every hour of the day, energy consumption is high. For this reason, energy use should be reduced, and renewable energy use should be supported. Wind, sun and rainwater should be used actively.

Reinforcement elements should be supported with solar panels, wind turbines and electricity generation should be provided in short-term use. Electrical energies to be used for lighting purposes should be evaluated within this scope. In addition, the use of water in the irrigation of open green areas should be provided from rainwater. Trans-portation is one of the most basic components on campuses. It is necessary for people to reach their desired destination safely and in a short time. For this reason, pedestrian, bi-cycle paths, wide structural grounds should be considered within the ecological im-provement model.

As a result; Measures should be taken to ensure energy efficiency in line with the principles of ecological campus planning.As the measures to be taken for this purpose provide energy savings during the operation process, they are capable of meeting the investment cost. While reducing energy consumption, which is one of the primary causes of global warming, ecological solutions will be obtained at the same time. As a result of the im-provement model developed on campuses, it will reduce the consumption of natural resources and preserve the qualities of existing resources. In the campuses, which are formed with ecological improvement activity targets, the targets of "energy efficient landscape design", "natural resource protection" and "bio comfort" are achieved.

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