International Journal of Sustainable Energy

ISSN: 1478-6451 (Print) 1478-646X (Online) Journal homepage: www.tandfonline.com/journals/gsol20

Assessment of the Yalova University Engineering Faculty Building using the B.E.S.T. green building certification system

Ozan Efe, Rabia Özdemir, Sena Işik, İlayda Durmuş & Ümit Ünver

To cite this article: Ozan Efe, Rabia Özdemir, Sena Işik, İlayda Durmuş & Ümit Ünver (2022) Assessment of the Yalova University Engineering Faculty Building using the B.E.S.T. green building certification system, International Journal of Sustainable Energy, 41:11, 1759-1777, DOI: 10.1080/14786451.2022.2109027

To link to this article: https://doi.org/10.1080/14786451.2022.2109027

Published online: 09 Aug 2022.

INTERNATIONAL JOURNAL OF SUSTAINABLE ENERGY
2022, VOL. 41, NO. 11, 1759–1777
https://doi.org/10.1080/14786451.2022.2109027

RESEARCH ARTICLE

Assessment of the Yalova University Engineering Faculty Building using the B.E.S.T. green building certification system

Ozan Efe [a], Rabia Özdemir [a], Sena Işik [a], İlayda Durmuş [a] and Ümit Ünver [b]

[a]Energy Systems Engineering Department, Engineering Faculty, Yalova University, Yalova, Turkey; [b]Mechanical Engineering Department, Engineering Faculty, Yalova University, Yalova, Turkey

ABSTRACT
Currently, there is no official green or sustainable built environment evaluation system in Turkey. When a certification is required for a building or a site, various certification systems are employed. To meet the demand, the Turkish Green Building Council released an evaluation system called B.E.S.T. in 2013. In this paper, the B.E.S.T. evaluation system is introduced as well as a sample application. The evaluation of the Yalova University Engineering Faculty Building using the B.E.S.T. evaluation system is presented. Field research was conducted and evidentiary documents were gathered in preparation. The study employed both analytical and field research methodologies in this regard. As a result of the study, Yalova University Engineering Faculty Building was assessed to be eligible for the lowest level certificate, the 'Approved' degree of the B.E.S.T. evaluation system. Furthermore, the results achieved with the B.E.S.T. were compared to those acquired previously with other green or sustainable building evaluation systems.

HIGHLIGHTS
- An exemplary set of the evaluation was performed for university campus buildings with the B.E.S.T. certification system.
- The conducted case study is one of the earliest samples of B.E.S.T. evaluations.
- A comparison of B.E.S.T. with LEED and BREAM is provided.
- The importance of establishing a local certification system has been discussed.

ARTICLE HISTORY
Received 9 April 2022
Accepted 29 July 2022

KEYWORDS
Green buildings; Zero Energy Building; B.E.S.T; sustainable built environment; energy efficiency

1. Introduction

Environmental crises, such as global warming and climate change, are on the agenda of almost the entire planet (Şentürk 2014; Satır Reyhan and Reyhan 2016). Most governments agree to agreements, such as the Paris Climate Agreement, and the Glasgow Climate Pact, and attend conferences and workshops, promising to adopt environmental policies for the following years (2016; Erten 2021). The main sources of these environmental issues are carbon and greenhouse gas emissions from energy use (Kılavuz 2015; Unver et al. 2020). Due to the greenhouse gas effect, global warming is thought to be at 1.1°C compared to the pre-industrial period and poses a danger to the future of the world (COP26 2021). The development of the civilisation results in an increase in energy consumption (Ersoy 2010; Yetkin 2015).

The building sector accounts for 40% of global energy consumption and that makes the sector a major contributor to the climate crisis (Sagbas and Başbuğ 2018; ODE Insulation; Özyurt and Karabalık 2009). Reducing greenhouse gas emissions with environment-friendly and sustainable

CONTACT Ümit Ünver umit.unver@yalova.edu.tr

building designs to solve this problem can be the most effective way (Şentürk 2014; Dalmaçyalı). Energy consumption in green buildings is recommended to be produced from renewable sources within or outside the site, as well as the effective and efficient use of energy (Dalmaçyalı; Bertiz et al. 2019). But today, investments in renewable energy sources are still high. Because of this, energy efficiency and sustainability studies should be targeted since it is 'the cheapest energy source' (Çengel 2018; Kuloğlu).

There are many green building certification programmes around the world. The popular ones are LEED (America), BREEAM (UK), DGNB (Germany) (Bertiz et al. 2019; Erbıyık et al. 2021). As geographic, cultural, and economic conditions vary according to region, the regional adaptation of certification systems provides a healthier application. Therefore, for instance, the BREEAM certification scheme assesses each region according to different parameters in the Netherlands, Norway, Sweden, Spain, and in international categories (İsmail and Mıhlayanlar 2013; Ürük and Külünkoğlu İslamoğlu 2019). Similarly, a system adapted for Turkey ensures a healthier assessment of candidate buildings and prevents international costs, reducing the detrimental effect on the Bertiz et al. (2019).

The green and/or sustainable building certification programmes have vital importance in reaching nZEB based on sustainable, ecological, and passive built environment goals, which are on the agenda of Europe in recent years (Mao, Lu, and Li 2009). For this purpose, detailed programmes, such as LEED, SBTool, and BREEAM, have significant effects on sustainable construction and building management processes in many countries (Ferreira, Pinheiro, and Brito 2014). While there are 46,538 BREEAM (The Green Building Information Gateway), 60,344 LEED (The Green Building Information Gateway)-certified structures in the world and there are only 23 B.E.S.T. certified buildings (Geçimli 2021; Turkish Green Building Council). The numbers show that the B.E.S.T. building evaluation system can be considered a candidate certification programme that needs development and dissemination (Bertiz et al. 2019; Deligöz, Kabak, and Aktan 2020).

Currently, there is no officially accepted evaluation system or standard in Turkey today. At the moment, related institutions study green building evaluation systems independently. Before implementing an official system, each proposed evaluation system should be scientifically discussed and compared with the alternatives. One of these evaluation systems is the B.E.S.T. green building evaluation system. This paper is unique and important as this is one of the first papers that introduce the B.E.S.T. The scope of this paper is to introduce and compare B.E.S.T. with alternative evaluation systems. The purpose of the paper is to create a forum about B.E.S.T. and to make suggestions for a better evaluation system by revealing the strengths and weaknesses of the system.

In this paper, B.E.S.T. (Ecological and Sustainable Design in Buildings (*In Turkish*)), which is a local certification system, proposed by CEDBIK, (Turkish Green Building Council) is introduced (Deligöz, Kabak, and Aktan 2020). First, the B.E.S.T. was presented, then the Yalova University Engineering Faculty building was evaluated using the B.E.S.T. system. Also, the evaluations of the same building with other green/sustainable assessment systems were compared. In this way, the variations of the evaluation systems in the same building have been shown. In this study, it is also aimed to create rich content as a guide for the B.E.S.T. evaluation system for future studies.

2. Green building certification systems

20% of CO_2 emissions, which are primarily responsible for greenhouse gases, are released from buildings (Topak and Pekeriçli 2021). Sustainability and efficiency concepts gained great importance and interest in our lives as a result of energy consumption and emissions that started to increase with the Industrial Revolution (Durak and Ayyıldız 2018; Ürük and Külünkoğlu İslamoğlu 2019). The sustainable built environment aims to provide efficient resource consumption throughout its entire lifecycle, while being environment- friendly and sustainable at the same time (Özaydın and Baz 2020). The sustainable built applications will result in a 24–50% reduction in energy consumption and a 33–39% reduction in CO_2 emissions (Republic Of Turkey Ministry of Industry and

Technology - Izmir Development Agency 2021). The improvements minimise damage to the environment and effectively support the goal of at least 15% energy savings in buildings, as outlined in the National Energy Efficiency Action Plan (Energy and Natural Resources Ministry 2021).

On the other hand, people spend nearly 87% of their time indoors (Klepeis et al. 2001). Carrying out all activities in buildings in comfortable, thermal comfort conditions (Kaynaklı, Unver, and Kılıç 2003a; Kaynaklı et al. 2003b) and in a healthy environment are indispensable conditions for building user satisfaction, work performance, and for relaxed mind (Yüksel 2005). Green building certification systems assess and promote the living conditions of all building users based on the ideal conditions they should have (Gökçen 2020).

To achieve this goal, countries have released their own certification systems. For example, BREEAM was developed in England in 1990 to assess buildings in energy, water, land-use planning, and administration. LEED was implemented in the United States in 1998, and concentrated on energy, water, and land use. DGNB was released in Germany in 2008 and focused on energy, land use, and administration (İsmail and Mıhlayanlar 2013; Ürük and Külünkoğlu İslamoğlu 2019). The SBTool system was introduced in Canada. This extremely flexible evaluation system is used to evaluate buildings or a site. SBTool evaluates a sustainable built environment, it is not a green building assessment system. After the system is adjusted according to the type of building, usage method and geography, the evaluation process is performed (Koç et al. 2021; Bahadiroglu et al. 2022). The general purpose of certification programmes is to control the consumption of primary natural resources, such as energy and water in buildings, to optimise land use, to ensure the comfort of the occupants, and to provide an environment-friendly building profile (Ürük and Külünkoğlu İslamoğlu 2019). A generalised comparison list is presented in Table 1 (Yurtçu et al. 2018).

3. The B.E.S.T. certification system

In Turkey, four seasons with variable climatic conditions can be seen at the same time. The country is densely populated with communities from different cultures (Balcı 2012). The local certification can be considered at the stage of evaluation, according to the other evaluation systems.

The B.E.S.T. certification system developed by ÇEDBİK has been prepared as a certification system that evaluates sustainability and brings different solutions according to the conditions of the country, in cooperation with academics, universities, and industry stakeholders (Yıldız 2019). The B.E.S.T. certification system has been proposed for Turkey. However, we recommend investigating its use in countries with similar climates. For example, the application we have presented in this paper is in the Marmara region of western Turkey. Therefore, it can be used in Mediterranean countries, such as Greece and Italy, or nearby countries such as Bulgaria. Although the climates of countries, such as Georgia, Azerbaijan, and Iran, are similar to that of eastern Turkey, the B.E.S.T. system should be carefully studied before being adopted.

Evaluation of B.E.S.T. within the scope of environmental, socio-cultural, and economic parameters can be seen in Table 2. B.E.S.T. certifies buildings at four levels; the lowest is 'Approved' and the highest is 'Excellent' according to the scores of the projects (Turkish Green Building Council 2019; Geçimli 2021). Certification levels, according to score ranges, are shown in Table 3 (Turkish Green Building Council 2019).

3.1. The evaluation/scoring method and description of the case study

The evaluation made within the scope of this study was performed by the Energy Systems Engineer experts, who are the authors of the article, and then approved by the project team in consultation. During the evaluation, the project team requested proof documents for each criterion. Evidence documents are invoices, photographs, and reports of information received from the authorities. Criteria evaluated over 1 point were considered as yes/no questions. Experts' weighted scores

Table 1. Comparison of building evaluation systems.

Evaluation systems Publish Date Origin	B.E.S.T. 2013 Turkey	LEED 1998 USA	BREEAM 1990 England	SBTool 1998 Canada
Certificate Types	45–64: B.E.S.T. Approved 65–79: B.E.S.T. Good 80–99: B.E.S.T. Great 100–110: B.E.S.T. Perfect	40–49: Leed Certificate 50–59: Silver Leed Certificate 60–69: Gold Leed Certificate 80+ Point: Platinum Leed Certificate	%30–%44: Pass %45–%54 Good %55–%69 Very Good %70–%84 Excellent %85–%110 Outstanding	−1 (negative) 0 (minimum practice) 3 (good practice) 5 (best practice)
SCORING CREDITS				
Innovation				
Innovation	+	+	+	+
Accredit Personnel	+	+	−	−
Location and Transportation				
Access to Public Transportation	−	+	+	−
Environmental Density	+	+	+	+
Maximum Car Parks	−	−	+	+
To Reduce Car Parks	+	+	−	−
Green Vehicles	−	+	−	−
Bicycle Facilities	−	+	+	+
Energy and Atmosphere				
Minimum Energy Performance	+	+	+	+
Low-Carbon Design	−	−	+	−
Renewable Energy	+	+	−	+
Energy Metering	−	+	+	+
Outdoor Lighting	+	−	+	−
Energy Efficient Equipment	+	−	+	−
Refrigerant Management	−	+	−	−
Greenhouse Gas Control	−	−	−	+
Climate Systems	−	+	−	−
Water Efficiency				
Water Consumption	+	+	+	+
Water Metering	−	+	+	+
Reduction of Water Leak	+	+	+	+
Water Efficient Equipment	−	−	+	+
Wastewater Reuse	+	−	−	−
Surface Water Flow	+	−	−	+
Sustainable Sites				
Impact on Biodiversity	−	−	+	−
Environmental Awareness	+	+	+	−
Restore and Protect Habitat	+	+	+	+
Indoor Environmental Quality				
Thermal Comfort	+	+	+	−
Quality Scenery	+	+	+	+
Fresh Air	+	+	+	+
Control of Pollutants	+	+	+	+
Shining Control	−	−	+	−
Tobacco Smoke Control	−	+	−	−
Acouistic Performance	+	−	+	+
Materials and Resources				
Environmental-friendly Material	+	+	−	−
Material Reuse	+	+	−	+
Local Material Use	+	−	−	−
Durable Material	+	+	+	−
Benefiting Existing Building Elements	+	−	−	−
Material Efficiency	−	+	+	−

(*Continued*)

Table 1. Continued.

Evaluation systems Publish Date Origin	B.E.S.T. 2013 Turkey	LEED 1998 USA	BREEAM 1990 England	SBTool 1998 Canada
Regional Priority				
Land Settlement	+	+	–	–
Disaster Risk	+	+	–	+
Impact on the Construction Site	–	+	+	–
Building Use and Maintenance Manual	+	–	+	–
Land Analysis	+	+	+	–
Ease of Maintenance	–	–	+	+
Congestion and Residence Structure Relationship	+	–	–	–
Land Reuse	+	–	+	–
Social Areas	+	+	–	+
Rainwater Management	+	+	–	+
Proximity to Urban Facilities	+	+	–	+

Table 2. Categories of the B.E.S.T. rating system.

	B.E.S.T. categories	Score
1	Integrated Green Project Management	9
2	Land Usage	13
3	Water Usage	12
4	Energy Usage	26
5	Health and Comfort	14
6	Material and Resource Usage	14
7	Residential Life	14
8	Operation and Maintenance	6
9	Innovativeness	2
Total		110

Table 3. B.E.S.T. score ratings.

Score range	Certıficate levels	Certıficate
45–64	Approved	
65–79	Good	
80–99	Great	
100–110	Perfect	

were used for criteria of 2 points and above. In scoring based on expert opinions, the team effort to score close to the lower limit as possible.

For example, the 'surface water' criterion is described as The amount of flow water transferred to the network after construction should not exceed the amount of flow water determined according to the design for 1 year 24 h and 2 years 24 h. The annual flow of water amount going from the project site to the network should be reduced by 20%. Soil loss should be prevented by drainage and control of flow waters. Within the scope of this criterion, the building scored 1 over 2 points because there is a surface water channel on the campus. However, since an evidence document could not be provided for '20% reduction of water discarded to network' no points were given. A total of 1/2 points from this criterion were deemed appropriate.

Of course, this study is not an official evaluation of certification application. Therefore, only the results are presented in the paper. We intend to present how an exemplary evaluation can be made and what approximate results can be obtained. So an official assessment of the faculty building may, of course, differ. However, the results obtained in this study give an idea about the feasibility of the application, its ease, and even the sustainability situation of the building as well as a brief comparison.

3.2. Advantages and disadvantages of the B.E.S.T. certification system

All green building systems used in the world have a common purpose to reduce the negative effects of the built environment on people and resources and to bring green buildings to the fore (Erten 2021). However, the most important advantage of B.E.S.T. is that it has been designed considering Turkey's geographical location, local climatic conditions, and legal regulations. For example, although LEED and BREEAM are internationally accepted green building evaluation systems, they cannot be as compatible as the B.E.S.T. system does with Turkish legislation (Kılavuz 2015; Unver et al. 2020).

In addition, the B.E.S.T certification system is local. This makes the certification fee more economical than other green building systems. Finally, because of the local certification, the certification income remains in the country, preventing international monetary flow (COP26 2021). The advantages and disadvantages of the B.E.S.T. certification system in various aspects are listed in Table 4.

4. B.E.S.T. main criteria

B.E.S.T. certification consists of 44 sub-criteria under 9 main headings seen in Table 2. Main titles and criteria are examined in this section.

4.1. Integrated Green Project Management

The Integrated Green Project Management Category, which is mainly at the beginning of the design step, focuses on the early cooperation approach. In this way, it aims to involve all stakeholders in the work, from the beginning steps, to act collectively on every issue, and focus on achieving the most successful result in design (Yılmaz, Arditi, and Korkmaz 2010). In the category, the integrated design criterion is mandatory. This category consists of 5 titles, and 9 points can be obtained when all criteria are completed. The criteria and scores in this category are given in Table 5.

Table 4. Advantages and disadvantages of the B.E.S.T. certification system.

Advantages	Disadvantages
A local certification programme.	Recognition and prestige are still low.
It promotes eco-friendly design in buildings.	There are only 23 buildings in the practice (Turkish Green Building Council).
It provides savings.	It requires extra workload, time, and materiality to carry out the procedures at the initial investment stage.
Including the pre-construction processes in the certification, it ensures that the entire building lifespan is at optimum consumption.	It is not yet a ready-to-use programme for structures such as schools and university campuses.
It provides healthy, comfortable, and social living spaces for all occupants of the building.	

Table 5. Definitions of criteria in the integrated Green Project Management category.

No	Score/BEST score	Criterion	Target
1	Prerequisite (Mandatory) 2/2	Integrated Design	To ensure that all actions required for the targeted green building performance are completed within reasonable time and costs, in an environment where experts on green building and sustainability designs work together.
2	1/2	Environmentally Responsible Contractor	To keep the effects of construction as low as possible and to develop construction organisation strategies that serve this purpose within the framework of social and ecological awareness.
3	0/3	Construction Waste Management	To provide active waste management aiming at preventing the environmental effects of the waste and debris that appears during the construction phase.
4	0/2	Noise pollution	To ensure noise precautions are taken during the construction in order not to disturb the environment.

The Faculty Building received 3 points out of 9 in this category and is suitable for development. The building has scored full points from the compulsory integrated design criterion because the prerequisite is contained in the laws on construction. Construction permits are not granted for unsuitable projects. The building scored 1 point from the criteria of the environmentally sensitive contractor but did not get a point from the construction waste management and noise pollution criteria. Since the construction phase of the engineering building is over, it is not possible to get more points in this category. However, appropriate construction management techniques can be developed, construction waste management can be ensured, and noise pollution can be prevented, together with the works of environment-friendly contractors for future constructions.

4.2. Land usage

The Land Usage Category aims to pay attention to the preservation of the existing environment in the built area. This category includes criteria about the building's layout on the land, the degree of disaster risks, population density, housing-structure relationship, the re-evaluation of the land, and the distances to other transportation points in the city. Thirteen points can be scored when all criteria in the Land Usage Category are completed. The criteria and ratings under this category are given in Table 6.

Yalova University Engineering Faculty Building (Figure 1) scored 5 points out of 13 in this category. It has scored full points from the density and housing-building relationship criteria, 1 point from the criteria of proximity to urban facilities, disaster risk, and settlement on the land, and failed to get a score from the land reuse criteria. Since the installation of this building has been completed, it is no longer possible to get more points from the category. But in the buildings to be built in the

Table 6. Definitions of criteria in the Land Usage Category.

No	Score/BEST score	Criterion	Target
1	1/3	Land Settlement	To create a balanced relationship between the direction of the land, slope, the prevailing wind directions, and the topographic situation in the choice of the residential area. To evaluate the urban ecology and natural resources as much as possible within the framework of climatic conditions, and to observe the ecological balance at the same time.
2	1/3	Disaster Risk	To keep the potential disaster damage at a minimum level.
3	2/2	Congestion and Residence Structure Relationship	This criterion aims to design living spaces by considering population/ building density during the design stage.
4	0/3	Land Reuse	To promote the preservation of undeveloped and unused lands by re-evaluating previously constructed lands.
5	1/2	Proximity Urban Equipment	To reduce travel times and frequencies by choosing a location as close as possible to other points in the city, thus reducing CO_2 emissions.

Figure 1. Photo of the Yalova University (by Mustafa Erkanat).

future within the university, measures to reduce disaster risk can be reduced, attention can be paid to land selection and settlement, and studies can be carried out to reuse previously built lands.

4.3. Water usage

The purpose of the Water Usage Category is to keep track of how much water is used and to suggest ways to reduce it. The goal of B.E.S.T. is to build a system that actively measures and reduces water use to the lowest achievable level. The scope of this category includes reducing water consumption, preventing losses, wastewater treatment and evaluation, and surface water flow. When all these criteria are met, 12 points can be scored. The criteria and ratings in the Water Usage Category are shown in Table 7.

The Faculty Building has received 4 points out of 12 in this category and is open to enhancement. It scored 2 points from the mandatory water use reduction criterion, wastewater treatment and evaluation received 1 point from the surface water flow criteria (Figure 2) but did not get any points from the water loss prevention criterion. In order to get higher score in this category, applications that will save water inside and outside the building can be increased. For example, the use of sensor faucets and grey water recycling or rainwater harvesting can be implemented (Kucukkaya et al. 2021). Apart from these, water consumption can be monitored periodically to prevent losses and leaks.

4.4. Energy usage

Consistent evaluation and optimisation of the building's energy performance is of great importance (Öztürk 2014). The criterion with the highest score among the criteria of the B.E.S.T. certificate is

Table 7. Definitions of criteria in the Water Usage Category.

No	Score/BEST score	Criterıon	Target
1	Prerequisite (Mandatory) 2/6	Reducing Water Use	Provide steps aimed at conserving water both within and outside the building, reducing consumption, and ensuring efficient use.
2	0/2	Preventing Water Loss	To actively monitor water consumption, to detect and prevent losses and leaks, and to minimise water waste.
3	1/2	Wastewater Treatment and Evaluation	To ensure efficient water use by promoting the treatment and reuse of wastewater within the building.
4	1/2	Surface Water Flow	To ensure the control of surface runoff water in terms of quantity and quality, thereby reducing the load created by groundwater and rainwater on the network.

Figure 2. The water channel for surface water control.

energy consumption. This category contains efficient energy use, renewable energy preference, exterior lighting, consumption of white goods, and elevators. When all criteria in this category are met, a total of 26 points can be obtained. The criteria and scores in the Energy Usage Category are shown in Table 8.

The Faculty Building has scored 11 points out of 26 in this category. It scored full points from the criterion for exterior lighting and elevators, and 2 points for renewable energy use. Six points were received from the energy efficiency criterion. According to prior assessments, the building's energy consumption profile was assessed as adequate for a score of 6 points (Küçükbingöl 2021). Previous studies provide plans to supply the energy needs of the institution from renewable sources and to model the energy consumption performance of the building with simulation applications, such as BEP-TR, HOMER, etc. (Kiliç et al. 2020). In addition, ensuring the implementation of efficient energy consumption practices in order to gain higher points from the related simulation applications will enable to gain a higher score in the Energy Usage Category and reduce the CO_2 emissions caused by the building. No points could be obtained from the category of energy-efficient white goods. There is no use of white goods in this building for education.

Table 8. Definitions of criteria in the Energy Usage Category.

No	Score/BEST score	Criterion	Target
1	Prerequisite (Mandatory)	Control, Commissioning, and Acceptance	To verify the compliance with the determined requirements, design principles, and technical specifications in the basic systems within the scope of energy. To ensure that the design, construction, and operation processes are carried out accordingly, in a way that will provide energy efficiency.
2	Prerequisite (Mandatory) 6/15	Energy Efficiency	Evaluation and reduction of the building's energy consumption and CO_2 emission without compromising comfort.
3	2/7	Renewable Energy Use	To reduce greenhouse gas emissions by utilising renewable resources in the energy supply.
4	1/1	Outdoor Lighting	To increase energy efficiency without sacrificing the desired visual comfort using appropriate technologies in lighting systems.
5	0/1	Energy Efficient White Goods	To prefer products that provide efficient energy consumption and thus to reduce CO_2 emissions.
6	2/2	Elevators	To encourage the elevators used in the building to be of energy-efficient standards.

4.5. Health and comfort

Buildings that reduce or eliminate damage to the environment, nature, and human health during the design, construction, and operation phases can have a positive impact on the climate and nature while also improving the quality of life without depleting natural resources (Şener Yılmaz). The B.E.S.T. certification programme, on the other hand, aims to create an efficient and healthy built environment for occupants. Health and Comfort Categores are examined in thermal comfort, visual comfort, fresh air, control of pollutants, and auditory comfort. When all criteria in this category are met, 14 points can be scored. The criteria and scores in the Health and Comfort Category are presented in Table 9.

The Faculty Building received 7 points out of 14 in this category. The building has received full points since the necessary fresh air intake is provided for the building users, while 2 points are received from the visual comfort and auditory comfort criteria. Since no study or document could be reached for the control of pollutants, no point was obtained. At the same time, an analysis should be performed according to the Fanger method for thermal comfort in the certification programme (Kaynaklı et al. 2003b; Turkish Green Building Council 2019). Since there is no simulation modelling of the building in this regard, no analysis was made with the relevant method, and the thermal insulation did not meet the relevant standards according to previous studies (Küçükbingöl 2021), a score could not be obtained from the thermal comfort criterion. Within the scope of visual lighting criteria, if artificial lighting is provided with LED applications instead of fluorescents, electrical energy savings are achieved (Demir et al. 2020). With the necessary arrangements, full points can be obtained from the Health and Comfort category.

Table 9. Definitions of criteria in the Health and Comfort Category.

No	Score/BEST score	Criterion	Target
1	0/3	Thermal Comfort	The verification of the thermal comfort requirements of the building by thermal modelling.
2	2/3	Visual Comfort	To ensure that the natural and artificial lighting used for visual comfort complies with the standards.
3	3/3	Fresh Air	The ventilation methods are used to ensure the fresh air supply and indoor air comfort. To observe the welfare of the occupants.
4	0/2	Control of Pollutants	To keep the pollutants that may arise from the materials in the building under control and to provide a healthy living environment to the occupants.
5	2/3	Auditory Comfort	To provide the acoustic performance of the building in accordance with the relevant standards.

4.6. Material and resource usage

Green building certification systems promote the sustainability of building materials. Sustainable building materials also make significant contributions to green buildings because they are recyclable or reusable, cause less harm to the environment during their lifetime and at the end of their life, reduce waste generation, and provide health and comfort to the occupant in the interior (Gökçen 2020). The B.E.S.T. certification system has analysed the category of material and resource use by dividing it into detailed subheadings. This category includes criteria related to the environmental friendliness of the materials used; the use of existing building elements, the reuse and recycling of materials, the choice of locally produced materials, and the use of durable materials. A total of 14 points can be obtained by fulfilling all criteria in the category. The criteria and ratings in the Material and Resource Usage Category can be seen in Table 10.

The Faculty Building scored 8 points out of 14 in this category. While it got full points from the criteria of Environmentally Friendly, Durable, and Local Material Use, it did not get any points from the criteria of Using Existing Building Materials. In order to get higher points in this category, waste of resources should be prevented in new renovations and increase the use of reusable, recycled, and durable materials.

4.7. Residential life

The Residential Life Category targets that the effects that will occur during the design and construction process of the building will contribute positively to the life of the individual and society, and to the environment. The B.E.S.T. certification programme targets universal buildings where all occupants have equal opportunities, regardless of physical factors or socioeconomic status. Fourteen points are obtained by fulfilling all the criteria in the Residential Life Category. The criteria and ratings in this category are presented in Table 11.

Although Yalova University Engineering Faculty Building is not considered a residence, it has been evaluated within this category and received a full score in Security, Art, Working From Home criteria, 0 from Parking Area because there was no study to reduce emissions, and 1 from Sports and Recreation Areas, Universal and Inclusive Design criteria. To provide a universal and inclusive design, there are textured walkways (Figure 3(A)) and wheelchair ramp (Figure 3(B)) inside and outside of the building. In order to get a higher score in this category, studies that will encourage reducing carbon emissions caused by transportation and applications to increase sports activities can be carried out.

4.8. Operation and maintenance

The main purpose within the scope of the Operation and Maintenance Category is to observe sustainable methods in the operation and maintenance processes of the structure, which was designed

Table 10. Definitions of criteria in the Material and Resource Usage Category.

No	Score/BEST score	Criterion	Target
1	3/3	Environment- Friendly Material	To ensure the use of materials whose entire lifetime has been analysed and the relevant environmental labels have been taken.
2	0/3	Benefiting Existing Building Elements	To encourage the evaluation of existing materials instead of new materials in order to prevent waste of resources and minimise waste.
3	0/3	Material Reuse	To prevent waste of resources and to ensure that recycled, renewable, and durable materials are preferred.
4	3/3	Local Material Use	To ensure the use of materials manufactured in the close environment in order to reduce the CO_2 emissions and resource consumption of the materials used in the logistics process.
5	2/2	Durable Material	Depending on the occupant's profile of the building and external factors, it consists of durable materials and provides protection inside and outside the building.

Table 11. Definitions of criteria in the Residential Life Category.

No	Score/BEST score	Criterion	Target
1	1/2	Universal and Inclusive Design	To ensure the well-being of all individuals within the building, including users with disabilities, children, elderly or restricted mobility.
2	2/2	Security	Pedestrian roads and building entrances provide safe conditions for users.
3	1/2	Sports and Recreation Areas	To contribute positively to a healthy life by encouraging the presence of sports fields in the building or neighbourhood and encouraging users to tend to these areas.
4	1/1	Art	Enabling the residents of the building to take part in art activities and providing the need for space and infrastructure for an integrated life with art.
5	2/3	Transportation	To reduce carbon emissions related to transportation using public transportation for long distances. Locating buildings close to public transportation lines to ensure that building users prefer carbon-free transportation such as walking or cycling for short distances.
6	0/2	Parking Area	To keep the parking area at an optimum level in order to reduce the preference for private vehicle use, thus reducing the carbon emissions related to transportation.
7	2/2	Working From Home	To create an environment with a suitable infrastructure for working within the building in order to reduce the time spent on transportation between the household and the working environment.

Figure 3. Textured walkways and wheelchair ramp.

and built with sustainable methods. Efficiency in energy and water consumption, air quality, building durability, and resource utilisation are important not only in the design steps but also in the operation and maintenance processes. The B.E.S.T. certification programme promotes actively operated, sustainable buildings that implement the recommendations available in the building's

Table 12. Definitions of criteria in the Operation and Maintenance Category.

No	Score/BEST score	Criterion	Target
1	2/2	On-site Waste Separation and User Access	It is to ensure that the wastes generated within the building are separated and collected according to their classes, then evaluated within the scope of recycling, and all users are included in this process.
2	0/1	Waste Technologies	It is the separation and storage of the wastes generated within the building in a clean and efficient way, and the recycling of these wastes within the building.
3	0/1	Building Use and Maintenance Manual	All users within the structure have knowledge and training in order to ensure efficient and active use.
4	0/2	Monitoring of Consumption Values	Establishing the systems needed for instant follow-up of the consumption in the building operation and ensuring that the necessary controls and measures are taken when uncontrolled consumption is achieved in this way.

use and maintenance manuals. Within the scope of this category there are four criteria: On-site Separation of Wastes and User Access, Waste Technologies, Building Use and Maintenance Manual, and Monitoring of Consumption Values. If all criteria in the Operation and Maintenance Category are fulfilled, 6 points can be scored. The criteria and ratings in this category are presented in Table 12.

The building is evaluated for these criteria and received 2 points out of 6 in this category. The building scored full points from the waste separation criterion. The recycling bins placed within the scope of the zero-waste project (Figure 4) are located in different parts of the building and are within the reach of all consumers in order to separate the consumed materials according to their types. Since the waste recycling process is not carried out within the building, there are no users

Figure 4. Waste recycling bins.

Table 13. Definitions of criteria in the Innovation Category.

NO	Score/BEST score	Criterion	Target
1	0/1	Innovativeness	To encourage the development of unique technologies, designs, and methods that will make a difference, under the umbrella of sustainability, excluding the literature and certification criteria.
2	0/1	Certified Advisor	Within the scope of B.E.S.T., it is to facilitate the certification process and to support the design requirements as well as to encourage it.

and maintenance manual of the building, and the consumption values are not monitored instantly with independent metres. In order to get more points in this category, the storage and recycling of wastes can be provided within the institution. More efficient and effective maintenance of the faculty building can be achieved by creating a building use and maintenance guide.

4.9. Innovation

Within the scope of the innovation category, the B.E.S.T. certification programme encourages the design of structures that adapt to developing technologies and have innovative ideas by collectively working with expert architects, engineers, and contractors. The category encourages the realisation of projects that will make a difference within the scope of sustainability. If all criteria in the Innovation Category are met, 2 points can be scored. The criteria and scores in the Innovation Category are listed in Table 13.

The Faculty Building did not get any points in this category since there is no study on innovation and there is no approved consultant. In order to get more points, up-to-date technologies and innovations can be followed and integrated into the faculty building. Academic studies can be provided within the university, and B.E.S.T. Employing an approved consultant for certification can also provide extra scores.

5. Discussion

In this paper, the Yalova University Engineering Faculty Building was evaluated within the scope of the B.E.S.T. certificate system. Energy efficiency, electronic and mechanical systems, water conservation, environment-friendly design, material and resource utilisation profiles, and human health and comfort were all taken into consideration during the evaluation.

The building has scored 49 points within the scope of the B.E.S.T. certification system, and it was evaluated that it could receive an 'APPROVED' certificate like the other 23 buildings in practice (Turkish Green Building Council).

The score can be increased by implementing solutions and recommendations given under the Case study to improve the 'APPROVED' grade of assessment. Especially, it has been determined that the score can be increased to 74 and a 'GOOD' certificate can be obtained if water losses are prevented, wastewater treatment and evaluation, increasing the use of renewable energy, increasing the use of sports and recreation areas, arranging the parking area, creating the building usage and maintenance guide, instantaneous follow-up of consumption values.

The main problem encountered during the study can be summarised as follows. B.E.S.T. is a Housing certification system and it is not suitable for the evaluation of structures such as universities and faculties. B.E.S.T. green building systems are divided into residential and commercial buildings. And according to the statement that buildings such as schools cannot be evaluated in commercial building type (Kucukkaya et al. 2021), we have considered the faculty building as the housing assessment. Within the scope of B.E.S.T., applying a different type of certification on behalf of schools, campuses, and public buildings provides a more accurate evaluation.

However, it has been observed that the B.E.S.T. certificate, which has been implemented, is very similar to the LEED certification programme, which is the most widely used today and published by the American Green Building Council in 1998 (Ürük and Külünkoğlu İslamoğlu 2019). The most important reason for the similarity is that the B.E.S.T. certification system is typically based on an earlier version of the LEED system (Turkish Green Building Council 2020). Although there are many similarities between these certification programmes, there are some differences.

In Table 13, the evaluations of the Yalova University Engineering Faculty Building with B.E.S.T. and LEED certification systems are compared. It was seen that the criteria of both systems were similar to each other. The reason is most of the certification systems employed around the world are considering similar themes such as environmental, economic, and socio-cultural (Geçimli 2021).

However, the points of view of assessment systems differ from each other. To illustrate this difference, Table 14 provides very valuable benchmark parameters. Please note that the score for each criterion in Table 14 is given as a percentage so that the systems are comparable to each other. The criterion that we clearly see the difference in the perspective of the evaluation systems is the ‘Location’ criterion. BEST scored 38.5 in the location criteria, while LEED scored 75. This high score difference highlights the difference between the perspectives of both systems. The reason for the 36.5% difference in the location criteria is the difference in the evaluation mechanics of the certification systems. The B.E.S.T. certification system focuses on technical issues, such as the direction of the land, slope, prevailing wind directions, disaster risk assessment, and recycled/reused material. On the other hand, the LEED system evaluates more socio-cultural focus on human and community life. Since the evaluated faculty building is not a recycled/reused building, it has a disaster risk plan or the land conditions were evaluated during the design phase, the building scored a low grade from the B.E.S.T. evaluation. But the LEED score is high because the building provides easy access to the city centre, bicycle opportunities, an open air environment, and access to natural life. These evaluation differences reveal the 36.5% score difference. This also proves that evaluation systems differ in various ways. In this case, the building gets the minimum score from both evaluation systems, which also proves that a sustainable building can achieve high scores from any evaluation system.

There is a slight difference of 6% in the water criterion. The building received no score in the LEED study, and while utilising the recommendations 90.9% criterion success could be achieved with 10 out of 11 points. However, 3 points were scored from this criterion because an open canal application for surface water was provided. In this criterion, scoring 3 points corresponds to 27.3%. LEED scoring is in somewhat good agreement with the B.E.S.T. score, with a difference of 6%.

In the Energy category, there was a 14.3% difference between BEST and LEED evaluation systems. The reason for the difference is that a preliminary study was made on the use of renewable

Table 14. Comparison of certification systems in percentage.

Crıterıa	B.E.S.T. score	LEED score (Erbıyık et al. 2021)
Integrated Green Project Management	33.3/100	–
Location	38.5/100	75/100
Water	33.3/100	27.3/100
Energy	38.5/100	24.2/100
Interior Quality	50/100	62.5/100
Material and Resource	57.1/100	23.1/100
Residental Life	64.3/100	–
Operation and Maintenance	33.3/100	–
Innovation	0/100	0/100
Sustainable Sites	–	58.3/100
Regional Priority	–	100/100
Total Score	44.5/100	49.1/100

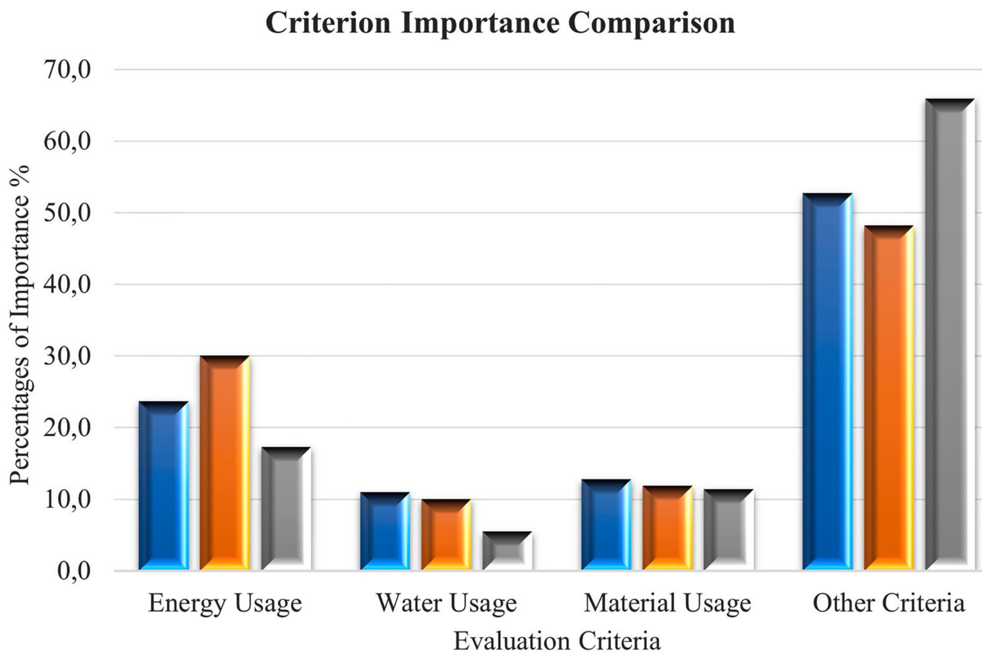

Figure 5. Importance of comparison of certification systems criteria.

energy during the project phase of the building. Although this preliminary study was not implemented at the project stage, it was deemed appropriate to give 2/7 points from the renewable energy criteria according to the B.E.S.T. However, this criterion is not scored according to the LEED system.

The reason for the 12.5% score difference in the indoor quality criterion is that no points were received from the categories of thermal comfort and control of pollutants in the B.E.S.T. evaluation. In the LEED evaluation system, it was stated that the thermal conditions within the building were relatively provided, and a score was achieved. The reason for not getting points in the B.E.S.T. study is not the lack of thermal comfort, but the fact that although analysis with the Fanger method is required for this category, no analysis has been made. Moreover, according to previous studies (Küçükbingöl 2021) the building could not get a score from this criterion because it did not meet the relevant insulation qualifications of the TS-825 standards. However, the lack of access to information or documents on the control of pollutants is one of the reasons for the difference.

The reason for the 34% difference in the material and resource criteria is unlike the B.E.S.T. evaluation, LEED was carried out across the campus. Since the Energy Systems Engineering and School of Foreign Languages buildings are built from recyclable materials, it was deemed appropriate to receive a high score, resulting in a 34% difference.

The differences in Figure 5 are because certification systems are created in different geographical and cultural conditions. Despite this, it can be said that there is a similarity between all systems.

In the innovation criterion, it was observed that both evaluation systems were not scored the building since there is no project, study, or document reachable throughout the university.

As a result of the compared common and non-common criteria, there is a 4.6% difference between the overall score of the two assessment systems. This small difference reveals the similarity of the certification systems. On the other hand, the personal and expert opinions of the evaluators may differ. However, it can be said that both evaluations are in good agreement. The percentages of some differences in the scoring mechanics and criteria of the certification systems are presented in Figure 5.

6. Conclusion

In this article, the BEST green building evaluation system proposed by CEDBIK was introduced and a sample application was made. The following results were concluded in the study:

1. The investigated system has similarities with the LEED certification system. However, there are local and legislative differences.
2. The building evaluated in the study received 49 points. This score corresponds to the lowest level of the BEST certification system.
3. This result is a satisfactory result for the evaluated building. But it is not an official evaluation. It provides an example of an application.
4. The BEST system is not suitable for educational buildings. Therefore, it was recommended to develop the BEST system for building constructed for different purposes.

In future studies, it is recommended to examine and propose new versions of the BEST certification system for buildings built for different purposes. The proposed system should have normal and detailed versions and the evaluation system should be adjusted according to the purpose, scale, and location of the building similar to the SBTool.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Ozan Efe http://orcid.org/0000-0003-3399-5174
Rabia Özdemir http://orcid.org/0000-0002-8207-3857
Sena Işik http://orcid.org/0000-0003-0341-6899
İlayda Durmuş http://orcid.org/0000-0002-8465-1040
Ümit Ünver http://orcid.org/0000-0002-6968-6181

References

Bahadiroglu, A., A. Y. Koç, E. Parlak, N. Larsson, W. Kujawski, and U. Unver. 2022. “Sustainable Building Evaluation: A Case Study.” *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects* 44 (2): 3149–3163.

Balcı, A. 2012. “A Qualitative Research on Teaching Turkey’s Geographical Features with Descriptive Activities.” *Marmara Journal of Geography* 0 (26): 215–258.

Bertiz, D., I. Ekşi, M. Tokmak, D. Özbey, M. Ak, and A. Güneş. 2019. “Comparison of International and National Green Building Certification Systems in Terms of Green Infrastructure (In Turkish).” *Landscape – Journal of Education, Science, Culture and Art* 1 (2): 31–39.

Çengel, Y. June 2018. “Energy Efficiency as an Energy Source,” [Online]. Accessed December 2021. http://www.yunuscengel.com/enerji-kaynagi-olarak-enerji-verimliligi/.

COP26. 2021. “Glasgow Climate Pact,”.

Dalmaçyalı. “Zero Energy Buildings to Decrease Carbon Emissions,” [Online]. Accessed November 2021. https://www.turkiye.zerobuild.org/decrease-carbon-emissions.

Deligöz, D., S. Kabak, and Aİ Aktan. 2020. “Analysis of Green Building Certification Systems Used in Residential Buildings in Turkey, Context of the Resource Conservation.” *Grid Journal of Architecture, Planning and Design* 3 (2): 222–245.

Demir, H., G. Çiraci, R. Kaya, and U. Unver. 2020. “Energy Efficiency in Lighting: Yalova University Engineering Faculty Case Study.” *Uludağ University Journal of The Faculty of Engineering* 3 (25): 1637–1652.

Durak, Ş, and S. Ayyıldız. 2018. “Evaluation of Daylight Benefit Performance of Houses in Terms of Comfort and Health Within the Scope of Çedbik Housing Certificate: The Case of Istanbul Pendik.” International Marmara Science and Social Sciences Conference, Kocaeli/Turkey.

Erbıyık, H., T. Çatal, S. Durukan, D. G. Topaloğlu ve, and U. Unver. 2021. “Assessment of Yalova University Campus According to LEED V.4 Certification System.” *Environmental Research & Technology* cilt 1 (4): 18–28.

Ersoy, A. Y. 2010. "Energy Consumption in the Context of Economic Growth (In Turkish)." *Akademik Bakış Dergisi* 20: 1–11. https://www.acarindex.com/dosyalar/makale/acarindex-1423868216.pdf

Erten, D. 2021. "All Roads Lead to Carbon and Now is the Time for Action!." *GreenBuilding Sustainable Building Technologies Magazine* 54: 20–22.

Ferreira, J., M. D. Pinheiro, and J. Brito. 2014. "Portuguese Sustainable Construction Assessment Tools Benchmarked with BREEAM and LEED: An Energy Analysis." *Energy and Buildings* 69: 451–463.

Geçimli, M. 2021. "Comparative Analysis of Green Building Certification Systems in Sustainable Design: BEST-DGNB (In Turkish)." *Online Journal of Art and Design* 9 (4): 28–37.

Gökçen, T. 2020. *Investigation of Construction Material Sub-Category in Green Building Certification Systems and the Situation in Turkey (In Turkish)*. Bursa: Bursa Uludag University Institute of Science and Technology.

The Green Building Information Gateway. "Breeam Buildings," [Online]. Accessed May 2022. https://www.gbig.org/collections/14564.

The Green Building Information Gateway. "Leed Buildings," [Online]. Accessed May 2022. http://www.gbig.org/collections/14544.

İsmail, S., and E. Mıhlayanlar. 2013. "Evaluation of National and International Model Buildings with Energy Efficiency and Green Building Certificate in Buildings (In Turkish)." 11th National Plumbing Engineering Congress, İzmir.

Karakaya, E. 2016. ""Paris Climate Agreement: Its Content and an Evaluation on Turkey," Adnan Menderes University." *Journal of Social Sciences Institute* 3 (1): 1–12.

Kaynaklı, Ö, U. Unver, and M. Kılıç. 2003a. "Evaluating Thermal Environments for Sitting and Standing Posture." *International Journal of Heat and Mass Transfer* 30 (8): 1179–1188.

Kaynaklı, Ö, U. Unver, M. Kılıç, and R. Yamankaradeniz. 2003b. "Thermal Comfort Zones According to the Continuous Regime Energy Balance Model (In Turkish)." *Journal of Engineering Sciences, Pamukkale University* 8 (1): 23–30.

Kiliç, G. A., K. Al, E. Dağtekin, and U. Unver. 2020. "Technical, Economic and Environmental Investigation of Grid-Independent Hybrid Energy Systems Applicability: A Case Study." *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 1–16. Advance Online Publication. https://doi.org/10.1080/15567036.2020.1825565

Kılavuz, H. 2015. "Causes of Environmental Crisis and Seeking Solutions (In Turkish)." *Mülkiye Magazine* 39 (1): 277–279.

Klepeis, N. E., W. C. Nelson, W. R. Ott, J. P. Robinson, A. M. Tsang, P. Switzer, J. V. Behar, S. C. Hern, and W. H. Engelmann. 2001. "The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants." *Journal of Exposure Science & Environmental Epidemiology* 11 (3): 231–252.

Koç, A. Y., A. Bahadıroğlu, E. Parlak, and U. Unver. 2021. "Evaluation of Yalova University Engineering Faculty Building with SBTool." 6th International Conference on Smart and Sustainable Technologies (SpliTech), pp. 01-06.

Küçükbingöl, G. 2021. *Investigation of Meeting the Electricity Consumption of Yalova University with Photovoltaic Panels with a Zero Energy Building Approach (In Turkish)*. Yalova: Yalova University Graduate Education Institute.

Kucukkaya, E., A. Kelesoglu, H. Gunaydin, G. Kilic, and U. Unver. 2021. "Design of a Passive Rainwater Harvesting System with Green Building Approach." *International Journal of Sustainable Energy* 40 (2): 175–187.

Kuloğlu, H. "What is Energy Efficiency? What is Energy Saving?," [Online]. Accessed December 2021. https://www.entes.com.tr/enerji-verimliligi-nedir-enerji-tasarrufu-nedir/.

Mao, X.-g., H. Lu, and Q. Li. 2009. "A Comparison Study of Mainstream Sustainable/Green Building Rating Tools in the World." International Conference on Management and Service Science.

Energy and Natural Resources Ministry 2021. *National Energy Efficiency Action Plan 2017-2020 Development Report (In Turkish)*. Department of Energy Efficiency and Environment / Department of Planning and Inspection, 2021. https://enerji.gov.tr//Media/Dizin/EVCED/tr/EnerjiVerimlili%C4%9Fi/UlusalEnerjiVerimlili%C4%9FiEylemPlan%C4%B1/Belgeler/UEVEP2020gelisimraporenv2.pdf

ODE Insulation. "Zero Energy Buildings and Thermal Insulation," [Online]. Accessed November 2021. https://www.turkiye.zerobuild.org/reduce-energy-consumption.

Özaydın, E., and İ Baz. 2020. "Addressing the Green Building Concept in Urban Transformation Applications." *Journal of Technology and Applied Sciences* 3 (2): 203–215.

Öztürk, M. 2014. *Investigation of Energy Efficiency in Green Buildings and Building Energy Modeling (In Turkish)*. İstanbul: Istanbul Arel University Graduate School of Natural and Applied Sciences Department of Architecture.

Özyurt, G., and K. Karabalık. 2009. "Energy Efficiency, Energy Performance of Buildings and the Situation in Turkey (In Turkish)." *Turkey Engineering News* 5 (457): 32–34.

Republic Of Turkey Ministry of Industry and Technology - Izmir Development Agency. 2021. *Sustainability and Green Building Practices in the Construction Sector (In Turkish)*. İzmir: Izmir Development Agency.

Sagbas, A., and B. Basbug. 2018. "Energy Efficiency Practices on the Axis of Sustainable Development: Turkey Evaluation (In Turkish)." *Tekirdağ: European Journal of Engineering and Applied Sciences* 1 (2): 43–50.

Satır Reyhan, A., and H. Reyhan. 2016. "New Evaluations on the Causes, Consequences and Solutions of Global Warming (In Turkish)." *Homeland Politics Management* 11 (26): 1–24.

Şener Yılmaz, F. "Daylight Criteria and Performance Evaluation Methods in Green Building Design (In Turkish)." EcoBEAM- Ecological Building Energy Lighting Architectural Consulting Services, İstanbul.

Şentürk, S. H. 2014. "Green Building Tax Incentives: The Case of the USA and Implications for Turkey (In Turkish)." *Journal of Economic and Social Research* 10 (2): 89–102.

Topak, F., and M. K. Pekeriçli. 2021. "Interface Transformation Future Human-Building Interactions (In Turkish)." *Grid Journal of Architecture, Planning and Design* 4 (1): 38–52.

Turkish Green Building Council. «Certificated Projects "In Turkish",» [Çevrimiçi]. https://cedbik.org/tr/sertifikali-projeler.

Turkish Green Building Council. "Certified Projects (In Turkish)," [Online]. Accessed December 2021. https://www.cedbik.org/tr/sertifikali-projeler?quick_search = &type = 22&start_date = &end_date = &city = &district = &project_owner = &project_area_min = &project_area_max = &sort_key = certificate_date.

Turkish Green Building Council. 2019. "B.E.S.T – Housing Certification Guide Version2.0 (In Turkish)".

Turkish Green Building Council. 2020. "B.E.S.T. – Commercial Buildings Certification Guide Version1.0 (In Turkish),".Fız.

Unver, U., E. Adıgüzel, E. Adıgüzel, S. Çivi, and K. Roshanaei. 2020. "Thermal Insulation Applications in Buildings According to Climate Zones in Turkey (In Turkish)." *Journal of Advanced Engineering Studies and Technologies* 1 (2): 171–187.

Ürük, Z. F., and A. K. Külünkoğlu İslamoğlu. 2019. "Comparison of Breeam, Leed and DGNB Green Building Certification Systems in a Standard Residence (In Turkish)." *European Journal of Science and Technology* 15: 143–154.

Yetkin, E. G. 2015. "Comparative Analysis of Leed, Breeam and Dgnb Systems Energy Metrics in Existing Buildings (In Turkish)." 2nd International Sustainable Buildings Symposium, Ankara.

Yıldız, S. 2019. *Examination of Green Building Evaluation Certificate Systems in the Context of Design Aiming Sustainability in Interior Architecture (In Turkish)*. İstanbul: Istanbul Technical University - Institute of Social Sciences.

Yılmaz, B., D. Arditi, and S. Korkmaz. 2010. "Integrated Design System in High Performance (Green) Buildings (In Turkish)." 1st Project and Construction Management Congress, Ankara.

Yüksel, N. 2005. "A Study on Determination of Structural Comfort Conditions in Today's Public Institutions (In Turkish)." *Journal of Uludag University Faculty of Engineering and Architecture* 10 (2): 21–31.

Yurtçu, M., E. Küçükkaya, O. Kara, and U. Unver. 2018. "Comprehensive Review on Heat Pump Systems for Green Building Concept." Proceedings Book of 7th International Conference on Advanced Technologies (ICAT'18), Antalya.