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Research Article

INTERACTION BETWEEN THE LEED CERTIFICATED UNIVERSITY BUILDINGS IN ISTANBUL AND INTEGRATED DESIGN PROCESS

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Abstract

Energy certification systems are used to labeling or quality assurance for sustainable buildings on the planet. Different certification, organizations or associations used some parameters for evaluating the buildings. Product or system integrated design is an approach that brings together different actors across the life cycle, providing new perspectives early within the design process. The integrated design process is increasingly utilized in the building design and construction sectors because it brings immediate value to the method. The integrated design facilitates sharing the knowledge among stakeholders, optimizing project management and merchandise quality. the method also helps minimize unforeseen costs and issues later within the process. This study is aimed to form a comparative assessment on the interaction between integrated architectural design and therefore the sustainability certificates which are used for the evaluation of sustainable buildings. The research question of this study is how and in what level integrated architectural approaches and integrated building design processes are in interaction to impact categories of energy certification systems. Seven university buildings from Istanbul had been applied to the assessment of the interaction between the impact categories of the chosen energy certification system which was LEED within the case study with basic principles of the integrated design process. The results show us that there's a robust correlation between the integrated design process and high scores within the impact categories of LEED certificates in some basic categories.

Keywords: Energy certificates, integrated design, sustainable building, university facilities

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Araştırma Makalesi

İSTANBUL' DAKİ LEED SERTİFİKALI ÜNİVERSİTE BİNALARI İLE BÜTÜNLEŞİK TASARIM SÜREÇLERİ ETKİLEŞİMİ

Özet

Enerji sertifikasyon sistemleri, Dünyanın her yerinde sürdürülebilir binalar için etiketleme veya kalite güvencesi sağlamayı genel eğilim haline getirmektedir. Farklı sertifikasyon kuruluşları veya dernekler binaları değerlendirmek için bazı parametreler kullanıyorlar. Ürün veya sistemle bütünleşik tasarım, yaşam döngüsü boyunca farklı aktörleri bir araya getiren ve tasarım sürecinin başlarında yeni bakış açıları sağlayan bir yaklaşımdır. Entegre tasarım süreci, yönteme anında değer kattığı için bina tasarımı ve inşaat sektörlerinde giderek daha fazla kullanılmaktadır. Entegre tasarım, paydaşlar arasında bilgi paylaşımını kolaylaştırır, proje yönetimini ve ürün kalitesini optimize eder. Yöntem ayrıca süreç içinde daha sonra öngörülemeyen maliyetleri ve sorunları en aza indirmeye yardımcı olur. Bu çalışma, bütünleşik mimari tasarım ve dolayısıyla sürdürülebilir binaların değerlendirilmesinde kullanılan sürdürülebilirlik sertifikaları arasındaki etkileşim üzerine karşılaştırmalı bir değerlendirme oluşturmayı amaçlamaktadır. Bu çalışmanın araştırma sorusu, bütünleşik mimari yaklaşımların ve bütünleşik bina tasarım süreçlerinin enerji belgelendirme sistemlerinin etki kategorileri ile nasıl ve ne düzeyde etkileşim içinde olduğudur. Örnek olay incelemesi kapsamında LEED sertifikası kriterleri ile bütünleşik tasarım süreçlerinin temel ilkeleri ile değerlendirilmesi için İstanbul' dan yedi üniversite binası araştırılmıştır. Sonuçlar, entegre tasarım süreci ile LEED sertifikalarının bazı temel kategorilerdeki etki değerleri ile alınan yüksek puanlar arasında güçlü bir ilişki olduğunu göstermektedir.

Anahtar Kelimeler: Enerji sertifikaları, bütünleşik tasarım, sürdürülebilir bina, üniversite tesisleri

1. INTRODUCTION

Current technologies give more opportunities to integrate the processes of various works in several disciplines. The integrated architectural design process approach is one of the causes for this integration within the planning, design, construction phases of architecture and its stakeholder disciplines. Integrated Design Process (IDP) was utilized in the first 1990s, by Canada's C-2000 program and concepts Challenge competition to explain a more holistic approach to putting together design (Zimmermann, 2006). it's been shown that the planning process that works properly and in coordination with the stakeholders produces more important and efficient results than the investment made for construction. IDP describes a special, intentional way of approaching sustainable building and community design that gives away a higher likelihood of success than the other approach (Zimmermann, 2006). within the process of building design, the concept of sustainable development is additionally a development goal that architecture design must follow (Liu, 2018). Not only "integrated design processes" but also "integrated design solutions" are examined by researchers. As defined by CIB working party, Integrated Design Solutions use collaborative work processes and enhanced skills, and integrated data, information, and knowledge management to attenuate structural and process inefficiencies and to reinforce the worth delivered during design, build, and operation and across projects (Tatum, 2009). because it relates to green building, an integrated process may be a method used for the planning and operations of sustainable built environments. "What it boils right down to is getting everyone who is going to be involved within the project, from the planning phase to construction to the particular day-to-day operations, together right from the beginning to collaborate" (Green Building, URL.1.). Product or system integrated design is an approach that brings together different actors across the life cycle, providing new perspectives early within the design process. The integrated design process is increasingly utilized in the building design and construction sectors because it brings immediate value to the method. The integrated design facilitates information sharing early, optimizing project management and merchandise quality. the method also helps minimize unforeseen costs and issues later within the process. during this study, a correlation has been researched between the approaches to the integrated design process within the planning, design, construction, and usage processes and therefore the criteria of LEED certification of the university buildings in Istanbul. Seven university buildings in Istanbul, which have received LEED certification were considered to seek out this correlation. The research question during this study is defined as "is there any correlation between the evaluation criteria of green building certifications and integrated design processes within the evaluated buildings which has one among these certificates?" A more specific research question is: "Is there any correlation between the standards for LEED certification and therefore the integrated design process for the LEED certificated university buildings from Istanbul?" to look the answers to those two questions; theory and history, criteria, and structure of the integrated design process are considered within the following section of the article. within the second section of the article aims, the most criteria and fields of evaluation for various green building certification systems were explained and obtained the interactions between basic principles of the integrated design process and therefore the evaluation criteria of green building certificates. The methodology of the articles had been structured on the search of interactions by using statistical graphics and tables. this system applied to the seven specific university buildings which had LEED certificates.

2. MATERIALS AND METHODS

Integrated Design Process:

The Integrated Design Process (IDP) may be a method of intervention within the early stages of the planning process that supports the event and style team to avoid sub-optimal design solutions. IDP isn't a replacement concept and should be applied within the past by some design teams on an ad-hoc basis, but the formal implementation of the method may be a development that has taken place over the past 15 years. The integrated Design Process is 'a procedure considering and optimizing the building as a whole system including its technical equipment and surroundings and for the entire lifespan (Kanters, Horvat, 2012). The integrated design process had some principles for implementation in obtaining building planning, design, construction, and usage phases.

The IDP process requires six major principles:

1. Diverse team collaboration,
2. Well-defined scope, vision, goals, and objectives,
3. Open communication,
4. Innovation and idea synthesis,
5. Systematic decision-making,
6. The iterative process with feedback loops (URL.2.).

The integrative design promotes the collaboration of all participating groups. By working together, the team as an entire will have a far better understanding of the project and can start their work together within the predesign phases then still collaborate throughout the occupancy stage. With all members on an equivalent page from day one, lower costs, also as higher efficiencies, are often achieved. All groups involved a particular project should collaborate, including clients, architects, project owners, engineers, general contractors, and more.

Furthermore, project involvement should extend beyond the particular building to comprise neighboring buildings and residents, community officials, and native artists. By creating an outsized and eclectic community around a particular project, the general process is going to be stronger and more beneficial.

Many factors are considered when designing a building: mechanical and electrical systems, building occupants, sustainability efforts, overall climate, cost, and far more. With the utilization of an integrative design process, all factors are combined into four main areas: climate, use, building design, and systems. These areas are then analyzed by all team members to seek out synergies and similarities between them. By doing this, different strategies are often utilized to style a more healthy and energy-efficient facility. Integrated Design Process (IDP) is here understood as a management concept. Concepts encompass recipes, process tolls, and technology and vary globally, across countries and sectors (Koch, Buhl, 2013). The IDP process contains no radically new elements but integrates well-proven approaches into a scientific total process. the talents and knowledge of mechanical and electrical engineers, and people of more specialized consultants, are often integrated at the concept design level from the very beginning of the planning process (Larsson, 2009). In architectural processes, interactive and integrated teamwork between multidisciplinary teams ranging from the conceptual design level is extremely important for integrated design processes. Austin, Baldwin, and Steele (2002) suggested managing the planning process; “Integrated Collaborative Design” within the availability chain; and proposes information technologies to support “Planning and Managing the development Briefing Design and Construction Process” and style activity using “Analytical Design Planning Technique” as methodology. the quality quantitative tools used during charrettes are “Building Energy Simulations” and “Life Cycle Assessments” (Leoto, Gonzalo, 2019). The methodology for integrated design process wont to the similar methodology of building certification systems used as far as building energy consumption, the life cycle of materials analytical planning and style studies, and managing the development process.

In general, an integrated design process is an approach to putting together a design that seeks to realize high performance on a good sort of well-defined environmental and social goals while staying within budgetary and scheduling constraints. It relies upon a multi-disciplinary and collaborative team whose members make decisions together supporting a shared vision and a holistic understanding of the project. It follows the planning through the whole project life, from pre-design through occupancy and into operation (Roadmap for the Integrated Design Process). it's a general approach to hunting the balance between durability, usability, and wonder, which are three basic principles supported in the past in architectural studies. By the way, the well-known motto of recent architecture "Form follows function", today used as “form follows energy” - and presents a perspective of perceiving architectural changes, especially within the context of sustainable development. All members of the planning and construction team should be collaborative so that the architect isn't simply the form-giver, but more the leader of broader team collaboration with additional active roles earlier within the process. the need for holistic or systemic thinking because the environment as an entire is bigger than the sum of its parts, and even meaning to produce something that would be more economical, requires the design, design, construction, use, evaluation of stakeholders to figure together. It allows trade-offs so money is spent where it's most beneficial when a holistic solution is found. Zimmermann (2006) states that iterative work and former decisions should be taken under consideration to permit new information to tell or improve. Under the concept of sustainable development, the integrated design of buildings can effectively support the rapid development of architectural design processes (Liu, 2018). As a summary of all the above information, the

characteristics of the integrated design process are defined as follows. The integrated design process is:
- A goal-driven system with the first goal being sustainability.
- An accountable for the method of design.
- Structured to affect issues and decisions in the proper order.
- Clear decision-making for a clearly understood methodology.
- Inclusive for everybody, from the owner to the operator.

The integrated design of a building requires close coordination between different professional designers and follows a green design concept in terms of form, function, and price of the building must achieve a sustainable design approach (Liu, 2018). The building information model is a crucial part of the integrated design processes and their applications. The Building Information Model, abbreviated as "BIM", combines various geometric information and related functional requirements to compile all the knowledge in one construction project to make a comprehensive information management system. BIM is design software for integrated design, to satisfy the various design requirements within the integrated design process (Hanjong et.al., 2015) (Liu. 2018).

Integrated design processes used the building information modeling system which has the interactive components as architectural design, property management, project budget, construction management, structural design, equipment & energy, owner, contractor are the parameters and their interactions defined in Figure 1.

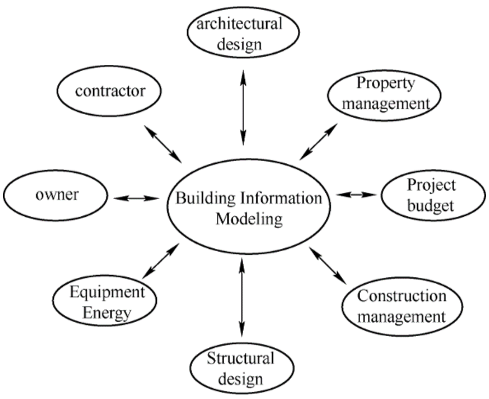


Figure 1. Building Information System for Integrated Design Process (Liu, 2018).

Hansen and Knudstrup (2005) stated that the integrated design process does not ensure aesthetic or sustainable solutions, but it enables the designer to control the many parameters that must be considered and integrated into the project when creating more holistic sustainable architecture to achieve better sustainable solutions because all the different parameters are considered during the process. The phases of integrated design processes have interaction between the actors and tasks defined in Figure 2. Clients' answers to questions, examples, surveys, site investigation, legal constraints, literature, experience are sources for a designer to define the brief as seen in the figure. The designers as the actors in the integrated design process work on the concepts, brief, sketches, and architectural design phases work with other partners about the financial issues and quantity surveying. The partners of the design team consist of interior designers, landscape architects, structural engineers, mechanical engineers, electrical engineers, specialist manufacturers, city planners, and these team members are in relation with architects. All these stakeholders work in a way of collaboration with the main design team and progress the different design and implementation projects and the related documents.

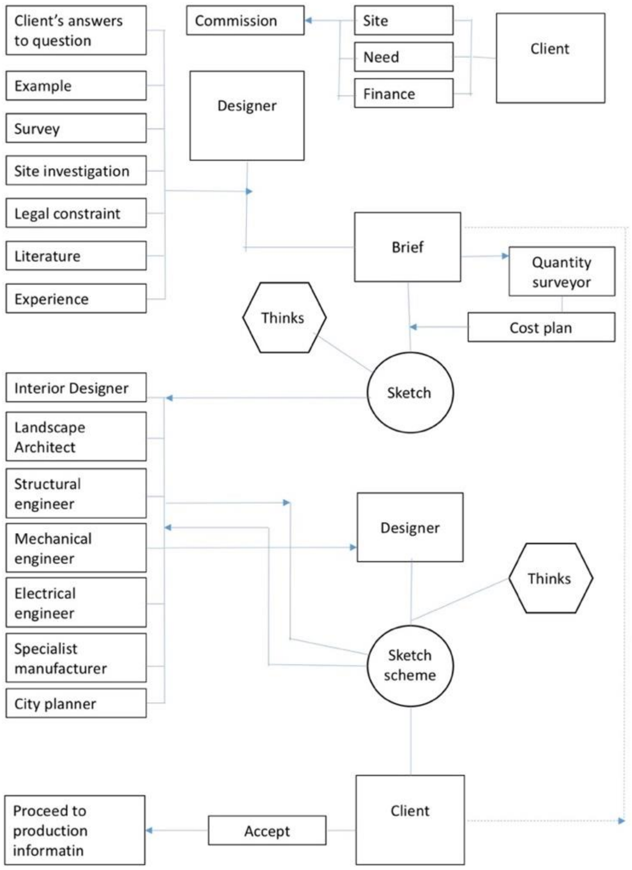


Figure 2. Relations between components of Integrated Design Process (Zunde, Bougdah, 2013).

The interaction between the integrated design process and therefore the green building or energy certification systems are evaluated within the following methodology section of the article by using the essential aims, criteria they applied, certification areas, scoring systems connected with basic principles of the integrated design process. Some findings insert within the matrix – table of interaction because the key component which was applied to the case study of university buildings in Istanbul Turkey.

Methodology, integration of "Integrated Design Process" into assessment systems for LEED certificated university buildings

Rating or rating systems are an important element in modern building design and evaluation. Most rating systems like LEED, BREEAM, Green Star, DGNB, HQE have started their existence as checklists of guidelines for designers, and although the stress has shifted to a more objective performance evaluation, they still play a crucial role during this respect. The objectives and criteria of green building certifications are listed in Table 1 to seek out the mixing points of the integrated design process and selected parameters of the certification systems criteria. As defined within the table of integrative thinking, sustainable sites and innovation criteria within the LEED system, innovation and management criteria within the BREEAM system, and management and innovation criteria within the Green Star system, design for all and current experts/survey reports and simulations within the DGNB system are found as criteria which interact with the integrated design processes.

Table 1. Aims and criteria of green building certificates

	LEED V4 **Leadership in Energy and Environmental Design**	**BREEAM** **Building Research Establishment Environmental Assessment Method**	**GREEN STAR**	**DGNB** **German Sustainable Building Council**	**HQE** **High Quality Environmental Standards**
	AIM: LEED certificate provides independent verification of a building or neighborhood' s green and sustainable features in different categories	AIM: BREEAM measures sustainable value in a series of categories, ranging from energy to ecology.	AIM: Green Star offers framework of best practice benchmarks for sustainability that you and the Marketplace can trust.	AIM The DGNB assesses buildings and urban districts which demonstrate an outstanding commitment to meeting sustainability objectives.	AIM: HQE certification covers the entire lifecycle of a building, non-residential buildings, residential buildings and detached houses as well as urban planning and development.
CRITERIA	1.(**Integrative Thinking**) 2.Enegry 3.Water 4.Waste 5.Materials 6.Location & Transportation 7.(**Sustainable Sites**) 8. Health and Human Experiences 9.Regional Impacts 9.(**Innovation**) 10. Global, regional, Local	1.Energy 2.Health and well being 3.(**Innovation**) 4.Land Use 5.Materials 6.(**Management**) 7.Pollution 8.Transport 9.Waste	1.(**Management**) 2.Indoor Environment Quality (IEQ): 3.Energy: 4. Transport: 6. Water: 7. Materials: 7. Land Use and Ecology: 8. Emissions: 9. (**Innovation**)	1.Indoor Air 2.(**Design for all**) 3.Legal requirements for fire safety and sound insulation 4.(**Up-to-date experts´/survey reports and simulations**)	
CERTIFICATION AREAS	Buildings Interiors Homes Building Operations and Maintenance Neighborhood Development	Commercial Healthcare Education Residential Industrial Retail (fashion and Durability)	Communities Design & As Built Interiors Performance	New offices Existing offices Residential buildings Dwellings, Healthcare Education facilities Hotels, Retail Assembly buildings Industrial, Tenant fit-out DISTRICTS Urban Districts, Office and Business districts, Industrial Locations, Event-areas	
SCORES	(**Sustainable Sites**) (26) Water efficiency (10) Energy and Atmosphere (35) Materials and Resources (14) Indoor environmental Quality (15) (**Innovation and Design**) (6) Regional Priority (4) Total (100+10)				

It is determined that the approaches for different green certifications by looking at the percentage of each measurement criterion that is related to the integrated design process, and investigate how the impact categories determined by this point of view are evaluated in buildings that receive LEED certification. For this, there is a percentage of the relevant criteria in the total. A correlation table is made for the related criteria of the green building certification system with the basic principles of the integrated design approaches. All the basic principles correlate with the LEED certification system as seen in Table 2.

Table 2. Interaction between basic principles of integrated design process and green building certificates

	Basic principles of Integrated Design Process					
	Diverse team collaboration	**Well-defined scope, vision, goals and objectives**	**Open communication**	**Innovation and idea synthesis**	**Systematic decision-making**	**Iterative process with feedback loops**
LEED	Integrative Thinking	Integrative thinking + Sustainable sites	Integrative thinking	Innovation	Integrative thinking	Sustainable sites
BREEAM		Management		Innovation		
GREEN STAR		Management		Innovation		
DGNB	Up-to-date experts´/survey reports and simulations	Design for all				
HQE	Comprehensive, multi-criteria approach that brings together all of the stakeholders of a project.				Project manage-ment support enables all project stake-holders to get involved and meet the goals set.	

Leadership in Energy and Environmental Design LEED is changing the way we think about how buildings and communities are planned, constructed, maintained, and operated. The impact categories developed for LEED v4 (version four-2009 new construction) are listed as a) Integrative thinking b) Sustainable sites, c) Water efficiency, d) Energy and atmosphere, e) Materials and resources, f) Indoor environmental quality, g) Innovation, h) Regional priority credits.

Assessment criteria of LEED and interaction with the basic principles of the integrated design process.

This section covers the interactions between the assessment criteria of LEED which listed in the following paragraphs and the basic principles of integrated design which are defined as a) Diverse team collaboration, b) Well-design scope, vision, goals, and objectives, c) Open communication, d) Innovation and idea synthesis, e) Systematic decision making, f) Iterative process with feedback loops

Integrative Thinking: Evaluation of the integrative thinking criteria of the LEED system interacts closely with various team collaborations, which is the basic principle of the first step of the design process. Bringing together people working as a team and with common goals and creating project teams within this framework saves valuable time and resources. Emerging requirements for Integrative Process development encourage and support the coordination of different buildings, building systems, and related processes. Strategies aim to integrate many components when evaluating the LEED certification system. Integration is also a priority for integrated design. Because LEED certification evaluates processes together with results, the impact of integrated design creates positive effects with the contributions of different actors at appropriate times. Integrative thinking is in principle a necessary criterion for green building certification. According to the LEED Project Team Social Impact Checklist, the stakeholder group for strong assessment is defined as; consists of community leaders, local experts, tenants/residents, public health professionals, government officials, business education organizations, local entrepreneurs and business leaders, educational/cultural institutions, local artists/designers. The same document also provides information on the importance of project team diversity, including the affected community, listening and collaboration within stakeholder groups, accessibility of all types of people with different abilities, the importance of communication, and the quality of visual representation. Integrative thinking has two distinct credits: a) Integrative project planning and design, b) Integrative process.

Sustainable sites: Strategies under the heading of sustainable sites, review the environmental decisions of the building or groups of buildings and evaluate the impacts by highlighting the vital relationships between buildings, ecosystems, and the proposed building-related services for ecosystem formation.

Water efficiency: In the Water Efficiency criterion, it evaluates water holistically, taking into account indoor use, outdoor use, specific water uses, and water use measurement. It includes measuring all water resources associated with a building, including cooling towers, appliances, fixtures, fixtures, process water, and irrigation Whole building-level water metering enables projects to monitor and control water use to identify water-saving opportunities. It also evaluates projects for solutions that promote water reuse, including recycled wastewater, gray water, condensate, process water, and rainwater for irrigation, toilet flushing, and more.

Energy and atmosphere: Certification processes that start with a focus on reducing energy demand and then rewarding renewable energies raise the bar for energy through guidance on its use and efficiency, and offer new solutions to meet targets. Evaluating the energy efficiency of the building with 20 percent of all points in the Energy and Atmosphere section, LEED studies put more emphasis on energy and related effects.

Materials and resources: LEED changes the paradigm of how decisions are made about the materials used in buildings, where we spend most of our time, and gives new insights to decision-makers. Usage, life cycle, and transparency are sub-titles of materials and resources. Rather than saying that a product is good or bad based on an attribute in terms of use within the materials and resources division, recycled content enables LEED project teams to engage in a more robust dialogue with manufacturers about optimizing environmental, social, and health. This section is designed to take into account the entire life cycle of buildings, from material extraction and manufacturing to transportation, operations, and maintenance, and ultimately to the end of their useful life. The purpose of the whole building life cycle assessment; is to encourage the architect to work with the structural engineer to explore opportunities to reduce the embodied energy of materials by correctly sizing the building's structure. As buildings become more operationally efficient, the materialized effect of materials increases proportionately. In the context of transparency, material content reporting tools such as environmental product statements and health product descriptions aim to provide architects and designers with more information about the content and production process in products. By providing this information, manufacturers can better distinguish and show their progress.

Indoor environmental quality: Buildings and spaces with good indoor quality protect the health and comfort of their occupants. High-quality indoor environments also aim to improve the use and exchange value of the building, increase productivity and sustainability. It aims to reduce the liability of building designers and owners to potential users.

Innovation: The most important feature of sustainable design strategies and measures is that they are continuously improved. Rapidly changing new technologies and developing current scientific researches with them affect the formation and evaluation of design strategies. The purpose of the innovation category is to evaluate the finding of solutions created for innovative building characteristics and sustainable building practices and strategies.

Regional priority credits: To address region-specific environmental problems in the assessments, different environmental priorities according to regions, determined with the support of experts in various regions, and evaluation measures addressing these problems have been determined. This includes monitoring the current LEED metrics that address regional problems specific to the location of buildings. Regional Priority credits encourage project teams to focus on local environmental priorities, and there are six LEED credits available for each location. LEED has become a common language of best practices in buildings around the world. In the new rating system, there is greater recognition of regional context with the incorporation of regional and local equivalent standards or programs used to achieve the same credit intent. Additionally, metric units have been included in all tools and resources. In this context, region priority credits highlight the region-specific handling of region-specific criteria by different experts as a team in terms of integrated design processes.

Waste: In the solid waste management hierarchy, the reduction of resources, reuse, recycling, and conversion of waste to energy are recommended and evaluated as the four preferred strategies for reducing waste. The materials and resources section directly addresses each of these proposed strategies, restructured and prioritized concerning solid waste management. Experts are expected to work together to construct solid waste management and to ensure the coordination determined in the integrated design processes for all proposals considered in this context.

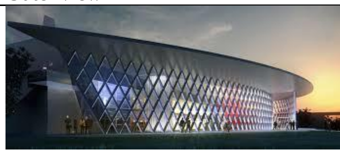
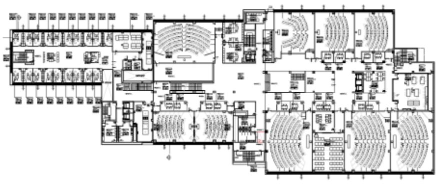
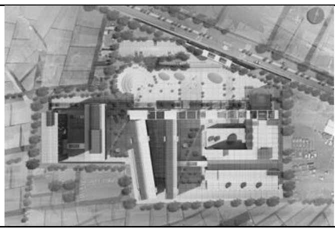
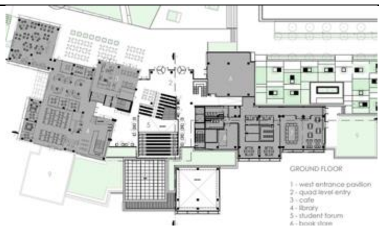
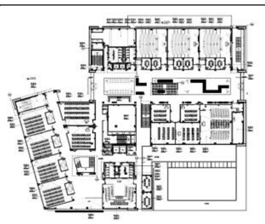
Location & Transportation: Choosing the right location is the first step in improving environmental performance. Proximity to existing services and transportation networks is important in terms of infrastructure and transportation costs for projects in choosing the right land. Being located in vibrant, habitable environments makes the building a destination for residents, employees, customers, and visitors, and provides a good model for future development by enabling occupants to contribute to the economic activity of the area. The section developed for the Location and Transport parameter includes an emphasis on more advanced performance metrics - walking distance instead of straight-line radius, number of trips instead of transit stops, absolute rather than relative parking requirements, and bike networks. bicycle storage is evaluated. The design team should work together with decision-makers, planners, local government officials, transportation experts.

3. RESULTS AND DISCUSSION

Energy Certificated University Buildings in Istanbul with Special Reference to Integrated Design Process

An assessment realized on the following university buildings which had LEED certificate between 2004 – 2014 focused on the different parameters, especially related to the basic principles of the integrated design process: Sabancı University NanoTechnology Center (Tuzla İstanbul 7137 m2, 2011), Özyeğin University Faculty of Engineering Building (Çekmeköy İstanbul, 20800 m2, 2013) Acıbadem University Faculty of Medicine Building (Ataşehir, İstanbul 32214 m2, 2014), Özyeğin University Student Center (Çekmeköy, İstanbul, 19838 m2 2013), Acıbadem University Vocational School (Ataşehir, İstanbul, 19000 m2, 2009), Özyeğin University Second Academic Building (Çekmeköy, İstanbul, 21914 m2, 2009). The buildings are listed and have information about the total points, total floor area, place, year of certificates in Table 3.

Table 3. Basic information of the university buildings in case study.

		Plan	Outer view
Sabancı University NanoTechnology Center	(79/110) 23047,8 m2 Tuzla, İstanbul, 2011		
Özyeğin University Faculty of Engineering Building	(72/110) 103423.8 m2 Çekmeköy, İstanbul, 2013		
Acıbadem University Faculty of Medicine Building	(71/110) 32027.9 m2, Ataşehir, İstanbul, 2014		
Boğaziçi University National Earthquake Monitoring Center (UDIM)	(67/110)		
Özyeğin University Student Center	(67/110) 19383.3 m2, Çekmeköy, İstanbul, 2013		
Acıbadem University Vocational School	(66/110) 19006.4 m2, Ataşehir, İstanbul, 2009		
Özyeğin University Second Academic Building	(62/110) 21914.2 m2 Çekmeköy, İstanbul, 2009		

University buildings in the case study listed according to total points, and the points they got for each criteria from LEED assessment in Table 4.

Table 4. Energy Certificated University Buildings in Istanbul

	Class	Energy and Athmosphere	Materials and Resources	Indoor Environmental Quality	Sustainable Sites	Water Efficiency	Innovation in Design
Sabancı University NanoTechnology Center (Tuzla İstanbul 23047,8 m2 - 2011)	LEED Gold Certificated (79/110 points)	20/35 points	6/14 points	10/15 points	25/26 points	12/10 points	6/6 points
Özyeğin University Faculty of Engineering Building (Çekmeköy İstanbul, 223,983 ft2, 67194,9 m2 - -103423.8 m2 - 2013)	LEED Gold Certificated (72/110)	19/35 points	6/14 points	9/15 points	20/26 points	12/10 points	6/6 points
Acıbadem University Faculty of Medicine Building (Ataşehir, İstanbul 32027.9 m2, 2014)	LEED Gold Certificated (71/110)	15/35 points	6/14 points	11/15 points	23/26 points	10/10 points	6/6 points
Boğaziçi University National Earthquake Monitoring Center (UDIM)	LEED Gold Certificated (67/110)	25/35 points	4/14 points	7/15 points	17/26 points	8/10 points	3/6 points
Özyeğin University Student Center (Çekmeköy, İstanbul, 19383.3 m2, 2013)	LEED Gold Certificated (67/110)	13/35 points	6/14 points	9/15 points	20/26 points	13/10 points	6/6 points
Acıbadem University Vocational School (Ataşehir, İstanbul, 19006.4 m2, 2009)	LEED Gold Certificated (66/110)	16/35 points	6/14 points	10/15 points	23/26 points	6/10 points	5/6 points
Özyeğin University Second Academic Building (Çekmeköy, İstanbul, 21914.2 m2, 2009)	LEED Gold Certificated (62/110)	10/35 points	6/14 points	7/15 points	20/26 points	13/10 points	6/6 points

Sabancı University Nanotechnology Center

The intensity of the work done on nanotechnology at Sabancı University required separate building planning. Thus, the Nanotechnology Research and Development Building (SUNUM), which includes the architectural technologies of the future and provides energy savings, was completed in July 2011. The building has exemplary features in terms of energy saving. Built with an international green approach with high construction technology, the environmentally friendly, energy-saving, LEED Gold certified building of approximately 7368 m2 is planned as the first research building in Turkey shaped according to green certificates.

Özyeğin University Faculty of Engineering Building

Özyeğin University Campus concept project was built around the academic spine formed on the parcel extending in the north-south direction, with student accommodation and sports fields around a valley. The Faculty of Engineering, the first academic structure of the campus, was designed as a structure that connects the south entrance, which is the lowest level, to the main academic axis. The Faculty of Engineering Building defines both horizontal and vertical academic circulation and strengthens the concept perception from the road front. The Engineering Faculty building is designed as a multi-purpose building with classrooms, laboratories, offices, academic units, a 350-seat auditorium, additional functions, and service areas. Especially on the south façade, additional shading and solar control are provided to reduce maintenance and energy costs. In cooperation with the LEED consultant of all project groups during the project and certification stages, additional measures have been taken in the façade and mechanical components to provide better energy recovery and energy control. All materials used in the building are defined within the technical specifications specified limits. During the entire working period, both the project team and the project management were informed about the process. Simultaneous updates were achieved by possible or expected deficiencies or needs.

Acıbadem University Faculty of Medicine Building

The Acıbadem University Faculty of Medicine building, which has been designed and built considering the sustainability criteria from the concept project stage, is located on a previously developed land, very close to public transportation facilities and social facilities. In order to minimize the damage to the environment and nature during the construction process, an erosion and sedimentation plan was developed by the experts in the team. Measures have been taken to prevent dust formation, water, and construction pollution. Wastes generated during construction are separated and used in areas such as recycling and reuse. Thus, the amount of construction waste is reduced. The amount of green space on the campus has been increased and natural and adapted plants have been selected. The amount of water consumption is reduced by using rainwater collected from hard ground and roof areas in landscape irrigation. In addition, the low water consumption in the building, the efficient use of taps, and the use of gray water in the reservoirs also contributed significantly to water efficiency. The necessary infrastructure and automation monitoring system has been designed to monitor the energy consumption of the systems that provide energy savings of more than 25% according to international standards in the building with high energy efficiency mechanical-electrical systems, facade layering, and appropriate glass selection. The amount of fresh air supplied to the spaces has been kept above international standards to increase the user's health and indoor comfort. For all studies, joint studies were carried out for the team.

Boğaziçi University National Earthquake Monitoring Center

Boğaziçi University National Earthquake Monitoring Institute, Tsunami Monitoring and Evaluation Center (UDİM) was deemed worthy of LEED certification in 2015. It was the first green building built by Boğaziçi University from scratch. Within the framework of the evaluations, criteria such as maximum energy and water efficiency of the building, indoor air quality, use of local materials in architecture, use of more sunlight, use of fixtures that consume less electricity, and supply of consumed energy from renewable energy sources came to the fore in the evaluations. Partnerships have been developed for these processes in the design process of the building. With this aspect, it can be stated that the integrated design principles are partially applied.

Özyeğin University Student Center

The new building of Özyeğin University Student Center, which has a Leed Gold Certificate, is heated and cooled with electrical energy, and no gas or other energy source is used. While some of the electricity is obtained from the solar panels on the roof; It is possible to recover water by collecting and filtering rainwater. Filtered rain and surrounding waters are used in the reservoirs inside the building. In addition, thanks to the air source heat pump, less energy consumption is achieved in heating and cooling the building by using the heat in the air. With all these applications, 39.12 percent less energy is consumed than the average energy consumption values of the building, according to the certification body. In building design, the design team worked with different engineering fields and other experts.

Acıbadem University Vocational School

Acıbadem University Kerem Aydınlar Campus is located on a previously developed land, very close to public transportation and social facilities. An erosion and Sedimentation plan was developed to minimize the damage to the environment and nature during the construction process; Measures have been taken to prevent dust formation, water, and construction pollution. Wastes generated during construction are separated and used in areas such as recycling and reuse. Thus, the amount of construction waste is reduced. The amount of green space on the campus has been increased and planted with natural and adapted plants. The amount of water consumption is reduced by using rainwater collected from hard ground and roof areas in landscape irrigation. In addition, low water consumption and the use of efficient taps in the building contributed significantly to water efficiency. More than 24% energy saving has been achieved in the building, according to international standards, with energy-efficient mechanical-electrical systems, facade stratification, and appropriate glass selection. Necessary infrastructure and automation monitoring systems have been designed to monitor the energy consumption of these systems separately. The amount of fresh air supplied to the spaces has been kept above international standards to increase the user's health and indoor comfort.

Özyeğin University Second Academic Building

The design of the OZÜ Faculty of Business defines the northern border of the main square of the campus. The main entrance of the building is planned to be made from the linear academic axis in the square and this entrance is characterized by a large atrium designed as a continuation of the square. The Faculty of Business Administration building is located on the main spine connecting the campus on a North-South axis. The ground floor, which serves as an extension of the main courtyard, aims to create a street atmosphere with the floor coverings, plants, and seating elements of the atrium located in the entrance building. The wide skylight above the atrium maintains a sustainable design approach by providing homogeneous daylight to the enclosed classrooms around it. The atrium located under the large skylight and its relationship with the building entrance has been consolidated, resulting in light and transparency in accessing the classrooms. The other entrance of the Faculty of Business Administration is designed for the academic spaces located on the west side overlooking the forest and offering educational programs in the name of "le cordon bleu". The facade design is based on the efficient use of daylight and the increased auxiliary transparency of the design criteria. Solar panels on the roof of the building contribute to the renewable energy system on campus. The design team of the building collaborated with other team members to work under the principles of integrated design processes, as in the other two buildings on the same campus.

Evaluations:

In the following charts, there is the evaluation of different parameters from case study buildings derived from the evaluation of the LEED certification system. The first one related to the total area of the buildings, the second one compare the total points that the buildings had, the third chart is related to energy and atmosphere, the fourth diagram is based on materials and resources, the fifth one gave the parameter about indoor environmental quality, the other one is related with sustainable sites, the following chart is based on evaluation on water efficiency, the last two gave the evaluation about innovation in design and regional priority respectively.

The total area of the buildings in the case study is between 7317 and 32037 square meters. As it is followed in Figure 3. The smallest building is Sabancı University Nano Technology Center and the biggest one is the Acıbadem University Faculty of Medicine Building. When we evaluate the total points they get in total we found that there is no correlation between the parameters of the total area of the building and the total score they get.

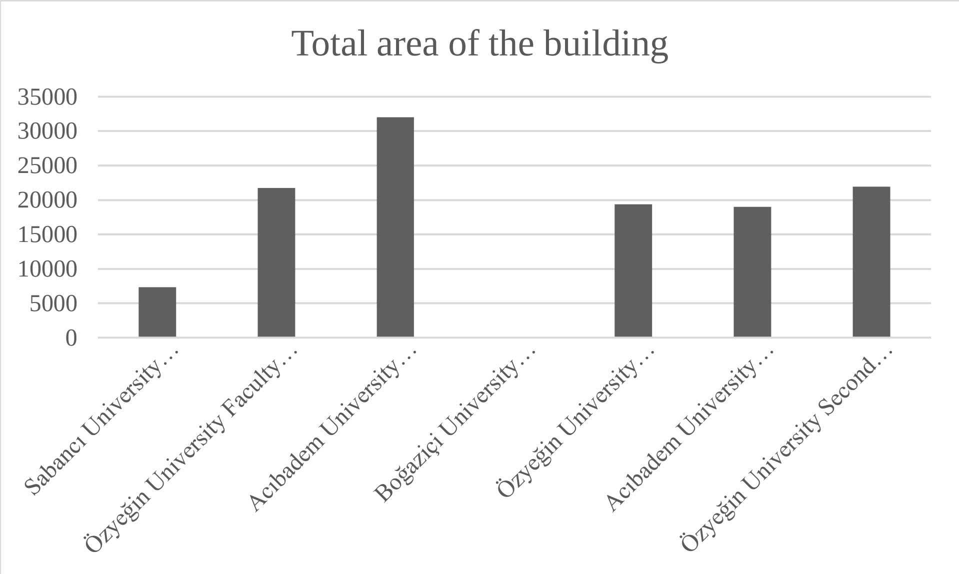


Figure 3. Total area of energy certificated university buildings in case study

Figure 4. identify the total points of the buildings in the evaluation of LEED certification. There are small differences between the buildings when the total points they get are compared. But the highest score by Sabancı University Nano Technology Center gets 79/110 and 0.72, on the other hand, Özyeğin Üniversity Second Academic Building gets 62/110 and 0,56 total points.

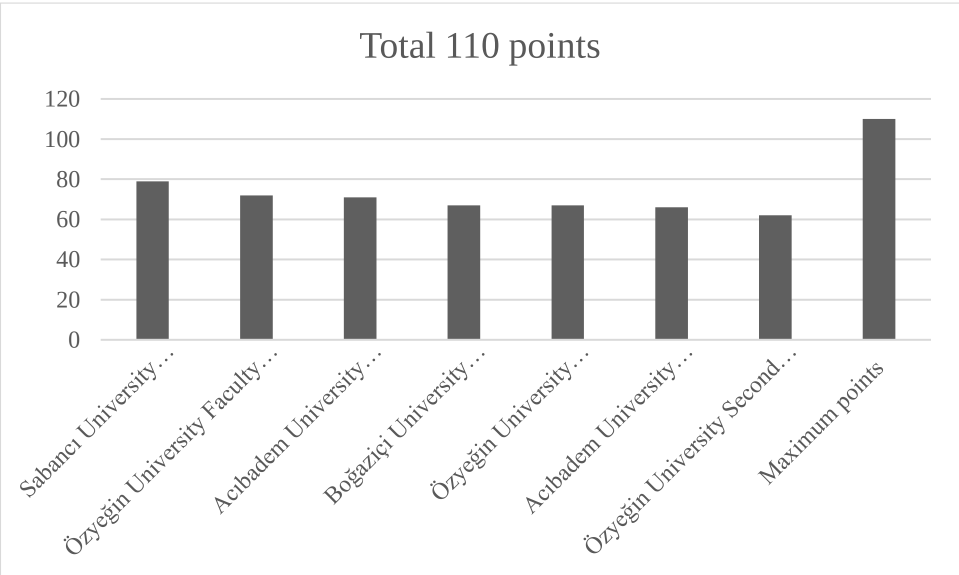


Figure 4. Total points

The energy and atmosphere section of LEED certification system and the score of the university buildings in the case study work are listed in Figure 5. When we evaluate the case buildings according to the scores they got in this section we see that the highest-ranked building is Boğaziçi University Kandilli National Earthquake Monitoring Center with 25 points over 35 for maximum.

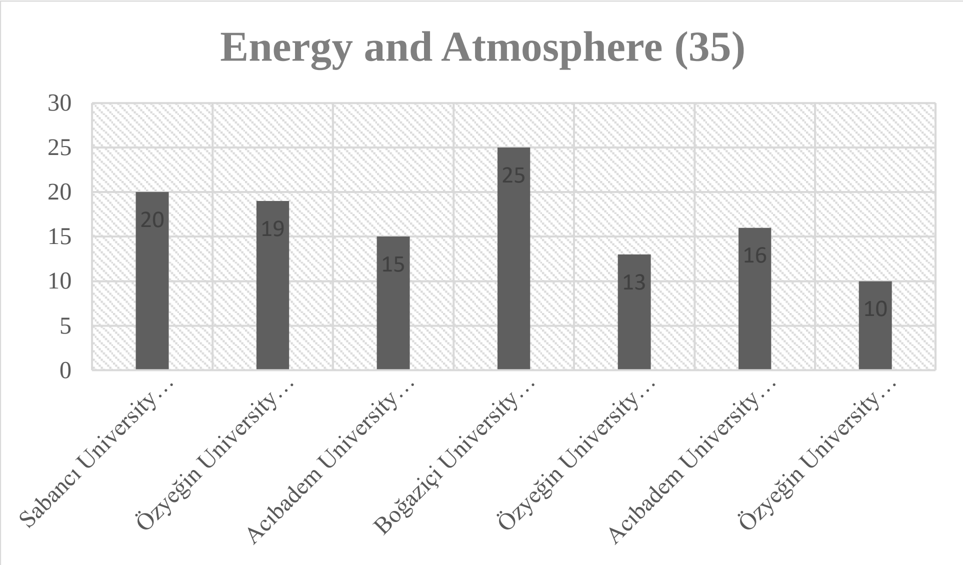


Figure 5. Energy and atmosphere points

Figure 6. shows the materials and resources section evaluations of the buildings as bar graphics. All buildings were very careful about the materials and resources since all the buildings got 6 out of 6 points except one.

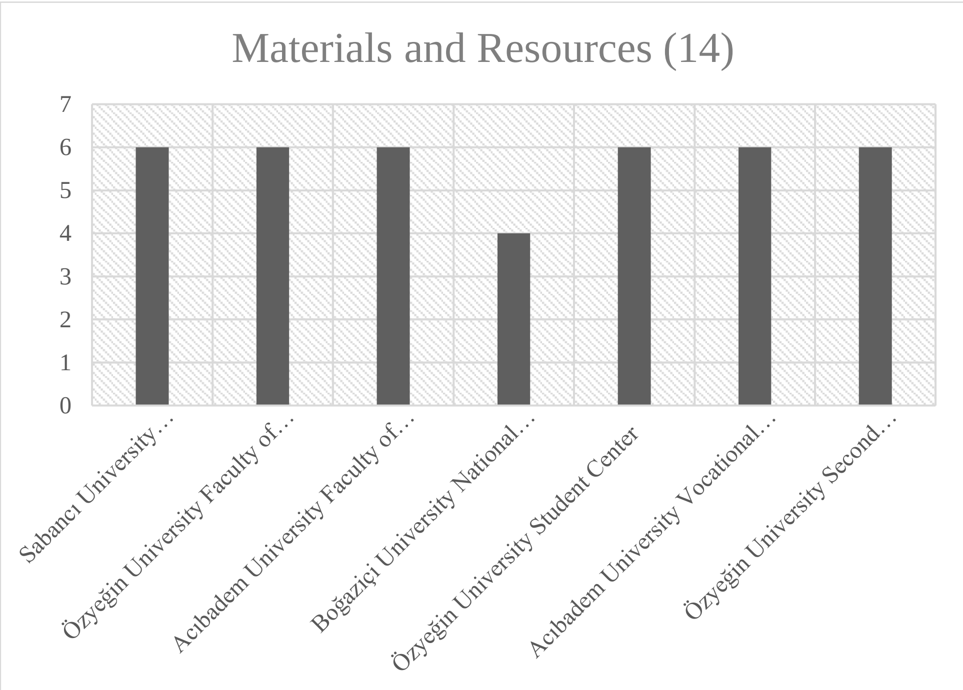


Figure 6. Materials and resources

The indoor environmental quality evaluation of the buildings are listed in Figure 7. as seen below Acıbadem University Faculty of Medicine Building got the highest score in this section.

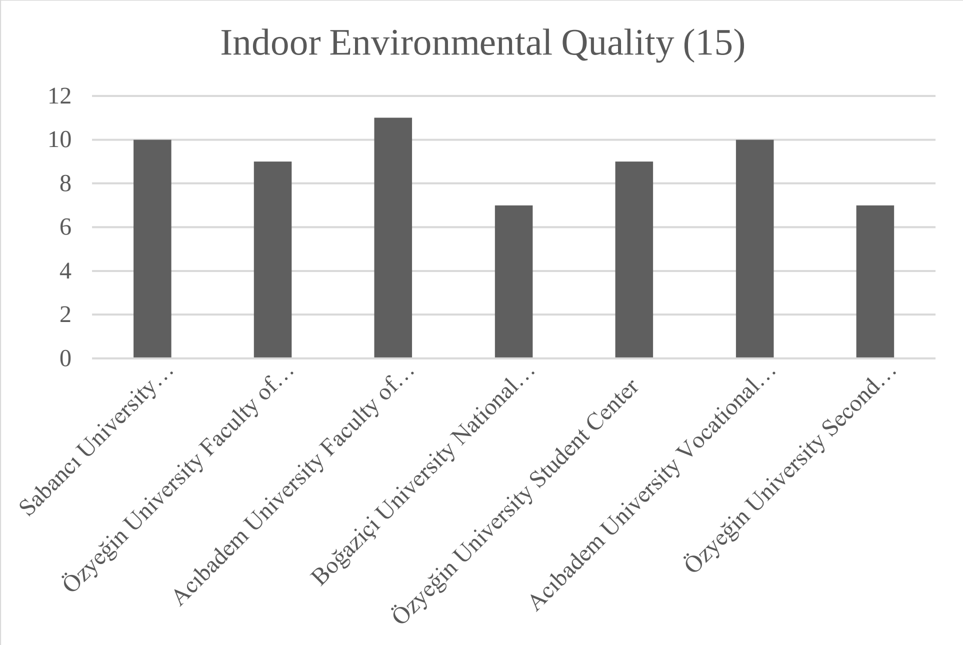


Figure 7. Indoor environmental quality

Figure 8. is dedicated to sustainable sites and shows the credits the university building had in this section of the evaluation. Sabancı University Nano Technology Center got the highest score in this part with 25 points of which 26 points is the maximum value for this credit. In general, all of the buildings in the study got high scores in sustainable site evaluation. This assessment shows us that integrated design solutions in sustainable sites with interdisciplinary teams of architects, engineers, landscape architects work well.

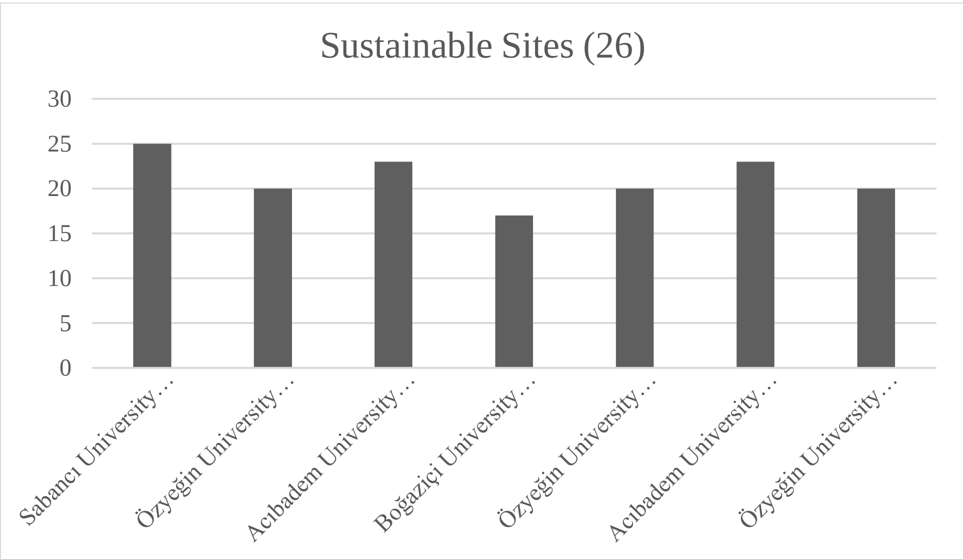


Figure 8. Sustainable sites

Water efficiency evaluation related to LEED certificated university buildings in İstanbul is seen in Figure 9. Two buildings from Özyeğin University got the highest score in this section. Student Center and Second Academic Building which is Faculty of Business building.

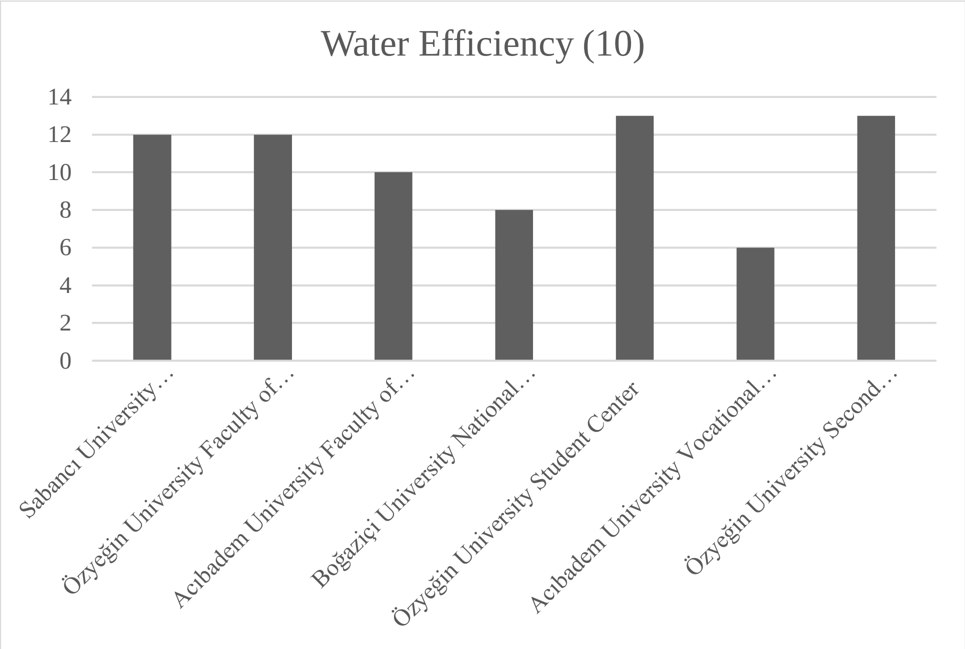


Figure 9. Water efficiency

Figure 10. consider innovation and design which is very effective on integrated design processes. Except for two all the case study buildings got full score in this section as seen in the figure.

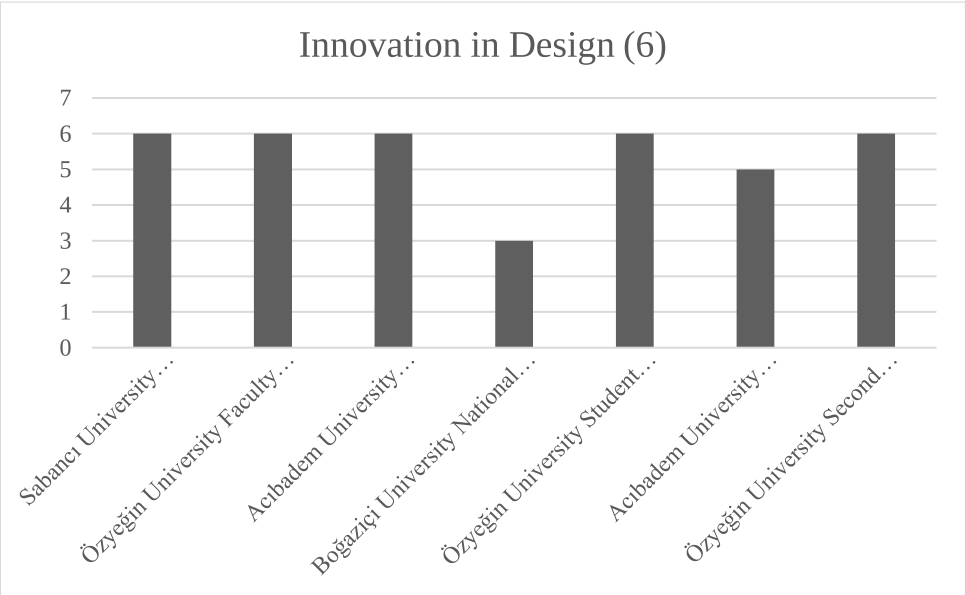


Figure 10. Innovation in design

The regional priorities added to LEED certification. Figure 11. Half of the buildings were evaluated with the highest score and the other half got 3 points in this evaluation. The regional priorities are important for integrated design processes those related with the regional factors and if the regional actors integrated as a partner in the design and construction team.

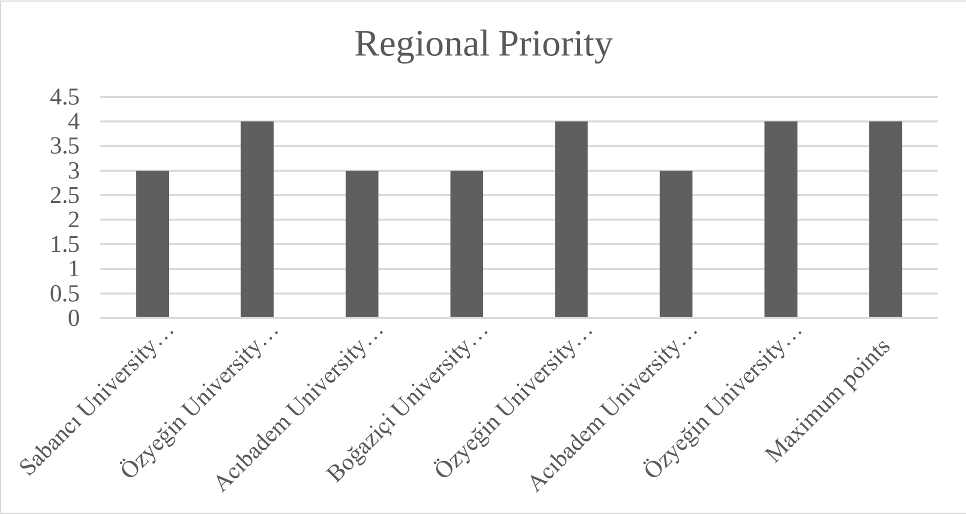


Figure 11. Regional priority

Discussion on LEED Certificated University Buildings

Discussion on LEED Certificated University Buildings The research was conducted on seven buildings of 4 universities with LEED-certified academic and research buildings in Istanbul, evaluations were made during a conceptual framework that supported the principles of integrated design processes, applications, and therefore the relationships between LEED credits. In these evaluations, special explanations for the credits that specialize in the relations between the most topics within the LEED certification and therefore the integrated design principles are studied. In this article, the correlation of LEED-certified academic and research structures in Istanbul with integrated design processes was investigated. the connection between the principles of the research methodology and integrated design processes of the study and therefore the green building certification criteria and therefore the relationship between the studies on seven buildings from 4 universities, which were determined within the framework of the model built on this relationship, was questioned. The results obtained have shown that buildings applying integrated design processes are successful in meeting the standards for green building certifications.

4. CONCLUSIONS AND RECOMMENDATIONS

Since the implementation of integrated design processes, what are the consequences of huge or small buildings on the planning and implementation processes and thus on the evaluation of green building certificates is that the main question of this research. A model has been established to answer this research question. This model includes LEED certification criteria that specialize in integrative thinking, sustainable spaces, innovation, and style. supported this setup, all criteria were evaluated and integrated building design processes and principles of green building criteria were investigated in seven LEED-certified university buildings in Istanbul. The principles of the integrated design process a) open communication; b) innovation and synthesis of ideas; c) systematic decision making; d) when investigating the interaction between the iterative process and LEED metrics with feedback loops interacting with the above-mentioned criteria of the certificate. it's been determined that the integrative thinking criterion is extremely important altogether seven buildings that were evaluated with the golden LEED certificate in line with team collaborations, well-defined scope, vision, and targets. Sustainable site assessment has proven to be very successful altogether buildings. Innovation and style criteria are vital within the evaluation of green building certificates. this is often evident within the assessments. On the opposite hand, when watching other criteria, the consequences of the integrated assignment are seen altogether criteria. the consequences of the planning team working together are vital, especially within the location-specific effects that are handled within the scope of regional priority criteria.

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