Research Article

ICONARP
International Journal of Architecture and Planning
Received: 25.09.2023 Accepted: 17.12.2023
Volume 11, Issue 2/ Published: 28.12.2023
10.15320/ICONARP.2023.269 E-ISSN:2147-9380

ICONARP

Green Building Assessment Model for Historic Buildings of Turkey

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Abstract

Grave structures are architectural works reflecting the cultural accumulation, continuity and political power of societies. In the context of sustainability, while "green building" certification systems are developing in building productions in the world, new guidelines are also being created. Of course, new guidelines are also being developed on the certification as green buildings within the scope of the protection and restoration of historical buildings that should be specially considered. In this study, it is aimed to create a model that will allow the historical buildings in Turkey to be evaluated in the context of “the green building” concept. With this model, it is considered that historical building conservation practices will contribute positively to the works of restorers in making those heritage sites more environmentally friendly and sustainable.
For the model designed to evaluate historical buildings within the scope of green buildings, historical buildings were handled under 3 groups: a) 1st Group Historical Buildings, b) 2nd Group Historical Buildings and c) Reconstructed Historical Buildings. As creating the designed model, GBC-Italy system criteria were taken as the basis. The criteria were carried out by conducting a questionnaire with experts in this field. Importance of the relevant evaluation criteria in the scoring system were determined by using the AHP method. As a result of the analyzes and calculations, the accuracy of the scoring was confirmed. As historical buildings are evaluated according to the conditions of their periods, it is obvious that they are sustainable buildings. Naturally, nowadays to be able to preserve historical buildings for the future generations in a proper way is usually ensured by giving them a new function. The requirements of the new functions given to create the necessary equipment to provide today's comfort conditions in historical buildings naturally change the sustainable characteristics of the historical heritage. This evaluation system, designed to preserve the green building characteristics of historical buildings and to ensure their sustainability with their new functions, will be an important guide.

Keywords:
Green building, green building assessment systems, GBC Italy, historical buildings, sustainability

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To cite this article: Yetkin, E. G., & Koç, İ. (2023). Green Building Assessment Model for Historic Buildings of Turkey. *ICONARP International Journal of Architecture and Planning*, Volume 11 (2), 904-923. DOI: 10.15320/ICONARP.2023.269

INTRODUCTION

In recent years, with the energy and resource crises experienced in the world, the construction industry has entered a new period of change. The reason for this is that buildings have a large share in energy consumption in the world. Today, the changing comfort conditions and the increase in technological devices that require energy use cause an increase in the amount of energy used in buildings. The uncontrolled consumption of fossil energy sources and other natural resources used in the construction and operational period of buildings creates great destruction in nature, increases environmental pollution, and causes global warming. In this context, in the buildings various strategies that aim to reduce energy, resource consumption and the negative effects of the building on the environment have been developed. Of them, sustainability strategy comes first. Ensuring the sustainability of buildings, built environment, and ecological environment are the main objectives of sustainable architecture.

Özkeresteci (2001) defined “sustainable architecture” as an approach that considers the relationship between human and nature, accepts climatic and topographic data as an indispensable preliminary data package and strives to use resources sparingly.

As a result of sustainable architectural research, various ideas and practices have emerged, of which the most striking and impressive is undoubtedly the "Green Building" discourse. The concept of green building has been rapidly accepted by the relevant circles from the day it emerged and has become widespread by developing. It has been foreseen that the new buildings built in the “Green Building” concept will consume less energy and resources than the existing buildings, and strategies have been developed accordingly. As developing sustainable architecture and green building strategies, new buildings have been the priority, but as stated by experts, the existing building stock is also an important area that should be evaluated in this context. Whereas, in this context within the existing building stock, historical buildings need completely customized strategies. However, the sustainability of the implementations made to historical buildings in line with traditional conservation approaches is discussed. Although it is important to ensure the sustainability of historical buildings by using them, it is necessary for the applications chosen for the historical building to contribute to their sustainability.

Approaches to the conservation of historical buildings continue to develop and today sustainability has become the main parameter in this field (Boarin, Guglielmino, Pisello, & Cotana, 2014). In this context, green building evaluation systems also develop new practices for historical buildings (Appleby, 2012).

As considered within the scope of green building evaluation systems, it has emerged that historical buildings should be handled differently from other existing buildings. International green building assessment systems have created guidelines that will allow historical buildings to be

DOI: 10.15320/ICONARP.2023.269

evaluated in this context. With these guidelines, it is aimed that historical building preservation approaches support environmentally friendly practices and that green building practices are used in applications for the protection of historical buildings.

The conservation and reusing of historical buildings is a sustainable practice. While the principles of protection and repair ensure the continuity of the buildings, minimizing their environmental effects has become an important parameter. By reusing a historical building, the entire building is recycled, thus reducing the demand for natural resources to be used to construct a new building and saving energy for demolition and new construction. By preventing the destruction of the historical structure, the wastes arising from this process are prevented. At a time when climate change and depletion of natural resources remain current, the environmental benefits of reusing historical buildings cannot be ignored. For this reason, environmentally friendly building production studies, which started with the emergence of the concept of sustainability in the construction sector in recent years, were evaluated and the examples of green building evaluation systems in the world were examined. Among those systems, the approaches of LEED, BREEAM, and GBC-Italy evaluation systems within the scope of historical structure were examined. In recent years although green building evaluation works are carried out in Turkey, there is no specific certification system for historical buildings yet.

In our country, studies are carried out towards reducing the negative effects of historical building preservation processes on the environment, but it is known that we are far behind in this area when compared to European countries. To ensure energy efficiency, sustainability and protection of cultural heritage, there is a need for a green building evaluation system specific to historical buildings by combining the criteria to be determined within the framework of the standards related to the national historical building rating system and documents on conservation practices. It is expected that the evaluation system to be created will have the characteristics of being a guide in ensuring sustainability in historical building conservation implementations.

HISTORICAL BUILDING ASSESSMENT STRATEGIES FOR GREEN BUILDING CERTIFICATION SYSTEMS

Historical buildings connect with the past by revealing how societies have developed socially, technologically, and culturally. While some historical buildings preserve their original functions after the conservation implementation, some are adapted to new functions out of necessity. Unfortunately, together with rapid population growth and urbanization generally, in the world, most historic structures are increasingly threatened by demolition. However, with the conservation approaches developed under the leadership of countries such as the USA, Australia, England, and Italy, they maintain their existence by ensuring that historical buildings largely preserve their environmentally sustainable characteristics (Eldek, 2014). In other words, it is ensured that historical buildings are reused by preserving their historical values with environmentally friendly sustainable conservation implementations.

Historical buildings mean much more than a mass formed by the combination of building elements. With their designs, textures, construction types, sizes, shapes, locations on the land, environmental landscapes, and climatic features, they are the assets that provide evidence for the place of a whole mechanism in history, the progress of technology, and the development of art. In this context, a successful reuse application can be ensured by the complete and holistic preservation of the characteristics of the historical building (Hamilton, 2012). As Mouzon (2010) remarked, "Conservation is an ongoing act of sustainability."

There are numerous reasons why historic building stock is worth reusing. However, historic building preservation also has complex issues. As developing approaches to the conservation of historic buildings there are many restrictions within the scope of the legal framework. These constraints can sometimes cause problems in implementing sustainability strategies. Many of the design techniques used by the green building industry today are the same techniques that have been used over the years, deriving from historical traditions and adapting to the regional climate, such as building orientation, daylight gathering, sun shading, regional materials, natural vegetation, and passive ventilation. Historical buildings built during periods of the absence of today's vehicles are generally located in densely populated areas, easily walkable, and close to many services and usage areas (Magrini, Franco, 2016). Historical buildings have been constructed to be climate responsive, economically and environmentally sound, using durable local materials of their period, with implementations aimed at prolonging their life.

The historical building's sustainability should be evaluated using historical, architectural, aesthetic, and social qualities, among others. In this context, green building evaluation systems have developed various strategies to select the methods applied in the preservation of historical buildings and then to determine the conservation rate of the energy-efficient properties of the historical building.

LEED, one of the two most widely used rating systems in the world, has not yet created a rating system specifically designed for the renovation and adaptation of historical buildings to their new function. Instead, to certified historic structures, existing LEED rating guides such as LEED New Building (LEED-NC) or LEED 2009 (Existing Building: LEED-EBOM (LEED for Existing Buildings: Operations & Maintenance) have been used, depending on the type and extent of renovation or conservation. However, in larger urban applications involving the reuse of historical buildings, the LEED-ND (LEED for Neighborhood Development) evaluation guide is used. It is important to identify key

DOI: 10.15320/ICONARP.2023.269

categories that can be used to develop a framework for assessing the environmental sustainability of historic buildings. For this reason, workings continuing LEED-NC and LEED-ND, implementations are being carried out.

The green building rating system BREEAM does not have a specific guide for assessing historic buildings. BREEAM guides differ according to the functions of buildings. As evaluating historical buildings, detailed information is considered in the explanation sections of the relevant criteria of the BREEAM system. As the evaluations made according to the BREEAM general guidelines are compared with the evaluations made for historical buildings, it is seen that historical buildings receive lower ratings (Global, 2015). This is because properties such as position, orientation, texture, and form cannot be changed, and other restrictions have existed. This situation is considered reasonable, as there may be further limitations on design options and specific requirements for building appearance due to the characteristics of historic buildings. It is known that conservation implementations for historical buildings perform much better than renovation implementations for other buildings (Yuschak, Yuschak, & Mu, 2016).

Since 2015 Italy has created its own guide based on the LEED rating system GBC "Historic Building". This guide is the first assessment guide for the historical buildings category among the green building rating systems. Due to their cultural and architectural values, historical buildings in Italy are considered as the first most important issues. Improving the performance of existing buildings through conservation practices or operational strategies is a priority determined by the European Community. To achieve this aim, in 2010, the American LEED (Leadership in Energy and Environmental Design) and the Italian GBC (Green Buildings Council) developed a local version of the LEED rating system called "LEED Italia" for historical buildings (Lee, Burnett, 2008). However, LEED Italia, which can be applied to conservation implementations for historic buildings, does not include specific criteria for the sustainable assessment of the historical and cultural aspects of a particular part of the built environment. For this reason, GBC-Italia has developed the "GBC Historic Building" which is a new LEED-based rating system for voluntary certification of the level of sustainability in the preservation, recovery and integration of historic buildings (Lucchi, Boarin, Zuppiroli, 2016). "GBC History Building" has emerged as an innovative tool based on the comparison and merging of two different cultures: the sustainability criteria of the LEED standard and the success of Italy's internationally recognized restoration knowledge and skill.

MATERIAL AND METHOD

Questionnaires were conducted to collect data in the creation of the "Historical Building Green Building Evaluation Model". The target group in the survey was determined as architects, engineers and others who are experts in historical buildings and conservation practices. While it was required from the academic participants to have been done academic work condition on the preservation of historical buildings, whereas it was required from architects and engineers to have been worked condition actively in practice working at least one historical building conservation site.

In the categories in which the criteria of the main target of the survey exist, it consists of questions relative to each other that will allow the determination of the importance levels of the criteria. Due to the model created having many evaluation criteria, as creating the model, it was approved appropriate to use the AHP method, which is one of the multi-criteria decision-making methods. Within the scope of the AHP method, the hierarchical order of the relevant criteria has been determined (Saty, 1994). With the program of "Expert Choice", which will facilitate the application of the AHP method, the survey questions were automatically created in accordance with the AHP method. Due to the large number of green building evaluation criteria and the fact that each criterion in AHP application has comparative questions with other criteria, an intense content was created in the application of the survey. In order to avoid disputes that may arise due to this intensity, it is aimed to answer the survey by experts, especially by conducting face-to-face interviews. Data were collected after a few hours of interviews with each participant on a specified day and time. Then, the data obtained were entered into the data entry platform where the AHP method was applied and evaluated.

The survey was carried out separately for three different application areas of historical building protection. These groups are specialized for structures that require different protection practices;1st Group Historical Buildings, 2nd Group Historical Buildings and Reconstructed Historical Buildings. The aim of this is to determine whether historical buildings differ according to the selected application area within the scope of green building certification systems and to create a separate guide for each. The differences determined in the degree of importance of the criteria are provided for the creation of a specialized scoring system for the three different historical building conservation implementation areas.

AHP Method and Reason for Choosing the Method

There are many reasons why the AHP method is preferred in this work. This method is suitable for priority order of the criteria of the model created and determining their weights within the categories; at the same time, its calculations are easy and understandable, it also checks its consistency within itself, provides the opportunity to progress step by step, and allows the priority determination values to be directly converted into weight values (Kuruüzüm, Atsan, 2001). The AHP program used was implemented using a software called Expert Choice-11. The software in question determines the consistency values by making all the sub-computations within itself.

DOI: 10.15320/ICONARP.2023.269

The Categories of Historic Building Green Building Evaluation Model and its Criteria

The approach applied by the green building evaluation systems to the preservation of historical buildings is basically similar to the general principles of historical building preservation, and it can be said that they constitute a guide suitable for the preservation of historical buildings. The first guide created specifically for historical buildings belongs to the "GBC-Italy" green building rating system. In the model created in this study, the historical building criteria of the GBC-Italy system were primarily examined. "GBC-Italy" has created its own system by using the guidelines and assessment methods of the LEED system as a base. Among green building systems in the world, GBC-Italy is the first and only evaluation system prepared in European norms for historical building evaluation. The criteria established within the scope of this model have been constituted to preserve the historical buildings in accordance with their preferred characteristics. These criteria have been prepared to guide the authorities in determining how green and sustainable the use of green and sustainable practices is during and after the works for the preservation of the historic building.

As a result of the research carried out, the historical building stock in Turkey is experiencing conservation problems in the rapidly developing green building evaluation practices. For this reason, the necessity of creating a model that will enable the evaluation of historical buildings within the scope of the green building evaluation system, has emerged without delay. The designed green building evaluation model should also be planned according to the green building performance criteria in accordance with the country conditions.

While determining the criteria of the model in question, especially the criteria in the historical buildings guide of the GBC-Italy system and some remarkable conservation practices and legal regulations in the country were examined one by one. Accordingly, changes have been made in the model prepared to ensure that it complies with the protection principles accepted in the country. As a result of these studies, the suggested categories for the historical green building evaluation model are given in Table 1.

Table 1. Historical Building Green Building Evaluation Categories

No	Categories
1	Historic Value
2	Sustainable Site
3	Water Efficiency
4	Energy and Atmosphere
5	Materials and Resources
6	Indoor Environmental Quality
7	Regional Priority
8	Innovation in Design
9	Health and Safety

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For the historical green building evaluation model, international green building evaluation systems were examined, and sub-evaluation criteria were created for each evaluation categories.

Evaluation criteria created are shown in Table 2. Within the scope of this study, the categories and criteria indicated in the table are the criteria that are considered to allow the evaluation of historical building conservation practices in the country. Other criteria are also those applied by the "GBC-Italy Historic Buildings" guide.

Table 2. Historical Building Green Building Evaluation Model Criteria

Historic Value	
Credit 1	Preliminary analysis
Credit 2	Advanced analysis: energy audit
	a) I Level Analysis
	b) Advanced analysis: thermography
	c) Advanced analysis: thermography and thermic conductance
Credit 3	Advanced analysis: diagnostic tests on structures and Structural monitoring
	a) Diagnostic tests on structures
	b) Diagnostic tests on structures and structural monitoring
Credit 4	Project reversibility
Credit 5	Querying the conservation application a) Compliance with the intended use and settlement benefit b) Structural similarity with the existing structure
	a) Compliance with the intended use and settlement benefit b) Structural similarity with the existing structure
	c) Diagnostic tests on materials and degradation
Credit 6	Sustainable restoration site
Credit 7	Scheduled maintenance plan
Credit 8	Specialist in restoration of architectural heritage and landscape
Sustainable Sites	
Credit 1	Construction activity pollution prevention
Credit2	Brownfield redevelopment
Credit3	Alternative transportation
	a) Alternative transportation: public transportation access
	b) Alternative transportation: bicycle storage and changing rooms
	c) Alternative transportation: low-emitting and fuel-efficient vehicles
	d) Alternative transportation: parking capacity
Credit4	Site development: open spaces recovery
Credit5	Stormwater design: quantity and quality control
Credit6	Heat island effect: non-roof and roof
Credit7	Light pollution reduction

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Water Management	
Credit1	Water use reduction
Credit2	Water efficient landscaping
Credit3	Water metering
Credit4	High efficiency appliances and process water systems 1
Energy and Atmosphere	
Credit1	Fundamental commissioning of building energy systems
Credit2	Minimum energy performance
Credit3	Fundamental refrigerant management
Credit4	Optimize energy performance
	a) Calculation of building energy performance
	b) Energy simulation of building internal dynamics
Credit5	Renewable energies
Credit6	Enhanced commissioning
Credit7	Use of automatic systems
Materials and Resources	
Credit1	Storage and collection of recyclables
Credit2	Demolition and construction waste management
Credit3	Maintenance of load-bearing systems and non-structural elements
Credit4	Building reuse:
	a) To be used in its main function
	b) The new function does not require structural changes
	c) The selection of the new function must be in accordance with the characteristics of the structure
Credit5	Materials reuse
Credit6	Environmental impact optimization of the material used.
Credit7	Material extracted, processed, and produced within a limited distance.
Credit8	Use of Local Materials
Indoor Environmental Quality	
Credit1	Minimum indoor air quality performance (IAQ)
Credit2	Environmental Tobacco Smoke (ETS) control
Credit3	Air monitoring
Credit4	Outdoor air delivery monitoring
Credit5	Construction IAQ management plan
Credit6	Low-emitting materials
	a) Low-emitting materials: adhesives and sealants
	b) Low-emitting materials: paints and coatings
	c) Low-emitting materials: flooring systems
	d) Low-emitting materials: composite wood and agrifiber products
Credit7	Indoor chemical and pollutant source control
Credit8	Management and control of systems:
	Visual comfort
	a) Lighting - Light Quality
	b) Lighting System Control
	Thermal comfort:
	a) Thermal comfort: design
	b) Thermal comfort: verification

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	c) Use of existing systems to provide thermal comfort
	Ventilation
	a) Natural ventilation
	b) Artificial ventilation
Credit9	Olfactory comfort
Credit10	Acoustics Comfort
Regional Priority	
Credit1	Regional Priority
Innovation in Design	
Credit1	Innovation in applications
Credit2	Innovation in material
Credit3	Innovation in evaluation
Health and Safety	
Credit1	Design for the disabled, the elderly and children
Credit2	User safety and health quality performance

CREATION OF HISTORICAL BUILDING GREEN BUILDING EVALUATION MODEL

There are some criteria and sub-criteria used in the evaluation of historical buildings by green building certification systems. The criteria that allow the grading of historical buildings within the scope of green building evaluation systems are guiding in determining the extent to which the building is green and sustainable.

According to the evaluation results of the surveys conducted within the scope of the AHP method applications, the categories and the importance degrees of the criteria are established. As stated in Table 3, the importance degrees of the evaluation categories belonging to the model were created in three different classes as the application area: 1st Group Historical Buildings, 2nd Group Historical Buildings and Reconstruction Historical Buildings. As applying the AHP method, the hierarchical structure established is shown in **Figure 1**.

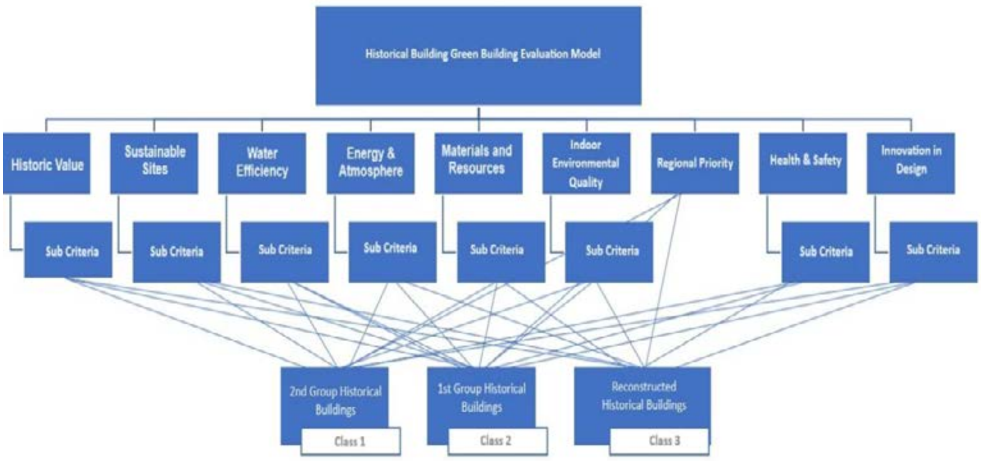

Figure 1. Historical Building Green Building Evaluation Model AHP Evaluation Hierarchy

As stated in Table 3, the importance degrees of the evaluation categories belonging to the model were created in three different classes as the application area: 1st Group Historical Buildings, 2nd Group Historical Buildings and Reconstruction Historical Buildings.

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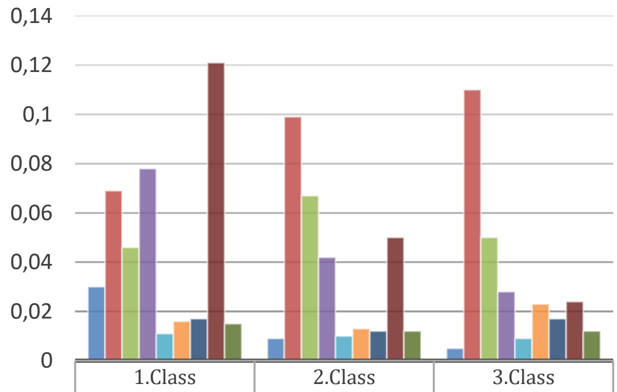
Table 3. The importance values of the Historical Building Green Building Evaluation Model categories determined by the AHP Method.

Evaluation Categories	1.Class	2.Class	3. Class	Sum.
Regional Priority (L: .045)	0,03	0,009	0,005	0,044
Energy and Atmosphere (L: .280)	0,069	0,099	0,11	0,278
Indoor Environmental Quality (L: .160)	0,046	0,067	0,05	0,163
Materials and Resources (L: .150)	0,078	0,042	0,028	0,148
Health and Safety (L: .031)	0,011	0,01	0,009	0,03
Water Management (L: .054)	0,016	0,013	0,023	0,052
Sustainable Site (L: .044)	0,017	0,012	0,017	0,046
Historic Value (L: .197)	0,121	0,05	0,024	0,195
Innovation in Design (L: .039)	0,015	0,012	0,012	0,039
Total	0,403	0,314	0,278	0,995

In the context of the evaluation categories of the building groups of "Historical Building Green Building Evaluation Model", the threshold point analysis graph is shown in Figure 2.



	1.Class	2.Class	3.Class
Regional Priority	0,03	0,009	0,005
Energgy and Atmosphere	0,069	0,099	0,11
Indoor Environmental Quality	0,046	0,067	0,05
Materials and Resources	0,078	0,042	0,028
Health and Security	0,011	0,01	0,009
Water Efficiency	0,016	0,013	0,023
Sustainable Sites	0,017	0,012	0,017
Historic Value	0,121	0,05	0,024
Inovation in Design	0,015	0,012	0,012

Figure 2. The threshold point analysis in the context of the evaluation categories of the building groups of "Historical Building Green Building Evaluation Model".

"The Regional Priority" category has no sub-criteria. The significance levels of this category obtained by AHP are shown in Table 3 and the threshold point analysis of the criteria is given in Figure 3. The importance degrees of the criteria that constitute the evaluation criteria within the scope of the categories, obtained by the AHP method, are given in Table 4, Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, and Table 12.

Table 4. Importance levels of Regional Priority Criteria determined by the AHP Method

Regional Priority (L: .045)	1.Class	2. Class	3. Class
Regional Priority	0,03	0,009	0,005

Table 5. Importance levels of Historic Value Criteria determined by the AHP Method

Historic Value (L: .197)	1.Class	2. Class	3. Class
Scheduled maintenance plan (L: .126)	0,011	0,008	0,006
Project reversibility (L: .142)	0,018	0,007	0,003
Sustainable restoration site (L: .072)	0,006	0,004	0,003
Inquiring conservation application (L: .171)	0,022	0,007	0,004
Advanced analysis: energy audit	0,018	0,007	0,002
Specialist in restoration of architectural heritage and landscape (L: .099)	0,011	0,006	0,002
Advanced analysis: diagnostic tests on structures and structural monitoring (L: .252)	0,035	0,011	0,004

Table 6. Importance levels of Water Management Criteria determined by the AHP Method

Sustainable Site (L: .044)	1.Class	2.Class	3.Class
Site development: open spaces recovery (L: .055)	0,002	0,001	0
Heat island effect: non-roof and roof (L: .420)	0,002	0,004	0,013
Light pollution reduction (L: .120)	0,004	0,001	0
Construction activity pollution prevention (L: .063)	0,002	0,001	0
Site development: open spaces recovery (L: .130)	0,003	0,002	0,001
Alternative transportation (L: .056)	0,001	0,001	0,001
Stormwater design: quantity and quality control (L: .157)	0,003	0,002	0,002

Table 7. Importance levels of Water Management Criteria determined by the AHP Method

Water Management (L: .054)	1.Class	2.Class	3.Class
Water efficient landscaping (L: .316)	0,002	0,005	0,01
Water use reduction (L: .351)	0,002	0,004	0,012
Water metering (L: .072)	0,002	0,001	0
High efficiency appliances and process water systems 1 (L: .261)	0,01	0,003	0,001

DOI: 10.15320/ICONARP.2023.269

Table 8. Importance levels of Energy and Atmosphere Criteria determined by the AHP Method

Energy and Atmosphere (L: .280)	1.Class	2.Class	3.Class
Optimize energy performance (L: .041)	0,004	0,004	0,004
Fundamental commissioning of building energy systems (L: .145)	0,028	0,009	0,003
Minimum energy performance (L: .058)	0,005	0,005	0,005
Use of automatic systems (L: .190)	0,015	0,034	0,004
Fundamental refrigerant management (L: .168)	0,005	0,015	0,027
Fundamental commissioning of building energy systems (L: .032)	0,001	0,002	0,006
Renewable energies (L: .366)	0,011	0,03	0,061

Table 9. Importance levels of Materials and Resources Criteria determined by the AHP Method

Materials and Resources (L: .150)	1.Class	2.Class	3.Class
Materials reuse (L: .285)	0,031	0,008	0,004
Storage and collection of recyclables (L: .089)	0,005	0,004	0,004
Materials reuse (L: .101)	0,005	0,005	0,004
Environmental impact optimization of the material used (L: .183)	0,01	0,01	0,007
Environmental impact optimization of the material used (L: .083)	0,004	0,005	0,004
Maintenance of load-bearing systems and non-structural elements (L: .110)	0,012	0,003	0,001
Use of Local Materials (L: .121)	0,01	0,006	0,002
Demolition and construction waste management (L: .028)	0,001	0,001	0,002

Table 10. Importance levels of Indoor Environmental Quality Criteria determined by the AHP Method

Indoor Environmental Quality (L: .160)	1.Class	2.Class	3.Class
Acoustic Comfort (L: .015)	0	0	0,002
Low-emitting materials (L: .207)	0,011	0,011	0,011
Minimum indoor air quality performance (IAQ) (L: .033)	0,002	0,002	0,002
Construction IAQ management plan (L: .034)	0,002	0,002	0,002
Indoor chemical and pollutant source control (L: .220)	0,012	0,012	0,012
Olfactory comfort (L: .047)	0,001	0,005	0,002
Outdoor air delivery monitoring (L: .036)	0,004	0,002	0
Air monitoring (L: .033)	0,002	0,002	0,002
Management and control of systems: Visual Comfort (L: .035)	0,002	0,002	0,002
Management and control of systems: Ventilation (L: .108)	0,002	0,011	0,004
Management and control of systems: Thermal Comfort (L: .145)	0,006	0,015	0,002
Environmental Tobacco Smoke (ETS) control (L: .088)	0,002	0,003	0,009

Table 11. Importance levels of Innovation in Design Criteria determined by the AHP Method

Innovation in Design	1.Class	2.Class	3.Class
Innovation in Assessment (L: .099)	0,002	0,001	0,001
Innovation in Material (L: .226)	0,003	0,003	0,003
Innovation in Applications (L: .675)	0,01	0,008	0,008

Table 12. Importance levels of Health and Safety Criteria determined by the AHP Method

Health and Safety (L: .031)	1.Class	2.Class	3.Class
Design for the disabled, the elderly and children (L: .776)	0,009	0,008	0,007
User safety and health quality performance (L: .224)	0,002	0,002	0,002

Historical Green Building Evaluation Model

As creating the model of "Historical Building Value Determination Method, the criteria were evaluated with the questionnaires carried out within the scope of the AHP method. For this evaluation, "Expert Choice 11" software was used.

The conversion of the obtained priority values to the scoring system consists of two stages. Firstly, the priority values of the categories of the Model are determined. Since the scoring system will be calculated of 100, the sum of the priority values of the relevant categories is equalized to 1, and then the resulting value is multiplied by 100. Thus, according to the 100-point of evaluation system score distributions were obtained and are indicated in Table 13.

Table 13. Evaluation Categories Score Distribution

Evaluation Categories	Score Distribution		
	1.Class	2. Class	3. Class
Regional Priority	7	3	2
Energy and Atmosphere	17	32	40
Indoor Environmental Quality	11	21	18
Materials and Resources	20	13	10
Health and Safety	3	3	3
Water Management	4	4	8
Sustainable Site	4	4	6
Historic Value	30	16	9
Innovation in Design	4	4	4
Total	100	100	100

In the Model, thereafter, creating the values of the categories according to the scoring system, the importance levels of the sub-criteria are determined by the AHP method. By making the sum of the importance levels equal to 1, the weight percentages of the criteria are determined Then, the point value of the relevant category is determined according to the weight percentages of the sub-criteria. With this method, the scoring system is established separately according to the three application areas. The score distributions of the criteria of the

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primary categories are shown in Table 14, Table 15, Table 16, Table 17, Table 18, Table 19, Table 20, Table 21 and Table 22.

Table 14. Historic Value category criteria score distribution

Historic Value	1.Class	2.Class	3.Class
Advanced analysis: energy audit	4	2	1
a) I Level Analysis b) Advanced analysis: thermography c) Advanced analysis: thermography and thermic conductance	Sub-criteria	Sub-criteria	Sub-criteria
Advanced analysis: diagnostic tests on structures and structural monitoring	9	2	1
a) Diagnostic tests on structures b) Diagnostic tests on structures and structural monitoring	Sub-criteria	Sub-criteria	Sub-criteria
Project reversibility	4	2	1
Querying the Conversation application	5	2	2
a)Compliance with the intended use and settlement benefit Compliance with the intended use and settlement benefit b) Structural similarity with the existing structure b) Structural similarity with the existing structure c) Diagnostic tests on materials and degradation	Sub-criteria	Sub-criteria	Sub-criteria
Sustainable restoration site	2	1	1
Scheduled maintenance plan	3	3	1
Specialist in restoration of architectural heritage and landscape	3	2	1

Table 15. Sustainable Site category criteria score distribution

Sustainable Site	1.Class	2.Class	3.Class
Construction activity pollution prevention	1	1	0
Brownfield redevelopment	0	0	0
Alternative transportation	0	0	0
a) Alternative transportation: public transportation access b) Alternative transportation: bicycle storage and changing rooms c) Alternative transportation: low-emitting and fuel-efficient vehicles d) Alternative transportation: parking capacity	Sub-criteria	Sub-criteria	Sub-criteria
Site development: open spaces recovery	0	0	0
Stormwater design: quantity and quality control	1	1	1
Heat island effect: non-roof and roof	1	1	5
Light pollution reduction	1	1	0

Table 16. Water Management category criteria score distribution

Water Management	1.Class	2.Class	3.Class
Water use reduction	1	1	4
Water efficient landscaping	1	2	3
Water metering	1	0	0
High efficiency appliances and process water systems	1	1	1

Table 17. Energy and Atmosphere category criteria score distribution

Energy and Atmosphere	1.Class	2.Class	3.Class
Fundamental commissioning of building energy systems	7	3	1
Minimum energy performance	1	1	2
Fundamental refrigerant management	1	5	10
Optimize energy performance	1	1	1
a) Calculation of building energy performance	Sub-criteria	Sub-criteria	Sub-criteria
b) Energy simulation of building internal dynamics			
Renewable energies	3	10	22
Enhanced commissioning	0	1	2
Use of automatic systems	4	11	2

Table 18. Materials and Resources category criteria score distribution

Materials and Resources	1.Class	2.Class	3.Class
Storage and collection of recyclables	1	1	1
Demolition and construction waste management	0	0	1
Maintenance of load-bearing systems and non-structural elements	3	1	1
Building reuse:	8	2	1
a) To be used in its main function	Sub-criteria	Sub-criteria	Sub-criteria
b) The new function does not require structural changes			
c) The selection of the new function must be in accordance with the characteristics of the structure			
Materials reuse	1	2	1
Environmental impact optimization of the material used	3	3	3
Material extracted, processed and produced within a limited distance.	1	2	1
Use of Local Materials	3	2	1

Table 19. Indoor Environmental Quality category criteria score distribution

Indoor Environmental Quality	1.Class	2.Class	3.Class
Minimum indoor air quality performance (IAQ)	0	1	1
Environmental Tobacco Smoke (ETS) control	1	1	2
Air monitoring	1	1	3
Outdoor air delivery monitoring	1	1	0
Construction IAQ management plan	0	1	1
Low-emitting materials	3	3	4
a) Low-emitting materials: adhesives and sealants	Sub-criteria	Sub-criteria	Sub-criteria
b) Low-emitting materials: paints and coatings			
c) Low-emitting materials: flooring systems			
d) Low-emitting materials: composite wood and agrifiber products			

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Indoor chemical and pollutant source control	3	4	4
Management and control of systems: Visual comfort	0	1	1
a) Lighting - Light Quality	Sub-criteria	Sub-criteria	Sub-criteria
b) Lighting System Control			
Management and control of systems: Thermal comfort	1	4	1
a) Thermal comfort: design	Sub-criteria	Sub-criteria	Sub-criteria
b) Thermal comfort: verification			
c) Use of existing systems to provide thermal comfort			
Management and control of systems: Ventilation	1	3	1
a) Natural ventilation	Sub-criteria	Sub-criteria	Sub-criteria
b) Artificial ventilation			
Olfactory comfort	1	1	1
Acoustics Comfort	0	0	1

Table 20. Regional Priority category criteria score distribution

Regional Priority	1.Class	2.Class	3.Class
Regional Priority	7	3	2

Table 21. Innovation in Design category criteria score distribution

Innovation in Design	1.Class	2.Class	3.Class
Innovation in applications	3	3	3
Innovation in material	1	1	1
Innovation in evaluation	1	0	0

Table 22. Health and Safety category criteria score distribution

Health and Safety	1.Class	2.Class	3.Class
Design for the disabled, the elderly and children	2	2	2
User safety and health quality performance	1	1	1

According to the Historical Building Green Building Evaluation Model, 40 points are the threshold points and a minimum of 40 points must be earned in order to have a certificate value. Certificate types and point distributions according to the evaluation system are shown in Table 23.

Table 23. Historical Building Green Building Assessment Model certificate types and scores

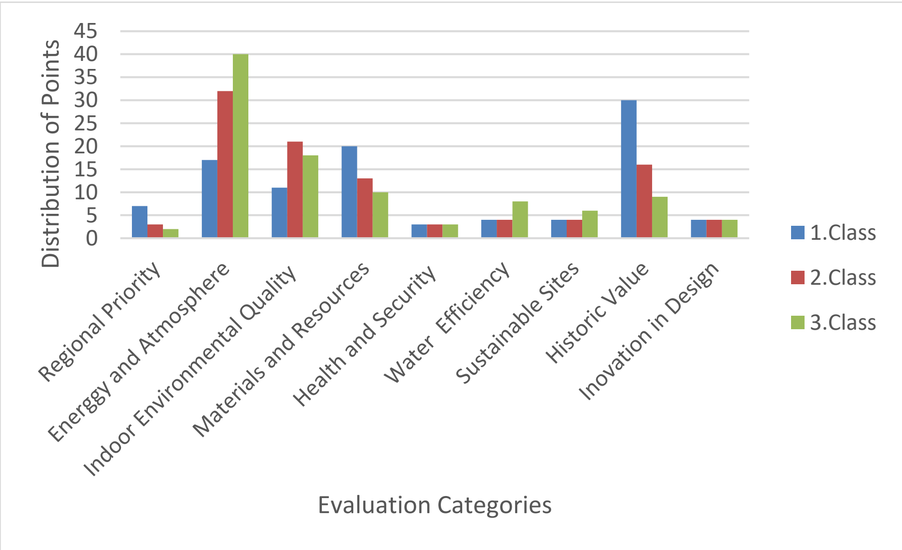
Certificate	Score
One Star	40-49
Two Star	50-59
Three Star	60-79
Four Star	80 and above

CONCLUSION AND RECOMMENDATIONS

In this study, it is aimed to create a national evaluation system for Turkey that will evaluate and certify historical buildings according to green building criteria. In current green building evaluation systems, it is difficult to determine which aspect of the building's sustainability is more or less important. Most rating systems use experts to determine the importance of relevant criteria when evaluating buildings. In addition, in these evaluation systems, the same rating system is applied to all historical buildings, ignoring the type of intervention to be applied to historical buildings. However, as seen in the research results, the importance of the criteria varies according to conservation practices and registration types of historical buildings. Therefore, considering the historical buildings registration system and conservation practices in Turkey, the establishing of a different rating system to be prepared, is of critical importance to reduce errors in green building evaluations of historical buildings and to make the planning of conservation interventions more effective.

In this research, using the AHP method, the importance levels of the relevant criteria in terms of three different groups were determined and the scoring systems were created based on these differences. As seen in Table 24, it is seen that the "Energy and Atmosphere" category has the highest degree of importance in Class 3 (reconstruction) and Class 2 historical buildings, and the "Historical Value" category has the highest degree of importance in Class 1 historical buildings.

Table 24. Scoring distribution of evaluation classes



This study is important as it will help make green building evaluations of historical buildings easier. It is thought that green building rating of historical buildings can be done effectively using this methodology. In future studies, it would be beneficial to improve the evaluation systems by adding different criteria and also conducting a broader survey.

DOI: 10.15320/ICONARP.2023.269

Historical building preservation itself is a green practice, but it must be supported by practices for conservation requirements. In Turkey, awareness of the use of environmentally friendly (green) practices in historical building conservation practices has not yet occurred and innovative steps need to be taken quickly in this field.

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Resume

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DOI: 10.15320/ICONARP.2023.269