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A Methodology for Selecting and Prioritizing Suitable Criteria for Sustainability Assessment of the Buildings and Development of Iran's Sustainable Building Rating System (ISBRS)

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Abstract: Iran's energy intensity in 2013 was four times the global average. The construction sector is responsible for about 40% of this consumption and the average energy consumption per square meter of the building isn't good compared to other countries. Today, the green building rating systems, as a method of environmental assessment of buildings has developed significantly. In line with promoting green building standards, these systems are of significant help for designers and builders and therefore, their usage has been increased day by day. However, selection of suitable criteria and weighting them is one of the challenges for developing and using these systems. This choice without considering the climatic conditions, the geographic location and the environmental priorities isn't possible. Hence, the development of regional ranking systems, comparing to international systems is of great importance. In this study with the aim of achieving a rating system in accordance with climatic conditions and environmental restrictions of our country, at first a comprehensive study on the available ranking systems have been done. Then among existing system, 6 of them including LEED, BREEAM, Pearl, GPRS, QSAS and SEAM have been selected and their criteria were categorized. Then by removing the similar criteria, a basket of 133 criteria is derived which is then divided into 11 groups. Afterwards, by forming a team of experts and performing a deep interview, a basket of 68 modified indexes in 8 areas was obtained. Then, by using the AHP technique and Expert-Choice Software, categories were compared and weighted. By calculating the coefficient of incompatibility, the comparison results are verified. We compared the proposed rating model, called Iran sustainable building rating system with the six other ranking systems and the obtained results are analyzed and the benefits of the system are discussed. At the end, we discuss our suggestions for the promotion and future development of the system.

Key words: Green building, sustainable building rating systems, green building rating tools, promotion, compared, calculating

INTRODUCTION

Nowadays, there are many agencies that have introduced tools or systems to evaluate the sustain ability of buildings that are known as sustainable building assessment tools or sustainable building rating systems. All of them have considered some criteria for sustain ability assessment and for each criteria, due to its importance and effectiveness, separate components are considered. Project assessor considers certain scores for criteria. From the sum of the scores of each criteria (is usually estimated based on 100), the total score of the project is obtained and shows the level of project success in observing sustain ability criteria. These tools help project managers to have a true understanding of the project condition. First, these tools were created as energy efficiency assessment tools or green building rating tools. Over time and with the development of public interest, environmental and economic aspects were considered, too. Terms such as sustainable construction, sustainable building and sustainable architecture were considered in this area. The most common tools for building's sustain ability assessment were BREEAM (Building Research Establishment Environmental Assessment Method) IEL. (2012), LEED (Leadership in Energy and Environmental Design), CASBEE (Comprehensive Assessment System for Built Environment Efficiency) and Green Srat and DGNB (Deutsche Gesellschaft für nachhaltiges Bauen-German Sustainable Building), respectively. Kibert (2013) enumerated some of these green building assessment tools in his book. The use of rating tools was started by vertical buildings and gradually moved toward horizontal buildings and transportation sector. Among the suitable tools for infrastructure projects, CEEQUAL (Civil Engineering Environmental Quality Assessment and Award Scheme) can be pointed out that started its services in 2003 in England. Studies five tools that have the most applicability in infrastructure projects.

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These tools are as follows: BE2ST-IN-HIGHWAYS (Building Environmentally and Economically Sustainable Transportation-Infrastructure-Highways (BE2ST-In-highways); Envision (Envision, developed by the Zofnass Program for Sustainable Infrastructure based at the Harvard Graduate School of Design and the Institute for Sustainable Infrastructure (ISI) http://www.asce.org/envision/); Green LITES (Green Leadership in Transportation and Environmental Sustainability); I-LAST (Illinois Livable and Sustainable Transportation); INVEST (Infrastructure Voluntary Evaluation Sustainability Tool). Numerous studies have been conducted on the development or promotion of sustainable building rating systems. Table 1, provides a summary of the previous studies in this area.

Problem description: Since, 1989 with the advent of the first assessment tool called BREEAM in England the type, weight and number of criteria for sustain ability assessment of buildings have changed constantly. Also, there were disagreements about how the criteria should be selected. There were concerns about the problems of these tools in several studies that were proposed by several critics. Priorities related to sustainable development are different in various countries. In some countries such as China, air pollution is the most important case. In Iran, dust, air pollution and shortage of water are the critical cases.

Neama (2012) mention the specific and general criteria in their study and affirm that the priorities in Middle East are different than in Europe and America and thus their local criteria are different (Neama, 2012). For example, as pointed in LEED system, the creation of facilities for bicycle in the building is advantageous while

Table 1: Six sustainable building rating systems

References	Title	Publication	Description
Bo Xia in 2014	Sustainable construction trends in journal	[8]	During 2000-2012, 743 articles were published in 12 journals. From these, 48 articles were published in technical journals. The author states that the articles are published in these seven areas: sustainable project management; sustainability assessment sustainable technology; sustainable building; government policies about sustainability Investment sustainability; Sustainability education
Yamany *et al.* in 2016	Applicability and Implementation of US Green Building Council rating system (LEED) in Egypt	[9]	Three buildings in Egypt that received LEED proposed suggestions. One of the important points in this regard is that in Egypt in addition to LEED, GPRS is used as a local rating system
Nguyen and Altan in 2011	Comparative review of five sustainable rating systems	[10]	Five rating systems were studied and some criteria were investigated in this regard. Some suggestions were proposed regarding these systems
Ammar in 2012	Evaluation of the Green Egyptian Pyramid	[11]	GPRS system of Egypt was compared with other systems in other countries and some suggestions were provided
Xia *et al.* in 2015	Comparison of sustainable community rating tools in Australia	[12]	Three rating systems in Australia were studied and differences and similarities were investigated
Alyami (2015)	The development of sustainable assessment method for Saudi Arabia built environment: weighting system	[13]	Using AHP, the criteria and weights were enumerated and finally, SEAM was proposed for Saudi Arabia
Nguyen and Altan in 2011	TPSI (Tall-Building Project Sustainability Indicator)	[14]	An accurate investigation on existing rating systems such as BREEAM, LEED, GB Tool, CASBEE and HK-Beam were performed and a new rating system called TPSI was introduced. The new system was only applicable for tall buildings. Besides showing its advantages, they explained how it can be implemented
Sharifi and Murayam in 2013	A critical review of seven selected neighborhood sustainability assessment tools	[15]	Seven neighborhood sustainability systems including LEED-ND, Earth Craft assessment tools Communities (ECC), BREEAM, communities, CABEE-UD, HQE2R, ecocity and SCR which are related to Australia, Europe, Japan and United States of America were investigated. The advantages and disadvantages of each system were explained
Asdrubali *et al.* in 2015	A comparison between environmental sustainability rating systems LEED and ITACA for residential buildings	[16]	LEED and ITACA were studied. First, two systems were introduced and then, buildings were assessed using these s ystems. Finally, advantages and disadvantages were enumerated
Wu *et al.* in 2016	A decade review of the credits obtained by LEED v2.2 certified green building projects	[17]	A decade of LEED V2.2 performance was investigated. More than, 5000 projects were assessed using this version of LEED. The author presented some recommendations for proper use of this system
Banihashemi *et al.* in 2014	Managerial sustainability assessment tool for Iran's building	[18]	Various systems were studied and some criteria were proposed for design, construction and operation steps. Then, the Satbir rating system proposed for assessment of sustainability in Iran's buildings

in a tropical zone like Saudi Arabia, the use of bicycle does not make sense. The Middle East countries are faced by the shortage of water and need cooling facilities. On the other hand, these countries have huge energy sources. Also, European and North American countries suffer from the shortage of energy. Moreover, they have cold weather and need warming devices. That means any region of the world will have specific credits which measure the environmental priorities and challenges. Besides, it will have some general credits that serve the global challenges. In Agenda 21 is has been pointed out that sustainable construction adopts different approaches and is accorded different priorities in different countries (CIB., 1999). In recent changes in LEED (ver.4), regional priority with the score of 4 is seen and this shows that importance of this issue that regional and local priorities are more determined for these systems. Maybe, one reason that different countries are looking for specific rating system is the attention toward local and regional criteria's. Authors investigated several rating systems using interview and questionnaire and showed that local systems, due to specific criteria, local systems have better performance compared to international systems (Saaty, 1980).

MATERIALS AND METHODS

The research process has been depicted in Fig. 1. Data collection method and tools consisted of interview and AHP technique (Saaty, 1980). The Expert Choice Software was used for criteria comparison. We used the quantitative analysis technique to analyze the interviews.

Preparing a basket of criteria: At first, a comprehensive study was performed on the various green (sustainable) building ratings systems. From different systems, 6 systems were studied according to Table 2. LEED and BREEAM as international systems with high popularity and other regional systems that are consistent with climatic conditions of Iran were selected.

At first, 285 criteria were selected and after eliminating the similar criteria and also criteria which included two or more other criteria, 133 criteria was remained and classified into 11 categories. For example, in Table 3 and 4, a comparison between the criteria between "water efficiency" and "energy" that are selected can be seen. Each system that has emphasized a certain criteria is indicated in the table.

Interview with experts: At this step, an expert panel is used to select criteria. This panel was randomly selected and in addition to interview with experts, the following questions were answered:

Which of the extracted criteria, considering climatic conditions and priorities is suitable for sustainable building rating system in Iran? (The expert panel rate the criteria in the range of 1-5. Number one indicates that the criterion is not appropriate, 2 indicates that the criterion

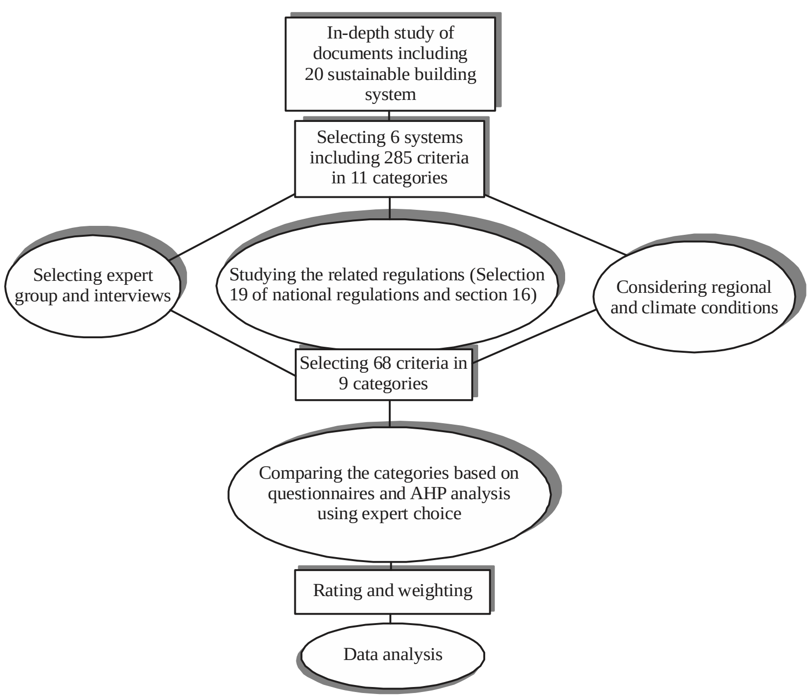


Fig. 1: Research method framework

Table 2: Six sustainable building rating systems

Reference	Pearl	QSAS	GPRS (NRCI)	SEAM (Alyami, 2015)	BREEAM-UK (IEL., 2012)	LEED-NC (USGBC)
System	The pearl rating system for Estidama	Qatar Sustainability Assessment System	Green Pyramid Rating System	Saudi Environmental Assessment Method	Building Research Establishment Environmental Assessment Method	Leadership in Energy and Environmental Design
Country	UAE	Qatar	Egypt	Saudi Arabia	England	USA
Developer	Abu Dhabi Urban Planning Council	Barwa and Qatari Diar Research Institute (BQDRI)	LEED	Saleh Alyami; Cardiff University	Building Research Establishment (BRE)	US Green Building Council
Year	2010	2010	2010	2014	1990	2000
Version	1	1	1	1	2008	4
Developed from	-----	CASBEE Green Globes SBTool BREEAM LEED CEPAS	LEED	LEED BREEAM Green Globes GPRS Pearl	Primary	Primary
Benchmarks	1 pearl mandatory 2 pearl: 60 3 pearl: 85 4 pearl:115 5 pearl: 145	1-6 Star	Certified: 40 Silver: 50 Gold: 60 Green: 80	Unclassified Pass: 35 Bronze: 45 Silver: 55 Gold: 75 Diamond: 85	Pass: 30 Very good: 55 Excellent: 70 Outstanding: 85	Certified: 40 Silver: 50 Gold: 60 Platinum: 80

Table 3: Comparing the criteria of water efficiency group in rating systems

Water efficiency	LEED	BREEAM	Pearl	GPRS	QSAS	SEAM
Water use reduction	√	√	√	√	√	√
Water use monitoring	√	√	√	√		
Water efficient equipment		√				
Water leakage detection		√	√	√		
Cooling tower water	√			√		
Grey water recycling	√					√
Collecting the rain water	√		√	√		√
Irrigation system						√
Decreased water consumption for cooling the air			√			
Water features efficiency			√			

Table 4: Comparison of energy efficiency criteria in rating systems

Energy efficiency	LEED	BREEAM	Pearl	GPRS	QSAS	SEAM
Minimum energy performance	√	`√	√	√	√	
Energy monitoring	√	√	√	√	√	√
Building envelope performance						√
HVAC system		√				√
Hot water system						√
Energy management system						√
Intelligent building control system					√	
Renewable energy technology	√	√	√	√		√
Ozone impacts of refrigerants	√	√	√	√		
Energy efficient appliances		√	√	√		
Demand response	√					
Peak load reduction			√	√		
Facility maintenance				√		√
Vertical transportation systems		√	√	√		
Drying space		√				
Fossil fuel conservation					√	
Shading strategy						√
CO_2 emission				√	√	
NOx and SOx emission		√		√	√	
Building user guide				√		
Energy monitoring during construction		√				
Leak detection					√	
Exterior lighting		√				

is not important and 3-5 indicate the amount of importance from low to high). Do you thing a new criteria can be added to the list?. Therefore, by extracting criteria that their mean was larger than 2.5 is list including 68 criteria in 8 categories was obtained that is depicted in Table 5. The average degree of importance in shown in column 1 and the score of the criteria is shown in column 2. “Location”, “ecology” and “transportation”

Table 5: Classification and prioritization of criteria according to the experts

Location, ecology and transportation	Expert	Points	Water efficiency	Expert	Points	Materials and wastes	Expert	Points
Development in rated and prioritized communities	2.6	1	Water use reduction	4.9	3	Green materials	4.4	3
Brown field site redevelopment	2.8	1	Water use monitoring	4.7	3	Responsible sourcing of material	4.2	3
Historical areas	2.9	1	Water leakage detection	3.2	2	Insulation	2.6	1
Compatibility with national development plan	3.1	2	Gray water	4.5	3	Local materials	4.3	3
Proximity to amenities	4.3	3	Collecting the rain water	4.6	3	Materials appropriate with climate	2.5	1
Protection of plant and animal habitats	3.3	2	Irrigation system	2.8	1	Construction waste management	5.0	3
Protection of environment against construction pollution	3.5	2	Indoor environment quality			Recycling facilities	2.3	1
Preservation, amendment and development of vegetation	4.6	3	Indoor air quality during construction and operation	3.6	2	Operational waste management	3.5	2
Greenhouse heating effect	2.6	1	Natural ventilation	3.8	2	Prefabricated elements	4.6	3
Desertification	2.7	1	Visual comfort	4.8	3	Materials reuse	4.3	3
Contaminated lands	2.8	1	Thermal comfort and control	4.6	3	building reuse	3.1	2
Access to transportation network	4.8	3	Water quality	2.7	1	Recycled materials	4.8	3
Bicycle facilities	3.2	2	Acoustic comfort	4.8	3	Design for material reduction	2.5	1
Car parking capacity	4.2	3	Low emitting materials	4.9	3	Modular systems	2.7	1
Electrical or hybrid cars	2.5	1	Smoke control	3.9	2	**Historical and cultural aspects**		
Energy efficiency			Security and safety	2.6	1	Cultural and historical identity	3.1	2
Minimum energy performance	5.0	3	Air tightness of building	5.0	3	Habits and customs effects (prevent dust)	2.6	1
Energy monitoring and reporting	4.9	3	Day lighting	3.1	2	Constancy of Islamic faith	2.7	1
Intelligent building control system	2.4	1	Outdoor noise pollution	4.1	3	**Management and operation**		
Renewable energy technology	4.8	3	External lighting	2.6	1	Contribution of advisors and constructors in green or sustainable rating	4.1	3
Ozone impacts of refrigerants	3.8	2	Quality views	3.1	2	Commissioning and decommissioning strategy	3.6	2
Energy efficient appliances	4.7	3				Procurement path	2.5	1
Vertical transportation systems	3.1	2				Committed and responsible stakeholders	2.6	1
Drying space	2.4	1				Operation and maintenance	2.7	1
Shading strategy	2.5	1				**Innovation**		
NOx and SOx emission	3.7	2				Innovating practice	4.8	3

categories were separated and finally were integrated in "site aspect". Also, "materials" and "wastes" were integrated, too.

Prioritizing and weighting of categories: After selecting the criteria, prioritization and weighting should be taken into consideration Trusty (2008) believes that distributing and weighting the criteria is one of the most complicated parts of each system. One method to compare several criteria is AHP. To prioritize the selection criteria and determining their importance level, numerous studies have used the same method (Wong and Li, 2007). In this study, this method has been used for distribution of points and weights at the second level.

The experts were asked to prioritize and compare the aspects in 8 different categories. In Saaty method Saaty (1980), the comparisons are rating by 1/9 to 9 where 9 indicate the highest degree compared to other criteria and 1/9 shows the lowest priority degree.

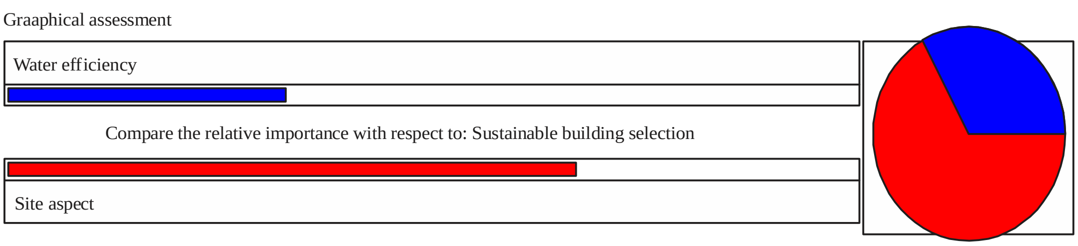
In this questionnaire, the importance between two parameters is rated between 1 and 9. Here, 1 means equality, 3 means moderate priority, 5 means strong priority, 7 means very strong priority and 9 means extreme priority. Also, 2, 6 and 8 show moderate priorities. In the following, the obtained matrix was analyzed by Expert Choice.

In Fig. 2, this matrix that has been made in the software can be seen. Each component is obtained from the mean of experts comments. Fig. 3 is another outcome of the software. As can be seen, "energy efficiency", "water efficiency", "materials" and "wastes" with the scores of 23, 15 and 14 from 100 are three priorities of a sustainable building from the perspective of experts.

Circle one number row below using the scale:
1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	Water efuciency	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Site aspect
2	Water efuciency	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Energy efficiency
3	Water efuciency	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Indoor environment
4	Water efuciency	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Material and waste
5	Water efuciency	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Management and oper
6	Water efuciency	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Cultural aspect
7	Water efuciency	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Inovation
8	Site aspect	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Enery efficiency
9	Site aspect	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Indoor environment
10	Site aspect	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Material and waste
11	Site aspect	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Management and oper
12	Site aspect	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Cultural aspect
13	Site aspect	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Inovation
14	Energy effuciency	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Indoor environment
15	Energy effuciency	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Material and waste
16	Energy effuciency	9	8	7	6	5	4	3	2	1	2	**3**	4	5	6	7	8	9	Management and oper
17	Energy effuciency	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Cultural aspect

Fig. 2: Matrix of comparison between categories (Expert Choice)



	Water efficiency	Site aspect	Energy efficiency	Indoor environment	Material and waste	Management and operate	Cultural aspect	Inovation
Water efficiency		(2.02)	(1.32)	1.88	1.88	2.11	2.37	1.91
Site aspect			(2.05)	1.23	(1.23)	1.44	1.63	1.3
Energy efficiency				2.5	1.56	2.77	3.51	2.5
Indoor environment quality					(1.6)	1.11	1.26	1.0
Material and waste						1.71	2.01	1.71
Management and operate							1.13	(1.11)
Cultural aspect								(1.25)
Inovation	Incon: 0.01							

Fig. 3: Comparison of criteria (Expert Choice)

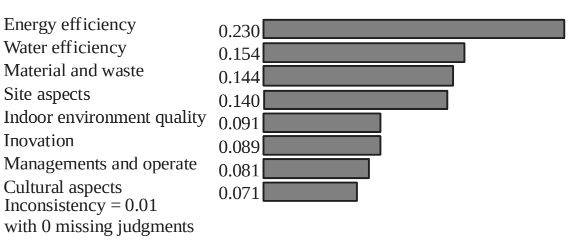


Fig. 4: Prioritization between categories (Expert Choice)

Consistency Ratio (CR): Basically, AHP method is based on pair wise comparison of options. Also, it is likely that inconsistency occurs in this comparison. For example, if A>B and B>C, we will have A>C. Now, if A<C, we have inconsistency. In this problem, Expert Choice estimated the inconsistency coefficient as 0.01 (IR = 0.01) and since, it is <0.1, it indicates the consistency of the comparison (Fig. 4).

RESULTS AND DISCUSSION

Alyami (2015) states that the main part of a rating system is weighing. Indeed, what makes distinction between rating systems is the difference in the weight of criteria. Table 6 shows the results and priorities of sustainable building rating system in Iran as well as the scores for each category.

Table 7 presents a comparison of each criterion weight between the proposed rating system for Iran and other 6 rating systems. In the energy efficiency category,due to the high energy consumption in the building (around 40% of the total energy consumption in this part-non-productive), the energy consumption have always been attracted attention. In spite of putting too much emphasis in the section 19 of national regulations (energy saving) which is compulsory, still the amount of energy consumption per square meter of buildings in Iran

Table 6: Point attribution method in Iran sustainable building rating system

Category	Weight percentage	No.of criteria	Points	Description
Energy efficiency	23.4	10	21	Minimum energy performance by proper insulation and double-glazed glass-boiler and generator emissions should be lower than the defined level-using separate meters to measure consumption-solar energy inside or outside the site-using energy efficient appliances-Intelligent control methods-natural lighting-natural ventilation-a climate oriented architecture. Using shading-balcony to dry clothes-using high efficiency lamps-lighting control by time and movement sensor
Water efficiency	15.4	6	15	Water use reduction inside and outside the building compared to the standard level-Water metering using separate meters for a 5-year period after receiving the certificate-using equipment to decrease water consumption-rainwater collection system-reusing water for irrigation-modern irrigation methods-using trees and vegetation with low need to water-controlling the concentration of parameters in cooling towers
Material and waste	14.4	14	30	Using material with low environmental effects-at least, 25% of materials should be recycled materials-local materials-reusing materials or building elements-materials consistent with the environment-prefabricated materials-modular design-waste management-waste separation location
Site aspects	14	15	27	Development in rated and prioritized communities-reuse of land (at least 75% of the development should not be undisturbed lands)-priority of development in historical and contaminated lands -employing ecologist consultant in large scale projects-preservation and development of landscape-design with at least 30% open space-reducing the construction effect on the environment-access to facilities-access to transportation network-bicycle facilities-limited parking space-electrical or hybrid cars
Indoor environment quality	9.1	14	31	Air quality during construction and operation-day lighting-glare Control-smoke control-low emitting materials (paints, carpet, …,) lighting and thermal control-acoustic comfort-visual comfort-air tightness-water quality
Innovation	8.9	1	3	Using innovative techniques and policies-innovative designs
Management and operation	8.1	5	8	Cooperation with green building assessment agencies-delivery Management-sustainable procurements-operation and maintenance
Cultural aspects	7.1	3	4	Cultural and historical identity-habits and customs effects-Islamic faith
	100	68	139	

Table 7: Classification and prioritization of criteria according to the experts

Category	Pearl UAE	QSAS Qatar	GPRS Egypt	SEAM Saudi Arabia	BREEAM UK	LEED-NC USA	ISBRS Iran
Site	17	17	14	5.4	16.4	23.6	14.0
Energy	26	24	24	26.7	26.4	30.0	23.4
Water	23	16	29	25.8	5.5	10.0	15.4
Materials	11	8	10	13.2	18.2	11.8	14.4
Indoor environment quality	15	14	10	12.7	13.6	14.5	9.1
Management	6	8	10	9.4	10.9	0.9	8.1
Innovation	2		3		9.1	5.5	8.9
Cultural aspect		13		2.5			7.1
Economic aspect				4.3			
Regional priority						3.6	
	100	100	100	100	100	100	100

is about 2.5 times greater than the global average. Thus, according to the conducted analysis, the highest priority with the weight of 23.4% has specified for this category, showing the great importance of the energy category from the perspective of expert panel. Also, the considered criteria for the energy category in this research are much more comprehensive than the section 19 of national regulations.

The most important criteria in this section (Table 6) include “energy efficiency”, ‘utilization of solar energy” (unfortunately the utilization level of clean energies in Iran is less than 2%), using “Energy efficient appliances” and “monitoring” and measuring energy consumption by different countries that all of these aspects have scores higher than 4.

In water efficiency category, since, Iran is located in dry area with low level of rainfalls, the underground water level has decreased in recent years and for this reason, we have witnessed ground settlement. Although, the major part of water consumption in Iran is related to agriculture sector, the water consumption level in household sector is two times the global average. According to the result of analysis, Iran has the second place among the criteria and has dedicated the weight of 15.4% to itself. Compared to other systems, Iran has water consumption about 3 times the level that has been considered by BREEAM and about 1.5 times the level that has been considered for LEED. In Saudi Arabia, this weight is considered as 25.8% and since, this country does not have any river nor lake, it is justifiable. In this section, the most important criteria that are taken into consideration by experts (scores higher than 4) include “water use reduction”, “water use monitoring”, “reusing water or grey water” and “reusing rainfall water” (for non-drinking purposes).

In material and waste category, it should be stated that the condition of materials and wastes is not acceptable. One of the main reasons for this condition is less attention to industrialization of buildings and lack of prefabricated buildings and modular systems. According to the experts, this category has the relative weight of 14.4. In this section, BREEAM with the score of 18.2 has gained more percentage. The most important priorities to achieve sustainable building from the perspective of experts include “green material”, “responsible sourcing of material”, “local material”,“construction waste management”, “prefabricated elements” and “recycled materials”.

In indoor environment quality that almost points to internal parts of the organization, appropriate lighting and comfort of residents has gained the weight of 9.1%. According to Table 7, the highest scores were allocated to Pear with 15 and LEED with 14.5. The most important criteria in this category with the scores above 4 are “air tightness” of building, “material with low emission”, “acoustic comfort”, “visual comfort”, “external noise pollution” and “thermal comfort”.

The management category with the weight of 8.1% gained the 6th place and despite defining five criteria in this category, only “Contribution of advisors and constructors in sustainable rating” rating above 4. In this category, BREEAM with the weight of 10.9% allocated the greatest weight to itself compared to other systems.

CONCLUSION

The innovation category that obtained the weight of 8.9%, gained the second place after BREEAM with the weight of 9.1%. This section aims to introduce solutions that are not predicted in rating system as a new and innovative method and each innovations receives 2 points.

The cultural aspect that is seen in rating systems of Qatar and Saudi Arabia, the experts gave the weight of 7.1 that compared to other systems is a relative high weigh but none of the suggested criteria in this category received scores higher than 4.

RECOMMENDATIONS

Each rating system should be assessed after 3 years. The scope of study consisted of residential buildings and for future studies, other buildings such as schools, administrative buildings, training centers and banks can be taken into consideration. The most important part of a rating system is referred to comprehensive standards that can cover these systems and review international standards of sustainable or green buildings. For example, the International green Construction Code (IgCC) and standard for the design of high-performance green building except Low-Rise Residential Buildings (ASHRAE189.1) can be pointed out. Therefore, it seems that from 22 sections of national building regulations, only 19 section (energy saving) have been emerged in energy criteria. Therefore, the development of an independent section in green or sustainable buildings area seems necessary. Rating systems require basic standards as well as assessment categories (for inspection and rating), guidelines (description of ratings, necessary certificates for each score, how to rate design and performance) and an applied guideline to implement methods and criteria of sustainable building and these aspects can be taken into consideration in future studies.

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