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Sustainability Assessment Criteria for Building Systems in Iran

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Abstract: Building construction plays crucial role in sustainable development, so Applying sustainability assessment tool in building systems can be effective in optimized decision- making to use them. The main objective of this research is presenting assessment criteria to investigate sustainability in building systems. In this study, assessment criteria firstly are made based on resources review and review of literature. In the following, these criteria are completed, arranged, measured and weighted by questionnaires. the final grouping of criteria are done and sustainability criteria are divided into three general groups as environmental, social and economical criteria and each group is consisting of sub-criteria.the table of criteria and weights and values from questionnaires and checklists, presents a simple scoring system to evaluate and assessment of sustainability. Determination of sustainability criteria is the first step of presenting a local model for sustainability assessment of building systems in coming researches.

Key words: Sustainability assessment % Sustainable construction % Sustainability criteria % Building systems % Iran

INTRODUCTION

One of the most important issues of building development in global and local scale and compatibility with conditions and environment is the environmental efficiency and sustainability of building systems. Today, environmental efficiency of the buildings has attracted the attention. Building construction plays crucial role in sustainable development. This issue is not only due to participation in national economy but also it is due to the fact that the constructed environment has considerable influence on life quality, comfort, safety, health and etc [1]. construction, maintenance and updating the constructed environment have importance influences on the environment and the consumer building is the major part of non-recycled resources and causes a lot of waste and the performance of the buildings cause half of the total of carbon dioxide emissions [1]. International organization of building researches (CIB) defines the goal of sustainable architecture as creation of a healthy artificial environment based on ecologic design and resources efficiency. A sustainable building is the one having the least incompatibility with the artificial and natural environment and it is including the building itself, its surrounding environment, local and global environment [2,3].

Problem Statement: For good planning and decision making in application of any kind of construction systems, the assessment of construction systems provides optimized planning and decision making. Different variables are effective in the assessment of the sustainability of construction systems as the variables related to the environment and background. By using these variables and criteria in assessment and decision making trend, the selection and application of building systems will be viable with more compatibility with the environment. Thus, applying appropriate sustainability assessment criteria in building systems can be effective to be used and its application is necessary in the condition of Iran construction industry due to increasing development of construction. The main aim of this study is presenting sustainability assessment criteria to assess and investigate sustainability in building systems.

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Literature Review: There are wide scope of researches titled "assessment in construction field" investigating different aspects and using various criteria and methods. Among them the environmental assessment is an issue that is discussed frequently. One of most important researches in this regard is Ying Chen *et al* research [4, 5]. In this research, according to resources review and also using questionnaire tools by the comments of four groups, some criteria are made for selection of optimized construction system [4, 5]. In arranging sustainability index model [6] the considerable criteria in sustainability are divided into four groups of environmental influences, external advantages, energy consumption and financial return and in each group they are consisting of some sub-criteria. These criteria are all compatible with sustainable development and to provide some goals such as reduction of environmental effects, increasing efficiency and usefulness, reduction of resources and increasing assets [6]. This kind of criteria grouping is to some extent equal to environmental, economical and social criteria. In Iran, Qasemzadeh *et al*. [8] presented a checklist for assessment and selection of optimized industrial construction method that is done by giving local coefficients to the applied criteria and the sum of assessment scores and decision making. Despite high efficiency, the investigated criteria have special characteristics of the related region being influence by regional conditions. In few researches being applied in Iran or similar regions, it seems that these criteria are still very general and they rarely could be executed. In table 1 Summary of criteria in the previous researches are presented.

Table 1: Summary of criteria in the previous researches

No	Assessment criteria	Author	source
1	Environmental impacts: on site operation as pollution, loss of habitat and operational life as pollution, Ecology damages External benefits: employment opportunities, living environment, indoor environment comfort, productivity, leisure Energy consumption: operational energy as Lighting and power, cooling and heating, Building maintenance, embodied energy as mining, manufacturing, on site process, Final disposal Financial return: project costs: land acquisition, plant and equipment, Materials, labor project benefits: revenue	Ding, 2008	Sustainable construction—The role of environmental assessment tools Grace K.C. Ding_ Journal of Environmental Management 86 (2008) 451–464 [6]
2	Economical criteria: Construction time, initial costs of construction, maintenance costs, disposal costs, life cycle costs, defects and damages, the speed of return on investment, flexibility and compatibility, loading capacity, integration of building services, lead-times, material costs, labor costs, constructability, integration of supply chains. Social criteria: Health of occupants (indoor air quality),influence on job market, physical space, aesthetic options, workers health and safety, labor availability, community disturbance, traffic congestion. Environmental criteria: site disruption, renewable contents, energy efficiency in building use (thermal mass), recyclable elements, material consumption, energy consumption in design and construction, waste, pollution generation, water consumption.	ying chen, 2010	Sustainable performance criteria for construction method selection in Concrete buildings, Ying Chen, Gül E. Okudan, David R. Riley, Automation in Construction 19 (2010) 235–244 [4]
3	Basic criteria Sustainability criteria Competitive criteria	Alireza Amirimehr	[7]

Table 1: Continued

No	Assessment criteria	Author	source
4	Economical factors	Qasemzadeh *et al*	[8]
	Responding mass production requirements		
	The easy supply of construction materials in the country		
	The dependency of material supply to foreign exchange.		
	Economical consumption scope		
	The condition of complete execution costs in special time and space conditions.		
	The condition of operation costs in special time and space conditions		
	Execution time and space		
	The dependency to auxiliary tools and facilities of installation and execution		
	The dependency of different execution actions to each other		
	The amount of execution operation for material production on site		
	Seasonal limitation in the execution of construction system		
	Consumed time and general schedule of system execution in definite time and space condition		
	The influence of administrative-execution stops in keeping the validity of work		
	Execution capabilities and the scope of the related system		
	The amount of requiring labor education and experience		
	The application of multi-use parts		
	Compatibility with modular design method		
	The connection of each component or part with other parts		
	The capability to give variation to architecture design		
	The way in which engineering tools are used in execution and installation		
	Various materials used in the related system		
	The number of actions and execution stages		
	Installations prediction		
	Dependency to the application of heavy machineries (or special tools)		
	Technical and specialized capabilities and characteristics		
	Compatibility of the system with climatic condition		
	Compatibility of a system with healthy and safety conditions in the environment		
	The condition of the installation of thermal insulation in the related system		
	Durability of the system in different climatic conditions		
	The recyclability of material and elements		
	The capability of creating changes in the related system after execution		
	Easy final operation		
	The amount of clearness of technical characteristics in the investigated systems		
	The existence of technical knowledge and regulations of common and national code for construction for the related system		
	Easy maintenance and repair		
	Efficiency and behavior of construction system considering applied expectations from its components and elements		
	The role of changing execution factors in changing the quality and precision of the related execution in the system.		

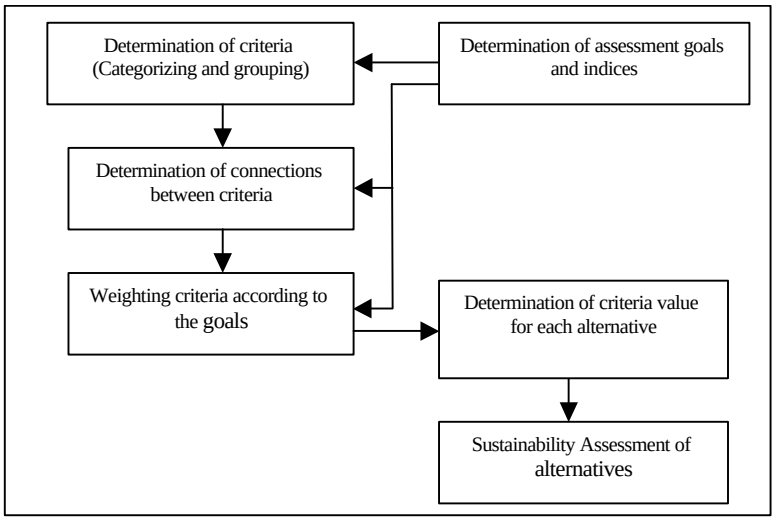

Fig. 1: The general process of criteria determination

Table 2: Sustainability Assessment Criteria

Main category	criteria	Sub criteria
Environmental criteria	Energy consumption	Energy consumption in production and execution stage
		Energy consumption during building life
	Compatibility	Compatibility with natural environment and climate
		Compatibility with built environment
	Waste	Material waste
		Resources waste
		Energy waste
	Recycle criteria	Material recycle
		The application of renewable material
	Pollution criteria	The amount of pollution in production and execution stage
		The amount of pollution in maintenance and consumption stage
		The amount of pollution in destruction stage
	Resources consumption	Materials consumption
		Water consumption
Economical criteria	Cost	Costs of resources and materials
		Labor costs
		Maintenance costs
		Renovation and destruction costs
	Investment criteria	Investment return
		Initial investment
		Exchange amount
	Time	Construction time
	Execution issues	Durability
		Constructability
		Continuity of execution stages
		flexibility
		Material and equipment availability
Social criteria	Social issues	Social participation
		Social disturbance
	Labor market	Labor availability
		Influencing labor market
	Safety and health	Work safety
		Occupants health
	Design and architecture issues	individualization and social identity
		Physical space and performance
		Aesthetics and architectural issues

Table 3: Range of Criteria scores

		Max	Min	Average
W	Criteria weight	5	1	3
U	The value of criteria for each alternative u	5	1	3

Table 4: The importance of scores

Ranking scores	Score5	Score 4	Score 3	Score 2	Score 1
Importance	Very high importance	High importance	Moderate importance	low importance	Very low importance

The Investigation of Assessment Criteria: One of the primary and main steps in each assessment is arranging assessment criteria. In this study, assessment criteria firstly are made based on resources review and review of literature. In the following, these criteria are completed, arranged, measured and weighted by questionnaires.

One of the most important parts of assessment and making its model is determination of assessment criteria and then the amount of importance and weight of each of these criteria. These activities are consisting of different stages and in figure 1 the process of making criteria is shown. After the initial investigation of criteria by different methods, according to the studies and reviews, the final grouping of criteria are done and sustainability criteria are divided into three general groups as environmental, social and economical criteria and each group is consisting of sub-criteria.. In table 2 these criteria and sub-criteria are presented.

Criteria weights and also alternative value in each criterion in this research is ranging from 1 to 5. 1denotes less important and gradually 5 shows great importance. Thus, number 3 shows average importance. In table 3 range of criteria scores and in table 4 the importances of scores are presented. To determine the weight and value of criteria, questionnaires and checklists are used. Questionnaires are designed to determine the weight of criteria in achieving sustainability and respondents are chosen among experienced faculty members and experienced engineers.

CONCLUSION AND DISCUSSION

Today, building and construction is raised as a necessity in most of developing countries. One of the challenges in building industry, is environmental damages being increased in wide development such as industrialization, its importance is increased. In this study, some criteria are proposed for sustainability assessment in building systems to select best methods from sustainability aspect. In arranging criteria, literature review and previous researches and also analytic method are used and in determination of weight and value of criteria in special options, questionnaire and comments of expert groups in the theory and execution are used. The table of criteria and weights and values from questionnaires and checklists, presents a simple scoring system to evaluate and assessment of sustainability. Determination of sustainability criteria is the first step of presenting a local model for sustainability assessment of building systems in coming researches.

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REFERENCES

1. Mohamad Kamar, K.M., E. Ismail, E. Ismail, Z. Abd. Hamid, C. Egbu, M. Arif, Mohd Zin, M.Z.N. Mohd, K. Ghani, A.H. Rahim, Sustainable and Green Construction, 2010, Construction Industry Development Board (CIDB) Malaysia.
2. Mofidi Shemirani, S.M., M. Akhtar Kavan and H. Akhtar Kavan, 2008. Sustainable architecture, energy and environment, the second conference and specialized fair of environment engineering 2008, Tehran University, Tehran, Iran.
3. Fallah, M.H., 2002. Building industry and sustainable development, Soffe Magazine, 40: 64-79.
4. Chen. Y., G.E. Okudan and D.R. Riley, 2010. Sustainable Performance Criteria for Construction Method Selection In Concrete Buildings, Automation in Construction, 19: 235-244.

5. Chen, Y., G.E. Okudan and D.R. Riley, 2010. Decision support for construction method selection in concrete buildings: Prefabrication adoption and optimization, Automation in Construction, 19-6: 665-675.
6. Ding, G.K.C., 2008. Sustainable Construction, the Role of Environmental Assessment Tools, Journal of Environmental Management, 86: 451-464.
7. Amiri Mehr, A. and E. Zarabi, 2010. Presenting dynamic model of industrialization system selection of housing in wear-out texture, 2nd national conference of new technologies of building and industrialization 2010, building and housing research center, Tehran, Iran.
8. Qasemzadeh, M., B. Mohammad Kari, S. Bakhtiari and H. Roushanbakhsh, 2008. Guideline of the assessment of construction systems in the design and construction of housing, research report NO. 399, building and housing research center, Tehran, Iran, 2008.