Environmental assessment of buildings through HQE[1]® Method; Case study: a three-story residential apartment in 5th District of Isfahan

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Nowadays, Sustainable Development (SD) has become one of the most important paradigms of the contemporary societies and all programs in various disciplines should coordinate their aims and approaches with its principles. But determining the degree of sustainability in different contexts has been one of the more challenging issues. According to the relative nature of sustainability, evaluation of sustainability needs to a set of Sustainable Development Indicators (SDIs) in order to achieving more realistic judgment. Preparing this set of indicators is one of the best methods of environmental assessment, which their comparison helps us to evaluate the actual situation and/or future's one. In this paper, after effectuating the above mentioned step on a residential apartment in Isfahan through HQE® method, a set of indicators in two categories containing four groups of fourteen objectives are defined and then investigated. The results showed that only in the group of hygienic objectives the building reach hardly the note over the average and concerning other three groups of indicators the note is not satisfying. This type of evaluation firstly increases our awareness and sensitivity about the existing projects and helps us considerably to understand and analyze the actual situation. This is also a very important factor for any future intervention according to our objectives and aims.

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Introduction

How could we insert the concerns of sustainable development to the fields of architecture and urbanism? What are the characteristics of a sustainable project of architecture or urbanism? How could we define the degree of sustainability? These are the questions that we are trying to find a response through the method of HQE®. At the first we have to be aware about the nature of "relativity" of sustainability. It is accepted that sustainability is not attainable in its absolute aspect. In this point of view, the example could be utopian and unreal; where everything is perfect and ideal. Usually the degree of sustainability is defined according to a comparison with another case or a defined level of performance. To do this, we need to develop an evaluation system with criteria and indicators which permit us to have a basis of judgment for case study.

The necessity of defining the indicators

In order to defining the degree of sustainability we need to develop a set of indicators. An indicator is a device that provides specific information or a sign that shows the state of something. Usually, indicators are known in two forms: measurable indicators, such as energy consumption, atmospheric pollution or noise pollution which the last one is measured in dB for example. These indicators have often a quantitative nature as percentage, note, number, grade, GPA, and scores. Qualitative indicators show characteristic of something or someone in such a way that is not measurable as quantitative indicators. This type of indicators usually focuses on environmental operations and functions and a kind of prescription. Thereby this indicator focuses on the level of attention to the functional requirements (ex: existence or inexistence of inflammable walls in the building) and executive procedures (ex: treatment of waste, fire ban, according to standards) to put on the agenda. Expert opinion about a phenomenon is one of the most widely used indicators in this category.

The approach of HQE®

The method employed in this research is called HQE® from French “Haute qualité environnementale” which means “high environmental quality”. HQE® includes both an environmental management system and also a target of environmental quality of buildings defined by 14 targets. The HQE® is a multi-criteria optimization approach. It aims at achieving healthy and comfortable structures and buildings whose impacts on the environment, assessed on the entire life cycle, are controlled as possible. The charter of HQE® provides the consideration of the following 14 targets for better environmental quality of buildings:

- The eco-construction targets (1-3): “harmonious relationship between buildings and their immediate environment”, “integrated choice of construction products and processes”, “low nuisance construction site”.

- The eco-management targets (4-7): “energy management” “water management”, “waste Management”, “care and maintenance”

- Targets of comfort (8-11): “hydrothermal comfort”, “acoustic comfort”, “visual comfort” and “olfactory comfort”.

- The health targets (12-14): “health conditions”, “air quality”, “water quality”.

Two principles underlie the HQE® approach:

1. The construction, maintenance and use of any building induce an impact on the environment, and therefore the overall cost, the HQE® will try to reduce or compensate, for maximum performance.

2. The principle of targets: it is linked to the quality process, if the target is reached in the field; the relative level of performance is equal to that of the best known project at the same time.

Material and methods

In our method, a three-story apartment in 5th district of Isfahan was chosen as case study especially because of it similarity to the most common type of residential parcel in Iran (the 60-40 pattern). The mentioned parcel was located between two neighboring divisions with the same number of stories and the same rate of land occupation. The built surface was about 200 m2 and the structure was from armed concrete. Some of the construction codes of this building were affected by the particular socio-cultural aspects of Isfahan who were not necessarily common in all cities of country. Level made the plaque located in the north and regulations governing equal to about privacy in Isfahan and nobility of vision, which incidentally North Side, located opposite the beautiful park, had been deprived of vision. Thus the height intended for the edge of the fuselage windows overlooking the street (North Side) 175 cm was considered that the residents actually saw two important living space including kitchen and one of the bedrooms to the proper perspective of natural had denied. Among them can be cited regulations relating to privacy (vis-à-vis), according to which one of two apartments located face to face, has the rights of visual access to the landscape in the middle of two buildings. To solve the problem of light, the inferior part of window's framework is installed at least at 175 cm from finished building floor and this could be very inconvenient. The majority of construction materials were masonry and concerning energy consumption (heating and cooling) the efforts were negligible. According to the HQE® method, the 14 objectives were categorized into four following groups where the first two categories were related to the exterior forces (opportunities and treats) and the last two ones, to the interior factors (strengths and weaknesses) (Table 1).

Table 1: Classification of objectives according to HQE®

Related to the exterior forces	Ecological construction	1. Harmonious relationship buildings/ immediate environment
		2.Integrated choice of construction methods and materials
		3. The avoidance of nuisance by the construction site
	Ecological management	4.Minimizing energy use
		5.Minimizing water use
		6.Minimizing waste in operations
		7.Minimizing building maintenance and repair
Related to the interior forces	Comfort	8.Hydrothermal control measures
		9.Acoustic control measures
		10.Visual attractiveness
		11.Measures to control smells
	Health	12.Hygiene & cleanliness of the indoor spaces
		13.Air quality controls
		14.Water quality controls

These are criteria for evaluation of a building in which in general could be constructed more than 500 indicators. In this paper we have developed a table of 47 indicators based on the first objective (Harmonious relationship between buildings and their immediate environment). The other objectives could be developed according the same way. In order to have a catholic approach, we have chosen two to four indicators in each objective (which is comparable to criteria in other methods) and so made a table of 40 indicators to evaluate the questioned building. The selection of indicators is done according to 11accessibility of data (quantity or quality). The next step was quantification of quality indicators in order to compare them with each other, and

finally have a general assessment of building. The value of each indicator has varied from 0 to 5. Some unites of evaluation like "yes/no" responses were not easy to be compared in same scale as others. So the value of 0 is considered for "no" response and 5 for "yes" response. The other qualitative responses were transformed to the 0-5 numbers in same way. In the next step, the average of values of each group, categorized according to the 14 objectives was calculated.

Results

After the calculation, the notes have varied from 0 to 3.5 (from 5). The best note (3.5) is recorded for the group 14 (Water quality controls) and three groups of objectives including 3 (The avoidance of nuisance by the construction site), 5 (Minimizing water use) and 8 (Hydrothermal control measures), have obtained the worst score of zero. The other notes were as shown below:

Group 1 (Harmonious relationship buildings/ immediate environment): 0.8

Group 2 (Integrated choice of construction methods and materials): 1.17

Group 4 (Minimizing energy use): 1.75

Group 6 (Minimizing waste in operations): 1

Group 7 (Minimizing building maintenance and repair): 2.33

Group 9 (Acoustic control measures): 0.5

Group 10 (Visual attractiveness): 2.67

Group 11 (Measures to control smells): 2

Group 12 (Hygiene & cleanliness of the indoor spaces): 2.5

Group 13 (Air quality controls): 2

For evaluating this building, 5 level of performance are defined. These levels are respectively from worst to the best as below: 1. Alert (0 - 0.99 point); 2. Undesirable (1–1.99 points); 3. Passable (2 – 2.99 points); 4.Agreeable (3 – 3.99 points) ; 5. Ideal (4 – 5 points).

The above mentioned groups have been classified in these categories to better understand the situation.

Discussion and Conclusion

This research has shown that this case study (a typical 40-60, residential pattern in Iran) has real problems with 3 groups of indicators. The groups 1 and 9 are also classified in the "alert" group and so consideration should be taken to modification of aspects relating to these indicators. Some aspects like using solar passive energy, separating natural gas and water counters, water recycling, waste separation, humidity control system, using thermostat for heating, anti-leakage system and double glazed windows are completely neglected. Efforts concerning noise reducing and visual pollution during construction must be taken into account. In general the average value of all 14 groups of objectives was 1.5/5. So according to the defined indicators, the building is evaluated under the average. It should be noted that more indicators are numerous, more the result is confident. Therefore the next step would be development of a complete system of indicators which could result to a more detailed and exact evaluation.