Green rating systems: an adoption of sharing layer concept

Svetlana Pushkar, Department of Civil Engineering, Ariel University, Israel, svetlanap@ariel.ac.il
Edna Shaviv, Faculty of Architecture and Town Planning, Israel Institute of Technology, Israel, shaviv@tx.technion.ac.il

Summary

The idea of the visualization of a building as six shared layers: Site, Structure, Skin, Services, Space and Stuff, each reflecting their different lifetime scales and subsequently, their different environmental damages. The division of the building to six-layer concept will result in more reliable green points allocation with accordance to the Israeli Green Building Standard, SBTool and LEED, is presented.

Keywords: Standardization, green building, sharing layer concept

1. Introduction

Since 1980 much interest has been devoted to decreasing building-related environmental impacts and promoting sustainable building-related activities. In general, rating systems have quite similar sustainable categories such as site, energy, water, materials, emissions, management, etc. Each category commonly includes together both credits for the site and structure that have long timescale influence as well as credits for the serving systems that have short timescale. Horvat and Fazio [1] suggested that “The relations between separate sub-systems within a building, and of the building itself with its surroundings is rarely linear. The performance assessing method needs to reflect that complexity”.

Shaviv [2] claimed "Energy efficiency in buildings, according to LEED can be achieved only by improving the mechanical, electrical and hot water systems. There is no need to improve the architectural design from bio-climatic and passive solar aspects." She stated that "The fact that all energy saving features are put in one basket...leads to the present situation". Moreover, "as the life expectancy of a building in Israel is about 50 to 100 years and that of the building systems is about 15 to 20 years only, the requirements for these two groups of the energy sub-categories should differ..." [3]. Therefore, she suggested dividing the energy category to two subcategories: Building energy performance and Building services systems. The separation procedure, which was initiated by Shaviv, is already embedded in the recent revision of SI 5281 [4].

In this respect it is appropriate to introduce “shearing layers” concept invented by architect Frank Duffy. The shearing layers concept separates a whole building into six layers [5]. The layers are: site (timescale: eternal), structure - the foundation and load-bearing elements (timescale: from fifty to three hundred years), skin - exterior surfaces (timescale: twenty to fifty years), services - communications wiring, electrical wiring, plumbing, fire sprinkler systems, HVAC, elevators and escalators (timescale: from ten to twenty years), space plan – interior walls, ceilings, floors, and doors (timescale: three to ten years) and stuff - chairs, desks, phones, pictures; kitchen appliances, lamps, hairbrushes (timescale: from daily to monthly).

This paper suggests adoption of the shearing layers concept to the green rating system. The idea of visualization of the building as six layers is due to their different timescales and consequently, due to their different environmental damages as well. Such a separation will allow allocating points to each sustainable building-related activities with an objective criterion of the life expectancy and the environmental damages. The paper will present how such a separation can be adopted to all subjects in each category of the Israeli Green Building Standard, in LEED, and in SBTool and how points could be allocated more objectively, based on such a separation that considers the timescale of each
design parameter. In this study all examples are taken from: SI 5281 Part 3 for office buildings, LEED 2009 for New Construction & Major Renovations [6], and SBTool [7] average variant (focused the following variants of SBTool: Energy and Emission, Indoor Environmental Quality, Site Regeneration, Urban Design and Infrastructure, Social and Perceptual and Residential design issues, Design phase).

As consequence of rapidly developing of science and technology, the Standard Institution of Israel recognized the need for new revision of the Israeli Green Building Standard every three to five years period. The authors will propose the study of the adoption of sharing layer concept as an important point to consider for the further development of the Israeli SI 5281.

2. The Energy category of the Israeli Green Building Standard

Launched in 2005, SI 5281 was the first version of the Israeli rating system offering building sustainability. In 2011 the second version of SI 5281 was available [4]. The essence of the revised SI 5281 is to undertake various sustainable activities within nine environmental categories: energy, site, water, materials, health and wellbeing, waste, transport, and management and innovation. SI 5281 already has a separate approach for allocating points associated with the energy category (building and services sub-categories). In this paper the sharing layers concept was adapted to all environmental categories of SI 5281 while the separation procedure itself is explained in the Energy category.

Credits with their maximum of available points in the sub-category “Building”, were relocated to the relevant sharing layers. The Passive heating and cooling (1.1.1 Bioclimatic Design - Passive heating credit) intends to determine bio-climatic design strategies, ensuring natural ventilation of the building, and applying passive heating and cooling techniques. Design strategies for natural ventilation and passive heating and cooling techniques mostly depend on the design of the building skin, in addition to the building structural design [4]. Therefore, the points of 1.1.1 Bioclimatic Design - Passive heating and cooling were divided between Skin (3pt) and Structure (1pt).

The credit 1.1.2 Bioclimatic Design - Sun and shade (7pt) intends to maintain the solar rights of the planned project and of the buildings and open areas in its close environment. Thus, the credit was relocated under the Site sharing layer.

The Energy Efficiency (1.1.3 Energy Efficiency according to SI 5282 [8]) intends to achieve savings in energy consumption required for heating and cooling of the building, by designing the building as energy conscious one. Energy conscious building strategies mostly depend on the design of the building skin (insulation of the envelope, window size, type of glazing and shading of them, building thermal mass and night ventilation for passive cooling), as well as the design of the building's structure (including the thermal mass of the structure, building geometry, compactness and proportions and window orientation) [3]. Therefore, the points of the credit were divided between Skin (13pt) and Structure (8pt).

The credit 1.1.4 Daylighting of public indoor areas (1pt) intends “to reduce energy for electric lighting in all public communal indoor spaces that are in daily use, like lobbies, stairways, etc.” [4]. The issue requires a certain minimum window area as 3% of the floor area of these spaces. Thus, the credit was relocated under the Skin sharing layer.

As the number of the total points allocated to the sub category 1.1 "Building energy performance" are 21, while all points allocated to all subjects summarized to 33, therefore, each point mentioned above in this sub-category should be corrected by a factor of 21/33.

All credits and their maximum available points of the sub-category “Services” such as: 1.2.1 Energy Lighting Performance (8pt), 1.2.2 Water Heating (1pt), 1.2.3 On-site Renewable Energy (2pt), 1.2.4
HVAC systems (6pt), 1.2.5 Sub-metering and control (1.5pt), 1.2.6 BEMS, Building Energy Management Systems (3pt), 1.2.7 Internal transportation systems (1.5pt), 1.2.8 Energy Efficient IT Solutions (0.75pt) were relocated under the Services layer due to the same expected timescale (from ten to twenty years) of these systems and appliances. Again, as the number of the total points allocated to the sub-category 1.2 “Services” are 16, while all points allocated to all subjects summarized to 23.75, therefore, each point in this sub-category should be corrected by a factor of 16/23.75.

In the same way the points of each category were allocated to the six shared layers.

3. Rating systems and tools

The sharing layer concept was applied to three systems, IS 5281, SBTool average variant, and LEED and the obtained results were compared. SI 5281 has nine environmental categories: energy, site, water, materials, health and wellbeing, waste, transport, management and innovation. SBTool average variant (design phase) evaluates seven issues: site regeneration and development, urban design and infrastructure; energy and resource consumption; environmental loadings; indoor environmental quality; service quality; social, cultural and perceptual aspects; cost and economic aspects. LEED estimates seven categories: sustainable site, water efficiency, energy and atmosphere, material and resources, indoor environmental quality, innovation and design process, regional priority credits.

To perform comparison of a sharing layer adoption to SI 5281, SBTool, and LEED systems, the credits and their relevant points of the systems were relocated to several generic sustainability categories that best represents their intent: energy, sustainable site, water, materials, health and wellbeing (H&WB), construction site management and innovations. It should be noted the LEED system has 110 points in total, while SI 5281 and SBTool are designed on a 100 points scale. Therefore the LEED points were standardized by a 100% scale. The results of a sharing layer adoption to SI 5281, SBTool, and LEED systems are presented in Fig. 1 – Fig. 4.

Analyzing the total percentages of Building and System layers, by summing all environmental categories (Fig. 1), SI 5281, SBTool (average variant) and LEED systems use different approaches for emphasizing importance of each of six building layers: SI 5281 focuses on importance of Building layers (Site, Structure and Skin) with a long timescale (from eternal to fifty years) and offers 60% of points to be achieved under these layers. SBTool (average variant) gives the same priority to both, Building layers (50% of points) and Service Layers (50% of points). Eventually, LEED focuses on the Service layers (Services, Space plan and Stuff) with a short timescale (from twenty years to daily) and gives 66% of points to these layers.
Nevertheless it should be noted, SBTool variant focused on site regeneration, urban design and infrastructure (Site) issues devotes more attention to Building layers (59% of points), while SBTool variant focused on energy and emission (Energy) issues gives a little more priority (53% of points) to Service layers (Fig. 2).

While analyzing Building layers allowable percentages per each environmental category (Fig. 3), all systems pay much attention to sustainable site category. In addition, H&WB category is more significant for 5281 and SBTool (average variant) than for LEED system. Somewhat dissimilar attention deserve to site management, material and innovation categories: site management category has evident consideration in SI 5281 systems in contrast to both LEED and SBTool (average variant), while in material and innovation categories LEED and SBTool (average variant) implement better than SI 5281. However, SI 5281 in contrast to LEED and SBTool (average variant) considers energy and water categories as significant issues for Building layers.
While analyzing System layers allowable percentages per each environmental category (Fig. 4), all systems devote large importance to energy category. Also water category is meaningful issue for all systems. Slightly different consideration takes place in material, site management and innovation categories: in material category LEED and SI 5281 perform better than SBTool (average variant), while site management and innovation categories have certain attention in both SI 5281 and LEED systems. However, LEED in difference with SI 5281 and SBTool (average variant) considers sustainable site H&WB categories as important issue for System layers.

4. Discussions

In order to fulfill the promise that Green Buildings will be designed as truly sustainable buildings, the adoption of a sharing layer concept to the Green rating system was suggested. Allocating points to each sustainable building-related activity with the objective criterion of the life expectancy and the environmental damages, the SI 5281 rating system was reshaped with accordance to the idea of visualization of the building as six sharing layers: Site, Structure, Skin, Services, Space and Stuff reflecting the different lifetime scales associated with them.
Furthermore, SI 5281 was compared with SBTool (average variant) and LEED, and these were also reshaped with accordance to the sharing layer concept. It was concluded that the current version of the LEED rating system is mostly out of compliance with the sharing layer concept. The system is not considers energy, water, and H&WB as important issues for Building layers. SBTool (average variant) adjusted better to the sharing layer concept. However the tool gives a little attention to energy and water categories within Building layers.

In contrast, SI 5281 is already on the road toward the application of the sharing layer concept, with only minor corrections to be suggested for the further development of the Israeli SI 5281 in the Structure and Services layers within the categories: material, site management, and innovation.

References


