

The energy chapter of the Israeli Green Building Standard



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Summary

The fundamental ideas, logic and thoughts that led to the definition of the requirements for an energy efficient building that warrants green points according to the Israeli Green Building Standard, is presented. Emphasis is put on the sections concerned with: Bio-climatic, Passive and Low Energy architecture of the building, design for minimal energy consumption for cooling, heating and lighting via building envelope optimization, as well as design for solar rights for the proposed building and the close surrounding environment: buildings and open spaces.

Keywords: Standardization, green architecture, energy, passive & bio-climatic design.

1. Introduction

Green Architecture has recently gained momentum to become the current fashion and the main stream architectural practice. Hence, one would expect bio-climatic, passive and low energy architecture to grow up with the Green Architecture movement. However, it didn't happen. By examining carefully different projects that are labeled "Green Buildings", the author found the reasons for that are [1]:

1. Current environmental assessment methods commonly use simple 'point hunting' approach [2,3]. As a result, the developers are looking for "cheap points" that are easy to obtain. Energy points are, in general, expensive ones. Hence, the developers are trying to avoid them.
2. This means that even if the rating system contains one third of all possible points assigned to energy efficiency [2], nevertheless, in order to be labeled as a "Green Building", there is no obligation to do it, as one can get the minimum score required for a building to be labeled green with only slight improvement in the energy performance of it.
3. Moreover, even when energy efficiency is considered, it may be achieved merely by improving the mechanical, electrical and hot water systems. There is no need to improve the architectural design from bio-climatic and low energy architectural aspects [1].

The Israel Green Building Standard ST-5281: "Buildings with Reduced Environmental Impact" was first issued on November. In 2008 it was decided to review periodically this standard at least every five years, in order to adapt it to scientific and technological developments. This paper refers to the revision of this Green Building Standard, as was approved by the expert committees but has not yet been approved by the public. Hence, changes may be introduced.

At the stage that this paper is written, eight parts are included in the revision, which are: Part 1 that presents the general requirements, parts 2 to 9 are devoted to different buildings types that includes: Residential, office, education, hotels, healthcare, retail, public and industrial buildings respectively. All types of buildings include the same categories, but the sections and points

allocated to each section and category are not always the same. In this paper all examples are brought from the ST 5281 Part 2 (residential) [4].

As many other current environmental assessment methods, the Israeli Green Building Standard uses the 'point hunting' approach. According to the number of points achieved, the building may be labelled as a "Green Building" on five "Green Grades" levels: Green (55-64), Silver (65-74), Gold (75-82), Platinum (83-89) and Diamond (90-100).

The number of points allocated to each category of ST 5281 Part 2 (residential) was determined by the Residential Expert Committee, which decided that the energy category is the most important issue in Israel and should get 40% of the total points available. Water and Land are second in importance and should get 17% each. The rest of the points will be allocated to all the other Categories. Thus the revision for ST 5281 Part 2 (residential) allocated points to the different categories as follows: Energy (40), Site (17), Water (17), Materials (6), Health and Wellbeing (9), Waste (4), Transport (1), Management (4), Innovation (2), Total: 100 points.

2. The Energy Chapter of the Israeli Green Building Standard

Based on the above mentioned observations and in order to avoid the faults that were mentioned above, the Energy Chapter was divided into two sub chapters: 1.1. Building energy performance and 1.2 Building services systems. 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 and we can't treat them on equal footing when assessing the energy consumption of the building.

The Energy Consumption of the Building services systems, like the mechanical equipments is controlled under an Israeli Standard that defines the minimum required efficiency for each system, while the Energy Consumption of the building is carried out according to the Israeli Standard IS 5282 "Energy rating of the building" [5]. In IS 5282, the calculations of the energy consumption for heating, cooling and daylighting for a proposed building design, as well as for the reference one, are performed according to the electricity consumption of an Air-condition system, with a required minimum COP. Thus, only the architectural aspects are considered under IS 5282.

Solar systems, like solar water heating and PV, are not included in the sub chapters "Building energy performance" as their life expectancy is much shorter than that of the building. On top of it, solar systems for water heating is mandatory in residential buildings in Israel for more than 30 years, so no points can be granted for it. Only in cases where it is not mandatory, solar water heating systems can be awarded points according to the size and efficiency of the system.

PV is not mandatory, but as it is highly subsidized by the government, the decision was to consider it as a separate issue.

The sections and the maximum available points in each section of the sub-chapter "Building Energy Performance" are: 1.1.1 Bioclimatic Design – Passive heating and cooling (4pt), 1.1.2 Bioclimatic Design – Sun and shade (7pt), 1.1.3 Energy Efficiency according to SI 5282 (25pt), 1.1.4 Daylighting of public indoor areas (1pt), 1.1.5 Drying Space (1pt) and in the sub-chapter "Building services systems" are: 1.2.1 Energy Lighting Performance (4pt), 1.2.2 Water Heating (5pt), 1.2.3 On-site Renewable Energy (4pt), 1.2.4 HVAC Systems (7pt), 1.2.5 Sub-metering and control (2pt), 1.2.6 BEMS, Building Energy Management System (1pt), 1.2.7 Internal transportation systems (1pt). As the total available points of all sections in the energy chapter exceeds the maximum points allocated to it, there is a freedom to choose the issues that the design team would like to apply to a particular project. However, there is a minimum required number of points that should be achieved in each sub-category in order to achieve "Green Building" label rating for each level. Moreover, there is a requirement to achieve in a new building energy rating of at least grade C According to SI 5282 [5] for the "Green Building" Label Rating (see Table 1).

Table 1: Minimum Standards of Energy Scores of "Green Building" Label Rating

Characteristic	Green	Silver	Gold	Platinum	Diamond
1.1. Building energy performance	12	16	19	22	26
1.2 Building services systems	5	7	8	9	11
At least Level According to SI 5282	C	B	A	A+	A+

The author of this paper was in charge of the revision of the building energy performance sub-chapter. She put an emphasis on the improvement of the architectural design, i.e. implementation of bio-climatic and passive solar solutions as well as on minimizing the energy consumption of the building. In this paper we will present in details the energy related issues of the first energy sub chapter "Building energy performance".

3. Building energy performance

The sub-chapter 1.1 Building energy performance includes the following sections:

- 1.1.1 Bioclimatic Design – Passive heating and cooling (4pt)
- 1.1.2 Bioclimatic Design – Sun and shade (7pt)
- 1.1.3 Energy Efficiency according to SI 5282 (20pt for new buildings, 25pt for retrofitting)
- 1.1.4 Daylighting of public indoor areas (1pt)
- 1.1.5 Drying Space (1pt)

The total points allocated to new buildings for all these sections are 33. However, for achieving the highest grade "Diamond" only 26 points are required (see table 1). Therefore the design team has the freedom to choose the subjects that fits best the project in the local context, as long as the building is rated A+ according to the Israeli standard IS 5282. To be rated A+ means that the building should save in climate zone A (Tel Aviv climate) at least 35% relative to a reference building. By achieving grade A+ the building already gets 20 points which means that at least another 6 points must be chosen from the other sections of sub-chapter, like bioclimatic design, daylighting of public indoor areas (in multifamily residential buildings), and drying space for the laundry. All this requirements grantee that energy efficiency will be achieved by good design of the building and not merely by improving the building services systems.

4. Bio- climatic Design

The Bio-Climatic design includes the following subjects: a. determining bio-climatic design strategies and applying passive and low energy design systems for passive heating and cooling and b. environmental assessment in regards to the sun and shade.

4.1 Passive heating and cooling

The intent of this section is to encourage energy efficient building design using passive heating and cooling techniques. The first part of this section includes Bio-climatic analysis and determining the design strategies that fit best the project location. The requirement is to present the climatic conditions; temperature and relative humidity on a Bioclimatic Chart, in order to determine the suitable passive and low energy strategies (Fig. 1). The Bio-climatic analysis is a prerequisite without awarding any point for it. It may be perform manually, or by using computer programs like PASYS [6]. The second part includes the physical application of passive heating and cooling systems according to the environmental-climatic design strategy appropriate for the location and ensuring natural ventilation in the building [7]. The passive systems to be applied in the project and the building area served by each system should be presented in schematic drawings. The points are determined according to the floor area of the building devoted to the primary functions that is served by passive system for heating or for cooling. The passive systems to be applied and the building area served by each system, should be documented and presented (Fig. 1).

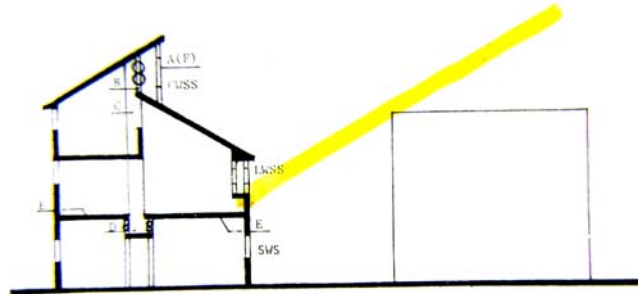


Fig. 1. Shaviv House - A Passive Solar Residential Building: Example of solar retrofit of existing building located in a high density urban area [7]. The passive system is a "Central Window Sunspace System (CWSS)" that collects the solar radiation at the roof top and transfers it to the first floor that is shaded by its neighbouring building. The CWSS serves also as wind chimney and thermal chimney that ensuring natural ventilation in the building (Arch. Edna Shaviv).

4.2 Sun and shade

The building density in Israel is one of the highest in the world. The green code, as its name declares, “Buildings with Reduced Environmental Impact”, should ensure suitable environmental conditions to the surrounding buildings and open spaces, as well as the building itself in regards to the sun and winds. (Winds analysis were first located in this chapter but was moved to the chapter “Health and Wellbeing”). Therefore, the intent of this section is to maintain the solar rights of the planned project and of the buildings and open areas in its close environment.

Analyzing the shadow cast by the surrounding buildings and objects and the shadow cast by the designed building on its close environment is a prerequisite without awarding any point for it. This analysis can be carried out manually, according to a prescription/description approach [8], or by using computer programs like SHADING [9] if the performance approach is applied (See Fig. 2).

Points are awarded according to achieved a predefined amount of solar exposure of the designed project, as well as the closed environment of: a. the solar systems (PV and water heating solar collectors), b. the building elevation, mainly in the southern section, and c. the open spaces of the proposed designed building. Moreover, the building should comply with the requirements of keeping the solar rights of the neighbouring buildings and open spaces [8]. The last requirement is mandatory for buildings taller than 90m or those taller than 45m if their length is greater than 45m.

Another point is awarded when 20% of the main open area of the project is designed for achieving summer shading, while keeping the winter required insolation. This might be achieved by fixed shading devices, or evergreen trees, in areas which are shaded by building masses during the winter or by dynamic shading devices including deciduous trees, in areas which are not shaded by building masses during the winter.

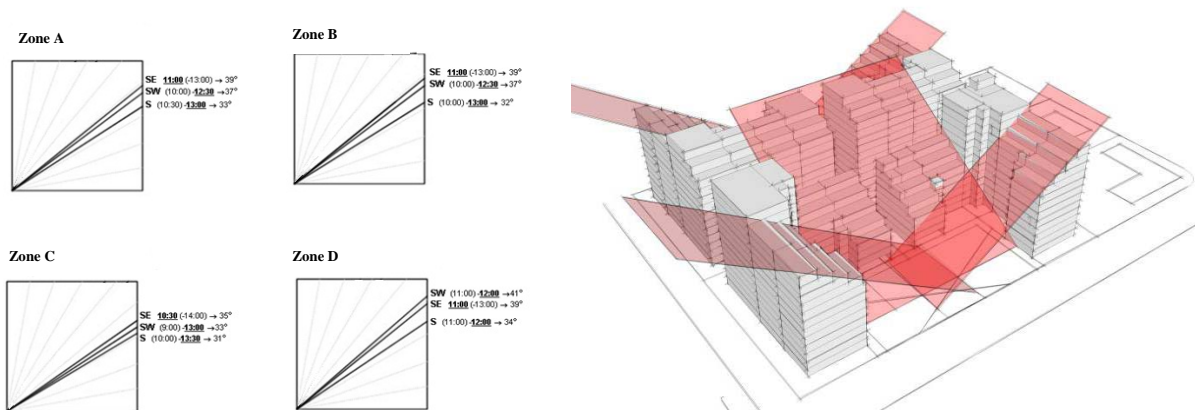


Fig. 2: Solar Rights Requirements – The Descriptive approach

5. Energy Efficiency according to SI 5282-1

Achieving points for minimizing the energy consumption of the building that is required for heating, cooling and lighting, is based on the Israeli Standard SI 5282 [4]. This Israeli Standard offers prescription/description methods as well as a performance method to evaluate the building energy consumption. The energy performance method defines a reference building that complies with the mandatory Israeli Standard 1045 [10] that prescribes the required insulation and shading of the building envelope. Saving 20% of the energy consumption of the reference building is a prerequisite in all climatic zones, except in zone D (the Jordan Valley) that has a very hot climate. There are 5 grades. The percent required for achieving of D to A+ rating is different for residential and commercial buildings. Moreover, these numbers are not the same in the four climatic zones of Israel as it was impossible to achieve 40% energy savings in the hot climatic zones, like in the temperate cool zone C (Jerusalem climate). The hotter the climate is the less saving could be

achieved. However, in all climatic zones, energy rating of A+ provides the green building with 20 points, while energy rating of C wins 5 points only. Achieving the same level of energy efficiency in existing buildings is more difficult. Hence each energy rating grade gets higher score (see table 2).

Table 2: Energy Rating of buildings in IS 5282 and IS 5281

Compliance level	New building	Existing building
Level D	-	5
Level C	5	10
Level B	10	15
Level A	15	20
Level A+	20	25

The Israeli standard IS 5282 emphasizes the building architecture: envelope insulation and shading, windows size and orientation, building thermal mass and night ventilation for passive cooling, as well as the building geometry, compactness and proportions. This is in contrast to ASHRAE 90.1 [11], the scope of which is: "This standard provides: minimum energy-efficient requirements for the design and construction of: 1. new buildings and their systems, 2. new portions of buildings and their systems, and 3. new systems and equipment in existing buildings. To ensure that the building is mechanically heated in winter or cooled in summer, the requirement is: "The provisions of this standard do not apply to: ... buildings that do not use either electricity or fossil fuel". Moreover, there is a minimum requirement of the capacity of the HVAC systems: "provided that the enclosed spaces are: 1. heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h-ft² or 2. Cooled by a cooling system whose sensible output capacity is greater than or equal to 5 Btu/h-ft². This means that the emphasis in ASHRAE 90.1 is put on improving the mechanical system, and not on the design of the building.

To cope with the scope of ASHRAE 90.1, the reference building is defined in appendix G according to the geometry of the proposed building, an action that practically eliminates the influence of the building's geometry. Contrary to this, the reference building in IS 5282 is defined with fixed geometry and depth to allow daylighting. In such a way the geometry of the proposed building is considered and is influential. On the other hand, In IS 5282, the calculations of the energy consumption for heating, cooling and daylighting for a proposed building designed, as well as for the reference one, are performed according to the electricity consumption of an Air-condition system, with a required minimum COP. Thus, only the building energy performance aspects are considered under IS 5282.

5. various issues

5.1 Daylighting of public indoor areas

The Intent of this issue is to reduce energy for electric lighting in all public communal indoor spaces that are in daily use, like lobbies, stairways, etc. The minimum required window area is 3% of the floor area of these spaces. The location and details of glazed areas, designed for these public communal indoor spaces and the building area served by it, should be documented and presented.

5.2 Drying Space

Providing drying space for the laundry is very common in Israel. In the past, it used to be a place on the common roof. Later, it was replaced by providing each apartment with a special space adjacent to a service balcony. However, as dryers became quite popular, there is a tendency today not to provide such spaces any more. The expert committee for the energy chapter, as well as the committee for residential buildings, decided to encourage energy saving for drying laundry by providing an adequate space it. This space may be either an outdoor space, like balcony, or special space outside the building (see fig. 4), or on the roof. Only in public areas like dormitories it may be an indoor space with adequate, controlled ventilation. The fixing for hanging the laundry needs to be a permanent feature. The location of drying fixings and details should be documented and presented.

6.



Fig. 3. Solar collectors for Hot Water



Fig. 4. Drying Spaces: Left, Hidden Space adjacent to a utility balcony in each floor of a High rise residential building. Right: Drying space in Low rise private house.

Discussions

In order to guarantee that Green Buildings will be designed as Low Energy ones and in order to avoid the faults of the present situation that the minimum required points for energy saving may be achieved with no need to design the building as a low energy one, the following criteria and rules were imposed:

- a. The Energy Chapter should get sufficiently more points than other green categories.
- b. A minimum required points from the energy chapter should be obligatory in order to achieve each "Green Grade" level.
- c. Low energy architecture requirements are imposed based on achieving a minimum required predefined Energy Rating for each "Green Grade" level according to IS 5282.
- d. "Passive and Low Energy Building Design" should be treated separately from the hot water systems (that is mandatory in Israel) and the mechanical systems (AC and others, like elevators) and Bio-climatic analysis should be required as prerequisite without awarded points for it. Therefore, the Energy Chapter is divided into two main Parts: The building energy performance and the building services systems performance. This separation is also important because the building is designed to outlive the services systems by a large margin.

7. References

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