Why PLEA buildings didn't glow with Green Architecture?
Can it be changed?

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Are Green Buildings Designed as Passive and Low Energy Ones?

Green Architecture emerged recently as the current fashion and strives to be mainstream architectural practice.

Hence, one would expect Passive & Low Energy Architecture (PLEA) to flourish with the GREEN Architecture movement.

However, it didn't happen.

Intel Building:

The first " LEED GOLD " Green Building in Israel

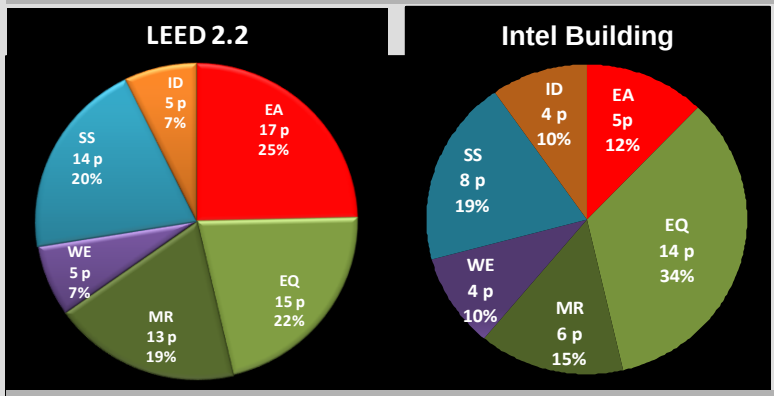
As for example:

Examination of the LEED GOLD *Intel Building* in Israel reveals that it saves very little energy!

- **It got in the entire Energy Chapter only 5 points**
- **and in optimizing Energy Consumption only 2 points**

Intel Building:

The first " LEED GOLD " Green Building in Israel



Left: LEED v2.2 - total possible points, Right: Points achieved by the Intel Building to obtained LEED Gold Accreditation

Moreover,

There are defaults from the point of view of Bio-Climatic and Passive Solar Architecture:

- **There are hardly any shades to protect the Western windows.**
- **There are no special elements to achieve passive cooling or heating.**
- **Windows on South and North facades are alike.**

Intel Building – Israel
West and South Elevations

Intel Building – Israel
West and North Elevations

One may also pose the inverse question:

Are PLEA buildings recognized by LEED as Energy Conscious, to be awarded LEED points for minimizing energy consumption?

Not for sure!

The SF Federal Building failed to obtain (at first) any LEED accreditation, although it embraces the following PLEA features:

- **It is a narrow building to allow daylight and cross-ventilation into all offices.**
- **The windows operate by automatic sensors, or manually.**
- **Two completely different facades, as each facade is shaded according to the orientation.**
- **Concrete floors and ceilings as thermal mass to reduce temperature swing in winter, and with natural night ventilation to cool the building in summer.**

Thus, no need for air conditioning!

South Elevation - horizontal perforated metal skin as

North Elevation - vertical glass fins as brises-soleils

Thermal Mass

SF Federal Building, 2007 Morphosis/Smith Group

So - How could it be that the SF Federal Building failed to receive the credit points for optimizing energy performance?

This is because <u>when the building is so good that mechanical systems are not required</u>, you lose the option to get the 10 credit points for minimizing energy performance.

RECALL that the Performance Rating Method is based in LEED on ASHRAE 90.1 that can't be used for buildings without mechanical systems.

If this is not a paradox, what is it?

The USGBC claims that LEED is a work-in-progress, and agreed to re-evaluate it. **After re-evaluation the building won a LEED Silver certification only.**

South Elevation - horizontal perforated metal skin as

North Elevation - vertical glass fins as brises-soleils

Daylight

What is MISSING in current assessments tools?

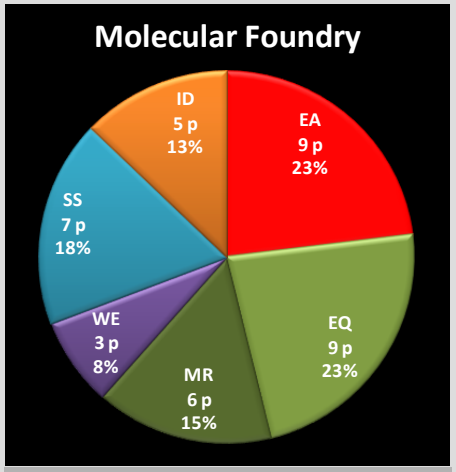
Most current environmental assessment methods use a simple 'point hunting' approach.

The tendency is to choose "cheap" and "easy" points. The points for reducing energy consumption are neither "cheap" nor "easy".

Moreover, putting all energy saving features into one basket leads to the fact that energy efficiency may be achieved only by improving the systems: HVAC, electrical, hot water and PV,

West and North Elevations

Contrast in main working cubical space from the unshaded West Elevation



Points achieved by the Molecular Foundry Lab. in LBNL (2007) to obtained LEED GOLD Accreditation

and not by improving the Building Energy Performance.

Furthermore:

Using PV, solar panels for hot water, or buying Green Power, is awarded twice in LEED: once, as it reduces the amount of total purchased energy and again, as it contributes to the "Green Power credit " or to the "On Site Renewable Energy".

On the other hand, Passive Solar Energy is not considered as "On Site Renewable Energy".

Consequently, there is no need to improve the architectural design of the building.

Plaza Apartments, 2006, Leddy Maytum Stacy Architects and Paulett Taggart Architects.

So, How can we ensure low energy building design?

1. **Passive Systems for Low Energy Buildings should be awarded.**

2. **On top of the prerequisites, minimum required points for not "easy", but important issues, like energy, should be imposed at each "Green Grade" level.**

3. **Energy conscious building design should be evaluated separately from the mechanical and the hot water systems. This is because the building is designed to last for at least 50 to 100 years, while the mechanical and hot water systems last less than 15 to 20 years.**

This is the Crucial Step towards the solution of the Problem

Being in charge of the Energy Chapter of the Israel Standard, I made sure that these principles are implemented in the revision of the Israeli "Green Building" Standard SI 5281

2. Passive and low energy architecture - The Israeli approach within the sustainable building standard

The revision (2011) of the Israeli Standard (5281-2 residential) includes the following issues:

EA - Energy (37%),

SS - Land (17%),

WE - Water (17%),

MR- Materials (6%),

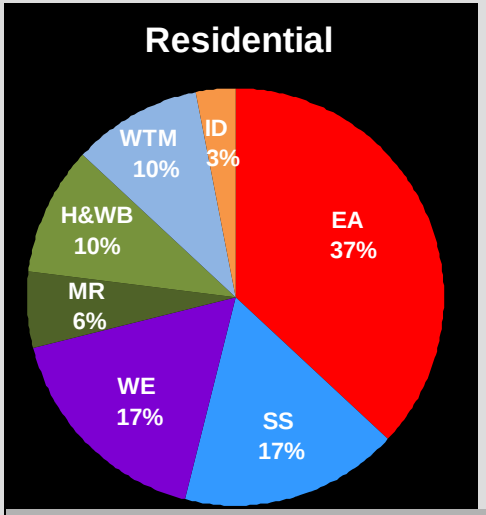
H&WB - Health & Well Being (10%),

WTM - Waste, Transportation & Management (10%),

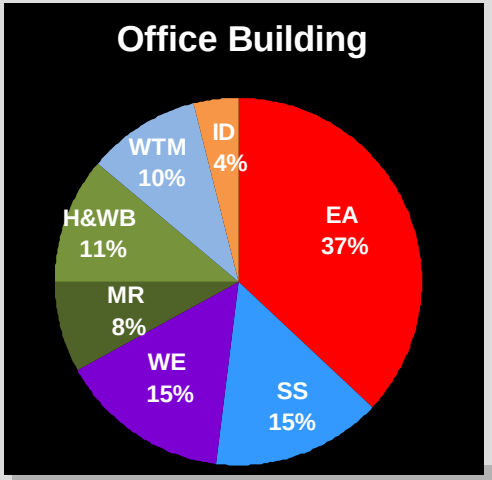
ID - Innovation & Excellence (3%),

Total: 100 points.

The difference between Residential and Office buildings is small



IS 5281 – 2 for Residential Buildings



IS 5281 – 3 for Office Buildings

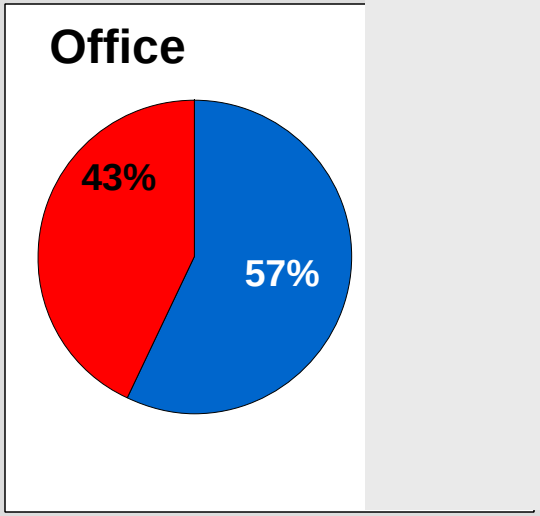
The energy chapter of the ISRAELI "GREEN BUILDING" STANDARD is divided into two subchapters:

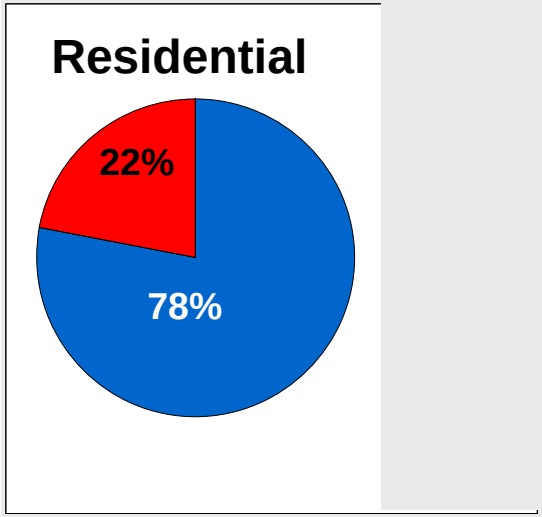
1.1 Building Energy Performance

Only Bioclimatic and PLEA aspects are considered under this title

1.2 System Performance

It includes HVAC and other mechanical systems, as well as solar water heating and PV.





The difference between Office Buildings and Residential Buildings is large

To obtain the different "Green Grade" levels

there is a minimum number of required points that should be achieved from each Energy Subchapter, as well as gaining a certain Energy Rating (according to the Israeli Standard SI 5282).

Thus, the higher the requested "Green Grade" level is, the need to save energy increases.

Residential Buildings: Min. required points for each "Green Grade" level

Green Grade Level	Minimum required points	1.1 Building	1.2 Systems	At least Energy Rating Level according to SI 5282-2	% of Energy Saving in Zones A & B
*	55-64	10	8	C	>20%
**	65-74	13	10	B	>25%
***	75-82	15	12	A	>30%
****	83-89	17	14	A+	>35%
*****	90-100	20	16	Passive Building	>60%

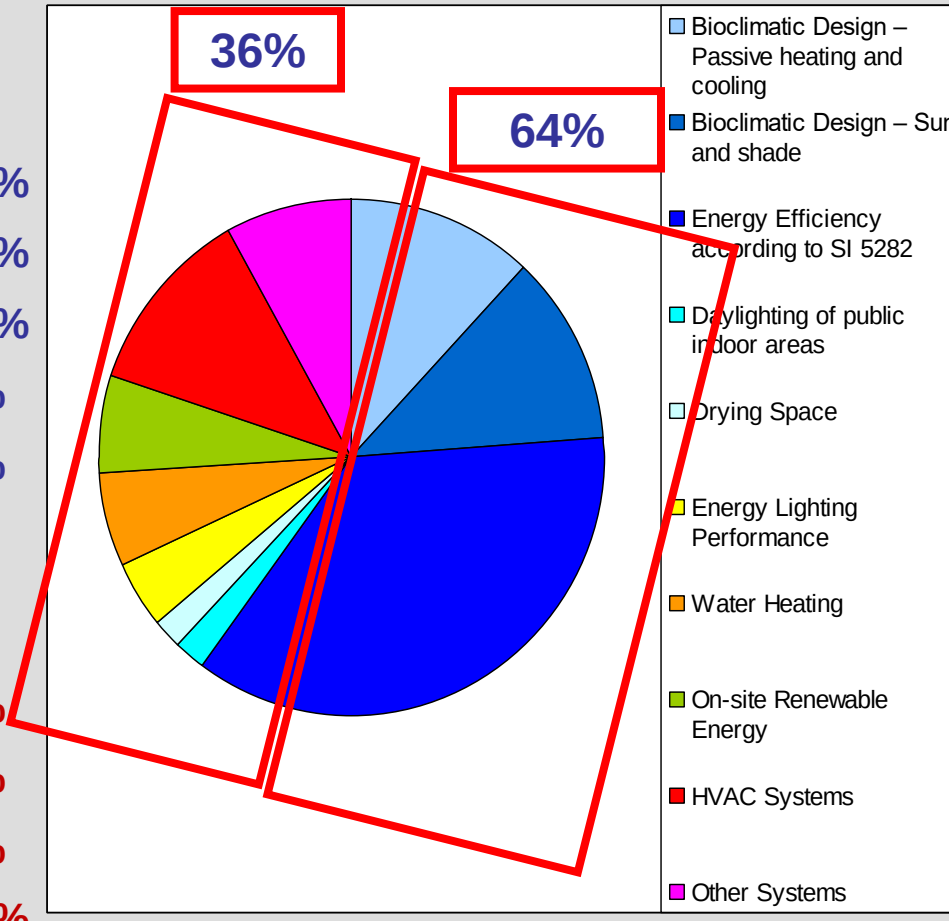
THE ENERGY CHAPTER for Residential buildings
includes the following articles:

a. Building Performance Subchapter: PLEA

1. Bioclimatic Design – Passive Systems	12%
2. Bioclimatic Design – Sun and shade	12%
3. Energy Efficiency (according to SI 5282)	36%
4. Daylighting of public indoor areas	2%
5. Drying Space	2%
Total:	**64%**

b. Systems Performance Subchapter:

1. Energy Lighting Performance	4%
2. Water Heating	6%
3. On-site Renewable Energy	6%
4. HVAC Systems	12%
5. Other systems	8%
Total:	**36%**



IS 5281 – The issues in the Energy Chapter of SI 5281

How can we encourage **PLEA** (passive and low energy architecture) To become a main fixture in **Green Buildings**?

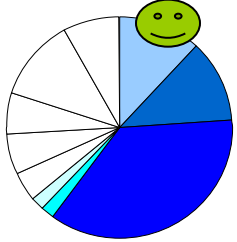
- **Achieving good "Low Energy Architecture" requires the architect to start with the correct decisions at the early design stage.**

- **However, to run heavy simulation models requires high expertise and that the building is already defined with all its details, Therefore, it is suits the advanced design stages.**

- **Hence, it is important to develop simple CAD tools, as well as design guidelines (or descriptive/prescriptive methods) to be used at the early design stages.**

Such CAD tools and design guidelines (or descriptive/prescriptive methods) **were developed in the Climate & Energy Lab. In Architecture at the Technion, and they are part of the Israeli Green Building Standard** (SI 5281).

3. The Building Energy Performance Subchapter for achieving PLEA and The applications of Simulation and CAD tools in the Israeli “green building” standard to support PLEA

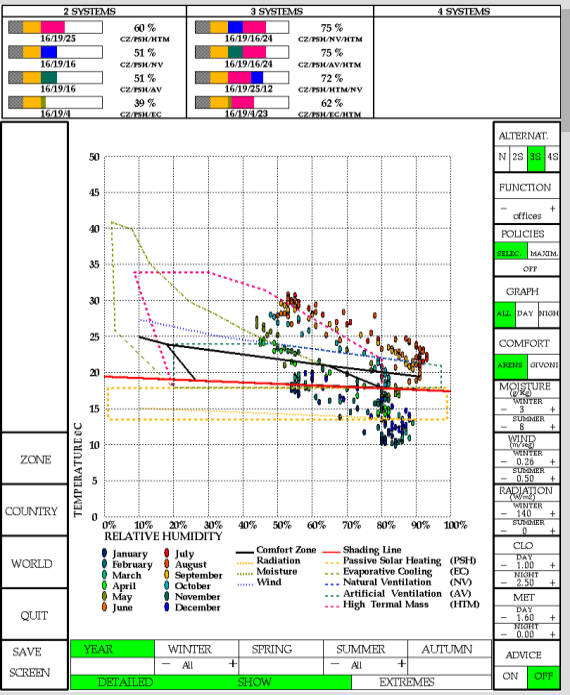


1. BIO-CLIMATIC DESIGN - Passive Systems – 12%

It includes Bioclimatic analysis and the determination of design strategies.

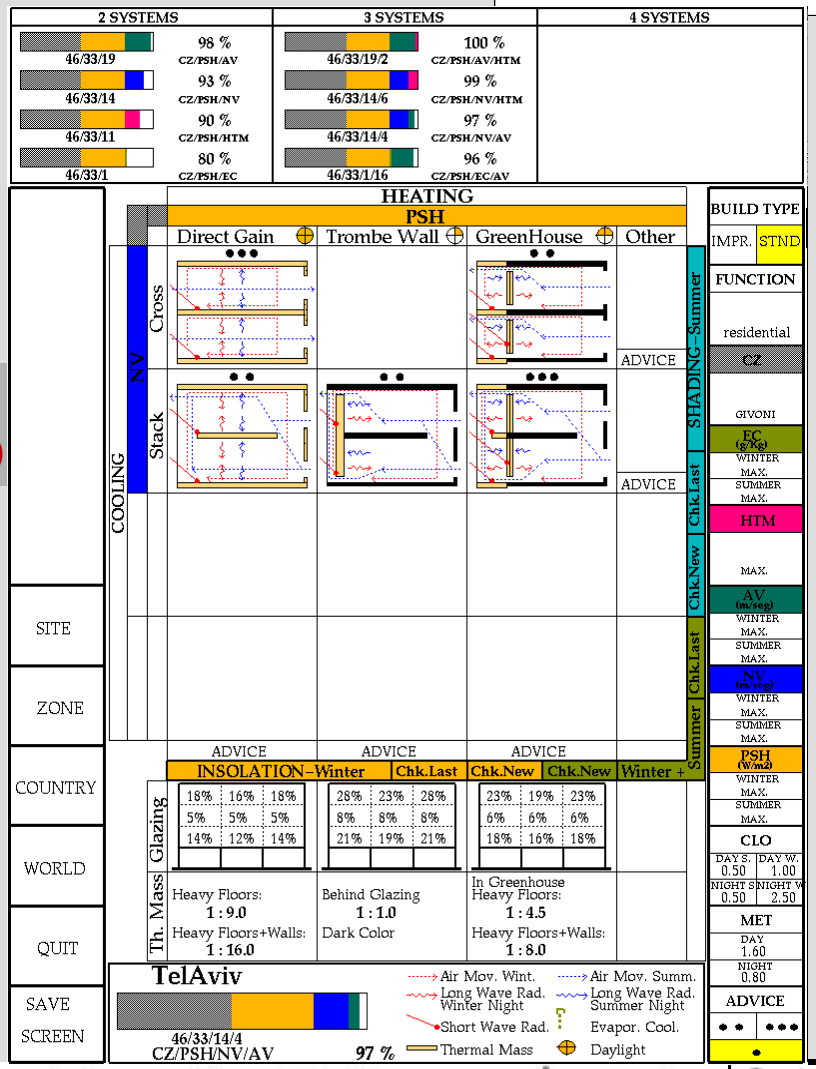
(prerequisite, no points).

Point are awarded for the physical implementation of all passive systems



Bioclimatic Chart using PASYS ***(Yezioro & Shaviv, 1996)***

PASYS answers all early design stage questions, about the best passive systems suitable for the specific project as well as their recommended size.



1. BIO-CLIMATIC DESIGN - Passive Systems

To encourage architects to design <u>Passive Heating Buildings</u> a prescription approach is presented in the Israeli Standard.

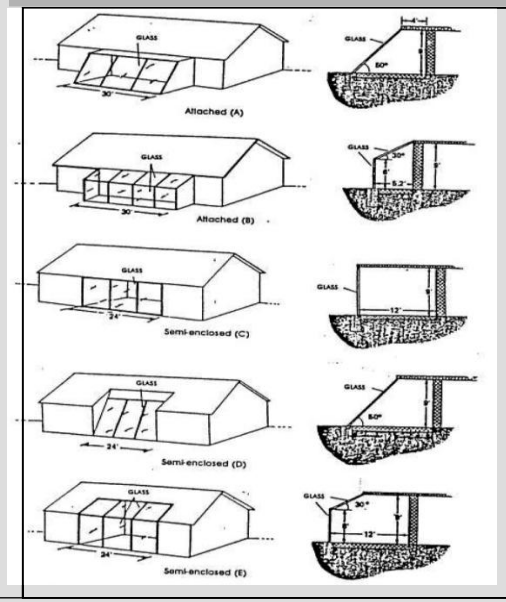
The prescription approach defines the Passive Systems as well as specifies the percentage of the required system area in relation to the floor area it serves.

The required system area is based on the LCR method (Balcomb et al., 1983) that was driven by running many simulations and adapted later to the Israeli climate and building technology (Shaviv, 1995).

Thus, the architect has a simple and easy to use design tool at the early design.

Different Configurations of Sunspace Systems

(Balcomb et al., 1983)



ss = sunspace
c = common
o = opaque
g = glass

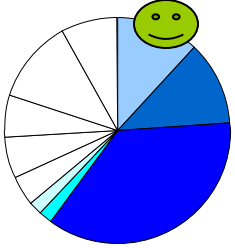
5 = 50^0
3 = 30^0
9 = 90^0

m = Thermal Mass
L = Light

Climate Zone Single Glazing	A	B	C	Climate Zone Double Glazing	A	B	C
SS5om1	16	17	18	SS5om2	15	15	16
SS5oL1	17	18	19	SS5oL2	16	16	18
SS5gm1	17	18	20	SS5gm2	15	16	17
SS5gL1	19	21	23	SS5gL2	17	18	19
SS5om1	17	19	20	SS5om2	16	17	18
SS5oL1	19	21	23	SS5oL2	18	19	20
SS5gm1	18	20	22	SS5gm2	16	17	19
SS5gL1	21	24	26	SS5gL2	18	20	22
SS9cm1	16	17	19	SS9cm2	15	16	18
SS9cL1	19	21	23	SS9cL2	18	20	21
SS5cm1	14	14	16	SS5cm2	14	14	15
SS5cL1	15	16	17	SS5cL2	14	15	16
SS3cm1	15	16	17	SS3cm2	14	14	16
SS3cL1	17	18	20	SS3cL2	16	17	18

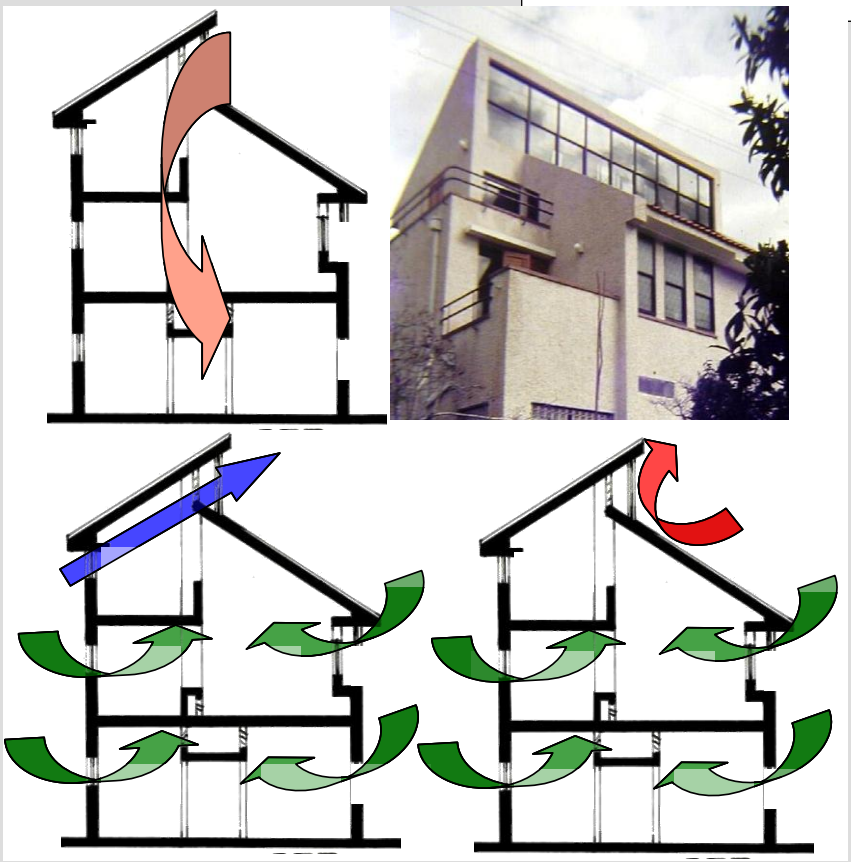
Required % of different Sunspace glazing area relative to the floor area it serves.

<u>From Appendix A of SI 5281 (Shaviv, 2011)</u>



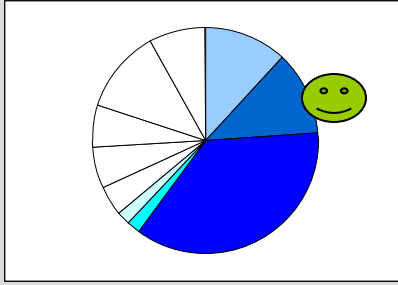
1. BIO-CLIMATIC DESIGN - Passive Systems – 12%

To encourage architects to design Passive Cooling Buildings an alternative approach is used by presenting explained examples in the Appendix of the Israeli Standard.



***SHAVIV HOUSE:** Vented Sunspace for space heating which also serves as Wind Chimney or Thermal Chimney for cooling (1984*

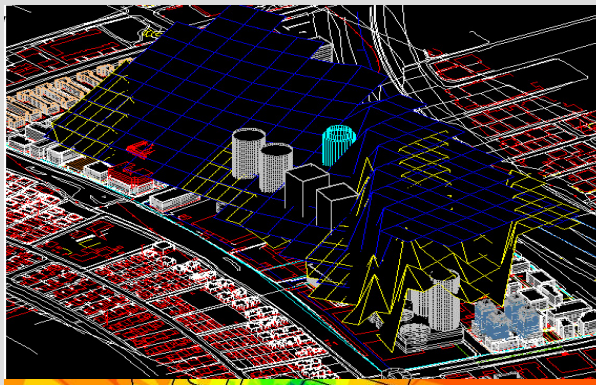
From Appendix A of SI 5281

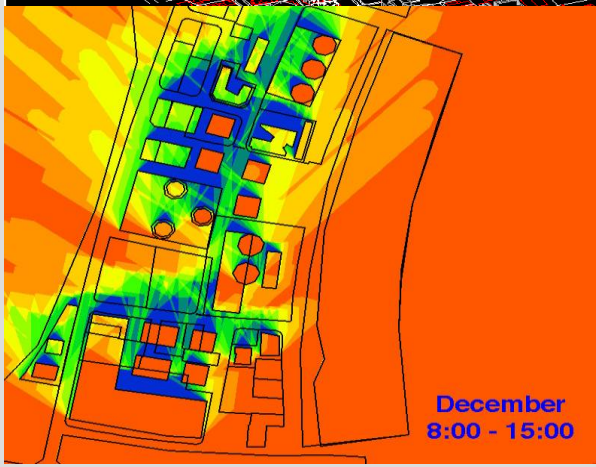


2. BIO-CLIMATIC DESIGN – Sun & Shade - 12%

The first part includes: analysis of the shadow cast by the surrounding buildings and objects and the shadow cast by the designed building itself.

(prerequisite, no points).





Solar rights design using the Model SustArc,
(Capeluto & Shaviv, 1999)

2. BIO-CLIMATIC DESIGN – Sun & Shade

Points are awarded according to achieving a predefined amount of solar exposure of:

a. **the solar systems,**

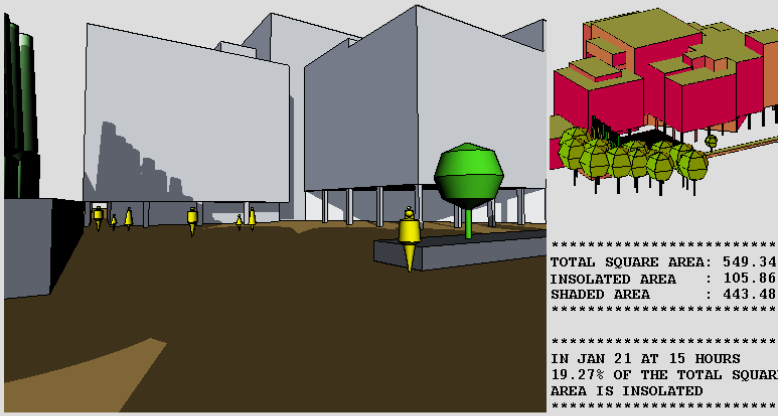
b. **the building elevations,**

c. **the open spaces.**

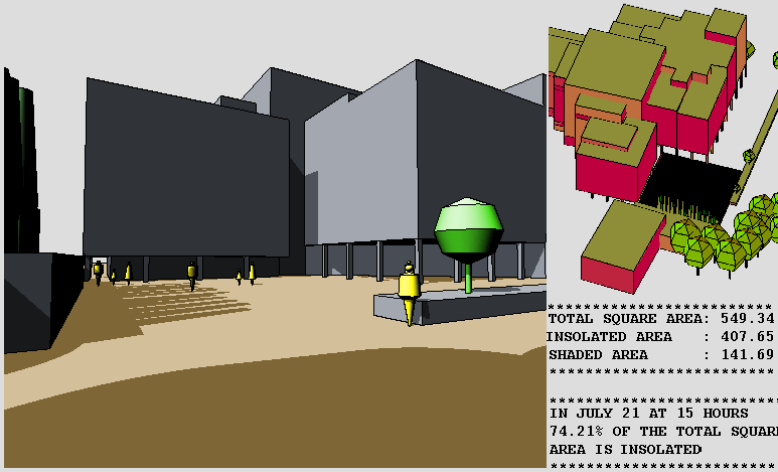
d. **An extra point is awarded for achieving in the main open area, summer shading, while keeping the winter required insolation.**

SHADING COEFFICIENT - HAIFA AUDITORIUM

January 15:00 hours



July 15:00 hours

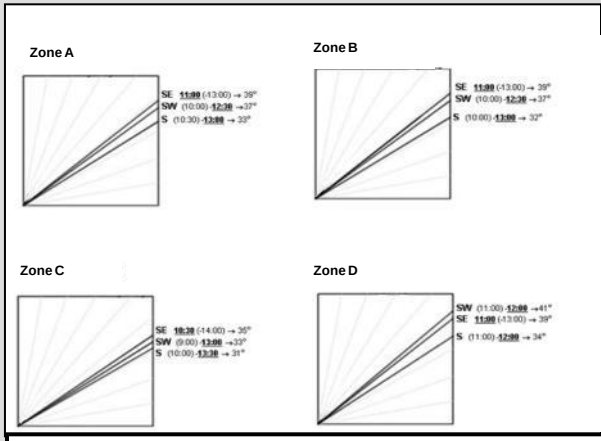


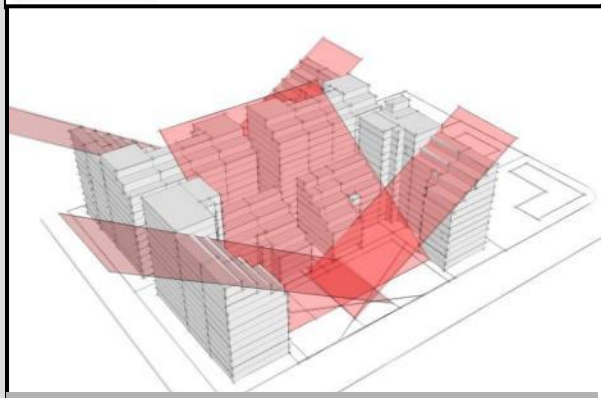
Calculation of the Geometrical Shading Coefficient by counting the pixels seen from the sun's point of view, using the Model SHADING
(Yezioro & Shaviv, 1994)

2. BIO-CLIMATIC DESIGN – Sun & Shade

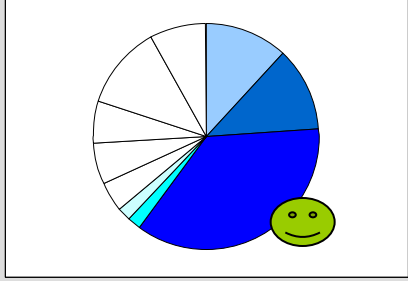
The analysis for keeping the Solar Rights may be carried out manually, according to a simple descriptive approach that was derived by using the Computer Model SUSTARC (Capeluto et al., 2005).

This Simple Design Tool can be used in the early design Stages.



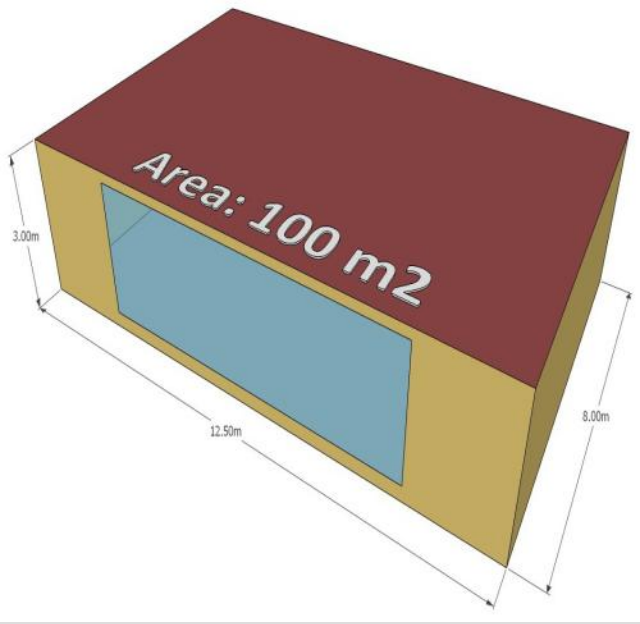


Solar rights design using the description approach obtained by the model SustArc (Capeluto & Shaviv, 1999).
From Appendix B of SI 5281



3. Energy Rating of Buildings according to the Israeli Standard SI 5282 - 36%

- **The Israeli standard SI 5282 emphasizes the building architecture: Geometry, as well as the Walls & Glazing Material.**
  (including: compactness and proportions, windows size, orientation, shading and glazing type, envelope insulation and thermal mass, as well as night ventilation for passive cooling and comfort ventilation).
- **As it puts an emphasize on PLEA, the reference building is defined with fixed geometry and depth that allows daylight.**
- **Hence, the geometry of the proposed building is considered and affects the results.**

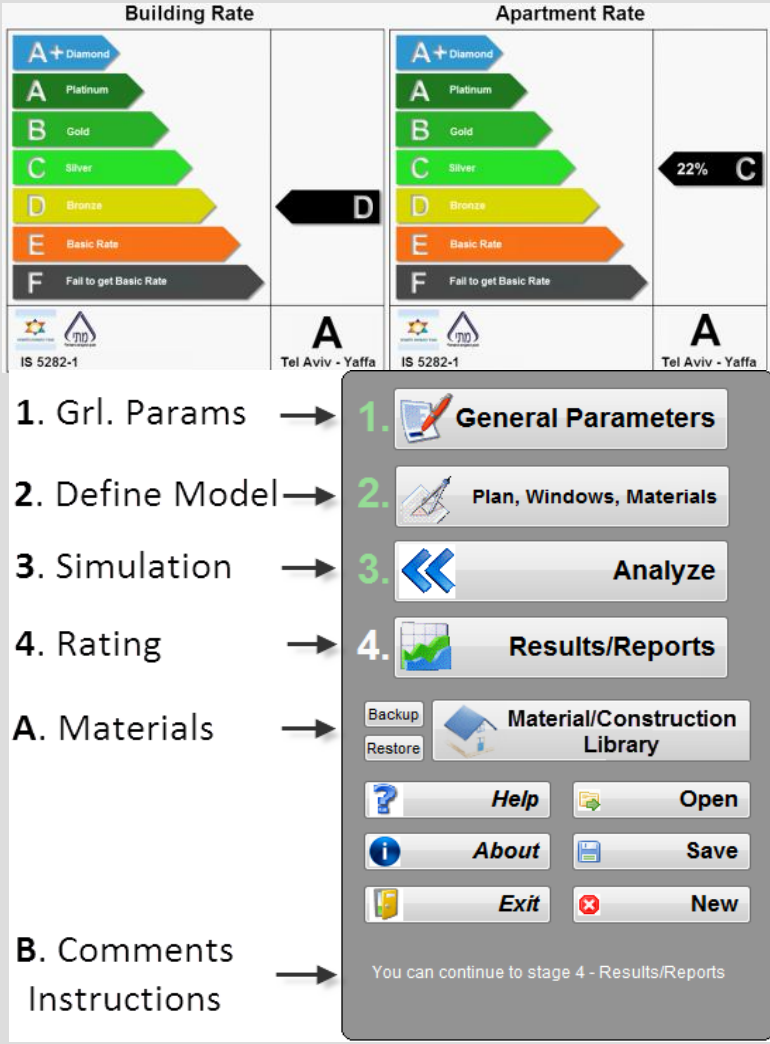


Office Buildings: The Reference Unit

This is in contrast to the ASHRAE 90.1 that defines the geometry of the reference building according to the proposed building, and thus the influence of the building's geometry is eliminated.

3. Energy Rating of Buildings according to SI 5282

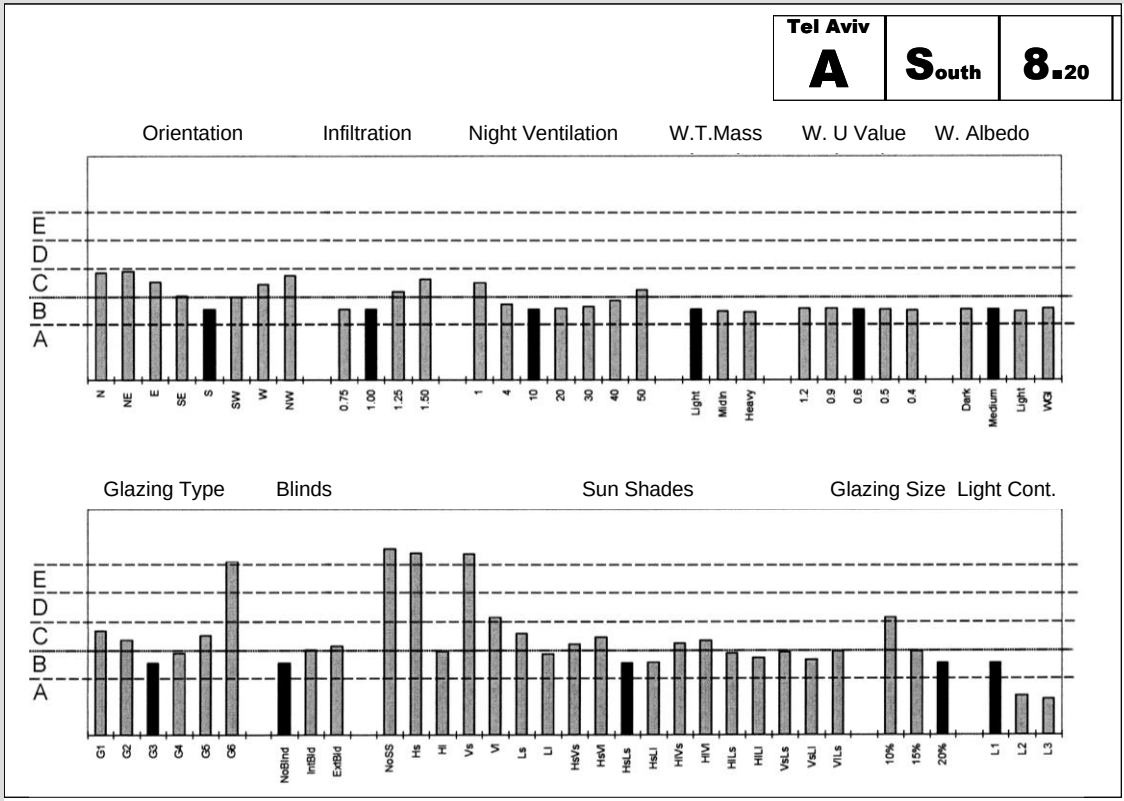
- **An easy to use interface EnergyUI, was written as part of the Israeli Standard** (5282). **(Yezioro et al., 2011).**
- **This interface includes the requirements about how to use the performance approach and how to define the reference building, which the interface builds automatically.**
- **It also creates automatically the building database required to run EnergyPlus.**
- **The "Energy Rating" label is produced as output for the whole building as well as for each apartment or office unit.**
- **Thus, EnergyUI allows the Architect to run the heavy simulation model EnergyPlus at the early design Stages.**



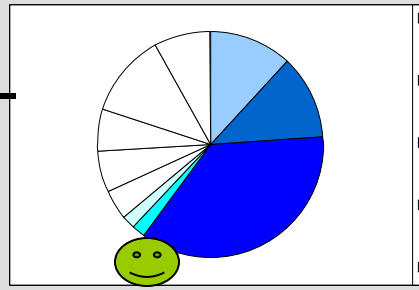
3. Energy Rating of Buildings according to SI 5282 – **The Descriptive Approach**

Another simple way to start the design is to follow the requirements of a descriptive approach that was derived by running a large number of simulations using the model ENERGY (Shaviv & Shaviv, 1978).

There are 16 graphs like this one for each climatic zone.
(8 orientations * 2 office depth).
Each graph presents results of 64 design solutions that were obtained from *a semi-optimal low energy solution, S.T. economical constrains.*
Hence, these graphs may be used by the architect as simple and easy to use design Guidelines at the early stages.



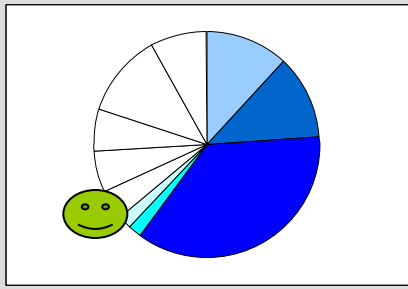
Energy Rating of Office Buildings. The dark bar is a semi-optimal low energy solution, S.T. economical constrains. The "Energy Grade" is defined on the sensitivity analysis graph. There are 48 graphs like this including: 4 climatic zones, 8 orientations and 2 office depths (5.00m & 8.20m). (Shaviv et al, 2005)



4. Daylighting of public indoor areas - 2%

The Intent of this issue is to reduce energy for electric lighting in public indoor spaces that are in daily use, like lobbies, stairways, etc.

Daylight for public indoor space in residential building



5. Drying Space - 2%

(Only for residential buildings).

The Intent of this issue is to encourage energy saving for drying laundry by providing an adequate space for it.

Hidden Space adjacent to a utility balcony in each floor of a High rise residential building

4. Examples of Integrating Passive & Low Energy Architecture into Green Buildings

Integrating PLEA
into Green Buildings

4 - a. The “Ramat Hanadiv” Visitors Center

Built in HOT- Semi HUMID climate (Israeli Climate Zone B)

lintegrating PLEA into Green Buildings

The "*Ramat Hanadiv* " *Visitors* Center is a living memorial to Baron Edmond de Rothschild.

It plays a leading role in the management of natural and cultural resources based on sustainable interactions between man, nature and the environment.

The Building was planned by architect Ada Karmi-Melamede as an "Earth Covered Sustainable Passive Solar Building" on a ground that was before a parking lot.

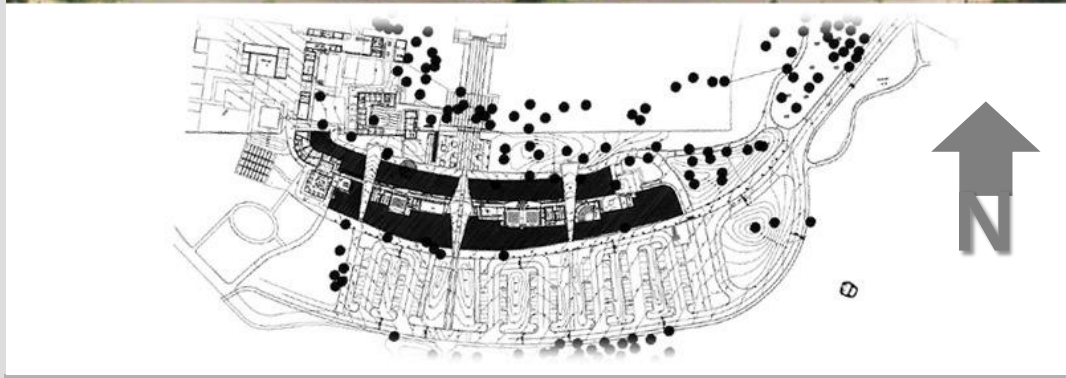
"Ramat Hanadiv" Visitors Center

Arch. Ada Karmi-Melamed (2006)

Iintegrating PLEA into Green Buildings

The building achieved in 2006 the first excellent Green Building Award according to the Israeli Standard (SI 5281 ver2005).

However, at that time it didn't receive the LEED accreditation. (Only in 2009, it was the first building to be awarded in Israel by LEED as a Green Building.)



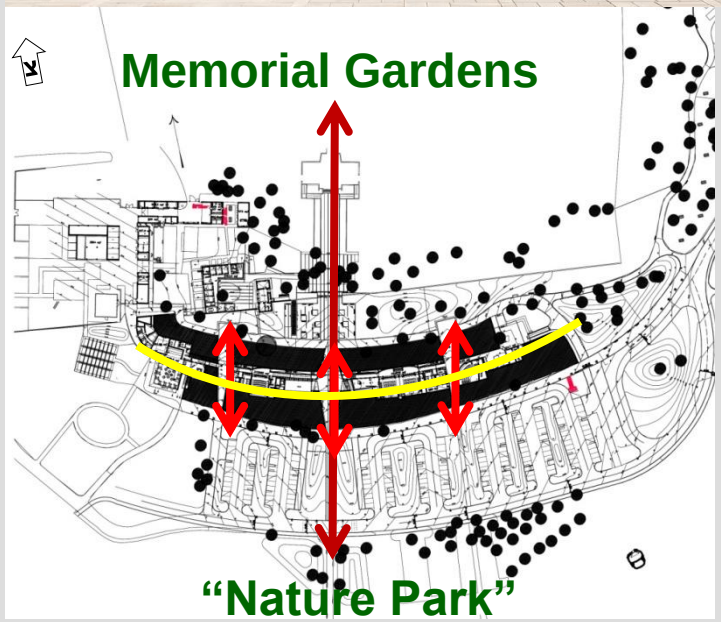
The Ramat Hanadiv Visitors Center (2008). The first "Excellent* Green" building awarded in *2006,* according to the Israeli Standard SI 5281 (Ver. 2005). *Arch. Ada Karmi-Melamede

Iintegrating PLEA into Green Buildings

There are two main perpendicular axes in the building.

- **The long axe** (150m length) **passes through the middle of the earth covered building.**

- **and the short one is the landscape axe that connects the Memorial Gardens and the "Nature Park".**



Ramat Hanadiv Visitors Center (2006)

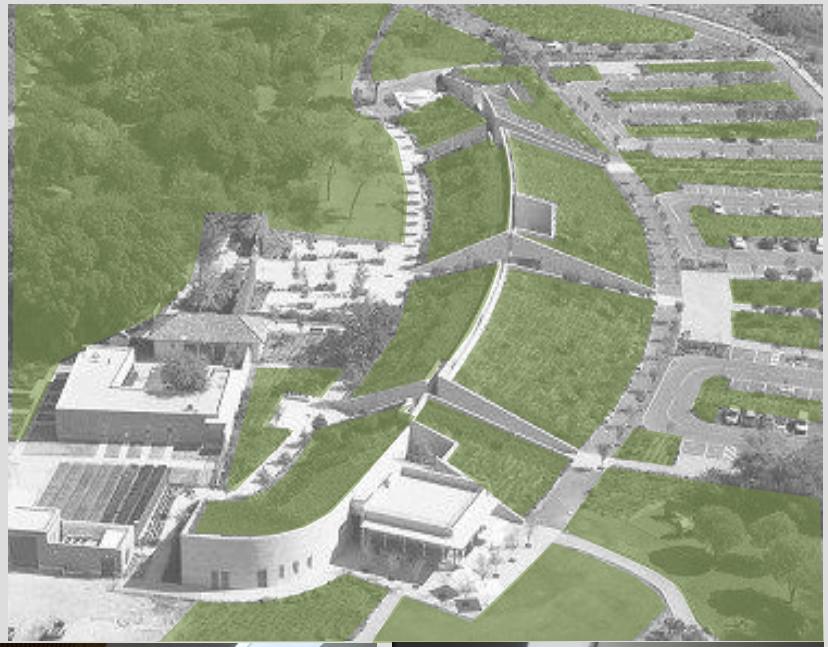
Iintegrating PLEA into Green Buildings

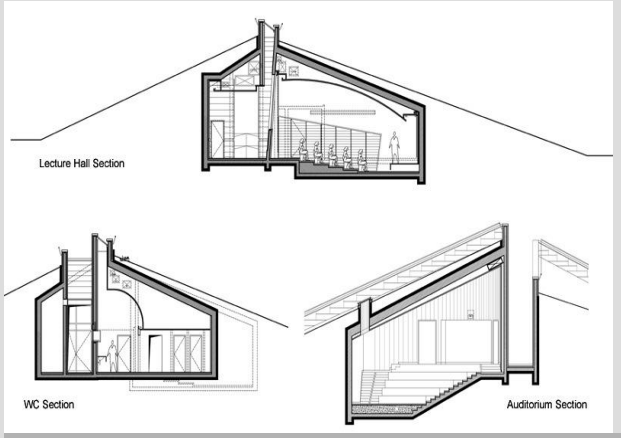
Along the main long axe there are internal courts through which Passive Solar Heating can reach the rooms.

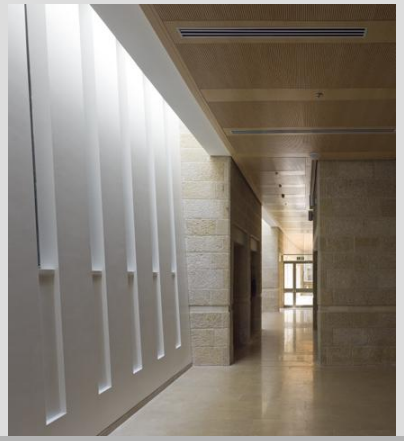
Ramat Hanadiv Visitors Center (2006)

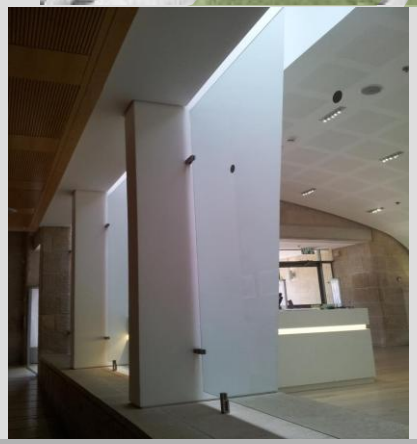
Iintegrating PLEA into Green Buildings

Also, this long axe passage permits natural light to enter the classes, auditorium, cafeteria, offices and even the bathrooms, through windows positioned along its entire length.







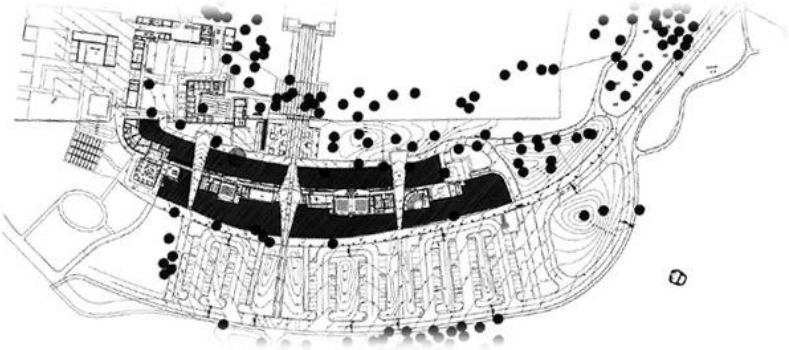


Ramat Hanadiv Visitors Center (2006)

Iintegrating PLEA into Green Buildings

Being a very well architecturally designed Passive and Low Energy building allows it to obtained the highest rank according to the Israeli Standard 5281, but only the lowest rank according to LEED.

This is because LEED doesn't consider much the Building Performance that has a long life time expectancy, and ignores its performance as passive solar and low energy one. Instead, it put the emphasis on the Systems Performance that have short life time expectancy.



The Ramat Hanadiv Visitors Pavilion. The first "Excellent* Green" building awarded *(2006), according to the Israeli Standard *(SI 5281 ver.2005)*
Arch. Ada Karmi-Melamede (2008)

Integrating PLEA
into Green Buildings

4 - b. “Beit Lidar” office building

Built in HOT- HUMID climate
(Israeli Climate Zone A)

lintegrating PLEA into Green Buildings

"Beit Lidar" is a Green Office Building as well as a Passive & Low Energy Architecture, designed by architect Alon Yitzhaki, Chairman of ILGBC (& partner in MYS Architects).

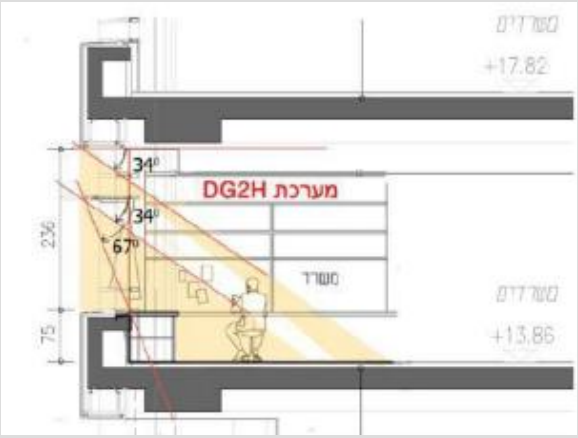
The building was awarded in 2015 the Israeli Green Building Standard
(SI 5281 ver. 2011).

The Owner of the building <u>did not want</u> to submit the building to LEED.

Architect Alon Yitzhaki
Passive consultant: MYS Architects.
Green Building Consultant: Chen Shalita, ALFA Sustainable Projects

1. BIO- CLIMATIC DESIGN - Passive Systems for heating by Direct Gain and with Sun-Shades

The entire South-facing section offices has Horizontal Sun Shades that allow the low winter sun to penetrate the building in order to heat it, but protect the windows from the high sun in summer.

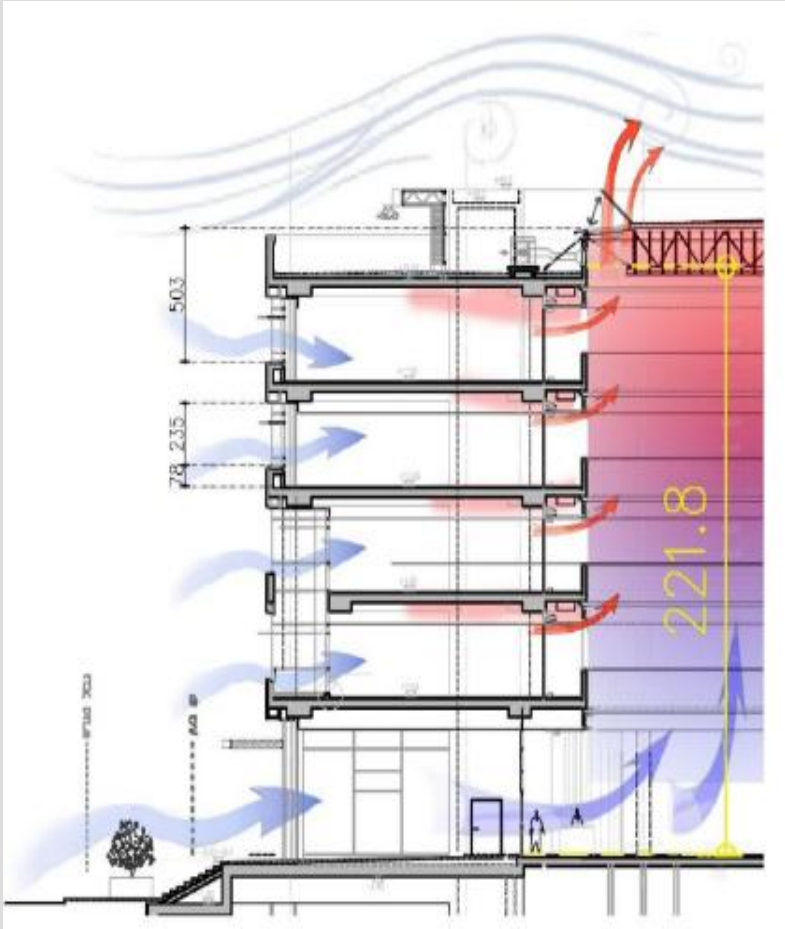


The NE and NW facades have Vertical SS, to shade the windows in summer morning and evening.

1. BIO- CLIMATIC DESIGN - Passive Systems for Cooling

Comfort Ventilation is achieved by cross ventilation enhanced by the Stuck Effect through the upper opening in the roof of the Atrium and the windows in each office.

All offices are connected to the Atrium.

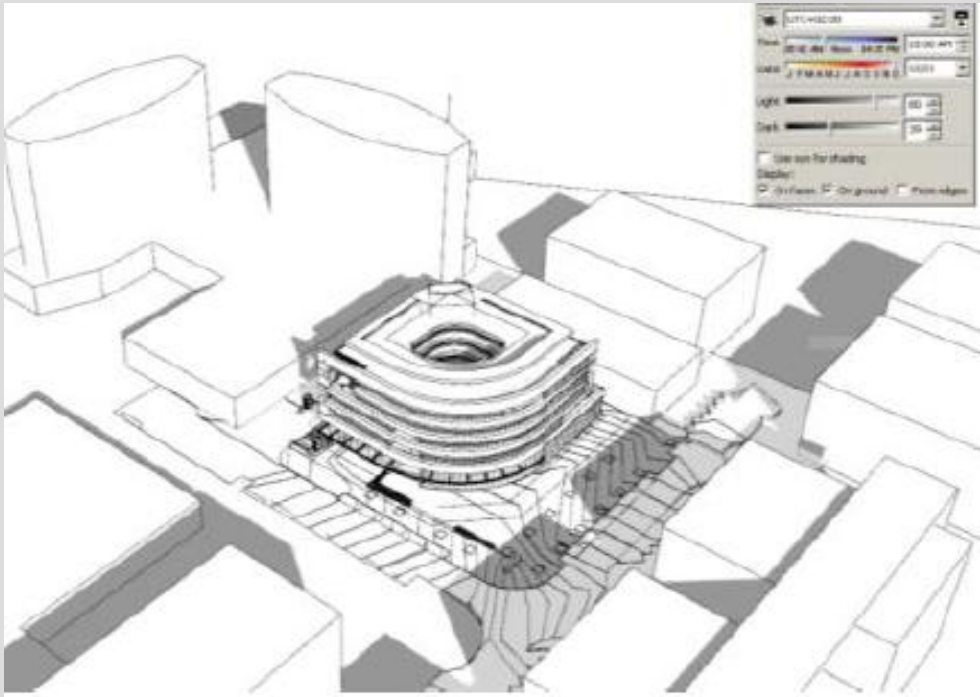


2. BIO- CLIMATIC DESIGN – Sun & Shade:

<u>The analysis shows :</u>

that the building and the open spaces are not shaded in winter by the surrounding buildings .

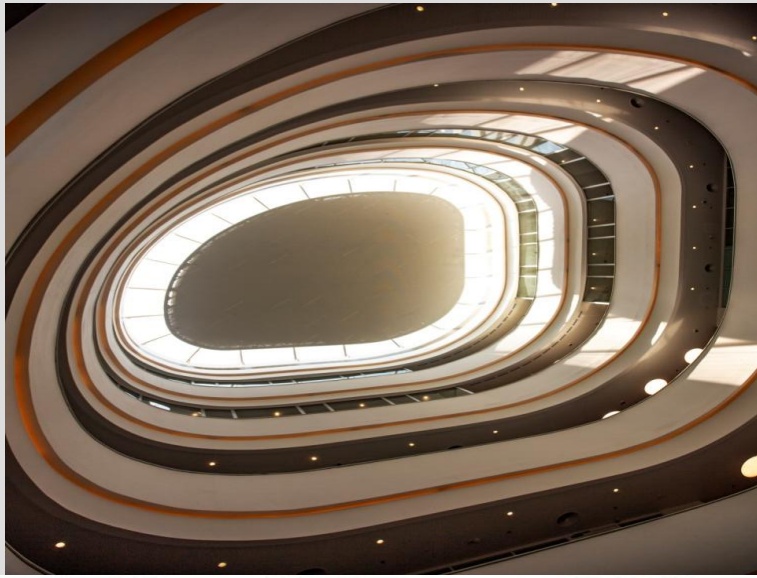
Also, the designed office building "Beit Lidar" keeps the solar rights of the neighboring buildings' South Facades and of the open spaces around it.



3. Energy Rating of Buildings according to the Israeli Standard (SI 5282)

The energy rating of the building is C – Silver, and was obtained by using EnergyUI ***(Yezioro et al., 2011)***.

4. Daylighting of public indoor areas



The analysis shows that Daylight penetrates through the windows in the roof of the Atrium, reaches all floors and reduces the energy required for electric lighting in all public indoor spaces that are in daily use.

“Beit Lidar” embraces the following PLEA features:

- **It provides daylight and cross-ventilation to all offices.**
- **Selective glasses in all windows that protect the offices from the sun but allows daylight.**
- **Daylight in public indoor areas is obtained by the roof of the atrium.**
- **Two completely different facades. The entire South-facing section offices has horizontal Sun Shades, and the NE and NW facades have vertical SS.**
- **Natural comfort ventilation is enhanced by the stuck effect.**
- **Concrete floors and ceilings as thermal mass to reduce temperature swing**
- **Natural night ventilation with the thermal mass to cool the building in summer.**

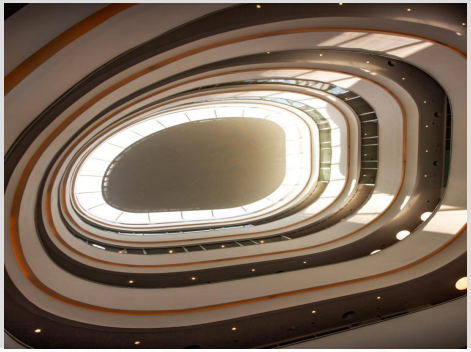
בית עמנואל בניין משרדים בבנייה, א.ת. הרצליה פיתוח

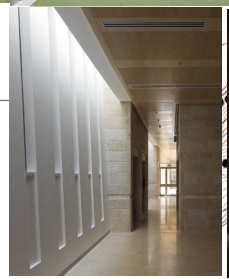
Coming back to the Questions:

Why PLEA buildings didn't glow with Green Architecture?

Can it be changed?

Yes, PLEA buildings <u>not only that they can glow with Green Architecture</u>, they can enhance new ideas to shape the building in a more interesting and more beautiful and correct form, as was presented in the two example.





Summary & Conclusions:

TO ENCOURAGE PASSIVE AND LOW ENERGY ARCHITECTURE - THE ISRAELI SUSTAINABLE BUILDING STANDARD USES THE FOLLOWING:

1. **The Energy Chapter is divided into two parts: "Building Energy Performance" and "Systems Performance" and a minimum required points from each subchapter is obligatory in order to achieve each "Green Grade" level.**
2. **Energy Rating of the building for each "Green Grade" level should reach at least a predefined level according to SI 5282.**
3. **Bioclimatic analysis as well as shading analysis are prerequisites without awarded points for it.**
4. **"Passive Systems" are awarded and treated separately from hot water systems (that is mandatory in Israel) and from PV and HVAC systems.**

Shaviv Passive Solar House – 1980 Architect E. Shaviv

Summary & Conclusions:

5. **Simple CAD tools, as well as simple user interface to run heavy simulations, or flexible descriptive/prescriptive methods and Guildlines are the required tools the architect needs at the early design stages.**

6. **Correct decisions at the early design stages will ensure achieving "Passive & Low Energy Buildings"**

7. **Allocating points according to lifetime expectancy of each green aspect is vital in order to fulfil the promise that Green Buildings will remain for a long time as a sustainable buildings.**

1st Green Office Building in Israel

Sussman Building for Environmental Sciences (1996)

Weitzman Inst. Of Science. Lerman Architects

Prof. Edna Shaviv – PLEA Consultant

Thank You