THE FIFTH ELEMENT IN SUSTAINABLE DESIGN

Dr. Joseph Cory
Geotectura Studio
www.geotectura.com

Introduction

In the ancient theory of classical elements and alchemy we can find five elements - Earth, Water, Air, Fire and a fifth element which is more mysterious, heavenly, none materialized and therefore less defined than the others. These elements were discussed in both western and eastern cultures and set the first direction towards classification of the world's phenomena and scientific breakthroughs. Eventually modern scientific theories replaced this simplified way of thinking but the echo of this tradition is still around. Tradition is a gradual build up of knowledge. The sustainability era is still in its early stage so it is closer to tradition than to advance science even though we use modern tools in it. So if we want to think in sustainable terms what will each element represent in the way we approach the design? And can we find the fifth element in sustainability?

Stirring theory into practice is a challenging process as it was described during the 7th Jerusalem Seminar in Architecture in 2009 that was chaired by Dr. Ken Yeang and I was privileged to be in its organizing committee. In the following pages I will discuss the design approach and principles for the EcoBuilding project that manifest the way to move from theory to practice as a case study. The EcoBuilding project (designed by my office - Geotectura together with NCArchitects and Axelrod-Grobman Architects) won the competition that aimed to erect the first LEED Platinum building in Israel.

Good architecture can be made more easily when we have great clients with a vision. Dame Shirley Porter founded the Porter School of Environmental Studies in 2000. It has since become the leading school of environmental studies in Israel under the direction of Dr. Arie Nesher. The school brings educational opportunities in many fields including architecture, renewable energy, wastewater treatment, ecology and much more. TAU's Porter School of Environmental Studies (PSES) is offering interdisciplinary degrees in environmental studies and unites researchers from different fields under one sustainable canopy. The school was established in response to the pressing need for greater academic knowledge in Israel on environmental issues. It promotes new areas of interdisciplinary environmental research, introduces novel environmental teaching programs and places environmental issues on the academic and public agenda. So we have a strong theoretical platform to begin with our journey.

The vision of Dame Shirley Porter included the need for a sustainable building to host all of the research activities. A competition was held with the target to design the most ecologic building for the school. In 2008, PSES embarked on the process of constructing its own building to house the school's growing activities. The selection process for the design team was comprised of two stages. In the first stage, the selection committee chose a shortlist of 7 teams from the 39 leading Israeli firms. By November 2008 our architecture

team was informed that it has been chosen by the selection committee to design the Porter School of Environmental Studies building. We shared from the beginning the passion to follow the vision of designing the most green building in Israel. Vision is essential for a pioneering project like a faculty for environmental studies. In her guiding vision for the Porter School of Environmental Studies Dame Shirley Porter wrote:

"Climate change is one of the world's greatest and most pressing challenges facing the planet today. It is a challenge that crosses all boundaries of race, creed and religion and it is only by working together that we will find solutions that are so vital to our survival. Israel must play its part and I am determined that the new building for PSES will demonstrate this commitment by providing real and practical applications of green technologies that may be held as a benchmark for sustainable development not only in Israel but across the whole region."

The role of people like Dame Shirley Porter on the University is important because it challenge universities to be updated and to improve all the time. The university understands that green buildings are being demanded by the donor and shortly will be demanded by students as well. Here is what the TAU president, Professor Zvi Galil said following the vision of Dame Porter:

"The construction of the PSES green building at Tel Aviv University emphasizes the great importance TAU places on environment in general and green building in particular, as a leader in these fields. The establishment of the building is another important step towards developing TAU as a green campus, the largest green campus in Israel" [3]

We felt during the design process since we won the competition that the question marks and the uncertainties that were imposed by the University administration soon were replaced by the notion that this is the appropriate way for present and future design. Striving for the design of a LEED Platinum project is very challenging in Israeli architecture, where there are only two other LEED green buildings and none of them is Platinum. The lack of case studies in this scale in Israel emphasize how deeply we need a place to hold not just a location for learning sustainability but also a place for demonstrating it to the entire public.

This paper analyzes the various local conditions (wind direction, orientation of the sun and the acoustic problem from the nearby highway) and explains the environmental elements that were derived from these conditions. . The parameters are classified according to the ancient elements. The paper will further explore the details, strategies and the dilemmas of the design team and will show different solutions and conclusions for this important mile stone in the sustainable architecture legacy in Israel in the overall effort to bring green vision into reality.

Fig. 1 The Porter School Entrance View

Fig. 2 Porter School - Competition Entry

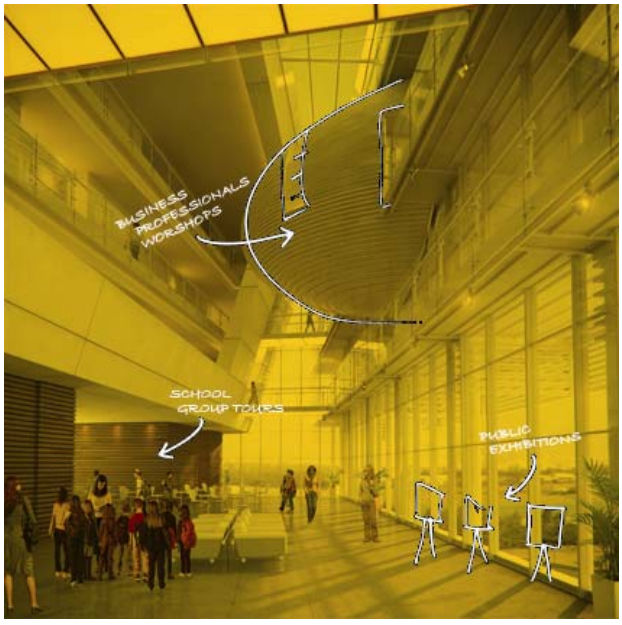

Fig. 3 Public Exhibitions

Fig. 4 Interdisciplinary Degrees

1 The First Element - Earth

Brownfield, Orientation, Transportation, Minimal Footprint, Urban Fabric

Earth is always a good starting point for a sustainable project. It reminds us that before we even start to dream we face a reality that keeps our legs on the ground. It is no surprise that the LEED system starts with the Site as well.

In the EcoBuilding project we started with selecting all the available climatic data analysis of the specific site that dictated the design process and helped us design the first mass concept. From the first survey we collected we found that the site had many disadvantages that we tried to turn into advantages later on. A soil survey determined that underneath the site that is a parking lot today one can find pollutants in the soil as a result of the disposal of construction waste the site, prior to the future construction work. Turning a site with construction waste disposal into a healthier environment is one of the building goals as well.

Orienting the building mass on the site was another major decision we had to take in an early stage. The climatic analysis and the site layout brought us to the optimal conclusion of facing the long façade towards the south. It is in these crucial decisions that the architect can save a lot of the energy consumption of the building with few minor passive decisions that are not costing more money.

We aimed for minimal parking within the building site parameter while using the existing parking spaces around the campus. So even though in the program we were asked to provide underground parking lot we convinced the client to better do without it and we saved a lot of money by this green way of thinking and gave an incentive for students and faculty members to use nearby public transportation and bicycles instead. Alternative transportation and public transportation access are once again part of the architect responsibilities. It is easy to talk about this in theory but much harder to make people understand why it is necessary when things get more practical.

We are part of the earth and as designers must be committed to have minimal impact upon the ground by our buildings. The respect to the earth is declared once again through maximizing the open space in the entrance lobby. This will be achieved by putting the mass of the building on top of several pillars and a translucent curtain walls. The site development is limited to minimal caving only around the auditorium and the mechanical rooms. The symbiotic relationship between the building and the landscape will even be manifested in the second phase of the project that will transfer the promenade into the green roof of the new addition.

To build green means to look beyond just the building. We asked ourselves what is the broader connection between the building and the landscape, the building and the campus, and even the building and the city. The connectivity of the campus is getting better because the building is a generator for a green belt around the University that will connect it to the city. The landscape architects Braudo-Maoz are developing functions such as a pedestrian

connection between the train station and the University, that can even reach the sea-shore as part of a promenade for strolling, biking and recreation. The environment surroundings the building should function as a demonstration garden of ecological design according to the landscape architects and it is all part of the dialog between the University, the architects and the municipality of Tel Aviv. The dense urban location of the campus on the one side is not hiding the strong impact of nature in this specific location where the building is on the verge of a hill and next to a zoological garden and a wide highway with a stream in its middle. Something should be done in order to protect of restore habitat.

From the complexity of just this one element that forced us to gather information and make important decisions one can understand that the traditional architecture team in sustainable design is not enough even if they are highly professional and motivated. We had to put together a multi-disciplinary team of experts including advisors for specific ecological issues. The following elements will demonstrate this point even further.

Fig. 5 Porter School - Soil Survey

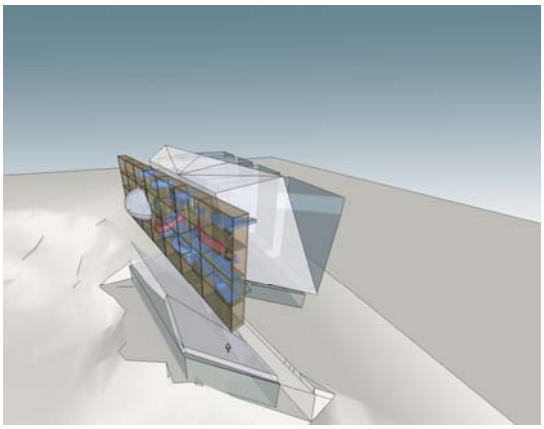

Fig. 6 Preliminary Building Mass Orientation

Fig. 7 Porter School - Green Belt

Fig. 8 Porter School - Promenade

2 The Second Element - Water

Green Roof, Gray Water, Stormwater, Low Water Consumption and Plants

The landscape architects examined with us and the plumbing engineers different water scheme options with green roofs and constructed wetlands, gray water treatment and vertical green walls, all together aim to meet the LEED standards and to reduce heat island effect and to improve water efficient landscaping. The landscape architects objectives included the use of captured rain water and gray water for irrigation, stormwater management, paving from recycled materials, choosing low water consumption plants, shade, purification of the air and much more. Stormwater penetration will be used for experimental and educational studies as well.

50% of the roof area will be an extensive green roof with local and water efficient vegetation that will improve the temperature beneath it during summer and winter as well. It will serve as a learning center as well and an open class room for the students.

The goals of the plumbing systems consultants was to save water and energy through the use of sanitary fixtures with saving devices, two separate sewage systems (drain water system known as gray water) and sewage water system (black water) and more. The gray water system that is going to be treated in biological pools and will be reused by the irrigation system was subject to the approval of the Health Ministry who is against gray water in general in Israel. In our project we have succeeded to convince the Health Ministry for the first time of the legitimacy of the gray water system and it will be a helpful reference for future ecological buildings in our region. This is a great example how even the phase of design can act as an educational one and influential one in the process of raising the awareness and updating our design principles.

The building act as a cup for the water, the walls and roof are directing it into different locations. All kind of water is welcome to experience and sense. Rain water, dew, moisture, gray and black are being tested, collected and exhibited. Water goes hand in hand with the landscape outside but also with the interior of the building. It is being handle with care as a scarce resource but for this reason as well being promoted to be in the front of the design like the other elements.

Things have evolved since the time that water was associated with intuition. In a sustainable design intuition has less impact. It is good to have intuition but real measurements and virtual simulations will make sure in our modern era that our intuition is for sure.

Fig. 9 Wastewater Treatment Pools

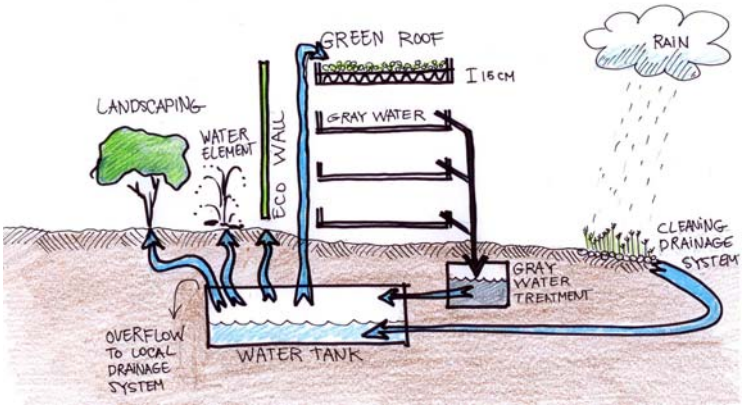

Fig. 10 Landscape Scheme

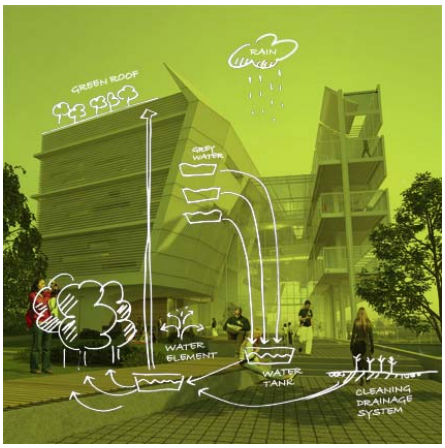

Fig. 11 Water Scheme

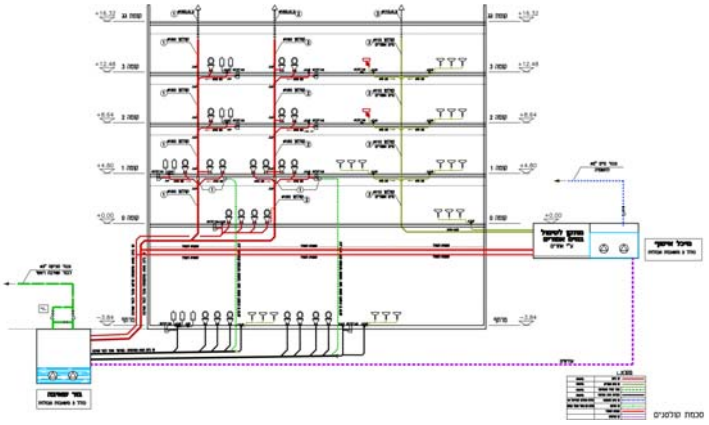

Fig. 12 Plumbing Scheme

3 The Third Element - Fire

Energy Saving, Energy Production, Natural Light, Efficient Artificial Light

Fire is energy. A sustainable fire should be energy efficient. And so is the design approach of the Porter School. Our energetic approach was conceived by Assa Aharoni Consulting Engineering who set the energy concepts early on in the design process.

In order to increase the energy savings potential the engineers recommended to use active chilled beam cooling (chilled beam cooling utilizes a finned cooling coil and an integral air supplied system that decreases energy consumption from baseline conventional systems like fan coil units). This system is energy efficient and provides many temperature control zones. An absorption chiller system with dedicated solar heat collectors will eliminate the high incremental cost of electricity and the solar heat source will provide the energy needed to drive the cooling system. The absorption process has no moving parts and is powered only by heat. It has other benefits such as low noise level, low operating and maintenance costs and long product life.

A 50 KW photovoltaic system will be installed next to the building in order to produce energy and sell it to the electric company. Two years ago without proper regulations on that matter the PV business in Israel was almost zero. After the government understood the potential of green energy it helped open up the market to new actors. It is an important reminder that sustainability is saving us money in the long run and we need some help in order to make it available to as many sectors as we can in our society. The electrical report for the Porter School presented the green principles of electrical, lighting and communication design. The objective was to reduce the energy consumption of the building according to LEED standards. The lighting design in this project is based on advanced lighting fixture using lamps with high level of light output throughout their longer life which mean higher energy efficiency, photocells that will measure lighting level inside the rooms and dim according to specified lighting level (used on daytime), motion detectors and so on.

Daylight simulations and glare control for all windows were examined and influenced the design (room area, furniture organization and so on). This is an important aspect that helps the active approach with good passive design that is usually better for the working and learning environment and saves a lot of money simple by thinking about what we are doing during the design method. The lighting presentation on the skin of the capsule (the beating heart of the project) gives the public outside of the building in the nearby highway and promenade information about the energy production/consumption level or the amount of air pollution on the highway below. We needed new data requirements that the university was never asked before to provide included total energy consumption, water consumption and waste production of the campus buildings and landscape. The data that will be gathered will serve other design teams to design better future buildings in the campus.

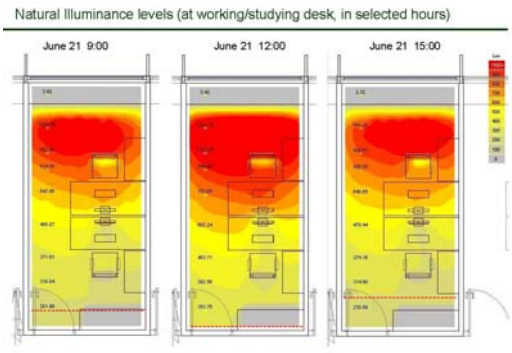

Fig. 13 Daylight Simulation - Offices

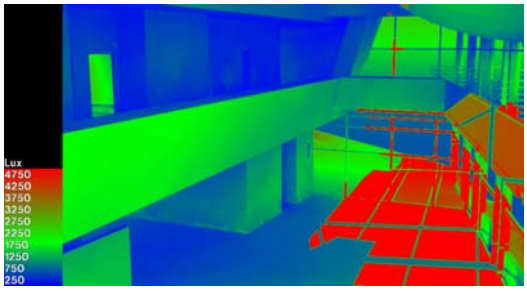

Fig. 14 Daylight Simulation - Atrium

Fig. 15 The LED Capsule

Fig. 16 Porter School - Atrium

4 The Fourth Element - Air

Acoustic, Wind, Air Pollution, Simulation

The nearby highway is causing acoustic problems and air pollution and so the building mass was born from the need to address these issues. So a wall barrier was conceived in order to absorb all the noise and pollution from the south-east direction. Understanding that we can make the building more iconic because of the fact that the wall can be seen from the highway is reassuring us that we are in the right direction in spite of the un ideal conditions.

In order to design the optimal building form we took into consideration the climatic conditions around the site that included wind velocities and directions and acoustic matters. But it is not easy to access accurate weather data. Although Israel is a small country the climatic conditions vary greatly from one location to another. It is very hard for planners to receive the accurate database about the climatic conditions in different places and is therefore harder to move from theory to practice. We were able to examine the wind conditions with and without our building mass and to choose according to this where to locate a wind turbine or a more calm location for the cafeteria for example.

The ecological consultant proposed a natural ventilation strategy plan that aided the energy efficiency concepts set by Assa Aharoni engineers. Thorough coordination between the architects and the client produced the reduction of energy losses as well as the efficient generation and utilization of energy. Eventually, the project will incorporate passive solar building design (maintaining interior thermal comfort while reducing the requirements for active mechanical heating and cooling systems), high performance envelope with optimized insulation techniques and building energy performance simulations such as CFD (Computational Fluid Dynamics) that helped us evaluate different scenarios and make the right decisions. We did several CFD sessions untill we were satisfied with the results. The Atrium was being analyzed over and over in order to enhance thermal comfort in all the floors open to it and to ensure air displacement and convenient temperatures. For example without any cooling or openings atria gets very hot in the Israeli climate exceeding 28c 70% of occupied time. This is why it is so important to check these things in order to improve the design.

The fact that a green building is more complicated than regular ones means that coordination between all the consultants is essential. The team members are working with Building Information Modeling process (BIM) meaning that they share the same 3D model of the building with access and total synchronization to all the data. This integration and streamlined process is an important tool for a sustainable design. The integration between BIM tools and CFD tools provides us with the capabilities to anticipate and reshape our design in a clear way in relation to the complicated data of indoor air quality and thermal comfort.

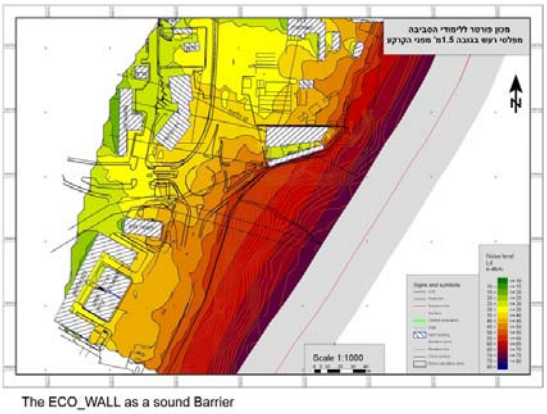

Fig. 17 Acoustic Analysis

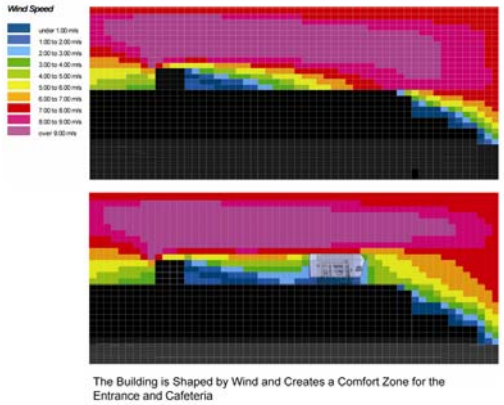

Fig. 18 Wind Analysis

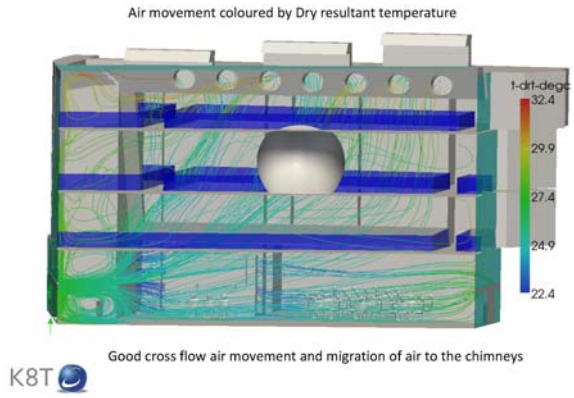

Fig. 19 CFD Simulation

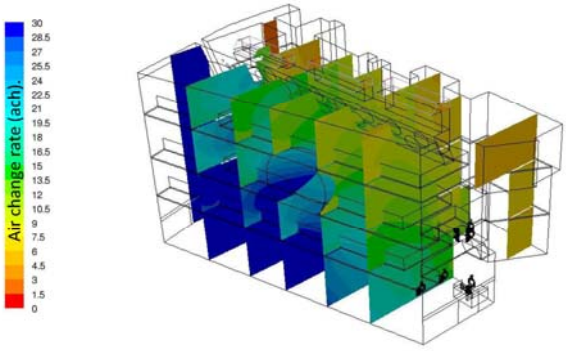

Fig. 20 Air Change Rates

5 The Fifth Element - Education

Adaptable, Dynamic, Eco-Global, Innovative, Creative

Environmental solutions to acoustic problems, wind and sun exposure, meteorological data, soil categories, passive energy saving positioning of the building and so on were analyzed over and over during the work flow as we saw in the other elements. But what does it take to step beyond a green checklist and make something that is above all that?

The Eco_Wall in the south façade is an iconic ever-changing display window for the other universities and visitors and serves as a constant social-educational contributor. The building will serve as a platform for ongoing experiments. The Eco_Wall is a unique concept allowing researchers to conduct several experiments in the eco-pods. The Eco_Wall is a window display for the rest of the students and the outside visitors (from different universities in Israel around the world, schools, kindergartens and so on). The innovative idea is the ability of the wall to absorb changing technologies overtime and not becoming a static monument of sustainable architecture. The kinetic wall represents the technological frontier of the faculty and the generation as well.

The project is designed to perform as a living lab of ecological and social values for the community and the environment. It tells the story of the complex sustainability term and simplifies it to the public by strolling along the Eco_Wall, the ground floor and the green roof that present current research of energy, water, soil, vegetation, materials that they can see, touch and learn. The fact that the building will be like a living lab for sustainable ideas means that the design process and all of the researchers' results are open to the public. In many green buildings the access of the public is limited and therefore they have lesser impact on others. In our case because the client is a school of environmental studies the whole process is dealing with future educational values of the building itself.

Architects should lead and be involved in wider aspects of the design in order to be able to meet with the complicated challenges of sustainable design. In the architecture team we share strong connections between the academy and the practical world. We teach sustainability as well as build in a sustainable manner so it was the most fitting project for us to win and share our knowledge. Education is not just for future students, the design process is educating the entire team all the time forcing us to be creative in response to the challenges and turning us all back into young students.

Fig. 21 Eco-Global Responsibilities

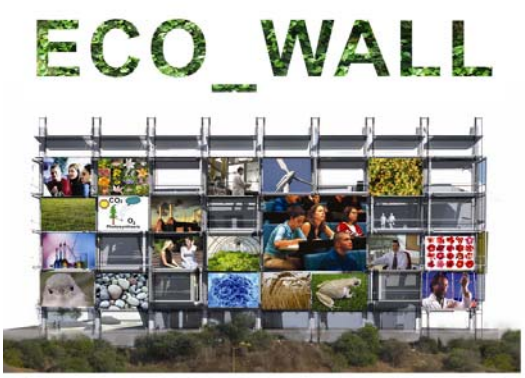

Fig. 22 The Eco_Wall Living Lab

Fig. 23 Inside the Eco_Wall

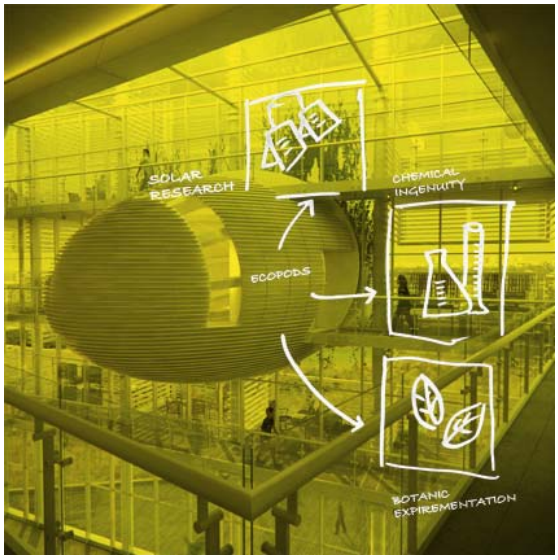

Fig. 24 Window Display for Innovation

6 Conclusion

In ancient times people tried to grasp the complicated universe in simplified terms of the five elements. Back then people knew they are part of nature and must relate to it in a way. But theories without practice are not reliable. Only when we test our theory we can rely on it more. On the other hand practice without theory is problematic as well and might suffer from disorientation and the lack of judging what is more suitable in the design so even if we build only according to the green regulations or the four modern elements or changing seasons is not enough!

We followed the environmental aspects that were considered during the design. But we must not neglect the values of good architecture that goes beyond check lists. Our building has a deeper meaning besides being green - it is aiming to be a lighthouse in Israel and the world for green design and to make people believe in what they will see and touch and to fight skepticism and ignorance on that matter. Using green regulations gave the project a solid platform to make architecture with meaning.

Even though we aim for LEED Platinum for the Porter School it does not mean we cannot improve our designs even further in future projects. In the near future we need our buildings to produce all of their energy and we might need a strong government to ask for it and finance it for several fragile sectors in the society. We need to aim towards zero carbon design as well. We will have to keep track on the performance and try to improve our design bit by bit. The cost and return of investment of the Porter school was less of an issue because the building need to educate first and be efficient second, but in regular projects efficiency might be more appropriate. We should ask ourselves how we can make green buildings with minimal budgets, how we can reduce bureaucracy, consider the urban and natural fabrics and so on.

We competed against many talented architects that included in theory the four sustainable elements in their proposals but we were able to make the integration between the ecological values and the aesthetic values in an educational way - the fifth element. The Porter School will be first of all an educational model for a sustainable design. Education is not alchemy - it is the starting point for moving from theory to green practice.