

Education Towards Environmentally Responsible Future – Low Energy and Passive Architecture for Schools and Kindergartens

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ABSTRACT: The projects of new schools and kindergartens, dedicated to the youngest generation, are the most current case studies for educational design. These facilities have the biggest potential for societal progression by means of multiplication of experienced architectural and ecological qualities. In harmony with the specific external factors the projects are supposed to be perfectly matched in bioclimatic context, well adapted to the local conditions, both urban and environmental. Among the most important analyzed aspects there are: a good balance and interaction between the architecture and the greenery, rainwater reuse, natural ventilation, daylight use and proper window shading, communication and accessibility. Local materials and natural components are promoted as well as the idea of material honesty. Exciting interior design has been also an important purpose. Architects are looking for solutions that with most minimal budget create the most maximized architectural and environmental performance. Finally the ecological education of the users has been emphasized. The intention and hope is to have all affected creatures experience the new building in the most true sense as a natural and stimulating part of their living environment, foremost the children, their teachers and parents.

Keywords: architecture, energy, education, environment, sustainable design

INTRODUCTION

It is impossible to overestimate the importance of education towards environmentally responsible future. The fact has been pointed out by the most respected international organizations. In the eight year of the United Nations Decade for Sustainable Development UNESCO declared again that “education for sustainable development remains crucial for building a better future” [1]. With the proper understanding of energy efficient and sustainable architecture children can learn some truly ecological attitudes that they will promote among their families and keep as something natural to shape their future lifestyles. They may also have significant impact in determining the energy performance of the building [2]. Therefore the projects of new schools and kindergartens are the most current case studies in the sequence of typological prototypes for educational design. These facilities, dedicated to the youngest generation, have “the biggest potential for societal progression and improvement by means of multiplication of experienced architectural and ecological qualities” through the future terrestrial advocates [3].

START AS EARLY AS POSSIBLE

The earlier we start the ecological education the more obvious and natural things appear. We should spread environmentally responsible attitude the same way that we train children to wash their hands and brush their teeth. Usually the first moment when children learn some

basics of social behaviour is when they attend to kindergarten. This is also the best moment to make them aware of the environmental issue. Properly designed architecture of these facilities dedicated to the youngest can be a very important tool in this process. Some excellent examples of sustainable kindergartens could be found all over the world.



Figure 1: The north-western part of the Göttingen Kindergarden in Germany, designed by Despang Architekten (2010), makes a perfect continuation of the landscape. Photography: Despang Architekten

THE HYBRID OF LANDSCAPE AND ARCHITECTURE

Despang Architekten, the authors of the kindergarten for the University of Göttingen (2010) in Germany, have created a very naturally looking but also truly sophisticated composition with the landscape (Fig. 1). Similarly as in their previous project of the kindergarten in Hanover the architects emphasized their educational mission using the expression “postfossil” to describe completely new attitudes towards the environment [4, 5]. One of the main goals for the designers was to provide maximum protection both to flora and fauna in the green campus area. Therefore the new structure has been located next to the existing 1970’s dormitory and a new laboratory building. The client’s expectations were analysed together with the environmental aspects, like for example the safety of the prairie dogs as the endangered species in the area. Regarding the requirements for passive house design in the temperate climate zone as orientation (open to the south, closed to the north) and insulation (wrapped all way around), the building became a hybrid of landscape and architecture. The thermally conditioning triple pane passive house glazing has been used to maximally open the southern façade to the existing urban context (Fig. 2). Biodynamic screen shades help stack effect cooling and do not disturb the view into the outdoor garden space [3] (Fig. 3).

In contrast, the north-western part of the building has been discretely hidden and protected against the heat loss with the green roof, that makes a natural continuation of the landscape. As Despang describes: “Due to their exposure to the sun the buildings are thermally self-regulating by the winter-wise solar harvested and in the summer through night cooling captured energy which it gains, stores and releases it in a delayed way. [3]”

The edifice is accessible from the east, under the roof that overshadows the entrance to the building and provides a shelter from the rain. The existing infrastructure has been synergistically used to lower costs, to intensify pedestrian activity and to allow visual presentation of the ecological value of the project.

In harmony with the specific external factors the project is supposed to be perfectly matched in bioclimatic context, well adapted to the local conditions, both urban and biological.

The architects put a lot of attention to obtain the best possible environmental and architectural performance with the minimal budget. Therefore they used a stereotomic prefab concrete system with exposed air distribution ducts. To make this raw material look less heavy and to take advantage of the natural light, a sequence of skylights has been designed in the hallway. The rays of sun change the character of concrete surfaces and create a very warm and natural look. Daylight helps saving energy while the skylight accent the entrances to the playrooms.

The slightly radial floor plan supports the similar dynamic move in section and improves the acoustics of the building. The natural wood-wool panels used for the ceilings cladding provide an additional acoustic support.



Figure 2: Göttingen Kindergarten in Germany, Despang Architekten (2010), the view of the southern façade in the winter. Photography: Despang Architekten



Figure 3: Göttingen Kindergarten in Germany, Despang Architekten (2010,) the view of the southern façade with the windows shading. Photography: Despang Architekten

All materials are shown in their natural texture and colour so that the surfaces represent different functions of the building components. This system should be easily

understandable for the children. The monolithic mineral walls are perceived as the storage of warmth in the winter and coolness in the summer. The wooden elements provide a natural background for all the activities of the young users, the absorption of noise and, together with bright coloured, soft furniture makes the interiors cosy and comfortable [3] (Fig. 4).



Figure 4: Göttingen Kindergarten in Germany, Despang Architekten (2010). The cosiness of the passive kindergarten interiors during the winter. Photography: Despang Architekten.

EDUCATIONAL ENVIRONMENT FOR MENTALLY HANDICAPPED CHILDREN

Thinking about the education towards environmentally responsible future we must remember about some special needs and challenges of mentally handicapped children. Such a sensitive and conscious approach can be observed in the project of the Paul-Moor (ILMASI) School in Grabsten, Germany (2003), designed by Despang Architekten. A hundred children with learning difficulties can take advantage of this facility, created with care for sustainability and energy conservation. The ecological aspects of the project have been emphasised from the very first stage (Fig. 5).

First of all the authors put a lot of attention to the careful prefabrication in purpose to minimise material waste on-site. An innovative timber structure provides a thermal mass of the building while a solar heating unit is used for heating the school's water. Finally natural



Figure 5: The Paul-Moor (ILMASI) School in Garbsten, Germany (2003), designed by Despang Architekten. Innovative timber structure and timber finishing. Photography: Despang Architekten.

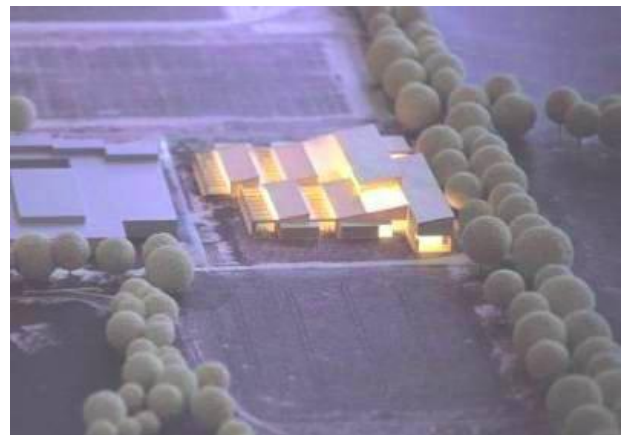


Figure 6: The Paul-Moor (ILMASI) School in Garbsten, Germany (2003), Despang Architekten. A network of courtyards covered with the skylights provides pleasant outdoor spaces with natural ventilation and allows daylight illumination. Photography: Despang Architekten.

daylight illuminates the building whilst printed film and wooden grating prevent uncontrolled glare or overheating [7].

The authors created a structure that they compared to the patchwork since it combines together the building and the landscape [3]. The network of courtyards with different functions provides a large number of pleasant outdoor space, easily accessible from the classrooms (Fig. 6). The courtyards are covered with the skylights to protect users against the precipitations and to allow the

maximum use of the natural light. This system of open areas, incorporated into the interior, helps ventilating the whole school in the way that reminds the breathing organism (Fig. 7).



Figure 7: Incorporated interior as an inspiration for the architectural structure of Paul-Moor (ILMASI) School in Garbsten, Germany (2003), Despang Architekten. Photo: Olaf Baumann



Figure 8: Natural wood structure can be sensually experienced by the handicapped children in Paul-Moor (ILMASI) School in Garbsten, Germany (2003), designed by Despang Architekten. Photography: Despang Architekten.

The effect is strengthened by the timber structure and the timber finishing, a mixture of oak and spruce. The wooden elements can be sensually experienced by these sensitive children (Fig. 8). This wood is not only a sustainable material. It is also pleasant in touch, smells beautiful and has the most natural look [7] (Fig. 9).



Figure 9: Paul-Moor (ILMASI) School in Garbsten, Germany (2003), Despang Architekten. The mixture of oak and spruce used for timber finishing. Photography: Despang Architekten.

SYNERGY AND INTEGRATION

While designing the new complex of Maslice Primary School and Kindergarten in Wrocław, Poland (2010), the architects from Grupa Synergia (Anna Bac and Krzysztof Cebart) and R2 wanted to create a safe, friendly place for the children. The authors desired to obtain the low-energy buildings, well integrated with the environment, accepted by the residents and users. In purpose to gain the synergy effect they developed the policy of "5 x R". In this case they explained that:

5 x R = REDUCE + REUSE + RECYCLE + RENEWABLE + RETHINK [8].

Each of these elements was very important during the design phase and should be considered equally valid by the final users, so that the process may be continued with the benefit of everyone involved. The five leitmotifs have been defined as:

- REDUCTION of any negative impact the building might have on the environment, including reduction of carbon dioxide emission.

- REUSE of water and heat: rainwater has been used for watering plants, the entire building complex is equipped with five air handling units, each with heat recuperation system.

- RECYCLE of materials and items: from the selective waste collection, through the utilization of soil, up to the recycle of the old furniture. The soil from the excavation for the building foundation has been used to form a hill that makes the area more attractive, with some places to seat for the children and the tribunes for the sports court. To save the costs, materials and energy, the architects decided to adapt a large part of equipment from the old school and to give it a new life.

- RENEWABLE resources have been used for the benefit of the environment and for the educational reasons. The heat pumps, equipped with vertical probes from the depth of 150 meters, drawing heat from the ground were installed as well as the heat exchangers. On the roof there are two groups of solar heat collectors. Solar heat is gained from almost entirely glazed southern façade, protected against overheating with the system of horizontal shading lamellas on outriggers. Additional textile interior blinds were added from the south, west and east. Only in the library and a school common room horizontal metal blinds were chosen.

- RETHINK how to do it better has formed the basis of the policy of continuous changes for better. Various improvements and modifications were made after consultations. Constant cooperation between specialists in different fields enriched the synergy effect.

The architects intention was to use and expose local materials and natural components (Fig. 10). To provide the best performance they also applied Building Energy Management System (BEMS) which is “an extremely cost effective form of reducing the energy consumption and carbon emissions from buildings” [9].

BEMS supervises the systems in the building so that it is fully operational. Furthermore its application results in the reduction of energy consumption and the improvement of the user comfort.

BEMS provides control over:

- energy sources,
- heating and ventilation installations,
- window shadings,
- electric lighting [motion detectors, dusk sensors and the system that switches off the lights as well as the mechanical ventilation when the key is turned in the lock from the outside,
- domestic hot water preparation solar system,
- surveillance and security systems.

Post occupancy assessment has been also conducted. After the first year the children and the teachers joined the survey to check their satisfaction level. The results proved that although the users liked the architecture, they pointed out the lack of rooms to work with children in the kindergarten. As a result some part of the storage area has been adapted for classrooms. The surprising fact is

that all the premises were disposed in accordance with the guidelines of the Department of Education. The architects informed the Department about the survey results and the changes they had to apply but they were answered that the previously given data was correct and there was no need of extra rooms for the children.

The post occupancy assessment also proved that there were also some minor technical problems with BEMS e.g. the mechanical ventilation did not work properly. All the necessary corrections have been done and currently the system works very well.



Figure 10: Maslice Primary School and Kindergarten, Wroclaw, Poland (2012), designed by Grupa Synergia and R2. The open air school yard with eco-benches. Photo: Grupa Synergia.



Figure 11: Maslice Primary School and Kindergarten, Wroclaw, Poland (2012), designed by Grupa Synergia and R2. The yellow colour in corridor increases the amount of light. Photo: Grupa Synergia



Figure 12: Maslice Primary School and Kindergarten, Wroclaw, Poland (2012), designed by Grupa Synergia and R2. The school library. Photo: Grupa Synergia.

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CONCLUSION

In all the examples given above the buildings help creating positive learning environment and are an important educational tools by themselves. Among the most important analyzed aspects there are: greenery, rainwater reuse, daylight use, window shading, communication, accessibility, low energy consumption, solar energy and passive solar gain, good insulation, natural ventilation as well as the ecological education of the users (Fig. 11, 12).

Green facilities dedicated to the youngest generation, like schools and kindergartens “are healthier places to learn and work, they have minimal negative impact on the environment, and they have lower overhead costs compared to conventional schools” [10]. Therefore a low budget is not an obstacle and should not stop the architects willing to design edifices that can contribute to the environmentally responsible future.

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