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HEALTH-AFFIRMING LANDSCAPES AND SUSTAINABLE ARCHITECTURE OF MODERN SCHOOLS

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Abstract

Modern schools face numerous challenges. They need to teach children about the need for sustainable development. Thus, school buildings and premises should be designed as living examples of the pursuit of sustainability. Moreover, green school grounds have the potential to become health-affirming landscapes. This paper discusses the close relationship between the concept of health-affirming everyday landscapes and sustainability in modern energy-efficient school design. In the first part of the paper, a literature review concerning the concept of health-affirming landscapes for children and teenagers and sustainability in school design is presented. In the second part, selected case studies of new energy-efficient schools in Poland and France are examined.

Keywords: school design, health-affirming landscapes, sustainable architecture

Streszczenie

Współczesna szkoła stoi przed licznymi wyzwaniami. Uczy dzieci o potrzebie zrównoważonego rozwoju, zatem zarówno teren szkoły, jak i jej budynek powinny być żywymi przykładami rozwiązań proekologicznych. Krajobraz terenu szkoły ma potencjał do promocji zdrowia. Artykuł omawia ścisły związek między koncepcją codziennych krajobrazów sprzyjających promocji zdrowia, a zrównoważonym projektowaniem nowoczesnych energooszczędnych szkół. W pierwszej części przedstawiono przegląd literatury dotyczący koncepcji krajobrazów sprzyjających promocji zdrowia dzieci i młodzieży oraz proekologicznego projektowania szkół. W drugiej części zanalizowano wybrane przykłady nowych energooszczędnych szkół w Polsce i Francji.

Słowa kluczowe: projektowanie szkoły, krajobrazy sprzyjające promocji zdrowia, zrównoważona architektura

1. Introduction – the concept of health-affirming everyday landscapes

Wilbert Gesler defined *therapeutic landscapes* as places where “physical and built environments, social conditions and human perceptions combine to produce an atmosphere which is conducive to healing” [1]. Numerous research projects on qualities of build and natural environment which are conducive to healing have thus far been published [2]. There are beautiful natural surroundings which for centuries have been perceived as therapeutic places, such as Epidaureus in Greece [3].

Today, the interesting question is how to use knowledge about *therapeutic landscapes* to convert everyday places into *health affirming everyday landscapes*. *Urban health-affirming landscapes* are everyday places which unite the qualities of *therapeutic landscapes* to influence people’s physical, mental and spiritual healing [4]. Modern schools may be designed and maintained to become *health affirming everyday landscapes*, which combine physical and built environments, social conditions and human perceptions to produce an atmosphere which is conducive to healing.

For modern architects, the interesting question is which qualities of physical and built environments should be combined. The majority of research concerning *therapeutic landscapes* has focussed on contact with nature.

2. Contact with nature

Nature has properties that have an impact on mood and attitude and help people disentangle the problems of life. This phenomena was explained with the concept of *biophilia*, which is an innate bond that humans have with nature. Contact with other living organisms has been proven to initiate and accelerate the medical healing processes [5–7]. There is a plethora of research about the impact of everyday contact with nature on longevity and general health [8–10]. Contact with nature can improve mood, reduce stress levels and aggressive behaviour across all age groups and can even help children with ADHD to concentrate better [11–14]. A green environment can also aid cognitive restoration and self-discipline [11–14]. The benefits of open green space can be divided into the following three categories [15]: physical and mental restoration, promotion of physical activity [16] and social contact. The therapeutic qualities which were studied for therapeutic parks [17, Table 1] are also relevant to the design of school premises. Put simply, the school ground should be designed as a therapeutic park.

The universal attributes of a therapeutic park are presented in Table 1. The attributes are organised into five groups which represent proposed phases of design. School children need places for psychological and physical restoration, enhancement of social contacts and opportunities for physical activities. Catering for basic needs is ensured within the school building.

Theoretically, if the school grounds are large enough, for example over 10 ha, they can accommodate the majority, if not all, of the attributes listed in the pattern. This argument can be useful when the local community is deciding about the location of a new school in order to

Table 1. Universal pattern of design for therapeutic parks; source [17]

1. PARK'S FUNCTIONAL PROGRAM	2. ORGANISATION OF SPACE AND FUNCTIONS	3. INTERIOR DESIGN, ARCHITECTURAL FORM AND DETAILS	4. PLACEMAKING	5. PURSUIT OF – SUSTAINABLE DEVELOPMENT
<p>1.1. Psychological and physical regeneration natural landscapes green open space place to rest in the sun and in the shade place to rest in silence and solitude possibility to observe other people possibility to observe animals</p> <p>1.2. Social Contacts Enhancement organisation of events inside the park gathering place for groups</p> <p>1.3. Physical Activity Promotion sports and recreational infrastructure community gardens</p> <p>1.4. Catering for basic needs safety and security places to sit and rest shelter toilet facilities drinking water food</p>	<p>2.1. The park spatial composition follows the surrounding urban pattern</p> <p>2.2. Architectural variety of urban environment focal points and landmarks structure of interiors and connections long vistas (extent) pathways with views invisible fragments of the scene (vista engaging the imagination) mystery, fascination framed views human scale</p>	<p>3.1. Optimal level of complexity</p> <p>3.2. Natural surfaces</p> <p>3.3 Engaging features risk/peril movement</p> <p>3.4. Presence of Water</p> <p>3.5. Sensory stimuli design sensory stimuli: sight sensory stimuli: hearing sensory stimuli: smell sensory stimuli: touch sensory stimuli: taste sensory path</p>	<p>4.1. Works of Art</p> <p>4.2. Monuments in the park</p> <p>4.3. Historic places culture and connection to the past</p> <p>4.4. Thematic gardens</p> <p>4.5. Personalisation</p> <p>4.6. Animation of place</p>	<p>5.1. Green Infrastructure</p> <p>5.2. Second (new) generation of parks</p> <p>5.3. Biodiversity protection part of park not-available to visitors habitat plants natural maintenance methods habitat animals</p> <p>5.4. Drinking water protection rainwater infiltration rainwater irrigation irrigation with non-potable water preventive measures if park is located in a flood risk zone</p> <p>5.5. Urban metabolism</p> <p>5.6. Ecological energy sources</p>

find a building plot which will be sufficiently large. This is also an argument against dividing the school premises and limiting the open green areas next to existing schools. However, there are situations when a new school is being built inside dense urban fabric, the open playground area is tiny or even non-existent and the recreational areas have to be located on the roof. In such cases, the question arises of whether there are any public parks which children could use located within walking distance of the school. There should be at least one. The location of a school next to green infrastructure is a question which concerns both architecture and urban planning.

Teenagers, in order to develop psychological resilience necessary to face adult life struggles, not only need contact with nature, they need to emerge into the wild [18]. Therefore, modern schools organise trips to national parks and reserves if possible. If the school grounds allow for it, semi-natural urban forests and meadows are planted. Natural plants and animals are encouraged to create semi-indigenous habitats. It is noteworthy that each tree planted contributes to the urban tree count and improves air quality. However, careful attention must be paid not to plant allergy-causing or invasive species. Of course, herbicides, pesticides and other chemical products must be strictly prohibited from the school environment.

Some school grounds cover large areas and offer practically endless possibilities for contact with nature. If school grounds are well-designed and maintained using natural methods, school gardens can be used to organise live lessons on ecology, sustainability and biodiversity. Back



Fig. 1. Elementary school and kindergarten in Montreuil – school gardens; source: photo by author

in the nineteenth century in Austria, official law stipulated that each school had to provide a school garden for its students. School gardens were organised in many other countries like Germany, Belgium, France, Russia, England and the USA from the late nineteenth century onwards [19]. Today, pedagogical gardens are being built to enable children to learn how food is produced and how biodiversity is promoted.

Today, there are numerous organisations which are dedicated to promote gardens for children and wild nature experiences for children. Eco-Schools is the largest global sustainable schools programme. Eco-Schools has developed from a European educational program to a global model for environmental education and sustainability on an international level [20]. The ambition of eco-school programs is to improve the environmental footprint of a school, hoping that it would lead to a more sustainable, less costly and more responsible school environment.

Nowadays, it is extremely important for school grounds to become health-affirming landscapes, because modern urban design has deprived our cities of much needed open public green spaces. Richard Louv, in his work *Last child in the woods*, [21] directly links the lack of nature in the lives of today's children to some of the most disturbing trends, such as obesity, attention disorders and depression. One of the possible remedies could be the sustainable and health promoting design of schools and school premises to bring children back into contact with nature.

3. Sustainability and health promotion – the role of education

Contact with nature can be extended to contact with natural building materials such as wood, straw, hemp, stone, etc. or even further to all technologies which in the long term protect our planet, its biodiversity and natural resources.

In designing the school and school premises, we must realise that it is the best expenditure of both effort and money in the long run. The children of today will grow up to be responsible adults in the future. Our planet is our common home and we all have to take care of it simultaneously [22]. Therefore, modern schools should become showcases of the most advanced solutions. They are funded with public money. Therefore, it is possible that they may become real life living laboratories displaying the most advanced solutions to entire neighbourhoods. School facilities are predisposed for construction in a passive standard. In the summer, when the air parameters are the least comfortable, there are no lessons, so even if the school building overheats, it will not affect students' comfort.

4. Modern energy-efficient school design

Two examples were chosen – a straw bale, hemp and wood school from France and a passive school from Poland. Both illustrate advanced ecological concepts.

4.1. École maternelle “Les Zéfirottes” et une école élémentaire “Stéphane Hessel”

Montreuil is a community located less than 7 km from the centre of Paris. It is one of the most densely populated suburbs in Paris. The urban context of the new school building was favourable to promote walking. The school is located within equal walking distances of two centres of adjacent neighbourhoods: one with a library and a theatre and the other with a conservatory and a swimming pool. This is why the spatial development of large vacant lot (8,500 m²) provided the opportunity to join together two neighbourhoods.

The school complex is formed by three buildings which follow the north-south axis. This was a deliberated decision to locate the school rooms so that they face north in order to avoid overheating in the summer. This decision was also taken to offer views of school gardens. Moreover, the placement of openings between the main building and garden create interesting long-vistas.

The ultimate objectives for school design is focussed on the protection of biodiversity, the development of coherent ecosystem and forming part of the green infrastructure. The demand was to design a school and a garden. The phrase “put a school in a garden” was coined by the architects. Therefore, the courtyards are not closed from the exterior world, but rather extend into the community garden. Existing trees – London planetree (*Platanus acerifolia*) which are over hundred years old – were saved during the construction phase.

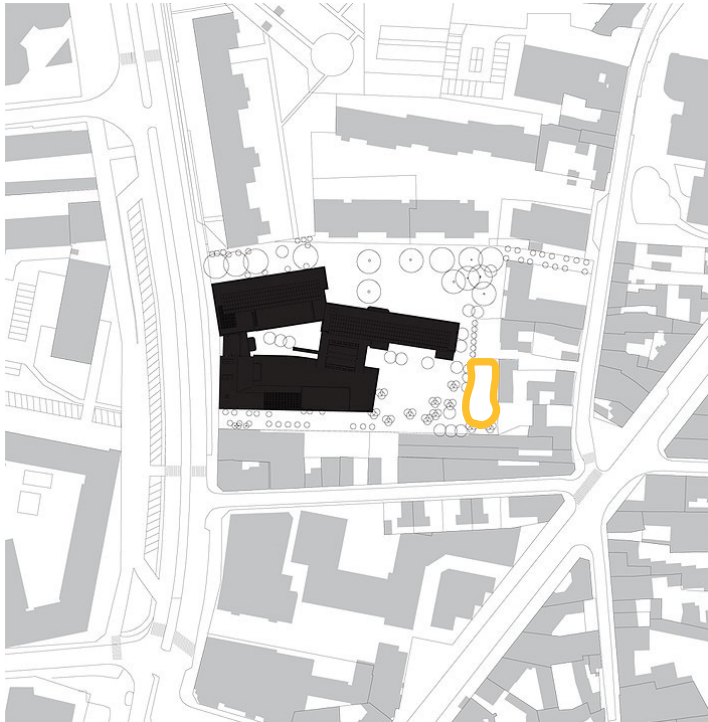


Fig. 2. Site plan of the elementary school and kindergarten in Montreuil; school gardens are located in the south-east corner; source: [27]

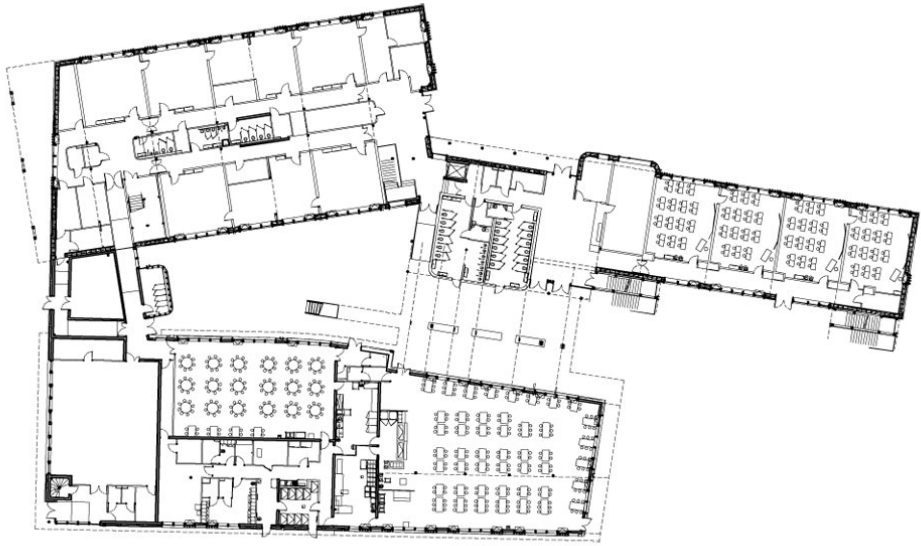


Fig. 3. Elementary school and kindergarten in Montreuil; ground floor plan; source: [27]

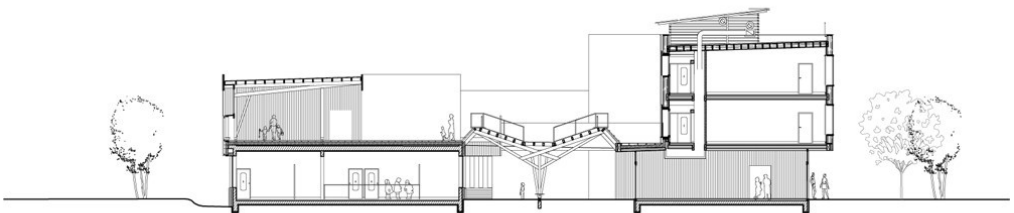


Fig. 4. Elementary school and kindergarten in Montreuil; section; source: [27]

The elementary school has three levels with a traversing hall which directly accesses the exterior court via the courtyard and two stairways. A leisure facility shares a double-height hall with the kindergarten. The kindergarten unfolds on the floor around the playground.

The school was designed for 650 children. It houses a kindergarten (9 classes), an elementary school (15 classes), a leisure facility and a restaurant (550 meals served a day) and it occupies 5000 m². The specialised activity rooms (computer, visual arts, video) are grouped on the second floor and are shared by the kindergarten, the elementary school and the leisure centre. The multipurpose room has a special status related to its dual use. Positioned on the Avenue de la Résistance, it is directly accessible independently of the school opening hours [23–36].



Fig. 5. Elementary school and kindergarten in Montreuil; view from air showing large canopies of mature trees which bring shadow to the north-east corner of the site – school gardens are located in the south-east; source: [35]



Fig. 6. Façade of elementary school and kindergarten in Montreuil; source: photo by author

The school is constructed of straw bales and hemp; however, there was no question of leaving the straw bales in sight because of the risks of fire or bad weather damaging the material. Therefore, the walls came to the site prefabricated. Parts of the construction – exterior wall panels (7.20 x 3.2 m) and roof panels – were prefabricated to increase the quality and speed of implementation on site. They were constructed, stuffed with straw and covered with a rain-protection layer. They were filled with compacted straw (36 cm thick) and hermetically enclosed with two layers of 50 mm rock wool and two plates of Fermacell (fire proofed). No exotic woods were used. Douglas fir and larch, two naturally rot-proof wood species that grow in France, were used for the construction. The Douglas pine was used for the exterior (protected with larch cladding), and spruce in the interior (with decking constructed from thermo-treated ash). For educational purposes, the natural scale model of wall construction was put on display in the school building in order to familiarise all students, teachers, parents and anyone interested with the unusual construction of the school [23–36].

Rainwater is collected and used for flushing the toilets and irrigation of a large garden of 3,500 m² with 8,000 plants. Rainwater from the roof is visibly circulating in rain gardens.

To meet the “zero energy” goal, a photovoltaic production area was needed; to meet this end, the roof houses 700 m² of photovoltaic solar panels. In addition, 90 m² of photovoltaic cells – monocrystalline silicon offering the best performance (12.5%) – are installed in a glass module where 60 m² act as a sunscreen for the elementary school and 30 m² as a sunscreen for the kindergarten.



Fig. 7. Elementary school and kindergarten in Montreuil – materials used for construction of school are being put on display for educative purposes; source: [34]

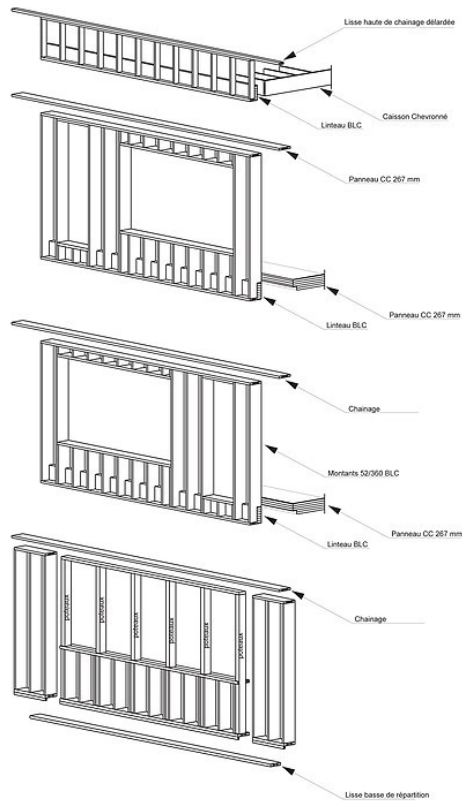


Fig. 8. Elementary school and kindergarten in Montreuil – lightweight timber frame construction of walls; source: [27]

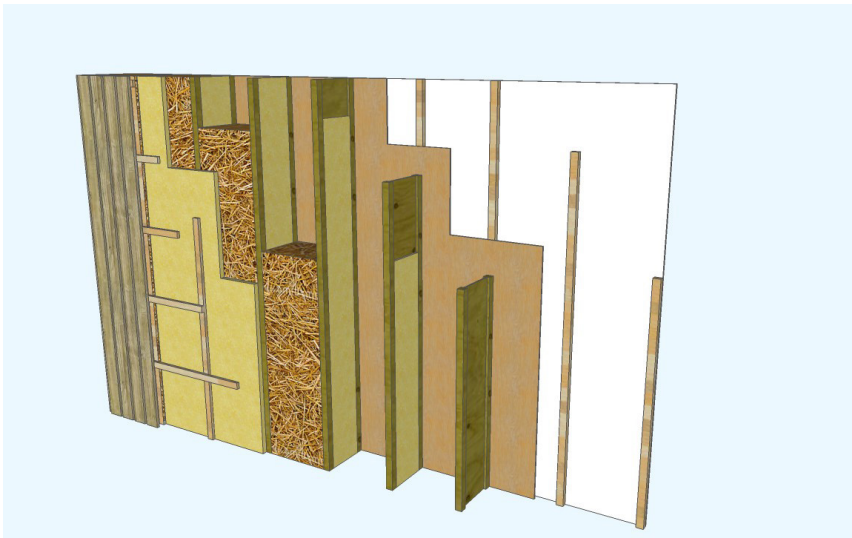


Fig. 9. Wood, straw and hemp construction of walls; source: [36]

Vegetable oil was used to heat the building. It is not the best solution as it is foodstuff and can be consumed. Therefore, a new solution is being proposed to recuperate the oil used for frying from the restaurant [23–36].

The school and schoolyard was analysed using Table 1. The universal pattern of design for the therapeutic parks. and the results were recognised as being satisfactory. The strategy to “put a school in a garden” has brought promising results.

5. Passive school design in Budzów, Stoszowice, Poland

The school in Budzów, Stoszowice is the first educational institution in Poland to be built in accordance with the passive standard. The almost zero-energy school in Budzów sets public construction standards that will apply in the country from 2020. The construction of the facility took over a year. As part of the investment, a single-story building with an area of approx. 836 m² was built, which provides a place of learning for about 170 students.

The primary school in Budzów is located in the middle of a flat meadow, gently sloping towards the north. The building is well connected to the surrounding landscape and greenery both from the outside and the interior. This location offers opportunities for psychological and physical restoration, enhancement of social contacts and opportunities for physical activities. Catering for basic needs is provided within the school building. This is a good starting point to create a health-affirming place next to the school.



Fig. 10. Passive school in Budzów, Stoszowice, Poland; source: [36]

The colour of the building makes reference to the traditional building materials of these regions, namely stone and brick. The size of the building is also inline with the scale of regional architecture.

Exceptional energy-saving is guaranteed by the building's architecture, ensuring, inter alia, the maximum lighting of rooms with sunlight, a ventilation system with heat recovery, energy-efficient windows and the insulation of the building with a thick, wide and solid layer of polystyrene.

On the ground floor of the school there is a common room, a canteen with facilities for preparing meals, a teacher's room, changing rooms and utility rooms. Six classrooms are planned on the first floor. The simple and compact building is conducive for energy savings. The correct location of the building, enabling the maximum illumination of interiors with natural light, was equally important. Heat pumps were used in the building to enable the recovery of exhaust heat. The entrance is located under a projecting part of building, which provides additional protection against heat loss in the winter season and provides an element of shading during the hot season.

The building has also had energy efficient windows installed, which both minimise energy losses, and are responsible for solar energy gains. The windows are placed in the exterior insulation to prevent thermal bridges.

In addition, photovoltaic panels will be installed on the roof of the building in the future, thanks to which, the school will be able to produce its own solar energy. Today, the school



Fig. 11. Passive school in Budzów, Stoszowice, Poland; windows are placed in the exterior insulation to prevent thermal bridges; source: [40]



Fig. 12. Aerial view of the passive school in Budzów, Stoszowice, Poland and its green surroundings; source: [41]

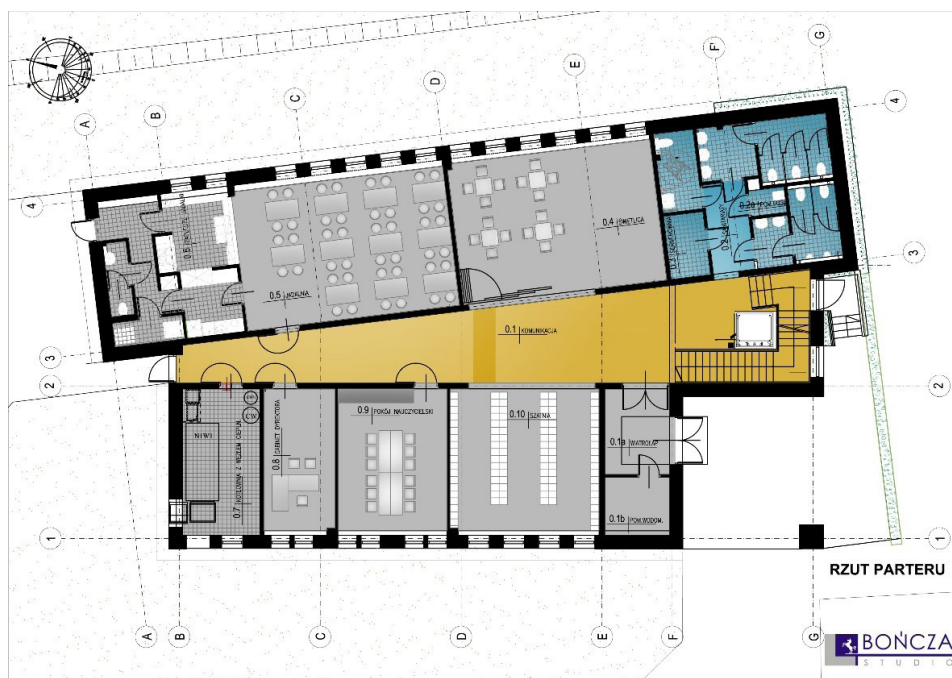


Fig. 13. Ground floor plan of the passive school in Budzów, Stoszowice, Poland; source: [42]

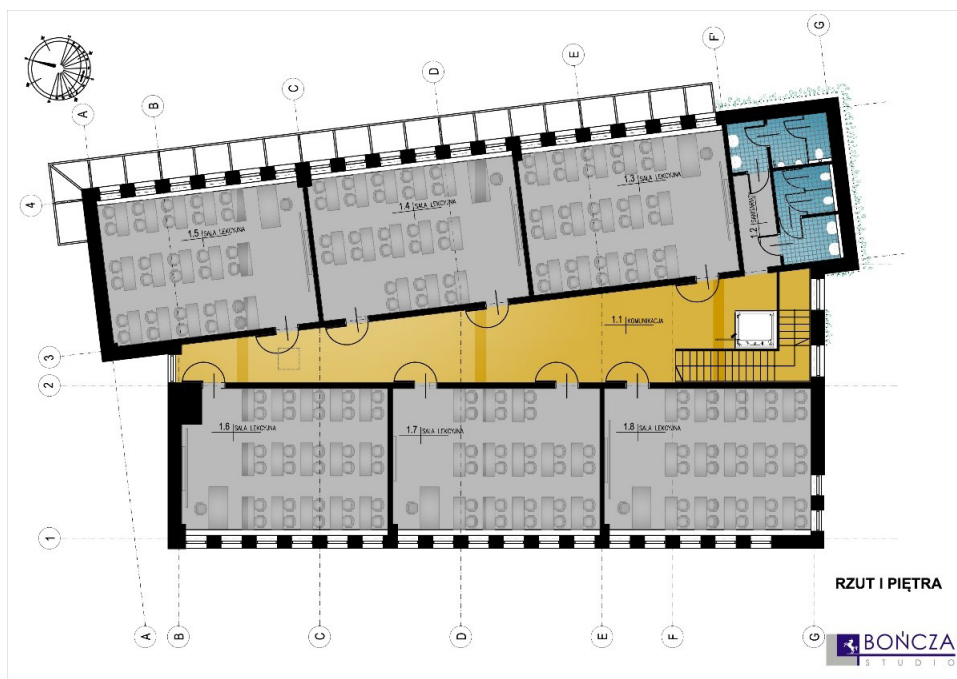


Fig. 14. First floor plan of the passive school in Budzów, Stoszowice, Poland; source: [43]

is showing significant savings on heating and electricity expenditure. The investment cost almost 3.4 million PLN and was more expensive than a traditional building by about 10–15% of the investment's value. The estimated cost of heating the building is approx. 1000 PLN per year. By comparison, the cost of heating a traditional building of a similar size amounts to approx. 40,000 PLN per year (including fuel costs and stoker's remuneration). The costs of heating a passive school in Budzów are therefore around 40 times lower [37–44]. Although energy savings were envisaged, the higher cost of construction remained a major obstacle which was difficult to overcome by the small community of Stoszowice, near Budzów.

6. Conclusions

Modern school design brings new challenges to architects. The new building must not only provide a valuable learning environment for children but also become a showcase of the best available sustainable solutions. Moreover, not only is the design of energy efficient school building important but also the design of the school grounds. The school grounds should compensate for loss of everyday contact with nature that modern children are experiencing. The school gardens should fulfil a new role, that of everyday health-affirming landscapes. The two schools presented as examples of good practices demonstrate that although this is difficult, it is possible.

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