

## **SUSTAINABLE DESIGN FOR SCHOOL BUILDINGS IN ALBANIA - KEY PRINCIPLES**

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### **Abstract**

The current situation of schools in Albania is such that there is an urgent need for reconstruction of existing schools and building new schools to meet the needs of the constantly growing number of students and the needs of increasing school standards in accordance with the time. Few of these schools meet the minimum norms on the basis of criteria which must be designed and built a school. In schools built and reconstructed after 90 years, it is noted a significant improvement in terms of quality of construction. But it must be said that this improvement still needs work. So it is very difficult to speak about sustainable schools in Albania, because we don't have any till now. This article presents precisely the main design principles of a sustainable school (so necessary for the situation in Albania), conditions that must be met, so that this kind of design typology be durable and efficient in many aspects. The principles that are treated here include the following main points:

- 1 - Functionality and flexibility.
- 2 - Aesthetic treatment.
- 3 - Climate Comfort.
- 4 - Climate control and ventilation.
- 5 - Natural and artificial lighting.
- 6 - Acoustics.
- 7 - Energy efficiency.

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**Keywords:** Sustainable, functionality, flexibility, control, efficiency

### **Introduction**

The current situation of schools in Albania is such that there is an urgent need for reconstruction of existing schools and building new schools to meet the needs of the constantly growing number of students and the needs of increasing school standards in accordance with the time.

It must be said that all schools built before the 90's, for which there have been investments are in a very bad conditions as well as by construction and conceptive phase.

Very few of these schools meet the minimum norms and criteria on the basis of which must be designed and built a school. This is obvious especially from the large number of students in a class, very small room windows (lack of natural light), the complete absence of thermal insulation, acoustic insulation, lack of heating system and ventilation, very poor quality of electrical installations and plumbing as well as the small number and poor hygienic conditions. In schools built and reconstructed after 90 years, it is noted a significant improvement in terms of quality of construction as well as meeting some basic norms and criteria of a school building. Given the numerous investments that are being made and will be made in the future to improve the school system, arises the necessity of implementing contemporary norms and criteria in the design and construction of new schools and the

renovation of existing ones . Term that includes this necessity is sustainability in design.In this article are elaborated the most important principles for a sostenible school.

**Main Text**

In Albania ,schools building (elementary,secondary and high schools) have problems such as:

- lack of classrooms and other educational spaces.
- high density of pupils in classes.
- lack of green spaces.
- use of dangerous materials that releases carbon gases in the air ,so harmful for the school community.
- lack of passive energy use .
- maximal electrical energy consume.
- high cost buildings.
- high acoustic pollution.

Below it is made a study for some albanian schools,about the number of pupils,classes,areas and other basic criterias.The study is made for the current situation in comparison with design criteria.

SCHOOLS	ACTUAL SITUATION							
	ELEMENTS	Number of pupils	Number of classes	Number of pupils in classes	school zone area (m2)	Ko (%)	Built area m2 /pupil	Built area m2
<b>SECONDARY SCHOOLS</b>								
"HASAN PRISHTINA"		1039	32	32	3490	46.5	1.53	1600
"KONGRESI I LUSHNYES"		817	24	34	2038	80	2	1638
"NIKET DARDANI"		543	20	27	2360	27	1.13	614
"XHEZMI DELLI"		342	14	24	2000	42	2.42	840
"LUIGJ GURAKUQI"		78	3	26	532	65	4.47	349
<b>HIGH SCHOOLS</b>								
"A.Z.CAJUPI"		1256	35	36	3800	33	0.99	1250
"JORDAN MISJA"		1300	35	36	4100	35	1.19	1470

<b>NORMS OF PROJECTING</b>					
<b>REFERENCES : "L'edilizia scolastica"; "URBANISTIKA 1" ENVER FAJA; "NEUFERT"</b>					
Number of pupils	Number of classes	Number of pupils/ classes	Total zone area (m2/pupil)	Ko (%)	Built area m2 /pupil
		25	2000-10000 (7.5m2/pupil)	30-40	6.68 (accepted 5)
Number of pupils	Number of classes	Number of pupils in classes	school zone area (m2)	Ko (%)	Built area m2 /pupil
1039	41	25	7792.5	30-40	6940.5
817	33	25	6127.5	30-40	4085
543	22	25	4072.5	30-40	2715
342	14	25	2565	30-40	1710
78	3	25	585	30-40	390
Number of pupils	Number of classes	Number of pupils in classes	2000-10000 (19m2/pupil)	Ko (%)	Built area m2 /pupil
1256	50	25	23 864	30-40	8792
1300	50	25	24 964	30-40	9792

<b>NEEDS FOR POSSIBLE EXTENSIONS</b>					
Number of pupils	Number of classes	Number of pupils in classes	school zone area (m2)	Built area m2	Conclusions
1039	+9	-7	+4302.5	+5340.5	The school has a high density of pupils and a lack of educational spaces.Estension of the school is needed .
817	+9	-9	+4302.5	+5340.5	The school has a high density of pupils and a lack of educational spaces.Estension of the school is needed .
543	+2	-2	+1712.5	+2101	The school has a normal number of students but its infrastructure is in a bad state and needs immediately reconstruction and a larger green space.
342	-	-	+565	+870	The school has a normal number of students but its infrastructure is in a bad state and needs immediately reconstruction and a larger green space.
78	-	-	+53	+41	The school has a normal number of students but its infrastructure is in a bad state and needs immediately reconstruction and a larger green space.It has lack in recreative and sportive spaces.
Number of pupils	Number of classes	Number of pupils in classes	school zone area (m2)	Built area m2	Conclusions
1256	+15	-11	+20 064	+7542	The school has a high density of pupils and a lack of educational spaces.Estension of the school is needed .
1300	+15	-11	+25 064	+8542	The school has a high density of pupils and a lack of educational spaces.Estension of the school is needed .

Based on this study , it is necessary to project in order to some rules and principles that give sustainability to the building .Finally a sustainable school must respect certain principles ,so necessary for the situation in Albania

### **It must be functional and flexible**

#### **Functionality**

During the design phase of schools buildings should be created a balance between quality and cost efficiency operation . This balance can be achieved by various ways , such as:

- Rational dimensions of spaces ;
- Oriented circulation : Circulation spaces should not exceed 25 % of the built useful area. They should have specified dimensions and shold be appropriate for the users of the school . Also they should be functional and respect some safety requirements ;
- The optimal number of areas : the number of spaces is determined initially by the tipology of the school .In small schools, where acceptable rate can not be achieved in particular for specialized teaching spaces , it is necessary a multifunctional space ;
- Maximum Compatibility : spaces should be designed with a maximum adaptability , which enables to adapt to changes and different subjects , in those cases where it fits with their functional requirements ;
- Grouping of spaces : spaces should be grouped in blocks in order to their function and interactivity.This would ensure easy identification of activities and their respective spaces , an easy communication between different spaces , unobstructed circulation through

areas and reception zone, an easy observation of space and optimal utilization of available land ;

- Inclusion of needs : the place of spaces within the school must follow the basic necessities such as sanitary and hygiene rules , regulations and safety functional comfort , acoustic comfort , visual and climate comfort.

### **Flexibility**

- It must be provided enough space for flexibility to enable school staff ,to adapt the school environment and different teaching methods , and to enable planners to adapt buildings for the future needs of the school , which coincide with the curriculum and with potential future programs .

- Flexibility required for buildings ( and furnishings ) enables multiple teaching methods to their classrooms ( frontal teaching , small group work , learning in the form of seminars, etc. . ) , Specialized laboratories and halls (practical work , demonstration and full group ) , and spaces for multiple purposes and sports halls (possibility of regrouping of some classes ) .

- Types of sharing space program that are given in the project must be designed into structures that can be easily modified to suit the requirements in the future . Planning flexibility is an important design evaluation / school project ,to adapt the continuous evolution of educational thought , as well as construction techniques and technologies . Also helps to adapt the school to new uses through changes in planning with a minimal cost .

### **It must be aesthetic**

#### **Aesthetics**

- The importance of physical appearance of a public school should not be minimized . A school that is attractive , which corresponds to design and environment context , evokes a sense of pride and ownership among students , teachers and community . As with most of the buildings , the school is a symbol of knowledge and the advancement of the community .

Precisely for this reason the architectural quality of school buildings should contribute to the school not only functionality , but also its integration into the community and its construction as a symbol by :

- - establishing a good sense of architecture to students through harmony and proportion of built up areas , open spaces , views ( facades ) ;

- - creating a pleasant environment in school by using good quality materials , colors and plants , and by creating a fluid circulation etc. .

- - enabling an easy identification of the different spaces through their grouping by activity and by providing easy connections between buildings and spaces ;

- - inclusion of cultural values and specific elements of the environment ,of the community in order to rise a feeling of accessibility and school pride . ;

Climate comfort:

Thermal Comfort usually involves two key parameters , which are :

- the feeling of thermal comfort as a result of the balance between accumulated calories and lost calories of our body;

- control of climatic conditions , including the position of the sun and its radiation , temperature , humidity and winds .

### **The climatic conditions of Albania**

- In Albania, prevails a Mediterranean climate , with warm summers and cold winters with Mediterranean and Alpine influences ( the average temperature in the country ranges from +30 ° C ( in summer ) to -10 ° C ( in winter ) .

- Based on climatic conditions , Albania can be divided into three climatic zones :
- Northeastern , southeastern and northern -cold winters and cool summers ;
- Western Zone - southern wet winters mild and hot summers ;
- Middle Albania - wet winters and hot summers and mild.

#### Improving the climate comfort

• In relation to improving school facilities thermal comfort measures should be taken to control the climate , such as :

• Natural or passive measures , which include building orientation , position and dimensions of openings , quality of materials , thermal insulation , planting trees near buildings etc.

• Artificial or active measures , which include those electrical or mechanical elements , such as heating, ventilation or air conditioning .

• To control the climate effects on schools building , in the design process should be taken a few simple measures , such as :

• Orientation of buildings : recommended orientation of learning areas is north and south , since this orientation offers protection from the direct rays of the sun . This preferred orientation can be deviated by about  $\pm 30^\circ$  (due to the requirements of location or orientation of prevailing winds ) , without having any major impact on the comfort of teaching rooms.

• Form of buildings is related to the possibility of cross- flow air to renew inside air with natural ventilation during the hot season , or by choosing the roof slope with four levels in areas with snow .

• Planted area : planting plants can play an essential role in the creation of microclimate in those cases when it is necessary . Planting effectively contributes to protection from dust , wind and sunlight . In addition, planting of shrubs and bushes makes possible the protection against sun rays reflecting from the earth .

• Appropriate elements of the building : this includes proper drainage from the roof and drainage around buildings ; creating shadows by folding the window ,using curtains sun that can bring extra protection from sunlight, especially in those cases when the orientation of the building is highly exposed to the sun .

• Necessary construction materials: includes materials (facades) that can create the possibility of reflection of the sun ; and insulation materials that protect the building in order to create good thermal comfort inside.

#### Active Climate Control

• Low Temperatures : comfortable lower level of temperatures can be considered between  $20^\circ\text{C}$  for learning areas, and  $15^\circ\text{C}$  for circulation areas . Efforts should be made to provide heat in order to achieve these levels in the indoor temperatures ( usually should not be too high ) .

• High temperatures : Albania climate is mostly dry and hot from May to September .

Most of the days are sunny . Hottest months of the year are : July and August with regional variations due to altitude . For a comfortable school , limit air temperature should be  $28^\circ\text{C}$  . However specialized halls such as computer labs , which have a large number of computers , temperatures can exceed  $38^\circ\text{C}$  and then cooling is required . Other laboratories may need cooling due to activities that bring heat or need to limit the degree of ventilation during certain activities and internships .

#### Passive climate control.

• Passive climate control in school buildings is achieved in two ways , with orientation and reflection of sunlight .

• Best orientation for a school building (to have proper light through the window ) is north - south . North orientation do not reflect directly the sunlight on the window , while the

south orientation reflects minimum rays on the window under a very small angle . In hot days , when the sun is at its zenith , angle radiation from the south windows is narrower . The sun , from this orientation may be reflected very easily .

- Sun reflection : For the reflection of the sun can be designed such devices that can operate in any orientation , since the angle of the sun is entirely predictable . However , due to seasonal changes , to avoid changing of sunlight fall , mobile elements are required . In practice reflection is usually a compromise , because , even in those cases when it is designed to reach the optimum orientation , reflection will be always present . When we orient the building through south , the window must be designed with an exterior exit level horizontally with the upper part of the window.

- Sunlight should not fall directly on windows , because the heat is more effective when it enters through the heated glass, by increasing the effect of heat . In the mean time it should be noted that the use of double glass is ineffective in stopping the sun , it is effective only in the prevention of loss of sunlight from outside.

### **Control of ventilation**

Ventilation needed is  $30 \text{ m}^3 / 1$  pupil during an hour of lessons. For permanent residency is needed minimally  $5 \text{ m}^3 / 1$  pupil clean air , it is necessary to change the air 4 times (  $4 \times 5 = 20 \text{ m}^3$  for one pupil ) .

Ventilation can be natural and mechanical for special occasions .

Natural ventilation is continuous air changes in a natural way .(by opening the windows)

Mechanical ventilation is part of natural ventilation . It is necessary only in laboratories and workshops , where are released gases and dust, and in multipurpose space .

### **Lighting needs**

#### **Natural**

The use of natural light should be the principle priority in a building school.

-Specific tasks for natural light :

-Work rooms and classrooms need large windows, that allow a deep natural lighting into rooms . The area of the window should cover at least 15 % of the floor area. In rooms , that during the classes it is allowed the enter of the sunlight , should be provided protective curtains .

-Windows are not allowed in the same wall with the blackboard .

Natural lighting must meet these requirements :

The entering ray angle till the furthest reflected angle from the window should be between  $25^\circ - 30^\circ$  .

Area of opening elements of windows should include  $1/3$  of the surface of the window. Classes must be oriented to south - east .

Visual comfort in classrooms can be achieved :

By having a high level of lighting on desks surfaces. This can be achieved by determining the ratio between the area of the window against floor's area and window's level towards room's depth. It is recommended  $B / H = 3.5$ . This is achieved if the area of the window is like 20 % of the floor area for ribs report 1.5-1 or 25%.

By using uniform lighting distribution due to the depth and length of the classroom. For this it is necessary that the parapet of the window should not be higher by more than 80 cm from the floor ;by using ribbon windows that improve the light uniformity . For deep classes it is recommended two sided windows or integrated natural and artificial lighting .

Surfaces of the walls , ceiling and floor must be rough to eliminate mirror reflections in order to create a diffuse light.Colors and their nuances should be warm and light.

Best orientation is east , west , south-east , south-west and south : except drawing classes that must be oriented to north ,because diffuse light comes from here .

**Artificial**

The level of lighting in ( lux )

Recommendations	
Spaces	(Lux environments demand)
Classes , blackboards , cabinets	300 lux
Hall of teachers , administration	300 lux
Library	300 lux
Gymnastics halls	200 lux
Courtroom drawing	300 lux
Laboratories , workshops , first aid environment	300 lux
Stairs , wardrobes , sanitary	100 lux
Entry secondary , secondary corridors , warehouses	100 lux

-Entry and exit routes should be illuminated with lights convenient ( about 10 lux ) .

**Contrast**

The maximum ratio of the density of light between two close surfaces is 5:1 and between two different surfaces is 100:1. Reflection Rank : possibly 70 % for ceilings , walls approximately 50 % , floor approximately 20 % , furniture , equipment and walls interior at least 30 %.

The object should be studied in order to the connection between the working and environmental surfaces .

Largest Contrast enhances object’s vision .

**Brightness**

Brightness is caused by natural changes conditions and may cause damages to the eyes.Brightness can be reduced by taking the following measures :

Light colored windows reduces levels of contrast .

Increasing the number of lights in the room .

By covering the lighting lamps ( in order not to shine directly )

Measures recommended for acoustics:

- To ensure a good listening environment ,during school design it is important to consider the location of the school : noise from outside can be controlled by projecting the school buildings as far as possible from noisy urban areas ; by orienting learning spaces away from noise sources ; by building fences around the school or by adding the planted area to limit the penetration of noise from outside ( from markets , highways , stations etc. . ) .

To guarantee an auscultation close to 85% is necessary that the noise that comes from outside does not exceed the limit of 55 dB .

- Noise rates between the two spaces should be:
  - a) between two classes 50 dB
  - b ) divisions between floors max . 48 dB
  - c ) between the hall and physical education classes 60 dB
  - d ) in work environments should be below 85 dB



Environments that develop an intense noise ( workshops , music classes ) should be positioned away from learning classes .

### **Energy efficiency**

Energy efficiency means that for the same service we use less energy. It is the key of reducing daily energy consumption and therefore reduces the cost of the building. This term should not be confused with energy conservation , because conservation means to reduce the number of services to save energy , for example turning off a light is energy conservation , but the substitution of a lamp with an economic one is an energy efficiency . Both these processes reduce the emission of harmful gases and bad substances in the air .

Energy efficiency is measured in kWh/m<sup>2</sup> per year .

Based on the value of energy consumption school buildings are divided into :

- buildings with high energy consumption amounting to 70 kWh / m<sup>2</sup> per year. Here are included large schools and mostly outdated one.
- Buildings with an average energy consumption value from 50 to 68 kWh / m<sup>2</sup> per year
- Buildings with low energy consumption 25 to 48 kWh / m<sup>2</sup> per year .
- Passive Buildings 15-40 kWh / m<sup>2</sup> per year
- Building with 0 kWh / m<sup>2</sup> per year energy consumption .

In Albania we are still far away from the concept of a passive building although in recent years we are making big efforts. Most of elementary , secondary and high schools that are built before the 90s , even though they are reconstructed over the years , they haven't paid attention to their energy efficiency. The average consumption of secondary schools in Albania is 65.3 kWh / m<sup>2</sup> per year , while for high schools runs 72.6 kWh / m<sup>2</sup> per year , ( the value obtained from the pilot project " Energy consumption of Albanian schools ' year 2005, the Ministry of Education and Science ) .

### **Conclusions**

Characteristics of a sustainable school :

A high Architectural Design quality .

Functional and rational organization of spaces.

Compact volumes to prevent energy losses .

Planning possible extensions in the future , physical changes , during the design phase.

Availability of space required for the performance of all activities programmed for a certain typology of school .

Integration with the district community by projecting the school as a mix building that offers various recreational activities .

Respect human kind as a key ingredient to increase the longevity of the building .

Continuous improvement of learning conditions ( ventilation , lighting , heating ) to promote active participation in class.

Use of ecological materials in the facade and interior in order to meet the hygienic sanitary standards , which would not affect the health of pupils .

Integration of nature and its elements in the school environment to enhance air quality and recreational opportunities .

Avoiding misuse by increasing energy efficiency. The use of inexhaustible resources like sun , wind, water to save energy and reduce the cost of the building .

Use of passive and active systems . Regarding the process of heating , cooling and ventilation .

Best orientation of the building towards the south to use solar energy and to apply passive and active systems .

Design of classes in such way to meet the norms required for a good lighting. Maximum use of natural light and good modeling of the interior spaces by using rational shapes, materials and colors that reduce visual discomfort .

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