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"Toward Sustainable School Design"

Researcher:
Salwa Nayef Al-Mashaqbeh
Architectural Engineering
City: Zarqa - District: Dulail - Dulail Municipality

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Abstract:

"All sustainable developments goals come to education." (Yousafzai, 2016)
Recently, the sustainability concept has become a common concern in many fields. This widespread concept is, to achieve the sustainable development of societies. sustainability is a big umbrella that includes various concepts such as sustainable development, sustainable environment, sustainable cities, and sustainable architecture. The sustainable architecture includes low energy consumption, high flexibility, and high efficiency in the use of resources to improve the quality of life and sustainable development, while reducing energy consumption and reducing environmental pollution, synchronizes its constituent elements to achieve sustainable development goals. the purpose of this paper is to endorse innovative strategies of sustainable design associated with high levels of energy efficiency, environmental indoor quality, and performance standards to enhance the Tariq bin Ziad school environment. The method of the paper will be a mixed-method approach that will be appropriate to evaluate the school data collection, which will combine a questionnaire survey to students and staff, and interviews with each administrator; to understand their overall satisfaction with the school's built environment and use program design-builder/Energy Plus to assess the Tariq bin Ziad school building energy simulation.
Keywords: Education environment, Sustainability, Sustainable school, Design guidelines, Sustainable strategies.

Introduction

The term sustainability in the Oxford English Dictionary is derived from the Latin sustainer (tenere, to hold; sus, up). Dictionaries provide more than ten meanings for sustain, the main ones being to ―maintain", "support", or "endure‖ (Onions, 1964). The World Commission on Environment and Development Sustainability defined the term as meeting the needs of today without compromising the ability of future generations to meet their own needs. (Haji Mohd. & Norhazarina , 2012). (Kilbert, 1994) Defined sustainable, it is the healthily built environment based on resource efficiency and ecological principles. (Vieria, 1993) Addressed sustainable strategies that look at a site's natural land, water, air, and energy resources as integral aspects of the design. In addition, (Beyer, 2012) had emphasized that sustainability can be classified as well-being constructed human places that satisfy people's needs such as security, health, comfort, and spiritual well-being, by exploiting the local natural resources (materials, climate) without adversely impacting on the natural environment (resource depletion, pollution, waste). Nowadays, the term sustainability is used to describe human and natural systems relationships that can be combined to survive the distant future.

Research Problem

students spend more time in their school than in their home environment. school as the building is mainly characterized by a low level of architectural quality and performance. This leads to high consumption of energy, and the indoor microclimate becomes below comfort level. This results in the Lack of interaction between the schools and their environment and the failure in non-exploitation of the natural environment. Paper has shown that poor indoor and outdoor environments can negatively affect the health and development of students in school buildings.

School buildings play a dual role: on one hand, they have to ensure adequate technical standards to all spaces used by the students, and on the other, they have to improve the school environment by effectively communicating the criteria and strategies of sustainable design.

Research purpose

The purpose of this paper is to investigate indoor and outdoor school environmental qualities and document the presence or absence of sustainable design elements in school design. This guides us to highlighting criteria, and strategies, which must be adopted in the sustainable design in Tariq bin Ziad School.

Research Objective:

- The paper aims to promote criteria, and innovative strategies of sustainable design that combine high levels of energy efficiency, performance standards, and environmental indoor quality to incorporate building and its related systems.
- Providing guidelines for architects, designers, and managers in enhancing the current school environment to become a sustainable environment in the future.

Research Hypothesis

Adapting sustainability criteria and their implementation in Tariq bin Ziad School will reduce energy consumption in addition to providing a comfortable place for users.

Research Significance

- The reduction of energy consumption and the possibility to meet the needs of students' comfort.
- Improving performance levels of school, providing better conditions of use and consuming less.
- Satisfaction of the students with the school's built environment and adequately supported their daily activities.
- To make guidelines for an architect when designing a sustainable school.

Literature review

Principles of Sustainable Architecture

Sustainable architecture is the means to "create a stable man-made environment" according to the general definition of Green Architecture, Echo Tech architecture, and Organic Tech architecture. In a general context, human architecture is designed to reduce damage to natural resources and energy consumption. The main objectives of sustainable architecture are: (Nazarian , 2015, pp. 47-48)

- Organizing the flexible and multifunctional actions;
- Maximizing the use of renewable energy;
- No adverse environmental impact on your site of living;
- Use the native form and by climatic conditions;
- Enhancing the quality of life.

Sustainable buildings

Sustainable Building is a comprehensive body; "whole building" way to design, construction, and operation. Sustainable buildings whether are stated as green or high-performance buildings designed to: provide optimal environmental and economic performance; increase efficiencies thereby saving energy, water, and other resources; furnish satisfying, productive, and quality indoor spaces; use an environmentally better choice of materials; and educate building occupants about efficiency and conservation (Olson, Stephen , & Kellum, 2003).

The OECD Project defined Sustainable buildings as buildings that have minimum negative impacts on the built and natural environment, in terms of the building itself, its current setting and the broader regional and global settings. Sustainable building is fully integrated, which attempts for integral performance (including economic, social, and environmental performance) in a comprehensive way. Thus, the rational use of natural resources and appropriate management of the building stock will contribute to saving rare resources, reducing energy consumption, and improving environmental quality. The OECD project identified five objectives for sustainable buildings;

1. Resource efficiency;
2. Energy efficiency (including greenhouse gas emissions reduction);
3. Pollution prevention (including indoor air quality and noise abatement);
4. Harmonization with the environment;
5. Integrated and systemic approaches.

Sustainable building involves considering the whole life of buildings, taking environmental quality, functional quality, and future values into account. Therefore, sustainable building design is the thoughtful integration of architecture with electrical, mechanical, and structural engineering resources.

Sustainable schools

Sustainable schools are the educational tool that brings together environmental education and community engagement. Sustainable schools create an environment where teachers have more chances to develop exclusive learning opportunities and students benefit through increased participation and productivity and improved problem-solving and critical thinking skills of students (Gough, 2006). These collaborative actions encourage all members of the school community, which creates a culture of continuous learning, growth, and development (Alliance, 2018).

Why sustainable schools are important

Students spend the majority of their day in a school building during their most crucial developmental years. Therefore, the Educational program is essential for students. This program combines physical place and organizational culture that enhances the development of environmentally sensible global citizens. In this time of crucial growth, schools must be a space for creative thinking, a source of inspiration, and a starting point for developing a sense of awareness and responsibility. The journey to that goal begins with educating students in a healthy and sustainable environment (Alliance, 2018). Figure 1 shows the reported case studies that analyze the impact of environmental education on students.

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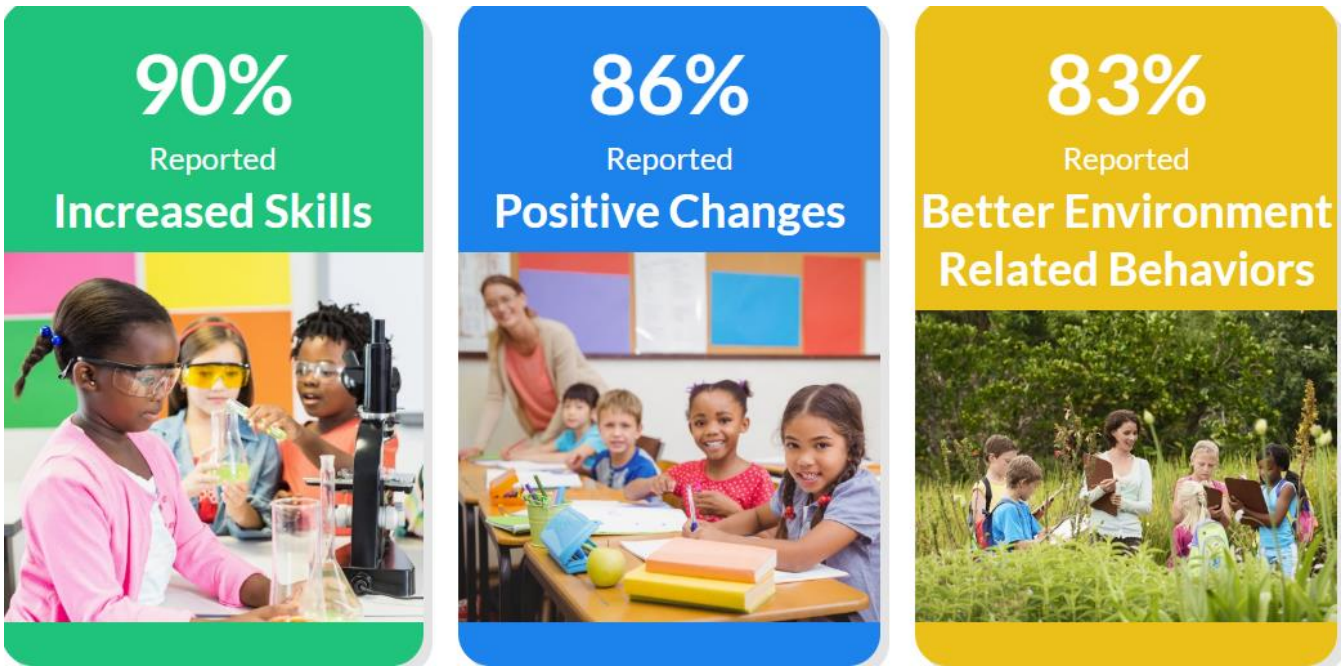

Figure1: Impact of Environmental Education on Students (NAAEE, 2011).

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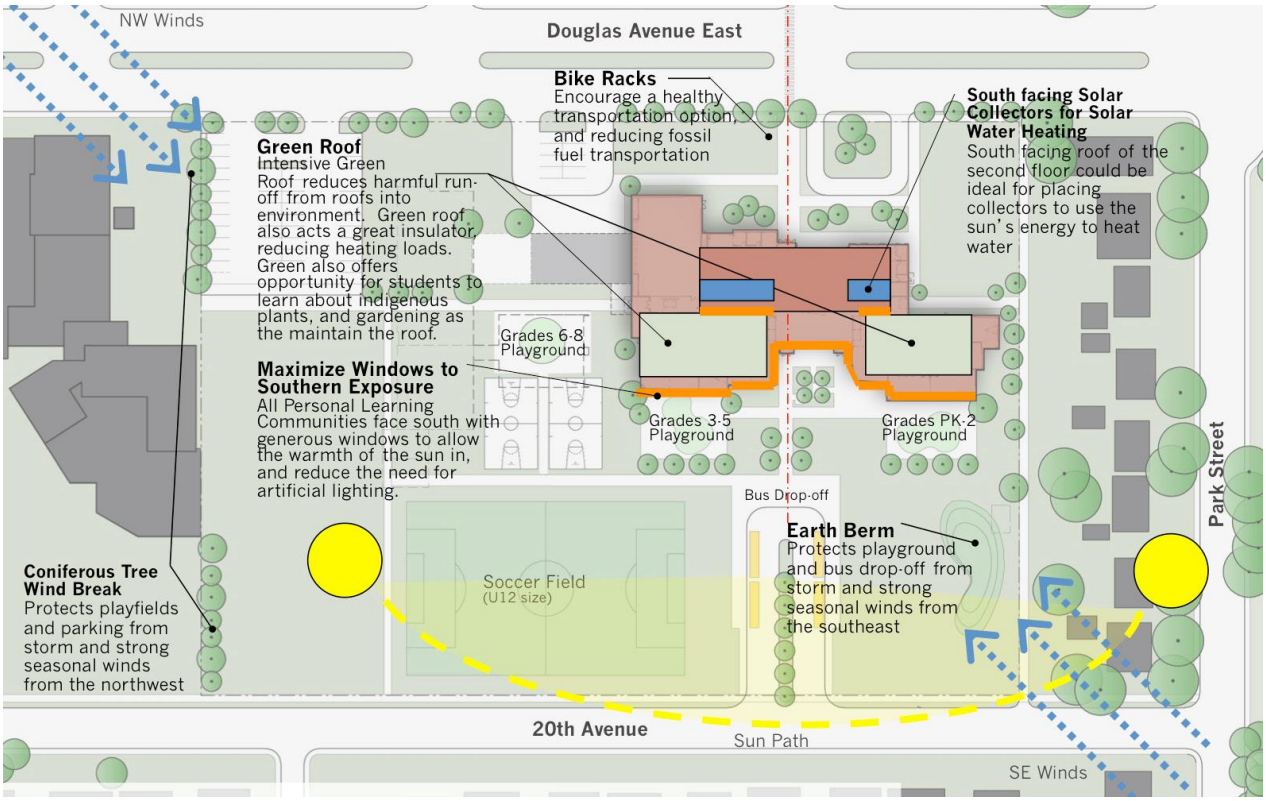

Figure 2 Sustainable Strategies for Douglas Park School (Rolston, et al., 2012)

Sustainable school building benefits the school district and community. These benefits are classified as Economic benefits, Environmental benefits, and society benefits; Economic benefits include reduced life cycle and operating and maintenance costs. Environmental benefits embrace improved energy and water efficiency, reduced pollution, and reduced landfill waste. In addition, other benefits include improved health of students and staff, reduced absence, improved indoor air quality, and possibly increased test scores (Ohio Project, Energy, 2000). As a result, society benefits from the decreased impact on the environment and the increased comfort, health, and quality of life for building users.

The following table shows the Benefits of Implementing a Whole-School Sustainability Program (Alliance, 2018).

Students	Schools	Planet
Sustainable strategies application revealed a positive impact because of environmental education.	The sustainable school uses 33% less energy and 32% less water than constructed school.	Sustainable school is designed to teach and represent Eco-friendly initiatives that reduce our environmental impact.
The sustainable school with natural light sources reported major increases in exams.	Sustainable schools save a lot of budgets that discharge operational costs.	The sustainable school building is constructed with renewable materials that decrease the reliance on fossil fuels, reducing carbon emissions.
Studies reported students could able equally engage in environmental education regardless of where they fell on the intellectual field.	Sustainable school improves the health of students and staff, and increase indoor air quality.	Green roofs last longer than typical roofs, reducing the amount of waste produced from replacement that is more frequent.

Studies reported increased student engagement in class, which is located in a sustainable environment.	The sustainable school receives direct and indirect savings from increased efficiency, higher teacher retention, and lower health costs.	Sustainable schools motivate the next generation of environmental issues

General Characteristics of Sustainable School

Determining the general characteristics of a sustainable school are important to develop and build a sustainable school design (Haji Mohd. & Norhazarina , 2012). So, The Centre of Green School under the U.S. Green Building Council had defined the sustainable school characteristics as the following:

- Saves energy and natural resources;
- enhancing indoor air quality;
- removes toxic materials from places where children learn and play;
- engage in daylighting strategies and improves classroom acoustics;
- minimizing the burden on municipal water and wastewater treatment;
- Encourages waste management efforts to benefit the local community and region;
- preserves fresh drinking water and helps manage stormwater runoff;
- Encourage recycling;
- Promote habitats protection;
- Reduced demand on local landfills.

To achieve a Sustainable school model, strategies guidelines go well beyond design and engineering criteria for the buildings, concentrate on land use, processes for construction and equipment installation, and operation and maintenance practices. It includes design and engineering techniques to meet specific objectives, which are (Gough, 2006):

- Select the site of the school near public transportation to reduce pollution;
- locating a building on a green site to minimize its environmental impact and make the most of available natural light and solar gain;
- Designing irrigation systems and indoor plumbing systems to conserve water;
- Designing energy and lighting systems thus conserving fossil fuels and maximizing the use of renewable resources;
- Selecting renewable materials that are non-toxic, biodegradable, and easily recycled;
- Designing an indoor environment that provides occupants with a comfortable temperature, good air quality, lighting, and acoustics (Haji Mohd. & Norhazarina , 2012).

Air and ventilation

In a school building, where the main purpose is education and the development of intelligent activities. Students spend most of the time in their school building: the existence of a lot number of occupants in an enclosed space results in a decrease in air quality leads to an increasing concentration of pollutants. Air pollution is one of the main causes of a decrease in the level of comfort and attention paid by the users. Therefore, good ventilation is essential to remove the sources of pollution and to maintain a high level of indoor comfort and save suitable indoor ventilation, favoring the necessary air change get fresh clean air and eject the exhausted inside air, to improve the user's well-being (Becker, Goldberger, I, & Paciuk, 2007).

Based on the extensive quantity of air that requires to be changed to create the best indoor comfort school buildings, whose goals are a high level of energy efficiency should be provided with passive ventilation systems equipped with efficient heat recovery units. This solution, attached with a careful sealing of all joints and openings where air could flow through, this systems allow to control the airflows and to reduce energy consumption (BOERI & LONGO, 2013).

Efficient ventilation needs to take into account proper planning of the positioning and the size of all openings, and the particular conditions of the site, such as the strength and the main direction of the wind. Proper natural ventilation needs the existence of openings on the two opposite sides of a room for a quick air change and a generation of cross-flows. In this case, the opening ports are located at a lower level and can be smaller than the opening ports, usually in a higher position. Ventilation, both natural and mechanical, can be used as a cooling system during the summer and is useful for removing, during the night, part of the accumulated heat of building elements during the day (BOERI & LONGO, 2013) .

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Natural light

Indoor lighting issue has great effects to achieve high levels of environmental quality and energy efficiency in a school building**.** So, increased of using natural light in greater part and reduced using artificial sources, since both in the energy budget of a school building the consumptions resulting from the use of lighting systems are an item of relevant impact and for the effects, the available natural light produces in terms of indoor comfort (BOERI & LONGO, 2013).

Research Design (methodologies)

Educational buildings need to stimulate student productivity and learning. This paper presents a mixed-method approach for estimating and optimizing the environmental comfort parameters of school buildings. Tariq bin Ziad School, Marka, Amman, analyzed and characterized to test the environmental comfort aspects. Four aspects of comfort were considered: thermal, acoustic, lighting, ventilation, and humidity. Since the questionnaire asked students and staff were used to understand their overall satisfaction with the school's-built environment, and if it adequately supported their daily activities. Results show the final assessment for each comfort aspect stated the building's average performance, and multi-criteria optimization can be applied as a design-builder tool during the simulation process.

Project Description

The school building selected for the study was a private school in Marka. The total floor area of the building is 7963 m2. The building has five floors. The orientation of the main building is toward the south. On the ground floors, there are staff rooms, administrative rooms, and a cafeteria. while as in upper floors, there are classrooms.

Table 1. Building summary.

	Description
Location	Marka
School name	Tariq bin Ziad school
Orientation	south
Use	Education facility (high school)
Stories	five floors
Building area	1260
Structure	Reinforced concrete
Building height	17.40m
floor height	3.30

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Figure 3: Tariq bin Ziad facad. By researchers

Figure 4: Tariq bin Ziad school – interior of class room. By researcher

Data collection

The process of data collection was done through two methods:

The First one is a Researcher observation and subjective surveys**,** and the second method is through the simulation of the school using the computerized program: design-builder/energy plus.

Researcher observation and subjective surveys

The survey was undertaken during four classrooms of December 2018, to evaluate environmental comfort as the class progressed. It consisted of the following steps: researchers collected the observation data from their notes and an interview with the school principal; then, the general survey questionnaire was distributed to the students; after that, correlating observation notes and the data.

During classes surveyed, observations were done for acoustic, ventilation, temperature, lighting, and humidity. The subjective survey questionnaires consisted of two parts: a general survey for students in particular classrooms and a second template for the school principal. Contents for each part have been provided as supplementary documents.

The students were intimated that they provide their feedback in a free and open-minded manner since the data collected would be treated confidentially and would solely be used for this study. The questions were written in easy language and terminology and when, during the class, they were expected to fill up the questionnaire.

The general survey questionnaire was filled out at the beginning of Lectures intended to identify students' comfort perception evolution through the class duration. Students are required for 5 to 10 minutes to be able to respond to their current environment. The general survey questionnaire queried the students' three aspects; heating comfort; visual comfort; and acoustic comfort. The questions had multiple responses according to several Likert scales, and other questions had just two choices like accept or not accept.

Design-builder/energy plus

The goal of the research was to build and evaluate a model of Tariq bin Ziad school using the Design-Builder interface for the Energy Plus simulation engine.

Building performance modeling (BPM) is the use of software to predict the energy use and consumption of a building. It is the attempt to model the various energy and mass flow within a building to forecast one or several performance aspects of a building using computer simulations.

Design-builder/Energy Plus. Energy Plus is one of the most advanced, publicly available building energy simulation programs, whose development began in 1996 with funding from the U.S. Department of Energy. While the program borrows what was effective from BLAST and DOE-2, it contains several innovative features, including sub-hourly time steps, user-

configurable modular HVAC systems that are integrated with a heat and mass balance-based zone simulation, as well as input and output data structures that can facilitate third-party module and interface development. The graphical user interface has recently been developed and released for Energy Plus, and a software development kit has been developed to simplify the creation of applications that use simulation models.

Data analysis

The form of the questionnaire is paper-based. Questions and options formulation (wording) was written in easy language to be clear for all ages. questionnaires answered at the end of one-hour class in the morning between (9:55 Am to 10:30 Am) o'clock., showed that students who came into the class from outdoors had a significantly warmer thermal sensation than those who came from inside the same building. Four classrooms in different orientations are considered for the survey: south, north, east, and south-west. Lectures in Southside (9 students); north side (9 students); east side (13 students); and southwest side (8 students). Of the respondents, 65 % were male and 35 % were aged between 11 and 13 years. Most of the respondents (37 out of 39). Missing answers disregarded. Such instances were less than 1% of the total number of responses. Excel program was used for statistical analysis.

Results

General survey results

In the survey questionnaire, Comfort parameters on various Likert scales querying the ability of the classroom to act as a good learning environment. so, the researchers measured the comfort satisfaction according to students' responses as the following:

The south and southwest classrooms have two openings are located on each side.

- Heating comfort: more than fifty percent of all responses preferred the current heating level, airspeed, and humidity conditions.
- Visual comfort: 77.7 percent of all responses in the classroom where is located in the south preferred the same lighting intensity. On the contrary, 87.5 percent of all responses in the classroom where is located in the southwest preferred maximizing the lighting intensity.
- Acoustic comfort: approximately, fifty percent of all responses suffered from the noise weather inside and outside the building (inside from the neighborhood lectures, outside from the street, and opposite school). The data is summarized in Table 1 and Table 2 for ease of reference.

There is another story for the north and east classes both had just one opening in the room

	الصف الثامن أ (جهة جنوب شرب)								
	الراحة الحرارية								
1	انا اشعر بأن درجة الحرارة في الصف	بارد جدا	بارد	بارد قليلا	معتدل	حار قليلا	حار	حار كثيرا	
50%		4	1	3	4				
2	انا اشعر بأن درجة الحرارة في الصف	مريحة جدا	مريحة	مريحة نوعا ما	لا ادري	مزعجة قليلا	مزعجة	غير مريحة	
37.50%		1	1			3			
3	انا اشعر بان حركة الهواء في الصف	ساكن كثيرا	ساكن	ساكن قليلا	معتدل	متحرك قليلا	متحرك	متحرك كثيرا	
75%		4			2				
4	أنا اشعر بان الرطوبة في الصف	رطب جدا	رطب	رطب قليلا	معتدل	جاف قليلا	جاف	جاف كثيرا	
50%		1	3		4				
5	أنا اشعر بان درجة الحرارة في الصف	تكفير كثيرا خلال النوم	تكفير خلال اليوم	تكفير قليلا خلال اليوم	لا تكفير خلال اليوم				
50%		1	2	4					
6	انا افضل	أن تزيد درجة الحرارة في الصف	أن لا تكفير درجة الحرارة في الصف	أن تقل درجة الحرارة في الصف					
50%		2	4	2					
7	انا افضل	ان تزيد سرعة الهواء في الصف	أن لا تكفير سرعة الهواء في الصف	أن تقل سرعة الهواء في الصف					
50%		1	3	4					
8	انا افضل	ان تزيد نسبة الرطوبة في الصف	ان لا تكفير نسبة الرطوبة في الصف	ان تقل نسبة الرطوبة في الصف					
75%		4	6	2					
9	انا اشعر بان درجة الحرارة في الصف	مقبولة	غير مقبولة						
62.50%		5	3						
10	انا اشعر بان سرعة الهواء في الصف	مقبولة	غير مقبولة						
75%		6	2						
11	انا اشعر بان نسبة الرطوبة في الصف	مقبولة	غير مقبولة						
50%		4	4						
	الراحة البصرية								
12	انا اشعر ان الإضاءة في الصف	مريحة جدا	مريحة	مريحة نوعا ما	لا ادري	مزعجة قليلا	مزعجة	غير مريحة	
62.50%		5	3	5		2		1	
13	انا افضل	ان تزيد شدة الإضاءة في الصف	ان لا تكفير شدة الإضاءة في الصف	ان تقل شدة الإضاءة في الصف					
87.50%		7	1						
14	انا اشعر بان شدة الإضاءة في الصف	مقبولة	غير مقبولة						
62.50%		5	3						
	الراحة السمعية								
15	انا ماشعر بان الأصوات من خارج المدرسة	غير مزعجة	مزعجة قليلا	مزعجة	مزعجة جدا				
50%		1	4	1	2				
16	انا اشعر بان الأصوات من ساحة المدرسة او	غير مزعجة	مزعجة قليلا	مزعجة	مزعجة جدا				
50%		4		2	2				

(Table.1). Questioner survey responses of the south classroom

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so the responses to comfort parameters come as the following:

- The north and east classes half of all responses showed Students' dissatisfaction with heating conditions, and most of them preferred the airspeed and humidity conditions.
- Visual comfort: most of all responses in the north classroom preferred the current lighting intensity. But in the east classroom approximately, half of all responses preferred maximizing the lighting intensity.
- acoustic comfort: most of all responses in the north classroom showed student satisfaction
- according to the acoustic issue, but half of all respondents in the east classroom com
- plained from the noise weather inside and outside the building (inside from the neighborhood lectures, outside from the

الصف السابع (الجهة الجنوب)											
	الراحة الحرارية										
		بارد جدا	بارد	بارد قليلا	معتدل	حار قليلا	حار	حار كثيرا			
1	أنا اشعر بأن درجة الحرارة في الصف		2	1	6				66.60%		
2	انا اشعر بأن درجة الحرارة في الصف	مريحة جدا	مريحة	مريحة نوعا ما	لا أدري	مزعجة قليلا	مزعجة	غير مريحة	66.60%		
3	انا اشعر بأني حركة الهواء في الصف	ساكن كثيرا	ساكن	ساكن قليلا	معتدل	متحرك قليلا	متحرك	متحرك كثيرا	88.80%		
4	أنا اشعر بأن الرطوبة في الصف	رطب جدا	رطب	رطب قليلا	معتدل	جاف قليلا	جاف	جاف كثيرا			
5	أنا اشعر بان درجة الحرارة في الصف	تتغير كثيرا خلال اليوم	تتغير خلال اليوم	تتغير قليلا خلال اليوم	غير خلال اليوم				66.60%		
	أن تزيد درجة الحرارة في الصف	لا تتغير درجة الحرارة في الصف	تقل درجة الحرارة في الصف								
6	أنا افضل	2	5	2							
	ان تزيد سرعة الهواء في الصف،	لا تتغير سرعة لهواء في الصف	تقل سرعة الهواء في الصف								
7	انا افضل	1	5	3					55.50%		
	ان تزيد نسبة الرطوبة في الصف	لا تتغير نسبة الرطوبة في الصف	تقل نسبة الرطوبة في الصف								
8	انا افضل		5	4							
9	انا اشعر بان درجة الحرارة في الصف	مقبولة	غير مقبولة						77.70%		
10	انا اشعر بان سرعة الهواء في الصف	مقبولة	غير مقبولة						77.70%		
11	انا اشعر بان نسبة الرطوبة في الصف	مقبولة	غير مقبولة						88.80%		
	الراحة البصرية										
		مريحة جدا	مريحة	مريحة نوعا ما	لا أدري	مزعجة قليلا	مزعجة	غير مريحة			
12	انا اشعر ان الإضاءة في الصف	2	5			1		1			
	ان تزيد شدة الإضاءة في الصف	لا تتغير شدة الإضاءة في الصف	تقل شدة الإضاءة في الصف								
13	انا افضل	3	6								
14	انا اشعر بان شدة الإضاءة في الصف	مقبولة	غير مقبولة						77.70%		
	الراحة السمعية										
		غير مزعجة	مزعجة قليلا	مزعجة	مزعجة جدا						
15	ياشعر بان الأصوات من خارج الغرفة		6	3					66.60%		
16	انا اشعر بان الأصوات من حادة الحد	غير مزعجة	مزعجة قليلا	مزعجة	مزعجة جدا				44.40%		

(Table.2). Questioner survey responses of the southwest classroom

street and opposite school). For more details, see Table 3 and Table 4 for ease of reference.

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الصف السابع (جهة الشمال)

الراحة الحرارية									
1	أن الشعر بأن درجة الحرارة في الصف	بارد جدا	بارد	معتدل	بارد قليلا	معتدل	حار قليلا	حار	حار كثيرا
		مريحة جدا	مريحة	لا أدري	مريحة نوعا ما	مزعجة قليلا	مزعجة	مزعجة	غير مريحة
2	أن الشعر بأن درجة الحرارة في الصف	ساكن كثيرا	ساكن	معتدل	ساكن قليلا	متحرك قليلا	متحرك	متحرك	متحرك كثيرا
3	أن الشعر بأن حركة الهواء في الصف	رطب جدا	رطب	معتدل	رطب قليلا	جاف قليلا	جاف	جاف	جاف كثيرا
4	أن الشعر بأن الرطوبة في الصف	تكهر كثيرا خلال اليوم	تكهر خلال اليوم	لا تكهر خلال اليوم	تكهر قليلا خلال اليوم				
5	أن الشعر بأن درجة الحرارة في الصف	أن تزيد درجة الحرارة في الصف	أن لا تكهر درجة الحرارة في الصف	أن تقل درجة الحرارة في الصف					
6	أن الفصل	أن تزيد سرعة الهواء في الصف	أن لا تكهر سرعة الهواء في الصف	أن تقل سرعة الهواء في الصف					
7	أن الفصل	أن تزيد نسبة الرطوبة في الصف	أن لا تكهر نسبة الرطوبة في الصف	أن تقل نسبة الرطوبة في الصف					
8	أن الفصل	مقبولة	غير مقبولة						
9	أن الشعر بأن درجة الحرارة في الصف	مقبولة	غير مقبولة						
10	أن الشعر بأن سرعة الهواء في الصف	مقبولة	غير مقبولة						
11	أن الشعر بأن نسبة الرطوبة في الصف	مقبولة	غير مقبولة						
الراحة البصرية									
12	أن الشعر أن الإضاءة في الصف	مريحة جدا	مريحة	مريحة نوعا ما					
13	أن الفصل	أن تزيد شدة الإضاءة في الصف	أن لا تكهر شدة الإضاءة في الصف	أن تقل شدة الإضاءة في الصف					
14	أن الشعر بأن شدة الإضاءة في الصف	مقبولة	غير مقبولة						
الراحة السمعية									
15	أن الشعر بأن الأصوات من خارج المدرسة	غير مزعجة	مزعجة قليلا	مزعجة					
16	أن الشعر بأن الأصوات من ساحة المدرسة أو الصفوف المجاورة	غير مزعجة	مزعجة قليلا	مزعجة					

الصف الثامن (جهة الشرق)

الراحة الحرارية									
1	أن الشعر بأن درجة الحرارة في الصف	بارد جدا	بارد	بارد قليلا	معتدل	حار قليلا	حار	حار كثيرا	
		مريحة جدا	مريحة	مريحة نوعا ما	لا أدري	مزعجة قليلا	مزعجة	غير مريحة	
2	أن الشعر بأن درجة الحرارة في الصف	ساكن كثيرا	ساكن	ساكن قليلا	معتدل	متحرك قليلا	متحرك	متحرك كثيرا	
3	أن الشعر بأن حركة الهواء في الصف	رطب جدا	رطب	رطب قليلا	معتدل	جاف قليلا	جاف	جاف كثيرا	
4	أن الشعر بأن الرطوبة في الصف	تكهر كثيرا خلال اليوم	تكهر خلال اليوم	تكهر قليلا خلال اليوم	لا تكهر خلال اليوم				
5	أن الشعر بأن درجة الحرارة في الصف	أن تزيد درجة الحرارة في الصف	أن لا تكهر درجة الحرارة في الصف	أن تقل درجة الحرارة في الصف					
6	أن الفصل	أن تزيد سرعة الهواء في الصف	أن لا تكهر سرعة الهواء في الصف	أن تقل سرعة الهواء في الصف					
7	أن الفصل	أن تزيد نسبة الرطوبة في الصف	أن لا تكهر نسبة الرطوبة في الصف	أن تقل نسبة الرطوبة في الصف					
8	أن الفصل	مقبولة	غير مقبولة						
9	أن الشعر بأن درجة الحرارة في الصف	مقبولة	غير مقبولة						53.80%
10	أن الشعر بأن سرعة الهواء في الصف	مقبولة	غير مقبولة						53.80%
11	أن الشعر بأن نسبة الرطوبة في الصف	مقبولة	غير مقبولة						84.60%
الراحة البصرية									
12	أن الشعر أن الإضاءة في الصف	مريحة جدا	مريحة	مريحة نوعا ما	لا أدري	مزعجة قليلا	مزعجة	غير مريحة	
13	أن الفصل	أن تزيد شدة الإضاءة في الصف	أن لا تكهر شدة الإضاءة في الصف	أن تقل شدة الإضاءة في الصف					
14	أن الشعر بأن شدة الإضاءة في الصف	مقبولة	غير مقبولة						61.50%
الراحة السمعية									
15	أن الشعر بأن الأصوات من خارج المدرسة	غير مزعجة	مزعجة قليلا	مزعجة	مزعجة جدا				46%
16	أن الشعر بأن الأصوات من ساحة المدرسة	غير مزعجة	مزعجة قليلا	مزعجة	مزعجة جدا				38.40%

(Table.4). Questioner survey responses of the east classroom

Figure 5: Tariq bin Ziad southwest class room.By researcher

Figure 6: Tariq bin Ziad east class room. By researcher

Figure 7: Tariq bin Ziad north class room.By researcher

Researcher observations show that the form of the building and the size of classrooms, depending on the location of openings, their solar orientation and ventilation possibilities with one or more openings, influence comfort variables.

The humidity observed was found to be well within the required limits. Humidity sensation was mostly satisfied with the experienced values and just 4% of the responses found any problems with air quality (smell). Therefore, the classroom had proper ventilation and air quality was not a cause for concern.

The modeling of the building began by modeling its geometry, as seen in. Then, inputs building's materials for exterior and interior walls, floors, windows glazing, doors, took it from the architectural drawing.

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Design-Builder/ Energy plus Program Results

The modeling of the building began by modeling its geometry, as seen in figure 8. Then, inputs building's materials for exterior and interior walls, floors, windows glazing, doors, took it from the architectural drawing.

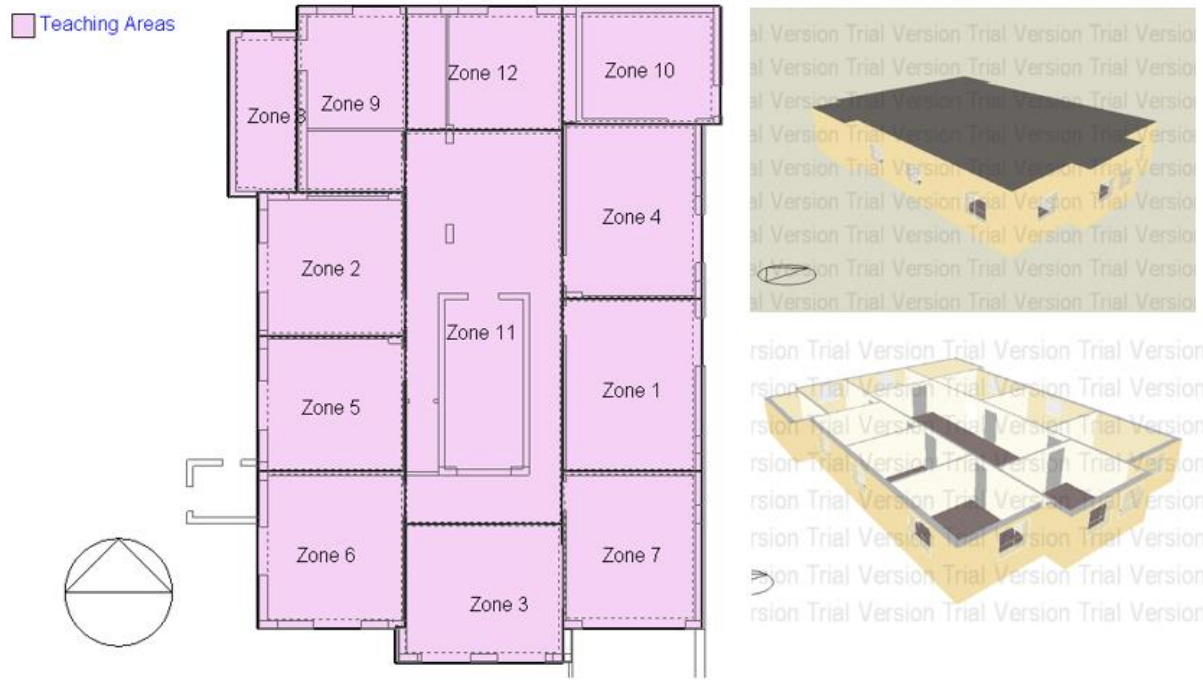

Figure 8 building geometry and building materials

In the original building design, the walls did not have an insulation layer and the windows consisted of a single glass layer. In addition, the windows in the southern façade didn't contain shading. So, we decided to re-design the building by using double glazes layers in windows and put the insulation layer in walls such as polyester, to reduce the heat transfer from inside to outside and vice versa, in addition, use shading in the southern façade school building.
The comparison between the original and re-designed school building is shown below.

In summer week from 12 August to 18 August.

Figure 9 in origin building for temperature distribution, surface heat transfers, and impact outdoor environment to indoor from 12 August to 18 August (summer week). It was observed that the indoor temperature varies with the outdoor weather for the building. The temperature is as high as 27.70 on 16 August and as low as 25.8 C on 12 and 13 August.

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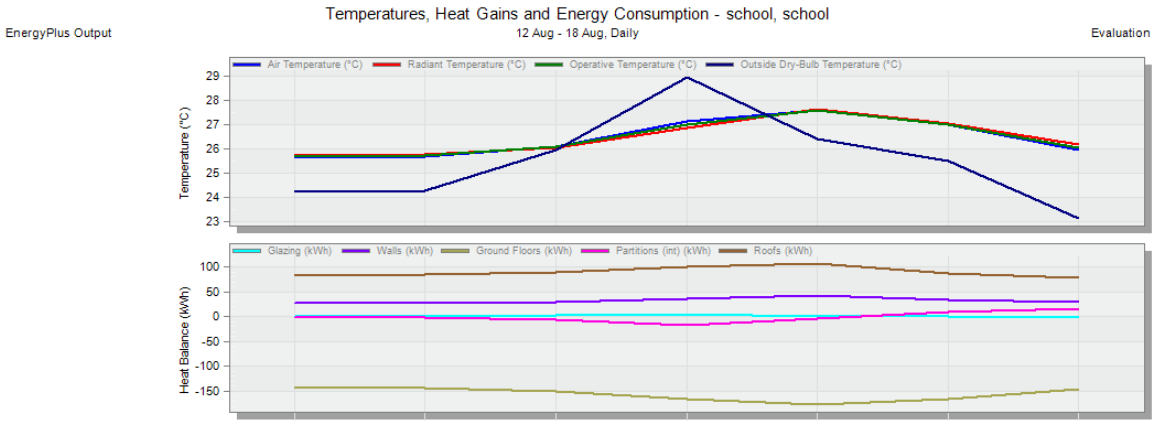

	12 Mon	13 Tue	14 Wed	15 Thu	16 Fri	17 Sat	18 Sun
Air Temperature (°C)	25.63	25.69	26.11	27.12	27.58	26.97	25.94
Radiant Temperature (°C)	25.71	25.76	26.04	26.85	27.63	27.06	26.18
Operative Temperature (°C)	25.67	25.72	26.07	26.99	27.60	27.02	26.06
Outside Dry-Bulb Temperature (°C)	24.21	24.25	25.95	28.96	26.40	25.50	23.12
Glazing (kWh)	1.34	1.36	2.58	4.70	1.32	1.04	-0.53
Walls (kWh)	27.95	28.20	29.94	36.41	42.79	34.86	29.36
Ground Floors (kWh)	-141.72	-142.96	-149.17	-166.26	-176.87	-164.47	-146.62
Partitions (int) (kWh)	-0.24	-1.78	-6.19	-17.36	-4.35	10.75	16.82
Roofs (kWh)	83.50	86.11	89.10	101.57	107.77	88.63	79.54

Figure 9 and table for temperature distribution, surface heat transfer, and environmental (original building)

But when we decided to re-design the building by using double glazes layers in windows and Put the insulation layer in walls such as polyester, to reduce the heat transfer from inside to outside and vice versa, in addition, use shading in the southern façade school building.

The result in figure 10 when re-design the building for temperature distribution, surface heat transfers, and impact outdoor environment to indoor from 12 August to 18 August (summer week). It was observed that the indoor temperature varies with

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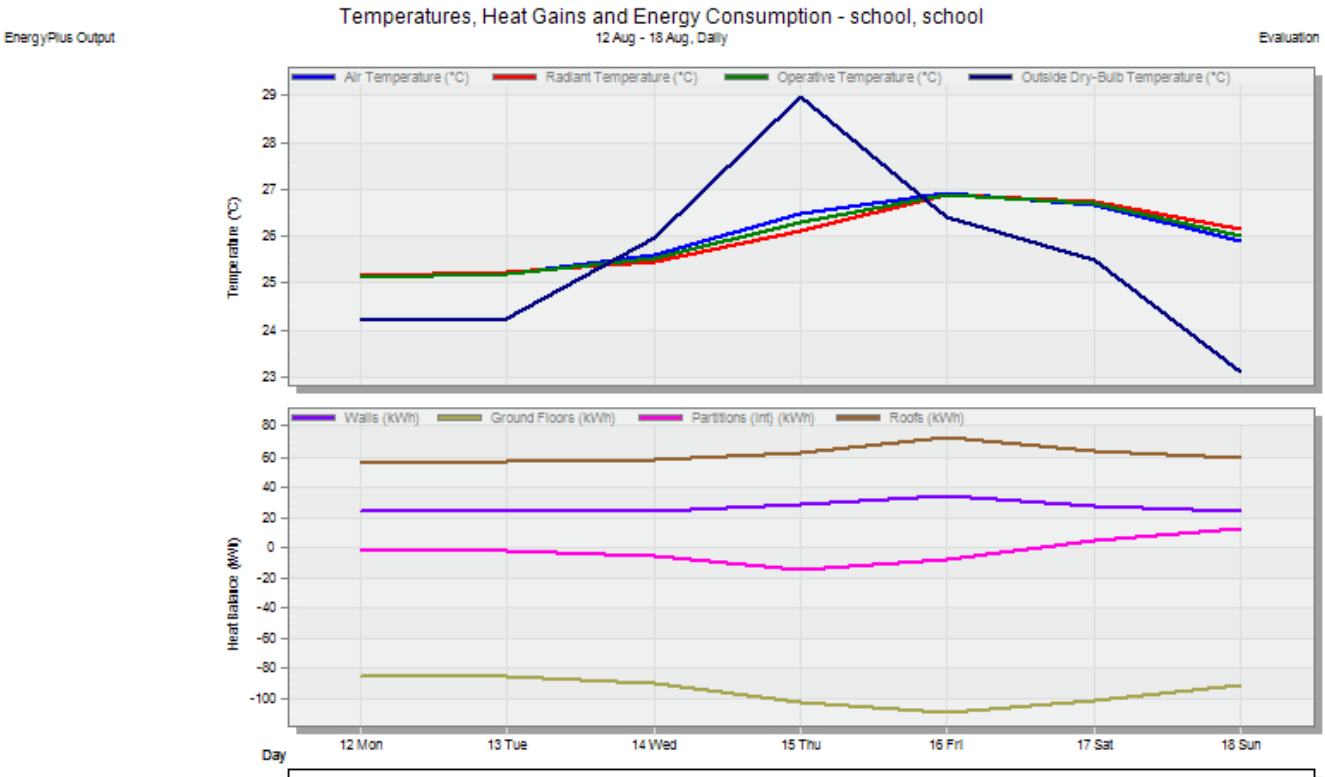
the outdoor weather for the building. The temperature is as high as 26.8 on 16 August and as low as 25C on 12 and 13 August. And reduce heat gain/loss, between the inside and outside.

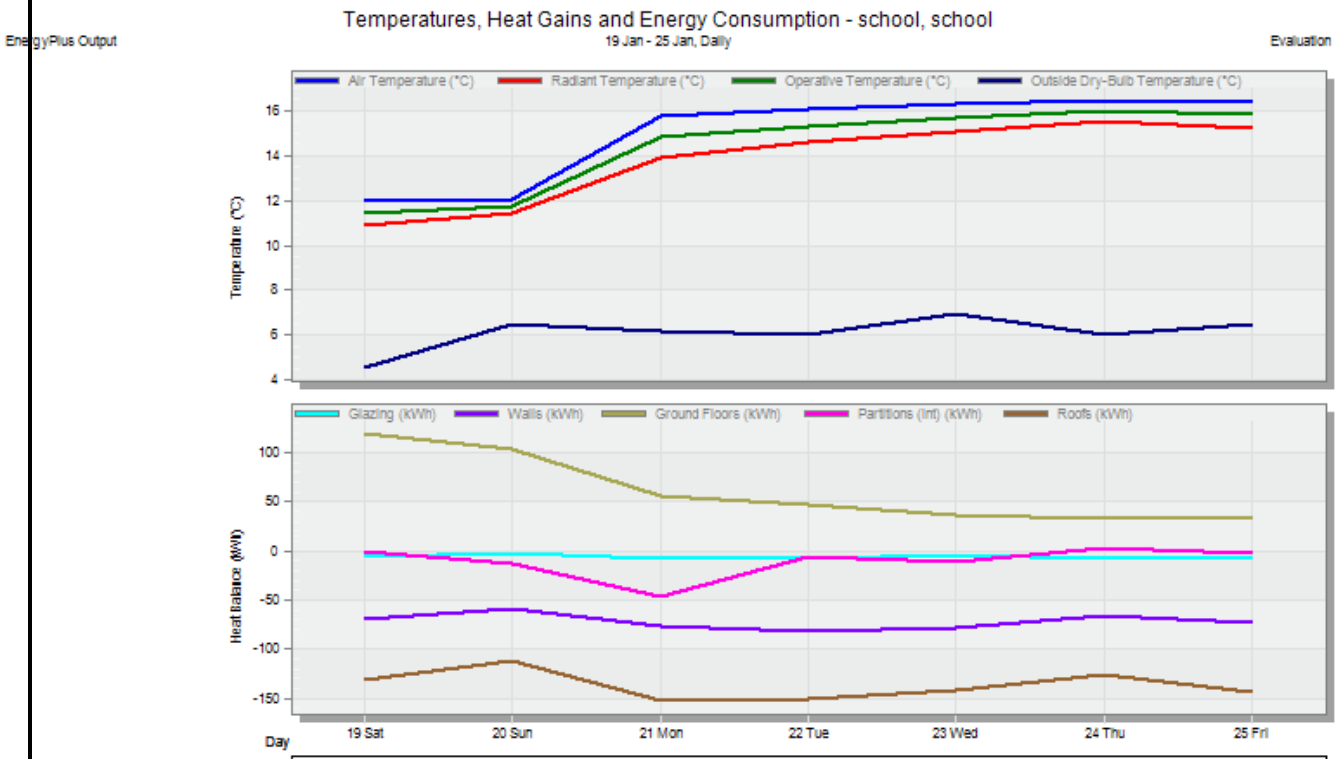
In winter week from 19 January to 25 January



	12 Mon	13 Tue	14 Wed	15 Thu	16 Fri	17 Sat	18 Sun
Air Temperature (°C)	25.12	25.19	25.59	26.47	26.91	26.68	25.88
Radiant Temperature (°C)	25.15	25.22	25.47	26.12	26.89	26.74	26.14
Operative Temperature (°C)	25.13	25.21	25.53	26.30	26.90	26.71	26.01
Outside Dry-Bulb Temperature (°C)	24.21	24.25	25.95	28.96	26.40	25.50	23.12
Walls (kWh)	23.91	23.92	24.49	28.41	34.97	28.05	24.11
Ground Floors (kWh)	-84.72	-85.65	-90.21	-101.75	-108.52	-101.61	-90.99
Partitions (int) (kWh)	-1.44	-1.83	-5.86	-14.98	-7.72	5.11	12.64
Roofs (kWh)	56.02	57.70	58.55	63.16	72.61	63.82	59.50

Figure 10 and table for tempreature distrubution, surfae heat transfer and invironmental (re- design building)

Figure 11 for temperature distribution, surface heat transfer, and impact outdoor environment to indoor from 19 January to 25 January (winter week). It was observed that the indoor temperature varies with the outdoor weather for the building. The temperature is as high as 15.50 on 24 January and as low as 10.90 C on 19 January.



	19 Sat	20 Sun	21 Mon	22 Tue	23 Wed	24 Thu	25 Fri
Air Temperature (°C)	12.00	12.06	15.77	16.02	16.27	16.41	16.38
Radiant Temperature (°C)	10.91	11.43	13.86	14.60	15.00	15.50	15.23
Operative Temperature (°C)	11.45	11.74	14.82	15.31	15.64	15.96	15.81
Outside Dry-Bulb Temperature (°C)	4.59	6.47	6.16	6.04	6.96	6.01	6.48
Glazing (kWh)	-6.70	-1.87	-6.89	-6.92	-4.29	-6.94	-5.46
Walls (kWh)	-69.39	-58.82	-76.81	-81.21	-77.99	-65.83	-72.99
Ground Floors (kWh)	118.95	104.03	55.55	47.45	36.05	33.39	34.03
Partitions (int) (kWh)	0.01	-13.12	-46.51	-6.58	-11.88	2.03	-1.71
Roofs (kWh)	-131.90	-112.02	-151.95	-149.96	-141.67	-125.47	-143.94

Figure 11 and table for temperature distribution, surface heat transfer and environmental (original building)

The result in figure 12 when re-design the building for temperature distribution, surface heat transfer, and impact outdoor environment to indoor from 19 January to 25 January (winter week). It was observed that the indoor temperature varies with the outdoor weather for the building. The temperature is as high as 16.10 on 22 January and as low as 11.90 C on 19 January. And reduce heat gain/loss, between the inside and outside.

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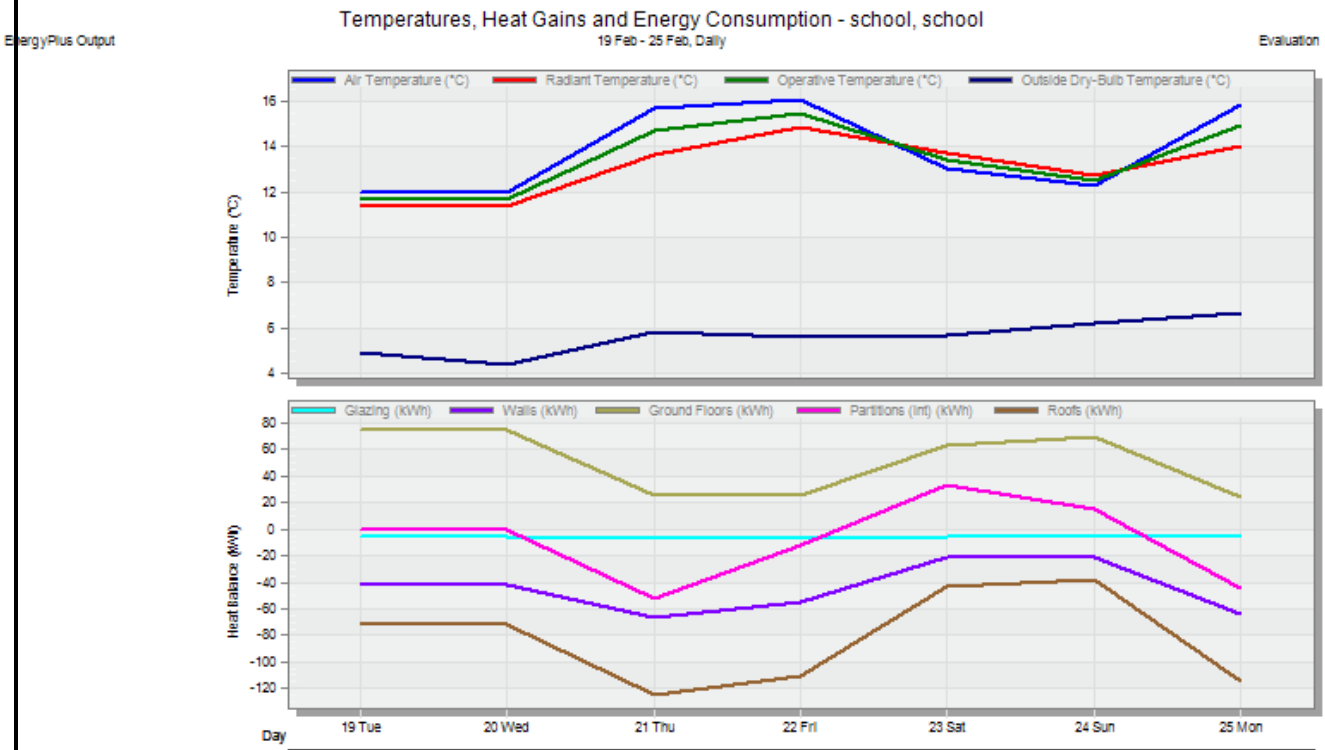

Air Temperature (°C)	12.00	12.00	15.73	16.07	13.03	12.26	15.86
Radiant Temperature (°C)	11.42	11.40	13.63	14.85	13.74	12.76	14.05
Operative Temperature (°C)	11.71	11.70	14.68	15.46	13.38	12.51	14.96
Outside Dry-Bulb Temperature (°C)	4.92	4.39	5.79	5.61	5.67	6.20	6.64
Glazing (kWh)	-5.87	-5.37	-6.62	-7.44	-5.67	-6.19	-5.20
Walls (kWh)	-40.35	-41.40	-66.07	-54.71	-21.47	-20.98	-63.43
Ground Floors (kWh)	74.58	74.28	26.16	25.55	62.73	69.13	24.55
Partitions (int) (kWh)	0.11	-0.72	-51.87	-11.55	33.38	15.64	-44.12
Roofs (kWh)	-69.84	-71.40	-124.68	-111.03	-42.99	-38.06	-114.80

Figure 12 and table for temperature distribution, surface heat transfer, and environmental (re-design building)

Cooling design

Table 5 shows exterior temperature 39.3 and interior temperature 31.2 on 15 July in the origin building.

Zone	Design Flow Rate (m3/s)	Total Cooling Load (kW)	Sensible (kW)	Latent (kW)	Air Temperature (°C)	Humidity (%)	Time of	Max ...	...	Volume (m3)	Flow/Floor...	Desig...	Outsi...
school													
Block1:Zone8	**0.1670**	1.89	1.78	0.11	23.0	54.2	Jul 15:0	31.2	4	32.8	17.82	232.4	39.3
Block1:Zone12	**0.2679**	3.03	2.86	0.16	23.0	55.7	Jul 15:0	29.3	3.6	65.0	14.42	187.3	39.3
Block1:Zone9	**0.2808**	3.17	3.00	0.17	23.0	55.7	Jul 15:0	29.3	3.4	67.8	14.49	188.3	39.3
Block1:Zone10	**0.2692**	3.05	2.88	0.18	23.0	55.0	Jul 15:0	30.5	7.0	59.4	15.85	206.6	39.3
Block1:Zone3	**0.3200**	3.62	3.42	0.20	23.0	55.3	Jul 15:0	30.0	1.1	73.8	15.17	197.4	39.3
Block1:Zone7	**0.3214**	3.64	3.43	0.21	23.0	55.0	Jul 15:0	30.7	0.2	70.9	15.87	206.9	39.3
Block1:Zone2	**0.3186**	3.61	3.40	0.21	23.0	55.1	Jul 15:0	30.1	0.6	72.0	15.49	202.1	39.3
Block1:Zone5	**0.3062**	3.48	3.27	0.21	23.0	55.0	Jul 15:0	30.2	3.4	67.9	15.78	205.9	39.3
Block1:Zone4	**0.3598**	4.07	3.84	0.23	23.0	55.3	Jul 15:0	30.2	3.9	83.6	15.06	195.9	39.3
Block1:Zone1	**0.3571**	4.04	3.81	0.23	23.0	55.3	Jul 15:0	30.1	3.7	82.8	15.10	196.5	39.3
Block1:Zone6	**0.3555**	4.04	3.80	0.24	23.0	54.7	Jul 15:0	30.8	1.5	75.3	16.52	215.6	39.3
Block1:Zone11	**0.8299**	9.29	8.86	0.43	23.0	56.8	Jul 15:0	29.3	1.8	226.7	12.81	165.0	39.3
Totals	**4.1535**	**46.93**	**44.35**	**2.58**	**23.0**	**55.5**	**N/A**	**31.2**	**79.5**	**978.1**	**14.86**	**193.1**	**N/A**

Table 5 cooling design (origin building)

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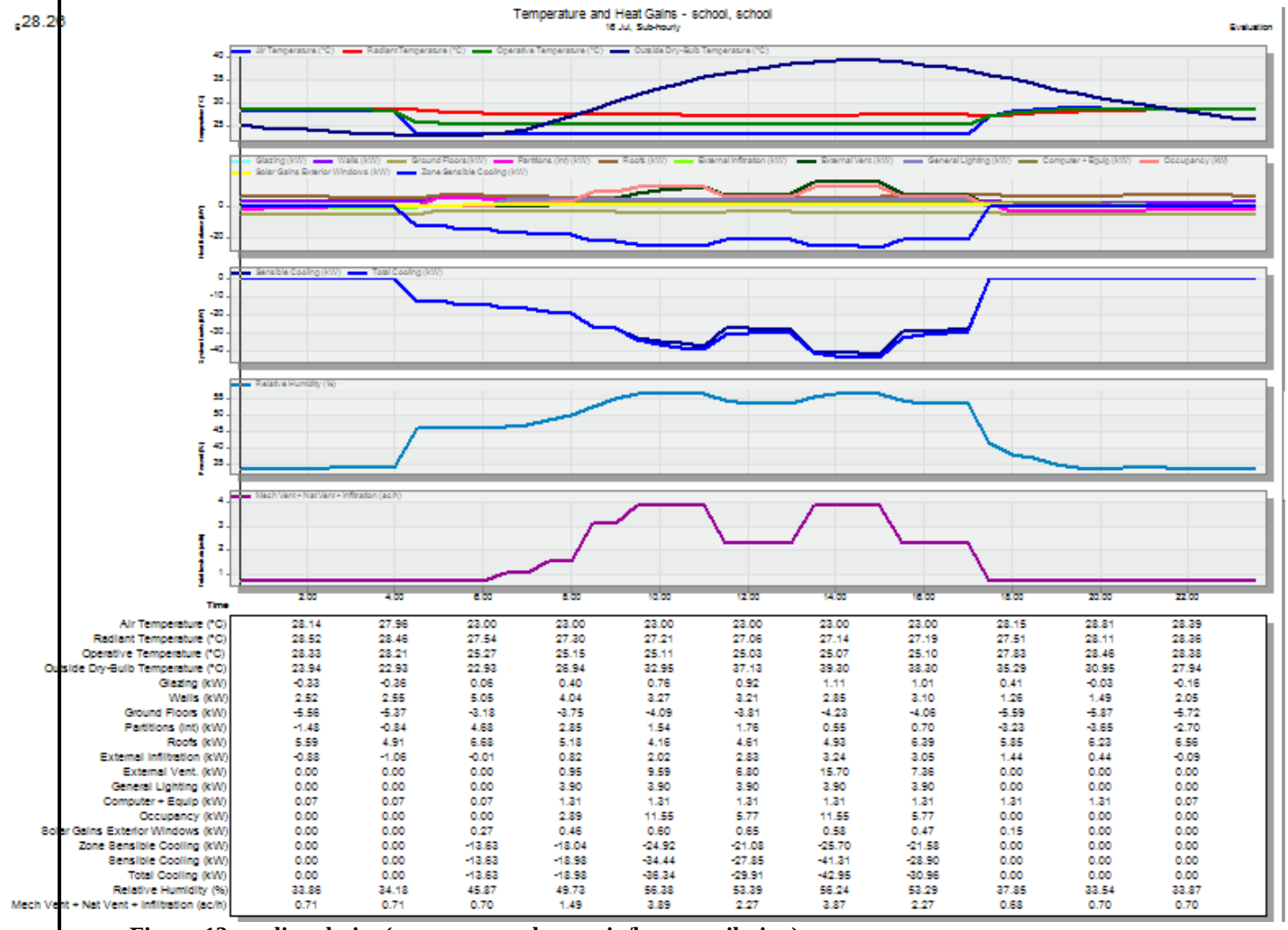

	2:00	4:00	6:00	8:00	10:00	12:00	14:00	16:00	18:00	20:00	22:00
Air Temperature (°C)	28.14	27.96	23.00	23.00	23.00	23.00	23.00	23.00	28.15	28.81	28.39
Radiant Temperature (°C)	28.52	28.46	27.54	27.30	27.21	27.06	27.14	27.19	27.51	28.11	28.36
Operative Temperature (°C)	28.33	28.21	25.27	25.15	25.11	25.03	25.07	25.10	27.83	28.46	28.38
Outside Dry-Bulb Temperature (°C)	23.94	22.93	22.93	26.94	32.95	37.13	39.30	38.30	35.29	30.95	27.94
Glazing (kW)	-0.33	-0.38	0.06	0.40	0.76	0.92	1.11	1.01	0.41	-0.03	-0.16
Walls (kW)	2.52	2.55	5.05	4.04	3.27	3.21	2.85	3.10	1.26	1.49	2.05
Ground Floors (kW)	-5.56	-5.37	-3.18	-3.75	-4.09	-3.81	-4.23	-4.06	-5.59	-5.87	-5.72
Partitions (int) (kW)	-1.48	-0.84	4.68	2.85	1.54	1.76	0.55	0.70	-3.23	-3.65	-2.70
Roofs (kW)	5.59	4.91	6.68	5.18	4.16	4.61	4.93	6.39	5.85	6.23	6.56
External Infiltration (kW)	-0.88	-1.06	-0.01	0.82	2.02	2.83	3.24	3.05	1.44	0.44	-0.09
External Vent. (kW)	0.00	0.00	0.00	0.95	9.59	6.80	15.70	7.36	0.00	0.00	0.00
General Lighting (kW)	0.00	0.00	0.00	3.90	3.90	3.90	3.90	3.90	0.00	0.00	0.00
Computer + Equip (kW)	0.07	0.07	0.07	1.31	1.31	1.31	1.31	1.31	1.31	1.31	0.07
Occupancy (kW)	0.00	0.00	0.00	2.89	11.55	5.77	11.55	5.77	0.00	0.00	0.00
Solar Gains Exterior Windows (kW)	0.00	0.00	0.27	0.46	0.60	0.65	0.58	0.47	0.15	0.00	0.00
Zone Sensible Cooling (kW)	0.00	0.00	-13.63	-18.04	-24.92	-21.08	-25.70	-21.58	0.00	0.00	0.00
Sensible Cooling (kW)	0.00	0.00	-13.63	-18.98	-34.44	-27.85	-41.31	-28.90	0.00	0.00	0.00
Total Cooling (kW)	0.00	0.00	-13.63	-18.98	-36.34	-29.91	-42.95	-30.96	0.00	0.00	0.00
Relative Humidity (%)	33.86	34.18	45.87	49.73	56.38	53.39	56.24	53.29	37.85	33.54	33.87
Mech Vent + Nat Vent + Infiltration (ac/h)	0.71	0.71	0.70	1.49	3.89	2.27	3.87	2.27	0.68	0.70	0.70

Figure 13 cooling design(temperature,heat gain/loss, ventilation)

Figure 13 shows the heat transfer gain/loss between the exterior and interior walls, roofs, and window glazing.

The result in table 6 when re-design the building by used double glazes layers in windows and Put the insulation layer in walls such as polyester, to reduce the heat transfer from inside to outside and vice versa, in addition, use shading in the southern façade school building. present the difference between exterior temperature 39.3 and interior temperature 29.5.

Zone	Design Capacity (kW)	Design Flow Rate (m3/s)	Total Cooling Load (kW)	Sensible (kW)	Latent (kW)	Air Temperature (°C)	Humidity (r)	Time of Ma...	Max O...	Floor Area (m2)	Volume (m3)	Flow/Floor Area ...	Design Cooli...	Outside T...
school														
Block1:Zone11	10.31	0.8045	8.97	8.59	0.38	23.0	57.2	Jul 15:00	28.1	64.8	226.7	12.42	159.2	39.3
Block1:Zone9	3.45	0.2662	3.00	2.84	0.15	23.0	56.1	Jul 15:00	28.0	19.3	67.7	13.77	178.2	39.3
Block1:Zone4	4.33	0.3343	3.77	3.57	0.20	23.0	55.9	Jul 15:00	28.7	23.8	83.5	14.02	181.7	39.3
Block1:Zone2	3.74	0.2888	3.26	3.08	0.17	23.0	55.9	Jul 15:00	28.4	20.5	71.8	14.07	182.4	39.3
Block1:Zone5	3.58	0.2763	3.12	2.95	0.17	23.0	55.8	Jul 15:00	28.5	19.4	67.8	14.27	185.1	39.3
Block1:Zone10	3.26	0.2509	2.84	2.68	0.16	23.0	55.4	Jul 15:00	29.0	16.9	59.1	14.85	193.0	39.3
Block1:Zone1	4.30	0.3315	3.74	3.54	0.20	23.0	55.9	Jul 15:00	28.7	23.6	82.6	14.05	182.0	39.3
Block1:Zone6	4.21	0.3241	3.66	3.46	0.20	23.0	55.3	Jul 15:00	29.0	21.4	75.0	15.12	196.5	39.3
Block1:Zone7	3.87	0.2978	3.36	3.18	0.18	23.0	55.5	Jul 15:00	29.1	20.2	70.5	14.78	192.0	39.3
Block1:Zone3	3.90	0.3003	3.39	3.21	0.18	23.0	55.9	Jul 14:30	28.5	21.0	73.6	14.28	185.3	39.3
Block1:Zone12	3.29	0.2542	2.86	2.71	0.15	23.0	56.1	Jul 15:00	28.0	18.5	64.8	13.72	177.6	39.3
Block1:Zone8	2.03	0.1560	1.77	1.67	0.10	23.0	54.6	Jul 14:30	29.5	9.3	32.5	16.79	218.9	39.3
Totals	50.28	3.8850	43.72	41.49	2.23	23.0	56.1	N/A	29.5	278.8	975.7	13.94	180.4	N/A

Table 6 cooling design (re-design building)

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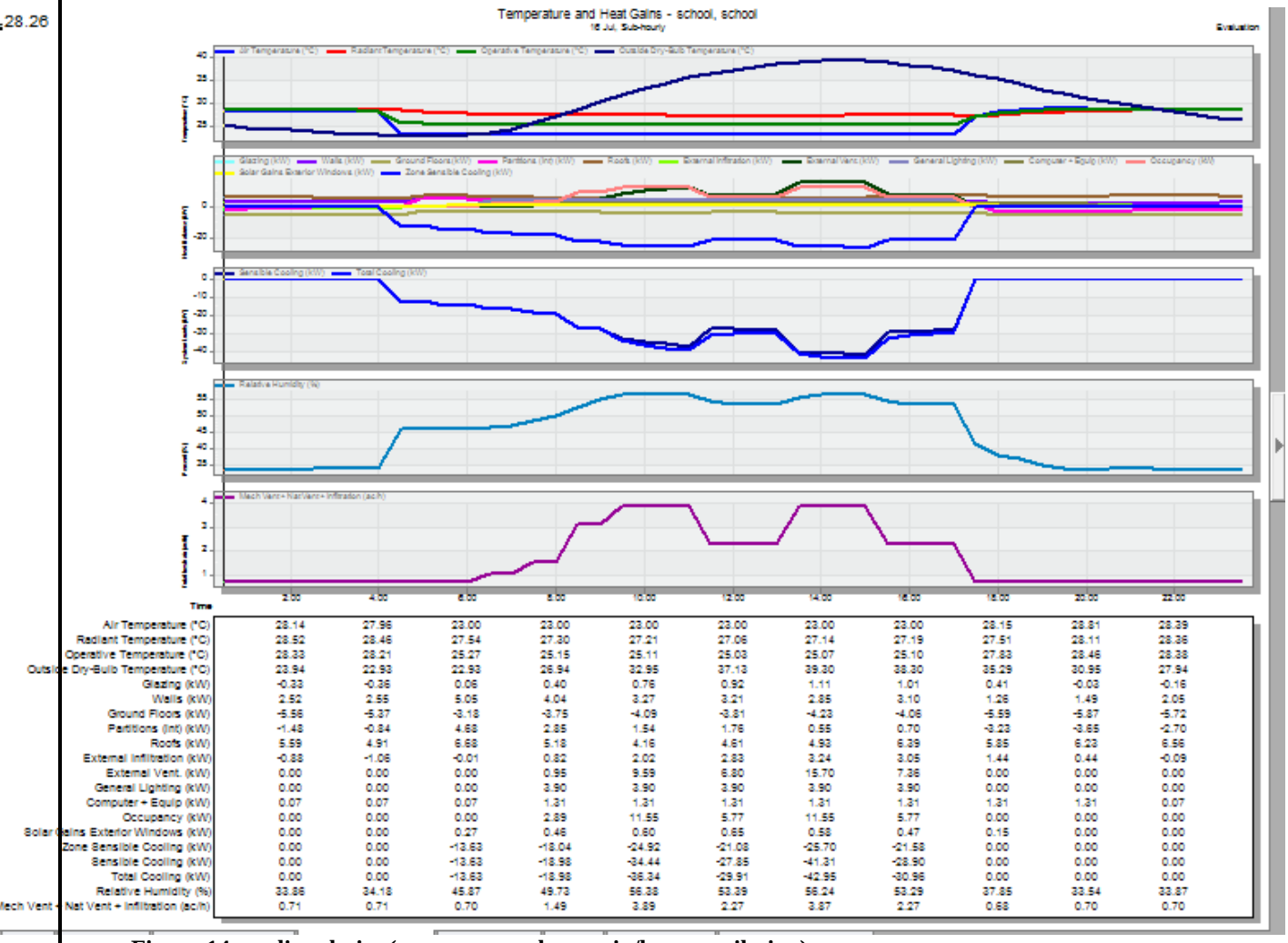

	1:00	4:00	6:00	8:00	10:00	12:00	14:00	16:00	18:00	20:00	22:00
Air Temperature (°C)	28.14	27.96	23.00	23.00	23.00	23.00	23.00	23.00	28.15	28.81	28.39
Radiant Temperature (°C)	28.52	28.46	27.54	27.30	27.21	27.06	27.14	27.19	27.51	28.11	28.36
Operative Temperature (°C)	28.33	28.21	25.27	25.15	25.11	25.03	25.07	25.10	27.83	28.46	28.38
Outside Dry-Bulb Temperature (°C)	23.94	22.93	22.93	26.94	32.95	37.13	39.30	38.30	35.29	30.95	27.94
Glazing (kW)	-0.33	-0.36	0.06	0.40	0.76	0.92	1.11	1.01	0.41	-0.03	-0.16
Walls (kW)	2.52	2.55	5.05	4.04	3.27	3.21	2.85	3.10	1.26	1.49	2.05
Ground Floors (kW)	-5.56	-5.37	-3.18	-3.75	-4.09	-3.81	-4.23	-4.06	-5.59	-5.87	-5.72
Partitions (Int) (kW)	-1.48	-0.84	4.68	2.85	1.54	1.76	0.55	0.70	-3.23	-3.65	-2.70
Roofs (kW)	5.59	4.91	6.68	5.18	4.16	4.61	4.93	6.39	5.85	6.23	6.56
External Infiltration (kW)	-0.88	-1.06	-0.01	0.82	2.02	2.83	3.24	3.05	1.44	0.44	-0.09
External Vent. (kW)	0.00	0.00	0.00	0.95	9.59	6.80	15.70	7.38	0.00	0.00	0.00
General Lighting (kW)	0.00	0.00	0.00	3.90	3.90	3.90	3.90	3.90	0.00	0.00	0.00
Computer + Equip (kW)	0.07	0.07	0.07	1.31	1.31	1.31	1.31	1.31	1.31	1.31	0.07
Occupancy (kW)	0.00	0.00	0.00	2.89	11.55	5.77	11.55	5.77	0.00	0.00	0.00
Solar Gains Exterior Windows (kW)	0.00	0.00	0.27	0.46	0.60	0.65	0.58	0.47	0.15	0.00	0.00
Zone Sensible Cooling (kW)	0.00	0.00	-13.63	-18.04	-24.92	-21.08	-25.70	-21.58	0.00	0.00	0.00
Sensible Cooling (kW)	0.00	0.00	-13.63	-18.98	-34.44	-27.85	-41.31	-28.90	0.00	0.00	0.00
Total Cooling (kW)	0.00	0.00	-13.63	-18.98	-36.34	-29.91	-42.95	-30.96	0.00	0.00	0.00
Relative Humidity (%)	33.86	34.18	45.87	49.73	56.38	53.39	56.24	53.29	37.85	33.54	33.87
Mech Vent + Nat Vent + Infiltration (ac/h)	0.71	0.71	0.70	1.49	3.89	2.27	3.87	2.27	0.68	0.70	0.70

Figure 14 cooling design(temperature,heat gain/loss, ventilation)

Figure 14 shows the heat transfer gain/loss between the exterior and interior walls, roofs, and window glazing which is reduced when re-design the building.

Daylighting

The amount of daylighting in classrooms with two windows is more than the classroom, which contains a single window as shown in figure 15, and the problem of small windows in the original design, which leads to inter small amount of daylighting and increased reliance on artificial lighting

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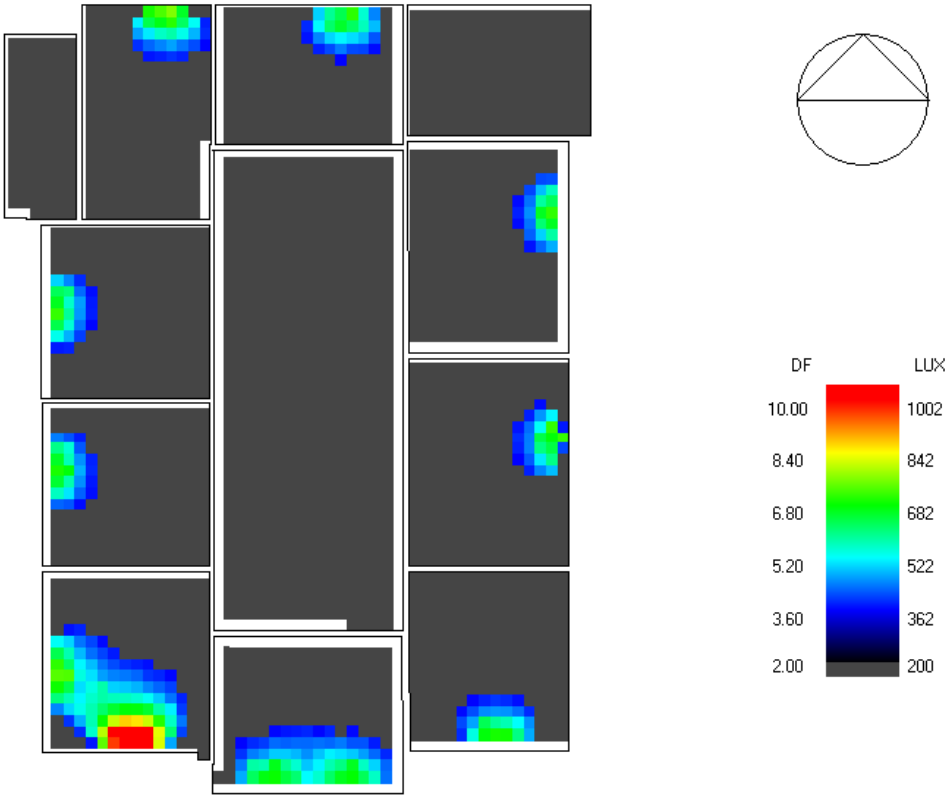

Figure 15 daylighting

Discussion

The idea of optimization described can be used in building performance assessments. In school designs, the method described in this paper emphasizes ensuring thermal comfort, acoustic comfort, for better natural lighting conditions that will ensure minimum visual comfort. Specific decisions in building design could improve the poor functional and acoustic ratings of this design. For example, relocated the classrooms and special acoustic walls could be integrated into the construction techniques, with special care not to affect ventilation and lighting. Building performance assessment is useful for the analysis of an existent design. In general, assessments can focus on the positive and negative points of the construction. As a result of the assessment can suggest improvements in relocation and reorganization of spaces, give various options and alternatives to energy saving in the building.

Conclusions

The design decisions in architecture are comprehensive, embodied the handling of a large number of variables. In this paper, the assessment mixed-method is presented to help designers in the decision-making process. Spatial configurations, which influence environmental comfort parameters of Tariq bin Ziad School Marka, Amman, were analyzed. The method can also be used to assess existing school buildings and introduce improvements. Therefore, comfort variables can be selected according to a qualification process. Assessment thus helps in the application of the method described here can help in designing better school buildings and direct the introduction of improvements to existing schools. The study presents a good set of comfort variables for future designs, based on simple relations between the form, orientation, and location of functions and openings. A proper choice of school sites is also important, as size and form can inhibit recommended initial design decisions of the school building. Environmental comfort variables, evaluated by researchers through a questionnaire ratified with technical measurements by the design-builder program. Environmental comfort variables are also seen as indicators for assessments of buildings. Finally, the environmental comfort optimization method, herein presented could be reflected in other building typologies, for example, housing developments and hospitals for improving the design process as a whole.

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الملخص:

في الآونة الأخيرة، أصبح مفهوم الاستدامة مصدر اهتمام في العديد من المجالات. هذا المفهوم الشائع هو لتحقيق التنمية المستدامة للمجتمعات. الاستدامة مظلة كبيرة تشمل مفاهيم مختلفة مثل التنمية المستدامة والبيئة المستدامة والمدن المستدامة والعمارة المستدامة. تتضمن العمارة المستدامة استهلاكًا منخفضًا للطاقة ومرونة عالية وكفاءة عالية في استخدام الموارد لتحسين نوعية الحياة والتنمية المستدامة، من خلال تقليل استهلاك الطاقة وتقليل التلوث البيئي، وتزامن العناصر المكونة لها لتحقيق أهداف التنمية المستدامة.

الغرض من هذه الورقة هو اعتماد الاستراتيجيات المبتكرة للتصميم المستدام المرتبطة بمستويات عالية من كفاءة الطاقة والجودة البيئية الداخلية ومعايير الأداء لتعزيز وتحسين البيئة المدرسية لمدرسة طارق بن زياد. ستكون طريقة البحث عبارة عن نهج متعدد الأساليب سيكون مناسبًا لتقييم جمع بيانات المدرسة، والذي سيجمع بين استبيان للطلاب والموظفين، ومقابلات مع كل مسؤول؛ لفهم رضاهم العام عن مبنى المدرسة واستخدام برنامج design-builder / Energy Plus لتقييم محاكاة طاقة مبنى مدرسة طارق بن زياد.