T.C.
HASAN KALYONCU UNIVERSITY
SCIENCES INSTITUTE
DEPARTMENT OF ENGINEERING
MASTER DEGREE

THE PASSIVE SOLAR BUILDING DESİGN AND ENERGY EFFICIENCY WITH BIM

MASTER'S THESIS

OKAN TUZLU
GAZİANTEP 2018

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CONSULTANT
PROF. DR. YUSUF ARAYICI

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KABUL VE ONAY

Okan TUZLU tarafından hazırlanan ‘The Design Of Passive Solar Building And Energy Efficiency With BIM’ başlıklı bu çalışma tarihinde yapılan savunma sınavı sonucu **başarılı** bulunarak jürimiz tarafından **Yüksek Lisans Tezi** olarak kabul edilmiştir.

Prof. Dr. Yusuf ARAYICI (Başkan)

(Üye)

(Üye)

Onay

Yukarıdaki imzaların, adı geçen öğretim üyelerine ait olduğunu onaylarım.

Enstitü Müdürü

TEZ ETİK VE BİLDİRİM SAYFASI

Yüksek Lisans Tezi olarak sunduğum ‘ The Design Of Passive Solar Building And Energy Efficiency With BIM’ başlıklı bu çalışmanın tarafımca, bilimsel ahlak ve geleneklere aykırı düşecek bir yardıma başvurmaksızın yazıldığını ve yararlandığım eserlerin kaynakçada gösterilenlerden oluştuğunu ve bunlara atıf yapılarak yararlanmış olduğumu belirtir ve onurumla doğrularım.

Öğrenci Adı soyadı

ABSTRACT

With the increase in population, the need for energy is increasing day by day and environmental pollution is generated by the use of non-renewable resources to meet the need. The Kyoto Protocol was signed in 2005 in order to reduce the harmful gases and to protect the environment. However, both renewable and clean energy sources have been sought.

The sun is the most efficient of these resources. Indirect or direct use of the sun and energy, buildings spend the annual amount is intended to reduce. For this, the low cost passive home issue has been discussed.

According to the climate conditions in which the structure is located, architectural design was made and energy costs were reduced. Special drawing and analysis programs have been developed to make these studies. All these approaches are combined under the BIM concept.

In this study, a nursery was designed in the Revit Architecture program in Gaziantep in accordance with passive house standards and environmental regulations. Energy analysis part is calculated in Design Builder program. As a result of the analysis, the positive effects of passive house standards and environmental regulations on energy performance were observed.

Key Words: passive houses, renewable energy, BIM, energy efficiency, environmental regulations

ÖZET

Nüfus artışıyla her geçen gün enerji ihtiyacı artmakta ve ihtiyacı karşılamak için yenilenemeyen kaynakların kullanılmasıyla çevre kirliliği oluşmaktadır. Oluşan zararlı gazların azaltılması ve çevrenin korunması amacıyla 2005 yılında Kyoto Protokolü imzalanmıştır. Bununla beraber hem yenilenebilir hem de temiz enerji kaynağı arayışına girilmiştir.

Güneş bu kaynakların en verimli olanıdır. Güneşi dolaylı veya direkt kullanıp enerji üretip, yapıların harcadığı yıllık miktarın azaltılması amaçlanmıştır. Bunun için düşük maliyetli olan pasif ev konusu üzerinde durulmuştur.

Yapının bulunduğu iklim koşullarına göre mimari tasarım yapılıp enerji maliyetleri azaltılmaya çalışılmıştır. Bu çalışmaları yapmak için özel çizim ve analiz programları geliştirilmiştir. Tüm bu yaklaşımlar BIM konsepti altında birleştirilmiştir.

Bu çalışmada Gaziantep ilinde, pasif ev standartlarına ve çevre yönetmeliklerine göre Revit Architecture programında bir kreş tasarlanmıştır. Enerji analiz kısmı Design Builder programında hesaplanmıştır. Analiz sonucunda pasif ev standartlarının ve çevre yönetmeliklerinin enerji performansı üzerindeki olumlu etkileri gözlenmiştir.

Anahtar Kelimeler: pasif evler, yenilebilir enerji, BIM, enerji verimliliği, çevre yönetmelikleri

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ABBREVIATIONS

BIM:	Building Information Modeling
LEED:	Leadership in Energy and Environmental Design
BREEAM :	Building Research Establishment Environmental Assessment Method
CASBEE:	Comprehensive Assessment System for Building Environment Efficiency
EU:	European Union
2D:	Two Dimensional
3D:	Three Dimensional
USGBC:	United States Green Building Council
VOC:	Volatile Organic Compound
CO_2 :	Carbon Dioxide
WNW:	West North West
kg:	Kilogram
km:	Kilometer
m:	Meter
cm :	Centimeter
HVAC :	Heating Ventilating Air Conditioning
ASHRAE :	American Society Heating Refrigerating and Air Conditioning Engineers
CFD :	Computational Fluid Dynamics
kWh:	Kilo Watt Hour
MEP:	Machanical Electrical and Plumbing
LOD:	Level of Development

CHAPTER 1. INTRODUCTION

1.1 Introduction

A built building, in line with the requirements of the natural life that resides within a building, must be compatible with daily and seasonal climatic conditions. At the same time has to address the changing needs of the occupants.

No provided structures to adapt to the environment, high heating, cooling and lighting costs have been exposed. Issues such as architectural design or the cost of the initial investment in heating, cooling and lighting have been left in the second plan. As a result of this in the long term, largely material and energy losses are experienced.

Depending on climatic conditions in the determination of internal environmental comfort conditions for the realization of minimum use of active heating and cooling system requires accurate determination of the design parameters. This main design parameters; the location of the building, building orientation, building form and the building shell.

The use of artificial energy sources with the reduction of active consumption and cost of energy sources will be reduced. The sun, which is a natural energy source, the energy consumption can be met by including design parameters and costs can be reduced. The sun's energy is clean and renewable energy.

In the solution of energy problems of the buildings designed as a system that enables to benefit from solar energy, passive solar homes are gaining in importance.

This study is the design of the building in terms of energy efficiency and solar parameters according to the climate of the region has been designed as a passive solar house and the energy costs were calculated.

1.2. Background

In nature, biotic and abiotic environment that creates integration is called *ecosystem*. If *sustainability* is to keep intact the natural balance of ecosystems is called. In recent years, sustainability has become the common concern of various disciplines. The reason for this is to perform the development of the sustainability of society.

Until recently it is well known that the concept of sustainability, but now environmental, economic, social and cultural discussed as a topic. This concept for the first time in 1987 by the World Commission on Environment and Development began to gain more recognition in the statement prepared. The requirements are discussed and identified several criteria after receiving acceptance all over the world.

The most discussed topic of sustainability in architectural design. Although this is not the full definition in each period since the 1970's has been interpreted in different ways. *Environmental Design* in the 1970's, in the 1980's*GreenDesign*, *Ecological Design* in the late 1980's to the mid-1990's, since *Sustainable Design* is called.

In general, within the scope of environmental awareness, sustainability, topography, building shape, location, construction applications and construction timeare of most importance. The right infrastructure, materials, waste management, recycling, energy and water consumption sub-titles constitute.

All the main titles and sub-titles are combined under the concept of BIM (building information modeling). In this way, minimizing damage to human and environment; environment, energy and the human are intended to be taken in the correct steps.

Today the buildings consume energy unnecessarily and uncontrollable environmental of the waste does not meet the requirement. The world's emissions of carbon dioxide is responsible for 40%. For this reason, reducing carbon emissions green rapidly developing building systems in the world. LEED, BREEAM, Green Star, CASBEE some certificates are developed for this purpose.

Today, designs are made these using certificates.The designs with the users of integration is required. It is intended to with integration the environment, energy and human improvements.

1.3. Aim and Research

To protect the ecosystem on the climate of greenhouse gas concentrations in the atmosphere and the people have signed the *Kyoto Protocol* in 1994 in order to check the effects. In the aftermath of the EU countries before 1990 and the protocol is to try to shoot their carbon emissions. Examine programs that have been established by European Standard slow energy buildings.

By this protocol and the generated certificates with reducing fossil fuel consumption, natural energy resources is targeted to consume. Orientation to the eternal source, such as solar and wind by increasing the balance of the natural ecosystem is intended to create. This balance will be created by the integration of users in the design.

Natural energy resources directly or indirectly use designs that are reviewed. Thus, reducing fossil fuel consumption and its heating, cooling and lighting will be used for natural resources. It has been tried to reduce environmental damage and energy spent on it.

In this study, which is the source of unlimited energy from the sun the health and comfort of user, as well as heating, cooling, ventilation and lighting is also intended to provide energy saving.

The design according to the sun, orientation is intended to gain the maximum from the sun.Thus to use the sun for heating, natural gas consumption will be reduced.With the amount and size of surfaces of transparent and opaque surfaces, both intended to gain both protection from the sun.The amount of these surfaces will be important factor for cooling. Also for lighting these features will be taken.

1.4. Scope

Firstly, the scope of this work, passive solar houses were investigated. Passive heating, cooling and lighting systems are given information. The need for energy are reduced to a minimum and the natural resource which is the sun, there is a need for.

The climatic characteristics of the region was examined. The summer season are hot and dry, winters are cold and rainy. For this, there is the need for sun protection in the summer. In the winter season, there is the need to the sun. Due to this dilemma of alternative projects designed in *Revit* program have been analyzed. BIM works on the concept of this program, which has provided time saving and ease of control during the project phase.

When creating designs based on LEED certification. LEED certification of heating, cooling and lighting regulations are examined. The conditions in these regulations have been added to the design.

Comprehensive analysis is complete, have been made in the *Design Builder* program. In the analysis the energy efficiency values were examined. Heating, cooling and lighting energy were seen in the data. Different designs were compared according to the values of azimuth angles. According to the results, in terms of energy efficiency the most appropriate one was selected.

1.5. Ethical Issues

Each construction as it is in sustainable design, even if some problems may occur. These issues can be derived for the project or application.

Changing regulations may lead to restrictions in the implementation phase the design or construction. Building area, gardens, spaces between buildings, openings such as the structure of the elements may need to be modified. This may require the creation of a broader vision for the design.

The structure of the transparent and opaque surfaces can be affected by these changes. Of private life, a violation may occur. For this purpose, the transparent surface designed in such a way that both of these elements will become opaque. The changes that occur at the same time, together with heating, cooling and lighting consumption may vary.

1.6. Conclusion

Most of the carbon emissions are generated by buildings, environmental pollution is increasing. Unconscious structuring also brings this situation even further.

Agreements have been made and implemented around the world to reduce the bad situation. However, population growth has led to other measures. Therefore, the situation of building design and energy use issues has started to be discussed. Structures that can use clean energy resources have started to be designed.

Regulations have been developed to interpret all these developments in a more positive way. Thus, the concept of sustainability has been approached by creating design energy and user integrity.

CHAPTER 2. LITERATURE REVIEW

2.1. Building Information Modeling

To digitize the construction industry building information modeling BIM equivalent (building information modeling). BIM, involving the generation and management of digital representations of physical and functional characteristics of spaces is a process. Enables significant productivity increase in the construction industry structures and planning, digital support for the construction and operation, is a process that emerged in the 1970s. BIM, rapidly gain in importance in the last decade due to the new developments of Information Technology, not just as a piece of software, maybe a construction project or a building's operation and the digital connections are located in the planning and development of the comprehensive approach took part in the study. In this model, all project disciplines (architectural, structural, mechanical) are provided the opportunity to work together. To manage this process with some software (Autodesk Revit, Archicad, Allplan) has been developed. Designs that are difficult to express with 2D drawings 3D models BIM has become quite fast and efficient in the process. Modeled designs are made in a static account during the projects quite fast. Corrections made in the project are experiencing hardship in situations where all are updated simultaneously. This situation also provided a fast way of communication between the disciplines because it provides more efficient project management. These are processed in the project while on the one hand, heating, ventilating and air conditioning system is added to the project. To verify that these systems are in conflict with other elements during manufacturing by checking in the project cost and loss of time are prevented.

It can be said that BIM is almost unlimited in terms of urban planning facilities. The fields of the country's network around the building to the city, the buildings themselves and through consultation with individual households and it covers everything from BIM users by just all these links will be planned. BIM and future smart cities in the world when you look at it one last time on the conference number is steadily increasing and thus, the methodology of BIM as a sign of the increasing interest in urban planning that clearly it seems.

First, the model is done and then the actual building process that is more efficient. Good cooperation, early detection of error and leads to overall faster construction process with fewer errors and collision. All stakeholders participates in the planning process so that changes may be made in the model and changes in the field of construction cost and time can be avoided. Digital model-based workflow, auto-save and helpers such as project history links it contains; thus, users then can watch while working on the model every process they make.

The project that may affect the efficiency of the connection with the past helps to prevent file corruption or the disappearances.

Instead of sending off to remeasure with the scale or one building into a correct folding plan, it is more effective to spend more time with. The designers of the building energy performance simulation tools or steadily increasing and allows the calculation to be quantified. To obtain the best performance from the software can make numerous analysis and model too. During construction, a model for each tier and sub-model, the next steps the steps for creating a more efficient construction process, materials, and a coordinated sequence of the crew. A model that is crafted with animations, steps and offers a predictable way by facilitating the coordination of processes the expected result. The focus of BIM is intended not only for planning. However, the benefit of BIM for the entire life cycle of the building.

2.1.1. BIM LOD Tables

The LOD table describes the details of the elements to be used in modeling and how much information is planned. The level of information that elements need to include is defined by LOD numbers by different organizations and companies. The American Institute of Architects is the most widely used reference for identification of LOD levels.

These definitions are generally expressed; as LOD 100 concept modeling and master planning , LOD 200 general modeling and schematic design, LOD 300 precise modeling and shop drawing, LOD 400 modeling for manufacturing and assembly , LOD 500 as-built modeling and operation.

It is important to make the LOD table for systems and elements before modeling starts, to describe what the model will contain, to know the exact level of information contained in the model, and to know why each employee is responsible. To accomplish the document’s intent, its primary objectives are:

- To help teams, including owners, to specify BIM deliverables and to get a clear picture of what will be included in a BIM deliverable.
- To help design managers explain to their teams the information and detail that needs to be provided at various points in the design process.
- To provide a standard that can be referenced by contracts and BIM execution plans.

2.1.2. BIM Life Cycle

1D: It is called ‘Scratch Point’. It has 3 contents. Firstly it investigates existing conditions and all of regulations. Also it is analysis location weather simulations and sun orientations. Then, it investigates software and consulting. All of them discussion. Finally step is concept design. It describes strategies, area estimation and cost analysis.

2D: It is called ‘Vector’. It has 4 steps. First step is production. On this step, it studies about 2D drawings, views, plans and documentations. Second step is implementation. It makes programming and file management. It is the most important communication on this step. Third step is development. It describes data sheets, scope, materials, structural loads and energy loads. The last step is sustainability. It investigates life cycle and solutions. Also it investigates certification strategies.

3D: It is called ‘ Shape’. It has 4 steps. First step is representation. On this step, it studies on rendering and walkthroughs on the project. Second step is implementation. It creates BIM objects and visual programming. It checks model. Third step is final docs. All of designers work together on this step. It makes details, MEP design and structural design. BIM 3D helps participants to manage their multidisciplinary collaboration more effectively in modelling and analysing complex spatial and structural problems. Furthermore because accurate data can be collected along the project life cycle, and stored in the Building Information Model, new value can be added to predictive models allowing to resolve issues proactively. Final step is sustainability. It studies on sun protection and daylight requirements.

4D: It is called ‘Time’. The fourth dimension of BIM allows participants to extract and visualize the progress of their activities through the lifetime of the project. It has 3 steps. First step is production. It makes time plan on this step. It creates scheduling, equipment deliveries and project phasing. Second step is system. It checks structural system and MEP system. Third step is simulation. On this step, it makes life cycle analysis, sun simulation, wind simulation and energy simulation. Also ıt checks certificate.

5D: It is called ‘Cost’. It has 3 steps. The utilization of 5D-BIM technology can result in a greater accuracy and predictability of project's estimates, scope changes and materials, equipment or manpower changes. 5D BIM provides methods for extracting and analysing costs, evaluating scenarios and changes impacts.First step is production. It investigates detail of bill and fabrication model. Second step is contract. On this step, it agrees all firm about project (consultant company, logistics company etc.). Third step is sustainability. It checks certification evaluation and life cycle costs.

6D: It is called ‘Performance’. It has 2 steps. First step is results. It compares all alternatives. It makes analysis certification and BIM model. It reports performance analysis. Second step is value engineering. It makes performances all of drawings and simulations.

2.2. LEED Certificate

LEED (Leadership in Energy and Environmental Design) certification (energy analysis tool), helps the project team assess the impact of design decisions on energy consumption and sustainability. Based on this architectural model, the analysis model is usually the main. Thereafter, material and building system inputs can be evaluated using the energy consumption and the sustainability of the project.

Leading the way in energy and environmental design (Leadership in Energy and Enviromental Design-LEED) to establish appropriate standards for environmentally sustainable construction Green U.S. Building Council (U.S. Green Building Council - USGBC) was developed in 1998 by.

Green Building Council LEED consists of representatives from every sector of the construction industry to continually improve the program. Six areas are evaluated in the environmental field, including five in one design area. These are;

- Sustainable Sites (18 points)
- The Efficient Use of Water (9 points)
- Energy Efficiency and Atmosphere (39 points)
- The Use of Materials and Resources (16 points)
- The Quality of The Internal Environment. (18 points)
- Innovation and Design (6 points)
- Regional Priority (4 points)

It determines the degree of LEED given a certificate with a score in the process. The mandatory conditions are met for certificates, Silver certificates, gold certificates and platinum the certificate is awarded. Over a total of 110 points are evaluated. Certification 40-49 points, 50-59 points silver certificate, 60-79 points gold certificate, platinum certificate 80 points and over are awarded a certificate from the certification.

Certified	Silver	Gold	Platinum
40-49 point	50-59 point	60-79 point	≧80 point

Picture 1 : LEED Point Table

The main criteria for each structure type according to the intended use of the structure to be the same there are differences.

2.2.1. LEED Certification Type

LEED– New Construction Certification: The certification office, new building, business centre, multistorey building, sports and convention center it is suitable for buildings such as. The duration of project development studies and sustainable business structures are followed during construction and certification.

LEED - Existing Building Certification: LEED for existing buildings certification it is possible for you to receive. Have completed their economic life, but not energy efficiency, health and low environmental impact of existing buildings LEED for existing buildings is targeted to receive a certificate.

LEED - Schools Certification: LEED for schools, training institutions and developed a certification system for schools. This certificate, specific standards are required for the schools in the system. Acoustic, daylight saving educational environments for students, certified healthy school furniture-furniture selection, and a similar number are provided in different standard LEED certification for schools.

These criteria are constructed with healthy and productive educational environments.Educational institutions, schools and universities, academic staff and students by taking the LEED for schools certification for healthy, economical and an environmentally sensitive building that can offer the possibility of training. LEED certified school on the educational success of of a 2% increase is known.

LEED - Core and Shell Certification: A certification system developed for business centers leased as hollow. This certificate was built with the users in the system, different standards for tenants of the building shell and the kernel are required. This certification is suitable for business centers, which will be rented, especially, the users are monitored by a process that is also joined to the system. LEED core andshell leased a much higher level, which will be the future of the business district environmentally sensitive and healthy environments for healthy, economical and environmentally-conscious.

LEED - Certification Hospital: Beds in the new hospital and over 200 have become a necessity. Hospital buildings and other buildings they need to be specifically sensitive to the needs of healthcare organizations certificate by a certification that has been developed in consideration of the aspects. Certification, especially the norms required of a building considers health hospital. However, also have other system as the LEED certification in buildings, materials selection, energy and water consumption in other areas such as LEED standards and certification systems similar to that of carries.

LEED - Certificate Hospitality: Hotel, resorts and accommodation facilities are engaged in building a significant amount of water and energy consumption. LEED certified hotel by up to 40 % energy and water savings. Hotel building certification system, especially in hotel and tourism should be sensitive to the needs of organizations that operate a facility and the other buildings is a certification that has been developed in consideration of the aspects. Certificate of hotel buildings, especially the accommodation and facilities of the building considers the required norms. However, also have other LEED certification systems, as with buildings, environmental awareness, materials selection, energy and water consumption in other areas such as LEED certification for implementing systems with similar standards.

LEED - Certificate in Warehouse and Distribution Centers: Especially the needs of the organisations who run warehouses and distribution centers and other building than the buildings in front that they need to be is a certification that has been developed in consideration of the aspects. The system considers the required norms, especially the building of warehouses and distribution centers. However, also have other system as the LEED certification in buildings, environmental awareness, materials selection, energy and water consumption with other similar standards in areas such as LEED certification implementing the system. The certification system, a certification is required for facilities that provide logistics services, especially international.

LEED– Neighborhood Development Certification: The countries in the region most important to the subject of urbanism in developing healthier, more energy efficient and more environmentally friendly to construct settlements.

2.2.2. LEED Certification Properties

2.2.2.1. Sustainable Sites

Sustainable site about preconditions, construction activities and soil erosion pollution prevention. Site selection, distance to social facilities, land use, transportation, open space, storm water design, heat island effect and are loans that need to be applied in the subject of illumination. Accordingly, the points are awarded.

Precondition 1	Construction Activity Pollution Prevention
Precondition 2	Environmental Site Assessment
Credit 1	Site Selection
Credit 2	Developing Density and Community Connectivity
Credit 3	Brownfield Redevelopment
Credit 4	Alternative Transportation
Credit 5	Site Development
Credit 6	Stormwater Design
Credit 7	Heat Island Effect
Credit 8	Light Pollution Reduction
Credit 9	Connection to the Natural World

Table 1: Sustainable Sites LEED Criteria

2.2.2.2. Water Efficiency

To reduce water consumption and waste water is a prerequisite. Landscape water use and total water consumption of the building's mains water loans offers. According to the applied credits, the points are awarded.

Precondition 1	Water Use Reduction
Precondition 2	Minimize Potable Water Use for Medical Equipment Cooling
Credit 1	Water Efficient Landscaping
Credit 2	Measurement and Verification
Credit 3	Water Use Reduction
Credit 4	Water Use Reduction - Equipment

Table 2: Water Efficiency LEED Criteria

2.2.2.3. Energy Efficiency and Atmosphere

The use of renewable energy sources is a necessary prerequisite for the reduction of gases and ozone. Minimum energy performance, renewable resources, gas management, gas measurement in the field of loans and facilities. According to the applied credits, the points are awarded.

Precondition 1	Fundamental Commissioning
Precondition 2	Minimum Energy Performance
Precondition 3	Fundamental Refrigerant Management
Credit 1	Optimize Energy Performance
Credit 2	On-site Renewable Energy
Credit 3	Enhanced Commissioning
Credit 4	Enhanced Refrigerant Management
Credit 5	Measurement and Verification
Credit 6	Green Power
Credit 7	Community Contaminant Prevention—Airborne Releases

Table 3: Energy and Atmosphere LEED Criteria

2.2.2.4. Materials and Resources

Objective to make efficient use of materials and environmentally friendly materials to use. Use of recycled materials, materials re-use and the use of local materials extra points are awarded.

Precondition 1	Storage and Collection of Recyclables
Precondition 2	Source Reduction
Credit 1	Building Reuse
Credit 2	Construction Waste Management
Credit 3	Sustainably Sourced Materials and Products
Credit 4	Source Reduction
Credit 5	Furniture
Credit 6	Resource Use—Design for Flexibility

Table 4: Material and Resources LEED Criteria

2.2.2.5. Indoor Environmental Quality

To ensure indoor air quality indoor pollutant sources to reduce is intended to provide thermal comfort and to control them. The amount of fresh air, smoke control, low emission use of materials (VOC reduction) and lighting control points are awarded.

Precondition 1	Minimum Indoor Air Quality Performance
Precondition 2	Environmental Tobacco Smoke Control
Precondition 3	Hazardous Material Removal or Encapsulation
Credit 1	Outdoor Air Delivery Monitoring
Credit 2	Acoustic Environment
Credit 3	Construction Indoor Environment Quality Management Plan
Credit 4	Low-Emitting Materials
Credit 5	Indoor Chemical and Pollutant Source Control
Credit 6	Controllability of Systems
Credit 7	Thermal Comfort
Credit 8	Daylight and Views

Table 5: Indoor Enviroment Quality LEED Criteria

2.2.2.6. Innovation and Design

The plan is intended to ensure the integration of project design and implementation. Points are earned based on innovative design and LEED applicability.

BIM, energy, environment to help in the construction of the project hence focused on the platform. Also integrated into the platform for improved environmental and energy certification LEED certification. Design, application and structure LEED certification in accordance with the regulations in the use of time, energy, and environmental sustainability is provided.

Precondition 1	Integrative Project Planning and Design
Credit 1	Innovation in Design
Credit 2	LEED Accredited Professional
Credit 3	Integrative Project Planning and Design

Table 6: Innovation and Design LEED Criteria

2.3. Conclusion

Environmental certificates have been developed during the design and construction phases of the buildings in order to protect the environment and human health. LEED certificate is developed by USGBC. It is arranged according to the type of building and contains both design and environmental regulations. The regulations to be applied during the design, construction and service of topography, water, energy efficiency, materials and internal air quality are compiled separately.

BIM concept has been established for more accurate implementation and analysis of developed regulations. With special drawing and analysis programs, the project will be designed and analyzed in 3D. During these processes, all project developers will work together to minimize the risk of errors. Time and cost savings will be provided.

CHAPTER 3. RESEARCH METHODOLOGY

3.1. Research Philosopy

With increasing the population, the resources used to meet energy needs have started to decrease. For this reason, different sources have been sought. These different sources must be both clean and renewable. Thus, resource consumption will be minimized and repeat itself.

Solar energy can be used both directly and indirectly. The sun is used directly with orientation, shell, design and materials. It is saved without extra cost. Environmental pollution is avoided.

3.2. Research Approach

Regulations have been written to ensure energy efficiency and reduce costs. These regulations have been developed with agreements made around the world. The idea of LEED certification was developed by U.S.A for this purpose.

LEED certification aims to project the environment with both design and environmental approach. Agreements have been made for different building types.

Taken while study working on LEED certification green building design were asked to create. The section on LEED certification for the school of design of the educational structure is based on. Passive heating, cooling and lighting systems are used where a structure is planned.

3.3. Research Strategy

The county Şahinbey Gaziantep province was selected as the place of study. Hasan Kalyoncu University campus are planned for nursery.

Hasan Kalyoncu University is a university that produces its own electricity with solar panels. It has active solar systems. The reason for this choice is the main system of the campus. The second reason is that the people who work and leave their children in the school will continue to work. With the nursery being on the campus, parents will benefit because of both time and money. Get into city traffic and spend some time with people and traffic this will not create. Save gas and CO_2 emissions, so the exhaust will be reduced.

3.4. Research Process

When planning the study design of 6 main categories were examined and the LEED certification was determined to do.

The first category is site applications which were investigated. Drinking water use human health as a result of the studies and hasn’t been found in violation of substances in the water. The campus is growing and renewed every day. Green design emphasis. The campus security is high and there isn't a traffic problem. Public transportation is available. There is also of infrastructure for campus ready. Life is for living is available. Rock structure soil lime mixture.

The second category is water efficiency which was investigated. Rainwater collection to reduce water usage it is considered a project. This water for use in landscape irrigation will be provided. Water saving fixtures and reservoirs will be preferred.

The third category is energy efficiency which was examined. The regulations required for energy efficiency have been investigated.

The fourth category is materials and resources which were examined. Materials were investigated to minimize waste. Structure materials, architectural materials and mechanical system materials were determined.

The fifth category is indoor environment quality which was examined. Material such as paint, plaster and adhesives have been created for the interior. These are compared to the relevant section of the LEED certificate. Materials are reviewed at permitted values.

The sixth category is innovation and design which wereexamined. Green and sustainable a building is required.At the same time given importance to the health of the child to the nursery. Use of recycled materials, LEED criteria and we will try to provide through the implementation of regional innovation.

3.5. Methods for Data Collection and Analysis

Climate conditions of Gaziantep have been investigated. According to conditions; insoulation in the month of August the maximum period of 9 hours, at least 2,5 hours in the month of February. Wind speed of 0.8 WNW, the southwest and North East prevailing winds, average humidity % 44,78 annual rainfall 46,53 kg/m² of habitat structure has been investigated and seen as.

The transportation plan has been obtained. The conncetions of campus to public transport systems have been investigated. According to the transportation master plan, metro tram, which is 3 km away and integrated into the system, it will be made available. Regional social human in the sense with the most superior performance showing. Has the strongest economy in the region. It is situated 8 km from the city centre and around the campus there are satellite cities. Bus stop 50 m. is located. There are two bus lines. Taxi and shuttles are available. Primary highway 200 m., 1 km from ring road, 300 m to the gas station is located.

Research has been carried out for water conservation. Saving fixtures are preferred for this. In addition, the water obtained by rain water collection system is used in pear irrigation.

Renewable energy source, the sun by using passive heating, cooling and lighting. For this, roof windows and double glazing applications are considered. The school produces its own electricity from the sun with solar panels already on campus.

For waste reduction shall be made of structural steel. Columns, beams and steel floor systems will be preferred. Recycled materials will be used. Large glass curtain walls, aluminum door-window profiles will be preferred. Flooring bamboo flooring is moisture resistant which grows quickly and will be preferred. Recycled materials will be used in both in architecture and structure.

Skylights and cross-placed windows natural ventilation will be provided with CO_2 and humidity control will be made. However, the allowed fields from a certain distance will be created. All the paint and glue for the group 'volatile organic emissions' regulations shall prevail.

3.6. Conclusion

Material lists have been created before the project started. Then, all sections of the LEED certificate were examined separately. The regulations in each section have been examined. All permissible values are compared with the values of the selected materials. Materials that are not allowed are selected instead of materials that are permitted by regulations.

CHAPTER 4. DESIGN MODELING IN REVIT ARCHITECTURE PROGRAM

4.1. Design Properties

Thesis defined the concept of passive solar houses and a school in the design of reviewed. While design has been based on LEED certification. The nursery school was designed in all of this was made.

Nursery 2-storey and rectangle (22,30 m. x 20,10 m.) type as designed. On the ground floor 4 classrooms, 1 sleeping room, 1 dining hall and kitchen, 1 health room, 1 teachers room, 1 girl toilet, 1 boy toilet and winter garden. Of living space is determined as the ground level of the students. There is at 1. floor 1 directory room, 1 open office, 1 women staff toilets, 1 men staff toilet and a terrace garden.

Most of the classes for areas to be used for a long time was placed on the south side. Because it will be warmer climatic features. Also the front and long rectangle to the south of all classes is directed. The format of the classes is designed in the cupola at the highest point of roof has a window and natural ventilation in terms of providing the most.

Placed on the north side of the fields that will be used less. A winter garden in the middle of the structure designed. On top that can be opened in the window the sun were placed. Thus, temperature, ventilation and lighting control are provided. The Eastern Front of the garden with floor to ceiling glass curtain system by placing the sun in the morning to heat the structure are provided.

The main construction material of outer walls 20 cm wide, *Nuh* brand gas concrete *G2/04* using the model were made. This walls acoustic insulation material in the inner layer, *Kanuf* brand *Cleaneo* modelwere used. The next layer for heat insulation, *Knauf* brand *Mineral IPB 037Plus* model were used. On top of this layer, 3 cm thick plaster *Cimko* brand content *CEM II/ B-M 32,5 R* cement were used. The paint *Filli Boya* brand *Extra Amphisilan* model were used. This wall of sound insulation in the same material as the inner layer with the inner layer material were used. Insulation *Knauf*brand *FKD-S* model for after were used in the thermal model. Again, the same as the outer layer of plaster and paint were used.

The main construction material of the interior walls 10 cm wide, *Nuh* brand gas concrete *G2/04* using the model were made. This walls acoustic insulation, *Knauf* brand *Cleaner* model both sides of the wall layer as were used as thermal insulation *Knauf* brand *Mineral IPB 037 Plus model*. On top of this layer as plaster *Cimko* brand content *CEM II/ B-M 32,5 R* cement were used. The paint *Filli Boya* brand *Amphisilan Extra* model were used.

Flooring in the main construction material is steel. The floors acoustic insulation,*Knauf*brand *Cleaneo* model were preferred. Bamboo flooring *Micro Carbonized Vertical Bamboo* model *Mezitha* brand were used. The *EGE Seramik* brand granite wet crown model was used as a coating material.

Picture 2: Nursery View

Green roof is designed as the top of the class. Thus, it is not affected by the heat island effect and overheating of classes will not occur. It consists of 10˚ of slopping parts, class 4 pieces roofs. At the junction of these parts can be opened to provide natural ventilation and natural lighting, the sun, the windows are designed. The main construction material of the roof is aluminum. The model were applied to the *ASSAN* brand *1000R4* model. By applying 1 cm thickness of impermeable layers on top green roof applications are reviewed. End of the inclined surface and drainage to evacuate excess water was put in the grooves provided. This collected water is stored for landscape gardening will be used.

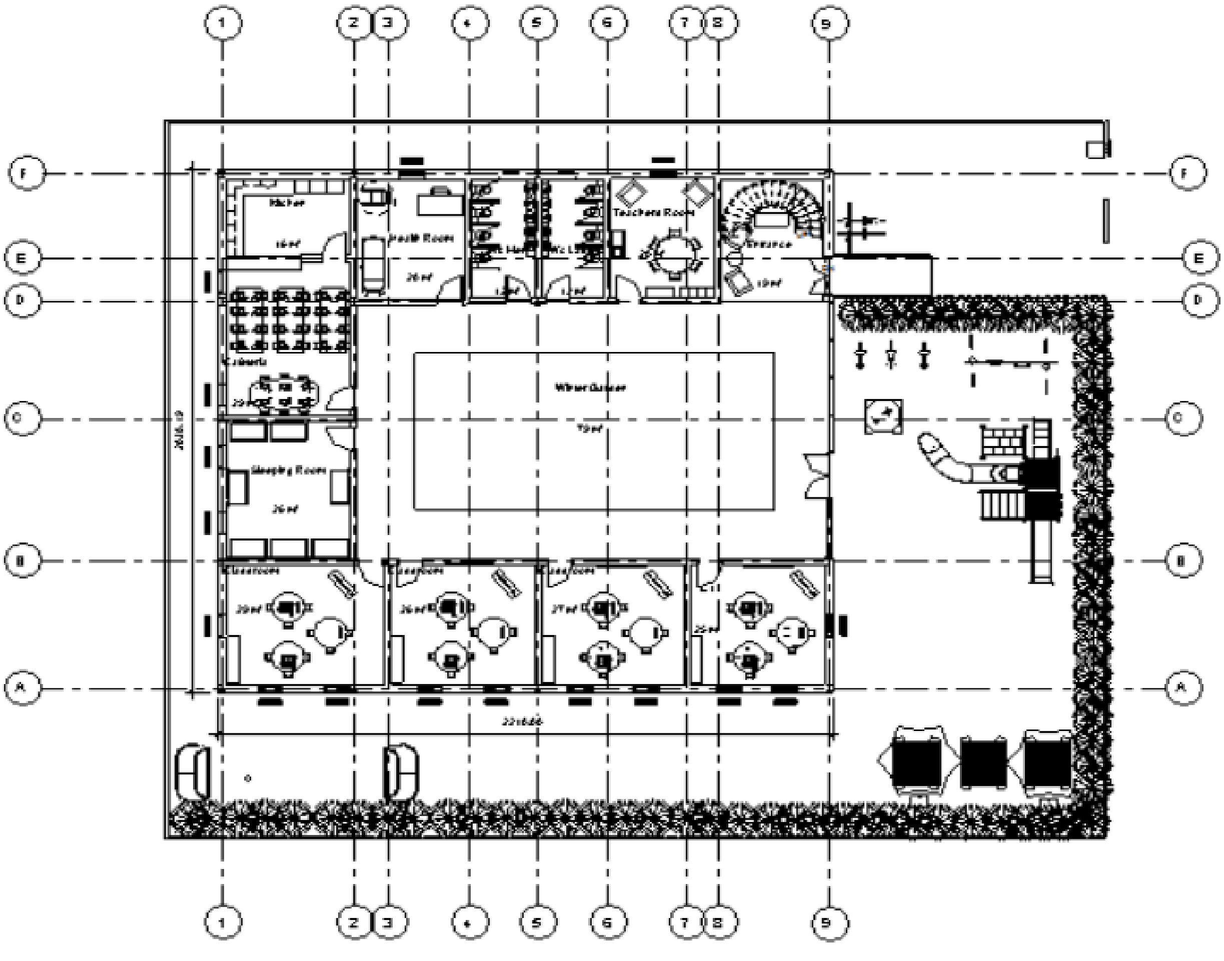


Figure 1: Ground Floor Floor Plan

4.1.1. C1 Classroom Properties

The class C1 to the South and the East is the facade double. On the Eastern facade, there is 1 window 90 cm x 120 cm, placed to a heigh of 60 cm from the ground, double glazed, tilt in the forward direction 30˚ windows that can be opened. On the Southern facade, there are 2 windows with the same features. The cupola designed in the format of the class 100 cm x 100 cm in size at the very top of the solar window that can be opened. In this way, the natural lighting will be provided. Comfort conditions in terms of the flat have been placed in the window. Also this window with natural ventilation are provided. Class C1 25 m^2. There are 2 pieces outer walls 32 cm thickness. There are 2 pieces inner walls 22 cm thickness. Natural lighting is provided with a light source. 75 watt lamp 2 wall lamps artificial light source is provided.

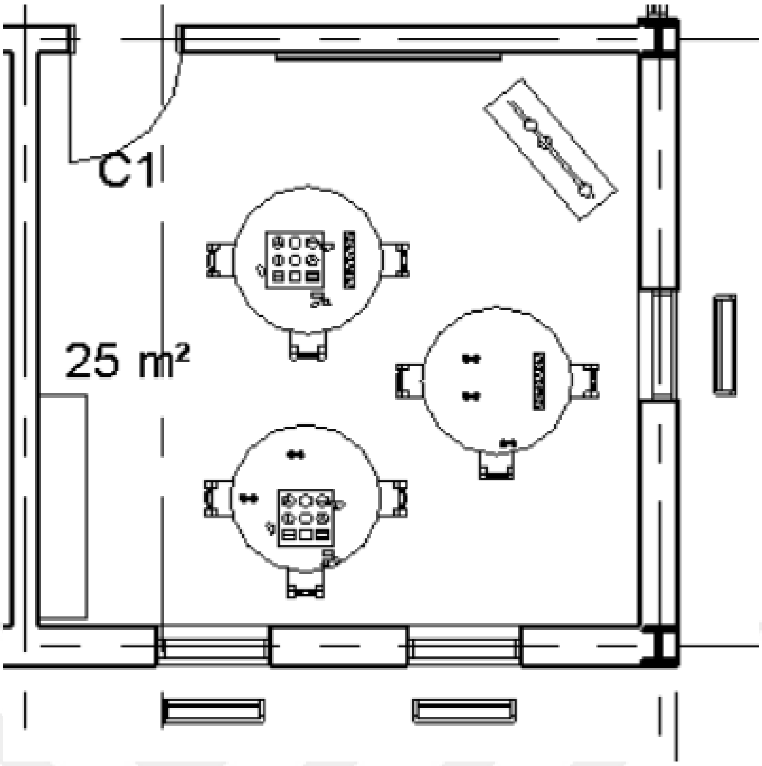


Figure 2: C1 Classroom Floor Plan

Picture 3: C1 Classroom Interior Details

4.1.2. C2 Classroom Properties

The class C2 is the one at the South of the facade. There are 2 windows, 90 cm x120 cm, placed to height a of 60 cm from the ground on the, double glazed, tilt in the forward direction 30˚ windows that can be opened. The cupola designed in the format of the class 100 cm x 100 cm in size at the very top of the solar window that can be opened. In this way, the natural lighting will be provided. Comfort conditions in terms of the flat have been placed in the window. Also this window with natural ventilation are provided. Class C1 27 m². There is 1 pieces outer wall 32 cm thickness. There are 3 pieces inner walls 22 cm thickness. Natural lighting is provided with a light source. 75 watt lamp 2 wall lamps artificial light source is provided.

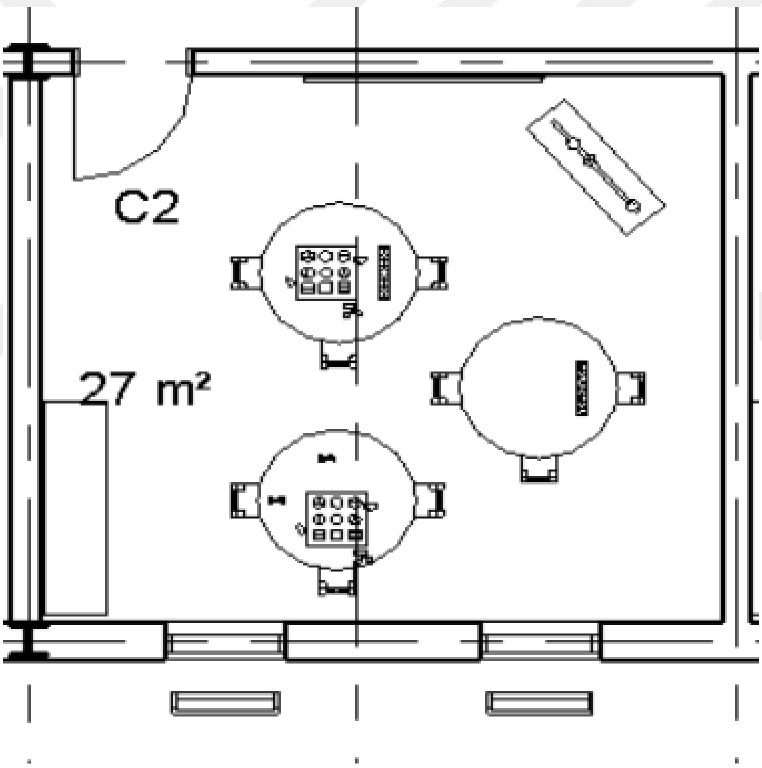
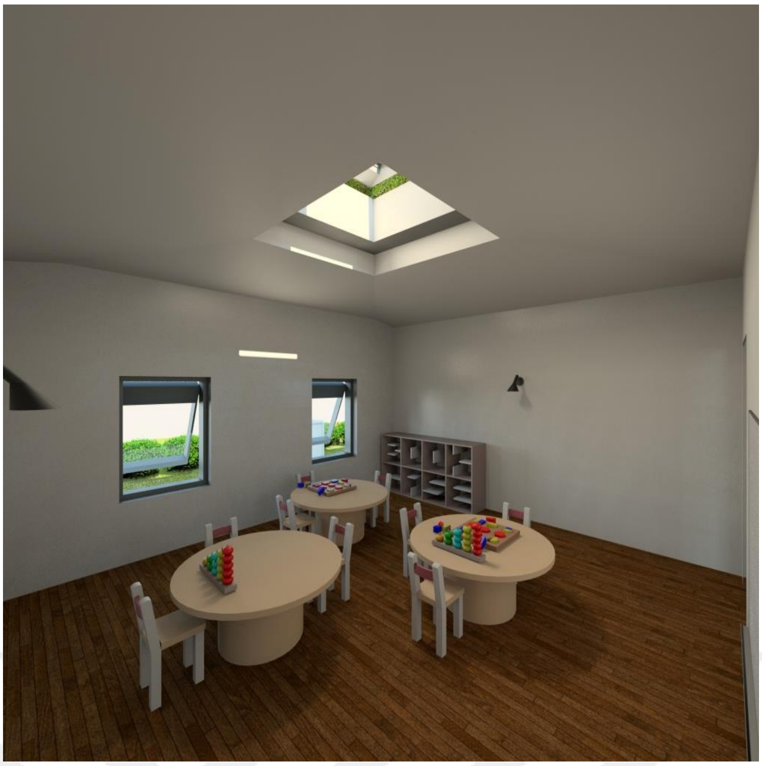


Figure 3: C2 Classroom Floor Plan



Picture 4: C2 Classroom Interior Details

4.1.3. C3 Classroom Properties

The class C3 is the one at the South of the facade. There are 2 windows, 90 cm x120 cm, placed to height a of 60 cm from the ground, double glazed, tilt in the forward direction 30˚ windows that can be opened. The cupola designed in the format of the class 100 cm x 100 cm in size at the very top of the solar window that can be opened. In this way, the natural lighting will be provided. Comfort conditions in terms of the flat have been placed in the window. Also this window with natural ventilation are provided. Class C3 26 m². There is 1 pieces outer wall 32 cm thickness.There are 3 pieces inner walls 22 cm thickness. Natural lighting is provided with a light source. 75 watt lamp 2 wall lamps artificial light source is provided.

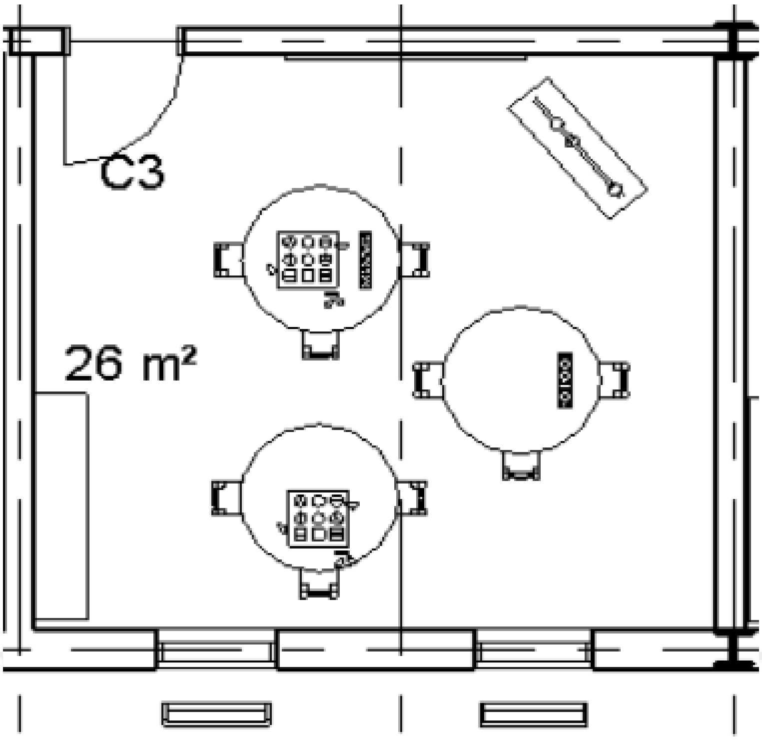
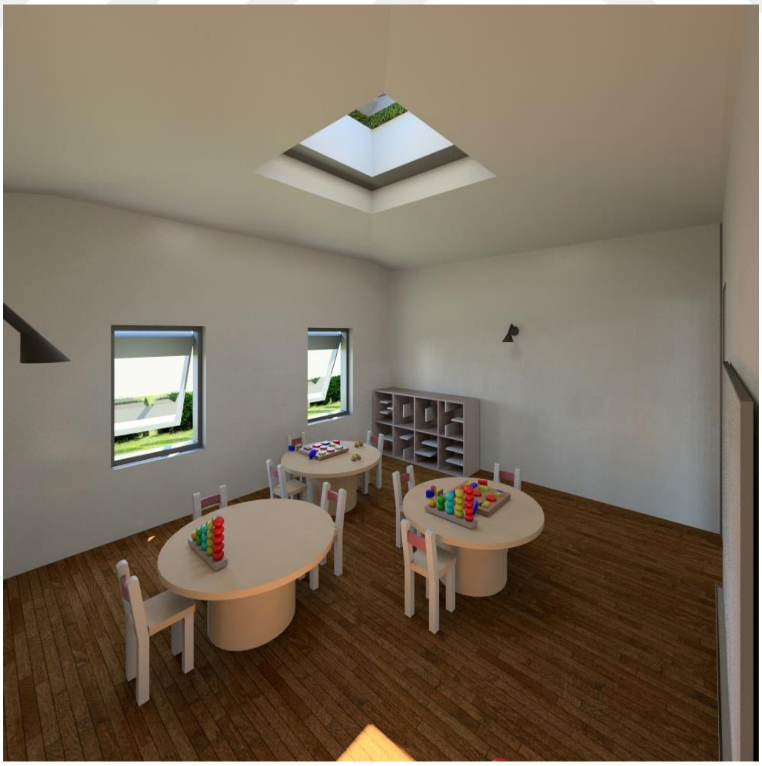


Figure 4: C3 Classroom Floor Plan



Picture 5: C3 Classroom Interior Details

4.1.4. C4 Classroom Properties

The class C4 to the South and the West is the facade. There is 1 window 90 cm x120 cm, place to height a of 60 cm from the ground, double glazed, tilt in the forward direction 30˚ windows that can be opened. On the southern front there are 2 windows with the same features. The cupola designed in the format of the class 100 cm x 100 cm in size at the very top of the solar window that can be opened. In this way, the natural lighting will be provided. Comfort conditions in terms of the flat have been placed in the window. Also this window with natural ventilation are provided. Class C4 25 m². There are 2 pieces outer walls 32 cm thickness. There are 2 pieces inner walls 22 thickness. Natural lighting is provided with a light source. 75 watt lamp 2 wall lamps artificial light source is provided.

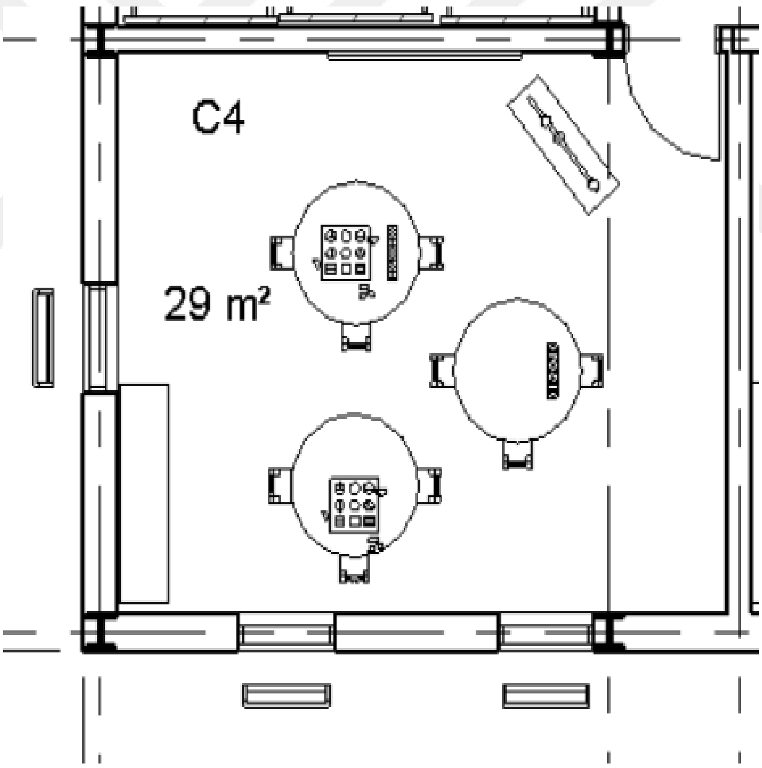


Figure 5: C4 Classroom Floor Plan

Picture 6: C4 Classroom Interior Details

4.1.5. C5 Classroom Properties

Class C5 is the one at the West of the facade. There are 2 windows 90 cm x 120 cm, placed to height a of 60 cm from the ground, double glazed, tilt in the forward direction 30˚ windows that can be opened. The cupola designed in the format of the class 100 cm x 100 cm in size at the very top of the solar window that can be opened. In this way, the natural lighting will be provided. Comfort conditions in terms of the flat have been placed in the window. Also this window with natural ventilation are provided. Class C5 26 m². There is 1 pieces outer wall 32 cm thickness. There are 3 pieces outer wall 22 thickness. Natural lighting is provided with a light source. 75 watt lamp 2 wall lamps artificial light source is provided. This room is sleeping room.

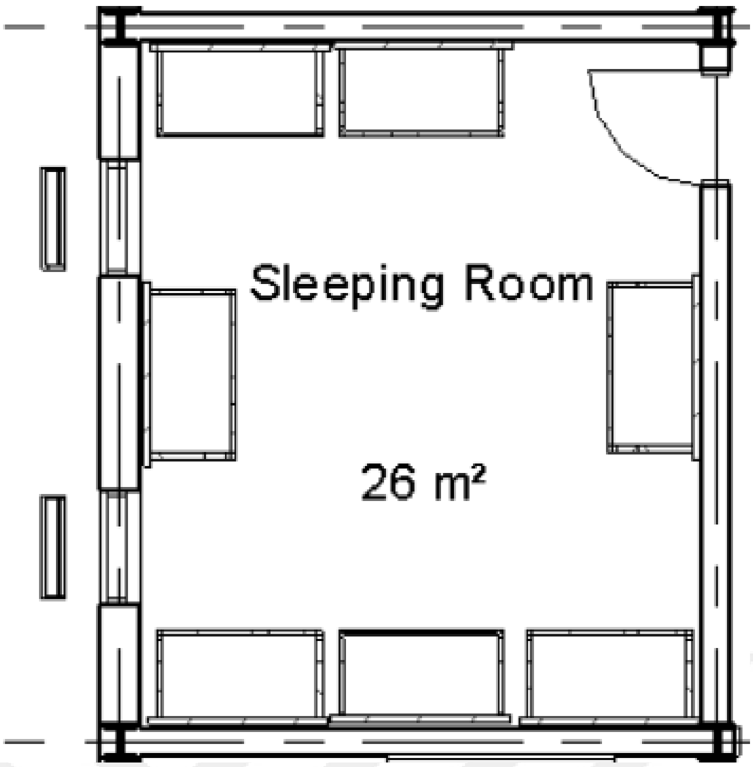


Figure 6: C5 Classroom Floor Plan

Picture 7: Sleeping Room Interior Detail

4.1.6. Kitchen and Dining Room Properties

The kitchen and dining hall of the North and Western side was placed. There is no window facing North. There are 2 windows 90 cm x 120 cm, placed height a of 60 cm from the ground, tilt in the forward direction 30˚ windows that can be opened, the double glazed. 16 m² kitchen, dining hall section 29 m². Students and teachers uses the same cafeteria. 75 watt lamp 7 spot lamps as artificial lighting were used. The ceiling material recycled aluminum, which reviewed the application of the suspended ceiling.

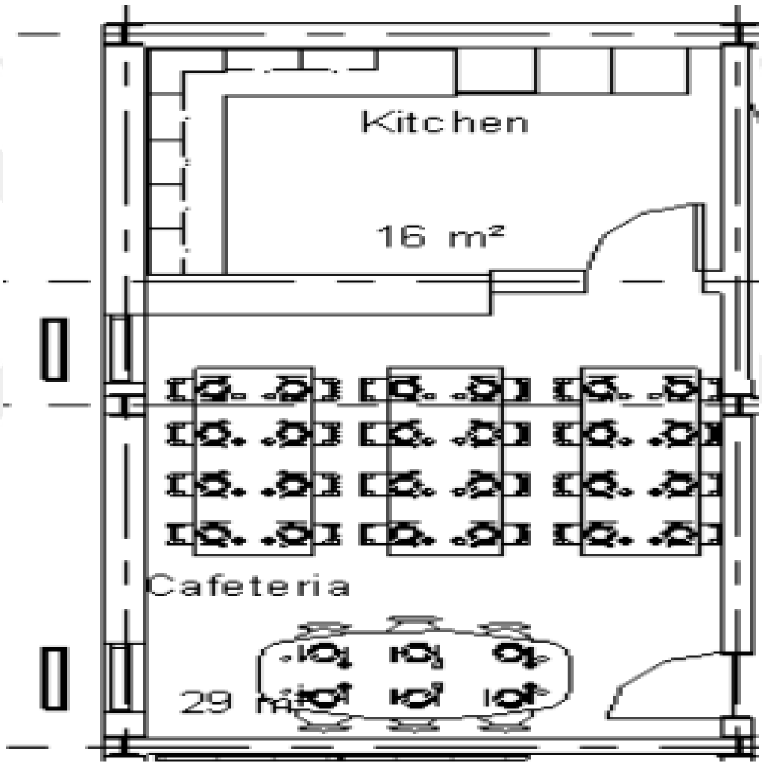


Figure 7: Kitchen and Cafeteria Floor Plan

Picture 8: Kitchen and Cafeteria Interior Details

4.1.7. Health Room Properties

The health room is located on the North side. There is 1 window 90 cm x120 cm, placed to height a of 60 cm from the ground, double glazed, tilt in the forward direction 30˚ windows that can be opened. Health room is 20 m². 75 watt lamp 4 spot lamps as artificial lighting were used.

Figure 8: Health Room Floor Plan

Picture 9: Health Room Interior Details

4.1.8. Toilets Properties

Student toilets located on the North side. Separate toilets for girls and boys are available. There are 4 sinks, 5 Toilet in each toilet. There is a window 50 cm x 50 cm, placed to height a of 180 cm from the ground, that can be opened for ventilation. Each of the toilet 12 m². 75 watt lamp 4 spot lamps as artificial lighting were used.

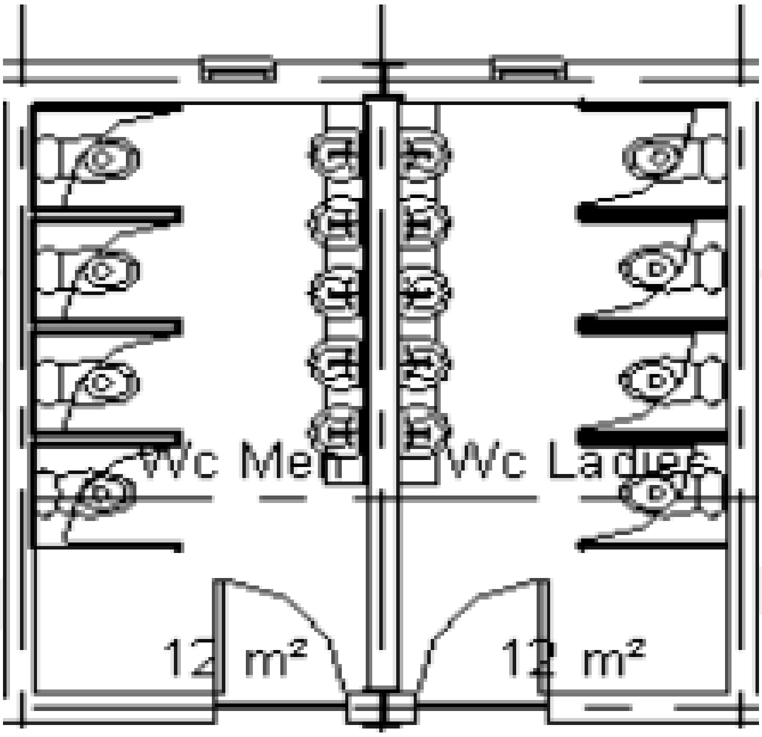


Figure 9: Students Toilet Floor Plan

4.1.9. Teachers Room Properties

The teachers room is located on the North side. There is 1 window 90 cm x 120 cm, placed to height a of 60 cm from the ground, double glazed, tilt in forward direction 30˚ that can be opened. Teachers room is 20 m². 75 watt lamp 4 spot lamps as artificial lighting were used.

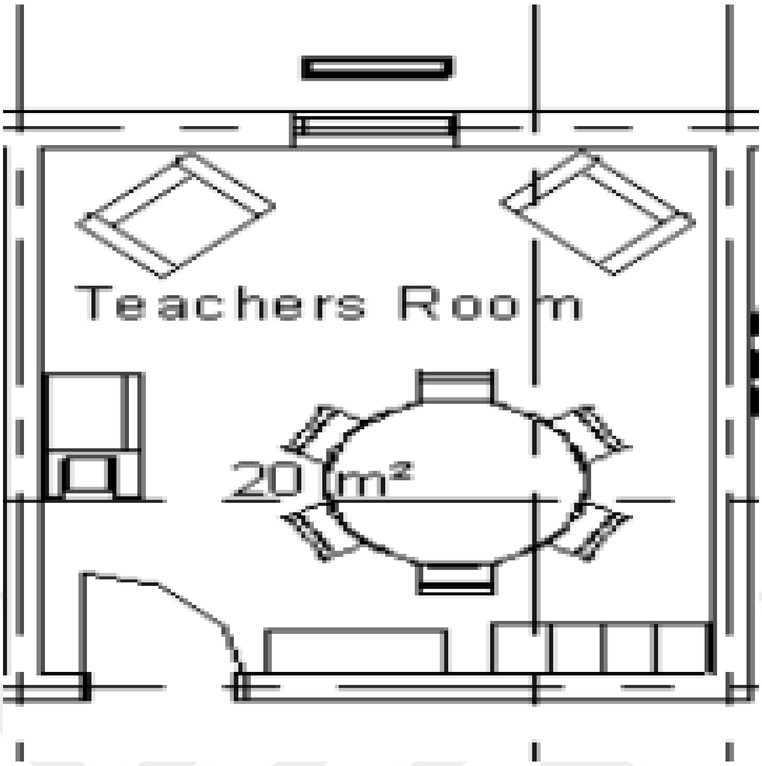


Figure 10: Teachers Room Floor Plan

Picture 10: Teachers Room Interior Details

4.1.10. Entrance Properties

The entrance of the building from the East side are given. From the hallway stairs to the upper floors are reached. In addition, this area student living areas, a winter garden, garden and communal areas allows you to reach.75 watt lamp 2 spot lamps as artificial lighting were used.

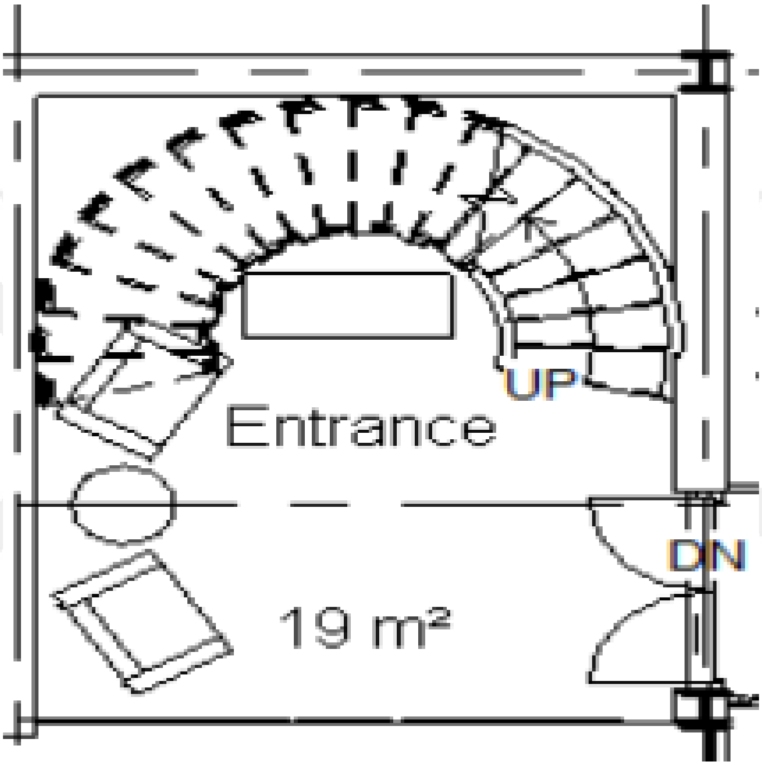


Figure 11: Entrance Floor Plan

Picture 11: Entrance Interior Details

4.1.11. Winter Garden Properties

The ground floor features in the middle of a garden winter. All classes, dining hall, toilets, staff room and entrance hall is connected to the garden. There is solar on the roof window that can be opened 260 cm x 250 cm. Both lighting and provides natural ventilation. The floor of this garden is covered in grass and 79 m².

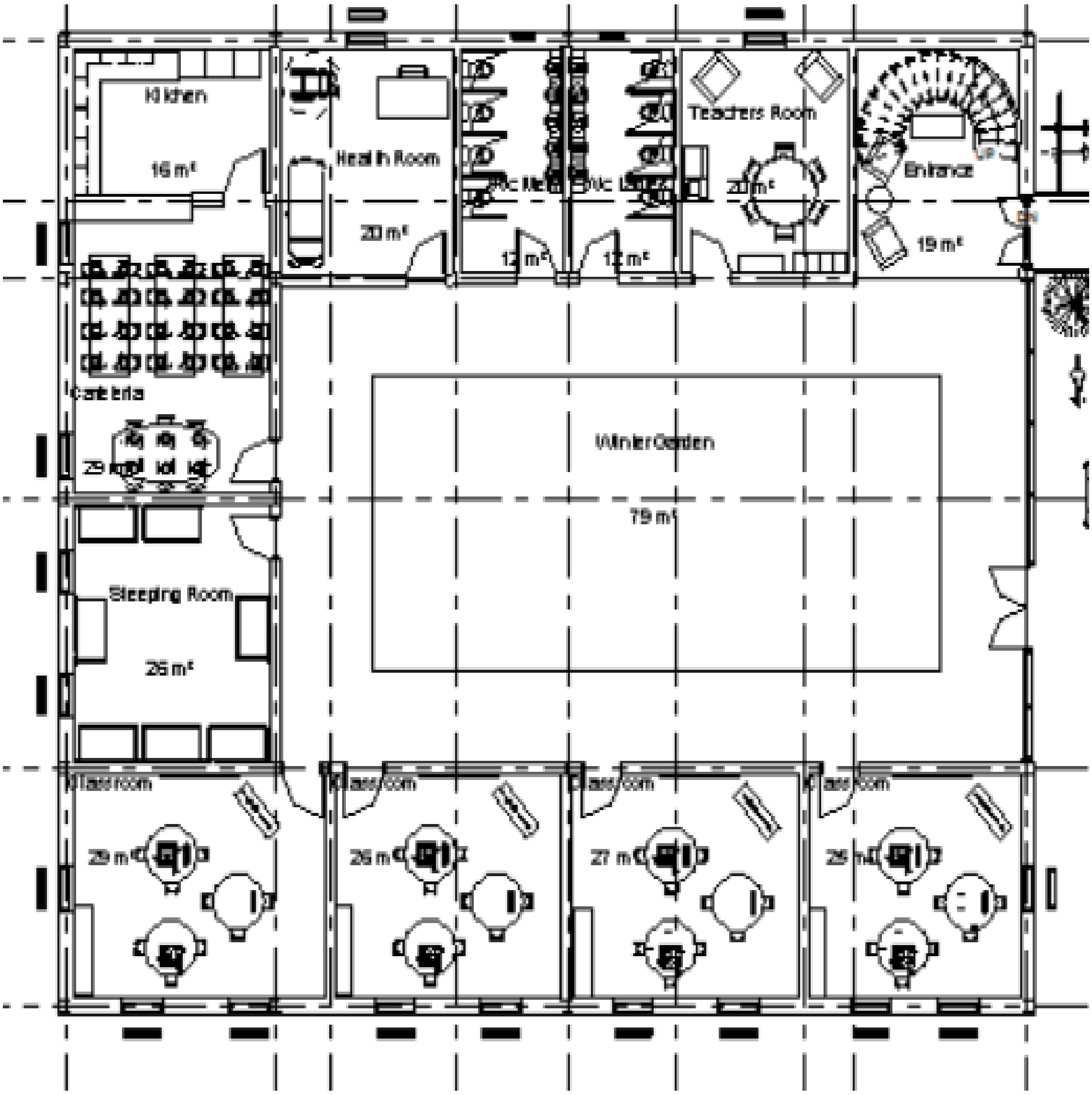


Figure 12: Winter Garden Floor Plan

Picture 12: Winter Garden Interior Details

First floor is designed as the administrative floor. 1 principal's office, 1work office, 2 staff toilets and 1 terrace. Total floor area 150 m². The window is not placed on the Northern facade. The Southern facade from the ground to a height of 100 cm toceiling glass curtain system was applied. Roof above the eaves to allow for heat and light control. Natural ventilation with windows on the East and West sides are provided with mutually placed. The vertex is also placed in the window of the stairwell that can be opened to the sun. Thus, both both natural natural lighting downstairs heated air is provided with the evacuation. The transition to the garden terrace South facade.

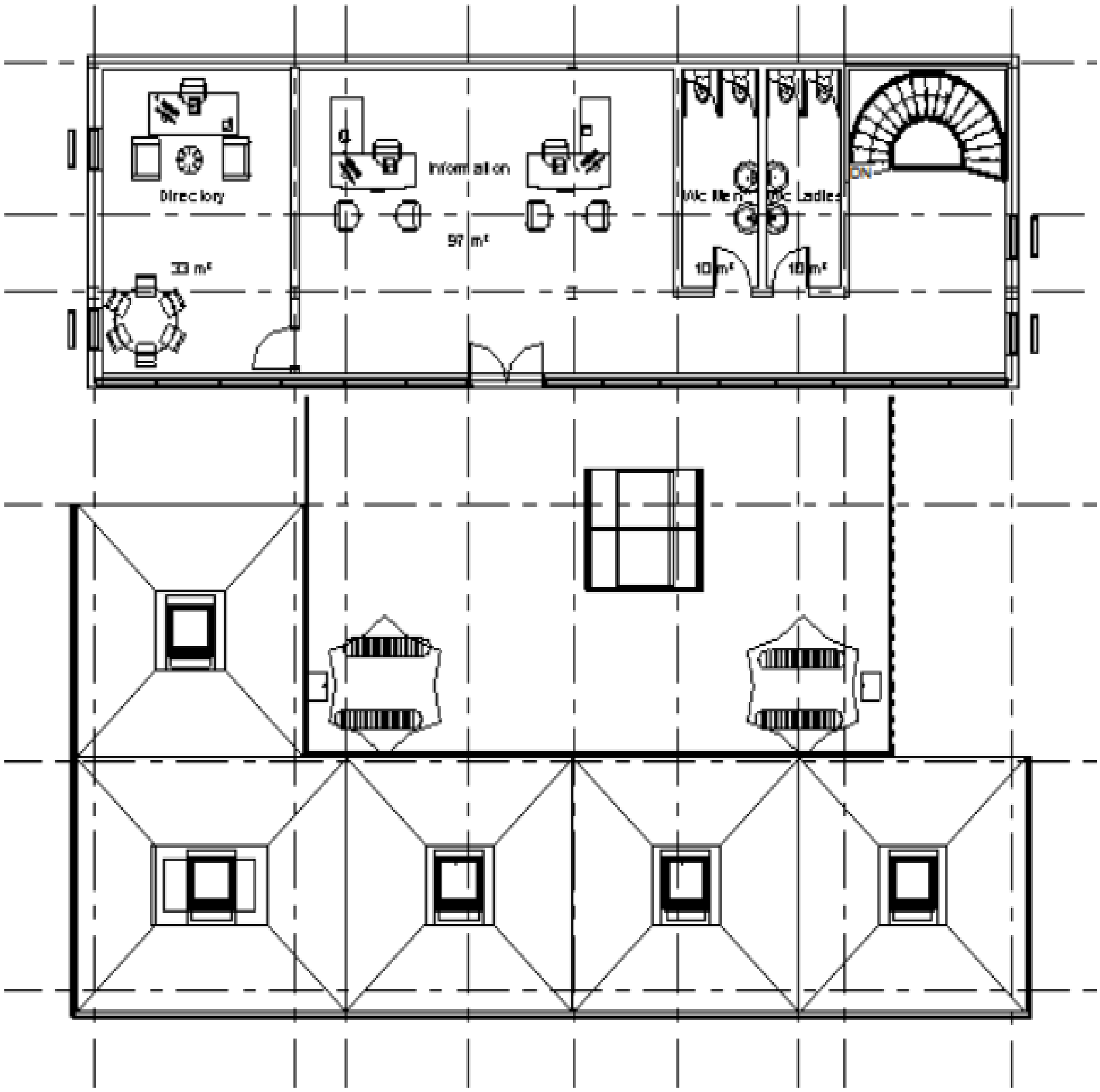


Figure 13 : 1. Floor Floor Plan

4.1.12. Directory Office Properties

The office of the administrator of the South, the West and the North facade is designed. There is no a window North facade.There are 2 windows 90 cm x 120 cm, placed to height a of 90 cm above floor level to the Western Front, double glazed, tilt in forward direction windows 30˚ that can be opened. A height of 100 cm from the ground to ceiling in the Southern facade to curtain wall. There are 3 pieces outer walls 32 cm thickness. There is 1 pieces inner wall 22 cm thickness. Room 33 m^2. 75 watt lamp 1 spot lamp for artificial lighting as an element was used.

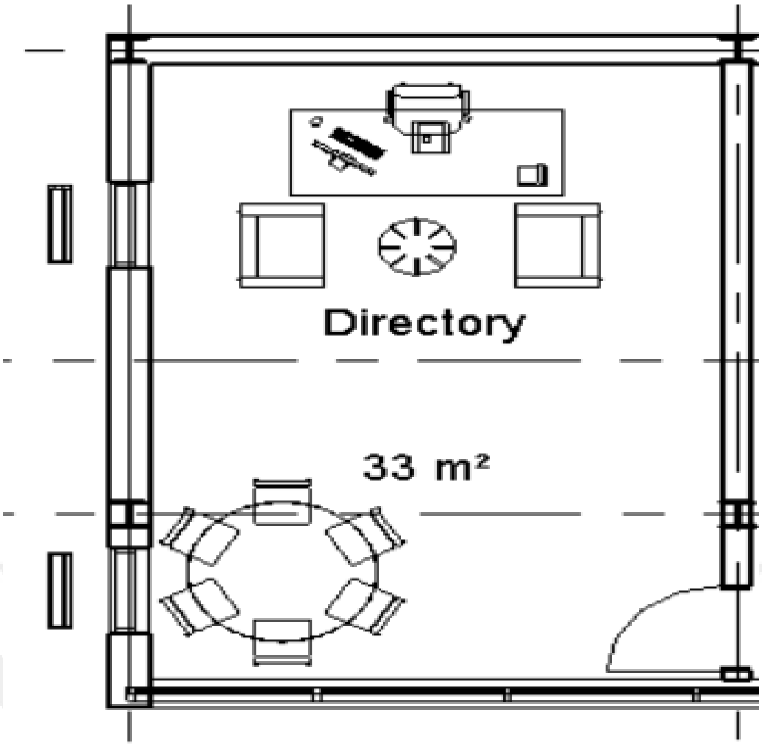


Figure 14: Directory Floor Plan

Picture 13: Directory Room Interior Details

4.1.13. Information Office Properties

Designed as an office administrative work of the department open. Thus, natural are not blocked by the walls of the light source. The southern glass facade, at a height of 100 cm from the ground in front of the curtain natural lighting provided with the application. 75 watt lamp 2 spot lamps as artificial lighting were used.

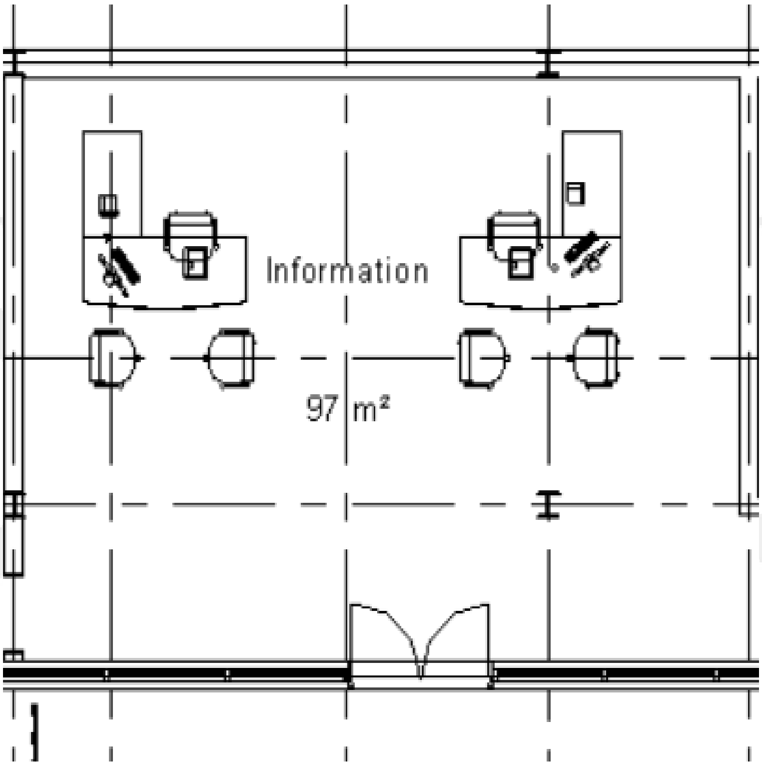


Figure 15: Information Floor Plan

Picture 14: Information Interior Details

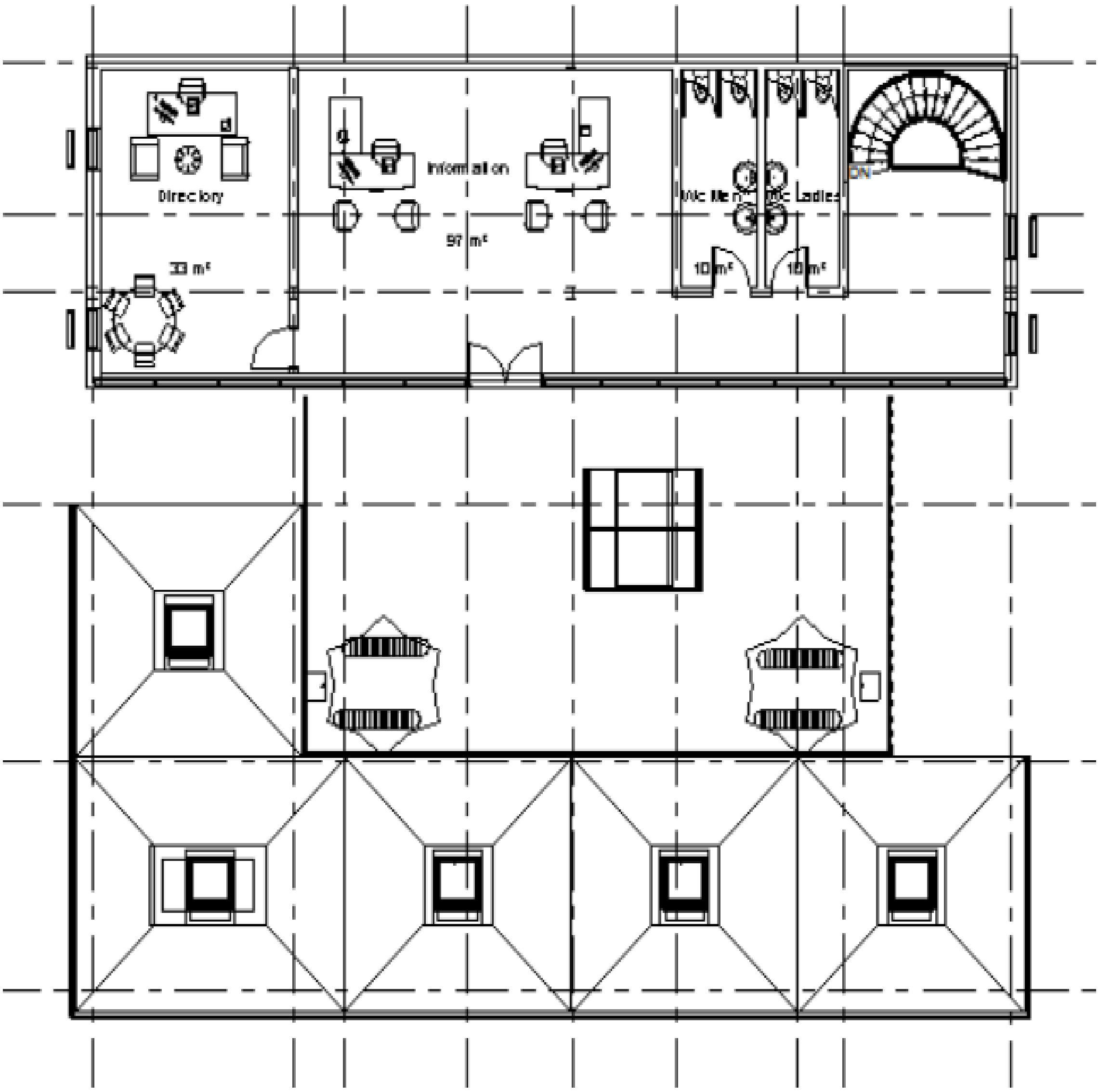


Figure 16: Terrace Garden Floor Plan

Picture 15: Terrace Garden Details

1. floor terrace garden application reviewed. The southern front on the entrance floor is designed. Seating areas were placed in the canopy for sun protection.

The exterior design of the building design to ensure compatibility with the other buildings on the campus have been made. cornered and out with the roof The Seljuk Architecture has been implemented.Natural stone has been selected as a coating material. The stones under the window were applied. The corners of the building, bamboo wood veneer material was applied to from the ground up to the roof. Natural stone and natural wood materials in terms of sustainability were selected. The other parts of the structure was used to paint. Due to geographical conditions, light colors are preferred.

Picture 16: Natural Stone and Natural Wooden Veneer

Picture 17: Outdoor Playing Area

The entrance of the building, no staircase and low sloping ramp was made. Private parking and bike to the park of the structure were made.

The ground in the garden was applied to the grass. Thus, it were tied to the balance of moisture. The garden to the edge were placed in a 60 cm short pine. The edge of the garden were placed wooden fences. It made from wood toys was put on to play for children on the garden. An outdoor seating area at the garden were placed. Also in the garden was made playing ball area.

Picture 18: Entrance Of Building

CHAPTER 5. ENERGY ANALYSIS AND SIMULATION WITH DESIGN BUILDER

5.1. About Design Builder Program

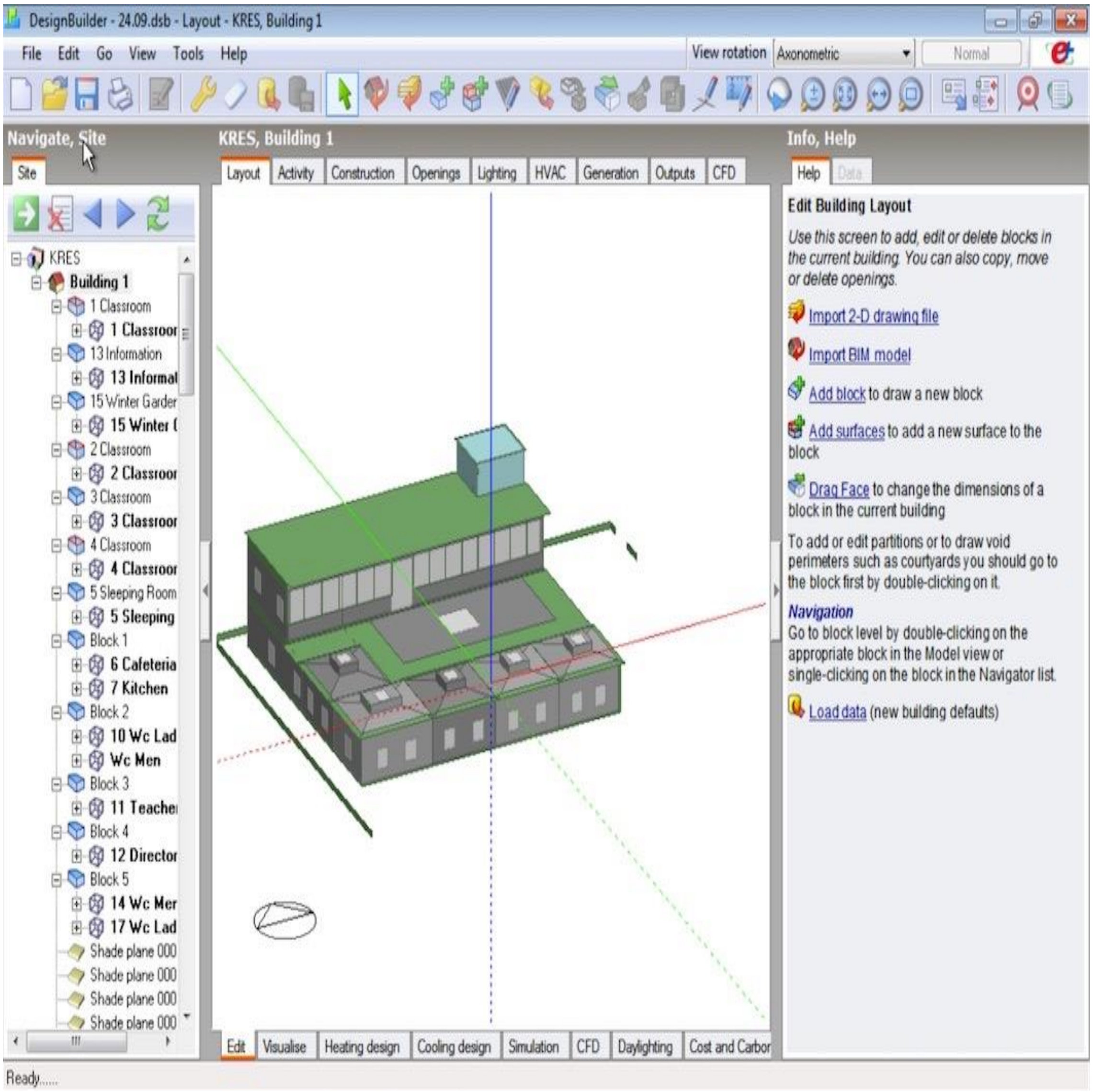
Design Builder program calculates the energy consumption of buildings in general. The program, designed the geometric form of the structure, shell characteristics, passive design recommendations the planned implementation of the thermal zones can be defined. Structural elements, material selection, and testing of active and passive design criteria during the design phase provides a quick feedback.

The climate of the region based on data of the structure, facade options, visual problems and overheating can be evaluated according to natural ventilated buildings thermal simulation, report electricity savings with the use of natural lighting, natural daylight propagation prediction, and visualization of environmental data shadowing can be achieved. The size of heating and cooling equipment can be calculated. The appropriate HVAC and temperature, air distribution and air velocity distribution inside a room that contains the design of natural ventilation systems using CFD can be elaborated. While *ASHRAE 90.1* energy model *EnergyPlus* simulations and uses these accounts.

Design Builder, easytouse interface, climate data, and also the width of the desired components can be easily created so that library material was selected for reasons. In the process of working, analysis of threedimensional visualization, detection, solution development and simulations has provided ease of acceleration when needed.

The design of the *Design Builder* in the creation within the structural model, has provided data transfer compatibility with other drawing programs. The results from structure, structural elements, environmental data, carbon emissions, such as energy consumption can vary, reports, tables, graphs and pictures can support.

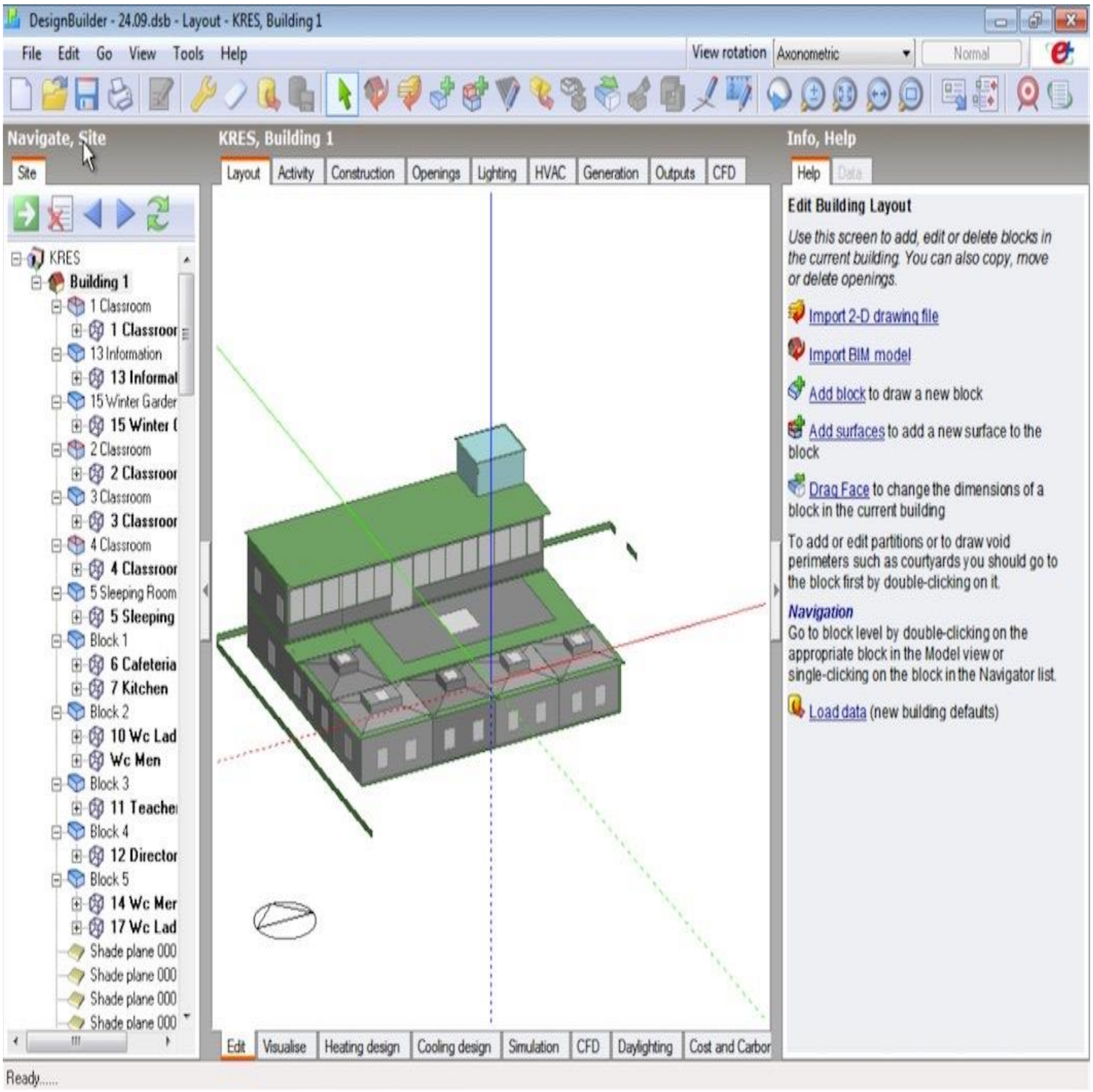
gbXML from *Revit* structure which is the subject of this study and calculated and converted to the format the program were transferred to the *Design Builder* program. Drawn with *Revit* structure is opened within the program, and each section opens as integrated in line with the given name. While drawing the bar on the left is seen in the names given in the chapter. Can be viewed in detail in the relevant sections. Gaziantep’s selection together with latitude and longitude information, altitude, and the two winter and summer seasons, the beginnings and ends of data is automatically generated.



Picture 19: 3D View

5.2. Defined Material With Design Builder

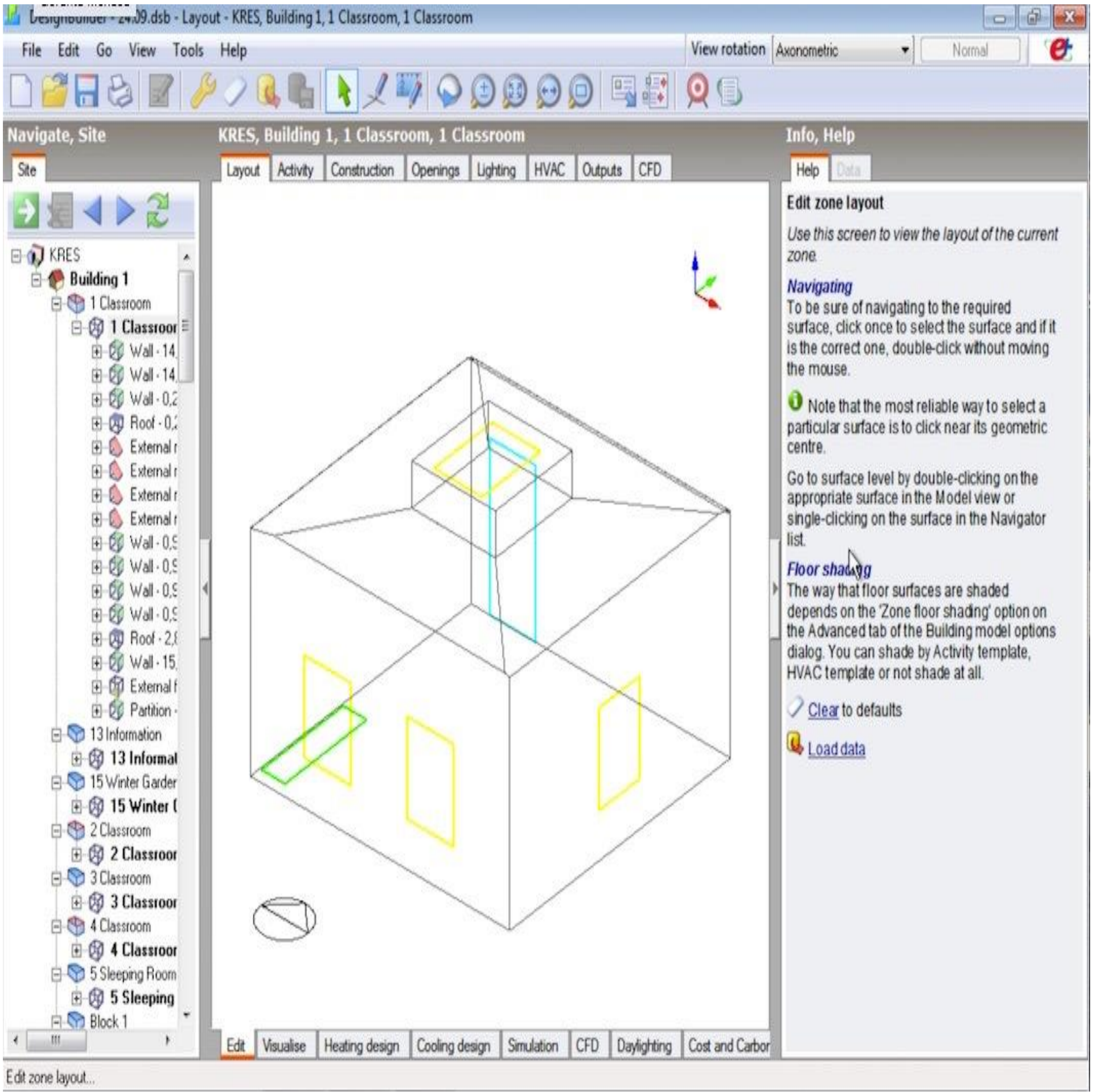
Activity under the title of include the factors that affect the thermal properties of the entire structure. The template structure the structure of activity as a function of users, frequency of use, metabolic activities of users, temperatures are expected from comfort heating and cooling systems, hot water usage, according to the function handle to internal structure elements specifies the use of ambient temperature.



Picture 20: Activity Title

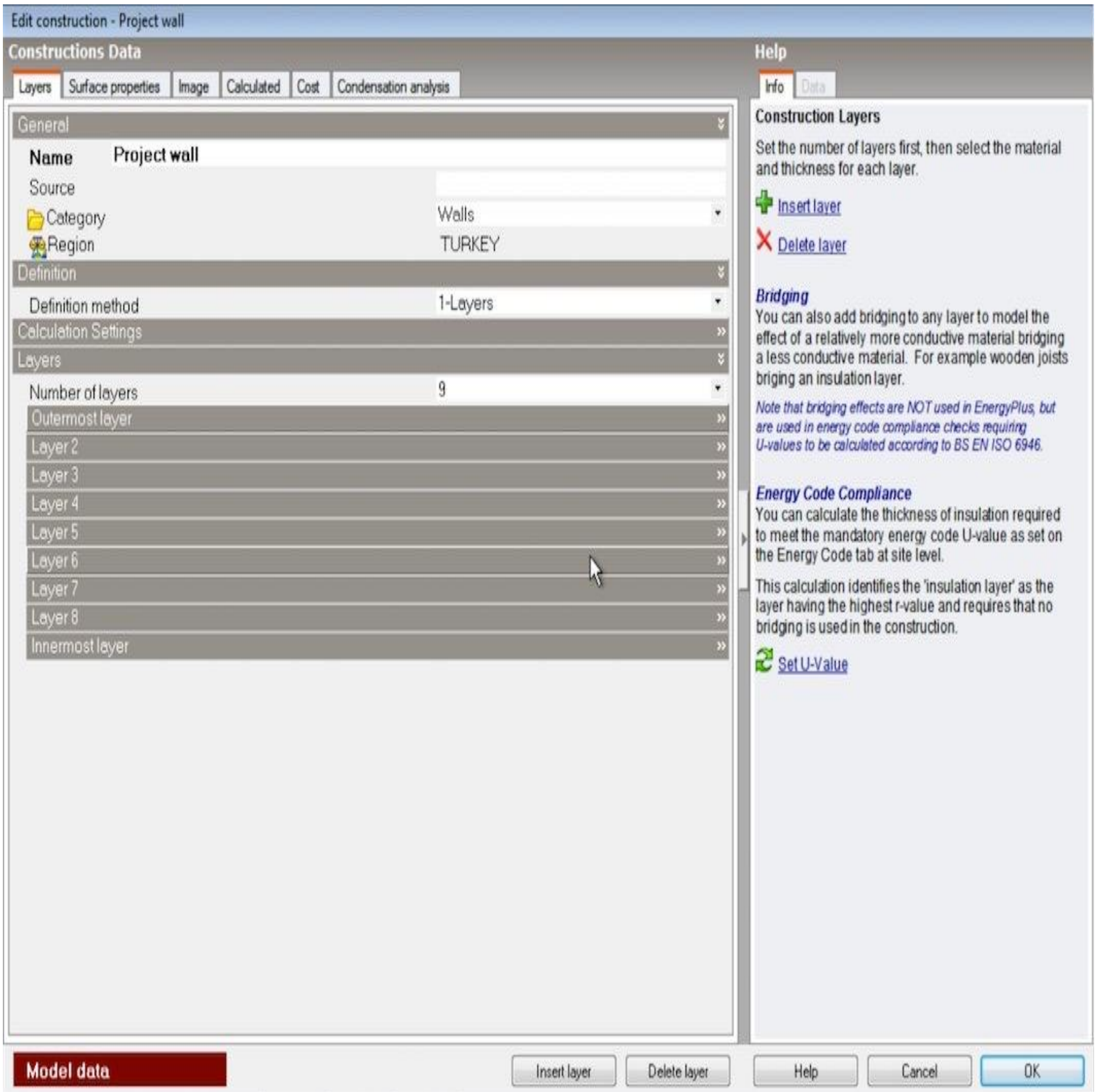
General school construction because it is the area *Teaching Areas* has been selected. Density per square meter, holidays, and selected the equipment that is used in building is approved. The factors that influence the entire structure then you should do a separate review for each section.

After a process, have been assigned individually by clicking on each section and material definitions are made. All classrooms, common areas, and offices are defined individually by clicking the materials.



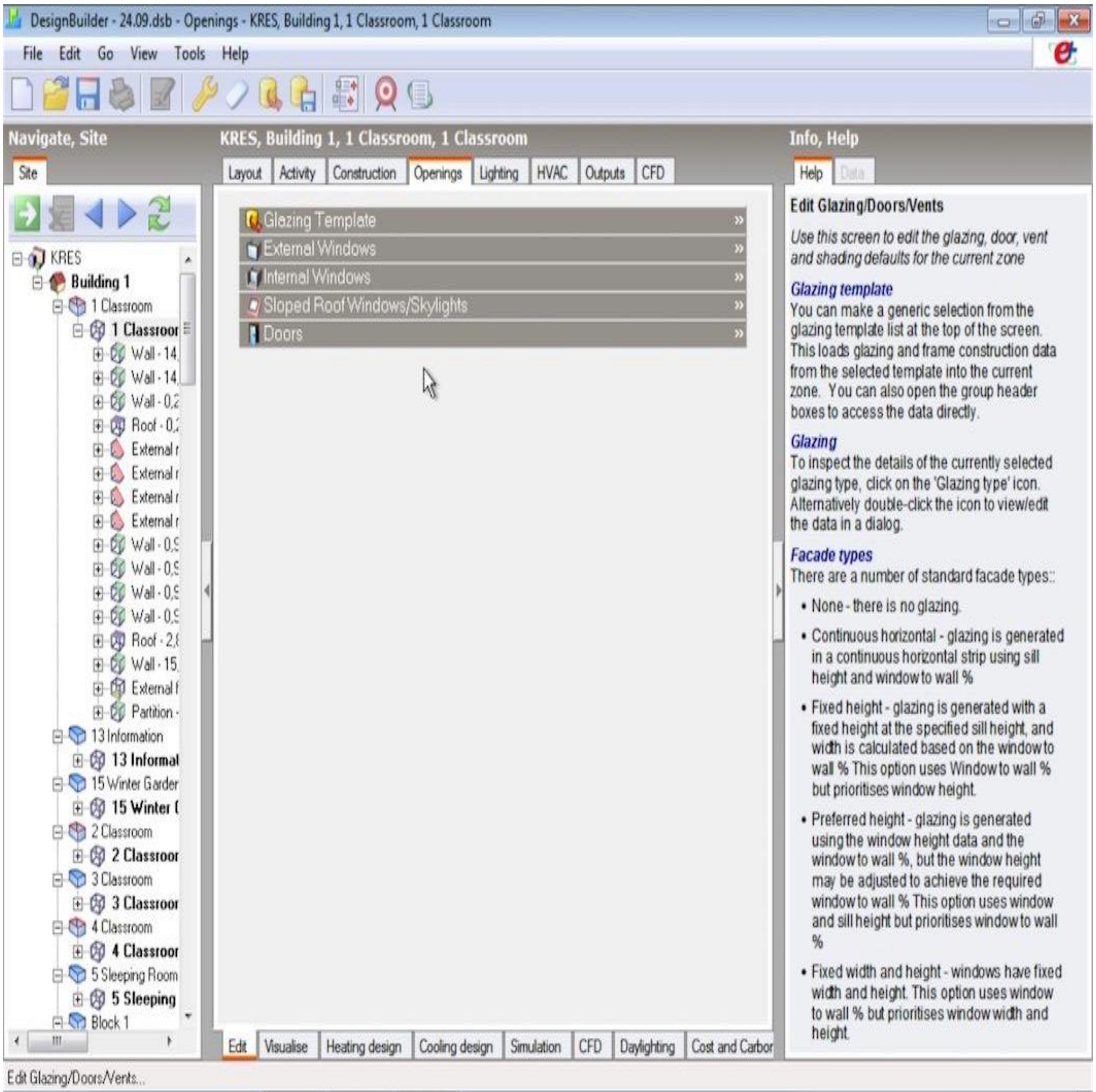
Picture 21: Assigned Material Each Section

1 classroom (class C1) section is entered in this section when all interior and exterior walls, openings, roof covering parts and ground appears. By clicking on each element one by one to filter the material. Material selection the materials supplied are defined as the same *Revit.*



Picture 22: C1 Classroom Assigned Walls Material

Exterior walls and interior walls in the project for a total of 9 in a layer are defined. The main building material, sound insulation, heat insulation, plaster and paint layers. All of the features selected from the library and thicknesses as same as the project has been identified. Materials, respectively, from the outermost layer to the innermost layer has been assigned correctly.

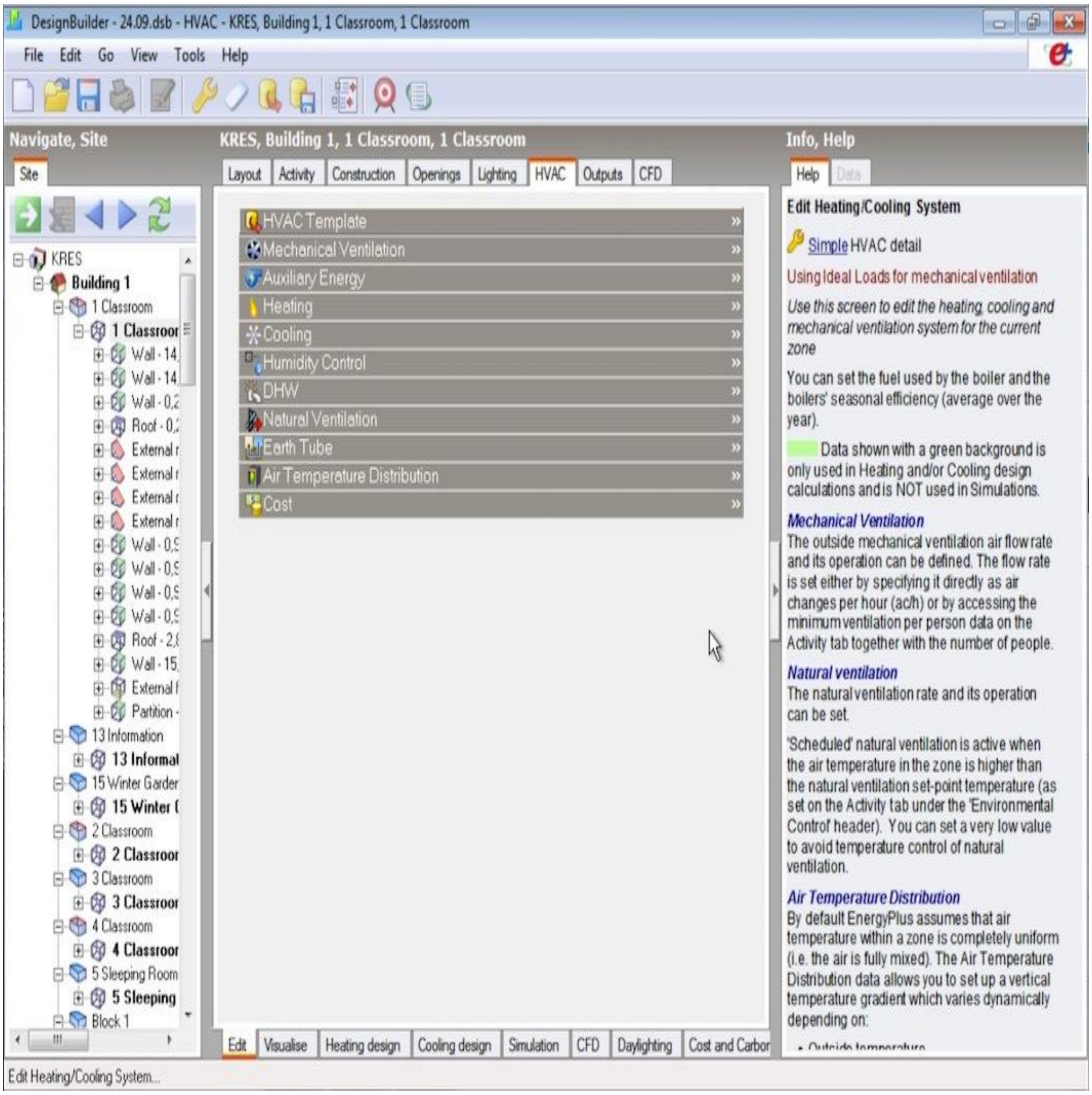


Picture 23: C1 Classroom Assigned Opening Material

The openings are defined later in the project. In the class C1 all window sizes, door sizes and materials in a way that is applied in the project were chosen. Windows are double-glazed, insulated, aluminum was chosen as the materials used.

After the identification of the openings, the roof elements of the class C1 are defined. The roof of the main building material, insulation layers and roofing in accordance with the project were selected from the material library. The main construction material is aluminium and the inner layers, waterproofing and cover the roof top lawn.

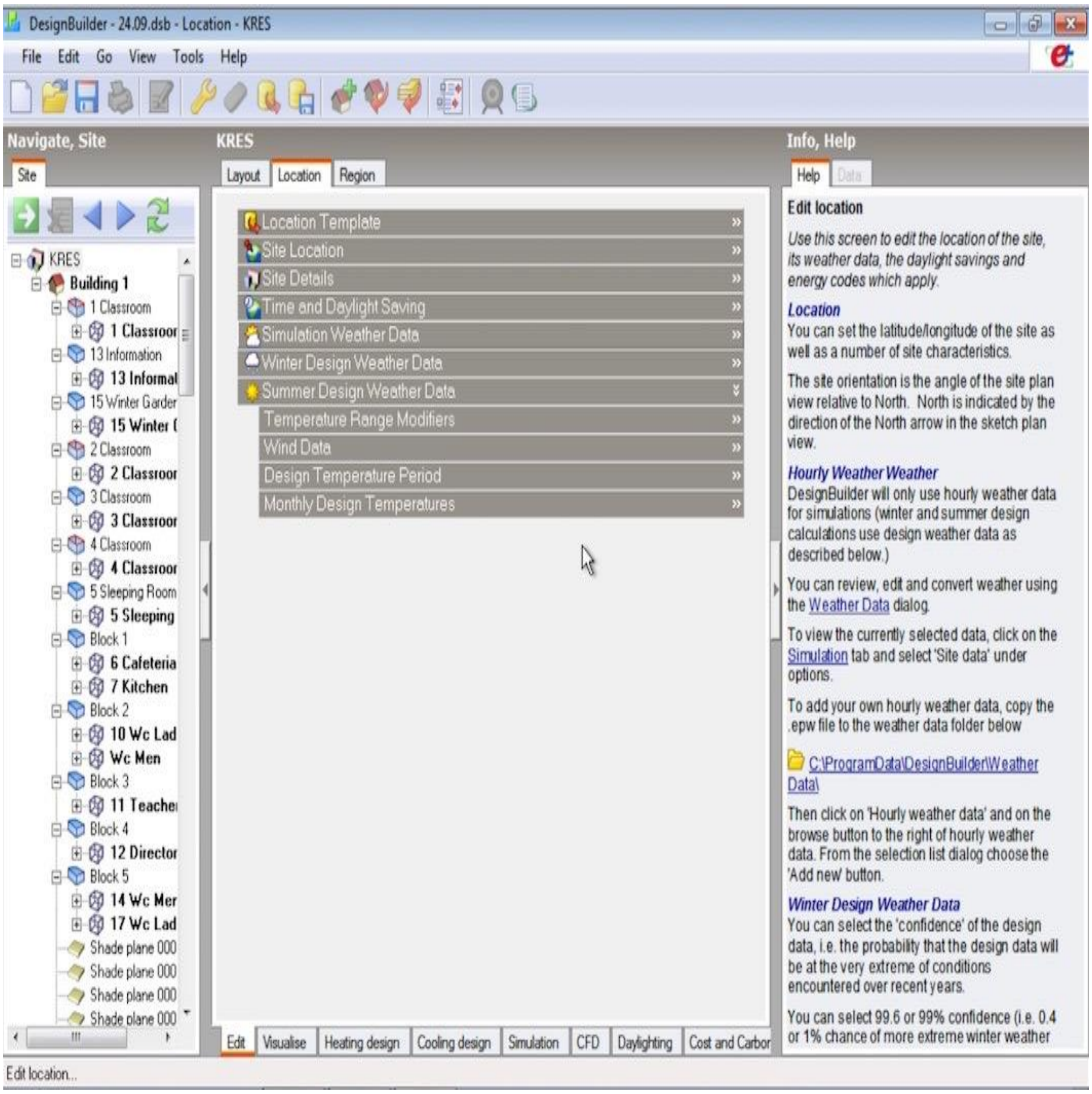
Then the roof of the class C1 are assigned to the base materials. The main base material, insulation material, and the protective top layer is defined as appropriate to the project. The mainbuilding material is steel, sound insulation and bamboo flooring were chosen from the material library.



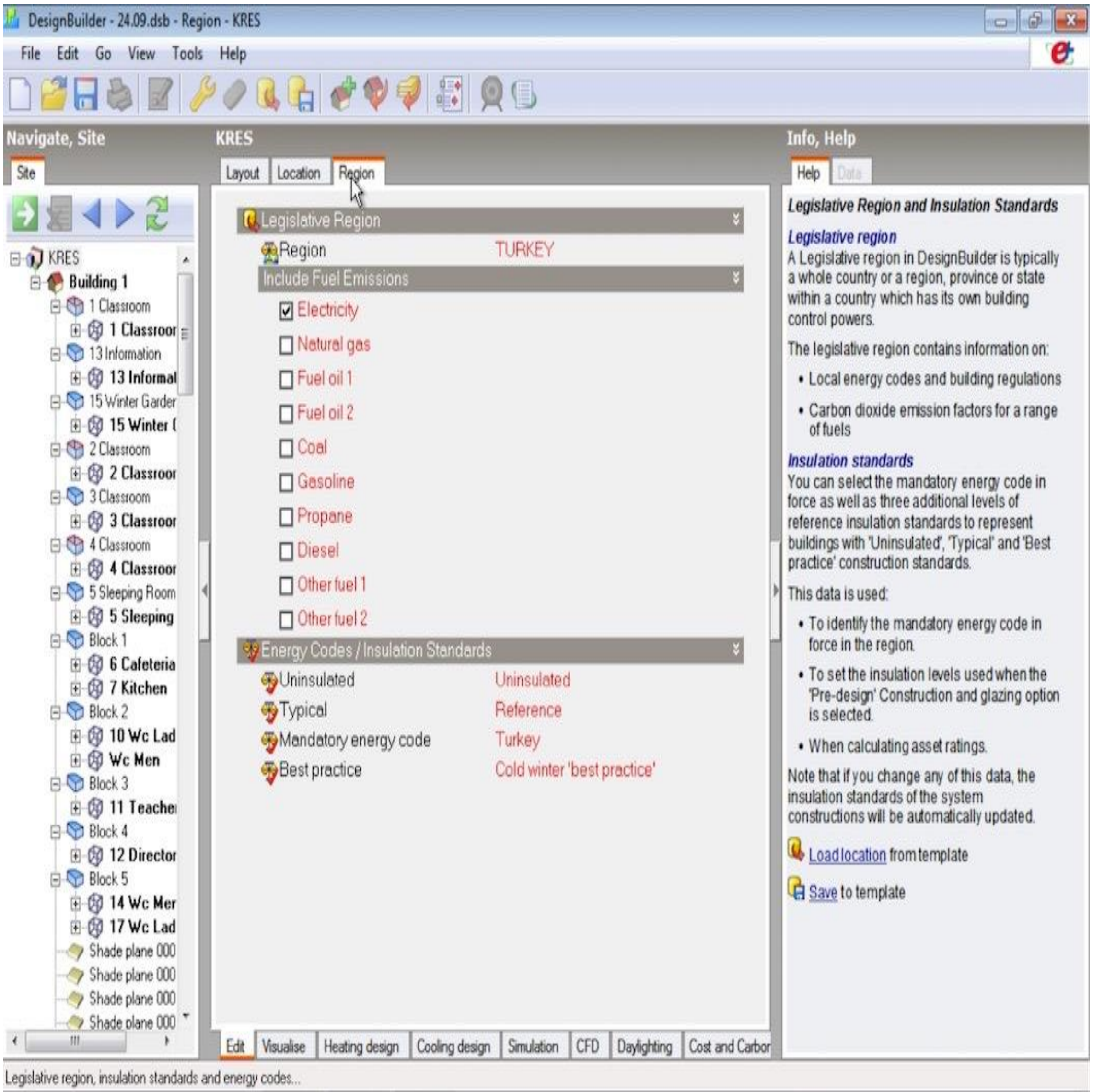
Picture 24: C1 Classroom Assigned HVAC System

In the next step, C1 is the class of lighting equipment and HVAC systems were selected. Artificial lighting 75 watt lamp 2 lampsource has been selected. HVAC temperature and humidity values were determined from tab.

The analysis begins when the orientation of the structure was determined. *Location* tab from the angle of the terrain, weather conditions, time of the simulation, the properties of the wind were determined. The *Azimuth Angle* of 0˚, 45˚, 90˚, 180˚ and 270˚ values have been entered and reviewed separately in the analyses.



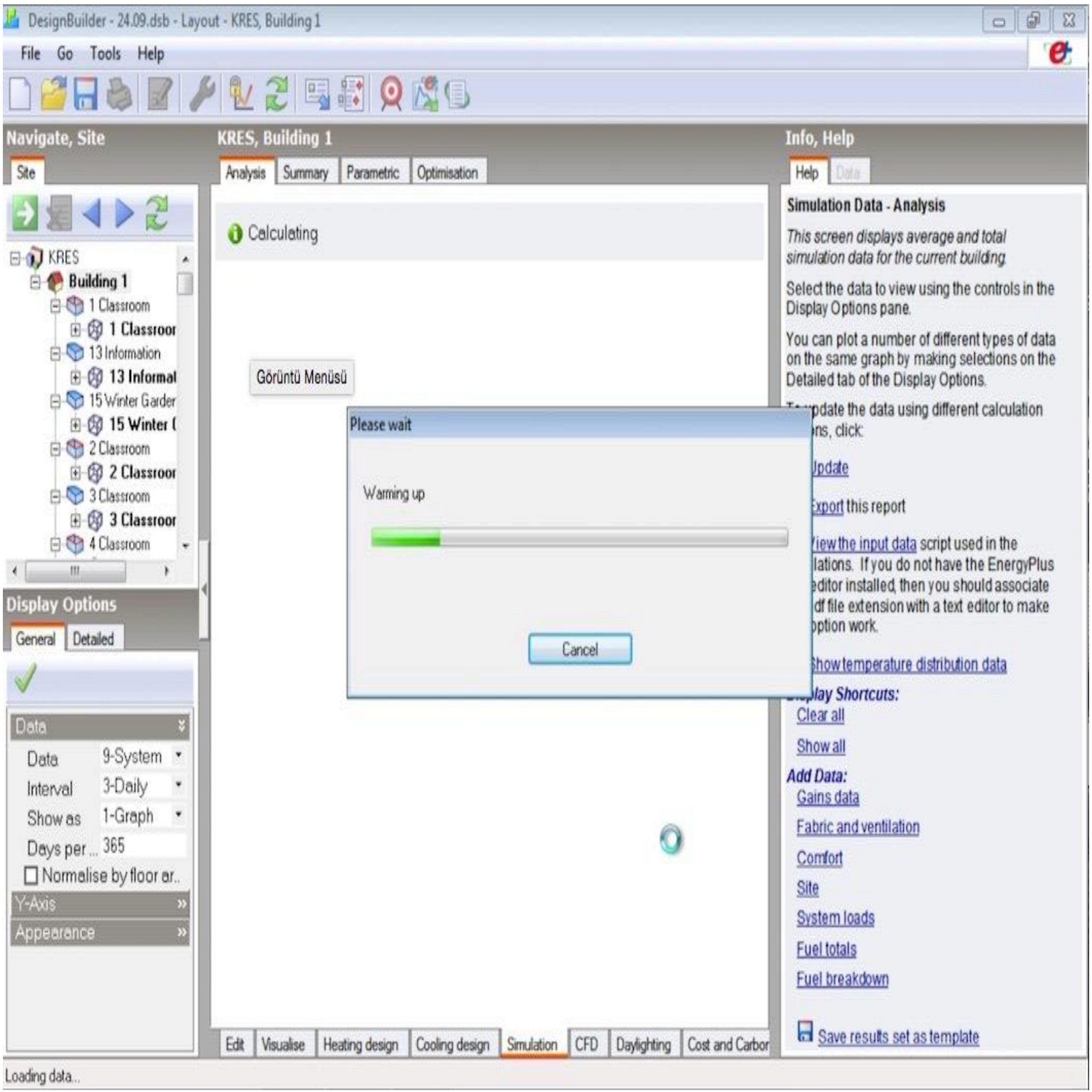
Picture 25: Defined Azimuth Angle



Picture 26: Energy Unit

Region was chosen as the unit of electrical energy used in the construction of artificial tab.

This is the last step in the analysis is introduced.



Picture 27: Analysis

5.3. Analysis Results

5.3.1. 0˚ Angle Results

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea **Building : Building** **Environment : TURKEY** **Report : Annual Building Utility Performance Summary** **Values Gathered Over 8760 hours**		
	Total Energy (kWh)	**Energy Per Total Building Area (kWh/m²)**
Total Site Energy	100024.68	255.09
Net Site Energy	100024.68	255.09
Total Source Energy	198421.01	506.02
Net Source Energy	160550.06	409.44

Table 7: Site and Source Energy For 0˚ Angle

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea **Building : Building** **Environment : TURKEY** **Report : Annual Building Utility Performance Summary** **Values Gathered Over 8760 hours**				
	Electricity (kWh)	**District Cooling (kWh)**	**District Heating (kWh)**	**Water (m³)**
Heating	0	0	6732.32	0
Cooling	0	50427.36	0	0
Interior Lighting	24562.28	0	0	0
Interior Equipment	16995.57	0	0	0
Water Systems	0	0	0	20.47
Total	41557.85	50427.36	6732.32	20.47

Table 8: End Uses For 0˚ Angle

5.3.2. 45˚ Angle Results

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea **Building : Building** **Environment : TURKEY** **Report : Annual Building Utility Performance Summary** **Values Gathered Over 8760 hours**		
	Total Energy (kWh)	**Energy Per Total Building Area (kWh/m²)**
Total Site Energy	71622.53	182.66
Net Site Energy	71622.53	182.66
Total Source Energy	156735.29	399.71
Net Source Energy	131967.86	336.55

Table 9: Site and Source Energy For 45˚ Angle

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea **Building : Building** **Environment : TURKEY** **Report : Annual Building Utility Performance Summary** **Values Gathered Over 8760 hours**				
	Electricity (kWh)	**District Cooling (kWh)**	**District Heating (kWh)**	**Water (m³)**
Heating	0	0	5456.53	0
Cooling	0	32979.27	0	0
Interior Lighting	14318.01	0	0	0
Interior Equipment	9522.12	0	0	0
Water Systems	0	0	0	146.36
Total	23840.13	32979.27	5456.53	146.36

Table 10: Site and Source Energy For 45˚ Angle

5.3.3. 90˚ Angle Results

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea Building : Building Environment : TURKEY Report : Annual Building Utility Performance Summary Values Gathered Over 8760 hours		
	Total Energy (kWh)	**Energy Per Total Building Area (kWh/m²)**
Total Site Energy	71398.58	182.08
Net Site Energy	71398.58	182.08
Total Source Energy	157957.60	402.83
Net Source Energy	133912.77	341.51

Table 11: Site and Source Energy For 90˚ Angle

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea Building : Building Environment : TURKEY Report : Annual Building Utility Performance Summary Values Gathered Over 8760 hours				
	Electricity (kWh)	**District Cooling (kWh)**	**District Heating (kWh)**	**Water (m³)**
Heating	0	0	6194.78	0
Cooling	0	32017.08	0	0
Interior Lighting	16367.61	0	0	0
Interior Equipment	10522.78	0	0	0
Water Systems	0	0	0	146.36
Total	26890.39	32017.08	6194.78	146.36

Table 12: End Uses For 90˚ Angle

5.3.4. 180˚ Angle Results

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea **Building : Building** **Environment : TURKEY** **Report : Annual Building Utility Performance Summary** **Values Gathered Over 8760 hours**		
	Total Energy (kWh)	**Energy Per Total Building Area (kWh/m²)**
Total Site Energy	68152.02	173.80
Net Site Energy	68152.02	173.80
Total Source Energy	153968.97	392.66
Net Source Energy	132678.05	338.36

Table 13: Site and Source Energy For 180˚ Angle

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea **Building : Building** **Environment : TURKEY** **Report : Annual Building Utility Performance Summary** **Values Gathered Over 8760 hours**				
	Electricity (kWh)	**District Cooling (kWh)**	**District Heating (kWh)**	**Water (m³)**
Heating	0	0	6615.22	0
Cooling	0	28350.09	0	0
Interior Lighting	9318.01	0	0	0
Interior Equipment	8922.23	0	0	0
Water Systems	0	0	0	146.36
Total	18240.24	28350.09	6615.22	146.36

Table 14: End Uses For 180˚ Angle

5.3.5. 270˚ Angle Results

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea **Building : Building** **Environment : TURKEY** **Report : Annual Building Utility Performance Summary** **Values Gathered Over 8760 hours**		
	Total Energy (kWh)	**Energy Per Total Building Area (kWh/m²)**
Total Site Energy	71314.38	181.87
Net Site Energy	71314.38	181.87
Total Source Energy	156295.21	398.59
Net Source Energy	131767.29	336.04

Table 15 : Site and Source Energy For 270˚ Angle

Program Version: EnergyPlus, Version 8.3.0-6d97d074ea **Building : Building** **Environment : TURKEY** **Report : Annual Building Utility Performance Summary** **Values Gathered Over 8760 hours**				
	Electricity (kWh)	**District Cooling (kWh)**	**District Heating (kWh)**	**Water (m³)**
Heating	0	0	5467.31	0
Cooling	0	32660.35	0	0
Interior Lighting	14568.11	0	0	0
Interior Equipment	10526.98	0	0	0
Water Systems	0	0	0	146.36
Total	25095.09	32660.35	5467.31	146.36

Table 16 : End Uses For 270˚ Angle

CHAPTER 6. DISCUSSION

6.1. Cost Effect

Sustainable building design is a platform where many sectors can work together. All design and engineering groups, implementers and customers gain time and cost by making joint decisions. However, it is not easy to bring all the affiliates together. This increases the cost of the first investment in the work. Especially in non-flexible budget structures can be the most important problem. Because this is done with special computer assisted programs, it requires high budget. At the same time, it increases the cost as it is necessary to work with staff with high professional experience. Because of this, people have negative thoughts about these structures.

6.2. Implementation

Implementing certificates and regulations developed to build environment friendly structures is the most important point. Because these certificates and regulations, both during construction and during the use of the structure gives some rules. It is very important that these are applicable. This is because it will achieve the purpose of building. otherwise, it does not contribute to the environment by creating a loss of time and cost.

6.3. Education

Implementation of the regulations is the most important point. Consultancy firms provide training to their employees at regular intervals. Then, they test them and measure their proficiency. Then, before the application, presentations are made to the customer clearly and clearly. The aim is to overcome the fear of prejudice. Thus, customers reach the most accurate information through the training of consultants. In addition, people working, sitting or studying in such a structure are asked to create environmental awareness by giving trainings. It is aimed to ensure that people use energy correctly and effectively.

6.4. Laws and Regulations

Zoning regulations are updated over time. Construction type, areas of use, roof and openness can be changed in the case of elements. However, these changes can be predicted by designers and practitioners. Considering these situations, flexible design structures should be made. Making the structure only according to the designed time can create additional cost for high-cost structures.

CHAPTER 7. CONCLUSION

7.1. Summary- Key Learnings

All the analysis results have been converted into tables. All results were compared. According to these results, 180˚ were chosen as the most efficient angle. For cooling 28350,09 kWh, for heating 6615,22 kWh were chosen. Total energy is 34965,31 kWh. The building consume least energy at this angle.

7.2. Key Findings – Regarding Research Objection

In this study, the effects of energy pollution on the environment were investigated and the study was carried out to minimize this effect. Instead of non-renewable sources of fossil fuels to reduce pollution, it is directed to clean and renewable sources.

Direct and indirect use of solar energy has provided energy efficiency and sustainability. For this purpose energy efficiency is designed in a nursery in high green design. In this design, LEED certificate was used in green environmental certificates.

.Passive solar house is designed to use the sun directly and integrate with the LEED certificate. All these approaches are combined under the BIM concept. Thus, error share of design and analysis accounts has been reduced to a minimum. In addition, speed has been gained in design and analysis.

7.3. Discussion – Regarding Research Aim and Question

There are major differences between the sliding structure design and the classical structure design. For sustainable building design, a large scale research needs to be done first. topography analysis is integrated with environmental certificates according to building needs. It is then created and implemented according to pre-design regulations.during construction use these regulations are checked periodically. Thus, the values calculated during the design phase and the values obtained during the service period are compared. Thus, the performance of the structure is measured. Because all of this will be calculated with special programs, Initial investment costs may be high. Investors can think about all these situations and make a decision instantly.

In addition, some defects may be observed during the application. The lack of timely and complete audits results in negative data. The long-term failure of the plans causes negative effects. The height of the initial investment cost, lack of full research or time problems provide a direction to classical structure. Long-term structure, human and environment are affected by this situation. Considering all these, adequate environmental and design training plan should be made.

Circumstances other than ours, such as laws and regulations that change over time, may have a negative effect on the accounts made. For this, the design vision should be kept wide. Different plans should be made to give flexibility to the structure. At the same time all these plans must be within the framework of the certificate.

7.4. Recommendation for Future Research

The study yielded efficient results on energy conservation. Renewable energy sources are used in heating, cooling and lighting systems as a result of the relationship between passive household and environmental standards. It was observed that the costs fell in the long term.

It has been observed that renewable sources do not generate harmful gas emissions. Thus, contribute to environmental protection. The innovations that environmental certificates add to the design issue have been observed. Thus, more creative designs will emerge.

With the BIM concept, the calculation of the cost of time and budget was accurate and the savings were observed. Thus, the design and analysis time has been shortened. the most accurate result was found in a shorter period of time.

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