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Modeling of Deaf Facades in the Design of the Facades of Buildings with the Index to Renewable Energy Generation

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Abstract
The concept of sustainability that emerged and influenced architecture has created serious environmental problems. In this study, the reasons for the use of solar energy in passive systems and the importance of passive systems in sustainable buildings are discussed. Furthermore, the construction of integrated models with passive systems was evaluated using a computer program. This study consists of eight chapters. Explain the purpose, the question and the necessity of the research. Assess why and why sustainability, its methods and alternative energy sources emerged. Exposes the design parameters of sustainable buildings, urban planning, ecology, intelligence, zero energy consumption, energy saving buildings and other types. Methods for harnessing solar energy in buildings, called active and passive systems, and their related types, discusses solar energy in buildings under several headings. The use of passive solar energy in buildings, the design parameters of buildings and spaces and the precautions or steps to be considered in different situations. Integrating the house and greenhouse as a simulation study and evaluating the efficiency of the system through a computer program, presenting the changes in tables and graphs. Conclusions and recommendations for evaluation.

Keywords: Renewable energy, Deaf facade applications, Design

1. Introduction

In the rapidly changing world, people's lifestyles and living spaces have also changed. Initially the needs were limited to shelter and food, but now efforts need to be made to get the most out of technology. With the industrial revolution, the production system undergoes some changes and enters the age of mechanization with the main energy sources iron and coal. Then, with the discovery of oil, steel, electricity and chemicals, industrialization or factories formed the way we live today. With the establishment of the factories, large-scale production systems were started and agricultural production began to be mechanized. While production is fast, continuous and machine-based, the dependence on muscle power has decreased and more workers are needed. With this working system, production has increased, the population has increased and more people are needed. As production increases, population increases and production becomes accessible to more people. Production of the factory system responded to increasing demand, but it was clear that large machines were not suitable for case production. Therefore, during the construction of the machines, the transition to large buildings located in urban areas is carried out. The working class changed their habitat and began to migrate from rural areas to urban areas. Along with all these developments, industrialization, population growth, the understanding of "consume more, thinking about the future", unconscious and excessive consumption of the resources of the welfare society; environmental problems and climate change. Pollution causes climate change; the natural environment, atmosphere, soil, oceans, coasts and water resources are all affected. As the natural environment begins to suffer, energy sources begin to suffer. The concept of "sustainability" has emerged to stop this irreversible

degradation of the natural environment. This concept basically means that it can be followed and applied in all areas of life. Over time, these changes and developments have also affected the field of architecture, architecture has shaped people's lifestyles and the concept of "sustainable architecture" has emerged. Sustainable architecture aims to enable future generations to live in a better environment. It should be designed in such a way that future generations can benefit from today's opportunities. It requires meeting the needs of the users without harming the natural environment that is, living in harmony with the environment. Conditions affecting all human life reveal the concept of sustainable structures. sustainable construction; Recognizing that natural resources can also be depleted, it aims to minimize pollution by reducing energy consumption in the design, production, construction and use of buildings and to encourage the use of clean alternative energy. Renewable energy sources are becoming more and more important because fossil fuels are expensive, pollute the environment and are an exhaustible resource. In the context of energy saving and reducing emissions, renewable energy is emerging as time goes on. The sun is an endless and independent energy source that meets 15 times the daily energy needs of the world's population every day (MPG, 2008).

In addition, the sun is the only energy source, it is quiet, economical, does not contain hazardous waste, does not deteriorate, can be stored, has no transportation problems, does not have environmental and pollution problems, it does not matter. Solar energy is the most important and efficient resource for human beings. It is also preferred as an energy source that can be used more efficiently in sustainable man- made environments and durable structures. Solar energy harvesting systems are used in active and passive systems in buildings. Active systems can be independent of both the building and the building elements and enable buildings to benefit from solar energy. In a passive system, the system is designed to take full advantage of solar energy by utilizing thestructural and physical properties of all elements of the building. While designing a passive system, efficient system operation can be achieved by increasing ambient temperature values and reducing artificial heating loads. However, necessary precautions should be taken by considering the design principles of sun protection and solar energy use. In this study, passive use methods in day and night conditions in summer and winter are evaluated and the design process from pre-design stage to implementation is explained. In addition, with a detailed case study; This study evaluates the use that solar energy can provide at different temperature values. Among the methods of benefiting from the sun are passive systems; It is studied from the literature, recent articles and methods scanned from internet resources. Based on all the information, try using a computer program, applying an indirect system with a conservatory, detecting differences in indoor temperature values. Architects, architecture students and other disciplines emphasize sustainable development values and encourage energy saving (Turan, 1993).

2. Deaf Facade Applications and Sustainability

Global environmental problems are developing at different rates but in the same way and cause the depletion of energy resources. Witnessed the emergence of a socially conscious life in general, consuming rather than producing, "sustainability" of future generations outdated The term sustainability can be explained by meeting the needs of the present without compromising the ability of future generations to meet their needs. It guarantees the quality of life by taking into account the carrying capacity of the biosphere, ecosystems and resources (Dumlupınar, 2008).

Along with the industrial revolution and urbanization, there is also a technological development that is reflected in the structure of housing units. Technically, the definition of the components that make up a structure has changed, the concept of support systems has improved and it has been separated from other components in material and functional terms. The wall, which is a load-bearing element, no longer belongs to the load-bearing system, and its mass and thickness also change. In this case, the problem of thin wall insulation emerged and solutions were sought. Early structural designs were airtight and required the support of an

artificial cooling system as the insulation was applied unknowingly. To solve this problem, new alternative insulation materials have emerged, but these products contain chemical additives as they are mostly petroleum based. These additives are not recyclable and are harmful to human health and the environment. On the other hand, in addition to these problems, many environmental problems arise during the use and construction phases of the building (Ayaz, 2002).

In 1992, the concept of sustainable development was discussed at a conference attended by the heads of state and government of 172 countries in Rio de Janeiro. In this meeting, it was determined that a good state of nature is a condition of human existence. Then, the World Summit on Sustainable Development was held between 26 August and 4 September 2002. The Summit decided to take sustainable development as the theme and implement actions to eradicate poverty and protect the environment. Sustainable development is not only the expression of a development understanding that emphasizes the protection of the environment, but also the coordination of economic, financial, commercial and industrial policies related to development in order to promote economic, social and ecological growth (Dumlupınar, 2008).

It is thought that the biggest support for sustainable development is the economic contribution of architecture to the country's economy. This concept will not only revive the construction industry, but also increase the diversity of production, consumption and building materials. In the process of pursuing sustainable development, the problem of energy resources has been emphasized. When energy is used, energy conservation requires that the source does not pollute the environment and that non- renewable energy is not exhausted. As a result of research on natural and alternative energy sources, the concept of sustainable and renewable energy has emerged. However, for life to be sustainable, it is not enough for its source to be sustainable, it must also be a renewable resource. Sustainability can be achieved by being renewable in various ways.

- Ecological conditions: Environmental protection,use of clean energy, energy interaction, recycling.
- Health and comfort conditions for users: Thermal conditions, visual conditions, acoustic conditions, air quality, environmentally compatible materials, electromagnetic fields.
- Feasibility conditions: The concepts of economic feasibility, technical feasibility, environmental quality should be combined (Ayaz, 2002).

2.1 - Renewable Energy Resources As

Technology is used more and more and environmental pollution increases, the balance of nature is also affected by these developments. The increase in environmental pollution, depletion of the ozone layer, climate change, greenhouse effect, desertification and flood are the results of the decrease in natural energy resources. These findings show that the use of renewable energy in buildings is becoming increasingly important due to the protection of natural resources and environmental concerns, and the search for more efficient use is growing rapidly. Renewable energy is energy that continues to exist in the natural cycle the next day. Renewable energy sources are divided into 3 groups according to their sources, they are considered to be of solar origin, terrestrial origin and lunar origin. Energy sources such as solar, wind, water (hydraulic), geothermal, biomass and biogas are not only renewable energies but also clean energies. Solar cells, solar panels, solar walls, etc. ways can be obtained. In these processes, electricity from solar energy is used to produce hot water and to generate both hot water and electricity. Energy can be collected at building scale or by collectors located at specific points in the city. In addition, excess energy can be used to light streets and parks, and excess energy can be stored and sold to the city grid (Öner, 2006).

Wind energy is produced by the hourly movement of the sun and the differential heating and cooling of different surfaces of the Earth. The kinetic energy of the moving air is called wind energy. Wind turbines capture the wind using the blades that start to rotate, and this movement transfers the kinetic energy to the

generator. Therefore, the energy produced by the wind turbine changes in direct proportion to the wind speed. Wind turbines are generally used in skyscrapers and towers. In addition, uninhabited forest areas, coastal areas and open areas close to transformer centers are also preferred. Geothermal energy is obtained from the natural transfer of heat to the underground waters coming from the depths of the earth's crust. Biomass absorbs carbon from the atmosphere to carbon dioxide (CO2) through photosynthesis during plant growth and gives oxygen to the air. When these plants are burned, the carbon dioxide they contain is released again. While creating energy forests, fast-growing plants are grown, on the other hand, electricity is produced by burning from steam. Biogas is methane gas produced by the decomposition of animal and vegetable wastes that are burned to produce energy. Geothermal energy in Turkey produces 20 MW of electricity (Uyar, 2007).

3. Sustainable Architecture and the Deaf Facade

There are 3 themes in the field of sustainable construction.

- Conserving resources,
- Reducing resource consumption,
- Reusing and recycling resources

The energy consumption of buildings during production, construction and use, to reduce the environmental impact of pollution Minimize environmental protection and careful management of its use, understand why natural resources can be depleted. Natural resources are consumed that give ecological balance and are harmful to the environment. Environmental, economic and social action requires sustainability in construction. In buildings that take into account climate data, fossils that cannot be recycled ecologically, as an alternative to energy sources, do not exceed what we consume during construction and use. Sustainable architectural design is in harmony with nature during construction and use; natural heating, cooling, hot water supply and ventilation. While developments in today's technology create more comfortable living conditions for people, environmentally friendly designs meet sustainable construction requirements, minimize the damage to the natural environment, and provide comfort and health to people. Requires more attention. Current and future, non-compliance with rules or failure to contain their effects. Acid rain, ozone depletion, air pollution and global warming will increase. In order to make lifebetter than ours, designers and users must be supported and conscious of sustainable development. Sustainable architecture: Sustainable urban design is Sustainable architecture.

3.1 Sustainable Urban Design

Includes plans for ecological transportation systems, conservation conditions and population density to create a life-centered culture. According to KG HOYER and P. NAESS, urban ecology is a field of study that studies how human behavior in cities affects natural resources and the environment, taking into account biodiversity and the quality of human life in the environment. Urban ecology adapts the development and structure of cities to the coexistence needs of social and economic ecology (Dumlupınar, 2008).

In order for the settlements to survive, it is important to develop them in a way that preserves natural cycles as much as possible and disrupts nature with the least amount of waste. The concept of sustainable planning and urbanization aims to minimize resource consumption, reduce dependency and reduce hazardous waste in the environment by using renewable energy and people living in similar social conditions. Then;

- Vehicle use should be minimized,
- Bicycle and pavement alternatives should be designed,
- Large and small greenery should be accessible,
- Settlement areas and social activity areas should be considered as projects,

- Solutions should be produced and designed in a way that brings together shops and commercial areas.
- Spacing of buildings and relative position of buildings; Design decisions should be taken regarding the use of solar energy and shading in all buildings,
- Urban planning should reflect the cultural understanding,
- Sustainable urbanization policies should be designed and developed and the localization process should be slowed down.

3.2 Sustainable Building

Sustainable building refers to structures that minimize the consumption of fossil resources in construction and use, encourage the use of renewable raw materials, use recyclable materials and respect the environment. In addition to all these, they are structures that can provide these qualities while satisfying the comfort of the users. In the context of sustainability, there are different building approaches, some of which are listed below.

3.2.1 Climate-stable structures

The construction, use and destruction of a building or group of buildings is carried out with respect for the environment. A climate-balanced building is one that is energy-based, respectful to the environment, and offers the comfort of use with the lowest possible energy consumption. The most important decisions in the design phase; location, building spacing, building shape and building envelope properties. In addition, the most appropriate evaluation should be made according to local climate data and energy savings should be provided. In the design of climate-friendly buildings, the climatic elements of the natural environment in which the building is located, the physical and environmental factors that affect the climatic comfort and are effective in the energy saving process are important determinants. . These include solar radiation, wind, topography, outdoor temperature and outdoor humidity. Interior architectural decisions are taken according to the current outdoor climatic conditions and, if necessary, measures such as sun protection and thermal insulation are taken depending on the conditions. Building design principles are important, the design of the built environment is the design of the building as passive air conditioning. Basic design principles of the built environment; are properties related to location, building spacing and layout structure, orientation, building shape, and cross- section of the building envelope.

3.2.2 Zero-energy buildings

Are developed in the context of Ecological principles and target green buildings, a system that focuses on creating an environment that can contribute, save and save without harming the ecosystem of the biosphere, use, recycle and ensure that no hazardous waste is generated. A zero-energy building is a nature-friendly design that produces its own energy from naturalinputs, nourishes the environment, uses resources efficiently, reuses and/or transforms them. A zero- energy building or net-energy building is a building with zero net energy consumption. Net zero energy cost buildings, net zero energy buildings, zero primary energy buildings and net zero emission buildings can be handled under different headings. When designing zero-energy structures, passive systems are used to take full advantage of solar energy. These buildings should be designed to utilize renewable and clean energy to meet their energy needs by ensuring that all mechanical functions of the building, such as heating, ventilation and cooling, operate naturally. (Solar collectors, solar rooms, wind chimneys, solar cells, etc.) The general features of these structures are design, low energy efficiency and low cost oriented. Zero fossil energy and zero emissions are structures that are used with biofuels such as the use of solar houses, the ventilation of wind chimneys, the use of solar panels, the facility of regeneration systems, and also do not pollute or use the environment. Renewable and clean energy. However, initial capital costs may be high, existing energy systems may be taken out of service if technological changes are required, and payback periods may be extended if energy prices fall (Utkutug, 2002).

3.2.3 Energy efficient structures

This can be achieved by directing a building or group of buildings to use the energy obtained from passive systems according to energy saving principles. There are a number of design principles, both regional and decisive, for a building to be considered energy efficient. The design principles of energy-efficient buildings vary according to the natural environment and climate data of the building in order to save energy. Its aim is to develop projects that give the most appropriate results without disturbing the balance of the natural environment, depending on the topography, wind and sun effects. Applicable to projects within a sustainability framework where natural environmental factors are becoming increasingly important, the principles of not ignoring climate data and the natural environment, using recycled materials, using renewable energies and reducing the need for fossil fuels are becoming increasingly important. In this context, energy efficient buildings should increase people's comfort and meet the above principles. Buildings offer optimum solutions with the use of passive lighting, heating, ventilation and cooling systems.

3.2.4 Ecological structures

Describe the process from production to destruction of the product, without affecting the cycle of the natural environment. Green buildings, on the other hand, define structures and seating groups that do not burden the environment during the design, construction, use, post-use and demolition phases of a building. Projects that can transfer today's opportunities to future generations by optimizing the use of existing resources and minimizing environmental concerns are key decisions. Approach human, nature and environmental awareness with a holistic perspective and direct your design accordingly. In addition to these data, local climatic conditions and energy saving principles are also used as a basis for planning decisions. The building is not visible regardless of local climate and conditions. In terms of sustainability, the renewable energy to be used is essential for the design of buildings and their surroundings. It is important to strike a balance between ecology, economy and technology and to eliminate conflicting conditions. Architectural design work defines the difficult task of giving spatial content to the relationship between natural and social systems, design adopts ecological principles and starts from the need for a nature-human-society approach to sustainable development (Dumlupınar, 2008).

3.2.5 Smart buildings

The use of renewable and clean energy is a prerequisite for the design of sustainable smart buildings. Norman Foster defines the concept of sustainability and the design of buildings to be considered in this context as follows: "Sustainability can achieve the maximum goal with the least amount of resources. Cleaning elements and equipment automatically control a building's energy consumption to increase energy efficiency. Therefore, the most important task of a smart building is to ensure that the energy consumption of the building is at a minimum level without compromising the comfort of the building occupants. A very significant portion of the total energy is used for heating, cooling, ventilation and lighting.Smart building applications are for large building areas as the building itself is passive energy efficient and requires expensive automatic control systems. Many buildings such as large public buildings and office buildings with very high energy consumption (Yılmaz, 2005).

- In smart buildings, the system should be a whole. Parts must be systematized. If no system is correctly identified, the building's energy efficiency will decrease and it will no longer be a smart building, so architects and engineers must collaborate in the early stages of the project Passive solar energy harvesting systems play an important role in smart buildings, these structures are designed to take full advantage of renewable energy. In addition to passive systems, there are the following systems in smart buildings:
- Control of heating, cooling, ventilation, lighting, electrical and electronic equipment,

- Time management to control energy saving,
- Garden irrigation systems, ambient lighting and pool control,
- Integration and security,
- High speed internet,
- Digital system such as satellite television and radio.

Smart buildings have disadvantageous features as well as improving living characteristics. Excessive use of IT services can create difficulties in adapting to this lifestyle. It is necessary to get used to the use of continuous control systems. It should also be noted that there will be a service interruption when troubleshooting electronic systems.

4. Utilization of the Deaf Facades of Buildings From Solar Energy

Use of solar energy: Basically, by making use of the structural properties of solar energy, building materials such as light, when necessary. It can be expressed in the form of storage and use when needed. Solar energy: It is not like hazardous fossil fuel waste, it can be used in varying amounts depending on the season and the day, it is an independent and powerful energy source that can be used unlimitedly, and many countries in the world may choose to benefit more or

less. Solar radiation: It reaches the Earth in two ways. It is direct solar radiation and diffuse solar radiation. Direct solar radiation is direct radiation that strikes the Earth through the atmosphere, depending on the day and season. These days and hours depend on the Earth's tilt of 23º 27, the rotation of the Earth's axis of rotation, and the axis of the Sun. Diffuse solar radiation is radiation from the scattering and scattering of atmospheric solar radiation in the atmosphere. The amount of solar radiation: The effect of the Earth's orbital motion, the thickness of the atmosphere depends on the mass of the atmosphere. In addition, the value of the total solar radiation varies according to the physical conditions around the terrestrial point, the tilt of the earth and the effect of the observation direction (Zorer, 2007).

Necessary information about the scale of buildings: climatic and regional conditions (rains, prevailing winds, etc.), topographic conditions (mountains, hills, slopes, wooded and flat areas, etc.). The amount of solar energy per unit surface (measures and daily, monthly, annual). Necessary information in the layout scale plan: Buildings and structures location (direction) and relative location, architectural structure of buildings and building assemblages, materials used in the building envelope and their properties, solid surface/glass ratios in the building envelope, etc. Another problem with the benefits of sunlight is the structural properties of the material. When solar radiation hits the surface of a building material, heat is stored and transferred to the volume by radiation, convection and transport processes, depending on the material's properties. They are the properties of the variables on the propagation path of solar radiation (Şerefhanoğlu, 2004).

For glass materials: The structural properties of glass or similar materials are an important factor in utilizing solar energy. Glass surfaces; reflection, absorption and transmission events are a function of wavelength. For clear window glass depending on wavelength: UV resistant up to 318 nm. Wavelengths between 318 and 380 nm allow 65-70% of UV radiation to pass through. It transmits about 90% of optical radiation from 380 - 760 nm. It also mainly transmits near infrared radiation between 760 and 2800 nm. Opaque to infrared radiation above 2800 nm, the light entering the volume from the glass surface heats the interior surfaces and objects in the volume and emits radiation at longerwavelengths than the heated surface. However, glass surfaces are impermeable to radiation with wavelengths above 2800 nm. In the building envelope, heat is stored in the volume by the surface heating of the glass. Solar radiation raises the temperature in the volume known as the Searle (lemon) effect (Serefanoğlu, 2004).

Physical properties of glasses: It plays an important role in controlling heat and sunlight. In thermal control, it is important to prevent heat leakage in the building and to reduce human-induced thermal loads. The thermal transmittance of the glass is expressed as the U value (W/m2 K) and varies according to the properties of the glass. Glass unit features: Glass slit width, gap distance is generally applied between 6 and

16 mm, after 20 mm, the heat transfer coefficient increases when the convection phenomenon begins. Dry glass is generally used as the room gas in glass room fill equipment, but the insulation value is higher due to the use of heavy gas grades, low emissivity coating is applied. The invisibility coating applied to the glass is designed to prevent the heat stored in the volume from escaping through reflection. Used for filling materials: solid surfaces that make up, support or transmit the building envelope, heat transfer coefficient, thickness, outer surface properties and color properties can play a decisive role in the absorption and accumulation of heat. The thermal storage properties of filler materials play an important role in utilizing solar energy. Thermal storage has the function of returning solar energy to storage and volume through thermal mass. If the heat storage body is a wall, the building material must have heat storage properties (Dumlupınar, 2008).

4.1 Active Systems

Active systems are one of the methods of utilizing the energy of solar radiation, utilizing the structural properties of building materials, converting into heat or electricity, storing for later use and serving as a complementary system to the building. Since passive solar energy utilization systems are discussed in this article, the details of active systems are not mentioned.

- Systems that convert sunlight into energy according to the energy it produces: Heating systems with solar energy that produces heat, thermoelectric systems that produce electricity, solar energy / photovoltaic heating systems that produce both heat and electricity (Sakınç, 2006)
- Solar heating systems: Usage it is used for water heating, pool water heating, air conditioning preheating and space heating.
- Type of fluid used in the system: Gas-liquid and water-liquid are divided into 2 types, while solar thermal system is divided into 3 types according to the amount of heat received; Low temperature: production of hot water, heating and cooling of buildings, heating of swimming pools; Medium temperature: Production of process steam, large heating and cooling systems; District heating, space or sanitary water three groups of solar oven applications are collected (Serephanoglu, 1987).

4.1.1 Thermal collectors

A collector that uses solar energy to generate heat. It depends on the thermal energy produced; It is divided into three types: low temperature, medium temperature and high temperature. According to the shape of the thermal collectors, flat, condenser. According to the fluidity, there are two types: liquid fluid and air fluid (Sakınç, 2006).

4.1.1.1 Planar solar collectors

- Are systems that collect the light and transmit it to the liquid. If the system elements are listed from top to bottom: Permeable top layer, Absorbent layer, Insulation layer and carrier.
- Permeable top cover, the front sheet and absorbent surface must be a permeable surface. To protect from the negative effects of external conditions that collect sunlight and are located between radiators and to reduce heat loss. The glass material prevents the heat from escaping and creates a harsh effect with the collector function. Isolation measures should be taken.
- Absorber surface: It is the most important element of the current collector. This is where the sun rays falling from the transparent surface are stored. System efficiency can be improved by high absorption, heat conduction and low heat loss.
- Insulation: It is used to prevent solar radiation
- from escaping from the sensor body stored for thesensor. Lightweight materials such as foam, polyurethane and glass wool are commonly used as insulation. The main factors that determine the efficiency of a collector are as follows; solar radiation falling on the collector surface, climatic characteristics of the region, determination of the

quality of the collector components.

- Collector, working system of collectors: It is a solar panel system for situations where high temperature readings are not required. It is of two types; natural and forced circulatory systems.
- Natural circulation system: It is provided by the increase of the liquid, the liquid heats up and the density in the collector decreases. The tank must be at least 50 cm above the collector. It works continuously while the liquid rises from the bottom of the tank and displaces the liquid. The position of the tank is not limited when the liquid is pumped. Forced circulation is divided into 2 types according to its performance in sanitary water or antifreeze, and they are open and closed circuit systems.
- Open circuit system: Service water and water circulating in the collector are not the same. Construction cost is low and efficiency is high. Care should be taken to prevent overheating, rusting, freezing and calcification.
- Closed circuit systems: Collector water and tap water are different in these systems. The water heated in the collector is heated with antifreeze. Since a circulation pump is required to heat tap water, it is less efficient than open systems (Dumlupınar, 2008).

4.1.1.2 Condensing systems

Condensation sensors are used to achieve higher temperatures than surface sensors. The area where the sun's rays fall is called the opening area, and the area where it transforms into thermal energy is called the receiving surface. While the opening area and receiving surface are the same in flat collectors, they are different in condensing systems. Linear condensation systems, Point condensation systems, Parabolic concentrators are divided into 3 groups. Active solar systems significantly affect the appearance of the building in terms of features such as size, shape, slope, interior color and texture. The outdoor surface application step positions the collector area. In solar water heating application; Proximity to collectors and storage rooms; Duct insulation and insulation addition optimization where heat demand is high; Considering the summer conditions on the channels, the efficiency effect of the channel and pipe passage system increases (Sakınç, 2008).

4.1.2 Thermal electricity (photovoltaic) systems

Photovoltaic (PV) refers to the generation of voltage from light. Photovoltaic modules convert solar energy into electricity. It was originally used to power the spacecraft. It will then be used in many different areas such as street lighting, headlights, power plants, buildings. In photovoltaic modules, the conversion of solar radiation into photovoltaic takes place via silicon between the two glasses. The main task of PV is; generating electricity, storing it when necessary and ensuring its safe distribution. Depending on the wavelength nature of sunlight, photons of different energies are reflected or absorbed when they hit the photovoltaic surface. It is the phenomenon that the received photons become a part of the photovoltaic current (Dumlupınar, 2008).

4.1.3 Structure of a PV (photovoltaic) cell

Layers of a typical photovoltaic cell: Transparent top layer, non-reflective layer, top conductor where electrons start working, semiconductor material where electrons start working together, bottom conductive layer where the circuit is completed. The efficiency of photovoltaic cells depends on the amount of solar radiation and the quality of the battery system. PV, photovoltaic collectors: The system formed by connecting many photovoltaic cells in parallel or in series to a surface is called photovoltaic collectors and can be divided into 3 ways: Planar collectors, flexible or frameless collectors, condenser collectors. PV, Photovoltaic collectors are divided into 2 according to the cell material: Crystal collectors and thin film collectors, Factors that determine the efficiency of a photovoltaic system: The efficiency of the collector area, the characteristics of the system elements, the system configuration the determination of the quantitative and qualitative parameters of the load (Sözen, 2008).

4.2 Deaf Façade Systems

Is a design method that allows the energy obtained from solar radiation or solar energy to be used in the context of sustainable buildings. In passive systems, the design phase is a whole. Decisions to be made such as the shape of the building, the choice of material and the determination of the cross-sectional properties of the building envelope directly affected the design.

- Passive thermal gain is provided by 2 systems: Direct system and Indirect system.
- Indirect systems: It can be expressed as vertical systems, trumpet walls, greenhouse or greenhouse systems, horizontal systems or systems for roof pools. On the other hand, indirect systems can be studied in two ways: they are horizontal systems and vertical systems.
- Direct systems: essentially have a positive effect by increasing the temperature of the volume, storing the solar radiation in the filling material, passing through the glassy material.

5. Use of Solar Energy of the Deaf Facades of Buildings

One of the ways of using solar energy in buildings, is passive systems, which are directly related to the natural environment and design decisions. The design principles for passive systems are: life scale and construction scale. For passive systems considered before starting the building design, all design decisions must be evaluated in terms of the quality and amount of sunlight, as the main concern will be the use of solar energy. Before the design begins, you need to obtain small-scale terrain data and guide design decisions. The data regarding the sunbathing conditions of the building, its distance from other buildings and the ground height should be specified precisely during the works to be carried out at the construction site. However, this benefit is desired to be provided in passive systems; They are systems based on the sun's trend over a year and a day, and the material properties of the components. The architect's job is to make the right design decisions, taking into account climatic data and material properties. Making these decisions early in the design is effective in achieving positive results in terms of system efficiency, functionality and aesthetic value. In addition, decisions taken early in a project offer a more cost-effective and practical solution than implementation at a later stage. Internal temperature value with passive system design; It should provide high temperature readings depending on summer and winter conditions, day and night, natural ventilation and necessary protection (Zorer, 2007).

5.1 Design Principles at Layout Scale of Deaf Facades

Passive systems for architectural design; It is necessary to take full advantage of the effects of the climate, to evaluate the climate data appropriately, to ensure its use and protection when necessary, and to minimize energy consumption. An effective architectural design approach can be considered under two headings: Design principles related to air conditioning and design principles related to architecture (Oral, 2007).

5.1.1 Climatic design principles In relation to

Climatic elements and energy conservation, the physical effects of atmospheric factors and the undeveloped environment are climatic design principles. When using solar energy, the design based on energy efficiency should meet the principles of winter use and summer protection. In all these measures, the design should be under the control of climatic and local data. In this sense, it differs according to the atmospheric characteristics of the region. Principles affecting the design; It is solar radiation or outside temperature or outside humidity or wind.

- Solar radiation: For more information on solar radiation, see. Chapter 4, Solar Energy in Buildings.
- Outside temperature: It can have different annual temperature values at the same latitude. The evolution of these temperature values depends on several principles: solar radiation, the passage of

the sun through the atmosphere, the nature of the soil, the relationship between the earth and the atmosphere, the amount of energy that changes during events, such as evaporation, melting, freezing, the movement of air and the direction of ocean currents, density, through convection and turbulence (Long, 1997).

- Outdoor humidity: Humidity is directly related to the amount of precipitation and evaporation per square meter. Precipitation varies by season and region.Other climatic factors such as amount of water, temperature, air movement and soil, vegetation and altitude have a significant impact.
- Wind: The main direction is the movement of air that develops parallel to the Earth. Air movements have been validated at design scales and with wind speed and wind speed as determining variables (Zorer, 2007).

5.1.2. Design principles for the layout of the building

In order to benefit from and conserve solar energy, it is important that the built environment is sustainable and climate controlled. These are the location of the building, the distance between the building and the installation structure, the direction of the building and the shape of the building, the characteristics of the building envelope, and the natural ventilation method. They are decisive factors for increasing and reducing the artificial heating load.

5.1.2.1 The location

Buildings depends on the location of a building, the characteristics of the site and its surroundings. The orientation of the building's location, the topography and the way the surface coverings reflect the light ground structure, the wind range interior comfort conditions are the basis for the development of the values.

5.1.2.2 Ettlement pattern

Distance from building - layout diagram, location and relative heights of a building are important and authoritative data in the design of a building and its surroundings, in the application of passive methods. Height and distance from buildings is an important factor influencing sunlight conditions. However, wind corridors formed by wind movement and air circulation are important factors. The exterior design wind speeds required to provide the desired interior wind speeds vary depending on the net height of the building. As you move away from the building, the exterior design wind speed decreases (Berköz, 1995).

5.1.2.3 Of the building and its form

Building orientation conditions and shape, external environmental climatic factors; sun and wind change with compass direction. According to the location of the building, an evaluation should be made to create a suitable project to benefit from winter and provide shelter in summer. The south façade of a building in the Northern Hemisphere benefits the most because it sees the sun longer than the façade in the other direction. The sun is most effective at 30° southeast and 30° west. Therefore, aligning the legislative unit with the south façade during the design process ensures that the system created is more efficient. Since the north facade is exposed to cold winter winds, it is preferred for short-term usage areas (stairs, bathrooms, rest rooms) where thermal comfort is not always required. In addition, the northern façade of the building should not have a long façade, necessary thermal insulation measures should be taken according to the climatic conditions. Building-related geometric quantities can be used to define building shape and form factors (the ratio of planned building length to building depth), building height, roof type (flat, gable, hipped), roof spacing, and height spacing (Berköz, 1995).

Long, ventilated facades, rectangular floors and high-floor roofs should be preferred to ensure adequate ventilation in hot and humid climates. Flat roof shapes with courtyards, square plants and courtyard openings should be preferred for hot and arid climatic regions. In cold climates, a compact, square and near-square mass that provides wind protection with minimal outer surface should be preferred. In areas with a humid temperate climate, rectangular or free-form shapes

with greater wind direction prevail; In moderately dry climatic regions, compact, sticky and windproof forms should be preferred (Oral, 2007).

5.1.2.4 Properties of the

Building envelope the properties of the building envelope have a significant impact on the thermal performance of a building as well as on the cross-sectional properties such as solid or transparent materials, different physical properties and thermal permeability. The transmission, absorption and reflection coefficients, which are called optical properties of solid and transparent components, have different values for transparent components for direct and diffuse solar radiation. The optical properties of transparent components with respect to direct radiation vary with the angle of incidence of solar radiation. For solid compositions, there is no transmission, assuming that absorption and reflection vary with the color of the surface and there is nodifference between direct and diffuse radiation. The use of solid or transparent elements to create the building envelope individually or as components affects the performance of the building elements. Used alone, transparent surfaces provide immediate benefits; Architectural elements used as components are used indirectly and have different effects (Dumlupınar, 2008). The ratio of the area of transparent or solid elements to the area of the entire building envelope is another factor affecting thermal performance. As crust formation direction changes, differences in crust formation patterns should be determined according to climate data and necessary changes should be made. For example, the north façade should be fuller and more isolated than the south façade, but the other façades should have a higher rate of transparent surfaces as they benefit from direct sunlight. In addition, the slope of the building envelope also changes the effect of sunlight on the material; The absorption of the solid surface increases as the angle between the incident solar radiation and the normal to the surface decreases; On the other hand, the penetration rate increases on transparent surfaces. The structural features of the building envelope should be determined and its suitability for the passive system to be built should be evaluated by the designers as necessary (Yılmaz, 2005).

5.1.2.5 Methods of providing

Natural ventilation When installing passive systems, natural ventilation of the building should be provided and solutions should be developed within the scope of the project. While the advantages of passive systems specified in the operating principles are given in winter, volume levels in summer should be supported by natural ventilation. Natural ventilation should be provided to prevent overheating in the summer and to minimize support for cooling systems. Natural ventilation techniques: Wall openings, gutters, greenery, landscaping can be done. The effect of the gaps in the walls on the air flow: Thanks to the quantitative and qualitative characteristics of the gaps in the walls, the natural circulation of the air flow in the volume is ensured. On the other hand, the fact that the space in the volume is on a single axis increases the power of the air flow and does not allow an efficient air exchange in the volume. If the axis of the wall cavity is deflected, the airflow circulates longer in the volume and there are fewer weak spots in the volume, resulting in more efficient ventilation. The size and number of wall cavities in the volume also play an important role in ventilation. As the number and size of the wall joints increase, the ventilation effect of the interior also increases. The type of window used in a room is decisive for air circulation. Horizontal or vertical pivot windows are oriented; horizontal and vertical sliding windows have no orientation effect. The length of the eaves causes pressure differences and changes the strength of the airflow. Due to the elongation of the eaves and the resulting pressure difference, the air circulates faster. Facilities; Planting it inside and outside the building has the effect of lowering the ambient temperature. As systems use ambient temperature for evaporation, the internal temperature drops and provides cooling. The selection of evergreen dwarf trees, especially on the northern façade of the building, towards the direction of the prevailing winds, is important as it reduces the effect of the wind. Large, sparse trees should be planted

to the east and west during the winter months to take advantage of the warming effects of the sun's rays. In summer, the greenery on the south façade will be used to cool the interior of the building. The materials used in the landscape also change the ambient temperature of the building depending on their heat storage properties. Grassy soils have a cooling effect because they always evaporate at room temperature. Prefabricated or cast-in- place porous materials should also be preferred due to their poor insulation properties. Asphalt materials and concrete materials also have different thermal insulation properties. Since concrete surfaces retain less heat than asphalt surfaces, they have a lower ambient temperature increase effect (Zorer, 2007).

5.2 Design Principles on the Building Scale of Deaf Façades

system, it is based on the principle that the heat is transferred by accumulating the thermal energy received by the building with passive solar radiation by using building elements such as roof, wall and flooring. The system is heated. Passive systems do not need additional systems to provide heat transfer between the source and the structure, and the heat transfer of the components takes place by conduction, convection and heating methods. Solar energy harvesting methods applicable to passive systems should provide functionssuch as collecting, storing, dispersing and controlling solar radiation. The material properties of the components are decisive for the realization of these functions. The collection of solar radiation is carried out by the glass material, and the deposition efficiency is carried out by the filling material. Passive thermal gain is provided by 2 systems: Direct system; It is an indirect system. İndirect systems; vertical systems or trumpet walls or systems for greenhouses or greenhouses, horizontal systems or systems for rooftop swimming pools.

5.2.1 Direct system

This is the simplest and most viable way to passively utilize solar energy. It is based on the principle of capturing and storing the sun rays passing through the glass surface, which has a greenhouse effect. Depending on the course of the day and the solar year, the amount of solar radiation changes. In this case; management can be thought of in general as direct income. The direct system for the northern hemisphere is based on the principle of collecting and storing solar radiation through the building elements on the glazed surfaces of the south, east and west facades.

- Positive features of this system: It is a simple system that can be used in single or multi-storey buildings.
- Thanks to the large glazed surfaces of the south façade, it creates a visual link between the interior and exterior by making use of natural light. However, necessary precautions should be taken against the summer sun and shading elements should be provided.
- Direct amplification systems provided with glass materials are cheaper than solar panels. There are advantages to using upper floor windows in direct systems, but effective results can be obtained especially on the upper floors of single-storey or multi-storey buildings. The use of skylights in multi-storey buildings is only effective in the design of gallery spaces throughout the building.

5.2.2 İndirect system is the

Horizontal system and the vertical system. In the vertical system; Trombe wall is Greenhouses. In horizontal systems, they are rooftop swimming pool systems.

5.2.3 Vertical systems - trombe wall system

Vertical Systems - Trumpet Wall System Solar studies are carried out in the French solar laboratory for local climate control and the world's largest furnaces are used in these studies. Using this furnace, which can be heated up to 3800 °C, the system studied and developed by Professor Trombe was created by architect Jacques Michel. Work was carried out on a house built with this method in the Pyrenees, with a Trombe wall system installed on its south façade. The technical simplicity of the method is due to the simplicity of the principles on which it is based. These principles are: using the vertical

south wall as a solar collector, using the greenhouse effect to store solar energy, accumulating heat, cement and water thanks to the natural thermal cycle of the air heated in this way. It is based on the principle of converting solar energy into thermal energy in the form of thermal mass in the trombe wall, storing and transferring it to individual components in the interior volume through transportation. The Trumbu wall needed to be a thick, dense material to collect and store heat, and the storage device had a double layer with the collecting material at the front. Other walls that do not have this feature in terms of volume may be thinner than the thermal mass and all building elements must be insulated to prevent heat loss (Dumlupınar, 2008).

5.2.3.1. Working principle of the Trombe

Wall functions as a thermal mass system placed behind the glazed surface of the northern hemisphere on the southern façade. Thicker materials such as concrete, brick, stone are generally used as thermal mass, and the distance between the glass and the filling material should be approximately 10-15 cm. Incoming solar radiation penetrates the glass surface and heats the surface, and longer wavelengths are emitted from the heated surface, causing a cooling effect. The thermal radiation converted into thermal energy is transferred partly to the interior and partly to the external environment. For this reason, double glazing or multiple glazing should be used depending on the climate data to minimize external losses. In double-glazed applications, about three quarters of the radiation is transmitted and stored indoors, and about a quarter of the radiation is transmitted to the outer space (Berköz, 1995).

In daytime conditions: Warm air is heated between the glazing material and the filling and is stored under theinfluence of a storm, passing through the cover and reaching the storage body and the volume. After a while, the heated air cools and becomes heavier, approaching the ground. The cooled air is exhausted through a flap at the bottom of the product. Heated and cooled air flows in this way and the airflow repeats. In order to ensure this cycle, bank covers must be opened alternately at certain time intervals and the user must take an active role. In night conditions: Thermal radiation stored in the storage volume and other building materials in the volume are released into the interior volume by convection and radiation. The amount of heat entering the volume through the channels of the heat storage wall varies in proportion to the properties of the building material. The north facade is an effective means of natural ventilation.

5.2.3.2. Evaluation of the trumpet wall

Trumpet wall; Thanks to the double-layer system, the glass surface protects the solid wall from external influences. Due to its internal temperature, the wall as a storage task provides more stable results than other heat storage methods. Sometimes artificial heating is not required without solar heating due to heat storage phenomena, so they are the systems of choice, especially in commercial buildings. However, since cleaning large transparent surfaces is important for the efficiency of the system, it is necessary to use arched passages for cleaning transparent surfaces in multi-storey buildings. The presence of the thermal storage wall complicates the control of the auxiliary heating and cooling system.

5.2.3.3. The positive features of the Trombe wall in winter are

The heat it provides in the cold season, increasing the internal temperature, helping to reduce the artificial heating loads, minimizing the effect in terms of temperature differences in external conditions.

- Negative features of the Trombe wall system: Minimizing the heat in a solid wall and transferring it to the interior volume depends on the static properties of the material, its thickness and external climatic conditions. Incorrect material selection at the design stage can reduce system efficiency. Especially since the surface of the thermal mass does not have thermal insulation, its conduction, heating and convection from the transparent surface increase in periods when there is no heat distribution due to solar radiation (Durmaz, 1997).

- Increasing the efficiency of the trombe wall in winter: It is possible to increase the number of layers on the glazed surface of the greenhouse effect. Minimizing the radiation emission by reflection phenomena and storing it as thermal energy on the fill surface should be the first choice for strong and thick materials that can store heat. All components of the volume must be adequately insulated and protected against heat dissipation. It is important for users to play an active role, it is important to get efficiency from the implementation of automation in order to increase productivity.

- Negative features of the trombe wall in winter: In cold winter months, due to the late heating of the wall in the mornings, the volume is also heated late, as there is a delay in heat transfer.

- Negative properties of Trombe wall in summer: It prevents thermal insulation, avoid shading and planting acts as a movement mechanism to prevent their use in winter. It can also be painted a light color in summer to prevent the thermal mass from trapping heat, but this is an expensive, temporary and difficult solution. Especially at night, natural cooling can be achieved by operating the system in reverse. In addition, natural ventilation can be provided by opening the windows on the north facade of the building.

- Precautions to be taken in the summer months of the Trombe wall: It prevents mass thermal insulation; shade elements and plants provide protection from sunlight. Shading elements should be preferred as movable mechanisms in order not to hinder their use in winter. It can also be painted a light color in summer to prevent the thermal mass from trapping heat, but this is an expensive, temporary and difficult solution. Especially at night, natural cooling can be achieved by operating the system in reverse. In addition, natural air circulation can be achieved by opening the windows on the north side of the volume.

- Aqueous systems: Solid and solid materials can be used as thermal mass in the Trombe-Wand method and a similar effect can be seen on the surfaces where water is supplied.

The heat absorbed by the glazed surface is transferred to the residential unit by accumulating on the water wall. In the absence of sunlight, it quickly transfers the accumulated heat to the residential unit by conduction, convection and heating. Since the task of the thermal mass is in the water pocket, it is faster and easier to store, that is, more efficient. It is a difficult system in terms of its application and the use of detailed solutions and special techniques, the system also suffers from corrosion, leakage and evaporation problems (Warchberger, 1988).

5.2.4. Winter garden (sun rooms, conservatory, greenhouse)

Greenhouse, equipped wall Trumpets, windows and heat storage this is achieved by turning the space between the walls into a constructive mass, a thermal collector. In this system, which is designed to make maximum use of the sun, the sun's rays are collected through the large glass surfaces on the south façade. When the first examples appeared, greenhouses were used for plant growing and commercial purposes in social parks. Then, with the effect of the Industrial Revolution and the discovery of iron, the complex grew and this was reflected in the geometry of the greenhouse. Knowing that it reduces the cost of artificial heating loads, its use has also increased in contemporary buildings, and today it is mainly used in buildings to benefit from sunlight.

5.2.4.1. Orientation and architectural formation of the winter gardens

The location of the greenhouse should be determined according to the latitude of the area where the building is located and the path of the sun during the day. The image below shows the rotation of the sun in one day in the Northern Hemisphere. When the sun's rays form the maximum angle with the ground, the sun rays are absorbed by the south façade in the volume of the winter garden. The decision to use sunlight during the building design phase plays an important role in the efficiency of the system. It is important for the winter garden to be in harmony with the landscape design and to improve the outdoor perception from the inside. According to

the structure of the building, its shape and function should be considered as a whole, and the building and greenhouse design should be made. The heat storage wall consists of a selective surface (for example, chrome foil or copper plating with aluminum) and a permeable surface in front of the heat storage wall, usually glass is used as a permeable material. Basically, the radiation passing through the glass is captured by the greenhouse effect and stored by the heat storage wall (Böke and Çakmanus, 2007).

Thermal masses can also be made with aqueous systems. Even in the water system, all-steel oil drums are arranged vertically on the glass surface. The sun- facing vats were painted black to absorb the sun's heat and store it in their bodies and released into volume by heating. The gap between the barrel and the glass surface lets sunlight and heat into the interior. In the morning, a solid wall spreads sunlight directly into the room, as does the ceiling, providing rapid heating. In this system, the continuous flow of water conducts heat very quickly, and water can store more heat than a solid wall of the same volume as a tank (Walchberg, 1988).

5.2.5. Evaluation of cold weather conditions

Cold season, solar radiation passing through the transparent surface of the greenhouse is collected in the volume. Here, solar radiation is absorbed by objects and surfaces and emits radiation at longer wavelengths, creating a greenhouse effect. In a winter garden, between the glazed surface and the heat storage wall, the heated air rises into the volume and enters the adjacent volume through vents or windows made at the top of the storage wall. Thermals cool here and near the surface, and the heat is directed into the conservatory through vents or windows under the storage wall. Here the air is heated and transferred to the volume, displacing the air flow (Dumlupınar, 2008).

5.2.5.1. Measures to be taken to increase efficiency in cold weather conditions of conservatories

Heat accumulating surfaces need dark colors, especially black surfaces, to improve their heat absorbing properties. On the other hand, the surface of the components outside the heat storage wall is lighter and the reflection is increased, which allows more heat to reach the heat storage wall and be converted into heat energy by the storage. Glass is the main material used in greenhouses and due to the structural properties of glass, these surfaces must be well insulated to prevent heat loss. Depending on the climatic conditions, two- layer glass systems or glass systems with differentphysical properties should be used. When the weather is cold, make sure there is direct sunlight during the day; Prevent heat loss when using at night. In addition, if the wall in vitreous ware needs to be raised according to climatic conditions, this also has a cost-increasing effect. Conditions that could prevent solar radiation from passing through the glass surface and reaching the thermal mass must be eliminated. Considering that protection from the heat of the sun is preferred in summer conditions, it is necessary to prefer removable coloring elements that can react to both situations (Durmaz, 1997).

5.2.5.2. Positive features of winter gardens in cold weather conditions

Greenhouse is a part of passive system. Since direct sunlight can be used, the artificial heating load of the building is reduced.

5.2.6 Evaluation of hot weather conditions

Warm season, solar radiation from ground level to the highest angle during the day provides a heat build-up in the greenhouse (especially at ground level). Solar radiation passing through the glass surface is converted into thermal energy by its effect on the cool volume. In order to provide natural ventilation and reduce the ambient temperature, the ventilation holes on the wall of the heat tank should be closed and the ventilation windows on the transparent surface should be opened. Prevent direct air circulation between the greenhouse and the building and avoid overheating due to heat transfer to adjacent areas. Ventilation windows should be provided on transparent surfaces for natural ventilation.

5.2.6.1. Negative effects of winter gardens in hot weather conditions

Some precautions should be taken to prevent the building from overheating in hot weather. Natural ventilation can provide cooling as long as the user uses the greenhouse windows in a controlled manner. Also, north-facing windows change the air flow, providing natural ventilation. Sun protection should be provided to prevent the collection and storage of sun rays from the glass surfaces of the greenhouse. According to the architectural concept, gutters should be used for sun protection, movable shutter systems, movable curtain elements to act both as shading and thermal insulation. In addition, some parts of factories and buildings can participate in shadow mechanics (Şerefhanoğlu, 2007).

5.2.6.2. Precautions to be taken in hot weather conditions in winter gardens

Open the upper and lower parts of the glazed surface to ensure the necessary air circulation in hot weather, windows or grilles these grilles should be opened and closed by the user in a controlled manner according to the comfort conditions of the environment. Glossy surfaces should be provided to prevent heat build-up on heat storage walls. However, this process is difficult, costly and a temporary solution. Ventilation windows on the greenhouse glass surface should be opened in time to allow air exchange. The interior can be cooled through wall slots that open to components located on the other side of the system. The windows on the north façade are open and the cool interior comes from the lower ceiling of the insulating wall where the greenhouse heats up and rises. The heated air should be thrown out through the ventilation windows of the greenhouse (Durmaz, 1997).

5.2.7 Horizontal systems

It is a system that functions as an accumulation in the thermal accumulation system. In this system, the roof is used as a layer in addition to the thermal mass used by heating water pockets placed on a metal support system.

5.2.7.1. Rooftop pools

In the case of a rooftop pool, the thermal mass being the roof itself causes the heat product to be distributed more comfortably and evenly. In this system application, bags are generally used in day and night units, and the task of the system is to provide cooling in summer and heating in winter. The larger the pool area created by the plastic bags placed on the roof, the greater the benefit of the system. In winter, the sun rays passing through the glass surface during the day radiate longer wavelengths and the radiation is stored here under the greenhouse effect. This increases the temperature of the water pocket and transfers body heat to the interior volume through heating and convection. The cover on the glass surface is kept open throughout the day so as not to interfere with the sun's rays. During the night, the heat shield is closed and the heat stored in the hydration bladder is released into the inner space. The ceiling acts as a heat accumulator, releasing the heat stored indoors through heating and convection. At night, open the lid to let thehot air out of the water bladder. While the water heated during the day gives off the stored heat as the air cools, the warm interior air is expelled through the water pockets. The solar energy use of the roof pool system has been increased by adding reflective surfaces to the system; this allows more solar heat to be collected during the cold season and during the day. Reflective surfaces can be made by using the covers in the open position and collecting vertically in the direction that the solar radiation falling on the surface will reach the mirror of the water in the tank with the reflection phenomenon. Increasing the amount of heat entering the system increases the utilization of the system by making a positive impact on the ambient temperature (Dumlupınar, 2008).

5.2.7.2. Evaluation of rooftop pools

To utilize a rooftop pool, the slope of the roof must be adjusted to the angle at which the sun will benefit most. Since it has benefits especially in winter in snowy climates, when the rooftop pool is covered with snow, the sun's rays cannot reach the pockets and the heating effect cannot be achieved. In order to eliminate this

problem and prevent the snow from closing the thermal mass pocket, it is recommended to develop special covers that do not block the beneficial heat of the sun. Automatically controlled systems should be preferred to manual systems because the overlay systems used often present accessibility issues. In this case, if the system is not maintained and repaired, the efficiency of the system will decrease and the ambient temperature value will be adversely affected as the coverage area cannot be controlled. The suitability of the roof type swimming pool system to the type of building used is also an important issue. In a multi-storey building, the heat accumulated on the upper floor is hardly transmitted to the lower floors. For this reason, it should be used in first and second floor buildings to be a whole building system (Şerefhanoğlu, 2007).

6. Dead Facade System Design Process

6.1 Main Objectives

The data of 1-year measurement values made with the measurement sensors placed on the south façade of the Ataköy tower building by the company selected in the Yenibosna district of Istanbul province are given in the Appendix. When this study is examined, it is seen that the northern façade is not affected by the sun's rays, and theeastern and western façades are affected by the sun's rays in certain time zones Figure 6.1. Therefore, within the scope of this thesis, the deaf areas on the south façade of the buildings will be studied.

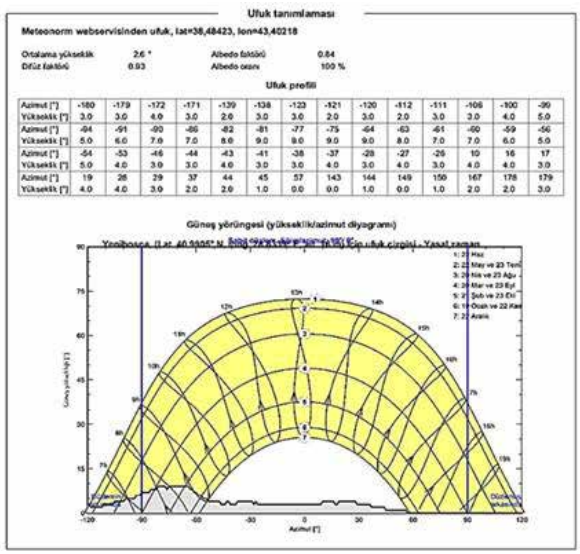

Figure 1. Horizon definition

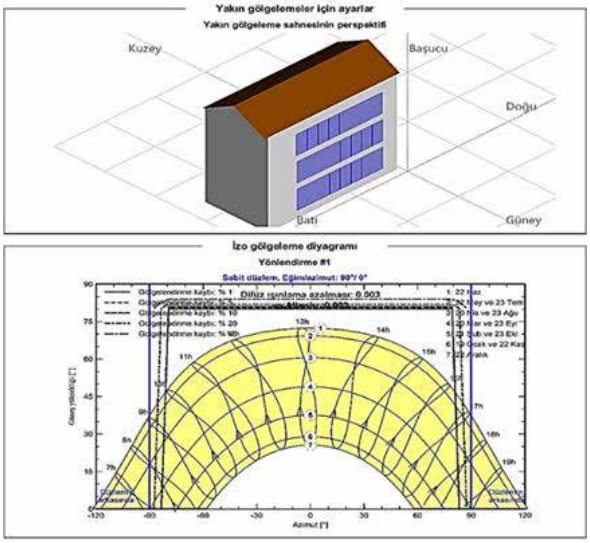

Figure 6.2. Iso-shading diagram

6.2 Taking the First Decisions

As can be seen in the table above, it was observed that there was a loss of shading in the sun sensors placed on the south façade when the position of the sun was between 120 degrees/90 degrees east and 120 degrees/90 degrees west. Shading losses may result from the position of the sun, as well as from the topography

Figure 6.3.
Deaf facade application

of the area where the building sits, its relationship with neighboring buildings, and environmental conditions. Therefore, it would be more efficient to limit our scope of work to the deaf façades of the parts of the south façade of the buildings that are not affected by external influences, and to evaluate it from the framework of these measurements. Another factor

that can cause shading is trees. During the design, thesurrounding trees should be analyzed well and if possible, deciduous trees should be preferred in winter. In this way, it is easier for the sun rays that come at a lower angle in winter to fall on the panel.

Figure 6.4. Energy losses due to tree canopy

Figure 6.5. Reflected shading from neighboring buildings

6.3 Design

Sustainable architecture is emphasized by utilizing the heating effect of solar radiation, increasing the room temperature in winter and positively affecting the artificial heating load in this direction. At the beginning of the passive use design, system alternatives should be evaluated according to user requirements and basic goals, and after the system is defined, the design should

be started. Factors Affecting Efficiency of PV Panels;

- Panel Temperature
- Zenit Angle
- Inclination Angle

Panel temperature and Zenith angle are the two most important parameters. All these factors affect the energy production of PV panels. In order to consider the facade design and the use of these panels in architecture, one of the two most important parameters of these factors, “Zenit Angle”, will be emphasized. Zenith Angle: It is the angle formed between the normal of the surface hit by the sun and the sun’s rays.

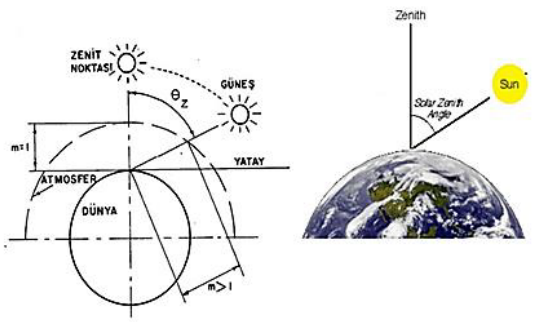

Figure 6.6. The effect of the zenith angle on the architectural facade design

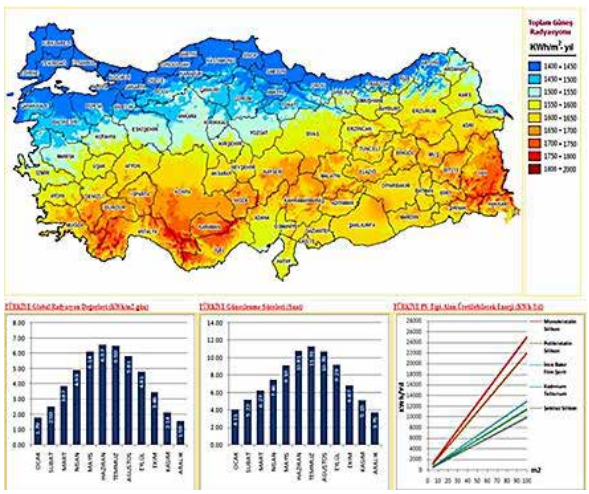

Figure 6.7. Annual sunshine durations

The angle of incidence of the sun’s rays on the earth differs from region to region in the world. For this reason, the annual insolation values of the area where a PV panel design will be made on the exterior of a building directly affects the energy to be obtained from the panel.Using the solar panel inclination angle table recommended for 81 provinces from Lighting.org site, it is suggested that the inclination angle of the panel should be 39 degrees in order to get the maximum efficiency from the solar panel in Istanbul.

6.4 Developed Design

Sustainable architecture aims to prevent hazardous wastes to the environment during the production and usage stages of buildings, to design artificial environments that are compatible with the natural environment, to provide energy savings and to choose appropriate sections and suitable materials. Passive use of solar energy; stresses that design decisions must be considered at the level of buildings and entire settlements when assessing the year-round and daily movement of solar energy.

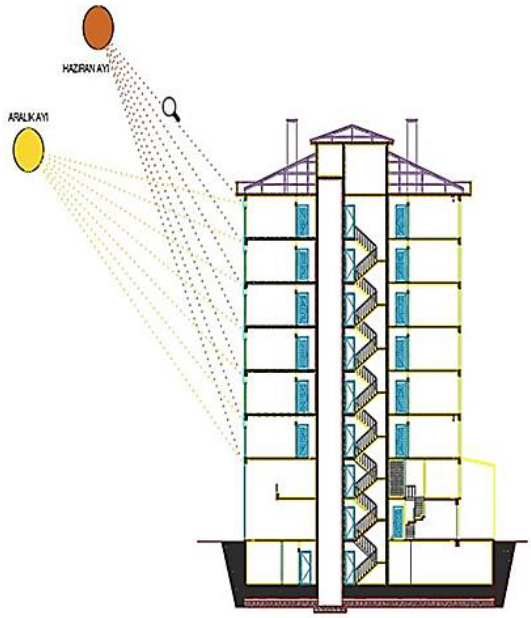

Figure 6.8. Arrangement of solar panels in a single row and at right angles

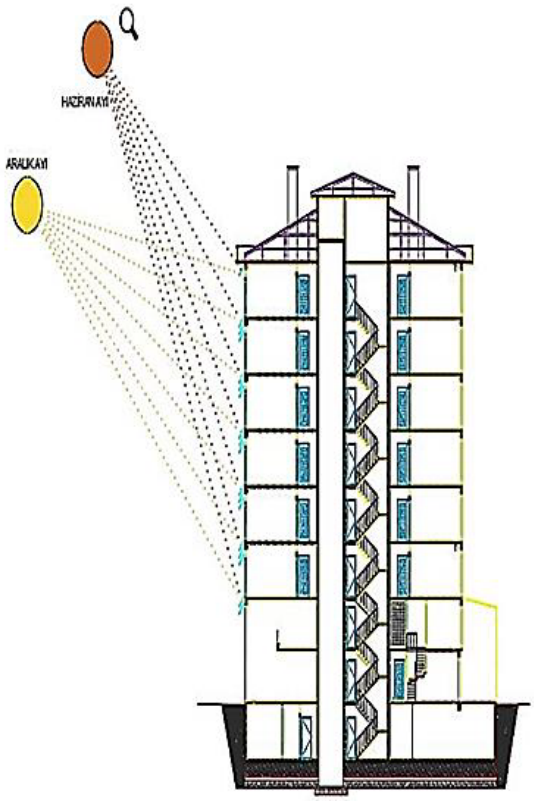

Figure 6.9. Placement of solar panels in parallel and at an angle of 39 degrees

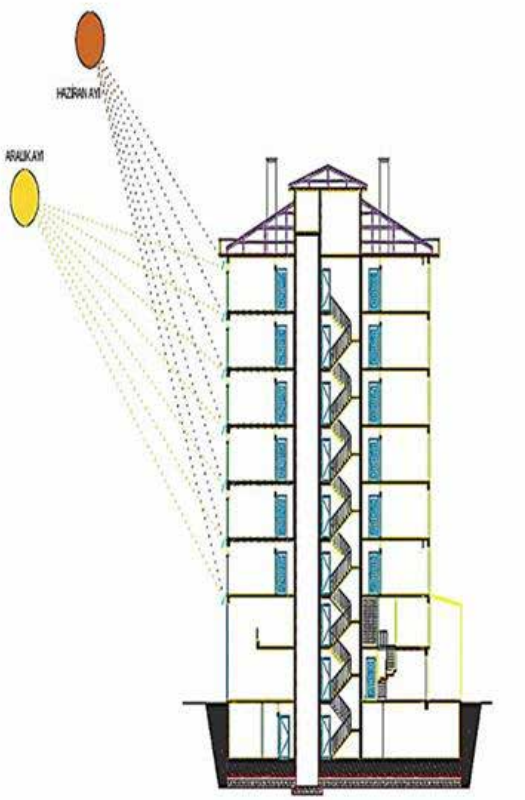

Figure 6.10. Placing the solar panels in a single row and at an angle of 39 degrees

When passive system methods is used, it has been observed that the temperature value of the volume in which the system operates increases and the artificial heating load decreases; however, as long as there was thermal insulation, this was proportional to the increase in the glass area. As buildings can be designed to take advantage of solar energy, one of these systems can then be added to an existing structure. The main goal is to come up with an aesthetic design solution suitable for the existing architecture and needs.

6.5 Application

Sustainable design can be achieved by increasing the ambient temperature and reducing artificial heating loads by using the heating effect of solar energy in winter. As for the building design; The relationship between the building and the sun and the path variables of solar radiation to the building should be determined appropriately and their effects on the project should be evaluated. It is possible to benefit from solar energy with passive systems by determining summer and winter day and night conditions by using very different methods and very different materials.

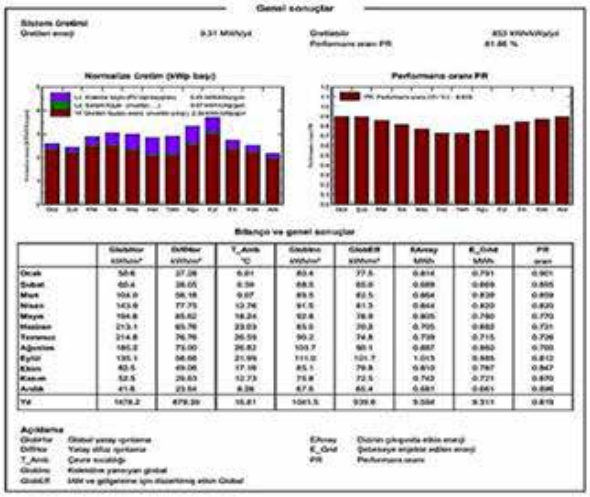

Figure 6.11. Overall results

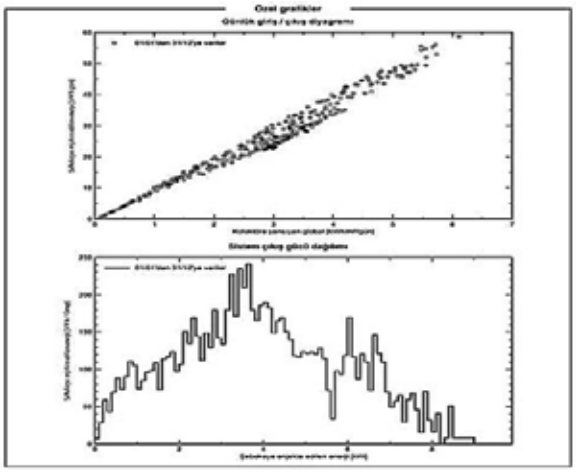

Figure 6.13. Log in/out diagram

The main goal is to come up with an aesthetic design solution that fits the existing architecture and needs. In order to make sustainable, aesthetic and need-oriented designs, it is necessary to cooperate with different disciplines from the very first design stage. When choosing a system; user needs, key objectives, climatic characteristics and environmental structure data should be correctly evaluated and selected based on these data, and decisions regarding supporting systems should be made if necessary.

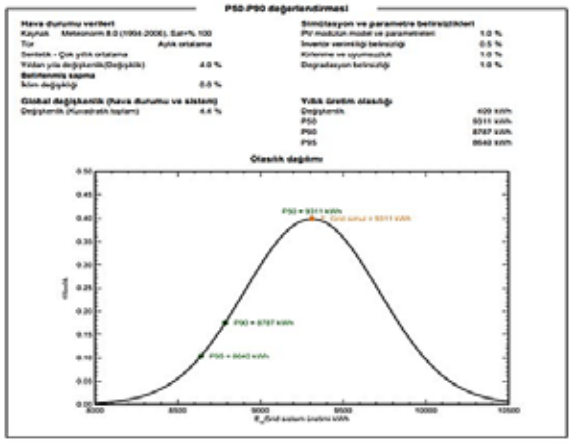

Figure 6.14. Evaluation of P50-P90

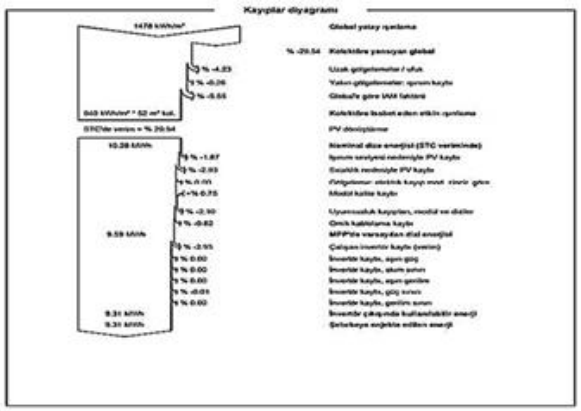

Figure 6.12. Losses diagram

In order to ensure that the building is used efficiently during the occupancy period, users should also be informed about the measures to be taken when conditions change. For this purpose, training programs should be developed with the support of local governments, educational institutions and the private sector, and the use of solar energy should be explained to users. Architects, students of architecture and builders must be aware of this in order for sustainable projects to emerge and meet their needs. While advocacy and support activities are possible, sustainable projects are required by law.

Figure 6.15. The world's largest solar powered façade Denmark

6.6 Application Example of Utilizing Deaf Façades of Buildings

Within the framework of sustainable architecture, the methods of passive solar energy use systems and their effects on the building are examined and the calculation results are evaluated on the basis of model house work. Passive solar energy utilization systems; It is important to save energy, make the building environmentally friendly and minimize the dependence on external energy sources.

To the special panels that provide 300 MWh of electricity per year, half of the energy needs of the campus are provided by the sun.

Figure 6.16. Solar energy application in buildings

Car Park Building Generates Electricity with Solar Panels; The south facade of the parking lot building of the UGC cinema, which was built 10 years ago in Strasbourg, France, was renovated. The façade, which was inaugurated on December 20, 2010, has gained a new look, and its other feature is that it is covered with photovoltaic installations and generates electricity. The architects of the electricity generation project with solar panels in the parking lot building are Jacques Meyzaud and Esra Üçcan. The structure's curved skeleton made of galvanized steel carries 624 solar panels arranged in 13 rows (covering a total area of 450m2). The 44-degree slope of the folds ensures that the solar panels placed on the upper sides benefit from the sun's energy optimally, without overshadowing each other. Colored perforated steel plates placed under the folds and visible from the outside add an architectural quality to the building without preventing the ventilation of the building. The colors of the building, which is described as an "event-wall", are red, green and yellow. The colors of green and yellow, which shake the red sun from time to time, and the colors of green and yellow, describe the shining works of nature. The dark color of the solar panels, on the other hand, refers to the emptiness of the technological dimension in the universe. The project added value to a city structure as a renewable energy source and at an aesthetic level.

7. Evaluation and Conclusion

Sustainable architecture aims not to give hazardous waste to the environment during the production and usage stages of buildings, to design artificial environments that are compatible with the natural environment, to provide energy savings and to choose appropriate cross-sections and suitable materials. Passive use of solar energy; stresses that design decisions must be considered at the level of buildings and entire settlements when assessing the year-round and daily movement of solar energy. The idea of sustainable architecture is emphasized by utilizing the heating effect of solar radiation, increasing the room temperature in winter and positively affecting the artificial heating load in this direction. At the beginning of the passive use design, system alternatives should be evaluated according to user requirements and basic goals, and after the system is defined, the design should be started. Within the framework of sustainable architecture, the methods of passive solar energy use systems and their effects on the building are examined and the calculation results are evaluated on the basis of model house work. Passive solar energy utilization systems; It is important to save energy, make the building environmentally friendly and minimize the dependence on external energy sources.

Sustainable design can be achieved by increasing the ambient temperature and reducing artificial heating loads by using the heating effect of solar energy in winter. As for the building design; The relationship between the building and the sun and the path variables of solar radiation to the building should be determined appropriately and their effects on the project should be evaluated. It is possible to benefit from solar energy with passive systems by determining summer and winter day and night conditions by using very different methods and very different materials. When one of the passive system methods is used, it has been observed that the temperature value of the volume in which the system operates increases and the artificial heating load decreases; however, as long as there was thermal insulation, this was proportional to the increase in the glass area.

One of these systems can then be added to an existing structure, as buildings can be designed to take advantage of solar energy. The main goal is to come up with an aesthetic design solution suitable for the existing architecture and needs. In order to make sustainable, aesthetic and need-oriented designs, it is necessary to cooperate with different disciplines from the very first design stage. When choosing a system; user needs, key objectives, climatic characteristics and environmental structure data should be correctly evaluated and selected based on these data, and decisions regarding supporting systems should be made if necessary. In order to ensure that the building is used efficiently during the occupancy period, users should also be informed about the measures to be taken when conditions change. For

this purpose, training programs should be developed with the support of local governments, educational institutions and the private sector, and the use of solar energy should be explained to users. Architects, students of architecture and builders must be aware of this in order for sustainable projects to emerge and meet their needs. While advocacy and support activities are possible, sustainable projects are required by law.

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