GREEN BUILDING

GUIDELINE - PALESTINE

SECOND EDITION

2024

PHGBC
Palestine Green Building Council

دولة فلسطين
State of Palestine

نقابة المهندسين
مركز القدس
Engineers association - Jerusalem center

Green Building Guidline - State Palestine

Second Edition

2024

Based on the decision of the Palestinian Engineers Association to establish the "Palestine Higher Green Building Council (PHGBC)" in 2010, its vision and plans to solve the problems that the Palestinian society suffers from within the framework of limited resources such as water and energy and the high costs of operating and maintaining buildings in the State of Palestine, and its willingness to contribute to mitigating harmful emissions that contribute to change the climate; It was decided to issue a guideline for green buildings in the State of Palestine in its first version in 2013. The aim was to spread this culture as much as possible in the Palestinian construction industry, in line with international standards for green buildings. This guide considers the peculiarity of the climatic, geographical, and topographical conditions of the region. The goal is to ensure a happy and safe life for our new generations, according to the perspective of sustainability in the projects.

Based on the experience gained during the last decade, the second edition (2023) is being launched to keep pace with technical progress in the use of modern materials and modern methods of building construction, to facilitate this guide for users and to be more effective. in achieving it. The desired objectives.

Governmental and academic institutions are represented at the PHGBC, each with a member of its steering committee.

Engineers Association	Ministry of National Economy	Ministry of Public Works
Ministry of Education	Ministry of Local Government	Palestinian Water Authority
Environment Quality Authority	Energy and Natural Resources Authority	Palestine Standards Institution
An-Najah National University	Birzeit University	Palestine Polytechnic University
Al-Quds University	Risk Reduction and Insurance Fund	

Introduction

The Palestinian society is one of the most in need of protecting its environment oppressed by the Israeli occupation, and it is also the most in need to rationalize water consumption in its life activities due to its lack of control over its natural resources, in addition to its urgent need to find alternatives to energy sources, where the energy bill is a nightmare for the Palestinian citizen at a time when energy in the State of Palestine is considered the most expensive when compared to the countries of the region.

Among the challenges facing the world due to the climate changes resulting from irresponsible human activities on the planet, many negative changes have emerged in recent years in the region, especially in the State of Palestine, whether in annual temperatures or in rainfall rates or seasonal changes and others, which reinforces the need to work to reduce these changes within a global system aimed at guiding man to the proper use of the environment without prejudice to the right of future generations to Life.

As part of the natural response to these circumstances and changes, the Engineers Association has taken the initiative to create a new body under its umbrella called the "Palestine Higher Green Building Council ", which is managed by a steering committee that includes representatives of all institutions, whether governmental, educational or private sector institutions. This Council aims to consolidate the culture of sustainability, preserve the Palestinian environment and rationalize consumption through holding conferences and seminars and issuing regulations and laws aimed at protecting the Palestinian society and creating a clean environment and working to raise awareness of the Palestinian society and give it facts about the reality of the Palestinian environment and the limited natural resources and the economic consequences of this.

In the context of the development of regulations, laws and directives for the design and implementation of green buildings, the Engineers Association formed a technical committee to prepare the first edition of the Guideline to Green Buildings, which includes a group of specialists and experts in all areas of green buildings to ensure the implementation of economic, high-quality and environmentally friendly and sustainable buildings, where the first edition was issued in 2013.

Almost ten years after the issuance of the first version of the manual, and as a result of the tireless effort of the project evaluation committees emanating from the technical committee, it was necessary to take into account all observations and points of development at the international, regional and local levels by updating and developing the manual through the issuance of the second edition of it in order to provide a more appropriate and flexible guide that simulates all similar procedural manuals at the global level. And to be clearer and easier to apply than before.

In conclusion, I would like to thank all the institutions supporting this effort, whether through its development in this (second) edition funded by the Belgian Development Agency (Enabel) and to United Nations Development Program (UNDP) for funding the first edition in 2013, and also thanks to the Steering and Technical Committees for the efforts made within the framework of communicating the Council's message. We hope that this Council will constitute the national lever and one of the most prominent tools used in achieving the Sustainable Development Goals, towards building our independent Palestinian State with its capital; Al-Quds Al-Sharif.

Eng. Nadia Habash

Engineers Association Head and President of

Palestine Higher Green Building Council

Second Edition Development Committee

The Palestinian Green Buildings Guidelines

2024

Dr. Eng. Mutasim Babaa'	**Chief Author**
Dr. Eng. Sameh Monna	**Member**
Dr. Eng. Fuad Baba	**Member**
Dr. Eng. Muhannad Haj Hussein	**Member**
Dr. Eng. Abdel-Fattah Hassan	**Member**

The second edition of the green buildings guidelines was prepared through the contract between NajahPal for Studies and Consultations and the Belgian Cooperation Program "Enabel" as part of the project.

Belgium partner in development

Enabel

Technical reviews were carried out through the technical committee emanating from the Palestinian Higher Green Building Council

Dr. Mutasim Baba
Dr. Sameh Monna
Dr. Muhannad Haj Hussein
Dr. Mohammad T. Alsayyed
Dr. Mohammad Jawabreh
Dr. Nidal Mahmoud
Dr. Shireen B. Alqadi
Eng. Abdelnaser H. Dwaikat
Eng. Loai Shaheen
Dr . Ishaq Sider
Eng . Elias Anton Dieck
Eng. Falah AL-Demeri
Dr. SAMI HIJJAWI
Dr. Abdel Fattah Hasan

Editorial Secretariat

Eng. Ma'moun Abu Rayyan
Eng. Linda Alkhatib

Table of contents

Table Contents

Figure Contents

Terminology

Term	Meaning
Addition	An increase in area or height outside the envelope (walls and ceilings) of the general building
Adequate	Sufficient to achieve certain requirements or certain urgency
Adhesive	A material used to glue a steaming surface
Air Break	Separator left between the drainage pipes from the water pipe and the drainage pipes, water collection basins, or water valve to prevent reflux (reverse drainage)
Air Contaminants	Discounts or unwanted airborne materials that reduce the suitability and deflection of air
Air leakage	The air that runs out of the building through the points of separation, linkage, confluence, or surfaces that surround the meaning, which is the uncontrolled flow of the building's air through cracks or openings.
Ventilation	It is the outdoor and recycled air complex that the building is supplied with after it has been purified or rehabilitated to maintain an acceptable level of indoor air quality.
Asbestos	A group of impure vinculum silicate metals that exist in the form of fiber, asbestos is used in a range of fabricated building materials as an insulator and will also serve as a fire-resistant material. Long-term exposure to large amounts of asbestos can have serious health effects such as chest and abdominal diseases and lung cancer, so the use of asbestos products has been reduced and restricted in many countries.
ASHRAE	American Society of Heating, Ventilation and Air Conditioning Engineers
Environment and its Elements	It is everything that surrounds and influences living things in one way or another, and in the broadest sense also means: water, land, atmosphere, man, and all forms of life that are fabricated, including domesticated and wild plants and animals and the relationship between them. It also includes economic and social conditions, as well as places of historical, archaeological, cultural, or aesthetic value.
Environmental Impacts	They are direct influences caused by the project, occurring at the same time and place or indirect or secondary influences resulting from the project, and appearing later or elsewhere.
Balancing (Air System)	A process that is done to ensure the provision of the correct amount of air by adjusting the airflow rates through the air distribution system devices (such as fans and air outlets) and by manually adjusting the position of the air ballasts and distribution blades or using automated controllers such as fixed or variable air supply units.
Building Envelope	It is the external area of the building that forms a separation of the structures of the internal and external spaces, and the cover of the building is defined for the air-conditioned contrasts as we have the grate of the building that separates the places from the outside
Building occupants Or Building users	The special ones who will use the building, and who will use the building for each whole are the ones who will use the building for at least 8 hours on most days, and who will use the building in each part are the ones who will use it for less than 8 hours in most days, and you will not use it Passers-by such as visitors, customers and students are the ones who will serve the building at irregular times.

Building Permit	Issued by the municipality to carry out construction work
Certified Timber	The process of granting wood a certificate or mark of conformity is a process that leads to obtaining a written and stamped certificate certifying the installation of the origin, condition and/or importance of the raw wood materials and their conformity to certain requirements, often after validation by an independent third party.
Composite wood products	Wood products such as plywood, treated wood boards, door fillings, pressed wood boards, as well as medium-density fiberboards
Construction and demolition waste	Waste that results from the construction, renovation, demolition, and dismantling of structures, and is not considered to be the preservation of construction sites including soil, vegetation and creek from construction and demolition waste.
Contractor	Any person or legal person who is restricted and licensed to practice the profession of contractor
Control Systems	The systems allow the occupants to change/modify the level of lighting and air conditioning in the space.
Cooling load	It is the amount of cooling required by the building to meet the design conditions specified by the municipality, and the amount of refrigeration is based on the result of the convection sap required by the Municipal Council
Day lighting	Use natural light derived from sunlight or sky to provide illumination of an indoor space
Designated preferred parking spaces	The parking spaces that are close to the entrance to the main building except for the places for people with special needs, or the parking spaces closest to the pedestrian exits leading to the parking lots
Enabled Access	The core of the project ensures the possibility of using and easy access for people with special needs to the building and move through it
Equivalent	Measurement, criterion, or reference material recognized by the municipality equal to or better than the original
Exhaust Air	Air that is deliberately removed from the building envelope and rejected to the environment during mechanical or natural ventilation.
Fan systems	A fan system that will be used to supply air or air from the neighborhood of G in the building
Fenestration	Another poison called the glazed elements in the building
Fresh Air	Outdoor air is supplied with space in the building using a natural mechanical ventilation system F to replace the air depleted by the building
Glazed areas	Glazed element spaces from the exterior walls of the building
Global Warming Potential GWP	The contribution of liberated greenhouse and emitted to the atmosphere in the occurrence of global warming
Grey water	Untreated household sanitary shelf water that has not been mixed with toilets, includes water used in showers and sinks and the sinks or the mother's sinks and the laundry sinks and the washing machines
Hazardous waste	Any waste that can cause significant damage to humans, property or the environment due to its inherent hazardous properties, and hazardous wastes are in solid, liquid, gaseous or sedimentary forms or any combination thereof.
Heat Load Calculation	Design parameters used in calculating heat load according to municipality requirements

Heating, Ventilation, and Air Conditioning System (HVAC)	Equipment, distribution systems and equipment that provide individual or collective heating, ventilation and air conditioning operations for a building or part of it.
Heritage building	The building with historical architectural elements located within the historical area where demolition and change works on the building is not allowed until after obtaining the approval of the concerned authority
Industrial building	Any building used directly in the fields of manufacturing, processing, technical production projects or storage, including workshops, factories, and warehouses.
Light fixture	Luminaire units that contain the lamps and their position, block them from view, distribute the light and include a connection to the power source, which may require the use of an electronic brake.
Lighting power density(LPD)	Maximum luminance power on a unit area
Light reflective Value LRV	A measure of the total amount of light that can be used and visible reflected from a surface in all directions and on a scale from zero percent to 10096 and zero percent represents a dark black surface, and one hundred percent represents a bright white surface. The blackest walls achieve a light reflection value of approximately 596 and the whitest walls achieve a light reflection value of approximately 8596.
Light transmittance	The proportion of external light that penetrates inward through glass elements, and the higher this percentage, the greater the amount of daylight entering the building.
Lux	The luminaire unit of the international system is equal to one lumen per square meter
Mechanical ventilation (active ventilation)	Ventilation that is provided by powered equipment such as fans
Minimum efficiency reporting value	Minimum Rated Efficiency Value for MERV Air Technology Expresses the air technology efficiency of an air filter evaluated using the ASHRAE standard
Mixed mode ventilation	Combining natural and mechanical ventilation
Natural ventilation (Passive ventilation)	It is ventilation that is provided by thermal influence, wind effect, or the effect of air diffusion through windows, doors, or any other openings in the building.
Occupant lighting controls	They are means of controlling the level of lighting easily available to the users of the building. Include power and fire switches.
Occupancy Sensor	It is a device that detects the presence or absence of people within a certain area. Accordingly, the work of lighting, equipment or appliances is organized.
Office	The building where clerical work or professional activities take place
Outdoor environment	It is an environment outside the building and not confined to walls
Ozone depletion potential (ODP)	An expression of the contribution to the gradual destruction of the ozone layer in the stratosphere
Parking area - enclosed	It is the spaces used by the building space for parking that does not meet the standards of open parking and is considered closed and require mechanical ventilation to compensate for the lack of natural ventilation

Parking area - open	It is the spaces used from the building space for parking that require openings that are homogeneously distributed on two or more sides by assuming that they have access to natural ventilation x all levels of parking. The percentage of the total area of the openings overlooking the outside should not be less than 20% of the total area of the surrounding (exterior) walls for each level of parking and no openings are required on the third side as it is preferable that the openings be on two opposite sides by imposing the provision of a ventilation duct
Parking ventilation	Is the ventilation required to maintain a satisfactory level of air quality in parking lots
Perimeter zone	Places in the inner perimeter of the space adjacent to the outer walls
Positive pressure	Group of pipes, pumps, valves, tanks, taps in control devices and other permanently installed devices used to distribute water inside and outside the building
Potable water	Water suitable for human consumption
Pressure differential	The difference in pressure between two points in a particular system or between two different spaces in a building
Public building	The building that is used by the general public and this type of building includes health facilities, educational buildings, government buildings, mosques, houses of worship, refueling stations, shopping malls, retail stores, post offices, banks, banks, museums, theaters, cinemas, historical and heritage buildings.
Recycling	Treatment and use of used materials for new products to avoid wasting materials that can be utilized, reduce the consumption of new raw materials, reduce energy use, reduce air, and water pollution by reducing waste disposal by traditional methods
Refurbish (Retrofit)	Basic modification of a building or services of a building by replacement or improvement of quality and this may occur when the building or part of it is occupied by a new inhabitant
Relative humidity	Ratio of the partial density of water vapor air multiplied by the density of saturation with water vapor at the same temperature and same total pressure
Residential / commercial building	This type of building includes apartments, workers' housing, student housing, offices, hotels, resorts, restaurants, food shops and laboratories.
Reuse	Any activity that prolongs the life of an element. This usually comes from reusing the element with the same capacity as the previous one.
Safety factor	A quota intended to cover any heating or cooling load greater than what the item required by the item with the same capacity as the previous one.
Sealants	Sticky materials with adhesion properties are used to enforce fillers, prevent leakage, insulate gaps against water, or connect two surfaces.
Secure bicycle racks or Storage areas	Places where private bicycles are stored and/or secured. These places must be indoor or shaded if they are external

Shading coefficient SC	A measure of the amount of heat passing through glass openings compared to the heat passing through a completely transparent glass consisting of one layer. It is the ratio of the sun's heat gain to natural conditions through glass openings to the sun's heat gain through the double-reinforced transparent glass, which is about 3 mm thick, or eight inches thick.
Showrooms	Any space dedicated to carrying out business such as displaying goods for wholesale or retail purposes and the width of the front façade of the exhibition on the street is not less than nine meters
Solar reflectance Index (SRI)	It is a coefficient that combines reflectivity and emission capacity and measures the ability of materials to expel the sun's heat. So that the value of 0.90 for the standard black color (reflective 0.05 and emission capacity (581)
Thermal bridges	An element or group of elements that are not insulated in the shell of the building, where heat is transmitted through it at a much higher rate than the surrounding area, for example, metal fastening materials, concrete bridges, ceilings, and the mayor.
Thermal comfort	The condition of a tried thermal environment satisfies the users of the building
Thermal insulation	Materials, methods, and processes used to reduce heat transfer and where thermal energy is transmitted by conduction, load or thermal radiation, the flow of heat during the processing of one of these mechanisms can be reduced depending on the physical properties of the materials used.
Thermal transmittance	Also known as U-Value, it is the rate of heat transfer (bW) over one square meter of a particular building divided by the temperature difference between the two sides of the building (internal and external) and expressed as (W) per square meter per degree Kelvin or (W/m2). K) Well-insulated parts of the building shall have a low heat transfer coefficient while poorly insulated parts shall have a high heat transfer coefficient.
Total vehicle parking capacity	The total number of car locations within the site as determined by the municipality
Treated sewage. Effluent TSE	The results of the removal of natural, chemical, and biological contaminants from wastewater. These processes result in appropriate treatment fluids for reuse or discharge into natural evidence as well as solid (or sedimentary) waste.
U-value	Refer to (heat transfer coefficient)
Vegetated roof (green roof)	Cultivated roofs consist of vegetation cover, soil or agricultural mediator teams of waterproofing layers placed on the roofs of buildings. Cultivated surfaces may be used on additional layers such as root blockers, drainage and irrigation systems and may be used for various purposes from saving energy to benefiting from rainwater and minimizing its effects in addition to aesthetic benefits.
Ventilation	It is the process of supplying space with air or expelling air to control the levels of air pollutants, humidity levels or temperature within this time.

Volatile organic Compound (VOC)	Organic chemicals with high vapor pressure easily form fumes at normal temperatures and pressures, and this term is applied to organic solvents, certain additives to paint, pressurized spraying, fuels (such as gasoline and kerosene), oil distillation derivatives, dry cleaning materials and other industrial and consumer products from office supplies to building materials.
Wall washing lights	A lighting unit used for aesthetic or advertising architectural purposes that allows the issuance of a color-changing light or flicker (with the possibility of adjusting the speed of its movement) and is programmed to work automatically and can work to drop light over long distances and can be used inside or outside the building

CHAPTER 1

GENERAL PROVISIONS

Chapter 1

General Provisions

1.1 Introduction

Palestine suffers from a shortage of natural resources for basic life requirements, especially water and energy, while Palestine covers its energy needs by importing 100% of its needs from Israel and neighboring countries. Palestine has also begun to suffer from the effects of climate change, represented by the shortening of the spring and autumn seasons, and the noticeable rise in temperatures in summer and their decline in winter. In addition, the lack of rain and the increase in winter from the annual average.

Palestine also suffers from the environmental pollution in its various forms, air, water, noise, radioactive, as well as soil pollution. To reduce these problems, the Engineers Association, through the Palestinian Green Building Supreme Council, has been moving towards green buildings because of their positive impact on preserving the environment, in addition to reducing the operational cost of buildings considering the high operational cost, as well as reducing the use of water considering the limited sources in Palestine.

This guide contributes to the strategic plan of the State of Palestine of creating a sustainable urban environment and improving the level and efficiency of infrastructure in line with future needs.

It is time for us as Palestinians to implement greener measures to tackle climate change. Where the efforts of experts in this field are united through a partnership with the Ministry of Local Government and with the support of Enabel (Belgian Development Agency), which resulted in the production of the second and revised edition of the guideline for green building in Palestine.

The second edition of the Green Building Guideline is the outcome of the experience gained by engineers and experts during the past nine years after applying the first guideline to a number of green building projects, the goal of which was to reduce the effects of buildings on health and the environment through efficient resource management.

This guide contains a set of minimum standards aimed at reducing greenhouse emissions, producing clean energy, and saving costs for buildings on viable buildings located under a given gross floor area to provide better energy efficiency, water and wastewater management, material sustainability, solid waste management, site sustainability and quality of the internal environment. By implementing the guideline and promising to reduce greenhouse gas emissions and energy and water consumption by at least 20%, we will herald the realization of the Palestinian government's commitment to reduce carbon emissions to the lowest possible levels as set out in the 2030 Sustainable Development Goals.

We have taken the first steps in engineering these guidelines with the help of the Association of Engineers, Palestine Higher Green Buildings Council, and stakeholders to respond to the call for organizing sustainable building. We now call on all concerned parties, investors, international financiers, and all relevant parties to spread the culture of green building and apply the contents of this guide, as we achieve an environmentally sound Palestine.1. Sustainable Architecture

The most important basic principles of sustainable buildings are the ability to adapt to the climate, reduce energy consumption and conserve energy. A healthy building must be designed and constructed in a way that reduces dependence on fuel and other consuming and polluting energy sources. This building relies heavily on renewable natural resources, especially the sun, and at the same time achieves the goal of its construction, which is to protect man from climate conditions and fluctuations, as well as try to create an internal environment that provides him with comfort.

1.2 Title

This document is known as the “Green Building Guideline – Palestine “hereinafter referred to as the "guideline".

1.3 Policy

The state must protect and promote the right of people to a balanced and healthy environment in harmony with the rhythm and harmony of nature against the harmful effects of climate change. It shall protect the environment, property, and public health, to serve the common good and public welfare in accordance with the principles of sound environmental management and control. For this purpose, an acceptable set of standards and requirements for relevant buildings for the organization of their location, layout, design, quality of materials, construction, use, occupancy, operation, and maintenance are determined.

1.4 Objectives

The guideline seeks to improve the efficiency of building performance through a framework of an acceptable set of standards that will promote the sound management of the environment and resources that will confront the harmful gases responsible for the negative effects of climate change, throughout the life cycle of the building including efficient resource use, site selection, planning and design Build, use, occupy, operate and maintain without a significant increase in cost.

This guideline is a set of regulations that define minimum standards of compliance by which buildings will be evaluated for green building certification at its various levels.

This guideline also aims to clarify the technical and technical standards necessary to reach and evaluate sustainability requirements in buildings in Palestine, to:

1. Reducing the amount of water used in building occupancy.
2. Reducing the amount of energy used in building occupancy.
3. Reducing the materials consumed during construction and after occupancy and encouraging their recycling.
4. Reducing the extent of the environmental impact of buildings on the surrounding environment.
5. Finding a starting point for preparing a building code for green buildings in Palestine.
6. Contributing to the creation of high-efficiency, healthy, sustainable, affordable, and environmentally friendly buildings.

1.5 General principles

1. Technical professionals, developers, contractors, property managers and building owners involved in the planning, design, construction and management of buildings have the opportunity and responsibility to assist the government in addressing the negative effects of climate change by ensuring that buildings are planned and designed, so that they are constructed, operated and maintained at the required level of efficiency.
2. Resources must be used efficiently to equitably meet the developmental and environmental needs of current and future generations.
3. Green building users will benefit from improved indoor environmental quality, which promotes higher productivity and better comfort.

1.6 Basic concepts

1. Sustainable Architecture

The most important basic principles of sustainable buildings are the ability to adapt to the climate, reduce energy consumption and conserve it. A healthy building must be designed and constructed in a way that reduces dependence on fuel and other consuming and polluting energy sources. This building relies heavily on renewable natural resources, especially the sun, and at the same time achieves the goal of its construction, which is to protect man from climate conditions and fluctuations, as well as try to create an internal environment that provides him with comfort.

2. Green Buildings

Green buildings can be defined as buildings that strike a balance between the biosphere and the building occupants. Where the building is designed and implemented within the local climate in which the building is located. And the consumption of resources, especially energy and water, in these buildings is much lower than that of traditional buildings. These buildings are distinguished by their ability to conserve energy, exploit renewable energy such as solar energy, and rely on natural ventilation and natural lighting to reduce energy consumption and reduce environmental pollution resulting from it.

Green buildings are designed, implemented, operated, and maintained, and then completed and removed after the end of their life, using methods and techniques that preserve the environment, reduce pollution, and reduce the consumption of various resources, while at the same time enhancing the integration between the building and the natural environment around it.

Green buildings include sustainable buildings and high-performance buildings. These buildings achieve balance and integration between man and his surrounding environment through three basic elements:

1. High efficiency of resource use and consumption
2. Effectively deal with the climatic, environmental, geographical, and social conditions in the building area.
3. Achieving material and social human needs and providing welfare for building users while preserving the rights of future generations

1.7 Scope of application:

This guide can be applied to most buildings that are constructed in Palestine, considering the differences for each type as indicated in the instructions for that type of building. In general, this guide can be applied to:

1) Public buildings include:

- Schools, universities, and educational buildings
- Government departments, including ministries and government institutions.
- Mosques and places of worship
- Administrative buildings of all kinds
- Cultural centers and theaters
- Hospitals and health buildings

2) Private buildings, including:

- Residential buildings, including homes, villas, and apartment buildings.
- Commercial buildings, including commercial complexes and malls.
- Meeting rooms and wedding halls

1.8 Palestinian rating system

1.8.1 Points calculation system

The process of calculating points for green buildings is divided into six main axes, as shown in Table 1-1.

Table (1-1): Points Calculation System

	Domain	Number of points
1	Site Sustainability	20
2	Indoor environmental quality	20
3	Energy Efficiency	30
4	Water Efficiency	25
5	materials and resources	15
Total		110

1.8.2 Classification of green buildings

The green building guideline gives five certificates and classifications of green buildings according to the categories listed in Table 1-2.

Table (1-2): Certification and Classifications of green buildings

	Classification	Certification	Number of points
1	★★★★★	Diamond	90 or more
2	★★★★	Golden	80-89
3	★★★	Silver	70-79
4	★★	Bronze	60-69
5	★	-	50-59

1.8.3 Minimum requirements of green buildings rating system

To evaluate any green building project, this project must achieve at least the minimum level, and the minimum level consists of the following conditions and requirements:

1) Compliance with and compliance with local and international laws. Such as the local building regulations and the modified Palestinian building system, safety laws, earthquakes...etc.

2) The building must be standing, permanent and immovable.

3) Use appropriate limits as determined by local and international laws: For shops, the area is not less than 20 m2 and 100 m2 for the rest of the buildings.

4) Conditions and requirements for operating the building include the following:

- The building must be fully inhabited and used by at least one person.
- That the building is occupied normally and with normal operating capacity.
- The building must be used for a period of no less than 12 months before evaluation for operation and maintenance projects.

5) The building owner or operator must provide complete information on water and energy consumption to the concerned authorities, specifically the Supreme Council for Green Building

1.8.4 Mandatory requirements in all areas of green building

All these requirements are necessary for the green building evaluation process, and points are not earned for them. Points are given based on the extent to which the requirements and conditions for each domain are adhered to.

Table (1-3): Mandatory requirements in all domains of green building

Domain	الاشتراط	النقاط
Site sustainability	pollution prevention from construction and construction	Mandatory
Indoor Environmental Quality	Achieving the mandatory minimum indoor air quality performance	Mandatory
	Environmental control and control of the effects of mandatory smoking	Mandatory
Energy Efficiency	1. Planning for all building energy systems	Mandatory
	2. Achieving the minimum mandatory energy efficiency	Mandatory
	Refrigeration and air conditioning systems do not use substances harmful to the ozone layer,	Mandatory
Water efficiency	rationalization and reduction of water consumption are mandatory	Mandatory
Materials and resources	Collection and storage of recyclable materials and mandatory reuse	Mandatory

1.9 Global green building rating systems

There has been a growing interest in sustainable building since the second half of the 1980s, which has led to the development of various methods and systems for assessing the environmental performance of buildings. Among the most popular systems developed are BREEAM (Building Research Foundation Environmental Assessment Method) in the UK, LEED (Leadership in Energy and Environmental Design) in the USA, SB Tool (Sustainable Building Tool) as an international project and CASBEE in Japan. These methods have attracted interest in many countries of the world. It also provided various systems for building evaluation. This type of evaluation, along with the dissemination of results, is one of the best ways now available to provide an incentive for clients, owners, designers, and users to develop and promote sustainable building practices.

As voluntary standards, there are a number of environmental assessment and certification systems for buildings around the world. The most popular of these are GBC (Green Building Challenge), LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Foundation Environmental Assessment Method), GREENSTAR (developed based on LEED and BREEAM by the Australian Green Building Council), and BEES (Building for environmental and economic sustainability), SBtool (sustainable building tool) from Canada, ECO-QUANTUM (simulation-based tool), ECOPROFILE (for existing office buildings), LCAid (based on building life cycle), and CASBEE from Japan, Estidama (Sustainability) from Abu Dhabi, IGBC from

India, HQE from France, and DGNB from Germany. These systems are found in different climate regions, from the cooler climates of North America and Eastern Europe to the warmer Mediterranean climate, the humid climate of Dubai and central Japan, and the global standard may seem an attractive and effective option for many environmental and sustainability experts. However, it is not currently possible to achieve a global green standard, given the different circumstances of each country, from climate to material and land availability, energy generation opportunities, cultural adaptation, and legislative support. Therefore, these systems are not designed to be used across different regions and countries and their requirements are representative of local conditions.

LEED and BREEAM are the world's most famous and rigorous systems for assessing and recognizing “green” buildings. Each provides a list of auditable criteria against which potential green buildings can be evaluated. These regulations are also largely responsible for the consensus on the meaning of "green building", and the widespread use of the term to describe a building that meets basic sustainability criteria.

The issue of legitimacy is critical to the adoption or adaptation of a green building classification system in Palestine, to be suitable for it from an environmental, economic, and political point of view. In this regard, LEED and BREEAM offer clear, reliable, and motivating pathways. However, (in its current form) its expected impact on the construction sector in Palestine is limited for a number of objective reasons. Although they have developed and matured in the United States and Britain because these systems are designed according to the strengths of their specific construction industries, they have recently begun to adapt to the international realities of climate, resource availability, and construction sectors. Therefore, most of the local projects in Palestine cannot meet the standards of the regulations due to the lack of human and material resources. Therefore, only a marginal amount of internationally designed and funded projects can realize the environmental benefits of LEED and BREEAM in the local environment or contribute to driving the market forward and popularizing the idea. Such systems that consider themselves global also contain many local biases. It cannot be loosely generalized for application in different contexts or societies. Therefore, to better serve local needs, it was necessary to develop a local system based on adapting the criteria that suit the needs of local development, excluding criteria that do not fit the environmental and economic conditions and the needs of local development.

The following table shows a comparison between the standards adopted in the three most popular green building assessment systems in the world, which were among the most important references used in preparing this guide. It also shows what was selected from the five criteria adopted by green building as basic elements in its composition.

Table (1-4): Comparison between the basic evaluation criteria for green buildings in the global systems BREEAM, LEED and CASBEE, and the approved standards for Palestine

	LEED (USA)	BREEAM (UK)	CASBEE	approved standards for Palestine
1	Local Environment	Ecology	Sustainable Site	Site Sustainability
		Transportation		
		Land use		
2	Indoor environment quality	environment Health	Indoor Environment	Indoor environment quality
		Pollution		
3	Energy and Atmosphere	Energy	Energy Efficiency	Energy Use Efficiency
4	Water	Water	-	Water Use
5	resource effectiveness	Materials	materials and resources	materials and resources
		construction waste		
		Administration		

Source: A. M. Ismail, Muhammad Abu Elaila and A. B. Ahmed, Local Green Building Standards: An Anti-globalization Thesis, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 9, September

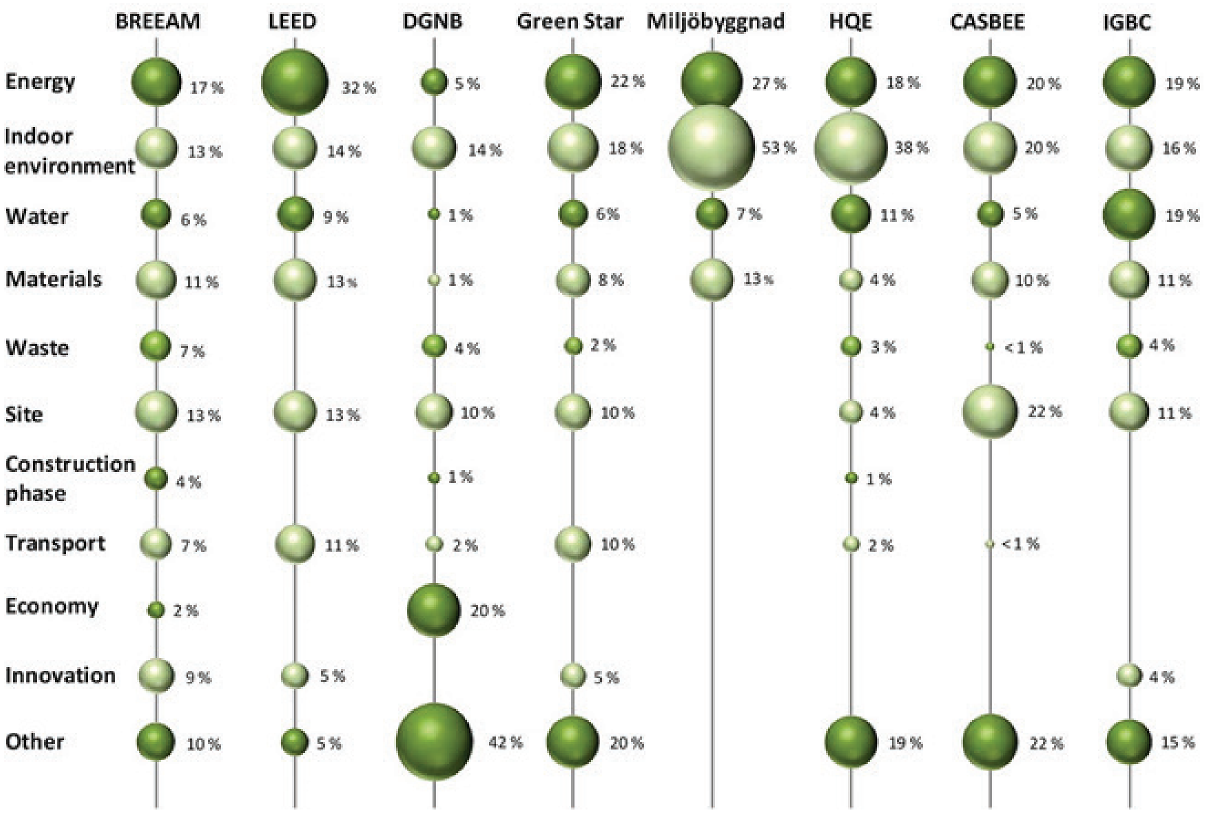
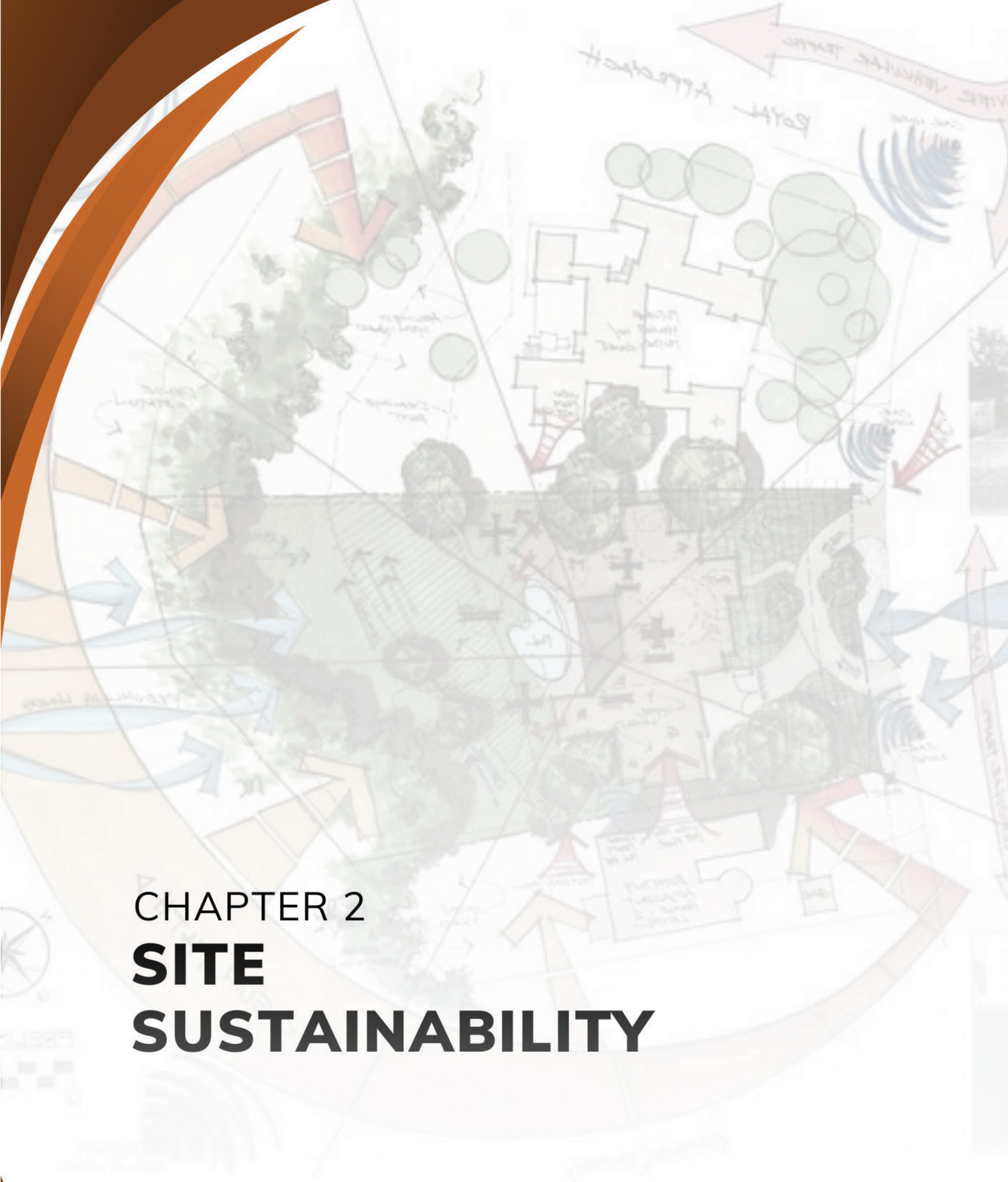


Figure 1.1: Weight distribution of the different items in the main rating systems

Source: The Value of Green Star - A decade of environmental benefits



CHAPTER 2

SITE SUSTAINABILITY

Chapter 2
Site Sustainability 2

2.1 Introduction

The site environment is defined as the natural flows and cycles of energy, water, and materials. This includes plants and animals (flora and fauna) that interact with and depend on these flows. Any new development through the construction of new buildings will affect it in all project stages. Existing ecosystems should be understood and maintained, and where ecosystems have been damaged by past developments, new development should seek to identify and restore these habitats.

In addition to the ecological aspect, attention must be paid to providing thermal comfort by providing appropriate shading and preventing the formation of heat islands. As well as preventing soil erosion and reducing energy and water consumption. This can be achieved using renewable energy and water harvesting of rainwater and the cultivation of plants that do not need large amounts of water. Choosing a site close to services and public transportation effectively contributes to reducing energy consumption and gas emissions for easy access to the building.

2.2 Concerns

Ecology is the study of living systems and their interrelationships, considering their biotic (living) and abiotic (non-living) environments. Biodiversity is defined as "the variability among living organisms from all sources" that includes, among other things, "terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within and among species and ecosystems humans and their activities are an integral part of many biophysical systems on earth.

The environmental impact of human activities can be understood at three levels of the process:

- Local: The local environment or site consists of soil type, substrate, water patterns in and around the site and local land use. Sites may be broadly categorized as environmentally sensitive, green, cluttered, or polluted. In all cases, the project team must understand the impact of new developments and opportunities to make use of existing resources through site studies.
- Regional: Buildings have the potential to achieve the collective good on a larger scale. Building integrated agriculture, for example, is one way to ensure food security for urban residents while increasing their demand for fresh and safe food. Limiting food production within development boundaries also reduces a community's carbon footprint and reduces the urban heat island (UHI) effect.
- Global: On a larger scale, the use of resources, such as energy and materials, is destroying the world's ecosystems at an alarming rate. This occurs either through greenhouse gas emissions related to energy use, or through changes in land cover and habitat destruction.

2.3 Considerations

Site selection is the first step in addressing the environment. Where possible, sites are chosen with the intent of minimizing damage to the existing ecosystem. An Environmental Impact Assessment (EIA) should be conducted early in the design process to assess the potential impacts of urban construction and development. An EIA can help the design team understand the negative consequences arising from the construction and operation of buildings and suggest ways to mitigate these consequences.

If the site environment has been damaged by previous developments, a rolling approach can be adopted. This seeks to restore the health of the ecosystem as much as possible by introducing medicated plants and water features that will attract insects and animals over time.

2.4 Implications and effects

By implementing green building rules and regulations we can conserve undeveloped lands for non-construction purposes. Sites can be broadly categorized into several types:

- Undeveloped areas (greenfields)
- Sites with agro-ecosystems in rural or semi-urban areas
- Urban sites with little or no natural systems (brown fields and green fields)

Environmentally sensitive sites should be avoided at all costs. Where possible, abandoned field sites should be preferred over green field sites.

Once the site has been selected, building designers must maximize the damage to the site's sensitive green spaces to restore ecological balance and reintroduce biodiversity. Plants must be grown in a way that approximates the biodiversity and density of indigenous ecosystems and supports ecological succession. The native species of plants are preferred because they are well adapted to the local climate.

2.5 Palestinian context

The area of agricultural land in the West Bank and Gaza Strip is 0.01 (hectares per capita), according to the latest report of the World Bank in 2016. This number is very low compared to the minimum value required for food security as stipulated by the Food and Agriculture Organization (FAO) which is 0.4 hectares/person. The Gaza Strip is considered the most densely populated area in the world. For this, urban sprawl in blue areas must be stopped and erosion should be prevented. Also, the importance and need for land rehabilitation and restoration will increase with the intensification of the effects of climate change.

Due to rapid urbanization, large areas of agricultural land or reclaimable land are currently being developed into inhabited urban areas, due to restrictions imposed on building outside areas A and B and the inability to build in the highlands due to full Israeli control and preventing the establishment of new neighborhoods in those areas. Therefore, green building is important for Palestine as it encourages construction in previously used or polluted areas and to stay away as much as possible from green areas, agricultural lands, or reclaimable lands.

2.6 Point distribution.

The total number of points is (20) and distributed over the following areas:

Table (2-1): The total points (20) and distributed over the following areas:

	Item	Points
1	Construction activity pollution prevention	إلزامي
2	Site selection	3
3	Quality of transportation and building accessibility	4
4	Site development	4
5	Outdoor thermal comfort and urban heat island effects	4
6	Stormwater management	2
7	Light pollution prevention	2
8	Innovation in design	1
	Total points	20

2.7 Construction activity pollution prevention

2.7.1 Aims

Completing the construction process with the least possible damage to the site's resources, the built environment, and the residents of the vicinity of the site

2.7.2 Requirements

During the Construction of the building, consider the application of the following points:

1. Protecting the resources on the site so that the surface or ground water is not polluted, and the soil is not eroded.

2. Make an assessment before starting the design and implementation process, investigate the opportunities and possibilities of creating a sustainable site, and develop a plan by all implementation teams to work effectively and to obtain creative solutions to the problems that can be encountered at the construction site.

3. Protecting the soil of the site during the construction process and planning for soil management so that we reduce possible damage such as pollution with construction waste or soil compaction by moving it to areas far from construction operations and returning it to the places supposed to be cultivated. In case the soil was damaged during the construction process, it must be rehabilitated and returned to the planting places after studying:

- Percentage of organic matter (containing at least 3% of organic matter)
- Soil compaction
- Filtration ratio
- Soil biological efficiency

4. Reducing the volume of excavation waste such as rocks, soil, sand, and plants by re-exploiting them in the site to reach a site without waste.

5. Reducing air pollution with greenhouse gases during the construction process through:

- Using highly efficient equipment and making a periodic plan for equipment maintenance
- Using low-sulfur diesel
- Reducing the period of operation of the equipment without actual work to less than 5 minutes for every 60 working minutes

6. Reducing the amount of dust generated from the construction process by:

- Reducing dust-producing activities and directing them away from the surrounding population and controlling dust that results from construction activities using water.
- Ensure that trucks transporting various building materials are covered during the transportation process.

7. Do not use drinking water on the site except drinking, washing, or doing concrete work.

8. Use noise and light pollution control and reduction during the construction process.

2.7.3 Points

No points: this is required.

Practical implementation- Construction activity pollution prevention			
Responsibility:	Engineer ◉	Contractor ○	Owner ○
Stage:	Design ◉	Construction ○	Operation ○

Examples of how the project complies with the requirements to prevent pollution from the construction process
Studying the surface and groundwater and making sure that none of them will be damaged during the construction process
Installation of equipment to reduce the amount of gases emitted by vehicles working on the site
Reducing the amount of dust resulting from the construction process by water spraying
Awareness that drinking water should not be used on the site except for drinking, washing, or concrete works and watering
Reducing noise and light pollution during the construction process by determining maximum noise levels and the working hours

Required documents for the green building evaluation process	Submission stage
Environmental protection plan for the site and surroundings	Before Construction
Management of construction waste through sorting and reuse or recycling	During Construction
Make a worksheet for a site maintenance plan	Before and During Construction
Plan for soil management at the construction site	Before and During Construction

Proposed references
Maps and studies from the Water and Irrigation Authority
The results of soil tests in terms of the percentage of organic matter, soil compaction, filtration rate, and soil biological efficiency
Site maintenance work plan

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	Materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☒	☐	☐	☐	☒	☒	☒	☒	☐	☒

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☐	☐	☒	☐

2.8 Site selection

2.8.1 Aims

Encouraging strategies that reduce the environmental impact of the building by directing the urban expansion to urban areas, reducing pressure on (previously untapped) space lands, reducing the waste of resources and preserving the ecosystem through site selection.

2.8.2 Requirements

Make sure that the construction site selection process considers the following consideration:

1. Choosing the site in pre-exploited lands or gray lands so that it is not more than 800 m away from the existing urban fabric. Or choosing the site in the available lands within urban areas and areas with high urban density, with a floor-building ratio equal to 130 % or more so that:

• The proposed building will be used in harmony with the surroundings.

• The available infrastructure is being exploited.

2. The construction is not on agricultural lands or vacant lands (free of construction and urban development), the site is not classified as a natural reserve, and it is not a home to living creatures threatened with extinction (in general, the building system and the Palestinian regulation amended in 2011 forbid construction in Natural Reserves)

3. Building in areas where the main services for the population are located, a basic school (in case of a residential building) and a public transportation station within a radius of 800 m, so that residents are urged to walk to get services and public transportation (note: the distance for high school does not exceed 1.6 km)

4. Choosing a site that is considered polluted, coordinating a plan to treat the environment of the site, and making use of the existing infrastructure during the implementation of the plan.

2.8.3 Possible points

Table (2-2): Point distribution for site selection

Point's requirements	Points distribution
Useing the pre-exploited site or the gray site or site selection in available land within urban areas	1
Availability of basic services and public transportation within 800m	1
Choosing a site considered contaminated or Brownfield	1
Total points	**3**

Practical implementation site selection						
Responsibility:	Engineer	◉	Contractor	○	Owner	○
Stage:	Design	◉	Construction	○	Operation	○

Examples of how the project complies with the requirements of Site Selection
Refer to the structural plan of the city or village and find the use of the land in the proposed area. Get proof that the site is pre-exploited or gray land through aerial photographs, in addition to a detailed explanation of the existing use of the area
Use of GIS and BIM programs in selecting the site so that the information such as population density, land uses, locations of parking lots and paths of public transportation, services and the condition of the land, whether previously used or not, is linked to the structural plan so that the plots of land that meet the previous requirements are known
Proving that the site is considered polluted by doing soil tests and site assessment, determining the amount of pollutants in the site's environment, and integrating the site treatment plan with the design process as a whole

Required documents for the green building evaluation process	Submission stage
The site plan and land use and regulations from the municipality show that the project is within urban areas	Design stage
Provide a plan of the area or a map showing the location of the project, the main services for the residents (commercial, educational, and public), and the walking route and distance for each of these services	Design stage
Environmental pollution measurement tests and Brownfield's assessment so that the amount of pollutants in the soil (such as pesticides and metals such as lead) are evaluated and the results are issued from accredited laboratories	Before construction

Proposed references
Aerial photos
The structural plan of the city or village
Scheme of public transport routes and stops

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	☒	☐	☐

2.9 Quality of transportation and building accessibility

2.9.1 Aims

Reducing the pollution resulting from the use of cars and encouraging the use of public transportation and environmentally friendly means of transportation. Facilitating the accessibility of the building for all ages and segments of society (especially those with special needs)

2.9.2 Requirements

1. The project is to be placed so that the distance between its main entrance and the nearest public transportation station does not exceed 500 m.

2. Provide a place and equipment for the use of bicycles at a distance of no more than 200 m from the street to the main entrance of the project.

3. Provide a charging station for electric cars.

4. Emphasis on the ease of access to the building by applying the following points:

• Provid car parks according to the classification of the site in the structural plan, and provid pedestrian paths between car parks with a width of no less than 1.5 m, painted in a distinctive color to differentiate it from car parks.

• Allocat preferred parking spaces (near the entrance to the building) for people with special needs and vehicles that use alternative fuel sources or have low emissions.

5. Providing a paved way to reach from the public road or the car park to the entrance of the building with a width of at least 1.2 m:

- at the same level as the entrance.
- If it is not at the same level as the entrance, a ramp must be provided with a width of 1.5 m and a slope less than or equal to 1:20 (in case the slope is more than 1:20 and less than 1:12, a handrail must be provided with a height of 0.8 - 0.9 m).

6. Reducing the number of car parks as permitted by regulations and laws and replacing them with minibusses or bicycles (the reduction in the number of car parks should not be less than 20% compared to the ITE Transportation Planning Handbook or any other reference)

2.9.3 Possible points

Table (2-3): point distribution for Quality of transportation and building accessibility

Point's requirements	Points distribution
The distance between the main project entrance and the nearest public transportation station is no more than 500 m	1
Provide a place for the use of bicycles or an electric car charging station at a distance of no more than 200 m from the entrance to the project	1
Providing safe entry for pedestrians, bicycles, and cars (separate paths)	1
Reducing the number of car parks as permitted by regulations and laws (by relying on minibusses or bicycles)	1
Total points	**4**

Practical implementation - Quality of transportation and building accessibility			
Responsibility:	Engineer	Contractor	Owner
Stage:	Design	Construction	Operation

Examples of how the project complies with the requirements of quality of transportation and building accessibility
Providing a site plan that includes the main entrances to the building, public transportation stations and places for bicycles
Determination of parking spaces with electric vehicle charging equipment as a percentage of the total parking capacity (%)
Using the Building Information Modeling (BIM) program so that decisions can be made about the accessibility of the site from the beginning of the design process
Refer to the structural plan of the city or village and the Palestinian re gulations and Building Law to find out the number of parking spaces required for the building

Required documents for the green building evaluation process	Submission stage
A site plan showing the building and its surroundings, the nearby public transportation stations, the pedestrian paths leading to them, and the distances between them and the project.	Design stage
A site plan showing the parking lots (and highlighting the location and places for electric parking spaces) so that the number of parking spaces for electric cars is not less than 2% of the total number of parking spaces.	Design stage
A general site plan showing the building and its surroundings, indicating entry paths to the building, parking lots and bicycles, and how to access them from the public street	Design stage
A report showing the reduction in the number of parking lots (so that the reduction is not less than 20% of the number of required parking spaces	Design stage

Proposed references
Transport and Public Transport Authority
The structural plan of the city or town, Palestinian Organization and Building Law
Michael D. Meyer , ITE transportation planning handbook, 4th edition, Wiley, Hoboken, New Jersey

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	☒	☐	☐

2.10 Site development

2.10.1 Aims

Develop the site to suit the function, protect the ecological system (Flora and Fiona), preserve the site's resources, and be in harmony with the requirements of parking lots, ease of access, rainwater management and shading.

2.10.2 Requirements

Development of the site, considering the application of the following:

1. Cultivate no less than 10% of the site area as stipulated in the Palestinian Building Law and Organization amended in 2011, and preserve as much as possible the trees on the site, especially the large ones, or replace the large trees (diameter more than 5 cm) with smaller trees (the diameter of its trunk is less than 5 cm) at a ratio of 2:1 and focus on the cultivation of native plants instead of invasive plants (invasive plants can be used within a plan to not harm the vital system) and it is worth noting that the priority should be given to plants that do not consume large amounts of water

2. Employing plants on the site for shading in a way that reduces the energy needed for heating and cooling inside the building and works as windbreaks when necessary.

3. Reducing dependence on potable water to irrigate plants on the site and replacing it with treated gray water.

4. Use of alternative energy sources such as photovoltaic cells to meet the needs of electricity in the site, especially lighting.

5. Reducing the soil erosion process through:

o Determine the paths of rivers, streams, and rainwater.

o Use of vegetation cover and trees to stabilize the soil.

o Use surfaces where water can penetrate.

o Making retaining walls, considering the method of water drainage behind these walls

2.10.3 Possible points

Table (2-4): point distribution for Site development

Point's requirements	Points distribution
Cultivate at least 10% of the site area, preserve as much as possible the existing trees, use native plants, and plants that need no irrigation.	1
Employing plants on the site to reduce the building energy need, or using alternative energy sources such as photovoltaic cells to meet the electricity needs on the site	1
Reduce dependence on potable water to irrigate plants on the site	1
Reduce soil erosion	1
Total points	**4**

Practical implementation - Site development					
Responsibility: Engineer	◉	Contractor	◉	Owner	○
Stage: Design	◉	Construction	◉	Operation	○

Examples of how the project complies with the requirements of Site development
A survey of the project site showing the following characteristics of the site: topography, hydrology, climate, vegetation cover and soil to determine the required intervention
Determining the quality of plants and trees (deciduous or evergreen) and their relationship to the openings and directing them so that they are employed throughout the year to improve the internal environment in the building
The plants that are intended to be irrigated using treated water must be chosen with caution.
Reducing soil erosion by studying the paths of rivers, streams, and rainwater in addition to the prevailing wind directions in the site and making a plan to ensure that the soil is not eroded

Required documents for the green building evaluation process	Submission stage
Submit a site plan showing the project boundaries, the footprint of the building, the vegetation cover, the original plants and a list of the plants and trees used in the site.	Design stage
Calculating the amount of electricity required on the site and the possibility of providing it through alternative energy sources such as photovoltaic cells	Design and operation stages
A report showing plants' water consumption and the method of using treated water	Design stage
Drawings show the strategies to reduce soil erosion	Design stage

Proposed references
Available specifications for the types of plants used on the site
WHO guidelines for gray water recycling

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☒	☐	☐	☒	☐	☐	☐	☒	☒	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	☐	☒	☒

2.11 Outdoor thermal comfort and urban heat island effects

2.11.1 Aims

Increasing the rate of thermal comfort in the environment surrounding the building in winter and reducing thermal discomfort during the summer in the outdoor spaces and corridors. It also aims to reduce the urban heat island phenomenon and reduce its impact on the local environment and humans.

2.11.2 Requirements

Emphasis on the use of different strategies to maintain thermal comfort in the external areas of the building. The strategy should consider the following points according to the project's needs:

1. Shading (the use of shading from existing trees or planted trees that are at least 5 years old when the building is operating) or the use of shading from elements used to exploit solar energy or the use of shading from architectural elements that have a reflection coefficient (SRI) not less than 30%
2. Shading at least 50% of the car parks with materials with a reflection coefficient of not less than 30%
3. Use of green roofs in at least 50% of the project roof area
4. Using materials that absorb less heat for floors and surfaces.
5. Use cooling through water vapor.

In the case of using shading, it must be considered that the percentage of shading will achieve the following values according to the use of the external space:

Outdoor space use	Minimum shading coefficient
Outdoor car parking	% 50
spaces around the building	% 60
Pathways	% 65
Bicycle roots	% 40
external playground	% 80

2.11.3 Possible points

Table (2-5): point distribution for outdoor thermal comfort and urban heat island effects

Point's requirements	Points distribution
Use design strategies such as shading (use at least two strategies)	1
use of high-reflective materials for external surfaces and floors (not less than 50% of the site area)	2
Use of green roofs at least 50% of the building roof area	1
Total points	**4**

Practical implementation - Outdoor thermal comfort and urban heat island						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	○	Operation	○

Examples of how the project complies with the requirementsof outdoor thermal comfort and urban heat island effects
Shadow calculations should be done at the equinox (21 March) and at the summer solstice 21. strategies used to improve the thermal comfort level of outdoor spaces, including drawings of shaded areas and a table showing the percentage of shading in June. Shaded grid areas with more than 60% shading percentage can be considered completely shaded areas
Determine the reflection of solar energy for outdoor spaces. This can be done using an SRI calculator
Making illustrations of the proposed green roofs and their impact on the building design

Required documents for the green building evaluation process	Submission stage
Drawings of the shaded areas and the type of shading and a table showing the percentage of shading achieved at 1:00 in the afternoon. A brief report of the materials used to provide a great reflection of the sun's rays, with a mention of their specifications and places of use	Design stage
A site plan or photographs showing the materials used, the areas they cover, and their SRI	Design stage
A site plan or other graphics or photos showing the green roofs used	Design stage

Proposed references
SRI (solar reflectance index) calculator in California's Energy Efficiency Standards for Residential and Nonresidential Buildings (California Code of Regulations, Title 24, Part 6; available at http://www.energy.ca.gov/title24/2008standards/sri_calculator/SRI_Calculator_Worksheet.pdf)
Cool Roof Rating Council Web site at http://www.coolroofs.org/ and the ENERGY STAR® Web site at http://www.energystar.gov/

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☒	☐	☐	☒	☒	☐	☐	☐	☒	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☒	☐	☐	☐

2.12 Storm water design

2.12.1 Aims

Reducing the amount of water lost and exposed to pollution during and after rainstorms through the process of rainwater management in the project.

2.12.2 Requirements

1. Emphasis on the use of a rainwater management system during and after storms by increasing water absorption and discharge. Emphasis on the existence of a storm water management system maintenance program that includes the following:

o Ensuring that the rainwater management system will not harm the buildings adjacent to the project.

o A strategy to prevent soil erosion on the site.

2. Ensuring that this system includes a strategy for collecting at least 90% (Percentile of rainfall events) of water and treating it to achieve the following:

o Removal of 70% of suspended solids

o Removal of at least 80% of the pollutants as large as 1mm

2.12.3 Possible points

Table (2-6): point distribution for Storm water design

Point's requirements	Points distribution
A strategy for collecting and treating at least 90% (percentile of rainfall events) of water	1
Existence of a storm water management program and storm water maintenance program	1
Total points	**2**

Practical implementation - Storm water design			
Responsibility:	Engineer ◉	Contractor ◉	Owner ○
Stage:	Design ◉	Construction ◉	Operation ◉

Examples of how the project complies with the requirements of Storm water design

Provides a completed precipitation event calculator showing the total precipitation from the selected storm event and site-managed runoff.

Describe the proposed practices that will be implemented at the project site as green infrastructure technologies that provide better site hydrology operations

Describe the approach used for stormwater management and maintenance of this program. Include in the maintenance program a description of the techniques used based on the water collection and drainage approach.

Required documents for the green building evaluation process	Submission stage
Sections of the specifications show the mechanisms used to collect and treat at least 90% (Percentile of rainfall events) of rainwater. Clarify that the project will not adversely affect the neighboring stormwater management system and the plan to prevent soil erosion on the site	Design stage
Operation and maintenance plan includes: Schedule an inspection of the stormwater management system to ensure that the system is operating as planned. A report describing the storm water management system in the project includes: Drawings illustrating the contents of a rainwater management system. Calculations from a civil engineer explaining the strategy for managing the amount of rainwater, especially the calculations related to the highest rate of flowing water before and after the implementation of the project. CV of a civil engineer specialized in rainwater management	Construction and operation stages Design stage

Proposed references

CSIRO Urban Stormwater Best Practice Environmental Management Guidelines (2006)

Meteorological data from (Palestine meteorological department https://www.pmd.ps/)

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	Materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	☐	☐	☒	☐	☒	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☒	☐	☐	☐

2.13 Light pollution prevention

2.13.1 Aims

Encouraging projects that reduce night light pollution and its impact on humans and their health.

2.13.2 Requirements

Confirmation that the project achieves the following specifications concerning lighting:

Interior lighting:

Not to increase the angle of installation of the interior lighting units so that they can exit the windows or close these units automatically when the existing spaces are not used.

Outdoor lighting

Use downlights or all lighting units except (public safety and emergency lighting) must be equipped with automatic shutdown between 23:00 and 7:00

Outdoor illumination level

External lighting should achieve the following:

Illuminated area	Maximum illumination level at the boundary of the illuminated area (Lux)	The upper limit of the illumination level at a certain distance outside the boundaries of the illuminated area (Lux)
Parking and low-density areas	< 1.0	N/A
Residential areas	1.1	Below 1.0 at 3 .0 m
Other areas	2.2	Below 1.0 at 4.5 m

In the absence of external lighting, these points are given automatically.

2.13.3 possible points

Table (2-7): point distribution for Light pollution prevention

Point's requirements	Points distribution
Confirmation that the reduction of light pollution is in line with the above points for indoor lighting	1
Confirmation that the reduction of light pollution is in line with the above points for outdoor lighting	1
Total points	**2**

Practical implementation - Light pollution prevention			
Responsibility:	Engineer	Contractor	Owner
Stage:	Design	Construction	Operation

Examples of how the project complies with the requirements of Light Pollution Reduction
The interior lighting scheme shows that the interior lighting does not go out through transparent surfaces. Or use the automatic shutdown of indoor lighting outside of normal business hours and provide tables of lighting specifications used. For upward-directed lighting and lighting that passes through openings, provide a lighting table showing the classification of the top light for each luminaire in the specified direction and inclination (BUG method) For light directed upwards and light that passes through the openings, provide the largest vertical illumination value for each level of vertical calculation at the luminous boundary (Calculation method)
Except for emergency lighting, public safety and compliance with the levels required by specifications, submit a report detailing the calculation of external lighting and achieving the required level of lighting intensity using BUG and/or Calculation method

Required documents for the green building evaluation process	Submission stage
Interior lighting scheme showing that interior lighting does not go out through the transparent surfaces or the use of automatic shutdown of interior lighting outside normal working hours. Interior lighting control strategy, including units that will be extinguished in hours when there are no users and confirmation of the presence of emergency lighting and public safety and compliance with the required levels	Design and operation stages
Provide a site lighting diagram showing the project boundaries, the lighting limit, and the location of all outdoor lights within the project. Exterior lighting drawings and details: control panels and tables for lighting specifications used, including installation height, and lighting direction. Exter ior lighting control strategy, including units that will be extinguished in hours when there are no users and confirmation of the presence of emergency lighting and compliance with the required levels as per IESNA RP-33-99 and IES RP-8	Design and operation stages

Proposed references
ANSI/ASHRAE/IESNA Standard 90.1-2007 , Illuminating Engineering Society IES RP-8, www.iesna.org
Illuminating Engineers Society of North America, IESNA RP-33-99, www.iesna.org

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	Materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Positive Effects on Climate (Based on Rio Policy Markers)											
Adaptation			Mitigation			Biodiversity			Desertification		
☐			☐			☐			☐		

2.14 Innovation in design for site sustainability

2.14.1 Aims

Encouraging creative ideas that have not been addressed in the site sustainability section, which represents innovative solutions that contribute to achieving sustainability for the project site and its surroundings. It also aims to reward ideas that contribute positively to the extension of the concept of site sustainability.

2.14.2 Requirements

To achieve the points requirements for innovative sustainable site design, achieving tangible and measurable environmental effectiveness which is not mentioned in this chapter, and one point is awarded for each innovative idea achieved in each chapter of this guide.

2.14.3 Possible points

Table (2-8): point distribution for Innovation in design for site sustainability

Point’s requirements	Points distribution
Presenting a creative design idea	1
Total points	**1**

Practical implementation - Innovation in design for site sustainability						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	◉	Operation	○

Examples of how the project complies with the requirements of Site selection

Studying the impact of this idea on the effectiveness and efficiency of the building site

Study the appropriateness of these ideas for the project and the site.

The feasibility study of these ideas includes the additional cost of implementing, maintaining and operating, and the return on the building site, and the efficiency achieved.

Study of potential weaknesses and maintenance and sustainability of the proposed solutions

Required documents for the green building evaluation process	Submission stage
A summary of the final design solutions contains: Detailing the creative idea supported by studies and experiences indicating the success of the idea, and illustrations of the idea and how to apply it in the project	Design and operation

Proposed references

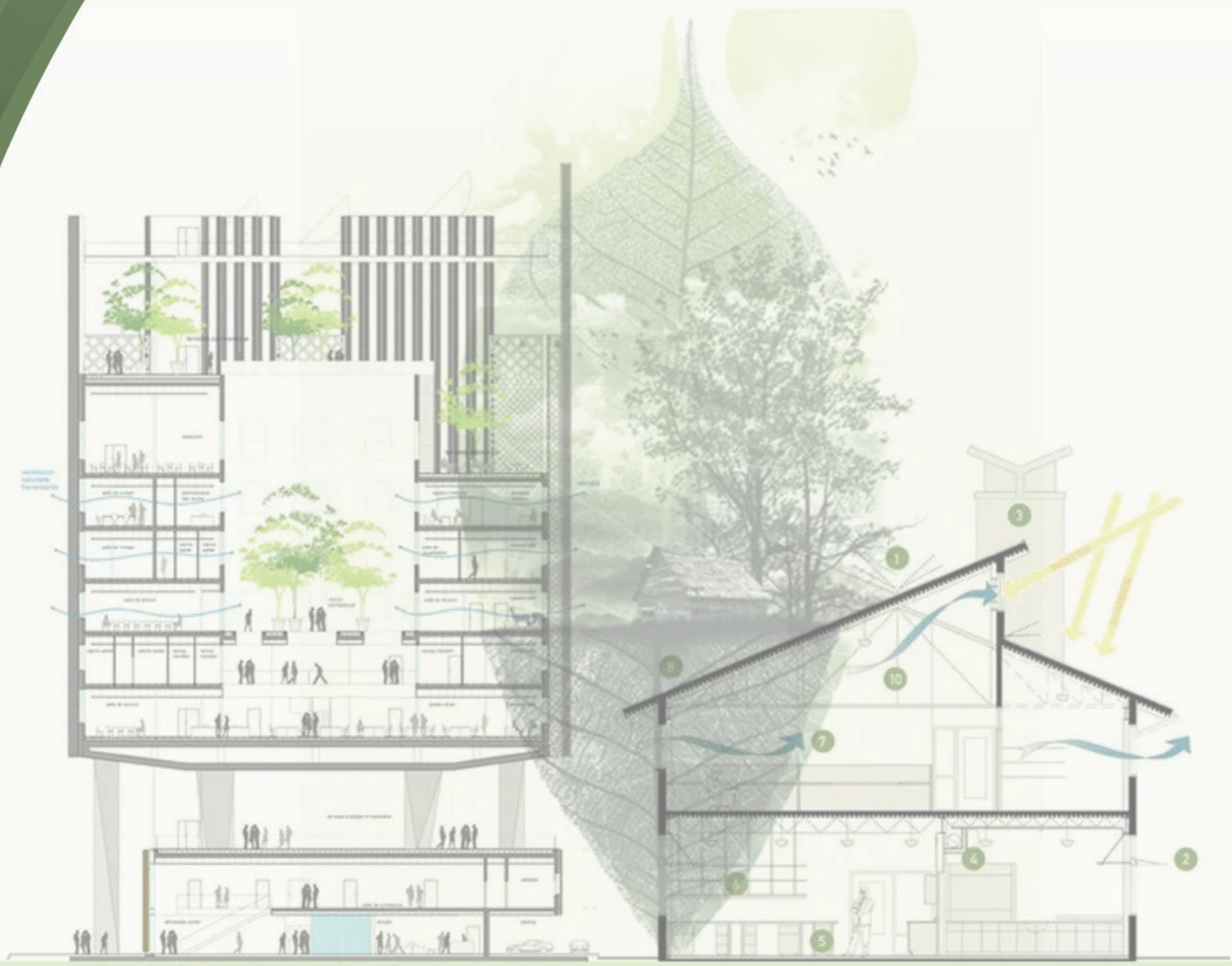
N/A

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☐	☐	☐	☐



CHAPTER 3

INDOOR ENVIROMENT QUALITY

Chapter 3
Indoor Environment Quality

3.1 Introduction

Buildings affect people, their productivity, and their general sense of safety and well-being. When building occupants are unwell or constantly feeling uncomfortable, the underlying cause may be a poor design of the building or poor operation of the systems.

Failure to address human health and comfort can be costly. It can lead, for example, to productivity losses and absenteeism in the workplace resulting in long-term health care and the need to build treatment. When designing buildings for health and comfort, three aspects of health and wellness must be addressed: physiological (physical) wellness, psychological wellness, and emotional satisfaction.

3.2 Concerns

Green building concerns focus on the three aspects of wellness:

• Physiological health focuses on measurable ambient conditions such as brightness and temperature. Physiological health concerns are addressed through standards governing internal environmental quality (IEQ) and external environmental quality (OEQ). IEQ is concerned with creating thermal comfort, visual comfort, acoustic quality, and indoor air quality (IAQ). OEQ refers to outdoor air quality (OAQ), the reduction of outdoor light pollution, and the attenuation of outdoor noise. While air quality refers to characteristics such as temperature, humidity, ventilation air flow, and the presence of pollutants or suspended particles such as dust, etc.

• Psychological health is concerned with specific environmental conditions. Conditions affecting psychological comfort include visual and physical contact with nature, outdoor views, access to daylight, etc. These conditions can improve the productivity and satisfaction of building users. The absence of these conditions for prolonged periods can lead to stress and agitation.

• Emotional satisfaction refers to the calming or exciting features of the environment that nurture our desire for order, coherence, and harmony. The cohesion and clarity of buildings, for example, through pattern, color and arrangement can work to this end.

3.3 Considerations

Physiological health requirements can be addressed through technical specifications and guidelines that stipulate IAQ standards and requirements, and the reduction of light and noise pollution. These specifications may specify prohibitions or restrictions on materials and products used in the construction and operation of the building that contains harmful chemicals or compounds such as VOC's.

Mental health may be defined by light and quality, feelings of privacy and unexposed, access to daylight and landscape, and visual or tactile contact with nature. Other aspects include providing personal control to building users of the internal ambient conditions through the decentralized operation of the systems.

Emotional satisfaction depends on the type of building and its program. Ease of movement and road clarity, for example, is important in complex buildings such as airports. A well-designed motion system facilitates user access and reduces stress through space planning and building form, pathways, and signage. In addition, the use of local materials and crafts gives the building familiarity and harmony with its community.

An increasingly important principle in interior comfort is adaptive comfort. The principle of adaptive comfort states that "if a change occurs that causes discomfort, people react in ways that restore their comfort." Building users are more tolerant and satisfied with buildings that allow them to access building controls or provide personal control through devices such as operable windows. Whereas when environmental control is centralized or controlled by the building manager, a lower tolerance for temperature fluctuations prevails and building users are less satisfied and tolerant.

3.4 Implications and effects

The impact of the built environment on the health and comfort of building users and occupants can be understood through two broad concepts - avoidance and adaptation.

a. Avoid: A well-designed building avoids conditions likely to worsen health or inconvenience to its occupants. Many building codes, for example, seek to enforce indoor environmental quality (IEQ) standards that state what a building must avoid.

b. Adaptation: The design of the building can also create conditions that contribute to the occupant's feeling of comfort, for example, the presence of green spaces or access to outside views.

3.5 Palestinian context

Very limited studies have been done on the quality of the internal environment in Palestine. The studies that were carried out on a small scale by construction specialists in Palestine proved the absence of elements of environmental comfort, especially with climate change and the increase in the density of buildings in residential communities, and the indoor air quality is low due to the use of materials containing high levels of pollutants such as volatile organic matter or lead and mercury. It is important to note that there are more than 5 different climatic zones in Palestine, despite its small geographical area. , There are dry and hot areas, while others are wet, moderate, or cold. And all this requires great attention from the designer of the building to consider the climatic conditions of the area for which it is designed. Accordingly, green building is concerned with the quality of the

internal environment of the built spaces by focusing on the following aspects:
1. Indoor air quality,
2. Good ventilation.
3. Interior finishes materials & avoiding harmful and hazardous materials.
4. Improving thermal comfort by using design, conditioning techniques, and allowing users to control their internal environment.
5. Visual satisfaction by making effective use of natural lighting and the use of appropriate artificial lighting.

When reviewing this section, the impact of these data on energy consumption and efficiency must be considered.

No	Item	Points
1.	Minimum IAQ performance	Required
2.	Smoking Control	Required
3.	Enhanced IAQ Quality	3
4.	Material Emissions	2
5.	Indoor Thermal Comfort	6
6.	Artificial lighting	2
7.	Daylight	3
8.	Acoustic performance	2
9.	Safe & Secure Environment	1
10.	Innovation in IAQ	1
Total points		**20**

3.7 Minimum IAQ performance

3.7.1 Aim

To contribute to the comfort and well-being of building occupants by establishing minimum standards for indoor air quality (IAQ).

3.7.2 Requirements

Undertake and document an observational survey of local air quality according to sections 4-7 of ASHRAE 62.1-2010.

Demonstrate that the building's mechanical system meets the following requirements:

Separation distances between outdoor air intakes and any exhausts or discharge points comply with ASHRAE 62.1-2010 or local code whichever is more stringent.

All exhausts are located outside of the defined public realm,

Demonstrate that all the occupied areas in the building comply with the minimum thresholds set out in ASHRAE 62.1-2010 using the ventilation rate procedure or local code, whichever is more stringent.

3.7.3 Possible points

No points: this is required.

Practical implementation – Minimum IAQ Performance						
Responsibility:	Engineer	◉	Contractor	○	Owner	○
Stage:	Design	◉	Construction	○	Operation	○

Examples of how the project complies with the requirements of minimum IAQ performance
The designer must follow one of three strategies to provide ventilation in buildings, which are: Natural ventilation (passive): the minimum ventilation must be achieved according to what is recommended by the special references, taking into account that all naturally ventilated spaces must be designed to be open at all times and within 6 meters at most from a wall or ceiling with an open window, and the minimum openable area to the outdoors is 4% of the floor area being ventilated. - Mechanical ventilation (active): The mechanical ventilation of space is designed based on references related to mechanical ventilation. The amount of ventilation required for the areas is determined according to the type of activity, occupancy rate and the type of system. - Mixed Mode ventilation: in which both natural and mechanical ventilation are used. It is followed by what is followed by the previous type.
Determine the location of Air Intake points and Exhaust Air Discharge points of the project
Narrative describing how the mechanical design system meets the Credit Requirements, including a description of a mechanical ventilation system.

Required documents for the green building evaluation process	Submission stage
Documentation of an observational study of local air quality including photographs of surrounding sources of pollutant emissions	Before construction
In naturally ventilated buildings (passive), architectural drawings must be provided showing the distances between windows and ventilated spaces and their respective area. For mechanical ventilation (active) or (mixed), it is important to provide drawings showing the mechanical ventilation systems used in the project, the distances between the Air Intake points and Exhaust Air Discharge points, and the distances from the air exhaust points to any defined public realm areas.	Design stage
Spreadsheet calculations of fresh air ventilation rates based on the ventilation rate procedure for all zones.	Design stage
Or Providing computer simulation results for the used ventilation system and providing the minimum quantity of air.	Design stage

Proposed references											
ASHRAE 62.1.2010 “Ventilation for Acceptable Indoor Air Quality,” www.ashrae.org											
Local or regional equiv ale nt codes related to natural and mechanical ventilation in buildings											
Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	☒	☐	☐

3.8 Smoking control

3.8.1 Aim

To eliminate or minimize exposure of building occupants to the harmful effects of tobacco smoke.

3.8.2 Requirements

1. Demonstrate appropriate measures are incorporated into the building design to reduce exposure to tobacco smoke:
2. Prohibit smoking inside the building including the enclosed parking area.
3. Designate smoking areas located at least 10 meters from all entries, outdoor air intakes, and operable windows.
4. Locate any dedicated external smoking areas away from public or high-use pedestrian thoroughfares and install suitable facilities for collecting smoking waste.
5. Install signage indicating the no-smoking policy in a project and other signage leading to a dedicated outdoor smoking area.

3.8.3 Possible points

No points: this is required

Practical implementation – Smoking control						
Responsibility:	Engineer	◉	Contractor	◉	Owner	◉
Stage:	Design	◉	Construction	◉	Operation	◉

Examples of how the project complies with the requirements of smoking control

To achieve this requirement, smoking must be prohibited in all spaces of the building, except for the outdoor areas designated for smoking.

Required documents for the green building evaluation process	Submission stage
Writ ecommitment from the building owner/developer that there will be a no smoking policy operated within the building (private or public building)	All project stages
Drawings indicating the location of dedicated outside smoking areas and facilities for collecting smoking waste which also clearly indicate their distance from entrances, operable windows,and air intakes	Design stage
Photos of posted no smoking and health impact signage and facilities for collecting smoking waste	construction & operation stages

Proposed references

N/A

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☐	x	☐	☐

3.9 Enhanced indoor air quality.

3.9.1 Aims

To promote occupants' comfort, well-being, and productivity by improving indoor air quality

3.9.2 Requirements

Demonstrate that all of the occupied areas meet the following, as appropriate for the type of ventilation:

- Mechanical ventilation:

1. Install an entryway system: which is at least 1.8m long in the primary direction of travel to capture dirt and particulates entering the building at regularly used exterior entrances. Acceptable entryway systems include permanently installed grates, grilles, slotted systems that allow for cleaning underneath, rollout mats, and any other materials manufactured as entryway systems with equivalent or better performance. Maintain all on a weekly basis.

2. Interior cross-contamination prevention: Sufficiently exhaust each space where hazardous gases or chemicals may be present or used (e.g., garages, housekeeping and laundry areas, copying and printing rooms), using the minimum exhaust rates of 2.54 l/s per square meter, to create negative pressure with respect to adjacent spaces when the doors to the room are closed. For each of these spaces, provide self-closing doors and deck-to-deck partitions or a hard-lid ceiling.

3. Install permanent carbon dioxide (CO_2) monitoring and alert systems to always ensure the adequate provision of outside air. At a minimum, one CO_2 sensor must be installed at each return point. The CO_2 level must not be allowed to exceed 1000ppm.

4. Demonstrate that the ventilation design meets or exceeds requirements for pollutant concentrations in car parks. This will be achieved via continuous measurement of the following pollutants:

Table (3-2): Ventilation design for the allowable concentration of air pollutants

Air Pollutant	Averaging Time	Maximum concentration
Carbon Monoxide (CO)	15 min	100 mg / m^3
Nitrogen Dioxide (NO_2)	1 hour	200 µg/m^3
Particular Matter PM10	24 hours	50 µg/m^3

Where the project does not contain any enclosed car parks (75% enclosure), the credit is automatically awarded.

5. After achieving the above credit point, demonstrate an increase in outdoor air ventilation of 15% above the minimum rates determined in section 3.1 (Minimum IAQ performance)

- Natural ventilation:

1. Install the entryway system as above.
2. Interior cross-contamination prevention as above
3. Comply with the Credit Requirement for CO2 monitoring and alert systems for mechanically ventilated buildings (above) for the period when the building is in air-conditioned mode.
4. Ensure the CO2 monitoring system has sensors located in the breathing zone and is capable of alerting occupants when additional fresh air is required. At minimum CO2 levels must not exceed 1000ppm
5. Undertake dynamic simulation modeling (DSM) for the natural ventilation period of operation, to demonstrate the effectiveness of the operable window open areas in terms of thermal comfort (as defined for Mixed Mode buildings in section 3.6 of Thermal Comfort)

3.9.3 Possible points

Table (3-3): points distribution for enhanced IAQ strategies

Point's requirements	Points distribution
CO_2 sensors at all return points	1
Ventilation exceeds minimum requirements by 15%	1
Ventilation rate in car parks meets the points in Table 3-2	1
Total points	**3**

Practical implementation - Enhanced Indoor Air Quality Strategies						
Responsibility:	Engineer	◉	Contractor	○	Owner	○
Stage:	Design	◉	Construction	◉	Operation	○

Examples of how the project complies with the requirements of Enhanced Indoor Air Quality Strategies
Use carbon dioxide (CO_2) monitoring and alert systems and clarify their reference points
Isolate the auxiliary rooms and their exhaust system from the rest of the project systems
Increase ventilation rates for all occupied spaces by at least 15% above the minimum rates defined for these spaces.
In the case of mixed -mode ventilation: the control of windows is based on the outside temperature, depending on the Historic Weather Data.

Required documents for the green building evaluation process	Submission stage
The summary describes how the project will achieve the above points	Design stage
Drawings illustrating used entryway systems, position, and dimensions	Design & construction stages
Drawings/ report illustrating the controlling strategies for auxiliary spaces (mentioned above)	Design & construction stages
Calculations of fresh air ventilation rates based on the ventilation rate procedure for all zones	Design stage
Drawings of mechanical system, including locations of CO2 monitoring systems, schematics clearly indicating ventilation systems and any air handling units	Design & construction stages
Sections, elevations and plans showing details of all proposed natural ventilation openings, locations of air quality sensors, alarm systems, waste air exhaust and fresh air intake places.	Design stage
For automated window opening control systems, provide a description of the proposed opening strategy	Design stage
Summary Report based on DSM modeling of Natural Ventilation Design Performance	Design stage
Taking field readings showing the concentration levels of air pollutants inside the garage and comparing them with the values shown above	Operation stage

Proposed references
ASHRAE 62.1.2010 “Ventilation for Acceptable Indoor Air Quality ,” www.ashrae.org
Local or regional equiv alent codes related to natural and mechanical ventilation in buildings
World Health Organization WHO Guidelines 2000 Air Quality Guidelines for Europe 2nd Edition w ww.who.int

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☐	x	☐	☐

3.10 Materials emission

3.10.1 Aim

Reduce the concentration of Volatile Organic Compounds (VOC) in the indoor environment, to encourage the desirability of these spaces in relation to improved occupant health.

3.10.2 Requirements

Confirm that all used finishing materials (adhesives, paints, composite wood, suspended ceiling system, etc) comply with the limits of volatile organic compounds (VOC) and formaldehyde in indoor spaces as defined in international standards. The tables below illustrate the maximum limits of some used materials.

Maximum VOC Limits – grams per liter (g/L), less water

Table (3-4): VOC limits for adhesives and sealants

Product type	Maximum of VOC (g/l)
Indoor carpet adhesives	50
Carpet pad adhesives	150
Rubber floor adhesives	60
Wood flooring adhesives	100
Ceramic tile adhesives	65
Architectural sealant	250
PVC welding	510
ABS welding	325

Table (3-5): VOC limits for adhesives and sealants

Paint type	Maximum of VOC (g/l)
Anti -corrosive/anti -rust paint	250
Clear wood finish: lacquer	550
Clear wood finish: varnish	350
Floor coating	100
Japan's/faux finishing coatings	350
Waterproofing concrete/masonry sealers	400

Table (3-6): Maximum formaldehyde limits for composite wood and suspended ceiling

Product	Formaldehyde Limit
Hardwood plywood	0.05 ppm
Particle board	0.09 ppm
Medium -density Fiberboard (MDF)	0.11 ppm
Suspended ceiling system	13.5 ppb (16.5μg/m^3)

3.10.3 Possible Points

Table (3-7): points distribution for material emissions

Point's requirements	Points distribution
Adhesive and sealants: A minimum of 95% (by weight) of all adhesives and sealants used in the building interior (i.e., inside the weatherproofing system) do not exceed the above VOC limits	1
Paints and coatings: A minimum of 95% (by weight) of all paints and coatings used in the building interior (i.e., inside the weatherproofing system) do not exceed the above VOC limits	1
Total points	**2**

Practical implementation – materials emission			
Responsibility:	Engineer	Contractor	Owner
Stage:	Design	Construction	Operation

Examples of how the project complies with the requirements of materials emission
Use of interior finishing materials such as paints, plasters, wood, false ceilings, and carpets of low emission types of volatile substances and formaldehyde.

Required documents for the green building evaluation process	Submission stage
List of all used interior finished materials and their specifications in relation to the project confirming which products will and will not comply with the requirements.	Design stage
Billing/purchase receipts for all interior materials used in the project	construction stage
Material Safety Data Sheets and Technical Data Sheets for all interior adhesives and sealants	construction stage
For all products containing formaldehyde, provide extracts from relevant specifications showing how credit requirements are met	Design stage
Test of formaldehyde content in the project after furniture installation	construction stage

Proposed references
SCAQMD: South Coast Air Quality Management District (California, US) – Rule 1168 “Adhesive and Sealant Applications”, www.aqmd.gov
Annex II, Table A of Directive 2004/42/CE of the European Parliament and of The Council of 21 April 2004 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:143:0087:0096:EN:pdf
Environment Protection Agency (EPA)
Palestinian standards institution (PSI)

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☐	☐	☐	☐

3.11 Indoor thermal comfort

3.11.1 Aim

To promote occupants' productivity, comfort, and well-being by providing quality thermal comfort and control over the indoor environment.

3.11.2 Requirements

1. Design for separate thermal zones and controls for a maximum of 35m2 of open plan space on the perimeter of the building and a maximum of 70m2 of open plan space in the internal areas of the building. Each thermal zone must have thermostats that allow control over air speed or temperature as a minimum.

2. After meeting the above requirement, a thermal control system must be provided for individuals according to the following cases:

Mechanical ventilation:

• 1 Credit Point: Provide individual thermal comfort controls for at least 50% of individual occupant spaces, allowing occupants to adjust the air temperature and air speed within the occupied space.

• 1 Credit Point: In addition to achieving the requirements above, provide occupancy sensors linked to HVAC control systems that automatically modulate temperature and air flowrate based on occupancy.

Mixed-mode ventilation:

In addition to the points that can be achieved from mechanical ventilation, in the case of mixed ventilation it is also possible to achieve:

• 1 Credit Point: The provision for operable windows as per ASHRAE 62.1-2016, paragraph 5.1 Natural Ventilation for 50% of the occupied area, and the minimum openable area to the outdoors is 4% of the floor area being ventilated.

• 2 Credit Points: The provision for operable windows as per ASHRAE 62.1-2016, paragraph 5.1 Natural Ventilation for 75% of the occupied area, and the minimum openable area to the outdoors is 4% of the floor area being ventilated.

Demonstrate that thermal modeling calculation has been undertaken during the design process and that the occupied areas perform as follows:

Mechanical ventilation:

Demonstrate that the Predicted Mean Vote (PMV) and Predicted Percentage Dissatisfied (PPD) levels, calculated in accordance with ISO 7730: 2005, are achieved during standard operating hours of occupancy for 98% of the year:

• 1 Credit Point: PMV levels between -0.7 and +0.7 (15% PPD),

• 2 Credit Points: PMV levels between -0.5 and +0.5 (10% PPD).

Mixed-mode ventilation:

Demonstrate compliance with the requirements above for the fully mechanically ventilated period of operation and comply with the requirements of ASHRAE 55-2010 section 5.3, achieving 90% acceptability limits for the naturally ventilated period of operation.

Table (3-8): PMV Values and their Meaning PMV

Thermal perception	ASHRAE, 55	ISO 7730
Hot	7	+3
Warm	6	+2
Slight warm	5	+1
Neutral	4	0
Slight cool	3	-1
Cool	2	-2
Cold	1	-3

Table (3-9): ISO 7730 comfort criteria

Maximum temperature (C°)	Thermal feeling	% PPD
26	Good	10%
27	Accepted	20-25%
28	Bad	<30%
29	Unaccepted	>30%

3.11.3 Possible points

Table (3-10): points distribution for thermal comfort

Point's requirements	Points distribution
Separate thermostatic controls are provided in each occupied space	1
Mechanical ventilation:	
Occupancy sensors in each living area and linked to the air conditioning system.	1
Natural ventilation:	
provision for operable windows for 50% of the occupied zones	1
provision for operable windows for 75% of the occupied zones	2
PMV levels between -0.7 and +0.7 (15% PPD)	1
PMV levels between -0.5 and +0.5 (10% PPD)	2
Total points (maximum points)	**6**

Practical implementation – Indoor thermal comfort						
Responsibility:	Engineer	◉	Contractor	○	Owner	○
Stage:	Design	◉	Construction	○	Operation	◉

Examples of how the project complies with the requirements of indoor thermal comfort
The design team determines the levels of temperature control inside the building according to the different requirements and desires of its users.
Using smart air conditioning systems and joint strategies in which natural and mechanical ventilation can be used together.
Using control systems and occupancy sensors to control the air temperatures and the air flow rate when the spaces are not filled, which contributes to reducing the cost of energy used
Awareness session s for building occupants about the operation mechanism of the thermal control systems in their building, in addition to training maintenance teams on how to perform maintenance operations for the air conditioning systems and their control systems.
At least 50% of occupants can control their thermal comfort systems in their building
Take the local climatic conditions into account when using an openable window system.

Required documents for the green building evaluation process	Submission stage
A b rief narrative describing how the project intends to meet the credit criteria	Design stage
Drawings of the mechanical ventilation systems clearly indicate zone boundaries and zone references. Drawings must also highlight locations for thermostatic controllers. intended for occupant control	Design stage
Spreadsheet listing of each zone including its reference name, zone floor area, zone air temperature, zone resultant or operative temperature, and peak cooling loads zone.	Construction & operation stages
Results for thermal comfort in the building based on Dynamic Simulation Modeling (DSM) software that must cover 8,760 hours (entire year).	Design stage
If the air conditioning systems are not used, provide the following:	Design & operation stages

Proposed references
ASHRAE 55-2010 Thermal Environmental Conditions for Human Occupancy
ASHRAE 62.1-2016 “Ventilation for Acceptable Indoor Air Quality”, www.ashrae.org
ASHRAE 62.2-2016 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
EN ISO 7730: 2005 “Ergonomics of the thermal environment – Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria”, www.bsigroup.com
Local or regional equivalent codes related to natural and mechanical ventilation in buildings

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
x	☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐		☐	☐

3.12 Artificial lighting

3.12.1 Aims

To promote occupants' productivity, comfort, and well-being by providing high-quality lighting and providing them with a high level of control over it.

3.12.2 Requirements

1. Confirm illuminance levels and uniformity according to the lighting requirements for different spaces and as mentioned in the manuals and special codes such as EN 12464-2:2014, CIE 97:2005 and others.

2. For all regularly occupied spaces, use light fixtures with a luminance of less than 2,500 cd/m2 between 45 and 90 degrees from the nadir or fixture of anti-glare. Exceptions include wall wash fixtures properly aimed at walls, as specified by manufacturer's data, indirect uplighting fixtures, provided there is no view down into these up-lights from a regularly occupied space above, and any other specific applications (i.e., adjustable fixtures).

3. For the entire project, use light sources with a CRI of 80 or higher. Exceptions include lamps or fixtures specifically designed to provide colored lighting for effect, site lighting, or other special use.

4. For at least 75% of the total connected lighting load, use light sources that have a rated life (or L70 for LED sources) of at least 30,000 hours (at 3-hour per start, if applicable).

5. For at least 90% of individual occupant spaces, provide individual lighting controls (i.e., especially the working areas adjacent to the external windows of the building) that enable occupants to adjust the lighting to suit their individual tasks and preferences, with at least three lighting levels or scenes (on, off, midlevel). The midlevel is 30% to 70% of the maximum illumination level (not including daylight contributions).

6. Install occupancy sensors in all rooms intended for individual occupancy, conferencing or meeting rooms, open-plan office spaces and hallways or corridors.

3.12.3 Possible points

Table (3-11): points distribution for artificial lighting

Point's requirements	Points distribution
All Light fixtures comply with the criteria above	1
Provide individual lighting controls and occupancy sensors for at least 90% of individual occupant spaces.	1
Total points	**2**

Practical implementation – Artificial lighting						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	◉	Operation	◉

Examples of how the project complies with the requirements of artificial lighting
Ensure illuminance levels and uniformity according to the lighting requirements
Use anti -glare light fixtures , with CRI > 80, and a life cycle > 30,000 hours
Provide individual lighting controls and occupancy sensors for occupied areas

Required documents for the green building evaluation process	Submission stage
Simulation results demonstrating the required illuminance and uniformity targets are achieved for each space.	Design stage
Floor plans and lighting drawings (Isolux) for each relevant space.	Design stage
Data sheet and specifications of used light fixtures and occupancy sensors	Design & construction stages
Field measurements for illuminance levels in different spaces and according to the requirements of each space	operation stage

Proposed references
IES Lighting Measurements (LM) 83 -12
IES The Lighting Handbook, 10th edition
CIE 97:2005
EN 12464 -2:2014
Local or regional equivilant codes related to lighting desing in buildings

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	û	☐	☐	û	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	û	☐	☐

3.13 Daylight

3.13.1 Aims

To promote building designs that maximize the use of natural daylight indoors, in addition to providing visual contact for users with the external environment.

3.13.2 Requirements

1. Install daylight sensors to ensure the availability of appropriate natural lighting.
2. Install occupancy sensors in all rooms intended for individual occupancy, conferencing or meeting rooms, open-plan office spaces and hallways or corridors.
3. Provide manual or automatic (with manual override) glare-control devices for all regularly occupied spaces.
4. Demonstrate a minimum daylight illuminance of 250 Lux on the working plane (762mm from finished floor level) for a percentage of the occupied areas as follows:

a. 50% of the net floor area of office and commercial buildings

b. 70% of the net floor area of residential buildings

c. 80% of the net floor area of educational buildings

5. Ensuring that 75% of the internal spaces used have direct contact with the external environment.
6. In the case of cellular offices, the interior glass walls (partitions) must have a direct line of sight to the outside.

3.13.3 Possible points

Table (3-12): Points distribution for Daylight

Points distribution	Point's requirements
Minimum daylight illuminance of 250 Lux, as follow: 50% of the net floor area of office and commercial buildings 70% of the net floor area of residential buildings 80% of the net floor area of educational buildings	1
Meet requirements for manual or automatic glare-control devices relevant to space type.	1
75% of the spaces used have direct visual contact with the outside	1
Total points	**3**

Practical implementation – Daylight						
Responsibility:	Engineer	◉	Contractor	○	Owner	○
Stage:	Design	◉	Construction	◉	Operation	◉

Examples of how the project complies with the requirements of Daylight
Avoid deep plan layout
Provide windows or glass spaces for the vital spaces used in the project, with a minimum of 10% of the floor area for each space
Window glass areas are located within 760 mm to 2280 mm from the floor of the interior spaces
Daylight simulation software must be used to calculate the internal daylight illuminance levels. Lux levels must be calculated based on a CIE standard clear sky at 10 am, 12 pm and 2 pm on the equinox and summer solstice. Artificial light must be excluded from the calculations.
Lux levels must be calculated 0.75m above the finished floor level (FFL).
Provide individual lighting controls and occupancy sensors for occupied areas

Required documents for the green building evaluation process	Submission stage
Floor plans, elevations and sections highlighting the occupied spaces	Design stage
Plots from the daylight simulation software for each modeled area showing isolux contours.	Design stage
A brief report showing how the project will achieve the above points, including a summary of the spaces with an external view and calculations showing that 75% of the spaces used have an external view	Design stage
Tables show the percentage of spaces in which the glass spaces and windows achieved no less than 10% of the floor area.	Design stage
Spreadsheet list of all modeled areas and the corresponding results (i.e., percentage floor area of each space that has achieved a minimum of 250 lux).	Design and operation stage
Plans (projections/sections) that contain lines looking out of the building and shading the non -viewing areas	Design and operation stage

Specifications detailing the required glazing performance.	Design & construction stages
Extracts from specifications listing all glare control devices (manual /automated)	Design & construction stages
Field measurements for daylight illuminance levels in different spaces	Operation stage

Proposed references
IES The Lighting Handbook, 10th edition

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	x	☐	☐	x	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	x	☐	☐

3.14 Acoustic performance

3.14.1 Aims

To provide workspaces that promote occupants' well-being, productivity, and communications through effective acoustic design.

3.14.2 Requirements

To achieve the desired objective of this credit, the following considerations must be ensured:

1. The internal background noise levels do not exceed 35 dB(A)Leq (8 hours) in bedrooms and do not exceed 40 dB(A)Leq in other areas.

2. The composite sound transmission class (STCC) should not be less than 50dB for all external walls, internal partitions, and slabs in the case of residential and educational buildings. While the Impact Insulation Class (IIC) must be greater than 56dB.

3. Confirm reverberation time inside occupied spaces meets requirements defined by international or local codes for the different space's activity, as shown in Table 3-13

Table (3-13): recommended reverberation time values for different spaces

Space	RT60 (second)
Apartment	< 0.6s
Office	< 0.6s
Classroom	< 0.6s
Library	< 1s
Gym	< 2s

3.14.3 Possible points

Table (3-14): points distribution for acoustic performance

Points distribution	Point's requirements
Comply with requirements of sound transmission and impact insulation class and comply with maximum background noise levels criteria	1
Meet the reverberation time requirements for the designed spaces	1
Total points	**2**

Practical implementation – Acoustic performance						
Responsibility:	Engineer	◉	Contractor	○	Owner	○
Stage:	Design	◉	Construction	◉	Operation	◉

Examples of how the project complies with the requirements of Acoustic performance
Take care of mechanical equipment (HVAC) specifications in order to reduce as can as possible interior ambient noise (Background noise)
Considering the importance of sound transmission and impact insulation class when designing the walls and slabs of the project
Specify materials, products systems installation details, and other design features to meet the optimum indoor acoustic performance and reverberation time

Required documents for the green building evaluation process	Submission stage
Design drawings (plans, elevation, sections) and simulations indicating noise control features such as wall thickness and material	Design & Construction stages
Field test reports by the Acoustic Engineer confirming the noise levels in relevant areas meet the requirements.	Construction and operation stages
Provide simulation-based analysis to confirm the compliance of reverberation time in the designed spaces with requirements	Design stage
Specifications for all building mechanical -electrical -plumbing systems, air distribution systems and other facility noise sources indicating their noise level	Design & Construction stages
Field test reports confirm the compliance of background noise level in the designed spaces with the requirements	Construction and operation stages

Proposed references
ASTM E492 -09 Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor -Ceiling Assemblies Using the Tapping Machine
ASTM E336 -17a Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings
BS 8233:2014, Guidance on Sound Insulation and Noise Reduction for Buildings
2011 HVAC Applications ASHRAE Handbook, Chapter 48, Noise and Vibration Control
Local or regional equivalent codes related to acoustical performance in buildings

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	x	☐	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	☐	☐	☐

3.15 Safe and secure environment

3.15.1 Aims

For all new and existing buildings, especially public buildings, including educational, healthcare, worship places, hotels, theaters, cinemas, and others, good ventilation must be provided to allow air to be renewed and prevent the concentration of various pollutants.

In all the previous cases, and to ensure a safe and secure environment for users, the percentage of pollutants must be less than what is specified in the following Table:

Table (3-15): maximum concentration of air contaminant

Contaminant	Maximum concentration
Carbon Dioxide CO_2	5000 ppm
Carbon Monoxide CO	25 ppm
Particulates PM_{10}	50 µg/m3
Particulates $PM_{2.5}$	15 µg/m3
Total volatile organic compounds TVOC	300 $\mu g/m^3$
Nitrogen Oxides NOx	3 ppm
Formaldehyde	0.08 ppm0
Ozone	120 $\mu g/m^3$
The total number of bacteria	500 CFU (Colony-forming unit)
The total number of fungi	500 CFU (Colony-forming unit)

3.15.2 Possible points

Table (3-16): points distribution for a safe and secure environment

Points distribution	Point's requirements
Comply with all contaminants with limits presented in the previous Table	1
Total points	**1**

Practical implementation – safe and secure environment						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	○	Construction	○	Operation	◉

Examples of how the project complies with the requirements of a safe and secure environment
Ensure that contaminants do not exceed the values shown in the above Table
Building inspection must be carried out by a licensed and approved body, and all inspection devices are approved and calibrated by the Palestinian Standards institution (PSI), or any other body approved by the institution.

Required documents for the green building evaluation process	Submission stage
Carry out indoor air quality tests after building operation for 8 continuous	operation stage
Re-examination every five years	operation stage

Proposed references
Comply with the test results with the maximum concentration values indicated in the above Tables

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☐	x	☐	☐

3.16 Innovation in design for indoor environment quality

3.16.1 Aims

Encouraging creative ideas that have not been addressed in the indoor environment quality section, which represent innovative solutions that contribute to achieving sustainability for the project's indoor environment. It also aims to reward ideas that contribute positively to the extension of the concept of indoor environment quality.

3.16.2 Requirements

To achieve the point’s requirements for an innovative indoor environment:

Achieving tangible and measurable environmental effectiveness which is not mentioned in this chapter, and one point is awarded for each innovative idea achieved in each chapter of this guide.

3.16.3 Possible points

Table (3-17): points distribution for acoustic performance

Point’s requirements	Points distribution
Presenting a creative design idea	1
Total points	**1**

Practical implementation - Innovation in design for indoor environment quality			
Responsibility:	Engineer ◉	Contractor ○	Owner ○
Stage:	Design ◉	Construction ○	Operation ◉

Examples of how the project complies with the requirements of Site selection
Studying the impact of this idea on the effectiveness and efficiency of indoor environment quality Study the appropriateness of these ideas for the project. The feasibility study of these ideas includes the additional cost of implementing, maintaining and operating, and the return on the indoor building quality and the efficiency achieved. Study of potential weaknesses and maintenance and sustainability of the proposed solutions

Required documents for the green building evaluation process	Submission stage
A summary of the final design solutions contains: Detailing the creative idea supported by studies and experiences indicating the success of the idea, and illustrations of the idea and how to apply it in the project	Design and operation

Proposed references
N/A

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	☐	☐	☐

CHAPTER 4

ENERG USE EFFICIENCY

Chapter 4
Energy Use Efficiency

4.1 Introduction
Studies show that buildings consume about 40% of the total energy consumption in many countries. In non-industrial countries like ours, this percentage may be as high as 60%. Mechanical heating and cooling systems and electric lighting are some of the most energy-consuming devices in buildings, especially residential buildings. Air conditioning can account for up to 60% of a building's energy consumption. Excessive energy consumption represents a significant economic burden on the building owner. Excessive energy consumption by buildings also puts pressure on the regional infrastructure that supplies them with electricity, which can lead to a power outage and to increase the economic burden on the state and country. Most power generation relies on fossil fuels, such as oil and coal, which result in the emission of greenhouse gases (GHGs) into the atmosphere. Therefore, an increase in energy consumption in buildings will lead to an increase in the use of fossil fuels and thus an increase in greenhouse gases which will increase global warming and climate change.

4.2 Concerns
When designing, constructing, and operating buildings, some auxiliary rules must be taken into account, and commitment to implementing regulations and specifications to save energy and reduce operating costs. This can be reached through the following:

1. Use insulation materials for all external elements of buildings such as roofs, walls, bridges, and columns.
2. Use double glazing for all external openings.
3. Use solar-saving alternatives to heat and cool internal spaces and any other renewable source of energy that can be used for this purpose.
4. Use solar energy to secure hot water for buildings in case of need.
5. Use energy-saving lamps.
6. Use solar cells for outdoor lighting and surveillance cameras.
7. Use energy efficient devices and appliances in the building.
8. Use smart techniques for control of all energy systems of the building.

Therefore, a green building is one of the projects that strives to reduce greenhouse gas emissions through energy management in terms of low consumption, efficiency of its systems, and reliance on clean and renewable energy sources wherever possible.

4.3 Considerations
The energy demand of a building is determined by several factors - the behavior of the building's users, the shape and orientation of the building, the architectural design, the elements of the building envelope, as well as its mechanical and electrical systems.

When planning the energy requirements for a green building project, start by reducing the energy demand first. One of the key steps is to reduce the demand for the following:

1- Harnessing “free energy” through passive design. Passive design is the adoption of architectural features and strategies that address the external climate through ecological design to create interior comfort. This is done by engaging or modifying the climatic features of the site; It includes designing for daylighting and natural ventilation, managing exposure to sunlight to reduce the risk of overheating or underheating, effectively insulating the building and using plants and water elements to create a more acceptable microclimate. Reduced demand for cooling and lighting will result in reduced equipment size for the building which in turn translates to a lower cost of capital. This will also lead to operational savings for building owners.

2- The next step is to address system efficiency and integration between different systems. This is partly related to the selection of equipment and partly the design of the system. The selection of air conditioning systems, for example, must begin with an understanding of the efficiency of the products available on the market. Designing the system requires an understanding of partial loads and peak loads, i.e., how the building is used, so that the system remains effective when there is partial operation of the building.

3- The third step is to increase reliance on smart building systems to carry out the necessary work to increase the efficiency of energy consumption and reduce waste by using different sensors. Including, for example, sensors to detect the absence of people in the room, which makes smart systems feel the necessity of turning off the lights and closing the ventilation, heating and air conditioning systems.

4- The fourth step is the use of highly energy-efficient devices and equipment by building operators throughout the life of the building. This is done by obtaining a high rating on the energy label.

5- Finally, clean, low-carbon or zero-carbon energy options such as solar, wind and geothermal energy should be explored. When there is an option for a powerful mix to be purchased from the central power grid, one that relies on cleaner fuels for electric power generation should be chosen. Where possible, consideration should be given to on-site power generation using renewable energy systems such as solar cell systems. This reduces the burden that the building will place on the city's electricity grid and reduces transportation losses.

When considering the initial cost of energy efficiency and renewable energy sources, the project team must consider the life-cycle cost of the building, i.e., the financial and environmental cost of building and operating the building over its expected life.

How occupants are managed is important. It is important to train staff to manage the building efficiently and maintain systems properly; This will reduce efficiency losses. It is also important that building occupants are aware of the building's performance and act responsibly, for example, turning off lights when leaving a room or purchasing energy-saving equipment. This building can help achieve its performance goals.

4.4 Implications and effects

There are three important outcomes of design for energy efficiency in green buildings:

1- Lower operating cost - this is important for the building owner and/or occupants. Reducing energy demand and improving the energy efficiency of equipment means lower overhead costs and, in most cases, lower capital investment as well.

2- Better Energy Security - This is important for government and power distribution companies that invest less in infrastructure and are less vulnerable to energy price volatility. Installing on-site power generation capacity can also be important to building owners in locations where there are frequent blackouts.

3- Decreased greenhouse gas emissions - this is an issue of planetary importance as it affects climate change; Lower energy use necessarily means lower greenhouse gas emissions.

4.5 Palestinian context

The Palestinian territories depend mainly on Israeli imports to meet their needs for fuel and electricity, and the percentage of electricity imported from Israel amounts to 99% of the total supply in the West Bank and 64% of the total supply in Gaza. The demand for energy in the West Bank exceeds the supply, and in Gaza, electricity is available for less than 10 hours a day for its vital services. Therefore, the highest priority is to achieve energy efficiency and use renewable energy to face the chronic shortage of energy and the high costs of electricity, which has become a permanent reality in Palestine. Therefore, green building is based on giving priority to energy efficiency and increasing access to energy through renewable energy technologies, which will contribute to improving the global environment by reducing greenhouse gas emissions and consumption of fossil fuels and a high economic benefit for the state and the citizen.

Therefore, green buildings represent one of the strategic solutions to the energy crisis in Palestine, its permanent deficit, and the high cost paid by the state as well as the citizen to cover the cost of energy it needs.

4.6 Points distribution

The total number of points is 30 points distributed over the following topics.

Table (4-1): Distribution of points within the energy efficiency domain

	Topics	Points
1-	Planning and operation of the building's power systems	Mandatory
2-	Achieve minimum energy efficiency and consumption	Mandatory
3-	Air conditioning and refrigeration devices do not contain CFC, HFC or Halocarbon gases	Mandatory
4-	Adhere to the required specifications for environmental design and building envelope	8
5-	Achieve the optimum energy efficiency	6
6-	On-site power production using renewable energy	6
7-	Use of high-efficiency appliances and devices in the building	7
8-	Smart Buildings	3
	Total	**30**

4.7 Planning of all energy systems in the building

4.7.1 Aims

The design and implementation of all power systems must be carried out to achieve the basics of proper design and construction according to international specifications as well as the requirements of the project owner.

Systems to be examined: lighting systems, heating and cooling systems, water heating systems, control systems and renewable energy systems.

4.7.2 Requirements

Provide a design and installation plan for all power systems in the building. Building energy systems include lighting and control systems, heating, ventilation and air conditioning (HVAC) systems, cooling systems, hot water systems and renewable energy systems - preferably in compliance with the operating plan based on ASHRAE 90.1-2013

The operating plan should include the following:

1. Develop energy systems that comply with the design and construction requirements of local codes and the regulations of the Engineers Association as well as the requirements of the entrepreneur made during the design phase.
2. Proposed mechanisms and procedures to verify the implementation of the designs of power systems as planned (making a checklist) and provide illustrative reports in the event of any change during the construction phase.
3. Develop accurate specifications for all devices that will be used in the system or installed in the building to ensure their compliance with the required specifications and achieve energy efficiency.

4.7.3 Strategy

All forms of operation of the systems should be defined at an early stage of the design. Plans for the operation and maintenance of the systems should be prepared carefully, in addition to periodic reports on their performance.

4.7.4 Possible Points

None: This requirement is mandatory.

Practical Applications: Planning all energy systems in the building is a mandatory requirement	
Responsibility: Engineer ◘ Contractor ◘ Owner ○	
Stage: Design ◘ Implementation ◘ Operation ○	
Examples of how the project complies with the planning requirements of all power systems in the building	
Provide a design and installation plan for all power systems in the building.	
Develop a plan of proposed mechanisms and procedures to verify the implementation of energy system designs as planned	
Provide illustrative reports in case of any change during the construction phase.	
Develop accurate specifications for all devices that will be used in the system or installed in the building that adheres to the specified standards and references	
required for the evaluation process	**Date of submission of the document**
Designs for the building's power systems	Documents Design Phase
Specifications of devices and equipment used in power systems or in the building	Design Phase
Report any amendments made during the implementation process	Implementation Phase
Suggested references	
ASHRAE 0-2013	
Hardware and equipment specifications and energy label for each of them	

Positive effects on the environment and health

Heat	Lighting	dins	Air Quality	Energy	waters	Materials	Soil	Plants	Solid waste	Hazardous wastes	Waste water
☐	☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐

Positive impacts on climate (based on Rio policy indicators)

Adaptation	Mitigation	Biodiversity	Desertification

4.8 Achieving minimum energy efficiency

4.8.1 Objective

Achieving minimal energy efficiency which is at least 5% higher than the baseline. Any additional reduction in energy consumption will lead to additional points. This will lead to a reduction in energy consumption and the resulting adverse environmental impacts.

4.8.2 Requirements

To achieve minimum energy efficiency, the building's energy consumption rate must be at least 5% lower than the baseline rates for the same building type and the same climatic environment. Note that the standard rates (baseline rates) of energy consumption in different buildings are currently not available in Palestine. The lack of data on baselines requires the designer engineer to prove that this condition is met through one of the following options:

1- Using smart whole building energy simulation programs and comparing the results with the baseline rates of energy consumption in similar buildings and in the same climatic zone. Modern simulation programs have the ability to design the baseline model for the proposed building under the same climate conditions.

2- Using mandatory design methods according to ASHRAE specifications and benchmark them with similar buildings through ENERGY STAR Portfolio Manager.

3- The type and function of the building must be defined precisely. The location of the project and its climatic zone must be specified. The climatic zone of any region can be identified using ASHRAE Climatic Zones

4.8.3 Strategy

The best energy performance can be achieved in the building through a range of strategies including.

1- Environmental design of the building or what is known as passive design.

2- Exploitation of alternative energy sources

3- Rationalize energy consumption by lighting and water heating.

4- Use of high-efficiency devices, lamps, and HVAC systems

5- Use intelligent systems with monitoring and control.

4.8.4 Possible Points

None: This requirement is mandatory

Practical Applications: Achieving Minimum Energy Efficiency – Mandatory Requirement			
Responsibility:	Engineer ◉	Contractor O	Owner O
Stage:	Design ◉	Construction ◉	Operation O

Examples of how the project complies with the requirements for achieving minimum energy efficiency
Environmental design of the building and its envelope to increase heat gain in winter and reduce it in summer
Designs renewable energy systems to generate energy on-site, heat the building, heat water, or increase the effectiveness of the HVAC system
Setting the specifications of devices and appliances to be highly energy efficient according to the Energy Label
Using smart devices and sensors to monitor energy consumption and control different systems in it

Documents required for the evaluation process	Date of submission of the document
Designs and construction details of building envelope, with thermal conductivity coefficients of every part of it.	Design Phase
Specifications of devices and equipment used in power systems or in the building	Design Phase
Building simulation report, including benchmarking energy consumption with baseline	Design Phase
Intelligent Systems Designs and Installation Method	Design Phase
A report comparing actual consumption of the building as recorded in the bills, simulation results and baseline,	Operation Phase

Suggested references
Benchmark Your Building Using ENERGY STAR® Portfolio Manager
Simulation software such as EnergyPlus, DesignBuilder, Quest
ASHRAE Code 90.1

Positive impacts on the environment and health

Comfort				Resources			Biological system		Waste		
Heat	Lighting	dins	Air Quality	Energy	Water	Materials	Soil	Plants	Solid waste	Hazardous wastes	Wastewater
☐	☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐

Positive impacts on climate (based on Rio policy indicators)

Adaptation	Mitigation	Biodiversity	Desertification
☐	x	☐	☐

4.9 Air conditioning and refrigeration equipment do not contain CFC, HFC or Halocarbon

4.9.1 Aims

Reduce the damage caused by cooling devices to the ozone layer.

4.9.2 Requirements

Do not use refrigerants based on CFC (Chlorofluorocarbon) or (Hydrofluorocarbons) HFC in all new buildings, and develop sound plans to dispose of them in existing buildings.

• CFC = Chlorofluorocarbons:

CFCs are chlorine-containing refrigerants. It has been banned since the early 1990s due to its negative environmental effects. Examples of CFCs are R11, R12 and R115. The conversion of equipment and systems using CFCs has not yet been completed. On the contrary, the illegal market for this type of refrigerant is booming worldwide, and it is estimated that not more than 50% of CFC systems worldwide have been upgraded.

•HFC = Hydrofluorocarbons:

HFCs are non-chlorine refrigerants that are not harmful to the ozone layer (ODP = 0). However, their impact on global warming is very large compared to conventional refrigerants. Table 4-2 contains a list of the most common refrigerants of HFCs available since the ban on CFCs.

•HCFC = Hydrochlorofluorocarbons:

The slow phase-out of CFCs is proving to be an expensive process. However, more importantly, it also illustrates the problems and inconclusiveness regarding the availability of HCFCs, which have been officially referred to as temporary (until 2030) alternatives to CFCs.

HCFCs contain less chlorine than CFCs, which means lower ODP. Examples of HCFCs include R22, R123, and R124

Table (4-2): The most common refrigerants among halogenated hydrocarbons

Refrigerant	Series	Safety
R32	Methane series	A2L
R125	Ethane series	A1
R134a	Ethane series	A1
R245ca R245fa	Propane series	A2
R404A	Zeotropic mixture (44% R125, 52% R143a, 4% R134a)	A1/A1
R407C	Zeotropic mixture (23% R32,25% R125, 52% R134a)	A1/A1
R410A	Zeotropic mixture (50% R32, 50% R125)	A1/A1
R507A	Azeotropic Mixture (50% R125, 50% R143a)	A1
R508B	Azeotropic mixture (46% R23, 54% R116a)	A1

A: non toxis
غير سام
1: non flammable
غير قابل للاشتعال
2: flammable
قابل للاشتعال
L: Low burning velocity
سرعة حرق بطيئة

4.9.3 Possible Points

None: This is a mandatory requirement

Practical Applications: Air conditioning and refrigeration equipment does not contain CFC, HFC or Halocarbon – Mandatory Requirement			
Responsibility:	Engineer ◙	Contractor ◙	Owner O
Stage:	Design ◙	Construction ◙	Operation O

Examples of how the project complies with the requirement that air conditioning and refrigeration equipment not contain CFCs or HFCs
All refrigerants and air conditioning systems used should not contain CFCs
All refrigerants used during installation and maintenance shall have an ozone depletion factor ODP = 0

Documents required for the evaluation process	Date of submission of the document
Specifications of all refrigeration and air conditioning devices	Design Phase
Manuals specifying the equipment installed in the building	Construction Phase
Specifications of coolants used in maintenance operations	Operation Phase

Suggested references
ANSI/ASHRAE 34-2019, Designation and Safety Classification of Refrigerants
European Commission on climate Action: Climate-friendly alternatives to HFCs

Positive impacts on the environment and health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	x	☐

Positive impacts on climate (based on Rio policy indicators)

Adaptation	Mitigation	Biodiversity	Desertification
☐	x	☐	☐

4.10 Compliance with specifications for the environmental design and building envelope.

4.10.1 Aims

Reaching a high efficiency building by relying on specifications specific to the building envelope and heating, ventilation and air conditioning systems with high efficiency in order to reduce energy consumption in the building and thus reduce environmental, economic, and social damages caused by excessive use of energy.

4.10.2 Requirements

One of the most important means necessary to achieve high energy efficiency in the building is to design the building in proportion to the environment of the site. This includes several important elements, including the orientation of the building, the insulation of the cover, the ratio of the area of windows to the area of the walls, the storage mass in the building, and others. Also, the choice of heating, air conditioning and ventilation systems affect the rate of energy consumption.

4.10.3 The environmental design of the building or what is known as Passive Design

Contemporary passive design is based on an understanding of the climate and taking advantage of the combinations of site, form, detail and construction to create buildings that achieve design excellence while minimizing the need for energy-intensive appliances for comfort and health. Reducing the need for energy makes it possible to reduce the size of HVAC equipment, shorten operating times and seasons, shorten duct operation and, in some cases, eliminate equipment altogether. Passive design can mean shifting the initial cost from setup to improvements to the building envelope. Passive design requires a focus on architecture first, before supplementing it with active systems.

Passive design elements depend on a set of environmental and structural elements that the architect must consider in the design process, namely:

Table (4-3): Commitment to the specifications required for environmental design and building envelope.

Points collection requirements	Points
Building Orientation	1
Building envelope efficiency (insulating the building thermally through the building envelope and preventing air leakage)	4
Appropriate shading of the building and glass openings in the summer	1
Providing natural ventilation in the building	1
Provide thermal mass for energy storage and temperature regulation during the hours of the day inside the building	1
Maximum points	**8**

4.10.3.1 [irst element: Orientation of the building, (one point)

In temperate regions such as Palestine, it is preferable that the building be elongated in the east-west axis, allowing maximum exposure to the sun on the southern facade in winter with the use of shading devices to prevent the hot summer sun. This directive provides the sun's natural heat during the times of the year when it is needed and keeps it out when it is not.

Objective

Increasing the heat gain from solar energy in the winter on the southern facade and increasing the area of the glass openings in them, while providing them with appropriate shading in the summer.

Requirements

• Making the extension of the building in the east-west axis

• Increasing the area of the glass openings in the southern facade to increase the heat gain in winter.

• Providing suitable shading for these openings to reduce solar heat gain to a minimum in the summer.

• Reducing the area of the glass openings on the eastern and western facades to a minimum, allowing the provision of natural lighting, view, and ventilation only.

• If it is impossible to direct the building to the south, it is possible to make inclined surfaces facing south on the eastern or western facade as shown in Figure 4.1

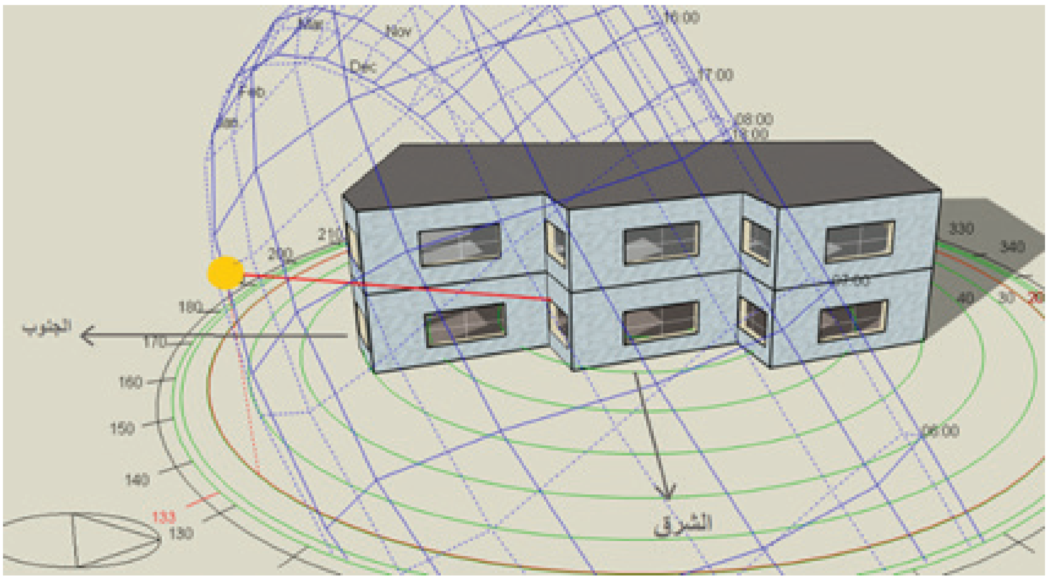


Figure 4.1: Inclined surfaces towards the south when the extension of the building is directed toward the east.

Table (4-4): points for orientation

Points collection requirements	Points
Orientation of the building to the south, with an inclination of no more than 15º - or making breaks to the south at a rate of no less than 30% of the area of the main façade	1

4.10.3.2 Second Element: Building Envelope Efficiency (Building Envelope Insulation and Air Infiltration Sealing) (Maximum: 4 points)

Objective

Preventing the transfer and leakage of heat from the outside to the inside or vice versa by different means of transmission such as conduction, convection, radiation, or through the leakage of air. This is done using materials with a high thermal resistance (heat insulation) and sealing the building envelope.

Requirements

The insulating materials used to reduce thermal transmission in the building envelope shall meet the following requirements:

1- The value of the thermal resistance should be high (with low thermal conductivity)

2- The insulating material shall be resistant to water and light permeability.

3- To be resistant to the absorption of water, moisture, and water vapor

4- To be resistant to bacteria, mold, and fungi, and not have health hazards.

5- It must be fire-resistant and not produce toxic gases.

6- To be highly resistant to chemical changes and reactions

7- It should be available locally and easy to install.

8- It shall conform to the Palestinian specifications and standards.

Minimum requirements for the performance of the building envelope

• For all the external elements of the building such as walls, roofs, external windows, and external doors (Exposed), which separate the internal environment of the building and the external atmosphere, the thermal transition values shown in Table 4-5 must be met.

• The rate of air infiltration should not exceed the maximum permissible limit of 0.25 air changes per hour.

• Ensuring that the calculations of the values of the thermal conductivity coefficient and the shading coefficient do not exceed the specified values and comply with all the instructions specified in accordance with the International Energy Conservation Code in items 502.4, 503.2, 504 and 505.

The maximum permissible limits for all structural elements in the building envelope:

Palestine is divided into several climatic zones. Therefore, the recommended thermal conductivity values should not exceed the values shown in Table 4-5, considering the location of the building and the climatic zone of the site.

Table (4-5): Maximum thermal transmittance (U-value) for the exposed envelope elements

Element of Building Envelope	Maximum U-value ($W/m^2.^oK$) In the warm coastal regions and the Jordan valley	Maximum U-value ($W/m^2.^oK$) In the cold mountain regions
External walls	0.5	0.35
Exposed sloped roofs	0.4	0.25
Exposed flat roofs	0.4	0.25
Hard flooring connected to the ground	0.46	0.35
Exposed floors	0.46	0.35
Exterior windows	3.0	2.7
Exterior doors	3.5	3.0

As for the semi-exposed elements that separate the occupied and unoccupied parts of the building (there is no heating and air conditioning), the heat transfer values are listed in Table 4-6 must be met.v

Table 4 6: Maximum thermal transmittance (U-value) for the semi-exposed envelope elements

Element in the building envelope	Maximum thermal transmittance U ($W/m^2.°K$)
Semi-exposed wall	0.6
Semi-exposed floors	0.6
Semi-exposed windows	5.2

Transparent glass elements

For all glass elements that transmit light in the walls, the values of the thermal transmission coefficient, the shading coefficient and the light transmittance must be less than the limits shown in Table 4-7.

Table (4-7): Maximum values of maximum thermal transmittance, Solar Shading Factor, and light transmittance

Building envelope parameter	Light transmittance	Solar Shading	U- Value For Summer Max.
For Walls			
Glazing area < 40% of wall area	25% min	0.4 max	2.1 $w/m^2.K$
Glazing area > 40% and < 60% of wall area	10% min	0.32 max	1.9 $w/m^2.K$
Glazing area > 60% of wall area	10% min	0.25 max	1.7 $w/m^2.K$
For roof skylights and windows			
Glazing area < 10% of roof area	40% min	0.32 max	1.9 $w/m^2.K$
Glazing area > 10% of roof area	30% min	0.25 max	1.9 $w/m^2.K$
Facades of exhibitions	30% min	0.75 max	1.9 $w/m^2.K$

Thermal bridges

For all new air-conditioned buildings, thermal bridges must be avoided or isolated. Thermal bridges can be found in connection points between concrete or metal bridges, between external walls and columns, and around doors and windows, which work to leak heat from outside to inside the building in order to reduce the amount of heat transferred.

Building Sealing

For all types of new air-conditioned buildings, the rate of air infiltration from the building or into the building must not exceed 0.25 air change per hour (0.25 ACH)

Possible points

Table (4-8): Distribution of points within the item of achieving the efficiency of the building envelope.

Points requirements	Possible points
U-value of all walls is less than the maximum value in Tables above	1
U-value of all roofs is less than the maximum value in Tables above	1
U-value of all windows is less than the maximum value in Tables above	0.5
Solar shading factor does not exceed maximum value in Tables above	0.5
U-value of all doors is less than the maximum value in Tables above	0.5
Air infiltration does not exceed maximum value	0.5
Total	4

4.10.3.3 Third element: Proper shading of the building and glass openings on warm and hot days (one point)

Objective

Preventing solar radiation from penetrating the building during warm or hot hours and days when the building does not need to gain heat from solar energy. Effective and intelligent shading systems allow sunlight to enter the building only on cold days and hours.

Requirements

To reduce heat gain and prevent overheating of air-conditioning systems, sunlight penetration into glass openings must be reduced and solar gain to a minimum. There are three basic methods of shading.

1- Fixed canopies - such as horizontal, vertical, inclined louvers and pergolas

2- Movable umbrellas - such as moving flaps, retractable rolls of fabric, and expandable metal slots

3- Electric shading using PDLC film whose transparency can be controlled through an electrical signal or a switch.

Proper shading is essential to the success of all the above-mentioned solar systems. The angle of elevation of the sun in summer and winter (altitude angle) can be relied upon to provide adequate shading for the glazed spaces on the southern façade of the building. As the sun does not rise much in winter (low altitude angles), horizontal louvers and overhangs will become ineffective for shading windows on eastern and western facades. For that, it is recommended to use vertical louvers for shading on the eastern and western facades.

Possible points

Table (4-9): Points for Proper shading of the building and glass openings on warm and hot days

Points requirements	Possible points
Conducting an analysis or simulation showing that the percentage of shading for glass spaces is not less than 70% in the summer on the southern facade, and not less than 30% in the eastern and western facades.	1

4.10.3.4 Fourth Element: Natural Ventilation (One point)

Objective

The main objective of the natural ventilation process is to provide the building with fresh air. The second goal is to get rid of excess heat inside the building, especially in summer.

Requirements

Natural ventilation can be provided through two means:

1- Single-Sided Ventilation: it is the use of openings on one side of a building. This is used to naturally ventilate the space of projects with limited area. Single-sided ventilation systems are also used in projects where cross-ventilation cannot be provided, due to structural or environmental constraints. Keep in mind that window height must be not less than 1.5m for effective single-sided ventilation.

2- Cross ventilation: it is when the openings in a structure are arranged on opposite or adjacent walls, allowing air to enter from both sides, cross the space, and exit from the opposite direction. This system is usually used in buildings located in climatic zones with higher temperatures, as it creates constant air renewal within the building, reducing the internal temperature.

3- Stack ventilation: it introduces cooler air from the outside into the building at a low level, which gradually becomes warmer as it gets exposed to heat sources within the space. This causes the now-warm air to rise and leave the space through openings situated at a higher level. Usually, stack ventilation is more effective in tall buildings with central atriums but can also be useful in buildings where cross ventilation is not able to penetrate sufficiently throughout the space. In order for this ventilation system to work properly, the indoor temperature must be higher than the outside, which is why it may not always be efficient enough to use on its own.

4- Solar Chimney Ventilation: In vertical buildings, the chimney effect is constantly used. Cold air produces pressure under the warm air, forcing it to go upwards. In this case, however, opened areas in the project's center or towers allow that same air to circulate throughout the indoor environment, leaving through the roof, clerestory, zenithal openings, or wind exhausts.

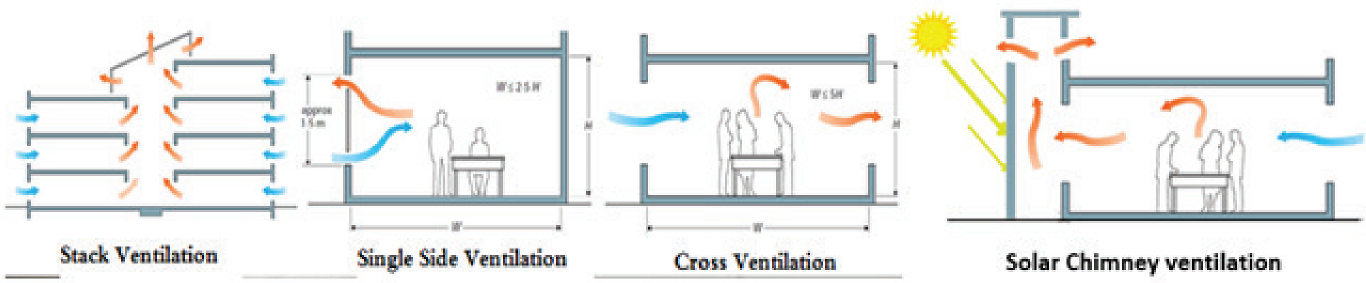


Figure 4.2:Types of natural ventilation systems

Possible Points

Table (4-10): points for Natural Ventilation

Points requirements	Possible points
Provide diagrams showing the type of natural ventilation technique, including windows orientation and heights and wind direction	1

4.10.3.5 Fifth element: Providing thermal mass for energy storage and temperature regulation (upper limit: 1 point)

Objective

Storing and releasing the energy gained through solar energy throughout the day, preventing and regulating temperature fluctuations.

Requirements

Thermal mass describes the ability of heavy building materials (such as concrete) to provide inertia against temperature fluctuations in buildings. This is achieved through its ability to absorb and release heat, which regulates thermoregulation. During warm weather hours, much of the unwanted heat gained will be absorbed by thermal mass in exposed floors and walls, helping to prevent sharp overheating and reduce the risk of overheating.

The main reason that heavy-weight floors and walls continue to provide a benefit for the comfort of building users throughout the day is that they can absorb a large amount of heat with a slight increase in temperature due to their high heat capacity. This ensures that a relatively low surface temperature is maintained providing a beneficial radiant cooling effect for those in the building throughout the day.

To obtain a suitable thermal mass in the building, three basic properties are required:

1- High specific heat capacity: so, a large amount of heat is absorbed in each cubic meter of it.

2- High density: The heavier the material, the more heat it can store by volume.

3- Moderate thermal conductivity: So, the rate of heat flow in and out of the material aligns with the building's daily heating and cooling cycle.

Heavy building materials such as rocks, marble, and concrete have these characteristics. It combines high storage capacity and moderate thermal conductivity. This means that heat travels between and within the surface of the material at a rate that matches the building's daily heating and cooling cycle.

In the absence of thermal mass in the building because of insulation from the inside or the use of lightweight materials or low heat capacity, Phase Changing Materials (PCM) can be used as an alternative to providing storage mass or heat regulation.

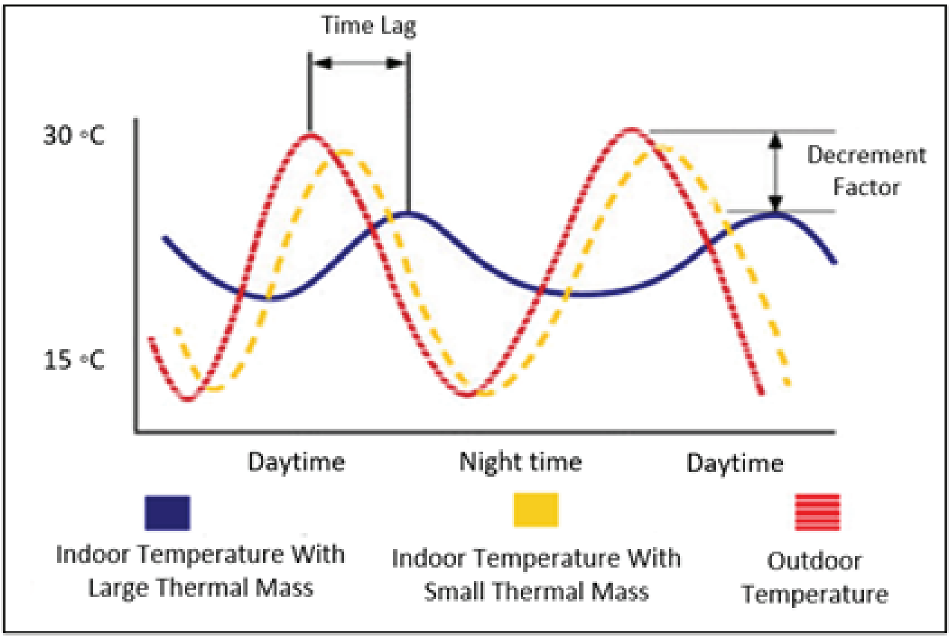


Figure (4.3): Impact of thermal mass on temperature regulation

Points Requirements		Points
Provide the structural details of the walls, ceilings, and floors, with an explanation of the location and type of thermal masses and their isolation from the outside		1

Practical implementation – Compliance with specifications for the environmental design and building envelope						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	◉	Operation	○

Examples of how the project complies with the requirements of Thermal Mass
Making calculations for the thermal mass storage in the building based on the construction details, providing specifications for PCM materials, if used in the building.
Providing designs that show the movement of air inside the building with simulation, providing designs for generating air current through the effect of the chimney
The use of suitable insulating materials that meet the required specifications, the use of various means to reduce air leakage into the building, the use of shading and glass with a coefficient of transmittance to solar radiation according to the specified specifications
Making building design to be the extension of the building is in an east-west direction. When it is impossible to orient the building towards the south, it is possible to make cracks on the eastern or western side to direct the windows towards the south

Required documents for the green building evaluation process	Submission stage
Architectural and structural designs with construction details	Design stage
Simulation results that show the absence of high-temperature fluctuations in the building	Design stage
Installation of control systems or for movable shading or switchable PDLC films	Design stage

Proposed references
International Energy Conservation Code Sections 502.4, 503.2, 504, 505
Certified Thermal Simulation Software
ANSI/ASHRAE/IES-STANDARD-90.1-2010

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
x	x	☐	☐	x	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
x	x	☐	☐

4.11 Achieving optimal energy efficiency

4.11.1 Aims

Achieving the minimum efficiency of energy use and consumption is a mandatory requirement, while achieving the best limit is a necessary requirement to achieve the points mentioned in this section. And the best performance of energy use and consumption means rationalizing consumption and reaching the lowest possible level of consumption without affecting the performance of the various systems in the building, while reducing the negative environmental and economic impacts resulting from this consumption.

4.11.2 Requirements

Design stage: Using whole building thermal simulation programs to prove that the entire building achieves the above-mentioned goal and comparing the annual energy consumption rate per square meter with the baseline rates for the same type of buildings and the same climatic zone.

Operational stage: submitting readings and bills of energy consumption of all kinds for at least a full year of operation and comparing them with the baseline rates and simulated rates.

4.11.3 Possible Points

Table (4-11): points distribution for Achieving optimal energy efficiency.

Points Requirements	**Points**
Presenting simulation results with a comparison with the baseline rates showing the rate of consumption reduction Submission of electricity and fuel bills after a full year of operating the building	
Reduce consumption by 5% minimum	Mandatory
Reduce consumption by 10%	1
Reduce consumption by 20%	2
Reduce consumption by 30%	3
Reduce consumption by 40%	4
Reduce consumption by 50% or more	6
Maximum points	**6**

Practical implementation – Achieving optimal energy efficiency						
Responsibility:	Engineer	¤	Contractor	¡	Owner	¡
Stage:	Design	¤	Construction	¡	Operation	¡

Examples of how the project complies with the requirements of *Achieving optimal energy efficiency*
Adhere to the specifications, procedures and strategies necessary to reduce energy consumption
Conduct whole buildings Simulation of the building and its corresponding baseline with the same design and climate.
Record energy consumption during the operational Stage

Required documents for the green building evaluation process	Submission stage
Simulation results that show energy consumption in each field and in the building in general	Design stage
Simulation comparison results with standard rates and energy savings	Design stage
Comparison of building actual energy consumption and simulated results	Operation stage

Proposed references
ASHRAE_90_1_Users_Manual
EnergyPlus Simulation software

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	x	☐	☐

4.12 Energy generation using renewable energy systems.

4.12.1 Aims

Producing clean energy on-site by relying on renewable sources, which contributes to reducing dependence on fossil energy and reducing gas emissions and the dangers of climate change.

4.12.2 Requirements

Use of different sources of renewable energy in the building and on-site for on-site power generation

1) Photovoltaic (PV) solar cells

Photovoltaic cells are used to generate electricity from sunlight falling on panels made of silicon. The generated electricity can be stored in special batteries to be used in the building for different purposes after converting it to an alternating current with a voltage of 220 volts using inverters. It is also possible to sell the energy directly to the public electricity grid without the use of batteries. As the regulations approved by the Energy Authority encourage electricity distribution companies to purchase electricity produced from PV-systems at encouraging prices due to their positive environmental effects and reduce dependence on imported energy.

Building Integrated PV (BIPV) solar cells can be used in construction processes to replace some of the traditional materials used in roofs, skylights, or facades. This is less expensive than the solar panels that are installed on the roofs or the ground because they reduce the cost of materials used in construction such as marble, glass, stone and others. In addition, it is an integral part of the building design process and is more aesthetically pleasing than other options.

2) Wind turbine (wind energy)

Wind fans are used to generate electricity from wind energy, especially in areas with high wind speeds of more than 6 m/s. Wind fans convert wind energy into mechanical energy that is used to generate electricity. It is also possible to use mechanical energy directly in some processes such as pumping water from wells or in some industrial processes.

3) Geothermal Energy

It is a system used to exploit underground energy, as it is known that the ground temperature at a depth of more than two meters remains constant, ranging between 15-17 degrees Celsius in our country. This energy can be used to raise the efficiency of heating and air conditioning devices in order to reduce energy consumption in buildings. Also, we can use ground tubes combined with solar energy systems to obtain high efficiency and greater energy savings.

4) Biofuel

Biogas is a mixture of gases, primarily consisting of methane, carbon dioxide and hydrogen sulphide, produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste, and food waste. It is a renewable energy source. Biomass waste from plant materials or solid waste can also be used to generate heat or electricity after treating it in different ways.

4.12.3 Possible Points

Table (4-12): Points distribution for Energy Generation Using Renewable Energy Systems

Points requirements	**Possible points**
Provide designs and plans for alternative energy systems used on the site. Provide a complete analysis or simulation program that shows the ratio of the amount of production of renewable energy to the amount of energy consumed annually in the building, as in item 4.12	
The ratio of production to total consumption is 20%	2
The ratio of production to total consumption is 40%	4
The ratio of production to total consumption is 60% or more	6
Maximum points	**6**

Practical implementation – Energy Generation Using Renewable Energy						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	◉	Operation	○

Examples of how the project complies with the requirements of Energy Generation Using Renewable Energy
Complete design of the proposed system
Make a full analysis or simulation to determine the amount of production expected annually from the proposed system
Calculate the ratio of the energy produced to the expected annual consumption of the building

Required documents for the green building evaluation process	Submission stage
Proposed System Designs	Design stage
Analysis or simulation results that show the amount of energy expected to be produced annually	Design stage
The results of comparing the quantity of production with the expected annual consumption rate and the percentage of energy savings	Design stage
Quantities of energy production from renewable sources through meter readings or other data	Operation stage

Proposed references
ASHRAE_90_1_Users_Manual
EnergyPlus Simulation software

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
☐	☐	☐	☐	x	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	x	☐	☐

4.13 Use of high-efficiency equipment and devices in the building

4.13.1 Aims

Setting rules for the devices used in buildings so that they are energy-saving (the efficiency of the devices is high).

4.13.2 Requirements

4.13.2.1 Use of high-efficiency heating, air conditioning and ventilation systems

Reducing the consumption of energy used in the ventilation, heating and air conditioning of the building, which positively affects the reduction of resource consumption and the resulting negative environmental impacts.

Requirements

1- The Coefficient of Performance (COP) of the HVAC system should achieve values no less than the values shown in Table 4-13.

2- The boiler efficiency (for the heating system) should be at least 0.8.

Table (4-13): Coefficient of Performance (COP) for different types of HVAC systems

System	Size of system	COP[1] (or equivalent[2])
Air conditioner -air, water or evaporatively cooled	< 70 kW	3.2
	>70 kW	2.8
Heat Pump- air or evaporatively cooled	Any size	3.2
Single-Package Vertical Air Conditioners-air cooled	Any size	2.5
Single-Package Vertical heat pump	Any size	3.0
Packaged Water Chillers	Any size	2.5
Packaged Terminal Air Conditioners	Any size	3.0

1COP = Coefficient of Performance, a ratio used to evaluate the efficiency of heating or cooling systems.

2EER = Energy Efficiency Ratio, a ratio used to evaluate the efficiency of cooling systems.

EER = COP ×3.41

Possible points

Table (4-14): points distribution for the use of high-efficiency heating, air conditioning and ventilation systems

Points requirements	Possible points
COP of all equipment matches or is higher than recommended values	1
Use efficient control devices to control all systems	1
Controllers can be linked with BMS	0.5
Use of energy recovery systems	0.5
Maximum points	**3**

4.13.2.2 Water heating devices

Use high-efficiency water heating systems in the building and encourage the use of solar and electric energy produced from renewable energy for water heating operations to reduce the operating cost of the building.

Requirements

Ensure that the building uses solar energy or renewable energy for water heating. Water heaters must adhere to thermal insulation requirements. Thermostat control and settings are essential in operating these devices.

Specifications and characteristics of water heaters

1- Using solar energy to heat water for domestic purposes and swimming pools.

2- Use of electric energy produced from renewable energy in water heaters.

3- Adjust the water temperature so that it does not exceed (50°C) when electric power or fossil fuel is used.

4- Insulation of hot water pipes with materials and thicknesses according to standards.

5- The efficiency of these devices should be higher than the minimum specified in the codes.

6- The heating devices shall be placed in designated places.

7- It shall be equipped with temperature control devices and means.

8- In the systems where water circulation pumps are used whose mission is to maintain the temperature of the stored water, the work of these pumps must be adjusted so that they are stopped after 5 minutes from the end of the heating cycle.

9- Cover swimming pools whose water is heated to reduce water evaporation.

10- Provid heaters with an anti-sedimentation electrode.

11- Insulate hot water tanks with thickness and conductivity according to the schedule.

12- Provid the points of consumption with systems to maintain the water temperature.

13- Use thermal energy recovery systems to heat swimming pool water.

14- Use solar energy in swimming pool water heating systems.

Possible Points (Water Heaters)

Table (4-15): points distribution for Water heating devices

Points requirements	Possible points
Presence of temperature controls	0.5
Effective thermal insulation for hot water tank and pipes according to specifications	0.5
Maximum points	**1**

4.13.2.3 Efficiency of washing machines, utensils, refrigerators, and office appliances

Using laundry equipment, utensils, refrigerators, and office equipment that are highly efficient in terms of energy or water use, and encouraging the use of equipment that consumes renewable energy.

Requirements

All appliances and office machines including washing machines, dishwashers and refrigerators must high energy efficiency certificate (Grade A or above Energy Label)

1- The washing machines should be equipped with motors that operate at multiple speeds, and the rate of use of these devices of water does not exceed 30 liters per cycle.

2- Refrigerators should be effectively isolated and highly efficient in rationalizing energy consumption.

3- These devices should be capable of operating on electrical energy produced from renewable energy.

4- To be refurbished with control devices

5- The materials manufactured from the devices should be resistant to bacteria, mold and fungi and not result in substances harmful to health.

6- It must be fire-resistant and not produce toxic gases.

7- The noise level should not be higher than 45 dB.

Possible Points

Table (4-16): points distribution for Efficiency of washing machines, utensils, refrigerators, and office appliances

Points requirements	Possible points
Commitment to using high-efficiency home appliances	0.5
Commitment to using high-efficiency office equipment and elevators	0.5
Maximum points	**1**

4.13.2.4 Efficiency of Artificial Lighting System

Rationalization of energy consumption used in lighting buildings using high-efficiency lighting units.

Requirements

To reduce the consumption of electrical energy used to illuminate buildings from inside and outside, the following instructions must be adhered to:

1- Rely as much as possible on natural lighting.

2- Using high-efficiency LED lamps

3- Programming the outside lamps to work according to the hours of sunset to sunrise.

4- Availability of manual and automatic control systems to control the level of lighting and not to exceed the required levels.

5- Avoid using energy-consuming lamps such as incandescent lamps and even fluorescent lamps, except for extreme necessity.

6- Using smart systems to control the system.

Possible Points

Table (4-17): points distribution for Efficiency of Artificial Lighting System

Points requirements	Points
Commitment to using high-efficiency lamps (LED)	1
Commitment to using natural lighting indoors and outdoors to the maximum	1
Maximum points	**2**

4.14 Smart buildings

4.14.1 Aims

The use of computerized systems, communication systems and sensors in managing the various systems in the building to save energy.

4.14.2 Requirements

1) Intelligent control systems

Smart buildings use information and communication technologies (ICT) to enable and control automated building processes. It can enhance comfort and productivity for building users while using less energy than traditional buildings. Whereas traditional buildings have systems that operate independently, smart buildings use information and communication technology to link building systems together to improve operations and performance for the entire building.

Smart buildings also allow operators and building users to interact with the building, providing insight into its operations and actionable information. In addition, smart buildings can communicate with the smart energy grid, a feature that is becoming increasingly important to achieve the responsive energy management processes required by the grid. Although most applications of smart technologies are in offices, their use is steadily growing in all types of buildings. Here are some of the most popular electronic systems in smart buildings.

1- Lighting control systems: (linear control or gradual control) according to natural lighting and the presence of people in the rooms
2- Control blinds and awnings to shade windows.
3- Controlling opening windows based on indoor and outdoor temperature.
4- Control of HVAC systems (using occupancy sensors), in addition, limit ventilation based on monitoring CO2 levels.
5- Smart plugs: change and adjust the sensitivity of the motion detector.
6- Energy Management Systems (EMS) or Energy Information Systems (EIS) are computer-based systems that monitor and measure energy consumption and look for areas to improve energy efficiency.
7- Building Management Systems BMS - also known as Building Automation System (BAS) can be used to automate buildings smartly. It is a computer-based control system that can monitor, regulate and control all the intelligent electrical and mechanical equipment in the building.
According to previous studies, the following table shows the most important applications of smart technologies in buildings and the expected savings rate for each technology.

Table (4-18): Energy saving by smart technology.

System	Smart Technologies	Energy Saving
Heating, air conditioning and ventilation	variable frequency drive	15-50% of the compressor or kinetic energy
HVAC	Smart Thermostat	5-10% HVAC
Plug load	smart plug	50-60%
Advanced power connector	plug load	25-50%
Lighting	Advanced lighting controls	45%
Lighting	Management of lighting through the Internet	20-30% in addition to saving through control
Window or window tinting	Automatic tinting system	21-38%
Window or window tinting	electrically controllable film	32-43%
Window or window tinting	smart glass	20-30%
Building Automation	BMS Automatic Building Management System	10-25% of the consumption of the entire building
Analytics	Cloud-based Energy Information System (EIS)	5-10% of whole building consumption

2) Monitoring energy consumption in the building

Manage and monitor the building's energy demand and consumption which can help reduce energy consumption by adding additional energy-saving measures - and respond to smart grid instructions whenever available in the future.The following topics should be observed to guide energy consumption.

1- Installation of one main meter for energy uses in the entire building (including fuel, gas, electricity, etc.). Monthly or annual bills can be used for other energy-producing materials such as wood, coal, etc.

2- Install a sub-meter for each individual energy branch that uses more than 10% of the total energy consumption and for renewable energy. The main meter and sub-meters should be:

- Able to record data (hourly) for at least two years and able to send this data, whether it is wireless, Bluetooth or any other data collection method.
- Able to store data for at least two years for the readings taken at a rate of at least one reading per hour.
- permanently installed.

4.14.3 Possible Points

Points requirements Possible points

Points requirements	**Possible points**
First option i. Using smart devices to control heating, air conditioning and ventilation devices. ii. Using smart devices to control lighting and shade windows	1 1
Second option: 1. Using a BMS or BAS device to control and monitor the building. 2. Energy monitoring, transmission, and storage devices	2
Maximum points	**3**

BMS: Building Management System **BAS: Building Automation System**

Practical implementation – Smart Buildings

Responsibility:	Engineer ◉	Contractor ◉	Owner ◉
Stage:	Design ◉	Construction ◉	Operation ◉

Examples of how the project complies with the requirements of *Smart Buildings*
Design the proposed system with its wiring diagrams
Simulate energy consumption while implementing smart techniques
Select the needed devices, control units, and sensors that suites the building.

Required documents for the green building evaluation process	Submission stage
Systems designs	Design stage
Specifications of all units with BOQ	Design stage
Report of estimated energy savings by using smart techniques and systems	Design stage

Proposed references
ASHRAE_90_1_Users_Manual
EnergyPlus Simulation software

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Wastewater
x	x	x	x	x	x	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
x	x	☐	☐

4.15 Simulation

The simulation model is a representation of the real building that allows impacts to be considered at a high level of detail and to analyze KPIs. Simulation is a high-potential technology that provides the ability to identify and compare the relative cost and performance characteristics of a proposed design in a realistic manner, with relatively low effort and cost. Energy demand, indoor environmental quality (including thermal and visual comfort, indoor air quality and humidity phenomena), HVAC performance, renewable energy systems, building automation, and operating optimization are important aspects of simulation systems.

Over the past six decades, many computer simulation programs have been developed and some cover only certain parts of the simulations (such as climate analysis, thermal comfort, energy calculations, plant modeling, natural lighting simulation, etc.). The BPS core tools are multi-domain, dynamic and fully built simulation tools, which provide users with key indicators such as heating and cooling loads, energy demand, energy savings to baselines, temperature and humidity ratings, thermal and visual comfort indicators, air pollutants, environmental impact, and costs.

A typical building simulation has local weather inputs such as a meteorological model year file; Architectural design, building envelope characteristics; internal heat gain from lighting loads, people, and equipment; HVAC system specifications, building use schedules and control strategies. The ease of input and accessibility of output data varies widely between different programs.

Among the most important inputs necessary for simulation programs are the following:

1- Climate: ambient air temperature, relative humidity, direct and diffused solar radiation, wind speed and direction

2- Location: the location and orientation of the building, the shading with the topography and surrounding buildings, the characteristics of the ground surface

3- Architectural design: building shape, site architecture and adjacent buildings.

4- Structural details: materials, structures, windows, shading, thermal bridges, air leakage from openings

5- Operating program: It includes the nature of the use of rooms and spaces, occupancy hours, number of people, and the required temperatures in each room.

6- Internal gains: lights, equipment and occupants including operating/occupancy schedules.

7- Ventilation system: transport and air conditioning (heating, cooling, and humidification)

8- Room HVAC units: Domestic units for heating, cooling, and ventilation

9- Control systems: window openings, shading devices, ventilation systems, etc...

The most important examples of the simulation outputs and key performance indicators are:

1- Temperatures: in rooms and corridors, in building layers or in double-glazed facades

2- Indicators of thermal comfort: such as PMV and PPD, radiant temperature inconsistency, carbon dioxide concentration and relative humidity

3- Heating and conditioning loads: for heating and cooling demand, and electrical profile for equipment and lighting

4- Energy consumption: for heating, cooling, ventilation, lighting, equipment, and auxiliary systems (such as pumps, fans, and elevators)

5- Natural lighting: in certain areas of the region, at different points in time with changing external conditions

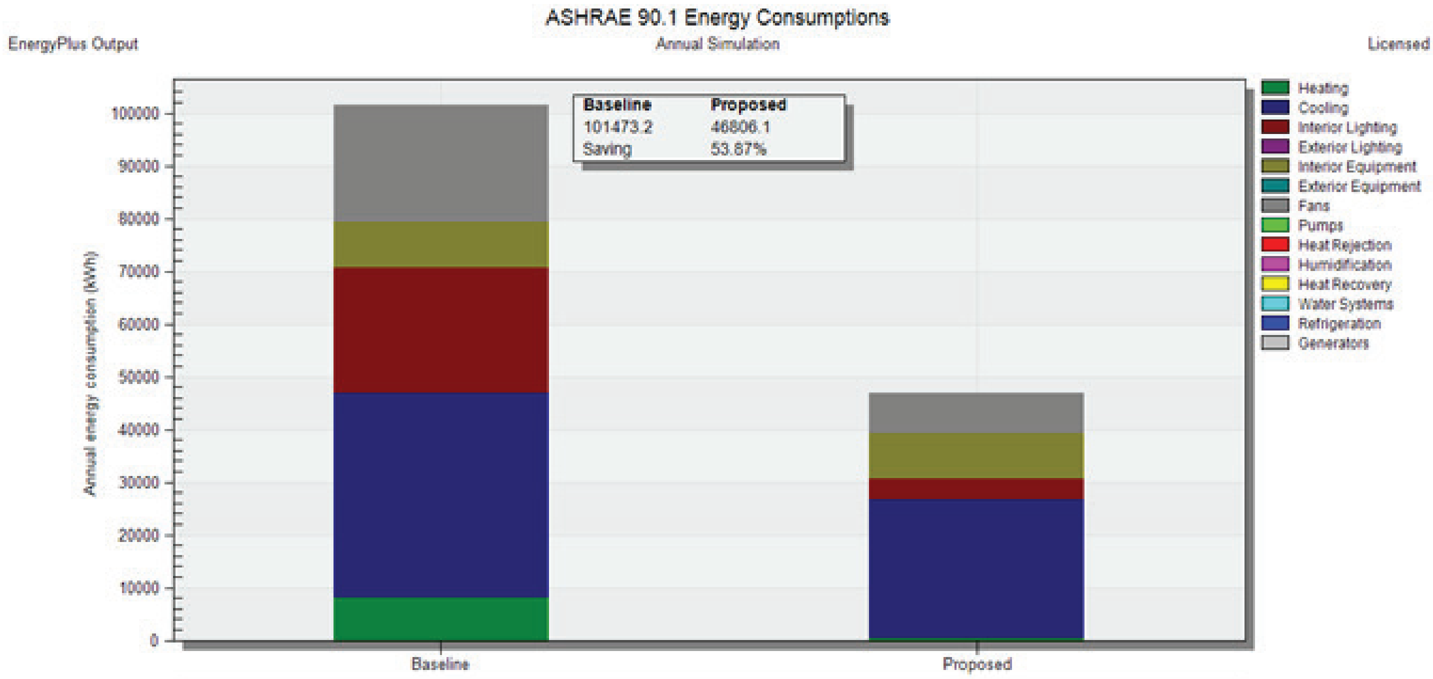
6- Air movement: inside and outside the building

There are hundreds of software tools available to simulate the performance of buildings and building subsystems, ranging in capability from whole building simulation to input calibration model to building audit. In general, simulation software can be categorized into:

1- Applications with integrated simulation engines such as EnergyPlus, ESP-r, TAS, IES-VE

2- Software that connects to a specific engine such as DesignBuilder, eQuest, RIUSKA, Sefaira

3- Other software plug-ins that allow specific performance analysis such as DIVA for Rhino, Honeybee and Autodesk Green Building Studio



	Baseline	Proposed
Heating	8041.10	408.24
Cooling	38727.82	26344.36
Interior Lighting	23768.98	3905.30
Exterior Lighting	0.00	0.00
Interior Equipment	8630.40	8630.40
Exterior Equipment	0.00	0.00
Fans	22304.86	7517.75
Pumps	0.00	0.00
Heat Rejection	0.00	0.00
Humidification	0.00	0.00
Heat Recovery	0.00	0.00
Water Systems	0.00	0.00
Refrigeration	0.00	0.00
Generators	0.00	0.00

Figure 4.4: Simulation output sample shows a comparison of the overall energy consumption in the building compared to baseline rates.

In a building performance-based approach, compliance with building codes or standards depends on the energy use expected from a building simulation, rather than a prescriptive approach that requires adherence to stipulated technologies or design features. Performance-based compliance provides greater flexibility in building design because it allows designers to miss some guiding requirements if the impact on building performance can be offset by bypassing some requirements.

CHAPTER 5

WATER USE EFFICIENCY

Chapter 5
Water Use Efficiency

5.1 Introduction

Globally, buildings are among the highest user sectors of freshwater resources. The massive amounts of water consumption in construction and operational processes deplete water resources and lead to a significant adverse environmental impact. This is mainly due to the energy required for the water cycle in built environments, which includes raw water treatment and distribution, indoor use, and wastewater treatment.

The impact of water use varies significantly between countries and regions due to different water use cycles. For example, many countries use traditional water treatments, while others rely on advanced desalination. In contrast to the use of energy in buildings, the impact of water use has not been fully addressed in research and studies, especially in developing countries where the production and distribution of water through city and village networks depends on the energy that can lead to greenhouse gas emissions. The water used in buildings constitutes a major source of liquid waste that needs to be treated and a source of environmental pollution. It includes an economic burden on the municipalities that manage this field.

5.2 Concerns

Water is essential to maintaining a healthy and livable built environment. Water quantity and quality are of primary concern, especially in places and seasons of water scarcity. Water quality can be broadly categorized as potable water, suitable for human consumption, and non-potable water for purposes where there is no danger of ingestion by humans. Drinking water is often available through a central network where municipalities or water distribution companies pump water from artesian wells, store it, treat it, and then distribute it on behalf of the community. When the piped water supply is unavailable, buildings rely on on-site sources. The most important sources of water on the site are rainwater tanks, which collect water that falls only in the winter season in Palestine.

A green building is a building that seeks to conserve water by managing consumption in terms of demand, system efficiency, and local resources that include rainwater harvesting and greywater recycling. It also ensures that wastewater discharged into waterways and/or site surfaces is free of contaminants and toxins.

5.3 Considerations

A building's water demand depends on several factors - user behavior, the efficiency of the water's fixtures and equipment, and the type and extent of landscaping.

When planning the water needs of a project, water demand reduction must first be considered. Project teams should consider the following measures related to the design and operation of buildings:

1- Reduce demand by selecting water-efficient fixtures (eg, electronic sensor taps, low-flow self-closing taps, and spray taps)

2- Reduce demand by selecting native plants for landscaping.

3- Reduce waste by monitoring leaks and maintaining equipment.

4- Rainwater harvesting requires little or no treatment for non-potable uses such as irrigation, washing, and rinsing.

5- Technologies such as reverse osmosis equipment can be used to treat rainwater and gray water for potable uses. (This usually consumes power which must be considered)
6- Natural cleaning systems where plants are propagated in landscaping features, a process known as phytoremediation.

How occupants manage their buildings is essential. Training staff to properly manage buildings and making sure occupants are aware of the need to act responsibly for buildings can help achieve performance goals. Since many areas in Palestine suffer from water scarcity and water quality issues, water consumption should be reduced for both potable and non-potable uses.

In addition to managing water within a building, it is also important to consider water movement around and through the building. Urbanization can have negative effects on water quality and quantity. Water quality is affected when land cover is changed from previous surfaces to large areas of impervious surfaces, reducing infiltration through the soil and replenishing groundwater. When buildings discharge pollutants, for example, cleaning chemicals, these impervious surfaces are washed away during rain and enter waterways, potentially damaging healthy ecosystems in their tracks. Human activities contribute to many pollutants such as heavy metals, synthetic organic compounds, and suspended solids.

Water quantity and flow are also adversely affected when natural waterways are straightened, deepened, and lined with impermeable materials. Increased hydraulic pressure in these engineered channels can cause water to collect in the direction of natural waterways in larger quantities and more quickly than expected.

Green development should strive to reduce impermeable roofs to increase the retention of rainwater runoff. Runoff should not be mixed with wastewater, and the separation of runoff from wastewater minimizes the energy consumed in pumping water and constructing pipework.

Rainwater runoff and its retention may take the form of a landscape element. When incorporated into the built environment, it can also be used for cooling, especially in industrial and commercial facilities. Ponds and fountains can be used to create a microclimate for human comfort.

5.4 Implications and effects

There are three crucial outcomes of designing for water in green buildings:
1- Lower operating cost - this is important for the building owner and occupants. Reducing demand and improving efficiency means lower overhead costs and, in some cases, less capital investment.
2- Better water security - This is important for governments and utility suppliers who invest less in infrastructure and are less susceptible to fluctuating water availability. Rainwater harvesting as an on-site water source can be important for building owners in places with a permanent or seasonal water shortage.
3- Less Negative Environmental Impact - Organized rainwater harvesting, gray water recycling, and less effluent will improve the health of ecosystems and neighboring communities.

1.1 Palestinian context

The average Palestinian per capita consumption is less than the minimum recommended globally according to the standards of the World Health Organization, which is 100 liters per day, due to the Israeli control over more than 85% of Palestinian water resources. During the year 2021, the average Palestinian per capita consumption of 81.9 liters of water per day, and this rate reached 85.6 liters per day in the West Bank and 77 liters in the Gaza Strip. By considering the high percentage of water pollution in the Gaza Strip and calculating the quantities of water suitable for human use of available amounts, the per capita share of fresh water is only 22.4 liters per day.

The urgent need for water will increase in the Middle East and North Africa region, which is already suffering from water scarcity, especially if the Earth is warming due to climate change. The fact remains that water resources in Palestine are dangerously scarce, and the situation in Gaza is catastrophic.

1.2 Point distribution.

The total number of points is (25) and is distributed over the following areas:

Table (5-1): The total points (25) and distributed over the following areas:

No	Item	Points
1	Water Use Efficiency	Mandatory
2	Efficiency of water appliances, sanitary fixtures, and water-consuming devices	6
3	Efficiency of water use in irrigation of gardens and green spaces	3
4	Use of gray water	3
5	Wastewater management	4
6	Rainfall harvesting systems	4
7	Water metering systems	4
8	Innovation in water systems	1
Total points		**25**

5.7 Water use efficiency

5.7.1 Aims

Increasing the efficiency of water use by reducing the consumption of fresh water and reducing wastewater production.

5.7.2 Requirements

Achieving a reduction in water consumption not less than 20% (the minimum)

5.7.3 Possible points

No points: this is a mandatory criterion.

Practical implementation - Water use efficiency

Responsibility:	Engineer ◉	Contractor ◉	Owner ◉
Stage:	Design ◉	Construction ◉	Operation ◉

Examples of how the project complies with the requirements of water waste efficiency

- Study the available water sources in the area in which the green building will be located, the presence of water networks, and the continuity of water supply
- Study of water consumption rates in the area in which the building is located
- Study wastewater disposal methods in the area where the green building will be located and the existence of sewage networks
- Develop a detailed plan to reduce water consumption during all phases of the project
- Awareness not to use drinking water on the site except for the purposes of drinking, washing, or concrete works and watering

Required documents for the green building evaluation process	Submission stage
Study of water sources, the network water supply to the building, and consumption rates	Before construction
Water rationalization plan during all phases of the project	Before construction
Any printed instructions or awareness posters to rationalize water consumption	Before and during Construction

Proposed references

- Palestinian Water Authority website
- The periodic reports of the Palestinian Water Authority and the Water Sector Regulatory Council
- Periodic reports for water and wastewater service providers in the area
- LEED Reference Guide for Building Design and Construction (2013). Version 4, updated August 2020 And the Jordanian Green Building Guide, Amman 2013

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☒

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☒	☐	☐	☐

5.8 Efficiency of water appliances, sanitary fixtures, and water-consuming devices

5.8.1 Aims

Providing new buildings with high-efficiency water appliances, sanitary fixtures, and water-consuming devices.

5.8.2 Requirements

Confirmation that the process of selecting water appliances, sanitary fixtures, and water-consuming devices has the following flow rates:

1. Toilet (flush valve) with a flow rate of no more than 4.8 liter/flush
2. A dual-flush flush toilet with a flow rate of 3 liters/flush for the first flush and 6 liter/flush for the second flush.
3. A rinser with a flow rate of no more than 4.5 liter/min at a pressure of 3 bars.
4. Urinal with a flow rate of no more than 1.9 liter/flush at a pressure of 3 bar.
5. Washbasin faucets with a flow rate of no more than 4.5 liter/minute.
6. Kitchen taps with a flow rate of no more than 8.5 liter/minute.
7. Shower with a flow rate of no more than 7.6 liter/min
8. The use of pot rinse valves in restaurants and hotels with a flow rate of no more than 6 liter/minute.
9. A domestic washing machine with a flow rate of no more than 8.75 liter/kg of laundry.
10. A household dishwasher with a flow rate of no more than 22 liters per cycle, or 15 liter per cycle for small models.

5.8.3 Possible points

Table (5-2): points distribution for Efficiency of water appliances, sanitary fixtures, and water-consuming devices

Points' requirements	Points distribution
Choosing toilets, bidets, and urinals with the required flow rates	2
Selecting faucets, showerheads, and vessel rinse valves at the required flow rates	2
Choosing washing machines, dishwashers, or any water-consuming devices at the required flow rates	2
Total points	**6**

Practical implementation – efficiency of water appliances, sanitary fixtures, and water-consuming devices											
Responsibility:	Engineer ◉			Contractor ◉				Owner ○			
Stage:	Design ◉			Construction ◉				Operation ○			
Examples of how the project complies with the efficiency of water appliances, sanitary fixtures, and water-consuming devices											
Surveying the local market to select water appliances, sanitary parts, and high-efficiency water-consuming devices											
Inclusion of the specifications of water appliances, sanitary fixtures, and water-consuming devices within the engineering plans and project documents, especially the flow rates											
In the absence of water appliances, sanitary fixtures, and high-efficiency water-consuming devices in the local market, a plan for operation is required to ensure the rationalization of water consumption											
Required documents for the green building evaluation process									Submission stage		
Drawings showing the distribution of water appliances, sanitary fixtures, and water-consuming devices									Design stage		
List of specifications of water appliances, sanitary fixtures, and water-consuming devices used in the project.									Design stage		
Water savings calculations									Before construction		
Proposed references											
Catalogs of sanitary water appliances, sanitary fixtures, and water consumables											
Operation manual for water-consuming appliances											
For water-saving calculations, the electronic calculator can be used by referring to: https://www.usgbc.org/resources/leed-v4-indoor-water-use-reduction-calculator											
LEED Reference Guide for Building Design and Construction (2013). Version 4, updated August 2020 And the Jordanian Green Building Guide, Amman 2013											
Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☒	☐	☐	☒	☐	☐	☐	☐	☐	☒
Positive Effects on Climate (Based on Rio Policy Markers)											
Adaptation				Mitigation			Biodiversity		Desertification		
☒				☒			☐		☐		

5.9 Efficiency of water use in irrigation of gardens and green spaces

5.9.1 Aims

Designing gardens and green spaces to consume the least amount of potable water possible.

5.9.2 Requirements

1- Use of highly efficient water-saving irrigation systems such as drip irrigation systems
2- Cultivation of plants that can adapt to local weather conditions and bear drought, or plants that in the first year of their life, may need systems that require temporary irrigation systems, with an area not less than the area determined by the competent authorities.
3- Designing outdoor gardens so that they are irrigated with no more than (60) percent of the reference transpiration rate of the irrigated area.
4- Covering the soil surface with mud cover to a depth of (50-120) mm.
5- Reducing the proportion of potable water used in irrigation using water.

5.9.3 Possible points

Table (5-3): points distribution for Efficiency of water use in irrigation of gardens and green spaces

Points requirements	Points distribution
Having a highly efficient irrigation system	1
Exploitation of additional water resources (for example: rain harvesting, greywater treatment, condensed water, etc.)	1
The presence of a system to reduce the rate of evaporation from the soil	1
Total points	**3**

Practical implementation - Efficiency of water use in irrigation of gardens and green spaces						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	◉	Operation	○

Examples of how the project complies with the requirements for water use in irrigation of gardens and green spaces
Using highly efficient irrigation systems such as drip irrigation
Reducing the proportion of potable water used in irrigation by using reclaimed water or any non-potable water that is treated and transferred from the competent purification plants to be used in irrigation, with an area not less than the area determined by the competent authorities.
Designing outdoor gardens so that rainwater can be collected from them or building a system or a rainwater collection tank for the purposes of irrigating outdoor gardens.
The use of automatic and self-controlled systems for all irrigation systems.

Required documents for the green building evaluation process	Submission stage
The plan of landscaping the site of green areas and solid surfaces, indicates on it the types of plants used and the shape of their expected horizontal projection after their growth.	Design stage
Documentation showing the total amount of water used in the design condition compared to the reference values for the reference line condition and the design condition of the project.	Design stage
Determining the amount of non-potable (reclaimed) water (m3) used for irrigation purposes only.	Design stage
Determining the strategies used in the project related to the coordination of natural sites, the irrigation process on the site, the calculations used to calculate the amount of water savings, and the identification of non-potable water sources and quantities available on the site. Technical reports showing the quality of the soil used for planting in the project and the procedures followed to protect it from evaporation regarding irrigation.	Design stage
Technical reports on water tests used in irrigation and their specifications.	Construction and operation stages

Proposed references
Ministry of Agriculture - Extension, Horticulture, and Irrigation Departments
Directorates of the Ministry of Agriculture
National Center for Agricultural Research
National Strategy for the Agricultural Sector
LEED Reference Guide for Building Design and Construction (2013). Version 4, updated August 2020 And the Jordanian Green Building Guide, Amman 2013

Positive Effects on the Environment and Health

Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☒	☒	☐	☒	☐	☒	☒	☐	☐	☒

Positive Effects on Climate (Based on Rio Policy Markers)

Adaptation	Mitigation	Biodiversity	Desertification
☒	☐	☒	☒

5.10 Use of gray water

5.10.1 Aims

Gray water recycling from the need for fresh water. Gray water treatment also contributes to reducing the large amount of wastewater leaving the building.

5.10.2 Requirements

Gray water is defined as untreated wastewater that has not come into contact with wastewater from toilets and urinals. Basically, its main sources are showers, bathtubs, bathroom sinks, washing machines and dishwashers. Gray water treatment can include:

1. Filtration
2. Precipitation of solids
3. Flotation and separation of lighter solids
4. Aerobic or anaerobic digestion
5. Chemical or UV disinfection

But again, regardless of the treatment, this water is not at all safe to drink, but it can be used to flush toilets, clean floors, wash clothes, and for irrigation. One of the main benefits of recycling gray water is that it is a huge source with a low concentration of organic matter. In the absence of sterilization, it may not be used in any way that leads to contact with the human body if inhaled. Therefore, it is not permissible to use them by irrigation with sprinklers if they are not sterilized. It is also preferable to use it within 24 hours and not to store it for more than 72 hours.

5.10.3 Points Requirements

1- Adherence to the requirements contained in the building code approved by the Association of Engineers regarding the provision of water and sanitation to buildings.

2- Installation of a dual-piping system for sewage; One for draining gray water and the other for draining black water, as well as installing two water distribution systems; One for potable water supplied to sinks and showers and the other for greywater flushing systems for toilets and urinals.

3- Installation of a complete gray water recycling system and use it for flushing toilets and urinals or for irrigation and agriculture.

5.10.4 Possible points

Table (5-4): points distribution for Use of gray water

Points requirements	Points distribution
An effective system for greywater collection, treatment, and storage	1
The presence of a gray water reuse system inside the building	1
There is a gray water reuse system outside the building	1
Total points	**3**

Practical implementation - Use of gray water						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	◉	Operation	◉

Examples of how the project complies with the requirements of the use of gray water
Estimation of the amount of gray water that can be collected from the building
Determining the appropriate diameters of the gray and black water collection pipes, as well as the capacity of the pumps, if necessary, before and after treatment
Determining a location for the collection of gray water, drainage, and black water and suggesting an appropriate treatment for the gray water
Estimating the need for treated gray water inside and outside the building and developing a design for reuse networks

Required documents for the green building evaluation process	Submission stage
Mechanical design drawings showing the greywater system, networks, treatment, and pumping plant.	Design stage
Presenting the calculations for selecting the capacity of the station and its accessories.	Design and operation stages
A report showing the quality of treated water and its suitability for use in the applications to be used in it.	Design and construction stages

Proposed references
Building code approved by the Association of Engineers regarding supplying buildings with water and sewage
WHO guidelines for gray water recycling
LEED Reference Guide for Building Design and Construction (2013). Version 4, updated August 2020 And the Jordanian Green Building Guide, Amman 2013

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☐	☐	☐	☒	☐	☒	☒	☐	☐	☒

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☒	☐	☐	☒

5.11 Wastewater management

5.11.1 Aims

Safe discharge of wastewater into sewage networks or reuse of wastewater, after treatment, and use for irrigation purposes by monitoring and following-up the amount of water consumed in buildings, collecting all water consumption data resulting from meters, placing them in a database, and identifying leak's locations and other malfunctions that can be discovered.

5.11.2 Requirements

1- The building is located in an area serviced by sewage service.

2- Or treating sewage water at the construction site and using it for irrigation purposes. As for the sludge, it is disposed of outside the construction site, or treats 50% of wastewater using tertiary treatment; The water being treated must be filtered or used on site for irrigation.

5.11.3 Possible points

Table (5-5): points distribution for Wastewater management

Points requirements	Points distribution
The existence of a sewage network affiliated to the local authority or private. Or treating the wastewater generated from the building with a system for reuse in irrigation and agriculture	2
The existence of a follow-up system for wastewater management and a record of the quantities and qualities of water in the case of on-site treatment	2
Total points	**4**

Practical implementation – Wastewater management						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	◉	Operation	◉

Examples of how the project complies with the requirements of wastewater management
Estimation of the amount of wastewater that can be collected from the building
Determining the appropriate diameters of the wastewater collection pipes, as well as the capacity of the pumps, if necessary, before and after treatment
Determine a wastewater collection site and suggest appropriate wastewater treatment and sludge disposal methods
Estimating the need for treated wastewater outside the building and developing a design for reuse networks

Required documents for the green building evaluation process	Submission stage
Engineering design schemes for wastewater collection and treatment systems	Design stage
Calculations related to the quantities of treated wastewater	Design and construction stages
Technical reports to show the quality of the generated water	Construction and operation stages

Proposed references
Building code approved by the Association of Engineers regarding supplying buildings with water and sewage
WHO guidelines for gray water recycling
Palestinian Water Authority

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous Waste	Waste water
☐	☐	☐	☐	☐	☒	☐	☒	☒	☐	☐	☒

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☒	☐	☐	☒

5.12 Rainfall harvesting systems.

5.12.1 Aims
Applying different rainfall harvesting systems for all new buildings of all kinds, considering the focus on the techniques used to collect rainwater during design, which helps to rationalize water consumption in buildings, in addition to focusing on general instructions for users.

5.12.2 Requirements
1. Construction and installation of water harvesting systems in all the buildings to be constructed, which have a water collection surface area of 200 square meters or more, and are located in an annual rainfall area equal to or more than 300 mm.
2. Provide a closed system that includes connecting rainwater gutters to an impervious and covered water harvesting tank to reuse the collected water for irrigation of gardens, flushing latrines, and urinals, among other uses.

5.12.3 Possible points

Table (5-6): points distribution for Rainfall harvesting systems.

Points requirements	Points distribution
Provides a complete system for the exploitation of rainwater to provide drinking water, after meeting all the required conditions	2
Provides a complete system for the exploitation of rainwater for non-potable water purposes after meeting all the required conditions	2
Total points	**4**

Practical implementation - Rainfall harvesting systems						
Responsibility:	Engineer	◉	Contractor	○	Owner	○
Stage:	Design	◉	Construction	○	Operation	○

Examples of how the project complies with the requirements for rainfall harvesting systems
Designing the project so that the roofs of the building/buildings are used for water harvesting.
Designing the project to use the paved surfaces around the site for water harvesting.
Benefiting from condensation water for cooling, especially in industrial and commercial establishments

Required documents for the green building evaluation process	Submission stage
Engineering drawings for rainwater harvesting system.	Design stage
System engineering calculations.	Design stage
Specifications of rainwater collection tanks, their capacity, and the necessary equipment and supplies	Design stage

Proposed references
CSIRO Urban Stormwater Best Practice Environmental Management Guidelines (2006)
Meteorological data from (Palestine meteorological department https://www.pmd.ps/)
LEED Reference Guide for Building Design and Construction (2013). Version 4, updated August 2020 And the Jordanian Green Building Guide, Amman 2013

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☐	☐	☐	☒	☐	☒	☒	☐	☐	☒

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☒	☐	☐	☒

5.13 Water metering systems

5.13.1 Aims

Monitoring the amount of water consumed in buildings and following it up, collecting all the water consumption data resulting from the meters and placing them in a database, and determining the places of leakage and other faults that can be located and this is done by applying systems for installing water meters on all water sources for all new buildings of different types: Water Potable and non-potable, whether supplied through the network or through water tanks.

5.13.2 Requirements

1- Providing plans for sanitary water, various water distribution networks, and water supply networks from additional sources inside the buildings

2- Documenting the water quantities from rain collection and gray water treatment or any other sources available in the building, and an indication of the locations of filters and water treatment devices.

3- Indicating water consumption measurement sites in the water supply and distribution networks and availability of consumption records and data for all utilities

4- Indicating the locations of the water flow and pressure control valves and systems in the network supplied with all water-consuming tools.

5- Indicating the locations of the anti-return devices, the locations for the separation of potable and non-potable water, the locations of the water treatment systems, and the ways to avoid pollution as a result of any contact between the different water sources.

6- Documenting the study of monitoring and controlling water quality and the availability of official records and data with the results and dates of the tests, according to the Ministry of Health and the World Health Organization.

7- Providing instructions and warning signs for all sites.

8- Documenting the study of the mechanisms and methods used to identify risks and their types and methods of application in avoiding and containing them.

9- Providing a statement of targeted awareness and guidance plans for all elements associated with the building.

5.13.3 Possible points

Table (5-7): points distribution for Water metering systems

Points requirements	Points distribution
The presence of systems for measuring, controlling, and monitoring water consumption inside and outside the building.	1
The existence of systems to control the quality of potable and non-potable water and take care of all its components from any health and environmental risks.	1
The existence of security and safety systems and mechanisms for using the water system in the building, identifying sources of danger, and containing dangerous events	1
Existence of awareness, guidance, and educational plans in rationalizing the consumption and use of water targeting owners, users, operators, technicians, and visitors to buildings	1
Total points	**4**

Practical implementation - Water metering systems						
Responsibility:	Engineer	◉	Contractor	◉	Owner	○
Stage:	Design	◉	Construction	○	Operation	◉

Examples of how the project complies with the requirements of Light Pollution Reduction
Install meters on all potable and non-potable water sources.
Provide all buildings with individual independent meters
Allocating a special meter for the areas where irrigation is used.
Installing sub-meters on the main devices that use water makes it possible to monitor and follow up on the quantities of water consumed in those devices, and to determine the places of leakage and other malfunctions that can be discovered. In the case of a Building Management System (BMS) or a central system for control and monitoring (Central Control and Monitoring System (CCMS)), meters can be linked to allow real-time reporting and management of water demand and consumption.

Required documents for the green building evaluation process	Submission stage
Engineering drawings showing the installation locations of water meters within the mechanical parts, and the specifications of those meters.	Design and operation stages
A plan to manage the measurement and control of water quantities inside and outside the building	Design and operation stages

Proposed references
Guidlines from the Ministries of Health, Agriculture and Labor regarding the use and treatment of water, including metering.
Measuring Systems Catalogs
LEED Reference Guide for Building Design and Construction (2013). Version 4, updated August 2020 And the Jordanian Green Building Guide, Amman 2013

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☐	☐	☐	☒	☐	☒	☒	☐	☐	☒

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☒	☐	☐	☐

5.14 Innovation in water systems

5.14.1 Aims

Design, implementation, or occupancy of the project in new innovative ways that were not addressed in the water standards.

5.14.2 Requirements

1- Achieving a positive environmental impact on financial efficiency in new innovative ways

2- Using smart systems such as faucets with infrared motion sensors

5.14.3 Possible points

Table (5-8): point distribution for Innovation in water systems

Points requirements	Points distribution
Engineering drawings, technical reports or explanatory text that includes information on the proposed methodologies and their positive impact on the water efficiency of the project.	1
Total points	**1**

Practical implementation - Innovation in water systems						
Responsibility:	Engineer	◉	Contractor	○	Owner	○
Stage:	Design	◉	Construction	○	Operation	◉

Examples of how the project complies with the requirements of the innovation in water systems
Study the impact of this idea on the water efficiency in the building
Study the appropriateness of these ideas for the project and the site
The feasibility study of these ideas includes the additional cost of implementing, maintaining, and operating the building, the return on the building, and the achieved water efficiency
Study of potential weaknesses and maintenance and sustainability of the proposed solutions

Required documents for the green building evaluation process	Submission stage
A summary of the final design solutions contains: Detailing the creative idea supported by studies and experiments indicating the success of the idea, and illustrations of the idea and how to implement it in the project	Design and operation

Proposed references
N/A

Positive Effects on the Environment and Health											
Comfort				Resources			Ecosystem		Waste		
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste	Waste water
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	Mitigation	Biodiversity	Desertification
☐	☐	☐	☐

CHAPTER 6

MATERIALS AND RESOURCES

Chapter 6
Materials and Resources

6.1 Introduction

The building and construction sector accounts for up to 50% of the total consumption of raw materials in many countries of the world. If we look at any building that is currently being constructed, we will find that a large number of materials are used in the various construction stages in addition to the operation stage. Excessive consumption and waste of materials place an economic burden on building owners and users.The materials can also have serious environmental, health and social impacts. Therefore, when choosing materials - like raw building materials or manufactured building products - the project must consider the impact of the materials used on occupants of the building in particular and the environment in general.

6.2 Concerns

Concerns about the effects of materials focusing on the negative impacts on the environment and/or human health are an important part of the green building concept. It can be summarized as follows:

1. Resource depletion
2. Effect of raw material extraction on land use, including clearing the natural habitats of existing plants and animals
3. The impact of raw material extraction on Indigenous communities, culture, crafts, and livelihoods
4. Impact on energy use, and greenhouse gas emissions due to the method of extraction, transportation, manufacturing, and assembly
5. Impact on water and wastewater resulting from extraction, processing, and assembly.
6. Generation of solid waste as a result of manufacturing and collection
7. Health hazards on workers at work sites
8. Health hazards on building occupants because of using unsafe materials.

Therefore, it is important for building owners and construction professionals to conduct a life cycle assessment of their building project to identify and mitigate any negative environmental impacts. This can help to promote sustainable building practices and reduce the overall environmental footprint of the building industry. This includes the extraction of raw materials, manufacturing of construction materials, transportation, construction, use, maintenance, and eventual demolition or disposal of the building. Without considering the entire life cycle of a building, building owners and occupants may unknowingly contribute to environmental damage and negatively impact the well-being of others.

6.3 Considerations and strategies

The most important strategies to follow in green building materials include the following:

• Selecting materials and products that use high efficiency resources, such as energy and water.
• Selecting materials and products that reduce embodied energy and embodied carbon.
• Selecting local materials, if possible, that strengthen local industries and communities and reduce dependence on transportation
• Avoiding materials and products known to be harmful to the environment, such as Ozone depletion substances

• Avoiding substances and products that can harm human health or the environment at any stage of their first life cycle.
• Designing building elements in a way that makes effective use of materials, for example, modeling and prefabrication.
• Reusing or modifying an existing building, in whole or in part, if possible. The energy embodied in an existing building can be up to thirty percent of the embodied energy of operations and maintenance (O&M).
• Minimizing waste at all stages, enforcing reuse and recycling
• Designing building components to be decommissioned and used elsewhere at the end of the building's life.

6.4 Results and Implications

There are several implications for the effective and responsible use of materials and resources:
• Reducing capital and operational cost: this is important to the owner and/or occupants of the building. Reducing material use and waste during construction lowers capital investment. Reducing waste during operations reduces cost overhead.
• Ensuring the health of building users: this is important for the owner and users because the indoor environment can affect productivity and wellness.
• Reducing environmental impact: this is an issue of local and global importance. Poor material selection and waste disposal can damage ecosystems, affecting the overall well-being of communities.
• Reducing greenhouse gas emissions: this is an issue of importance to the planet; the embedded energy of a substance can be related to greenhouse gas emissions.

6.5 Palestinian context

The local building materials widely used in Palestine include natural and artificial stone, cement blocks, aluminum, steel, and concrete. However, excessive reliance on natural stone has resulted in the destruction of large areas of stone quarries. Therefore, we must carefully study the possibility of exploiting the quarries with high efficiency, reducing the thickness of the stones used in construction, and reusing the lands of the quarries for agriculture or other purposes. Currently, little attention is paid to reuse and recycling in the built environment in Palestine, which deserves more attention in green buildings.
Also, Construction and demolition (C&D) activities are major contributors to waste streams. Design for disassembly will significantly reduce waste in the construction and demolition stages while extending the life of building materials and components.

6.6 Points distribution

To address the concerns, five topics are determined, as shown in Table 6-1
Table(6-1): Material and source topics with distribution points

No	Topics	Points
6.7	Non-hazardous materials	Mandatory
6.8	Construction and demolition waste management plan	2
6.9	Reuse and use of recycled materials	5
6.10	Optimized and Non-Polluting Materials	8
Total points		**15**

6.7 Non-hazardous materials

6.7.1 Aims

Reduce exposure of building occupants to hazardous materials such as asbestos, and reduce the toxic effects of heavy materials such as lead, mercury, etc.

6.7.2 Requirements

The following points should be considered.

1. All materials do not contain asbestos in new buildings and must be removed from existing buildings during renovation.

2. Paint and other materials do not contain heavy metals above the acceptable limit:

• Lead: 100 ppm (mg/kg) when tested according to BS 3900 B6 or ASTM E1613 or any equivalent test method.

• Cadmium: 500 ppm (mg/kg) when tested according to BS 3900 B9 or any equivalent test method

• Chromium(VI): 500 ppm (mg/kg) when tested according to BS 3900 B10 or any equivalent test method.

• Mercury: 100 ppm (mg/kg) when tested according to BS 3900 B16 or any equivalent test method.

• Arsenic: 100 ppm (mg/kg) when tested according to BS 4404 or any equivalent test method

3. Indoor and outdoor wood does not contain chromate copper arsenate (CCA) and urea-formaldehyde (UF) that are used during wood processing.

4. Equipment (especially refrigerators and air conditioners and Fire fire extinguishers) materials (especially insulation foam) must be with low Ozone Depleting Potential (ODP) and Global Warming Potential (GWP).

5. Any product whose harmful effects on human health are proven by the official authorities in the country

6.7.3 Possible points

Table (6-3): points distribution for Non-hazardous materials

6.7	Topic 2: Non-hazardous materials	
	Points (For more detail review Section 6.7.2)	**Points**
1.	No asbestos	Pre-request
2.	Paint and other materials do not contain heavy metals above the acceptable limit	
3.	Indoor and outdoor wood does not contain CCA and UF	
4.	Materials with Zero-ODP and GWP (100-Year Time Horizon, CO2 equivalent) less than 100	

Practical implementation – Non-hazardous materials						
Responsibility:	**Engineer**	☒	**Contractor**	☒	**Owner**	☐
Stage:	**Design**	☒	**Construction**	☒	**Operation**	☒

Examples of how the project complies with requirements
Include product specifications to ensure that it does not contain harmful substances
Proof the product has certificates from local, regional, and international authorities that it does not contain harmful substances

Required documents for the green building evaluation process	Submission stage
A brief description confirming that the materials used do not contain hazardous material and that the maximum permitted substances listed in Section 6.7.2 have been met.	Design stage

Proposed references
Palestinian Environmental Quality Authority (EQA)
IPCC Fifth Assessment Report or newer version- Global Warming Potentials, and Ozone depletion: substances

Positive Effects on the Environment and Health										
Comfort				**Resources**			**Ecosystem**		**Waste**	
Thermal	Light	Noise	Air quality	Energy	Water	materials	Soil	Plants	Solid waste	Hazardous waste
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	**Mitigation**	**Biodiversity**	**Desertification**
☐	☒	☐	☐

6.8 Construction and demolition waste management plan

6.8.1 Aims

Illustrate the environmental impact of construction, demolition and operating waste disposed of in landfills and how it can be reduced by reducing, reusing, and recycling building material waste.

6.8.2 Requirements

The following points shall be considered.

1. Develop a construction or demolition waste management plan (CDWMP) and strategy before starting construction or demolition activities. The strategy must:

- Determine at least 3 most used materials (Called Selected Materials), such as metal, concrete, wood and/or plastic, in the building. The selected materials should be:

• easily separated from the waste
• reusable at different stages of construction
• recyclable

- Specify the collection and storage places for the selected materials and other waste on the site.
- Determine places of a landfill in a way that does not affect the environment.
- Set a timeline for demonstrating the ability to reuse selected materials at different stages of construction.
- Define a list of suggested buyers who can recycle the selected materials.
- Identify sources of materials used off-site or recycled materials.

2. Develop a solid waste management plan (SWMP) for the stage of occupancy and operation. The plan must provide:

- Annual estimates of operational waste
- Summary of the waste management program and infrastructure available from the local authority
- Provide the appropriate size for the various types of waste containers and how they can be accessed according to the waste management program. At least the following containers must be provided:

• Containers for hazardous materials and chemicals that contain toxins or chemicals. Examples of potentially hazardous waste include paints, solvents, oils, mercury-containing lamps, electronic waste, and batteries (any colour with Hazard Logo)
• Containers for recyclable materials such as plastics, glass, and metals (green colour)
• Containers for non-recyclable materials (black colour)
• Containers for organic materials and waste (gray or brown colour)
• Dedicated places with an area of no less than 10 m3 for assembling furniture.

- All containers at the nearest collection point inside or outside the building, with a distance of not more than 30 meters, with a suitable entrance to the garbage collection vehicle

3. Reduce the percentage of waste materials selected to be landfilled

6.8.3 Possible points

Table (6-2): points distribution for Construction and Demolition Waste Management Plan

6.8	**Topic 1: Construction and Demolition Waste Management Plan**	
	Points (For more detail review Section 6.8.2)	**Points**
1.	Develop a construction or demolition waste management plan (**CDWMP)**	Pre-request
2.	Develop a solid waste management plan (SWMP)	
3.	Reduce construction waste for the selected materials to be landfilled by	
	at least 30% (this number does not include hazardous waste), or ensure that the waste does not exceed 2.5 kilograms per square meter of work	Pre-request
	1- Option 1: at least 50%	1
	2- Option 2: at least 70%	2

<table>
<tr><th colspan="2">Practical implementation – Construction and Demolition Waste Management Plan</th></tr>
<tr><td colspan="2">Responsibility: Engineer ☒ Contractor ☒ Owner ☐</td></tr>
<tr><td colspan="2">Stage: Design ☒ Construction ☒ Operation ☒</td></tr>
<tr><th colspan="2">Examples of how the project complies with it</th></tr>
<tr><td colspan="2">Determine the most commonly used materials that can be easily separated, reusable at different stages of construction and recyclable such as Steel, Concrete, and Wood</td></tr>
<tr><td colspan="2">Design adequate volume and access to waste storage, collection, and separation containers for operational waste</td></tr>
<tr><th>Required documents for the green building evaluation process</th><th>Submission stage</th></tr>
<tr><td>Summary of CDWMP and SWMP strategy to treat, reduce and store waste, and the relationship of this strategy with local or municipal infrastructure</td><td rowspan="3">Design stage</td></tr>
<tr><td>Drawings indicating the location of the storage facilities/disposal of building operating waste and the areas designed to ensure sufficient space for the movement of vehicles for waste collection</td></tr>
<tr><td>Table of materials that can be recycled, reused and/or reduced waste source with the percentage of the weight of these materials from the total weight of all materials</td></tr>
<tr><td>Provide proof of container installation and implementation of all requirements proposed in the design</td><td>Operational stage</td></tr>
<tr><th colspan="2">Proposed references</th></tr>
<tr><td colspan="2">Catalogs of sanitary water appliances, sanitary fixtures, and water consumables Ministry of National Economy to find the recycling companies</td></tr>
<tr><td colspan="2">Municipality and local authorities to find waste management programs and infrastructure design</td></tr>
</table>

<table>
<tr><th colspan="11">Positive Effects on the Environment and Health</th></tr>
<tr><th colspan="4">Comfort</th><th colspan="3">Resources</th><th colspan="2">Ecosystem</th><th colspan="2">Waste</th></tr>
<tr><td>Thermal</td><td>Light</td><td>Noise</td><td>Air quality</td><td>Energy</td><td>Water</td><td>materials</td><td>Soil</td><td>Plants</td><td>Solid waste</td><td>Hazardous waste</td></tr>
<tr><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☒</td><td>☐</td><td>☒</td><td>☐</td><td>☐</td><td>☒</td><td>☒</td></tr>
<tr><th colspan="11">Positive Effects on Climate (Based on Rio Policy Markers)</th></tr>
<tr><th colspan="4">Adaptation</th><th colspan="3">Mitigation</th><th colspan="2">Biodiversity</th><th colspan="2">Desertification</th></tr>
<tr><td colspan="4">☒</td><td colspan="3">☐</td><td colspan="2">☐</td><td colspan="2">☐</td></tr>
</table>

6.9 Used and recycled materials

6.9.1 Aims

Reduce the consumption of various raw materials by reusing previously used or recycled materials and products, thus improving the environmental life cycle impact of products and materials.

6.9.2 Requirements

The following points should be considered.

1. Refurbished or used/existing Building Materials and Construction Materials on-site or off-site should be used.

- Refurbished materials are used materials that have been repaired to be in good condition.
- Used/existing materials are old materials that are already on-site or have been used off-site and are in good condition.
- Building Materials include structural elements (foundations, columns, beams, etc.), envelope elements (walls, windows, roof, roof sidings etc.), and interior elements (doors, tiles, etc.).
- Construction Materials that are used during the construction stage include scaffolding, film-faced Plywood, metal, etc.

2. Recycled materials, such as steel, aggregate plastic, and aluminum, should be used.

- Steel is mainly used in the construction elements such as columns, beams, foundations, etc.
- Recycled concrete aggregate (RCA) is crushed cement concrete or asphalt pavement resulting from the demolition of buildings. It is mainly used in the construction elements, for example, shoulders, sidewalks, reinforced concrete, and backfill for buildings.
- Plastic can be implemented in many elements in buildings. For example, Driveway Plastic Pavers, plastic sidewalks, Plastic roof tiles, insulation with recycled plastic, plastic lumber, window frames (uPVC windows), recycled plastic ceiling tiles.
- Aluminum can be implemented in many elements in buildings. For example, Window frames, doors, siding and panels for exterior and interior walls, ceiling and roof, staircases, etc.

6.9.3 Possible points

Table (6-4): points distribution for Used and Recycled Materials

6.9	Topic 3: Used and Recycled Materials	
	Points (For more detail review Section 6.9.2)	**Points**
1	Use refurbished or used/existing materials. At least 3 main **Building Materials** used in the building and 2 main **Construction Materials** used during construction must be selected. These materials are called Chosen Material	
	Option 1: 1) For existing buildings (renovation), refurbished or used materials must be used in 50% of the total area for each selected material	2
	2) For new buildings, refurbished or used materials must be used in 50% of the total area of each selected **Construction Material** and 20% of each selected **Building's Materials**	2
	Option 2: 1. Based on the Calculation of the whole building Life Cycle Assessment (LCA), at least 2 out of 4 Environmental Impact items must be reduced by at least 10% of the baseline* 1. Global warming potential 2. Ozone Depletion potential 3. Acidification 4. Eutrophication LCA must be used for structure and envelope and interior materials/products only	1
	2. at least 30% from the baseline* *The baseline case here is the value of LCA for the building with the assumption that all materials used in building and construction are only new materials even if the building exists	2
2	Use recycled materials	
	• For steel buildings, at least 30% of the total steel structure (by weight) contains recycled materials. For reinforced concrete, at least 20% of the total reinforcement or steel (by weight) contains recycled materials.	1
	• Use at least 15% recycled aggregate on site (by volume) for both structural and non-structural applications	1
	• Use 100% recycled aluminum or plastic for at least two examples in Section 6.9.2-Point 2	1

<table>
<tr><th colspan="6">Practical implementation – Used and Recycled Materials</th></tr>
<tr><td>Responsibility:</td><td>Engineer ☒</td><td colspan="2">Contractor ☒</td><td colspan="2">Owner ☐</td></tr>
<tr><td>Stage:</td><td>Design ☒</td><td colspan="2">Construction ☒</td><td colspan="2">Operation ☐</td></tr>
<tr><th colspan="6">Examples of how the project complies with requirements</th></tr>
<tr><td colspan="6">Select the most commonly used building materials in the existing building such as walls, slabs, and beams for reuse in the new design</td></tr>
<tr><td colspan="6">Select the recycled materials in the new building such as plastic, aluminum, aggregate and steel</td></tr>
<tr><th colspan="5">Required documents for the green building evaluation process</th><th>Submission stage</th></tr>
<tr><td colspan="5">Provide a List of Chosen Materials in the project and recycled materials</td><td rowspan="3">Design stage</td></tr>
<tr><td colspan="5">Provide calculations of the percentage of the surface area of refurbished, used/existing or recycled for at least three Chosen Materials to the total area of those materials, or</td></tr>
<tr><td colspan="5">Provide calculation report for whole building Life Cycle Assessment ATHENA program any equivalent calculation method</td></tr>
<tr><th colspan="6">Proposed references</th></tr>
<tr><td colspan="6">For LCA, ATHENA program, LCA tool or any equivalent calculation can be used</td></tr>
<tr><td colspan="6">For Global warming potential reduction, Concrete Embodied Carbon Footprint Calculator or any equivalent calculation method can be used</td></tr>
</table>

<table>
<tr><th colspan="11">Positive Effects on the Environment and Health</th></tr>
<tr><th colspan="4">Comfort</th><th colspan="3">Resources</th><th colspan="2">Ecosystem</th><th colspan="2">Waste</th></tr>
<tr><td>Thermal</td><td>Light</td><td>Noise</td><td>Air quality</td><td>Energy</td><td>Water</td><td>Materials</td><td>Soil</td><td>Plants</td><td>Solid waste</td><td>Hazardous waste</td></tr>
<tr><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☒</td><td>☐</td><td>☐</td><td>☒</td><td>☐</td></tr>
</table>

<table>
<tr><th colspan="4">Positive Effects on Climate (Based on Rio Policy Markers)</th></tr>
<tr><th>Adaptation</th><th>Mitigation</th><th>Biodiversity</th><th>Desertification</th></tr>
<tr><td>☐</td><td>☒</td><td>☐</td><td>☐</td></tr>
</table>

6.10 Non-polluting and optimized materials/products

6.10.1 Aims

Encouraging the use of materials and products that do not have a long-term (life cycle) negative impact on human health or ecosystem pollution (environmentally, economically, and socially).

6.10.2 Requirements

The following points should be considered.

1. Choice of local and regional building materials/products that mitigate transportation impacts and boost local economies.

2. Use materials/products that do not have a long-term (life cycle) negative impact on the environment.

- Select products from manufacturers who have verified improved environmental life-cycle impacts. For example, an Environmental Product Declaration (EPD) certificate that explains what the product is and how it affects the environment throughout its entire life cycle.
- Conduct an LCA for the original product and the proposed improved product* intended to reduce the gases with a greenhouse effect (GWP) and/or the ozone-depleting potential (ODP) from the product generation process, whether by optimizing transportation, raw materials, and/or manufacturing . Carrying out calculations to estimate the expected percentage of water consumption reduction between the improved product and the original product in case of improving water consumption efficiency.

For example, in the concrete mix (product), the raw material of Portland cement is the main contributor to the embodied carbon footprint and GWP, so reducing the amount of this substance in the product without affecting its properties would achieve the goal.

3. Use of renewable sources of raw materials that can be considered renewable if their renewal rate is 10 years or less. Examples of these materials are wool, cotton, bamboo, and some approved types of wood.

* The original product is defined as the product that is widely used in the domestic market and whose components are at least 50% compatible with those of the proposed improved product. If these mentioned conditions are not available in any of the traditional local products, then the original product is defined in this case as the product that is commonly used and approved in the local or regional market and is close to the characteristics of the improved product and is approved as a "standard" or "reference point" (benchmark) for comparison.

6.10.3 Possible points

Table (6-5): points distribution for Non-Polluting and Optimized Materials/Products

6.04	**Topic 4: Non-Polluting and Optimized Materials/Products**	
	Points (For more details, read section 6.10.2)	**Points**
1.	Choice of local and regional building materials/products	
	a. **Option 1:** 20% of the total price of building materials/products is the price of the local materials/products (within 1500 km between project and manufacture of material/product)	2
	b. **Option 2:** 40% of the total price of building materials/products is the price of the local materials/products (within 800 km)	3
2.	Use products that have low effect on the environment	
	1. Select EPD-approved (or any equivalent certificate) products	
	a. **Option 1:** 10% of the total price of building envelope and interior products is the price of the EPD-approved products (Product-Specific Declaration type or Industry-Wide (Generic) type)	1
	b. **Option 2:** 20% of the total price of building envelope and interior products is the price of the EPD-approved products (Type III)	2
	c. Option 3: 10% of the total price of the building envelope and interior materials/products is the price of the improved materials/products that have GWP potential and/or ODP emissions 20% lower than the original product and be within 200 km of the work site	3
	2. Improved products by reducing GWP and/or ODP	
	1- **Option 1**: 5% of the total price of the building envelope and interior materials/products is the price of improved materials/products that have GWP and/or ODP emissions 10% lower than the original product	1
	2- **Option 2:** 10% of the total price of the building envelope and interior materials/products is the price of improved materials/products that have GWP and/or ODP emissions 20% lower than the original product	2
3.	Use of rapidly renewable sources of raw materials	
	a. **Option 1:** Use at least 50% of the wood to be used from wood that is certified as renewable and that is quickly replanted.	2
	b. **Option 2:** Use percentage of rapidly renewable materials in the project must be no less than 2.5% of the total building envelope and interior materials costs.	2

Practical implementation – Non-Polluting and Optimized Materials/Products						
Responsibility:	**Engineer**	☒	**Contractor**	☒	**Owner**	☐
Stage:	**Design**	☒	**Construction**	☒	**Operation**	☐

Examples of how the project complies with requirements
Choice of local and regional building materials/products such as stone, concrete blocks, etc.
Use materials/products that have EPD certificates such as insulation, tile window frame, steel profile, exterior materials for roof and walls, etc
Use of renewable sources of raw materials, such as wool, cotton, bamboo, and some approved types of wood.

Required documents for the green building evaluation process	Submission stage
Prove where the target products are manufactured to achieve points	Design stage
Proof of EPD Certificate (or equivalent)	
Provide calculation report for Life Cycle Assessment of improved products	
Calculations of the percentage of EPD and improved products and prices compared to total products prices	
Calculations of the percentage of rapidly renewable sources of raw materials prices or surface area compared to total products prices or surface area	

Proposed references
Palestine Standards Institution
LCA and ATHENA programs
Concrete Embodied Carbon Footprint Calculator

Positive Effects on the Environment and Health										
Comfort				**Resources**			**Ecosystem**		**Waste**	
Thermal	Light	Noise	Air quality	Energy	Water	Materials	Soil	Plants	Solid waste	Hazardous waste
☐	☐	☐	☐	☐	☐	☒	☐	☐	☒	☐

Positive Effects on Climate (Based on Rio Policy Markers)			
Adaptation	**Mitigation**	**Biodiversity**	**Desertification**
☒	☒	☐	☐

CHAPTER 7

GREEN BUILDING AND CLIMATE CHANGE

Chapter 7
Green building and climate change

7.1 Environmental reality

The current state of the climate is alarming at best. A marked increase in the global average temperature, and a decrease in ice levels near the poles with a rise in sea level. In 2018, the most significant portion of the world's final energy usage (36%) and energy-related CO2 emissions (39%) came from building operations and construction. One of the most significant sources of gas emissions from buildings relates to fluorinated gases (F gases) used in refrigerants or in some types of foam insulation. These fluorinated gases have a direct impact on ozone-depleting agents and/or global warming agents. These gases are released into the atmosphere through leaks in the system or by deliberate release rather than being recycled at the end of the system’s life. Therefore, many countries of the world have taken measures to reduce greenhouse gas emissions, but there are no indications of a slowdown in these trends so far. If significant measures are not taken to reduce greenhouse gas emissions around the world, this situation will continue or worsen in the coming years. In fact, the United Nations has called for countries to achieve net zero by 2050, which means that by then any emissions must be balanced by removing carbon dioxide from the air.

Rapid urbanization poses a major challenge to combating climate change, as the construction sector has an enormous impact on the environment. Buildings contribute significantly to greenhouse gas emissions throughout a building's life cycle, from the construction phase, the period of its use, to its removal or demolition.

During the construction phase, most emissions come from making carbon-intensive materials such as concrete and steel (steel), which can account for up to 10 percent of the world's annual greenhouse gas emissions. Many scientists believe that concrete has a significant negative impact on the environment, and some consider it "the most destructive material on Earth".

However, the main impacts of buildings on the environment come from operations during the life of the building. Where buildings need a lot of energy to run. And the more sophisticated it is with sensors and smart devices, the more power it needs. Since most non-specialists believe that the lighting of buildings and public utilities represents the highest percentage of electricity consumption, other systems represent higher energy consumption. Heating, Ventilation and Air Conditioning, also known as HVAC. According to the International Energy Agency, it already accounts for about one-fifth of all electricity used in buildings around the world - or 10% of total global electricity consumption today.

Air conditioning is referred to as a “vicious cycle”: the warmer the world, the more people need air conditioning installations, which in turn contributes significantly to a warming climate. “The growing demand for air conditioners is one of the most significant blind spots in today's energy debate,” says the Executive Director of the International Energy Agency. While there are approximately 1.6 billion air conditioning units in the world today, that number is expected to rise to 5.5 billion units by mid-century Supplying energy for these air conditioners comes with significant costs and negative environmental impacts that contribute to climate change.

HVAC is not solely responsible for energy demand in buildings. Refrigerators, chargers, and water heaters consume a fair amount of energy...and last but not least, there is a ridiculous amount of energy wasted - from electrical appliances that are turned on while not in use, to large amounts of heat loss due to poor thermal insulation in buildings' enclosures More than 30% of energy is wasted in US homes, according to researchers at the Massachusetts Institute of Technology. What is the case in a country where most of its buildings are not completely isolated, as is the case in Palestine today?

The important question is how can we make our buildings sustainable? The concept of "green buildings" has already received a lot of attention around the world, with residential and commercial buildings becoming carbon-neutral, or even carbon positive. According to the World Green Building Council (WGBC), which is the leading authority on such matters, a green building “is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Buildings maintain green over precious natural resources and improve our quality of life.”

The benefits of sustainable buildings listed as green buildings are numerous and include more efficient use of energy and water, use of renewable energy, reduction of waste, use of sustainable materials, improved air quality and more attention to the quality of life and social interactions of its occupants. All these benefits are as much social and environmental as they are economic. With higher efficiency, less waste and renewable energy, it often makes green buildings much less expensive to operate than traditional buildings.

7.2 Urbanization makes things worse.

The United Nations reports that by 2050, an additional 2.5 billion people are expected to move to the city. This is in addition to the fact that nearly half of the world's population already lives in cities. Not only are cities vulnerable to climate change, such as the impact of extreme heat events, epidemics and infectious diseases, or rising tides and floods in many parts of the world, but it also exacerbates the problem. Even though cities cover less than 2 percent of the Earth, they contribute nearly three-quarters of the world's carbon dioxide from global final energy use, as well as a significant portion of the total emissions of various greenhouse gases.

Smart cities are becoming increasingly important to combat the global climate change crisis. These cities are uniquely positioned to address many approaches to sustainability, from green commercial buildings to electric public transportation, using the Internet of Things (IoT) to communicate and better understand the major contributors to carbon emissions.

In urban areas, the impact on the environment is significantly different from that in rural areas. People in urban environments consume much more food and goods than rural people. They also own more cars per capita and use more energy. Increased energy consumption is creating heat islands in some places that contribute to changing local temperatures and weather patterns. At the micro level, buildings in cities consume a large portion of primary energy and electricity, which is important because the energy-making process is one of the largest sources of greenhouse gas (GHG) emissions worldwide.

Despite these challenges, action is being taken at all levels of society to combat climate change. One of these changes takes place at the micro level within the four walls which is what is known as a 'green building'

.7.3 Strategies to mitigate climate change reasons.

7.3.1 Strategy 1: New buildings

Reducing carbon emissions from new buildings is an important strategy to stem the increasing emissions of greenhouse gases. Designing new buildings to be net- or near-zero helps reduce energy consumption in buildings and use low- or zero-carbon energy sources.

Currently, architecture and building engineers design buildings to be "zero-negative" buildings. This building has net energy consumption, zero carbon emissions, and provides clean energy to the municipal grid.

Net Zero Building Design Steps

This guideline presents the essential steps for getting net- or near-zero buildings. The summary of these steps is:

7.3.1.1 Step 1: Site Location

Assess and select an environmental priority site and has community resources, as described in Chapter 2

7.3.1.2 Step 2: Architectural Building design

The success of achieving net zero depends on the architectural design of the building, especially the orientation and shape of the building. The building design should fulfill most of the requirements for indoor thermal comfort without the use of electrical systems, and use environmentally and human-friendly materials, such as F-Gases in refrigerants, as described in Chapters 3 and 6.

7.3.1.3 Step 3: Passive and Active Building design

Passive building design strategies aim to reduce energy and water consumption in buildings. These strategies include, the thermal performance of building envelope parameters, building infiltration rate, internal loads, solar and daylighting, natural ventilation, water efficiency, gray water use, and rainfall harvesting systems, as described in Chapters 4 and 5.

Active building design strategies aim to maximize the efficiency of mechanical, electrical, and plumbing systems in buildings.

7.3.1.4 Step 4: Renewable energy generation

Generate renewable energy on-site or purchase it off-site to offset remaining energy needs, as described in Chapter 4.

7.3.2 Strategy 2: Old existing buildings

Existing buildings make up more than 90% of the world's total buildings. In 2030, 70% of all current existing buildings worldwide are expected to exist in 2030. Therefore, improving the environmental performance of existing buildings has a significant impact on reducing the causes of climate change. Some strategies can be used to improve the environmental performance of existing buildings:

1- Encourages people to retrofit their equipment, lighting systems, and HVAC systems to be more energy efficient by lowering taxes on highly energy-efficient equipment.

2- Encourage people to deepen energy retrofit by making renovation investments that provide 50% or more energy savings through favorable financing.

3- People who are renovating their building envelope must meet the minimum energy efficiency requirements for the new design.

7.3.3 Strategy 3: Building operation.

To ensure that the energy performance of the building is the same as it was designed, continuous monitoring of the building system and periodic retro-commissioning must be carried out. Continuous monitoring of the building system is achieved by having sub-metering systems. Sub-metering systems provide information about when and why energy demand was increased, so professional engineers develop new plans to reduce them. The performance of existing building systems is examined, analyzed, and improved through a systematic process of Retro-commissioning. This procedure improves operating and maintenance procedures and helps ensure their continued performance over time.

7.3.4 Strategy 4: Renewable Energy Sources

Renewable Energy Sources must take the place of fossil fuels to achieve the aim of eliminating GHG emissions from buildings. Renewable Energy Sources can be solar, wind, hydropower, and geothermal, etc.

7.3.5 Strategy 5: Geoengineering Technologies

Additional methods exist for reducing global warming:

1- Carbon Dioxide Removal method: the term "Carbon Dioxide Removal", "Greenhouse Gas Removal", or "Carbon Removal" (CR) refers to methods for extracting CO2 from the atmosphere and permanently storing it through anthropogenic activities.

2- Solar Radiation Management method: To increase the amount of solar radiation reflected from the Earth and lower the peak temperature caused by climate change, Solar Radiation Management (SRM) entails intentional adjustments to the Earth system's albedo.

Adapting to climate change will require shifts from current practices and demands, adjustments to the carbon-based economy, and even a transformation of our core values. Not surprisingly, the public debate about adaptation to climate change has turned to building practices in response to evidence of the enormous pressure that today's buildings place on energy supplies and natural resources. Through green building practices, we seek to address building design, construction, and operation in a comprehensive manner to reduce the overall environmental impact of the built environment, increase the efficiency of the use of energy, water, and other resources, reduce waste and pollution, and environmental degradation. In large part, green building practices differ from traditional building codes by setting standards for acceptable performance for buildings (rather than specifying design metrics) and by making an accounting of the life cycle of the materials that make up the structure. This guide explores strategies for adapting the construction sector to climate change using green building practices. Aspects of green building explored in this guide include the use of sustainable building practices through the implementation of building efficiency standards and the incorporation of resource efficiency throughout the construction process. This guide emphasizes the need for regional construction priorities in building practices, where local requirements may make special adaptive demands on buildings, which aim to change buildings so that they are able to respond to environmental changes.

There are many ways to prevent, control and reduce air pollution, by reducing the consumption of fossil fuels, and reducing industrial emissions and waste.

7.4 Building design requirements under climate change Requirements

The following points should be considered.

1. Choose local weather data for the selected location.
2. Generate future climate data for typical future years based on Representative Concentration Pathway RCP scenarios from Intergovernmental Panel on Climate Change IPCC Fifth Assessment Report in 2014 or newer scenarios from newer reports.
3. Evaluate the energy and thermal performance of a building under future typical years (at least 50 years from now)
4. Check the HVAC size and the indoor thermal condition under future climates.
5. Provide a report about the future climate scenarios used and suggestions for dealing with climate change.

Second Edition
2024