ASSESSMENT OF SUSTAINABLE BUILDING PRACTICE CONDITION IN THE CASE OF ASELLA CITY ADMINISTRATION.

Jiregna Tesfaye Etefa

A thesis Submitted to the department of Civil Engineering School of Civil Engineering and Architecture Presented in Partial Fulfillment of the Requirement for the Degree of Master's in civil Enginering (Construction Engineering and Management)

Office of Graduate Studies

Adama Science and Technology University

Sep 15, 2023

Adama, Ethiopia

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APPROVAL SHEET

I/we, the advisors of the thesis entitled **"Assessment of sustainable building practice condition in the case of Asella city administration"** and developed by **Jiregna Tesfaye Etefa** here by certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Bahiru Bewket (PHD)

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We, the undersigned, members of the Board of Reviewers of the thesis by Jiregna Tesfaye Etefa have read and evaluated the thesis entitled **"Assessment of sustainable building practice condition in the case of Asella city administration"** and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in **Construction Engineering Management.**

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DECLARATION

I hereby declare that this Master thesis entitled **"Assessment of sustainable building practice condition in the case of Asella city administration"** is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation

Jiregna Tesfaye		
Name of student	Signature	Date

RECOMMENDATION

I, the major advisor(s)/supervisor(s) of this thesis, hereby certify that I/we have read the revised version of the thesis entitled **"Assessment of sustainable building practice condition in the case of Asella city administration" s)** prepared under my/our guidance **Bahiru Bewket (PHD)** by **Jiregna Tesfaye Etefa** submitted in partial fulfillment of the requirements for the degree of Mater's of Science in **Construction Engineering and Management**. Therefore, I/we recommend the submission of revised version of the thesis to the department following the applicable procedures.

Bahiru Bewket (PHD)

Major Advisor/Supervisor	Signature	Date
Co-advisor/Co-supervisor	Signature	Date

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LIST OF ARONMYS AND ABBREVATIONS

AC	Air Conditioner
BREEAM	Building Research Establishment Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Built Environmental Efficiency
CFC	Chlorofluorocarbon
DGNB	German Green Building Council
EiABC	Ethiopia Institute of Architecture, Building construction and City Development
GB	Green Building
GBCA	Green Building Council of Australia
GIZ	German Society for International Cooperation
HCB	Hollow Concrete Block
HVAC	Heating, Ventilation and Air Conditioner
HoA-REC&N	Horn of Africa Regional Environmental center and network
ICS	International Community School
IEQ	Indoor Environmental Quality
LEED	Leadership in Energy and Environmental Design
SB	Sustainable building
UN	United Nation
UK	United Kingdom
U.S.	United State
USGBC	United State Green Building Council
VOC	Volatile organic compounds
WNCGBC	Western North Carolina Green Building Council

ABSTRACT

Buildings play a big role in environmental degradation, which has given rise to the idea of "sustainable buildings," which are built to be energy and water efficient, employ sustainable materials that aren't harmful, and provide healthy, productive indoor and outdoor settings. This idea, however, is highly novel in Ethiopia cities specially Asella City, which has recently seen a huge expansion in the building industry and is currently experiencing a building construction boom. The majority of city buildings employ HCB wall and glass facades, which increase energy consumption and cause glares, rather than taking advantage of the great climate. In order to increase sustainability efforts, it is necessary to improve the environmental performance of these structures through the application of green/sustainable building principles before the issue becomes unfixable. In order to understand the gap, its challenges, opportunities, and appropriate approaches for application and implementation in Asella, this thesis evaluates the nature of a few chosen buildings based on sustainable building principles, by using a case study and document review to gather the essential data. In order to get the necessary data, a mixed strategy that makes use of both qualitative and quantitative data was used to gather information from primary sources through site surveys, interviews, and questionnaires as well as secondary data through document reviews and case studies. The majority of the surveyed buildings have poor indoor quality that can sometimes contribute comfortless of occupants, rely on imported materials rather than using local and low impact materials, consume a significant amount of unnecessary energy, and pay little attention to water efficiency or the surrounding area. These findings come from the analysis of the data gathered. According to the practitioners' responses, lack of knowledge about sustainable buildings, developers' lack of interest, the lack of government incentives, and other factors make it difficult to put the concept of sustainable building into practice. The best approach, in the practitioners' opinion, is to promote sustainable buildings through public awareness campaigns. Finally, the thesis makes the required suggestions in light of the issues found.

Key words*:* Sustainable building, Green building, Indoor air quality, Water efficiency

CHAPTER 1 INTRODUCTION

1.1 Background of Study

One of the key issues arising from Internal/external drivers for Construction and Engineering firms is being green or sustainable. Sustainable building expands and supplements conventional building design considerations such as cost, utility, durability, and comfort. Sustainable building is typically associated with the structure and implementation of environmentally responsible and resource-efficient processes throughout the life cycle of a building, from design to construction to operation, maintenance, renovation, and demolition.(Gizaw, 2021)

All over the world, large amount of buildings is being built and their design, construction, maintenance and demolition have a tremendous impact on the environment and natural resources. According to the U.S. Green Building Council, buildings are among the heaviest consumers of natural resources and energy, thereby creating a significant portion of the greenhouse gas emissions that affect climate change. The Construction of Building has a huge effect on the environment, using about 40% to 45% of natural resources in industrialization, consuming nearly 10% to 12% of portable water and 65% to 70% of the electricity, and 40% to 60% of the waste disposed in the landfill. These are responsible for emitting harmful gases like producing 30% to 35% of greenhouse gases like Carbon dioxide (CO2), Methane (CH4),evaporation of water, and nitrous oxide.(Singh et al., 2022) In view of these circumstances, Sustainable building movement which seeks to achieve balance between Environmental, Social and Economic performance of buildings has gained momentum in recent years. As stated in (U.S. Green Building Council, 2008), the core idea of Sustainable building is the optimization of one or more of its principles such as Siting and Structure Design Efficiency, Energy Efficiency, Water Efficiency, Materials Efficiency, Indoor Environmental Quality Enhancement, Operations and Maintenance Optimization, and Waste and Toxics Reduction. Sustainable buildings use less energy, water and natural resources, further it creates less waste and provide healthier living environment compared to the conventional buildings. Sustainable building strategies not only stand for sustainable materials in their construction (e.g. reused, recycled content or made from renewable resources) but also making use of natural processes (e.g. shading effects of trees, insulation capacities of green roofs and green facades, mitigation of urban heat due to

evapotranspiration). Greening the exterior of buildings (walls and roofs) provides numerous ecological and economic benefits, including storm water management, energy conservation and mitigation of the urban heat island effects, reducing air pollutants, increased longevity of building materials, as well as providing a more aesthetically pleasing environments in which to work and live. (Mahamadata, 2018) In the developed world, there have been extensive studies on sustainable buildings, as evidenced in the rapidly growing number of assessment tools (such as LEED United States, BREEAM United Kingdom, GBCA Australia, DGNB Germany and CASBEE Japan) developed to assist 2 the Sustainable building development in the last decades. However, in the developing world such as Africa, sustainable construction has not received sufficient attention despite being an important aspect of sustainable development. According to the World Bank Development report of 2009, only South Africa has an established Green Building Council (GBC) but this is slowly changing with Morocco, Mauritius and Egypt being in the process of establishing their councils. (Nura Mohammed, 2018) Currently, the number of GBCs in Africa has increased including countries such as Ghana, Kenya, Namibia, Rwanda, Tanzania and Zambia but Ethiopia is yet to join these groups. Similar to the majority of developing African countries, the concept of sustainable buildings is very new in Ethiopia. It is rare to find researches which address this topic. Therefore, there is scarcity of research concerning the difficulties and prospects of applying these principles in different city of Ethiopia, which is of prompt importance to bring about sustainable practices and techniques that minimize the negative effects of conventional buildings. This paper raises serious concern to take the necessary actions for management of green building construction projects by conducting a survey study on the sustainable buildings found in Assela city. A total of 9 buildings were assessed focusing on their sustainability practice by international practices.

1.2 Statement of the Problem

Sustainable building (SB) is receiving global praise as the most impressive answer to the unfavorable effects brought upon the environment by buildings and construction activities. The developed countries have accepted this as a best preference to the mitigation of the impacts on the environment and created codes, policies and frameworks to encourage and enforce the employment of Sustainability building concepts in their construction industries. Current evidence, on the other hand, indicates that green building adoption in developing countries, especially in Sub-Saharan Africa (SSA), is slow and characterized by the lack of

green building construction project management codes and frameworks; though there have been significant attempts in the last few years to investigate green buildings ,the Constitution of the Federal Democratic Republic of Ethiopia sets the overall environmental values to be preserved and protected under the Environmental Objective of 92(sub-articles 2&4). But, the uncontrollable rate of urban population growth in the country has damaged the environment by degrading the resources found on it. Conventional buildings being a vital component of the urban environment largely contribute to the problems of urban areas. Buildings consume many of the natural resources and are responsible for many problems including 40% of the world's total energy use, 30% of raw materials consumption. 25% of timber harvest, 35% of the world's CO2 emissions, 40% of municipal solid waste destined for local landfills, 50% of ozone-depleting CFCs still in use and has negative affect for watersheds, habitat, air quality, and community transportation patterns (Mahamadata, 2018). Additionally, the misuse of resources in rural and urban areas leads to different environmental degradation. Buildings, both in urban and rural, misuse the quality and quantity of sensitive resources. With the ongoing rapid construction dynamics, our city is prone to such degradation. Nowadays, there are many improvements in constructing sustainable buildings. Many initiatives and experiments have been taken in order to make buildings to be built in the future sustainable and durable. This concept is poorly applied on the currently being built buildings in Ethiopia particularly in like Asella city. Currently rapid road constructions are being carried out in urban centers of Ethiopia like in Asella city. Following this road construction multistory and multi functioning glazed buildings are being built along the roads. These collections of buildings alongside of the road have 4 caused for the formation of urban heat island. The temperature is higher around those buildings as areas are dominated with impervious parking lots and paved walkways. Multi storied buildings which are situated next to wide vehicular roads are suffering from noise pollution, vehicular smoke pollution and dust particles, lack of privacy and discomfort due to increase in CO2 from smoke. Greeneries that can sequestrate CO2 produced due to urbanization are being degraded and altered to more build up masses because of population pressure. Curtain walls which had been used in western world to let in sufficient light to their buildings are invading our high-rise buildings as fashionable construction material. Although Asella does not have problem of receiving sufficient natural light all year round, curtain walls are being used as finishing material redundantly. This unnecessary usage of glass has caused glare and

entrapment of unneeded heat. Greenhouse effect is the gradual result of the un-proportional application of Curtain walls in our country. And the extra energy used to cool such interior spaces has increased the overall energy consumption of the buildings'. The other problem one comes across while overseeing the characters of buildings in Asella is that they are simply abandoned units that are functional only in the inside. But externally they do not compliment the environment or their aesthetics is somewhat alien when we look at them from nature's point of view. They do not merge into the environment or emerge from the environment. There is no anchoring natural element that connects the buildings to the ground they are built on. Therefore, researching the contextual aspect of buildings in Asella towards the natural environment and proposing sustainable building concepts, which this research paper is aimed to address, is very important.

1.3 Objective of the Study

1.3.1 General Objectives

The main objective of the study is to focuses on Condition assessment of sustainability practices on selected buildings in Ethiopia in case of Assela city Administration and also to recommend possible remedial solutions to the selected buildings.

1.3.2 Specific Objectives

1. To assess the Current Practice of sustainability on selected building in Asella city.

2. To identify the Challenges and Opportunities in implementing practice of sustainability on selected building in Asella city.

3. To develop possible remedial solutions appropriate strategies to improve the sustainability construction on selected building in Asella city.

1.4 Research Question

1. What are the current situations on Practice of sustainability on selected public building in Asella city?

2. What are Challenges and Opportunities in practice sustainability on selected public building in Asella city?

3. What are the possible appropriate strategies to improve the sustainability construction on selected building in Asella city?

1.5 The Scope of the Study

The investigation is geographically limited to a few buildings in Asella city administration. Thematically, it investigates building practice in relation to sustainable building principles,

as well as its prospects and challenges for application, by merging information from several disciplines such as architecture, contractor, regulatory body and others. It focuses

1.6 Significance of the Study

This study provides practical significance as it is an eye opener in the sustainable building construction project management field of practice for our country Ethiopia, especially for the local city like Asella city by awakening policy makers, concerned stakeholders and the public. And it would provide the foundation for a comprehensive uptake framework of the sustainable building construction project management concepts in the Ethiopian construction industry and in the project management field of study by initiating the development of a specific project management framework for SBC projects. The study will initiate governmental bodies to adjust their regulatory incentives to SBC so as to let its exponential growth and project managers to dispense sustainable construction according to clients' expectations, by making modifications to traditional project management processes and practices. Most importantly, it can be used as a valuable source for further similar studies in the field of project management.

This study provides valuable knowledge as it is one of the few studies to investigate the application of sustainable building concepts in buildings of Asella city. It is significant because it contributes to a better understanding of the concept and implementation of sustainable building principles and its role for achieving sustainability in building design and construction. Through its recommendations, it suggests ways of increasing adoption of sustainability concepts in buildings and can also be used as a useful reference for both industry practitioners and academics that are interested in green building developments.. Lastly the study will influence the practice of consultants in the building industry in Asella city.

1.7 Delimitation and Limitation of the Study

Limitation:-Since the concept of sustainable buildings is relatively new, conducting this research required the cooperation of organizations that may no longer be able to collect data

formally and on time. These limitations include the absence of prior research on sustainable buildings that was tailored to Asella city buildings and the lack of timely updated data that are relevant to the research.

Delimitation:- This study's delimitation is Asella city is a relatively narrow city, making it easy to visit the selected building, and all parties involved in this building are eager to answer questions, conduct interviews, and supply the necessary data for my research.

CHAPTER 2 LITERATURE REVIEW

This chapter discusses the literature that was reviewed. The literature review will start by explaining the concept of sustainable buildings, how it came to be and its principles. Secondly there is a discussion on the benefits of sustainable buildings and its challenges of sustainable building practices. There is a focus on green buildings and Sustainable Building Councils and what they comprise off. Furthermore, the concept of a Sustainability rating tool

is discussed, followed by the different Sustainability rating tools and models that are applied globally.

2.1 Definitions and Concepts of Sustainability

Sustainability is not considered as a new concept as it was used since the 1970's (2) even though the practice during the time was still largely hold a preservationist philosophy

Several attempts have been made to describe sustainability concept. Sustainable development defines in any words and from different point of views. Sustainable development is about ensuring a better quality of life for everyone, now and for generations to come. (Gizaw, 2021)

(Anteneh, 2021), Sustainability requires meeting four key objectives at the same time in the world as a whole: social progress which recognizes the needs of everyone, Effective protection of the environment, Prudent use of natural resources, Maintenance of high and stable levels of economic growth and employment.

The main idea of sustainability is to concentrate on environmental conditions to achieve a designed product with maximum internal attributes of environment so that it can minimize the undesirable aspects of these constructions. Buildings must reply to environment from design stage and settling when they are to decrease confronting with nature.

The term and concept of sustainability are actively redesigned for the specific purpose at any given time and context. In construction industry, a variety of sustainable based concepts are used such as sustainable and green building, sustainable and green construction and sustainable and green project management and so on.

The fact shows that the words green and sustainable are often used synonymously and interchangeably. However, according to the Brunt Land Report published in 1987, sustainable means meeting the needs of the present generation without compromising the needs of future generations. Due to flexible nature of the concept, many definitions currently exist for the term 'sustainable' and 'sustainable development' which most of them have been extended to be based upon the three pillars of 'triple bottom line' concept that developed in 1997 by John Ellington. Summing up the arguments, sustainable building is considered as an approach for the building industry to move towards sustainable development by taking into account environmental, social and economic issues. On the other and.

2.2 The Concept of Sustainable Building

Sustainable buildings are buildings that are built in an environmentally responsible manner by maximizing use of materials, minimizing use of resources and ensuring the health and well-being of occupants and the surrounding built environment both today and for generations to come. (Sobek,2009)

Applying sustainability management to buildings requires work under three main headings: construction, lifetime use and decommissioning. Throughout these stages, the three-fold objective is to be efficient in the use of resources, protective of the occupants' health and well-being, and reducing the negative impacts, such as waste and pollution. (Sobek, 2009)

The design, construction and maintenance of building have a tremendous impact on our environment and our natural resources. Traditional building practices often overlook the interrelationships between a building and its components, its surroundings and its occupants, and consume more of our resources than required, impacting negatively the environment. The basic resources like ground cover, forests, water and energy are depleted to construct and operate buildings. This is where sustainable buildings step in with an aim to address all these issues in an integrated and scientific manner. (Ferreira, 2002)

Sustainable building, also known as Green building refers to a structure constructed using process that is environmentally responsible and resource-efficient throughout a building's lifecycle: from site selection to design, construction, operation, maintenance, renovation, and demolition. In other words, Sustainable buildings involve finding the balance between home building and the sustainable environment. This requires close cooperation of the design team, the architects, the engineers, the client and occupants at all project stages and at operation. The green Sustainable building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Sustainable building is meant to be a building that exhibits energy efficiency, resource depletion, impact on environment and protection of health and environment.

Most published works relating to the concept of sustainable building, however undeniably was influenced by the initial concept of sustainability which are about limited resources and to reduce impact to the natural environment with emphasis on the technical issues such as materials, building components, construction technologies and energy related design concepts. (Mohd Isa,2014)

According to (Sobek,2009), With respect to the LEED guidelines there are seven topics that should be addressed in the designing and building of sustainable buildings.

1. **Sustainable sites:-** Sites should be selected by determining which site would pose the least Environmental threat if construction were to take place. Pollution prevention including controlling soil erosion, waterway sedimentation and airborne dust generation are important factors to be considered. Sites should also be chosen that are closer to urban development where supporting infrastructure is available; this will preserve green spaces and wildlife areas. The redevelopment of brownfields would be preferential as no new land is needed. Alternative transportation is another important factor to consider. The availability of public transport, bicycle parking and shower facilities can minimize the GHG emissions associated with travel to a building. Other factors that promote sustainability would be, for example, preferential parking for low-emission vehicles and/or hybrids. Biodiversity can be promoted by designing large amounts of open space in the new building complexes. Another factor are the water management systems that take into account the natural environment design for storm-water systems to ensure proper management of water. Reduction of the heat island effects from roofs and parking lots as well as the reduction of light pollution is another factor that should be taken into account to promote sustainability.
2. **Water efficiency: -** The main goal is to increase water efficiency use within the building, thereby reducing the amount of water needed for operations. Some methods which can be designed in a building include water efficient landscaping to reduce irrigation requirements and the use of innovative wastewater management technologies.
3. **Energy and atmosphere: -** Energy systems should be properly installed and calibrated to perform to their intended efficiency levels. This should reduce the overall energy use and lower operating costs. A minimum level of acceptable energy performance for the facility should be determined and monitored. A refrigerant management system to reduce refrigerant losses and resulting potential ozone depletion. Various methods for on-site renewable energy production can reduce the overall footprint of the building and other means of using green power. Methods to monitor, verify and continually improve on energy consumption are key to ensuring that energy performance is maintained. In the UK, it is estimated that construction is responsible for 50% of the emissions of greenhouse gases and 60% of that emission is attributable to space heating of buildings. Buildings also use energy in the heating of water, lighting, mechanical ventilation and machinery such as lifts

4. Materials and resources:-The construction process is highly energy dependent, particularly through the manufacture and transport of materials. (Morton R., 2009). The amount of landfill waste created during construction and operation can be reduced by efficient use of materials and designing for recycling. Specifying used construction materials can reduce the need for virgin materials. Specifying materials that are locally sourced, that come from certified sustainable sources (e.g. Forest Stewardship Council (FSC) forest products), that contain recycled materials or are rapidly renewable enhances overall environmental sustainability and lowers the embedded carbon footprint of a building.

5. Indoor environmental quality

To enhance the well-being of occupants, design should use low emitting materials in construction including sealants, adhesives, paints, coatings, flooring, and wood and agro fiber. Ventilation systems that promote outdoor air ventilation are preferable and should not allow for outside pollution to enter the building, if possible. Buildings should be designed to maximize the use of natural light for all occupants. Lighting and heating systems should be designed to manually or automatically turn off to reduced energy consumption.

6. Innovation in design:-Design decisions should be made early in the process as good design can greatly reduce the energy consumption of a building; for example, the orientation and location of a building can compromise shading and ventilation decisions. This part of the assessment encourages and rewards design and construction methods that are particularly innovative. Since there are no real criteria, this allows for architects and contractors to experiment and innovate and receive credit in the scoring system. The UK guidance below proposes1 that a Low Carbon Design Taskforce should be created and that this taskforce could develop a blueprint that focuses on four levels in design: Site selection, Orientation, materials and use of renewable forms of energy.

7. Regional priority: - Designs should be maximized to take into account regional priorities. In colder climates, buildings could be designed to maximize heating efficiency; in hotter climates, cooling and water usage would gain more importance in the design process. Sustainable buildings are designed to minimize their environmental footprint and, at the same time, improve the well-being of the persons who live, work and play in those buildings. While improved building performance significantly reduces resource use, effective urban planning reduces a city's overall environmental impact by reducing the movement of people between buildings and pressure on municipal infrastructure.

2.3 Overview of Construction Industry in Ethiopian

2.3.1 Construction industry in Ethiopian

Ethiopia is a country located in the Horn of Africa. It is a large country with an area of1.13 million square kilometers. Ethiopia is home to a large population of inhabitants, according to a report by self-help Africa, 2013, these amounts to about 91 million. The average number of inhabitants per km² can be estimated to be around 80 people.(And & Yadeta, 2021)

Ethiopia has a rich history of magnificent construction endeavors. The ruined palace of Queen Sheba at Yeha, the Obelisks of Axum, the rock-hewn churches of Lalibela, and the castles of Gondar are few examples of these expertises. With the advent of modern civilization, especially during the late 19 th and early 20 th century, there have been some significant developments in this regard. Even though, the development of the construction industry in Ethiopia is slow, it plays a key role in the development of the national economy. From 2001 onwards, the construction industry in Ethiopia is developing tremendously. Recent studies by indicated that the GDP contribution of the industry has been raised to 5.6% and approaches to the sub Saharan average (6%). Meanwhile the Gross Domestic Capital Formation (GDCF) which was about 60 percent in 1996/97 has reached nearly 75 percent in 2002/03. Beyond it contribution to the nation, the industry is also the 6th major contributor of the content infrastructure stock following South Africa, Egypt, Morocco, Algeria and Nigeria.(Ayalew , 2016)

The role the construction industry plays in socio-economic development is significant. It provides the basis upon which other sectors can grow by constructing the physical facilities required for the production and distribution of goods and services. The construction industry has a significant multiplier effect on the economy as a whole. (Fetene Nega, 2008)

According to (Fetene Nega, 2008), the interrelationship between the construction industry and the broader economy largely emanates from three of the industry's characteristics namely:

The public sector is its major client; It's large size, ability to produce investment or capital goods which contribute significantly to national GDP and It is a major source of employment, directly and indirectly by its multiplier effect.

2.3.2 Building industry in Ethiopian on sustainability

Sustainable building is not realized in Ethiopia as it was intended by west as holistic concepts of social, Economic and Ecological Measures. Sustainable building as a western standard it fail in contemporary Ethiopian standard. (Baron, N and Donath, 2016)

Study conducted revealed that, the sustainable building construction challenges in Ethiopia are different from the developed and most of the developing nations in many aspects. The main challenges that lead to wastage of resource, time and money in addition to affecting the environment are: weak implementation of standards. Currently Ethiopia building industry is not focus on sustainability it's all about money making.(Baron, N. and Donath, 2016)

2.4 The Fundamental Principles of Sustainable Building

The construction of sustainable building is part of sustainable construction. According to, the ecological, social, and economic problems of a building in the context of its environment are addressed through sustainable construction. From design to demolition, sustainable construction is used in the construction process. Through designing and overseeing a construction project in accordance with the contract agreement, such construction aimed to reduce the environmental effects of construction practices According to (Gizaw, 2021), the followings are the fundamental principles of sustainable building.

I. Sustainable Site Design

Buildings start with proper site selection, including consideration of the reuse of existing buildings. The location, orientation, and landscaping of a building affects the local ecosystems, transportation methods and energy use characteristics of the building. Smart growth principles should be incorporated in the project development process, whatever the scale of development. Whether designing a new building or retrofitting an existing building, site design must integrate with sustainable design to achieve a successful project.

II. Optimize Energy Use

Sustainable buildings often include measures to reduce energy consumption – both the embodied energy required to extract, process, transport and install building materials and operating energy to provide services such as heating and power for equipment. It is essential to reduce demand, increase efficiency, and utilize renewable energy. The use of passive

measures such as orientation, air tightness, solar shading, thermal mass, and natural ventilation, must be considered from the outset; it must work with the natural environment, rather than against it, to reduce operating energy use, designers also use details that reduce air leakage through the building envelope (the barrier between conditioned and unconditioned space). They also specify high-performance windows and extra insulation in walls, ceilings, and floors.

III. Protect and Conserve Water

The sources of fresh water which can be used by humans in their daily lives are limited. With the rapid increase in population the demand for water is also growing. The current population of the world is approximately 6.7 billion with a growth rate of around 80 million people every year. This implies that the need for freshwater is increasing by a rate of 64 billion cubic meters per year. By the year 2001 the global per head water supplies decreased by almost one-third of the value in the year 1970 due to the rapid increase in population. According to UN, by the year 2050 two-third of population or as many as 5 billion people will face shortage of clean freshwater.

Reducing water consumption and protecting water quality are key objectives in sustainable building. One critical issue of water consumption is that in many areas, the demands on the supplying aquifer exceed its ability to replenish itself. To the maximum extent feasible, facilities should increase their dependence on water that is collected, used, purified, and reused onsite. The protection and conservation of water throughout the life of a building may be accomplished by designing for dual plumbing that recycles water in toilet flushing. Wastewater may be minimized by utilizing water conserving fixtures such as ultralow flush toilets and low-flow shower heads. The use of non-sewage and grey water for on-site use such as site-irrigation will minimize demands on the local aquifer. Fresh water is an increasingly scarce resource. A sustainable building should reduce, control, and/or treat site runoff, use water efficiently, and reuse or recycle water for on-site use when feasible

IV. Use Environmentally Preferable Products

A sustainable building must be constructed of materials that minimize life-cycle environmental, social and economic impacts such as climate change, resource depletion, and human toxicity and have been produced in a responsible and ethical way. Sustainable materials have a reduced effect on human health and the environment and contribute to

improved worker safety and health, reduced disposal costs, and achievement of sustainability targets. Unfortunately, these products may have a slightly higher capital cost but we must always consider this against the whole life cost and the whole life value of the building legacy.

V. Enhance Indoor Environmental Quality (IEQ):- Provide a healthy, comfortable and productive indoor environment for building occupants and visitors.

Provide a building design, which affords the best possible conditions in terms of indoor air quality, ventilation, and thermal comfort, access to natural ventilation and day lighting, and effective control of the acoustical environment.

The Indoor Environmental Quality of a building has a significant impact on occupant health, comfort, and productivity. Among other attributes, a sustainable building maximizes day lighting; has appropriate ventilation, acoustic and moisture control and avoids the use of materials with high Volatile Organic Compounds and ionizing radiation emissions.

VI. Resources conservation and Sustainable Waste Management

Conserving resources is a cornerstone of green building techniques. There are many ways to conserve resources during the building process. For example, selecting materials that have at least some recycled content can conserve natural resources and virgin materials. Minimizing construction waste can ease the impact on landfills and resources. Construction waste management practices start with onsite waste separation and source reduction, and end with reusing of the materials (on site or off site) and recycling.

Minimize the use of non-renewable construction materials and other resources such as energy and water through efficient engineering, design, planning and construction and effective recycling of construction debris. Maximize the use of recycled content materials, modern resource efficient engineered materials, and resource efficient composite type structural systems wherever possible. Maximize the use of re-usable, renewable, sustainably managed, bio-based materials. Remember that human creativity and our abundant labor force is perhaps our most valuable renewable resource. The best solution is not necessarily the one that requires the least amount of physical work.

VII. Optimize Operational and Maintenance Practices

No matter how sustainable a building may have been in its design and construction, it can only remain so if it is operated responsibly and maintained properly. Ensuring operations and maintenance (O&M) personnel are part of the project's planning and development process will help retain the green criteria designed at the onset of the project. Every aspect of green building is integrated into the O&M phase of a building's life. The addition of new green technologies also falls on the O&M staff. Although the goal of waste reduction may be applied during the design, construction and demolition phases of a building's life-cycle, it is in the O&M phase that green practices such as recycling and air quality enhancement take place.

2.5 Benefits of Sustainable Buildings

Sustainable building practices aim to reduce the environmental impact of new buildings by promoting resource conservation. They create a healthy and comfortable environment; reduce operation and maintenance costs and address issues such as heritage conservation, access to public transportation and other community infrastructure systems.

Within the last two decades, Green and Sustainable buildings have come to be known as buildings that are mostly designed and constructed with more priorities on Environmental; Social and Economic benefits. (Onuoha, 2019)

According to (Mahamadata, 2018),The development of sustainable building brings influential Economic, Social and Environmental benefits to the communities. Most importantly, these concepts can enhance occupant health, happiness and wellbeing. Some of the benefits of a Sustainable building owner, user, and the society as a whole are as follows:

2.5.1 Economic benefits

With a better and healthier environment provided for occupants, their working productivity is believed to be increased and this can bring positive impact to the economy.. According to economist, green building can save 30% of energy consumption than conventional buildings. The research report released by showed that extra up front cost is required for green office building than conventional office buildings. However, the cost of not going green is high as well, considering the carbon trade cost and rocket high energy price. The cost savings during the operation and maintenance stages will help to offset the upfront cost required for green building features. Nowadays, people are concerned about environmental friendliness more than ever; green building thus can help businesses build up corporate image and reputation.

Hence, the asset value of green building is higher than conventional building. According to, sustainable commercial buildings have a competitive advantage over conventional buildings and are able to attract higher profile tenants, command above market rentals and thus increase capital values. In addition, a city providing outstanding green environs can attract investment and bring profits to the communities. Green Building Council of Australia (2008) reported that sustainable buildings in Australia commanded 5% to 10% higher rents and had higher relative investment return and asset values of 10%.

2.5.2 Environmental benefits

From environmental perspective, sustainable buildings help to improve the urban biodiversity and protect the eco-system by means of Sustainable land use. Reduction of construction and demolition waste is a critical component of sustainable building design. Compared with conventional buildings, Sustainable buildings generally provide higher performance reflected from energy efficiency, water efficiency and carbon emission reduction. Sustainable building can minimize environmental impacts by reducing or minimizing pollution and waste. In addition, as Sustainable building emphasizes the importance of clean energy and environmental friendly materials, it also helps conserve our limited natural resources. (Mahamadata, 2018)

Buildings consume a significant amount of our natural resources and have a wide range of environmental impacts. These environmental concerns are a key driver behind the sustainable design movement. Various estimates indicate that buildings use 30% of the raw materials consumed in the United States Considering what buildings are made of – steel, concrete, glass, and other energy-intensive materials buildings have a high level of "embodied" energy. Based on lifecycle assessments, the structural and envelope material of a typical North American office building has 2 to 4 gigajoules per square meter (175 to 350 kBtu/ft2) of embodied energy Producing these materials depletes nonrenewable resources and has environmental effects, and these impacts intensify the more frequently buildings are demolished and replaced. Building operations also contribute significantly to environmental pollutant levels in the United States and abroad. As a whole, U.S. buildings use 36% of U.S. energy demand, 68% of the country's electricity (more than half of which is generated from coal), and nearly 40% of U.S. natural gas consumption (Bordass, 2003) As a result, U.S. buildings are accountable for 48% of the nation's SO2 emissions, 20% of the NOx, and 36% of the CO2 Buildings also produce 25% of the solid waste, use 24% of the water, create 20%

of the water effluents, and occupy 15% of the land. In addition, U.S. builders produce between 30 and 35 million tons of construction, renovation, and demolition waste.

2.5.3 Social and human benefits

Humans spend a considerable amount of time inside buildings and benefit from sustainable buildings. The indoor environmental quality (IEQ), including volatile organic compound emissions and other contaminants is another critical issue in buildings. Extensive studies have suggested that sustainable building can achieve higher level of IEQ than conventional buildings, which helps to improve the health and productivity of occupants. As a result, the level of satisfaction of building users is enhanced. In fact, study found that users of green building tend to be more tolerant than those of conventional building in terms of indoor environmental quality. Different studies have shown that users of sustainable building are more satisfied with thermal comfort and visual comfort than those in conventional building. Studies also found that the health conditions and level of productivity improve when occupants moved to sustainable buildings. For instance, suggested that economic benefits of sustainable building in terms of productivity and absenteeism should not be overlooked. Their study found an increase of 25% of productivity and the absenteeism is significantly reduced when occupants moved from a conventional building to a green building.

2.6 Challenges and Opportunities of Sustainable Buildings

There are many challenges and opportunities associated with sustainable construction. These challenges and opportunities stem mainly from the need for balancing the main sustainability dimensions namely economic, social and environmental issues. (Baloi, 2003). According to (Baloi, 2003), all players have to realize that the achievement of sustainable construction requires a change in processes of creation of built environments from linear to cyclical approaches. That is, the construction industry has to change the way in which all the construction activities are undertaken, namely placing much emphasis on recycling, reuse of materials as well as the reduction in the energy and natural resources use.

2.7 Challenges to the Adoption of Sustainable Building Practice

While the advantages of sustainable buildings and sustainable development continue to show encouraging results, there are a number of challenges affecting the realization of their full Environmental, Economic and Social potential. The challenges of sustainable buildings are discussed below.

I. Capital Cost (Economic)

While sustainable construction has many potential economic benefits, difficulties and barriers still exist in practice. According to (Lowe and Proverbs ,2003), The general industry view is that sustainable buildings come at a premium, with a minimal connection made between the up-front (capital) costs of construction and the operating costs, once the building is completed. Indeed, there is a widespread perception that sustainable buildings are higher in cost than the marketplace is will pay for; even when they are not. (Hayles & Kooloos, 2008) This is believed to be due to the lack of accurate, thorough, and quantifiable information regarding the financial and economic impacts of high performance buildings. (Sobek et al, 2009) The barriers to developers choosing high performance sustainable buildings Centre on the perception of higher first-dollar costs, and that the market is not willing to pay them, further there are not reliable cost models to assist developers to understand the true costs and benefits of high performance buildings. Developers also face a risk that the lending institutions may not understand high performance aspects and their value in the marketplace. Finally, any new approaches are perceived as risky, and the developers are reliant on others' information and may not be able to determine who to trust. (Hayles & Kooloos, 2008) Economic barriers to sustainable design can include: lack of information about inherent long-term economic benefits of sustainable building; lack of integration among various incentive programs (rebates, loans, technical assistance, and recognition programs); reality that first cost is the overriding concern among financial institutions and investors; and the inherently conservative nature of the building industry.(Mahamadata, 2018)

While sustainable construction has many potential economic benefits, difficulties and barriers still exist in practice. The demand for most buildings is 'derived demand', that is, it depends on the demand for goods and services which can be produced from the building or from utility offered by the building. Thus, the construction industry exists at the interface between, on the one hand, the supply of existing buildings, each with its own physical and locational characteristics, and, on the other, the general conditions of demand prevalent in the economy. (Lowe, 2003) Whereas (Bordass,2000), found that UK's pioneering sustainable buildings have often been procured by owner-occupiers, who are less constrained by market norms.(Lowe, 2003) founded that sustainable construction faces economic challenges at three levels. On the microeconomic level, building are created within shorter

time horizons in response to being a demand-derived commodity and increasingly dominated by mechanical, electrical and electronic equipment. Finance is adjusted to the short and medium term, which is in conflict with sustainable construction, which relies on decision based on the long-term perspective. The primary barrier to the introduction of sustainable construction is a clients' widely held belief that sustainable construction will cost more and high risk for example, the belief that cost will increase by using new technologies and green materials. While extra design features might increase the consultant's fees. Landman argues that higher cost resulted from the unfamiliarity of the design team and contractors with sustainable method. Therefore, it is not only the higher capital cost but also a lack of education about the economic benefits for both developer and bank, financers of the builders. There is little market incentive for clients to put more additional money into the innovation without extra return over the short-term period. The client's cost advisors form a further barrier.. Sustainability is a kind of process, which is not an action, style, etc. While sustainable construction has plenty of long-term benefits but few present the market value. The analysis of the responses to the UK Government's Consultation paper on sustainable construction' highlights that "There is little sense at present that sustainable construction is an approach that will increase efficiency, productivity or profitability. The major obstacle to change is perceived to be a lack of client demand, especially, as several respondents suggest, that much of the science in the short-term is uneconomic. An important barrier is that short term economic costs do not equate to long- term sustainability and the fear of low profitability is an important concern for the industry.

II. Information Gathering

It is not always possible to predict whether a building will perform as predicted, whether the sustainable costs are affordable or indeed whether the technology reliable. (Edwards, 1998 LL)

There is a lack of research on the performance of green building. There is also concern that the complexity of some green designs (technological high performance) may bring about obsolescence earlier than conventional design (McKee, 1998 MM) Further issues include a lack of consensus about what sustainable building actually means. There is also disagreement as to: what the minimum performance standards should be; which activities are considered to be environmentally stressful; what the economics are; and how to evaluate

or measure sustainable building (Townsend, 1997KK) Attempts to integrate the vast amount of information currently available and effectively disseminate it have so far fallen short.

III. The Design Process

There appears to be limited understanding of available green options by design professionals. This includes: insufficient knowledge to produce specifications; a lack of available high performance materials; difficulties in gaining approval of new technologies for building codes; uncertainty about approvals; regulatory barriers to adoption of technologies and labor issues due to potential labor-saving measures; all providing further challenges to sustainable design .(Hayles & Kooloos, 2008)

In order for sustainable building techniques and materials to be adopted they must be specified by the designer. However, there is no standard assessment criterion for products that allows them to be directly evaluated, and therefore design professionals must invest a lot of time in assessing potential materials and technology. (Hayles & Kooloos, 2008)

IV. The Construction Process

Building on the issues described in the design process, the construction process can also be a difficult one. Issues include a lack of knowledge and consequently skilled labor to install and maintain new technologies (and minimal availability of training for the industry). There is limited infrastructure to handle and make available recycled material from deconstruction, thereby making costs prohibitive. (Hayles & Kooloos, 2008)

The additional workers and time required also make deconstruction seem costlier than mechanical demolition.(Leigh & Patterson, 2006) Furthermore, time and financial pressures can have a negative impact on the effectiveness of environmental management systems on building sites.

V. Materials and Technology

The challenges described above are all impacted on by materials and technology selection. Sustainable building practices can make a huge difference to global environmental sustainability, particularly through a drastic reduction in the use of natural resource consumption and energy intensive materials like cement, steel, aggregates and aluminum. (Shah, 2019)

The process of transporting materials via road, sea or air can leave a trail of pollution in its wake, making it more sustainable to use local products. Issues arise where, what is considered to be the most appropriate environmentally friendly product for a particular purpose is not available locally, thereby making materials selection extremely complex . Most architects find it difficult to establish the embodied energy or life cycle costs of a particular product. For example, establishing a balance between harvesting practices, manufacturing processes, shipping, and the positive/negative impact a certain timber may have on indoor air quality once it is in situ (Hayles & Kooloos, 2008) not to mention disposal or re-use at the end of the buildings life, is extremely difficult. While the process of Life Cycle Analysis (LCA) exists to make this evaluation, a number of issues arise, such as the incentive for suppliers to perform this analysis on their products. This is likely to be consumer or industry demand driven, however if the results are not positive in environmental terms they are unlikely to be published. Furthermore, LCA commonly needs to be completed from a whole of installation perspective, which involves obtaining LCA data for a number of components and therefore suppliers. Further, these suppliers often consider this information proprietary and are reluctant to release it into the public domain where competitors will be able to access it; making the information currently in the public domain limited and the process involved obviously expensive, resulting in few clients who are willing to pay the premium required how efficiently and environmentally the completed building operates is most commonly measured in terms of energy efficiency and productivity, detracting focus from the cost to the environment of the structure itself, which can often be unsustainable.

2.8 Strategies for Promoting Sustainable Buildings

We want to lead the world in sustainable construction. The Strategy for Sustainable Construction represents a commitment from the industry to work towards this vision by reducing its carbon footprint and its consumption of natural resources, while creating a safer and stronger industry by training and retaining a skilled and committed workforce. It lays out specific actions by industry and by Government which will contribute to the achievement of overarching targets within each of the main areas covered by the sustainability agenda. According to (Marvin & Weetman, 2008), Construction industry considered as one of the most resources. It is well-known that this sector is a key one for environmental protection and for a sustainable resource management. At the global scale we are currently consuming

about 150% of the resource that the Earth can renew in one year Thus, the existing patterns of production and consumption are unsustainable The construction industry plays an important role, since it consumes more raw materials than any other economic activity, approximately 50% of the global consumption. Furthermore, it is expected that this industry will grow in the next years. (Al-Geelawe & Mohsin, 2015)

According to (Mahamadata,2018),there are three approaches to promote Sustainable buildings: the Prescriptive or Regulatory approach, the incentive-based approach, and the promotional/educational approach.

The prescriptive or Regulatory approach: involves setting rules requiring development be built to meet a specified level of environmental performance or certification under a third-party rating system. Meeting the specified standard becomes a condition of receiving a building permit, zoning amendment and/or development approval. The incentive-based approach: involves providing bonuses, subsidies, or other incentives that make green building more attractive or feasible to a prospective developer, while stopping short of actually making it a requirement.

The Incentive-Based approach: Involves providing bonuses, Subsidies, or other incentives that make Sustainable building more attractive or feasible to a prospective developer, while stopping short of actually making it a requirement.

Educational/Promotional approaches: these includes:-web pages dedicated to promoting environmental and energy efficiency initiatives, Online information, guides and checklists to homebuilders and businesses to help explain the advantages of standards such as Energy Star, LEED 21 online calendars of local sustainability events and a directory of local businesses that provide goods and services such as recycled building materials, contractors who build green and energy auditors among other and research to identify obstacles to sustainable building.

CHAPTER 3 MATERIALS AND METHODS

3.1 Introduction

Research Methodology is the path to find answers to a research questions. It is a practical step through which a researcher must pass in his/her research journey in order to find answers to his/her research questions. This research focuses on the assessment of sustainable building practice condition in the case of Asella city administration.

Asella city is a town in central Ethiopia. Located in the Arsi Zone of the Oromia Region 175 km south from Addis Ababa, this town has a latitude and longitude of 7°57′N 39°7′E / 7.950°N 39.117°E respectively, with an elevation of 2,430 meters. Asella was the capital of Arsi Province until that province was demoted to a Zone of Oromia with the adoption of the 1995 Constitution. It retains some administrative functions as the seat of the present Arsi Zone.

The 2007 national census reported a total population for Asella of 67,269, of whom 33,826 were men and 33,443 were women. The majority of the inhabitants said they practiced Ethiopian Orthodox Christianity, with 67.43% of the population reporting they observed this belief, while 22.65% of the populations were Muslim, and 8.75% of the population were Protestant. The 1994 national census reported this town had a total population of 47,391 of whom 21,993 were males and 25,398 were females. History Asella town got its start before the Second Italian-Abyssinian War. The Italian occupiers wanted to make Asella into a provincial capital, but they were unable to build more than one two-story building and some warehouses of masonry. Currently total population of Asella city estimated that 103,000. The city is growing rapidly in modernity like other Ethiopian cities. The city is undergoing a major construction boom, and new hotels are being built at a breakneck speed. Hotels, shopping centers and office complexes rise from where small shacks once stood.

In order, to protect the country from the adverse effects of climate change, the nation has forwarded a Green Economy Strategy that will help Ethiopia reach its development goals while maintaining a low-carbon society. One of the pillars of the strategy is leap-frogging to modern and energy efficient technologies in the transportation, industrial, and building sectors. Even though, the green economy strategy of the country promotes modern technologies in the building sector, the 2013 Ethiopian Building Code Standard doesn't mention green buildings. It rather sets standards in certain areas including.

This section discusses the research design and methodology that is used in acquiring the necessary information to answer the research questions. It explains how the data consisting of secondary and primary data was retrieved, followed by description of the method for the interviews and how the analysis and presentation of the data was conducted.

3.2 Research Design

This research consists of both descriptive and explanatory research types. Descriptive research type tries to describe a certain problem, phenomenon or a situation systematically to simply to provide information about the living condition. Descriptive research aims to accurately and systematically describe a population, situation or phenomenon whereas explanatory type of research is used to explain the how and why there is an existence relationship / interdependence between two or more aspects of a situation.

It is designed of site survey, interview, questionnaires, document review & case study to obtain the necessary information. A mixed approach that utilizes both qualitative and quantitative data is used. The qualitative data include attitudes, opinions and experience of residents within the selected buildings concerning sustainable building principles such as recycling, water efficiency, day lighting and energy efficiency. For quantitative method, parameters that define sustainable buildings, determining the degree of sustainability of the sampled buildings in Asella city were statistically analyzed.

3.3 Population and Sampling

Buildings for the field work were identified by means of purposive sampling. It is one type of non-probability sampling method in which the researcher relies on his or her own judgment when choosing the samples.

These sampling techniques were selected based on: The Experience gained during the selection of the study area, the purpose of the study and also for the need to reach the targeted issues and Nine buildings are chosen which qualify the criteria and to participate in the sample.

The Criteria that were used to limit the number of buildings that are taken under consideration were as follows:

1. The buildings to be assessed are to be within the Asella city at different Sub Cities (Kebeles)

2. Buildings with high Land value following main road

3. Mixed use buildings, Hospital building, Hotels and Governmental buildings (service giving or rentals) must be included in sample survey to analyze the different level of consumption and production of buildings of different type of function.

4. Construction Material: - Ceramics (Tiles), Aluminum cladding, HCB and other materials

5. Availability of resources: - Access to floor plans and others for some buildings.

This framing technique helps to limit not only the number of buildings that are within the Sub cities but also facilitates us to focus and centralize our attention on the objective the paper plans to accomplish.

Simple random selection was used to identify respondents from various construction industries and private companies. Three surveys were issued to architects, engineers, and individuals in managerial positions at each workplace.in order to collect the opinions of all individuals who part engage in any building construction projects. As a result, 52 of the 70 distributed surveys were completed and collected.

3.4 Research Data

3.4.1 Types of data

The research used both primary and secondary data collection methods as a tool to gather the necessary information. The types of data and materials used in this research helped in Illustrate what the major problems of the sustainable building are and also in filtering the causes in hierarchical value.

I. Primary Data

Primary data was obtained from residents and managers of selected buildings concerning their opinions, difficulties and needs with regard to water efficiency, energy consumption, recycling and indoor environmental quality or include the: - Problem, Interest and the Attitude of the residents toward their living and working conditions which includes waste management (sanitation),water resource, energy consumption, and living comfort. Furthermore, primary data was emanated from questionnaires directed to consultants and concerning body about their understanding of sustainable building concept, its challenges and proper approach for its application.

II. Secondary Data

These include written national and international literature in the concept of sustainable building collected through internet sources, books and journals. Architectural plans, utilities, infrastructure maps were collected from different sources including building owners, consulting offices, Regulatory body, Sectorial engineers and contractors responsible for that particular building to better understand the existing situation of the selected buildings.

3.4.2 Data sources and collection techniques

I. Primary data source and collection techniques

The research relied on the data collected from related literature reviews, site visits and observations, questionnaires. Since the concept of sustainable Building is relatively new to our country, it was necessary to rely upon internet search on legitimate web sites. Personal observation and experiences; building occupiers, owners and managers, the residents in the study area, concerned government officials and professionals were the main sources of the primary data. The following data collection methods were used to collect these primary data:

A. Questionnaires (Survey) method

Both direct and indirect approach questions were used with the aid of Structured Surveys and Unstructured Surveys

- **Structured approach** is the first inquiry mode used was the structured approach in which everything that forms the research process, objectives, design, sample, and the questions planned to ask the respondents was predetermined. This approach was

applied to determine the extent of a problem, issue or phenomenon by quantifying the variation.

- **Unstructured approach** is the approach allows flexibility in all aspects of the research process. It was selected to more appropriately explore the nature of a problem, issue or phenomenon without quantifying it. The main objective was to describe the variation in a phenomenon, situation or attitude which included the description of an observed situation, an account of different opinions of different people towards an issue

A combination of both open-ended and close ended questions was employed to enhance efficiency and reliability of the data. This method was used in order to confirm information that has been gathered from the theoretical documents and compare it with interviewee's response that revealed their personal experiences.

B. Instrument: questionnaire format

Two questionnaires were designed, one for selected building residents and the other for industry practitioners. Several types of questions were presented on the questionnaire including multiple choices with single response, multiple choices with multiple response, Likert scale, and short answer questions.

C. Interviews

The interviews with the selected building managers, owners or concerning body helped to generate data about their perceptions, opinions and understanding of the selected buildings water efficiency, energy efficiency, indoor quality, waste management and materials used. Semi Instrument: semi - structured interview schedule: -These interviews were open ended and directed mainly to building owners and managers structured interviews were used.

D. Site Survey

This method was applied to observe the existing situation of the area under study and was made by visiting the selected buildings to independently assess the current condition based on Sustainable building principles.

Instrument: Site survey checklist

A checklist that defines sustainable building concepts such as energy consumption, material, water efficiency, waste management and indoor ventilation and natural lighting was

prepared to compare the existing building with that of sustainable building principles. Digital camera aided with field notes was used to capture relevant data which revealed factual conditions concerning the area

Secondary data source and collection techniques

The main sources used to collect the secondary data were both hard and Softcopies which include: Published books and journals; unpublished norms and standards, reports, brochures from internet, libraries and office stacks; The secondary data were collected through reading and note taking; scanning and photocopying books, journals, reports and maps; browsing and extracting through trusted websites.

Approach Data

This research utilizes the case study approach because it is useful to carry out an intensive study of a small number of buildings (the selected cases), for the purpose of understanding a larger class of similar units (the buildings in Asella city).

Study cases.

Professional Building practice in Asella city: based on the selection criteria appropriate buildings in Asella city are selected to review the building practice, its constraints and opportunities as well as recommend appropriate measures. Case of application of sustainable building principle

3.4.3 Data analysis method

Data analysis included systematically reaching and arranging the interview transcripts, filled questionnaire, field notes and other material accumulated to increase understanding of the respondent's subjective experiences.

Software such as Microsoft office Word, Microsoft office Excel was used to write texts, create tables and graphs. This software is also used to analyze and present the surveyed data from questionnaires and interviews. The collected primary and secondary data were analyzed through the comparison selected building with sustainable buildings principles. Different software such as AutoCAD which was used for working on the general functional layout of buildings. The qualitative data was organized and presented in the form of narratives. Different soft wares such as SPSS and excel were used to analyze the data in a

descriptive and statistical method including mean, standard deviation, frequencies and percentages. Finally, data was processed and presented.

3.5 Validity and Reliability

Before completing an analysis based on the questionnaire responses, Cronbach analysis was performed to determine the internal consistency of the questions using the Likert scale. The interpretation of Cronbach's alpha is the range of Cronbach's alpha normally is between 0 and 1. Guide line provided by them to assess the reliability of any data as shown in table below

Table 1: Guidelines for assessing reliability results

S.No	Range	Reliability
1	0.9 and above	Excellent
2	0.7 to 0.9	High
3	0.7 to 0.5	Moderate
5	Beow 0.5	Low

(Source: - Perry R. Hinton and Brownlow, 2014)

The Cronbach Alpha test that shows the reliability of the questionnaire was conducted for Opportunities to applying sustainable building practices. Obtained values are shown in table below.

Table 2: Reliability analysis for Challenges to applying sustainable building practices

Reliability Statistics	**N of Items**	**Cronbch's Alpha**
Opportunities of applying sustainable building	13	0.946

(Source: Own survey data analysis)

(Source: By researcher 2023) The result indicates that the 13 items in the opportunities of applying sustainable building are correlated. There is internal consistency between the items. Since the data collected was based on five Likert-scales; therefore, to check reliability of the

research Cronbach's Alpha method was used and all the components is excellent or close to 1. As a matter of fact the overall Cronbach Alpha value for the 13 items is 0.944 which showed excellent reliability of the data. Therefore, the researchers conclude that the test and questions were reliable and valid. The Cronbach Alpha test that shows the reliability of the questionnaire was conducted for Challenges in the public procurement. Obtained values are shown in table below.

Table 3: Reliability analysis for strategies to applying sustainable building practices

Reliability Statistics	**N of Items**	**Cronbch's Alpha**
Strategies of applying sustainable building	7	0.804

(Source: Own survey data analysis)

CHAPTER 4 EXISTING CONDITION AND ANALYSIS OF SELECTED BUILDING

This chapter discusses about the results gained through the methods predefined under the methodology of the study to answer the objectives sated to be attained in this thesis paper. In this chapter, the study area is briefly described and the nine selected buildings are described and analyzed based on the principles of sustainable building. The result includes: the general information of the respondents, the building location and orientation, indoor environment quality, energy consumption, water consumption, waste management and building materials of all 9 buildings.

4.1 Athlete Derartu Hotel

1. Building description and Orientation

Derartu Hotel is located in Asella city Kebele 06, on the road from Assela to Sagure around Ethiopian Post Office Assela Branch. The Hotel was established in 1997 and currently the compound has an approximate area of 1000m2. According to the Hotel Manager that was interviewed, the building was designed by Engineer Mulata Abebe and Constructed Tsegaye G/Median GC. It started operation in August, 1998 and hotel service has bar, offices, Pension and Basement restaurant and stores. The building longer side is orientated towards the East to west direction which façade its front to north direction.

Figure 1: Athlete Derartu Hotel

(Source: - Captured by researcher)

2. Sustainable Site

I. Site location and transportation

In a neighborhood that is quickly expanding, the building is near the Sol Jam Hotel. Various activities take place in the areas around the mixed-use neighborhood. From the main road, there are taxi and Bajaj routes that run alongside it, as well as a Bajaj stop close by. In order to get around the hotel, most people use a Bajaj and a private vehicle. There is nothing near the hotel that promotes using bicycles or other non-motorized modes of transportation.

II. Site design and management

A. Open space and Green areas: - There is a parking lot in front of the building, but there are no green spaces on the building's plot. However, there is riverine flora in front of the buildings outside enclosure.

B. pavement: - Concrete is used for the circulation into and around the building while asphalt is used for parking in front of the building.

C. Storm water management: - Ditches are used to divert storm water from the building to the main line. The rain water from the roof of the building is channeled through down pipes and released to the main drainage line.

D. Green Roof and Wall: - The structure lacks any green roofs or walls. The slopped corrugated decra sheet roof makes it challenging to build a green roof.

3. Water Efficiency

Tap water is the primary water supply for the building and is used for everything, including showers, watering plants, washing cars, and flushing the toilet. There is no plan for recycling wastewater or deploying any water-saving equipment throughout the entire facility

4. Energy Efficiency and Atmosphere

I. Energy Consumption

The primary source of energy is electricity. Appliances including televisions, heaters, cookware, and refrigerators are utilized regularly. The building mostly makes use of natural lighting and ventilation, while certain rooms do, according to observations made during a survey; use artificial lighting during the day.

II. Energy efficient equipment and renewable energy

The building's components don't utilize any renewable energy source

5. Material and Resources

I. Type of construction materials

A. Roof: the material used for the roof is corrugated Decra sheet.

B. Walls: - The Exterior and The Interiors Wall of the building are HCB.

C. Floor: - The building's internal floor is finished entirely with ceramic tiles, while the exterior stair is made of marble.

6. Waste management and renewable materials

According to the interview both domestic and foreign elements were employed. The hotels staff member claimed that although they don't reuse or recycle their waste, it primarily comprises of organic elements. Instead, they gather the trash and dump it at the main trash disposal site, which is existing at the back of the building.

7. Indoor environmental quality

I. Temperature of the building

Here are some effects brought about by the building's southern orientation. People who respond in the spaces that face north say the building is really cold through all year long.

II. Lighting

The building has ground units in each floor and it is typical throughout. Every room in the building has windows and access to daylight. There are open downs with the staircase in the middle, this allows the kitchens, stairs and toilets to have opening. The circulation also has square openings throughout. According to the occupant's response about the lighting in their room, most replied their apartment is bright while the remaining said it is normal. In addition, all said they don't use artificial lighting during the day unless in the ground restaurant during day.

III. Ventilation: - All the rooms in the building are naturally ventilated and there is no utilization of air conditioners.

IV. Acoustic and views

The building's main source of noise pollution is the noise from the main road, and the occupants assert that there are no acoustic problems inside. Unrestricted views of the surroundings are available from the building.

V. Dampness & microbial growth

Because there are no windows in the toilet, it is suitable for microbial growth to take place on the damp surfaces of the toilet. Additionally, improper pipe installation and leakage are seen.

4.2 Arsi Zone and Assela City Prosperity Party Building

1. Building description and orientation

Arsi Zone and Assela City Prosperity Part Building is located in Asella, Welkesa Sub-city, Kebele 10. The building was built on 1365 m2 Area. From the lay out, it is clear to see the building was designed for office and Hall service. Currently, the building is owned by Arsi Zone and Assela City Prosperity party. It is an G+3 and B stories building which is designed by Arsi Zone Housing Development office and Constructed Birhanu Assefa BC. T the building gives longest side to North West East direction.

Figure 2: Asella and Arsi zone PP Building office

(Source:- Cuptared by researcher 2023)

2. Sustainable Site

I. Site location and transportation

The structure is situated next to a significant road in the center of the city. It has good pedestrian access and is situated close to a variety of services and amenities. Both a bus

station and a Bajaj stop are located close to the building in terms of public transportation. Both the absence of bicycle parking racks and any potential expansion are uncooperative.

II. Site design and management

a. Open space and Green areas: - although there are open areas on the left side of the building which used for parking area, the only greenery is a few potted plants in front of the structure. There was no gathering or recreation place on the roof.

b. Pavement: - At the left side and front of the building, a terrazzo-tiled pedestrian walkway and a gravel-paved street encircle it respectively.

c. Storm water management: -Without being collected or recycled, rainwater from the roof drains into the main drainage system through the downpipes.

d. Green roof: - The building lacks a green roof and its roof is likewise unsuitable for one.

3. Water Efficiency

The primary supply of water for toilets, cleaning, and other functions in the structure is tap water. Nothing is done to recycle or reuse waste water or employ water-efficient fixtures or rainwater.

4. Energy Efficiency and Atmosphere

I. Energy Consumption

Computers and light bulbs are the two devices that utilize the most power, which is the primary energy source. Fans and air conditioners are never used. During the day, artificial lighting is used in practically all of the building's rooms. While certain rooms need artificial illumination, other areas with enough natural light nonetheless use light bulbs possibly carelessly.

II. Energy efficient equipment and renewable energy

The majorities of the light bulbs utilized in the structure are fluorescent and LED bulbs. There is absolutely no use of renewable energy.

5. Material and Resources

Type of materials

A.Roof: - Ega on sheet steel is the main material used for the roof.

B.Walls: - The interior partition walls office, it includes aluminum, and glass. The exterior walls are made of HCB walls with Ceramic clinker and Quartz Painting finishing. Aluminum is used for the door and Windows.

C.Floor: - For whole circulation, Hall and offices used different materials such as ceramic tiles are the most common.

D. Waste management :- Each office's trash is regularly collected and dumped in the back of the building in preparation for door-to-door service.

The idea of recycling and reuse of garbage is new to the building, but nothing is being done to implement this Concept.

6. Indoor environmental quality

I. Lighting and Windows

The windows that cover the majority of the walls on all four sides of the building provide enough light for the entire structure. Additionally, the building's central open down and skylight flood the interior with plenty of natural light. Windows that let light in illuminate the staircases and main corridor. The deep volume of the balcony shields the rooms from direct sunlight to some level. Curtain walls act as a breaker or shade to shield the building from the intense sun, which is why the majority of workplaces use them to cover their windows.

Figure 3: Open down and skylight of the building

(Source**: -** captured by researcher 2022)

III. Ventilation

The structure is naturally ventilated and operates without any fans or air conditioning. The residents' only means of cooling off is through opening windows. In comparison to the higher floors, there is a lot more activity on the first and second floors, which are home to various offices. It is clean and fresh in terms of the air.

IV. Dampness and microbial growth

The site visit revealed no evidence of microbial growth or wetness, according to the building management and all occupants who were questioned.

V. Temperature

Due to the significant usage of curtain walls, respondents located on the left side of the building believe that the inside climate is chilly. Additionally, responders in the building's right wing have said that the air quality inside is a little warmer there. The entrances to the offices that have been used to support the aforementioned statement are shown by the doors.

VI Acoustic and views

The building occupant’s claims that noise is a concern, particularly in the top floors where meetings are frequently held and the first and second floors where activity is strong but generally consistent. Through its huge window, the structure provides an unrestricted view of its surroundings.

VI. Efficiency and health problems

All of the inhabitants who were questioned said they had never had health issues as a result of the indoor air quality.

4.3 Soljam Hotel

1. Building description

The building's ground floor is home to the hotel's lobby, a bar, a restaurant, and a reception area. Pension services are offered on the first and second floors. The structure houses a very fashionable and opulent hotel in the city, and the third floor has meeting rooms and a terrace. There are stairs in the building. But another flaw in the building’s architecture is the absence of a fire escape staircase.

Figure 4: Sol jam Hotel

(Source: -Captured by researcher 2023)

As one of the newest building in the Asella sector of the capital of Arsi Zone, the Soljam Hotel is situated close to the main route connecting Asella to Sagure. The direction of travel on this road is somewhat tilted from east to west. This suggests that the building's front façade is facing north. As a result, the longest side of the G+3 structure faces north.

The east sunrise is received by the structure from its back. Because it faces adjacent compounds, this side is typically treated with smaller windows (per building code requirements). On the other hand, the front of the building features considerably wider windows, allowing the afternoon sun to enter the structure unhindered.

2 . Sustainable Site

I. Site location and transportation

The structure is situated in an area of the inner city that was formerly a slum. After it has good pedestrian access and is situated close to a variety of services and amenities. Both a train station and a bajaj stop are accessible by foot from the building in terms of public transit. There are no bike parking spaces, and there are no plans to add any in the future.

II. Site design and management

A. **Open space and Green areas:-**The building has a tiny front green lawn and a compound border at the back. Grass and decorative plants predominately cover the green spaces. The majority of planted species are exotic ones like Cypress, Araucaria, and Grevillea Robusta.

B. Pavement:-The compound's primary pavement materials are Terrazzo tile and cobblestone.

C. Green Roof and wall:-The building is devoid of green walls and roofs. On the third terrace and all around the interior circulation, there are potted plants.

D. Storm water management:-Without being collected or recycled, rainwater from the roof drains into the main drainage system through the downpipes.

Figure 5: Parking area, rain water released to surrounding using down pipe and garden area left at rear side of the building.

(Source: - Capture by researcher at 2022)

3. Water Efficiency

The primary supply of water for toilets, cleaning, and other functions in the structure is tap water. Nothing is done to recycle or reuse waste water or employ water-efficient fixtures or rainwater.

The structure serves a variety of purposes. Almost none of such tasks do not include the use of water. However, the structures still don't recycle water, don't utilize rainwater, and don't employ recycled water for non-essential secondary uses. The restrooms in the building lack a double plumbing system, which might ensure a decrease in water usage.

4. Material and Resources

Types of construction material

A. Roof: -Corrugated iron roof The primary roofing material is Ega sheet on steel.

B. **Walls**: The majority of the interior partition walls were built by HCB.

The external walls are constructed from HCB walls and painted with Quartz. The windows and entrance are made of aluminum.

C. **Floor**: Granite is used for the staircase, although ceramic tiles are most frequently used for the other areas.

5. Waste management

Every room's trash is gathered and kept in a temporary storage facility. After that, the building's janitors and cleaners take it and set it down in front of the building's corner so that door-to-door collectors may easily collect it. Even though they lack the space to build a composting facility, they may still have recycled by first separating the trash.

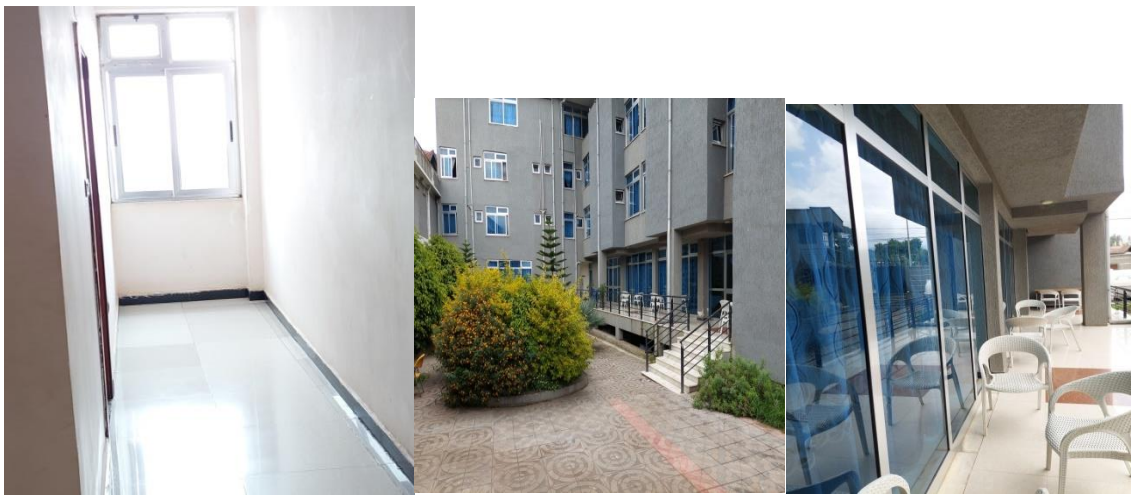


Figure 6: Exterior and Interior materials in the building

(Source: captured by the researcher, 2022)

6. Indoor environmental quality

The indoor climate of the building is influenced by a number of factors, including orientation, windows, light, temperature, and humidity. The indoor environment needs to be aggressively tackled as one of the primary sustainable building challenges**.**

I. Temperature of the building

The information on the room temperature was obtained via interviews with the management and residents. Although it is stable, the temperature does drop occasionally.

II. Windows and light

The building's medium-sized windows allow ample light to penetrate. They still turn on artificial lighting even though some space that can receives adequate natural light. Pictures of the restaurant, bedroom area, and toilet area are shown below, from left to right. Every room in the structure receives natural light, as can be seen in the photos. However, artificial lighting is still used some space.

Figure7:Natural Lighting rooms and free microbial growth toilet and toilet free of microbial growth

(Source: - Captured by researcher 2023)

III. Dampness and microbial growth

The building manager Ato Fikadu claims that the third floor Gypsum ceiling has dampness and microbial growth as a result of improper roof construction at a different location because this final floor ceiling seemed to be damaged during the site visit.

Figure 8: Dampness problem of the building

(Source: - Captured by researcher 2023)

IV. Acoustic and views

The building manager claims that noise is an issue, particularly in the top floors where meeting rooms are located; nevertheless, on the first and second floors where there is high activity, there is no noise pollution. The building's huge windows and unrestricted terrace provide views of the surrounding area.

Figure 9: surrounding views of the building from terrace

(Source: - Captured by researcher 2023)

V. Efficiency and health problems

When asked if the interior air quality has ever caused them health issues, all of the occupant said no.

7. Energy Efficiency and Atmosphere

I. Energy Consumption

Electricity is the primary energy source, and the most common appliances include cooking appliances, various electronic devices, and light bulbs. Fans and air conditioners are never used. During the day, artificial lighting is employed in practically every aspect of the structure. While some rooms need artificial illumination, others with enough natural light use light bulbs, maybe out of carelessness.

II.Energy efficient equipment and renewable energy

The majority of the light bulbs utilized in the building are fluorescent LED lights and ornamental lights. Building owners are still unable to use alternate energy sources. There is no alternative energy source available at the Sol jam Hotel. Even though the facility houses numerous energy-intensive operations (such as a restaurant, bar, meeting space, and lodging), it nevertheless depends on the nation's cyclical energy system.

4.4 Asella Teaching and Referral Hospital

1. Building description

Founded in 1964, the Asella Teaching and Referral Hospital is now a part of the recently established Arsi University and its College of Health Sciences. It provides healthcare for the more than 3.5 million residents of the Arsi Zone as a tertiary hospital and referral hospital. The Emergency Room, Internal Medicine, Pediatrics, Gynecology and Obstetrics & Fistula Unit Surgery, and Ophthalmology are examples of specialized departments. An intensive care unit has recently been built.

On the primary road from Adama to Asella town, the Asella Teaching and Referral Hospital compound is situated in Asella, Kebele 10 around Asella Rehoboth Hospital. The building was constructed for use as a hospital during the Derg dictatorship. The government currently owns the structure, building contains such as lecture hall, various health classes, garden, and common areas make up the compound. In the compound, there are several building types and various sizes.

Figure 10: Asella Referral Hospital

(Captured by researcher 2023)

2. Sustainable Site

I. Site location and transportation

The Hospital is situated in an area of the inner city. After It has good pedestrian access and is situated close to a variety of services and amenities. Both a train station and a Bajaj stop are accessible by foot from the building in terms of public transit. There are no bike parking spaces, and there are no plans to add any in the future.

II. Site design and management

A. Open space and Green areas: - Large open and green spaces, including playgrounds and recreational green spaces are present throughout the entire site. Large green lawn spaces surround the building under study, both in front of and next to it.

B. Pavement: - For the primary traffic lanes and parking areas, asphalt is used. Terrazzo tiles are frequently utilized for pedestrian circulation; in certain places, there is no cement lining between the tiles to increase penetration.

C. Storm water management: - Storm water in the compound is diverted using a ditch system that is connected to the main drainage line. Rainwater from the roof is discharged by floor drains into the nearby green space, where it travels through various levels and regions of green spaces until arriving at the drainage line. As a result, more rainwater can be absorbed into the ground and used to irrigate some of the greenery.

D. Green roof: - There is no green roof on the residential complex**.**

Figure 11: Surrounding and inner green area the hospital, pavement and rainwater released to different to side ditch

(Source: - Captured by researcher 2023)

3. Water Efficiency

Groundwater from two boreholes is used as an alternate water supply to irrigate the green spaces around the entire compound. Tap water is used for drinking and other purposes. Wastewater is not recycled or reused in any way. Additionally, dual flushing is the only water-saving device employed to lower water usage.

Figure 12: Water tanker of the hospital

(Source: - Captured by researcher 2023)

4. Energy Efficiency and Atmosphere

I. Energy Consumption

Electricity is the main energy source. The most popular items include refrigerators, televisions, and medical equipment. The building mostly uses natural daylight and ventilation, while some buildings use artificial illumination throughout the day for no apparent reason.

II. Energy efficient equipment and renewable energy

The majority of the light bulbs utilized in the Hospital is fluorescent and LED lights. Building blocks are still unable to use alternate energy sources. There is no alternative energy source available at the Asella Teaching and Referral Hospital. Even though the facility of the hospital energy-intensive operations, it nevertheless depends on the nation's cyclical energy system.

5. Material and Resources

Construction material types

A. **Roof: -** The roof is constructed using an Ega Sheet on Steel Truss roofing system and steel plate as privet of the building.

B. Walls: - The external and internal walls of the building are composed of HCB walls and some block construct wooden cover on external wall which increase aesthetics value of some blocks.

C. Floor: - In the building, terrazzo and ceramic tiles are the two most popular floor finishes.

Figure 13: Construction material of the building and Artificial illumination

(Source: - Captured by researcher 2023)

6. Waste management

Garbage is gathered and dumped in the dump site at the back of the hospital before the wall garbage from the hospital class is burned. The hospital and lecture hall are cleaned twice daily. Within the structure, there are no efforts made to recycle and reuse garbage.

Figure 14: Waste disposal and Burning area of the building

(Source: captured by the researcher, 2023)

7. Indoor environmental quality

This section talks about things like light, windows, ventilation, dampness, and microbiological development inside of an enclosed building.

The health sector, which includes a set of buildings where the quality of the indoor environment is very important, has a considerable impact on the economies of countries and their policies. This form of construction has more negative effects than any other since it directly affects human health**.** The fact that these equipment's operate continuously for 24 hours, the volume of people moving through them, the existence of distinct work zones with different energy requirements, the presence of various functions like treatment, education, research, rehabilitation, health promotion, and disease prevention, the requirement for the existence of systems for strategic equipment reserves for continuous energy supply, and the size of the facilities are key factors that set these apart from others.

I. Temperature of the building

Respondents assert that the interior temperature is comparatively more or less stable as a result of the building material. However, opening windows to cool their classes in the afternoon can be difficult for those who live in buildings that face the main road.

II. Windows & Light

Although the Hospital building is thought to have been constructed in the past, its layout and style make it one of the most recognizable structures in our city. The rooms space in the building each blocks have a functional window. However, out of habit, the building's tenants continue to turn on the lights during the day. Additionally, various alterations made by the building's users resulted in gorges and nooks that are a little challenging to naturally light.

Figure 15: Windows of the buildings.

(Source: - Captured by researcher 2023)

III. Microbial growth and dampness

Some spaces created as a result of user changes have been left without adequate ventilation, while some places (such as toilet) have also been left without windows and ventilation as a result of poor planning. This has left a room without ventilation and with a bad odor. Their also dampness at some location wall area and ceiling

Figure 16:- Dampness exist in the buildings

(Source: - Captured by researcher 2023)

IV. Durability

The longevity and strength of the building's materials may be attested to by the building's age. Most of its facilities perform better than those found in more current structures.

4.5 Gidad Building.

1. Building description and Orientation

Gidad building is located in Assela City, Kebele 06 on the road from Dashen to Chicho Square. It is a four story building which is constructed by Abdi Construction PLC at 1997.The building is Located in front of main Road where highly active building with shops, offices, cafes, banks, game zone, and public market center as well as other uses are available. The building is orientated towards the East West direction.

Figure 17: Gidad Hotel

(Source: - Captured by Researcher at 2023)

2. Sustainable Site

I. Site location and transportation

The building's location, kebele 06 around Dashen Bank is one of main centers in the city. As the kebele center different services and functions can be found in it. Therefore, almost anything can be accessed in a close proximity to Gidad building. There are different Bajaj and train routes connecting the site from different locations making transportation to and from the building relatively easy. Bajaj stations and train stations are located within a walking distance from the building. There is Narrow vehicle parking on the in front of the building, but no bicycle racks.

II. Site design and management

A. Open space and Green areas: - The building does have small a green area. The small open space in front of the building is used for parking. The majority of the building's green infrastructure is located on the third floor, which is home to the "Green Garden Pension."

B. Pavement: -Terrazzo used as a paving material for the parking while asphalt with tiled pedestrian walkways in front of the building.

C. Storm water management: - rainwater from the roof is released through downpipes straight to the surrounding area.

D. Green Roof and wall: - there are no green roofs and walls in the building but the roof can accommodate a vegetated roof if needed. Potted plant in brick structure can be seen in the final floor or around the building pension.

3. Water Efficiency

Municipal tap water is the main source of water used for toilets, cleaning and other uses. None of the toilets use any of the water efficient fixtures and no action is taken to reuse and recycle

4. Energy Efficiency and Atmosphere

I. Energy Consumption

The main source of energy for the building is electricity. The items used the at most include computers, lighting, elevators and others. Fans are not utilized. Artificial lighting is used during the day through different class of the building.

II. Energy efficient equipment and renewable energy

Regular light bulbs and fluorescent make up the majority of the lighting while LED is used in some rooms. In addition, most Rooms use advertising light inside the building. No renewable energy is used in this building.

5. Material and Resources

Type of materials

A. **Roof:** - The building's roof is made of corrugated iron sheet with a skylight in the center.
B. **Walls:** - HCB walls make up the exterior walls of the building while the interior partitions range from gypsum, HCB and aluminum.
C. **Floor:** - Marble and ceramic tiles are the main floor finishing used in the entire building.

6. Waste management

The building classes are cleaned once or twice a day and waste is collected and disposed in the dumping site found at the back of the building then the collected waste is removing from the building compound by municipal door to door service. There are no actions taken to recycle and reuse wastes within the building. In addition, no trash cans can be seen inside the building.

7. Indoor Environmental Quality

This section covers topics including lighting, windows, ventilation, moisture, and microbiological growth inside of an enclosed building

I. Temperature of the building

The building is oriented with its longest side facing east to west, as was already mentioned. the temperature is noticeably cooler on the building's back side than it is up front. The afternoon sun (10:00 – 12:00) comes through the fronted façade which is treated with curtain.

II. Windows & light

The third-floor roof's skylight is intended to provide lighting for the inside hallways. However, as can be seen in the image, the building's lights are carelessly left on throughout the day and night in various rooms and the corridors.

Since it is on the boundary, the HCB-built building's northern façade is without windows. These rooms have windows up till the last floor. But the windows grow bigger over the third story. Because these sides of the building do no receive enough light and heat, and because of the small windows, the temperature on these sides of the building drops relatively.

III. Energy consumption findings

Computers, lighting, and other devices are among those that utilize the most power, which is the primary energy source for the structure. In general, the building doesn't use any other energy sources. Poor to medium levels of knowledge about renewable energy are present among the respondents.

IV. Water conservation findings

Clean water is used by building occupants for toilet flushing, laundry, and automobile washing. They continue to struggle with finding ways to reuse, recycle, and gather.

Waste management findings

Waste is gathered in each functional space and at the back of the building, as is typical of many mixed-use structures, for door-to-door collection. Tendency to recycle the waste does not see.

V. Dampness and microbial growth

According to the building administrator interviewed, there are no microbial growths in the whole building. But water leakage resulting in dampness can be seen in limited parts of the building especially around toilets.

VI. Acoustic and views

The building is home to several different functions and is highly active, plus it is situated near a busy main street, so some noise annoyance is unavoidable. The majority of the rooms lack access to exterior views; however, those towards the building's front enjoy a view of the outer part of environment

VII. Efficiency and health problems

Some of the respondents claimed they had experienced health issues such as colds as a result of the poor air quality and the strong winds that came from the outer part of building that were left open for ventilation, while others claimed they had never experienced any health issues. When asked about productivity, the majority of the residents responded that because the temperature varies during the day, their productivity suffers.

4.6 Arsi Zone Administration Building

1. Building function & description

The building is located in Arsi zone Asella city Kebele 03, around Ethiopia red cross Asella district branch. This building is one of the typical buildings built for each of the Oromia Zone. Designed by and consulted by Oromia Housing development office and constructed by _____construction, it was completed in 2013. It is a 5 stories building housing having different zone sectorial offices. The building is mostly used for offices but it also has a conference Hall, Cafe and other services. The building gives its longest side to the North to south direction

Figure 18: Arsi Zone admin office

(Source: - Captured by researcher 2023)

2. Sustainable Site

Site location and transportation the building is located around Ethiopia Red Cross Asella district branch which is not city's center, Different services and diverse functions are

available within a walking distance from the building. In regards to transportation, Bajaj station is located very close by. Furthermore, there is Asphalt main road which connect the building with city center near to the building. There is a vehicle parking in the front, sides and back side of the building, but no bicycle racks or any other devices that encourage alternative transportation. Most of the occupants use other means transportation exists in the local like Bajaj, Gari etc.

I. Site design and management

a. Open space and Green areas: The building has small green lawn in the front main Gate, at side, back and around the outside boundary of the compound. The green areas are mostly covered with grass and ornamental plants. Introduced species such as Cypress, Araucaria and Robusta are predominantly planted.

b. Pavement: There is Asphalt road which come from center of city up to main gate of building and cobble stone which is used mostly in building compound for parking and pedestrian walkway service.

c. Storm water management: according to the building administrator interviewed, flooding has occurred a few times in the building overflowing in to surrounding. The main method used to manage storm water is a ditch system around the building. Rain water is released to the ditch through the downpipe from the roof.

d. Green Roof and wall: there are no green roofs and walls in the building. Potted plants are seen in the different floors and around the inside circulation.

Figure 19: Greenery area of the building

(Source: - Captured by researcher 2023)

3. Water Efficiency

Municipal tap water is the main source of water for the building for toilets, cleaning, and other uses. no action is taken to reuse and recycle wastewater or rainwater.

4. Energy Efficiency and Atmosphere

I. Energy Consumption

The main source of energy for Arsi Zone Administration building is electricity; the building has its own transformer and the items used the most include computers, lighting, and others. Natural daylight and ventilation is mainly used in the building. According to the building administrator and users, the building doesn't utilize air conditioners (HVAC) system. Electric breakers are found on the corridor outside each office to turn off lights left lit after working hours; this is checked by security every night when they do their rounds**.** The building use natural light during day in most offices and Corridors.

Figure 20: Natural Lighting of the building

(Source: - Captured by researcher 2023)

II. Energy efficient equipment and renewable energy

The building is uses LED lights in the circulation, offices and meeting halls. LEDs (light-emitting diodes) are the most energy efficient lighting option available. LED Lights consume less energy than regular light bulbs. No renewable energy is used in this building.

5. Types of Material and Resources

Type of materials

a. **Roof: -** Corrugated iron sheet on steel make the roof of the building.

b. **Walls:** The interior wall partitions are mostly aluminum and HCB wall. The exterior wall is HCB painted with white Quartz paint wall finishing.

c. **Floor:** Marble floor finishing is used for the Stair case, while porcelain tiles are used for the offices. Conference hall and other rooms.

Figure 21: Construction material of the building

(Source: - Captured by researcher 2023)

6. Waste management

The building is cleaned twice a day; I haven't seen waste collection and disposal dumping site in building compound. There are no actions taken to recycle and reuse wastes within the building. In addition, no trash cans can be seen inside the building.

7. Indoor environment findings

I. Temperature of the building

Respondents claimed that the temperature within the facility is generally comfortable for them, despite occasional cold feelings.

II. Windows and light

Every room has a window that is adequate and acceptable for use.

III. Microbial Growth, Ventilation and Dampness

There is a slight leakage (dampness) issue in the building's moist parts, particularly the restroom.

Figure 22: Dampness of the building around the toilet.

(Source: - Captured by researcher 2023)

Energy consumption findings

The standard energy kinds are supported without the usage of any additional systems. Although the majority of respondents do have sufficient information on the subject, none have worked together to make it a reality.

Water consumption findings

Rainwater harvesting is not practiced. Water is not recycled or reused by residents. The majority of water use is for toilets, a secondary activity for which clean water is not always required.

Waste material management findings

The organic, plastic, and other waste from the building is dumped in a public dump next to the building compound. This trash that hasn't been processed or recycled may include materials that can be sold or used again. However, they are just carelessly thrown into a huge mound.

Acoustic and views :-In the interview the building user stated that, the no noise disturbance from Outside Street and the interior acoustic is not under problem. The building offers a view to all four sides without restrictions.

Figure 23: Surrounding views of the building standing on the terrace

(Source: - Captured by researcher 2023)

Efficiency and health problems

There are no recorded health issues arising from the indoor air quality of the building. Concerning their productivity and efficiency most of the building occupants responded that it remains answered it decreases throughout the day since sometime air condition is cold.

4.7 Arsi Zone Higher Court Office

1. Building siting, Orientation and description

The building is located Asella kebele 04. It is one of the recently built structures in Asella. The ground plus two building is longer side oriented North to South direction

Arsi zone Higher Court building is located in Asella city kebele 03 Sub-city, Construction began mid-20 and by 2010 the completed building started operation. The building stands on 830 m2 plot and has three stories. The entire building is used for offices and Court Halls which occupies different floors each. The building has a slightly slanted North- South orientation.

Figure 24: Arsi zone higher court office

(Source: - Captured by researcher 2023)

2. Sustainable Site

I. Site location and transportation

The building's location, Asella Kebele 03 is one of main centers in the city. As the city's center different services and functions can be found in it. Therefore, almost anything can be accessed in a close proximity from this building. There is Bajaj other transport means routes

connecting the site from different locations making transportation to and from the building relatively easy. Bajaj station is located within a walking distance from the building. There is vehicle parking Space on the right side of the building which is constructed from Cobble Stone, but no bicycle racks.

II. Site design and management

a. Open space and Green areas: - the building does not have a green area but has small green area in the front the building. The open space on the right side and back of the building is used for parking and for waiting area of people for court service respectively.

b. Pavement: - Cobble Stone is used as a paving material for the parking while Gravel with tiled pedestrian walkways bound the front and right side of the building.

c. Storm water management: - rainwater from the roof is released through downpipes straight to the surrounding area.

d. Green Roof and wall: - there are no green roofs and walls in the. Not even a single potted plant can be seen in or around the building.

3. Water Efficiency

Municipal tap water is the main source of water for the city used for toilets, cleaning and other uses. But for this building case water is didn't used at the toilets and different room and no action is taken to reuse and recycle rainwater.

4. Energy Efficiency and Atmosphere

The main source of energy for the building is electricity. The items used the utmost include computers, lighting, and others. Artificial lighting is used during the day as most offices even if offices and circulations bright in the day time.

Energy efficient equipment and renewable energy

Regular light bulbs and fluorescent make up the majority of the lighting while LED is used in some rooms. No renewable energy is used in this building.

5. Material and Resources

Type of materials

A. **Roof: -** The roof is covered with corrugated iron sheet on wooden.

B. Walls: - walls are makeup from HCB for both the exterior walls and Interior partitions.

C. Floor: - Marble and ceramic tiles are the main floor finishing used in the entire building.

6. Waste management

The office is cleaned twice a day and I can't observe during research waste collection and disposal found in the building. There are no actions taken to recycle and reuse wastes within the building. In addition, no trash can be seen inside the building.

4.8 Assela City Mall

1. Building siting and orientation

Asella City Mall is located between Dashen Area and Chicho Square which is the highest value area of the city. The location is indicated on the map below. The building faces the east direction with full advantage of receiving morning sun. It slanted its longer side east to west direction and others.

The building site gives it advantage because the land itself has high land value because it is near to the main road Asella to Sagure and exists in city center.

Figure 25:-Location of Asella city mall

(Source: Captured by researcher 2023)

2. Sustainable Site

I. Site location and transportation

The building is located in around of the Dashen Bank Area which is existing the most city center from other selected buildings. Offices, cafes, shops, Banks and others are the functions found within a walking proximity from the building. Many bajaj routes from and to different locations passes through in front of the building very closely. In the Asella city mall building, most occupants use private cars, Bajaj and other means. There are no bicycle users and nothing positive to encourage sustainable transportation can be seen there, since the area is very confined with building and highly dense movement of peoples.

II. Site design and management

a. Open space and Green areas: there is no open space at the back, sides and in front of the building so the buildings haven't parking area. There are also no green areas within the building as potted or around the building. This makes the building grace less and unselected building for different services relatively specially for offices.

b. Pavement: The is Asphalt road in front and cobble stone at left side of the building which is used for pedestrian cars and walkways respectively.

c. Storm water management: - rainwater is released to the surrounding area through downpipes from the roof and drain through main road ditches from the roof with no intention of reusing or recycling it**.**

d. Green roof and wall: there are no green roofs or walls in the building. The roof is suitable for a vegetated roof but is currently used for placing of water tanks Ditches and advertising posts.

e. Green roof.

The structure's flat roof is ideal for supporting a green roof. But it has no structure even vaguely resembling a green roof, as can be seen in many of the city's structures.

3. Water Efficiency

The main source of water for the building is tap water which is used for everything activities in the building. There is no scheme for reusing and recycling wastewater or rainwater. Almost all the building toilets and Sanitation equipment fixtures are not considered as water efficient fixtures.

4. Energy Efficiency and Atmosphere

I. Energy Consumption

The items used most by building occupants include, Stoves and Computer, ATM Machine and other electronics machines others with electricity being the main source. Artificial lighting is used in most offices, Cafés, shops and Bank during the day including for public spaces and circulation. The occupants don't use air conditioners or fans and mainly rely on natural ventilation**.**

Figure 26: Artificial Lighting used in the building during day time

(Source: Captured by researcher 2023)

II. Energy efficient equipment and renewable energy

None of the rooms/ unit in the building use renewable energy. With the majority being fluorescent light, Decor lights and LED and regular light bulbs can also be found in the building.

5. Resource and materials

Type of materials

a. **Roof**:- G28 cover is used for the roof.

b. **Walls**: - the exterior HCB walls of the building are lined with different color of Aluminum cladding. The interior partitions differ from unit to unit ranging from HCB walls, gypsum board and aluminum frame

c. **Floor**:-ceramic tile, marbles, carpets and plastic tiles are the most common floor finishing used in the building.

The structure is made of Aluminum curtain wall and HCB. The two construction materials, as mentioned above in earlier sections, may function effectively if they are handled and built in accordance with a carefully considered design.

6. Waste management:-The Building Occupants don't recycle or reuse their wastes from the room which are mostly paper, plastic bottles and tissues. They collect waste in the building for temporary. after some accumulation municipality wastes disposal service remove it.

Figure 27: Material of the building

(Source: Captured by researcher 2023)

7. Indoor environment quality

I. Temperature of the building

Respondents reported that the interior air temperature is generally appropriate, yet generally they still felt cold.

II. Windows and light

Every room has a window that is functional and adequate for the job.

III. Microbial growth, ventilation and dampness

There is a little amount of leakage (dampness) in the building's moist spaces (kitchen and restroom), which involves seepage from floor to floor as well as from room to room.

Figure 28: Dampness in the building around the toilet

(Source: Captured by researcher 2023)

IV. Energy consumption

As Seen during survey building do not utilize alternative or renewable energy sources or recycle such green energies. Their understanding of bio gas is inadequate and hardly ever used in building conditions. The many building functions result in significant daily energy consumption. Additionally, most restaurants employ equipment and ovens, and most stores use artificial lighting for show. This feature makes more use of energy.

V. Water resource management

All of the water used in a building's sanitary systems, toilets, and other services is clean water. No reusing or recycling. The cost of maintaining function increases as a result.

4.9 Berhe International Hotel

I. Building Siting and Orientation

One of Asella City's iconic buildings, the five-story International Hotel has numerous offices, as well as stores, restaurants, banks, pensions, and meeting halls. It may be found on the main thoroughfare that runs between Asella and Sagure City. This road has a little tilt to it and runs from east to west. The front façade of the building faces north, benefiting from morning sunlight, which has been shown to provide all living things within with a boost in vitality.

Figure 29: Location of Berhe International Hotel

(Source: Captured by researcher 2023)

2. Sustainable Site

I. Site location and transportation

This iconic structure is situated close to the Kenga Building of the Ethiopian Red Cross, which is the area in the city center that is visited the most out of all the structures that were considered. Offices, cafes, stores, banks, and other facilities can be reached on foot from the building.Numerous Bajaj routes from and to various areas pass just in front of the building. The majority of people that live nearby Berhe International Hotel utilize private vehicles, Bajaj, and other transportation. Since the area is heavily constrained by buildings and highly congested human activity, there are no bicycle users and nothing encouraging promoting sustainable mobility can be seen there.

II. Site design and management

a. Open space and Green areas: -A tiny green area is located at the back of the building, in the open space and green spaces. Grass and decorative plants predominately cover the areas that are green. The majority of planted plants are exotics including Cypress, Araucaria and Grevillea.

b. Pavement: Terrazzo and concrete, which are primarily employed inside of buildings, are the two main paving materials used in the property.

c. Storm water management: - The building administrator who was interviewed stated that flooding has occasionally happened in the building, spilling over into the basement floor. A ditch system surrounding the structure serves as the primary means of storm water management. Rainwater from the roof is discharged to the ditch using downpipes.

d. Green Roof and wall: - there are no green roofs and walls in the building.

Figure 30: Rainwater through downpipe to main drainage line (Left), Ground level garden at the back of buildings and Terrazzo paved parking area at the back of the building

(Source: Captured by researcher 2023).

3. Water Efficiency

The primary supply of water for toilets, cleaning, and other functions in the structure is tap water. Nothing is done to recycle or reuse waste water or employ water-efficient fixtures or rainwater.

4. Energy Efficiency and Atmosphere

I. Energy Consumption

Computers, different machines, Electronics and light bulbs are among the devices that require the most power, which is the primary energy source. Fans and air conditioners are never used in the building. Almost every room in the building has artificial illumination, which is notably prevalent throughout the day in the banks. While certain rooms need artificial illumination, other areas with enough natural light nonetheless use light bulbs—possibly carelessly.

II. Energy efficient equipment and renewable energy

The majorities of the light bulbs utilized in the structure are fluorescent and LED bulbs.

The use of renewable energy is nonexistent.

5. Material and Resources

Type of materials

a. **Roof**: - The primary roofing material is corrugated iron sheet.

b. **Walls**: - The internal partition walls vary from room to room and might be made of wood, HCB, or aluminum. The external walls are constructed from HCB walls and painted with quartz. The window and entrance are made of copper.

c. **Floor: -** Granite is employed for circulation while alternative materials, such as ceramic and plastic tiles, are frequently used in workplaces.

5. Waste management

Every day, trash is gathered from each office and thrown at the back of the structure. The idea of recycling and reusing waste is new to the building, and little is being done to implement it.

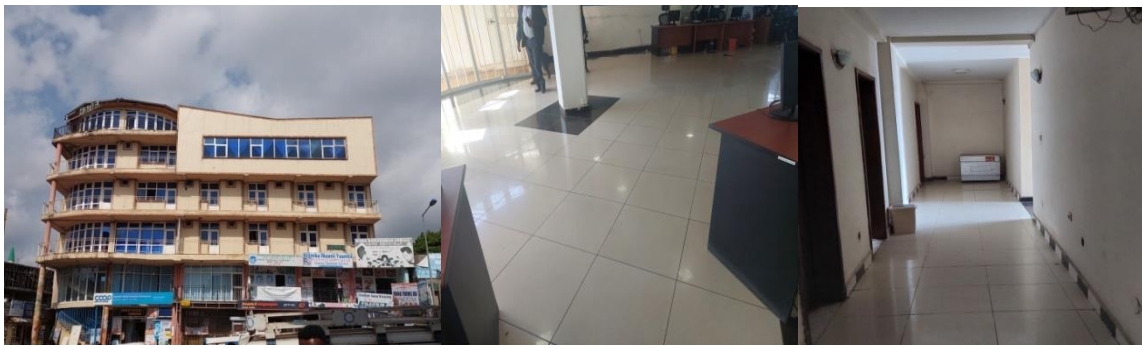


Figure: Exterior and Interior materials in the building

(Source: captured by the researcher, 2023)

6. Quality of the indoor environment

I. Lighting

Large windows that span two levels can't help but catch one's eye as they enter. Due to the afternoon sun, most of the residents use curtains that are closed throughout the day, which limits natural lighting considerably. However, this window would have allowed in plenty of light. Furthermore, the dividers are constructed in a way that limits access to natural illumination. The stairways have glass block windows, and the building's pitched roof has a dormer window to let in natural light.

II. **Ventilation**:-The structure is naturally ventilated and operates without any fans or air conditioning.

The only way the residents utilize to cool and cold themselves is through the windows. The Oromia cooperative bank and Wegagen Bank are located on the first floor, which has a lot of activity and, as a result, has slightly worse air quality than the upper floors.

III. Dampness and microbial growth

The building manager who conducted the interview and every occupant claim that the building has dampness and microbial growth in both the inside and exterior specially in toilets. I have personally observed this on a site visit.

Figure 31:-Dampness of the building in toilet

(Source: captured by the researcher, 2023)

Figure 32: Naturally lighted circulation in the building

(Source: captured by the researcher, 2023)

IV. Acoustic and views

The building's manager claims that noise is an issue because the structure is next to a vehicles road. Noise pollution is present on the first and second floors, where there is a lot of activity. Through its windows, the structure provides unrestricted views of its surroundings..

CHAPTER 5 RESULTS AND DISCUSSIONS

This chapter uses various software to examine the collected data using descriptive and statistical methods. The data is finally processed and presented as seen below.

5.1 Analysis Data of selected buildings

As previously mentioned, a total of 9 buildings were surveyed. The buildings were chosen in accordance with the established selection criteria, and the graph below summarizes their ownership and function.

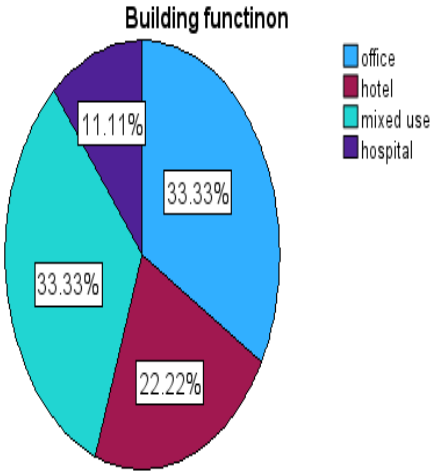
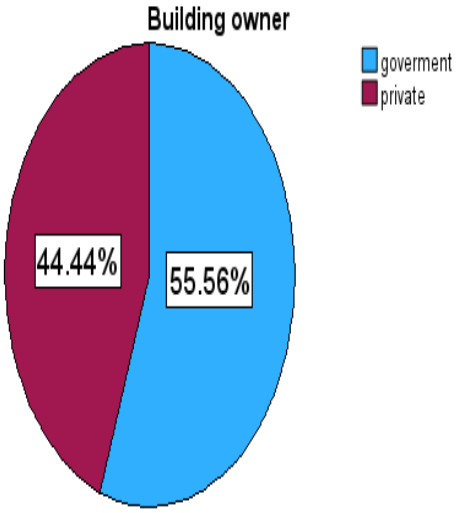


Figure 33: Building function and occupation

(Source: Computed by researcher, 2023)



Therefore, only one building Asella referral and Teaching Hospital out of the total of 9 is Health center (Hospital), whereas, Derartu and Sol jam building are exclusively Hotels. Office space is located in Arsi zone higher court, Arsi Zone Administration office and Arsi zone prosperity party, which account for 33.33% of the structures surveyed. While Asella City Mall, Berhe international Hotel and Gidad Building are mixed use buildings. Fourth four (44.44%) of the buildings are owned by the government (Arsi zone higher court, Arsi Zone Administration office, Asella referral and Teaching Hospital and Arsi zone prosperity party), however 55.56% owned by private owners (Derartu Hotel, sol jam building, Gidad Building, Assela city mall, Berhe International Hotel).

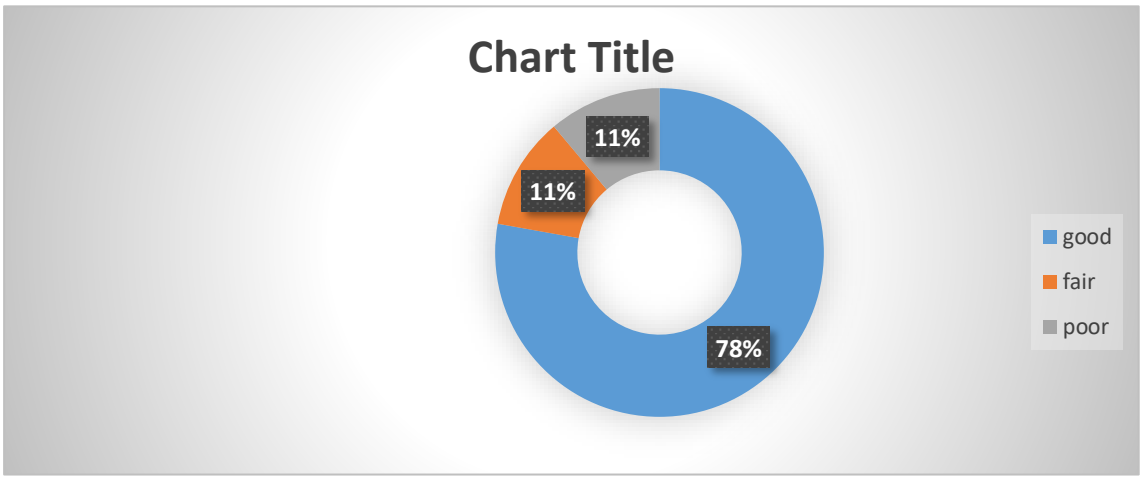
5.1.1 Sustainability of site

I. Sustainable sites of selected buildings Location of the buildings:

Out of all the buildings surveyed, 78% are in the city's center and have easy access to services and transportation thanks to the proximity of Bus and Bajaj stations; examples include the (Asella Referral and Teaching Hospital, Derartu Hotel, sol jam building, Gidad Building, Assela city mall, Berhe International Hotel and Arsi zone prosperity party). Due to their remoteness (Arsi zone higher court, Arsi Zone Administration office) the difficulty of getting there, and the fact that they can only be reached by transport mean routes, 11% have fair and 11% Poor access. I haven't given any thought to bicycles as a form of alternate transportation or the placement of parking spaces or other solutions for all selected buildings.

Figure 34: Access to transport and service of selected buildings

(Source: Computed by researcher, 2023)



II. Storm water management

Underground storm water from each of the nine buildings feeds into the main drainage system via ditches. One of the structures that flooded as a result of poor storm water management was the Berhe International Hotel. I haven't seen any buildings that drain the discharge of rainfall to the nearby green spaces and utilize as irrigation for vegetation as well as infiltration of rainwater into the earth. All buildings use downpipes that are connected to ditches to drain rainwater from the roof to main drainage.

III. Open and green areas, Green Roof and Green Wall

22% of the entire building, which includes the Gidad Building and the Asella City Mall, is devoid of any green space. Various sorts of flora, from dense tree cover to sparse lawn areas, occupy the remaining 78% of the space. There are no structures with green walls and roofs.

Open and Green areas

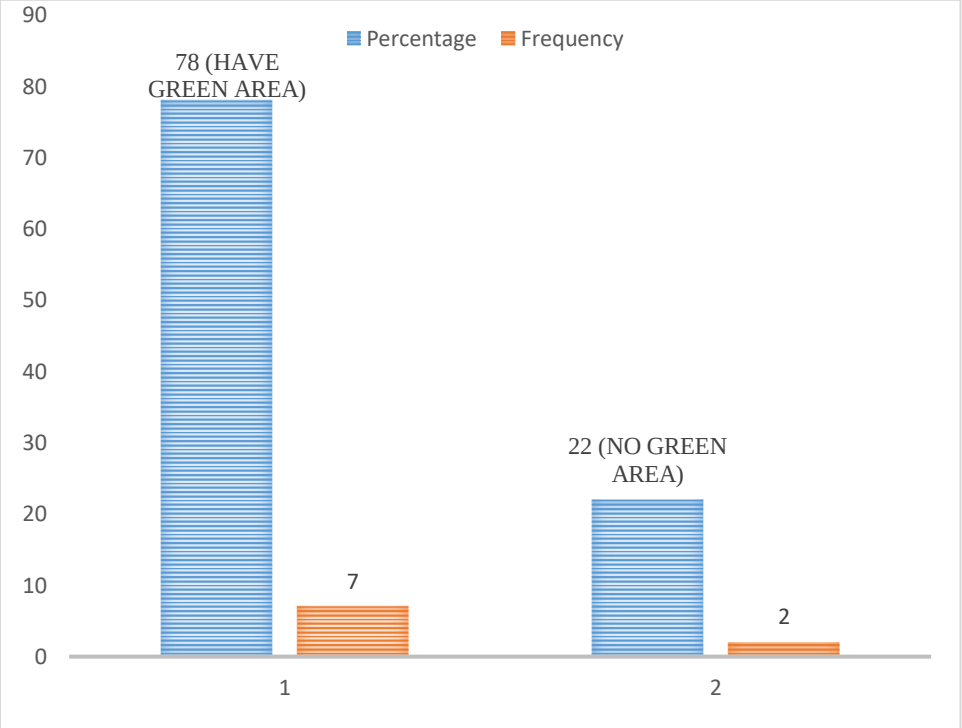


Figure 35: Availability of open and green areas for selected buildings

(Source: Computed by researcher, 2023)

5.1.2 Disparities between sustainable building and assessed building in terms of sustainable site

- There is extremely little use of alternative sustainable modes of transportation like bicycles and fuel-efficient cars.
- There are few efforts made to lessen the building's total footprint.
- It is quite rare for buildings to provide space for open and green areas, particularly those that are located in the inner city.
- There is a complete lack of sustainable storm water management strategies including rain gardens, bio swales, bio retention, and others.
- Habit of growing exotic plants rather than local, drought-tolerant ones in order to save water and lessen the urban heat island effect.

- More effort needs to be done on the planning, building, and upkeep of green roofs and walls.

According to (Marchesini et al., 2008), the erection of buildings takes over the entire site with complete disregard for the surrounding environment in many urban areas of Africa. This is consistent with the study's conclusions that most examined buildings, particularly those in the inner city, lack areas where greenest building concepts, like open spaces and site landscaping, impermeable surfaces, and sustainable storm water management, can be implemented.

Green roofs and walls can offer many advantages as an alternative to open spaces on the ground, but the study has found that the design, construction, and maintenance of these green roofs and walls is a problem (as evident in the Hope roof's leaking roof and the GBG roof's damaged green roof) due to main reasons including: lack of awareness and technology, among others. According to (Labuschagne & Zulch, 2016), the main challenges in the majority of African nations are a lack of professional knowledge on the advantages of green roof top systems and the building of such systems.

5.1.3 Water Efficiency of selected buildings

In our daily lives, we use water. It is well known that more than 70% of the earth's surface is covered by water. 70% of the earth's surface is covered by water, much of which is saline water. Only 1% of the water is now unsalted. With what we have, we must get by.

During the survey, it was discovered that toilets used the most water. Additionally, all businesses, hotels, and stores flush their toilets with clean water. (Statement based on observations from a field survey.) Office and retail enterprises did not recycle water when asked if they did so. This suggests that office and retail operations could benefit from greater use of the water needed for toilets. More than half of all water use is for toilet flushing.

Nearly all of the buildings surveyed (Arsi Zone Higher Court, Arsi Zone Administration office, Sol jam Building, Gidad Building, Asella City Mall, Berhe International Hotel, Derartu Hotel, Arsi Zone Prosperity party office, and Asella Hospital referral and teaching hospital) lack any water-efficient fittings and no water, so building occupants use water as a common means of transportation. There are no fixed waterless urinals or automated shutoff faucets in any of the buildings.

Recycling is the most significant difference between sustainable and assessed buildings. The successful sustainable building recycles used water and uses it in diverse activities that require less clean water, whereas most surveyed buildings do not follow this trend. Water bills thus rise as a result of this. Despite the fact that most buildings in Asella city use municipal tap water in an inefficient and hasty manner. And in the absence of water supply (which occurs regularly and for an extended period of time in our city, particularly in the examined area), the reservoir has proven to be ineffective. This is due to reckless reservoir water consumption. The rate of use depletes the available water.

Figure below shows that municipal tap water is the primary supply of water for toilets and for other service, with the exception of Asella Referral and teaching Hospital, which uses its own reservoir for hospital activities service and furthermore for watering of the green spaces, however, the use of recycled water for any purpose is elusive to all buildings. Their is no tendency seen to wastewater treatment system in all surveyed building.

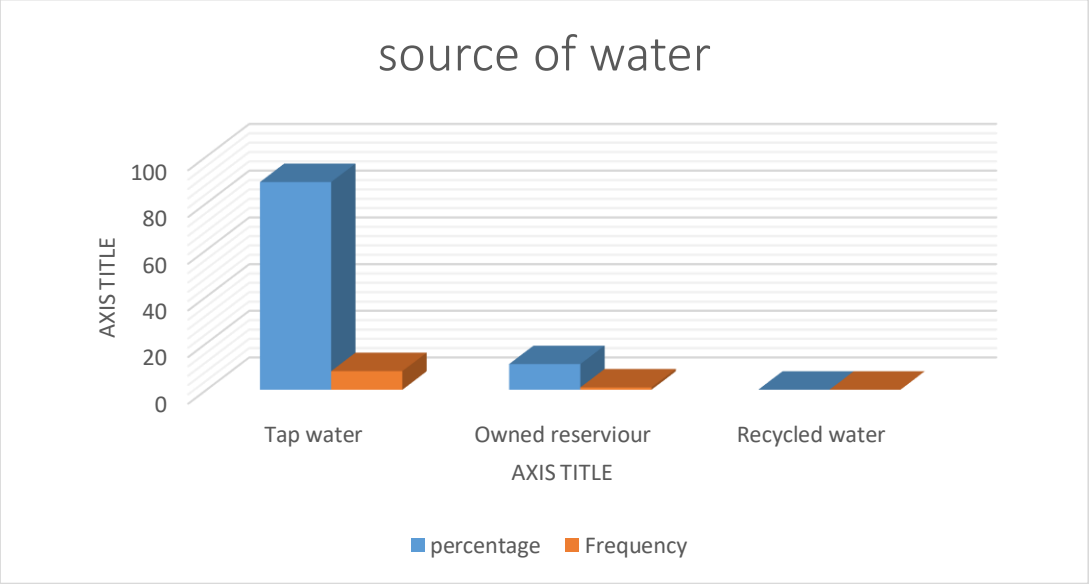


Figure 36: Sources of water for selected building

(Source: Computed by researcher, 2023)

5.1.4 Disparities between sustainable building and assessed building in terms of water efficiency

- Complete reliance on public water systems.

- There is no attempt made to recycle wastewater or rainwater.
- using tap water to hydrate landscaping plants that need ongoing irrigation instead of giving water directly to the plants, which could cause the water to evaporate into the air, the irrigation technique used by all structures is to spray water using hoes. Particularly with regard to water faucets and shower heads, installing high-efficiency fixtures is absent.
- Insufficient knowledge of wastewater treatment technology, design, and maintenance.
- Though almost all of the buildings use the closed system of sewerage collection, there has not been a step taken to utilize the untapped energy that lays underneath those pits.

The results of the study demonstrate that water efficiency is one of the least used sustainable building concepts, with none of the assessed buildings recycling waste water (the GBG has a waste water treatment system, but it is inoperable). The use of non-sewage and grey water for on-site uses such site irrigation will reduce demand on the nearby aquifer, as stated in (Yamany et al., 2016). A sustainable building should use water wisely, decrease, control, and/or treat site runoff, and reuse or recycle water for on-site consumption. The dread of residents' attitudes about recycling has, however, limited its adoption due to various factors including lack of room and awareness. Additionally, the lack of water recycling, which results in increased water costs, has also been recognized by (Haileleul,2015) as the primary water efficiency gap in Asella buildings.

Reducing water usage from fixtures and equipment is reportedly the simplest way to reduce overall potable water use, according to the conclusions of this study practitioners' responses

Just mentioning certain products is all that is needed in terms of design solutions. Only recently constructed buildings, particularly those with dual flushing, use the technique, whilst older ones still do not.

5.1.5 Energy Efficiency and Atmosphere of selected building

When compared to the rest of the globe, our country's unhealthy approach to energy manipulation may not be deemed harmful. However, the path we are on with our consumption is a guaranteed way to put a stop to the dangerous stage the globe is currently in.

Because of the city's great weather, Asella city most buildings do not have air conditioners or fans. During survey only three buildings: Derartu Hotel, the sol jam Hotel, and the Arsi Zone Prosperity Party Office do not utilize artificial lighting during the day, whereas the others do. The reason also differs from negligence to actually requiring lighting because the rooms are dark, However, the extent and rationale vary; for example, in most rooms, artificial lighting is essential.

Movement sensors are not used almost all in surveyed buildings. Public buildings such as (Arsi zone higher court, Arsi Zone Administration office, Asella referral and Teaching Hospital and Arsi zone prosperity party) use both LED and fluorescent light bulbs, while the remaining (Derartu Hotel, sol jam building, Gidad Building, Asella city mall, Berhe International Hotel) use all three types of light bulbs incandescent, halogen, and CFL (compact fluorescent light). No building utilizes any type of renewable energy.

5.1.6 Disparities between sustainable building and assessed building in terms of energy efficiency

- Lack of emphasis on the best building orientation and envelop to minimize the need of ACs and fans .there is virtually little testing and application of various forms of renewable energy.
- Lack of regard for natural lighting while building wall partitions results in the usage of artificial lighting, which necessitates the use of mechanical ventilation solutions. Early stages of the design process don't take energy demand, consumption, and conservation into account.
- Failing to turn off lights and appliances when not in use by building inhabitants and other authorities.
- Use of renewable energy is uncustomary and unlikely in the surveyed buildings.
- Consumption of energy due to faulty design of building and also unwise usage of equipment’s is high. Making inappropriate material choices for the weather. Using materials with poor thermal resistance, which leads to greater temperatures and perhaps more energy-intensive HVAC use.
- Limited technology and knowledge of low-impact and environmentally acceptable materials Lack of garbage reuse and recycling.
- Limited use of recycled materials and quickly regenerated materials.

- Reliance on imports of materials.

Buildings are not recommended to utilize HVAC&R or to use systems that reduce or completely stop the emission of substances that contribute to ozone depletion and climate change in green building literature (Bazjanac et al., 2011). Due to the city's weather, the majority of the examined buildings do not have any HVAC, indicating that a balance between energy efficiency and a good indoor climate may be achieved with only minor adjustments, careful material and orientation selection, and the promotion of passive design.

One aspect of energy efficiency that is severely absent in the assessed buildings is planning for energy efficiency and energy modeling during the design stage (such as calculating energy demand and consumption in various scenarios). This is in line with research from another African nation which found that few buildings had solar panels installed at their commercial building because most owners thought it would be too expensive to set up the panels, even though doing so would likely result in long-term cost savings (Mahapsari, 2013). Therefore, probably its high cost, together with other factors like a lack of technology and knowledge, can also account for its low application in Asella City.

Due to neglect and narrow partitioned spaces, commercial and office buildings leave lighting and appliances on when not in use more often than other functions. During blackouts, these structures also employ generators, which increase energy use.

5.1.7 Material and Resource of selected buildings

I. Types of materials

To choose the most ecologically friendly option for each application, a thorough, trustworthy life-cycle assessment should be the foundation for all decisions about products and materials. For the majority of construction and renovation projects right now, such a selection process is not practical. However, data from the National Institute for Standards and Technology's Building for Environmental and Economic Sustainability software tool makes it possible to do such comparisons for at least one product category carpets.

IAQ will be improved by selecting building materials and interior finish products with zero or low VOC emissions during the design and construction phase. The majority of cleaning and maintenance products and building materials release gases, some of which are harmful. The productivity, comfort, and health of occupants may all be negatively impacted by these gases. The IEQ of a building will improve by avoiding these products. There are

requirements for using low-emitting interiors in LEED, HQE, and Green Star. The range of the products concerned is about to be increased by Draft LEED 2012. Only formaldehyde emissions are restricted by BREEAM. In buildings like Asella City Mall, Berhe International Hotel, and some portions of Arsi Zone and Asella city Prosperity Party Office

HCB with plastering or painting is the most prevalent wall material, followed by Clinker and Aluminum cladding, and remaining survey building constructed from HCB Wall and concrete as shown in assessment figures. Although adobe bricks are the most environmentally beneficial type, they are not utilized in the buildings under study. Some areas of the Arsi Zone Prosperity Party Office are made of glass. Corrugated iron sheet (G30, G28), Ega sheet and Decra tile are the most common type of roof and no building has a green roof. All buildings need tiles, whether they are made of ceramic, marble, plastic, or porcelain. Bamboo and wood parquets are never employed in construction of surveyed building.

II. Thermal properties of materials used in the surveyed buildings

The main point of contact between interior and the outside is the building envelope, which has an impact on both the inhabitants' perception of comfort and the heating and cooling demands of the structure.

The thermal performance of building materials is assessed using conductivity tests known as R- and U- values. The R-value is a measurement of a wall's effectiveness as an insulator; the higher the resistance to heat conduction, the higher the R-value, and the better the insulator. The R-value is derived by dividing the thickness of the wall by the thermal conductivity of the wall, which is the rate at which heat flows from the warmer to the colder side of the wall per square foot per hour. The R value's reciprocal, or U-value, represents conductance and shows the rate at which.

a. **Buildings with HCB walls**: - These buildings have relatively low thermal resistance, which causes their inside temperatures to vary significantly during the day and occasionally necessitates the use of additional energy to maintain comfort levels.

b. **Building with Stone Masonry and Cladding**: - Although the mineral makeup and constitution of natural stones vary, in general, stones do not easily allow heat to enter or escape. The indoor temperature in buildings made of this material is cooler during the day and releases heat at night, making the environment warmer. In addition, stones are enduring and have a little carbon footprint compared to other materials.

c. **Building with Adobe brick**: - A building made of adobe brick has a reasonably high thermal conductivity, which enables it to collect heat during the day to keep the inside cold and release it at night to warm the house. Additionally, it aids in minimizing significant changes in indoor temperature throughout the summer and winter. Adobe bricks are also environmentally friendly and sound proof.

d. **Buildings with Glass**: - This kind of materials also make it simple to transport heat from hot to cold locations, which affects the building's interior temperature. It is usual for several issues, such as glare and discomfort of building inhabitants owing to greater temperatures, to arise if the right shade is not implemented.

e. **Building with Magnesium oxide**:- has only a minimal degree of thermal insulation

Regional, Renewable and Recycled Materials

The majority of buildings used a combination of native and foreign materials, although the exact amount used could not be identified. Local resources must account for at least 20% of all resources used in order to receive the full two LEED points. However, just 33% of the studied buildings used locally sourced eucalyptus for the construction of their trusses; no such buildings were visible. This indicates that every single construction item, whether it is the raw materials or the finished product, was transported from somewhere else. No attempt has been made to use a swiftly renewable material in building. During the design and construction phases, none of the newly built structures used recycled materials or materials with a second life, according to an interview with the building engineers and architects.

5.1.8 Disparities between sustainable building and assessed building in terms of material and resources.

- Making inappropriate material choices for the weather.
- Using materials with poor thermal resistance, which leads to greater temperatures and perhaps more energy-intensive HVAC use.
- Limited technology and knowledge of low-impact and environmentally acceptable materials Lack of garbage reuse and recycling.
- Limited use of recycled materials and quickly regenerated materials. Reliance on imports of materials.

According to a study done in Kenya, the use of materials with low environmental impact was the idea under sustainable materials that was most frequently implemented, followed by the use of local materials and components. This might be explained by the establishment of numerous environmental rules by the relevant authorities. Contrarily, the results of this study suggest that local and sustainable materials are applied the least. It's possible that this is due in part to a lack of laws addressing the problem. (Were, 2015) did a study that supports the conclusions of this study about the utilization of recycled materials, both of which showed that most buildings do not employ recycled materials.

A different study reveals that recycling construction materials is a relatively new idea that has only been evaluated in a few studies, indicating that more work is needed to apply this idea. When it comes to garbage management, paper and plastic bottles dominate in commercial, educational, and office buildings, whereas organic wastes make up the majority of waste in residential structures. In addition, recycling and reusing garbage is a brand-new idea that is currently being implemented in only two buildings. This conclusion is reinforced by (Haileleul, 2015) study, which found that almost all of the buildings under investigation did not sort, reuse, or recycle their waste.

5.1.9 Waste Management of surveyed buildings

It improves ecosystem services, human health, and well-being when people have access to proper sanitation, which reduces local environmental degradation.

To maintain a healthy environment, proper human waste disposal that is both sanitary and safe from biological threats is essential. Sanitation and sewage treatment, especially for surface waters and shallow groundwater resources, could be seen as preventive barriers in local source water protection.

According to the physical, social, and economic findings, the assessed building does not create income, do not encourage socialization, and their contact with the environment is very weak. The amount of garbage generated by a structure is one way it interacts with its surroundings. The giant land fill site surrounding koshe safer Kebele 13 is the judge of how much rubbish is produced in the research area. The frontal length of the land is around a kilometer, and the breadth is about 400 meters. And the landscape is littered with garbage piles made up of various chemicals. Plastic, paper, metal, glass, clothing, ashes, and so on.

This indicates that a large amount of garbage is generated in buildings and families. Though the fundamental notion of sustainable design is to limit waste that goes to landfills, building occupants must first sort their garbage in order to take that step. However, this explicitly states that the majority of respondents do not separate rubbish. According to the preceding section, the first step toward being sustainable is rubbish sorting. Because the surveyed buildings do not separate their rubbish, they cannot progress to the next stage of being sustainable structures. This implies that more rubbish is dumped in landfills, causing a foul odor that disturbs the neighbors.

Paper and plastics is a relatively common waste in commercial and public buildings, although organic wastes like food are more prevalent in hotels. The amount of garbage created in each building varies depending on its use. A common trash disposal area is one thing all buildings share in common. Within the building and is picked up by the city at regular periods. Most building inhabitants have never heard of sorting at the source or recycling. No one in the building sorts their trash before giving it to the recyclers. When it came to composting, all of the buildings occupants that were surveyed (100%) did not even think about it.

Liquid waste management of survey buildings

Though the globe has advanced to numerous technologies that deal with toilet waste, the chambered Eco-toilet is the most modern and clearer version of technologies that everyone looking at the graphic can understand.

Some sustainable buildings have such a method of separating urine and feces into their sanitary design, making it very easy to turn toilet waste into bio gas. It was also simple to add mesh and dividing funnels to septic tanks, allowing the slug to settle on the base and the urine liquid waste) to be suspended and pass through a funnel to its own collection pit.

The portable eco-Toilet takes into account the following criteria:

The mesh, which is intended to allow only liquid waste, is offered on the side of the portable toilet intended to hold feces to reduce closure of the mesh opening, which may come from settling of the feces, which in turn slows urine flow through the mesh. Although the proposed mesh extends on the side, it is slightly lower than the upper part of the toilet to prevent against excrement overflow during toilet filling.

The portable Urine holding toilet is designed to collect excrement at the lowest area of the toilet. This facilitates the easy drainage of urine into this chamber of the proposed portable eco toilet.

Septic tanks are on-site waste water treatment systems that let wastewater flow through a leaching field and allow for part of its solid contents to be broken down by microorganisms. In essence, they eliminate the requirement for public sewage to reach your property.

The technology of closed septic tanks used by almost all of the buildings surveyed makes it simple to transform the waste that is stored into biogas. Although no attempt was made to turn the garbage into biogas, it still offers a fantastic opportunity to switch non-renewable energy sources to sustainable and renewable ones.

5.1.10 Indoor environmental quality of selected buildings

Microbial growth, Ventilation and Dampness.

We frequently refer to a building as having a dampness problem or as a damp building when the materials inside the building get sufficiently moist to result in material damage or apparent mold growth. There are various reasons why a structure becomes wet, including seepage between improperly made window and door features that allow water to enter the interior, the environment in which the building was built, and others.

The dampness and mold development may be evident on internal building surfaces, such as those in basements or crawl spaces, or they may be concealed inside of walls and air conditioning units. Building dampness issues can be caused by a variety of things, such as groundwater intrusion, plumbing system leaks, water leaks through walls and roofs, damp construction materials, high indoor moisture generation rates, entry of humid outdoor air combined with inadequate de humidification, water vapor condensation on cold surfaces of windows and walls, and floods.

Even while most respondents to the survey were unaware of the connection between moisture, microbial growth, and discomfort, they nonetheless felt uncomfortable and frequently contracted minor diseases.

Nine buildings were surveyed, and eight of them, with the exception of three recently built public buildings, did not claim to have any microbial growth. Instead, almost all of the buildings have water leakage problems, such as seepage between improperly constructed

details of windows, doors, roofs, plumbing systems, and groundwater entry causing dampness. Mold and bacteria frequently invade structures that are moist for an extended length of time. Molds and bacteria have the ability to release spores, tiny airborne particles, and other poisons.

In 2004, the Institute of Medicine (IOM) of the National Academy of Sciences finished a comprehensive evaluation of the scientific literature on the effects of mold and moisture on human health. A comparable review by the World Health Organization (WHO) was finished in 2009 and was updated in 2011 and published. Each of these evaluations reached the same results, while the later ones noted a few additional health consequences linked to moisture and mold. According to Mendel's review, dampness and mold in homes are linked to an increase in a number of harmful health effects, such as upper respiratory symptoms, coughing, wheezing, difficulty breathing, asthma exacerbations, new asthma development, bronchitis, allergic rhinitis (inflammation of the nasal passages caused by allergies with a runny nose or congestion), and more (Haileleul, 2015)

One of the characteristics of sustainable building is the increase in productivity and efficiency of building occupants in an ideal and adequate indoor environment. The indoor environment, as demonstrated by the bar chart above, affects how productive building inhabitants are in practically all buildings. As as result if the guidelines for sustainable buildings are followed and the inside. When a building's quality is boosted, its tenants' productivity can also rise, which benefits the company in question and perhaps even the entire nation.

Sustainable buildings do not handle microbial growth well. In the past ten years, there has been a major evolution in the sampling and analysis techniques for fungus speculation. This specification specifies the use of quantitative polymerase chain reaction (QPCR) for DNA detection based on discussions with EPA researchers. Compared to traditional morphology utilizing visual identification, which is very reliant on the technician's skill, the QPCR approach is more consistent and reliable.

Reduced volatile organic compounds, often known as VOCs, and other air pollutants such microbiological contaminants are the goals of indoor air quality. Buildings rely on a correctly constructed ventilation system to supply enough ventilation of cleaner outdoor air

or re-circulated, filtered air as well as segregated operations (kitchens, dry cleaners, etc.) from other occupancies.

Section 01 81 09, "Testing for Indoor Air Quality" of the LEED requirement guide specifications contains more explicit requirements for testing indoor air before occupancy and for evaluating products that will be installed.

Appliances are the fundamental feature covered in Green Building. The appliances have been carefully chosen to include minimal VOC generating components. These elements contribute to green buildings' reduced risk of microbial infection and comfortable environments that typically improve productivity. Suffocation and unpleasant odor brought on by microorganisms are prevented with the help of orientation that enhances ventilation. Additionally, moisture could be avoided with enough ventilation.

Construction materials of the selected building

Buildings Built with Stone Masonry

High thermal resistance of 0.66 m2 k/W is possessed by this substance. It follows that this type of construction material makes it difficult for heat to enter or escape. People who live in these buildings experience cool daytime temperatures, but at night, when the furnace releases heat, they experience warmth.

Buildings Built with HCB Walls (Most of their Parts Built from HCB)

The construction materials used to construct these structures have a relatively low thermal resistance of 0.56m2k/W. When interviewed, occupants of buildings with HCB walls reported experiencing temperature fluctuation as well as seasonal changes. However, the typical characteristics of these structures, as determined by interviews, showed that they typically experience temperature drops in comparison to the 71°F standard room temperature.

This suggests that these buildings (66.7% of them) require the extra energy required to stabilize the temperature required to carry out the activities.

Buildings Built with Curtain Walls

When it comes to indoor air quality, buildings with more glazing relative to their solid walls or those constructed with curtain walls tend to have similar climatic characteristics. During the warm season, occupants experience temperature during the day (midday to late afternoon) and temperature decline during the night (from 12:30 to dawn), and during the cold season, occupants suffer overall temperature fall during the night and day.

Anyone who has spent enough time in Asella city would realize that HCB and Curtain walls are used in the construction of the majority of buildings. According to the shown their respective thermal resistance in literature review in the previous section, these two construction materials have low thermal resistance, which causes the inhabitants to have mild to severe issues. As a result, it may be inferred that 78% of the buildings that are tested specifically and the majority of the building in Asella city generally have uncomfortably low interior air quality.

Windows and Light

The size and orientation of the windows in sustainable buildings are very different from those in the studied structure.

Orientation of Buildings

The interior living and working conditions of a building can be greatly influenced by its orientation.

It should be emphasized that surveyed buildings facing the uneasy direction of south west are not aligned incorrectly. They are the incorrect design format if and only if nothing has been done to shade that side, or if the building materials are not a thermal mass (thermal resistant), or if it is built with a curtain wall or huge windows.

Efficiency of employees

According to the results of the poll, most users and employees of a building perform worse in the morning. This is a result of the atmosphere becoming colder on average, which varies from day to day, and there being no tendency among building staff or owners to steady the cooling trend. Since the majority of the surveyed structures are constructed with non-thermal mass and are oriented in cold directions, they intend to heat up as the temperature rises and cold when temperature decrease which lead to decrease efficiency of employees. Human

metabolism often slows down as temperature rises or falls. Animals often exhibit this trait, and at its most extreme, the process is known as hibernation.

5.1.11 Disparities between sustainable building and assessed building in terms of Indoor Environmental quality

To maximize energy efficiency and occupant comfort, green buildings in the literature on IEQ balance the effects of ventilation rates on energy use and indoor air quality. The provision of daylight and vistas, among other things, helps building inhabitants establish a connection between internal spaces and the outside. To be specific, this category has the following gaps:

- Almost all of the assessed buildings face temperature rise or fall from the room temperature.
- Most buildings do not follow the proper window to room ratio so that they could have
- Proper ventilation and temperature balance.
- Most buildings are built with HCB and Curtain walls that have weak thermal resistance.
- Daytime variations in the interior temperature
- Temperature changes caused by unbalanced ventilation
- Leakage leading to moisture and microbiological development
- Lack of optimal orientation with adequate shading or sun breakers from direct sunlight
- Leaks that result in wetness and microbiological development; poor indoor air quality that reduces productivity and makes people sick;
- Room configurations that don't make use of natural ventilation and illumination

Lack of concern and restricted availability to low emission materials; use of materials and facades that do not take advantage of the city's pleasant weather conditions affecting the IEQ; and a lack of legislation pertaining to smoking in buildings

Indoor environmental quality is generally applied more than other suitable building concepts, with the exception of the gaps mentioned above. As stated in (Mapp et al., 2011) and other studies, the LEED points in IEQ tend to be the most frequently sought-after of all the categories because so many of them are already incorporated into typical designs as a

result of building codes and material availability. It is therefore possible to implement this notion with minor adjustments, careful attention to detail throughout the design, construction, and maintenance of buildings, as well as the appropriate selection and orientation of materials.

5.2 Sustainable Building Implementation Challenges and Opportunities

5.2.1 Respondents profession and professional experience

Collected data shows that 26.9% are regulatory body office Engineer, 15.3% of respondents are architects, 19.4% managers or design heads and 38.4% are different project sectorial engineers. Regarding professional experience, out of the 52 practitioners, 42.3% have less than five years, 25% have six to ten years, 19.2% have eleven to fifteen years, 9.6% have sixteen to twenty years, and the remaining 3.8% have been in practice for more than twenty years.

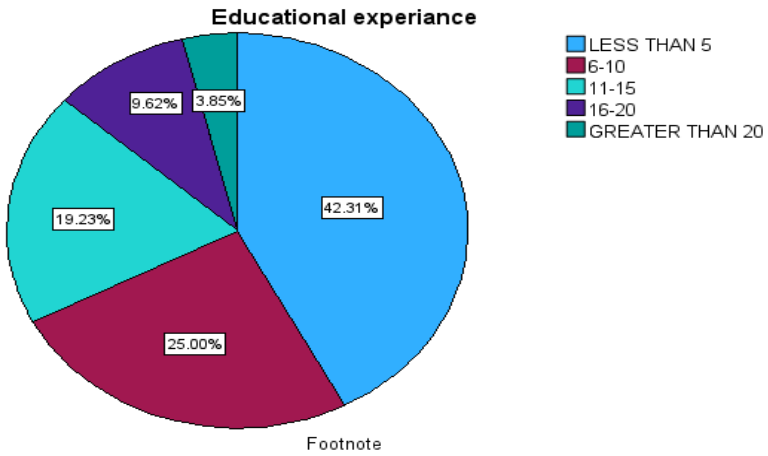


Figure 37: Educational back ground of respondents

(Source: Computed by researcher, 2023)

5.2.2 Familiarity with sustainable building concept

The respondents' responses to this question, which was intended to gauge the amount of their familiarity with the idea of sustainable building, are as follows. Accordingly, 76.9% of all respondents stated they were familiar with it with the notion, while 21.3% said they were done familiar with it.

Generally, the vast majority of respondents are aware of the idea, albeit it should be highlighted that most of their knowledge about sustainable buildings is theoretical and not specific to its construction.

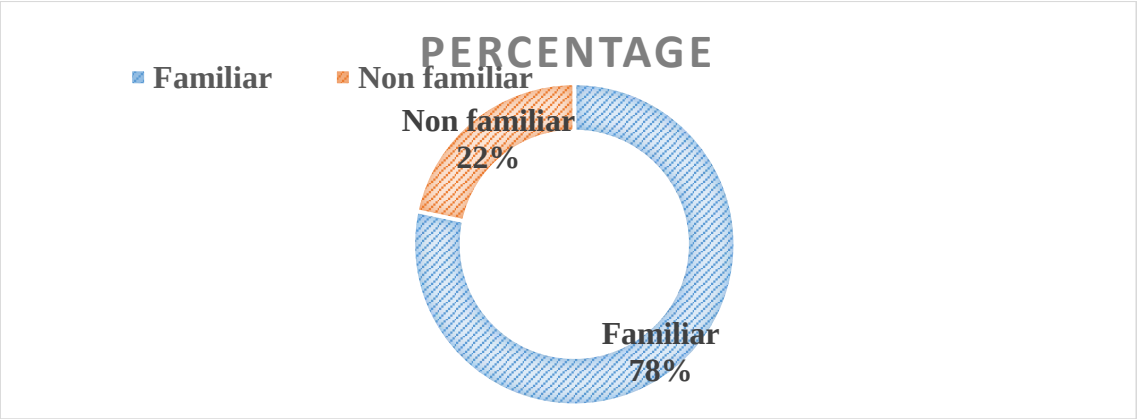


Figure 38: Familiarity of respondents with sustainability concepts

(Source: Computed by researcher, 2023)

5.2.3 Application and Difficulty of sustainable building principles

In order to better understand the gap and barriers that are present in the execution of the sustainable building concept, it is crucial to find out which concepts the consultants have employed and which principles they found simple or complex to incorporate in their designs.

Since no approved sustainable building project has been undertaken, none of the consultants surveyed had experience with it. Certain consultants, though, claim that they incorporated certain sustainable construction ideas into their designs. Result shows that just 30.7% of respondents claimed to have incorporated some sustainable site concepts into their design, with the remaining 69.3% either saying no or being unsure. While 32.7% of the respondents included some energy efficiency principles into their designs, only 32.7% of practitioners had included water efficiency in their designs. On the other hand, 27% and 38.5% of the respondents, respectively, used the concepts of sustainable material and indoor environmental quality.

Because certain ideas like using natural lighting, natural ventilation, and energy-efficient fixtures including LEDs are reasonably straightforward and are also evident in the examined buildings as well, they are implemented the most in terms of energy efficiency and interior environmental quality. However, the other principles, which call for additional resources,

expertise, and technology, haven't been put to use, therefore more work needs to be done on sustainable site, material, and water efficiency.

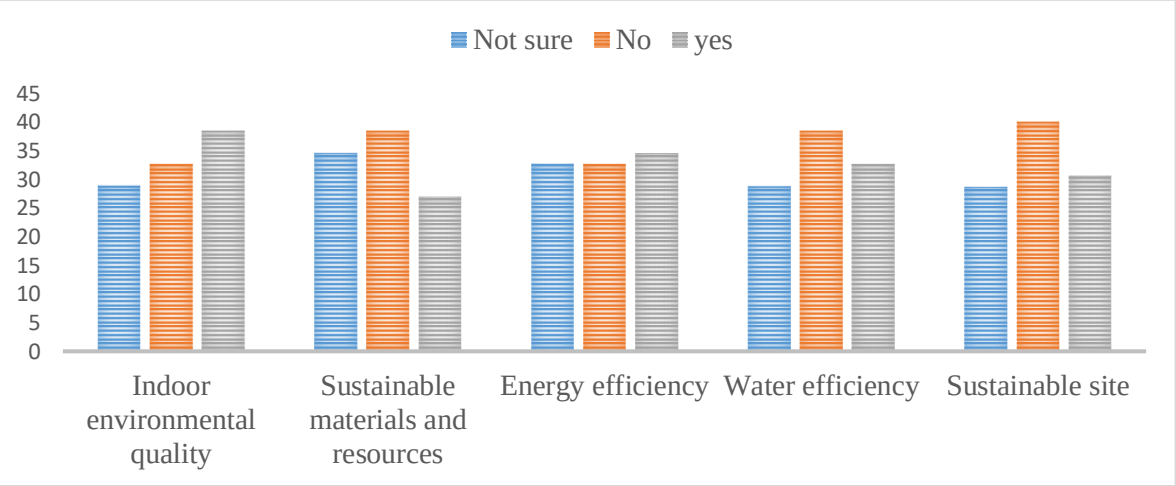


Figure 39: Barriers

(Source:-Computed by researcher, 2023)

Waste management and recycling were identified as the most challenging components of green building to implement in Asella city by respondents who shared their opinions on the subject, with 45% of them noting that doing so presents numerous difficulties. Reusing and recycling waste water ranks second most challenging, with 44.2%, while using materials with low environmental effect and materials that can be used after a building's life, with 20.4% and 36.4%, respectively, rank third and fourth. Use of day lighting (1.5%), natural ventilation (8%), use of artificial lighting control, such as dimmers and movement sensors (8%), and site landscaping (10.5%), on the other hand, are the least challenging, according to the 52 practitioners. The respondents' responses to the question raised above are depicted in the figure below. The most challenging aspects of sustainable building are difficult not only due to a lack of knowledge and technology, but also because the designer, client, contractor, manufacturers of building materials, and building operators or managers are not integrated from the beginning of any architectural project. Therefore, the design, building, and operating teams should always be in touch with one another in order to prevent errors.

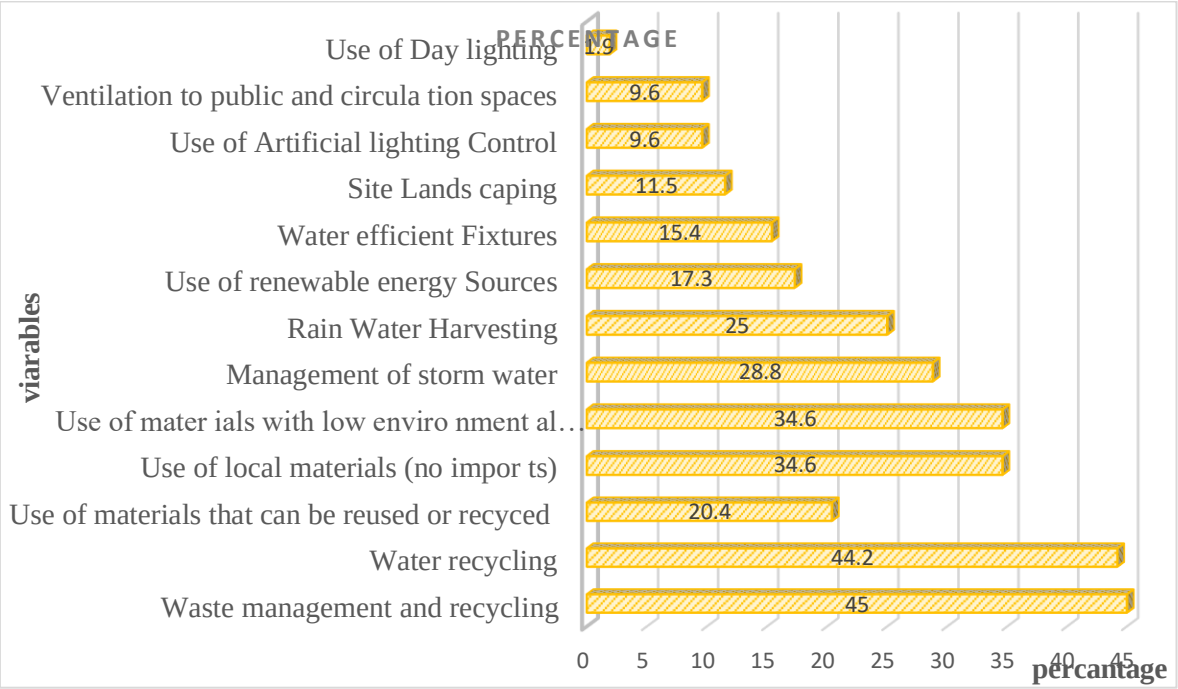


Figure 40: Challenges and Difficulty

(Source: Computed by researcher, 2023)

In order to provide explanations for the gaps discovered in the aforementioned research question, the second research question examined the challenges and potential for implementing the green building idea in Asella city

The sustainable site, material, and resource management, as well as water efficiency, are the practices that practitioners use the least in their projects, per the data gathered on the sustainable building idea. Additionally, the top six most challenging green building principles to implement in Asella city include waste management and recycling, water recycling, use of materials that can be reused or recycled after the building's life, use of local materials (no imports), use of materials with low environmental impact, management of storm water, and rainwater harvesting.

5.2.4 Economic Challenges

The result below demonstrates the consultants' responses to three questions about the economic difficulties of implementing sustainable building principles in Asella City. The questions ranged from strongly disagree to strongly agree.

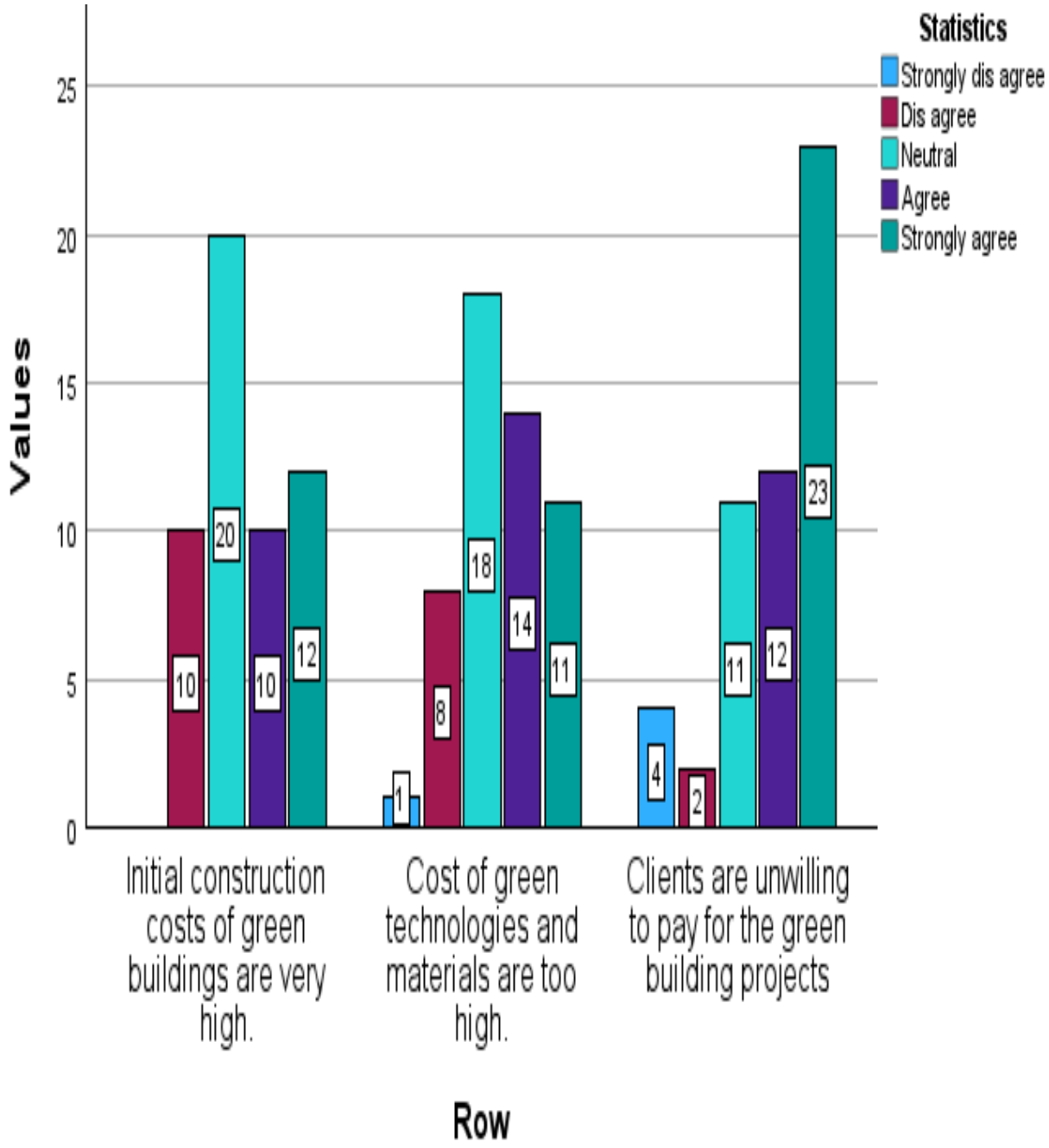


Figure 41: Economic challenges

(Source: Computed by researcher, 2023)

Table 4: Mean score of economic challenges

No	Variables	Mean	Standard Deviation	Rank

1	Initial construction costs of green buildings are very high.	3.46	1.056	3
2	Cost of green technologies and materials are too high.	3.5	1.057	2
3	Clients are unwilling to pay for the sustainable building projects	3.98	1.244	1

(Source: Computed by researcher, 2023)

From above graph with a mean value of 3.98 the overall result demonstrates that the majority of respondents concurred that clients are unwilling to pay for green buildings. The majority, 34.6%, gave a neutral response when asked about the high cost of green materials and technology, most likely because most consultants find it challenging to employ the recycled and low-impact products indicated in the previous section. With a mean score of 3.5, this question was rated second with a moderate level of agreement. The majority of 36.5% of respondents gave a neutral response to the green building's higher initial cost, largely because the majority of consultants haven't worked on their development. Therefore, as previously stated, it is crucial to educate clients about the advantages of turning green and to increase their awareness of it.

5.2.5 Knowledge and Education challenges

Table 5: Mean score of knowledge and education challenges

No	Variables	Mean	Standard dv	Rank
1	Lack of awareness about sustainable building.	4.15	1.038	2
2	There are not sufficient consultant and education program about green building concept.	3.92	1.1	5

3	Because green building knowledge (technologies, materials) is new, there are not enough resources or documentation.	4.02	1.038	4
4	There is a shortage of professionals and workers with suitable experience.	4.13	0.929	3
5	Limited Research on sustainable Building Concepts.	3.72	1.113	6
6	Lack of Interest from Clients	4.23	1.096	1

(Source: -computed by researcher)

The aggregate findings indicate that challenges with Lack of Interest from Clients outweigh those with the economy. Significant difficulties, according to 59.6% of the total respondents strongly agree the lack of Interest from Clients. The highest and equal mean of these two issues, 4.23 indicates that it is the position that most respondents agree with. The Lack of awareness about sustainable building received the second-highest mean score, at 4.15, with 21% agreeing and 57.7% strongly agreeing. There is a shortage of professionals and workers with suitable experience come next. Working to increase knowledge and understanding as well as shifting everyone involved in the industry's perspective is therefore essential to its progress.

Figure 42: Education and Knowledge challenges

(Source: Computed by researcher, 2023)

5.2.6 Industry and Organizational challenges

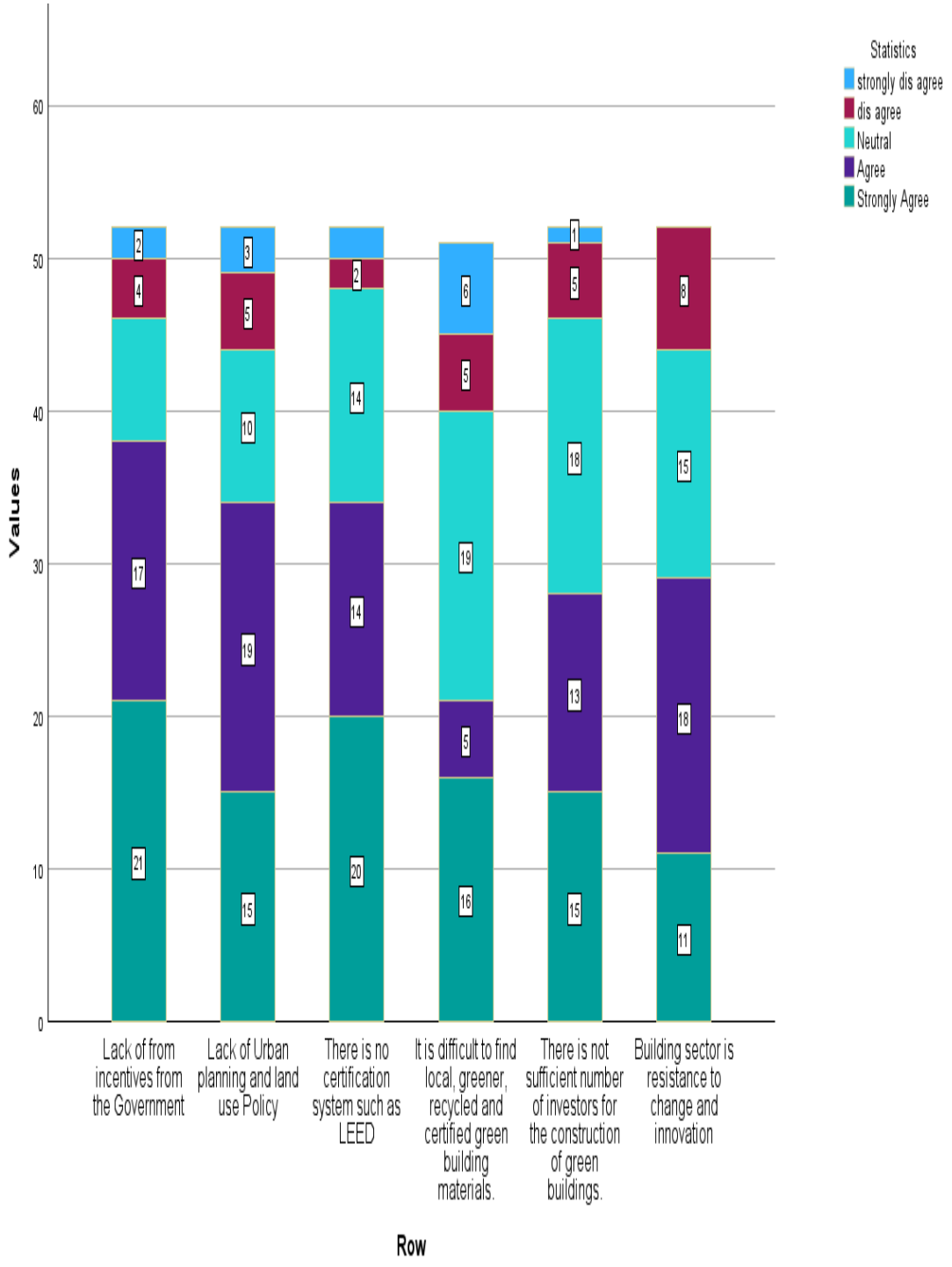


Figure 43: Institutional and Organization challenges

(Source: Computed by researcher, 2023)

5.2.7 Opportunities' in implementing sustainable building practice

The majority of respondents cited Asella city moderate climate as an opportunity, claiming that by relying solely on natural lighting and ventilation, energy consumption may be decreased and IEQ can be attained. This was in reference to opportunities that stimulate the adoption of sustainable building construction concepts. Second, there are currently opportunities for fresh and original ideas in the building business due to the construction boom and many regeneration and rehabilitation initiatives being performed by the city, zone and Oromia region in the city. Thirdly, resources from various parts of the country can be accessed due to Asella city is geographically center. A few advisors concluded by saying that working with architectural firms from other nations that have sufficient experience in sustainable building is a great promise for the future.

Table 6: Opportuties rank

Major Opportunities	Rank	Remark
Climatic conditions in the city	1	
Central location of Asella city	2	
Collaboration now and in the future with international architectural firms	3	
The current building construction boom	4	

(Source: Computed by researcher, 2023)

5.3 Strategies for Application of Sustainable Building Practice

The consultants were polled in order to determine the best course of action for advancing the sustainable building movement in the city of Asella. The results are shown in the figure and table below. According to the overall results in the above figure and table below, all seven of the promotion strategies are deemed to be extremely crucial, which implies that these tactics help to promote sustainable building. The topic that is most commonly mentioned as the best way to put sustainable building principles into effect in Asella city, with a mean score of 4.44, is public awareness campaigns. 57.7% of respondents strongly agree this

strategy. The second category, with a mean score of 4.4, includes education and training focused on sustainable buildings, the development of a rating system for sustainable buildings, and investment in research linked to sustainable buildings, including cost-benefit analysis, with mean ratings of 4.33 and 4.25, respectively. The top four essential promotion strategies were identified. Mean score for strategies for application of sustainable building practice.

Figure 44: Strategies to application sustainable building

(Source: Computed by researcher, 2023)

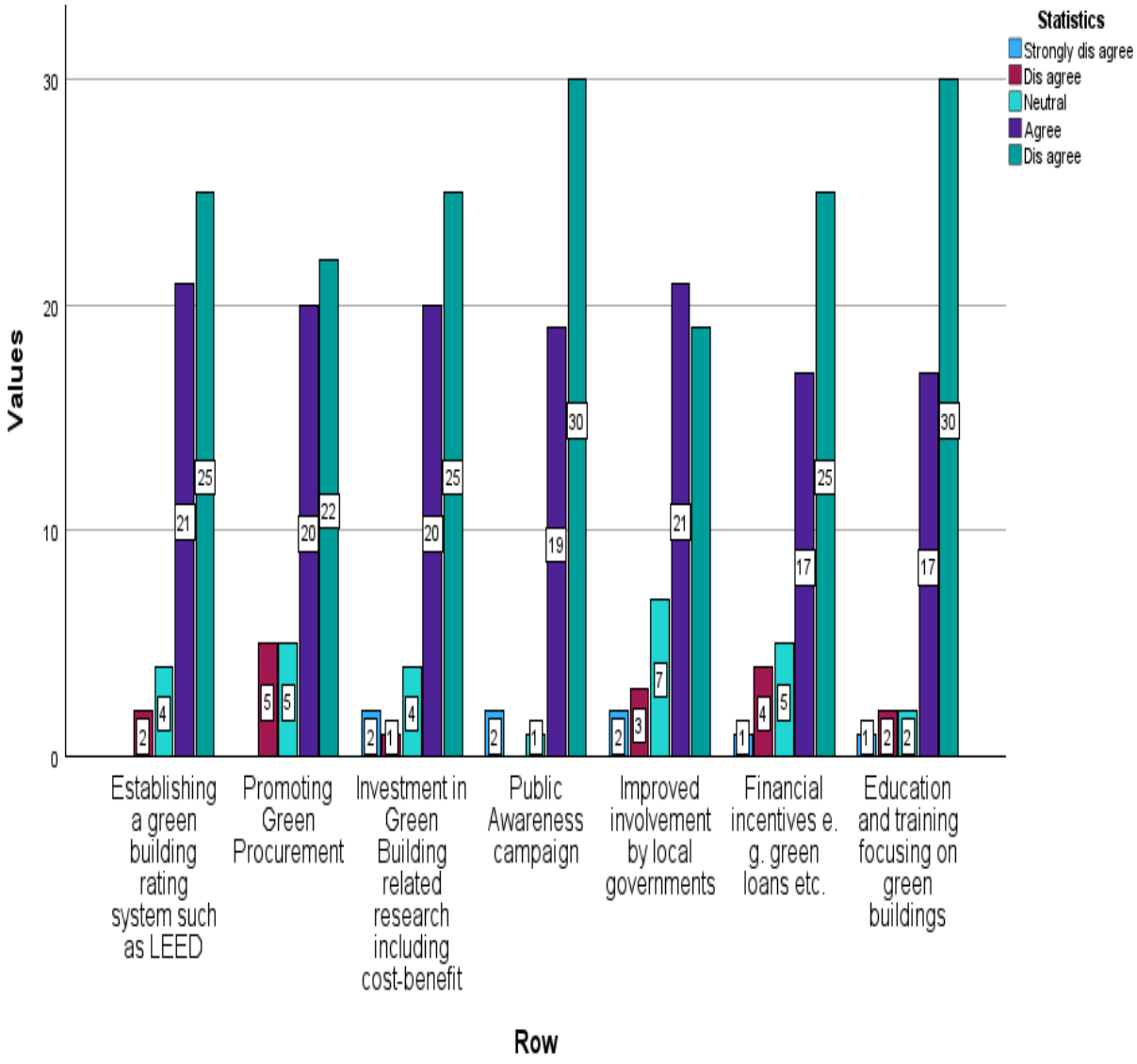


Table 7: Mean score of strategies

No	Variables	Mean	Standard Deviation	Rank

1	Establishing a green building rating system such as LEED	4.33	0.785	3
2	Promoting Green Procurement	4.13	0.950	5
3	Investment in Green Building related research including cost-benefit	4.25	0.968	4
4	Public Awareness campaign	4.44	0.873	1
5	Improved involvement by local governments	4	1.048	7
6	Financial incentives e.g. green loans etc.	4.17	1.024	6
7	Education and training focusing on green buildings	4.4	0.891	2

(Source: Computed by researcher, 2023)

5.3.1 Appropriate techniques for the application and implementation of sustainable building practices.

1. Creating public awareness and Education

Three categories are used in the literature to separate the tactics for implementing sustainable building practices: the regulatory or prescriptive approach, the incentive-based approach, and the promotional/educational approach. The results of this study show that the most effective technique.

Raising awareness through public awareness campaigns, education, and trainings that focus on sustainable buildings, according to practitioners, falls under the promotional and educational approach.

- Important tactics falling into this category include the following:
- Radio, newspaper, and television coverage can help get the word out about green buildings.

- Expert interviews and programs increase public understanding.
- Conferences, workshops, seminars, and educational opportunities on green building design and advantages are available.

An excellent opportunity to disseminate knowledge about green buildings is provided by several expos and exhibitions organized by the construction industry and others.

Publication of newspapers, periodicals, brochures, and flyers Outdoor advertising on billboards, benches, buses, maps of the region, and transit shelters.

Developing a website and utilizing interactive social media platforms (such as Facebook, Twitter, YouTube, etc.).

2. Monetary Incentives

The results of this study demonstrate that financial motivations are the third crucial technique to apply sustainable building principles in the city, after public awareness and education. These findings suggest that financial institutions and other private parties can significantly influence the adoption of sustainable building practices by construction stakeholders.

This is a common finding in numerous studies, including one by (Mahamadata, 2018), who claims that financial incentives offer a valuable economic support for the industry, especially individual stakeholders or firms, as economic issues continue to be the most important issues for the business survival of every stakeholder. Furthermore, it was said that financial incentives are a requirement in order to assist spread the increased costs associated with green buildings unless there is a significant market demand. The following economic and financial incentive techniques are useful for putting green construction principles into practice:

Create incentives for sustainable building initiatives within the tax, insurance, and procurement systems.

- Direct financial aid, grants, and subsidies for green construction initiatives.
- Increase loans for eco-friendly construction.
- Bonuses for high development densities, such as licenses for unusually high floors.
- Reduced fees and expedited permitting.
- A higher monetary value for green construction certification.
- Lower premiums for environmentally friendly structures.

- Discounts on utilities like electric bills.
- Popularity and a marketing benefit.

III. Rating system of sustainable building

The fourth critical method in implementing green building principles is to establish a green building rating system such as LEED, BREEAM, or others. This study supports the views of other studies who have suggested that green building grading systems are vital for green building adoption because they provide useful and helpful recommendations and information about green building to industry experts and the general public. Furthermore, green building rating systems aid in the development of more certified and skilled green specialists.

To promote the wider application of sustainable building principles in a more effective way, it is crucial to develop authoritative sustainable building rating systems that suit the specific local environment and climate. Sustainable buildings differ among countries due to the different climatic conditions and construction practices.

IV. Conduct related research

According to the aforementioned findings, green building is a relatively new idea in our country cities so it is not surprising that sustainable building-related research is the fifth technique for putting green building principles into practice. This demonstrates the significance of thorough studies that consider the spatial, social, and environmental characteristics of green buildings as well as their advantages over conventional structures.

Additionally, conducting studies like cost-benefit analyses is essential to its implementation because it gives stakeholders better access to information about the lifecycle benefits of implementing the sustainable building concept compared to the higher initial investment.

The distribution of information and the allocation of financing are other crucial factors that should be taken into consideration before beginning these studies.

V. Policies and procedures

It should be observed that the mean value differences between these methods are not statistically significant because the difference between the first and last issue is only 0.44 points, indicating that all of these strategies are crucial for implementing the green building concept.

A key factor in boosting market interest in green buildings is the development of mandatory policies and regulations, which encourage, compel, or put pressure on industry practitioners to take the necessary steps in order to avoid fines or penalties for using traditional technologies.

In order to implement the notion of sustainable building, policies and regulations are crucial. A few are listed below:

- Building codes should be examined and updated to better reflect sustainability objectives and sustainable building initiatives.
- Creating a legal framework, such as the International Green Construction Code, which acknowledges a broad range of environmental concerns not typically covered by building regulations.
- Make environmental impact assessments a requirement for building approvals.
- Building codes should take into account a region's unique climatic characteristics.
- Creation of standards for environmentally friendly products, equipment, and structures.
- Create national laboratories and initiatives for the creation of sustainable materials.
- Implement taxes on resource, energy, and pollution usage to internalize external costs.
- Regulations governing land use and urban design support the construction of green buildings.
- Energy standards that are more clearly defined and stringent, such as the labeling of key electrical equipment for energy efficiency, regular inspections of buildings and facilities, the use of solar heating, and yearly energy reports for municipalities, among others.
- Building performance codes must be required, and violations are punishable.
- Better access to laws, rules, and regulations.

CHAPTER 6 CONCLUSIONS AND RECOMMENDATION

6.1 Conclusion

Sustainability is not a sophisticated idea that only appeals to the educated. However, it is what we can see in our daily actions when we appreciate our surroundings.

The achievement of a livable city is thought to depend heavily on maintaining a sustainable urban environment. In order to improve the quality of life in the city and as an important metropolis on the continent, Asella City must manage and control the effects of the booming building industry.

In order to clearly grasp the discrepancy and the steps needed to adopt sustainable building principles in Asella City; this study was done to compare the construction practices of a few selected building with those of sustainable building principle. It also looked into the potential and problems they posed, as well as the best approaches. To fully grasp the viewpoint of building tenants, managers, owners, and professionals on sustainable buildings, data was gathered from these groups. Physical inventory of the chosen buildings was also carried out in order to understand the problem better.

The concepts of sustainable site, water efficiency, and sustainable material and resources require sufficient space, professionals from various disciplinary fields, and different technologies. For these and other reasons, sustainable buildings are rarely implemented, and when they are, they are not properly designed or maintained. Additionally, these concepts were also thought to be the most challenging by the practitioners, indicating that this area needs significant attention and that various experiments and studies should be carried out in order to advance the sustainable building movement.

The concepts of sustainable site, water efficiency, and sustainable material and resources, which require sufficient space, professionals from different disciplinary fields, and different technologies, are where the major differences between the surveyed buildings and sustainable buildings lie. For these reasons and others, it is rarely implemented, and when it is, it is not properly designed or maintained. The practitioners also noted that these principles were the most challenging; indicating that this area needs special attention and that many experiments and studies should be carried out to further the sustainable construction movement. As many of these concepts are already incorporated into typical designs, some IEQ principles can be found unintentionally in most buildings. Additionally, since most buildings do not use HVAC, sustainable building practices can be applied and implemented in Asella city by taking advantage of the local climate, choosing the right orientation and material, paying attention to small details, and the human aspect of buildings.

The total analysis reveals that much work needs to be done to introduce the idea of sustainable building in Asella city. The biggest barriers to applying its ideas are issues with client interest, lack of knowledge and education, a lack of specialists, a lack of government incentives, economic difficulties and the absence of certification programs like LEED. The study also identified the most crucial strategy as increasing public awareness of the concept, advantages, and technologies associated with sustainable buildings. Research, legislation, and financial incentives were also mentioned as essential strategies. However, from the beginning to the end of the project, integration of all actors, including developers, designers, the government, material manufacturers, contractors, and building managers, is absolutely essential.

According to the adage, "the wise learn from the mistakes of others," it is now time for Asella city to switch from conventional buildings to sustainable buildings by taking use of its favorable climate, the current construction boom, and partnerships with other multinational corporations, as revealed by the study.

This research shows there is still hope to attain sustainability and minimize the harmful effects of conventional buildings before it is too late by putting the tactics described and issues recommended into practice, whether it is building a new one or retrofitting an old one.

6.2 Recommendations

This study's objective, in addition to examining the existing state of sustainable buildings, is to offer recommendations for strengthening its flaws and preserving or enhancing its strengths. Therefore, based on the findings of the study the following general recommendations were drawn for the implementation of sustainable building concept and bring about sustainable development.

6.2.1 Recommendations from specialized professionals

After using the restroom, one should wash their hands right away for reasons of hygiene and confidence. Therefore, the toilet and hand washing must be continual functions.

Second, no one wants their trash taken out the front door while they are eating at a restaurant. The assessed building should have a back door that acts as a passageway to remove waste and undesired goods if it is a restaurant. This is very crucial.

1. To stop trash from being mixed together, which causes an unpleasant stench?

2. To avoid seeing the repulsive rubbish collection in person

3. To safeguard clients from illnesses and irritations that could result from microbes that reside on waste.

In terms of both location and architectural design, the public must be open to everyone. Accessible refers to a space that is open to everyone, healthy individuals included, without barriers. A facility must have a ramp to offer such equitable service.

The majority of the buildings surveyed lack ramps that may provide disabled individuals access to level surfaces. People with disabilities ask for assistance in order to use the services. When moving from one story to another in some buildings, it has been seen that the restroom moves (reshuffles). Because of this, the structure is vulnerable to leaks and moisture. When functions are switched around in buildings, maintenance must be performed.

6.2.2 Design and Construction Recommendation

I. Sustainable Site

1. Utilization of alternate modes of transportation, including bicycles and electric vehicles.
2. Promote carpooling and make public transportation available in the area.

3. Increase the amount of open space and greenery while preserving the current habitat and natural resources as much as you can.

4. The flooding issues in two of the surveyed buildings can be resolved as well as increased surface moisture and a decrease in urban heat islands with proper storm water management.

5. Test out several environmentally friendly storm water management strategies, such as bio retention, bios wales, rain gardens, ponds, and rainwater harvesting.

6. Design and install vertical greeneries, particularly for construction in urban areas with limited land.

8. Installing pervious surfaces that permit infiltration as opposed to the asphalt seen in most structures.

II. Water efficiency

1. Teaching people about water-saving appliances that cut down on excessive water use and point them in the direction of sustainability.

2. By using water-saving fixtures, you can lessen your reliance on the municipal water system.

3. Rainwater and sewage waste are both recycled and reused.

4. Reducing water loss when watering plants by using the drip irrigation technique.

5. Applying xeriscaping and locally-adapted flora.

6. Replacing municipal water with recycled water or rainwater for irrigation.

III. Energy Efficiency

Since it is the first stage in any sustainable building project, the building's orientation should be taken into consideration.

1. Looking at various renewable energy sources, particularly for structures with significant energy usage.

2. Create buildings that take into account local factors including the temperature, the local way of life, and the materials available.

3. The improvement of thermal quality through the application of cutting-edge passive cooling and lighting systems while reducing the energy consumption of buildings by integrating several techniques.

4. Designing an energy commission plan and conducting energy simulation.

5. Optimizing the energy performance of the building envelope and systems.

6. Make use of energy-efficient lights and appliances.

7. Informing building tenants on appropriate and effective energy use.

IV. Material and resources

1. Experimenting with low impact and environmentally friendly materials, such as economical green paint, finishes, and aesthetics;

2. Investing in locally produced products to cut shipping costs and boost the country's economic growth

3. Recycling garbage during construction and operation of buildings to minimize waste transported to landfills

4. Reusing and recycling items and building supplies to cut down on the demand for virgin resources

5. Encourage the reuse, recycling, and composting of trash as well as the use of low albedo, low emission, and reflecting materials to lessen the impact of the urban heat island.

V. Indoor environmental quality

Building materials, orientation, and many other ideas need to work together to create a logical indoor atmosphere where comfort comes first in order for people to perform correctly. Temperature is one of the key terms we encounter while trying to improve indoor air quality among the various ideas mentioned above.

Temperature changes and adjustments may be made in conjunction with building orientation and material. The interior temperature of a structure with curtain walls facing the south-west will undoubtedly be different than a one with the same material facing the north. a higher temperature is felt by those who live or work in a space that faces south-west. It was noted that the floors without any natural shade devices for cooling the area. Sustainable structures cool the area they are grown around via transpiration, whereas shading devices like plastic shutters block the light but do not immediately cool the inside.

6.2.3 Recommendation concerning Indoor environmental quality

- Provide well-lit rooms with views of the outside world to boost the productivity and efficiency of the building's occupants.
- Using a variety of natural illumination sources, including skylights, dormer windows, open downs, and others.
- Utilize proper shading techniques, such as awnings, overhangs, and louvers, to help create a comfortable indoor atmosphere for inhabitants by giving them control over ventilation and illumination.
- To enhance passenger comfort and wellbeing, keep an eye on the air quality.
- Use low emission materials and coatings to reduce noxious, uncomfortable, and/or dangerous contaminants like VOCs.
- Reduce noise both inside and outside the building by using appropriate materials and other noise-reducing techniques, such as acoustic panel fins.
- To have adequate illumination and cross ventilation, use windows in the right. proportion to the size of the space.
- Maintenance work should be done regularly to stop leaks.

6.2.4 Recommendations for stock holders

A good sustainable building project needs to be well-managed and integrate all stakeholders carefully. Each player in the effort to promote green development in the city has a duty and a contribution, whether it be promoting awareness or addressing policy or economic challenges. Therefore, each of the primary actors should consider the following.

I. Experts and Educational Facilities

- Universities and colleges should do research and development on the subject of green building.
- Planning awareness and education campaigns to raise public awareness.
- Examining the financial effects of green construction using cost-benefit analysis
- Promoting the viability and economic, social, and environmental benefits of green projects to owners in order to start upgrading the construction market.
- Designers should promote their green building design so that it can be exemplary and inspire others.
- Recognition/Awards Program for Outstanding Green Design Professionals and Organizations
- Maintain accurate records throughout the entire process.

II. Local and national governments

- Government regulations ought to be set up to encourage the development of green buildings.
- The development of a national green building certification program that is tailored to local and regional climate, geography, and environmental conditions is necessary.
- For green buildings, policies can be established such as green loans and tax reduction schemes.
- To raise awareness, the government should create model green building projects and promote their advantages.
- The government can enact laws, environmental policies, and obligatory regulations to help the green construction industry.
- Government should step in by updating regionally imposed building norms and enforcing sustainability standards, at the very least in public buildings.

III. Building supplies and the construction sector

- Importers of building materials should concentrate on regional and low-impact resources to bring down the price of eco-friendly goods.
- Establishment of certified independent third party authority for quality and environmental control of locally manufactured construction materials. Investors do not like green buildings because too expensive initial capital cost.
- This third party must be responsible for materials green labeling and confirming environmental data such as the recycled content, the source of the material, the SRI value, and the VOC content.
- Strong local manufacturers, incentive programs, and renovation of existing structures are all necessary to reduce the upfront cost.
- For building systems commissioning and energy modeling, an independent qualified authority shall be in charge of authenticating and certifying qualified third-party commissioners who would ensure that energy building systems are built in accordance with environmental preferences.

IV. Financial institutions and non-governmental organizations

- Fostering research activities and the sharing of knowledge.
- Facilitating larger loans on green and certified properties.
- Establishing a green building council and rating systems for green building

6.3 Area of further investigation

To successfully execute the sustainable building movement in Asella, more research is required to comprehend and improve it. More experts are needed to study sustainable buildings so that there will be various options for resolving the current issues. To demonstrate the effects and advantages of sustainable architecture, extensive research concentrating on a single principle are first and foremost required. Second, while this research focused on practitioners in particular, it also addressed difficulties and tactics. However, more research is needed to fully understand how other key actors, such as the government and developers, see the world. Additionally, it is crucial to conduct more study to determine the city and the nation's overall best financial incentives, policies, and sustainable rating system. It is important to do financial cost and benefit analyses for sustainable buildings that are supported by solid statistical evidence.

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APPENDIXES

Adama Science and Technology University

Post Graduate Studies

Dear respected Respondents

The purpose of this questionnaire is to collect information for a research project entitled: "**Assessment of sustainable building practice condition in the case of Asella city administration**". The information gathered through this questionnaire will be used only for academic purpose, and it will be kept confidential. The researcher strongly believes that the success of this study will entirely depends on your careful and timely response. Therefore, you are kindly requested to answer each question honestly and responsibly.

Thank you for your cooperation

General Instruction

- ✓ No need of writing your name/address
- ✓ To those questions with alternatives mark your response on the space provided by putting "□"
- ✓ For any additional option or explanation you are kindly requested to write briefly on the space provided.

PART 1:- DEMOGRAPHIC INFORMATION

(Please tick one box for each of the questions)

- **Your company/organization**

Client □ Consultant □ Regulatory □ Contractor □

- **Educational Back ground**

Certificate ☐ Diploma ☐ Degree ☐ Masters ☐ PhD and ☐ Above

- **Total years of service in the company/Organization**

Below 5 years ☐ 6-10 years ☐ 11-15 years ☐

16 - 20 years ☐ Above 21 years ☐

- **Current Position**

Regulatory officer ☐ Office engineer ☐ Project manager ☐ ☐ Other

- **Years of service in the current position**

Below 5 years ☐ 6-10 years ☐ 11-15 years ☐

16 - 20 years ☐ above 21 years ☐

PART 2: - INDIVIDUAL AND ORGANIZATIONAL PERSPECTIVE QUESTIONS

1. Do you have understanding of sustainable construction?

Yes ☐ No ☐ Sometimes ☐

2. Have you ever consider sustainability in your practice?

Yes ☐ No ☐ Sometimes ☐

3 . How serious does your organization take the issue of sustainability and why?

_____

4. Does your company have sustainability strategy?

Yes ☐ No ☐ Sometimes ☐

5. Does your company have any form of sustainability reporting?

Yes ☐ No ☐ Sometimes ☐

6. What do you think are the barriers to the uptake of sustainable construction practices?

_____

PART 3:- CHECKLIST FOR ACCESSING SUSTAINABILITY OF BUILDINGS

No	**I .Sustainable site**	**yes**	**No**	**Remark**
	I .Sustainable site			
	Building function			
	Access to transportation			
	Access to mass transit Bicycle and Pedestrian access and Services			
	Brown field development and high density area			
	Landscaping			
	Impervious surface			
	Use of reflective surfaces			
	Open spaces and Green areas			
	Erosion control methods such as seeding, mulching, earth dikes, silt fencing, sediment traps and sediment basins			
	Reduce impact on surrounding habitats			
	Storm water management techniques			
	Rain water harvesting			
	Distance from noise areas			
	Orientation of building			

	II .Water efficiency			
	Detecting water leakage			
	Use of efficient Fixtures: On-demand faucet units automatic shut off system Dual flush toilet			
	Reuse of water			
	Source and consumption of water for boilers, chillers and cooling system			
	The irrigation technology to water green areas			
	Native or exotic plants			
	Potable or reused water for irrigation			
	III .Energy efficiency and atmosphere			
	Natural light			
	Natural ventilation			
	Artificial lighting			
	Skylights			
	windows			
	Insulation material LED light bulbs or Fluorescent bulbs Dimmers and controls			

	Daylight sensors Movement sensors			
	Building envelop			
	Mechanical system (Air conditioners HVAC, heating, ventilation, fans)			
	High-efficiency appliances			
	Use of thermal energy storage			
	Green roofs or walls			
	IV. Material and resources			
	Type of materials			
	Green materials: biodegradable or have little impact on the environment			
	Local or imported materials			
	Recycling			
	Waste Collection and management techniques			
	Compost			
	V Indoor Environmental quality			
	Smoking and non-smoking areas			
	Use of low emitting materials			
	Cleaning routine and habits			

	Volatile organic compound			
	Damp conditions inside a building cause microbial growth			
	Temperature			
	Operable windows			
	Access to views			
	Occupants control or lighting and temperature and Acoustical finishes			

PART 4. BARRIERS/ CHALLENGES /OF SUSTAINABILITY PRACTICE

From the table below please **Rank** in a **scale of 1 – 5** the factors you feel largely challenge the application of sustainability practices on public Building Concepts in Assela, where **1** is the lowest rank and **5** the highest.

No	**Barriers of practice of sustainability**	**1**	**2**	**3**	**4**	**5**
1	**Economic**					
1.1	Initial construction costs of green buildings are very high.					
1.2	Cost of green technologies and materials are too high.					
1.3	Clients are unwilling to pay for the green building projects					
1.4	Lack of financial incentives					
1.5	Ignorance of life cycle cost					

1.6	Fair of long payback period					
1.7	Client worries on probability					
2	**Awareness / Education**					
2.1	Lack of awareness about green building					
2.2	There are not sufficient consultant and education program about green building concept.					
2.3	Because green building knowledge (technologies, materials) is new, there are not enough resources or documentation.					
2.4	There is a shortage of professionals and workers with suitable experience.					
2.5	Limited Research on Green Building Concepts					
2.6	Lack of Interest from Clients					
2.7	Ignorance or misunderstanding about sustainability					
2.8	Lack of environmentally sustainable materials					
2.9	Lack of awareness of benefits					
2.10	Lack of technical ability and chronic skills and labor shortage					
2.11	Lack of education and knowledge in sustainable design					
2.12	Lack of awareness of professionals					

2.13	Lack of professional knowledge					
2.14	Ignorance or misunderstanding about sustainability					
3	**Awareness / education**					
3.1	Lack of awareness about green building					
3.2	There are not sufficient consultant and education program about green building concept.					
3.3	Because green building knowledge (technologies, materials) is new, there are not enough resources or documentation.					
3.4	There is a shortage of professionals and workers with suitable experience.					
3.5	Limited Research on Green Building Concepts					
3.6	Lack of Interest from Clients					
3.7	Ignorance or misunderstanding about sustainability					
3.8	Lack of environmentally sustainable materials					
3.9	Lack of awareness of benefits					
3.10	Lack of technical ability and chronic skills and labour shortage					
3.11	Lack of education and knowledge in sustainable design					

3.12	Lack of awareness of professionals					
3.13	Lack of professional knowledge					
3.14	Ignorance or misunderstanding about sustainability					
4	**Institutional and Organization challenges**					
4.1	Building sector is resistance to change and innovation.					
4.2	There is not sufficient number of investors for the construction of green buildings.					
4.3	Recycled and certified green building materials. It is difficult to find local, greener.					
4.4	There is no certification system such as LEED and BREEAM					
4.5	Lack of Government policy and support					
4.6	Lack of Government Commitment					
4.7	Delay in Decision making					
4.8	Lack of demand of sustainability products and Cultural resistivity					
4.9	Lack of Leadership					
4.10	Lack of motivation of managers					
4.11	Lack of easily accessible guidance					

4.12	Lack of Building code on sustainability					
4.13	Delay in Decision making					
4.14	Lack of demand of sustainability products and Cultural resistivity					
4.15	Lack of market segmentation					
4.16	Lack of idea demonstration project					
4.17	Lack of sustainability measurement tools					
4.18	Lack of issue of sustainability					
4.19	Poor contract management					

PART 5:- WHAT ARE THE OPPORTUNITIES PRESENT FOR APPLYING THE PRINCIPLES OF SUSTAIANABILITY

Rate the following statements, on a scale of 1 to 5, according to the best of your knowledge.

1 represents. 'I fully agree' and 5 represent 'I fully disagree'

No	Opportunities	1	2	3	4	5
1	Rain Water Harvesting					
2	Water recycling					
3	Water efficient Fixtures					
4	Use of renewable energy Sources					
5	Use of Day lighting					
6	Use of Artificial Lighting Control					

7	Site Landscaping					
8	Management of storm water					
9	Use of local materials (no imports)					
10	Use of materials that can be reused or recycled after the building life					
11	Use of materials with low environmental impact					
12	Natural ventilation to public and circulation spaces					
13	Waste management and recycling					

In your opinion, what can be done to accelerate Sustainability movement in Assela?

_____

_____

PART 6:- Strategies.

Which of the following strategies do you think would promote uptake of sustainability Building Concepts in Buildings in Asella? Use a 5-point scale to Rank the strategies where 1 is the lowest and 5 the highest Rank.

Strategies	1 Fully Agree	2 Agree	3 Neutral	4 Disagree	5 Fully disagree
A. Education and training focusing on green buildings.					
B. Financial incentives e.g. green loans etc.					
C. Improved enforcement by local governments.					

D. Public Awareness and campaign.					
E. Investment in Green Building related research including cost-benefit.					
F. Promoting sustainable Procurement.					
G. Establishing a sustainability rating system such as LEED and BREAM.					

In your opinion, what can be done to accelerate Sustainability movement in Assela?

_____

_____