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A COMPARATIVE STUDY OF SUSTAINABLE BUILDING MATERIALS EFFECT USING BIM

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Master's Thesis

Supervisor

Assoc. Prof. Dr. Sepanta NAİMİ

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ABSTRACT

A COMPARATIVE STUDY OF SUSTAINABLE BUILDING MATERIALS EFFECT USING BIM

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Thermal efficiency, also known as U-value, is a measure of the thermal qualities of a building envelope and a crucial criterion for determining heat loss via building elements due to heat transmission. It can be calculated depending on the thermal properties of the building components. Improving the thermal properties of composite walls offers the potential to achieve high energy and environmental performance criteria for buildings, such as almost zero-energy structures. Compared to conventional construction, composite walls excel in sustainability, cost-effectiveness, the building process, and worker safety. Due to the high thermal conductivity of structural materials, thermal bridges can occur in wall elements notwithstanding the advantages of this construction approach. In this study, the effect of thermal insulation layers on the performance of composite walls is studied. Several composite wall types are tested for this aim utilizing the climate conditions of four distinct regions in Iraq. This method for determining thermal transmittance requires simply the temperatures of the interior and exterior air, as well as the wall material specifications. Three types of results founded from four zones in Iraq. The first result is the heat load of 21 type of composite material, the second result is the total cost of used wall composite materials and finally, is the ranking results using the developed method T-TOPSIS.A comprehensive statistical analysis demonstrates the direct effect of the Iraqi climate on the heat load of the building and the efficacy variations between insulating materials.

Keywords: Thermal Efficiency, Insolation Materials, Thermal Properties, HCFC, HFC.

TABLE OF CONTENTS

Pages

ABSTRACT .... **v**

LIST OF TABLES .... **ix**

LIST OF FIGURES .... **x**

ABBREVIATIONS .... **xi**

1. INTRODUCTION **1**

1.1 OVERVIEW 1

1.2 SUSTAINABILITY OF BUILDING MATERIALS 2

1.3 BUILDING INFORMATION MODELING 3

1.4 THE APPLICATIONS OF BIM 4

1.5 PROBLEM STATEMENT 5

1.6 OBJECTIVES 6

1.7 THESIS LAYOUT 6

2. LITERATURE REVIEW **8**

2.1 INTRODUCTION 8

2.2 SUSTAINABLE CONSTRUCTION IMPORTANCE 9

2.3 WAYS TO BUILD PROJECT SUSTAINABILITY 9

2.3.1 Sustainable Building Materials 10

2.3.2 Resources for Plastic Construction 10

2.3.3 Leadership in Energy and Environmental Design Guideline 10

2.3.4 Sustainable Places 10

2.3.5 Efficiency in The Water 11

2.3.6 Energy and Air 11

2.4 MATERIALS AND RESOURCES: 12

2.5 STRUCTURE PHASE 12

2.6 POST-BUILDING STAGE 13

2.7 POLLUTION DETERRENCE MEASURES 13

2.8 WASTE REDUCTION EVENTS 14
2.9 ENERGY EFFICIENCY 14
2.9.1 R- Value 15
2.9.2 Shading Constant 15
2.10 SCHEME EFFICIENCY 15
2.11 WATER TREATMENT/ UPKEEP 16
2.12 USING NON-TOXIC RESOURCES BEFORE THOSE THAT ARE LESS TOXIC 16
2.13 BETTER AIR QUALITY THEN LESS TOXICITY 17
2.14 RENEWABLE ENERGY SYSTEMS 18
2.15 CURRENT WORK 18
2.16 LITERATURE SURVEY 18
3. RESEARCH METHODOLOGY 27
3.1 BUILDING SUSTAINABLE FACTORS 28
3.2 SUSTAINABLE MATERIALS CONCEPT 28
3.3 INSULATION MATERIALS FOR BUILDINGD 29
3.4 IMPLEMENTING REVIT MODEL 30
3.5 CLIMATE CONDITION IN IRAQ 40
3.6 HEAT LOAD CALCULATIONS 41
3.7 T-TOPSIS TECHNIQUE 42
4. RESULTS AND DISCUSSION 44
4.1 INSULATION MATERIALS HEAT LOAD RESULTS 47
4.2 RESULTS O COMPOSITE WALL EVALUATION 50
4.2.5 Apply Light Weight Concrete 56
4.3 APPLY THE MATERIALS IN REVIT CASE STUDY 56
5. CONCLUSION 60
REFERENCES 61
APPENDIX A 67

.

LIST OF TABLES

Pages

Table 4.1: Boundary Conditions of Maximum Temperature in Four Iraqi Regions. 45

Table 4.2: Wall Thickness of The Used Materials. 46

Table 4.3: The Used Material Costs and Specification. 46

Table 4.4: Specification of Polystyrene (Expanded). 47

Table 4.5: Specification of Glass Fiber. 48

Table 4.6: Specification of Glass Wool. 48

Table 4.7: Specification of Perlite. 48

Table 4.8: Specification of Polystyrene (Extruded). 49

Table 4.9: Specification of Polyurethane. 49

Table 4.10: Specification of Light Weight Concrete. 49

Table 4.11: Baghdad Region Results. 51

Table 4.12: Najaf Region Results. 52

Table 4.13: Sulaymaniyah Region Results. 53

Table 4.14: Basra Region Results. 54

Table 4.15: Light weight Concrete Results. 56

Table 4.16: The Revit Results. 59

LIST OF FIGURES

Pages

Figure 1.1: Data Exchange in Comparison with BIM Interoperability 4

Figure 3.1: Draw The Foundation And Basic Walls With Specific Dimensions. 31

Figure 3.2: Insert The Concrete Column. 31

Figure 3.3: Building The Walls Of The First Floor and Specify The Building Levels. 32

Figure 3.4: Specify The Doors. 33

Figure 3.5: Specify The Windows. 33

Figure 3.6: Specify The Floors Of The Building. 34

Figure 3.7: Specify The Building Roof. 34

Figure 3.8: Specify The Building Floor Levels. 35

Figure 3.9: Side View of Building Levels. 36

Figure 3.10: Specify Walls Types. 37

Figure 3.11: Walls Specification Changes. 37

Figure 3.12: Walls New Features. 38

Figure 3.13: Specify The Type of Brick of The Wall. 39

Figure 3.14: Calculate The Quantities of The Building. 40

Figure 4.1: Comparison Between The Useful Sustainable Materials Properties Based on Regions in Iraq. 55

Figure 4.2: The Revit Case Drawing Front View 57

Figure 4.3: The Revit Case Study Side View. 58

ABBREVIATIONS

AC	:	Air-Conditioning
°C	:	Celsius degree
C.O. P	:	Coefficient of Performance
CO_2	:	Carbon dioxide
HCFC	:	Refrigerant–Absorbent Pairs
HFC	:	Refrigerant–Absorbent Pairs
HVAC	:	Heat Ventilation Air-Conditioning
IC	:	Investment Cost
kWh	:	Kilowatt-Hour
Kg	:	Kilogram

1. INTRODUCTION

1.1 OVERVIEW

Our cities would collapse without concrete's structural support. Its omnipresent gray material's significance to contemporary urban life is unquestionable; it is used to construct everything from houses and apartments to bridges, viaducts, and sidewalks. Yet, there is a less pleasant side to concrete that you may have heard about: every year, tons of the greenhouse gas carbon dioxide (CO2) are released into the atmosphere from the manufacturing of commercial concrete products, adding to the catastrophe that is climate change. It's not inevitable, however. Environmental pollution, natural resource depletion, and sustainable construction are all becoming more widely recognized as important concerns around the world. One of the primary sustainability challenges that improves the quality of life and harmonizes within the resources and recycling materials is sustainable building. This sort of building is a critical area where cities may integrate sustainability aims and design to reduce some negative environmental impacts through the use of technology in building development. It also refers to the use of technology in the home to improve energy efficiency and provide humans with a comfortable, safe, and healthy living environment. It is mostly powered by environmentally friendly resources that are readily available, such as wood (trees harvested and replanted), solar energy, hydroelectric electricity, and wind power. An essential factor in realizing sustainable development objectives is the sustainable construction. Every definition of sustainability has to account for financial factors. We are talking about the actual money spent on research, design, and construction, as well as the money spent on upkeep during the products' useful lifetimes, and not just abstract economic factors like productivity and growth. The duration of that lifetime is another factor to consider. While the initial cost of building a wooden home may be lower than that of a brick or concrete home, there are additional costs to consider, such as periodic painting, and the overall lifespan of wooden buildings is much lower than that of brick or concrete buildings, despite the fact that the material itself is renewable during the building's lifespan. Also, while designing sustainable structures, it is crucial to specify materials that persist, increase the lifetime of the structure, and decrease the energy consumption of the project. For this reason, each eco-friendly building must be equipped with weather barriers and other forms of protection.

1.2 SUSTAINABILITY OF BUILDING MATERIALS

The selection of construction materials is particularly essential in buildings' life cycle evaluation. Building materials significantly affect the structures' energy consumption and environmental consequences, and have a substantial impact on the sustainability of buildings. The construction industry consumes roughly 24% of global raw resources and a considerable amount of energy. Steel, concrete, aluminum, and glass, among other classic construction materials, are all high-energy materials. Concrete is one of the most regularly employed materials in the building sector. According to research, the initial energy consumption of concrete components is relatively modest, yet the total energy consumption of construction is highly high owing to the vast volume of concrete used in structures. Several studies have highlighted the relevance of material selection, stressing the value of low-energy materials over the operating energy of a building. Selecting high-energy-consumption materials will require more energy throughout the original manufacturing process and result in bigger levels of greenhouse gas emissions. Nevertheless, according to Saghafi and Teshnizi's results from 2011, choosing sustainable building materials is a more difficult and hard job, since it takes into consideration environmental elements such as building materials and construction technology. In addition, researching and developing the environmental effects of building materials is an unknown field with a great number of factors and uncertainties. It's vital to identify sustainable materials early in the design process, make sustainable building material strategies, and do market research. Conventional building materials are grouped into three groups depending on its primary ingredients: oil, such as polymers; ores, such as metals and ceramics; and biomass, such as wood. The criteria for environmentally friendly construction components include the following features. To begin, eco-friendly building supplies are often made from renewable resources, need little in the way of upkeep, may be recycled once they've served their useful purpose, and have a cheap initial outlay. Secondly, sustainable materials should be ecologically benign and eliminate environmental threats without producing toxins or other emissions that impair human health and comfort throughout the life cycle. Materials containing pollutants may have harmful consequences throughout their life cycle, impacting employees during the manufacturing process, affecting the residents of the building during the usage phase, and generating pollution during recycling and terminal treatment. Consequently, sustainable building materials are materials with little or no emissions of carcinogens, renewing noxious chemicals or irritants, and have no detrimental influence on the building and the natural environment. In addition, sustainable construction materials are generally sourced from renewable energy sources, not non-renewable energy sources. They should be energy efficient throughout production and last for an extended period of time without degrading their quality.

1.3 BUILDING INFORMATION MODELING

The field of architecture, engineering, and construction (AEC) has recently adopted a new technology known as Building Information Modelling (BIM). This innovation may be used to the lifecycle management of any facility. Most people who utilize BIM are architects. Yet, despite the benefits being stressed, its adoption is still in its infancy owing to poor architect acceptance [3]. This is especially true when compared to prior innovations like as Computer Assisted Design (CAD) tools. Often, when people hear the phrase "BIM," they think of the design team. Although construction managers (CMs) are seldom included in the model-writing process, they play a crucial role in making sure the essential ingredients for a successful project are in place. In order to be successful, construction managers need knowledge of procedures and tools used at every stage of a project, not just the beginning when the design is being developed.

The asset has to be managed from its inception through its use and eventual retirement. Building information modelling (BIM) data is only useful if construction managers can read it, analyse it, add to it, and verify it. Leveraging the value of data via the use of model information and new methods of working, they must better support new building techniques, scheduling, cost, quality, coordination, fabrication, sequencing, and facilities management, to name a few. The construction manager will need to revaluate their current methods, procedures, and skill sets in light of their increased responsibilities [4]. In light of the many explanations, Building Information Modelling (BIM) may be thought of as digital data presented in the form of a three-dimensional model that aids in communication and understanding among the members of the building team. On the other side, BIM does things backwards. This system stores all information in one place and associates it with certain items (building and building components). Hence, the BIM model is a unified database architecture in which data is thoughtfully linked. Furthermore, the unified design makes it easier for all relevant fields to work together (BIM interoperability). Figure 1.1 shows how conventional methods of communication are required when working with older technology like CAD. [1].

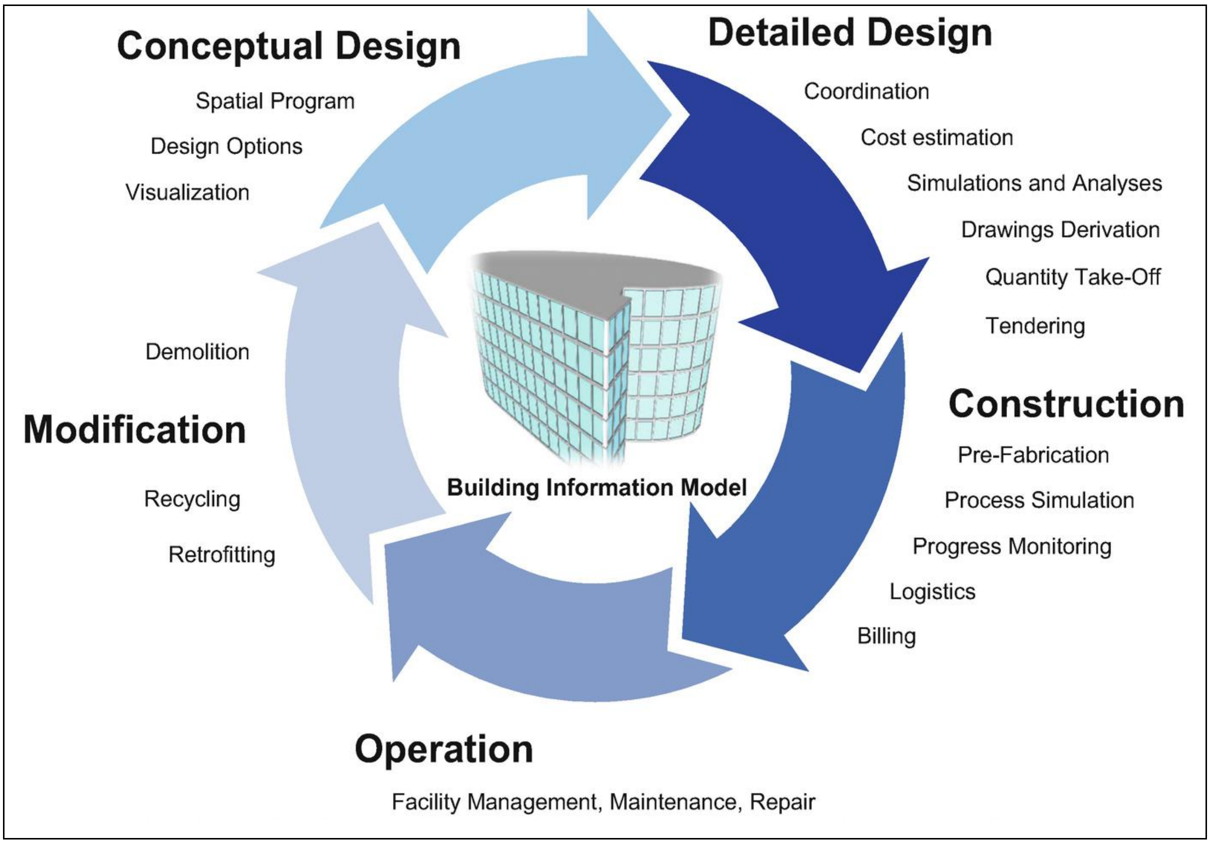

Figure 1.1: Data Exchange in Comparison with BIM Interoperability [1].

There are a variety of uses for building information modelling during the construction and occupancy phases of a structure. The many uses for BIM technology stem from its many facets' implementation. The examples that follow are only a small sample of the many ways BIM may be used over the course of the whole development process, from conceptualization to final construction.

1.4 THE APPLICATIONS OF BIM

Several different kinds of BIM software are utilized at various stages of a building's creation and operation. Several implementations of building information modeling (BIM) are addressed by these programs. There are several BIM applications that may be connected to various phases of the development process, such as design, planning, and construction.

a. Scheduling of Development: The specific time plans can be effectively organized and communicated to contractual workers and other actors precisely as planned [6].

b. Site Utilization Planning: Optimize the construction site by allocating space for different temporary facilities such as material storage, construction equipment, and so on. This will help prevent onsite disputes during the construction period. For instance, before they are actually utilized, new construction materials will occupy a certain amount of space on site for a certain period of time. Considering these factors, the materials must be positioned on the construction site so as not to impede work progress or the arrival of further building components and supplies. The construction site's permanent and temporary amenities must both be included in the model at all stages of the development process. The models must be connected to the construction schedule to analyze space planning, site logistics, sequencing needs, temporary works, and safety (4D).

c. Energy efficiency: Energy efficiency has to be improved immediately in the Indian economy. Infrastructural projects like buildings will make up over 70% of 2030's total construction in the following 20 years, from 2012 to 2032. By 2032, the demand for energy is predicted to triple. Such a sharp increase in energy supply will be difficult to control due to resource limitations. The Energy Conservation Act (ECAct, 2001) was approved by the Government of India (GoI) in 2001, and the Bureau of Energy Efficiency (BEE) was established in accordance with its provisions the following year. One of BEE's earliest efforts was the creation of an Energy Conservation Action Plan, which was published in August 2002 [8].

d. Cost Estimating: A excellent illustration of how to use the cost estimating method is a model to establish the weights of criteria. Moreover, models that can predict construction time and cost at an early stage of a project are being created. The depiction of development activities and cumulative expenditures is possible with BIM. Moreover, cost assessment using BIM technology is more accurate than it is using conventional techniques [9].

1.5 PROBLEM STATEMENT

In construction projects, the concept of sustainable development and the related environmentally friendly attitudes are becoming more prevalent. The expenses of construction projects are influenced by designing with sustainable development ideas in mind. The use of BIM in the management of construction projects is gaining traction around the world. For comparison value, the audit team's data must include the building's operation characteristics as well as the technical characteristics of its numerous cooling parameters, as well as a long-term cost study. In addition, the crew must study the available equipment for cooling the building and be familiar with the equipment specs. The question is whether it is feasible to provide functional evaluations using the existing building envelope systems, building orientation, integration of renewable energy sources, and day lighting design techniques, which were the most widely used in structures.

1.6 OBJECTIVES

This study's goal is to learn more about building energy management. Certain tasks are scheduled in order to accomplish the goal, which include:

a. To investigate the effective factors of sustainable building characteristics from the related studies.

b. To evaluate the building solar effect based on different conditions using BIM software.

1.7 THESIS LAYOUT

This thesis includes five chapters pertaining to this study, and each chapter overview is as follows:

Chapter one introduces the overview of the present study which includes the introduction, brief background of the BIM method as a tool to study the building energy effects.

Chapter two explores the relevant literature of the past related research from key people in the energy field.

The third chapter describes the research approach and aims to make the methods utilized in this study clearer. It also demonstrates how to identify the building, where it is located, and how to gather data in order to establish the baseline information for the present research.

The findings and comments are included in Chapter 4, which also provides an overview of the data analysis that was done. Also, it demonstrates the suggestions made after the findings are made to enhance this study in subsequent publications.

Lastly, chapter five presents the conclusion and recommendation. Study on findings, discussion, and interpretation of analysis results are summarized.

2. LITERATURE REVIEW

2.1 INTRODUCTION

The creation of a sustainable building, also referred to as a green building, is the result of a design philosophy that places a focus on increasing resource efficiency in the use of energy, water, and materials while minimizing the effects of the building's structure on human health and the environment over the course of the building's lifecycle. Better siting, design, building, operation, maintenance, and removal are used to achieve this. While "green construction" is defined in a variety of ways, it must be planned and executed in a manner that minimizes the overall detrimental impacts of the built environment on human health and the environment [2]:

a. Utilizing energy, water, and other resources wisely,

b. protecting occupant health,

c. Enhancing staff productivity.

d. Degradation of the environment followed by falling waste and pollution

a building built with environmental considerations in mind, particularly in rural settings. This includes resource conservation, on-site recycling, the use of renewable energy sources, the use of recyclable or biodegradable construction materials, and fitting in with the surroundings. Prior to considering human fitness concerns, the goals are to minimize the environmental effect as much as feasible. A thorough design and construction process that uses methods to minimize negative environmental effects then lowers the amount of energy a building consumes, improving the health and productivity of its residents. Creating livable, environmentally friendly buildings has become a trend in architectural and construction circles. Sustainability, energy efficiency, and healthfulness criteria are taken into consideration. [3].

Maintainable construction involves using recyclable and then renewable materials in construction projects and reducing energy use and waste production. Using sustainable building practices primarily aims to lessen their influence on the environment [4].

After the construction project is finished, sustainable building continues since the structure's design itself should have a negligible effect on the environment. The design of the building should thus include elements and materials that have a continuous negative influence on the environment. Solar panels, enough insulation to prevent heat loss, rooftop energy-efficient trapdoors, and lowering reliance on the grid, which mostly relies on fossil fuels and durable construction materials, are some examples [5].

2.2 SUSTAINABLE CONSTRUCTION IMPORTANCE

From energy use to awake emission, the building sector has a significant influence on the environment. He uses a lot of energy, and it's possible that he'll build over natural ecosystems. The bulk of large machinery and equipment still heavily depends on fuels. Even inefficient usage of energy causes unnecessary fuel to be used to power the grid power source lines. The distribution and production of resources can have a big impact on carbon emissions. The exploitation of raw minerals like metals can pollute the environment. Loads of CO2 have been produced by the actual cement factories, which have increased dramatically each year. Construction can produce hazardous waste as a result of inappropriate organization or disposal, which causes contamination that harms the area's environment and residents [6].

2.3 WAYS TO BUILD PROJECT SUSTAINABILITY

There are various practices that might increase the sustainability of construction projects before building structures.

There has been great progress in getting renewable energy to building sites. One of the most popular methods is the modular battery system, which can be quickly assembled on site and recharged by solar panels. On construction sites, these systems may power vehicles, electric machinery, and security apparatus. These batteries may reduce tons of CO2 and nearly 100 liters of fuel every week when utilized in large building projects, thus benefiting the environment [7].

2.3.1 Sustainable Building Materials

Wood - Sufficient management of forests to ensure that they serve as habitat for wildlife and a source of priceless building materials [8].

Other Bricks - Without utilizing an oven, which would cause harmful emissions into the environment, wool and muck are great raw materials to manufacture bricks that are just as durable as typical brick supplies.

Recyclable materials and plastics are a perfect replacement for traditional concrete, which can greatly reduce carbon dioxide emission.

2.3.2 Resources for Plastic Construction

One of the main threats to the environment and ecology before ecosystem is plastic. When employed properly in building, it can turn into a considerable strength. Longer lifespan construction is one of the main aims of sustainable building. He doesn't need a lot of spare parts or maintenance because plastic resources won't decay for a long period. Builders can begin using plastic to create sturdy, recyclable building materials [9].

2.3.3 Leadership in Energy and Environmental Design Guideline

Sustainable buildings are ones that are constructed by emphasizing environmental responsibility. Utilizing materials, minimizing resource usage, and preserving the current and future health and wellbeing of residents and the surrounding built environment. Here are seven issues that should be addressed in the designing and construction of new environmentally friendly buildings, with respect to the LEED regulations (and this is consistent with practically all other "green" building requirements) [10].

2.3.4 Sustainable Places

Sites must be chosen based on which location would present the least environmental risk if building were to occur. Contamination prevention is crucial, it includes preventing soil erosion, stream sedimentation, and airborne dust accumulation [11].

In order to conserve natural spaces and wildlife habitats, sites that are closer to urban development and where supporting substructure is present must also be picked. Brownfield redevelopment would be preferred because no new land is required. Alternative modes of transportation should also be considered. The amount of greenhouse gas emissions from portable sources to a building can be reduced by having access to public transportation, bike parking, and shower facilities. promoted by incorporating significant open planetary space inside the new structural complexes. The organization of water systems that depend on the typical environment's architecture for storm-water systems to ensure proper management of water is another problem. Another element that must be considered in order to enhance sustainability is the reduction of the heat island effects from roofs and land areas as well as by reducing light pollution [12].

2.3.5 Efficiency in The Water

The major objective is to boost water efficiency within the building, which will lower the amount of water required for operations. About two strategies that can be incorporated into a structure are the employment of creative wastewater treatment techniques and restructuring irrigation systems to utilize less water [13].

2.3.6 Energy and Air

Energy systems need to be correctly connected and calibrated in order to operate at their intended levels of competence. This should decrease energy use overall and cut down on labor expenditures. It is important to establish and then keep track of a minimum level of performance for the ability. Reduce refrigerant losses and potential ozone depletion by using a refrigerant management system [14].

There are many ways to produce renewable energy on-site that can lessen the building's total footprint and other costs associated with adopting green controls. Energy consumption screening, verification, and improvement techniques are essential for ensuring that energy performance is preserved. According to estimates, construction is to blame for 50% of greenhouse gas emissions, 60% of which are related to structures being heated by the earth. Additionally, buildings use vitality for machinery like lifts, lights, mechanical ventilation, and water heating [15].

2.4 MATERIALS AND RESOURCES:

The fabrication and transportation of materials are two major energy-intensive aspects of the construction process. By using resources efficiently and designing for recycling, the quantity of landfill waste produced during construction and operation can be decreased.Specifying second-hand building supplies can lessen the need for new materials. A building's embedded carbon footprint is reduced and its overall ecological sustainability is improved by specifying materials that are quickly renewable, incorporate recycled materials, are locally produced, or come from FSC-certified sustainable sources (forest crops). Excellence in indoor environmental design is required to improve occupant well-being. Examples of such materials are sealants, adhesives, dyes, coatings, parquet, wood, and fiber. Ventilation systems that encourage external air exchange are preferred, and if possible, they must prevent outdoor pollution from entering the structure. All residents should have access to as much natural light as possible in buildings. To reduce energy usage, lighting and heating systems should be set up to turn off manually or automatically. 6) Design innovation: Early in the process, design decisions should be made because a successful project can significantly lower a building's energy use., Decisions about shading and ventilation can be affected by a structure's orientation and location [16].

2.5 STRUCTURE PHASE

The usable life of a building fabric is mentioned at the construction phase. This process starts when the material is put together for a building, lasts as long as the material is used in the building and involves maintaining and repairing the material. Construction: On a building site, a substantial quantity of material waste might be produced. It is riskier to choose building materials for less construction waste than trash that can be recycled at this point of the building life cycle. Use/Maintenance: Certain construction materials might be dangerous to renters' health if exposed for an extended period of time. Even with a growing awareness of the ecological health issues associated with contact with certain products, there is little emphasis on choosing materials based on their potential for outgassing hazardous chemicals, necessitating frequent maintenance by such chemicals, before necessitating frequent replacements that perpetuate the exposure series [17].

2.6 POST-BUILDING STAGE

Building The Pole When a building's materials are no longer useful, phase makes a note of it. A material may now be completely reused, have its components recycled and utilized again in new products, or be scrapped. When a structure or substance has reached the end of its useful lifetime, it may be that the designer has given this phase the least thought and understanding of all. The environmental cost of demolishing buildings and disposing of the garbage produced is substantial. Toxic waste may be produced by degradable materials alone or in combination with other components. Slow-moving items take up more and more limited landfill space. The energy used to manufacture an existing structure and then utilize it in an adaptable way is conserved. If these "resources" are not used effectively, the energy invested in the construction itself and the creation of these components would be wasted [18].

2.7 POLLUTION DETERRENCE MEASURES

During the production process, industrial pollution avoidance methods can make a substantial contribution to environmental sustainability. Several builders employing distinct procedures may produce indistinguishable building materials. When it comes to where and how their raw materials are acquired, some producers are more concerned than others. While government pollution rules affect all industries to some extent, certain particular businesses go above and above the call of duty to make sure that their processes pollute as little as possible. These businesses continuously review and improve their methods of production in an effort to increase productivity and lessen the amount of waste and toxins that escape the sweatshop. They essentially carry out their own life cycle analyses of internal activities. Choosing products made by environmentally conscious businesses supports their efforts to reduce pollution. Choosing crops that produce higher levels of pollution abuses the environment even though their initial "off-the-shelf" pricing may be higher [19].

Reduced demand for a product leads to lower output, according to the "rule of supply then demand." Reduced production results in less waste being released, less energy being used during production, as well as a healthier number of raw materials needing to be acquired. Packaging. Being environmentally friendly can help avoid pollution since how a product is packaged and transported affects how much garbage it produces overall. The production of paper, cement, and metal all need enormous volumes of water, among other raw materials. The potential presence of dangerous compounds in this wastewater is one reason why it is often allowed to run untreated into streams. Rug fiber and coloring-paper dye are two examples of environmental hazards that may easily get into the discard stream. By being familiar with which companies use eco-friendly manufacturing techniques, architects may push for the widespread use of such items in the construction industry [20].

2.8 WASTE REDUCTION EVENTS

a Manufacturing The builder has shown they care about efficiency in their work as shown by the waste reduction eye by their efforts to decrease the number of unwanted byproducts. It's possible that the different molding, cutting, and finishing processes, as well as defective and damaged products, all contribute to this rubbish. This characteristic may allow crops to assimilate waste materials before removing them for processing elsewhere. Some companies use waste crops produced locally or by other companies to power their processes. These choices reduce the amount of waste that ends up in landfills. The efficiency of storing resources rises as waste in the industrial process declines. Oriented strand panels and other wood composite materials are almost exclusively created from the scraps left over after trees are crushed to create dimensional wood. Burning locally produced sawdust can power kilns used to dry wood, cutting down on both the amount of trash shipped to landfills and the need for refined fossil fuels. Fly ash created during melting processes might mix with concrete. Once burnt, brick becomes inert and does not interact with its surroundings. Low-level dangerous waste can be converted into an element through the fire process, lowering the risks associated with landfill disposal. Filtered and recycled water can be used for refrigeration equipment and mixing instead of being dumped into the waste water system [21].

2.9 ENERGY EFFICIENCY

Improving the energy efficiency of a building material is essential for its long-term viability in the built environment. The goal of using energy-efficient materials is to reduce the quantity of fossil fuels needed to get that material to the building site. The resources utilized to construct a building have a significant impact on its long-term energy expenses. R-value, shading coefficient, luminous efficiency, and fuel efficiency are a few examples of criteria that can be used to determine how energy-efficient a building resource is. Favored materials reduce the need for a boiler or cooling by slowing the transmission of heat through a building's skin.

To aid in resource comparison and establishing suitability for certain installations, it is possible to measure the efficiency of a building material [22].

2.9.1 R- Value

Building envelopes are typically graded according to their R-value, which is a measure of how well they insulate. Materials with higher R-requirements perform better as insulators than those with lower standards. R-values must be applied in denser layers in order to provide the same level of insulation. Before calculating R-values for composite physical parts, distinct materials (such as insulation, siding, wood wainscoting, and brick) can be measured (e.g., roofing, walls, floors, windows). There are many different types of insulating materials available, from carbon-based cellulose made entirely of recycled paper to bubbles made of petrochemicals [23].

2.9.2 Shading Constant

The extra heat gain from sun radiation is not always desired, particularly in hotter areas, even if daylighting is the cheapest and most pleasant type of illumination. A building's shading constant (SC) is the ratio of the solar heat gain via its particular fenestration to that through a standard, same-sized pane of dual-strength glass. This makes it possible to evaluate the effectiveness of sun protection provided by different types of glass, covering methods, and varnishing patterns. In the summer, overhangs shield a building from the high sun, while in the winter they let in natural light. At certain periods of the day or year, solar heat gain may be reduced by using shading measures. Some glasses or practical coatings allow for the selective broadcast of visible energy (light) while blocking or reducing the transmission of infrared radiation (heat) [24].

2.10 SCHEME EFFICIENCY

More than half of a building's annual energy costs are attributable to electrical and mechanical systems. 3 HVAC (heating, ventilation, and air conditioning) systems must be chosen for maximum effectiveness during the most frequent fevers. The best option may not always be a system that operates at its best on an exterior temperature that is just 5 percent of the time determined by the building's weather. To maintain equipment operating at its highest level of efficiency, regular maintenance programs are also crucial [25].

2.11 WATER TREATMENT/ UPKEEP

Items that treat or maintain water often do one of two things: either increase the quality of the water or decrease the quantity of water used at a given place. This often means less water is required to be treated by municipal septic systems, which adds to the biochemical and energy costs of treating wastewater. You may either physically restrict the quantity of water that can flow through a fixture (such a showerhead, faucet, or toilet), or you can recycle water that has already been brought to the site. Toilet water may, for instance, be made from collected rainwater or recycled from water used in the kitchen or for hand-washing. Money Spent on Irrigation[26].

Through a general decrease in the capacity consumed, problems also address efficient water utilization. Showerheads and toilets that consume less water are now commonly found in both business buildings and homes. Even in the Great Lakes region, where freshwater is abundant, conservation becomes a problem when urban growth stresses septic systems and municipal water treatment plants. All water that enters or greeneries a structure, with the exception of those using well-water and septic systems, must be treated [27].

2.12 USING NON-TOXIC RESOURCES BEFORE THOSE THAT ARE LESS TOXIC

Resources that are not previously less toxic pose fewer risks to construction workers and building occupants. Many materials show health risks to occupants and have a negative impact on indoor air quality. Some materials used in construction, like glues, release hazardous vapors just briefly during and after installation, while others might cause air quality issues for the whole of a building's life [28].

2.13 BETTER AIR QUALITY THEN LESS TOXICITY

In response to the energy crisis of the 1970s, there was a rush to make buildings airtight, which gave rise to the term "sick structural syndrome." This occurs when the scents and compounds released by specific building materials cannot be adequately removed by natural or artificial ventilation. These materials may be dangerous, even cancerous. The chemicals used in foam insulation, the resins in plywood, and particleboard have all been linked to unhealthy building conditions. Many building materials, furniture, and cleaning products include dangerous or fungus-causing substances such formaldehyde, benzene, ammonia, and others. In the past, the rate at which outside air entered a structure through its envelope's gaps and fractures offset any indoor air pollution caused by human respiration, bacteria or mold, or material emissions. The issue of indoor air pollution is made worse by buildings becoming more airtight. Buildings that have been well-insulated in an effort to preserve energy have less airborne infiltration, which means that residents are exposed to higher toxic concentrations for longer periods of time. When deciding which resources to use and figuring out air conversation rates, the health implications of these contaminants must be taken into account [29].

Environmental health hazards may be avoided, and the need for costly air scrubbers reduced, by selecting resources with lower or no amounts of these resources. Material toxicity is a major cause of worry as more and more construction materials contain petroleum quantities. These chemicals, commonly known as volatile carbon-based compounds (VOCs), may continue to be released into the air after the materials covering them are fitted. The substances involved, the rate of release, the concentration in the air, and the distance of exposure all influence the severity of the "outgassing" process. Several common products, such as adhesives, paints, sealants, cleaners, and others, contain VOCs. Typically, the materials are only exposed for a short amount of time before and after installation; outgassing significantly diminishes until ending completely after the original materials have dried before being covered by other building materials. As a result, it is recommended to pedal faster while installing these resources and for a few months after tenants join the building [30].

2.14 RENEWABLE ENERGY SYSTEMS

Natural energy in the forms of breeze, sun radiation, and geothermal heat surround construction sites. Through the use of this regular energy, renewable energy systems can be used to supplement or replace conventional heating, cooling, and electrical systems. This group includes elements that promote daylighting, on-site power generation, and inert and active solar boilers. Solar energy can be used in many ways, including to generate electricity and heat water. In many regions of the country, it is practical to produce energy and move water using wind power. Even while active astral or geothermal heating requires external electricity for drives, they nonetheless use less energy than outdated mechanical heating systems because of this [31].

2.15 CURRENT WORK

The study aimed to investigate the ways to construct the sustainable building according the surrounding conditions and related factors. The study built conceptual analysis with scientific hierarchy to figure out the validity pathway for implementing the sustainable construction projects. The study based on the techniques of building information modeling (BIM) to assign the strategy of the research and to support the line for achieving better results. The study showed the energy conserving issue as a scope for sustainable design and found out the chances to evaluate the building solar effect based on different conditions using BIM software.

2.16 LITERATURE SURVEY

Structure information modeling (BIM), which can improve the competency of sustainable construction plans, is still having adoption issues. It is important to think about and remove these hurdles if the designer want to integrate BIM more professionally. With the use of quantitative and qualitative methodologies, this course aims to investigate then design strategies to lower barriers in developing nations like Malaysia so that BIM can be applied more widely. To accomplish this, a thorough literature research was conducted to determine the impediments, and a questionnaire review with the stakeholders in building projects was done. The ranking study results showed that "lack of standards then guidelines," "absence of BIM training," "lack of know-how," "high cost," then "lack of investigation and BIM implementation" were the top five harmful hurdles. According to comparative study results, "lack of research and BIM application" is the least significant barrier in other nations including China, the United Kingdom, Nigeria, and Pakistan. Additionally, a qualitative analysis uncovered methods to lower BIM application hurdles and improve maintainable goals. The formation of a framework, known as the "BIM-founded research framework," which incorporates BIM implementation challenges and solutions can help project managers and policymakers move toward truly sustainable building is the final result of this instruction [32].

One of the major issues facing the building, engineering, and construction (AEC) sector is collaboration amongst scheme stakeholders in facility management (FM). Building information modeling (BIM) can support collaboration by advancing facility management tasks carried out by various investors. An FM community knowledge resource, a building info model is a numerical representation of a facility's physical and functional features. Consequently, a building information model provides a trustworthy foundation for making decisions throughout a building's existence. Despite the apparent overlap between FM and BIM, maintainable facility management guidelines—which take into account issues related to a building's lifetime cycle sustainability—do not include BIM applications. This study examines the distinctions between BIM requirements and sustainable facility organization standards. In particular, a German sustainable facility organization guideline is provided and contrasted with typical BIM requirements from the AEC sector. The comparison intends to highlight how well BIM can be used to achieve sustainable capability management standards, which could open up a way to incorporate BIM requests into sustainable FM guidelines [33].

Green building materials have been utilized extensively in construction because of their benefits for health, the environment, and safety. However, because construction projects are sometimes intricate and protracted, as well as because there are too many interested parties in supply chains, it is important to raise the organization level and efficiency of green building materials. This study investigates the green building materials organization and supply chain scheme using Building Info Modeling (BIM), and develops a green building material organization evaluation technique. that BIM can quickly, precisely, and safely convey source chain information, minimizing information loss and management costs.

Purposefulness, operability, simplicity, and continuity are the hallmarks of the five-level stepwise evaluation directory of green building resources. The application of BIM in the green building resources management system is theoretically supported in this research. [34].

The building sector in Malaysia has considerable obstacles, such as high construction prices and a lack of awareness, in order to continue sustainable growth. Integrating sustainable development with building information modeling (BIM) is essential if the designer are to pass these assessments. Therefore, the goal of this study was to develop approaches for incorporating BIM into sustainable structural projects. To categorize the plans to achieve this goal, a rigorous literature review was conducted. This was followed by a questionnaire survey of 129 project stakeholders. To examine the precise impact of BIM adoption strategies on sustainable building schemes, mean score and investigative factor analysis (EFA) were conducted. According to the results, "greater knowledge on the costs and advantages of sustainable resources" and "wired sustainable development" were the most essential techniques for promoting sustainable development in building projects. Public awareness is raised via workshops, lectures, and session activities. EFA was also used to categorize the standardization-related strategy, the economic-related strategy, the consciousness-related strategy, and the environment-related strategy. This lesson will allow future researchers, policymakers, and practitioners to analyze the limitations of future studies [35].

Customers and architects are always concerned about how much energy is used in a sustainable project. In response to this admiration, the UK's national regulations on energy disclosure and "carbon" reporting have called for more consistency in building information in order to meet the CO2 emission target. Therefore, in order to achieve the CO2 emission objective, Clients and Industry should closely collaborate in devising strategies to make the switch to low carbon structures viable. Building info modeling (BIM), which has the ability to further homogenize the construction supply chain, can play a significant role in this area. The energy analysis packages typically provide feedback to the designers on their designs, including how much energy the building will use, what CO2 emissions are projected, and whether the building will meet performance standards (such as: LEED or BREEAM). Applications for BIM have been developed for vigor analysis to enhance this process, mostly during the design stage. However, a proper then methodical technique is crucial for the pole-occupancy stage to screen the behavior of structures and make risky judgments to make sure that the energy criteria of the design are actually met in reality. In this study, a conceptual BIM-based model is presented that can meet the industry standards for sustainable buildings and recover the post-tenancy evaluation process [36].

As a result, the development of new practical techniques that may support the information of specific objects and guarantee the activation of green buildings in accordance with green building standards is necessary. This study aims to produce a useful method for supporting the project of green buildings using a GBT, BIM-based green template, and then to create a helpful and evaluative environment for the requirements of lime building standards using GBT. All nations are passing laws relating to environmental improvements and establishing plans to reduce greenhouse gases as a result of administrations (GHG). Due to the fact that 26.9% of all national GHG reduction boards' discount programs are related to the building sector, most nations are encouraging the growth of green buildings through the adoption of regulations that reflect their own standards in order to meet the 2020 objective. Studies that take into account this criterion should be carried out from the early design stage on in order to produce buildings that adhere to the promise by satisfying the eco-friendliness of structures. However, there are many intricate work procedures that lead to issues with in-depth substance analysis, understanding information need, and using information in the workplace [37].

Building maintainable management is a complicated topic that requires effective and appropriate assessment tools and methodologies that are well-organized enough to solve concerns of incommensurability and complexity regarding environmental legislation and legal frameworks. Assessment techniques have been discussed, compared, and reviewed within the context of the standards set by the International Group for Standardization within the confines of this article. Building Research Establishment Ecological Assessment Method, Management in Energy and Ecological Design, Deutsche Gesellschaft für Nachhaltiges Bauen, and Green Star are among the certification programs reviewed., As healthy as the proposed EU Ecolabel for office buildings are Tall Environmental Quality, Complete Assessment System for Structure Environmental Efficiency, and GB Tool. With regard to innovative construction schemes, emphasis has been kept on data pertaining to aims, practice, criteria used in the evaluation process, environmental topics assessed, stages of the life cycle analysis covered, expenses, and applications' outcomes. Last but not least, the effect of green certification programs on the building industry has been examined in relation to the absence of a requirement for worldwide uniformity in sustainable structure management [38].

Being resource-conserving and made of sustainable materials, buildings are gaining popularity not only in the cowboy movie industry but also throughout India. These buildings address issues like pollution control, climate change, and global warming. The authors believe that simply building a construction out of sustainable materials is insufficient. This essay focuses on various aspects of sustainable construction management, such as site selection through feasibility analysis, material selection through lifetime cycle assessment, period, cost and reserve controls, durability and stability, fitness for occupancy, construction protocols and procedures, and designs based on original concepts. The publication promotes that the building's competency and presentation can both be considerably improved, and that using the right building materials and employing best practices in construction management can produce the greatest gains. The advantages and requirements of sustainable construction, a component of management in building practice, management methods, and a comparison between conventional and sustainable construction organization are also covered in the study. The study states that once the idea of sustainability is included into each and every step of construction practice, the goal of building a green building is fully done and the process is not restricted to using sustainable resources [39]

The finest small molecule and protein-protein docking techniques cannot tackle the difficult problem of predicting how flexible polypeptides will bind to proteins. Here, we show that the decorative Glide sampling for flexible polypeptides may significantly improve the accuracy of posture prediction, and we test the program using a dataset of 19 non-helical peptides. Post-processing using solvent MM- GBSA calculations grounded on physics led to an increase in posture score. The success rate (RMSD 2.0 for the interface backbone atoms) in the scenario of redocking to the innate protein structure rose from 21% with default Glide SP settings to 58% with the revised peptide sampling and scoring approach. Although this is over a hundred times quicker than the newly developed Rosetta FlexPepDock approach, the latter proved more accurate (63% success rate for these 19 peptides). When cross-docking was performed on a subset of bags where an unbound receptor structure was available, 40% of the peptides docked successfully. The statistics show that lengthy peptides that are relatively short in size and have few formal charges are where the optimized polypeptide method shines [40].

The validation of STURE demonstrates that it is possible to monitor construction work before works to ascertain if it is headed toward being a sustainable, a partially sustainable before non-sustainable growth, with modest assistance from an environmental management scheme in use by the client. This is an illustration of a neutral judgment that avoids making generalizations. It is time to set goals to make it simple for regular property developers, clients, and project managers to gather information, create policies, and execute plans before opportunities to inspire the mainstream construction industry to strive toward sustainability. It goes without saying that a general, international program of sustainable building must be supplemented by the particulars of the actual site, the particular project before the facility, the client's skill or knowledge, the design team, the project management team, and, of course, the regional and local circumstances in the context of the triple bottom-line of sustainability. It is actually a question of knowledge transfer based on regionally appropriate bottom-up and top-down viewpoints, regardless of whether the site is located in a southern tropical metropolis area or a northern frigid mountain area. The challenge is to transform this into a user-friendly, streamlined approach that caters to the needs and skills of a mainstream construction project organization team. This investigation might be a necessary step towards overcoming this problem. The time window is indeed limited, and the effects of irreparable damage to our planet are already being felt. The responsibility to reduce this injury is mostly on the building industry, and in particular, the property developer [41]

Climate change and global warming are among the many challenges and issues the globe is currently facing. Numerous scientific studies have revealed the significant contributions of various industries to the development of this illness. Particularly, the building sector bears the most of the blame for these tests on the planet. Without a doubt, today's buildings use of improper technologies, appliances, and resources has put the environment and human health in jeopardy. Therefore, a crucial question arises: Is forgiveness the best way to address these issues in the construction industry? Engineers and scientists have understood for some time now that certain techniques and materials used in the building sector are the source of the ecological issues. The best strategy, according to scientists, for fending off the aforementioned dangers is to think about "sustainable" or "green" building design. Therefore, the main goal of a sustainable construction is to change harmful skills and materials in buildings to those that are harmless. In order to produce positive effects on people, nature, and civilization, one of the key goals of this study is to examine generally sustainable technologies, values, and materials that assist structures in consuming less energy and resources. Accordingly, "sustainable" structures can use resources like electricity, water, and materials more effectively than traditional ones while also being more environmentally and humanely friendly. Additionally, the study was intended to discuss the advantages of developing sustainability in buildings from many angles. It was established on a review and then pointed forth future study guidelines [42].

Building maintenance plays a big role in sustainable construction. Careful upkeep serves to minimize the use of physical resources and encourages the advancement of greater energy efficiency. It also enables to maintain the constructed environment already in place, its monetary value, and the associated cultural heritage. The development of knowledge management techniques is necessary to enable the optimization of maintenance procedures. Goals of optimization include reducing ecological effect and maintenance costs while maintaining the acceptable level of building presentation. By contrasting the different maintenance profiles, it is possible to determine the most advantageous maintenance plan. Prognostic, life-series based, optimizing, and integrated describe the lifetime-cycle design that VTT has created that is ideal for buildings. Owners and architects can use the model to strategically manage building maintenance. The newspaper analyzes the definition of maintenance management of structures with regard to maintainable buildings after summarizing the study project's findings [43].

One of the main levers for achieving global weather protection agreements is the sustainable transformation of the construction industry. Individual choices regarding building energy systems (BESs) so take on greater significance, and building investors need concrete options to develop a structure stock that is based on renewable energy sources. Our research aims to address this issue and presents a decision support system built on a software manufacturing approach that complies with the project science research methodology. This system then seeks to provide leadership for investment decisions in BESs by emphasizing practical, economical, and finally ecological performance indicators. The computational study evaluates the effectiveness of various cost and CO2 emission scenarios for various types of buildings. Our findings offer design guidance for future BESs and give building investors a comprehensive viewpoint to address converging goals and pursue a sustainable transformation path [44].

Energy use is increasing as a result of factors like digitalization and improved living standards. However, all energy consumption is seeing an increase in the percentage of renewable energy sources. Given this use of renewable energy, environmental problems and global warming are still becoming worse. Fossil-based energy sources cause more pollution and deplete more resources than others. Studies on environmental pollution indicate that fossil fuel-based energy sources are the main polluters. The most common source of energy is still one that derives from fossil fuels. Additionally, the utilization of renewable energy sources is quite low. Therefore, it’s crucial to increase the usage of renewable energy, which produces cleaner emissions. Incentives for renewable energy consumption should be appropriate in buildings. Renewable energy can be used to meet needs for lighting, refrigeration, and boilers. This study intends to investigate and show how renewable energy might benefit from fulfilling the needs of public buildings. The degree of utilization of renewable resources like solar, wind, and geothermal resources in structures can be raised by combining conservative techniques with innovative ideas. As a result, significant contributions to minimizing the environmental problems brought on by energy usage can be made [45].

In order to provide an accurate assessment of the building's energy usage, the authors of this paper conduct an analysis based on BIM (Building Info Modeling). The inquiry object is a four-story Beijing student housing where the data was collected, and it was created utilizing the typical processes for acquiring BIM-based energy consumption simulation data (SOP). Designers may take part in the operational method's conceptual project stage in real time using a three-dimensional information perfect, eliminating the requirement for a separate project. Compared to the standard method of calculating how much energy a device consumes, the SOP developed as a consequence of this study has the following benefits. The SOP's adaptable file structure makes it possible for it to facilitate easier procedure while exchanging data across programs. Via the SOP, users may see issues early on in a project and adjust the scheme rendering to the simulation's outcomes. The development of the building process is aided by the fact that SOP function analysis is more expert than the visual presentation method, which is more well-known than intuitive. Lastly, this guide encourages the study and evaluation of energy usage throughout the building's life cycle in order to offer researchers with ideas for improvement [46].

The goal of the lime building concept is to achieve both cost- and energy-efficiency. The lime-colored buildings serve as a symbol of major sustainable development and user responsibility for the environment. utilizing common resources like wind and solar control, daylight, adequate midair ventilation, rainwater, and daylight. Buildings can be well-organized in terms of cost and energy use. In order to create a green building, it is important to focus on midair ventilation, daylighting, and clay wall utilization during the building process. These concepts are simple to use and are beneficial to the environment. Higher ventilation maintains improved IAQ, and better IAQ satisfies the requirements for lime buildings. Increasing the number of daylight-finished apertures will cut back on artificial lighting and energy use. In this project, clay walls are used in modern buildings along with suitable ventilation and daylighting research. The amount of natural illumination can be increased with the aid of good ventilation and clay walls, which also serve to naturally cool the inside of the structure. Additionally, the idea of collecting rainwater is employed to maintain the humidity of the clay wall throughout time. [47]. Due to the need for precision, cost estimation can be a difficult aspect of budgeting. The planning process of a project manager must consider inflation, interest rates, fixed and variable costs, and overhead [48]. Some businesses may decide to pursue quantitative methods, such as parametric modeling and program evaluation and review, while others may opt for a qualitative approach [49, 50]. Additionally, one has the option of approaching the problem from the top down or the bottom up. If historical price information is available, the top-down method is applicable [51]. Due to their extensive experience working on comparable initiatives, project managers are in an ideal position to make decisions [52]. Bottom-up strategies, which use task-specific cost estimates prior to aggregating them at the project level, are useful when an organization lacks sufficient prior project information [53]. Earned Value Management, or EVM for short, is a project management technique for controlling expenses. By incorporating the project's budget, timeline, and scope, it offers an objective evaluation of the project's success and growth [54].

3. RESEARCH METHODOLOGY

A building that serves both business and educational purposes Construction includes a wide variety of building kinds, in addition to structures educational facilities, hospitals, sports stadiums, retail stores, light manufacturing facilities, depots, and buildings business and lodging enterprises." Due to its minimal production energy and high savings potential (up to 50 years in some instances), XPS is one of the most energy-efficient insulation materials, according to research. One of the most common forms of insulation, fiberglass consists of extremely thin filaments of glass. It is commonly employed as a variety of insulation varieties, including blanket (batts and sheets), loose-fill, rigid boards, and duct insulation. The R-value measures how well an insulating material retains or transmits heat. This term is typically used as a business identifier when purchasing insulation materials. The R-value of an object may vary according to the direction of thermal flow. Insulation with a higher R-value prevents heat loss more effectively. This suggests that some of these institutions' demand is less susceptible to changes in the state of the economy as a whole. As a consequence, once work has started on some of these structures, it will take a long time to finish it. This might result in a scenario where there are only a few general contractors competing in the same industry. In an oligopoly, a small number of businesses control the market. The rate at which the temperature of a material elevates after being exposed to a heat source. Typically, calories per level are expressed in terms of the actual amount of material being examined, which is a mole (the molecular weight in grams). The influenced by rivals in the same sector. In order to quickly strike an equilibrium between a project's working progress and its budget and minimize money wasted, the growth of cost estimation in connection to project management has emerged as a crucial subject. It is crucial to encourage the use of this technique of expenditure forecasting through monitoring and research. He provided a three-step process to complete the goals of the research. The most cost-effective material was found using the T-TOPSIS technique, and the impact of solar energy was assessed using building information modeling. The objective of this thesis is to increase cost estimation precision, allowing the choice of a suitable project process building style. The approach we've been talking about involves examining different facets of an undertaking to determine which ones are the smartest.

3.1 BUILDING SUSTAINABLE FACTORS

Insulation can prevent this heat loss. Numerous materials are utilized as insulation. Insulation for construction can be produced from numerous materials, such as fiberglass, wool, cotton, paper (wood cellulose), straw, and foams. Typically, cellulose insulation is made from 75 to 85 percent recycled paper and is heavily treated with flame retardants such as boric acid, borax, or ammonium sulfate. These substances can be utilized as flame retardants and pesticides without harming humans. Cellulose insulation products, which are primarily manufactured from post-consumer recycled paper, have some of the highest environmental ratings of all insulation materials. Up to 30 times less energy is required to produce cellulose insulation than material insulations such as fiberglass and wool. Consider the climate, the condition of the site, your budget, and your desired level of comfort when making your material selection. Current popular topics in the field include energy-efficient building surfaces, heating, ventilation, and air conditioning (HVAC) equipment, high-efficiency lighting, water resource management, sustainable energy technologies, and intelligently installed control systems. What occurs within the building envelope: The energy consumption of a structure is directly proportional to its "membrane," which consists of the roof, walls, windows, foundation, and air leakage. Improving a building's exterior efficacy can have a significant impact on its energy consumption. The preponderance of a building's energy consumption is devoted to interior heating and ventilation. Utilizing the building's exterior in an efficient manner can significantly reduce the amount of money spent on heating and chilling the building's interior.

3.2 SUSTAINABLE MATERIALS CONCEPT

When constructing a physical structure, the phase of material selection is crucial. The objective is to locate materials that fit within a budget while still meeting the requirements of the plan. In recent years, there has been an increased emphasis on the significance of utilizing eco-friendly materials in the design of green buildings that are both environmentally responsible and cost-effective. The objective was to produce structures that would not damage the environment. For instance, when selecting green building materials for a renovation or new structure, the insulating properties of the materials should be a top priority. When designing or constructing a building, the designer or builder must have a comprehensive understanding of the properties of the building materials and how these properties respond to external forces. To reiterate, these variables alter the "product's sustainability" based on local climate and topography. The ability of the materials to withstand high temperatures, resist corrosion, maintain their functional integrity, and transmit heat efficiently are among the many essential considerations. Choosing which components to use is the focus of this section. It is possible that the value of the work that depends on a particular material exceeds the value of the material itself, which would expedite the construction process and reduce the amount of time required to complete the project. There may be a reduction in costs at first glimpse, but any material flaws will ultimately result in higher costs for maintenance and repair. If inferior materials are used to construct a structure, its lifespan will be drastically reduced. As a consequence of the strain that the encircling atmosphere places on the building's materials, the framework corrodes over time. The source of the burden is the external environment. Due to the fact that the building's long-term impact is primarily reflected in its performance, the choice of construction materials influences the planning process.

3.3 INSULATION MATERIALS FOR BUILDINGD

Insulation can be installed anywhere within a building, not just the floors, windows, walls, ceilings, and top. Due to the large surface area that it insulates, wall insulation has been determined to be the most effective insulation placement in the overwhelming majority of cases. In the past, researchers have debated whether protecting the outer or interior barriers is preferable. Multiple studies have demonstrated that insulating the interior walls of a building is more effective than insulating the exterior walls, but this is not the only factor to consider. The majority of research indicates that the type of building, the weather, the building's orientation, the height of the thermal insulation, and whether or not the building is heated or cooled all play a significant role in determining where insulation should be positioned on the walls. The optimal location for installing wall insulation is near the point where heated air enters or exits the structure. In actuality, however, wall insulation is typically affixed on the interior wall face or in the stud cavities. These locations are typically found inside the residence. Typically, one will use either mirrored insulation or thermal mass insulation when insulating a roof. It was determined that reflective insulation is significantly more effective in milder regions than in frigid regions[48][49].

3.4 IMPLEMENTING REVIT MODEL

In order to increase the efficiency, accuracy, and timeliness during the design and construction phases, structural engineers and builders employ a wide variety of instruments. As intriguing as the discipline of design may be to some, it has something for everyone. He struck his ear with the mallet a minimum of twice. Because of its versatility, high degree of precision, and lightning-fast performance, Revit is one of the most popular engineering software applications. Modeling Information Infrastructure is the meaning of the acronym REVIT, which describes what Revit is. The development of information modeling enabled the collection and organization of all available data, information, and studies. The only way to paint a complete image is to consider both the final product and the tangible structure that will be constructed. There is a need for additional context in order to accurately interpret this source's content. This refers to the actual side dishes. The most prevalent techniques for limiting a project's duration and budget were outlined. It has been determined what issues presently exist in AEC production that cause delays and cost increases in quality. After that, a local architect and a building management company were recruited to assist with the REVIT methodology. Both the procedure and the central concept were investigated for their depths. Through the analysis of data derived from 3D models, it was shown that this innovative method of project execution increases productivity and reduces costs. We've compiled a list of prospective REVIT technique-related challenges and potential solutions. As the final step in this intricate procedure, the benefits of using REVIT for the project were extensively discussed. Future REVIT application recommendations were provided. The difficulties encountered by users when attempting to use REVIT were also covered in the presentation. Here is a summary of the various procedures required when using the Revit software:

a. draw the foundation of the building

b. draw the walls layout of the building

These two steps are crucial in Revit software; they are beginning from the articular icon as shown in the figures:

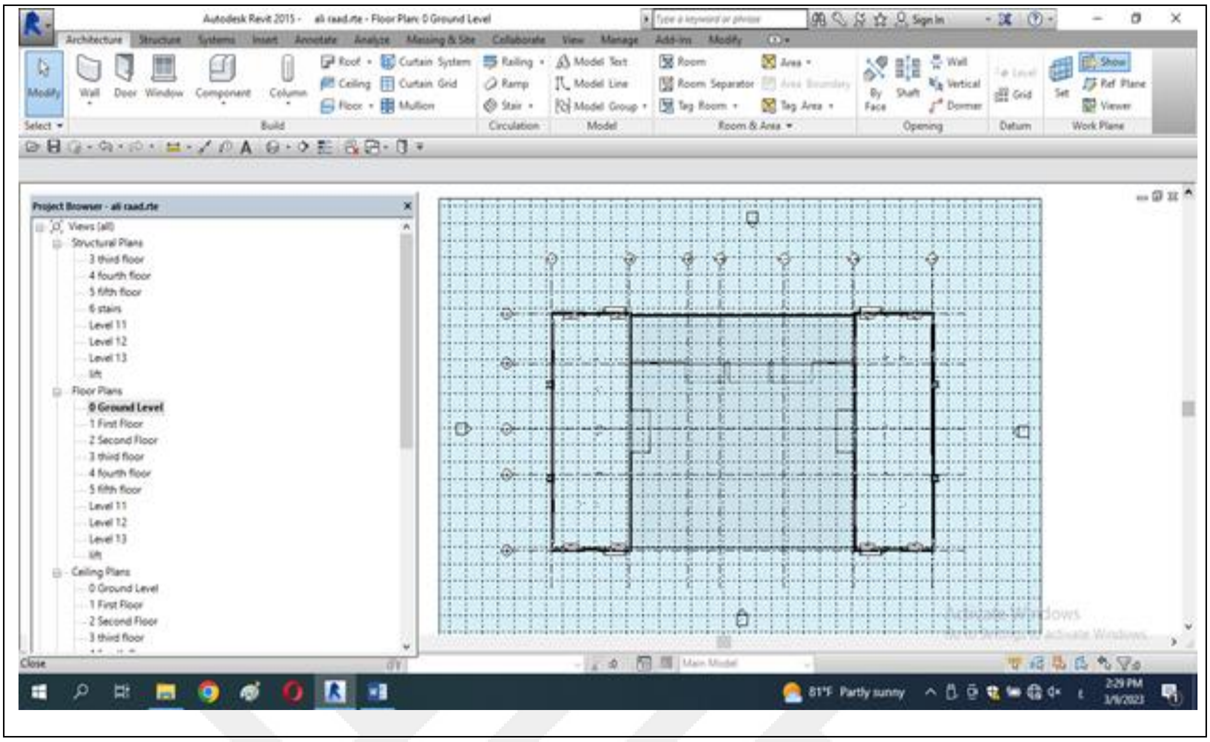

Figure 3.1: Draw The Foundation And Basic Walls With Specific Dimensions.

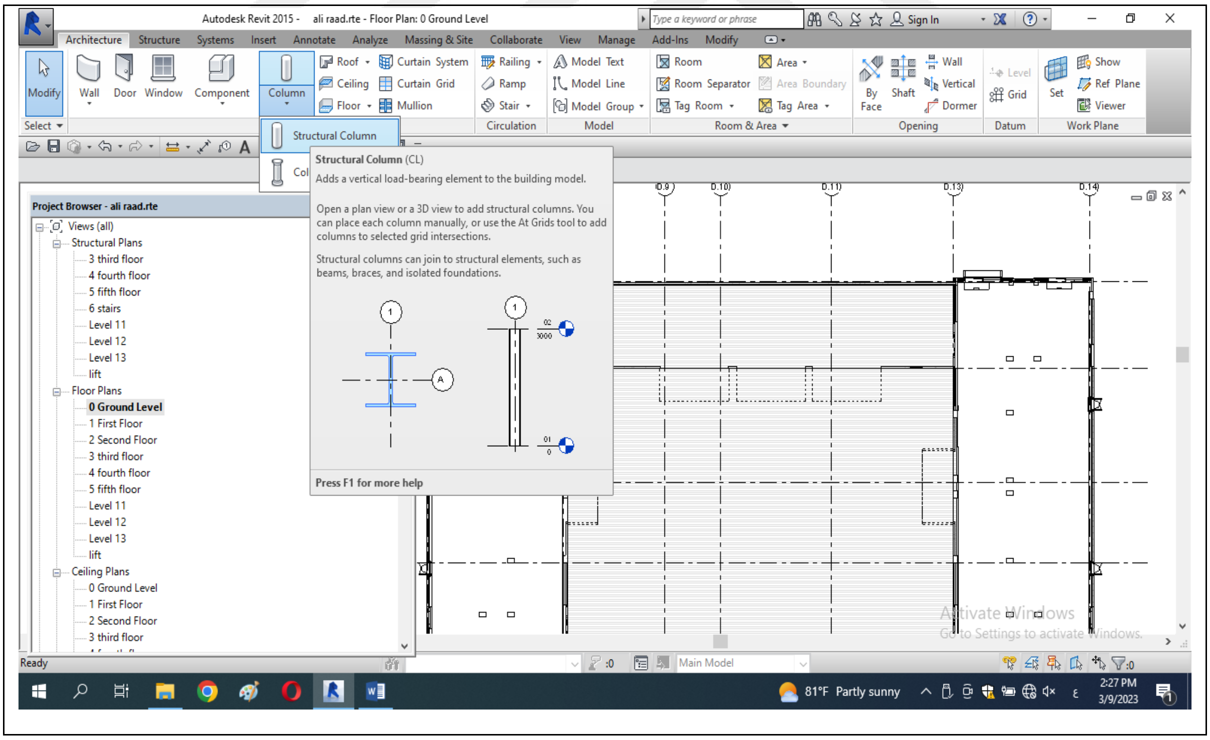

Figure 3.2: Insert The Concrete Column.

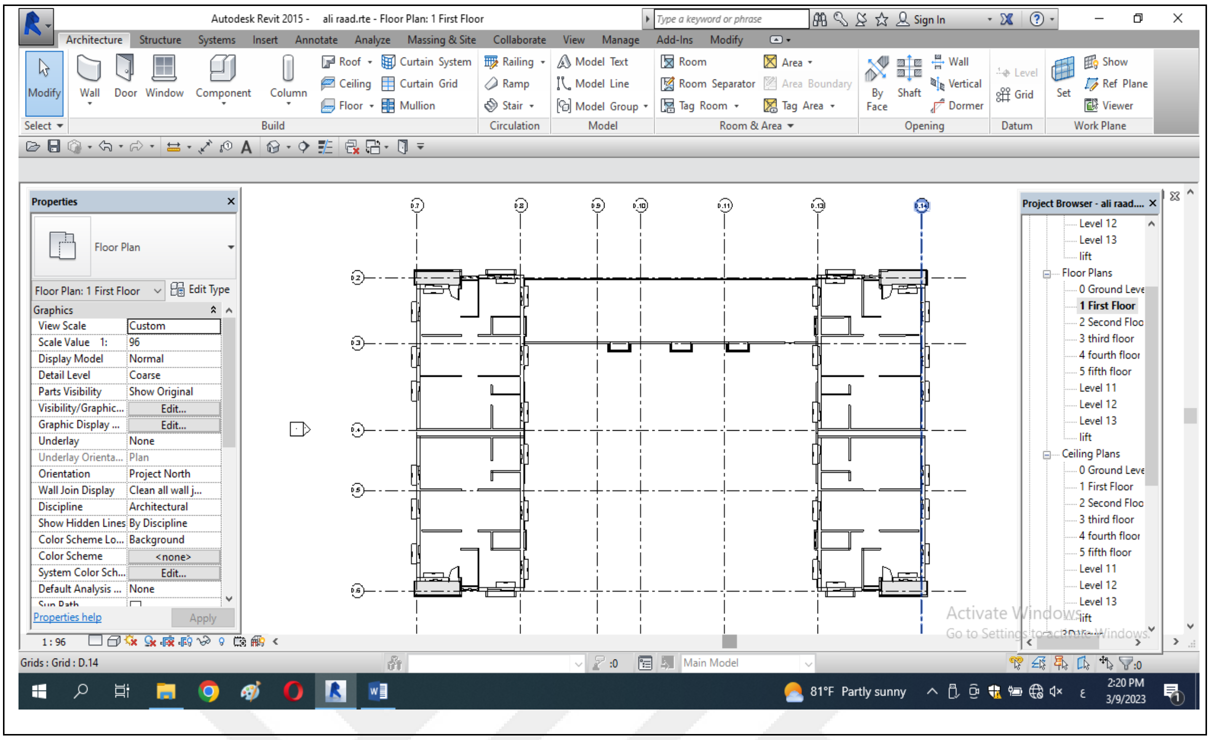

Figure 3.3: Building The Walls Of The First Floor and Specify The Building Levels.

The Floorplan dataset's Floorplan Polyline feature class makes it possible to examine the components from these groups that will be used. The design will take these elements into account. Infrastructure in 3D The BIM file workspace's Exterior Shell feature class is used to create Multipitch features, which are then added to the file's Facilities 3D layer to depict the facility's façade. The components that make up this feature in the Revit model have the Function property assigned to Exterior. These components form the basis of this functionality. 3D components The Units 3D layer, which depicts the size of objects in the Revit model's Rooms category, generates multi-patched elements. These traits are kept in the Multipitch feature category. The information in the Name field of the Rooms components is transferred by Revit into the USE TYPE field of the Units component. The number from the Room Number field of the Rooms components is what Revit uses to fill the NAME field of the Units component.

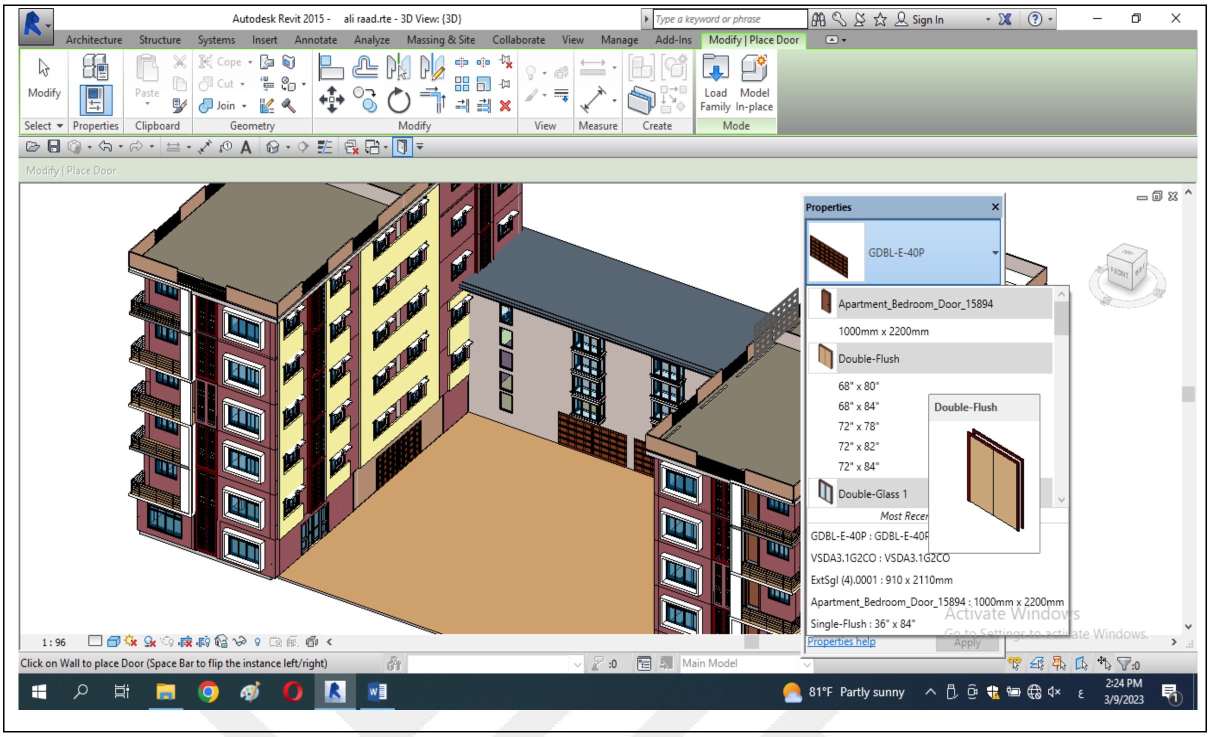

Figure 3.4: Specify The Doors.

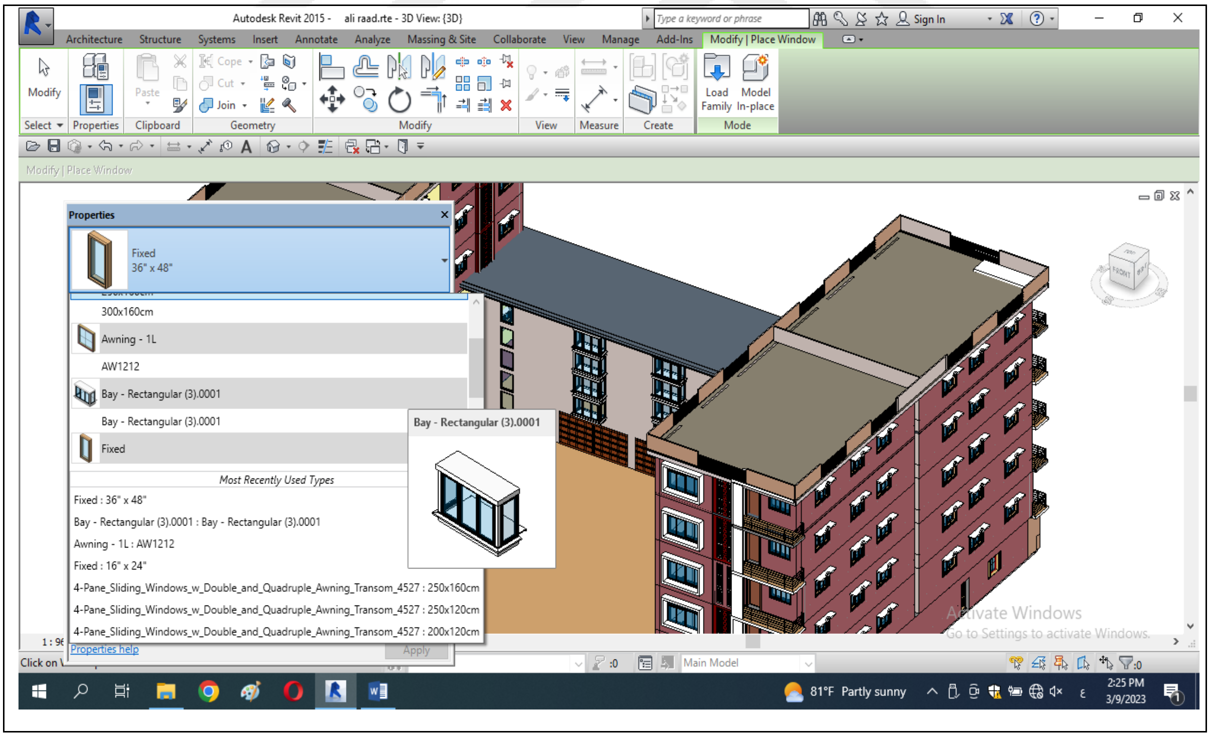

Figure 3.5: Specify The Windows.

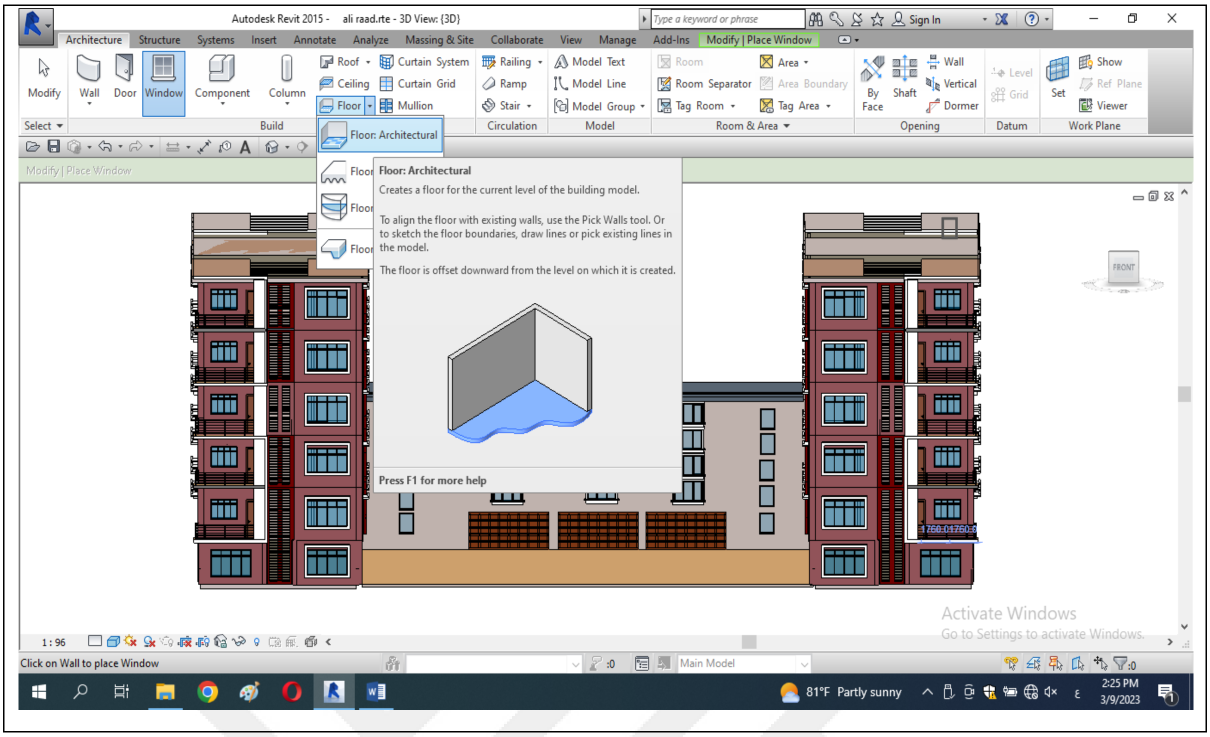

Figure 3.6: Specify The Floors Of The Building.

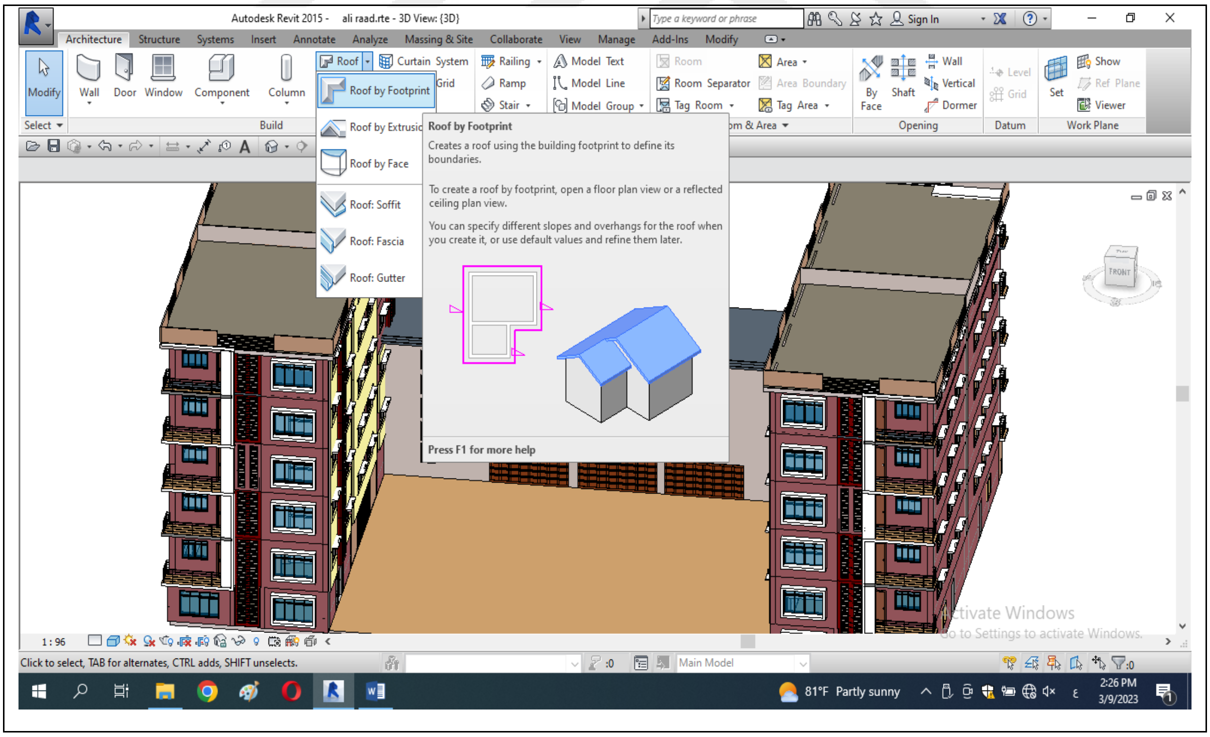

Figure 3.7: Specify The Building Roof.

The following components and characteristics from the BIM file workstation are transferred into the Indoors model as it is being filled out during the import procedure using the Import BIM To Indoor Dataset utility. The Floorplan collection's facilities are created using the Facilities Footprint. The Floorplan can then be expanded with utilities. Levels: New Levels are created using existing Floor components that share the same Level property. You can examine the features that will be added to the Floorplan Polygon feature class in the Floorplan dataset when examining the Revit model. You'll be able to see the layout more clearly as a result. Based on the existence of Room components, units in the Revit model are created. Prior to import, make sure that all internal locations are modelled in Revit as Rooms so that they can be imported into the Indoors model as distinct units. To Interior Dataset feature in Revit, it is possible to receive accurate floor plan data.

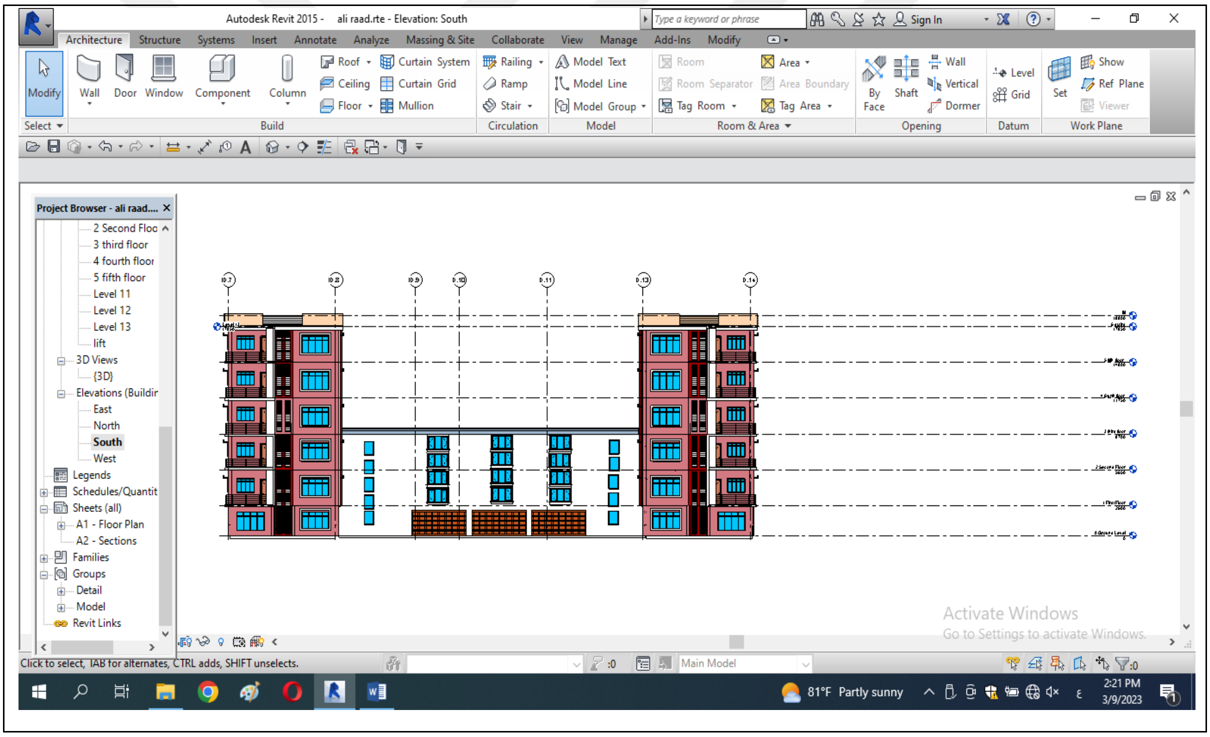

Figure 3.8: Specify The Building Floor Levels.

The information in the Name field of the Rooms components is transferred by Revit into the USE TYPE field of the Units component. The number from the Room Number field of the Rooms components is what Revit uses to fill the NAME field of the Units component. The appropriate Building Level is entered into the LEVEL ID area using this information. If the appropriate factors are already present in the Units layer, you can add more Rooms characteristics to that layer. Details The features are created using the Revit groups listed below: Entrance, ramps, stairs, stair railings, wall panels, windows, columns, structural columns, and stair landings. Additionally, specifics can be developed from scratch. The appropriate Building Level is entered into the LEVEL ID area using this information. 3D specifics Multipath elements in the Details 3D layer are created using doors, ramps, stairs, stair supports, stair landings, columns, structural columns, walls, windows, and curtain wall panels. On the basis of the object data in the Details 3D layer, these traits are produced. Before starting the Transfer BIM To Indoor Dataset tool, each 3D component needs to be connected to a level. A distinct 3D detail feature is created for each level that a 3D feature that spans multiple levels, such as walls or drapery panels, stretches across during the import process.

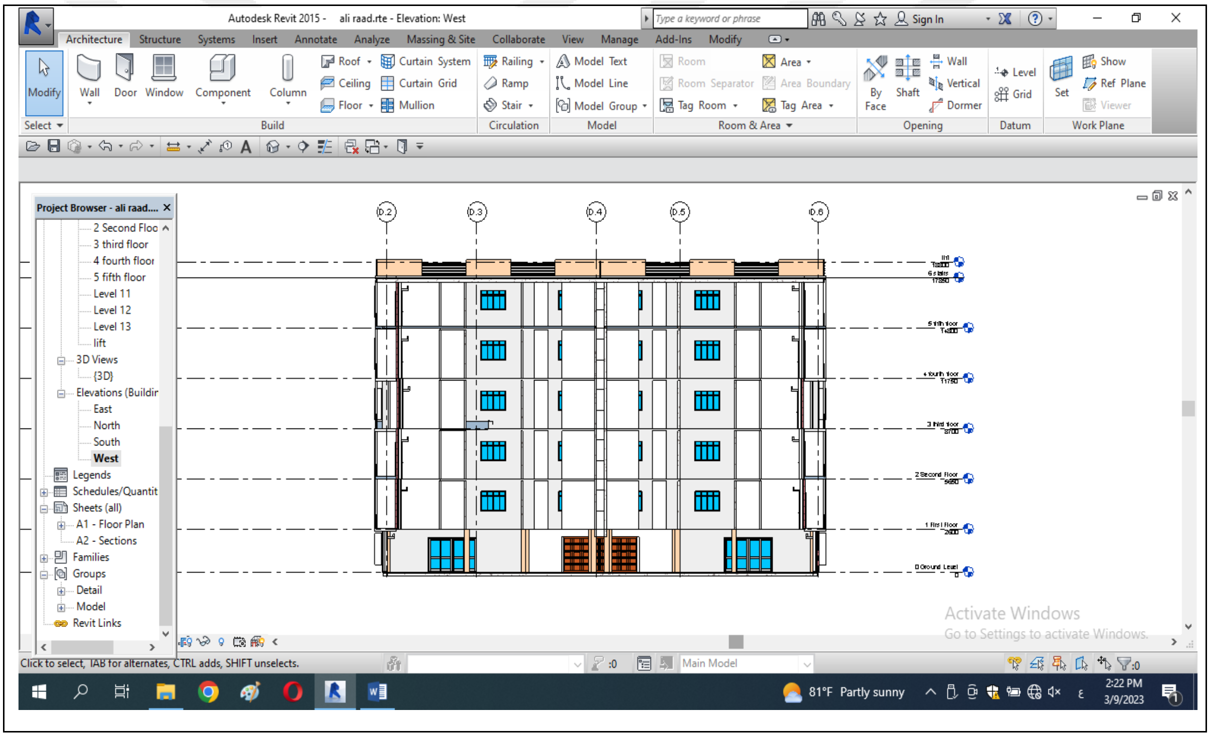

Figure 3.9: Side View of Building Levels.

When determining the quantity of materials required, the type of wall, its dimensions, and the material it is made of are the most crucial considerations. It is possible to specify the type of wall that will be used in a given area, as well as the materials that will be incorporated into the wall, such as insulating or covering materials. By clicking the Insert icon, which is located on the same screen as the type options, you can insert new layers or remove existing ones. Layers, materials, types, and hues must all be described, along with the precise characteristics of each layer, material, type, and hue. After making a selection in the Layers table to investigate the material page for the desired layer, click the area in the row's middle. On the "Material" page, you can select one of the pre-made materials or create a material that is unique to the component you are currently editing. The Methodology Involved in the Development of Sectionalized Lists)

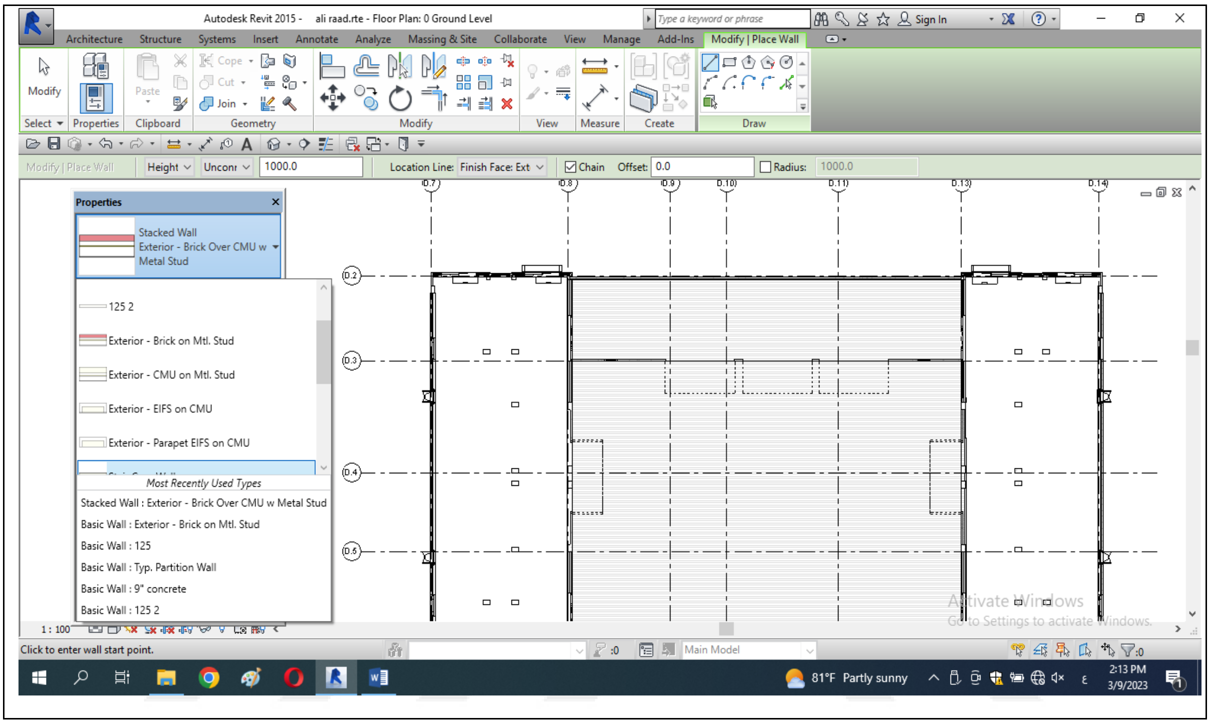

Figure 3.10: Specify Walls Types.

The next step is to specify the type of the walls, the exterior walls can be changed and add more specification such as isolation are additional resistance.

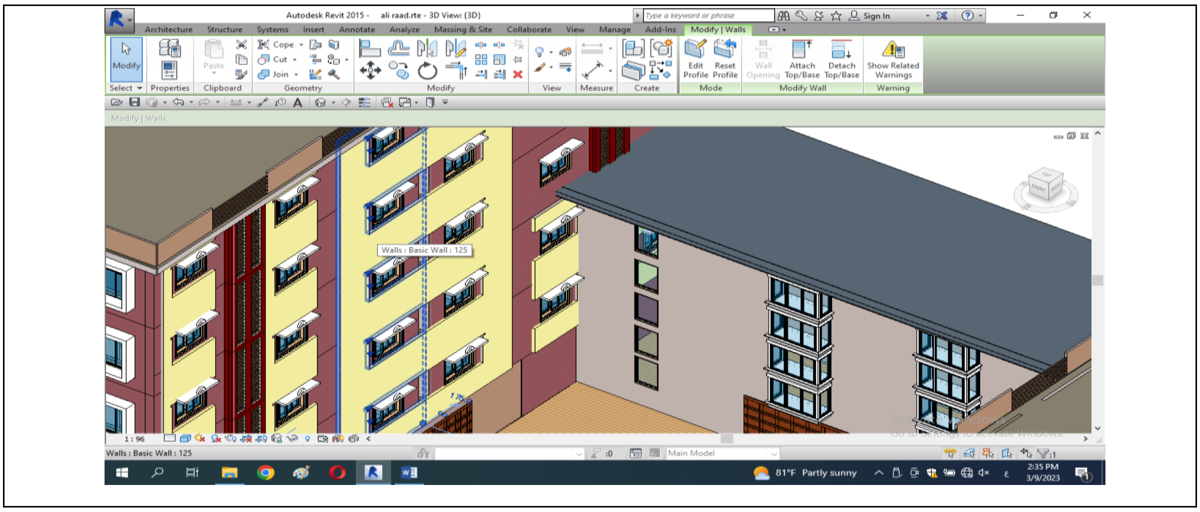

Figure 3.11: Walls Specification Changes.

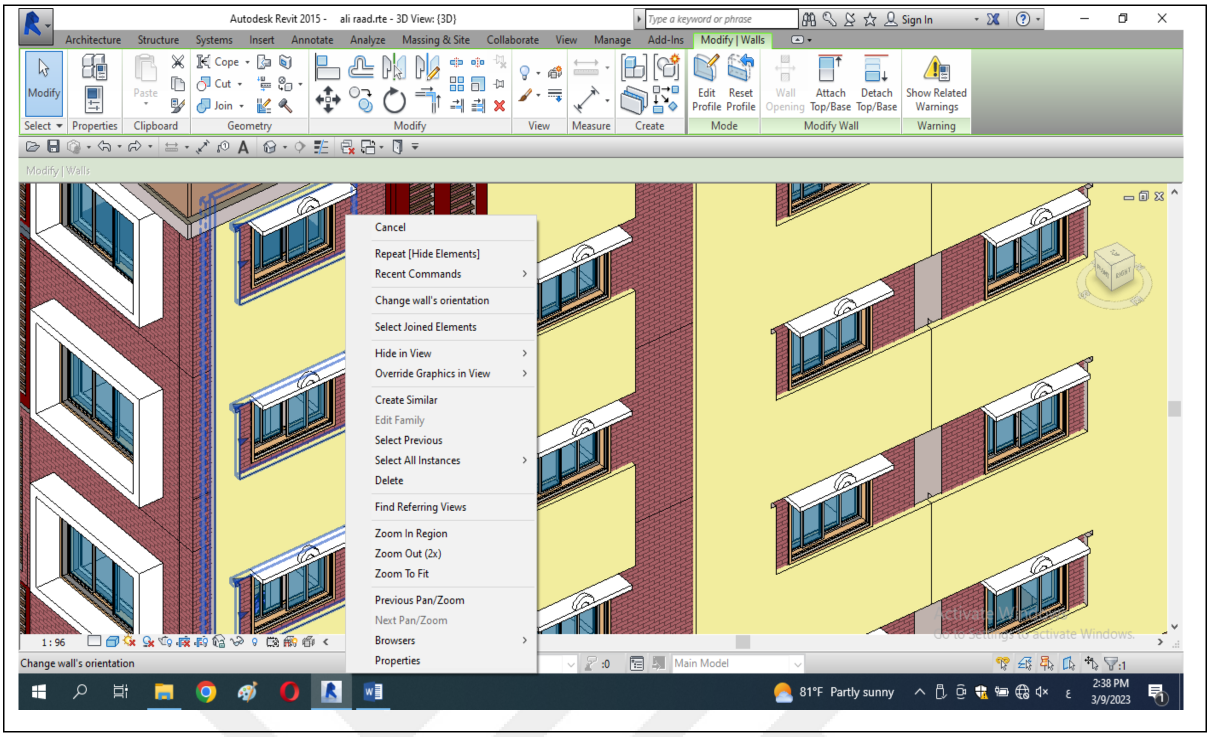

Figure 3.12: Walls New Features.

However, an important distinction must be made between this and the method by which walls are assigned, which is similar in that it depends on the architectural flooring style. Characteristics You may continue to refer to this species by its previous name whenever necessary, such as when painting the floor of the first level. In the remaining sections of this chapter, we will examine a variant of this system that employs distinct concepts for the various types of labor, all of which are based on the same fundamental concept of designing levels and designating employees to them. The construction of stairs and the designating of a level as a garden are two examples of labor that must be performed repeatedly. When describing the strata with all of their dimensions, it is necessary to specify the materials, hues, and species that comprise each layer. To view the material page associated with a layer, first select the layer in the "layer" column, then click the tiny box in the row's center.

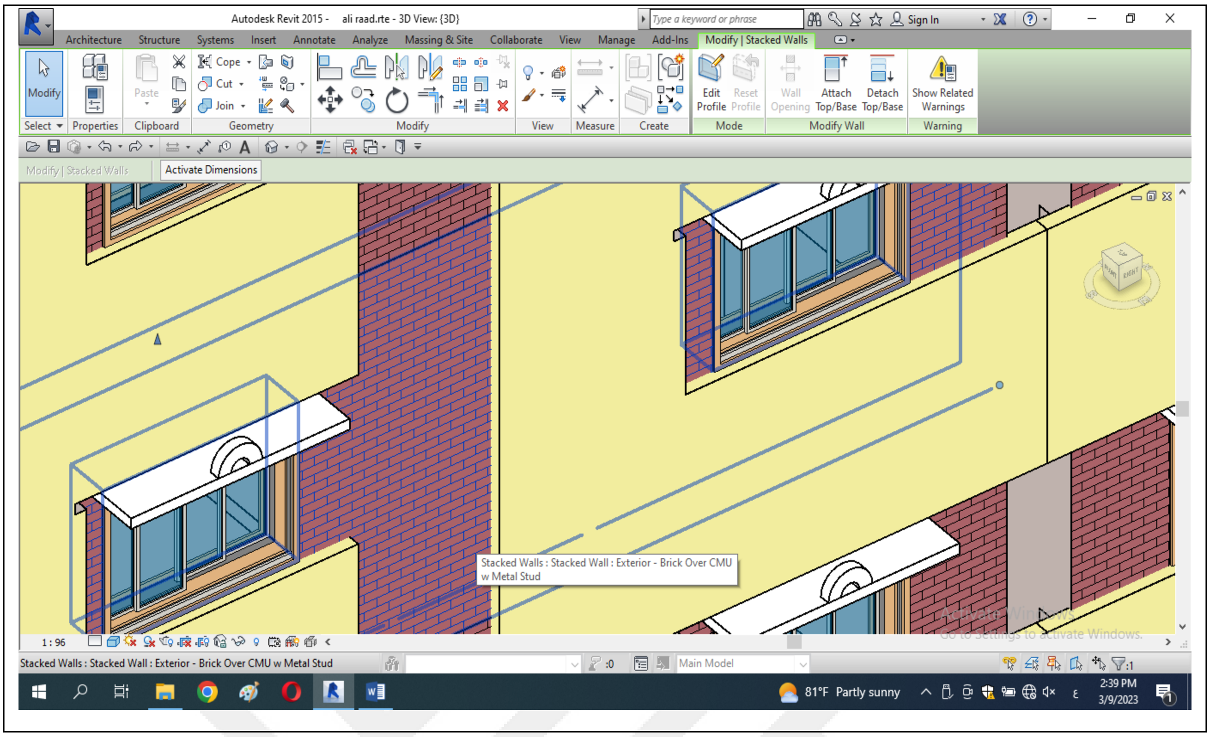

Figure 3.13: Specify The Type of Brick of The Wall.

There is an alternative method for designing staircases; this method relies solely on the dimensions of the stairs to determine the height of each step. This technique will automatically construct and sketch levels based on the number of staircases that have the appropriate one; all that remains is to clear the ceiling to make space for the transit of the stairs. By clicking the QUANTITIES / SCHEDULES icon while investigating the two Quantities / Schedules associated with the project, you have the option of imposing limitations on the quantities and expenditures associated with the project. It allows us to select the table type we require, whether for doorways, windows, columns, plinths, or any other type of construction.

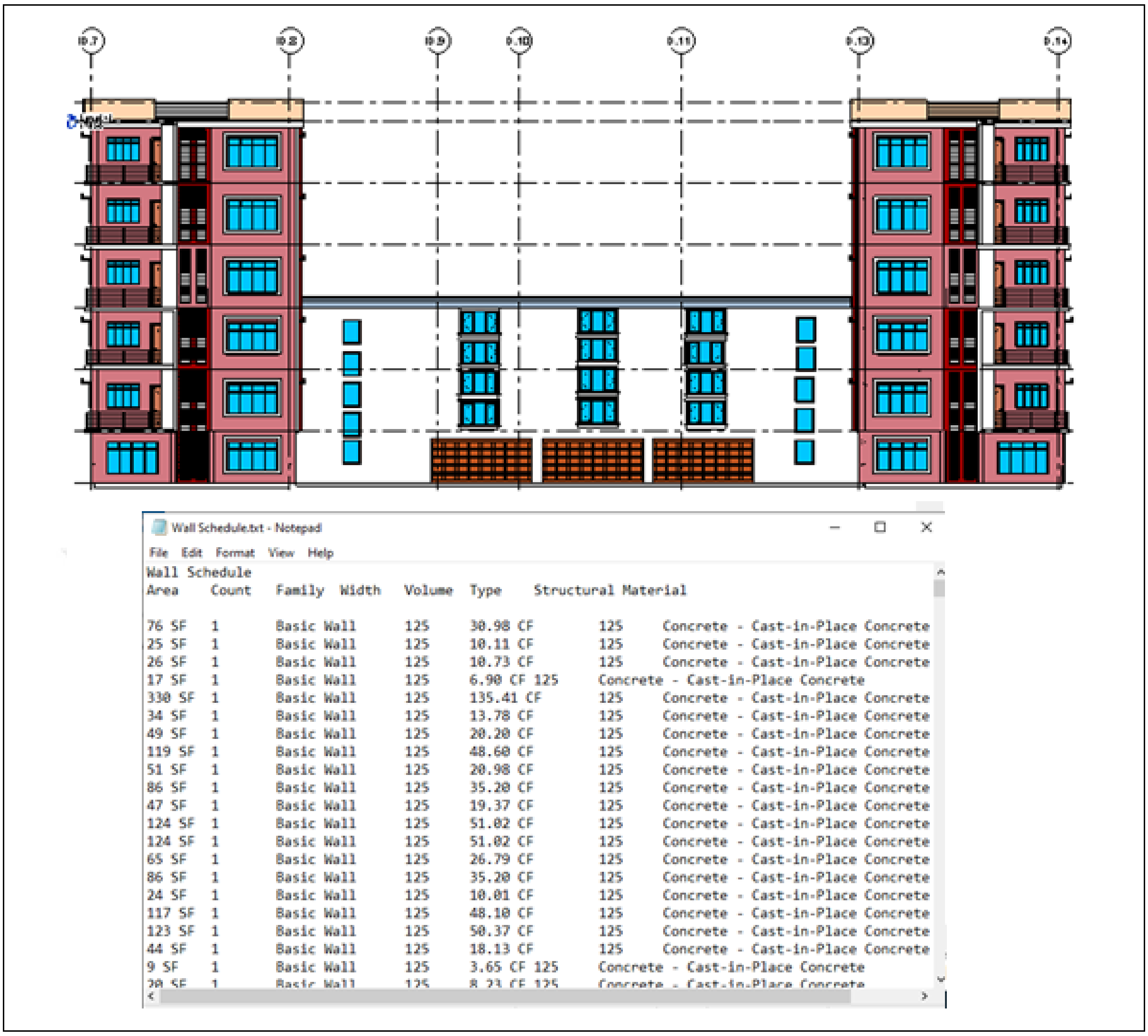

Figure 3.14: Calculate The Quantities of The Building.

3.5 CLIMATE CONDITION IN IRAQ

The region's proximity to open water generates a protective barrier between it and the outside world, resulting in an unusually high temperature. Each season is characterized by either extraordinarily high or extremely low temperatures. There is less illumination during the winter, and the sun's rays have a tendency to penetrate deeper into the atmosphere. Additionally, the region is vulnerable to the intrusion of continental arctic air masses, which have the potential to significantly reduce temperatures. During the summer months, the absence of clouds in the atmosphere is predominantly responsible for the significant increase in atmospheric temperature that occurs during this season. The region that is accessible to the balmy tropical air currents that flow off the continent. The well-being of humans and their cognitive output are affected by a number of variables, including the weather. These elements include the sun's beams, the temperature, the relative humidity, and the wind, among others.

3.6 HEAT LOAD CALCULATIONS

Accurate design, including the selection of the right equipment for the summer cooling adaptation of air and air handling devices, depends heavily on an accurate estimate of the thermal loads of the building(s) in question. This is because summertime cooling energy requirements are calculated based on the building's temperature demands. This is done to ensure that the modified space provides the necessary functionality, thermal comfort, and sufficient air dispersal. Before trying to design an effective HVAC system, some preliminary data collection is required. The first stage is to collect the necessary data. Examples of this type of data include the building's direction, the weather, the distance between structures, the materials used to construct them, and so on. The load assessment will be more reliable if as much information as possible is provided. Estimates of cooling loads for a building depend on its location, direction, and construction design in addition to the internal design conditions of the building. The phrase "external heat gains" is used to describe the process by which hot energy is transferred from an outside source into an indoor space. Solar radiation, which penetrates the structure through windows and doors, as well as ventilation and infiltration, contribute to the transmission of heat in addition to convection, which moves through the exterior walls, the roof, and the earth below. People, electrical equipment, and lights all contribute to the internal heat load. The bulk of a building's perceptible heat load comes from the sun's rays, but a building's own structure also contributes some heat. The building's various parts, including its walls, floors, roof, doorways, and windows, all contribute to this warm air inside. There will be heat transfer between two solid surfaces when there is a temperature disparity between them. Most of the heat that a surface absorbs from the air around it is carried away by convection. Following that, conduction causes the heat to move through the structure and onto the interior surface. The term "convection" refers to the process by which heat is transferred from an interior surface to the air within the room.

$$Q = UA\,(dt) \qquad (3.1)$$

Where U = over all heat transfer coefficient (W/m^2-^{o}C), dt = cooling load temperature difference (C), A = surface area (m^2)

When the wall, floor, or ceiling is made up of layer of different materials, then the overall heat transfer coefficient ‘U’ can be calculated by the formula

$$U = \frac{1}{\frac{1}{he} \div \frac{x1}{k1} \div \frac{1}{ke} \div \frac{x2}{k2} .. \frac{1}{hi}} \tag{3.2}$$

Where:

U: overall heat transfer coefficient

x: wall thickness

k: thermal conductivity

h: eat transfer coefficient

It is common practice to use non-uniform materials, such as air gaps, hollow brickwork, or plaster, in the construction of a building's walls. Adjacent wall structure describes this style of building. Due to the simultaneous nature of conduction, convection, and radiation, heat movement through such obstacles is a multi-step process that can be difficult to conceptualize. In order to calculate the cooling burden, a standard mathematical formula will be introduced in its totality in the next part.

3.7 T-TOPSIS TECHNIQUE

The developed method in this thesis named T-TOPSIS method. It’s a combination between tied rank and TOPSIS algorithm. If tied rank(X) is executed, it will ascertain the ranking of each item in the vector X. If X values are tied, the average rank is calculated using tied rank to determine which of the ties is superior. This adjustment is denoted by the return value TIEADJ and is necessary for the nonparametric tests sign rank, rank sum, and the computation of Spearman's rank correlation. Methods that rank potential answers based on how closely they approach the optimal solution are frequently used when making decisions based on multiple factors (TOPSIS). This strategy prioritizes the favorable option over the undesirable one. Hwang and Yoon (1981) developed a technique called TOPSIS (Technique for Order Selection by Similarity to the Ideal Solution) for MCDM problems. This method is founded on the premise that the best option is the one that meets the most criteria. Using the TOPSIS method, a variety of decision-making problems have been resolved. Method comprises evaluating all potential solutions to the issue and selecting the optimal one. Similar to methods for optimizing value or utility (MAVT), TOPSIS employs the full spectrum of possible attribute performance values to generate a positive and a negative optimal option. Using the results of these evaluations, coordinates are determined for each of the potential options. Calculating ratings for the examined real alternatives by dividing the Euclidean distance between the optimal response and each positive and negative alternative. A graphical representation of the results is permissible, as is the use of actual performance data, and trait weighting is permitted but not required [50, 51]. This technique, based on the ascending order of the criteria, can be used to designate a weighted value to a set of alternatives. Based on the direction in which the decision matrix is rotated, the approach implies that the utility of each criterion either steadily increases or steadily decreases over time. When using a decision matrix, it is essential to have n options, m criteria, and a set of weights for each criterion. Any result that can be measured using a method that makes sense in the given context must be quantified.

4. RESULTS AND DISCUSSION

It is essential to learn how to create in a manner that is both economical and kind to the natural environment. The achievement of a project's monetary objectives is essential to its overall accomplishment. In the sustainable design process, the environmental impact of the use of resources (such as energy and natural materials) is also considered. To get the most out of one's available resources, builders should meticulously select their building materials. As people become more aware of the impact their actions have on the environment, an increasing number of them seek eco-friendly alternatives when constructing new objects.In more developed real estate markets, eco-friendly construction techniques may increase the resale value of a property and reduce its operating and maintenance expenses. When discussing ecology, energy-generating or energy-saving components are frequently the first things that come to mind. In contrast, the use of enduring components is frequently disregarded in the construction industry. Due to their frequent use, the upkeep and replacement of these facilities put a significant strain on limited resources. Common roofing tile materials, such as asphalt shingles and timber shakes, have a propensity for buckling, fracturing, and fading, which can be costly.

This is the case for a variety of reasons, not the least of which is the fact that they require extensive maintenance to function correctly. Don't simply accept my word for it; consider this alternatively. Wide windows, which let in more natural light while reducing a building's reliance on artificial illumination, have acquired popularity among environmentally conscious architects in recent years. Smart glass can be used as the primary window material, which not only maximizes the positive effects of this approach to building construction but also eliminates any potential negative effects. When it's frigid outside and the sun's beams are needed to warm things up, the glass turns translucent to help keep the temperature down, and when it's sweltering outside and air conditioning is needed to keep the temperature down, the glass turns visible to help keep the temperature up. The benefits accrue because the air conditioner is not working as hard. Insulated concrete forms (ICF) surround a structure with a thermal envelope that prevents the transfer of heat or cold. This barrier will also provide an excellent thermal mass, which will help maintain a constant temperature within the structure. In contrast, prefabricated wood will have microscopic fissures and holes that allow air and moisture to pass through. Because they are mass-produced in a facility, this is the case. In contrast, the ICF structure functions as an impenetrable seal, preventing the passage of any unwanted forms of energy. This thesis calculates the total cost of a project employing green construction materials by adding the estimated costs of the roof, walls, and windows. This strategy was evaluated in a real-world case study during the construction of an office building in Iraq. Using BIM, subsequent decisions regarding the construction of a new structure were made. This thesis seeks to identify the factors that allow building projects to use environmentally favorable materials without jeopardizing their economic viability. simultaneously utilizing environmentally friendly materials.

Table 4.1: Boundary Conditions of Maximum Temperature in Four Iraqi Regions.

Region	Maximum temp. in Jul
Baghdad climate temperature	48 ºC
Sulaymaniyah climate temperature	48 ºC
Najaf climate temperature	47 ºC
Basra climate temperature	50 ºC

It is of the uttermost importance to conduct research in order to design building projects that are environmentally sustainable and financially viable. A project cannot be deemed fruitful unless its financial objectives are met. Moreover, sustainable design takes into account not only the quantity of resources (such as electricity and natural resources) used, but also the environmental impact of these resources. By meticulously selecting the construction materials, all available resources should be optimized. As climate awareness increases, an increasing number of individuals are attempting to locate environmentally friendly building materials. Many who contemplate the concept of sustainability investigate various materials that generate their own energy or aid in reducing or eliminating the need for external energy sources. The thermal efficacy of five distinct eco-friendly materials was evaluated to determine if any of them could be used as wall insulation in Iraqi structures. Among the utilized materials were hollow blocks, clay bricks, white blocks, lightweight concrete, and multi-layer concrete. Additionally, hollow block was a viable alternative. The tests will include various forms of insulation, all of which are readily available in the area. In Table 4.2, the observable characteristics of insolation are specified.

Table 4.2: Wall Thickness of The Used Materials.

th1	wall thickness of isolation materials	0.05 (m)
th2	wall thickness of concrete block	0.20 (m)
th3	wall thickness of brick	0.24 (m)
th4	wall thickness of White block	0.20 (m)
th5	wall thickness of Light Weight Concrete	0.2 (m)

To assist Iraq in selecting environmentally friendly building materials, a matrix was developed that considers the environmental, fiscal, and social impacts of various building materials throughout their entire life cycles. This study considers walls, reinforced walls, ceilings, and openings in its analysis of building design. Also considered are the building's components, such as the wood, steel, and concrete. The thermal efficacy of these components is shown to be affected by factors such as the material's cost, its workability, its availability, and its simplicity of maintenance. Market pricing and component supply are the two most important aspects of economic research. When constructing a home, it is essential to consider thermal comfort, interior attractiveness, construction pace, and durability.

Table 4.3: The Used Material Costs and Specification.

No.	insulation material	Cost ($/m2)	Thermal Conductivity (W/m. K)
1	Polystyrene (expanded)	1	0.0374
2	Glass Fiber	2.5	0.05
3	Glass Wool	2.5	0.051
4	Perlite	4	0.035
5	Polystyrene (extruded)	1.3	0.0288
6	Polyurethane	6	0.026
7	Light Weight Concrete	4	0.065

4.1 INSULATION MATERIALS HEAT LOAD RESULTS

The installation of thermal insulation in buildings has the double advantage of keeping the interior comfortable and hygienic even when the weather is cold. Minimum thermal insulation is required to protect building components from thermal impact and moisture-related damage. When insulation is installed prior to winter, it reduces the need for heat, thereby protecting the environment. This objective necessitates meticulous planning and consideration when constructing new structures and updating existing properties. Installing low-U-value windows and utilizing construction materials with low heat transmission values is one method to accomplish this objective (see Windows). This objective is attainable, however, if thermal bridges and uncontrolled intrusion are avoided (see Ventilation). In addition to maintaining a pleasant indoor temperature, thermal insulation helps keep a building cool in the summer by limiting the amount of solar energy that can enter from the exterior. It is conceivable for the value of stationary air to fall to a level lower than that of any unreleased element. Therefore, the objective of developing insulation materials is to incorporate as much still air as is practically possible into the material's framework without compromising structural stability requirements. The insulation components with the lowest -values are those manufactured from insulation panels with ventilation holes.

Table 4.4: Specification of Polystyrene (Expanded).

Polystyrene (expanded) (W/m. K)		
k1	thermal conductivity 1(W/m. K)	1.8
k2	thermal conductivity 2 (W/m. K)	0.0374
k3	thermal conductivity 3 (W/m. K)	1.8
R 1	thermal resistance 1 (kw)	0.027778
R 2	thermal resistance 2 (kw)	1.336898
R 3	thermal resistance 3 (kw)	0.027778
R-total		1.392454
heat transfer		18.67207

Table 4.5: Specification of Glass Fiber.

Glass Fiber (kw)		
R 1	thermal resistance 1 (kw)	0.027778
R 2	thermal resistance 2 (kw)	1
R 3	thermal resistance 3 (kw)	0.027778
R-total		1.055556
heat transfer		24.63158

Table 4.6: Specification of Glass Wool.

Glass Wool (kw)		
R 1	thermal resistance 1 (kw)	0.027778
R 2	thermal resistance 2 (kw)	0.980392
R 3	thermal resistance 3 (kw)	0.027778
R-total		1.035948
heat transfer		25.09779

Table 4.7: Specification of Perlite.

Perlite (kw)		
R 1	thermal resistance 1 (kw)	0.027778
R 2	thermal resistance 2 (kw)	1.428571
R 3	thermal resistance 3 (kw)	0.027778
R-total		1.484127
heat transfer		17.51872

Table 4.8: Specification of Polystyrene (Extruded).

Polystyrene (extruded) (kw)		
R 1	thermal resistance 1 (kw)	0.027778
R 2	thermal resistance 2 (kw)	1.736111
R 3	thermal resistance 3 (kw)	0.027778
R-total		1.791667
heat transfer		14.51163

Table 4.9: Specification of Polyurethane.

Polyurethane (kw)		
R 1	thermal resistance 1 (kw)	0.027778
R 2	thermal resistance 2 (kw)	1.923077
R 3	thermal resistance 3 (kw)	0.027778
R-total		1.978632
heat transfer		13.14039

Table 4.10: Specification of Light Weight Concrete.

Light Weight Concrete (kw)		
R 1	thermal resistance 1 (kw)	0.027778
R 2	thermal resistance 2 (kw)	0.769231
R 3	thermal resistance 3 (kw)	0.027778
R-total		0.824786
heat transfer		31.52332

4.2 RESULTS O COMPOSITE WALL EVALUATION

In this research, three types of results founded from four zones in Iraq. The first result is the heat load of 21 type of composite material, the second result is the total cost of used wall composite materials and finally, is the ranking results using the developed method T-TOPSIS.

Due to its streamlined methodology, the T-TOPSIS technique is both straightforward and reliable. In a variety of oil field circumstances, the T-TOPSIS mechanical lift technique demonstrates to be the most effective option. Normalization is the process of converting the various scales and units used for each criterion into a standard set of measurements, allowing for easier comparisons between the criteria. The flexibility and usability of T-TOPSIS are two of the system's most notable characteristics. Due to the fact that the computations can be performed on a standard spreadsheet, you will not need to be a math expert to complete this endeavor. T-primary TOPSIS's deficiency is the subjectivity with which it determines its criteria and weights, which can have a significant effect on the results produced by the technique. The T-TOPSIS method provides a means of evaluating and selecting approaches based on aspects of information and communication technology by employing a comprehensive strategy and a simplified version of a practical model. This can be attained in a variety of methods. Due to the complexity and unpredictability of the negotiation process, this communication system and assessment model is particularly useful. also, the demand for a more environmentally responsible method of construction is no longer a matter of personal preference; the industry is now regulated to implement measures that enhance the environmental behavior of infrastructures and buildings. A sustainable architecture takes into account the use of resources (energy, natural resources), the impact these resources have on the environment, and the specific hazards they pose to people. Which types of products should be chosen to maximize the utilization of available resources when building? When it comes to construction, environmentally friendly materials, also known as green building materials, are those that have been produced, installed, and maintained with minimal negative impact on the environment. They must be durable, biodegradable, or reusable; composed of recyclable materials; and sourced from the resources of the region where the construction activity will occur; i.e., they must be local materials.

the results of zones shown in tables below

Table 4.11: Baghdad Region Results.

	materials	Heat load (W)	Cost(IRD)	Rank
1	Block with Polystyrene (expanded)	10.69	20.80	0.69
2	Block with Glass Fiber	12.57	23.40	0.61
3	Block with Glass Wool	12.70	23.60	0.55
4	Block with Perlite	10.27	25.40	0.66
5	Block with Polystyrene (extruded)	9.07	25.30	0.80
6	Block with Polyurethane	8.47	26.85	0.71
7	Block with Lightweight Concrete	14.30	26.20	0.44
8	Brick with Polystyrene (expanded)	13.28	34.70	0.25
9	Brick with Glass Fiber	16.32	36.30	0.16
10	Brick with Glass Wool	16.54	36.50	0.11
11	Brick with Perlite	12.64	38.30	0.22
12	Brick with Polystyrene (extruded)	10.88	35.40	0.36
13	Brick with Polyurethane	10.03	39.75	0.36
14	White block with Polystyrene (expanded)	8.68	25.70	0.77
15	White block with Glass Fiber	9.88	27.30	0.62
16	White block with Glass Wool	9.96	27.50	0.57
17	White block with Perlite	8.40	29.30	0.64
18	White block with Polystyrene (extruded)	7.58	26.40	0.77
19	White block with Polyurethane	7.16	30.75	0.62
20	White block with Lightweight Concrete	10.92	30.10	0.40

Table 4.12: Najaf Region Results.

	materials	Heat load (W)	Cost(IRD)	Rank
1	Block with Polystyrene (expanded)	10.24048	17.888	0.5
2	Block with Glass Fiber	12.04762	20.124	0.6182
3	Block with Glass Wool	12.17264	20.296	0.5399
4	Block with Perlite	9.838889	21.844	0.5748
5	Block with Polystyrene (extruded)	8.694988	21.758	0.6977
6	Block with Polyurethane	8.120988	23.091	0.6278
7	Block with Lightweight Concrete	13.70417	22.532	0.3634
8	Brick with Polystyrene (expanded)	12.72485	29.842	0.2757
9	Brick with Perlite	12.11062	32.938	0.2469
10	Brick with Polystyrene (extruded)	10.42281	30.444	0.3828
11	Brick with Polyurethane	9.608696	34.185	0.3578
12	Brick with Lightweight Concrete	18.55109	33.626	0.05
13	White block with Polystyrene (expanded)	8.316851	20.12892	0.8236
14	White block with Glass Fiber	9.470588	21.49788	0.7243
15	White block with Glass Wool	9.547674	21.669	0.6745
16	White block with Perlite	8.05	23.20908	0.6182
17	White block with Polystyrene (extruded)	7.267712	19.79784	0.95
18	White block with Polyurethane	6.862295	24.4497	0.6198
19	White block with Lightweight Concrete	10.465	22.03356	0.5

Table 4.13: Sulaymaniyah Region Results.

	materials	heat load (W)	Cost(IRD)	Rank
1	Block with Polystyrene (expanded)	9.80	18.72	0.69
2	Block with Glass Fiber	11.52	21.06	0.61
3	Block with Glass Wool	11.64	21.24	0.55
4	Block with Perlite	9.41	22.86	0.66
5	Block with Polystyrene (extruded)	8.32	22.77	0.80
6	Block with Polyurethane	7.77	24.165	0.71
7	Block with Lightweight Concrete	13.11	23.58	0.44
8	Brick with Polystyrene (expanded)	12.17	31.23	0.25
9	Brick with Glass Fiber	14.96	32.67	0.16
10	Brick with Glass Wool	15.16	32.85	0.11
11	Brick with Perlite	11.58	34.47	0.22
12	Brick with Polystyrene (extruded)	9.97	31.86	0.36
13	Brick with Polyurethane	9.19	35.775	0.36
14	White block with Polystyrene (expanded)	7.96	23.13	0.77
15	White block with Glass Fiber	9.06	24.57	0.62
16	White block with Glass Wool	9.13	24.75	0.57
17	White block with Perlite	7.70	26.37	0.64
18	White block with Polystyrene (extruded)	6.95	23.76	0.77
19	White block with Polyurethane	6.56	27.675	0.62
20	White block with Lightweight Concrete	10.01	27.09	0.40

Table 4.14: Basra Region Results.

	materials	heat load (W)	Cost (IRD)	Rank
1	Block with Polystyrene (expanded)	11.58	22.14	0.67
2	Block with Glass Fiber	13.62	24.53	0.52
3	Block with Glass Wool	13.76	24.71	0.46
4	Block with Perlite	11.12	26.37	0.48
5	Block with Polystyrene (extruded)	9.83	26.28	0.62
6	Block with Polyurethane	9.18	26.70	0.58
7	Block with Lightweight Concrete	15.49	26.10	0.37
8	Brick with Polystyrene (expanded)	14.38	31.92	0.25
9	Brick with Glass Fiber	17.68	33.40	0.16
10	Brick with Perlite	13.69	35.24	0.22
11	Brick with Polystyrene (extruded)	11.78	32.57	0.36
12	Brick with Polyurethane	10.86	36.57	0.36
13	Brick with Lightweight Concrete	20.97	35.97	0.04
14	White block with Polystyrene (expanded)	9.40	21.64	0.86
15	White block with Glass Fiber	10.71	23.12	0.77
16	White block with Glass Wool	10.79	23.30	0.72
17	White block with Perlite	9.10	24.96	0.72
18	White block with Polystyrene (extruded)	8.22	21.29	0.97
19	White block with Polyurethane	7.76	26.29	0.67
20	White block with Lightweight Concrete	11.83	23.69	0.57

When designing a structure, it is essential to assess its energy efficiency using a variety of techniques that minimize energy waste. There have also been developments in soundproofing techniques. Aerogels have become one of the most extensively used products as nanotechnologies have advanced. These materials are increasingly displacing fiberglass in the insulation market, as they are typically composed of silicon polymers, which are considerably lighter than fiberglass and can provide approximately forty times as much insulation. The vacuum insulated panel is an additional cutting-edge method for reducing heat loss by hermetically encapsulating a panel within a vacuum. Unfortunately, the high cost of production currently precludes widespread market adoption. Thermal mass is the best and most extensively used form of shielding. When evaluating the effectiveness of thermal mass insulation, it is essential to consider both the volume and thermal transfer of the materials employed. Numerous varieties of insulation, such as extruded polystyrene, expanded polystyrene, mineral wool, fiberglass, perlite, and foamed polyurethane, have been evaluated for their ability to insulate commercial and residential structures. It has also been established that using reflective insulation techniques for roof insulation is beneficial. The thermal efficacy of reflective insulation is highly dependent on the thermal resistance of the air spaces and the thickness of the material. Insulation that reflects light reduces the amount of roof space available for alternative energy systems such as photovoltaic panels, but it can prevent a significant amount of solar heat from penetrating buildings in humid or equatorial climates (PV).

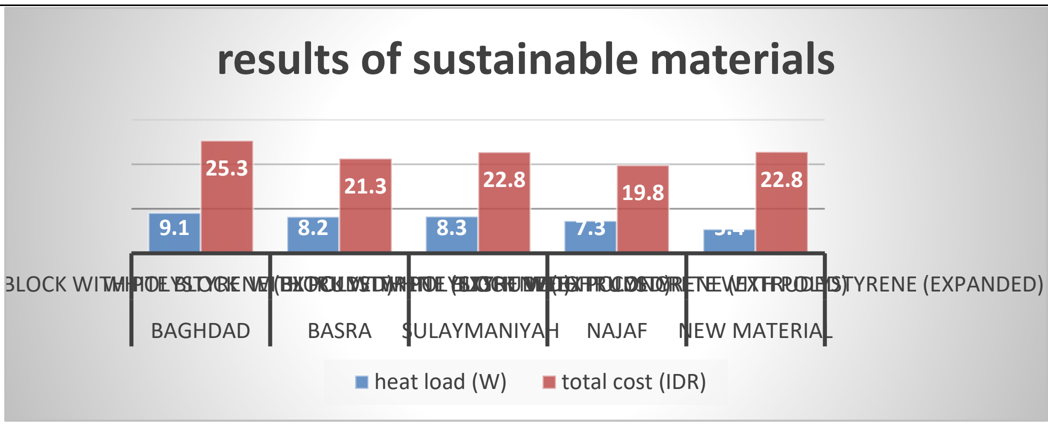

Figure 4.1: Comparison Between The Useful Sustainable Materials Properties based on Regions in Iraq.

The figures provide an overview of the results achieved in this study for the various forms of wall insulation. In addition to presenting the U-values of the walls, the difference between them is also given. The analysis demonstrates how the heat load of composite walls might differ depending on the kind of insulation. These variances are a result of the dissimilar thermal insulating capabilities of each material. In a warm environment, increasing the continuous thermal insulation reduces the thermal effect and, as a result, increases both U-values. This is a structural solution that maximizes the effectiveness of the total applied thermal insulation.

4.2.5 Apply Light Weight Concrete

To enhance building energy, this research suggests to use the Light Weight Concrete as a material in building walls. The same procedure is used to calculate the thermal properties and the cost in each region.

Table 4.15: Light weight Concrete Results.

Materials	Heat load (W)	Total cost (IRD)	Rank
Light Weight Concrete with Polystyrene (expanded)	5.44	22.80	0.94
Light Weight Concrete with Glass Fiber	5.89	24.40	0.84
Light Weight Concrete with Glass Wool	5.92	24.60	0.80
Light Weight Concrete with Perlite	5.33	26.40	0.70
Light Weight Concrete with Polystyrene (extruded)	4.99	23.50	0.92

4.3 APPLY THE MATERIALS IN REVIT CASE STUDY

Revit's drawings and other supporting documents are incorporated into BIM (Building Information Model). You can create your own plans from beginning using Revit. Architects and engineers who have worked with analogous software will recognize the fundamentals of Revit. Using Revit BIM software, the transition from two-dimensional to three-dimensional design is simple. Only a single model is required to generate multiple early documents. Alternatively, architects can utilize Revit because it was designed for that specific purpose. Revit users can not only design their concepts, but also create interactive

3D models. Autodesk Revit is a reliable instrument for building information modeling (BIM). Revit's compatibility with BIM significantly simplifies the process. Instead of being designed for use by any arbitrary group, Revit was created to meet the specific needs of engineers and architects. BIM is, as might be expected, included in the plan. The primary purpose of Revit is to facilitate this type of digitalization. Environment influences behavior, which is modified and retained through memory. One of the most significant benefits is the time saved by eliminating the need to review designs to verify and ensure that everything is in order.

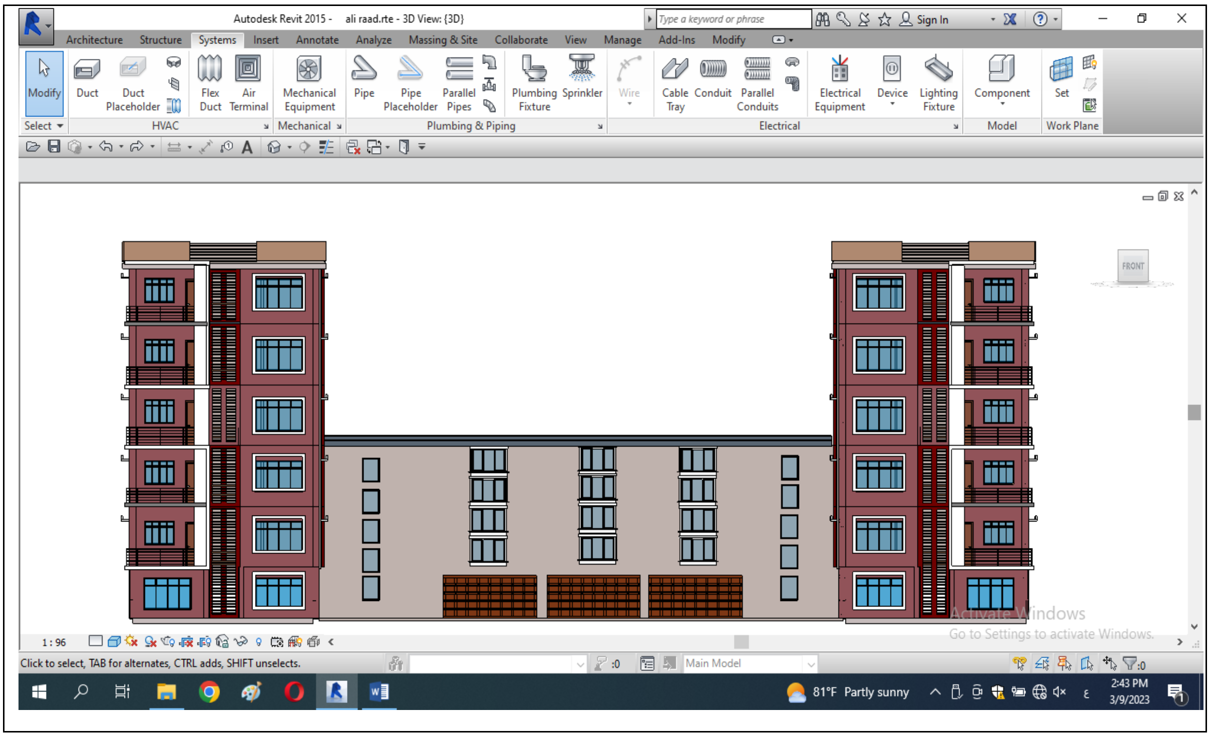

Figure 4.2: The Revit Case Drawing Front View .

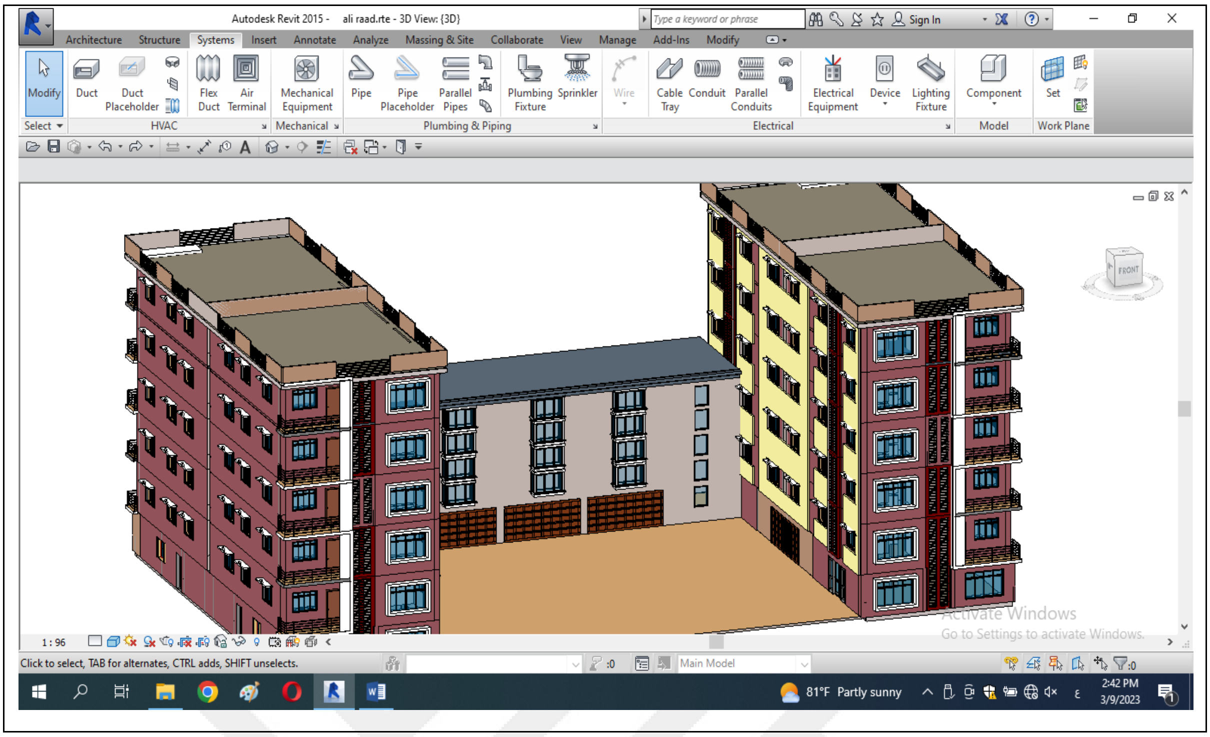

Figure 4.3: The Revit Case Study Side View.

Utilizing Building Information Modeling to specify the components Observe any distinctive characteristics that may be associated with the building's construction materials. In addition to the quantity, additional preparation instructions may be provided. Relevant newly discovered information may be incorporated into the summary. The "Project Details" system family in Revit stores information such as the project's address and the name of the client. Access to these characteristics is essential for foundation analysis and construction, as they serve to safeguard the information garnered during the site investigation. The generated structure and parameters are "Shared parameters," allowing them to be utilized in a variety of contexts. For the structural analysis and design processes in this endeavor, material characteristics, or the qualities of the proposed building materials, are necessary. The following table details these attributes. On the list are properties such as compressive strength, yield strength, tensile strength, elongation at break, mass, compressive strength, and tensile strength. Also present are tensile rigidity and density.

Table 4.16: The Revit Results.

Sustainable Materials	Total wall cost (IRD)
Block with Polystyrene (extruded)	6,382,621,285.96
White block with Polystyrene (extruded)	5,370,483,870.97
Block with Polystyrene (extruded)	5,744,359,157.36
White block with Polystyrene (extruded)	4,994,550,000.00
Light Weight Concrete with Polystyrene (expanded)	5,751,927,483.00

5. CONCLUSION

During the process of assessing the building material attributes of various building projects, it is possible to uncover positive and inspiring search results based on the concept of sustainability. This technique will need to be modified, however, to accommodate the huge emphasis that civil engineering focuses on this particular field. Nonetheless, this study's findings revealed a substantial evaluation of isolation materials in the building industry as well as by future research. Any company that will be participating in the construction process must have a thorough understanding of how cost estimates relate to the ability to recover energy from generated heat in line with the materials that will be used. When it comes to building development, there is a significant opportunity to utilize readily available sustainable resources; therefore, the process of estimating costs should place a greater emphasis on applying this recently developed technique. In this research, three types of results founded from four zones in Iraq. The first result is the heat load of 21 type of composite material, the second result is the total cost of used wall composite materials and finally, is the ranking results using the developed method T-TOPSIS.

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APPENDIX A

MATLAB CODE

```
clc;clear;close all
%the present T-TOPSIS algorithm%
 %developes to achive optimum %
    %sustainable material%
input_thermal_and_cost_values=[ ];
rescal_data = tiedrank(-input_thermal_and_cost_values)
input_representation=rescal_data;
weight_of_factors = [0.5,0.5]';
Wcriteria = [ 1,1];
values_domain=length(input_representation(:,1));
Y = zeros([values_domain,length(weight_of_factors)]);
%% calculating the normalized matrix
for j=1:length(weight_of_factors)
    for i=1:values_domain
    Y(i,j)=input_representation(i,j)/sqrt(sum((input_representation(:,j).^2)));
    end
end
Normalized_Matrix = num2str([Y])
%% calculating the weighted mormalized matrix
for j=1:length(weight_of_factors)
    for i=1:values_domain
        Yw(i,j)=Y(i,j).*weight_of_factors(j);
    end
end
Weighted_Normalized_Matrix = num2str([Yw])
%% calculating the positive and negative best

for j=1:length(weight_of_factors)
    if Wcriteria(1,j)== 0
        Vp(1,j)= min(Yw(:,j));
        Vn(1,j)= max(Yw(:,j));
    else
        Vp(1,j)= max(Yw(:,j));
        Vn(1,j)= min(Yw(:,j));
    end
end
 Positive_best = num2str([Vp])
 Negative_best = num2str([Vn])

%% Euclidean distance from Ideal Best and Worst
for j=1:length(weight_of_factors)
    for i=1:values_domain
```

```
        Sp(i,j)=((Yw(i,j)-Vp(j)).^2);
        Sn(i,j)=((Yw(i,j)-Vn(j)).^2);
    end
end

for i=1:values_domain
    Splus(i)=sqrt(sum(Sp(i,:)));
    Snegative(i)=sqrt(sum(Sn(i,:)));
end
```