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Towards Green And Sustainable Building Practises For Future

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ABSTRACT

In recent years, the global community has increasingly recognized the urgent need to address environmental challenges, including climate change and resource depletion. As a significant contributor to carbon emissions and resource consumption, the construction industry plays a crucial role in shaping our sustainable future. Adopting green and sustainable building practices is paramount in mitigating environmental impact and ensuring a resilient built environment for generations to come.

Key Principles of Green Building:

Energy Efficiency: Designing buildings to minimize energy consumption through efficient insulation, passive design strategies, and the integration of renewable energy sources such as solar and wind power.

Resource Conservation: Employing materials and construction techniques that minimize resource extraction, waste generation, and carbon emissions throughout the building's lifecycle.

Water Management: Implementing water-efficient fixtures, rainwater harvesting systems, and wastewater recycling to reduce water consumption and mitigate strain on local water resources.

Indoor Environmental Quality: Enhancing indoor air quality, natural lighting, and thermal comfort to promote the health, well-being, and productivity of building occupants.

Resilience and Adaptability: Designing buildings to withstand environmental hazards, such as extreme weather events and seismic activity, while also allowing for future adaptation to changing climatic conditions.

Sustainable or green building design and construction is a way of using resources wisely to create. high quality, healthier and more energy efficient buildings. Green building finds a balance between high quality construction and low environmental impact. A lighter footprint means durability that benefits you today, tomorrow and long into the future. We saw green building as both a goal and a process, meaning that it combines both materials and processes to maximize efficiency, sustainability and savings.

This research seeks solutions for efficient water supply, energy conservation, alternative green materials and resources, and improvement of the indoor environmental quality of buildings. The aim of the project is to prepare a preliminary plan of the theme museum building. It uses all the sites it receives. Accordingly, the plan of the museum is prepared listing the various rooms, their importance, area calculation, zoning and connectivity. As today's children shape the future of the nation, it is very important to educate them about sustainable development. Thus, the concept of green and sustainable construction serves the future generation.

INTRODUCTIONS

"So, I say that the earth belongs to each generation wholly and separately during its course, no generati on can incur more debts than it can pay in its existence."

Thomas JeffersonConcerns regarding the preservation of resources, the environment, and lifestyles have b een raised by our developing globe.

Our population is growing faster than ever before, so we must make sure we have enough resources to grow and satisfy the demands of both the present and the future.

The commercial production paradigm that our society has established need greater planning in order to protect natural capital and reduce waste during the development process.

Growth is vital, but it needs to be done effectively and with awareness of how scarce many of our resource s are. Over the last 20 years, our state's energy and material consumption has risen drastically, especially for the built environment. While coal, oil, and gas took millions of years to produce, human use is consuming more of them.

"We are using more of the Earth's natural resources than they can sustainably regenerate," writes author Herman Daly. The majority of people would likely concur that innovations and advances in technology are critical to the advancement of our planet and to new discoveries that benefit humanity. Meeting present requirements without compromising the capacity of generations to come to meet their own needs is referred to as sustainable development. The impacts of development on our biosphere, energy efficiency, the built environment's impact on the planet, sustainable communities, and economic and social sustainability are just a few of the numerous subjects it addresses space. The built environment, or the frameworks in which we live and work, is the main focus of sustainability. Tackling sustainable development concerns in our built environment is the primary objective of this thesis.

1.1 GREEN BUILDING

Green building (also known as green construction or sustainable construction) refers to the design and implementation of environmentally friendly and resource-efficient processes during the life cycle of the building: from planning to design, construction, operation, maintenance, renovation and demolition. This requires close collaboration with the contractor, architects, engineers and client at all stages of the project. Green Building practice expands and complements the economy, usability, sustainability and comfort of classical building design.

Green building is an economical, healthy and above all ecological idea that more and more people are adopting today. Green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- efficiently using energy, water and other resources
- using renewable energy sources such as solar energy protecting health of the inhabitants and improving employee productivity
- Use of non-toxic and sustainable materials.
- Reduce waste, pollution and environmental pollution.
- Reuse and recycling of materials.

The growth and development of our communities has a significant impact on our natural environment. The production, design, construction and use of the buildings in which we live and work are responsible for the consumption of many natural resources.

1.1.1 ENVIRONMENTAL BENEFITS OF GREEN BUILDING:

- Improve and protect biodiversity and ecosystems.
- Improve air and water quality.
- Reduce waste flows.
- Save and restore natural resources

1.1.2 ECONOMIC BENEFITS OF GREEN BUILDING:

- Reduce operational costs cost
- Improve the productivity of the occupants.
- Improves value and performance.
- Optimize lifecycle financial results.

1.1.3 SOCIAL BENEFITS OF A GREEN BUILDING:

- Improves user health and comfort
- Fix operating costs. indoor air quality
- Locally minimize the load on the electricity distribution infrastructure
- Improves overall quality of life

1.2 GREEN BUILDING RATING SYSTEMS

1.2.1 IGBC (INDIAN GREEN BUILDING COUNCIL)

The IGBC Green New Buildings rating system is primarily intended for new buildings, both with and without air conditioning. New buildings include (but are not limited to) offices, IT parks, banks, shopping malls, hotels, hospitals, airports, stadiums, convention centres, educational institutions (colleges, universities), libraries, museums, etc. Building types such as residential buildings, factory buildings, schools and integrated municipalities are covered by other IGBC classification programs. Green New buildings can have enormous benefits, both tangible and intangible.

1.2.2 THE IGBC GREEN NEW BUILDING RATING SYSTEM IS DIVIDED BROADLY INTO TWO TYPES

1) **Ownership buildings** are buildings where 51% or more of the built-up area of the building is occupied by the owner.

2) **Tenant-occupied buildings** are buildings where 51% or more of the built-up area of the building is occupied by tenants.

1.2.3 THE IGBC GREEN NEW BUILDINGS RATING SYSTEM APPLIES GREEN FEATURES IN THE FOLLOWING CATEGORIES SUSTAINABLE ARCHITECTURE AND DESIGN

- Site selection and design
- Water conservation
- Energy efficiency
- Building materials and resources

1.2.4 THE VARIOUS LEVELS OF RATING AWARDED ARE AS BELOW:

Certification Level	RECOGNITION
Certified	Good Practices
Silver	Best Practices
Gold	Outstanding Performance
Platinum	National Excellence
Super Platinum	Global Leadership

1.2.5 GRIHA

GRIHA, or Green Rating for Integrated Habitat Assessment, is India's national rating system for all completed buildings. It is an assessment tool for measuring and evaluating the environmental performance of a building. GRIHA aims to calculate aspects such as energy consumption, waste production, deployment of renewable energy, e.g. trying to manage, control and reduce them in the best possible way. GRIHA evaluates the environmental protection of the building as a whole during its life cycle and thus offers the classic criterion of "green building". GRIHA has always emphasized the maximization of resources (water, energy and materials) and the economy and efficiency of the system and operation.

1.2.6 GRIHA RATING CRITERIA

- For any building or building, the structure is as important as the end result - the finished product itself. GRIHA follows the scoring rules according to the criteria that the builder fulfils. Let's look at some of these criteria.
- Percentage of outdoor lighting with a solar lighting system according to GRIHA principles that is at least 25% of the total connected load, whichever is greater, receives 1 point
- Demonstrated use of minimizing and connecting transport or service corridors and shading of footpaths gets GRIHA 1 point.

Points achieved	GRIHA Rating
50-60	★
61-70	★★
71-80	★★★
81-90	★★★★
91-100	★★★★★

1.2.7 SUSTAINABLE DESIGN

All the residential and business architecture industries have an excellent opportunity to incorporate sustainable principles in their development in order to save natural resources, demonstrate the use of healthier and more efficient products, and improve people's conditions of residence and employment. Buildings having an impact on our environment at each phase of their life cycle, from design to construction to usage and reuse. The production of atmospheric greenhouse gases during the extraction and processing of raw materials, habitat shifting, and garbage generation that burdens existing landfills may be the cause of this. Architecture students have to acquire the required environmental education in order to improve environmental sustainability.

One of the most prominent and important sectors of the economy is architecture. As our nation grows and develops, there is a greater need for factories, office buildings, and apartments. Since buildings utilize over 40% of the world economy's residential and commercial construction materials annually, it is essential to build inefficiently because construction uses a lot of resources. AIA may also play an important part in helping young designers chose truly green or sustainable solutions.

Causes of Air Pollution	
Carbon Dioxide	Increasing in the atmosphere it builds up and acts like a blanket over the earth, trapping its heat causing global warming and affecting weather patterns. Everyone contributes, residents of large areas generate about 10 tons of carbon dioxide a year.
Carbon Monoxide	Is emitted by the incomplete combustion of fossil fuels for home heating, lighting, manufacturing and transportation. It is colorless and odorless because it inhibits the health functioning of human and animal organs and blood cells. Estimates are that the average human adds 3 tons of carbon monoxide a year to the atmosphere from energy used for transportation, heating and lighting.
Sulfur Dioxide	It is given off from many industrial processes and becomes sulfuric acid when it comes in contact with atmospheric moisture. Like nitrous oxide, if produces acid rain, which damages soil, waterways, lakes and forests
Nitrous Oxide	Reacts with volatile organic compounds (VOCs) found in many home decorating products. It generates a damaging form of ozone at low levels and causes respiratory irritations. When volatile organic solvents (chemicals such as methyl, chloroform, halons and methyl bromides) come in contact with the sun, they produce chlorine, which destroys the ozone layer more rapidly than the earth naturally generates

1.2.8 BUILDING DEVELOPMENT

From the beginning to the present, building design and development have undergone numerous phases. Having sufficient knowledge to make informed decisions is vital to being able to make decisions that support environmentally friendly construction and development. We understand that certain traditional building design and product usage concepts apply to contemporary structures, particularly residential ones. The materials used in home décor and construction, which are evolving in the modern construction sector, are the components of the new design. It is more about concerns about how items are produced and how they impact the quality of indoor air.

1.2.9 TRADITIONAL HOMES

The manner in which people have built and decorated dwellings since ancient times can be used to build an approach for designing homes. Creating materials and products for the house needed a number of processes in the pre-industrial age. Wood goods and natural finishes were examples of natural elements that lack the toxicity seen in contemporary construction. Natural wood surfaces, stone, tiles, and slabs were amongst the materials that were more in tune with the physical environment since they were procured locally and handled with care. Of course, the building was heated and cooled using safe yet effective methods. For instance, big walls constructed of native desert mud were used in arid regions to maintain an even temperature by absorbing solar heat during the day then releasing it at night when the temperature cooled down. Massive grass banks are effective insulators in forested areas. Traditional cultures try to preserve natural resources using the simplest materials and forms; The design didn't have to be complicated to be attractive and amazing.

1.2.10 MODERN HOMES

The construction of large-scale mass-produced housing, in addition to some new products and materials that weren't used at home, supplanted the development of contemporary housing in the middle of the 20th century. building following World War II. Cheap mass-built housing, of which plastic is the most renowned example, has been built utilizing new materials and techniques made possible by the petrochemical industry. The fact that some of the new products will ultimately cease the fumigation and discharge chemicals into the air was not realized at the time. The drive to save energy in two ways since the 1970s was a further incentive. First, energy usage was decreased by improving the building's insulation with a substance like urea-formaldehyde, which is frequently employed for wall insulation. In addition, it was used together with home sealing to prevent heat loss. Less heat gain in the summer and less heat loss in the winter were made possible by this new building idea, which reduced the demand for HVAC systems and total energy consumption.

1.2.11 GREEN HOMES

Whilst there have been major shifts in home construction over time, contemporary techniques for building adhere to historical ideas. Thousands of years have passed before the invention of several materials that we now consider modern. Building materials including brick, concrete, glass, metal, and wood haven't changed much over time. As was previously noted, some modern structures use clay, mud, and straw bales instead of wood and metal frames. Recognizing how material choices impact the environment is essential to a sustainable construction approach. Due to improved indoor air quality, it also implies that alternative ecological building designs result in significant energy savings and a healthier working and living environment. The selective recycling is an additional functioning. Another feature is the selective recycling of construction waste in a landfill, where part of the waste can be turned into new products. To figure out what to look for in green products, the customer must ask for and receive this information. Many architectural commissions do not now include green building efforts. Clients and designers must gradually form an alliance for green projects to be effective. It can be challenging to locate an architect with green knowledge. The material is readily available to interested architects, and a customer may wish to seek out an architect who is interested in practising green design.

LITERATURE REVIEW

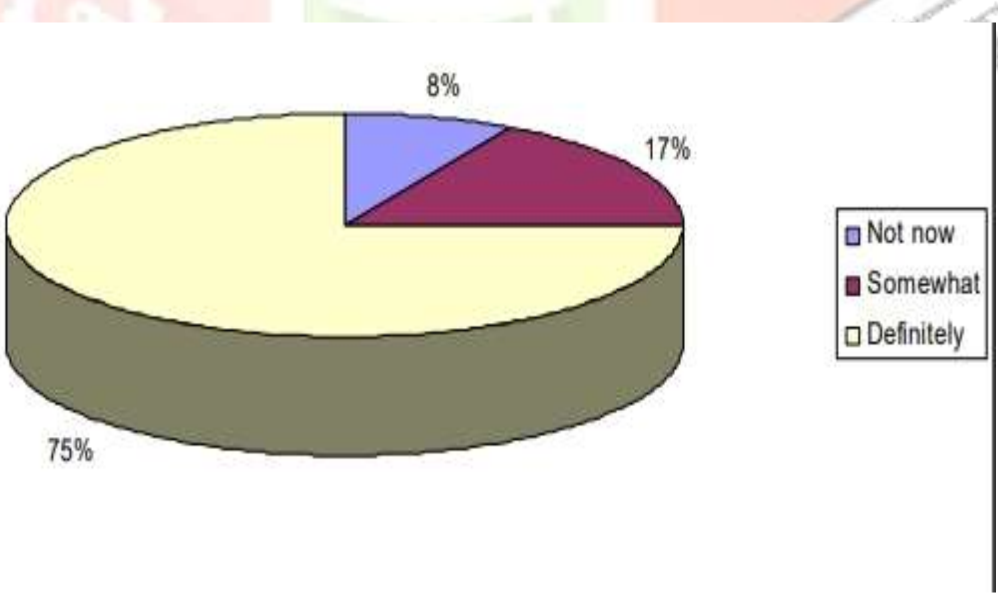
2.1 LITERATURE ABOUT MUSEUMS

Museums are often located in historic buildings. In order to provide suitable housing for a museum in a historic building, these buildings are usually adapted to the storage needs of the objects with HVAC control (heating, ventilation and air conditioning). Maintaining a dense indoor climate and limiting short-term fluctuations in indoor temperature and relative humidity of indoor air reduces the risk to objects. museum buildings. The conclusion is that by using an adaptive thermal comfort guide to determine the operating temperature and allowing the collection criteria developed by ASHRAE climate classes to determine the relative humidity of the day, savings of up to approximately 15% can be achieved in a historic museum building. without addition collection risk.

Museums are obliged to protect their art collection and present the collection as safely as possible. Among other things, the indoor climate is extremely important to minimize the deterioration of the collection. Many museums follow strict climate guidelines that allow only small differences between indoor temperature and relative humidity, which leads to the following problems: huge energy consumption, need for high-capacity HVAC systems, additional stress on historic buildings. This simulation study investigates the energy saving potential of different setpoint strategies. The Adaptive Temperature Guideline evaluation used damage functions and thermal comfort to assess the risk of node rupture. To meet the enormous challenges of the future, they must integrate all three dimensions of sustainable development, ecology, economy and society.

It is important to try to understand how the museum collections and the peoples they represent were seen by the authorities responsible for museum collections, presentation and interpretation in the past, which proved their success in passing on cultural knowledge to younger people generations by their revival. They also contributed to the preservation of the conditions enabling the preservation of living traditions, thanks to the true participation of the communities in question. In addition, they have grown out of their role of acting as community awareness and a place where learning and traditional skills can take place, making them an ideal platform to address community issues.

Is there any market for green buildings?



2.2 CASE STUDY

The Harvard Art Museums are part of Harvard University and consist of three museums: the Fogg Museum (founded 1895), the Busch-Reisinger Museum (founded 1903), and the Arthur M. Sackler Museum (founded 1985) and four research institutes. **centres:** Sardis Archaeological **Centre** (founded 1958), **Centre** for

Technical Studies of Modern Art (founded 2002), Harvard Art Museums Archives, and Straus **Centre** for Conservation and Technical Studies (founded 1928). The three museums that make up the Harvard Art Museums were merged in 1983 into a single institution called the Harvard University Art Museums. The word "university" was dropped from the institution's name in 2008. The collections include approximately 250,000 objects from the media, ancient to modern, and from Europe, North America, North Africa, the Middle East, South Asia, East Asia, and Southeast Asia.

Location	Boston
Established	1983
Location	32 Quincy Street Cambridge, Massachusetts, United States
Coordinates	42.3742°N 71.1147°W
Type	Art museum
Collection size	over 250,000
Director	Martha Tedeschi
Architect	Renzo Piano
Owner	Harvard University
Public transit access	Harvard
Website	harvardartmuseums.org

2.3 HISTORY

The museum was originally housed in an Italian Renaissance building designed by Richard Morris Hunt. In 1925, the building was replaced by a Georgian Revival building on Quincy Street designed by Coolidge, Shepley, Bulfinch and Abbott. (The original hunting lodge sat unused until it was demolished in 1974 to make way for new freshmen.) Calderwood Courtyard takes advantage of natural light streaming through a new glass roof to reduce energy consumption.

• Museums' commitment to sustainability did not end with the laying of the last brick. In the post-commissioning project, the performance of the building's mechanical systems is constantly evaluated and monitored, and at the same time, new opportunities to make operations more efficient are mapped.

• "Harvard Art Museum's LEED Gold certification, particularly its innovative use of LEDs to illuminate the collection, is an excellent example of how the university's commitment to sustainability extends to all types of spaces on campus, from labs and classrooms to cafeterias and museums," said Heather Henriksen, director of Harvard's Office of Sustainability.

AIM & OBJECTIVES OF THE STUDY

- Identification of project location according to IGBC.
- Design green building components according to IGBC.
- Implementation of a sustainable concept of green building in selected units
- Develop and implement strategies to improve the energy efficiency of buildings by a certain percentage over a defined timeframe, aiming to reduce overall energy consumption and carbon emissions.
- Set targets to increase the adoption of renewable energy sources in buildings, such as installing a certain number of solar panels or wind turbines, to achieve a specified percentage of on-site renewable energy generation.
- Establish guidelines for prioritizing the use of sustainable and eco-friendly materials in construction projects, aiming to reduce embodied carbon and minimize environmental impact throughout the supply chain.

METHODOLOGY

4.1 EVAPORATIVE AIR-COOLERS

4.1.1 FIXTURES /COMPONENTS TO BE INCORPORATED IN ANNEXURE:

Design the building in accordance with the Energy-Efficient Building Code (Amended in May 2008) (or) ASHRAE Standard 90.1-2010 (without amendments) using one of methods:

Option 1 - performance-based approach (Whole building simulation)

Option 2 - prescriptive approach: -The total annual energy consumption of the property must not exceed the total energy consumption calculated according to ECBC (or ASHRAE standard 90.1-2010).

Option 1: - Performance-based approach (whole building simulation): Demonstrate compliance of building performance with whole building simulation according to the basic principles described in ECBC (or) ASHRAE Standard 90.1-2010 (as modified).

Option 2: - Prescriptive approach: The project must meet the applicable criteria defined in ECBC (or) ASHRAE Standard 90.1-2010 (as modified) Prescriptive Measures.

4.2 ECO-COOLER

4.2.1 SALIENT FEATURES OF ECO- COOLER

- As hot air rushes into each plastic bottle, it is pushed to the rim where it begins expanding. This expansion then leads to the cooling of the air as it enters the target room.

- This cooling results from pressure change. As air enters the plastic bottle's wider part it comes out the bottleneck with higher pressure. As it quickly disperses into the room, its temperature drops.
- It can reduce the temperature of a room by as much as 5 degrees Celsius- a difference that can be quite significant when looking at comfortable 25 degrees C versus sweaty 30 degrees C.

4.3 WATERLESS URINALS

4.3.1 SPECIALITY OF WATERLESS URINALS:

- Urine flows into the Eco Trap drain.
- Inside the Eco Trap, urine travels through a floating layer of patented, immiscible Blue Seal liquid, which forms a barrier and prevents sewer gases and urine Odors from entering the toilet.
- Urine under the Blue Seal barrier overflows into the centre tube and travels down the drain tube.
- About 1,500 hygienic uses are possible with just 3 ounces of Blue Seal. When Blue Seal fluid runs out, it is simply refilled.
- Urine sediments remain in the Eco Trap. Changing is easy and only needs to be done 2-4 times a year, depending on the flow of urine.

4.4 SEGREGATION OF WASTE

There are three types of dustbins used:

1. Red Dustbin

2. Green Dustbin

3. Yellow Dustbin

4.5 ENERGY EFFICIENCY

Energy efficiency means less energy to produce the same service. The goal of efficient energy use is to reduce the energy required for the production of products and services.

4.6 COOL ROOF

A cool roof is a roof that reflects more sunlight and absorbs less heat than a normal roof. Cool ceilings can be made with highly reflective paint. Cool Roof Roofs contain white or special reflective pigments that reflect sunlight. Coatings are like very thick paints that can protect the roof surface from ultraviolet (UV) radiation and chemical damage, and some also offer waterproofing and repair properties.

4.7 CHAJJA

- It usually protects against external sunlight.
- It also protects the building from rainwater.
- It improves aesthetics.

4.8 WATER BODY

- The water body is made near the front surface of the building.
- This helps to cool the room and the water vapor blows as cool air inside the building and cools the building.
- This improves the aesthetics of the site.
- This prevents soil erosion around the pond.
- The pond plays an important role in maintaining a sustainable landscape.
- This helps create a peaceful environment.

4.9 REDUCING ENERGY DEMAND FOR VENTILATION

- Cross ventilation was arranged for all the maps inside the museum. For cross ventilation, there are windows or fans in the outer wall and a window in the wall up to 2.1 m high in the inner wall
- The chemical exhibition hall and virtual playground have one-way ventilation as they face south to avoid harsh sunlight
- Stack ventilation - cold air enters through lower vents and warmer air exits through higher vents
- Using solar radiation through the interior of the building, the internal surfaces heat up and the temperature rises, which accelerates the ventilation between the top and bottom edges of the stack

4.10 REDUCING ENERGY DEMAND FOR LIGHTING

4.10.1 WINDOWS

In the current plan windows acts as major openings in the building to admit daylight inside the building.

4.10.2 CLERESTORY WINDOWS

- Clerestory windows are placed above the exposed exhibition area, which is raised above normal ceiling level
- They are used for natural lighting and ventilation
- They let more light into the building and reduce glare. of.

4.10.3 SKYLIGHTS

- Ceiling lights are placed above the exposed exhibition area, which is raised above the natural ceiling level.
- This skylight provides diffused sunlight throughout the building, ideal for a museum space.
- Because they are located higher than other windows, they can bring sunlight deeper into living spaces than conventional vertical windows.
- Less dependence on artificial light.

4.10.4 JAALI WALLS

- Jaal walls are placed on the front side of the museum building. The front is north. The northern lights are a natural light that comes from the north in the northern hemisphere.
- Because the light of the northern lights consists of the blue sky, not the light coming directly from the sun, and is better.
- Foot walls are placed on interior walls to help guide visitors.
- Jaal walls help to achieve natural ventilation and natural light
- Jaal walls emphasize the aesthetics of the museum entrance
- This reduces the weight of the wall by 30%. of.

MATERIALS AND RESOURCE MANAGEMENT

The key pillar in achieving the objectives of material and resource management is by using the 3R policy are:

- Reduce
- AAC block
- Jaali wall
- Filler slab
- Reuse
- AAC block: fly ash is used.
- Mud from excavation for Jali wall
- Recycle
- Grey water recycling

5.3 INDOOR ENVIRONMENT QUALITY

- Cross ventilation
- Indoor plants
- Vertical garden
- Low VOC emitting materials
- Natural cooling
- Adequate lighting

5.4 PRESERVATION AND PROTECTION OF ENVIRONMENT

5.4.1 LANDSCAPE

Sustainable landscapes respond to the environment, regenerate and can actively promote the development of healthy communities. Local plants are used. Native plants used as buffer strips on waterfronts slow runoff and absorb nutrients. They are also self-sustaining and support wildlife such as insects, pollinators and native birds.

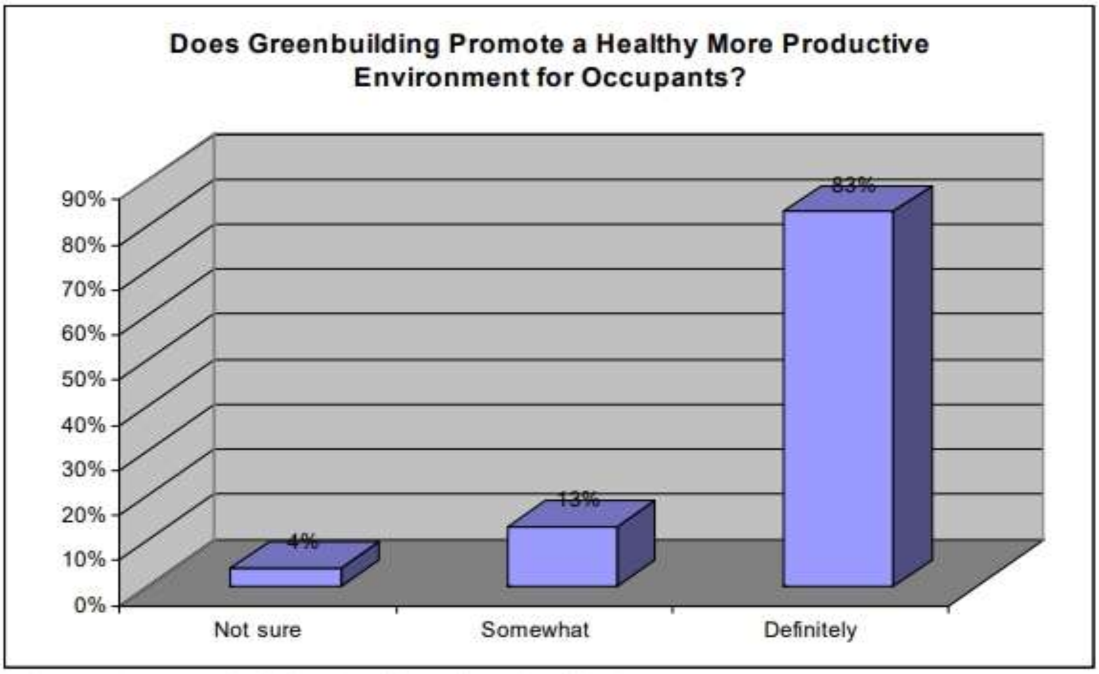
5.4.2 TERRACE GARDEN

- Green roofs can act as habitat
- Green roofs last longer
- Green roofs reduce rainwater
- Green roofs are energy efficient
- Green roofs improve air quality.

5.4.3 VERTICAL GARDEN

Aesthetic effects

- Works as a natural insulator of hot and cold air and saves energy in your building.
- Lowers CO2 levels and increases oxygen content and improves air quality.
- Saves water and requires less effort to humidify.



5.5 BUILDING ENERGY SYSTEMS

Establishing a low energy profile is an important challenge for designers for efficient green buildings. The world's population is growing, which is driving up energy demand, while the output of oil along with other finite resources has begun to plateau. This is essential due to the high expectations for the structure of buildings in the future. There is still time to make crucial choices about the structures we create, even as we get closer to realizing that high global demand and competition are likely to result in a major increase in energy prices. The objective of the movement for environmentally friendly construction is to significantly change building design and increase energy efficiency. Buildings should be neutral, or net exporters of energy, according to proponents of the shift. In today's green building environment, this requirement can be offset by efficient design of building exteriors and HVAC systems that help reduce the demand for expensive and environmentally damaging fossil energy sources.

5.6 PASSIVE DESIGN

Taking into consideration solar energy harvesting or passive design in its whole must be one of the initial steps towards green design. Designing a building's ventilation, lighting, heating, and cooling systems for taking advantage of natural resources like sunlight, wind, and vegetation is known as passive design. Before contemplating active and electrical systems like coolers, boilers, pumps, and other electrically powered equipment, all feasible ways to conserve energy should be taken into account. A key component of green building is the design of passive solar buildings. This strategy minimizes summertime solar energy to the east and west sides of the structure by positioning it on the long side of the property on a true east-west axis.

5.7 SOLAR DHW WATER

Our homes use solar energy to heat water and generate power, and commercial buildings can use it to satisfy their electricity needs. Although some city utilities provide incentive programs for the installation of energy-efficient appliances that heat domestic hot water, hot water systems are more prevalent in houses and apartments. By reducing the amount of heat produced by a traditional water heating system, solar water heating systems directly replace traditional energy with renewable energy, reducing the need for electricity and fossil fuels.

5.8 GEOTHERMAL

Geothermal systems (ground heat pumps) are similar to conventional heat pumps and air conditioners, but use the earth instead of the outside air for heating and cooling, and in other cases for hot domestic water. They absorb heat energy in winter and act as heat in summer. Earth is a viable alternative to air because of its relatively stable temperature. In many places, the soil temperature does not change much during the year at a depth below 6.5 meters. Various systems have been developed to thermally connect the heat pump to the ground, but the two most common are vertical and horizontal systems.

5.9 PHOTOVOLTAIC SYSTEMS

Photovoltaic (PV) cells are semiconductors that convert sunlight into electricity using solar cells. Solar energy is almost maintenance free and seems to have a long life. They have no moving parts and the energy storage is equipped with batteries if necessary. They will be used more in homes and commercial buildings to offset the need for electricity. They are also used in large solar farms the west coast, where large reflective fields collect the sun and turn it into electricity. Countries like Japan are investing heavily in solar energy, believing that this renewable energy source is the fuel of the future.

5.10 WIND ENERGY

Wind is an abundant source of energy that has been used since ancient times. After years of stagnation in the field of alternative energy sources, the wind turbine is making a comeback. It is the fastest growing form of energy production, with annual growth estimated at 25%. The systems are designed for small residential to large wind farms in Oregon and California.Wind energy plants do not cause pollution, and the use of wind energy compensates. for this. because of the pollution that the power companies would cause. A small dormitory power plant can offset about 1.2 tons of air pollution and 200 tons of greenhouse gases (carbon dioxide and other gases that cause climate change) during its lifetime.

5.11 FUEL CELLS

Fuel cells are devices that produce electricity in a process described as reverse electrolysis. During electrolysis, electricity is sent to the electrodes, which breaks down water into hydrogen and oxygen. In a fuel cell, hydrogen and oxygen molecules are recombined to produce electricity, water and heat.

CONCLUSION AND FUTURE SCOPE

6.1 CONCLUSION

Sustainability requires the effort and mindset of using best practices to ensure the most efficient use of our precious resources, minimize waste and protect the human and natural environment now and for future generations. One dominant area of incorporating these principles is the construction of resource efficient or green buildings. In this thesis, I introduced the nature and role of green construction in the construction industry. I wanted to show how this affects the building, the nourishing indoor and outdoor environments, and propose practical methods to achieve the goal of building energy efficient buildings that are healthy for the occupants. I wanted to determine the level of participation in green building within the local building community and across the country. There are many elements involved in the development and construction of a green building. The process includes an efficient workplace and building, construction, materials, indoor air quality, systems and operations. It initially starts with a vision where the owner requires a construction project path for a green building. The owner works closely with the architect and other specialists in the field of construction, participating in the training process, where he learns about the products and design options related to the project. Planning includes the evaluation of materials and products used in the acquisition, manufacture, application, use and final processing of materials. It is important to find architects familiar with sustainable design. they are an important link in the design of a green building. The builder is also a critical factor in the training and planning of an environmentally sustainable building. The design and development process requires an integrated approach where all parties work closely together to realize the vision and goals of the project. Thus, the educational level rises and there is a general consensus on what it contains and what is expected from the success of the project. Once the green building plan is designed, the choice of materials and systems is crucial so that the project can achieve energy saving goals, improve the quality of the indoor environment and make the system work efficiently. New non-toxic and recycled products are more readily available to designers today and the market continues to grow. The nature of green building offers financial benefits to residential and commercial buildings, as energy bills decrease and property values increase. It also offers benefits by increasing workplace productivity and minimizing health problems caused by sick building syndrome. Green building is a growing force in the construction industry today. How much depends on the support and will of the owners, state authorities and organizations promoting its development. My interviews and research indicate that green building is being built in the Spokane/Coeur d'Alene and Washington area. This is not a general consensus, but one that is growing with great interest in the professional construction community.

6.2 SCOPE OF FUTURE WORK

As global awareness of environmental issues grows, the future of green and sustainable building practices looks promising. Here are some key areas where these practices are expected to evolve and expand:

Technological Advancements:

1. Advanced Materials

- **Innovative Insulation Materials**: Development of advanced insulation materials that provide superior thermal performance and are environmentally friendly.
- **Self-Healing Materials**: Materials that can repair themselves, reducing maintenance costs and extending the lifespan of buildings.

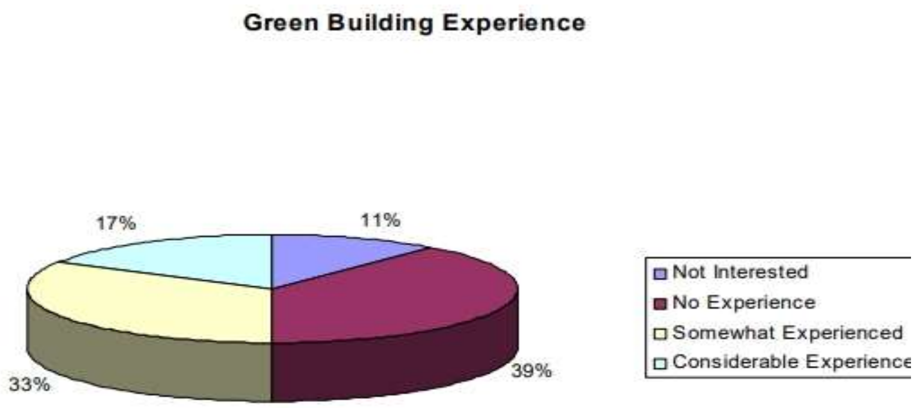
2. Renewable Energy Technologies:

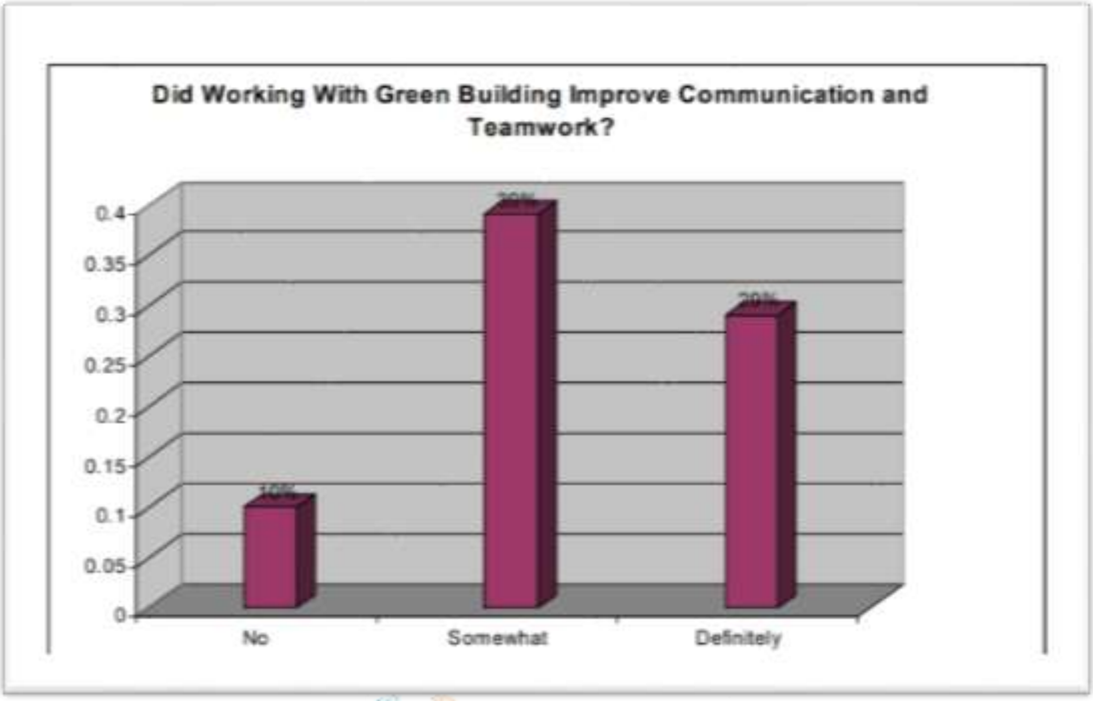
- **Improved Solar Panels**: More efficient and aesthetically pleasing solar panels integrated into building designs.
- **Energy Storage Systems**: Advances in battery technology to store renewable energy for use during peak demand times.

Environmental and Health Benefits:

1. Improved Health Outcomes

- **Healthier Indoor Environments**: Enhanced focus on indoor air quality, natural light, and non-toxic materials leading to better health outcomes for occupants.
- **Biophilic Design**: Incorporation of natural elements into building design to improve mental well-being and productivity.





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1. Annual Energy Review Energy Overview. Energy Information Administration. 2006.
2. A Brief History of Green Building. U.S. Green Building Council. 2006.
3. A Study of Student Performance and the Indoor Environment. Heschong Mahone Group.
4. Barnett, Lopez Dianna and William D. Browning. A Primer on Sustainable Building.
5. Berman, Alan. Your Naturally Healthy House. London: France Lincoln Limited, 2001.
6. Academic Journals: Look for peer-reviewed journals focusing on architecture, construction, sustainability, and environmental science. Journals like "Building and Environment," "Journal of Green Building," and "Sustainable Cities and Society" often publish research articles on sustainable building practices.
7. Industry Reports and Whitepapers: Organizations such as the United Nations Environment Programme (UNEP), World Green Building Council (World GBC), and Green Building Initiative (GBI) publish reports, whitepapers, and case studies on sustainable building practices, standards, and trends.
8. Government Publications: Government agencies at the national, regional, and local levels often publish guidelines, standards, and reports related to green building regulations, incentives, and initiatives.
9. Books and Book Chapters: Explore books authored by experts in the fields of architecture, sustainability, and construction management. Look for titles covering topics such as green building design, LEED certification, sustainable materials, and energy-efficient construction techniques.

10. Conference Proceedings: Proceedings from conferences and symposiums on sustainable architecture, green building, and environmental sustainability may contain valuable research findings, case studies, and best practices shared by industry professionals and academics.