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Economic Analysis Between Conventional Building and Green Building

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Abstract: ***Globally, half of the whole energy is produced and consumed by buildings and is liable for an oversized share of Co2, radiation, and gases. Despite a lot of assessments that have been taken throughout the globe to establish smart and sustainable construction, whereas pollution and global warming are rapidly increasing far and wide universally. Climate changes within the previous few years have conjointly been detected due to a surge in greenhouse gases everywhere on the planet. An initiative for world awareness and global climate change has escalated adequately throughout the earth for the depletion of carbon emissions and harmful gases. The developed countries like Australia, Germany, USA square measure already targeted on this sector, and their government has taken demanding rules to realize eco-friendly and sustainable expansion. Countries like Nepal, India, and Bangladesh face an obstacle regarding the shorter information provided to them in achieving and enhancing eco-friendly construction and property development. Lack of perception amongst the individuals regarding the world wide problems is clouded in economically developing nations. This research paper presents the need for sustainable green construction especially in developing countries like India, Bangladesh has maximum population growth, extremely which are living in most populated areas inflicting a threat to the surroundings, and also the living organisms within the future. This study is specially designated for a building that is designed and created as a conventional building. This Analysis understands the selling price of greening existing buildings before upgrading the building into a sustainable building. The upkeep and operational price are conjointly computed. This study targeted the economic edges and environmental edges once the building is remolded into a Green building.***
Keywords: IGBC rating system, Sustainability, Green building, Life cycle Energy, LEED rating system.

I. INTRODUCTION

A Green building is energy-efficient, water-efficient, conserves natural resources, generates fewer wastes, improved indoor environmental compatibility, and provides healthier areas for occupants, as compared to a conventional building[1] A building that incorporates a harmony between Environmental Responsibility and Resource Efficiency throughout its life-cycle. Green buildings lessen the overall effect of the created environment on human health and the natural environment by:-

1) Buildings Maintenance value is reduced/replacement costs over the building's life process.
2) Sustainable development and eco-friendly environment.
3) Energy and water conservation.
4) Innovation and development.
5) Concern for human comfort and indoor environment.
6) Protects occupant's health and improves employee's productivity.

A. Energy And Water Savings In The Building

"Green building improves operational savings and reduced operative prices by 40-50% in energy savings and 20-30% in water savings [2]. According to the World Business Council for Sustainable Development, building block accounts for 40% of total energy consumption. [3] In property construction, the Economy plays a vital role in future work. The primary purpose of building assessment tools is to assess the environmental tendency of the buildings by employing a set of standards that aim to comprehend extra environmentally friendly building execution[4] Several of those building environmental assessment tools have emerged throughout the planet.[5,6] It is well recognized that there are a variety of advantages associated with green buildings. From an environmental perspective, green buildings facilitate enhancing the urban biodiversity and shield the eco-system by suggests that of sustainable land use [7,8]. The Reduction of construction and demolition waste is a critical component of sustainable building design [9,10]. Indeed, the recycling rate needs to be above 90% to mitigate the obvious environmental impacts of construction and demolition waste which implies reused and recycled materials in new buildings.

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[11] At the time of construction, the operating and maintenance cost is high at some heights that is incredibly tough to manage after you reside in developing countries like the Republic of India. For this, we have to seek out many straightforward ways that to construct, innovate, maintenance of inexperienced homes by reducing non-renewable resources and provides a healthy environment and profitable advantages after some years. From the new building's initial stage to the building completion saves a load of cash, the value is going to be higher for the prevailing building at this point as a result of a lot of work comes underneath remodeling that makes it costlier. Throughout this paper, we'll study the up-gradation of the prevailing building in numerous sub-criteria that helps in obtaining certification for sustainable building and additionally obtaining a return of investment once a handful of years.

B. IGBC for existing buildings

The Indian Green Building Council (IGBC) also the part of (cii) was formed in the year 2001. The vision of IGBC is to make the building sustainable by reducing environmental impacts on the building. By 2025 India should be one of the global leaders in the sustainable environment. The council offers a large array of services which includes developing a new green building rating program shown in table 1., certification services, and green building training programmers**.[Indian Green Building Council]**

1) IGBC Green buildings rating system® addresses the following green features:-

Table 1 IGBC Green building rating system.

Module	points
Sustainable Architecture and Design	05
Site Selection and Planning	14
Water Conservation	18
Energy Efficiency	28
Building Materials and Resources	16
Indoor Environmental Quality	12

2) The guidelines careful underneath every necessary demand & credit enable the design and construction of new buildings of all sizes and types (as outlined in scope).Table 2 shows Complete Different levels of green building certification are awarded based on the total credits earned.

Table 2 Green building certification level

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

Table 3 Threshold criteria for certification levels:

Certification Level	Owner-occupied Building	Tenant-occupied Building	Recognition
Certified	50-59	50-59	Good Practices
Silver	60-69	60-69	Best Practices
Gold	70-79	70-79	Outstanding Performance
Platinum	80-89	80-89	National Excellence
Super-Platinum	90-100	90-100	Global Leadership

II. OBJECTIVES

As per the study conducted on the National leading hostel building of Sharda University. Since the building was found conventional after certain aspects were not fulfilled Like Energy potency, water potency as per IGBC Guidelines shown in Table 4. There is a necessity to up-gradation in numerous sub-criteria that helps in obtaining certification. Criteria within which capital costs are low and the likelihood of obtaining additional points like water potency, Energy potency, indoor air quality. This cost is higher at this point as a result of its associate and plenty of works comes underneath remodeling that makes it costlier. However, if these changes are going to be done then this building saves a lot of cash and additionally less effect on atmosphere however these changes should be done as it makes a negative impact on Environment.

Table 4 Data Assortment of the projected building as per IGBC guidelines.

Module	Points	Achieved
Sustainable design	05	01
Site choice and planning	14	01
Water conservation	18	02
Energy potency	28	02
Building Material resources	16	0
Indoor environmental quality	12	02
Innovation and development	07	01

Hence the following objectives are drawn:

1) To find out Monthly energy and water consumption inside the building.
2) Effective Control & Building Management Systems
3) To counsel a suitable method for installation of Renewable Energy/Renewable resources.
4) To counsel a technique of gardening and metallic element paint
5) To install efficient concrete payers within the building.
6) Improvement of materials utilized within the projected building.

III. METHODOLOGY

The following methodology is adopted for petrifying the building.

A. Vertical Gardening/Living Green Walls

Vertical gardening may be a special quite agriculture largely within the urban areas for decorating the roofs and walls of the building and it grows vertically upward direction of the building as shown in fig 1 and fig 2. In urbanization, the folks have kept smaller horizontal space for outdoor gardening. Green walls can absorb the heated gases that are present within the air in indoor and outdoor temperatures. It provides healthier areas for occupants and improves indoor environmental quality and provides fascinating areas for the occupants. There are two kinds of vertical gardening Green façade and Living/Green walls, Green façade is the type of green walls during which the plant's square measure trained to climb or grow on the designed structure. Green walls can be anchored to existing walls such as fences and columns. Living wall systems are composed of pre vegetated panels that are fastened in an upward direction or vertically to a structural wall or panel. These panels are often manufactured from synthetic fiber, plastic fiber and support a range of diversity and density of plant species and need a lot of maintenance such as fertilizer and water as that of green façade that is planted onto the ground.



Fig.1 vertical wall plantation



Fig. 2 vertical plantation in pots

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B. Low VOC Aluminum Paints

Aluminum paints are made from aluminum pigment in the form of thin layers and it's a coating material. The risen helps the paint to flow. Hence, it provides sturdiness and strength, whereas the aluminum flakes provide shine to paint. Aluminum paints replicate the sun rays falling on it therefore it reduces the warmth intake into the building and provides healthier areas or an improved setting for the occupants. This kind of paint contains a silver end and plenty of manufactures manufacture just one shade of aluminum paint. The outer face wall is exposed to the daylight throughout the daytime so that it will absorb plenty of heat, to avoid and reducing the warmth the aluminum paint is employed to the outer wall and roof of the building. It has smart protective properties with heat resistance, thermal insulation, and corrosion resistance.



Fig. 3 Low VOC Aluminum paint

C. Grass Pavers/Turf Pavers

Grass pavers are called grow-through pavers. They are made of concrete or recycled plastic that is having open cells that permit grass to pass and grow through them. Grass pavers are like paving tiles, within the kind of rhombus-shaped as shown in fig .4 and fig. 5so that the water will suffer the bottom thus it will facilitate by raising the groundwater table. Grass pavers area unit utilized in areas wherever there is a clear stage of wearing or voidance of water. Stormwater runoff is reduced by Grass block pavers that are one of the most sources of pollution. Stormwater is caused once water washes the concrete or asphalt that mixes with road waste product surface and picks some oil and washes the entire cyanogenetic soup into rivers and streams. Grass pavers absorb the water and curtail the flow of water for a specific time by preventing erosion of that space. Grass pavers permit water to pass free and clean to give healthier and friendly surroundings to the occupants.



Fig.4 concrete grass pavers



Fig.5 concrete grass pavers with lawn view

D. AC and Fans

Air conditioning is that the technology for providing indoor and environmental comfort by maintaining the temperature through heating or cooling. It is also used to take control of the environmental condition inside the building. It controls the humidness level that is present within the atmosphere by dominant the movement and distribution of air within the space.

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There are many varieties of HVAC systems, Split and window AC, prepackaged Heating air-con system, and Central AC system. Manufactures provide completely different quite- togged ACs a pair of 2star, 3star, 5star. One should contemplate the age and size of the space, the rating of that AC, and their warranties, and also the kind of system that meets custom best.

E. LED Lighting

LED (Light-emitting Diode) lighting systems facilitate individuals to feel safe and comport.LED needs low voltage lightweight sources and a constant DC voltage. It transforms 120v or 50HZ AC power to the low voltage of the system.LED lights are more efficient and economical than ancient lighting and are economical up to 75% -90% for light sources and solely 5% is wasted as heat[12]. It decreases greenhouse emissions and for an influence power plant, it reduces energy.

F. Solar Power Plant/Solar Panels

Solar power is outlined owing to the conversion of daylight energy into electricity by directly using photovoltaic. The solar power plant is employed for the larger development of solar power generation. In a building, the solar panels are installed on high of the roof of any of the residential, commercial, and industrial buildings as shown in Fig 6 . The storage of the energy is either by using an electric battery or an electrical phenomenon method. There are two forms of solar PV systems: off-grid and grid-connected.



Fig. 6 solar panels on top of the projected building

G. An Off-Grid System

An off-grid system requires battery storage and isn't connected to the electricity grid. The off-grid system can be a stand-alone power system to provide electricity for a small community fig.7. An off-grid system has enough battery capacity to fulfill the need habitant and is installed in such a way so that it will generate enough power throughout the year. An off-grid system is often used in remote areas that are far from the electricity grid. In an off-grid system, the batteries and inverters are costlier than the on-grid system.

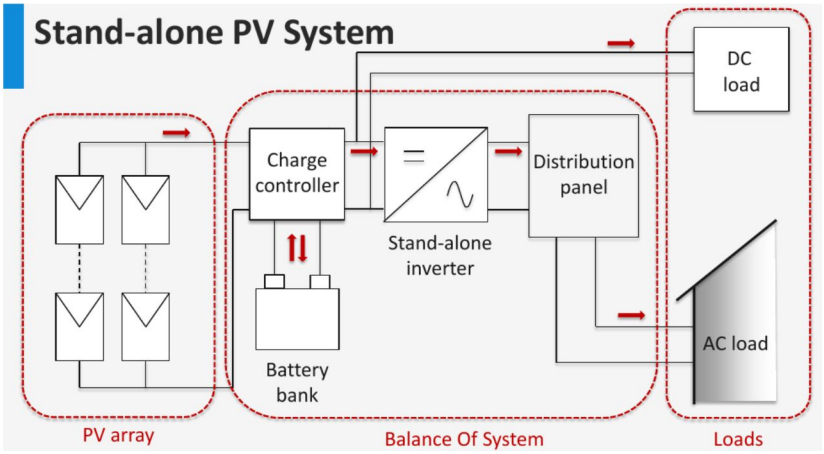


Fig. 7 Off -grid connected system

H. On Grid-System

The on-grid system is most typically utilized in universities and commercial buildings. They are directly connected to the electricity grid and don't need batteries as compared to an off-grid system. From an on-grid system, you generate electricity from a solar array that is directly exported to the electricity grid and you always get paid feeding-tariff (FIT) for the energy you export to the grid. The on-grid power station consists of cables, a solar grid-tied inverter, solar panels, solar web meter, explaining in fig. 8 for reconciliation the installation of an influence plant. Batteries may be also utilized in an on-grid system throughout the night time for backup use once there is no light because of weather.

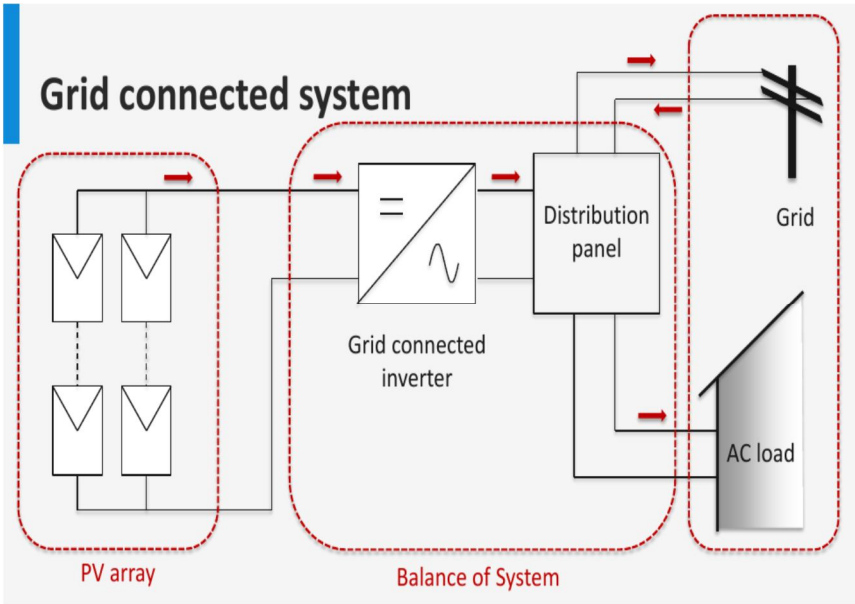


Fig. 8 on-grid connected system

IV. CALCULATIONS AND RESULTS

A. Vertical Gardening

1) Analysis of cost for the vertical gardening on walls and south portion of the building:

Area to be needed for plantation=850sqm.

Table 5 Cost Analysis of vertical gardening

Items	Total quantity of the items	Price/cost
Total pots needed in No's	350 no.	Rs 30,450.00
Requirement of drip for watering and irrigation	L=160m	Rs.13,780.00
Plants and seeds		Rs 65,600.00
Adding manure and fertilizers		Rs.35,000.00
Sheet and fabrics employed in the pot	200 pieces per 6 pots	Rs. 515.00
Installation		Rs.50,600.00
Total price of the items		Rs.195,945.00

2) Cost comparison of heating and cooling system within the needed building:

Cost of Air-con in an exceedingly single room=Rs.29, 000.00

Cost of Air conditioners for 20 rooms in an exceedingly building =2,9000X20=Rs. 3, 48000, 00

Total cost=Rs3, 48000.00

Cost reduction in building=3, 48000-195,945=Rs.1, 50,000.00

Cost saving in building=Rs.1, 50, 000, 00.

B. Low VOC metallic Aluminum Paint

Table 6 Cost Analysis of Aluminum paint

Category	Quantity
Area to be painted of the building	900sqm
Requirement of the full paint	50 Liters
Cost of paint per liter	Rs 150 per liter
Total price of labor for painting	Rs 5000
Total	12500.00

Cost comparison by using acrylic Asian paint on the building
Quantity of the total requirement of paint=70 liter.
Cost of paint=Rs 90 per liter
Cost of total paint=(70X90)+5000=Rs. 11,300.00
Cost reduction =12500-11300=Rs.1200.00
Cost saving=Rs. 1200.00

C. Grass Pavers

1) Cost analysis of grass pavers is given below:
Dimensions of the grass paver=0.8mx3.0
Area to be paved of the site=2mx20m and 2mx 14m
Total no of pavers needed for that area=70
Cost by every paver=Rs.65
Total price of the pavers=Rs. 4550.00
Charges to be placing=Rs 500.00
Total cost=2860+500=Rs. 3360.00

2) Cost analysis by using plain concrete brick pavers
Pavers to be employed in an equivalent area=118
Cost of every solid pavers=Rs. 55
Total price found by the pavers=55 X 118=Rs 6490.00
The Total price of charging to be placing=5000+500=Rs. 5500.00
Cost reduction=5500-3360=Rs 2140.00
Total cost saved =Rs. 2140.00
Total cost on paver operation=500+1500=Rs. 2000.00
Total cost=3360+2000=Rs. 5,360.00

D. Ac and fans

1) Analysis of AC by 3- star rating:
Cost of air-con in a single room=Rs29, 000.00
Cost of Air conditioners in twenty rooms of a building=2, 9000X20=Rs.580, 000.00
Total cost=Rs.580, 000.00

2) Comparison of Ac by 5star rating:
Cost of AC In a very single room=Rs.40, 000.00
The Total value of AC in twenty rooms of a building=40,000X20=Rs. 96, 0000.00
Cost reduction=960000-580,000=Rs.38, 0000.00
Saving=Rs. 380,000

3) Analysis of fan by 3star rating
Cost of fans in a single room=Rs.1200.00
Total no fans in a building=300
Total cost of fans in overall building=Rs.360, 000.00

Total cost=Rs.360, 000.00

4) Comparison of fans by 5star rating:

Cost of fan in a single room=Rs.3200.00

Total value of fans in overall building=3200X300=Rs960, 000.00

Cost reduction=960000-360,000=Rs.600000.00

Cost saving=Rs.600000.00

E. LED lights

Table 7 cost Analysis of LED lighting system

Items	Quantity	Price
CFL power bulb	200no/40w	Rs 300 each
Total price of CFL bulbs	8000W	Rs 60,000
LED bulb power	200no/12w	Rs 120 each
Total price of LED bulb	2400w power	Rs.24000.00

Energy consumed is 8000w-2400w=5,600w

Total additional price to be paid =60000-2400=Rs.57600.00

So, the total savings in energy is =Rs.57, 600.00

Total saving of cost =60,000-24,000=Rs. 36000.00

The analysis of energy saved per hour is given below:

Total no of tube lights within the building=200

Power of every tube light=40w

Total power of all tube lights=200x40=8000w

Total no of fans=300

Power of each fan=55w

Total power of all in watt=55x300=16,500w.

F. Solar Power Plant/Solar Panels

Watt Total power all fans = 54 X 60 = 3,240 Watt

Other miscellaneous consumptions=10,000w

Energy consumption per hour=30,500watt=30.50 kilo watt

Cost of energy consumption per day=30.50x8 hrs per day=244kwh per day

Cost of energy consumption per month=244kwx30 days=7320kwh per month

Total Energy consumption per month=8x7320=Rs.58, 560.00

Cost reduction

Cost reduction when the implementation of charges=2000units per month (approx.)

Total energy reduction=2000kwX8hrs-7320kwh=12284.8kwh per month

1kwh=Rs 6

The total cost of energy created by solar power=18,000kwhX6=Rs. 108,000.00

Total energy saved=108,000-58,560=Rs.49, 440.00

V. CONCLUSION

1) Total cost of vertical farming is found to be Rs. 195,945.00

2) Total cost saved in vertical gardening is found to be Rs.150, 000.00

3) The area required for aluminum paint on the roof is about 900sq m

4) The total cost required for aluminum-based paint is found out to be Rs 12500.00

5) The total savings in aluminum paint=Rs.1200.00

6) The total demand for semiconductor diode bulbs in a building is about 200 bulbs.

7) The cost of LED light is found to be Rs 60,000.00

8) Total energy savings=5,600w
9) Total cost savings by semiconductor diode bulbs=Rs 36000.00
10) Total cost of ACs by 3 star ratings=Rs.5, 80,000.00 and total cost of ACs by 5 star ratings=Rs.960, 000
11) Total savings in cost=Rs. 380,000
12) Total cost of fans by 3star rating=Rs. 360, 000, 00 and total cost of ACs by 5 star rating=Rs.960, 000.00
13) Total savings in cost=Rs.600000.00
14) The area grass paver is to be as=35 sqm
15) The total cost of grass paver is to be found as=Rs.5360.00
16) Total cost saving by plain brick concrete=Rs.2140.00
17) Total cost energy produced by solar panels. =Rs.58, 560.00
18) Total energy savings =Rs 49,440.00.

Payback of Total Cost

19) Total approx. cost of the solar plant is to be found Rs 527,490.00
20) Total cost of the building after retrofitting is to be found as Rs12, 72,365.00
21) Total cost saving is Rs 876,780

The total cost is to found once retrofitting the building as Rs 527,490.00 and the total cost savings is to found as Rs 876,780. If the life of the solar panel is 25 to 30 years the price of solar will be returned in 3-4 years and the total cost will be returned in 6-7 years.

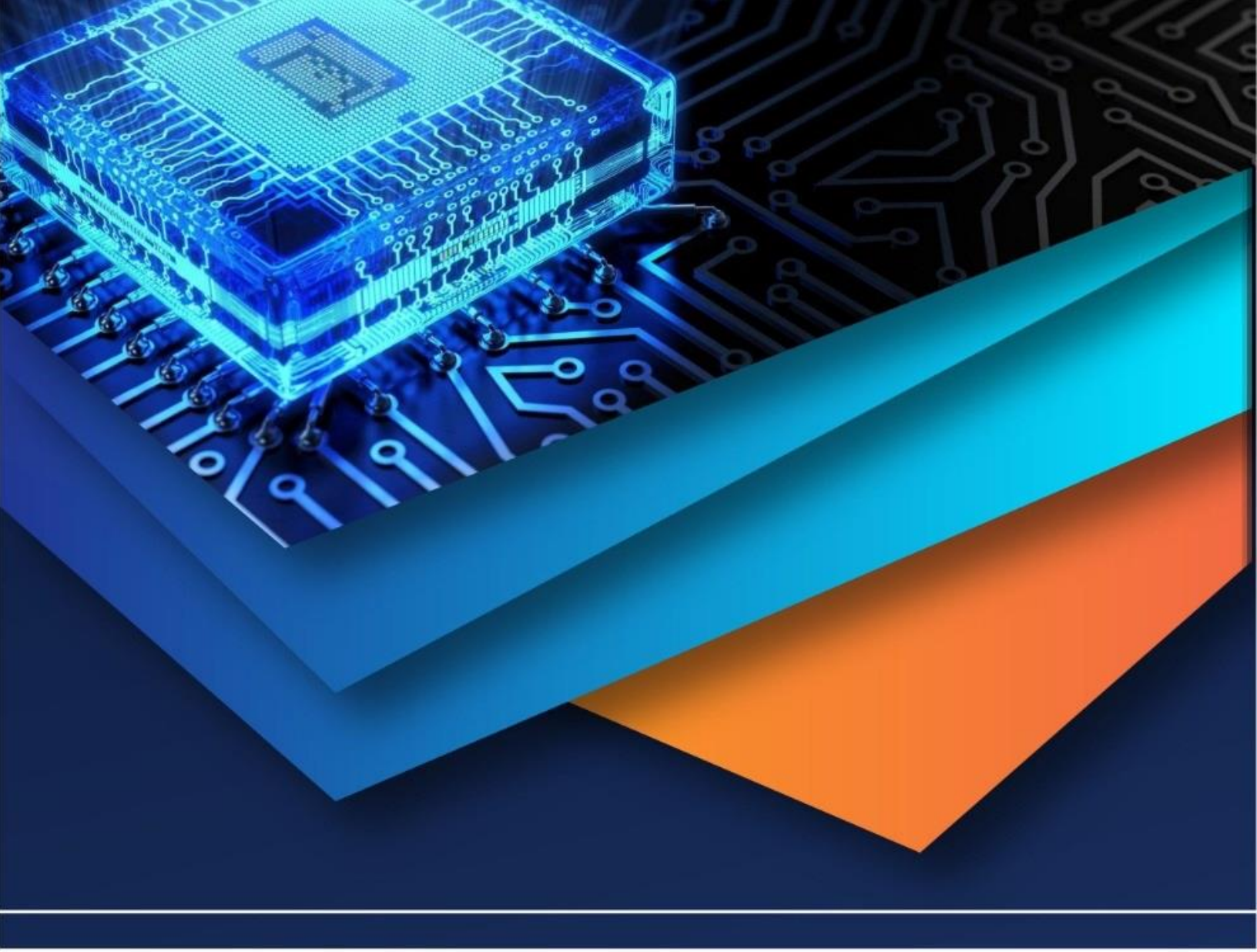
Table 8 IGBC certification points to categories in the building rating system

category	Points
Sustainable architecture and design	01
Site selection and planning	O5
Water conservation	10
Energy efficiency	15
Building materials	12
Indoor environmental quality	09
Innovation and development	05
Total	57

Hence it is eligible to fall under the certified" CATEGORY" according to IGBC standards
Total points achieved of the projected building as shown in Table 3 as per IGBC guidelines = 9
Hence, the total points after retrofitting will be (57+9) =66.
Hence it will undergo in "GOLD" categories.

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