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Cost Optimization of a Building Using Sustainable Building Concept

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Abstract*: The global energy crisis and water scarcity have brought the threats and challenges of climate change and environmental concerns for developing and developed countries. Especially developing countries have to address the increasing energy and water demands of growing economies. Energy performance and water consumption of a building are key element in order to control and eliminate the threats. Buildings have huge impacts on the environmental development, economy and social development. Buildings are accountable for almost 40% of total energy consumption and greenhouse gasses emissions. The purpose of this quantitative research is to investigate cost optimization of existing residential buildings for sustainability in a composite climate zone, through energy and water efficient strategies in order to address the concept of sustainability for existing built environment. The findings shows there is a strong need for adopting the green retrofitting energy and water efficient strategies where we can conserve total of 691665 KWh energy annually by replacing of conventional electrical fans, exhausts fans with energy efficient ones and geysers with solar water heaters with a payback period of 8 to 15 months, and reduce water usage by 40% by replacing conventional water fixtures with efficient ones but it won't be financially attractive because the source of water is from tube well inside the campus ground water and is supplied free of cost but it is advised to go for purpose of sustainability and conservation of water for future generation. Finally, it is suggested that application of these strategies are not only cost effective but for sustainability and utilizing of resources.

Index Terms*: Cost optimization, Sustainable Building, Water conservation, Energy conservation, GHG, Global Warming.

I. INTRODUCTION

India, the seventh largest country in the world, is a leading economy with more than a billion human living in five different climatic zones. Since the beginning of the 1991 economic reform India's economy has grown rapidly. Construction industry has played a very important role in its economy and contributed to about 6.5% of GDP. Residential and commercial sectors have remained a key market for the building and construction industry. These Sectors consume a lot of energy throughout the building's life cycle, making it the most important contribution of greenhouse gas emissions. In Indian buildings it is projected that energy consumption would significantly increase due to human development, economic growth and construction development(Meghraj, 2007).

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In India almost 65% of total generated energy is generated from nonrenewable sources of energy like coal, diesel, gas and etc.(S. N. Singh, Singh, & Østergaard, 2009). It is the major source which contributes to generate air pollution and causes to death of 1.27 million deaths in India annually (Balakrishnan et al., 2019). There is a strong demand for sustainability and sustainable development. Sustainable development has been defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment Development). The increased demand for luxurious life style and natural resources have produced greater impacts on the environment in developing countries. At present the world is facing many major problems such as environmental, social and economic. Environmental problems especially climate change is now affecting all countries on every continent. It is disrupting national economies and affects lives, costing people, communities and countries today and even tomorrow. In today's world climate change is a great concern for the world, it is why the concept of sustainability is defined to address these concerns and find alternatives, cost efficient and sustainable solutions for societies. These concerns have made each and every authority i.e. designers, companies and researchers with modern technologies and energy efficient design structures within the construction sector that will provide green solutions to address some of the global warming challenges. The idea behind the activities are innovation to reduction the carbon emissions that occurs as a result of some constructions activities in the built environment (Yusuf Arayici, 2015). Weather is changing, sea levels are rising, greenhouse gas emissions, Ozone layer depletion, global warming, water scarcity, energy crisis and air pollution are now at their highest level. Without taking action, the average surface temperature of the earth could increase by 3 degrees Celsius during this century. The poorest and most vulnerable people are the most affected. These are the major environmental problems which is created by the daily activities of human on the earth. These problems have adverse effect on ecology and ecosystem. The environmental concerns cannot be fully eliminated but can be reduced by a high level through sustainable development (SD) and its goals. The three pillars of SD are sustainable development-economic, social and environmental (UN, 2015). The ecological stability of human settlements is part of the relationship between humans and their natural, social and built environments (Scerri & James, 2010) . Environmental sustainability (ES) is about the natural environment and how it lasts and remains diverse and productive.

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Since natural resources come from the environment, air, water and climate, are of particular concern. ES requires society to plan activities to meet the needs of the human at present but preserves the life support of the planet. This, for example, sustainable use of water, using renewable energy and supply of sustainable materials. For applicability of sustainability concept in construction industry we design sustainable building or green building which inflects the lowest effects on the built environment through its life cycle and it comes under sustainable development. Measures for sustainability is different from climatic pint of view. India, a country which subjected to different climatic conditions and zones, ranging from very hot to very cold and dry to very humid. The characteristics of each climate vary and consequently comfort requirements differ from one climate zone to another. Depending on the intended use, the comfort requirements and the type of design, the energy demand of the buildings is evolving. The five different climatic zones are based on hourly temperature, various climatic parameters and solar radiation: Composite, Warmed, Moderate, Warm-wet and Cold(Meghraj, 2007).

1.1. Cost Optimization

Cost is an amount to be paid or given up to get something. In the business, it is usually a monetary valuation of the effort, resources, materials, time and utilities consumed, the resulting risks and the opportunities lost in the production and supply of a product, goods or service (Barbole, Nalwade, & Parakh, 2013). (Rajguru, 2016) defines optimization as an organized effort made for improving profit margins and obtaining the best outcomes under given conditions or situation. (Vinod Jetley, 2016) explains that cost optimization is all about finding alternatives with the most cost effective or highest achievable performance under the given constraints, by minimizing undesired factors and maximizing desired ones or in other words cost optimization means performing same tasks or more at lower cost. In order to go for optimization of buildings we have to go for analysis of initial and long terms expenses of buildings.

In the construction projects, the key features to be considered in the planning of every project are cost and time (Rajguru, 2016). The criteria for successful projects are Time, Cost, Quality, and Client’s Satisfaction but apart from these parameters due to environmental concerns those projects are successful which have the lowest impacts on environment.(Silva, Warnakulasooriya, & Arachchige, 2017)

1.2. Sustainable Building

Sustainable building, is also called a green building (GB), it is a building which is planned, built, renewed, functioned, or re-used in an environmental and resource effective manner. Prior to building a green buildings few parameters to consider for a green building are sustainable site planning and landscaping, efficient use of water, energy efficiency, and use of eco-friendly materials, indoor environment quality and for health and well-beings of occupants. The main goal is a step towards sustainable development (Balramdas et al., 2016). In other definition a GB is the one, which optimizes energy efficiency, conserves natural resources, uses less water, generates less waste and provide healthier environment for dwellers as compared to traditional building. It integrated vast practices to ultimately reduce impacts of buildings on built environment and emphasizes on taking use of advantages of renewable resources, e.g. reduction of rainwater runoff, rainwater harvesting, using tree through green roofs, rain gardens, using sunlight through passive solar, active solar and photovoltaic tools (Prasang Yadav, Shubhangi Kirnapure, 2018).

1.3. Scope

Today, India's manufacturing industry is developing and with the development of more new buildings, it is likely that Indian CO2 footprints will increase significantly. However, it can be reduced to a greater extent by applying strong rules and regulations for building design and construction activities. While the main challenge will be to convert existing buildings into energy-efficient and water-efficient buildings. Thus, in order to optimize the cost of existing buildings, it is sufficient to raise awareness of the way in which it can benefit, because various amounts should be invested from the initial phase. The amount invested will be recovered within a few years of its use compared to long-term benefits, even in terms of health. It also reduces electricity and water tariffs and helps save and preserve the environment. The life of the building is also rising due to the use of green technologies. The basic energy performance of a building type is defined as the typical energy consumption of a building type in a given geographic area, using the technologies, construction methods and building materials that apply (energy efficiency tends to change drastically with changing climatic zones of the operation of the building). Few studies are available on the energy performance of basic building structures of different types located in different climatic zones of India and even those that are limited. In the absence of such a study, efforts are being made to develop basic energy efficiency and link greenhouse gas emissions to large types of buildings in India.

1.4. Objective of the Study

The objective of the study is to investigate the cost optimization of an existing residential building through green and cost effective strategies of energy and water efficiency in a composite climate zone, to find and recommend the best alternatives in order to encourage and aware clients from its economics, social, environmental and healthier aspects of implementing it. In addition, to reach sustainable development goals and preserve the environment for our future generation.

1.5. Adopted Parameters

- Water efficiency
- Energy Efficiency
- Improved air quality and health.
- Return on investment and payback period

II. LITERATURE REVIEW

(Prasang Yadav, Shubhangi Kirnapure, 2018) have done a research on building long term benefits. It is found that the initial cost of green buildings are higher than conventional buildings which the extra amount will be paid back after some years of use. Going for green building will only increase the initial cost in the range of 12-15% compare to conventional. But is to live in better and in a healthier atmosphere the extra amount

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should be tolerated. Optimized energy will not only reduce the use of natural resources but it helps to reduction of direct and indirect cost saving for water and electricity bills. For a new construction buildings some countries have made mandatory to adopt at least some strategies of sustainable building while the existing buildings are still a big concern for sustainability. Especially existing traditional building are accountable for huge impacts in its operational, maintenance and life cycle period. Building operational phase is a significant factor for the reduction in energy, water and material resources. (Vyas & Jha, 2018) have found from their research on buildings which were constructed conventionally but later on converted to green buildings and achieved that green buildings are financially attractive over the lifecycle. The cost premiums were in the range of 2-5% for 3 stars rating and 5-17% for 5 star rated buildings. The discounted payback period for green building were 2.04-7.56 years for 3 star GRIHA and 2.37-9.14 years for 5 star GRIHA rated buildings. (Alexeew, Johannes, Carolin Anders, 2015) have found from energy efficient building cost analysis that initial incremental cost was in the range of 0.8–2.8% higher than that of the conventional buildings and giving energy saving up to 36% with a payback period of two to four years and the life cycle cost of EE building is substantially lower than the conventional buildings up to 1.6% of investment cost. Buildings represent approximately 36 % of the global energy demand and 40% of direct and indirect carbon dioxide emissions which means that they are the major responsible in energy consumption and suggested that green energy retrofit actions can reduce considerably the energy demand and running cost of buildings (IEA, 2017). Green building strategy is couple with a focused approach of an extended lifespan of natural resources, reduced operating costs like the use of energy and water, offering human comfort, safety and efficiency. While experts believe that the occupants pay three to five per cent more for such properties when compared to the conventional ones but they save 25-30 per cent in water and electricity consumption bill. Hence, the additional expenses can be recovered within five years and in fact, profitable in the long run (Anindita Sen, 2017b). Market estimates suggest that India will be adding 11.5 million homes every year thus, making it the world's third largest construction market by 2020. With rapid urbanization and strong economic growth, the construction industry is becoming one of the fastest growing sectors in India. Providing employment to nearly 18 million people. The sector is becoming one of the highest contributors to the country's carbon emissions. It alone accounts for 22 per cent of India's total carbon emissions (Anindita Sen, 2017a).

(Han, Woo, Suh, & Hwa, 2016) have also studied green building benefits and concluded that green building is a movement towards to achieve the short and long term goals of sustainability including conserving water, energy and materials savings and improving indoor air quality, in the built environment. (Vyas & Jha, 2018) have studied the importance of a green building that a green building is not just a fusion of ecological design, techniques and materials but it is a holistic solution to bring the concept of sustainability into the project lifecycle, including the design, design, construction, operation and demolition of the project.

(S. Singh, 2015) Have carried out their research on Analysis of conversion of conventional building to green building. The existing construction of IIST, Block A to the efficient use of resources and energy. Firstly, the overall consumption of water and energy is determined. Later on technologies were installed which save energy and water. Although initially it is expensive but reduces long term costs. 1200CUM/annum water is harvested which makes about 22.22% of annual water consumption and 40% of energy is saved by energy efficient electrical tools. (Anindita Sen, 2017b) has also suggested that recycling and reuse of waste water with the right treatment, rainwater harvesting and making use of organic as well as inorganic solid waste for more purposeful uses like composting and power generation, can complement further in converting existing buildings into green ones or sustainable. (Yongtao Tan, Guo Liu, Yan Zhang, Chenyang Shuai, 2018) have investigated and found that residential aged building green retrofitting helps to decrease global greenhouse gas emission, energy demand and consumption and water demand. The preferment of green retrofit and the performance of retrofitted structures depends upon most advanced and applicable technologies.

2.1. Green Buildings Rating System

In order to build a sustainable building multiple countries have developed rating systems for achieving sustainability goals in construction industry. UK has developed Building Research Establishment's Environmental Assessment Method (BREEAM) for green building rating system. While United States Green Building Council (USGBC) has developed Leadership in Energy and Environmental Design (LEED) rating system for new construction and existing buildings. Meanwhile there are three primary rating systems in India; Green Rating for Integrated Habitat Assessment (GRIHA), Indian Green Building Council (IGBC), and Bureau of Energy Efficiency (BEE) (Shailesh, 2012)

III. RESEARCH METHODOLOGY

This research was conducted by using quantitative approach through a study on Nick Chand hostel campus. Initially the required data were collected from the respective departments regarding energy and water consumption, the technology and techniques for the campus's existing case to further pave the way for making decision about possible changes. For achieving the objectives of the research, first, an extensive and comprehensive literature review on optimization of buildings was carried out. The purpose of the review of literature to find out how to optimize an existing residential building in order to find out the best possible alternatives for reducing running cost during the operation and maintenance phase in a composite climate zone. Furthermore, the objective behind the review of literature was to find and investigate the best of financial, social and environmental and healthier benefits applied in this project to its occupants.

3.1. Area of the Study

In order to appropriately address the objectives of the study Chandigarh university's Nick Chand hostel campus is appropriate area for study and is comprised of six symmetrical residential towers which provides accommodation for about 3672 Students throughout the year and is located in Punjab State of India.

The temperature in Punjab remains hot in summer and raises above 40 °C and minimum of below 5 °C during winter season. Furthermore, Monsoon season provides most of the rainfall for the region which starts from the month of July till end of September and with average of 900 mm annual rainfall.

Table 1. Hostel Description

BLOCK	TOWER DESCRIPTION	NO. OF COMMON ROOM	STUDENTS PER ROOM	STUDENTS PER BLOCK
NC T-1	11 STORIED	204	3	612
NC T-2	11 STORIED	204	3	612
NC T-3	11 STORIED	204	3	612
NC T-4	11 STORIED	204	3	612
NC T-5	11 STORIED	204	3	612
NC T-6	11 STORIED	204	3	612
TOTAL NO. OF STUDENTS				3672

Figure 1. NC-Campus Towers (Source: Google map)

Each tower is comprised of basement, ground floor and nine levels up. Each level has 24 living rooms and 6 washrooms except first level. First level has 12 living rooms, 3 washroom, one reading room and a warden room. On the ground floor of all towers mess and warden's office are located and in all basements two TV rooms, game play room and two gyms each in tower three and six are located.

IV. ANALYSIS AND DISCUSSION

A. Existing Case Energy analysis

1. Living rooms

Each living room is equipped with appliances below along with its usage and it can be seen from Table 2 that major source of energy consumption in room is fan.

Table 2. Appliances used in living rooms

Table 3. Appliances used in Washroom

APPLIANCE	QUANTITY	RATING EACH (WATT)	DAILY USE PER HOURS	DAILY CONSUPTION (KWh)	MONTHLY CONSUPMTION (KWh)	MONTHLY CONSUMPTION (Rs)
EXHAUST FANS	1	60	20	1.2	36	288
TUBE LIGHTS	6	20	10	1.2	36	288
GEYSERS2	1	2000	4	8	240	1920
TOTAL					312	2496

1. Fans are calculated for hot season (195days) and assumed off during cold season for the last total calculation.

Note: Unit cost of energy is Rs.8.

2. Washrooms

There are six washrooms in each floor from second level up to ninth and three on first level of each tower. Each washroom is equipped with appliances below in the table 3.

APPLIANCE	QTY	RATING EACH (WATT)	DAILY USE (hours)	DAILY CONSUPTION (KWh)	MONTHLY CONSUPMTION (KWh)	MONTHLY CONSUPTION (Rs)
FANS[1]	2	80	16	2.56	76.8	614.4
TUBE LIGHTS	3	20	10	0.6	18	144
COMPUTER CHARGERS	3	65	4	0.78	23.4	187.2
MOBILE CHARGERS	3	10	4	0.12	3.6	28.8
TOTAL					121.8	974.4

2. Geysers are calculated for winter season only for the last total calculation.

3. Corridors

Each corridor is equipped with appliances below in the Table 4 along with its daily use and energy consumption:

Table 4. Appliances Available in Corridors

APPLIANCE	QUANTITY	RATING EACH (WATT)	DAILY USE PER HOURS	DAILY CONSUPTION (KWh)	MONTHLY CONSUPMTION (KWh)	MONTHLY CONSUPTION (Rs)
TUBE LIGHTS	38	20	10	7.6	228	1824
COOLERS[3]	6	1120	16	107.52	3225.6	25804.8
		TOTAL			3453.6	27628.8

1. Coolers are calculated for hot season only for the last total consumption

4. Ground floor and Basement

Electrical appliances installed and used on ground floor and basement listed in Table 5 below.

Table 5. Appliances Available in Ground floor and basement

APPLIANCE	QUANTITY	RATING EACH (WATT)	DAILY USE PER HOURS	DAILY CONSUPTION (KWh)	MONTHLY CONSUPMTION (KWh)	MONTHLY CONSUPTION (Rs)
TUBE LIGHTS	100	20	10	20	600	4800
FANS[4]	40	80	16	51.2	1536	12288
EXHUAST FAN	8	60	20	9.6	288	2304
TVs	2	300	4	2.4	72	576
COMPUTERS	3	250	14	10.5	315	2520
TOTAL					2811	22488

B. Existing Case Water Analysis

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Source Water of water for the hostel is ground water from centralized tube wells inside the campus which supplies water throughout the year. Water consumption per capita is about 200 lit/day. For achieving our goal of cost optimization we look for strategies to reduce consumption of water, optimize costs and gain concept of sustainable use of water.

1. **Provisions of Rain water harvesting**

In present case, the total consumption of water in hostel campus are provided by tube wells which are leading to depletion of ground water and is urgent need for ground water harvesting system and rain water harvesting system is provided inside the campus.

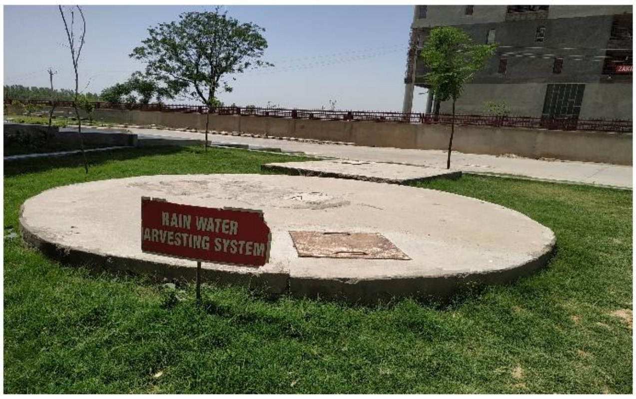

Figure 2. Rainwater harvesting system.

2. **Provision of Sewage treatment plan**

In present scenario, water consumption per capita is 200 lit/ day, so total wastewater produced by the hostellers is 734400 lit/day. At site there is Lehra sewage treatment plant (STP) with capacity of 1500KL/day. The used water in NC hostel campus, Tagore hostel, Zakir hostel and base kitchen is collected and transported for tertiary treatment to Lehra STP. Treated water is later used for Greenery, landscaping and the extra amount is disposed in eucalyptus plants.

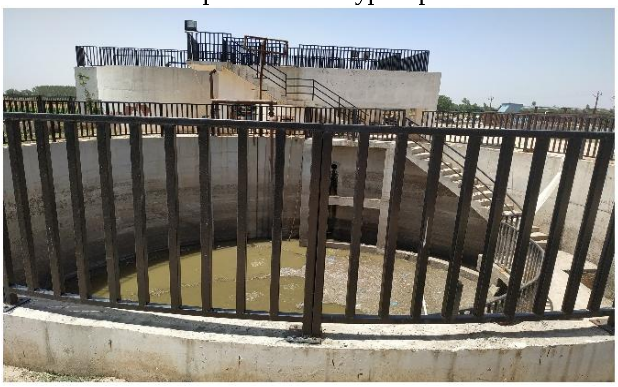

Figure 3. Lehra Sewage Treatment Plant.

C. Analysis for Proposed Case:

1. Heating and cooling analysis

In existing case there is not any provision for heating of rooms but tremendous energy is consumed for cooling, and final decision is made that present conventional fans can be replaced with energy efficient fans which are available in market, analysis is as per below in Table 6.

Table 6. Heating and Cooling Energy saving Calculations

APPLIANCE	QTY	RATING EACH (WAT T)	DAILY USE PER HOURS	DAILY CONSUPTION (KWh)	MONTHLY CONSUPMTION (KWh)	MONTHLY CONSUMPTION (Rs)	YEARLY CONSUPMTION (Rs)
CONVENTIONAL FANS	2688	80	16	3440.64	103219	825753	5367398
ENERGY EFFCIENT	2688	28	16	1204.22	36126	289013	1878589

Energy saving by replacing fans:

Daily savings: 3440.64-1204.22=2236KWh

= 2236x8= Rs17891

Monthly (30DAYS) =Rs536740,

Annually (195 DAYS) =Rs.3488745

Payback period calculation:

Investment on one 28 watt energy efficient fan=Rs.3000

Total cost of replacement= 2688x3000= Rs.8064000

Payback period= 8064000/536740= 15Months 6 days

2. Ventilation Analysis for washroom

In our existing case for ventilation purpose the existence exhaust fan is a conventional and expensive due to recent advancement of energy efficient exhaust fan availability in the market final decision is made that present conventional exhaust fans can be replaced with energy efficient exhaust fans which are available in market, analysis is as per below in the Table 7.

Table 7. Exhaust Fans savings Calculations

Type	Qty	RATING EACH (WATT)	DAILY USE PER HOURS	DAILY CONSUPTION (KWh)	MONTHLY CONSUPMTION (KWh)	MONTHLY CONSUMPTION (Rs)	YEARLY CONSUPMTION (Rs)
CONVENTIONAL	354	60	20	424.8	12744	101952	1019520
ENERGY EFFCIENT	354	34	20	240.72	7221.6	57772	577728

Energy saving by replacing Exhaust fans:

Daily savings= 424.8-240.72=184.08 KWh

= 184.08x8= Rs.1472.64

Monthly (30 DAYs) =Rs.44179.2

Annually (300 DAYS) =Rs.441792

Payback period calculation:

Investment on one 34 watt energy efficient exhaust fan =Rs.1000

Total cost of replacement= 354x1000= Rs.354000

Payback period= 354000/44179.2= 8Months

3. Water Heating

In the existing case for heating of water electrical geysers are used and is a accountable for huge energy consumption during winter while in market availability of solar water heater systems are the best alternative in order to heat water with sustainable sources of energy market. Final decision is made that present

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electrical geysers can be replaced with solar water heater systems (SWHS) which are available in market, analysis are as per below in Table 8.

Table 8. Water heaters Analysis

APPLIANCE	QUANTITY	RATING EACH (WATT)	DAILY USE PER HOURS	DAILY CONSUPTION (KWh)	MONTHLY CONSUPMTION (KWh)	MONTHLY CONSUMPTION (Rs)	YEARLY CONSUPMTION (Rs)
GEYSERS	318	2000	4	1908	57240	457920	1602720

Hot water demand:

Hot water required per person= (10-20) lit/day,
We assume 15 lit per person/day.
Total hot water required= 3672x15=55080 lit,
We assume 55000lit/day
No of SWHS required=55000/500 lpd= 110No

Payback period calculation:

Each SWHS cost for 500 lpd capacity=Rs.62000,
After Gov. subsidy (Rs.4500 per 100lpd)=Rs.39500
Investment on 110 SWHs= Rs.4345000
Payback period=4345000/457920= 9Months 15 Days

4. Provision of Net Metering

The net metering system is a process by which you achieve a dual benefit by installing a solar panels on the rooftop, an open area, building walls for electricity generation. The output power is initially used in the building as required, even during power outages and the excess energy is directed to the distribution network. Net metering system is not provided in the campus and is better sources for generating energy but in our case, it is not financially attractive because hostel is free of students at day time as students are at college during daytime.

5. Provision of water efficient fixtures

Low flow tools include special kind of fittings applied to plumbing appliances to moderate the water flow rate. Low-flow fittings quickly help to reduce water consumption and its bill tariffs, yielding to conservation of water and reduces bills because it reduces water usage in buildings by 40%. At present case, at hostel towers all fixtures are conventional and replacing it would not be financially attractive because water source of water for the hostel is ground water from centralized tube wells inside the campus and free of cost. Reducing water consumption is advised for resources conservation.

Table 9. Conventional and Water efficient fixtures (Source: PA& IAPMO)

		WEP - I Efficiency Star Ratings		
Plumbing Fixture/Fitting	Conventional Product Consumption	* 1 Star Efficient	** 2 Stars Highly Efficient	*** 3 Stars Ultra Highly Efficient
European Water closets	6 Lpf Full Flush	4.8 Lpf Full Flush 1.20 Lpf Savings, or 20% Lpf Savings	< 4.8 Lpf Full Flush > 1.20 Lpf Savings, or > 20% Lpf Savings	< 4.0 Lpf Full Flush > 2.0 Lpf Savings, or > 33% Lpf Savings
Urninals	4 Lpf	< 3.8 Lpf > 0.20 Lpf savings, or > 5% Lpf savings	< 2.0 Lpf > 2.0 Lpf savings, or > 50% Lpf savings	< 1.0 Lpf > 3.0 Lpf savings, or > 75% Lpf savings
Shower Heads	10 Lpm	9.5 Lpm 0.50 Lpm savings, or 5% Lpm savings	7.5 Lpm 2.50 Lpm savings, or 25% Lpm savings	5.7 Lpm 4.30 Lpm savings, or 43% Lpm savings
Lavatory/Sink faucets	8 Lpm	8.0 Lpm 0 Lpm savings, or 0 Lpm savings	5.7 Lpm 2.3 Lpm savings, or 29% Lpm savings	5.0 Lpm 3.0 Lpm savings, or 38% Lpm savings

V. CONCLUSION

The study clearly demonstrates adopting strategies of sustainability (Energy conservation and water conservation) both have benefits to business and environment. It is concluded that green renovation of an existing building through energy and water efficient strategies, is a goal to achieve long and short term goals of sustainability. Where adopting these strategies significantly reduce the environmental concerns due to operation and maintenance process of a buildings. Replacement of conventional fans with energy efficient ones will reduce electrical consumption of 67092KWH per months which equals to Rs.536740 and Rs.3488745 per year. With payback period of 15 months and 6 days of its use. Energy efficient exhaust fans instead of traditional ones will reduce electrical consumption of 5522 KWH per months which equal to Rs.44180 and Rs.441800 per year. With payback period of 8Months of its use. Solar water heater is the most cost effective and energy efficient alternative of electrical geyser to reduce electrical consumption of 57240 KWH per months which equal to Rs.457920 and Rs.1602720 per year. While the payback period is 9Months and 15 Days of its use. Low flow fixtures help to quickly reduces consumption and costs, yielding water saving s and reduces utility bills because it reduces water usage in buildings by 40%. At present case, at hostel towers all fixtures are conventional and replacing it would not be financially attractive because source of water for the hostel is ground water from centralized tube wells inside the campus and is free of cost. But is advised to replace it for resources conservation and sustainability. Converting of an existing residential buildings into energy and water efficient can significantly solve the country's growing energy, air quality and water crisis.

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