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Innovations in Transforming a Traditional Building into Green Building

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***Abstract*— Implementation of sustainable practices in construction sector is not new; this concept has already gained tremendous importance worldwide. It includes many aspects such as environmental, social, economic etc. With the increasing awareness of sustainable development in the construction industry, today's market is full of innovative green building materials and technologies. The rating systems like LEED are becoming universal so as to measure and verify the sustainable practices employed in the design, construction, and operation of commercial real estate in the world. Despite the increasing adoption of the LEED Rating Systems, the knowledge of how to "green" existing buildings through the implementation of sustainable practices remains largely unfamiliar to the real estate industry. The driving force behind implementing green practices in existing buildings is knowledgeable and diligent. Unlike fulfilling green building requirements for new construction, converting existing buildings into green buildings requires an ongoing commitment to monitor building systems, train staff, and keep up to date with certification requirements. By doing so, we can save up to 30-40% of water, 40-50% energy and 20-40% of construction material. While this may seem like added work with added costs, the financial benefits of pursuing green practices are pronounced and long lasting.**

Keywords: Sustainability, growing awareness, "green" existing buildings, financial benefits

I. INTRODUCTION

A green building uses less energy, water and other natural resources, creates less waste & Green House Gases and is healthy for people during living or working inside as compared to a standard building. Another meaning of Green Structure is clean environment, water and healthy living. Green building is not about a little more efficiency, it is about creating buildings that optimize on the local ecology, use of local materials and most importantly they are built to minimize power, water and material requirements. Thus, if these things are kept in mind, then we will realize that our traditional architecture was in fact, very green. Today, we have forgotten how to create a natural environment, instead we are copying it from developed countries. Buildings are a major energy consuming sector in the economy. About 35 to 40% of total energy is used by buildings during construction. The major consumption of Energy in buildings is during construction and later in lighting or air-conditioning systems. This consumption must be minimized. Possibly, this should be limited to about 80-100 watts per sqm.

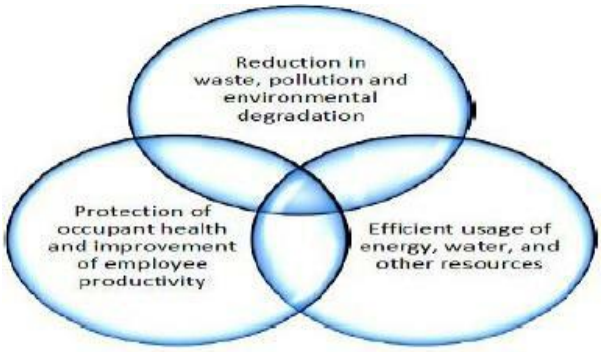

Fig-1: Parameters defining green building concept

Green building in India is experiencing major growth. According to the World Green Building Trends 2016 Smart Market Report, green construction in the country accounts for 37 percent of respondents' total work. What's more, those surveyed estimate that by 2018, it will be 57 percent, the second highest among all countries taking part in the survey.

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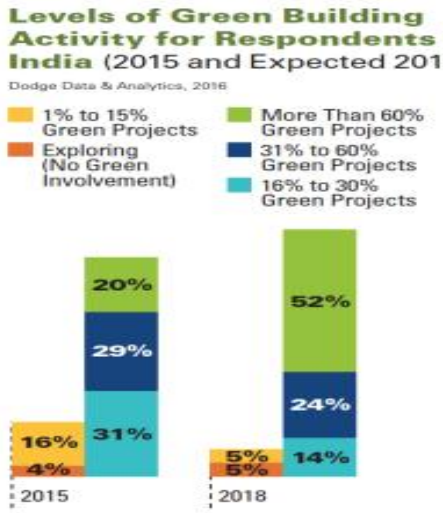

Fig 2: Level of Green Building Activity

Despite of the increasing demand of green building concept in India, the knowledge of how to convert existing buildings into green building through various sustainable practices remains largely unfamiliar to the real estate industry. The real estate industry lacks the data of how to "green" an existing building by implementing sustainable practices.While the LEED Rating System for New Construction was launched in 2000, the Rating System for Existing Buildings was only introduced to the market in late 2004. As of February 2007, there were a total of 715 LEED certifications, 550 of which represented new construction, while only 45 represented existing buildings. Of the existing buildings rated, almost all were single tenant buildings. Education, training, and experience remain barriers to implementing green practices in existing buildings. The USGBC now offers training and exams for LEED Accredited Professionals working with existing buildings.

Green practice in the existing buildings can help address national issues like water efficiency, energy efficiency, reduction in fossil fuel use in commuting, handling of waste and conserving natural resources. Most importantly, these concepts can enhance occupant health, happiness and well-being.

Against this background, the Indian Green Building Council (IGBC) has launched 'IGBC Green Existing Building O&M Rating System' to address the National priorities. By applying IGBC Green Existing Building O&M criteria, existing buildings can be sustainable over the life cycle of the building. This rating program enables the building owner / developer to apply green concepts and criteria, so as to reduce the environmental impacts, which are measurable.

Green existing buildings can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water & energy consumption. The operational savings through energy & water efficiency could range from 15 - 30 %. The consumer waste generated in the building can also be substantially reduced. Intangible benefits of green existing buildings include enhanced air quality, health & higher satisfaction levels of occupants.

II. LITERATURE REVIEW

1. IGBC Green Existing Buildings O&M Rating System-Pilot Version

IGBC Green Existing Building O&M is the first rating program developed in India, exclusively for existing building stock. It is based on accepted environmental principles and strikes a balance between known established practices and emerging concepts. The system is designed to be comprehensive in scope, yet simple in operation. Green existing buildings can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water & energy consumption. The operational savings through energy & water efficiency could range from 15 - 30 %. The consumer waste generated in the building can also be substantially reduced. Intangible benefits of green existing buildings include enhanced air quality, health & higher satisfaction levels of occupants.

National Priorities Addressed-

●Water Conservation: Most of the Asian countries are water stressed and in countries like India, the water table has reduced drastically over the last decade. Green Existing Buildings O&M Rating System encourages use of water in a self-sustainable manner through reducing, recycling and reusing strategies. By adopting this rating program, green existing buildings can save potable water to an extent of 15 – 30%.

●Handling of Consumer Waste: Handling of waste in existing buildings is extremely difficult as most of the

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waste generated is not segregated at source and has a high probability of going to land-fills. This continues to be a challenge to the municipalities which needs to be addressed. IGBC intends to address this by encouraging green existing buildings to segregate the building waste.
●Energy Efficiency: The building sector is a large consumer of electrical energy. Through IGBC Green Existing Building O&M rating system, buildings have scope to reduce energy consumption through energy efficient-lighting, air conditioning systems, motors, pumps etc. The operational energy savings that can be realized by adopting this rating program can be to the tune of 15 – 30%.
●Reduced Dependency on Virgin Materials: The rating system encourages projects to use recycled materials, and discourages the use of virgin wood during renovation, thereby, addressing environmental impacts associated with extraction and processing of virgin materials.
●Health and Well-being of Occupants: Health and well-being of occupants is the most important aspect of Green Existing Buildings. IGBC Green Existing Buildings O&M Rating System ensures minimum ventilation aspects, occupant well-being facilities which are critical in a building. The rating system also recognizes measures to minimize he indoor air pollutants.

2. Jigneshkumr R. Chaudhari1 and Prof.Keyur D. Tandel's paper "Energy saving of Green Building Using Solar Photovoltaic Systems"states the idea of green buildings promotes use of renewable energy, recyclable & recycled products Green building design reduces energy consumption over its lifetime. Green building has to save water 36-40%, save energy 30-40% and save material 25-40% compared to conventional building. Green building is which one high thermal insulations, Rain water harvesting, terrace gardening, ventilation and energy efficient appliances.

III. METHODOLOGY

We have carried out analysis of green retrofitting in existing residential building; and for that purpose we have selected a residential building- Swami Krupa, Pune, India. In this survey we have analyzed the existing energy and water consumption of the total 6 flats - 3 flats of 2BHK and 3 flats of 1BHK. With the help of this data we calculated the energy and water consumption of the building by implementing the green concepts like solar photovoltaic panels, rain water harvesting and WTP. Also, we suggest some green concepts to convert the existing traditional building to green building. These are as follows:

ENERGY CONSERVATION:-
1.Energy conservation through lighting systems:
1.Use compact fluorescent lamp (CFL) in place of incandescent lamps.
2.Commonly T12 fluorescent tube is used which consumes 40W power by tube plus 10-18W power by electromagnetic ballast. Replace these lamps with more efficient T8 or T5 lamps.
3.Use of metal halide lamps in place of LPMV or HPSV lamps.
4.Use LED lighting.
5.Proper installation of luminaries.
6.Improving lighting control (Occupancy Sensors).
7.Use maximum daylight.
8.Proper maintenance.
9.Energy management systems.

(B)Solar photovoltaic system:
In solar photovoltaic system solar energy is directly converted to electric power. This makes the system far more convenient and compact compared to thermal methods of solar energy conservation. It uses the energy of visible and infrared regions of the solar radiations for conservation into electric power.

Items	Wattage	Nos.	Approx.Working hours per day	Energy consumption(wh/day)
Incandescent lamps	60	21	7	8820
Fluorescent tubes in Flats	40	24	7	6720
Fluorescent tubes in common area	40	15	10	6000
Fan	70	21	5	7350
Computers	100-200	6	3	2700

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Refrigerators	225-500	6	10	21750
T.V.	210-400	9	10	27450
Microwave	800-1000	5	1.5	6750
Heater/ Geyser	1000-1500	5	1.5	9375
Mixer	150-450	6	0.5	900
Iron	40-60	6	0.5	150
Washing Machine	600-800	6	2	8400
Radio	50-200	4	2	1000
DVD	80-85	3	2	495

If in place of Incandescent lamps, we use CFL lamps of 15 watts then we can save up to 205.065 KWh per month and in place of Fluorescent tubes if we use LED tubes of 18 watts then we can save up to 216.876 KWh per month. That is a total of about 422 KWh/month and around 10-12% of total energy consumed in the building.

If we use a solar system of 5kW as a renewable source of electricity, we will need 20 solar panels (250W panel). The panel will be about 1.6m x 1m, so you'll need at least 32m² of roof space, to giveyou a feel for how big 32m² is, this picture may help(fig 1). This 5kW solar system will generate approximately 23kWh per day, depending on the location and a variety of other factors. This will further save approximately 18-20% of the building electricity consumption.

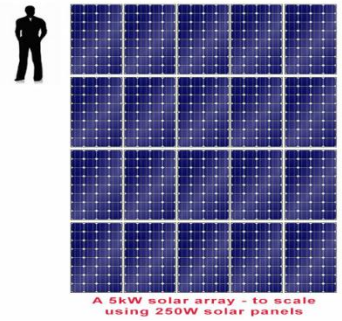

Fig 3: 5kW solar panel- using 250W panels

(C) Eco-friendly refrigerants and halons - To encourage the use of eco-friendly refrigerants and halons in the facility, thereby minimizing leakage in the atmosphere and the resultant impact on the ozone layer.

(D) On-site renewable technologies- Encourage the use of on-site renewable technologies to minimize the environmental impacts of generating energy through fossil fuels and demonstrate renewable energy generation for at least 2.5% of total annual energy consumption of the building.

(E) Energy metering and monitoring - Encourage continuous energy monitoring to identify improvement opportunities in energy performance of building

WATER CONSERVATION:-

Principles of Conservation: While talking about any conservation, we should remember the basic principles as shown below:

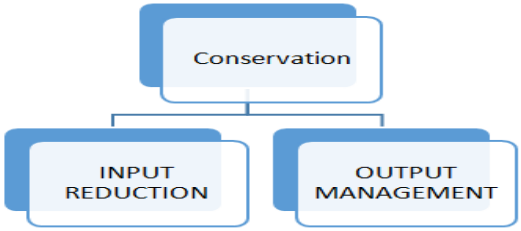

Fig 4: Basic principles of conservation

Methods for water conservation may reduce input, output, or both. Here it is shown how water changes its form after getting used in buildings.

Fig 5: Input & output process of water in buildings
Reduce Consumption

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A cursory look at the statistics of water consumption in different types of buildings will reveal which areas need to be stressed upon so that we can make an effective reduction in the consumption of water at all levels.

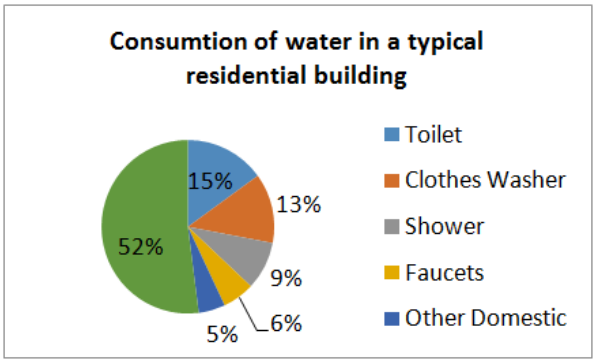

Fig 6: Consumption of water in a residential building

On an average we can see that the major portion of water goes in flushing and outdoor purposes in residential buildings and in commercial buildings, air conditioning and cooling also plays a significant role. This makes very clear what our major thrust areas should be. Few of the methods which can help are discussed below:

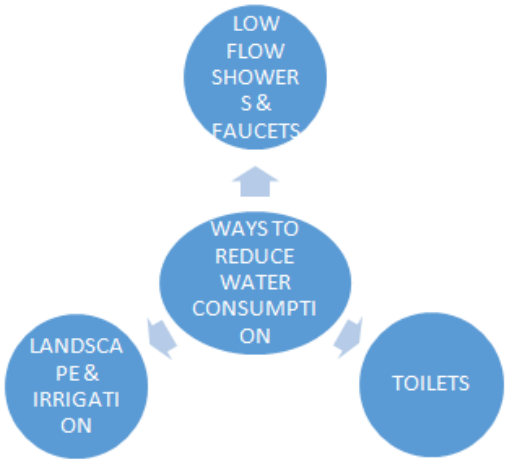

Fig 7: Methods to reduce the consumption of water

A. Reuse Water Onsite

Apart from planning for efficient consumption of water, the professionals should design plumbing systems so as to allow reuse of water onsite. Water consumed in buildings can be classified as two types:

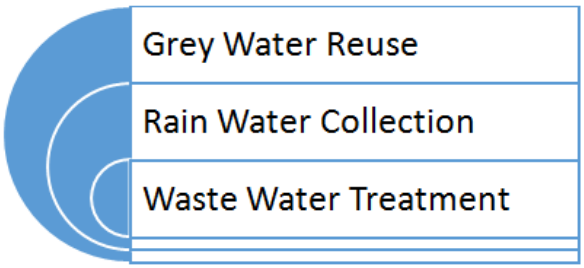

Fig 8: Methods that can be adopted to reuse water onsite

B. Grey Water reuse

"Gray water" is wastewater collected from clothes washers, bathtubs, showers, and laundry or bathroom sinks. If properly collected and stored, it can be safely re-used, thereby reducing fresh water consumption, along with reducing the load on septic tanks. Hence it can be recycled within a building, either to irrigate ornamental plants or flush toilets by separating grey water through well-planned plumbing systems.

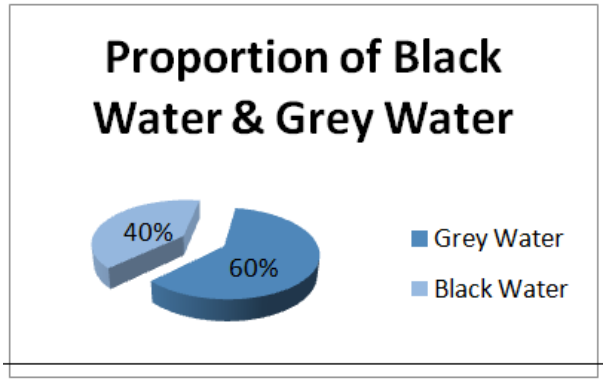

Fig 9: Proportion of Black water& Grey water in a typical building

C. Sewage / Black water treatment:

Perhaps the most significant difference between black water and grey water lies in the rate of decay of the pollutants in each. By separating black water we can utilize it as odor-free fertilizers and a valuable soil conditioner and even save the ground water from pollution. Since it is an expensive process, at small

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scale, the black water is generally disposed into the main sewer and in buildings at large scale like commercial and industrial buildings, separate Sewage Treatment Plants are installed to treat the black water and recycle the soft water for air cooling and irrigation. Following is the process shown for that:

Rain Water collection:

1. By providing impermeable surfaces on the plot, such as bare ground or pavement, or roof with gutters and downspouts, some rain can be captured and directed to the landscaping.
2. Surface runoff can be directed to turfed areas or shallow basins around trees and shrubs by contouring the land surface. The goal is to collect the runoff, direct it to where it can be of use, and slow it down so it has time to soak into the ground.
3. Rain that falls onto roofs can not only be directed to landscape plants, it can be stored in tanks or rain barrels for later use in car wash, firefighting or toilet flush etc.

HEALTH & COMFORT

A. Smoking is prohibited- Minimize exposure of non-smokers to the adverse health impacts arising due to passive smoking in the building.
B. Fresh air ventilation- Provide adequate outdoor air ventilation so as to avoid pollutants affecting indoor air quality.
C. Carbon dioxide Monitoring & Control- Continuously monitor and control carbon dioxide level in the building to provide occupant comfort and well being
D. Eco-friendly Housekeeping Chemicals- To encourage the use of eco-friendly housekeeping chemicals so as to reduce adverse health impacts for building occupants
E. Occupant Well-being Facilities- The project has at least 2 occupant well-being facilities (such as gymnasium, aerobics, yoga, meditation or any indoor / outdoor games) to cater to at least 10% of building occupants)

INNOVATION CATEGORY

A. Accredited professionals- To involve green building accredited professionals in the project so as to facilitate design & implementation of environment friendly measures
B. Terrace Gardens- Terrace gardens help to maintain the internal temperature of the building. The vegetation on the roofs helps to create a healthier environment and also keeps the temperature cooler.
C. Insulated water tank- A water tank is installed which receives the hot water from the solar and it stores and supplies the hot water as per the requirements. This concept ensures equal distribution of hot water throughout the day.

CONCLUSION

In conclusion, we can say that, by implementing the above mentioned green concepts, we can transform an existing building into a green building which will save approximately 20-22% of energy consumption. Along with it the water is also conserved, recycled and reused for various purpose using green methods. By planting vegetation around the plot and on the roof, we can ensure healthy and cooler environment and thus improve the quality of living for the occupants. These concepts conform with the IGBC norms for existing green buildings and helps the building get a LEED recognition. Such initiatives will also encourage other engineers and builders to adopt green practices and promote sustainability not only in new construction but also in the existing structures.

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