



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 1, January 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118

Green Retrofitting for old Buildings: A case study of Government Aashram School Inambari

Vrishabh Anil Poche, Prof. G. N. Kanade, Dr. R. V. Kajave

PG Student, Department of Construction Management, Tatyasaheb Kore of Engineering and Technology, Warananagar, MH,
India

Assistant Professor, Department of Construction Management, Tatyasaheb Kore of Engineering and Technology Warananagar,
MH, India

Professor, Department of Construction Management, Tatyasaheb Kore of Engineering and Technology, Warananagar, MH, India

ABSTRACT: This work inspects inventive styles, practices and objectives of old building retrofits while demonstrating green design methods and execution strategies. The present building stock is substantively huge and denotes one of the largest chances to decrease energy waste and control air contamination and worldwide warming. In relations of tall buildings, numerous will advantage from retrofits. There are lengthy lists of unproductive all-glass curtain walls, primarily endorsed by the modernist crusade, that are outstanding to retrofit. The all-glass curtain wall buildings depend on synthetic freshening, refrigeration and heating system, and suffer from poor insulation, which together create them energy hogs. Latest practices specify that green retrofit has facilitated older buildings to growth energy efficiency, enhance building performance, growth tenants' pleasure and boost economic return while decreasing greenhouse gas emission. This survey also focus on how retrofitting is possible on old building with different levels with initial cost estimation. We have collected the survey base on 8 type different questions. The system also denotes each step of execution of GASI building in entire work. The phase 1 focus on stakeholder commitment, phase 2 for building integrity audit, in 3 building operation, 4 used for resolve building operation and finally phase 5 improvements of building. Once finish all phases all phases done the outcome of proposed work

KEYWORDS: sustainable design; green retrofit; energy efficiency; building's performance; holistic approach

I.INTRODUCTION

In early days the peoples don't know the importance energy and environment. Underestimate the environmental degradation and vast use of energy was a largest problem in those days. By considering these things the concept of green buildings was upraise in mind and the people thinks about the constructing of green buildings which should be energy efficient and waste reduction building. Green building practices aim to reduce the environmental impact of building. The first rule is that the greenest building is the building that doesn't get built. Since construction almost always degrades a building site, not building at all is preferable to green building, in terms of reducing environmental impact. The second rule is that every building should be as small as possible. The third rule is not to contribute to sprawl, even if the most energy-efficient, environmentally sound methods are used in design and construction. Urban infill sites are preferable to suburban "greenfield" sites.

While the practices or technologies employed in green building are constantly evolving and may differ from region to region, fundamental principles persist from which the method is derived: Siting and Structure Design Efficiency, Energy Efficiency, Water Efficiency, Materials Efficiency, Indoor Environmental Quality Enhancement, Operations and Maintenance Optimization, and Waste and Toxics Reduction. The essence of green building is an optimization of one or more of these principles. Also, with the proper synergistic design, individual green building technologies may work together to produce a greater cumulative effect. On the aesthetic side of green architecture or sustainable design is the philosophy of designing a building that is in harmony with

the natural features and resources surrounding the site. There are several key steps in designing sustainable buildings: specify 'green' building materials from local sources, reduce loads, optimize systems, and generate on-site renewable energy.

II.LITERATURE SURVEY

The National Capital Territory of Delhi, has a population of about 11 million and a metropolitan population of about 16.3 million, making it the second most populous city and second most populous urban agglomeration in India [11]. The urban expansion in Delhi has expanded beyond the NCT to incorporate towns in neighbouring states and at its largest extent can count a population of about 25 million residents as of 2014 [2]. Buildings in Delhi-NCR are an integral part of the city's heritage, skyline and a valuable asset but they also consume significant energy and resources. Built up area in Delhi has been on a rise and using Green Building concept for new construction can definitely reduce the environmental impact of buildings in Delhi. But the area in and around Delhi was probably inhabited before the second millennium BC, and there is evidence of continuous inhabitation since at least the 6th century B.C.[1]. Thus, besides the new constructions, there is quite a huge potential of existing buildings to adversely affect the environment unless their operation and maintenance methods checked and evaluated. Mandatory restrictions will have to be imposed in the Govt. Policies regarding energy/water use and CO₂ emissions[4]. Aside from energy/water efficiency, many other significant sustainability improvements can be made in existing buildings in terms of resource use, waste reduction via recycling programs[6] as also, sustainable purchasing policies, procurement, and ongoing operations & maintenance procedures which will improve a buildings' performance[7,8]. In addition to the tangible benefits, there are other „intangible“ benefits associated with green buildings such as Employee comfort and indoor environmental quality that are hard to quantify but are equally important to address[5]. „Indoor Environmental Quality (IEQ)“, encompasses items like access to natural daylight, air quality, views, thermal and physical comfort, and the ability to control one's environment (i.e. temperature, air flow and lighting) which have positive psychological and physical effects and contribute to happier, healthier occupants. Good IEQ has been shown to increase productivity, decrease absenteeism due to sickness and improved morale of the employees. Thus good IEQ will also contribute towards economic benefits in the same manner as energy or water efficiency[9]. A well designed and well operated building will have enhanced value, demand and lower operating costs. The need to build, operate and maintain our buildings in a more sustainable way will only increase as energy costs rise, potable water and material resources become increasingly scarce and the impact of Govt. legislation increases.

Green Building Rating Schemes like LEED by IGBC or GRIHA[10] by TERI can be used to assess the environmental performance of buildings in India. Leadership in Energy and Environmental Design (LEED) is an internationally adopted program of the U.S. Green Building Council (USGBC,1998) and later adopted by Indian Green Building Council(IGBC). The system covers the majority of certified projects as New Construction, or LEED-NC. But, adverse effects on environment, sustainability and potential cost savings do not stop once a building is constructed. To address this, the USGBC developed LEED for Existing Buildings, or LEED-EB[12] which includes 14 prerequisites and 85 distinct credits.

LEED for Existing Buildings: Operations & Maintenance ("LEED EBOM" or "LEED EB") establishes uniform standards for existing buildings that focus on environment sensitive operations and maintenance. An existing building that applies and achieves LEED certification, whether at the Certified, Silver, Gold, or Platinum level, demonstrates high performance as "green building" in five major categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality (USGBC,2009)[12]. LEED EBOM certification is highly achievable for a number of different building types, and is becoming increasingly popular as building owners and managers exhibit their environment responsibility and seek to distinguish their spaces from among those of their competitors. Evaluating your building for its green status sets a target level of achievement against these tools, and can be used to track the progress[13]. Here, the existing building is in Delhi NCR which has been evaluated for green status using LEED-EB rating tool, de facto green building standard. The case study presented here documents the sustainability approach taken in the specific organization and building. It also offers insights on getting an organizational commitment to pursue LEED-EB certification, managing a environmentally responsible project, the problems that may arise, and the solutions that can be used to address those problems.

Previous published literature on the financial implications of "green" certification mostly focuses on new construction within the U.S., and results generally designate a optimistic connection between environmental certification and economic results in the market. One study, based in Australia, by Miller and Buys (2008)studied the paybacks of retrofits from the viewpoint of tenants in

a large office property. They found very optimistic sentiments that green retrofits would continue and were well received by tenants. No study we are alert of has inspected the economics from a broadly selected sample. Eichholtz, Kok and Quigley (2010) document huge and optimistic effects on market rents and selling prices subsequent ecological certification of office buildings. Relative to a control sample of conservative office buildings, LEED or Energy Star labelled office buildings' rents per square foot are about 2 percent greater, effective rents are about 6 percent greater, and dividends to selling prices per square foot are as high as 16 percent.

Other studies (Fuerst and McAllister 2011; Miller, Spivey and Florance 2008) authorize these findings. Moreover, these results appear tough over the course of the financial crisis, system document for a recent dataset of 3,000 green buildings that both energy effectiveness and "greenness" of buildings are capitalized into rents and sales prices. Moreover, this outcome is not smashed by the recent recession in property markets. Other studies mention evidence signifying positive financial benefits from earlier absorption, higher occupancy rates, lower functioning expenses, greater residual values as well as greater occupant productivity. To date, there are no theoretical studies examining the market performance of "green" renovations. There are many case studies of single buildings which have been retrofit for the owner-occupant but less so in the private rental market.

Anecdotal suggestion suggests that the move of occupants towards "green" real estate is due to improved reputational benefits, business social accountability directives and employee productivity. Such a shift in occupant favourite suggests that occupants are using the buildings that they vacate to interconnect their commercial vision to stakeholders and employees.

The literature on corporate social responsibility (CSR) has generally investigated this link between corporate social performance, reputation benefits and employer attractiveness. In a current broader study Pivo and Fisher (2010) recommend higher rents and proceeds for those engaged in CSR. In other approaches frequently invoked rationale for occupy green office space is tenant productivity. Miller et al. (2009) document in reviews that over minimum of occupants of environmentally certified buildings found their employees to be more productive. Interpretation of these results is problematic, though, as these responses cannot be controlled for with management style and individual employee characteristics. However, surveys reporting on tenants in London indicate that there is indeed a shift in corporate preferences.

A 2008 research report documents that 58 percent of tenants find energy efficiency "essential" and 50 percent find green attributes "essential. Improving the bottom line concluded building energy competence is frequently reported as one of the direct economic benefits for real estate investment companies when considering energy productivity and sustainability in their portfolios.

III.METHODOLOGY

After carrying out literature review of available literature in the field of Green Retrofitting, the methodology of project was finalised. The Flowchart of the methodology is designed as follows:

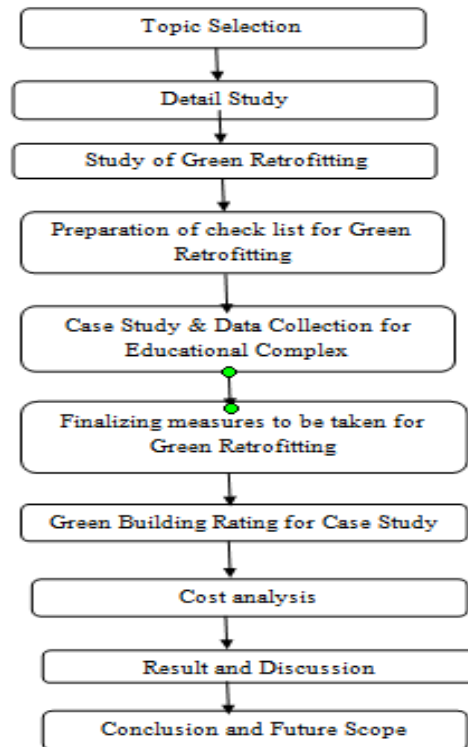


Figure 1 : Proposed research methodology

We first undertake a waste audit to find out the total amount of waste the building generates and also how much of this is being recycled and how much is sent to incineration and landfill. This knowledge will help you find opportunities to increase recycling efforts and reduce the amount of waste sent to incineration and landfill. A condition audit is intended to determine the current condition and expected remaining economic life of a building's components. It is a vehicle for producing a complete inventory of a building (including equipment) that identifies deficiencies. Typical areas to be examined will include the structure, external walls and roof, mechanical, electrical and IT systems, hazardous materials (asbestos, lead, etc), security and a review of safety issues. Also study to Many existing buildings have a poor indoor environmental and/or air quality (IEQ/IAQ). IEQ e-compasses thermal comfort, air quality, lighting levels and noise levels. Audit each of these to find out how they currently perform and where improvements can be made.

Government Ashram School Inambari (GASI)

SHASKIYA ASHRAM SCHOOL INAMBARI was established in 2004 and it is managed by the Tribal Development Department. It is located in Rural area. It is located in PEINT block of NASHIK district of Maharashtra. The school consists of Grades from 1 to 10. The school is Co-educational and it doesn't have an attached pre-primary section. The school is Ashram (Govt.) in nature and is not using school building as a shift-school. Marathi is the medium of instructions in this school. This school is approachable by all weather road. In this school academic session starts in June.

The school has Government building. It has got 8 classrooms for instructional purposes. All the classrooms are in good condition. It has 2 other rooms for non-teaching activities. The school has a separate room for Head master/Teacher. Also boys and girls hostel are also there. The school has No Boundary Wall boundary wall. The school has have electric connection. The source of Drinking Water in the school is Tap Water and it is functional. The school has 9 boys toilet and it is functional. and 12 girls toilet and it is functional. The school has a playground. The school has a library. The school need ramp for disabled children to access classrooms. The school has 6 computers for teaching and learning purposes and all are functional. The school is not having a computer aided learning lab. The school is Not Applicable providing mid-day meal.

We consider school and hostel building for analysis.

- **Name of Project :** Government Aashram School Inambari (GASI)
- **Side Margins :** Front Margin 3M, Rear Margin 1M.
- **No. of Stories :** G+3
- **Total Building Area.** 251333.33 SQ/Ft
- **Total Built up Area :** 122805.45 SQ/Ft

Preparation of Check list for Green Retrofitting

Green Building Retrofit Checklist

The CPD Green Retrofit Checklist promotes energy efficiency and green building practices for residential retrofit projects. Grantees must follow the checklist in its entirety and apply all measures within the Checklist to the extent applicable to the particular building type being retrofitted. The phrase “when replacing” in the Checklist refers to the mandatory replacement with specified green improvements, products, and fixtures only when replacing those systems during the normal course of the retrofit.

Water and Energy Conservation measures

Water-Conserving Fixtures

Install or retrofit water conserving fixtures in any unit and common facility, use the following specifications: Toilets-- 1.28 gpf; Urinals-- 0.5 gpf; Showerheads-- 2.0 gpm; Kitchen faucets-- 2.0 gpm; and Bathroom faucets-- 1.5gpm. [gpf = gallons per flush; gpm = gallons per minute]

Energy Star Appliances

Install Energy Star labeled clothes washers, dishwashers, and refrigerators, if these appliance categories are provided in units or common areas.

Air Sealing: Building Envelope

Seal all accessible gaps and penetrations in the building envelope. If applicable, use low VOC caulk or foam.

Insulation:

For attics with closed floor cavities directly above the conditioned space, blow in insulation per manufacturer's specifications to a minimum density of 3.5 Lbs. per cubic foot (CF). For attics with open floor cavities directly above the conditioned space, install insulation to meet or exceed IECC levels.

Insulation: Flooring

Install \geq R-19 insulation in contact with the subfloor in buildings with floor systems over vented crawl spaces. Install a 6-mil vapor barrier in contact with 100% of the floor of the crawl space (the ground), overlapping seams and piers at least 6 inches.

Duct Sealing

In buildings with ducted forced-air heating and cooling systems, seal all penetrations of the air distribution system to reduce leakage in order to meet or exceed energy star for Homes' duct leakage standard.

Air Barrier System

Ensure continuous unbroken air barrier surrounding all conditioned space and dwelling units. Align insulation completely and continuously with the air barrier.

Radiant Barriers: Roofing

When replacing or making a substantial repair to the roof, use radiant barrier sheathing or other radiant barrier material; if economically feasible, also use cool roofing materials.

Windows

When replacing windows, install geographically appropriate energy star rated windows.

Sizing of Heating and Cooling Equipment

When replacing, size heating and cooling equipment in accordance with the Air Conditioning Contractors of America (ACCA) Manuals, Parts J and S, or 2012 ASHRAE Handbook--HVAC Systems and Equipment or most recent edition.

Domestic Hot Water Systems

When replacing domestic water heating system(s), ensure the system(s) meet or exceed the efficiency requirements of energy star for Homes' Reference Design. Insulate pipes by at least 7 R-4.

Efficient Lighting: Interior Units

Follow the guidance appropriate for the project type: install the energy star Advanced Lighting Package (ALP); OR follow the energy star MFHR program guidelines, which require that 80% of installed lighting fixtures within units must be energy star qualified or have energy star qualified lamps installed; OR when replacing, new fixtures and ceiling fans must meet or exceed energy star efficiency levels.

Efficient Lighting: Common Areas and Emergency Lighting

Follow the guidance appropriate for the project type: use energy star labeled fixtures or any equivalent high-performance lighting fixtures and bulbs in all common areas; OR when replacing, new common space and emergency lighting fixtures must meet or exceed energy star efficiency levels. For emergency lighting, if installing new or replacing all exist signs shall meet or exceed LED efficiency levels and conform to local building codes.

Efficient Lighting: Exterior

Follow the guidance appropriate for the project type: install energy star qualified fixtures or LEDs with a minimum efficacy of 45 lumens/watt; OR follow the energy star MFHR program guidelines, which require that 80% of outdoor lighting fixtures must be energy star -qualified or have ENERGY STAR-qualified lamps installed; OR when replacing, install energy star compact fluorescents or LEDs with a minimum efficacy of 45 lumens/watt.

Indoor Quality

Air Ventilation: Single Family and Multifamily (three stories or fewer)

Install an in-unit ventilation system capable of providing adequate fresh air per ASHRAE 62.2 requirements.

Air Ventilation: Multifamily

Install apartment ventilation systems that satisfy ASHRAE 62.2 for all dwelling units and common area ventilation systems that satisfy ASHRAE 62.1 requirements. If economically feasible, consider heat/energy recovery for 100% of corridor air supply.

Composite Wood Products that Emit Low/No Formaldehyde

Composite wood products must be certified compliant with California 93120. If using a composite wood product that does not comply with California 93120, all exposed edges and sides must be sealed with low-VOC sealants.

Environmentally Preferable Flooring

When replacing flooring, use environmentally preferable flooring, including the Floor Score certification. Any carpet products used must meet the Carpet and Rug Institute's Green Label or Green Label Plus certification for carpet, pad, and carpet adhesives.

Low/No VOC Paints and Primers

All interior paints and primers must be less than or equal to the following VOC levels: Flats--50 g/L; Non-flats--50 g/L; Floor--100 g/L. [g/L = grams per liter; levels are based on a combination of the Master Painters Institute (MPI) and GreenSeal standards.]

Low/No VOC Adhesives and Sealants

All adhesives must comply with Rule 1168 of the South Coast Air Quality Management District. All caulks and sealants must comply with regulation 8, rule 51, of the Bay Area Air Quality Management District.

Clothes Dryer Exhaust

Vent clothes dryers directly to the outdoors using rigid-type duct work.

Mold Inspection and Remediation

Inspect the interior and exterior of the building for evidence of moisture problems. Document the extent and location of the problems, and implement the proposed repairs according to the Moisture section of the EPA Healthy Indoor Environment Protocols for Home Energy Upgrades.

Combustion Equipment

When installing new space and water-heating equipment, specify power-vented or direct vent combustion equipment.

Mold Prevention: Water Heaters

Provide adequate drainage for water heaters that includes drains or catch pans with drains piped to the exterior of the dwelling.

Mold Prevention: Surfaces

When replacing or repairing bathrooms, kitchens, and laundry rooms, use materials that have durable, cleanable surfaces.

Mold Prevention: Tub and Shower Enclosures

When replacing or repairing tub and/or shower enclosures, use non-paper-faced backing materials such as cement board, fiber cement board, or equivalent in bathrooms.

Integrated Pest Management

Seal all wall, floor, and joint penetrations with low-VOC caulking or other appropriate sealing methods to prevent pest entry.

IV.RESULTS AND DISCUSSIONS

For the proposed system results, study on “Green building retrofitting” has been carried out by selecting case study and questioners survey conducted ,the conclusion are drawn as Present practices of redevelopment of housing societies need to be reviewed so that these can be more technically and commercially viable. We also planned redevelopment can be an alternative to the unlimited horizontal growth of the city. This experimental research highlights how commercial property tenants, from predominantly smaller organizations, were on a journey to sustainability. On the one hand, there was general attentiveness of how the built atmosphere donates significantly to greenhouse gas emissions, with cumulative support for bearable commercial office buildings designed to develop competence, preserve natural wealth, and decrease carbon emissions. On the other hand, although tenants were interested and willing to involve in debates about sustainability initiatives, knowledge was limited and they wanted significantly more information about the costs and remunerations of sustainability designs, products and features, as well as details about the retrofitting process. Such findings highpoints the value of continuing generic industry and consumer awareness-raising doings, as well as the prominence of developing and distributing detailed cost/benefit info about precise sustainability initiatives that are common in commercial building retrofits, such as smart/low energy lighting, solar hot water, waterless urinals and green rated carpets. Several other important themes emerged from this qualitative research. We consider the below details of building as well as cost for Avoid or minimalist exposure of building tenants, indoor surfaces and systems to Environmental Tobacco Smoke (ETS).

Table 1: GASI Total Capital and Payback of Green Retrofitting

Sr. No.	Description	Total Capital (in Rs.)	Payback
1	High SRI Tiles (JOHNSON ENDURA)	10,70,000	-
2	Plumbing low-Flow Fixtures (Jaquar / Hindware)	2,07,160	-
3	Rain water harvesting (Ira Sustainable)	26,34,625	15-20 Years
4	Solar Panels installation	40, 34,000	5-6 Years
5	Lighting and Fans Retrofitting	35.00,000	3-4 Years
6	Eco-Friendly Chemicals (HAYLIDE)	2,68,000	-
Total Costing for Green Retrofitting		Rs.1,17,13,785	-

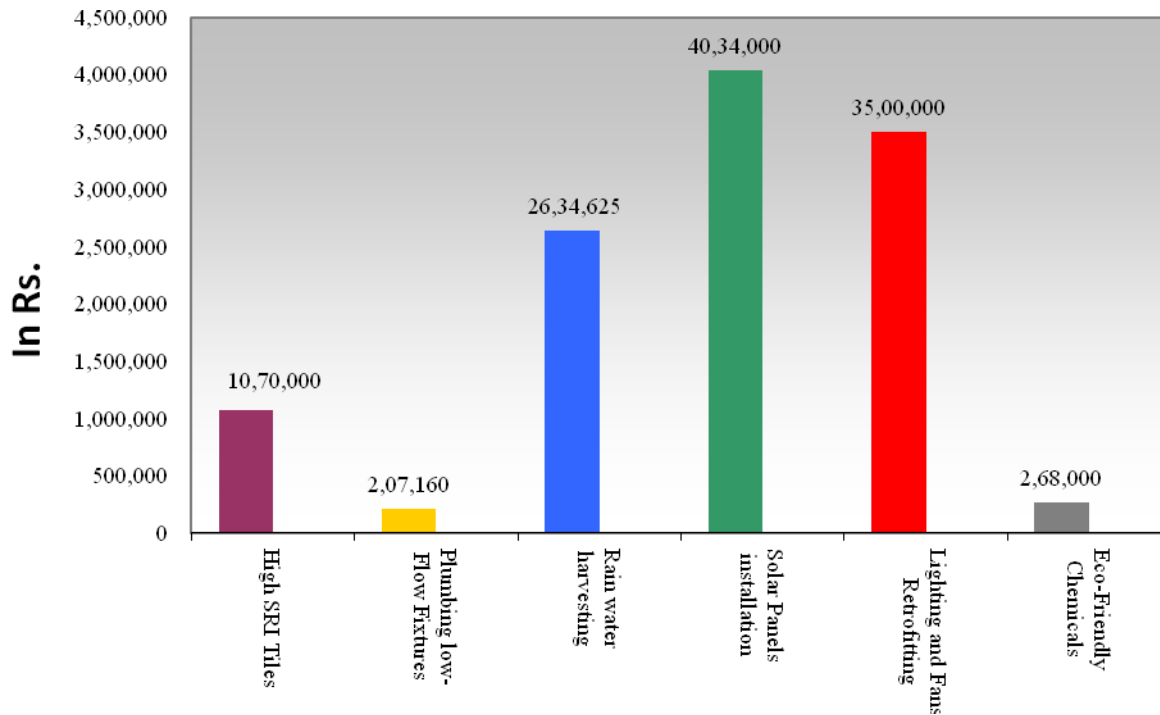


Fig. 3: Total Investment

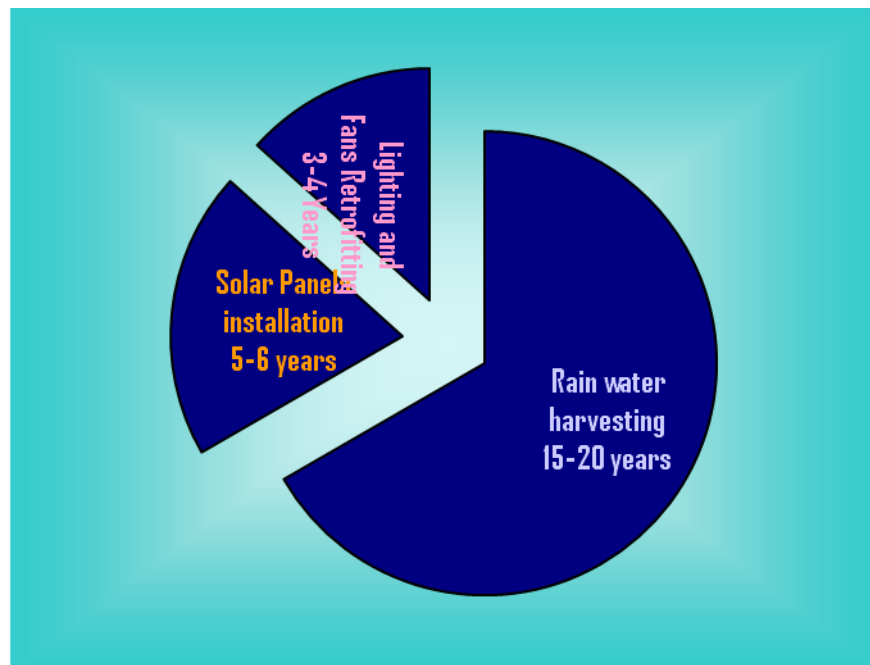


Fig. 4: Payback Period

This exploratory research highlights how commercial property tenants, from predominantly smaller organizations, were on a journey to sustainability. On the one hand, there was general awareness of how the built environment contributes significantly to greenhouse gas emissions, with increasing support for sustainable commercial office buildings designed to improve efficiency, conserve natural resources, and reduce carbon emissions. On the other hand, although tenants were interested and willing to engage in discussions about sustainability initiatives, knowledge was limited and they wanted significantly more information about the costs and benefits of sustainability designs, products and features, as well as details about the retrofitting process. Such findings highlights the value of ongoing generic industry and consumer awareness-raising activities, as well as the importance of developing and disseminating detailed cost/benefit information about specific sustainability initiatives that are common in commercial building retrofits, such as smart/low energy lighting, solar hot water, waterless urinals and green rated carpets. Our findings, whilst informative, are based on in-depth interviews with seven commercial building tenants from pre-dominantly smaller organizations residing in Melbourne, Australia. Whilst the financial cost of sustainability initiatives was clearly the key deciding factor for most participants, such considerations will most likely be less relevant for larger organizations who may view residing in a sustainable building as a relatively easy way to demonstrate their corporate social responsibility. However, as it is smaller organizations who reside in older buildings which are prime targets for sustainability retrofitting, this research offers a beginning point for understanding the difficulty of integrating green technology in older commercial buildings. Overall, traditional twentieth century buildings were not viewed as suitable for a twenty-first century focused on sustainability; the challenge is how to make the transition in a socially acceptable and cost-effective manner.

- Such system can easily applicable for old building like old college buildings, old government office building etc.
- It is mostly applicable in metro cities only.
- We can also apply some strategies for new building constructions also.
- It is found out that while doing repair work for older buildings (which are 25 years older) would only increase the life of the building by forty to sixty years.
- Green retrofitting can withstand with the new climatic and geographic conditions and is constructed with latest safety measures.

Basically retrofitting is recommended for building which older than 20-25 years. But need to consider some points like old buildings also have other drawbacks such as lack of security and maintenance services, absence of common facilities like gymnasium and society office, unavailability of proper open area for children in the compound, leakage problems, absence of elevators, poor interior planning of rooms and low resale value due to the poor condition of the buildings.

V.CONCLUSION

The fast paced growth in economic and human activity across the globe has put environmental resources under tremendous pressure thereby becoming a cause for irreversible damages to the environment at large and putting the quality of life of future generations to unknown risks. The increasing apprehension towards the environment is pushing the policy makers to seek sustainable solutions, leading to the origin of the theory of green buildings. The concept and criteria of green buildings is being incorporated in new as well as old structures around the globe. Even though green buildings are the need of the hour worldwide, developers face a major challenge in the development of green buildings due to increase in construction costs and lack of awareness on the benefits of green buildings, materials and technology. Green building are today the most widely used form of architecture. Creating green buildings is an important focus of building owners and even governments worldwide. In India some world class Green Buildings have constructed in past few years, but still the concept of green buildings for general masses is in infancy stage. Present work is an attempt in the direction to make people, communities and general public aware about the advantages of green buildings for sustainable environmental development and management. In this work we achieved our all objectives, with this proposed research. We replace all the existing facilities with new assets. The case study also define the overall payback for current asset. Basically with the help of all figures and analysis, retrofitting is possible for any kind of old building in metro cities.



VI.FUTURE SCOPE

For the future enhancement of this work can be extend in metro cities old buildings. Upgrading commercial property including hotels so they are more energy-efficient also brings other competitive advantages, including increased building value, higher rent premiums and increased occupancy rate. It concludes that businesses should be upgrading their buildings sooner rather than later to stay ahead of the green regulatory curve, reap the incentives and remain competitive.

REFERENCES

1. Asher, Catherine B (2000) [2000]. "Chapter 9:Delhi walled: Changing Boundaries". In James D. Tracy. City Walls. Cambridge University Press. pp. 247–281. ISBN 978-0-521-65221-6. Retrieved 1 November 2008.
2. "Cities with population of 1 Lakh and Above". Census india.gov.in. Retrieved 30 January 2014.
3. Fischer, E. A. (2009). Issues in Green Building and the Federal Response: An Introduction. Congressional Research Service.
4. Gour, A.A., Singh, S.K., Tyagi, S.K. and Mandal, A. (2015) Variation in Parameters of Ambient Air Quality in National Capital Territory (NCT) of Delhi (India), Atmospheric and Climate Sciences; 5:13-22.
5. J.C, howe. (2010). Overview of green buildings. National Wetlands Newsletter, 33(1).
6. Shishir Bansal, S.K. Singh, (2014), "A Sustainable Approach Towards The Construction and Demolition Waste", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 2, February, 2014.
7. Shishir Bansal, S.K. Singh, (2015), "SUSTAINABLE HANDLING OF CONSTRUCTION AND DEMOLITION (C & D) WASTE", International journal of sustainable Energy and Environmental Research, 4(2): 22-48
8. Sunita Bansal, Srijit Biswas, S.K. Singh, (2015), "APPROACH OF FUZZY LOGIC FOR EVALUATION OF GREEN BUILDING RATING SYSTEM", International Journal of Innovative Research in Advanced Engineering (IJIRAE), Volume 2, Issue 3: 35-39.
9. Sunita Bansal, Srijit Biswas, S.K. Singh, (2015), "SELECTION OF MOST ECONOMICAL GREEN BUILDING OUT OF n-ALTERNATIVES: APPROACH OF VAGUE FUZZY LOGIC", International Journal of Research in Engineering and Technology, 4(2): 164-168.
10. TERI. (2010). Green Rating for Integrated Habitat Assessment (GRIHA). Delhi: Ministry of New & Renewable Energy Government of India
11. "Urban agglomerations/cities having population 1 million and above" (PDF). Provisional population totals, census of India 2011. Registrar General & Census Commissioner, India. 2011. Retrieved 26 January 2012.
12. USGBC. (2009). LEED-Existing Buildings Operations and maintenance. US Green Building Council. 13. USGBC. (December,2004). LEED-EB Project Case Study:JohnsonDiversey



INNO  SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.118



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details