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RETROFITTING RESIDENTIAL BUILDINGS

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Abstract: Building activity in the world is moving increasingly towards new construction and causing environmental exploitations in forms of land use, use of non-renewable resources, materials etc. India is the 2nd most popular country in the world with a population of 136.64 Crores, where 1/3 of the construction is already been done, and residential buildings are a considerate amount of built structure in it. With the already available constructed residential buildings which sometimes fail to meet housing needs, retrofitting of these already constructed (and in use) buildings will lead to not only the sustainable development but also cure the problem of negative impact these mismanaged buildings are creating on economy and environment of the country. The paper states about the need and importance of retrofitting residential buildings in India and the beneficial strategies in order to improve the living conditions and making it more habitable considering the site, the materials used, services, energy required, climate changes and architecture of the structure. The study focuses on the strategies, measures and the process of retrofitting.

***Index Terms* - retrofitting, residential, India, changes.**

1. INTRODUCTION

India is a land of wide variety of beliefs, values, religions and philosophies and it also has vast disparity in economic classes, financial considerations which make it very difficult for decision making regarding any changes. This is in spite of an ingrained respect for nature intrinsic to our socio-religious value systems. To bring about a convincing change in how India as country manages its resources (land, energy, non-renewable resources etc.), it is necessary to leverage the potential of acceptable changes in the homes of billions and making it more habitable. Awareness about the strategies, process and measures of retrofitting can make an achievable change in the living conditions.

India's urbanization is accelerating. According to a 2010 McKinsey report on urbanization, 590 million people will live in cities by 2030, up against 377 million in the 2011 census of India's total population of 1210 million MGI (2010, MGI). According to census data from 2011, there were 78 million housing units in the built stock, which accounted for approximately 78 million urban households. It continues to fall short of meeting housing demand, as shown by the following:

- The current stock is largely dilapidated and unfit for human habitation;
- Households with multiple families are congested and extremely crowded;
- There is a lot of stock that isn't being used.

With already built residential buildings that often struggle to meet housing needs, retrofitting these already constructed (and in use) buildings can not only contribute to sustainable growth, but can also solve the issue of the negative effect these poorly run buildings have on the country's economy and environment.

Where Retrofit can be defined as changes or upgrades that improve a building’s efficiency or performance without significantly altering its bulk, scale and form. It also includes changes to external features such as shading and landscaping.

2. PROCESS OF RETROFITTING:

The first and foremost step is to check the Feasibility of the project, the team working on the project run a detailed test on the project. The test is regarding the mandatory requirements. Then all the provided details and the information of existing building is discussed. After that all the planning and the decisions are taken for the changes. These decisions are discussed between the owner, maintenance team, and project team. After that the final step and that is the changes are been made.

3. MEASURES OF RETROFITTING

After the feasibility of the project is checked following measures are taken for the retrofitting of the residential:

3.1 Microclimatic impact: - The intent of this point is to encourage plantation of trees to reduce the impact of urban heat island effect and enhance the micro-climate of the project site.

To reduce the urban heat island effect, more than 50% of the site surface visible to sky should be either soft paved or shades by trees, vegetation, pergolas, or solar panel.

3.2 Maintenance, Green Procurement and waste management: - The intent of this point is to ensure that good practices are followed in operation & maintenance of building systems, eco-friendly and biodegradable products are used for housekeeping, energy efficient appliances are used in operations, and solid waste is managed responsibly within the project boundary.

For maintenance it is mandatory to maintain the HVAC, plumbing systems and civil work repair and the HVAC systems in use should be CFC free and fire-fighting equipment are halon-free.

For green procurement use environment-friendly cleaning and pest control products for housekeeping materials with low ozone depleting materials in building interiors. Use appliances with at least 3-star BEE (Bureau of energy efficiency) rating.

For waste management provide segregated dustbins and hygienic storage space in the project site for different treatments. And tie-up with the waste recyclers. And also implement strategies to treat all organic waste on site and to convert it into a resource as manure and reuse.

3.3 Metering and Monitoring: - The intent of this point is to support metering of energy and water consumption of the building to monitor and analyse the performance of the building.

For energy metering install digital meters at utility grid, on-site renewable energy system and diesel generators, gas, and generators sets, etc. For water metering install digital members at municipal supply, bore tank, tanker water and STP inlet and outlet. And also the quality of the water should also be tested before use.

3.4 Energy Efficiency: - The intent of this point is to facilitate the project to reduce their energy consumption by adoption of energy efficient strategies. To reduce the use of energy, follow energy efficient measures.

Percentage reduction in energy consumption: -

% Reduction in energy consumption = {(A–B)/A} × 100

Where, A = Base case energy consumption11 (kWh/year)

B = Existing case energy consumption12 (kWh/year)

3.5 Renewable Energy Utilization: - The intent of this point is to promote the use of renewable energy technologies and enable energy generation on site. Install renewable energy systems on on-site or off-site and use the energy generated to reduce the annual total energy consumption.

3.6 Water Footprint: - The intent of this point is to estimate water consumption under different uses and to identify potential areas to optimize water consumption in the project.

There is a detailed water audit report that clearly states the water supply and usage study, process and discharge analysis. Using which, one can identify the ways in which the water use can be reduced or is already less in use.

Methodology for calculating water consumption and water use reduction is as follows:

Water consumption (lpd) = N×FR×U

Where,

- N = Total occupants
- FR = Flow rate of each type of fixtures
- U = Number of uses of each type of fixtures fixed

Water use reduction (%) = [(A–B)/A] × 100

Where,

- A = Annual building water consumption through water fixture- Base case (liters/year)
- B = Annual building water consumption through water fixture Existing case (liters/year)

3.7 Reduction in Cumulative Water Performance: - The intent of this point is to promote water reuse and recycling to meet non-portable water use requirement and to reduce overall water demand from the local municipal supply/ground water.

To calculate the Cumulative water performance=

(Annual water demand of the municipal or ground water/Annual water demand of the project) × 100

Where,

Annual fresh water demand (liters/year) =

(Annual water demand of the project) – (Annual water recycled & reused)

Where Annual water demand liters/year of the project includes the water requirement of Planned and floating population, landscape and services like HVAC, Fire-fighting and etc.

4. STRATEGIES OF RETROFITTING IN LAYERS

	LIGHT LAYER - (Nil to Minimal Disturbance to the Dwelling unit)	LIGHT DEEP LAYER- (A base level of cost & interference to the unit, can be achieved without major disruption to the unit and inhabitants)	DEEP LAYER- (A complete re-haul towards net-zero neutrality of the Dwelling unit common areas and neighbourhood)
4.1 Lighting	1. LEDs can be used to replace all lamps, both in public areas and inside the home. 2. Wherever possible, progressively replace with solar lanterns.	1. Redesigning and replacing luminaires, controls, sensors, and dampers for efficient lighting in compliance with the Lux Levels specified by the code. 2. Solar Lanterns and lighting systems	1. Redesigning the internal and external lighting systems to be in sync with day-lighting in compliance with the Lux Levels stipulated by the code. 2. Steps at the district/neighbourhood level, such as resident sensor street lighting, daylight sensors, solar lighting, etc.
4.2 Appliances & energy	Upgrading appliances to star-rated energy-efficient models, especially for heating and cooling, refrigerators, microwaves, ovens, etc. which are the major consumers of electricity in the home.	Installation of renewable energy to meet up to 50% unit's energy requirements, like solar water heaters & solar cookers.	The whole system Develop, retrofit, build, and augment RE to achieve Net-Zero energy standards for individual dwellings and common areas.
4.3 Wiring	Capacitors must be installed in the house wiring to reduce transmission and distribution losses inside the structure.	Replace old wiring and ensure that transmission and delivery losses are kept to a minimum throughout the distribution circuit.	Redesign distribution and electrical networks to ensure reduced losses, using sensors, displays, and other technologies.
4.4 Lifts	Lifts, such as those used in multi-story apartment buildings, should be tuned for optimum efficiency.	For maximum performance, lift motors, especially in older multi-story apartment buildings, should be replaced.	Wherever possible, switching to low-energy and hydraulic systems.
4.5 Envelope - passive measures	1. Roof paints/tiles with a high solar reflective index. 2. Textures/cladding for walls that self-shade 3. Adding trees, greenery, and shade to the south and west walls.	1. To reduce solar heat gain and cooling/heating losses, use roof deck shade, landscaping, and/or insulation (as applicable) 2. Integration of wall insulation to minimise solar heat gain and heating/cooling losses.	1. Roof Deck, Wall Envelope, and Retrofit to achieve zero heat gain / loss in compliance with the climate. 2. Envelope integrated cooling/heating systems, such as chilled beams and water cooled walls, are energy efficient.
4.6 Damage repairs	Checks and reports on air quality. Paints and finishing compounds with low volatile organic compounds (VOCs).	Detection and repair of waterproofing failures.	If necessary, structural rehabilitation/redesign.
4.7 Fenestration - heat gain	Ensure that both heated / cooled rooms are airtight and leak-free. Refresh the trims around all fenestrations, such as windows, glazing, doors, and other openings.	1. Low-energy glazing films that minimise heat gain. 2. Installation of awnings and shading devices for exterior openings.	Window removal and configuration for a lower Solar Heat Gain Coefficient.
4.8 Fenestration - day lighting	Internal layouts and paint schemes for furniture, blinds, sheets, shelves, floors, walls, and ceilings in deeper spaces should be planned and modified to ensure adequate reflected light and therefore sufficient lux levels without artificial illumination during sun-lit hours.	1. Passive day-light penetration and diffusion systems, such as light racks, are designed and installed. 2. Landscape and exterior steps and facades are being redesigned to ensure optimal indoor day lighting while minimising direct solar heat gain.	1. Low-SHGC glass with a high VLT. 2. Added/removed skylights, clerestories, and openings to reach optimal levels to reduce glare. 3.District/neighbourhood level landscape and colour strategy to analyse shading and day light specific to each inhabited space within the neighbourhood.

4.9 Energy efficient cooling	1. Used natural ventilation to its full potential. 2. Whenever possible, incorporate or replace refrigerant-based cooling systems with evaporative cooling systems. 3. Modification of existing equipment with engines, controls, and correction steps such as higher temperature tolerance settings, etc.	1. Radiant heating/cooling systems with centralised power, such as chilled panel false ceilings, underfloor cooling, chilled beams, etc. 2. Enhancing and incorporating cross ventilation, shading, convection currents, solar chimneys, and other traditional techniques.	1. District cooling / heating. 2. Solar powered cooling system. 3. Geo-thermal cooling systems.
4.10 Water demand reduction	1. Switching to low-flow fixtures. 2. RO waste water, and so on. To be redirected for drainage or flushing in the kitchen garden. 3. Encouragement of the Bucket Bath and water recycling.	1. Fitting low-flow faucets and fixtures in the plumbing system. 2. Rainwater harvesting, if necessary and feasible. 3. For multi-story buildings and housing units, upgrade for gravity-based delivery rather than pressurised jockey pump distribution.	1. Low-flow faucets and fixtures should be used instead of standard faucets. 2. Rainwater harvesting where applicable. 3. Re-design multi-story buildings and housing units to use gravity-based distribution rather than a pressurised jockey engine.
4.11 Water Pumping and distribution Management	1. Cleaning and repair of the water pumping, storage, and drainage systems on a regular basis to prevent blockages and leaks. 2. Pumps in the open areas and individual housing units are being re-haulled for optimum efficiency. 3. Domestic supply pumps are scheduled and operated on a daily basis to prevent repetitive and frequent operations.	1. Pumps and motors must be overhauled or removed to ensure that they operate at 75% efficiency. 2. If applicable, calibration and correction of piping systems to ensure energy efficient pumping and delivery.	1. Reviewing, designing, and upgrading (if necessary) the water supply, drainage, and pumping systems so that they all function together and are as effective as possible. 2. Installation of a softener and an iron filtration device to secure the system from rust, iron deposits, and scaling. 3. Run-off prevention using rainwater management. 4. Recharge of groundwater.
4.12 Solid waste management	1. Waste segregation, as well as recycling, reduction, and reuse, can be facilitated, but waste disposal and distribution would have to be a district-level intervention, as will electricity from waste management. 2. Paper recycling already has a thriving industry, especially in the domestic market. Plastics and other similar items, especially The waste, that may be added to the list by incentivizing collectors, or local ‘raddiwalas,' to gather, sort, and properly recycle or sell the items through proper channels.	1. Solid waste disposal at the district level, including segregation, compaction, composting, and recycling, as necessary. 2. District level awareness and reduction drive including A. Levying fines/ taxes on RWAs for littering B. Incentives to minimise non-biodegradable waste C. Compost and fertilizer management at neighbourhood level D. Encourage urban agriculture and organic farming.	1. District Level Energy from Waste. 2. Neighbourhood incentives or certificates for lower carbon and waste footprint, like A. Electricity bill reduction, by DISCOMs B. Property tax exemption, assessed annually C. Subsidised RE installation, D. Special Assessment zone considerations, E. Neighbourhood's Green Appraisals and review via Municipal channels

5. CONCLUSION

Building activity in the world is moving increasingly towards everyday new construction, and the construction is leading to environmental exploitation. So, for the future of this planet some measures are needed to be taken. And Retrofitting of already constructed building is one of the effective and efficient way to reduce environment exploitation.

It is Important to note that all throughout this study the focus relied primarily upon un-explored/under-explored strategies, measures and process of retrofitting. The choice of strategies of retrofitting is very case-sensitive and makes difference in our approach towards construction activities. And Taking a conscious decision while choosing retrofitting strategies can be affective for the project and our environment.

With buildings consuming 40% of energy, 25% of water and 40% of resources, we can use it as an opportunity to reduce increasing demand by enhancing recourse efficiency in existing buildings.

Retrofitting of residential buildings and making it habitable can make a big difference towards the change. So, it may be start but it should reach to extents, following it will make a big difference.

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