Energy Efficient Urban Resident Autonomus Buildings

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Abstract- *An Autonomous Building is a building designed to be operated independently from infrastructural support services such as the electric power grid, gas grid, municipal water systems, sewage treatment systems, storm drains, communication services, and in some cases, public roads. Advocates of autonomous building describe advantages that include reduced environmental impacts, increased security, and lower costs of ownership. Some cited advantages satisfy tenets of green building, not independence per se (see below). Off-grid buildings often rely very little on civil services and are therefore safer and more comfortable during civil disaster or military attacks. (Off-grid buildings would not lose power or water if public supplies were compromised for some reason.) Most of the research and published articles concerning autonomous building focus on residential homes.*

Nation is climbing a ladder of growth day by day with various parameters, construction is one of them. Due to tremendous increase in population and urbanization, there are a lot of problems like Global warming, rise in population, shortage of resources, pollution of water and air and products of globalization. On other side of coin, all above have given new vision of self sufficient energy efficient residential buildings in urban areas. Eco-Urbanism, Green Architecture and Eco-friendly construction are the important subjects connected with sustainable development. Hence it is need of an hour to proceed with the steps to stop the detoriation of the environment.

This study highlights the study of current scenario of self sufficient, energy efficient residential buildings in urban areas which is the only way to achieve self sufficiency, energy efficiency, indoor air quality, reduction in waste and efficient use of water. It also involves the different implementation of sustainable practices during pre-construction and construction stages on post-construction activities with available sources.

Keywords- Energy Efficiency, Residential Buildings, Self Sufficiency, Sustainable Development and Water Efficiency

I. INTRODUCTION

As tremendous increase in population and migration from villages to cities from last century, as there is a requirement of shelter in developing cities like Pune. To fulfil the needs and wants of human the consumption of natural resources is continued without considering their permanent

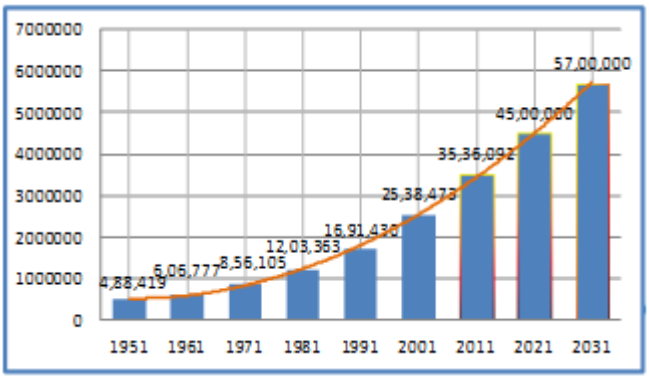

Fig.1 The rising urban population in Pune(Census 2011)

Pune is expected to record a high house demand – supply gap of nearly 70% where demand is expected to be as high as 180,000 units while supply will remain low at around 53,000 units [6].

The present rate as the development is going on with resulting the tremendous degradation of environment. Sustainable development is only solution to control the degradation of environment. It can create clean, green and less carbon intensive world which will achieve environment sustainability. From last decades demand for 'Sustainable Development' is increased for resources planning. There are some certifying agencies like IGBC, GRIHA, LEED, ASHARE, USGBC etc[10].

Sustainable development is undertaken with view of an organized effort to design buildings, providing facilities for comfort living using proper material and processes that achieve sustainability.

Green practices in construction of new buildings contributes the reducing the load on natural resources like water efficiency, energy efficiency and reduction in use of fossil fuel for handling of waste[1].

Cavity Walls: The walls facing west and south directions are constructed as cavity walls using burnt bricks. The cavity is continuous from plinth level to lintel and from lintel to slab level. (**Case study NO.3 Prof S. D. Suryavanshi`s residence)** thus maintaining the temperature inside the building in summer & winter season. Cavity walls prevent

heat gained through exposed walls to enter inside the building because air vacuum in cavity walls acts as a barrier for heated air.

Openings in walls:. The openings of nominal size 0.6mx0.6m are provided in external & internal walls immediately below slab level & above lintel level. Self operating exhaust fans are placed in the openings provided in external walls. Openings in internal walls are simply kept open. The floor to floor height of a building is increased by 10% i.e. 3.3m in place of 3.0 m increasing its volume correspondingly. When inside room temperature increases and air is heated, air starts rising up due to decreased density. This heated air find exit through the openings provided in external walls. The habitants feel cooling effect inside the building.

II. PROBLEMS OF INCREASE IN POPULATION AND MIGRATION FROM VILLAGES TO CITIES

There is a very heavy and unexpected load on providing basic facilities and services on concerned authorities like Municipal Corporations. Fiscal impact is one of major of them. Global warming, shortage of resources, food scarity, air pollution, water pollution, land pollution, these are some products of urbanization. This has given new vision to self sufficient and energy efficient residential buildings in urban area. It will fulfil the present needs without neglecting the future demand**.**

III. NEED OF SELF SUFFICIENT AND ENERGY EFFICIENT BUILDINGS

A. Site and facility management-

Choosing a building's site and managing that site during construction are important considerations for a project's sustainability. As a result of that, operation and maintenance cost of the building get reduces. The Sustainable Sites category discourages development on previously undeveloped land; minimizes a building's impact on ecosystems and waterways; encourages regionally appropriate landscaping; rewards smart transportation choices; controls storm-water run-off; and reduces erosion, light pollution, heat island effect and construction-related pollution. Provision of maximum shading for non-roof areas, use of heat reflective material on roof, reduction in external lighting and its pollution and building's operation and maintenance practices leads reduction in dependency on natural recourses.

Building owners, architects, consultants, developers, facility managers and project managers that they need to design, construct and operate green buildings. A voluntary certification program that can be applied to any building type and any building lifecycle phase. It promotes a whole-building approach to sustainability by recognizing performance.

B. Water Efficiency

Buildings are major users of potable water supply. The goal of the Water Efficiency is to encourage smarter use of water, inside and out. Water reduction is typically achieved through more efficient appliances, fixtures and fittings inside and water-wise landscaping outside. Planning and storage of different quality of water with respect to use increases water efficiency. Planning and executing of rainwater harvesting, waste water treatment, separate water supply for non-potable purpose etc results more efficient use of water. Water efficient homes can save potable water to an extent of 30-50%.[]13

C. Energy Efficiency

It encourages a wide variety of energy strategies. Energy use monitoring, efficient design and construction, separate energy meters for regular supply and back-up supply, efficient appliances, systems and lighting in rooms and common areas the use of renewable and clean sources of energy, generated on-site or off-site; and other innovative strategies which results the efficient use of energy. There is saving of energy up to 30% by use of efficient application.

D. Health and Comfort

Due to no smoking policy implementation during construction and prohibited smoking in common areas, ill effects of smoking can be minimized. Due to using eco-friendly material for construction like low VOC paints it will be beneficial for workers as well as user. Providing ramps near lifts, elevators and special W.C and bath rooms in common area will offer comfort for physically challenged occupants. Provision of jogging track, gymnasium, swimming tank leads to fitness for users which results reduced absenteeism for their workplace and increase in productivity.

E. Materials & Resources

During both the construction and operations stages, buildings are a source of waste generation and use a lot of materials and resources. This encourages the selection of sustainably grown, harvested, produced and transported products and materials. Result of it there is reduction of waste as well as reuse and recycling of material, and it takes into account the reduction of waste at a product's source.

F. Indoor environmental quality

Indians spend about 90% of their day indoors at their residences, schools and workplaces, where the air quality can be significantly worse than outside. Maintaining Healthy and working Indoor Environmental Quality promotes strategies that can improve indoor air as well as providing access to natural daylight and views and improving acoustics [13].

IV. VARIOUS AGENCIES FOR CERTIFICATION OF SELF SUFFICIENT AND ENERGY EFFICIENT RESIDENTIAL BUILDINGS

Major rating systems:

In India Indian Green Building Council (IGBC) and Green rating Integrated Habitant Assessment (GRIHA) are major rating systems

A. IGBC- This rating system provides a roadmap for measuring and documenting success for every building type and phase of a building lifecycle. It offers four certification levels for new construction -- Certified, Silver, Gold and Platinum -- that correspond to the number of credits accrued in above mentioned green design categories. Indian, formed by Confederation of Indian Industry (C.I.I) in the year 2001, is continuously striving towards wider adoption of eco-friendly / green building concepts in the Indian Industry.

TABLE-I
RATING SYSTEM FOR GREEN BUILDINGS

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

Triggering off the Green building movement in India is the first Platinum Green Building in India; Sohrabji Godrej Green Business Centre in Hyderabad as per the IGBC Rating system. This landmark achievement put India on the global map of green building movement, through support of all stakeholders from the construction industry.

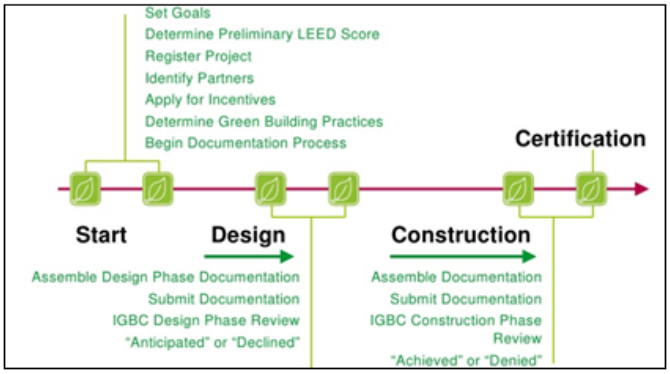

FIG.2 STEPS OF CERTIFICATION
Sourse- www.igbc.in

With a modest beginning of 20,000 sq ft (1,900 m2). Green built-up area in the country in the year 2003, as on date, 3088 projects in India have registered under the IGBC Rating programmes, with a total footprint of over 2.68 billion sq. ft. Charges per new building certification is (Registration 25000 + Precertification 150000+ Certification 140000) total 315000 for IGBC members. For non-members it is (Registration 30,000 + Precertification 1,85,000 + Certification 1,50,000)

B. GRIHA:-

GRIHA rating system consists of 34 criteria categorized under various sections such as Site Selection and Site Planning, Conservation and efficient utilization of resources, Building operation and maintenance, and Innovation points. Eight of these 34 criteria are mandatory, four are partly mandatory, while the rest are optional. Each criterion has a number of points assigned to it. It means that a project intending to meet the criterion would qualify for the points. Different levels of certification (one star to five stars) are awarded based on the number of points earned. The minimum points required for certification is 50. on date, 575 projects in India have registered under the RIHA Rating programmes, with a total footprint of over 20 billion sq.m.

V. INCENTIVES OF CERTIFICATION

Developer has to spend some amount for certification as per area to be developed. Once the building get certified then benefits of certified building guarantees. Also it will have different identity. Due to having very less operation and maintenance cost it have improved sales and more resale value. Apart from this there are attractive incentives offered by different state governments. Some major incentives are

A. Rebates on Property Premiums and Taxes

Some municipal corporation offers tax and premium rebates to certain certified buildings. Ex-The Pimpri Chinchwad Municipal Corporation offers rebates on premiums paid by developers with property tax discounts based on the number of stars the building achieves through GRIHA certification.

TABLE-II
DETAILS OF DISCOUNTS BY P.C.M.C FOR CERTIFIED BUILDINGS

Points Scored	Rating	Discount in Premium	Discount in Property tax
50-60	1 Star	10%	5%
61-70	2 Star	20%	8%
71-80	3 Star	30%	10%
81-90	4 Star	40%	12%
91-100	5 Star	50%	15%

1. Discount in property tax for home owner

Once the construction is complete, the developer will hand over the green building to the flat owners, and henceforth, the flat owners of the green building will get a discount of 10% on property tax.

Some other municipal corporations in the state of Maharashtra like Nashik and Navi Mumbai, are developing property tax-based incentives for green buildings. In Pune , Pune Municipal Corporation offers buildings with solar or wind power to be taller and thus more valuable, providing a significant incentive to developers.

B. Fast track environmental clearance for GRIHA pre certified projects-

As per government of India it is compulsory to obtain an environmental clearance certificate for residential construction projects having area 20000 m2 before an approval is granted. Such rules has created a negative feeling because of delays in starting such projects. If such kind of projects if certified by GRIHA then it will be very simple to get environmental clearance. Hence delays due to get environmental clearance can be minimized by certification.

C. Financial incentives-

Financial institutions also offer incentives to encourage energy efficient construction in India. Some of the banking groups such as Bank of Baroda, ICICI, Industrial Development Bank of India and State Bank of India sanction loanat lower rate of interest or concessional rate for certified buildings. These banks offer project financing to carry out audits, upgrades or retrofits to corporations or ESCOs. Larger groups like the International Finance Corporation (IFC) and the Asian Development Bank provide financing to smaller banks or financial institutions to further fund energy efficiency upgrades.

Along with these incentives other remaining state wise incentives have mentioned in following diagram.

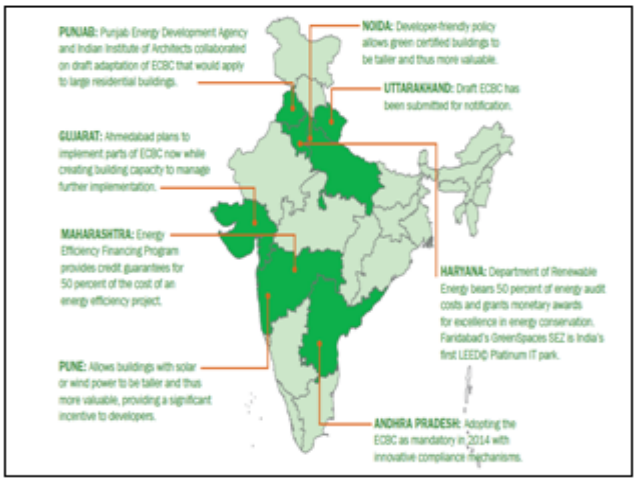

FIG-3 GREEN BUILDING INCENTIVES
SOURCE-GREENER CONSTRUCTION SAVES MONEY: INCENTIVES FOR ENERGY EFFICIENT BUILDINGS ACROSS INDIA.

VI. CURRENT SCENARIO OF SUSTAINABLE BUILDING

Current scenario of surveyed certified green building-

A. Consideration of sustainability aspects in building design and planning-

Architectural planning of observed building is each flat is three sided open which helps to get maximum light and ventilation which ultimately reduces the load on electricity. Building is planned to have maximum Natural light, Natural ventilation considering local wind data and solar path analysis, which has been calculated by computer simulation. No common wall in between any of the flat which achieves very good cross ventilation. Total area of opening (inlet and outlet) is more than 30% of floor area. As a result of it there is 20-30% saving in indoor energy consumption[13].

B. Landscaping-

All trees planted are “Native Fauna” of Pune. e.g. Bahava, Kadamb,Saptaparni, Sitaphal, Shirish, Mango,

Sonchafa, Limbu. The trees are planted in such a way that most of the paved area will be covered by shadow of trees. All trees are numbered and allotted to the flat owners who will take care of them. The open parking lots are covered by group of veins such as Jai, Jui, Krishna- Kamal etc.The complex has vegetable patch from where all the flat owners will get daily vegetables which are produced by Organic method[13].

C. Other eco sensitive measures:

Electric charging point for charging of vehicles is provided which will use "Green Energy" only. All W.C's are with dual flush system with a flow rate of 3L & 6L per flush. Building has also provided separate chutes for collection & separation of 100% bio-degradable, and non-biodegradable wastes. Also onsite treatment plant using bio culture for the treatment of 100% of organic wastes. The manure from bio-degradable wastes will be utilized within the site itself.

D. Energy Efficiency

All flats have solar water heating system. Common lighting in outdoor passage as well as parking areas have time & motion sensors i.e. after sunset they will automatically turned on & then turned off only to start when there is any motion, which will again turned off when there is no motion for 1 minute. When all 9 floors are dark, to avoid any mishap, every mid landing has 3 W LED light which is sufficient for the entire common area. Thus the building practically runs on only 27 W powers throughout the night, which saves electricity in common area by 80%. .Provided lifts is "Green Lift" i.e. it is machine room less, gear less and weight-sensing. The energy consumption will be as per the weight inside the lift & this lift always run on "Green Energy". It is compulsory to use energy efficient fixtures & fittings in each flat such as all Tube Lights- T5-28 W or CFL only, all Toilets & Terraces- CFL lights only and all Fans - energy saver or power saver -50 W only.

To make sure that the flat owner will use the same energy efficient fixtures throughout the life the building has a unique system which is as follows:

a) Every flat has Blink Free Changeover (BFC) switch, which limits use of current from "Green Energy" up to 1.5Amp.
b) If the consumption exceeds 1.5 Amp, the system will change automatically from "Green Energy" to "Grid Energy". This will be shown by LED on the changeover box, which will create awareness towards energy saving.

Normally minimum 3 T5 tube lights, 2 CFL, 2 Fans, 1 TV/computer can run in the limit of 1.5 Amp current. Green energy is free of cost to flat holders this automatically controls the usage of Grid Energy.

E. Water efficiency

Uniform pressure water supply system is maintained to reduce consumption of water. Advanced plumbing fixtures have been provided for efficient use of water. Duel flush valve has provided for flushing in toilets to restrict the flow rate to 3-6 lpm. Separate water meter has been provided for water use monitoring. Drip and sprinkler irrigation system has been provided for landscaping. Rain water harvesting is done to reduce the load on sewage treatment plant. Underground storage tank has been provided to store rainwater. Waste water treatment plant has been provided for waste water treatment and treated water. From 86 CMD treated water 19 CMD treated water is used for flushing, 44 CMD treated water is for landscaping and 7 CMD treated water is used for car washing.

VII. ENERGY CONSUMPTION COMPARISON BETWEEN TRADITION BUILDING AND GREEN BUILDING

Following data has been worked out after carrying out the survey of Conventional building and Green Building by taking the interviews of the flat owners from door to door through questionnaire survey.

As vision and ventilation parameters directly affects the consumption of energy in conventional buildings only tube-light, CFL bulbs and fan is considered rest of all appliances energy consumptions is as per efficiency and other factors.

Data required:

1. Total no of T5 Tube lights: 180.
2. Total no of CFL: 54
3. Total no of fan: 108.

For Conventional Building:

Energy Consumption due to Normal Fixtures:-

– T5 Tub Lights -180Nos×28W×6Hrs×365 days=11037 Units.
– CFL-54Nos×9W×2Hrs×365days=354 Units.
– Normal Fans- 108nos×80W×6Hrs. ×365 days=18921Units.
– Lift- 5KW×5Hrs×365 days = 9125 Units.

Total annual energy consumption for normal fixtures = 39437 Units/year.

Energy consumption for water heating –

- Water required for bathing = 40 litre/person
- No. of persons in house = 5 persons (Assuming)
- Daily hot water required = 5 × 40 = 200Litre
- Consumption of energy required to heat 1 liter of water = 37.5 Watt

Energy consumption for water heating = 200 × 37.5 = 7500 watt/day = 7.5 Units /day

Annual energy consumption for water heating = 7.5 × 300 = 2250 Units /year

Total annual energy consumption in Conventional Building =39437+2250=41687 Units.

For Green Building:

- Energy consumption due efficient fixtures

T5 Tub Lights: - 180Nos×28W×6Hrs×365 days = 11037 Units
CFL: - 54Nos×9W×2Hrs×365days = 354 Units.
Power saver fans: -108nos×50W×6Hrs×365 days
= 11826 Units.
.
Green lift:- 5KW×60%×5Hrs×365 days = 5475 Units.

Thus total energy consumption = 28692 Units/year
Energy saving using Solar water heating system:-2250 Units.

Total electricity saving in existing certified energy efficient building = 41687 – 28692
=12995 Units/year.

Excavation for foundation in earth, soil of all types, sand, gravel and soft murum, including removing the excavated material up to a distance of 50 m. beyond the building area & stacking and spreading as directed, dewatering, preparing the bed for the foundation and necessary backfilling, ramming, watering including shoring and strutting etc. complete. With Lift upto 1.5 m.

47.25, 73, 47.25, 3449.25

Cost of Construction for **Conventional Building** is Rupees Eight Lacs Twenty Thousand Three Hundred Thirty Four only

Cost of Construction for **Autonomous Building** is Rupees Ten Lacs Sixty Eight Thousand One Hundred only Cost of Autonomous Building is more than Conventional Building by Rs
23.19%

VIII. CONCLUSION

- As increase in population in the world automatically migration takes place in urban areas due to urbanization. With increase in urban population automatically load on basic facilities provided by concern authorities will gat increases with environmental degradation. So to minimize this effect sustainable development should be implemented to preserve the natural recourses and to reduce load on basic services.
- It should be planned through different pre-construction activities and effectively implemented through construction activities. Sustainable practice is not hard and fast rule that effects of it may vary with annual climatic condition and which may not same every year and every place.
- Though India is a country whose footprint for sustainable development is second in the world, awareness at root level is very less. For awareness, sustainable awareness programmes should be carried out at root level.
- Certification procedure should make simple by merging all certifying agencies from national level to local level through appointing an officer at local level. As a result of it there will be early, time saving and effective pre-certification and final certification will take place. Also incentives should be finalized and offered at national level for whole country

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