ISSN: 2456-1363
International Journal of Scientific Research & Growth
A Multidisciplinary Peer Reviewed and Refereed International Journal
Volume-2 Issue-2 June- 2017
www.ijsrg.com
editor@ijsrg.com

Transformation Of Existing Building Stock Green Technology Application In Construction

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Abstract
Conventional Building when compared to a green building seems same externally as well as in building use but differs in the operational savings and concerns for human comfort and indoor environment. Green Buildings offer the benefits of saving 40-50% energy, reduction in CO_2 emissions into the atmosphere. It also saves about 20-30% water by using various techniques. Since green buildings save approximately 50% of the energy, so the annual power consumption is also reduces i.e. saving in the electricity bill. We are trying to find ways and modes to make existing building stock more eco-friendly and energy efficient.
Keywords: - *Green technology, Green buildings, Power consumption.*

1- INTRODUCTION

The building construction of modern cities can have significant negative impacts on the environment; from the clearing of natural areas for building sites and materials, heating and cooling, transporting materials and workers, the ecological impact of modern buildings is enormous. Apart from these environmental impacts, buildings can also have direct effects on the physical and mental health of their residents. There are, however, current alternatives to such construction practices and unsustainable use of building materials. Known as "sustainable," "high performance" or "green" building techniques. Their aim is to minimize environmental impacts through careful site selection and design, increased water and energy efficiency, and appropriate sourcing and use of materials in building construction. The most commonly used name for this type of construction is "green building." But available Building stock in India is conventional construction consumes lots of natural resources in operational life,

Transformation of existing Building refers to using a process that is environmentally responsible and resource efficient in operational lifecycle of building, Since buildings consume nearly 50% of World's Total Energy. Transformation of existing building stock are designed to reduce the overall impact on human health and the natural environment by using energy, water and other resources efficiently; by reducing waste, pollution, and environmental degradation.

The transformation of existing building stock is to implement green concepts, understanding their viability and using them to modified conventional buildings which will prove to be an iconic building, a standing example of a transformation of building which would be healthy for the people inside as well as outside.

2- OJECTIVES

The objective of paper may be enlisted as bellow

1. What are the specific requirements of the programs?
2. In what ways and to what extent do existing building stock transformed to aim to preserve or enhance the quality of the environment?

3. In what ways and to what extent do existing building stock transformed to aim to improve the health of the people and communities?

4. In what ways and to what extent are existing building stock transformed to make cost effective relative to conventional building?

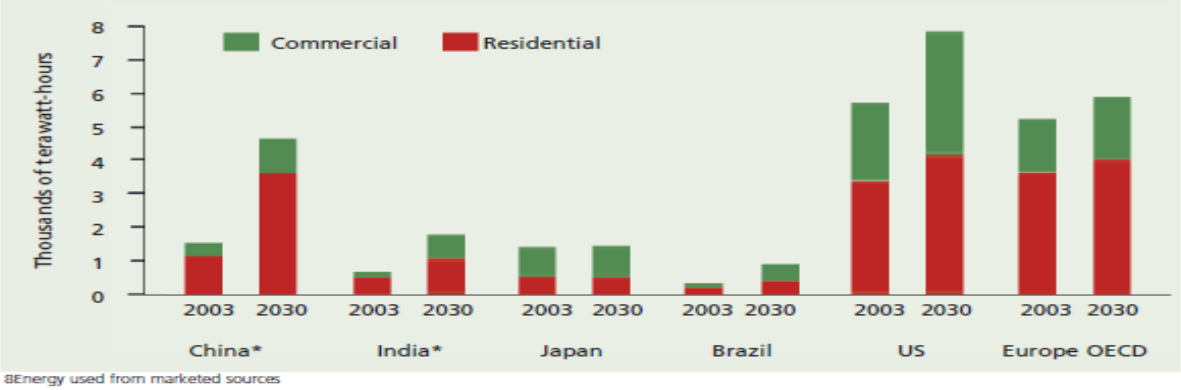
3- BUILDING & ENERGY

According to the International Energy Outlook 2013, the energy use tracker of the US Energy Information System, the building sector accounts for more than one-fifth of total worldwide energy use, and India mirrors the trend.

The Energy Statistics 2013 of National Statistical Organisation (India) shows energy consumption of electricity is more than 57 per cent of the total energy consumption during 2011-12, and building sector is already consuming nearly 40 per cent of the electricity. This is expected to increase to 76 per cent by 2040. A large quantity of incremental electricity demand will come from the residential sector in India.

The International Energy Outlook 2013 also projected that India's residential energy consumption trend resembles that of China at 3.7 % per year, and India's commercial sector energy consumption growth is projected to increase at an average rate of 5.4 % per year, which is also the world's highest (see Graph: Projection of energy for buildings by region 2003-30).

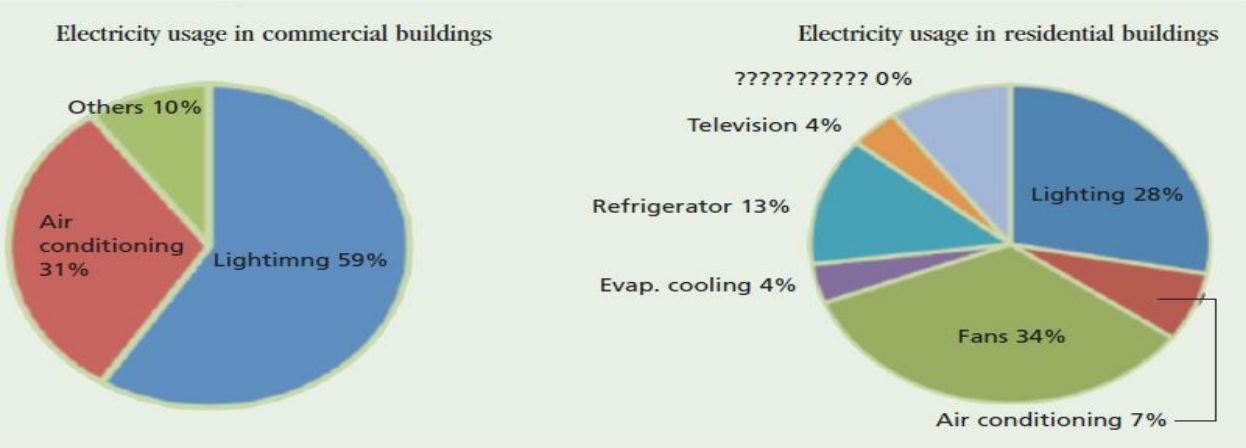
Graph: Projection of energy for buildings by region, 2003-30



8Energy used from marketed sources

Classification of consumption of electrical energy shown in graph below

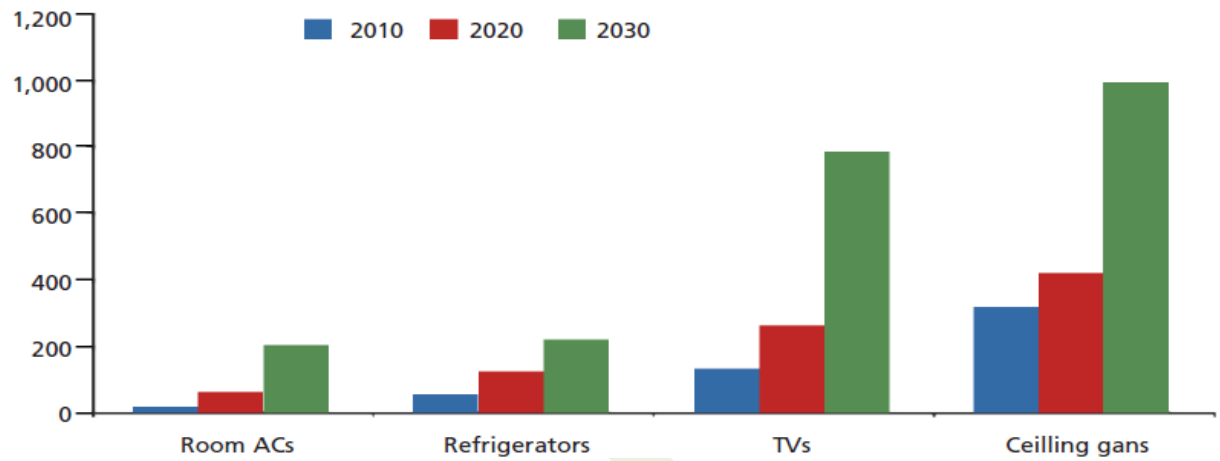
Graph: End use of electricity in commercial and residential buildings



Source: Bureau of Energy Efficiency

If we see owner ship of appliances, 70% of appliances increase by 2030(According to Prayas Energy). Between 1990 and 2005 commercial building energy consumption has increased by 60 per cent. It further states that the approved 580 special economic zone that is expected to cover 1.1 billion sq meters, by 2030. This will drive demand for energy intensive air conditioned space as about 60 per cent of the commercial space in India will be air conditioned and while four out of every 10 urban homes will have at least one air conditioned system, as per the Mckinsey 2009 estimates

Graph: Ownership of appliances in India growing rapidly



4- TECHNIQUES THAT CAN BE APPLIED TO THE EXISTING BUILDING

- Effective lighting, Cooling and heating system
- Water conservation and water management
- Active use of natural light and air by re-orientation of the windows and openings
- Employment of efficient insulating building material for reduction of heat convection as well as radiation
- Efficient occupancy based control of lighting and air conditioning loads

ADDITIONAL METHODS

That are effective in converting existing buildings into green ones

- Use of rooftop solar system
- Solar wind hybrid system
- Recycling and reuse of waste water
- Use of organic as well as inorganic solid waste for more purposeful uses like composting and power generation. Converting existing buildings into green ones.

5- FEATURES FOR TRANSFORMATION OF EXISTING BUILDING.

- Energy efficient-through the natural lighting ventilation and solar passive designs
- Efficient use of water-through recycling and water harvesting
- Use of renewable energy-through photo voltaic systems and solar system etc.
- Non toxic material indoor environment
- Efficient waste utilization and disposal

6- METHODOLOGY ADOPTED FOR TRANSFORMATION

Following methodology recommended for efficient and cost effective transformation of existing building stock, and which needed least alteration and modification in main structure of building.

A- COOL ROOF

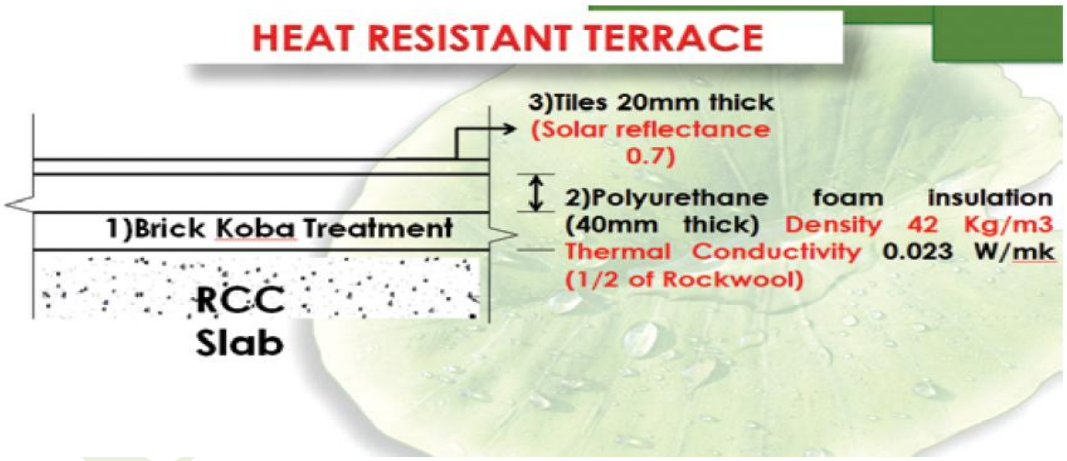
Over past few decades, roof top become a large contributor to excessive heat gain. As many as 99% of Rcc roofs in India in conventional buildings are non reflective, dark and heat absorbing materials. Because of this temperature of rooftop can raised about degree above the prevailing air temperature. Cool roofing is a emerging and powerful technology used for temperature control of building area. A cool roof prevent heat absorption by reflecting Sun's heat and than emitted radiations back into the atmosphere. By this cool roof allows for more comfortable and controlled indoor environment. The results from research carried out by department of energy California shows that solar reflective roofs and vegetated roof should reduces overall air temperature in urban area as well as indoor temperature of building.

To Enhance the Thermal Performance of Roofs following methods may adopted

• Application of Insulation over the roof top
• Arrangement of Inverted earthen pots
• providing White glazed ceramic tiles or Vermiculite tiles having high reflective properties.
• Highly Reflective paint coatings
• Green Roofs etc.

Additional cost of insulation pays back in energy savings that result from correctly sizing the HVAC equipment to reduced cooling loads. Good insulation also extends the life of the roof system. A typical roof assembly which is recommended by CPWD shown below. This may be applied on finished roof by providing polyurethenefoam insulation of 40 mm thickness with solar reflective tiles.

Roof Assembly



Source-CPWD

B- WALLS TREATMENT

To enhance the thermal performance of walls one of following method may be adopted

- Application of Thermal Insulation
- building additional walls out side the structure to provide Air Cavities in walls
- Green walls by Veg. / tiles
- Double skin facades
- Applying Coatings & Light color paints

In application of Insulation on Wall Surfaces materials with lower conductivity are preferred, as they are better insulators and reduce the external heat gains from the

surroundings. It should be noted that Insulation must be placed on the hotter side of the surface. In hot areas, insulation should be placed on the external side and In Cold Climates, Insulation on Inside.

C- INDOOR AIR QUALITY

Conventional paints have major negative impact on indoor air quality, they have VOC and other harmful chemicals. Green paints having low VOC. Benefits of green paints and VOC Limits as per rating systems, are as tabulated below

Table No1 – Compare green paint versus conventional paints

Green paint	Conventional paint
Cleaner indoor air, Reduced ozone depletion	Contribute to environmental pollution, Ozone depletion
Minimum health risks	Significant health risks
High initial cost- Same as high quality paints Low O&M cost	Low initial cost, High O&M cost

Table No. 2 - VOC requirement for paints

VOC REQUIREMENT				
IGBC Specification		GRIHA Specification		
Coating type	VOC in gms/lit. Minus water	Paint Application	Coating type	VOC in gms/lit.
flat	50	Interior Coating	flat	50
			Non flat	150
		Exterior Coating	flat	200
Non flat	150		Non flat	100
		Anti corrosive	Gloss/semi gloss/flat	250

So it is recommended, use of low VOC paints to improve the indoor air quality,

D- DOORS & WINDOWS

Provision of double glazed windows and application of high performance glass as well as extension of sunshade projections over doors and windows improve the thermal performance of existing buildings**.**

High performance Glass

High performance glass reduces the ingress of heat and same times allow higher penetration of daylight. Right choice of glazing material can significantly lower the cost of energy consumption.

Types of high performance glass

(a) Insulated (double-glazed, triple-glazed) – unit consists of two or more panes of glasses spaced apart and sealed to form single unit with air space to resist heat flow. This type of unit have lower U-factor and solar heat gain coefficient.

(b) Gas filled glazing – the space between panes of glasses filled with inert gases

generally argon and krypton and sealed to form single unit have higher resistance to heat flow. This type of unit have lower U-factor,

(c) **Heat absorbing tints –** the tinted glass absorbs a large fraction of incoming solar radiation and glare thus reducing solar heat coefficient. However also reduce VLT.

(d) **Gas filled glazing –** the space between panes of glasses filled with inert gases generally argon and krypton and sealed to form single unit have higher resistance to heat flow. This type of unit have lower U-factor,

(e) **Low–emissivity (Low-E) coated glass-** Low-E coating are microscopically thin, virtually invisible matellic layer deposited on glass to reduce U-factor by suppressing radio-active heat flow. These glasses made for reducing heat transfer by long wave radiations. Low-E glass have emissivity 0.35 to 0.04, means 65% to 96% of long wave radiations reflect back to the atmosphere.

(f) **Reflective coating glass-** this coating consist of thin metallic layer in difference colors including silver, gold and bronze, apllied to outer surface of glassing exoosed to atmosphere. This coating reduce the transmission of radiations as well as visible light transmittance (VLT)

E- ENERGY EFFICIENT ELECTRICAL FIXTURES AND APPLIANCES

Cost of operations is linked to the technology and materials chosen for construction.

Energy efficiency – This is find from literature review that energy efficiency of green building design depends upon; type of building, climatic responsive design adopted or not, type of green material used and technology use for green building. Table Number 3 shows reduction in electricity demand after transformation of existing building.

Table No. 3 - reduction in electricity demand

Feature	**Conventional Building**	**After transformation**
Electrical Demand (1 Mn sq. ft)	- 10 MW	6 - 7 MW
Lighting Power Density (watts/ sq.ft)	1.5 - 2.0	0.6 - 0.8
Equipment Power Density (watts/ sq.ft)	2.5 - 3.0	1.5 - 2.0

Source - Green Building Concept by Ms. Anuja, Consultant, TSG.

The % of average energy saving, depending upon utility of building, in after transformation of existing building over the average base energy consumption of conventional building shown in table 4

Table No.4 - Average Energy Savings

Type of Building	**Average Energy Savings over Conventional Buildings (%)**
Corporate Offices	47%
Tech Parks	27%
Hotels	35%
Hospitals	33%
Educational Institutions	39%

Source - Green Building Concept by Ms. Anuja, Consultant, TSG.

It is observed that the initial cost of green energy efficient electrical appliances like fan, bulbs, heaters, A.C etc. is slightly higher but low operational cost compensate cost differences in very short period of time. If we consider total saving from green alternative in its lifespan it's became much economical. (Table No5)

Table No. 5– Pay Back Green Electrical Appliances

S.No.	**Conventional**	**Alternative green**	**Pay back of difference**
1	Incandescent bulb	CFL, LED	1.0 yr.
2	Ordinary tube lights	triphosphor tubelight	2.0 yr.
3	ordinary AC (1.5 -Tonne)	BEE 4-star rated 1.5-tonne AC	0.75 yr.
4	Electric geyser (2-kW)	Solar water heater, capacity -100 lpd (litres per day)	3.0-4.0 yr.
5	Outdoor lighting	Solar power light	-

F- LOW WATER FIXTURES

Water efficiency can be achieved by use of water efficient fixtures such as ultra-low flush toilets and low-flow shower heads, gray water treatment system, efficient home irrigation system, rain water harvesting, Using suitable technology and plumbing accessories we can save up to 60% of water demand depending what purpose the building used for. (Table No. 6).

Table No. 6 – Average Water Saving.

Type of Building	**Average Water Savings over Conventional Buildings (%)**
Corporate Offices	60%
Tech Parks	50%
Hotels	45%
Hospitals	35%
Educational Institutions	40%

Source - Green Building Concept by Ms. Anuja, Consultant, TSG

G- SOLAR ENERGY

Solar energy is one of the most cleanly renewable sources available, multiple applications available solar photovoltaic is one of them. Using photovoltaic cell we use produced electricity which reduces demand of conventionally generated electricity.

H- WATER SAVING MEASURES

Use of land and roof water harvesting is the best option for saving of water. this process is classified as below

Roof top harvesting

Rainwater may be collected from all kind of impervious roof. Exceptional case of roof which is not suitable to collect Rainwater are roofs with lead flashings or roofs with lead based paints and asbestos roofs with loose fibers. This water either collected in water storage structures or used for recharging ground water through Bore well / Open well.

(a) Water Storage Structures

The Rainwater can be collected from the rooftop and diverted after filtration to a storage structure.

Types of storage structure

• Overhead Tanks
• Surface Tanks
• Underground Sump

(b) Recharge through Bore well / Open well

The recharge area is commonly known as water intake area. In case of water table aquifer, usually the areas occupying higher elevations with deeper water table constitute to the recharge area.

Recharge pits may be created around the bore well / open well by using layers of Sand, Pebble, Boulders and Aggregates through which water is made to infiltrate to the ground for increasing the yield of bore well / open well.

7- CONCLUSION

To face India's challenge to conserve energy & water, the most efficient solution is making our existing buildings green, by doing this, we can save 20-30% in energy and 30-40% in water and same time, enhance health & comfort of occupants as well as reduces carbon emission. Today we have 25 billion Sq. ft. of building stock. There is an urgent need of making strategy to make the existing building stock more sustainable and efficient.

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