Domain of Green Technologies in Building Sector

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***Abstract* :** This paper outlines the recent trends in change of weather and climatic change phenomenon with regards to building sector : contribution of buildings in climatic variations, policy options for reducing emissions from buildings, preparation for climate change : *need for green buildings* and *adoption of green technologies* and presents examples of mitigation and adaptive strategies for building design

***Keywords*—** LEED, HVAC, VOC , *retroftting, building information technology, fly-ash, passive technology, fibreglass.*

I. INTRODUCTION

World is facing recent climate changes and this alarming rate of change need to be addressed. Besides the policy reduction at worldwide level by various organizations, there is need to get adaptive to these changes hence making our living and working places more adaptable and that can be achieved by adoptive architectural climatology. As we know that buildings consume 52% of total energy in terms of their construction, use and maintenance with world facing this problem, the concept of sustainable building design has come to forefront particularly in last two decades based on the concept of climate responsive design and use of green technologies.

II. CHANGING CLIMATIC PATTERN

According to World Meteorological Organization (WMO), the exceptional and alarming rate of climate change is giving a potent message to world leaders. The unpredictably high temperatures so far in 2016 have sent shockwaves to everyone around the globe. WMO reports that 2011-2015 has been the warmest five-year period on record and that this year is on track to be the hottest ever. Based on climate models, severe weather events such as droughts, floods and tropical storms were developing in line with the WMO's expectations [1].

And point here is we attribute these extreme weather events to climate change? These are indicators of the big climate problem set the tone of great urgency for the negotiators in Paris making a meaningful agreement and lead to various outcomes that will put us on right path of greenhouse gas emission reductions[2].

III. PREPARATION FOR CLIMATE CHANGE

The United Nations Framework Convention on Climate Change (UNFCCC) draw on two noteworthy terms: *MITIGATION*, intended at reducing emissions to minimize global warming or 'avoiding the unmanageable', and *ADAPTATION*, which means 'managing the unavoidable'[3]. It implies apart from implementing the steps for policy reductions in emissions, what we can do is to limit climate change to an amount that we can probably cope with by various means for example building green and retrofitting existing buildings into green buildings.

Building green is one of the best strategies for meeting the challenge of climate change because the technology to make considerable reductions in emissions already exists. For illustration, taking a case of average LEED certified building; it saves 350 metric tons of CO_2 emissions annually by consuming 32% lesser electricity [4].

IV. BUILDING SECTOR AND CLIMATE CHANGE

As the building sector contributes up to 30 of worldwide yearly green house gas emanations and expends up to 40 of all energy. Given the massive development in construction and also the economy in move, in the case of nothing is done, greenhouse gas outflows from buildings will be more than twofold in the following 20 years. If goal for greenhouse gas emissions drop off are to be met, tackle emissions from the building sector should be the part of mitigating strategy [5].

But the good part here is that buildings have huge potential for delivering cost-effective and significant GHG emission reductions. Moreover, knowledge, proven policies, and technologies as of now exist which focuses in this direction and application. The advancement in the technologies today is not only alluring but also modest investment and unobtrusive interests in the available energy saving and other environmental friendly advances can yield structures that are more promising in terms of comfort and adaptive to the climate change pattern.

Not only in terms of adaptability of climate change but these green technologies also make substantial reductions in energy consumption and Co_2 emissions responsible for climate change pattern and global warming

As much importance is given in making new sustainable buildings, it should also be given to retrofit existing buildings. For say, if government buildings in power starved state would retrofit into green buildings such states could become power excess states eventually. The up gradation or can say retrofitting of the existing building by green technologies can be a daunting task, but it is worth doing it.

V. GREEN TECHNOLOGIES IN BUILDING SECTOR

Existing buildings have major footprint of build environment, hence it's imperative to make the first move towards retrofitting in energy & water consumption and channelize the assets to balance the consumption and trim down the various costs involved with them.

Focus areas for this should be using green technologies in building components such as ***using sustainable materials for construction, green insulation and green interior finishes ; water efficient fixtures ;waste management systems , energy conservation by efficient appliances, sensors & controls, simulation and modeling techniques, Performance monitoring of buildings and adopting best practices in operations & maintenance.***

Various technologies which can be used at today's date can be put together in following list:

*1)*Solar *Technologies*

When we think of solar power, the image of massive fields of huge solar panels or solar panels at rooftops comes in mind but the interesting thing is that the solar power doesn't essentially need lots of equipments. In fact, some solar power mechanisms doesn't even need any equipment at all, means there's a difference in active solar technology -what most likely get pictured in mind when we think of solar energy and passive solar technology, which is designing of building features and architecture tailored on climatogy. Basically passive solar design simply uses strategies like the orientation relative to sun path in winters and summers through planned placement of fenestrations, shading devices or using the earth ,wind etc for cooling or heating purposes or thermal mass[6].The efficiency of solar panels directly depends on the local climate and size of the system and. nonetheless, at right conditions, a solar system will compensate for the advance expenses of establishment over the long haul with years of free energy. Solar PV plants, solar based street lights, solar water heaters, solar based fixtures are some of the technologies to be always relied on.

The report titled "Saving Money and Energy: Solar Heating & Cooling Is Paying Big Dividends for U.S. Businesses," minutiae dozens of examples of SHC applications, including a system installed last year at Duffield Regional Jail in Duffield, Virginia, that will save an estimated $1.5 million over the life of the project. Another example, the owner of the NOMAD Aquatic Center in Huntersville, North Carolina informed researchers that his bills had gone up to $12,000 a month before the installation of 269 solar collectors and the projected return on his investment (ROI) for that SHC system is just one year [7].You can imagine how much savings it can do!

2)Smart and Green appliances :

These today's new appliances are smarter than ever as they are latest appliances are designed to save energy and simplify our lives. Like smart meters are essentially electrical meters that gather real-time data and can communicate with devices to provide useful power data and with that data, smart appliances can find out energy rates and automatically run when electricity rates are at their lowest New appliances are incorporating joining the innovation we're accustomed to seeing in devoted PC frameworks – like a smart refrigerator uses an LCD screen to guide and help to arrange, sort and stock the refrigerated food, for example. By inputting the expiration dates, the fridge will notify when food's going bad and also whole grocery record is accessible on a gadget like a smart phone [8].Energy efficient HVAC systems,chillers, refrigerators, lighting systems which form major energy load and consumption have upgraded in terms of emissions but still, the up gradation and improvements in energy efficiency are what make smart appliances a reliable green technology.

3)Smart windows and glass

Today, new materials are being developed and are coming in market as smart and sustainable upgrades of traditional materials, because they effectively deal with natural elements. For instance, a green version of windows are low-emittance windows, coated with metallic oxide so as to block the sun's harsh rays during summer and keep the heat inside in the winter. More than serving the conformist utility of windows, low-emittance windows considerably bring down HVAC costs. A more advanced version of this, which has yet to be widely and commercially available, is smart glass, also known as Electro-chromic glass in which the glass charge ions to manage the amount of light it reflects only by using a small amount of electricity. Many other options such as glazed, double glazed coated etc are available by various leading brands. These kinds of windows can also be integrated with building automation systems and programmed, along with other building equipment, to utilize natural sunshine and heat to offset the need for artificial lighting and artificial heating from HVAC [9].

4)Paints and Coatings

Green technologies complying with the minimal voc content limits are available in market Range of paints and coatings vary from oil-based paints -a number of companies have introduced "waterborne enamels" or "waterborne alkyds, paint finishes-matte paint, eggshell and satin paint and many more and imagine the wonders of nanotechnology a paint has been introduced that invisibly cleans air . Boysen, a philippines-based company has come up with the world's first air-cleaning paint. it's based on nano- scale titanium dioxide, which is used to reduce harmful emissions in motor vehicles. Its working principle is that it interacts with light to break down various volatile organic compounds (vocs) and nitrous oxide and into nontoxic and harmless substances[10].

5) Sustainable Materials

Looking at construction trends of Indian buildings mostly the major frame of structures are either made of concrete or steel or glass or others. The advancement in technology helps researchers to come up with new sustainable materials like use of fly ash, steel and glass fibres in concrete, waste demolished

materials in concrete etc. Another practice of environmental friendly and smart technology adoption is pre fabricated assemblies such as steel sections, channels etc. or the pre engineered structural systems.

Besides all these,today the building makers are heading towards natural green materials for making one of the or all the components of the structure.One such example is use of bamboo in making a whole village.yes a whole village ! it have schools ,homes,shops and many more in it.It is a master planned community located along the length of Bali Ayung's river named as *Green Village,* designed and built by Ibuku, a team of designers and builders[11].

The main aim of incorporating these materials with available technologies is to keep redundant materials out of landfills fill in addition to cutting back on using natural resourcesto construct thus making them green technologies.

5) Roofing

Roofing systems which aim to offer more solar reflectance and lesser thermal emittance, means they reflect more of the sun's rays than your normal roof, and prevent the warm or cool air inside from escaping through the top of a building, also called as cool roofs,is also one of the green technologies available today . The reflectance of a cool roof can cut that down by more than 50 degrees.Of course lowering the temperature of the roof itself is an advantage, but the real savings are inside as at it reduces the load placed on air conditioning systems, thereby reducing the emissions that result from powering our heating and cooling.

Cool roofs can be constructed with a number of materials, including special reflective paint and cool roof shingles and tiles.For example adding a coating of black membranes to make the roofs reflective or using reflective marble chips or mineral granules to a coat of dark asphaltic emulsion coating can also contribute to a cooler house. or other option can be use of membranes for roofs such as ethylene propylene diene terpolymer or provison of ventilated double roofs,pergolas,roof gardens,etc. One real example is of Wild life Fund Headquarters which is one of the largest green roof on a non-governmental building in D.C. Since installation, this roof has collected more than 50 percent of total local rainfall and this strategy helped WWF obtain LEED Platinum Rating achieved in 2011 [12].

6) Insulation

Apart from reducing heat and sound flow from outside environment, it saves energy moreover lowers the operating costs. But the important point for consideration is what type and amount of insulation is to be provided and it depends on how the building is framed and market availability, cost comparisons of various types of insulation materials. The stuff need not to be pleasant, because it's basically and mostly wall filler. And the key point which is to think is if it's going to stay out of view, why not make insulation from or out of any old junk? That's the central gist of green insulation, which uses recycled materials to line our walls. Cotton insulation is a great example. Also It's the humble newspaper insulation, recyclable, which comes in several forms but one of the most common is blow-in cellulose, which can be sprayed into walls or attics rather than being laid out in sheets. Even fiberglass insulation can include recycled glass, but there's a downside: Melting down the glass and forming fiberglass insulation is far more energy-intensive than producing cellulose insulation from paper. Cellulose insulation consists of 75 to 85 percent recycled material, which is higher than fiberglass' 30 to 40 percent, and cellulose is even better at preventing airflow than fiberglass. Cellulose and cotton are definitely better choices when it comes to green insulation, and neither poses the discomfort or health concerns of fiberglass [13].

7) Water reuse and supply technologies

According to Jerry Yudelso, *green building expert and author of "Dry Run: Preventing the Next Urban Water Crisis,"*the fresh water shortages call for actions and awareness in the face of this water crisis. In the same streak as zero-energy buildings, Yudelso outlined actions to achieve net-zero water use in buildings. These include water-conservation fixtures to efficiently manage water consumption; rainwater harvesting and greywater reuse to make use of recycled water, and on-site sewage treatment to remove contaminants from wastewater [9].

One of the latest green technology example in this stream is Parabosol, which is a portable solar-powered water purification system for use in remote areas devised by Hakan Gürsu of Designnobis. This system filters and purifies drinking water by a parabolic mirror that boils contaminated water at up to 400 degrees celsius . In a single use , it can clean up to 170 liters of water [14].

8) Building information technology

Various technologies like Building information Modeling, simulation tools and analytics software are todays smart innovation and these contribute to implement various smart and green technologies ,help detect and address numerous sources of waste, such as HVAC (heating, ventilation, and air conditioning) equipment that is simultaneously heating and cooling a given space due to a failed sensor or other fault. In recent times, many buildings especially commercial ones have been outfitted with an increasing number of sensors, controls and other devices and many of them have built-in control systems, referred to as building automation systems (BAS) or building management systems (BMS) which facilitate building engineers, real estate management and facility managers to control their infrastructure. Basically all these helps to manage, conserve the building resources and attain the "green targets".

VI. CONCLUSION

So with the increased awareness and attention and adoption of modest investment in the green technologies, it can prove to be a way forward to the sustainable living which not only goes in line the adaptation strategy of facing climate change but also contribute to lesser emissions on our part**.**

GO GREEN! THERE IS NO PLANET B!

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