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Concepts for climate Proofing design - Sustainable Architecture

Author

Asst. Professor, Crescent School of Architecture, B.S.Abdur rahman University, Chennai, India

Author Email id ukshabana@gmail.com

ABSTRACT- *Sustainable development can be defined as a technology that mainly aims to balance two aspects i.e., the environment protection and human economic development. Man has the fundamental responsibility to safe guard the environment and should preserve the natural resources for the benefit of present as well as future generations. In the present scenario the traditional sustainable practices and technologies are being replaced by modern unsustainable technologies which caused adverse climatic changes. Global climate change is one of the major problems which are caused due to the implementation of unsustainable and hazardous practices.*

There has been an increasing trend in the annual mean temperature in India. In order to reduce the effect of climate change, we need to include climate-proofing concepts in national development initiatives. As living standards rise people want to install heating and/or cooling equipment to improve thermal comfort. For buildings not adapted to the climate, the amount of energy to run the equipment, and its cost, will be excessively high, and it will have a negative impact on the environment.

A newly awakened interest for passive climatization should have a great deal to learn from the past, but purely traditional solutions assuming continuity of life styles and kinds of work seem rather unlikely. Combining traditional knowledge and advanced technology is therefore necessary.

The objective of this paper is to discuss about the climatic design of buildings today, using passive techniques.

Keywords - Evaropative cooling, Passive cooling, climatization, sustainability, indoor climate, energy conservation.

1, INTRODUCTION

Sustainable Development means equity in development and sectoral actions across space and time. It requires an integration of economic, social and environmental approaches towards development. Sustainable urban development refers to attaining social equity and environmental protection in urbanization while minimizing the costs of urbanization.

Concerns are raised at environmental damages and depletion of nonrenewable resources and rising levels of pollution in urban areas. In recent times cities have become places of urban environmental degradation and wasteful use of resources, which is proving to be costly to generations present and future. In order to mitigate the problem we require to minimizing the depletion of non-renewable resources and resort to environmentally

sustainable economic development.But this has to be done in ways that are socially, economically and politically acceptable. While planning for sustainable development of the towns, we should also take into account the factor of climate change.

Climate change will hamper sustainable development of India as it increases the pressures on natural resources and the environment associated with rapid urbanization, industrialization and economic development. In order to reduce the effect of climate change, we need to include climate-proofing concepts in national development initiatives. Several traditional practices that are sustainable and environment friendly continue to be a regular part of the lives of people in developing countries. These need to be encouraged rather than replaced by more 'modern' but unsustainable practices and technologies.

India is one of the five fast developing countries.Energy is the primary and most universal measure of all kinds of work by human beings andnature. Whatever happens in the world is only the expression of flow of energy in either of itsforms.Energy is a crucial input in the process of economic, social and industrial development. Energyconsumption in the developing countries is increasing at a faster rate. As conventional energysources are depleting day by day, utilization of alternative energy sources is the only solution.
India has made rapid strides towards economic self-reliance over the last few years.

On theenergy demand and supply side, India is facing severe shortages. To overcome energy crisis, there is a need to develop projects related to alternative energy sources. Development decisions regarding technology and infrastructure are a major determinant of consumption patterns. It is therefore important to evaluate and make development decisions which structurally lead to a more sustainable society.

Local innovations and capacity building for developing and managing locally relevant and appropriate technologies must be encouraged and supported. Integrating highly-sophisticated modern technology with traditional practices sometimes produces the most culturally-suited and acceptable solutions, which also makes them more viable. This trend should be encouraged.

2, NEED OF THE STUDY

Global climate change leads to long-term fluctuations in temperature, precipitation, wind and all other aspects of earth climate. The major contributors of the greenhouse effect are the greenhouse gases which include carbon dioxide (co_2), methane, nitrous oxide, ozone, hydroflurocarbons and chloroflurocarbons.

The effect of climate change can be found on among other things, on rising sea level that may accelerate coastal erosion, on increasing temperature, on increase in intensity of natural disaster, and very importantly on vector borne diseases. A building design practice based exclusively in economic and aesthetic considerations, without an environmental analysis, leads almost always to a prejudice for the final user, resulting in buildings strange to the environment and with comfort parameters far above the tolerable limits.

Additional heating and cooling should represent only a marginalenergy use, while the building itself must account for the main part of the climatization through its materials, structure and design.

2.1 Objectives of the study

- Protecting the environment by adopting sustainable development technologies.
- Eradicating the depletion of natural resources and preserving them for the future generations.
- Considering the climate changes and developing climate proofing techniques within a building.
- Reducing the consumption of energy for heating, ventilating and air-conditioning systems.

3, STATISTICAL DATA

Heating / Cooling		2006	2011	2016	2021	2026	2031
Electric Water Heater	Urban	27.0	38.9	55.7	78.1	103.9	132.4
	Rural	0.0	0.0	0.0	0.0	0.0	0.0
	Total	27.0	38.9	55.7	78.1	103.9	132.4
Fans	Urban	123.1	179.7	254.7	344.7	435.5	527.3
	Rural	105.8	174.2	270.3	384.3	482.4	564.3
	Total	228.9	353.9	525.0	729.1	917.8	1,091.7
Air cooler	Urban	17.6	28.3	43.1	61.8	83.2	107.8
	Rural	4.9	10.1	19.5	33.5	48.2	61.1
	Total	22.5	38.5	62.6	95.3	131.4	168.9
Air-conditioning	Urban	1.7	4.0	8.9	17.5	28.5	40.0
	Rural	0.3	0.6	1.3	2.6	4.8	8.0
	Total	2.0	4.7	10.2	20.1	33.3	48.0

Figure.1 Population using Heating/Cooling Appliances (millions)

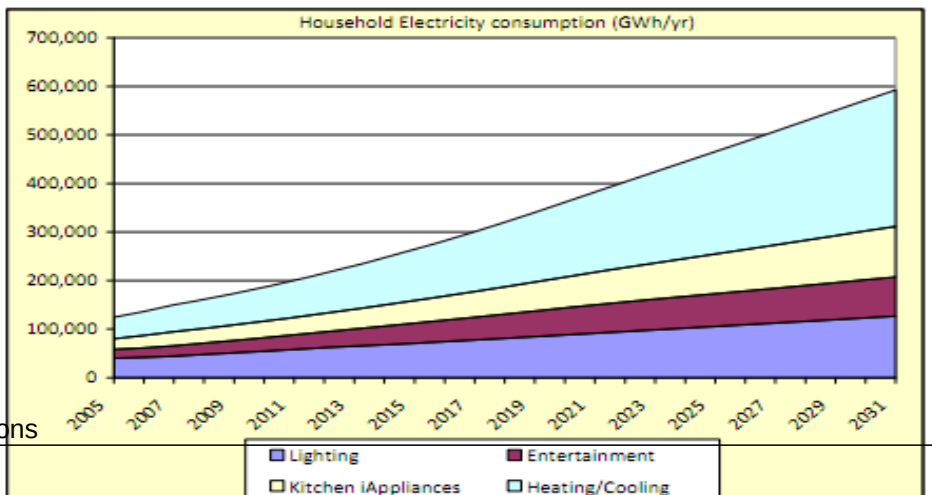

Figure.2 Total Power Consumed by Appliances

Heating / Cooling			2006	2011	2016	2021	2026	2031
Electric Water Heater	Operating	GWh/yr	16,298	22,738	31,628	43,657	57,668	73,289
Fans	Operating	GWh/yr	22,724	34,100	49,310	67,521	84,441	100,185
Air cooler	Operating	GWh/yr	8,091	13,373	21,186	31,828	43,626	55,975
Air-conditioning	Operating	GWh/yr	2,298	5,084	10,783	20,966	34,675	49,913
	Standby	GWh/yr	10	15	23	39	61	87
	Total	GWh/yr	2,308	5,099	10,806	21,005	34,737	50,000

Figure.3 Total Power Consumed by Heating/Cooling Appliances

4, CONCEPTS FOR CLIMATE PROOFING DESIGN

4.1 Passive Cooling Desugn

Passive design is design that does not require mechanical heating or cooling. Homes that are passively designed take advantage of natural energy flows to maintain thermal comfort. Incorporating the principles of passive design in home:

- Significantly improves comfort.
- Reduces or eliminates heating and cooling bills.
- Reduces greenhouse gas emissions from heating, cooling, mechanical ventilation and lighting.

Building envelope is a term used to describe the roof, walls, windows, floors and internal walls of a home. The envelope controls heat gain in summer and heat loss in winter.Its performance in modifying or filtering climatic extremes is greatly improved by passive design.Well-designed envelopes maximise cooling air movement and exclude sun in summer. In winter, they trap and store heat from the sun and minimise heat loss to the external environment.Design parameters of homes/buildings; vary with different climatic zones of the country.

4.2 Orientation of building

The orientation of a building in a particular direction can heat or cool the building depending on the climatic zone in which it is constructed. Proper orientation can help increaseor decrease the heat load by 5%. For example, if the long sides of the building in

thecomposite climatic zone face north and south and the short sides face east and west, the heat load can be reduced.

4.3 Building insulation

Insulation can be added to walls or roofs to reduce heat transfer. It also helps in moderating indoor thermal comfort and is effective in reducing temperature fluctuations in non-air-conditioned spaces. Some commonly used insulation materials are mineral wool, extruded/expanded polystyrene, PUF (polyurethane foam), and vermiculite, among others. Since roofs receive maximum solar radiation, it is advisable to insulate them using any of the above materials. Cavity walls are an effective method of insulation. Fly ash-based aeratedconcrete blocks and cellular concrete blocks have good insulating properties and can be used for wall insulation.

4.4 Evaporative cooling

When water stored in a water body evaporates into thesurrounding air, it lowers theambient temperature. Thisphenomenon is known asevaporative cooling. Thepresence of a water body such asa pond, lake or sea near thebuilding or even a fountain in thecourtyard can provide thecooling effect. The mostcommonly used system is adesert cooler, which compriseswater, evaporating pads, a fan, and a pump. Externalcooling through humidification can also be achieved bykeeping surfaces of roofs moist using sprays or lawnsprinklers. Evaporative cooling is very effective in the hotand dry climatic zone, where humidity is low.

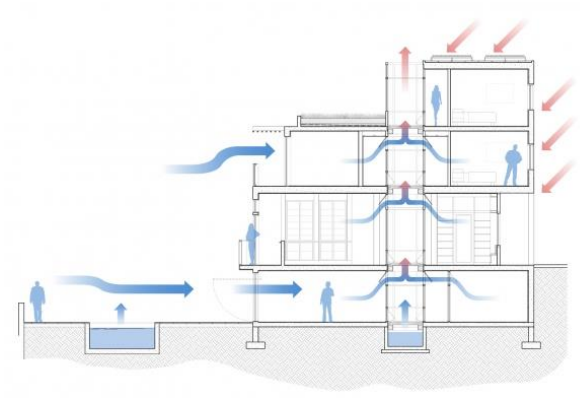

Figure.4 Evaporative Cooling

4.5 Surface to volume ratio

A compact building gains less heat during daytime and loses less heat at night. The compactness of the building is the ratio of its surface area to its volume, that is, Compactness = S/V (surface area/volume). In hot-dry climates the S/V ratio should be as low as possible to

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minimize heat gain. In warm humid climates the prime concern is creating airy spaces. This would require a higher S/V ratio.

4.6 Earth air tunnel

At a depth of 4 m below ground, the earth'stemperature remains more or less constantthroughout the year. This temperature is nearlyequal to average temperature of the place.

The earth air tunnel takesadvantage of this phenomenon. Concrete Humepipes are laid at a depth of 4 m below ground andare surrounded by earth. The earth acts as a heatexchanger for air that is passed through this tunnel. Hotsummer air is passed through this buried pipe, and as it passes through, there is an exchange of heat between theair and the surrounding earth. Hence, during the summer,the air gets cooled and during winter it gets heated. Itworks in a similar manner during the winter, absorbingearth's heat and releasing it into the structure. Tunnel aircan be supplied to a house for cooling during summersand heating during winters.

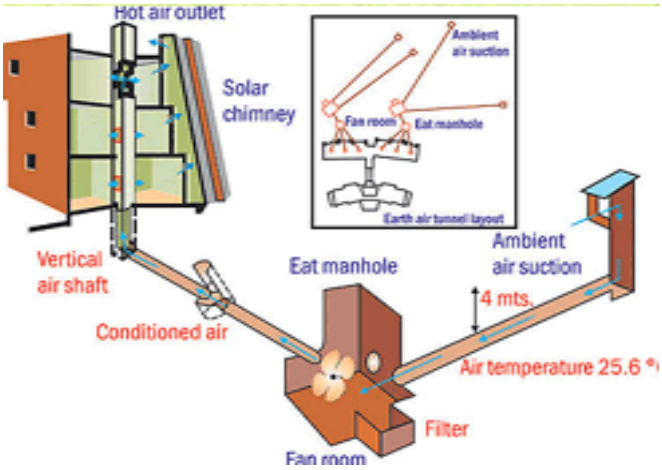

Figure.5 Space conditioning through earth air tunnels

5, APPLICABLE PASSIVE FEATURES FOR VARIOUS CLIMATIC ZONES

S.No	Parameters	Hot-dry climate	Warm-humid climate	Composite climate
1.	Appropriate orientation and shape of building	✓	✓	✓
2.	Insulation of building envelope	✓	✓	✓
3.	Massive structure	✓	X	X
4.	Air locksand balconies	✓	X	✓
5.	Weather stripping	✓	X	✓
6.	Pale colours and glazed china mosaic tiles	✓	✓	✓

7.	Windows and exhausts	✓	✓	✓
8.	Trees, ponds, and evaporative cooling	✓	X	✓
9.	Dehumidifiers and desiccant cooling	X	✓	✓
10.	Courtyards, wind towers, and arrangement of openings	✓	✓	✓

Figure.6 checklist of the Parameters in Passive Cooling

6, ANALYSIS

- Buildings, as they are designed and used today consume enormous amount of energy in their operation. This energy at present in most of the buildings is produced by consuming non-renewable resources.
- Passive architectural design strategies can help in reducing the annual electricity consumption of buildings by 5 to 20 %.
- The main objective of a passive building is to provide high quality thermal and visual comfort using nature's sources that save energy and have environmental benefits.
- These buildings can also function independent of mechanical systems; hence, in case of power failure they are still well lit by natural daylight and are thermally comfortable also.
- Indoor environment inside the buildings have direct impact on health and well-being of its occupants. In passive buildings occupants have direct connection with the outside environment; they have access to natural daylight, outside air, etc.
- The passive features avoid the problem of sick building syndrome in buildings which are healthy places to live and work.

VII CONCLUSION

Implementation issues like financing, public acceptance, regulatory and cost should be considered. Many such design consideration with respect to the site condition is required. The cost of passive design elements can run the same or slightly more than normal building costs.
The main function of the passive house is that it is suitable for all type of climatic condition. This building can also be called as a bio-climatic building. Even though the cost is very high when compared with that of the normal building the sustainability of the passive house is very high.

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BIOGRAPHY

Ar. Ummulkhair Shabana MD, is assistant professor at Crescent School of Architecture, Chennai. She is a post graduate in Construction Engineering and Management and had published research papers related to Sustainability in Built environments.