Architecture and Climate change as a Challenge to developed & developing countries

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ABSTRACT- **Global warming is an issue growing at an alarming rate and needs to be dealt with at various levels. Global warming particularly has been affecting the field of architecture as it involves adapting building designs for climate change. Certainly, the global temperature has increased during the last century. Over time, building designs are changing. There is increased awareness that design practices need to take into consideration the predictions of increased risk and intensity of extreme events. This paper examines the potential effects of varying climate change patterns and its effects on buildings especially in under developed/developing countries and highlighting the potential for upcoming technologies and presents examples of adaptive strategies for building design. The goal of this research is to mitigate global warming from building construction by suggesting an alternative building scheme and choice of materials.**

Keywords—Adaptive Strategies, Building design, Climate change, Global warming, Materials, Technologies.

I INTRODUCTION

Climate change is a phenomenon being experienced globally, but its effects are experienced most by the poorest and most marginalized communities, residing in regions that are most gullible to these changes in the climate and whose means of living are solely dependent on naturally occurring resources – for example the drought-prone Thar desert region, or in areas prone to floods or landslides. These varying patterns of temperature and climate change attributing to global warming has had adverse effects in all spheres, especially in the field of architecture in developing and under developed countries. Due to this, work in energy access, agriculture, disaster risk reduction and waste and water management needs to be addressed, to equip the vulnerable to be able to adapt to a changing climate and be prepared to face the severity of weather events. And there is no better way to address this problem but through architecture and adaptive building technologies. These could include the use of more sustainable materials, preferably being available locally or easily acquirable, that would enhance the strength and fracture resistance of structures, building a comfortable building envelope which is energy efficient and which would be least affected by weather change. Architecture not only being the solution but also a key driver of climate change, from the construction to the energy required to sustain the building, the building industry accounts for half of the greenhouse gas emissions.

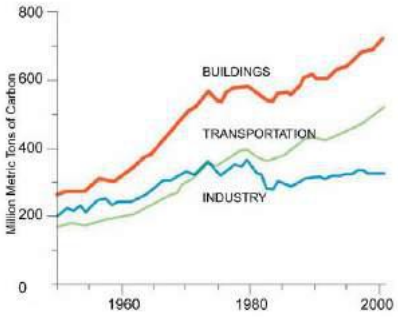

Figure 1 –Graph indicating Carbon di oxide levels over the years.
(Source: Architects and Climate Change)

Combating climate change requires combined and focused action. This includes the reduction in carbon dioxide emissions by remodeling the ways in which buildings are designed, constructed, managed and used. The measures needed to alleviate climate change are complementary to the principles of sustainability or sustainable development, but addressing climate change has surfaced as an issue that must be waded into in its own right.Thus this article includes a brief on the effects of climate change on buildings, adaptive design strategies, alternative buildings schemes and choices of materials.

Global temperatures are escalating due to the increased concentration of greenhouse gases in the atmosphere, particularly carbon dioxide. "The concentrations of carbon dioxide in the atmosphere increased from 280 parts per million to 380 parts per million in the pre-industrial era. It is projected to increase to over 500 parts per million by 2050." [1]
Figure 2 illustrates the trend in global average surface temperature since 1860.

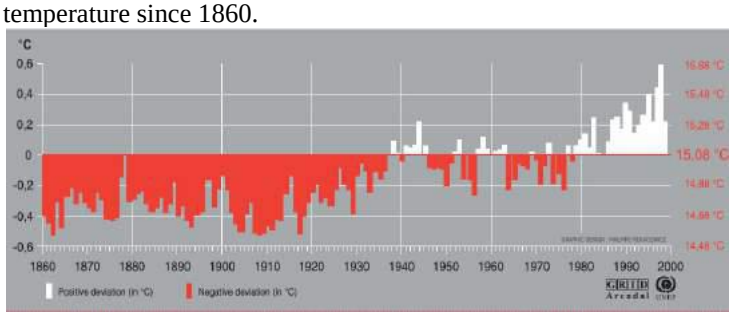

Figure 2 –
(Source:School of Environmental Sciences, Climatic Research Unit, University of East Anglia, UK, 1999.)

The general effects of climate change include, rise in average temperature, sea levels, increased precipitation and more frequent weather events.

"A changing climate affects the poorest people in developing countries the most. Droughts or heavy rains that lead to floods are disastrous to people with no buffers or savings. A changing climate may cause major migrations of displaced peoples which will affect all countries." [2]

These weather effects come unexpectedly and are at scales which we aren't prepared for, especially in developing countries where infrastructure isn't adaptive or strong enough to face such events. In such countries with high levels of poverty and unawareness, people still sought to conventional methods of building houses. These methods include shelters which are temporary or are suitable to the general climate type, but as we've seen over the years, almost no place in the world has had a constant climate, with such variations; these methods of building would be unsuitable and unstable and would hold no resistance to local or drastic weather events.

II PLANNING CONSIDERATION FOR CLIMATE CHANGE

The adversities of climate change need to be taken into account in all spheres of construction, from land use planning to positioning, construction and life-cycle management of buildings. Clever infrastructure planning can counterpoise some of the negative effects of climate change and create conducive built environments.

Climatology being a major factor in planning and architecture plays the key role in determining how the living spaces should be planned, viable to the local climate. But as mentioned earlier local climate is no longer a certainty, in such cases houses or any kind of built environment needs to have a configuration suitable to this variation. As per the conclusions of the IPCC Fourth Assessment Report, amongst the important mitigation practices and technologies to be adopted within the design of built environment before 2030, an essential role is to be played by "integrated design" of buildings, which should include making maximum utilization of the advances in technology and implementing both "passive and active techniques" to minimize the energy requirements and maximize comfort for their users.

The primary step being analysis of the site, its exposure, climate, orientation, topographical factors, local constraints and the availability of natural resources and sustainable forms of energy, in relation to the duration of use, which are ecological.

The next step would include the investigation of the characteristics of the structure with its permanence or temporariness as well as its integration with other building components such as its interior, envelope or the mechanical systems, the fixing to the footings or founding materials along with the desired aesthetics.

The exploration of construction and assembly of building components enabling shorter construction time, reduction in energy consumption and wastes and easy maintenance and replacement with flexibility and interchangeability of components is key solution.[3]

Green Construction- a sustainable design and construction to utilize resources more effectively while creating a healthier as well as more efficient homes, must be encouraged. The ultimatum being, leaving a lighter footprint on the environment through conservation resources, while striking a balance between energy-efficiency, cost-effectiveness and low-maintenance products. Green construction involves finding the delicate balance between the sustainable environment and the built one.

In reference of a particular case of flood prone areas of Bangladesh, building techniques for flood proof houses with locally available materials and labor, being cost effective, would include:

- Walls made of brick up to sill level, increase resilience of the structure. Jute panels also make resilient walls that are inexpensive, quick and easily replaceable. Treated bamboo poles on concrete bases are fastened with metal tie rods to strengthen it.
- The basic principle of a plinth raising a house further above the surrounding land, made from a combination of soil, cement, stone and brick makes it sturdy and elevated enough to withstand repeated floods, unlike the vernacular earthen floors that would simply get washed away.
- Bracings and fastenings bind the walls firmly to the house 'skeleton' through a series of holes and notches – "clam system", such that the whole building can withstand the strongest of winds and rains.[4]

In terms of desert climate (in regions like Africa), where hot and dry conditions prevail, the following methods can be adopted:

- An exoskeleton system can be used to create a chimney effect in order to pipe hot air up through the void between the building and its perforated shell.
- Folded concrete plates can be integrated in the building design to form hard reflecting surfaces, reflecting back the solar heat radiation and keeping the area cool during summer. [5]
- Green roofs in the form of terrace gardens can be adopted along with the use of permeable as well as natural surfaces.
- Solar panels can be integrated into roofing systems which will not only help generate renewable energy but also provide a certain degree of insulation and shading.

III IMPACT OF MATERIAL SELECTION ON CLIMATE CHANGE

The choice of building materials also plays a major role in combating climate change and building adaptive shelters.

With the advancement in technology and growing awareness of carbon emissions a large variety of sustainable materials which also serve the economic aspect of the society are being formulated.

Concrete is the most produced material worldwide. Scientists today have developed sustainable materials with the help of advancement in nanotechnology. Professor Franz-Josef Ulm of MIT has engineered concrete using elements of glass. This molecular-scale approach allows modification of the behavior of electrons and atoms, thereby modifying the large-scale behavior of roads, buildings, and bridges.

The result is a concrete with enhanced strength and fracture resistance, something twice as strong as the industry standard, thus promoting durability and resistance.

Even color plays a vital role in mitigating its effect on climate change. For instance, lighter roads reflect more sunlight in comparison to darker roads which absorb it, making it hotter. The same case applies to white roofs which not only help in reducing internal temperatures but also help reducing warming of climate, so can lighter pavements — which can be produced by adding lighter-colored aggregate (gravel or crushed rock) to the concrete mixture. [6]

CONCLUSION

Sustainability is the key survivable future on Earth, we must formulate ways to conserve our resources, reuse materials that we have extorted from the Earth and turn to renewable sources of energy. Unremitting economic growth is impossible on a planet with limited resources. All building technologies and production of building materials have used demonstrable improvements in energy savings and reduced reliance on non-renewable sources of energy, along with reduced waste and carbon emission. Action to help reduce the effects of climate change and adapt to it is being undertaken by the built environment professions. The first step is to raise awareness, not just about the issue of climate change but also of the development in language and figures as related in specific to the built system. Followed by the establishment of the scope of action accessible to architects, their clients and the associated cost. [7]

Climate change has affected all spheres of life, most adversely felt by the under developed and developing countries and sustainability being key response to this issue, needs to be promoted and adopted in these regions to enhance adaptivity and comfort.

Developing countries can shift to lower-carbon paths while promoting development and reducing poverty, but this also depends on financial and technical assistance from high-income countries

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