CONSTRUCTION INDUSTRY & CLIMATE CHANGE

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ABSTRACT

Climate change is now recognised as one of the major problems that the globe faces today. With the pace at which climate on our planet is changing, humans will not have the time to evolve in order to survive the change. Human beings, as a species, is being threatened, and unless we seek out ways to mitigate climate change, or adapt to its consequences, we, and the whole planet, stand to suffer. Underlying the need to mitigate and adapt, is a need to be informed, and be conscious of our contribution to the issue. From there, we can work towards a more sustainable future, for the human species, and other beings that live on Planet Earth. Climate change is a global phenomenon which disturbs all aspects of human lives. These range from rising temperatures, higher sea levels, and more frequent extreme weather events. The result of these changes is rippled throughout all aspects of the environment. The durations and start of seasons are shifting with greater periods on change introducing less stable environmental conditions (NASA, n.d.). The largest changes to seasons are with winters becoming shorter, and spring is becoming longer. As the overall temperatures rise, so are the ocean's temperatures (Dupigny-Giroux, 2018). This warmer water allows for more intense coastal storms with greater frequency. The world today has encountered with global warming and climate change. Besides other contributors, extraction of natural resources as building materials itself consume energy, cause environmental degradation and contribute to global warming. Buildings are the largest energy consumers and greenhouse gases emitters, both in the developed and developing countries. Urgent changes are therefore required relating to energy saving, emissions control, production and application of materials. Immediate suggestion related to use of renewable resources, and to recycling and reuse of building materials is necessary. This paper describes how much a typical building is contributing to global warming by releasing the carbon dioxide emission. And how the architects and building designers can decrease the amount of carbon footprint emitted from the building materials.

***KEYWORDS**: Green house gases, global warming, climate.*

I. Introduction

The average pattern of weather, called climate, usually stays pretty much the same for centuries if it is left to itself. Climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. But the climate we've come to expect is not what it used to be, because our climate is rapidly changing with disruptive impacts and that change is progressing faster than any seen in the last 2,000 years.

Scientists have pieced together a picture of Earth's climate, dating back hundreds of thousands of years. The historical record shows that the climate system varies naturally over a wide range of time scales. So, Climate change itself is not new. The Earth is some 4.5 billion years old and during those years there have been significant changes in climate. The causes of these changes were decidedly natural and not caused by humans since the influence of early people was very small at that stage. In general, climate changes prior to the industrial revolution in the 1700s can be explained by natural causes, such as changes in solar energy, volcanic eruptions, and natural changes in greenhouse gas (GHG) concentrations.

Recent climate changes, however, cannot be explained by natural causes alone. Research indicates that natural causes are very unlikely to explain most observed warming, especially warming since the mid-20th century. Rather, human activities can very likely explain most of that warming. In other words, up until the last century, humans have been accelerating the rate at which the Earth's climate changes and this is known as anthropogenic climate change.

Anthropogenic climate change is caused by the release of extra greenhouse gases by humans at rates with which the Earth's atmosphere cannot keep up. As a result, these greenhouse gases built up in the Earth's atmosphere, and act as insulation around the earth's atmosphere. In this way, the gases prevent much of the Earth's heat from escaping, leading to a gradual increase in the Earth's temperatures. This is called the enhanced greenhouse effect, more commonly referred to as global warming.

II. Climate Change and Its Effects on The Construction Industry.

The construction industry plays vital role in the economy of every nation as it contributes to the process of development. The construction industry comprises a wide range of businesses involved in engineering standards, building design, and the construction of various types of materials and structures. This sector is affected in many ways by climate change.

Knowledge about short term weather and longer term climate conditions are essential to adequately design and successfully manage construction projects. When we can no longer predict weather or climate, then construction can be heavily affected.

Climate change may affect the construction industry through a range of biophysical and socioeconomic impacts. Generally speaking, it makes the planning process and physical location of infrastructure an even more critical issue than it used to be.

Long term climate impacts, such as sea level rise, coastal erosion, and drought, and short term weather related impacts, such as high winds and flooding influence the choice of site construction, building techniques, and materials for construction. The potential risk of severe weather and climate conditions also influence planning and project completion timelines.

• Choice of site location

Climate change events such as sea level rise, drought, and increased incidence of flooding can greatly influence the choice of site location. Sea level rise and flooding events can deter the development of low lying or coastal areas. Construction may then be concentrated on higher, often steeper elevations, with disastrous effects on the environment.

• Damage to, and destruction of, buildings and infrastructure

The increased frequency and severity of extreme weather events has the potential to damage, destroy, or severely impair the operation of the construction industry. Buildings may be damaged or even destroyed by the effects of extreme weather events and natural disasters.

• Buildings may become less comfortable as spells of extreme temperatures become more frequent or severe. They could also suffer accelerated degradation if changes in air pollution patterns increase their exposure to agents that may potentially be harmful to the building material such as acid rains.

• Construction projects that require dry conditions, such as laying roads or foundations, may be delayed indefinitely if there are floods due to heavy rain until the weather subsides. This can cost contractors thousands of dollars/rupees per day, if not properly planned for in advance.

The soil will have to be drained first so as to be able to place concrete and allowed to dry. This will involve more resources such as pumps, and thus more energy and time waste. Also, in a muddy type of soil, the foundations will be deeper until a hard rock surface is reached. This is to prevent the building from dropping inside the ground. This will in turn use more machine and man power and also more concrete.

• Temperature increase

Increases in temperatures will greatly affect the comfort of people using buildings. Air conditioning costs may increase for existing buildings, but for buildings yet to be build, an increase in temperature may signify tighter legislation that impose building designs and orientation that may help in keeping the building cool.

• Precipitation changes

Increases or decreases in precipitation amounts in the tropics, especially in Seychelles, may greatly affect the design of foundations and basements as well as rooftops. Even plumbing designs may be affected. Perhaps a decrease in rainfall amounts may necessitate connection of all dwelling homes and office buildings to a rainwater harvesting system. As such, changes in precipitation levels associated with climate change also have the ability to influence building design. Furthermore, increases in the incidence of rainfall can lead to severe flooding events in some parts of the tropics, which may cause extensive damage to buildings and other infrastructures. Moreover, the weather conditions may affect the transportation of materials on site.

• Relative humidity

Changes in relative humidity have the potential to affect condensation, and associated mould growth. Buildings may become covered in moss due to high relative humidity, and contractors may need to find a way of adapting to this in their building design. One way of adapting to this in Seychelles is seen in the example where tiles are used on the outside walls of buildings, instead of paint.

III. Contribution of Construction Industry For Climate Change.

Construction industry contributes significantly in terms of scale and share in the development process for both developed and developing countries. The construction products provide the necessary public infrastructure and private physical structures for many productive activities such as services, commerce, utilities and other industries. The industry is not only important for its finished product, but it also employs a large number of people and therefore has an effect on the economy of a country/region during the actual construction process.

As with many activities undertaken by humans, the construction of buildings and other infrastructures has many impacts on the environment and contributes enormously to climate change.

Construction industry accounts 19% of global GHG (Green House Gases) emission. Although construction practices typically do not produce large quantities of GHGs compared to the operations of many other sectors, the sheer number of construction projects results in significant aggregate emissions for the sector. For the construction industry, the two major sources of emissions relate to fossil fuel combustion, primarily from construction equipment, and fuel use from electricity used to power the equipments.

- **Impact of the mining and manufacture of materials and chemicals.**

This represents the source of highest impact. The mining and manufacture of materials proves to be a very energy- intensive and water consuming activity. The mining and metals industry is responsible for more than 20% of global emissions of greenhouse gases (GHGs) since it is estimated that the industry consumes about 10-20% of fossil fuels.

This consumption occurs in the use of machinery and processes for mineral exploitation, and also occurs with

intensity during refining and processing of minerals to prepare construction materials like cement, lime, bricks, paints, steel reinforcement, etc. Metallurgical smelters require large amounts of energy in the process of moisture removal (drying), heating of ores (roasting), melting, recrystallization, distillation, electrolysis, among others.

The primary material used in road construction in Seychelles is asphalt, also known as bitumen. It is used as a binding substance to hold aggregate particles together. The end product is asphalt concrete, which is used then to surface roads.e **separated from** the other

➢ Mitigation For Climate Change.

Mitigation refers to policies or actions that reduce the size of climate change, for example, any action that reduces greenhouse gas concentrations. In other words, mitigation can be defined as reducing the physical causes of an environmental problem.

Adaptation however, is any response that reduces the impact of climate change. It may also be described as any action or steps taken to make the impacts of climate change less problematic.

The building and development industries are under tight scrutiny about their overall contribution to overall greenhouse gas emissions.

Construction contractors may have control over many of the activities associated with GHG emissions at a construction site, such as how efficiently they use fuel and electricity. This section examines options for reducing greenhouse gas emissions associated with construction activities, focusing on the activities that construction companies control or influence. The options presented in this section are based on currently available technologies and techniques.

- **Reducing Fuel Use**

Approximately three-quarters of the GHG emissions from the construction sector result from diesel, gasoline, and natural gas combustion. The GHG reduction options focus

on reducing the emissions from fuel combustion, primarily by improving fuel efficiency. Better fuel efficiency results in less fuel consumed to complete the same job often, the steps taken to improve fuel efficiency also result in other benefits, including increased equipment life and reduced emissions of other air pollutants such as particulate matter. As contractors implement techniques to reduce their fuel costs, they will simultaneously reduce their GHG emissions.

- **Reduced Idling**

Unnecessary idling occurs when trucks wait for extended periods of time to load or unload, or when equipment that is not being used is left on, such as to maintain heating or cooling for driver comfort. Reduced idling reduces fuel consumption and the associated costs and GHG emissions.

- **Equipment Maintenance**

Proper maintenance often results in fuel savings, although the magnitude of savings varies by equipment type and condition. Maintenance may include systematic equipment inspection, detection of potential failure, and prompt correction. A recent study of forklift maintenance estimated that 50% of forklifts were not properly maintained, each of which could be wasting more than 400 gallons of propane annually. Propane emits about 12.7 lbs of CO2 per gallon, resulting in more than 2.3 tons of CO2 emitted by each improperly maintained forklift each year.

- **Reusing/ Recycling Building Materials**

GHGs are released during the manufacturing and transportation of construction materials. When materials are reused or recycled, the associated emissions that would have occurred during virgin material manufacturing are avoided.

Recycling is the process of reprocessing or reforming used materials into new products, while reuse is the process of using a recovered, previously used product instead of a new product.

- **Materials Selection, Procurement And Shipment Methods**

The selection of materials with lower environmental impact provides a range of opportunities to reduce GHG emissions, although emissions reductions vary considerably depending on the material. Delivery of materials to a construction site also results in GHG emissions. Reducing delivery-vehicle trips to the construction site results in lower fuel consumption, which will contribute to reduced GHG emissions.

For large projects or group of projects in close proximity, creating a consolidated location for materials delivery may reduce transport emissions by allowing contractors to request materials and quantities closer to the time of use. For shipments over a significant distance, switching transportation methods may also enable emissions reductions.

Buying locally produced lumber and other materials can reduce the emissions impacts of transporting materials. The magnitude of these savings varies widely by the construction site location and the source of the materials.

➢ **Adaptation of Climate Change**

Adaptations can range from traditional structures built to cope with increased flooding, to innovative engineering techniques aiming to withstand hurricanes.

Traditional building designs and techniques will not cut it in the future and the industry needs to wake up to its dual role in helping people cope with the unavoidable effects of climate change whilst making more efficient buildings to aid efforts to prevent things getting worse. There are several aspects to an efficient building:

- **Orientation**

Buildings should be orientated in the proper direction so as to minimise the use of energy. In Seychelles, buildings should limit the use of air conditioning and artificial lightings.

Therefore, since the sun rises in the east and sets in the west, this implies that there will be heat accumulation on the east face in the morning and on the west face during the afternoon. For this reason, the house should be designed rectangular rather than square, with the shorter faces on the east and west.

Also, due to inclination of the earth, the sun will tend to incline a bit to the north during winter in the southern hemisphere (to the south in northern hemisphere). This is known as the northern exposure, which will cause the

northern face to be the hottest face in the Seychelles. So, fewer openings should be on that face, with maximum
possible shade from trees. On the southern face, on the contrary, the openings should be large so as to welcome in maximum natural light, without excessive heating.

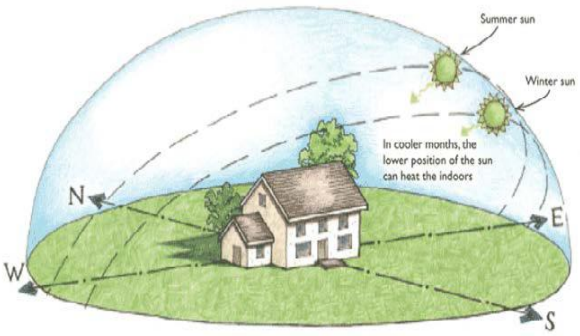

Fig: Orientation of Building

- **Maximising The Use of Daylight**

Light can be allowed inside a house as shown in the diagram, whereby a reflecting pane will reflect the light, even at angles, to the ceiling and back to the house. The reflecting plate is best if made of a heat absorbing material, so as to reflect only light, and block undesired heat.

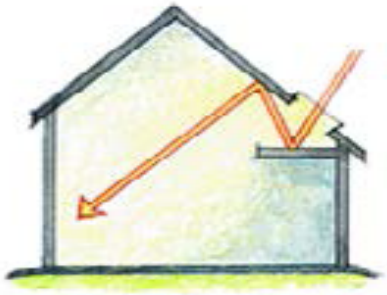

Fig: Opening in roof of Building.

- **Insulation**

A major concern so as to reduce both the direct effect and indirect effect of households on climate change is house insulation. The direct effect is that through heat loss form houses, the immediate environment of the house will be hotter, thus heating up the atmosphere directly. The indirect effect is that through energy loss by heating or cooling, there will be more use of fuel, thus more carbon emission to the atmosphere.

In the Seychelles, the major problem is the roofs which are mostly made of steel sheets. Steel is a very good conductor of heat. Thus, heat can pass in and out almost freely. During the day, the sun will heat up the steel sheet, causing excess heat accumulation. At night, heat will be lost by the same way, this time from the inside. The false ceiling will of course reduce the effect, but not as much as required. It would be optimised if above the false ceiling; the roof was to be insulated by wool as it is in snowing countries, to try to preserve the house from losing heat, and in our case to preserve the house from gaining heat. Wool is a very good insulating material as naturally, it has air particles trapped in between the threads.

Fig: Insulation of Building Roof

- **Double Glazed Windows**

It is well known that a lot of energy is lost through windows. In Hot Climates, the energy loss comes in cooling down the room. But a lot of heat passes through and the coldness is lost through windows since window panes are very thin, and thus, not so good insulators.

This problem must be tackled in the construction process itself. The effect of loss of coldness can be reduced considerably by double glazing. This is a structure where two window panes are placed in the same window pace with a small air gap held airtight between them. As mentioned earlier, still air is among the best insulators known to man, and is very accessible at low cost projects.

For warm climates like the Seychelles, it would be best to use a soft low-e coating that is typically a spattered layer of silver on the already-hardened pane of glass. This layer is less durable compared to the hard coat of indium tin oxide, but delivers less light transmittance, thus rejecting more radiant energy from the sun.

This will eventually lead to the gain of unwanted heat. For even better results, this

layer should be applied to the outer most surface of the window, but due to the delicate nature of the soft low-e coatings, can be applied to the surface just inside the air-space of the window (in double glazing).

- **Roof Vents**

During hot seasons, a lot of heat is accumulated in the attic, especially if the roof is made of steel. This heat radiates down to the house, eventually creating the need of cooling the house. This phenomenon can be greatly reduced by ventilating the attic.

Roof vents are inexpensive and easy to install. They should be located at each end of the roof and every 12' between ends. Installing roof vents will not make the house cooler in winter; they will help remove moisture from the attic.

- **Eco-Lighting in the House**

A very simple, but un-thought method to reduce cost of lighting in houses would be the use of mirrors in specific orientations with adequate openings inside the house. Big openings will ensure a good lighting during the day. But for places where it is not practical to put domes, such-as in toilets or bedrooms, mirrors are a good solution.

Mirrors, during the day can direct the light of the sun in places inaccessible to natural light. At night time also, if the mirrors are placed near artificial lighting sources and directed properly, a lot of energy can be saved instead of placing an additional light, say for studying.

IV. Conclusion

The concept of sustainable building incorporates and integrates a variety of strategies during the design, construction and operation of building projects. The use of green building materials and products represents one important strategy in the design of a building.

Building and construction activities worldwide consume 3 billion tons of raw materials each year or 40 percent of total global use. Using green building materials and products promotes conservation of dwindling non-renewable resources internationally. In addition, integrating green building materials into building projects can help reduce the environmental impacts associated with the extraction, transportation, processing, fabrication, installation, reuse, recycling, and disposal of these building industry source materials.

Climate change is an imminent multi-faceted concern that encompasses a large array of industries and will continue to evolve as the extent of this force is continuously explored and researched. In its current capacity climate change has already had a direct impact on the construction industry. Climate change has impacted all aspects of a construction projects from the type and sources of building materials to the equipment and methods used in the physical construction, to the planning and designing of future projects with the intent of minimizing climate changes effects. Like the construction industry, climate change is a numbers game and being at the forefront of climate change, innovation and resiliency projects can effectively strategizes and minimizes its adverse effects while simultaneously delivering a superior and greener product.

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