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REVIEW ON CLIMATE CHANGE AND ITS EFFECTS ON CONSTRUCTION INDUSTRY

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Abstract - *The construction industry is impressionable to extreme weather events due to most of its action being direct by physical work done by people. Although research has been conducted on the effects of extreme weather events, such as flooding, rainfall and High temperature limited research has been conducted on the effects of rainfall and hot weather conditions. Rainfall presents a somewhat different risk profile to construction, unlike of extreme weather events such as flooding and hot weather that present physical obstacles to work on site. However rainfall and hot weather have devastated the construction industry. And a construction states have been made due to adverse weather conditions. With rainfall and hot weather being expected to occur more commonly in the coming years, the construction industry may suffer unlike any other industry during the period. This creates the need to investigate methods that would allow construction activities to progress during rainfall and hot weather condition periods with minimum effect on construction projects. Hence, this study aims to assess the climate change and its effect on building construction project in the India. The method used for the data collection was structured questionnaire and the target population consisted of clients (private and government developers) and four classes of experts who were architects, builders, quantity surveyors and engineers.*

Key Words: Climate change, Building construction, Rainfall, Hot weather.

1. INTRODUCTION

The changes we are experiencing in our climate are affecting all of our lives. Every industry is being affected by what is happening, but is having an especially big impact on the construction sector. All around the world Governments are waking up to the fact that extremes of weather are rapidly becoming the usual. In many countries, they are gradually changing construction legislation to take account of this fact. Across the world, new laws are being occurred that require both residential and commercial builders to work on higher standards. Buildings that can withstand higher summer temperatures, colder winters, as well as floods and high winds, are now essential. In some areas of the world, they also need to be built to withstand earthquakes, and other natural disasters. For those of us who work in construction this presents challenges, but also means that we are working in interesting times. In order to keep pace with the changing needs of our customers we have to learn new skills, as well as develop innovative building techniques, and materials.

The outcome of barometrical factors on human establishment has long been considered so much so that in the conventional architectural designers and new civil engineering, this issue has been clarified for according to the available facilities and information. Considering climate factors certified based on durable climate data is essential in designing and building construction in diverse locations so as to incorporate with the region's climate and minimize the potential adverse effects and also to optimize the climate potentials .But the effect of all climate parameters on building design and civil operations has never been analyzed altogether briefly. This study endeavour to invoke to the most significant climate factors affecting in the field and analyzed their aspects. There is no studied have been done on the use of weather conditions in near future operations in construction industry particularly on weather and climate disasters like flood, heavy rain and snowfall, heavy wind, etc. in any scientific papers. This study tries to accord shortly about this issue as well.

There are distinct climate factors that need to be studied in civil activities, building designs and building constructions. The following climate factors are mostly important one; they are weather temperature, relative humidity, direction and wind speed, flood, rainfall and sunlight. Climate factors cannot be reduced in these items. Rather barometric pressure and such are also considered as climate factors but they don't play a big part in designing and civil operations. Besides, the changes of some climate parameters are not high over the year so it does not make a big difference knowing about their time changes. Now, we'll be dealing with each of these factors.

Climate change is on the leading edge of construction industry discussions because of the articulate consequences that affect the projects life cycle, so the construction sector has to be more effective and tackle challenges. Excellence in project management is achieved through a structured process that includes a series of phases that a project passes

through from its initiation to its closure or so-called project management lifecycle. There are four basic project phases otherwise regarded as initiation phase, planning, and design phase, execution phase and at the end of cycle, the closing phase shows that value is now being lost, and it is no longer profitable to continue the process. Therefore, the project cycle is closed.

Climate change increases the risks associated with commence on construction project cycle. Climate change can affect construction sector directly through weather and climate, but can also make indirect impacts such as site programming, delay, extra expense, laborers safety, material cost, and delivery. There is devastating evidence that climate change has created threats. The project management practitioners need to suit their experience and expertise to understand better the influence that climate change could have on the way they secure their projects in the future. They should know how do they minimize the impacts of climate change on their profession and continue to develop and grow as successful businesses and yet continue to meet the needs of their clients.

2. LITERATURE REVIEW

M.Camilleri, R. Jaques, & N.Isaacs (2001) in this paper, the results of this research are summarized, and the implications for future building performance, design, standards, and regulation discussed. Climate change is expected to have an impact on many aspects of building performance. As the replacement rate of buildings in New Zealand (and many other countries) is low, and the lifetime of buildings long, much of the existing and future building stock will be affected by any long-term (30- 70 years) changes in climate. There is a need to identify what impacts climate change may have on buildings, how serious they are, and what action (if any) could be taken to ensure that future building performance is not compromised. Climate change scenarios for New Zealand defined the scale of climate changes considered for building performance. For each climate fluctuating, relevant aspects of building performance were investigated to determine if there is likely to be a serious impact. Where serious impacts were determined they were studied in detail and, where possible, the scale of the impacts evaluated. A risk profiling tool was formulated to mask the risk/severity of the most significant climate change impacts, which include flooding (inland and coastal), tropical cyclones and overheating. This method is used on houses and office building.

Michael Camilleri, Roman Jaques and Nigel Isaacs(2010) In this paper, says about the Climate change is possibly to impact on several aspects of building performance, with much of the actual and future building stock likely to be affected. Potential impacts of climate change on buildings are analysed, evaluated as to how serious they might be, and actions are considered to ensure that future building performance is not negotiated. Climate change scenarios for New Zealand illustrate the scale of climate changes as studied for building performance. For each climate volatile, relevant aspects of building performance were tested and to determine if there is likely to be a major impact. Where significant impacts were identified, they were studied in detail and quantified where possible. A risk-profiling tool was formulated to cover the risk/severity of the most significant climate change impacts, which include flooding, tropical cyclones and overheating. Modifying the strategies was developed for each climate change impact, with different return appropriate for each impact. Mitigation of greenhouse emissions is also addressed. Delaying the action has serious consequences will lead to risk and it may be appropriate to consider to changes in the building or zoning regulations to assume the future impacts of climate change. Some implications for future building performance, design, standards and regulation are discussed.

Adrián Garlati(2013) In this study is about the climate change is changing the frequency and anxiety of Extreme Weather Events (EWEs), especially in poor developing countries, and the international community is progressively suggesting the design of adaptation funds to resolve this situation. Measures of vulnerability and submission to EWEs are a critical instrument in guaranteeing a transparent, economical and equitable allocation process in these funds. Latin American countries, which provide little to climate change but are hard-hit by EWEs, urgently need new index to back up their requirement for financial and technical assistance. Using DesInventar data, the paper develops a creative Disaster Exposure Index (DEI) that encloses many disasters' impacts. DEI calculations stipulate an unexpected scenario where some territory usually considered resilient are found to be exposed. The results call for further development of regional indicators to facilitate the international, national and sub national allocation of adaptation funds.

Sarieh Zareaian & Khaled Aziz Zadeh (2013) In this papers says about the role of various barometrical factors on civil activities and building construction is of high importance. Existence aware of climatic parameters of construction site including the measures and type of rainfall, temperature, humidity, direction and wind speed, harmful environmental incident including heavy showers, heavy winds, local changeability, glacial times, heavy snow, etc. It is necessary before designing a building. It is literally obvious that considering these items especially extreme values would result in sustainability and strength of the building against desirable provincial climate events and also cause the fall of energy loss at the time of exploitation. Likewise the emphasis of climate factors, knowledge and considering weathering condition and taking necessary measures and reacting at the time of building construction, the unconditional adjustment and correlation of project exercise with the weather forecast would decrease the possible

damages and loss. The most exceptional example is the care must be given to flood estimate for dam building workshops on the way of rivers which would prevent locomotive equipment loss and human wound. This study attempts to consider long term climate data and the future of weather condition in order to highlight the major role of weather and climate knowledge in construction operations.

Mohammed N Alshebania and Gayan Wedawatta. (2014) Investigated by three interviewees in three different company roles with experience of working in hot weather conditions in the Middle East have been selected .The interviews conducted were exploratory, semi-structured interviews .Therefore, from the analysis the experience of managing projects in such extreme hot weather conditions plays a vital role in future planning and scheduling of site activities .

P.O. Akanni, A.E. Oke, O.A. & Akpomiemie (2014) in this study is about the concept of construction project development may be defects without a good philosophy and successful management of the effect of environmental factors determining the performance of such projects. This study intent to assess the impact of environmental factors on building project performance in the Delta State, Nigeria. The method used for the data collection was structured questionnaire and the target people consisted of clients (private and government developers) and four classes of professionals who were architects, builders, quantity surveyors and engineers. The tools engaged were Spearman correlation, Kendall's coefficient and Chi-Square. Factors that describes the impact on building project performance were twenty-nine variable and they were classified under the clusters of political, legal, construction specialized and resources, commercial and economic, socio-cultural and physical. The Spearman correlation result were analysis for the time and cost overruns with the determined factors affecting project performance revealed that the clusters of Economic and financial and Political had important relationship with time overrun on p-values of 0.004 and 0.011, respectively, while the cluster of communal and artistic had significant relationship with cost overrun with a p-value of 0.007. The research suggested that stakeholders should take knowledge of the variables under these three clusters for proper management and prevention of cost and time overruns.

John Napier (2015) this paper is to elaborate double skin façades and complicated the motorized shading systems repeatedly masking a lack of basic environmental philosophy. This article returns to the physics of comfort in buildings and the static strategies which can help achieve this with a low energy and carbon footprint. Passive and active façade design strategies are defined as the basis of a critical tool and a design methodology for new projects. A new architectural sensibility can start the modeling based on the inputs of sunlight, daylight and air temperature in time and space at the early stages of design. Early but sound strategies can be tested and refined using advanced environmental modeling techniques. Architecture and environmental thinking can proceed hand in hand through the design process.

Gary Martin & Patricia Ballamingie (2015). This paper is intended to inform discussions between industry and government policymakers in and beyond Ottawa, Canada about climate change and potential impacts on residential development regulations and corresponding industry practices. Ultimately, both private and public stakeholders must acknowledge the impacts of urban form on greenhouse gas (GHG) emissions, and, conversely, the impacts of climate change on cities, for any meaningful progress on urban sustainability to ensue. Section 1 introduces the basic relationships between urban development and climate change. Urban form is directly tied to energy consumption and GHG emissions, mainly through building and transportation energy consumption. Section 2 summarizes regional changes from climate change projected by various research organizations. Projected weather changes include more severe heat waves, rain and freezing rain in the future, with flooding identified repeatedly as the main concern for the Ottawa region. Section 3 reflects on the potential impacts of more severe weather on buildings and on the building industry. Impacts may include risks to structures and workers, as well as shifting regulations and insurance liabilities. Section 4 provides an overview of changes to government environmental policies that may signal future regulatory change. And finally, Sections 5 and 6 pose questions of interest for future regulators and builders.

Nabil El-Sawalhi1 and Mahdi Mahdi(2015) This paper says about the climatic change impact on construction project lifecycle. The climate changing is over time based on the highly confidence evidence thought the scientific. Now construction industry is facing the one of the challenging climate change factors. As no project is risk free and climate change, the construction project lifecycle is affected by the strong impact in different phases in the lifecycle. This research aimed at providing a platform of specialized for the construction management practitioners about the impacts of climate change on the construction projects lifecycle, determine the most dangerous climate change factors on the construction project lifecycle, and analyze the most affected phase by climate change factors through the construction projects lifecycle. The study depended on the opinions of civil engineers, project managers etc. who have worked in the construction projects in the Gaza Strip. Questionnaire tool was adopted as the main research methodology in order to conclude the desired objectives. The questionnaire included 127 factors in order to obtain responses from 88 construction practitioners out of 98 representing 89.79% response rate about the impact of climate change on the generic lifecycle of construction projects. The results infer the most compelling impact on the construction project

lifecycle which is related to the extreme weather events of rainfall change, and temperature change respectively. There was a general agreement between the defendants and the most affected phase by temperature, rainfall, and extreme weather events is the execution phase. The results also asserted with a high return.

Yi Zhang,Keqin Yan, Tao Cheng, Quan Zhou,Liping Qin and Shan Wang (2016) In this paper, a simple wind load problem is used to investigate the influence of climate change to reliability analysis of high rise building. Several sampling methods are utilized to estimate the extreme wind speed. They are, Kernel Density Estimation; Bootstrap Re-sampling Method & Monte Carlo Simulation etc**.** The wind speed generally has a linear relation to the daily mean temperature. This can help us to do a rough approximation of the future wind speed by considering the climate change.

Xuepeishan Chen (2016) According to the severe climate change in recent days, professionals among different fields now pay more attention to the management and adjustment when meeting the issues of climate. Moreover, climate also obviously affects the natural and designed landscape. To carefully and especially understand how mural is described in response to different climate, this paper will firstly review the fundamental cooperation between landscape design and climate. And then it will figure out the different landscape elements dealing with different types of climate, finally and predominantly to analysis the definite impact on practical landscape design based on former conclusion. The result will focus on the decision making on design methods within climate change and provide analytical recommendations for designers and planning of future landscape design.

Audrius Sabunas & Arvydas Kanapickas(2017) This study aims at evaluate the influence that climate change is expected to have on the energy performance of a residential building in Kaunas, Lithuania, essentially due to changes in heating and cooling demand. Predict temperature data of IPCC (Intergovernmental Panel on Climate Change) typically concentrates pathways (RCP) 2.6 and RCP 8.5 are used for the periods of the 2020s (near subsequent) 2050s (middle subsequent) and 2080s (far subsequent), incorporated into hourly Energy Plus Weather data files and modeled by Home Energy Efficient Design (HEED) software to assess a difference in consumption. Climate averages of over 30 year period were evaluated. The results show that the overall energy consumption in smaller. The changes were noticed in all scenarios and periods, from a drop by 8.5 %–10.3 % in total consumption in the 2020s under RCP2.6 scenario to 26.7 %–29.6 % decrease in case of the 2080s RCP8.5 scenario (the decrease by 15 %–15.6 % was observed under RCP8.5 scenario). The sensational decrease is due to a decreased number of days when space heating is required, while a slightly increase of a cooling load in a modeled house still does not make it effective over a heating load.

Fanchao Meng1, Mingcai Li1, Jingfu Cao1, Ji Li Mingming Xiong1, Xiaomei Feng & Guoyu Ren(2017) This study is about the effects of climate change on heating energy consumption of office buildings. A climate plays a virtual role in heating energy consumption due to the directly parallel in between the space heating and changes in climate conditions. To compute the impact, the Transient System Simulation Program software was used to affect the heating loads of office buildings in Harbin, Tianjin, and Shanghai, characterizing three major climate zones (i.e., severe cold, cold, and hot summer and cold winter climate zones) in China during 1961–2010. Stepwise multiple linear regression was implemented to determine the key climatic parameters impact on heating energy consumption. The results showed that dry bulb temperature (DBT) is the dominant climatic parameter influencing building heating loads in all three climate zones across China during the heating period at daily, monthly, and yearly scales ($R2 \geq 0.86$). Continuous warming climate comes in with the winter over the past 50 years, heating loads decreased by 14.2, 7.2, and 7.1 W/m2 in Harbin, Tianjin, and Shanghai, respectively; announce that the decreasing rate is more possible in severe cold climate zone. When the DBT increases by 1 °C, the heating loads decrease by 253.1 W/m2 in Harbin, 177.2 W/m2 in Tianjin, and 126.4 W/m2 in Shanghai. These results suggest that the heating energy consumption can be well anticipate by the regression models at particular temporal scales in different climate conditions due to the high determination coefficients. In extension, a greater decrease in heating energy consumption in northern severe cold and cold climate zones may efficiently improve the energy saving in these areas with high energy consumption for heating. Particularly, the likely future increase in temperatures should be treated in improving building energy efficiency.

3. CONCLUSIONS

The aim of this report was to provide a platform of intelligence for the construction management practitioners about the impacts of climate change on the construction projects. The prime objectives of this study is to review the climate change trajectory at India.So, to identify the most affected phases by climate change factors through the construction projects and to propose logical approach to assist the construction experts to criterion their efforts with different phases together, which would reduce the influence of climate change. The factors were about the impact of climate change on the construction projects whether by temperature, rainfall, or extreme weather events, and about the required measures to face climate change within construction industry. After exploring the impact of climate change on the construction project, it can be concluded that.

The most important factors of temperature change suppose to affect are concrete curing, concrete casting and workability, concrete hardening, choice of site

location and increase in the minimum required standards of building code. The most important factors that the rainfall change expects to affect are concrete curing, structural damage which leads to extra cost, high volumes of interest for insurance companies, delay in handing over to the clients, excavation and earthwork. The most important factors that the extreme weather events expects to affect are concrete curing, high amount of claims for insurance companies, delay in handing over to the clients, structural damages which lead to extra cost and the use of tower, cranes and scaffoldings. The research says on the importance of working to develop serious mechanism to implement approaches in order to mitigate or comply with the effects of climate change, whether on the managerial level or towards the various factors of climate change.

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