A REVIEW ON IMPACT OF CLIMATE ON THE CONSTRUCTION INDUSTRY

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ABSTRACT: Buildings are designed for a specific climate yet they often have a lifetime of 100 years. This effect is compounded by the fact that much of the climatic data currently used for design purposes is some 30 years old. This paper investigates the impact that climate change over the last two decades may have on the design and performance of buildings by examining the specific impact that changes in temperature and solar radiation have had on one particular design variable, energy use. The results indicate that the temperature and solar radiation in India has changed significantly in the last 15 years and that the climatic data currently being used for energy design calculations leads to inaccuracies in predictions of energy use. It is concluded that the climatic data used in these calculations should be urgently reviewed as it may be leading designers to adopt solutions which will be inappropriate for future use.

1. INTRODUCTION

Climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly today and even more tomorrow. Weather patterns are changing, sea levels are rising, weather events are becoming more extreme and greenhouse gas emissions are now at their highest levels in history. Without action, the world's average surface temperature is likely to surpass 3 degrees centigrade this century. The poorest and most vulnerable people are being affected the most.

Affordable, scalable solutions are now available to enable countries to leapfrog to cleaner, more resilient economies. The pace of change is quickening as more people are turning to renewable energy and a range of other measures that will reduce emissions and increase adaptation efforts. Climate change, however, is a global challenge that does not respect national borders. It is an issue that requires solutions that need to be coordinated at the international level to help developing countries move toward a low-carbon economy.

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.

Another concern for the construction industry is the effect climate change is having on building materials and current structures. Extreme changes in temperatures cause materials like brick and wood to decay and crack faster. A case study done by CSIRO in 2015 called "climate impacts on concrete infrastructure," found that "increased concentrations of atmospheric carbon dioxide (due to climate change) – particularly in urban areas – mean greater penetration of carbon dioxide into concrete.” As a result, there is a high demand for new types of building materials and sustainable construction strategies to reduce the effects of climate change in future structures.

2. LITERATURE REVIEW

(1) Lisa Guan (2008) The dynamic interaction between building systems and external climate is extremely complex, involving a large number of difficult-to-predict variables. In order to study the impact of climate change on the built environment, the use of building simulation techniques together with forecast weather data are often necessary. Since most of building simulation programs require hourly meteorological input data for their thermal comfort and energy evaluation, the provision of suitable weather data becomes critical. In this paper, the methods used to prepare future weather data for the study of the impact of climate change are reviewed. The advantages and disadvantages of each method are discussed. The inherent relationship between these methods is also illustrated. Based on these discussions and the analysis of Australian historic climatic data, an effective framework and procedure to generate future hourly weather data is presented. It is shown that this method is not only able to deal with different levels of available information regarding the climate change, but also can retain the key characters of a “typical” year weather data for a desired period.

(2) Michael Camilleri, Roman Jaques & Nigel Isaacs (2010) Climate change is expected to impact on many aspects of building performance, with much of the existing and future building stock likely to be affected. Potential impacts of climate change on buildings are identi ed, evaluated as to how serious they might be, and actions are considered to ensure that future building performance is not compromised. Climate change scenarios for New Zealand de ned the scale of climate changes considered for building performance. For each climate variable, relevant aspects of building performance were examined to determine if there is likely to be a signi cant impact. Where signi cant impacts were indicated, they were studied in detail and quanti ed where possible. A risk-pro ling tool was formulated to cover the risk/severity of the most signi cant climate change impacts, which include ooding, tropical cyclones and overheating. Adaptation strategies were developed for each climate change impact, with different responses appropriate for each impact. Mitigation of greenhouse emissions is also addressed. For those risks where delaying action has serious consequences, it may be appropriate to consider changes in building or zoning regulations to anticipate the future impacts of climate change. Some implications for future building performance, design, standards and regulation are discussed.

(3) T H Kabanda and Lobina Gertrude Palamuleni (2011) The study used time series analysis of climatic data (1978 to 2009) of rainfall, temperature and wind to investigate the impact of extreme weather events on buildings and their surroundings in Mafikeng, South Africa. Questionnaires were administered on 100 households in order to establish residents' experiences on seasonal weather events. Mafikeng and its environs, belong to arid climate regions; it features a long term mean seasonal rainfall of approximately 76mm and it receives a unimodal rain season which starts in October and end in April of the following year. In this study, the results reveals that Mafikeng experienced the highest rainfall during the 1997 with a seasonal rainfall mean of 117 mm and the lowest rainfall was experienced during the 1991 season (32 mm). The 1997 rainfall resulted into waterlogging and leaking of roofs in the homes. Extreme temperatures were experienced in the area during 1992 summer season where the highest mean maximum temperature of 37 0 C was recorded. Usually the maximum temperature in Mafikeng range between 25 0 C and 32 0 C. The lowest minimum temperature (-7.5 0 C) was observed in 1994 during the cold season. The study identified that the extreme weather events in Mafikeng are associated with building fatigue, which resulted into structural damages such as cracked walls, windblown roofs, and dust accumulating indoors from dust storms and noise pollution. The study highlights the need for maintaining appropriate building standards, designs and regular review of standards in Mafikeng and its surroundings in order to address climate extreme and the climate change issues.

(4) Scott Schuetter, Lee Debaillie And Doug Ahl (2014) In this article, they discuss an initial effort that uses a building energy modeling framework to examine the impacts of future climate variability on the energy consumption, peak energy demand and energy costs at NASA's John C. Stennis Space Center (SSC) in southern Mississippi. They additionally look at adaptation strategies to mitigate the effects of climate change on building energy performance.

(5) Lexuan Zhong, **Chang-Seo Lee** and **Fariborz Haghighat (2016)** It has been anticipated that climate change impacts ambient air pollution and thereby affects indoor air quality through ventilation. Yet, it is not clear how a changing climate, along with new developed interior building materials, products, and air cleaners, affects indoor air quality, and how to minimize negative effects. In this paper, ozone, as one of the greenhouse gases, has been selected to examine the photochemical mechanism for the explanation of ground level changes in the outdoors. The effects of temperature and precursors on ground level ozone formation have been discussed. Ozone concentration changes for different regions within Canada in recent 20 years are examples to demonstrate the trend of ozone levels in the future. In addition, the indoor sources contributing to the ozone levels are characterized. Moreover, this paper explores the feasibility of photo catalytic oxidation (PCO) technology based air cleaners for indoor ozone removal with the objectives of providing reliable technology and updating the literature.

(6) I.Andrić, AndréPina, PauloFerrão, JérémyFournier, BrunoLacarrière and OlivierLe Corre (2017) Heat demand may decrease in the future due to changing weather conditions and building renovation policies, possibly impacting the efficiency and profitability of renewable heat production and distribution systems which are commonly proposed in the literature as an adequate measure for building sector emissions mitigation. In this work, the potential evolution of building heat demand in characteristic locations (within heating dominant climates) is assessed for different scenarios by using a sample building as a case study. Three future weather scenarios were created based on a previously developed methodology, along with one building renovation scenario based on market penetration rates of different renovation measures. Heat demand was calculated through a heat demand model previously developed and validated by the authors. To represent the results, heat demand-outdoor temperature function parameters were used.

The results indicated that the impact of changed weather conditions was significantly lower than the impact of building renovation. Overall, the difference in the parameters rate of decrease/increase was lower than 2% between weather scenarios for the same year considered. After the initial building renovation in 2020, the slope coefficient of the outdoor temperature-heat demand function increased between 45% and 51%, while the intercept decreased within the range of 48% and 51% (depending on the weather scenario and location considered). The reduction in the number of heating hours was almost negligible in the colder climates considered, while in the warmer climates the decrease rate was significant – 0.8% and 43% of heating hours respectively in 2050 compared to 2010, for the medium weather scenario. Such decrease in demand and heating hours could significantly impact the operational parameters of heat production and distribution units, as well as their feasibility.

(7) S.N.K.Pravin1, Dr.K.Murali2, Mr.R.Shanmugapriyan3 (2017) 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.

(8) Zhiqiang JohnZhaiJacob MichaelHelman (2018) Analyzed the potential influences of 23 climate models for total of 56 model scenarios on building energy. Identified four representative climate models that can cover the full range of the 56 model scenarios for seven climate zones in US. Illustrated the potential impacts of climate change to the current climate zones that directly relate to building energy and design.

(9) VíctorPérez-Andreu, CarolinaAparicio-Fernández, AnaMartínez-Ibernón and José-LuisVivancos (2018) Temperatures are projected under two Global Circulation Models for 2050 and 2100. Eight energy measures are modeled under Mediterranean climate-change scenarios. Passive and active improvements are modeled in a residential building. Heating energy demand decreases significantly and cooling energy demand increases. Thermal insulation and infiltration have the greatest effect on total energy demand.

(10) DayiLai, SusuJia, YueQi and JunjieLiu (2018) A typical window operation schedule was determined for Chinese bedrooms across difference climates. The length of time that the windows were open in cold regions was shorter than that in warm regions. The open duration increased as the outdoor air temperature increased, until a “cut-off” temperature was met.

(11) KonstantinVerichev and ManuelCarpio (2018) In this study presents updated boundaries of thermal zones for construction in the southern regions of Chile. Climatic zoning was performed using two methods (Degree-days method and Climate severity index method). In this research used complex data obtained from measurements at meteorological stations during the last decade. The effects of urban heat islands on climatic zoning for construction was shown.

3. CONCLUSION

Generally, weather and climate role in civil operation and building construction is of importance in respect to looking at the past climate with the goal of building design and forecasting weather condition in the future to adjust civil operations. Looking at the past climate, the outcome of all climate factors must be taken into account and focusing on only one or two climate factors is by no means enough for all factors are significant though they have different weights. In the discussion of weather forecast which covers predicting a range of less than 10 days, damaging limit events (high-low damage) is important since they play a part in setting civil operations. It is necessary to note that weather forecast is not immune of error. Each forecast's precision rate depends on different factors including forecast term, the accuracy of prediction model, changes of map patterns during different days and the precision of individual predictor. In our country weather forecast is done by the state's meteorological organization freely. But in other countries, private companies or individuals do it in return for money. Therefore, they take responsibility for what they forecast. Given what mentioned here, it is important ad essential to pay enough attention to both past climate and weather forecast in the future for civil operations. Although the administrators of small and big civil projects pay a general attention to these points, it seems that civil engineers shall take the first step to institutionalized these information and shape this cooperation with the help of meteorologists.

REFERNACES

1. S.N.K.Pravin, Dr.K.Murali and Mr.R.Shanmugapriyan, "Review On Climate Change And Its Effects On Construction Industry", International Research Journal of Engineering and Technology Volume: 04 Issue: 11 | Nov -2017
2. Michael Camilleri, Roman Jaques and Nigel Isaacs, "Impacts of climate change on building performance in New Zealand", Building Research & Information (2001) 29(6), 440–450.
3. Lisa Guan, "Preparation of future weather data to study the impact of climate change on buildings", Building and Environment 44 (2009) 793–800.
4. "The effects of climate change on construction", www.concentra.com/resource-center
5. T H Kabanda and Lobina Gertrude Palamuleni, "Seasonal weather events and their impact on buildings around Mafikeng, North West Province, South Africa", Life Science Journal 8:8-1 · January 2011
6. Lexuan Zhong, Chang-Seo Lee and Fariborz Haghighat, "Indoor ozone and climate change", Sustainable Cities and Society 28 · August 2016

7. Scott Schuetter, Lee Debaillie and Doug Ahl, "Future Climate Impacts On Building Design" ASHRAE Journal, September 2014.
8. Zhiqiang John Zhai and Jacob Michael Helman, " Implications of climate changes to building energy and design" Sustainable Cities and Society, Volume 44, January 2018, Pages 511-519
9. VíctorPérez-Andreu, CarolinaAparicio-Fernández, AnaMartínez-Ibernón and José-LuisVivancos, "Impact of climate change on heating and cooling energy demand in a residential building in a Mediterranean climate" Volume 165, Part A, 15 December 2018, Pages 63-74.
10. DayiLai, SusuJia, YueQi and JunjieLiu "Window-opening behavior in Chinese residential buildings across different climate zones" Volume 142, September 2018, Pages 234-243.
11. KonstantinVerichev and ManuelCarpio "Climatic zoning for building construction in a temperate climate of Chile" Volume 40, July 2018, Pages 352-364
12. I.Andrić, AndréPina, PauloFerrão, JérémyFournier, BrunoLacarrière and OlivierLe Corre **"**The impact of climate change on building heat demand in different climate types**"** Volume 149, 15 August 2017, Pages 225-234