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Heat Indices of Selected Buildings at the University of Northern Philippines

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Abstract: The heat indices of rooms without air conditioner of three selected buildings at the University of Northern Philippines were analyzed. We measure the temperature and relative humidity in the dif- ferent buildings using the INGCO HETHT01 digital humidity and temperature meter from November 2023 to December 2023, at different times of the day, from 8:00 to 9:00, 12:00 to 13:00 and 16:00 to 17:00. We use Lans P. Rothfusz's heat index equation to calculate the heat indices of each build- ing. The heat indices of the buildings are higher than the tolerable heat index, where the College of Architecture Building recorded the highest. We find that the heat index being reported in media is different than the heat indices in these buildings. It might be prudent that heat indices inside the classroom be calculated than rely on heat indices quoted in the internet or media as these are based on measurements outside of the actual classroom. Our results can be used for policy making and class scheduling.

Keywords: *Temperature, Relative Humidity, Heat Index.*

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I. INTRODUCTION

The human body has the ability to perspire to regulate its temperature. However, evaporation of this perspiration may not take place due to high humidity and extreme temperatures hence the body will not be able to cool down[1]. The measure of this impact to the human body is the heat index[2]. High heat indices may result to rhabdomyolysis, heat exhaustion, heat stroke, heat cramps, sunburn and heat rash and in extreme cases, even death[3–8]. The tolerable threshold heat index is 35^0C[9–12]

School children aere susceptible to high heat indices. Most Philippine classrooms are made of concrete and glass window, which absorbs and retains heat making rooms unequipped of excessive heat[13]. Class hours are reduced. Students spent four hours in school and must avoid going outdoors during 10:00 to 15:00 as heat index is believed to be at its maximum[14, 15]. On the other hand, there are areas that classes are suspended and opt for alternative modes such as online and modular learning[16].

Classrooms also lack proper cooling systems. Some classrooms had no air conditioner or electric fans. Some may have three or four electric fans and air conditioner; however, it is not enough to accommodate the large number of students occupying a room, especially when the temperature increases[13]. Students became physically uncomfortable, felt dehydrated and fatigue[17] which makes them seldom attend their classes , resulting to declination of their academic performance[18–20]. They became unfocused, their cognitive function decreases and got lower test scores[21, 22].

In this paper, we analyze the heat indices in selected buildings at the University of Northern Philip- pines. We aimed to raise awareness of present heat indices in each selected building of the University of Northern Philippines and serve as baseline data for the administration of the university to improve the physical environment of the university, its cooling system, and its insulation. We also hope that our paper can be used to help inform decisions for making policies and class scheduling.

II. METHODOLOGY

The INGCO HETHT01 digital humidity and temperature meter was used in this study. It has an ambient air temperature which ranges from -20.0 degree Celsius to 60.0 degree Celsius (-4.0 degree Fahrenheit to 140.0 degree Fahrenheit) and humidity ranging from

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zero percent to 99.9 percent. It was used in the selected rooms without air conditioning, from 8:00 to 9:00, 12:00 to 13:00 and 16:00 to 17:00, from November 2023 to December 2023. The basis of selection is the large number of students going and occupying the College of Architecture Building, Encarnacion Building, and Science Complex Building.

We use the heat index equation of Lans P. Rothfusz generated from Steadman's heat index chart: $HI = c_1 + c_2 \cdot T + c_3 \cdot R + c_4 \cdot T \cdot R + c_5 \cdot T^2 + c_6 \cdot R^2 + c_7 \cdot T^2 \cdot R + c_8 \cdot T \cdot R^2 + c_9 \cdot T^2 \cdot R^2$ where,T = temperature in Fahrenheit, R = relative humidity, $c_1 = -42.379$, $c_2 = 2.04901523$, $c_3 = 10.14333127$.

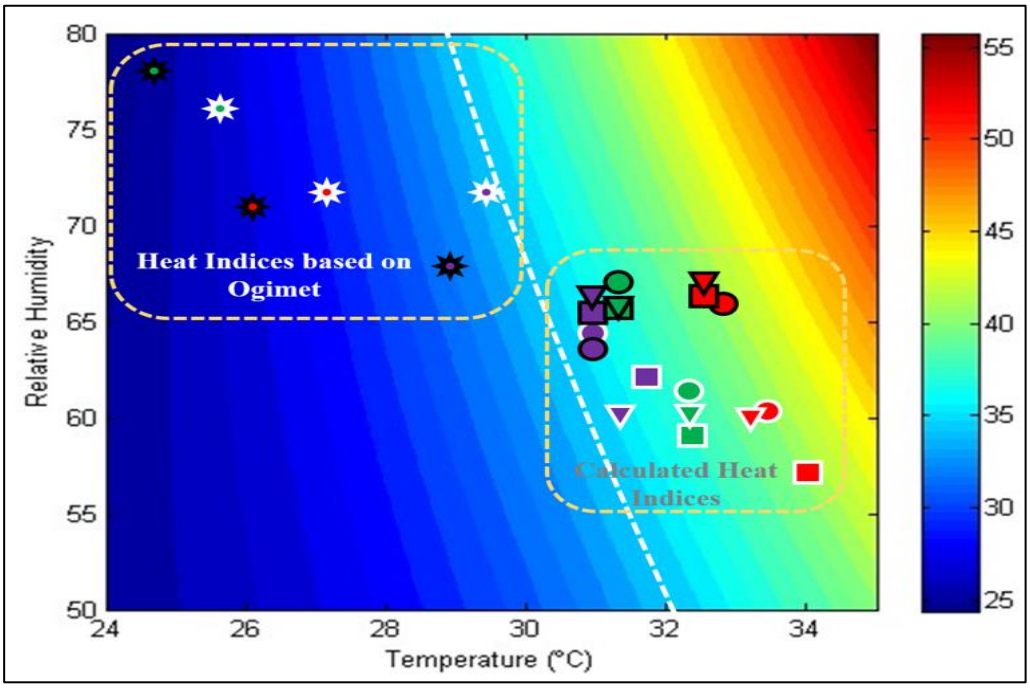

Fig 1 Heat Indices of Selected Buildings

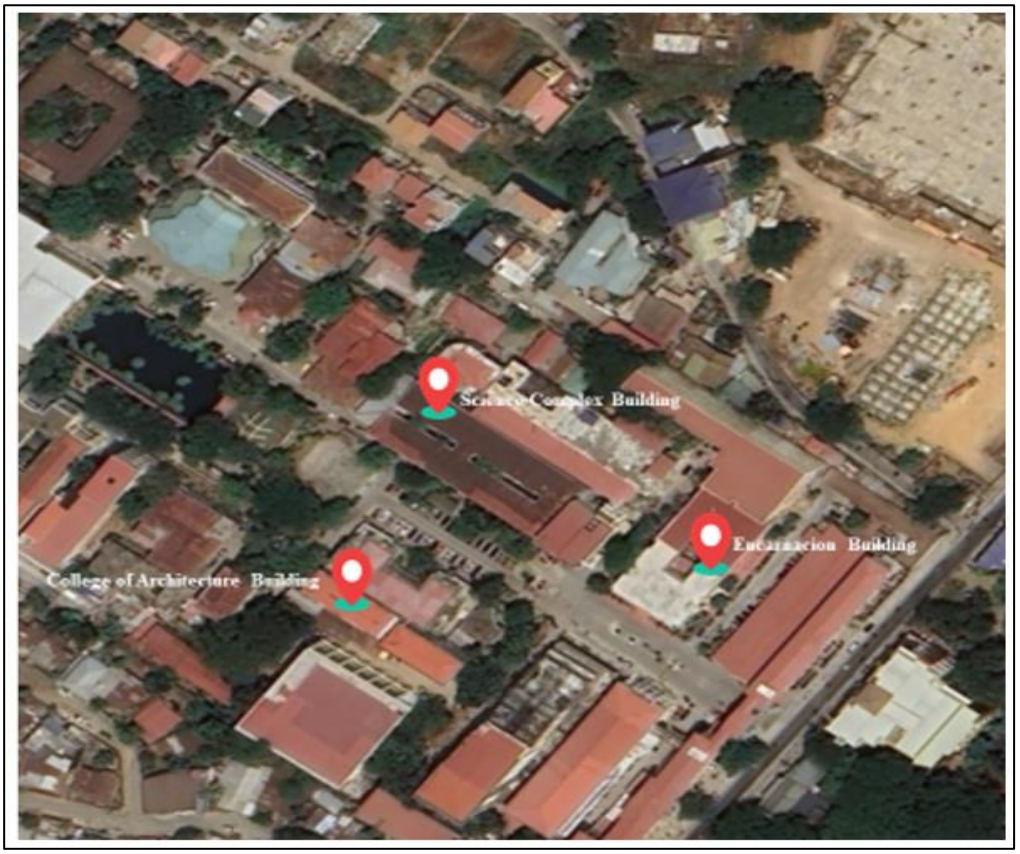

Fig 2 Location of Selected Buildings

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Figure 1: Heat indices of selected buildings at the University of Northern Philippines. The gradient plot is based on Steadman's heat index chart. The shapes represent the buildings, where the colors represent time. The circle represents the College of Architecture Building, square represents Encarnacion Building and the triangle represents the Science Complex Building. The purple represents 8:00 to 9:00, red represents 12:00 to 1:00 and green represents 16:00 to 17:00. The sun shape represents the heat index calculated from the average temperature and humidity of Vigan, Ilocos Sur for the same months and year based on Ogimet[23]. The white dot line is tolerable heat index of 35^0C. The pinned locations on the maps on the right part are the buildings where data were measured.

$$c_4 = -0.22475541,\ c_5 = -6.83783 \cdot 10^{-3},\ c_6 = -5.481717 \cdot 10^{-2},\ c_7 = 1.22874 \cdot 10^{-3},\ c_8 = 8.5282 \cdot 10^{-4},\ c_9 = -1.9985282 \cdot 10^{-6}.$$

We calculate the monthly mean values of the relative humidity, temperature, and heat index for each room.

III. RESULTS & DISCUSSIONS

Figure 1 reveals that the calculated heat indices vary across different buildings and times of day. In November 2023, at 8:00 to 9:00 and 12:00 to 13:00, the Encarnacion Building is the highest. while at 16:00 to 17:00, the College of Architecture Building has the highest calculated heat index. In December 2023, at 8:00 to 9:00, the Science Complex Building has the highest heat index, while at 12:00 to 13:00 and 16:00 to 17:00, the College of Architecture Building is the highest. This discrepancy among the three buildings could stem from various factors such as the location of the buildings, the presence of trees and their orientation towards the sun as shown in Figure 1. The Encarnacion Building is located at the east part, with small number of trees and south-oriented. The College of Architecture Building is located at the southern part, with trees at its western part and buildings at its northern and southern part. The building is facing east. The Science Complex Building is located at the northern part, surrounded by buildings and trees and is facing east. These factors can significantly influence the amount of solar radiation absorbed by each building and subsequently impact the indoor temperature[24].

In addition, the heat indices calculated during November were higher than December. The observed differences between these months emphasizes seasonal changes in indoor temperatures. Northeast mon- soon prevails more in December making it less humid. These differences can be caused by weather patterns and solar radiation intensity.

Figure 1 also shows that calculated heat indices from our measurement differs from the calculated heat indices from the Ogimet data. The calculated indices were higher at 12:00 to 13:00 while Ogimet data have higher heat indices at 8:00 to 9:00. The contradictions highlight the importance of localized measurements for precise and accurate assessments of indoors. This underscores the necessity of on-site monitoring rather than relying solely on internet weather data or the Philippine Philippine Atmospheric, Geophysical, and Astronomical Services Administration bulletin since data collected is much broader.

It is shown in Figure 1 that the calculated heat indices is beyond the tolerable heat index. This conforms with a study indicating that some areas have already experienced a heat index higher than 35°C[9]. This also emphasizes the potential health risks associated with high heat indices. On the other hand, heat indices based on internet were lower than the tolerable, thus heat index being reported in media differs from the heat indices inside buildings.

IV. CONCLUSIONS

We were able to find that heat indices of the selected buildings in our university varies. We also discovered that the heat indices of the buildings were higher than the tolerable threshold and it differs from the heat indices from media data or PAG-ASA. The November heat indices are higher than December heat indices. We suggest that a data logger must be placed inside rooms of buildings to get a data driven results which can be used to calculate heat indices daily and monthly for data driven policy making.

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REFERENCES

[1]. N. Oceanic and A. Administration, What is the heat index? — weather.gov, https://www.weather. gov/ama/heatindex, [Accessed 26-04-2024].

[2]. P. A. G. A. S. Administration, Meteorological Terms, https://www.pagasa.dost.gov.ph/ learning-tools/meteorological-terms, [Accessed 26-04-2024].

[3]. N. I. for Occupational Safety and Health, Heat Stress Related Illness — NIOSH — CDC — cdc.gov, https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html (2022), [Accessed 26- 04-2024].

[4]. N. Disasters and S. Weather, Warning Signs and Symptoms of Heat-Related Illness — Natural Disasters and Severe Weather — CDC — cdc.gov, https://www.cdc.gov/disasters/extremeheat/ warning.html (2017), [Accessed 26-04-2024].

[5]. U. S. E. P. Agency, Climate Change Indicators: Heat-Related Deaths — US EPA — epa.gov, https:

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26nov1106

n//www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths (2017), [Accessed 26-04-2024].

[6]. J. Ballester, M. Quijal-Zamorano, R. F. M. Turrubiates, F. Pegenaute, F. R. Herrmann, J. M. Robine, X. Basagan˜a, C. Tonne, J. M. Ant´o, and H. Achebak, Heat-related mortality in europe during the summer of 2022, Nature Medicine 29, 1857 (2023).

[7]. T.-I. Sung, P.-C. Wu, S.-C. Lung, C.-Y. Lin, M.-J. Chen, and H.-J. Su, Relationship between heat index and mortality of 6 major cities in taiwan, Science of The Total Environment 442, 275 (2013), ISSN 0048-9697.

[8]. R. Villanueva, DOH records 34 heat-related illnesses, with 6 deaths — philstar.com, https://www.philstar.com/headlines/2024/04/23/2349753/ doh-records-34-heat-related-illnesses-6-deaths (2024), [Accessed 26-04-2024].

[9]. C. Raymond, T. Matthews, and R. M. Horton, The emergence of heat and humidity too severe for human tolerance, Science Advances 6 (2020).

[10]. C. Crownhart, How hot is too hot for the human body? (2021), https://www.technologyreview.com/2021/07/10/1028172/climate-change-human-body-extreme-heat-survival/.

[11]. J. Vanos, G. Guzman-Echavarria, J. W. Baldwin, C. Bongers, K. L. Ebi, and O. Jay, A physiological approach for assessing human survivability and liveability to heat in a changing climate, Nature Communications 14 (2023).

[12]. S. C. Sherwood and M. Huber, An adaptability limit to climate change due to heat stress, Proceedings of the National Academy of Sciences 107, 9552 (2013).

[13]. [13] K. D. Pen˜a, Heat turns PH classrooms into ovens: What to know — newsinfo.inquirer.net, https://newsinfo.inquirer.net/1927564/heat-turns-ph-classrooms-into-ovens-what-to-know (2024), [Accessed 26-04-2024].

[14]. J. S. Dalumpines, Still up to mayors, school heads to suspend classes due to extreme heat — pia.gov.ph, https://pia.gov.ph/news/2024/04/19/ still-up-to-mayors-school-heads-to-suspend-classes-due-to-extreme-heat (2024), [Accessed 26-04-2024].

[15]. P. Garcia, Pasig City implements shortened classes to protect students, teachers from extreme heat — mb.com.ph, https://mb.com.ph/2024/4/3/ pasig-city-implements-measures-against-hot-weather-for-students-teachers (2024), [Accessed 26-04-2024].

[16]. E. Marcelo, 5,844 schools suspend onsite classes due to extreme heat — philstar.com, https://www.philstar.com/headlines/2024/04/12/2347075/ 5844-schools-suspend-onsite-classes-due-extreme-heat (2024), [Accessed 26-04-2024].

[17]. Q. A. S. Jaranilla-Mondejar, PressReader.com - Digital Newspaper & Magazine Subscrip- tions — pressreader.com, https://www.pressreader.com/philippines/panay-news/20230429/ 281852942887735 (2023), [Accessed 26-04-2024].

[18]. C. Chi, Teacher survey finds 'intolerable' summer heat affecting attendance, learn- ing — philstar.com, https://www.philstar.com/headlines/2023/03/28/2255097/ teacher-survey-finds-intolerable-summer-heat-affecting-attendance-learning (2023), [Accessed 26-04-2024].

[19]. R. J. Park, J. Goodman, M. Hurwitz, and J. Smith, Heat and learning, American Economic Journal: Economic Policy 12, 306 (2020).

[20]. R. J. Park, A. P. Behrer, and J. Goodman, Learning is inhibited by heat exposure, both interna- tionally and within the united states, Nature Human Behaviour 5, 19 (2021).

[21]. H. Cho, The effects of summer heat on academic achievement: A cohort analysis, Journal of Environmental Economics and Management 83, 185 (2017), ISSN 0095-0696.

[22]. T. M. Vu, Effects of heat on mathematics test performance in vietnam, Asian Academic Journal 36, 72 (2022), ISSN 1.

[23]. G. B. Valor, Synop report summary, https://www.ogimet.com/cgi-bin/gsynres?lang=en&ind=98222&ndays=100&ano=2024&mes=01&day=08&hora=08&ord=DIR&Send=Send, [Accessed 22-04- 2024].

[24]. F. A. Oumarou, A. Ouedraogo, S. M. T. Ky, R. Bhandari, A. Konfe, R. Konate, R. Adamou, D. J. Bathiebo, and S. Kam, Effect of the orientation on the comfort of a building made with compressed earth block, Scientific Research 12, 99 (2021).