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COMPARISON OF ENVIRONMENTAL STRESS IN RELATION TO INFRASTRUCTURE OF OLD AND NEW BUILDING OF RAMMOHAN COLLEGE, KOLKATA, WEST BENGAL

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ABSTRACT

The phrase "environmental stress" is used to characterise the physical, chemical, and biological constraints on the diversification of organisms and ecosystems. Environmental stressors are the tiny annoyances and frustrations of everyday living. One important aspect of education is the support system. In the tropical nation of India, the state of West Bengal, the summers are hot and muggy for almost half the year. The problem is getting worse as a result of global warming. A stressful environment can be produced by infrastructure elements such as wall textures, ceiling heights, window positioning, air flow, lighting, and fan designs, among others. College teachers may experience professional burnout as a result of the environment's stress. There has been research done on the environments of the classrooms at Rammohan College in two separate buildings. According to the reference range, it has been discovered that the indoor classroom environment of the New Building is consistently within the "Partial Discomfort" range (lowest and highest TH1 values 75.86 & 79.20). According to the reference range, the indoor classroom atmosphere of the old building runs from "Comfortable to Partial Discomfort" (74.15 & 77.56).

Key Words: Rammohan College, TH1, WBGT, Class room, Infrastructure, Stress

INTRODUCTION

Due to severe occupational and environmental restrictions, it is possible that a teacher may experience stress. Environmental stress is the term used to describe the physical, chemical, and biological limitations on species production and ecosystem expansion. The minor irritations and frustrations of everyday life are what are known as environmental stressors (Miller and Bates, 2007). Physiological reactions may occur when environmental stressors worsen. Stressors can be a result of human action or they might exist naturally in the environment. While certain environmental stressors primarily have an impact on the local community, others may potentially have repercussions farther afield or even globally (Eres and Atanasoska, 2011).

The effects of global warming will worsen millions of workers' health and productivity by increasing indoor and outdoor heat loads. This estimates the effects of two climatic scenarios on future productivity by using physiological evidence regarding the effects of heat, climate recommendations for safe work environments, climate modeling, and the distribution of working people worldwide (Sikka and Kulshrestha,2003). Under the straightforward premise of no specific adaptation, climate change will reduce labour productivity in the majority of regions. The economic consequences of occupational health measures against heat exposures may require workers to put in longer hours in order to provide the desired output (Kjellstorm and Lemke, 2009).

Teachers, particularly those employed at the college and university level, experience high levels of stress as a result of many professional, infrastructural and environmental pressures. Occupational stressors are linked to decreased job satisfaction, sick leave, higher health care expenses and organizational inefficiency. Professional burnout results from a sustained experience of occupational stress. A sample of the study is drawn from nine state institutions in the southern Indian states of Tamil Nadu and Andhra Pradesh that were chosen using a basic random selection procedure. The investigators created a five-point rating scale to measure the professional burnout and occupational stress of university instructors. Utilizing statistical methods including multiple regression, descriptive statistics, and Spearman's correlation, the information gathered from the rating scales was examined. According to the findings, 74 percent of university instructors report moderate to high levels of work-related stress, and 86 percent of educators report professional burnout. The investigation also provided considerable evidence in favour of the idea that workplace stress and university instructors' professional burnout are positively correlated.

The infrastructure for education is a crucial component of education. India is a tropical country, and the state of West Bengal experiences hot, humid summers for around half the year. As a result of global warming, the issue is getting worse. Infrastructure components like wall types, ceiling height, window placement, air flow, lighting, and fan design, among others, can create a stressful environment. The stress of the atmosphere might lead to professional burnout in college teachers, silently (Bhattacharya *et al*, 2010, 2013).

By analyzing several stressors, the current study aims to quantify the level of environmental stress brought on by the Rammohan College infrastructure. Rammohan College provides a unique model for assessing the stress brought on by the interior environment. The college has two different buildings. One is a 200-year-old brick building and the other is a 30-year-old reinforced concrete one.

METHODOLOGY

Study Area Description: The Rammohan College is under University of Kolkata, West Bengal, India, right in the middle of Kolkata city. This region is about 300 years old, heavily urbanized, and has little to no greenery. The New Building, which was built 30 years ago (at 22.5829520N and 88.3709970E) is mostly made of a concrete superstructure covered by a 5" (inch) brick wall attached with cement mortar (obstructing the capillary route of water evaporation). The average ceiling height is 11' (Ft.), the windows are glass-paned (producing a greenhouse effect) and the electrical appliances include ceiling fans and LED lights. The historic old building was built 200 years ago (at 22.5810230N and 88.3701490E). The building is made of 20" (inch) thick bricks that are not mortared (producing water evaporation capillaries), has an average ceiling height of 20' (ft), wooden windows, regular tubes and ceiling fans as electrical fixtures. The study was conducted in the years 2021–2022 and 2022–2023. Data was collected once every two months in the classrooms on the upper floors of these two buildings (three rooms in each building).

Technique and methods

For observing the working environment of the teachers we studied different type of environmental parameter like noise, light, relative humidity and temperature by the following instrument-

SILVA ADC pro: By using SILVA ADC pro we measured dry bulb temperature, wet bulb temperature, dew point temperature, relative humidity.

The **dry-bulb temperature** (DBT) is the temperature of air measured by a thermometer freely exposed to the air but shielded from radiation and moisture. DBT is the temperature that is usually thought of as air temperature, and it is the true thermodynamic temperature. As a matter of fact, it indicates the amount of heat in the air and it is directly proportional to the mean kinetic energy of the air molecules. Temperature is usually measured in degrees Celsius (°C), Kelvin (K), or Fahrenheit (°F).

The **wet-bulb temperature** is the temperature a parcel of air would have if it were cooled to saturation (100% relative humidity) by the evaporation of water into it, with the latent heat being supplied by the parcel. A wet-bulb thermometer will indicate a temperature close to the true (thermodynamic) wet-bulb temperature. The wet-bulb temperature is the lowest temperature that can be reached under current ambient conditions by the evaporation of water only. Wet-bulb temperature is largely determined by both actual air temperature (dry-bulb temperature) and the amount of moisture in the air (humidity). At 100% relative humidity, the wet-bulb temperature equals the dry-bulb temperature. The thermodynamic wet-bulb temperature is the temperature a volume of air would have if cooled adiabatically to saturation by evaporation of water into it, all latent heat being supplied by the volume of air.

The **dew point** is the temperature at which the water vapor in a sample of air at constant barometric pressure condenses into liquid water at the same rate at which it evaporates. The dew point is the saturation temperature for water in air. The dew point is associated with relative humidity. A high relative humidity implies that the dew point is closer to the current air temperature. Relative humidity of 100% indicates the dew point is equal to the current temperature and that the air is maximally saturated with water. When the moisture content remains constant and temperature increases, relative humidity decreases.

Relative humidity (abbreviated RH) is the ratio of the partial pressure of water vapor to the equilibrium vapor pressure of water at the same temperature. Relative humidity depends on temperature and the pressure of the system of interest.

Lux meter: By using this instrument we measure the light (in lux) in the studied area.

Sound level meter: With this instrument we measure noise in the studied area-

I. **THI:** Thermo hygrometric index is one of the simple indices used by Indian Meteorological Department and was developed by **Thom, E.C (1959)**.

$$THI = 0.72 (Ta + Tw) + 40.6$$

where, Ta is the ambient air temperature in ºC and Tw is the wet bulb temperature in ºC.

II. **WBGT:** Wet Bulb Globe Temperature was developed to account the heat related injuries during field training.

$$WBGT = 0.1Ta + 0.7Tw + 0.2 Tg$$

where, Ta is the ambient air temperature in ºC and Tw is the wet bulb temperature in ºC. Tg is the globe temperature in ºC. For indoor work Tg may be replaced by Ta.

WBGT index is recommended by many international organizations and was adopted by **NISOH** (1972).

Survey Data: A blind fold (not mentioning the objectives) has been conducted among the teachers of Rammohan College for validation of the experiment by their experience.

RESULT

The results are shown in the following tables and figures

Table I: DATA OBTAINED FROM OLD BUILDING

Environ mental parameter	Minimum	Maximum	Average	Standard deviation
Dry bulb temp(˚C)	30.50	36.41	33.02	± 1.31
Wet bulb temp(˚C)	22.60	27.34	25.45	± 1.83
Dew point temp(˚C)	19.12	26.76	22.71	± 3.16
RH(%)	34.6	80.9	59.21	± 12.10
Noise (dBA)	53.3	83.1	66.64	± 6.02
Light (lux)	27	67	30.23	± 14.85

Table II: DATA OBTAINED FROM NEW BUILDING

Environ mental parameter	Minimum	Maximum	Average	Standard deviation
Dry bulb temp(˚C)	32.17	36.81	33.63	± 1.36
Wet bulb temp(˚C)	24.98	29.62	27.27	± 1.17
Dew point temp(˚C)	22.66	27.41	25.39	± 1.08
RH(%)	56.3	86.3	61.24	±12.26
Noise (dBA)	57.62	89.58	66.37	± 8.49
Light (lux)	987	18000	6677.61	± 4371.36

Table III: Discomfort scale of THI and WBGT

Category	**Degree of discomfort**	**THI (%)**	**WBGT (%)**
1	Comfortable	65≤THI<75	15.86 to 24.65
2	Partial discomfort	75≤THI<80	24.66 to 27.33
3	Discomfort	80≤THI<85	27.34 to 31.87
4	Severe Stress	85≤THI<90	31.87 to 34.2
5	Very severe stress	>THI90	>34.2

Table IV

Lowest and Highest THI and WBGT of OLD and NEW building

Building	Lowest/Highest	TH1	WBGT
NEW	Lowest	75.86	24.68
NEW	Highest	79.20	27.93
OLD	Lowest	74.15	23.02
OLD	Highest	77.56	26.33

Figure I: Comparison of TH1 and WBGT of Old and New Building of Rammohan College

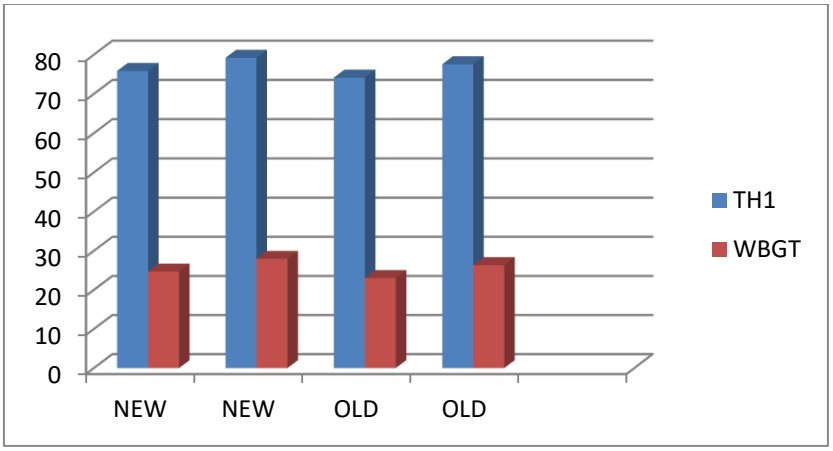


Figure II: Teachers Taking Classes either/or Single/both the building

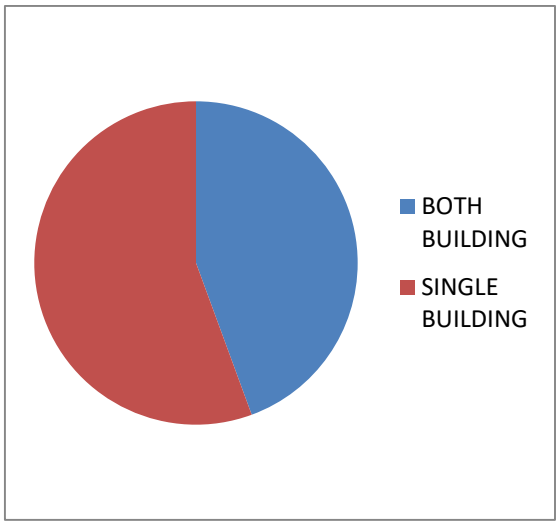
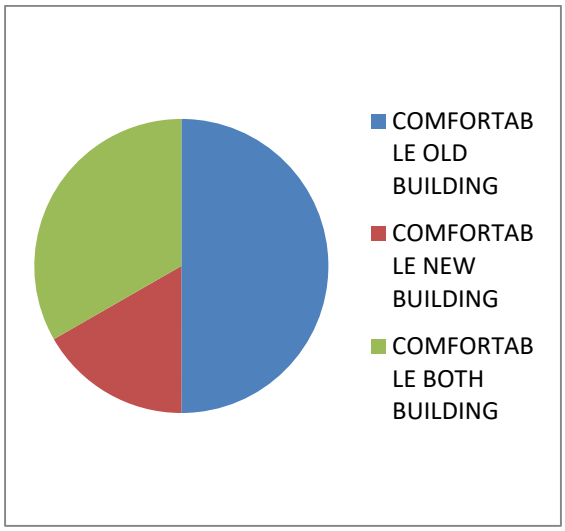


Figure III: Experience of Teachers who are taking classes in both the buildings



DISCUSSION

Considering Thermo hygrometric index (THI) of old and new building respectively, it has been found that indoor class room environment of New Building is always within "Partial discomfort" range throughout (Lowest and Highest TH1 value 75.86 & 79.20) as per the reference range.

The indoor class room environment of Old building ranges from "Comfortable to Partial Discomfort" (74.15 & 77.56) as per reference range.

The frequency wet bulb globe temperature (WBGT) of OLD and NEW BUILDING respectively showing that, the class room environment of New building belongs to "Partial discomfort" to "Discomfort" level (24.68 & 27.93) whereas the Old building belongs to "Comfortable" to "Partial discomfort" range (23.02 & 26.33).

The Relative Humidity is also higher in New Building than Old building (Maximum range 86.30 & 80.90 respectively) making the situation further worse. The noise level is also high in New building due to proximity of a crossing. The indoor light of Old building is insufficient whereas there is excessive light at New building.

During validation experiment from the blindfold experience of the teachers, we have found that 44% of the teaching staff used to take classes in both the buildings. Among these 44%, 50% found that the class room environment of Old building is comfortable, whereas 33.3% found both the building comfortable. So, in conclusion 83.30% teachers experience the classrooms of old building comfortable in comparison to 16.70% teachers experience the classrooms of New building comfortable.

CONCLUSIONS

Air temperature (dry bulb temperature, wet bulb temperature, and dew point temperature), relative humidity, direct solar radiation and air flow are the four major variables of human thermal comfort which is defined as "condition of mind which express satisfaction with thermal environment". It also depends on the heat exchange between bodies. Objective of our study is to find out the environmental condition of the class rooms in which they expand maximum time.

Whereas maximum teachers in the class room also works in the discomfort scale, some are partial discomfort condition, prolonged exposure may result severe stress condition.

If the teachers are not getting a suitable environment for taking classes, they will become irritated for work, it will affect their mental condition and health also.

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