



Effects Of Hot And Humid Climates On Indoor Natural Light From Fenestration Of A Building At Navi Mumbai: A Meteorological Analysis Of A Year

Satish Dhale

Abstract

This research paper analyzes the effects hot and humid climates on Indoor Natural Light from building Fenestration based on data obtained from the Indian meteorological department (IMD). The study explores the impact of climatic conditions, such as high temperatures, precipitation, and Solar radiation, on indoor natural light value. By scrutinizing IMD data, this paper aims to offer valuable understandings into the tasks faced by buildings in hot and humid climate to control heat and at the same time optimize the natural light, encouraging sustainable building practices that familiarize to these climatic environments. In the modern world, it might be challenging to construct a structure in a tropical region that meets acceptable interior requirements. In order to protect the environment by reducing cooling loads, this study explores the development of indirect cooling strategies in residential architecture. It does so within the parameters of interior design, with a case study focused on Navi Mumbai. This paper outlines traditional cooling methods, such as convective, evaporate cooling, radiant cooling using individual radiators, and radiant cooling at night, rooftop swimming pools and air conditioning. In recent years, the cozy surroundings of Navi Mumbai have become controlled by considering relationships between the environment, cozy surroundings, and framework cooling levels that outline the amount of cooling needed to achieve certain goals. figuring out the ideal combination that will yield

Keywords: Fenestration, Precipitation, Relative humidity, IMD (Indian Meteorological Department), Transit spaces, Standard lux values, Elevation and Azimuth

1. INTRODUCTION

Hot and humid climates extant very unique challenges for buildings due to their extreme climate environments. The amalgamation of high humidity and temperature, along with heavy precipitation and intense solar radiation, can have substantial effects on the indoor natural light. This paper aims to discover the effects of hot and humid climates on Indoor Natural Light of a building from its fenestration by using data from the IMD (Indian Metrological Department) to gain a clear understanding of the influence of these climatic aspects. Maharashtra's capital, Mumbai, is home to the city known as Navi Mumbai, which sprang developed around its eastern harbor. It's one of the biggest planned communities on Earth, including a tropical climate that's moderate in many ways and traditional architecture that's long provided decent living quarters for those with modest tastes in architecture and technology. Every few years, when air conditioners and generators need to be replaced due to wear and tear, this cycle repeats itself. From the comfort of their fully air-conditioned offices powered by standby generators that provide 88.97 percent of their energy needs,

politicians and scientists are sharply criticizing this booming industry, the reliance on trade in technology, and the greenhouse gas emissions produced by air facilities and machines.

A. Lessing Of Cooling Loads for Passive Cooling

Passive cooling techniques are employed for the aeration and cooling of suburban structures. This method's primary flaw is that it aims to prevent cooling loads rather than merely reduce the structure's temperature. The issue of effective cooling would be partially resolved if excess heating could be reduced. Examples of externally induced cooling loads include heat gain from the same, hot air approaching the home, and sunlight coming through openings or on the exterior of walls or roofs.

2. LITERATURE REVIEW

A. Data Collection: Meteorological (IMD) data will be collected from the IMD's databases and records, i.e., publicly available open sources on the internet by the department (IMD). Constraints such as Solar radiation, relative humidity, precipitation and temperature will be collected for analysis of Airoli, Navi Mumbai location a hot and humid region.

B. Climate Analysis: The collected meteorological data will be examined to identify variations and patterns in Solar radiation, temperature, precipitation and humidity, over one year.

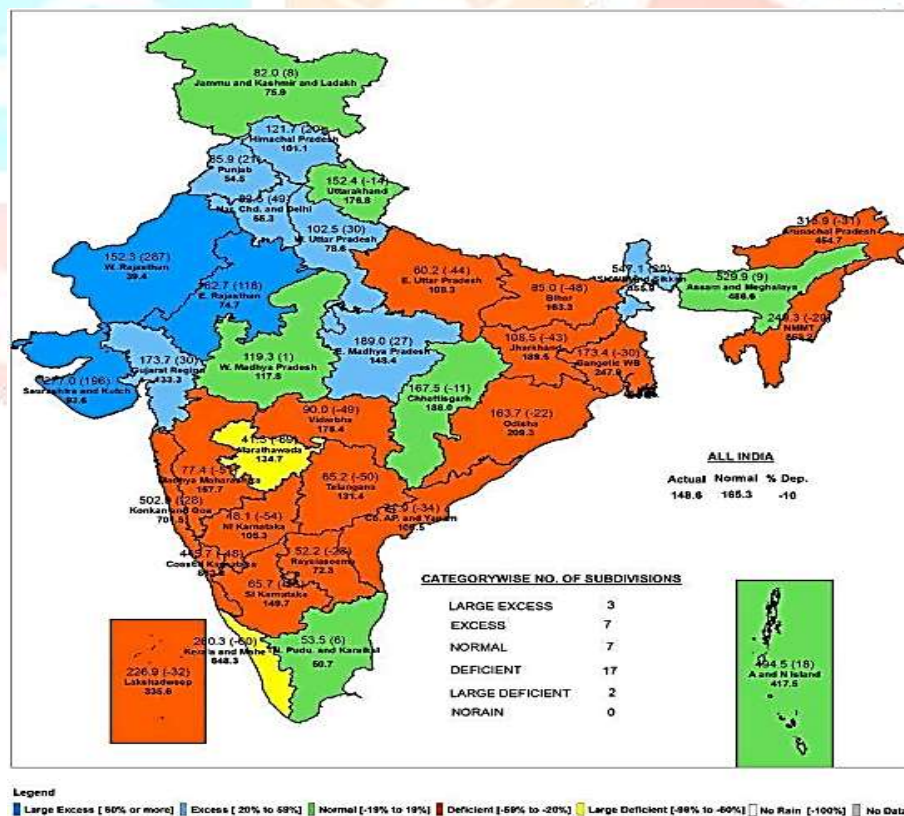


Fig: 1. sub divisional rainfall Map (Period 01/06/2023 – 30/06/2023)

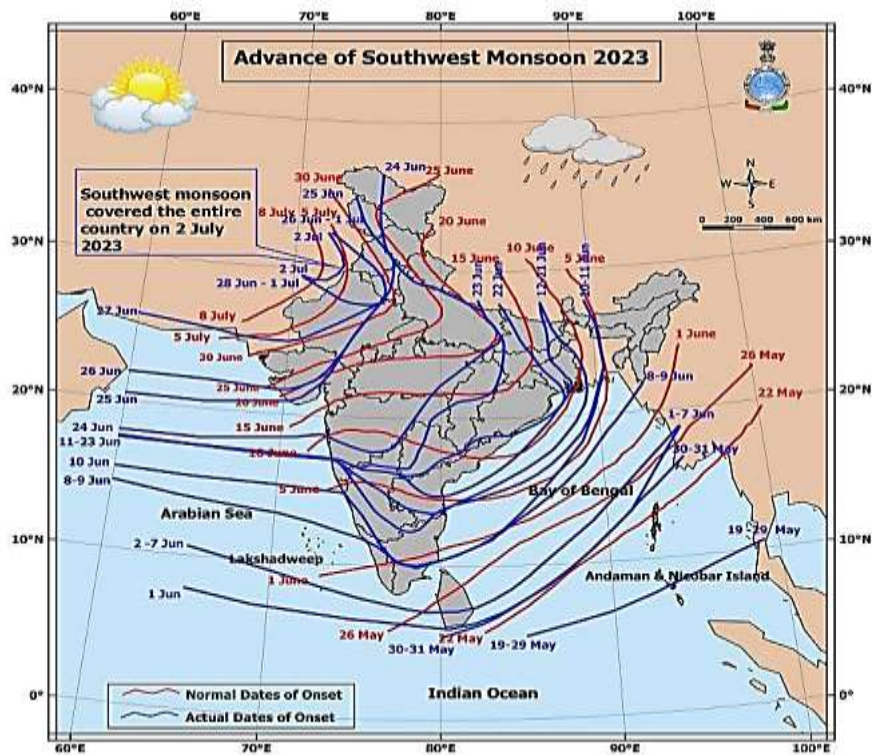


Fig: 2. Onset of Southwest Monsoon 2023.

JUN 2023		Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)
ALL INDIA	ACTUAL	34.60	25.39	29.99
	NORMAL	33.73	24.76	29.25
	ANOMALY	0.87	0.62	0.75
	Rank from Top	10	8	7
NORTHWEST INDIA	ACTUAL	34.93	23.52	29.22
	NORMAL	35.78	23.45	29.61
	ANOMALY	-0.85	0.07	-0.39
	Rank from Top	102	68	91
EAST & NORTHEAST INDIA	ACTUAL	33.87	25.11	29.49
	NORMAL	32.14	24.11	28.13
	ANOMALY	1.73	1.00	1.37
	Rank from Top	3	2	3
CENTRAL INDIA	ACTUAL	35.62	26.40	31.01
	NORMAL	34.81	25.93	30.37
	ANOMALY	0.81	0.47	0.64
	Rank from Top	25	24	22
SOUTH PENINSULAR INDIA	ACTUAL	34.05	26.04	30.05
	NORMAL	32.47	25.18	28.82
	ANOMALY	1.58	0.868	1.22
	Rank from Top	1	3	1

Note: Values are rounded off to nearest two decimal

Fig: 3. The Temperature during June 2023 for all India and Homogeneous regions with its top ranks since 1901.

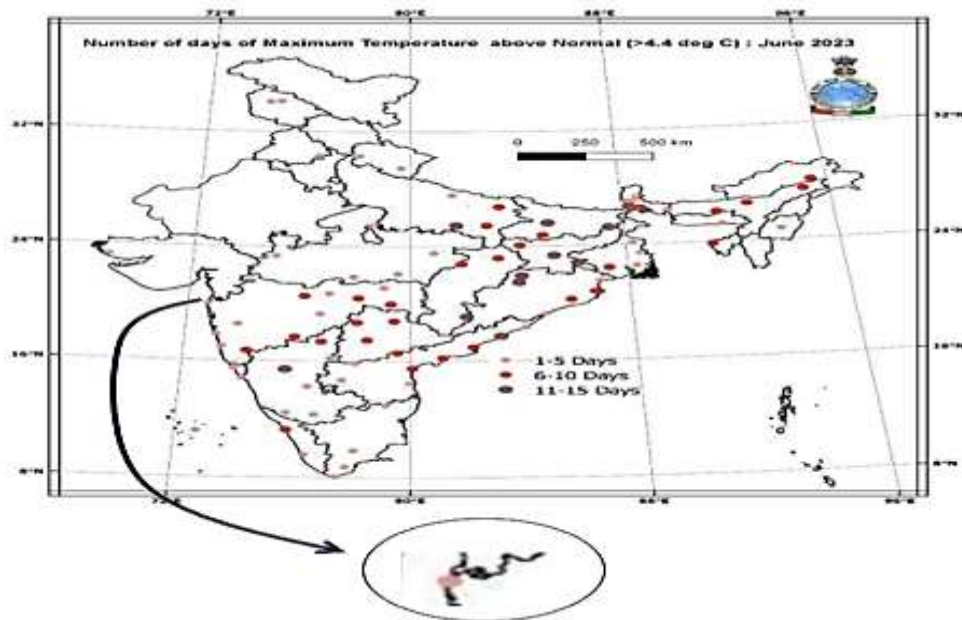


Fig: 4. Number of days with maximum temperature above normal ($>4.4^{\circ}\text{C}$) Over the country for June 2023.

The observed spatial temperature pattern of monthly average maximum, average minimum and mean temperature over India and their departures from normal (1981 to 2010 period) for the month of June 2023 is given in figure below.

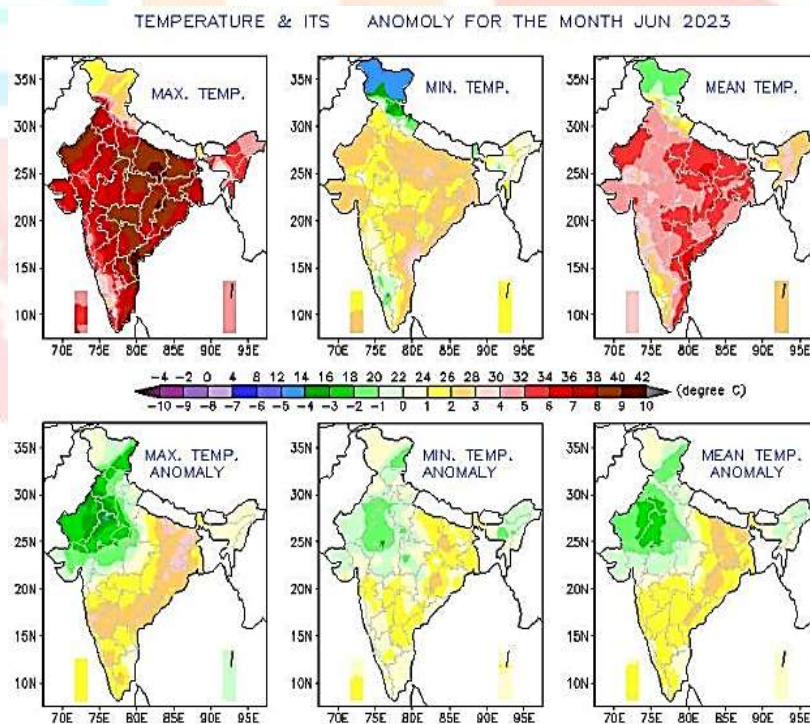


Fig: 5. Observed spatial temperature pattern of monthly average maximum, average minimum, and mean temperature over India (top three from left to right) and their departure from normal (1981 to 2010 period) for June 2023.

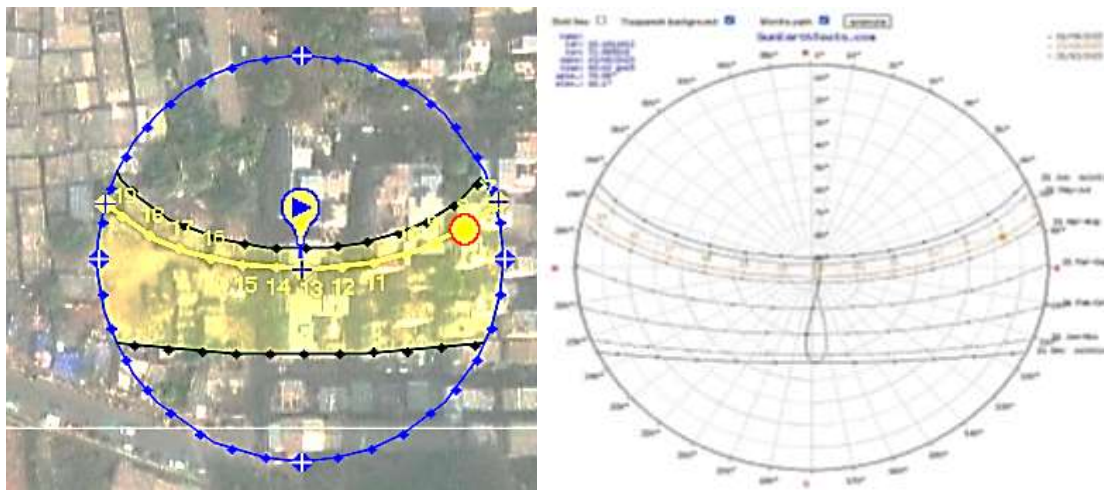


Fig. 5. Sun path diagram



Fig. 6. Elevation and Azimuth at Airoli

3. ILLUMINANCE LEVELS IN A BUILDING FOR VARIOUS ACTIVITIES

Living Room: The living room serves as a space for relaxation and socialization. It is generally recommended to have an illuminance level of approximately 100-200 lux. However, the specific level may vary depending on individual preferences and the activities taking place in the room. If you plan to engage in activities such as reading or other detailed tasks, you might require higher levels, reaching around 300-500 lux.

Kitchen: Kitchens demand higher levels of illumination, particularly for activities like cooking and food preparation. It's advisable to maintain illuminance levels of 300-500 lux on countertops and workspaces. For dining areas within the kitchen, around 200-300 lux should suffice.

Bedroom: Bedrooms are primarily used for relaxation, so lower illuminance levels are often preferred. A typical bedroom may have an illuminance of roughly 50-100 lux for general use. If you need to read or perform tasks by the bedside, higher levels of about 200-300 lux may be necessary.

Dining Room: In dining rooms, illuminance levels of 200-300 lux are generally adequate for regular use. However, you may want to consider the option of dimmable lighting to create a more intimate atmosphere during meals.

Bathroom: Bathrooms require adequate lighting for grooming activities. It's recommended to maintain illuminance levels of 300-500 lux for the mirror area, while lower levels of about 100-200 lux can be suitable for the rest of the bathroom.

Transit spaces: Circulation and corridors are primarily meant for transit, so illuminance levels in these areas can be lower, typically around 50-100 lux.

Home Office: A home office should provide illuminance levels similar to those found in a commercial office setting. Aim for around 300-500 lux to ensure comfortable working conditions.

Standard requirements of lux values required for residential building activities

Sr. No	Specific task and activities	Foot candles	Lux Values
01	Living & Dining	15 - 50	200-500
02	Kitchen	30 - 50	300-500
03	Bedroom	20 - 30	200-300
04	Study	70	700

Table no 1 Ref: Times saver standard for Interior Design and Space Planning (ISBN 0-07-016299-9)

Building Performance Assessment: The impact of hot and humid climates on indoor natural light from the fenestration of buildings will be assessed. This assessment will include penetration of natural light inside the building during the sunrise to sunset.

4. CASE STUDIES SELECTION

The building is located in hot and humid climatic zone at Sector 2B, Airoli, Navi Mumbai, India. The building is assessed based on effects of the summer climate on indoor natural light. In a given specific building design and its fenestration.

5. DISCUSSION

The research findings will present a comprehensive analysis of the effects of hot and humid climates on natural light from fenestration of a buildings. The paper will highlight how solar radiation, temperature, humidity, and precipitation effect building natural light quality performance in hot and humid climatic regions.

6. CONCLUSION

This research paper is concluding a summary of the key findings derived from the IMD meteorological data investigation. It is discussing the inferences of hot and humid climates on indoor natural light from fenestration of a buildings. The inference will offer recommendations for indoor natural light level and penetration to adopt it for sustainable building design in a hot and humid climatic zone.

The natural light in the hot and humid climatic zones can be used for indoor illumination during the 8.00 am to 5.00 pm i.e., for the full day if the light is taken form the southern side but it also increases the indoor heat (in the building at Airoli with its existing orientation)

6. References:

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