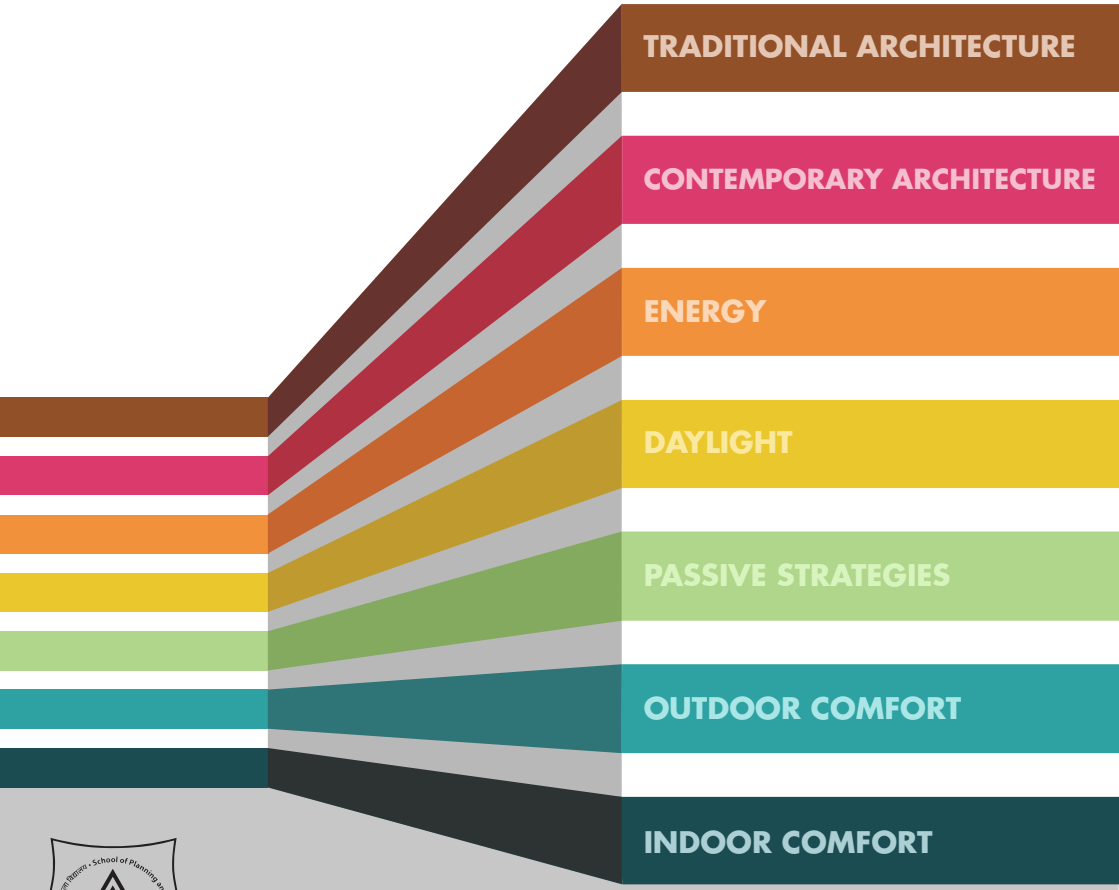
SEMINAR
2024

Climate Responsive Energy Efficient Design of Built Environments (CREEDBE)



Department of Architecture,
School of Planning and Architecture, New Delhi

Fourth Year Semenster VII (2024-25)

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SEMINAR 2024

"CLIMATE RESPONSIVE ENERGY EFFICIENT DESIGN OF BUILT ENVIRONMENTS (CREEDBE)"

BOOK OF ABSTRACTS

Presented by students of the Department of Architecture,
B.Arch. Fourth year 2024-25

PREFACE

Sustainable design lays a new emphasis on climate responsive energy efficient design of the built environment. Our commitment to designing net zero energy by 2070 and carbon-neutral built environments is critical to environment equity and the UN Sustainable Development Goals (SDGs). Globally traditional architecture is replete with examples of climate-responsive and environmentally sound built environment. Over the past half-century, contemporary architecture has been driven by high-performance (green) building practices in response to growing energy demands and environmental degradation. Over the past half-century much progress has been made in our understanding of the climate-responsive design and thermal behaviour of buildings with the more sophisticated analytical techniques available and relying on the assistance offered by computers, many factors can be quantified which were previously handled in qualitative terms only.

Climate-responsive design takes advantage of the natural energy sources present at the boundary of the built environment for passive and low-energy comfort provision and appropriate integration with mechanical systems (heating, cooling, and lighting). The whole building design will combine multiple techniques that together result in a comfortable building with an effective energy balance primarily fed by natural energy flows, as visualized in Figure 1.

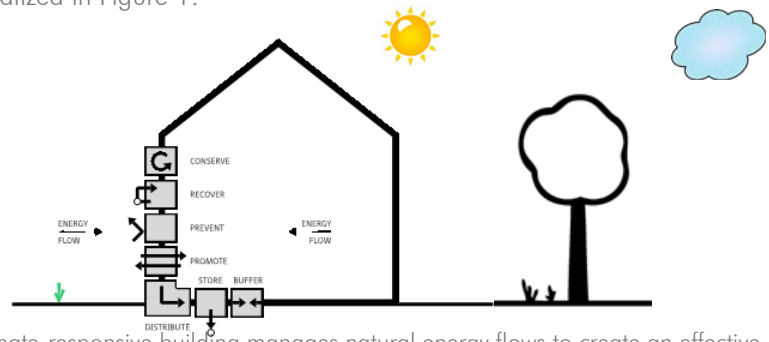


Figure 1 A climate-responsive building manages natural energy flows to create an effective energy balance.

This architectural research seminar course aims to understand the dynamics of climate at the micro (site-specific) and macro (regional level), human comfort (outdoor as well as indoor), climate-responsive design principles, and architectural design strategies for energy conservation, natural conditioning, and daylighting. Further, take up traditional and contemporary exemplar projects to identify how to integrate lessons learned in present and future building practices. The following seven objectives are delineated to achieve the aim within the context of each of the five climatic zones of India (Figure 2):

i) Climate analysis to identify passive design strategies
ii) Climate-responsive design strategies in traditional architecture exemplar
iii) Climate-responsive design strategies in contemporary architecture exemplar
iv) Indoor comfort field study in the built environment
v) Outdoor comfort field study in the built environment
vi) Daylighting strategies simulation in a built environment
vii) Energy efficiency strategies simulation in a built environment

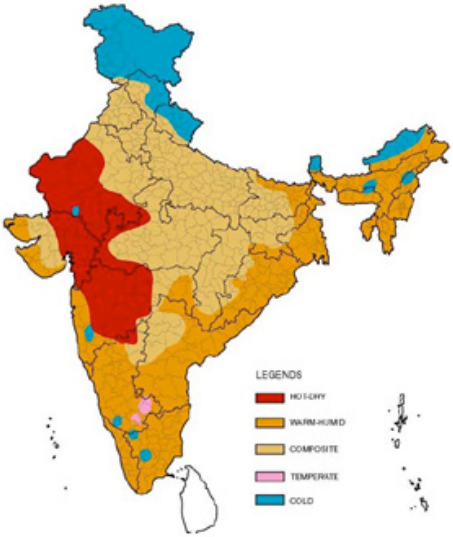


Figure 2: Five climate zones in India

The Process

Climate Responsive Energy Efficient Design of Built Environments (CREEDBE) can have five verticals and seven horizontals as illustrated in Figure 3. The seminar proposals revolve within this broad framework. Student groups have researched selected topics of their interest, to examine the phenomena through a set of seven sub-themes in five climate zones. The students examined the theoretical underpinnings of climate-responsive design of built environments through a review of books. They were expected to familiarize themselves with the existing literature related to the topic, outline a methodology, carry out exemplar studies, conduct primary fieldwork, and analyze the data to yield outcomes. The presentations in this seminar are the output of four months of research done by the fourth-year undergraduate architecture students, respective guides, and coordinators engaging with this course. We hope that you will find value in this work.

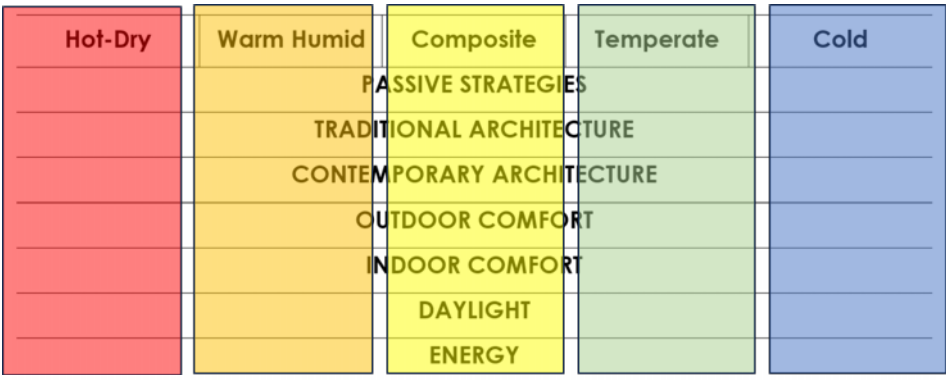


Figure 3 :Climate Responsive Energy Efficient Design of Built Environments(CREEDBE)

As a group research activity, researching and presenting the seminar findings is intended to get the students to appreciate collaborative activity as well as the importance of each group member. This would be established by understanding the research as an ongoing activity and having each student be a seminar speaker presenting an aspect of the research. Under the supervision of the coordinators, each group has a faculty expert assigned as a guide to oversee the research, revising research questions, restricting the scope to a relevant and doable one, suggesting reference material as well and giving the students references of other experts in the field. Apart from all the learnings, this program is expected to be a preparation for their Dissertations and Design Thesis which are both individual efforts in their next and final year at SPA. Therefore, they would be expected to know how:

i.to choose a topic based on the need of study or identifying gaps in the field;
ii.to source information on the chosen topic;
iii.to collate, critically analyze, and reflect upon it utilizing discussions within the research group and;
iv.to synthesize research findings/conclusions in a research paper in the form of a seminar presentation to a live audience.

We appreciate the commendable task done by the editorial and design team and their initiative for giving in time and taking responsibility for bringing out this book of abstracts. Transsolar Academy, Germany guided five groups this year under the aegis of a Memorandum of Understanding signed between SPA, New Delhi, and Transsolar KlimaEngineering Germany. All the seminar groups have given their best and the coordination by the group leaders throughout the semester is worth mentioning. We congratulate the entire batch for making Seminar 2024 a success! The semester was one that has been gratifying and we do hope you enjoy the presentations as well as the papers that will be published later!

Coordinators
Prof. (Dr) Chitrarekha Kabre
Dr Shuvojit Sarkar
Dr K Bangkim Singh

ACKNOWLEDGMENT

There are many whom we would like to thank for the success of the Seminar 2024. Our sincere gratitude to our coordinators Prof. (Dr) Chitrarekha Kabre, Dr Shuvojit Sarkar, and Dr. K Bangkim Singh for their mentoring, relentless support, constant enthusiasm, endless patience, and motivation throughout the seminar programme.

We also express our appreciation towards administration of the School: the Director of the School Prof. (Dr) Virendra Kumar Paul, Dean Academics Prof. (Dr) Meenakshi Dhote, Dean (Research) Prof. (Dr) Sewa Ram and Head, Department of Architecture Prof. (Dr) Jyoti Pandey Sharma; without their unconditional support such a refined output would not have been possible.

Our sincere thanks to the respective guides, including the faculty from the Transsolar Academy, Germany, for their valuable input and time. We appreciate the resource persons for sharing their knowledge and experience with us. Lastly, a word of thanks to the School at large and congratulations to all of us - the graduating class of 2026.

DAY - 1

18 DECEMBER, 2024

01 10:15 AM

Energy Efficiency Framework for Office Buildings in Warm and Humid Climate

02 10:45 AM

Comparing the Thermal Performance of Conventional, green & cool roofs in the Hot-Dry climate of India

03 11:15 AM

Evaluating the Impact Potential of Passive Design Strategies in Warm and Humid Climates: A Case of an Apartment in Odisha

04 11:45 AM

Optimization of daylighting in wards and naturally lit indoor spaces of hospitals in Tropical Climate of India

05 12:15 PM

Assessment of Thermal Comfort in Outdoor Plaza – A Case of New Delhi

06 12:45 PM

Optimizing the building envelope for daylighting and energy efficiency - A case of Udaipur airport

07 02:00 PM

Energy-efficiency through building envelope; A study of an office building in Delhi

08 02:30 PM

Energy-Efficient Design for Boarding Schools in Cold Climatic Regions of India

09 03:00 PM

Adaptive Passive Cooling Strategies for Hot and Dry Climate: A Study of Ahmedabad's Pol Houses

10 03:30 PM

Assessment of design strategies on outdoor thermal comfort in university campuses located in hot and dry climate: A case study of IIT Jodhpur.

11 04:00 PM

Enhancing natural ventilation through urban street geometry in Bengaluru

DAY - 2

19 DECEMBER, 2024

12

10:15 AM

Retrofitting Contemporary Buildings for Energy Efficiency Through a Comprehensive Study of Passive Strategies in Composite Climate

13

10:45 AM

Temperate tensions: Building facade energy performance in Bengaluru's office spaces

14

11:15 AM

Microspatial Analysis of Traditional Elements in Contemporary Architecture in Hot Dry Climate

15

11:45 AM

Framework for Biophilia Integration in Hospitality Architecture

16

12:15 PM

Varied cold climates of Northern Himalayan Region: Passive strategies for improved energy efficiency of the building envelope of contemporary hotels.

17

12:45 PM

Comparative study of materials and strategies for indoor thermal comfort in cold Indian regions

18

02:00 PM

Effectiveness of atriums in Improving Daylighting in office buildings in Composite Climates

19

02:30 PM

Designing for Daylight: The Interplay of Wall-to-Window Ratio with Building Orientation in Mid-Rise Office Buildings of Bengaluru

20

03:00 PM

Effectiveness of Stack Ventilation in offices for warm and humid climate

21

03:30 PM

Impact of Vernacular Adaptive Reuse on Street-level Heat: A comparative study of the streets in Shahjahanabad, Delhi

22

04:00 PM

Study of Thermal Adaptability in university hostels in a Composite Climate of a Diverse Student Population accustomed to different climatic zones

DAY - 3

20 DECEMBER, 2024

23

10:00 AM

Influence of Konkan traditional architecture on contemporary design practices

24

10:30 AM

Assessing Cooling Strategies in Composite Climates: A Qualitative Analysis of Direct and Indirect Systems

25

11:15 AM

Architectural Shifts and Thermal Comfort: Kerala's Traditional vs. Contemporary Residences

26

11:45 AM

Assessing the influence of outdoor thermal comfort on public streets in composite climate

27

12:15 PM

Vernacular Architecture in Temperate Climate: Influence of Traditional Wada's climate-responsive elements in Modern Houses of Pune

28

12:45 PM

Studying Climate-Responsive Architectural strategies in Contemporary Housing design for Cold Climates

29

02:00 PM

Assessing the Impact of Construction Materials on Energy Efficiency of Urban Housing in the Temperate Climate of India - Bengaluru

30

02:30 PM

Performance Evaluation and Application of Passive Downdraft Evaporative Cooling (PDEC) Systems in Hot and Dry Climates of India: A Case Study of Jodhpur

31

03:15 PM

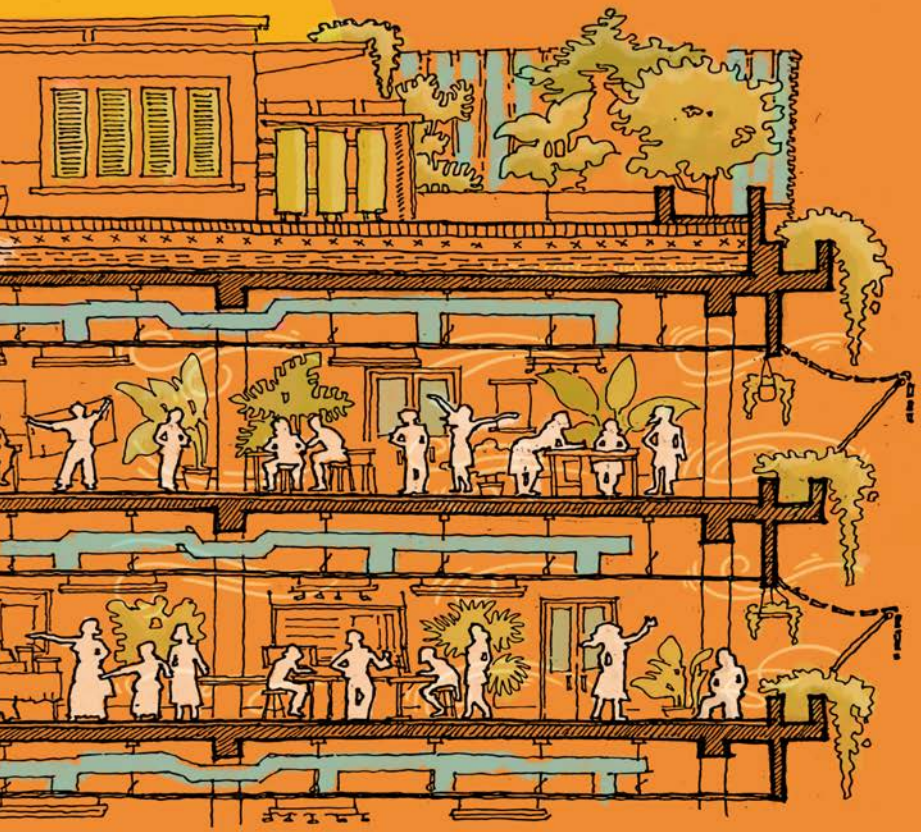
Comparative Study of Wall System Materials for Cold Climates: An Analysis of Traditional, Contemporary, and Hemp-Earth Wall Systems in Uttarakhand

32

03:45 PM

Quantifying Daylight Availability and Energy consumption in Shimla's Town Hall Building: A Simulation Approach

ENERGY CONSERVED IS LIFE PRESERVED



WARM AND HUMID CLIMATE: ENERGY

Energy Efficiency Framework for Office Buildings in Warm and Humid Climate

01

Authors: Aloisio Rodrigues, Anway Kundu, Monira Laha, Pinakin Dutta, Vikhotono Tase

Guide: Prof. (Dr) Bandana Jha

Sustainable development in the building sector requires the integration of energy efficiency and renewable energy utilization in buildings. In recent years, the concept of net zero energy buildings (NZEBs) has become a potentially plausible solution to improve efficiency and reduce energy consumption in buildings. Especially in the case of office buildings, achieving energy-efficient goals becomes important if not necessarily due to their extensive working hours and huge energy demand required for various services. To achieve a NZEB goal, building systems and design strategies must be integrated and optimized based on local climatic conditions. This research paper presents a comprehensive energy efficiency framework tailored specifically for Class A office buildings with traditional working layouts and standard 9 - 5 schedules in hot and humid climates. The suggested framework integrates different design strategies, passive and active cooling techniques, as well as various composite materials; orientation, sizing, placement, and materiality of fenestrations, and building skin. It also aims to provide guidelines on advanced Building Management Systems (BMS) combined with Building Automation Systems (BAS) to significantly reduce energy consumption while maintaining comfort and productivity in office spaces.

Keywords: Office buildings, Warm, Humid, Energy efficiency, Thermal comfort, Framework, Retrofitting

HOT AND DRY CLIMATE: ENERGY

Comparing the Thermal Performance of Conventional, green & cool roofs in the Hot-Dry climate of India

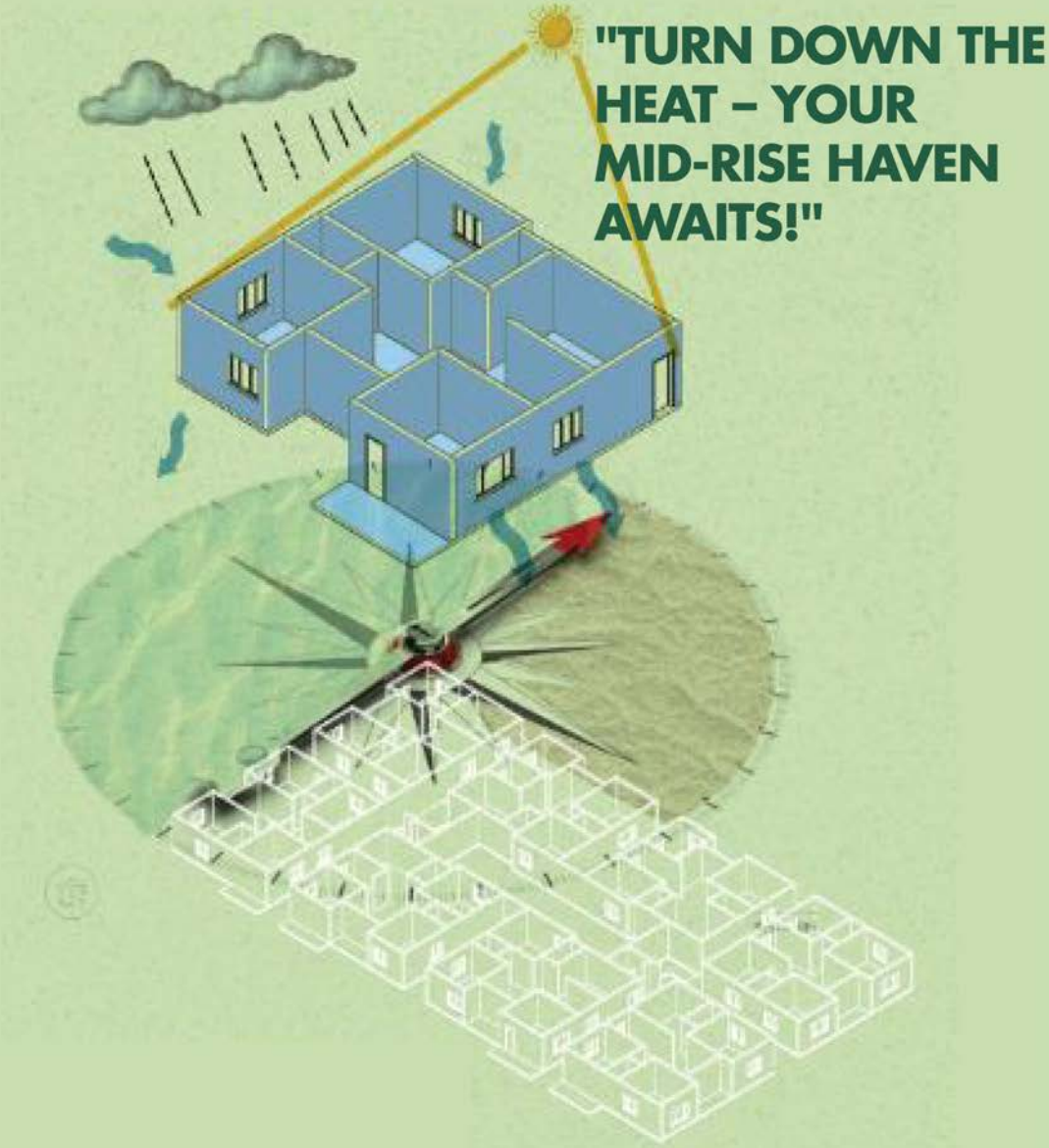
02

Authors: Dixant Singh, Kaushal Kumar Paswan, Nil Katva, Zuroor Zaman

Guide: Dr. Khushal Matai

This paper compares various rooftop design strategies in India's hot and dry climate.,and analyzes them, through the window of energy efficiency and internal thermal comfort of the structure. Building Roofs are known to be the most exposed building element, and hence play a critical role in the overall performance. Roofs face significant challenges in mitigating heat gain and reducing cooling loads, directly impacting energy consumption and indoor thermal comfort. This paper tries to present a comparative analysis of the thermal performance of three roofing typologies—conventional roofs, green roofs, and cool roofs. —through a series of simulations specially designed for the hot-dry climatic zone of India. A fourth case has also been analyzed for interventions created by the roof-based Solar PV's. The simulations are based on identical building geometry ensuring a fair comparison. The results are then compared and analyzed to the various cases that, are presented in the literature review. Through developments of such subtle understandings, it is hoped that this paper shall aid the reader in making informed building decisions that not only reduce demands on energy consumption but also contribute positively towards the outdoor thermal environment. The results indicate that green roofs provide substantial insulation and surface temperature reduction, enhancing indoor comfort while promoting biodiversity. Cool roofs, on the other hand, significantly reflect solar radiation, resulting in the lowest surface temperatures and reduced cooling loads. It highlights the potential of cool and green roofs as viable options for energy efficiency and thermal comfort in India's hot-dry regions.

Keywords: Climate Responsive Design, Urban Rooftops, Sustainability, Simulation Modeling, Thermal Comfort.


"TURN DOWN THE HEAT – YOUR MID-RISE HAVEN AWAITS!"

Evaluating the Impact Potential of Passive Design Strategies in Warm and Humid Climates: A Case of an Apartment in Odisha

03

Authors: Manjima Das, Tisha, Kuheli Sarkar, Chakshita Mittal

Guide: Dr. Jatinder Kaur

Natural environmental conditions cannot be regulated, but passive design strategies can be incorporated into buildings to maintain a comfortable indoor environment and reduce energy consumption simultaneously. This paper provides scope for enhancement in energy efficiency through an assessment and quantification of impact potential by using passive design strategies for mid-rise apartment buildings in the warm and humid climate of Odisha, India. This paper focuses on three passive strategies: thermal mass, shading, and WWR. This research is valuable to architects and builders working in the same climatic region to optimize their designs through the use of passive design strategies. The paper adopts a five-stage methodology for the study. Initially, the design challenges in warm and humid climates were identified; followed by a wide literature review. A base model of an apartment building in Odisha was then developed using Rhino 7 and simulated with Grasshopper and Ecotect. Simulations were carried out to assess the impact potential of various passive strategies under warm and humid climatic conditions. The outcomes from these simulations in terms of annual energy consumption and loads for cooling and lighting were analyzed with iterations in the insulation of the building envelope, WWR, and design of shading devices. The study shall contribute towards developing recommendations that move beyond general principles to deliver relevant guidelines for optimizing the use of passive design strategies and enhancing indoor comfort in warm and humid climates.

Keywords: Passive design strategies, Apartment buildings, Warm and Humid climate, Energy consumption.

WHY SHOULD WINDOWS BE CLOSED- LIGHT OR DAYLIGHT?

HOT AND DRY, COMPOSITE CLIMATE: DAYLIGHT

Optimization of daylighting in wards and naturally lit indoor spaces of hospitals in Tropical Climate of India

04

Authors: Anurag Agrawal, Vasundhara Gagrai, Pranav Ashokkumar, Muhammad Faiz T, Apoorva RG

Guides: Dr. Jatinder Kaur , Mr. Nadir Abdessemed, Ms. Anja Raab

Daylighting plays a crucial role in healthcare design, especially in tropical climates, where natural light can enhance patient recovery, reduce stress, and improve the well-being of both patients and staff. Despite these benefits, many hospitals in India rely heavily on artificial lighting, underutilizing the potential of natural light. This reliance not only affects the patient's health and comfort but also increases energy consumption, with artificial lighting contributing up to 30% of a hospital's total energy use. Researches has proven the direct relation between ample amount of daylighting and the healing of patients. Addressing this revelation, the study explores the optimization of daylighting in hospital wards and public spaces to enhance patient outcomes, visitor comfort, and energy efficiency. A mixed-methods approach was adopted, combining quantitative lux level measurements with lux meter and through simulations and qualitative feedback from key stakeholders, including patients, healthcare staff, and visitors. Field studies were conducted at four major hospitals—AIIMS Delhi, AIIMS Jodhpur, Indraprastha Apollo Hospital, and Fortis Gurgaon—representing diverse climatic conditions. Daylighting performance was analyzed through on-site measurements and daylight simulation tools to assess the limitations of existing designs. The findings reveal a substantial underutilization of natural light, particularly in patient wards, where artificial lighting predominates even during daylight hours. Responses from the questionnaire revealed a direct impact on the psychological well-being of various users and the availability of daylight in spaces. However various public spaces in hospitals lack adequate natural illumination, contributing to increased energy demands and a less comfortable environment for patients, doctors, and visitors. The study highlights the importance of strategic design interventions, such as optimizing window orientation, integrating shading devices, and employing adaptive daylighting strategies to create more sustainable and therapeutic healthcare environments and enhancing ventilation, to reduce energy consumption and improve the quality of healthcare environments. This research offers practical recommendations for architects and healthcare planners, demonstrating how optimized daylighting strategies can improve patient and staff well-being, while also reducing energy costs. It contributes to the ongoing discourse on sustainable healthcare design, particularly within tropical regions, by promoting a balance between energy efficiency and occupant comfort.

Keywords: Daylighting, Energy Efficiency, Hospital Design, Tropical Climate, Artificial lighting

"SHADE OR SIZZLE?

COMPOSITE CLIMATE: OUTDOOR COMFORT

Assessment of Thermal Comfort in Outdoor Plaza – A Case of New Delhi

05

Authors: Sejal Navin Zode, Gaurav Sambhaji Khairnar, Noha Samuel, Vasundhara Tanwar, Aadithyan K P

Guide: Ar. Kalpana

Historically Indian society has utilized outdoor spaces for celebration, gathering, interaction, trade and commerce, etc. However, this usage has sharply declined over the past century due to the effect of climate change and an increase in global temperatures. Delhi's built-up area has increased from 31.4% in 2003 to 38.2% in 2022 (CSE). This urban expansion traps heat, making the city hotter, and has altered the way people use open spaces. This reduced usage of outdoor spaces has led to a cultural shift, with a limited number of people choosing to stay outdoors, while the majority of people moved indoors, impacting the health and well-being of society as a whole. As per statistics and research-based predictions, temperatures are projected to rise by 9°C by 2050 (IMD). This research aims to highlight the key factors responsible for the thermal comfort experienced in urban plazas located around the capital city of New Delhi, and focuses on a comparative analysis of outdoor comfort in Delhi, India: Nehru Place and Bhikaji Cama Place established in the 1980s, and two spaces: Ambience Mall, Vasant Kunj, and Select City Walk, Saket established in the 2010s. The study investigates the influence of context, architectural decisions, and climatic adaptations on visitor comfort in spaces. Studied parameters considered Air temperature, lux levels, relative humidity, and wind speed which were identified as the most significant factors. Real-time data of Air temperature, lux, relative humidity, and wind speed were gathered with the help of an Environmental meter, The outdoor thermal comfort indices: universal thermal climate index (UTCI), Mean Radiant Temperature (Tmrt), PET indices, heat index (HI) and Discomfort Index (DI) were calculated. Simulations using Rhino Grasshopper and (ENVI-Met software) were carried out to validate the results obtained via primary data. The comparison of the studies shows that the plazas built in the 1980s offer better outdoor thermal comfort than those built in the early 2010s. The findings indicate that fewer apertures in shading devices combined with tree canopies might double the effectivity in lowering UTCI values, thereby enhancing thermal comfort, especially during peak summer months. The study also shows that incorporating vegetation, canopy shades, and reflective materials can reduce the annual radiation gains by 40%, thereby enhancing outdoor thermal comfort in plazas. This aids in developing new regulations to enhance outdoor thermal comfort in these areas, which will further contribute to the improvement of an urban environment.

Keywords: Outdoor thermal comfort, Urban commercial and Admin plazas, Public health, User-centric design, Heat mitigation strategies


FORM
FOLLOWS
LIGHT
HOT AND DRY CLIMATE: DAYLIGHT

Optimizing The Building Envelope for Daylighting and Energy Efficiency - A Case of Udaipur Airport

06

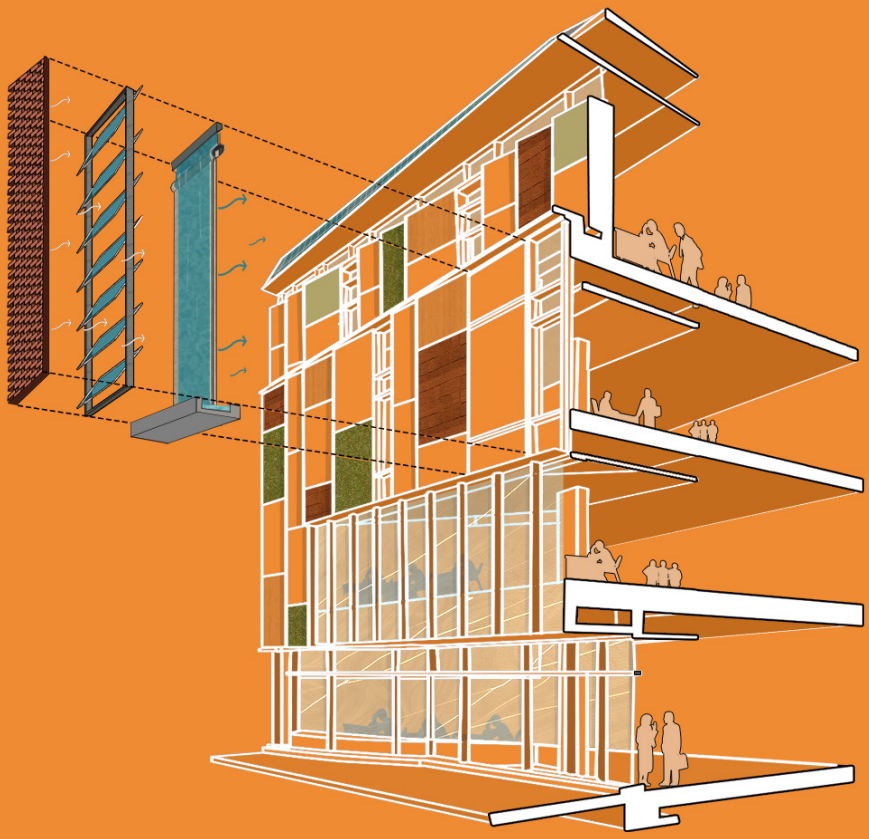
Authors: Deekshit D, Hanna Abdulla, Haridev P P, P M Zaida Badriya, Reema Krishnan

Guide: Ar. Kalpana

In India, airports account for about 10% of the energy consumed by the transportation sector (MoSPI). Airports are energy-intensive infrastructures, with annual electrical consumption ranging from 270 kWh to 350 kWh per square meter. In regions like Udaipur, where temperatures can soar up to 40°C, as airports continue to grow in scale and complexity, the need for energy-efficient strategies becomes essential for reducing energy use while enhancing passenger comfort. This study investigates the potential of kinetic facades—adaptive building envelopes—to enhance energy efficiency and daylighting quality in airports. The methodology involves iterative simulations for different kinetic facades, such as folding, sliding, and rotating. The base case was modeled as per the Energy Conservation Building Code (ECBC) to compare the energy performance and daylighting of different kinetic facades. The research uses parametric models of airports developed in Rhino and Grasshopper and simulated under varying environmental conditions using Ladybug and Honeybee. An evolutionary algorithm, Wallacei, is applied to optimize facade designs for improved daylight penetration and energy efficiency. Analysis shows that certain kinetic facade systems significantly enhance daylighting while reducing energy consumption, suggesting that such envelopes can make airports more energy-efficient and comfortable for passengers. The results highlight the potential of kinetic facades for significant energy savings when daylighting is efficiently harnessed. These findings offer practical insights for architects and designers aiming to balance aesthetics, functionality, and sustainability in airports.

Keywords: Kinetic facades, Energy efficiency, Parametric modeling, Daylighting optimization, façade optimization, Hot & Dry climate

WRAPPING BUILDINGS IN THE FABRIC OF INNOVATION



COMPOSITE CLIMATE: ENERGY

Energy-Efficiency through Building Envelope: A Study of an Office Building in Delhi

07

Authors: Karan Rawat, Khushi Jha, Rudransh Tank, Anjali Jangra, Vikram Uphade

Guide: Prof.Dr Chitrarekha Kabre

Increasing carbon emissions in the environment has affected the planet in every way possible. If seen deeply in this matter, the construction industry amounts to 40% of global CO2 emissions. It can be on the increasing side due to rapid urbanization in the populous cities around the world. To combat this, our buildings need an energy-efficient sustainable approach in the design. Globally, energy demand has increased in the past years due to the digital revolution and has affected the construction industry towards improving the environment. As the building design approaches energy efficiency, the system becomes sustainable. In India, the rate of development is increasing due to the growing demands of the population and the weather of India is so diverse, that this paper is going to be specific towards composite climate. According to ECBC 2017, materials have been specified for skin and structure which reduces the total energy consumption of the building by 40% - 60%. This sets a baseline for working towards a more sustainable and energy-efficient design of the building envelope in the composite climate of Delhi. This paper explores the possibilities of a more energy-efficient building envelope by adopting two parameters: Materialities, and Strategies keeping Biomimicry as the third parameter for future growth in the specific field with LCA assessment of the proposed composition of different material types.

Furthermore, to have a better understanding of sustainability, two more parameters are added for the sustainability of the building envelope. A prototype model has been adopted from the "Optimization of energy-efficiency measures (EEMs) for mid-rise office buildings in 5 climatic zones in India". The building envelope is digitally constructed in Design Builder for simulation and analysis for energy-efficient systems.

Keywords: Energy efficiency, Sustainable, Environment, Building envelope, LCA

ENERGY, TRUST, AND A TOUCH OF PIXIE DUST: REDEFINING COMFORT FOR COLD–CLIMATIC SCHOOLS

COLD CLIMATE: ENERGY

Energy-Efficient Design for Boarding Schools in Cold Climatic regions of India

08

Authors: Surabhi Kumar, Kashvi Budia, Manya Nagpal, Alankrita Datt, Vaibhav Pal

Guides: Prof. (Dr) Chitrarekha Kabre , Prof. Thomas Lechner, Ms Lakshmishree V.

This paper aims to investigate the optimal strategies for designing energy-efficient boarding schools in cold climatic regions in India. This paper primarily focuses on finding the optimal architectural principles and subsequently, the architectural strategies that operate on those principles, namely thermal mass, infiltration of air through gaps, window-to-wall ratio, and glazing types. While the existing literature review addresses the multiple scenarios in cold climatic regions, only a few studies explore strategies that are tailored for cold climates specifically in India. Most of the country has scarce regulations on structures built in cold climates . The approach will be to create three shoebox base cases for the three chosen cold climates in Transys lite, comparing them with simulations to find the parameters of the strategies optimal for each state. To summarize, the creation of a complete design framework for boarding schools in cold climate regions of India must prioritize thermal comfort and energy efficiency through sustainable practices. By utilizing passive design methods, educational settings may be created that not only assist learning but also contribute to the larger aims of sustainability and ecological health.

Keywords: Passive design strategies, Cold climate, Boarding school, Energy efficiency, Thermal comfort

ROLE OF POLI

HOT AND DRY CLIMATE: TRADITIONAL ARCHITECTURE

Adaptive Passive Cooling Strategies for Hot and Dry Climate: A Study of Ahmedabad's Pol Houses

09

Authors: Soniya Pathare, V. Madhunisha, Dhanwada Guru Shri Nanda, Dhyan Ramesh TV, Surya Kiran S

Guide: Ms. Gunjan Jain

This study examines the climate-responsive design of Ahmedabad's historic Pol houses, focusing on their courtyards, narrow streets, and passive cooling techniques. These traditional cluster dwellings integrate social and environmental factors for sustainable living. Features such as natural ventilation, the Venturi effect from narrow streets, and the stack effect in courtyards enhance thermal comfort in the hot and dry climate. The research employs a comprehensive methodology, including a literature review, site surveys, measurements, questionnaires, radiation analysis, and simulations to assess the effectiveness of these passive cooling strategies. Drawing on field observations and climatic data, the study emphasizes the relevance of traditional methods in addressing modern challenges related to urban heat and sustainable housing. By analyzing architectural features and cultural contexts, the findings highlight the value of preserving traditional practices and offer insights for integrating these strategies into contemporary urban design, fostering resilient and sustainable communities.

Keywords: Pol houses, Climate, Passive design, Thermal comfort

HOT AND DRY CLIMATE: OUTDOOR COMFORT

Assessment of Design Strategies on Outdoor Thermal Comfort in University Campuses located In Hot and Dry Climate: A Case Study of IIT Jodhpur

10

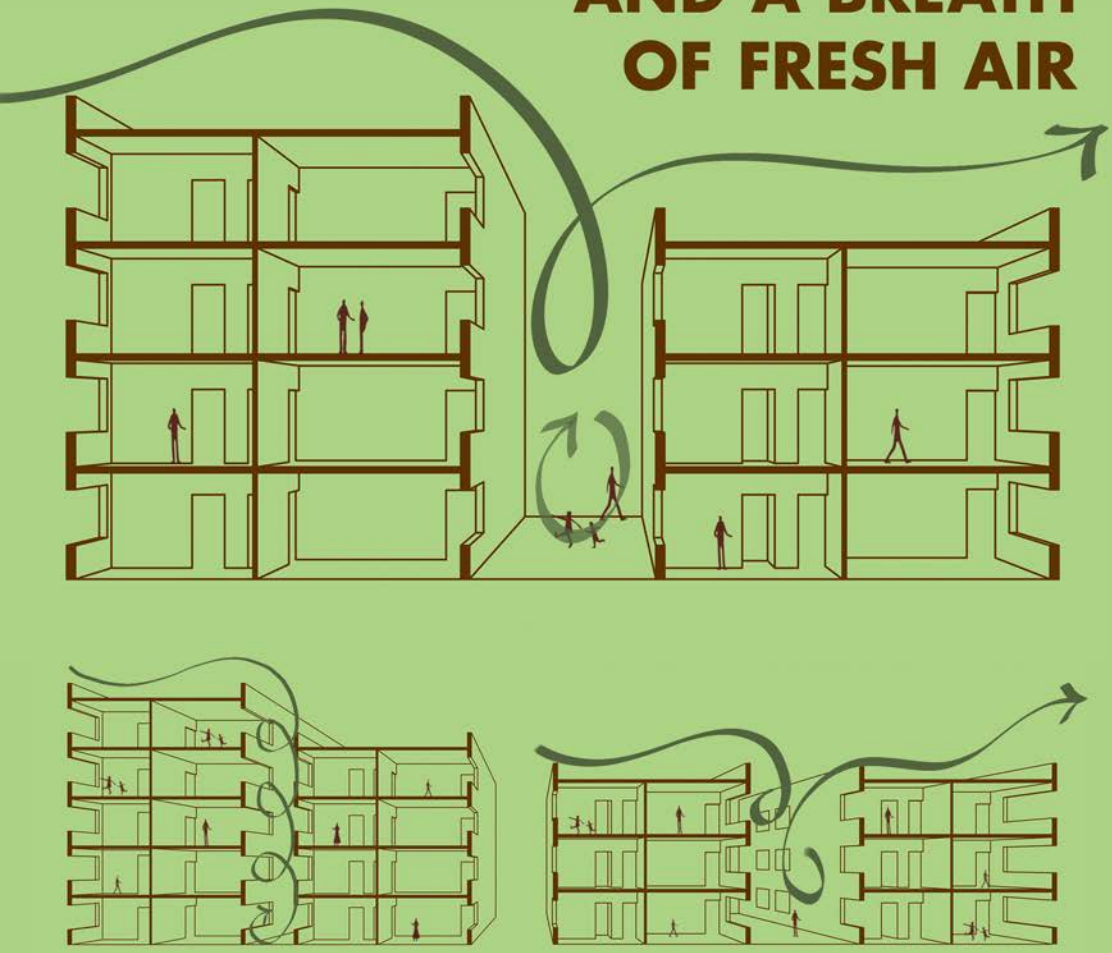
Authors: Alisha, Debroop Roy Choudhury, Harshil Katira, Sancheti Samiksha Santosh, Sanjana Bhatia

Guide: Ar. Gunjan Jain

Outdoor thermal comfort within university campuses is an essential factor in the well-being and productivity of students, faculty, and staff in a hot and dry climate area. This study examines how various design strategies can improve outdoor thermal comfort in such environments. Pursuing an evaluation of heat mitigation, the study employs a qualitative as well as quantitative approach in assessing the microclimatic conditions within chosen university campuses focusing on the effectiveness of shading devices, vegetation, water entities, building orientation, and choice of materials. The Universal Thermal Climate Index (UTCI) is evaluated through surveys, which are subsequently validated and examined to comprehend perceptions of human comfort in large-scale outdoor spaces. This study further employs simulation tools, by combining site measurements to evaluate the temperature variations and degree of comfort attained by the interventions in the form of foliage and materials. Additionally, the research recommends architectural and urban design strategies to enhance outdoor thermal comfort and reduce heat exposure, thereby promoting energy efficiency in the outdoor built environment.

Keywords: Passive Strategies, Microclimate, Materiality, Green Cover, Evaporative Cooling, University Campus, UTCI

HEIGHT, WIDTH AND A BREATH OF FRESH AIR



Enhancing Natural Ventilation through Urban Street Geometry in Bengaluru

11

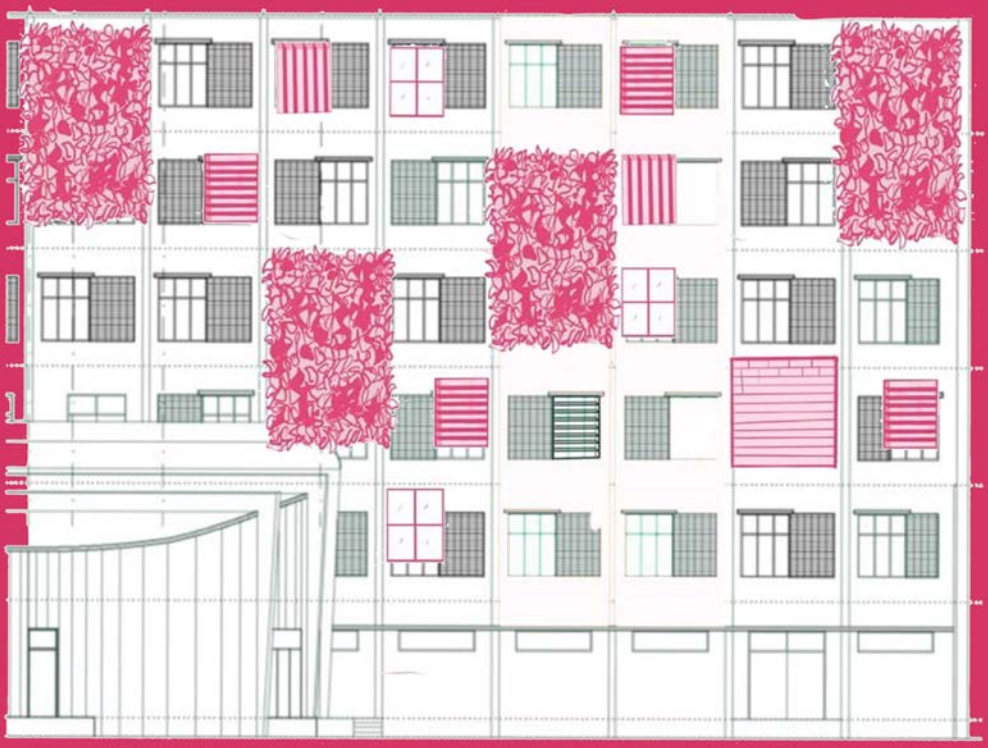
Authors: Kesang Edron Komu, Jimmy Warna, Gourav Sandil, Abhay Kumar Singh Shaily, Archisman Mali

Guide: Ar. K Mehar Kumar

In a climate like the temperate climate, the temperature is rarely seen to be extreme. One may find this climate the most pleasant due to its moderate temperatures and distinct seasonal changes. For architects, who focus on creating comfortable living spaces, this calls for subtle passive strategies in building design. An efficient natural ventilation system will induce cooler summers and warmer winters, off-loading the need for mechanical systems. However, in urban hubs like Bangalore, the high building density creates compact and hotter spaces, intensifying the Urban Heat Island (UHI) effect. The closely packed buildings limit air circulation, leading to higher localized temperatures. Designing buildings to facilitate natural ventilation becomes challenging, as surrounding structures interfere with wind flow. Here, implementing ventilation corridors within urban environments is crucial, helping mitigate the UHI effect while fostering microclimate development. This paper explores how variations in urban street geometry can enhance airflow within buildings in Bangalore by utilizing the wake effect of wind, ultimately contributing to cooler, more sustainable urban spaces.

Keywords: Natural ventilation, street geometry, wake effect, airflow patterns.

WHY RETROFIT CONTEMPORARY BUILDINGS?



COMPOSITE CLIMATE: CONTEMPORARY ARCHITECTURE

Retrofitting Contemporary Buildings for Energy Efficiency through a comprehensive study of Passive Strategies in Composite Climate

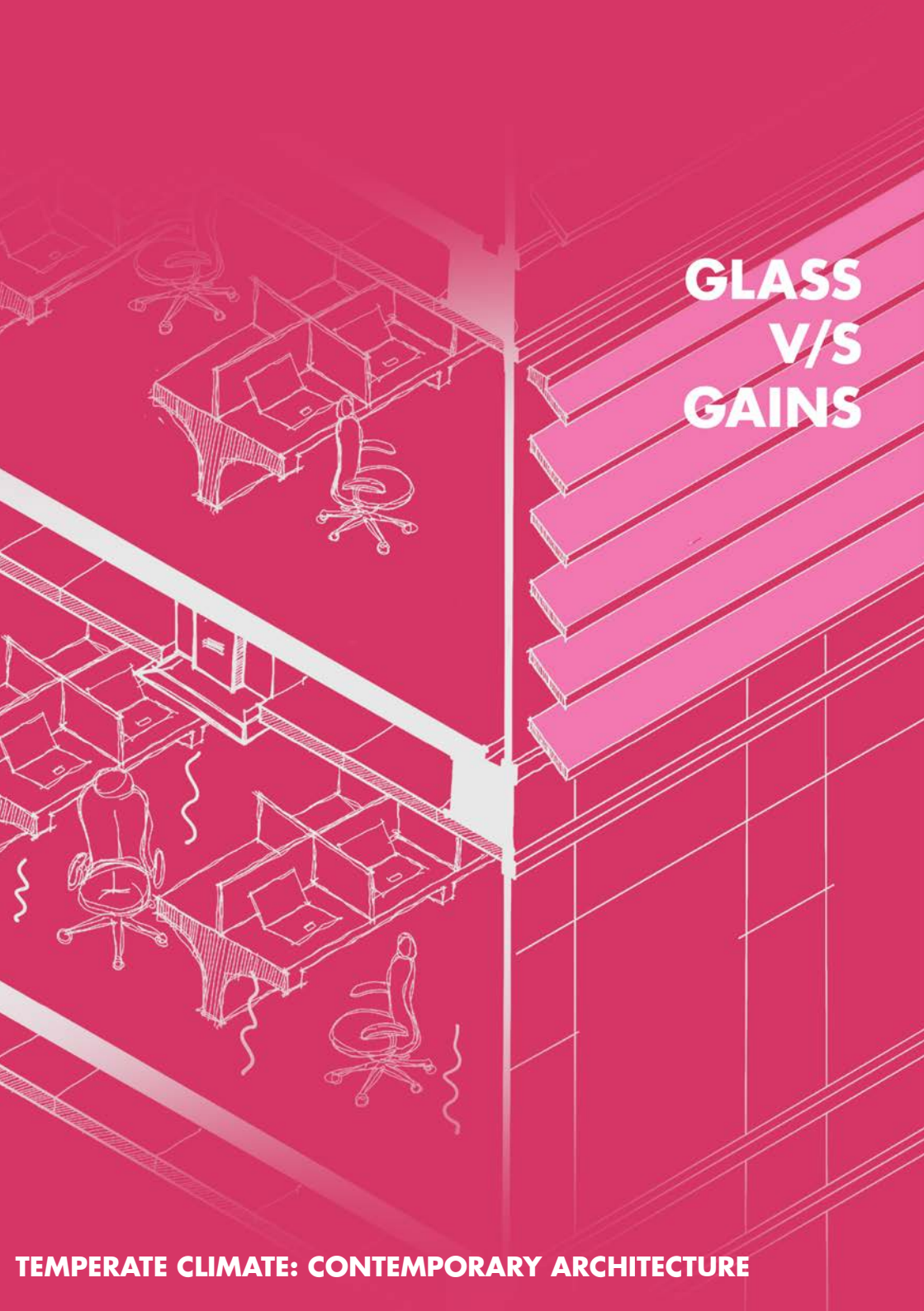
12

Authors: Shreema Bera, Abha Bharatkumar Patel, Ashani Sanjiv Srivastava, Hemmant Raj, Vishwanth V

Guide: Ar. Rajesh Luthra

The architectural sector plays a significant role in contributing to global carbon emissions, due to the shortcomings of contemporary building practices to address local climatic conditions. There is a need to improve the energy efficiency of a building once the building has already been established, particularly in composite climates that experience both hot and cold seasons. This study focuses on the potential of retrofitting existing structures by utilizing passive design strategies such as natural ventilation, passive solar heating, thermal insulation, and shading systems to enhance energy efficiency and occupant comfort. By analyzing successful case studies and reviewing pertinent literature, the paper aims to offer a practical framework for integrating climate-responsive retrofitting strategies into both new and existing buildings. A practical approach has been illustrated through the simulation of the architecture block in the School of Planning and Architecture, Delhi campus. The findings underscore retrofitting as a cost-effective and sustainable method for reducing the environmental impact of buildings.

Keywords: Retrofitting, Composite climates, Energy efficiency, Thermal comfort



TEMPERATE CLIMATE: CONTEMPORARY ARCHITECTURE

Temperate Tensions: Building Facade Energy Performance in Bengaluru's Office Spaces

13

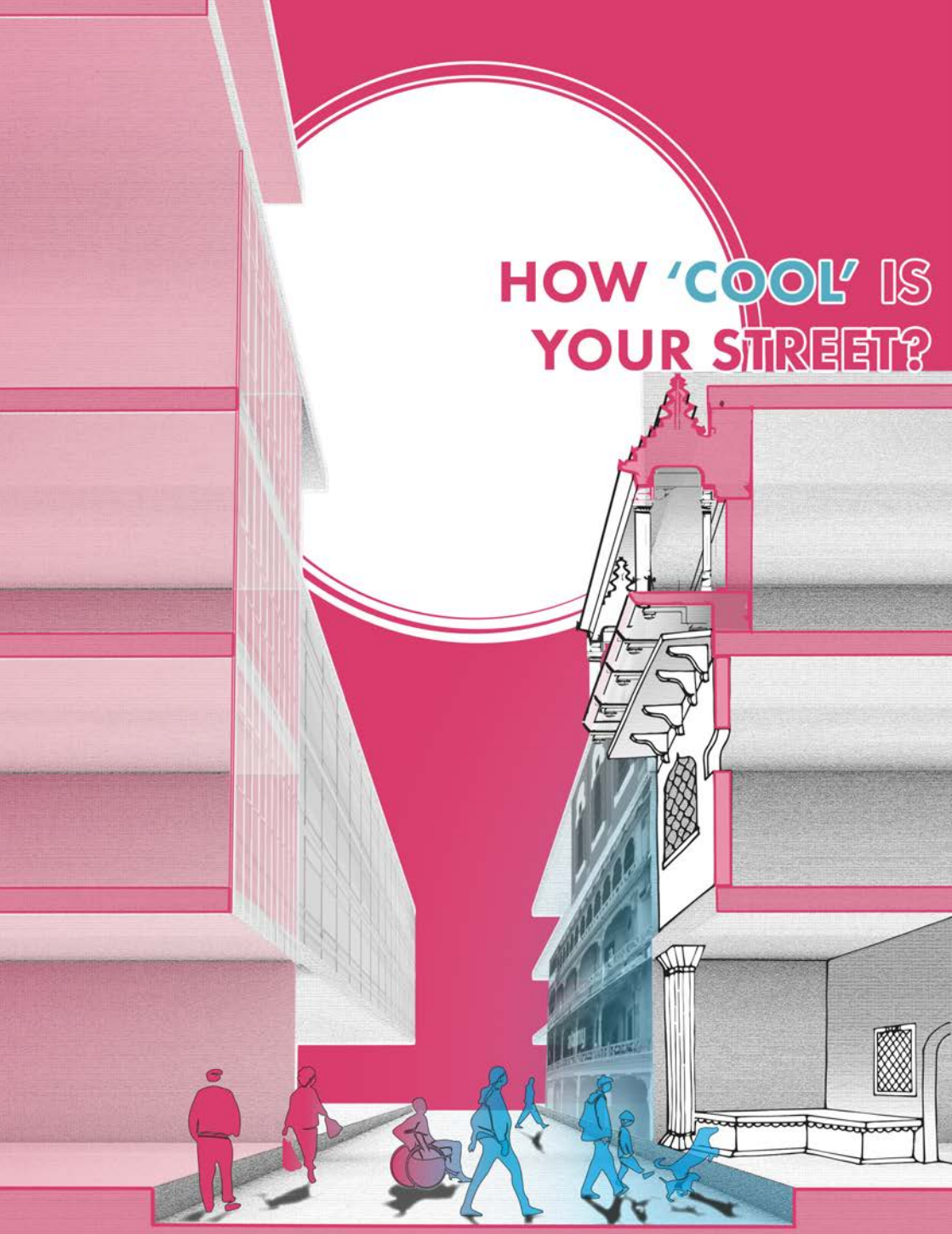
Authors: Manu Sagar, Katrothu Santhosh Kumar, Pavani Hamilpure, Harsh Kumar, Gopal Garg

Guide: Ar. Rajesh Luthra

Throughout history, people have moved to regions that offer comfort and favorable living conditions. Today, this pattern continues as more people migrate to temperate zones like Bengaluru, Pune, San Diego, and Barcelona, attracted by their mild and pleasant climates. However, this climatic comfort has led architects to neglect important design considerations in building facades, resulting in uncomfortable indoor conditions or excessive energy consumption. This research paper aims to conduct a comprehensive energy performance of building facades in Bengaluru, focused on glazed, insulated, and shading systems. We investigate optimal solutions to minimize indoor temperature fluctuations while maximizing natural light and energy efficiency in temperate climatic conditions. After a comprehensive analysis of facades of different types, a facade inventory of 10 representative buildings was analyzed and simulated. We examined kinetic, geometric, and textile-based facade systems through a comparative analysis of their thermal and energy performance. The analysis shows that dynamic and kinematic facades perform better than static solutions in temperate climates. Horizontal movable panels and textile-based facades demonstrate superior energy efficiency, with western facades requiring particular attention for shading optimization. The Energy Performance Index (EPI) analysis proves that adaptive facade solutions achieve better temperature regulation and reduce cooling loads. Architects and designers can use these insights to select optimal facade solutions for office buildings in similar climatic conditions, contributing to more sustainable and comfortable built environments.

Temperate climate; Bengaluru; Office buildings; Energy performance; Sun shading devices.

HOW 'COOL' IS YOUR STREET?



HOT AND DRY CLIMATE: CONTEMPORARY ARCHITECTURE

Microspatial Analysis of Traditional Elements in Contemporary Architecture in Hot Dry Climate

14

Authors: Shreya Sharma, Tanish Patil, Tejaswini Wande, Sushant Gajghate, Himanshu Tawer

Guide: Prof. Shhilpi Sinha

This paper explores the use of traditional design elements in contemporary architecture in hot dry climates through the study of streets in Udaipur and Jaipur. The study involves a microspatial analysis of the effect of traditional elements on thermal comfort at the street level. Focusing on the elements like jaali, jharokha, chajja, chabutra, and courtyards; the study also analyses the historical, cultural, social, and environmental relevance of these elements and their evolution over time through intensive literature review. It focuses on a street in Udaipur, where these elements are still being used, to check the effects of such an environment on the regulation of temperature and air circulation. The study will conduct comparative analyses with digital simulation by eliminating these elements from the street to check the environmental performance without them to check the impact in a contemporary context. Findings reveal how the integration of such elements is one of the easiest passive design strategies to enhance energy efficiency and create more sustainable architecture.

The paper aims at emphasizing passive design strategies which are often overlooked in contemporary architecture. It seeks to bridge the gap between traditional and contemporary architecture by demonstrating the potential of integrating traditional elements in contemporary aesthetics to enhance thermal comfort. This can lead to the development of more and better climate-responsive designs without compromising the loss of cultural identity as well as embracing contemporary aesthetics.

Keywords: Traditional elements; contemporary architecture; thermal comfort; passive design strategies; climate responsive design.

DESIGNING NATURAL COMFORT

COMPOSITE CLIMATE: PASSIVE STRATEGIES

Framework for Biophilia Integration in Hospitality Architecture

15

Authors: Nabh Gupta, Meghna Gupta, Anika Malhotra, Mohammad Nihal C Z, Azif Aziz

Guide: Prof. Shhilpi Sinha

Biophilic design, which celebrates human's affinity for nature, has emerged as an integral approach for enhancing comfort and well-being in built environments. In the context of hospitality architecture, where guest experience and comfort are of utmost importance, integrating biophilic principles can significantly improve comfort, reduce stress, and contribute to overall guest satisfaction. This research explores the potential of biophilia as a passive design strategy to enhance occupant comfort in hospitality architecture. By studying natural elements such as daylighting, vegetation, natural ventilation, and water features, the study analyzes the effect of biophilic design on the physiological as well as psychological comfort of the user. Apart from user experience, biophilia can act as a strategy to reduce energy consumption and environmental impact. Through the help of literature reviews, case studies, and field surveys, the study aims to examine the effect of various biophilic design strategies in increasing occupant comfort while reducing the dependence on mechanical methods to achieve comfort. The study identifies key biophilic elements that can be seamlessly integrated with hospitality design to efficiently enhance guest experience. The resulting design guide would serve as a resource for architects with recommendations on methods to incorporate biophilia in hospitality design for spaces that are aesthetically pleasing and functionally effective. Ultimately, this paper highlights the importance of biophilic design in creating hospitality environments that not only meet the expectations of comfort but also contribute to sustainability by leveraging passive strategies to reduce dependence on mechanical systems..

Keywords: Biophilia, Passive Design, Occupant comfort, Hospitality buildings

IS COLD JUST A CLIMATE, OR A SPECTRUM?

Varied Cold Climates of Northern Himalayan Region: Passive Strategies for Improved Energy Efficiency of the Building Envelope of Contemporary Hotels.

16

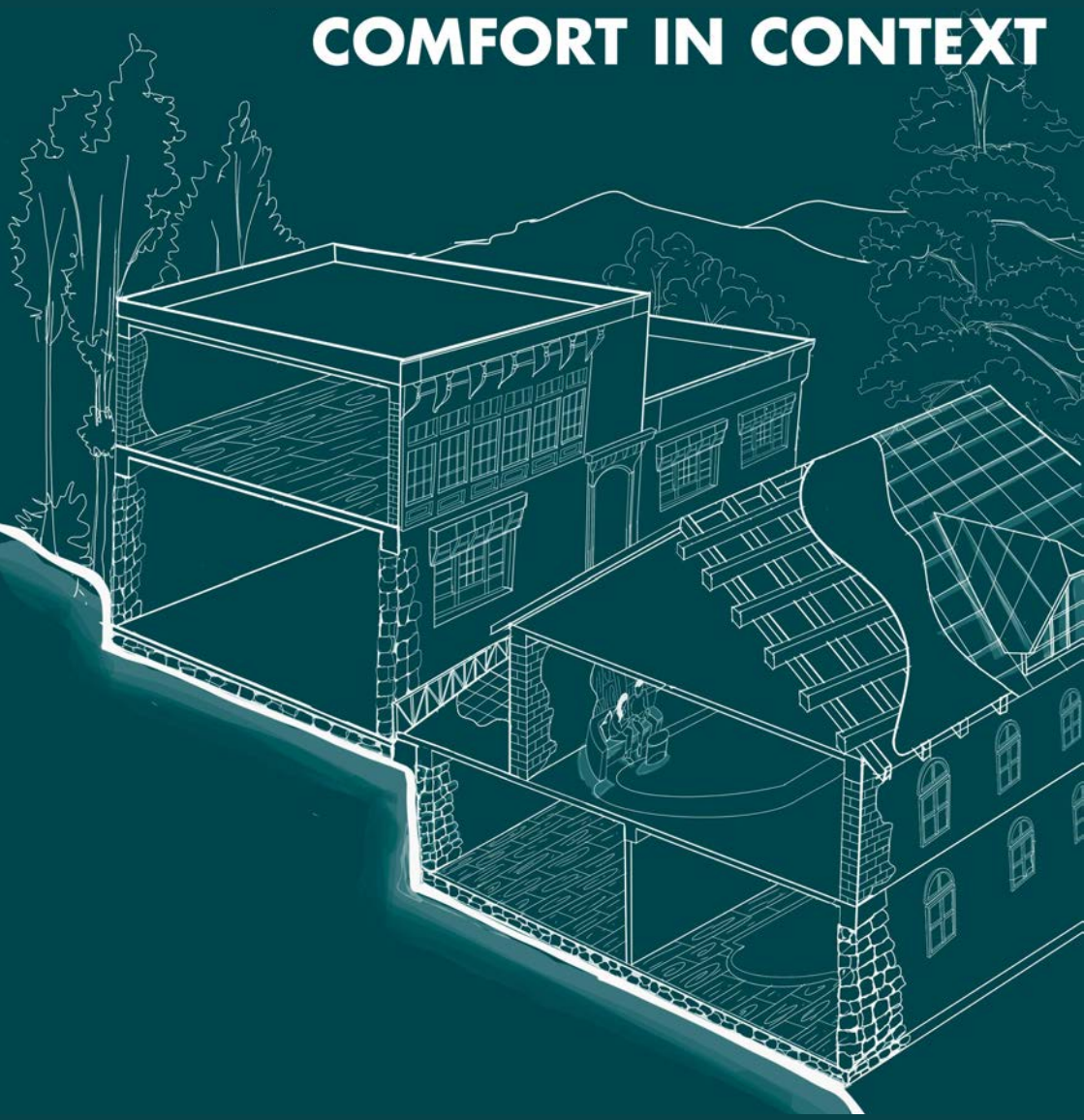
Authors: Khune Sanika Ajit, Hannah Elsa Bobby, Neha Basumatary, Anushka, Pasumarthi Bavyesh

Guide: Prof. (Dr) Jaya Kumar

This research paper reinterprets traditional building techniques through a comparative analysis of passive strategies for building envelopes in contemporary hotels across different cold climates in India in the Northern Himalayan Region (NHR). The NHR has witnessed growth in the tourism sector owing to its spiritual and ecological significance. This has led to the development of the hospitality sector which directly relates to the construction of new hotels. This paper investigates the mechanism of local building techniques; and further implements that in the form of material composition and passive strategies for building envelopes of contemporary hotels, which are located in the varied cold climates of the NHR. The regions in focus include the arid cold desert of Leh Ladakh, the moist continental areas of Bhutan, and the subtropical highland climates of Himachal Pradesh. By simulating varied environments and envelope permutations, this paper aims to identify climate-specific, energy-efficient passive design solutions for building envelopes for contemporary hotels.

Keywords: Cold climate, Passive Design Strategies, Contemporary hotels, Building envelope

COMFORT IN CONTEXT



COLD CLIMATE: INDOOR COMFORT

Comparative study of materials and strategies for indoor thermal comfort in cold Indian regions

17

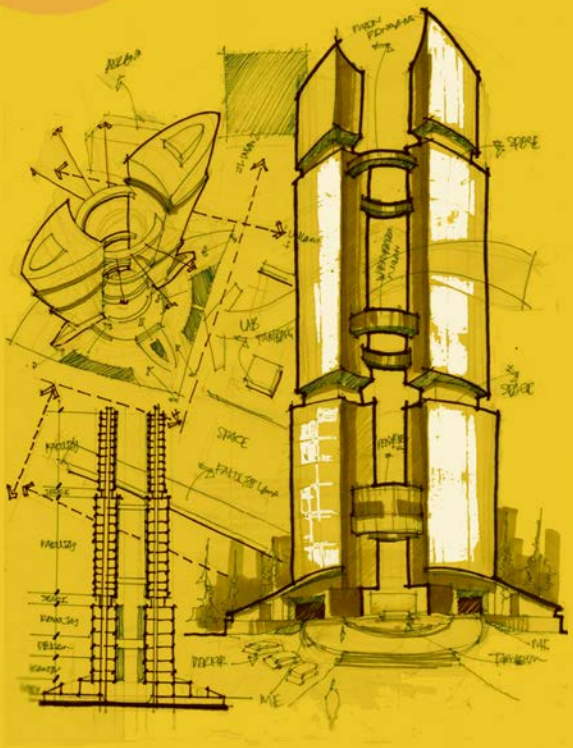
Authors: Parth Mehta, Souri Dasgupta, Purnima Sharma, Kachhadiya Krunal Ghanshyambhai

Guide: Prof. (Dr) Jaya Kumar

Designing a building at higher altitudes has always been difficult due to the harsh climatic conditions, topography, and resources, which make indoor thermal comfort hard to achieve. Various psychological, physiological, and environmental factors also depend on indoor thermal comfort. The study is solely focused on the Indian colder climates in the proposed cities of Shimla, and Leh in India. The purpose of the paper is to analyze the different techniques that come into consideration while designing for each area and how each factor contributes to achieving indoor thermal comfort in the respective spaces. The study is focused on generating standardized regional indoor thermal comfort models unique to each proposed location (Shimla and Leh). A review of several corresponding research papers and case studies was insightful in understanding the colder context of the regions. The study also involves a survey of the residents and architects of the particular locations to get a better understanding of the present building conditions. This helped create a database of the materials and strategies that are responsible for a thermally comfortable interior space. The database further helped in understanding how the materiality of the indoors changes with each climatic difference and how each of these factors is responsible for maintaining indoor thermal comfort. All of this information has resulted in the development of indoor thermal comfort models, which are used to determine the levels of comfort in the respective residences of the cities in the proposed locations of the study.

Keywords: Indoor thermal comfort, Adaptive thermal comfort, Cold climate, Residential, materials, Strategies

HOW NATURAL IS YOUR LIGHT?



COMPOSITE CLIMATE: DAYLIGHT

Effectiveness of atriums in Improving Daylighting in office buildings in Composite Climates

18

Authors: Aliza Masroor, Abdullah Chaus, Omkar Namdev Waghchoure, Siddharth Kumar, Dukare Yash Rajendra

Guide: Ar. Renu Premi

For a climatic-responsive office building, proper daylighting is essential, since artificial lighting and HVAC are the biggest energy consumers. Natural lighting is also proven to have psychological and physiological health benefits. Among the variety of daylighting strategies, our research focuses on atriums in composite climates. Atriums have been used in buildings for a long time, especially in commercial buildings. In addition to daylighting, atriums also improve the thermal performance of a building through ventilation via the stack effect. The amount of daylighting through an atrium is dependent on its configuration as well. While there is no universal classification of atriums, some research does specify certain types, like central, one-sided, etc. Daylighting is quantified and assessed through daylight factor and illuminance levels. This research will measure these two factors via daylight simulations.

Keywords: Daylighting, Atrium, Daylight Factor, Illuminance, Office building

DESIGNING FOR DAYLIGHT

Designing for Daylight: The Interplay of Wall-to-Window Ratio with Building Orientation in Mid-Rise Office Buildings of Bengaluru

19

Authors: Patel Kandarp Pankajbhai, Vahora Taha Hatimali, T Santhosh Kumar, Jayesh Chaudhary

Guide: Ar. Renu Premi

Daylight, while a historically abundant and sustainable illumination source, is often supplemented by artificial lighting due to resource constraints in contemporary building design. Visual comfort is significantly influenced by the level of illumination within a space. Careful consideration of design principles is essential to optimize daylight utilization in buildings. This research focuses on optimizing the window-to-wall ratio (WWR) in office buildings located in the temperate climate of Bengaluru, intending to achieve a balance between maximizing natural daylight and maintaining visual comfort. The study explores the relationship between different WWR configurations and the resulting levels of daylight, taking into account factors such as building fenestrations, orientation, and geometry. Through a series of simulations and analyses, the research provides insights into how varying WWRs can be optimized to enhance daylight quality while minimizing the need for artificial lighting. It also provides insights related to what are the optimum geometry and orientation for maximizing daylight in office buildings in Bengaluru. This study offers a comprehensive framework for architects to consider WWR as a key factor in creating well-lit office environments in temperate climate zones.

Keywords: Wall-to-Window Ratio (WWR), Daylight Integration, Building Orientation, Building Geometry, Office Buildings.

WARM AND HUMID CLIMATE: CONTEMPORARY ARCHITECTURE

Effectiveness of Stack Ventilation in Offices for Warm and Humid Climate

20

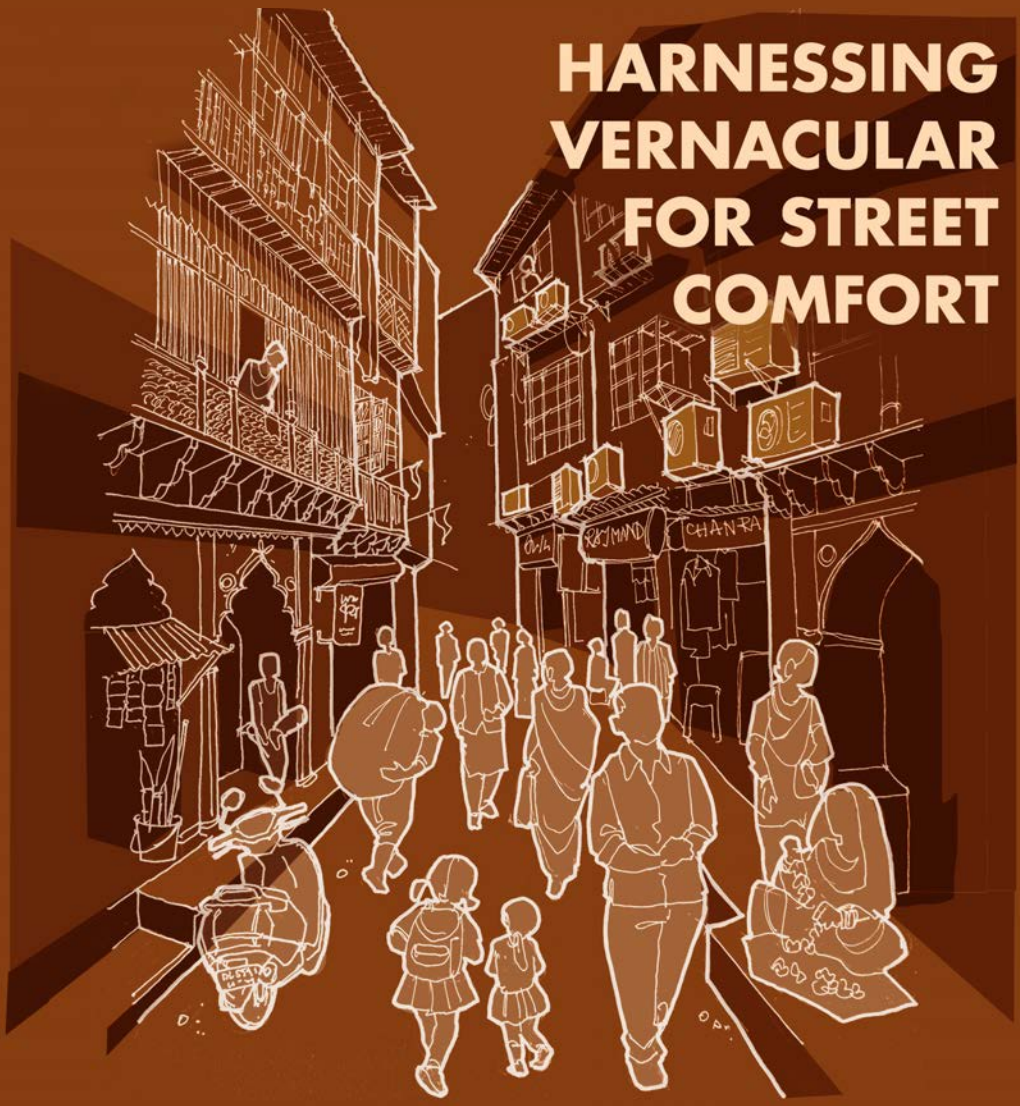
Authors: Radhika Bansal, Saisha Sikka, Surabhi Jain, Vanshika Mittal, Kushal Gupta

Guide: Ar. Vaishali Verma

Buildings present in warm and humid climate zones face the challenge of maintaining indoor thermal comfort due to a combination of high temperature and high humidity levels. Minimal day-to-night temperature fluctuations and substantial moisture content in the air create uncomfortable indoor environments that are prone to overheating. In the contemporary setting, HVAC is being widely used as a solution, however, these systems lead to high energy consumption, operational costs, and environmental impact. Consequently, there is a growing need to start relying on passive strategies to enhance thermal comfort and reduce the dependency on active systems. These passive strategies may be accelerated using active components becoming hybrid systems. Understanding the thermal comfort parameters of this climate type shows the importance of ventilation as a factor in improving indoor comfort. A comprehensive review of case studies reveals that passive ventilation is effective in promoting airflow and improving indoor comfort in such climates. Among the various ventilation strategies, stack ventilation appeared to be the most widely used strategy for office buildings. The study evaluates the effectiveness of stack ventilation by conducting simulations using Design Builder software. Findings indicate that stack ventilation can significantly improve indoor thermal comfort by reducing relative humidity in warm and humid settings. The results provide insights for architects and designers aiming to implement climate-responsive ventilation strategies, highlighting the role of passive cooling technologies in creating comfortable, energy-efficient indoor environments in warm and humid climate zones.

Keywords: Thermal Comfort, Stack Ventilation, Warm and Humid Climate, Office, Solar Chimney, Double skin facade

HARNESSING VERNACULAR FOR STREET COMFORT



COMPOSITE CLIMATE: TRADITIONAL ARCHITECTURE

Impact of Vernacular Adaptive Reuse on Street-level Heat: A comparative study of the streets in Shahjahanabad, Delhi

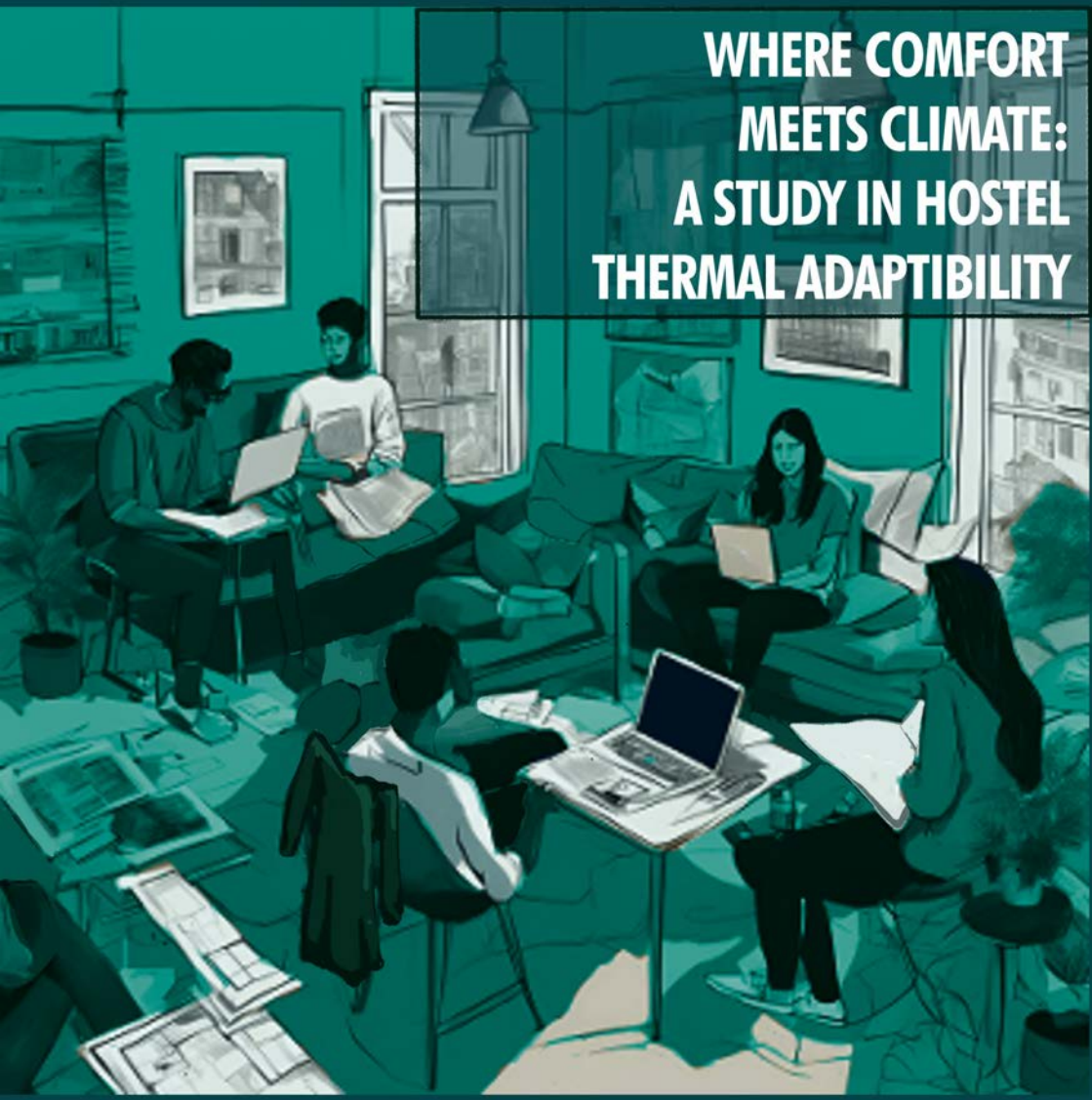
21

Authors: Shruti Chandra, Zhepitoli G Yepto, Nidhan Debbarma, Swuyekhrulu Nakro

Guide: Dr. Shuvojit Sarkar

The adaptive reuse of traditional architecture in historic urban centers like Shahjahanabad, Delhi, presents both opportunities and challenges. This research investigates the impact of such interventions on the urban heat island (UHI) effect and user comfort by doing a comparative analysis of two streets, Katra Neel and Katra Dharampura in Shahjahanabad. This paper assesses the influence of varying levels of architectural modification on thermal performance and user experience. The study employed a mixed-methods approach, combining quantitative analysis of thermal comfort indicators (e.g., wet-bulb globe temperature, air temperature, globe temperature, and humidity) with qualitative analysis of user perceptions and behavioral adaptations. The research seeks to evaluate the extent to which interventions in the original vernacular character of streets contribute to or mitigate the urban heat island (UHI) effect and sheds light on how vernacular architecture contributes to the development of sustainable urban forms that strike a balance between contemporary demands and environmental and cultural resilience.

Keywords: Vernacular architecture, Composite climate, Adaptive reuse, User experience, Urban Heat Island



WHERE COMFORT MEETS CLIMATE: A STUDY IN HOSTEL THERMAL ADAPTIBILITY

COMPOSITE CLIMATE: INDOOR COMFORT

Study of Thermal Adaptability in University Hostels in a Composite Climate of a Diverse Student Population accustomed to different climatic zones

22

Authors: Duvvi Shiv Raj Yadav, Badavath Kiran Kumar, Kunwar Aditya Singh, Salman Ahmed Khan, Aasish Sriram K

Guide: Dr. Shuvojit Sarkar

The migration of young adults throughout India from one state to another for the means of education is a known phenomenon. Students who hail from different states, having experienced different climatic conditions, a different culture regime, and being accustomed to it for years come over to a different state, for higher studies experiencing a different climatic zone and culture. Indoor comfort is taken into consideration, we put a lot into the mechanical support building design, passive strategies, and everything that has a physical measurement. Human thermal comfort is measured through metabolic rate, clothing, humidity, activity level, and so on. When thinking of student immigration to a different climatic zone, there are huge cultural and personal habits that come along the way for indoor thermal comfort. There was an interesting study that revealed the difference in comfort levels of a local tribe and a migrant tribe from a subtropical climate who settled in the rather colder climate of Nepal. It was found that the migrant tribe was sensitive to the cold at two degrees above that of the local tribe. In terms of educational university context, there is higher variation in the climatic zones that the students experience. Over periods of time, it is known that humans do get acclimatized to their environment and its climate. This study aims to know how well people from different climatic zones over time get acclimatized to composite climates. A university hostel in Delhi is the perfect example to do so. The students are surveyed quantitatively and also qualitatively. This brings in the cultural aspect of daily life that may incur ease in daily life in terms of physical health and thermal comfort. This includes food, clothing, and behavioral patterns, subjected to each weather type and also subjective to each person. The study tends to find a recurring pattern among commoners when subject to thermal discomfort over the seasons of composite climate. The people are taken into climatic zones and it is seen how they react to the temperature across the seasons over three different years of stay in the university.

Keywords:Thermal Comfort;Thermal adaptability; Acclimatization;Occupant surveys; Thermal perceptions.

WARM AND HUMID CLIMATE: TRADITIONAL ARCHITECTURE

Influence of Konkan Traditional Architecture on Contemporary Design Practices

23

Authors: Vanshika Garg, Lakshanya V Khanna, Sonali Wankhede, Patil Swaraj Devendra. Utkarsh Yadav

Guide: Ms. Mitali Madhusmita

This study aims to examine the growing interest in traditional ventilation techniques and architecture, driven by the global shift toward sustainable building design, especially in warm and humid climates. Focusing on the Konkan region, the research investigated how climate-responsive elements from traditional architecture have been incorporated into contemporary construction, emphasizing the revival of methods and materials that reduce reliance on energy-intensive systems. Using a mixed-methods approach—including stakeholder interviews, case studies, and field surveys—the study provided comprehensive insights into the applicability of traditional knowledge in current architectural practices. By exploring the relationships between time-honored building techniques and contemporary architectural methods, the study contributed to the discourse on sustainable architecture, presenting a framework for harmonizing traditional practices with contemporary design. The findings highlighted the effective ventilation strategies and spatial configurations of traditional Konkan dwellings and their influence on contemporary residential layouts, illustrating opportunities to integrate traditional principles to address contemporary environmental challenges while enhancing thermal comfort and energy efficiency in urban settings. This research ultimately aimed to inspire architects and designers to draw from the rich legacy of Konkan architecture, fostering a stronger connection between culture and innovative solutions that meet the demands of urban living.

Keywords: Traditional ventilation techniques; Traditional architecture; Sustainable design; Konkan region; Thermal comfort

WHICH IS MORE EFFECTIVE ?

DIRECT / INDIRECT EVAPORATIVE COOLING SYSTEM

COMPOSITE CLIMATE: PASSIVE STRATEGIES

Assessing Cooling Strategies in Composite Climates: A Qualitative Analysis of Direct and Indirect Systems

24

Authors: Archita Kankerwal, Sahil Mech, Prabalya Goyari, Shah Ketan, Kommu Chaitanya Joseph

Guide: Ms. Mitali Madhusmita

This research aims to qualitatively assess and analyze the effectiveness of direct and indirect cooling systems in composite climates during the summer season. With the growing emphasis on creating energy-efficient and comfortable indoor environments, the study focuses on specific buildings to explore the design intentions of architects and engineers concerning cooling strategies. Through qualitative interviews and surveys, the research captures occupants' experiences of thermal comfort during summer, offering critical insights into the real-world performance of these systems.

Additionally, a review of climate studies will provide an understanding of the particular summer conditions typical of composite climates, which is essential for evaluating various cooling strategies. The research identifies key performance indicators related to energy efficiency and indoor air quality, which are vital for measuring the effectiveness of both direct and indirect cooling approaches. By conducting a comparative analysis, the study aims to highlight the benefits and drawbacks of each cooling strategy, focusing on their impacts on occupant comfort and energy consumption.

Based on the findings, the study will develop practical recommendations to improve cooling strategies for buildings situated in composite climates. The goal is to equip architects, engineers, and policymakers with a thorough understanding of how to optimize cooling systems, thereby enhancing indoor environments while reducing energy use. Ultimately, this research aspires to contribute to the broader conversation on sustainable design practices, providing a framework for the advancement of effective cooling solutions across varying climatic conditions.

Keywords: Cooling Strategies, Thermal Comfort, Energy Efficiency, Composite Climates.

INDOOR THERMAL COMFORT

KERALA HOMES: TIMELESS VS TRENDY

WARM AND HUMID CLIMATE: INDOOR COMFORT

Architectural Shifts and Thermal Comfort: Kerala's Traditional vs. Contemporary Residences

25

Authors: Sunanda Datal, Jumana P, Samhita S K, Anooja N, Shreerang MK

Guide: Dr. Bangkim Singh

This study aims to compare and analyze the indoor thermal comfort levels of traditional and contemporary houses in Kerala, with a focus on the architectural responses of each style to the region's tropical climate. Traditional Kerala houses incorporate passive cooling techniques such as natural ventilation, cross-ventilation, and solar shading, which are integral to achieving thermal comfort in a sustainable manner. Conversely, contemporary Kerala homes often adopt Western architectural influences, incorporating HVAC systems for climate control. The study examines the thermal performance of both types, using parameters like indoor temperature, wind velocity, and relative humidity, to understand how each architectural style impacts occupant comfort. The objectives of this research include assessing the influence of design elements such as building orientation, layout, material selection, and occupant behavior factors that are critical to thermal comfort. User perceptions of comfort will be gauged through questionnaires and interviews conducted with residents, providing insight into satisfaction levels in both traditional and modern dwellings. By exploring the principles underlying thermal comfort in traditional Kerala architecture, the study aims to highlight sustainable, energy-efficient design practices that could inform future building designs in Kerala. The findings are expected to contribute to an understanding of how indigenous architectural techniques and modern advancements can be harmonized to create thermally comfortable, sustainable, and culturally resonant residential spaces in tropical regions. This study will also give an idea about the relationship between human and the space they live, and how design plays a huge role in their physical and mental health.

Keywords: Thermal comfort, Traditional architecture, Passive cooling, Contemporary architecture, Kerala

BEAT THE HEAT, SHAPE THE STREET

COMPOSITE CLIMATE: OUTDOOR COMFORT

Assessing The Influence of Outdoor Thermal Comfort on Public Streets in Composite Climate

26

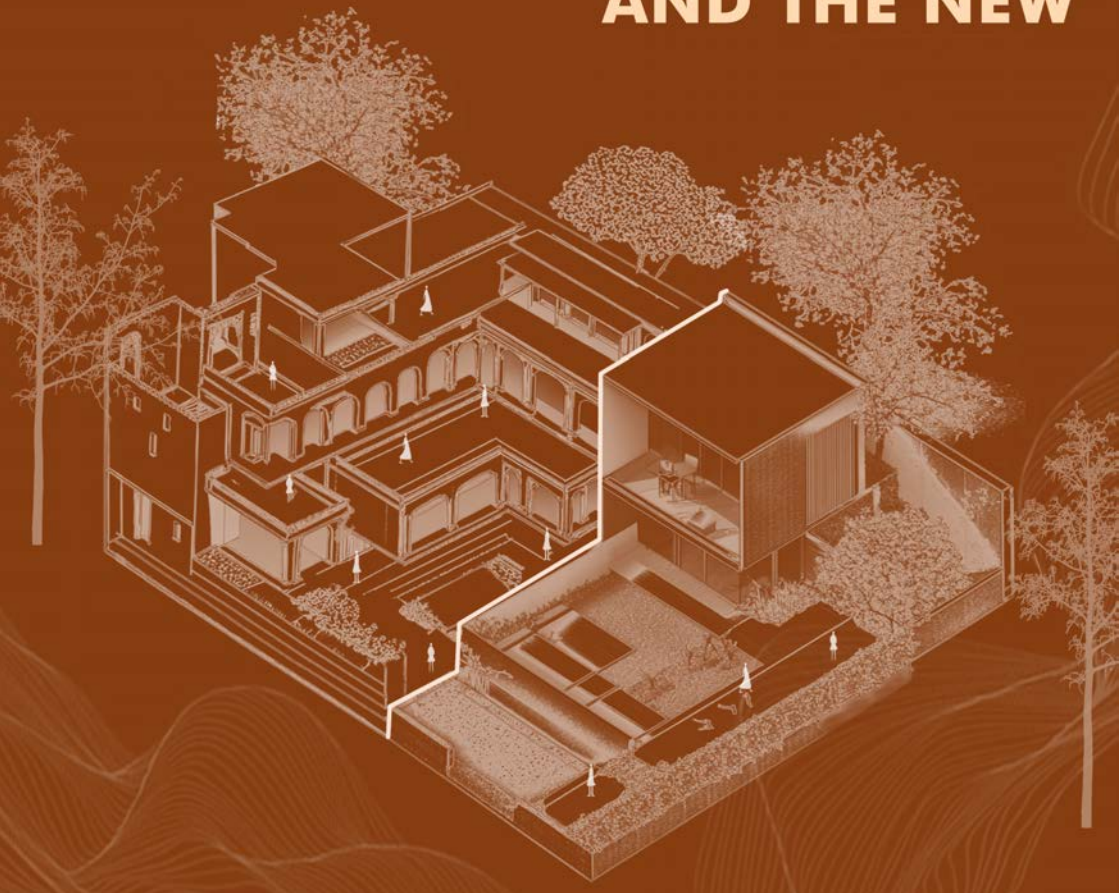
Authors: Shaikh Umarfarooq Abulkalam Azad, Krishnav Singh, Gargi Satish Nanir, Mustqim Alam, Gayatri Vaishya

Guides: Dr K Bangkim Singh, Mr Markus Krauss, Mr. Moritz Muetchele

In India, streets are vibrant spaces used for much more than transportation, hosting a variety of activities. Outdoor thermal comfort plays a significant role in determining the use of streets. Due to this, it becomes an important factor for livelihood on streets and its effect on streets. Assessment of outdoor thermal comfort on human behavior is not done in the Indian context. The main aim is to identify and analyze the type of streets in Delhi and the influence of outdoor thermal comfort on Indian streets. So, this research studies the adaptive behaviors of users in response to thermal comfort in the composite climate of India. Through structured survey observation and activity mapping on two streets of similar typologies and statistics. It is found that most people prefer shaded regions to commute, avoiding exposed regions, and vegetation has become the hotspot of the street. People's adaptive behavior was analyzed through a survey. This research suggests that pedestrians prefer natural vegetation over man-made shading. Therefore, it is important to promote streetscape design that creates natural shade and ventilation.

Keywords: Outdoor thermal comfort; Adaptive behavior; Natural shading; Street; Vegetation.

MARRIAGE OF THE OLD AND THE NEW



TEMPERATE CLIMATE: TRADITIONAL ARCHITECTURE

Vernacular Architecture in Temperate Climate: Influence of Traditional Wada's Climate-Responsive Elements in Modern Houses of Pune

27

Authors: Suvash Yadav, Bhoomi Bora, Shikha Kamad, A R Jishnu
Guide: Ms. Ninave Vasantrao Pooja

The vernacular architecture of a region is more than just a style of construction. It embodies a region's heritage, reflecting its traditions, culture, and environmental knowledge accumulated over centuries. In Pune's temperate climate, the traditional Wada houses—built during the Maratha era—are remarkable examples of climate-responsive design. These multi-storied structures, ranging from modest houses to huge mansions, were initially designed to accommodate joint families and have since become an essential part of Pune's architectural identity. Through features such as thick walls, inner courtyards, etc., Wadas were carefully crafted to respond to the local climate. These design elements work in tandem to provide comfortable living spaces year-round. However, with rapid urbanization, the region has seen a rise in the aspirations for modern living and hence a rapid progression in the construction of standardized modern houses that often emphasize functionality over climate responsiveness while not paying much attention to the context of the region, failing to meet the specific climatic demands of Pune. As the importance of sustainability and energy efficiency has grown, there has been a resurgence of interest in revisiting these vernacular methods to create living spaces that are well-suited to local conditions. Several attempts have been made at simulating the effect these vernacular elements create within the space in the context of modern housing. This paper explores the success of inculcating the olde with the nouveau through both a quantitative and qualitative analysis of some such attempts made. It aims to demonstrate the relevance of passive cooling techniques, spatial configurations, and sustainable building materials from Wada architecture that can be effectively incorporated into contemporary residential projects. By investigating the environmental, cultural, and climatic attributes of Wadas, the study emphasizes the practical benefits of blending these elements with modern design to enhance energy efficiency, sustainability, and overall occupant comfort. Through detailed case studies of recent housing projects that incorporate Wada-inspired features, this paper highlights the efficacy of these traditional components in addressing today's environmental challenges, while also fulfilling the aspirations of modern living. Further, through quantitative analyses of the occupant thermal comfort using software such as Rhino + Grasshopper to simulate the interior conditions in a digital 3D model replica, the paper aims to come to an educated conclusion about the efficacy of inculcating these vernacular elements in some such attempts. Ultimately, the study aims to demonstrate whether merging the climate-responsive strategies of Wada architecture with contemporary housing can pave the way for resilient, energy-efficient urban development in Pune's rapidly changing landscape or if it is just a myth.

Keywords: Wada, Vernacular, Temperate, Climate-responsive architecture, Passive strategies

CAN WE DESIGN COMFORT INTO THE HEART OF WINTER?

COLD CLIMATE: CONTEMPORARY ARCHITECTURE

Studying Climate-Responsive Architectural strategies in Contemporary Housing design for Cold Climates

28

Authors: Muhammad Shahal K, Aswin Das V, Fathima Zama PV, Afsana Hayarudeen, Narra Deekshita

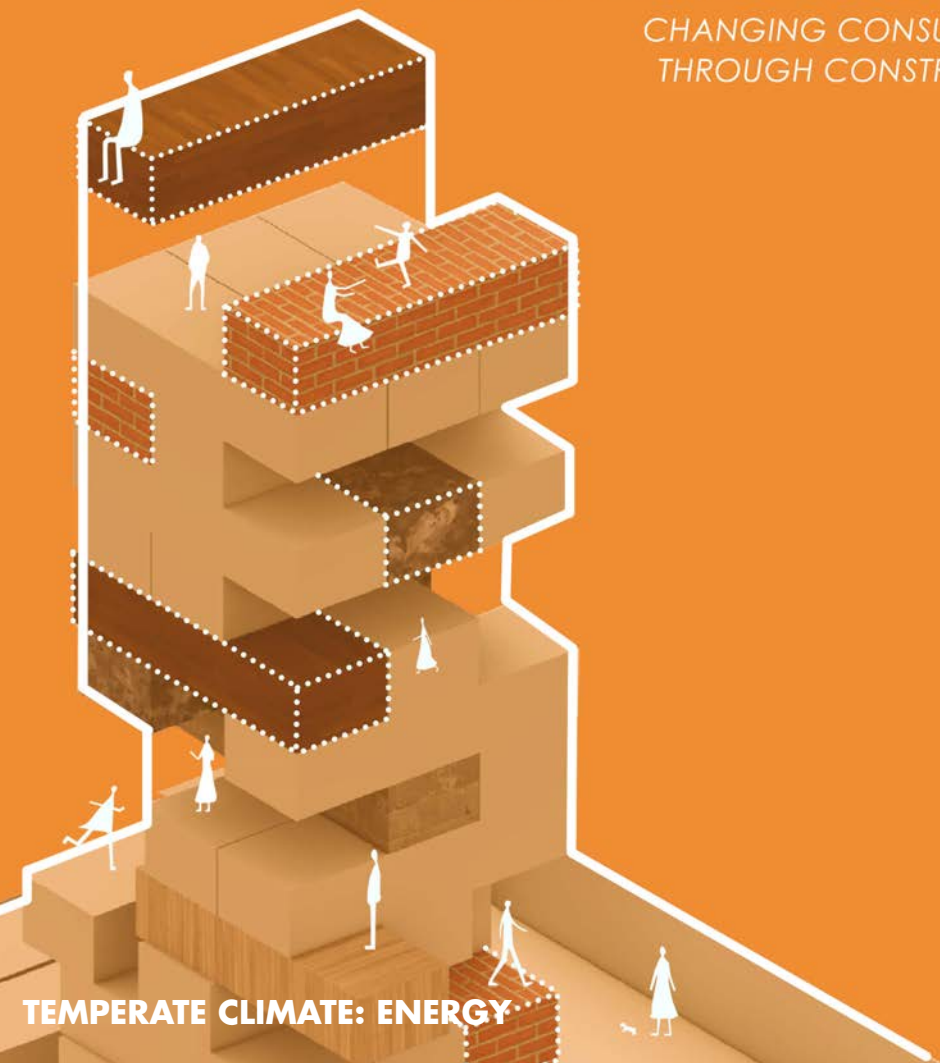
Guide: Ms. Ninave Vasantrao Pooja

This research delves into the potential of climate-responsive architectural strategies to enhance the sustainability and energy efficiency of contemporary housing design in cold climates. Focusing on Ladakh as a case study, the research explores the integration of passive design techniques, locally sourced materials, and modern technologies. Through a comprehensive literature review and analysis of existing case studies, the study identifies and evaluates strategies that optimize thermal comfort and reduce energy consumption. To further validate these findings, site visits to Ladakhi houses are conducted to observe firsthand the implementation of these strategies. A traditional Ladakhi building typology is redesigned incorporating the identified strategies, and both the original and redesigned models are subjected to energy simulations to assess their annual Energy Performance Index (EPI) and thermal comfort. By developing a building energy simulation model of a typical Ladakhi house, this research provides quantitative insights into the effectiveness of different climate-responsive strategies, contributing to the development of more sustainable and resilient housing solutions for cold regions. The findings of this research have the potential to improve the economic and environmental performance of housing in cold climates, leading to increased thermal comfort, reduced energy consumption, and lower carbon emissions.

Keywords: Climate-Responsive Architecture, Cold Climate Housing, Passive Design, Ladakh modern houses, Climate Adaptation

ENERGY THRIFT
THE GREEN SHIFT

CHANGING CONSUMPTION
THROUGH CONSTRUCTION



TEMPERATE CLIMATE: ENERGY

Assessing the Impact of Construction Materials on Energy Efficiency of Urban Housing in the Temperate Climate of India - Bengaluru

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The unprecedented urbanization and climate change impacts in developing cities have created significant environmental challenges, as exemplified by Bangalore, India, where rapid development has led to resource depletion, energy crises, and housing deficits. This study examines the pivotal role of construction materials in sustainable urban development, focusing on passive design strategies. While contemporary construction predominantly employs high-carbon-footprint materials like concrete and steel, traditional local materials adapted to temperate climates-such as clay blocks, Mangalore tiles, and rammed earth walls—offer potentially sustainable alternatives. Through comparative analysis and energy simulation modeling of three contemporary residential buildings in Bangalore, this research demonstrates that incorporating indigenous construction materials can reduce overall energy consumption by 17%-76%. The findings underscore the importance of material selection in sustainable architecture and provide quantitative evidence supporting the integration of traditional building materials into modern construction practices.

Keywords: Energy Performance, Construction materials, Building Envelope, Temperate Climate, Bangalore

HARNESSING WINDS FOR SUSTAINABLE COMFORT

HOT AND DRY CLIMATE: INDOOR COMFORT

Performance Evaluation and Application of Passive Downdraft Evaporative Cooling (PDEC) Systems in Hot and Dry Climates of India: A Case Study of Jodhpur

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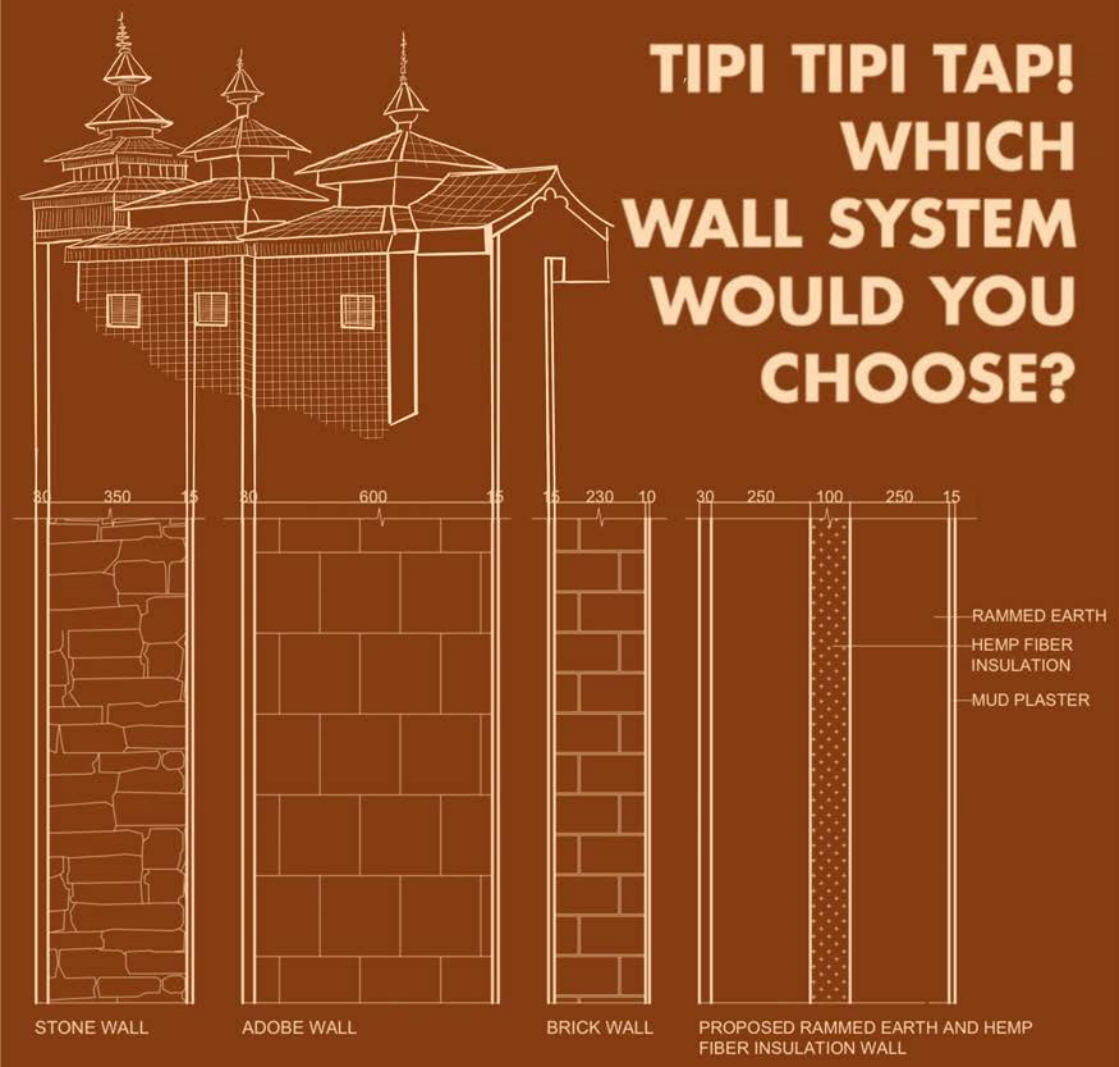
Based on a case study conducted in Jodhpur, India, this paper discusses the performance and application of PDEC systems that utilize natural evaporative cooling to lower indoor temperatures in hot and dry climates. Cooling down hot, arid regions like India requires nature-friendly cooling systems that aren't as expensive as traditional cooling systems. The paper will set up the stage for a more detailed exploration by first reviewing the mechanisms, types, advantages, and limitations of PDECs. The entire research has been divided into two major sections: performance assessment and application strategies. In this context, this paper will present the evaluation of the effectiveness of PDEC systems, through the case studies of Indian buildings like Torrent Research Centre in Ahmedabad and Pearl Academy in Jaipur. Apart from this, a range of interviews of successfully practicing architects Sanjay Prakash and Neeraj Manchanda provide invaluable insights into the practical successes and challenges related to PDEC systems. In the application section, we have detailed climate analysis for Jodhpur in order to establish guidelines for integrating PDEC systems specifically into institutional buildings. Recommendations on optimum shaft sizing, orientation, room dimensions, and material choices will be notified based on recommendations given due to the prevailing climate in Jodhpur. From the findings, it is ascertained that PDEC systems are feasible alternatives in regions like India's hot and dry regions as well, using good design along with suitable material choices. The potentiality and best practices for implementing PDEC systems as a sustainable, low-cost cooling solution in similar climates will conclude the study.

Keywords: Passive Downdraft Evaporative Cooling (PDEC), energy efficiency, indoor comfort, sustainable cooling, wind tower, Jodhpur, hot and dry climates.

TIPI TIPI TAP! WHICH WALL SYSTEM WOULD YOU CHOOSE?



COLD CLIMATE: TRADITIONAL ARCHITECTURE

Comparative Study of Wall System Materials for Cold Climates: An Analysis of Traditional, Contemporary, and Hemp-Earth Wall Systems in Uttarakhand

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The research investigates the integration of traditional rammed earth construction with a carbon-sequestering bio-material, hemp fiber, specifically in the Chamoli region of Uttarakhand. The study aims to evaluate how this combination can enhance thermal comfort, improve energy efficiency (by reducing heating and cooling loads), and lower the embodied energy and carbon footprint of buildings. The primary objectives are to compute and simulate the embodied energy and carbon footprint, the thermal properties, and the affordability and accessibility of Earth-Hemp walls and compare the results with that of traditional construction techniques like stone and adobe and contemporary techniques such as brick and plaster walls.

Keywords: Earth-based Construction, Vernacular architecture, Cold Climate, Hemp fibers and Shives, Thermal Insulation

OPTIMIZING DAYLIGHT, PRESERVING LEGACY, REDUCING ENERGY

COLD CLIMATE: DAYLIGHT

Quantifying Daylight Availability and Energy consumption in Shimla's Town Hall Building: A Simulation Approach

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Daylighting under cold conditions—such as the cooler climate of Shimla where reduced daylight hours compared to temperate regions, and harsh winters necessitate an intricate balance between natural light penetration and maintaining thermal comfort. This research focuses on optimizing daylighting strategies in Shimla's Colonial Railway Board Building, utilizing advanced parametric simulation tools such as Grasshopper and Ladybug to enhance both daylighting performance and thermal efficiency. This will seek to produce design interventions for maximizing natural light usage while minimizing heat loss, created around cold-climate institutional buildings. The study aims to investigate, by means of simulations, how window orientation, glazing types, and shading devices can be utilized in a way that maximizes the penetration of light into rooms without overheating them. The process will combine parametric simulations along with case studies to provide a more holistic understanding of the daylighting performance of the building in different circumstances. The results of these simulations are used to develop design recommendations, potentially related to people of cold climate regions. In addition to contributing practical solutions for daylighting optimization in heritage buildings, the research also points out gaps and limitations that propose future directions in using real-time occupancy data as an input to the model and refining energy models for better performance. The results of the study offer valuable insights for architects and designers, supporting sustainable architectural practices in cold-climate regions.

Keywords: Daylighting, Simulation tools, energy efficiency, Cold climate, Town hall