

Training Program on Innovative Construction Technologies & Thermal Comfort in Affordable Housing



RACHNA for Practitioners

Venue: Online

Time: 10:00 AM to 5:30 PM

'RACHNA for Officers' training program delivered in-depth knowledge on thermal comfort, its nuances, and its relationship with building physics. Moreover, it discussed design strategies, construction techniques, policy documents, building codes, international practices, and other aspects relevant to thermal comfort in affordable housing through a suite of case studies. Additionally, it familiarized participants with the evaluation process of thermal comfort, the statistics, and indicators involved as well as affordable cooling technologies and their applicability in various climates.

Day 1 *all names of the presenters/faculty are placeholders		
10h00 - 10h05	Welcome Address and Introduction to PMAY-U	MoHUA
10h05 - 10h10	Introduction to Climate Smart Buildings Programme (IGEN – CSB) and overview of workshop	GIZ
10h10 - 10h15	Session 1: Overview of the workshop, the introduction of the project, and introduction of the trainers.	Shivani S

Session proceedings













It briefly exposed the audience to the connection between buildings and comfort.















To limit the heat gain/loss from the building envelope, the code specifies:

Maximum value of thermal transmittance of roof (U_{roof}= 1.2 W/m².K) for all climate zones

Maximum value of Residential Envelope Transmittance Value (RETV) for building envelope (except roof)

It provided overarching guidance about the ways and means to achieve comfort in buildings.

Importance of thermal comfort : Ways to achieve it

























mechanism and its effect on the thermal comfort. Each heat transfer mode will be discussed in detail with its associated building elements. The session also will discuss climate context in detail and the impact of building elements on the comfort. The session will also provide selected case studies that demonstrates the correlation between envelop thermal performance, HVAC energy consumption and thermal comfort.

Heat Transfer in Buildings: Influencing Factors

Spatial Design

- · Geometry Massing
- · Orientation of bldg. mass
- · External Surface to Building Volume Ratio
- · Extent of fenestration and characteristics of it
- Internal Volume Stack Ventilation
- Location of Fenestration
 - Pressure Driven Ventilation

Materials and Methods

- · Thermal properties of the material
- · Optical properties of the material
- Surface Characteristics
- Construction Method
- Assembly formation



















































The session provided insights into the site level design decisions as well as building-level design decisions.

Other Passive Design Strategies: Spatial Configuration



Optimizing Radiation

Wind Direction and Speed

Rectangular Plan Less 'tight' buildings

Orientation: Positive, Negative and Neutral

It further provided a comparative understanding of appropriate orientation & use of building mass to reduce radiative heat gains in warm climates













The session also provided selected case studies that have adopted best practice approaches at the site and at the building level to implement passive design strategies.





Blessing In and out a Out air temp Or opening Cosing time 6:50 Cosing time	 s House: Auroville ir temperature - hourly average 26 - 30 April 2014 Gosed Balancing Ta and Insulation NV operation controlled V Warm Hum mg and nighttime comfort strategy show good results in perperature rise in the building 	Thermal Mass on on with Ventilation id Climate preventing
15h45 - 16h00	Questions and Answers	
16h00 - 16h15 16h15 - 17h15	Health Break Session 6 (Technical): Building Materials and Methods of Construction for Affordable Housing This session will start with the overview of affordable walling, roofing and fenestration materials and technologies. It will further detail the appropriateness of materials and methods of the construction for housing and its applicability in various housing typologies. The session further enhances the understanding of the reader to adopt materials and methods according to the climate context. The focus would also be given to alternative construction technologies, low embodied carbon materials, availability of material locally and economics of it. The session will also provide selected case studies that have adopted best practice approaches at the	Dr. Rajan Rawal







The session further enhanced the understanding of the audience to adopt materials and methods according to the climate context.





































Day 2

*all names of the presenters/faculty are placeholders

10h00 - 10h15	Session 8: Day 1 Recap	Smita Chandiwala
10h15 - 11h15	Session 9 (Technical): Building Codes, Affordable Housing and Thermal Comfort Understanding of the provision of various thermal comfortrelated clauses in the National Building Code, Eco Niwas Samhita, various guidelines provided by the government. It also will provide insights into the implementation of policy. The reader will be able to comprehend the process of implementing the code at the local level. It will discuss the programming of code implementation, the economics of it as well as the benefits of the codes. Further, this section will outline the codes implemented internationally through the voluntary market based systems, government byelaw, provisions in ISO, and ASHRAE standards.	Smita Chandiwala

























Affordable Housing- A Suite of Case Studies This session will bring salient features of the projects that have demonstrated approaches to achieve thermal comfort in affordable housing. This session will include the projects that were conceived using integrated design practices. The case studies in this session will highlight more than one aspect of the project that meets the objective of affordability and comfort. The on-site performance of the housing also will be included to help the participants understand the methods of field performances.	
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Thermal and Comfort Performance of NE India vernacular house



Case studies : Vernacular: Imphal

Case studies : Vernacular: Tejpur

ource: Singh, M. K., Mahapatra, S., &: <u>Arroya</u>, S. K. (2010). Thermal performance study and evaluation of comfort temperatures in vernacular buildings of northeast India. Building and Environment, 45(2), 320–29. https://doi.org/10.1016/j.buildinv.2009.06.009 Application of Thermal Comfort in Affordable Housing-A Suite of Case Studies 1 Prof. Rajan Rawal

Thermal and Comfort Performance of Pol vernacular house





City map of Ahmedabad showing the location of PH (red) and CH (blue)

Estimated operation modes for a typical building in Ahmedabad

Source: Singh, M. K., Mahapatra, S., & amp; Atrong, S. K. (2010). Thermal performance study and evaluation of comfort temperatures in vernacular buildings of northeast india. Building and Environment, 45(2), 320oi.org/10.1016/j.buildenv, 2009.06.000 329. https:

Application of Thermal Comfort in Affordable Housing-A Suite of Case Studies | Prof. Rajan Rawal











Rajkot Smart Ghar 3





- Indo Swiss Building Energy Efficiency Project Bureau of Energy Efficiency
- 1176 Units of 33.6 m²/each
- U value of 0.8 W/m² achieved using AAC Blocks, South sidewall with 50mm air cavity leading to 0.3 W/m²
- Roof with PU foam 0.56 W/ m²
- Window shutter glazing area reduced to 30%
- Improved ventilation through common service shaft

nurce: Ministry of Power, & amp: Bureau of Energy Efficiency. (n.d.). Indo-Swiss, Building Energy Efficiency Project, Case Study on "Green" Affordable Housing: Smart GHAR III, Rajkot. Retrieved from 125://www.beepindia.org/wp-content/uploads/2013/12/Smart-GHAR_final_0_14.pdf

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12h30 – 12h45 12h45 – 13h00	Questions and Answers Discussions on quiz-questionnaires	
13h00 - 14h00	Lunch Break	
14h00 – 15h00	Session 11 (Technical): Thermal Comfort Study Methods This session will outline the field-based methods, theorybased method and laboratory-based methods adopted in the past and in the contemporary world to understand the thermal comfort. It will demonstrate the applicability of various methods. The session also will introduce some handheld tools and research protocols that can help derive thermal comfort studies. The session further will help to develop an understanding of the analytical approach for data collection and data analysis using appropriate methods of statistics.	Bhavya Pathak















Source: freepik. (n.d.). Field studies. freepik. Retrieved from https://www.freepik.com/search?format=searchd:amp;guery=field%20studies. freepik. (n.d.). Laboratory Studies. freepik. Retrieved from https://www.freepik.com/search?format=searchd:amp;guery=Laboratory%20Studies. freepik. (n.d.). Desert. freepik. Retrieved from https://www.freepik.com/search?format=searchd:amp;guery=Laboratory%20Studies. freepik. (n.d.).



























15h15 - 16h15		
	Session 12 (Technical): Low Energy Cooling Technologies and Comfort This session will familiarize the participants with low energy cooling systems and technologies in gaining comfort. It will provide climate specific guidance as well as insights into their benefits and challenges. The participants will be able to comprehend the design and operation aspects of the low energy cooling system that can work in sync with building envelop. The session also will discuss spatial	Bhayya Pathak
	configuration of the building envelop to accommodate some of the low energy cooling systems.	

Evaporative Cooling (and its variations): Low Energy Cooling Systems



Low Energy Cooling Technologies and Comfort 1 Prof. Raian Ra











Night Cooling by Mechanical Ventilation: Low Energy Cooling Systems













17h00 – 17h15	Session 13: Discussions on quiz-questionnaires	
17h15 - 17h30		
	Session 14: Feedback from Participants and Concluding Remarks	Palak Patel



