fAIR CONDITIONING

With the support of

OAK FOUNDATION

presents

'Sustainable Cooling and Building Energy Modelling' Workshop for Architects

(part of 'Thoughtful Cooling' workshop series)

2nd to 4th December, 2016
Pune, India

Software Partner: Design Builder

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1 Executive Summary

The Indo-Swiss *Fairconditioning* programme held the ninth workshop in the '***Thoughtful Cooling***' series of the Building Energy Modelling and Advisory Project (BEMAP). The workshop on ***'Sustainable Cooling and Building Energy Modelling'*** was organized from December 2nd to 4th, 2016 in Pune, India for architects.

The workshop aims to equip architects with knowledge in building physics, climate analysis, passive design (for cooling and daylighting) and sustainable active cooling systems. The workshop also provides basic training on energy modelling software to help participants understand impact of early-design decisions on building cooling loads and energy efficiency. All participants were provided with a free on-line course covering the above-mentioned topics. Technical theory sessions were conducted on the first day of the workshop followed by two days of hands-on training on Design Builder (DB) software. Each participant received 60 days free trial license for the software post the workshop. They are also offered a 15% discount on purchase of Design Builder modules used for modelling building geometry, daylighting, envelope, HVAC systems and natural ventilation.

A total of 11 participants were a part of the workshop. The participants were architects, professors, students and engineers representing 8 different firms and universities from Pune. The BEMAP team received largely positive feedback from the participants about the workshop.

2 Introduction

Fairconditioning is a Building-Cooling Demand-Side-Management (DSM) related education, capacity building, and pilot implementation programme. It is designed as an evidence-based policy support programme that seeks to create a critical mass of evidence for programmes that could be scaled-up across India and other tropical climates to achieve behaviour change amongst occupants of conditioned indoor spaces, reduce building heat loads (cooling demands), reduce energy and GHG intensity of artificial cooling systems.

The program is organized into four sub-projects that focus on education (Academic Curricula Integration Project, ACIP), capacity building (Building Energy Modelling Project, BEMAP), corporate technology adoption (Technology Adoption Project, TAP), and corporate behaviour change (Corporate Thermal Comfort Policies Campaign Project, UpBy2) with the legacy of establishing a sustainable cooling eco-system and driving evidence-based policy-change.

This policy change will be created through distilling field experiences, over the program period, to establish a critical mass of evidence for additional programs that could be scaled-up across other tropical climates to achieve behaviour change amongst occupants of conditioned indoor spaces, reduce building heat loads (cooling demands), and reduce energy and GHG intensity of artificial cooling systems. Fairconditioning aims to deeply integrate sustainability and efficiency into architectural and HVAC-engineering higher education curricula, into practicing architecture & HVAC consulting firms, and into commercial enterprises.

The Fairconditioning Programme engages with architects and HVAC engineers through the Building Energy Modelling Advisory Project (BEMAP). The programme provide professionals with training, tools and processes that can help them integrate sustainable cooling in their projects. The workshop detailed below is part of the capacity-building activities for architects across the country. Architects from small, medium and large scale firms are invited to be a part of the workshop. The workshops are currently organised in 5 cities in India - Mumbai, Pune, Delhi, Bengaluru and Chennai.

3 About the Workshop

The Sustainable Cooling and Building Energy Modeling workshop training consisted of the following modules:

- Impact of energy-intensive active cooling systems and refrigerants on climate change
- Building physics and impact on indoor and outdoor environment
- Processes and techniques for climate analysis
- Passive design interventions (cooling) to help reduce building cooling loads
- Technical training for sustainable active cooling technologies
- Training on tools to aid in energy analysis of early-design decisions (building energy modeling software)

Architects from small, medium and large scale architecture firms were invited to participate in the workshop.

4 Organizers

The Fairconditioning Programme is conceived by cBalance, a social enterprise from Pune, India and Noe21, a NGO based in Geneva, Switzerland. cBalance is a knowledge-centric solutions hub that specializes in tool building and strategy development for integration of carbon ERP into institutional processes, while enabling measurable, reportable, and verifiable GHG emissions, energy, water and waste mitigation roadmaps. Noe21 is an organisation that evaluates and promotes solutions to climate change. It focuses on solutions that focus on behaviour change, innovative technology, public policy and research. The training material for the BEMAP workshop has been developed by cBalance and Noe21 in collaboration with well-known practitioners in the field of sustainable architecture and sustainable cooling. It is certified by the Indian Society of Heating Refrigeration and Air-conditioning (ISHRAE) and the Alliance for an Energy Efficient Economy (AEEE).

5 Date and timing of the workshop

The workshop was scheduled from 2nd to 4th December, 2016 from 10 am to 6 pm daily.

6 Venue of the workshop

The venue for the workshop was:

Dr. Bhanuben Nanavati College of Architecture for Women (BNCA)
Cummins Girls Engineering College Campus, Karve Nagar, Pune, Maharashtra 411052

Care was taken to ensure that the workshop was planned to have a low-carbon footprint. Use of natural lighting and ventilation, use of non-disposable cutlery, reuse of stationary where applicable, travel using public transport etc. are measures that are followed by the team.

7 Fees

Fairconditioning is a non-profit programme funded by the State of Geneva, Switzerland, OAK Foundation, and Shakti Sustainable Energy Foundation. The workshop is free-of-charge for all participants contingent on completing an on-line course specially developed by Fairconditioning and bringing their own laptop for the training. A registration fee of Rs.2500/- was applied to all participants. The fee was returned to the participants post the workshop.

8 Topics Covered

Different subjects related to building physics, climate and solar geometry analysis, passive design for cooling and sustainable active cooling technologies were covered.

8.1 Pre Workshop

A brief on-line course is provided to participants on registration. The online course (MOOC) has been developed especially for the Fairconditioning Programme workshops. This is an open-book quiz format with presentations provided to participants with quiz questions.

The 10 hour course has a total of 7 sections on:

1. Introduction to Buildings and Climate Change
2. Heat transfer in Buildings
3. Psychrometrics
4. Climate Analysis
5. Thermal Comfort
6. Passive Building Design
7. Fundamentals of Solar Geometry

8.2 During Workshop

A workshop outline for all three days is provided below.

The first day was reserved for training in theory. Several exercises are conducted on the theory subjects-

i. Plotting Climate Data on Psychrometric Chart
ii. Climate identification based on Weather Psychrometry Chart
iii. Plotting Sun Path for Different Cities at Different Times
iv. Identifying Shading Requirements using Average Dry Bulb Temperature, Average Global Horizontal Radiation
v. Creating Shadow Masks

The second and third day involved hand-on energy modeling training on Design Builder software. The participants were also encouraged to build energy model of their own projects during the software practice session.

8.3 Post Workshop

Participants were provided with extended license for Design Builder and several follow ups were made regarding their interest to purchase the license.

Table 1- Details of the workshop schedule

	DAY 1:THEORY MODULES 9.30 AM TO 6.00 PM	**DAY 2:**BEM MODULES 9.30 AM TO 6.00 PM	**DAY 3:** BEM MODULES 9.30 AM TO 6.00 PM
1	Warming Up	Introduction to Energy Simulation	Recap
2	Introduction to the Fairconditioning Program	Introduction to Design Builder	Brief introduction to detailed HVAC interface and templates
3	Buildings and Heat: Understanding Heat Flows and Forms	Model Inputs and Simulations (geometry, climate)	
RECESS FOR THE MIND			
5	Psychrometrics and Climate Analysis	Model Inputs and Simulations (schedules, constructions, simple/ideal)	Benchmarking (EUI)/ Making results table
6	Solar Geometry: Studying the Sun for Better Architecture		Daylighting
FUEL UP (LUNCH, WALK, BREATHE)			
7	Animations/ Interactive Session	Design Iterations - shading, construction (wall, glazing, roof)	Project Report
8	Passive Design Techniques: Concepts and Case-Studies		Designbuilder Outputs (stack ventilation etc.)
RECESS FOR THE MIND			
10	Sustainable Cooling Technologies: Principles and Applications	Results and Inferences	Overall Takeaways
11	Evaluation of Learnings/ Feedback	Quiz - Evaluation of Learnings	Relevance to Architecture Practice
12	Flow time	Update for next day events/ Flow time	

9 Participants

The participants in this workshop were from diverse field and of different age group. A total of 17 architects, engineers and students from Mumbai participated in the workshop.

Table 2- Details of the Participants attending the Workshop

Sr.No	Name of Participant	Firms/Colleges that the Participants Represent	Profession	Annual breakup of their project types										
				Stand Alone Houses	Apartments	Banks	Hotels	Office Space	Retail	Hospital	Industrial	Institutional	Urban Planning	Other
1	Ravindra Kanhere	Kenarch Architects	Architect	2 – 3	2 – 3						1	1 – 2		
2	Pranav Mandowara	KIT College of Engineering	Student											
3	Nachiket Apte	TATA Projects Ltd	Manager - MEP		1 – 2			2 – 3	1 – 2		2 – 3			Metro, Airport etc
4	Tejaswini Datar	Datar Architects	Architect	15 – 20				2 – 3	2 – 3			1		
5	Meghana Kulkarni	M+P Architects Collaborative	Architect	4								2		Retrofitting/Interiors 3
6	Harendra Singh	TATA Projects Ltd	EPC Contractor		10		4	4	3	1		3		
7	Pooja Chaphalkar	M+P Architects Collaborative	Architect		10									

Sr.No	Name of Participant	Firms/Colleges that the Participants Represent	Profession	Annual breakup of their project types										
				Stand Alone Houses	Apartments	Banks	Hotels	Office Space	Retail	Hospital	Industrial	Institutional	Urban Planning	Other
8	Manish Sahu	Marathon Realty Pvt Ltd	Architect											
9	Sonali Rajwade	Third Wave Design	Architect											
10	Anusha Mulpuri		Architect	2	1							1		
11	Prajwala Gaware	Eco Solutions	Architect	2	1									

10 Trainers

Two trainers conducted training sessions in the 3-day workshop.

Table 3- Details of the Trainers

Trainer	Organization and Designation	Professional Synopsys	Sessions Conducted
Vivek Gilani	Managing Director At: cBalance Solutions Hub	Vivek is an Ashoka Fellow and an Environmental Engineer (MS Environmental Engineering, University of Massachusetts) with expertise in water, wastewater treatment and GHG inventorying, and energy auditing/analytics. He is a Bureau of Energy Efficiency (India) Certified Energy Auditor and a Certified Building Energy Modeller. He is co-founder of India's first Carbon-Footprint-Calculation and Reduction movement – the NO2CO2 project, developer of India-specific carbon ERP tools and GHG emission factor databases under the climate economics platform, co-founder and member of the steering committee for the first ecolabelling program in India – 'The Green Signal'. He is also the co-founder of cBalance Solutions Hub, which specializes in tool building and strategy development for integration of carbon ERP into institutional processes.	Theory sessions on first day: • Introduction • Psychrometrics and Climate analysis • Solar Geometry • Sustainable Cooling Technologies
Apeksha Gupta	Architect At:	Apeksha completed her BArch from Kamla Raheja Vidyanidhi Institute of Architecture, Mumbai. She pursued her MSc in Sustainable Building Technology from University of Nottingham, UK and her PhD from Cardiff University, UK. Apeksha has over 8 years of work experience in the sustainable building technology industry. She practices as a green building consultant with Ecofirst Services Ltd., Mumbai and was senior project manager at Educated Environments, Mumbai. She was an associate at Building Research Establishment (BRE), UK where she developed an IFC-compliant renewable energy modelling tool for architects. Apeksha's interests include Passivhaus design, renewable energy systems, low	Sessions conducted on 2nd and 3rd day are: • Introduction to Energy Simulation and Design Builder • Model inputs and simulation (location, geometry and schedule) • Model inputs and simulation (material, construction, HVAC) • Design Iterations • Benchmarking (EUI)/ making results table • Daylighting • Project Report • Natural Ventilation

		energy buildings and environmental assessment standards such as BREEAM. She has teaching experience in subjects related to building material and construction, academic writing, literature review and research methodology.	

11 Feedback

Oral as well as written feedback from participants was documented. The feedback will be used to upgrade the programme as well as the training content.

Workshop Impact:
Almost all the participants were comfortable using solar analysis and climate analysis for their projects and can confidently identify appropriate passive design strategies for their project. Around 73% of the participants have better understanding of the physical properties of commonly used building materials. 27% of the participants were still not comfortable enough in using building energy modelling for their projects.

77% of the participants opted to use simulation tools as it would enhance evaluation of complex design and provide confidence in building performance. 27% of them agreed to use tool as it would help them achieve green building rating certificate for their projects and only 9% agreed to use based on client's requirement.

27% of the participants were not ready to use the tool as they felt they still lack the training and also if client will not pay for simulation study. 36% are not aware of simulation tools and 18% did not find the software user friendly and does not speed up the design process. Around 70% of the participants were able to clearly understand the objective of the workshop.

Trainer's Competency:
86% of the participants felt that all the trainers seemed knowledgeable about their topic.

Content Upgrade/Skill Building:
We received a mix response from participants on workshop improvement. Some asked to focus on simulation strategies for passive cooling technologies rather than conventional cooling systems, some requested to give more time on explaining graphs and simulation result outputs. Lot of architects were not able to cope with the trainer as they were using design builder for the first time and hence have requested to provide step by step hand-outs for every iteration.

Overall experience and engagement:
Around 73% of the participants rated their workshop experience good. 45% and 36% of the participants have offered support for outreach and technical knowledge. They have also shared contact details of their colleagues and friends for our next workshop. They felt that the workshop was important for architects as they need to re-visit and refresh their skills and learnings time to time should be updated with tools. Most of them mentioned that the content was well organized.

12 Next Steps

The following activities are identified to continue engagement with the participants and to improve the impact of the workshops:

- **Roundtable:** A half-day brainstorming session will be conducted 6 months after the workshop between architects, HVAC engineers and technology providers to identify opportunities and gaps in moving towards sustainably cooled buildings in India. The core participants for the roundtable session will be participants from the previously conducted workshops. The expected outcome of the round-table is the creation of a specific set of action-points that can be applied by participants in their respective work processes.
- All participants were informed of this event. Majority of the participants expressed keen interest in being a part of the follow-up session.
- **Fairconditioning Network:** All participants were informed of the 'Fairconditioning Network', which is an on-line eco-system for all professionals connected to the building design, construction and operation industry. All the participants will be added to a google-group to keep them posted of latest resources until the network is set up.
- **Training Content Upgrade:** The 2 main objectives of the workshop are - to help architects learn processes/techniques for climate analysis and responsive design, to increase exposure and understanding of sustainable active cooling systems. The participants were fairly confident of the latter but wanted better training for processes/techniques that could help them. Hence, the following upgrades are being considered to the training program:
  - Use of less expensive (free) software for training
  - Appointing a trainer with experience in energy simulation projects
  - Including more manual exercises
  - Preparing and conducting a modelling assignment during the training to help participants understand the different analysis options that can aid in building design (massing, openings, orientations, shading devices, materials, equipment efficiencies, passive cooling systems etc)
  - Provide cost-health-productivity benefits of these interventions
  - Provide concise resources for building physics and simulation/modeling methodologies
  - Appoint trainer with experience in practical implementation of passive design techniques for appropriate modules

13 Photographs

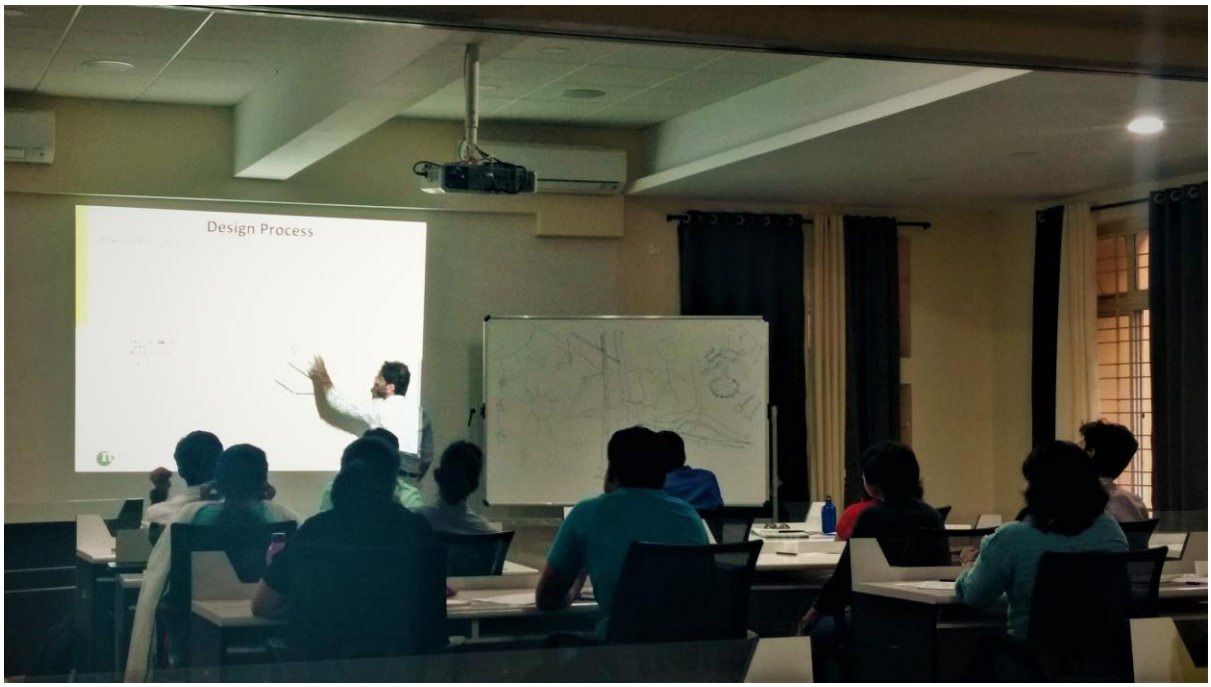

Figure 1: Vivek Gilani explaining psychrometry chart_Day 1

Figure 2: Apeksha Gupta training participants on Design Builder_Day 2

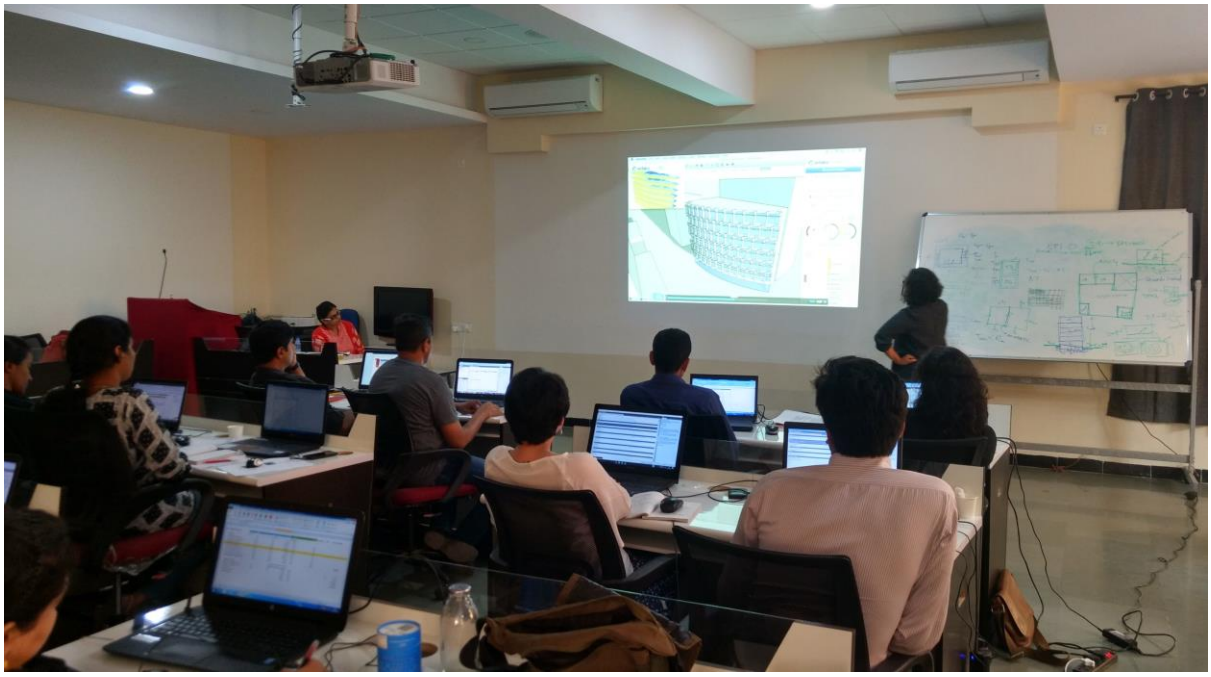

Figure 3: Ruchie Kothari demonstrating other energy modeling softwares_Day 3

Figure 4: Participant analysing cooling load simulation results