

# fAIR CONDITIONING

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## **‘Sustainable Cooling and Building Energy Modelling’ Workshop for Architects**

(part of 'Thoughtful Cooling' workshop series)

**11<sup>th</sup> to 13<sup>th</sup> November, 2016  
Mumbai, India**

**Software Partner: Design Builder**

**Project Report Prepared By:**

Ruchie Kothari (Project Manager, Fairconditioning Programme)

Mahima Rathore (Project Assistant, Fairconditioning Programme)

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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 November 11<sup>th</sup> to 13<sup>th</sup>, 2016 in Mumbai, 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 17 participants were a part of the workshop. The participants were architects, professors, students and engineers representing 14 different firms and universities from Mumbai. 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 workshop on 'Sustainable Cooling and Building Energy Modelling' was organized from November 11<sup>th</sup> to 13<sup>th</sup>, 2016 in Mumbai, India for architects. The 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 11<sup>th</sup> to 13<sup>th</sup> November, 2016 from 10 am to 6 pm daily.

## 6 Venue of the workshop

The venue for the workshop was:

Rachana Sansad's (Academy of Architecture)  
278, Shankar Ghanekar Road, Prabhadevi, Mumbai, Maharashtra 400025

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**

	<b>DAY 1:THEORY MODULES</b> 9.30 AM TO 6.00 PM	<b>DAY 2:BEM MODULES</b> 9.30 AM TO 6.00 PM	<b>DAY 3: BEM MODULES</b> 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)	
<b>RECESS FOR THE MIND</b>			
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
<b>FUEL UP (LUNCH, WALK, BREATHE)</b>			
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.)
<b>RECESS FOR THE MIND</b>			
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	Preeti Kolamberkar	Nature Nurture Architects And Planners	Architect	3 - 4	3 - 4			3 - 4		2				
2	Ambarin Chougale	Nature Nurture Architects And Planners	Architect	1				1						Interior
3	Suhas Bamardekar	Sandeep Shirke Associates	Architect		1			1 - 2						
5	Aparna Dwivedi	JJ College of Architecture	Professor											Teaching
8	Sulakshana Bhanushali	Rachana Sansad College	Professor											
9	Chetan Desai	Rachana Sansad College	Professor	3 - 4	2			1						Dental Clinic 1 -2
10	Suchita Karale	Rachana Sansad College	Professor		3 - 4		4 - 5	1 - 2	1 - 2		1			

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
11	Ajit Nirmal	Bharti Vidyapeeth College of Architecture	Architect											Research
12	Sunanda Satwah	CTESCOA college	Architect		1 – 2					2 – 3				
13	Mihika Sarkara	Eunoia Designs	Architect		2 – 3			3			4			

## 10 Trainers

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

**Table 3- Details of the Trainers**

Trainer	Organization and Designation	Professional Synopsis	Sessions Conducted
<b>Vivek Gilani</b>	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: <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Psychrometrics and Climate analysis</li> <li>• Solar Geometry</li> <li>• Sustainable Cooling Technologies</li> </ul>
<b>Deepa Parekh</b>	Architect At: EDS Global	Deepa completed her B.Arch from the Institute of Environmental Design - Sardar Patel University, Gujarat and her Msc. in Building Science from the University of Southern California, USA. She practises as a Project Manager with Environmental Design Solutions, Mumbai. Deepa has conducted over 30 programs in the areas of daylighting, energy simulation, building energy efficiency, thermal comfort and passive design and associated topics. She has taught programs at Rachna Sansad's Institute of Environmental Architecture (India), University of Southern California (U.S.A) and D.C. Patel School of Architecture (India). Deepa has extensive work experience in simulation based architectural design assistance, green building	Sessions conducted on 2 <sup>nd</sup> and 3 <sup>rd</sup> day are: <ul style="list-style-type: none"> <li>• Introduction to Energy Simulation and Design Builder</li> <li>• Model inputs and simulation (location, geometry and schedule)</li> <li>• Model inputs and simulation (material, construction, HVAC)</li> <li>• Design Iterations</li> <li>• Benchmarking (EUI)/ making results table</li> <li>• Daylighting</li> <li>• Project Report</li> <li>• Natural Ventilation</li> </ul>

		certification and policy review projects including the HCFC phase-out plan in the Asia Pacific building sector. Deepa is a LEED AP and a member of the Society of Building Science Educators (SBSE).	
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## 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:**

90% of the participants felt comfortable using climate analysis and solar analysis for their project and now have better understanding of physical properties of commonly used building materials. They were confident in identifying appropriate passive design strategies for their projects. 70% of the participants were comfortable in recommending active cooling systems to their clients. But only 50% of them were comfortable in using building energy modelling for their projects.

When asked reason for using simulation tools during the design process, 90% of the participants were of the opinion that the tools provide confidence in building performance whereas only 10% agreed to use based on client's requirements. On average, 35% opted to use the tools as it would increase their company's competitiveness and help them achieve green building rating certificate.

On the other hand, 60% people marked lack of training and unwillingness of client to pay for simulation study as the reason for NOT using the simulation tools. Out of them, 10% also felt that the learning curve is steep and interface is not user friendly.

Along with that, almost all the participants were able to understand the objective of this training workshop.

### **Trainer's Competency:**

90% of the participants rated competency skill of both our trainer, Vivek Gilani and Deepa Parekh out of 5.

### **Content Upgrade/Skill Building:**

Participants commented that the pace of the workshop was fast on Day 1 and reduced subsequently on Day 3. They have also requested for more hands on exercise and video/animations for better visualisation and practice.

### **Overall experience and engagement:**

Almost all the participants completely enjoyed the workshop and provided us the contact details of their colleagues for next workshop. They enthusiastically are offering support for trainer and technical knowledge support.

## 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 taking session on Passive Strategies on Day 1



Figure 2: Deepa Parekh training architects on Design Builder on Day 2



Figure 3: Deepa Parekh explaining Passive cooling techniques in Design Builder on Day 3