fAIR CONDITIONING

With the support of

SHAKTI
SUSTAINABLE ENERGY
FOUNDATION

Introduces

THOUGHTFUL COOLING

Cooling Interiors Efficiently and Sustainably
Certificate Program for Mechanical/Civil Engineering students

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WORKSHOP AGENDA

Venue: Seminar Hall, 5th Floor, Shri Bhagubhai Mafatlal Polytechnic
Address: Irla, N. R. G Marg Opposite Cooper Hospital, Vile Parle, Mumbai, Maharashtra 400056

Date: 19 – 20 October 2018

Venue: Mukesh Patel School of Technology Management & Engineering
Address: Bhakthi Vendanth Swami Marg, Near Cooper Hospital, JVsPD Scheme, Vile Parle West, Mumbai, Maharashtra 400056

Date: 21 October 2018

1. BACKGROUND

Cooling and refrigeration for buildings is by far the most significant source of energy demand throughout the country, and these needs and demands are rising at the same rapid pace as economic development. The amount of energy (and related GHG emissions) necessary to cool Indian building interiors in the years ahead will depend on how they are designed and built today and in the coming years, the technology used for cooling, as well as the behaviour and operation of the equipment by occupants of air-conditioned spaces.

The Student Certification Workshop created for engineering students titled '*Thoughtful Cooling*' seeks to highlight the most efficient mechanical cooling techniques outside of traditional ACs, State-of-the-art information and system level design considerations, energy and GHG emissions performance parameters, and cost-benefit analysis techniques related to efficient/sustainable Cooling Technologies including Radiant Cooling, Evaporative Cooling (Direct and Indirect), Vapour Absorption, and Natural Refrigerant based cooling.

Topics include:

- Climate Change, Ozone Depletion, and Cooling Systems
- Energy Efficiency, Thermal Comfort, and Cooling
- Systems Sustainable Cooling Technologies (End-of-pipe Solutions)
- Methods for Comparative Assessment of Cooling Technologies
- Site Visits to Buildings with Efficient Cooling Systems
- Integration into Academic Curriculum

2. ITINERARY FOR STUDENTS:

Reporting Time: 15 mins prior to 1st session		
Day 1: 9:45 am – 5:30 pm		
Number	**Time**	**Title**
1.1	9:45 am - 10:00 am	**Warming up** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal Icebreaker Session
1.2	10:00 am - 11:00 am	**Group Debate: Personal position mapping and articulation in the context of Climate Change** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal, Hasan ul Banna Khan Moderators stimulate a discourse to help students explore personal and collective perspectives on the artificial or real incongruencies and conflicts between economic and ecological wellbeing of the planet and its living communities. Group 1 – espouses the view, and presents supporting arguments, that in the short term, economic development at the cost of the environment is prudent and that the damage done now can be repaired later when economic goals are achieved; Group 2 – espouses the view that ecological well-being and social equity are paramount and that economic growth activities and projects must be carried out within the limits of the ecological capacity and bounded by needs of social equity.

Break 1	***11:00 am - 11:15 am***	***Recess for the mind***
1.3	11:15 am – 11:30 pm	**Workshop Objectives and Participant Expectations** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal The overarching workshop structure, content, activities and objectives are explained to the participants. The Key takeaways are highlighted - all in the context of embedding efficiency and sustainability within the existing concepts, to bridge the gap between knowledge and action and improve the cooling design skills and software simulation skills.
1.4	11:30 pm - 12:00 pm	**Climate Justice and the Built Space: An Introduction to Fairconditioning** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal In this session, participants are introduced to the Fairconditioning Program, focusing on the Academic Curricula Integration project (ACIP). The participants are exposed to relationship between the existing problems with our Built Space and Climate Change, further underpinning the guiding principles of the overarching program, and the underlying reasons for devising this specific intervention. The realm of curricula integration as viewed by the Program's Executive Board and Board of Advisors is further highlighted.
1.5	12:00 pm – 1:15 pm	**Psychrometry** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal In this session, the concept of psychrometry and climate analysis are introduced to the participants, explaining how the psychrometric chart for a specific climatic zone, helps in designing energy efficient buildings. This session further includes an introduction to passive design strategies, and the prioritisation of cooling load reduction before exploring sustainable cooling technologies and renewable energy supply.
Break 2	***1:15 pm - 1.45 pm***	***Fuel Up (Lunch, Walk, Breathe)***
1.6	1:45 pm – 2:30 pm	**Thermal Comfort and Indoor Air Quality** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal The following concepts are explained: Thermal comfort and its influencing factors, Solar passive design, Envelope design and its material property, Mode of heat transfer - conduction, convection and radiation. Additional highlights: adaptive comfort – one size fit all approach, micro climate and how it is affected by landforms, and street width or other external factors.
1.7	2:30 pm – 3:00 pm	**Climate Analysis & Passive Design Strategies** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal In this session, the different climatic zones requiring different means of cooling are delved into, with the help of the psychrometric chart. This session includes an introduction to passive design strategies, and the prioritisation of cooling load

		reduction before exploring sustainable cooling technologies and renewable energy supply.
1.8	3:00 pm – 4:00 pm	**Active Cooling - Efficient HVAC Systems** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal The issue of growing Airconditioning demand with regard to building sector growth is emphasized. Conventional building EPI and Energy efficient building EPI & its effect on electricity consumption is also discussed. It is ensured that the students are aware of and understand the environmental, spatial and structural implications of using this technology, in comparison the conventional HVAC systems for building design. Further, working of Refrigeration & AC – basics of enthalpy, Coefficient of Performance to evaluate the whole system, introduction to terms like Integrated Part Load Value, Energy Efficiency Ratio and cooling load estimation format – models used for simulation are also made known.
Break 3	***4:00 pm - 4:15 pm***	***Recess for the mind***
1.9	*4:15 pm – 5 pm*	**Sustainable Cooling Technologies - Natural Refrigerant Air Conditioning** Trainer: Vivek Gilani Session Jockey: Prachi Bhujbal The students are made aware of the environmental, spatial and structural implications of using this technology, in comparison the conventional HVAC systems for building design. The students are made to realize that these are already commercially available and implementable technologies, further emphasizing that they are sustainable technologies and not alternative technologies. The environmental benefits of using this technology as it replaces f-gasses, along with the different safety implications and application constraints are also covered. Unitary and Centralized systems are focused upon, with a special module on R-290 based refrigerant technology. The need to leapfrog to natural refrigerants is also highlighted. The issues with usage of carbon dioxide as a natural refrigerant and lack of commercial application examples are also delved into.
1.10	5:00 pm – 5:30 pm	**Sustainable Cooling Technologies - Direct/Indirect Evaporative Cooling** Trainer: Vivek Gilani Session Jockey: Hasan ul Banna Khan The students are made aware of the environmental, spatial and structural implications of using this technology, in comparison the conventional HVAC systems for building design. The students are made aware that these techniques are commercially available and easily implementable and are ‘sustainable’ and not alternative technologies. The environmental benefits of this technology since it avoids vapour compression, are highlighted. Along with the aforementioned points, the climatic constraints of evaporative cooling and overcoming them by blending with conventional HVAC systems to still derive energy efficiency and low f-gas benefits, are explained.
Day 2: Timing: 10 am – 6 pm		
2.1	10:00 am - 11.00 am	**Sustainable Cooling Technologies - Direct/Indirect Evaporative Cooling – Contd.**

2.2	11.00 am – 12:00 pm	**Sustainable Cooling Technologies – Structure Cooling** Trainer: Dhrumit Parikh Session Jockey: Hasan ul Banna Khan The students are made aware of the environmental, spatial and structural implications of using this technology, in comparison the conventional HVAC systems for building design. The different types of these cooling techniques, along with their application in different circumstances is also explained. The students are made aware that these techniques are commercially available and easily implementable and are 'sustainable' and not alternative technologies. The environmental benefits of radiant and structure cooling technology are highlighted, since it reduces vapour compression. It is also explained how the partial addressing of cooling load is overcome by blending it with conventional HVAC systems to derive energy efficiency and low f-gas benefits.
Break 1	***12:00 pm - 12:15 pm***	***Recess for the mind***
2.2	12.15 am – 12:45 pm	**Sustainable Cooling Technologies – Structure Cooling – Contd.**
2.3	12:45 pm – 1:15 pm	**Sustainable Cooling Technologies – Radiant Cooling** Trainer: Vivek Gilani Session Jockey: Hasan ul Banna Khan The students are made clear of the fundamental science concepts underlying the technology, operation principles, environmental and cost benefits, safety and technical constraints. It further aims to ensure that the students are aware of the environmental, spatial and structural implications for using this technology in comparison to conventional HVAC systems for their building design. The environmental benefit of this technology is stressed upon as it reduces vapour compression and the partial addressing of cooling load (does not dehumidify) can be overcome by blending with conventional HVAC systems to still derive energy efficiency and low f-gas benefits.
Break 2	***1.15 – 1:45 pm***	***Fuel Up (Lunch, Walk, Breathe)***
2.3	1:45 pm – 2:15 pm	**Sustainable Cooling Technologies – Radiant Cooling – Contd.**
2.4	2:15 pm – 4:00 pm	**Introduction to Energy Modelling** Trainer: Dhrumit Parikh Session Jockey: Hasan ul Banna Khan The students are introduced to a web-based tool to calculate HVAC load and further simulate those effects on the building's performance. The need for load calculation and theory regarding heat load is discussed, along with a brief about the Energy Plus software on which major energy modelling software's are based on. Various capabilities of the Smart Energy software are also explained.
Break 3	***4:00 pm - 4:15 pm***	***Recess for the mind***
2.4	4:15 pm – 6:00 pm	**Introduction to Energy Modelling – Contd.** Trainer: Dhrumit Parikh Session Jockey: Hasan ul Banna Khan The students are introduced to a web-based tool to calculate HVAC load and further simulate those effects on the building's performance. The need for load calculation and theory regarding heat load is discussed, along with a brief about the Energy Plus software on which major energy modelling software's are based

		on. Various capabilities of the Smart Energy software are also explained.
Day 3 Timing: 10.00 am – 6.00 pm		
3.1	10.00 – 11.30 am	**Introduction to Energy Modelling (contd.)**
Break 1	***11.30 am – 11:45 am***	***Recess for the mind***
3.2	11:45 am – 1.30 pm	**Smart Energy Tool - Modelling Sustainable Cooling Technologies** Trainer: Dhrumit Parikh Session Jockey: Hasan ul Banna Khan Practice sessions with the students on the smart energy tool are conducted in a Computer Lab.
Break 2	***1.30 – 2.00 pm***	***Fuel Up (Lunch, Walk, Breathe)***
3.3	*2.00 – 4.00 pm*	**Smart Energy Tool - Modelling Sustainable Cooling Technologies (contd.) and Case Study Detailing** Trainer: Dhrumit Parikh Session Jockey: Hasan ul Banna Khan Practice sessions with the students on the smart energy tool are conducted in a Computer Lab,and students are assigned a problem statement and asked to generate heat loads and run simulations on the Smart Energy tool. The capability of the software, advantages and limitations are showcased. Further, need for these software's, basic terminologies, importance of internal load and pay back periods are discussed.
Break 3	***4.00 – 4.15 pm***	***Recess for the mind***
3.4	4.15 – 6.00 pm	**Feedback & Evaluation** Trainer: Dhrumit Parikh Session Jockey: Hasan ul Banna Khan

3. POINT OF CONTACT

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