# *LOW-CARBON BUILT ENVIRONMENTS:*

## *DESIGN APPROACH AND PERFORMANCE ASSESSMENT*

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## Overview

Anthropogenic carbon emissions and resultant global climate change are subjects of great concern given their effect on environment, ecosystem and human lives. There is a strong need to develop and implement clean development mechanisms in the construction industry, which accounts for about 30% of global carbon emissions. Various processes associated with a building's life cycle like design, construction, retrofit and demolition – aggregated as Embodied carbon and operation and maintenance – aggregated as operational carbon vary in their magnitudes of emissions and resultant global climate change impact. Sensitivity of these emissions vary significantly depending on the building typology, construction technology, materials used, climatic, geographic factors and operational patterns. Across the globe, several process level efficiencies and roadmaps for low-carbon buildings have been developed and being researched for continual improvements.

Design and informed decision making necessitates an understanding of physical principles of building science and through knowledge on tools, techniques and state-of-the-art developments in this field of research. Another major factor of consideration is the modeling, prediction, investigation and performance assessment of such propositions. They vary from conceptual modeling and walk-through audits for a schematic level assessment to micro-modeling and elementary level resource flow audits for a detailed assessment. This course is aimed at introducing the principles of building physics associated with low-carbon design, develop an appreciation of low-carbon design philosophies practiced world-wide, equip with state-of-the-art tools and techniques, build confidence in practice through hands-on experience and develop skills on performance analysis and investigation of low-carbon built environments. This course will inculcate a sustainable, life cycle performance based approach to building design.

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| **Modules** | **MODULE 1: Climate responsive Design and Operational Energy Efficiency**<br>**Day 1:**<br>Lecture 1: 9:00 to 10:00 AM – Climate responsive buildings: Passive, Bio-climatic strategies<br>Lecture 2: 10.30 to 11.30 AM- Thermal comfort – principles and indices<br>Tutorial I: 2.30 to 4.30 PM- Group exercise on bio-climatic design and concept development: Climate consultant tool<br><br>**Day 2:**<br>Lecture 3: 9:00 to 10:00 AM – Operational Energy in buildings – Characteristics and baseline<br>Lecture 4: 10.30 to 11.30 AM- Energy efficient strategies and implications<br>Tutorial II: 2.30 to 4.30 PM- Group exercise on operational energy efficiency measures for real-life buildings<br><br>**Day 3:**<br>Lecture 5: 9:00 to 10:00 AM – Whole building simulation – concepts and modeling approach<br>Lecture 6: 10.30 to 11.30 AM- Overview of tools and potential applications<br>Tutorial III: 2.30 to 4.30 PM- Hands-on work with IES-VE simulation tool<br><br>**Day 4:**<br>Lecture 7: 9:00 to 10:00 AM – Heat and Moisture transfer through building envelop<br>Lecture8: 10.30 to 11.30 AM- Building envelop design and optimization<br>Tutorial IV: 2.30 to 4.30 PM- Hands-on field exercise on real-time comfort and envelop thermal assessment |

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<tr><td></td><td>Day 5:<br>Lecture 9: 9:00 to 10:00 AM – Real-time monitoring of operational energy in buildings<br>Lecture 10: 10.30 to 11.30 AM- Ongoing projects from UK<br>Tutorial V: 2.30 to 4.30 PM- Hands-on experience with real-time data analysis and validating simulation models<br><br>MODULE 2: Life cycle energy and Cost-benefit considerations<br>Day 6:<br>Lecture 11: 9:00 to 10:00 AM –Concepts in low-energy heating and cooling<br>Lecture 12: 10.30 to 11.30 AM- Natural ventilation in buildings – modeling and analysis<br>Tutorial VI: 2.30 to 4.30 PM- Hands-on experience with Cradle CFD software<br><br>Day 7:<br>Lecture 13: 9:00 to 10:00 AM – Embodied energy – principles and assessment<br>Lecture14: 10.30 to 11.30 AM- Embodied carbon emission from building products and processes<br>Tutorial VII: 2.30 to 4.30 PM- Group exercise on embodied energy assessment<br><br>Day 8:<br>Lecture 15: 9:00 to 10:00 AM – Life cycle energy approach in built environments<br>Lecture 16: 10.30 to 11.30 AM- Design decision making based on life cycle energy<br>Tutorial VIII: 2.30 to 4.30 PM- Hands-on experience with life cycle energy assessment<br><br>Day 9:<br>Lecture 17: 9:00 to 10:00 AM – Life cycle costing in buildings<br>Lecture 18: 10.30 to 11.30 AM- Uncertainties in cost estimations for low-carbon buildings<br>Tutorial IX: 2.30 to 4.30 PM- Hands-on exercise on life cycle cost analysis<br><br>Day 10:<br>Lecture 19: 9:00 to 10:00 AM – Introduction to Passivhaus standard<br>Lecture 20: 10.30 to 11.30 AM- Passivhaus: Criteria and design approach<br>Tutorial X: 2.30 to 4.30 PM- Mock project based on Passivhaus concept<br><br>Number of participants for the course will be limited to fifty.</td></tr>
<tr><td>You Should Attend If…</td><td>▪ you are an Architect, Civil Engineering and Construction industry professional, Planner, Energy Engineer.<br>▪ you are building facility manager, professional associated with City/ Town Development Authorities interested to learn and apply low-carbon approach in your profession.<br>▪ you are a student or faculty from academic institution interested in learning and researching on low-carbon design</td></tr>
<tr><td>Fees</td><td>The participation fees for taking the course is as follows:<br>Participants from abroad : US $350<br>Industry/ Research Organizations: 20000<br>Academic Institutions: 10000<br>The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. The participants will be provided with accommodation on payment basis.</td></tr>
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# The Faculty

**Dr. Sukumar Natarajan** is a faculty of Environmental Design at the University of Bath's Department of Architecture and Civil Engineering, UK. His research intent is to deliver healthy and comfortable low-carbon buildings. Work ranges from the first controlled trial of interface design for smart meter In-Home Displays (IHDs); communicating automated personalised energy and health advice to social housing tenants; the first quantifiable measure of energy literacy; low-cost sensing for Big Data applications in smart living; and the link between overheating risk, building insulation and thermal comfort under climate change.

**Dr. E. Rajasekar** is a faculty member at the Department of Architecture and Planning, Indian Institute of Technology Roorkee, India. He researches in the field of High performance buildings. His work ranges from thermal comfort in built environments, energy efficiency, carbon-footprint assessment and mapping and building information modeling.

# Course Co-ordinator


**Dr. E. Rajasekar**
Phone: 01332-284838; +91 9790828093
E-mail: raj.fap@iitr.ac.in; erajas@gmail.com


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http://www.gian.iitkgp.ac.in