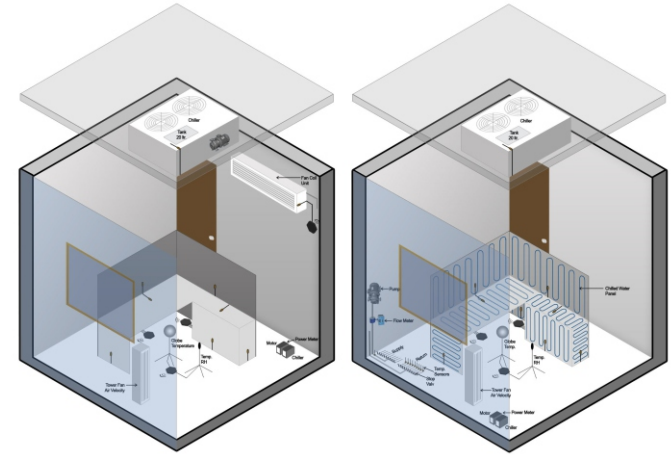
Centre for Excellence in Solar Passive Architecture and Green Building Technologies

Overview

The main aim of the Centre for Excellence in Solar Passive Architecture and Green Building Technologies established at CEPT University with support from Ministry of New and Renewable Energy (MNRE), was to frame strategies for developing energy efficient, low carbon and sustainable built environment using concepts of green architecture and integration of renewable energy systems.

The specific objectives for the project duration of five year (2011-2016) were to enhance knowledge and develop a database of construction materials and practices for energy efficient buildings in India. Under the project testing facilities and protocols as per standards were developed to characterize materials including glass and mirrors for their thermo-physical-optical properties. Database for energy efficient built environment in India as per indigenize guidelines, codes and standards was generated. Extensive research was done in energy policy with integrated approach to resource planning. Existing curriculum was reviewed and recommendations were developed based on feedback obtained from stakeholders. A living laboratory was established to develop concepts of Net-Zero Energy Technologies – construct technology demonstration building to house centre activities. The implementation of GRIHA, ECBC and other codes, develop standards and labeling program for Fenestration, Insulation and Solar Thermal products were facilitated under the project. It also developed criteria for sustainable higher educational campuses and conduct post-occupancy evaluations. Conducted capacity building activities by developing e-lectures, training of trainers, organizing workshops on computer simulation and various related topics.



The main activities carried out during the term are:

1) Development of an India Model for Adaptive (thermal) Comfort

Considering India's rapid economic growth in its commercial sector, soaring demand for air-conditioned (AC) buildings is predictable. If left unchecked, building air-conditioning will add immense pressure on electricity and exaggerate the peak-demand problem. The trend observed in India was to design AC office buildings (that often operate at 22.5 ± 1 °C all year round) to meet the stringent "Class A" comfort specifications articulated in documents such as ISO 2005 and ASHRAE 55 for

AC buildings. This approach elevated Indian comfort expectations to levels that required unsustainable energy inputs, without improving overall occupant comfort and productivity.

The 'IMAC 2014' model was developed from the data collected over four survey campaigns in office buildings conducted over a period of one year. These surveys were administered in naturally ventilated, mixed-mode and AC buildings in five cities from different climate zones of India during three distinct seasons. This was done using scientifically recognized methodologies for post occupancy evaluation and thermal assessment of buildings. The goal was to demonstrate a wider band of comfort acceptable whenever occupants are permitted to adapt to their indoor environment. This study was completed in partnership with international research team from the University of Technology, Sydney.

2) Building Material Characterization and Construction Assemblies

Building materials play a major role in achieving energy efficiency. Many computer models have been developed to envisage future energy demand and are practiced across the country. However, thermo-physical-optical property of local materials is limited and the characterization of newly developed building material is not much in public domain. Through this project, an extensive data of these properties of building materials, building components and construction assemblies was developed. Opaque building materials such as clay bricks were characterized for their thermal conductivity, specific heat, etc. Transparent – translucent materials such as glass, were characterized for transmittance, absorptance and reflectance. Database and online web tool for material and construction assemblies were developed.

3) Calibrated Building Energy Simulation

Building simulations and energy calculations based on detailed modeling form an important tool for design and investigation of energy efficient buildings. Simulation tools are developed globally based on empirical data, research and software development, yet it is believed that discrepancies against actual data is inevitable. The idea was to study these differences and derive parallel relations between simulated and measured data.

Two identical life size 'test beds' were constructed with separate characteristics. One of the test beds deployed materials like brick whereas the other test bed used Resource Efficient Brick. This test bed became a base for experimenting different materials, components and envelope properties.

High accuracy data loggers (Onset ZedW) were installed within the test beds. These instruments recorded data of environmental parameters over duration of a year. The energy usage of the test beds was also monitored. Furthermore, an outdoor weather station measured weather parameters, which helped to analyze the data received in the internal environment. Virtual simulations generated results for two corresponding building models. The calibrated model was developed based on guidelines by ASHRAE International Standards. The input data in these models was matched with the construction data for accurate results. The results were compared against the logged data from the two test beds. The differences were analyzed and possible reasons for the deviation were evaluated. This research was furthered, by calibrating a various building envelopes and analyzing them to develop a critical database for Indian context.

List of available tools *Online:*

- Assembly U-factor Calculator
- Comfort and Weather Analysis tool
- Multi-city Comfort and Weather Comparison tool
- IMAC Assistant (India model for adaptive thermal comfort tool assistant)

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