Net Zero Energy Building: A Living Laboratory

CARBSE's varied endeavors have all come together in the form of a Net Zero Energy Building (NZEB) which can be best described as a Living Laboratory. NZEB is defined as a highly energy efficient building, which uses energy-efficient technologies that reduce energy demand and also consumes as much energy on annual basis as it produces energy at site using renewable energy sources. The NZEB at CEPT University campus in Ahmedabad, is the home for CARBSE. It houses state-of-art laboratory facilities for building materials characterization, thermal comfort studies, daylighting and energy measurement studies.

Along with dedicated testing facilities, the building itself is used to evaluate the performance of various materials, construction technologies and systems. This provides a unique opportunity for industries to participate in experimental research with the objective of generating new knowledge, product validation, along with an engagement in policy and regulation driven research projects.

Throughout design and construction, the goal was to use an integrated design process that demonstrates the symbiotic relationship between architecture and services. In this intensely focused collaborative effort, one of the most unique aspects is that CARBSE is working as designer, building operator and monitor, which gives the centre an ideal situation in which it controls the research it wishes to conduct, while also testing the technologies it has worked to develop and support at the scale of an actual building. Furthermore, occupying the building will give researchers an insight into the relationship between designed intentions and practical application and use.

The building envelope minimizes glare and heat gain as the openings are oriented away from East and West, focusing fenestration on a North South axis. It uses materials –bricks, insulation and a cool roof – to reduce heat gain. The building floor plate is thin to allow cross ventilation and optimal daylight, with well-shaded operable windows to aid in natural ventilation. The project was monitored continuously during construction and continues to be monitored after occupation. In its attempt to combine state-of-the-art technology with passive technologies rooted in the tradition of the area, architect BV Doshi sees this architecture sitting at the edge of new trends of thought, suitable not only to India but also to the future, in and outside the country. The building builds on past knowledge but looks toward the future.

To achieve its goal in operation, the building design contains sophisticated and flexible control systems that can support continuous research experiments on building monitoring and performance optimization. The Building Management System (BMS) in the building is designed to serve as a single platform for monitoring and operating controls in the building, to provide test bed for development of new technologies and control algorithms, and to integrate with test chambers for effective operations and controls. This system is mainly divided in four components: monitoring, integration, controls, and display.

The monitoring component incorporates high accuracy research grade sensors to continuously monitor building performance and occupant comfort. The air conditioning and envelope monitoring system contains built-in controllers with networking capabilities and are integrated with the building control system. Envelope, energy, and environment systems have been specified with built-in controllers for integration with the building control system. Key energy and operational parameters (such as building information, current operation, historical energy consumption, and current energy consumption) is continuously displayed on a display screen located on the ground floor.

The hybrid ventilation and cooling system combines natural ventilation with radiant cooling to maximize the use of fresh air for passive cooling, and still offsets peak temperature discomfort. In natural ventilation mode, the active air-conditioning system is turned off and chimney window is opened to allow the natural draft through the building. In mechanical system mode, the building runs a primary (active radiant system with direct outdoor air units) and secondary cooling system (VRV/digital scroll) to maintain space comfort. In lighting, with a goal of just three to four watts per square meter, minimal artificial lighting is used, and what is required is designed with reduced lighting power density.

The living laboratory houses CARBSE's test chambers, the thermal comfort chamber, guarded hot box, mirror box and artificial sky. Their control platform is integrated with the building level platform. These chambers are available both for scholarly research and for industry testing.

Project Partners

- Gujarat Energy Development Agency, Govt. of Gujarat
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