Infosys EC-53 building, Bengaluru.

An efficiency benchmark for the building industry

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Buildings account for over one third of global energy consumption and are responsible for an equally significant amount of carbon dioxide (CO_2) emissions. In the Indian context, with rapid urbanization and growing energy demand, it is essential to make sure that the upcoming building stock is built in the most efficient way. The fact that 70% of the India of 2030 is still to be built, provides a great opportunity for the building industry fraternity to transform the way buildings are designed and to adopt a sustainable approach. Though renewable energy sources like solar photovoltaic (PV) are getting cheaper and are witnessing tremendous growth, it is important to understand that the first step to being sustainable is to bring down the demand (energy, water, materials, etc.) through resource efficiency measures, and the second step is to meet the demand through renewables, recycling, etc.

While the building industry embarks on the path of efficiency, it helps to have a building efficiency benchmark to guide design and operations. The benchmark should be unreasonable and challenging, but at the same time practically achievable. One such benchmark is the Infosys EC-53 building, which was inducted into the *ACREX Hall of Fame* in 2017.

Building Features

The Infosys EC-53 building, located in Electronics City, Bengaluru, is a combination of innovation and excellence in building design and operation. Sustainability measures were an integral part of the design right from the concept stage, and included the building envelope, innovative cooling system, energy metering, automation and continuous performance monitoring. The salient features of the building are described below.

Pushing the Envelope

Building envelope is the most important aspect of an efficient building design and can impact up to 50% of cooling demand. While most critics would vote against insulation in a moderate climate like Bengaluru, the EC-53 building has a fully insulated high performance envelope. This includes insulated walls (U value: 0.4 W/m²K), insulated roof (U value: 0.3 W/m²K) and a high-performance glass and shading for windows. What this has resulted in is an exceptionally low cooling requirement of about 160 TR* (563 kW or 37,5 W/m²) at peak for a building area of about 15,000 m² (160,000 ft²). High performance spectrally selective glass (light transmission of 42%, solar factor of 0.22 and U value of 1.05 W/m²K) and shading on windows has ensured that there is ample natural light inside the building and at the same time occupants feel comfortable without glare or heat radiation from the windows.

Selecting the Right Systems and Efficient Equipment

The second most important step for achieving a high-performance building is to select the most efficient system. LED lighting is used throughout the building to ensure low energy consumption and low maintenance due to long life of LED lamps. All the rest of the rooms are equipped with motion sensors that ensure switched off lights when there is no occupancy.

Efficient LED lighting in the building.

The EC-53 building was the first in India to implement a radiant panel based cooling system. The radiant panels (supplied by Uponor) are in the form of ceiling tiles and have small pipes within them through which cold water at 16°C circulates to take care of the sensible load in

Natural day-lighting inside the building.

* 1 TR (Tons of Refrigeration) = 3,517 kW

the building. One floor of the building uses radiant panels developed by the Infosys team to achieve cost effectiveness and higher cooling efficiency. Air handling units take care of the latent load in the building and are equipped with two cooling coils – one with 16°C chilled water and the other with 7°C chilled water.

Uponor radiant panel system.

Radiflux radiant panels developed by Infosys team.

Other important features of the HVAC system include:

- All equipment with variable speed drives (chillers, pumps, cooling towers, AHUs).
- Magnetic bearing chillers for high efficiency and low maintenance.
- Automatic tube cleaning system to ensure chiller efficiency.
- Dual source units (DX + chilled water) for critical areas like server rooms.

With all these interventions in HVAC, the annual average efficiency of the chiller plant (chiller, pumps and cooling tower) was measured to be 0.42 kW/TR.

Performance Monitoring

An efficient design does not always translate into efficient operation if the right metering and performance measurement is not carried out. The EC-53 building is equipped with a Building Management System (BMS) with accurate sensors that enable efficient operation of the building systems including proper scheduling and control of different equipment remotely. The role of the BMS does not end here. Smart algorithms defined in the BMS make sure the systems ramp up or down based on the building requirement. The efficiency of various equipment like chillers and pumps is continuously tracked with respect to their design curves, and any deviation is highlighted to enable the operations personnel to take appropriate action. Any critical parameter going out of range triggers an alarm and notification to the operations personnel so that any equipment failure can be foreseen and preventive action taken. Effective use of BMS for control as well as continuous performance monitoring of the building is a distinguishing feature of the EC-53 building and several other buildings of Infosys.

Floor Energy Summary
Lighting, Fans, UPS & Rawpower

	Lighting			RAW Power		Fans			UPS Work-station		
Floor	Inst.kW	Target kW Unocc Mode	No. of Lights ON	Inst. kW	Target kW Unocc Mode	Inst. kW	Target kW Unocc Mode	No. of Fans ON	Inst. kW	Target kW Unocc Mode	No. of PCs ON
Ground floor	0.0	0.2	0	1.9	0.1	0.0	0.0	0	11.3	5.2	141
First floor	1.6	0.0	41	0.1	0.0	0.0	0.0	0	9.6	3.3	120
Second floor	3.6	0.1	89	0.6	0.1	0.0	0.0	0	12.3	0.9	154
Third floor	3.5	0.2	87	1.8	0.1	0.0	0.0	0	15.0	3.1	187
Fourth floor	0.6	0.1	14	1.1	0.1	0.0	0.0	0	11.3	3.1	141
Fifth floor	2.1	0.1	52	0.7	0.1	0.0	0.0	0	7.7	2.4	96
Sixth floor	1.6	0.1	41	--	0.1						
Total	13.0	0.1	324	6.1	0.2	0.0		0	67.2	16.0	839

Screenshot of floor wise energy consumption.

Granular metering in the building enables study of energy patterns among different systems in the building, and helps in focusing action on the right system to minimize energy consumption. Separate energy meters for lighting, computers, ceiling fans and other plug loads at the floor level give an accurate account of the energy consumption and identify opportunities for savings.

Central Command Center for monitoring performance.

Solar Energy

The EC-53 building has an installed capacity of 90 kWp solar PV plant on the rooftop. A unique feature of the plant is that it consists of 5 different solar technologies of equal capacity on the same roof. This makes for a very accurate comparison between different technologies for the same weather parameters including temperature, humidity, dust, etc. The technologies installed are monocrystalline, polycrystalline, HIT, CIS thin film and Cd-Te thin film. The plant is able to meet about 10% of the energy requirement of the building on an annual basis.

Water Wise

Water is a precious resource, the value of which is inadequately understood by the society today. Water scarcity is a serious problem that is increasing every day. When a significant population of the country does not have access to clean water, it is more imperative to use the available water most judiciously and harvest every drop of rainwater.

The Infosys EC-53 building has a very low water demand of 25 liters per person per day in all (15 liters fresh water and 10 liters recycled water), owing to low flow fixtures, dual flush toilets, waterless urinals, etc. Hundred percent of the wastewater is recycled in the Sewage Treatment Plant (STP), and the recycled water is used for flushing, irrigation and cooling tower makeup requirements. Rooftop rainwater is harvested in a dedicated tank and used for potable purposes. Last year, about 42% of the fresh water requirement in monsoon months was met through rainwater.

Benchmarking Parameters

- Energy Performance index (EPI): 84 kWh/m² per annum (includes all the energy consumed in the building) for 100% daytime occupancy and 50% night time occupancy.
- Building peak electrical load: 2.85 W/ft² (0.26 W/m²) (peak observed at building incomer in a year).
- Light Power Density (LPD): 0.5W/ft² (0,05 W/m²)
- Peak cooling capacity: 1000 ft² per TR (37,5 W/m²)
- Chiller plant efficiency: 0.42 kW/TR (annual average).
- Solar PV plant capacity: 90 kWp (meets about 10% of annual energy requirement).
- Water requirement: 25 liters per person per day.

Conclusion

All the above strategies are replicable for other buildings as well. The cost of the building is not higher than a regular building. At Infosys, we have consistently observed that efficient buildings are less expensive than regular buildings when there is a focus right from the initial design stage. It only requires a small additional effort at the design stages and setting the expectations right with the entire design team. It requires questioning every assumption and frugal engineering. It requires rejecting thumb rules and adopting a data driven approach. Most importantly, it requires will from the entire design team including the owner to achieve a sustainable high performance building. ■

Different solar PV technologies on the roof of EC-53 building.