

Spectral's New Corporate Office Green & Platinum Rated



Photo 1 : Spectrals new office building in Noida.

by **Ashish Rakheja**
Chief Operating Officer,
Spectral Services Consultants Pvt. Ltd., Noida

Spectral recently completed construction of their new corporate office at Noida in the national capital region of India. Being involved so actively with the green building movement in India, we decided to lead by example and set about the task of constructing our new corporate office building in the greenest possible way. This new office crystallizes the experience we have gained over the last 25 years and three earlier completed LEED Platinum buildings.

Our task was to construct an office building with an area measuring 16000 sq.ft., that our immediate staff of 150 people in Delhi would be proud to occupy and keeping in mind the possibility of expansion to 200 people within 12 months.

The result is there for all to see.

We were successful in designing the building as per the norms laid down by the US Green Building Council and it was awarded the most coveted Platinum rating under the LEED (Version 2.2) rating system, thereby joining the elite group of the selected few Platinum buildings all over the world and especially outside the USA, to achieve this distinction. *Photo 1* shows the outside view of the completed building. I am presenting this article to summarize our experiences and elaborate on our design philosophy for the benefit of readers.

Selecting the Site

This was the most uphill task, especially in the light of burgeoning land prices in the capital of India. We decided to prioritize on the issue

of community connectivity while finalizing the location. It was essential that employees find the place easy to commute to and avoid dependence on expensive private transport. We knew that this would go a long way in our

About the Author

Ashish Rakheja is an M.Tech in thermal engineering from IIT, Delhi. Besides his position in Spectral services, he is a visiting faculty at several architecture colleges and was a panel member in the revision of the National Building Code on HVAC System as well the BIS standard on ducting system. He was involved in the design of several green building projects in India, five of which have been rated LEED-Platinum by US Green Building Council. He is a certified LEED India trainer and a key member of the green building movement in India. He is the national president of ISHRAE, president elect ASHRAE India Chapter, and past president of Delhi Chapter of ISHRAE and can be contacted on ashishrakheja@spectralservices.net

green endeavor even if this feature was unlikely to generate any formal weightage in the process of getting a rating.

We finally zeroed in on a site that was found feasible and met most of the requirements. It was a plot admeasuring 800 sq.m. in NCR, Noida, well connected to the city transport service and also on the proposed Metro route. It was also well populated with several IT/ ITES offices in the vicinity and hence had several public amenities such as banks, places of worship, school, hospital and entertainment places in the neighborhood.

We decided to build a 5 storied office on this land.

Our Design Philosophy

Before commencing the task of designing the office, a focused effort on following key design issues was made:

- Environmental protection
- Energy conservation
- Security
- Modularity
- Redundancy
- Fire safety
- Measurement and verification
- Occupant comfort

Architecturally Green

ABRD Architects from Delhi were engaged for the project and as per our brief, the initial architectural plans were firmed up with a clear aim of optimizing an all resources. The key architectural features of building design are:

- The building is oriented primarily north-south which is the best orientation for this part of the Indian sub-continent. Photos 2 and 3 show the north-west and south-west views.



Photo 2 : North West view.



Photo 3 : South West view.

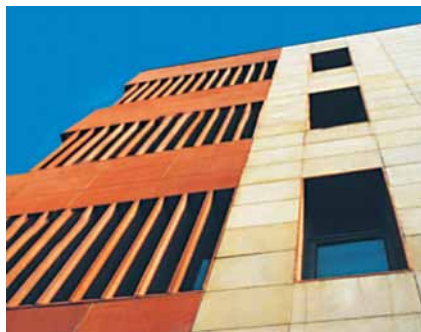


Photo 4 : Recessed windows cut down direct solar gain.



Photo 5 : Broken china mosaic tiles on roof.

- Large glazing is provided on the north and south facades, which brings in natural light in the space

- Windows on the most offensive west façade are recessed and provided with fins to ensure that these remain shaded at all times and this cuts down the direct solar gain. Refer Photo 4 for a glimpse of these recessed windows.

- The wall-window ratio has been optimized at 22.5% to maintain a fine balance between heat ingress and daylight harnessing.

Optimizing the Building Envelope

We started the building design by sticking to ancient text book concepts of building envelope optimization techniques which have deep roots in traditional Indian architecture duly realizing that the best way to have a sustainable low-energy consuming building is to reduce the heat gain from the building envelope. With one eye on the initial cost, several options of available construction and insulation materials were evaluated. Computer aided tools such as building simulation softwares (Visual DOE, Ecotect, Desktop Radiance etc.) helped us arrive at an optimal design solution. The highlights of the final selected building envelope are as follows:

Wall Construction

- 20 mm stone cladding
- 225 mm thick AAC block
- 25 mm closed cell insulation
- 12 mm gypsum board

Refer Figure 1 for a cross-sectional view of the wall construction.

Glazing

- SHGC = 0.33
- VLT = 0.48
- Glass specifications selected to enhance available daylight in the space and maintain visual comfort for occupants

Roof Construction

- 100 mm thick RCC slab
- 75 mm thick extruded polystyrene insulation
- High albedo paint with reflectivity of 0.45
- Broken glazed white tiles on roof (Refer Photo 5)

As a result of the above carefully chosen materials, we

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Surface	Conventional Buildings	Spectral Corporate Office
Wall	1.8	0.4
Roof	0.56	0.28
Glass	3.2	1.9

Table 1: Overall heat transfer coefficients of different surfaces in $W/m^2\text{ }^\circ\text{C}$.

were successful in achieving very low overall heat transfer coefficients. Comparison versus a conventional building is shown in Table 1.

Day Lighting and Natural Views

The building has a large atrium spread over all floors with a south-inclined 'light catcher' on top with permanent inclined louvres to enhance the day lighting effect. The angle of the louvres has been computer simulated to study its performance round the year, for ensuring that there is no ingress of direct sunlight at any time of the day, thus avoiding glare on the workstation computer screens and also minimizing air conditioning load. A computer generated image from one of the simulation packages in Figure 2 will enable the readers to get an insight of the process.

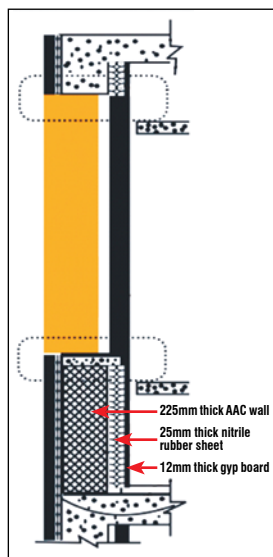


Figure 1 : Wall cross section.

Photo 6 shows the 'light catcher' while Photos 7 & 8 show the visible effects of this. More than 75% of the building areas are day-lit and no artificial lights are switched on in all the regularly occupied working areas during the day. Even the basement is naturally lit to a large extent as a result of direct & indirect light ingress.

In the evening, internal lighting is automatically controlled through an advanced lighting management system, which ensures a constant lux level with the help of dimmable ballasts on each lighting fixture.

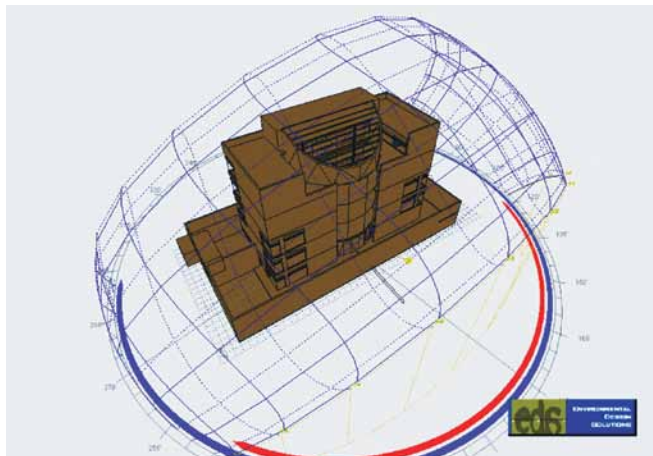


Figure 2 : Computer generated image of solar simulation.

Lights in utility areas like toilets and meeting rooms are connected to occupancy sensors for control. As a result of these measures, the average internal lighting power density LPD is 0.63 W/ft^2 , which is approximately half of the ASHRAE recommended LPD of 1 W/ft^2 for office buildings and 25% of conventional building LPD of 2 W/sft .

It is always pleasant to be able to look up from your work desk and find an expanse of greenery or any other natural element. It acts as a great refresher and a natural cooler for the eyes. With this in mind, our architects have ensured that 90% of our office space has a natural view from the window. This is a marked deviation from the standard office formats where, all that meets the eye is depressing steel, glass and chrome structures, elements that tire the eyes.

The Airconditioning System

We decided to base our AC system on an indoor temperature of $23\text{ }^\circ\text{C} \pm 1\text{ }^\circ\text{C}$ and RH of less than 60%. As a thumb rule, the peak AC load of a conventional office building for such a design is found to be in the range of 150 to 200 ft^2 per ton. With our conscious efforts at the architectural level, we arrived at an average load of only 40 tons, or 400 ft^2 per ton, a saving of nearly 50% with respect to the highest band! The peak load is 50 tons



Photo 6 : Light catcher



Photo 7 : The day-lit conference room



Photo 8 : Day-lit basement

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which is encountered for a few hours in the year.

We then set about selecting the best possible chiller configuration, for this load profile and chose a 72 ton high COP (COP = 4.48 at ARI conditions), water cooled screw chiller with twin compressors. We also installed a variable speed pumping system as well as VFD on the cooling tower.

The air handling units on all five floors are coupled to VFDs and the internal air distribution is through VAV boxes. The AHU fans are all high efficiency fans driven by motors of efficiency 88% and above.

An Economical IAQ Solution

Even though we have designed our system for a fresh air rate of 30% above the ASHRAE 62.1 – 2004 standard, to optimize on energy consumed, we have installed 'demand based ventilation' system, i.e. the indoor CO₂ levels are monitored and fresh air is introduced only when levels exceed limits. Modulating fresh air dampers are installed for this. The entire fresh air is pre-cooled by recovering energy from the toilets and atrium exhaust. Electronic precipitators (MERV 13 efficiency) in combination with MERV 6 efficiency pre filters on all air handling units ensure a dust free indoor environment.

Humidification and dehumidification packages are installed on each AHU, that are capable of controlling both the indoor temperature as well as RH. In addition, all AHUs can execute the complete air side economizer cycle for free cooling the indoors during pleasant weather.

Fire Fighting and Alarm Systems

Ours is a small building by any standard but we decided to ensure it as best as we could against fire dangers. For this we have followed the standards laid down by the National Building Code for water-based fire fighting systems. We have provided sprinklers for the basement as well as internal and external fire hydrants, portable hand held fire extinguishers as well as an intelligent addressable smoke detection system. All vertical shafts have been fire-sealed at the floor level.

Energy Savings

They say, the proof of the pudding is in the eating! All our claims of a world-class design have withstood the acid test and our efforts bore fruit when we realized that we have been able to achieve a saving of nearly 38.6% over the ASHRAE standard 90.1-2004!

Table 2 summarizes the energy consumption figures and corresponding savings.

ASHRAE Base Building		Baseline Design		Percent Savings	
Energy (kWh)	Cost (INR)	Energy (kWh)	Cost (INR)	Energy (kWh)	Cost (INR)
242086	1210433	394196	1970984	38.6%	38.6%

Table 2: Comparison of energy figures.

Managing the Building Systems

All the building utilities are coordinated through IP based advanced BMS. These include:

- Chillers
- Variable pumping system
- Cooling towers
- Air handling units
- DG sets
- Water tanks
- Fire fighting system
- Plumbing pumps
- VAV boxes
- Electronic metering
- Fire alarm system
- Electrical breaker status

The operating parameters can be accessed from any of the 150 workstations, each of our staff can thus find out what's going on and give a feedback in case of anomaly. We have only two operation and maintenance staff for day to day working. Without an effective and well-programmed BMS, monitoring and ensuring our planned energy savings would not have been possible.

Some More Green Features

Zero Discharge Building

Our premises is categorized as a zero discharge building with 100% rain water harvesting and an in-house sewage treatment plant (STP) of 10,000 litres; this water being used for gardening, cooling tower make-up and flushing.

Pollution Prevention During Construction

- Top soil preservation
- Preventing sedimentation of storm water mains
- Sprinkling of water and barricading of the site to prevent air pollution.
- Stacking of waste at one point
- Keeping construction material covered when not in use
- 97% of building waste collected and diverted to authorized disposal agencies

Minimal Waste

Furniture from our old offices has been remodeled and used in our new office. Very little new wood has been used for the executive floor and that too is FSC certified i.e. it is sourced from trees earmarked for cutting and not from virgin forests. In number terms, 2.5% of building material is from renewable resources (for eg. bamboo flooring). Also, 7.65% of the building material is reused/ salvaged, for eg. furniture and the broken tiles on our roof.

Indoor Pollution Prevention

In a tropical and dusty country like ours, we carry a lot of dust/ wet mud/ dirt on our footwear as we step

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Photo 9 & 10 : Gratings at the entrance of the staff canteen.

indoors. Traditionally, we remove our footwear outside the door when we step into someone's home and we first wash our feet when we enter our own homes. This practice is impossible to follow in an office and we hit on an idea to minimize this dirt getting indoors. We have installed gratings at all building entrances and especially our lunch areas. This at least reduces if not totally eradicates dirt from coming indoors. Photos 9 & 10 explain this.

The Green Team

We are thankful to all our business associates who worked together with us in realizing our dream. The project outlay was Rs. 4 crore and we have overshot the conventional construction cost figures by nearly 8%. But with the kind of long term energy savings that we have realized and the smile on the faces of our staff members, we expect a payback of less than 4 years. Our Green Team consists of:

- Architects – ABRD Architects
- Fundamental and Enhanced Commissioning Agent – Godrej and Boyce Co. Ltd.
- Construction Manager – Consortium Consultancy
- Energy Consultant – Environmental Design Solution
- LEED Facilitation – CII-Godrej GBC
- MEP Consultant – Spectral Services Consultants
- Interior Designer – Payal Jain Inc.
- Civil Contractor – Ahluwalia Contracts (I) Ltd.
- HVAC Contractor – Suvidha Engineers India Ltd.
- Electrical Contractor – Ahluwalia Contracts (I) Ltd.
- IBMS Contractor – iMetrex Technologies Ltd.
- Public Health Engineering Contractor – D S Gupta Constructions

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