Net-zero energy... and a 100% score

With Delhi's Paryawaran Bhawan, Voltas DPG vaults to a new level of 'Green' building capability.

The imposing entrance to Paryawaran Bhavan.

Imagine a building that has physical mass, and a striking visual presence -- but is otherwise non-existent. It doesn't register on the city's electricity grid. Viewed from space, it has almost no heat signature. Its carbon footprint is nil. It has absolutely no effect on its environment. That, in a nutshell, captures the unique quality of Delhi's Paryawaran Bhawan, headquarters of the Ministry of the Environment, and India's first net-zero building.

It's also a huge leap forward for Voltas, catapulting the company to the front rank in 'green' building projects. In a building intended to minimise its electricity needs, and then meet its requirements through its own solar panels, energy-efficiency of all utilities is critical. This is especially true of HVAC, which takes up the bulk of energy usage. That was DPG's challenge: to design, install and commission HVAC systems of the utmost energy-efficiency, for a building that aspired to 'Net-Zero' status, as well as LEED Platinum and GRIHA 5-Star ratings.

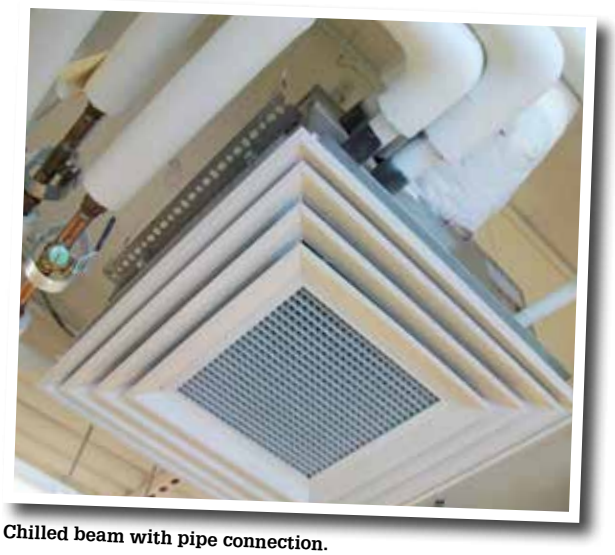
When Voltas DPG took up the challenge, the team had some clear advantages. There was its history of

high-value 'green' building projects, such as TCS Siruseri and Fortis Hospital. There was also its prior relationship with main contractor Swadeshi Construction, who were responsible for MEP, Civil works and BMS services, and with whom DPG had worked on Delhi's Indira Gandhi Main Stadium for the Commonwealth Games 2010. Nevertheless, taking nothing for granted, the team got to work even before the tender was formally announced. They developed a clear and convincing bidding platform, working closely with client CPWD's tendering team. That carried the day, edging out formidable competitors like Sterling Wilson, Blue Star, Unique and Suvidha Engineers.

(From left) Faraz ul Abidin, Amit Kumar, Shashanka Tiwari and Mohd. Sharique discuss the finer nuances of the project design.

Chilled Beam Chiller-160TR.

Secondary pump with pipe connection.



Chilled beam with pipe connection.

Less convention for more conservation

To achieve the strikingly low energy-consumption required, DPG had to almost re-think its whole HVAC approach, breaking with tradition in several ways. The first major unconventional decision was the use of chilled beams, with 376 units covering 93,000 sq ft of the AC area, leaving 27,000 sq ft for conventional systems. Chilled beams call for less capacity in AHUs, saving in power consumption of fan motors, while yielding thrice the volume of secondary air compared to primary input air.

Configuring the chilled beams was far from easy. Their performance had to be evaluated prior to installation, using Computational Fluid Dynamics. To preempt condensation, accurate parameters had to be calculated and maintained for chilled water and air input, bearing in mind the steady interior temperature of 26°C and 50% relative humidity.

Nevertheless, condensation did occur, an annoying drip

Piping header in the plant room.

Dual mode Chiller - 240/160TR.

Interior details of chilled beam with coils and nozzles (coloured green).

from chilled beams of the original design and make. Psychometric analysis revealed that the Apparatus Dew Point (ADP) of the room's air was greater than the chilled water inlet temperature of 16°C. The solution lay in substituting chilled beams from Nuclimate (USA), which had condensate drain pans with vertical coils. The technical deviation was accepted by consultant Spectral Swadeshi Construction as well as CPWD, who authorized purchase of the higher-priced Nuclimate product – but only after the project team talked them through an extraordinary number of calculations to make their point.

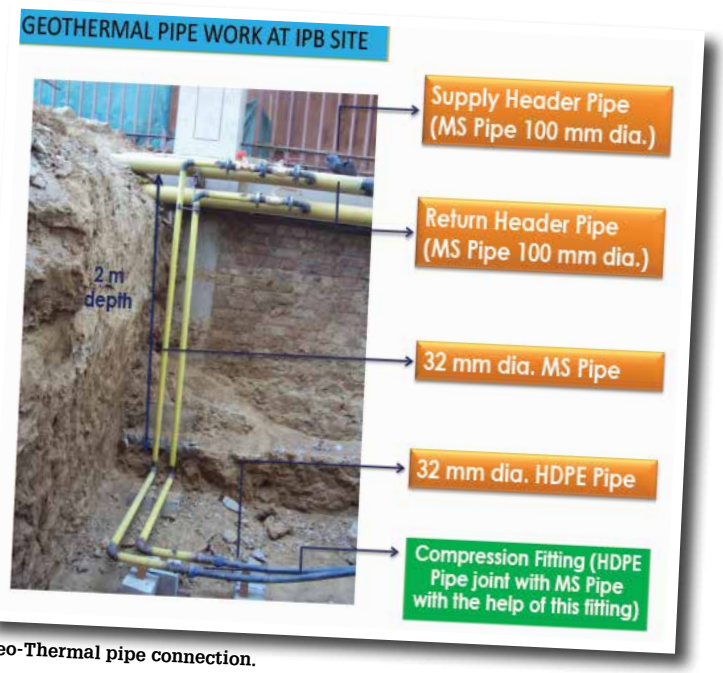
It was also a demanding task to drain the condensate through natural gravity flow to available shafts, for which piping had to be laid at precise levels. The solution was to create small drain piping channels for 3-4 beams together.

The second major 'green' measure was the use of a geothermal heat exchange system on an unprecedented scale, for expelling up to 180TR of heat into the ground. Executionally it was daunting: it involved drilling 180 bores of 100mm diameter down to 80m depth, each bore carrying U-lip HDPE piping of 32mm diameter. By doing away with the use of cooling towers, the ejected heat could be absorbed without consuming water or power for fan motors.

Hurdles without hitches

As one would expect in such a radically different HVAC set-up, there were plenty of technical challenges other than the 'green' measures.

There was the exacting task of selecting chillers for the chilled beams, which had to operate at 16°C input and 20°C output, rather than the normal mode of 7 & 12°C. Additionally, the design required 'dual-mode' standby chillers, that could operate in both chilled beam and normal modes.



Geo-Thermal pipe connection.

Then there was the conundrum posed by the low height of the basement parking areas. If ventilation ducts were placed without due care, it would leave too little headroom for the mechanised car parking systems. Circumventing this obstacle called for ingenious and tedious design work.

Those 3 basements also required ventilation fans for fire smoke. The tender spelt out static pressure of 40mm, which proved to be insufficient. The team's own calculations showed that in fact 150mm was called for. Once again, the technical variation had to be okayed by the consultant and client. This was a recurring and delicate task: making a pitch for technical and commercial approval of design and technical changes while treading softly, to protect the professional relationship.

There was also the need to develop ducting that would remain leak-proof at the 0.6" static pressure, at the inlet of chilled beams. As well as the tedious and intricate task of designing the central plant piping schematic, suitable for the various modes of the chiller circuit.

Sheer execution too posed its share of problems. 3-ton heat recovery wheels and a 3-ton dedicated outdoor air unit had to be hoisted up to terrace level, 35m above the ground, and maneuvered into limited spaces. It could only be done by using a Hydra crane with a chain-pulley block, manned by skilled workers protected by a wire safety net, helmets, life safety jackets and other precautions.

The glories of 'green'

Finally, on completion, Paryawaran Bhawan had achieved total electrical consumption of 14 lakh KWhr (compared to the 22 lakh KWhr of conventional buildings). With its power requirement entirely met by solar cell generation, its net consumption was indeed zero. Target achieved.

The lion's share of that triumph belongs with Voltas, not just for designing and implementing some rather unconventional technologies – like chilled beams and geothermal systems – but also for making a host of other energy-saving choices. Such

Glimpses of the inauguration

Shashanka Tiwari
Execution and Design Head – DPG

Ashwani Kumar Sharma
Zonal Head – DPG

as VFD-driven screw chillers, VFD for all Air Handling Units and cooling towers in the conventional portions of the HVAC, variable pumping systems for chilled water circulation, variable air volume boxes to regulate the air flow in public areas, and BMS programmed to regulate energy usage.

Reflecting that sense of accomplishment are the words of Shashanka Tiwari (Execution & Design Head): "This is a milestone project proving the design capabilities of Voltas engineers." Adds Naresh Bhola (Project Manager): "The project was very challenging in terms of execution, involving several mammoth tasks. It's amazing that we were able to commission it successfully at the first go."

Ashwani Kumar Sharma (Zonal Head) sums up DPG's achievements: "Our Design team once again demonstrated its sound knowledge and skills in the latest HVAC technologies and application engineering. The Site team has been nothing short of perfect in its first-time-right installation. I am confident that with this milestone, our people's confidence will soar, and we will be leveraging learnings from this project in many other jobs to come."

M Gopi Krishna (EVP & COO - DPG) has the last word. "For some years, we have seriously pursued the goal of working towards a 'greener tomorrow'. With Paryawaran Bhawan, we have brought that tomorrow closer for the nation, and helped create ecological history. At the same time, we have taken a bold step forward in our proven 'green' building capability, and secured our place as one of India's foremost practitioners of energy-saving technologies."

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M Gopi Krishna
EVP & COO – DPG

Project highlights:

Total AC area – 120,000 sqft

AC area with chilled beams – 93,000 sqft → Load: 310TR (200 w chilled beams, 110 w primary air AHUs)

Area air conditioned with conventional system – 27000 sqft → Load 130 TR

Ventilation area – 106,400 sq ft (three basements)

Equipment highlights:

Screw chillers:
- 2 x 240TR (one standby) ,
- 1 x 200TR for chilled beams, variable pumping system + cooling towers (for conventional system)

23 x AHUs for chilled beams, 9 x AHUs for conventional system

2 x heat recovery units

376 x chilled beams

Geothermal system: for heat rejection of 180 TR

Ventilation fans : 16 for smoke extraction, 24 for normal ventilation

24 x VAV boxes

BMS system: 2-way PIVC valves + motorized butterfly valves.

3 x air-cooled DX type package units

The Project Team

Ashwani Kumar Sharma Zonal Head – DPG

Bidding

Anuj Gupta	Sr. Sales Mgr
Rahul Sharma	Area Mgr. - Sales

Planning

Shashanka Tiwari	Planning Head
Amit Kumar	Area Mgr. - Planning
Faraz ul Abidin	CAD Engineer

Project

Naresh Bhola	Project Mgr.
Mohd. Sharique	Sr. Project Engineer
Yogesh Gupta	Supervisor

Commissioning

Jagmohan Trehan	Commissioning-in-charge
Durga Singh Rathore	Commissioning Engineer


Naresh Bhola
Project Manager


Mohd. Sharique
Sr. Project Engineer


Amit Kumar
Area Mgr. – Planning


Faraz ul Abidin
CAD Engineer


Yogesh Gupta
Project Supervisor