



HVAC for Delhi International Terminal 3

An artist's impression of Terminal 3 at Indira Gandhi International Airport, New Delhi

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The new Terminal 3 building at Indira Gandhi International Airport, New Delhi is designed as a state-of-the-art, intelligent building comparable to other modern International airports throughout the world. The building will be used for managing both international and domestic flights.

The key objective of IGI T3 project is to build a world class international airport and provide a gateway for passengers coming to India via Delhi. It is predicted to be the third largest terminal in the world (after Dubai International Airport's Terminal 3 and Beijing Capital Airport's Terminal 3) This massive, modern terminal will revolutionize Indian airports and usher the country into the 21st century. The terminal will have Metro connectivity.

The proposed passenger terminal building (PTB) comprises of multiple levels, namely sub-basement, basement, arrivals, mezzanine, departure, CIP & retail, offices, and a hotel. In addition to PTB, two piers – international and domestic extend on both sides of the PTB with 58 loading bridges and nodes / rotundas. Each pier has multiple levels namely apron, arrival, and departure.

The HVAC system is designed for an occupancy level of 33.8 million passengers per annum, covered area of 375,000 m², and equipped with an installed chiller refrigeration base of 20,000 TR. The HVAC plant capacity designed and installed for this project is the biggest in India, so far.

The project is like running a race against time, and will be one of the fastest

completion airport terminals in the world.

The T3 project is slated to be handed over by 31st March 2010 and will be fully functional before the scheduled Commonwealth Games in Delhi.

Special Features of the Building Design

A number of key issues were identified as guiding principles while designing the HVAC system for Terminal 3:

- Safety in use by passengers and staff.
- Durability of HVAC equipment.
- Comfort for passengers and staff.

About the Author

R. K. Sahu is a mechanical engineer (gold medalist) from Pantnagar with 14 years experience, all in the HVAC field. He has been working with ETA Engineering both in Dubai/India for the past 6.5 years. He is currently executing DIAL T3 HVAC project.

- Fully integrated with civil engineering, electromechanical, airport systems, and fire safety etc.
- Energy efficiency.
- Free-cooling concept
- Noise criteria.
- Design based on Seismic Zone V considerations.
- Design of big diameter pipe (1200 & 1000 mm dia) supports.
- Thermal stress generated in pipes of size upto 1200 mm dia.

Energy Control Features

Many features have been added in the HVAC design to meet the requirement of energy efficiency such as:

1. Equipment selection is based on specific use of the building. The heat load is at peak during the day in the domestic terminal and at night hours in the international terminal.
2. The roof of the building will have stylized incisions to allow daylight, but will be angled to protect the interior from direct sunlight. The use of natural light will reduce the dependency on artificial light during daytime and thereby reduce the air-conditioning load.
3. The high side equipment selection is an optimized selection based on hourly analysis of heat loads. High efficiency chillers were selected for the project.
4. High efficiency pumps and fans were selected for the project.
5. AHU's supplied for the project comply with international standards viz EN-1886. Low leakage rates, low thermal conductivity and other aspects have resulted in lower losses and in turn lower energy consumption.
6. Application of effective under-deck insulation has reduced heat load and increased energy saving.
7. Air purification system (APS) provided for reducing volatile organic compounds, which minimizes the fresh air requirement and results in energy saving.
8. Variable Frequency Drives (VFD) equipped on all AHUs to allow running at minimum required RPM, thus resulting in energy saving.
9. Variable Air Volume (VAV) boxes provided wherever AHU is serving multiple zones. VAVs determine the minimum air flow requirements, and results in energy savings.
10. Free-cooling concept was implemented to save energy in the event when outside thermal conditions are lower than indoor design conditions.
11. Secondary chilled water pumping system in combination with Pressure Independent Dynamic Valves (PIDV) were installed to optimize the use of energy in fluid operations.

Work Magnitude

To cater to the HVAC needs of the building, a huge quantum of work is required. It calls for more than 2000 moving equipments, along with all other associated works like air distribution system, electrical, insulation, piping etc. which was counted in terms of hundreds of kilometers. Mammoth quantum of work required the same quantum of design and engineering work.

Control of Inside Comfort Conditions

Air temperature sensors are provided along with all cooling / heating equipments at strategic locations. The signal is communicated to a CMS system. CMS system generates a command for proportionate opening or closing of PIDVs installed in return chilled water line of the equipment, based on the set point chosen by the operator. PIDVs control the rate of chilled water flow from the equipment, as per temperature requirement. Secondary chilled water pumping system is equipped with differential pressure sensors (DPS). DPS gives a signal to pump VFD and allows the pump to run at minimum required RPM. Energy consumption of pumps is also minimized as per inside load variations.

Fresh Air / Exhaust Air System

A dedicated system is engineered and installed to meet the huge requirement of fresh air, in lakhs of CFM, for the comfort of occupants. Treated fresh air units and dedicated fresh air fans are provided. For similar quantities of exhaust CFM requirement, dedicated fans / toilet exhaust fans have been designed and installed.

Outdoor air is allowed to enter inside the building only after being treated in a specialized way. OA is first passed through pre-filter, bag filter, and then Air Purification System (APS). When OA is cleaned from all unwanted dust particles, and volatile organic compounds are reduced, it is allowed to mix with re-circulating air.

Noise Control

All moving equipment is selected for the minimum possible sound level. All plant rooms are examined in detail and acoustic treatment of walls designed. To avoid sound travel inside the ducts, adequate capacity sound attenuators are designed and provided.

Vibration Control

Proper selection of spring isolators for ceiling suspended equipment and vibration isolator pads for floor mounting equipments have been selected to ensure that no vibration is transferred to the building.

Seismic Considerations

All HVAC equipment and services such as ducting, piping etc. are provided with Seismic restraint supports, suitable to withstand Seismic Zone V applicable impacts. This will ensure protection of lives in case of such eventualities. The complete installation is being thoroughly examined and designed to meet this criteria.

Although Delhi is in Seismic Zone IV, this project has been designed for Zone V. This factor alone distinguishes this project from normal air conditioning projects being installed in India.

Special considerations were required for larger diameter pipes and heavy equipment, which are designed and installed with special supporting structural designs.

Fire / Smoke Control

Adequate provisions were designed as a part of the HVAC system such as motorized smoke-cum-fire dampers (MSFD), dedicated smoke extraction fans, staircase pressurization, lift/lift lobby pressurization etc. These systems were designed to meet

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stringent fire safety requirements, such as NFPA and local fire regulations requirement. Smoke extraction systems are precisely selected as per results of Computational Fluid Dynamics – Fire model (CFD) analysis. MSFDs are provided at all fire rated partitions. Masonry / fire rated ducts are installed for smoke removal from fire affected areas to ensure normal working is possible in adjoining areas.

Cooling Water Treatment

A pre-engineered chemical system is designed to remove mill scale, dirt, kill bacteria etc. and to provide a protective corrosion resistant layer on the inside surface of piping. Automatic chemical dosing system will be provided to minimize corrosion, biofilm prevention, preventing scale deposition and to control the water quality / chemistry. This will maintain the chilled water and condenser water PH and total dissolved solids as per requirements.

Central Monitoring System

For effective monitoring, control, and operation of such a big HVAC system, a complete CMS network was designed for the implied needs. The magnitude of CMS works can be visualized from the fact that more than 30,000 I.O. points were required in the design.

Difference between Normal and T3 Project

1. The high side equipment selection is based on an hourly analysis of heat load requirement of the building in consideration of the building use. The load in the domestic area of the airport is higher in day hours, while on the international side, it is higher during night hours, in spite of having favorable outdoor conditions.

2. Although Delhi is in Seismic Zone IV, this project has been designed for Zone V. This factor distinguishes this project from normal air conditioning projects being installed in India. It plays a vital role in designing and installation of the HVAC system.

3. The insulation material designed and installed on this project has a higher R value than specified in the NBC. This increases the energy savings.

4. Return air ducts were designed and installed extensively to minimize energy consumption.

5. The latest concept of making use of ductless jet fans was widely used in the design of smoke removal.

6. Tempered cooling concept is widely used in design and equipment selection instead of ventilation units for non public areas / equipment rooms. This concept minimizes the space requirement for the ventilation equipment, adding to energy saving while maintaining better comfort conditions in the area.

Conclusion

Overall, designing of the HVAC system for the biggest project to date on Indian soil has been a challenging, exciting and complicated affair. The rich experience of designing a world class project has brought in vast knowledge to the country, uplifted the manufacturing standards and developed a design base which will open avenues for bringing about a revolution in the way future projects will be designed in India. ❖

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