



Chicago Board of Trade

Located in the famous Loop commercial center, the 600-foot-tall Chicago Board of Trade Building (CBOT) houses the world's oldest futures and options exchange. Until recently, the building also housed a pair of aging built-up systems that were beginning to worry management. Due to their location, replacing these systems would be a virtually impossible task. But a difficult retrofit job was greatly simplified by the modular design of FANWALL TECHNOLOGY[®] by Nortek Air Solutions. Despite limited access to the mechanical room, there was no need to knock down walls or make other significant structural changes.

Designated a National Historic Landmark, the 45-story CBOT Building is an Art Deco structure consisting of two towers. For many years, the air-handling system—including two large supply fans and two return fans—provided airflow for floors 10 to 23 in each tower. Installed in 1970, these old air handlers were becoming a cause for concern at CBOT. Maintenance costs were increasing; moreover, building owners wanted to ensure uninterrupted HVAC service to traders and tenants.

AT A GLANCE

- Rising maintenance costs and the higher probability of an HVAC system failure provided ample support for replacing aging built-up air handlers installed in 24th floor mechanical rooms.
- Access restrictions and uptime requirements eliminated options to fully replace the air handlers or use similar fans.
- Modular fan array system using FANWALL TECHNOLOGY allowed contractors to replace blowers and coils without significant structural demolition and reconstruction.
- Retrofit completed over weekends and holidays with little or no interruption to normal operations.
- Tenants and building management now benefit from a much quieter system, redundancy to avoid downtime, and VAV control on each floor to improve overall system performance.

Deciding to replace the old coils and fan systems may have been easy, but carrying out the task posed unique challenges for the general contractor, Alps Construction and the mechanical contracting firm, Competitive Piping Systems Inc. (CPS), Chicago. “The age of the building, the location of the equipment in the building, the need to keep the old system operational with a single weekend cut-over, and access were the most unique items about the retrofit,” said Adam Smith, project manager, Alps Construction. The initial problem centered on how to move equipment to and from two mechanical rooms that house the air handlers, which are located on the 24th floor. The only access to those rooms is through a door that leads into tenant office space where electronic trading and other important activities take place.

The contractors knew they had to find another way to get men and equipment into and out of the mechanical rooms during the project. They developed a different route, one that lead into the mechanical room through a small exterior opening cut to the outside and then down to a subroof on the 23rd floor.

The difficulties involved in moving equipment via this route played a big role in the choice of new airhandling equipment. The original plan was to replace the old units with something similar, but given the access limitations, that idea no longer seemed feasible.

“The original blowers were extremely large,” said Tom Muraski, vice president of Competitive Piping Systems. “In order to get something that size into the building, we would have had to take out walls. It would have been a massive undertaking.”

Photo by Antoine Taveneaux



Modular System Delivers 470,000 cfm

So instead of large conventional fans like the old ones, the team chose a modular fan system. A FANWALL® system consists of a number of individual cube-shaped cells, each of which houses a fan, motor and electrical connections. The number and configuration of these relatively compact cells depend on the application and its requirements. “The FANWALL components were of a manageable size to allow us to work around the existing equipment that remained in the penthouse and gain access through standard doors,” said Smith.

Because the modular fan system could be installed cell by cell, no significant structural changes were needed. With FANWALL fan cubes, “we could bring the system up in small pieces and build everything onsite,” said Muraski.

FANWALL systems are customconfigured by specifying the number of fans, as well as fan operating speed (rpm) and wheel width and diameter. This allows each system to be optimized for maximum efficiency.

For this job, Environmental Systems Design, a global consulting engineering firm headquartered in Chicago, worked with Midwest Applied Solutions of Hillside, IL, the Huntair manufacturer representative, to design two identical fan systems totaling 470,000 cubic feet per minute (cfm). Each system consists of a 130,000 cfm supply array made up of 21 FANWALL cells and a 105,000 cfm return array made up of 15 cells. The cells measure approximately 3 feet by 4 feet and weigh about 400 pounds.

One by one, CPS personnel brought the 72 fan cells up to the 23rd floor using a dolly. Then the installers moved the cells outside onto the sub-roof, where scaffolding and a hoisting rig lifted each cell up to a catwalk next to the mechanical

room on the 24th floor. Finally, a construction worker wheeled the cells into the mechanical room through the temporary hole in the wall.

HVAC Service Continues Uninterrupted During Workdays

Another factor in the complicated installation was the requirement that airflow to floors 10 to 23 in both towers never be turned down during normal business hours. To meet this requirement, CPS divided the project into phases. First, while the existing supply fans were running, technicians demolished the old exhaust fans and replaced them with a new FANWALL supply system. Piping ran through the space designated for the new fan array, but this presented no problem, thanks to the flexibility of the modular system. The array was simply split into two parts, one part five cells wide by three high and the other two cells wide by three high, allowing piping to run in between.

The modular design of FANWALL systems provided the ideal fan replacement solution by removing access barriers to the existing air handlers located in two mechanical rooms on the 24th floor of the CBOT building.





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Once the supply FANWALL systems were in place, CPS switched over power and ductwork to the new FANWALL array, which began functioning as the new supply system over the weekend. Finally, the contractor demolished the old supply fans and replaced them with a FANWALL® array for the exhaust system.

The entire job, which included installing new coils and dampers, took about three months. All system shutdowns and startups occurred during nights, weekends and holidays so that the project wouldn't disrupt building operations during normal business hours.

VAV boxes Allow Floor-By-Floor Control

Now operational in the two towers of the CBOT Building, the FANWALL systems produce a uniform piston of air that creates a uniform velocity

profile at the unit coils and filters, as well as throughout the unit's airway path. This uniform airflow profile reduces static pressure drop due to turbulence and system effects.

The FANWALL motor-control panels include three active variable-frequency drives (VFDs), each of which controls a third of the 21 motors in the supply array. The supply systems also include one redundant VFD wired for automatic switchover in the event of a VFD failure.

In addition, the new airflow systems are equipped with a full complement of variable air volume (VAV) boxes that allow airflow control on each floor served by the systems. The old airhandling system did not include VAV boxes for all floors. On floors without VAV boxes, static pressure would build up at certain times of the year with no way to relieve it.

Multiple Fan System Prevents Mission-Critical Failure

The identically sized fans and motors that make up a FANWALL array operate in parallel to create the same airflow rate (cfm) as a single, larger fan sized for the same duty. Due to this system redundancy, a fan/motor failure is only a high-priority maintenance issue rather than a mission-critical failure that disables the entire airhandling system.

If one fan motor fails during operation, the VFD and control system increase the speed of the other motors so overall system performance can be maintained at the same level until the failed motor is replaced. Losing one fan doesn't noticeably affect the system's operation. The modular design also simplifies maintenance. For example, each fan motor is much smaller than those required by systems with large plenum fans. Further reducing maintenance, the direct-drive design requires no belts or sheaves. Nor does it require fan bearings, the HVAC component most likely to fail or deteriorate over time. The fan assembly also eliminates lubrication requirements with permanently sealed motor bearings.

Low-Frequency Rumble No Longer an issue

In the mechanical rooms of the CBOT Building, small fans operating at relatively high speeds produce less of the particularly troublesome low-frequency noise than lower-speed larger fans sized for the same airflow and static pressure. The modular fan design also benefits from careful attention to balance within each of the fan wheels, which significantly reduces vibration. Another key to noise reduction, a Coplanar Silencer® surrounds the fan and motor of each fan cube with acoustically absorbent material to greatly reduce airborne noise at the source.

“I remember being in the mechanical rooms with the old fans running and having to yell at everyone at the top of my lungs. Now we can have a piano recital up there if we want to,” said Joe Kurcz, sales engineer for Midwest Applied Solutions.

In addition, the footprint of the FANWALL system is about half the size of the old fans, which has opened up about 600 square feet of additional space in each of the mechanical rooms. “We literally gave them their mechanical rooms back,” Kurcz added.

Now, the building's tenants and visitors benefit from an HVAC system that delivers better performance and reliability. Giving up an old, unwieldy fan system for a modular FANWALL system was definitely a “good trade” for the Chicago Board of Trade Building.

Retrofit Vs. Replacement

For air handlers that are reaching the end of their service life, replacing existing fans and other components can be the most cost-effective solution for avoiding the cost and business disruption of an air handler failure. Access limitations are a barrier to many replacements because they cannot be accomplished without the time and expense of a major demolition and reconstruction project. FANWALL® systems can minimize these and other barriers.

- An air handler cabinet can retain its integrity well beyond fans, coils and other components, allowing it to be retained.
- The modular design of FANWALL systems allows individual cubes to be navigated through a standard 3-foot door and assembled inside the existing air handler cabinet.
- There is no need to have a crane on site as is often the case with larger conventional fans.
- The performance of the new system can be upgraded to better match actual capacity and airflow requirements.
- Ancillary components such as sound attenuators and air blenders that created static pressure penalties in the old system can be removed.
- Design flaws and other maintenance concerns – such as component access issues and corrosion – can also be addressed, essentially resulting in a new, more efficient air handler in an old skin.
- All of this often can occur over a weekend or during unoccupied time frames to minimize downtime or disruption of normal business.



For more information or to explore retrofit opportunities for your fan systems, contact your local Huntair representative. To locate your representative, visit www.nortekair.com.