



## Schermerhorn Symphony Center

### Case Study

*Properly staged: Knock-down air handlers with FANWALL TECHNOLOGY® simplify retrofit, help Symphony Center recover from flood*

During the first two days of May 2010, a nearly 14-inch downpour fell on “Music City USA” and the Cumberland River burst its banks, causing the worst flood in Nashville’s history. Among the businesses that suffered terrible losses during the flood was Schermerhorn Symphony Center, completed just four years earlier and home of the Nashville Symphony. Floodwaters rose too fast for officials to take preemptive action and musical instruments as well as mechanical systems in the basement were destroyed. To replace a number of damaged air handlers, the mechanical contractor chose knock-down air handlers with FANWALL TECHNOLOGY from Huntair. Besides providing the necessary airflow for the Symphony Center, the air-handler system helped the contractor meet the job’s formidable challenges for access, space-saving, and acoustical excellence.

#### Music stops at Symphony Center

Designed as a world-class symphony hall, the 197,000-square-foot, 1,844-seat neoclassical building sustained about \$40 million in damages—mostly in the basement and sub-basement. When the river crested, the force of the rising water table cracked the basement floor. “We had too much rain too fast; there was nowhere for it to go,” said Eric Swartz, associate vice president of venue management, Nashville Symphony. “The water penetrated through the walls and the floors.”

Because the water rose so fast and unexpectedly, there wasn’t time to retrieve the musical equipment stored in the basement, which filled with 22 feet of water overnight. The most officials could do was turn off electrical power. Two concert grand pianos were destroyed, as well as the console and blower for the \$2.5 million Martin Foundation Concert Organ, a state-of-the-art catering kitchen, all of the building’s electrical equipment and many prized orchestral instruments.



#### At a Glance

- Custom air handlers at Schermerhorn Symphony Center in Nashville are damaged beyond repair in a May 2010 flood.
- Like-for-like replacement would require major structural demolition and reconstruction, and leave facility vulnerable to future floods.
- Knock-down air handlers with FANWALL TECHNOLOGY from HUNTAIR were brought into the space in individual pieces through an existing outdoor air opening 20 feet below grade.
- Space savings provided by FANWALL TECHNOLOGY allowed air handlers to be reconfigured to fit on a platform 6 feet above the basement floor to help avoid a recurrence of flood damage.
- Acoustic performance of HUNTAIR air handlers exceeds that of the extremely quiet air handlers that were replaced.
- Facility re-opened in time for a New Year’s Eve performance by world-renowned violin virtuoso Itzhak Perlman.

In addition to this heart-wrenching damage, floodwaters completely submerged ten of the building's 11 air-handling units, which were custom-designed to provide efficient airflow at the lowest possible sound levels. Everything was replaceable; the challenge was how to complete the job efficiently and quickly and so that such damage would never happen again.

Nashville Symphony officials had seven months to complete the task. A grand re-opening was scheduled for New Year's Eve, when world-renowned violin virtuoso Itzhak Perlman was scheduled to perform.

### **Knock-down configuration a must**

Nashville Symphony hired American Constructors Inc., the locally based firm that built Schermerhorn Symphony Center, to oversee the immense retrofit project. The mechanical contracting firm, Lee Company, Franklin, Tennessee, was responsible for the removal of the old equipment as well as installing new air-handling systems.

The original air-handling system utilized single large plenum fans and motors in custom cabinets. The six units serving the performance hall were stacked top-and-bottom units because of the extra space required for the plenum fans. All of the units had to be cut out and removed piece by piece. With the location 20 to 30 feet below building grade, it would have been impossible to bring in motors or fan wheels to match the original units without knocking down one of the Symphony Center's beautiful neoclassical exterior walls.

According to Jimmy Grun, senior project manager, Lee Company, the new air-handling units had to be compact enough to meet the space needs of a new flood-remediation scheme and quiet enough to measure up to the Symphony Center's stringent noise criteria. And it had to be done



*Named in honor of the late Maestro Kenneth Schermerhorn, who led the GRAMMY® Award-winning Nashville Symphony for 22 years, Schermerhorn Symphony Center is home of the Nashville Symphony.*

quickly. "It was two-and-a-half months before the area was considered a clear zone, and that left four months to complete the job," he said. "Our real limitation was that we needed a unit that we could install in pieces through a grated outside air opening."

Grun found his answer in a modular knock-down air handler from Huntair. The custom-designed knock-down units are manufactured and assembled at the Huntair factory to ensure fit. The unit is then disassembled and each part is labeled prior to being shipped to the job site for easy reassembly. This feature allowed the construction crew to easily identify each part for any given air handler they were working on, making jobsite coordination and scheduling much simpler and helping to meet project deadlines.

Integral to HUNTAIR air-handling units is FANWALL TECHNOLOGY®—an array of smaller fans and motors in individual cube-shaped cells, each of which houses a fan, motor and electrical connections. The number and configuration of these compact cells depend on the airflow and static pressure requirements of the particular air-handling application. Custom

FANWALL® systems are configured by selecting the number of fans, as well as operating speed (rpm) and wheel width and diameter. This allows each design to be optimized for maximum efficiency.

"When we learned about all the benefits of HUNTAIR knock-down units and FANWALL TECHNOLOGY, we didn't even vote on it," said Swartz. "We all just said, 'Yeah, let's get that.'"

Because they are delivered completely knocked-down, all of the air-handler pieces were brought into the building through the grated air opening 20 feet below grade. The individual pieces—fans, panels, and other components—were lowered using a lift crane. The modular FANWALL cubes were moved individually into position without requiring any building damage and then stacked on site into the appropriate configurations. "This project was a mega version of Extreme Makeover," said Grun, referring to the popular ABC TV series. "But the knock-down units and FANWALL TECHNOLOGY made the task a lot easier. I'd call them construction-friendly."



The manufacturer's representative firm, Tom Barrow Co., supplied the air handlers for Schermerhorn Symphony Center. "FANWALL TECHNOLOGY® turned out to be the perfect solution for the project, since all of the fans could be brought down in their cubes individually," said Jacob Blystone, outside sales. Tom Barrow Co. also designed the custom configurations for the 10 separate locations afforded for the Symphony Center's mechanical system. After approximately 6,000 man-hours, 18 truckloads of palletized equipment were assembled into 10 new air handlers in the Symphony Center's mechanical rooms.

### Design features keep noise down

"Symphony Hall is an acoustically perfect little building," said Swartz. "The reason the building works as well as it does is because everything that makes noise is buried in the basement. Our original air-handling units were extremely superior pieces of equipment, with, among other things, double-lined ductwork to stop noise and vibration. However, those units were placed in the building when it was still a hole in the ground, so in addition to the retrofit issues, we needed something quiet."

Using Preferred Noise Criteria (PNC), an indoor noise measurement system, the Symphony Center's designers required a low PNC-30 in the areas surrounding the performance hall and an extremely low PNC-10 in the hall itself. To reach these levels, the original air-handling units had four-inch-thick panels with fiberglass insulation between two sheet-metal layers. Similar noise-attenuating panels are installed in the ductwork connected to the air handlers.

"Using FANWALL TECHNOLOGY, the units meet or exceed the acoustic specs of the previous units and perform exceptionally well from when we turned them on," said Swartz. Small fans operating at relatively high speeds produce less of the troublesome low-frequency noise than lower-speed larger fans. Careful attention to balance of the fan wheel in each modular FANWALL cube



*Even though they were brought into the mechanical room in piece parts, the installed HUNTAIR® air handlers looked as if they had been factory-assembled.*

significantly reduces vibration. Another key to noise reduction is the patented Coplanar Silencer® of each FANWALL® cube, which surrounds the fan and motor with acoustically absorbent material to greatly reduce airborne noise at the source.

In most octave bands, the units with FANWALL TECHNOLOGY were more than a 15 dB improvement over the Symphony Center's old air handlers. As a result of this superior acoustical performance, Tom Barrow Co. was able to eliminate over 25 percent of the sound-attenuation structure installed in the ductwork of the air-handling systems, according to Blystone. In addition, the six air handler systems serving the performance hall required much less sound-attenuating paneling than their much larger "stacked" predecessors.

### FANWALL TECHNOLOGY: A wall of efficiency

The operating characteristics of a FANWALL system make it much more efficient than the single double width, double inlet fans it replaced in the Symphony Center's mechanical system. 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 losses due to turbulence and system effects.

By using FANWALL TECHNOLOGY, Tom Barrow Co. could redesign the stacked units into single-level units. That's because of the amount of "airway length" required by the two different fan systems. "The old air-handling system, with a single large plenum fan, may have required a six-foot-long

fan section and another four feet of downstream length for the proper air pattern to develop," said Blystone. "A configuration of smaller FANWALL® fans can require less than half that length for the same purpose."

The vertical space gained by the new configuration will help the center deal with future flooding. The new HUNTAIR air-handling units with FANWALL TECHNOLOGY® sit on structural steel platforms raised six feet off the floor of the mechanical rooms. Turbine pumps installed in the spaces beneath the units will allow those spaces to be used as sump pits in the event of a future flood. Thanks to these sump pits, enough water can be removed from the building so that a flood twice as large as the May 2010 event will not damage mechanical or electrical equipment.

### System redundancy boosts reliability

Perhaps no advantage of FANWALL TECHNOLOGY is more important than its superior reliability. Multiple identically sized fans and motors operating in parallel to create the same airflow rate (cfm) as a single, larger fan sized for the same duty provides inherent redundancy. As a result, a fan/motor failure is only a high-priority maintenance issue rather than a mission-critical failure that disables the entire air-handler.

"With the original design, if a motor were to fail during operation, the Symphony Center would be out of luck," said Blystone. "First, it would take time to get a new motor. Then they would have to rent a crane to get that motor into the mechanical room." With a FANWALL system, however, such an occurrence causes no air-handler downtime. In fact, it doesn't

even affect output. If one of the motors fails during operation, the variable-frequency drive and control system can increase the speed of the other motors so that overall system performance can be maintained at the same level until the failed motor is replaced.

Maintenance is also made easier by the FANWALL TECHNOLOGY design. "If a five-horsepower motor goes out, it's a lot easier to replace than a 100-horsepower motor that weighs 1,000 pounds," said Blystone. To further reduce 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.

### A standing ovation for HUNTAIR knock-down air handlers and FANWALL TECHNOLOGY

"This was definitely a project that was staged properly," said Swartz. "Not only did we meet some tough requirements, but everything showed up on time and on demand. Nobody wanted this disaster, but we now find ourselves way ahead of any replacement cycle we would have gone through. We haven't proven it yet, but we're hopeful that the efficiency of the FANWALL system is better than a traditional unit and that our real payoff is down the road with reduced energy costs."

The grand re-opening and New Year's Eve concert were a hit. With renowned violinist Itzhak Perlman as guest soloist, attendees enjoyed renewed appreciation for the restored Schermerhorn Symphony Center.

## The Perfect Fit For Challenging Fits

HUNTAIR knock-down air handlers with FANWALL TECHNOLOGY allow you to replace aging or end-of-life air handlers with even the most severe access limitations. Units are fully assembled to verify fit and function. They are then sent to the site for disassembly, or they can be disassembled at Huntair into sections or components (down to the piece part) before being palletized for delivery to the jobsite. Each delivered component is numbered and labeled according to detailed assembly drawings for reassembly at the jobsite. Options for factory supervision of the rebuild and contractor training further enhance the rebuild process at the jobsite.

Benefits of HUNTAIR knock-down air handlers include:

- Expertise and processes developed over thousands of applications help you minimize downtime.
- Components and parts, including the FANWALL cubes, can be navigated through standard 3-foot doors to minimize any cost or disruption from structural demolition and reconstruction.
- The space savings resulting from using a FANWALL system can allow mechanical space to be reconfigured.
- Ancillary components such as sound attenuators and air blenders may also be removed for further space savings and to eliminate static pressure penalties.
- The performance of the new system can be upgraded to better match actual capacity and airflow requirements.



[www.huntair.com](http://www.huntair.com)  
[info@huntair.com](mailto:info@huntair.com)

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