

Reaching New Heights with Radiant

Boston churchgoers receive a warm reception following wet heat retrofit

In 2009, one of Boston's better-known buildings embarked on a multi-phase renovation project designed to implement structural, aesthetic,

and energy improvements.

The recent harsh winter presented comfort problems at Church of the Covenant. Upon entering the sanctuary, church-

goers could borrow a shawl for the duration of the service. Tuning the huge pipe organ was also a challenge, since it needs to be 65°F to operate as intended.

The big church, which was completed in 1867 and stood 240 feet high, held the title of tallest building in Boston for 48 years. While the massive stone church has aged gracefully, its original single-pipe steam system hasn't, and neither did the collective members' tolerance for sitting through cold worship services. And, those who oversee the treasury were losing patience with the inflated operating and maintenance costs.

Recently, the church's method of keeping fuel costs in check was to maintain 50°F inside all winter, only turning the temperature up in the cavernous sanctuary once a week, five hours prior to Sunday worship service. Needless to say, the floor and thick pew benches never had time to warm up before church goers arrived.

When church managers began comparing heat delivery options initially, in-floor radiant continually trumped perimeter radiators in performance and appearance. While it came with a higher upfront cost, the radiant option meant no disturbance along the walls of the sanctuary — a key advantage considering the building's national historic landmark designation. After



SKYSCRAPER: Rick Calhoun (left), mechanical engineer, SED Engineering; Mike Oppel (middle), heating sales, Emerson Swan; and Ray Circys (right), operations manager, Farina Corp., Charlestown, Massachusetts, stand outside the historic church.

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CUT TO SIZE: A Farina Corp. technician uses a router to cut a channel for the PERT tubing. At roughly 10 gallons per minute per manifold, the Watts Radiant system emits 20-35 Btuh per square foot.

FIELD SOLUTIONS

all, in the 1890s, the 7,000-square-foot room was redecorated by Tiffany Glass and Decorating Co.

In-floor heat bested perimeter radiation from a practical standpoint, too. Inside the cavernous church, the existing steam radiators sent most of their heat upward, toward the structure's magnificent arched ceiling. The interior pew areas remained cold. Converting the radiators to hot water or installing baseboard radiators would result in similar conditions.

"Some churches with high ceilings, such as this one, use destratifying fans in conjunction with radiators in order to push the heat down to the floor," said Brian Reardon, church administrator and building manager. "We didn't want to detract from the beauty of the place with fans."

Another consideration was the noise that radiators make. The acoustic quality of the sanctuary makes it an excellent venue for concerts, but the tinkering, banging radiators had always been a distraction."

What finally spurred the replacement of the heating system was the need for new floor tiles in the sanctuary. Replacing the floor and the heating elements at the same time made sense, and the decision was made to go with radiant since the pews and flooring would be removed, regardless of the system.

FAST TRACK

"We're only concerned about the conditions of the first 9 feet off the floor; the temperature up at the gables isn't of interest," said Rick Calhoun, mechanical engineer at SED Associates in Boston, who was hired to design the big radiant system. The multidiscipline firm employs 12 full-time engineers and has been applying its MEP/FP focus to all industries, from defense to health care, for the past 42 years.

"I first talked to Reardon in December of last year," continued Calhoun. "The design phase for the new system began in early January." A few short weeks later, the job went to three installing contractors for bid. By the second week of March, Charlestown, Massachusetts-based mechanical contractor Farina Corp. had men in the mechanical room while GreenEdge Builders, the general contractor, removed church pews and stripped the old flooring.

Farina Corp., a 15-employee residential, commercial, and industrial mechanical firm, had installed water-source heat pumps at an adjacent building owned by the church 20 years ago.

The company's held the property's service contract ever since. As a result, the company's techs already knew the old system and some of the challenges the retrofit was likely to present.

To get a comprehensive building envelope condition assessment, the congregation contacted Spencer & Vogt Group, a Boston company that specializes in architectural preservation. Through each phase of the building's renovation — culminating with the heating system retrofit — Spencer and Vogt was involved.

"We started working with the church in 2009," said Lynne Spencer, principal of the firm. "Among many other things, we helped the church gain recognition as a national historic landmark. As far as the heating system was concerned, one of the largest challenges from our standpoint was selecting a flooring material that both worked with the radiant heat and didn't disrupt the historic integrity of the magnificent space. The new cork floor fits the profile."

LOSE THE RADIATORS

The goal was to have the sanctuary back together by Easter; April 20. With a hands-on engineer, help with equipment specification from manufacturer's representative firm Emerson Swan Inc. and a mechanical contractor familiar with the site, the church's lofty goal was becoming more realistic.

Without delay, the old 700-MBtuh steam boiler and radiators were removed. Meanwhile, upstairs, the brunt of the work was taking place.

"After the general contractor had the pews removed and the floor stripped, we started laying the Watts Radiant SmartTrac™ radiant panel system," said Ray Gircys, operations manager, Farina Corp. The composite modular panel system has pre-cut grooves for 3/8-inch PERT or PEX tubing and is stapled and/or adhered to the subfloor.

"We've used a number of different panel and track systems for radiant jobs where pouring a slab isn't an option, but this one is at least 25 percent faster than the next best," added Gircys. "The guys laid only 10 panels the first day while they figured it out, but, after that, the install flew."

Structural pillars throughout the sanctuary created obstacles for placement of the panels, but utility panels with a checkerboard pattern were used in these areas. A router was used to cut random grooves where needed.

Watts Radiant RadiantPERT™ tubing was cut into 250-foot



RACING TOWARD RESURRECTION: Barely five weeks after the retrofit project began, the Church of the Covenant sanctuary was reassembled in time for Easter service.



MIXED HYDRONICS: Mike Oppel (left), heating sales, Emerson Swan, and Ray Gircys (right), hang a pre-manufactured Watts radiant Hydronex Panel in the church's basement.

loops, and workers simply walked it into the panel grooves. All loops stemmed from four stainless steel manifolds.

"At design temperature, the supply water is 122°F. During normal operation, temperatures are between 100° and 110°, depending on the outdoor reset," said Calhoun. At roughly 10 gallons per minute (gpm) per manifold, it results in 20-35 Btuh per square foot."

The installation of the panel system progressed without a hitch because of the design work that Calhoun did on the front end to locate the manifolds properly.

But, radiators weren't written off entirely. A 10-by-2-foot wall-mounted Runtal radiator adds

supplementary heat to the choir loft, and the large foyer has four similar radiators. The floor in these areas wasn't disturbed, so adding in-floor heat wasn't ideal.

DESIGN CHALLENGES

"The biggest challenge came while we figured out where to place the radiant manifolds, and how to route 1-inch pipe to them," said Calhoun. "A day shelter occupies the space beneath the sanctuary. Because those areas had just been refurbished, we wanted to avoid cutting into the ceiling."

Luckily, there were numerous lower-level storage and mechanical spaces. These allowed the manifolds to be placed around the perimeter of the sanctu-

ary. So, upstairs, the 40 radiant loops spread inward toward the center of the sanctuary from four points along the side walls.

While the boiler room was being piped and the PERT was going down, a few Farina technicians followed Calhoun's drawings to sort out the venting challenge for the two new HTP condensing boilers. As with most historical buildings, Church of the Covenant presented some roadblocks when it came time to route vent and supply air piping. Not only did Calhoun need to maintain the unaltered 1867 façade, but the thick stone presented challenges of its own.

By penetrating only one block wall inside the church, Calhoun



VENTING SOLUTIONS: The design team was challenged with how to vent the boilers in such a huge, solid stone structure.



CIRCULATORY SYSTEM: Four large stainless steel manifolds provide circulation to the radiant system below Boston's Church of the Covenant's cavernous sanctuary.

was able to access a stairwell. From there, he was able to hide the vent pipes behind one of the building's large buttresses.

The boilers' installation requirements called for the exhaust and intake pipe to be located 4 feet from the nearest inside corner. There was simply nowhere on the building where the vents could be hidden while still conforming to the instructions. So, Calhoun sketched the pipe layout, including distance from the nearest inside corner and the height differential between the intake and exhaust pipes, and sent it to HTP for approval. Not long after, he received confirmation that his design met all safety and operating requirements.

BOILER ROOM

In place of the large steam boiler, two 199-MBtuh HTP Elite FT boilers hang on the mechanical room wall. The condensing boilers were set up in a lead, lag, and rotate configuration. One Taco Inc. 0013 circulator provides circulation through each unit.

Two pre-manufactured Watts Radiant Hydronex® panels provide plug-and-play operation near the boiler piping — one for the radiant system and one for the baseboard zones. Each panel is produced in the factory to the design engineer's specifications. Under the protective metal shroud lies all near-boiler components, including the circulators, zone valves, a Taco 4900 air

separator, etc. Once on location, the panels were simply hung on the wall and sweated to supply and return piping.

Two forms of radiation call for a two-temp system. The boilers supply 180° for the baseboard — fluctuating slightly depending on outdoor conditions. From that supply, an injection pump draws just enough water to maintain optimum radiant loop temperatures.

Each Hydronex panel includes four Taco 0015 pumps — one for each zone. "All Taco components, as well as the Watts Radiant material and boilers, were specified with the help of Mike Oppel, an outside salesman with Emerson Swan," said Calhoun. "It's always a pleasure working with Emerson Swan because of the level of service and support they provide to both engineers and installers."

BEFORE PALM SUNDAY

"The job took a good bit of manpower on our part," said Gircys. "But, thanks to a solid design, great drawings, and a good general contractor, it went off without a hitch. I really didn't envy the guys who had to put the pews back in, though. We marked off the loops on the walls, but the carpenters really had to have their wits about them when they started sinking anchors."

In all, the sanctuary uses 10,000 lineal feet of PERT tubing at 8-inch centers. At 5/8-inch thickness, the SmartTrac panels don't create a challenge when fastening items to the subfloor below.

Eight days before Easter, Farina Corp. had the sanctuary cleaned up and ready for the general contractor to reinstall

the pews. Temporary heat was used for the big Easter service until the new system could be inspected and put into service.

"Before the retrofit, the sanctuary just wasn't comfortable," said Reardon. "I guess we'll have to wait until next winter to really put the new system to the test, but we expect handing out shawls to be a thing of the past, just like the tuning challenges on the pipe organ. And, of course, we're looking forward to the rebate from the gas utility for the boilers." **N**

Information courtesy of Dan Vastyan, an account manager and writer for Common Ground. Vastyan writes about HVAC, hydronic, plumbing, mechanical, radiant heat, geothermal, solar, and broad building systems industries. For more information, call 717-664-0535 or email cground2@ptd.net.

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