Hydronic Systems Case Study Library

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The Science of Comfort™

Project: **Ogden High School**

Location: **Ogden, Utah**

Project Cost: **$48,823,000**

Square Footage: **8,000 ft²**

Architect: **EDA Architects Inc.**

Mechanical Engineer: **Colvin Engineering Associates, Inc.**

Price Representative: **Midgley-Huber, Inc.**

The Challenge: Built in 1936, Ogden High School relied on noisy unit ventilators for cooling. The project mandated that the art deco façade of the building be maintained, meaning that the renovations required to lower ceilings and allow ductwork would not be possible. The temperature extremes in Salt Lake City also meant that comfort would be a significant concern. With spaces like the Commons Area accommodating 600-800 people at one time, the design team wanted to ensure that the students would not be hot or uncomfortable, and that the HVAC system could adapt to large variations in occupant load.

The Solution: Price Active Beams were able to meet the comfort requirements of the space without disrupting the aesthetic of the building. The piping requirements were easily incorporated into the existing structure of the school, eliminating the need for extensive renovation. After the beams were installed, the occupants reported that they loved how quiet the system was and were impressed with the high level of thermal comfort and the virtual elimination of cold drafts. In the Commons Area, the beams were attractively integrated into the 16-foot high cloud ceiling. The system has also proven to be extremely low maintenance, which was an important consideration for the school custodians.

Project: **Gensler Los Angeles Office**

Location: **Los Angeles, CA**

Square Footage: **45,000 ft²**

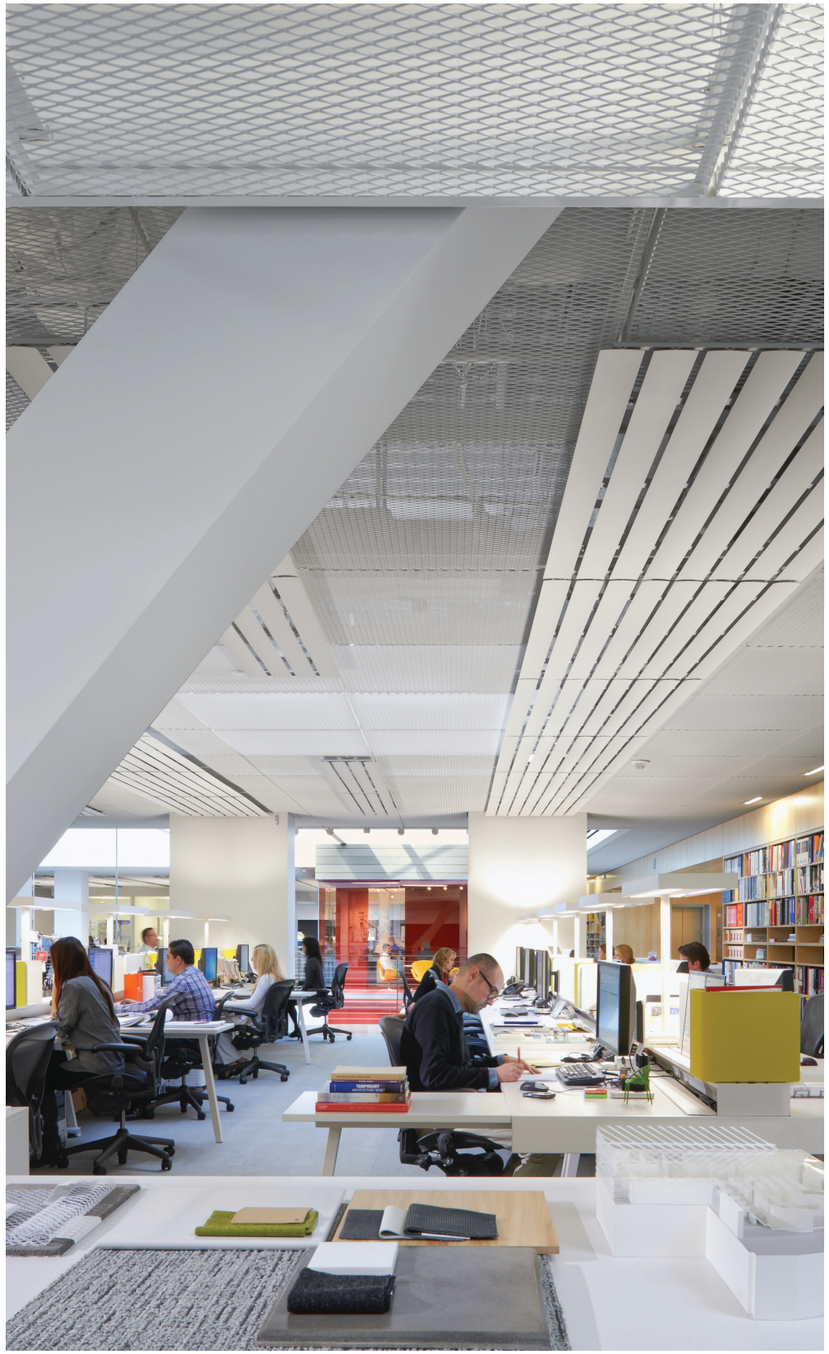
Architect: **Gensler**

Mechanical Engineer: **Glumac**

Price Representative: **Norman S. Wright / Airelink Mechanical**

The Challenge: When Gensler, one of the world's leading architecture firms, designed their new Los Angeles office, visual elegance was of the utmost importance. However, the air distribution solution also needed to be functional, providing a comfortable space that would promote creative thinking and cutting-edge design. The conference room was going to be used as a video conference area, which put strict noise requirements on the mechanical system. Energy efficiency was also a goal, with Gensler hoping to reduce energy consumption below California Title 24 standards.

The Solution: The employees at Gensler's L.A. Office spend their careers creating beautiful spaces for people to work and live in, and require a workspace that will be conducive to creativity and collaboration. In the open office area, Price Chilled Sails were used to create a space that would allow free expression of ideas, balancing comfort and energy efficiency through sustainable design. Round floor displacement diffusers were used to supply the space with clean, fresh air, while also minimizing energy use. In the conference room, active beams with slimline coupling were integral in providing a continuous, pleasing look. The beams also fulfilled the room's tight acoustical requirements, eliminating the need for an oversized mechanical system. Together, these solutions help Gensler's L.A. office to serve as a model workplace of the future, providing inspiration to those who inspire us.



Project: **130 Bishop Allen Drive**

Location: **Cambridge, MA**

MEP/FP: **SMMA**

Architects: **HMFH Architects Inc., Ruhl Walker Architects, Anderson Porter Design**

Price Representative: **Buckley Associates, Inc.**

The Challenge: The retrofit of this facility's structure and mechanical equipment was initiated to facilitate the development of a multi-tenant commercial space. The low ceiling heights presented a significant challenge and required a creative solution that minimized ductwork. The goal was to keep the design as flexible as possible for the widest range of appeal to prospective tenants, while ensuring energy efficiency, occupant comfort and air quality were uncompromised.

The Solution: The collaboration between Price, the engineer and the architect was significant to ensure a custom solution that would meet not only the performance requirements of the space but also high aesthetic standards. This was particularly important on the fourth floor, where HMFH Architects were designing their own corporate space. Price active beams, passive beams and chilled sails were integrated throughout this retrofitted building to achieve both goals.

HMFH Architects, the fourth floor tenants, integrated beams into a drop ceiling in their lobby and hallways, using slimline coupling to create the visually pleasing appearance of one continuous beam. In their office space, beams were suspended from the slab and integrated into a special drywall ceiling along the perimeter of the building. Both active and passive beams were used to meet the load requirements of the space and were developed with a matching face, so that from the outside they appear identical for visual consistency.

On the fifth floor, Anderson Porter Design used suspended beams in exposed ceilings to maximize the feeling of space within Workbar's open office plan.

The third floor, designed by Ruhl Walker Architects, was last to be completed and reflects a similar solution and layout to the fourth floor, where the office space is similarly open concept.

Photos courtesy of Ed Wonsek © 2014

Project: **Upper Iowa University Liberal Arts Building**

Location: **Fayette, Iowa**

Project Cost: **$8.6 million**

Square Footage: **34,000 ft²**

Architect: **Meyer Scherer & Rockcastle**

Mechanical Engineer: **Karges-Faulconbridge, Inc.**

Price Representative: **TMS Johnson Inc.**

The Challenge: The core objectives for the Liberal Arts Building's HVAC system were not unlike those another institution might deem important – deliver a solution that would reduce operating costs, provide maximum comfort for students, and afford future flexibility as the space evolves. Demonstrating leadership through forward thinking and sustainable building design was another key goal for the team, with LEED Silver certification being targeted from the outset. Extremely close collaboration at all stages of design and construction would be essential.

The Solution: The UIU team challenged conventional performance expectations by selecting a cutting-edge hybrid HVAC system that incorporates both underfloor air distribution and chilled sails – one of the first designs of its kind. This unique system helped the Liberal Arts Building achieve its LEED Silver target, and received further recognition when Alliant Energy of Iowa offered the university a six-figure rebate based on the energy efficiency of the facility. Ultimately, the building was found to be 67% more efficient than a conventionally designed "baseline" building, and is projected to recoup its initial investment in energy saving systems within three and a half years through reduced operating expenses.

Project: **Memorial Hospital & Health Care Center**

Patient Safety Excellence and Outstanding Patient Experience Awards, 2012 - *HealthGrades*

Location: **Jasper, IN**

Square Footage: **5,600 ft² (Pharmacy, 2009); 36,000 ft² (Patient Wings, 2012)**

Architect & Engineer: **BSA LifeStructures**

Price Representative: **R.L. Craig Company, Inc. & Colby Equipment**

The Challenge: Price Active Beams were selected for the Pharmacy renovation in 2009, and the immense success of these beams in meeting the design team's goals led to their inclusion in the Patient Wing renovation in 2012.

There were several shared goals of both renovations: improving energy efficiency (and subsequently reducing operating costs), working with restricted interstitial space, and controlling humidity. Occupant safety was prioritized in different ways: the pharmacy renovation needed to account for the regulatory requirements of a compounding pharmacy, and geriatric psychiatry patient wing required a secure diffuser solution to restrict potential occupant ductwork access.

The Solution: Price Active Beams were selected for the pharmacy and subsequently the patient wings for their energy efficient performance (via reduced air handler requirements), space savings and the high standard of occupant comfort and air quality they provide. Humidity control was easily addressed through the primary air handler, and moisture sensors were incorporated into the active beams for additional safety.

Installing beams in the patient rooms allowed the engineers to use 100% outside air. By combining the active chilled beams with a Dedicated Outdoor Air System (DOAS), the design team reduced the volume of primary air supplied to the space by 30-60% when compared to a conventional overhead mixed air system, resulting in both significant operating cost savings and a great reduction of the risk of airborne infection.

The security needs of the second-floor patient wing were addressed by applying the same perforated face used for Price's maximum security grilles to the beams.

Project: **Bournedale Elementary School**

Location: **Bourne, MA**

MEP Construction Cost: **$3.7 Million**

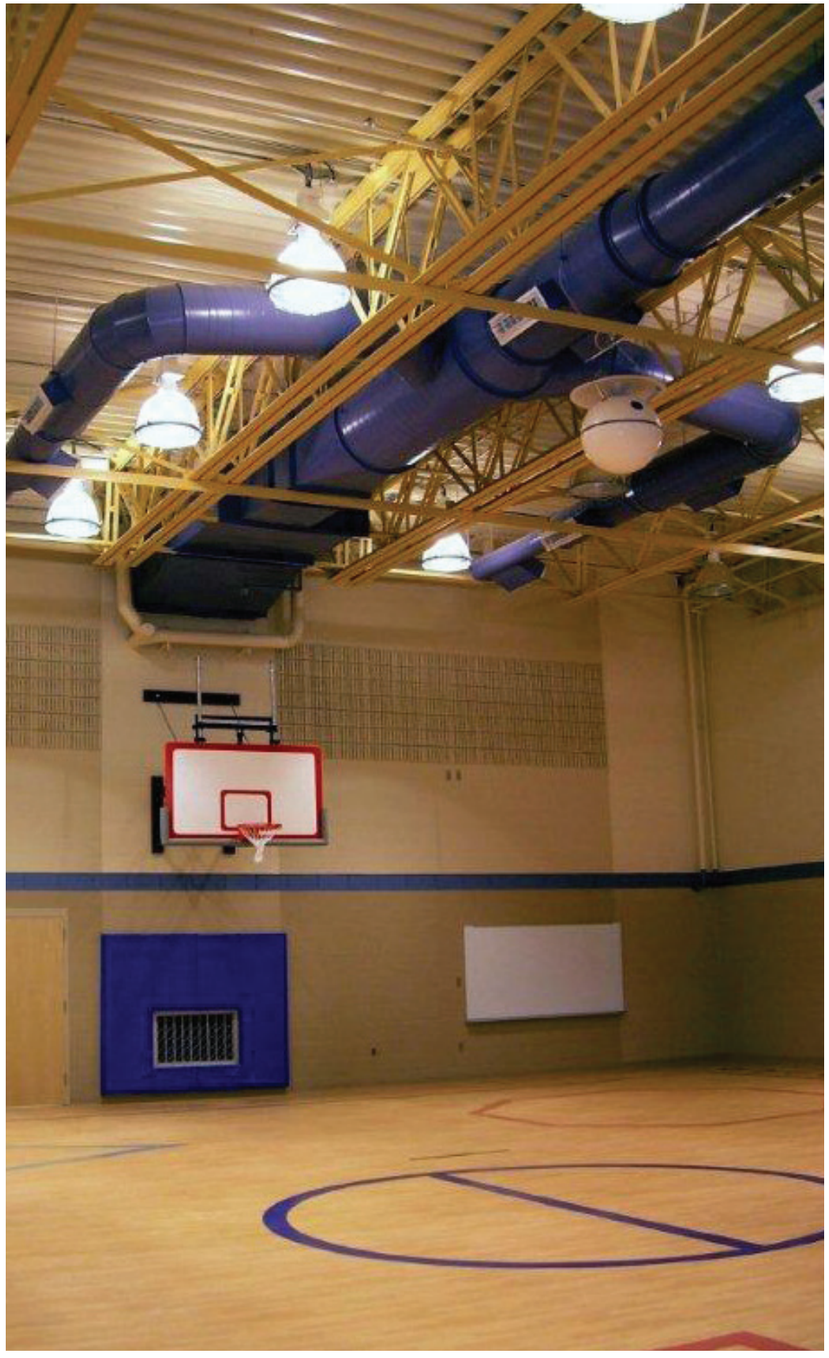
Square Footage: **68,200 ft²**

Engineer: **Garcia Galuska DeSousa Consulting Engineers**

Price Representative: **Buckley Associates**

The Challenge: Comfort, energy efficiency, and a high level of indoor air quality were the primary goals of the Bournedale Elementary design team. The HVAC system also had to address the high humidity that is typical in ocean boundary communities, as well as the owners' desire for air-conditioning. Maintaining simplicity in maintenance and control, as well as the conservative noise levels recommended by the American National Standards Institute (ANSI), presented additional challenges. Finally, all of these concerns needed to be addressed at or below the cost of traditional system design.

The Solution: The design team selected to employ both Price Active Beams and Displacement Ventilation to meet their goals. Displacement diffusers were integrated seamlessly into the classroom cabinetry at Bournedale, providing comfortable cooling and improved indoor air quality at noise levels under 25 dBA. Price also conducted a classroom mock-up so the design team could witness displacement ventilation under typical conditions experienced at Bournedale Elementary. The team was also able to familiarize themselves with the features and performance of the active chilled beams that were selected for the design. The final construction cost of the HVAC system was $23.60/ft², almost a 27% reduction compared to conventional mechanical system design.



Project: **Henry Ford Health System**

Location: Detroit, MI

Contractor: **Conti Mechanical**

Price Representative: **Michigan Air Products**

The Challenge: In 2012 a partnership between Michigan Air Products and Henry Ford Health System (HFHS) began around a conversation to upgrade the building's aging HVAC system. The hospital was receiving complaints for noisy patient rooms, and the current units (see photo bottom left) were not effective in the chilly winters. The cleaning staff had also noticed that accessing the induction units to clean them regularly was difficult.

In summary, HFHS needed a warm, quiet and serviceable product.

Additional logistical hurdles had to be factored in, such as the unpredictable installation schedule. The hospital was open continually and functioning near capacity, so only a few rooms were able to close for installation work at any given time. The new solution also needed to handle a wide range of pressure that would change throughout the building.

The Solution: Michigan Air Products worked with Price Industries to develop a custom solution (see photo bottom right) that met the requirements of a warm, quiet product that is simple to maintain.

The design was finalized through an iterative and collaborative process, with feedback from the hospital and a site visit by Price influencing the improvements to the design through its generations.

The first-generation design worked well as installed. However, when attempting to repeat the same build in a different location in the hospital, noise levels were much worse. The second-generation design addressed that problem by including a damper. This version tested very well in both noise and thermal comfort in lab conditions, but when implemented on-site, it was just as loud as the original generation.

The source of the noise in the second-generation design was uncovered, and it was found to be very dependent on duct type (hard duct vs flex). To free up flexibility in installation, the third generation opted to use an internal damper that allows the chilled beam to quietly operate at a large range of entering pressures.

The third-generation solution has been installed in multiple batches to date. Over 100 patient rooms have been outfitted with upgraded HVAC units. The current chilled beams have been operating well, with increased ease of maintenance, lower noise levels and fewer heating complaints.

Project: **University of Michigan Ford Motor Company Robotics Lab**

Location: **Ann Arbor, MI**

Square Footage: **134,000 ft²**

Architect / Engineer: **Harley Ellis Deveraux (HED)**

Price Representative: **Michigan Air Products**

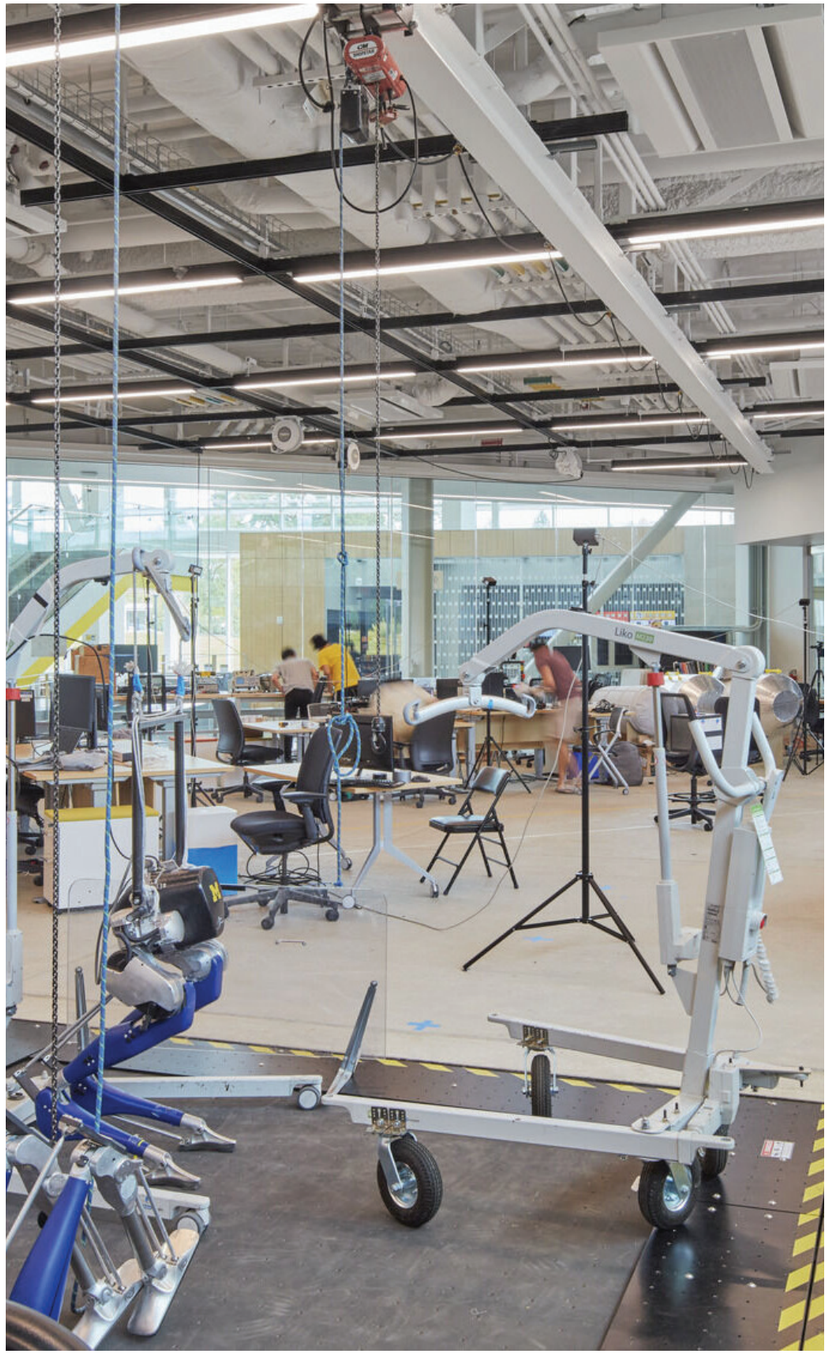
The Challenge: The University of Michigan's Ford Motor Company Robotics Building is a four-story, $75 million complex. The first three floors hold custom research labs for robots that fly, walk, roll and augment the human body, as well as classrooms, offices and makerspaces. Through a unique agreement, the fourth-floor houses Ford's first robotics and mobility research lab on a university campus, as well as 100 Ford researchers and engineers.

With such an expansive building housing a variety of spaces, it was critical that the HVAC systems not only meet the unique needs of each space to provide occupant comfort, but also provide energy efficiency.

The Solution: Chilled beams are installed throughout the building to provide cooling and ventilation to various lab-testing areas, offices and collaboration spaces. Designed to work in conjunction with the lab's heating system to maintain a comfortable and consistent temperature throughout the year, the use of chilled beams in the lab was part of a larger effort to improve the facility's energy efficiency and reduce its overall environmental impact.

The use of Coanda wings on the chilled beams allowed for this solution to work well in an open-ceiling space.

With a focus on energy efficiency from the start, the completed building is now LEED Gold certified, which is only given to buildings that meet stringent sustainability requirements, positively impacting surrounding communities by reducing carbon emissions, energy and waste. The chilled beams used in the Robotics Building contributed to this by requiring less energy to cool or heat the various spaces, compared to traditional forced-air systems, while providing more even temperature distribution throughout. The building has also been recognized as a 2022 building award recipient by the American Institute of Architects (AIA) Huron Valley.



Project: **University of Michigan Munger Graduate Residences**

Location: **Ann Arbor, Michigan**

Square Footage: **380,000 ft²**

Architect / Engineer: **Integrated Design Solutions**

Contractor: **Walbridge**

Price Representative: **Michigan Air Products**

The Challenge: A first-of-its-kind residential facility for the campus, University of Michigan's Munger Graduate Residences provide apartment-style living for 634 graduate students, fellows and visiting faculty, and was designed to maximize opportunities for personal connection and foster a sense of belonging. Each apartment features a large kitchen, dining and community space, as well as six or seven single-occupancy bedroom suites, each with a private bathroom.

The design required an HVAC solution that would conserve a minimum of 30% energy compared to the ASHRAE Baseline Building standards, while maintaining occupant comfort and effective use of space as priorities.

The Solution: To maximize occupant comfort, each interior room is equipped with a custom Price model ACBR active chilled beam with a horizontal discharge piping package with manual balance valves, as well as modulating heating and cooling temperature control valves. These chilled beams were mounted in the ceiling, saving space over more traditional placements, such as on a wall or under a window. Chilled beams allow for precise temperature control and uniform temperature distribution, circulating the air quietly and efficiently.

Michigan Air Products worked in concert with Integrated Design Solutions and the university to ensure all design features and associated performance would meet the design's energy conservation goals. This project is registered under the LEED® green building certification program with the certification goal of LEED Silver and has been approved for the Designed to Earn ENERGY STAR® certification, recognizing that this design project has met Environmental Protection Agency (EPA) criteria for energy efficiency.

Project: Michigan State University Wells Hall

Location: **East Lansing, MI**

Engineer: **Peter Basso Associates**

Contractor: **Myers Plumbing & Heating, Inc.**

Price Representative: **Michigan Air Products**

The Challenge: The largest building on Michigan State University's campus, Wells Hall, features four wings and houses the departments of Mathematics, English, and all the languages. It is also a popular gathering place for students, featuring a Starbucks and the campus center cinema.

As an older building on campus, Wells Hall was previously equipped with induction units. These units were noisy, inefficient and had difficulty rezoning with changing occupancy profiles.

The Solution: When upgrading the building's HVAC system, chilled beams were chosen. Chilled beams offer several advantages over induction units, with the primary advantages being energy savings, lower operating costs and reduced maintenance. The comfort, quiet and efficiencies that a chilled beam system provides make chilled beams a popular choice for buildings with moderate to high sensible heat ratio environments, such as residential buildings, office buildings, educational buildings and healthcare facilities.

Chilled beams handle return air and sensible load within the space, reducing the total volume of supply air and shifting partial loads. They use water instead of air as the heat transfer fluid, which reduces the reheat and fan energy required to operate the system. With fewer moving parts, chilled beams have fewer components that can break down or fail, reducing the need for repairs and replacements. Overall, the reduced maintenance requirements of chilled beams can provide significant cost savings over the lifetime of a building.

Michigan Air Products collaborated with Michigan State University, Peter Basso Associates, and Myers Plumbing & Heating, Inc. to replace the existing induction units, ultimately installing 345 chilled beams throughout Wells Hall. With industry-best lead times from Price Industries, the project was able to be completed on spec, on budget and on time.

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