jaga

INDOOR CLIMATE CONTROL IN GLASS BUILDINGS

MAINTAINING OCCUPANT COMFORT IN BUILDINGS
WITH FLOOR-TO-CEILING GLASS

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If you live or work in a high-rise building, it's likely that there are a lot of windows from which you can look out to the ground below or the sky above. A recent forecast on flat glass, which is used to make windows, facades and doors for buildings, highlights a steady rise in the construction of glass buildings. The Global Flat Glass Report 2015-2019 predicts yearly growth for the flat glass industry due to high demand from the construction and automotive sectors. The report specifically notes that the increasing number of skyscrapers can be attributed to current and future projected growth.

Buildings with glass facades are becoming more common among new construction because they are aesthetically pleasing to occupants and passers-by, as well as to developers hoping to make their building stand out among numerous others. Studies have found that spaces with improved daylight and/or views offer increased retail value, improved worker productivity and decreased absenteeism and turnover.

Although they are eye-catching, glass buildings can present temperature control and energy efficiency challenges if they aren't coupled with the proper heating, ventilation and air conditioning (HVAC) systems. It's important for engineers, developers and architects to understand how hydronic heating and cooling systems can alleviate issues within glass buildings without taking up too much space.

IMPACT ON DESIGN, COMFORT AND SUSTAINABILITY

Engineers and developers always want to reduce costs and increase efficiency whenever possible. The intent when constructing building exteriors from glass is to allow more natural light and heat to enter through the large walls of windows. This allows buildings to cut down on the use of artificial lighting, which reduces electricity bills. Floor-to-ceiling glass also provides occupants with more expansive views.

However, there are also challenges to this architectural trend. These include:

1. **Condensation. When warm moist air comes into contact with cooler surfaces, droplets and fog can form on windows.** In colder climates especially, buildings may struggle with frost build up on the outside of windows if perimeter heating is not installed. This condensation can prevent occupants from enjoying the views from their windows.

2. **Poor insulation.** Glass does not provide insulation as effectively as walls do. Because cool air is denser than warm air, it sinks and creates cold drafts near windows. Discomfort also occurs when a person sits close to a cold window because their body temperature is higher than the temperature of the window. This will cause the individual to lose heat in the direction of the window.

3. **Fluctuating energy loads.** Buildings experience changes in energy loads as doors and windows are opened and closed, and as more people enter or leave a space. The time of day and weather conditions also lead to significant temperature fluctuations. For instance, when the sun is out without a cloud nearby, interior temperatures can rise by nearly 8° F/4° C, making employees and residents uncomfortable. In order to cool down, occupants may open windows, which causes direct energy loss. Without the ability to offset the temperature, occupants must either relocate to a more comfortable area or suffer in the heat, ultimately reducing productivity and satisfaction. In the opposite scenario, when the sun is not present, occupants can be left too cold, leading to discomfort.

These issues don't go unnoticed. A 2013 TreeHugger article raises concerns about glass building construction when the proper solutions aren't in place. John Straube with Building Science Corporation, a building science consulting and architecture firm explains: "Most of the tremendous performance gains in glazing technology over the past 25 years have been squandered on increased window area, not improved performance."

For developers seeking all-glass exteriors, Straube proposes a balance between maximizing natural light and limiting unwanted heat gain and loss. To achieve sustainability and occupant comfort without compromising design, more designers are seeking energy-efficient heating, ventilation and air conditioning (HVAC) systems to offset condensation, cold zones and fluctuating indoor temperatures. Specifically, they are incorporating low-temperature hydronic heating and cooling systems. This type of technology is ideally powered by renewable energy sources, such as geothermal or solar.

SO WHY LOW-TEMPERATURE HYDRONIC HEATING?

Some hydronic heating systems rely on water to heat the surrounding area through a process called convection, or the transfer of heat energy by movement of a medium. With convection, air flows from below and is forced up or naturally rises across a coil when hot water is passed through. This hot air is then expelled out above the coil and dispersed throughout the room. This circular airflow has multiple benefits in glass buildings.

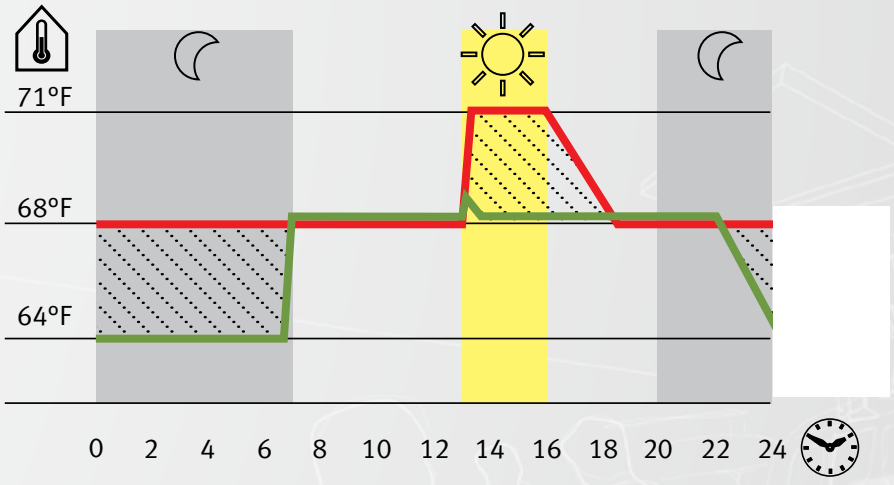
Reduced Condensation: These systems, which can be placed discretely along floor-to-ceiling windows, solve condensation and cold zone issues because they use convection to create a curtain of warm air throughout an entire room, providing a barrier between a cold window and nearby occupants. A sleek, thin unit also ensures views are not obstructed and allows residents to place a sofa, desk or bed closer to a window. The same effect can't be achieved solely through in-floor radiant heating systems and radiant panels, which, although popular, rely on radiation rather than convection to warm a surrounding area from the floor upwards. Heat from radiation is concentrated on both sides of a traditional radiator's panels but the effect causes significant energy losses on the window side. The heating effect from the room-facing side of a radiator decreases as a person gets further away from the unit.

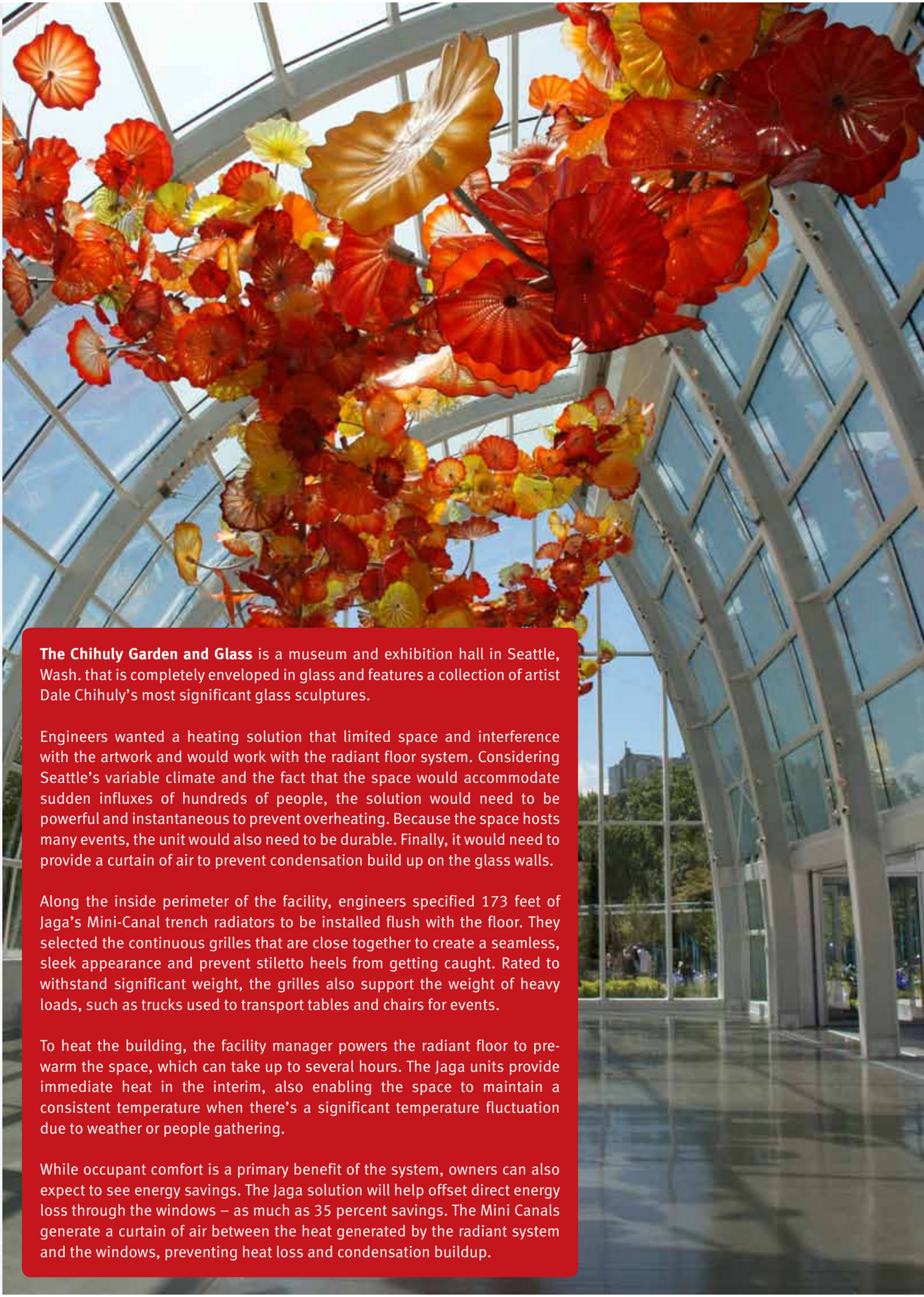
Improved Comfort and Safety: Hydronic heating systems can also solve the issue of fluctuating energy loads, which can become a larger issue within expansive spaces that attract many visitors (see **"Chihuly Garden and Glass"** and **"National September 11 Memorial Museum"** sidebars). However, in order for a unit to respond rapidly to the temperature changes due to internal and external energy loads, the mass of the radiator needs to be as low as possible. The lower the water content and weight of the heat emitter, the lower the inertia and the more controllable it becomes.

Compared to in-floor radiant solutions, radiators equipped with optimized heat exchange technology are better heat conductors and have a lower overall mass. Jaga's Low-H2O solutions contain only 10 percent of the water content compared to traditional radiators, allowing them to react almost immediately as external factors change. Because the units contain a lower water content, they also remain at a lower exterior temperature, increasing safety for occupants. The units also operate at much lower noise levels, making them less disruptive.

Low-H2O solutions are also a safer choice compared to hot panel radiators near windows, because during a cold winter day, traditional radiators generate a lot of thermal stress on the glazing. In these periods, the glass becomes brittle and can easily crack from the slightest impact.

Financial Savings: Improved response to changes in temperature increases





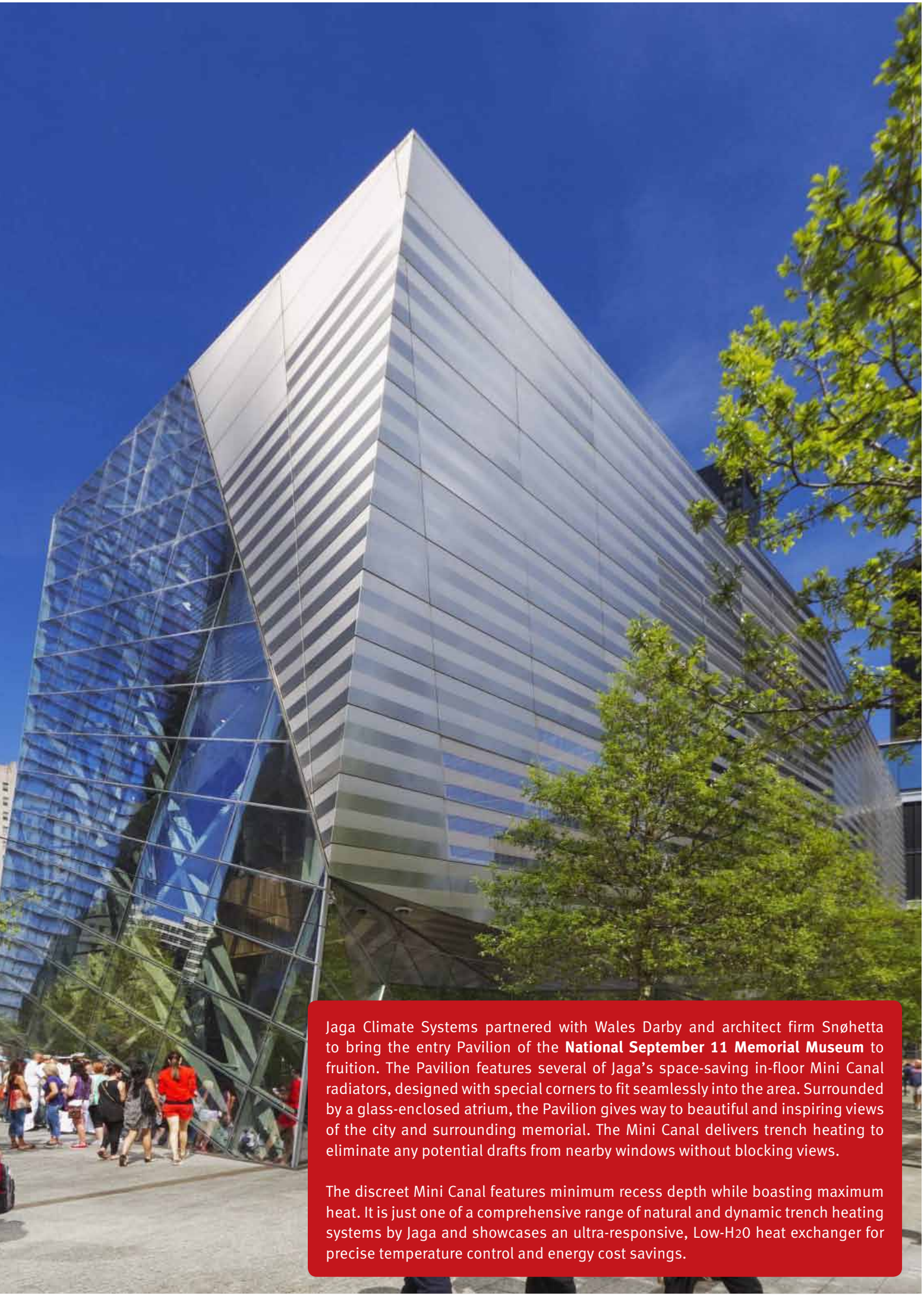
The Chihuly Garden and Glass is a museum and exhibition hall in Seattle, Wash. that is completely enveloped in glass and features a collection of artist Dale Chihuly's most significant glass sculptures.

Engineers wanted a heating solution that limited space and interference with the artwork and would work with the radiant floor system. Considering Seattle's variable climate and the fact that the space would accommodate sudden influxes of hundreds of people, the solution would need to be powerful and instantaneous to prevent overheating. Because the space hosts many events, the unit would also need to be durable. Finally, it would need to provide a curtain of air to prevent condensation build up on the glass walls.

Along the inside perimeter of the facility, engineers specified 173 feet of Jaga's Mini-Canal trench radiators to be installed flush with the floor. They selected the continuous grilles that are close together to create a seamless, sleek appearance and prevent stiletto heels from getting caught. Rated to withstand significant weight, the grilles also support the weight of heavy loads, such as trucks used to transport tables and chairs for events.

To heat the building, the facility manager powers the radiant floor to pre-warm the space, which can take up to several hours. The Jaga units provide immediate heat in the interim, also enabling the space to maintain a consistent temperature when there's a significant temperature fluctuation due to weather or people gathering.

While occupant comfort is a primary benefit of the system, owners can also expect to see energy savings. The Jaga solution will help offset direct energy loss through the windows – as much as 35 percent savings. The Mini Canals generate a curtain of air between the heat generated by the radiant system and the windows, preventing heat loss and condensation buildup.



Jaga Climate Systems partnered with Wales Darby and architect firm Snøhetta to bring the entry Pavilion of the **National September 11 Memorial Museum** to fruition. The Pavilion features several of Jaga's space-saving in-floor Mini Canal radiators, designed with special corners to fit seamlessly into the area. Surrounded by a glass-enclosed atrium, the Pavilion gives way to beautiful and inspiring views of the city and surrounding memorial. The Mini Canal delivers trench heating to eliminate any potential drafts from nearby windows without blocking views.

The discreet Mini Canal features minimum recess depth while boasting maximum heat. It is just one of a comprehensive range of natural and dynamic trench heating systems by Jaga and showcases an ultra-responsive, Low-H20 heat exchanger for precise temperature control and energy cost savings.

occupant comfort and provides cost savings. When installed in an office or school, a hydronic heating system provides output within minutes, generating enough energy to heat the space in a short period of time. This is a much more cost-effective and sustainable option to the traditional method of starting up the heating system several hours before building occupants arrive in the morning.

Conversely, on a warm day, the system can quickly reduce output during times when the building is able to take advantage of the natural solar and internal loads. Studies have shown that sunlight that suddenly enters a building through double glazing can add more than 3400 BTU/hr per 11 square feet of glass to a room. A system that is slow to adjust will cause occupants to overheat. Plus, each second that a radiator is emitting heat after switching off the system is a waste of energy.

Improved Worker Productivity: For businesses, proper heating can actually translate to a better bottom line. Studies have shown that improved comfort can positively impact employee productivity. According to David Pogue, national director of sustainability at CB Richard Ellis, worker performance improves with temperatures up to 72° F, and experiences a downturn with temperatures above 73 to 75° F.
As building owners look to renovate older buildings with more advanced technology or build new structures, old coal and oil-fired boiler systems are being phased out and hydronic solutions are being incorporated. Using them, developers and engineers have found energy savings of up to 30 to 40 percent above what the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) finds acceptable, as stated in Standard 90.1, titled "Energy Standards for Buildings Except Low-Rise Residential Buildings." They are also seeing a return of investment of less than five years with low-temperature systems. Whether hydronic heating solutions are installed in residential properties or commercial spaces (see **"Mill Woods Library"** sidebar), they result in more reactive outputs and fewer heat and noise-related complaints to management.

COOLING MADE EASY

Similar to the dynamic heating systems, hydronic cooling options also improve occupant comfort by accommodating quick and efficient cooling. With systems that can be equipped with individual climate control units, building occupants can set the unit to their preferred temperature rather than having a single thermostat control the temperature for every unit on a floor. This allows for more personalized control of temperature within a space, and is especially ideal for residential units on the same floor (see **"The Robert"** sidebar).

Additional features of new energy-efficient hydronic cooling technology include:

1. **Extra Space.** Forced air systems require extensive ductwork throughout the building, which takes up a lot of valuable space. With new hydronic systems, ductwork is eliminated and extra ceiling space is freed--up to one additional foot per floor. This gives architects and engineers the opportunity to add additional floors or penthouse suites in high-rise constructions compared to buildings using conventional forced air systems. By choosing a hydronic heating and cooling solution, it is possible to generate additional and unanticipated revenue from extra suites within the same vertical footprint. In many cities where office space and residential rent comes at a high price, building owners can expect to take in tens of thousands of extra dollars for these extra suites.

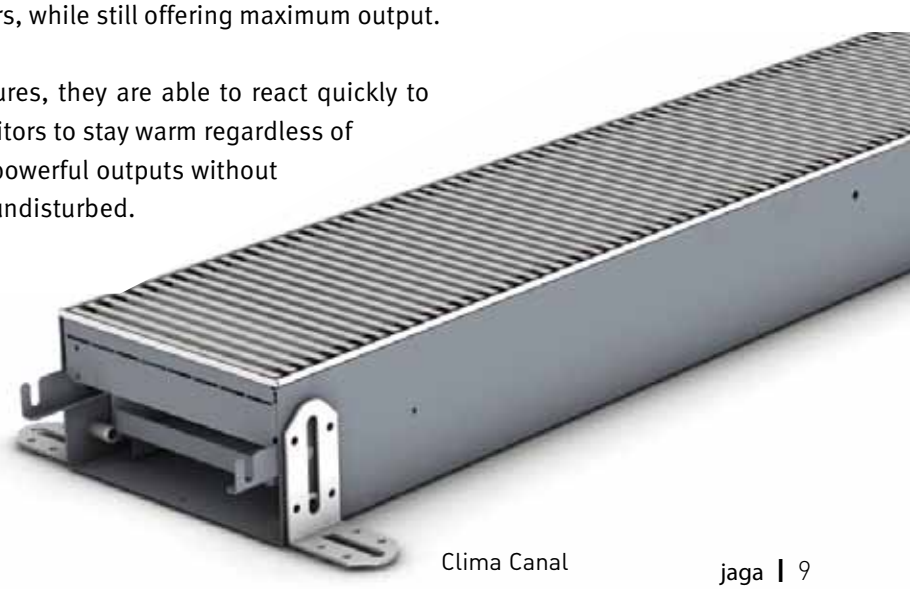
2. **Better indoor air quality.** Ductwork within a building can be a magnet for bacteria and dust if it is not regularly cleaned and maintained. Hydronic heating systems help promote healthy, clean indoor air by eliminating opportunities for these materials to collect in a building's ventilation system.

3. **Lower total cost of ownership.** Largely constructed from renewable resources such as aluminum, Low-H_2O systems reduce the overall heating and cooling costs over the lifespan of the building.

The Mill Woods Library, Seniors and Multicultural Centre in Edmonton, Canada recently renovated in order to create more library, social and recreational space for visitors. With the need for quiet, comfortable spaces in mind, developers wanted a heating system that could handle a high heating capacity at low water temperatures while performing with minimum noise. They also needed a solution that would not block outdoor views from the library's various rooms, including reading rooms, a community room, quiet study rooms and the children's reading area.

To meet these needs, Jaga installed 200 Clima Canal radiators throughout the new spaces. The Clima Canal's built-in profile allows the units to fit perfectly into the raised floor so windows are never blocked by mechanical equipment. With the help of a condensing boiler and in-floor placement, the units eliminate any potential drafts from the windows. Furthermore, fans operating on brushless EC motors allow the units to consume less than one-tenth the electrical power of conventional motors, while still offering maximum output.

Since the units operate at low-water temperatures, they are able to react quickly to temperature changes, enabling patrons and visitors to stay warm regardless of how cold it may be outside. They also provide powerful outputs without creating high noise levels, ensuring guests go undisturbed.



Clima Canal

INCORPORATING HYDRONIC SOLUTIONS

Today, building owners and developers are looking for ways to provide impressive views, save space and provide efficient heating and cooling solutions. However, in buildings with glass facades, if HVAC systems do not react quickly to temperature fluctuations, building occupants will be uncomfortable and building owners will pay the price with higher utility bills.

Low-temperature hydronic heating and cooling solutions can work in a number of applications, including retrofits and new build scenarios, and in both large and small areas. For any system that operates using a low-temperature energy source, such as a condensing boiler, solar or geothermal application, low-temperature heating and high-temperature cooling systems are well-suited to provide numerous benefits. Hydronic heating and cooling solutions have also been used in conjunction with radiant systems to provide more responsive outputs, or as a complete replacement for in-floor radiant panels.

A solution that delivers the "triple bottom line" of people, planet and profit, hydronic heating and cooling systems are a sustainable option that maximize energy efficiency in glass buildings and make sense for both today and tomorrow's indoor climate needs—and for the health, comfort and morale of building occupants.

The Robert is a mixed-use building featuring 70 rental units and 14,000 square feet of premium retail space in Vancouver. The studio, one-, two- and three-bedroom units feature large glass windows, so developers wanted a solution that would operate well despite their presence.

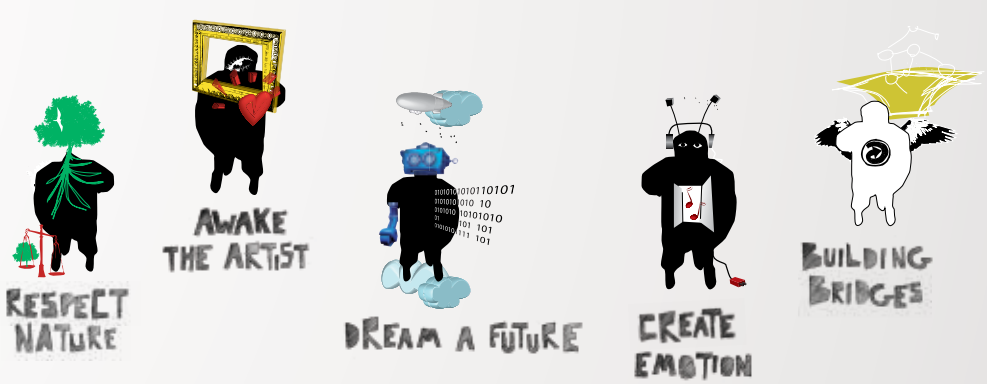
Engineers installed 152 Jaga Briza convectors into ceilings, providing a discrete and functional heating solution. The thinnest fan coil on the market at 4.61 inches, the Briza is a hybrid heating solution that warms rooms in the winter to keep residents comfortable as temperatures and preferences change.

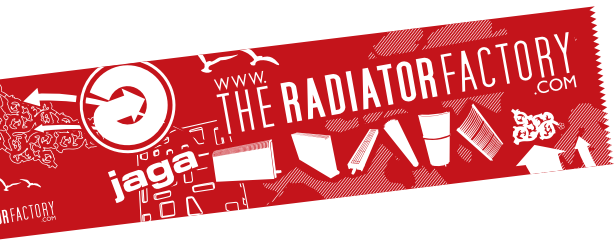
In addition to the convectors' compact size and efficiency, developers selected the units because they are much quieter than traditional fan coils and would limit disruption for residents.

ABOUT JAGA CANADA CLIMATE SYSTEMS INC.

For more than 50 years, Jaga has led the world in hybrid heating and cooling concepts, innovation and art. Jaga manufactures award-winning, energy-saving heating solutions, such as its Low-H_2O radiator systems, which contain only 10 percent of the water content from a panel radiator with identical output. The radiators also operate at lower water temperatures, making them much safer than traditional radiators.

Jaga's products have been used in many notable projects in North America, including the Evergreen Brickworks Building in Toronto, the World Trade Center Museum in New York and the Cite Verte project in Montreal. As the demand for comfortable, energy-efficient products increases, more architects, engineers and contractors are turning to its stylish and energy-efficient solutions.





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