



## KEY INNOVATION: NEW TECHNOLOGY IN RADIANT HEATING AND COOLING

Olympic International made a significant contribution to the most environmentally sustainable community in North America. Olympic International recommended and supplied radiant heating and cooling capillary mat, at Millennium Water, home of the Vancouver 2010 Winter Olympic Athlete's Village. The application of this European high-efficiency technology contributed to the community achieving LEED® Platinum ND (neighborhood development), LEED® NC (new construction) Gold for the buildings, along with one Net Zero Building (parcel 9).

Millennium Water – now known as the Village on False Creek – spans eight city blocks and includes 21 buildings. The sustainable mechanical design effort of the 1.5 million ft<sup>2</sup> complex was

led by Goran Ostojic, LEED AP, partner at Cobalt Engineering (mechanical consultant). “We had the opportunity to create something that’s going to be the benchmark of sustainability in North America on this size and scale,” Ostojic says.

Adds Peter MacLellan, partner at Olympic International: “We had a vision of what we wanted to do at the Olympic Athlete’s Village: to reduce energy consumption and increase the comfort of occupants. We proposed the capillary mat system as a viable opportunity and invited the team to see first-hand how the technology was being applied in Germany where it originated. We felt it was a good fit with the overarching sustainable goals of this project.”

LOCATION:  
Vancouver

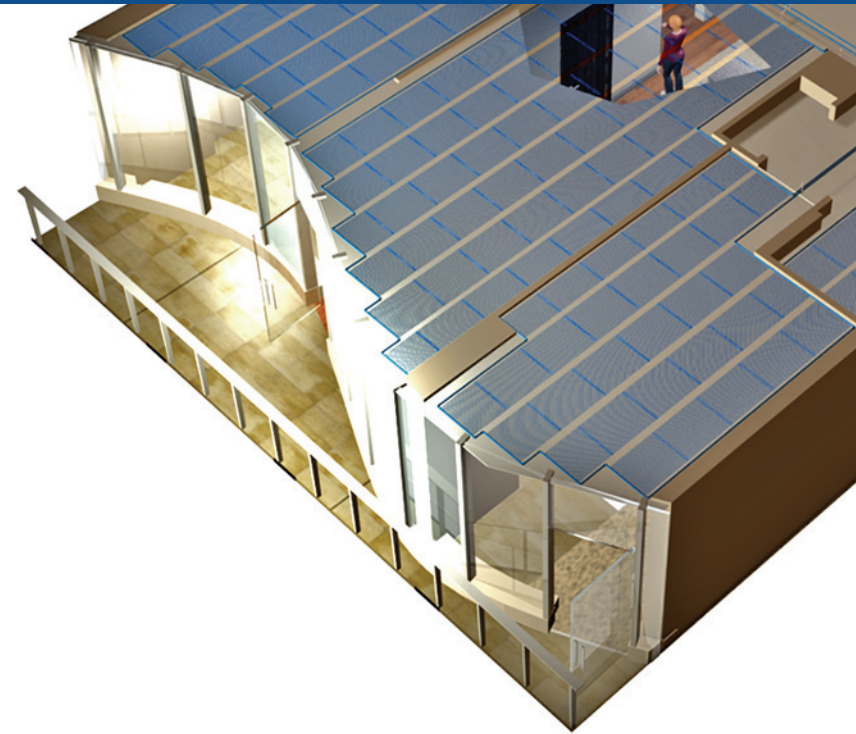
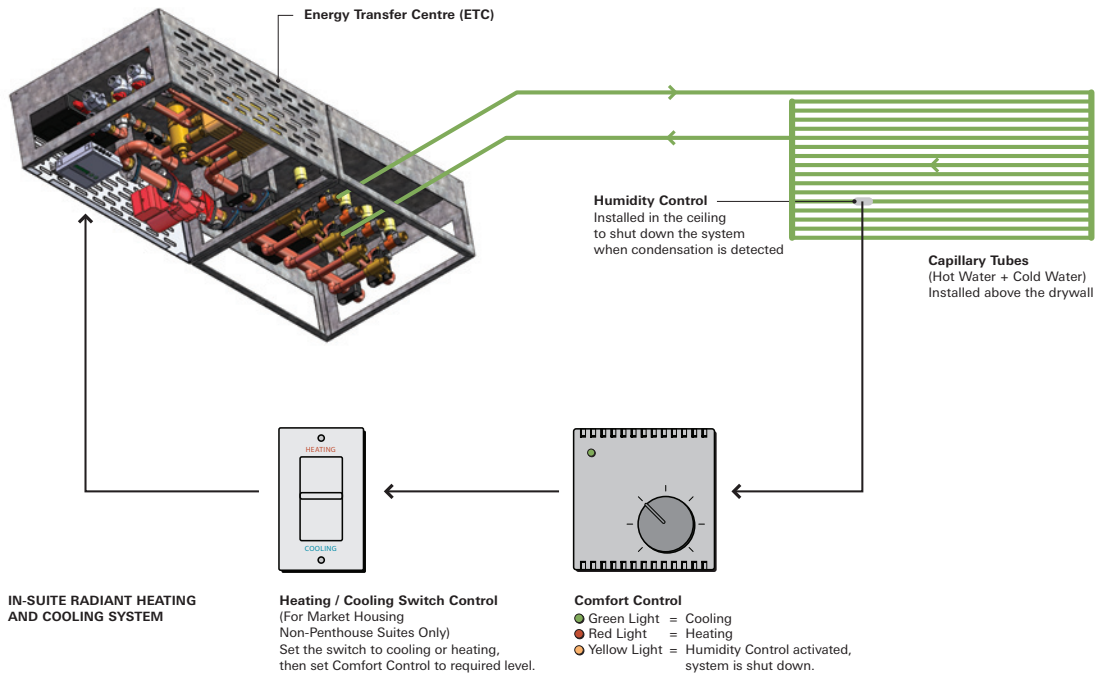
LEAD ARCHITECT:  
Merrick Architecture (Parcels 3, 6, 10);  
GBL Architects (Parcels 2, 5, 9);  
Walter Francl Architects with Nick Milkovich  
Architects (the Community Centre, Parcel 11);  
Nick Milkovich Architects with  
Arthur Erickson / Lawrence Doyle (Parcel 4)

GENERAL CONTRACTOR:  
Metro-Can Construction, Ltd.,  
ITC Construction Group

MECHANICAL CONSULTANT:  
Cobalt Engineering

MECHANICAL CONTRACTOR:  
Division 15, Sentrax, William Kelly and Sons,  
DMS, Pitt Meadows and Jeda Mechanical





## REVOLUTIONARY RADIANT HEATING

Roger Bayley, founding principal of Merrick Architecture and design manager for the project, was impressed with the technology in Berlin. “Once people experience the kind of comfort, acoustical performance and indoor air quality, I’d be very surprised if cap mat doesn’t gain momentum as a viable option for cooling and heating buildings in North America,” Bayley says, noting the initial draw was energy efficiency. “We’re estimating this technology, along with the district energy system applied at the Village, contributes to a 40 percent energy reduction

versus a conventional fan coil or heat pump type system,” he adds.

The capillary mat system has clear advantages for the developer compared to conventional heat pump or fan coil systems, including:

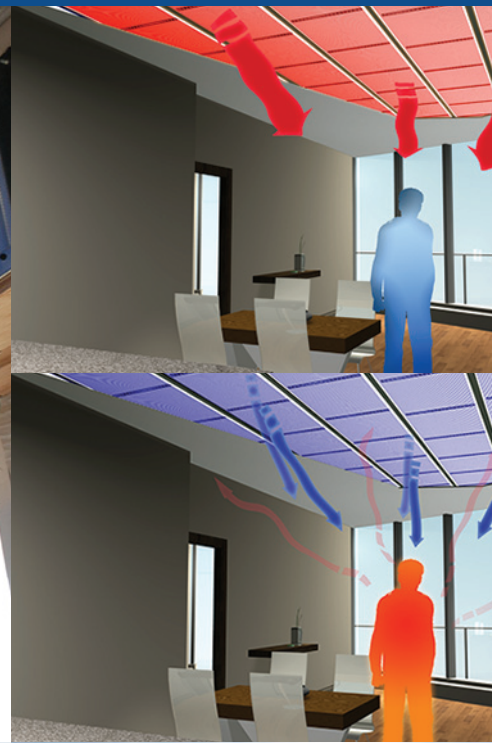
- > significantly improved sound performance by eliminating in-suite fan or compressor noise
- > individual control for each zone in the suite
- > increased ceiling height, due to the elimination of overhead duct work and

bulkheads, can significantly reduce construction costs as floor by floor heights are reduced by at least a foot. Builders and owners also benefit by maximizing marketable floor space, gaining an extra floor or reducing the height and material cost of the building.

The capillary mat application at the Village circulates warm or cold water through narrow polypropylene tubes. All installations were ceiling mounted in 1,100 residential units and included approximately 6,500 individual zones. The majority of housing

units have cap mat heating and cooling; 252 units are heating only. The tubes connect to an energy transfer centre (ETC) [see illustration], located in the storage room or closet in each suite. “The end user was provided a simplified controls system to easily set the demand for heating or cooling, along with a real-time resource monitoring system, that instantly reported on energy use,” says Dan MacKay, manager for Olympic Controls.





**WATER MOVES ENERGY**

Water is 3,000 times more efficient at carrying energy than air. The power used for pumping heated water – per unit of heat energy transferred – is approximately one-tenth what is required to transfer the same heat using a forced air system.

**RADIANT EFFECT**

Heat transfers in three modes: convection, conduction and radiation. "Radiation is how energy reaches us from the sun. It crosses a vast distance of universe and warms the earth," Ostojic of Cobalt Engineering says. "A radiant exchange occurs between two objects or elements with mass that have different temperatures. The air is completely insignificant. Radiant heat always moves in one direction only – from a warmer element to a colder element. During the winter, we heat the ceiling to a slightly higher temperature than we want in the space, and it radiates to solid objects in the room, whether it's a human body or the furniture. The opposite occurs in summer, when we cool the ceiling to a temperature below what we want to achieve in the space, then the human body or objects in the space lose heat towards it," Ostojic says.

"Water is a far better heat transfer medium than air," MacLellan says. "Forced air systems use so much more energy because it's designed to maintain a particular temperature by mixing the air in order to maintain the same temperature in all areas." "Capillary mat technology is more comfortable and better for the environment than forced air," says Greg Borowski, LEED AP, principal at Merrick Architecture. "You can zone the cap mats so you have one room

heated and another cooled. Combined with passive design elements like solar shading with automated blinds, the fact that you can zone up to eight zones in some of the larger suites is a benefit." Plus, the cap mat uses minimal ceiling space. "We can fit the cap mat and piping into a two-inch cavity whereas forced air takes about a foot. We were able to design higher ceilings as a result," Borowski explains.

**clockwise from top left:** Capillary mat system around architectural features (Image: Olympic International); Radiant effect – heating mode (Image: Olympic International); Radiant effect – cooling mode (Image: Olympic International); Radiant effect (Image: Codrin Tabala)

Excerpts from:  
The Challenge Series, Millennium Water.  
Chapter 5, Energy Design, Thermal Comfort in the Home (by Roger Bayley and team).  
<http://www.thechallengeseries.ca/chapter-05/energy-design/>





## DESIGN AND INSTALLATION COLLABORATION

Olympic International provided custom-sized fabricated mats to meet the unique architectural features of the project. Prior to construction, Olympic International worked closely with Merrick Architecture, GBL Architecture and Cobalt Engineering for a year and a half to create detailed CAD drawings of the configurations for each unit down to the zone level. In addition, Olympic International collaborated with project interior designers and lighting specialists. "Design and installation of the radiant heating and cooling system required

an integrated approach in coordinating between different trades and disciplines," MacLellan says. The construction of the Village was fast tracked for completion in two and a half years.

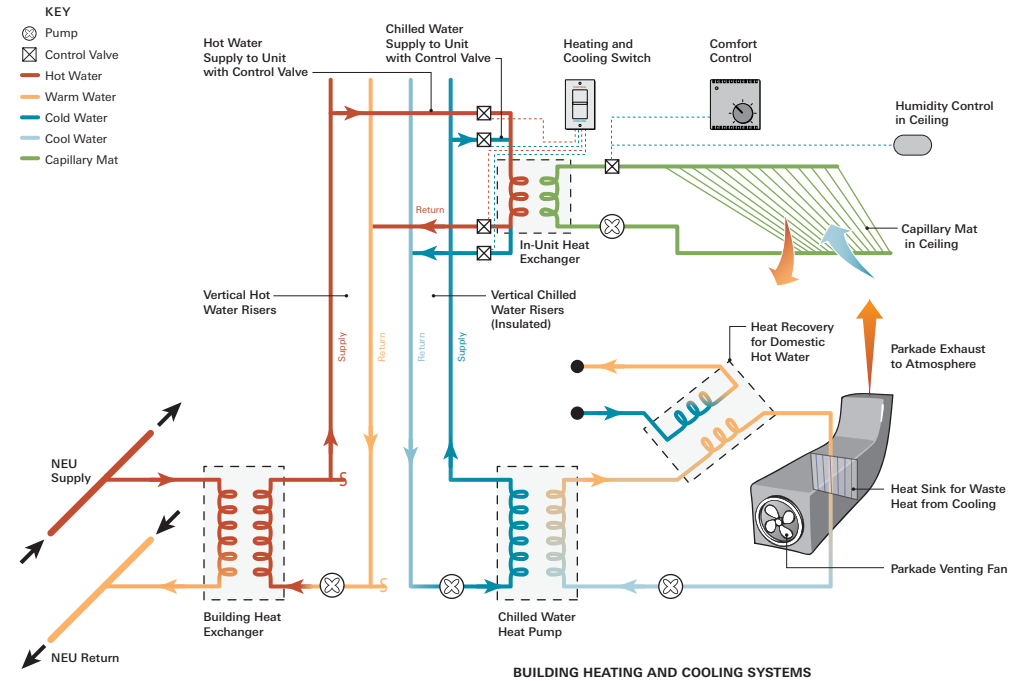
"Having a common design approach to the HVAC design for each building helped," Ostojic says. "We placed the capillary mats between the steel stud channels in the ceiling. In our design we had to allow space for sprinklers and lighting fixtures mounted in the ceilings."

Ernest Fink, president of Sentrax Mechanical Contractors, was one of the mechanical contracting firms working with the technology. Sentrax installed the radiant cap mat heating and cooling system in two buildings that contained 60 large, luxury suites. "After the steel stud and insulation was installed, we coordinated our piping routes with the drywallers. Spending the time up front with the drywallers, electricians and the sprinkler trades really helped."

Dale Miller, construction manager at Division 15 Mechanical, oversaw the installation at

the 45,000 ft<sup>2</sup> False Creek Community Centre, which includes a gymnasium, daycare and restaurant. As one of two LEED Platinum buildings at the Village, "There had to be close coordination with the drywallers with the installation of the grid system. We attached the cap mats to the grid in a manner that didn't puncture holes in the mat," Miller says, noting the detailed mechanical drawings showed the length and width of each space ensuring careful installation. "There was a learning curve on how to install it, but it wasn't overly difficult."





## SUSTAINABLE VILLAGE

Like other buildings at the Village, the Community Centre uses district energy heating, connected to the Neighborhood Energy Utility (NEU). “The Village energy system utilizes heat pumps to upgrade the reclaimed low temperature water to high temperature water that is supplied to the capillary mat system in the space,” Ostojic says. The development also uses solar hot water thermal collectors and a heat recovery system to supply domestic hot water. Other sustainable design features of the Village include green roofs, sustainable building materials and rainwater harvesting.

A centrally located mechanical room with a full DDC system supplied and installed by Olympic Controls provides ease of control and maintenance to the Village.

The innovative use of radiant heating and cooling in this large-scale application shows that comfort, indoor air quality, reduced noise and energy efficiency can all be achieved. The annual cost savings for the entire neighborhood development based on energy conservation measures is estimated at \$780,000 per year.

### Benefits of Radiant Heating & Cooling

#### OCCUPANTS

- > transfers large amounts of energy with no draught or noise
- > optimum thermal comfort
- > reduced airborne particles provide a cleaner indoor air quality over conventional systems
- > radiant systems work much more efficiently and effectively than other systems with open windows for ventilation

#### ARCHITECTS AND BUILDERS

- > minimal ceiling space requirement creates opportunities to maximize ceiling height

#### MECHANICAL INSTALLERS

- > easy installation with minimal specialized training

#### BUILDING OWNERS

- Benefits over conventional HVAC:
- > significant reduction in energy usage supports return on investment (ROI) and
  - > marketability
  - > lower operating and maintenance costs