Canadian Consulting Engineering Awards 2020

Jim Pattison Children's Hospital Saskatoon, SK. Mechanical Design

A Submission by

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Mechanical Consulting Engineers

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JIM PATTISON CHILDREN'S HOSPITAL

PROJECT SUMMARY

Saskatchewan was one of only two provinces in Canada without a dedicated children's hospital, the children and families of Saskatchewan deserved more. Decades of planning and fundraising led to a new hospital.

The mechanical systems serving this hospital needed to meet stringent safety standards while being mindful of the energy impact. Maintenance, reliability, comfort, and lifecycle were all requirements. Daniels Wingerak Engineering's careful design and use of innovative technologies met and exceeded all requirements.

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Air Handling System Design

Central to the mechanical system of any hospital, much care was placed on the design of the main air handling units.

Seven custom central station air handling units were designed with external and internal redundancies to allow for maintenance and failure without any loss of capacity to the system.

The system was designed to absorb multiple simultaneous failures, as well as having the ability to convert to a 100% fresh air ***'Pandemic mode'***, a feature that was called upon shortly after opening the doors.

One of seven (7) central station air handling units

Air Filtration

Filtration at the air handlers is also critical. For filtration efficiency while reducing pressure drop, innovative *Dynamic V8* filters were selected for their long service life (~ 5 years) which reduces maintenance, while still providing MERV-15 levels of filtration at the lowest pressure drop of any filter. Low pressure drop reduces energy consumption dramatically on large continuously operated equipment. The primary filters are backed-up by a carbon matrix grid filter to further reduce incoming VOC's.

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INNOVATION
Putting Technology to Work

Konvecta Heat Recovery Unit

This skid-mounted unit houses the control and pumping systems

Highly Efficient Heat Recovery

Heating of the air system is entirely supplied though a unique ***'Konvekta'*** system.

This system allowed for exhaust heat recovery, matched with process load heat recovery, while maintaining 0% cross-contamination.

Skid-Mounted Vertical Flooded Heat Exchanger Package

Heat Generation

The building heat is generated from redundant steam feeds from the adjacent University.

Steam is converted through the innovative use of a 'flooded' vertical heat exchanger that decreases steam use by capturing condensate energy while also eliminating flash steam and condensate pumps.

DANIELS WINGERAK

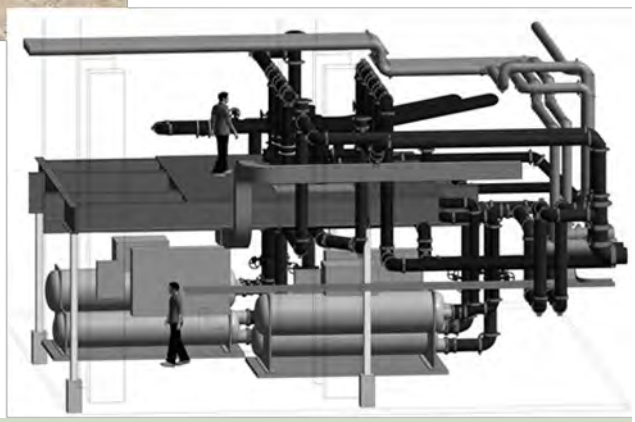
Optimized Cooling Plant

Cooling is supplied to the building from a new state-of-the art chiller plant located in the adjacent hospital.

Variable speed compressors are matched with an all variable pumping arrangement and variable speed cooling tower fans.

Year-round cooling was made available for the new, and existing hospital with the use of integrated coils in the new cooling towers.

Full N+1 redundancy was achieved by integrating this chiller plant with the existing hospital plant, increasing operational efficiency of both buildings.



Closed Circuit Cooling Tower (top left)

3D Modelling of Chiller Room enhanced with the use of 3D laser scanning (bottom right)

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INNOVATION
Putting Technology to Work

Venturi-Style Air Valve with Silencer and Reheat Coil

Airflow Controls

Venturi-style air-valves with dedicated controls were used throughout all air systems to allow careful control of airflow and pressure relationships in the building.

These valves allow precisely measured airflow in and out of every space, as well as the ability to alter pressure relationships if required.

Bed-Pan Cleansing Units in each Patient Room Enhances Infection Control

Plumbing and Medical Gases

Cutting edge plumbing fixtures were selected to meet or exceed newest healthcare codes and minimize infection vectors.

Medical gases were supplied per code, and a new oxygen generation plant was designed to allow for the local generation of a critical gas for the entire health region.

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COMPLEXITY

The location of the construction brought many challenges. Located adjacent to and connecting to an existing hospital drove innovation in design. Integrating the mechanical systems of both facilities allowed for the both hospitals to benefit from increased efficiency and redundancy.

One major challenge for the mechanical design was that a new central heating, cooling plant and generator plant for both hospitals was cancelled, which left the completed hospital design without a source of heating or cooling. The existing basement mechanical room was fortunately able to absorb the addition of a new redundant steam supply and flooded vertical heat exchanger, but no space was available in the new hospital for a chiller plant and cooling towers. Space was found in the existing hospital to locate the new chillers, and they were also then integrated with the existing plant. The existing plant's cooling towers were replaced with larger shared redundant fluid coolers.

Another major design challenge was the addition of a helicopter landing pad on the roof of the hospital, on top of the mechanical penthouse. Fresh air intakes could easily draw in contaminated exhaust from landing helicopters. The solution generated was to provide intakes on two sides of the penthouse, fully connected to each air handlers. If exhaust is detected at one intake, a bank of dampers closes and the air for the hospital is drawn from the other side. At the AHU, Dynamic V8 filters, backed with carbon filters were used to remove any stray VOCs.

DANIELS WINGERAK

Reducing the Carbon Footprint

The energy use in a hospital is tremendous. Energy savings are important, but the health and safety of the hospitals staff and patients is paramount. Many considerations were taken to reduce the energy use of the hospital where possible, one of the most dramatic was the use of the Konvekta heat recovery system.

Steam, Hydronic & Domestic Systems Color-Coded for Ease of Identification

The Konvekta heat recovery system is a high-pressure runaround heat recovery system that allows for heat recovery from all of the building's exhaust streams as well as from process heat (server room, electrical rooms, etc) with 0% cross contamination. The unique controls of the system allow for a 90% recovery, when a traditional similar system would be less than 50%. In actual operation, the recovery of the facility is enough that no additional heat is required to temper the over 100,000 cfm of fresh air that the facility consumes nearly all winter long despite Saskatchewan's frigid temperatures. This saves thousands of dollars and reduces carbon emissions.

When heat is required it is supplied through a redundant vertical flooded steam heat exchanger. This system allows for greatly improved steam usage, as the energy from the hot condensate is captured and used, and the pressure of the incoming steam is not reduced, but instead used to return the condensate back to the plant without pumping.

SOCIAL BENEFITS

The Jim Pattison Children's Hospital filled a void by becoming the first Children's Hospital in Saskatchewan. The hospital provides tremendous benefits to the province, and the mechanical system supports the operation of the hospital.

Hidden away in equipment rooms and above ceiling tiles, the mechanical systems of the hospital provide clean fresh air to patients, careful humidity and temperature control, dependable plumbing, and medical gas for procedures and patients. Infection control is central to the hospital, and the mechanical system is integral: air change rates, filtration, pressurization, laminar flow hands-free faucets and more all support infection control.

State-of-the-art operating theaters were designed using the latest air distribution technology to reduce secondary site infections. These theaters also boast the ability to control an extended range of temperatures and humidities to suit the requirements of the surgeons; these suites can be ran as cool as 15 degrees or as warm as 28 degrees at any time of the year.

Careful mechanical design also created the ability for the hospital to be entered into a 'Pandemic Mode' with a few keystrokes at the building management system.

Designing the Pandemic Mode came with significant challenges as the ventilation systems, heating and cooling plants had to be designed to handle the harsh design environments (-40C to 40C) in regular operation, as well as during times of 100% outdoor air, efficiently, and with redundancy. This mode was quickly brought forward during COVID19 and the hypothetical scenarios generated during design are being put to use.

MEETING CLIENT NEEDS

The client's goal was to achieve a modern children's hospital to serve the needs of Saskatchewan. The result was the new Jim Pattison Children's Hospital.

Which offers state-of-the-art equipment and facilities for children, mothers, and families from across our province.

Equipment Rooms Offer Space for Service, Maintenance and Growth

The new maternal and children's hospital offers neonatal intensive care, pediatric intensive care, general pediatrics, pediatric emergency, and ambulatory services. Maternal services include labour and delivery, antepartum and postpartum care. The 176-bed facility provides the highest quality of care and is putting Saskatchewan at the forefront of research and innovation.

The client deserved a mechanical system that was safe, met all applicable codes, was efficient, redundant, and maintainable. The installed systems meet and exceed all project goals.

The mechanical system was designed and installed with reliability, replaceability and maintainability as key elements. Mechanical rooms were carefully laid-out to allow proper access to every component. Also planned for in the mechanical rooms was the ability to expand as the facility, and the expectations of healthcare change with time. Where located in the ceiling, all components were designed to remain easily accessible.

Ease of future renovation is facilitated by locating 'Construction Exhaust' ducts throughout the facility. These ducts allow the hospital to connect 'construction exhaust fans' in areas of renovation anywhere in the hospital without having to drape hundreds of feet of flexible ductwork through the hospital to a window. They are dedicated for renovation and flexibility for the life of the hospital.