Model Description

Our design process seeks to push the boundaries of computational design of building passive systems. Our goal was to use algorithmic optimization of building form and opening areas to develop a design that is as close to passive as possible before applying ECMs and high-performance HVAC systems. Occupant experience and wellness will be built into this optimization to ensure that our design is not just a low energy building but a fully functional museum that brings delight to visitors and employees alike. Our model was developed cognizant of constraints that apply to “real-world” museums; high bay spaces were included to accept a variety of exhibits and all conditioning of exhibit areas was via remote systems that kept wet coils out of the space. Solar PV area was maximized and angle optimized for maximum generation and snow shedding. The modules were installed as a canopy over the parking area to help mitigate heat island effects.

Energy Savings Strategies

Our design process relied on the classical formula for low energy buildings of tackling the external loads first, then minimizing internal loads before applying ECMs at the system and plant level of the HVAC system. To that end we have proposed a very thermally effective wall system performing just below R34 when the effects of thermal bridging through cladding supports are considered. Similarly a high performing triple pane glazing system was used with a system u-factor of 0.15 Btu/h-ft²-F. Optimizations were conducted for required space adjacencies to evaluate how the Museum’s form could be best used to minimize excess solar loading while maintaining daylight and views in office areas to enhance occupant wellness. Opening areas were further adjusted to ensure that adequate natural ventilation of office spaces was possible and that glare for occupants was minimized. A low, building wide lighting power density was employed based on actual results from the Royal Alberta Museum. HVAC systems were configured to minimize the amount of humidification energy that was necessary via the use of a two stage humidification process that first relies on evaporative media before local compartment units use steam injection to “top-up” space humidity levels as needed. A high efficiency dual-core energy recovery system was used to ensure that as much heat and humidity as possible was maintained inside the exhibit and archive spaces. Finally a ground coupled “triple-bundle” chiller, capable to rejecting heat to the heating water system or the ground field as well as operating as a more traditional ground source heat pump in heating mode was used to supply heating and cooling via local fan coil and compartment units.