ASHRAE TECHNOLOGY AWARDS APPLICATION FORM (Page 1)
APPLICATION MUST BE COMPLETE TO BE CONSIDERED FOR JUDGING
(Required for Society-Level Competition)

21

(For ASHRAE Staff Use Only)

I. Identification (0 Points)

Name of building or project: [redacted] Island Medical Center

II. Category (Check one and indicate New or Existing, if applicable)

☐ Commercial Buildings	☐ New or	☐ Existing
Institutional Buildings:		
☐ Educational Facilities	☐ New or	☐ Existing
☐ Other Institutional	☐ New or	☐ Existing
■ Health Care Facilities	■ New or	☐ Existing
☐ Industrial Facilities or Processes	☐ New or	☐ Existing
☐ Public Assembly	☐ New or	☐ Existing
☐ Residential (Single and Multi-Family)		

III. Project Description (0 Points)

1. Type of building or process: Medical Center - Hospital and Clinic
2. Size – gross floor area of building (ft. sq. or m. sq.): 40,000 sf
3. Function of major areas (such as offices, retail, food services, laboratories, guest/patient rooms, laundry, operating rooms, warehouse/storage, computer rooms, parking, manufacturing, process, etc., or industrial process description:
   Emergency department, Surgical suite, Imaging, Patient beds, Cancer care clinic
4. Project study period: 06/2013 (Begin date (mm/yyyy)) to 05/2014 (End date (mm/yyyy))
5. Project Occupancy and Operation Period: 11/2012 (Begin date (mm/yyyy)) to current (End date (mm/yyyy))

[redacted] Island Medical Center [redacted] Friday Harbor, WA

It started with a vision to create a place of healing for an island community of 2,287 inhabitants. Evident in the location, this place would need to cultivate a culture of peace and serenity as a crucial part of the healing process and minimize its impact on the already strapped island infrastructure. However, the nature of the building type presented real challenges. Overcoming these challenges, [redacted] Island Medical Center [redacted] is living that vision in Friday Harbor, WA (a part of the San Juan Islands).

[redacted] is a high performance, Critical Access Hospital and Clinic, at Friday Harbor in San Juan Island, WA. It is a 40,000 sf facility that includes 10 Inpatient Beds, Emergency, Imaging, Surgery Departments, and an Ambulatory Outpatient Clinic with a Cancer Care Center. The hospital is approx.. 33,600 sf and the clinic is approx.. 6,400 sf.

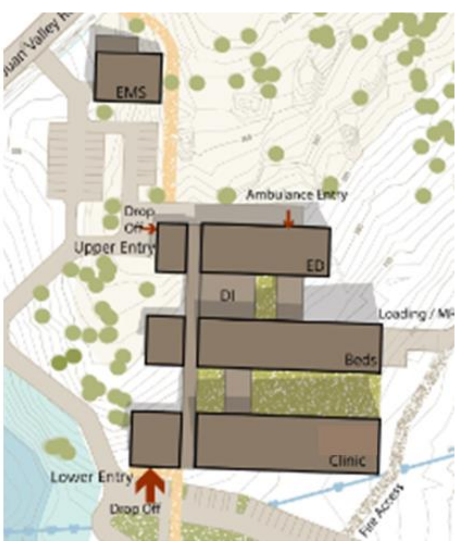
<u>Designing on an island</u>

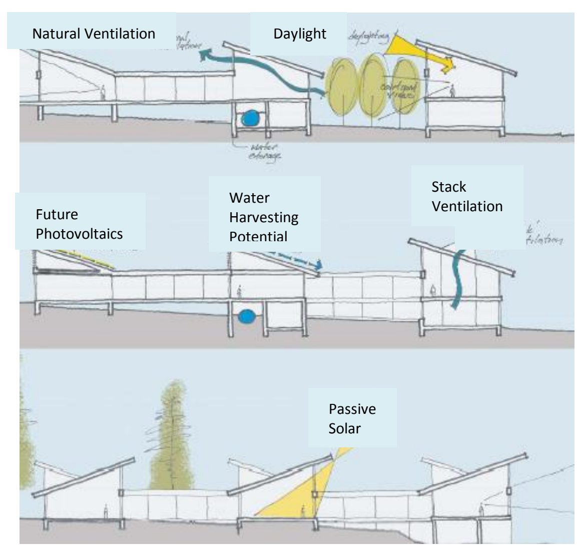
Island resources are limited, making sustainable choices vital and simple system design essential. The phrase “doing more with less” set the tone for the project. The design team used the “Living Building Challenge” as a roadmap and developed sustainable strategies through simplified systems that a single facility manager can operate.

1.0 Energy Efficiency

The mechanical system was designed to use only electricity, the only available energy source on the island. This enabled the design team to arrive at a target energy budget for the project to meet the site's potential PV generation capacity of 65 EUI. The project employs the following energy efficiency measures and achieves an average EUI of 87.7 kBtu/sf-yr. The design complies with the local WA State Energy Code 2009 that is more stringent than ASHRAE 90.1 2007. The energy modeling software "eQuest" was used for early design energy model to support design decisions.

1. The project employs **Passive Design Strategies** that provide for load reductions and facilitate natural ventilation. The major program functions are housed in a series of bars, that are oriented along the east-west axis, programmed by load intensity. A conscious effort was made to ***Reduce Cooling Demand*** resulting from building envelope and plug loads. The orientation allows for controlled penetration of sun for passive solar heat in exam and waiting areas. Unwanted heat gain is minimized on the east and west exposures. Heat gain from solar is further controlled with the use of appropriate overhangs. Roofs are sloped to the south allowing for future installations of solar collectors.





2. *Figure 1.1 Site Plan*

Figure 1.2 Conceptual design section sketch

3. Natural ventilation works in concert with the narrow floor plan and the orientation to prevailing breezes. A high performance envelope was specified and carefully detailed to minimize heating and cooling loss. Glazed areas were reduced to less than the allowed 30% of wall area. Windows are high performing wood framed units.

4. A major contributor to energy reduction was the use of **Decentralized Systems** sized to specific loads. This approach allows for systems to be tailored to the individual needs of each program area. The Emergency Department and spaces use four pipe fan coil units to decouple heating/cooling from ventilation loads, which significantly reduces reheat. Public spaces and outpatient areas have radiant heating systems and natural ventilation with fan assist for cooling. Mechanical and other facilities spaces are served by two pipe fan coil units. The Surgery and Inpatient Bed spaces use a VAV system.

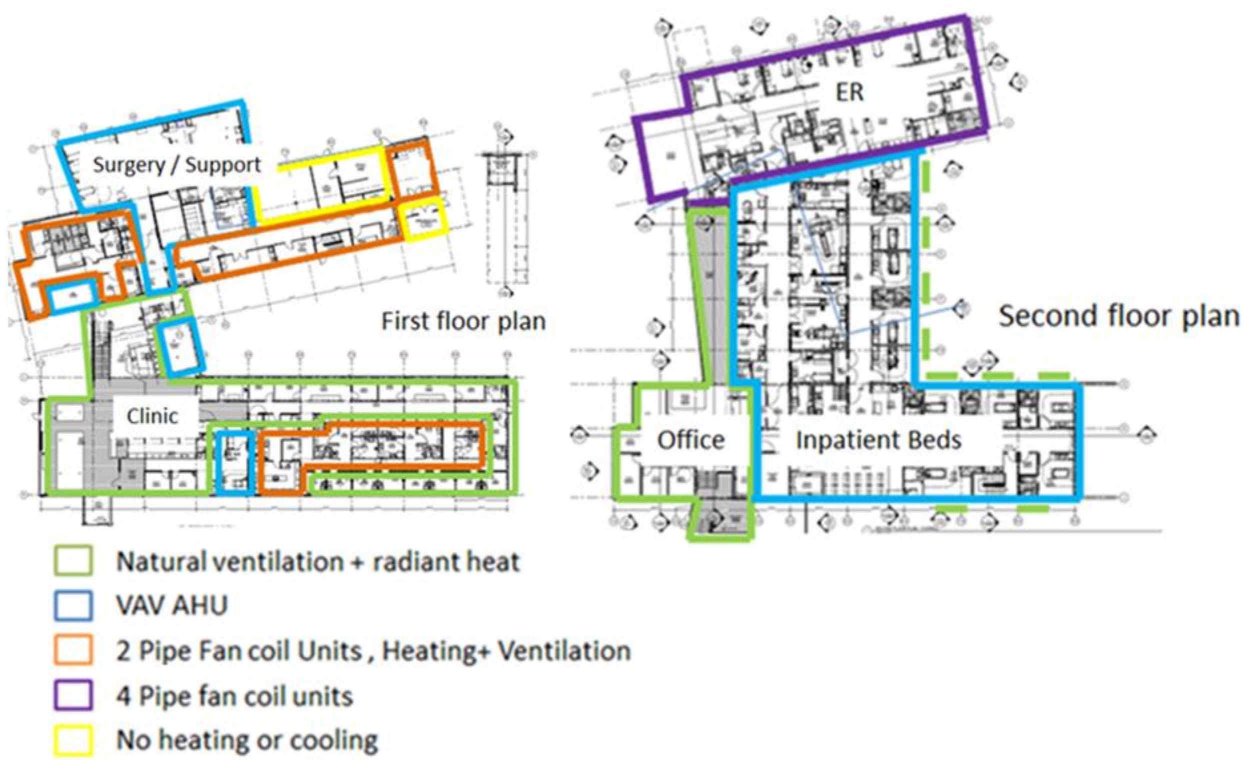


Figure 1.3 Floor Plan - HVAC Systems

5. The moderate summer temperatures and clean island air provided for ideal conditions for the use of natural ventilation. The project employs the use of ***Operable Windows*** in the clinic spaces. A bulk airflow analysis confirmed that these spaces will be thermally comfortable in summer, thus eliminating energy use for mechanical cooling in these areas.

6. The project includes a ***Ground Source Heat Pump (GSHP)*** system that uses the earth as a heat source (in the winter) and as a heat sink (in the summer) to reduce the plant energy use. The moderate temperature of the earth enables this system to operate more efficiently than an air-source heat pump. This provides significant energy and operational cost savings.

   The Well Water Loop absorbs heat from the cooling mode heat pumps and rejects heat to the heating mode heat pumps. The mild climate of Friday Harbor allows for simultaneous heating and cooling for the majority of the year. This absorption and rejection of heat is the sharing of energy and thus limits the impact to the ground.

   The Chilled Water Loop was sized to operate using two heat pumps the majority of the time. During warm times of the year the standby heat pump can be manually valved into the Chilled Loop and brought on for additional cooling. This distributed, small component system design allows for ultimate flexibility.

   The Heating Water Loop works similarly to the Chilled Loop, the majority of the time a single heat pump provides the needed heat, but the standby heat pump can be manually valved into the heating loop as needed. The 100% capacity electric backup boiler is available in the event of a heat pump system failure.

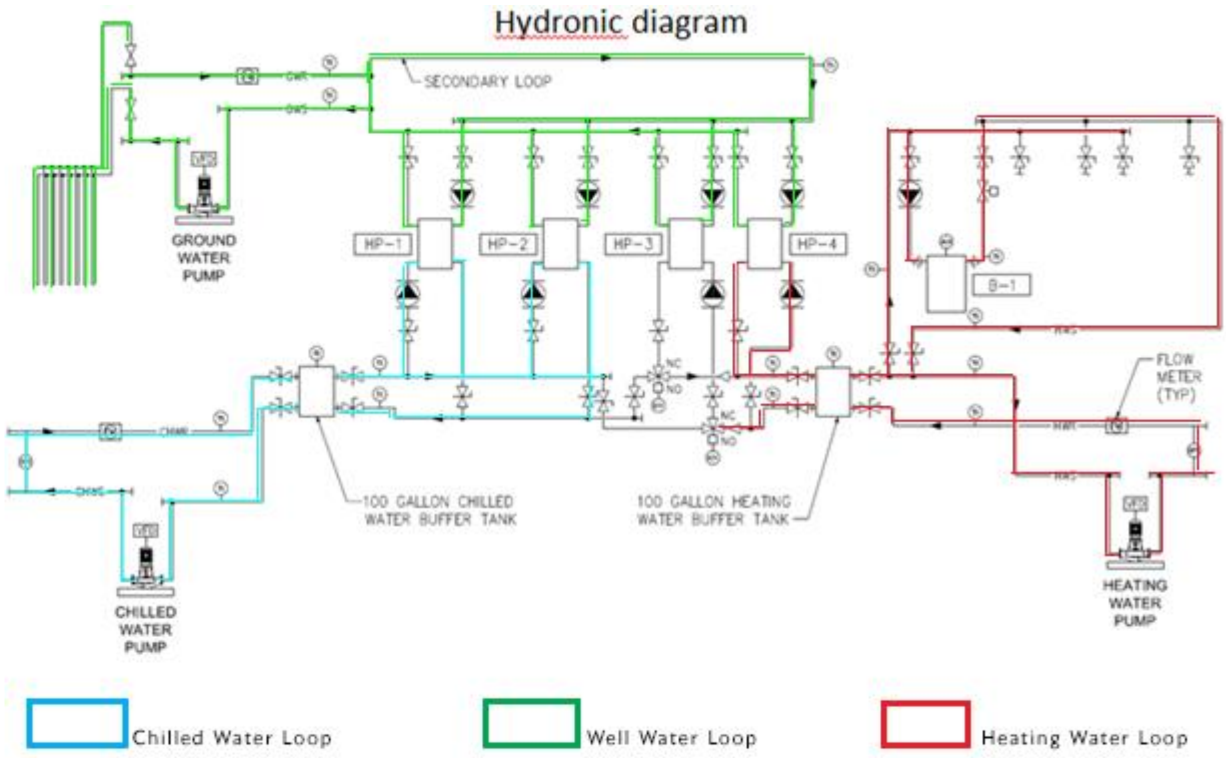


Figure 1.4 Hydronic Diagram

7. The hospital and clinic have various pressurization requirements that typically are designed to be served by a constant volume air system. The project uses a ***Variable Air Volume System*** to enable reduction in air volumes while adding additional controls for airflow tracking to maintain the pressurization requirements. This results in significant fan energy savings. This also enabled partial shutdown of HVAC systems in unoccupied mode, as explained below.
8. In an island hospital where patient traffic can be unpredictable and intermittent, partial shutdown of HVAC and Lighting systems proved to be a critical energy saving measure. ***Occupancy Sensors*** were designed to enable unoccupied airflow setback in OR suite and partial shutdown of the HVAC system and lights in other unoccupied rooms.
9. The project achieves additional heating savings by using ***Heat Recovery Ventilators*** that recover heat from exhaust air in the ED and Clinic and pretreat the outside air. These ventilators use air-to-air plate heat exchangers which typically operate in the 80% efficiency range.

10. All equipment ECM motors in the project are ***Premium Efficient Motors***.
11. A lower duct static pressure is achieved with the use of ***Low Velocity Duct Design*** resulting in fan energy savings.
12. A ***Reset of Heating Water Temperature*** is achieved based on T-stats. As demand is reduced for heating based upon satisfied room t-stats, the heating water supply temperature is reduced, limited the demand on the heat pumps.

CBECS 2003 benchmark is a limited database. The team was not able to find data relevant to a small island hospital. There is, however, a reference to an EUI of 250 for Large Hospitals and an EUI of 95 for Clinic Buildings. The project includes approx. 33,600 sf of Hospital spaces and 6,400 sf of Clinic spaces. Thus, a weighted average benchmark was derived to be a EUI of 225 kBtu/sf-yr.

Measured energy use data of the facility over a year indicates an average EUI of 87.7 kBtu/sf-yr. The facility has been occupied since Nov' 2012 and measured EUI data is available since Mar' 2013.

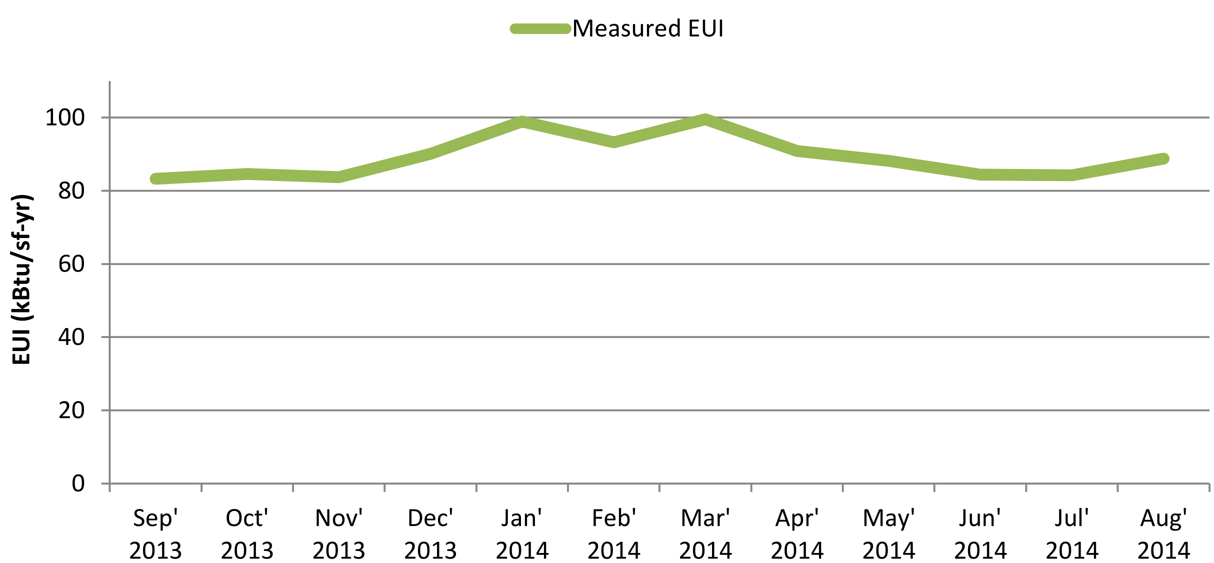


Figure 1.5 Measured EUI graph

2.0 Indoor Air Quality/ Thermal Comfort/Indoor Environmental Quality

The clean island air was an ideal scenario to utilize ***Operable Windows*** and to provide patients in the clinic with individual control over their space. The design complies with Facility Guidelines Institute (FGI) prescribed ASHRAE Standard 170 outside air requirements, which is more stringent than ASHRAE 62.1. Bulk airflow calculations were performed to assess natural ventilation effectiveness. The Department of Health (DOH) was consulted throughout the design process, and they approved the use of operable windows in the clinic. The Living Building Challenge ***Red List*** was used as a guide to help select materials that did not have off-gasing and other health concerns. This consequently contributed to healthy air quality of the space. ***Displacement Ventilation*** *i*s used in the main hallway leading to the ER waiting, providing better ventilation effectiveness.

The individual control facilitated by the use of operable windows contributes to a better sense of T***hermal comfort***. Displacemnet ventilation where used also provides for better thermal conditioning at the occupied zone. T- stats are provided in every patient room for added thermal comfort.

The project was designed to optimize ***Daylighting*** and reduce lighting loads as recommended by the daylighting studies performed by a private consultant. This provides for a better circadian rhythm among the patients and staff. The design emphasizes a visual ***Connection to the Outdoors*** and leverages the health benefits of biophilia – people's biological need to connect to nature.

The Patient Rooms were also designed with acoustical finishes and sound isolation for ***Acoustic Comfort***. The building design also complies with ASHRAE Std 170 guidelines for positive pressurization in patient rooms and direct exhaust of soiled rooms that prevent cross contamination and providing ***for Source control of Contaminants.***

Figure 2.1 Outdoor views and Daylighting in Patient areas

3.0 Innovation

The project used the Living Building Challenge and LEED as a roadmap. Many design alternates were considered for lighting, HVAC systems, water use, and plug loads. Energy modeling was used as a design tool to study the energy impact of various strategies including decreased SHGC in glazing, increased U factor glazing, increased wall insulation, increased roof insulation, building shading, reduced lighting density, high efficiency equipment, GSHP optimization, VAV, decoupled fan coil units, and energy recovery ventilators. A richly integrated design and collaboration between Architects, Mechanical Engineers, General contractor and the HVAC Controls contractor was achieved to maximize energy efficiency. Operable windows included right sized fin tubes for heating that resulted in a window not being opened beyond minimal ventilation needs during winter. This enabled the team to not use automatic systems to control window operation.

4.0 Operation and Maintenance

Designing around small, simple systems also simplified the operation and maintenance. Decentralized systems allowed for increased controllability due to each system serving a specific space type need. It also resulted in smaller systems with easier access for delivery of equipment / replacements. This was particularly important when the primary means of transport is via boat.

Figure 4.1 Accessible mechanical room layout

A DDC system controls the operation of the entire system. The system components were designed to be small and simple requiring minimal maintenance. The primary heating and cooling system are heat pumps where maintenance can be easily provided by local HVAC contractors instead of more complex chiller and cooling tower systems.

5.0 Cost Effectiveness

Compared against a benchmark construction cost of around 70-80 $/sf for mechanical / plumbing and fire systems, [redacted] was designed at approx. $65/sf. In addition, maintenance cost is expected to be low as the systems were designed to be simple and handled by available maintenance staff (one staff member at time of occupancy).

6.0 Environmental Impact

The building systems are 100% driven by electricity. The fuel mix for the electric utility provider OPALCO consists of 3% or less fossil fuel as the energy source. This achieves a significant ***Reduction in CO2***

emissions compared to a building with typical electricity and natural gas use. This also makes it feasible for a net zero design in the future. It was envisioned that the roof area could support PV panels to provide the energy source for the building upto an EUI of 65 kbtu/sf-yr.

The design utilizes sustainable strategies like dual flush and low flow fixtures that limit the use of potable water and achieves a high standard of ***Water Use Efficiency***.

The existing sewer treatment plant on the island is currently at capacity, the town dump is at capacity and in the process of being closed. The wells that provide water to residents at times go dry in the summer. An onsite pod system that would treat wastewater and separate waste/effluent in order to reuse grey-water was considered, but the design was not accepted in a DOH (Department of Health) review.

7.0 Community involvement

The community was eager to participate in the design process, expressing diverse priorities and opinions. Design input was also gathered from across the service area – including neighboring islands. By making community involvement a cornerstone of the process, broad consensus and resilient support for the project was built and momentum continues.

[redacted] Island Medical Center personifies innovation and resourcefulness—redefining how to build a healthcare facility in a resource-limited setting. By reflecting the beauty of the surrounding area with site-specific design solutions, incorporating challenging and aggressive sustainability goals and pushing the "sharing" envelope among department staff, the project provides essential knowledge for similar future endeavors. The project instills confidence & inspires us to always the push the envelope to do better even with less.