CASE STUDY: NEW PERFORMANCE BUILDING

By Peter Alspach PE, LEED AP

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The nonprescriptive design turned out to be the better option for Seattle Opera at the Center.

Figure 1

Note the facade complexity and simplifications made in the energy model representation at the Seattle Opera at the Center. Courtesy: NBBJ/Seattle Opera.

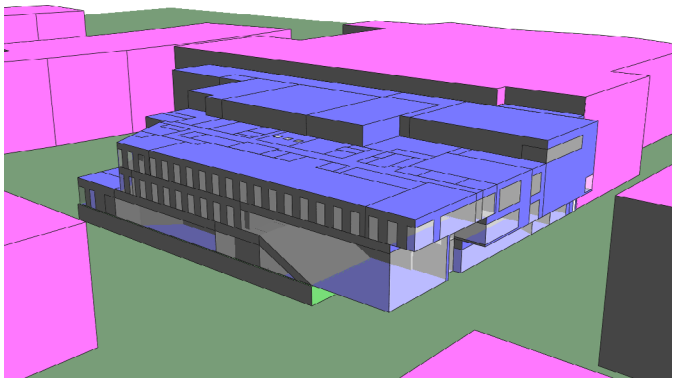
Seattle Opera at the Center is a new facility for the Seattle Opera that houses performance space as well as administrative office and production support facilities. The project uses a mix of variable refrigerant flow heat pumps and packaged rooftop heat pumps for space conditioning. The areas served by VRF are provided with ventilation air by an energy recovery ventilator. The project was permitted under the 2012 Seattle Energy Code.

The mechanical system required a performance-based energy code compliance solution because the VRF areas do not have full air-side economizer for cooling as required by the code. Other aspects of the project, such as the envelope and lighting design, met all the aspects of the energy code and did not require offsets through a performance-based approach.

The 2012 Seattle Energy Code has a well-defined whole building energy consumption-based performance compliance path that is based on the International Energy Conservation Code Section C407: Total Building Performance. As is typical for these requirements, the code compares the whole building energy performance of a standard reference design versus the proposed design. In the case of the 2012 Seattle Energy Code, the city requires that the proposed design energy performance be 7% lower than the standard reference design. This requirement is unique to Washington and was put in place to offset what the code officials felt were inaccuracies in energy modeling.

The main difference between the standard reference design and the proposed design HVAC systems was in the area served by the VRF systems—here the standard reference design was one packaged VAV air handling unit (with fan powered terminals and electric heat) per outdoor condensing unit.

Figure 2

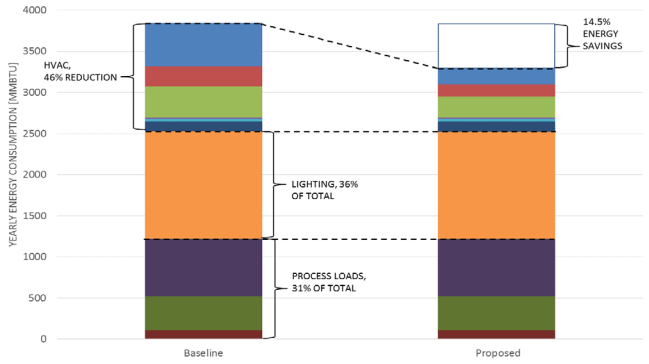


Seattle Opera at the Center code compliance energy model is shown with adjacent buildings. Modeling adjacent buildings is important in urban contexts. Courtesy: Arup.

The standard reference design included a code compliant air-side economizer but no heat recovery, while the proposed design was the VRF units and the energy recovery ventilator with heat recovery.

Lighting was kept the same for both models (code minimum efficiency) for permitting simplicity, while the actual building envelope values were used for the proposed design model. The glazing areas were kept the same as the proposed design had a window to wall ratio of 28%— less than the code maximum of 30%.

Figure 3



Code compliance energy model results for Seattle Opera at the Center are shown. Large HVAC energy savings don't always translate into large overall energy savings. Courtesy: Arup.

The final modeling showed that the proposed design had an overall energy savings of 14.5% over the standard reference design. This performance allowed the project to use the more efficient and cost effective VRF systems in lieu of the code standard packaged variable air volume with economizer. The savings come primarily from three areas: the high heating coefficient of performance of the VRF units, the air-side energy recovery and the elimination of subcooling and reheat inherent in a VRF design.

In this case the nonprescriptive design was actually better, just not recognized as such by the code. Interestingly, in the following code cycle, the Seattle Energy Code added a prescriptive path for zonal systems with energy recovery dedicated outside air systems and mandated that design approach for certain occupancy types. As mentioned, the codes are catching up and making the more efficient solutions standard. The documentation also is getting easier.

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