ASHRAE Student Design Competition 2017

Winner of category System Selection: Warsaw University of Technology (WUT)

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WUT PROJECT ABSTRACT

The purpose of the project was to present the system selection process of a heating, ventilation and air-conditioning system for a new single-story government meteorological and housing building in the Diego Ramirez Islands (Islas Diego Ramirez) in Chile, South America. All of the design concepts were made in accordance with ASHRAE Standards, especially 90.1, 62.1, 55.1. The scope of study included creating the design of heating (including both room heating and preparing Domestic Hot Water), ventilation and air-conditioning systems for a given building.

The final HVAC System Selection and Design for the proposed building addressed the following major design goals:

→ Low Life Cycle Cost (building’s considered life cycle equaled 50 years)
→ Low Environmental Impact
→ Comfort and Health
→ Creative High Performance Green Design
→ Synergy with architecture

The team created a BIM model, containing parametric information about the building, that was used for calculations and simulations. To determine building loads and system energy usage, students used IES Virtual Environment software and ran dynamic analysis, with a 1-hour time step.

According to ASHRAE 90.1 Appendix G the team simulated baseline system with Packaged Rooftop Air Conditioner (PSZ AC) with a Fossil Fuel Furnace. Rooms were heated with air prepared by gas furnace unit. Air was humidified by duct steam humidifier where steam was generated by gas boiler. Hot air was distributed by wall and underfloor diffusers. Gas storage water heater was applied to produce domestic hot water.

For the proposed design, the team considered three HVAC system options:

→ WSHP (Water Source Heat Pump)
→ GHP&CB (Gas Heat Pump & Condensing Boiler)
→ WERH (Wind Energy Radiant Heating)

All systems' operation was modeled in actual weather conditions. Factors like Life Cycle Cost, energy usage, sustainability or environmental impact were considered. Design options were judged with a multi-criteria analysis, that included grading with LEED v4 rating system.

Finally, the last option - Wind Energy Radiant Heating was chosen to be the best solution for the given building, thanks to that it gained the biggest number of points in multi-criteria analysis matrix created by the team. This system showed a 37 % overall cost improvement over the Baseline.