

Redmond High School



The courtyard at Redmond High School provides a popular gathering place for students, while allowing visual supervision.

FLOOR SPACE: 211,092 ft²
BUDGET: \$ 37.8 million (\$179/ft²) construction costs
BUILDING POPULATION: 1,500 high school students (capacity), plus teachers and staff
CONSTRUCTION DATES: Completed July 2003
OWNER: Lake Washington School District No. 414, WA
ARCHITECT: McGranahan Architects
GENERAL CONTRACTOR: Stand Hunt Construction
STRUCTURAL ENGINEERS: Putnam, Collins & Scott Associates
MECHANICAL & ELECTRICAL ENGINEERS: BCE Engineers
PROGRAM MANAGER & COMMISSIONING: Coffman Engineers
CIVIL ENGINEERS: SvR Engineers
LANDSCAPE ARCHITECTS: The Berger Partnership
THEATER DESIGN: Knudsen Ward
ACOUSTICAL: Michael Yantis, Associates

PROJECT NOTES

SITE AND WATER

- **Minimize Site Impact:** The project was able to maintain the existing building and operations during construction and reuse the site for the new building. The new building includes more area overall, but has a more compact footprint, so it uses less space on the site to meet an expanded level of service and capacity.
- **Water Use Reduction:** Unlike typical water source heat pumps, the ground-coupled heat pump system uses the earth as a heat sink, eliminating the need for a cooling tower, saving approximately 450,000 gallons of potable water annually.

ENERGY AND ATMOSPHERE

- **Design for Daylight:** Clerestory windows were used extensively to bring daylight deeper into the building. Overhangs and shading reduce solar gain during the summer.
- **Ground-Coupled Water Source Heat Pump:** GCWSHP systems have been modeled showing 30% savings over a standard code-compliant system by eliminating the electricity and natural gas that a standard cooling tower and boiler system would use. Variable speed pumping of hydronic water with 2-way valves at each heat pump produces further savings.
- **Exceeding Code in the Envelope:** Superior insulation is used on the building envelope including high performance glazing, better wall and roof insulation than code requires.

- **Controls Manage Demand:** Occupancy sensors disable lighting when classrooms are not in use. CO₂ sensors reduce the required outside air and associated conditioning. Variable air volume system for the theater reduces the volume of air when the space is not filled to capacity.

MATERIALS AND RESOURCES

- **Rapidly Renewable:** Medium Density Fiberboard (MDF) is used as an accent material throughout and is made from fiber from rapidly growing tree species.
- **Reduced Mechanical Maintenance:** In addition to all the energy efficiency measures, the HVAC design has other benefits, including central air handlers that serve several classrooms which reduces the number of filters and belt changes needed.

INDOOR ENVIRONMENTAL QUALITY

- **System Controllability:** All classrooms have individual control of temperature and lighting levels that can be controlled by the people in the space. Operable windows are provided along with the HVAC system for greater flexibility.
- **Improved Acoustical Performance:** All the classrooms at Redmond High School were designed for an NC30 or less.
- **Fresh Air without Heat Loss:** Heat recovery units in the locker rooms recover heat while providing 100% outside air to keep the space fresh and mold free.

SCHOOL DESIGN GROUNDED IN INNOVATION AND ENERGY PERFORMANCE

Redmond High School has a unique heating, ventilation, and air conditioning system (HVAC). A ground-coupled water source heat pump (GCWSHP) system uses the earth as a heat sink which removes the traditional boiler and cooling tower. A cooling tower requires potable water to evaporate in to the atmosphere to reject the required heat. The system saves considerable water, natural gas and electricity.

Typical WSHP systems have individual heat pumps in the ceiling space of each classroom. This causes noise in the classroom space and is very difficult to maintain (filter changes every 3 months, lubing, belt changes, etc.). Redmond High School has central air handlers, with 6 heat pumps serving 6 classrooms each, located in mechanical rooms. There is minimal noise transmitted to the classrooms and maintenance is very easy. Larger, industrial quality motors and fans are used in these combined air handlers instead of the lower quality small, commercial grade motors and fans reducing the frequency and difficulty of motor and fan maintenance and replacement.

In operation the system is serving a 19% larger space and using 47% less energy. The overall energy costs have been cut by \$60,000 a year (23%) resulting in a payback of 7.5 years for the additional cost of the system in the new building. Savings are even higher if water is included. The system cost \$950,000 to install, approximately \$450,000 more than a traditional water source heat pump. Even more impressive is that these gains in efficiency were made despite code requirements quadrupling the amount of outside air required to provide good ventilation.



Ground source manifold. The loop field contained over 300 bore holes.

The extensive use of daylight creates inviting spaces and visual quality. Exposed mechanical and structural systems reduce materials use while giving students a greater understanding of building systems.



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