The Dalles Middle School: High-Performance Design and Low-Cost Innovation

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1. INTRODUCTION

It is a noble goal to accomplish high performance design within a modest budget. But, as it turns out, noble doesn’t translate to easy. It is especially difficult in a community with a declining population, low-income wage earners, seasonal laborers and a stagnant economic climate. The Dalles Middle School suffered through years of make-do efforts to keep the school structurally sound as it literally was sliding down a hill. Vacillating between repair and new construction, the community had been waiting since 1981 for a new middle school.

Finally, substandard conditions and the mandated closure of several buildings served as an ultimatum to take action. Today, 600 students enjoy a new $12.5 million, 96,500-square-foot middle school, which opened in September 2002 at a cost of $127 per square foot, including considerable site work and site repair work.

Architects demonstrated that even in areas with extreme weather, it is possible to use natural systems for heating and cooling a building. The Dalles Middle School is an example of how sustainable, high performance strategies can solve complex problems even within a very modest budget and still achieve LEED Gold. But the way to success wasn’t easy.
2. PRESENTATION EXCITES COMMUNITY

2.1 First Effort Stabilizes School in Landslide Area
With old and dilapidated buildings in the middle of a large landslide zone, The Dalles School District in northern Oregon needed help. The district hired Portland-based BOORA Architects in 1981 to design a new middle school on a different site. When a city-retained geologist identified groundwater as the cause of the Kelly Avenue landslide, workers dug deep wells and installed pumps to collect groundwater—130 gallons of water per minute—and stabilize the site. Federal grants funded the dewatering project. New school plans were scrapped, and BOORA’s work appeared to be over.

![Aerial photograph of school site and Kelly Ave. slide area](image)

2.2 Problems Continue but Community Gets Another Chance
In 1996, problems with the poorly built school persisted. The wells had slowed the pace of the slides but had not fully arrested them. District officials again hired BOORA to examine alternate sites and prepare schemes for a new facility, but voters rejected a bond levy to fund the project.

In 1999, the district approached BOORA and invited the firm to attend a series of Town Hall meetings with the community to discuss options for the middle school on the existing site. Architects outlined how The Dalles could turn a damaged and neglected site and a constant reminder of failure into an asset. Clear, enthusiastic support emerged from these meetings for a new school that architects described as sustainable, high performance design: with materials selected for longevity, space organized for functionality, and natural systems designed for
superior student learning. Designers said all of this was possible for a modest construction cost, and would produce low operating and maintenance costs in the future.

This time, voters approved a new school, choosing to revitalize the existing site. The school district retained BOORA to design it.

3. TEAM GATHERED WITH SIMILAR GOALS DISCOVERS NOTHING IS IMPOSSIBLE

3.1 Team Commitment to Principles
To kick off the programming and design process, BOORA and The Dalles School District selected team members who were dedicated to the goals of high performance design, including energy efficiency and sustainability. Local, state and regional agencies assisted with services and resources where possible. For example, the Oregon Office of Energy provided funding for LEED documentation, commissioning and technical DOE-2 modeling services. A program of the four-state Northwest Energy Efficiency Alliance supported studies at the BetterBricks daylighting lab in Seattle of various approaches for integrating daylighting and minimizing the need for electrical lighting.

![Site Plan](image)

Figure 3 Site Plan
3.2 Performance-based Contract Sets Stage for the Process
The School District and the Oregon Office of Energy pursued a performance-based contract with
the architect to compensate the design team for the research and development time required to
identify optimal solutions within the modest construction cost budget. While these contracts are
still unusual, they are gaining popularity. BOORA considers them as a vital instrument to bind
all team participants together in serious commitment to achieve the utmost for the project.

Table 1 LEED Credit Summary

| Sustainable Sites | 5  | 2  |
| Water Efficiency  | 2  | 1  |
| Energy & Atmosphere | 9  | 1  |
| Materials & Resources | 2  | 3  |
| Indoor Environmental Quality | 10 | 2  |
| Innovation & Design | 2  | 2  |
| LEED Certified Professional | 1  |    |

**TOTALS 31 + 11 = 42**

**LEED Certified Gold Level = 39 - 51 Points**

3.3 Building Considered as a System
With the team and the process in place, the group began to review the program and concept ideas
as a system. Instead of targeting individual components, the team recognized that a systematic
design concept would achieve the greatest performance. For optimum results, not only architects
but structural, mechanical and electrical engineers studied overlapping dual use program areas,
square footage savings, initial construction costs, operating costs, exterior wall composition, size of
openings, and exposure. The exterior wall, which provided much of the structural support for the
school was also optimized to provide thermal mass that reduced the heat gain through the wall by
82% (Table 2). If correct, the solutions were sanctioned by the cost estimator. The process
instilled enthusiasm and inspired the team to take the challenge to another level and aim to produce
an extraordinary facility within the modest funds. Good ideas became better ones, and seemingly
insurmountable hurdles were resolved under the guiding mantra, “Nothing is impossible.”

Table 2 External Mass Evaluation of Exterior Walls for The Dalles Middle School

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>Max Heat Gain</th>
<th>Ext. Temp w/ Mass</th>
<th>Ext.Temp. w/o Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Wall - Exterior Finish, R13 Batt, Interior Sheetrock</td>
<td>2.05 btu/hr/sf</td>
<td>109.2 degrees F</td>
<td>109.2 degrees F</td>
</tr>
<tr>
<td>Medium Wall - Same as Light Wall w/ 4&quot; Exterior Conc. Wall</td>
<td>0.86</td>
<td>89.3</td>
<td>108.5</td>
</tr>
<tr>
<td>Heavy Wall - Same as Light Wall w/ 8&quot; Exterior Conc. Wall</td>
<td>0.36</td>
<td>81.0</td>
<td>107.8</td>
</tr>
<tr>
<td>Extra Heavy Wall - Same as Light Wall w/ 12&quot; Exterior Conc. Wall</td>
<td>0.33</td>
<td>80.5</td>
<td>107.0</td>
</tr>
</tbody>
</table>
4. SITE CHALLENGES FIRST ON THE LIST

4.1 Columbia Gorge Climate Considered
BOORA’s designers had to figure out how to accomplish the team’s goals for natural systems and sustainability with very formidable site issues. The site was still near a slide area, and it was very small. Furthermore, The Dalles is situated in the Columbia Gorge with weather patterns unlike the more temperate climate two hours west in Portland. Residents in The Dalles experience more extreme weather—hot summers; cold, harsh winters; and near-constant wind. BOORA could not rely solely on natural ventilation to heat and cool the building.

4.2 Ground Source Heat Pump Desired but Too Costly
Designers explored different heating and cooling options to minimize the system’s size and maximize energy efficiencies. They wanted a ground source heat pump system but could not justify the high first cost, which in this case would have substantially exceeded the cost of a conventional gas-fired boiler and chiller.
The design team recalled the 18-year-old dewatering wells one mile above the site, with the considerable volume of 130 gallons of water per minute flowing from the site to the nearby Columbia River. After much negotiation, but with the promise of reaping substantial savings, city officials and state well agencies approved the idea. The school would divert water from the wells for a heat pump system using the very ground water that was causing the landslides. The system’s projected energy savings justified the cost of building a 20,000-gallon tank to store the re-routed water, via a new line from the well pumps to the storage tank.

Figure 5    Ground source heat pump diagram with photos of heat pump

Using geothermal principles, the pump extracts heat from the 58 to 60 degree ground water to warm the building, and reverses the process to cool it. Furthermore, the cool ground water chills the air flowing through the ventilation system, also helping to keep the building cool. The water storage is also used to irrigate playing fields, saving over $17,000 per year in watering costs.

4.3 Site Improvements
When voters approved the new school, the bond measure also included the purchase of adjacent land to expand the original, small nine-acre site to 13 acres. Old buildings were demolished to make room for the new, compact two-story building configuration. BOORA also re-oriented buildings to the far end of the landslide area. Workers controlled erosion with grading, sediment control and landscaping. In lieu of a $1 million retaining wall the design team proposed an innovative key rock trench 180 feet long, 80 feet wide and 35 feet deep at one-third the cost helped protect the new school from further slides.
5. SUSTAINABLE FEATURES ARE THE SOLUTION

5.1 Abundant Daylighting for High Student Performance
As promised in the Town Hall community meetings, architects found that incorporating sustainable elements into the new school produced the best solutions for the students, staff and community. Designers maximized daylighting in order to minimize electrical lighting and improve student performance. Different approaches included:

-- Orienting the building on an east/west axis, so classrooms face north and south and avoid east and west sun during the hottest periods of the day;
-- Incorporating high performance window glazing to minimize glare and heat;
-- Using light shelves and window shading devices on the south side and vertical sunscreen louvers on the east and west sides. These help diffuse the sunlight without blocking views and also bounce light deeper into classrooms; and
-- Incorporating Solatubes® to balance daylight in the classrooms on both floors.
5.2 Wind Powers Individual Classroom Turbines for Natural Ventilation

The school employs wind turbine vents for ventilation, yet features a back-up conventional fan system. When outside weather is moderate (55 to 75 degrees Fahrenheit), a green light in the classrooms let the teachers know that the wind turbine vent system can be engaged to harness the Columbia Gorge region's abundant wind for natural ventilation. Through dampers to the rooftop, these vents regulate the natural airflow. Under this mode, air from the central fan will not be delivered to the classroom, saving energy. The back-up mechanical ventilation system turns on automatically if outside temperatures are too low or too high, or if carbon dioxide sensors require greater ventilation. This system had a lower initial cost and will save The Dalles School District considerable energy and maintenance expenses in the future.
6. SCHOOL HONOURED FOR SUSTAINABLE FEATURES

6.1 LEED Gold
The school is registered as LEED Gold. Other key sustainable and energy efficient features that will save the school district money and natural resources include:

-- Experts projected energy savings at 51 percent below code.
-- Actual tracking of energy consumption by the Oregon Office of Energy vary by approximately 5% from their initial modeling. The on-site tracking of energy consumption clearly shows the energy efficiencies produced by the heat pump once in operation as well as the significance of commissioning of a project. Current documentation indicates and even better than modeled performance (Figure 9).

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![Energy use charts by Oregon Department of Energy](image)

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-- A building commissioning agent verified mechanical design during the design process.
-- Energy efficient fluorescent T-5s light fixtures in classrooms are linked to occupancy and daylight sensors. Teachers turn off light fixtures close to windows if there is enough daylight.
-- Student and community users of the gym enjoy a glare-free gym floor, thanks to interior skylights that are lined with a spun fiberglass to diffuse natural light.
-- The school’s landscaping includes drought-resistant plants. Reclaimed ground water serves as a source for heating and cooling the building, and is used to irrigate all three athletic fields.
-- The parking area is light-colored concrete to reduce heat islands and includes 176 bicycle spots as well as a charging station for future electric cars.
-- Durable building materials contain post-consumer recycled content; shower dividers and toilets are made from recycled plastic, and ceiling tiles contain 75% post-consumer waste.
-- Designers specified woods, paints and sealers that meet strict emissions guidelines
-- Students avoid exposure to chemicals with mechanically-zoned science classrooms.
-- Students and staff enjoy outside views with windows in 90 percent of all occupied rooms.

6.2 School Applauded with Oregon Department of Energy Award

The Oregon Department of Energy recognized the Dalles School District with a “High Performance School Award” for outstanding achievement in school design. The State of Oregon presented architect Heinz Rudolf with an award of appreciation: “In recognition of your accomplishments in promoting healthy watersheds by participating in the Oregon Plan for Salmon and Watersheds. We want to thank you for protecting our state’s natural resources to assure a sustainable and profitable future for all Oregonians.”

Figure 10  Main Entrance to The Dalles Middle School

7. CONCLUSION

The energy office summed up the result of many years of struggle by the community and a not-always-easy road of searching for the best solutions by the architect and design team. “The Dalles School District has created a high performance school that is an asset to the community, enhances teaching and learning, reduces operating costs and protects the environment,” said Michael Grainey, Director of the Oregon Office of Energy.

8. REFERENCES
