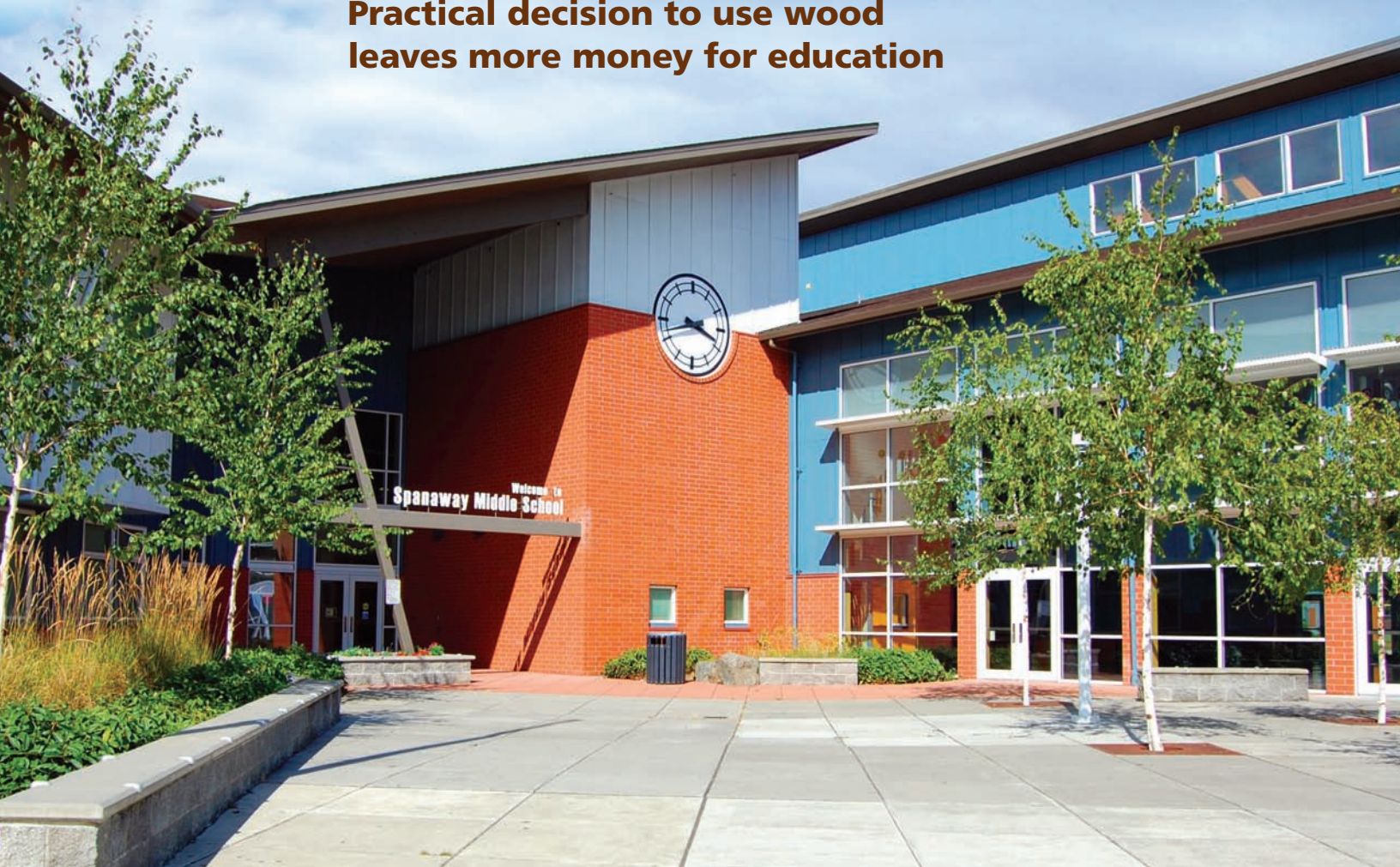


# Cost-Efficient Wood Framing Leads to Energy-Efficient Schools

**Practical decision to use wood  
leaves more money for education**



**WoodWorks**



**B**ethel School District (BSD) is proving they can save construction costs and build energy-efficient schools at the same time, leaving more money for educating students.

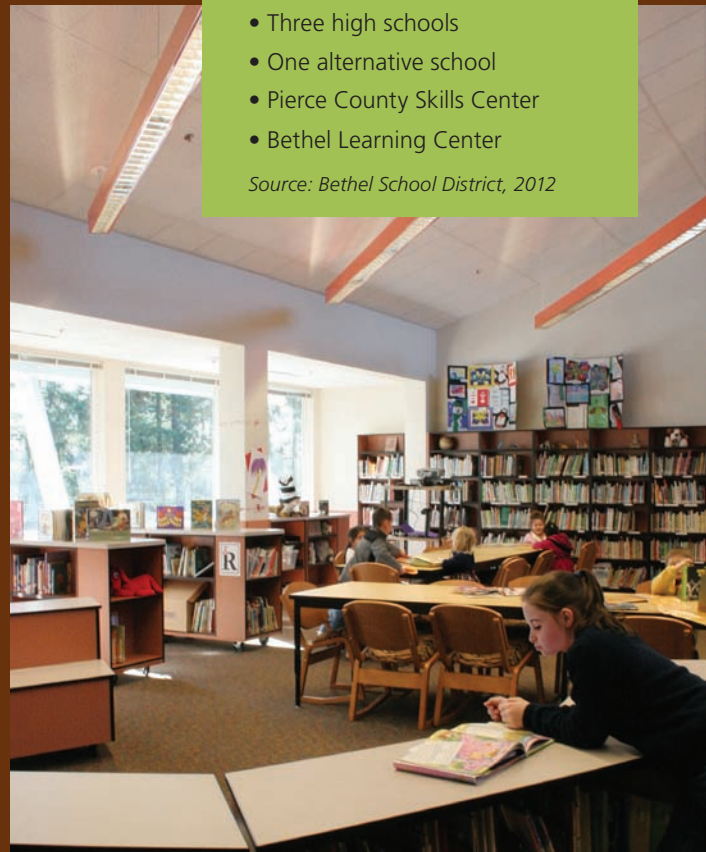
The District reports an 81 percent ENERGY STAR rating overall; several of their 17 elementary and six middle schools have ratings ranging from 95 to 98 percent. And, while size, configuration and age of the 23 facilities vary, one thing remains constant: each is wood-frame.

Wood-frame schools can be easily designed to meet or exceed the demanding energy-efficiency requirements of school districts—and they can do so cost effectively. BSD’s Clover Creek Elementary, completed in 2012, was built at a cost of \$197.70 per square foot—a savings of more than \$50 per square foot over the average construction cost of an elementary school in Western Washington.

### **Bethel School District by the Numbers**

- 215 square miles in unincorporated Pierce County, near Tacoma, Washington
- 17,500 students
- 17 elementary schools
- Six middle schools
- Three high schools
- One alternative school
- Pierce County Skills Center
- Bethel Learning Center

*Source: Bethel School District, 2012*



## Energy Efficiency Funds Better Education

Cost efficiency is a key goal for Bethel School District Superintendent Tom Seigel, a former Navy commander. He challenges his operations team to run facilities as efficiently as possible, so they can put the savings in the classroom. "Half of our schools are new or completely modernized," said Seigel. "Our buildings are recognized as being energy efficient with excellent technology to support student learning. Exceptional staff, design innovation, accountability and conservation efforts have kept our construction and operations costs down."

Like school districts across America, BSD has a limited amount of money to spend on facilities. "If I can save money by using wood framing in our new building projects, I can then use that money to buy more expensive but more efficient mechanical or lighting systems," said James Hansen, BSD's Director of Construction and Planning. "And that, in the long term, helps us save money in the general fund. Our decision to improve energy efficiency in our schools wasn't driven by a commitment to the environment, although that's an added benefit. It was a very practical decision. We want to save money on the operation side so we can have more money for education."

## Wood Costs Less and Reduces Construction Time

Bethel School District reports construction costs per square foot that are much lower than the average for other schools in the region. Hansen is quick to credit the fact that they consistently use wood framing, which saves them both in cost of materials and erection time.

"In Western Washington, wood studs cost almost half as much as metal," he said. "In 2012, our costs averaged \$0.53 per lineal foot for wood versus \$0.98 for metal studs. Plus, on a two-year project, I probably cut three to four months off construction time because wood framing goes up so much quicker."

Babbit Neuman Construction Company builds both wood-frame and metal schools throughout the Pacific Northwest; they have built several of BSD's schools. "Scott Babbit told me we save about 20 percent in materials and installation by using wood framing for a school," said Hansen. "So, if it's a \$10 million project, this can be a \$2 million savings, which is significant."

## Wood Framing Improves Envelope Efficiency

BSD's construction philosophy is to reduce costs for framing, which allows them to invest in (among other things) better, more efficient lighting and HVAC systems. They also maximize their use of inexpensive batt insulation, which helps improve energy efficiency over time.


"Why put just six inches of insulation into a 12-inch cavity?" asked Wayne Lerch, principal with Erickson McGovern Architects, a Tacoma, Washington-based firm that has designed a number of BSD facilities. "Batt insulation is a cost-effective way to increase energy efficiency just by filling the spaces, and we take advantage of that with wood framing."

Wood studs do not transfer heat and cold in the same way metal studs do, so wood also helps improve the energy efficiency of the exterior envelope. "You can seal a wood-frame building tighter than you can a metal or a concrete building," said Hansen. "Plus, because wood-frame walls, floors and roofs easily accommodate batt insulation, it's simple and cost effective to over-insulate."

For example, Hansen said they typically use 12- to 14-inch-wide laminated strand lumber (LSL) studs in gymnasium walls. "We fill those cavities up to get an R-38 or an R-40 rating, whereas code requires only R-21," he said. "A lot of districts use concrete in the gym because they think they need it for durability, but concrete is hard to insulate. We can easily control temperature because we super insulate that space. And durability is no problem because we use medium density fiberboard (MDF) to protect the walls."

COMPARING THE COST OF NEW CONSTRUCTION				
	Completion Date	Total Square Feet	Construction Cost per Square Foot	Average Cost*
<b>BSD Elementary Schools</b>				
• Nelson Elementary	2009	63,495	\$241.73	\$248.12
• Frederickson Elementary	2009	64,569	\$218.05	
• Clover Creek Elementary	2012	63,121	\$197.70	
<b>BSD Junior High/Middle Schools</b>				
• Liberty Middle School	2009	98,431	\$222.99	\$269.32
• Spanaway Middle School	2008	100,899	\$187.26	

Source: Office of Superintendent of Public Instruction, Washington State  
 \*Average Construction Cost for New Schools in Western WA; 2008 - 2012

A photograph of Nelson Elementary school, a modern building with green and blue siding, multiple windows, and a flagpole in the foreground. The sky is blue with some clouds.

## Nelson Elementary

**COMPLETED:** September 2009  
**ARCHITECT:** Erickson McGovern  
**STRUCTURAL ENGINEER:** PCS Structural Solutions  
**GENERAL CONTRACTOR:** Babbit Neuman Construction Company  
**AREA:** 63,495 square feet  
**PROJECT COST:** \$241.73 per square foot  
**GRADES:** K-6  
**NUMBER OF STUDENTS:** 600  
**CONSTRUCTION TYPE:** Type VB construction

Nelson is located on a 100-acre site with a middle school and high school, designed to provide a campus-like setting. "It was a tight site though," recalled Lerch. "More than half the site is comprised of wetlands, so it had to be a compact structure."

The school is oriented to take advantage of direct north and south exposures; clerestory windows, exterior sun shades, and interior light shelves collect and control daylight to minimize additional lighting needs and maximize views of Mount Rainier. Lerch and his team conducted daylighting studies for the classrooms. They even built a model of the proposed classroom configuration options and tested the configurations at the Seattle Lighting Lab in order to meet their sustainability goals.

According to the Northwest Energy Efficiency Council, thermal bridging through framing components reduces envelope insulation performance by 15 to 20 percent in wood-frame construction, but by as much as 45 to 60 percent in metal-frame construction.

Source: Northwest Energy Efficiency Council



## Thermal Breaks and Continuous Insulation

Wood framing offers a number of other thermal benefits. "Steel and concrete need separation between the structure and exterior envelope," said Lerch. "This separation is not required with wood because of its inherent thermal properties."

"In years past, the building code did not distinguish between wood and metal or concrete when it came to exterior walls and thermal breaks," explained Hansen. "However, we all know heat doesn't transfer through wood like it does through metal and concrete. In Washington State, the new energy code requires a thermal break between the exterior and interior walls if you use metal and concrete, which means a thicker wall, which therefore adds cost. Wood doesn't have this requirement, so the exterior skin can be directly attached to the wood stud."

Table 13-1 of the *2009 Washington State Energy Code, Building Envelope Requirements* details the fact that metal and steel-framed buildings need a minimum R-value of R-13 + R-7.5 with continuous insulation on the above-grade walls. The minimum R-value for insulating a wood-framed non-residential building is R-21, and continuous insulation is not required.

Cost to provide that extra layer of continuous insulation is significant. Lerch estimates that it doubles the amount of time required to insulate an average school, which would add about 30 percent to the cost of insulation versus a single layer of standard R-21.

## Savings from the Roof Down

When it comes to saving money on school design and construction, Hansen said they start with the roof and work their way down.

"We typically look at a 40- to 50-year life cycle for our schools, so we use sloped roofs with shingles," said Hansen. "That allows us to get a 40-year shingle that is, in my opinion, the best value. A metal roof will last 50 years, but if I replace or remodel a school in 40 years, it means I paid five times more than I needed to for a roof that I just tore off."

Hansen said they also super-insulate their wood roof structures with batt insulation to a rating of R-40 or R-50, depending on the size of the rafters. "If I tried to do that with a concrete or steel building, it would cost quite a bit more. Batt just costs less than rigid insulation. That's why we can save so much energy; it's the little things we do during construction."

Lerch cited lighting as another area where they're able to save on infrastructure costs. By continuously searching for improved lighting systems that diffuse light better and provide more uniform illumination, he said they've been able to reduce the overall height of the building by 6 inches per floor. "Older indirect light fixtures required that the fixture be hung 18 inches below the ceiling to achieve a uniform illumination," said Lerch.

## Energy Savings Specific to Bethel School District

While researching the comparative efficiencies of various school districts, energy consultant Fritz Feiten with Ameresco Quantum, Inc. stumbled upon some interesting facts. "When you compare Western Washington school districts with 15,000 to 20,000 full-time students each, the Bethel School District operates at the lowest total utility cost per student," he said.

"Bethel spends 34 percent less per student than the average for all peer districts, and 52 percent less than the highest cost peer," Feiten added. "Interestingly, both Bethel and the highest cost school district peer use mechanical cooling in most if not all their schools. While this is admittedly a rough measure of efficiency, I think it speaks volumes about the great job Bethel School District is doing to minimize energy costs in their District."

DISTRICT	Issaquah	Bethel	Everett	Highline	Bellevue	Northshore	Edmonds	Puyallup	AVERAGE*
FTEs**	16,557	17,016	17,744	17,852	18,156	18,444	19,802	20,623	19,380
Utility Cost	\$4,694,760	\$2,743,345	\$4,200,651	\$5,478,627	\$6,067,571	\$4,070,702	\$4,004,658	\$5,437,839	\$4,718,712
Utility Cost/FTE	\$284	\$161	\$237	\$307	\$334	\$221	\$202	\$264	\$244
High Schools	4	4	4	4	4	3	5	4	
Middle Schools	5	5	5	5	5	6	4	7	
Elementary Schools	15	17	18	18	15	21	21	21	
Total Schools	24	26	27	27	24	30	30	32	

Source: 2011/2012 budgets, Office of Superintendent of Public Instruction, Washington State

\*Average includes data for three school districts not shown

\*\*Full-time equivalent



### Bethel School District is an ENERGY STAR

Of BSD's 25 eligible buildings, 19 have earned the ENERGY STAR label. The District has received national recognition from the U.S. Environmental Protection Agency as an ENERGY STAR Leader.

"New technology, using T5 lamps, allows us to achieve the same results with fixtures hung just 12 inches from the ceiling. So we can cut costs by adjusting the overall height of the building."

### Design Versatility

Ninety-five percent of the work Erickson McGovern Architects does is school design, and Lerch says wood is well-accepted by all the districts they work with. "Because it is a versatile framing material, wood allows us to be as creative as we want in terms of design," he said.

At the same time, simplicity and functionality are priorities. "This is a blue-collar community," said Hansen, "so we work to give families a good solid building that is not overbuilt. We want our schools to fit into the surroundings. Most of our schools are in single-family residential zones, so we use sloped roofs and natural but durable materials on the exterior."

Wood lends itself well to surface treatments. "Kids like color, and a good bucket of paint costs \$30 or \$35 a gallon," said Hansen. "If it's applied correctly, that paint will last 12 to 15 years or longer. If you want to change it or update to a more current color scheme, it's relatively inexpensive to do. If you paint on metal or concrete, it becomes a long-term maintenance issue, since neither holds paint as well as wood. Plus, both metal and concrete surfaces feel cold. Wood is a product people like because it has warmth."





## Bethel Learning Center

**COMPLETED:** November 2012  
**ARCHITECT:** Erickson McGovern  
**STRUCTURAL ENGINEER:** PCS Structural Solutions  
**GENERAL CONTRACTOR:** Jones & Roberts  
**AREA:** 5,567 square feet  
**PROJECT COST:** \$349.66 per square foot  
**CONSTRUCTION TYPE:** Type VB construction, blast-resistant design

At slightly more than 5,500 square feet, the Bethel Learning Center is a small structure that had big requirements. Built for the Bethel School District, this multi-functional facility is also used as a neighborhood community center. “We wanted to feature the warmth of wood, so we left wood beams and trusses exposed throughout,” said Lerch.

The facility’s location was selected because of its proximity to the center of the District. The project is near an elementary school, middle school and high school. However, it is also located adjacent to a natural gas pipeline, so the structure needed to be designed to withstand a natural gas blast. “We had specific structural minimums for blast protection, including 8-inch stud spacing and laminated glazing requirements,” added Lerch. “In all, we have a lot of variety in a small building, which drove the cost per square foot up. But it’s a facility that will serve the District well now and in the future.”

## \$4.3 Million in Utility Savings

In 2011, the Bethel School District was recognized by the U.S. Environmental Protection Agency (EPA) as an ENERGY STAR Leader. Between 2004 and 2011, BSD reduced kilowatt usage by more than 7.6 million kilowatts and saved \$4.3 million in utility costs—equivalent to the cost of electricity for 15 of the District’s elementary schools for one year. Through the EPA’s Portfolio Manager, BSD has shown a nearly 15 percent increase in energy efficiency, with an average overall portfolio rating of 82 for 25 buildings. In 2008, 10 of the District’s schools received the ENERGY STAR for superior energy efficiency.

Source: ENERGY STAR, U.S. Environmental Protection Agency



## Speed of Construction

When BSD assesses the advantages that wood-frame construction provides in terms of construction timing, they first consider two factors: availability of the raw material and how the product goes together.

“Wood is a relatively easy product to get; we don’t have long lead times like we would with other materials,” said Hansen. “Plus, we tend to use products that help the local community because it helps provide jobs. Wood does that here in Washington. The people who live in our District pay taxes in our District, and like to see their products stay in their District. Plus, they’re also parents whose children attend school here.”

Regardless of whether it’s a structural member or a trim product, Hansen said they can normally get wood products within a week or two, where steel and masonry products often require more time. “And time on the job is money,” he added. “It costs a general contractor about \$80,000 to \$100,000 per month to be on site. The faster you can get the job done, the more money you can save.”

Carpenters can work with simple tools in all types of weather. The contractor usually requires less heavy-duty equipment because wood members are lighter and easier to erect. “It’s just a simpler process to erect a wood building,” said Hansen, “and simpler usually means less expensive.”

## Looking Ahead

Through its financial assistance program, Washington State provides funding toward school construction or remodeling every 30 years. Therefore, schools are remodeled in the Bethel School District every 30 to 40 years. By using wood, they’ve made the process easier for years to come.

“It’s simpler and more cost effective to go back and modify a wood structure than a concrete or steel building,” noted Hansen. “I don’t think many people look ahead 30 or 40 years, but I look at what people are going to be left with when I’m gone. From the time you start planning a bond issue until you get a school built, it’s a long process with a public agency. A wood building will be easier to modify and maintain years from now.”

Durability and maintenance are both key considerations for school districts. “I encourage my colleagues to pay attention to the details,” Hansen said. “For example, if I use brick on a facility, I have to apply moisture sealant and anti-graffiti coatings, which run over \$180 a gallon. We need to reapply that every 12 to 15 years, just like paint.

So, if you’re tracking your maintenance costs, a bucket of paint costs \$30 and sealant and anti-graffiti costs \$180. Over time, I believe you can save money with wood versus concrete or masonry as long as you’re doing proper maintenance and paying attention to the details.”

## Using Wood to Manage Money

Jerch said that his firm looks at all aspects of a school design project. “We work to balance cost, energy efficiency, maintainability, functionality and many other factors. Schedules are also a consideration; everyone needs their school built as soon as possible, and it has to be done on time. We know wood is less expensive; it’s a natural material and people are naturally drawn to it. We think wood is just a better product for schools.”

Hansen encourages other districts to have the conversation with their architects about using wood in schools. “Districts can save up front in construction costs over the long term by super-insulating to save utility costs.

And, by saving money with the framing, you can install more energy-efficient mechanical and lighting systems, which provide long-term operational savings.”

The fact that they can use wood to build good quality school buildings without overspending is important, emphasized Hansen. “We need people to believe we do a good job, not only educating their children but managing their money. Our decision to use wood has a very practical basis. We’re focused on becoming more energy efficient, which is good for the environment. Going green is the right thing to do, but our decision was really about saving energy, which saves money. Constructing our schools with wood allows us to do both.”



**Thompson Elementary**

**COMPLETED:** December 2006  
**ARCHITECT:** Erickson McGovern  
**STRUCTURAL ENGINEER:** PCS Structural Solutions  
**GENERAL CONTRACTOR:** Babbit Neuman Construction Company  
**AREA:** 64,926 square feet  
**PROJECT COST:** \$169.42 per square foot  
**GRADES:** K-6  
**NUMBER OF STUDENTS:** 550  
**CONSTRUCTION TYPE:** Type VB construction

Selected to be one of the pilot schools for the Washington Sustainable Schools Protocol (WSSP), the design for Thompson Elementary focuses on sustainability and efficiency. What began as a remodel to a 40,000-square-foot building ended up becoming a 64,000-square-foot new building.

“When we developed the systems for this project,” recalls Jerch, “we looked at everything from wainscoting on the walls to framing systems, light fixtures and HVAC options. Everything was planned around our goal of finding a better way to do things. For example, we developed a mezzanine system for mechanicals that was built into the sloped roof attic space. The system gave us easy access and the sloped wood roof helped us better blend the school into the surrounding neighborhood.”



**Spanaway Middle School**

**COMPLETED:** September 2008  
**ARCHITECT:** Erickson McGovern  
**STRUCTURAL ENGINEER:** PCS Structural Solutions  
**GENERAL CONTRACTOR:** Babbit Neuman Construction Company  
**AREA:** 100,899 square feet  
**PROJECT COST:** \$187.26 per square foot  
**GRADES:** 7-9  
**NUMBER OF STUDENTS:** 1,000  
**CONSTRUCTION TYPE:** Type VB construction

Spanaway Middle School shares its site with Thompson Elementary, and since Thompson served as a pilot school for the WSSP, Spanaway includes a number of similar sustainable features. “This was one of the earlier projects, where we really studied the different wood systems and then applied the most cost-effective design options,” said Jerch. “The fact that this school has three grades dictated the design, so we have three separate wings with a shared hub.”

Classroom wings are organized around a central commons with a stage that also serves as a music classroom. The commons also opens out to the front entry plaza, creating well-utilized indoor and outdoor student gathering spaces. Rain gardens, located in the courtyards between classroom wings, integrate the school’s science curriculum and the natural environment. Gym walls were designed with 12-inch-thick LSL, which allowed them to increase the R-value of the insulation from R-21 to R-38.



## Clover Creek Elementary

**COMPLETED:** September, 2012  
**ARCHITECT:** Erickson McGovern  
**STRUCTURAL ENGINEER:** PCS Structural Solutions  
**GENERAL CONTRACTOR:** Jody Miller Construction, Inc.  
**AREA:** 63,121 square feet  
**TOTAL PROJECT COST:** \$197.70 per square foot  
**GRADES:** K-6  
**NUMBER OF STUDENTS:** 645  
**CONSTRUCTION TYPE:** Type VB construction

Built to replace an existing school, history played an important role in Clover Creek's design as architects worked to blend modern technologies with historical features, including a cupola from the old school. The two-story wood-frame structure features two classroom wings and a third common area with performance/assembly space. To meet sustainability goals, architects used strategic window placement and other daylighting techniques to reduce electrical usage. They also used modern heat recovery technologies to improve efficiency of the heating and ventilation systems.

Outside, they incorporated a rain garden to collect stormwater runoff from downspouts and other hard surface areas at the school, while also providing a natural learning environment. An elevated wooden boardwalk leads students through the rain garden to the historic cupola, salvaged from one of the original school buildings from 1938.



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