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HIGH PERFORMANCE SCHOOLS: ARTICLE

High Performance Classroom Prototype

Mt Angel, Oregon

As sustainability and energy efficiency have come to occupy an ever-greater role in mainstream architecture and construction, no building type has embraced these principles more than schools. Maybe it's because of the higher test scores that come when students learn in naturally lit classrooms. Or the reduced operating expenses that ease the burden of constricted school budgets. But the Northwest is now dotted with elementary, middle and high schools that offer better learning environments and significantly reduced operating expenses through sustainable high performance design.

Recently, a trio of the Northwest's foremost experts on energy-efficient design resolved to build a full-scale mockup of a K-12 classroom. GZ "Charlie" Brown (professor of architecture at the University of Oregon and manager of the University's Energy Study in Buildings Lab in Portland and Eugene supported by BetterBricks) and Mike Hatten, principal of SOLARC Architecture and Engineering, joined with Heinz Rudolf (principal with BOORA Architects and designer of several nationally-renowned LEED-rated Northwest schools) to create a classroom that so adeptly utilized available light and outside air that no artificial lights, heating or air conditioning would ever be needed during the day. They also wanted to prove that such a prototype classroom could be built for less than a regular K-12 classroom.

The idea starts with a wide skylight in the middle of a classroom. But this is no ordinary skylight. "In order to meet the required light levels on overcast days you need a large opening," Brown explains. "But that means that the rest of the time it's too big." As a result, the skylight is outfitted on top with a succession of louvers that automatically adjust themselves, opening and closing in relation to the amount of sunlight outside, so that a minimum interior light level of 20 foot candles is maintained at all times during daylight hours.

Another issue was distributing light from the middle to the outer portions of the classroom. That's where a specially-designed apparatus called "the halo" comes in. The halo is a rectangular-shaped fixture that hangs below the central skylight. Each of its four sides consists of translucent material that reflects a portion of the light from the skylight onto the ceiling and walls, while some of the light also passes through the material and into the center. "The edge (of the classroom) gets two sources of light: from the skylight, called the sky component, and reflected light off the halo and ceiling,"

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Brown explains. "The middle of the room gets light reflected around the room and light that penetrates through the halo."

Part of what Brown, Hatten and Rudolf hoped to prove with the prototype classroom was to light a classroom during daylight hours without any electric light needed. This is based on the assumption that classrooms are occupied only during daylight hours. But of course there are infrequent times when even a K-12 classroom is used at night. Brown and his team decided an electric light was needed as part of the halo.

"What makes the cost in a lighting system is all the luminaries that all the wires go to," Brown continues. "So we said, 'We'll use one big light and put it in the middle of the room and shine it towards the ceiling. We'll light the whole space with just that one light.' Which is what we did. It's a 450-watt HID pointed upward." The classroom that Brown, Hatten and Rudolf envisioned has been built and today sits in a modified warehouse at the Mt. Angel Abbey in Mt. Angel, Oregon, about an hour's drive from Portland.

The results of the Mt Angel prototype are impressive. "We're looking at some fairly phenomenal energy use index (EUI) numbers," Hatten says of the Seminary building's classrooms, based on monitoring of the prototype. "28,400 BTUs per square foot a year is what's projected. The base case code classroom would be 73,200. That's 62% better than code." Brown believes that with some additional insulation, like that originally intended, energy savings could be even higher: as much as 70% better than code requirements.

The reason it was built at Mt Angel has to do with Kent Duffy, SRG Partnership's designer for a new building at the Seminary consisting of classrooms and offices. Purely by happenstance, several months ago Duffy happened to be visiting the Energy Studies in Buildings Lab in Portland in Portland while Brown was studying a model of the classroom. Intrigued, Duffy asked about using the prototype classroom with its high-tech halo for SRG's in-progress Mt. Angel building design.

"To me, that's one of the really interesting parts of the story," Hatten says. "We had a concept that came into being because the Northwest Energy Efficiency Alliance (BetterBricks) supported it. Then we had an architect who happened to be at the lab and notice one of the models sitting on the table and say, 'What's that? That's interesting. Maybe I can do this in my project.'"

Brown and Hatten (whose firm is also is providing engineering services for the Mt. Angel project) then tailored the classroom design more toward Mt Angel's needs.

Where it differs most is in the insulation. "SRG added more insulation than they normally would, and much more than what code requires," Hatten continues, "but not to what I would call super insulation levels. And this was a key feature, because it got the load down to where we actually didn't need heaters in the classroom. But we still need heaters in other areas of the Mt. Angel project.”

Although this classroom prototype is finished, Brown and Hatten believe there is an opportunity for further experimentation. For example, the classroom prototype is designed to meet climate conditions specifically west of the Cascades, where the climate is moderate. Ultimately it is hoped a modified prototype could be adapted to the range of temperatures east of the mountains, or perhaps another region altogether. “It is likely to require some aspect of supplemental heating and/or cooling,” Hatten says.

The prototype classroom is also geared specifically for single-story ground floor buildings, but Brown a version of the design could ultimately be adapted to two-story buildings using light shafts coming down through the upper floor to the lower floor.

“We have a relatively dynamic and complex lighting and cooling system in the Mt Angel building project,” he explains. “We are relying on continuous modification of the aperture in the skylight to maintain light levels. If we don’t commission these, I can guarantee you they won’t be working exactly as intended.”

The efforts of design experts like Brown, Hatten, Duffy and Rudolf will continue as more and more schools embrace the opportunity for enhanced human performance and energy efficiency that comes with sustainable schools. The classroom prototype that was created is merely one step in a longer journey. But it is also something not to be forgotten any time soon, for the classroom essentially proves that in the Northwest it is entirely possible to light, heat and cool classrooms using only the abundant natural resources of sun and wind. That’s a lesson architects and school administrators are apt to keep learning every day.

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