they're each 16 feet in diameter. They take up a lot of space and have a lot of associated ductwork. Architects, generally speaking, don't like to incorporate them in their buildings because they take up so much room. The architect, Perkins+Will, did a great job, making circular windows, like portholes, on two sides of the building so you can actually look through the windows and see the wheels rotating. Also there is a graphic display next to the window that shows how much energy is being saved real-time.

Because all of the air coming in and all of the air going out has to go through the system, it's got to be in a fairly central location unless you want miles of ductwork. The engineer has to work very closely with the architect to make sure you can locate them somewhere central in the building. It's perhaps 80 percent engineering and 20 percent architecture involved in getting these integrated correctly into the building.

A High-Performance Laboratory Project

Let's look at another challenging LEED Platinum project, a high-altitude [6300 feet (1910 meters)] laboratory, a joint venture project between Sierra Nevada College, the University of California, Davis, the Desert Research Institute, and the University of Nevada, Reno. The Tahoe Center for Environmental Sciences is a 45,000-square-feet lab and classroom building. Todd Lankenau was the principal in charge and project architect for the architectural firm, Collaborative Design Studio and Peter Rumsey was principal in charge and design engineer for the mechanical engineers, Rumsey Engineers.* Todd Lankenau talked about how they began:

> The client's original goal was to achieve LEED Silver. We started the project by going through a detailed interview process with various consultants to find the most appropriate people to include on the design team. We selected consultants for their technical and creative abilities as well as their commitments to be very personally involved with the project. Our goal was to create a very hands-on team of highly motivated, communicative, and personable individuals to foster excellence in the design process, which was of particular importance due to the large number of stakeholders from different institutions and the complex nature of the building and regulatory environment. As the project progressed, it became evident how important those initial choices were, since the success of this as well as any project is a result of the collective enthusiasm of the participants, and their ability to be leaders and champion the cause of designing an exceptional project.
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> We developed a detailed project program with the owners and user groups and put into writing a very specific room-by-room requirement. This was critical as a reference throughout the design process to be sure all of the owners' requirements were met. We were very fortunate to have owners who were very committed to and regularly involved in the design process, as well as being highly knowledgeable in the building type and sustainable design practices.

*Interview with Todd Lankenau, Collaborative Design Studio, February 2008, and with Peter Rumsey, Rumsey Engineers, April 2008.

> We conducted numerous design charrettes that included the design team members and the owners, plus the various user groups and advisors from Lawrence Berkeley National Laboratory, Carnegie Mellon University, an architect from Germany, and others. The charettes were designed to optimize and integrate building systems while at the same time reduce energy consumption and initial construction cost. Our first goal was to reduce the heating and cooling loads of the building by optimizing the building envelope and reducing otherwise assumptive loads such as plug loads. We then studied various mechanical systems, and selected a hybridized system which resulted in a 100 percent outside air system with an energy savings of approximately 60 percent. The integration of these systems into a building, which had a predetermined footprint and severe height restrictions due to the regulatory agency requirements in the Lake Tahoe area, created a separate challenge in itself, requiring significant design creativity. It was also necessary that the exterior design of the building reflect the Lake Tahoe alpine architectural vernacular which further restricted the choices of style, form, and building materials.
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> There were essentially two types of charrettes and workshops generally categorized by size. The larger charrettes were important and provided the opportunity to step back and listen to divergent opinions and provided a forum for stimulating discussions while providing some long range perspective which is needed and helpful at times to prevent you from getting tunnel vision. However, the most productive and focused meetings were smaller group workshops of 8 to 12 people consisting of the core design team members with representation from the owners and the user groups. The smaller group size enabled us to focus on, and further evaluate, specific issues which may have been raised at the larger charrettes, but also to refine the details of the design concepts. It was optimum for our project to have the larger design charrettes at intervals of about 60 days, with focused smaller workshops at two week intervals.

There was a certain "bottom line" philosophy, according to Lankenau, about how to use LEED as a metric, considering that it is still, and will probably remain for the foreseeable future, a work in progress:

> Our goal was this: if there was a choice between good design practice and sacrificing the best design solution in an effort to attain a LEED credit, we would always choose good design practice. As a design team, we agreed that we would try never to design something just to attain a LEED credit, but rather, if it appeared close, we would simply work harder to refine the design, and through the additional effort, perhaps achieve a better design which would result in achieving the credit. It can be a formidable challenge to avoid the temptation to accumulate additional credits, but I believe that good design practice will yield a well-designed building incorporating exemplary sustainable design principles which may or may not qualify as a LEED credit.

Of course, the temptation during the construction documents phase is always to get just a few more points, to get to the next certification level, a practice that inevitably distorts the goals of LEED and probably at this stage adds cost to the project without attendant gain. Lankenau says there has to be a balance and that at the construction document (CD) phase level it can be very effective to try harder:

> Our philosophy was that if we're so close on so many of the credits, if we roll up our sleeves and refine the design, we can achieve something that's even better. Rather than being satisfied with let's say a 40 percent energy savings as compared to an ASHRAE 90.1 equivalent, we said, why not make it 50 percent. When we reached 50 percent, we said why not 60 percent? We ultimately ended up achieving a savings of about 63 percent. We did that just by continually refining elements of the design. An example of that is the ductwork. Every time there's an elbow in ductwork, it creates a static pressure drop, which makes the fan work a little bit harder, which in turn consumes additional power. [For example], we went through an exercise of reviewing the mechanical system and eliminating every conceivable elbow that wasn't necessary. We achieved our goal merely by going to that level of detail during the design process and rigidly enforcing it during construction. This was also coupled with continual review and improvement of the efficiency of the building envelope and further reduction of loads where possible. This is an example of taking what was an already a highly efficient and cost effective system and making it better. The mechanical and electrical engineers deserve significant credit for being so dedicated to the continual improvement of the building systems efficiency.

In the end, the Tahoe Center for Environmental Sciences received a LEED Platinum rating with 56 credits, which has delighted the owners who were only hoping for a LEED Silver rating. It also was awarded the Best Overall Sustainable Design Project for 2008 from the University of California System, among others, and has become a model for the design of energy efficient laboratory buildings and sustainable design practices.

PLATINUM PROJECT PROFILE

Tahoe Center for Environmental Sciences, Incline Village, Nevada

Completed in the fall of 2006, the Tahoe Center for Environmental Sciences houses classrooms and laboratories for programs that focus on understanding and protecting fragile alpine lakes. The three-story, 47,000-square-feet facility cost $25 million and is used by Sierra Nevada College, the University of California at Davis, the Desert Research Institute, and the University of Nevada, Reno. The facility uses 60 percent less energy and 30 percent less water than a comparable building. A variety of mechanical designs were used including chilled beams, displacement ventilation, radiant floor heating, overhead radiant heating and cooling panels, a turbine with cogeneration, lab exhaust heat recovery, 30-kW of building-integrated photovoltaics, nighttime chilled water production with a cooling tower and 50,000 gallons of chilled water storage, direct evaporative cooling in air handlers and a demonstration solar hot water heater. Water-free urinals and low-flow toilets were installed in the facility. A snowmelt/rainwater catchment system captures water for reuse.*

*Heather Livingston, "Tahoe Science Lab Goes for Platinum-LEED," *AIArchitect*, October 27, 2006. Kate Gawlik, "Active and Passive," *Eco-Structure*, November 2006.

Photography by Van Fox, courtesy of Collaborative Design Studio.

Peter Rumsey led the engineering team. He says that having the LEED Platinum goal helped even during the CD phase of the project, when some teams might think it's too late to make significant changes:

> There was clarity in the goal. The owner said, "We're going to go for the highest LEED rating possible and if you can get Platinum that would be great." At the eleventh hour in the CD phase of the design, they said, "If we need to spend a little bit of extra money on a couple of the LEED features of the building, we're willing to do that." A couple of elements of the design were added then to push it over the top and get it into LEED Platinum. All of the design team members were on the same page, and were confident that we could do it.
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> This is the first lab building in the country to use chilled beams, which are a way of heating and cooling without using reheat [the energy-inefficient practice of cooling down outside air for general distribution and then reheating it for certain rooms]. It's one of only a small handful of the labs that don't use reheat for air-conditioning the lab, eliminating reheat can be a gigantic energy-saving measure. The chilled beams save on construction costs as well. I think not only is it a LEED Platinum building, but for a lab, it's a real breakthrough design. Since this building has been built, many labs are using or have seriously considered using chilled-beams.